

United States
Environmental Protection
Agency

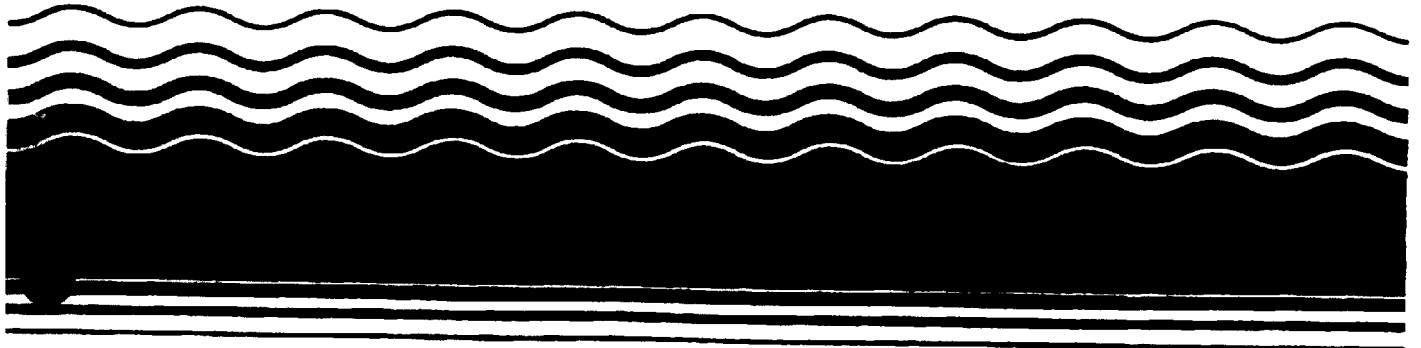
Office of Solid Waste
and Emergency
Response

Publication 9345.1-07
PB92-963377
EPA 540-R-92-026
November 1992

Superfund



Hazard Ranking System Guidance Manual



The Hazard Ranking System Guidance Manual

Interim Final

**Hazardous Site Evaluation Division
Office of Solid Waste and Emergency Response
U.S. Environmental Protection Agency
Washington, DC 20460**

NOTICE

The procedures set forth in this document are intended as guidance to employees of the U.S. Environmental Protection Agency (EPA), States, and other government agencies. EPA officials may decide to follow the guidance provided in this directive, or to act at variance with it, based on analysis of specific site circumstances. EPA also reserves the right to modify this guidance at any time without public notice.

These guidelines do not constitute EPA rulemaking and cannot be relied upon to create rights enforceable by any party in litigation with the United States.

Mention of any company or product names in this document should not be considered as an endorsement by EPA.

CONTENTS

	<u>Page</u>
CHAPTER 1 INTRODUCTION	
Section 1.1 Introduction to the HRS	1
Section 1.2 Overview of the Superfund Process	2
Current Superfund Process	2
Superfund Accelerated Cleanup Model	4
Section 1.3 Organization of the HRSGM	5
Section 1.4 Related Site Assessment Guidance Materials	6
CHAPTER 2 POLICY AND STATUTORY ISSUES	
Section 2.1 Source and Site Definition	9
Multiple Sources	9
Federal Facilities	10
Section 2.2 Scoring All Pathways and Threats	11
Section 2.3 Evaluation of Sites with Waste Removals	11
Requirements for Considering Removal Actions	12
Determining the Cutoff Date	12
Scoring Considerations When a Qualifying Removal Has Occurred	16
Section 2.4 CERCLA Pollutants or Contaminants	18
Section 2.5 Statutory and Policy Exclusions	18
CERCLA Petroleum Exclusion	19
Radioactive Materials	19
RCRA Site Policy	20
CHAPTER 3 THE HRS SCORING PROCESS	
Section 3.1 General Approach to HRS Scoring	21
Step 1: Assemble and Review All Available Site Information	22
Step 2: Identify and Characterize Sources	22
Step 3: Identify and Characterize Significant Pathways	23
Step 4: Evaluate Targets for Significant Pathways	24
Step 5: Collect Additional Information, If Necessary	26
Step 6: Check Validity of Factor Values	26
Step 7: Assemble and Submit Complete HRS Package	27
Step 8: Respond to Reviews	27

CONTENTS (continued)

	<u>Page</u>
Section 3.2 The HRS Scoring Package	27
The Documentation Record	27
References	28
Other Items in the HRS Scoring Package	29
Section 3.3 The Package Review Process	30
Section 3.4 HRS Scoring Strategy	31
Scoring Effort	31
Implications of HRS Equations for Site Scoring	32
Pathway Considerations	35
CHAPTER 4 SOURCES	
Section 4.1 Characterization of Sources and Areas of Observed Contamination	41
Definitions	41
Evaluating Sources	43
Evaluating Sites with No Identified Sources	46
Characterizing Unique Sources	46
Tips and Reminders	48
Section 4.2 Overview of Sites with Multiple Sources	49
Definitions	49
Scoring Multiple Source Sites	49
Aggregating Sources	51
Tips and Reminders	54
CHAPTER 5 OBSERVED RELEASE	
Section 5.1 Establishing an Observed Release and Observed Contamination	55
Definitions	55
Establishing an Observed Release by Chemical Analysis	58
Using Published Data for Background Levels	62
Using Qualified Data	63
Establishing an Observed Release by Direct Observation	63
Tips and Reminders	65
Section 5.2 Selecting Appropriate Background Samples	67
Definitions	67
Data Requirements	68
Data Evaluation Guidelines	69
Tips and Reminders	78

CONTENTS (continued)

	<u>Page</u>
Section 5.3 Transformation Products	79
Definitions	79
General Requirements	79
Establishing an Observed Release (or Observed Contamination) for Transformation Products	80
 CHAPTER 6 HAZARDOUS WASTE QUANTITY	
 Section 6.1 Overview of Hazardous Waste Quantity for the Three Migration Pathways	83
Definitions	86
Beginning the Hazardous Waste Quantity Evaluation	86
Locating Hazardous Waste Quantity Information	88
Tips and Reminders	89
 Section 6.2 Tier A — Hazardous Constituent Quantity	91
Definitions	91
A1. Locating Data	91
A2. Using Concentration Data	93
A3. Evaluating RCRA Hazardous Wastes	93
A4. Calculating Hazardous Constituent Quantity	96
Tips and Reminders	97
 Section 6.3 Tier B — Hazardous Wastestream Quantity	99
Definitions	99
B1. Locating Data	99
B2. Evaluating RCRA Hazardous Waste	101
B3. Extrapolating Data	101
B4. Calculating Hazardous Wastestream Quantity	102
Tips and Reminders	102
 Section 6.4 Tier C — Volume	105
C1. Locating Data	105
C2. Calculating Volume	105
Tips and Reminders	107
 Section 6.5 Tier D — Area	109
D1. Locating Data	109
D2. Calculating Area	109
 Section 6.6 Hazardous Waste Quantity Calculation	111
Selecting Source Hazardous Waste Quantity Values	111
Calculating Pathway Hazardous Waste Quantity Factor Value	111
Applying the Minimum Factor Value	111

CONTENTS (continued)

	<u>Page</u>
CHAPTER 7 GROUND WATER PATHWAY	
Section 7.1 Determining Aquifer Boundaries and Number of Aquifers	115
Definitions	116
Identifying and Evaluating Aquifers	117
Identifying Aquifer Discontinuities	125
Identifying Aquifer Interconnections	127
Tips and Reminders	134
Section 7.2 Treatment of Karst	137
Definitions	138
Identifying Karst	138
Scoring Differences for Karst Aquifers	140
Tips and Reminders	146
Section 7.3 Containment Factor	147
Definitions	147
Scoring the Ground Water Containment Factor	148
Tips and Reminders	151
Section 7.4 Actual Contamination	153
Definitions	153
Establishing Actual Contamination	154
Determining Level of Contamination	156
Scoring Sites with Actual Contamination	159
Tips and Reminders	162
Section 7.5 Population and Nearest Well Factors	163
Definitions	163
Evaluating the Ground Water Population Factor	165
Evaluating the Nearest Well Factor	170
Evaluating Ground Water Pathway When Multiple Sources Are Present	172
Tips and Reminders	175
Section 7.6 Blended Water Supplies	177
Definitions	177
Scoring the Population Factor for Blended Water Supplies	178
Scoring Interconnected Blended Systems	180
Tips and Reminders	185
Section 7.7 Standby Wells	187
Definitions	187
Scoring the Nearest Well Using Standby Wells	188
Scoring the Population Using Standby Wells	189
Tips and Reminders	192

CONTENTS (continued)

	<u>Page</u>
Section 7.8 Resources and Wellhead Protection Area	193
Definitions	193
Scoring the Resources Factor	194
Scoring the Wellhead Protection Area Factor	194
Tips and Reminders	196
Section 7.9 Scoring Sites with Multiple Aquifers	197
Definitions	197
Scoring Multiple Aquifer Systems	197
Examples of Multiple Aquifer Systems	198
Tips and Reminders	202
CHAPTER 8 SURFACE WATER PATHWAY	
Section 8.1 Hazardous Substance Migration Path	203
Definitions	203
Delineating the Overland Segment	204
Scoring the Distance to Surface Water Factor	206
Scoring the Flood Frequency Factor	208
Evaluating the Target Distance Limit for Non-tidally Influenced Water Bodies	208
Evaluating the Target Distance Limit for Tidally Influenced Water Bodies	216
Tips and Reminders	218
Section 8.2 Delineation of Watersheds and Drainage Areas	219
Definitions	219
Delineating Watersheds	220
Determining Drainage Area	221
Tips and Reminders	227
Section 8.3 Characterization of Surface Water Bodies	229
Definitions	229
Determining Breakpoints between Surface Water Categories	230
Assigning Surface Water Dilution Weights	231
Estimating Flow	233
Evaluating Targets in Multiple Water Body Categories	239
Determining Salinity Category of Water Body	239
Tips and Reminders	241
Section 8.4 Surface Water Containment Factor	243
Definitions	243
Scoring Surface Water Containment for Overland Flow	245
Scoring Surface Water Containment for Flood	245
Tips and Reminders	248

CONTENTS (continued)

	<u>Page</u>
Section 8.5 Overview of Actual Contamination for All Three Threats	249
Definitions	249
Section 8.6 Efficiency of Scoring the Drinking Water Threat	253
Definitions	253
Estimating Actual Contamination	253
Estimating Potential Contamination	254
Section 8.7 Actual Contamination In the Drinking Water Threat	259
Definitions	259
Establishing Actual Contamination for a Drinking Water Intake	260
Determining Level of Contamination	261
Scoring Intakes Subject to Actual Contamination	263
Tips and Reminders	263
Section 8.8 Population and Nearest Intake Factors	265
Definitions	265
Evaluating the Drinking Water Population Factor	266
Evaluating the Nearest Intake Factor	271
Tips and Reminders	271
Section 8.9 Blended Water Supplies	273
Definitions	273
Scoring the Population Factor for Blended Water Supplies	274
Scoring Multiple Blended Systems	276
Tips and Reminders	280
Section 8.10 Standby Intakes	281
Definitions	281
Scoring the Nearest Intake Factor Using Standby Intakes	282
Scoring the Population Factor Using Standby Intakes	283
Tips and Reminders	288
Section 8.11 Resources	289
Definitions	289
Scoring the Resources Factor	289
Tips and Reminders	291
Section 8.12 Actual Human Food Chain Contamination	293
Definitions	293
Documenting Presence of a Fishery	294
Establishing Actual Contamination of a Fishery	295
Determining the Level of Actual Contamination	298
Scoring Sites with Actual Contamination	300

CONTENTS (continued)

	<u>Page</u>
Tips and Reminders	304
Section 8.13 Human Food Chain Production	305
Definitions	305
Estimating the Human Food Chain Population Factor	306
Determining Production Using Site-specific Data	309
Estimating Production Using Surrogate Data	315
Estimating Production without Actual or Surrogate Data	315
Tips and Reminders	316
Section 8.14 Sensitive Environments	317
Definitions	317
Sensitive Environments Eligible to Be Evaluated in the Surface Water Pathway	318
Calculating the Sensitive Environments Factor Value	318
Tips and Reminders	324
Section 8.15 Level I and Level II Concentrations for Listed Sensitive Environments	325
Definitions	325
Determining Level of Contamination	326
Tips and Reminders	329
Section 8.16 Wetlands	331
Definitions	331
Identifying and Delineating Wetlands	331
Determining Wetland Size (Length or Perimeter)	332
Establishing Actual and Potential Contamination	338
Determining Wetland Length (or Perimeter) Subject to Actual and Potential Contamination	338
Tips and Reminders	342
CHAPTER 9 SOIL EXPOSURE PATHWAY	
Section 9.1 Areas of Observed Contamination	343
Definitions	343
Establishing Areas of Observed Contamination	344
Tips and Reminders	350
Section 9.2 Waste Characteristics for the Soil Exposure Pathway	351
Definitions	351
Evaluating Toxicity	352
Evaluating Hazardous Waste Quantity	352
Evaluating Tier A — Hazardous Constituent Quantity	353
Evaluating Tier B — Hazardous Wastestream Quantity	353
Evaluating Tier C — Volume	355
Evaluating Tier D — Area	356

CONTENTS (continued)

	<u>Page</u>
Calculating Hazardous Waste Quantity Factor Value	356
Tips and Reminders	357
Section 9.3 Resident Population Threat	359
Definitions	360
Identifying Resident Individuals and Workers	361
Identifying Resources and Terrestrial Sensitive Environments	362
Level I and Level II Concentrations	362
Tips and Reminders	362
Section 9.4 Resident Individual and Resident Population	363
Definitions	363
Evaluating Level of Contamination	364
Evaluating Resident Individual	365
Evaluating Resident Population	366
Tips and Reminders	369
Section 9.5 Workers and Resources	371
Definitions	371
Evaluating the Workers Factor	372
Scoring the Resources Factor	373
Tips and Reminders	374
Section 9.6 Terrestrial Sensitive Environments	375
Definitions	375
Scoring Terrestrial Sensitive Environments	376
Tips and Reminders	381
Section 9.7 Estimation of Nearby Population Threat Scores	383
Definitions	383
Estimating Nearby Population Threat Score	383
Section 9.8 Evaluation of Nearby Population Threat	389
Definitions	389
Scoring the Likelihood of Exposure Factor Category	390
Scoring Waste Characteristics Factor Category	390
Scoring Targets Factor Category	390
Calculating the Nearby Population Threat Score	394
Tips and Reminders	396
CHAPTER 10 AIR PATHWAY	
Section 10.1 Observed Release	397
Definitions	397

CONTENTS (continued)

	<u>Page</u>
Establishing an Observed Release by Direct Observation	398
Establishing an Observed Release by Chemical Analysis	399
Tips and Reminders	401
Section 10.2 Potential to Release	403
Definitions	404
Distinguishing between Gaseous and Particulate Hazardous Substances	404
Combining Sources Before Calculating Potential to Release	404
Evaluating Gas and Particulate Containment	406
Section 10.3 Actual Contamination and Nearest Individual	411
Definitions	411
Determining Level of Actual Contamination	412
Evaluating Sites with Actual Contamination	414
Evaluating Nearest Individual Factor	416
Tips and Reminders	420
Section 10.4 Resources	421
Definitions	421
Scoring the Resources Factor	421
Tips and Reminders	422
Section 10.5 Evaluation of Sensitive Environments	423
Definitions	423
Calculating the Sensitive Environments Factor Value	423
Tips and Reminders	431
APPENDIX A SENSITIVE ENVIRONMENTS	
Section A.1 Pathway-specific Eligibility Requirements for Sensitive Environments	A-1
Air Pathway	A-1
Soil Exposure Pathway	A-1
Surface Water Pathway	A-1
Section A.2 Definitions of Sensitive Environments Including Wetlands	A-3
Section A.3 Process for Identifying and Delineating Sensitive Environments	A-25
Sensitive Environments Likely to Be Delineated on USGS Topographic Maps	A-25
Sensitive Environments Likely to Be Delineated on Specialized Maps or in Special Documents	A-25
Sensitive Environments That Require Professional Judgment and/or Specific Expertise to Identify and Delineate	A-26
Section A.4 Sources of Information for Identifying Sensitive Environments	A-33

HIGHLIGHTS

	<u>Page</u>
CHAPTER 1 INTRODUCTION	
Highlight 1-1: The Superfund Process	3
Highlight 1-2: Icons for HRS Pathways, Threats, and Factor Categories	6
Highlight 1-3: Site Assessment Guidance Documents and Scoring Tools	8
CHAPTER 2 POLICY AND STATUTORY ISSUES	
Highlight 2-1: Flowchart for Identification of the Cutoff Date	14
Highlight 2-2: Examples of Determining Cutoff Date	15
CHAPTER 3 THE HRS SCORING PROCESS	
Highlight 3-1: The PRescore Software Program	21
Highlight 3-2: The Superfund Chemical Database Matrix	29
Highlight 3-3: Combinations of Pathway Scores That Yield Site Score of 28.50	33
Highlight 3-4: Additional Score Required to Yield Site Score of 28.50	34
Highlight 3-5: Minimum Targets Factor Value Required to Yield Pathway Score of 57	36
Highlight 3-6: Distance and Dilution Weights under Potential Contamination	37
Highlight 3-7: Population Required to Yield Pathway Score of 57	37
Highlight 3-8: Drinking Water Threat Scores under Potential Contamination	39
CHAPTER 4 SOURCES	
Highlight 4-1: Commonly Confused Source Types	44
Highlight 4-2: When to Consider Natural Ponds as Sources	47
Highlight 4-3: HRS Factors Summed for Multiple Sources	50
Highlight 4-4: HRS Factors Selected from Individual Source Factor Values	50
Highlight 4-5: HRS Factors Affected by Minimum Size Requirements	50
Highlight 4-6: Checklist for Source Aggregation	51
Highlight 4-7: When to Aggregate Overlapping Sources	52

HIGHLIGHTS (continued)

	<u>Page</u>
Highlight 4-8: When to Aggregate Contaminated Soil with Other Sources	53
CHAPTER 5 OBSERVED RELEASES	
Highlight 5-1: Flowchart for Establishing an Observed Release or Observed Contamination	56
Highlight 5-2: Flowchart for Determining Significance above Background	60
Highlight 5-3: Examples for Deciding Whether Significance above Background Is Established	61
Highlight 5-4: Definitions and Applications of Common Data Qualifiers	64
Highlight 5-5: Illustration of Appropriate Background Samples: Ground Water Pathway — Single Aquifer	71
Highlight 5-6: Illustration of Appropriate Background Samples: Ground Water Pathway — Multiple Aquifers	72
Highlight 5-7: Illustration of Appropriate Background Samples: Ground Water Pathway — Interconnected Aquifers	73
Highlight 5-8: Illustration of Appropriate Background Samples: Surface Water Pathway — Streams and Rivers	75
Highlight 5-9: Typical Degradation Products	80
CHAPTER 6 HAZARDOUS WASTE QUANTITY	
Highlight 6-1: Flowchart for Evaluating Hazardous Waste Quantity	84
Highlight 6-2: Data Availability by Source Type	87
Highlight 6-3: Flowchart for Evaluating Tier A	92
Highlight 6-4: Scoring Examples for Tier A	94
Highlight 6-5: Flowchart for Evaluating RCRA Hazardous Wastes under Tier A	97
Highlight 6-6: Flowchart for Evaluating Tier B	100
Highlight 6-7: Flowchart for Evaluating Tier C	106
Highlight 6-8: Flowchart for Evaluating Tier D	110
Highlight 6-9: Calculation of Source Hazardous Waste Quantity Value	112
Highlight 6-10: Calculation of Pathway Hazardous Waste Quantity Factor Value	113

HIGHLIGHTS (continued)

	<u>Page</u>
CHAPTER 7 GROUND WATER PATHWAY	
Highlight 7-1: Aquifer Data Used for First Level of Investigation	118
Highlight 7-2: Aquifer Data Used for Second Level of Investigation	119
Highlight 7-3: Aquifer Data Used for Third Level of Investigation	119
Highlight 7-4: Combining Horizontal Formations	121
Highlight 7-5: Combining Vertical Formations	122
Highlight 7-6: Combining Vertical Formations with Differences in Hydraulic Conductivity	123
Highlight 7-7: Delineating Aquifer When a Boundary Is Continuous throughout 2-Mile Distance	124
Highlight 7-8: Delineating Aquifer When Boundary Partially Transects Aquifer.	126
Highlight 7-9: Horizontal Aquifers Separated by Formation of Similar Hydraulic Conductivity	128
Highlight 7-10: Using Well Logs to Assess Aquifer Interconnection	129
Highlight 7-11: Using Contaminant Migration to Assess Aquifer Interconnection	131
Highlight 7-12: Using Pumping Test Data to Assess Aquifer Interconnection	132
Highlight 7-13: Using Numerous Man-made Conduits to Assess Aquifer Interconnection	133
Highlight 7-14: Bodies of Salt Water as Aquifer Discontinuities	136
Highlight 7-15: Defining Boundaries for a Karst Aquifer	139
Highlight 7-16: HRS Factors Given Special Consideration for Karst Aquifers	141
Highlight 7-17: Scoring Considerations for Karst Aquifers: Depth to Aquifer Factor	142
Highlight 7-18: Scoring Considerations for Karst Aquifers: Travel Time Factor.	143
Highlight 7-19: Scoring Considerations for Karst Aquifers: Mobility Factor	144
Highlight 7-20: Scoring Considerations for Karst Aquifers: Nearest Well Factor	145
Highlight 7-21: Scoring Considerations for Karst Aquifers: Population/ Potential Contamination Factor	146
Highlight 7-22: Data Needs for Evaluating Containment.	149
Highlight 7-23: Source Measurements That Meet the Minimum Size Requirement	150

HIGHLIGHTS (continued)

	<u>Page</u>
Highlight 7-24: Comparison of Actual Contamination to Observed Release	154
Highlight 7-25: Examples of Wells Subject to Level I, Level II, and Potential Contamination	155
Highlight 7-26: Data Needs for Level of Contamination	156
Highlight 7-27: Flowchart for Determining Level I, Level II, or Potential Contamination	157
Highlight 7-28: Calculating I and J Indices	159
Highlight 7-29: Comparison of Scoring Level I, Level II, and Potential Contamination	160
Highlight 7-30: Scoring Ground Water Population Subject to Level I, Level II, and Potential Contamination	161
Highlight 7-31: Identifying Target and Non-target Residences	164
Highlight 7-32: Data Needs for Ground Water Population	166
Highlight 7-33: Documenting Ground Water Population for an Aquifer	168
Highlight 7-34: Scoring Example of Ground Water Population Factor	171
Highlight 7-35: Establishing Target Distance Categories: Method 1	173
Highlight 7-36: Establishing Target Distance Categories: Method 2	174
Highlight 7-37: Pumpage and Capacity Data	178
Highlight 7-38: Data Needs for Evaluating Blended Systems	179
Highlight 7-39: Scoring Example of Single Blended System with Wells Outside the Target Distance Limit	181
Highlight 7-40: Scoring Example for Two Separate Blended Systems	182
Highlight 7-41: Scoring Example for Multiple Blended Systems	184
Highlight 7-42: Data Needs and Sources for Standby Wells	188
Highlight 7-43: Pumpage and Capacity Data for Standby Wells	190
Highlight 7-44: Using Pumpage Data for Standby Wells	190
Highlight 7-45: Evaluating Population Factor Using a Standby Well	191
Highlight 7-46: Checklist for Resources Factor	195
Highlight 7-47: Information Sources for Resource Use	195

HIGHLIGHTS (continued)

	<u>Page</u>
CHAPTER 8 SURFACE WATER PATHWAY	
Highlight 8-1: Hazardous Substance Migration Path	205
Highlight 8-2: Overland Segment for Contaminated Soils	205
Highlight 8-3: Characterization of the Overland Segment for Storm Sewers and Covered Drains	206
Highlight 8-4: Eligible Surface Waters	207
Highlight 8-5: Probable Point of Entry for Wetlands and Intermittent Streams	208
Highlight 8-6: Probable Point of Entry and Target Distance Limit for Sites with More Than One Overland Segment	209
Highlight 8-7: Determining Target Distance Limit	210
Highlight 8-8: Determining Target Distance Limit for Sites with Observed Release Beyond 15 Miles	210
Highlight 8-9: Determining Target Distance Limit for Sites with More Than One Probable Point of Entry into Rivers	212
Highlight 8-10: Determining Target Distance Limit for Sites with More Than One Probable Point of Entry into Lakes	212
Highlight 8-11: Determining Target Distance Limit for Sites with Probable Points of Entry into Two Branches of a River	213
Highlight 8-12: Determining Target Distance Limit for Sites with Probable Points of Entry into Two Lakes	214
Highlight 8-13: Determining Target Distance Limit When the In-water Segment Branches	215
Highlight 8-14: Determining the Target Distance Limit for Sites Consisting Solely of Contaminated Sediments	216
Highlight 8-15: Determining Upstream Target Distance Limit for Tidally Influenced Rivers	217
Highlight 8-16: Defining a Single Watershed with Multiple Probable Points of Entry	222
Highlight 8-17: Defining Multiple Watersheds	223
Highlight 8-18: Drainage Area Determination	225
Highlight 8-19: Drainage Area Restricted by Man-made Structures	226
Highlight 8-20: Breakpoint between Coastal Tidal Waters and Ocean	232

HIGHLIGHTS (continued)

	<u>Page</u>
Highlight 8-21: Sources of Flow Data	233
Highlight 8-22: Extending Short-term Streamflow Records	234
Highlight 8-23: Estimating Target Flow Using Interpolation	236
Highlight 8-24: Scoring Targets in Two Dilution Weight Categories	240
Highlight 8-25: Source Measurements That Meet the Minimum Size Requirement	246
Highlight 8-26: Data Needs for Evaluating Source Containment	247
Highlight 8-27: Samples and Criteria for Level I and Level II Concentrations by Threat	251

DRINKING WATER THREAT

Highlight 8-28: Approximate Drinking Water Threat Scores for Population Subject to Actual Contamination	254
Highlight 8-29: Approximate Drinking Water Threat Scores for Population Subject to Potential Contamination	256
Highlight 8-30: Example of Estimating Drinking Water Threat Score	258
Highlight 8-31: Benchmarks for the Drinking Water Threat	262
Highlight 8-32: Comparison of Scoring Level I, Level II, and Potential Contamination	263
Highlight 8-33: Data Needs for Drinking Water Threat Population	266
Highlight 8-34: Documenting Drinking Water Threat Population	269
Highlight 8-35: Example of Scoring Drinking Water Population Factor	270
Highlight 8-36: Pumpage and Capacity Data	274
Highlight 8-37: Data Needs for Evaluating Blended Systems	275
Highlight 8-38: Scoring Example of Single Blended System with Intakes Outside of the Target Distance Limit	277
Highlight 8-39: Scoring Example of Two Separate Blended Systems	278
Highlight 8-40: Scoring Example for Multiple Blended Systems	280
Highlight 8-41: Pumpage and Capacity Data for Standby Intakes	284
Highlight 8-42: Data Needs for Standby Intakes	285
Highlight 8-43: Using Pumpage Data for Standby Intakes	285

HIGHLIGHTS (continued)

	<u>Page</u>
Highlight 8-44: Evaluating Population Factor Using a Standby Intake	286
Highlight 8-45: Checklist for the Resources Factor	290
HUMAN FOOD CHAIN THREAT	
Highlight 8-46: Flowchart for Identifying Contaminated Fisheries	296
Highlight 8-47: Use of Tissue Samples from Aquatic Organisms	297
Highlight 8-48: Samples and Criteria for Level I and Level II Concentrations in the Human Food Chain Threat	299
Highlight 8-49: Benchmarks for the Human Food Chain Threat	300
Highlight 8-50: Comparison of Scoring Level I, Level II, and Potential Contamination	301
Highlight 8-51: Identifying Level of Contamination for Fisheries	302
Highlight 8-52: Values for Human Food Chain Population Factor Given Actual Contamination in a Fishery	307
Highlight 8-53: Values for Human Food Chain Population Factor Given Potential Contamination in a Fishery	308
Highlight 8-54: Sources of Fishery Production Data	310
Highlight 8-55: Production Data Typically Available from NMFS	311
Highlight 8-56: Apportionment of Production Data in a River	312
Highlight 8-57: Apportionment of Production Data along a Coastline	313
Highlight 8-58: Scoring Example for Potential Contamination	314
ENVIRONMENTAL THREAT	
Highlight 8-59: Scoring Example for Sensitive Environments	319
Highlight 8-60: Scoring Example for Level I and Level II Contamination	322
Highlight 8-61: Determining Length for Wetlands along a River	333
Highlight 8-62: Determining Length for Wetlands along a Lake, Coastal Tidal Water, or Ocean	334
Highlight 8-63: Determining Length for Wetland for a Watershed with a River and Lake, or Coastal Tidal Water	335
Highlight 8-64: Determining Length for Wetland Divided by a Stream	336

HIGHLIGHTS (continued)

	<u>Page</u>
Highlight 8-65: Determining Perimeter of a Wetland When the Probable Point of Entry Is in the Wetland	337
Highlight 8-66: Delineating Actual Contamination for Wetlands in a River	339
Highlight 8-67: Delineating Actual Contamination for Wetlands in a Lake, Ocean, and Coastal Tidal Water	340
Highlight 8-68: Delineating Actual Contamination for Wetlands When the Probable Point of Entry Is in the Wetland	342
 CHAPTER 9 SOIL EXPOSURE PATHWAY	
Highlight 9-1: Background Samples for Areas of Observed Contamination	344
Highlight 9-2: Delineating Areas of Observed Contamination for Sources Other Than Contaminated Soil	345
Highlight 9-3: Delineating Areas of Observed Contamination for Contaminated Soil	346
Highlight 9-4: Delineating Areas of Observed Contamination Using Composite Samples	347
Highlight 9-5: Inferring Contamination between Multiple Areas of Observed Contamination	348
Highlight 9-6: Delineating Areas of Observed Contamination When Uncontaminated Soils Are Intermingled	349
Highlight 9-7: Comparison of Hazardous Waste Quantity Evaluation in the Migration Pathways and the Soil Exposure Pathway	354
 RESIDENT POPULATION THREAT	
Highlight 9-8: Targets in the Resident Population Threat	359
Highlight 9-9: Identifying Resident Individuals	361
Highlight 9-10: Scoring Example for Resident Population on Adjacent Properties	367
Highlight 9-11: Scoring Example for Multiple Residences on One Property	368
Highlight 9-12: Evaluating Workers at a Multiple-building Facility	372
Highlight 9-13: Checklist for the Resources Factor	373
Highlight 9-14: Data Sources for the Resources Factor	373
Highlight 9-15: EC Values Corresponding to Waste Characteristics Factor Values	379

HIGHLIGHTS (continued)

	<u>Page</u>
Highlight 9-16: Scoring Example for Terrestrial Sensitive Environments	380
NEARBY POPULATION THREAT	
Highlight 9-17: Approximate Distance-weighted Population Values Based on Local Population Density	384
Highlight 9-18: Approximate Nearby Population Threat Scores	385
Highlight 9-19: Estimated Area of Contamination Factor Values	387
Highlight 9-20: Estimated Nearby Population Likelihood of Exposure Factor Values	387
Highlight 9-21: Examples of Attractiveness/Accessibility Values	391
Highlight 9-22: Establishing Target Distance Categories for Nearby Threat: Method 1	393
Highlight 9-23: Establishing Target Distance Categories for Nearby Threat: Method 2	395
CHAPTER 10 AIR PATHWAY	
Highlight 10-1: Selected EPA Guidance on Air Sampling	400
Highlight 10-2: Vapor Pressure Ranges For Gaseous and/or Particulate Hazardous Substances	405
Highlight 10-3: Vapor Pressures for Selected Hazardous Substances	405
Highlight 10-4: Selected Containment Descriptions That Are Assigned the Same Gas and Particulate Containment Values	407
Highlight 10-5: Flowchart for Potential to Release: Particulate Hazardous Substances.	409
Highlight 10-6: Flowchart for Potential to Release: Gaseous Hazardous Substance.	410
Highlight 10-7: Determining Areas of Actual and Potential Contamination with Multiple Sources	415
Highlight 10-8: Determining Potential Contamination with Multiple Sources	417
Highlight 10-9: Effect of Sample Location on Target Population	418
Highlight 10-10: Illustration of Target Populations Subject to Level I, Level II, and Potential Contamination	419
Highlight 10-11: Checklist for Resources Factor	422
Highlight 10-12: Data Sources for the Resources Factor	422

HIGHLIGHTS (continued)

	<u>Page</u>
Highlight 10-13: Identifying Sensitive Environments in the Air Pathway	425
Highlight 10-14 Determining Actual and Potential Contamination for: sensitive Environments	426
Highlight 10-15: Scoring Example for Sensitive Environments	427
APPENDIX A SENSITIVE ENVIRONMENTS	
Highlight A-1: Eligibility Requirements for Evaluating Terrestrial Sensitive Environments in Surface Water Pathway	A-2
Highlight A-2: Key Terms Used in Defining Sensitive Environments	A-3
Highlight A-3: Determining HRS Categories for Coastal Barrier	A-6
Highlight A-4: HRS Categories for Wild and Scenic Rivers	A-8
Highlight A-5: CERCLA Natural Resource Trustees	A-12
Highlight A-6: Appropriate Documentation for Migratory Pathways and Feeding Areas Critical for Maintenance of Anadromous Fish Species within Rivers, Lakes, or Coastal Tidal Waters	A-13
Highlight A-7: Appropriate Documentation for Spawning Areas Critical for Maintenance of Fish/Shellfish Species within Rivers, Lakes, or Coastal Tidal Waters	A-17
Highlight A-8: Comparison of HRS Wetlands Definition and Wetlands Classification System Used for NWI Maps	A-22
Highlight A-9: Eligibility of Wetland Categories on NWI Maps for HRS Scoring	A-30
Highlight A-10: U.S. Geological Survey Earth Science Information Center Offices	A-43
Highlight A-11: U.S. National Park Service Regional Offices	A-44
Highlight A-12: U.S. Fish and Wildlife Service Regional Offices	A-45
Highlight A-13: U.S. Bureau of Land Management State Offices	A-46
Highlight A-14: U.S. National Forest Service Regions	A-47
Highlight A-15: National Estuarine Research Reserve System	A-48
Highlight A-16: Near Coastal Waters Program EPA Regional Contacts	A-50
Highlight A-17: EPA Regional Clean Lakes Program Offices	A-51
Highlight A-18: Nautical Chart Numbers for Maine Sanctuaries	A-52

HIGHLIGHTS (continued)

	<u>Page</u>
Highlight A-19: National Estuary Program Information Sources	A-53
Highlight A-20: EPA Regional Offices	A-54
Highlight A-21: National Park Service Regional Boundaries	A-55
Highlight A-22: U.S. Fish and Wildlife Service Regional Boundaries	A-56
Highlight A-23: U.S. Forest Service Regional Boundaries.....	A-57

HRS CROSS REFERENCE

<u>HRS Rule Section</u>	<u>HRS Rule Section Title</u>	<u>HRS GM Section(s)</u>
1.1	Definitions	7.2
2.1.3	Common evaluations	4.1
2.2	Characterize sources	4.1
2.2.1	Identify sources	4.1
2.2.2	Identify hazardous substances associated with a source.	4.1
2.2.3	Identify hazardous substances available to a pathway	9.1, 9.2 4.1
2.3	Likelihood of release	5.1, 5.2, 5.3 7.4 8.5, 8.12 9.1 10.1, 10.3
2.4.1.1	Toxicity factor	9.2
2.4.2	Hazardous waste quantity	6.1 9.2
2.4.2.1	Source hazardous waste quantity	6.1
2.4.2.1.1	Hazardous constituent quantity	6.1, 6.2
2.4.2.1.2	Hazardous wastestream quantity	6.1, 6.3
2.4.2.1.3	Volume	6.1, 6.4
2.4.2.1.4	Area	6.1, 6.5
2.4.2.1.5	Calculation of source hazardous waste quantity value	6.1, 6.6
2.4.2.2	Calculation of hazardous waste quantity factor value	6.1, 6.6.
2.5	Targets	7.4 8.5, 8.7, 8.12, 8.14, 8.15 10.3
2.5.1	Determination of level of actual contamination at a sampling location	7.4 8.5, 8.7, 8.12, 8.15 10.3
2.5.2	Comparison to benchmarks	7.4 8.5, 8.7, 8.12, 8.14, 8.15 10.3

HRS CROSS REFERENCE (continued)

<u>HRS Rule Section</u>	<u>HRS Rule Section Title</u>	<u>HRSGM Section(s)</u>
3.0	Ground water migration pathway	7.9
3.0.1	General considerations	7.5
3.0.1.1	Ground water target distance limit	7.1, 7.5
3.0.1.2	Aquifer boundaries	7.1
3.0.1.2.1	Aquifer interconnections	7.1
3.0.1.2.2	Aquifer discontinuities	7.1
3.0.1.3	Karst aquifer	7.2
3.1.1	Observed release	5.1, 5.2, 5.3 7.4
3.1.2	Potential to release	7.9
3.1.2.1	Containment	7.3
3.1.2.3	Depth to aquifer	7.2
3.1.2.4	Travel time	7.2
3.2.1.2	Mobility	7.2
3.3	Targets	7.9
3.3.1	Nearest well	7.2, 7.4, 7.5, 7.7, 7.9
3.3.2	Population	7.5, 7.6, 7.7, 7.9
3.3.2.1	Level of contamination	7.4
3.3.2.2	Level I concentrations	7.2, 7.4
3.3.2.3	Level II concentrations	7.2, 7.4
3.3.2.4	Potential contamination	7.2, 7.9
3.3.3	Resources	7.8
3.3.4	Wellhead protection area	7.8
3.4	Ground water migration score for an aquifer	7.9
4.0.2	Surface water categories	8.1, 8.2, 8.3, 8.16
4.1.1.1	Definition of the hazardous substance migration path for overland flow/flood migration	8.1, 8.2

HRS CROSS REFERENCE (continued)

<u>HRS Rule Section</u>	<u>HRS Rule Section Title</u>	<u>HRSGM Section(s)</u>
4.1.1.2	Target distance limit	8.1, 8.2, 8.5, 8.7, 8.8, 8.12, 8.14
4.1.2.1.1	Observed release	5.1, 5.2, 5.3 8.5, 8.12
4.1.2.1.2.1.1	Containment	8.4
4.1.2.1.2.1.2	Runoff	8.1, 8.2
4.1.2.1.2.1.3	Distance to surface water	8.1
4.1.2.1.2.2.1	Containment	8.4
4.1.2.1.2.2.2	Flood frequency	8.4
4.1.2.1.2.2.3	Calculation of the factor value for potential to release by flood	8.4
4.1.2.1.2.3	Calculation of potential to release factor value	8.4
4.1.2.3	Drinking water threat - targets	8.5, 8.7, 8.9
4.1.2.3.1	Nearest intake	8.3, 8.7, 8.8, 8.10
4.1.2.3.2	Population	8.7, 8.8, 8.9, 8.10
4.1.2.3.2.1	Level of contamination	8.7
4.1.2.3.2.2	Level I concentrations	8.7
4.1.2.3.2.3	Level II concentrations	8.7
4.1.3.2.1.3	Bioaccumulation potential	8.3, 8.12
4.1.3.3	Human food chain threat - targets	8.5, 8.12, 8.13
4.1.3.3.1	Food chain individual	8.12
4.1.3.3.2	Population	8.12, 8.13
4.1.3.3.2.1	Level I concentrations	8.12, 8.13
4.1.3.3.2.2	Level II concentrations	8.12, 8.13
4.1.3.3.2.3	Potential human food chain contamination	8.13
4.1.4.2.1.1	Ecosystem toxicity	8.3
4.1.4.2.1.3	Ecosystem bioaccumulation potential	8.3
4.1.4.3	Environmental threat - targets	8.5, 8.14, 8.15, 8.16

HRS CROSS REFERENCE (continued)

<u>HRS Rule Section</u>	<u>HRS Rule Section Title</u>	<u>HRS GM Section(s)</u>
4.1.4.3.1	Sensitive environments	8.3, 8.14, 8.15, 8.16
4.1.4.3.1.1	Level I concentrations	8.14, 8.15, 8.16
4.1.4.3.1.2	Level II concentrations	8.14, 8.15, 8.16
4.1.4.3.1.3	Potential contamination	8.14, 8.16
4.1.4.3.1.4	Calculation of environmental threat - targets factor category value	8.14
5.0.1	General considerations	4.1 5.1, 5.2, 5.3 9.1,9.8
5.1	Resident population threat	9.6
5.1.1	Likelihood of exposure	9.1
5.1.2	Waste characteristics	9.1
5.1.2.1	Toxicity	9.2
5.1.2.2	Hazardous waste quantity	9.2
5.1.3	Targets	9.3, 9.4, 9.5, 9.6
5.1.3.1	Resident individual	9.3, 9.4
5.1.3.2	Resident population	9.3, 9.4
5.1.3.3	Workers	9.3, 9.5
5.1.3.4	Resources	9.3, 9.5
5.1.3.5	Terrestrial sensitive environments	9.3, 9.6
5.1.3.6	Calculation of resident population targets factor category value	9.5
5.2	Nearby population threat	9.8
5.2.1	Likelihood of exposure	9.1
5.2.1.1	Attractiveness/accessibility	9.8
5.2.1.2	Area of contamination	9.2, 9.8
5.2.2.1	Toxicity	9.2
5.2.3	Targets	9.8
6.1	Likelihood of release	10.1

HRS CROSS REFERENCE (continued)

<u>HRS Rule Section</u>	<u>HRS Rule Section Title</u>	<u>HRSGM Section(s)</u>
6.1.1	Observed release	5.1, 5.2, 5.3 10.1
6.1.2	Potential to release	10.2
6.1.2.1	Gas potential to release	10.2
6.1.2.2	Particulate potential to release	10.2
6.1.2.3	Calculation of potential to release factor value for the site	10.2
6.3	Targets	10.3, 10.4, 10.5
6.3.1	Nearest individual	10.3
6.3.2	Population	10.3
6.3.2.1	Level of contamination	10.3
6.3.2.2	Level I concentrations	10.3
6.3.2.3	Level II concentrations	10.3
6.3.3	Resources	10.4
6.3.4	Sensitive environments	10.5
6.3.4.1	Actual contamination	10.5
6.3.4.2	Potential contamination	10.5
6.3.4.3	Calculation of sensitive environments factor value	10.5

ACRONYMS

AALAC	ambient aquatic life advisory concentration
AOC	area of observed contamination
AWQC	ambient water quality criteria
BCF	bioconcentration factor
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BPF	bioaccumulation potential factor
BPFV	bioaccumulation potential factor value
BTAG	Biological Technical Assistance Group
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CERI	Center for Environmental Research Information
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CRDL	contract-required detection limit
CRQL	contract-required quantitation limit
DDD	dichloro-diphenyl-dichloro-ethane
DDE	dichloro-diphenyl-ethane
DDT	dichloro-diphenyl-trichloro-ethane
DL	detection limit
DNAPL	dense non-aqueous phase liquid
DOE	Department of Energy
DOT	Department of Transportation
EIS	environmental impact statement
EP	Extraction Procedure
EPA	Environmental Protection Agency
ES	sensitive environment
FDAAL	Food and Drug Administration advisory level
FRDS	Federal Reporting Data System
FWRS	Fish and Wildlife Reference Service
GIS	Geographic Information System
GW	ground water
HFC	human food chain
HRS	Hazard Ranking System
HRSGM	Hazard Ranking System Guidance Manual
HWQ	hazardous waste quantity
IAG	interagency agreement
IDL	instrument detection limit
LNAPL	light non-aqueous phase liquid
LR	likelihood of release
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MDL	method detection limit
MMS	Minerals Management Service
NAAQS	National Ambient Air Quality Standard
NAWDEX	National Water Data Exchange
NCP	National Contingency Plan
NESHAP	National Emission Standard for Hazardous Air Pollutants
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
NPL	National Priorities List

ACRONYMS (continued)

NPS	National Park Service
NRC	Nuclear Regulatory Commission
NSFF	National Sport Fishing Federation
NWI	National Wetlands Inventory
OSM	Office of Surface Mining
OSWER	Office of Solid Waste and Emergency Response
OVA	organic vapor analyzer
OWRS	Office of Water Regulations and Standards
PA	preliminary assessment
PCB	polychlorinated biphenyls
PPE	probable point of entry
PRP	potentially responsible party
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study
RREL	Risk Reduction Engineering Laboratory
SACM	Superfund Accelerated Cleanup Model
SARA	Superfund Amendments and Reauthorization Act
SAV	submerged aquatic vegetation
SC	screening concentration
SCDM	Superfund Chemical Data Matrix
SCS	Soil Conservation Service
SDWA	Safe Drinking Water Act
SF	slope factor
SI	site inspection
SQL	sample quantitation limit
SW	surface water
SWDA	Solid Waste Disposal Act
TCLP	Toxicity Characteristic Leaching Procedure
TDL	target distance limit
TSCA	Toxic Substances Control Act
TSDF	treatment, storage, or disposal facility
USC	U.S. Code
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UV	ultraviolet
WC	waste characteristics
WPA	wellhead protection area

CHAPTER 1

INTRODUCTION

The Hazard Ranking System Guidance Manual (HRSGM) provides general and technical guidance for individuals involved in determining Hazard Ranking System (HRS) scores and preparing HRS scoring packages. The HRSGM clarifies terms and concepts in the HRS, presents strategies and specific guidance for scoring selected HRS factors, and provides guidelines to assist in collecting and organizing relevant data. Although it is targeted primarily to HRS scorers and package preparers (frequently contractors or state agency staff), others involved in the U.S. Environmental Protection Agency's (EPA'S) site assessment process (e.g., package reviewers) may find parts of the document useful.

This document has certain limitations. The HRSGM does not account for the infinite ways in which conditions may vary from one site to another. Thus, all parts of the guidance may not apply to every site. Scorers should consider Site- specific conditions and consult, as appropriate, the EPA Region's National Priorities List (NPL) Coordinator, the Regional Site Assessment Manager, the Site Assessment Regional Coordinator at EPA Headquarters, Quality Assurance (QA) staff, field investigators, and other personnel associated with the site assessment process. The HRSGM focuses on scoring guidance, such as where to find information and how to calculate factor values, rather than on documentation requirements for HRS scoring packages. Additionally, the HRSGM is not intended to be an all-inclusive reference. No specific guidance is provided, for example, on scoring procedures for radioactive substances or on the ground water to surface water component of the surface water pathway. The HRS, published as a Federal regulation on December 14, 1990 (*55Federal Register* 51532), constitutes the definitive reference and should be consulted throughout the process of scoring a site.

The remainder of this introductory chapter presents overviews of the HRS and the Superfund process, describes the content and organization of the HRSGM, and identifies several related site assessment guidance documents and scoring tools.

1.1 INTRODUCTION TO THE HRS

The HRS is the scoring system used by the EPA's Superfund program to assess the relative threat associated with actual or potential releases of hazardous substances. The HRS is the primary screening tool for determining whether a site is to be included on the NPL, EPA's list of sites that are priorities for further investigation and, if necessary, response action under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601, *et seq.* An HRS score for a site is determined by evaluating four pathways:

- Ground water migration;
- Surface water migration (composed of the three threats — drinking water, human food chain, and environmental);
- Soil exposure (composed of two threats — resident population and nearby population); and
- Air migration.

The scoring system for each pathway is based on a number of individual factors grouped into three factor categories: (1) likelihood of release (or, for the soil exposure pathway, likelihood of exposure); (2) waste characteristics; and (3) targets. Individual factors are evaluated and the factor values are combined mathematically to produce factor category values. To obtain a pathway score (e.g., the ground water migration pathway score) the factor category values are multiplied and then normalized to 100 points. In the case of the surface water migration and soil exposure pathways, scores are calculated for each threat and then added to yield the pathway score. The HRS site score, which ranges from 0 to 100, is obtained by combining the four pathway scores using the following root-mean-square equation:

$$S = \sqrt{\frac{S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2}{4}}$$

where: S = site score
 S_{gw} = ground water migration pathway score
 S_{sw} = surface water migration pathway score
 S_s = soil exposure pathway score
 S_a = air migration pathway score

Under this equation, higher scoring pathways have a greater relative impact on the overall site score than lower scoring pathways. Section 3.4 explains the mathematics of scoring in more detail.

Any site scoring 28.50 or greater is eligible for the NPL. This score does not represent a specified level of risk, but is a cutoff point that serves as a screening-level indicator of the highest priority releases or threatened releases. Sites that score below 28.50 may be addressed under other Federal and state response authorities. Some sites that score above 28.50 may be addressed by other Federal programs.

1.2 OVERVIEW OF THE SUPERFUND PROCESS

The principal components of EPA's Superfund program are set forth in CERCLA, which was enacted in 1980 and amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and in the National Contingency Plan (NCP) (40 CFR 300). The Superfund program responds to threats posed by uncontrolled releases of hazardous substances into the environment.

CURRENT SUPERFUND PROCESS

The process by which EPA determines and implements the appropriate response to releases that require a remedial response action consists of two phases (see **Highlight 1-1**):

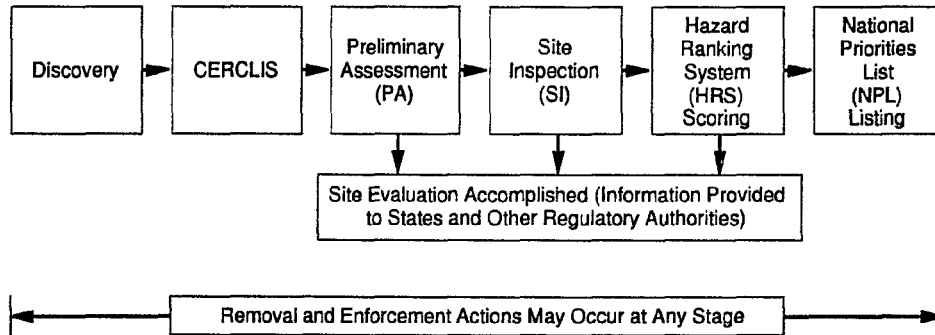
- Site assessment: screening-level evaluation of all sites to determine those for which response action may be required, culminating in the listing of sites on the NPL, where appropriate; and
- Remedial response action: comprehensive evaluation of NPL sites to determine the nature and extent of contamination, and to select and implement any necessary site cleanups.

Releases that require immediate or short-term response actions are addressed under the removal portion of the Superfund program,

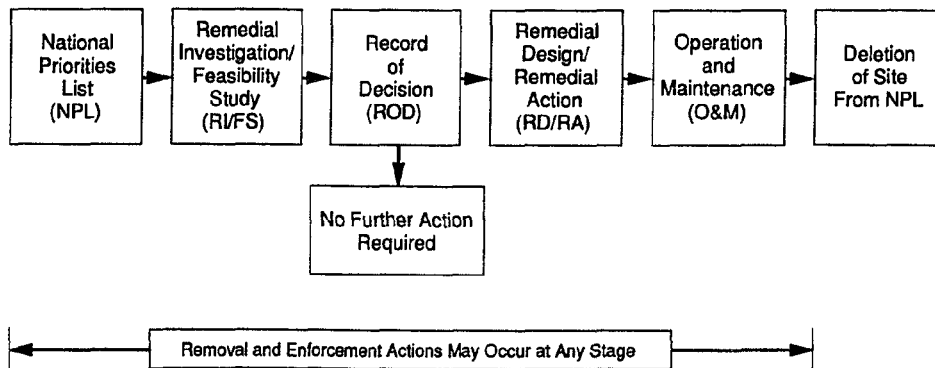
The site assessment phase begins with site discovery, or notification to EPA of possible releases of hazardous substances. Sites are discovered by various parties, including EPA Regional offices, state agencies, and citizens who petition EPA to perform a preliminary assessment. Once

HIGHLIGHT 1-1 THE SUPERFUND PROCESS

SITE ASSESSMENT PHASE



REMEDIAL PHASE



discovered, sites are entered into the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS), EPA's computerized inventory of potential hazardous substance release sites. EPA then evaluates the potential for a release of hazardous substances from the site during two investigative steps:

- Preliminary Assessment (PA): A PA is a limited-scope investigation performed on every CERCLIS site. PA investigators collect readily available information about a site and its surrounding area. The PA is designed to distinguish, based on relatively limited data, between sites that pose little or no threat to human health and the environment and sites that may pose a threat and thus require further investigation. The PA also identifies sites requiring assessment for possible emergency response (i.e., removal) actions.
- Site Inspection (SI): If the PA results in a recommendation for further investigation, an SI is performed. The objectives of the SI are to identify which sites have a high probability of qualifying for the NPL and to collect the data needed for HRS scoring and documentation. SI investigators typically collect environmental and waste samples to determine what hazardous substances are present at a site, whether they are being released to the environment, and whether they have reached nearby targets. The SI can be conducted in one stage or in two. The first stage, or focused SI, tests critical hypotheses developed during the PA and, in some cases, yields information sufficient to prepare an HRS scoring package. If further information is necessary to document an HRS score, an expanded SI is conducted.

Information collected during the PA and SI is used to calculate an HRS score. Sites with an HRS score of 28.50 or greater are eligible for listing on the NPL and require the preparation of a complete HRS scoring package, including a site narrative summary, Quality Control (QC) checklist, QA signature page, HRS scoresheets, HRS documentation record and references, and NPL characteristics data collection form. Section 3.2 discusses the HRS scoring package.

SUPERFUND ACCELERATED CLEANUP MODEL

EPA recently developed the Superfund Accelerated Cleanup Model (SACM) to increase the efficiency of the Superfund program by streamlining cleanup efforts at all Superfund sites. The traditional Superfund response follows a prolonged initial phase of study and assessment, while SACM is designed to combine immediate action with continuing study as necessary. SACM is a new process for new sites and an administrative improvement for processing existing sites.

SACM involves the following five elements: (1) a one-step screening and risk assessment at the beginning of the process; (2) Regional Decision Teams to serve as "traffic cops" for all sites to ensure quick yet thorough risk reduction; (3) early actions to reduce immediate risk to human health and the environment; (4) long-term actions to address sites expected to require more than five years to clean up; and (5) a combination of enforcement, community relations, and public involvement throughout the process. Benefits of SACM include measuring success by total risk reduction at all Superfund sites and making long-term restoration a separate activity. SACM will restore public confidence through early risk reduction, balancing priorities by cleaning up the worst sites first, and cleaning up a large number of sites.

Under SACM, EPA can institute actions to address threats to health and safety of the surrounding population and environment as soon as those threats are identified, using removal action authority or early remedial action authority. The remedial action can be long-term, such as ground water restoration, or short-term, such as soil treatment. Whenever possible, Superfund assessment activities should be conducted concurrently with short-term removal and long-term remedial actions. For instance, under SACM EPA may decide to conduct the SI and the remedial investigation, which previously were separate activities, as a single investigation at sites that are expected to require significant response action.

Consistent with the NCP, listing sites on the NPL will continue to be a prerequisite to using certain remedial action authorities to clean up sites. The HRS will continue to be the primary basis for selecting sites for the NPL.

1.3 ORGANIZATION OF THE HRSGM

The HRSGM is organized in two parts. The first provides guidance on broad policy issues and an introduction to the site scoring process. These chapters, intended to be read through in their entirety, are:

- Chapter 1: Introduction
- Chapter 2: Policy and Statutory Issues
- Chapter 3: The HRS Scoring Process.

The second part of the HRSGM provides specific, detailed guidance on various topics important to HRS scoring. Each section within these chapters addresses a particular topic and provides self-contained guidance. Chapters need not be read in their entirety, but rather are intended to be used primarily as reference material for specific topics, or to answer specific questions. Chapters 4 through 6 and Appendix A provide guidance on topics that relate to more than one HRS pathway:

- Chapter 4: Sources
- Chapter 5: Observed Releases
- Chapter 6: Hazardous Waste Quantity
- Appendix A: Sensitive Environments.

Chapters 7 through 10 address the four HRS pathways:

- Chapter 7: Ground Water Pathway
- Chapter 8: Surface Water Pathway
- Chapter 9: Soil Exposure Pathway
- Chapter 10: Air Pathway.

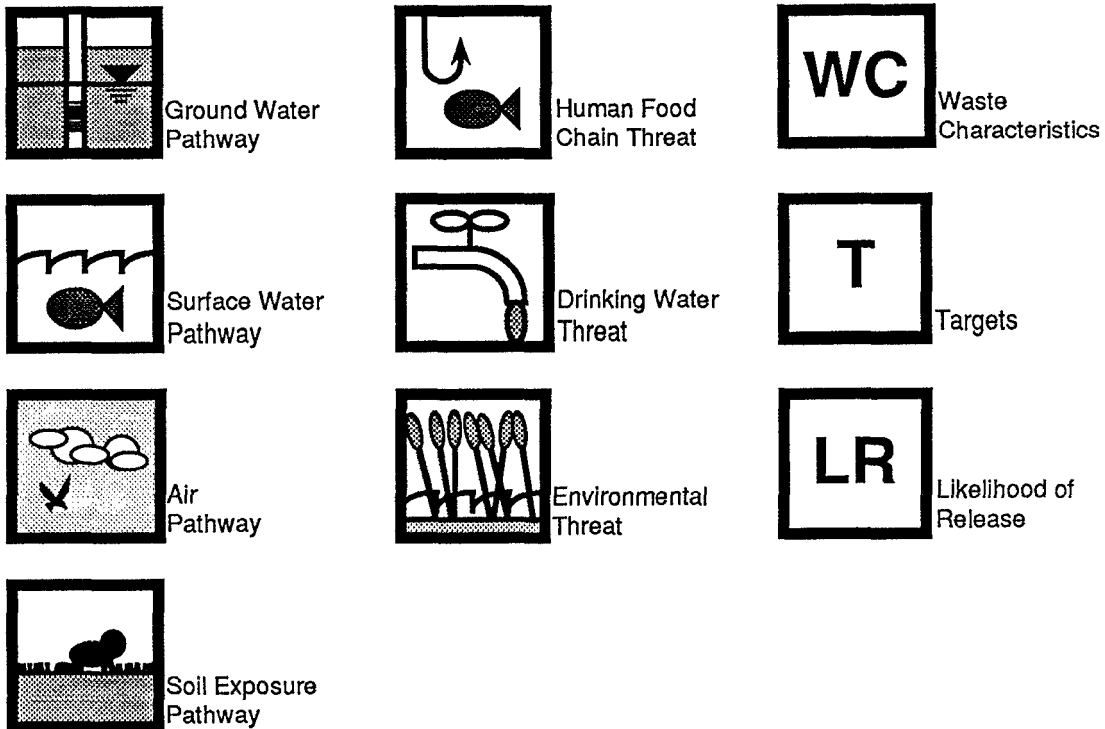
A typical section in Chapters 4 through 10 contains the following subsections:

- Introduction: a brief overview of the topic, including its context within the HRS.
- Relevant HRS Sections: a text box referencing relevant HRS section numbers and titles.
- Definitions: a subsection defining and clarifying important terms, particularly those with HRS-specific definitions.
- How to Score (or How to Evaluate): step-by-step instructions for scoring and/or evaluating the relevant factors or topics.
- Topic Icons: graphics in the top right-hand corner of the first page of each section, indicating the topic(s) (e.g., air pathway, targets) covered in the section. **Highlight 1-2** provides a listing of all the icons.

Sections may also include:

- Tips and Reminders: bullet points that present strategies for efficient scoring and data collection, identify common mistakes, and restate key issues.

HIGHLIGHT 1-2 ICONS FOR HRS PATHWAYS, THREATS, AND FACTOR CATEGORIES



- Highlights: text boxes providing reference tables, figures, or other related information, such as examples of how to score particular factors under certain, specified circumstances or a listing of reference data commonly used to score particular factors and suggesting where to obtain such data.

An index is included at the beginning of the document that cross references HRS rule section numbers with relevant HRSGM Sections.

1.4 RELATED SITE ASSESSMENT GUIDANCE MATERIALS

In addition to the HRS rule and this guidance document, EPA has developed several other documents and scoring tools to assist investigators with various aspects of the site assessment process. These include:

- PA Guidance
- SI Guidance
- QC Guidance for NPL Candidate Sites
- PREscore and PA-Score Computer Software and Users Manuals
- Data Useability Guidance for Site Assessment (under development).

Highlight 1-3 compares the audience and scope for each of these site assessment guidance documents and scoring tools.

Other information about the HRS is available through several "Quick Reference Fact Sheets" prepared by EPA:

- *The Revised Hazard Ranking System: An Improved Tool/ for Screening Superfund Sites* (OSWER Publication 9320.7-01 FS, November 1990);
- *The Revised Hazard Ranking System: Qs and As* (OSWER Publication 9320.7-02FS, November 1990);
- *The Revised Hazard Ranking System: Background Information* (OSWER Publication 9320.7-03FS, November 1990); and
- *The Revised Hazard Ranking System: Evaluating Sites After Waste Removals* (OSWER Publication 9345.1-03FS, October 1991).

HIGHLIGHT 1-3 SITE ASSESSMENT GUIDANCE DOCUMENTS AND SCORING TOOLS

Guidance Document	Guidance for Performing Preliminary Assessments Under CERCLA	Guidance for Performing Site Inspections Under CERCLA	Data Useability Guidance for Site Assessment	Hazard Ranking System Guidance Manual	Regional Quality Control (QC) Guidance for NPL Candidate Sites	PREscore Users Manual and Tutorial / PA-Score Users Manual and Tutorial
Reference #	9345.0-01A	9345.1-05	9345.1-06	9345.1-07	9345.1-08	9345.1-04 (PREscore) 9345.1-11 (PA-Score)
Status/Date	Final/September 1991	Interim Final/ September 1992	Under Development	Interim Final/ November 1992	Final/December 1991	Ver 1.1/July 1992 (PREscore) Ver 2.0/July 1992 (PA-Score)
Primary Audience	PA Investigations	SI Investigators	Field Technicians, Data Reviewers, and Data Analysts	HRS Scores, EPA Regional Staff	EPA Regional Staff, HRS Scorers	HRS Scorers
Scope and Content	Provides instructions for conducting PAs and reporting the results, including: determining CERCLA eligibility; information required to evaluate a site; how and where to find such information; how to conduct a site reconnaissance; how to evaluate a PA site; and reporting requirements, format, content, and review. The purpose of this document is to assist PA investigators in conducting high-quality assessments that result in correct site recommendations on a nationally consistent basis.	Provides guidance for the SI scoping, planning, and sampling strategies. The document addresses focused SI and expanded SI activities, including development of field work plan, sampling strategies, data analysis and scoring reviews, and report preparation. The purpose of this document is to assist SI investigators in conducting efficient, high-quality SIs that result in correct site recommendations on a nationally consistent basis.	Focuses on the collection, interpretation, and useability of chemical analysis data to support the scoring of sites under the HRS.	Provides general and technical guidance for prepares of an HRS scoring package. Guidance includes: general approach to scoring, clarification of terms and concepts in the rule, general policy issues, and specific guidance for scoring selected factors in all pathways.	Provides required and recommended procedures for an EPA Regional QC program for HRS packages. This guidance is intended to standardize Regional QC review and improve HRS package quality. The document provides a checklist that must be reviewed prior to submitting the HRS documentation to Headquarters. It also provides guidance on a number of policy issues, including site definition, the CERCLA petroleum exclusion, and the RCRA policy.	The PREscore Users Manual and Tutorial provides instructions for installing PREscore on a computer and a step-by-step lesson on the use of PREscore. The computer program calculates HRS scores, assists in creating documentation for HRS scoring packages, and provides excerpts of the HRS. The PA-Score Users Manual and Tutorial provides instructions on installing PA-Score on a computer and step-by-step lessons on the use of PA-Score. The computer program performs calculations to determine the PA score. See also Highlight 3-1 for a more detailed description of PREscore.

CHAPTER 2

POLICY AND STATUTORY ISSUES

This chapter addresses the following key policy issues related to HRS scoring:

- Source and site definition
- Scoring all pathways and threats
- Evaluating sites with waste removals
- CERCLA pollutants or contaminants
- Statutory and policy exclusions.

Although this chapter presents general information to help the scorer understand policy and statutory issues, it does not describe specific scoring strategies or provide detailed instructions. These are provided in the appropriate sections of the guidance.

2.1 SOURCE AND SITE DEFINITION

This section defines sources and sites and lists criteria for deciding whether multiple sources should be addressed, for purposes of HRS scoring, as one or more sites (this issue is sometimes referred to as site aggregation). The section also discusses special considerations for defining sites at Federal facilities. Section 4.2 addresses the related issue of how to group individual sources to facilitate scoring at a site that has already been defined to include multiple sources.

The HRS defines a source as any area where a hazardous substance has been deposited, stored, disposed, or placed, plus those soils that have become contaminated through migration (note that other media contaminated by migration usually are not considered sources). A site, for HRS purposes, can be any area or areas where a hazardous substance has been deposited, stored, disposed, or placed, or has otherwise come to be located (e.g., through migration). Thus, the definition of site is broader than the definition of source. A site may include multiple sources and may include the area between sources. For HRS purposes, the term site does not simply refer to legal property boundaries or fenced-in areas, but instead refers to the sources of hazardous substances and areas of hazardous substance contamination that are to be scored as a single unit, even if a site is listed for administrative or tracking purposes (e.g., in CERCLIS) in geographic or ownership terms. The area considered to be the site may change during the RI/FS and/or later remedial actions as the extent of contamination becomes better defined.

MULTIPLE SOURCES

When multiple sources are in an area, Regional EPA personnel must decide whether to treat the area as one site or as several sites for HRS scoring purposes. This decision should be made before scoring; however, new sources may be discovered during scoring or later remedial activities, which could result in redefining the site. Professional judgment and experience must be used in deciding, on a case-by-case basis, how to evaluate these newly discovered sources (e.g., whether to treat them as part of the existing site under evaluation, or whether to treat the newly discovered sources as a new site). Section 4.2 provides more information on evaluating sites where multiple sources may be grouped and considered a single source to simplify scoring.

Keep in mind the following criteria for defining sites in multiple source situations:

- Proximity of the sources to each other;
- Similarity of wastes contained in the sources;
- Similarity of targets (e.g., potential to affect one or more of the same aquifers, surface water bodies, sensitive environments, or populations); and
- Common owner, operator, or potentially responsible party (PRP).

These criteria are not a comprehensive list of requirements that must be met to address multiple sources as a single site, but instead are some of the site-specific factors that should be considered. Present any questions about grouping multiple sources to the EPA Regional contact.

FEDERAL FACILITIES

Federal facilities are often very large and encompass multiple potential sources of hazardous substances contamination. Because of their size, and the fact that SIs to collect the data for scoring are not supervised by EPA, it is not always possible to ensure that all areas of contamination have been identified. Moreover, issues of site ownership and the identity of responsible party(ies) are irrelevant to site definition. Because of these features, Federal facilities may be evaluated as one or more sites, depending on how the sources are clustered and how the releases are described in the scoring package. Below are some approaches for evaluating multiple sources at Federal facilities.

- Score the site based on a small number of sources, and describe the site at proposal as including those sources as well as all other contaminated areas within the boundaries of the facility. Thus, the site would include any contamination, either known at the time of proposal or discovered later, within those boundaries. This approach should be made very clear because of the potentially large scope of the site.
- Fully characterize the sources that drive the HRS score, but also describe other areas known or believed to be sources of contamination. Using this method, all sources characterized or generally described in the package, plus areas contaminated by migration from these sources, would be part of the NPL site.
- Include multiple sources in the same site if:
 - They were part of the same operation or activity;
 - They affect the same target population in one or more pathways; and
 - They are in the same watershed.

As a general rule, sources at Federal facilities may be combined if the result is real environmental or cleanup benefits, even if sources are miles apart.

Even if sources at a Federal facility are not contiguous and may contain different hazardous substances from different activities, they can be grouped as a single site. Agency policy, established on September 8, 1983 (48 *Federal Register* 40663) when the first NPL was promulgated, is that noncontiguous releases and unrelated sources may be grouped together as one site. This policy is generally appropriate because of the presence of a single responsible party that will serve as lead agency for any response and with whom EPA may enter into an umbrella Interagency Agreement (IAG) for the site response. Remember, however, that Federal facilities also may be listed as several sites. For example, the Department of Energy (DOE) Hanford Facility is listed as four separate NPL sites, each containing multiple sources.

2.2 SCORING ALL PATHWAYS AND THREATS

The statutory mandate of the HRS is to assess, to the maximum extent feasible, the relative degree of risk to human health and the environment posed by sites under review. EPA uses the HRS as a screening tool in its site assessment process to identify sites that merit further investigation under Superfund. The site assessment program, however, has limited resources for identifying, evaluating, and scoring large numbers of sites. The competing goals of assessing relative risk to the maximum extent feasible and screening large numbers of sites have caused some confusion over whether to score all pathways and threats at a site when the additional effort will not change the site's listing status. The Agency must balance the need to characterize site risks for all pathways and threats with the constraints imposed by the limited resources available for data collection and analysis.

Generally, all pathways and threats that pose potentially significant risks to human health and the environment should be scored to reflect the importance of that pathway or threat to the overall evaluation of the site. The scorer should use professional judgment to evaluate the potential seriousness of the risk. Criteria to consider when deciding whether a pathway or threat should be scored include:

- Existence of documented releases or contaminated targets
- Potential magnitude of the pathway score
- Availability of scoring data
- Likely range of the overall site score (e.g., near the 28.50 cutoff or not).

In general, score the pathway if there is an observed release, if targets are subject to actual contamination, or if there are major target areas for the pathway.

If the contribution of a pathway or threat to the overall score is minimal, scoring and fully documenting the pathway may not be necessary, even if extensive data are available. As a general guideline, pathways and threats scoring less than 10 points usually do not need to be scored, unless the overall site score is near the cutoff. (Note that near 28.50, the most a 10-point pathway can add to an overall score is approximately half a point. See Section 3.4 for more details.) If a pathway is not scored, the scorer should describe the pathway and available data in the HRS package. This discussion helps present a more thorough and accurate picture of conditions at the site and may be useful later in the remedial process.

If a site score is close to the cutoff, score all pathways even if they add only a few points to the overall site score. In many cases, site scores drop after Quality Assurance review or response to public comments, and the initial inclusion of these additional pathways may keep the site above the cutoff.

In conclusion, the site assessment process should not be viewed simply as an exercise to achieve the maximum HRS score possible by always scoring every pathway, nor as a mechanical process that automatically ends when a score of 28.50 is reached. The scorer must make decisions about whether to score individual pathways or threats based on knowledge of the site, professional judgment and experience, and an understanding how the site score might be affected.

2.3 EVALUATION OF SITES WITH WASTE REMOVALS

A removal action is a relatively short-term response taken to eliminate a threat or prevent more serious environmental problems resulting from the release of CERCLA hazardous substances. Under the original HRS, a site was scored based on conditions that existed prior to a removal action. Under the revised HRS, waste removals (a specific type of removal action in which hazardous substances, or wastes containing hazardous substances, are physically removed from a site) may be considered for scoring purposes under certain circumstances. This section outlines the requirements for evaluating removal actions for HRS purposes, defines a qualifying removal, explains how to determine the cutoff date for qualifying removals, and discusses other relevant scoring issues. The waste removal policy is

designed to provide an incentive for rapid response actions by PRPs, reducing risks to the public and the environment and allowing for more timely and cost-effective cleanups. The Agency's waste removal policy is explained in greater detail in *The Revised Hazard Ranking System: Evaluating Sites After Waste Removals* (OSWER Publication 9345.1-03FS, October 1991).

REQUIREMENTS FOR CONSIDERING REMOVAL ACTIONS

In the preamble to the HRS (55 *Federal Register* 51567, December 14, 1990), EPA established three requirements that must be met for the results of a removal action to be considered in scoring a site with the HRS. A removal action that meets these three requirements is referred to as a qualifying removal.

The first requirement is that the removal action physically remove from the site wastes containing hazardous substances. Note that it is not necessary that all wastes from the site or even all wastes from a particular source be removed; partial removals can be considered in scoring. This requirement for actual physical removal ensures that there is no scoring benefit for simply moving the waste and its associated risks to another portion of the same site. A removal action conducted under Superfund's emergency response program does not necessarily involve physical removal of wastes from the site. For example, Superfund removal actions, as defined in CERCLA section 101(23), may include stabilizing or containing waste on-site through engineering controls or limiting exposure potential by erecting fences or providing alternate water supplies. These types of actions do not constitute a qualifying removal.

The second requirement is that the removal must have occurred prior to the cutoff date applicable to the site. The HRS preamble states that EPA will only consider removals conducted prior to the SI. This requirement encourages prompt action and avoids the need to resample or rescore sites due to waste removals conducted after the SI. Because of differences in site assessment activities for different types of sites (e.g., EPA-lead, state-lead, Federal facilities), criteria for determining the appropriate cutoff date differ among sites. The next section provides detailed guidance on determining a site-specific cutoff date.

The third requirement is that all waste removed must be disposed of or destroyed at a facility permitted, as appropriate, under the Resource Conservation and Recovery Act (RCRA) or the Toxic Substances Control Act (TSCA) or by the Nuclear Regulatory Commission (NRC). This requirement encourages proper disposal of the removed waste and discourages simply moving the waste and its associated hazards to another location.

DETERMINING THE CUTOFF DATE

The paragraphs below describe how to determine the cutoff date for non-Federal and Federal facility sites and for sites with more than one SI.

Non-Federal Facility Sites with One SI

An SI for non-Federal facility sites generally begins with development of a workplan, which often includes the sampling strategy for the site. EPA believes it would disrupt SIs to consider the results of removal actions conducted after this point because to do so could require revising sampling plans, resampling, or rescoring the site. Because of variation in the way Regions have historically tracked SIs, it is impossible to define a single event as the cutoff date for sites that had SIs before the removal policy fact sheet was distributed in December 1991. Therefore, the cutoff date for those sites generally is the date development of a workplan for the SI begins. Examples of dates that can be considered analogous to workplan development for purposes of determining the cutoff date include:

- SI start date in CERCLIS;
- Date of Technical Decision Document (TDD) or Technical Decision Memorandum (TDM) issued for work assignment to develop SI workplan;
- Date when EPA approves the site-specific SI workplan; or
- Date of an SI reconnaissance to develop SI workplan.

If no workplan or analogous event is available, the cutoff date is the earliest documented date that EPA conducted SI activities for the site. For all sites with SIs conducted after December 1991, Regions are expected to enter the date of site-specific workplan approval by EPA as the SI start date in CERCLIS, and that date should be used as the cutoff date for determining qualifying removals.

If EPA determines that previous investigations by other parties (e.g., states, EPA's removal program) are suitable for SI purposes, then the date when drafting of a Superfund SI report collating previous analytical data is begun serves as the cutoff date. The cutoff date is not the date of a state or PRP investigation conducted independently of CERCLA; the cutoff is based on the date these data are collated for Superfund SI purposes.

Non-Federal Facility Sites with Multiple SIs

For non-Federal facility sites with more than one SI, the cutoff date for most sites will be keyed to the first SI. However, the Agency may establish a later cutoff date under certain circumstances:

- If a second SI implementing a completely new sampling strategy is conducted, the Agency may consider basing the cutoff date on workplan development for the second SI. In these cases, considering removals prior to the second SI is not likely to unduly disrupt the site assessment process.
- For sites where the first SI was conducted more than four years prior to HRS scoring, the Agency may consider, on a case-by-case basis, changing the cutoff date to a later date. (CERCLA section 116, added by SARA, mandates that EPA conduct site assessment work within four years of CERCLIS listing.)

The transition to the revised HRS and the follow-up sampling needed for some sites may mean that site assessment activities take longer than four years. Follow-up sampling should not be used to determine a new cutoff date in that situation, even if more than four years have elapsed since the first cutoff date, unless a completely new sampling strategy is implemented.

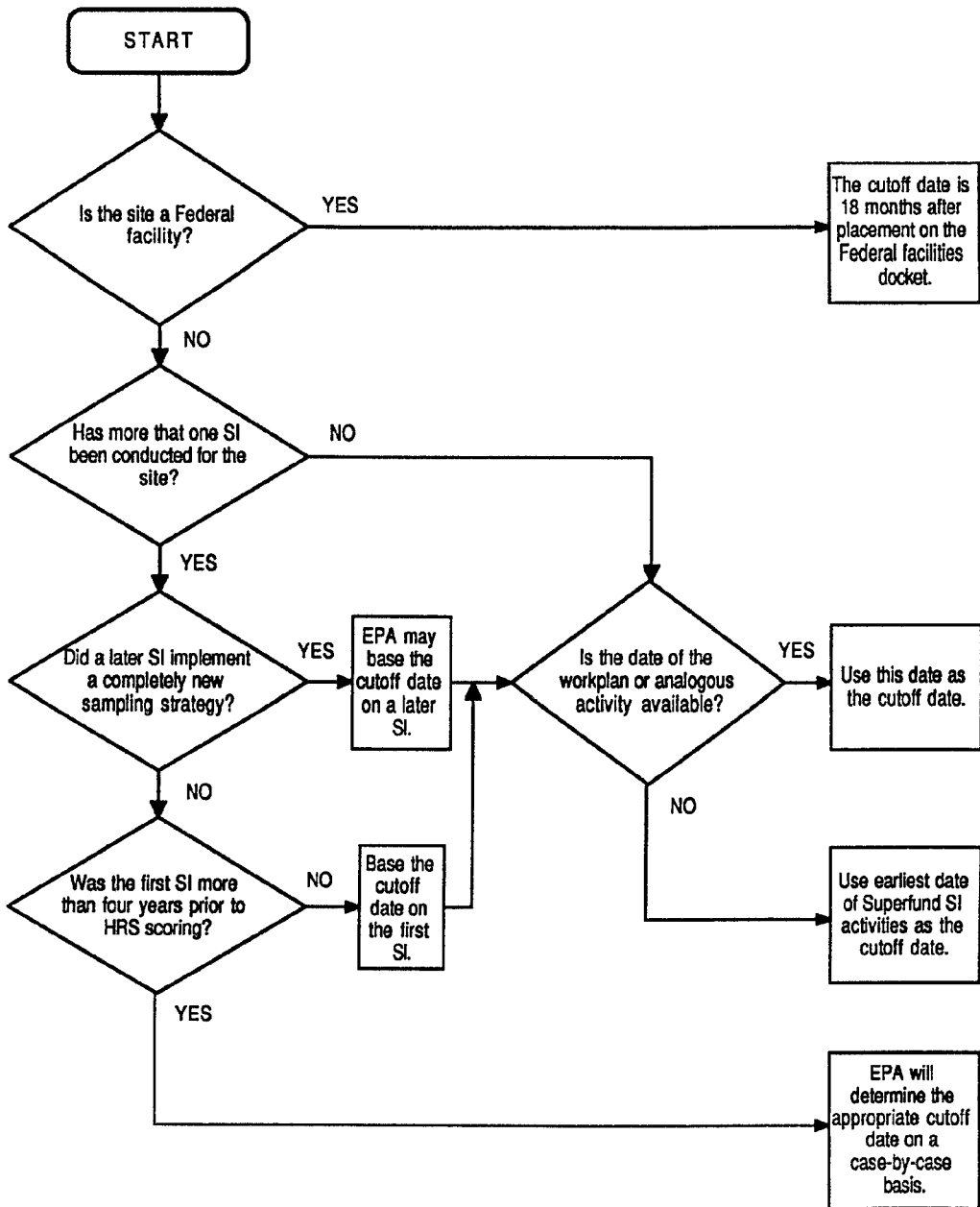
Federal Facility Sites

Federal facility sites undergo a somewhat different site process than other sites. Assessments of Federal facility sites are expected to be conducted within 18 months of their placement on the Federal Agency Hazardous Waste Compliance Docket, set up under CERCLA section 120(c), added by SARA. Therefore, the cutoff date for Federal facility sites is 18 months after the site is placed on the Federal facilities docket.

Summary

Highlight 2-1 is a flowchart for determining a site-specific cutoff date. **Highlight 2-2** provides examples of determining the cutoff date for hypothetical sites.

HIGHLIGHT 2-1 FLOWCHART FOR IDENTIFICATION OF THE CUTOFF DATE



HIGHLIGHT 2-2 EXAMPLES OF DETERMINING CUTOFF DATE

SITE #1	
Site Assessment Activities	<p>PA was conducted in May 1988</p> <p>SI sampling took place in October 1989. The date workplan development for SI began is unknown; however, the date of the Technical Decision Document authorizing the contractor to develop an SI workplan was dated July 1989.</p> <p>HRS package prepared began in January 1991.</p>
Cutoff Date	July 1989: Cutoff date is the date analogous to workplan preparation.

SITE #2	
Site Assessment Activities	<p>No PA was conducted.</p> <p>The State conducted an independent (i.e., non-Superfund) investigation of this site, including sampling in May 1988. The State issued a final report of the investigation in December 1988.</p> <p>In May 1990, EPA examined the State's December 1988 report. EPA decided this investigation constituted an SI, and began drafting a Superfund SI report in May 1990. The report was finalized in July 1990.</p> <p>HRS package preparation began in August 1991.</p>
Cutoff Date	May 1990: Cutoff date is the date EPA began drafting an SI report using previous analytical data, <u>not</u> the date of the state investigation or report on which EPA's report is based.

SITE #3	
Site Assessment Activities	<p>PA was conducted in January 1989.</p> <p>EPA's emergency response program conducted a removal assessment in June 1989 and removed a number of corroding drums in July 1989.</p> <p>Development of an SI workplan began in November 1989. Sampling took place in March 1990.</p> <p>HRS package preparation began in February 1991.</p>
Cutoff Date	November 1989: Cutoff date is based on development of SI workplan, <u>not</u> on the date of the removal assessment.

(continued on next page)

HIGHLIGHT 2-2 (continued) EXAMPLES OF DETERMINING CUTOFF DATE

SITE #4	
Site Assessment Activities	<p>PA was conducted In March 1986</p> <p>SI sampling was conducted by an EPA contractor In January 1987. No date for workplan development or analogous date Is available. The earliest identified date for Superfund SI activities Is December 1986.</p> <p>A second SI with a similar sampling strategy was conducted in September 1989.</p> <p>Limited sampling to collect additional data to support HRS scoring was conducted In April 1991.</p> <p>HRS package preparation began In August 1991.</p>
Cutoff Date	<p>To be determined: The cutoff date normally would be December 1986. This date (earliest identified date of Superfund SI activities) is used because the date of workplan development for the first SI is not available. In addition, the September 1989 and April 1991 SI activities did not implement completely new sampling strategies. However, because the first SI was conducted more than four years prior to HRS scoring, EPA may determine a later cutoff date than December 1986 for the site.</p>

SCORING CONSIDERATIONS WHEN A QUALIFYING REMOVAL HAS OCCURRED

A qualifying removal affects scoring of the hazardous waste quantity factor and also may affect the scoring of a number of other HRS factors. Scoring hazardous waste quantity for sites with qualifying removals is discussed in detail in the removal policy fact sheet. For a qualifying removal, do not count the amount of waste removed when scoring hazardous waste quantity. For a non-qualifying removal, score hazardous waste quantity as if the waste was not removed. For a partial qualifying removal, the waste removed generally may be subtracted from the total amount of waste, if the same hazardous waste quantity tier (e.g., both must be based on volume) can be used.

Changes in factors other than hazardous waste quantity caused by a qualifying removal should be considered in scoring a pathway only if all of the following conditions are met.

- Change in the factor was a direct result of a qualifying removal. For example, if during a qualifying removal waste is removed from a surface impoundment and the impoundment is refilled with clean soil, the clean fill can be considered in scoring factors other than hazardous waste quantity (e.g., containment) if the following two conditions are also met.
- No observed release of a hazardous substance associated with the source is established. If an observed release associated with the source involved in the qualifying removal is established, the effects of the removal are not considered in scoring factors other than hazardous waste quantity. This requirement is pathway specific. If, for example, an observed release is established for ground water but not for air or surface water, then changes in factors other than hazardous waste quantity can be considered in scoring the air and surface water pathways (as long as the other two conditions are also met).

- The removal completely eliminated the source or resulted in a containment factor value of zero for the source. If the removal is partial or if changes that result from the removal would result in a lower, but non-zero, containment factor value, the effects of the removal are not considered in scoring factors other than hazardous waste quantity. Again, this requirement is pathway-specific; the removal may result in a zero containment factor value for air but a non-zero containment factor value for ground water and surface water.

The requirements above apply to all HRS factors other than hazardous waste quantity. Instructions for applying these requirements to specific factors are provided below.

Observed Release

An observed release to a migration pathway, whether documented before or after a qualifying removal, can be used to score likelihood of release. That is, a qualifying removal does not negate the fact that the source has released substances to the environment. However, areas of observed contamination in the soil exposure pathway reflect continuing hazards at the site. Therefore, the soil exposure pathway factor is evaluated based on conditions that exist following a qualifying removal.

Source Containment and Source Type

Scoring of the containment and, for the air pathway, source type factors is affected only by qualifying removals that result in a factor value of 0. Changes in containment or source type that result in a lower but non-zero factor value are not considered in scoring.

Substance-specific Factors

Substance-specific factors cannot be based on a hazardous substance that was completely eliminated from a pathway by a qualifying removal. Such a removal must eliminate all sources of the hazardous substance, and no prior releases of the substance may have occurred. Substance-specific factors include:

- Toxicity
- Mobility
- Persistence
- Bioaccumulation potential
- Gas migration potential.

EPA generally will be unable to document complete elimination of a hazardous substance within the scope of an SI and will rely on PRPs to produce these data. If a portion of a source is eliminated in a qualifying removal, the remaining portion of that source is assumed to contain the same hazardous substances as the removed portion, unless the PRP can document otherwise (e.g., provide analytical results or manifest data that convincingly demonstrate a given hazardous substance is not present in the remaining portion of the source).

Targets Factors

Site-specific TDL (or distance categories) and the distance to nearest targets in migration pathways may change if a qualifying removal meets the three requirements above. In such cases, the source is eliminated from the pathway and, therefore, is not used to measure target distances. If a qualifying removal does not meet the three requirements above (e.g., an observed release of a hazardous substance associated with the source is established or the source containment factor value is non-zero), the source is included when measuring target distances for that pathway.

2.4 CERCLA POLLUTANTS OR CONTAMINANTS

HRS scores on the basis of likelihood of release of hazardous substances into the environment, waste characteristics (e.g., toxicity and quantity) on site, and the targets potentially affected by releases from the site. Therefore, the scorer must know what substances can and cannot be considered in scoring. The HRS definition of hazardous substance, with one exception, includes both CERCLA hazardous substances and pollutants or contaminants, as defined in CERCLA sections 101(14) and 101(33). Section 101(14) of CERCLA defines hazardous substances by referencing substances specifically listed under other Federal laws. Section 101(33) of CERCLA does not specifically list the substances considered to be "pollutants or contaminants," but instead gives the following definition:

"pollutant or contaminant shall include, but shall not be limited to, any element, substance, compound, or mixture, including disease-causing agents, which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformations, in such organisms or their offspring ...".

Thus, the term "pollutant or contaminant" is very broadly defined in CERCLA and could include any substance known or reasonably anticipated to be harmful to human or ecological health. Because no substances are actually listed as pollutants or contaminants, either in CERCLA or in the HRS, the Agency determines on a case-by-case basis which substances fall within the definition. This determination is important because pollutants or contaminants may, for example, contribute to the waste quantity factor value, be used to determine substance-specific factor values, and affect source identification and targets evaluation. Direct any questions regarding whether a substance is a pollutant or contaminant, or how to score a site involving pollutants or contaminants, to the EPA Regional Site Assessment Manager.

These two basic HRS scoring scenarios involve releases of pollutants or contaminants:

- Substances at the site include only pollutants or contaminants (i.e., no CERCLA hazardous substances). This scenario is relatively unusual. Most sites that have been identified for potential listing contain a number of substances, usually including CERCLA hazardous substances. However, even if no CERCLA hazardous substances are identified, the site can be scored and is eligible for the NPL if at least one substance present is documented to be a CERCLA pollutant or contaminant. In these situations, the standard HRS scoring process is followed, except that Tier A under the hazardous waste quantity factor is not applicable.
- Substances at the site include both CERCLA hazardous substances and pollutants or contaminants. The scorer should follow the standard HRS scoring process. Before using a substance that is not a CERCLA hazardous substance in scoring, document that the substance qualifies as a CERCLA pollutant or contaminant.

Pollutants or contaminants are treated the same in the HRS as CERCLA hazardous substances except pollutants or contaminants cannot be used to score Tier A of the hazardous waste quantity factor.

2.5 STATUTORY AND POLICY EXCLUSIONS

A number of statutory and policy provisions affect a site's eligibility for CERCLA response actions and listing the NPL. CERCLA specifically excludes certain types of releases and wastes from response actions, and in some cases, it is more appropriate to conduct response under another

statutory authority. This section summarizes several statutory and policy exclusions that HRS scorers may encounter.

Although a site's eligibility for the NPL should be determined before HRS scoring begins, new information may surface during scoring that relates to site eligibility. HRS scorers should be familiar with general site eligibility considerations so they can recognize issues that need to be addressed by EPA Regional staff. For additional information on determining a site's eligibility under CERCLA, see *Guidance for Performing Preliminary Assessments Under CERCLA* (OSWER Publication 9345.0-01, September 1991) and *Regional Quality Control Guidance for NPL Candidate Sites* (OSWER Publication 9345.1-08, December 1991).

CERCLA PETROLEUM EXCLUSION

CERCLA sections 101 (14) and (33) exclude petroleum from the definitions of "hazardous substance" and "pollutant or contaminant," respectively. The exclusion applies to petroleum, including crude oil or any fraction thereof (if the fraction is not specifically listed nor designated a hazardous substance by other listed acts), natural gas, natural gas liquids, liquified natural gas, and synthetic gas usable for fuel.

The Regional Quality Control (QC) Guidance for NPL Candidate Sites (OSWER Publication 9345.1-08, December 1991) raises several issues to consider when scoring a site possibly containing petroleum or petroleum products:

- CERCLA does not define petroleum. Crude petroleum includes a number of hazardous substances that would otherwise be CERCLA hazardous substances, such as benzene, toluene, xylene, and ethylbenzene. In their pure forms, these substances remain hazardous substances and can be scored. When they are part of, or released directly from, a petroleum product, they cannot be used in scoring.
- The presence of petroleum products at a site, as a part of site contamination, does not exclude the site from consideration. Sites are excluded if they contain only excluded petroleum products.
- Releases of petroleum products contaminated with hazardous substances (i.e., used oil/waste oil contaminated with metals or PCBs) can be listed if the hazardous substances cannot be separated from the petroleum.
- If two distinct plumes commingle, one of petroleum and one of a hazardous substance that can be listed, the release can be listed; however, only the non-petroleum plume can be used in HRS scoring.
- A petroleum release can be used to show aquifer interconnection.

RADIOACTIVE MATERIALS

Section 101 (22) of CERCLA excludes a limited category of radioactive materials from the statutory definition of "release," making them ineligible for CERCLA response or the NPL. These are (1) releases of source (uranium or thorium, or any combination of the two, in any physical or chemical form), by-product (any radioactive material that was made radioactive by exposure to radiation from the process of using or producing special nuclear material), or special nuclear material (plutonium, uranium-233, enriched uranium-233 or -235, or any material that the NRC determines to be special nuclear material (not including source material)) subject to section 170 of the Atomic Energy Act; and (2) any release of source, by-products, or special nuclear material from any processing site specifically designated under the Uranium Mill Tailings Radiation Control Act of 1978.

The exclusion of these substances does not exclude other types of radioactive materials. However, it is Agency policy not to list releases of radioactive materials from facilities with a current license issued by the NRC (e.g., certain medical facilities, manufacturing plants, research laboratories). These facilities are under the authority of the NRC which is responsible for requiring and overseeing cleanup at these sites. All other types of radioactive materials sites, including state licensees and former NRC licensees, are eligible for the NPL.

RCRA SITE POLICY

In general, it is Agency policy to use RCRA Subtitle C authority to respond to sites that can be addressed under RCRA Subtitle C corrective action authority, and not to place such sites on the NPL (see generally, 54 *Federal Register* 41000, October 4, 1989). According to the Agency's NPL/RCRA deferral policy, however, some facilities subject to RCRA Subtitle C authority may be placed on the NPL when corrective action is unlikely to succeed (refer to the QC Guidance for more details). Sites subject to corrective action under RCRA Subtitle C authority which may be placed on the NPL include:

- Treatment, storage, or disposal facilities (TSDFs) that have demonstrated an unwillingness to undertake corrective actions;
- TSDFs that have demonstrated an inability to pay for cleanup, as evidenced by a bankruptcy filing or similar action;
- Former treatment or storage facilities that did not pursue a RCRA operating permit and have changed their RCRA status to "generator" or "non-handier" (these facilities are sometimes referred to as "converters"); and
- RCRA "Non- or Late Filers" (i.e., facilities that operated as TSDFs after the statutory deadline but either did not notify EPA or delayed notification).

If the scorer finds new evidence indicating that the site may be eligible for RCRA Subtitle C corrective action, notify the Regional EPA Site Assessment Manager.

CHAPTER 3

THE HRS SCORING PROCESS

This chapter provides an introduction to the process by which HRS packages are prepared, identifies the elements of a complete package, describes the package review process, and discusses effective scoring strategy. The approach and strategy for implementing the HRS discussed in this chapter are very broad; Chapters 4 through 10 and Appendix A present more specific guidance for scoring particular pathways, threats, and factors.

3.1 GENERAL APPROACH TO HRS SCORING

This section outlines an eight-step approach that breaks down the HRS scoring process into a series of manageable tasks. Although geared to the inexperienced HRS scorer, this approach can serve as a guide for experienced scorers as well. The approach presented here is only a suggested one; experienced scorers may develop their own approaches. In addition, because every site is different, an approach appropriate for one site may be inappropriate for another.

Throughout the scoring process, all information used in scoring must be recorded in the HRS documentation record. EPA has developed a computer software package (and companion user's manual) called PREscore, which automates HRS scoring and allows the scorer to enter limited narrative descriptions of scoring rationales and data sources. The PREscore printout can serve as a starting point for the final HRS documentation record. See **Highlight 3-1** for an introduction to PREscore.

HIGHLIGHT 3-1 THE PRESCORE SOFTWARE PROGRAM

The PREscore software package includes the PREscore and PREprint computer programs, as well as a users manual and tutorial (OSWER Dir. 9345.1-04). PREscore provides an efficient and convenient means of scoring sites using the HRS. PREscore performs HRS calculations from some raw data, retrieves values from hazardous substance reference tables, and calculates pathway and sites cores. PREprint generates HRS score sheets, an HRS documentation record, and an NPL characteristics data collection form. The user's manual provides instruction for installing and using PREscore and PREprint.

PREscore partially automates HRS scoring, allowing for entry and evaluation of site-related information such as sampling data, waste quantities, waste characteristics, physical parameters of the site, and population data. Scorers can enter descriptive narrative text and reference citations to document the selection of specific HRS factor values and scoring decisions.

PREscore users must be familiar with the HRS. The software does not provide detailed HRS instructions, although help screens with text from the HRS are available throughout the program. PREscore contains HRS related information on over 300 hazardous substances that may be encountered at Superfund sites. This information includes substance characteristics (such as toxicity and persistence) and concentration benchmarks.

For more information on PREscore, contact the appropriate Regional NPL Coordinator.

STEP 1: ASSEMBLE AND REVIEW ALL AVAILABLE SITE INFORMATION

Scorers often have limited first-hand knowledge of a site when they begin an HRS evaluation. Thus, the first step is to become familiar with the site by assembling and reviewing existing documents, a step sometimes referred to as a "file search." The PA and SI reports should contain most of the relevant site data collected to date. In addition, any preliminary HRS scoring results (e.g., PA-Score results) should be reviewed as a means of generating hypotheses about which pathways and factors are likely to be most significant in scoring the site.

When reviewing available information about a site, be sure to consider the following questions:

- What are the primary sources at the site? Are other (i.e., not part of the site) potentially important sources of hazardous substances nearby? (As in the HRS rule, the term "hazardous substance" is defined in this guidance document to include both CERCLA hazardous substances and CERCLA pollutants or contaminants; see Section 2.4 for additional related discussion.)
- What hazardous substances are associated with the site, and in what quantities are they present? Are they at least partially attributable to sources at the site?
- Have any observed releases or areas of observed contamination been documented?
- Are there any major targets (e.g., populations, municipal wells, fisheries, sensitive environments) located near the site (i.e., within the TDLs)? Are any targets located on or very near (e.g., within 1/2 mile) sources at the site?
- Are any targets exposed to actual contamination that is at least partially attributable to the site? If so, are there any data indicating the hazardous substance concentrations to which targets have been exposed?

The answers to these questions will provide a basic understanding of the nature of the threat posed by the site and will assist in determining whether available information contains any significant "gaps" that require additional investigation.

The scorer also should consider up front the site definition (i.e., which specific sources and/or areas of contamination comprise the site) and the site's eligibility for the NPL (see Sections 2.1 and 2.5). Both of these issues should have been resolved before HRS scoring and package preparation begins, but the scorer should confirm that the issues have been addressed.

STEP 2: IDENTIFY AND CHARACTERIZE SOURCES

Understanding the sources (and, for the soil exposure pathway, areas of observed contamination) at a site is one of the keys to HRS scoring. The HRS defines a source as any area where a hazardous substance has been deposited, stored, disposed, or placed, plus any soils that have been contaminated through migration (contaminated media other than soil usually are not considered sources). A site may include multiple sources and/or areas of observed contamination.

With this definition in mind, review source-related information and complete the source characterization portion of the HRS documentation record. Describe the dimensions and identify the hazardous substances associated with each source, and classify each source into a source type category (the assigned category can vary by pathway). Then, for each source, determine the containment characteristics and evaluate hazardous waste quantity for each pathway.

Evaluate source information to determine if:

- A source has been eliminated through a qualifying removal action and there is no observed release is associated with that source (see Section 2.3).
- A source has a containment factor value of zero for each migration pathway and an attractiveness/accessibility factor of zero for the soil exposure pathway.

If either of these conditions applies, do not use the source in scoring the site.

STEP 3: IDENTIFY AND CHARACTERIZE SIGNIFICANT PATHWAYS

While the potential hazards should be described qualitatively (at a minimum) for all HRS pathways, some pathways and threats may not be scored for a particular site. The identification of significant pathways depends to a large degree on professional judgment based on knowledge of the site and preliminary HRS scoring results. As a general rule, a pathway should be considered significant at this early stage of the scoring process if either of the following conditions is met: (1) there is an observed release (or observed contamination) for that pathway; or (2) several major target areas are within the TDL for that pathway. See Section 2.2 for general considerations about scoring all pathways and Section 3.4 for more quantitative guidance on the efficiency of scoring particular pathways.

The following are some of the more significant HRS considerations and information needs when characterizing pathways to be scored. See Chapters 7 through 10 for more detailed pathway-specific guidance.

Ground Water Pathway

- Evaluate all aquifers used as sources of potable water. The aquifer that yields the highest score is used to evaluate the pathway.
- Identify the geologic formations present (including known aquifer boundaries, discontinuities, and interconnections), especially underlying aquifers used for drinking water supply. Identify any karst aquifers within the TDL.
- Determine whether there has been an observed release of a hazardous substance from the source(s) to one or more aquifers.
- Identify ground water uses and well locations within the TDL.

Surface Water Pathway

- Identify all surface water bodies within the TDL.
- Determine whether multiple watersheds exist. If so, evaluate all watersheds. The watershed that yields the highest score is used to evaluate the pathway.
- Evaluate the hazardous substance migration path(s), including the overland segment(s) (including runoff routes, distance from source to surface water) and the in-water segment(s) (including probable point of hazardous substance entry, TDL(s)) for all surface waters to which hazardous substances have been or have the potential to be released, or have floodplains that include a source at the site.
- Determine whether there has been an observed release of a hazardous substance from the source(s) to surface water.

- Evaluate waste characteristics carefully, particularly for the human food chain and environmental threats because the maximum waste characteristics factor category value is 1,000 (rather than 100) in these threats due to consideration of bioaccumulation potential.
- Identify surface water uses (e.g., drinking water intakes, fisheries) within the TDL.
- Identify all sensitive environments within the TDL.
- Determine which of the three threats (drinking water, human food chain, and environmental) should be scored. Human food chain and environmental threats may score high if a substance with a bioaccumulation potential factor value of 500 or greater is present.
- Evaluate whether the ground water to surface water component should be scored. Note that no specific guidance on this component is provided in this manual.

Soil Exposure Pathway

- Identify and delineate areas where hazardous substances have been documented within 2 feet of the surface and do not lie beneath an essentially impenetrable cover (i.e, the areas of observed contamination). If no such areas have been documented, assign a zero to the pathway score.
- Identify property boundaries for areas of observed contamination.
- Determine the 200-foot distance from areas of observed contamination for the resident population threat.
- Identify land uses within areas of observed contamination.
- Identify all terrestrial sensitive environments at least partially within areas of observed contamination.
- Determine the 1/4-mile, 1/2-mile, and 1-mile travel distances for the nearby population threat. (Travel distances need not be straight line measurements.)

Air Pathway

- Determine whether there has been an observed release of a hazardous substance from the source(s) to air.
- Evaluate gas potential to release for sources with gaseous hazardous substances and particulate potential to release for sources with particulate hazardous substances. Evaluate both for sources with both types of hazardous substances.
- Identify land uses within the TDL.
- Identify all sensitive environments in the TDL.

STEP 4: EVALUATE TARGETS FOR SIGNIFICANT PATHWAYS

Targets consist of people, sensitive environments, fisheries, and resources that potentially can be affected by a site. The HRS targets factor category is the only category that has no maximum value. The relative contribution of a particular target to the overall site score is determined by its assigned point value and the level of contamination to which the target is subject. For each significant

pathway, identify all targets within the appropriate TDL and determine whether they are exposed to Level I, Level II, or potential contamination.

The following is a list of general guidelines for evaluating targets by pathway. For more detailed guidance, see the appropriate sections of Chapters 7 through 10. Refer to Appendix A for additional information on sensitive environments.

Ground Water Pathway

- Identify all wells drawing water from the aquifer(s) of concern.
- Determine whether ground water wells are part of a blended water supply system (including blending with surface water intakes), as this will affect the targets calculations.
- Identify and evaluate standby wells and emergency ground water supplies.
- Identify private drinking water wells and determine populations that rely on them for drinking water. Some private wells are not used as drinking water supplies.
- Focus on populations subject to actual contamination (Level I or Level II or within 1 mile of a source, as these generally will dominate the targets factor category value. Do not, however, ignore large populations beyond 1 mile.
- Collect sufficient data to be confident that the population subject to contamination within each distance category falls within the range of populations assigned the same factor value.

Surface Water Pathway

- Estimate average annual flow for all streams and rivers within the TDL. If the site is near an ocean or the Great Lakes, estimate the depth of these water bodies within the TDL.
- Focus on targets subject to actual contamination (Level I or Level II) or located on water bodies with an average annual flow of 100 cubic feet per second or less (i.e., high value for dilution weight multiplier), as these generally will dominate the targets factor category value.
- If actual contamination of targets cannot be established, identify the presence of significant targets (drinking water intakes, fisheries, sensitive environments) and calculate target factor category values after applying the appropriate dilution weight for the water bodies in which these targets are located.
- Determine whether drinking water intakes are part of a blended water supply system (including blending with ground water wells), as this will affect the targets calculations.
- Identify and evaluate standby intakes and emergency surface water supplies.
- Evaluate nearest intake and food chain individual values.
- Collect sufficient data to be confident that the population subject to contamination within each distance category falls within the range of populations assigned the same factor value.

Soil Exposure Pathway

- Focus on the resident population threat; the nearby population threat rarely will affect the pathway score significantly.
- Determine whether observed contamination exists that is within the property boundary and within 200 feet of any residences, day care centers, schools, or work areas.
- Determine whether observed contamination exists in terrestrial sensitive environments.

Air Pathway

- Identify all individuals regularly occupying areas an or near sources.
- Focus on populations and sensitive environments subject to actual contamination (Level I or Level II) or within 1/4 mile of a source, as these generally will dominate the targets factor category value.
- Collect sufficient data to be confident that the population subject to contamination within each distance category falls within the range of populations assigned the same factor value.

STEP 5: COLLECT ADDITIONAL INFORMATION, IF NECESSARY

At this stage of the HRS scoring process, the scorer should assess whether the available information is sufficient to document all the HRS factors relevant to the site's score. If not, collect the additional information needed. This may include verifying target populations. Additional sampling may be considered for a number of reasons, including:

- To score all HRS factors for all significant pathways;
- To replace low-quality chemical analysis data that support observed releases, and/or the calculation of targets exposed to actual contamination;
- To replace other low-quality data, if required;
- To attribute hazardous substances to sources at the site; and/or
- To establish representative background levels (in most cases, additional "release" samples would need to be collected at the same time background levels are established).

This step will not be necessary for all sites. In general, additional data collection at this point should focus on those factors critical to the site's HRS score.

STEP 6: CHECK VALIDITY OF FACTOR VALUES

The calculation of factor values should be reviewed to determine whether the "best" data available have been used for scoring and whether the professional judgments made in scoring are appropriate. It is strongly recommended that inexperienced scorers consult more experienced scorers for this review. Areas that require a particularly thorough review include:

- Source characterization
- Hazardous waste quantity
- Aquifer boundaries, discontinuities, and interconnections
- Quality of sampling data

- Observed releases
- Extent of observed surficial contamination
- Documentation of targets exposed to Level I or Level II contamination
- Factor values for which data are near scoring range boundaries.

STEP 7: ASSEMBLE AND SUBMIT COMPLETE HRS PACKAGE

When assembling the HRS package, it may be helpful to prepare a working draft of the documentation record, indicating raw data values and the references used to support specific HRS factors. Use the working draft to enter information into PREscore (see **Highlight 3-1**), which will convert the input data into factor, pathway, and site scores. More detailed information on the HRS scoring package itself is provided in Section 3.2. The completed HRS package is submitted to the appropriate EPA Regional office for review.

STEP 8: RESPOND TO REVIEWS

The EPA Regional QC review process will identify potential problems with the HRS package. If QC indicates that an HRS score is inaccurate or that the documentation is incomplete, the scorer must work with the Region to resolve any problems before the package is submitted to EPA Headquarters for QA review. Only sites scoring at or above the cutoff of 28.50 are submitted for QA review. See Section 3.3 for more information on the HRS package review process.

3.2 THE HRS SCORING PACKAGE

A complete HRS scoring package consists of the following materials (in order):

- (1) A site narrative summary
- (2) A signed QC checklist (completed by Regional reviewer)
- (3) A QA signature page (completed by EPA Headquarters)
- (4) HRS scoresheets (hard copy and disk; should be from PREscore)
- (5) HRS documentation record, including bibliography of references
- (6) Complete copies of referenced reports or documents, including legible maps (with scales) of sampling points and target locations
- (7) NPL characteristics data collection form
- (8) Other information as appropriate (e.g., RCRA documentation).

This section focuses on the materials most important to the HRS scorer, the documentation record and references. Refer to EPA's *Regional Quality Control (QC) Guidance for NPL Candidate Sites* (OSWER Publication 9345.1-08, December 1991) for information on other materials listed above.

THE DOCUMENTATION RECORD

The documentation record is the central element of the HRS package. It contains all of the information upon which a site score is based and a list of the references from which the information was obtained. The documentation record and references for sites proposed to the NPL are available for public review. If a site's listing is challenged in court, EPA's defense of the site score is restricted to the information contained in the documentation record. To refute legal challenges, information in the HRS documentation record must be objective, accurate, and complete. Every statement of fact in the record that is not a matter of general public knowledge should be supported by a reference number and a page number. Although the use of professional judgment is acceptable where appropriate, the documentation record should not contain assertions based strictly on opinion.

As a general rule, HRS documentation should be sufficient for an independent observer to replicate the observations, measurements, and calculations and arrive at the same quantitative or qualitative decision (factor value). More specific guidance on the HRS documentation record includes:

- All HRS factors that are scored must be documented in the documentation record.
- Adequate documentation of observed releases or observed contamination is extremely important. Be certain they are documented carefully and thoroughly.
- "Proof" is not required for documenting a factor value. The HRS has been designed with wide scoring ranges for many factors, reflecting the uncertainties in SI data.
- An entry in the documentation record should include a reference to the supporting documents upon which the information is based (e.g., reports, well logs, geologic investigations). Always include the appropriate reference page number(s).
- Take particular care in documenting factor values upon which the final site score is critically dependent. Successful challenges to these factor values could prevent a site's placement on the NPL.
- Delete pages of the documentation record relating to HRS factors, pathways, and threats that have not been evaluated.
- Be as specific as possible given the available data. For example, do not indicate the HRS range into which site information falls (e.g., nearest well is 1/4 mile to 1/2 mile from Source A) when more precise information (e.g., 1,500 feet) is available.
- When information is close to a "break point" in an HRS scoring range, estimate it as precisely as possible.
- Show all intermediate calculations in documenting hazardous waste quantities, blended target populations, and food chain production. Do not merely list the final values for these (and similar) factors.
- Remember that incomplete entries in the documentation record could form the basis of challenge to the scoring during public comment; support all entries with sufficient references.

REFERENCES

A complete list of references, including the number of pages in each, should be included at the front of the documentation record. Number references sequentially in the order in which they are cited in the documentation record, with the following exceptions:

- List the HRS as reference 1; and
- List the version of the Superfund Chemical Data Matrix (SCDM) used as reference 2. **Highlight 3-2** provides more details on SCDM.

Include a complete copy of most references cited in the documentation record (except references 1 and 2, listed above) in the HRS scoring package. For unusually lengthy references, provide only the appropriate excerpts and the title page. For any document that is not publicly available (e.g., those phone logs, PA/SI reports, consultant reports), include a complete copy, regardless of length. Maps (e.g., those indicating sampling points, target locations) must be legible and include distance scales.

HIGHLIGHT 3-2 THE SUPERFUND CHEMICAL DATA MATRIX

SCDM contains data for more than 300 chemicals frequently found at Superfund sites. For each substance, SCDM provides selected HRS factor values (primarily for contaminant characteristics) and HRS benchmarks for each of the four pathways. HRS factor values listed include: toxicity, groundwater mobility, surface water persistence, human food chain and environmental bioaccumulation, ecosystem toxicity, air gas migration potential, and air mobility. Available benchmarks for all four pathways include toxicity-based benchmarks (e.g., cancer risk and reference dose screening concentrations) and regulation-based benchmarks (e.g., Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs) promulgated under the Safe Drinking Water Act). SCDM is essential for HRS scoring because benchmarks and HRS factor values are found more easily in SCDM than by consulting primary references.

SCDM is published by EPA and is updated periodically. To obtain a copy of SCDM, contact the Hazardous Site Evaluation Division at EPA Headquarters.

When referencing target measurements, describe where the measurement began (e.g., the identified PPE), where the measurement ended (e.g., a specific sampling location), and how the measurement was made (e.g., measured during the SI, or estimated from a map). This description enables reviewers to repeat each step of the measurement and verify the supporting information in the references.

Whenever possible, ensure that references cited are primary sources; that is, the original material from which the information was obtained. Examples of primary sources are:

- Geologic publications
- Records of field observations/measurements
- Analytical data reports
- Waste manifests
- Phone logs
- Field notebooks
- Contractor's reports.

Examples of references that can be used but are not considered primary references are:

- Summaries of analytical results with the appropriate QA/QC information
- PA or SI reports.

Examine very carefully the use of PA and SI reports as references. In addition to actual field observations or measurements and sampling results, these reports may contain summaries of information gathered from other documents. Ensure that the documents referenced within the PA and SI reports are reviewed and used as the primary references in the HRS documentation record.

OTHER ITEMS IN THE HRS SCORING PACKAGE

Other items in the HRS package include:

- The HRS scoresheets, which list HRS factor values, pathway and threat scores, and the total site score.
- The site narrative summary, which is a brief description of the site including the site's name, location, approximate size, general nature of contamination problem, and a description of current status of any response actions or enforcement actions.

- The QC checklist which is filled out and signed by the Regional site assessment personnel responsible for performing QC review of HRS packages before submitting them to EPA Headquarters for formal QA.
- The NPL characteristics data collection form, used to update an EPA data base of NPL sites.
- The QA signature page, which is signed by the EPA Headquarters Regional Coordinator and Site Assessment Branch Chief, indicating that all QA issues have been resolved and that the site is ready for proposal to the NPL.

In some cases, other information is included in the HRS package. For example, when multiple sources that are some distance apart or otherwise may appear unrelated are treated as a single site, a statement of the rationale for doing so – a document sometimes referred to as an aggregation memorandum – may be part of the HRS package. As another example, the package may include a statement regarding the use of RCRA permits to document hazardous waste quantity.

3.3 THE PACKAGE REVIEW PROCESS

All HRS scoring packages developed by states and EPA contractors are subject to QC review by EPA Regional site assessment staff. EPA Headquarters will not review any package that has not completed Regional QC and is not accompanied by a signed QC checklist. The purpose of the Regional QC is to:

- Confirm the eligibility of a site for the NPL;
- Verify that the package is complete, information is accurate and readable, and every statement of fact is supported by documentation in the package;
- Check the arithmetic;
- Ensure that scores for individual HRS factors are appropriate, given the information contained in the package;
- Review key assumptions and professional judgments made in scoring the site and ensure that they are adequately explained and documented;
- Resolve and correct any errors or discrepancies; and
- Review the site narrative summary and NPL characteristics data collection form to ensure that they are adequate.

For more information on the QC process, refer to EPA's *Regional Quality Control (QC) Guidance for NPL Candidate Sites* (OSWER Publication 9345.1-08, December 1991).

After Regional QC is complete, packages undergo an in-depth QA review at EPA Headquarters. Analysis of HRS scoring packages submitted to Headquarters in the past shows a high incidence of incorrect referencing and illegible photocopies, especially of maps. Avoiding these common errors will streamline the review process considerably.

After any scoring errors or issues are resolved, EPA may propose adding sites scoring greater than 28.50 to the NPL through a proposed rulemaking in the *Federal Register*. Comments received during the ensuing public comment period are reviewed and addressed, and site scores modified as necessary. In some cases, site scores may drop below 28.50. A final rule is then published in the *Federal Register* identifying the sites added to the NPL (i.e., sites with scores remaining above 28.50 and remaining eligible under EPA's policy).

3.4 HRS SCORING STRATEGY

This section discusses a strategy for efficient HRS scoring. Guidelines are presented for determining the extent of scoring effort and the number of pathways to score. In addition, this section discusses the implications of the HRS equations for site scoring and provides several scoring principles that will help in preparing HRS packages.

The HRS evaluates hazards to human health and the environment on the basis of a large number of individual factors. For most sites, it is neither feasible nor productive to gather data for and score every factor in every pathway, because:

- One of the primary objectives of HRS scoring is to determine whether or not the site score is greater than 28.50 (i.e., cutoff score for NPL listing).
- Many sites pose threats primarily via one or two pathways.
- The mathematics of the HRS is such that higher-scoring pathways exert a proportionately greater influence on the site score than do lower-scoring pathways.

Without a clearly defined scoring strategy, considerable resources may be expended gathering data and scoring factors and pathways that will have little impact on the site score.

SCORING EFFORT

Scoring a site with the HRS involves various types of decisions. Quantitative decisions may include determining the correct scoring ranges for waste characteristics and targets. Qualitative decisions may include deciding which pathways, threats, aquifers, and watersheds to evaluate, and whether existing sampling results are sufficient to document an observed release or observed contamination. One of the most important decisions is determining when the data collection and scoring effort is complete.

The level of effort devoted to scoring a site is governed by two competing requirements: (1) to accurately determine the relative threat posed by the site, and (2) to efficiently use EPA's limited data collection and analysis resources. The HRS includes numerous factors that must be evaluated for each pathway scored, and comprehensive data are rarely readily available for every factor. Moreover, some factor evaluations are more resource-intensive than others. At most sites, it would be possible to refine factor values by gathering or analyzing additional data (e.g., take one more sample, count one more house), but such efforts may consume resources better devoted to other sites. It is important to have a strategy for accurately and efficiently scoring a site. The following general principles should help determine the extent of scoring effort:

- The HRS score should reliably reflect the site's eligibility for the NPL. If the site score is greater than or equal to 28.50, the scorer should be confident that the score will remain at or above 28.50 after QA/QC review and public comment. If the site score is less than 28.50, the scorer should be confident that additional scoring efforts would not raise the score to 28.50 or greater.
- To the extent practicable, the HRS score should reflect the relative threat posed by the site.

In developing a scoring strategy, the scorer must realize that the HRS is a screening tool, not a detailed risk assessment. Given the considerable uncertainties regarding specific characteristics of a site and its surrounding environment at the time of scoring, the HRS score should not be viewed as a measure of absolute risk that must be determined to the last decimal point. Moreover, qualitative information regarding specific site characteristics may be as important as the numerical HRS score in determining some aspects of relative threat. For example, the immediate threat a site poses as a

result of a few drinking water wells contaminated above health-based benchmarks would be greater than the immediate threat posed by a site at which nearby municipal wells were threatened with contamination (but not currently contaminated), even if the two sites received similar HRS scores.

IMPLICATIONS OF HRS EQUATIONS FOR SITE SCORING

Understanding the mathematical dynamics of the HRS requires familiarity with (1) the way in which the site score is determined from pathway scores and (2) the way in which pathway scores are determined from factor category values.

Dynamics of the HRS Site Score

The HRS site score (S) is calculated by a root-mean-square formula:

$$S = \sqrt{\frac{S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2}{4}}$$

where: S_{gw} = ground water migration pathway score
 S_{sw} = surface water migration pathway score
 S_s = soil exposure pathway score
 S_a = air migration pathway score.

Each pathway score has a minimum value of 0 and a maximum value of 100. The mathematics of the root-mean-square equation is such that higher-scoring pathways exert a proportionately greater influence on the site score than lower-scoring pathways. For example,

$$S = \sqrt{\frac{100^2 + 30^2 + 30^2 + 30^2}{4}} = 56.35$$

$$S = \sqrt{\frac{100^2 + 0^2 + 0^2 + 0^2}{4}} = 50.00$$

$$S = \sqrt{\frac{0^2 + 30^2 + 30^2 + 30^2}{4}} = 25.98$$

In the root-mean-square equation, the sum of the squared pathway scores is the key to reaching the cutoff score:

$$S = \sqrt{\frac{3,249}{4}} = 28.50$$

The value of 3,249 can be reached in a variety of ways, as shown by the examples in **Highlight 3-3**.

HIGHLIGHT 3-3
COMBINATIONS OF PATHWAY SCORES THAT YIELD SITE SCORE OF 28.50

Individual Pathway Scores			Sum of Squared Pathway Scores	Site Score
57.00	0.00	0.00	3,249	28.50
40.31	40.31	0.00	3,250	28.50
32.91	32.91	32.91	3,249	28.50
28.50	28.50	28.50	3,249	28.50

The root-mean-square equation and **Highlight 3-3** illustrate that it is easier to raise a site score by adding points to a high-scoring pathway than by adding the same number of points to a second, lower-scoring pathway. Given an existing single-pathway score (A) less than 57, the additional score required for the same pathway to reach a site score of 28.50 is:

$$57-A$$

whereas the score required for a second pathway is given by:

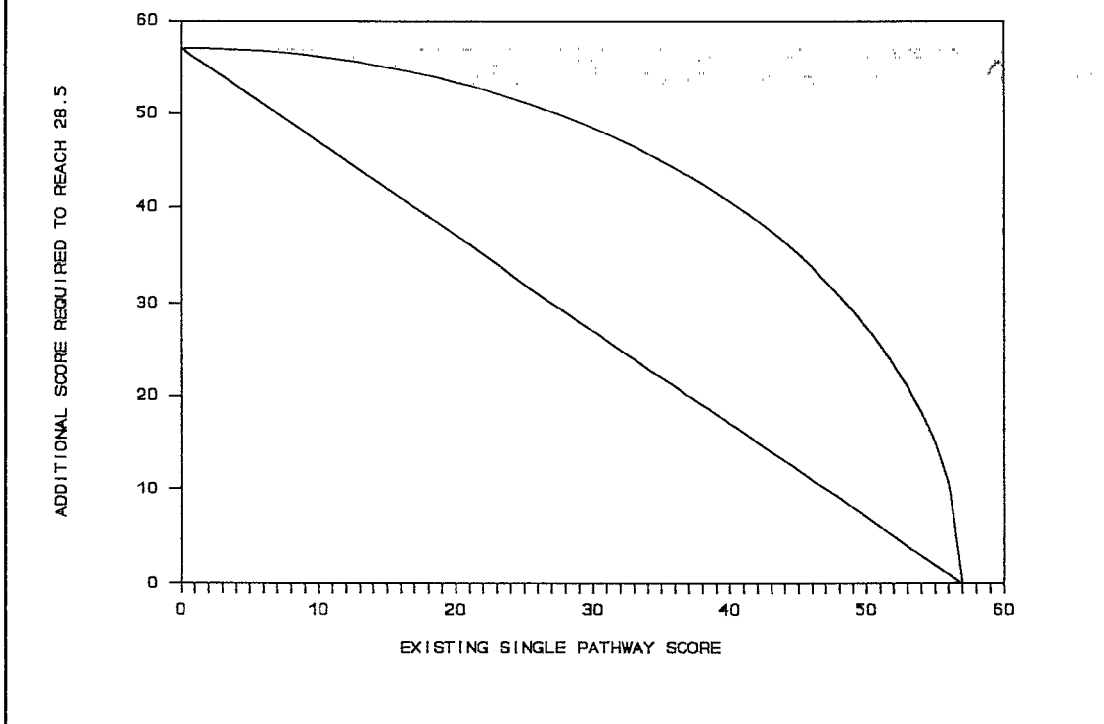
$$\sqrt{3,249 - A^2}$$

For example, suppose a preliminary scoring effort resulted in a single-pathway score of 50. Within that same pathway, only (57-50)=7 additional points would be required for a site score of 28.50, while in a different pathway, (3,249-2,500)=27.37 points would be required. **Highlight 3-4** presents the general relationship between additional points required within the same pathway versus a second pathway.

Several general conclusions can be reached from the dynamics of the algorithm used to derive the HRS site score:

- Knowing the two highest pathway scores usually is sufficient to determine whether the site score is likely to be above 28.50.
- The site score is unlikely to be above 28.50 unless one pathway score is greater than 50, two pathway scores are greater than 35, or three pathway scores are greater than 30.
- Pathways that receive a score lower than 10 points are unlikely to have a significant effect on the site score in the range of the cutoff score or above (e.g., a single-pathway score of 50 would result in a site score of 25.00; pathway scores of 50 and 10 would result in a site score of 25.50).

**HIGHLIGHT 3-4
ADDITIONAL SCORE REQUIRED TO YIELD SITE SCORE OF 28.5**



Dynamics of the HRS Pathway Scores

Each HRS pathway score (A) is the product of the three factor category values (likelihood of release or likelihood of exposure, waste characteristics, and targets) divided by a scaling factor:

$$A = \frac{LR \times WC \times T}{82,500}$$

where: LR = likelihood of release
 WC = waste characteristic
 T = targets factor.

The scaling factor of 82,500 results in a pathway score of 100 when the values for likelihood of release (or likelihood of exposure) and waste characteristics are at their "typical" maxima and the targets factor category value is 150 (i.e., (550 x 100 x 150)/82,500 = 100). However, several characteristics of the HRS scoring algorithms make it difficult to determine *a priori* for a specific site which factor category or individual factor has the greatest influence on pathway score:

- The multiplicative nature of the factor categories, which means, for example, that doubling any one factor category value will double the pathway score, is subject to certain maximum values (i.e., "caps").
- The hazardous substance used to determine toxicity and other waste characteristics factor values may vary among pathways and threats.

- Caps on the waste characteristics factor category value vary among pathways and threats.
- The maximum pathway score based solely on environmental threat is 60.
- The targets factor category has no cap.
- The point value assigned to specific targets depends on whether they are subject to actual contamination.

If the values for likelihood of release and waste characteristics are known (or have been approximated) for a pathway, the targets factor category value required to obtain a particular pathway score (A) is:

$$T = \frac{82,500 \times A}{LR \times WC}$$

For example, if likelihood of release is 550, waste characteristics is 32, and the pathway score required for a site score of 28.50 is 47.5, the minimum targets factor category value necessary for this score is $(82,500 \times 47.5)/(550 \times 32) = 222.66$. Assuming maximum values for likelihood of release and waste characteristics, the minimum targets factor values required for a pathway score of 57 (and hence a single-pathway site score of 28.50) are presented in **Highlight 3-5**. Note that the targets factor category value includes Level I, Level II, and potential contamination values; values for nearest well, intake, or residence; and values for wellhead protection areas, workers, resources, sensitive environments, and other targets factors. The relative weight given each of these targets factors determines the overall contribution of a single target to the pathway and site score. For example, individuals and sensitive environments evaluated under Level I or Level II contamination are weighted, respectively, a minimum of 100 and 10 times more heavily than those evaluated under potential contamination.

A high pathway score generally requires relatively high values for all three factor categories, and with a few exceptions (e.g., when the targets category value, which is not capped, is very high) a low value for any single factor category will limit the pathway score. This results partly from the multiplicative relationship between the three factor category values in the pathway score equation, and partly from how the values for each factor category are assigned in the HRS. For example, minimal waste quantity and a moderate or low likelihood of release are likely to result in a low pathway score unless a very high targets value is obtained. A high targets value could be difficult to obtain in this scenario because all targets would be evaluated under potential contamination.

PATHWAY CONSIDERATIONS

Certain combinations of site characteristics usually result in a high pathway score. The following generalizations may help identify potentially high-scoring pathways:

- Pathways with actual contamination of targets are likely to score higher than pathways in which only potential contamination is established. Therefore, consider scoring all pathways with actual contamination of targets.
- The decrease in target values due to distance-weighting of targets subject to potential contamination is less in the ground water pathway than in the air and soil pathways (see **Highlight 3-6**).
- The surface water pathway is likely to receive a relatively high score if an observed release to a fishery or sensitive environment is established.

HIGHLIGHT 3-5
MINIMUM TARGETS FACTOR VALUE REQUIRED TO YIELD
PATHWAY SCORE OF 57

Pathway or Threat	Maximum Likelihood of Release Factor	Maximum Waste Characteristics Factor Category	Minimum Targets Factor Category Value for Pathway Score of
Ground Water	550	100	85.5
Surface Water			
Drinking Water	550	100	85.5
Human Food Chain	550	1,000	8.55
Environmental ^b	550	1,000	8.55
Soil Exposure			
Resident	550	100	85.5
Nearby Population ^c	500	100	94.05
Air	550	100	85.5

^a Assumes maximum value for likelihood of release and waste characteristics; required targets factor value increases as values for likelihood of release and/or waste characteristics decrease

^b Maximum Score for the environment threat is 60.

^c A targets factor category value as high as 94.05 is unlikely for this threat.

- In the surface water pathway, the maximum value for waste characteristics is 1,000 in the human food chain and environmental threats. A waste characteristics value greater than 100 means the pathway can score > 57 with lower values for the likelihood of release and targets factor categories (see **Highlight 3-5**).
- If the likelihood of release and waste characteristics factor values are maximum, a pathway or threat score of 57 or greater may result when actual contamination is established for between 4 and 41 persons (see **Highlight 3-7**).

Several other generalizations for pathway scoring are presented below. For specific pathway and factor scoring strategies, see the appropriate chapters of this document.

Ground Water Pathway

The ground water pathway may receive a score of 57 or greater based on actual or potential contamination if target populations are sufficiently large.

- Score the ground water pathway if any targets are evaluated under actual contamination (Level I or II concentrations).
- Score the pathway if there is a large population within the TDL, even if all targets are evaluated under potential contamination.
- The nearest well factor may have a significant effect on the pathway score.
- A large distance-weighted population is most likely when a large number of private wells are within 1/2 mile of the site, municipal wells are within the TDL, and/or a karst aquifer is within the TDL.

HIGHLIGHT 3-6
DISTANCE AND DILUTION WEIGHTS UNDER POTENTIAL CONTAMINATION

Distance Category ^a	Relative Distance Weight Assigned to Population Targets Evaluated Under Potential Contamination		
	Ground Water Pathway ^b	Air Pathway	Soil Exposure Pathway ^c
Onsite	1.00	1.000	1.000
> 0.00 - 0.25	1.00	0.250	0.025
> 0.25 - 0.50	0.62	0.054	0.013
> 0.50 - 1.00	0.32	0.016	0.006
> 1.00 - 2.00	0.18	0.005	0
> 2.00 - 3.00	0.13	0.002	0
> 3.00 - 4.00	0.08	0.001	0

^a Distance from source (miles).

^b For karst aquifers, relative weight is 0.50 beyond 0.5 mile.

^c Nearby population threat only.

HIGHLIGHT 3-7
POPULATION REQUIRED TO YIELD PATHWAY SCORE OF 57

Number of Persons Evaluated Under Actual Contamination		Pathway or Threat Score ^{a,b}
Level I	Level II	
4	0	60.00
3	6	57.33
2	16	57.33
1	26	57.33
0	41	57.33

^a Pathway or threat score based solely on population evaluated under actual contamination (e.g., no resources, no sensitive environments).

^b Ground water pathway, surface water pathway (drinking water threat), soil exposure pathway (resident population threat), and air pathway.

Surface Water Pathway

The surface water pathway score is the sum of the three separate scores for the drinking water, human food chain, and environmental threats. Any threat may score 57 or greater if actual contamination of targets is established; if actual contamination is established for either the human food chain or environmental threat, the surface water pathway is very likely to score 57 or greater.

- Score the surface water pathway if any targets are evaluated under actual contamination (Level I or II concentrations).

- Score the surface water pathway if there is an observed release to surface water and a fishery is present within the TDL, even if the fishery is not subject to actual contamination.
- If an observed release to surface water is not established, an individual threat is unlikely to score greater than 10 points unless many targets (or a large fishery) are present within a surface water body with a dilution weight of 0.01 or greater (for a list of such surface water body types, see HRS Table 4-13); however, the sum of the three threats may exceed 10.
- Within the surface water pathway, threat scores are additive (i.e., they are not combined using a root-mean-square equation), and therefore an individual threat score lower than 10 may contribute significantly to the pathway score.
- At many sites, several types of surface water bodies are located within the TDL.; therefore, targets within all surface water body types must be considered in developing a scoring strategy.

Drinking Water Threat

- A large dilution-weighted population is most likely when a municipal intake is located on a stream or river with low or moderate flow characteristics. The low dilution weight for large surface water bodies often will result in a low threat score, even when population served is large (for examples, see **Highlight 3-8**).
- When evaluated based on potential contamination, the nearest intake factor generally will not have a significant effect on the drinking water threat score unless the intake is located within a minimal stream.

Human Food Chain Threat

- The human food chain threat score is likely to be 57 or greater if actual contamination of a fishery is established. If actual contamination is established and the waste characteristics value is 180 or greater, the human food chain threat score will almost always be 57 or greater.
- Even if actual contamination of a fishery is not established, the human food chain threat score is likely to be significant if there is an observed release to the watershed and the waste characteristics value is 100 or greater.
- If no observed release is established, the human food chain threat score is unlikely to be significant unless there is a fishery within a minimal or small to moderate stream and the waste characteristics value is greater than 320.

Environmental Threat

- The environmental threat score is likely to be 57 or greater if Level I concentrations are established for a sensitive environment with a point value of 25 or greater. If actual contamination is established for at least one sensitive environment and the waste characteristics value is 320 or greater, the environmental threat score will almost always be 57 or greater.

HIGHLIGHT 3-8
DRINKING WATER THREAT SCORES UNDER POTENTIAL CONTAMINATION

Type of Surface Water Body ^b	Drinking Water Threat Score for Intake with Given Population Served ^a				
	2,500	7,500	25,000	75,000	250,000
Rivers and Streams					
Minimal stream	98.79	100.00	100.00	100.00	100.00
Small to moderate stream	9.70	31.52	98.79	100.00	100.00
Moderate to large stream	1.21	3.03	9.70	31.52	98.79
Large stream to river	0.12	0.30	1.21	3.03	9.70
Large river	0.01	0.03	0.12	0.30	1.21
Very large river	0.0	0.0	0.01	0.03	0.12
3-mile mixing zone in quiet flowing river	49.70	100.00	100.00	100.00	100.00
Other Surface Water Bodies^c					
Shallow ocean/Great Lake	0.01	0.03	0.12	0.30	1.21
Moderate depth/Great Lake	0.0	0.0	0.01	0.03	0.12
Deep zone/Great Lake	0.0	0.0	0.0	0.02	0.06

^a Assumes likelihood of release value of 500, waste characteristics value of 100, and no other drinking water intakes within the TDL.

^b For definitions, see HRS Table 4-13.

^c Assumes no drinking water intakes in salt or brackish water; for other lakes, see HRS section 4.1.2.3.1.

- If actual contamination of a sensitive environment cannot be established, the environmental threat score is unlikely to be significant unless there are several sensitive environments within a minimal or small to moderate stream and the waste characteristics value is greater than 100.
- The maximum score for the environmental threat is 60.

Soil Exposure Pathway

The soil exposure pathway score is derived by combining separate scores for the resident population and nearby population threats. The soil exposure pathway is only evaluated when areas of observed (surficial) contamination are documented. The area of observed contamination is an important determinant of waste characteristics in the resident population threat and of likelihood of exposure and waste characteristics in the nearby population threat.

- Score the soil exposure pathway if any targets are within 200 feet of an area of observed contamination.
- The soil exposure pathway usually will not score 57 or greater unless residents, students (including day care), workers, or sensitive environments are on or within 200 feet of an area of observed contamination on the property.
- The nearby population threat is unlikely to contribute significantly to the soil exposure pathway score unless there is a very large population near the site and areas of observed contamination at the site are readily accessible.

- Within the soil exposure pathway, threat scores are additive (i.e., they are not combined using a root-mean square equation), and therefore an individual threat score lower than 10 may contribute significantly to the pathway score.
- The maximum soil exposure pathway score that can be achieved when the only targets are terrestrial sensitive environments is 60.

Resident Population Threat

- Evaluating a relatively small number of resident threat targets may result in a significant pathway score. For example, if the waste characteristics value is 32, documenting one resident and one 50-point sensitive environment both subject to Level II concentrations plus one worker would result in a pathway score of 21.55 (based solely on resident population threat).

Nearby Population Threat

- The nearby population threat score is likely to be significant by itself only if there is a large population very near the site and likelihood of exposure and waste characteristics are moderate to high.

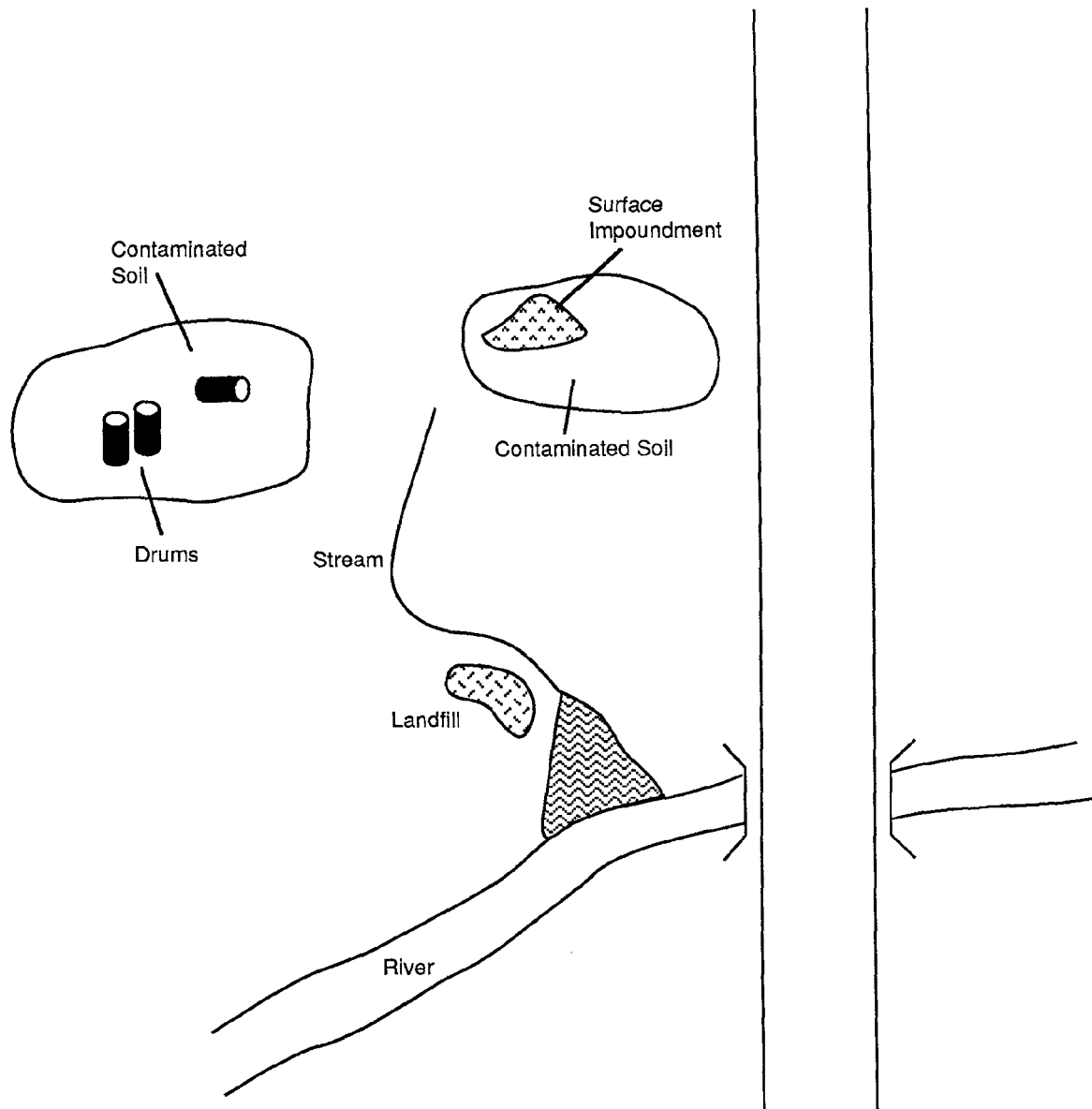
Air Pathway

The air pathway may score 57 or greater based on actual or potential contamination. However, if all targets are evaluated under potential contamination, the pathway score is likely to be lower than 10 unless at least some targets are on or very near sources.

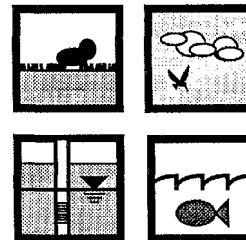
- Score the air pathway if any targets are evaluated under actual contamination (Level I or II concentrations).
- Score the pathway if there are any targets on or within 1/4 mile of sources at the site, even if all targets are evaluated under potential contamination.
- The relative value assigned to targets evaluated under potential contamination declines steeply with distance (see **Highlight 3-6**). Therefore, the targets factor category value generally will be determined primarily by targets on or within 1/4 mile of a source.
- The maximum air pathway score that can be achieved when the only targets are sensitive environments is 60.

CHAPTER 4

SOURCES



SECTION 4.1 CHARACTERIZATION OF SOURCES AND AREAS OF OBSERVED CONTAMINATION



This section provides guidance to assist the scorer in characterizing sources and areas of observed contamination by assigning factor values based on source type. Because source information is used throughout the HRS and deficiencies in that information or in its interpretation may have a significant impact on the site score, it is critical to correctly classify and characterize each source. This section defines sources (and areas of observed contamination), provides pathway-specific guidance for identifying and documenting sources and their hazardous substances, and discusses special cases where characterizing sources (or areas of observed contamination) is especially complex. This section does not discuss multiple-source sites.

RELEVANT HRS SECTIONS	
Section 2.1.3	Common evaluations
Section 2.2	Characterize sources
Section 2.2.1	Identify sources
Section 2.2.2	Identify hazardous substances associated with a source
Section 2.2.3	Identify hazardous substances available to a pathway
Section 5.0.1	General considerations (soil exposure)

DEFINITIONS

Area of Observed Contamination: Evaluated only in the soil exposure pathway and established based on sampling locations as follows:

- Generally, for contaminated soil, consider the sampling locations that indicate observed contamination and the area lying between such locations to be an area of observed contamination, unless information indicates otherwise.
- For sources other than contaminated soil, if any sample taken from the source indicates observed contamination, consider the entire source to be an area of observed contamination.

If an area of observed contamination (or a portion of such an area) is covered by a permanent, or otherwise maintained, essentially impenetrable material (e.g., asphalt), exclude the covered area from the area of observed contamination. However, asphalt or other impenetrable materials contaminated by site-related hazardous substances may be considered areas of observed contamination.

Hazardous Substances: CERCLA hazardous substances and pollutants or contaminants as defined in CERCLA sections 101 (14) and 101 (33), except as otherwise specifically noted in the HRS.

Source: Any area where a hazardous substance has been deposited, stored, disposed, or placed, plus those soils that may have become contaminated from hazardous substance migration. In general, however, the volumes of air, ground water, surface water, and surface water sediments that may have become contaminated through migration are not considered sources.

Unallocated Source: Not an HRS source type, rather a means of including within the hazardous waste quantity factor those hazardous substances or hazardous waste streams that are known to be at the site but that cannot be allocated to any specific source. Thus, the term only applies for hazardous waste quantity.

The following definitions are for specific source types evaluated in the HRS.

Above-ground Tank: Any tank that does not meet the definition of a below-ground tank (including any tank that is only partially below the surface).

Active Fire Area: Area presently burning or smoldering.

Below-ground Tank: A tank with its entire surface area below the surface and not visible; however, a fraction of its associated piping may be above the surface.

Buried/Backfilled Surface Impoundment: A surface impoundment that has been completely covered with soil or other cover material after the final deposition of waste materials.

Burn Pit: An uncovered area on the land surface that is not presently burning but that was at one time used to burn hazardous substances or was otherwise significantly inflamed.

Container or Tank: A stationary device constructed primarily of nonearthen materials (such as wood, concrete, steel, or plastic) used to contain an accumulation of a hazardous substance; or a portable device in which a hazardous substance is stored or otherwise handled.

Contaminated Soil (excluding land treatment): Soil onto which available evidence indicates a hazardous substance was spilled, spread, disposed, or deposited.

Drum: A type of container used to hold hazardous substances. For HRS purposes, drums are standard 55-gallon cylindrical containers.

Landfarm/Land Treatment: A method of waste management in which either liquid wastes or sludges are spread over land and tilled or liquids are injected at shallow depths into soils.

Landfill: An engineered (by excavation or construction) or natural hole in the ground into which wastes have been disposed of by backfilling or by contemporaneous deposition of soil and wastes.

Other: A source type used when defined source types do not apply. Examples include: contaminated buildings, storm drains, dry wells, injection wells, and French drains. "Other" also can be used for ground water plumes and sediments with no identified source.

Piles:

Chemical Waste Pile: A pile consisting primarily of discarded chemical products (whether marketable or not), by-products, radioactive wastes, or used or unused feedstocks.

Other: A term reserved for a pile of indeterminate origin that contains hazardous substances.

Scrap Metal or Junk Pile: A pile consisting primarily of scrap metal or discarded durable goods such as appliances, automobiles, auto parts, or batteries, that contain or have contained hazardous substances.

Tailings Pile: A pile consisting primarily of any combination of overburden from a mining operation and tailings from a mineral mining, beneficiation, or processing operation.

Trash Pile: A pile consisting primarily of paper, garbage, or discarded nondurable goods that contain or have contained hazardous substances.

Surface Impoundment: A topographic depression, excavation, or diked area, primarily formed from earthen materials (lined or unlined) and designed to hold accumulated liquid wastes, wastes containing free liquids, or sludges that were not backfilled or otherwise covered during periods of deposition; depression may be dry if deposited liquid has evaporated, volatilized or leached; structures that may be more specifically described as lagoon, pond, aeration pit, settling pond, tailings pond, sludge pit, etc.; also a surface impoundment that has been covered with soil after the final deposition of waste materials (i.e., buried or backfilled).

EVALUATING SOURCES

Evaluating sources consists of five steps: (1) identifying the sources and areas of observed contamination, (2) classifying the source type, (3) identifying the hazardous substances associated with each source or area of observed contamination, (4) evaluating the containment associated with each source, and (5) calculating the hazardous waste quantity for each source. A complete source characterization should include:

- Narrative summary describing the source or area of observed contamination;
- Reference location for the source or area of observed contamination on the site map;
- List of hazardous substances associated with the source or area of observed contamination;
- Containment description; and
- Hazardous waste quantity evaluation.

This section outlines the general strategy for evaluating sources. The order in which topics are discussed here does not imply that any one action is always taken before another. At some sites, the source may be identified and the evaluation will include identifying hazardous substances present in the source and the containment for that source; at others, the hazardous substances may be found in a media and then traced to sources.

(1) **Identify sources and areas of observed contamination.** Locate all sources and areas of observed contamination at the site. For sources readily seen, the scorer can move directly to Step (2). Sources not readily seen can be identified by several methods including (but not limited to):

- Visual observation of geographic or other site features followed by sampling
- Site records indicating historical disposal areas
- Discovery during the SI

- Aerial photographs showing historical evidence of a source
- Statements by individuals who have knowledge of the site.

Another method to identify sources is through the presence of hazardous substances. In this method, first identify hazardous substances through sampling and then define the source based on the sampling location or trace back from the sampling location to identify the source of the migration. This process may become complicated at sites with more than one source or hazardous substance.

- (2) **Classify source type.** After identifying sources at the site, classify each source in one of the HRS source type categories identified for that pathway. If the source classification is unclear, consult **Highlight 4-1** and the subsection below, Characterizing Unique Sources.
- (3) **Identify hazardous substances associated with sources.** After identifying and classifying the sources at a site, the next step in the characterization process is identifying the hazardous substances associated with each source. The basic methods for identifying hazardous substances associated with a source include:
 - Labels, manifests, or other historical records;
 - Site operations (e.g., if a plating facility uses trichloroethylene and disposes sludge into a surface impoundment, the scorer could assume trichloroethylene was present in the surface impoundment); and
 - Sampling.

HIGHLIGHT 4-1 COMMONLY CONFUSED SOURCE TYPES

At times, it is difficult to categorize a source at a facility as one particular HRS source. In some cases, the scorer must use professional judgment and knowledge of the waste management practices at the site to assign a source type. The following can help the scorer differentiate commonly confused source types.

Landfill: Landfills are generally characterized by the addition of fill (e.g., soil) during or after disposal, covering the wastes from view. Often, landfills are dug out in the ground and then the soil from the resulting pit is used as fill during disposal. Sometimes, open pits (e.g., old quarries) are used and soil is brought in as cover.

Pile: Piles are characterized by periodic addition of wastes to stacks resulting in one large pile. Piles may occur in a pit, liquid impoundment, or on the land surface. Piles differ from landfills because the wastes generally are not mixed with fill during disposal. Piles in liquid impoundments differ from surface impoundments because the wastes (e.g., often slurries) are deposited with the intention of dewatering the waste and accumulating a large pile of wastes in one area.

Surface Impoundment: Surface impoundments are distinguished by two characteristics - the waste management unit is intended to contain liquid wastes and lacks a soil cover. If the liquid has evaporated, the waste management unit should still be considered a surface impoundment for HRS purposes. A buried/backfilled surface impoundment is similar to a surface impoundment, only this source type has been filled with soil or other cover material after the final deposition of wastes.

Contaminated Soil: Contaminated soil can be distinguished by the method of deposition. Unlike other sources, contaminated soil is not intended to be a waste management unit and is often formed by migration, deposition, or spills of wastes.

However, consider these important points before associating hazardous substances with a source:

- An observed release to the migration pathways can be shown by sampling or by direct observation (e.g., if sampling finds hazardous substances in a ground water plume associated with a landfill, the hazardous substances can be associated with the landfill).
- Transformation products from a hazardous substance associated with a source can be scored only if sampling indicates they are present.
- Comparison to background is not necessary to establish the presence of hazardous substances for sources confirmed by manifests (e.g., RCRA, DOT).
- Visual observation of stained soils may be a clue to the presence of hazardous substances, but their presence must be verified through sampling or other means.

There are significant differences between the three migration pathways (ground water, surface water, and air) and the soil exposure pathway for associating hazardous substances with sources. The differences are highlighted below.

For the migration pathways:

- Consider those hazardous substances documented to be present in a source or known to be deposited in that source (e.g., by sampling, labels, manifests, oral or written statements) or in releases from the source to be associated with that source when evaluating each pathway.
- When a hazardous substance can be determined to be present at a site (e.g., by labels, manifests, oral or written statements, observed release), but the specific source cannot be documented, consider the hazardous substance to be present at all the sources, except those for which definitive information indicates that the hazardous substance was not or could not be present.

For the soil exposure pathway:

- Consider only the hazardous substances that meet the criteria for observed contamination for an area of observed contamination to be present in that area of observed contamination.

(4) **Evaluate the containment for each source.** Only hazardous substances associated with a source with a containment greater than zero or with an area of observed contamination are available to the pathway under consideration. Acceptable means of documenting hazardous substances available to the migration pathways and the soil exposure pathway are listed below.

- For the migration pathways, the hazardous substances (including any transformation products) available to a particular pathway are those that:
 - Meet the criteria for an observed release to the pathway under consideration; or
 - Are associated with a source with a containment factor greater than zero for the pathway under consideration (see Sections 7.4 and 8.5).

- For the soil exposure pathway, the hazardous substances available are those that:
 - Meet the criteria for observed contamination at the site; or
 - Meet the criteria for observed contamination at areas with an attractiveness/accessibility factor greater than zero, for the nearby population threat (see Section 9.8).
- (5) **Calculate hazardous waste quantity.** After identifying the sources and determining the hazardous substances available to each pathway, calculate the hazardous waste quantity. For guidance on calculating the hazardous waste quantity, see Chapter 6 of this document.

EVALUATING SITES WITH NO IDENTIFIED SOURCES

Occasionally, sites that consist of a plume of contaminated ground water or an area of surface water sediment contamination, with the original source of the contamination unidentified, enter the Superfund process. Before scoring such sites, efforts should be undertaken to identify the original source(s) of contamination. These efforts should be equivalent to those of an expanded SI and should include:

- Research on site history and regulatory status;
- Site reconnaissance;
- Consideration of hazardous substances affiliated with industries of potential concern at the site;
- Records search and interviews with employees; and
- Sampling to eliminate or confirm other possible sources.

A source should generally not be designated as “unidentified” until sampling has been undertaken in an area and a search for the original sources has been conducted (within the scope of an expanded SI).

If the original source(s) of contamination cannot be identified, evaluate the ground water plume or the sediment contamination as the source for scoring purposes. In order for a ground water plume or sediment contamination to be characterized as a source, generally consider the following:

- The plume or sediment contamination has been established solely by sampling and inference, using the observed release criteria; and
- The level of effort to identify the original source is similar to an expanded SI.

CHARACTERIZING UNIQUE SOURCES

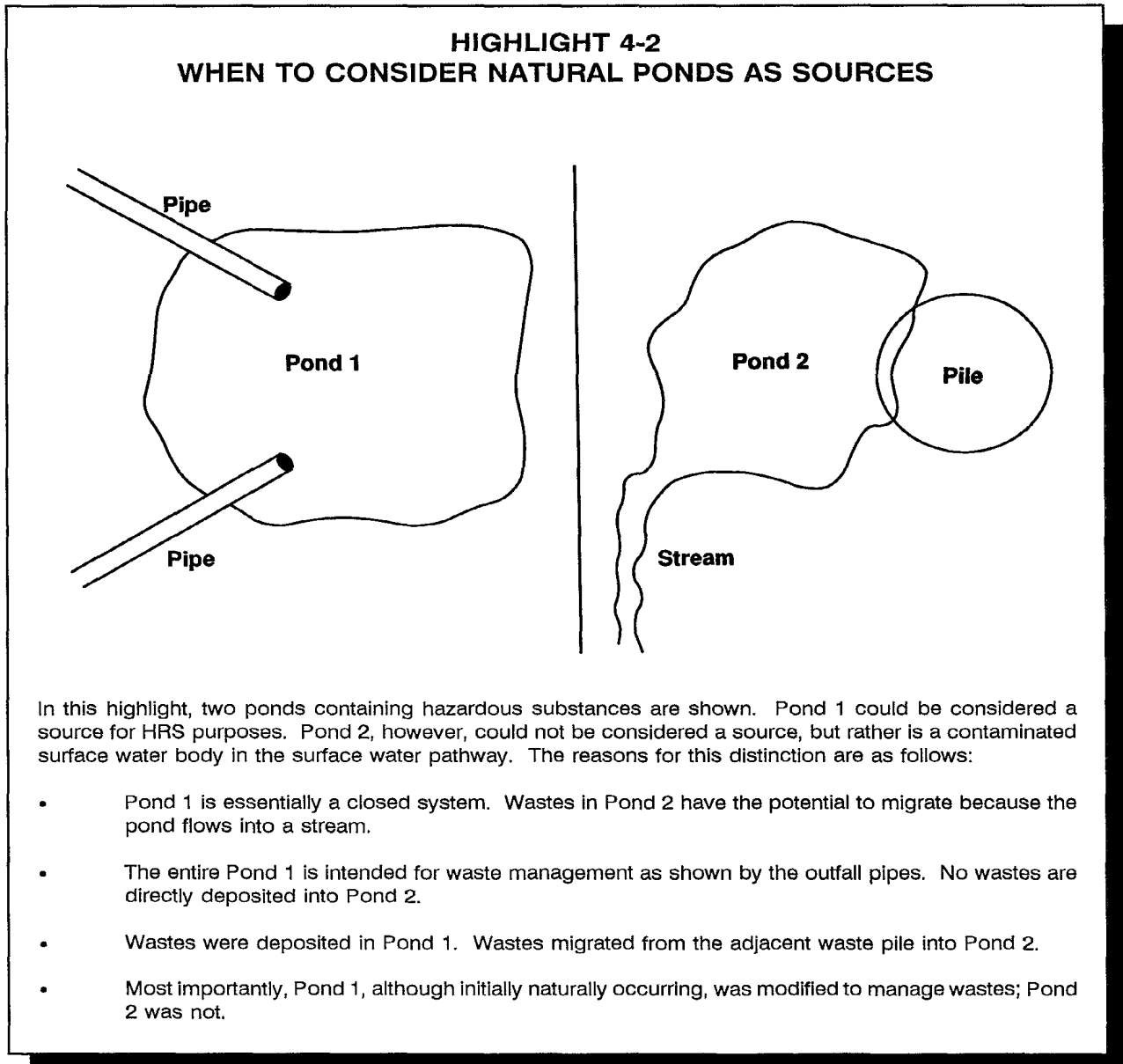
Some sources do not easily fit into HRS source types. These sources should be evaluated on a case-by-case basis. The unique sources described below do not comprise a complete list.

NATURAL PONDS

A natural pond used as a surface impoundment into which one or more hazardous substances were deposited can be considered a source in some circumstances. The following criteria provide guidelines for determining if a natural pond may be considered a source:

- The pond is an isolated water body (or has been modified so as to be an isolated water body).
- The entire pond is intended to be used as a waste management area.
- The hazardous substances in the pond result from deposition, as opposed to migration (see definition of source).

When a natural pond meets all of the above criteria, it may be considered a source and the assigned source type is usually surface impoundment. Water bodies such as rivers, oceans, or the Great Lakes should generally not be considered sources. **Highlight 4-2** shows two ponds, one that would be considered a source and another that would not.



INJECTION WELLS

Any documentation of direct deposition of a material that contains one or more hazardous substances into an injection well identifies it as a source. Such documentation can include (but is not limited to) manifests, permits, employee interviews, and sworn testimony. Injection wells are considered source type "other" for scoring purposes.

CONTAMINATED SEEPS AND LEACHATES

Because contaminated seeps and leachates arise from migration rather than from deposition, they should not be considered sources for the migration pathway. However, soils contaminated by seeps and leachates can be considered areas of observed contamination for the soil exposure pathway. If soil samples show observed contamination within two feet of the surface, consider the surface soil delineated by these samples to be an area of observed contamination.

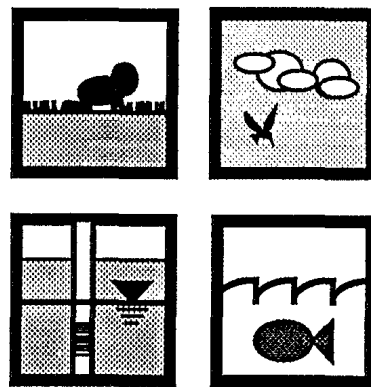
WALLS OR OTHER PARTS OF BUILDINGS CONTAINING HAZARDOUS SUBSTANCES

Walls or other parts of buildings can be considered sources subject to the restrictions in CERCLA concerning what constitutes a release (i.e., CERCLA section 101 (22), definition of release). Generally, the contamination of the building must be the result of activities within the building. The assigned source type is "other."

TIPS AND REMINDERS

- Sources must contain hazardous substances.
- Contaminated soil is considered a source for all three migration pathways, even if the soils have become contaminated by hazardous substance migration from another source type.
- Contaminated bayous are generally not considered surface impoundments; however, the contaminated sediments in a bayou may be classified as source type "other" if no other sources can be identified.
- Discuss qualitatively alleged or possible sources in the documentation record; however, only sources that can be described and documented should be used in scoring.
- Evaluate the documentation, other than sampling data, for sources with attention to the original purpose of the information. For instance, a letter giving permission for disposal of a hazardous substance in a landfill is generally not sufficient by itself to document that the substance was deposited.
- Manifests indicating deposition of hazardous substances are acceptable evidence of the presence of those hazardous substances in a source.
- Do not confuse "unidentified source" and "unallocated source." The unidentified source is used as a source type for ground water plumes or contaminated sediments when the original source of the contamination is unknown. The unallocated source is not actually a source, but rather is a means of evaluating hazardous waste quantity at sites where hazardous substances cannot be allocated to specific sources.

SECTION 4.2 OVERVIEW OF SITES WITH MULTIPLE SOURCES



The purpose of this section is to assist the scorer in deciding when to treat multiple areas containing hazardous substances as one source and when to treat these areas separately. This section defines multiple-source sites, orients the scorer to factor-specific considerations for HRS scoring, lists criteria necessary for source aggregation, and helps the scorer develop effective scoring strategies. If sources are similar in type and have similar target populations, the scorer should consider aggregating them into one source. Decisions to aggregate sources should be considered carefully because they may affect distance categories for some targets. This section does not address site aggregation issues.

DEFINITIONS

Site: Areas where a hazardous substance has been deposited, stored, disposed, or placed, or has otherwise come to be located. Such areas may include multiple sources and may include the area between sources.

Source: Any area where a hazardous substance has been deposited, stored, disposed, or placed, plus those soils that may have become contaminated from hazardous substance migration. In general, however, the volumes of air, ground water, surface water, and surface water sediments that may have become contaminated through migration are not considered sources.

Source Aggregation: The treatment of two or more areas that could be considered individual sources as one discrete source. The area between two or more individual sources may or may not be considered part of the aggregated source.

SCORING MULTIPLE SOURCE SITES

The HRS establishes different procedures for scoring sites with single sources vs. multiple sources. Two types of HRS factors are affected.

- Factors for which the mechanism of scoring differs for single and multiple source sites are affected (**Highlights 4-3** and **4-4**). These are divided into two groups: (1) factors which are summed to obtain the score for multiple sources; and (2) factors in which a value is assigned to each source and the highest score for any one source is used for scoring; and
- Factors for which sources must meet specific criteria to be eligible for HRS scoring are affected (**Highlight 4-5**).

HIGHLIGHT 4-3

HRS FACTORS SUMMED FOR MULTIPLE SOURCES

When scoring the factors listed below for multiple sources, sum the values from all individual sources to obtain the factor value.

Section 2.4.2	Hazardous waste quality
Section 4.1.2.1.2.1.2	Runoff (surface water)
Sections 5.1.2.2 and 5.2.2.2	Hazardous waste quantity (soil exposure)

In addition, most targets factors (including the TDL, populations associated with distance categories, and sensitive environments) belong in this category.

HIGHLIGHT 4-4

HRS FACTORS SELECTED FROM INDIVIDUAL SOURCE FACTOR VALUES

When scoring factors (for pathways and threats) at sites with multiple sources, determine the factor values listed below for each individual source and then select the highest factor value for any one source as the pathway (or threat) factor value.

Section 3.1.2.1	Containment (ground water)
Section 4.1.2.1.2.1.1	Containment (surface water)
Section 4.1.2.1.2.2	Potential to release by flood (surface water)
Section 5.2.1.1	Attractiveness/accessibility (soil exposure)
Section 6.1.2	Potential to release (air)
Section 6.1.2.1.4	Calculation of gas potential to release value (air)
Section 6.1.2.2.4	Calculation of particulate potential to release value (air)

HIGHLIGHT 4-5

HRS FACTORS AFFECTED BY MINIMUM SIZE REQUIREMENTS

A few HRS factors are affected by the minimum size requirement. For such factors, the scorer should consider only those sources with a hazardous waste quantity factor value of 0.5 or more. However, if no sources meet the minimum size requirement, evaluate each source for the factors listed below. At sites with only one source, evaluate the source regardless of its hazardous waste quantity factor.

Section 3.1.2.1	Containment (ground water)
Section 4.1.2.1.2.1.1	Containment (surface water)
Section 4.1.2.1.2.2.3	Calculation of factor value for potential to release by flood (surface water)
Section 6.1.2.1.2	Gas source type (air)
Section 6.1.2.2.2	Particulate source type air

AGGREGATING SOURCES

Source aggregation refers to documenting two or more areas that could be considered individual sources as one discrete source when evaluating one or more pathways. **Highlight 4-6** provides criteria necessary to consider before aggregating sources. Sources may be aggregated in one pathway and treated separately in another pathway, based on the criteria listed in **Highlight 4-6**. In general, it is advantageous to aggregate sources where possible because this should limit the number of separate sources evaluated without generally changing the overall site score.

The criteria in **Highlight 4-6** are appropriate for use when the sources under consideration are spatially separated from each other. When two sources overlap, consider site-specific information about the nature of the disposal operation, the hazardous substances found in the overlapping sources, and the containment characteristics of the sources in determining what sources should be aggregated. **Highlights 4-7** and **4-8** illustrate when to consider potential sources that apparently overlap as one source or two sources.

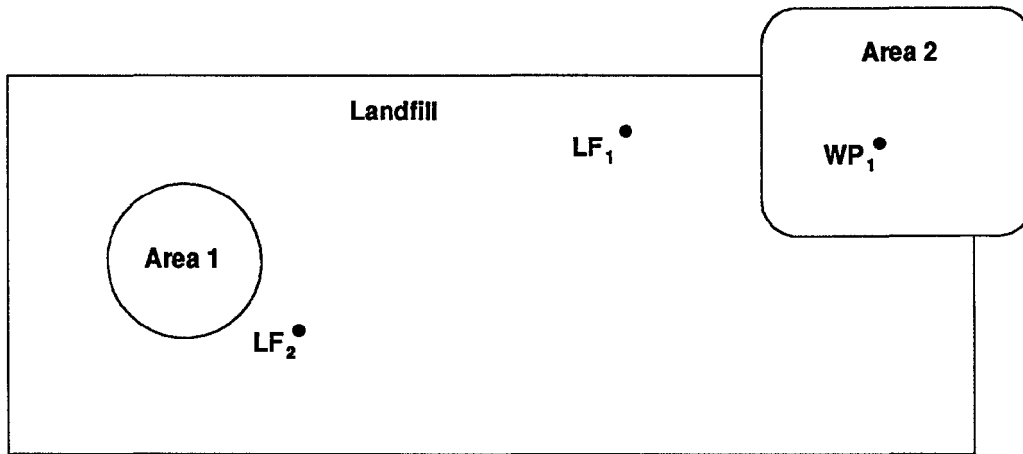
HIGHLIGHT 4-6 CHECKLIST FOR SOURCE AGGREGATION

Questions on this checklist should be used to determine whether to aggregate two or more sources for each pathway being evaluated.

- | | | | |
|-----|---|-----|----|
| (1) | Can the sources be classified as the same source type for the pathway? (e.g., drums, landfills, piles) | Yes | No |
| (2) | Do the sources affect similar target populations for the pathway? (i.e., target populations significantly overlap) | Yes | No |
| (3) | Do the sources have similar containment for the pathway? (e.g., liner, run-on and runoff controls, cover) | Yes | No |
| (4) | Do the sources contain substances with similar waste characteristics factor values available to the pathway? (e.g., toxicity, persistence mobility) | Yes | No |
| (5) | Are the sources in the same watershed and floodplain? (surface water only) | Yes | No |
| (6) | Are the sources overlying the same aquifer system(s)? (ground water only) | Yes | No |

If the answer to each of these questions is "Yes" then the sources should be aggregated and treated as one source for the pathway. If the answer is "No" to one or more of these questions, then the sources should be treated separately for the pathway.

HIGHLIGHT 4-7 WHEN TO AGGREGATE OVERLAPPING SOURCES



LF_x = Sampling point in landfill
 WP_x = Sampling point in waste pile

- In assessing overlapping sources, consider site-specific disposal operations, hazardous substances found in the overlapping sources, and containment characteristics of the sources.
- In this example, two hazardous wastestreams (Areas 1 and 2) overlap within a closed landfill. Drums containing hazardous substances had been deposited in part of the landfill (Area 1) and tailings had been piled on top of the landfill (Area 2) after it closed.
- Sampling data show the following constituents exceed background:

WP_1 = Arsenic, lead
 LF_1 = Arsenic, cadmium, mercury
 LF_2 = Arsenic, mercury, toluene

Additionally, manifests indicate that drums containing benzene had been deposited in Area 1.

- The buried drums are a wastestream deposited in the landfill. These drums should not be considered a separate source.
- Consider Area 2 a separate source because the waste pile was deposited after the landfill was closed, and because the containment factors would score significantly different in selected pathways (e.g., air).

HIGHLIGHT 4-8 WHEN TO AGGREGATE CONTAMINATED SOIL WITH OTHER SOURCES

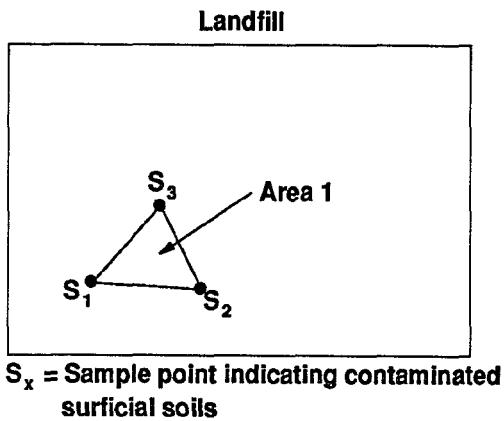


Figure 1

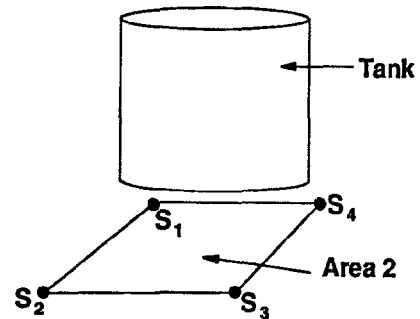


Figure 2

S_x = Sampling point indicating contaminated surficial soils

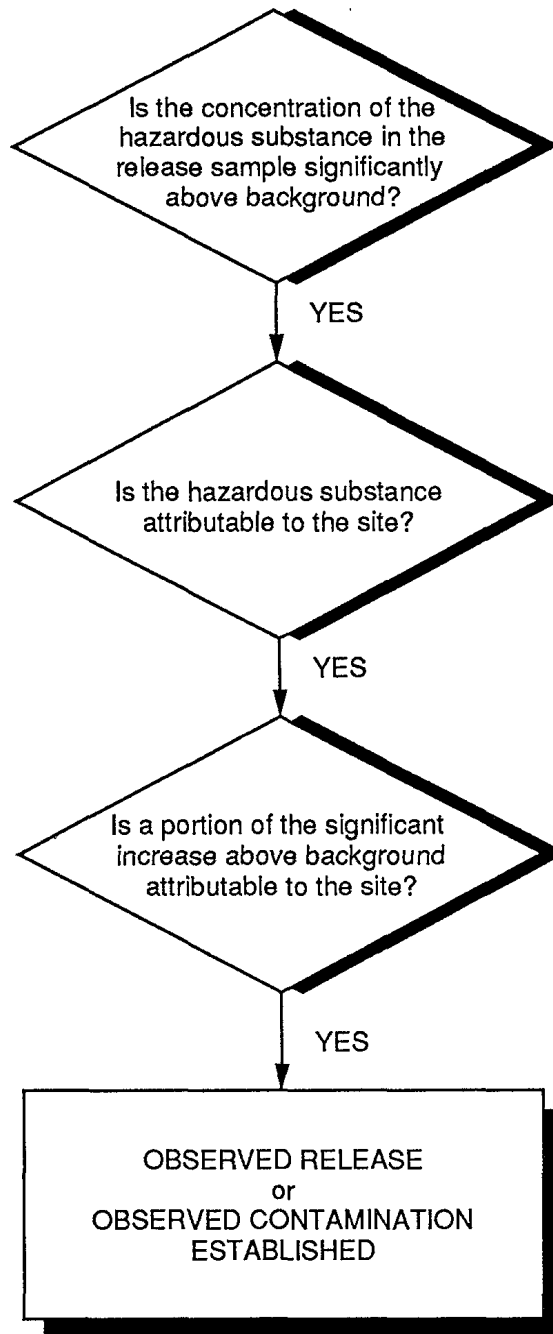
- In Figure 1, contaminated soil (Area 1) is covering a landfill. Determine if this is one source or two sources.
- If the hazardous substances found in surficial soil samples are also found in deeper samples in the landfill, the source is simply a landfill.
- If the hazardous substances found in surficial soil are not found in deeper samples, then consider this two sources -- contaminated soil and a landfill.
- In Figure 2, a leaking tank overlies an area of observed contamination (Area 2). Two sources would be present -- the tank and contaminated soil.

TIPS AND REMINDERS

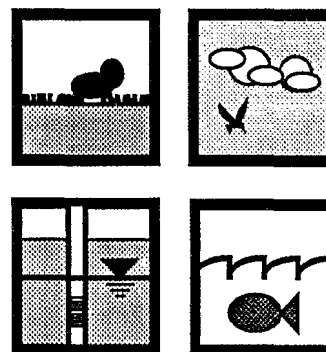
- Score all sources that may significantly affect site score. In particular, consider possible changes to waste quantity, contaminant characteristics, or targets if the source is evaluated.
- Consider aggregating sources if they are the same source type and have similar characteristics (e.g., containment, proximity of units, target location, and hazardous substances associated with the units). Source aggregation for multiple-source units can change from pathway to pathway.
- For ground water, air, and soil exposure pathways, two strategies may be used to evaluate the applicable TDL and targets for multiple sources:
 - S Targets can be the sum of the targets that fall into the distance categories around each individual source. This method is most appropriate when evaluating multiple sources that are large or far apart (i.e., distance categories drawn around each source do not overlap extensively).
 - S Targets can be determined based on a single source that gives the highest targets factor category value. This method is appropriate for sites where considering multiple sources will not significantly affect the score.
- In the ground water migration pathway, it may be more efficient to measure the distance from each target well (if there are few) to the nearest source (if there are multiple sources) than to draw distance categories.
- For sources that are in the same watershed but have multiple PPEs to a watershed, the TDL should generally include the distance from the most upstream PPE to 15 miles from the most downstream PPE.
- For sources that have PPEs to different surface water bodies in the same watershed, determine the TDL from each PPE. The TDL for the watershed includes all in-water segments from these PPEs to the point where the water bodies merge plus the longest downstream distance as determined from each PPE.
- If sources are in different watersheds, score each watershed separately, and use the highest scoring watershed to score the pathway.

CHAPTER 5

OBSERVED RELEASE



SECTION 5.1 ESTABLISHING AN OBSERVED RELEASE AND OBSERVED CONTAMINATION



This section provides guidance on establishing an observed release in the ground water, surface water, and air migration pathways and on establishing observed contamination in the soil exposure pathway. Establishing an observed release (or observed contamination) is an important determinant of an HRS pathway score. If an observed release is established for a migration pathway (i.e., ground water, surface water, and air pathways), likelihood of release for that pathway is automatically assigned its maximum value of 550 points. Establishing observed contamination is a necessary condition for evaluating the soil exposure pathway; the pathway score is automatically assigned a 0 if observed contamination is not established. Establishing an observed release (or observed contamination) also is necessary for establishing actual contamination for targets.

An observed release can be established either by direct observation or by chemical analysis. Observed contamination (in the soil exposure pathway) can be established only by chemical analysis. Establishing an observed release by direct observation generally requires information on material containing a hazardous substance that has been placed into or has been seen entering the medium of concern and attribution of that substance to the site (see **Highlight 5-1**). Establishing an observed release (or observed contamination) by chemical analysis generally requires attributing the hazardous substance to the site, and also requires determining background, demonstrating that the concentration of the hazardous substance in a release sample is significantly increased above background, and attributing some portion of the significant increase to the site.

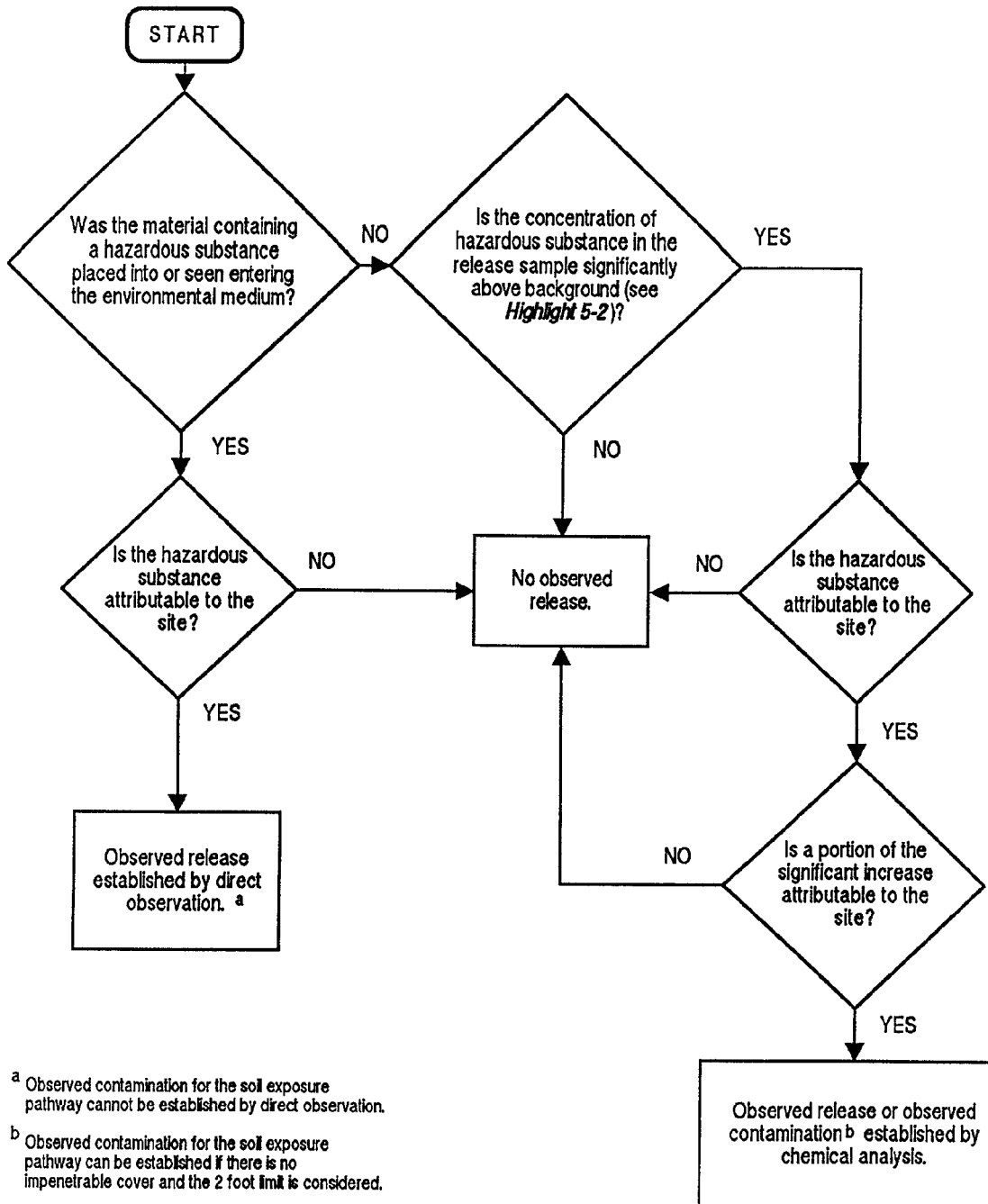
RELEVANT HRS SECTIONS	
Section 2.3	Likelihood of release
Section 3.1.1	Observed release (ground water)
Section 4.1.2.1.1	Observed release (surface water)
Section 5.0.1	General considerations (soil exposure)
Section 6.1.1	Observed release (air)

DEFINITIONS

Attribution: The determination that a hazardous substance in a release is likely to have originated in one of the sources at a site. Attribution usually requires documenting that at least one hazardous substance found in a release at a concentration significantly above background (or directly observed in the release) was produced, stored, deposited, handled, or treated at the site; and at least a portion of the significant increase could have come from a source at the site.

Background Level: The concentration of a hazardous substance that provides a defensible reference point that can be used to evaluate whether or not a release from the site has occurred. The background level should reflect the concentration of the hazardous substance

**HIGHLIGHT 5-1
FLOWCHART FOR ESTABLISHING AN OBSERVED RELEASE
OR OBSERVED CONTAMINATION**



in the medium of concern for the environmental setting on or near a site. Background level does not necessarily represent pre-release conditions, nor conditions in the absence of influence from source(s) at the site. A background level may or may not be less than the detection limit (DL), but if it is greater than the DL, it should account for variability in local concentrations. A background level need not be established by chemical analysis.

Background Sample: A sample used in establishing a background level.

Contract Laboratory Program (CLP): The analytical program developed for CERCLA waste site samples to fulfill the need for legally defensible analytical results supported by a high level of quality assurance and documentation.

Contract-required Detection Limit (CRDL): A term equivalent to the contract-required quantitation limit (CRQL), but used primarily for inorganic substances.

Contract-required Quantitation Limit (CRQL): The substance-specific level that a CLP laboratory must be able to routinely and reliably detect in specific sample matrices. The CRQL is not the lowest detectable level achievable, but rather the level that a CLP laboratory must reliably quantify. The CRQL may or may not be equal to the quantitation limit of a given substance in a given sample. For HRS purposes, the term CRQL also refers to the CRDL.

Detection Limit (DL): The smallest quantity of a hazardous substance that can be distinguished from the normal random "noise" of an analytical instrument or method. For HRS purposes, DL is the method detection limit (MDL) or, for real-time field instruments, the instrument detection limit (IDL) as used in the field.

Method Detection Limit (MDL): The lowest concentration of a hazardous substance that a method can detect reliably in either a sample or blank.

Observed Contamination: Surficial contamination related to a site. It must be established by chemical analysis. Observed contamination is present at sampling locations where analytical evidence indicates that:

- A hazardous substance attributable to the site is present at a concentration significantly above background levels for the site (i.e., meets the observed release criteria in HRS Table 2-3).
- The hazardous substance is present at the surface or covered by two feet or less of cover material (e.g., soil).

Observed Release: An observed release is established for the ground water, surface water, or air migration pathway either by chemical analysis or by direct observation. Observed release is not relevant to the HRS soil exposure pathway. The minimum requirements for establishing an observed release by chemical analysis are analytical data demonstrating the presence of a hazardous substance in the medium significantly above background level, and information that some portion of that increase is attributable to the site. The minimum criterion for establishing an observed release by direct observation is evidence that the hazardous substance was placed into or has been seen entering the medium.

Release Sample: A sample taken to determine whether the concentration of a hazardous substance is significantly above its background level in order to determine whether an observed release (or observed contamination) has occurred.

Sample Quantitation Limit (SQL): The quantity of a substance that can be reasonably quantified given the limits of detection for the methods of analysis and sample characteristics that may affect quantitation (e.g., dilution, concentration).

Similar Samples: Samples from the same environmental medium that are identical or similar in every way (e.g. field collection procedure, analytical technique) except the degree to which they are affected by a site.

ESTABLISHING AN OBSERVED RELEASE BY CHEMICAL ANALYSIS

Establishing an observed release (or observed contamination) by chemical analysis generally requires documenting that the concentration of at least one hazardous substance in a release sample is significantly increased above its background level, and that the substance in the release can be attributed to the site. Note that some additional rules apply for observed contamination (see Section 9.1). General guidance for establishing an observed release by chemical analysis is presented below. An observed release is established at most sites by comparing analytical data derived from samples reflective of site-specific background with analytical data derived from site-related samples. Sample data used to establish an observed release should be of known and documented quality. Analytical data may come from the SI or from studies done by other EPA offices, states, other Federal agencies, or PRPs.

CONSIDERATIONS FOR BACKGROUND

All relevant data should be evaluated to determine representativeness of the background samples and attribution. In certain circumstances, background samples are not required to establish an observed release by chemical analysis. Additional guidance used for selecting background samples is provided in Section 5.2. See subsection below, Using Published Data for Background Levels, for a discussion on establishing background levels. The general guidelines below introduce the main concepts.

- Background and release samples must be from the same medium (e.g., soil, water, tissue) and should be as similar as possible. Similar sampling methods should be used to obtain background and release samples. Ideally, background samples also should be outside the influence of contamination from the site, but background levels may be determined from samples which contain measurable levels of contamination.
- Many hazardous substances may be widespread in the environment in the vicinity of a site. Widespread substances may originate naturally, from non-point sources, or from large point sources. The background level for widespread substances should account for local variability. Several background samples may be required to establish variability in background concentrations (see Section 5.2).

SIGNIFICANCE ABOVE BACKGROUND

The concentration in the release sample must be equal to or greater than the release sample SQL. Continue with the steps below only after determining that the release sample is above its SQL. The criteria used for determining significance above background depend on whether the background level is above or below the background DL.

- If the background level is greater than or equal to its DL, the minimum requirement for an observed release is that the concentration in the release sample is at least three times greater than the background level.
- If the background level is below its DL, the minimum requirement for establishing an observed release is that the concentration in the release sample is greater than or equal to the background SQL.
 - If the SQL for the hazardous substance cannot be established and the sample analysis was performed under the CLP, use the CRQL in place of the SQL.

- If the SQL for the hazardous substance cannot be established and the sample analysis was not performed under the CLP, use the DL in place of the SQL.

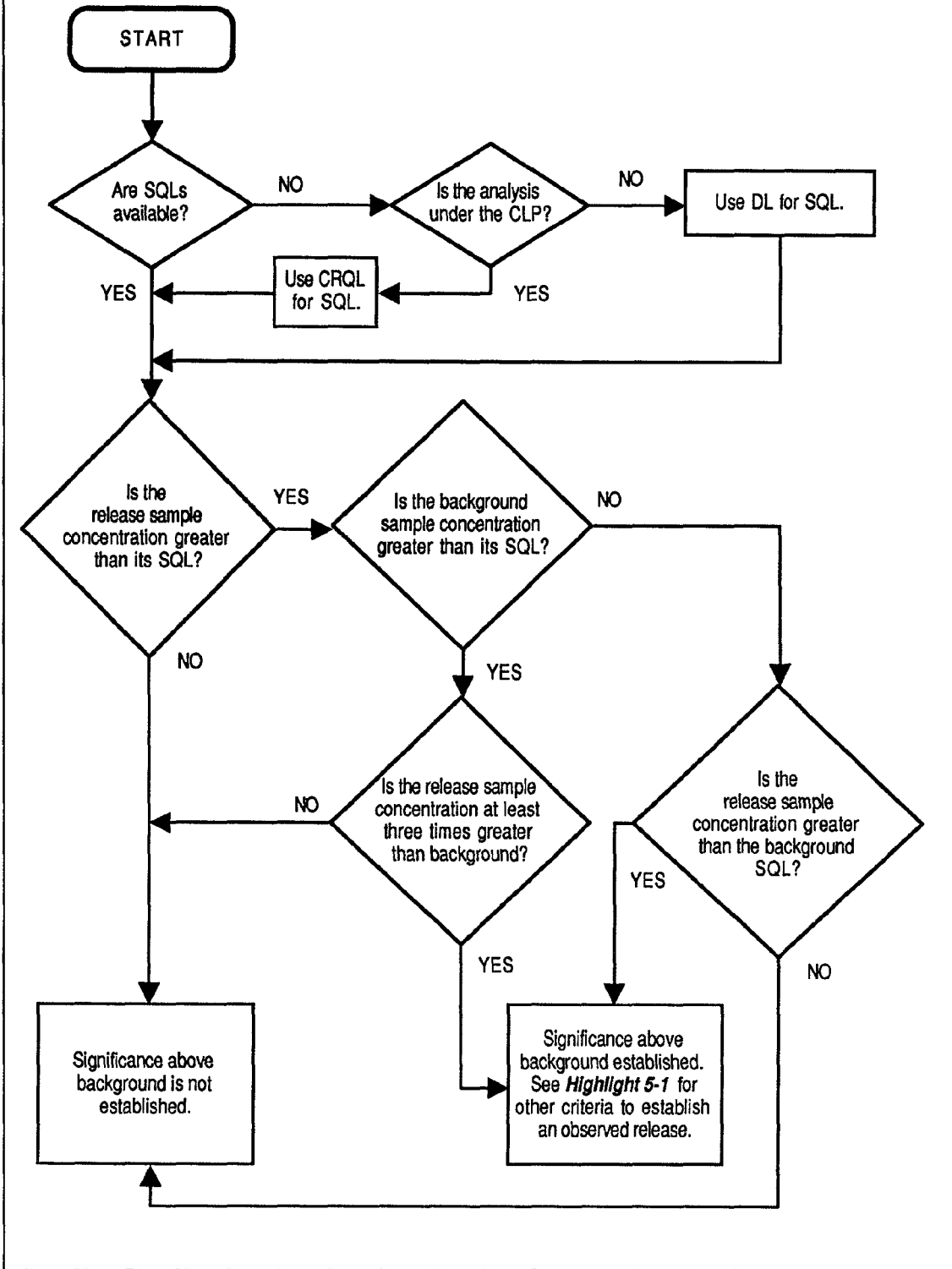
The considerations detailed in the bullets above are presented in flowchart form. **Highlight 5-2. Highlight 5-3** presents several examples of how to decide whether or not significance above background is established.

ATTRIBUTION

Attribution generally involves demonstrating that the hazardous substance used to establish an observed release can be associated with the site, and the site contributed at least in part to the significant increase in the concentration of the hazardous substance. Attribution can be established based on sampling or non-sampling data.

- The following information generally is sufficient to associate the hazardous substance to the site:
 - Manifests, labels, records, oral or written statements, or other information about site operations exist that demonstrates that the hazardous substance was deposited or is present in a source (or somewhere at the site). Note that if confirmed by manifests, labels, or oral or written statements, attribution generally can be established even if the specific source(s) where the substance was deposited cannot be documented.
 - Analytical sampling data that demonstrate the presence of the hazardous substance in a source at a concentration greater than background.
- The data required to attribute a portion of the significant increase in the concentration of the hazardous substance to the site generally depend on whether or not the site being evaluated is located in an area where other sources may have contributed to the significant increase.
 - When no other nearby sources are likely to have contributed to the release, or when the site-specific background concentration is less than the DL, it generally will be sufficient to document that the hazardous substance is associated with a source at the site that could have released to the environmental medium of concern.
 - When other sources are present in the vicinity of the site being evaluated and may have contributed to the significant increase (e.g., in highly industrialized areas), it generally is necessary to obtain sufficient samples between the site being evaluated and other known potential sources (or between the site and adjacent sites) in order to demonstrate an increase in concentration attributable to the site. Additional information may be required if other sites are known to release substances intermittently, such that "pulses" of hazardous substances are created in environmental media. Types of information that will strengthen such attribution include:
 - Data on concentration gradients (e.g., established based on samples from multiple wells or a series of samples between the site and the alternative source);
 - Data on flow gradients or other information about the movement of hazardous substances in the environmental medium of concern; or

**HIGHLIGHT 5-2
FLOWCHART FOR DETERMINING SIGNIFICANCE ABOVE BACKGROUND**



**HIGHLIGHT 5-3
EXAMPLES FOR DECIDING WHETHER SIGNIFICANCE
ABOVE BACKGROUND IS ESTABLISHED**

Background SQL (ppb)	Background Concentration (ppb)	Sample SQL (ppb)	Sample Concentration (ppb)	Significance Above Background Established?
20	30	50	100	Yes, sample concentration is greater than three times the background concentration
20	30	50	60	No, sample concentration is less than three times the background concentration
20	5 ^a	20	16 ^a	No, sample concentration is less than the SQL
20	ND ^b	50	55	Yes, sample concentration is greater than both SQLs
50	ND ^b	20	55	Yes, sample concentration is greater than both SQLs
50	ND ^b	20	25	No, sample concentration is less than the background SQL
50	ND ^b	60	55	No, sample concentration is less than the sample SQL

^a When reported concentrations are less than SQLs, it is likely that data qualifiers would be associated with the concentrations (see **Highlight 5-4**).

^b The entry "ND" signifies the substance was not detected (i.e., the background concentration is less than the background SQL).

- Analytical "fingerprinting" data that establish an association between the site and a unique form of the substance or unique ratios of different substances.

The above general guidelines apply to all HRS pathways and threats. Additional pathway-specific considerations are presented below.

PATHWAY-SPECIFIC CONSIDERATIONS

Ground Water Pathway

- Background and release samples must be from the same aquifer because background levels, water chemistry, and other parameters may vary among aquifers.
- In some cases a contaminated well can serve as its own background (e.g., if similar samples at different points in time establish background levels and levels significantly above background).

- When evaluating a ground water plume with no identified source, background samples are required, but the release need not be attributed to a specific site.

Surface Water Pathway

- Background samples and release samples must be the same type of sample (e.g., aqueous samples must be compared to aqueous samples, sediment samples must be compared to sediment samples).
- For tissue samples, only samples from essentially sessile, benthic organisms (e.g., mussels, oysters) can be used to establish an observed release.
- When evaluating contaminated sediments with no identified source, background samples are required, but no separate attribution is required.

Soil Exposure Pathway

- Observed contamination can be established only when the hazardous substance is present at the surface or covered by two feet or less of cover material (e.g., soil). However, any area covered by a permanent or otherwise maintained, essentially impenetrable material (e.g., asphalt) cannot be considered an area of observed contamination.
- For contaminated soil, areas of observed contamination can be inferred for the area lying between sampling locations at which observed contamination is established unless available information (e.g., topography, site operations, impenetrable cover, drainage patterns) indicates otherwise.
- For sources other than contaminated soil, the entire source is considered an area of observed contamination if observed contamination is established at any point on the source and within two feet of the surface.

Air Pathway

- Indoor air samples cannot be used to establish an observed release.

USING PUBLISHED DATA FOR BACKGROUND LEVELS

At some sites, it may not be possible to collect sample(s) to determine a background level. Certain circumstances may preclude background sampling (or use of available background sampling data) for the site. Several such circumstances are outlined below.

- No appropriate background sampling locations for the site were found. This circumstance generally applies only to the surface water pathway (e.g., a release to an isolated pond or wetland; surface water originates from a spring on the site).
- Resource constraints precluded background sampling.

Under such circumstances, it may be necessary to establish the background level based on published data relevant to the site. Existing data from published reports should be evaluated to determine if background levels can be developed. Documentation should focus on establishing what the concentration of the hazardous substance of concern should be for the medium of concern in the absence of contamination attributable to the site.

The appropriateness of published data for establishing background levels must be determined on a case-by-case basis. *Noa priori* set of criteria regarding use of published data can be

established for every hazardous substance and type of site. The guidelines presented below, while helpful in evaluating the appropriateness of such data, are not intended as definitive criteria for accepting or rejecting such data. Published values may not be site-specific enough to be appropriate for determining background levels.

- Potential background levels should be obtained from multiple data sources. Sources of data should include regional and local studies. Ideally, only primary sources should be used. Examples of primary data sources include regional soil lead studies, surveys of sediment contamination in harbors and bays, and national tissue residue surveys such as NOAA's mussel watch program.
- The variability of background concentrations for the substance on a national, regional, and local scale should be described as fully as possible. Variability will depend, in part, on the nature of the hazardous substance. Naturally occurring substances such as heavy metals, for example, are expected to be distributed more widely in the environment than are organic substances used in a limited number of manufacturing practices. Variability will also depend on the local environment. Information on other sources near the site will help determine whether unusually high background concentrations are expected (e.g., soil lead levels are expected to be higher near major highways).
- Regional geology may help determine where higher concentrations of naturally occurring substances are likely (e.g., ore veins, soil types with unusually high metals concentrations).

USING QUALIFIED DATA

For analytical results, particularly those developed within the CLP, various data qualifiers and codes (collectively termed "qualifiers") may be attached to certain data by the laboratory conducting the analysis. Data qualifiers also may be added, modified, or changed during data validation. The qualifiers pertain to QA and QC variations which result in uncertain confidence concerning the identity of the substance being analyzed, its concentration, or both. The QA and QC conditions that result in data qualification must be evaluated with respect to the decision being made (e.g., establishing an observed release) before using the data in HRS scoring. Because non-CLP laboratories may assign codes that differ from those of the CLP, it is important to ascertain the exact meaning of all data qualifiers. See **Highlight 5-4** for some considerations that are usually applicable to data generated within CLP.

ESTABLISHING AN OBSERVED RELEASE BY DIRECT OBSERVATION

In contrast to establishing an observed release by chemical analysis, where significance above background and attribution are interrelated, establishing an observed release by direct observation generally only requires information that material containing a hazardous substance attributable to the site was placed into or has been seen entering the medium of concern. Attribution in this case generally involves documenting that the substance in the release is associated with the site, either with non-sampling or sampling data. Pathway-specific considerations are outlined below.

GROUND WATER PATHWAY

- Establishing an observed release by direct observation generally requires information that material containing a hazardous substance has been deposited directly into or otherwise has come to be located (e.g., due to a rising water table) below the top of the aquifer being evaluated.

HIGHLIGHT 5-4

DEFINITIONS AND APPLICATIONS OF COMMON DATA QUALIFIERS

- “J” The identity of the hazardous substance is known with certainty, but the reported concentration is considered an estimate. Data may be useable in selected circumstances (see examples below).
- “U” The hazardous substance was analyzed for and was not present above the reported concentration. Data may be useable as an upperbound on background concentration.
- “R” The identity and concentration of the hazardous substance are uncertain due to exceeded QC limits.
Data generally not useable for either background or release purposes.

For example, suppose a scorer had a background sample of 3J, which is biased high, and a release sample of 10J, which is biased low. The direction of bias indicates that the accurate background concentration is lower than the reported concentration, and the accurate release concentration is greater than the reported release concentration. Assuming attribution can be established, the data are useable to establish an observed release, because the release concentration (i.e., 10 or more) is more than three times background (i.e., 3 or less).

In a more complex example, suppose a scorer had background sample of 10J, which was biased high at 30 percent, and a release sample of 40J, which was biased high at 20 percent (i.e., concentration could be as high as 48). Assuming attribution can be established, these data also would be useable to establish an observed release, because the lower bound of the release sample (i.e., 40) is more than three times the upper bound of the background sample (i.e., 13).

SURFACE WATER PATHWAY

- Establishing an observed release by direct observation generally requires information that:
 - Material containing a hazardous substance has been seen entering surface water through migration or direct deposition;
 - A source area has been flooded at a time that a hazardous substance was present in the source, and material containing a hazardous substance was in direct contact with the surface water; or
 - Information documenting adverse effects associated with a release of a hazardous substance to surface water (e.g., a fish kill incident) supports the inference of a release of material containing that hazardous substance from the site to surface water.
- When basing an observed release on inference of a release by demonstrated adverse effects, it generally is necessary to provide a rationale for inferring the release from the site, to document that the substance was present on the site prior to or at the time the adverse effects occurred, and to document that the adverse effects were likely caused by the substance.
- When the source area that has been flooded is contaminated soil, it is necessary to demonstrate that the hazardous substance was present at a concentration significantly above background level in order to document an observed release.

SOIL EXPOSURE PATHWAY

- Observed contamination in the soil exposure pathway cannot be established by direct observation.

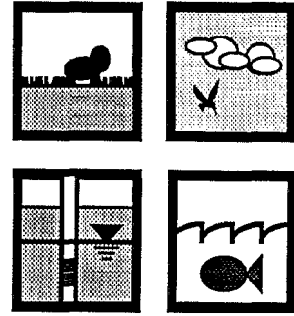
AIR PATHWAY

- Establishing an observed release by direct observation generally requires information that:
 - Material containing a hazardous substance has been seen entering the atmosphere directly (e.g., particulate material blowing off a pile);
 - Information supports the inference of a release from the site to the atmosphere of material that contains at least one hazardous substance; or
 - Information documenting adverse effects associated with the release of a hazardous substance to air (e.g., human health effects) supports the inference of a release of material containing that hazardous substance from the site to air.
- When basing an observed release on inference of a release by demonstrated adverse effects, it generally is necessary to provide a rationale for inferring the release from the site, to document that the substance was present on the site prior to or at the time the adverse effects occurred, and to document that the adverse effects were likely caused by the substance.
- If the source used to establish an observed release is contaminated soil, it is necessary to demonstrate that the hazardous substance was present at a concentration significantly above background level to document an observed release.

TIPS AND REMINDERS

- Establishing an observed release by direct observation generally requires the following information: (1) material containing a hazardous substance was placed into or has been seen entering the medium of concern, and (2) the substance in the release is associated with the site. If the source is contaminated soil, the concentration of the hazardous substance in the contaminated soil must be significantly above background and some portion of the increase must be attributable to the site.
- Establishing an observed release by chemical analysis generally requires the following information: (1) the concentration of at least one hazardous substance in a release sample is significantly increased above the background level, (2) the substance in the release is associated with the site, and (3) the site contributed at least in part to the significant increase.
- Background level need not be established by chemical analysis.
- The difficulties in attributing an increase in concentration to a site can be avoided if an observed release by direct observation can be established.

SECTION 5.2 SELECTING APPROPRIATE BACKGROUND SAMPLES



A background level for a site provides a reference point by which to evaluate whether or not a release of a hazardous substance from the site has occurred. Determining background level is necessary to establish an observed release (or observed contamination) by chemical analysis. This section provides guidance on selecting appropriate samples for determining background level for a site. The application of background levels in establishing an observed release (or observed contamination) by chemical analysis is discussed in Section 5.1 of this document.

When chemical analysis is used to determine background levels, the background and release samples must be from the same medium (e.g., soil, water, tissue) and should be as similar as possible except for potential influence from the site. Similar sampling methods should be used to obtain background and release samples. Ideally, background samples should be outside the influence of contamination from the site, but background levels may be determined from samples that contain measurable levels of contamination. Background levels also do not need to represent pre-release conditions at the site.

RELEVANT HRS SECTIONS	
Section 2.3	Likelihood of release
Section 3.1.1	Observed release (ground water)
Section 4.1.2.1.1	Observed release (surface water)
Section 5.0.1	General considerations (soil exposure)
Section 6.1.1	Observed release (air)

DEFINITIONS

Background Level: The concentration of a hazardous substance that provides a defensible reference point that can be used to evaluate whether or not a release from the site has occurred. The background level should reflect the concentration of the hazardous substance in the medium of concern for the environmental setting on or near a site. Background level does not necessarily represent pre-release conditions, nor conditions in the absence of influence from source(s) at the site. A background level may or may not be less than the DL, but if it is greater than the DL, it should account for variability in local concentrations. A background level need not be established by chemical analysis.

Background Sample: A sample used in establishing a background level.

Release Sample: A sample taken to determine whether the concentration of a hazardous substance is significantly above its background level in order to determine whether an observed release (or observed contamination) has occurred.

Similar Samples: Samples from the same environmental medium that are identical or similar in every way (e.g., field collection procedure, analytical technique) except the degree to which they are affected by a site.

DATA REQUIREMENTS

The minimum data requirements for establishing background levels by chemical analysis include the actual analytical data from the background sample(s) and sufficient other information to establish similarity between background and release samples. Analytical data may be obtained from one or more background sample(s).

NUMBER OF SAMPLES FOR ESTABLISHING BACKGROUND LEVELS BY CHEMICAL ANALYSIS

Where background is established by chemical analysis, a single sample may provide a defensible background level. However, when the hazardous substances being considered are widespread in the environment (e.g., pesticides in an agricultural area, naturally occurring trace metals) and/or may have come from other nearby sites, one sample generally will not be sufficient. At such sites, attribution also may be difficult (see Section 5.1). Factors influencing the number of samples used to establish background levels by chemical analysis include:

- Physical complexity of the site (e.g., size, number of source types);
- Physical complexity of migration routes (e.g., number of watersheds, number of overland segments in each hazardous substance migration path);
- Temporal complexity of site data (e.g., time periods over which sampling and other data were collected);
- Meteorological conditions under which samples were collected;
- Number of hazardous substances present at the site, their expected concentrations in sources and releases, and the degree to which they are widespread in the vicinity of the site;
- Number and physical/chemical complexity of environmental media being sampled (e.g., number and interconnection of aquifers, heterogeneity of soils and sediments, number and type of water bodies within watershed);
- Type of samples (e.g., filtered or unfiltered); and
- Other potential sources in the vicinity of the site.

At some sites, multiple background samples appropriate for a particular environmental medium will exhibit different concentrations for the same hazardous substance. In this situation, using the sample with the highest concentration is always defensible in a legal sense (i.e., the background level based on available samples could not be higher than the value selected), but it may not always be appropriate. Generally, it is best to decide on a case-by-case basis whether to use the highest, lowest, or a measure of central tendency of the samples to establish background.

ESTABLISHING SIMILARITY BETWEEN BACKGROUND AND RELEASE SAMPLES

Analytical data from background samples is necessary but may not be sufficient to establish background levels by chemical analysis. Additional information related to the site and sampling procedures is often desirable to establish similarity between the background and release samples. Examples of things to consider in establishing similarity may include:

- Type of samples (e.g., soil, sediment, air);
- Time and location at which samples were collected;
- Physical conditions under which samples were collected (e.g., meteorological conditions, season);
- Sampling, handling, and analytical chemistry procedures used; and
- Environmental setting for each sample (e.g., topography, land use in the vicinity of the sampling locations, streamflow).

DATA EVALUATION GUIDELINES

Temporal and spatial variations in measured concentrations often make it difficult to define background. Large differences in analytical results may result from differences that are independent of site-related contamination (e.g., differences in the manner in which samples were collected, differences in the physical or chemical conditions under which the samples were collected). This section provides guidance for selecting background samples that will yield the most defensible background levels. General considerations are followed by pathway-specific considerations.

GENERAL CONSIDERATIONS

- In most cases, samples will be designated as background at the time of an SI. In some cases, however, it may be necessary to re-evaluate which samples are background and release after the data have been collected (e.g., when analytical data or additional site information suggest a different pattern of contamination than originally expected).
- Sampling and analysis methods should be the same for background and release samples.
- Background samples do not have to be completely outside the influence of the site. This may be particularly applicable in areas where the presence of other potential sources and/or the complexity of the nearby environment make it difficult to select a background sampling location that is not influenced by the site.

GROUND WATER PATHWAY

Data evaluation guidelines for the ground water pathway are presented below. General guidelines are presented first, followed by guidelines specific to the following situations: the background well and release well are in the same aquifer; there is no background well in the aquifer in which the release well is located; and the release well serves as its own background well.

General Guidelines

- An understanding and description of aquifers and their boundaries are necessary for identifying background samples. Information must be sufficient to identify the types and boundaries of geologic materials within the TDL for the site. Minimum information includes types of bedrock, soil, or other non-consolidated material, and their lateral and vertical boundaries; types of surficial deposits and their boundaries (i.e., thicknesses and lateral extents); and locations and screened depths of release and background wells. Guidance on determining aquifers and aquifer boundaries is presented in Section 7.1.

- When a connection has been established between two individual aquifers, the background sample must be taken from the same aquifer as the release sample (e.g., a background sample taken from a bedrock aquifer cannot be compared to a release sample taken from an overlying alluvial aquifer, even if a hydrologic connection has been documented between the two aquifers and they are being considered a single hydrologic unit for purposes of HRS scoring). Different aquifers may have very different background levels as well as other important differences in water chemistry.
- Information on ground water flow gradients in the area is not required and may not be known completely at the time of the SI. Depending on site conditions, background wells may be upgradient, side-gradient, or downgradient from sources. In complex situations, with multiple sources and aquifers, selecting or installing wells for background samples will require considerable knowledge of aquifers, aquifer boundaries, and aquifer interconnections.

Background Well and Release Well In Same Aquifer

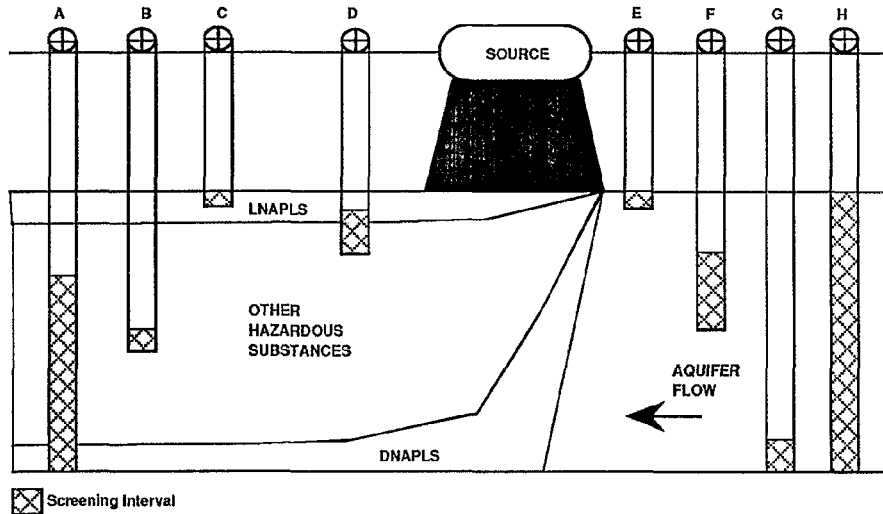
At some sites, one or more potential background wells already exist in the aquifer(s) of concern (i.e., these wells did not need to be installed during the SI). Such a situation generally will make it easier to obtain background samples. However, existing wells may not be suitable for background samples, even if they are not influenced by sources at the site. **Highlights 5-5, 5-6, and 5-7** provide illustrations of appropriate background wells for the ground water pathway. Note that these illustrations are highly idealized and are not meant to reflect expected site-specific conditions.

- In general, background and release samples should be from approximately the same depths in an aquifer, although different depths may be appropriate under certain circumstances. Factors to consider include aquifer structure, the nature of the hazardous substances, and other possible sources, including natural sources. Ground water tends not to be well mixed, and water quality can vary significantly in the vertical plane within an aquifer. This is particularly true when substances that have a tendency to sink or float in the aquifer are present (i.e., dense non-aqueous phase liquids (DNAPLs) and light non-aqueous phase liquids (LNAPLs)). Depth should be determined relative to a fixed reference point (e.g., mean sea level) rather than the ground surface to eliminate apparent differences caused by surface topography.
- If the background sample well is screened, the well screen interval must be in the same aquifer as the release sample well.
- A well screened over two or more distinct aquifers cannot be used to establish background or release levels of hazardous substances.
- Take particular care in areas that are hydrogeologically complex. In glaciated terrain, for example, water may occur within sand lenses of limited areal extent, and surrounding soil with a substantial clay component could serve to isolate these lenses. Thus, each sand lens may be, in effect, a small, independent aquifer, making it difficult to establish background. In such areas, geologic cross sections may be necessary to understand the underlying aquifer system.

No Background Well In Release Well Aquifer

At some sites, no potential background wells exist in the aquifer(s) of concern prior to the SI. At these sites, background levels may be determined only in two ways: by installing monitoring wells at appropriate background locations, or based on appropriate published concentration data. Data from monitoring wells generally are preferred over data from the literature. Guidance for using published concentration data to establish background levels is presented in Section 5.1.

**HIGHLIGHT 5-5
ILLUSTRATION OF APPROPRIATE BACKGROUND SAMPLES:
GROUND WATER PATHWAY — SINGLE AQUIFER**

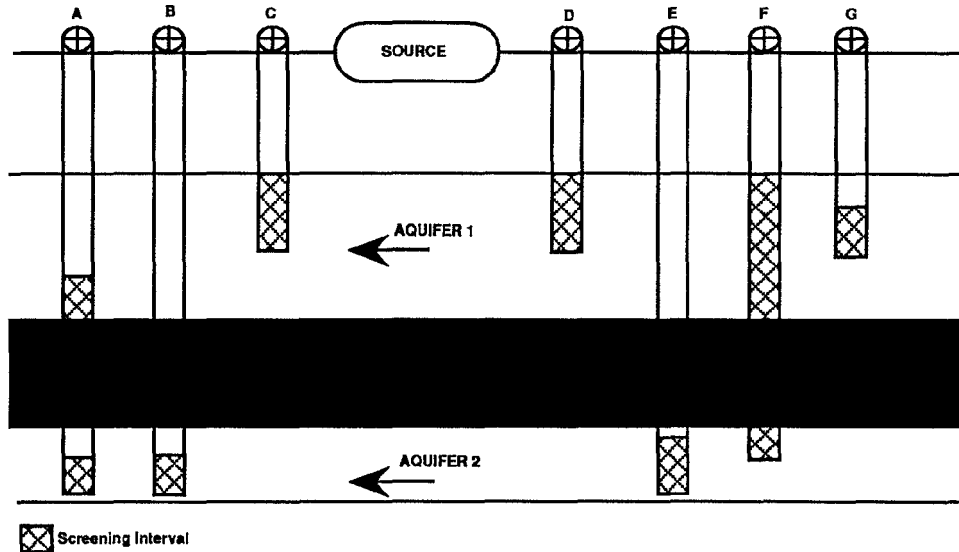


Illustrated in this idealized drawing is a source releasing LNAPLs, DNAPLs, and other hazardous substances to a single aquifer. Assume that the eight wells have a similar development history. The appropriateness of each well for release and background samples is given below:

Type of Hazardous Substance	Release Samples				Background Samples			
	A	B	C	D	E	F	G	H
LNAPLs	N/A	N/A	Yes	Yes	Yes	No	No	Yes
Others	Yes	Yes	N/A	Yes	No	Yes	No	Yes
DNAPLs	Yes	N/A	N/A	N/A	No	No	Yes	Yes

- For LNAPLs, E and H are appropriate background wells and C and D are appropriate release wells because their screening intervals are at the top of the aquifer (where LNAPLs are likely to occur).
- For DNAPLs, G and H are appropriate background wells and A is the only appropriate release well because their screening intervals are at the bottom of the aquifer (where DNAPLs are likely to occur).
- For other hazardous substances, F and H are appropriate background wells and A, B, and D are appropriate release wells because their screening intervals are in the middle of the aquifer (where these substances are likely to occur).

HIGHLIGHT 5-6
ILLUSTRATION OF APPROPRIATE BACKGROUND SAMPLES:
GROUND WATER PATHWAY — MULTIPLE AQUIFERS

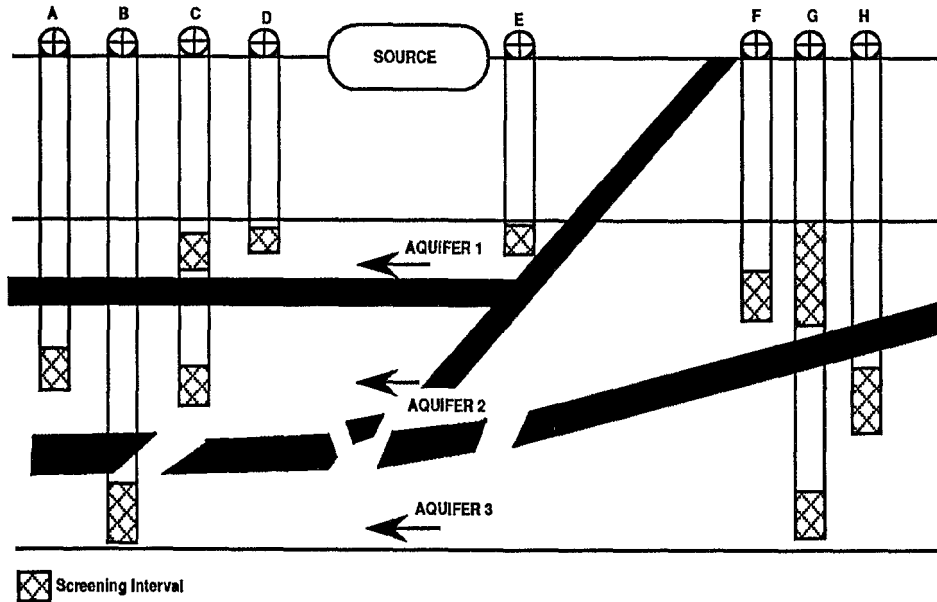


Illustrated in this idealized drawing is a source releasing hazardous substances to two aquifers that are not interconnected within 2 miles of sources at the site. Assume that the seven wells have a similar development history. The appropriateness of each well for release and background samples is given below:

Aquifer	Release Samples			Background Samples			
	A	B	C	D	E	F	G
Aquifer 1	No	No	Yes	Yes	No	No	Yes
Aquifer 2	No	Yes	No	No	Yes	No	No

- For Aquifer 1, D and G are appropriate background wells and C is an appropriate release well.
- For Aquifer 2, E is an appropriate background well and B is an appropriate release well. A is not an appropriate release well and F is not an appropriate background well because both wells are screened in both aquifers.

HIGHLIGHT 5-7
ILLUSTRATION OF APPROPRIATE BACKGROUND SAMPLES:
GROUND WATER PATHWAY — INTERCONNECTED AQUIFERS



Illustrated in this idealized drawing is a source releasing hazardous substances to three aquifers, two of which are interconnected within 2 miles of sources at the site. Assume that the eight wells have a similar development history. The appropriateness of each well for release and background samples is given below:

Aquifer	Release Samples				Background Samples			
	A	B	C	D	E	F	G	H
Aquifer 1	No	No	No	Yes	Yes	No	No	No
Aquifer 2	Yes	No	No	No	No	Yes	No	No
Aquifer 3	No	Yes	No	No	No	No	No	Yes

- For Aquifer 1, E is the only appropriate background well and D is the only appropriate release well.
- For Aquifer 2, F is the only appropriate background well and A is the only appropriate release well. Although Aquifers 2 and 3 are interconnected, H is not an appropriate background well for Aquifer 2 because it is screened in Aquifer 3.
- For Aquifer 3, H is the only appropriate background well and B is the only appropriate release well.
- Well G cannot serve as a background well because it is screened in both Aquifer 2 and Aquifer 3. Well C cannot serve as a release well because it is screened in both Aquifer 2 and Aquifer 3.

Release Well Serves as its Own Background

Under some circumstances a single well, over time, may provide both background and release samples. For example, where a regular water quality monitoring program is in effect (e.g., at municipal wells), a time series of monitoring data may document encroachment of a hazardous substance plume. Data must be available from a sufficient period of record, so that a trend in increasing concentrations can be demonstrated clearly.

SURFACE WATER PATHWAY

Data evaluation guidelines for the surface water pathway are presented below. General guidelines are presented first, followed by guidelines specific to particular types of surface water bodies (i.e., streams and rivers; lakes, Great Lakes, and other large water bodies; and tidally influenced areas) and particular types of samples (i.e., aqueous, sediment, and tissue). **Highlight 5-8** provides an idealized illustration of appropriate background sampling locations for the surface water pathway.

General Guidelines

- An observed release by chemical analysis can be established in the surface water pathway using aqueous samples, sediment samples, and/or tissue samples from essentially sessile benthic organisms. Background and release samples must be of the same type (e.g., aqueous samples must be compared to aqueous samples, sediment to sediment).
- Chemical and physical properties of surface water and sediments may vary substantially within a small area. Stratification of lakes, lack of mixing in slowly moving rivers, and mixing effects induced by tributaries may affect the appropriateness of a given sampling location for establishing background levels. Environmental conditions at both the background and release sample locations should be similar.

Non-tidal Streams and Rivers

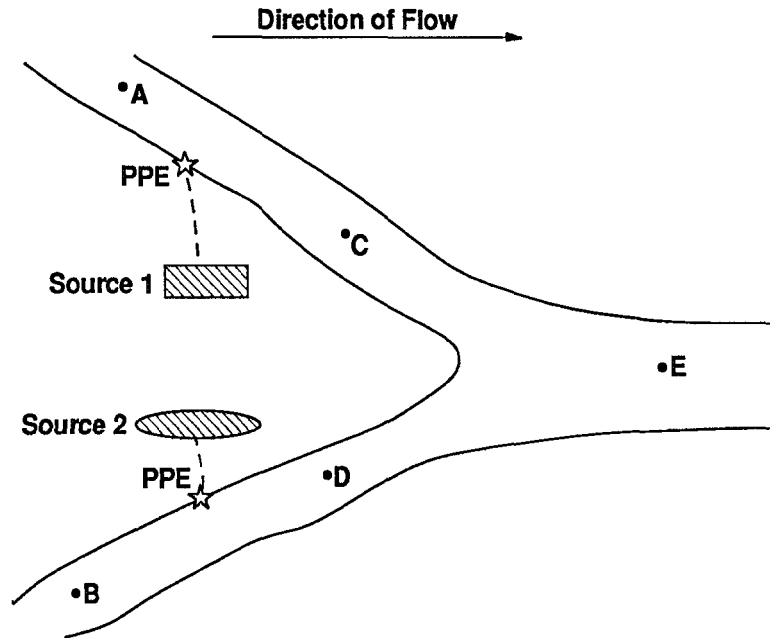
- Background samples should be collected upstream from the potentially contaminated area. In the simplest case (i.e., one PPE and one main channel), one background sample may be sufficient. In cases where there is significant branching or tributary input upstream of the PPE, more than one background sample may be appropriate.
- If there are multiple PPEs, background samples may be appropriate for each PPE, particularly if the hazardous substances for each PPE are different and significant branching or tributary input occurs between PPEs.
- Where possible, background and release samples should be collected from the same general part of the surface water body (e.g., a background sample taken near one bank generally should not be compared with a release sample taken from the center of the main channel).

Ponds and Other Small, Isolated Water Bodies

In ponds and other small, isolated water bodies, it may not be possible to collect background and release samples from the same water body (e.g., the entire pond may be influenced by the site). In that case, background can be established as follows.

- Samples of water flowing into the pond may provide background levels if there is a clear inflow and this is not influenced by the site.

**HIGHLIGHT 5-8
ILLUSTRATION OF APPROPRIATE BACKGROUND SAMPLES:
SURFACE WATER PATHWAY — STREAMS AND RIVERS**



Illustrated in this idealized drawing is a site releasing hazardous substances from two sources to two branches of a river. Assume that the five samples are similar (e.g., they are all sediment samples collected from similar substrates at similar times and were handled and analyzed in an identical manner). The appropriate background sample for each release sample is given below:

Release Sample	Appropriate Background Sample(s)	
	A	B
Sample C	Yes	No
Sample D	No	Yes
Sample E	Yes	Yes

- For Release Sample C, A is the only appropriate background sample because any increased hazardous substance concentrations could be attributed to Source 1.
- For Release Sample D, B is the only appropriate background sample because any increased hazardous substance concentrations could be attributed to Source 2.
- For Release Sample E, both A and B are appropriate background samples because contamination could be flowing down either or both branches upstream of Sample E.

- Samples from an analogous water body outside of the area influenced by the site (e.g., a nearby pond of similar size and type) may provide background levels.
- Background levels may be established based on literature values without having to take samples (see Section 5.1).

Lakes, Great Lakes, and Other Large Water Bodies

- In smaller lakes, samples at the point where surface water enters the lake generally will provide appropriate background levels. If there is no obvious point of entry, it generally is best to use samples as far as possible from the PPE(s) to establish background levels. However, the presence of springs, other potential sources, and points of flow out of the lake may influence selection of background locations.
- If other potential sources are near the site, background samples should be collected between the PPE for the site and the PPE for other potential sources. Ideally, background samples should also be out of the zone of influence of the other potential sources.
- In large water bodies, background samples should be collected as far from the PPE as possible, except when other potential sources, points of flow into the lake, or points of flow out of the lake are present in between.

Tidal Areas

- In tidal water bodies, background samples ideally should be collected beyond the farthest upstream point at which substances from the site might be transported by the tide. If it is difficult to determine exactly how far upstream substances might be transported, it may be appropriate to collect background samples above the "head of the tide" (i.e., the most upstream point at which tidal cycles are present), as long as it isn't too far upstream to be unrepresentative of background. In some cases, a series of samples successively farther upstream may be required.
- In tidally influenced areas, it is especially important to be aware of attribution problems that might be presented by non-site related sources of contamination either upstream or downstream from the PPE. In general, attribution will be more difficult as distance from the PPE increases.
- For aqueous samples, sample collection times in relation to tidal cycles should be considered. Hazardous substance transport upstream will be greatest during a rising tide and lowest during a falling tide. Background aqueous samples are most likely to have the least site-related contamination toward the end of the falling tide, when downstream flow is expected to exert maximum flushing effect. Site-related concentrations in the background sample are likely to be higher toward the end of the rising tide, when contaminated water is carried upstream to the maximum extent.

Sediment Samples

- Sediment type should be similar in background and release samples. Fine clay particles are more likely to adsorb hazardous substances such as metals and hydrophobic organic compounds than are larger particles or particles with a predominately sandy matrix. Different sediment types tend to accumulate in different areas of a stream or lake. Fine sediments will predominate in quiescent zones, whereas sandy sediments, with fewer fine particles, will be found in more turbulent areas. Visual documentation of sediment type similarity is generally sufficient.

Tissue Samples

- The only tissue samples that may be used to establish an observed release are those from essentially sessile, benthic organisms. Such organisms do not need to be human food chain species. This ensures that any contamination found in the tissue can be attributed to the immediate area in which the organism was collected. Benthic organisms are generally those which spend most of their lives on the bottom of a water body, and sessile organisms are those which are relatively immobile. Examples of essentially sessile, benthic organisms include sponges, oysters, and mussels.
- Concentrations of hazardous substances in tissue samples may vary among different species, different individuals within a species, and different organs and tissues within an individual organism. At a minimum, background and release tissue samples must be of the same species. Ideally, background and release samples should be from organisms of similar age, if age can be determined. If variability among individuals is high, multiple background and release samples may be appropriate.

SOIL EXPOSURE PATHWAY

- Soil is a heterogeneous material that may vary substantially in texture and other physical and chemical properties. Background and release samples should be collected in areas with similar soil characteristics.
- Site setting and operational history should be considered in selecting background samples. Information about site operations may indicate which areas were subject to a particular type of contamination and which areas may serve as background for the contaminated areas. Land features might prevent the migration of liquids to certain portions of the site. Other contaminated sites nearby may affect the appropriateness of a particular location for background samples.
- Some sites may be located in or near areas that have been filled, and the fill soils may have come from different locations. If possible, background samples should be from undisturbed areas (e.g., those with mature vegetation).
- Soil within a dry drainage ditch or swale is subject to many outside influences and generally should not be used for determining background levels. An exception might be if the contaminated soil source is in the same swale or drainage ditch.

AIR PATHWAY

Wind direction is of paramount importance in determining background levels for air samples. A background air sample will ideally be collected upwind from the area of contamination. However, cross-wind samples may also be acceptable for background conditions and should be used if potential sources of similar contamination are located cross-wind. Consideration must be given to the entire time period over which a sample was collected. Data on the predominant wind direction in an area are insufficient to determine background; wind direction must be established during the sampling period.

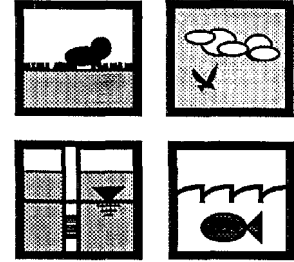
- During any sampling event it is likely that changes in wind speed and direction will occur. A wind rose, based upon continuous data collected during the entire period of site sampling, may be helpful for selecting background.
- Background and release samples should be from approximately the same heights above the ground surface. Samples do not need to be collected from the "breathing zone." Samples from very low heights should be evaluated carefully because field activities, particularly soil disturbance, may introduce contamination.

- Background and release samples generally should be collected simultaneously.
- Indoor air samples cannot be used to establish background levels (or to establish an observed release).

TIPS AND REMINDERS

- Large differences in the physical or chemical characteristics of background and release samples may indicate artifacts introduced during the sampling process. For example, a high concentration of suspended solids in a ground water sample may indicate insufficient purging of the well prior to sampling and/or substantial disturbance to the well during sampling.
- Ground water wells from which background and release samples are obtained must be completed in the same aquifer and should generally be at approximately the same relative depth in the aquifer.
- Background and release samples should be collected within the same time frame, as appropriate for the pathway.
- Background and release sediment (or soil) samples should be of similar type.
- Tidal effects should be considered when establishing background sampling locations in surface water.
- Knowledge of site operations can often provide clues to appropriate locations for background soil samples.

SECTION 5.3 TRANSFORMATION PRODUCTS



A hazardous substance exposed to other substances or to the environment is susceptible to transformation by physical, chemical, and biological processes. The products of these reactions are termed transformation products. Substances found in the environment (i.e., the transformation products) may be different than those found or otherwise documented in sources at the site (i.e., the parent substances). This section provides guidance for establishing an observed release (or observed contamination) based on transformation products.

RELEVANT HRS SECTIONS

Section 2.3	Likelihood of release
Section 3.1.1	Observed release (ground water)
Section 4.1.2.1.1	Observed release (surface water)
Section 5.0.1	General considerations (soil exposure)
Section 6.1.1	Observed release (air)

DEFINITIONS

Transformation Product: The substance(s) resulting from the transformation of a hazardous substance in the environment by physical, chemical, and/or biological processes. The original hazardous substance is referred to as the parent substance. When a transformation product is a simpler, less complex substance than the parent substance, it is referred to as a degradation product. When a more complex substance is produced, the product is often referred to as a formation product.

GENERAL REQUIREMENTS

Most transformation products of environmental concern at waste sites are degradation products. Examples of physical degradation processes include spontaneous decay of radioactive substances (e.g., uranium to radium) and dechlorination of aromatic hydrocarbons due to photodegradation (e.g., heptachlorobiphenyl to hexachlorobiphenyl). Examples of chemical degradation processes include oxidation/reduction reaction of chromium VI to chromium III, acid/base reaction of sulfuric acid to sulfate salts, and dissolving of metals due to ground water acidification by landfill leachate (e.g., lead solid to lead ion under low pH conditions). Examples of biological degradation processes include transformation of trichloroethane to dichloroethane; hydroxylation of benzenes to phenolics by aerobic microorganisms (dichlorobenzene to dichlorophenol); and dehalogenation (i.e., removal of a halide) of aromatic pesticides by anaerobic microorganisms (e.g., pentachlorophenol to tetrachlorophenol). **Highlight 5-9** provides some examples of common degradation products and their parent substances.

HIGHLIGHT 5-9 TYPICAL DEGRADATION PRODUCTS

Parent Substance(s)	Typical Degradation Product(s)
Chloromethanes (e.g., carbon tetrachloride)	Other chloromethanes with fewer chlorines; formaldehyde; chloroform
Chloroethanes (e.g., tetrachloroethane, trichloroethanes (1,1,1 or 1,1,2), dichloroethanes, chloroethanes)	Other chloroethanes with fewer chlorines; chloroethanols; ethanol; chloroethenes
Chloroethenes (e.g., tetrachloroethene, trichloroethene, dichloroethenes vinyl chloride)	Other chloroethenes with fewer chlorines; chloroethanols; chloroethanes
Chlorobenzenes and chlorophenols, hexachlorobenzene, pentachlorophenols	Other chlorobenzenes and chlorophenols with fewer chlorines; chlorocatachols; chlorobenzoic acids; phenols
Polychlorinated biphenyls (PCBs)	Other PCBs with fewer chlorines; chlorobenzenes
DDT	DDE, DDD
Disulfoton	Carbon disulfide
2,4-Dichlorophenoxyacetic acid (2,4-D)	2,4-Dichlorophenol; 3,5-Dichlorocatechol; 2,4-Dichloromuconic acid
Aldrin	Dieldrin

The same requirements for establishing an observed release by chemical analysis that apply to hazardous substances in general apply to transformation products (see Section 5.1). Transformation products must be hazardous substances in order to be used to establish an observed release (or observed contamination). Also, an observed release based on transformation products cannot be established by direct observation.

ESTABLISHING AN OBSERVED RELEASE (OR OBSERVED CONTAMINATION) FOR TRANSFORMATION PRODUCTS

The steps outlined below describe how to establish an observed release (or observed contamination) for transformation products.

- (1) **Document the presence of the transformation product(s) in the release sample at levels significantly greater than background.** Analytical data used to demonstrate the presence of a transformation product must meet the same significance, attribution, and QA/QC requirements as for any other hazardous substance (see Section 5.1). The transformation products should be considered to be present in the media they have been found in, but this does not mean they necessarily are available to other pathways. For example, a transformation product detected in ground water is not necessarily available to the air pathway. Any hazardous substance documented to be in a source is considered available to all pathways for which the source has a non-zero containment factor value.

- (2) **Attribute the parent substance to the site.** Establishing attribution of the parent substance to the site usually involves documenting that the parent substance was deposited or is present in a source, or that the parent substance was produced, stored, deposited, or treated at the site and/or originated in or resulted from activities at the site.

The following types of information may be used to establish attribution of a parent substance to a site (in order of preference).

- The most complete information is chemical analysis of samples from at least one source in the site and documentation that the substance was placed in the source. If the source is contaminated soil or contains soil used as cover or fill material, it generally also will be necessary to document that the concentration of the substance in the source is significantly above background.
- If the above information cannot be obtained, documentation by chemical analysis that the parent substance is in a source can be used alone if the source does not contain soil or if the substance is not a naturally occurring substance.
- If analytical data are not available, records or manifests indicating the parent material was placed in a source are preferred. Documentation that the parent substance was used, stored, or handled at the site is also acceptable.
- In some situations, information indicating that a parent substance was most likely present at a site because of the nature of the site activity may also be considered adequate attribution (e.g., carbon tetrachloride or tetrachloroethene at a dry cleaning facility).

- (3) **Attribute the transformation product to the site.** Attributing the transformation product to the site generally involves documenting that the hazardous substance detected in the receiving medium is the transformation product of a parent substance attributable to that site. Establishing attribution of a transformation product to the site usually involves documenting the following.

- The substance detected in a medium is a transformation product of the parent material, as shown by:
 - Site-specific studies on the transformation process by qualified research organizations (e.g., universities, EPA research laboratories);
 - EPA technical reports discussing the transformation of the parent substance, such as from the Office of Research and Development, the Risk Reduction Engineering Laboratory (RREL), and/or the Center for Environmental Research Information (CERI);
 - Information in data bases containing EPA-reviewed information (e.g., the computerized RREL "Treatability Data Base");
 - Articles from peer reviewed journals; or
 - Textbooks on soil and environmental microbiology, biotechnology, and biotreatment processes and their effectiveness.
- A significant increase of the transformation product relative to its background for the site has occurred.

- At least some portion of the significant increase of the transformation product above background can be attributed to the site.

Information that would further support attribution (but would not be sufficient by itself) includes:

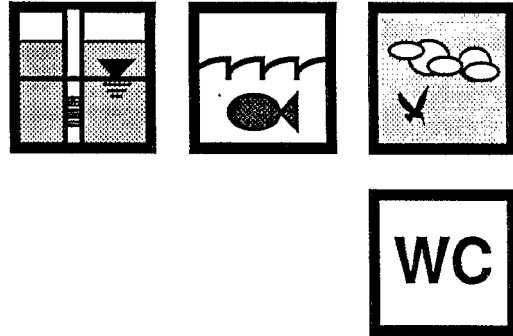
- Conditions at the site are such that it is possible that the parent material has transformed into these substances, or, at minimum, that the conditions at the site do not prevent the transformation from occurring (e.g., the transformation requires oxidizing conditions and these exist at the site); and
- There is a non-zero containment factor value for at least one source at the site containing the parent material.

CHAPTER 6

HAZARDOUS WASTE QUANTITY

TIER A	HAZARDOUS CONSTITUENT QUANTITY	POUNDS
TIER B	HAZARDOUS WASTESTREAM QUANTITY	POUNDS
TIER C	VOLUME	CUBIC YARDS
TIER D	AREA	SQUARE FEET

SECTION 6.1 OVERVIEW OF HAZARDOUS WASTE QUANTITY FOR THE THREE MIGRATION PATHWAYS



This section introduces the concept of hazardous waste quantity and provides a flowchart summarizing how to calculate the hazardous waste quantity factor value for the migration pathways. A discussion of possible information sources that may assist in documenting hazardous waste quantity values is also included. Hazardous waste quantity for the soil exposure pathway is discussed in Section 9.2.

The purpose of the hazardous waste quantity factor in the HRS is to represent the quantity of hazardous substances at a site. The hazardous waste quantity factor allows the use of various measures of hazardous waste quantity depending on data availability and adequacy. The factor has a hierarchical structure of four tiers:

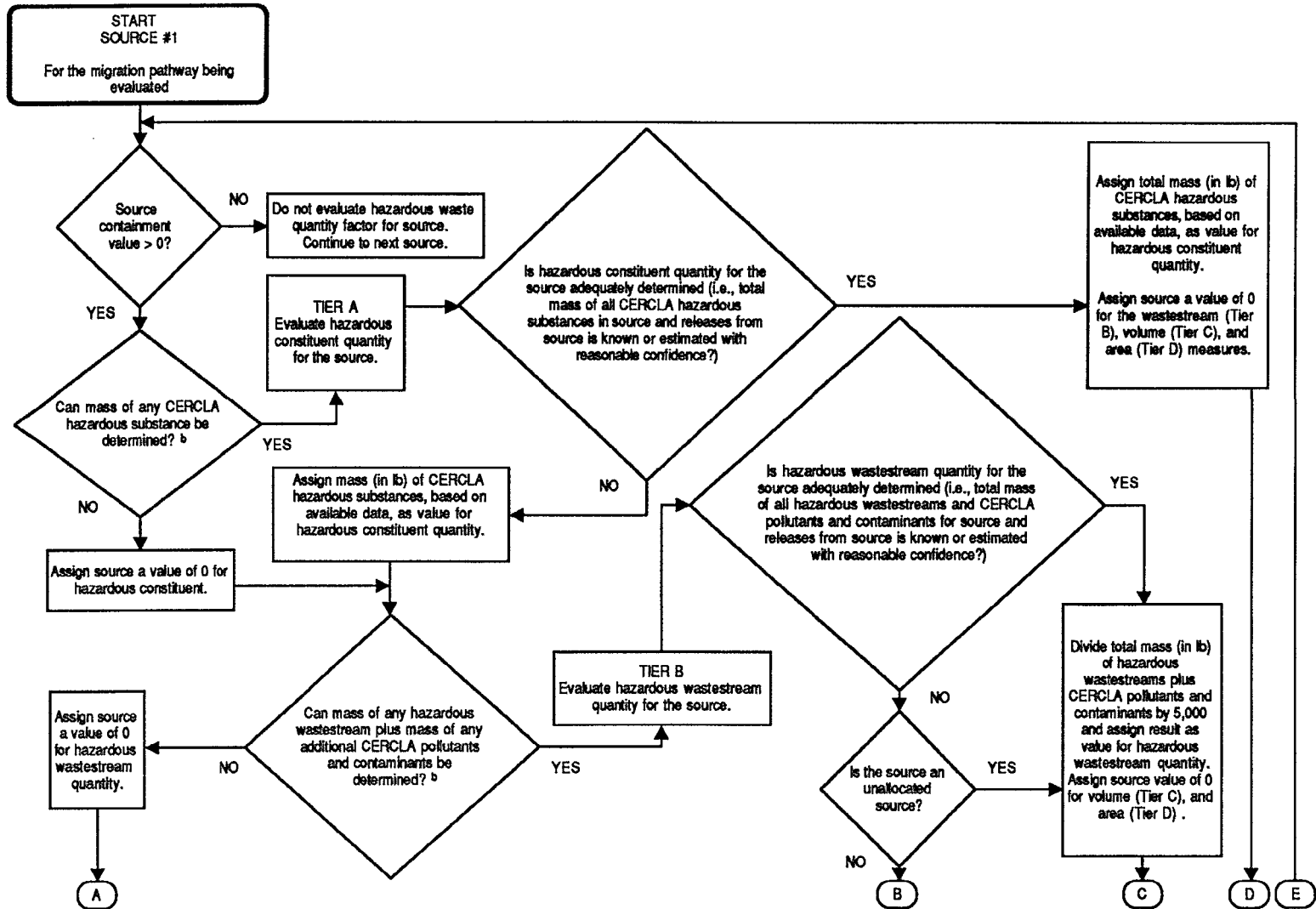
- Tier A Hazardous Constituent Quantity
- Tier B Hazardous Wastestream Quantity
- Tier C Source Volume
- Tier D Source Area.

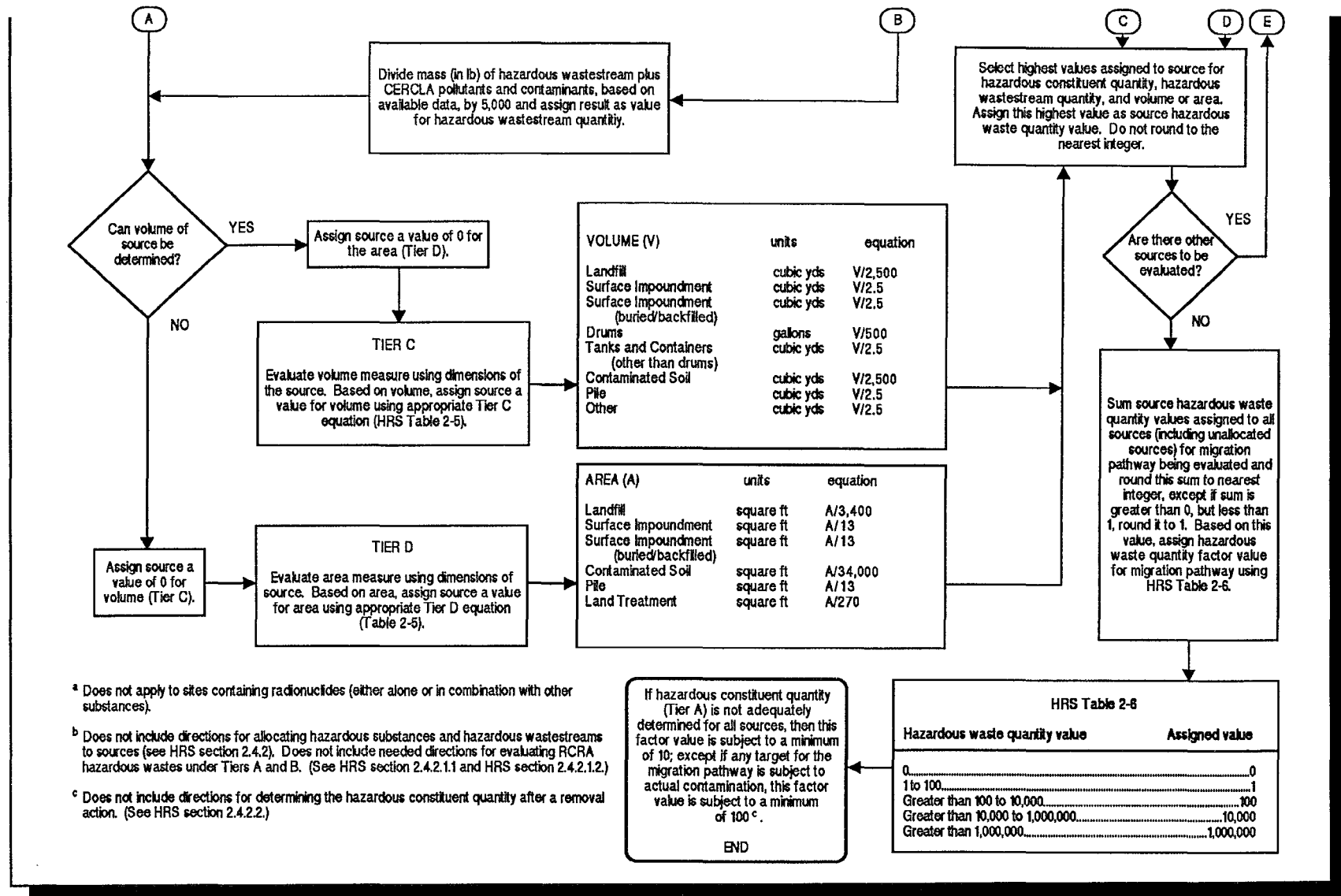
In general, Tier A is the most exact measure of hazardous waste quantity and also requires the highest level of data to score; successive tiers are less accurate and have less rigorous data requirements. The hierarchy allows evaluation of a source at the most precise level for which data are reasonably available, while not requiring extensive data collection where less information is available. The hazardous waste quantity for each source at a site is determined by evaluating as many of the tiers as necessary to estimate the mass of hazardous substances for the source (and in any associated releases from the source). The highest value among the tiers used is then selected as the source hazardous waste quantity value. The overall pathway hazardous waste quantity factor value is determined by summing the individual source hazardous waste quantity values, and then assigning a value using HRS Table 2-6.

The quantity of hazardous substances in each source generally should be estimated as a specific number, not a range or qualitative estimate. However, if data are only available to support a range of source hazardous waste quantity values, the range can be used. The documentation presented in the HRS scoring package should clearly demonstrate how the source hazardous waste quantity value was calculated, and the references should support that demonstration.

Highlight 6-1 is a flowchart that summarizes the methodology for evaluating hazardous waste quantity. In addition, flowcharts in subsequent sections provide step-wise instruction for scoring each individual tier.

HIGHLIGHT 6-1 FLOWCHART FOR EVALUATING HAZARDOUS WASTE QUANTITY





RELEVANT HRS SECTIONS

Section 2.4.2	Hazardous waste quantity
Section 2.4.2.1	Source hazardous waste quantity
Section 2.4.2.1.1	Hazardous constituent quantity
Section 2.4.2.1.2	Hazardous wastestream quantity
Section 2.4.2.1.3	Volume
Section 2.4.2.1.4	Area
Section 2.4.2.1.5	Calculation of source hazardous waste quantity value
Section 2.4.2.2	Calculation of hazardous waste quantity factor value

DEFINITIONS

Hazardous Waste Quantity Factor Value: An assigned value for the pathway that is based on the sum of all source hazardous waste quantity values, and assigned using HRS Table 2-6.

Source Hazardous Waste Quantity Factor Value: The highest of the values assigned to a source using the four hazardous waste quantity tiers.

BEGINNING THE HAZARDOUS WASTE QUANTITY EVALUATION

The evaluation of hazardous waste quantity begins with allocation of hazardous substances to sources and evaluation of containment factor values. These steps are an extension of source characterizations, discussed in Section 4.1.

- (1) **Allocate hazardous substances to sources.** Review the evidence that hazardous substances and/or wastestreams are associated with the site. This information can be retrieved from a variety of references. See subsection below, Locating hazardous waste quantity Information. These references may indicate which and possibly how much hazardous substances are present. To begin evaluating the hazardous waste quantity factor, allocate the substances and wastestreams deemed hazardous to specific sources at the site.
- (2) **Evaluate an unallocated source, if necessary.** If hazardous substances and/or wastestreams are documented as deposited at the site, but cannot be allocated to a specific source, consider them allocated to a separate "unallocated source." Assign the unallocated source a containment factor value of greater than 0. In rare circumstances, there may be definitive information that the substance or wastestream that cannot be allocated to a specific source could only have been placed in sources with a containment factor value of 0 for a particular pathway; in this particular situation, do not evaluate hazardous waste quantity for these hazardous substances. In all situations, only Tier A and Tier B can be used to evaluate the unallocated source.
 - To begin evaluating hazardous waste quantity, allocate hazardous substances and wastestreams at the site to specific sources, to the extent possible. If necessary, assign hazardous substances and/or wastestreams to an unallocated source.

(3) **Evaluate pathway-specific containment factor values for each source.** To be evaluated for hazardous waste quantity, a source must have a containment factor value greater than 0 for the pathway being scored. As discussed above, always assume that the unallocated source has a containment factor value greater than 0 for all migration pathways. If a source has a containment factor value equal to 0, hazardous waste quantity cannot be evaluated for that particular source in that particular pathway.

- To evaluate hazardous waste quantity for a source for a particular pathway, the containment factor value for the source must be greater than 0 for that pathway.

Highlight 6-2 is a matrix that indicates tiers for which hazardous waste quantity data are most likely to be available for each HRS source type. For instance, when calculating hazardous waste quantity for a landfill, it is more likely that data adequate for evaluating Tier D will be available than data adequate for evaluating Tier A. Note that the information provided in **Highlight 6-2**, although generally appropriate, may or may not apply to particular sources at a site and is to be used only for general guidance.

**HIGHLIGHT 6-2
DATA AVAILABILITY BY SOURCE TYPE**

Source Type	TIER A Hazardous Constituent Quantity	TIER B Hazardous Wastestream Quantity	TIER C Volume	TIER D Area
Landfill	—	+	+	++
Surface Impoundment	+	+	++	++
Surface Impoundment (buried/backfill)	—	+	+	++
Drums	+	++	++	—
Tanks/Containers	+	++	++	—
Contaminated Soil	—	—	—	++
Pile	—	+	++	+
Land Treatment	+	+	+	++
Other	—	+	+	++

++ Likely that data on HWQ will be available.
 + Possible that data on HWQ will be available.
 — Unlikely that data on HWQ will be available.

LOCATING HAZARDOUS WASTE QUANTITY INFORMATION

Various types of information may be helpful for determining hazardous waste quantity. Although Tiers A and B require more detailed information, Tiers C and D also require documentation to substantiate the volume or area being used. It may be necessary to rely on a single particular recordkeeping reference to estimate hazardous waste quantity, and to incorporate other documents supporting such an estimate.

- **RCRA Waste Manifests.** The RCRA Subtitle C program uses the Uniform Hazardous Waste Manifest to track the movement of hazardous waste from the point of generation to off-site points of treatment, storage, or disposal. RCRA manifests include:
 - Name and EPA identification number of the generator, transporter(s), and facility where the waste is to be treated, stored, or disposed;
 - Department of Transportation (DOT) description of the waste being transported;
 - Quantity of each hazardous waste being transported by units of weight or volume; and
 - Address of the treatment, storage, or disposal facility to which the generator is sending waste.

For purposes of hazardous wastestream quantity, RCRA manifests are most useful when the site being scored is (or was) a RCRA treatment, storage or disposal facility; then, manifests document the types and quantities of waste that have been received. If the site being scored is a generator of RCRA hazardous wastes that were transported off-site, manifests can be used to document the quantity of waste generated.

- **State Manifests.** Many states impose additional or more stringent regulations that require the manifesting of materials/wastes other than RCRA Subtitle C wastes. Although each state's requirements vary, investigating state manifests may be helpful in scoring hazardous waste quantity.
- **Permits.** Permits may provide helpful information about a site. Permits, however, establish levels that should be complied with and not levels that actually occur at the site. Any permits used to provide information must be signed and finalized. Permits are rarely used as the only supporting documentation for actual hazardous waste quantity at a site. However, permits can provide supporting documentation to allocate certain hazardous substances to a wastestream (e.g., support the presence of benzene in a wastewater discharge under a National Pollution Discharge Elimination System (NPDES) permit).
- **EPA Compliance Orders.** EPA signed and finalized compliance orders may provide information relevant to hazardous waste quantity. For example, a violation of a NPDES permit may be used to document that certain concentration levels of hazardous substances were actually released.

- **Section 10(k) Reports.** The Securities and Exchange Commission requires section 10(k) reports that may contain detailed information related to hazardous waste quantity. The section 10(k) report, a version of the annual report that all U.S. corporations must file with the Securities and Exchange Commission, frequently contains more information on the company's assets and liabilities (e.g., hazardous waste) than the annual report distributed to stockholders.
- **CERCLA 103(c) "Notification of Hazardous Waste Site" Forms.** These forms are a direct source of waste quantity information. If a facility stored, treated, or disposed of hazardous substances before (and during) 1980, then the owner/operator was required to submit a CERCLA 103(c) "Notification of Hazardous Waste Site" form. This form provides the amount and types of hazardous substances on the site, as well as any known, suspected, or likely releases of such substances from the facility.
- **PRP Records.** At sites where PRPs have been identified, PRP records of incoming/outgoing wastes may be used to estimate the hazardous waste quantity at a site.
- **Property Owners' Tax Assessment Documents.** Property owners' tax assessment documents may contain some useful information.
- **Emergency Response Monitoring Data.** The scorer might find relevant information in this general source.
- **Material Safety Data Sheets.** This source can provide limited information such as chemical properties, Chemical Abstract Service number, percent technical grades and safe handling procedures.
- **Other Records.** In addition, numerous other records may be used to estimate the hazardous waste quantity at a site. A facility's product records, annual reports, property records, and production reports may be useful, as may trade association information, transcripts of interviews with former employees, and aerial photographs. Completeness, accuracy, and validity of these information sources varies and should be evaluated on a case-by-case basis.

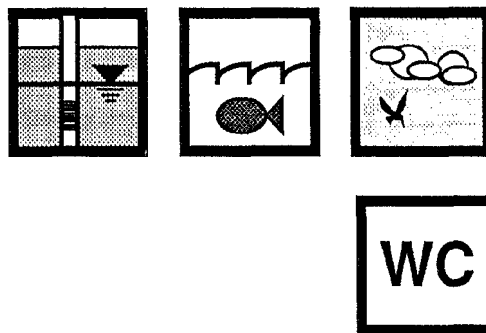
TIPS AND REMINDERS

- Some scorers find it helpful to start evaluating hazardous waste quantity under Tier D and then work backward to Tier A. In certain situations (e.g., landfills, manufacturing sites), this method makes it easier to recognize which tier should be used to evaluate hazardous waste quantity.
- Incomplete information on a higher tier can at times score higher than complete information on lower tiers.
- Adequate references should be included for all tiers evaluated for the hazardous waste quantity factor. At a minimum, references should support the tier(s) used to score the source and also at least one tier both below and above (e.g., if Tier B is used, references should also be provided for Tier C or D, and Tier A if scored). This provides usable data for these other tiers if the assumptions used during evaluation of the tier do not hold up. Note that although Tier A or Tier B may be adequately determined in some situations, it may be advisable to include references for Tier C or Tier D.
- Additional sampling generally will not be performed to obtain Tier A data. Instead, use a different tier as the basis of the source hazardous waste quantity value.

- Hazardous waste quantity is a measure of the hazardous substances deposited in sources at the site rather than a measure of hazardous substances in sources at the site. Therefore, the hazardous substances in the sources and in the releases from those sources are evaluated for hazardous waste quantity.
- The unallocated source is not used in scoring factors other than hazardous waste quantity. An unallocated source results when a hazardous substance or hazardous wastestream is known to have been deposited at the site but cannot be allocated to any specific source.
- Do not confuse the unallocated source with sources that are "ground water plumes (or surface water sediments) with no identified source."
- For an unallocated source, only Tier A or Tier B can be used to evaluate the hazardous waste quantity.
- The most reasonable and defensible estimate of hazardous waste quantity should always be applied for each of the tiers used for calculating hazardous waste quantity, regardless of whether the estimate is based on the most recent or highest figures.

SECTION 6.2

TIER A – HAZARDOUS CONSTITUENT QUANTITY



This section clarifies the method for evaluating hazardous waste quantity under Tier A of the HRS. Topics include definitions that pertain to Tier A, data requirements for scoring under Tier A, data sources that can provide hazardous waste quantity information, and evaluation of RCRA wastes.

Tier A is used when data are available on the quantities of individual CERCLA hazardous substances. If complete data are available for the evaluation, Tier A yields the most accurate measure of the mass of CERCLA hazardous substances in the source. Any data that provide quantities of CERCLA hazardous substances deposited into a particular source are ideal for evaluating Tier A. However, in many cases, a representative value for the average concentration of CERCLA hazardous substances present in a source will not be adequately documented or obtainable. **Highlight 6-3** is a flowchart that provides step-wise instructions for scoring a source with Tier A.

DEFINITIONS

Adequately Determined (for purposes of Tier A only): The total mass of all CERCLA hazardous substances in the source and releases from the source (or for the area of observed contamination) is known or is estimated with reasonable confidence. (For the site hazardous waste quantity factor value to be adequately determined for Tier A, this definition must apply for all sources.)

CERCLA Hazardous Substances: Hazardous substance as defined by statute in CERCLA section 101 (14); the list of CERCLA hazardous substances having reportable quantities is found in 40 CFR 302 in Table 302.4.

Hazardous Constituent Quantity: The mass (in pounds) of CERCLA hazardous substances allocated to a source (with certain exceptions for RCRA wastes).

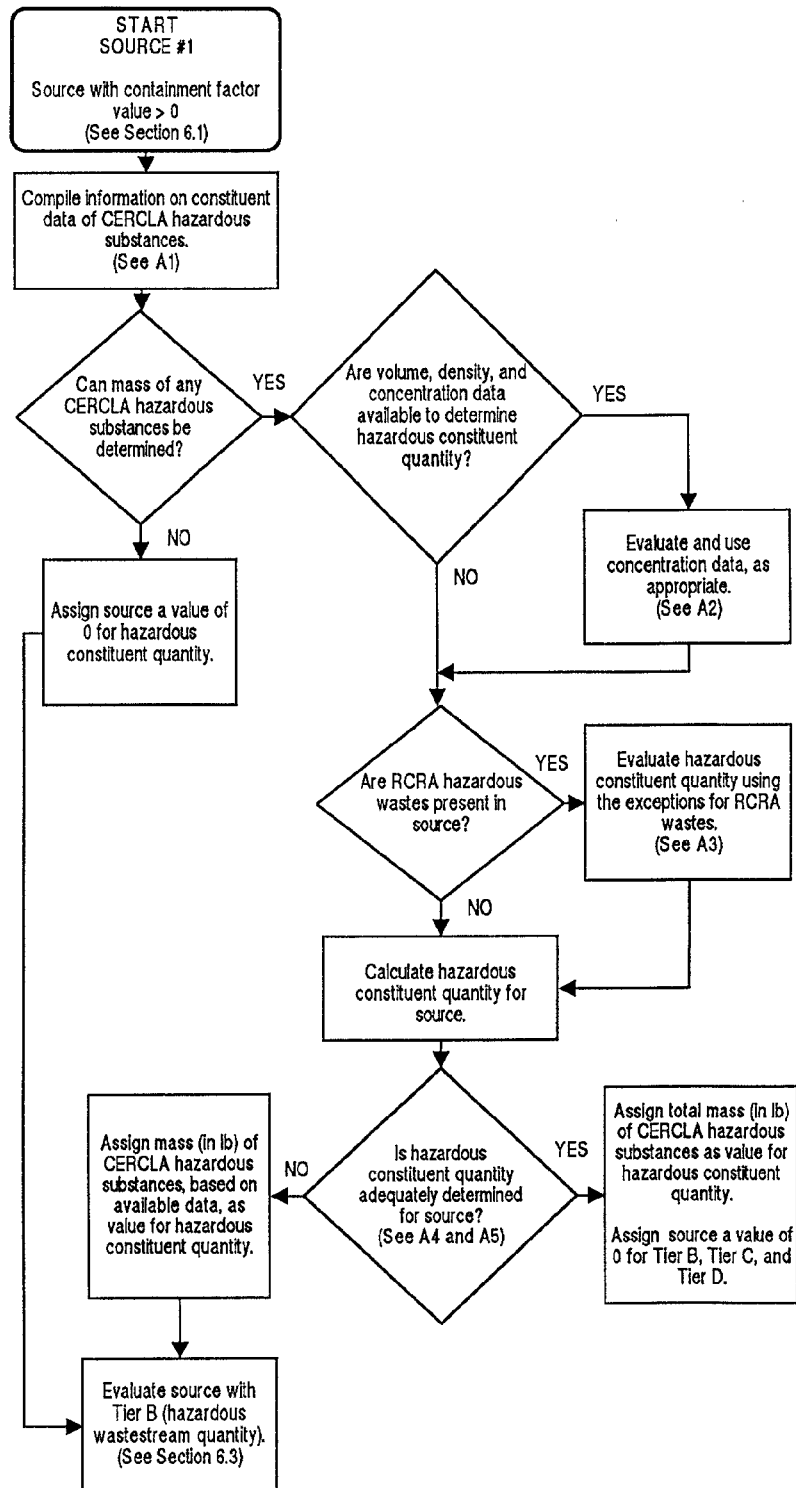
Hazardous Substances: CERCLA hazardous substances and pollutants or contaminants as defined in CERCLA sections 101 (14) and 101 (33), except as otherwise specifically noted in the HRS.

A1. LOCATING DATA

The following records or resources, which are described in more detail in Section 6.1, can provide accounts of quantities of hazardous substances deposited into sources:

- Manifests
- PRP records
- State records
- EPA signed and finalized compliance orders
- Material Safety Data Sheets (for product)
- Permits
- Waste concentration data (see discussion in A2).

HIGHLIGHT 6-3 FLOWCHART FOR EVALUATING TIER A



The hazardous constituent quantity is evaluated based solely on the mass of CERCLA hazardous substances present in the source (with certain exceptions for RCRA wastes). The mass of CERCLA pollutants or contaminants, if any, are not included. HRS Table 2-5 designates hazardous constituent quantity as C – the mass in pounds of CERCLA hazardous substances. No further calculations are required (e.g., no divisors).

A2. USING CONCENTRATION DATA

To use concentration data to calculate the hazardous constituent quantity, the following must be true:

- Volume and density of the source (or portion of the source) are known with reasonable confidence; and
- Concentration data are representative of the source (or portion of the source).

If concentration data meet the above criteria, the following equation can be used to calculate the hazardous constituent quantity:

$$HCQ_S \sum_{i=1}^n C_i \times D_M \times V_S$$

- where:
- HCQ_s = hazardous constituent quantity for source S (mass)
 - C_i = average concentration of CERCLA hazardous substance i (mass/mass)
 - n = total number of CERCLA hazardous substances
 - D_M = density of source medium (mass/volume)
 - V_S = volume of source S (volume)

The equation can be modified to estimate the quantity of hazardous constituents in a portion of the source or in different media within a source. Note that when concentration data are available for some but not all hazardous substances in a source, the equation can still be used and a hazardous constituent quantity value determined under Tier A; in such cases, however, the scorer would have to proceed to Tier B because scoring under Tier A would be incomplete.

Highlight 6-4 presents some sample scoring examples for the hazardous constituent quantity evaluation.

A3. EVALUATING RCRA HAZARDOUS WASTES

The HRS provides exceptions when calculating hazardous constituent quantity for certain RCRA hazardous wastes. For HRS purposes, the presence of RCRA hazardous wastes is usually documented through manifests or other PRP records. It is not the intent of the SI to sample in order to determine the presence of RCRA hazardous wastes. If RCRA hazardous wastes are evaluated for hazardous constituent quantity, evidence supporting their presence must be provided and documented. The next section provides background about the classification scheme for RCRA hazardous wastes, and the HRS scoring instructions.

HIGHLIGHT 6-4 SCORING EXAMPLES FOR TIER A

Scenario 1 1,000 gallons of pure toluene were found in 19 drums onsite. (The density of toluene is 7.2 lbs/gallon.) These 19 drums are the only source at the site.

Hazardous Constituent Quantity:

$$1,000 \text{ gallons} \times 7.2 \text{ lb/gallon} = 7,200 \text{ lb}$$

Hazardous constituent quantity is adequately determined for this source.

Scenario 2 1,000 gallons of pure toluene leaked onto the ground at a site. The source of this information is an emergency response notification report. The spill area is the only source at the site.

Hazardous Constituent Quantity:

$$1,000 \text{ gallons} \times 7.2 \text{ lb/gallon} = 7,200 \text{ lb}$$

Hazardous constituent quantity is adequately determined for this source.

Scenario 3 1,000 gallons of pure toluene were spilled onto the ground onsite; 1,000,000 pounds of soil were excavated to clean up the spill; the excavated soil was placed in a waste pile on the site. The site is located in a deserted industrial park and it is not known whether other sources exist.

Hazardous Constituent Quantity:

$$1,000 \text{ gallons} \times 7.2 \text{ lb/gallon} = 7,200 \text{ lb}$$

Hazardous constituent quantity is not adequately determined -- other substances may have been present in the soil prior to the spill. The other tiers need to be evaluated.

Scenario 4 1,000 gallons of pure toluene mixed with 1,000,000 gallons of process water discharged to a settling surface impoundment.

Hazardous Constituent Quantity:

$$1,000 \text{ gallons} \times 7.2 \text{ lb/gallon} = 7,200 \text{ lb}$$

Hazardous constituent quantity is not adequately determined -- other substances may be present in the process water. The other tiers need to be evaluated.

All mass is converted to pounds. In each scenario the source HWQ value is 7,200.

BACKGROUND AND DEFINITIONS

RCRA, an amendment to the Solid Waste Disposal Act (SWDA), was enacted in 1976 to manage the large volumes of solid wastes being generated, including certain municipal and industrial wastes. Subtitle C of RCRA establishes a system for managing hazardous wastes.

The RCRA regulations in 40 CFR 261 specify that a solid waste is a RCRA hazardous waste if it is not excluded from regulation, and it either:

- Exhibits any of the characteristics of a hazardous waste (known as characteristic hazardous waste); or
- Has been listed as a hazardous waste in the RCRA Subtitle C regulations (known as listed hazardous waste).

For purposes of the RCRA Subtitle C regulations, a solid waste is any discarded material (solid, semisolid, liquid, and contained gas) that is not excluded under SWDA.

RCRA characteristic wastes. EPA has identified four characteristics for hazardous waste. Any solid waste that exhibits one or more of these characteristics is classified as a RCRA hazardous waste:

- Ignitability (40 CFR 261.21);
- Corrosivity (40 CFR 261.22);
- Reactivity (40 CFR 261.23); or
- Toxicity (40 CFR 261.24; determined either by the Toxicity Characteristic Leaching Procedure (TCLP) or Extraction Procedure (EP)). (Note that the transition from the EP to the TCLP occurred between 1990 and 1991.)

Guidelines defining each of these characteristics are contained in the CFR citations.

RCRA listed wastes. A solid waste is a RCRA hazardous waste if it is named on one of the lists developed by EPA:

- **Nonspecific source wastes** (40 CFR 261.31, also called **F**" list wastes) – generic wastes, commonly produced by manufacturing and industrial processes. Examples include spent halogenated solvents used in degreasing and wastewater treatment sludge from electroplating processes.
- **Specific source wastes** (40 CFR 261.32, also called **K**" list wastes) – wastes from specifically identified industries such as wood preserving, petroleum refining, and organic chemical manufacturing. These wastes typically include sludges, still bottoms, wastewaters, spent catalysts, and residues.
- **Commercial chemical products** (40 CFR 261.33(e) and (f), also called **P**" and **U**" list wastes) – specific commercial chemical products or manufacturing intermediates. These products are considered hazardous wastes when discarded.

EPA developed these listed wastes by examining different types of wastes and chemical products and by determining if any of the following criteria were met:

- Exhibits one of the four characteristics of a hazardous waste (Hazard Codes for ignitability), **C** (for corrosivity), **R** (for reactivity), and **E** (for toxicity));

- Is acutely toxic or acutely hazardous (Hazard Code **H**); or
- Is otherwise toxic (Hazard Code **T**).

These criteria and associated codes are listed in 40 CFR 261.30(b). For a particular listed waste, one or more of the hazard codes are assigned as the basis for listing that waste (in 40 CFR 261.31, 261.32, and 261.33).

SPECIAL CONSIDERATIONS FOR CALCULATION OF HAZARDOUS CONSTITUENT QUANTITY

For a RCRA characteristic waste that exhibits only the characteristic of toxicity (either TCLP or EP), only the mass of constituents in the hazardous waste that are CERCLA hazardous substances are included in the hazardous constituent quantity.

For a RCRA characteristic waste that exhibits any characteristic other than toxicity (including any other characteristic plus the characteristic of toxicity), the entire mass of the hazardous waste is included in the hazardous constituent quantity.

For hazardous constituent quantity for a RCRA listed waste that is listed solely for Hazard Code T, only the mass of constituents in the hazardous waste that are CERCLA hazardous substances is included in the hazardous constituent quantity.

If the RCRA listed waste is listed for any other Hazard Code (including T plus any other Hazard Code), then the mass of the entire hazardous waste is included in the hazardous constituent quantity.

Highlight 6-5 is a flowchart that enables scorers to decide which situation applies.

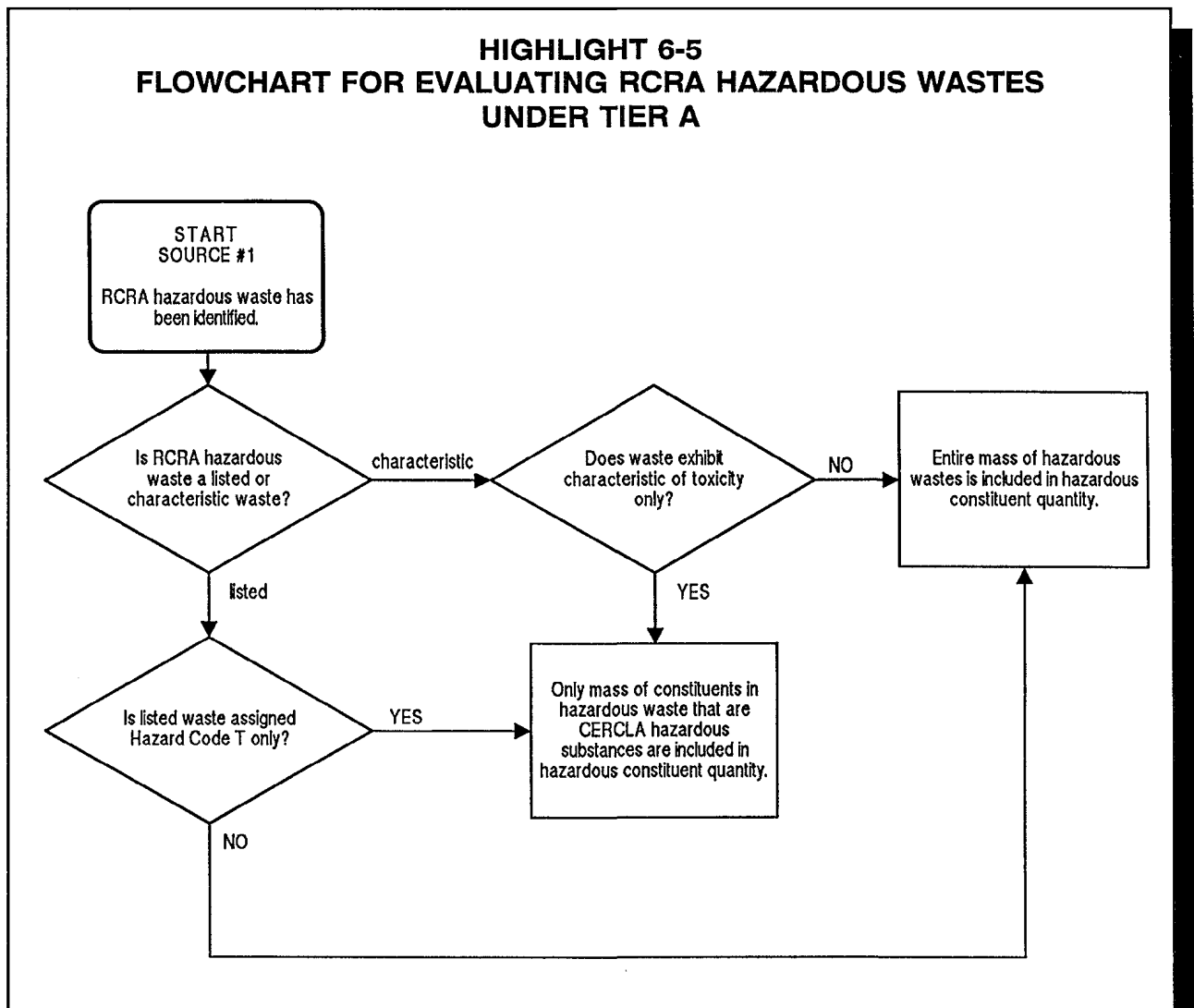
A4. CALCULATING HAZARDOUS CONSTITUENT QUANTITY

At this point in the hazardous waste quantity evaluation, the scorer needs to answer the following question for the source:

Is the hazardous constituent quantity adequately determined? That is, is the total mass of all CERCLA hazardous substances in the source and associated releases from the source known or estimated with reasonable confidence?

- If the answer to the question is YES:
 - Assign the total mass (in pounds) of CERCLA hazardous substances as the value for hazardous constituent quantity. Assign the other three tiers (hazardous wastestream quantity, volume, and area) values of 0 for the source.
 - Assign the hazardous constituent quantity value as the source hazardous waste quantity value. (Do not round to the nearest integer.)
- If the answer to the question is NO:
 - Assign the total mass (in pounds) of the CERCLA hazardous substances, based on the available data, as the value for hazardous constituent quantity.
 - Continue the hazardous waste quantity evaluation for this source. See Section 6.3 for guidance on evaluating Tier B.

HIGHLIGHT 6-5 FLOWCHART FOR EVALUATING RCRA HAZARDOUS WASTES UNDER TIER A



TIPS AND REMINDERS

- The scorer is unlikely to find information to adequately determine the hazardous constituent quantity. Tier A (hazardous constituent quantity) can be used to evaluate hazardous waste quantity if the mass of some CERCLA hazardous substances in the source or in releases from the source is known. Even if Tier A is not adequately determined, it may result in a higher value than the other tiers.
- Include the mass of all deposited CERCLA hazardous substances, even if they have migrated, in calculating hazardous constituent quantity for the source.
- When evaluating Tier A, only CERCLA defined hazardous substances are used; CERCLA defined pollutants and contaminants are not used. However, CERCLA hazardous substances, pollutants, or contaminants can be used in all other waste characteristics factor evaluations, including waste quantity evaluations using Tiers B, C, and D.
- The most reasonable and defensible estimate of hazardous waste quantity should always be applied for each of the tiers used for calculating hazardous waste quantity, regardless of whether the estimate is based on the most recent or highest figures.

- Do not subtract background levels for hazardous substances before calculating hazardous constituent quantity, except for radioactive substances.
- Sampling data can only be used to extrapolate hazardous constituent quantity if the source is documented to be homogeneous.
- Mining wastes generally should not be considered "homogeneous," particularly since ores and mining processes change over time.
- Tier A can be used where representative concentration data are available from sampling or manifest data. However, sampling to determine hazardous constituent quantity is typically beyond the scope of the SI. For some sites, sampling conducted by other parties (e.g., PRPs or states) may be sufficient to score Tier A.
- Drums, tanks, and containers are examples of source types most likely to have Tier A data.
- For Tier A, RCRA listed or characteristic hazardous wastes are given special consideration. For certain RCRA waste codes, only the mass of constituents in the hazardous waste that are CERCLA hazardous substances are included in the hazardous waste quantity.
- Unless there is evidence that products have spilled or been abandoned, the total volume of tanks, drums, or containers containing product should not be used to determine hazardous constituent quantity.
- For the site hazardous waste quantity factor value to be adequately determined, the hazardous waste quantities for all the sources must be adequately determined.

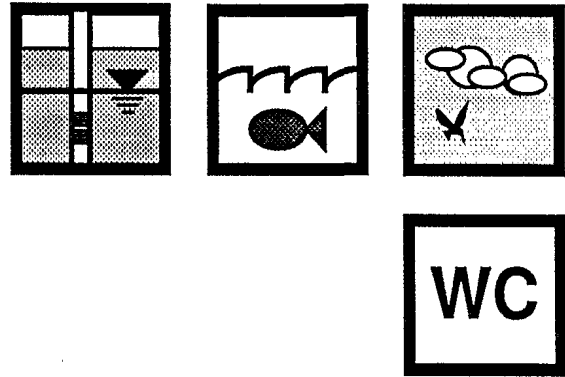
SECTION 6.3

TIER B —

HAZARDOUS

WASTESTREAM

QUANTITY



This section clarifies the method for evaluating hazardous waste quantity under Tier B of the HRS. Topics include definitions that pertain to Tier 8, data requirements for scoring under Tier B, evaluation of RCRA wastes, and extrapolation of data.

Tier B is used when Tier A data are not adequately determined and when wastestream and/or CERCLA pollutant and contaminant data are available. This tier deals with wastes "as deposited", as does Tier A. **Highlight 6-6** is a flowchart that provides step-wise instructions for scoring a source with Tier B.

DEFINITIONS

Adequately Determined (for purposes of Tier B only): The total mass of all hazardous waste streams and CERCLA pollutants and contaminants for the source and releases from the source (or for the area of observed contamination) is known or is estimated with reasonable confidence. (For the site hazardous waste quantity to be adequately determined for Tier B, this must apply for all sources.)

CERCLA Pollutant or Contaminant: Section 101 (33) of CERCLA states that: "*pollutant or contaminant shall include, but not be limited to, any element, substance, compound, or mixture, including disease-causing agents, which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformations, in such organisms or their offspring, except that the term "pollutant or contaminant shall not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance under subparagraphs (A) through (F) of paragraph (14) and shall not include natural gas, liquefied natural gas, or synthetic gas of pipeline quality (or mixtures of natural gas and such synthetic gas).*"

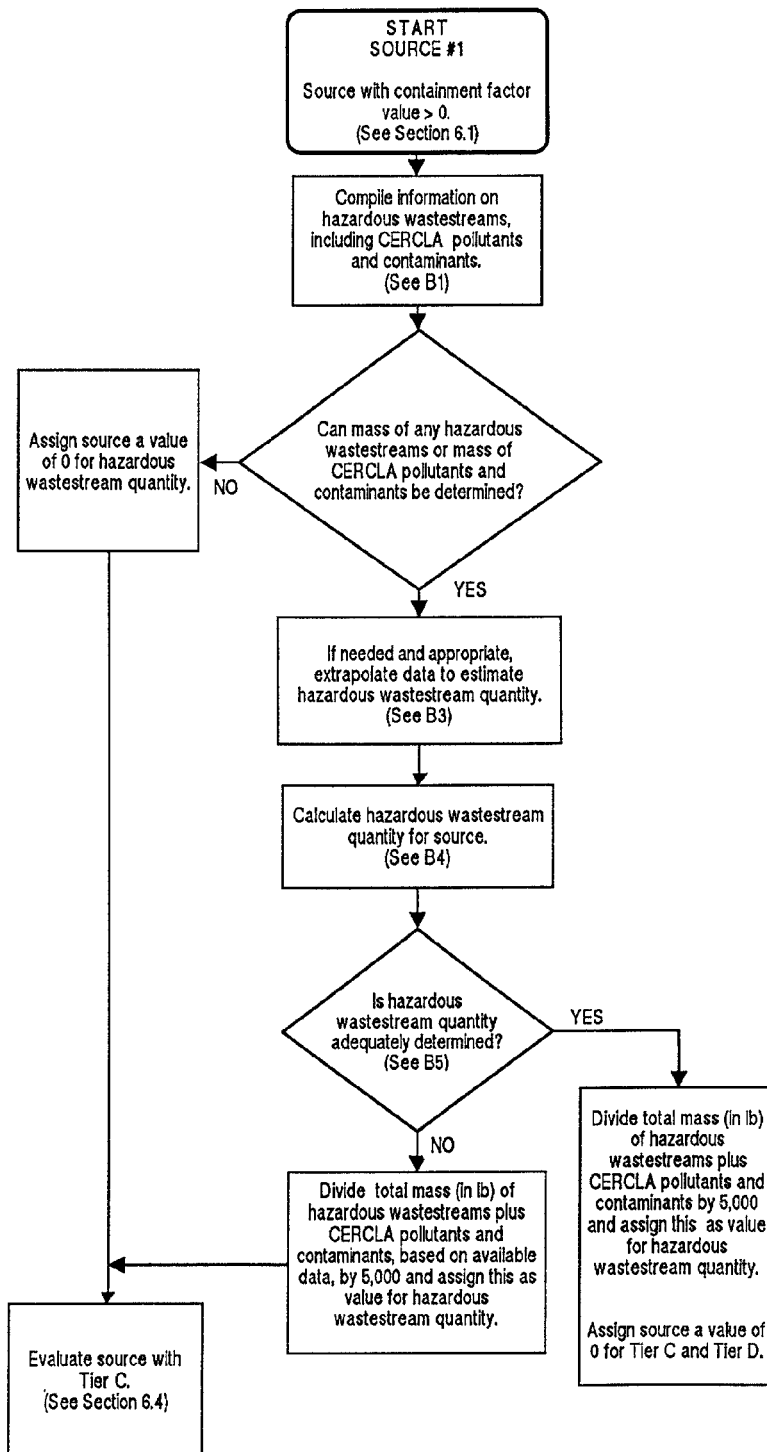
Hazardous Waste Stream: Material containing CERCLA hazardous substances as defined in CERCLA section 101 (14), that was deposited, stored, disposed, or placed in, or that otherwise migrated to, a source.

B1. LOCATING DATA

The following records or resources usually provide direct accounts of hazardous wastestreams:

- Manifests
- PRP and state records
- Permits.

HIGHLIGHT 6-6 FLOWCHART FOR EVALUATING TIER B



To evaluate Tier B for hazardous wastestream quantity for a source, the following must be true:

- The mass of any hazardous wastestream or the mass of any additional CERCLA pollutants and contaminants allocated to the source are known.
- Hazardous constituent quantity (Tier A) was not adequately determined for that source.

HRS Table 5-2 designates the hazardous wastestream quantity as M . Once this mass (in pounds) is determined, assign the source a value for hazardous wastestream quantity by dividing M by 5,000.

B2. EVALUATING RCRA HAZARDOUS WASTE

Under Tier B, RCRA hazardous wastes are treated the same as all other hazardous wastestreams. For a wastestream that consists solely of RCRA listed wastes or RCRA characteristic wastes, the mass of the entire hazardous wastestream is used to calculate hazardous wastestream quantity. (Note that RCRA hazardous wastes under Tier B are treated differently than under Tier A (see Section 6.2)).

B3. EXTRAPOLATING DATA

Scorers should employ data that support the most accurate estimate of hazardous wastestream quantity for each source. Generally, the best data to use are those that document wastestream disposal over the longest time period. If information is available for only one year, extrapolating that information to multiple years may be acceptable, depending on the documentation available to support the required assumptions. Extrapolating short-term wastestream data over much longer periods (e.g., six months of data extrapolated over 20 years of operation) is generally not acceptable.

The following may provide information to document the extrapolation of wastestream data over a longer period:

- Property records
- Production reports
- NPDES signed and finalized permits
- EPA signed and finalized compliance orders
- RCRA manifests
- Annual reports
- Tax records
- Interviews with former employees
- The Kirk-Othmer Encyclopedia of Chemical Technology (this reference provides information on constituents normally present in certain process wastestreams, and can be used to support reasonableness of data)
- Effluent guidelines documents
- Trade association information
- Industry studies and data bases from EPA's Office of Solid Waste.

If there is sufficient evidence supporting the assumption that a discharge for a particular day was typical, a discharge estimate based on that day may be sufficient basis for estimating discharge over the entire year. For example, the scorer could verify that the production figure is reasonable for the industry as a whole. The scorer would also need to know the typical number of days of operation per year. In addition, the scorer needs to provide a convincing argument that the extrapolated value being used is defensible. Information about continuity of the plant operations could be included in the argument, especially if data are extrapolated over time. For example, if the plant was bankrupt or the local economy depressed for a portion of the time period, that would need to be documented and

considered in the calculation. General industry or local economy descriptions could be included as further evidence of reasonable estimates.

B4. CALCULATING HAZARDOUS WASTESTREAM QUANTITY

At this point in the hazardous waste quantity evaluation, the scorer needs to answer the following question:

Is the hazardous wastestream quantity adequately determined for the source? That is, is the total mass of all hazardous wastestreams and any additional CERCLA pollutants and contaminants in the source and associated releases from the source known or estimated with reasonable confidence?

- If the answer to the question is YES:
 - S Sum the total mass (in pounds) of hazardous wastestreams plus any additional CERCLA pollutants and contaminants and divide the sum by 5,000. This result is the hazardous wastestream quantity value. Assign the source a value of 0 for the Tier C (volume) and Tier D (area) measures.
 - S Select the highest of the values assigned to the source for hazardous constituent quantity and hazardous wastestream quantity as the value for the source hazardous waste quantity value (do not round to the nearest integer).
- If the answer to the question is NO, and the source is not an unallocated source:
 - S Sum the mass (in pounds) of hazardous wastestreams plus any additional CERCLA pollutants and contaminants, based on the available data, and divide the sum by 5,000. Assign the result as the value for hazardous wastestream quantity.
 - S Evaluate Tier C for this source.
- S If the answer to the question is NO, and the source is an unallocated source:
 - S Sum the mass (in pounds) of hazardous wastestreams plus any additional CERCLA pollutants and contaminants based on available data and divide the sum by 5,000. This result is the hazardous wastestream quantity value. Assign the source a value of 0 for the Tier C (volume) and Tier D (area) measures.
 - S Select the highest of the values assigned to the source for hazardous constituent quantity and hazardous wastestream as the source hazardous waste quantity value. (Do not round to the nearest integer).

TIPS AND REMINDERS

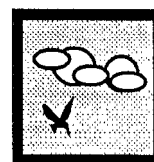
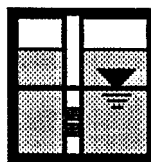
- Tier B can be used to evaluate hazardous waste quantity if the mass of some hazardous wastestream is known; the total mass of all wastestreams need not be determined in order to evaluate Tier B.
- Wastestreams can be liquid, sludge, or solid (e.g., wastewater, slag pile).
- Tier B is based on the actual contents of the source not on its hypothetical capacity (e.g., weight or volume of contents actually in tank is used, not volume of tank). Tier C or D would involve the capacity of the tank.

- Drums, tanks, containers, surface impoundments, and waste piles are examples of source types most likely to have Tier B data.
- If long-term information regarding waste disposal at the site is not available, short-term data regarding waste disposal may be extrapolated to a longer time period depending on the documentation available to support the required assumptions. However, extrapolating short-term data over very long periods of time (e.g., six months of data extrapolated over 20 years of operation) is generally not acceptable.
- Tier B treats RCRA hazardous wastes identical to other hazardous wastes.
- Process models can sometimes be used to estimate hazardous wastestream quantity. However, convincing evidence must be presented to demonstrate the applicability of the assumed process flows to the source being scored.
- When extrapolating wastestream data, if the Tier B calculation assumes constant and continuous production levels, the rationale for this assumption needs to be included in the documentation record.
- One way to support a Tier B estimate of wastestream quantity is to assume a certain number of batch processes per year, when the approximate mass of hazardous waste produced is known per batch.

SECTION 6.4

TIER C –

VOLUME



Tier C of the HRS is used when the volume of the source can be determined. Tier C cannot be used for the unallocated source. HRS Table 2-5 designates volume as *V*. **Highlight 6-7** is a flowchart that provides step-wise instructions for scoring a source with Tier C.

C1. LOCATING DATA

The following may provide accounts of the source volume (i.e., capacity):

- PRP data
- State records
- Property records
- EPA signed and finalized compliance orders
- Permits
- Aerial photographs.

To calculate the volume of the source, all of the following must be true:

- The volume of the source can be estimated.
- The hazardous constituent quantity and/or hazardous wastestream quantity were not adequately determined for the source.

C2. CALCULATING VOLUME

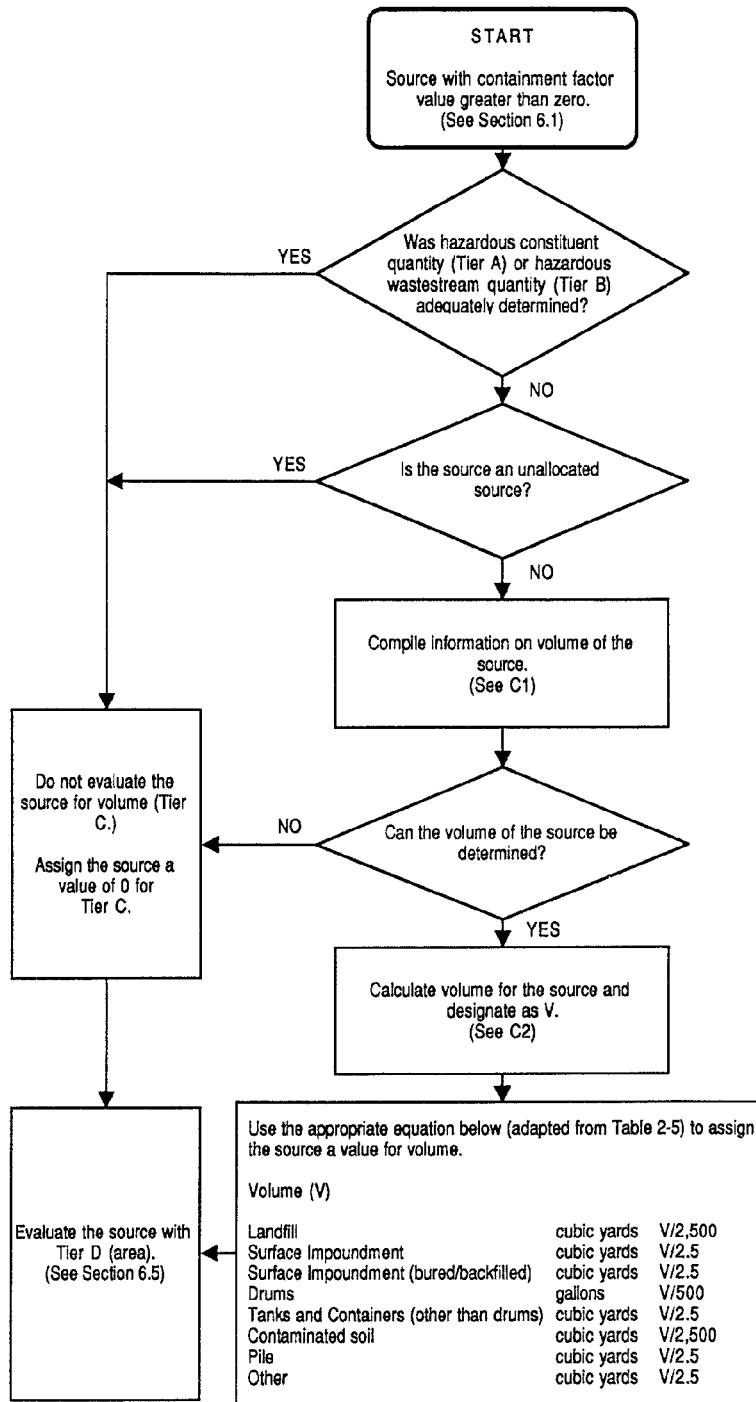
If the volume of the source can be estimated:

- (1) **Evaluate the volume measure using the dimensions for the source type, specified in HRS Table 2-5.** This measure can be obtained by using the engineered capacity for certain source types (e.g., landfills) or the maximum volume for source types that are not specifically engineered (e.g., piles, quarries).
- (2) **Based on the volume, assign the source a value for volume using the appropriate Tier C equation found in HRS Table 2-5.**
- (3) **Assign the source a value of 0 for the area measure (Tier D).** Select the highest of the values assigned to the source (hazardous constituent quantity, hazardous wastestream quantity, and volume) as the source hazardous waste quantity value. (Do not round to the nearest integer.)

If the volume of the source cannot be determined:

- (1) Assign the source a value of 0 for Tier C.
- (2) Evaluate Tier D for this source.

HIGHLIGHT 6-7 FLOWCHART FOR EVALUATING TIER C

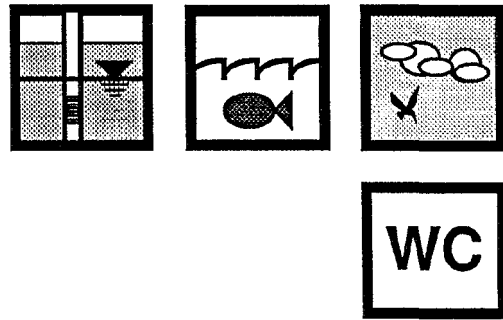


TIPS AND REMINDERS

- Tier C is based on capacity, not the actual contents of the source (e.g., use the total drum volume, not the volume of the waste when deposited; use the surface impoundment once-filled volume, not the volume of the waste disposed of in the impoundment).
- Use Tier C for containerized source types (e.g., drums, tanks) and for source types with reasonably well-defined horizontal and vertical boundaries (e.g., waste piles).
- Subsurface source types generally need engineered drawings to support volume calculations (e.g., landfills, buried surface impoundments). Obtaining representative depth measurements of these source types during the SI is not recommended. Geophysical surveys generally should not be used to document source volume.
- Waste permit applications often include waste unit designs specifying volume capacity.
- Tier C is not applicable for unallocated sources.
- For a quarry, Tier C volume measures cannot be assumed to be equal to the volume of the filled quarry unless there is a reasonable basis for making that assumption. The scorer should attempt to estimate the level at which the waste accumulated in the quarry. For dry quarries or quarries where waste has migrated, the scorer should look for indicators of the previous maximum depth of wastes (such as contaminated waterlines). Volume may be calculated based on this depth. If the scorer cannot establish that waste was historically deposited to a certain depth, calculate hazardous waste quantity based on current conditions (i.e., using Tiers A, B, and D, as appropriate).

SECTION 6.5

TIER D – AREA



Tier D is used when data on the surface area of the base of a source are available. Tier D assumes a default depth for each source and, thus, provides a less reliable estimate than when the depth of a source can be estimated. Thus, Tier D is not used when Tier C can be used. Aerial photographs, especially historical photographs, are particularly helpful in evaluating this tier. Tier D should be used for source types without reasonably well-defined vertical boundaries (e.g., contaminated soil, landfills). Tier D cannot be used for unallocated sources HRS Table 2-5 designates area as A.. **Highlight 6-8** is a flowchart that provides step-wise instructions for scoring Tier D.

D1. LOCATING DATA

The following may provide accounts of the areas of sources containing hazardous substances:

- PRP data
- State data
- Property records
- EPA signed and finalized compliance orders
- Permits
- Aerial photographs.

To calculate the area of the source, all of the following must be true:

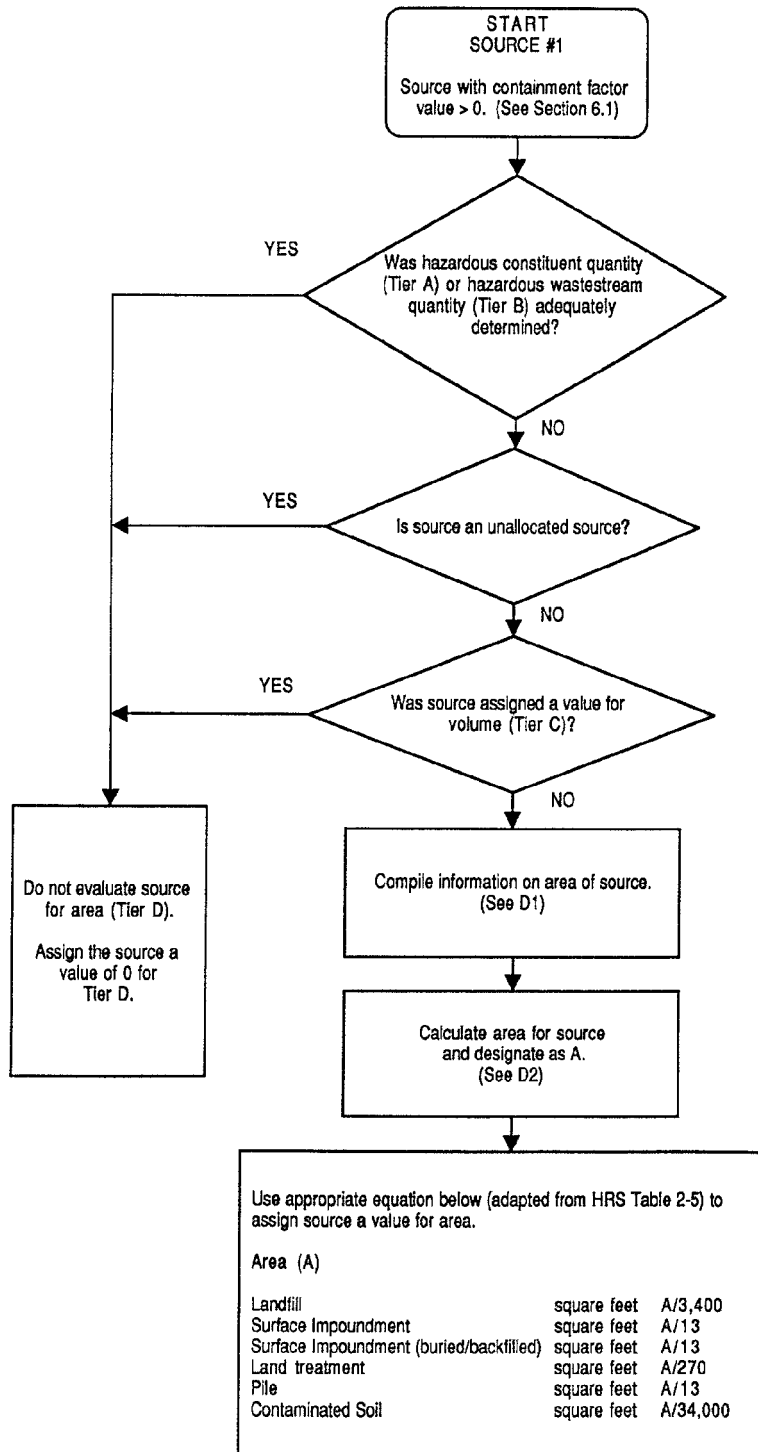
- The area of the source (or a portion of the area) can be estimated.
- The source was not assigned a value for volume.
- The hazardous constituent quantity and/or hazardous wastestream quantity were not adequately determined for the source.

D2. CALCULATING AREA

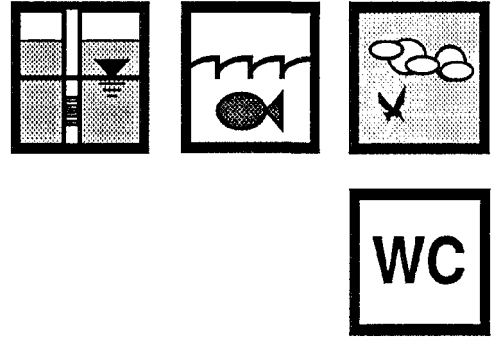
If the area of the source (or a portion of the area) can be determined:

- (1) **Evaluate area using the required dimensions for the source type, specified in HRS Table 2-5.**
- (2) **Based on the area, assign the source a value for area using the appropriate Tier D equation found in HRS Table 2-5.**
- (3) **Select the highest of the values assigned to the source (hazardous constituent quantity, hazardous wastestream quantity, and area) as the source hazardous waste quantity value. (Do not round to the nearest integer.)**

HIGHLIGHT 6-8 FLOWCHART FOR EVALUATING TIER D



SECTION 6.6 HAZARDOUS WASTE QUANTITY CALCULATION



This section discusses, in greater detail, calculating the hazardous waste quantity factor value and provides the scorer with some examples. Minimum factor values are also discussed.

SELECTING SOURCE HAZARDOUS WASTE QUANTITY VALUES

After evaluating all the appropriate tiers for the source, make a list of the scores for each tier. Select the highest of the values assigned to the source for hazardous constituent quantity, hazardous wastestream quantity, volume, and area. This value is the source hazardous waste quantity value. **Highlight 6-9** is a typical calculation for the source hazardous waste quantity value.

CALCULATING PATHWAY HAZARDOUS WASTE QUANTITY FACTOR VALUE

After assigning source hazardous waste quantity values to all the sources (both allocated and unallocated) at a site, determine the hazardous waste quantity factor value for the migration pathway. Sum the source hazardous waste quantity values assigned to all the applicable sources (including the unallocated sources) for the migration pathway being evaluated. Round this sum to the nearest integer, except if the sum is greater than 0, but less than one, round it to one. Based on this value, select a hazardous waste quantity factor value for the migration pathway using HRS Table 2-6.

APPLYING THE MINIMUM FACTOR VALUE

If the hazardous constituent quantity (Tier A) is not adequately determined for all sources, then the hazardous waste quantity factor value is subject to a minimum value of 10. However, if any target for the migration pathway is also subject to Level I or II concentrations, this factor value is subject to a minimum of 100. If a removal has taken place, see the removal fact sheet for additional considerations regarding the minimum factor value.

Highlight 6-10 provides a typical calculation for the pathway hazardous waste quantity factor value.

HIGHLIGHT 6-9 CALCULATION OF SOURCE HAZARDOUS WASTE QUANTITY VALUE

Site A has a surface impoundment filled to capacity with various wastes. The hazardous substances that are present in the surface impoundment include: ethyl acetate, acetone, lead, chromium, dichlorophenol, and phenol. All of these hazardous substances were detected in soil below the impoundment.

Tier A: No concentration data are available for any waste in the impoundment. Representative samples could not be obtained.

Tier B: Internal waste tracking forms at the site indicate that 475,000 pounds of waste from a plating operation were deposited into the impoundment between 1965 and 1970. The data are incomplete; however, because there were other hazardous wastestreams deposited prior to 1965.

For Tier B, the mass (in pounds) of the hazardous wastestreams, based on incomplete data, is to be divided by 5,000, according to HRS Table 2-5.

$$475,000 \text{ pounds} / 5,000 = 95$$

Tier C: The surface impoundment measures 150 x 10 x 8 feet. Therefore, the volume is:

$$150 \times 10 \times 8 \text{ ft} = 12,000 \text{ ft}^3 = 444.444 \text{ yd}^3$$

According to HRS Table 2-5, the appropriate divisor for a surface impoundment that is not buried or backfilled is 2.5. Therefore, the value for source volume is:

$$444 \text{ yd}^3 / 2.5 = 176$$

Tier D: Because the volume has been determined, assign a value of 0.

Final Values:	Tier A:	N/A
	Tier B:	95
	Tier C:	176
	Tier D:	0

Source HWQ Value **176**

HIGHLIGHT 6-10
CALCULATION OF PATHWAY HAZARDOUS WASTE
QUANTITY FACTOR VALUE

For each pathway, add source HWQ values for sources with containment values greater than 0 for that pathway plus the HWQ from any unallocated source. This sample site has three sources and no targets are subject to Level I or II concentrations:

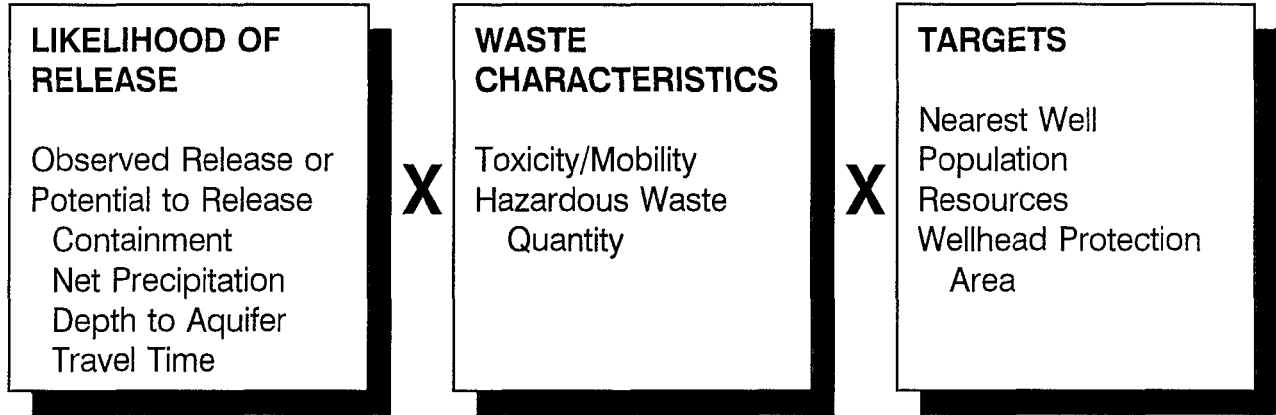
Source	Source HWQ Value	Source Containment Factor Value
Surface impoundment	4,615.38	Greater than 0 for all pathways
Contaminated soil area	0.28	Greater than 0 for all pathways
Buried trench	177.78	0 for air pathway; greater than 0 for ground water and surface water pathways

The air pathway HWQ value is 4,616 ($4,615.38 + 0.28$). The ground water and surface water pathway HWQ value is 4,793 ($4,615.38 + 0.28 + 177.78$). The HRS requires rounding off to the nearest integer.

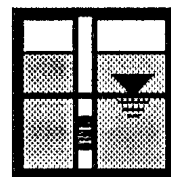
Based on the HWQ value for each pathway, select the HWQ factor value from HRS Table 2-6. For all pathways, the value is 100.

CHAPTER 7

GROUND WATER PATHWAY



SECTION 7.1 DETERMINING AQUIFER BOUNDARIES AND NUMBER OF AQUIFERS



In the HRS, a ground water pathway score is developed for each aquifer that underlies either sources at the site or contamination that is attributable to the site. In addition, aquifers that are in direct contact with or interconnected with aquifers that underlie sources at the site may be included in the evaluation. The first step in scoring the ground water pathway, therefore, is to identify the geologic materials that comprise aquifers that directly underlie sources at the site. This section provides guidance on information sources that can be used to identify such geologic materials.

Once the geologic materials under sources at the site are identified, guidance is provided on how to carry out these next steps:

- Identify boundaries for each aquifer that underlies sources at the site by combining appropriate geologic materials;
- Determine if any discontinuities completely transect such aquifers within the 4-mile TDL and disregard portions of the aquifers on the far side of the discontinuity from evaluation;
- Examine possible interconnections between aquifers that are separated by apparent aquifer boundaries; and
- Combine aquifers interconnected with aquifers that underlie sources at the site into a single hydrologic unit, and determine how many hydrologic units need to be evaluated for the ground water pathway.

Guidance in this section focuses on the major issues typically arising in aquifer evaluations. To the maximum extent possible, this information is presented in a form that does not require extensive expertise in the principles of geology. However, expertise in geology is often required to compile and analyze the data used to define aquifers for HRS purposes. Further, while this guidance is intended to be applicable across a wide range of sites, professional judgment will be needed to apply the evaluation criteria to site-specific circumstances.

In general, aquifer boundaries occur between two different geologic materials, only one of which is used as an aquifer (or both are used as aquifers and one has a significantly lower hydraulic conductivity). However, there can be geologic features that occur within the same geologic materials and that present a barrier to ground water flow and hazardous substance transfer. Such features are referred to as aquifer discontinuities.

The presence of aquifer interconnections is evaluated only when one or more aquifer boundaries (including discontinuities) are present within 2 miles of sources at the site (or within areas underlying ground water contamination attributable to the site). For HRS purposes, aquifers can be combined into a single hydrologic unit if they are shown to be interconnected.

A precise definition of aquifers requires comprehensive scientific data that may be beyond the scope of an SI. Further, in complex geologic settings, precise definition of aquifers may be beyond

current scientific understanding. Therefore, the guidance in this section describes a level of investigation associated with gathering the necessary information on aquifers and their boundaries to support HRS scoring of a site that is consistent with the level of investigation that has been employed successfully for purposes of listing sites on the NPL..

RELEVANT HRS SECTIONS	
Section 3.0.1.1	Ground water target distance limit
Section 3.0.1.2	Aquifer boundaries
Section 3.0.1.2.1	Aquifer interconnections
Section 3.0.1.2.2	Aquifer discontinuities

DEFINITIONS

Aquifer: One or more strata of rock or sediment that is saturated and sufficiently permeable to yield economically significant quantities of water to wells or springs. An aquifer includes any geologic material that is currently used or could be used as a source of water (for drinking or other purposes) within the TDL.

Aquifer Boundary: A physical barrier to ground water flow identified as the contact between geologic materials defined as an aquifer and materials defined as non-aquifer (or as an aquifer but with a significantly lower hydraulic conductivity). Where aquifer interconnections are documented, aquifer boundaries are expanded to encompass the interconnected aquifers.

Aquifer Discontinuities: Geologic and hydrologic features or structures that entirely transect an aquifer (or multiple aquifers, if interconnected) and that are expected to disrupt and/or prevent the flow of ground water and hazardous substances across the feature or structure. Aquifer discontinuities are a type of aquifer boundary.

Aquifer Interconnections: Subsurface conditions that allow two or more aquifers separated by aquifer boundaries to be combined into a single aquifer (i.e., a single hydrologic unit). Subsurface conditions must demonstrate that the aquifer boundaries separating the aquifers do not or would not impede the flow of ground water and hazardous substances between the aquifers. Aquifer interconnections are evaluated within two miles of sources at the site and in areas underlying contamination attributable to the site.

Confining Layer: A layer of low hydraulic conductivity (relative to adjacent geologic materials) that is not expected to be used as an aquifer.

Hydraulic Conductivity: The overall ability of water to flow through a geologic material, accounting for all openings in the material (e.g., between grains, through fractures, along lava tubes). For HRS purposes, the terms hydraulic conductivity and permeability are used interchangeably.

Layer of Lower Relative Hydraulic Conductivity: A geologic material with lower hydraulic conductivity than adjacent geologic materials. If used to establish aquifer boundaries, the difference in hydraulic conductivity should be at least two orders of magnitude.

Single Hydrologic Unit: The combination of geologic materials and aquifers that are determined to be within the same aquifer boundaries, including all interconnected aquifers.

Target Distance Limit (TDL) for the Ground Water Migration Pathway: The distance over which targets are evaluated. The TDL is generally a 4-mile radius from sources at the site, except:

- Include any drinking water well with an observed release attributed to the site, regardless of its distance from the source.
- Exclude wells completed in portions of an aquifer that are beyond an aquifer discontinuity.

Top of the Aquifer: In unconfined (water table) aquifers, the uppermost elevation of water, accounting for temporal variations, as long as the water table occurs in the materials used as an aquifer. In confined aquifers, the top of the geologic material producing water.

Well Log: A record of geologic materials with depth based on data obtained beneath a point on the land surface and representative of types, depths, and thicknesses of materials beneath that point. The data may represent visual observations, physical/chemical characterizations, and/or geophysical properties. The record also contains information on wells (drinking and monitoring), where appropriate.

IDENTIFYING AND EVALUATING AQUIFERS

To understand and describe aquifers and their boundaries for HRS purposes, the scorer must compile sufficient information to identify the types and boundaries of geologic materials that underlie sources at the site. The ultimate goal of the evaluation is to determine which drinking water wells within the 4-mile TDL are located in geologic materials that either underlie sources at the site (or contamination attributable to the site) or are interconnected with such geologic materials within 2 miles of sources at the site. The information should, at a minimum, identify:

- Types of bedrock and their boundaries (both lateral and vertical);
- Types of surficial deposits and their boundaries (both thicknesses and lateral extents); and
- Locations and screened depths of wells being evaluated as targets.

Scorers are faced with determining the appropriate level of investigation to define aquifers and their boundaries. Given the level of effort associated with PAs, SIs, and preparation of HRS packages, the definition of aquifers and their boundaries relies principally on existing information. This existing information may be augmented with site-specific information collected during the SI, such as through the installation of soil borings, construction of monitoring wells, sampling of monitoring or other wells, visual observations of springs or any other measurements or observations providing insight into geologic materials and aquifers.

The approach used in the HRS evaluation and scoring of aquifers is first to establish an aquifer, and then to expand its boundaries, combining it with other aquifers for HRS purposes as information arises to justify the expansion or combination. The types of data and levels of investigation used to evaluate aquifer boundaries can be divided into three categories. The first level of investigation is expected to be adequate to define aquifer boundaries at the majority of sites. The second level of investigation is expected to be needed at a small percentage of sites to refine aquifer boundary determinations. Both the first and second levels of investigation rely on existing data or that collected during the PA/SI. The third level of investigation defines activities beyond the scope of a typical PA/SI that, on a limited basis, may be performed to define aquifers for HRS purposes. Data collected to support these levels of investigation are described in more detail in **Highlights 7-1, 7-2, and 7-3**.

HIGHLIGHT 7-1

AQUIFER DATA USED FOR FIRST LEVEL OF INVESTIGATION

Although this type of data is expected to be adequate for a majority of sites, some sites may require collection of additional data. At some sites, however, aquifer boundaries may be described when only portions of the data in this category have been collected.

- Use state, regional, or county bedrock geology maps as a starting point for identifying geologic formations and materials within the 4-mile TDL.
- Use state, regional, or county maps on surficial deposits of unconsolidated materials, overburden thickness, and depth to bedrock (if available) to augment the bedrock geology map.
- Collect scientific journals on geology or ground water resources in the area published by Federal agencies (at a minimum, check bibliographies of the USGS and the U.S. Department of Agriculture). Look for geologic descriptions, geologic maps, cross-sections of geologic formations, and ground water use information.
- Collect publications, circulars, bulletins or any other reports from state agencies responsible for geologic or ground water resource information. The responsibility for geologic and ground water resource information may reside with separate state agencies; Investigate Departments of Environments, Departments of Natural Resources, Pollution Control Agencies, Ground Water Resource and/or Protection Offices, Departments of Health, and any others with possibly pertinent information, Look for information described above for Federal sources along with well logs for drinking water wells.
- Check with county and other local environmental and health officials for information on geology and ground water use, including well logs for drinking water wells.
- Contact site personnel, area residents, local officials, and water supply companies to determine sources of drinking water.
- Augment data identified above with site-specific information collected during the PA/SI, including depth to ground water, depth of drinking water wells, geologic materials at the site, and ground water use.

The data collected above should serve in most cases to delineate geologic materials and to identify which geologic materials are being used as drinking water sources. If these data do not adequately identify aquifers, their boundaries, and ground water targets, additional data collection may be necessary.

HIGHLIGHT 7-2

AQUIFER DATA USED FOR SECOND LEVEL OF INVESTIGATION

A review of the data identified as primary usually is adequate to evaluate aquifers for HRS purposes. However, secondary data may be needed to characterize more fully the boundaries of aquifers relative to adjacent materials. Such data include:

- Existing data on aquifer testing such as pumping and slug test data
- Contaminant migration studies
- Cross-sections generated from well log data by the scorer
- Ground water data and references from other NPL sites within the 4-mile TDL (this is considered secondary information since it may only serve to identify sources of information previously undetected)

Secondary aquifer data are not necessary to define aquifers at a site. Rather, they serve to expand aquifer boundaries, as appropriate, so that the potential threat to ground water targets within the TDL is more accurately reflected. Nonetheless, secondary aquifer data should be collected and compiled if encountered during collection of primary aquifer data.

HIGHLIGHT 7-3

AQUIFER DATA USED FOR THIRD LEVEL OF INVESTIGATION

Tertiary aquifer data include those data that are determined to be absolutely critical to the scoring of a site, but are not available after the collection of primary and secondary aquifer data. Under these circumstances, the allocation of additional resources may be warranted. The decision to allocate additional resources should incorporate a consideration of the costs of acquiring additional information. EPA is prepared to provide technical support on a case-by-case basis to assist in these decisions. Tertiary aquifer data include the following:

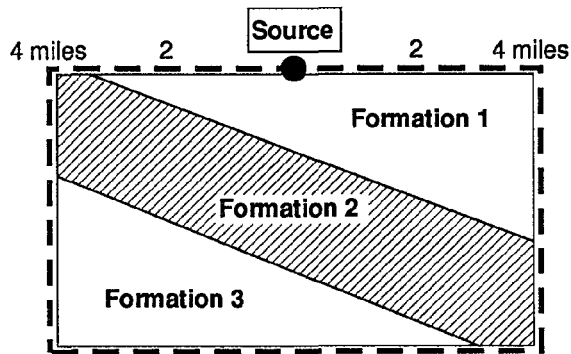
- Installation of additional monitoring wells beyond those included in an SI
- Performance of aquifer (pumping and slug) tests
- Mapping of geology in the field

It is anticipated that tertiary data will only be warranted at a limited number of sites.

This section describes one approach for identifying and evaluating aquifers. In general, this approach is based on the fact that much of the geologic literature and information to be collected is presented and organized by geologic formations. Indeed, aquifers may be identified in the literature as corresponding to specific geologic formations. However, for HRS purposes, an aquifer may consist of multiple formations or may be limited to discrete portions of a single formation which differ from aquifer boundaries as identified in the literature. Thus, the procedures outlined below are intended to provide one possible approach for the compilation of information on geologic formations and to provide guidance on evaluating the data in order to establish aquifer boundaries for purposes of HRS scoring.

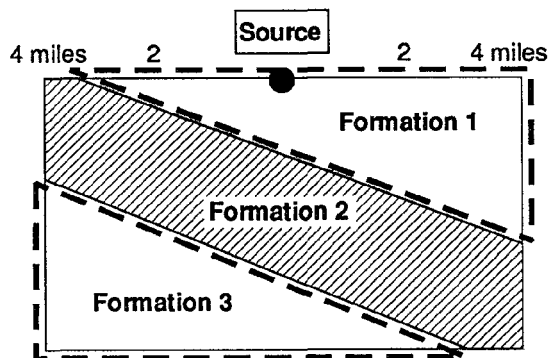
- (1) **Collect readily available information on geology.** Focus on first level data, as detailed in *Highlight 7-1*, but collect any second level data encountered. Proceed until all first level data are collected or until a person knowledgeable about scoring of aquifers for HRS purposes has determined that sufficient information is available to identify aquifers and their boundaries.
- (2) **Collect information on ground water use.** Continue to collect data until the source of drinking water can be characterized for all ground water targets being evaluated (this effort overlaps with identification of drinking water sources for the surface water pathway). Note other, non-drinking water uses for ground water within the TDL. Although specific guidance is provided in later sections on the detailed evaluation of targets (see Sections 7.4 through 7.9), it is important to remember that if no drinking water wells are located in geologic materials, it generally is not necessary to characterize these materials.
- (3) **Compile and analyze data from Steps (1) and (2).** Resolve any real or apparent discrepancies in the geologic or ground water use information. Where information is deemed credible, give preference to local or site-specific information over regional information. Similarly, give preference to regional information over state-wide information. The result of Step (3) should be an understanding of the geologic setting and ground water use sufficient to do the following:
 - Create a map of the geologic formations within the 4-mile TDL;
 - Construct typical cross-sections of the geologic formations in several different directions through the 4-mile TDL (the cross-sections do not necessarily have to be prepared, but the information available should be sufficient to be able to do so); and
 - Determine the geologic material being used if provided with well location, well log, and screened interval.
- (4) **Identify the geologic materials being used as aquifers.** Note that geologic formations may be comprised of multiple layered strata and that materials used as an aquifer may be limited to discrete layers of a specific formation. Using maps of geologic formations within the 4-mile TDL and/or cross-sections of the geology, mark all geologic materials being used as an aquifer. The boundaries of the geologic materials being used as an aquifer represent the initial identification of aquifers and their boundaries for HRS purposes.
- (5) **Evaluate aquifer boundaries by examining physical relationships between geologic materials used as aquifers, as follows:**
 - If geologic materials are used as aquifers, are in contact with one another within the TDL, and have hydraulic conductivities within two orders of magnitude, then combine the materials into a single aquifer for HRS purposes (see *Highlights 7-4* and *7-5*). Specific exceptions and/or clarifications to this rule are provided in *Highlights 7-6* and *7-7*.

**HIGHLIGHT 7-4
COMBINING HORIZONTAL FORMATIONS
(formations are shown in cross-section)**



Scenario A

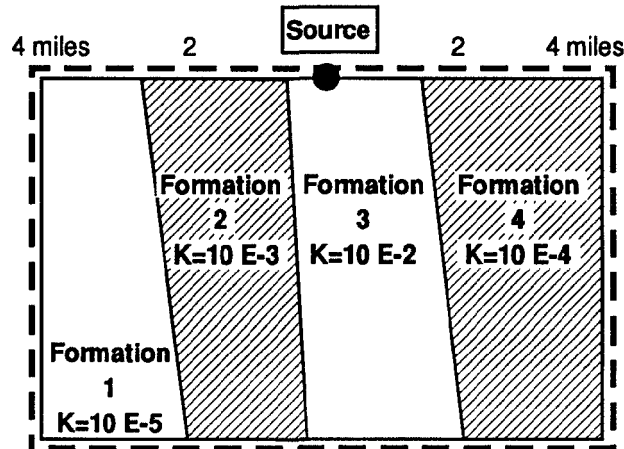
- All three geologic formations are used as aquifers within the TDL.
- Formations 1 and 2 are in direct contact, and Formations 2 and 3 are in direct contact.
- The hydraulic conductivities for all three formations are within two orders of magnitude of adjacent formations.
- Therefore, there is no aquifer boundary between Formations 1 and 2, or between Formations 2 and 3; Formations 1, 2, and 3 are combined into a single hydrologic unit (i.e., aquifer) for HRS scoring purposes.



Scenario B

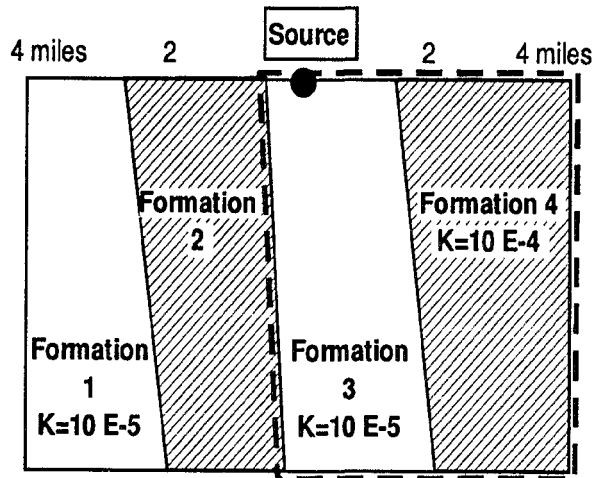
- Formations 1 and 3 are used as aquifers.
- Although no specific information is available for Formation 2, there is no evidence of use.
- Therefore, until more information becomes available, Formation 2 is an aquifer boundary for Formations 1 and 3; thus, Formations 1 and 3 are evaluated as separate aquifers. The documentation of an aquifer interconnection between Formations 1 and 3 would result in combining the formations into a single aquifer.

HIGHLIGHT 7-5
COMBINING VERTICAL FORMATIONS
(formations are shown in cross-section)



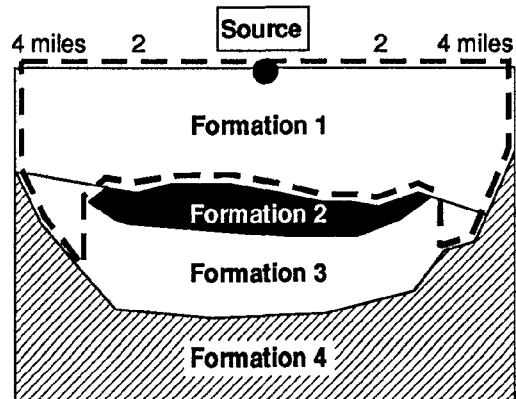
- All four formations are used as aquifers within the TDL.
- Hydraulic conductivity (K) of each the formation (provided in units of centimeters per second; therefore, $10 \text{ E-}4 = 0.0001 \text{ cm/sec}$) is within two orders of magnitude of the hydraulic conductivities of adjacent formations.
- No aquifer boundaries exist between Formation 3 (which underlies the site) and Formations 1, 2, and 4.
- Therefore, Formations 1, 2, 3, and 4 are combined into a single hydrologic unit (i.e., aquifer).

HIGHLIGHT 7-6
COMBINING VERTICAL FORMATIONS WITH DIFFERENCES IN
HYDRAULIC CONDUCTIVITY
(formations are shown in cross-section)



- All four formations are used as aquifers within the TDL. Formation 3 underlies sources at the site.
- The hydraulic conductivities of Formations 1, 3, and 4 shown in the diagram are provided in cm/sec; no information exists on the hydraulic conductivity of Formation 2.
- Formation 3 and Formation 4 have hydraulic conductivities within two orders of magnitude; thus, no aquifer boundary exists between Formations 3 and 4.
- Formation 2 is considered an aquifer boundary because no hydraulic conductivity information is available and no aquifer interconnection has been documented between Formation 2 and Formations 1 or 3.
- Therefore, Formations 3 and 4 are combined into a single hydrologic unit (i.e., aquifer). Formations 1 and 2 are not evaluated as aquifers because neither underlies sources at the site or areas of contamination attributable to the site.

HIGHLIGHT 7-7
DELINEATING AQUIFER WHEN A BOUNDARY IS
CONTINUOUS THROUGHOUT 2-MILE DISTANCE
(formations are shown in cross-section)



- Four formations underlie the site within the TDL.
- Formations 1 and 3 are very similar in nature and are both used as aquifers within the TDL.
- Formations 2 and 4 are not used as aquifers and are low hydraulic conductivity layers relative to Formations 1 and 3. Therefore, they are aquifer boundaries.
- Formations 1 and 3 are in direct contact within the TDL but are completely separated by a low hydraulic conductivity layer throughout the 2-mile radius.
- Therefore, the portion of Formations 1 and 3 that are in direct contact are combined into a single hydrologic unit (i.e., aquifer) indicated by dashed lines on the figure. Those portions separated by the aquifer boundary are excluded unless an aquifer interconnection can be documented between Formations 1 and 3 within the 2-mile radius.
- If Formation 2 did not underlie Formation 1 throughout the entire 2-mile radius, Formation 1 would be combined with all of Formation 3 for HRS scoring purposes.

- If materials used as aquifers are not in contact within the TDL, evaluate the potential for aquifer interconnections, as explained in the subsection below, Identifying Aquifer Interconnections. Where interconnections exist, combine the boundaries of the interconnected materials into a single aquifer for HRS purposes.

Continue with Step (5) until aquifer boundaries are documented sufficiently to support an accurate ground water pathway score, or until all primary and secondary sources of data have been exhausted. Evaluate the need for tertiary data on a case-by-case basis.

- (6) **Identify aquifer discontinuities.** See subsection below, Identifying Aquifer Discontinuities. Where discontinuities are identified, restrict aquifer boundaries as specified in HRS section 3.0.1.2.2. Use all information to evaluate aquifer boundaries to determine if discontinuities exist. If this information does not indicate the presence of potential discontinuities, assume that no discontinuities are present. However, the identification of potential discontinuities to be evaluated further is subject to professional judgment. As necessary, collect further information until all potential discontinuities have been evaluated and incorporated into aquifer boundaries, as appropriate. If aquifer boundaries (including discontinuities) are identified within two miles of sources at the site or within areas underlying ground water contamination attributable to the site (if contamination extends beyond two miles), proceed to Step (7). Otherwise, use the information gathered to identify those aquifers to be scored.
- (7) **Identify aquifer Interconnections.** See subsection below, Identifying Aquifer Interconnections. Where interconnections are identified, combine the aquifers having interconnections in scoring the ground water pathway. If data are not adequate to establish aquifer interconnections, only evaluate aquifers that underlie sources at the site.

IDENTIFYING AQUIFER DISCONTINUITIES

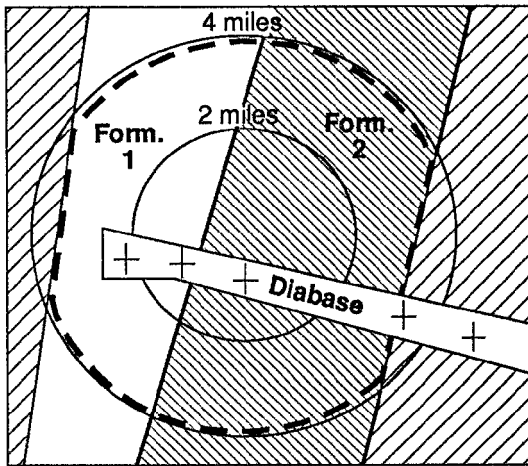
Aquifer discontinuities are physical barriers to flow and do not include boundaries based on ground water flow directions (e.g., ground water divides and ground water discharge boundaries). To be considered an aquifer discontinuity, the feature must entirely transect the aquifer(s) being evaluated. Examples of aquifer discontinuities include major faults, intrusive formations (e.g., dikes, sills), erosional channels (e.g., rivers, streams), and large bodies of water (e.g., lakes, bays, estuaries, and oceans).

Sources of evidence for aquifer discontinuities include geologic maps, scientific literature, and topographic maps. In general, any geologic or hydrologic features that are mapped or described and appear to be of sufficient size to transect an aquifer should be considered a potential discontinuity. If sufficient information has been collected to identify aquifer boundaries and ground water targets and no discontinuities are identified, it can be assumed for HRS scoring purposes that no discontinuities exist. When a potential discontinuity is identified, evaluate the data to determine:

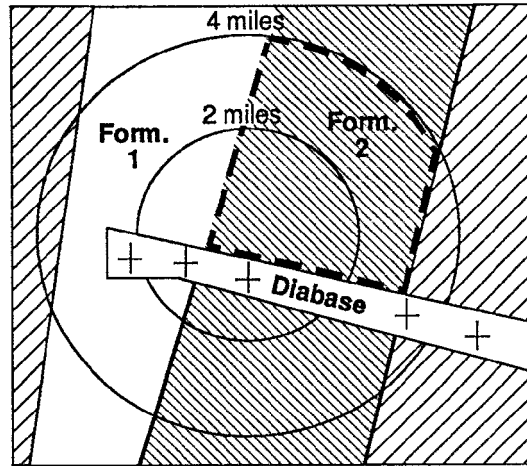
- If the discontinuity entirely transects the aquifer(s) being evaluated within the TDL; for interconnected aquifers, a discontinuity must transect the entire interconnected unit (see **Highlight 7-8**); and
- If the discontinuity disrupts the flow of ground water and hazardous substances between the materials on opposite sides of the discontinuity (i.e., a discontinuity does not exist if hazardous substances have been shown to migrate across the potential discontinuity within the TDL).

To evaluate whether the feature entirely transects an aquifer, rely on geologic maps and cross-sections. For erosional channels such as streams and rivers, knowledge of the depth of the channels with respect to the depth (thickness) of the aquifer usually is sufficient.

**HIGHLIGHT 7-8
 DELINEATING AQUIFER WHEN BOUNDARY
 PARTIALLY TRANSECTS AQUIFER**



Scenario A



Scenario B

Scenario A

- Formations 1 and 2 are in direct contact, both are used as aquifers, and they have similar hydraulic conductivities; thus, no aquifer boundaries are established between Formations 1 and 2, and they are considered a single hydrologic unit.
- A diabase dike (an intrusive, igneous rock) cuts across the formations; the diabase extends to depths below the bottom of Formations 1 and 2.
- The diabase has a significantly lower hydraulic conductivity than Formations 1 and 2.
- Since Formations 1 and 2 are combined into one aquifer for scoring purposes, the diabase is not considered a discontinuity because it does not entirely transect the aquifer being scored.

Scenario B

- Only Formation 2 is used as an aquifer. Formation 1 has a significantly lower hydraulic conductivity than Formation 2.
- A diabase dike of significantly lower hydraulic conductivity cuts across Formation 2.
- The diabase forms an aquifer discontinuity for Formation 2. Because only the dashed portion of the formation underlies sources at the site, only that portion is evaluated.

To show that the feature disrupts the exchange of ground water and hazardous substances, use the guidance below for documenting aquifer interconnections. If an aquifer interconnection can be documented, the feature being evaluated does not represent an aquifer discontinuity for HRS scoring purposes.

IDENTIFYING AQUIFER INTERCONNECTIONS

Evaluate the presence of aquifer interconnections only if aquifer boundaries and discontinuities occur within 2 miles of sources at the site (or within areas underlying ground water contamination attributable to the site). To identify an aquifer interconnection, evaluate the ability of nonaquifer materials occurring between aquifers to transfer ground water and hazardous substances. Where the nature of the intervening materials and/or features penetrating the intervening materials allows for such transfer with minimal or no disruption in flow path or velocity, consider the aquifers interconnected.

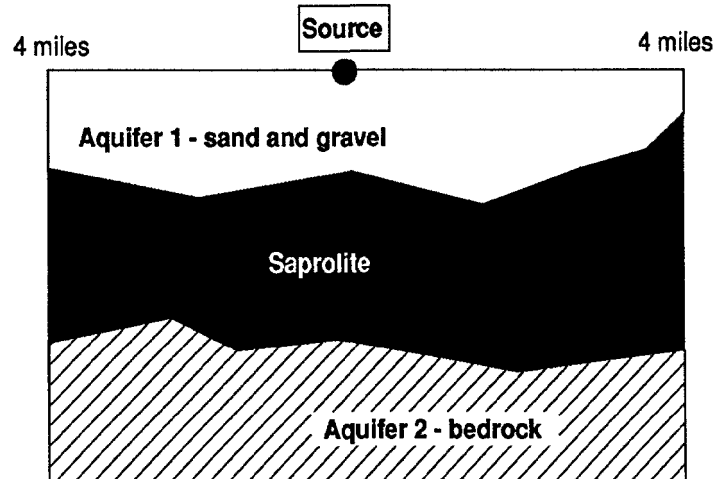
Precise definitions are not available for determining when intervening materials would have "minimal or no disruption" on hazardous substance and ground water flow. However, **Highlights 7-9** through **7-13** are provided as guidance for identifying aquifer interconnections. The principles inherent in these highlights are applicable to a wide variety of sites. To summarize, aquifers generally can be considered interconnected if one or more of the following is true:

- There are no intervening materials of significantly (i.e., more than two orders of magnitude) lower hydraulic conductivity (see **Highlight 7-9**).
- There is no continuous, significantly lower hydraulic conductivity layer that separates the two aquifers throughout the 2-mile radius. Well logs can frequently be used to establish that intervening layers are continuous (see **Highlight 7-10**).
- Contamination has been shown to have migrated across an aquifer boundary separating the aquifers. The flow of non-hazardous substances between aquifers can also be used to evaluate the potential for flow of hazardous substances between aquifers (see **Highlight 7-11**).
- Aquifer test (pumping test) data show that pumping in one aquifer has a measurable impact on water levels in another aquifer(s). The interconnection is established at the location of the well being pumped (see **Highlight 7-12**).
- Numerous man-made conduits occur through and/or across the aquifer boundaries that separate the aquifers. The numbers and sizes of man-made conduits considered sufficient to document an interconnection cannot be defined; this determination is made on a site-specific basis. (see **Highlight 7-13**).

Information to establish aquifer interconnections for HRS scoring is most commonly available for geologic settings comparable to **Highlights 7-9** and **7-10**. This information is typically collected during the evaluation of aquifer boundaries. Data to support evaluations comparable to **Highlights 7-11** and **7-12** are typically based on studies performed by others outside the scope of an SI. The situation illustrated in **Highlight 7-13** occurs less frequently than the situations presented in **Highlights 7-11** and **7-12**. For most sites where none of the above-listed principles apply to site-specific data, aquifer interconnections are not likely to be documented.

This section presents criteria that have been used to document aquifer interconnections at NPL sites. Although these principles can be applied across a wide variety of sites and geologic settings, other types of data may be used for determining aquifer interconnections. An aquifer interconnection can be based on any hydrogeologic information that shows that an aquifer boundary between two aquifers would have no or minimal disruption on the flow of ground water or contaminants between the aquifers.

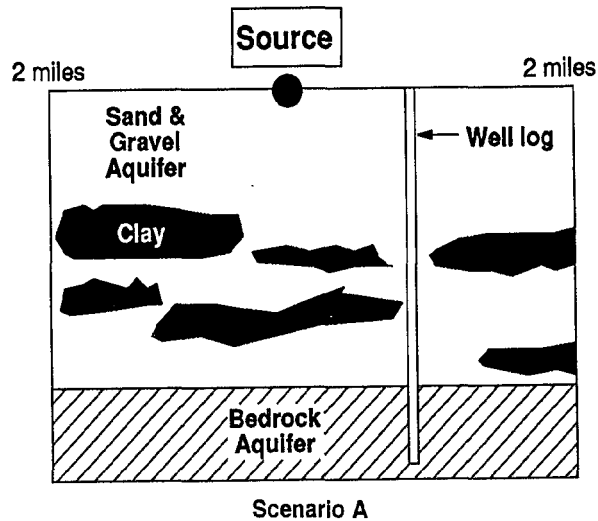
HIGHLIGHT 7-9
HORIZONTAL AQUIFERS SEPARATED BY FORMATION
OF SIMILAR HYDRAULIC CONDUCTIVITY
(formations are shown in cross-section)



- An upper sand and gravel aquifer is separated from an underlying bedrock aquifer by a layer of saprolite (i.e., weathered bedrock).
- The underlying bedrock is a moderately permeable igneous rock.
- The saprolite is not used as an aquifer.
- Geologic information indicates that the saprolite is the equivalent of a fine-grained, poorly sorted sand.
- Based on HRS Table 3-6, the hydraulic conductivities of the formations are as follows:
 - sand and gravel - 10^{-2} cm/sec
 - bedrock (moderately permeable igneous rock) - 10^{-4} cm/sec
 - saprolite (equivalent of a fine-grained, poorly sorted sand) - 10^{-4} cm/sec
- Although the intervening saprolite is not used as an aquifer, it does not have a hydraulic conductivity more than two orders of magnitude lower than the sand and gravel aquifer.
- Because the sand and gravel aquifer and the bedrock aquifer are not separated by a layer of significantly lower hydraulic conductivity, the aquifers are considered interconnected and combined into a single hydrologic unit for HRS scoring purposes.

HIGHLIGHT 7-10
USING WELL LOGS TO ASSESS AQUIFER INTERCONNECTION
(formations are shown in cross-section)

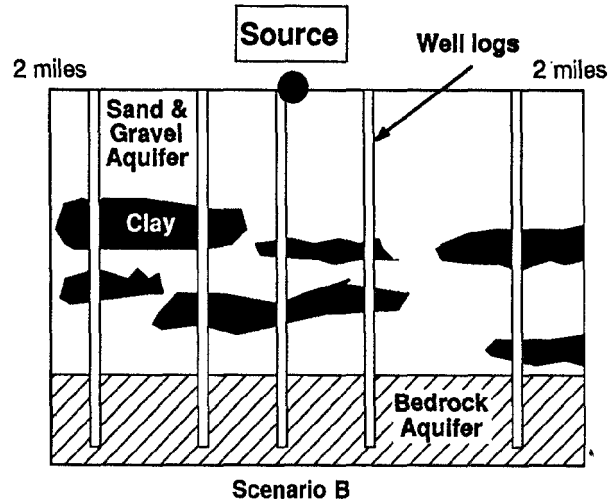
- An upper sand and gravel aquifer is separated from an underlying bedrock aquifer by a layer of interbedded sands and clays.
- Different log results are presented for each of three scenarios below. In all scenarios, well logs at the site show that drinking water wells are screened in sands and gravels above 30 feet in depth or in bedrock below 70 feet in depth; no wells are screened at depths correlating with the interbedded zone of sands and clays.
- The upper (sand and gravel) aquifer has the same hydraulic conductivity as the lower (bedrock) aquifer. Also, the sand zones between the aquifers have the same hydraulic conductivity as the aquifers. In contrast, the clay zones are of significantly lower hydraulic conductivity relative to the aquifers.
- Aquifer interconnections can be identified as follows:



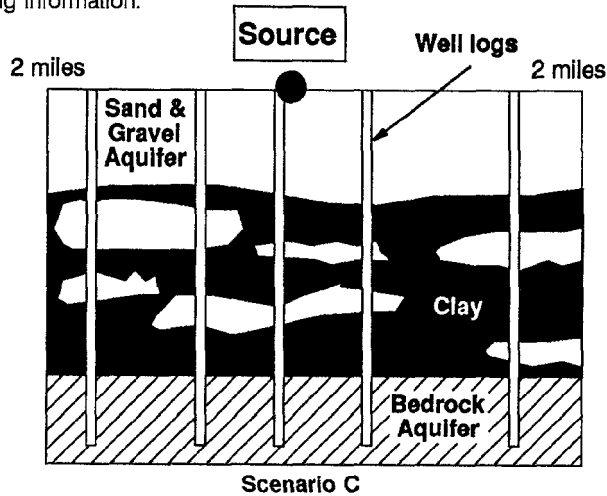
A well log within the 2-mile radius shows a location where no clay layer (or other layers of significantly lower hydraulic conductivity) separate the surficial and bedrock aquifers. The upper (sand and gravel) and lower (bedrock) aquifers are combined for HRS scoring purposes because there is not a continuous layer of significantly lower hydraulic conductivity that separates the two aquifers throughout the 2-mile radius. This evidence for interconnection is considered conclusive.

(continued on next page)

HIGHLIGHT 7-10 (continued)
USING WELL LOGS TO ASSESS AQUIFER INTERCONNECTION
(formations are shown in cross-section)

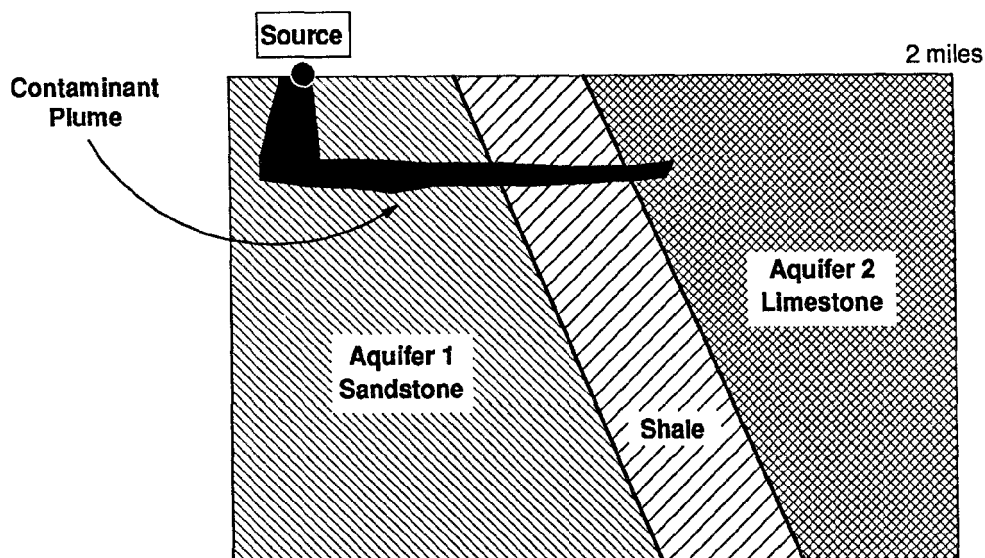


Multiple well logs show that clays are of limited extent and comprise less than 25 percent of the materials between 30 and 70 feet. The upper (sand and gravel) and lower (bedrock) aquifers are combined for HRS scoring purposes because it is assumed that there is no continuous layer of significantly lower hydraulic conductivity that separates the two aquifers throughout the 2-mile radius. The conclusion is based on a preponderance of evidence and professional judgment. The use of 25 percent in this highlight is not intended to establish a benchmark; rather, it provides a hypothetical example of the use of professional judgment in light of site-specific supporting information.



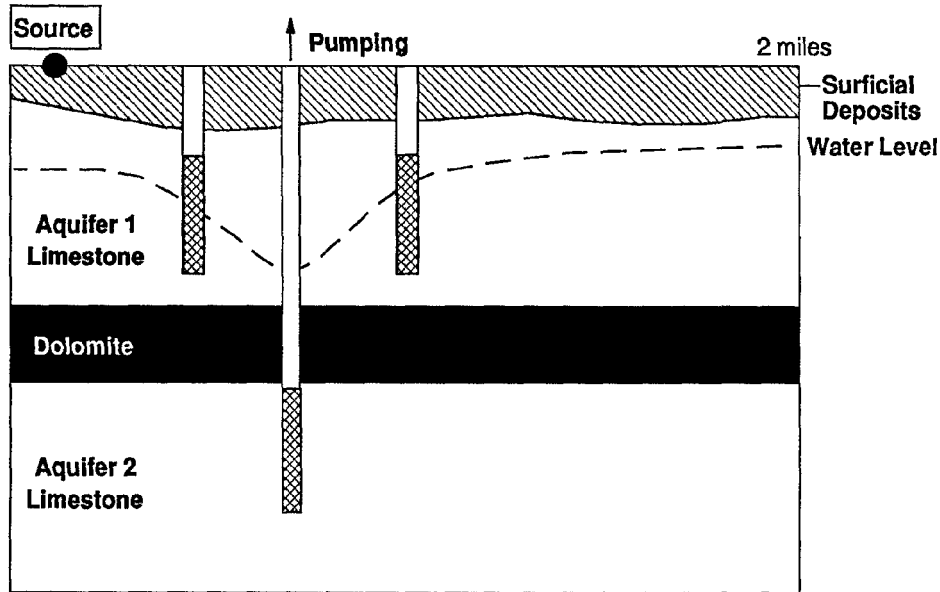
Multiple well logs show a high percentage of clay within the interbedded zone. The aquifers would not be considered interconnected for HRS purposes.

HIGHLIGHT 7-11
USING CONTAMINANT MIGRATION TO ASSESS
AQUIFER INTERCONNECTION
(formations are shown in cross-section)



- A series of fractured bedrock formations dip in the same direction as follows: (a) a sandstone formation underlies the site and is used as an aquifer, (b) adjacent to the sandstone in the downdip direction is a shale formation that is not used as an aquifer and is a low hydraulic conductivity layer relative to adjacent formations, and (c) adjacent to the shale in the downdip direction is a limestone formation that is used as an aquifer.
- The sandstone (Aquifer 1) and limestone (Aquifer 2) formations are separated by a shale formation that is not used as an aquifer and has a significantly lower hydraulic conductivity; thus, the aquifers are initially evaluated separately.
- Without documenting aquifer interconnections, Aquifer 1 can be scored while Aquifer 2 does not underlie the site and would not be evaluated.
- Ground water contamination has been shown to have moved from Aquifer 1 to Aquifer 2 across the shale and within the 2-mile radius. This contamination does not have to be attributable to the site. Also, contaminant migration from Aquifer 2 to Aquifer 1 may not be used to document an interconnection.
- Therefore, Aquifers 1 and 2 are considered interconnected and are combined into a single hydrologic unit for scoring purposes because contamination has been shown to have migrated between two aquifers across an aquifer boundary. Although the mechanism of contaminant transport does not have to be identified, sufficient evidence should be presented to eliminate other likely mechanisms for the introduction of the contaminant into the limestone aquifer.

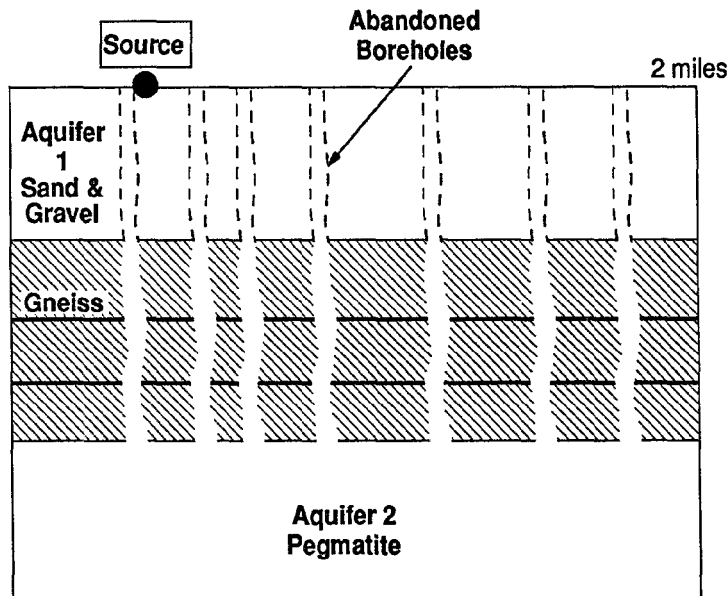
HIGHLIGHT 7-12
USING PUMPING TEST DATA TO ASSESS
AQUIFER INTERCONNECTION
 (formations are shown in cross-section)



Screening Interval

- A formation is flat-lying and consists of interbedded layers of limestone and dolomite; from the surface, there is a 50-foot thickness of limestone, a 40-foot thickness of dolomite, and a 90-foot thickness of limestone.
- The limestone layers are used as aquifers while there is no indication that the dolomite is used as an aquifer.
- No information on hydraulic conductivity is available for the limestone or dolomite layers.
- Initially, the dolomite layer is considered an aquifer boundary, and the limestone aquifers are evaluated separately.
- A pumping test is conducted of the lower limestone aquifer, and water levels in the upper limestone aquifer are monitored before, during, and after the test.
- Static water level was determined in the upper limestone; fluctuations were within 8 inches.
- During pumping, water levels in the upper aquifer dropped, on average, 2 feet and 9 inches; following a cessation of pumping, water levels in the upper aquifer returned to static levels.
- Therefore, the upper and lower limestone aquifer are considered interconnected at the location of the well being pumped in the lower aquifer; the aquifer test (pumping test) data show that pumping of the lower aquifer has a measurable impact on water levels in the upper aquifer.

HIGHLIGHT 7-13
USING NUMEROUS MAN-MADE CONDUITS TO ASSESS
AQUIFER INTERCONNECTION
(formations are shown in cross-section)



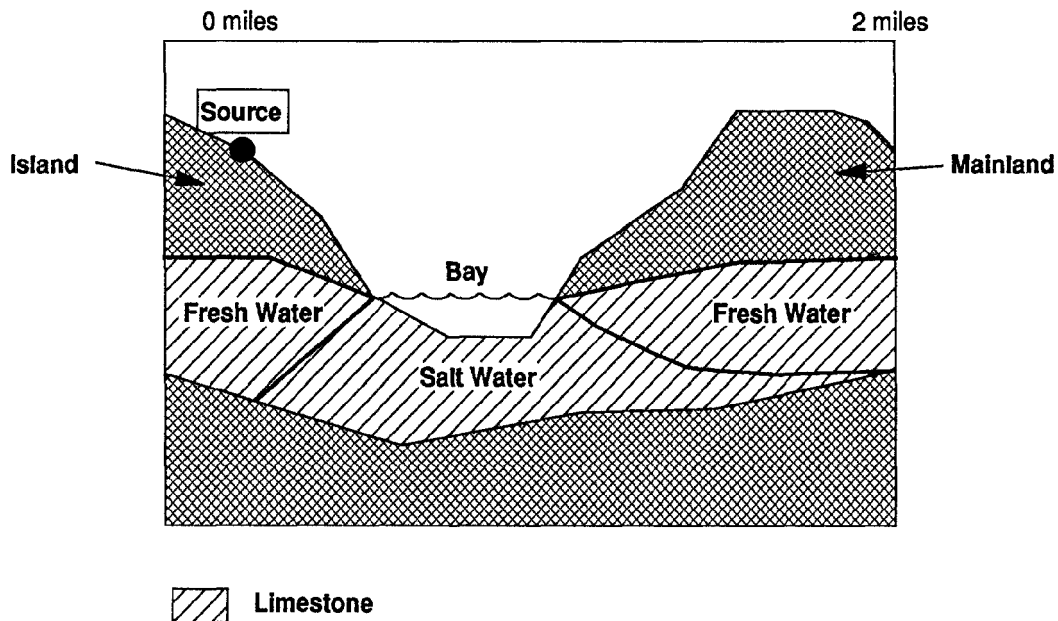
- A sand and gravel formation is separated from a fractured pegmatite (i.e., type of igneous rock) formation by a layer of gneiss (i.e., type of metamorphic rock).
- Well logs show that the sand and gravel formation and the pegmatite are used as aquifers; there is no indication that the gneiss is used as an aquifer.
- No information on hydraulic conductivity of the materials is available; initially, the sand and gravel aquifer and the pegmatite aquifer are evaluated separately.
- Historical records and well log information indicate that uncased boreholes were placed through the gneiss in order to mine the pegmatite.
- Numerous (more than 100) mining shafts could be located, based on boring logs, within 1 mile of the site; none of the borings had been sealed.
- Based on site-specific considerations, the extent, number, and type of boreholes through the gneiss were sufficient to conclude that the gneiss did not have the ability to disrupt the flow of hazardous substances between the sand and gravel aquifer and the pegmatite aquifer.
- Therefore the aquifers are combined for scoring purposes. The numbers and sizes of man-made conduits considered sufficient to document an interconnection cannot be precisely defined; this determination is made using professional judgment on a site-specific basis.

TIPS AND REMINDERS

- As a first step, identifying and locating wells that can potentially be evaluated as ground water targets may help to focus remaining data requirements for establishing aquifer boundaries. Establishing aquifer boundaries will then determine which targets are evaluated.
- Aquifers can be established in both horizontal and vertical directions.
- For unconfined (water table) aquifers, the uppermost elevation of ground water may not be known near the site; this elevation can be estimated as follows:
 - In areas where streams are known to be "gaining" (that is, ground water elevations are greater than surface water elevations resulting in ground water discharge to the surface water), the elevation of the water surface in a nearby stream can be used to determine the minimum elevation of ground water beneath the site. Note that elevations of flood stages in the stream would not be appropriate for this determination because the stream is not likely to be a "gaining" stream during the flood.
 - Using well logs, evaluate water elevation data and data on ground water flow gradients on a regional basis to approximate the top of the aquifer beneath the site. The use of this approach must be based on site-specific considerations regarding the relative accuracy of the data and the degree to which the site data fits within appropriate HRS ranges.
- For confined aquifers, evaluate the top of the aquifer based on regional well logs, information on degree and direction of formation dip, and geologic maps.
- A body of salt water can form an aquifer boundary with the boundary defined by the location of the fresh water/salt water interface. Variations in the location of the interface would potentially represent variations in an aquifer boundary (this is not expected to affect the HRS evaluation of most sites because fresh water wells generally are not located within the zone of variation of the fresh water/salt water interface).
- The presence of fractures in a geologic material does not in itself establish the material as an aquifer or disqualify the material as an aquifer boundary; rather, the ability of the fractures to transmit water and the overall hydraulic conductivity of the material are the key data to consider (e.g., materials can be fractured and still have relatively low hydraulic conductivities).
- Information on use of a geologic material as an aquifer outside the TDL does not qualify the same material as an aquifer within the TDL; there must be specific information on use within the TDL. However, use of the materials as an aquifer outside the TDL could be used to evaluate whether the material is an aquifer boundary inside the TDL. Specifically, professional judgment should be used to evaluate whether properties of the material where it is being used as an aquifer are likely to be representative of the materials within the TDL.
- Evaluate aquifer discontinuities within the 4-mile TDL.
- An aquifer discontinuity must be a physical barrier that entirely transects all geologic materials combined into a single hydrologic unit for scoring purposes, or else the discontinuity is not evaluated.
- If hazardous substances have migrated across a potential discontinuity in the direction of flow from the site, do not consider this a discontinuity.

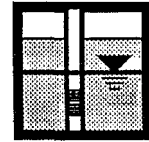
- Bodies of salt water, if they entirely transect an aquifer, would be considered a discontinuity (see **Highlight 7-14**).
- Ground water flow gradients and related features, such as ground water divides (e.g., ridges, topographic highs), are not sufficient by themselves to establish a discontinuity.
- Aquifer interconnections cannot be assumed, but must be supported by evidence.
- Evaluate interconnections within 2 miles of sources at the site or within areas underlying ground water contamination attributable to the site (if contamination extends beyond two miles).
- Where aquifer interconnections are documented, combine all interconnected aquifers and intervening materials into a single hydrologic unit for HRS scoring purposes.
- Computer models have not been used to demonstrate interconnections. Documenting that the assumptions used to construct and run models accurately represent hydrogeologic conditions throughout the 2-mile distance for aquifer interconnections and the 4-mile TDL has not been possible.

HIGHLIGHT 7-14
BODIES OF SALT WATER AS AQUIFER DISCONTINUITIES
(formations are shown in cross-section)



- A limestone formation is continuous between the mainland and a nearby island; a salt-water bay separates the island from the mainland.
- The limestone is used as an aquifer on both the mainland and the nearby island.
- Salt water occupies the limestone formation for its entire thickness beneath the bay.
- The bay is considered an aquifer discontinuity and the freshwater zones are two separate aquifers for HRS purposes. The aquifer that underlies the sources at the site (i.e., under the island) would be evaluated. The aquifer under the mainland would not be evaluated as it does not underlie sources at the site, and it is not in direct contact or interconnected with an aquifer that does.

SECTION 7.2 TREATMENT OF KARST



This section provides guidance on the identification of karst terrain and karst aquifers and on the treatment of karst in the HRS evaluation of the ground water pathway. Guidance provided in Section 7.1 on identification of aquifers also applies in karst terrain and should be consulted in conjunction with this section.

Karst refers to a characteristic of a geologic material or formation resulting from the dissolution of the formation by natural waters over time. Because of the dissolution cavities and the channels that comprise them, karst aquifers are considered extremely vulnerable to contamination. The movement of hazardous substances released into karst aquifers is highly unpredictable, and transport over relatively long distances can occur very rapidly. For these reasons, a karst aquifer that underlies any portion of the sources at the site is given special consideration in the evaluation of several HRS factors within potential to release, waste characteristics, and targets. These factors are:

- Potential to Release
 - Depth to aquifer
 - Travel time
- Waste Characteristics
 - Mobility
- Targets
 - Nearest well
 - Population/potential contamination

At sites evaluated for potential to release (i.e., no observed release is documented), several specific considerations for scoring karst aquifers apply. For sites with a documented observed release (i.e., hazardous substances attributable to the site have reached the aquifer being evaluated) and targets subject to actual contamination, there are few, if any, specific scoring considerations for karst aquifers.

For purposes of identifying aquifers and establishing aquifer boundaries, karst is evaluated in the same manner as any other geologic formation. For each of the factors that is treated differently for karst aquifers, a highlight presented in this section compares the general scoring steps for a karst aquifer with those for aquifers without karst characteristics.

RELEVANT HRS SECTIONS

Section 1.1	Definitions (karst)
Section 3.0.1.3	Karst aquifer
Section 3.1.2.3	Depth to aquifer
Section 3.1.2.4	Travel time
Section 3.2.1.2	Mobility
Section 3.3.1	Nearest well
Section 3.3.2.2	Level I concentrations
Section 3.3.2.3	Level II concentrations
Section 3.3.2.4	Potential contamination

DEFINITIONS

Karst: A kind of terrain with characteristics of relief and drainage arising from a high degree of rock solubility. The majority of karst conditions occur in limestone areas, but karst may also occur in areas of dolomite, gypsum, or salt deposits. Features associated with karst terrain may include irregular topography, abrupt ridges, sinkholes, caverns, abundant springs, disappearing streams, and the lack of a well-developed surface drainage system of tributaries and streams. Karst aquifers generally are associated with karst terrain on the surface. Karst aquifers at depth may not be associated with karst terrain.

IDENTIFYING KARST

To identify karst, determine the structures and features that characterize karst. This information is often contained within the scientific literature and other primary data sources for determining aquifer boundaries, as described in Section 7.1.

- (1) **Use geologic maps and other readily available information to determine if karst features are expected within 4 miles of the site.** A map of the entire United States that indicates areas containing karst features is published by USGS; using this map, Engineering Aspects of Karst (document number 38077-AW-NA-07M-00), it is possible to determine if karst features are predicted in the site vicinity. Because of the large scale of this map, scorers should also review site-specific information, including more detailed geologic maps. Where information is uncovered to identify a karst formation within the TDL, continue with the following steps.
- (2) **Compile the available site-specific evidence that indicates the presence of karst.** Note on a map locations with evidence of a karst feature (e.g., spring, disappearing stream, sinkhole, or cave); such information can be obtained from topographic maps, aerial photographs, maps of caves, and visual observations. Also, well logs that note a drop of several feet in the bit during drilling may be indicative of karst features.

It is generally impractical at the level of an SI to perform adequate field investigations to identify and evaluate the extent of a karst material. Thus, existing information will be the basis for identification of karst. However, where information is available prior to the SI to indicate the possible presence of karst, limited field checks for karst features in the area of the site may be compatible with the level of effort normally associated with an SI.

- (3) **Estimate the lateral extent of karst.** Based on the distribution of the karst features within the formation, use professional judgment to delineate laterally the areas containing karst features.
- (4) **Estimate the thickness of karst.** While the lateral extent of karst is based on visual observations and surface expressions, it can be more difficult to determine the thickness of

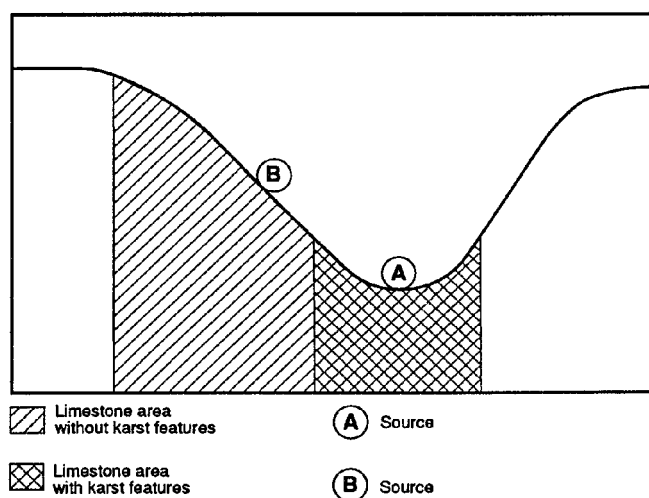
karst. As an initial determination, the depth and thickness of the formation(s) containing the karst features should be evaluated. Determining formation depth and thickness for aquifers that underlie sources at the site is especially important for HRS scoring purposes. Indications of depth and thickness may be available from well log data, scientific literature, or other information compiled during the evaluation of aquifer boundaries.

- (5) **Define the aquifer boundaries for karst aquifers.** The boundary between karst and adjacent materials is based on the boundary between karst and non-karst characteristics (see **Highlight 7-15**).

To identify karst aquifer boundaries, start with geologic maps and information compiled during the identification and definition of aquifers. Based on this information, compile a list of geologic materials and/or formations that are known to contain karst features. Also note whether the information indicates the presence of karst features under sources at the site, within the 4-mile radius, or regionally. In those formations with karst features, evaluate the lateral and vertical extent of karst within the TDL, as described above.

- (6) **Identify wells that draw drinking water from a karst aquifer that underlies sources at the site.** These drinking water wells qualify for special consideration when scoring potential contamination.

**HIGHLIGHT 7-15
DEFINING BOUNDARIES FOR A KARST AQUIFER
(formations are shown in cross-section)**



The extent of a karst aquifer or formation for HRS purposes is based on the extent of the structures and features associated with karst. Where these structures or features are not present, the rapid and highly unpredictable movement of ground water associated with karst would not be expected, and special scoring considerations in the ground water pathway would not be appropriate. In this example, a limestone formation forms part of both a valley wall and valley floor. The karst characteristics are present along the valley floor but do not occur along the valley wall. An aquifer underlying Source A would be scored as a karst aquifer, because the portion of limestone formation along the valley floor would be considered karst. An aquifer underlying Source B would not be scored as a karst aquifer, however, because the features leading to rapid ground water flow do not underlie this source.

SCORING DIFFERENCES FOR KARST AQUIFERS

The highlights on the following pages contrast the scoring procedures for each of the factors that is scored differently (i.e., depth to aquifer, travel time, mobility, nearest well, population/potential contamination) for karst and non-karst aquifers.

Before using these highlights, review **Highlight 7-16** to determine which of the factors need to be cored for the aquifer under evaluation. This highlight divides aquifers depending on how the likelihood of release factor is evaluated (i.e., observed release by chemical analysis, observed release by direct observation, potential to release) and by how targets are evaluated (i.e., actual contamination only, potential contamination with or without actual contamination). For each scoring situation, factors that may receive special consideration for karst aquifers are listed. Remember, these special considerations apply only to karst aquifers underlying at least a portion of the sources at the site.

When karst aquifers are present, there are either differences from the scoring procedures or additions to the scoring procedures used in non-karst situations. In **Highlights 7-17** to **7-21**, which explain these differences, the following key is used:

- A bullet (followed by text) in the "non-karst" column and no bullet in the "differences due to karst" column: "non-karst" evaluation step is used without change in evaluating a karst aquifer.
- Directly parallel bullets in columns labelled "non-karst" and "differences due to karst": step in the "differences due to karst" column replaces the opposing "non-karst" step.
- A bullet in the "differences due to karst" column has no parallel bullet in the "non-karst" column: "differences due to karst" step is in addition to the steps in the "non-karst" column.

These highlights are designed to summarize key differences, not to provide detailed scoring instructions.

HIGHLIGHT 7-16
HRS FACTOR GIVEN SPECIAL CONSIDERATION FOR KARST AQUIFERS

		Type of Drinking Water Targets in Karst Aquifer	
		Evaluated Under Actual Contamination Only	Some or All Evaluated Under Potential Contamination
Type of Likelihood of Release Evaluation In Karst Aquifer	Observed Release by Chemical Analysis	Mobility (for hazardous substances that don't meet observed release criteria)	Population/Potential Contamination Mobility (for hazardous substances that don't meet observed release criteria)
	Observed Release by Direct Observation	Mobility (for all hazardous substances)	Mobility (for all hazardous substances) Nearest Well Population/Potential Contamination
	Potential to Release	Combination never occurs	All five factors may be given special consideration

HIGHLIGHT 7-17
SCORING CONSIDERATIONS FOR KARST AQUIFERS:
DEPTH TO AQUIFER FACTOR

Non-karst	Differences Due to Karst
<ul style="list-style-type: none"> • Determine the depth to aquifer only at locations within 2 miles of the sources at the site, except: if observed ground water contamination attributable to sources at the site extends more than 2 miles beyond these sources, use any location within the limits of this observed ground water contamination when evaluating the depth to aquifer for any aquifer that does not have an observed release. • Evaluate the depth to an aquifer as the distance from the surface to the top of the aquifer minus the distance from the surface to the lowest known point of hazardous substance eligible to be evaluated for that aquifer. • Based on the calculated depth, assign a value from HRS Table 3-5 to the depth to aquifer factor. 	<ul style="list-style-type: none"> • In evaluating depth to aquifer in karst terrain, assign a thickness of 0 feet to a karst aquifer that underlies any portion of the sources at the site.

HIGHLIGHT 7-18
SCORING CONSIDERATIONS FOR KARST AQUIFERS:
TRAVEL TIME FACTOR

Non-karst	Differences Due to Karst
<ul style="list-style-type: none"> • Determine the travel time only at locations within 2 miles of the sources at the site, with the same exception as in evaluating depth to aquifer (see <i>Highlight 7-17</i>). • Evaluate travel time factor based on the geologic materials in the interval between the lowest known point of hazardous substances at the site and the top of the aquifer being evaluated. • If the depth to aquifer is 10 feet or less, assign a factor value of 35 and skip the remaining steps for travel time. • Determine hydraulic conductivities for individual layers from HRS Table 3-6 or from in-situ or laboratory tests. Use representative, measured hydraulic conductivity values whenever available. • Otherwise, select the lowest hydraulic conductivity layer(s) from within the above interval. Consider only layers at least 3 feet thick. However, do not consider layers or portions of layers within the first 10 feet of the depth to the aquifer. • If more than one layer has the same lowest hydraulic conductivity, include all such layers and sum their thicknesses. • Assign a value from HRS Table 3-7 to the travel time factor, based on the thickness and hydraulic conductivity of the lowest hydraulic conductivity layer(s). 	<ul style="list-style-type: none"> • If, for the interval being evaluated, all layers that underlie a portion of the sources at the site are karst, assign a factor value of 35 and skip the remaining steps for travel time. • Assign a thickness of 0 feet to a karst layer that underlies any portion of the sources at the site.

**HIGHLIGHT 7-19
SCORING CONSIDERATIONS FOR KARST AQUIFERS:
MOBILITY FACTOR**

Non-karst	Differences Due to Karst
<ul style="list-style-type: none"> • For any hazardous substance that meets the <u>criteria for an observed release by chemical analysis</u> to one or more aquifers underlying the sources at the site regardless of the aquifer being evaluated, assign a mobility factor value of 1. • For any hazardous substance that <u>does not meet the criteria for an observed release by chemical analysis</u> to at least one of the aquifers, assign a mobility factor value from HRS Table 3-8 for the aquifer being evaluated based on its water solubility and distribution coefficient (K_d). • See HRS section 3.2.1.2 to determine the water solubility to be used in HRS Table 3-8 for the hazardous substance. • See HRS section 3.2.1.2 to determine the distribution coefficient to be used in HRS Table 3-8 for the hazardous substance. Use either the distribution coefficient categories "≤ 10", "> 10 to 1,000", or "$>1,000$", as appropriate, if part or all of the interval from a source to the aquifer is not karst. • If a hazardous substance cannot be assigned a mobility factor value because data on its water solubility or distribution coefficient are not available, use other hazardous substances for which information is available in evaluating the pathway. • If none of the hazardous substances eligible to be evaluated can be assigned a mobility factor value, use a default value of 0.002 as the mobility factor value for all these hazardous substances. 	<ul style="list-style-type: none"> • If the entire interval from a source at the site to the aquifer being evaluated is karst, use the distribution coefficient category "Karst" in HRS Table 3-8 in assigning the mobility factor value. If karst is present in the interval, but the entire interval is not karst, then use the step listed under "non-karst" instead of the step in this column. • If a hazardous substance cannot be assigned a mobility factor value because data on its water solubility are not available and the entire interval is karst, use other hazardous substances for which solubility information is available to evaluate the pathway. If karst is present in the interval, but the entire interval is not karst, then use the step listed under "non-karst" instead of the step in this column.

**HIGHLIGHT 7-20
SCORING CONSIDERATIONS FOR KARST AQUIFERS:
NEAREST WELL FACTOR**

Non-karst	Differences Due to Karst
<ul style="list-style-type: none"> • If for the aquifer being evaluated, there is an observed release by direct observation for a drinking water well within the TDL, assign Level 11 concentrations to the well. • However, if one or more samples meet the criteria for an observed release for a target well for the aquifer, determine if that well is subject to Level I or Level II concentrations as specified in HRS section 2.5.1 and 2.5.2. • If one or more target drinking water wells for the aquifer are subject to Level I concentrations, assign a factor value of 50. • If not, but if one or more target drinking water wells for the aquifer are subject to Level II concentrations, assign a factor value of 45. • If none of the target drinking water wells is subject to Level I or Level II concentrations for the aquifer, determine the shortest distance to any drinking water well for the aquifer, as measured from any source at the site with a ground water containment factor value greater than 0. Select a value from HRS Table 3-11 based on this distance. Assign it as the value for the nearest well factor for the aquifer. 	<ul style="list-style-type: none"> • If none of the target drinking water wells is subject to Level I or Level II concentrations for the aquifer, and if one of the aquifers being evaluated is a karst aquifer that underlies any portion of the sources at the site, and if any well draws drinking water from this karst aquifer within the TDL, assign a value of 20 for the nearest well factor for the aquifer.

**HIGHLIGHT 7-21
SCORING CONSIDERATIONS FOR KARST AQUIFERS:
POPULATION/POTENTIAL CONTAMINATION FACTOR**

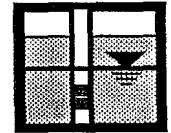
Non-karat	Differences Due to Karst
<ul style="list-style-type: none"> • Determine the number of people served by drinking water from points of withdrawal (for the aquifer being evaluated) subject to potential contamination. Do not include those people already counted under Level I and/or Level II concentration factors. <p>! Use the "Non-karst" portion of HRS Table 3-12 for that portion of the target population served by points of withdrawal subject to potential contamination, excluding any points of withdrawal that draw drinking water from a karst aquifer that underlies any portion of the sources at the site.</p> <p>! Calculate the value for the population/potential contamination factor as directed in HRS section 3.3.2.4.</p>	<ul style="list-style-type: none"> • Use the "Karst" portion of HRS Table 3-12 to assign values only for that portion of the target population served by points of withdrawal that draw drinking water from a karst aquifer that underlies any portion of the sources at the site.

TIPS AND REMINDERS

- Karst aquifers that do not underlie any portion of site sources are evaluated in the same manner as non-karst aquifers.
- A significant percentage of karst in the U.S. occurs in limestone. The presence of springs, sinkholes and caverns in a limestone formation may be indicative of karst.
- Lava aquifers or aquifers with numerous abandoned mine shafts do not meet the HRS definition of karst and, even though hazardous substance transport may be facilitated in such aquifers, they cannot be considered karst aquifers for purposes of HRS scoring.

SECTION 7.3

CONTAINMENT FACTOR



This section provides definitions for many of the terms used in the ground water containment descriptions and explains how to score the containment factor. If an observed release to an aquifer cannot be established, then that aquifer is evaluated based on potential to release. Four factors are used to evaluate the potential to release factor: containment, net precipitation, depth to aquifer, and travel time. The containment factor is a measure of the methods (either natural or engineered) that have been used to restrict the release of hazardous substances from a source to the subsurface or to prevent released substances from entering ground water.

Containment criteria have been compiled for several types of sources on a numerical scale selected to provide a relative degree of discrimination among different levels of containment. HRS Table 3-2 includes containment factor rating descriptions for the following specific categories of hazardous waste sources: surface impoundments, land treatment facilities, containers, and tanks. The table also provides containment factor rating descriptions that apply to all other hazardous waste sources, including landfills, piles, and contaminated soil.

The containment factor is evaluated for each source for the aquifer being evaluated, and the highest containment factor value for any source that meets the minimum size requirement is assigned as the containment factor value. If none of the sources meets the minimum size requirement, the highest containment factor value of any source is assigned.

RELEVANT HRS SECTION	
Section 3.1.2.1	Containment

DEFINITIONS

The following definitions elaborate on terms used in the containment descriptions in HRS Table 3-2.

Above-ground Tank: Any tank that does not meet the definition of a below-ground tank (including any tank that is only partially below the surface).

Associated Containment Structures: As used in HRS Table 3-2, constructed barriers (e.g., liners, dikes, berms) that may have been placed under, over, or around a source (e.g., a landfill or a waste pile) to prevent the release of hazardous substances to the environment.

Below-ground Tank: A tank with its entire surface area below the surface and not visible; however, a fraction of its associated piping may be above the surface.

Bulk Liquids: Noncontainerized liquids deposited directly into a source by pipe, tanker truck, or other means of transport.

Essentially Impervious Base: A base underlying containers that is free from cracks and gaps and prevents penetration of leaks, spills, or precipitation.

Evidence of Hazardous Substance Migration: Chemical analyses and/or visual evidence that demonstrate hazardous substances attributable to a source have migrated away from that source into the surrounding soil, ground water, surface water, or air (e.g., leachate, containing hazardous substances coming out of the source; stained or contaminated soil that can be attributed to migration from the source; evidence of the overflow from a surface impoundment containing hazardous substances).

Free Liquids: Liquids that readily separate from the solid portion of a substance under ambient temperature and pressure.

Freeboard: Vertical distance between the top of a tank or surface impoundment dike and the surface of the hazardous substance contained therein. Freeboard is intended to prevent overtopping resulting from normal or abnormal operations, wind and wave action, rainfall, and/or run-on.

Functioning Ground Water Monitoring System: A system of test wells installed around a source to detect migration of hazardous substances. In evaluating the containment factor in the ground water pathway, wells should be sampled and maintained to constitute a functioning ground water monitoring system.

Land Treatment Zone: Soil layer in the unsaturated zone of a land treatment unit within which hazardous substances are intended to be degraded, transformed, or immobilized.

Liner: A continuous barrier that covers all the earth likely to be in contact with a source so that hazardous substances or leachate containing hazardous substances would not migrate to the surrounding earth. The barrier may be synthetic material (e.g., a thick, continuous, polyethylene membrane) or engineered, compacted, natural material (e.g., re-worked and low permeability clay). An in-situ clay layer that has not been re-engineered by compaction or other methods is not considered a liner.

Maintained Engineered Cover: Vegetated cover, usually made of compacted clean soil. It is generally placed over a source at its closure and is designed and constructed to minimize the migration of liquids through the closed source, function with minimum maintenance, and accommodate settling and subsidence. Maintenance of the integrity and effectiveness of the final cover may include repairing it as necessary to correct the effects of settling, subsidence, erosion, and other events.

Secondary Containment: As used in HRS Table 3-2, secondary containment is applicable to the evaluation of the containment factor for tanks. Methods of secondary containment include a liner external to the tank, a vault, a double-walled tank, or an equivalent device.

Tank and Ancillary Equipment: Tanks and associated pipes, pumps, sumps, manifolds, fittings, flanges, and valves used to distribute, meter, or control flow of hazardous substances to or from the tank.

SCORING THE GROUND WATER CONTAINMENT FACTOR

- (1) **Identify the sources at the site.** HRS section 1.1 defines a source as many area where a hazardous substance has been deposited, stored, disposed, or placed, plus those soils that have become contaminated from migration of a hazardous substance. The HRS divides sources into five categories for evaluating ground water containment: surface impoundments, land treatment, containers, tanks, and all other sources. Each category has a separate list of criteria used to assign containment values.

- (2) **Use HRS Table 3-2 to assign a containment value to each source.** Use the definitions provided above to interpret the criteria in Table 3-2. **Highlight 7-22** summarizes the types of information that generally should be collected during the SI for the purposes of evaluating the containment factor.
- (3) **For each source for the aquifer being evaluated, determine whether the source hazardous waste quantity value is 0.5 or greater.** Only sources with a source hazardous waste quantity value of 0.5 or greater can be used to assign the containment value, unless no source for the aquifer being evaluated has a source hazardous waste quantity value of 0.5 or greater. This limitation is referred to as the "minimum size requirement". **Highlight 7-23** summarizes the minimum measurements of sources that will give a source hazardous waste quantity value of 0.5. Any of the hazardous waste quantity tiers can be used to determine whether a source meets the minimum size requirement. Detailed guidance on determining hazardous waste quantity values is provided in Chapter 6.
- (4) **Assign a pathway containment factor value for the aquifer being evaluated.**
- Assign the highest containment value for those sources with hazardous waste quantity values greater than or equal to 0.5 as the containment factor value for the ground water pathway.
 - If none of the sources at the site for the aquifer being evaluated has a source hazardous waste quantity value of greater than or equal to 0.5, assign the highest containment value among all sources as the containment factor value for the ground water pathway.

HIGHLIGHT 7-22

DATA NEEDS FOR EVALUATING SOURCE CONTAINMENT

The following types of information are helpful for evaluating the containment factor:

- The physical location of the hazardous substance(s) (e.g., buried, in a below-ground tank).
- Evidence of hazardous substance migration (e.g., overflow from surface impoundments).
- Evidence, or lack thereof, of diking, berms, or other engineered physical barriers that completely surround the source area.
- The presence of bulk and/or free liquids.
- Evidence of liners that are continuous and that would prevent the source hazardous substance(s) from coming in contact with the earth beneath (or around) the source. In the case of liners, the site investigator may assume that there is not a liner unless evidence indicates otherwise.
- Evidence, or lack thereof, of leachate collection systems (functioning or not), and ground water monitoring systems.
- Evidence of the existence and condition of physical structures that provide protection from precipitation, and/or run-on and runoff control.

The above list is illustrative. It is meant neither to be all inclusive of the types of information that can be used to characterize the containment of any particular hazardous substance source nor to establish minimum requirements.

**HIGHLIGHT 7-23
SOURCE MEASUREMENTS THAT MEET
THE MINIMUM SIZE REQUIREMENT**

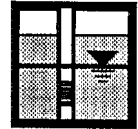
Tier	Measure or Source Type	Minimum Measurements for Hazardous Waste Quantity Value of 0.5
A	Hazardous constituent quantity	0.5 pounds
B	Hazardous wastestream quantity	2,500 pounds
C Volume	Landfill	1,250 cubic yards
	Surface impoundment	1.25 cubic yards
	Surface impoundment (Buried/backfilled)	1.25 cubic yards
	Drums	250 gallons
	Tanks and containers other than drums	1.25 cubic yards
	Contaminated soil	1,250 cubic yards
	Pile	1.25 cubic yards
	Other	1.25 cubic yards
D Area	Landfill	1,700 square feet
	Surface impoundment	6.50 square feet
	Surface impoundment (buried/backfilled)	6.50 square feet
	Land treatment	135 square feet
	Pile	6.50 square feet
	Contaminated soil	17,000 square feet

TIPS AND REMINDERS

- Regardless of source type, if there is evidence of hazardous substance migration from the source, a containment factor value of 10 applies. Note that evidence of migration from a source does not have to meet the criteria for observed release.
- Every source may not be evaluated for every aquifer, depending on the location of the source and the hydrogeology in the area of the site. Only sources for the aquifer being evaluated are used in assigning the containment factor value for that aquifer.
- Only those sources that have a non-zero containment factor value for ground water should be evaluated.
- The presence of a liner that extends under the entire source area is considered when evaluating containment; if the liner does not extend under the entire source area (i.e., a partial liner), the source should be evaluated as if no liner were present. The condition of the liner (e.g., damaged, torn, or leaking) would typically not be discernible during the SI.
- A site may be considered to have a "natural" liner only if the clay underlying the site has been reworked to provide an engineered barrier. The mere existence of a natural clay layer or a confining layer is not sufficient. However, such a layer would be accounted for when evaluating the travel time factor.
- Assign a containment factor value for only those sources with a source hazardous waste quantity value of 0.5 or more. If no source meets this minimum size requirement, select the highest containment factor value among all sources for the aquifer being evaluated as the containment factor value.
- Any hazardous waste quantity tier (A, B, C, or D) can be used to determine if a source meets the minimum size requirement.

SECTION 7.4

ACTUAL CONTAMINATION



This section provides guidance on identifying drinking water wells subject to actual contamination, determining whether wells subject to actual contamination have Level I or Level II concentrations, and scoring sites with actual contamination. A drinking water well is subject to actual contamination if it meets specific criteria that demonstrate that the well has been contaminated by hazardous substances attributable to the site. Target drinking water wells at which actual contamination is not documented are evaluated based on potential contamination. All wells subject to actual contamination are classified as Level I or Level II. Wells subject to actual contamination receive higher values for several factors.

RELEVANT HRS SECTIONS

Section 2.3	Likelihood of release
Section 2.5	Targets
Section 2.5.1	Determination of level of actual contamination at sampling location
Section 2.5.2	Comparison to benchmarks
Section 3.1.1	Observed release
Section 3.3.1	Nearest well
Section 3.3.2.1	Level of contamination
Section 3.3.2.2	Level I concentrations
Section 3.3.2.3	Level II concentrations

DEFINITIONS

Actual Contamination In the Ground Water Pathway: A drinking water well is subject to actual contamination if a sample from the well meets the criteria for an observed release. (**Highlight 7-24** discusses the difference between actual contamination and observed release.) Actual contamination of a drinking water well cannot be inferred based on other samples (e.g., from downgradient wells).

Level I Concentrations for the Ground Water Pathway: Level I concentrations are established in samples from drinking water wells in which the concentration of a hazardous substance that meets the criteria for an observed release is at or above its drinking water benchmark. A drinking water well also may be subject to Level I concentrations if multiple hazardous substances that meet the criteria for an observed release are present below their respective benchmarks, and the I or J index is greater than or equal to one. Benchmarks for the ground water pathway include MCLs, nonzero MCLGs, and screening concentrations for cancer and chronic noncancer effects.

HIGHLIGHT 7-24

COMPARISON OF ACTUAL CONTAMINATION TO OBSERVED RELEASE

Because actual contamination involves observed release as part of its definition, the two concepts are often confused. Observed release is a necessary but not sufficient condition for establishing actual contamination of specific targets. Scoring an observed release to ground water generally involves detecting a hazardous substance (attributable to the site) in ground water samples at levels significantly above background for the site. The samples that are used to score an observed release can be taken from any well - monitoring wells, drinking water wells, or other types of wells. Scoring actual contamination requires that the same criteria for an observed release be met, but the samples meeting these criteria must be taken from drinking water wells. If the only ground water samples that show hazardous substances at levels significantly above background (i.e., an observed release) are taken from monitoring wells, no actual contamination can be scored. In addition, an observed release to ground water can sometimes be scored by direct observation (e.g., by documenting deposition of hazardous substances in the aquifer). Actual contamination of a drinking water well can be documented by direct observation only if hazardous substances were disposed in the well itself or were observed entering the well, both of which are unlikely scenarios. If actual contamination cannot be scored, all targets are scored based on potential contamination. In essence, for the ground water pathway, actual contamination is a concept that applies only to targets and target locations, while observed release is not so restricted.

Level II Concentrations for the Ground Water Pathway: Level II concentrations are established in samples from drinking water wells in which the concentration of at least one hazardous substance meets the criteria for an observed release, but the conditions for Level I concentrations are not met. In addition, Level II is assigned for observed releases established by direct observation.

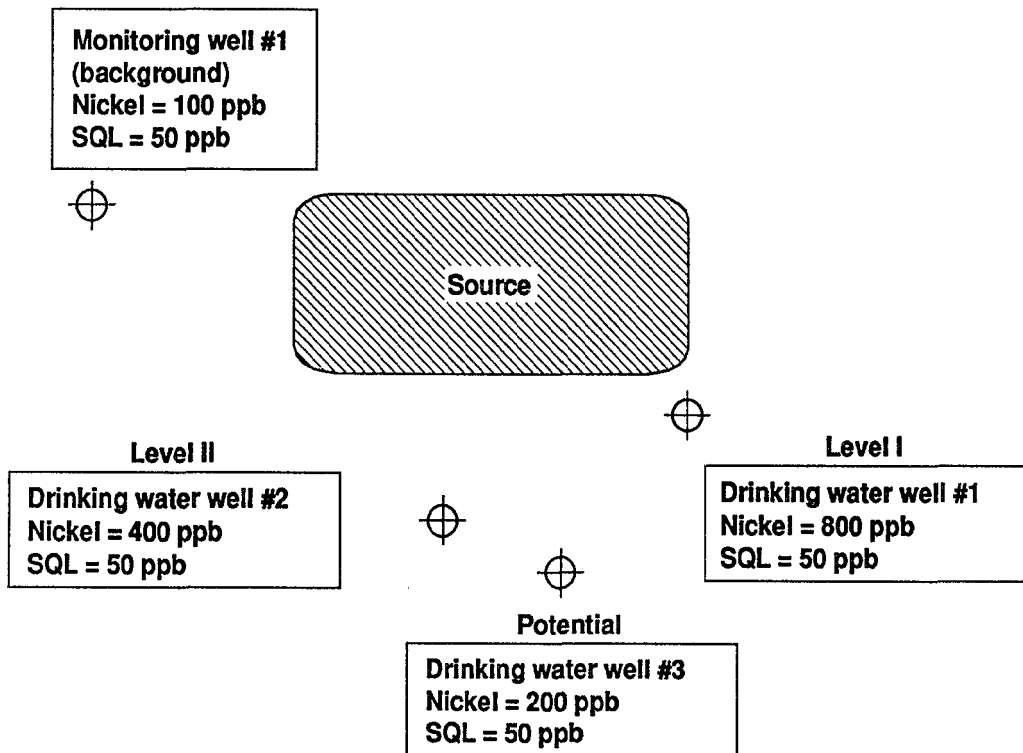
Highlight 7-25 illustrates wells with Level I, Level II, and potential contamination.

ESTABLISHING ACTUAL CONTAMINATION

The steps outlined below describe how to establish actual contamination based on chemical analysis for a single hazardous substance. Actual contamination based on direct observation is not discussed. These steps explain how to meet the observed release criteria at a target well and should be repeated for other hazardous substances to establish actual contamination for each individual hazardous substance, or to establish Level I contamination based on several hazardous substances using the I or J index. The data needed to establish actual contamination are summarized in *Highlight 7-26*.

- (1) **Compile analytical results that indicate that a hazardous substance has been detected in a drinking water well.** Results that show hazardous substances in monitoring wells cannot be used to document actual contamination, except for possible use as a background in establishing the observed release.
- (2) **Determine the background level for the hazardous substance.** Determining the appropriate background level requires analytical results from an appropriate background well for substances that could be naturally occurring, ubiquitous, or attributable to other sources in the areas. A background level of 0 can be assumed for substances that are neither naturally occurring, ubiquitous, nor attributable to other sources in the areas (i.e., a background sample may not be needed). See Chapter 5 for information on determining the appropriate background level for comparison with a drinking water well sample.
- (3) **Determine whether the concentration of the hazardous substance is significantly above background.** Detailed guidance for making this determination is found in Section 5.1, particularly *Highlight 5-2*.

**HIGHLIGHT 7-25
EXAMPLES OF WELLS SUBJECT TO
LEVEL I, LEVEL II, AND POTENTIAL CONTAMINATION**



- Drinking water wells #1 and #2 are subject to actual contamination. The concentration of nickel is above the SQL (50 ppb) and greater than three times the background level ($3 \times 100 \text{ ppb} = 300 \text{ ppb}$) at both wells. The ground water benchmark for nickel is 700 ppb.
 - Drinking water well #1 is subject to Level I contamination. The concentration of nickel (800 ppb) is higher than the benchmark of 700 ppb.
 - Drinking water well #2 is subject to Level II contamination. The concentration of nickel (400 ppb) is lower than the benchmark of 700 ppb.
- Drinking water well #3 is subject to potential contamination. The concentration of nickel (200 ppb) is above the SQL, but less than three times the background level.

HIGHLIGHT 7-26 DATA NEEDS FOR LEVEL OF CONTAMINATION

Actual Contamination

- Analytical results for drinking water wells
 - Concentrations of hazardous substances present in samples
 - Applicable DLs (i.e., SQL, CRQL, or DQ for hazardous substances in each sample).
- Background concentrations and applicable DLs of those hazardous substances detected in drinking water wells that are being used to document actual contamination
 - Should be comparable analytical results if hazardous substances could be naturally occurring, ubiquitous, or attributable to other sources in the area
 - If substances are not naturally occurring, not ubiquitous, and there are no other potential sources of that hazardous substance in the area, a background concentration of 0 can be assumed.

Level I or Level II

- Information listed above for actual contamination
- Health-based benchmarks for ground water for substances that meet observed release criteria (available in SCDM)

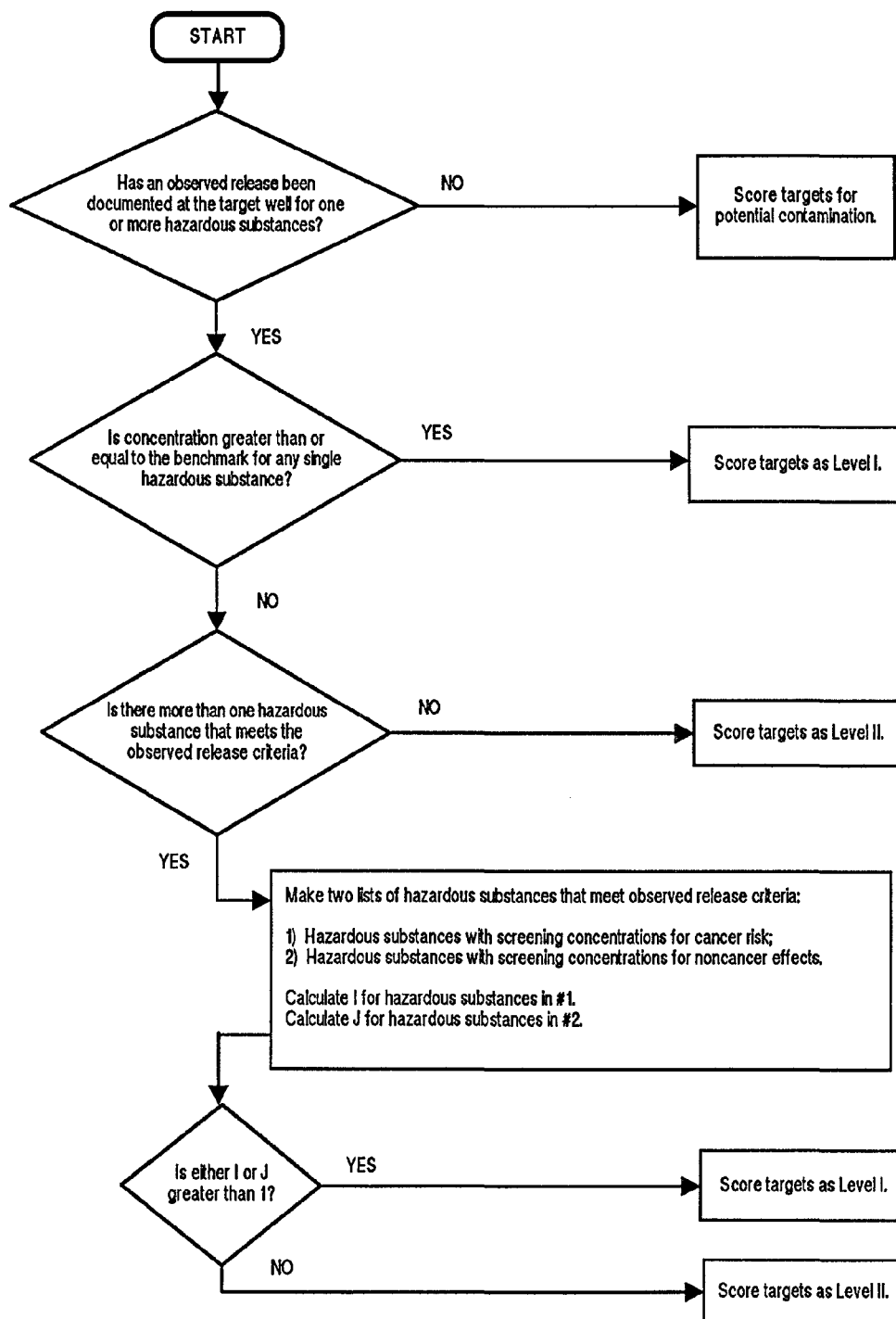
- (4) **Determine whether the hazardous substance can be attributed to the site.** Sampling results or records (e.g., manifests) indicating the presence of the hazardous substance in a source or sources at the site are the strongest documentation. Information that the hazardous substance was used at the facility also may be acceptable. See Chapter 5 for additional guidance on attribution, including attribution of degradation products.
- (5) **Repeat this process for as many hazardous substances as feasible at the site.**

DETERMINING LEVEL OF CONTAMINATION

The steps outlined below and in the flowchart in *Highlight 7-27* describe how to determine whether a target well should be scored as Level I, Level II, or potential contamination for an aquifer.

- (1) **Determine which wells are target wells for the aquifer being evaluated and perform Steps (2) through (4) for each well.**
- (2) **Determine whether actual contamination can be established for any hazardous substance detected in the well.** If actual contamination cannot be established (using the seven steps outlined above), score the well under potential contamination. If the well has not been sampled, score it under potential contamination, even if actual contamination has been established at downgradient wells. Note that if a well in an upper aquifer is subject to actual contamination and that well is also a target well for a lower aquifer, then that well is to be evaluated based on actual contamination when scoring the lower aquifer (see Section 7.9, Example 3).
- (3) **Compare the concentration of each hazardous substance that meets the observed release criteria for the well with its applicable benchmark for the ground water pathway.** Benchmarks are available in SCDM. If more than one benchmark applies (e.g., an MCL and a

HIGHLIGHT 7-27 FLOWCHART FOR DETERMINING LEVEL I, LEVEL II, OR POTENTIAL CONTAMINATION



screening concentration), then make the comparison only to the benchmark with the lowest concentration.

- If the concentration of any one or more of these hazardous substances is greater than or equal to its benchmark, score the well as Level I. Continue with the guidance provided in Section 7.5.
- If only one hazardous substance meets the observed release criteria and its concentration is less than its benchmark, score the well as Level II. Continue with the guidance provided in Section 7.5.
- If more than one hazardous substance meets the observed release criteria, but no single substance establishes Level I, continue to Step (4).

(4) **Calculate the I and J indices for all hazardous substances for this well that meet the observed release criteria.** Make two lists of substances that meet the observed release criteria: hazardous substances with screening concentrations for cancer risk; and hazardous substances with screening concentrations for noncancer effects. Each hazardous substance may be on one, neither, or both of the lists. If more than one sample has been taken from a well and these samples are comparable (e.g., taken in the same time frame, collected using the same field techniques, analyzed by the same methods), for each hazardous substance, select the highest concentration to use in the calculations below.

- Calculate the I index for all hazardous substances with screening concentrations for cancer risk that meet the observed release criteria, using the following equation:

$$I = \sum_{i=1}^n \frac{C_i}{SC_i}$$

where: C_i = concentration of substance i in well;
 SC_i = screening concentration for cancer risk, which is the concentration corresponding to 10^6 individual cancer risk for oral exposure for hazardous substance i; and
 n = number of hazardous substances that meet observed release criteria and for which an SC is available.

- Calculate the J index for all hazardous substances with screening concentrations for noncancer effects that meet the observed release criteria, using the following equation:

$$J = \sum_{j=1}^m \frac{C_j}{CR_j}$$

where: C_j = concentration of substance j in well;
 CR_j = screening concentration for noncancer effects, which is the concentration corresponding to the reference dose for oral exposure for hazardous substance j; and
 m = number of hazardous substances (1) that meet observed release criteria and (2) for which a CR is available.

- If either the I or J index is greater than or equal to 1, score the well as Level I. If both the I and J indices are less than one, score the well at Level II. An example of calculating the I and J indices is presented in **Highlight 7-28**.

HIGHLIGHT 7-28 CALCULATING I AND J INDICES

A well contains chemicals in the concentrations listed below. While no one of the chemicals alone was found in a concentration that would place the well in Level I, consideration of the chemicals in combination places the well in this category. When the I and J indices are calculated, the value for I is greater than 1 (i.e., 1.4) and the well is scored as Level I. This is true even though the J index is less than 1.

Chemical	Concentration C_i (mg/L)	Cancer Risk Screening Concentration SC_i (mg/L)	C_i/SC_i	I
X	4.7×10^{-4}	6.3×10^{-4}	0.75	1.36
Y	3.1×10^{-4}	4.2×10^{-3}	0.074	
Z	1.5×10^{-4}	2.8×10^{-4}	0.54	

Chemical	Concentration C_j (mg/L)	Reference Dose Screening Concentration CR_j (mg/L)	C_j/CR_j	J
X	4.7×10^{-4}	1.6×10^{-1}	0.0029	0.0039
Y	3.1×10^{-4}	6.7×10^{-1}	0.00046	
Z	1.5×10^{-4}	2.8×10^{-1}	0.00054	

SCORING SITES WITH ACTUAL CONTAMINATION

The determination of level of contamination is necessary to score the nearest well and population factors. In addition, establishing actual contamination may affect the minimum value for the hazardous waste quantity factor. **Highlight 7-29** summarizes the differences in scoring among wells subject to Level I Level II, or potential contamination. Detailed instructions for scoring nearest well and population factors for wells subject to actual contamination are provided in Section 7.5.

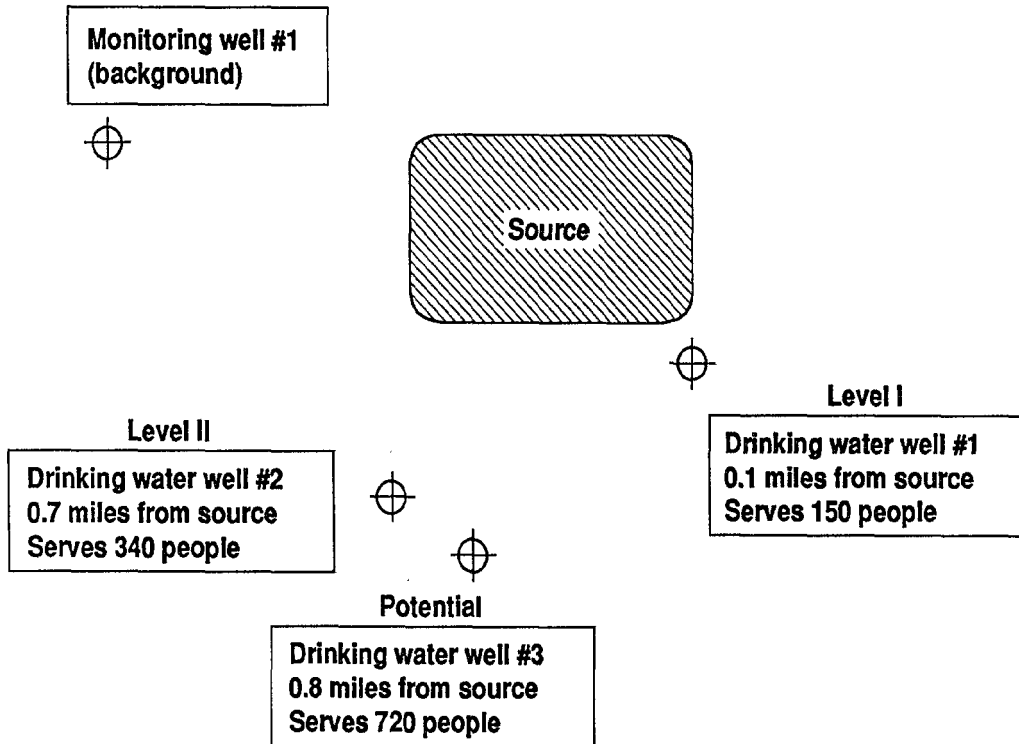
Highlight 7-30 illustrates scoring for Level I, Level II, and potential targets.

**HIGHLIGHT 7-29
COMPARISON OF SCORING LEVEL I, LEVEL II,
AND POTENTIAL CONTAMINATION**

Level of Contamination	Nearest Well Factor Value	Population Factor Value	Minimum HWQ Factor Value^a
Actual – Level I	50	10 x number of people	100
Actual – Level II	45	1 x number of people	100
Potential	0 to 20 – depends on distance to nearest drinking water well and presence of karst	0.1 x distance-weighted population	10 ^b

^a Minimum hazardous waste quantity factor values apply if Tier A is not adequately determined for all sources.
^b May be 100 in certain cases when there has been a removal action; see HRS section 2.4.2.2 and EPA's removal policy fact sheet.

**HIGHLIGHT 7-30
SCORING GROUND WATER POPULATION SUBJECT TO
LEVEL I, LEVEL II, AND POTENTIAL CONTAMINATION**



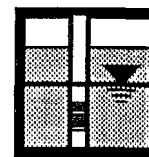
Factor	Factor Value
Level I: 150 x 10	= 1,500
Level II: 340 x 1	= 340
Potential ^a : 167 x 0.1	= 17
Population factor:	= 1,857

^a Because the wells are not in a karst aquifer, use the "other than karst" portion of HRS Table 3-12 to determine the distance-weighted population value. For a drinking water well 0.8 miles from the source, serving 720 people, the distance-weighted population value is 167.

TIPS AND REMINDERS

- Actual contamination cannot occur without an observed release, but an observed release does not necessarily establish actual contamination. Hazardous substances detected in drinking water wells or monitoring wells may be used to document a release; however, only hazardous substances in drinking water wells may be used to document actual contamination.
- Documenting actual contamination in a municipal well (or other wells serving multiple families) will generally result in a large number of targets points. Documenting one municipal well subject to actual contamination may provide a score greater than the cutoff. Consider sampling these types of wells if there is a possibility that they may be contaminated.
- If there is no Level I contamination, documenting actual contamination (Level II) in a single residential well results in 45 targets points for the nearest well factor plus one point for each person served by that well. Unless contamination is at Level I, actual contamination in additional residential wells may result in only a moderate number of additional targets points (i.e., one point per person served) and requires considerable effort and expense.
- Actual contamination cannot be inferred, even for wells that are within the TDL and between groups of contaminated wells.
- Former drinking water wells that have been abandoned can be scored based on actual contamination if (1) analytical data indicate an observed release at the wells when they were in use, and (2) the wells were closed because of site-related contamination.
- Assuming a maximum value for waste characteristics, for a site to score greater than or equal to the cutoff on the basis of actual contamination:
 - At least four people must be exposed at Level I contamination, assuming no Level II or potential populations;
 - At least 41 people must be exposed at Level II contamination, assuming no Level I or potential populations; or
 - Various combinations of populations may be exposed, such as two people exposed at Level I and 16 people exposed at Level II.
- Assign a minimum hazardous waste quantity factor value of 100 for the ground water pathway if a drinking water well is actually contaminated for any aquifer (not just the one being evaluated) and Tier A is not adequately determined for all sources.
- If wells in an upper aquifer that are subject to actual contamination are also target wells for a lower (non-interconnected) aquifer, then these wells still are evaluated based on actual contamination when scoring the lower aquifer. The likelihood of release value, however, is based on the lower aquifer (see Section 7.9, Example 3).
- In determining Level I contamination, if multiple benchmarks (e.g., an MCL and a cancer risk screening concentration) apply to a hazardous substance, use the benchmark with the lowest concentration in making the comparison.

SECTION 7.5 POPULATION AND NEAREST WELL FACTORS



The population factor in the ground water pathway evaluates the number of residents, students, and workers served by ground water wells (in the aquifer being evaluated and appropriate overlying aquifers) located within the TDL. The nearest well factor evaluates the threat to the maximally exposed individual and takes into account whether that individual is subject to actual or potential contamination. This section explains how to estimate the population (i.e., residents, students, and workers) that regularly uses ground water from wells within the TDL, how to score the ground water population factor, and how to score the nearest well factor.

The ground water population is the people served by wells located within the TDL, not the residents living within the TDL (see **Highlight 7-31**). People living within the TDL may obtain drinking water from wells outside the TDL or from surface water sources, and people living outside the TDL may obtain drinking water from wells located within the TDL.

RELEVANT HRS SECTIONS	
Section 3.0.1	General considerations
Section 3.0.1.1	Target distance limit
Section 3.3.1	Nearest well
Section 3.3.2	Population

DEFINITIONS

Nearest Well Factor: Factor for evaluating the maximally exposed well. This factor is based on the presence of actual contamination or, for aquifers where no drinking water well is subject to actual contamination, the presence of karst and distance to nearest drinking water well.

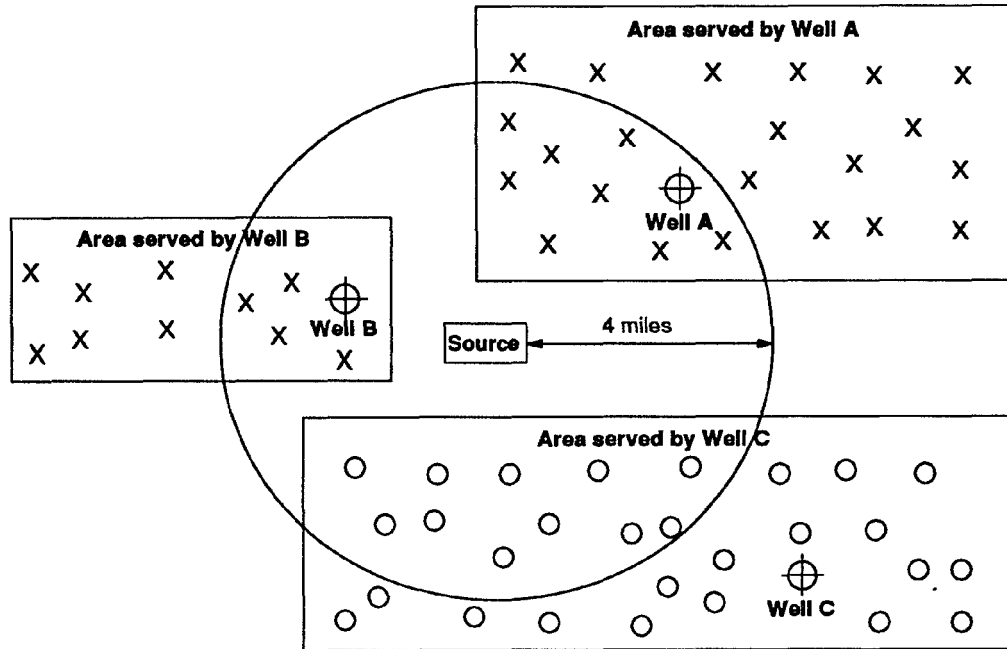
Population for the Ground Water Pathway: Number of residents, students, and workers regularly served by wells that are located within the TDL for the aquifer being evaluated (and appropriate overlying aquifers). This population does not include transient populations, such as hotel and restaurant patrons, but may include seasonal populations (e.g., a resort area).

Students: Full- or part-time attendees of an educational institution or day care that is served by a well located within the TDL.

Target Distance Categories: Concentric rings (not necessarily circular) with radii 1/4, 1/2, 1, 2, 3, and 4 miles from the sources at the site. These distance categories are used to group the wells subject to potential contamination for distance weighting.

Target Distance Limit for the Ground Water Migration Pathway: The distance over which targets are evaluated. The TDL is generally a 4-mile radius from sources at the site, except:

**HIGHLIGHT 7-31
IDENTIFYING TARGET AND NON-TARGET RESIDENCES**



X indicates a residence served by a target well
O indicates a residence served by a non-target well

All persons living in residences served by Wells A and B are included in estimating the ground water population. Because Well C is outside the TDL, persons served by Well C are not included in the ground water population.

NOTE: The situation above is presented for illustration purposes only. Typically, water from wells in a municipal system is blended together and distributed to residences in the municipal system. That is, a single municipal well generally does not serve a particular group of residences. Guidance on scoring blended water supplies is provided in Section 7.6.

- Include any drinking water well with an observed release attributed to the site, regardless of its distance from the source.
- Exclude wells completed in portions of an aquifer that are beyond an aquifer discontinuity (see Section 7.1).

Target Wells for Aquifer Being Evaluated: Wells that are located within the TDL, and drawing water from the aquifer being evaluated or an overlying aquifer through which hazardous substances would migrate.

Workers: Permanent employees (part-time or full-time) of a facility or business that is served by a well located within the TDL.

EVALUATING THE GROUND WATER POPULATION FACTOR

The steps below describe an approach to estimating the population served by target wells for the aquifer being evaluated. First, contact water authorities that have wells within the TDL to determine or estimate the population served by municipal water systems. (See **Highlight 7-32** for data needs that the water authority may be able to fulfill.) If the water authority provides an estimate of the population served by the system, use that number for your ground water target calculations. The water authority should know if the population served includes workers and/or students in addition to residents. If the population estimate does not include workers and/or students, it may be possible to modify the following methodology. The assumptions used should be clearly presented in the documentation record.

If the water authority provides just the total number of connections, then estimate the population served by multiplying the number of connections by the county average number of persons per household. After making an initial estimate of residential population served, estimate any student and worker populations served by the municipal system, and adjust the total. Next, evaluate residential populations served by private wells within the TDL. At each stage, evaluate whether documenting additional population will be important to the site score.

Depending on site circumstances, the scorer may conduct these steps in a different order. For example, if many people within the TDL use private wells or if private wells are subject to actual contamination, it may be more efficient to consider residential populations served by private wells before considering student or worker populations served by municipal connections.

- (1) **Draw target distance categories.** Draw concentric rings with radii 1/4, 1/2, 1, 2, 3, and 4 miles on a topographic map from the edges of the source. If there is an aquifer discontinuity, exclude any areas beyond the discontinuity. Remember that any well with a documented observed release attributable to the site is evaluated regardless of its distance from sources.
- (2) **Identify all municipal systems with target wells for the aquifer being evaluated.** Repeat Steps (3) through (5) for each system if more than one municipal system has wells within the TDL. If no municipal system has a well within the TDL, proceed to Step (7).
- (3) **Identify all system water supply units in the aquifer being evaluated or an overlying aquifer.** These units may include drinking water wells and standby wells. If the municipal system is a blended system, identify all wells inside and outside the TDL. Also identify all surface water intakes and standby intakes contributing to a blended system.
- (4) **Evaluate the population served by the municipal water system, assuming all service connections are residential.** Because connections to schools or businesses generally serve more individuals than those in a typical household, this assumption may result in a lower estimate of the target population. If this assumption yields a high score, however, time consuming inquiries to document student or worker populations may be avoided.

HIGHLIGHT 7-32 DATA NEEDS FOR GROUND WATER POPULATION

Obtain from Local, Municipal, or Other Water Authorities:

- Location of all municipal wells within the TDL and the aquifer(s) in which each is completed
- Number of persons reserved or service connections for each well that is not part of a blended system
 - If number of persons is provided, determine if number includes students and/or workers
 - If number of service connections is provided, obtain any available information about breakdown for connections to residences, schools, and businesses
- For wells in a blended system:
 - Total number of wells and intakes in the system (including those outside the TDL)
 - Total population served or number of service connections
 - Whether any well of intake provides more than 40 percent of the system's water
 - Average annual pumpage or capacity for each well (only needed if the water authority states that one well provides more than 40 percent of the system's water, or if the percent contribution of each well to the system needs to be determined by calculation)
- Delineation of areas within the TDL served by municipal water system

Obtain from Local Health Department, Water Commission, or Other Entity:

- Delineation of areas within the TDL not connected to the municipal system
- Information on where residents in these areas obtain water

Obtain from U.S. Bureau of Census Reports:

- Average number of persons per residence for each county served by target wells in the aquifer being evaluated.

Obtain from Business and Schools:

- Information on how they obtain water
- Number of workers and/or students

- Locate target municipal wells. Mark all municipal wells located within the TDL and completed in the aquifer being evaluated (or an overlying aquifer) on the map.
- Estimate population served by municipal wells, assuming all residential connections.
 - Independent systems. If a single well serves a particular group of residences and is not blended with water from other wells or surface water intakes, determine the number of service connections for that well. Multiply the number of connections by the county average number of persons per residence from, for example, U.S. Bureau of Census reports.
 - Blended systems. If the wells are part of a blended system, obtain information about the entire system in order to apportion the total population served to each well or intake. The necessary data include:
 - total number of people served or service connections for the blended system;
 - number of wells inside the TDL;
 - number of wells outside the TDL;
 - number of surface water intakes in the system;
 - whether any individual well or intake provides more than 40 percent of the water to the system; and
 - whether any wells or intakes are standby wells or intakes.

If any one well or intake provides more than 40 percent of the water to the system, collect data on the annual average pumpage or capacity for each well or intake (see Section 7.6, which provides additional information on apportioning population in blended systems). Multiply the number of service connections assigned to each well within the TDL by the average number of persons per residence.

- Identify any municipal wells subject to Level I or Level II concentrations for the aquifer being evaluated. (See Section 7.4.) Keep a separate count of persons served by wells contaminated at Level I or Level II; do not count them in the population subject to potential contamination for that aquifer. Tabulate data on number of persons served by level of contamination and, for wells subject to potential contamination, by karst/non-karst and target distance category.

(12) **Calculate a population factor value, assuming all residential connections. *Highlight 7-33*** illustrates tabulating populations and calculating the population factor value.

- Multiply the total number of individuals served by wells subject to Level I concentrations by 10.
- Multiply the total number of individuals served by wells subject to Level II concentrations by 1.
- Use HRS Table 3-12 to assign a distance-weighted population value for karst and non-karst for populations served by wells subject to potential contamination. For each target distance category, sum the karst and non-karst distance-weighted population values. Multiply the total distance-weighted population value by 1/10.

HIGHLIGHT 7-33
DOCUMENT GROUND WATER POPULATION FOR AN AQUIFER ^a

Level I Concentrations			
Level I Well	Population (individuals)	Reference ^b	
W-1	4	32,10, 11	
Level I Concentrations Factor Value: $1 \times 4 = 40$			
Level II Concentrations			
Level II Well	Population (individuals)	Reference ^b	
W-2	3	32, 10, 12,	
W-3	4	32, 10, 13	
Level II Concentration Factor Value: $1 \times [3 + 4] = 7$			
Potential Contamination			
Distance Category (miles)	Population (individuals)	Distance-weighted Population Value (other than karst)	Reference ^b
0 to 1/4	None	0	
>1/4 to 1/2	None	0	
>1/2 to 1	3241	1669	30, 25, 18
>1 to 2	3241	939	30, 25, 18
>2 to 3	8052	678	31, 25, 18
>3 to 4	None	0	
Potential Contamination Factor Value: $1/10 \times [1669 + 939 + 678] = 329$			
Total Population Factor Value: $40 + 70 + 329 = 376$			

^a The document should identify in which aquifer the well being evaluated is screened. All wells in this example are assumed to be screened in the same aquifer. If wells were completed in more than one aquifer, add a column to the table that identifies the aquifer.

^b The numbers in the reference column would identify particular references in the HRS scoring package.

- Sum the values calculated for Level I, Level II, and potential contamination to obtain the population factor value (for municipal wells, assuming residential connections only).
- (6) **Determine if documenting student or worker populations is cost effective.** If it is, continue to Step (7). If not, proceed to Step (9). In making this decision, consider:
- Ground water pathway score assuming all residential connections. If the ground water pathway scores well over 100 by assuming all residential connections, it may not be cost-effective to document the student or worker populations. However, note the presence of student or worker populations using wells within the TDL in the documentation record.
 - Position within ranges for determining distance-weighted population. If the population served by municipal wells located in a particular target distance category is in the lower part or middle of a broad range (HRS Table 3-12), documenting students and workers may not change the population factor value. However, if the population served by municipal wells is near the upper end of a range, a substantially higher population factor value might be achieved by documenting the students and workers. If the population is at the lower end of a range, evaluating the student or worker population may help solidify the score.
- (7) **Document student and/or worker populations.**
- Identify schools and businesses served by wells within the TDL. Obtain information from water authorities on schools and businesses served by the municipal system. Identify schools or businesses within the TDL that do not use municipal water (and thus may have a private well).
 - Document any schools or businesses served by wells subject to actual contamination.
 - For potential contamination, focus efforts generally on large schools (e.g., universities) or schools and businesses that are supplied by wells in the closer target distance categories.
 - For any newly identified private well, document that it is completed in the aquifer being evaluated or an overlying aquifer.
 - Document the number of students or workers for those schools or businesses identified.
 - Contact the school officials to document student population.
 - Contact the business in question to document worker population, or refer to business census data.
- (8) **Calculate a population factor value that includes the student/worker populations.** Follow the procedure outlined in Step (5) above. Be sure to subtract any service connections to schools or businesses from the total number of service connections (i.e., no longer assume all service connections are residential).
- (9) **Evaluate population served by private/community wells within the TDL.**
- Delineate areas served by municipal and private/community wells.

- **Municipal wells.** Some areas may be served by water systems with no wells within the TDL. Mark these areas on a topographic map(s). Generally exclude these areas from the evaluation of private/community wells.
 - **Private/community wells.** If some areas within the TDL are not supplied by a municipal water system, determine if they use private/ community wells (completed in the aquifer being evaluated or an overlying aquifer). Sources of this information include local agencies such as: water authority, public health department, or water commission. It may be helpful to mark areas that rely on private or community wells on a map.
- Estimate population served by private/community wells. Refer to the areas served by private/community wells (perhaps using the reference map). Use the most accurate information available to document this population. Computerized census data for small areas (e.g., block-by-block) are likely to be most accurate. If such data are not available, count the number of houses within these areas for each target distance category as indicated on a topographic map and multiply this number by the county average number of persons per residence. If the USGS map is outdated due to recent population growth (e.g., a new residential development), consider supplementing this house count using land use maps, aerial photographs, field counts, or other methods.
- (10) **Revise the tabulation of ground water population from Step (5).** Add the number of persons served by private wells to the appropriate category based on level of contamination and, for wells subject to potential contamination, karst/non-karst and target distance category. Use this revised tabulation to calculate a new population factor value.
- (11) **Calculate a population factor value that includes populations served by private wells.** Follow the procedure outlined in Step (5) above.

Highlight 7-34 provides an example of scoring the ground water population factor.

EVALUATING THE NEAREST WELL FACTOR

In evaluating the nearest well factor, consider all target drinking water wells for the aquifer being evaluated used by residents, students, or workers. Do not consider wells other than drinking water wells, nor wells used exclusively by transient populations.

- (1) **Determine If any drinking water well is scored based on actual contamination for the aquifer being evaluated.** If not, continue to Step (2). If so, score the nearest well factor as follows:
- If any target drinking water well is subject to Level I concentrations, assign a factor value of 50.
 - If any target drinking water well is subject to Level II concentrations, but no well is subject to Level I concentrations, assign a factor value of 45.
- (2) **Determine If any target drinking water well for the aquifer being evaluated is in a karst aquifer that underlies any portion of the sources at the site.** If not, continue to Step (3). If so, assign a nearest well factor value of 20.
- (3) **Determine the shortest distance to any target drinking water well for the aquifer being evaluated from any source at the site with a ground water containment factor value greater than 0.** Use HRS Table 3-11 to assign a nearest well factor value based on this distance.

HIGHLIGHT 7-34
SCORING EXAMPLE OF GROUND WATER POPULATION FACTOR

Water Supply: Blended municipal system consisting of 12 wells. No single well or intake supplies more than 40 percent of the system's water.

Location of Water Supply: Two of the municipal wells are located within the TDL;

W-A in the >1/2 - 1 mile category, and

W-B in the >1 - 2 mile category.

Neither well is subject to actual contamination. Both wells are completed in the aquifer being evaluated, which is non-karst.

Evaluation: The total number of service connections for the municipal system is 69,840. The entire area served by the municipal system lies within one county. 1990 census data indicate that the average number of persons per residence for that county is 2.8. Assuming all connections are residential, the total population served by the system is:

$$69,840 \times 2.8 = 195,552$$

Because no single well supplies more than 40 percent of the blended system's water, the scorer apportions the population equally to all 12 wells (see section 7.6 for guidance on evaluating blended systems):

$$W-A: (1/12) \times (195,552) = 16,296 \text{ persons}$$

$$W-A: (1/12) \times (195,552) = 16,296 \text{ persons}$$

Use HRS Table 3-12 to assign distance-weighted population values to each well for the aquifer.

Potential Contamination		
Distance Category (miles)	Population (individuals)	Distance-weighted Population Value (other than karst)
0 to 1/4	None	0
>1/4 to 1/2	None	0
1/2 to 1	16,296	5,224
>1 to 2	16,296	2,939
>2 to 3	None	0
>3 to 4	None	0
Potential Contamination Factor Value: $1/10 \times [5,224 + 2,939] = 816$		

Because no well is subject to actual contamination:

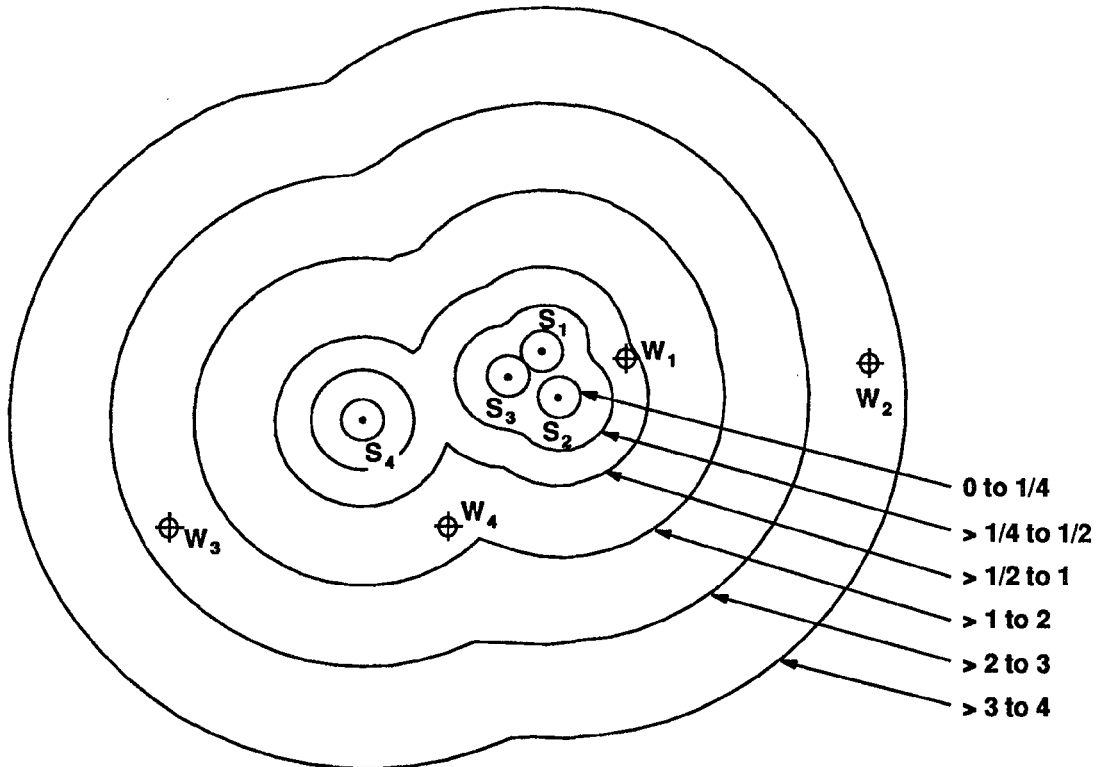
Population Factor Value = 816

EVALUATING GROUND WATER PATHWAY WHEN MULTIPLE SOURCES ARE PRESENT

This section presents two methods that may be used to evaluate the potential contamination and nearest well factors when multiple sources are present at a site.

- (2) In the first method (see **Highlight 7-35**), draw distance categories independently around every source, determine aggregate distance categories (e.g., make overlapping rings of the same distance category), and total the population subject to potential contamination from drinking water wells for each distance category. The total populations for each distance category are then used to determine the potential contamination factor value. Individuals are counted only once (except when an individual is a resident and a student or worker), in the distance category for the well nearest to a source and used by the individual. The distance to the nearest well is the shortest distance from any source with ground water containment greater than 0 to any target drinking water well for the aquifer being evaluated. At sites with a large number of sources, this method may be time-consuming and inefficient. Because factor values are assigned based on population range within distance categories, a simplified method may be used with little or no impact on the pathway score.
- (3) In this method (see **Highlight 7-36**), the nearest well is measured from any eligible source (i.e., as in the first method). However, rather than calculate the population subject to potential contamination for all sources, the scorer determines which source or sources will give the most representative score for the site based on distances to wells from each source and populations served by each well. Distance categories are drawn only for this source (or sources). This method is most effective for sites with a large number of sources and for sites with large populations using wells within the TDL. Note, however, that this method may underestimate target scores.

**HIGHLIGHT 7-35
ESTABLISHING TARGET DISTANCE CATEGORIES: METHOD 1**



Well

W₁ - Population = 750
 W₂ - Population = 1000
 W₃ - Population = 3000
 W₄ - Population = 1500

Nearest Well Value = 9

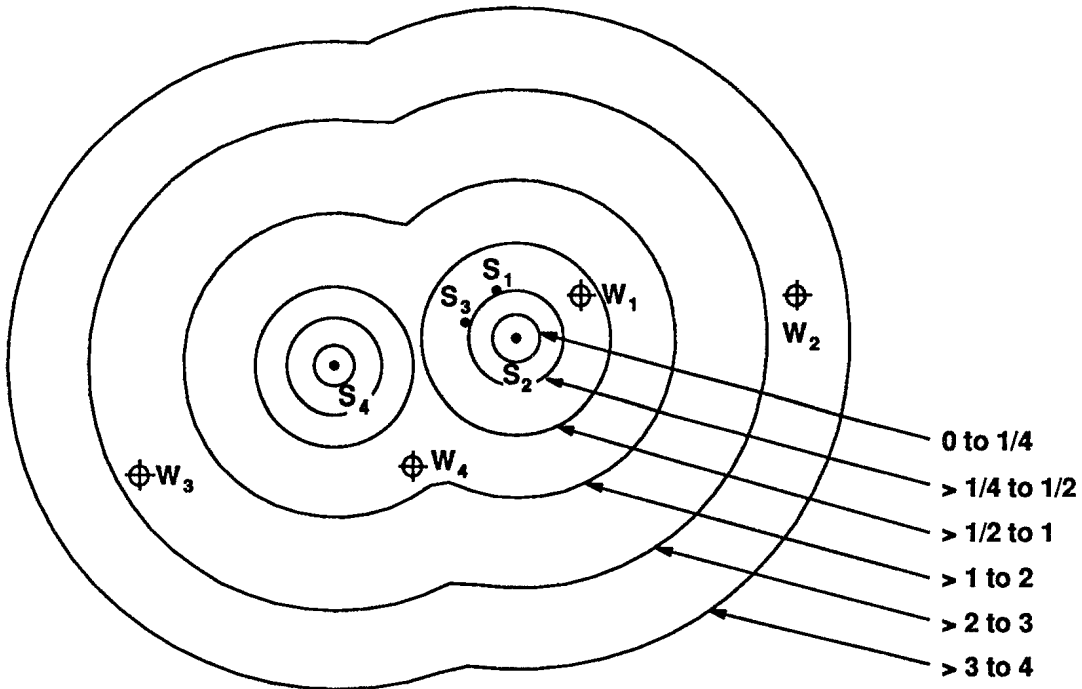
Potential Contamination Factor Value = 72

(Well 1, >1/2 to 1 mile from Source 2)

(>1/2 to 1 mile = 750
 >1 to 2 miles = 1500
 >2 to 3 miles = 3000
 >3 to 4 miles = 1000)

- Measure the nearest well distance from the nearest source.
- Draw distance categories around every source, and then determine aggregate distance categories.
- Sum the population subject to potential contamination assigned to wells within each specified distance category to determine the total population for each distance category (e.g., sum the populations subject to potential contamination for >1 to 2 mile distance for all sources to get a total potential contamination population value for the >1 to 2 mile distance category).
- Count individuals only once (except when an individual is a worker, student, and/or resident). Assign each target well to the distance category nearest to a source (e.g., Well 4 in this diagram would be counted only in the 1 to 2 mile distance category for Source 4 and would not be counted for other sources).
- This method may be unwieldy and time-consuming for sites with many sources. For such sites, a simplified method (method 2) may be followed with little or no impact on the overall site score.

**HIGHLIGHT 7-36
ESTABLISHING TARGET DISTANCE CATEGORIES: METHOD 2**



Well

W₁ - Population = 750
 W₂ - Population = 1000
 W₃ - Population = 3000
 W₄ - Population = 1500

Nearest Well Value = 9

Potential Contamination Factor Value = 72

(Well 1, >1/2 to 1 mile from Source 2)

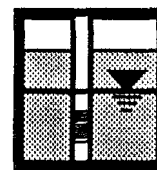
(>1/2 to 1 mile = 750
 >1 to 2 miles = 1500
 >2 to 3 miles = 3000
 >3 to 4 miles = 1000)

- Measure the nearest well distance from the nearest source.
- Determine which well or wells may give the most representative score for the site based on distances to wells from each source and populations served by each well.
- Draw distance categories around only those sources significantly affecting the potential contamination factor.
- In this example, the nearest well is calculated from Source 2 and the population subject to potential contamination could be calculated from Sources 2 and 4 because Sources 1 and 3 would not contribute significantly to the total population score (compare with **Highlight 7-35**).
- This method may simplify scoring efforts at sites with many sources or dense populations, with little or no impact on the overall score. However, in some instances, it may underestimate the ground water population factor value.

TIPS AND REMINDERS

- Determine if individuals are within the TDL by the location of their well, not the location of their residence, school, or workplace.
- If a maximum score for the ground water pathway can be reached by evaluating only municipal wells, it may not be necessary to include the population served by private wells in the scoring. If people in the area use private wells, note this fact in the documentation record. One exception is that any well subject to Level I concentrations should be evaluated.
- Remember that the distance-weighted population values for potential contamination are assigned based on population ranges. Documenting a few private wells subject to potential contamination will result in a different population factor value only if the original population estimate was at the higher end of the range.
- The nearest well factor may have a significant effect on pathway score; therefore, evaluate this factor as accurately as possible. The nearest well factor can be scored based only on drinking water wells.
- Include the population using wells that were closed because of site-related actual contamination in estimates of the ground water population. This population should reflect the number of people using the well at the time it was closed.
- If a drinking water system being evaluated includes portions of more than one county and the specific number of residences supplied in each county is known, use county-specific estimates of persons-per-residence. Otherwise, use the lowest persons-per-residence figure to estimate the entire population served.
- An individual may be counted as a resident and as a student or worker. If an individual lives and attends school at locations served by drinking water wells within the TDL, count that individual as a resident and as a student.
- Well logs obtained from local drillers are a good data source for determining in which aquifer(s) private wells are completed. In areas with a large number of private wells, one way of documenting how many wells are completed in each of two aquifers is to obtain a representative sample of well logs and assume the same ratio for all private wells in the area.

SECTION 7.6 BLENDED WATER SUPPLIES



The population factor for the ground water pathway is evaluated based on level of contamination (i.e., Level I, Level II, and potential contamination) and on the locations of the ground water wells that supply people with drinking water. In some instances, discrete populations can be linked directly to individual water wells. In other cases, water from multiple wells and/or surface water intakes is blended prior to or during distribution to a target population. This section provides guidance on evaluating the population factor in the ground water pathway when water from multiple wells, or wells and surface water intakes, is blended prior to or during distribution.

In general, the HRS provides for dividing a target population among all the water supplies that contribute to a blended distribution system in either of the following two ways:

- If no supply unit contributes more than 40 percent (based on average annual pumpage or capacity) of the total supply, divide population equally among all the units.
- If any one supply unit provides more than 40 percent, estimate the percentage contribution of each unit and assign each a percentage of the population based on its relative contribution.

RELEVANT HRS SECTION	
Section 3.3.2	Population

DEFINITIONS

Blended Water Distribution System: A drinking water supply system that can or does combine (e.g., via connecting valves) water from more than one well or surface water intake, or from a combination of wells and intakes.

Capacity: The amount of water a well or intake can deliver to a water distribution system. Capacity may be expressed in units that are equivalent to a pumpage rate or as a percentage of the system's requirements.

Pumpage Data: A measure of the volume of water per unit of time discharged from a well, or collected within an intake, either by pumping or free flow. Well pumpage is commonly measured in gallons per minute (gpm), cubic meters per day (m^3/day ; $1\text{ gpm} = 5.45\text{ M}^3/day$), or cubic feet per second (cfs; $1\text{ gpm} = 0.0023\text{ cfs}$). Pumpage data may also be termed well production data, well discharge data, well flow data, well yield data, pumping line data, and for intakes, intake pipe flow data. For HRS purposes, pumpage data relate to the measured or estimated rate of water withdrawal from a well or intake, not from a storage tank or reservoir used as a receptor for water drawn from one or more wells and/or intakes. See **Highlight 7-37** for more information on pumpage data.

HIGHLIGHT 7-37 PUMPAGE AND CAPACITY DATA

A water authority may provide data on the contribution of each well or intake to the total blended water system in several forms, including pumpage, capacity, or specific capacity. All data used to apportion population must be of the same type (e.g., do not use capacity data for some wells or intakes and pumpage data for others) and in the same units. An abbreviated conversion table is provided below.

1 gal/min	= 0.00223 ft ³ /sec	= 5.45 m ³ /day
1 ft ³ /sec	= 448.8 gal min	= 2,447 m ³ /day
1 m ³ /day	= 4.09 X 10 ⁻⁴ ft ³ /sec	= 0.183 gal/min

Pumpage. Many water authorities keep pumpage records expressed as the total quantity of water pumped in a given interval, usually a day, a month, or a year, not in terms of pumpage for the period during which a well is used. Metered pumpage data are the most reliable. However, estimates of pumpage calculated by the water authority based on engineering parameters built into the well or intake design, construction, and pump configuration may also be acceptable.

Capacity. The sum of the capacities may represent more than the total needs of the system. The relative capacity of each component, however, may be calculated by dividing the capacity of the component by the sum of the capacities of all the components. This normalization procedure means that the sum of the relative capacities of all the components in the system will total 100 percent.

Specific Capacity. Because it is difficult to derive an equivalent term for surface water intakes, specific capacity data should only be used when the blended water system is supplied exclusively by ground water wells and when the specific capacity data are available for all wells in the system. If necessary, convert the specific capacity data for multiple wells to uniform units, then calculate the percentage contribution of each well to the blended system.

Standby Wells. When using pumpage data for a standby ground water well, use average pumpage for the period during which the standby well is used rather than average annual pumpage (HRS section 3.3.2). See Section 7.7 for additional information.

Specific Capacity: An alternative term to capacity that is associated with acceptance testing of ground water wells. Specific capacity is reported as the rate at which water is discharged from a well per unit drawdown in the aquifer in which the well is completed. This is usually expressed in gallons per minute per foot of drawdown (gpm/ft) or cubic meters per day per meter of drawdown (m³/d/m). The latter term may appear in the technical literature as m²/d.

Standby Well: A well held in reserve by a water supply entity (e.g., agency, authority, cooperative, private company, or individual) and maintained for use. It is designated as a drinking water supply well for use during a water supply shortage or emergency such as pump failure, drought, sudden water quality deterioration, or interruption in the regular supply. Additional terms commonly used to signify standby wells include reserve wells, drought wells, safety wells, emergency wells, backup wells, substitute wells, and uncommitted wells.

SCORING THE POPULATION FACTOR FOR BLENDED WATER SUPPLIES

The steps below outline the procedure for evaluating the population factor for blended water supplies, **Highlight 7-38** summarizes the data needed.

HIGHLIGHT 7-38 DATA NEEDFOR EVALUATING BLENDED SYSTEMS

The typical data needed to evaluate the population factor when blended water systems are involved can include all of the following:

- Identification of all the water supply entities potentially affected by site activities
- Number and location of water supply units (i.e., ground water wells, surface water intakes, standby/emergency supplies).
- Well completion data for those wells identified as water supply units.
 - Aquifer used
 - Screened interval
 - Water use
 - Well owner
- Specifics of the water distribution system
 - Geographic extent
 - Number and types of connections (residential, industrial, commercial)
- Pumpage and/or capacity data for wells and intakes expressed in comparable units.

Much of the information required to evaluate blended water systems can be collected directly from the water supply entities or local regulatory authorities. In addition, because some of the required information relates specifically to water resources studies, the district office of the Water Resources Division of the U.S. Geological Survey and its state counterpart should be contacted as necessary. These governmental units can provide more detailed well and flow data through such publications as their Water Resources Investigation series, the Hydrologic Atlas series, and annual reports on specific river basins.

- (1) **Identify all blended water supply systems that may have wells within the TDL.** If there is more than one blended system, repeat the following steps for each system. If a blended system supplies water to another blended system or receives water from another blended system, refer to the subsection below, Scoring Multiple Blended Systems.
- (2) **Identify all water supply units for the blended system.** The units may include ground water wells, surface water intakes, and standby/emergency supplies. Obtain this information from the water supply entity and mark the location of each supply unit on a topographic map. Information on surface water intakes and wells that are not within the TDL or not in the aquifer being evaluated is needed to correctly apportion the population served.
- (3) **Determine which wells to evaluate as targets for the population factor.**
 - Include as targets only wells that are within the TDL. Remember that any well subject to actual contamination is evaluated regardless of its distance from sources.
 - Include as targets only wells that are completed in the aquifer being evaluated (or an overlying aquifer).
 - If the blended system includes standby wells, see Section 7.7 for more detailed guidance on evaluating standby wells. Include or exclude some, all, or none of the standby well(s) to obtain the highest population factor. Exclude all standby surface water intakes.

- (4) **Determine the total number of persons served by the blended system.** Obtain this information from the water supply entity. If the data are provided in terms of service connections rather than persons served, multiply the number of service connections by the average number of persons per residence for the county. For more details on this evaluation, see Section 7.5.
- (5) **Determine whether any single well or intake supplies more than 40 percent of the system's water.** Obtain this information from the water supply entity, if possible.
- (6) **Apportion the population in the blended system as follows:**
 - If no single well or intake supplies more than 40 percent of the system's water, apportion the population equally to all wells and intakes in the system (i.e., divide the total population by the number of wells and intakes).
 - If a single well or intake supplies more than 40 percent of the system's water, apportion population to each well or intake based on the percentage of water it supplies. Use average annual pumpage or capacity (see **Highlight 7-39**) to determine the percentage of water each well or intake supplies.
- (7) **Tabulate the population assigned to target wells for the aquifer being evaluated by:**
 - Actual (Level I or II) or potential contamination
 - Karst and non-karst (for wells subject only to potential contamination)
 - Target distance categories (for wells subject only to potential contamination).

Highlights 7-39 and **7-40** illustrate scoring the population factor for blended systems.

SCORING MULTIPLE BLENDED SYSTEMS

Some blended water systems receive water from (or supply water to) another blended water system via one or more water mains. The steps below describe how to apportion population to each supply well or intake in such cases. The blended system that supplies water is referred to as System S; the blended system that receives water is referred to as System R. Note that if two or more blended systems provide water to each other, evaluate both as just one combined blended system; do not use the steps below.

APPORTION POPULATION SERVED BY RECEIVING SYSTEM (SYSTEM R)

- (1) **Determine population served by System R.** This step is identical to that for a normal blended system. Do not include the population served by the supplying system in the total.
- (2) **Identify all water supply units for System R.** The units are wells in System R, surface water intakes in System R, and water mains from the supplying system. Treat each water main in the same manner as one well or intake.
- (3) **Determine whether any single System R water supply unit provides more than 40 percent of System R's total water.** Note that the mains from System S are considered in this determination.
- (4) **Apportion the population in System R as follows:**
 - If no water supply unit supplies more than 40 percent of the system's water, apportion the population equally to each water supply unit in System R.

HIGHLIGHT 7-39
SCORING EXAMPLE OF SINGLE BLENDED SYSTEM WITH WELLS
OUTSIDE THE TARGET DISTANCE LIMIT

Site Setting: A mixed-use suburban community.

Water Supply: Single ground water authority with one water treatment plant. Seven wells (all completed in the aquifer being evaluated) supply water to the treatment plant prior to distribution.

Location of Water Supply

- One well between 1/2 and 1 mile of the site
- One well between 2 and 3 miles of the site
- Two wells between 3 and 4 miles of the site
- Three wells in a well field 5 miles from the site

The water authority reports 100,000 residential connections.

Population Served:

The population density in the county in which the site is located is 2.5 persons per residence. Assuming all residential connections:

Population served = 100,000 x 2.5 = 250,000 people

Evaluation:

No Level I or Level II contamination is identified. Evaluate population based on potential contamination. The water authority reports no well contributes more than 40 percent to the system. Therefore, assign 35,714.3 people (250,000/7) to each well in the system (do not round at this point).

Distance-weighted population values (non-karst) are:

Between 1/2 and 1 mile (one well: 35,714 people)	16,684
Between 2 and 3 miles (one well: 35,714 people).	6,778
Between 3 and 4 miles (two wells: 71,428 people)	4,171
Beyond 4 miles (three wells: 107,143 people)	N/A

Total distance-weighted population value 27,633

Potential contamination factor value = 1/10 x 27,633 = 2,763

Population factor value = 2,763

HIGHLIGHT 7-40
SCORING EXAMPLE FOR TWO SEPARATE BLENDED SYSTEMS

Site Setting: A densely populated urban center.

Water Supply: Two water authorities (Systems A and B) with separate water treatment plants and separate distribution systems. All wells are completed in the aquifer being evaluated.

- System A is supplied by four ground water wells.
- System B is supplied by five ground water wells.

Location of

Water Supplies: System A:

- One well between 1 and 2 miles of the site
- One well between 2 and 3 miles of the site
- Two wells between 3 and 4 miles of the site

System B:

- Two wells between 3 and 4 miles of the site
- Three wells more than 4 miles from the site

Population

Served: The population density in the county served by the water systems is 2.5 persons per residence.

Water Authority A reports 80,000 residential connections.

$$\text{Population served by System A} = 80,000 \times 2.5 = 200,000 \text{ people}$$

Water Authority B reports 20,000 residential connections.

$$\text{Population served by System B} = 20,000 \times 2.5 = 50,000 \text{ people}$$

Evaluation:

No Level I or Level II contamination is identified. Evaluate population based on potential contamination. Both water authorities report no wells contributing more than 40% of their total needs.

Assign 50,000 people (200,000/4) to each System A well.

Assign 10,000 people (50,000/5) to each System B well.

The distance-weighted population values (non-karst) are:

Between 1 and 2 miles (System A - 50,000)	9,385
Between 2 and 3 miles (System A - 50,000)	6,778
Between 3 and 4 miles (System A - 100,000; System B - 20,000)	13,060
Beyond 4 miles (System B - 30,000)	N/A

Total distance-weighted population value 29,223

Potential contamination factor value = 1/10 x 29,223 = 2,922

Population factor value = 2,922

- If a water supply unit supplies more than 40 percent of the system's water, apportion population to each water supply unit based on the percentage of water it supplies. Use average annual pumpage or capacity to determine the percentage of water supplied by each well, intake, or main.

- (5) **Apportion the population to the wells and intakes in System R, plus the mains from System S.** Then, for System R determine which wells are within the TDL. Tabulate only the population served by System R wells. Do not include the population apportioned to mains from System S. In some cases, no System R wells will be within the TDL for the aquifer being evaluated. Even in these cases, population must be apportioned so that System S can be evaluated. As with all blended systems, the population is tabulated by level of contamination and, for wells subject to potential contamination, by karst/other than karst and target distance category.

APPORTION POPULATION SERVED BY THE SUPPLYING SYSTEM (SYSTEM S)

- (1) **Determine the total population served by System S.** This population includes all people served by System S plus some of the people served by System R.

- Refer to Step (4) above for the number of people served by System R that were apportioned to each System S water main.
- Add this number to the population served directly by System S to calculate the total population served by System S.

After calculating the total population served by System S, ignore the water mains for the rest of these steps.

- (2) **Identify all water supply units for System S.** The water supply units are ground water wells in System S and surface water intakes in System S. The water mains to System R are not water supply units for System S.

- (3) **Determine whether any single System S well or intake supplies more than 40 percent of System S's water.**

- (4) **Apportion the population in System S as follows:**

- If no well or intake supplies more than 40 percent of the system's water, apportion the population equally to all wells and intakes in System S.
- If a well or intake supplies more than 40 percent of the system's water, apportion population to each well or intake based on the percentage of water it supplies. Use average annual pumpage or capacity to determine the percentage of water each well or intake supplies.

- (5) **Include the population apportioned to any System S well within the TDL in the tabulation of population served for the aquifer being evaluated.** As with all blended systems, the population is tabulated by level of contamination and, for wells subject to potential contamination, by karst/non-karst and target distance category.

An example of apportioning population to two blended systems in which one is supplying water to the other is provided in **Highlight 7-41**.

HIGHLIGHT 7-41
SCORING EXAMPLE FOR MULTIPLE BLENDED SYSTEMS

Water Supply: System R: Blends water from four wells and receives water from System S via 2 water mains; no single well or main provides >40% of the system's water.

System S: Blends water from eight wells; no well provides >40% of the system's water.

Location of Wells:

System R: 2 wells > 1-2 miles from the site
 2 wells > 2-3 miles from the site

System S: 2 wells > 3-4 miles from the site
 Other 6 wells outside TDL

Population Served:

System R: 30,000 people
 System S: 20,000 people

Evaluation: Apportion population served by receiving system - System R

Number of water supply units = 4 wells + 2 mains = 6 units
 People/unit = 30,000/6 = 5,000

Assign 5,000 people to each System R well and to each water main from System S.^a

Apportion population served by supplying system - System S

Total Population = 20,000 (population served by System S) + 10,000 (population apportioned to the two water mains supplying system R) = 30,000

Number of water supply units = 8 wells
 People/unit = 30,000/8 = 3,750

Assign 3,750 people to each System S well.^a

Population Factor:

The distance-weighted population values (non-karst) are:

Between 1-2 miles (2 System R wells = 10,000 people) 939
 Between 2-3 miles (2 System R wells = 10,000 people) 678
 Between 3-4 miles (2 System S wells = 7,500 people) 417

Total distance-weighted population value 2,034

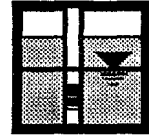
Potential contamination factor value = 1/10 x 2,034 = 203

^aNote that the total number of individuals allocated to wells is 50,000 (i.e., 5,000 for each System R well and 3,750 for each System S well). Although the total allocated is the same total as the population served (i.e., 20,000 plus 30,000), the population assigned to systemS wells is greater than that served by System S (i.e., 30,000 versus 20,000) while the population allocated to System R wells is less than that served by System R (i.e., 20,000 versus 30,000).

TIPS AND REMINDERS

- If no single well or intake supplies more than 40 percent to the total blended system, apportion the population equally to all wells and intakes even if more definitive information is available. Equal apportionment simplifies the scoring process and provides a nationally consistent approach.
- Allocate population served to each well or intake in the blended system, but only include in the evaluation of the aquifer those populations that are allocated to wells located within the TDL.
- When two or more blended systems provide water to each other, evaluate both as one combined blended system.
- If some wells in a blended system are subject to actual contamination and some to potential contamination, first use the rule for apportioning population for a blended system to assign a population to each well. Then score the population assigned to each well based on whether Level I, Level II, or potential contamination applies to that well.

SECTION 7.7 STANDBY WELLS



This section defines standby wells and associated terms, provides guidance regarding the use of standby wells to evaluate certain targets factors in the ground water pathway, and explains how to apportion population to standby wells. If a standby well located within the TDL draws water from the aquifer being evaluated or from any overlying aquifer, the well may be used to evaluate both the nearest well and population factors. To designate a standby well as the nearest well, HRS section 3.3.1 states that it must be "used for drinking water supply at least once every year." A standby well can be used to evaluate the population factor when it is "maintained on a regular basis so that water can be withdrawn" (HRS section 3.3.2). Standby wells are not considered in the evaluation of the resources factor.

Highlight 7-42 summarizes the use of standby wells in evaluating targets.

RELEVANT HRS SECTIONS	
Section 3.3.1	Nearest well
Section 3.3.2	Population

DEFINITIONS

Annual Use: Criterion for determining whether a standby well may be used to evaluate the nearest well factor. To meet this criterion, a standby well generally should supply drinking water for at least one 24-hour period in a year.

Pumpage Data: A measure of the volume of water per unit of time discharged from a well, or collected within an intake, either by pumping or free flow. Well pumpage is commonly measured in gallons per minute (gpm), cubic meters per day (m³/day; 1 gpm = 5.45 m³/day), or cubic feet per second (cfs; 1 gpm = 0.0023 cfs). Pumpage data may also be termed well production data, well discharge data, well flow data, well yield data, pumping line data, and for intakes, intake pipe flow data. For HRS purposes, pumpage data relate to the measured or estimated rate of water withdrawal from a well or intake, not from a storage tank or reservoir used as a receptor for water drawn from one or more wells and/or intakes.

Regular Maintenance: The routine inspection, cleaning, and testing of a well so that it can be ready for immediate use. This is a criterion for determining whether a standby well may be used to evaluate the population factor. Regular maintenance of a standby well may include direct measurement of the static water level, inspection of the well and pump, and testing of the pump. Such activities generally should be conducted at least once a year, and the operating authority should consider the well functional. Rehabilitation activities, with the intent of retaining a standby well in a state of readiness, also can be considered regular maintenance. Such activities include pump cleaning and lubrication, screen and gravel pack cleaning, and treatment for encrustation and/or biofouling.

Specific Capacity: An alternative term to capacity that is associated with acceptance testing of ground water wells. Specific capacity is reported as the rate at which water is discharged

HIGHLIGHT 7-42

DATA NEEDS AND SOURCES FOR STANDBY WELLS

- Consider both the definition of standby well and the aquifer in which it is completed in identifying eligible standby wells.
- Document annual use when evaluating the nearest well factor.
- Document regular maintenance when evaluating the population factor.
- Do not consider when evaluating resources.
- Contact water supply entities (or regulatory authorities) directly to obtain the following data needed to evaluate standby wells:
 - Ensure that the well is one that is held in reserve to be used during a water supply emergency.
 - Confirm that the well is regularly maintained.
 - Obtain well logs or completion records that link the standby well to either the aquifer being evaluated or an overlying aquifer.
 - Additional information (e.g., pumpage or capacity data) may be required when apportioning populations to standby wells and then using the standby well to evaluate the population factor (See Section 7.7).

from a well per unit drawdown in the aquifer in which the well is completed. This is usually expressed in gallons per minute per foot of drawdown (gpm/ft) or cubic meters per day per meter of drawdown ($\text{m}^3/\text{d}/\text{m}$). The latter term may appear in the technical literature as m^2/d .

Standby Well: A well held in reserve by a water supply entity (e.g., agency, authority, cooperative, private company, or individual) and maintained for use. It is designated as a drinking water supply well for use during a water supply shortage or emergency such as pump failure, drought, sudden water quality deterioration, or interruption in the regular supply. Additional terms commonly used to signify standby wells include reserve wells, drought wells, safety wells, emergency wells, backup wells, substitute wells, and uncommitted wells.

Wellfield Rotation Program: Program in which wells within a water supply system are used only for specified intervals. Generally, a pattern is repeated until every supply well has been used, and then the entire cycle is repeated. Rotation programs are designed to minimize drawdown interference and to maximize efficient use of water in relation to varying water demand. Do not consider a well that is part of a planned wellfield rotation program a standby well.

SCORING THE NEAREST WELL FACTOR USING STANDBY WELLS

Follow the general steps given below to evaluate the nearest well factor based on a standby well.

- (1) **Identify target standby wells.** The well must meet the definition of standby well and be within the TDL for the aquifer being evaluated. If the standby well is subject to actual contamination, it can be evaluated regardless of its distance from sources.

- (2) **Determine whether a target standby well is eligible to be used to score the nearest well factor.** The standby well can be used to score the nearest well factor if:
 - It is used to supply drinking water.
 - It has been used annually (as defined above). It is not necessary to document that the well has been used annually for the entire time it has been designated as a standby well. Documenting recent annual use (e.g., for the past five years) generally is sufficient. If the well was brought into a state of readiness only within the past few years, annual use since that time should be documented.
- (3) **Use the eligible standby well as the nearest well if it results in a higher factor value score than any regular well.** This could occur if the standby well is subject to actual contamination and the regular wells are not, or if the standby well is closer to the sources at a site (or possibly if the standby well is in a karst aquifer and the regular wells are not).

SCORING THE POPULATION FACTOR USING STANDBY WELLS

- (1) **Identify target standby wells.** The well must meet the definition of standby well and be within the TDL for the aquifer being evaluated. If the standby well is subject to actual contamination, it can be evaluated regardless of its distance from sources.
- (2) **Determine whether a target standby well is eligible to be used to score the population factor.** The standby well can be used to score the population factor if it:
 - Is used to supply drinking water
 - Has been regularly maintained (as defined above)
- (3) **Calculate the population factor with and without the standby well.**
 - If there is more than one eligible standby well, calculate the population factor value for various combinations of wells. Each combination must include:
 - All regular wells (and regular surface water intakes)
 - Some, all, or none of the standby wells (standby switches are not included)
 - None of the standby surface water intakes
 - Do not assign the same population to both a standby well and a regular well or surface water intake.
 - Use the average pumpage (e.g., gallons per minute) for the period during which the standby well is used (i.e., do not attempt to annualize pumpage data for standby wells as done for regular wells). If these data are not available, use capacity for all wells to calculate the population factor. **Highlight 7-43** provides additional information on pumpage and capacity data for standby wells.
- (5) **Choose the combination of regular and standby wells that results in the highest population factor value for the aquifer being evaluated.**

Highlight 7-44 provides an example of calculating average pumpage for a standby well. **Highlight 7-45** provides an example of scoring the population factor using a standby well.

HIGHLIGHT 7-43 PUMPAGE AND CAPACITY DATA FOR STANDBY WELLS

If no well or intake provides more than 40 percent of the total water supply for the system, simply apportion the population equally among the wells and/or intakes. However, if one well or intake does provide more than 40 percent of the total water supply, apportion the population according to each well's or intake's relative contribution to the total blended system. Consider the following points when apportioning population in a system with standby wells where one water source provides more than 40 percent of the total supply.

- (8) Use either capacity or pumpage data to calculate the percentage of the population to be assigned to each component of the system. Do not use pumpage data for one component and capacity data for other components. Data from standby wells and regular supply wells must be in the same units.
- (9) When using pumpage data for a standby well, use average pumpage for the period during which the standby well is used rather than average annual pumpage. The period during which a standby well is on line but not actually pumping should not be considered part of the period during which the standby well is used.
- (10) Often, pumpage data for standby wells are not based on water flow meter readings, but reflect estimates based on pumping test data, pump size, orifice of effluent pipe, or duration of pumping. Use metered pumpage data whenever possible; alternatively, estimate pumpage based on these or other appropriate parameters.
- (11) If possible, attempt to calculate an average over the most recent periods of use. However, calculation of the pumpage rate for a standby well can be based on a period of use several years ago.

HIGHLIGHT 7-44 USING PUMPAGE DATA FOR STANDBY WELLS

Standby Well

Use: Used for 28 days in a year.
60,480,000 gallons are pumped during the 28 days.

Calculation of Pumpage:

For evaluation purposes, calculate the pumpage rate for the standby well as follows:

$$\frac{60,480,000 \text{ gallons}}{(28 \text{ day})(24 \text{ hr/day})(60 \text{ min/hr})} = 1,500 \text{ gpm}$$

Apportionment:

Water from this standby well is blended with water from three regular supply wells with pumpage rates of 2,000, 1,000, and 4,000 gpm. The largest contribution of any well is:

$$\frac{4,000}{1,500 + 2,000 + 1,000 + 4,000} = 0.47 = 47\%$$

Therefore, apportion population to the four wells based on each well's relative contribution. Note that if the standby well was not considered, the largest contribution would be 57 percent and apportionment to the three regular supply wells would still be based on relative contribution.

HIGHLIGHT 7-45 EVALUATING POPULATION FACTOR USING A STANDBY WELL

Site Setting: Rural location with low population density.

Water Supply: Local water authority blends water from one surface water intake (pumping 450 gpm), and one well (pumping 550 gpm).

Another ground water well (capable of pumping at a rate of 550 gpm) is regularly maintained to serve as an emergency supply.

Location of

Water Supply: Intake is located on a stream within 1/2 mile of PPE for the site.

Regular well is between 1/2 and 1 mile of the site.

Emergency well is between 1 and 2 miles of the site.

Population

Served: 1,000 residential connections.

Population density in the county is 2.4 persons per residence.

Total population served = 1,000 x 2.4 = 2,400

Evaluation: No Level I or Level II contamination is identified. Evaluate population served on the basis of potential contamination. Water authority reports that the standby well can provide enough water during any interruption in either the surface water or regular ground water supply.

Alternative 1: Include the standby well in apportioning population to the blended system.

The largest relative contribution by any well or intake is:

$$\frac{550}{(550 + 450 + 550)} = 35.5\%$$

Because none of the water supply units provides more than 40 percent of the total, assign one-third of the total population (800 people) to each well or intake.

The distance-weighted population values (non-karst) are:

Between 1/2 and 1 mile (800 people)	167
Between 1 and 2 miles (800 people)	94
Total distance-weighted population value	261

Potential contamination factor value = 1/10 x 261 = 26

Do not evaluate the 800 people assigned to the surface water intake in the ground water pathway; they would be evaluated in the surface water pathway. In evaluating the surface water pathway, the standby well would not be included.

(continued on next page)

HIGHLIGHT 7-45 (continued)
EVALUATING POPULATION FACTOR USING A STANDBY WELL

Alternative 2: **Exclude the standby well in apportioning the population to the blended system.**

The largest relative contribution to the blended system is provided by the ground water well:

$$550/(550 + 450) = 55\%$$

Therefore, assign the total population to the two water units based on their relative percentage contribution:

$$\begin{aligned} \text{Well} &= (2,400)(0.55) = 1,320 \text{ people} \\ \text{Intake} &= (2,400)(0.45) = 1,080 \text{ people} \end{aligned}$$

The distance-weighted population values (non-karst) are:

Between 1/2 and 1 mile (1,320 people)	523
Total distance-weighted population value	523

Potential contamination factor value = 1/10 x 523 = 52

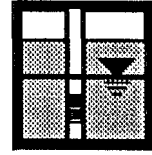
NOTE: The 1,080 people assigned to surface water intake are not evaluated for the ground water pathway.

Selected Alternative: **Because Alternative 2 results in a higher potential contamination factor value, use it to evaluate the aquifer.**

TIPS AND REMINDERS

- (12) The annual use criterion applies only to the nearest well factor evaluation. A standby well can be used to evaluate the population factor without meeting the annual use criterion, providing it is regularly maintained so that water can be withdrawn.
- (13) Standby wells need not be evaluated; if they are, evaluate only those that raise the score. The apportioning of population using standby wells may differ for each aquifer evaluated (i.e., it is not necessary to consider an eligible standby well for one aquifer simply because it is considered for a different aquifer). Do not assign the same population to both a standby well and a regular well or intake when apportioning drinking water population,
- (14) Do not include standby surface water intakes when scoring the ground water pathway.
- (15) Wells that are part of a planned wellfield rotation program are not considered standby wells.
- (16) Any standby well used to determine relative contributions for a blended system should also be used in the apportionment of population.
- (17) Use average pumpage for the period of use, rather than average annual pumpage, when evaluating standby wells.

SECTION 7.8 RESOURCES AND WELLHEAD PROTECTION AREA



This section provides guidance on scoring the resources and wellhead protection area (WPA) factors for the targets factor category of the ground water pathway. The resources factor (HRS section 3.3.3) evaluates the possible loss of ground water use value resulting from site-related contamination. It does not evaluate threats to human health that are considered in the nearest well and population factors. The wellhead protection area factor (HRS section 3.3.4) evaluates the possibility that a source or observed release lies in or near an area that a state has designated for protection under the SDWA.

RELEVANT HRS SECTIONS	
Section 3.3.3	Resources
Section 3.3.4	Wellhead protection area

DEFINITIONS

Commercial Aquaculture: Cultivation of fish or shellfish to be sold for widespread distribution. Examples include a rearing pond used to raise catfish or a pond for nonfood crops such as goldfish and tropical fish.

Commercial Food Crops: Crops that are intended to be sold widely, such as in supermarkets, and locally, such as those sold at local produce stands. Crops grown for domestic consumption or for use in a single restaurant are not considered commercial food crops.

Commercial Forage Crops: Crops grown to be sold as food for livestock (it is not necessary to document that these crops were sold only for commercial livestock), and grasslands used for grazing by commercial livestock (including areas technically defined as "pasture/rangeland" by the USDA).

Ingredient In Commercial Food Preparation: Ground water used for wholesale food preparation (e.g., a manufacturer that prepares food products to be sold in supermarkets or produce stands). Food prepared in restaurants is not included in this category.

Major or Designated Water Recreation Area: A major water recreation area is an area used by a large number of people for recreational purposes (e.g., a water theme park). A designated water recreation area is an area designated and maintained by a government body (e.g., local, state, or Federal) as an area for public recreation (e.g., municipal swimming pool).

Wellhead Protection Area (WPA): Area designated by states according to section 1428 of the SDWA, as amended, to protect wells and recharge areas that supply public drinking water systems.

SCORING THE RESOURCES FACTOR

- (1) **Use the checklist in *Highlight 7-46* to determine whether any uses that are assigned resource points apply to any target well for the aquifer being evaluated.** Standby wells cannot be used to score the resources factor. Use the definitions above to assist in making this determination. Because the resources factor receives an "all or nothing" value, it may not be necessary to continue with the other questions on the checklist after one resource use is identified. Note that the factor can be evaluated based on any target well in the aquifer being evaluated or in overlying aquifers. *Highlight 7-47* provides sources of information that may help document resource use.
- (2) **If a resource use can be documented, assign a value of 5 to the resources factor for the aquifer.** If no resource use can be documented, assign a value of 0.

SCORING THE WELLHEAD PROTECTION AREA FACTOR

WPAs are designated by state or local agencies; however, some states may not have any designated WPAs. Contact the state department of environmental protection or equivalent agency to determine the status of the state's WPA program and to obtain information on the location of WPAs.

- (1) **Determine whether there is a designated WPA within the TDL.** The WPA must be applicable to the aquifer being evaluated or an overlying aquifer through which hazardous substances would migrate to reach the aquifer being evaluated.
 - If not, assign a value of 0 to the WPA factor
 - If so, continue to Step (2).
- (2) **Determine whether a source (with a ground water containment factor value greater than 0) lies either partially or fully above the designated WPA.**
 - If so, assign a value of 20 to the WPA factor
 - If not, continue to Step (3).
- (3) **Determine whether an observed release attributable to the sources at the site can be documented within the designated WPA.**
 - If so, assign a value of 20 to the WPA factor
 - If not, assign a value of 5 to the WPA factor.

**HIGHLIGHT 7-46
CHECKLIST FOR RESOURCES FACTOR**

For the aquifer being evaluated:

(1)	Is ground water used to irrigate five or more acres of commercial food crops or commercial forage crops?	Yes	No
(2)	Is grouped water used to water commercial livestock?	Yes	No
(3)	Is ground water used as an ingredient in commercial food preparation?	Yes	No
(4)	Is ground water used as a supply for commercial aquaculture?	Yes	No
(5)	Is ground water used as supply or a major or designated water recreation area, other than for drinking water use?	Yes	No
(6)	If there are no drinking water wells within the TDL is ground water usable for drinking purposes?	Yes	No

If the answer is “yes” for any of the above possibilities, assign a resources factor value of 5. Otherwise, assign a resource factor value of 0.

**HIGHLIGHT 7-47
INFORMATION SOURCES OF RESOURCE USE**

The following sources of information on possible ground water uses will help in documenting resource use for an aquifer:

- Topographical maps
- Field observations
- Well service records
- Interviews with water company officials
- Existing PA/SI reports
- Correspondence with nearby businesses
- Correspondence with other nearby entities, such as farms or universities
- Files from adjacent or nearby CERLIS sites
- USGS hydrogeologic investigation reports
- USGS's Ground Water Site Inventory (GWSI) data base
- The National Water Well Association's WELLFAX data base
- Agricultural extension agents
- Local Chambers of Commerce

TIPS AND REMINDERS

- A maximum of 5 targets points can be assigned for the resources factor. Do not spend a lot of time documenting resource use unless those 5 points may be critical to the site score.
- A well used for both drinking water and irrigation can be assigned targets points for the population, nearest well, and resources targets factors.
- Standby wells cannot be used to score the resources factor.
- Sole source aquifers do not qualify as WPAs unless they are so designated.
- Proposed WPAs should not be scored as WPAs; however, their proposed designation should be mentioned in the documentation record. If the proposed WPA is designated as a WPA before the scoring package goes final, the site score can be adjusted.

SECTION 7.9

SCORING SITES WITH MULTIPLE AQUIFERS



This section provides guidance on scoring the ground water pathway when multiple aquifers are present. A ground water pathway score is calculated for each aquifer at the site, and the highest score is selected as the ground water pathway score. When evaluating an aquifer, the HRS specifies that the targets using water from that aquifer are included as well as targets using water from all overlying aquifers through which hazardous substances would migrate to reach the aquifer being evaluated. This section provides several examples of scoring multiple aquifer systems.

RELEVANT HRS SECTIONS	
Section 3.0	Ground water migration pathway
Section 3.1.2	Potential to release
Section 3.3	Targets
Section 3.3.1	Nearest well
Section 3.3.2	Population
Section 3.3.2.4	Potential contamination
Section 3.4	Ground water migration score for an aquifer

DEFINITIONS

Multiple Aquifer System: A hydrogeologic situation consisting of two or more aquifers that are not interconnected and that underlie sources at the site.

SCORING MULTIPLE AQUIFER SYSTEMS

- (1) **Determine waste characteristics factor category value.** Calculate according to HRS section 3.2. Generally the waste characteristics factor category value will be the same for all aquifers evaluated for the site. However, it is possible for the mobility factor value to vary by aquifers (e.g., if there is an observed release to one aquifer but not others).
- (2) **Determine likelihood of release factor category value for each of the aquifers being evaluated.**
 - If an observed release to the aquifer being evaluated can be demonstrated based on direct observation or chemical analysis, assign that aquifer a likelihood of release factor value of 550.
 - If an observed release cannot be documented, score potential to release according to HRS section 3.1.2. Because several of the components of potential to release (depth to aquifer and travel time) are aquifer-specific, the potential to release factor value may be different for each of the aquifers being evaluated.

- (3) **Determine all targets for the shallowest aquifer being evaluated.** Document all targets for the shallowest aquifer, including the population, nearest well, resources, and WPAs.
- (4) **Determine all targets for each deeper aquifer that is evaluated at the site.** Identify all targets in the deeper aquifer, plus those in any overlying aquifer through which hazardous substances would migrate to reach the aquifer being evaluated.
- (5) **Calculate a separate ground water score for each aquifer.**
- (6) **Select the highest score from among the aquifers evaluated as the ground water pathway score for the site.**

EXAMPLES OF MULTIPLE AQUIFER SYSTEMS

EXAMPLE 1: OVERLYING AQUIFERS EVALUATED UNDER POTENTIAL TO RELEASE (FIRST SCENARIO)

The site is located over two non-karst aquifers that are not interconnected. The shallower aquifer is designated Aquifer A and the deeper one is designated Aquifer B. Aquifer A lies 20 feet below the lowest known point of the hazardous substances at the site, and Aquifer B is approximately 85 feet below that same lowest known point. The same sources overlie Aquifers A and B, and waste characteristics values are the same for both aquifers. The lowest hydraulic conductivity layer in the interval between the lowest known point of hazardous substances at the site and the top of Aquifer A is a 7-foot layer of silty clays. For Aquifer B, the lowest hydraulic conductivity layer is a 15-foot layer of clay.

Several private wells and one municipal well use Aquifer A, the nearest of which is 3/4 mile from the source. The only well that uses Aquifer B is 3.5 miles from the source, and serves a small trailer park community. There is no observed release to either aquifer. For both aquifers, the waste characteristics factor category value is 56, the containment factor value is 10, and the net precipitation factor value is 6.

Targets

Nearest Well. For Aquifer A, the nearest drinking water well from any source at the site is 3/4 mile. Assign it a nearest well factor value of 9 (from HRS Table 3-11). For Aquifer B, the nearest well factor may be based on the shortest distance from any source to a well in Aquifer B or Aquifer A. Because the nearest drinking water well in Aquifer B is 3.5 miles from the source, use the nearest well in Aquifer A to score Aquifer B's nearest well factor. Assign Aquifer B a nearest well factor value of 9.

Population. The following table presents the population served by drinking wells within the TDL for both aquifers. Because Aquifer A is an overlying aquifer through which hazardous substances would migrate to reach Aquifer B, the entire population evaluated in Aquifer A is included in the evaluation of Aquifer B.

As specified in HRS section 3.3.2.4, multiply the total distance-weighted population by 1/10 to determine the value for the potential contamination factor. Therefore, the potential contamination factor is 69 for Aquifer A and 74 for Aquifer B.

Resources. No resource uses, as defined in HRS section 3.3.3, were documented for either aquifer.

Wellhead Protection Area. None were designated for either aquifer.

Distance Category (miles)	Evaluation of Aquifer A			Evaluation of Aquifer B (Wells in Overlying Aquifer A Included)		
	Wells	Population	Distance-weighted Population	Wells	Population	Distance-weighted Population
0 to 1/4	0	0	0	0	0	0
>1/4 to 1/2	0	0	0	0	0	0
>1/2 to 1	4	16	5	4	16	5
>1 to 2	12	48	10	12	48	10
>2 to 3	1	5,000	678	1	5,000	678
>3 to 4	0	0	0	1	320	42
Totals	–	5,064	693	–	5,384	735

Targets Factor Category Value. For each aquifer, this value is the sum of the four factors detailed above (population, nearest well, resource, wellhead protection area). Therefore, the targets factor category value is 78 for Aquifer A and 83 for Aquifer B.

Likelihood of Release

There is not an observed release to either aquifer, so potential to release is evaluated separately for each aquifer. Containment and net precipitation, two of the factor values used to determine potential to release, are the same for both aquifers and are equal to 10 and 6, respectively.

The other two factors, depth to aquifer and travel time, are different for Aquifers A and B. Because Aquifer A is 20 feet from the lowest known point of hazardous substances and Aquifer B is 85 feet from that point, assign Aquifer A and Aquifer B depth to aquifer factor values of 5 and 3, respectively. The geologic information provided indicates that Aquifer A should be assigned a travel time factor value of 15 and Aquifer B a value of 5 (see HRS Tables 3-6 and 3-7).

Calculate the likelihood of release factor category value by multiplying the containment factor value by the sum of the travel time, depth to aquifer, and net precipitation factor values. Based on this formula, Aquifer A has a likelihood of release factor category value of 260 (i.e., $10[15+5+6]$) and Aquifer B has a likelihood of release category factor value of 140 (i.e., $10[5+3+6]$).

Ground Water Pathway Score

As defined in HRS section 3.4, calculate a ground water score for each aquifer by multiplying the likelihood of release, waste characteristics, and targets factor category values and dividing the product by 82,500. The ground water score is 13.77 (i.e., $[260 \times 56 \times 78]/82,500$) for Aquifer A and 7.89 (i.e., $[140 \times 56 \times 83]/82,500$) for Aquifer B. Therefore, the score calculated for Aquifer A is used as the ground water pathway score for the site.

Although Aquifer B had a slightly higher targets value than Aquifer A, Aquifer B had a lower overall ground water score. This is because for this site the extra targets in Aquifer B did not contribute as much to the pathway score as the higher potential to release value (i.e., depth to aquifer and travel time factors) in Aquifer A.

EXAMPLE 2: OVERLYING AQUIFERS EVALUATED UNDER POTENTIAL TO RELEASE (SECOND SCENARIO)

The description of this site is the same as in Example 1, except that the drinking water well that uses Aquifer B is a municipal well that serves 15,000 people. This well is 3.5 miles from the source.

Targets

Nearest Well. The evaluation of the nearest well factor is performed as described in Example 1. For both Aquifers A and B, the nearest well factor is assigned a value of 9.

Population. The following table presents the population served by drinking water wells within the TDL for Aquifers A and B.

Distance Category (miles)	Evaluation of Aquifer A			Evaluation of Aquifer B (Wells in Overlying Aquifer A Included)		
	Wells	Population	Distance-weighted Population	Wells	Population	Distance-weighted Population
0 to 1/4	0	0	0	0	0	0
>1/4 to 1/2	0	0	0	0	0	0
>1/2 to 1	4	16	5	4	16	5
>1 to 2	12	48	10	12	48	10
>2 to 3	1	5,000	678	1	5,000	678
>3 to 4	0	0	0	1	15,000	1,306
Totals	--	5,064	693	--	20,064	1,999

As specified in HRS section 3.3.2.4, multiply the total distance-weighted population by 1 /10 to determine the value for the potential contamination factor. Therefore, the potential contamination factor is 69 for Aquifer A and 200 for Aquifer B.

Resources. No resource uses, as defined in HRS section 3.3.3, were documented for either aquifer.

Wellhead Protection Area. None were designated for either aquifer.

Targets Factor Category Value. For each aquifer, this value is the sum of the four factors detailed above (population, nearest well, resource, wellhead protection area). Therefore, the targets factor category value is 78 for Aquifer A and 209 for Aquifer B.

Likelihood of Release

The likelihood of release factor category values for Aquifers A and B are the same as in Example 1 - 260 for Aquifer A and 140 for Aquifer B.

Ground Water Pathway Score

As defined in the HRS section 3.4, a ground water score for each aquifer is calculated by multiplying the likelihood of release, waste characteristics, and targets factor category values and dividing the product by 82,500. The ground water score is 13.77 (i.e., $[260 \times 56 \times 78]/82,500$) for Aquifer A and 19.86 (i.e., $[140 \times 56 \times 209]/82,500$) for Aquifer B. Therefore, the score for Aquifer B is used as the ground water pathway score for the site.

In this example, the significantly larger targets value for Aquifer B compared with Aquifer A offsets the fact that Aquifer B has a lower likelihood of release value than Aquifer A.

EXAMPLE 3: ONE AQUIFER EVALUATED UNDER OBSERVED RELEASE AND ONE UNDER POTENTIAL TO RELEASE

Aquifer A lies above Aquifer B. An observed release by chemical analysis has been established to Aquifer A. One well, located 0.7 miles from the source, draws from Aquifer A, and it serves a family of five. Level I concentrations have been documented. There is no observed release to Aquifer B. Approximately 2.8 miles from the source, a municipal well serving 12,000 individuals uses Aquifer B. The waste characteristics factor category was assigned a value of 32 for both aquifers.

Targets

Nearest Well. Because Aquifer A is subject to Level I concentrations, assign it a nearest well factor value of 50 (see HRS section 3.3.1). The distance to the nearest well does not need to be taken into account.

The nearest well factor value for Aquifer B is also 50. Because hazardous substances would have to migrate through Aquifer A to reach Aquifer B, evaluate the nearest well factor for Aquifer B and any overlying aquifers (i.e., Aquifer A). The nearest well in Aquifer B is 2.8 miles from the source and would therefore be assigned a nearest well factor value of 3 (see HRS Table 3-11). Use 50, the higher of the two values, as Aquifer B's nearest well factor value.

Population. A single, private drinking well uses Aquifer A and serves a family of five. Because the well is subject to Level I concentrations, multiply the total population by 10. Therefore, the population factor value for Aquifer A is 50.

The municipal well 2.8 miles from the source that serves 12,000 people uses Aquifer B and is subject to potential contamination. According to HRS Table 3-12, assign a distance-weighted population value of 2,122. Multiply this value by 1/10 to obtain the potential contamination factor value of 212. Add to this the factor value of the Level I concentration population value of 50, which was calculated for Aquifer A. The total population factor value for Aquifer B is therefore 262.

Resources. No resource uses, as defined in HRS section 3.3.3, were documented for either aquifer.

Wellhead Protection Area. None were designated for either aquifer.

Targets Factor Category Value. For each aquifer, this value is the sum of the four factors detailed above (population, nearest well, resources, wellhead protection area). Therefore, the targets factor category is 100 for Aquifer A and 312 for Aquifer B.

Likelihood of Release

Because an observed release by chemical analysis was documented in Aquifer A, assign a likelihood of release value of 550. A potential to release value of 240 was calculated for Aquifer B, based on containment, net precipitation, depth to aquifer, and travel time factors.

Ground Water Pathway Score

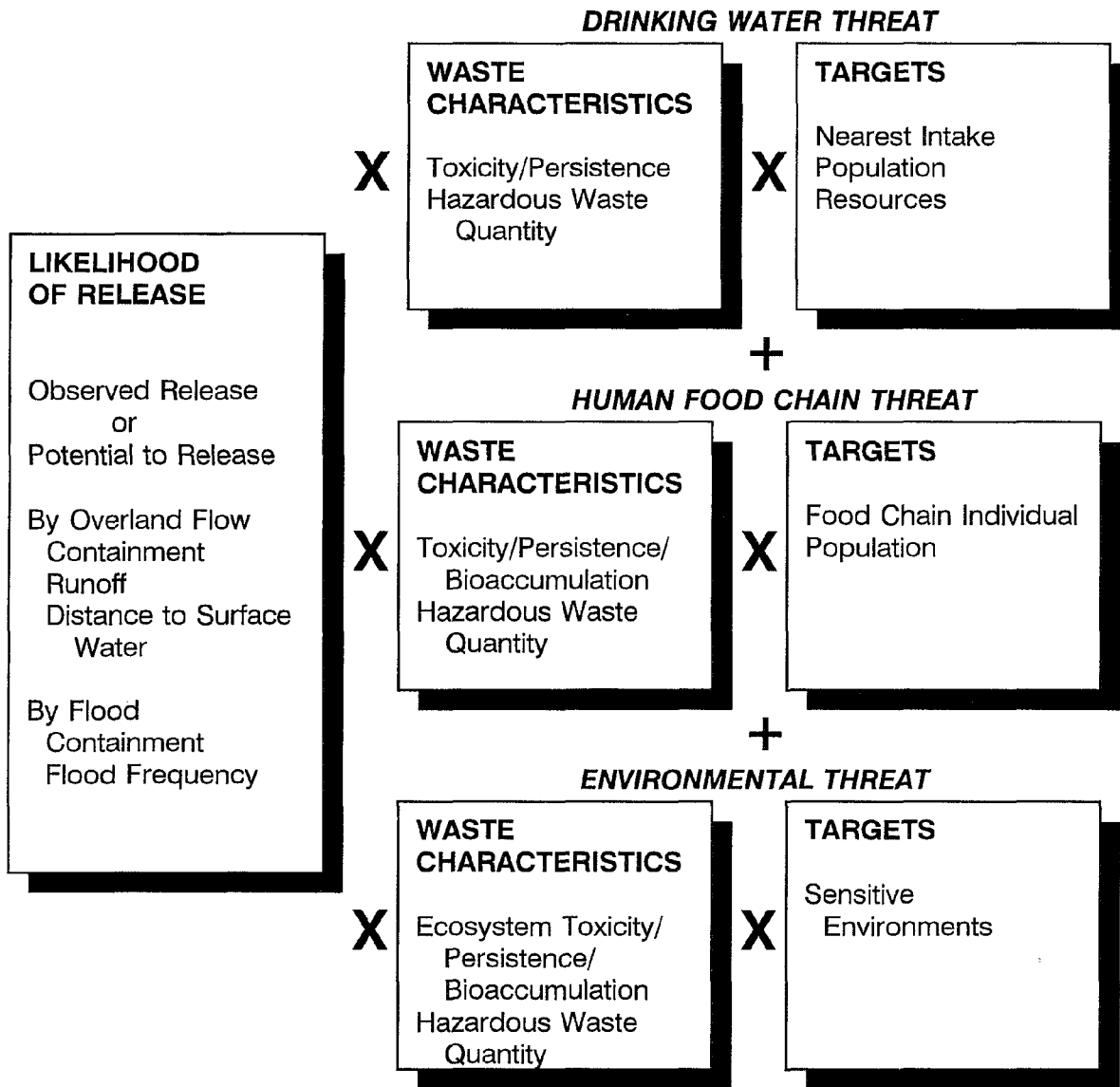
As defined in the HRS section 3.4, calculate a ground water score for each aquifer by multiplying the likelihood of release, waste characteristics, and targets factor category values and dividing the product by 82,500. The ground water score is 21.33 (i.e., $[550 \times 32 \times 100]/82,500$) for Aquifer A and 29.04 (i.e., $[240 \times 32 \times 312]/82,500$) for Aquifer B. Therefore, the score calculated for Aquifer B is used as the ground water pathway score for the site.

TIPS AND REMINDERS

- The nearest well factor value can be based on either the aquifer being evaluated or an overlying aquifer through which hazardous substances would migrate.
- The population factor for a lower aquifer in a multiple aquifer system includes the population served by any overlying aquifer through which hazardous substances would migrate.

CHAPTER 8

SURFACE WATER PATHWAY



SECTION 8.1

HAZARDOUS SUBSTANCE

MIGRATION PATH



This section explains how to determine the hazardous substance migration path of the overland/flood component of the surface water pathway, including how to determine the overland and in-water segments, and how to identify the PPE and TDL. The guidance in this section does not apply to the ground water to surface water component of the surface water pathway.

RELEVANT HRS SECTIONS

Section 4.0.2	Surface water categories
Section 4.1.1.1	Definition of the hazardous substance migration path for overland flow/flood migration component
Section 4.1.1.2	Target distance limit
Section 4.1.2.1.2.1.2	Runoff
Section 4.1.2.1.2.1.3	Distance to surface water

DEFINITIONS

Hazardous Substance Migration Path: The path that hazardous substances travel or would travel over land from a source to surface water (overland segment) and within surface water to the TDL (in-water segment). In certain cases (e.g., sites consisting only of contaminated sediments, sites where sources are located in surface water bodies), the hazardous substance migration path consists of only an in-water segment.

Intermittent Water Body: Water bodies that do not contain water during all seasons of the year under normal conditions.

In-water Segment: Portion of the hazardous substance migration path from the PPE to the TDL. For tidally influenced rivers, the in-water segment may include portions of surface water bodies upstream from the PPE to the extent that the in-water migration path is reversed by tides. For contaminated sediments with no identified source, the in-water segment begins at the upstream boundary (for streams and rivers) or center (for water bodies with no direction of flow) of the area of contaminated sediments.

Observed Release: An observed release is established for the ground water, surface water, or air migration pathway either by chemical analysis or by direct observation. Observed release is not relevant to the HRS soil exposure pathway. The minimum requirements for establishing an observed release by chemical analysis are analytical data demonstrating the presence of a hazardous substance in the medium significantly above background level, and information that some portion of that increase is attributable to the site. The minimum criterion for establishing an observed release by direct observation is evidence that the hazardous substance was placed into or has been seen entering the medium.

Overland Segment: Portion of the hazardous substance migration path from a source to a surface water body.

Perennial Water Body: Contains water throughout the year under normal conditions. Under extreme conditions (e.g., severe drought) some water bodies considered perennial may not contain water.

Probable Point of Entry (PPE): Point at which the overland segment of a hazardous substance migration path intersects with surface water. A site may have multiple PPEs. The PPE is assigned as the point at which entry of the hazardous substances to surface water is most likely.

Surface Water: Water present at the earth's surface. Surface water includes rivers, lakes, oceans, ocean-like water bodies, and coastal tidal waters, as defined in HRS section 4.0.2.

Target Distance Limit (TDL) for the Surface Water Migration Pathway: Distance over which the in-water segment of the hazardous substance migration path is evaluated. The TDL extends 15 miles from the PPE in the direction of flow (or radially in lakes, oceans, or coastal tidal waters) or to the most distant sample point establishing an observed release, whichever is greater. In tidally influenced surface water bodies, an upstream TDL is also determined. For some sites (e.g., sites with multiple PPEs), an overall target distance of greater than 15 miles may result.

Watershed: Portion of the watershed downgradient of sources at the site. The watershed includes the surface water bodies between the PPEs and the TDL (i.e., the in-water segment of the hazardous substance migration path). A single watershed includes all in-water segments that intersect within the TDL. A site is in two or more watersheds if two or more hazardous substance migration paths from the sources do not reach a common point within the TDL. In these cases, each distinct watershed is evaluated separately.

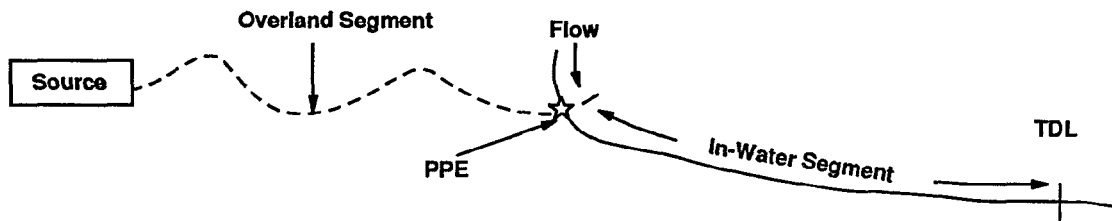
DELINEATING THE OVERLAND SEGMENT

The overland segment is used to evaluate potential to release to surface water and establish the PPE. In the simplest case, a site will have one source with a single hazardous substance migration path, with a single overland segment (see **Highlight 8-1**). Because the overland segment is defined from a source to surface water, a single site with multiple sources may have more than one hazardous substance migration path, and hence more than one overland segment (although they may be very near to one another and/or may converge). The steps below apply to sources in a single watershed. These steps should be repeated for each source within the watershed and for each watershed.

(1) **Identify each source at the site with a containment factor value greater than 0 for the surface water pathway.** Do not evaluate sources with a surface water containment factor value of 0.

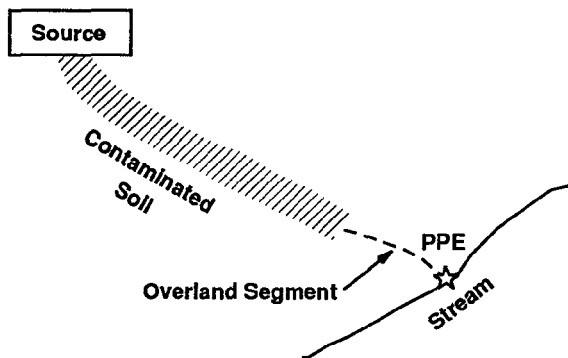
- In general, each source serves as the beginning of an overland segment.
- Sometimes hazardous substances will have already migrated from the source toward surface water. If evidence of this migration is contaminated soil, the contaminated soil is itself a source. Use the farthest point of documented soil contamination as the beginning of the overland segment (see **Highlight 8-2**).
- If a site consists of contaminated sediments with no identifiable source, then there is no overland segment.

HIGHLIGHT 8-1 HAZARDOUS SUBSTANCE MIGRATION PATH



- The hazardous substance migration path is comprised of two segments: an overland segment and in-water segment.
- The overland segment extends from the source to the PPE.
- The in-water segment extends from the PPE to the TDL.
- The overland segment determines the distance to surface water; the in-water segment determines the targets that will be evaluated.

HIGHLIGHT 8-2 OVERLAND SEGMENT FOR CONTAMINATED SOILS



If hazardous substances have started to migrate toward surface water, the overland segment is the distance from the contaminated soil to surface water.

The contaminated soil must be attributed to a source associated with the site being evaluated.

- **Determine the overland flow paths that surface water would take from a source to a surface water body.** Delineate the overland segment by determining the routes that runoff would take from a source to surface water. The routes may be determined solely from topographic maps; however, the overland segment generally should be refined from site observations.

- Storm sewers and other covered drains (or other man-made runoff controls, such as a wall) along the overland migration path must be considered in determining the overland flow (see **Highlight 8-3**).
- If contaminated soil is directly adjacent to the PPE, the distance to surface water is 0.
- At sites with a large source and/or complex topography, there may be more than one overland segment from a single source in a single watershed.

If all the overland segments are greater than 2 miles, assign a value of 0 for the potential to release by overland flow component. However, potential to release by flood can still be evaluated for that watershed, if applicable.

(3) **Identify the PPE.** The PPE is the point where the overland segment reaches an eligible surface water body. Eligible surface waters are listed in **Highlight 8-4**.

- **Highlight 8-5** provides additional guidance on determining the PPE for water bodies with wetlands and for intermittently flowing streams and ditches.
- At sites with a large source and/or complex topography, there may be more than one PPE to a single surface water body (see **Highlight 8-6**).

SCORING THE DISTANCE TO SURFACE WATER FACTOR

Evaluate the distance to surface water factor only for watersheds scored based on potential to release by overland flow. Do not evaluate this factor for watersheds where an observed release to surface water has been documented.

(1) **Determine the shortest overland segment from any source with a containment factor value greater than 0 to the surface water body.** If this distance is near a breakpoint between distance ranges in HRS Table 4-7, use the mean high water level for tidal waters or the mean water level for other surface waters.

HIGHLIGHT 8-3 CHARACTERIZATION OF THE OVERLAND SEGMENT FOR STORM SEWERS AND COVERED DRAINS

Storm sewers and other covered drains along the overland migration pathway have proved difficult to characterize for two reasons:

- (2) **Where does the drain discharge come out?** Engineering drawings and/or dye tests can help determine the migration path through the drain.
- (3) **Are the hazardous substances coming out the far end of the drain attributable to the sources at the site?** To strengthen the attribution of the hazardous substances to the site:
- Carefully document the storm drain's pathway and connections.
 - Evaluate the contribution of other potential sources to the drain.
 - Show similarity between the materials from the site that enter the drain and those that come out.

See Section 5.1 for additional guidance concerning attribution.

HIGHLIGHT 8-4 ELIGIBLE SURFACE WATERS

HRS section 4.0.2 identifies and categorizes surface water for HRS purposes. Additional guidance on distinguishing among these types of surface waters is provided in Section 8.2.

Rivers Include:

- Perennially flowing waters from point of origin to the ocean or to coastal tidal waters;
- Wetlands contiguous to perennially flowing waters;
- Above ground portions of disappearing rivers;
- Man-made ditches that perennially flow into other surface water; and
- Intermittently flowing waters and contiguous intermittently flowing ditches, in arid or semi-arid areas with less than 20 inches of mean annual precipitation.

Lakes Include:

- Natural and man-made lakes (including impoundments) that lie along rivers, but excluding the Great Lakes;
- Isolated, but perennial lakes, ponds, and wetlands;
- Static water channels or oxbow lakes contiguous to rivers;
- Small rivers, without diking, that merge into surrounding perennially inundated wetlands; and
- Wetlands contiguous to water bodies defined as lakes.

Ocean and ocean-like water bodies Include:

- Ocean areas seaward from the baseline of the Territorial Sea (i.e., seaward from the generalized coastline of the United States);
- The Great Lakes; and
- Wetlands contiguous to the Great Lakes.

Coastal tidal waters Include:

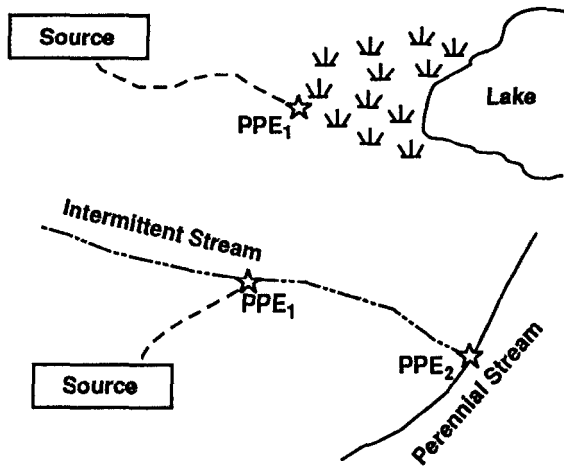
- Waters that are seaward from mouths of rivers and landward from the baseline of the Territorial Sea (e.g., embayments, harbors, sounds, estuaries, back bays, lagoons, wetlands).

Surface waters specifically excluded from evaluation as surface water bodies for HRS purposes Include:

- Intermittent rivers in areas with 20 or more inches mean annual precipitation; and
- Intermittent ponds or lakes, regardless of mean annual precipitation.

- If there is only one overland segment, the distance to surface water is the distance from a source to the PPE, measured along the overland segment.
- If there are two or more overland segments, the distance to surface water is the shortest distance from any source to the PPE for the watershed being evaluated.
 - If the in-water segments associated with different overland segments reach a common point within the TDL, select the shortest overland segment, and use its length as the distance to surface water (see **Highlight 8-6**).
 - If the in-water segments associated with different overland segments do not reach a common point within the TDL, the site is in more than one watershed (see **Highlight 8-6**). Assign a separate distance to surface water factor and calculate a separate surface water pathway score for each watershed. Section 8.2 provides guidance on scoring sites with more than one watershed.

HIGHLIGHT 8-5 PROBABLE POINT OF ENTRY FOR WETLANDS AND INTERMITTENT STREAMS



A wetland contiguous to river, lake, or coastal tidal water is considered to be surface water. PPE₁ is where the overland segment meets the wetland.

Intermittently flowing streams and ditches are considered surface water only in arid areas with less than 20 inches mean annual precipitation. PPE₁ is the PPE in such areas. PPE₂ is the PPE in areas with 20 inches or more mean annual precipitation.

- (2) **If the shortest overland segment for a watershed exceeds 2 miles, potential to release by overland flow cannot be evaluated for the watershed.** Assign potential to release by overland flow a value of 0 for the watershed.
- (3) **Assign a distance to surface water factor value using HRS Table 4-7.** Because this factor is assigned based on distance ranges, precise measurement of the distance of the overland segment is generally not necessary unless the distance is near a breakpoint between two ranges.

SCORING THE FLOOD FREQUENCY FACTOR

- (1) **Determine the floodplain category (i.e., floods annually, 10-year, 100-year, 500-year) in which the source is partially or wholly located.** Potential to release by flood does not consider distance to surface water. Therefore, a source with an overland segment greater than 2 miles can be evaluated if it is located in an appropriate floodplain.
- (2) **Assign a flood frequency factor value using HRS Table 4-9.**

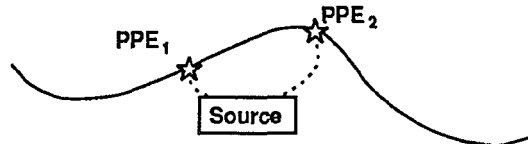
EVALUATING THE TARGET DISTANCE LIMIT FOR NON-TIDALLY INFLUENCED WATER BODIES

This section discusses determining the TDL for sites with and without a PPE, sites with multiple PPEs, and sites where the in-water segment branches.

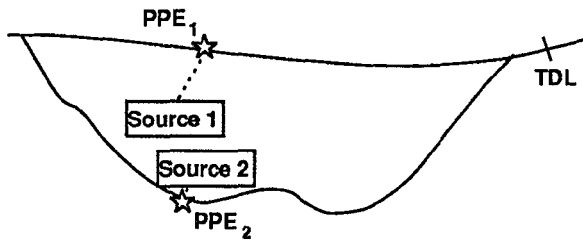
A. SITES WITH A SINGLE PPE

- (A1) **Determine the PPE, based on delineation of the overland flow segment.**
- (A2) **Measure the distance along each surface water body.** Measure from the PPE to the most distant sampling point that meets the observed release criteria (downstream for rivers and streams; or radially for lakes, oceans, and coastal tidal waters).

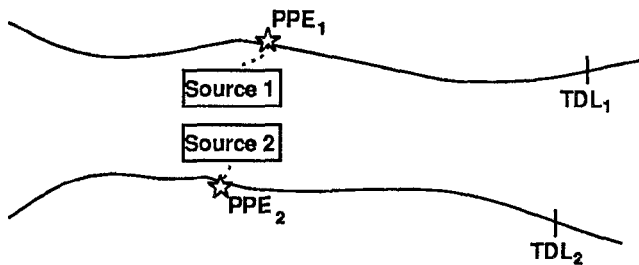
HIGHLIGHT 8-6
PROBABLE POINT OF ENTRY AND TARGET DISTANCE LIMIT
FOR SITES WITH MORE THAN ONE OVERLAND SEGMENT



Use the distance of the shortest overland segment to assign the distance to surface water factor value.



The in-water segments for Sources 1 and 2 reach a common point within the TDL. Source 1 and Source 2 are in the same watershed.



The in-water segments for Source 1 and Source 2 do not reach a common point within the TDL. Source 1 and Source 2 are in different watersheds.

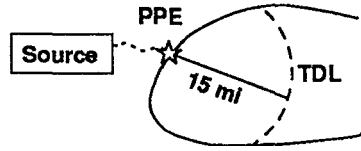
- If no sample meets the observed release criteria or if the most distant sample that meets this criteria is less than 15 miles from the PPE (measured along the surface water body), extend the TDL to 15 miles from the PPE (see **Highlight 8-7**).
- If the most distant sample that meets the observed release criteria is more than 15 miles from the PPE (measured along the surface water body), extend the TDL to that point (see **Highlight 8-8**).

(A3) Evaluate those surface water targets that are located partially or wholly within, or contiguous to, the TDL.

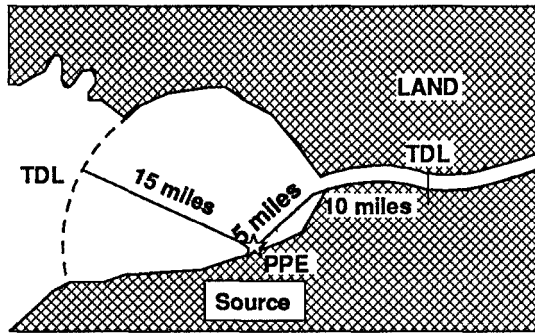
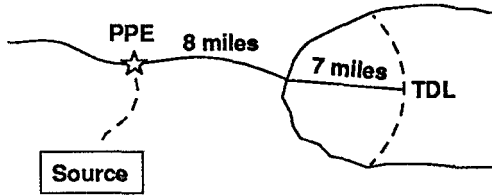
HIGHLIGHT 8-7 DETERMINING TARGET DISTANCE LIMIT



For a river, the TDL is 15 miles downstream from the PPE.

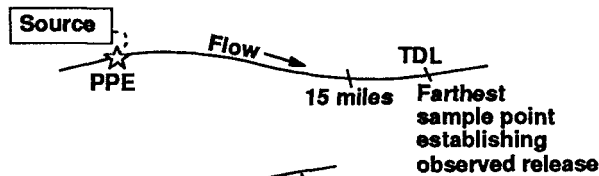


For a lake, ocean, or coastal tidal water, direction of flow is not considered. The TDL is drawn as an arc with radius of 15 miles.

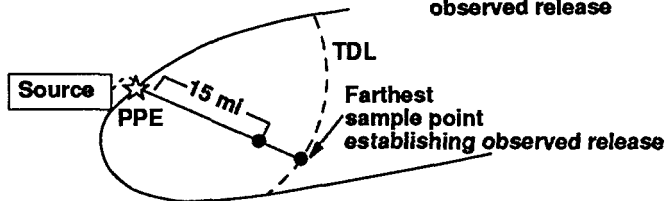


If the TDL for a water body includes both a river/stream and an open water body, the sum of the downstream distance and radius of the arc equals 15 miles.

HIGHLIGHT 8-8 DETERMINING TARGET DISTANCE LIMIT FOR SITES WITH OBSERVED RELEASE BEYOND 15 MILES



When the farthest sample establishing an observed release is more than 15 miles from the PPE, the TDL is extended to this point.



B. SITES WITH MORE THAN ONE PPE

For sites with more than one PPE, define an in-water segment for each PPE, and evaluate targets in each in-water segment of a watershed.

(B1) **Determine the location of each PPE based on delineation of the overland flow segment.**

(B2) **Identify the In-water segment from each PPE.**

(B3) **Determine whether the site is within one watershed.**

- If all of the in-water segments from each PPE do not join within the TDL, consider the site to be in more than one watershed. Evaluate each watershed separately and use the highest score for any watershed as the surface water pathway score for the site (see Section 8.2).
- If all of 8.2 the in-water segments from each PPE join within the TDL, consider the site to be in one watershed and evaluate the in-water segment as follows.
 - If the PPEs for different sources are in the same water body and are relatively close together, determine a single PPE. Evaluate the TDL as described for a single PPE.
 - If hazardous substances from different sources enter the same water body at distant points, the target distance is the distance from the most upstream PPE to 15 miles downstream from the most downstream PPE (or the combined overlapping arcs for two or more PPEs into a lake, coastal tidal water, or ocean). This may result in an overall TDL of greater than 15 miles (see **Highlights 8-9** and **8-10**). The downstream PPE must be within the TDL of the upstream PPE. If this is not true, each PPE is considered to be in a separate watershed and each watershed is scored separately.
 - If the PPEs for different sources are in two different water bodies (e.g., two rivers, two lakes) that later merge into one water body, determine the target distance from each PPE for each source. Total targets are the sum of each segment for each water body. Count targets common to more than one source only once (see **Highlights 8-11** and **8-12**). The merge point should be within the TDL of each PPE; otherwise the sources are considered to be in two or more watersheds.

C. SITES WHERE THE IN-WATER SEGMENT BRANCHES

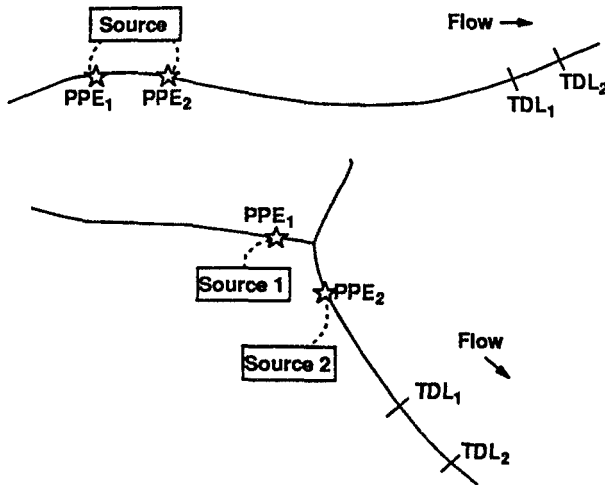
(C1) **Measure the TDL separately for each branch.**

(C2) **Determine If the branches join within the TDL.**

- If the branches do not rejoin within the TDL, determine the TDL in each branch separately (see **Highlight 8-13**).
- If the branches rejoin within the TDL, determine the TDL within each branch and select the one that is farthest downstream (see **Highlight 8-13**).

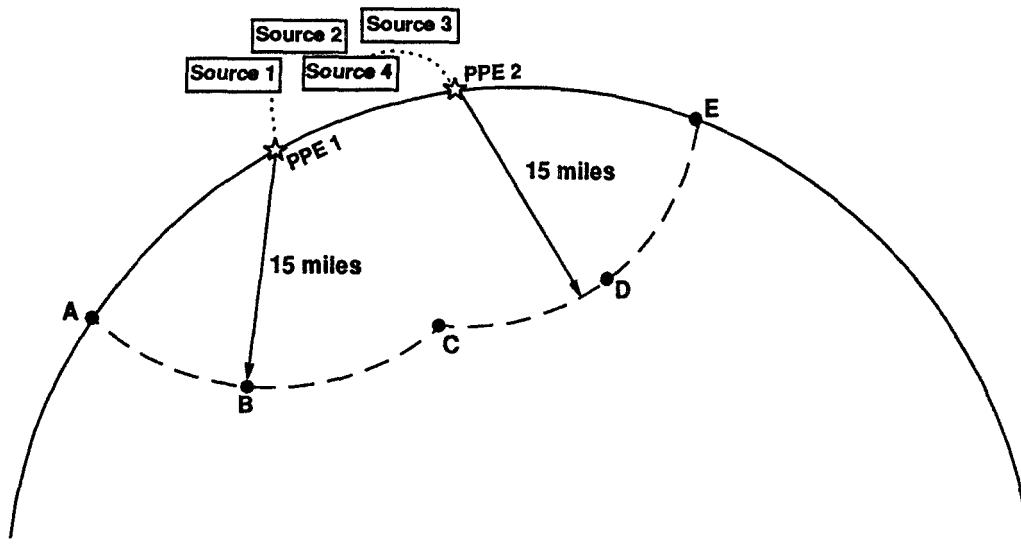
(C3) **Score only those surface water targets that are located partially or wholly within, or contiguous to, the TDL.** Targets in all branches (see **Highlight 8-13**) are considered when evaluating the watershed.

HIGHLIGHT 8-9 DETERMINING TARGET DISTANCE LIMIT FOR SITES WITH MORE THAN ONE PROBABLE POINT OF ENTRY INTO RIVERS



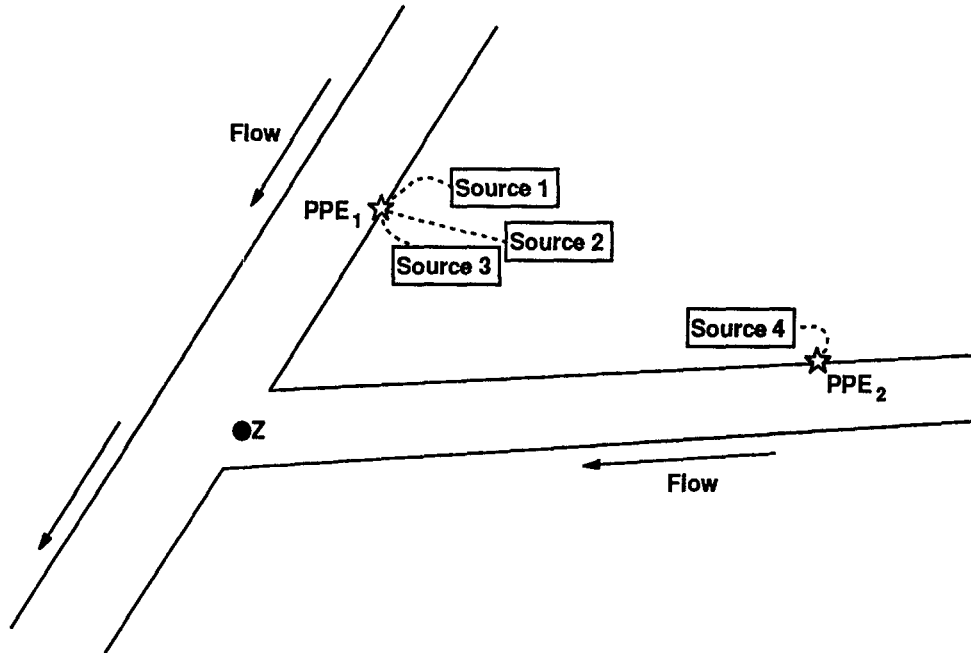
When a site has more than one PPE and the in-water segments join within the TDL, the in-water segment for evaluating the site extends from the most upstream PPE (PPE_1) to the most downstream TDL (TDL_2). The length of the in-water segment in this case may be longer than 15 miles, regardless of whether actual contamination is documented. In both illustrated cases, use TDL_2 as the TDL for the site.

HIGHLIGHT 8-10 DETERMINING TARGET DISTANCE LIMIT FOR SITES WITH MORE THAN ONE PROBABLE POINT OF ENTRY INTO LAKES



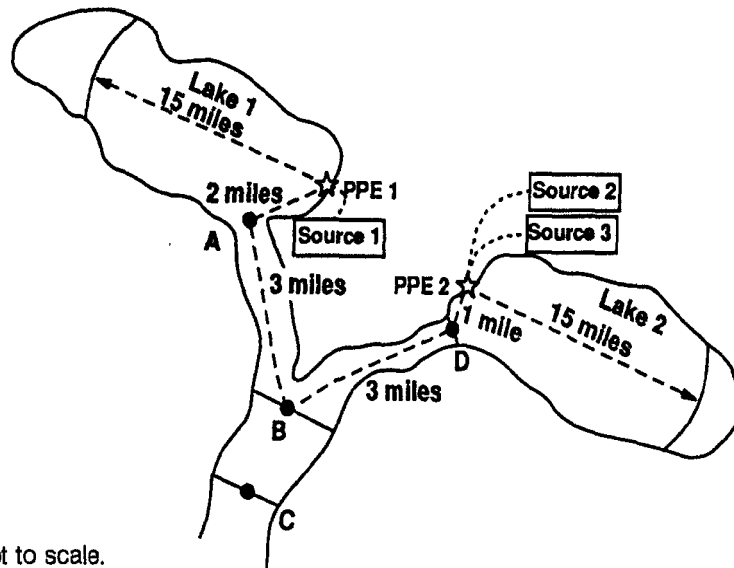
- Determine the TDL from PPE_1 , the PPE to the lake for Source 1.
- Determine the TDL from PPE_2 , the PPE to the lake for Sources 2, 3, and 4.
- Determine the aggregate TDL. In this example, it is the shape formed by arc ABC and arc CDE.
- If the TDLs do not intersect, the water bodies are considered separate watersheds and each watershed is evaluated separately.

HIGHLIGHT 8-11
DETERMINING TARGET DISTANCE LIMIT FOR SITES WITH
PROBABLE POINTS OF ENTRY INTO
TWO BRANCHES OF A RIVER



- The PPE for Source 4 (PPE₂) is in a different water body than the PPE for Sources 1, 2, and 3 (PPE₁).
- To determine the target distance, include all of the following:
 - The distance from PPE₁ to Point Z, the juncture of the two water bodies;
 - The distance from PPE₂ to Point Z; and
 - The distance from Point Z to a point 15 miles minus the distance (Z - PPE₁) or 15 miles minus the distance (Z - PPE₂), whichever is greater.
- Consider all waters with PPEs when calculating the total target population values. In this example, consider segment PPE₁ - Z, segment PPE₂ - Z, and segment Z - end of TDL when determining the target populations.
- If the distance from either PPE₁ to Point Z or PPE₂ to Point Z is greater than 15 miles, this example should be scored as two separate watersheds.

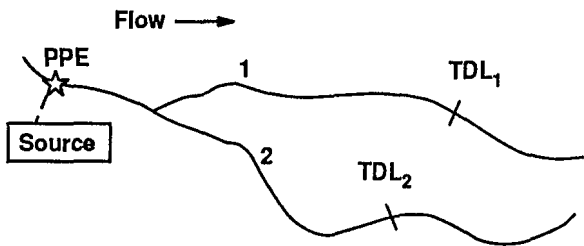
HIGHLIGHT 8-12
DETERMINING TARGET DISTANCE LIMIT FOR
SITES WITH PROBABLE POINTS OF ENTRY INTO TWO LAKES



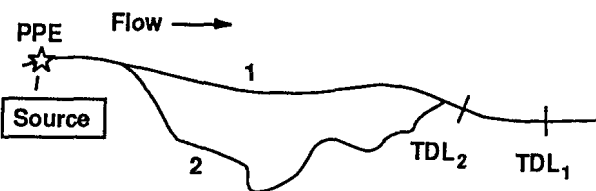
NOTE: Graphic not to scale.

- In this example, the site has probable points of entry into two lakes (PPE₁ and PPE₂) with outflow to the same river. In this situation, the lakes should be considered in the same watershed because their in-water segments meet within 15 miles.
- Measure the TDL in each lake. Also, measure the distance from the PPE to the point of outflow to the river.
- In this example, the TDLs would be:
 - The 15-mile target distance in each lake;
 - The river segments from the lake outfall to the point the outfalls from each lake meet, A-B and D-B; and
 - The 11-mile distance from point B to point C, which is 15 miles from the PPE for Lake 2. This distance is used because it is farther downstream than the TDL for the PPE into Lake 1 (which would end 1 mile upstream of point C).

**HIGHLIGHT 8-13
DETERMINING TARGET DISTANCE LIMIT WHEN
THE IN-WATER SEGMENT BRANCHES**



If the branches do not rejoin within the TDL, mark the TDL in each branch independently. Count targets in each branch.



If the branches rejoin within the TDL, determine the TDL for each branch and select the one that is farthest downstream. Count targets in each branch and in the combined portions.

D. SITES CONSISTING SOLELY OF CONTAMINATED SEDIMENTS WITH NO IDENTIFIED SOURCE

(D1) **Determine if the surface water body containing the contaminated sediments has a clearly defined direction of flow.**

- If there is a clearly defined direction of flow, proceed to Step (D2).
- If there is no clearly defined direction of flow, proceed to Step (D4).

(D2) **When there is a clearly defined direction of flow, begin measuring the TDL from the farthest upstream sediment sampling point that meets the criteria for an observed release.**

(D3) **Use the sediment sampling point identified in Step (D2) in lieu of the PPE.**

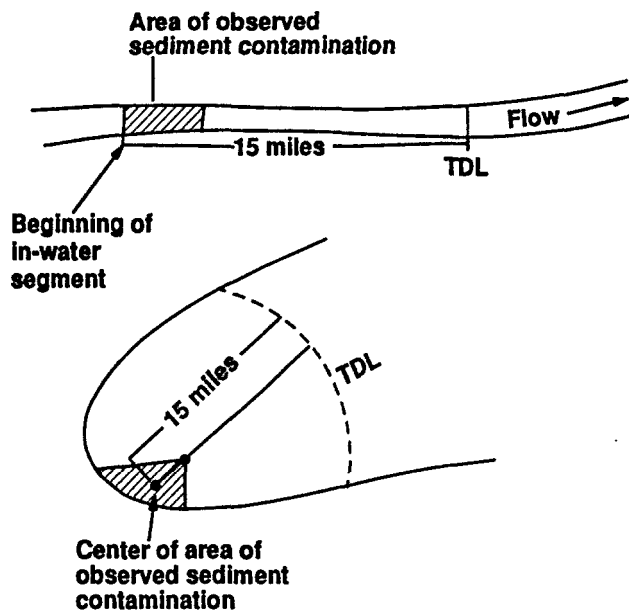
- Follow Steps (A2) and (A3) for sites with a single PPE to determine the TDL.
- Skip Steps (D4), (D5), and (136) below.

(D4) **When there is no clearly defined direction of flow, begin measuring the TDL at the center of the area of observed sediment contamination.** Determine the center using only those sediment sampling points that meet the criteria for an observed release.

(D5) Extend the TDL as an arc with a radius extending either 15 miles along the surface water, or to the most distant sample point that meets the observed release criteria to surface water, whichever is greater. See **Highlight 8-14** for an example of determining the TDL in this case.

(D6) Score only those surface water targets that are located partially or wholly within, or contiguous to, the TDL.

HIGHLIGHT 8-14 DETERMINING TARGET DISTANCE LIMIT FOR SITES CONSISTING SOLELY OF CONTAMINATED SEDIMENTS



Clearly Defined Flow Direction:

Use the most upstream sediment sampling point that meets the observed release criteria as the beginning of the in-water segment. TDL is 15 miles downstream from this point.

No Clearly Defined Flow Direction:

Use the center of the area of observed sediment contamination as the beginning of the in-water segment. Draw the 15-mile arc for the TDL from this point.

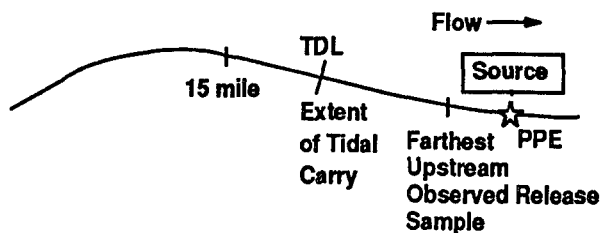
EVALUATING THE TARGET DISTANCE LIMIT FOR TIDALLY INFLUENCED WATER BODIES

In tidally influenced water bodies, the TDL may extend upstream from the PPE of hazardous substances. Evaluate the downstream TDL for such water bodies in the same manner as for other surface water bodies. The following procedures describe how to establish the upstream TDL for tidally influenced water bodies.

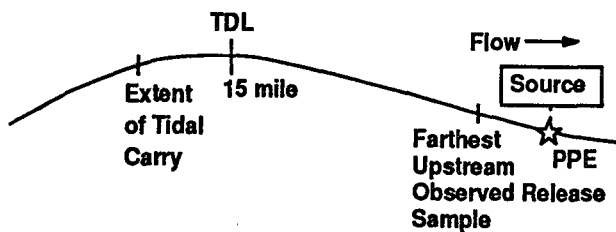
- (1) **Because the evaluation of tidal influence is complex, determine if there are any significant upstream targets (e.g., sensitive environments, wetlands, fisheries).**
 - If there are no significant upstream targets, do not evaluate the effect of tidal influence on the TDL.
 - If there are significant upstream targets, proceed to Step (2).
- (2) **Document how far upstream the tide can carry hazardous substances.** Use existing documentation on the upstream point of flow reversal, extent of brackish water, or salt water intrusion data. Such documentation is often available from local water authorities. Often, these data can be obtained from appropriate state agencies such as water resource commissions.
- (3) **Locate the farthest upstream sample establishing an observed release.**
- (4) **Determine the upstream boundary of the TDL.** The upstream boundary of the TDL depends on the extent of tidal carry and the farthest upstream observed release sample. *Highlight 8-15* illustrates these considerations.

- If the farthest upstream sampling point establishing an observed release is located greater than 15 miles from the PPE, use the location of that sampling point as the upstream boundary of the TDL.
- If the tidal influence is at least 15 miles upstream from the PPE, use 15 miles upstream from the PPE as the upstream boundary of the TDL.
- If the tidal influence is less than 15 miles upstream from the PPE, use the documented distance to which the tide could carry hazardous substances as the upstream boundary of the TDL.

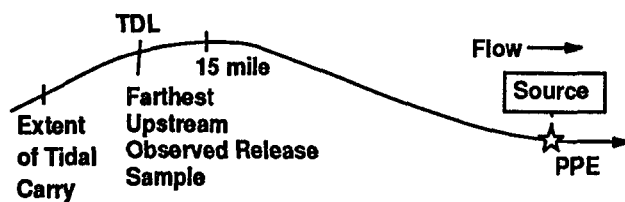
HIGHLIGHT 8-15 DETERMINING UPSTREAM TARGET DISTANCE LIMIT FOR TIDALLY INFLUENCED RIVERS



Upstream TDL is the documented point to which the tide can carry the hazardous substance, because this is less than 15 miles from the PPE.



Upstream TDL is 15 miles from the PPE, because the documented point to which the tide can carry hazardous substances is greater than 15 miles from the PPE.



Upstream boundary of TDL is location of the farthest upstream sampling point establishing an observed release, because this point is greater than 15 miles from the PPE.

TIPS AND REMINDERS

- Consider a perennially flowing irrigation ditch as part of the in-water segment of the hazardous substance migration path.
- If there is no HRS-defined surface water body within 2 miles of the site, do not evaluate the surface water pathway, unless there is an observed release to surface water from the site or the site is in a 500-year (or less) floodplain of the nearest surface water.
- Intermittent rivers in areas with 20 or more inches mean annual precipitation and intermittent lakes (regardless of annual precipitation) are not evaluated as surface water bodies for HRS purposes.

SECTION 8.2 DELINEATION OF WATERSHEDS AND DRAINAGE AREAS



This section provides guidance on the determination of watersheds, drainage areas and their boundaries, and discusses the use of watershed and drainage area evaluations within the HRS. A watershed is the area drained by, or contributing water to, a surface water body. If the sources at a site are in more than one watershed, each watershed is evaluated separately, and the highest score for any watershed is assigned as the surface water pathway score. The portion of a watershed upgradient from the sources at the site is delineated to determine a drainage area category, which is used to score the runoff factor for potential to release.

RELEVANT HRS SECTIONS	
Section 4.0.2	Surface water categories
Section 4.1.1.1	Definition of the hazardous substance migration path for overland flow/flood migration component
Section 4.1.1.2	Target distance limit
Section 4.1.2.1.2.1.2	Runoff

DEFINITIONS

Direction of Overland Flow: Determined on a topographic map by drawing flow lines perpendicular to contour lines. Direction of flow will normally be along these flow lines, from areas of higher elevation toward areas of lower elevation but can be affected by man-made barriers such as walls and sewers. The determination of flow direction is important for identifying the drainage area upgradient of sources at the site and for identifying the overland segment of the hazardous substance migration path.

Drainage Area: The area upgradient of sources contributing water to the sources via overland flow; this area is based on topography, except where overland flow is captured and/or diverted (e.g., storm sewers, run-on control features, walls) around the source. In cases where upland flow is captured or diverted, only the area of the source and areas upgradient of the source between the source and the device or structure diverting overland flow from the source are included in the drainage area.

Hazardous Substance Migration Path: The path that hazardous substances travel or would travel over land from a source to surface water (overland segment) and within surface water to the TDL (in-water segment). In certain cases (e.g., sites consisting only of contaminated sediments, sites where sources are located in surface water bodies), the hazardous substance migration path consists of only an in-water segment.

In-water Segment: Portion of the hazardous substance migration path from the PPE to the TDL. For tidally influenced rivers, the in-water segment may include portions of surface water bodies upstream from the PPE to the extent that the in-water migration path is reversed by

tides. For contaminated sediments with no identified source, the in-water segment begins at the upstream boundary (for streams and rivers) or center (for water bodies with no direction of flow) of the area of contaminated sediments.

Overland Segment: Portion of the hazardous substance migration path from a source to a surface water body .

Probable Point of Entry (PPE): Point at which the overland segment of a hazardous substance migration path intersects with surface water. A site may have multiple PPEs. The PPE is assigned as the point at which entry of the hazardous substances to surface water is most likely.

Target Distance Limit (TDL) for the Surface Water Migration Pathway: Distance over which the in-water segment of the hazardous substance migration path is evaluated. The TDL extends 15 miles from the PPE in the direction of flow (or radially in lakes, oceans, or coastal tidal waters) or to the most distant sample point establishing an observed release, whichever is greater. In tidally influenced surface water bodies, an upstream TDL is also determined. For some sites (e.g., sites with multiple PPEs), an overall target distance of greater than 15 miles may result.

Watershed: Portion of the watershed downgradient of sources at the site. The watershed includes the surface water bodies between the PPEs and the TDL (i.e., the in-water segment of the hazardous substance migration path). A single watershed includes all in-water segments that intersect within the TDL. A site is in two or more watersheds if two or more hazardous substance migration paths from the sources do not reach a common point within the TDL. In these cases, each distinct watershed is evaluated separately.

DELINEATING WATERSHEDS

The key to evaluating watersheds is to first identify the hazardous substance migration paths (see Section 8.1). Most sites are in a single watershed. However, multiple watersheds may be identified for larger sites. Where multiple watersheds occur, evaluate each watershed separately.

- (1) **Compile maps that show the sources being evaluated and all surface water bodies within the TDL.**
 - Locate all sources on a map.
 - Examine topography and surface water bodies around the site to identify PPEs (if this is not possible, use a straight line distance between sources at the site and surface water bodies to estimate locations of PPEs).
 - Compile sufficient maps to evaluate 15 miles radially or downstream of all PPEs, as appropriate. Additional maps may be needed as the hazardous substance migration path is refined to reflect precise locations of PPE's, TDLs within a water body, and tidal influences.
- (2) **Identify the overland segment from each source to all surface water bodies within 2 miles of the source.** Identify all other routes of migration to surface water, such as flooding. (Remember, for surface water migration by flooding, sources in a 500-year or less floodplain do not need to be within 2 miles of a surface water body.)
 - Each source may have multiple overland segments to a single surface water body or to different surface water bodies, establishing multiple PPEs. These PPEs may or may not differ for sources.

- Locate each overland segment and associated PPE on the maps. The overland segment may not be able to be determined solely from a topographic map. Supplement the maps with field observations, if needed, to determine the presence of man-made impediments.
 - Locate all other PPEs due to flooding or observed releases by direct observation to surface water.
- (3) **For each PPE, draw the In-water segment of the hazardous substance migration path to the TDL.**
- (4) **All hazardous substance migration paths with in-water segments that intersect within the TDL are considered to be In the same watershed for scoring purposes.**
- Targets for a watershed are evaluated along all portions of the hazardous substance migration paths comprising the watershed.
 - All sources with PPEs in a watershed are assigned to that watershed for scoring purposes. A source can be assigned to more than one watershed.

Highlight 8-16 provides an example of delineating a single watershed. **Highlight 8-17** provides an example of evaluating multiple watersheds.

DETERMINING DRAINAGE AREA

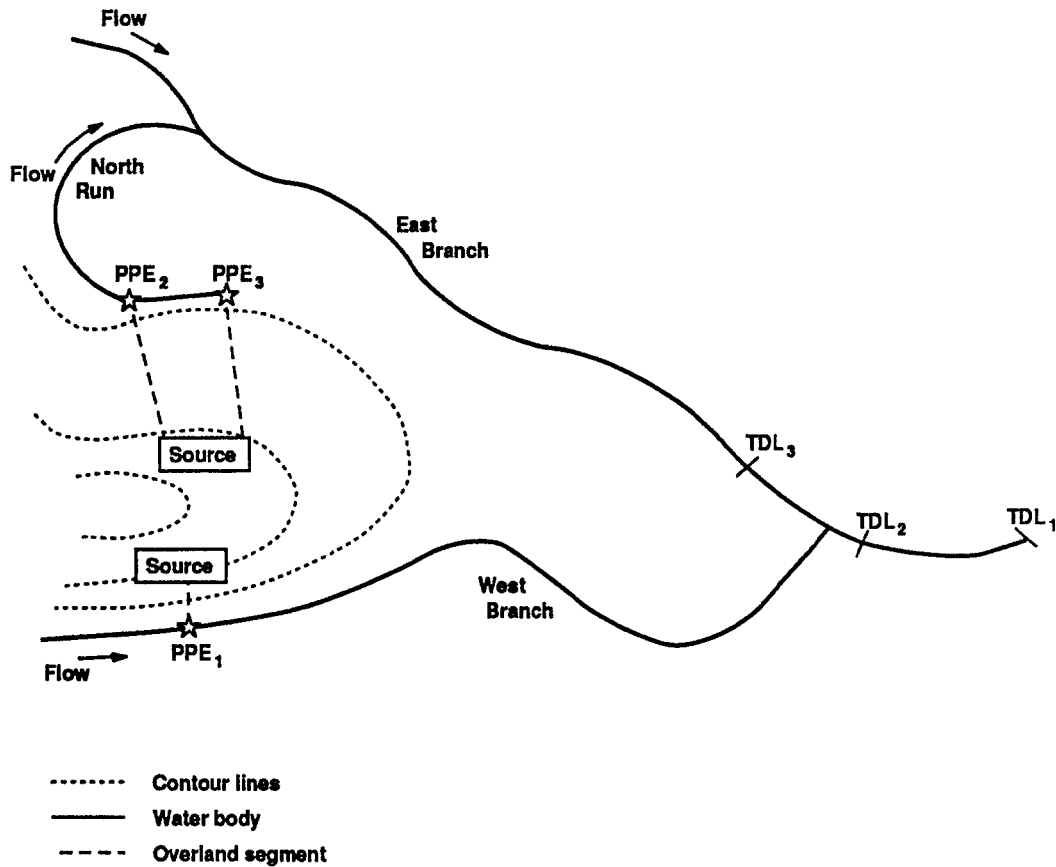
Drainage area includes both the area of the sources and the areas upgradient of sources that can contribute runoff to the sources. Drainage area is evaluated under potential to release via overland flow and is evaluated separately for each watershed. It is not necessary to evaluate drainage area if an observed release has been established.

HRS Table 4-3 provides factor values assigned to drainage areas. As shown in that table, drainage area is evaluated within broad ranges, with ranges between 50, 250, and 1,000 acres. The level of precision required for drainage area calculations should be consistent with the need to identify the appropriate range.

Both the area of sources for each watershed and the areas upgradient of these sources can be readily estimated from USGS topographic maps. Observations from the SI may be critical for identifying runoff control or diversion structures (e.g., storm drains) that may not appear on topographic maps.

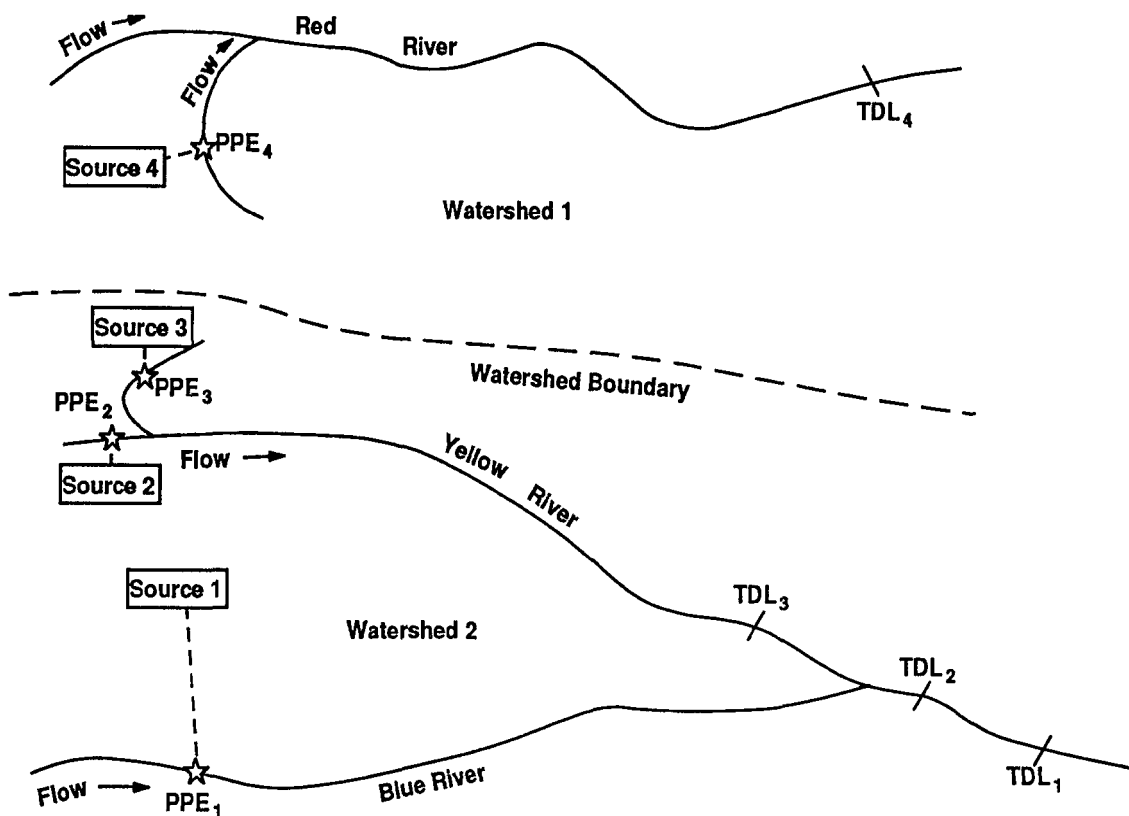
- (1) **Determine the area (or portion of the area) of each source applicable for the watershed being evaluated.** Information may be available from hazardous waste quantity evaluations.
- If source dimensions are known from site visits or other information, use this to determine area.
 - If source dimensions are not known, locate each source on a topographic map and approximate dimensions using the map scale.
- (2) **Determine the area upgradient of each source.**
- Identify structures or features that prevent the flow of runoff onto, across, and/or off sources at the site; field observations should identify locations of such structures.
 - Determine upgradient areas based on a topographic map (or other representations of elevation data).

HIGHLIGHT 8-16 DEFINING A SINGLE WATERSHED WITH MULTIPLE PROBABLE POINTS OF ENTRY



- In this example, two sources are located along a topographic high.
- Establish all PPEs for each source.
- Determine the TDLs from each PPE:
 - The TDL from PPE₁ ends farthest downstream, past the confluence of the East and West Branches (TDL₁).
 - The TDL from PPE₂ ends just past the confluence of the East and West Branches (TDL₂).
 - The TDL from PPE₃ ends on the East Branch (TDL₃).
- Since the hazardous substance migration paths for both sources overlap within the TDL, evaluate the in-water segments of North Run, East Branch, and West Branch as a single watershed, using TDL₁ as the TDL for the site.

HIGHLIGHT 8-17 DEFINING MULTIPLE WATERSHEDS

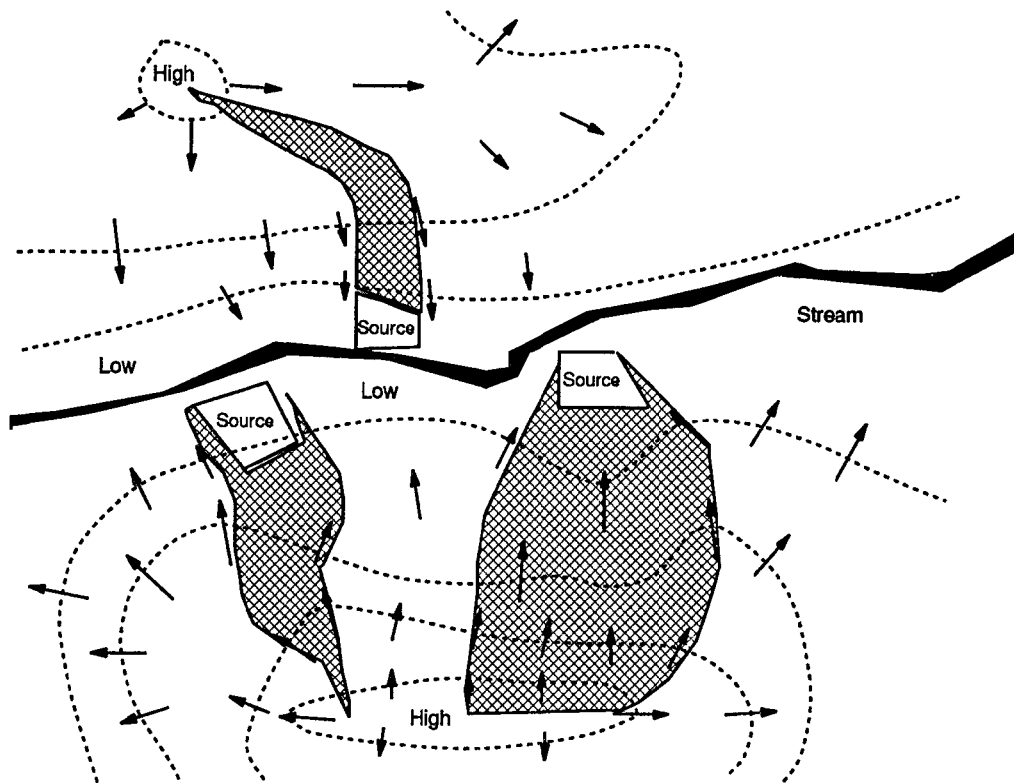





- In this example, four sources are located at a single site.
- Establish PPEs for each source.
- Determine the in-water segment for each PPE.
- The hazardous substance migration paths for Sources 1, 2, and 3 overlap to establish one watershed.
- The hazardous substance migration path for Source 4 does not overlap with any others; a second watershed is established.
- Sources 1, 2, and 3 are assigned to Watershed 2 for scoring purposes and Source 4 is assigned to Watershed 1.
- If the hazardous substance migration path for Source 2 did not reach Blue River (TDL₂), three watersheds would be scored — Source 1 with a PPE into Blue River, Sources 2 and 3 with PPEs into Yellow River, and Source 4 with a PPE into Red River.

- Outline the areas upgradient of each source, as follows:
 - Draw flow lines on the topographic maps, perpendicular to the contour lines.
 - Place arrows on the flow lines in the direction of decreasing elevation.
 - For flow lines that intersect sources, extend the flow lines in the upgradient direction (i.e., direction of increasing elevation) until one of the following is reached:
 - A structure or feature that prevents runoff from crossing the source (e.g., railroad track, wall, road); or
 - An area where elevation ceases to increase.
 - Draw an outline around the areas contained by flow lines that intersect a source and meet the criteria outlined above.
- Calculate the area within the outline of the drainage area using the scale of the topographic map.

Highlights 8-18 and **8-19** provide examples of determining drainage area.

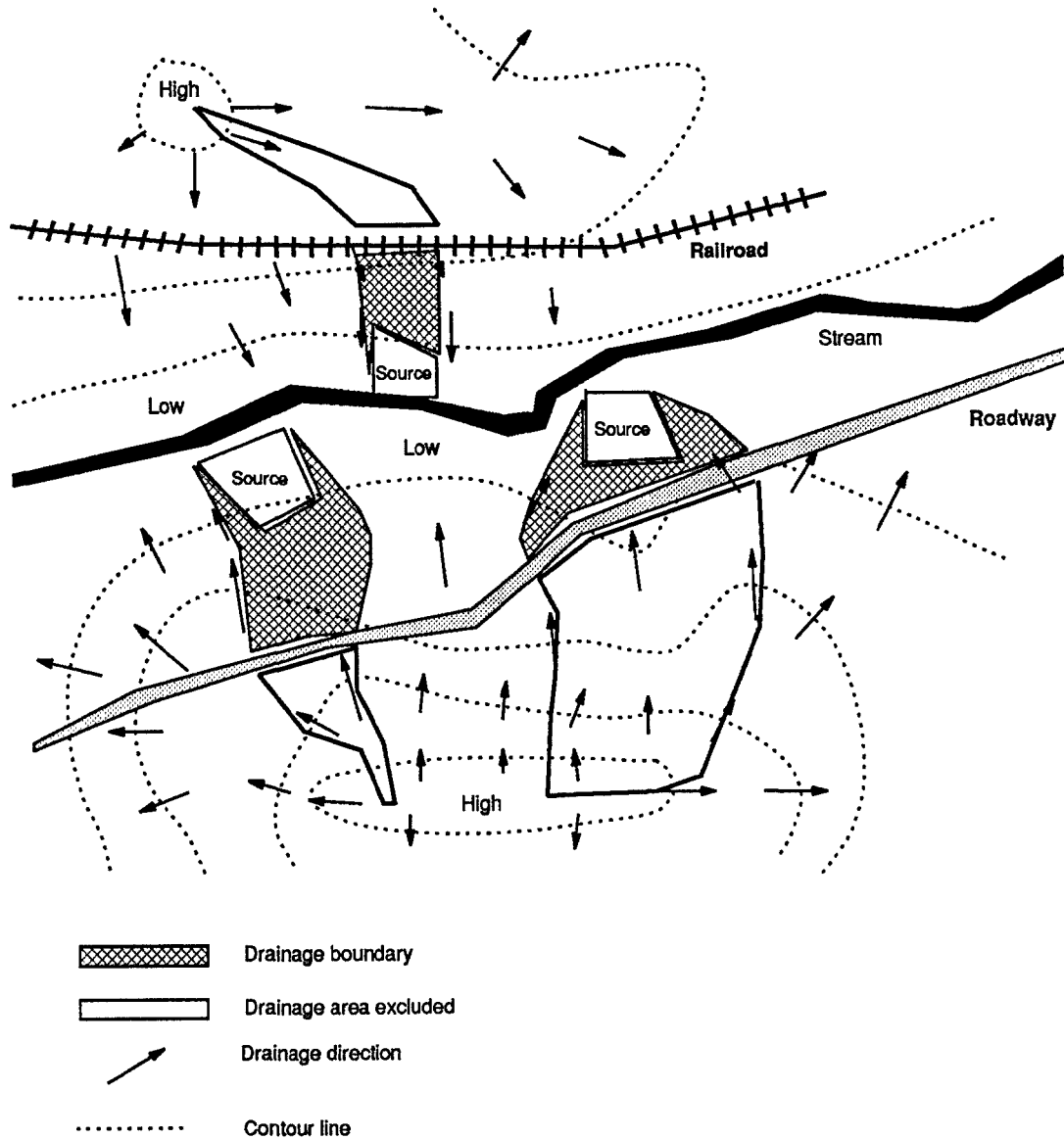
HIGHLIGHT 8-18 DRAINAGE AREA DETERMINATION



-  Drainage boundary
-  Drainage direction
-  Contour line

- Draw flow lines perpendicular to the nearest upgradient contour line from the edges of each source.
- Extend the flow lines between contour lines in the upgradient direction until a topographic high is encountered (a closed ring on a topographic map).
- Close off the drainage area at the topographic high.
 - For circular topographic highs, use the center of the area enclosed by the highest contour line as the highest point of elevation.
 - For elongated topographic highs, draw a ridge line along the center of the length of the area enclosed by the highest contour line to represent the highest points of elevation.

HIGHLIGHT 8-19 DRAINAGE AREA RESTRICTED BY MAN-MADE STRUCTURES



- Draw flow lines perpendicular to the nearest upgradient contour line from the edges of each source.
- Extend the flow lines between contour lines in the upgradient direction until a topographic high is encountered (a closed ring on a topographic map).
- A roadway and railroad tracks are located on opposite sides of the surface water body.
- The roadway and railroad tracks are upgradient of the sites and are considered to divert runoff from the sites.
- Boundaries of the drainage area do not extend beyond the railroad tracks or roadway.

TIPS AND REMINDERS

- Score each watershed separately within the surface water migration pathway. Use the watershed with the highest score as the pathway score for the site.
- Establish a single watershed for all hazardous substance migration paths whose in-water segments intersect within the TDL..
- An isolated body of surface water (e.g., small lake or pond) is evaluated as a separate watershed. In an area with several isolated ponds, wetlands, lakes, or quarries, consider each to be a separate watershed.
- Evaluate drainage area at the level of detail needed to identify the appropriate factor value range, which has breakpoints defined at 50, 250, and 1,000 acres. Often the measure or estimate of drainage area does not need to be very precise because of these ranges.
- Drainage area boundaries are important for evaluating the soil group factor, which considers the predominant soil group within the drainage area boundaries.

SECTION 8.3

CHARACTERIZATION OF SURFACE WATER BODIES



This section explains how to characterize several aspects of surface water for the purpose of evaluating the surface water pathway. Specifically, this section explains how to determine the surface water body category, how to determine the salinity category of surface water, and how to evaluate targets in multiple water body categories. The surface water body category is important for determining TDLs, dilution weights, and persistence factors. Salinity categories are important for selecting bioaccumulation potential and ecosystem bioaccumulation potential factor values, ecosystem toxicity values, and ecological-based benchmarks.

RELEVANT HRS SECTION	
Section 4.0.2	Surface water categories
Section 4.1.2.3.1	Nearest intake
Section 4.1.3.2.1.3	Bioaccumulation potential
Section 4.1.4.2.1.1	Ecosystem toxicity
Section 4.1.4.2.1.3	Ecosystem bioaccumulation potential
Section 4.1.4.3.1	Sensitive environments

DEFINITIONS

Bioaccumulation Potential: Evaluates the tendency for a substance to accumulate in the tissue of an aquatic human food chain organism and forms one component of the toxicity/persistence/bioaccumulation and toxicity/mobility/persistence/bioaccumulation factors within the human food chain threat-waste characteristics factor category.

Brackish Water: Water with an average tidal cycle chloride concentration of greater than 250 mg/l but less than 18,700 mg/l (corresponding to salinity of greater than 0.45 but less than 34 parts per thousand).

Dilution Weight: A unitless parameter that adjusts the assigned point value for certain targets subject to potential contamination based on the flow or depth of the water body at the target.

Ecosystem Bioaccumulation Potential: Evaluates the tendency for a substance to accumulate in the tissue of any aquatic organism, not just human food chain organisms (as in bioaccumulation potential), and forms one component of the ecosystem toxicity/persistence/bioaccumulation and ecosystem toxicity/mobility/persistence/bioaccumulation factors within the environmental threat-waste characteristics factor category. HRS Table 4-15 and sections 4.1.3.2.1.3 and 4.1.4.2.1.3 provide the data hierarchy to follow when evaluating bioaccumulation potential.

Ecosystem Toxicity: The toxicity of a substance to aquatic organisms. It forms one component of the ecosystem toxicity/persistence/bioaccumulation and ecosystem

toxicity/mobility/persistence/bioaccumulation factors within the environmental threat-waste characteristics factor category. HRS Table 4-19 provides the data hierarchy to follow when evaluating ecosystem toxicity.

Flow: The long-term average annual discharge of a river or stream (i.e., the annual discharge averaged over many years of record).

Fresh Water: Water with an average tidal cycle chloride concentration of 250 mg/l or less (corresponding to salinity of 0.45 parts per thousand or less).

Salt Water: Water with an average tidal cycle chloride concentration of 18,700 mg/l or greater (corresponding to salinity of 34 parts per thousand or greater).

DETERMINING BREAKPOINTS BETWEEN SURFACE WATER CATEGORIES

Determining the breakpoint between surface water categories is the first step in identifying the water body type in which a target is located. If targets clearly are located within a particular category, it generally is sufficient to approximate these breakpoints (e.g., by drawing lines on a scale map or diagram). When targets are located close to a breakpoint, determine the breakpoints with greater precision, as follows.

- (1) **Determine the breakpoint between rivers and coastal tidal waters.** The mouths of rivers are the breakpoints between rivers and coastal tidal waters. Estuarine portions of rivers affected by tidal waters are classified as rivers under the HRS. The presence of tidal water is not a criterion for separating rivers from coastal tidal waters. Identify the mouths of rivers using the following sources.
 - Contact the appropriate river basin commission, state or local planning commission, district office of the U.S. Army Corps of Engineers, or the state or district office of the USGS Water Resources Division to identify the river mouth. For many areas, river mouths have been established through intergovernmental processes and legal definition.
 - Refer to river reach data bases (e.g., STORET) to determine river mile 0 for the river in question. This can be used as a surrogate for the river mouth.
 - Manually draw the river mouth from headland to headland (e.g., the mouth of the Potomac River is drawn from Point Lookout, MD to Smith Point, VA). Where headlands, points, or other topographic features are not identifiable, delineate the mouth of the river so as not to depart from the general direction of the shoreline of the coastal tidal water body into which the river flows. In general, the area of the river lying within the line should be subject to the net seaward flow.
- (2) **Determine the breakpoint between coastal tidal waters and the ocean.** The baseline of the Territorial Sea is the breakpoint between coastal tidal waters and the ocean. Consider the following to identify the baseline of the Territorial Sea.
 - The baseline of the Territorial Sea is indicated on some nautical maps, especially when local intergovernmental agreements have established an unusual baseline configuration.
 - If the baseline of the Territorial Sea is not indicated on available charts, determine the baseline from maritime boundaries (3, 9, or 12 nautical mile lines) shown on conventional nautical coast charts prepared by the National Oceans Service, or similar coastal maps.

- Measure back toward the shoreline from the maritime boundaries nearest to the shore shown on the available charts. See **Highlight 8-20**.
- On December 27, 1988, the maritime boundary was moved from 3 miles to 12 miles from the baseline of the Territorial Sea. Therefore, measure back either 3 or 12 nautical miles from the maritime boundary, depending on the date of the nautical chart.
- The maritime boundary is 3 leagues from the baseline of the Territorial Sea in the Texas and Florida Gulf Coasts and in Puerto Rico.
- A maritime boundary may meander as it aligns with offshore sandbars or other features. In such cases, waters located offshore, but shoreward of a sandbar, are classified as coastal tidal waters for HRS purposes.

(3) **Determine the breakpoints between lakes and rivers.** The heads of rivers leading from a lake or the mouths of rivers entering a lake are the breakpoint between lakes and rivers.

- Breakpoints between rivers and lakes should be determined by looking at maps for obvious areas of in-flow or out-flow.
- A constant elevation across a water surface is indicative of a lake, while a drop in elevation is indicative of a river. This criterion may be used to determine breakpoint between the two.
- If not easily determined (i.e., broad widening of river into lake), approximate the breakpoint as half the distance between the start and end points of the widening.

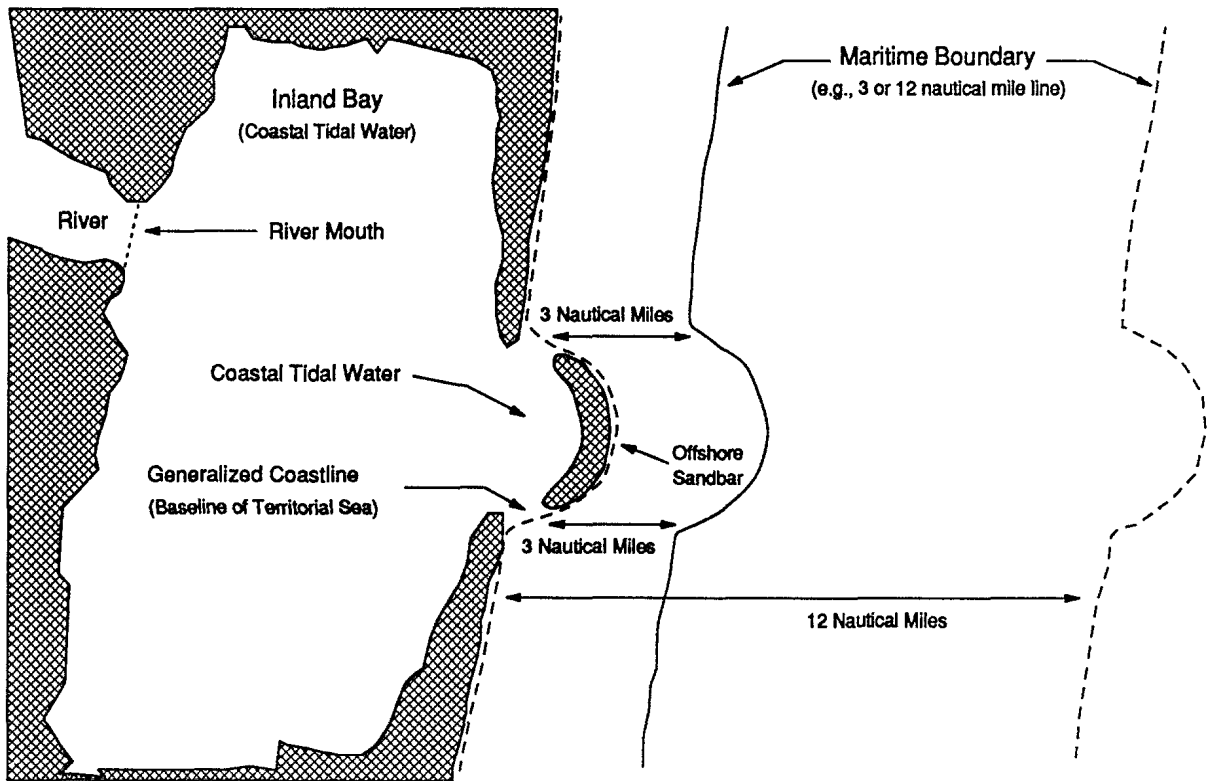
ASSIGNING SURFACE WATER DILUTION WEIGHTS

Targets subject to potential contamination are evaluated using dilution weights as outlined in HRS Table 4-13. The dilution weight reduces the point value assigned to targets subject to potential contamination as the flow or depth of the surface water body increases. To assign a dilution weight in a river, estimate the flow at targets. For lakes, assign the dilution weight based on flow into or out of the lake. For oceans and the Great Lakes, assign the dilution weight based on depth of the ocean or Great Lake. Dilution weights are assigned based on ranges of flow or depth; precise measurement generally is needed only near a range breakpoint.

(1) **Identify locations where flow must be estimated.**

- For rivers, flow is estimated at locations of targets subject to potential contamination.
- For lakes, flow is estimated as follows:
 - For a lake with surface water flow entering, assign a dilution weight based on the sum of the average annual flows for the surface water bodies entering the lake, up to the location of the target.
 - For a lake with no surface water flow entering, but that does have surface water flow leaving, assign a dilution weight based on the sum of the average annual flows for the surface water bodies leaving the lake.
 - For a lake with no surface water flow entering or leaving, assign a dilution weight based on the average annual ground water flow into the lake, if available. If not available, assign a default dilution weight of 1.

HIGHLIGHT 8-20 BREAKPOINT BETWEEN COASTAL TIDAL WATERS AND OCEAN



The baseline of the Territorial Sea is the boundary between coastal tidal waters and the ocean. If the baseline of the Territorial Sea is not indicated on a nautical map, determine it as follows:

- Find the maritime boundary on a nautical map.
- Determine whether the boundary is 3 or 12 nautical miles from the baseline of the Territorial Sea, depending on the date of the map. On December 27, 1988, the boundary was moved from 3 to 12 nautical miles from the baseline.
- Measure the appropriate distance (3 or 12 nautical miles) shoreward from the maritime boundary.

- (2) **Determine If flow data are available at the locations Identified above.** If gauging stations are located near the locations identified in Step (1), assign a dilution weight using average annual discharge or flow data from these stations. **Highlight 8-21** lists sources of flow data. When no gauging stations are located near these locations, estimate the average annual discharge or flow for the target as summarized in the subsection below, Estimating Flow.
- (3) **Estimate the flow at each location Identified In Step (1).** Four methods that can be used to estimate flow are: (1) interpolation of flow data, (2) extrapolation of flow data, (3) estimation of flow using downstream gauging stations, and (4) estimation of flow using the runoff-area method. The level of precision required in determining the flow should be consistent with being able to place the flow at the target in the appropriate range. These methods are detailed below.

HIGHLIGHT 8-21 SOURCES OF FLOW DATA

Primary Source

- *The Water Resources Data Annual Report*, published for each state by USGS. This Report lists various water quality and quantity parameters for each gauging station in the USGS network for the water year (October 1 - September 30)

Secondary Sources

- National Water Data Exchange (NAWDEX) data base, maintained and administered by USGS Headquarters in Reston, VA, or NAWDEX Assistance Centers at the Water Resources Division district offices can help acquire data.
- EPA Regional STORET data.
- *Average Annual Runoff in the United States, 1951-80*, published by USGS.
- *Map of the Mean Annual Runoff for the Northeastern, Southwestern, and Mid-Atlantic United States, Water Years 1951-80*, published by USGS.

Other Possible Sources

- Federal Agencies
 - USGS
 - Army Corps of Engineers
 - National Weather Service
 - Forest Service
 - Soil Conservation Service (SCS)
 - Bureau of Land Management
 - Bureau of Reclamation
 - Bonneville Power Administration
 - Tennessee Valley Authority
- Canadian Agencies
 - Inland Water Directorate, Water Resources Branch
- State Agencies
 - Departments of Water Resources
 - Departments of Natural Resources
 - Departments of Environmental Protection
 - Water Control Boards
- River Basin Commissions
 - Susquehanna River Basin Commission
 - Upper Colorado River Basin Commission
- Non-profit Organizations
 - Alliance for the Chesapeake Bay
- Local Agencies and Organizations
 - Departments of Health
 - Municipal Water Authorities
 - Electric Power Utilities

- (4) **If applicable, evaluate short-term streamflow information.** Estimating streamflow information is described in *Highlight 8-22*.
- (5) **Use estimate of flow to assign dilution weight to targets.** Use HRS Table 4-13 to assign a dilution weight.

ESTIMATING FLOW

When estimating flow, first identify where gauging stations are located and determine which methods are appropriate. In many instances, no gauging stations will be located near a target or within the TDL, but one or more gauging stations may be found some distance upstream or downstream from the target. In these cases, it may be possible to use interpolation or extrapolation to

HIGHLIGHT 8-22 EXTENDING SHORT-TERM STREAMFLOW RECORDS

In some cases, short-term streamflow information may be available for fewer than five complete water years as required by the USGS for calculating "average" because the years of record may have been unusually wet or dry and the mean may be skewed accordingly. A better approach is to compare the mean flow calculated to a nearby gauging station which has a long-term data record. A ratio (DR_{AB}) is calculated between the mean flow at the short-term station (Q_A) and the mean flow at the long-term station (Q_B) for the same years. The ratio is then multiplied times the discharge from the long-term gauging station for all years as follows:

		Discharge (cfs)	
A.	Available Data Water Year	Station A (Short-term)	Station B (Long-term)
	1989	94	188
	1988	85	176
	1987	95	195
	1986	--	219
	1985	--	233
	1984	--	220
	Means for period of record;	91	205
	Means for 87-89	91	186
B.	Calculate ratio between mean discharges for Station A and Station B for the same period of record (87-89):		
	$DR_{AB} = Q_A / Q_B = 91 \text{ cfs} / 186 \text{ cfs} = 0.49$		
D.	Estimate the long-term corrected annual discharge at Station A using discharge ratio and data from Station B:		
	$Q_{A(84-89 \text{ Est.})} = Q_{B(84-89)} \times DR_{AB} = 205 \text{ cfs} \times 0.49 = 100 \text{ cfs}$		

estimate the flow at the target. In other cases, it may not be possible to interpolate or extrapolate, but it may be possible to estimate the flow using downstream gauging stations or by the runoff-area method.

When interpolating or extrapolating, follow these guidelines:

- Rivers or streams should have flows greater than 100 cfs when interpolating, and greater than 1,000 cfs when extrapolating.
- There should be no significant inflows from tributaries relative to the discharge in the main branch.
- Watershed should be fairly uniform in character and not be in an arid or semi-arid region.
- No major lakes, dams, significant diversions, withdrawals, or other controls should be between the gauging stations and the target areas.
- Area between gauging stations (not necessarily the entire watershed) should not be subject to significant variations in rainfall patterns.

In addition use the following guidelines when extrapolating:

- The gauging station should be as close to the target as possible.
- For downstream targets, the gauged discharge value of the station nearest to the target should be at the low to middle portion of the flow characteristics range listed in HRS Table 4-13; conversely, for upstream targets, the gauged discharge value should be at the middle to high portion of the range.

ESTIMATING FLOW BY INTERPOLATION

When using interpolation to estimate flow at a target, the gauging stations generally should not be located far apart. The maximum acceptable distance will depend on the characteristics of the river or stream, the tributary inflows, and the characteristics of the watershed. For a large river with no inflows equaling a significant percentage of the main flow, it may be possible to interpolate 50 miles or more. For small streams, linear interpolation may only be valid for short distances. **Highlight 8-23** provides an example of estimating flow using interpolation.

- (1) **Identify two gauging stations.** One gauging station should be upstream (station A) and the other downstream (station B) of the target.
- (2) **Using HRS Table 4-13, determine the assigned dilution weight for each gauging station.**
 - If the dilution weights are the same for station A and station B, document that the annual discharge values yield the same dilution weight in HRS Table 4-13, and assign that dilution weight to the target.
 - If the dilution weights are different, proceed to Step (3).
- (3) **Perform linear Interpolation.** In more complex cases, there is a change in the assigned dilution weight from station A to station B. If the size of the river or stream is much larger than the size of any tributary inflows (e.g., a 6th order stream with 1st and 2nd order tributaries) and the watershed between the two stations is uniform (e.g., the tributary inflows are about equal in magnitude and uniformly distributed along the length of the stream segment between the two stations), it may be possible to perform a linear interpolation.
 - Determine the incremental discharge. Subtract the average annual discharge of the upstream station, Q_A (in cfs), from the downstream station, Q_B , to determine what is known as the incremental discharge, Q_I .

$$Q_I = Q_B - Q_A$$

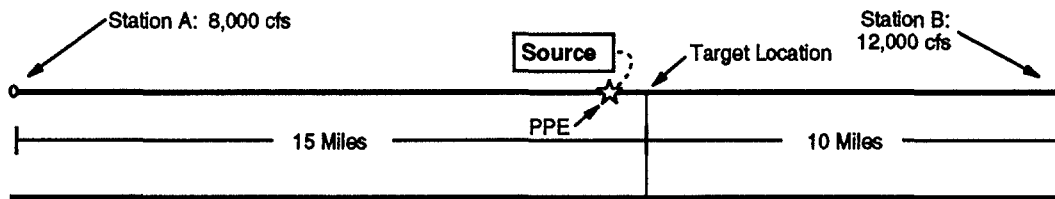
- Calculate a change in discharge per unit length. Divide the incremental discharge by the length of the stream segment from station A to station B, L_{AB} (units of length may be chosen as needed, but use the same units throughout), to yield a change in discharge per unit length, Q_X .

$$Q_X = Q_I / L_{AB}$$

- Calculate the estimated discharge at the target. Multiply the change in discharge per unit length, Q_X , times the distance from the upstream station A (in the same units used for L_{AB}) to the target of concern, L_{AT} , and add the result to the discharge at station A, Q_A , to yield the estimated discharge at the target, $Q_T(\text{est.})$.

$$Q_T(\text{est.}) = (Q_X \times L_{AT}) + Q_A$$

HIGHLIGHT 8-23 ESTIMATING TARGET FLOW USING INTERPOLATION



A site is located in a mixed use suburban community, in close proximity to a river. The river is subject to potential contamination, and the PPE for hazardous substances has been identified. The river is not subject to tidally influenced waters.

In order to evaluate a target subject to potential contamination, a dilution weight must be assigned to the target. Because there is no gauging station located at or in close proximity to the target, the flow rate at the target must be estimated. Existing conditions (e.g., there are no significant inflows from tributaries relative to the discharge in the main branch) allow for the interpolation method to be used.

- (1) **Identify two gauging stations — one upstream (station A) and one downstream (station B) of the target.**

Station A — $Q_A = 8,000$ cfs
 Station B — $Q_B = 12,000$ cfs

- (2) **Using HRS Table 4-13, determine the assigned dilution weight for each gauging station.**

Station A = 0.001
 Station B = 0.0001

Because the dilution weights are different, proceed to Step (3).

- (3) **Perform linear interpolation.**

- Determine the incremental discharge.
 $Q_I = 12,000 \text{ cfs} - 8,000 \text{ cfs} = 4,000 \text{ cfs}$
- Calculate a discharge per unit length.
 $Q_L = 4,000 \text{ cfs} / 25 \text{ mi} = 160 \text{ cfs/mi}$
- Calculate the estimated discharge at the target.
 $Q_T(\text{est.}) = (160 \text{ cfs/mi} \times 15 \text{ mi}) + 8,000 \text{ cfs} = 10,400 \text{ cfs}$
- Using HRS Table 4-13, assign a dilution weight to the target based on the estimated flow for the target, 10,400 cfs. The dilution weight for the target is 0.0001.

ESTIMATING FLOW BY EXTRAPOLATION

If two gauging stations are located either upstream or downstream from the target, an estimate of flow at the target can be obtained by extrapolation, as described below.

(1) **Identify the nearest gauging station upstream or downstream of the target.**

- If this gauging station is located relatively close to a target, assign the dilution weight that corresponds to the gauged flow to the target.
- If this gauging station is located too great a distance from the target to allow confidence in using this method, proceed to Step (2).

(2) **Perform linear extrapolation.** This method may be used in situations where a target is located in a river or stream in which two gauging stations (C and D) are located on a river or stream segment that does not include the target area. The linear extrapolation method uses the linear interpolation calculation described above to estimate a rate of change for the discharge in the segment of the river or stream bounded by stations C and D, and then assumes that the rate of change is constant from the nearest station to the target.

- Identify two gauging stations, both either upstream or downstream of the target.
- Calculate a change in discharge per unit length (Q_x), as discussed for the interpolation method.
- Calculate the estimated discharge at the target. Multiply the change in discharge per unit length, Q_x , times the distance from the target to the nearest gauging station, L_{DT} or L_{CT} , to yield an estimated incremental discharge value.
 - If the target is located downstream from the nearest gauging station, the estimated incremental discharge value is added to the gauged discharge value for the nearest station.

$$Q_T(\text{est.}) = Q_D + (Q_x \times L_{DT})$$

- If the target is located upstream from the nearest station, the estimated incremental discharge value is subtracted from the gauged discharge value for the nearest station.

$$Q_T(\text{est.}) = Q_C - (Q_x \times L_{CT})$$

ESTIMATING FLOW USING ONE DOWNSTREAM GAUGING STATION

In some instances, only one gauging station is present on a river or stream, but at some distance from a target. In these cases, it may be possible to extrapolate the flow data to the target location. However, this technique should be applied only over relatively short distances since there is no way to estimate the rate of change of the discharge between the gauging station and the target.

To use this method, the flow at target locations is set equal to the flow at a downstream gauging station, as long as the flow at the target will not exceed this value. This approach is acceptable because it will not underestimate the actual flow and thus, overestimate target values.

ESTIMATING FLOW FOR UNGAUGED WATERSHEDS

Some rivers or streams may not have gauging stations. To estimate the average flow in an ungauged river or stream, use the runoff-area method described below.

- (1) **Draw the watershed boundaries for the point in the stream where the flow is to be map estimated on the topographic map.** The scale of the map to be used will depend on the size of the watershed to be measured. The 7.5 minute (1:24,000) topographic maps can be used for small watersheds (e.g., less than 25 miles), especially if they fit on one or two adjacent map sheets. For larger watersheds or elongated watersheds spanning several map sheets, a larger scale such as 1:50,000 or 1:100,000 should be used. Maps with scales greater than 1:250,000 should be avoided because the resolution of the topographic lines is too crude to estimate boundaries correctly.
- (2) **If there are multiple targets, delineate the additional downstream watershed area for the farthest downstream target area.** If, after advancing through this procedure, it is found that a change in the dilution weighting factor occurs somewhere upstream of the last target, estimate where the transition may occur, delineate the watershed for the point, and then estimate flow at that point. The best place to look for transitions is where a major tributary meets the stream.
- (3) **For each watershed delineated, determine the enclosed area.** This may be done by any of several methods including using a planimeter, counting squares, weighing paper, or digitizing the boundaries with a CAD or GIS system. The area should be expressed in units of square miles.
- (4) **Select gauging stations using the following guidelines.**
 - The gauged watersheds should be as close to the ungauged watershed as possible.
 - The gauged watersheds should be of a similar character in terms of topography, precipitation, and land use.
 - The gauged watersheds should be approximately the same size as the ungauged watershed area.
- (5) **Divide the "average flow" value (Q_{gauge} , in cfs) for each selected station by the "drainage area" (A_{gauge} , in mi^2) to derive a flow per unit area parameter, R_{gauge} (in cfs/mi^2).**

$$R_{\text{gauge}} = Q_{\text{gauge}} / A_{\text{gauge}}$$

- If any value varies from the others by more than 25 percent, examine the watershed that it drains and try to determine whether the station is actually representative of the ungauged area.
 - Average the R_{gauge} values of the selected stations to yield a regional unit flow value R_{region} .
- Another procedure to obtain R_{region} is to use average annual runoff maps, such as the *Average Annual Runoff in the United States, 1951-80*, which is published by the USGS, to calculate an estimate of a regional unit flow value. The map displays the U.S. with contour lines of equal average runoff. If the drainage area under investigation is in an area on the map that exhibits little variation in runoff, it may be possible to visually estimate an average runoff value. This average annual runoff value in inches can then be converted to flow per square mile (cfs/mi^2) by multiplying it by 0.07362.
- (6) **For each ungauged flow point to be estimated, multiply the regional unit flow value times the watershed area determined for that point.**

$$Q_{\text{target}} = R_{\text{region}} \times A_{\text{target}}$$

EVALUATING TARGETS IN MULTIPLE WATER BODY CATEGORIES

Some targets in the surface water pathway (i.e., wetlands, other sensitive environments, fisheries) may span more than one water body category. The steps below describe how to evaluate such targets. **Highlight 8-24** provides an example of evaluating targets in two dilution weight categories.

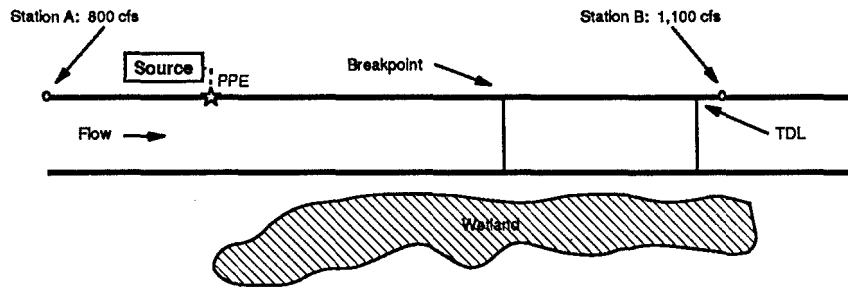
- (1) **For listed sensitive environments, identify all dilution weights applicable to the water bodies in which the sensitive environment is located.** Choose the dilution weight that results in the highest target value for that sensitive environment. .
- (2) **For wetlands and fisheries, determine where the breakpoint(s) between the surface waters and/or water body categories occur.**
 - Divide the wetland or fishery into two or more portions, based on the breakpoints determined above.
 - Evaluate each portion as a separate wetland or fishery, applying the appropriate dilution weight from HRS Table 4-13.

DETERMINING SALINITY CATEGORY OF WATER BODY

The use of certain reference data to score bioaccumulation potential, ecosystem bioaccumulation potential, and ecosystem toxicity, and to select ecological-based benchmarks depends on the salinity of the water body in which targets are located. Most lakes and portions of rivers are fresh water, and oceans and most portions of coastal tidal waters are salt water. In tidally influenced waters (and certain non-tidally influenced waters), determining which data to use may be complicated by the presence of water of relatively low salinity, known as brackish water.

- (1) **Gather the following information about the surface water bodies within the TDL, as necessary and available:**
 - Average tidal cycle salinity;
 - Average tidal cycle chloride concentration; and
 - Presence of certain aquatic organisms.
- (2) **Determine if targets are located in fresh water, salt water, and/or brackish water.**
 - If data on salinity or chloride concentration are available, use the definitions given at the beginning of this section to classify the water body,
 - If no data are available, contact a state or Federal agency representative (e.g., National Marine Fishery Service (NMFS) personnel) or a recognized expert to provide a judgment based on the presence or absence of "indicator" species. Certain species are sensitive to salinity, and their presence may indicate fresh water. The same is true for some species that only inhabit salt water. In addition, assemblages of species are indicative of salinity gradients. Documenting salinity by use of indicator species should be supported by either a professional's statement or by scientific literature confirming the correlation of the indicator species with the water body's salinity.
 - If no data or professional judgment regarding indicator species are available, assume that the portion of the river from the mouth upstream to the extent of salt water intrusion is brackish, all areas upstream from this point are fresh water, and all coastal tidal waters are salt water.

HIGHLIGHT 8-24 SCORING TARGETS IN TWO DILUTION WEIGHT CATEGORIES



The site is located adjacent to a stream. The two gauging stations located nearest the site are approximately 5 miles upstream from the PPE (Station A) and approximately 16 miles downstream from the PPE (Station B). Annual average discharge for these stations is as follows:

Station A: 800 cfs
Station B: 1,100 cfs

Wetlands are adjacent to the stream beginning at the PPE and continue for 17 miles. The entire wetland is a critical habitat for a Federal designated endangered species.

The TDL for this site includes water bodies in two different flow categories. To evaluate targets correctly, you must determine the breakpoint in the flow categories, so that the appropriate dilution weights can be assigned.

- (1) **Determine the incremental flow between the two gauging stations (Q_i) and then calculate the flow per unit length (Q_L).**

$$Q_i = 1,100 \text{ cfs} - 800 \text{ cfs} = 300 \text{ cfs}$$

$$Q_L = 300 \text{ cfs} / 21 \text{ mi} = 14.3 \text{ cfs/mi}$$

- (2) **Determine breakpoint between dilution weight categories.**

$$800 \text{ cfs} + (14.3 \text{ cfs/mi}) (B \text{ mi}) = 1,000 \text{ cfs}$$

$$B = 200 \text{ cfs} / 14.3 \text{ cfs/mi} = 14 \text{ mi}$$

Breakpoint is 14 miles downstream from Station A, or 9 miles downstream of the PPE.

- (3) **Score targets.**

For critical habitat, choose dilution weight that gives higher score (i.e., 0.01). Critical habitat for Federal designated endangered species receives value of 100 from HRS Table 4-23. Therefore,

$$\text{Sensitive Environment Value} = 100 \times 0.01 = 1$$

For wetland, divide the wetland into two parts, and score each segment separately:

$$\text{Segment A: } 9 \text{ mi frontage, dilution weight} = 0.01$$

$$\text{Wetland Value} = 250 \times 0.01 = 2.5$$

$$\text{Segment B: } 6 \text{ mi frontage, dilution weight} = 0.001$$

$$\text{Wetland Value} = 150 \times 0.001 = 0.15$$

$$\text{Potential Contamination Factor Value} = 1/10 \times [1 + 2.5 + 0.15] = 0.365$$

- (3) **Select appropriate reference data, based on salinity of water body at target locations.**
Determine the salinity category for each threat based on the location of targets (e.g., the food chain targets may be in salt water and the sensitive environment targets may be in fresh water).
- Select a bioaccumulation potential, ecosystem toxicity, and ecosystem bioaccumulation potential value (as needed) for the watershed.
 - If all targets for the threat are located in fresh water, use fresh water reference data values to score the appropriate factor. If the applicable fresh water data for the hazardous substances being evaluated are not available, use salt water (marine) reference data.
 - If all targets for the threat are located in salt water, use salt water reference data values to score the appropriate factor. If the applicable salt water data for the hazardous substances being evaluated are not available, use fresh water reference data.
 - If some targets for the threat are located in fresh water and others are located in salt water, or if any targets are located in brackish water, select the applicable reference data value that results in the higher score for the appropriate factor.
 - Select appropriate benchmarks for each sensitive environment target subject to actual contamination.
 - If target being evaluated is located in fresh water, use the fresh water reference data value to determine a benchmark. If applicable fresh water data for the hazardous substances being evaluated are not available, use salt water reference data if available.
 - If the target being evaluated is located in salt water, use the salt water reference data value to determine a benchmark. If applicable salt water data for the hazardous substances being evaluated are not available, use fresh water reference data if available.
 - If the target being evaluated is located in both fresh water and salt water, or if it is located in brackish water, use the lower of the fresh water or marine values to determine the benchmark.

TIPS AND REMINDERS

- It may not be necessary to define precise breakpoints between water body types unless important targets are located near the breakpoints.
- If the fresh and salt water reference values are identical, do not spend significant time documenting whether waters are fresh, brackish, and/or salt. However, if reference values differ for one or more of the factors, the distinction needs to be made.
- In the case of ecological-based benchmarks for sensitive environments subject to actual contamination, the use of the lower benchmark concentration results in the higher factor score.
- Score inland waters with high salinity due primarily to sodium chloride (e.g., Great Salt Lake, Salton Sea, and saline water-draining salt beds) as brackish waters. Score inland waters with

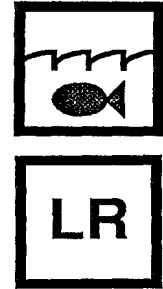
high salinity due primarily to salts other than sodium chloride (e.g., mineral springs, volcanic lakes, and playa lakes) as fresh water.

- If salinity for a water body varies significantly over time, determine water type based on the presence of fresh and/or salt water indicator species.
- HRS dilution weights are assigned based on order-of-magnitude ranges of flow or depth. Therefore, estimate flow or depth at a target with a degree of precision that places the flow or depth within one of these ranges.
- The SCS often has flow data for small (10 to 50 cfs) streams that are not gauged.
- Before applying the runoff-area method, carefully consider the watershed especially in areas where runoff patterns are highly variable (e.g., the Southwest and Pacific Northwest).

SECTION 8.4

SURFACE WATER

CONTAINMENT FACTOR



This section provides definitions for many of the terms used in the surface water containment descriptions and explains how to score the containment factor in the surface water pathway. If an observed release to a watershed cannot be established, then that watershed is evaluated based on potential to release. Two factors are used to evaluate the potential to release factor: potential to release by overland flow and potential to release by flood. The containment factor is a measure of the methods (either natural or engineered) that have been used to restrict the release of hazardous substances from a source to the watershed or to prevent released substances from entering surface water.

Containment criteria have been compiled for several types of sources on a numerical scale selected to provide a relative degree of discrimination among different levels of containment. HRS Table 4-2 includes containment factor rating descriptions for the following specific categories of hazardous waste sources: surface impoundments, land treatment facilities, containers, and tanks. The table also provides containment factor rating descriptions that apply to all other hazardous waste sources, including landfills, piles, and contaminated soil.

The containment factor is evaluated for each source for the watershed being evaluated, and the highest containment factor value for any source that meets the minimum size requirement is assigned as the containment factor value. If none of the sources meets the minimum size requirement, the highest containment factor value of any source is assigned.

RELEVANT HRS SECTIONS	
Section 4.1.2.1.2.1.1	Containment
Section 4.1.2.1.2.2.1	Containment (flood)
Section 4.1.2.1.2.2.2	Flood frequency
Section 4.1.2.1.2.2.3	Calculation of factor value for potential to release by flood
Section 4.1.2.1.2.3	Calculation of potential to release factor value

DEFINITIONS

The following definitions elaborate on terms used in the containment descriptions in HRS Table 4-2.

Above-ground Tank: Any tank that does not meet the definition of a below-ground tank (including any tank that is only partially below the surface).

Associated Containment Structures: As used in HRS Table 4-2, constructed barriers (e.g., liners, dikes, berms) that may have been placed under, over, or around a source (e.g., a landfill or a waste pile) to prevent the release of hazardous substances to the environment.

Below-ground Tank: A tank with its entire surface area below the surface and not visible; however, a fraction of its associated piping may be above the surface.

Bulk Liquids: Noncontainerized liquids deposited directly into a source by pipe, tanker truck or other means of transport.

Essentially Impervious Base: A base underlying containers that is free from cracks and gaps and prevents the penetration of leaks, spills, or precipitation.

Evidence of Hazardous Substance Migration: Chemical analyses and/or visual evidence that demonstrate hazardous substances attributable to a source have migrated away from that source into the surrounding soil, ground water, surface water, or air (e.g., leachate containing hazardous substances coming out of the source; stained or contaminated soil that can be attributed to migration from the source; evidence of overflow from a surface impoundment containing hazardous substances).

Free Liquids: Liquids that readily separate from the solid portion of a substance under ambient temperature and pressure.

Freeboard: Vertical distance between the top of a tank or surface impoundment dike and the surface of the hazardous substance contained therein. Freeboard is intended to prevent overtopping resulting from normal or abnormal operations, wind and wave action, rainfall, and/or run-on.

Land Treatment Zone: Soil area in the unsaturated zone of a land treatment unit within which hazardous substances are intended to be degraded, transformed, or immobilized.

Liner: A continuous barrier that covers all the earth likely to be in contact with a source so that hazardous substances or leachate containing hazardous substances would not migrate to the surrounding earth. The barrier may be synthetic material (e.g., a thick, continuous, polyethylene membrane) or engineered, compacted natural, material (e.g., re-worked and low permeability clay). An in-situ clay layer that has not been re-engineered by compaction or other methods is not considered a liner.

Maintained Engineered Cover: Vegetated cover, usually made of compacted clean soil. It is generally placed over a source at its closure and is designed and constructed to minimize the migration of liquids through the closed source, function with minimum maintenance, and accommodate settling and subsidence. Maintenance of the integrity and effectiveness of the final cover may include repairing the cap as necessary to correct the effects of settling, subsidence, erosion, and other events.

Run-on Control/Runoff Management System, Functioning and Maintained: A functioning and maintained, engineered system or structure designed to prevent flow into or onto a source or, alternatively, to control runoff from a source and prevent hazardous substance migration.

Secondary Containment: As used in HRS Table 4-2, secondary containment is applicable to the evaluation of the containment factor for tanks. Methods of secondary containment include a liner external to the tank, a vault, a double-walled tank, or an equivalent device.

Tank and Ancillary Equipment: Tanks and associated pipes, pumps, sumps, manifolds, fittings, flanges, and valves used to distribute, meter, or control flow of hazardous substances to or from the tank.

SCORING SURFACE WATER CONTAINMENT FOR OVERLAND FLOW

- (1) **Identify the sources at the site.** (See Section 4.1 for discussion of potential sources.) HRS section 1.1 defines a source as "any area where a hazardous substance has been deposited, stored, disposed, or placed, plus those soils that have become contaminated from migration of a hazardous substance." The HRS divides sources into five categories for evaluating ground water containment: surface impoundments, land treatment, containers, tanks, and all other sources. Each category has a separate list of criteria used to assign containment values.
- (2) **Determine if one or more sources are located in surface water in the watershed being evaluated (e.g., intact sealed drums in surface water).**
 - If so, assign a containment factor value of 10 for that watershed.
 - If not, continue to Step (3).
- (3) **For each source within the watershed, determine whether the source hazardous waste quantity value is 0.5 or greater.**
 - Only sources with a source hazardous waste quantity value of 0.5 or greater can be used to assign the containment value, unless no source for the watershed being evaluated has a source hazardous waste quantity value of 0.5 or greater. This limitation is referred to as "minimum size requirement." **Highlight 8-25** summarizes the measurements of sources that will give a source hazardous waste quantity value of 0.5. Any of the hazardous waste quantity tiers can be used to determine whether a source meets the minimum size requirement. Detailed guidance on determining hazardous waste quantity values is provided in Chapter 6.
 - If no source meets the minimum size requirement, evaluate containment for all sources.
- (4) **Assign a containment value to each eligible source.**
 - Use the definitions provided above to interpret the containment criteria in HRS Table 4-2.
 - **Highlight 8-26** summarizes the information requirements to evaluate source containment.
- (5) **Assign a containment factor value for the potential to release by overland flow component for the watershed.**
 - Assign the highest containment value for those sources with hazardous waste quantity values greater than or equal to 0.5 as the containment factor value for the watershed.
 - If none of the sources in the watershed being evaluated at the site has a source hazardous waste quantity value greater than or equal to 0.5, assign the highest containment factor value from all eligible sources for the watershed as the containment factor value for the watershed.

SCORING SURFACE WATER CONTAINMENT FOR FLOOD

Assign the flood containment factor value as described below.

- (1) **Identify the sources at the site.** (See Section 4.1 for discussion of potential sources.)

HIGHLIGHT 8-25
SOURCE MEASUREMENTS THAT MEET THE
MINIMUM SIZE REQUIREMENT

Tier	Measure or Source Type	Minimum Measurements for Hazardous Waste Quantity Value of 0.5
A	Hazardous constituent quantity	0.5 pounds
B	Hazardous wastestream quantity	2,500 pounds
C Volume	Landfill	1,250 cubic yards
	Surface impoundment	1.25 cubic yards
	Surface impoundment (buried/backfilled)	1.25 cubic yards
	Drums	250 gallons
	Tanks and containers other than drums	1.25 cubic yards
	Contaminated Soil	1,250 cubic yards
	Pile	1.25 cubic yards
	Other	1.25 cubic yards
D Area	Landfill	1,700 square feet
	Surface impoundment	6.50 square feet
	Surface impoundment (buried/backfilled)	6.50 square feet
	Land treatment	135 square feet
	Pile	6.50 square feet
	Contaminated soil	17,000 square feet

(2) **Determine if each source meets the minimum size requirement.**

- Only sources with a source hazardous waste quantity value of 0.5 or greater can be used to assign the containment value, unless no source for the watershed being evaluated has a source hazardous waste quantity value of 0.5 or greater.
- If no source meets the minimum size requirement, evaluate containment for all sources.

(3) **Assign potential to release by flood factor value to each eligible source in the watershed.**

- Determine the floodplain category in which the source (or portion of the source) lies.

HIGHLIGHT 8-26

DATA NEEDS FOR EVALUATING SOURCE CONTAINMENT

The following types of information is helpful for evaluating the containment factor:

- The physical location of the hazardous substance(s) (e.g., buried, impounded, in a below-ground tank).
- Evidence of hazardous substance migration (e.g., overflow from surface impoundments or stained soil).
- Evidence, or lack thereof, of diking, berms or other engineered physical barriers that completely surround the source area.
- The presence of bulk and/or free liquids.
- Evidence of liners that are continuous and that would prevent the source hazardous substance(s) from coming in contact with the earth beneath (or around) the source. In the case of liners, the site Investigator may assume that there is not a liner unless evidence indicates otherwise.
- Evidence, or lack thereof, of leachate collection systems (functioning or not), and ground water monitoring systems.
- Evidence of the existence and condition of physical structures that provide protection from precipitation, and/or run-on and runoff control.

The above list is illustrative in nature. It is meant neither to be all inclusive of the types of information that can be used to characterize the containment of any particular hazardous substance source nor to establish minimum requirements.

- Assign a floodplain frequency value (see HRS Table 4-9) for each applicable floodplain category.
- Assign a containment factor value (see HRS Table 4-8) for each floodplain category in which the source is located.
- Multiply the floodplain containment value by the floodplain flood frequency value for each floodplain in which the source is located.
- Select the highest product as the source's potential to release by flood factor value.

(4) **Assign the highest potential to release by flood factor value for the watershed from sources meeting the minimum size requirement.**

- Assign the highest potential to release by flood factor value for those sources with hazardous waste quantity values greater than or equal to 0.5 as the factor value for this component of the surface water pathway.
- If none of the sources in the watershed being evaluated at the site has a hazardous waste quantity value greater than or equal to 0.5, assign the highest potential to release by flood factor value from all eligible sources for the watershed as the factor value for this component of the surface water pathway.

TIPS AND REMINDERS

- Regardless of source type, if there is evidence of hazardous substance migration from the source, assign a containment factor value of 10 for the overland flow component for that watershed.
- Any hazardous waste quantity tier can be used to determine that a source meets the minimum size requirement.

SECTION 8.5 OVERVIEW OF ACTUAL CONTAMINATION FOR ALL THREE THREATS



This section provides guidance on establishing actual contamination in the surface water migration pathway for the drinking water, human food chain, and environmental threats. This section presents a summary table of sample types that can be used in each of the three threats. Detailed guidance for each threat is contained in subsequent sections of this chapter.

In evaluating the surface water migration pathway, a water body is subject to actual contamination if it meets specific criteria that demonstrate that hazardous substances attributable to the site have migrated to targets for the water body. Additional criteria apply for the human food chain threat (see Sections 8.12 and 8.13). Surface water bodies subject to actual contamination are classified as being subject to either Level I or Level II concentrations. Several targets factors receive higher weighting when surface water bodies are subject to actual contamination. Targets not subject to actual contamination are evaluated based on potential contamination. **Highlight 8-27** summarizes the requirements for establishing actual contamination of a surface water body. Sections on each threat within the surface water pathway provide details on how to determine the level of contamination.

RELEVANT HRS SECTIONS	
Section 2.3	Likelihood of release
Section 2.5	Targets
Section 2.5.1	Determination of level of actual contamination at a sampling location
Section 2.5.2	Comparison to benchmarks
Section 4.1.1.2	Target distance limit
Section 4.1.2.1.1	Observed release
Section 4.1.2.3	Drinking water threat - targets
Section 4.1.3.3	Human food chain threat - targets
Section 4.1.4.3	Environmental threat - targets

DEFINITIONS

Actual Contamination for the Surface Water Pathway: A portion of a surface water body is subject to actual contamination if it meets the criteria for an observed release. Sampling data from aqueous, sediment, or essentially sessile, benthic organisms may be used to establish actual contamination. However, the requirements for establishing actual contamination vary by threat.

Level I Concentration for the Surface Water Pathway: Level I concentrations are established in samples in which the concentration of a hazardous substance that meets the criteria for an observed release is at or above its specific health-based benchmark for the

surface water threats, with certain exceptions for the human food chain threat. Targets also may be subject to Level I concentrations if multiple hazardous substances that meet the criteria for an observed release are present below their respective benchmarks and the I or J index is greater than or equal to one. Benchmarks for the surface water pathway include MCLs, non-zero MCLGs, Food and Drug Administration Advisory Levels (FDAAL) for fish or shellfish, ambient water quality criteria (AWQC) for protection of aquatic life, ambient aquatic life advisory concentrations (AALAC), and screening concentrations for cancer and chronic noncancer effects.

Level II Concentration for the Surface Water Pathway: Level II concentrations are established in samples in which the concentration of at least one hazardous substance meets the criteria for an observed release, but the conditions for Level I concentrations are not met, with certain exceptions for the food chain threat. In addition, Level II is assigned for observed releases established by direct observation.

Observed Release: An observed release is established for the ground water, surface water, or air migration pathway either by chemical analysis or by direct observation. Observed release is not relevant to the HRS soil exposure pathway. The minimum requirements for establishing an observed release by chemical analysis are analytical data demonstrating the presence of a hazardous substance in the medium significantly above background level, and information that some portion of that increase is attributable to the site. The minimum criterion for establishing an observed release by direct observation is evidence that the hazardous substance was placed into or has been seen entering the medium.

HIGHLIGHT 8-27
SAMPLES AND CRITERIA FOR LEVEL I AND LEVEL II CONCENTRATIONS BY THREAT^a

Sample Type	Drinking Water Threat	Human Food Chain Threat	Environmental Threat
Level I			
Surface Water	[C] ^b must meet criteria for an observed release and be at or above concentrations corresponding to: <ul style="list-style-type: none"> • Non-zero MCLG, • MCL, • Oral 10⁻⁶ cancer risk level, or <ul style="list-style-type: none"> • Oral RfD. 	Cannot be used to establish Level I.	[C] ^b must meet criteria for an observed release and be at or above concentrations corresponding to: <ul style="list-style-type: none"> • AWQC for protection of aquatic life, or • AALAC.
Benthic or Other Tissue	Cannot be used to establish Level I.	[C] ^{b,c} must meet criteria for an observed release and be at or above concentrations corresponding to: <ul style="list-style-type: none"> • FDAAL for fish or shellfish, • Oral 10⁻⁶ cancer risk level, or • Oral Rfd. 	Cannot be used to establish Level I.
Sediment	Cannot be used to establish Level I.	Cannot be used to establish Level I	Cannot be used to establish Level I.
Level II^d			
Surface Water	[C] must meet criteria for an observed release.	[C] ^{e,f} must meet criteria for an observed release.	[C] must meet criteria for an observed release.
Benthic or Other Tissue	[C] must meet criteria for an observed release.	[C] ^c must meet criteria for an observed release.	[C] must meet criteria for an observed release.
Sediment	[C] must meet criteria for an observed release.	[C] ^{e,f} must meet criteria for an observed release.	[C] must meet criteria for an observed release.

^a Only those drinking water intakes, portions of fisheries, and portions of wetlands within the boundaries of Level I or Level II contamination are considered subject to such contamination. However, if any portion of a sensitive environment other than a wetland is subject to Level I or Level II contamination, the entire sensitive environment is evaluated as that level of contamination.

^b [C] refers to the concentration of a hazardous substance in a sample. Only one of the listed benchmarks needs to be equalled or exceeded by this concentration for Level I to be established (or, for multiple substances, the I or J index needs to exceed 1).

^c Concentrations of hazardous substances must be measured in a sample from an essentially sessile benthic human food chain organism from the watershed or in a tissue sample from an organism (1) taken from a location within the boundaries of the actual food chain contamination and (2) from a species of human food chain organism that spends extended periods of time within the boundaries of the actual food chain contamination but is not an essentially sessile benthic organism. Hazardous substances in this latter type of tissue sample do not need to meet the criteria for an observed release but must meet the criteria for actual food chain contamination in a surface water, benthic, or sediment sample.

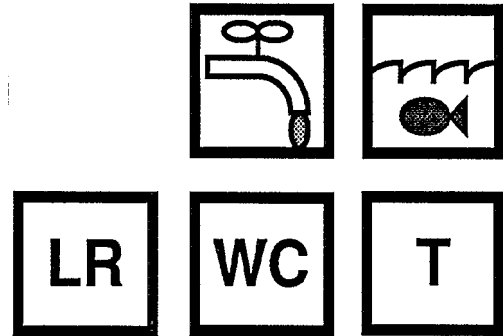
^d Level II contamination in all threats also is established by an observed release by direct observation.

^e The hazardous substance also must have a bioaccumulation potential factor value greater than or equal to 500, with certain exceptions for a closed fishery.

^f A fishery also may be considered subject to Level II contamination if the fishery is closed, a hazardous substance for which the fishery has been closed has been documented in an observed release to the watershed from the site, and at least a portion of the fishery is within the boundaries of the observed release. The bioaccumulation potential factor value greater than or equal to 500 does not apply in this case.

SECTION 8.6

EFFICIENCY OF SCORING THE DRINKING WATER THREAT



The drinking water threat is one of three threats used to evaluate the surface water pathway; the other two are the human food chain threat and the environmental threat. The drinking water threat for each watershed is evaluated based on three factor categories: likelihood of release, waste characteristics, and targets. The drinking water threat targets factor category reflects the human population and resources potentially at risk from exposure to hazardous substances in the surface water. Three factors are used to evaluate drinking water threat targets: nearest intake, population, and resources. Populations and intakes actually exposed to contaminated drinking water are weighted more heavily than those potentially exposed.

This section provides guidance for estimating the score that can be expected from the drinking water threat before the detailed scoring and documentation process begins. This is done by presenting look-up tables that provide rough estimates of drinking water threat scores based on estimates for the likelihood of release, waste characteristics, and population factors. Such a determination may already have been made during the PA and/or SI. This section provides guidance on how to estimate the drinking water threat score when a single water body is present. If more than one water body is present within the watershed, the scorer should estimate the score of the water body with the greatest population served by drinking water intakes to determine the efficiency of scoring this threat. However, this method may underestimate the actual drinking water threat. This section is intended to be used as a general guideline and not as an absolute determination of whether to score the drinking water threat.

DEFINITIONS

Actual Contamination for a Drinking Water Intake: A drinking water intake is subject to actual contamination if it is located in a portion of a surface water body that meets the criteria for an observed release.

Dilution Weight: A unitless parameter that adjusts the assigned point value for certain targets subject to potential contamination as a function of the flow or depth of the water body at the target.

Target Distance Limit (TDL) for the Surface Water Migration Pathway: Distance over which the in-water segment of the hazardous substance migration path is evaluated. The TDL extends 15 miles from the PPE in the direction of flow (or radially in lakes, oceans, or coastal tidal waters) or to the most distant sample point establishing an observed release, whichever is greater. In tidally influenced surface water bodies, an upstream TDL is also determined. For some sites (e.g., sites with multiple PPEs), an overall target distance of greater than 15 miles may result.

ESTIMATING ACTUAL CONTAMINATION

Score the drinking water threat whenever a drinking water intake is considered subeect to actual contamination (i.e., Level I or Level II concentrations). Because populations and nearest intake subject to actual contamination receive higher weight and higher scores, respectively, than those

subject to potential contamination, the drinking water threat score based on actual contamination may be sufficient for NPL consideration. **Highlight 8-28** provides an analysis of approximate drinking water threat scores obtained when intakes are subject to actual contamination. If intakes subject to potential contamination are also present, consider whether documenting the population served by these additional intakes will significantly affect the pathway score. At a minimum, discuss the presence of intakes subject to potential contamination in the documentation record even if they are not scored.

ESTIMATING POTENTIAL CONTAMINATION

Many factors must be scored when evaluating the drinking water threat based on potential contamination. This section provides a step-wise procedure and look-up tables that can be used to estimate the drinking water threat score for a site before beginning the detailed documentation process. If a preliminary score has been developed for the site during the PA or SI, many of the estimates in the steps below will already have been made. In this case, proceed to Step (3).

- (1) **Estimate the waste characteristics factor category value.** The waste characteristics factor category value generally will not vary significantly among the migration pathways (except for the human food chain threat and environmental threat). If you have already determined the waste characteristics factor category value for the ground water pathway (or any other migration pathway), use it to approximate the value (although the drinking water threat waste characteristics are based on toxicity/persistence rather than toxicity/mobility). Note that if the drinking water threat is actually scored, waste characteristics must be determined as outlined in HRS sections 4.1.2.2 and 4.2.2.2 (i.e., do not use any estimated values for actual HRS scoring).

HIGHLIGHT 8-28 APPROXIMATE DRINKING WATER THREAT SCORES FOR POPULATION SUBJECT TO ACTUAL CONTAMINATION ^a

Contamina- tion Type	Likelihood of Release	Nearest Intake	Waste Charac- teristics	Population Served by Intake(s)							
				1	5	10	25	50	100	250	500
Level I	550	50	100	43	70	100	100	100	100	100	100
			56	24	39	58	100	100	100	100	100
			32	14	22	33	65	100	100	100	100
			18	8	13	19	37	67	100	100	100
			10	4	7	10	20	37	70	100	100
Level II	550	45	100	34	37	40	50	67	100	100	100
			56	19	21	22	28	37	56	100	100
			32	11	12	13	16	21	32	64	100
			18	6	7	7	9	12	18	36	66
			10	3	4	4	5	7	10	20	37

^a These drinking water threat scores are rounded to the nearest integer and assume a resources factor value equal to 5. Likelihood of Release is assigned a value of 550 if an observed release to surface water can be established.

- (2) **Determine the type of surface water body and, if appropriate, estimate the flow (or depth).** The targets factor value for intakes subject to potential contamination is derived using dilution weights based on the flow or depth at the intake. If available, use actual flow and/or depth data. If data for flow are not readily available, estimate the flow according to instructions in Section 8.3 of this guidance. After an estimate for flow and/or depth is obtained, use HRS Table 4-13 to determine the water body type and the appropriate dilution weight.
- (3) **Estimate the population served by drinking water Intakes subject to potential contamination within the TDL.** Determine the approximate number of people with sufficient accuracy to determine the population range category (from HRS Table 4-14) for all intakes subject to potential contamination within the TDL. Section 3.6.2 of EPA's *Guidance for Performing Preliminary Assessments* (OSWER Publication 9345.0-01 A, September 1991) provides guidance on obtaining population counts for each intake.
- (4) **Determine approximate maximum drinking water threat score for a single water body in the watershed.** Use the table in **Highlight 8-29** to determine the approximate maximum drinking water threat score for the water body. As a first approximation, assume a likelihood of release factor category value of 550 (there can be an observed release without actual contamination of targets). The resultant threat score may indicate whether it is worthwhile to score the drinking water threat. Note that the watershed score requires combining scores from all water bodies in the watershed and could be significantly higher than a score based on a single water body. If it appears to be efficient to score the drinking water threat, proceed to Step (5). If a very low score is obtained even assuming maximum likelihood of release, then documenting potential drinking water contamination is probably not an efficient use of scoring resources, unless those few points will be important to the total site score. If not, stop here.
- (5) **Estimate the likelihood of release factor category value.** Likelihood of release consists of observed release and two types of potential to release: potential to release by overland flow, and potential to release by flood. The value for potential to release by overland flow is calculated based on three factors: containment, runoff, and distance to surface water. The value for potential to release by flood is calculated based on two factors: containment (flood) and flood frequency. The values assigned to the watershed for potential to release by overland flow and potential to release by flood are summed, and this sum is assigned as the likelihood of release value, with a maximum value of 500. Section 3.6 of EPA's *Guidance for Performing Preliminary Assessments* (OSWER Publication 9345.0-01 A, September 1991) provides information on estimating a value for likelihood of release.
- (6) **Determine the approximate drinking water threat score.** Using the value estimated for likelihood of release in Step (5), determine the approximate drinking water threat score for this water body by using the table in **Highlight 8-29**, based on the population estimated in Step (3). Because the scores in the table in **Highlight 8-29** include the nearest intake and resources factor values, scores for intakes on two different water body types cannot be added to get a pathway score. (Adding them would result in double counting the nearest intake and resources factor values.)

Highlight 8-30 provides an example of how to use the table in **Highlight 8-29**.

HIGHLIGHT 8-29
APPROXIMATE DRINKING WATER THREAT SCORES
FOR POPULATION SUBJECT TO POTENTIAL CONTAMINATION ^a

Likeli- hood of Release	Waste Char.	Water BodyType ^b	Popuation Served by Intake(s)						
			31- 100	101- 300	301- 1,000	1,001- 3,000	3,001- 10,000	10,001- 30,000	30,001- 100,000
550 ^c	100	minimal stream	20	28	51	100	100	100	100
		3-mile mixing zone	12	15	27	64	100	100	100
		small to moderate steam	5	6	8	16	39	100	100
		all other water bodies ^d	4	4	4	5	7	14	38 ^e
	56	minimal stream	11	15	29	70	100	100	100
		3-mile mixing zone	7	9	15	36	100	100	100
		small to moderate steam	3	3	5	9	22	64	100
		all other water bodies ^d	2	2	2	3	4	8	21 ^e
	32	minimal stream	6	9	16	40	100	100	100
		3-mile mixing zone	4	5	9	21	59	100	100
		small to moderate steam	2	2	3	5	13	36	100
		all other water bodies ^d	1	1	1	1	2	5	12 ^e
400	100	minimal stream	15	20	37	91	100	100	100
		3-mile mixing zone	9	11	20	47	100	100	100
		small to moderate steam	4	4	6	11	29	82	100
		all other water bodies ^d	3	3	3	3	5	10	28 ^e
	56	minimal stream	8	11	21	51	100	100	100
		3-mile mixing zone	5	6	11	26	75	100	100
		small to moderate steam	2	2	3	6	16	46	100
		all other water bodies ^d	1	1	2	2	3	6	16 ^e

(Continued on next page)

HIGHLIGHT 8-29 (continued)
APPROXIMATE DRINKING WATER THREAT SCORES
FOR POPULATION SUBJECT TO POTENTIAL CONTAMINATION ^a

Likelihood of Release	Waste Char.	Water Body Type ^b	Population Served by Intake(s)						
			31-100	101-300	301-1,000	1,001-3,000	3,001-10,000	10,001-30,000	30,001-100,000
	32	minimal stream	5	6	12	29	85	100	100
		3-mile mixing zone	3	4	6	15	43	100	100
		small to moderate stream	1	1	2	4	9	26	82
		all other water bodies ^d	1	1	1	1	2	3	9 ^e
300	100	minimal stream	11	15	28	68	100	100	100
		3-mile mixing zone	7	8	15	35	75	100	100
		small to moderate stream	3	3	4	8	21	62	100
		all other water bodies ^d	2	2	2	3	4	8	21 ^e
	56	minimal stream	6	8	16	38	100	100	100
		3-mile mixing zone	4	5	8	20	56	100	100
		small to moderate stream	2	2	2	5	12	35	100
		all other water bodies ^d	1	1	1	1	2	4	12 ^e
	32	minimal stream	3	5	9	22	64	100	100
		3-mile mixing zone	2	3	5	11	32	97	100
		small to moderate stream	1	1	1	3	7	20	61
		all other water bodies ^d	1	1	1	1	1	2	7 ^e

^aThese drinking water threat scores assume a resources factor value equal to 5 and incorporate the appropriate nearest Intake factor. Consequently, scores from this table cannot be summed to provide an estimated score for intakes on different water body types.

^bAll water bodies with a dilution weight equal to or less than 0.01 are grouped together in the category "all other water bodies." The drinking water threat scores in this grouped row are equal to that of the "moderate to large stream" category, but the scores of the larger water bodies are generally sufficiently close that the "all other water bodies" category will serve as a useful approximation for all water bodies included in the category (except where otherwise noted).

^cNote that it is possible to score an observed release to a watershed but still have all targets scored under potential contamination.

^dLakes with flow characteristics similar to the first three water body types would have values similar to the first three water body types.

^eThese drinking water threat scores will be substantially lower for water bodies larger than a moderate to large stream.

HIGHLIGHT 8-30
EXAMPLE OF ESTIMATING DRINKING WATER THREAT SCORE

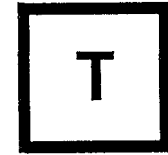
Site Description: The site is adjacent to surface water. Waste characteristics have been scored at 100.

Water Body Type: The hazardous substance migration path involves only one stream approximately 30 feet in width. Estimated flow is approximately 70 cfs, indicative of a "small to moderate stream."

Population Estimate: Population served by all intakes along the stream is between 1,001 and 3,000. All population is subject to potential contamination.

Maximum Estimated Drinking Water Threat Score: Given these parameters, the estimated maximum drinking water threat score for the site is 16 based on potential contamination. This score of 16 assumes that the likelihood of release is scored at its maximum value (i.e., 550 points for an observed release). If scoring the drinking water threat would appear to affect the site score significantly, then the actual likelihood of release would be estimated in order to arrive at a closer approximation of the drinking water threat score. If the stream had been in the "moderate to large stream" category, the maximum drinking water threat score would have been 5.

SECTION 8.7 ACTUAL CONTAMINATION IN THE DRINKING WATER THREAT



A drinking water intake is subject to actual contamination if it meets specific criteria that demonstrate that the intake has been contaminated with hazardous substances attributable to the site. See Section 8.5 for general guidance on establishing actual contamination of targets in the surface water pathway. All intakes subject to actual contamination are classified as Level I or Level II. Drinking water intakes subject to actual contamination receive higher values for the nearest intake factor and higher weight for the population factor than intakes subject to potential contamination. This section provides guidance on differentiating between Level I and Level II contamination, including information on the types of samples and health-based benchmarks that can be used. Information on scoring the drinking water threat for sites with intakes subject to actual contamination is also provided in this section.

RELEVANT HRS SECTIONS	
Section 2.5	Targets
Section 2.5.1	Determination of level of actual contamination at a sampling location
Section 2.5.2	Comparison to benchmarks
Section 4.1.1.2	Target distance limit
Section 4.1.2.3	Drinking water threat - targets
Section 4.1.2.3.1	Nearest intake
Section 4.1.2.3.2	Population
Section 4.1.2.3.2.1	Level of contamination
Section 4.1.2.3.2.2	Level I concentrations
Section 4.1.2.3.2.3	Level II concentrations

DEFINITIONS

Actual Contamination for a Drinking Water Intake: A drinking water intake is subject to actual contamination if it is located in a portion of a surface water body that meets the criteria for an observed release.

Level II Concentrations for the Drinking Water Threat: Level I concentrations are established in aqueous samples in which the concentration of a hazardous substance that meets the criteria for an observed release is at or above its drinking water benchmark. A drinking water intake also may be subject to Level I concentrations if multiple hazardous substances that meet the criteria for observed release are present below their respective benchmarks, and the I or J index is greater than or equal to one. Benchmarks for the drinking water threat include MCLGs, MCLs, and screening concentrations for cancer and chronic noncancer effects.

Level II Concentrations for the Drinking Water Threat: Level II concentrations are established in samples in which the concentration of at least one hazardous substance meets

the criteria for an observed release, but the conditions for Level I concentrations are not met. In addition, Level II is assigned for observed releases established by direct observation.

Nearest Intake Factor: Factor for evaluating the maximally exposed intake. This factor is based on the presence of actual contamination or, for watersheds where no intake is subject to actual contamination, the flow or depth of the water body at the intake nearest to the PPE within the TDL.

Population for the Drinking Water Threat: Number of residents, students, and workers regularly served by surface water intakes that are located within the TDL for the surface water bodies evaluated for a given watershed. This population does not include transient populations, such as hotel and restaurant patrons, but may include seasonal populations (e.g., a resort area).

Target Distance Limit (TDL) for the Surface Water Migration Pathway: Distance over which the in-water segment of the hazardous substance migration path is evaluated. The TDL extends 15 miles from the PPE in the direction of flow (or radially in lakes, oceans, or coastal tidal waters) or to the most distant sample point establishing an observed release, whichever is greater. In tidally influenced surface water bodies, an upstream TDL is also determined. For some sites (e.g., sites with multiple PPEs), an overall target distance of greater than 15 miles may result.

ESTABLISHING ACTUAL CONTAMINATION FOR A DRINKING WATER INTAKE

The steps outlined below describe how to establish actual contamination for a drinking water intake. These steps should be repeated for multiple hazardous substances and/or samples as necessary.

- (1) **Determine if an observed release can be established by direct observation.** If an observed release is established by direct observation, actual contamination of a drinking water intake can be established only if the observation is made at the location of the drinking water intake. Direct observation cannot be used to establish Level I concentrations.
- (2) **Identify sampling locations that can establish actual contamination for the intake based on chemical analysis.** Surface water, sediment, or benthic samples taken at, or downstream from, a drinking water intake can be used to establish actual contamination for the intake. Select one hazardous substance in one of these samples and proceed to Step (3). If no such sampling locations are identified and actual contamination is not established based on direct observation, score the intake based on potential contamination.
- (3) **Determine the background level for the hazardous substance.** Determine the appropriate background level (e.g., concentration from an appropriate background sample) for hazardous substances that could be naturally occurring, ubiquitous, or attributable to other sources in the area. A background level of 0 can be assumed for substances that are neither naturally occurring, ubiquitous, nor attributable to other sources in the areas (i.e., a background sample may not be needed). See Section 5.1 for detailed information on determining the appropriate background level for comparison with a sample.
- (4) **Determine whether the concentration of the hazardous substance is significantly above background.** If yes, proceed to Step (5); if no, select another hazardous substance and/or sample and return to Step (3). Detailed guidance for making this determination is found in Section 5.1, particularly **Highlight 5-2**.

- (5) **Determine if the hazardous substance can be attributed to the site.** If yes, actual contamination is established; if no, select another hazardous substance and/or sample and return to Step (3). Obtain sampling results or records (e.g., manifests) indicating the presence of the hazardous substance in a source at the site. Information that the hazardous substance was used at the facility also may be acceptable. See Sections 5.1 and 5.3 for additional guidance on attribution and transformation products.

DETERMINING LEVEL OF CONTAMINATION

After identifying intakes within the TDL and establishing whether the intake is subject to actual contamination, determine the level of contamination for the intake. The steps outlined below describe how to determine if the intake should be scored as Level I, Level II, or potential contamination.

- (1) **Determine whether actual contamination can be established for the surface water intake for any detected hazardous substance.** Follow the guidance in the above section, Establishing Actual Contamination for a Drinking Water Intake. See **Highlight 8-27** for a summary of the types of samples and criteria used to establish the level of contamination for the drinking water threat.
- If actual contamination cannot be established for the intake (e.g., there is neither sampling data nor direct observation), score the drinking water intake based on potential contamination.
 - If actual contamination can be established for the intake, proceed to Step (2).
- (2) **Evaluate the level of contamination for the intake, based on the data used to establish actual contamination at that intake.**
- For sites that consist of contaminated sediments with an unknown source evaluate all intakes subject to actual contamination as Level II, regardless of the surface water concentration of hazardous substances at an intake.
 - If actual contamination is established by direct observation, evaluate the intake based on Level II concentrations.
 - If actual contamination is established using only sediment or benthic samples (i.e., actual contamination cannot be established for that intake using surface water samples), evaluate the intake based on Level II concentrations.
 - If actual contamination is established by surface water samples, compare the concentration of each hazardous substance that meets the observed release criteria with its appropriate health-based benchmark for surface water. See **Highlight 8-31** for a list of applicable benchmarks.
 - If the concentration of any hazardous substance that meets the observed release criteria is greater than or equal to its benchmark, evaluate the intake based on Level I concentrations.
 - If no hazardous substance that meets the observed release criteria intake has an applicable health-based benchmark, evaluate the intake based on Level II concentrations.
 - If only one hazardous substance meets the observed release criteria intake and its concentration is less than its benchmark, evaluate the intake based on Level II concentrations.

HIGHLIGHT 8-31 BENCHMARKS FOR THE DRINKING WATER THREAT

The following benchmarks apply to the drinking water threat. Values for specific hazardous substances are available in SCDM under the health-based benchmarks section. For evaluating the drinking water threat these benchmarks are applicable to surface water samples only (i.e., do not use with sediment or benthic samples). If several benchmarks are provided for a substance, choose the benchmark with the lowest concentration. For some hazardous substances, values are not available for all benchmarks.

- MCLG (use only values greater than 0).
- MCL.
- Screening concentration for cancer, corresponding to a 10^6 individual cancer risk for oral exposures.
- Screening concentration for noncancer effects, corresponding to the RfD for oral exposures.

- If more than one hazardous substance meets the observed release criteria intake and none of these substances exceeds its applicable benchmark, continue to Step (3).

(3) **Calculate the I and J indices for all hazardous substances that meet the observed release criteria.** Make two lists of substances that meet the observed release criteria: hazardous substances with screening concentrations for cancer risk, and hazardous substances with screening concentrations for noncancer effects. Each hazardous substance may be on one, neither, or both of the lists. If more than one sample has been taken, and these samples are comparable (e.g., taken in the same time frame, collected using the same field techniques, analyzed by the same methods), then for each hazardous substance select the highest concentration to use in the calculations below.

- Calculate the I index for all hazardous substances with screening concentrations for cancer risk that meet the observed release criteria, using the following equation:

$$I = \sum_{i=1}^n \frac{C_i}{SC_i}$$

where: C_i = concentration of substance i in sample;
 SC_i = screening concentration for cancer risk for hazardous substance i; and
 n = number of hazardous substances that meet observed release criteria and for which an SC is available.

- Calculate the J index all hazardous substances with screening concentrations for noncancer effects that meet the observed release criteria, using the following equation:

$$J = \sum_{j=1}^m \frac{C_j}{CR_j}$$

where: C_j = concentration of substance j in sample;
 CR_j = screening concentration for noncancer effects for hazardous substance j; and
 m = number of hazardous substances that meet observed release criteria and for which a CR is available.

- If either the I or J index is greater than or equal to 1, evaluate the drinking water intake based on Level I concentrations. If both the I and J indices are less than one, evaluate the surface water intake based on Level II concentrations.

SCORING INTAKES SUBJECT TO ACTUAL CONTAMINATION

The level of contamination must be determined to score the nearest intake and population factors and may affect the minimum value for the hazardous waste quantity factor. Once the level of contamination has been established for each intake within the TDL, score these targets as shown in **Highlight 8-32**. Section 8.8 provides detailed instructions for scoring nearest intake and population factors for intakes subject to actual contamination.

HIGHLIGHT 8-32 COMPARISON OF SCORING LEVEL I, LEVEL II, AND POTENTIAL CONTAMINATION

Level of Contamination	Nearest intake Factor Value	Population Factor Value	Minimum HWQ Factor Value ^a
Actual – Level I	50	10 x number of people	100
Actual – Level II	45	1 x number of people	100
Potential	(dilution weight) x 20	0.1 x dilution-weighted population	10 ^b

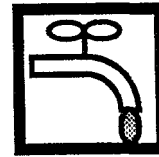
^a Minimum hazardous waste quantity factor values apply if Tier A is not adequately determined for all sources.

^b May be 100 in certain cases when there has been a removal action; see HRS section 2.4.2.2 and EPA's removal policy fact sheet.

TIPS AND REMINDERS

- Actual contamination cannot be established without an observed release to surface water, but an observed release to surface water is not necessarily sufficient to document actual contamination of a drinking water intake.
- Benthic tissue and sediment samples cannot be used to establish Level I concentrations for the drinking water threat, but can be used to establish Level II concentrations. Only analytical data from surface water samples can be used to establish Level I concentrations.
- To use multiple hazardous substances to establish Level I concentrations using the I or J index, all hazardous substance concentrations must be from the same sample or comparable samples. Comparable samples are samples taken at essentially the same location and at essentially the same time, and analyzed by equivalent methods.
- The area of actual contamination and the level of actual contamination within that area can vary for each of the three surface water threats.
- Intakes at sites that consist solely of contaminated sediments with an unknown source cannot be evaluated at Level I, regardless of surface water concentrations at the intake.

SECTION 8.8 POPULATION AND NEAREST INTAKE FACTORS



The population factor in the drinking water threat evaluates the number of residents, students, and workers regularly served by surface water intakes within the TDL for the watershed being evaluated. This evaluation is essentially the same as that for the ground water pathway, except that surface water intakes are considered instead of drinking water wells. This section also briefly discusses the nearest intake factor.

RELEVANT HRS SECTIONS	
Section 4.1.1.2	Target distance limit
Section 4.1.2.3.1	Nearest intake
Section 4.1.2.3.2	Population

DEFINITIONS

Dilution Weight: A unitless parameter that adjusts the assigned point value for certain targets subject to potential contamination as a function of the flow or depth of the water body at the target.

Nearest Intake Factor: Factor for evaluating the maximally exposed intake. This factor is based on the presence of actual contamination or, for watersheds where no intake is subject to actual contamination, the flow or depth of the water body at the intake nearest to the PPE within the TDL.

Population for the Drinking Water Threat: Number of residents, students, and workers regularly served by surface water intakes that are located within the TDL for the surface water bodies evaluated for a given watershed. This population does not include transient populations, such as hotel and restaurant patrons, but may include seasonal populations (e.g., a resort area).

Students: Full- or part-time attendees of an educational institution or day care facility that is served by an intake located within the TDL.

Target Distance Limit (TDIL) for the Surface Water Migration Pathway: Distance over which the in-water segment of the hazardous substance migration path is evaluated. The TDL extends 15 miles from the PPE in the direction of flow (or radially in lakes, oceans, or coastal tidal waters) or to the most distant sample point establishing an observed release, whichever is greater. In tidally influenced surface water bodies, an upstream TDL is also determined. For some sites (e.g., sites with multiple PPEs), an overall target distance of greater than 15 miles may result.

Workers: Permanent employees (part-time or full-time) of a facility or business that is served by an intake within the TDL.

EVALUATING THE DRINKING WATER POPULATION FACTOR

The steps below describe an approach for estimating the population served by surface water intakes located within the TDL. First, estimate the population served by municipal water systems with intakes within the TDL. Contact municipal water authorities to obtain estimates of populations served. The water authority should know whether the population served includes workers and students in addition to residents. If the population estimate does not include workers and/or students, modify the methodology presented below as necessary. **Highlight 8-33** summarizes the information needed to obtain drinking water population estimates.

HIGHLIGHT 8-33 DATA NEEDS FOR DRINKING WATER THREAT POPULATION

Obtain from Local, Municipal, or Other Water Authorities:

- Identification of all municipal surface water intakes located within the TDLs for surface water bodies in the watershed being evaluated;
- Number of persons served or service connections for each intake that is not part of a blended system; and
- For intakes that are part of a blended system:
 - Total population served or number of service connections;
 - Total number of wells and intakes in the system (including those outside the TDL);
 - Whether any wells or intakes are standby;
 - Whether any well or intakes provides more than 40 percent of the system's water; and
 - Average annual pumpage or capacity for each intake and well (only needed if one intake or well provides more than 40 percent of the system's water).

Obtain from Local, Municipal, or Other Water Authorities, or Local Health Agencies:

- Identification of private intakes located within the TDL; and
- Identification of schools and large businesses possibly served by intakes located within the TDL.

Obtain from U.S. Bureau of Census Reports (or more recent source if appropriate):

- Average number of persons per residence for each county served by a system with intake located within the TDL.

Obtain from Business and Schools:

- Information on how they obtain water; and
- Number of workers and/or students.

If the water authority can only provide the total number of connections, estimate the population using the following process.

- (1) **Identify all municipal systems with intakes within the TDL.** Repeat Steps (2) through (4) for each system if more than one system has intakes within the TDL. If no municipal systems have intakes within the TDL, proceed to Step (5).
- (2) **Identify all water supply units that are components of the municipal system.** These units may include surface water intakes, ground water wells, and standby intakes or wells. If the municipal system is a blended system, all water supply units – both within and outside of the TDL – must be identified.
- (3) **Evaluate the population served by the municipal system, assuming all service connections are residential.** This assumption may underestimate the target population because typically more people are served at a school or business than at a residence. However, if a high score is achieved assuming only residential connections, time-consuming inquiries to document student or worker populations may not be necessary.
 - **Identify locations of surface water intakes.** Contact local water authorities to determine the locations of surface water intakes within the TDL and applicable blended intakes outside the TDL. Mark the locations on a map that includes the PPE and surface water sample collection points.
 - **Identify any Intakes contaminated at Level I or Level II.** Section 8.7 provides instructions for identifying intakes subject to Level I and Level II concentrations. Keep a separate count of persons served by intakes that are subject to Level I concentrations, Level II concentrations, and potential contamination.
 - **Estimate the flow or depth for the surface water body at each intake.** This information may be available from the water authority for major drinking water intakes. If flow at the intake has not been gauged, refer to Section 8.3 for guidance on estimating flow for each intake. Flow (or for some types of water bodies, depth) is used to assign a water body type for the purpose of dilution weighting.
 - **Estimate population served by municipal intakes, assuming all service connections are residential.**
 - Independent systems. If an intake serves an independent system (i.e., a single intake serves a particular group of residences and is not blended with water from ground water wells or other surface water intakes), determine the number of service connections. Multiply the number of service connections by the county average number of persons per residence (available from U.S. Bureau of the Census reports). Tabulate the number of persons served for each independent system intake within the TDL, by level of contamination; for intakes subject to potential contamination, tabulate by water body type.
 - Blended systems. If the intakes are part of a blended system, obtain information about the entire system so that the total population served can be apportioned to each intake or well. The necessary data include:
 - total number of people served or service connections for the blended system,
 - number of surface water intakes inside the TDL,
 - number of surface water intakes outside the TDL,
 - number of ground water wells in the system,

- whether any individual well or intake provides more than 40 percent of the water to the system, and
- whether any wells or intakes are standby wells or intakes.

If any well or intake provides more than 40 percent of the water to the system, obtain annual average pumpage or capacity data for each intake or well (standby intakes or wells require slightly different information; refer to Section 8.10). Apportion the population served to the intakes and wells in the blended system, following the guidance given in Section 8.9. Multiply the number of service connections assigned to each intake within the TDL by the average number of persons per residence. Tabulate the number of persons served for each intake within the TDL, by level of contamination; for intakes subject to potential contamination, tabulate by water body type.

(4) **Calculate a population factor value for the drinking water threat assuming all service connections are residential.** *Highlight 8-34* provides an example of the tabulation of populations and calculation of the population factor value.

- Tabulate the total number of persons served by all drinking water intakes within the TDL by (1) level of contamination (i.e., Level I, Level II, potential) and (2) water body type for intakes subject to potential contamination.
- For intakes subject to Level I concentrations, multiply the number of individuals served by 10 to calculate the Level I concentrations factor value.
- For intakes subject to Level II concentrations, the number of individuals served is the Level II concentrations factor value.
- For intakes subject to potential contamination, assign a dilution-weighted population value for each water body type using HRS Table 4-14. Sum the dilution-weighted population values assigned for each water body type. Multiply the result by 0.1 to obtain the potential contamination factor value. If the potential contamination population factor value is less than 1, do not round to the nearest integer. If it is greater than 1, round to the nearest integer.
- Sum the factor values assigned for Level I, Level II, and potential contamination to obtain the population factor value (for municipal intakes, assuming residential concentrations only).

(5) **Determine if student or worker populations should be documented.** This evaluation may involve a number of considerations, including those listed below.

- **Surface water pathway score assuming all residential connections.** If the surface water pathway score for the site is over 100 points assuming all service connections are residential, it may not be cost-effective to document the student or worker populations for scoring purposes. The presence of student or worker populations served by intakes within the TDL, however, should be noted in the documentation record.
- **Position within ranges for determining dilution-weighted population value.** If the population served by municipal intakes drawing from a particular water body type is in the lower part or middle of a broad range (HRS Table 4-14), documenting the population served at schools or businesses may not change the population factor value. If the population is near the upper end of a range, however, a substantially higher population factor value might be achieved by documenting the additional

HIGHLIGHT 8-34 DOCUMENTING DRINKING WATER THREAT POPULATION

LEVEL I CONCENTRATIONS			
Level I Intake	Population (individuals)	Reference ^a	
None	–	–	
Level I Concentrations Factor Value: 0			
LEVEL II CONCENTRATIONS			
Level II Intake	Population (individuals)	Reference ^a	
I-1	34,000	32, 18, 21	
Level II Concentrations Factor Value: 34,000 x 1 = 34,000			
POTENTIAL CONTAMINATION			
Potential Intake Water Body Type	Population (individuals)	Dilution-weighted Population Value	Reference ^a
I-2 large stream to river	34,000	52	32, 33, 25
I-3 large river	34,000	5	32, 33, 25
Potential Contamination Factor Value: $[52 + 5] \times 0.1 = 5.7$, which is rounded to 6			
TOTAL POPULATION FACTOR VALUE: 34,000 + 6 = 34,006			

^a The numbers in the reference column would identify particular references in the HRS scoring package.

population served at schools or businesses. If the population is near the lower end of a range, evaluating the student or worker population may help solidify the score.

To document student/worker populations, continue to Step (6); otherwise continue to Step (8).

(6) Document student and/or worker populations served by municipal systems.

- **Identify schools and businesses served by intakes within the TDL.** Obtain from water authorities information on the schools and businesses they serve.
 - Document any schools or businesses served by intakes subject to actual contamination.
 - For potential contamination, focus efforts on large schools (e.g., universities) or businesses and on those served by intakes on small water bodies.
- **Document the number of students or workers.**
 - Contact the school officials to document student population.

- Contact the individual businesses to document worker population or refer to business census data. The local Chamber of Commerce may be able to provide helpful data.
- (7) **Calculate a population factor value that includes the student/worker populations.** See Step (4). Make sure not to double count drinking water system connections as both residential and serving students or workers.
 - (8) **Determine if private intakes should be documented.** This determination involves the same considerations listed in Step (5). In addition, any private intake subject to actual contamination should be documented. If documenting private intakes is necessary, proceed to Step (9). If not, evaluation of the population factor is complete.
 - (9) **Evaluate population served by private intakes within the TDL.** If private intakes are identified, contact the owners to determine if the intakes are used for drinking water.
 - (10) **Revise the previous tabulation of drinking water population.** Add the number of persons served by private intakes to the appropriate population totals according to level of contamination and, for those subject to potential contamination, water body type.
 - (11) **Calculate a population factor value that includes populations served by private intakes.** Follow the procedure outlined in Step (4).

Highlight 8-35 provides an example of scoring the population factor for the drinking water threat.

HIGHLIGHT 8-35
EXAMPLE OF SCORING DRINKING WATER POPULATION FACTOR

Water Supply: Independent system consisting of a single surface water Intake located approximately ½ mile downstream from the PPE on a moderate to large stream (700 cfs).

Population Served: The total number of service connections for this system is 1,500. The entire area served by the system lies within one county. 1990 Census data indicate that the average number of persons per residence for that county is 2.8. Assuming that all connections are residential, the total population served by the system is:

$1,500 \times 2.8 = 4,200$ people

Evaluation: The intake is subject to potential contamination. Use HRS Table 4-14 to assign a dilution-weighted population value.

The population served by this intake gives the following potential contamination factor value:

Potential contamination factor value = $1/10 \times 52 = 5.2$, rounded to 5

Because this is the only drinking water intake within the TDL,

Population factor value = 5.

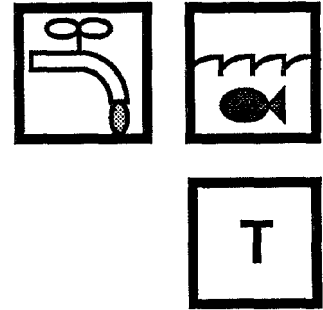
EVALUATING THE NEAREST INTAKE FACTOR

- (1) **Determine if any drinking water intake for the watershed being evaluated is subject to actual contamination.** If not, continue to Step (2). If so, score the nearest well factor as follows:
 - If any drinking water intake is subject to Level I concentrations, assign a factor value of 50.
 - If any drinking water intake is subject to Level II concentrations, but no intake is subject to Level I concentrations, assign a factor value of 45.
- (2) **Identify the nearest drinking water intake within the TDL for the watershed being evaluated.** Measure from the PPE (or, for contaminated sediments with no identified source, from the point where measurement of TDLs begins).
- (3) **Assign a dilution weight to the nearest intake.** Use HRS Table 4-13 to assign a dilution weight based on the type of surface water body in which the intake is located.
- (4) **Calculate the nearest intake factor value.** Multiply the dilution weight from Step (3) by 20. Round the product to the nearest integer, and assign the result as the nearest intake factor value.

TIPS AND REMINDERS

- Determine target populations by the location of the intake, not the location of the residence, school, or workplace served by the intake.
- If a drinking water system includes portions of more than one county and the specific number of residences supplied in each county is known, use county-specific estimates of persons-per-residence. Otherwise, use the lowest known persons-per-residence figure for the applicable counties to estimate the entire population served.
- The definition of students may include students at nontraditional schools (e.g., fire training class, truck driving school). Use the school's daily average enrollment as the figure for number of students. For example, if the school has four classes per year, each lasting three months and each with an enrollment of 30 students, then the number of students is thirty.
- For water bodies other than small streams, dilution weights are very small. Consequently, intakes subject to potential contamination often result in relatively few targets points, even if they serve a large population.
- Private intakes subject to actual contamination (particularly Level I) can result in a substantial drinking water threat score. Because of the broad population ranges used to evaluate intakes subject to potential contamination and the small dilution-weighting factors for all but the smallest water bodies, private intakes subject to potential contamination generally will not increase the drinking water threat score based on municipal intakes.
- Include the population using intakes closed because of site-related actual contamination in estimating the drinking water population. This population should reflect the number of people using the intake at the time it was closed.

SECTION 8.9 BLENDED WATER SUPPLIES



This section presents guidance and background information regarding the evaluation of the population factor for the drinking water threat when a surface water intake is part of a blended water supply system. The population factor for the drinking water threat is evaluated based on the level of contamination (i.e., Level I, Level II, and potential contamination), the number of people, and for potential contamination, the flows (or depths) at surface water intakes within the TDL. In some instances, discrete populations can be linked directly to individual intakes. In other cases, water from multiple intakes (or multiple intakes and ground water wells) is blended together prior to or during distribution to a target population. The HRS specifies a method for apportioning the total population served by such a system among the units (i.e., intakes, wells, or mains) making up the system.

The HRS provides for dividing a target population equally among all the water supply units that contribute to the blended system, as long as no single supply (i.e., intake, well, or main) contributes more than 40 percent (based on average annual pumpage or capacity) of the total supply. If any one unit provides more than 40 percent, the percentage contributed by each of the water supply units needs to be determined. Under these circumstances, each intake or well is assigned a percentage of the population based on its relative contribution.

RELEVANT HRS SECTIONS	
Section 4.1.2.3 Section 4.1.2.3.2	Drinking water threat — targets Population

DEFINITIONS

Blended Water Distribution System: A drinking water supply system that can or does combine (e.g., via connecting valves) water from more than one well or surface water intake, or from a combination of wells and intakes.

Capacity: The amount of water a well or intake can deliver to a water distribution system. Capacity may be expressed in units that are equivalent to a pumpage rate or as a percentage of the system's requirements.

Pumpage Data: A measure of the volume of water per unit of time discharged from a well, or collected within an intake, either by pumping or free flow. Well pumpage is commonly measured in gallons per minute (gpm), cubic meters per day (m³/day; 1 gpm = 5.45 m³/day), or cubic feet per second (cfs; 1 gpm = 0.0023 cfs). Pumpage data may also be termed well production data, well discharge data, well flow data, well yield data, pumping line data, and for intakes, intake pipe flow data. For HRS purposes, pumpage data relate to the measured or estimated rate of water withdrawal from a well or intake, not from a storage tank or reservoir used as a receptor for water drawn from one or more wells and/or intakes. See **Highlight 8-36** for more information on pumpage data.

HIGHLIGHT 8-36 PUMPAGE AND CAPACITY DATA

Data on the contribution of each intake or well to the total blended water system may be supplied in several forms, including pumpage or capacity. All data used to evaluate a given system for the purposes of apportioning population should be of the same type (e.g., do not use capacity data for some intakes or wells and pumpage data for others). In addition, the data must be in the same units. An abbreviated conversion table is provided below.

1 gal/min	= 0.00223 ft ³ /sec	= 5.45 m ³ /day
1 ft ³ /sec	= 448.8 gal/min	= 2,447 m ³ /day
1 m ³ /day	= 4.09 x 10 ⁻⁴ ft ³ /sec	= 0.183 gal/min.

Pumpage. Many water authorities keep pumpage records expressed as the total quantity of water pumped in a given interval, usually a day, month, or year, not in terms of pumpage for the period during which a well is used. Metered pumpage data are the most reliable and, therefore, the preferred type of data. However, estimates of pumpage calculated by the water authorities based on engineering parameters built into the well or intake design, construction, and pump configuration may also be acceptable.

Capacity. The sum of the capacities may represent more than the total needs of the system. The relative capacity of each component, however, may be calculated by dividing the capacity of the component by the sum of the capacities of all the components. This normalization procedure means that the sum of the relative capacities of all the components in the system will total 100 percent.

Standby intakes. When using pumpage data for a standby surface water intake, use average pumpage for the period during which the standby intake is used rather than average annual pumpage (HRS section 4.1.2.3.2). See Section 8.10 for additional information.

Standby Intake: A surface water intake held in reserve by a water supply entity (e.g., agency, authority, cooperative, private company, or individual) and maintained for use. It is designated as a drinking water supply to be used during a water supply shortage or emergency such as pump failure, drought, sudden water quality deterioration, or interruption in the regular supply.

Standby Well: A well held in reserve by a water supply entity (e.g., agency, authority, cooperative, private company, or individual) and maintained for use. It is designated as a drinking water supply well for use during a water supply shortage or emergency such as pump failure, drought, sudden water quality deterioration, or interruption in the regular supply. Additional terms commonly used to signify standby wells include reserve wells, drought wells, safety wells, emergency wells, backup wells, substitute wells, and uncommitted wells.

Population for the Drinking Water Threat: Number of residents, students, and workers regularly served by surface water intakes that are located within the TDL for the surface water bodies evaluated for a given watershed. This population does not include transient populations, such as hotel and restaurant patrons, but may include seasonal populations (e.g., a resort area).

SCORING THE POPULATION FACTOR FOR BLENDED WATER SUPPLIES

The steps described below outline the procedures for evaluating the population factor for blended water supplies. **Highlight 8-37** summarizes the data needed for the evaluation.

HIGHLIGHT 8-37 DATA NEEDS FOR EVALUATING BLENDED SYSTEMS

The typical data used to document the evaluation of the population factor when blended water systems are involved may include all of the following:

- Identification of all the water supply entities with intakes within the TDL.
- Number and location of water supply units (i.e., surface water intakes, ground water wells, standby/emergency supplies) and flow (or depth) data for surface water intakes subject to potential contamination.
- Specifics of the water distribution system:
 - Geographic extent
 - Number and types of connections (residential, industrial, commercial)
- Pumpage and/or capacity data for intakes and wells expressed in comparable units.

Much of the information required to evaluate blended water systems can be collected directly from the water supply entities or local regulatory authorities. In addition, because some of the required information relates specifically to water resources studies, the district office of the Water Resources Division of the USGS and its counterpart in the state should be contacted as necessary. These sources may provide more detailed well and flow data through such publications as their Water Resources Investigation series, the Hydrologic Atlas series, and annual reports on specific river basins.

- (1) **Identify all blended water supply systems that may have drinking water intakes within the TDL.** If more than one blended system is present, repeat Steps (2) through (6) for each system. If a blended system supplies water to another blended system or receives water from another blended system, refer to the subsection, Scoring Multiple Blended Systems.
- (2) **Identify all water supply units (i.e., intakes and/or wells) for the blended system.** Identify all water supply units of the blended system including units within and outside the TDL. The water supply units may include surface water intakes, ground water wells, and standby/emergency supplies. Mark the location of each intake or well relative to the site on a scale map or diagram.
- (3) **Determine which intakes will be evaluated as targets for the population factor.**
 - Although all water supply units must be identified to apportion population, include only intakes that are within the TDL for the watershed in scoring the population factor. Remember that any intake subject to actual contamination is evaluated regardless of its distance from the site.
 - If the blended system includes standby intakes, include or exclude some, all, or none of the standby intakes to obtain the highest population factor value. Exclude all standby ground water wells. See Section 8.10 for more detailed guidance on evaluating standby intakes.
- (4) **Determine the total number of persons served by the blended system.** If the data are provided in terms of service connections rather than persons served, multiply the number of service connections by the average number of persons per residence for the county.

- (5) **Determine whether any single intake or well supplies more than 40 percent of the system's water.** Base this determination on average annual pumpage or capacity data.
- (6) **Apportion the population served by the blended system as follows:**
 - If no single intake or well supplies more than 40 percent of the system's water, apportion the population equally to all intakes and wells in the system (i.e., divide the total population by the number of intakes and wells).
 - If a single intake or well supplies more than 40 percent of the system's water, apportion population to each intake or well based on the percentage of water it supplies. Use average annual pumpage or capacity to determine the percentage of water each intake or well supplies.
- (7) **Tabulate the population assigned to intakes within the TDL.** Add this population to any other target population (e.g., from other independent or blended systems) to evaluate the drinking water population factor for the watershed. See Section 8.8 for detailed information on scoring the population factor.

Highlights 8-38 and **8-39** provide examples of scoring the population factor for blended water systems.

SCORING MULTIPLE BLENDED SYSTEMS

Some blended water systems receive water from (or supply water to) another blended water system via one or more water mains. The steps below describe how to apportion population to each supply intake or well in such cases. The blended system that receives water is referred to as System R; the blended system that supplies water is referred to as System S. If two or more blended systems supply water to each other, evaluate the systems as one combined blended system; do not use the steps below.

APPORION POPULATION SERVED BY RECEIVING SYSTEM (SYSTEM R)

When evaluating a blended system that receives water from another system, include the water mains through which the system receives water as water supply units (i.e., treat as a well or intake).

- (1) **Determine population served by System R.** This step is identical to that for a normal blended system.
- (2) **Identify all water supply units for System R.** The water supply units are ground water wells in System R, surface water intakes in System R, and water mains from System S. Each water main is treated in the same manner as one well or intake.
- (3) **Determine whether any single System R water supply unit provides more than 40 percent of System R's total water.** Consider all wells and intakes in System R, and all water mains from System S.
- (4) **Apportion the population in System R as follows:**
 - If no water supply unit supplies more than 40 percent of the system's water, apportion the population equally to each water supply unit in System R.
 - If a water supply unit supplies more than 40 percent of the system's water, apportion population to each water supply unit based on the percentage of water it supplies. Use average annual pumpage or capacity to determine the percentage of water each well, intake, or water main supplies.

HIGHLIGHT 8-38
SCORING EXAMPLE OF SINGLE BLENDED SYSTEM WITH INTAKES
OUTSIDE OF THE TARGET DISTANCE LIMIT

Site Setting: The site is located in a suburban community, close to a river. The river is subject to potential contamination, and a PPE has been identified. For HRS purposes, the river is classified as a "large stream to river" (i.e., flow of > 1,000 to 10,000 cubic feet per second) at both intakes within the TDL (see HRS Table 4-13).

Water Supply: Three surface water intakes and three groundwater wells supply water to a blended system prior to distribution.

Location of Water Supply

- One intake 2 miles downstream of the PPE;
- One intake 5 miles downstream of the PPE;
- One intake 2 miles upstream of the PPE; and
- Three wells in a well field adjacent to the site.

Population Served: The water authority reports 80,000 connections.

The population density in the county in which the site is located is 2.5 persons per residence. Assuming all residential connections:

Population served = 80,000 x 2.5 = 200,000 people.

Evaluation: No Level I or Level II contamination is identified. Evaluate population based on potential contamination. The water authority reports no intake or well contributes more than 40 percent of its total need. Therefore, assign 33,333.3 people (200,000/6) to each intake and well in the system.

66,666.6 people are assigned to the two intakes within the TDL, which are on a water body of the type "large stream to river."

Using HRS Table 4-14, the dilution-weighted population value is 52.

Potential contamination factor value (to nearest integer) = $1/10 \times 52 = 5$

Population factor value = 5

HIGHLIGHT 8-39

SCORING EXAMPLE OF TWO SEPARATE BLENDED SYSTEMS

Site Setting: The site is located in a densely populated urban center.

Water Supply: Two water authorities (Systems A and B) with separate water treatment plants and separate distribution systems.

- System A is supplied by five surface water intakes.
- System B is supplied by three surface water intakes and one ground water well.

Location of Water Supplies: All intakes are within the TDL for surface water.

System A's intakes are located on a river with an average annual flow of 25,000 cfs (a "large river" by HRS definition from Table 4-13).

System B's intakes are located on a river with an average annual flow of 8,000 cfs (a "large stream to river" by HRS definition from Table 4-13).

Population Served: The population density in the county served by the water systems is 2.5 persons per residence.

Water authority A reports 100,000 residential connections.

Population served by System A = 100,000 x 2.5 = 250,000 people

Water authority B reports 40,000 residential connections.

Population served by System B = 40,000 x 2.5 = 100,000 people

Evaluation: No Level I or Level II contamination is identified. Evaluate population based on potential contamination. Both water authorities report that no well or intake contributes more than 40 percent of their total needs.

Assign 50,000 people (250,000/5) to each of the five intakes in System A. Because all intakes are on the same water body and are within the TDL, all 250,000 people in System A are evaluated for a "large river."

Assign 25,000 people (100,000/4) to each of the three System B intakes and the System B well. 75,000 people from System B (3 intakes x 25,000) are evaluated for a "large steam to river." Do not include the population served by the ground water well when calculating the surface water population factor value.

The dilution-weighted population values are as follows (from HRS Table 4-14):

Value for 250,000 people served by intakes on a "large river".....	16
Value for 75,000 people served by intakes on a "large steam to river".....	52
Total dilution-weighted population value.....	68

Potential contamination factor value (to the nearest Integer) = 1/10 x 68 = 7

Population factor value = 7

- (5) **Determine which System R intakes are within the TDL and tabulate the population served.** In determining the population served, consider only the population apportioned to intakes within the TDL. Tabulate only the population served by System R intakes. Do not include the population apportioned to mains from System S. As with all blended systems, the population is tabulated by level of contamination and, for intakes subject to potential contamination, by dilution weighting category.

APPORTION POPULATION SERVED BY THE SUPPLYING SYSTEM (SYSTEM S)

When calculating the total population served by a blended system that supplies water to another blended system, include the total population served by the supplying system.

- (1) **Determine the total population served by System S.** This population includes all people served by System S plus some of the people served by System R.
- (6) Refer to Step (4) above for the number of people served by System R that were apportioned to each System S water main.
- (7) Add this number to the population served directly by System S to calculate the total population served by System S.

After the total population served by System S is calculated, the water mains are not considered further in the evaluation for System S.

- (2) **Identify all water supply units for System S.** The water supply units are ground water wells in System S and surface water intakes in System S. The water mains to System R are not water supply units for System S.
- (3) **Determine whether any single System S well or intake supplies more than 40 percent of the water for System S.**
- (4) **Apportion the population in System S as follows:**
- If no well or intake supplies more than 40 percent of the system's water, apportion the population equally to all wells and intakes in the system.
 - If a well or intake supplies more than 40 percent of the system's water, apportion population to each well or intake based on the percentage of water it supplies. Use average annual pumpage or capacity to determine the percentage of water each well or intake supplies.
- (5) **Include the population apportioned to any System S intake within the TDL in the tabulation of population served.** As with all blended systems, the population is tabulated by level of contamination and, for intakes subject to potential contamination, by dilution weighting category.

An example of apportioning population to two blended systems in which one is supplying water to the other is provided in ***Highlight 8-40***.

HIGHLIGHT 8-40

SCORING EXAMPLE FOR MULTIPLE BLENDED SYSTEMS

Water Supply: System S: Blends water from four intakes; no intake provides >40 percent of the system's water.

System R: Blends water from four intakes and receives water from System S via 1 water main; no intake or main provides >40 percent of the system's water.

Location of Intakes: System S: Two intakes are within 10 miles downstream from the PPE. The other two intakes are outside of the TDL.

System R: All four intakes are within 10 miles downstream from the PPE.

All intakes within the TDL for both systems are subject to Level II contamination.

Population Served: System S: 10,000 people
System R: 20,000 people

Evaluation: **Apportion Population Served by Receiving System - System R**

Number of water supply units = 4 Intakes + 1 main = 5 units
People/unit = 20,000/5 = 4,000

Assign 4,000 people to each System R intake and the water main from System S.

Apportion Population Served by Supplying System - System S

Total Population = 10,000 (System S) + 4,000 (System R) = 14,000
Number of water supply units = 4 intakes
People/unit = 14,000/4 = 3,500

Assign 3,500 people to each System S intake.

Population Factor: Two System S intakes within TDL = 7,000 people
Four System R intakes within TDL = 16,000 people

Total Level II concentrations factor value = 23,000

Population factor value = 23,000

TIPS AND REMINDERS

- If no single intake or well supplies more than 40 percent of a system's total needs, apportion the population equally to all intakes and wells even if more definitive information is available.
- Allocate population served to each well or intake in a blended system, but only include as targets those populations allocated to intakes located within the TDL for the watershed.
- When two or more blended systems regularly provide water to each other, evaluate the systems as one combined blended system.

SECTION 8.10 STANDBY INTAKES



This section defines standby intakes and associated terms, provides guidance and background information on the use of standby intakes to evaluate certain factors within the targets factor category of the drinking water threat, and explains how to apportion population to standby intakes. Standby intakes in the drinking water threat are treated in the same manner as standby wells in the ground water pathway. A standby intake that meets certain criteria may be used to score the nearest intake and/or the population factors. To designate a standby intake as the nearest intake, it must be used for drinking water supply at least once a year. In order to include a standby intake when evaluating the population factor, the intake must be maintained regularly so that water can be withdrawn. Standby intakes are not considered in the evaluation of the resources factor.

RELEVANT HRS SECTIONS	
Section 4.1.2.3.1	Nearest intake
Section 4.1.2.3.2	Population

DEFINITIONS

Annual Use: Criterion for determining whether a standby intake may be used to evaluate the nearest intake factor. To meet this criterion, a standby intake generally should supply drinking water for at least one 24-hour period in a year.

Regular Maintenance: The routine inspection, cleaning, and testing of a standby intake so that it can be ready for immediate use. This is a criterion for determining whether a standby intake may be used to evaluate the population factor. Regular maintenance of a standby intake may include direct measurement of (or knowledge of) the surface water level, inspection of intake screen and pump, and testing of the pump. Such activities generally should be conducted at least once a year and the operating authority should consider the intake functional. Rehabilitation activities, with the intent of retaining a standby intake in a state of readiness, also can be considered regular maintenance. Such activities include pump cleaning and lubricating or screen cleaning.

Standby Intake: A surface water intake held in reserve by a water supply entity (e.g., agency, authority, cooperative, private company, or individual) and maintained for use. It is designated as a drinking water supply to be used during a water supply shortage or emergency, such as pump failure, drought, sudden water quality deterioration, or interruption in the regular water supply.

Water Withdrawal Rotation Program: Program in which intakes within a water supply system are used only for specified intervals, after which other intakes or wells are used. Rotation programs are designed to minimize drawdown interference and to maximize efficient use of

water in relation to varying water demand. Do not consider an intake that is part of a planned water withdrawal rotation program a standby intake

Nearest Intake Factor: Factor for evaluating the maximally exposed intake. This factor is based on the presence of actual contamination or, for watersheds where no intake is subject to actual contamination, the flow or depth of the water body at the intake nearest to the PPE within the TDL.

Population for the Drinking Water Threat: Number of residents, students, and workers regularly served by surface water intakes that are located within the TDL for the surface water bodies evaluated for a given watershed. This population does not include transient populations, such as hotel and restaurant patrons, but may include seasonal populations (e.g., a resort area).

Pumpage Data: A measure of the volume of water per unit of time discharged from a well, or collected within an intake, either by pumping or free flow. Well pumpage is commonly measured in gallons per minute (gpm), cubic meters per day (m³/day; 1 gpm = 5.45 m³/day), or cubic feet per second (cfs; 1 gpm = 0.0023 cfs). Pumpage data may also be termed well production data, well discharge data, well flow data, well yield data, pumping line data, and for intakes, intake pipe flow data. For HRS purposes, pumpage data relate to the measured or estimated rate of water withdrawal from a well or intake, not from a storage tank or reservoir used as a receptor for water drawn from one or more wells and/or intakes.

Capacity: The amount of water a well or intake can deliver to a water distribution system. Capacity may be expressed in units that are equivalent to a pumpage rate or as a percentage of the system's requirements.

SCORING THE NEAREST INTAKE FACTOR USING STANDBY INTAKES

(1) Identify the standby Intake(s).

- Water supply entities generally refer to standby intakes by any of the following terms: standby intakes, reserve intakes, drought intakes, safety intakes, emergency intakes, backup intakes, substitute intakes, and uncommitted intakes.
- Even when one of the above terms is applied to an intake, the intake should not be considered a standby intake unless it meets HRS criteria.
- Standby intakes may be located either upstream of or downstream from the primary intake or even in a different watershed. They are commonly found where water works facilities have been upgraded or where municipalities have merged or collaborated to form a single water supply system.
- Some water supply entities utilize multi-level water withdrawal intakes at a single point in a lake or impounded portion of a river. One or more of these intakes may be used for water withdrawal on a regular basis, while other intakes may be designated for use only under critical water level conditions. Multi-level intakes with at least one level used on a regular basis should not be evaluated as standby intakes.

(2) Determine whether the standby Intake Is eligible to be used to score the nearest intake factor. The standby intake may be used if it meets both of the following conditions:

- The standby intake is within the TDL for the watershed being evaluated; and
- The standby intake has been used annually. It is not necessary to document that the intake has been used annually for the entire time it has been designated as a standby

intake. Documenting annual use in recent years (e.g., during the past five years) generally is sufficient. If the intake has been brought into a state of readiness only within the past few years, annual use since that time should be documented.

- (3) **Use an eligible standby intake as the nearest intake if it results in a higher nearest Intake factor value than any regular Intake.**

SCORING THE POPULATION FACTOR USING STANDBY INTAKES

- (1) **Identify the standby Intake(s).**

- (2) **Determine whether any standby intake is eligible to be used to score the population factor.** The standby intake may be used to score the population factor if it meets both of the following conditions:

- The standby intake is within the TDL for the watershed being evaluated; and
- The standby intake is receiving regular maintenance (as defined above). If a standby intake meets the annual use criterion for the nearest intake factor, it is likely to have also received regular maintenance.

- (3) **Evaluate the population factor with and without the standby intake(s).**

- For a system consisting entirely of surface water intakes within the TDL, including or excluding an eligible standby intake will only affect the score if the intake is at a different level of contamination or dilution weight from the regular intakes, or if it is in a different watershed.
- If there is more than one standby intake, calculate the population factor value for various combinations of intakes and wells. PREscore can be very useful for scenario testing. Each combination of wells and intakes must include:

- S All regular intakes and wells;
- S Some, all, or none of the standby intakes; and
- S None of the standby wells.

Note that the inclusion or exclusion of standby intakes may change the relative contribution of each water supply unit to the total water supply. In some cases, this may affect whether one well or intake provides more than 40 percent of the system's water.

- Do not double count by assigning the same population to both a standby intake and to a regular intake or well. Each segment of the population must be assigned to one and only one intake or well.
 - When apportioning the population of a blended system based on pumpage data, use average pumpage (e.g., gallons per minute) for the period during which the standby intake is used, rather than average annual pumpage. **Highlight 8-41** provides additional information on pumpage and capacity data for standby intakes. Section 8.9 provides detailed guidance on scoring the population factor for blended systems.
- (4) **Choose the combination of regular and standby intakes that results in the highest population factor value.**

HIGHLIGHT 8-41

PUMPAGE AND CAPACITY DATA FOR STANDBY INTAKES

If no well or intake provides more than 40 percent of the total water supply for the system, simply apportion the population equally among the wells and/or intakes. However, if one intake or well provides more than 40 percent of the total water supply for the system, population must be apportioned according to each well's or Intake's share of the total supply. Consider the following points when apportioning population in a system with standby intakes where one water source provides more than 40 percent of the total supply.

- Use either capacity or pumpage data to calculate the percentage of the population to be assigned to each component of the system. Do not use pumpage data for one component and capacity data for other components. Data from standby intakes and regular intakes and wells must be in the same units.
- When using pumpage data for a standby intake, use average pumpage for the period during which the standby intake is used rather than average annual pumpage. The period during which a standby intake is on line but not actually pumping should not be considered part of the period during which the standby intake is used.
- Often pumpage data for standby intakes are not based on water flow meter readings, but reflect estimates based on pumping test data, pump size, orifice of effluent pipe, or duration of pump operation. Although metered pumpage data should be used whenever possible, pumpage may be estimated based on these or other appropriate parameters.
- If possible, attempt to calculate pumpage rates based on an average over the most recent periods of use. However, calculation of the pumpage rate for a standby intake can be based on a period of use several years ago.

Highlight 8-42 summarizes the data needed for evaluating standby intakes. **Highlight 8-43** provides an example of (1) calculating average pumpage for a standby intake and (2) calculating the relative contributions for a blended system including a standby intake. **Highlight 8-44** provides an example of scoring the population factor using a standby intake.

HIGHLIGHT 8-42 DATA NEEDS FOR STANDBY INTAKES

Contact local water supply entities (or regulatory authorities) directly to obtain the following data needed to evaluate standby intakes:

- Ensure that the Intake is one that is held in reserve to be used during a water supply emergency.
- Confirm that the intake has a working pump
- For the nearest Intake factor, document that the intake has been used annually (e.g., for a 24-hour period during a calendar year). Documenting annual use in recent years (i.e., during the past five years) generally is sufficient.
- For the population factor, document that the intake has been regularly maintained since established as a standby intake.
- Additional information (e.g., pumpage or capacity data) may be required when apportioning population to standby intakes and then using the standby intake to evaluate the population factor.

HIGHLIGHT 8-43 USING PUMPAGE DATA FOR STANDBY INTAKES

Standby Intake A standby intake is used for 28 days
Use: 30,240,000 gallons of water are drawn from the intake during the 28-day period

Calculation of Pumpage:
$$\frac{\text{Total pumpage for period of use}}{(\# \text{ days used})(24 \text{ hours/day})(60 \text{ minutes/hour})} =$$

$$\frac{30,240,000}{(28)(24)(60)} = 750 \text{ gpm}$$

Apportionment: Water from this standby Intake is blended with two regular Intakes that have pumpage rates of 1,600 gpm and 4,000 gpm respectively. The relative contribution of each is:

$$\frac{750}{(750 + 1,600 + 4,000)} = \frac{750}{6,350} = 12\%$$

$$\frac{1,600}{(750 + 1,600 + 4,000)} = \frac{1,600}{6,350} = 25\%$$

$$\frac{4,000}{(750 + 1,600 + 4,000)} = \frac{4,000}{6,350} = 63\%$$

Because one intake provides more than 40 percent of the total supply, population apportionment is based on each intake's relative contribution to the total.

HIGHLIGHT 8-44 EVALUATING POPULATION FACTOR USING A STANDBY INTAKE

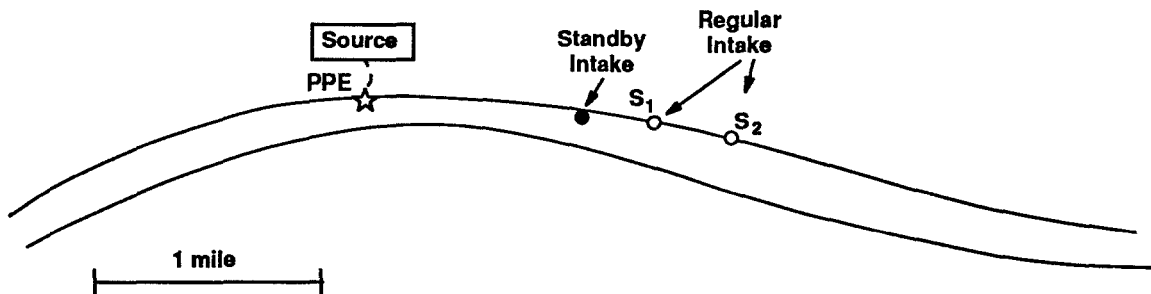
Site Setting: The site is in a suburban location with moderate population density.

Water Supply: The local water system utilizes two surface water intakes, S_1 and S_2 (each pumping at a rate of 1,500 gpm), along a small river and one ground water well (also pumping at a rate of 1,500 gpm) as part of a water withdrawal rotation program. Each is used as the primary drinking water source approximately one-third of the time, as part of a rotation program.

Another surface water intake (with a pump capacity of 1,500 gpm) is regularly maintained to serve as an standby supply.

Location of Water Supply: Regular surface water intakes are located between 1/2 and 1 mile (S_1) and between 1 and 2 miles (S_2) downstream from the site. The standby intake draws from a location near intake S_1 . Average flows at these intakes range from 8,000 to 9,000 cfs.

The ground water well, G_1 , is located between 1/2 and 1 mile from the site.



Population Served: The local water purveyor reports 2,400 residential connections.

The population density in the county in which the site is located is 2.5 persons per residence.

$$\text{Total population served} = 2,400 \times 2.5 = 6,000$$

Evaluation: Evaluate the water withdrawal rotation system as a blended system. Level II concentrations have been documented at intake S_1 , well G_1 , and the standby intake. S_2 is subject to potential contamination only. The water authority reports that the capacity of the standby intake is sufficient to replace any interruption in either the ground water or regular surface water supply.

Alternative 1: Include the standby intake in apportioning population to the system.

Each of the four water supply units provides 25 percent.

Because none of the four provides more than 40 percent of the total water supply, assign one-fourth of the population ($1/4 \times 6,000 = 1,500$ people) to each well or intake.

- (1) **Sum the population served by surface water intakes subject to Level II concentrations.**

(continued on next page)

HIGHLIGHT 8-44 (continued)
EVALUATING POPULATION FACTOR USING A STANDBY INTAKE

$$1,500 (S_1 \text{ population}) + 1,500 (\text{Standby intake population}) = 3,000$$

Level II concentrations factor value = 3,000

- (2) **Assign dilution-weighted population values from HRS Table 4-14 to surface water Intake subject to potential contamination (S_2).**

1,500 people served by an intake located on a river are assigned 2 points.

$$\text{Potential contamination factor value} = (1/10)(2) = 0.2$$

(Note that the HRS specifies that this value is not rounded if it is less than 1.)

- (3) **Add the values from Steps (1) and (2) to get the population factor value.**

$$3,000 + 0.2 = 3,000.2$$

Note: The 1,500 people assigned to the ground water well are not included as surface water pathway targets; they would be evaluated in the ground water pathway.

Alternative 2: Exclude the standby well in apportioning population to the system.

Each of the three water supply units provides 33 percent.

Because none of the 3 provides more than 40 percent of the total water supply, assign one-third of the population ($1/3 \times 6,000 = 2,000$ people) to each well or intake.

- (1) **Sum the population served by surface water intakes subject to Level II concentrations.**

$$\text{Level II concentrations factor value} = 2,000 (S_1 \text{ population})$$

- (2) **Assign dilution-weighted population values from HRS Table 4-14 to surface water Intake subject to potential contamination (S_2).**

2,000 people served by an intake located along a small river receive a dilution-weighted population value of 2.

$$\text{Potential contamination factor value} = (1/10)(2) = 0.2$$

- (3) **Add the values from Steps (1) and (2) to get the population factor value.**

$$2,000 + 0.2 = 2,000.2$$

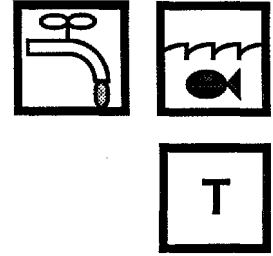
Note: The 2,000 people assigned to the ground water well are not evaluated for the surface water pathway.

Selected Alternative: **Because Alternative 1 results in the higher population factor value, Alternative 1 is used to evaluate the factor.**

TIPS AND REMINDERS

- The annual use criterion applies only to the nearest intake factor evaluation. A standby intake can be used to evaluate population without meeting the annual use criterion, providing it is regularly maintained so that water can be withdrawn.
- Including a standby intake is likely to yield a higher population score if its level of contamination is higher than that of regular intakes within the system (e.g., the standby intake is subject to Level I contamination and the regular supply intakes are subject only to Level II or potential contamination).
- If only potential contamination is scored, including a standby intake is likely to yield a higher population factor score if it is located on a smaller water body than the regular supply intakes or if the blended system includes ground water wells.
- Do not include standby ground water wells when scoring the surface water pathway.
- Use average pumpage for the period in which the standby intake is used, rather than average annual pumpage, when evaluating standby intakes.
- Standby intakes do not have to be included in scoring. Even if one standby intake is included, it is not necessary to include all of them. Include only those standby intakes that will increase the population factor value. The apportioning may be different than for the ground water pathway and may also differ for each watershed evaluated.

SECTION 8.11 RESOURCES



This section provides guidance on scoring the resources factor for the targets factor category of the surface water drinking water threat. The resources factor evaluates the possible loss of surface water use resulting from site-related contamination of the surface water. The resources factor does not evaluate threats to human health, which are considered in the nearest intake and population factors, and in the human food chain threat. Unlike the ground water resources factor, the surface water resources factor does not address commercial aquaculture, which is evaluated in the human food chain threat. HRS section 4.1.2.3.3 discusses the resources factor.

DEFINITIONS

Commercial Food Crops: Crops that are intended to be sold widely, such as in supermarkets, and locally, such as those sold at local produce stands. Crops grown for domestic consumption or for use in a single restaurant are not considered commercial food crops.

Commercial Forage Crops: Crops grown to be sold as food for livestock (it is not necessary to document that these crops were sold only for commercial livestock), and grasslands used for grazing by commercial livestock (including areas technically defined as "pasture/rangeland" by the USDA).

Commercial Livestock: Livestock raised for sale to commercial wholesalers or supermarkets. Livestock raised for private or domestic use is not considered commercial livestock.

Designated for Drinking Water Use: Section 305(a) of the Clean Water Act requires states to prepare a water quality inventory that designates and classifies certain waters for drinking water use. The water can have such a classification even if it is not currently used for or is not currently suitable to be used for drinking water.

Ingredient In Commercial Food Preparation: Surface water used for wholesale food preparation (e.g., a manufacturer that prepares food products to be sold in supermarkets or produce stands). Food prepared in restaurants is not included in this category.

Major or Designated Water Recreation Area: A major water recreation area is an area used by a large number of people for recreational purposes (e.g., swimming or fishing). A designated water recreation area is an area designated and maintained by a government body (e.g. local, state, or Federal) as an area for public recreation.

SCORING THE RESOURCES FACTOR

- (1) **Use the checklist in *Highlight 8-45* to determine if any surface water uses that are assigned resource points apply to the watershed.** Do not use standby intakes to evaluate the resources factor.

The following sources of information on possible surface water uses will help in documenting resource use for a watershed:

- USGS topographic maps and land use data
- USDA county crop records and irrigated acreage data
- Field observations
- Interviews with water company officials
- Public utility trade association online services (e.g., American Water Works Association's WaterNet data base)
- Existing PA/SI reports for the site or nearby sites.
- Correspondence with nearby businesses
- Correspondence with other nearby institutions, such as farms or universities
- EPA's FRDS
- Agricultural extension agents
- Local chambers of commerce
- Federal, state, or regional parks and recreation departments
- State public water supply offices (usually found in state departments of health or environment)
- State water classification and designation maps

(2) **If a resource use is documented, assign a value of 5 to the resources factor for the watershed; otherwise, assign a value of 0.**

**HIGHLIGHT 8-45
CHECKLIST FOR THE RESOURCES FACTOR**

For the watershed being evaluated:

(1)	Is surface water used to irrigate five or more acres of commercial food crops or commercial forage crops?	Yes	No
(2)	Is surface water used to water commercial livestock?	Yes	No
(3)	Is surface water used as an ingredient in commercial food preparation?	Yes	No
(4)	Is surface water used as, or used to supply, a major or designated water recreation area, excluding drinking water use?	Yes	No
(5)	If surface water is not used for drinking water within the TDL, is any portion of the surface water designated by the state for drinking water use under Section 305(a) of the Clean Water Act, as amended, or is any portion usable for drinking purposes?	Yes	No

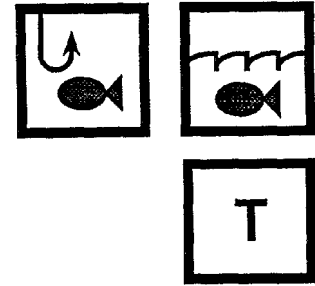
If the answer to any of the above questions is "yes", assign a resources factor value of 5. If the answer to all questions is "no", assign a resources factor value of 0.

TIPS AND REMINDERS

- Because the surface water resources factor receives only 5 target points, this factor generally has little impact unless the site score is near the cutoff score.
- A surface water body used for drinking water and other specified resource use (e.g., irrigation) can be assigned target points for both the population and resources target values.
- A major or designated recreation area may also overlap with a sensitive environment and/or a fishery. Such an area may receive points for resources and sensitive environments and fisheries, if each type of use is documented.
- Resources for the surface water pathway are evaluated anywhere within the TDL for the watershed.

SECTION 8.12

ACTUAL HUMAN FOOD CHAIN CONTAMINATION



A fishery (or portion of a fishery) is subject to actual contamination if specific criteria demonstrate the fishery has been contaminated by hazardous substances attributable to the site. Fisheries subject to actual contamination are weighted more heavily than fisheries subject to potential contamination in the human food chain target evaluation. In many cases, documenting actual human food chain contamination results in a site score above the HRS cutoff.

This section provides guidance on identifying and scoring fisheries (or portions of fisheries) subject to actual human food chain contamination. When a fishery is present, data used to document an observed release to surface water may also satisfy the criteria for establishing actual human food chain contamination. This section also provides guidance on determining whether fisheries (or portions of fisheries) subject to actual contamination are exposed to Level I or Level II concentrations, and scoring sites with actually contaminated fisheries.

RELEVANT HRS SECTIONS	
Section 2.3	Likelihood of release
Section 2.5	Targets
Section 2.5.1	Determination of level of actual contamination at a sampling location
Section 2.5.2	Comparison to benchmarks
Section 4.1.1.2	Target distance limit
Section 4.1.2.1.1	Observed release
Section 4.1.3.2.1.3	Bioaccumulation potential
Section 4.1.3.3	Human food chain threat - targets
Section 4.1.3.3.1	Food chain individual
Section 4.1.3.3.2	Population
Section 4.1.3.3.2.1	Level I concentrations
Section 4.1.3.3.2.2	Level II concentrations

DEFINITIONS

Actual Contamination for the Human Food Chain Threat: Any portion of a fishery is subject to actual contamination if a hazardous substance with a BPFV of 500 or greater meets the criteria for an observed release; a fishery is closed, and a hazardous substance for which the fishery was closed is documented in an observed release; or a hazardous substance is present in a tissue sample from an essentially sessile, benthic food chain organism at a level that meets the criteria for an observed release.

Aquatic Human Food Chain Organism: Aquatic species directly consumed by humans, including certain finfish, shellfish, crustaceans, amphibians, and amphibious reptiles.

Benthic Organisms: Organisms that live on or at the bottom (i.e., not in the water column) of water bodies for most of their adult life cycle, such as clams, lobsters, and crayfish.

Bioaccumulation Potential Factor Value (BPFV): BPFV is a measure based on a hierarchy of three types of data: bioconcentration factor; n-octanol-water partition coefficient (K_{ow}); and water solubility. BPFV reflects the tendency for a substance to accumulate in the tissue of an aquatic organism – the greater the BPFV, the greater the relative tendency of a substance to accumulate. BPFVs for commonly encountered hazardous substances are listed in SCDM.

Closed Fishery: A fishery closed or restricted by a government entity. Such closure prohibits fishing for commercial, recreational, or subsistence purposes. To be evaluated for the HRS, closure must be due to hazardous substances released from sources at the site.

Essentially Sessile Benthic Organisms: Organisms that essentially stay at or near a localized spot in a water body during the adult stage of their life cycle (e.g., barnacles, oysters, muscles, sponges, and stalked diatoms). These organisms may not live on the bottom, but must not live suspended in the water column. They may be attached to rocks, pilings, or submerged banks at or near the surface. Samples from these organisms can be used in the HRS for two purposes:

- (1) To establish an observed release (use any essential sessile benthic organism); and
- (2) To establish actual contamination and the level of contamination (use only human food chain organisms).

Fishery: Any area of a surface water body from which human food chain organisms are taken or could be taken for human consumption on a commercial, recreational, or subsistence basis. Food chain organisms include fish, shellfish, crustaceans, amphibians, and amphibious reptiles. Fisheries are delineated by changes in dilution weights, level of contamination, or annual production. To establish a fishery, document that human food chain organisms are present and that people fish in the surface water body.

Level I Concentrations for the Human Food Chain Threat: Level I concentrations are established in tissue samples from aquatic human food chain organisms in which the concentration of a hazardous substance that meets the criteria for an observed release is at or above its specific health-based benchmark. The tissue sample must also be taken from within the boundaries of the area of actual contamination. Aqueous and sediment sample results cannot be used to establish Level I concentrations for this threat. Benchmarks for the human food chain threat include FDAAL for fish or shellfish and screening concentrations for cancer and chronic noncancer effects.

Level II Concentrations for the Human Food Chain Threat: Level II concentrations are established in samples in which the concentration of at least one hazardous substance meets the criteria for an observed release, but the conditions for Level I concentrations are not met. In addition, Level II is assigned for observed releases established by direct observation.

Sessile Organisms: Organisms permanently attached to some substrate for most of their life cycle, such as sponges, barnacles, stalked diatoms, and oysters.

DOCUMENTING PRESENCE OF A FISHERY

Before evaluating the level of contamination, document that the surface water body under evaluation is a fishery. Collect evidence to document both of the following:

- Human food chain organisms are present in the surface water body; and
- Some attempt has been made to catch those human food chain organisms.

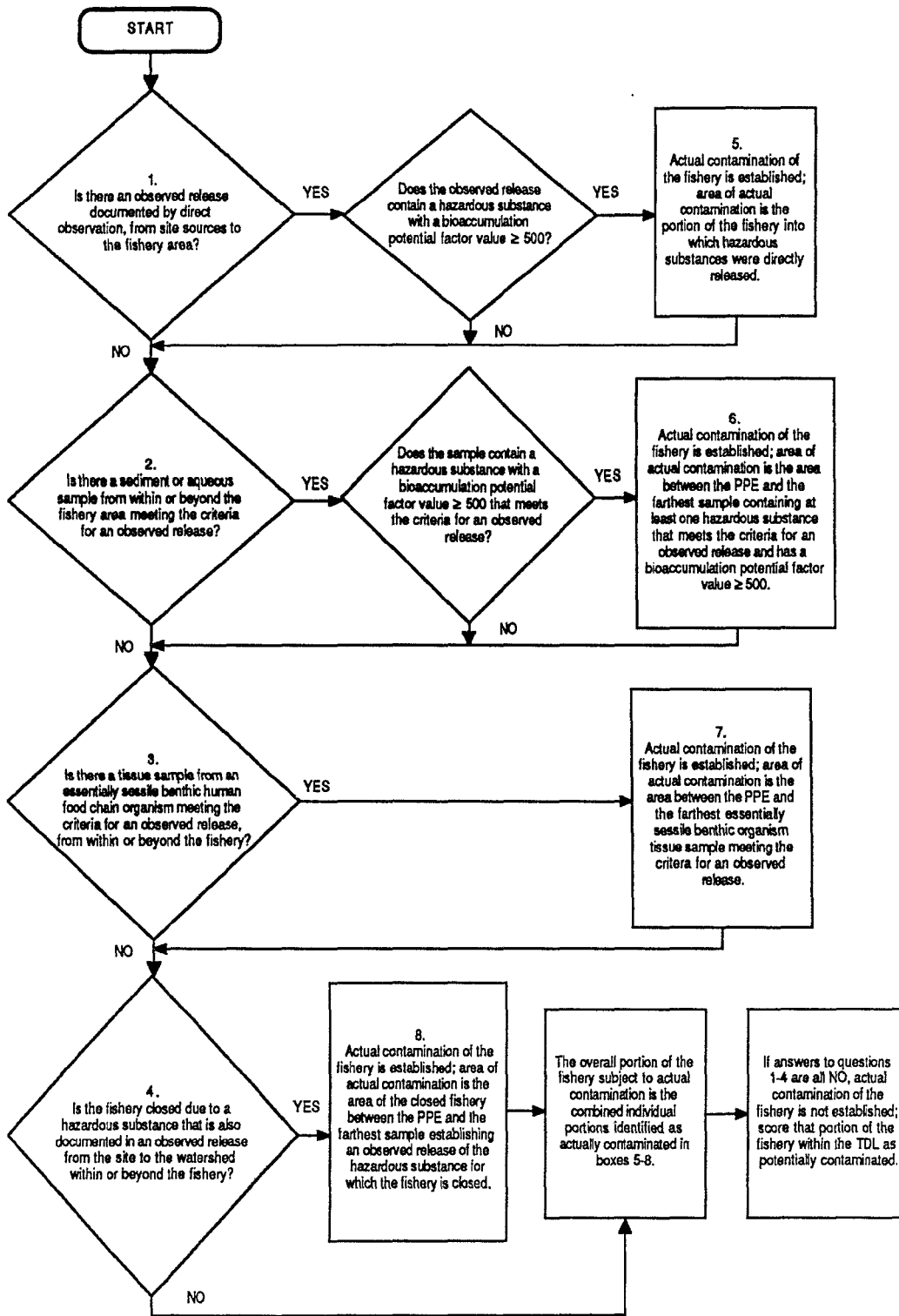
Useful sources of information include state and local fish and wildlife agencies, local bait and tackle shops, visual observation during the SI of individuals fishing or of past fishery activity (e.g., fishing lines and hooks left behind near the surface water body).

ESTABLISHING ACTUAL CONTAMINATION OF A FISHERY

The following steps describe the procedures used to establish actual contamination. Because a necessary criterion for establishing actual contamination is documentation of an observed release, the first five steps are designed to document an observed release by chemical analysis. To establish an observed release by direct observation, follow the procedures in the first step. To establish an observed release by chemical analysis, use Steps (2) to (5). These steps should be repeated for each hazardous substance attributable to the site detected in applicable surface water samples **Highlight 8-46** summarizes procedures for determining whether fisheries are actually contaminated.

- (1) **Establish an observed release by direct observation.** An observed release can be demonstrated if at least one of the following criteria is met:
 - A material that is documented to contain one or more site-related hazardous substances has been directly deposited into or has been seen entering surface water through migration (e.g., leachate, outfall, effluent);
 - A source (or a portion of a source) has been flooded and at that time hazardous substances in the source were in contact with flood waters (e.g., a wet surface impoundment inundated by flood waters); or
 - Evidence supporting the inference of a release of hazardous substances from the site exists and adverse effects associated with the inferred release can be demonstrated (e.g., a significant fish kill occurred after electroplating wastes containing heavy metals were inadvertently spilled in a work area immediately adjacent to surface water).
- (2) **Compile analytical results indicating that a hazardous substance has been detected in surface water samples.** To establish an observed release by chemical analysis to surface water and/or actual fishery contamination, review sediment, aqueous, and tissue sample data. To be eligible for establishing an observed release, tissue samples must be from essentially sessile benthic organisms (e.g., oysters) (see **Highlight 8-47**).
- (3) **Determine the background level for the hazardous substance.** Determining the background level usually requires analytical results from one or more appropriate sample locations for each type of sample being evaluated (e.g., aqueous, sediment), particularly for substances that could be naturally occurring, ubiquitous, or attributable to other sites. A background level of 0 generally can be assumed for a substance that is not naturally occurring, ubiquitous, or attributable to other sites.
- (4) **Determine whether the concentration of the hazardous substance is significantly above background.** Detailed guidance for making this determination is found in Section 5.1, particularly **Highlight 5-2**.
- (5) **Determine whether the hazardous substance can be attributed to the site.** Sampling results or records (e.g., manifests, permits) indicating the presence of the hazardous substance in a source or sources at the site are one useful type of documentation. Information that the hazardous substance was used at the facility also may be acceptable. See Chapter 5 for additional guidance on attribution, including attribution of degradation products.

HIGHLIGHT 8-46 FLOWCHART FOR IDENTIFYING CONTAMINATED FISHERIES



HIGHLIGHT 8-47 USE OF TISSUE SAMPLES FROM AQUATIC ORGANISMS

For the human food chain threat, tissue samples can be used to establish actual contamination and are required to establish Level I concentrations. Aquatic organisms can be divided into two groups: (1) essentially sessile benthic organisms and (2) organisms likely to spend extended periods of time within a fishery that are not essentially sessile benthic organisms. Only tissue samples from essentially sessile benthic human food chain organisms can be used to establish both an observed release to surface water and actual human food chain contamination. Tissue samples from other aquatic organisms, in certain circumstances, can be used to establish Level I contamination, but only within an area of actual contamination established with other samples (or by direct observation). Evaluate tissue samples, as follows.

- Compare samples from similar organisms (e.g., similar age) of the same species.
- Compare samples of the same tissue type (e.g., liver samples should be compared with liver samples, roe samples with roe samples).
- The hierarchy of preference for sample types is: edible tissues (e.g., fillets for most finfish), edible tissues with associated tissues attached or only partially removed, whole-body samples, and samples of other specific tissues or organs. Use less desirable sample types only when other data are not available.
- Verify the sample locations and note possible influences on sample data such as intervening tributaries.

The following table provides examples of different tissue samples used for HRS scoring and the function the samples serve when evaluating the human food chain threat.

Sample Type	Sample Use	Example Organisms
Essentially Sessile Benthic Organisms	Used to establish an observed release.	Barnacles Stalked Diatoms Sponges
Essentially Sessile Benthic Human Food Chain Organisms	Used to establish an observed release and actual contamination.	Mussels Oysters
Organisms Likely to Spend Extended Periods of Time Within the Boundaries of Actual Food Chain Contamination but not Essentially Sessile Benthic Organisms	Can be used to raise Level II concentrations to Level I concentrations but cannot be used to establish an observed release or actual contamination.	Non-sessile Benthic: Lobsters Crabs Snails Shrimp Crayfish Scallops Finfish: Pike Bass Tuna Flounder Trout Salmon Other Food Chain Organisms: Frogs Salamanders Squid

- (6) **Establish actual contamination.** To establish actual contamination of a fishery (or portion of a fishery), the fishery must be within the area bounded by an observed release and at least one of the following criteria must be met:
- A hazardous substance with a BPFV of 500 or greater is present in an observed release sample (aqueous or sediment), or by direct observation;
 - For a closed fishery, a hazardous substance for which it was closed must be documented in an observed release from the site. The hazardous substance need not have a BPFV of 500 or greater to establish actual contamination; or
 - A hazardous substance attributable to the site is present in tissue samples from an essentially sessile benthic human food chain organism at levels that meet the criteria for an observed release. The hazardous substance need not have a BPFV of 500 or greater to establish actual contamination.

Only fisheries (or portions of fisheries) located within the boundaries of actual contamination are evaluated as subject to actual contamination. A fishery (or portion of a fishery) may be located within the boundaries of an observed release to surface water but not be subject to actual contamination. For example, assume asbestos contamination was detected in aqueous and sediment samples at concentrations demonstrating an observed release to surface water. The BPFV for asbestos is less than 500. In the absence of other data, the fishery must be evaluated as subject to potential contamination because no substance with a BPFV greater than 500 has been documented in an observed release.

DETERMINING THE LEVEL OF ACTUAL CONTAMINATION

A fishery (or portion of a fishery) is subject to actual contamination if it is located within the boundaries of an observed release and the other criteria specified in Step (6) above, are met. The following procedures outline how to determine if a fishery for which actual contamination has been established should be evaluated for Level I or Level II concentrations. **Highlight 8-48** describes sample types and criteria used to establish Level I and Level II concentrations.

- (1) **If actual contamination is established based only on aqueous samples, sediment samples, or direct observation, score the portion of the fishery within the area of actual contamination as Level II concentrations.**
- (2) **If tissue samples from a human food chain organism are available, determine if such samples are eligible to be used to establish Level I, as follows.**
 - For essentially sessile benthic human food chain organisms, both of these criteria must be met:
 - One or more hazardous substances in the tissue samples must establish an observed release to surface water from the site; and
 - The tissue samples must be from an aquatic species typically consumed by people.
 - For non-sessile or non-benthic human food chain organisms, all three of the following criteria must be met:
 - The species sampled spends extended periods of time within the boundary of actual fishery contamination; and

- Actual contamination is established through aqueous or sediment samples or from tissue samples from an essentially sessile benthic organism; and
- The hazardous substances found in tissues and compared to benchmarks are also present in the aqueous sample used to establish actual human food chain contamination.

(3) **For samples that meet the criteria in Step (2), compare the concentration of each hazardous substance with its health-based benchmarks for the human food chain threat.** If the hazardous substance concentration equals or exceeds its lowest applicable benchmark concentration, consider the sampling location subject to Level I concentrations for the human food chain threat. See **Highlight 8-49**. If more than one hazardous substance meets the criteria in Step (2), but no single hazardous substance establishes Level I, continue to Step (4).

**HIGHLIGHT 8-48
SAMPLES AND CRITERIA FOR LEVEL I AND LEVEL II CONCENTRATIONS
IN THE HUMAN FOOD CHAIN THREAT**

Sample Type	Usefulness for Human Food Chain Threat
Level I	
Surface Water/Sediment	Cannot be used to establish Level I concentrations.
Tissue From Essentially Sessile Benthic Human Food Chain Organisms (e.g., clams)	Hazardous substance concentrations must equal or exceed lowest human food chain benchmark concentration (or indices I or J must equal or exceed 1); must also meet criteria for an observed release.
Tissue From Non-Sessile or Non-Benthic Human Food Chain Organisms (e.g., finfish, crabs) ^a	Hazardous substance concentrations must equal or exceed lowest human food chain benchmark concentrations (or indices for I or J must equal or exceed 1).
Level II	
Surface Water/Sediment	A hazardous substance with a BPFV of 500 or greater must meet criteria for an observed release.
Tissue From Essentially Sessile Benthic Human Food Chain Organisms (e.g., clams)	Hazardous substance concentrations less than lowest HFC benchmark concentrations (or indices for I and J are less than 1); must also meet criterial for an observed release
Tissue From Non-Sessile or Non-Benthic Human Food Chain Organisms (e.g., finfish, crabs)	Cannot be used to establish actual contamination and therefore cannot be used to establish Level II (i.e., Level II must already be established).

^a Concentrations of hazardous substances must be measured in a tissue sample from a non-sessile or non-benthic human food chain organism taken from within the boundary of actual food chain contamination and from a species that spends extended periods of time within this boundary. The specific hazardous substance which is compared to its benchmark must also be present in an aqueous, sediment or benthic sample that establishes actual food chain contamination for the fishery.

HIGHLIGHT 8-49 BENCHMARKS FOR THE HUMAN FOOD CHAIN THREAT

- FDAALs for fish or shellfish
- Screening concentration corresponding to oral RfD
- Screening concentrations corresponding to oral 1×10^6 cancer risk level.

(4) **Calculate the I and J indices based on all hazardous substances that meet the criteria for actual contamination.** Make two lists of hazardous substances that meet the criteria in Step (2) above: hazardous substances with screening concentrations for cancer risk; and hazardous substances with screening concentrations for noncancer effects. Each hazardous substance may be on one, neither, or both of the lists. If more than one tissue sample has been taken and these samples are comparable (e.g., taken in the same time frame, collected using the same field techniques, analyzed by the same methods), select the highest concentration for each hazardous substance to use in the calculations below.

- Calculate the I index for all hazardous substances in the tissue sample that meet the criteria in Step (2) above, and that have screening concentrations for cancer risk using the following equation:

$$I = \sum_{i=1}^n \frac{C_i}{SC_i}$$

where: C_i = concentration of substance j in tissue sample
 SC_i = screening concentration for cancer risk corresponding to 10^6 individual cancer risk for oral exposure for hazardous substance i ; and
 n = number of hazardous substances that meet the criteria in Step (2) above and have a SC available.

- Calculate the J index for all hazardous substances that meet criteria in Step (2) above and that have oral screening concentrations for noncancer effects using the following equation:

$$J = \sum_{j=1}^m \frac{C_j}{CR_j}$$

where: C_j = concentration of substance j in tissue sample
 CR_j = screening concentration for noncancer effects corresponding to the reference dose for oral exposure for hazardous substance j ; and
 m = number of hazardous substances in sample that meet the criteria in Step (2) above and for which a CR is available.

- If either the I or J index is greater than or equals 1, consider the sample location to be subject to Level I concentrations for the human food chain threat. If both the I and J indices are less than 1, consider the sample location to be subject to Level II.

SCORING SITES WITH ACTUAL CONTAMINATION

Establishing actual human food chain contamination can affect the scoring of three HRS factors: food chain individual, human food chain population, and hazardous waste quantity. **Highlight 8-50** summarizes the scoring for these three factor values in relation to various levels of contamination.

HIGHLIGHT 8-50
COMPARISON OF SCORING LEVEL I, LEVEL II, AND
POTENTIAL CONTAMINATION

Level of Contamination	Food Chain Individual Factor Value	Population Factor Value	Minimum Surface Water HWQ Factor Value ^a
Level I Concentrations	50	10 x Level I Human Food Chain Population Value	100
Level II Concentrations	45	1 x Level II Human Food Chain Population Value	100
Potential Food Chain Contamination	0 to 20 -- depends on dilution weight and whether there is an observed release	0.1 x Potential Human Food Chain Population Value x Dilution Weight	10

^a Only applies if Tier A is not adequately determined.

(1) Assign a Food Chain Individual Factor Value.

- If any fishery (or portion of a fishery) is subject to actual contamination, base the value on the highest level of contamination present. Assign a value of 50 if Level I concentrations are present, or a value of 45 if only Level II concentrations exist.
- If no fishery is subject to actual contamination, but there is an observed release of a hazardous substance having a BCFV of 500 or greater to the watershed, assign a value of 20.
- If there is no observed release of a hazardous substance having a BCFV of 500 or greater, assign a value by multiplying the highest applicable dilution weight by 20 and round to the nearest integer.

(2) Calculate Human Food Chain Population Factor Value (see Section 8.13). Calculate the human food chain population factor value for all fisheries (or portions of fisheries) being evaluated as follows:

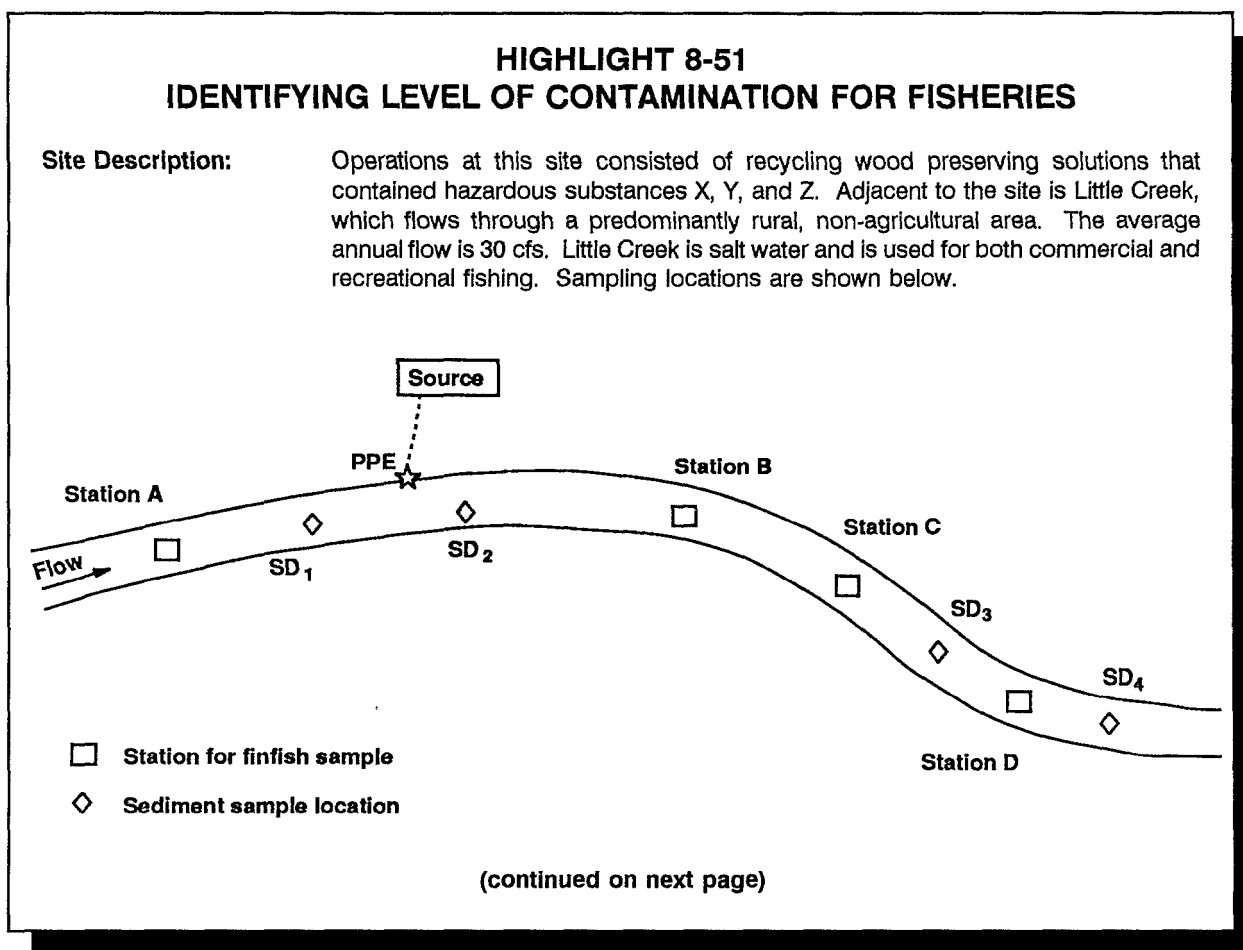
- For the Level I concentrations factor value, sum HRS-assigned human food chain population values (HRS Table 4-18) and multiply by 10. If the product is less than 1, do not round to nearest integer; if the product is greater than or equal to 1, round to the nearest integer.
- For the Level II concentrations factor value, sum the HRS-assigned human food chain population values (HRS Table 4-18) and multiply by 1. If the product is less than 1, do not round to nearest integer; if the product is greater than or equal to 1, round to the nearest integer.
- For the potential human food chain factor value, multiply the HRS-assigned human food chain population value (HRS Table 4-18) for each fishery by the surface water body dilution weight (HRS Table 4-13), sum the values, and multiply by 0.1. If the

product is less than 1, do not round to nearest integer; if the product is greater than or equal to 1, round to the nearest integer.

- Sum the values for the Level I concentrations, Level II concentrations, and potential human food chain factors. Do not round the sum to the nearest integer. Assign the sum as the population factor value for the watershed.

- (3) **Review the Hazardous Waste Quantity Factor Value.** If the hazardous waste quantity evaluation is not based on complete hazardous constituent quantity data (i.e., Tier A) and if Level I or Level II concentrations are demonstrated for any of the three surface water threats, the minimum factor value for hazardous waste quantity is 100 for all surface water threats.

Highlight 8-51 provides a site-specific example for determining whether a fishery (or portion of a fishery) is subject to Level I concentrations, Level II concentrations, or potential contamination.



HIGHLIGHT 8-51 (continued)
IDENTIFYING LEVEL OF CONTAMINATION FOR FISHERIES

Compound	Sediment Sampling Data by Location ^a (ppm)		Finfish Sampling Data by Location ^b (ppm)			Substance-Specific Screening Concentrations	
	SD ₂	SD ₃	Station B	Station C	Station D	RfD SC (ppm)	Cancer Risk SC
X	440	18	26	3	7	48	N/A
Y	25	<SQL	<SQL	<SQL	<SQL	6.5	N/A
Z	50	<SQL	2	1	<SQL	1.3	7.2x10 ⁻⁴

^aConcentrations of compounds X, Y, and Z were below SQLs at sample locations SD₁ and SD₄.

^bConcentrations of compounds X, Y, and Z were below SQLs in the finfish sample collected at Station A.

Area of

Contamination: Sample results indicate a zone of actual contamination between the PPE and SD₃. The SD₂ sample location establishes actual contamination based on levels of substances X, Y, and Z (all of which have BPFVs \$500) compared to levels in SD₁. The portion of the fishery between Samples SD₂ and SD₃ is also actually contaminated based on levels of X in SD₃. Station B and C sample results indicate the presence of X in finfish samples, but levels are below the benchmark, so results do not support Level I concentration.

Level of

Contamination: Because sediment samples cannot be used to establish concentrations in the human food chain threat, the finfish samples are the only possibility for establishing Level I.

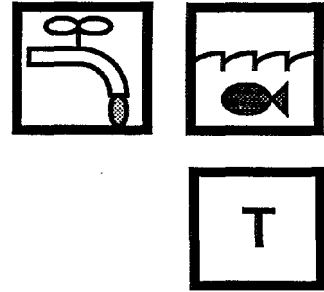
- Although the substance Z concentration detected at Station C is above the applicable benchmark, it cannot be used to establish Level I concentration because this finfish sampling location is beyond the boundary of actual contamination for substance Z (e.g., substance Z concentrations from finfish samples are not applicable beyond SD₂).
- Similarly, substance X detected in finfish at Station D cannot be used because the boundary for actual contamination based on substance X ends at SD₂.
- In this sample, Level I cannot be demonstrated by calculating I and J indices based on finfish sample results.

Conclusion: Therefore, the portion of the fishery between the PPE and SD₃ is evaluated based on Level II concentrations. The portion of the fishery between Sample SD₃ and the TDL is subject to potential human food chain contamination.

TIPS AND REMINDERS

- In general, hazardous substance concentrations from edible tissue samples (i.e., fillets for most finfish, soft tissue for mussels and oysters) are preferred for evaluating the level of actual contamination.
- When evaluating fisheries in brackish water, use the higher BPFV (i.e., salt water or fresh water value) when determining actual contamination.
- Use only BPFVs associated with those substances that establish an observed release to surface water to determine if actual human food chain contamination exists.
- If an observed release is based on chemical analysis, analytical results for comparing release to background must be from the same medium (e.g., sediment samples should be compared with sediment samples; aqueous samples should be compared with aqueous samples).
- An observed release is a necessary but not sufficient condition for establishing actual human food chain contamination.
- Not all aquatic human food chain species can be used to establish an observed release to surface water; however, all aquatic human food chain species can be used to establish Level I contamination if an observed release is already established (by use of other sample types).
- Finfish tissue samples (and samples from any non-sessile or non-benthic organisms) cannot establish an observed release or actual contamination by themselves.
- When documenting actual contamination of a closed fishery, a BCFV of 500 or greater is not required if the substance being used to establish the observed release (and actual contamination) is one for which the fishery was closed.
- Consider analytical results from tissue samples from non-benthic or non-sessile human food chain organisms only if they are collected in an area of actual contamination.
- Assign a minimum hazardous waste quantity factor value of 100 for the human food chain threat if a fishery is subject to actual contamination and Tier A is not adequately determined.
- Direct observation cannot be used to establish Level I concentrations.
- Because no aqueous or sediment benchmarks exist for evaluation of the food chain threat, surface water and sediment samples cannot be used to establish Level I concentrations.
- Tissue samples from non-sessile and non-benthic human food chain organisms can only be used to establish Level I concentrations in an area of actual human food chain contamination established by other samples.
- When using tissue sample results from essentially sessile benthic human food chain organisms to evaluate Level I or Level II concentrations, establish background levels using similar organisms of the same species.

SECTION 8.13 HUMAN FOOD CHAIN PRODUCTION



This section provides guidance on estimating human food chain production for fisheries within the surface water TDL. Human food chain production can be estimated based on production data or stocking rate data. In order to assign a human food chain population value from HRS Table 4-18, estimates must be expressed in pounds of edible species or organisms harvested annually from a portion of the fishery subject to a specific level of contamination – Level I concentrations, Level II concentrations, and potential human food chain contamination. Guidelines are provided to determine when it is necessary and efficient to score the human food chain population factor.

RELEVANT HRS SECTIONS	
Section 4.1.3.3	Human food chain threat - targets
Section 4.1.3.3.2	Population
Section 4.1.3.3.2.1	Level I concentrations
Section 4.1.3.3.2.2	Level II concentrations
Section 4.1.3.3.2.3	Potential human food chain contamination

DEFINITIONS

Actual Contamination for the Human Food Chain Threat: Any portion of a fishery is subject to actual contamination if a hazardous substance with a BPFV of 500 or greater meets the criteria for an observed release; a fishery is closed, and a hazardous substance for which the fishery was closed is documented in an observed release; or a hazardous substance is present in a tissue sample from an essentially sessile, benthic food chain organism at a level that meets the criteria for an observed release.

Actual Human Food Chain Organism: Aquatic species directly consumed by humans, including certain finfish, shellfish, crustaceans, amphibians, and amphibious reptiles.

Fishery: Any area of a surface water body from which human food chain organisms are taken or could be taken for human consumption on a commercial, recreational, or subsistence basis. Food chain organisms include fish, shellfish, crustaceans, amphibians, and amphibious reptiles. Fisheries are delineated by changes in dilution weights, level of contamination, or annual production. To establish a fishery, document that human food chain organisms are present and that people fish in the surface water body.

Production: Estimate of annual pounds of human food chain organisms harvested for human consumption through all activities, including commercial, recreational, and subsistence fishing. Often times, production can be determined from harvest, catch, or commercial landings data, if the reported data refer only to human food chain organisms.

Productivity: Common surrogate for yield data, often expressed as pounds of human food chain organisms present per acre per year. Productivity data are not equivalent to production estimates and generally are not used for HRS purposes.

Standing Crop: Biomass of all human food chain organisms in a given area of a surface water body at one time. Standing crop data are not equivalent to production estimates and generally are not used for HRS purposes.

Stocking Rate: Number of human food chain organisms (or pounds of human food chain organisms) per unit time introduced into a given surface water body by local, state, or Federal fishery agencies.

Yield: Maximum amount of human food chain organisms that could be caught by commercial, recreational, and subsistence fishermen from a given water body. Yield is expressed as weight of human food chain organisms present per unit area (or volume) per unit time. Yield data are not equivalent to production estimates and generally are not used for HRS purposes.

ESTIMATING THE HUMAN FOOD CHAIN POPULATION FACTOR

This section provides lookup tables to determine the annual production required to assign a certain number of target points to the human food chain population factor. If a preliminary estimate of the likely range of annual production (in pounds of human food chain organisms) can be made, these tables assist in determining the range of target points likely to be assigned after fully documenting a food chain production value.

- (1) **Evaluate actual contamination.** If there is actual contamination within a portion of the fishery, the human food chain individual will score significantly (i.e., at least 45 points). Therefore, pursue production data not readily available only when production is expected to be significant (e.g., greater than 1,000 pounds/year).
 - See **Highlight B-52** to determine the level of production that would be needed to assign the indicated number of points to the human food chain population factor under actual contamination. A higher score may result when more than one fishery or several levels of contamination are present within the TDL.
- (2) **Evaluate potential contamination.** Potential human food chain contamination only contributes significantly to the human food chain threat target score when:
 - High production in pounds per year is documented within the TDL; and
 - A water body with a large surface water dilution weight (e.g., minimal and small to moderate streams having average annual flows less than or equal to 100 cfs, closed lakes, or lakes with low flows entering or leaving) is being evaluated.

In many circumstances, only one of these conditions will be present. For example, oceans and Great Lakes generally have large production levels, but they also have relatively small dilution weights (e.g., 0.0001 or less), greatly reducing the target points. For a fishery with dilution weight of 0.0001 subject to potential contamination to receive more than 3 target points, annual production of more than 10^8 pounds would need to be documented.

- See **Highlight 8-53** to determine the level of production that would be needed to assign the indicated number of points to the human food chain population factor under potential contamination. The highlight focuses on a single fishery evaluated under potential contamination. A higher score may result when more than one fishery or several levels of contamination are present within the TDL. However, the score is

HIGHLIGHT 8-52
VALUES FOR HUMAN FOOD CHAIN POPULATION FACTOR
GIVEN ACTUAL CONTAMINATION IN A FISHERY

Factor Values for Human Food Chain Population ^a	Annual Production in Pounds Required - Level I	Annual Production in Pounds Required - Level II
0.03	Not Applicable	>0 to 10 ²
0.30	>0 to 10 ²	>10 ² to 10 ³
3.00	>10 ² to 10 ³	>10 ³ to 10 ⁴
30.00	>10 ³ to 10 ⁴	Not Applicable
31.00	Not Applicable	>10 ⁴ to 10 ⁵
310.00	>10 ⁴ to 10 ⁵	>10 ⁵ to 10 ⁶
3,100.00	>10 ⁵ to 10 ⁶	>10 ⁶ to 10 ⁷
31,000.00	>10 ⁶ to 10 ⁷	>10 ⁷ to 10 ⁸
310,000.00	>10 ⁷ to 10 ⁸	>10 ⁸ to 10 ⁹
3,100,000.00	>10 ⁸ to 10 ⁹	>10 ⁹
31,000,000.00	>10 ⁹	Not Applicable

^aAssumes a single fishery and a single level of actual contamination. Note that these values do not represent assigned values from Table 4-18; they represent the factor value for Level I or Level II which is the assigned value multiplied by 10 for Level I, or the assigned value multiplied by 1 for Level II.

not likely to be significantly higher if all fisheries are evaluated based on potential contamination.

For many sites, expending extensive effort to evaluate fisheries subject to potential contamination when productivity data are not readily available may not be the most efficient use of resources.

(3) **Use the guidance below to document production.** If the above assessment indicates that it is efficient to document human food chain production, the subsections below present the generally preferred type of documentation first, followed by alternative approaches.

- Document production using site-specific data. Apportion that data to include only surface water bodies within the fishery being evaluated, if necessary.
- Estimate production using surrogate data (e.g., estimates of production from nearby fisheries with similar characteristics).
- If specific production data are not available and a reasonable estimate of production cannot be made, use a production estimate of greater than 0 pounds per year to evaluate the human food chain population factor.

HIGHLIGHT 8-53
VALUES FOR HUMAN FOOD CHAIN POPULATION FACTOR GIVEN
POTENTIAL CONTAMINATION IN A FISHERY

Factor Values for Human Food Chain Population ^a	Dilution Weights	Annual Production in Pounds Required
0.02	0.000005	$>10^7 - 10^8$
0.03	1 0.1 0.01 0.001 0.0001 0.00001	$>10^2 - 10^3$ $>10^3 - 10^4$ $>10^4 - 10^5$ $>10^5 - 10^6$ $>10^6 - 10^7$ $>10^7 - 10^8$
0.16	0.000005	$>10^8 - 10^9$
0.31	1 0.1 0.01 0.001 0.0001 0.00001	$>10^3 - 10^4$ $>10^4 - 10^5$ $>10^5 - 10^6$ $>10^6 - 10^7$ $>10^7 - 10^8$ $>10^8 - 10^9$
1.6	0.000005	$>10^9$
3.1	1 0.1 0.01 0.001 0.0001 0.00001	$>10^4 - 10^5$ $>10^5 - 10^6$ $>10^6 - 10^7$ $>10^7 - 10^8$ $>10^8 - 10^9$ $>10^9$
31	1 0.1 0.01 0.001 0.0001	$>10^5 - 10^6$ $>10^6 - 10^7$ $>10^7 - 10^8$ $>10^8 - 10^9$ $>10^9$
310	1 0.1 0.01 0.001	$>10^6 - 10^7$ $>10^7 - 10^8$ $>10^8 - 10^9$ $>10^9$
3,100	1 0.1 0.01	$>10^7 - 10^8$ $>10^8 - 10^9$ $>10^9$
31,000	1 0.1	$>10^8 - 10^9$ $>10^9$
310,000	1	$>10^9$

^aAssumes a single fishery and a single level of potential contamination. Note that the dilution weight of 0.5 is not used for the population factor. Note that these values do not represent assigned values from Table 4-18; they represent the factor value for potential contamination which is the assigned value multiplied by the applicable surface water body dilution weight multiplied by 0.1.

DETERMINING PRODUCTION USING SITE-SPECIFIC DATA

- (1) **Collect available data.** Collect data on fishery production within the TDL. General data sources are listed in **Highlight 8-54**. Additional information on the types of data typically available from NMFS is detailed in **Highlight 8-55**.
- Confirm that the data collected represents the fish biomass removed from the water body that is used for human consumption. In heavily fished areas, production data (commercial, recreational, and/or subsistence) needed for evaluating population often will be available.
 - Review units associated with production data. If available production data are reported in numbers or pounds harvested per hour, attempt to convert these into pounds harvested per year by using estimates of average weight per organism and/or total number of hours the water body is fished per year.
 - Select data from an appropriate time frame. Depending on the records available, annual production may be best represented by an average of data from several years. However, if data are available for only a few non-consecutive years, (e.g., 1967 and 1985), it may be appropriate to use only the more recent production.
 - Avoid relying on data sources that do not represent a reasonable estimate of annual production from a specific surface water body.
 - Creel surveys of recreational and subsistence fishing may be available where fishing is substantial and, therefore, likely to be studied by state agencies involved in managing fishery resources. The creel survey is aimed at obtaining broad information on fishing trends such as kinds of fishing, amount of time spent fishing, species and size of fish caught. Because creel surveys are not performed routinely, they are frequently outdated.
 - Local fish consumption rates are generally not relevant because it is the amount of fish consumed from a specific water body that is of interest, not the total amount of fish consumed by individuals in the vicinity of the site.
 - If the fishery management technique has changed (e.g., a stream is no longer stocked by the state), production data from earlier time periods may not be representative.
 - If conflicting production estimates are generated from different sources, select the most defensible production data.
- (2) **Apportion production data.** If actual annual production data are available for the TDL, but include production for a portion of the surface water body not within the fishery being evaluated, apportion data to determine production within the TDL. Multiply the total production for the fishery by the ratio of the area of fishery being evaluated (or the length of coastline) to the total area of the fishery (or length of coastline) for which production data were obtained. There are several circumstances where apportioning may be necessary:
- Production data are given for a stretch of river, only a portion of which is within the TDL. See **Highlight 8-56**.
 - Production data are available for a NMFS distance category (e.g., 3 to 12 miles offshore), and the fishery being evaluated does not extend the whole distance category (e.g., extends to 7 miles offshore). See **Highlight 8-57**.

HIGHLIGHT 8-54

SOURCES OF FISHERY PRODUCTION DATA

Sources of information for production data for fresh water and marine habitats include:

- Literature searches (e.g., published reports) from FWRS. The FWRS receives materials regarding fresh water habitats from Federal, state, and private sources, including: Federal Aid in Fish and Wildlife Restoration Program; Anadromous Sport Fish Conservation Program; Cooperative Fish and Wildlife Units; State Game and Fish Agencies; and Endangered Species Grants Program;
- NMFS, NOAA, U.S. Department of Commerce;
- Dingell-Johnson State Fish Chiefs and their staffs—these personnel coordinate and conduct fishery surveys with funding established under the Federal Aid In Fish and Wildlife Restoration Program;
- State Game and Fish Departments, and Parks and Recreation Departments;
- Local fishery laboratories;
- USFWS; and
- University biology departments which may have field research labs, and may also have specialists in ichthyology or fish management.

Additional sources of Information for production data for fresh water habitats Include:

- Local Office of Bass Unlimited, Trout Unlimited, and other associations;
- SCS (stocks and maintains small impoundments);
- Associations and Commissions (e.g., Sport Fishing Institute);
- River Basin Commissions; and
- National Sport Fishing Federation (NSFF).

Additional sources of Information for production data for marine habitats Include:

- Sea Grant Advisory Service, NOAA; and
- Great Lakes Fish Commission.

HIGHLIGHT 8-55

PRODUCTION DATA TYPICALLY AVAILABLE FROM NMFS

Salt Water Fishery Production - Commercial Fisheries

NMFS maintains and updates annually extensive data bases on commercial and recreational marine production. Commercial data are kept for inland marine areas such as estuaries and bays, as well as for offshore areas. For most coastal states, these data are provided for three distance categories, and as state and country landings. The distance categories are:

- 0 to 3 miles offshore
- 3 to 12 miles offshore
- 12 to 200 miles offshore

Because commercial marine data are often reported as landings (i.e., the numbers or pounds of human food chain organisms brought to a port), data on commercial landings by state and by county do not indicate where the human food chain organisms were actually caught. For example, human food chain organisms caught off the Texas coast might be landed in Louisiana and reported as Louisiana landings. As a result, the geographic location associated with commercial catch data may bear only a tenuous relationship to the locations where the human food chain organisms were harvested or caught. However, commercial landings data for the county (or counties) that a fishery is located adjacent to or contiguous with can generally be used for up to 12 miles offshore. Human food chain organisms landed but not caught in the county are assumed to be offset by human food chain organisms caught in the county but landed elsewhere. Production data for 0 to 3 miles and 3 to 12 miles, therefore, are often representative for a particular area of interest.

Commercial data from NMFS are available for finfish and shellfish. For shellfish, data are available on live weight (i.e., weight with the shell) and on meat weight (i.e., weight without the shell). For commercial shellfish harvest data, use the meat weight and only the proportion of the county commercial production that is used for human consumption to estimate human food chain production. If only the live weight is available, use this data as a reasonable production estimate. NMFS data are sometimes broken down by end-use disposition, for example, human consumption, bait, animal food, and reduction to meal and oils. When possible, determine the proportion of the commercial harvest that is for human consumption.

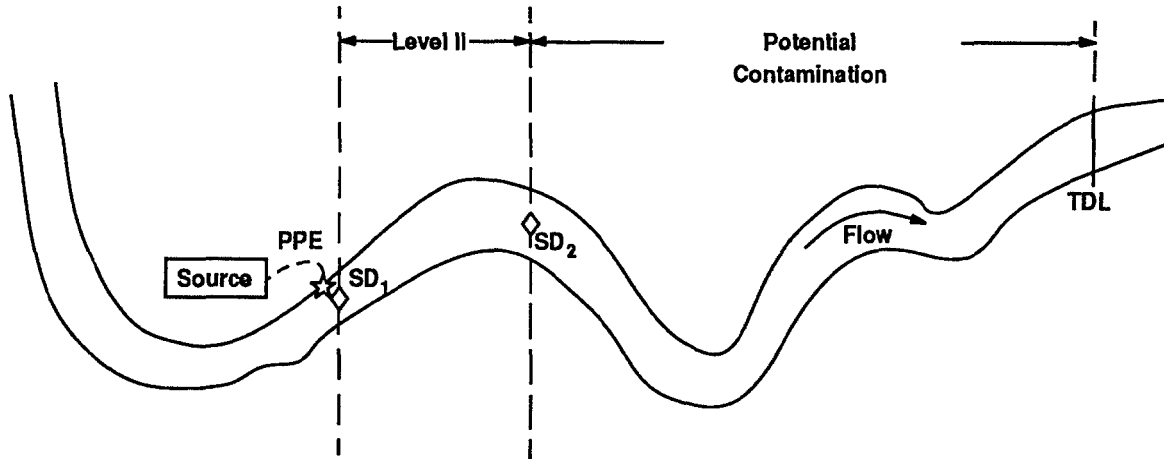
Salt Water Fishery Production - Recreational Fisheries

Data on recreational production are available from NMFS for finfish from 0 to 3 miles offshore. However, these data generally are reported as state or county totals and cannot be broken down by a specific water body (e.g., by a bay or estuary) within the state or within a particular county. Because NMFS does not maintain recreational marine shellfish production data, recreational production data for shellfish are generally not available even though this production can be significant and can equal or exceed the commercial production. Alternate sources for recreational shellfish production are appropriate fish management officials.

Fresh Water Fishery Production - Recreational Fisheries

Data on recreational production are available from NMFS for finfish from fresh waters. These data are reported by state, and generally are not broken down by a specific water body within the state or within a particular county.

HIGHLIGHT 8-56 APPORTIONMENT OF PRODUCTION DATA IN A RIVER



Site Setting: Spearfish Creek is a cold water fishery for both brown and brook trout. The average annual recreational production for the entire length (approximately 35 miles) of Spearfish Creek is 250 pounds based on information provided by the State Department of Game, Fish, and Parks.

Level II Contamination: The fishery in approximately 2 additional miles of Spearfish Creek is subject to Level II concentrations from the site based on Samples SED-01 and SED-02.

$$\frac{2 \text{ miles}}{35 \text{ miles}} = 0.0571 \quad 0.0571 \times 250 \text{ lbs/yr} = 14 \text{ lbs/yr}$$

Assigned human food chain population value = 0.03 (from HRS Table 4-18)

Potential Production: Approximately 13 miles of Spearfish Creek is within the surface water TDL and subject to potential contamination.

$$\frac{13 \text{ miles}}{35 \text{ miles}} = 0.3714 \quad 0.3714 \times 250 \text{ lbs/yr} = 93 \text{ lbs/yr}$$

Assigned human food chain population value = 0.03 (from HRS Table 4-18)

HIGHLIGHT 8-57

APPORTIONMENT OF PRODUCTION DATA ALONG A COASTLINE

NMFS collects data on the total annual catch in pounds from the nearshore zone (i.e., 0 to 3 miles from shore). To apportion this data when the TDL includes waters in the nearshore area, determine the total acreage within that area for a state and divide the total annual catch for that state to derive production in pounds per acre. Multiply the acreage within the TIDL by this production figure and use the result as a production estimate.

For example, New Hampshire has 13 miles of coastline. The nearshore zone, therefore, has 39 square miles (i.e., 13 miles x 3 miles) and 24,960 acres (i.e., 39 square miles x 640 acres/square mile). NMFS determined that 689,000 pounds of shellfish and fish were commercially captured in the 0- to 3-mile region in a recent year. Based on this data, the annual catch is approximately 28 pounds per acre. Assuming that the PPE is along a portion of the shoreline that is straight (i.e., an arc with a 3-mile radius encompasses a semi-circle), approximately 9,000 acres are within the TDL, corresponding to a production of about 250,000 pounds per year. Additional production could be determined using NMFS data in the 3- to 12-mile region to estimate commercial landings and by documenting recreational production.

- State recreational marine production data are available for the whole state, and the production can be apportioned based on the length of coastline within the TDL.

It may also be necessary to apportion production so that a production value can be associated with each surface water body type and dilution weight (e.g., to account for changes in flow rate or depth when evaluating potential contamination), and portions of fisheries subject to potential, Level II or Level I concentrations.

(3) **Apply stocking rates.** If annual production data are not available, a stocking rate for the fishery may be used. Stocking data can provide an indication of food chain production when:

- The stocking is a put-and-take operation;
- The stocked fish population will be caught for human consumption; and
- The stocked fish population will be caught within the TIDL or within the boundaries of the fishery being evaluated.

Appropriate stocking data have been used for places like Colorado and West Virginia where trout are released for the spring fishing season and are usually all caught by early summer. Stocking data are usually not appropriate when yearlings or juveniles are released to maintain natural species balance or to build up populations after a decline.

(4) **Evaluate closed fisheries.** For a closed fishery subject to actual human food chain contamination (i.e., when a hazardous substance for which the fishery or a portion of the fishery was closed is documented in an observed release to the fishery from the site), estimate fishery production based on data collected before the fishery was closed.

(5) **Sum all data.** If data represent different types of fisheries (i.e., subsistence, commercial, or recreational) or different species (e.g., finfish and shellfish), the production for each type of fishery and species can be summed to determine the total production for the fishery being evaluated. For an example, see **Highlight 8-58**.

(6) **Evaluate fisheries with no production data.** If neither annual production data nor stocking rates are available, continue with the guidance in the next subsection.

(7) **Calculate the human food chain production factor.** See Section 8.12.

HIGHLIGHT 8-58 SCORING EXAMPLE FOR POTENTIAL CONTAMINATION

- Big River is a fishery for four salmon species (chinook, chum, coho, and pink). The river is about 90 miles long when measured from its headwaters to coastal tidal waters (i.e., Deep Sound), and its average width is 200 yards. Thus, the entire river covers an area of approximately 6550 acres. The TDL includes 12 miles of Big River and 3 miles of Deep Sound. Each fishery is subject only to potential contamination and each is associated with a different flow rate (i.e., Big River ranges from 9,600-9,900 cfs/year; Deep Sound is characteristic of coastal tidal waters).
- The state maintains production data for several stations along the Big River and one station falls within the TDL. The state fishery management official commented that the production for this station was not representative of the actual production within this portion of the salmon fishery. Thus, the scorer apportioned annual production associated with the entire river to the portion of the fishery within the TDL.
- The 10-year average total production for pink salmon is about 200,000 fish/year, and all of these fish pass through in-water segment and spend an extended period of time within Big River. The average weight usable for human consumption of each adult pink salmon is about 5.0 pounds. Thus, the annual production for pink salmon within the entire length of the Big River is approximately 1,000,000 pounds/year or roughly 150 pounds/acre-year.
- Since the 12 miles of Big River within the TDL covers about 870 acres.
- $870 \text{ acres} \times 150 \text{ pounds/year-acre} = 130,500 \text{ pounds/year}$
- This value equals the annual production for pink salmon within the TDL. Based on similar estimations for the other salmon species, the total annual production for the portion of the Big River within the TDL for all four salmon species is 640,000 pounds. A human food chain population value of 310 is assigned from HRS Table 4-18.
- Annual production for the Deep Sound fishery was based on 5 years of commercial harvest data, and 3 years of recreational harvest data. Production estimates based on State Department of Fisheries recreational salmon management and catch reporting data were added to production from commercial harvest records provided by NMFS. The total annual production for Deep Sound is 2,300,000 pounds. A human food chain population value of 3,100 is assigned from HRS Table 4-18.
- Calculate annual production for each fishery separately, multiply by the appropriate dilution weight, sum, and multiply by 0.1 for potential human food chain contamination.

Big River $310 \times 0.001 = 0.31$

Deep Sound $3,100 \times 0.0001 = 0.31$

Potential Human Food Chain Contamination Factor Value for the Watershed = $0.62 \times 0.1 = 0.06$

This value of 0.06 represents the population factor value for the watershed since no fisheries were subject to actual contamination.

ESTIMATING PRODUCTION USING SURROGATE DATA

If estimates of annual production data specific to the fishery are not available, estimate production by collecting information for similar surface water bodies containing comparable fisheries. Determine if the surrogate fishery (and the water body itself is similar to the fishery being evaluated in terms of:

- Fish species or other human food chain organisms present (e.g., production data for a fishery consisting primarily of pike should not be used when evaluating a fishery consisting primarily of smallmouth bass);
- Flow rate (or depth for oceans);
- Characteristics (e.g., salinity, flow, depth, subsurface bottom, state classification, overall water quality);
- Distance from each water body to possible surrogate water body; and
- Fishing activities.

Consider these criteria before assuming that production data from a similar water body can be used for estimating production for the fishery (or portions of the fishery) within the TDL. State fish and game officials are a likely source for such information. Document the rationale for using surrogate data from another fishery for the fishery being evaluated.

For example, production data for a fishery consisting primarily of trout could be used for a fishery consisting of trout that is 30 miles away. The average annual flows of both water bodies should be similar even though the surface water dilution weight assigned to each water body may be different (e.g., a small to moderate stream may have a flow of 90 cfs (an assigned dilution weight of 0.1) while an acceptable surrogate fishery may be a moderate to large stream having a flow of 140 cfs (an assigned dilution weight of 0.01)). In addition, the characteristics of both the surrogate water body and the water body within the TDL should share similar attributes. Both should be either managed as a high quality cold-water fishery or be managed as a limited warm-water fishery. Likewise, both should be either annually stocked and aggressively managed for sport fishing or not stocked.

ESTIMATING PRODUCTION WITHOUT ACTUAL OR SURROGATE DATA

If surface water is documented to be a fishery and production data (actual and surrogate) are not available, assign the fishery a minimum human food chain production of greater than 0 pounds per year. Then, assign the fishery a human food chain population value of 0.03 based on HRS Table 4-18. Use this human food chain population value to assign factor values for Level I concentrations, Level II concentrations, and potential human food chain contamination. Show that the fishery supports human food chain organisms by documenting that at least one human food chain organism lives within fishery boundaries and that fishing occurs in the surface water body.

TIPS AND REMINDERS

- To evaluate human food chain production:
 - Determine the population factor value needed to significantly affect the site score.
 - Review **Highlights 8-52** and **8-53** to determine the annual production that would be required to achieve this population factor value.
 - Determine if such production is likely. If so, try to obtain production data from local officials. If unsure about the amount of annual production for a fishery, or about using a particular production surrogate value, ask the officials if such production is likely.
 - If such production is unlikely, or if production data are not readily available, either assign a value based on the level of contamination present using a production value of greater than 0 pounds per year or see below. For all fisheries scored using a production value greater than 0, assign a value of 0.03 for human food chain population for that fishery.
 - In many cases, evaluating production for those fisheries subject to potential contamination will not significantly affect the human food chain threat targets score; therefore, the minimum assigned value of 0.03 for the human food chain population factor does not have to be used for evaluating a fishery subject to potential contamination. Instead, reference the absence of this information and indicate in the HRS documentation record that no reasonable production estimate can be made at the time of scoring.
- For potential contamination, do not use that the dilution weight for the 3-mile mixing zone in quiet flowing rivers; rather, assign the dilution weight based on average annual flow.
- In the absence of actual contamination, large productions are generally necessary to significantly affect the human food chain threat targets score. Therefore, pursue production data for potential contamination only if production for a particular water body is expected to be significant.
- For HRS purposes, standing crop measures or other productivity estimates are not used for estimating food chain production. These estimates do not correlate well with production for various water body types, and are more reflective of biomass (weight of all living organisms in the water body), than of productivity. However, standing crop estimates may help check the validity and adequacy of actual production data, particularly when there are large differences between standing crop and production data, or between several estimates of actual production data. Production data should always be smaller than standing crop.

SECTION 8.14

SENSITIVE ENVIRONMENTS



This section provides general guidance for evaluating sensitive environments in the surface water pathway as well as specific guidance and examples for evaluating more complex situations in which multiple sensitive environments overlap. Sensitive environments include those environments described in HRS Table 4-23 – hereafter referred to as listed sensitive environments – and wetlands as defined in 40 CFR 230.3. Assigning point values to sensitive environments is straightforward in most cases. In other cases (e.g., when the boundaries of several sensitive environments overlap, or if more than one designation may apply to a single environment), this determination may be less obvious; however, most scoring difficulties can be eliminated by treating each sensitive environment as a separate, independent target. This section addresses only the pathway-specific information necessary to evaluate sensitive environments in the surface water pathway. Specific definitions of sensitive environments, sources of information, and steps for identifying sensitive environments are provided in Appendix A. Guidance for determining level of actual contamination is presented in Section 8.15. Wetlands are discussed in more detail in Section 8.16.

RELEVANT HRS SECTIONS

Section 2.5	Targets
Section 2.5.1	Determination of level of actual contamination at a sampling location
Section 2.5.2	Comparison to benchmarks
Section 4.1.4.3	Environmental threat - targets
Section 4.1.4.3.1	Sensitive environments
Section 4.1.4.3.1.1	Level I concentrations
Section 4.1.4.3.1.2	Level II concentrations
Section 4.1.4.3.1.3	Potential contamination
Section 4.1.4.3.1.4	Calculation of environmental threat - targets factor category value

DEFINITIONS

Actual Contamination for Listed Sensitive Environments: Any portion of a listed sensitive environment is subject to actual contamination if it falls within an area that meets the criteria for an observed release. Direct observation and/or analytical data from aqueous, sediment samples, or essentially sessile benthic organism may be used to establish actual contamination. However, only surface water samples may be used to establish Level I concentrations.

Listed Sensitive Environment: Areas that are evaluated as one or more of the sensitive environments listed in HRS Table 4-23, even if these areas (or portions of these areas) also are being evaluated as a wetland. The distinction is necessary because a wetland that is also a listed sensitive environment (e.g., a wetland area that also is habitat known to be used by an endangered species) would be evaluated as two separate sensitive environments. Point values are assigned differently for wetlands than for the other types of sensitive environments.

Sensitive Environment In the Surface Water Pathway. A sensitive environment is defined as a wetland (as defined in 40 CFR 230.3) or any area that meets the criteria listed in HRS Table 4-23. No other areas are considered sensitive environments for the surface water pathway.

SENSITIVE ENVIRONMENTS ELIGIBLE TO BE EVALUATED IN THE SURFACE WATER PATHWAY

All areas that are located along the hazardous substance migration path for a watershed and that meet the definition for a wetland and/or at least one category listed in HRS Table 4-23 are eligible to be evaluated in the surface water pathway for that watershed. In all cases, surface water sensitive environments (including wetlands) along or contiguous to the hazardous substance migration path are eligible. In some cases, terrestrial sensitive environments (as defined in HRS Table 5-5), or the terrestrial portions of sensitive environments, also are eligible to be evaluated in the surface water pathway.

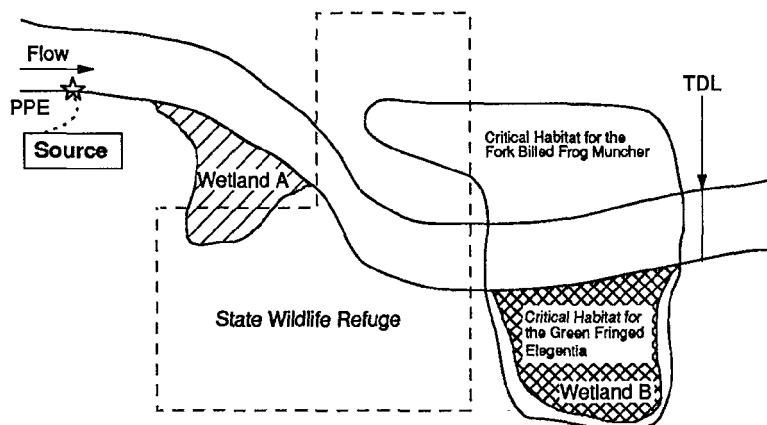
- Terrestrial sensitive environments not defined by the presence of one or more particular species (e.g., wildlife refuges) and whose boundaries cross or border a surface water body within the TDL are always eligible to be evaluated in the surface water pathway.
- Terrestrial sensitive environments defined by the presence of one or more particular species (e.g., habitat known to be used by an endangered or threatened species, terrestrial areas used for breeding by large or dense aggregations of animals) and whose boundaries cross or border a surface water body within the TDL are eligible to be evaluated in the surface water pathway unless there is clear information that the particular species of concern is unlikely to come into contact with surface water bodies within the TDL.
- Terrestrial sensitive environments defined by the presence of one or more particular species and whose boundaries do not cross or border a surface water body within the TDL are eligible to be evaluated in the surface water pathway only if there is clear information that the particular species of concern is likely to come into contact with surface water bodies within the TDL.

Additional guidance for determining if terrestrial sensitive environments are eligible to be evaluated in the surface water pathway is provided in Appendix A.

CALCULATING THE SENSITIVE ENVIRONMENTS FACTOR VALUE

- (1) **Identify all listed sensitive environments within the TDL.** For each sensitive environment, assign the appropriate point value from HFIS Table 4-23. See Appendix A for guidance in identifying sensitive environments. Use the following guidelines in identifying and assigning point values to each sensitive environment:
 - Evaluate each discrete sensitive environment as a separate target, regardless of the degree to which it overlaps with other sensitive environments. For example, a critical habitat for an endangered species has the same point value whether located in a state wildlife refuge or not; the wildlife refuge is evaluated as a separate sensitive environment in either case (see **Highlight 8-59**).

HIGHLIGHT 8-59 SCORING EXAMPLE FOR SENSITIVE ENVIRONMENTS



The above figure is a schematic map (not to scale) of the 15-mile TDL associated with a hypothetical site. From background documents and discussions with appropriate Federal and state agencies, the following information is available:

The entire length of the river between the PPE and the TDL is a Federal designated Scenic River and is a state designated area for the protection of aquatic life. The areas identified as Wetland A and B are wetlands. Wetland B is also designated as Critical Habitat for the Green Fringed Elegentia, a hypothetical Federal designated plant species. The labelled area delineated by large dashed lines is a designated State Wildlife Refuge. The labelled area delineated by a continuous line is designated as Critical Habitat for the Fork Billed Frog Muncher, a hypothetical Federal designated endangered bird species whose diet consists entirely of frogs.

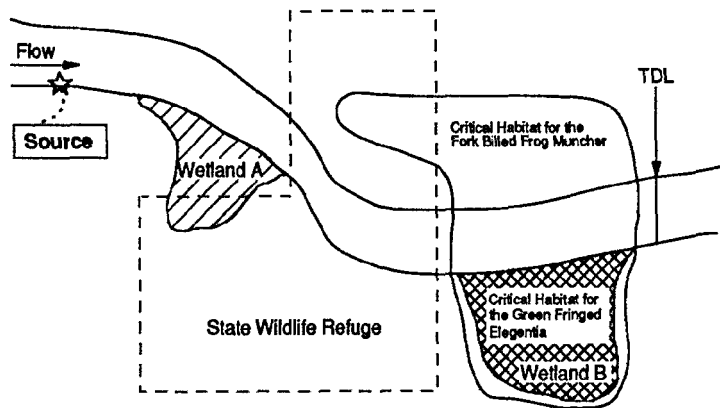
Based on this information, and by referring to HRS Tables 4-23 and 4-24, seven separate sensitive environments are identified:

- The entire length of the river between the PPE and the TDL is identified as a Federal designated Scenic River and assigned a value of 50 points;
- The entire length of the river between the PPE and the TDL is also identified as a state designated area for the protection of aquatic life and assigned a value of 5 points;
- Wetland A is identified as a wetland and will be assigned a point value based on its total linear frontage with the river and the levels of contamination under which it is evaluated (see Section 8.16);
- The area delineated by dashed lines is identified as a designated State Wildlife Refuge and assigned a value of 75 points;
- The area delineated by a continuous line is identified as Critical Habitat for a Federal designated endangered species and assigned a value of 100 points;
- Wetland B is identified as a wetland and will be assigned a point value based on its total linear frontage with the river and the level(s) of contamination under which it is evaluated (see Section 8.16);
- Wetland B is also identified as Critical Habitat for a Federal designated threatened species and assigned a value of 100 points.

These seven sensitive environments are illustrated further on the following page.

(continued on next page)

**HIGHLIGHT 8-59 (continued)
SCORING EXAMPLE FOR SENSITIVE ENVIRONMENTS**



<u>Sensitive Environment</u>	<u>Designation</u>	<u>Assigned Value</u>
	1) Federal designated Scenic River	50
	2) Designated area for the maintenance of aquatic life	5
	3) Wetland	Dependent on linear frontage
	4) State Wildlife Refuge	75
	5) Critical Habitat for the Fork Billed Frog Muncher	100
	6) Wetland	Dependent on linear frontage
	7) Wetland as Critical Habitat for the Green Fringed Elegendia	100

- Evaluate "critical habitat for" or "habitat known to be used by" endangered or threatened species as follows:
 - Identify at least one distinct habitat for each individual species (e.g., if there are three different species, identify three or more habitats, even if they partially or completely overlap (see **Highlight 8-59**)).
 - For each individual species, assign only the endangered or threatened category that results in the highest point value. For example, if the same species is both a Federal proposed threatened species (75 points), and a state designated endangered species (50 points), evaluate the species as a Federal proposed threatened species for HRS scoring purposes.
 - If both "critical habitat for" and "habitat known to be used by" the same species occur within the TDL, consider each a separate sensitive environment for HRS scoring purposes. However, if these areas overlap within the TDL, evaluate the overlapping area only as "critical habitat for" the species (i.e., do not consider the zone of overlap as both "critical habitat for" and "habitat known to be used by" the species). In other words, overlapping areas designated as "critical habitat for" an endangered or threatened species cannot also be evaluated as "habitat known to be used by" the same species.

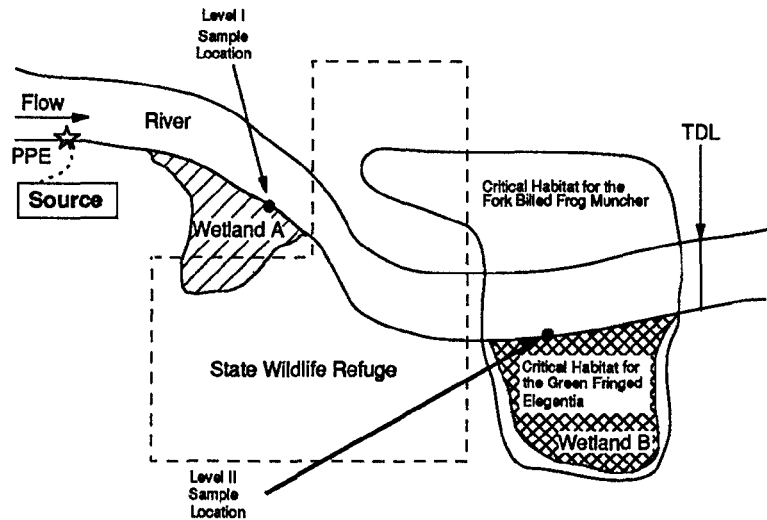
(2) **Evaluate level of contamination for each listed sensitive environment.** See Section 8.15 for guidance on determining level of actual contamination (see **Highlight 8-60**).

- Level I: Identify each listed sensitive environment subject to Level I concentrations and sum their assigned point values (from HRS Table 4-23) to obtain the Level I value for listed sensitive environments.
- Level II: Identify each listed sensitive environment subject to Level II concentrations and sum their assigned point values (from HRS Table 4-23) to obtain the Level II value for listed sensitive environments.
- Potential contamination:
 - Identify each listed sensitive environment subject to potential contamination.
 - Multiply its assigned point value (from HRS Table 4-23) by the appropriate dilution weight (from HRS Table 4-13) for the surface water body within which the sensitive environment is located.
 - Sum these products to obtain the potential contamination value for listed sensitive environments.

(3) **If wetlands are present, determine whether each discrete wetland should be evaluated under Level I concentrations, Level II concentrations, potential contamination, or a combination of these.** See Section 8.15 for guidance on determining level of contamination for wetlands. (Also see **Highlight 8-60**).

(4) **Determine the length of each discrete wetland evaluated under each level of contamination and assign the appropriate wetland rating value.** Wetland scoring depends on size (i.e., linear frontage or perimeter) while all other sensitive environments are scored independently of their size. Guidance on determining wetland length under Level I concentrations, Level II concentrations, and potential contamination is provided in Section 8.16.

HIGHLIGHT 8-60 SCORING EXAMPLE FOR LEVEL I AND LEVEL II CONTAMINATION



The above figure is a schematic map (not to scale) of the 15-mile TDL associated with the same hypothetical site as illustrated in *Highlight 8-59*. In this example, however, analytic sampling results indicate that Level I concentrations are present from the PPE to Point 1 (i.e., the Level I Sample Location), and Level II concentrations are present from Point 1 to Point 2 (i.e., the Level II Sample Location).

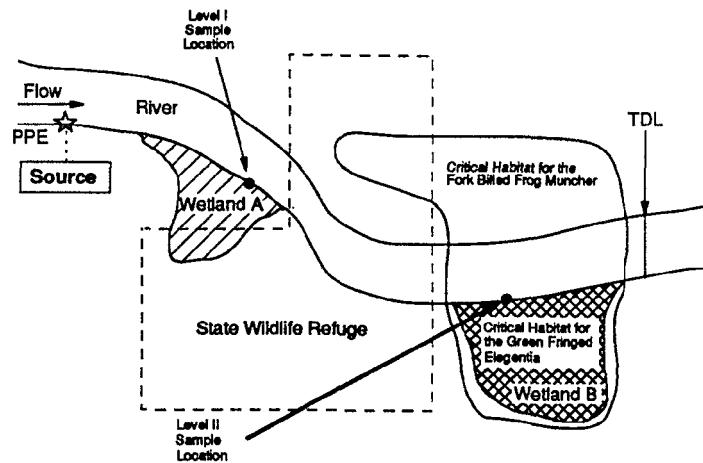
Based on the location of the sensitive environments within the TDL relative to the sampling points, they are scored under the following contamination levels:

- The length of the river between the PPE and TDL identified as a Federal designated Scenic River is scored under Level I concentrations (both Level I and Level II concentrations are present within this sensitive environment).
- The length of the river between the PPE and TDL identified as a state designated area for the protection of aquatic life is scored under Level I concentrations (see above).
- Wetland A is scored under both Level I and Level II concentrations as a result of its location relative to Point 1. The length of Wetland A adjacent to the river upstream of Point 1 is scored under Level I concentrations; the length of Wetland A adjacent to the river downstream of Point 1 is scored under Level II concentrations.
- The entire area identified as a State Wildlife Refuge is scored under Level II concentrations.
- The entire area identified as Critical Habitat for the Fork Billed Frog Muncher is scored under Level II concentrations.
- Wetland B, when being evaluated as a wetland, is scored under both Level II concentrations and potential contamination as a result of its location relative to Point 2. The length of Wetland B adjacent to the river upstream of Point 2 is scored under Level II concentrations; the length of Wetland B adjacent to the river downstream of Point 2 is scored under potential contamination.
- Wetland B, when being scored as critical habitat, is scored under Level II concentrations.

These seven sensitive environments are illustrated further on the following page.

(continued on next page)

HIGHLIGHT 8-60 (continued)
SCORING EXAMPLE FOR LEVEL I AND LEVEL II CONTAMINATION



<u>Sensitive Environment</u>	<u>Designation</u>	<u>Contamination Level</u>
	1) Federal designated Scenic River	Level I
	2) Area for the maintenance of aquatic life	Level I
	3) Wetland	Level I upstream of Point 1, Level II downstream of Point 1
	4) State Wildlife Refuge	Level II
	5) Critical Habitat for the Fork Billed Frog Muncher	Level II
	6) Wetland	Level II upstream of Point 2, potential downstream of Point 2
	7) Wetland as Critical Habitat for the Green Fringed ELEGENTIA	Level II

- Level I: Determine the total length of the wetlands subject to Level I concentrations, and assign the appropriate wetland rating value using HRS Table 4-24. Assign this value as the Level I value for wetlands.
- Level II: Determine the total length of the wetlands subject to Level II concentrations, and assign the appropriate wetland rating value using HRS Table 4-24. Assign this value as the Level II value for wetlands.
- Potential contamination:
 - Determine the total length of wetlands subject to potential contamination for each type of surface water body (as defined in HRS Table 4-13).
 - Based on this total length for each type of surface water body, obtain the appropriate wetlands rating value using HRS Table 4-24.
 - Multiply the wetlands rating value for each surface water body by the appropriate dilution weight for the surface water body as defined in HRS Table 4-13.
 - Sum these products and assign this value as the potential contamination value for wetlands.

(5) **Calculate the Level I concentrations factor value, the Level II concentrations factor value, and the potential contamination factor value.**

- Level I: Sum the assigned Level I values for wetlands and listed sensitive environments and multiply that value by 10. Assign this value as the Level I concentrations factor value.
- Level II: Sum the assigned Level II values for wetlands and listed sensitive environments and assign this value as the Level II concentrations factor value.
- Potential contamination: Sum the assigned potential contamination values for wetlands and listed sensitive environments and divide that value by 10. If the result is one or greater, round to the nearest integer. If the result is less than one, do not round. Assign this value as the potential contamination factor value.

(6) **Calculate the environmental threat-targets factor category value.** Sum the factor values for Level I concentrations, Level II concentrations, and potential contamination. Assign this value as the environmental threat-targets factor category value.

TIPS AND REMINDERS

- Identify at least one separate sensitive environment (i.e., "critical habitat for" or "habitat known to be used by") for each endangered or threatened species, but assign only one category (e.g., Federal endangered, state threatened) to each species.
- Designation of state threatened or endangered species are valid only within that state.
- A wetland area can be evaluated both as a wetland and as a listed sensitive environment (e.g., critical habitat).
- The minimum total wetland length within a given level of contamination or dilution category to obtain a non-zero wetlands rating value from HRS Table 4-24 is 0.1 miles.

SECTION 8.15 LEVEL I AND Level II CONCENTRATIONS FOR LISTED SENSITIVE ENVIRONMENTS



This section provides guidance for the types of observations, samples, and benchmarks used to establish Level I or Level II concentrations and potential contamination for listed sensitive environments. The sensitive environments factor value in the surface water pathway is assigned based on whether sensitive environments within the TDL are considered subject to actual contamination (i.e., Level I or Level II concentrations) or potential contamination, and on the assigned value for each sensitive environment. In order to establish actual contamination, an observed release must be documented (either by direct observation or by chemical analysis) for the location in the surface water body where targets are present. To determine the level of actual contamination by chemical analysis, concentrations of hazardous substances are measured in samples that meet the criteria for an observed release and that are taken within, beyond, or adjacent to a sensitive environment within the TDL; these concentrations are then compared to ecological-based benchmarks. Wetlands are discussed in more detail in Section 8.17.

RELEVANT HRS SECTIONS

Section 2.5	Targets
Section 2.5.1	Determination of level of actual contamination at a sampling location
Section 2.5.2	Comparison to benchmarks
Section 4.1.4.3	Environmental threat - targets
Section 4.1.4.3.1	Sensitive environments
Section 4.1.4.3.1.1	Level I concentrations
Section 4.1.4.3.1.2	Level II concentrations

DEFINITIONS

Actual Contamination for Listed Sensitive Environments: Any portion of a listed sensitive environment is subject to actual contamination if it falls within an area that meets the criteria for an observed release. Direct observation and/or analytical data from aqueous, sediment samples, or essentially sessile benthic organism may be used to establish actual contamination. However, only surface water samples may be used to establish Level I concentrations.

Level I Concentrations for the Environmental Threat: Level I concentrations are established in aqueous samples in which the concentration of a hazardous substance that meets the criteria for an observed release is at or above the appropriate ecological-based benchmark. Benchmark for the environmental threat include AWQC and AALAC. I and J indices do not apply because there are no screening concentration benchmark for sensitive environments.

Level II Concentrations for the Environmental Threat: Level II concentration are established in samples in which the concentration of at least one hazardous substance meets the criteria for an observed release, but the conditions for Level I concentrations are not met. In addition, Level II is assigned for observed established by direct observation.

Listed Sensitive Environment: Areas that are evaluated as one or more of the sensitive environments listed in HRS Table 4-23, even if these areas (or portions of these areas) also are being evaluated as a wetland. The distinction is necessary because a wetland that is also a listed sensitive environment (e.g., a wetland area that also is habitat known to be used by an endangered species) would be evaluated as two separate sensitive environments. Point values are assigned differently for wetlands than for the other types of sensitive environments.

Observed Release: An observed release is established for the ground water, surface water, or air migration pathway either by chemical analysis or by direct observation. Observed release is not relevant to the HRS soil exposure pathway. The minimum requirements for establishing an observed release by chemical analysis are analytical data demonstrating the presence of a hazardous substance in the medium significantly above background level, and information that some portion of that increase is attributable to the site. The minimum criterion for establishing an observed release by direct observation is evidence that the hazardous substance was placed into or has been seen entering the medium.

DETERMINING LEVEL OF CONTAMINATION

The following steps describe how to determine whether a listed sensitive environment is considered subject to Level I concentrations, Level II concentrations, or potential contamination.

- (1) **Identify all listed sensitive environments within the TDL.** Guidance for identifying and delineating listed sensitive environments is provided in Appendix A. Delineate the position and boundaries of these sensitive environments and their position relative to the hazardous substance migration path. It may be helpful to note these locations on a scale map or diagram.
- (2) **Delineate all areas of actual contamination within the TDL.** The procedures for delineating areas of actual contamination depend on whether actual contamination is established based on chemical analysis or direct observation.
 - Delineate areas of actual contamination based on chemical analysis:
 - For rivers and streams, the area of actual contamination is the area between the PPE for a hazardous substance and the location of the farthest "hit" (i.e., the farthest sampling location that meets the criteria for an observed release by chemical analysis). At sites where there are multiple sources and PPEs, it may be necessary to establish an area of actual contamination for each hazardous substance (i.e., the area between the PPE for that substance and the location of the farthest "hit" for that substance). On a scale map or diagram, draw a line from bank-to-bank at the appropriate PPE, and draw a second line from bank-to-bank at the location of the farthest "hit." The lines from bank-to-bank should be drawn roughly perpendicular to both banks. The portion of the river or stream between the two lines is the area of actual contamination for that hazardous substance. In tidally influenced rivers and streams, the area of actual contamination can be both upstream and downstream of the appropriate PPE(s).
 - For lakes, coastal tidal waters, and oceans, the area of actual contamination for a hazardous substance is the area within an arc with a radius from the PPE for that hazardous substance to the location of the farthest "hit." At sites

where there are multiple sources and PPEs, it may be necessary to establish an area of actual contamination for each hazardous substance. On a scale map or diagram, draw an arc using the appropriate PPE as the center point and the distance between this point and the location of the farthest "hit" as the radius. Continue drawing this arc in each direction until it reaches the shores of the water body or completes a circle. The area within this arc is the area of actual contamination.

- Delineate areas of actual contamination based on direct observation. Actual contamination of a sensitive environment based on direct observation can be established at Level II concentrations if the observation is made at some point within the sensitive environment. It may be helpful to note these locations on a scale map or diagram.

(3) **Delineate areas subject to Level I and Level II concentrations within areas of actual contamination based on chemical analysis.** Delineate areas subject to Level I and Level II concentrations as follows:

- For each surface water sample location that meets the observed release criteria, determine whether the sample location is considered subject to Level I or Level II concentrations as follows:
 - If the concentration of any hazardous substance is equal to or greater than its ecological-based benchmark, the sample location is subject to Level I concentrations.
 - If the concentrations of all hazardous substances for which an applicable benchmark is available are lower than their respective ecological-based benchmarks, the sample location is subject to Level II concentrations.
 - If none of the hazardous substances has an applicable benchmark, the sample location is considered subject to Level II concentrations.

Use EPA's AWQC and AALAC as the only ecological benchmarks. To determine the appropriate benchmark for the hazardous substance, use the lower of the applicable AWQC and AALAC values, if available, as follows:

- Use the chronic value; otherwise use the acute value.
 - If the sensitive environment is in fresh water, use the fresh water value; otherwise, use the marine value.
 - If the sensitive environment is in salt water use the marine value; otherwise, use the fresh water value.
 - If the sensitive environment is in both fresh water and salt water, or is in brackish water, use the lower of the applicable fresh water and marine values.
- For each sediment or benthic sample location, if any hazardous substance meets the criteria for an observed release, the location is considered subject to Level II concentrations. Sediment and benthic samples cannot be used to establish Level I concentrations.
 - Delineate areas subject to Level I concentrations as follows (if both fresh and brackish or salt water bodies are within the TDL, note the final two bullets in Step (3) below):

- For rivers and streams, the area subject to Level I concentrations is the area between the PPE and the location of the farthest sample location subject to Level I concentrations. On a scale map or diagram, draw a line from bank-to-bank at the farthest location subject to Level I concentrations. The portion of the river or stream between the two lines at the appropriate PPE (see Step (2) above) is the area subject to Level I concentrations.
- For lakes, coastal tidal waters, and oceans, the area subject to Level I concentrations generally is the area within an arc with a radius from the PPE to the farthest location subject to Level I concentrations. On a scale map or diagram, draw an arc using the appropriate PPE as the center point and the distance between this point and the farthest location subject to Level I concentrations as the radius. Continue drawing this arc in each direction until it reaches the shores of the water body or completes a circle. The area within this arc is the area subject to Level I concentrations.
- Delineate areas subject to Level II concentrations as follows (if both fresh and brackish or salt water bodies are within the TDL, note the final two bullets in Step (3)):
 - For rivers and streams, the area subject to Level II concentrations generally is the area between the location of the farthest sample location that is considered subject to Level I concentrations and the location of the farthest sample location considered subject to Level II concentrations (i.e., the area of actual contamination that is not considered subject to Level I concentrations). The portion of the river or stream between the line at the farthest sample location subject to Level I concentrations (see above) and the line at the farthest sample location that meets the criteria for an observed release (see Step (2) above) is the area subject to Level II concentrations.
 - For lakes, coastal tidal waters, and oceans, the area subject to Level II concentrations generally is the area between the arc drawn through the farthest sampling location considered subject to Level I concentrations (see above) and the arc drawn through the farthest sample location considered subject to actual contamination (see Step (2) above). The area within these two arcs is the area considered subject to Level II concentrations.
- If the listed sensitive environments within the TDL are present in, or adjacent to, both fresh water and brackish or salt water, then it may be necessary to establish separate areas of Level I and Level II concentrations for the fresh water and the brackish or salt water. For some hazardous substances, the marine ecological-based benchmark is lower than the fresh water benchmark. Thus it is possible for areas subject to Level I concentrations (based on the marine benchmark) to be farther from the PPE than areas subject to Level II concentrations (based on the fresh water benchmark).
- If the stream or river is tidally influenced, see Section 8.1.

(4) **Determine which listed sensitive environments are considered subject to Level I concentrations, Level II concentrations, and potential contamination.** Level of contamination for each listed sensitive environment is determined by the relative position of its boundaries to areas subject to Level I and Level II concentrations. Determine the appropriate level of contamination for each listed sensitive environment within the TDL as noted below.

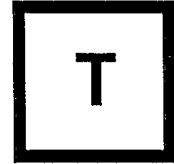
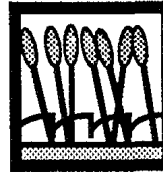
- If any portion of the listed sensitive environment falls within an area considered subject to Level I concentrations, the entire sensitive environment is considered subject to Level I concentrations.

- If any portion of the listed sensitive environment falls solely within an area subject to Level II concentrations (or actual contamination), the entire sensitive environment is considered subject to Level II concentrations.
- If no portion of the listed sensitive environment falls within an area of actual contamination (i.e., Level I or Level II concentrations), the sensitive environment is considered subject to potential contamination.
- If any portion of the listed sensitive environment is considered subject to both Level I and Level II concentrations (or potential contamination), evaluate the sensitive environment under Level I concentrations. For example, if one portion of a National Park is within an area considered subject to Level I concentrations, and another portion of the Park is within an area considered subject to Level II concentrations, the entire National Park is considered subject to Level I concentrations.

TIPS AND REMINDERS

- Direct observation can establish Level II concentrations for a sensitive environment, but only if the observation is within the boundaries of the sensitive environment.
- Surface water samples can be used to establish both Level I and Level II concentrations; sediment and benthic samples can be used only to establish Level II concentrations.
- Only those hazardous substances that meet the criteria for an observed release at a surface water sample location should be compared to ecological-based benchmarks.
- Level I concentrations for a sensitive environment cannot be established using the I or J index.
- If any portion of a listed sensitive environment is considered subject to a given level of contamination, the entire sensitive environment is considered subject to that level of contamination. Only wetland scoring is based on the size of the sensitive environment subject to a particular level of contamination.
- If a listed sensitive environment can be considered subject to more than one level of contamination, evaluate that sensitive environment under the level of contamination that will result in the highest targets factor value (i.e., evaluate it under Level I concentrations, if possible; otherwise, under Level II concentrations, if possible; otherwise, under potential contamination).
- Any samples (surface water, sediment, or benthic) taken within, adjacent to, or beyond a sensitive environment can establish actual contamination.
- The area of actual contamination in the environmental threat will be identical to that in the drinking water threat. However, the areas of Level I and Level II concentrations within the area of actual contamination may differ between the two threats and will need to be established separately. The area of actual contamination in the human food chain threat may differ from that in the drinking water and environmental threats (e.g., if the hazardous substance that establishes actual contamination has a BPFV of less than 500, actual contamination may not be established for the human food chain threat).
- If sensitive environments for the site are present in both fresh water and salt or brackish water, then areas of Level I and Level II concentrations may need to be established separately for the fresh water and the salt or brackish water bodies.

SECTION 8.16 WETLANDS



This section provides guidance to assist the scorer in identifying wetlands, evaluating wetlands, and developing effective scoring strategies for wetlands. The guidance in this section is limited to considerations for the surface water pathway (environmental threat). In the environmental threat, wetlands are evaluated based on level of contamination (i.e., Level I, Level II, or potential) and size (i.e., length or perimeter of wetland area subject to a given level of contamination). To evaluate wetlands, the scorer should document the presence of all wetlands within the TDL, delineate their boundaries sufficiently so that length or perimeter may be estimated, and determine what portions of each wetland are considered subject to Level I concentrations, Level II concentrations, or potential contamination.

RELEVANT HRS SECTIONS	
Section 4.0.2	Surface water categories
Section 4.1.4.3	Environmental threat - targets
Section 4.1.4.3.1	Sensitive environments
Section 4.1.4.3.1.1	Level I concentrations
Section 4.1.4.3.1.2	Level II concentrations
Section 4.1.4.3.1.3	Potential contamination

DEFINITIONS

Wetlands: Generally include swamps, marshes, bogs, and similar areas. As defined in 40 CFR 230.3, wetlands are those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands can be natural or man-made. Wetlands identified using other definitions (e.g., the Food Security Act of 1985, the wetlands classification system of the U.S., the 1989 Federal Manual for Identifying and Delineating Jurisdictional Wetlands) are not eligible unless they also meet the 40 CFR 230.3 definition. A discussion of the wetland classification system used on NWI maps and its relationship to the 40 CFR 230.2 definition is provided in Appendix A.

IDENTIFYING AND DELINEATING WETLANDS

Identify and delineate wetlands using readily available maps, brief written documentation (e.g., a statement that hydrophytic vegetation is present), or photographs. If historical data document the presence of a wetland (e.g., an old topographic map), and the SI shows that the wetland no longer exists, score the wetland if it was eliminated because of activity related to the site. However, the wetland should not be scored if it was eliminated for reasons not related to the site.

There are two common methods to identify and determine the length (or perimeter) of wetlands subject to actual or potential contamination:

- Using maps (e.g., National Wetland Inventory maps, USGS topographic maps, Soil Conservation Service (SCS) soil maps) or other documentation (e.g., aerial photo); and
- Contacting a wetlands expert to delineate the wetlands.

For most wetland evaluations, NWI maps can support reasonable estimates of the presence and boundaries of wetlands. However, wetlands identified on these maps may not meet the definition of a wetland as stated in 40 CFR 230.3 and may not be eligible for HRS scoring (see Appendix A). When wetlands may significantly impact the site score (i.e., result in a site score greater than 28.50), further documentation may be needed to show that the wetlands meet the definition in 40 CFR 230.3 (documentation may include contacting a wetlands expert to delineate the wetlands).

DETERMINING WETLAND SIZE (LENGTH OR PERIMETER)

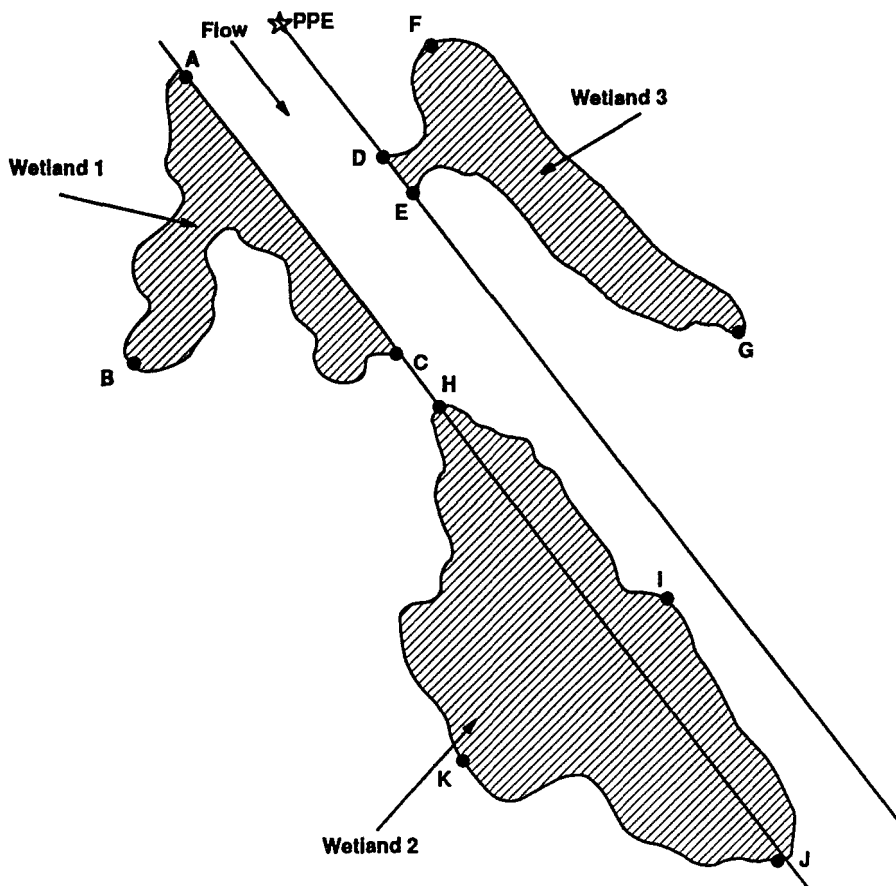
To develop a targets score for the environmental threat pathway, the scorer must assess the length or perimeter of all wetlands within the TDL. Common situations for which the scorer determines wetland length include:

- Wetlands contiguous to a river or stream (see **Highlight 8-61**);
- Wetlands contiguous to a lake, coastal tidal water, or ocean (see **Highlight 8-62**);
- A watershed with wetlands contiguous both to a river and to a lake or ocean (see **Highlight 8-63**); or
- Wetlands divided by a stream or river (see **Highlight 8-64**).

Common situations for which the scorer determines wetland perimeter include:

- Isolated wetlands (see **Highlight 8-65**); or
- Wetlands where the PPE into surface water is in the wetland (see **Highlight 8-65**).

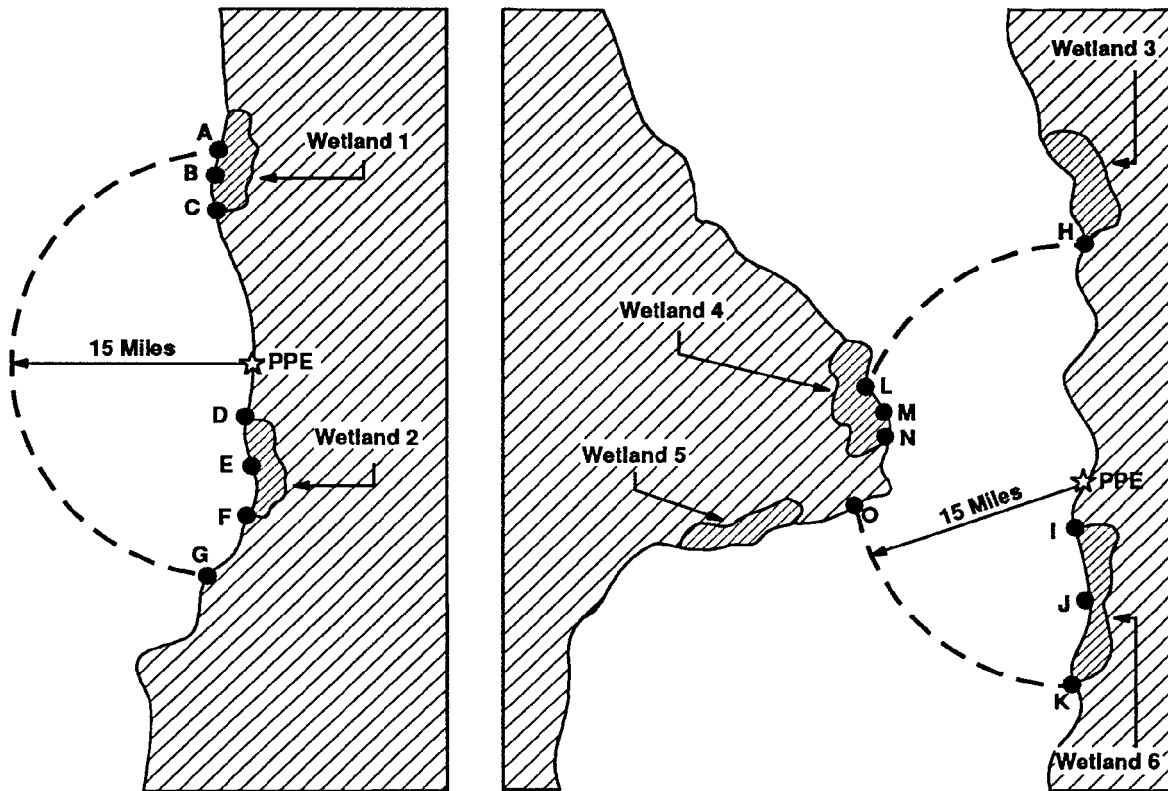
HIGHLIGHT 8-61
DETERMINING LENGTH FOR WETLANDS ALONG A RIVER



- The length of wetlands along a river or stream is determined by the frontage of wetlands contiguous to the waterway. The distance should be measured as the actual shoreline (frontage) distance and not the straight-line distance between the upstream and downstream points where the wetland meets the surface water body. In this example:

- Frontage for Wetland 1 is the distance A to C, not the distance A to B to C.
- Frontage for Wetland 2 is the distance H to I to J, not the distance H to J.
- Length for Wetland 3 is the distance D to E.

HIGHLIGHT 8-62
DETERMINING LENGTH FOR WETLANDS ALONG A LAKE, COASTAL
TIDAL WATER, OR OCEAN

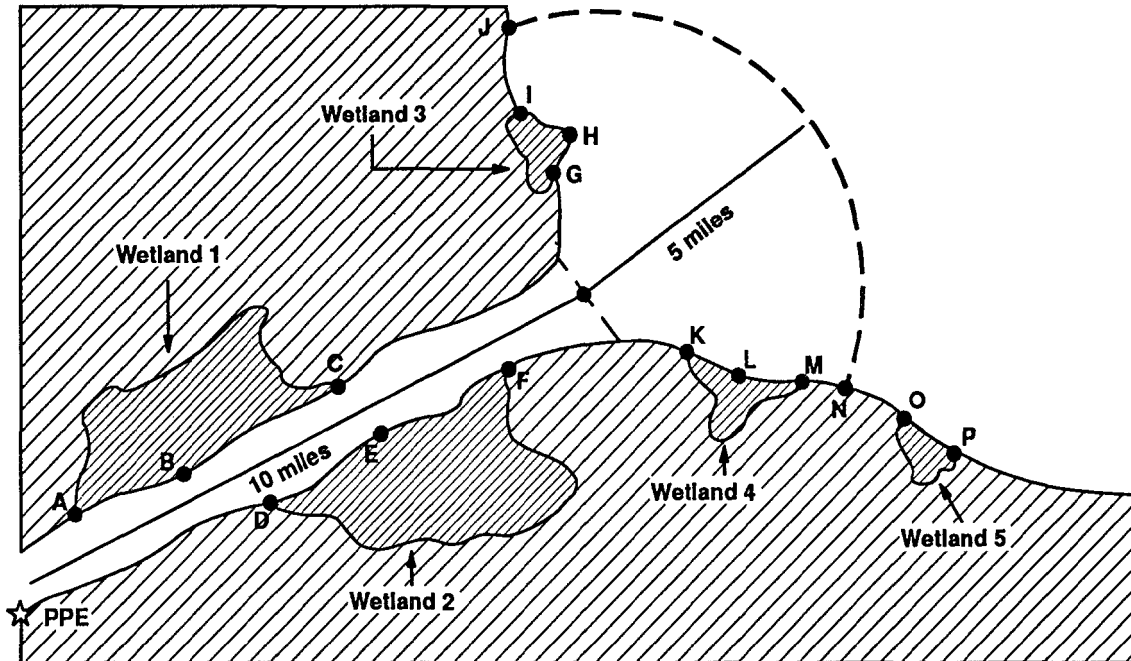


Example 1

Example 2

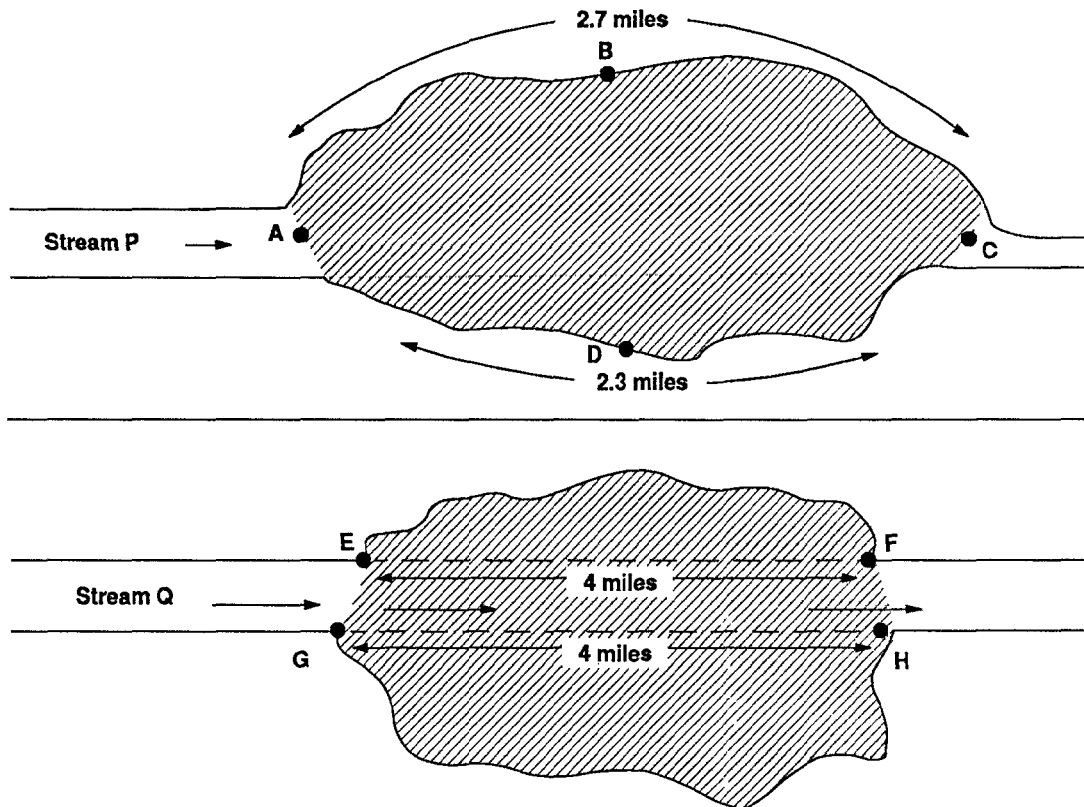
- In Example 1, the arc A-G (15-mile radius) centered on the coastline length to be considered.
- The length of wetlands to be considered is the sum of wetlands within the arc. Length of wetlands should be determined as the coastline length and not a straight-line distance. For this example the following should be considered:
 - Frontage for Wetland 1 (the distance A to B to C); and
 - Frontage for Wetland 2 (the distance D to E to F).
- In Example 2, the arc H-K (15-mile radius) centered on the PPE is drawn to determine the coastline length to be considered.
- The length of wetlands to be considered is the sum of wetlands within the arc. Length of wetlands should be determined as the coastline length and not a straight-line distance. For this example, the following should be considered:
 - Frontage for Wetland 4 (the distance L to M to N); and
 - Frontage for Wetland 6 (the distance I to J to K).

HIGHLIGHT 8-63
DETERMINING LENGTH FOR WETLAND IN A WATERSHED
WITH A RIVER AND LAKE, OR COASTAL TIDAL WATER



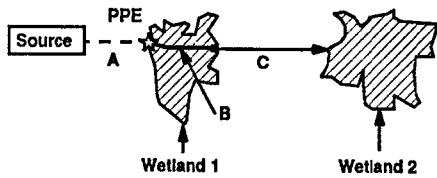
- The wetlands frontage is calculated as the sum of the length of wetlands contiguous to the river portion of the hazardous substance migration pathway and the length of wetlands contiguous to the coastline in the lake or ocean.
- In this example, the total length of wetlands is equal to the length of wetlands associated with the river and the length of wetlands associated with the coastline within the TDL. The radius of the arc into the lake or ocean should be drawn from the center of the river emptying into the lake or ocean and is equal to the TDL (15 miles) minus the length of the TDL in the river or stream (in this example, 10 miles). The following lengths of wetlands should be included:
 - The distance of wetlands along the river, A to B to C and D to E to F; and
 - The distance of wetlands along the coastline within the TDL, G to H to I and K to L to M.

HIGHLIGHT 8-64 DETERMINING LENGTH FOR WETLAND DIVIDED BY A STREAM

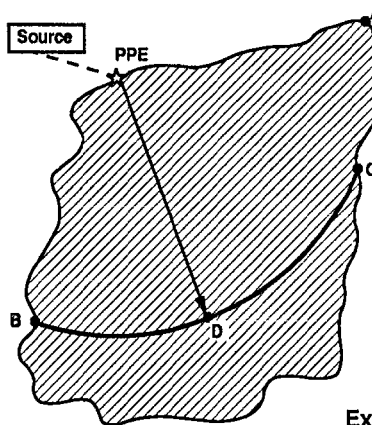


- For surface water systems with no discernible flow (e.g., a defined channel) through a wetland, the perimeter of the wetland should be considered the wetland length.
- For all surface water systems with a discernible flow through a wetland, the wetlands on opposite banks of the stream should be considered as two wetlands. The length of wetland should be determined for both sides of the water body and added together when determining total length of wetlands.
- In this example, Stream P has no discernible flow through the wetland, and, therefore, the perimeter of the wetland (5 miles) should be considered the length. However, in Stream Q, the stream has a discernible continuous flow through the wetland, and therefore lengths E to F and G to H should be considered as two separate wetlands with a length of 8 miles (4 miles each).

HIGHLIGHT 8-65
DETERMINING PERIMETER OF A WETLAND
WHEN THE PROBABLE POINT OF ENTRY IS IN THE WETLAND



Example 1



Example 2

- For isolated wetlands or wetlands where the PPE into the surface water body is the wetland, the perimeter of the wetland is used for wetland length rather than the frontage contiguous with the in-water segment of the hazardous substance migration path.
- In Example 1, the PPE is within a perennial, isolated wetland. The scorer should do the following:
 - Measure from the PPE to the end of the TDL and draw an arc.
 - If the boundaries of the isolated wetland are entirely within the arc, the total perimeter should be used as the wetland length.
 - If the wetland is not completely within the arc, measure the perimeter of the wetland within the arc and the length of the arc to determine the wetland length.
 - If the wetland is entirely within the TDL, sum the overland distance from the source to the isolated wetland, the distance of the hazardous substance migration pathway within the isolated wetland, and the overland distance from the isolated wetland to the next surface water body. If this distance is greater than 2 miles, evaluate only the isolated wetland.
 - If the sum of these distances is less than 2 miles, evaluate the next surface water body as a separate watershed. Remember to evaluate the hazardous substance migration path, not the straight-line distance.
- In Example 1, if distance A is less than 2 miles and the total perimeter of Wetland 1 is within the 15-mile TDL, the entire perimeter is used as the wetland length. If the sum of distances A, B (the shortest distance from the PPE to the hazardous substance migration pathway from the wetland), and C is less than 2 miles, evaluate Wetlands 1 and 2 as two separate watersheds (i.e., draw a 15-mile TDL in each wetland). If the distance is greater than 2 miles, evaluate only Wetland 1. Continue evaluating the overland distance until the sum of distances for the hazardous substance migration pathway is greater than 2 miles.
- In Example 2, the PPE is in an isolated wetland. The 15-mile TDL is completely within the wetland. The length of wetland to be considered is the perimeter distance ABDCA (i.e., the length of the arc in the wetland and the perimeter of wetland bisected by the arc), assuming the entire wetland is subject to the same level of contamination (for wetlands with various levels of contamination, see **Highlight 8-68**).

ESTABLISHING ACTUAL AND POTENTIAL CONTAMINATION

The criteria for establishing whether a wetland (or portion of a wetland) is considered subject to Level I concentrations, Level II concentrations, or potential contamination generally are identical to those for a listed sensitive environment (see Section 8.15):

- Actual contamination can be established based on direct observation and/or surface water, benthic, or sediment samples taken within or beyond the wetland (or adjacent to the wetland if it is contiguous to the hazardous substance migration path).
- Level I concentrations can be established only if at least one hazardous substance in an applicable aqueous surface water sample is present at a concentration that is equal to or greater than the applicable ecological-based benchmark (i.e., EPA AWQL or EPA AALAC for the substance).
- Level II concentrations are established:
 - If the concentration of all applicable hazardous substances from all applicable surface water samples are lower than their respective ecological-based benchmarks;
 - If none of the applicable hazardous substances in all applicable surface water samples has an ecological-based benchmark; or
 - If actual contamination is established based on sediment samples, benthic samples, or direct observation.
- Potential contamination is established for wetlands within the TDL if Level I or Level II concentrations (i.e., actual contamination) cannot be established.

However, only those portions of wetlands subject to a given level of contamination are evaluated under that level of contamination (e.g., different portions of the same wetland can be evaluated under Level I concentrations, Level II concentrations, and potential contamination).

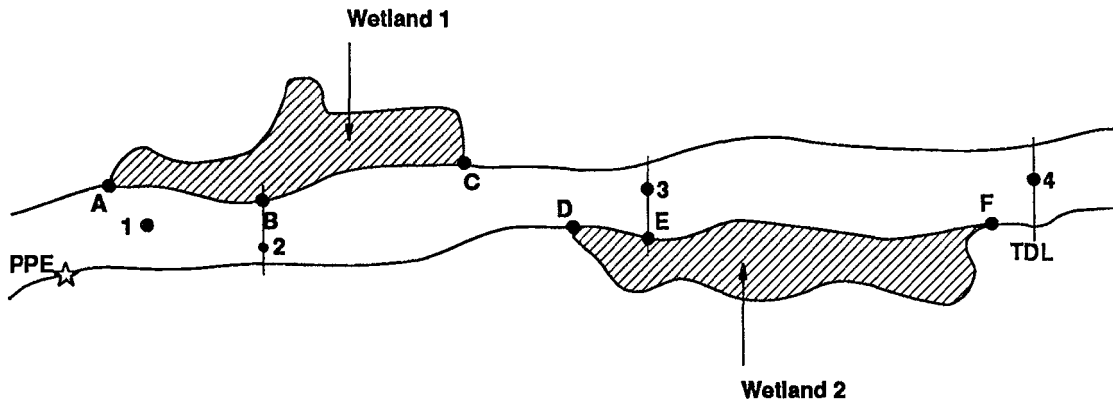
DETERMINING WETLAND LENGTH (OR PERIMETER) SUBJECT TO ACTUAL AND POTENTIAL CONTAMINATION

This section provides guidance for determining wetland length or perimeter associated with Level I concentrations, Level II concentrations, and potential contamination. **Highlights 8-66** through **8-68** provide examples of evaluations of wetlands contiguous to rivers, lakes or oceans, and isolated wetlands. For guidance on calculating the environmental threat targets factor value, see Section 8.14.

(1) Determine wetland length (or perimeter) associated with Level I concentrations.

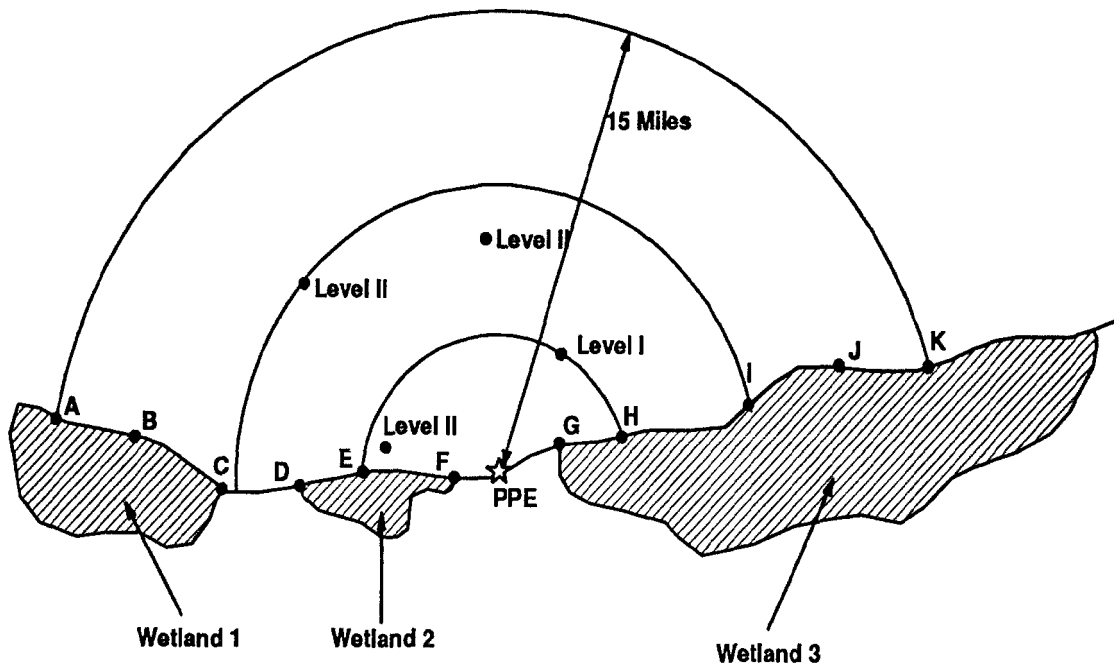
- For rivers and streams, use the length of the wetlands contiguous to the in-water segment of the hazardous substance migration path (i.e., wetland frontage) from the PPE to the farthest downstream sample establishing Level I concentrations (see **Highlight 8-66**).
- For lakes, oceans, coastal tidal waters, and Great Lakes, use the length of the wetland frontage along the shoreline subject to Level I concentrations from the PPE to the intersection of the arc of the most distant sample establishing Level I concentrations and the shoreline (see **Highlight 8-67**).

HIGHLIGHT 8-66
DELINEATING ACTUAL CONTAMINATION FOR WETLANDS IN A RIVER



- In this figure, two wetlands (Wetland 1 and Wetland 2) contiguous to a river are evaluated for actual and potential contamination.
- Point 2 represents the farthest downstream sample establishing Level I concentrations; Point 3 represents the farthest downstream sample establishing Level II concentrations.
- The wetland length considered subject to Level I concentrations is measured from the upstream boundary of Wetland 1 to the farthest downstream sample that establishes Level I concentrations (i.e., Point 2).
- Length considered subject to Level II concentrations is measured from the farthest downstream sample that establishes Level I concentrations to the farthest downstream sample that establishes Level II concentrations (i.e., Point 3).
- Potential contamination is measured from the farthest downstream sample that establishes Level II concentrations to the TDL (i.e., Point 4). However, if the TDL is greater than 15 miles due to samples that establish actual contamination, potential contamination is not scored.
- In this example:
 - The shoreline length A to B is subject to Level I concentrations;
 - The shoreline length B to C and D to E is subject to Level II concentrations; and
 - The shoreline length E to F is subject to potential contamination.
- In areas with both fresh and brackish water (i.e., tidal areas), the applicable benchmark for a given hazardous substance may be different in the fresh water portion of the river than the brackish portion of the river (e.g., a given concentration could be below the benchmark in fresh water but above the benchmark in brackish water).
- Special consideration should be given to tidal areas.

HIGHLIGHT 8-67
DELINEATING ACTUAL CONTAMINATION FOR WETLANDS IN A LAKE, OCEAN, AND COASTAL TIDAL WATERS



- For lakes, oceans, and coastal tidal waters, an arc bisecting the coastline is drawn from the PPE to the TDL. To determine the coastline subject to different levels of contamination, draw separate arcs, each with a distance equal to the length from the PPE to the most distant sampling point that establishes Level I and Level II concentrations, each arc bisecting the coastline.
- In this example, the lengths of wetland subject to Level I concentrations are the lengths E to F and G to H measured along the coastline (i.e., not a straight-line distance). Note that even though a sample that establishes Level II concentrations was found within the Level I concentration arc, the Level I concentration arc is determined by the most distant sample establishing Level I concentrations.
- Lengths of wetland subject to Level II concentrations are the coastline lengths D to E and H to I.
- Potential contamination includes those portions of wetlands outside the Level I and/or Level II arc(s), but within the TDL. In this example, lengths subject to potential contamination are A to B to C, and I to J to K.

- For an isolated wetland, or for a wetland where the PPE to surface water is in the wetland, use the perimeter of that portion of the wetland considered subject to Level I concentrations as the length. If the PPE to surface water is within a wetland and other wetlands within the TDL are subject to Level I concentrations, use the perimeter for the wetland in which the PPE is located and the length for all other wetlands within the TDL (see **Highlight 8-68**).
- See Section 8.1 if the surface water bodies being evaluated are tidally influenced.
- See Section 8.3 if both fresh water and salt water (or brackish) surface water bodies are within the TDL.

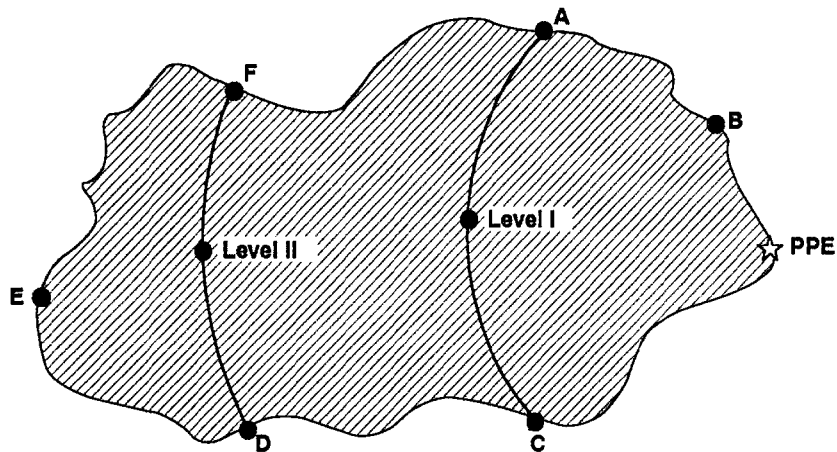
(2) **Determine wetland length (or perimeter) associated with Level II concentrations.**

- For rivers and streams, use the length of the wetlands contiguous to the in-water segment of the hazardous substance migration path (i.e., wetland frontage) between the farthest downstream samples establishing Level I and Level II concentrations. In the absence of Level I concentrations, use the length from the PPE to the farthest downstream sample establishing Level II concentrations (see **Highlight 8-66**).
- For lakes, oceans, coastal tidal waters, and Great Lakes, use the length of wetland frontage along the shoreline between the farthest downstream samples establishing Level I concentrations. In the absence of Level I and Level II concentrations, use the length from the PPE to the farthest sample establishing Level II concentrations (see **Highlight 8-67**).
- For an isolated wetland, or for a wetland where the PPE to surface water is within the wetland, use the perimeter of the portion of the wetland considered subject to Level II concentrations as the length (see **Highlight 8-68**).
- See Section 8:1 if the surface water bodies being evaluated are tidally influenced.
- See Section 8.3 if both fresh water and salt water (or brackish) surface water bodies are within the TDL.

(3) **Determine wetland length associated with potential contamination.**

- For rivers and streams, use the length of wetlands contiguous to the in-water segment of the hazardous substance migration path. Include the length of wetlands within the TDL from the farthest downstream sampling point establishing actual contamination or from the PPE, if no sampling points establish Level I or Level II concentrations.
- For lakes, oceans, coastal tidal waters, and the Great Lakes, use the length of wetlands along the shoreline within the TDL not subject to Level I or Level II concentrations.
- For an isolated wetland or for a wetland where the PPE to surface water is within the wetland, use the perimeter of that portion of the wetland not subject to Level I or Level II concentrations as the length.
- See Section 8.1 if the surface water bodies being evaluated are tidally influenced.
- See Section 8.3 if both fresh water and salt water (or brackish) surface water bodies are within the TDL.

HIGHLIGHT 8-68
DELINEATING ACTUAL CONTAMINATION FOR WETLANDS WHEN THE
PROBABLE POINT OF ENTRY IS IN THE WETLAND



- In this example, there is an observed release to an isolated wetland. To determine the perimeter of wetland subject to actual and potential contamination, draw an arc with a radius equal to the distance from the PPE to the farthest sampling point that establishes Level I and/or Level II concentrations. This arc will have the PPE as the center, pass through the farthest sampling point, and intersect with the wetland boundaries.
- For Level I concentrations, the perimeter is equal to those portions of the arc delineating Level I concentrations within the wetland plus the length of wetland boundary the arc intersects. For Level II concentrations, the perimeter is equal to the arc drawn from the PPE to the farthest Level II sample, the arc delineating Level I concentrations (if applicable), and the length of wetland boundary connecting these arcs.
- In this example, the arc delineating Level I concentrations is shown by arc A-C. Therefore, the length of wetland subject to Level I concentrations is shown by ABCA.
- The perimeter of the arc marking Level II concentrations intersects the wetland boundaries at points D and F. The perimeter of wetland to be considered for Level II concentration is shown by AC DFA.
- Potential contamination is scored as the remainder of the isolated wetland and other surface water bodies within the TDL. For this isolated wetland, the perimeter of the wetland subject to potential contamination is FDEF.

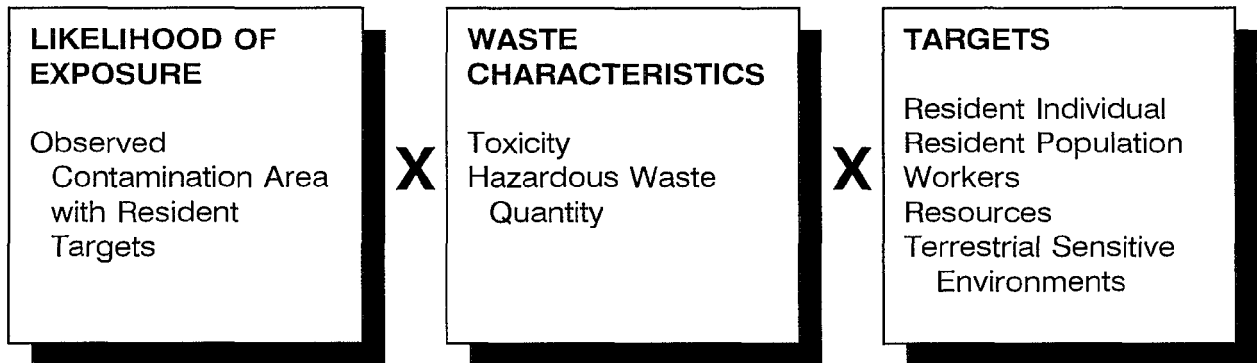
TIPS AND REMINDERS

- A significant environmental threat score based solely on potentially contaminated wetlands can generally be achieved only with a large wetland area and a water body type of minimal stream or small to moderate stream.
- Under potential contamination, minimize efforts to identify and delineate wetlands unless the waste characteristics factor category value is greater than 100, and river size (or lake size) is less than a moderate to large stream.

CHAPTER 9

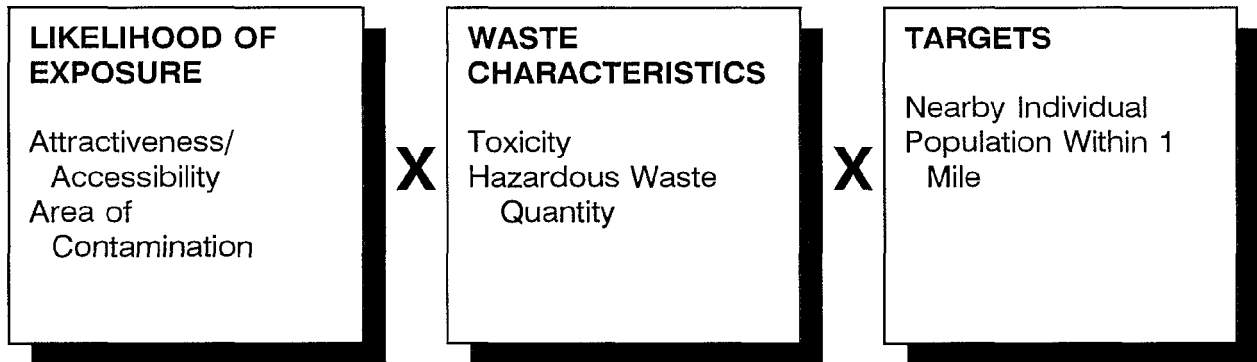
SOIL EXPOSURE PATHWAY

RESIDENT POPULATION THREAT



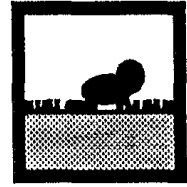
+

NEARBY POPULATION THREAT



SECTION 9.1

AREAS OF OBSERVED CONTAMINATION



The soil exposure pathway evaluates the threat to individuals and sensitive environments of exposure to surficial contamination. The purpose of this section is to assist the scorer in identifying and delineating areas of observed contamination. It is essential to identify and delineate areas of observed contamination because:

- The pathway can be evaluated only if there are areas of observed contamination;
- Target values are assigned based on their distance from areas of observed contamination; and
- The hazardous waste quantity is based on areas of observed contamination.

The soil exposure pathway is based on current conditions; potential migration to additional targets is not evaluated. Although called the soil exposure pathway, any surficial contamination is eligible to be evaluated.

RELEVANT HRS SECTIONS	
Section 2.2.2	Identify hazardous substances associated with a source
Section 2.3	Likelihood of release
Section 5.0.1	General considerations
Section 5.1.1	Likelihood of exposure
Section 5.1.2	Waste characteristics
Section 5.2.1	Likelihood of exposure

DEFINITIONS

Area of Observed Contamination: Established based on sampling locations as any of the following:

- Generally, for contaminated soil, consider the sampling locations that indicate observed contamination and the area lying between such locations to be an area of observed contamination, unless information indicates otherwise.
- For sources other than contaminated soil, if any sample taken from the source indicates observed contamination, consider that entire source to be an area of observed contamination.

If an area of observed contamination (or a portion of such an area) is covered by a permanent, or otherwise maintained, essentially impenetrable material (e.g., asphalt), exclude the covered area from the area of observed contamination. However, asphalt or other impenetrable materials contaminated by site-related hazardous substances may be considered areas of observed contamination.

Observed Contamination: Surficial contamination related to a site. It must be established by chemical analysis. Observed contamination is present at sampling locations where analytic evidence indicates that:

- A hazardous substance attributable to the site is present at a concentration significantly above background levels for the site (i.e., meets the observed release criteria in HRS Table 2-3).
- The hazardous substance is present at the surface or covered by two feet or less of cover material (e.g., soil).

ESTABLISHING AREAS OF OBSERVED CONTAMINATION

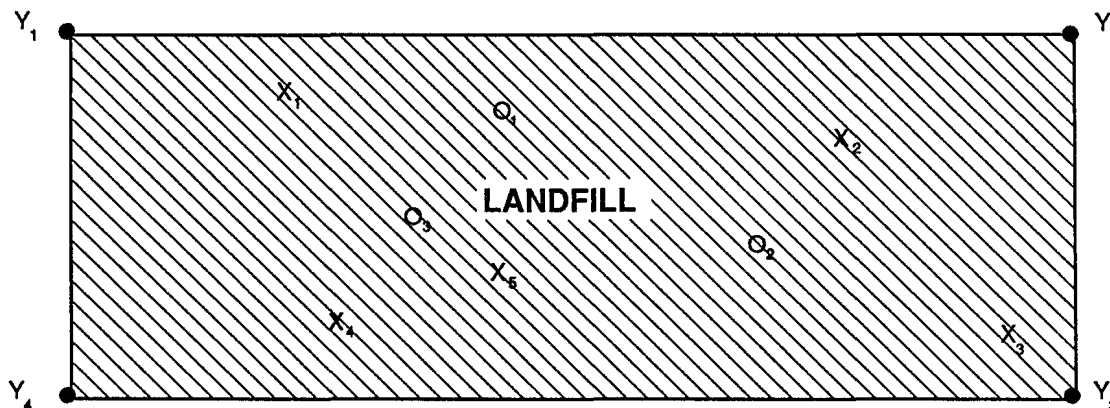
- (1) **Identify sampling locations that meet the criteria for observed contamination.** Consult *Highlight 9-1* for appropriate source-specific background samples.
- (2) **Define the areas of observed contamination.**
 - For all sources other than contaminated soil, consider the entire source to be an area of observed contamination if any sampling location within the source meets the criteria for observed contamination (see *Highlight 9-2*).
 - For contaminated soils, consider sampling locations that meet the criteria for observed contamination and the areas lying between such sampling locations to be areas of observed contamination, unless information indicates otherwise (see *Highlights 9-3* and *9-4*).

HIGHLIGHT 9-1 BACKGROUND SAMPLES FOR AREAS OF OBSERVED CONTAMINATION

SOURCE	Background Sample
Contaminated Soil	Soil in vicinity of the site. See Sections 5.1 and 5.2 for additional considerations.
Tanks/Drums Filled with Contaminated Soil	Same as for the soil at the site.
Tanks/Drums Containing Liquid or Solid Wastes	Background is zero.
Landfill ^a	Soil in vicinity of the site.
Piles ^a	Soil in vicinity of the site.
Surface Impoundment ^a (liquid)	Aqueous samples from vicinity of the site. Background may be zero.
Surface Impoundment ^a (sludges or backfilled)	Soil in the vicinity of the site.
Other Sources	review on a site-specific basis

^a For these source types, the indicated sample is likely to be the most appropriate background.

**HIGHLIGHT 9-2
DELINEATING AREAS OF OBSERVED CONTAMINATION FOR
SOURCES OTHER THAN CONTAMINATED SOIL**



X_x = Sample location that establishes observed contamination

Y_x = Boundaries of landfill

O_x = Sample location that does not establish area of observed contamination

Lined areas = Areas of observed contamination

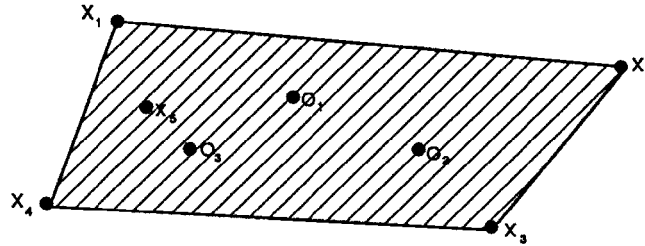
Several samples indicate observed contamination, others do not. The scorer should consider the following:

- Because the landfill is a source type other than contaminated soils, and at least one sample establishes observed contamination, consider the entire landfill as the area of contamination. The area does not need to be delineated by samples.

Information that may indicate that areas lying between sampling locations do meet the criteria for observed contamination includes the following:

- The route by which hazardous substances could have migrated to areas at the site involves wide dispersion of contamination (e.g., if stack emissions are the principal mechanism of deposition, areas between sampling locations are likely to be subject to observed contamination, see **Highlight 9-5**).
- If the principal mechanism of deposition is spills (e.g., at a loading dock or process area), then generally, the entire area delineated by samples is likely to be subject to observed contamination.
- Downgradient portions of a well-defined hazardous substance migration route meet the criteria for observed contamination, even if some discrete sampling locations within the migration route do not meet the criteria.

HIGHLIGHT 9-3 DELINEATING AREAS OF OBSERVED CONTAMINATION FOR CONTAMINATED SOIL



X_x = Sample location that establishes observed contamination
 O_x = Sample location that does not establish observed contamination
 Lined areas = Areas of observed contamination

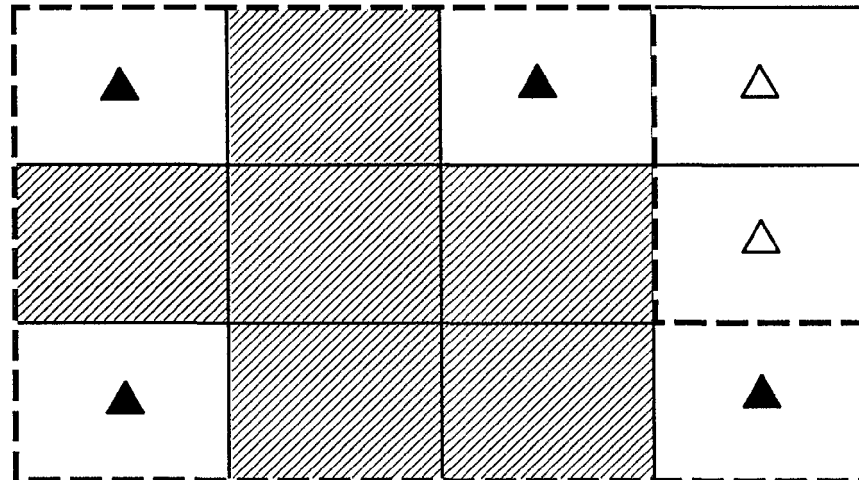
The area of observed contamination resulted from spills and is not limited to a specific area. Consider the following:

- Delineate the area of observed contamination. In this example, it would be the polygon formed by sampling locations X_1 , X_2 , X_3 , and X_4 . The left boundary of the contamination area would be X_4 to X_1 rather than X_4 to X_5 to X_1 , because site-specific evaluations indicate the area to the left of X_5 may be subject to contamination.
- Include the sampling locations that do not indicate surficial contamination (e.g., O_1 , O_2 , and O_3) in the area of observed contamination because, based on the site operations, topography, and hazardous substance migration route, there is reason to infer these areas are subject to contamination.

(3) **Refine areas of observed contamination.** Consider information that might indicate areas lying between sampling locations meeting the criteria for observed contamination should not be included:

- Areas are covered by a permanent or otherwise maintained, essentially impenetrable material (e.g., asphalt, concrete).
- Contamination is the result of run-off from a site, and topography indicates that certain areas within an area of contamination are on higher land and not influenced by run-off (see **Highlight 9-6**).
- The location and type of operations at a facility could preclude hazardous wastes from being in certain areas (e.g., soils near a process area and near a loading dock may be contaminated, but the area between these locations may not be expected to be contaminated).
- Cover material or fill (e.g., soil) has been deposited on top of contaminated surficial material, resulting in no observed contamination within two feet of the surface (see **Highlight 9-6**).

**HIGHLIGHT 9-4
DELINEATING AREAS OF OBSERVED CONTAMINATION
USING COMPOSITE SAMPLES**

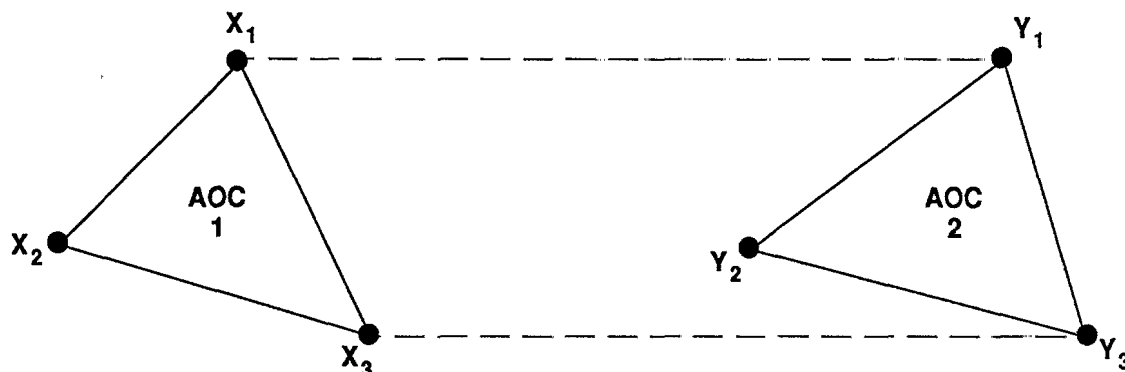


- ▲ Sampling grid with samples establishing observed contamination
- ▨ Sampling grid with inferred contamination
- △ Sampling grid with samples not establishing observed contamination

Soil has been contaminated by atmospheric deposition. As part of an emergency action, extensive sampling was conducted to delineate the extent of contamination. All samples were taken within two feet of the soil surface. To delineate the area of observed contamination using the grid sampling:

- Consider each grid with a sampling location meeting the criteria for observed contamination part of the area of observed contamination.
- Consider grids with no sampling data located between grids with observed contamination (inferred or sampled) to be contaminated unless information indicates otherwise (e.g., the grid is covered by asphalt).
- Exclude grids with sampling data indicating no observed contamination.
- Exclude portions of grids that are covered by a permanent or otherwise maintained, essentially impenetrable material from the area of observed contamination.
- Therefore, the grids outlined above by the dashed line are the area of observed contamination.

HIGHLIGHT 9-5
INFERRING CONTAMINATION BETWEEN MULTIPLE
AREAS OF OBSERVED CONTAMINATION



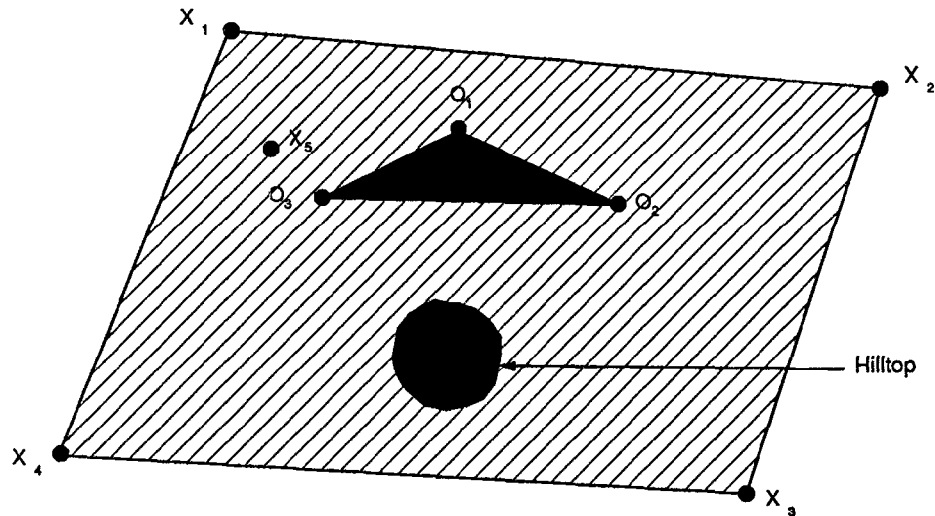
X_x = Sample location that establishes observed contamination

Y_y = Sample location that establishes observed contamination

Two areas of observed contamination (AOC 1 and 2) are defined by sampling locations. Determine if the area between these areas can be inferred to be contaminated. Consider the following:

- If the contamination results from atmospheric deposition (e.g., releases from a smelter located in the vicinity), consider the area between AOC 1 and AOC 2 (i.e., the outlined area) to be an area of observed contamination.
- If the two areas of observed contamination are located in two separate work areas (e.g., two loading docks) and the contaminated soil results from processes performed in the work area, it may not be reasonable to infer the area between these locations to be an area of observed contamination.
- If the two areas of observed contamination are associated with different hazardous constituents and sampling data do not indicate an overlap of hazardous substances, do not include the area between these two areas of observed contamination.

**HIGHLIGHT 9-6
DELINEATING AREAS OF OBSERVED CONTAMINATION WHEN
UNCONTAMINATED SOILS ARE INTERMINGLED**



- X = Sample location that establishes observed contamination
- O = Sample location that does not establish observed contamination
- Lined areas = Areas of observed contamination

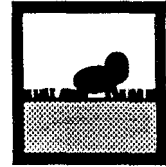
Soil has been contaminated by run-off. Areas in the center of the contamination have been disturbed and two feet of topsoil has been brought in to fill and cover an excavated area near sampling locations O_1 , O_2 , and O_3 . In this case, consider the following:

- Delineate the area of observed contamination as the polygon formed by sampling locations X_1 , X_2 , X_3 , and X_4 . The left boundary of the contaminated area would be X_4 to X_1 rather than X_4 to X_5 to X_1 , because site-specific evaluations indicate the area to the left of X_5 may be subject to contamination.
- Delineate the area marked by the samples indicating no surficial contamination. In this example, two or more feet of topsoil has been deposited in the vicinity of sampling locations O_1 , O_2 and O_3 to fill an excavated area. Because the topsoil was deposited in this area and analytic samples indicate no observed contamination, assume the surficial soil is not contaminated in this area.
- Since the hilltop is not in the hazardous substance migration route (i.e., it is at a higher elevation and the run-off flows around the hill), do not consider the hilltop subject to observed contamination (samples are not necessary in this situation).
- Subtract the area of no observed contamination (i.e., the area marked by samples and the hilltop) from the total area of observed contamination to determine the actual area of observed contamination.

TIPS AND REMINDERS

- Score the soil exposure pathway only if observed contamination is established.
- Analytic evidence supported with non-sampling evidence may be used to infer the extent of observed contamination. Non-sampling evidence may include soil staining, documented historical waste deposition patterns, stressed vegetation patterns, and data derived from investigations such as soil gas surveys.
- An area of observed contamination can be defined by one sampling location. For example, one sample is collected from a residential property to which site-related contamination has migrated.
- Contaminated samples from leachate and sediments can be used to document observed contamination if they are attributable to the site, and for sediments, if they are not covered by water at all times.

SECTION 9.2 WASTE CHARACTERISTICS FOR THE SOIL EXPOSURE PATHWAY



This section compares the differences in evaluating toxicity and hazardous waste quantity for the soil exposure pathway and the migration pathways. (For guidance on evaluating hazardous waste quantity for the migration pathways, see Chapter 6.)

Because the soil exposure pathway assesses the risks associated with exposure to existing surficial contamination, evaluation of waste characteristics for the soil exposure pathway differs from the evaluation for the migration pathways. There are differences in both the contaminant characteristics and the hazardous waste quantity components of waste characteristics. In evaluating contaminant characteristics, only substances that establish observed contamination can be used (e.g., do not use any other hazardous substance in the source). Furthermore, toxicity is the only contaminant characteristic included in the soil exposure pathway; other factors such as mobility and persistence are not considered.

This section details differences in the evaluation of hazardous waste quantity. In general, the evaluation performed for the migration pathways is modified to include only hazardous waste present in the top two feet of surficial matter. Thus, several divisors in the default equations are different (i.e., HRS Table 5-2 is used instead of HRS Table 2-5). Although termed the "soil exposure" pathway, all sources on which areas of observed contamination are established can be included in the site hazardous waste quantity factor value.

RELEVANT HRS SECTIONS	
Section 2.2.2	Identify hazardous substances associated with a source
Section 2.4.1.1	Toxicity factor
Section 2.4.2	Hazardous waste quantity
Section 5.1.2.1	Toxicity
Section 5.1.2.2	Hazardous waste quantity
Section 5.2.1.2	Area of contamination
Section 5.2.2.1	Toxicity

DEFINITIONS

Area of Observed Contamination: Established based on sample locations as any of the following:

- Generally, for contaminated soil, consider the sampling locations that indicate observed contamination and the area lying between such locations to be an area of observed contamination, unless information indicates otherwise.

- For sources other than contaminated soil, if any sample taken from the source indicates observed contamination, consider that entire source to be an area of observed contamination.

If an area of observed contamination (or a portion of such an area) is covered by a permanent, or otherwise maintained, essentially impenetrable material (e.g., asphalt), exclude the covered area from the area of observed contamination. However, asphalt or other impenetrable materials contaminated by site-related hazardous substances may be considered areas of observed contamination.

Observed Contamination: Surficial contamination related to a site. It must be established by chemical analysis. Observed contamination is present at sampling locations where analytic evidence indicates that:

- A hazardous substance attributable to the site is present at a concentration significantly above background levels for the site (i.e., meets the observed release criteria in HRS Table 2-3).
- The hazardous substance is present at the surface or covered by two feet or less of cover material (e.g., soil).

EVALUATING TOXICITY

Select the hazardous substance with the highest human toxicity factor value from among the substances that meet the criteria for observed contamination for the threat evaluated. In addition, for the nearby threat, the substance must also be from an area with an attractiveness/accessibility factor value greater than zero.

Assign a toxicity factor value for a hazardous substance in the soil exposure pathway the same as for any other pathway (except the surface water environmental threat). The process, described in HRS section 2.4.1.1 and presented in HRS Table 2-4, is based on this hierarchy:

- Chronic toxicity using RfDs/carcinogenicity using SFs and weight-of-evidence ratings; and, if these are not available,
- Acute toxicity using LD₅₀s and LC₅₀s.

Both PRescore and SCDM can help determine the toxicity value of a particular hazardous substance. See HRS section 2.4.1.1 for detailed direction in obtaining toxicity values and assigning a toxicity factor value for hazardous substances not included in PRescore or SCDM.

EVALUATING HAZARDOUS WASTE QUANTITY

Primary differences in evaluating hazardous waste quantity in the soil exposure pathway compared to the migration pathways, include the following:

- Only areas of observed contamination are considered.
- Only the first two feet of depth of an area of observed contamination are considered (except as specified for volume measures).
- Areas covered by essentially permanent, impenetrable material are excluded (e.g., contaminated soil covered by uncontaminated asphalt).
- Tier C (volume) can be used only for drums, tanks and containers other than drums, and surface impoundments containing liquid hazardous substances.

- Some equations for assigning a source hazardous waste quantity value in Tier D are different (Note that, if available, Tier A and B data can also be used for drums, tanks, and surface impoundments).
- If Tier A is not adequately determined, the minimum factor value is always 10.

These differences are summarized in *Highlight 9-7*.

EVALUATING TIER A — HAZARDOUS CONSTITUENT QUANTITY

To evaluate Tier A for an area of observed contamination:

- (A1) **Determine whether the source is an area of observed contamination.** See Section 9.1. For the nearby population threat, also determine if the area of observed contamination has an attractiveness/accessibility factor value greater than 0 (see Section 9.8). If not, do not evaluate hazardous waste quantity for that particular area of observed contamination.
- (A2) **Determine whether CERCLA hazardous substances meet the criteria for observed contamination (i.e., attributable to the site, present at a concentration significantly above background levels, and present within 2 feet of the surface).**

For each area of observed contamination, consider only those hazardous substances that meet the criteria for observed contamination within that area (e.g., if substance X meets the criteria for observed contamination in Source A, it cannot be evaluated in Source B unless it also meets the criteria for observed contamination in Source B);

- If there are such substances, continue to Step (A3).
- If not, do not evaluate the area of observed contamination with Tier A. Assign a value of zero for source hazardous constituent quantity and evaluate the area of observed contamination with Tier B.
- (A3) **Evaluate the area of observed contamination using Tier A in the same manner as for migration pathways.** See Section 6.2. There are two exceptions to this evaluation:
 - Consider only the top two feet of the area of observed contamination, based on present conditions at the site.
 - Assign a value for the area of observed contamination using the Tier A equation in HRS Table 5-2 (Note the Tier A equation is identical in HRS Tables 5-2 and 2-5).

Hazardous substance concentration data that is representative of the top two feet of an area of observed contamination may be used.

EVALUATING TIER B — HAZARDOUS WASTESTREAM QUANTITY

To evaluate Tier B for an area of observed contamination in the soil exposure pathway:

- (B1) **Determine whether the source is an area of observed contamination.** See Section 9.1. For the nearby population threat, also determine if the area of observed contamination has an attractiveness/accessibility factor value greater than 0 (see Section 9.8). If not, do not evaluate hazardous waste quantity for that particular area of observed contamination.

HIGHLIGHT 9-7
COMPARISON OF HAZARDOUS WASTE QUANTITY
EVALUATION IN THE MIGRATION PATHWAYS AND
THE SOIL EXPOSURE PATHWAY

Migration Pathways	Soil Exposure Pathway
Evaluate all sources.	Evaluate only areas of observed contamination.
Consider entire source when evaluating all four tiers.	Consider only top two feet of an area of observed contamination, except when evaluating Tier C (volume).
Tier C (volume) can be used for these types of sources: Landfill Surface impoundment Surface impoundment (buried/backfilled) Drums Tanks and containers other than drums Contaminated soil Pile Other	Tier C (volume) can be used only for these types of sources: Surface Impoundment containing hazardous substances present as liquids Drums Tanks and containers other than drums
Table 2-5 provides the equations for assigning the source hazardous waste quantity value.	Table 5-2 provides the equations for assigning the source hazardous waste quantity value.
If hazardous constituent quantity (Tier A) is not adequately determined for all sources, the minimum factor value depends on: <ul style="list-style-type: none"> • Whether the targets are subject to actual contamination, and • Whether there has been a removal action. 	If hazardous constituent quantity (Tier A) is not adequately determined for all areas of observed contamination, the minimum factor value is always 10.

- (B2) **Determine whether Tier A has been adequately determined for the area of observed contamination.** If so, do not evaluate Tiers B, C, or D for this area. If Tier A is not adequately determined, continue to Step (B3).
- (B3) **Determine If the hazardous wastestream contains hazardous substances that meet the criteria for observed contamination (i.e., attributable to the site, present at a concentration significantly above background levels, and present within 2 feet of the surface).** Only hazardous wastestreams that contain at least one hazardous substance that meets the criteria for observed contamination within an area of observed contamination are considered present in that area of observed contamination.
- Do not evaluate those wastestreams, that do not contain at least one hazardous substance that meets the criteria for observed contamination.
 - If no wastestreams contain hazardous substances that meet the criteria for observed contamination do not evaluate the area of observed contamination with Tier B. Assign

a value of 0 for source hazardous wastestream quantity and evaluate the area of contamination with Tier C.

- If wastestreams contain hazardous substances that meet the criteria for observed release, continue to Step (B4).

(B4) **Evaluate the area of observed contamination using Tier B in the same manner as for the migration pathways.** See Section 6.3. There are two exceptions:

- Consider only the top two feet of the area of observed contamination, based on present conditions at the site.
- Assign a value for the area of observed contamination using the Tier B equation in HRS Table 5-2. (Note the Tier B equation is identical in HRS Tables 5-2 and 2-5.)

Manifests and process records usually provide good accounts of wastestreams. However, since the evaluation of hazardous wastestreams in the soil exposure pathway is restricted to the top two feet of the area of observed contamination and is based on present conditions, it should be documented that the waste, reported in the manifests and process records, was deposited or migrated within the top two feet. As general guidance, if manifests specify how much waste was deposited into a landfill and the landfill is known to be, for example, 10 feet deep, then 24/10 (or 1/5) of the manifested wastestream quantity can be assumed to be within the top two feet, unless information indicates otherwise.

EVALUATING TIER C — VOLUME

To evaluate Tier C for an area of observed contamination in the soil exposure pathway:

(C1) **Determine whether the source is an area of observed contamination.** See Section 9.1. For the nearby population threat, also determine if the area of observed contamination has an attractiveness/accessibility factor value greater than 0 (see Section 9.8). If not, do not evaluate hazardous waste quantity for that particular area of observed contamination.

(C2) **Determine whether Tier A or B has been adequately determined for the area of observed contamination.** If so, do not evaluate Tier C or D for this area. If Tier A or B is not adequately determined, continue to Step (C3).

(C3) **Determine if the type of area of observed contamination is eligible to be evaluated under Tier C in the soil exposure pathway.**

- Use Tier C only for the following types of areas of observed contamination:
 - S Surface impoundments containing hazardous substances present as liquids (evaluate dry, buried or backfilled surface impoundments under Tier D);
 - S Drums; or
 - S Tanks and containers other than drums.

If the area of observed contamination is eligible to be evaluated under Tier C, continue to Step (C4).

- If not, do not evaluate the area of observed contamination with Tier C. Assign a value of 0 for source volume, and evaluate the area of contamination using Tier D.

(C4) **In evaluating volume for the eligible types of areas of observed contamination, use the full volume, not just the volume within the top two feet.** Evaluate the area of observed contamination using Tier 0 in the same manner as for migration pathways (see Section 6.4) except:

- Assign a value for the area of observed contamination using the Tier C equation in HRS Table 5-2.

EVALUATING TIER D — AREA

To evaluate Tier D (area), for an area of observed contamination not eligible to be evaluated under Tier C (volume):

(D1) **Determine whether the source is an area of observed contamination.** See Section 9.1. For the nearby population threat, also determine if the area of observed contamination has an attractiveness/accessibility factor value greater than 0 (see Section 9.8). If not, do not evaluate hazardous waste quantity for that particular area of observed contamination.

(D2) **Determine whether Tier A, B, or C has been adequately determined for the area of observed contamination.** If so, do not evaluate Tier D. If Tier A, B, or C is not adequately determined, continue to Step (D3).

(D3) **Determine if the area of contamination is one of the following:**

- Surface impoundments containing hazardous substances present as liquids (evaluate dry, buried or backfilled surface impoundments under Tier D);
- Drums; or
- Tanks and containers other than drums.

If the area of contamination is one of these three types, evaluate using Tier C. Do not evaluate using Tier D.

If the area of contamination is not one of these three types, continue to Step (D4).

(D4) **Evaluate the area of observed contamination using Tier D in the same manner as for migration pathways.** See Section 6.5. There is one exception:

- Assign a value for the area of observed contamination using the Tier D equations in HRS Table 5-2.

CALCULATING HAZARDOUS WASTE QUANTITY FACTOR VALUE

Select the highest of the values assigned to each area of observed contamination from all tiers evaluated. This value is the source hazardous waste quantity for the area of observed contamination.

Sum the source hazardous waste quantity values assigned to each area of observed contamination to determine the hazardous waste quantity factor value. Round this sum to the nearest integer, except if the sum is greater than 0, but less than 1, then round it to 1. Based on this value, select the hazardous waste quantity factor value for the soil exposure pathway using HRS Table 2-6.

The minimum hazardous waste quantity factor value for the soil exposure pathway is 10, unless Tier A is adequately determined, regardless of whether targets are actually contaminated or whether a qualifying removal action has taken place.

TIPS AND REMINDERS

- The hazardous waste quantity value calculated for the resident population threat will be equal to or greater than the hazardous waste quantity value calculated for the nearby population threat. This is because of the additional requirement that only areas of observed contamination with an attractiveness/accessibility factor value greater than 0 can be evaluated for the nearby population threat.
- Use available volume measurements for surface impoundments containing hazardous substances as liquids, drums, and other containerized wastes. Otherwise, use the area measure of the upper two feet for all sources.
- Consider only substances that meet the criteria for observed contamination when calculating waste characteristics.

SECTION 9.3 RESIDENT POPULATION THREAT



This section provides an overview of the targets factor category of the resident population threat of the soil exposure pathway and explains how to identify targets for that threat. **Highlight 9-8** summarizes the targets considered in the resident population threat, the maximum factor value assigned to each of these targets, and references to the sections of this guidance and the section in the HRS that discuss each target. All targets evaluated in the resident population threat are subject to actual contamination. If no targets are identified, the resident population threat receives a score of 0; however, the nearby population threat may still be evaluated.

RELEVANT HRS SECTIONS

Section 5.1.3	Targets
Section 5.1.3.1	Resident individual
Section 5.1.3.2	Resident population
Section 5.1.3.3	Workers
Section 5.1.3.4	Resources
Section 5.1.3.5	Terrestrial sensitive environments

HIGHLIGHT 9-8 TARGETS IN THE RESIDENT POPULATION THREAT

Target	Maximum Factor Value	HRSGM Section	HRS Section
Resident Individual	50	9.4	5.1.3.1
Resident Population	no maximum	9.4	5.1.3.2
Workers	15	9.5	5.1.3.3
Resources	5	9.6	5.1.3.4
Terrestrial Sensitive Environment	site-specific-limited to that which results in a pathway score of 60 based solely on sensitive environments	9.7	5.1.3.5

DEFINITIONS

Area of Observed Contamination: Established based on sampling locations as any of the following:

- Generally, for contaminated soil, consider the sampling locations that indicate observed contamination and the area lying between such locations to be an area of observed contamination, unless information indicates otherwise.
- For sources other than contaminated soil, if any sample taken from the source indicates observed contamination, consider that entire source to be an area of observed contamination.

If an area of observed contamination (or a portion of such an area) is covered by a permanent, or otherwise maintained, essentially impenetrable material (e.g., asphalt), exclude the covered area from the area of observed contamination. However, asphalt or other impenetrable materials contaminated by site-related hazardous substances may be considered areas of observed contamination.

Observed Contamination: Surficial contamination related to a site. It must be established by chemical analysis. Observed contamination is present at sampling locations where analytic evidence indicates that:

- A hazardous substance attributable to the site is present at a concentration significantly above background levels for the site (i.e., meets the observed release criteria in HRS Table 2-3).
- The hazardous substance is present at the surface or covered by two feet or less of cover material (e.g., soil).

Resident Individual: A person who lives or attends school or day care on a property with an area of observed contamination and whose residence, school, or day care center, respectively, is on or within 200 feet of the area of observed contamination.

Resources: Resources considered for the soil exposure pathway are commercial agriculture, commercial silviculture, and commercial livestock production or grazing. Resources must be located on an area of observed contamination. See Section 9.5 for additional guidance.

Students: Full- or part-time attendees of an educational institution or day care facility located on or within 200 feet of an area of observed contamination. That area must also be within the property boundaries of institution or facility.

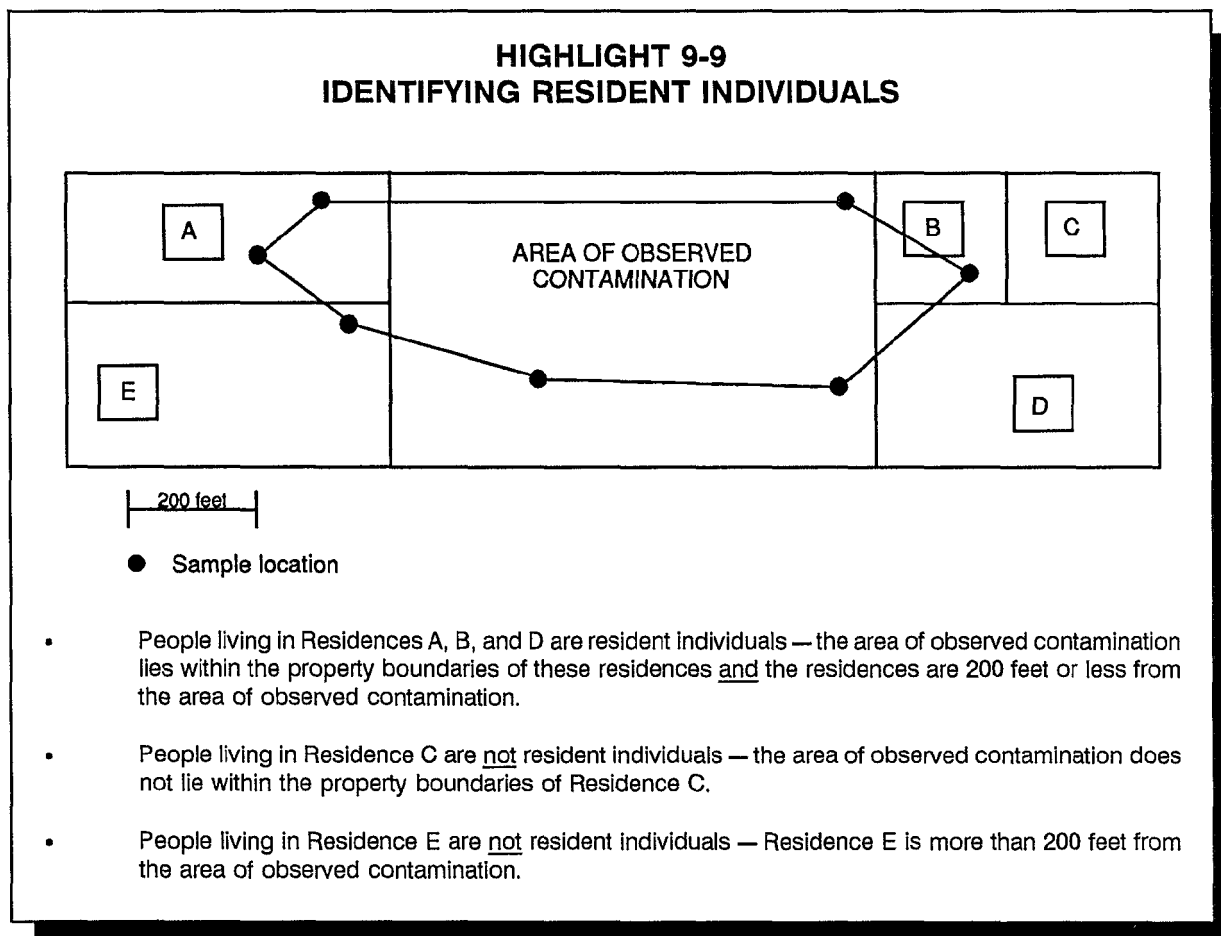
Terrestrial Sensitive Environment: A terrestrial sensitive environment is defined as any area that meets the criteria listed in HRS Table 5-5. No other areas are considered terrestrial sensitive environments. Appendix A defines each terrestrial sensitive environment and provides sources for identifying terrestrial sensitive environments. See Section 9.6 for additional guidance on scoring terrestrial sensitive environments.

Worker: A person working on a property with an area of observed contamination and whose workplace area is on or within 200 feet of an area of observed contamination. Both full and part-time workers are considered. Section 9.5 provides additional guidance.

IDENTIFYING RESIDENT INDIVIDUALS AND WORKERS

Identify resident individuals and workers as follows (see **Highlight 9-9** for an example):

- (1) **Delineate areas of observed contamination.** Section 9.1 provides step-by-step instructions for delineating areas of observed contamination. Mark these areas on a map that also indicates property boundaries (usually legal boundaries are the most appropriate) in the vicinity of the site.
- (2) **Identify those properties with areas of observed contamination.** If an area of observed contamination is located within the property boundaries of a residential property, school/day-care center, or workplace, continue to Step (3).
- (3) **Determine whether the residence, school, day care center, or workplace is within 200 feet of an area of observed contamination.**
 - Measure this distance as a straight line from the part of the building nearest the area of observed contamination unless there is a major obstacle (e.g., building, fence) between the two points. If the residence, school, day care center, or workplace area is within 200 feet of an area of observed contamination, then the resident, student, day care attendee, or worker is a target for the resident population threat. If the distance is greater than 200 feet, then those persons are not targets for the resident population threat.



- Evaluate multiple-unit residences such as apartments and condominiums as follows:
 - If the area of observed contamination is located in a common area, count all residents that regularly use the area as resident individuals, regardless of the distance from the area of observed contamination to the individual residences (e.g., if an apartment has four playgrounds, count 1/4 of the residents for each playground).
 - If the entire area of observed contamination is located in private areas (e.g., individual backyards), count only those residents living within 200 feet of the area of observed contamination as resident individuals.

IDENTIFYING RESOURCES AND TERRESTRIAL SENSITIVE ENVIRONMENTS

- (1) **Delineate areas of observed contamination.** Section 9.1 provides step-by-step instructions for delineating areas of observed contamination. Mark these areas on a scale map or diagram.
- (2) **Identify resources or terrestrial sensitive environments present on an area of observed contamination.**
 - If one of the designated resource uses (see Section 9.5) is on an area of observed contamination, that use is a target for the resources factor.
 - If one of the terrestrial sensitive environments listed in HRS Table 5-5 is on an area of observed contamination, that terrestrial sensitive environment is a target for the resident population threat.

Resources or terrestrial sensitive environments must be on an area of observed contamination to be scored; if they are within 200 feet, but not on an area of observed contamination, they cannot be scored.

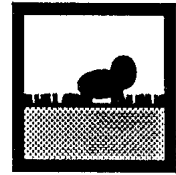
LEVEL I AND LEVEL II CONCENTRATIONS

Evaluate only targets subject to actual contamination in the resident population threat; do not evaluate targets subject to potential contamination. For resident individuals (i.e., residents, students, and children attending day care), the scorer should determine whether the targets are subject to Level I or Level II concentrations (see Section 9.4). Workers, terrestrial sensitive environments, and resources are not differentiated by Level I and Level II.

TIPS AND REMINDERS

- Assuming a maximum value for waste characteristics, a site can score greater than 28.50 based on the soil exposure pathway resident population if:
 - Four resident individuals are exposed to Level I concentrations; or
 - 41 resident individuals are exposed to Level II concentrations.
- If no resident individuals are identified, do not determine if the observed contamination is at Level I concentrations or Level II concentrations.

SECTION 9.4 RESIDENT INDIVIDUAL AND RESIDENT POPULATION



This section provides instructions for determining the level of contamination for resident individuals, and scoring resident individual and resident population factors in the soil exposure pathway. The resident individual and resident population factors are two components used to score the targets factor category of the resident population threat. The scorer should consider the number of qualifying residents on or near the area of observed contamination, and determine if they are subject to Level I or Level II concentrations.

RELEVANT HRS SECTIONS	
Section 5.1.3	Targets
Section 5.1.3.1	Resident individual
Section 5.1.3.2	Resident population

DEFINITIONS

Resident Individual: A person who lives or attends school or day care on a property with an area of observed contamination and whose residence, school, or day care center, respectively, is on or within 200 feet of the area of observed contamination. Section 9.3 provides guidance for identifying resident individuals.

Resident Individual Subject to Level I Concentrations: A resident individual is subject to Level I concentrations if the concentration of a hazardous substance that meets the criteria for observed contamination is at or above the appropriate benchmark and the sampling location is within the property boundary and within 200 feet of the residence/school. Level I concentrations also may be established if multiple hazardous substances are present below their respective benchmarks, but the I or J index is greater than or equal to one. Benchmarks for the soil exposure pathway include screening concentrations for cancer and screening concentrations for chronic noncancer effect.

Resident Individual Subject to Level II Concentrations: A resident individual not subject to Level I concentrations.

Resident Population: Total number of people meeting the criteria for resident individual.

Students: Full- or part-time attendees of an educational institution or day care facility located on or within 200 feet of an area of observed contamination. That area must also be within the property boundaries of the institution or facility.

Worker: A person working on a property with an area of observed contamination and whose workplace area is on or within 200 feet of an area of observed contamination. Both full and part-time workers are considered. Section 9.5 provides additional guidance.

EVALUATING LEVEL OF CONTAMINATION

To score the resident individual and resident population factors, the scorer should first determine the areas of observed contamination (see Section 9.1) and identify all resident individual targets (see Section 9.3). (Do not count workers in the resident individual or resident population factors. Section 9.5 describes how to score workers in the soil exposure pathway.) Next, determine whether each target is subject to Level I or Level II concentrations. Finally, evaluate the resident individual and resident population factors.

All resident individuals identified as targets for the resident population threat will be either at Level I or Level II. No targets in the resident population threat are evaluated as subject to potential contamination.

- (1) **Identify sampling locations that meet the criteria for observed contamination.** See Section 9.1.
- (2) **Determine the level of contamination for each sampling location.** Compare the concentration of each hazardous substance that meets the observed contamination criteria for that sampling location with its benchmark(s) for the soil exposure pathway. These benchmarks are available in SCDM.
 - If the concentration of any one of these hazardous substances is greater than or equal to its benchmark, that sampling location is Level I. Go to Step (4).
 - If only one hazardous substance meets the criteria for observed contamination and its concentration is less than the benchmark, that sampling location is Level II. Go to Step (4).
 - If more than one hazardous substance meets the observed contamination criteria for that sampling location but no single substance by itself can be used to establish Level I, continue to Step (3).
- (3) **Calculate the I and J indices for all hazardous substances that meet the observed contamination criteria.** Make two lists of substances that meet the observed contamination criteria: (1) hazardous substances with screening concentrations for cancer risk and (2) hazardous substances with screening concentrations for noncancer effects. Each hazardous substance may be on one, neither, or both of the lists. If more than one sample has been taken at a sampling location and these samples are comparable (e.g., taken in the same time frame, collected using the same field techniques, analyzed by the same methods) for each hazardous substance, select the highest concentration to use in the calculations below.
 - Calculate the I index for all hazardous substances with screening concentrations for cancer risk that meet the observed contamination criteria for that sampling location, using the following equation:

$$I = \sum_{i=1}^n \frac{C_i}{SC_i}$$

- where: C_i = concentration of hazardous substance i at sampling location;
- SC_i = screening concentration for cancer corresponding to a concentration associated with a risk of 10^6 from oral exposure for hazardous substance i ; and
- n = total number of hazardous substances that meet observed contamination criteria; that are carcinogens; and for which an SC is available.

- Calculate the J index for all hazardous substances with screening concentrations for noncancer effects that meet the observed contamination criteria, using the following equation:

$$J = \sum_{j=1}^m \frac{C_j}{CR_j}$$

- where: C_j = concentration of hazardous substance j at sampling location;
- CR_j = screening concentration for noncancer effects corresponding to oral exposure at reference dose for hazardous substance j ; and
- m = number of hazardous substances that meet observed contamination criteria and for which a CR is available.

- If either the I or J index is greater than or equal to 1, the sampling location is Level I. If both the I and J indices are less than 1, the sampling location is Level II.

- (4) **Indicate on the site map(s) (with property boundaries marked) where areas of observed contamination have been delineated and identify each sampling location as Level I or Level II.**
- (5) **Identify targets subject to Level I concentrations.** For each resident individual (see Section 9.3), determine whether a Level I sampling location is located within the property boundaries and within 200 feet of the residence, school, or day care center. If so, evaluate the target as Level I. Remember, an inferred area of observed contamination between Level I sampling locations is generally evaluated as Level II. If Level I concentrations cannot be established, continue to Step (6).
- (6) **Identify targets subject to Level II concentrations.** All resident individuals not subject to Level I concentrations are subject to Level II concentrations.

EVALUATING RESIDENT INDIVIDUAL

Evaluate this factor based on whether a resident individual, as specified above, is subject to Level I or Level II concentrations. Assign a value to the resident individual factor as follows:

- Assign a value of 50 if at least one resident individual is subject to Level I concentrations.
- Assign a value of 45 if no resident individual is subject to Level I concentrations, but at least one resident individual is subject to Level II concentrations.
- Assign a value of 0 if no resident individual is identified.

EVALUATING RESIDENT POPULATION

The resident population factor value is scored based on the number of resident individuals subject to Level I and Level II concentrations. The Level I and Level II concentration factor values are summed to calculate the resident population factor value.

Evaluate properties that have been subdivided as follows: if a subdivision consists of individual lots that are owned by the residents, then treat them as individual properties. If the individual lots are rented by the individuals living on them, but are still owned by one separate entity (e.g. a trailer park), treat them as one common property.

(1) **Evaluate the Level I concentration factor.**

- Determine the total number of resident individuals subject to Level I concentrations. Take an exact count or multiply the number of residences by the average number of people per residence for that county. This number should reflect the number of resident individuals at the time of SI scoring. However, if a residence or school was abandoned for reasons related to site contamination, use the population at the time it was abandoned.
- Calculate the Level I concentration factor value. Multiply the number of persons subject to Level I concentrations by 10 to calculate the factor value. Round the number to the nearest integer.

(2) **Evaluate the Level II concentration factor.**

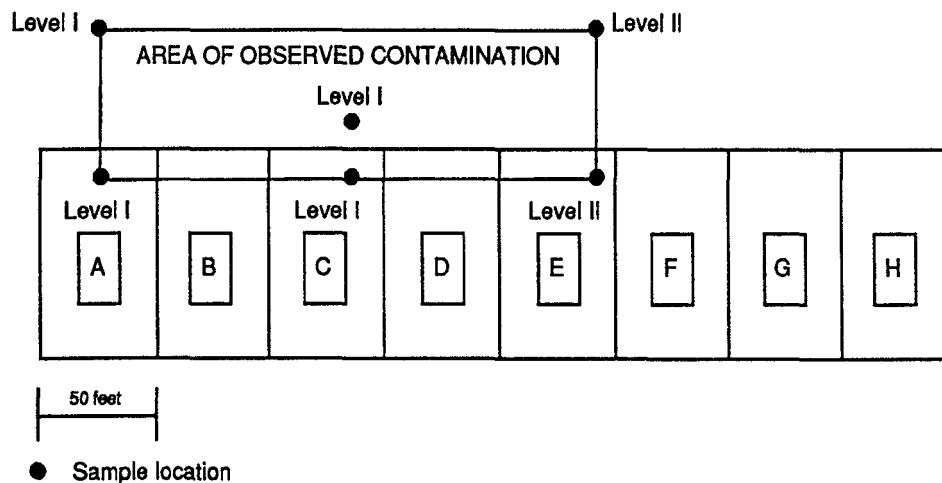
- Determine the total number of resident individuals subject to Level II concentrations. Determine as indicated in Step (1). Do not include anyone already counted in the Level I concentration factor.
- Calculate the Level II concentration factor value. The number of persons subject to Level II concentrations is the Level II concentration factor value. Round the number to the nearest integer.

(3) **Calculate the resident population factor value.** Sum the factor values for Levels I and II concentrations. This number is the resident population factor value.

Highlights 9-10 and **9-11** provide examples of determining the level of contamination, scoring the resident individual factor value, and scoring the resident population factor value.

HIGHLIGHT 9-10 SCORING EXAMPLE FOR RESIDENT POPULATION ON ADJACENT PROPERTIES

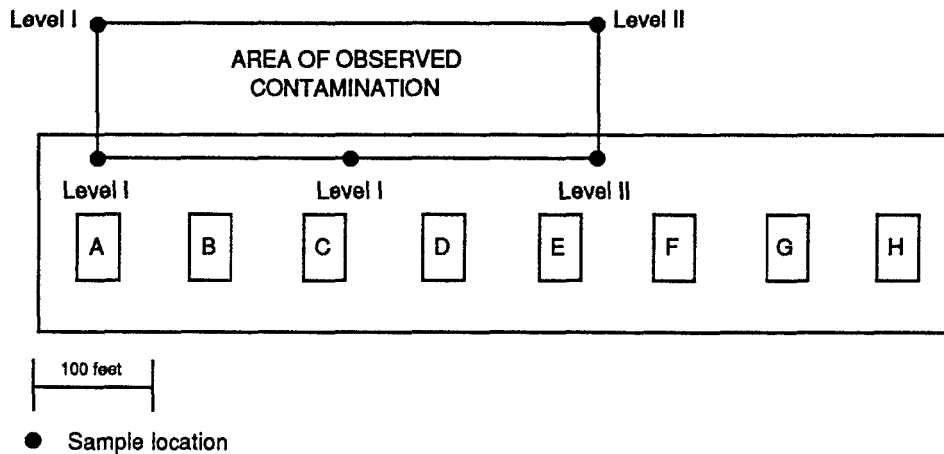
This example illustrates how to determine whether targets are subject to Level I or Level II concentrations and how to score the resident individual and resident population factors for several residences on individual properties located adjacent to the site.



- (1) **Determine the level of contamination.**
 - People living in residences A and C are subject to Level I concentrations because their residence is within 200 feet of a Level I sample on their property.
 - People living in residence B are subject to Level II concentrations because their residence is within 200 feet of an inferred area of contamination on their property.
- (2) **Assign points for the resident individual factor.** In this example, assign a value of 50, because at least one resident individual is subject to Level I concentrations.
- (3) **Evaluate the resident population factor.**
 - The 8 people living in residences A and C are subject to Level I concentrations. Level I concentration factor value = $8 \times 10 = 80$
 - The 3 people living in residence B are subject to Level II concentrations. Level II concentration factor value = 3
 - Sum the Level I and Level II values to obtain the resident population factor value, . Resident population factor value = $80 + 3 = 83$

HIGHLIGHT 9-11 SCORING EXAMPLE FOR MULTIPLE RESIDENCES ON ONE PROPERTY

This example illustrates how to determine whether targets are subject to Level I or Level II concentrations, and how to score the resident individual and resident population factors for a single property containing a number of residences (e.g., trailers). All residences in the figure below are within one property boundary.



(1) **Determine the level of contamination.**

- People living in residences A, B, C, D, and E are subject to Level I concentrations because they are within 200 feet of a Level I sample on their property.
- People living in residences F and G are subject to Level II concentrations because F and G are within 200 feet of a Level II sampling point on their property, but not within 200 feet of a Level I sampling point.
- People living in residence H are not evaluated as resident individuals because H is not within 200 feet of an area of observed contamination.

(2) **Assign points for the resident individual factor.** In this example, assign a value of 50, because there is at least one resident individual subject to Level I concentrations.

(3) **Evaluate the resident population factor.**

- The 18 people living in residences A, B, C, D, and E are subject to Level I concentrations. Level I concentration factor value = $18 \times 10 = 180$
- The 8 people living in residences F and G are subject to Level II concentrations. Level II concentration factor value = 8
- Sum the Level I and Level II values to obtain the resident population factor value. Resident population factor value = $180 + 8 = 188$

TIPS AND REMINDERS

- Evaluate and document the resident population factor accurately because a relatively small increase in the number of targets can significantly affect the site score.
- Because individuals can be exposed both at home and at school, count a student twice if that student attends school and resides within 200 feet of an area of observed contamination on a property with an area of observed contamination. Count teachers who both live and work in such areas once in the resident population factor value and once in the worker factor value (see Section 9.5).
- A property can be inferred to have observed contamination if the property lies between points of observed contamination, unless information indicates otherwise. Level I concentrations, however, generally should not be inferred across property boundaries.
- Do not count transient populations such as customers and travelers passing through the area.
- When scoring a school population for the resident threat, score teachers as workers and score students (including college students) as resident individuals if the school is on a property with an area of observed contamination and the school is within 200 feet of the area of observed contamination.
- If individuals abandoned schools, homes, or workplaces for reasons related to site contamination, score these individuals as targets in the appropriate factor. If the individuals abandoned their schools, homes, or workplaces for reasons other than the site contamination, do not score the individuals as targets.

SECTION 9.5 WORKERS AND RESOURCES



This section provides guidance for evaluating workers and scoring the resources factor for the targets factor category in the resident population threat of the soil exposure pathway. The workers factor is used to score the targets factor category of the resident population threat. The scorer must consider the number of workers who frequent workplace areas on or near the area of observed contamination. The resources factor evaluates the possible loss of resource use resulting from surficial contamination at a site. The factor evaluates the presence of commercial agriculture, commercial silviculture, commercial livestock production, and commercial livestock grazing; it does not evaluate threats to human health or sensitive environments.

RELEVANT HRS SECTION	
Section 5.1.3	Targets
Section 5.1.3.3	Workers
Section 5.1.3.4	Resources
Section 5.1.3.6	Calculation of resident population targets factor category value

DEFINITIONS

Commercial Agriculture: Production of crops for sale, including crops intended for widespread distribution (e.g., supermarkets) and more limited distribution (e.g., local produce stands), and any nonfood crops such as cotton and tobacco. Commercial agriculture does not include livestock production, livestock grazing, or crops grown for household consumption (e.g., backyard garden or fruit trees).

Commercial Livestock Production or Commercial Livestock Grazing: Raising or feeding of livestock for sale.

Commercial Silviculture: Cultivation of trees for sale (e.g., Christmas tree farm, trees raised for lumber).

Worker: A person working on a property with an area of observed contamination and whose workplace area is on or within 200 feet of an area of observed contamination. Both full and part-time workers are considered.

Workplace Area: Any area where workers are regularly present. Areas receiving only brief but regular use (e.g., parking areas, lunch areas) may qualify as work areas.

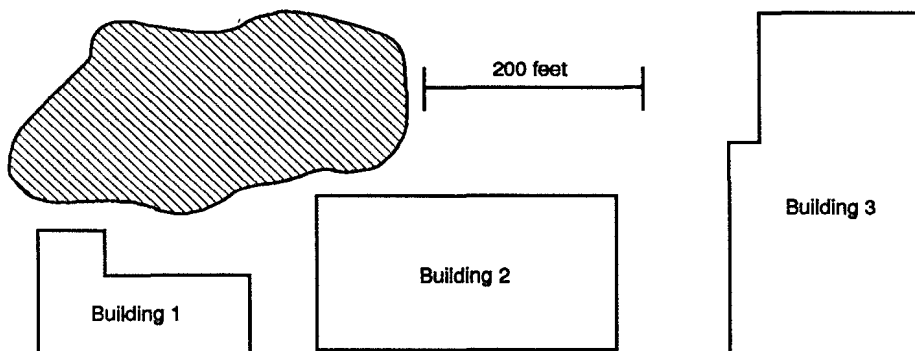
EVALUATING THE WORKERS FACTOR

Workers are not resident individuals and therefore cannot be used to score either the resident individual or resident population factors. Workers can be used to score the workers factor of the resident population threat as long as their workplace qualifies as an area of observed contamination. **Highlight 9-12** provides an example of scoring workers in the soil exposure pathway. Follow the steps below to score the workers factor.

- (1) **Identify areas of observed contamination.** Section 9.1 provides detailed instructions for identifying areas of observed contamination.
- (2) **Determine which groups of workers have workplace areas within 200 feet of the area of observed contamination.** Refer to facility maps and descriptions of job responsibilities.
- (3) **Evaluate the workers factor value based on the number of workers that meet the criteria above.** Contact the workplace directly, remembering that the factor value is assigned based on broad ranges of numbers. Thus, it is not necessary to obtain an exact count of workers.
- (4) **Assign a value for these workers using HRS Table 5-4.**

HIGHLIGHT 9-12 EVALUATING WORKERS AT A MULTIPLE-BUILDING FACILITY

This example illustrates how to evaluate workers at a facility with more than one workplace area.



Building 1 has approximately 50 workers, Building 2 has approximately 125 workers, and Building 3 has approximately 250 workers. All the buildings and the area of observed contamination are within the same property boundary.

Count workers in Buildings 1 and 2 as targets in the soil exposure pathway. Do not count workers in Building 3 because they do not work within 200 feet of the area of observed contamination and are not expected to frequent Buildings 1 or 2 on a regular basis.

The total number of qualifying workers is 175. Assign the workers factor a value of 10, using HRS Table 5-9.

SCORING THE RESOURCES FACTOR

- (1) **Determine if any land uses for which resource points are assigned are located on areas of observed contamination.** See *Highlight 9-13*. Use the definitions above in making this determination. The resource use must be within the boundary of the area of observed contamination. *Highlight 9-14* provides sources of information that may help document resources at the site.
- (2) **If a resource use is documented, assign a value of 5 to the resources factor for the site.** If no resource use is documented, assign a value of 0.

HIGHLIGHT 9-13 CHECKLIST FOR THE RESOURCES FACTOR

For the site being evaluated:

- | | | | |
|-----|--|-----|----|
| (1) | Is commercial agriculture present on an area of observed contamination at the site? | Yes | No |
| (2) | Is commercial silviculture present on an area of observed contamination at the site? | Yes | No |
| (3) | Is commercial livestock production or commercial livestock grazing present on an area of observed contamination at the site? | Yes | No |

If the answer is "yes" for any of the possibilities above, assign a resources factor value of 5. Otherwise, assign a resources factor value of 0. Remember that "yes" should be circled only if an activity takes place on an area of observed contamination.

HIGHLIGHT 9-14 DATA SOURCES FOR THE RESOURCES FACTOR

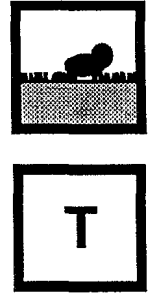
The following sources of information may help in documenting resource use for a site:

- **Agricultural extension agents**
- **Correspondence with nearby businesses**
- **Correspondence with other nearby institutions, such as farms or universities**
- **County land use maps**
- **PA/SI reports**
- **Field observations**
- **Files from adjacent or nearby CERCLIS sites**
- **Local chambers of commerce**
- **Soil Conservation Service State departments of natural resources or state environmental departments, especially forestry departments**
- **The U.S. Department of Agriculture/U.S. Forest Service**
- **Topographic maps.**

TIPS AND REMINDERS

- Likelihood of exposure rather than duration is the important factor in determining if an individual may be exposed to hazardous substances at a workplace area. For example, workers who frequent a lunch area or administrative building located within 200 feet of an area of observed contamination may be counted as workers, even if their "regular" workplace area is more than 200 feet from the area of observed contamination.
- When evaluating school populations, score students as resident individuals if they attend school on a property with an area of observed contamination and the school is within 200 feet of the area of observed contamination. Score teachers at such a school as workers, and not as residents.
- In general, do not expend resources to determine if there is any overlap in student, worker, and resident populations (i.e., do not try to determine where students or workers live).
- Only 5 targets points are assigned for the resources factor. Do not spend significant time documenting resource use unless those 5 points may be critical to the site score.

SECTION 9.6 TERRESTRIAL SENSITIVE ENVIRONMENTS



This section provides a method for identifying terrestrial sensitive environments and for calculating the terrestrial sensitive environments factor value in the soil exposure pathway. Definitions of all terrestrial sensitive environments and specific sources of information for identifying terrestrial sensitive environments are provided in Appendix A. Only those areas that meet the definitional criteria for one or more terrestrial sensitive environments listed in HRS Table 5-5 are eligible for evaluation. All terrestrial sensitive environments located partially or wholly on the area of observed contamination are eligible. Because there are no applicable benchmarks for sensitive environments in the soil exposure pathway, they are always considered subject to Level II concentrations.

RELEVANT HRS SECTIONS	
Section 5.1	Resident population threat
Section 5.1.3	Targets
Section 5A.3.5	Terrestrial sensitive environments

DEFINITIONS

Area of Observed Contamination: Established based on sampling locations as any of the following:

- Generally, for contaminated soil, consider the sampling locations that indicate observed contamination and the area lying between such locations to be an area of observed contamination, unless information indicates otherwise.
- For sources other than contaminated soil, if any sample taken from the source indicates observed contamination, consider that entire source to be an area of observed contamination.

If an area of observed contamination (or a portion of such an area) is covered by a permanent, or otherwise maintained, essentially impenetrable material (e.g., asphalt), exclude the covered area from the area of observed contamination. However, asphalt or other impenetrable materials contaminated by site-related hazardous substances may be considered areas of observed contamination.

Observed Contamination: Surficial contamination related to a site. It must be established by chemical analysis. Observed contamination is present at sampling locations where analytic evidence indicates that:

- A hazardous substance attributable to the site is present at a concentration significantly above background levels for the site (i.e., meets the observed release criteria in HRS Table 2-3).

- The hazardous substance is present at the surface or covered by two feet or less of cover material (e.g., soil).

Terrestrial Sensitive Environment: A terrestrial sensitive environment is defined as any area that meets the criteria listed in HRS Table 5-5. No other areas are considered terrestrial sensitive environments. Appendix A defines each terrestrial sensitive environment and provides sources for identifying terrestrial sensitive environments. Sensitive environments that are eligible to be scored in the soil exposure pathway and their assigned point values are as follows:

- Terrestrial critical habitat for Federal designated endangered or threatened species (100 points);
- National Park (100 points);
- Designated Federal Wilderness Area (100 points);
- National Monument (100 points);
- Terrestrial habitat known to be used by Federal designated or proposed threatened or endangered species (75 points);
- National Preserve (terrestrial) (75 points);
- National or state Wildlife Refuge (terrestrial) (75 points);
- Federal land designated for protection of natural ecosystems (75 points);
- Administratively proposed Federal Wilderness Area (75 points);
- Terrestrial areas utilized for breeding by large or dense aggregations of animals (75 points);
- Terrestrial habitat known to be used by state designated endangered or threatened species (50 points);
- Terrestrial habitat known to be used by species under review as to its Federal designated endangered or threatened status (50 points);
- State lands designated for wildlife or game management (25 points);
- State designated Natural Areas (25 points); and
- Particular areas, relatively small in size, important to maintenance of unique biotic communities (25 points).

SCORING TERRESTRIAL SENSITIVE ENVIRONMENTS

Many terrestrial sensitive environments will be relatively easy to identify and delineate with readily available materials (e.g., maps or EPA Regional files for other sites located near the site being evaluated); more in-depth investigation may be necessary to determine if other types of terrestrial sensitive environments are within the area of observed contamination. The following steps will help identify and score the terrestrial sensitive environments listed in HRS Table 5-5.

- (1) **Determine the areas of observed contamination.** See Section 9.1. Determining Level I or Level II concentrations is not necessary in evaluating terrestrial sensitive environments
- (2) **Identify and delineate all eligible terrestrial sensitive environments.** All terrestrial sensitive environments (i.e., those listed in HRS Table 5-5) that are at least partially on an area of observed contamination are eligible. The 200-foot rule for resident populations does not apply to terrestrial sensitive environment targets. Property boundaries are not considered.
 - Obtain a USGS topographic map of the area. Maps are available from USGS map stores, most outdoor stores, and local outfitters. Delineate areas of observed contamination on the topographic map.
 - Identify terrestrial sensitive environments delineated on the map. The following terrestrial sensitive environments are likely to be found on USGS topographic maps:

- National Park
- Designated Federal Wilderness Area
- National Monument
- National Preserve (terrestrial)
- National or state terrestrial wildlife refuge
- State lands designated for wildlife or game management (in some cases).

In many cases, the level of detail provided by USGS maps will be sufficient for HIRS purposes. In other cases, more specialized maps or professional judgment may be needed.

- Obtain additional maps, documents, or other relevant information to determine whether other terrestrial sensitive environments are at least partially on an area of observed contamination. The following sensitive environments may be delineated on specialized maps, charts, or other special documents available from various Federal and state agencies:

- Terrestrial critical habitat for Federal designated endangered or threatened species (in some cases);
- Federal land designated for the protection of natural ecosystems;
- Administratively proposed Federal Wilderness Areas;
- State lands designated for wildlife or game management; and
- State designated Natural Areas.

Sources of information on sensitive environments and specific guidance for obtaining specialized maps is provided in Appendix A.

If all potential terrestrial sensitive environments can be identified and delineated using USGS topographic maps and other specialized maps, no further investigation will be necessary. However, many sensitive environments are not delineated on either USGS or specialized maps, so other sources may need to be consulted.

- Contact appropriate Federal, state, or local agencies if an area not delineated on a map may be a terrestrial sensitive environment. The following terrestrial sensitive environments generally are not delineated on maps or otherwise described in specialized publications.

- Terrestrial habitat known to be used by Federal designated or proposed endangered or threatened species;
- Terrestrial areas utilized for breeding by large or dense aggregations of animals;
- Terrestrial habitat known to be used by state designated endangered or threatened species;
- Terrestrial habitat known to be used by species under review as to its Federal endangered or threatened status; and
- Particular areas, relatively small in size, important to maintenance of unique biotic communities.

The assistance of appropriate Federal, state, or local agencies or recognized experts in identifying these sensitive environments is encouraged. Try to obtain copies of any published information that helps to establish the area as a sensitive environment and/or delineate its boundaries. If possible, obtain a written statement from a responsible agency official verifying the existence and boundaries of the terrestrial sensitive environments. For guidance on identifying these sensitive environments and on sources of information to delineate these sensitive environments, see Appendix A.

- Draw the boundaries of each terrestrial sensitive environment on the USGS topographic map or a scale map of the site. While this step is optional, it may be helpful in delineating the terrestrial sensitive environments.
- (3) **Assign a point value for the terrestrial sensitive environment(s).** Assign the appropriate point value from HRS Table 5-5 to each terrestrial sensitive environment at least partially on an area of observed contamination. If more than one point value applies to a single area of observed contamination, go to Step (4), otherwise go to Step (5).
- (4) **If more than one point value applies to a single area of observed contamination:**
- Score each discrete physical area identified as a terrestrial sensitive environment as a separate target for HRS purposes, regardless of the degree of overlap with other terrestrial sensitive environments.
 - Treat "critical habitat for" or "habitat known to be used by" endangered or threatened species as follows:
 - Identify at least one distinct habitat for each individual species (e.g., if there are three different species, identify three or more habitats - even if they partially or completely overlap).
 - For each species, assign the category with the highest point value. For example, if the same species is both a Federal proposed threatened species (75 points), and a state designated endangered species (50 points), evaluate the species as a Federal proposed threatened species.
 - If there is overlap between "critical habitat for" and "habitat known to be used by" the same species, consider the overlapping area to be only a "critical habitat" for HRS purposes (i.e., do not consider the zone of overlap as both "critical habitat for" and "habitat used by" the species).
- (5) **Calculate the total targets value for terrestrial sensitive environments.** Because only those terrestrial sensitive environments wholly or partially on an area of actual contamination are evaluated as targets in the soil exposure pathway, and no ecological-based benchmarks are used, do not evaluate levels of concentrations for terrestrial sensitive environments in the soil exposure pathway. To obtain the total targets value for sensitive environments (ES), sum assigned point values for all terrestrial sensitive environments wholly or partially on an area of actual contamination.
- (6) **Calculate the terrestrial sensitive environments factor value.** Because the soil exposure pathway score based solely on terrestrial sensitive environments is limited to 60 points, the method for determining the terrestrial sensitive environments factor value depends on the total targets value for sensitive environments (ES - calculated in Step (5) above), the likelihood of exposure value for the resident population threat (LE - 550 points for the resident population threat), and the waste characteristics value for the resident population threat (waste characteristics (WC) - see Section 9.2).

- Multiply the values assigned to the resident population threat for LE, WC, and ES and divide this product by 82,500.

$$S = \frac{(LE)(WC)(ES)}{82,500}$$

- If the resulting score (S) is 60 or less, assign ES as the terrestrial sensitive environments factor value.
- If the resulting score (S) is greater than 60, assign only that portion of ES that will result in a resident population threat score of 60 as the terrestrial sensitive environments factor value. This value, termed EC, is calculated as follows:

$$EC = \frac{(60)(82,500)}{(LE)(WC)} = \frac{4,950,000}{(LE)(WC)}$$

Since all the values in this equation are constants except WC, only one EC value corresponds to each WC value. These values are presented in **Highlight 9-15**. Do not round EC to the nearest integer.

Highlight 9-16 illustrates how to score terrestrial sensitive environments.

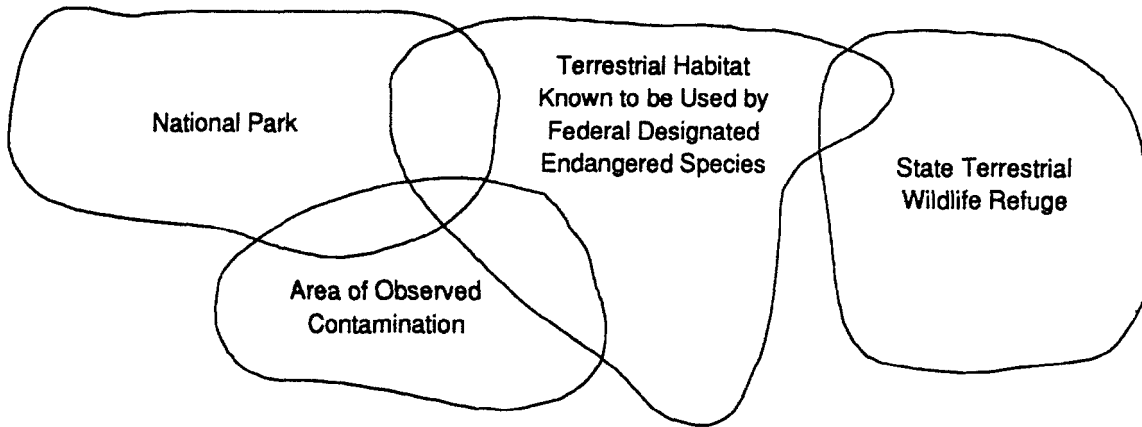
- (7) **The value calculated in Step (6) (either ES or EC) is added to the values for resident individual, resident population, workers, and resources, to calculate the total targets score.**

HIGHLIGHT 9-15 EC VALUES CORRESPONDING TO WASTE CHARACTERISTICS FACTOR VALUES

Because the soil exposure pathway score based solely on terrestrial sensitive environments is limited to 60 points, the product of the likelihood of exposure (LE), waste characteristics (WC), and sensitive environments (ES) divided by 82,500 cannot exceed 60. If this value does exceed 60, the scorer calculates the maximum value for sensitive environments that will not exceed 60. (I.e., the value of EC). Because all the values in this equation for calculating EC are constants except WC, there is only one EC value associated with each WC factor value.

Waste Characteristics Factor Value	EC Value
1	9000
2	4500
3	3000
6	1500
10	900
18	500
32	281.25
56	160.71
100	90

HIGHLIGHT 9-16
SCORING EXAMPLE FOR TERRESTRIAL SENSITIVE ENVIRONMENTS



At this site, the area of observed contamination has been determined, the assigned value for likelihood of exposure (LE) is 550, and the assigned value for waste characteristics (WC) is 100. Three terrestrial sensitive environments are identified and delineated as shown.

- The National Park and the terrestrial habitat known to be used by a Federal endangered species are identified as eligible to be evaluated in the soil exposure pathway because each is partially on the area of observed contamination. The state terrestrial wildlife refuge is not eligible because it is not partially within the area of observed contamination.
- The National Park is assigned a point value of 100 from HRS Table 5-5 and the habitat known to be used by the endangered species is assigned a point value of 75 from HRS Table 5-5.
- The total targets value for sensitive environments (ES) is determined by summing the assigned point values for the National Park and the habitat known to be used by the endangered species (i.e., $100 + 75 = 175$).
- The terrestrial sensitive environments factor value is determined as follows:
 - The values for LE, WC, and ES are multiplied and divided by 82,500 to obtain the score (S) of 116.67.
 - Because 116.67 is greater than 60, the value $EC = 90$ is calculated by dividing $(60 \times 82,500)$ by $(LE \times WC)$.
 $EC = 4,950,000/55,000 = 90$
 - The terrestrial sensitive environments factor was assigned a value of 90 (i.e., EC).

TIPS AND REMINDERS

- The 200-foot rule for resident populations does not apply to sensitive environment targets. Sensitive environments must be listed in HRS Table 5-5 and be at least partially on the area of observed contamination to be evaluated as a terrestrial sensitive environment in the soil exposure pathway.
- If overlapping sensitive environments (i.e., those listed in HRS Table 5-5) are at least partially on an area of observed contamination, evaluate each sensitive environment separately, with certain restrictions for habitats of endangered or threatened species.
- The sensitive environment category "wetland" is not evaluated in the soil exposure pathway. However, portions of wetlands that are periodically out of water and that meet the criteria for one or more terrestrial sensitive environment categories may be evaluated as that type of sensitive environment.
- Terrestrial sensitive environments are evaluated only in the resident population threat, not in the nearby population threat.

SECTION 9.7 ESTIMATION OF NEARBY POPULATION THREAT SCORES



This section is designed to estimate the maximum score that can be expected from the nearby population threat of the soil exposure pathway before beginning the detailed scoring process. This section presents general formulae and look-up tables that provide estimates of nearby population threat scores. Section 9.8 provides guidance on scoring the nearby population threat. Because the nearby population threat evaluates only non-residents and students coming onsite, nearby population threat scores tend to be low. Therefore, sites must be relatively accessible and attractive, with a fairly large nearby population, to obtain a significant score or to warrant detailed scoring of the threat. This section provides guidance for estimating nearby population, the area of observed contamination, and the maximum expected nearby population threat score. This section is intended as a general guideline and should not be used to determine whether nearby population threat should be scored.

DEFINITIONS

Nearby Population: Total number of people who live or attend school within a 1 -mile travel distance of an area of observed contamination and who do not meet the criteria for resident individual.

Resident Individual: A person who lives or attends school or day care on a property with an area of observed contamination and whose residence, school, or day care center, respectively, is on or within 200 feet of the area of observed contamination. Section 9.3 provides guidance for identifying resident individuals.

ESTIMATING NEARBY POPULATION THREAT SCORE

Follow these steps to quickly determine if detailed scoring and documentation of the nearby population threat is warranted.

- (1) **Estimate nearby population.** Estimate nearby population using one of the following three approaches:
 - In the first method, if nearby population data are readily available for each of the three travel distance categories (i.e., >0 to 1/4 mile, >1/4 to 1/2 mile, >1/2 to 1 mile), determine the distance-weighted population value from HRS Table 5-10.
 - In the second method, nearby population data are not readily available, obtain a recent estimate of population density in the vicinity of the site and use this estimate to approximate nearby population (see **Highlight 9-17**). Assume that the travel distance categories are delineated by concentric circles around the areas of observed contamination and that the local population is evenly distributed within the TDL. If information suggests otherwise (e.g., no one lives within 1/2 mile of the site), adjust the estimate of nearby population.

HIGHLIGHT 9-17
APPROXIMATE DISTANCE-WEIGHTED POPULATION
VALUES BASED ON LOCAL POPULATION DENSITY (D)^a

Approximate Dimension of Area of Observed Contamination	Travel Distance Category	Approximate Population ^{b,c}
1.8 acres	>0 to 1/4	0.2 x D
	>1/4 to 1/2	0.6 x D
	>1/2 to 1	2.4 x D
126 acres	>0 to 1/4	0.6 x D
	>1/4 to 1/2	1.0 x D
	>1/2 to 1	3.1 x D
3.2 square miles	>0 to 1/4	1.8 x D
	>1/4 to 1/2	2.2 x D
	>1/2 to 1	5.5 x D

^a D = local population density (people per square mile).

^b Formulas assume concentric travel distance categories.

^c See HRS Table 5-10 to determine the approximate distance-weighted population value.

- In the third method, if local population density cannot be readily estimated, estimate population density based on whether the site is located in an urban, suburban, or rural area. Typically population densities (people per square mile) for these areas are as follows: 5,100 (large urban area), 1,300 (suburban or urban in small city), 300 (rural).

(2) **Determine the approximate maximum nearby threat score assuming maximum values for waste characteristics and likelihood of exposure.** To determine an approximate upper-bound limit for the nearby population threat score, assume the maximum waste characteristics factor category value (i.e., 100) and the maximum likelihood of exposure factor category value (i.e., 500).

- If an approximate distance-weighted population value is obtained using methods 1 or 2 under Step (1), determine the approximate maximum nearby population threat score by multiplying the result by 0.061 (i.e., (100 x 500)/82,500).
- If a nearby population is estimated using method 3 under Step (1), **Highlight 9-18** can be used to estimate maximum nearby population threat score (**Highlight 9-18** also assumes concentric travel distance categories and an evenly distributed population).

Highlight 9-18 can also be used to determine a range of maximum nearby population threat scores when population density data are available from method 2 under Step (1). From the population density data, area of observed contamination, and likelihood of exposure factor, estimate the maximum nearby population threat score. For example, for a medium site with maximum values for likelihood of exposure and waste characteristics factor categories, and a population density of 2,500 people per square mile, the maximum nearby population threat score is between 4 and 13.

If the approximate maximum nearby threat scores suggest that it may be worthwhile to score the nearby population threat, proceed to Step (3).

HIGHLIGHT 9-18
APPROXIMATE NEARBY POPULATION THREAT SCORES ^a

Area of Observed Contamination	Likelihood of Exposure	Population Density (people per square mile)						
		50	100	500	1,000	5,000	10,000	50,000
1.8 acres	500	1	1	1	2	9	13	83
	375	1	1	1	1	7	10	62
	250	0	0	1	1	4	7	41
	125	0	0	0	1	2	3	21
	50	0	0	0	0	1	1	8
	25	0	0	0	0	0	1	4
	5	0	0	0	0	0	0	1
126 acres	500	1	1	2	4	13	32	100
	375	1	1	1	3	10	24	95
	250	0	0	1	2	7	16	63
	125	0	0	0	1	3	8	32
	50	0	0	0	0	1	3	13
	25	0	0	0	0	1	2	6
	5	0	0	0	0	0	0	1
3.2 square miles	500	1	1	3	6	27	58	100
	375	1	1	2	5	20	43	100
	250	0	1	2	3	14	29	100
	125	0	0	1	2	7	14	66
	50	0	0	0	1	3	6	26
	25	0	0	0	0	1	3	13
	5	0	0	0	0	0	1	3

^a The scores presented in this table assume a waste characteristics factor category value of 100, nearby individual factor value equal to one, concentric travel distance categories, and uniformly distributed population (see text). Also, these values reflect the nearby population threat's overall effect on the soil exposure pathway score (i.e., they are divided by 82,500).

- (3) **Determine the approximate maximum nearby population threat score assuming maximum value for waste characteristics.** If the maximum approximate nearby population threat score suggests that it may be worthwhile to score the nearby population threat, obtain a more realistic upper bound on the nearby population threat score by estimating likelihood of exposure (and continuing to assume maximum waste characteristics). The likelihood of exposure factor category value is based on area of contamination and attractiveness/accessibility.
- Determine the approximate area of observed contamination. If the area of contamination is known or can easily be determined or estimated (e.g., areas of observed contamination are limited to surface impoundments or other areas with known dimensions), determine the area of contamination factor value using HRS Table 5-7. If the area of contamination is less apparent, use **Highlight 9-19** to determine the area of contamination factor value that best approximates the maximum size of the area(s) of observed contamination for the site.
 - Determine the approximate maximum attractiveness/accessibility factor value. If any area of observed contamination is within a designated recreational area, national park, or other similar area, assign an attractiveness/accessibility factor value of 100. Otherwise, assume an attractiveness/accessibility factor value of 75.
 - Estimate likelihood of exposure. Use the estimated area of contamination factor value and the estimated attractiveness/accessibility factor value to approximate the likelihood of exposure factor category value, using **Highlight 9-20**.
 - Determine the approximate nearby population threat score. From **Highlight 9-18**, estimate the approximate nearby population threat score using the estimate for the likelihood of exposure factor category. Remember that this step still assumes a waste characteristics factor value equal to 100. Score the nearby population threat only if this approximate nearby population threat score suggests that it is worth proceeding further. To actually score the nearby population threat, follow HRS section 5.2 and Section 9.8.

**HIGHLIGHT 9-19
ESTIMATED AREA OF CONTAMINATION FACTOR VALUES**

Assigned Factor Value for Area of Contamination	Minimum Area of Contamination Needed to Score Factor Value (square feet)	Diameter of Contaminated Circular Area Needed to Achieve Value (feet)
5	>0	>0
20	>5,000	80
40	>125,000	400
60	>250,000	565
80	>375,000	690
100	>500,000	800

**HIGHLIGHT 9-20
ESTIMATED NEARBY POPULATION LIKELIHOOD OF EXPOSURE FACTOR VALUES**

Attractiveness/ accessibility Factor Value	Area of Contamination Factor Value					
	100	80	60	40	20	5
100	500	500	375	250	125	50
75	500	375	250	125	50	25

SECTION 9.8 EVALUATION OF NEARBY POPULATION THREAT



This section provides guidance for scoring the nearby population threat of the soil exposure pathway. The nearby population threat targets factor category reflects the non-resident population potentially at risk from exposure to contaminated soil or other contaminated surficial materials. This section provides instruction for scoring the likelihood of exposure, waste characteristics, and targets factor categories. In addition, this section clarifies how to determine travel distance.

RELEVANT HRS SECTIONS

Section 5.0.1	General considerations
Section 5.2	Nearby population threat
Section 5.2.1.1	Attractiveness/accessibility
Section 5.2.1.2	Area of contamination
Section 5.2.3	Targets

DEFINITIONS

Nearby Individual: Resident or student with the shortest travel distance to any area of observed contamination. If one or more individuals meet the criteria for resident individual, the nearby individual factor value is zero.

Nearby Population: Total number of people who live or attend school within a 1-mile travel distance of an area of observed contamination and who do not meet the criteria for resident individual.

Public Recreation Area: Publicly or privately owned area used for recreation by individuals not evaluated as workers in the resident population threat.

Resident Individual: A person who lives or attends school or day care on a property with an area of observed contamination and whose residence, school, or day care center, respectively, is on or within 200 feet of the area of observed contamination. Section 9.3 provides guidance for identifying resident individuals.

Travel Distance: The shortest overland distance an individual would travel from a residence or school to the nearest area of observed contamination, considering natural barriers (e.g., ravines, streams). If there are no natural barriers, the travel distance is the shortest straight-line distance.

SCORING THE LIKELIHOOD OF EXPOSURE FACTOR CATEGORY

To score the likelihood of exposure factor category for the nearby population threat, determine the attractiveness/accessibility factor value and the area of contamination factor value for the areas of observed contamination as follows.

(1) **Assign the attractiveness/accessibility factor value.** Assign each area of observed contamination a value for attractiveness/accessibility, excluding any area of observed contamination on a residential property. If an area falls into two or more categories, use the higher score. Select the highest value assigned to the areas evaluated and use it as the attractiveness/accessibility factor value for the site. If the attractiveness/accessibility factor value for a site is 0, the nearby population threat score will be 0.

Highlight 9-21, which is based on HRS Table 5-6, provides attractiveness/accessibility factor values along with examples of the types of areas that would receive a given value. Public recreation use can be activities such as walking, sports, fishing, air shows, and hayrides, and can occur on public or private lands. The examples presented in **Highlight 9-21** are not exhaustive. Select the best-fitting category and document why it was selected.

(2) **Determine the area of contamination factor value.** The area of contamination factor value is based on the total area of all areas of observed contamination at the site with an attractiveness/accessibility factor value greater than 0. To determine the area of contamination factor value:

- Identify all areas of observed contamination with an attractiveness/accessibility value greater than 0.
- Determine their total area.
- Assign the approximate area of contamination factor value using HRS Table 5-7.

Section 9.1 provides instruction on identifying areas of observed contamination.

(3) **Determine the likelihood of exposure factor category value.** The likelihood of exposure factor category value is based on the values assigned to the attractiveness/accessibility and area of contamination factors. Use HRS Table 5-8 to assign this value. The maximum value is 500.

SCORING WASTE CHARACTERISTICS FACTOR CATEGORY

The waste characteristics factor category for the nearby population threat is scored as it is scored for the resident population threat, except that the nearby threat considers only those areas of observed contamination that have an attractiveness/accessibility factor value greater than 0. The waste characteristic factor category value for the nearby population threat, therefore, will be equal to or less than that for the resident population threat. Section 9.2 provides guidance on scoring the waste characteristics factor.

SCORING TARGETS FACTOR CATEGORY

The targets factor category value for the nearby population threat is based on two factors: nearby individual and population within a one-mile travel distance from the site. Sum these two factor values for the targets factor category value.

HIGHLIGHT 9-21
EXAMPLES OF ATTRACTIVENESS/ACCESSIBILITY VALUES

Area of Observed Contamination	Assigned Value
<p>Designated recreational areas Includes areas designed specifically to encourage recreational use.</p> <ul style="list-style-type: none"> • Playground • Golf course (public or private) • Baseball field with backstop and maintained basepaths or infield • Areas with Improvements aimed at enabling people to view scenic attractions 	100
<p>Areas regularly used for public recreation Includes areas used regularly for public recreation but not designated for such use.</p> <ul style="list-style-type: none"> • Open fields where people play frisbee • Fields where people play baseball (provided that they are not maintained for such use) 	75
<p>Accessible and unique recreational areas</p> <ul style="list-style-type: none"> • Vacant lot in an urban area • Shoreline of stream in an urban area 	75
<p>Moderately accessible areas with some public recreation use Includes areas used for recreation with some Improvements that increase accessibility even if these improvements are not made specifically for the areas In question.</p> <ul style="list-style-type: none"> • Undeveloped land along corridors to a recreational area where there are not thousands of acres of similarly undeveloped land (e.g., areas adjacent to a road or trail leading to a public lake or river) • Shoreline of public lakes or rivers that can be reached via moderately improved roads (e.g., gravel or dirt) 	50
<p>Slightly accessible areas with some public recreation use Includes areas used for public recreation but with few improvements that increase accessibility to the areas. It can also include areas that have nothing unique about them relative to their surroundings.</p> <ul style="list-style-type: none"> • Shorelines of relatively remote public lakes (e.g., lakes that cannot be reached by automobile) • Undeveloped land along corridors to a recreational area where there are thousands of other acres of similarly undeveloped land along the corridor 	25
<p>Accessible areas with no public recreation use</p> <ul style="list-style-type: none"> • Unfenced industrial or commercial site (guarded or not) with no vacant lots, sand piles, or other recreational attractions • Abandoned lagoons or other surface impoundments in an industrial area 	10
<p>Areas surrounded by maintained fence or combination of maintained fence and natural barriers</p> <ul style="list-style-type: none"> • Fenced, unguarded industrial or commercial sites 	5
<p>Areas physically Inaccessible to public, with no evidence of public recreation use Includes areas where (1) steps have been taken to absolutely preclude public access to the areas or (2) natural conditions make access physically impossible.</p> <ul style="list-style-type: none"> • Area off-limits to unauthorized personnel at guarded and fenced military base or industrial complexes. 	0

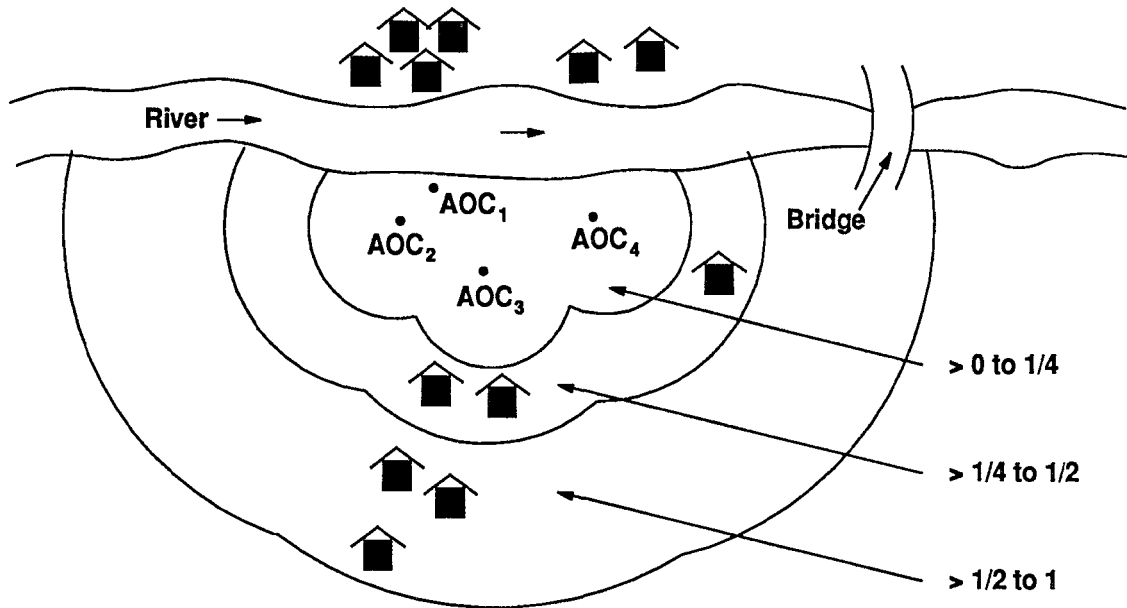
(1) **Determine the nearby Individual factor value.** Determine the nearby individual factor value as follows:

- If one or more persons meet the criteria for resident individual (as specified in HRS section 5.1.3 and Section 9.4), assign a value of 0 for the nearby individual factor.
- If no person meets the criteria for a resident individual, determine the shortest travel distance from the site to any residence or school. The travel distance is the shortest overland distance an individual would travel from a residence or school to the nearest area of observed contamination for the site with an attractiveness/accessibility factor value greater than 0.
 - If there are no natural barriers to travel, measure the travel distance as the shortest straight-line distance from the residence or school to the area of observed contamination.
 - If natural barriers exist (e.g., a river, a ravine), measure the travel distance as the shortest distance that a person would be expected to travel to get from the residence or school to the area of observed contamination, assuming the person avoided these barriers (e.g., did not wade the stream or scale the ravine).
- If the travel distance of the nearby individual is less than or equal to 1/4 mile, the nearby individual factor value is 1; otherwise, this factor value is 0.

(2) **Determine the population within 1 mile.** To score the population within 1 mile, determine the population within each travel distance category (i.e., >0 to 1/4 mile, >1/4 to 1/2 mile, >1/2 to 1 mile).

- Count residents and students who attend school within this travel distance. Do not include those people already counted in the resident population threat (except for individuals evaluated as workers in the resident population threat who are not also resident individuals and who live within a one-mile travel distance).
- Determine travel distances for the population within one mile as specified for the nearby individual (i.e., determine the approximate travel distance from each residence and school to the area of observed contamination; do not simply draw distance rings unless there is only one area of observed contamination and there are no natural or constructed barriers).
- For sites with multiple areas of observed contamination, two methods are generally used to determine a representative score for populations within one mile for the nearby threat.
 - In the first method (see **Highlight 9-22**), draw travel distance categories around each area of observed contamination (however, do not draw distance categories across natural barriers), determine aggregate travel distance categories (e.g., make overlapping rings of the same travel distance one travel distance category), and total the population within each travel distance category. The total population is then used to determine the factor value assigned for population within one mile. Assign each individual to the travel distance category nearest to an area of observed contamination (e.g., an individual within one-quarter mile of one area of observed contamination and one-half mile of another area of observed contamination is counted only in the zero to one-quarter mile distance category). Also, count individuals only once, except for individuals who are both residents and students.

HIGHLIGHT 9-22
ESTABLISHING TARGET DISTANCE CATEGORIES
FOR NEARBY THREAT: METHOD 1



 = Residence

AOC_x = Area of observed contamination

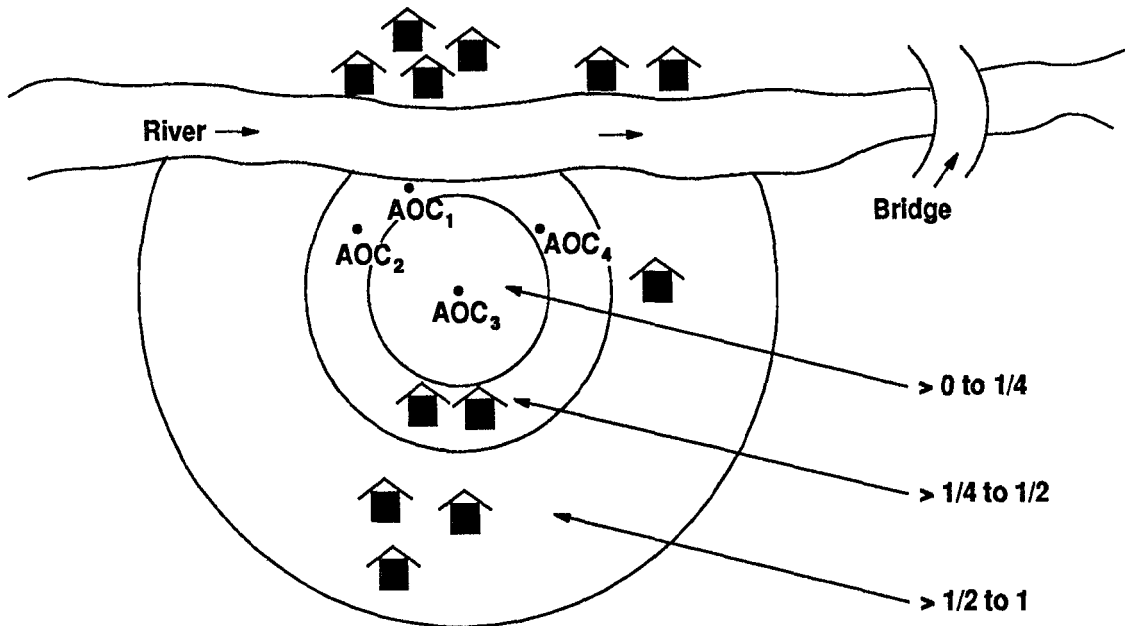
- Each sample location establishes an area of observed contamination. Due to site-specific conditions, it is not appropriate to connect the points into one area of observed contamination.
- Draw travel distance categories from each area of observed contamination and then aggregate travel distance categories.
- Sum the population within each travel distance category (excluding those counted in the resident population) to determine the total population within each travel distance category. From HRS Table 5-10, determine the population within one mile factor value.
- If no individual qualifies as a resident individual, use the resident nearest an area of observed contamination to determine the nearby individual factor value.
- Do not include residences on the far side of the river, even though they are within one mile in straight-line distance, because they are not within a one-mile travel distance of the area of observed contamination.
- This method may be unwieldy for sites with many areas of observed contamination.

- At sites with a large number of areas of contamination, this method may be time-consuming and inefficient. Because factor values are assigned based on population ranges within each travel distance category, a simplified method may be used with little or no impact on the threat source.
 - In the second method (see **Highlight 9-23**), rather than calculate the population within one mile for all areas of contamination, determine which area(s) of observed contamination will give the highest score for the site based on travel distances to populations and population densities. Draw travel distance categories only for these areas of contamination. This method is most effective for sites with a large number of areas of contamination, and for sites with large population densities, but it may underestimate target scores.
- When the number of residences within a travel distance category are used to estimate the population, multiply each residence by the average number of people per residence for the county in which the residence is located.
 - When the number of people within each travel distance have been determined, assign the appropriate distance-weighted population value for that travel distance from HRS Table 5-10. Sum these distance-weighted population values and divide the total by ten. If this number is less than one, do not round it to the nearest integer; otherwise, round to the nearest integer. This value is the population within one-mile factor value.
- (3) **Determine the nearby population targets factor category value.** Sum the values for the nearby individual factor and the population within one mile factor. This sum is the targets factor category value for the nearby population threat.

CALCULATING THE NEARBY POPULATION THREAT SCORE

To assign a score to the nearby population threat, multiply the values for likelihood of exposure, waste characteristics, and targets for the nearby population threat, and round the product to the nearest integer. Assign this product as the nearby population threat score.

**HIGHLIGHT 9-23
ESTABLISHING TARGET DISTANCE CATEGORIES
FOR NEARBY THREAT: METHOD 2**



 = Residence

AOC_x = Area of observed contamination

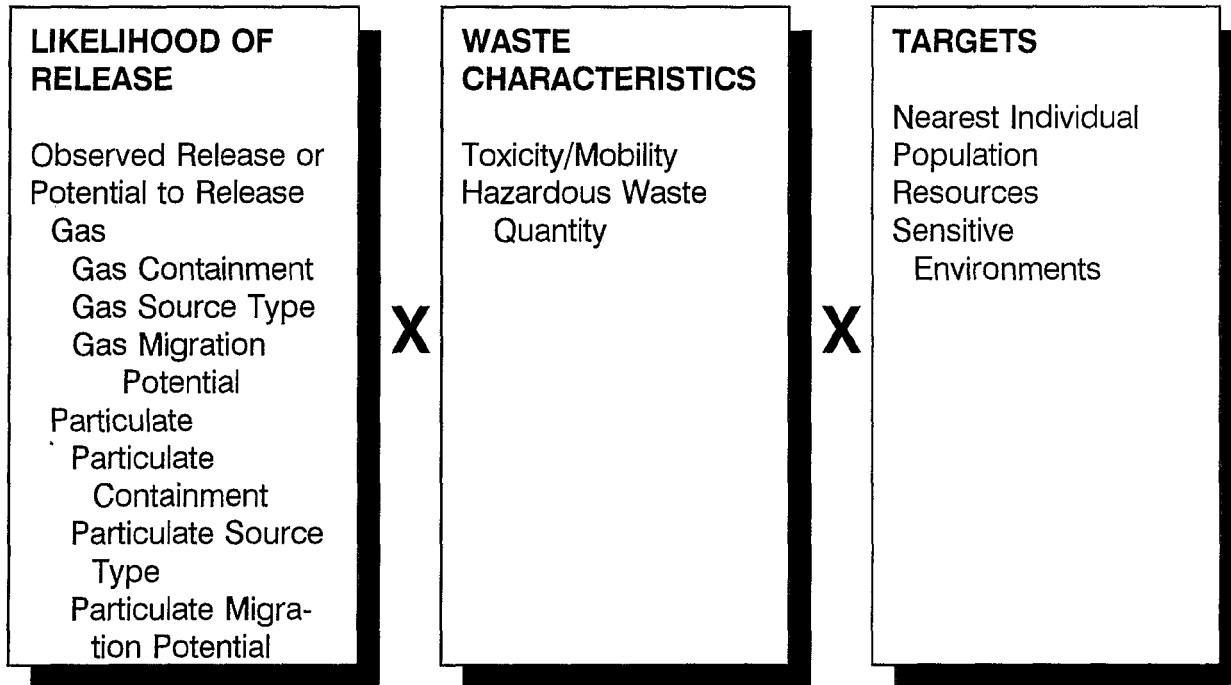
- Each sample location establishes an area of observed contamination. Due to site-specific conditions, it is not appropriate to connect the points into one area of observed contamination.
- Decide which area(s) of observed contamination will likely give the most representative HRS score, and then draw travel distance categories from only those areas of observed contamination.
- Sum the population for each travel distance category and calculate the population within one mile factor value from HRS Table 5-10.
- If no individual qualifies as a resident, use the resident nearest an area of observed contamination to determine the nearby individual factor value.
- Do not include residences on the far side of the river, even though they are within one mile in straight-line distance, because they are not within a one-mile travel distance of the area of observed contamination.
- This method may underestimate target scores in some instances, but it may simplify efforts at sites with many areas of observed contamination or dense populations, with little or no impact on the threat score.

TIPS AND REMINDERS

- Do not include in the nearby population individuals evaluated as resident individuals.
- Include in the nearby population individuals evaluated as workers for the resident population threat who are not resident individuals but live within a one-mile travel distance.
- Assign 0 as the nearby individual factor value if one or more persons meet the criteria for resident individual.
- Evaluate travel distance based on the shortest distance a person would be expected to travel, given existing natural barriers, which may not be the straight-line distance.
- Evaluate only areas of contamination with an attractiveness/accessibility factor value greater than 0 in the nearby population threat.
- When population estimates are based on number of residences, multiply by average number of persons per residence for the county.

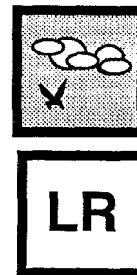
CHAPTER 10

AIR PATHWAY



SECTION 10.1

OBSERVED RELEASE



This section provides guidance on demonstrating and documenting observed releases in the air pathway and discusses observed releases established both by direct observation and by chemical analysis. See Chapter 5 for general guidance on scoring observed releases. The emphasis in this section is on HRS scoring rather than field activities; only limited information is provided on monitoring, sampling, handling, and analysis procedures. For the air pathway, documentation of observed releases by direct observation does not involve the use of atmospheric sampling but is established through visual observation of a release or through inferential observations (see discussion below). Observed releases by chemical analysis require atmospheric sampling and laboratory analysis to establish the presence of the chemical. EPA's *Guidance for Conducting Site Inspections Under CERCLA* (OSWER Publication 9345.1-05) provides information on sampling strategies for the air pathway.

RELEVANT HRS SECTIONS

Section 2.3	Likelihood of release
Section 6.1	Likelihood of release
Section 6.1.1	Observed release

DEFINITIONS

Attribution: The determination that a hazardous substance in a release is likely to have originated in one of the sources at a site. Attribution usually requires documenting that at least one hazardous substance found in a release at a concentration significantly above background (or directly observed in the release) was produced, stored, deposited, handled, or treated at the site; and at least a portion of the significant increase could have come from a source at the site.

Background Level: The concentration of a hazardous substance that provides a defensible reference point that can be used to evaluate whether or not a release from the site has occurred. The background level should reflect the concentration of the hazardous substance in the medium of concern for the environmental setting on or near a site. Background level does not necessarily represent pre-release conditions, nor conditions in the absence of influence from source(s) at the site. A background level may or may not be less than the DL, but if it is greater than the DL, it should account for variability in local concentrations. A background level need not be established by chemical analysis.

Background Sample: A sample used in establishing a background level.

Contract Laboratory Program (CLP): The analytical program developed for CERCLA waste site samples to fulfill the need for legally defensible analytical results supported by a high level of quality assurance and documentation.

Contract-required Detection Limit (CRDL): A term equivalent to the CRQL, but used primarily for inorganic substances.

Contract-required Quantitation Limit (CRQL): The substance-specific level that a CLP laboratory must be able to routinely and reliably detect in specific sample matrices. The CRQL is not the lowest detectable level achievable, but rather the level that a CLP laboratory must reliably quantify. The CRQL may or may not be equal to the quantitation limit of a given substance in a given sample. For HRS purposes, the term CRQL also refers to the CRDL.

Detection Limit (DL): The smallest quantity of a hazardous substance that can be distinguished from the normal random "noise" of an analytical instrument or method. For HRS purposes, DL is the MDL or, for real-time field instruments, the IDL as used in the field.

Method Detection Limit (MDL): The lowest concentration of a hazardous substance that a method can detect reliably in either a sample or blank.

Observed Release: An observed release is established for the ground water, surface water, or air migration pathway either by chemical analysis or by direct observation. Observed release is not relevant to the HRS soil exposure pathway. The minimum requirements for establishing an observed release by chemical analysis are analytical data demonstrating the presence of a hazardous substance in the medium significantly above background level, and information that some portion of that increase is attributable to the site. The minimum criterion for establishing an observed release by direct observation is evidence that the hazardous substance was placed into or has been seen entering the medium.

Release Sample: A sample taken to determine whether the concentration of a hazardous substance is significantly above its background level in order to determine whether an observed release (or observed contamination) has occurred.

Sample Quantitation Limit (SQL): The quantity of a substance that can be reasonably quantified given the limits of detection for the methods of analysis and sample characteristics that may affect quantitation (e.g., dilution, concentration).

Similar Samples: Samples from the same environmental medium that are identical or similar in every way (e.g., field collection procedure, analytical technique) except the degree to which they are affected by a site.

ESTABLISHING AN OBSERVED RELEASE BY DIRECT OBSERVATION

An observed release by direct observation can be established in the air pathway by one of two methods:

- A material containing one or more hazardous substances is seen entering the atmosphere directly. Visually observing dust blow off a pile into the atmosphere during an SI is an example of an observed release by direct observation. However, sampling from the dust's point of origin (e.g., the area on the pile from which the dust is released) should indicate that the dust contains hazardous substances. Although not required, photographs are helpful in documenting an observed release by direct observation.
- If evidence supports an inference of a release to the atmosphere, a demonstrated adverse effect may be used to establish an observed release. This approach for establishing an observed release by direct observation will be useful when visual evidence is not available. Visual evidence is preferable for establishing an observed release, but may not be practical in cases where the hazardous substance is an invisible gas or in cases where the release of the hazardous substance can only be

documented historically. For example, if available evidence demonstrates that two substances, which may react to form a poisonous gas, are present in an open surface impoundment, an adverse effect that would satisfy the criteria for an observed release would be an individual at the site overcome by fumes from the impoundment. Even if the fumes were invisible (and thus could not be "seen"), an observed release by direct observation could be established based on demonstrated adverse effects (e.g., a hospital report stating that a person was overcome by fumes containing a hazardous substance). The emphasis of this example is the ability to support the inference of a release (i.e., that the two reactive chemicals are present) and the occurrence of the demonstrated adverse effect. There are other cases in which a scorer may infer that a release to the atmosphere probably has occurred but cannot score an observed release. For example, if a row of trees near the site is dead, it would usually not be possible to determine if the trees died from a hazardous substance in the atmosphere that was released from the site or from another, unrelated cause.

ESTABLISHING AN OBSERVED RELEASE BY CHEMICAL ANALYSIS

An observed release by chemical analysis in the air pathway is established based on analytical data that indicate that hazardous substances have been detected in the air. Perform the following steps for each detected hazardous substance.

- (1) **Determine whether a detected hazardous substance can be attributed to sources at the site.** Sampling results or records (e.g., manifests) indicating the presence of the hazardous substance in a source at the site are the strongest documentation. Information that the hazardous substance was used at the facility is also acceptable.
- (2) **Determine the background level for the hazardous substance.** Determining the appropriate background level requires analytical results from an appropriate background sampling location (e.g., upwind from the site, outside a smoke plume) for substances that could be naturally occurring, ubiquitous, or attributable to other sources in the area. A background level of 0 can be assumed for hazardous substances that are not naturally occurring, not ubiquitous, and not attributable to other sources in the area (i.e., a background sample may not be needed).
- (3) **Determine the appropriate quantitation limit for the hazardous substance.** If available, the SQL should be used. If the SQL cannot be established and the sample analysis was performed under the EPA CLP, use the EPA CRQL in place of the SQL. If the SQL cannot be established and the sample analysis was not performed under the EPA CLP, use the DL (as defined in HRS section 1.1) in place of the SQL.
- (4) **Compare the hazardous substance concentration at the sampling location (e.g., downwind from the site, crosswind from the site) to the appropriate quantitation limit.** If the concentration of the hazardous substance at an appropriate sampling location is less than the quantitation limit, an observed release is not established at the sampling location. If other hazardous substances were detected at the sampling location, start again with Step (1). If the concentration is greater than or equal to the quantitation limit, continue to the next step.
- (5) **Compare the hazardous substance concentration at the downwind or crosswind sampling location to the background level.** If the background concentration is not detected or is less than the DL (includes cases where the background level is 0), an observed release is established if the sample measurement equals or exceeds the quantitation limit and at least some portion of this significant increase is attributable to the site. If the background concentration is greater than or equal to the DL, the minimum requirements for establishing an observed release are:

- The sample concentration should be greater than or equal to three times the background concentration; and
- At least some portion of this significant increase should be attributable to the site.

See Section 5.1 for a discussion of significance above background.

The ability to obtain reliable sampling data (i.e., from background and test samples) that document an observed release is limited by the highly variable nature of the atmosphere and its effects on emissions from a site. In recognition of the difficulties of atmospheric sampling, EPA has published several relevant guidance documents. **Highlight 10-1** presents guidance of particular interest.

In reviewing sampling data for the air migration pathway, the scorer should determine whether background samples and samples with significant concentration increases attributable to the site (e.g., downwind samples) can be considered similar. Meteorological monitoring (e.g., temperature, relative humidity, precipitation, and especially wind speed and direction) should be conducted at the same time and location as sampling so that non-site-related factors possibly influencing the samples can be identified. The most important of these meteorological measurements are wind speed and direction, which are crucial to an accurate sampling regimen. In addition, the scorer should determine if all of the following are true for background samples and samples with significant concentration increases attributable to the site:

- Samples are taken at nearly the same time or during the same approximate time period;
- Samples are taken at approximately the same elevation relative to the suspected sources at the site; and
- Samples are collected and analyzed using equivalent methodologies.

HIGHLIGHT 10-1 SELECTED EPA GUIDANCE ON AIR SAMPLING

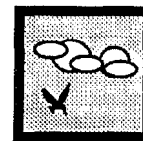
The documents listed below do not discuss the particular requirements of the HRS, but rather provide general information on atmospheric monitoring, sampling, and analysis. These are suggested sources of information; other documents also may provide appropriate guidance.

- *Air/Superfund National Technical Guidance Study Series. Volume II - Estimation of Baseline Air Emissions at Superfund Sites* (EPA-450/1-89-002a, August 1990).
- *Air/Superfund National Technical Guidance Study Series. Volume IV - Procedures for Dispersion Modeling and Air Monitoring for Superfund Air Pathway Analysis (Interim Final)* (EPA-450/1-89-004, July 1989).
- *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air* (EPA600/4-89-017, June 1988).
- *Guidance on Applying the Data Quality Objectives Process for Ambient Air Monitoring Around Superfund Sites (Stage III)* (EPA-450/4-90-005, March 1990).
- *Technical Assistance Document for Sampling and Analysis of Toxic Organic Compounds in Ambient Air* (EPA-600/4-83-027, June 1983).

TIPS AND REMINDERS

- Any accepted monitoring, sampling, and analysis methods that are equivalent to EPA standards may be used to establish an observed release. EPA has produced a number of guidance documents that may assist scorers in the selection of appropriate monitoring, sampling, and analysis methods (see **Highlight 10-1** for a discussion of suggested guidance documents), but other methods may be appropriate.
- Sampling is not restricted to the "breathing zone;" however, sampling elevation for background and contaminated samples should be similar. Often site-specific meteorological and topographical considerations will determine the appropriate sampling elevation.
- Stationary ambient air monitors may be used to establish an observed release provided that the methods used in monitoring, sampling, and analysis are equivalent to EPA standards.
- Data collected with real-time instruments (e.g., Organic Vapor Analyzers (OVA)), which provide instantaneous results, may be used to identify locations for more accurate sampling, but in most cases should not be used to establish an observed release by chemical analysis.
- Indoor air samples cannot be used to establish an observed release by chemical analysis.
- Stack analyses from operating facilities generally should not be used to establish an observed release.
- In some cases, wipe samples may be used to document historical releases to air, although it is often difficult to attribute contamination to the site based on this type of data alone.
- Regional background levels may be used on a case-by-case basis, when the regional background is deemed to reflect conditions at the site. Site-specific atmospheric monitoring at the time of sample collection is always preferable for establishing background concentrations.
- The presence of an active fire is not considered to be evidence that a hazardous substance has been released to the air unless appropriate sampling has been conducted that confirms the release of a hazardous substance.

SECTION 10.2 POTENTIAL TO RELEASE



This section provides guidance on evaluating selected features of the air pathway potential to release factor. This section addresses the distinction between gaseous and particulate hazardous substances, provides guidelines for combining sources with similar characteristics, and discusses selected issues related to the gas and particulate containment factors. Flowcharts that summarize the scoring steps for potential to release are presented at the end of this section.

The potential to release factor in the air pathway is only scored if an observed release cannot be established (see Chapter 5 and Section 10. 1 for guidance on establishing an observed release). If no observed release to air can be established at the site, the potential to release factor value for the air pathway is determined by separately evaluating the gas potential to release and the particulate potential to release for each source at the site.

- The gas potential to release value for a source is calculated by multiplying the gas containment factor value for the source by the sum of its gas source type factor value and its gas migration potential factor value.
- The particulate potential to release value for a source is calculated by multiplying the particulate containment factor value for the source by the sum of its particulate source type factor value and its particulate migration potential factor value.

In evaluating gas source type and particulate source type, consider only sources that meet the minimum size requirement based on HRS Table 2-5 (i.e., those with a source hazardous waste quantity value of 0.5 or greater), unless there are no sources at the site that meet the minimum size requirement. If there are no sources at the site that meet the minimum size requirement, assign each source at the site a source type factor value from HRS Table 6-4.

The highest gas potential to release and the highest particulate potential to release values from among all sources are selected. The higher of these two potential to release values is the potential to release value for the air pathway.

RELEVANT HRS SECTIONS

Section 6.1.2	Potential to release
Section 6.1.2.1	Gas potential to release
Section 6.1.2.2	Particulate potential to release
Section 6.1.2.3	Calculation of potential to release factor value for the site

DEFINITIONS

Source: Any area where a hazardous substance has been deposited, stored, disposed, or placed, plus those soils that may have become contaminated from hazardous substance migration. In general, however, the volumes of air, ground water, surface water, and surface water sediments that may have become contaminated through migration are not considered sources.

DISTINGUISHING BETWEEN GASEOUS AND PARTICULATE HAZARDOUS SUBSTANCES

Before evaluating potential to release, determine whether each source has only gaseous, only particulate, or both gaseous and particulate hazardous substances associated with it. Evaluate the gaseous potential to release factor only for sources that have gaseous hazardous substances. Similarly, evaluate the particulate potential to release factor only for sources that have particulate hazardous substances. Many sources will have both gaseous and particulate hazardous substances and potential to release factors and should be evaluated for both.

- A hazardous substance is considered to be a gaseous hazardous substance whenever its vapor pressure (at or near 25°C) is greater than or equal to 10⁰ torr (1 torr = 1 millimeter of mercury).
- A hazardous substance is considered to be a particulate hazardous substance whenever its vapor pressure (at or near 25°C) is less than or equal to 10⁰ torr.

Highlight 10-2 provides an illustration of the vapor pressure ranges for which hazardous substances are considered gaseous and/or particulate. Note that in the mid-portion of the range, hazardous substances are considered to be both gaseous and particulate for purposes of HRS scoring.

Vapor pressure varies with temperature, so it is very important to be certain that the value given is at or near 25°C. Data on vapor pressures at or near 25°C for many common hazardous substances can be found in SCDM. Alternatively, vapor pressure data can be found in many common chemical data references or can be calculated from available data on boiling point. **Highlight 10-3** provides examples of vapor pressures for several selected hazardous substances. Values from information sources (e.g., chemistry reference books) other than SCDM may need to be adjusted to reflect vapor pressure at the appropriate temperature. Units besides torr are frequently used for pressure and need to be converted (e.g., 1 torr equals 1 mm Hg, 1 torr equals 1/760 of an atmosphere (atm)).

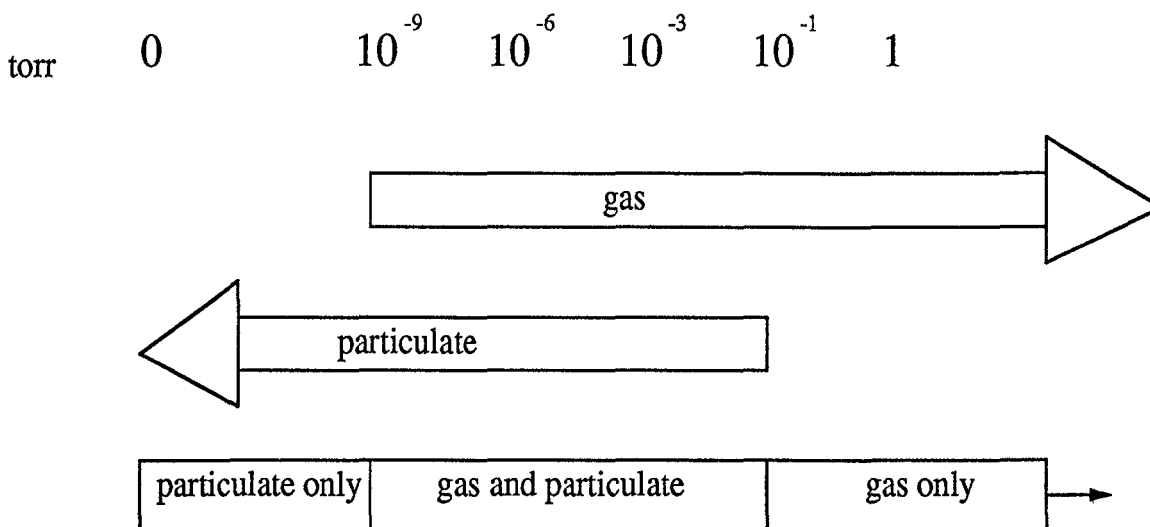
COMBINING SOURCES BEFORE CALCULATING POTENTIAL TO RELEASE

The HRS states that when evaluating either gas potential to release or particulate potential to release, the scorer can combine sources with similar characteristics into a single source. It is most useful to evaluate two sources with similar characteristics as a combined source if the combined source exceeds the minimum size requirement, but the sources when evaluated separately do not exceed this minimum. Scorers can also combine sources to lessen the complexity of a documentation record.

For two sources to have similar characteristics in the gas (or particulate) potential to release evaluation, they should meet all of the following guidelines:

- The same gas (or particulate) containment factor value
- The same gas (or particulate) source type
- Significantly overlapping hazardous substances.

**HIGHLIGHT 10-2
VAPOR PRESSURE RANGES FOR GASEOUS AND/OR PARTICULATE
HAZARDOUS SUBSTANCES**



NOTE: Diagram not drawn to scale.

**HIGHLIGHT 10-3
VAPOR PRESSURES FOR SELECTED HAZARDOUS SUBSTANCES^a**

Hazardous Substance	Vapor Pressure (torr)	Evaluate Potential to Release for
benzene	9.5×10^1	gas only
chlordane	9.8×10^{-6}	gas and particulate
chromium	0	particulate only
1,2- dichlorobenzene	1.5	gas only
hexachloroethane	2.1×10^{-1}	gas only
lead	0	particulate only
methylene	4.4×10^2	gas only
terachloroethene	1.9×10^1	gas only
vinyl chloride	3.0×10^3	gas only

^aVapor pressures in this table were obtained from SCDM; they are presented for illustrative purposes only. When preparing HRS packages, the most current version of SCDM should be consulted.

To combine sources, determine the containment factor value for each of the sources separately. Hazardous substances present in either source may be used to calculate the gas (or particulate) migration potential value. A single containment factor value is assigned as the containment factor value for the combined source. Sources with gas and particulate hazardous substances should be scored separately (i.e., their scores should not be combined) regardless of other similarities between the sources.

EVALUATING GAS AND PARTICULATE CONTAINMENT

In the air pathway, containment refers to the physical characteristics of a source that impede or preclude the release of hazardous substances to the atmosphere. Containment in the air pathway is evaluated using HRS Table 6-3 for gas containment and HRS Table 6-9 for particulate containment. The evaluation is based on the presence of characteristics that match a description given in the applicable table (Section 4.1 provides assistance in characterizing sources). The descriptions in both Tables 6-3 and 6-9 have a number of limitations placed on the types of sources that will match each description. Some of these limitations are listed below:

- "Source covered with essentially impermeable, regularly inspected, maintained cover" includes only engineered containment structures (e.g., asphalt, concrete, or clay) that are in place over the entire source and by their physical structure prevent migration of hazardous substances into the atmosphere.
- "Soils that are resistant to gas migration" include only moist fine-grained (e.g., silt loams and clays) and saturated coarse-grained (e.g., sands and sandy loams) soils. For purposes of assigning gas or particulate containment factor values, consider soils with USGS classifications of ML, CL, CH (fine-grained), or GC (coarse-grained) resistant to gas migration.
- "Particulate hazardous substances totally covered by liquids" includes only hazardous substance particulates that are overlain by liquids (thereby preventing their migration). Particulates that are controlled by application of a liquid to the land surface (e.g., dust control chemicals) would not fall under this description unless the application of the liquid resulted in the particulate being totally covered.

Several common features between the two containment evaluation tables (HRS Tables 6-3 and 6-9) should be noted.

- As in the other migration pathways, the maximum containment factor value is 10, with lower values indicating a greater degree of containment; a value of 0 indicates essentially complete containment.
- If the characteristics of a source do not match any of the descriptions, then a value of 10 is assigned to the applicable containment factor. In other words, only those characteristics specifically described in Tables 6-3 and 6-9 constitute containment barriers sufficient to warrant assignment of a value other than 10.
- With the caveats noted below (i.e., biogas release, active fire), any source covered with an essentially impermeable, regularly inspected, maintained cover would be assigned a containment of 0 for both gas and particulate containment. It should be noted, however, that some containment types may be "essentially impermeable" to particulates, but permeable to gases. For this reason, this description may apply to a particulate release, but not to a gas release from the same source.
- As indicated in **Highlight 10-4**, many of the containment descriptions most likely to be encountered are assigned the same gas and particulate containment values.

HIGHLIGHT 10-4
SELECTED CONTAINMENT DESCRIPTIONS THAT ARE ASSIGNED THE
SAME GAS AND PARTICULATE CONTAINMENT VALUES

GAS/PARTICULATE CONTAINMENT DESCRIPTION	ASSIGNED VALUE IN BOTH HRS TABLES 6-3 AND 6-9
Source substantially surrounded by engineered windbreak and no other containment specifically described in this table applies	7
Uncontaminated soil cover > 3 feet:	
• Source substantially vegetated with little exposed soil	0
• Source lightly vegetated with much exposed soil	3
• Source substantially devoid of vegetation	7
Uncontaminated soil cover \$ 1 foot and # 3 feet:	
• Source heavily vegetated with essentially no exposed soil	
— Cover soil type resistant to gas migration	3
— Cover soil type not resistant to gas migration or unknown	7
• Source substantially vegetated with little exposed soil and cover soil type resistant to gas migration	7
• Other	10
Uncontaminated soil cover < 1 foot:	
• Source heavily vegetated with essentially no exposed soil and cover soil type resistant to gas migration	7
• Other	10
Totally or partially enclosed within structurally intact building and no other containment specifically described in HRS Tables 6-3 and 6-9 applies	7

- Several of the descriptions in both tables are only assigned if no other containment description applies (e.g., "source substantially surrounded by engineered windbreak"). Values associated with these descriptions should only be assigned to the source if none of the other descriptions apply.

The key to evaluating most of the containment descriptions in the air pathway is visual observation of the surface characteristics of the source and, in the case of containerized wastes, the condition of the containers. Important physical characteristics to note at each source include:

- The extent of vegetation on the entire source;
- The presence of windbreaks designed to impede air flow over the source;
- The condition of containers (e.g., whether they are intact and sealed); and
- In the case of particulate containment, the presence of liquids that act as a barrier between the particulate and the atmosphere.

Each source should be evaluated as a single entity based on its source type. While several containment types may apply to a given source, only the highest applicable containment value should be assigned (i.e., assign only one containment value for each source). For example, if one portion of a source with greater than 3 feet of uncontaminated cover matches one containment description (e.g., source substantially vegetated with little or no exposed soil) and another portion of the same source

matches another description (e.g., source substantially devoid of vegetation), a separate description that describes the source as a whole should be used instead and the corresponding value should be assigned. In this case, neither 0 (source substantially vegetated with little or no exposed soil) nor 7 (source substantially devoid of vegetation) would be assigned. Instead, the description "source lightly vegetated with much exposed soil" would be used and its corresponding value of 3 would be assigned.

There are two special situations in which the gas containment factor is not based on the type of source containment present. If either of the descriptions "evidence of biogas release" or "active fire within source" applies, then a gas containment value of 10 is assigned to the source. For example, consider a landfill with a 4-foot uncontaminated soil cover that has grass growing-over the entire surface. Based on these characteristics, a gas containment value of 0 would be assigned using the description "uncontaminated soil cover > 3 feet: source substantially vegetated with little exposed soil." However, if evidence of a biogas release from the landfill was available, then a gas containment value of 10 would be assigned. Similarly, if an active fire is present within the landfill, a gas containment value of 10 would be assigned.

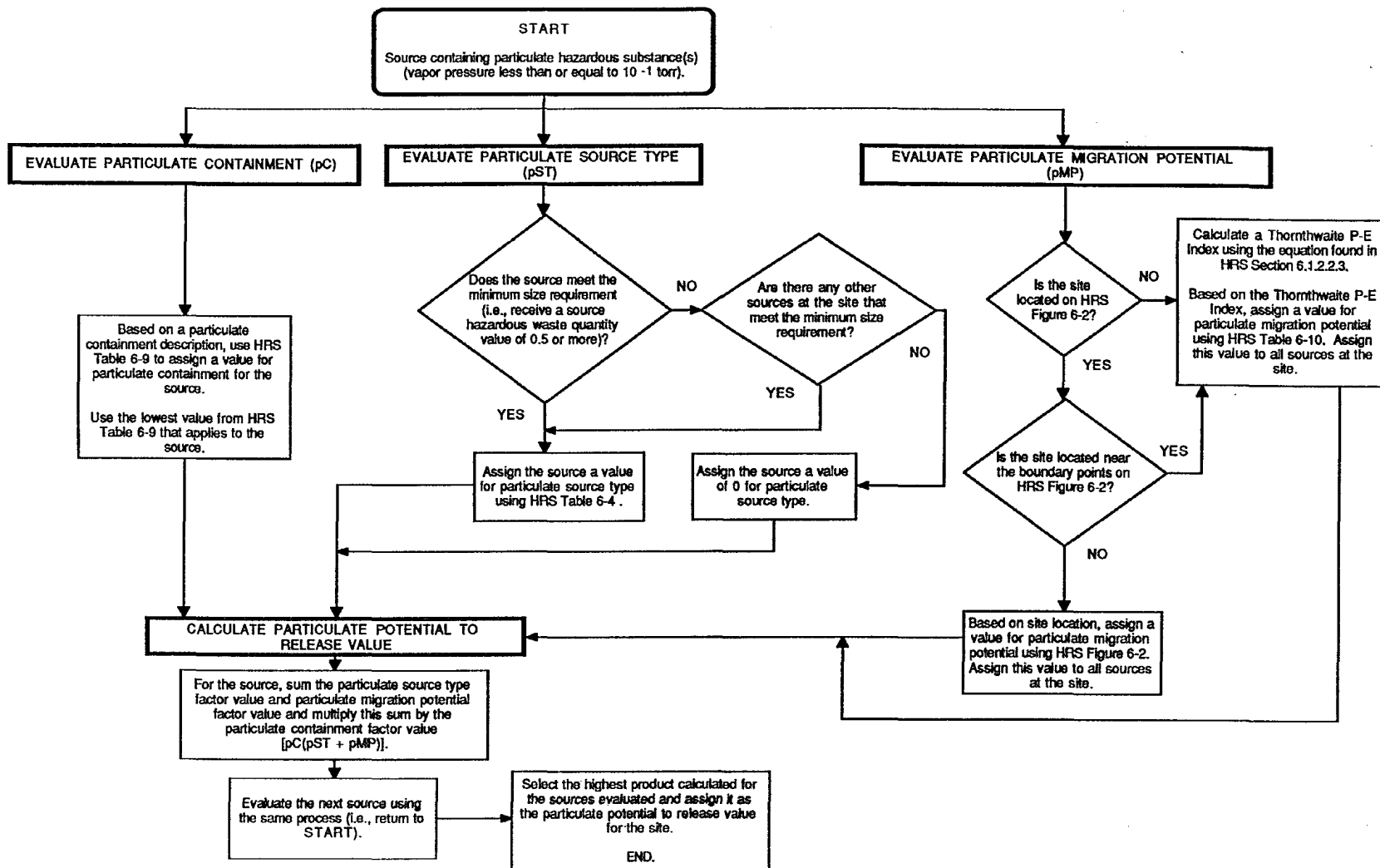
Determining whether evidence of a biogas (e.g., methane) release exists may involve site-specific considerations and require professional judgment. Evidence of biogas release can be based on field measurements collected on or near a source. Several types of field measurements are commonly used to document a biogas release, including:

- Direct reading colorimetric Indicator tube for methane
- Use of an OVA with a methane scrubber
- Use of both an OVA and a photoionization analyzer. If the OVA gets a hit and the photoionization analyzer does not, there is probably a methane release.

In order to receive the 10-point value for biogas release, the release should be attributable to the site and the supporting documentation should verify that no other potential sources of biogas (e.g., a nearby swamp) are present. Visual observations, such as physical evidence that an explosion due to biogas buildup has occurred, may also be acceptable documentation provided that the explosion occurred because of the presence of biogas and not from the presence of other substances at the site. For purposes of scoring the gas containment factor, the biogas released does not have to be a hazardous substance.

Flowcharts that illustrate the methodology for evaluating the gas potential to release factor and the particulate potential to release factor are presented in **Highlights 10-5** and **10-6**, respectively.

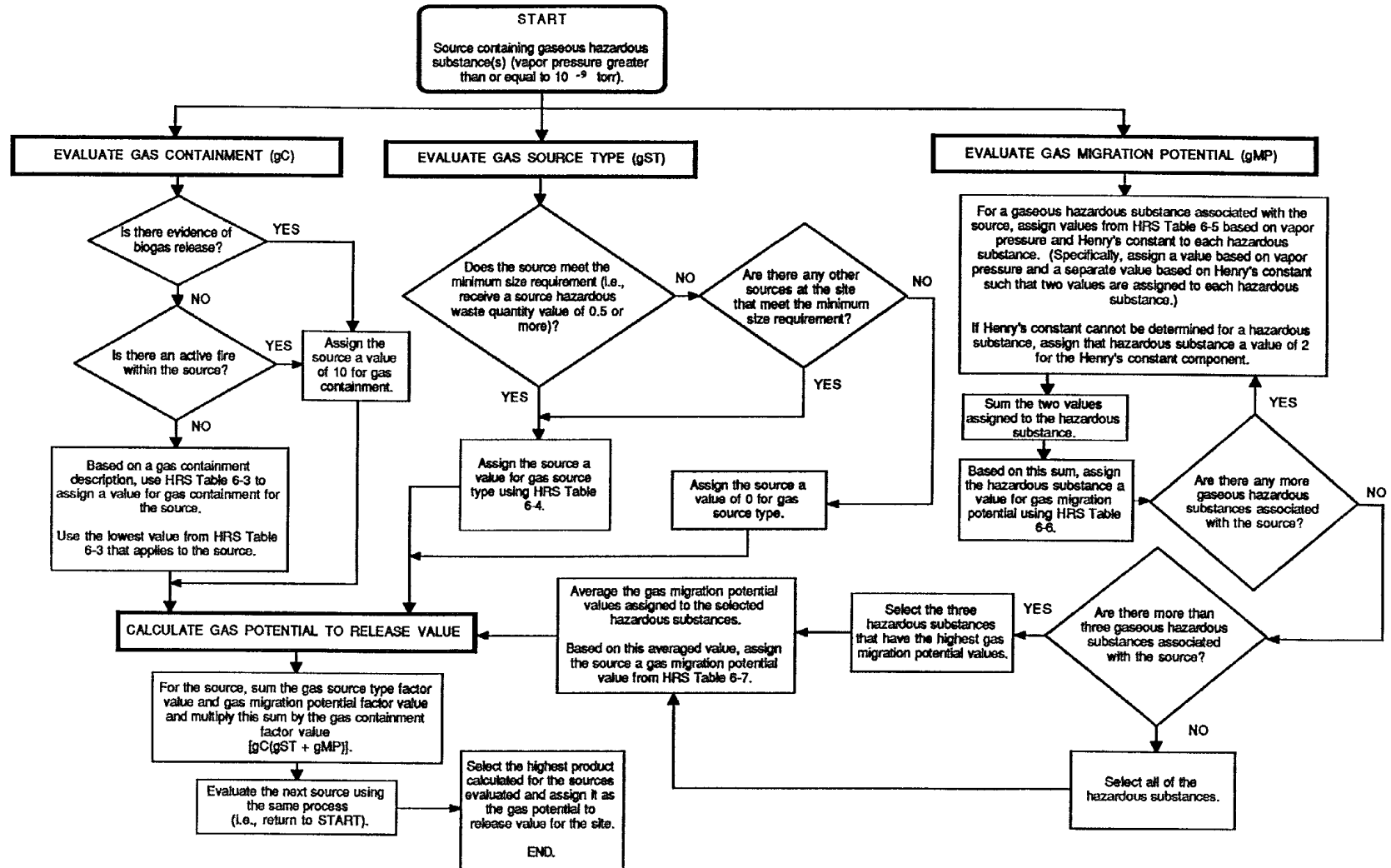
HIGHLIGHT 10-5 FLOWCHART FOR POTENTIAL TO RELEASE: PARTICULATE HAZARDOUS SUBSTANCES



409

Section 10.2

HIGHLIGHT 10-6 FLOWCHART FOR POTENTIAL TO RELEASE: GASEOUS HAZARDOUS SUBSTANCES



SECTION 10.3 ACTUAL CONTAMINATION AND NEAREST INDIVIDUAL



This section provides guidance on establishing actual contamination in the air pathway. The entire population within a target distance category in the air pathway is evaluated for actual contamination when an observed release is established anywhere within that target distance category. In addition, this section provides guidance on how to evaluate the nearest individual factor.

RELEVANT HRS SECTIONS	
Section 2.3	Likelihood of release
Section 2.5	Targets
Section 2.5.1	Determination of level of actual contamination at a sampling location
Section 2.5.2	Comparison to benchmarks
Section 6.3	Targets
Section 6.3.1	Nearest Individual
Section 6.3.2	Population
Section 6.3.2.1	Level of contamination
Section 6.3.2.2	Level I concentrations
Section 6.3.2.3	Level II concentrations

DEFINITIONS

Actual Contamination In the Air Migration Pathway: A target population is subject to actual contamination if a sample location within its distance category meets the criteria for an observed release. Targets located within distance categories closer to the source than the distance category where the observed release is established are also subject to actual contamination.

Level I Concentrations for the Air Migration Pathway: Level I concentrations are established for sampling locations at which the concentration of a hazardous substance that meets the criteria for an observed release is at or above its health-based benchmark. Targets also may be subject to Level I concentrations if multiple hazardous substances that meet the criteria for an observed release are present below their respective benchmarks, and the I or J index is greater than or equal to one. Benchmarks for air include National Ambient Air Quality Standards (NAAQS), National Emission Standard for Hazardous Air Pollutants (NESHAPs), screening concentrations for cancer, and screening concentrations for chronic effects.

Level II Concentrations for the Air Migration Pathway: Level II concentrations are established for sampling locations where the concentration of at least one hazardous substance meets the criteria for an observed release, but the conditions for Level I concentrations are not met. In addition, Level II is assigned for observed releases established by direct observation.

Nearest Individual: Factor evaluated based on the presence of actual contamination or, for potential contamination, the shortest distance from any source at the site to any residence or regularly occupied building or area.

Population for the Air Migration Pathway: Number of residents, students, and workers regularly present within the TDL. This population does not include transient populations, such as hotel and restaurant patrons, but may include seasonal populations (e.g., a resort area).

Students: Full- or part-time attendees of an educational institution or day care facility located within the TDL.

Target Distance Limit for the Air Migration Pathway: Distance over which population and other targets are evaluated. The TDL generally is a 4-mile radius from the sources at the site. However, if a sampling point meeting the criteria for an observed release is located beyond the 4-mile radius, that point defines the outer boundary of the TDL. For example, if an observed release is established 6 miles from the source, the TDL is 6 miles.

Workers: Permanent employees (part-time or full-time) of a facility or business that is located within the TDL.

DETERMINING LEVEL OF ACTUAL CONTAMINATION

In order to evaluate level of actual contamination, an observed release should first be established (see Section 10.1 for establishing observed releases in the air pathway). If an observed release to air is established in or beyond a distance category, actual contamination is also established for that distance category and the level of contamination for the observed release location need to be determined. The steps below explain how to determine if a location is evaluated as Level I or Level II.

- (1) **Determine whether an observed release can be established for any hazardous substance detected in air samples or based on direct observation.** See Section 10.1 for information on establishing an observed release.
 - If an observed release is established only by direct observation, Level I cannot be established and all locations for the direction observation are Level II. Continue with the guidance in the next subsection, Evaluating Sites with Actual Contamination.
 - If an observed release is established based on chemical analysis, continue to Step (2).
 - If no observed release can be established, evaluate the entire population within the 4-mile TDL for potential contamination.

- (2) **For each sample location, compare the concentration of each hazardous substance that meets the observed release criteria to its applicable benchmark(s).** When comparing sampling results to benchmarks, concentrations from longer collection times may be compared to shorter time-frame benchmarks, but concentrations from shorter collection times may not be compared to longer time-frame benchmarks. Sample concentrations tend to decrease as sampling time increases (e.g., 8-hour concentrations generally are lower than 3-hour concentrations). Applicable benchmarks (available in SCDM) for hazardous substances include:
 - NAAQS;
 - NESHAPs;
 - Screening concentrations for cancer, which correspond to the 10^6 individual cancer risk for inhalation exposure; and

- Screening concentrations for noncancer toxicological responses, which correspond to the RfD for inhalation exposure.

If more than one benchmark applies to a substance, use the benchmark with the lowest concentration. If no benchmark for the air pathway is available for a substance, that substance cannot be used to establish Level I.

- If the concentration of any one or more of the hazardous substances for which an observed release has been established is greater than or equal to its benchmark, score the sample location as Level I. Continue with the guidance in the next subsection.
- If only one hazardous substance meets the observed release criteria and its concentration is less than the lowest applicable benchmark, score the sample location as Level II. Continue with the guidance in the next subsection.
- If more than one hazardous substance meets the observed release criteria and no single substance can be used to establish Level I, continue to Step (3).

(3) **Calculate the I and J indices for all hazardous substances for this sampling location that meet the observed release criteria.** Make two lists of substances that meet the observed release criteria: hazardous substances with screening concentrations for cancer risk, and hazardous substances with screening concentrations for noncancer effects. Each hazardous substance may be on one, neither, or both lists. If more than one sample has been collected at a location and these samples are comparable (e.g., taken in the same time frame, collected using the same field techniques, analyzed by the same methods), for each hazardous substance select the highest concentration to use in the calculations below.

- Calculate the I index for all hazardous substances with screening concentrations for cancer risk that meet the observed release criteria, using the following equation:

$$I = \sum_{i=1}^n \frac{C_i}{SC_i}$$

where: C_i = concentration of substance i at the sample location;
 SC_i = screening concentration for cancer risk corresponding to a 10^6 individual cancer risk for inhalation exposure for hazardous substance i; and
 n = number of hazardous substances that meet observed release criteria and for which an SC is available.

- Calculate the J index for all hazardous substances with screening concentrations for noncancer effects that meet the observed release criteria, using the following equation:

$$J = \sum_{j=1}^m \frac{C_j}{CR_j}$$

where: C_j = concentration of substance j at the sample location;
 CR_j = screening concentration for noncancer effects corresponding to the reference dose for inhalation exposure for hazardous substance j; and
 m = number of hazardous substances that meet observed release criteria and for which a CR is available.

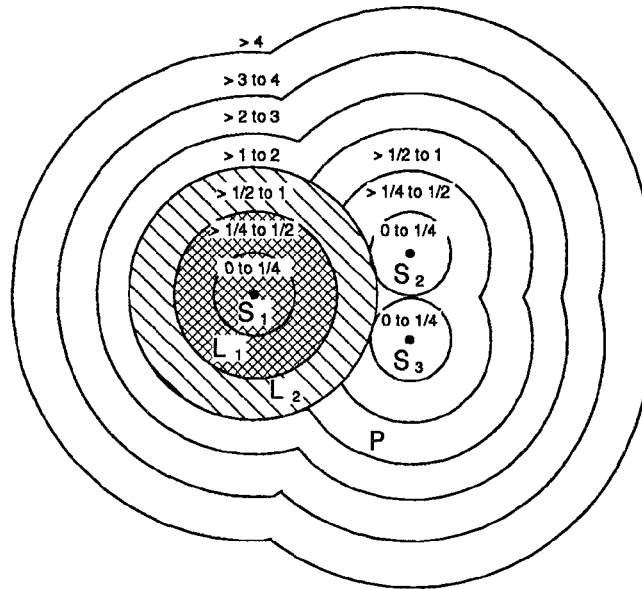
- If either the I or J index is greater than or equal to 1, score the sample location as Level I. If both the I and J indices are less than 1, score the sample location as Level II.



EVALUATING SITES WITH ACTUAL CONTAMINATION

The steps outlined below describe how to evaluate sample locations with actual contamination.

- (1) **If only one source is being evaluated, skip to Step (2).** If multiple sources are being evaluated:
 - Determine the source to which the observed release is attributable. If this determination cannot be made, select a single source to which the hazardous substance could be attributable (see **Highlight 10-7**).
 - When scoring potential contamination, aggregate identical distance categories that partially or totally overlap (see **Highlight 10-8**).
- (2) **Determine the most distant sample location (observed release) that meets the criteria for Level I concentrations and the most distant location that meets the criteria for Level II concentrations.** The most distant location meeting the criteria for Level II concentrations can be either a sample location (see **Highlight 10-9**) or a direct observation location. If the most distant Level II location is closer to the source than the most distant Level I sample location, do not score any distance categories as Level II.
- (3) **If a sample location (observed release) meets the criteria for Level I concentrations, determine the distance category into which that sample location falls.** That distance category and all distance categories closer to the source are scored as Level I concentrations. If the Level I sample location is beyond the 4-mile TDL, no distance categories would be scored as Level II and all populations and sensitive environments between the sample location and the source would be scored at Level I.
- (4) **If the most distant observed release meets the criteria for Level II concentrations and is beyond the most distant sample location meeting the criteria for Level I concentrations, Level II concentrations should be scored.** The distance category containing the most distant Level II location and all distance categories between that distance category and the most distant category containing a Level I sampling location should be scored at Level II (see **Highlight 10-10**). If no distance category contains a Level I sampling location, then the distance category containing the Level II location and all distance categories closer to the source are scored as Level II.
- (5) **Score all distance categories not scored as Level I or Level II as potential contamination.** Note that if the most distant Level I or Level II sampling location is beyond the 4-mile TDL, all distance categories should be scored as Level I or Level II; therefore, potential contamination would not be scored.

HIGHLIGHT 10-7 DETERMINING AREAS OF ACTUAL AND POTENTIAL CONTAMINATION WITH MULTIPLE SOURCES



- L₁ = Level I sample location
- L₂ = Level II sample location
- P = Sample location subject to potential contamination
-  = Scored at Level I
-  = Scored at Level II

Actual Contamination

- (1) Determine the source to which the observed release is attributable.
- (2) If this determination cannot be made, select a single source (S₁ in this example) to which the observed release could be attributable.
- (3) Draw distance categories around the source selected in Step (1) or (2).
 - Targets within the outermost distance category containing a Level I sample location (> 1/4 to 1/2 in this example) and targets within all distance categories closer to the source (> 0 to 1/4 in this example) are subject to Level I contamination.
 - Targets within any distance category containing a Level II location that is beyond the outermost distance category containing a Level I sample location (i.e., > 1/2 to 1 in this example) are scored at Level II. If there were distance categories between the one containing the Level II location and the Level I distance category most distant from the source, targets within those distance categories would also be scored at Level II.

(continued on next page)

HIGHLIGHT 10-7 (continued)

DETERMINING AREAS OF ACTUAL AND POTENTIAL CONTAMINATION WITH MULTIPLE SOURCES

Potential Contamination

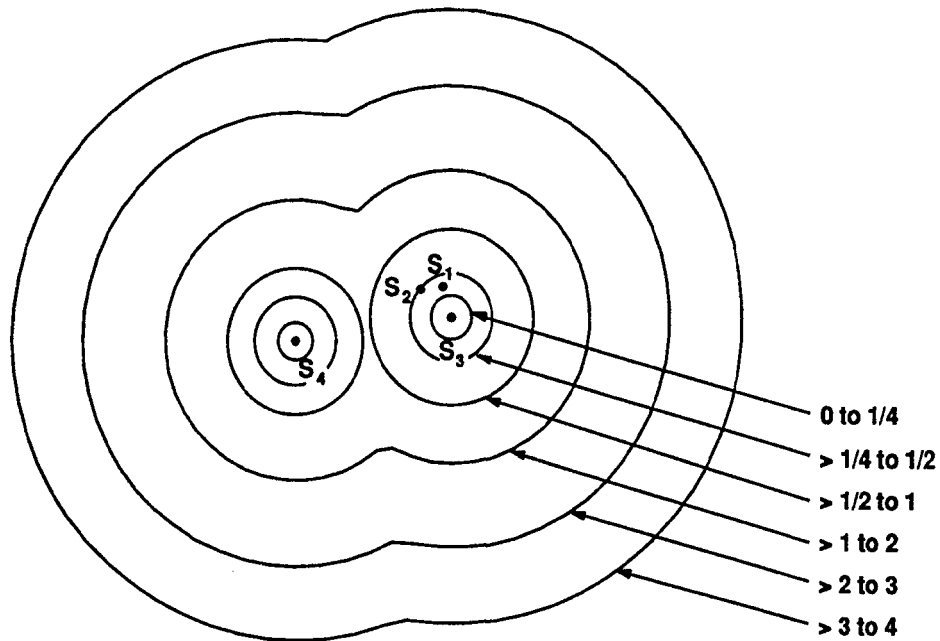
- (1) Targets should be assessed for potential contamination based on the nearest source. To determine the nearest source, draw distance categories around the remaining sources (S_2 and S_3 in this example). All distance categories outside the area of actual contamination (established above) and within the 4-mile TDL are subject to potential contamination.
- (2) Aggregate distance categories that are subject to potential contamination for all sources where identical distance categories would overlap.
 - For S_2 and S_3 , the first distance category to be aggregated is the $>1/4$ to $1/2$.
 - The first distance category to be aggregated for all sources is the > 1 to 2 .
- (3) Score targets subject to potential contamination based upon the distance category into which they fall.

EVALUATING NEAREST INDIVIDUAL FACTOR

In evaluating the nearest individual factor, consider all residences, regularly occupied buildings, and areas that are within a 1-mile radius of the site.

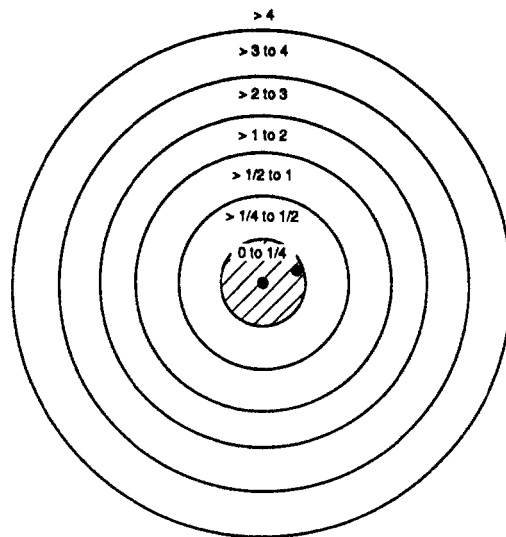
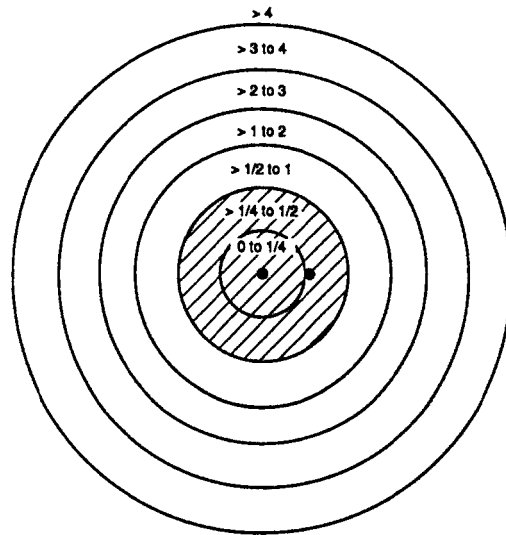
- (1) **Determine whether any residences or regularly occupied buildings or areas are subject to Level I or Level II concentrations.** If not, continue to Step (2). If so, score the nearest individual as follows:
 - If one or more residences or regularly occupied buildings or areas is subject to Level I concentrations, assign a factor value of 50.
 - If one or more residences or regularly occupied buildings or areas is subject to Level II concentrations, but none is subject to Level I concentrations, assign a factor value of 45.
- (2) **Determine the shortest distance to any residence or regularly occupied building or area, as measured from any source at the site with an air migration containment factor value greater than 0.** Based on this shortest distance, use HRS Table 6-16 to assign a value to the nearest individual factor. Note that the distance categories used for evaluating the nearest individual factor differ slightly from the categories used for distance-weighted population values in HRS Table 6-17 (e.g., the 0 and >0 to $1/4$ mile category are replaced by the 0 to $1/8$ and the $>1/8$ to $1/4$ mile categories).

HIGHLIGHT 10-8 DETERMINING POTENTIAL CONTAMINATION WITH MULTIPLE SOURCES



- Draw distance categories around each individual source and then determine aggregate distance categories (i.e., combined categories reflecting overlap of identical distance categories for multiple sources).
- Count each individual only once (however, do not expend extra resources to determine if a resident is also being evaluated as a student or worker) and sum the populations subject to potential contamination for each distance category (e.g., all those individuals located between 1 to 2 miles at each source are added together).
- Determine the nearest individual as the single individual located nearest to any source. Distance categories for assigning a value to the nearest individual factor replace the on-source (0) and >0 to 1/4 category (shown in the diagram) with 0 to 1/8 and >1/8 to 1/4 mile distance categories.

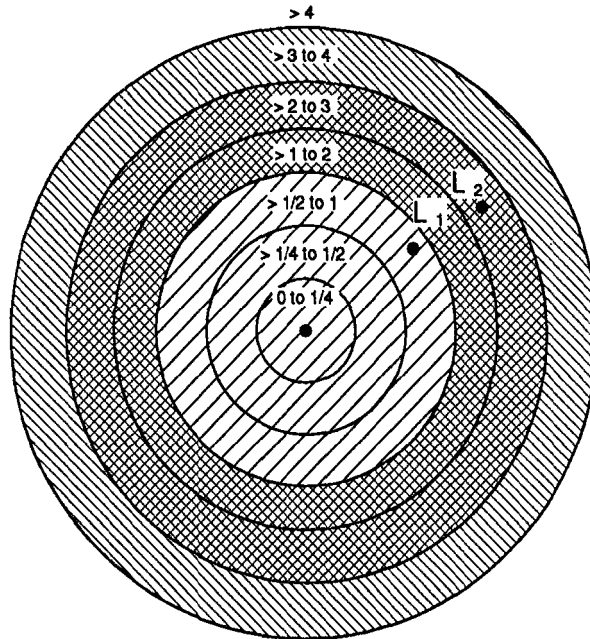
HIGHLIGHT 10-9 EFFECT OF SAMPLE LOCATION ON TARGET POPULATION



- = Sample location
- ▨ = Target population subject to actual contamination

These figures indicate that by placing a sampler (or making a direct observation for Level II) just beyond a distance category boundary versus just inside a distance category boundary, a population over a greater area can be evaluated as subject to actual contamination.

**HIGHLIGHT 10-10
ILLUSTRATION OF TARGET POPULATIONS SUBJECT TO LEVEL I,
LEVEL II, AND POTENTIAL CONTAMINATION**



- L_1 = Level I sample location
- L_2 = Level II sample location
- = Level I target population
- = Level II target population
- = Targets population subject to potential contamination

Distance categories for assigning a value to the nearest individual factor replace the 0 and >0 to $1/4$ category (shown in the diagram) with 0 to $1/8$ and $>1/8$ to $1/4$ mile distance categories.

TIPS AND REMINDERS

- The basic approach for scoring actual contamination in the air pathway is to set up distance categories around the sources and assign each distance category to Level I, Level II, or potential contamination, depending upon the location of observed releases and the results of comparisons of sample concentrations to benchmarks. Note that an observed release detected just off a source can result in the entire population within the greater than 0-1/4 mile distance category being evaluated as Level I or Level II.
- Any resident, student, or worker located anywhere within the distance category in which the observed release is located is evaluated as subject to actual contamination. In addition, any resident, student, or worker located in distance categories closer to the source is also evaluated as subject to actual contamination.
- The TDL for the air pathway is 4 miles from the edge of a source, unless an observed release is established beyond 4 miles.
- For the nearest individual factor, note that the distance category nearest the source is >0 to 1/8 mile, not >0 to 1/4 mile as it is for the population factor.
- The distance-weighted population value drops sharply farther from the site. Hence, it is most important that the population close to sources be documented carefully.

SECTION 10.4 RESOURCES



This section provides guidance for scoring the resources factor in the air pathway. The resources factor evaluates potential damage to recreation areas, commercial agriculture, and commercial silviculture due to site-related atmospheric contaminants. It does not evaluate threats to human health or sensitive environments.

RELEVANT HRS SECTIONS	
Section 6.3 Section 6.3.3	Targets Resources

DEFINITIONS

Commercial Agriculture: Production of crops for sale, including crops intended for widespread distribution (e.g., supermarkets) and more limited distribution (e.g., local produce stands), and any nonfood crops such as cotton and tobacco. Commercial agriculture does not include livestock production, livestock grazing, or crops grown for household consumption (e.g., backyard garden or fruit trees).

Commercial Silviculture: Cultivation of trees for sale (e.g., Christmas tree farm, trees raised for lumber).

Major or Designated Recreation Area: A major recreation area is an area used by a large number of people for recreational purposes (e.g., swimming or baseball). A designated recreation area is an area designated and maintained by a government body (e.g. local, state, Federal) as an area for public recreation.

SCORING THE RESOURCES FACTOR

- (1) **Using the checklist In *Highlight 10-11*, determine if there are any commercial agricultural or silvicultural areas, or major or designated recreation areas within 1/2 mile of a source at the site.** Use the above definitions in making this determination. *Highlight 10-12* lists examples of data sources for the resources factor.
- (2) **If any of these areas are present within 1/2 mile of a source with an air migration containment factor value greater than 0, assign a resource factor value of 5.** If none of these areas is present within 1/2 mile of a source, or if the source has an air migration containment factor of 0, assign a resource factor value of 0.

HIGHLIGHT 10-11 CHECKLIST FOR RESOURCES FACTOR

For the site being evaluated:

- | | | | |
|-----|---|-----|----|
| (1) | Is commercial agriculture present within 1/2 mile of a source at the site? | Yes | No |
| (2) | Is commercial silviculture present within 1/2 mile of a source at the site? | Yes | No |
| (3) | Is there a major or designated recreation area within 1/2 mile of a source at the site? | Yes | No |

If the answer is "yes" for any of the questions above, assign a resources factor value of 5. If the answer is "no" for each question, assign a resources factor value of 0. Remember that the answer is "yes" only if the activity takes place within 1/2 mile of a source with an air migration containment factor value greater than 0.

HIGHLIGHT 10-12 DATA SOURCES FOR THE RESOURCES FACTOR

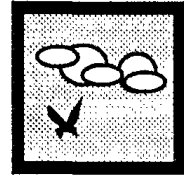
The following sources of information may help in documenting resource use at the site.

- Agricultural extension agents
- Correspondence with nearby businesses
- Correspondence with other nearby institutions, such as farms or universities
- County land use maps
- Existing PA/SI reports
- Field observations
- Files from adjacent or nearby CERCLIS sites
- Local Chambers of Commerce
- Soil Conservation Service (SCS)
- State departments of natural resources or state environmental departments, especially forestry departments
- The USDA/U.S. Forest Service (USFS)
- Topographic maps

TIPS AND REMINDERS

- Only 5 target points are assigned for the resources factor, regardless of the number of resources present within 1/2 mile of the site. Do not expend significant efforts documenting resource use unless those 5 points may be critical to the site score.
- Resources are only evaluated within 1/2 mile of sources at the site. Resources documented for other pathways may not be close enough to the site to score in the air migration pathway.

SECTION 10.5 EVALUATION OF SENSITIVE ENVIRONMENTS



This section provides general guidance for evaluating sensitive environments for the air migration pathway as well as specific guidance and examples for evaluating more complex situations in which multiple sensitive environments overlap. Assigning point values to sensitive environments is straightforward in most cases. In other cases (e.g., when the boundaries of several sensitive environments overlap, or if more than one designation may apply to a single environment), this determination may be less obvious; however, most scoring difficulties can be eliminated by treating each sensitive environment as a separate, independent target. This section addresses only the pathway-specific information necessary to evaluate sensitive environments (including wetlands) in the air pathway. Specific definitions of sensitive environments, sources of information, and steps for identifying sensitive environments are provided in Appendix A.

RELEVANT HRS SECTIONS	
Section 6.3	Targets
Section 6.3.4	Sensitive environments
Section 6.3.4.1	Actual contamination
Section 6.3.4.2	Potential contamination
Section 6.3.4.3	Calculation of sensitive environments factor value

DEFINITIONS

Actual Contamination for Listed Sensitive Environments: A listed sensitive environment is considered subject to actual contamination if any portion of the sensitive environment falls within a distance category where an observed release has been established, or in any distance category closer to the site. Direct observation and/or analytical data from air sampling may be used to establish actual contamination.

Sensitive Environment In the Air Pathway: A sensitive environment is a wetland (as defined in 40 CFR 230.3) or any area that meets the criteria listed in HRS Table 4-23. No other areas are considered sensitive environments for the air migration pathway.

CALCULATING THE SENSITIVE ENVIRONMENTS FACTOR VALUE

The following steps describe how to calculate the sensitive environments factor value.

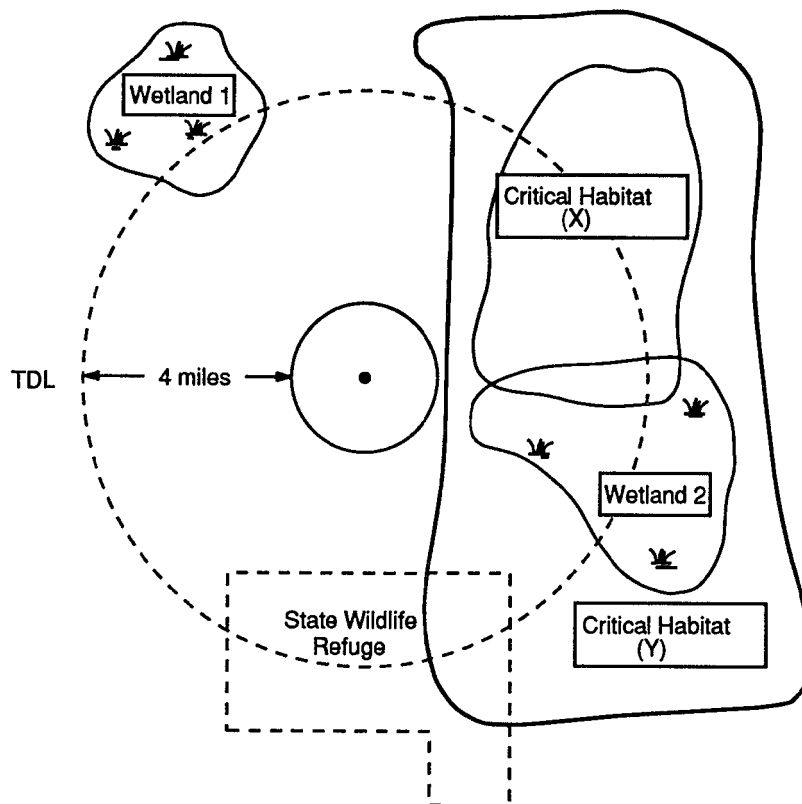
- (1) **Identify all sensitive environments listed in HRS Table 4-23 within the TDL.** For each sensitive environment, assign the appropriate point value from HRS Table 4-23. For guidance in identifying sensitive environments, see Appendix A. Use the following guidelines in identifying and assigning point values to each sensitive environment.

- Treat each discrete physical area that can be designated as a sensitive environment as a separate environmental target for HRS scoring purposes, regardless of the degree to which it overlaps with other sensitive environments. For example, critical habitat for an endangered species has the same point value whether located in a state wildlife refuge or not. The state wildlife refuge would be evaluated as a separate sensitive environment (see **Highlight 10-13**).
- Treat “critical habitat for” or “habitat known to be used by” endangered or threatened species as follows.
 - Identify at least one distinct habitat for each individual species (e.g., if there are three different species, identify three or more habitats, even if they partially or completely overlap).
 - For each individual species, assign only the endangered or threatened category that results in the highest point value. For example, if the same species is both a Federal proposed threatened species (75 points), and a state designated endangered species (50 points), evaluate the species as a Federal proposed threatened species for HRS scoring purposes.
 - If both “critical habitat for” and “habitat known to be used by” the same species occur within the TDL, consider each a separate sensitive environment for HRS scoring purposes. However, if these areas overlap within the TDL, evaluate the overlapping area only as “critical habitat for” the species (i.e., do not consider the zone of overlap as both “critical habitat for” and “habitat known to be used by” the species).

(2) **Based on the most distant location establishing an observed release to air, determine which listed sensitive environments are subject to actual contamination.**

- If multiple sources are present, determine to which source the observed release is attributable. If this determination cannot be made, select a single source to which the hazardous substance could be attributable (see **Highlight 10-7** for guidance on drawing distance categories at sites with multiple sources).
- If this location is within the 4-mile TDL, use HRS Table 6-15 to identify the distance category in which the observed release is located. Consider that distance category and all distance categories closer to the source as subject to actual contamination; all other distance categories (i.e., those farther from the source than the distance category in which the observed release is located) should be considered subject to potential contamination. Note that because no appropriate benchmarks exist, no distinction is made between Level I and Level II contamination when scoring sensitive environments in the air migration pathway. Sensitive environments within the TDL are evaluated simply as subject to either actual or potential contamination (i.e., actual contamination is not divided into Level I and Level II).
- If this location is beyond the 4-mile TDL, draw the boundary of a distance category extending to that location. Any sensitive environments located partially or entirely within that distance category or a distance category closer to the source are considered subject to actual contamination. In such a case, no sensitive environments are considered subject to potential contamination (see **Highlights 10-14** and **10-15**).

HIGHLIGHT 10-13 IDENTIFYING SENSITIVE ENVIRONMENTS IN THE AIR PATHWAY



The above figure is a schematic map (not to scale) of the 4-mile TDL associated with a hypothetical site. From background documents and discussions with appropriate Federal and state agencies, the following information is available:

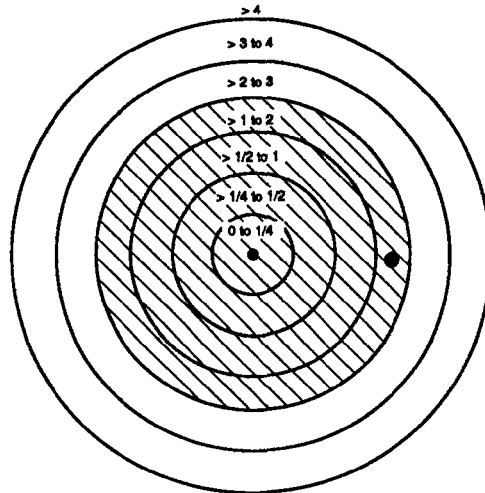
The area labelled Critical Habitat (Y) is a critical habitat for Federal endangered species. The area labelled Critical Habitat (X) is a critical habitat for a different Federal endangered species. The outlined area at the bottom of the map, directly beneath the source, is a state wildlife refuge. The areas designated as Wetland 1 and Wetland 2 are wetlands as defined in 40 CFR 230.3.

Based on this information, and by referring to HRS Tables 4-23 and 6-18 of the HRS Rule, the following sensitive environments are identified:

- (1) The area labelled Critical Habitat (Y) is identified as a critical habitat for Federal endangered species (Y) and assigned a value of 100 points;
- (2) The area labelled Critical Habitat (X) is identified as a critical habitat for Federal endangered species (X) and assigned a value of 100 points;
- (3) The state wildlife refuge is assigned a value of 75 points;
- (4) The area designated as Wetland 1 and the area designated as Wetland 2 are assigned a point value based on total acreage within the TDL (see **Highlight 10-15**).

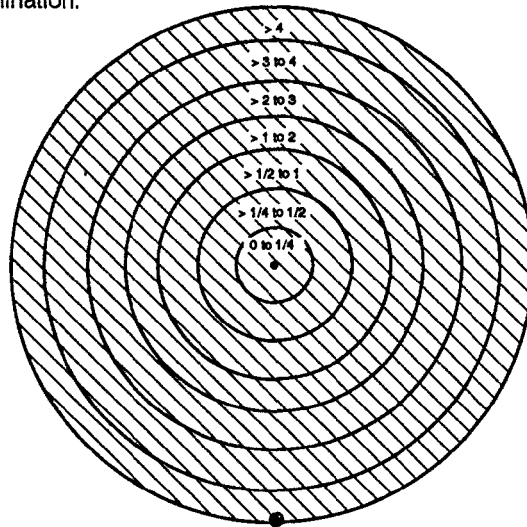
HIGHLIGHT 10-14 DETERMINING ACTUAL AND POTENTIAL CONTAMINATION FOR SENSITIVE ENVIRONMENTS

If an observed release location falls within a distance category less than 4 miles from the nearest edge of the source, the distance category that contains the observed release and all distance categories that are closer to the site are considered subject to actual contamination.



= Actual contamination
 = Observed release

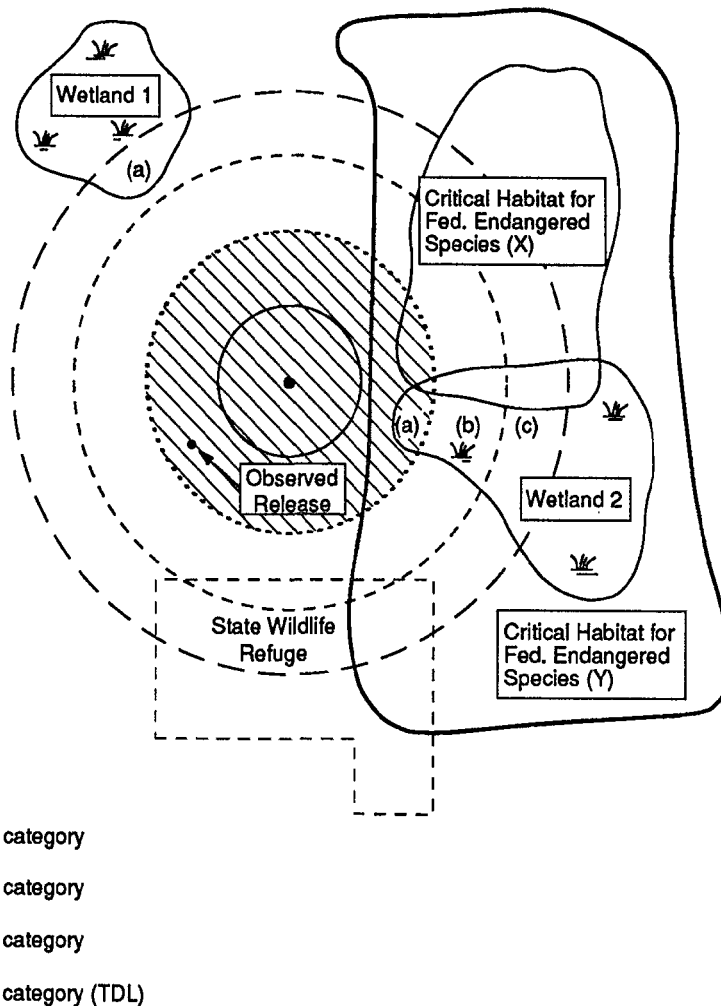
If an observed release location is more than 4 miles from the nearest edge of the source, the entire area between the source and a distance ring established by the radii extending to the location of the observed release is considered subject to actual contamination. In such cases, no distance categories are considered subject to potential contamination.



= Actual contamination
 = Observed release

For sensitive environments in the air pathway, there are no established benchmarks and, therefore, there is no distinction between areas of Level I and Level II contamination.

HIGHLIGHT 10-15 SCORING EXAMPLE FOR SENSITIVE ENVIRONMENTS



At this site, the area of actual contamination has been determined, the assigned value for likelihood of release (LR) is 550, and the assigned value for waste characteristics (WC) is 56. Five sensitive environments were identified and delineated as shown. Portion (a) of Wetland 1 (i.e., portion within >3 to 4 miles of the source) was determined to be 43 acres. Portions (a), (b), and (c) of Wetland 2 were determined to be 13 acres, 34 acres, and 60 acres, respectively. The sensitive environments factor value was obtained using the steps outlined below.

(continued on next page)

HIGHLIGHT 10-15 (continued) SCORING EXAMPLE FOR SENSITIVE ENVIRONMENTS

- (1) Critical habitats (X) and (Y) are considered subject to actual contamination because they are each partially within the area of actual contamination (identified with diagonal lines). The combined value for these two environments is 200. Portion (a) of Wetland 2 is subject to actual contamination and is assigned a wetland rating value of 25. These two values are added ($200 + 25 = 225$) to calculate the actual contamination value.
- (2) The state wildlife refuge, portion (a) of wetland 1, and portions (b) and (c) of wetland 2 are outside the area of actual contamination, but within the TDL, and therefore, are considered subject to potential contamination. The state wildlife refuge, at a distance of >2 to 3 miles, is assigned a value of 75 and a distance weight of 0.0023. Portion (b) of Wetland 2 is also assigned a distance weight of 0.0023 and a wetlands rating value of 25. The 43 acres in Portion (a) of Wetland 1 and the 60 acres in Portion (c) of Wetland 2 are summed ($43 + 60 = 103$ acres), and this total acreage is assigned a wetlands rating value of 125. Portion (a) of Wetland 1 and Portion (c) of Wetland 2 are also assigned a distance weight of 0.0014 because they are within the >3 to 4-mile distance category. The sensitive environment rating values for each distance category are summed and then multiplied by the distance weight for that distance category. All of these values are summed, such that $[(0.0023)(75 + 25) + (0.0014)(125) = 0.41]$. This value divided by 10 (i.e., 0.041) is the potential contamination value. This figure is not rounded because it is less than one.
- (3) The total targets value for sensitive environments (EB) was determined by summing the actual contamination value and the potential contamination value [$225 + 0.041 = 225.041$].
- (4) The sensitive environments factor value was determined as follows:
 - The values for LR, WC, and EB were multiplied together and then divided by 82,500 to obtain the score (S) of 84.015.
 - Because 84.015 is greater than 60, it was necessary to calculate the value EC = 160.71, which was obtained by dividing 4,950,000 by (LR x WC).
 - The sensitive environments factor was assigned a value of 160.71 (i.e., EC).

— Note that if any portion of a sensitive environment listed in HRS Table 4-23 is subject to actual contamination, the entire sensitive environment is scored as subject to actual contamination.

- Sum all of the sensitive environments values (from HRS Table 4-23) for sensitive environments subject to actual contamination. Do not distance weight these values. Assign this total as the actual contamination value for listed sensitive environments not being evaluated solely as wetlands.
- (3) **Determine which listed sensitive environments are subject to potential contamination.**
- If the distance category containing the most distant observed release to air is closer than the 4-mile TDL, any listed sensitive environments entirely beyond that distance category, but at least partially within the TDL, are considered subject to potential contamination. Note that if a sensitive environment is subject to actual contamination, it cannot also be considered subject to potential contamination. If no observed release to air is established, all sensitive environments at least partially within the 4-mile TDL would be considered subject to potential contamination.

- Determine the distance category that each listed sensitive environment subject to potential contamination falls within. If a listed sensitive environment falls into more than one distance category, assign only the highest applicable distance weight (i.e., count it only once and use the closest distance category).
 - Sum the assigned values for all of the listed sensitive environments that fall within a single distance category and multiply that total by the appropriate distance weight. Remember to count each listed sensitive environment only once in the closest distance category. Sum all of these distance weighted values and assign this total as the potential contamination value for listed sensitive environments not being evaluated solely as wetlands.
 - When scoring potential contamination, aggregate identical distance categories that partially or totally overlap (see **Highlight 10-8** for guidance on drawing distance categories at sites with multiple sources).
- (4) **If wetlands are present within the TDL, determine which portions of the wetlands are subject to actual contamination and which portions are subject to potential contamination.**
- Only the portion of each discrete wetland area that is within the distance category established by the most distant observed release location (or a distance category closer to the sources) should be considered subject to actual contamination.
 - Wetlands or portions of wetlands farther from the source than the distance category containing the most distant observed release location, but within the 4-mile TDL, should be considered subject to potential contamination.
- (5) **Determine the total acreage of wetlands subject to actual contamination and the total acreage of wetlands subject to potential contamination.** There are a number of relatively simple quantitative methods for estimating the acreage of a given area. These include:
- Using a digitizing tablet;
 - Using graph paper as an overlay for a map with an accurate scale (e.g., a USGS topographic map); or
 - Cutting out a standard (e.g., a 10-acre square of the map) and comparing the mass of the standard against the mass of the clippings from the portion of the map for which the acreage is to be determined. This can be done using a standard laboratory balance scale.
- (6) **Assign the appropriate wetland rating value using HRS Table 6-18 based on the total acreage of wetlands subject to actual contamination.** Assign this value as the actual contamination value for wetlands.
- (7) **Identify the distance categories (listed in HRS Table 6-15) that include portions of wetlands subject to potential contamination.** Based on total acreage of all wetlands within a particular distance category, assign the appropriate wetland rating value for the portions of wetlands subject to potential contamination. For example, if 10 acres of a 100-acre wetland are within a particular distance category, only those 10 acres should be evaluated for that particular distance category.
- Sum the total acreage of wetlands or portions of wetlands present within a single distance category.

- Assign a single wetlands rating value to that distance category based on the total acreage of all wetlands within that distance category.
- Multiply the sum of the wetlands rating values for a single distance category by the distance weight for that distance category. Distance weights are provided in HRS Table 6-15.

Repeat the above procedure for each distance category subject to potential contamination (i.e., those within the TDL not subject to actual contamination).

Sum the potential contamination values calculated for each distance category and assign this value as the potential contamination value for wetlands.

(8) **Calculate the actual contamination factor value and the potential contamination factor values.**

- Sum the assigned actual contamination values for listed sensitive environments and for wetlands. Assign this value as the actual contamination factor value.
- Sum the assigned potential contamination values for listed sensitive environments and for wetlands. Divide that value by ten. If this value is less than 1, do not round it to the nearest integer. If this value is greater than 1, round it to the nearest integer. Assign this value as the potential contamination factor value.

(9) **Calculate the total value for sensitive environments.** Sum the factor values for actual contamination and potential contamination. Assign this value as the sensitive environments total value (EB).

(10) **Calculate the sensitive environments factor value.** Because the air migration pathway score based solely on sensitive environments is limited to 60 points, the method for determining the sensitive environments factor value depends on the total value for sensitive environments (EB, as calculated in Step (9) above), the likelihood of release value for the air pathway (LR), and the waste characteristics value (WC).

- Multiply the values assigned to LR, WC, and EB for the site and divide this product by 82,500.
- If the resulting score (S) is 60 or less, assign EB as the sensitive environments factor value.
- If the resulting score (S) is greater than 60, assign only that portion of EB that will result in a score of 60 as the sensitive environments factor value. This value, termed EC, is calculated as follows:

$$EC = \frac{(60)(82,500)}{(LR)(WC)} = \frac{4,950,000}{(LR)(WC)}$$

Note: Do not round EC to the nearest integer.

TIPS AND REMINDERS

- Only wetlands (as defined in 40 CFR 230.3) and areas that are listed in HRS Table 4-23 are considered sensitive environments in the air pathway.
- Treat each discrete sensitive environment as a separate, independent target for assigning point values and determining level of contamination, regardless of the degree to which its boundaries overlap with those of other sensitive environments.
- Identify at least one separate sensitive environment for each endangered or threatened species, but assign only one category (e.g., Federal endangered or state threatened, but not both) to each species.
- Designations of threatened or endangered species listed at the state level are valid only within the borders of that state.
- Wetland areas can be evaluated both as a wetland and as other types of sensitive environments (e.g., critical habitat).
- If any portion of a listed sensitive environment is subject to actual contamination, the entire sensitive environment is considered subject to actual contamination. Note that this is not true for wetlands.
- Wetland acreage estimates must be based on the portion of each wetland area within each distance category (e.g., only the portion of a wetland within a distance category subject to actual contamination is evaluated under actual contamination).
- In evaluating wetlands for potential contamination, evaluate all wetlands in a single distance category as a distinct sensitive environment.
- There is no limit to the air pathway targets factor category score; however, the air pathway score based solely on sensitive environments is subject to a maximum of 60 points.

APPENDIX A

SENSITIVE ENVIRONMENTS

CONTENTS OF APPENDIX A

Page

APPENDIX A SENSITIVE ENVIRONMENTS

Section A.1 Pathway-specific Eligibility Requirements for Sensitive Environments	A-1
Air Pathway	A-1
Soil Exposure Pathway	A-1
Surface Water Pathway	A-1
Section A.2 Definitions of Sensitive Environments Including Wetlands	A-3
Section A.3 Process for Identifying and Delineating Sensitive Environments	A-25
Sensitive Environments Likely to Be Delineated on USGS Topographic Maps.	A-25
Sensitive Environments Likely to Be Delineated on Specialized Maps or in Special Documents	A-25
Sensitive Environments That Require Professional Judgment and/or Specific Expertise to Identify and Delineate	A-26
Section A.4 Sources of Information for Identifying Sensitive Environments	A-33

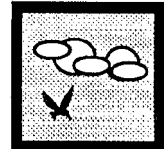
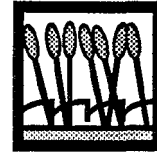
HIGHLIGHTS IN APPENDIX A

Highlight A-1	Eligibility Requirements for Evaluating Terrestrial Sensitive Environments in Surface Water Pathway.	A-2
Highlight A-2	Key Terms Used in Defining Sensitive Environments	A-3
Highlight A-3	Determining HRS Categories for Coastal Barrier.	A-6
Highlight A-4	HRS Categories for Wild and Scenic Rivers.	A-8
Highlight A-5	CERCLA Natural Resource Trustees	A-12
Highlight A-6	Appropriate Documentation for Migratory Pathways and Feeding Areas Critical for Maintenance of Anadromous Fish Species Within Rivers, Lakes, or Coastal Tidal Waters.	A-13
Highlight A-7	Appropriate Documentation for Spawning Areas Critical for Maintenance of Fish/Shellfish Species Within Rivers, Lakes, or Coastal Tidal Waters.	A-17
Highlight A-8	Comparison of HRS Wetlands Definition and Wetlands Classification System Used for NWI Maps	A-22
Highlight A-9	Eligibility of Wetland Categories on NWI Maps for HRS Scoring.	A-30
Highlight A-10	U.S. Geological Survey Earth Science Information Center Offices.	A-43
Highlight A-11	U.S. National Park Service Regional Offices	A-44
Highlight A-12	U.S. Fish and Wildlife Service Regional Offices.	A-45
Highlight A-13	U.S. Bureau of Land Management State Offices.	A-46
Highlight A-14	U.S. National Forest Service Regions.	A-47
Highlight A-15	National Estuarine Research Reserve System.	A-48
Highlight A-16	Near Coastal Waters Program EPA Regional Contacts	A-50
Highlight A-17	EPA Regional Clean Lakes Program Offices.	A-51
Highlight A-18	Nautical Chart Numbers for Marine Sanctuaries.	A-52
Highlight A-19	National Estuary Program Information Sources	A-53
Highlight A-20	EPA Regional Offices	A-54
Highlight A-21	National Park Service Regional Boundaries.	A-55
Highlight A-22	U.S. Fish and Wildlife Service Regional Boundaries	A-56
Highlight A-23	U.S. Forest Service Regional Boundaries.	A-57

ACRONYMS IN APPENDIX A

BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BTAG	Biological Technical Assistance Group
CFR	Code of Federal Regulations
EIS	environmental impact statement
HRS	Hazard Ranking System
MMS	Minerals Management Service
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NWI	National Wetlands Inventory
OSM	Office of Surface Mining
OWRS	Office of Water Regulations and Standards
SAV	submerged aquatic vegetation
SCS	Soil Conservation Service
TDL	target distance limit
USC	U. S. Code
USFS	U. S. Forest Service
USFWS	U. S. Fish and Wildlife Service
USGS	U. S. Geological Survey

SECTION A.1 PATHWAY-SPECIFIC ELIGIBILITY REQUIREMENTS FOR SENSITIVE ENVIRONMENTS



The Hazard Ranking System (HRS) evaluates environmental threat only for a specified set of targets (i.e., sensitive environments) that meet certain criteria. With some pathway-specific exceptions, sensitive environments located partially or wholly within the target distance limit (TDL) for the surface water, soil exposure, and/or air pathway(s) are eligible targets. Two key steps to evaluate an area as a sensitive environment in the HRS are (1) determine if the area meets HRS criteria for one or more sensitive environments, and (2) delineate boundaries of the area eligible for scoring with respect to the pathway being evaluated. Sensitive environments include:

- Those defined and delineated by statute (e.g., National Parks, Designated Federal Wilderness Areas);
- Those that meet a particular classification (e.g., spawning areas critical for the maintenance of fish/shellfish species, habitat known to be used by a proposed Federal endangered species) or statutory definition (e.g., wetlands) but are not statutorily delineated.

Evaluating sensitive environments that fall into the first category is relatively straightforward, because the areas are officially designated and delineated. Evaluating environments that fall into the second category requires professional judgment both to determine if an area is eligible for scoring and to delineate the eligible area. This section provides descriptive criteria and examples to assist in evaluating sensitive environments in the latter category.

General pathway-specific eligibility requirements are listed below.

AIR PATHWAY

All portions of all sensitive environments at least partially within the TDL are eligible, with the following qualifier: terrestrial areas utilized for breeding by large or dense aggregations of animals are limited to those used by terrestrial vertebrate species.

SOIL EXPOSURE PATHWAY

Only terrestrial sensitive environments (as listed in HRS Table 5-5) that are at least partially on an area of observed contamination are eligible. Terrestrial portions of other sensitive environments, and portions of wetlands that are periodically out of water, may be eligible to be evaluated as a terrestrial sensitive environment (see Section 9.6).

SURFACE WATER PATHWAY

All surface water (and wetland) portions of the sensitive environment at least partially within the TDL for a watershed are eligible to be evaluated for that watershed. Circumstances under which

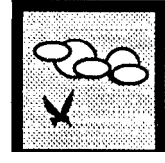
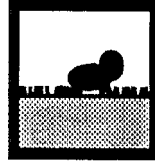
terrestrial sensitive environments or terrestrial portions of a sensitive environment are eligible are illustrated in **Highlight A-1** and described below.

- Terrestrial sensitive environments that are not defined by the presence of one or more particular species (e.g., wildlife refuges) and whose boundaries cross or border a surface water body within the TDL for a watershed are eligible to be evaluated for that watershed.
- Terrestrial sensitive environments that are defined by the presence of one or more particular species (e.g., habitat known to be used by an endangered or threatened species, terrestrial areas used for breeding by large or dense aggregations of animals) and whose boundaries cross or border a surface water body within the TDL for a watershed are eligible to be evaluated for the watershed unless there is clear information that the particular species of concern is unlikely to come into contact with the surface water body or bodies within the TDL. Examples include terrestrial plant species not located in floodplains and terrestrial animal species that rarely or never drink water.
- Terrestrial sensitive environments that are defined by the presence of one or more particular species and whose boundaries do not cross or border a surface water body within the TDL are eligible to be evaluated for that watershed only if there is clear information that the particular species of concern is likely to come into contact with the surface water body or bodies within the TDL. Examples of such information include evidence that grouse from a display ground some distance from water regularly use a surface water body within the TDL for drinking or bathing; evidence that a bald eagle nesting several miles from water is known to forage in a surface water body within the TDL (note that such evidence probably would be sufficient to demonstrate that the surface water body was habitat known to be used by the bald eagle).

HIGHLIGHT A-1
ELIGIBILITY REQUIREMENTS FOR EVALUATING TERRESTRIAL SENSITIVE ENVIRONMENTS IN SURFACE WATER PATHWAY

Area Delineated by Presence of One or More Species	Boundary of Area Crosses or Borders Surface Water Body within TDL	Eligibility Requirements
Yes	Yes	Eligibility unless species of concern is unlikely to contact surface water within TDL
	No	Not eligible unless species of concern is likely to contact surface water within TDL
No	Yes	Always eligible
	No	Never eligible

SECTION A.2 DEFINITIONS OF SENSITIVE ENVIRONMENTS INCLUDING WETLANDS



This section defines all sensitive environments in HRS Tables 4-23 and 5-5, as well as wetlands. These definitions, presented in alphabetical order, are intended to assist the scorer in identifying sensitive environments that may be applicable to the surface water, soil exposure, or air pathway(s). Each definition includes a general section applicable to all pertinent pathways (i.e., surface water, soil exposure, and air), followed by a pathway-specific discussion. The statutory authority for designating the sensitive environment, where appropriate, also is included. *Highlight A-2* defines key terms used in defining sensitive environments. This section also includes a discussion of the relationship between wetlands definitions used by the U.S. Fish and Wildlife Service (USFWS) and the HRS.

HIGHLIGHT A-2 KEY TERMS USED IN DEFINING SENSITIVE ENVIRONMENTS

Aquatic Vertebrate Species: Vertebrate species that lay eggs or bear young in water. Includes all fishes, nearly all amphibians, and a few mammals (i.e., manatees, whales, porpoises).

Recognized Expert: A university professor or member of a professional society in a discipline such as ornithology, herpetology, ichthyology, entomology, or botany. The individual also must have authored at least one peer-reviewed scientific publication on the geographic area or species of concern.

Species Habitat: The place where a population of a species normally lives and its surrounding area, both living and nonliving. Habitat generally is characterized by dominant plant form (e.g., broadleaf deciduous forest) and/or physical characteristics (e.g., fast-moving stream with rocky substrate).

Species Range: The geographic extent over which a species occurs, including areas that comprise suitable habitat as well as those that do not. Current range is the geographic extent over which the species occurs at present; historic range is the geographic extent over which the species occurred at some time in the past.

Terrestrial Vertebrate Species: Vertebrate species that lay eggs or bear young outside of water. Includes all reptiles, all birds, most mammals, and amphibians that lay their eggs in shaded, moist sites on land.

Vertebrate Species: Animals belonging to the Phylum Chordata Subphylum Vertebrata. Includes organisms in the Class Agnatha (e.g., lampreys), Class Chondrichthyes (e.g., sharks, rays), Class Osteichthyes (most living forms of fishes), Class Amphibia (e.g., frogs, toads, salamanders), Class Reptili (e.g., snakes, lizards, turtles, alligators), Class Aves (birds), and Class Mammalia (mammals).

Vertebrate Species with Semi-aquatic Habits: Vertebrate species that either breed in water but live primarily on land (e.g., many amphibians) or breed out of water but live primarily in water (e.g., waterfowl, turtles, alligators, seals). Species in the former category are termed aquatic species with semi-aquatic habits; species in the latter category are termed terrestrial species with semi-aquatic habits.

ADMINISTRATIVELY PROPOSED FEDERAL WILDERNESS AREA

General

Remote areas of undeveloped Federal lands proposed by U.S. Forest Service (USFS), National Park Service (NPS), USFWS, or the Bureau of Land Management (BLM) to become a Federal Wilderness Area based on their primeval character and influence, lack of permanent roads, and lack of permanent improvements or human habitation. Areas must be proposed in the *Federal Register* for Federal Wilderness Area status to meet this definition. Areas already designated by Congress as Federal Wilderness Areas are considered a separate sensitive environment in the HRS (see subsection below, Designated Federal Wilderness Area). Statutory Authority: National Wilderness Preservation Act (16 U.S.C. § 1131, *et seq.*).

Pathway Specific

- Air - General eligibility requirements apply.
- Soil exposure - General eligibility requirements apply.
- Surface water - General eligibility requirements apply.

AREAS IDENTIFIED UNDER THE COASTAL ZONE MANAGEMENT ACT

General

Areas of coastal waters, the Great Lakes, and their connecting waters identified in state Coastal Zone Management Plans as requiring protection because of their ecological value. The following areas meet this definition for HRS purposes:

- Areas designated by the Secretary of Commerce as a National Estuarine Research Reserve (proposed areas are not eligible).
- Areas (identified in the Act) designated as of particular concern in a final State Coastal Zone Management Plan that has been approved by the National Oceanic and Atmospheric Administration (NOAA):
 - Areas of unique, scarce, fragile, or vulnerable habitat.
 - Areas of high natural productivity or essential habitat for living resources, including fish, wildlife, endangered species, and the various trophic levels in the food web critical to their well-being.
 - Areas needed to protect, maintain, or replenish coastal lands or resources, including coastal flood plains, aquifers and their recharge areas, estuaries, sand dunes, coral and other reefs, beaches, offshore sand deposits, and mangrove stands.
- Areas proposed, designated, or otherwise identified in draft plans that have not been approved by NOAA are not eligible for HRS purposes. Moreover, areas designated as of particular concern for reasons (defined by the Act) other than their ecological value do not meet this definition. Examples include areas of urban concentration where shoreline utilization and water uses are highly competitive and areas where developments and facilities are dependent upon the utilization of or access to coastal waters. Note that some National Estuarine Research Reserves were formerly designated as National Estuarine Sanctuaries. Statutory Authority: Coastal Zone Management Act (16 U.S.C. § 1451, *et seq.*; 15 CFR 921, *et seq.*; 15 CFR 923, *et seq.*)

Pathway Specific

- Air - General eligibility requirements apply.
- Soil exposure - Category is not evaluated.
- Surface water - General eligibility requirements apply.

COASTAL BARRIER - PARTIALLY DEVELOPED

General

Coastal barriers that are no more than 50 percent developed and that are not designated as units of the Coastal Barrier Resources System. A coastal barrier is a depositional geologic feature (e.g., a bay barrier, tombolo, barrier spit, or barrier island) that consists of unconsolidated sedimentary materials; is subject to wave, tidal, and wind energies; and protects landward aquatic habitats from direct wave attack. The coastal barrier includes all associated aquatic habitats, including the adjacent wetlands, marshes, estuaries, inlets, and nearshore waters. Under the Coastal Barrier Resources Act, a coastal barrier is considered partially developed if no more than 50 percent of the fastland area (i.e., the area between the landward and shoreward sides of the barrier) is covered by one or more man-made structures (i.e., walled and roofed buildings constructed in conformance with legal requirements, with a projected ground area exceeding 200 square feet) per 5 acres of fastland area. A coastal barrier that is more than 50 percent developed is not eligible for evaluation as a partially developed coastal barrier. Partially developed coastal barriers that are designated as units of the Coastal Barrier Resources System are considered a separate sensitive environment for HRS purposes (see subsection below, Coastal Barrier - Undeveloped). **Highlight A-3** summarizes criteria for determining the appropriate HRS sensitive environments category for a coastal barrier. Statutory Authority: Units of the Coastal Barrier Resource System are designated under the Coastal Barrier Resources Act (16 U.S.C. § 3501, *et seq.*); coastal barriers that meet the definition for this sensitive environment are not statutorily defined.

Pathway Specific

- Air – General eligibility requirements apply.
- Soil exposure – Category is not evaluated.
- Surface water – General eligibility requirements apply.

COASTAL BARRIER - UNDEVELOPED

General

Undeveloped coastal barriers that are not designated as units of the Coastal Barrier Resources System. A coastal barrier is a depositional geologic feature (e.g., a bay barrier, tombolo, barrier spit, or barrier island) that consists of unconsolidated sedimentary materials; is subject to wave, tidal, and wind energies; and protects landward aquatic habitats from direct wave attack. The coastal barrier includes all associated aquatic habitats, including any adjacent wetlands, marshes, estuaries, inlets, and/or nearshore waters. Under the Coastal Barrier Resources Act, the definition of an undeveloped barrier varies according to whether the entire barrier is being considered or only a portion is being considered. If the entire barrier is being considered, it must contain (on average) fewer than one man-made structure (i.e., a walled and roofed building constructed in conformance with legal requirements, with a projected ground area exceeding 200 square feet) per 5 acres of fastland area (i.e., the area between the landward and shoreward sides of the barrier). If only a portion of the barrier is being considered, the portion must have at least 1/4-mile of undeveloped shoreline on the shoreward side of the coastal barrier, and the undeveloped area must extend through the fastland from the beach to the associated landward aquatic habitat. Undeveloped coastal barriers that are designated as units of the Coastal Barrier Resources System are considered a separate sensitive environment for HRS purposes (see subsection above, Coastal Barrier – Partially Developed). See **Highlight A-3** for a summary of criteria for determining the appropriate HRS sensitive

**HIGHLIGHT A-3
DETERMINING HRS CATEGORIES FOR COASTAL BARRIER**

Description		HSR Category
Area designated as a Unit of the Coastal Barrier Resources System		Unit of Coastal Barrier Resources System
"Otherwise Protected" area depicted on Coastal Barrier Resources System maps		Not eligible unless it can be classified as partially developed or undeveloped coastal barrier
Area not designated as a Unit of the Coastal Barrier System	Entire barrier -- fewer than one man-made structure per 5 acres of fastland area	Coastal Barrier (Undeveloped)
	Portion of barrier -- at least 1/4-mile of undeveloped shoreline on the shoreward side, with the undeveloped area extending through the fastland area from the beach to the associated landward aquatic habitat	
	No more than 50 percent of fastland area covered by one or more man-made structures per 5 acres of fastland area	Coastal Barrier (Partially Developed)
	At least 50 percent of fastland area covered by one or more man-made structures per 5 acres of fastland area	Not eligible

environments category for a coastal barrier. Statutory Authority: Units of the Coastal Barrier Resource System are designated under the Coastal Barrier Resources Act (16 U.S.C. § 3501, *et seq.*); coastal barriers that meet the definition of this sensitive environment are not statutorily defined.

Pathway Specific

- Air - General eligibility requirements apply.
- Soil exposure - Category is not evaluated.
- Surface water - General eligibility requirements apply.

CRITICAL AREAS IDENTIFIED UNDER THE CLEAN LAKES PROGRAM

General

Subareas within publicly owned lakes, or in some cases entire, small, publicly owned lakes, identified in State Clean Lakes Plans as critical habitat under the Clean Water Act (commonly referred to as the section 305(b) report). Each state is required to submit: a Clean Lakes plan to receive grant assistance under section 314 of the Clean Water Act. Statutory Authority: section 314 of the Clean Water Act (33 USC § 1324).

Pathway Specific

- Air - General eligibility requirements apply.
- Soil exposure - Category is not evaluated.
- Surface water - General eligibility requirements apply.

CRITICAL HABITAT FOR FEDERAL DESIGNATED ENDANGERED OR THREATENED SPECIES

General

Habitat designated by the Secretary of the Interior as critical to the survival of an endangered or threatened species. Only those areas listed in 50 CFR 17.95 (critical habitats for fish and wildlife species) or 17.96 (critical habitats for plant species) meet this definition for HRS purposes; areas proposed as critical habitat do not meet this definition. Other habitat areas known to be used by the species are considered a separate sensitive environment in the HRS (see). Note that critical habitat has not been designated for all endangered or threatened species. Statutory Authority: Endangered Species Act (16 U.S.C. § 1531, *et seq.*; 50 CFR 424.02).

Pathway Specific

- Air - General eligibility requirements apply.
- Soil exposure - Category is evaluated for the soil exposure pathway only if the designated critical habitat includes one or more terrestrial areas within an area of observed contamination.
- Surface water - Category is evaluated only if the designated critical habitat includes one or more surface water bodies within the TDL.

DESIGNATED FEDERAL WILDERNESS AREA

General

Remote areas of undeveloped Federal land designated by an act of Congress as a Federal Wilderness Area based on their primeval character and influence and lack of permanent roads, improvements, or human habitation. Federal Wilderness Areas are administered either by the USFS, NPS, USFWS, or BLM. Proposed Federal Wilderness Areas are considered a separate sensitive environment in the HRS. Statutory Authority: National Wilderness Preservation Act (16 U.S.C. § 1131, *et seq.*).

Pathway Specific

- Air - General eligibility requirements apply.
- Soil exposure - General eligibility requirements apply.
- Surface water - General eligibility requirements apply.

FEDERAL DESIGNATED SCENIC OR WILD RIVER

General

Rivers or segments of rivers (and the related adjacent land area) that are (1) designated as National Wild and Scenic Rivers by an act of Congress or the Secretary of the Interior based on their degree of free-flow; lack of development; and the outstanding scenic, natural, and cultural characteristics of the segments and their surrounding environments and (2) classified as wild or scenic. Under the Wild and Scenic Rivers Act, segments are designated wild because they are free of impoundments and generally accessible only by trail, with essentially primitive watersheds or

shorelines, and unpolluted waters. Segments are designated scenic because they are free of impoundments, with shorelines or watersheds still largely undeveloped, but accessible in places by roads. Administering agencies and the conditions under which a river segment is designated a National Wild and Scenic River are listed under National River Reach Designated as Recreational. Note that National Wild and Scenic Rivers may be classified either as wild, scenic, or recreational; segments classified as recreational are considered a separate sensitive environment in the HRS (see subsection below, National River Reach Designated as Recreational). River segments designated by a state as wild or scenic, but not included in the national system, also are considered a separate sensitive environment in the HRS (see subsection below, State Designated Scenic or Wild River). **Highlight A-4** summarizes criteria for determining the appropriate HRS sensitive environments category for a wild or scenic river. Statutory Authority: National Wild and Scenic Rivers Act (16 U.S.C. §§ 1271-1287).

Pathway Specific

- Air – General eligibility requirements apply.
- Soil exposure – Category is not evaluated.
- Surface water – General eligibility requirements apply.

FEDERAL LAND DESIGNATED FOR THE PROTECTION OF NATURAL ECOSYSTEMS

General

This sensitive environment includes two types of areas: (1) public lands designated by an appropriate Federal Agency (e.g., USFS, BLM, Bureau of Indian Affairs (BIA), Minerals Management Service (MMS), Office of Surface Mining (OSM)) in a relevant document as an area for protecting natural ecosystems (e.g., a BLM Area of Critical Environmental Concern), and (2) public lands established as Wildlife Mitigation Areas in accordance with an environmental impact statement (EIS) for Federal land. Statutory Authority: sections 103(a) and 202(c)(3) of the Federal Land Policy and Management Act (43 U.S.C. §§ 1702(a), 1712(c)(3)).

HIGHLIGHT A-4		
HRS CATEGORIES FOR WILD AND SCENIC RIVERS		
Designation	Classification	HRS Category
National Wild and Scenic River	Recreational	National River Reach Designated as Recreational
	Wild	Federal Designated Scenic or Wild River
	Scenic	Federal Designated Scenic or Wild River
State Scenic River or State Wild River not included in National Wild and Scenic River System		State Designated Scenic or Wild River
State Scenic River or State Wild River included in National Wild and Scenic River System		National River Reach Designated as Recreational or Federal Designated Scenic or Wild River, as appropriate (see above)

Pathway Specific

- Air – General eligibility requirements apply.
- Soil exposure – General eligibility requirements apply.
- Surface water – General eligibility requirements apply.

HABITAT KNOWN TO BE USED BY FEDERAL DESIGNATED OR PROPOSED ENDANGERED OR THREATENED SPECIES

General

Areas known to be used by a species designated or proposed for designation by the Secretary of the Interior as endangered or threatened by listing in 50 CFR 17.11 (fish and wildlife), listing in 50 CFR 17.12 (plants), or notification in the *Federal Register*. Definition does not include those areas that are designated as critical habitat for the endangered or threatened species; such areas are considered a separate sensitive environment in the HRS. To evaluate this sensitive environment, provide evidence that at least one member of the species is present in and is using the habitat within the TDL. Field survey evidence (not necessarily direct sightings) should be sufficient to conclude that the species would likely be found in the habitat. Note that evidence of presence but not use, (e.g., sighting an individual member of a species flying over the habitat) generally will not be sufficient. Examples of sufficient evidence include (but are not limited to):

- A recent sighting (e.g., within the past five years) has been made by a representative of an appropriate Federal, state, county, or local agency (e.g., USFWS, National Marine Fisheries Service (NMFS), state fish and game department, state Natural Heritage program) or by a recognized expert, preferably written on official letterhead, of at least one individual member of the species within and using the area of concern.
- A written statement from a representative of an appropriate Federal, state, county, or local agency, or from a recognized expert indicates that the area of concern is suitable habitat for and is within the current range of the species in question.
- Evidence from a published document or logbook indicates that the area of concern is suitable habitat for and is within the current range of the species of concern. Only original, primary sources are suitable; secondary sources such as an EIS are not. For example, a statement in an EIS that an endangered species was seen using the surface water body during a site survey is not sufficient evidence; the logbook or original notes of the individual making the observation may be sufficient evidence. Statutory Authority: endangered and threatened species are designated or proposed under the Endangered Species Act (15 U.S.C. § 1531, *et seq.*); habitat known to be used by these species is not statutorily defined.

Pathway Specific

- Air – Document suitable terrestrial or aquatic habitat and current range of the species within the TDL.
- Soil exposure – It generally will be sufficient to document suitable terrestrial habitat and current range or the presence of the species within at least one area of observed contamination. Evidence will be strengthened by documenting that the species spends all or a considerable portion of its time in direct contact with surface soils (e.g., plants, snakes, burrowing mammals) or consumes such organisms (e.g., birds that eat worms, owls or hawks that eat small rodents).
- Surface water – For aquatic species (e.g., fish, whales) or aquatic species with semi-aquatic habits (e.g., toads, salamanders), it generally will be sufficient to document

suitable habitat used by the species (e.g., for feeding or breeding) or the presence of the species within one or more surface water bodies (or wetlands) within the TDL. For terrestrial species with semi-aquatic habits (e.g., herons, mink), it generally will be necessary to document that the species of concern is likely to come into contact with one or more surface water bodies within the TDL (e.g., the species consumes fish or other aquatic organisms that might inhabit the surface water body or drinks water from similar types of surface water bodies). Habitat used by terrestrial species that are unlikely to contact surface water within the TDL is generally not eligible (e.g., terrestrial plant species not located in floodplain areas, terrestrial animal species that rarely or never drink water).

HABITAT KNOWN TO BE USED BY SPECIES UNDER REVIEW AS TO ITS FEDERAL ENDANGERED OR THREATENED STATUS

General

Areas known to be used by a species which the Secretary of the Interior has formally announced is under review as to its Federal endangered or threatened status by notification in the most recent Comprehensive Notice of Review (fish, wildlife, and plant species) or Candidate Species List (marine animal species) published in the *Federal Register*. The USFWS publishes one Comprehensive Notice of Review each year with plant and animal species included in alternating years (e.g., animals were published in 1989, plants were published in 1990). NOAA publishes a candidate species list periodically, as needed. The definition of this sensitive environment category is identical to habitat known to be used by Federal designated endangered or threatened species, with the following exceptions:

- If the species of concern also is a state designated or proposed endangered or threatened species, evaluate the habitat either as habitat used by a state endangered or threatened species, or as habitat used by a species under review as to its Federal endangered or threatened status, but not as both, using the higher of the appropriate scores.
- For eligible species, this definition includes areas designated as critical or important habitat for the endangered or threatened species of concern, as long as it can be established that the species is present in and uses these areas.

Statutory Authority: Endangered Species Act (15 U.S.C. § 1531, *et seq.*).

Pathway Specific

- See subsection above, Habitat Known to be Used by Federal Designated Endangered or Threatened Species, for pathway-specific information.

HABITAT KNOWN TO BE USED BY STATE DESIGNATED ENDANGERED OR THREATENED SPECIES

General

Areas known to be used by a species designated as endangered or threatened within the state by the Governor, administering agency, or state legislature. The definition of this sensitive environment category is identical to habitat known to be used by Federal designated endangered or threatened species, with the following exceptions:

- If the species of concern also is a Federal designated or proposed endangered or threatened species, the species should not be considered a state endangered or

threatened species for HRS purposes. Evaluate habitat known to be used by a Federal designated or proposed endangered or threatened species).

- Species that are proposed for designation as endangered or threatened by the state do not meet this definition for HRS purposes.
- For eligible species, this definition includes areas designated as critical or important habitat for the endangered or threatened species of concern.

Note that species listed as "significantly rare" or "of special concern" in the state are not eligible under this category unless they have been designated as endangered or threatened within the state. Statutory Authority: state endangered species laws.

Pathway Specific

- See subsection above, Habitat Known to be Used by Federal Designated Endangered or Threatened Species, for pathway-specific information.

MARINE SANCTUARY

General

Areas of coastal and ocean waters, the Great Lakes, and their connecting waters designated as a National Marine Sanctuary by the Secretary of Commerce based on their conservation, recreational, ecological, or aesthetic values. All National Marine Sanctuaries are administered by NOAA. Proposed National Marine Sanctuaries do not meet this definition for HRS purposes. Statutory Authority: Marine Protection Research and Sanctuaries Act (16 U.S.C. § 1431, *et seq.*; 15 CFR 922.1 and 15 CFR 922.2).

Pathway Specific

- Air — General eligibility requirements apply.
- Soil exposure — Category is not evaluated.
- Surface water — General eligibility requirements apply.

MIGRATORY PATHWAYS AND FEEDING AREAS CRITICAL FOR MAINTENANCE OF ANADROMOUS FISH SPECIES WITHIN RIVER REACHES OR AREAS IN LAKES OR COASTAL TIDAL WATERS IN WHICH THE FISH SPEND EXTENDED PERIODS OF TIME

General

Surface water bodies along or contiguous to the hazardous substance migration path that are identified by a representative of an appropriate Federal, state, county, or local agency or by a recognized expert as critical migratory pathways or feeding areas for anadromous fish species (i.e., species such as salmon and striped bass that spend most of their adult lives in the ocean but migrate to freshwater or low salinity coastal tidal waters for breeding). Only areas in which adult, juvenile, or larval forms of the species of concern spend prolonged periods of time meet this definition for HRS purposes. Appropriate agencies are limited to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) natural resource trustees (**Highlight A-5**) and state or local agencies that have statutory responsibility for or involvement in management of the area or species of concern (e.g., state fish and game departments). Provide the individual with the definitional criteria (i.e., as stated in HRS Table 4-23) to determine whether any surface water body or bodies within the TDL meets this definition. Obtain written documentation (on appropriate letterhead) that the area of concern is a critical migratory pathway and/or feeding area as well as some information about the species and habitats of concern (e.g., some explanation as to why the habitat is critical). Examples of appropriate documentation are provided in **Highlight A-6**. Statutory Authority: Not statutorily defined.

**HIGHLIGHT A-5
CERCLA NATURAL RESOURCE TRUSTEES**

Government Level	Designated Trustee	Delegated Trustee
Federal ^a	Secretary of the Interior Secretary of Commerce Secretary of Agriculture Secretary of Energy Secretary of Defense	USFWS USGS NPS MMS BLM Bureau of Indian Affairs Bureau of Reclamation NOAA Costal Resource Coordinators
State ^b	State official designated by the Governor	
Native American Tribes ^c	Tribal Chairman or head of the governing body of a tribe	Individual designated by Tribal Chairman or head of governing body BIA, if requested by tribe

^aBy Executive Order 12580, and in the National Contingency Plan (NCP), the President has designated the Secretary of the Departments of the Interior, Commerce, Agriculture, Energy, and Defense as Federal trustees for natural resources.

^b Superfund Amendments and Reauthorization Act (SARA) Section 107(d) requires each Governor to designate state trustees for natural resources within the boundaries of, belonging to, controlled by, or appertaining to the state; most Governors have done so.

^c Native American Tribes are trustees for resources on or related to tribal lands or for resources for which they may have treaty rights.

Pathway Specific

- Air — General eligibility requirements apply.
- Soil exposure — Category is not evaluated.
- Surface water — General eligibility requirements apply.

NATIONAL LAKESHORE RECREATIONAL AREA

General

A lakeshore designated by an act of Congress as a National Lakeshore Recreational Area because of its recreational and ecological values. All National Lakeshore Recreational Areas are administered by NPS. Not all lakeshore areas administered by NPS (or other agencies) are designated National Lakeshore Recreational Areas. Statutory Authority: 16 U.S.C. § 1, *et seq.*

**HIGHLIGHT A-6
APPROPRIATE DOCUMENTATION FOR
MIGRATORY PATHWAYS AND FEEDING AREAS CRITICAL FOR
MAINTENANCE OF ANADROMOUS FISH SPECIES WITHIN
RIVERS, LAKES, OR COASTAL TIDAL WATERS**

Based on written statements from CERCLA Natural Resource Trustee Agency

Example 1: "Information from the [state fish and game department] that [identified surface water bodies] are moderately to heavily used by anadromous fishes for transportation and/or rearing. Substantial runs of [identified fish species] use these waters en route to or from upriver spawning grounds. [Identified surface water bodies] provide critical salt/fresh water transition habitat where [identified fish species] must acclimate before moving from one environment to the other. This site is near critical migratory pathways and feeding areas."

Example 2: "The [identified surface water body] in this area is a major migration and feeding area for salmon [referenced personal communication from representative of state fish and game department]. Anadromous species of concern are: [identified fish species]. The [identified fish species] is a candidate species for listing under the Endangered Species Act, and a petition for listing has been submitted for the [identified fish species]. This site is near a critical migratory pathway and feeding area."

Pathway Specific

- Air — General eligibility requirements apply.
- Soil exposure — Category is not evaluated.
- Surface water — General eligibility requirements apply.

NATIONAL MONUMENT

General

Areas designated by an act of Congress as National Monuments because of their cultural or historical significance. All National Monuments are administered by NPS. Not all lands administered by NPS are designated National Monuments. Statutory Authority: 16 U.S.C. § 1, et seq.

Pathway Specific

- Air — General eligibility requirements apply.
- Soil exposure — Category is not evaluated.
- Surface water — General eligibility requirements apply.

NATIONAL OR STATE WILDLIFE REFUGE

General

Area designated for the protection of fish and wildlife, within which hunting and fishing are either prohibited or strictly controlled. National Wildlife Refuges are designated by an act of Congress or through Executive Order, by the President, and are administered by USFWS. State Wildlife Refuges are designated by a state Governor, administrative agency, or legislature, and are administered by the appropriate state agency. Proposed National and State Wildlife Refuges do not meet this definition for HRS purposes. Statutory Authority: National Wildlife Refuge Administration Act of 1966 (16 U.S.C. §§ 668dd-668ee) or comparable state law.

Pathway Specific

- Air — General eligibility requirements apply.
- Soil exposure — General eligibility requirements apply.
- Surface water — General eligibility requirements apply.

NATIONAL PARK

General

Area designated by an act of Congress as a National Park for purposes of protection and recreation based on its uniqueness, natural, historic, or cultural values. All National Parks are administered by NPS. Not all lands administered by NPS are designated as National Parks. Statutory Authority: 16 U.S.C. § 1, *et seq.*

Pathway Specific

- Air — General eligibility requirements apply.
- Soil exposure — General eligibility requirements apply.
- Surface water — General eligibility requirements apply.

NATIONAL PRESERVE

General

Area designated by an act of Congress as a National Preserve because of its unique flora and fauna. All National Preserves are administered by NPS. Not all areas administered by NPS (or other agencies) are designated National Preserves. Statutory Authority: 16 U.S.C. § 1, *et seq.*

Pathway Specific

- Air — General eligibility requirements apply.
- Soil exposure — General eligibility requirements apply.
- Surface water — General eligibility requirements apply.

NATIONAL RIVER REACH DESIGNATED AS RECREATIONAL

General

Rivers or segments of rivers (and the related adjacent land area) that are both (1) designated as National Wild and Scenic Rivers by an act of Congress or the Secretary of the Interior based on their degree of free-flow, lack of development, and the outstanding scenic natural and cultural characteristics of the segments and their surrounding environments and (2) classified as recreational. Under the Wild and Scenic Rivers Act, segments are classified as recreational because they are readily accessible by road or railroad, may have some development along their shoreline, and may have undergone some impoundment or diversion in the past. The Secretary of the Interior can designate a river segment as a National Wild and Scenic River only if the river has been designated "wild and scenic" by one or more state(s). To obtain designation the Governor of the state(s) submits an application to the Secretary, the Secretary determines that the river has the necessary outstanding values to meet the criteria for inclusion in the National Wild and Scenic Rivers System, and the Secretary determines that the state(s) will protect these values. National Wild and Scenic Rivers are administered either by a Federal agency (i.e., NPS, USFWS, USFS, or BLM), a state agency, or a Native American Tribe. Note that National Wild and Scenic Rivers may be classified either as wild, scenic, or recreational; segments classified as wild or scenic are considered a separate sensitive environment in the HRS (see subsection above, Federal Designated Scenic or Wild River). See **Highlight A-4** for a summary of criteria for determining the appropriate HRS sensitive environments

category for a wild or scenic river. Statutory Authority: National Wild and Scenic Rivers Act (16 U.S.C. §§ 1271-1287).

Pathway Specific

- Air — General eligibility requirements apply.
- Soil exposure — Category is not evaluated.
- Surface water — General eligibility requirements apply.

NATIONAL SEASHORE RECREATIONAL AREA

General

Coastline designated by an act of Congress as a National Seashore Recreational Area because of its recreational and ecological values. All National Seashore Recreational Areas are administered by NPS. Not all coastal areas administered by NPS are designated National Seashore Recreational Area. Statutory Authority: 16 U.S.C. § 1, *et seq.*

Pathway Specific

- Air — General eligibility requirements apply.
- Soil exposure — Category is not evaluated.
- Surface water — General eligibility requirements apply.

PARTICULAR AREAS, RELATIVELY SMALL IN SIZE, IMPORTANT TO MAINTENANCE OF UNIQUE BIOTIC COMMUNITIES

General

Areas that are important for the maintenance of unique, rare, or otherwise ecologically valuable biotic communities. Eligible areas differ by pathway (see below). This definition generally includes but is not limited to the following four types of areas:

- Areas with a high proportion of species with highly restrictive habitat requirements due to unusual natural biotic and/or abiotic conditions;
- Highly isolated area that may or may not have an unusual community structure *per se*, but because of its geographic isolation is particularly important to the continued existence of that community;
- Areas with a high proportion of species that are locally endemic because of a relatively long period of geographic isolation and/or are exceptional examples of "climax" communities because of minimal human disturbance; or
- Areas vital for a species that are important to the maintenance of a community.

Statutory Authority: Not statutorily defined.

Pathway Specific

- Air — Eligible areas include those areas listed for the surface water and soil exposure pathways that are at least partially within the TDL.
- Soil exposure — Eligible areas are limited to terrestrial areas at least partially within an area of observed contamination. Examples of the first type of area may include riparian woodlands in arid/semi-arid areas; sand dunes and other coastal areas with

high salinity; high-altitude tundra; coastal pine barrens, and cove forests. Examples of the second type of area may include small patches of tall grass prairie within agricultural areas and old-growth forest areas. Examples of the third type of area may include "hammocks" of Florida and some mountain-top communities in arid/semi-arid areas. Examples of the fourth type of area may include traditional roosting areas for species important to a community (e.g., turkey vulture roosts). Note that communal roosts for other types of species (e.g., starlings, blackbirds) generally are not eligible.

- Surface water — Eligible areas include surface water bodies (including wetlands) located along the hazardous substance migration path for a watershed. Examples of the first type of area may include volcanic lakes, hot springs, salt lakes, alkali lakes, peat bogs, and bog lakes. Examples of the second type of area may include small water bodies or wetlands in otherwise dry areas (e.g., prairie potholes, playas, pocosins, vernal pools, wet meadows) or other unique surface water bodies (e.g., alligator holes). Note that other types of wetlands do not qualify under this category. Examples of the third type of area may include water bodies located in relatively ancient or remnant geological formations. Examples of the fourth type of area may include isolated surface water bodies in arid areas that are important amphibian breeding ponds.

SENSITIVE AREAS IDENTIFIED UNDER NATIONAL ESTUARY PROGRAM OR NEAR COASTAL WATERS PROGRAM

General

Subareas within estuaries or near coastal waters identified in state Comprehensive Conservation and Management Plans, filed with EPA, because they support critical life stages of key estuarine or coastal species. Statutory Authority: Sections 104(b)(3), 304(1), 319, and 320 of the Clean Water Act (33 U.S.C. §§ 1254(b)(3), 1314(1), 1329, and 1330).

Pathway Specific

- Air — General eligibility requirements apply.
- Soil exposure — Category is not evaluated.
- Surface water — General eligibility requirements apply.

SPAWNING AREAS CRITICAL FOR THE MAINTENANCE OF FISH/SHELLFISH SPECIES WITHIN RIVER, LAKE, OR COASTAL TIDAL WATERS

General

Areas that are used for intensive or concentrated spawning by fish or shellfish species and are identified by a representative of an appropriate Federal, state, county, or local agency or by a recognized expert as critical for the maintenance of fish or shellfish species within river, lake or coastal tidal waters. Appropriate agencies are limited to the natural resource trustees designated under CERCLA (see **Highlight A-5**) and state or local agencies that have statutory responsibility for or involvement in management of the area or species of concern (e.g., state fish and game departments), even if these agencies are not designated CERCLA natural resource trustees. The scorer should provide the appropriate agency representative or recognized expert with the definitional criteria (i.e., as stated in HRS Table 4-23) to determine whether any surface water body or bodies within the TDL meets this definition. Obtain written documentation (on appropriate letterhead) that the area of concern is a critical spawning area as well as some information about the species and habitat(s) of concern (e.g., some explanation as to why the habitat is critical). Examples of appropriate documentation are provided in **Highlight A-7**. Fish and shellfish spawning typically involves the release of gametes (ova and sperm) into the water column; however, species with internal fertilization are not necessarily excluded. Areas critical for the survival or maintenance of larval or

HIGHLIGHT A-7
APPROPRIATE DOCUMENTATION FOR SPAWNING
AREAS CRITICAL FOR MAINTENANCE OF FISH/SHELLFISH
SPECIES WITHIN RIVERS, LAKES, OR COASTAL TIDAL WATERS

Based on written statements from CERCLA Natural Resource Trustee Agency

Example 1: "Salmonid spawning is widespread; generally any tributary that is physically accessible within [water bodies within the TDL] is utilized for spawning by salmon and trout [literature citations]. As noted earlier, regionally heavy watershed development has impacted fish production capabilities of upstream tributaries. Also, it must be noted that the study area is a small percentage of the entire spawning habitat available, particularly for [specified water basins]. Further, these systems each have numerous small unnamed tributaries. As such, a large percentage of preferred spawning habitat is outside of the study area or unmentioned. Nonetheless, recognized important spawning tributaries for each sub-basin are identified as follows: [lists of specific rivers, creeks, and watersheds (or portions thereof) for three river basins]".

Example 2: "Wetland composition and distribution is similar to that found in the main basin [literature citation]. Unlike the main basin, larger areas of intertidal emergent habitat are evident particularly in [identified embayments]. These wetlands are characterized as excellent fish and invertebrate habitats noted for high productivity and value [literature citation]. Numerous freshwater, moderate gradient streams feed the [identified river basin]. Most are typical of lowland drainages: sand/gravel substrates, riffle/pool profiles, shallow depths, total lengths between 1-6 km, and high water quality; each highly conducive to productive anadromous fish habitat [literature citation]. Principal streams noted include: [identified creeks] [referenced personal communication]."

juvenile forms are not included in this definition unless they also are used by adults for spawning; such areas may qualify as feeding areas critical for maintenance of anadromous fish species (a separate HRS sensitive environment). Note that state, Federal, commercial, or other hatcheries or aquaculture facilities are not included and should be evaluated only under the human food chain threat. Statutory Authority: Not statutorily defined.

Pathway Specific

- Air — General eligibility requirements apply.
- Soil exposure — Category is not evaluated.
- Surface water — General eligibility requirements apply.

STATE DESIGNATED AREAS FOR PROTECTION OF AQUATIC LIFE

General

Navigable waters (as defined by the Clean Water Act) listed by a state as adequate, or reasonably expected to be made adequate, to provide for the protection and propagation of a balanced population of shellfish, fish, and wildlife pursuant to section 305 of the Clean Water Act. This designation is based solely on the classification assigned to the water body in the Section 305(a) Report and updated biennially in the Section 305(b) Report. The specific procedure for classifying these areas varies among states. Note that in some states, waters designated for drinking water use also are considered to be designated for protection of aquatic life and would be included in this category; in other states, waters classified for drinking water use are not automatically considered to be designated for the protection of aquatic life and would not be included in this category. The specific classification scheme must be determined on a state-by-state basis. Statutory Authority: sections 305(a) and (b) of the Clean Water Act (33 U.S.C. § 1315).

Pathway Specific

- Air — General eligibility requirements apply.
- Soil exposure — Category is not evaluated.
- Surface water — General eligibility requirements apply.

STATE DESIGNATED NATURAL AREAS

General

Areas designated by a state Governor, administrative agency, or legislature as a natural area based on their unique aesthetic, ecological, or recreational values. Statutory Authority: State laws.

Pathway Specific

- Air — General eligibility requirements apply.
- Soil exposure — General eligibility requirements apply.
- Surface water — General eligibility requirements apply.

STATE DESIGNATED SCENIC OR WILD RIVER

General

Rivers or segments of rivers (and the related adjacent land area, if so designated) that are designated as wild and/or scenic by a state Governor, administrative agency, or legislature under an appropriate state law. Segments generally are designated as wild or scenic because of their degree of free-flow, lack of development, and the outstanding scenic, natural and cultural characteristics of the segment and their surrounding environments; however, specific criteria may vary among states. Note that state-designated wild or scenic rivers that have been included in the National Wild and Scenic Rivers System are considered Federal Wild and Scenic Rivers or National River Reaches Designated as Recreational for HRS purposes (see subsections above, Federal Designated Scenic or Wild River and National River Reach Designated as Recreational). See **Highlight A-4** for a summary of criteria for determining the appropriate HRS sensitive environments category for a wild or scenic river. Statutory Authority: State laws.

Pathway Specific

- Air — General eligibility requirements apply.
- Soil exposure — Category is not evaluated.
- Surface water — General eligibility requirements apply.

STATE LAND DESIGNATED FOR WILDLIFE OR GAME MANAGEMENT

General

Land set aside or managed for the propagation and maintenance of wildlife or game under some type of state sponsorship and approval. Some of these areas are open on a limited basis to hunting and/or fishing, but this is not an eligibility criterion. As a general rule, eligible areas would include any land for which use for wildlife or game management can be altered only with state approval, and only under certain circumstances. Eligible areas include (but are not limited to) lands owned by a state and designated by the state Governor, legislature, or appropriate administrative agency for the propagation and maintenance of wildlife or game; lands leased by the state; privately owned lands maintained for eventual sale to the state; and state-owned lands that are privately managed. All Pittman-Robertson Preserves and some Nature Conservancy lands are eligible. Statutory Authority: State laws.

Pathway Specific

- Air — General eligibility requirements apply.
- Soil exposure — General eligibility requirements apply.
- Surface water — General eligibility requirements apply.

TERRESTRIAL AREAS UTILIZED FOR BREEDING BY LARGE OR DENSE AGGREGATIONS OF ANIMALS

General

Terrestrial areas used for intensive or concentrated breeding by terrestrial vertebrate species. Eligible areas differ by pathway (see below). Evidence for the existence of this sensitive environment will be strengthened if the breeding habitat requirements (e.g., substrate, vegetation) of the species of concern is defined, suitable breeding habitat within the TDL is delineated, and it can be shown that the species typically nests or breeds in large colonies or dense aggregations. Examples of areas that may meet these criteria include heron or cormorant rookeries, beaches used for rearing young by seals or sea lions, and sand cliffs used by bank swallows. Only the areas utilized for breeding (i.e., nesting or brood rearing areas) meet this definition for HRS purposes; areas used solely for feeding (e.g., open fields near nest sites) are excluded. Note that eligible areas include areas used for breeding by seals, sea lions, turtles, and other vertebrates that spend most of their time in the water but breed on land. However, ponds and other surface water bodies used for breeding by amphibians and other aquatic vertebrate species with semi-aquatic habits do not meet this definition because these are not terrestrial areas. Note also that it is not necessary to demonstrate that these areas are critical for the maintenance of the species of concern. Statutory Authority: Not statutorily defined.

Pathway Specific

- Air — Eligible areas are limited to terrestrial areas that are at least partially within the TDL and are used by terrestrial vertebrate species. Eligible areas for this pathway include areas used for breeding by terrestrial vertebrates with semi-aquatic habits.
- Soil exposure — Eligible areas are limited to terrestrial areas that are at least partially within the area of observed contamination and are used for breeding by vertebrate species. Eligible areas include areas used for breeding by terrestrial vertebrates with semi-aquatic habits.
- Surface water — Eligible areas are limited to terrestrial areas that are located along or contiguous to the hazardous substance migration path and are used for breeding by terrestrial vertebrate species with aquatic or semi-aquatic foraging habits (i.e., birds, mammals, or reptiles that consume fish or other aquatic organisms that inhabit or might inhabit the surface water bodies within the TDL). Such species generally correspond to those defined as "terrestrial vertebrates with semi-aquatic habits" (see **Highlight A-2**).

UNIT OF COASTAL BARRIER RESOURCES SYSTEM

General

Coastal barriers (e.g., bay barrier, tombolo, barrier spit, or barrier island) selected by the Secretary of the Interior and designated by an act of Congress as a unit of the Coastal Barrier Resources System. Areas depicted as "otherwise protected" on the Coastal Barrier Resources System maps do not meet this definition for HRS purposes because they are not part of the System (these are areas held for conservation purposes under Federal, State, or local law, or by an organization primarily for conservation purposes). "Otherwise protected" areas may be eligible for evaluation as a separate sensitive environment in the HRS if they meet the definition of undeveloped and partially developed

coastal barriers (see subsections above, Coastal Barrier — Partially Developed and Coastal Barrier — Undeveloped). Maps that depict the Coastal Barrier Resources System are administered by USFWS. Statutory Authority: Coastal Barrier Resources Act (16 U.S.C. § 3501, *et seq.*).

Pathway Specific

- Air — General eligibility requirements apply.
- Soil exposure — Category is not evaluated.
- Surface water — General eligibility requirements apply.

WETLANDS

General

Wetlands generally include swamps, marshes, bogs, and similar areas. As defined in 40 CFR 230.3, wetlands are those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands can be natural or man-made. Wetlands identified using other definitions (e.g., the Food Security Act of 1985, the wetlands classification system of USFWS, the 1989 Federal Manual for Identifying and Delineating Jurisdictional Wetlands) are not eligible to be evaluated with the HRS unless they also meet the 40 CFR 230.3 definition. A discussion of the wetland classification system used on National Wetlands Inventory (NWI) maps and its relationship to the 40 CFR 230.3 definition is provided below.

Pathway Specific

- Air — General eligibility requirements apply.
- Soil exposure — Category is not evaluated.
- Surface water — General eligibility requirements apply.

Relationship between USFWS and 40 CFR 230.3 Wetland Definitions

The HRS uses the following definition of wetlands (40 CFR 230.3): *Areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.* USFWS uses the following definition of wetlands (for NWI maps): *Lands that are transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water, and have one of the following three attributes: at least periodically, the land supports predominantly hydrophytes; the substrate is predominantly undrained hydric soil; and/or the substrate is nonsoil and is saturated with water or is covered by shallow water at some time during the growing season of each year.*

The primary difference between the HRS and USFWS definitions is that under the HRS definition, wetlands must, under normal circumstances, support a prevalence of rooted emergent hydrophytes. Hydrophytes are a sufficient, but not necessary, requirement for the USFWS definition. Areas that under normal circumstances do not support hydrophytes may be classified as a wetland by USFWS, but would not be classified as a wetland for HRS purposes.

USFWS describes five categories of wetlands. Two of these fall within the HRS definition of wetlands:

- Areas with hydrophytes and hydric soils (e.g., marshes, swamps, and bogs); and
- Areas where hydrophytes have become established but hydric soils have not yet developed (e.g., margins of impoundments or excavations).

Three other categories do not meet the HRS definition of wetlands:

- Areas without hydrophytes but with hydric soils (e.g., flats where drastic fluctuation in water level, wave action, turbidity, or high concentration of salts may prevent the growth of hydrophytes);
- Areas with hydrophytes but without soils (e.g., seaweed-covered portions of rocky shores); and
- Areas without hydrophytes and soils (e.g., gravel beaches or rocky shores without vegetation).

Deepwater habitats that support submerged aquatic vegetation (SAV) but not emergent vegetation do not fall within either the HRS or the USFWS definition. Although SAV is hydrophytic, it is not "vegetation typically adapted for life in saturated soil conditions" because substrates that support SAV but not emergent vegetation are considered nonsoil.

USFWS divides wetlands (and deepwater systems) into five categories based on salinity, tidal influence, and wave action. Hydrophytes and hydric soils exist in each of these categories:

- The marine system includes all wetlands that occur along the high energy coastline of the open ocean overlying the continental shelf. Salinities exceed 30 parts per thousand (ppt), with little or no dilution except near the mouths of estuaries.
- The estuarine system includes all wetlands in areas, partially enclosed by land, with open, partly obstructed, or sporadic access to marine waters. Salinities are 0.5 ppt or greater and fluctuate due to evaporation and mixing of fresh water and seawater.
- The riverine system includes all wetlands within channels (i.e., open conduits which at least periodically contain moving water or which form a connection between two bodies of standing water). The riverine system also includes wetlands dominated by trees, shrubs, persistent emergents, and emergent mosses or lichens; and wetlands in areas with water containing ocean derived salts in concentrations exceeding 0.5 ppt.
- The lacustrine system includes all wetlands situated in topographic depressions or dammed river channels in areas where trees, shrubs, persistent emergents, and emergent mosses and lichens cover less than 30 percent of the total area. Lacustrine systems must be at least 8 hectares (ha) in size and are subdivided into two zones: limnetic (all deepwater habitats), and littoral (areas from the shoreward boundary to a depth of 2 meters below low water or to the maximum extent of non-persistent emergents). All wetlands fall into the littoral zone.
- The palustrine system includes all non-tidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses and lichens, and all such wetlands that occur in tidal areas where the salinity due to ocean derived salts is less than 0.5 ppt. A wetland lacking the above vegetation is also palustrine if: it is less than 8 ha in size; it does not have an active wave-formed or bedrock shoreline; water depth in the deepest part of the basin is less than 2 meters at low water; or salinity due to ocean derived salts is less than 0.5 ppt.

Note that salinity category does not affect whether or not an area qualifies as a wetland under either the HRS or the USFWS definition.

Highlight A-8 divides wetland and deepwater categories defined on NWI maps into three categories: those presumed to be eligible for HRS purposes, those that may under certain

circumstances be eligible for HRS purposes, and those that generally will not be eligible for HRS purposes.

**HIGHLIGHT A-8
COMPARISON OF HRS WETLANDS DEFINITION AND WETLANDS
CLASSIFICATION SYSTEM USED FOR NWI MAPS**

Wetlands Category on NWI Maps	Eligible as HRS wetlands?		
	Yes ^a	Possibly ^b	Generally Not ^c
Marine System			
Subtidal			
Rock Bottom			T
Unconsolidated Bottom			T
Aquatic Bed			T
Reef			T
Intertidal			
Aquatic Bed			T
Reef			T
Rocky Shore		T	
Unconsolidated Shore		T	
Estuarine System			
Subtidal			
Rock Bottom			T
Unconsolidated Bottom			T
Aquatic Bed			T
Reef			T
Intertidal			
Aquatic Bed			T
Reef			T
Streambed		T	
Rocky Shore		T	
Unconsolidated Shore		T	
Emergent Wetland	T		
Scrub-Shrub Wetland	T		
Forested Wetland	T		
Palustrine System			
Rock Bottom			T
Unconsolidated Bottom		T	
Aquatic Bed			T
Unconsolidated Shore		T	
Moss-Lichen Wetland	T		
Emergent Wetland	T		
Scrub-Shrub Wetland	T		
Forested Wetland	T		

^a Can be presumed to meet the 40 CFR 230.3 definition of a wetland.

^b May meet the 40 CFR 230.3 definition of a wetland if emergent hydrophytes are present.

^c Generally will not meet the 40 CFR 230.3 definition of a wetland, except for some unique types of wetlands (e.g., some shoals or reefs).

(continued on next page)

HIGHLIGHT A-8 (continued)
COMPARISON OF HRS WETLANDS DEFINITION AND WETLANDS
CLASSIFICATION SYSTEM USED FOR NWI MAPS

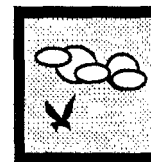
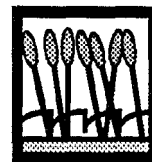
Wetlands Category on NWI Map	Eligible as HRS wetlands?		
	Yes ^a	Possibly ^b	Generally Not ^c
Riverine System			
Tidal			
Rock Bottom			T
Unconsolidated Bottom			T
Aquatic Bed			T
Streambed		T	
Rocky Shore		T	
Unconsolidated Shore		T	
Emergent Wetland	T		
Lower Perennial			
Rock Bottom			T
Unconsolidated Bottom			T
Aquatic Bed			T
Rocky Shore		T	
Unconsolidated Shore		T	
Emergent Wetland	T		
Upper Perennial			
Rock Bottom			T
Unconsolidated Bottom			T
Aquatic Bed			T
Rocky Shore		T	
Unconsolidated Shore		T	
Intermittent			
Stream Bed		T	
Lacustrine System			
Limnetic			
Rock Bottom			T
Unconsolidated Bottom			T
Aquatic Bed			T
Littoral			
Rock Bottom			T
Unconsolidated Bottom			T
Aquatic Bed			T
Rocky Shore		T	
Unconsolidated Shore		T	
Emergent Wetland	T		

^a Can be presumed to meet the 40 CFR 230.3 definition of a wetland.

^b May meet the 40 CFR 230.3 definition of a wetland if emergent hydrophytes are present.

^c Generally will not meet the 40 CFR 230.3 definition of a wetland, except for some unique types of wetlands (e.g., some shoals or reefs).

SECTION A.3 PROCESS FOR IDENTIFYING AND DELINEATING SENSITIVE ENVIRONMENTS



This section provides guidance for obtaining the information required to identify and delineate sensitive environments evaluated in the HRS. The steps in this section are based on the definitions of sensitive environments in Section A.2 and the data sources found in Section A.4. This section divides the HRS sensitive environment categories into three groups: those likely to be delineated on USGS topographic maps, those likely to be delineated on specialized maps or in special documents, and those that require professional judgement to identify and delineate. Each category requiring professional judgement is followed by a stepwise approach to assist the scorer in identifying whether or not the specific sensitive environment is at least partially within the TDL or area of observed contamination. The steps presented for each sensitive environment category should not be viewed as a list of definitive criteria, but rather are intended to guide professional judgment in identifying non-statutorily defined sensitive environments. The definitions provided in Section A.2 and the information sources provided in Section A.4 supplement the guidance provided in this section.

SENSITIVE ENVIRONMENTS LIKELY TO BE DELINEATED ON USGS TOPOGRAPHIC MAPS

The following sensitive environments are likely to be identified and delineated on U.S. Geological Survey (USGS) topographic maps:

- Designated Federal Wilderness Area
- National Lakeshore Recreational Area
- National Monument
- National or State Wildlife Refuge
- National Park
- National Preserve
- National Seashore Recreational Area
- State Lands Designated for Wildlife or Game Management (in some cases)
- Wetlands (in some cases).

If site topographic maps are outdated, the scorer may need to check Federal Register notices and other materials (e.g., state publications) to update information. A list of sources for updating information on these sensitive environments is provided in Section A.4. In many cases, the level of detail provided by USGS topographic maps in delineating the above sensitive environments will be sufficient for HRS scoring (see discussions of scoring strategies in pathway-specific sections of this document). In other cases, more specialized maps will be required.

SENSITIVE ENVIRONMENTS LIKELY TO BE DELINEATED ON SPECIALIZED MAPS OR IN SPECIAL DOCUMENTS

The sensitive environments listed below are likely to be delineated on specialized maps or described in special documents, Most of the sensitive environments delineated on USGS topographic

maps also are delineated on specialized maps; these specialized maps should be used if more precise delineations are required.

- Administratively Proposed Federal Wilderness Area
- Areas Identified Under the Coastal Zone Management Act
- Critical Areas Identified Under the Clean Lakes Program
- Critical Habitat for Federal Designated Endangered or Threatened Species
- Federal Designated Scenic or Wild River
- Federal Land Designated for Protection of Natural Ecosystems
- Marine Sanctuary
- National River Reach Designated as Recreational
- Sensitive Areas Identified Under the National Estuary Program or Near Coastal Waters Program
- State Designated Areas for Protection and Maintenance of Aquatic Life
- State Designated Natural Areas
- State Designated Scenic or Wild River
- State Land Designated for Wildlife or Game Management (in some cases)
- Unit of the Coastal Barrier Resources System
- Wetlands (in some cases).

If needed, check *Federal Register* notices and other materials (e.g., state publications) to update information about these sensitive environments. A list of specialized maps and other sources for obtaining updated information is provided in Section A.4. Specialized maps may not be sufficient to evaluate wetlands; professional judgment may also be required.

SENSITIVE ENVIRONMENTS THAT REQUIRE PROFESSIONAL JUDGMENT AND/OR SPECIFIC EXPERTISE TO IDENTIFY AND DELINEATE

The sensitive environments listed alphabetically below generally are not delineated on maps or described in specialized publications. Identifying and delineating these sensitive environments generally require assistance from appropriate Federal, state, or local agencies or recognized experts. It may be necessary to meet with these individuals and/or provide them with maps and other site information. Agencies designated as CERCLA natural resource trustees (see **Highlight A-5**, page A-12) and state or local agencies that have statutory responsibility for or involvement in management of sensitive environment generally should be consulted (e.g., state fish and game departments). If the Superfund remedial program has a biological technical assistance group (BTAG) in the Region, the BTAG chairperson may be able to identify appropriate agencies and/or individuals to contact. The Regional Site Assessment Manager can provide the name and phone number of the BTAG chairperson.

COASTAL BARRIER – PARTIALLY DEVELOPED

- (1) Determine whether any coastal barriers (as defined in Section A.2) are at least partially within the air and surface water pathway TDLs. A state coastal zone management agency, EPA's Near Coastal Waters program, or county real estate officials may be able to offer assistance in making this determination. If no such areas are found, stop; otherwise, proceed to Step (2).
- (2) Determine if any of the areas is a unit of the National Coastal Barrier Resources System. If so, the area qualifies as a separate sensitive environment for HRS purposes and should be evaluated based on that classification. If all areas in question are units of the National Coastal Barrier Resources System, stop; otherwise proceed to Step (3).

- (3) Determine which of the areas meet the definitions of a partially developed coastal barrier or an undeveloped coastal barrier (as specified in Section A.2):
- The entire coastal barrier is undeveloped if it contains (on average) fewer than one man-made structure per 5 acres of fastland area.
 - A portion of the coastal barrier is undeveloped if it has at least 1/4-mile of undeveloped shoreline on the shoreward side of the coastal barrier and the undeveloped area extends through the fastland from the beach to the associated landward aquatic habitat.
 - A coastal barrier is partially developed if it contains (on average) one or more manmade structures per 5 acres of fastland, but no more than 50 percent of the fastland area is covered by one or more man-made structures per 5 acres of fastland area. A coastal barrier that is more than 50 percent developed is not eligible for evaluation as a partially developed coastal barrier.
- (4) Evaluate each of the qualifying areas as an undeveloped or partially developed coastal barrier. If the same coastal barrier has portions that qualify as both undeveloped and partially developed, evaluate either the undeveloped or partially developed portions, but not both (i.e., do not score the same coastal barrier as both undeveloped and partially developed).

COASTAL BARRIER – UNDEVELOPED

See subsection above, Coastal Barrier — Partially Developed.

HABITAT KNOWN TO BE USED BY A FEDERAL DESIGNATED OR PROPOSED ENDANGERED OR THREATENED SPECIES

- (1) Determine whether any of the species (as defined in Section A.1) are known to be present in and using suitable habitat within the TDLs (or areas of observed contamination) for the site. Contact a representative of an appropriate Federal, state, county, or local agency (e.g., USFWS, NMFS, state fish and game department, state Natural Heritage program) or a recognized expert to help determine if suitable habitat for any of the species exists within the TDLs or areas of contamination and if the habitat is currently occupied and used by the species. It may be difficult to obtain information beyond the known presence of a species within a given area, distance ring, or surface water body. If it is not possible to document the presence of one or more of the species within the TDLs (or areas of contamination), stop; otherwise, proceed to Step (2).
- (2) Document all habitat known to be used by each eligible species within the TDL. Appropriate documentation includes (but is not limited to):
- A written or documented oral statement from a representative of the appropriate Federal, state, or local agency (or from a recognized expert) that establishes the presence of the species within the TDLs or area of observed contamination; or
 - Any other evidence that documents the recent presence of the species in suitable habitat within the TDLs or areas of observed contamination (e.g., within a 5-year period prior to HRS package preparation).

Ensure that a habitat identified as used by a Federal designated or proposed endangered or threatened species (or a portion thereof) is not listed as a critical habitat for that species as defined in Section A.2. If an area is a critical habitat for a Federal designated species, the area qualifies as a separate sensitive environment for HRS scoring and should be evaluated for that species based solely on that classification.

HABITAT KNOWN TO BE USED BY A SPECIES UNDER REVIEW AS TO ITS FEDERAL ENDANGERED OR THREATENED STATUS

See subsection above, Habitat Known to be Used by a Federal Designated or Proposed Endangered or Threatened Species.

HABITAT KNOWN TO BE USED BY A STATE DESIGNATED ENDANGERED OR THREATENED SPECIES

See subsection above, Habitat Known to be Used by a Federal Designated or Proposed Endangered or Threatened Species.

MIGRATORY PATHWAYS AND FEEDING AREAS CRITICAL FOR MAINTENANCE OF ANADROMOUS FISH SPECIES WITHIN RIVER REACHES OR AREAS IN LAKES OR COASTAL TIDAL WATERS IN WHICH THE FISH SPEND EXTENDED PERIODS OF TIME

- (1) Contact one or more of the following, provide them with the definitional criteria for these sensitive environment categories (i.e., as stated in HRS Table 4-23), and ask them to determine whether any surface water bodies within the TDLS-s meet one or all of the definitional criteria:
 - Representatives of agencies designated as CERCLA natural resource trustees (see **Highlight A-5**);
 - Representatives of state or local agencies that have statutory responsibility for or involvement in management of the area or types of species of concern (e.g., state fish and game departments), even if these agencies are not designated CERCLA natural resource trustees; and/or
 - Recognized experts familiar with the area or types of species of concern.
- (2) Request written documentation (on appropriate letterhead) that the area of concern is a critical spawning area and some information about the species and habitat(s) of concern (e.g., some explanation as to why the habitat is critical). The documentation should be legally defensible for CERCLA damage assessment purposes. Examples of suitable evidence are provided in **Highlights A-6** and **A-7**. If these individuals do not identify any qualifying areas, stop; otherwise, proceed to Step (3).
- (3) Evaluate each qualifying area identified as a critical spawning area, migratory pathway, or feeding area.

PARTICULAR AREAS, RELATIVELY SMALL IN SIZE, IMPORTANT TO MAINTENANCE OF UNIQUE BIOTIC COMMUNITIES

- (1) Contact representatives from State Natural Heritage Programs, state natural resources agencies, and recognized experts to determine if any unique, rare, or otherwise ecologically valuable biotic areas (e.g., old growth areas, pine barrens, bogs) are located within the TDLS-s (or areas of observed contamination) for the site. If there are no such areas within the TDLS-s of the site, stop; otherwise, proceed to Step (2).
- (2) Determine if each area in question meets the definitional criteria as specified in Section A.2. Four types of areas generally will meet the following definitional criteria for this sensitive environment (note that other areas that do not meet these criteria may be eligible):
 - Areas with a high proportion of species with highly restrictive habitat requirements due to unusual natural biotic and/or abiotic conditions;

- Isolated areas that may or may not have an unusual community structure per se, but are particularly important to the continued existence of their biotic communities because of their geographic isolation;
- Areas with a high proportion of locally endemic species because of a relatively long period of geographic isolation and/or are exceptional examples of “climax” communities because of minimal human disturbance; or
- Areas that are vital to a species for maintenance of a community.

SPAWNING AREAS CRITICAL FOR THE MAINTENANCE OF FISH/SHELLFISH SPECIES WITHIN RIVER, LAKE, OR COASTAL TIDAL WATERS

See subsection above, Migratory Pathways and Feeding Areas Critical for Maintenance of Anadromous Fish Species Within River Reaches or Areas in Lakes or Coastal Tidal Waters in which the Fish spend Extended Periods of Time.

TERRESTRIAL AREAS USED FOR BREEDING BY LARGE OR DENSE AGGREGATIONS OF ANIMALS

- (1) Contact state fish and game officials, USFWS officials, or recognized experts to determine whether any terrestrial species that normally breed in large or dense aggregations have been observed or are expected to be present within the air and surface water pathway TDLs or areas of observed contamination of the site. If no such species have been observed or are expected to be present within the TDL or area of observed contamination, stop; otherwise, proceed to Step (2).
- (2) Determine if each area in question meets the definitional criteria specified in Section A.2 and if such breeding occurs within that area. Support documentation may include defining the breeding habitat requirements of the species of concern and demonstrating that the species typically nests or breeds in large colonies or dense aggregations. Additional pathway-specific criteria include:
 - In the surface water pathway, eligible areas are limited to terrestrial areas that are used for breeding by terrestrial vertebrate species with aquatic or semi-aquatic foraging habits (i.e., birds, mammals, or reptiles that consume fish or other aquatic organisms that inhabit or might inhabit the surface water bodies within the TDL). Such species generally correspond to those defined in Section A.2 as “terrestrial vertebrates with semi-aquatic habits”.
 - In the soil exposure pathway, eligible areas are limited to terrestrial areas that are at least partially on the area of observed contamination and are used for breeding by terrestrial vertebrate species.
 - In the air pathway, eligible areas are limited to terrestrial areas that are at least partially within the TDL and are used for breeding by terrestrial vertebrate species.

WETLANDS

- (1) Determine if there are any wetlands within the air or surface water pathway TDLs. As a starting point, use existing maps to delineate wetlands within the TDL. The preferred maps are the NWI Maps or state maps of equivalent quality. If these maps are not available, use USGS topographic maps or Soil Conservation Service (SCS) maps to initially screen wetlands locations.

- Some wetlands delineated on NWI maps do not meet the 40 CFR 230.3 wetlands definition required for HRS eligibility. **Highlight A-9** provides a guide to which wetlands delineated on NWI maps definitely can, possibly can, and generally cannot be presumed to meet the 40 CFR 230.3 definition of a wetland.
- Most wetlands delineated on USGS topographic maps meet the 40 CFR 230.3 definition. Because these areas are mapped based largely on aerial photographs, wetlands less than 40 feet wide may not appear on the maps, and wetlands boundaries are relatively crude.
- Areas delineated as wetlands on SCS maps are based largely on the presence of hydric soils and may not meet the 40 CFR 230.3 definition.

(2) If the NWI, USGS, SCS, and/or state maps are out of date, verify the areas delineated as wetlands on maps (e.g., during site reconnaissance). For many wetland areas, a photograph will be sufficient documentation. Some eligible wetlands may not appear on any map. For areas not delineated as a wetland on maps to be eligible for HRS evaluation as wetland, there should be adequate documentation (e.g., photographs, identification by a recognized wetlands expert) that the area meets the 40 CFR 230.3 definition. If there are no wetland areas within the TDLs; stop; otherwise proceed to Step (3).

**HIGHLIGHT A-9
ELIGIBILITY OF WETLAND CATEGORIES ON NWI
MAPS FOR HRS SCORING**

Wetlands Category on NWI Maps	Eligible as HRS wetlands?		
	Yes ^a	Possibly ^b	Generally Not ^c
Emergent wetland	T		
Scrub-shrub wetland	T		
Forested wetland	T		
Moss-lichen wetland	T		
Streambed		T	
Rocky Shore		T	
Unconsolidated shore		T	
Streambed (vegetated)		T	
Unconsolidated Shore (vegetated)		T	
Unconsolidated bottom			T
Aquatic bed			T
Reef			T
Rock bottom			T

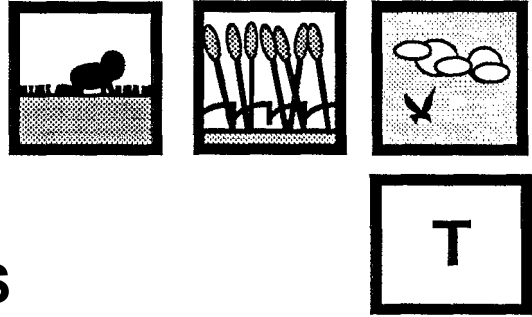
^a Can be presumed to meet the 40 CFR 230.3 definition of a wetland.

^b May meet the 40 CFR 230.3 definition of a wetland if emergent hydrophytes are present.

^c Generally will not meet the 40 CFR 230.3 definition of a wetland, except for some unique types of wetlands (e.g., some shoals or reefs).

- (3) If historical data (e.g., an old aerial photograph) document the presence of a wetland, and the SI shows that the wetland no longer exists, the area still may be eligible if the wetland was eliminated because of site-related activity. Conversely, the area generally will not be eligible if the wetland was eliminated for non-site-related reasons.
- (4) Under certain circumstances, surface impoundments that meet the 40 CFR 230.3 definition of a wetland may be considered wetlands for HRS purposes.
 - Surface impoundments constructed in an area that was previously occupied by a wetland generally are eligible (e.g., if a natural wetland was used as a surface impoundment).
 - Surface impoundments that have inadvertently become wetlands may be eligible on a case-by-case basis (e.g., a surface impoundment that has become a wetland due to poor waste management practices may be eligible on a case-by-case basis).
 - Surface impoundments created solely as waste management units generally are not eligible. However, surface impoundments created both as waste management units and as wetland mitigation areas may be eligible on a case- by-case basis.
 - Surface impoundments created in an area that originally was non-wetland but has become a wetland area due to site- or non-site related activities (e.g., altered streamflow patterns) may be eligible on a case-by-case basis.
- (5) Evaluate each qualifying wetland based on linear frontage or perimeter as specified in Section 8.16 and/or Section 9.6.
- (6) If the targets score for wetlands is critical for Nation Priorities List (NPL) listing (i.e., the site would not score above 28.50 unless the wetland areas are scored), there should be adequate documentation that the presumed wetlands meet the 40 CFR 230.3 definition of a wetland. Delineation by a recognized wetlands expert may be necessary.

SECTION A.4 SOURCES OF INFORMATION FOR IDENTIFYING SENSITIVE ENVIRONMENTS



This section provides sources of information for identifying and delineating wetlands and all sensitive environments listed in HRS Tables 4-23 and 5-5. Many HRS sensitive environments are identified and delineated with readily available materials (e.g., maps or U.S. Environmental Protection Agency (EPA) regional site files); however, more in-depth investigation may be necessary to determine whether they are present within the TDLs or areas of observed contamination for the site. If an area within the TDL could be a sensitive environment, identify whether it is an HRS sensitive environment and document the point value rating into which the area could be classified.

This section provides names of maps and other documents where sensitive environments are likely to be delineated, and appropriate contacts for additional information. The EPA regional office is encouraged to develop and maintain a library of all relevant documents listed in this section. The National Wildlife Federation's Conservation Directory, which is revised annually, is a valuable reference that lists governmental and nongovernmental organizations and personnel engaged in conservation work at state, national, and international levels. The HRS sensitive environments categories can be divided into three groups:

- Those likely to be delineated on USGS topographic maps. Many categories of sensitive environments are delineated on USGS topographic maps. However, if site topographic maps are out of date, it may be necessary to check *Federal Register* notices and other materials to obtain updated information. In many cases, the level of detail provided by USGS topographic maps will be sufficient for HRS purposes. In some cases, more specialized maps (available from the appropriate administering agency) or professional judgment (e.g., for wetlands) will be required. USGS topographic maps are available from USGS Earth Science Information Centers (see **Highlight A-10**), most outdoor sport stores, and local outfitters. Categories of sensitive environments in this group include:
 - Designated Federal Wilderness Area
 - National Lakeshore Recreational Area
 - National Monument
 - National or State Wildlife Refuge
 - National Park
 - National Preserve
 - National Seashore Recreational Area
 - State Lands Designated for Wildlife or Game Management (in some cases)
 - Wetlands (in some cases).
- Those requiring special maps or charts from specific agencies and other sources. Several categories of sensitive environments are delineated on specialized maps, charts or other documents available from various Federal and state agencies. Note that most of the sensitive environments delineated on USGS topographic maps also

are delineated on specialized maps; these specialized maps should be used if more precise delineations are required. Beneath each of the following sensitive environments, the name and source of the specific map, chart, or document is provided along with a contact in case additional information is needed. Categories of sensitive environments in this group include:

- Administratively Proposed Federal Wilderness Area
 - Areas Identified Under the Coastal Zone Management Act
 - Critical Areas Identified Under the Clean Lakes Program
 - Critical Habitat for Federal Designated Endangered or Threatened Species
 - Federal Designated Scenic or Wild River
 - Federal Land Designated for Protection of Natural Ecosystems
 - Marine Sanctuary National River Reach Designated as Recreational
 - Sensitive Areas Identified Under the National Estuary Program or Near Coastal Waters Program
 - State Designated Areas for Protection and Maintenance of Aquatic Life
 - State Designated Natural Areas
 - State Designated Scenic or Wild River
 - State Land Designated for Wildlife or Game Management (in some cases)
 - Unit of the Coastal Barrier Resources System
 - Wetlands (in some cases).
- Those that may require professional judgment to identify and delineate. Several categories of sensitive environments generally are not delineated on maps or otherwise described in specialized publications. Identifying and delineating these sensitive environments generally will require professional judgment. The assistance of appropriate Federal, state, or local agencies or experts in identifying these sensitive environments is encouraged. The scorer should try to obtain copies of any published information that helps to establish the area as a sensitive environment and/or delineate its boundaries. If possible, obtain a written statement from a responsible agency official or individual verifying the existence and boundaries of the sensitive environments. Sources of information provided below are not exhaustive and focus primarily on the national level. EPA regional offices are encouraged to develop lists of sources at a regional, state, and/or local level. Categories of sensitive environments in this group include:
 - Coastal Barrier — Partially Developed
 - Coastal Barrier — Undeveloped
 - Habitat Known to be Used by a Federal Designated or Proposed Endangered or Threatened Species
 - Habitat Known to be Used by a Species under Review as to its Federal Endangered or Threatened Status
 - Habitat Known to be Used by a State Designated Endangered or Threatened Species
 - Migratory Pathways and Feeding Areas Critical for Maintenance of Anadromous Fish Species within River Reaches or Areas in Lakes or Coastal Tidal Waters in which the Fish Spend Extended Periods of Time
 - Particular Areas, Relatively Small in Size, Important to Maintenance of Unique Biotic Communities

- Spawning Areas Critical for the Maintenance of Fish/Shellfish Species Within River, Lake, or Coastal Tidal Waters
- Terrestrial Areas Used for Breeding by Large or Dense Aggregations of Animals
- Wetlands.

ADMINISTRATIVELY PROPOSED FEDERAL WILDERNESS AREA

Federal Wilderness Areas may be proposed by BLM, USFS, NPS, or USFWS.

- (1) The boundaries of the proposed wilderness area should be available in a public docket or *Federal Register* notice. Contact the appropriate BLM, USFS, NPS, or USFWS regional office listed in **Highlights A-11** through **A-14** to obtain information on proposed Federal Wilderness Areas.

AREAS IDENTIFIED UNDER THE COASTAL ZONE MANAGEMENT ACT

Areas designated under the Coastal Zone Management Act include: those nominated, proposed, and designated as National Estuarine Research Reserves by NOAA, and those designated as being of particular concern in State Coastal Zone Management Plans that have been approved by NOAA.

- (2) **Highlight A-15** lists all proposed and designated National Estuarine Research Reserves as of September, 1991. Latitudes and longitudes of these areas are available from NOAA's Marine and Estuarine Management Division, Office of Ocean and Coastal Resource Management, NOS/NOAA, 1825 Connecticut Ave., Washington, DC 20235; (202) 606-4126.
- (3) A list of locations for areas nominated for the National Estuarine Research Reserve System and copies of State Coastal Zone Management Plans that delineate other areas designated as being of particular concern are available from the appropriate state coastal zone management agency or NOAA's Office of Ocean and Coastal Resource Management at (202) 606-4126.
- (4) Many eligible coastal areas are delineated on USGS topographic maps or NOAA nautical charts. USGS topographic maps can be obtained from one of the Earth Science Information Centers listed in **Highlight A-10**, most outdoor sport stores, and local outfitters. NOAA nautical charts can be obtained from NOAA's Document Distribution Office at (301) 436-6990 and from various commercial stores specializing in marine recreation (e.g., boating, fishing).
- (5) Other potential sources of information on estuaries and near coastal waters include EPA's Office of Marine and Estuarine Protection at (202) 260-7166 and Sea Grant program offices (located at major universities in coastal areas).
- (6) If further assistance is needed to delineate an area identified under the Coastal Zone Management Act, contact the appropriate state coastal zone management agency or the appropriate regional office of the National Estuarine Research Reserve System listed in **Highlight A-15**.

COASTAL BARRIER — PARTIALLY DEVELOPED

Undeveloped and partially developed coastal barriers are generally administered by a state coastal zone management agency or by EPA's Near Coastal Waters Program.

- (1) If the coastal barrier is publicly owned and administered by a state coastal zone management agency or a Federal agency, contact the appropriate agency for assistance in determining and uses on the coastal barrier.
- (2) Other sources of information for undeveloped and partially developed coastal barrier areas include aerial photographs, flood hurricane insurance maps, developers, real estate agents, and planning commissions. Alternatively, the regional contacts for the Near Coastal Waters Program (**Highlight A- 16**) may be able to provide assistance in determining land uses on the particular coastal barrier.

COASTAL BARRIER — UNDEVELOPED

See subsection above, Coastal Barrier — Partially Developed.

CRITICAL AREAS IDENTIFIED UNDER THE CLEAN LAKES PROGRAM

The Clean Lakes Program is administered by state water quality and natural resource agencies and receives funding from EPA.

- (1) The Clean Lakes Program Data Table lists latitudes and longitudes for all elements of the Clean Lakes Program. Contact EPA's Office of Water Regulations and Standards (OWRS) at (202) 260-5404 for a copy of this table.
- (2) Many eligible areas are delineated on USGS topographic maps. They can be obtained from one of the Earth Science Information Centers listed in **Highlight A- 10**, most outdoor sport stores, and local outfitters.
- (3) Further assistance in delineating a given area can be obtained from the Clean Lakes Program Regional contacts (**Highlight A- 17**), EPA's OWRS at (202) 260-5404, or the appropriate state water quality/natural resources agency.

CRITICAL HABITAT FOR FEDERAL DESIGNATED ENDANGERED OR THREATENED SPECIES

Critical habitat has not been designated for all endangered or threatened species. Although USFWS and NMFS can still designate critical habitat, in recent years they have been reluctant to do so because pinpointing specific habitats in public documents can pose a danger for the species of concern (e.g., from poachers). Only those areas listed in 50 CFR 17.95 (critical habitats for fish and wildlife species), 50 CFR 17.96 (critical habitat for plant species), or a *Federal Register* notice, are designated critical habitat. Areas proposed as critical habitats are not evaluated in the HRS.

- (1) All critical habitat for Federal endangered or threatened species are identified in 50 CFR 17.95 and 50 CFR 17.96 in the form of maps and/or detailed descriptions.
- (2) If further assistance is needed to delineate a critical habitat, contact the appropriate USFWS regional office listed in **Highlight A-12**.

DESIGNATED FEDERAL WILDERNESS AREA

A designated Federal Wilderness Area may be administered by USFWS, BLM, USFS, or NPS.

- (1) The Wilderness Society publishes a map entitled *The National Wilderness Preservation System, 1964-1989* which locates all Federal Wilderness Areas designated before 1989. Contact the Wilderness Society at (202) 842-3400 to obtain a current listing of all designated Federal Wilderness Areas.

- (2) Federal Wilderness Areas should be delineated on USGS topographic maps of the area. In most cases, this delineation will be adequate for HRS purposes.
- (3) If a Federal Wilderness Area is not identified or adequately delineated on USGS topographic maps, contact the appropriate regional office of the appropriate administering agency listed in **Highlights A-11 through A-14**.

FEDERAL DESIGNATED SCENIC OR WILD RIVER

Rivers or segments of rivers that are designated as National Wild and Scenic Rivers are administered by either a Federal agency (i.e., NPS, USFWS, USFS, or BLM), a state agency, or a Native American nation.

- (1) All Federal designated scenic or wild rivers are delineated on a map entitled, *National Wild and Scenic Rivers System*, Map Number 38077-BQ-NA-05M-00, December 1990. A listing of each unit, along with the name and address of the administering agency, is included with the map. This map can be obtained from the USGS Earth Science Information Centers listed in **Highlight A-10**.
- (2) NPS maintains a computerized database of information for each unit of the National Wild and Scenic River System. Information includes: the name of the unit, statutory or other authority for inclusion in the system, administering agency, total number of miles, and number of miles designated as wild, scenic, or recreational. Contact NPS's Division of Park Planning and Protection at (202) 208-4290 for this listing.
- (3) The Wild and Scenic Rivers Act identifies each river or river segment as wild, scenic, or recreational. Contact NPS's Division of Park Planning and Protection at (202) 208-4290 to obtain a copy of the act.
- (4) If additional information is needed for a particular river segment, contact the appropriate BLM, USFS, NPS, or USFWS regional office listed in **Highlights A-11 through A-14**.
- (5) River reaches designated under the Clean Water Act and identified in STORET are not eligible for HRS evaluation.

FEDERAL LAND DESIGNATED FOR THE PROTECTION OF NATURAL ECOSYSTEMS

These areas are usually administered by BLM or USFS.

- (1) Resource Management Plan (or other similar document) published by BLM or USFS will identify areas designated for the protection of natural ecosystems in Resource Areas administered by those agencies. Resource Management Plans provide maps and latitude and longitude for delineating these areas (note that prior to 1980 these documents were known as Management Framework Plans and provided less complete environmental data). **Highlight A-13 or A-14** lists BI-M and USFS regional offices that can supply most Resource Management Plans.
- (2) EIS documents delineating public lands designated as Wildlife Mitigation Areas can be obtained by contacting the appropriate BLM or USFS regional office.
- (3) If an area designated for the protection of natural ecosystems is not identified or adequately delineated in the Resource Management Plan, contact the appropriate BLM or USFS regional office. If the area is managed by another Federal agency (e.g., BIA, MMS, OSM), contact the appropriate agency for copies of the appropriate Resource Management Plan(s) or EIS(s).

HABITAT KNOWN TO BE USED BY FEDERAL DESIGNATED OR PROPOSED ENDANGERED OR THREATENED SPECIES

Endangered or threatened fish, wildlife, and plant species fall under the jurisdiction of USFWS. Endangered or threatened marine animals (e.g., marine mammals, sea turtles) fall under the jurisdiction of NMFS.

- (1) All Federal designated endangered or threatened species are listed in 50 CFR 17.11 (fauna) and 17.12 (flora) or in a *Federal Register* notice. Species proposed by the Secretary of the Interior for designation as Federal endangered or threatened species are published in the *Federal Register*. To obtain current lists of designated and proposed Federal endangered or threatened species, contact the appropriate USFWS regional office listed in **Highlight A-12** or NMFS's Office of Protected Resources at (301) 427-2322.
- (2) A number of sources can provide assistance in determining whether habitat known to be used by any of the species identified in Step (1) is within the TDLs. They include: state fish and game or wildlife, natural resource, or environmental conservation agency, the state Natural Heritage program, other local or regional experts (e.g., faculty members at a nearby university, members of the local Audubon society), the appropriate USFWS regional office and/or NMFS at (301) 427-2322. If the Superfund remedial program has a BTAG in the region, the BTAG chairperson may be able to direct you to the appropriate agencies and individuals. Contact the regional Site Assessment Manager to obtain the name and phone number of the BTAG chairperson.

HABITAT KNOWN TO BE USED BY SPECIES UNDER REVIEW AS TO ITS FEDERAL ENDANGERED OR THREATENED STATUS

- (1) Plant and animal species under review as to their Federal endangered or threatened status are listed in a Comprehensive Notice of Review, published biennially in the *Federal Register* by USFWS. Marine animals under review as to their Federal endangered or threatened status are listed periodically in a Candidate Species List, published in the *Federal Register* by NOAA. To obtain current lists of species under review as to their endangered or threatened status, contact the appropriate USFWS regional office or NMFS's Office of Protected Resources at (301) 427-2322.
- (2) A number of sources can provide assistance in determining whether habitat known to be used by any of the species identified in Step (1) is within the TDLs. They include: state fish and game or wildlife, natural resource, or environmental conservation agency, the state Natural Heritage program, other local or regional experts (e.g., faculty members at a nearby university, members of the local Audubon society), the appropriate USFWS regional office and/or NMFS at (301) 427-2322. If the Superfund remedial program has a BTAG in the region, the BTAG chairperson may be able to direct you to the appropriate agencies and individuals. Contact the regional Site Assessment Manager to obtain the name and phone number of the BTAG chairperson.

HABITAT KNOWN TO BE USED BY STATE DESIGNATED ENDANGERED OR THREATENED SPECIES

A number of agencies can provide assistance to identify and delineate this sensitive environment category. They include: the state fish and game or wildlife, natural resource, or environmental conservation agency, other local or regional experts (e.g., faculty members at a nearby university, members of the local Audubon society), and/or the appropriate USFWS regional office. Note that the USFWS Small Wetlands Acquisition Program protects prairie potholes and other small wetlands important for waterfowl production. If the Superfund remedial program has a BTAG in the region, the BTAG chairperson may be able to direct you to the appropriate agencies and individuals.

Contact the regional Site Assessment Manager to obtain the name and phone number of the BTAG chairperson.

MARINE SANCTUARY

These areas are administered by NOAA.

- (1) NOAA has mapped the general locations of National Marine Sanctuaries. Contact NOAA's Office of Ocean and Coastal Resource Management at (202) 606-4126 for a copy of this map. **Highlight A-18** provides a listing of the nautical chart numbers of all of the National Marine Sanctuaries.
- (2) National Marine Sanctuaries will be delineated on the appropriate nautical chart(s) available from the NOAA's Document Distribution Office at (301) 436-6990 and from various commercial stores specializing in marine recreation (e.g., boating, fishing).
- (3) If further information is needed to delineate a National Marine Sanctuary, contact NOAA's Office of Ocean and Coastal Resource Management at (202) 606-4126.

MIGRATORY PATHWAYS AND FEEDING AREAS CRITICAL FOR MAINTENANCE OF ANADROMOUS FISH SPECIES WITHIN RIVER REACHES OR AREAS IN LAKES OR COASTAL TIDAL WATERS IN WHICH THE FISH SPEND EXTENDED PERIODS OF TIME

See subsection above, Habitat Known to be used by State Designated Endangered or Threatened Species.

NATIONAL LAKESHORE RECREATIONAL AREA

These areas are administered by the NPS.

- (1) The boundaries of these sensitive environments generally are delineated on USGS topographic maps. In most cases, this delineation will be adequate for HRS purposes.
- (2) If the sensitive environment is not identified or adequately delineated on USGS topographic maps, contact the appropriate NPS regional office listed in **Highlight A-11**.
- (3) NPS maintains a computerized database that lists all lands under its jurisdiction. Contact NPS at (202) 343-7014 to obtain a copy.

NATIONAL MONUMENT

See subsection above, National Lakeshore Recreational Area.

NATIONAL OR STATE WILDLIFE REFUGE

National Wildlife Refuges are administered by the USFWS. State wildlife refuges generally are administered by a state fish and game or wildlife management agency.

- (1) All lands under USFWS jurisdiction, including national wildlife refuges, are identified in the *Annual Report of Lands Under Control of the USFWS*. Contact the USFWS Division of Realty at (703) 358-1816 to obtain a copy of the report. Lists of state wildlife refuges should be available from the appropriate fish and game or wildlife management agency.
- (2) National and state wildlife refuges generally are delineated on USGS topographic maps. State wildlife refuges also may be delineated on some official state highway maps. In most cases, this delineation will be adequate for HRS purposes.

- (3) If a wildlife refuge is not identified or adequately delineated on USGS topographic maps or other maps, contact the appropriate USFWS regional office listed in **Highlight A-12** or the appropriate state fish and game or wildlife management agency.

NATIONAL PARK

See subsection above, National Lakeshore Recreational Area.

NATIONAL PRESERVE

See subsection above, National Lakeshore Recreational Area.

NATIONAL RIVER REACH DESIGNATED AS RECREATIONAL

See subsection above, Federal Designated Scenic or Wild River.

NATIONAL SEASHORE RECREATIONAL AREA

See subsection above, National Lakeshore Recreational Area.

PARTICULAR AREAS, RELATIVELY SMALL IN SIZE, IMPORTANT TO MAINTENANCE OF UNIQUE BIOTIC COMMUNITIES

See subsection above, Habitat Known to be used by State Designated Endangered or Threatened Species.

SENSITIVE AREAS IDENTIFIED UNDER THE NATIONAL ESTUARY PROGRAM OR NEAR COASTAL WATERS PROGRAM

This sensitive environment category includes areas identified in both the National Estuary Program and the Near Coastal Waters Program. Both programs are administered by EPA.

- (1) **Highlight A-19** identifies the components of the National Estuary Program for each EPA region. Contact the appropriate office to delineate the estuary program component in question.
- (2) **Highlight A-16** lists the EPA Regional contacts for the Near Coastal Waters Program. Contact the appropriate office to delineate sensitive areas identified under the Near Coastal Waters Program. (Note that as of December 1991, no areas within the Near Coastal Waters Program had been designated as sensitive areas.)
- (3) Other potential sources of information on estuaries and near coastal waters include EPA's Office of Marine and Estuarine Protection at (202) 260-7166 and Sea Grant program offices (located at major universities in coastal areas).

SPAWNING AREAS CRITICAL FOR THE MAINTENANCE OF FISH/SHELLFISH SPECIES WITHIN RIVER, LAKE, OR COASTAL TIDAL WATERS

See subsection above, Habitat Known to be used by State Designated Endangered or Threatened Species.

STATE DESIGNATED AREAS FOR PROTECTION OF AQUATIC LIFE

These areas generally are administered by a state environmental protection or water quality agency.

- (1) Locations and boundaries of these areas can be found in the Clean Water Act Section 305(a) Report filed by the state, and is updated biennially with Section 305(b) Reports filed with EPA.
- (2) Copies of these reports can be obtained from the state environmental protection or water quality agency, the appropriate EPA regional office listed in **Highlight A-20**, or in the *Environmental Reporter* (under state regulations).

STATE DESIGNATED NATURAL AREAS

These areas generally are administered by a state natural resources or land management agency.

- (1) If available, obtain copies of any relevant documents (e.g., maps or state regulatory codes) delineating the designated natural area.
- (2) If no official maps or documents are available, request a signed statement from a responsible official of the appropriate state natural resources or land management agency to document the boundaries of state designated natural areas within the TDLs of the site.

STATE DESIGNATED SCENIC OR WILD RIVER

These areas generally are administered by a state park service or natural resources agency.

- (1) Maps or other documents that specify river reaches designated as state scenic or wild rivers may be available from a state park service, state natural resources agency or local outfitters.
- (2) Contact NPS's Division of Recreation Resources Assistance, Washington, D.C. at (202) 343-3780 to obtain information on state systems.
- (3) If no official maps or documents are available, request a signed statement from a responsible official of the appropriate state park service or natural resources agency to document the boundaries of state designated scenic or wild rivers within the TDLs of the site.

STATE LAND DESIGNATED FOR WILDLIFE OR GAME MANAGEMENT

Some state lands designated for wildlife or game management are delineated on USGS maps. These lands generally are administered by a state fish and game or wildlife management agency.

- (1) Lists of state wildlife or game management areas should be available from the appropriate fish and game or wildlife management agency.
- (2) In some cases, state lands designated for wildlife and game management will be delineated on USGS topographic maps.
- (3) If an area is not identified or adequately delineated on USGS maps, contact the appropriate state fish and game or wildlife management agency.

TERRESTRIAL AREAS UTILIZED FOR BREEDING BY LARGE OR DENSE AGGREGATIONS OF ANIMALS

See subsection above, Habitat Known to be used by State Designated Endangered or Threatened Species.

UNIT OF COASTAL BARRIER RESOURCES SYSTEM

The Coastal Barrier Resources System is administered by state coastal zone management agencies; maps that depict the system are maintained by USFWS.

- (1) All units of the Coastal Barrier Resources System are listed in Part VI of the June 6, 1991 *Federal Register*, which contains an index to the map series entitled *Coastal Barrier Resources System*, numbered A01 through T12 (excluding maps T02 and T03), and the maps designated T02A and T03A.
- (2) Using the index referenced in Step (1), obtain the appropriate map from the USGS Book Sales Office at (303) 236-7476, or order them using the order form provided in the *Federal Register* notice. Alternatively, maps covering a particular state are available for inspection at selected regional and field USFWS offices listed in the *Federal Register* notice and at the state coastal zone management agency.
- (3) After May 15, 1992, no units will be added to the Coastal Barrier Resource System; however, individual units may change in size or location due to natural forces (e.g. wave action). If any major natural changes have occurred in the coastal barrier since the map was published, contact the state coastal zone management agency or USFWS.

WETLANDS

The level of documentation required for identifying and delineating wetlands will vary among sites (see Sections 8.17, 9.6, and A.3 for guidance in determining required level of documentation). In many cases, wetlands delineation provided by maps may be sufficient for HRS purposes.

- (1) The preferred maps are the NWI Maps or state maps of equivalent quality (e.g., Wisconsin). NWI maps are available from USGS Earth Science Information Centers listed in **Highlight A-10**. The availability of state maps must be determined on a state-by-state basis. Note that wetlands identified on these maps may not meet the HRS definitional criteria for a wetland.
- (2) USGS topographic maps or wetlands maps provided by the SCS can be used to approximate wetland boundaries. USGS topographic maps are available from USGS Earth Science Information Centers (see **Highlight A-10**), most outdoor sport stores, and local outfitters. SCS maps are available from each state office of the SCS. Note that not all areas listed as wetlands on these maps meet the HRS definitional criteria for a wetland. Note also that SCS maps often err on the side of listing areas as wetlands that are not actually wetlands.
- (3) Other wetlands maps can be used to verify wetlands boundaries. Again, note that wetlands identified on these maps may not meet the HRS definitional criteria for a wetland.
 - The USFWS Small Wetlands Acquisition Program protects prairie potholes and other small wetlands important for waterfowl production and may have maps.
 - USGS has computerized maps delineating wetlands in Alabama, Florida, North Carolina, and Texas.
 - BIA has delineated 400,000 acres of wetlands on Native American reservations in Minnesota and Wisconsin.
 - Wetlands maps are included in North American Waterfowl Management Plans.
 - Other contacts include: the Isaak Walton League, Ducks Unlimited, Trout Unlimited, and The Wilderness Society.

- (4) If an even greater level of detail is required to verify the presence of a wetland and determine its length (or perimeter), a wetlands expert should be contacted. These other contacts include:
- The U.S. Army Corps of Engineers Civil Works district offices and EPA regional offices (see **Highlight A-20**) have wetlands experts who deal with permitting issues under Section 404 of the Clean Water Act.
 - State soil and water conservation offices often have wetlands experts who deal with various permitting and regulatory issues.

**HIGHLIGHT A-10
U.S. GEOLOGICAL SURVEY EARTH SCIENCE
INFORMATION CENTER OFFICES**

ESIC Office	Address	Telephone
Virginia (National Headquarters)	Earth Science Information Center USGS 507 National Center Reston, VA 22092	1-800-USA-MAPS or (703) 648-6045
Alaska	Earth Science Information Center USGS 4230 University Dr., Room 101 Anchorage, AK 99508-4664	(907) 786-7011
California	Western Mapping Center-ESIC USGS 345 Middlefield Rd. MS 532 Menlo Park, CA 94025	(415) 329-4309
Colorado	Rocky Mountain Mapping Center- ESIC USGS Box 25046, Stop 504 Federal Center Denver, CO 80225	(303) 236-5829
Mississippi	Earth Science Information Center USGS Building 3101 Stennis Space Center, MS 39529	(601) 688-3544
Missouri	Mid-Continent Mapping Center-ESIC USGS 1400 Independence Rd. MS 231 Rolla, MO 65401	(314) 341-0851
South Dakota	USGS EROS Data Center Mundt Federal Building Sioux Falls, SD 57198	(605) 594-6161

**HIGHLIGHT A-11
U.S. NATIONAL PARK SERVICE
REGIONAL OFFICES**

Region	Regional Office Address	Telephone
North Atlantic	15 State St. Boston, MA 02109	(617) 223-5200
Mid-Atlantic	143 S. 3rd Street Philadelphia, PA 19106	(215) 597-7013
Southeast	75 Spring St. Atlanta, GA 30303	(404) 331-4998
Midwest	1709 Jackson St. Omaha, NE 68102	(402) 221-3471
Rocky Mountain	P.O. Box 25287 Denver, CO 80225	(303) 969-2100
Southwest	P.O. Box 728 Santa Fe, NM 87504-0728	(505) 988-6012
Western	600 Harrison St. Suite 600 San Francisco, CA 94107	(415) 745-3955
Pacific Northwest	83 S. King St. Suite 212 Seattle, WA 98104	(206) 553-5565
Alaska	2525 Gamble St. Anchorage, AK 99503	(907) 257-2687

See **Highlight A-21** for NPS regional boundaries.

**HIGHLIGHT A-12
U.S. FISH AND WILDLIFE SERVICE
REGIONAL OFFICES**

Region	Regional Office Address	Telephone
1	911 NE 11th Ave Portland, OR 97232-4181	(503) 231-6118
2	P.O. Nox 1306 500 Gold Ave SW Room 3018 Albuquerque, NM 87103	(505) 766-2321
3	Whipple Federal Building 1 Federal Dr. Fort Snelling, MN 55111	(612) 725-3502
4	Richard B. Russell Federal Building Room 1200 75 Spring St. SW Atlanta, GA 30303	(404) 331-3588
5	One Gateway Center Suite 700 Newton Corner, MA 02158	(617) 965-5100
6	P.O. Box 25486 Denver Federal Center Denver, CO 80225	(303) 236-7920
7	1011 East Tudor Rd. Anchorage, AK 99503	(907) 786-3542
8	1849 C St. SW MS 725 - ARLSQ Washington, DC 20240	(703) 358-1801

See **Highlight A-22** for USFWS regional boundaries.

HIGHLIGHT A-13
U.S. BUREAU OF LAND MANAGEMENT STATE OFFICES

State	State Office Address	Telephone
Alaska	222 West 7th Ave #13 Anchorage, AK 99513-7599	(907) 271-5076
Arizona	3707 North 7th St. Phoenix, AZ 85011	(602) 640-5501
California	2800 Cottage Way Sacramento, CA 95825	(916) 978-4743
Colorado	2850 Youngfield St. Lakewood, CO 80215	(303) 239-3700
Eastern States Office	350 South Pickett St. Alexandria, VA 22304	(703) 461-1400
Idaho	3380 Americana Terrace Boise, ID 83706	(208) 384-3001
Montana	P.O. Box 36800 Billings, MT 59107	(406) 255-2904
Nevada	P.O. Box 1200 Reno, NV 89520-006	(702) 785-6590
New Mexico	P.O. Box 27115 Santa Fe, NM 87502-7115	(505) 438-7400
Oregon	P.O. Box 2965 Portland, OR 97208	(503) 280-7026
Utah	324 South State St. Salt Lake City, UT 84111-2303	(801) 539-4010
Wyoming	P.O. Box 1828 Cheyenne, WY 82003	(307) 775-6001

HIGHLIGHT A-14
U.S. NATIONAL FOREST SERVICE REGIONS

Region	Regional Office Address	Telephone
Northern (Region 1)	P.O. Box 7669 Missoula, MT 59807	(406) 329-3316
Rocky Mountain (Region 2)	P.O. Box 25127 Denver, CO 80225	(303) 236-9427
Southwestern (Region 3)	Federal Building 517 Gold Ave. SW Albuquerque, NM 87102	(505) 842-3300
Intermountain (Region 4)	Federal Building 324 25th St. Ogden, UT 84401	(801) 625-5352
Pacific Southwest (Region 5)	630 Sansome St. San Francisco, CA 94111	(415) 705-2870
Pacific Northwest (Region 6)	P.O. Box 3623 Portland, OR 97208	(503) 326-3625
Southern (Region 8)	1720 Peachtree Rd. NW Atlanta, GA 30367	(404) 347-4177
Eastern (Region 9)	310 West Wisconsin Ave. Room 500 Milwaukee, WI 53203	(414) 297-3693
Alaska (Region 10)	P.O. Box 21628 Juneau, AK 99802	(907) 586-8863

See **Highlight A-23** for USFS regional boundaries.

**HIGHLIGHT A-15
NATIONAL ESTUARINE RESEARCH RESERVE SYSTEM^a**

Project Name	Address	Status	Phone
Ahepoo-Combahee-Edisto Basin	ACE Basin S. Carolina Wildlife & Marine Resource Center P.O. Box 12559 Charleston, SC 29412	Proposed	(803) 762-5052
Apalachicola	Apalachicola National Estuarine Research Reserve System 261 7th Street Apalachicola, FL 32320	Designated	(904) 653-8063
Chesapeake Bay (VA)	Virginia Institute of Marine Sciences P.O. Box 1346 Gloucester Point, VA 23062	Proposed	(804) 642-7135
Chesapeake Bay (MD)	Dept. of Natural Resources Tidewater Admin. Coastal Resources Division CBNERR/MD Towes State Office Bldg B-3 580 Taylor Ave. Annapolis, MD 21401	Designated	(410) 974-2784
Delaware	Delaware Estuarine Reserve 89 Kings Highway P.O. Box 1401 Dover, DE 19903	Proposed	(302) 739-3091
Elkhorn Slough	Elkhorn Slough Reserve 1700 Elkhorn Rd. Watsonville, CA 95076	Designated	(408) 728-2822
Great Bay	New Hampshire Fish and Game Department 37 Concord Rd. Durham, NH 03824	Designated	(603) 868-1095
Hudson River	Hudson River National Estuarine Research Reserve c/o Bard College P.O. Box 67 Annandale-on-Hudson, NY 12505	Designated	(914) 758-5193
Jobos Bay	Jobos Bay Estuarine Reserve P.O. Box 1170 Guayama, PR 20785	Designated	(809) 864-0105
Narragansett Bay	Narragansett Bay National Estuarine Research Reserve Department of Environmental Management 22 Hayes St. Providence, RI 02908	Designated	(401) 683-6780
North Carolina	Center for Marine Research 7205 Wrightsville Ave. Wilmington, NC 28403	Designated	(919) 256-3721

^a Note that proposed reserves are not eligible for HRS scoring but are included because they may be designated in the near future.

(continued on next page)

HIGHLIGHT A-15 (continued)
NATIONAL ESTUARINE RESERVE SYSTEM

Project Name	Address	Status	Phone
North Inlet-Winyah Bay	Baruch Marine Lab P.O. Box 1630 Georgetown, SC 29442	Proposed	(803) 546-3623
Old Woman Creek	Old Woman Creek 2514 Cleveland Rd. East Huron, OH 44839	Designated	(419) 433-4601
Padilla Bay	Padilla Bay 1043 Bayview-Edison Rd. Mt. Vernon, WA 98273	Designated	(206) 428-1558
Rookery Bay	Rookery Bay 10 Shell Island Rd. Naples, FL 33962	Designated	(813) 775-8845
St. Lawrence River Basin	St. Lawrence Eastern Ontario Commission 317 Washington St. Watertown, NY 13601	Proposed	(315) 785-2460
Sapelo Island	Department of Natural Resources P.O. Box 15 Sapelo Island, GA 31327	Designated	(912) 485-2251
South Slough	South Slough P.O. Box 5417 Charlestown, OR 97420	Designated	(503) 888-5558
Tijuana River	Tijuana River 301 Caspian Way Imperial Beach, CA 91932	Designated	(619) 575-3613
Waimanu Valley	Dept. of Land and Natural Resources Division of Forestry 7 Wildlife 567 S. King St. Room 132 Honolulu, HI 96813	Designated	(808) 587-0054
Waquoit Bay	Waquoit Bay (WBNERR) P.O. Box 3092 Waquoit, MA 02536	Designated	(508) 457-0495
Weeks Bay	Weeks Bay Estuarine Research Reserve 10936-B US Highway 98 Fairhope, AL 36532	Designated	(205) 928-9792
Wells	Wells Estuarine Reserve RR 2 Box 806 Wells, ME 04090	Designated	(207) 646-1555

HIGHLIGHT A-16
NEAR COASTAL WATERS PROGRAM EPA REGIONAL CONTACTS

EPA Region	Regional Office Address	Telephone
Headquarters	401 M Street SW Washington, DC 20036	(202) 260-5554
1	JFK Federal Building (WQE-425) Boston, MA 12203	(617) 565-4870
2	Marine and Wetland Protection Branch 26 Federal Plaza New York, NY 10278	(212) 264-5170
3	Marine and Estuary Section 841 Chestnut St. Philadelphia, PA 19104	(215) 597-9589
4	Coastal Planning Unit 345 Courtland St. NE Atlanta, GA 30365	(404) 347-1740
5	Water Division 77 West Jackson Boulevard (WQ-16J) Chicago, IL 60604	(312) 353-2079
6	Marine and Estuary Section 1445 Ross Avenue Suite 1200 Dallas, TX 75202	(214) 655-6680
9	Wetland and Coastal Planning Section 75 Hawthorne St. San Francisco, CA 94105	(415) 744-1974
10	Office of Coastal Waters 1200 6th Ave. Seattle, WA 98101	(206) 553-0966

HIGHLIGHT A-17
EPA REGIONAL CLEAN LAKES PROGRAM OFFICES

EPA Region	Regional Office Address	Telephone
1	JFK Federal Building Boston, MA 02203	(617) 565-3515
2	26 Federal Plaza New York, NY 10278	(212) 264-8708
3	841 Chestnut St. Philadelphia, PA 19107	(215) 597-3429
4	345 Courtland St. Atlanta, GA 30365	(404) 347-2126
5	77 West Jackson Boulevard Chicago, IL 60604	(312) 886-0209
6	First Interstate Bank Tower 1445 Ross Avenue Dallas, TX 75202	(214) 655-7140
7	726 Minnesota Ave. Kansas City, KS 66101	(913) 551-7500
8	One Denver Place 999 18th St, Suite 500 Denver, CO 80202-2406	(303) 293-1574
9	75 Hawthorne Street San Francisco, CA 94105	(415) 744-2018
10	1200 Sixth Ave. Seattle, WA 98101	(206) 553-6911

HIGHLIGHT A-18
NAUTICAL CHART NUMBERS FOR MARINE SANCTUARIES

National Marine Sanctuary	State or Territory	Nautical Chart Number ^a
Monitor	NC	12200 13003 11009
Grays Reef	GA	11009 11480
Florida Keys	FL	111013 411 11450
Key Largo	FL	111013 411 11450
Looe Key	FL	111013 411 11450 11434 11420
Cordell Banks	CA	18640
Gulf of the Farallones	CA	18640 18680 18645
Channel Islands	CA	18740 (San Miguel Pass) 18727 (Santa Cruz Channel) 18728 (Anacapa Pass) 18729 (Santa Barbara Island) 18756 (San Nicolas Island) 18755
Fagatele Bay	American Samoa	83484

^aProvided by NOAA for ordering purposes. May represent categories of charts rather than individual charts; this will be clarified in a subsequent draft.

HIGHLIGHT A-19
NATIONAL ESTUARY PROGRAM INFORMATION SOURCES

Project Name (EPA Region)	Headquarters Address (all projects)	Phone Number (at Headquarters)
Buzzards Bay (1)	OCPD	(202) 260-9176
Casco Bay (1)	U.S. EPA	(202) 260-9176
Long Island Sound (1)	401 M Street SW	(202) 260-9176
Massachusetts/Cape Cod Bays (1)	Washington, DC 20460	(202) 260-6504
Narragansett Bay (1)		(202) 260-6466
Delaware Bay (2)		(202) 260-9799
Long Island Sound (2)		(202) 260-9176
Delaware Bay (3)		(202) 260-6466
New York/New Jersey Harbor (2)		(202) 260-6779
Delaware Inland Bays (3)		(202) 260-9799
Albemarle-Pamlico Sounds (4)		(202) 260-9137
Indian River Lagoon (4)		(202) 260-9137
Sarasota Bay (4)		(202) 260-9137
Tampa Bay (4)		(202) 260-9137
Barrataria-Terrebone Estuarine		
Complex (4)		(202) 260-6467
Galveston Bay (6)		(202) 260-6467
San Francisco Bay (9)		(202) 260-9038
Santa Monica Bay (9)		(202) 260-9038
Puget Sound (10)		(202) 260-9038

**HIGHLIGHT A-20
EPA REGIONAL OFFICES**

EPA Region	Regional Office Address	Telephone
1	JFK Federal Building Boston, MA 12203	(617) 565-3420
2	26 Federal Plaza New York, NY 10278	(212) 264-2657
3	841 Chestnut St. Philadelphia, PA 19107	(215) 597-9800
4	345 Courtland St. NE Atlanta, GA 30365	(404) 347-4727
5	77 West Jackson Boulevard Chicago, IL 60604	(312) 353-2000
6	First Interstate Bank Tower 1445 Ross Avenue Dallas, TX 75202	(214) 655-6444
7	726 Minnesota Ave Kansas City, KS 66101	(913) 551-7000
8	One Denver Place 999 18th St. Suite 500 Denver, CO 80202-2406	(303) 293-1603
9	75 Hawthorne Street San Francisco, CA 94105	(415) 744-1180
10	1200 Sixth Ave. Seattle, WA 98101	(206) 442-1200

**HIGHLIGHT A-21
NATIONAL PARK SERVICE REGIONAL BOUNDARIES**



Alaska:	Alaska Region
Hawaii:	Western Region
Guam and American Samoa:	Western Region
Puerto Rico:	Southeast Region
U.S. Virgin Islands:	Southeast Region

Not all Park Service boundaries follow state boundaries.

A-55

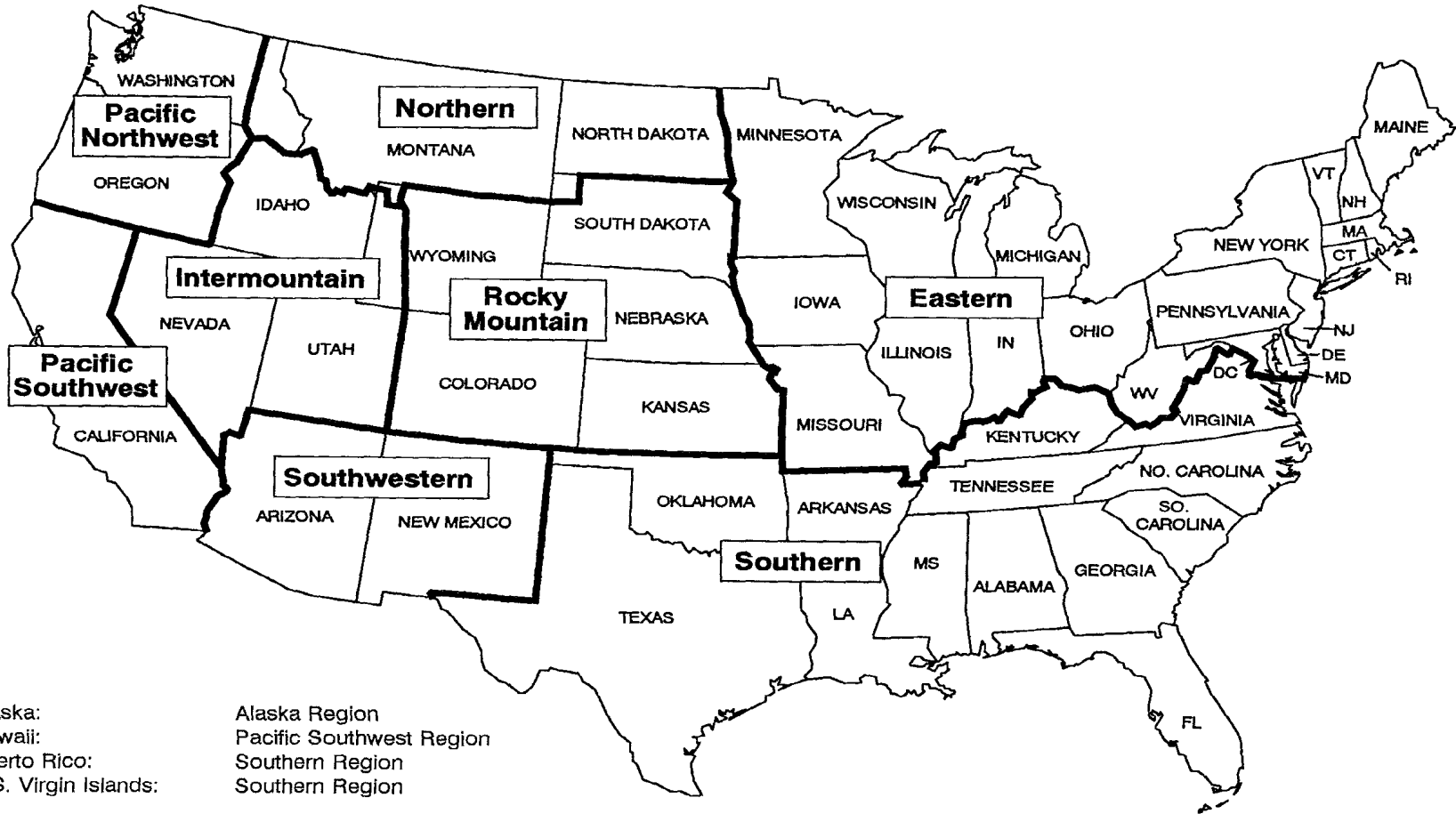
Section A.4

HIGHLIGHT A-22 U.S. FISH AND WILDLIFE SERVICE REGIONAL BOUNDARIES



Alaska: Region 7
Hawaii: Region 1
Puerto Rico: Region 4
U.S. Virgin Islands: Region 4

**HIGHLIGHT A-23
U.S. FOREST SERVICE REGIONAL BOUNDARIES**



Alaska: Alaska Region
 Hawaii: Pacific Southwest Region
 Puerto Rico: Southern Region
 U.S. Virgin Islands: Southern Region

Not all Forest Service regional boundaries follow state boundaries.



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

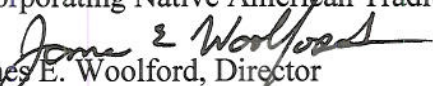
MAR 20 2007

OFFICE OF
SOLID WASTE AND EMERGENCY
RESPONSE

OSWER-9200.0-66

MEMORANDUM

SUBJECT: Transmittal of Amendments to Superfund Hazard Ranking System Guidance Incorporating Native American Traditional Lifeways

FROM: 
James E. Woolford, Director
Office of Superfund Remediation and Technology Innovation

TO: Superfund National Policy Managers, Regions 1 - 10

Purpose

The attached document amends the November 1992 Hazard Ranking System (HRS) Guidance Manual (EPA 540-R-92-026, November 1992) by adding examples, consistent with the HRS, on ways Native American lifeways can be considered under the HRS; it does not otherwise supersede or change the guidance. This will help the Superfund program to better recognize and account for Native American traditional lifeways in the National Priorities List (NPL) process.

Background

In 1998 the Assistant Administrator of EPA's Office of Solid Waste and Emergency Response (OSWER) agreed to examine technical scoring guidance for the HRS, a mathematical model used to determine site eligibility for the NPL. This examination would identify ways in which the HRS Guidance could better take into account Native American cultural practices (traditional lifeways). The Office of Inspector General, in a 2004 evaluation report on the Superfund Tribal Program, also recommended HRS and risk assessment guidance more appropriately consider tribal cultural practices.

Implementation

When the HRS Guidance Manual was first developed over a decade ago, the preparers did not explicitly consider using Native American cultural examples. However, there are a number of ways in which EPA's HRS Guidance can appropriately consider traditional lifeways. Amendments to the 1992 HRS Guidance Manual follow as an attachment. In these amendments we present examples, consistent with the HRS, of some of the ways site assessors can consider Native American traditional lifeways when developing HRS scores.

Encourage Active Tribal Involvement

Regional Superfund staff should follow the consultation procedures presented in “Consulting with Indian Tribal Governments at Superfund Sites: a Beginner’s Booklet” (<http://www.epa.gov/superfund/partners/oerr/stsi.htm>), OSWER 9200.3-42, November 2006. Staff should make other personnel working in site assessment aware of the guidance as well. Further, EPA Regional assessment personnel should involve interested tribes in assessment and potential listing activities, since tribes can be a valuable source of information. As the consultation booklet says: “EPA is better able to fulfill its responsibility to ‘protect human health and the environment’ if the Agency utilizes the tribal consultation process by taking advantage of the insight and knowledge tribal governments can provide.”

Limitations of this Guidance

Several tribes have provided feedback on several concerns that unfortunately cannot be addressed in these amendments.

- **Tribal Populations** - Small and/or rural tribal populations believe they are at a disadvantage in the HRS formula provided at 40 CFR 60, Appendix A. They believe that risks posed to an entire reservation or tribe, regardless of number, should have greater weight than what the current HRS provides. Addressing this concern would require a regulatory change to the HRS, which is beyond the scope of this guidance.
- **Potential scoring misperception** – There was a perception that sites with higher HRS scores are always riskier and will be cleaned up sooner than sites with lower scores. This is not true. The HRS is not a risk assessment and a site’s HRS score does not determine risk. Moreover, the HRS score does not determine site priority for EPA. It is usually only used to document the eligibility of a site for inclusion on the NPL.

Conclusion

EPA should consider, to the extent allowed under the HRS, Native American traditional lifeways when assessing a site for listing. Further, Native Americans should be aware that there are many other options that may be available to address environmental problems. Other programs within OSWER, such as Superfund removal, brownfields cleanup, solid waste, underground storage tanks or oil spill prevention and cleanup, may be appropriate mechanisms for reducing the human health and ecological risks on tribal lands. Similarly, programs under other Federal agencies, such as those of trustee agencies, may be able to perform response activities.

Contact

For additional information or questions concerning this guidance amendment, please contact me or have your staff contact Robert Myers, the Superfund Headquarters Tribal Coordinator, at (703) 603-8851.

Attachments

cc: OSRTI Managers
Susan Bodine, OSWER
Barry Breen, OSWER
Scott Sherman, OSWER
Ed Chu, Land Revitalization Staff
Debbie Deitrich, OEM
David Lloyd, OBCR
Matt Hale, OSW
Cliff Rothenstein, OUST
Mary-Kay Lynch, OGC
Susan Bromm, OSRE
David Kling, FFEO
Marsha Minter, IPCO
Gail Cooper, FFRRO
Joanne Marinelli, Superfund Lead Region Coordinator, US EPA Region 3
NARPM Co-Chairs
OSRTI Documents Coordinator

HRS Guidance Amendments

Native American Advice on Sensitive Environments ¹

The HRS Guidance Manual explains the categories used for identifying contaminated sensitive environments in the surface water, soil, and air pathways.

The guidance indicates that Natural Resource Trustees should determine whether a potentially sensitive area meets the definition of the following two categories:

- *Migratory pathways and feeding areas critical for maintenance of anadromous fish species within river reaches or areas in lakes or coastal tidal waters in which the fish spend extended periods of time.*
- *Spawning areas critical for maintenance of fish/shellfish species within river, lake, or coastal tidal waters.*

Tribes are identified in the HRS Guidance as Natural Resource Trustees.² Thus, for these sensitive environments, no changes to the HRS Guidance are necessary, but the Office of Superfund Remediation and Technology Innovation (OSRTI) would like to remind site assessors that Native American tribes are trustees for resources on or related to tribal lands or for resources for which they may have treaty rights.³

Example: Salmon are a significant part of some tribes' traditional lifeways. If a tribe is the Natural Resource Trustee for a salmon spawning area, a designated tribal fish and wildlife official could make the determination whether the area meets the definition of a "spawning area critical for maintenance of fish/shellfish species within rivers, lakes, or coastal tidal waters."⁴

For other sensitive environment categories, the HRS Guidance asks the site assessor to consult with various governmental agencies to make the determination. These categories are:

- *Habitat known to be used by federal designated or proposed endangered or threatened species.*
- *Particular areas, relatively small in size, important to maintenance of unique biotic communities.*
- *Terrestrial areas utilized for breeding by large or dense aggregations of animals.*

For these, the guidance does not include the example of consulting with tribal agencies or officials. However, the guidance does say to consult with appropriate federal, state, county, or

¹ HRS Tables 4-23 and 5-5, HRS Sections 4.1.4.3.1 for surface water, 5.1.3.5 for soil and 6.3.4 for air

² Guidance Manual Highlight A-5

³ Guidance Manual Highlight A-5, footnote c

⁴ Guidance Manual Highlight A-7

local representatives of agencies,⁵ and tribal officials could also be knowledgeable and appropriate representatives. We are amending the guidance to explicitly include tribal officials as contacts for identifying these sensitive environments.

Example: A tribal fish and wildlife official might identify an area of traditional medicinal plant growth as a “unique, rare, or otherwise ecologically valuable biotic area.”⁶

See guidance amendments in Appendix I.

Native American Resource Usage⁷

The HRS guidance resources factor discussion clarifies the possible loss of resource use resulting from site-related contamination in the ground water, surface water, soil, and air pathways. The HRS identifies the uses, including crop irrigation, watering of commercial livestock, ingredients for commercial food preparation, commercial aquaculture (or agriculture or silviculture), and supply for a major or designated recreational area. The uses vary depending on the pathway. The HRS Guidance Manual defines these terms more specifically and provides illustrations.⁸ Many of the resources listed are commercial resources, but some Native American communities use a barter system in which food or other products are traded rather than purchased. Although such a system is outside the mainstream U.S. currency economy, it is consistent with the examples provided in the HRS Guidance Manual to consider products widely traded or distributed similarly as products widely sold. The tribal system merely removes the extra step of currency exchange. Including the tribal system also is consistent with the standard definition of commercial as “engaged in or related to commerce”, and commerce as the “exchange or buying and selling of commodities.”⁹ The guidance is changed to apply tribal trading to all of the commercial resource categories.

Native American recreation resource use areas (such as canoeing for surface water and community gathering areas such as sweat lodges for ground water and pow wow grounds for the air pathway) are appropriate examples of major recreational areas and they are consistent with the guidance definitions of major or designated recreation area for ground water,¹⁰ surface water,¹¹ and air.¹² The guidance is amended to include these examples.

The guidance applicable to the surface water pathway includes a list of sources of information on possible surface water uses, and includes local chambers of commerce, state or regional parks and recreation departments and state water supply offices.¹³ We are amending the guidance to

⁵ Guidance Manual, p. A-27–29

⁶ Guidance Manual p. A-28

⁷ HRS sections 3.3.3, 4.1.2.3.3, 5.1.3.4, 6.3.3

⁸ Guidance Manual p. 193 for ground water, p. 289 for surface water, p. 371 for soil, and p. 421 for air

⁹ Webster’s Ninth New Collegiate Dictionary, 1985

¹⁰ Guidance Manual p. 193

¹¹ Guidance Manual p. 289

¹² Guidance Manual p. 421

¹³ Guidance Manual p. 290

add Native American officials as a source in determining resource uses. Finally, site assessors are reminded they should also use the checklist for resources,¹⁴ provided in the original guidance, in identifying potential Native American resources.

See guidance amendments in Appendix 2.

Native American Workers¹⁵

The HRS ground water migration pathway discusses how to evaluate the population factor. The population factor includes residents, students, and workers who regularly use the water, but excludes transient populations such as customers and travelers passing through the area. Similar population considerations of workers occur for the surface water and air pathways. The soil pathway has additional constraints; workers must be working on a property with observed contamination and in a workplace area within 200 feet of that contamination.

The HRS Guidance generally defines workers as permanent employees (part-time or full-time) of a facility or business.¹⁶ Clearly, Native American or other outdoor artisans or craft people can be considered workers in calculating the target population, provided they meet all other appropriate HRS target criteria. Although we might typically think of workers as located in office buildings or manufacturing facilities, this is not necessarily true of Native American or other outdoor artisan workers. Workers include those working outdoors, as well as indoors. Workplace areas (unique to the soil pathway) include areas outdoors, as well as indoors.¹⁷

The guidance is amended to include this change in all four pathways.

See guidance amendments in Appendix 3.

Native American Seasonal Populations¹⁸

As mentioned under workers above, the HRS specifies that “Population” for the ground water, surface water, and air pathways includes resident, worker, or student populations. The HRS Guidance clarifies this by saying workers and students can be part-time, and seasonal populations (such as at a resort area) are included.¹⁹ Clearly, a seasonal tribal camp or work area population could be considered a seasonal population.

The guidance is amended to add this tribal example in the surface water, ground water, and air pathways.

¹⁴ Guidance Manual Highlight 8-45

¹⁵ HRS sections 3.3.2, 4.1.2.3.2, 5.1.3, and 6.3.2

¹⁶ Guidance Manual p. 165 for ground water, p. 266 for surface water, p. 371 for soil, and p. 412 for air

¹⁷ Guidance Manual p. 371 for soil

¹⁸ HRS sections 3.3.2, 4.1.2.3.2, and 6.3.2

¹⁹ Guidance Manual p. 163-165 for ground water, p. 265-266 for surface water, and p. 412 for air

See guidance amendments in Appendix 4.

Attractiveness/Accessibility of Native American Recreational Use Areas²⁰

The HRS provides, for the soil pathway only, assigning a value for attractiveness/accessibility to areas of observed contamination. The HRS Guidance Manual²¹ adds examples, such as open fields where people play frisbee or non-maintained baseball fields, under the areas regularly used for public recreation.

Evaluations of the attractiveness/accessibility of an area of observed contamination for the soil exposure pathway should take into account Native American recreational areas, such as traditional hunting or community gathering areas such as camping or pow wow grounds. Pow wow grounds, regularly used in late summer and fall and containing bleachers and coverings for the performers, would fit under “designated recreational areas”,²² and the attached amendments add the pow wow grounds example to the guidance. The appropriate categories for other tribal recreational areas would depend on the specific usage of those areas. It is necessary to document why each assigned value was selected. As mentioned in other sections, tribal officials may be helpful in identifying such areas, which could be unique to the tribe.

See guidance amendments in Appendix 5.

Notice: This document provides guidance to EPA personnel regarding ways to consider Native American traditional lifeways when scoring sites under the HRS. This document does not create any legally binding requirements, but rather suggests an approach that may be used, as appropriate, given the site-specific circumstances. This document does not substitute for EPA’s statutes and regulations, and interested parties are free to raise questions and objections about the appropriateness of applying the approach presented in this guidance to a particular situation. EPA may change this guidance in the future.

²⁰ HRS section 5.2.1.1 and Table 5-6

²¹ Guidance Manual p. 390 and Highlight 9-21

²² Guidance Manual Highlight 9-21

Appendix 1

- (3) Determine which of the areas meet the definitions of a partially developed coastal barrier or an undeveloped coastal barrier (as specified in Section A.2):
- The entire coastal barrier is undeveloped if it contains (on average) fewer than one man-made structure per 5 acres of fastland area.
 - A portion of the coastal barrier is undeveloped if it has at least 1/4-mile of undeveloped shoreline on the shoreward side of the coastal barrier and the undeveloped area extends through the fastland from the beach to the associated landward aquatic habitat.
 - A coastal barrier is partially developed if it contains (on average) one or more manmade structures per 5 acres of fastland, but no more than 50 percent of the fastland area is covered by one or more man-made structures per 5 acres of fastland area. A coastal barrier that is more than 50 percent developed is not eligible for evaluation as a partially developed coastal barrier.
- (4) Evaluate each of the qualifying areas as an undeveloped or partially developed coastal barrier. If the same coastal barrier has portions that qualify as both undeveloped and partially developed, evaluate either the undeveloped or partially developed portions, but not both (i.e., do not score the same coastal barrier as both undeveloped and partially developed).

COASTAL BARRIER – UNDEVELOPED

See subsection above, Coastal Barrier — Partially Developed.

HABITAT KNOWN TO BE USED BY A FEDERAL DESIGNATED OR PROPOSED ENDANGERED OR THREATENED SPECIES

- (1) Determine whether any of the species (as defined in Section A.1) are known to be present in and using suitable habitat within the TDLS ~~(or areas of observed contamination)~~ for the site. Contact a representative of an appropriate Federal, state, county, or local agency (e.g., USFWS, NMFS, state fish and game department, ~~state Natural Heritage program~~) or a recognized expert to help determine if suitable habitat for any of the species exists within the TDLS or areas of contamination and if the habitat is currently occupied and used by the species. It may be difficult to obtain information beyond the known presence of a species within a given area, distance ring, or surface water body. If it is not possible to document the presence of one or more of the species within the TDLS (or areas of contamination), stop; otherwise, proceed to Step (2).
- (2) Document all habitat known to be used by each eligible species within the TDL. Appropriate documentation includes (but is not limited to):
- A written or documented oral statement from a representative of the appropriate Federal, state, or local agency (or from a recognized expert) that establishes the presence of the species within the TDLS or area of observed contamination; or
 - Any other evidence that documents the recent presence of the species in suitable habitat within the TDLS or areas of observed contamination (e.g., within a 5-year period prior to HRS package preparation).

Ensure that a habitat identified as used by a Federal designated or proposed endangered or threatened species (or a portion thereof) is not listed as a critical habitat for that species as defined in Section A.2. If an area is a critical habitat for a Federal designated species, the area qualifies as a separate sensitive environment for HRS scoring and should be evaluated for that species based solely on that classification.

A-27

Section A.3

...Federal, state, **tribal**, county, or local agency...

HABITAT KNOWN TO BE USED BY A SPECIES UNDER REVIEW AS TO ITS FEDERAL ENDANGERED OR THREATENED STATUS

See subsection above, Habitat Known to be Used by a Federal Designated or Proposed Endangered or Threatened Species.

HABITAT KNOWN TO BE USED BY A STATE DESIGNATED ENDANGERED OR THREATENED SPECIES

See subsection above, Habitat Known to be Used by a Federal Designated or Proposed Endangered or Threatened Species.

MIGRATORY PATHWAYS AND FEEDING AREAS CRITICAL FOR MAINTENANCE OF ANADROMOUS FISH SPECIES WITHIN RIVER REACHES OR AREAS IN LAKES OR COASTAL TIDAL WATERS IN WHICH THE FISH SPEND EXTENDED PERIODS OF TIME

- (1) Contact one or more of the following, provide them with the definitional criteria for these sensitive environment categories (i.e., as stated in HRS Table 4-23), and ask them to determine whether any surface water bodies within the TDLs meet one or all of the definitional criteria:
 - Representatives of agencies designated as CERCLA natural resource trustees (see **Highlight A-5**);
 - Representatives of state or local agencies that have statutory responsibility for or involvement in management of the area or types of species of concern (e.g., state fish and game departments), even if these agencies are not designated CERCLA natural resource trustees; and/or
 - Recognized experts familiar with the area or types of species of concern.
- (2) Request written documentation (on appropriate letterhead) that the area of concern is a critical spawning area and some information about the species and habitat(s) of concern (e.g., some explanation as to why the habitat is critical). The documentation should be legally defensible for CERCLA damage assessment purposes. Examples of suitable evidence are provided in **Highlights A-6** and **A-7**. If these individuals do not identify any qualifying areas, stop; otherwise, proceed to Step (3).
- (3) Evaluate each qualifying area identified as a critical spawning area, migratory pathway, or feeding area.

PARTICULAR AREAS, RELATIVELY SMALL IN SIZE, IMPORTANT TO MAINTENANCE OF UNIQUE BIOTIC COMMUNITIES

- (1) Contact representatives from State Natural Heritage Programs, state natural resources agencies, and recognized experts to determine if any unique, rare, or otherwise ecologically valuable biotic areas (e.g., old growth areas, pine barrens, bogs) are located within the TDLs (or areas of observed contamination) for the site. If there are no such areas within the TDLs of the site, stop; otherwise, proceed to Step (2).
- (2) Determine if each area in question meets the definitional criteria as specified in Section A.2. Four types of areas generally will meet the following definitional criteria for this sensitive environment (note that other areas that do not meet these criteria may be eligible):
 - Areas with a high proportion of species with highly restrictive habitat requirements due to unusual natural biotic and/or abiotic conditions;

Section A.3

A-28

...state or tribal natural resources agencies...

- Isolated areas that may or may not have an unusual community structure per se, but are particularly important to the continued existence of their biotic communities because of their geographic isolation;
- Areas with a high proportion of locally endemic species because of a relatively long period of geographic isolation and/or are exceptional examples of “climax” communities because of minimal human disturbance; or
- Areas that are vital to a species for maintenance of a community.

SPAWNING AREAS CRITICAL FOR THE MAINTENANCE OF FISH/SHELLFISH SPECIES WITHIN RIVER, LAKE, OR COASTAL TIDAL WATERS

See subsection above, Migratory Pathways and Feeding Areas Critical for Maintenance of Anadromous Fish Species Within River Reaches or Areas in Lakes or Coastal Tidal Waters in which the Fish spend Extended Periods of Time.

TERRESTRIAL AREAS USED FOR BREEDING BY LARGE OR DENSE AGGREGATIONS OF ANIMALS

- (1) Contact state fish and game officials, USFWS officials, or recognized experts to determine whether any ~~terrestrial species that normally breed in large or dense aggregations~~ have been observed or are expected to be present within the air and surface water pathway TDLs or areas of observed contamination of the site. If no such species have been observed or are expected to be present within the TDL or area of observed contamination, stop; otherwise, proceed to Step (2).
- (2) Determine if each area in question meets the definitional criteria specified in Section A.2 and if such breeding occurs within that area. Support documentation may include defining the breeding habitat requirements of the species of concern and demonstrating that the species typically nests or breeds in large colonies or dense aggregations. Additional pathway-specific criteria include:
 - In the surface water pathway, eligible areas are limited to terrestrial areas that are used for breeding by terrestrial vertebrate species with aquatic or semi-aquatic foraging habits (i.e., birds, mammals, or reptiles that consume fish or other aquatic organisms that inhabit or might inhabit the surface water bodies within the TDL). Such species generally correspond to those defined in Section A.2 as “terrestrial vertebrates with semi-aquatic habits”.
 - In the soil exposure pathway, eligible areas are limited to terrestrial areas that are at least partially in the area of observed contamination and are used for breeding by terrestrial vertebrate species.
 - In the air pathway, eligible areas are limited to terrestrial areas that are at least partially within the TDL and are used for breeding by terrestrial vertebrate species.

WETLANDS

- (1) Determine if there are any wetlands within the air or surface water pathway TDLs. As a starting point, use existing maps to delineate wetlands within the TDL. The preferred maps are the NWI Maps or state maps of equivalent quality. If these maps are not available, use USGS topographic maps or Soil Conservation Service (SCS) maps to initially screen wetlands locations.

...state or tribal fish and game officials...

SECTION 7.8 RESOURCES AND WELLHEAD PROTECTION AREA



This section provides guidance on scoring the resources and wellhead protection area (WPA) factors for the targets factor category of the ground water pathway. The resources factor (HRS section 3.3.3) evaluates the possible loss of ground water use value resulting from site-related contamination. It does not evaluate threats to human health that are considered in the nearest well and population factors. The wellhead protection area factor (HRS section 3.3.4) evaluates the possibility that a source or observed release lies in or near an area that a state has designated for protection under the SDWA.

RELEVANT HRS SECTIONS

Section 3.3.3	Resources
Section 3.3.4	Wellhead protection area

DEFINITIONS

Commercial Aquaculture: Cultivation of fish or shellfish to be sold for widespread distribution. Examples include a rearing pond used to raise catfish or a pond for nonfood crops such as goldfish and tropical fish.

Commercial Food Crops: Crops that are intended to be sold widely, such as in supermarkets, and locally, such as those sold at local produce stands. Crops grown for domestic consumption or for use in a single restaurant are not considered commercial food crops.

Commercial Forage Crops: Crops grown to be sold as food for livestock (it is not necessary to document that these crops were sold only for commercial livestock), and grasslands used for grazing by commercial livestock (including areas technically defined as "pasture/rangeland" by the USDA).

Ingredient In Commercial Food Preparation: Ground water used for wholesale food preparation (e.g., a manufacturer that prepares food products to be sold in supermarkets or produce stands). Food prepared in restaurants is not included in this category.

Major or Designated Water Recreation Area: A major water recreation area is an area used by a large number of people for recreational purposes (e.g., a water theme park). A designated water recreation area is an area designated and maintained by a government body (e.g., local, state, or Federal) as an area for public recreation (e.g., municipal swimming pool).

Commercial Aquaculture:

...sold **or traded** for widespread distribution...

193

Section 7.8

Commercial Food Crops: Crops that

are intended to be sold **or traded** widely, such as in supermarkets, and locally, such as those sold at local produce stands **or traded within a Native community**...

Commercial Forage Crops:

...sold **or traded** as food for livestock...

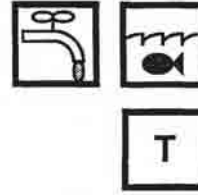
Ingredient in Commercial Food Preparation:

...sold **or traded** in supermarkets, produce stands, **or traded within a Native community**..

Major or Designated Water Recreation Area: ...for recreational

purposes (e.g., a water theme park **or sweat lodge**). ...by a government body (e.g. local, state, **tribe**, or Federal)...

SECTION 8.11 RESOURCES



This section provides guidance on scoring the resources factor for the targets factor category of the surface water drinking water threat. The resources factor evaluates the possible loss of surface water use resulting from site-related contamination of the surface water. The resources factor does not evaluate threats to human health, which are considered in the nearest intake and population factors, and in the human food chain threat. Unlike the ground water resources factor, the surface water resources factor does not address commercial aquaculture, which is evaluated in the human food chain threat. HRS section 4.1.2.3.3 discusses the resources factor.

DEFINITIONS

Commercial Food Crops: Crops that are intended to be sold widely, such as in supermarkets, and locally, such as those sold at local produce stands. Crops grown for domestic consumption or for use in a single restaurant are not considered commercial food crops.

Commercial Forage Crops: Crops grown to be sold as food for livestock (it is not necessary to document that these crops were sold only for commercial livestock), and grasslands used for grazing by commercial livestock (including areas technically defined as "pasture/rangeland" by the USDA).

Commercial Livestock: Livestock raised for sale to commercial wholesalers or supermarkets. Livestock raised for private or domestic use is not considered commercial livestock.

Designated for Drinking Water Use: Section 305(a) of the Clean Water Act requires states to prepare a water quality inventory that designates and classifies certain waters for drinking water use. The water can have such a classification even if it is not currently used for or is not currently suitable to be used for drinking water.

Ingredient in Commercial Food Preparation: Surface water used for wholesale food preparation (e.g., a manufacturer that prepares food products to be sold in supermarkets or produce stands). Food prepared in restaurants is not included in this category.

Major or Designated Water Recreation Area: A major water recreation area is an area used by a large number of people for recreational purposes (e.g., swimming or fishing). A designated water recreation area is an area designated and maintained by a government body (e.g. local, state, or Federal) as an area for public recreation.

SCORING THE RESOURCES FACTOR

- (1) Use the checklist in *Highlight 8 45* to determine if any surf h assigned resource points apply to the h ed. Do not use standby intakes to evaluate the resources factor.

289

Section 8.11

Commercial Food Crops: Crops that are intended to be sold **or traded** widely, ...and locally, such as those sold at local produce stands **or traded within a Native community**....

Commercial Forage Crops:
...sold **or traded** as food for livestock...

Commercial Livestock:
...raised for sale **or trade**...

Ingredient in Commercial Food Preparation:
...sold **or traded** in supermarkets, produce stands, **or traded within a Native community**...

Major or Designated Water Recreation Area:
...for recreational purposes (e.g., swimming, **or** fishing, **or canoeing**). ...by a government body (e.g. local, state, **tribe**, or Federal)...

SECTION 9.5 WORKERS AND RESOURCES



This section provides guidance for evaluating workers and scoring the resources factor for the targets factor category in the resident population threat of the soil exposure pathway. The workers factor is used to score the targets factor category of the resident population threat. The scorer must consider the number of workers who frequent workplace areas on or near the area of observed contamination. The resources factor evaluates the possible loss of resource use resulting from surficial contamination at a site. The factor evaluates the presence of commercial agriculture, commercial silviculture, commercial livestock production, and commercial livestock grazing; it does not evaluate threats to human health or sensitive environments.

RELEVANT HRS SECTION

Section 5.1.3	Targets
Section 5.1.3.3	Workers
Section 5.1.3.4	Resources
Section 5.1.3.6	Calculation of resident population targets factor category value

DEFINITIONS

Commercial Agriculture: Production of crops for sale, including crops intended for widespread distribution (e.g., supermarkets) and more limited distribution (e.g., local produce stands), and any nonfood crops such as cotton and tobacco. Commercial agriculture does not include livestock production, livestock grazing, or crops grown for household consumption (e.g., backyard garden or fruit trees).

Commercial Livestock Production or Commercial Livestock Grazing: Raising or feeding of livestock for sale.

Commercial Silviculture: Cultivation of trees for sale (e.g., Christmas tree farm, trees raised for lumber).

Worker: A person working on a property with an area of observed contamination and whose workplace area is on or within 200 feet of an area of observed contamination. Both full and part-time workers are considered.

Workplace Area: Any area where workers are regularly present. Areas receiving only brief but regular use (e.g., parking areas, lunch areas) may qualify as work areas.

371

Section 9.5

Commercial Agriculture: ...crops for sale **or trade**...(e.g., local produce stands **or traded within a Native community**),...

Commercial Silviculture:
...for sale **or trade**...

Commercial Livestock Production or Commercial Livestock Grazing: ...for sale **or trade**...

SECTION 10.4 RESOURCES



This section provides guidance for scoring the resources factor in the air pathway. The resources factor evaluates potential damage to recreation areas, commercial agriculture, and commercial silviculture due to site-related atmospheric contaminants. It does not evaluate threats to human health or sensitive environments.

RELEVANT HRS SECTIONS

Section 6.3	Targets
Section 6.3.3	Resources

DEFINITIONS

Commercial Agriculture: Production of crops for sale, including crops intended for widespread distribution (e.g., supermarkets) and more limited distribution (e.g., local produce stands), and any nonfood crops such as cotton and tobacco. Commercial agriculture does not include livestock production, livestock grazing, or crops grown for household consumption (e.g., backyard garden or fruit trees).

Commercial Silviculture: Cultivation of trees for sale (e.g., Christmas tree farm, trees raised for lumber).

Major or Designated Recreation Area: A major recreation area is an area used by a large number of people for recreational purposes (e.g., swimming or baseball). A designated recreation area is an area designated and maintained by a government body (e.g. local, state, Federal) as an area for public recreation.

SCORING THE RESOURCES FACTOR

- (1) **Using the checklist in *Highlight 10-11*, determine if there are any commercial agricultural or silvicultural areas, or major or designated recreation areas within 1/2 mile of a source at the site.** Use the above definitions in making this determination. *Highlight 10-12* lists examples of data sources for the resources factor.
- (2) **If any of these areas are present within 1/2 mile of a source with an air migration containment factor value greater than 0, assign a resource factor value of 5.** If none of these areas is present within 1/2 mile of a source, or if the source has an air migration containment factor of 0, assign a resource factor value of 0.

421

Section 10.4

Commercial Agriculture: ...crops for sale or trade...(e.g., local produce stands or traded within a Native community),...

Commercial Silviculture:
...for sale or trade...

Major or Designated Recreation Area:
...for recreational purposes (e.g., swimming, or baseball or Native American pow wows).
...by a government body (e.g. local, state, tribe, or Federal)...

The following sources of information on possible surface water uses will help in documenting resource use for a watershed:

- USGS topographic maps and land use data
- USDA county crop records and irrigated acreage data
- Field observations
- Interviews with water company officials
- Public utility trade association online services (e.g., American Water Works Association's WaterNet data base)
- Existing PA/SI reports for the site or nearby sites.
- Correspondence with nearby businesses
- Correspondence with other nearby institutions, such as farms or universities
- EPA's FRDS
- Agricultural extension agents
- Local chambers of commerce
- Federal, state, or regional parks and recreation departments
- State public water supply offices (usually found in state departments of health or environment)
- State water classification and designation maps
- **Native American officials**

(2) **If a resource use is documented, assign a value of 5 to the resources factor for the watershed; otherwise, assign a value of 0.**

**HIGHLIGHT 8-45
CHECKLIST FOR THE RESOURCES FACTOR**

For the watershed being evaluated:

(1)	Is surface water used to irrigate five or more acres of commercial food crops or commercial forage crops?	Yes	No
(2)	Is surface water used to water commercial livestock?	Yes	No
(3)	Is surface water used as an ingredient in commercial food preparation?	Yes	No
(4)	Is surface water used as, or used to supply, a major or designated water recreation area, excluding drinking water use?	Yes	No
(5)	If surface water is not used for drinking water within the TDL, is any portion of the surface water designated by the state for drinking water use under Section 305(a) of the Clean Water Act, as amended, or is any portion usable for drinking purposes?	Yes	No

If the answer to any of the above questions is "yes", assign a resources factor value of 5. If the answer to all questions is "no", assign a resources factor value of 0.

Appendix 3

- Include any drinking water well with an observed release attributed to the site, regardless of its distance from the source.
- Exclude wells completed in portions of an aquifer that are beyond an aquifer discontinuity (see Section 7.1).

Target Wells for Aquifer Being Evaluated: Wells that are located within the TDL, and drawing water from the aquifer being evaluated or an overlying aquifer through which hazardous substances would migrate.

Workers: Permanent employees (part-time or full-time) of a facility or business that is served by a well located within the TDL.

EVALUATING THE GROUND WATER POPULATION FACTOR

The steps below describe an approach to estimating the population served by target wells for the aquifer being evaluated. First, contact water authorities that have wells within the TDL to determine or estimate the population served by municipal water systems. (See **Highlight 7-32** for data needs that the water authority may be able to fulfill.) If the water authority provides an estimate of the population served by the system, use that number for your ground water target calculations. The water authority should know if the population served includes workers and/or students in addition to residents. If the population estimate does not include workers and/or students, it may be possible to modify the following methodology. The assumptions used should be clearly presented in the documentation record.

If the water authority provides just the total number of connections, then estimate the population served by multiplying the number of connections by the county average number of persons per household. After making an initial estimate of residential population served, estimate any student and worker populations served by the municipal system, and adjust the total. Next, evaluate residential populations served by private wells within the TDL. At each stage, evaluate whether documenting additional population will be important to the site score.

Depending on site circumstances, the scorer may conduct these steps in a different order. For example, if many people within the TDL use private wells or if private wells are subject to actual contamination, it may be more efficient to consider residential populations served by private wells before considering student or worker populations served by municipal connections.

- (1) **Draw target distance categories.** Draw concentric rings with radii 1/4, 1/2, 1, 2, 3, and 4 miles on a topographic map from the edges of the source. If there is an aquifer discontinuity, exclude any areas beyond the discontinuity. Remember that any well with a documented observed release attributable to the site is evaluated regardless of its distance from sources.
- (2) **Identify all municipal systems with target wells for the aquifer being evaluated.** Repeat Steps (3) through (5) for each system if more than one municipal system has wells within the TDL. If no municipal system has a well within the TDL, proceed to Step (7).
- (3) **Identify all system water supply units in the aquifer being evaluated or an overlying aquifer.** These units may include drinking water wells and standby wells. If the municipal system is a blended system, identify all wells inside and outside the TDL. Also identify all surface water intakes and standby intakes contributing to a blended system.
- (4) **Evaluate the population served by the municipal water system, assuming all service connections are residential.** Because connections to schools or businesses generally serve more individuals than those in a typical household, this assumption may result in a lower estimate of the target population. If this assumption yields a high score, however, time consuming inquiries to document student or worker populations may be avoided.

Workers: ... 'Workers' include those working outdoors, as well as indoors.

Workers: ... 'Workers' include those working outdoors, as well as indoors.

Workers: Permanent employees (part-time or full-time) of a facility or business that is served by an intake within the TDL.

EVALUATING THE DRINKING WATER POPULATION FACTOR

The steps below describe an approach for estimating the population served by surface water intakes located within the TDL. First, estimate the population served by municipal water systems with intakes within the TDL. Contact municipal water authorities to obtain estimates of populations served. The water authority should know whether the population served includes workers and students in addition to residents. If the population estimate does not include workers and/or students, modify the methodology presented below as necessary. **Highlight 8-33** summarizes the information needed to obtain drinking water population estimates.

HIGHLIGHT 8-33 DATA NEEDS FOR DRINKING WATER THREAT POPULATION

Obtain from Local, Municipal, or Other Water Authorities:

- Identification of all municipal surface water intakes located within the TDLs for surface water bodies in the watershed being evaluated;
- Number of persons served or service connections for each intake that is not part of a blended system; and
- For intakes that are part of a blended system:
 - Total population served or number of service connections;
 - Total number of wells and intakes in the system (including those outside the TDL);
 - Whether any wells or intakes are standby;
 - Whether any well or intakes provides more than 40 percent of the system's water; and
 - Average annual pumpage or capacity for each intake and well (only needed if one intake or well provides more than 40 percent of the system's water).

Obtain from Local, Municipal, or Other Water Authorities, or Local Health Agencies:

- Identification of private intakes located within the TDL; and
- Identification of schools and large businesses possibly served by intakes located within the TDL.

Obtain from U.S. Bureau of Census Reports (or more recent source if appropriate):

- Average number of persons per residence for each county served by a system with intake located within the TDL.

Obtain from Business and Schools:

- Information on how they obtain water; and
- Number of workers and/or students.

SECTION 9.5 WORKERS AND RESOURCES



This section provides guidance for evaluating workers and scoring the resources factor for the targets factor category in the resident population threat of the soil exposure pathway. The workers factor is used to score the targets factor category of the resident population threat. The scorer must consider the number of workers who frequent workplace areas on or near the area of observed contamination. The resources factor evaluates the possible loss of resource use resulting from surficial contamination at a site. The factor evaluates the presence of commercial agriculture, commercial silviculture, commercial livestock production, and commercial livestock grazing; it does not evaluate threats to human health or sensitive environments.

RELEVANT HRS SECTION

Section 5.1.3	Targets
Section 5.1.3.3	Workers
Section 5.1.3.4	Resources
Section 5.1.3.6	Calculation of resident population targets factor category value

DEFINITIONS

Commercial Agriculture: Production of crops for sale, including crops intended for widespread distribution (e.g., supermarkets) and more limited distribution (e.g., local produce stands), and any nonfood crops such as cotton and tobacco. Commercial agriculture does not include livestock production, livestock grazing, or crops grown for household consumption (e.g., backyard garden or fruit trees).

Commercial Livestock Production or Commercial Livestock Grazing: Raising or feeding of livestock for sale.

Commercial Silviculture: Cultivation of trees for sale (e.g., Christmas tree farm, trees raised for lumber).

Worker: A person working on a property with an area of observed contamination and whose workplace area is on or within 200 feet of an area of observed contamination. Both full and part-time workers are considered.

Workplace Area: Any area where workers are regularly present. Areas receiving only brief but regular use (e.g., parking areas, lunch areas) may qualify as work areas.

Worker: ... 'Workers' include those working outdoors, as well as indoors.

Workplace Area: ... 'Workplace areas' include those outdoors, as well as indoors.

Nearest Individual: Factor evaluated based on the presence of actual contamination or, for potential contamination, the shortest distance from any source at the site to any residence or regularly occupied building or area.

Population for the Air Migration Pathway: Number of residents, students, and workers regularly present within the TDL. This population does not include transient populations, such as hotel and restaurant patrons, but may include seasonal populations (e.g., a resort area).

Students: Full- or part-time attendees of an educational institution or day care facility located within the TDL.

Target Distance Limit for the Air Migration Pathway: Distance over which population and other targets are evaluated. The TDL generally is a 4-mile radius from the sources at the site. However, if a sampling point meeting the criteria for an observed release is located beyond the 4-mile radius, that point defines the outer boundary of the TDL. For example, if an observed release is established 6 miles from the source, the TDL is 6 miles.

Workers: Permanent employees (part-time or full-time) of a facility or business that is located within the TDL.

DETERMINING LEVEL OF ACTUAL CONTAMINATION

In order to evaluate level of actual contamination, an observed release should first be established (see Section 10.1 for establishing observed releases in the air pathway). If an observed release to air is established in or beyond a distance category, actual contamination is also established for that distance category and the level of contamination for the observed release location needs to be determined. The steps below explain how to determine if a location is evaluated as Level I or Level II.

- (1) **Determine whether an observed release can be established for any hazardous substance detected in air samples or based on direct observation.** See Section 10.1 for information on establishing an observed release.
 - If an observed release is established only by direct observation, Level I cannot be established and all locations for the direction observation are Level II. Continue with the guidance in the next subsection, Evaluating Sites with Actual Contamination.
 - If an observed release is established based on chemical analysis, continue to Step (2).
 - If no observed release can be established, evaluate the entire population within the 4-mile TDL for potential contamination.
- (2) **For each sample location, compare the concentration of each hazardous substance that meets the observed release criteria to its applicable benchmark(s).** When comparing sampling results to benchmarks, concentrations from longer collection times may be compared to shorter time-frame benchmarks, but concentrations from shorter collection times may not be compared to longer time-frame benchmarks. Sample concentrations tend to decrease as sampling time increases (e.g., 8-hour concentrations generally are lower than 3-hour concentrations). Applicable benchmarks (available in SCDM) for hazardous substances include:
 - NAAQS;
 - NESHAPs;
 - Screening concentrations for cancer, which correspond to the 10^{-6} individual cancer risk for inhalation exposure; and

Workers: ... 'Workers' include those working outdoors, as well as indoors.

SECTION 7.5 POPULATION AND NEAREST WELL FACTORS



The population factor in the ground water pathway evaluates the number of residents, students, and workers served by ground water wells (in the aquifer being evaluated and appropriate overlying aquifers) located within the TDL. The nearest well factor evaluates the threat to the maximally exposed individual and takes into account whether that individual is subject to actual or potential contamination. This section explains how to estimate the population (i.e., residents, students, and workers) that regularly uses ground water from wells within the TDL, how to score the ground water population factor, and how to score the nearest well factor.

The ground water population includes the people served by wells located within the TDL, not the residents living within the TDL (see **Highlight 7-31**). People living within the TDL may obtain drinking water from wells outside the TDL or from surface water sources, and people living outside the TDL may obtain drinking water from wells located within the TDL.

RELEVANT HRS SECTIONS

Section 3.0.1	General considerations
Section 3.0.1.1	Target distance limit
Section 3.3.1	Nearest well
Section 3.3.2	Population

DEFINITIONS

Nearest Well Factor: Factor for evaluating the maximally exposed well. This factor is based on the presence of actual contamination or, for aquifers where no drinking water well is subject to actual contamination, the presence of karst and distance to nearest drinking water well.

Population for the Ground Water Pathway: Number of residents, students, and workers regularly served by wells that are located within the TDL for the aquifer being evaluated (and appropriate overlying aquifers). This population does not include transient populations, such as hotel and restaurant patrons, but may include seasonal populations (e.g., a resort area).

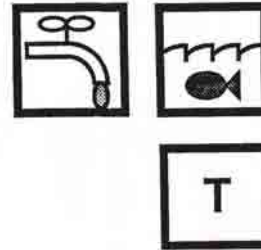
Students: Full- or part-time attendees of an educational institution or day care that is served by a well located within the TDL.

Target Distance Categories: Concentric rings (not necessarily circular) with radii 1/4, 1/2, 1, 2, 3, and 4 miles from the sources at the site. These distance categories are used to group the wells subject to potential contamination for distance weighting.

Target Distance Limit for the Ground Water Migration Pathway: The distance over which targets are evaluated. The TDL is generally a 4-mile radius from sources at the site, except:

Population for the Ground Water Pathway: ... but may include seasonal populations (e.g., a resort area **or seasonal tribal camp or work area population**).

SECTION 8.8 POPULATION AND NEAREST INTAKE FACTORS



The population factor in the drinking water threat evaluates the number of residents, students, and workers regularly served by surface water intakes within the TDL for the watershed being evaluated. This evaluation is essentially the same as that for the ground water pathway, except that surface water intakes are considered instead of drinking water wells. This section also briefly discusses the nearest intake factor.

RELEVANT HRS SECTIONS

Section 4.1.1.2	Target distance limit
Section 4.1.2.3.1	Nearest intake
Section 4.1.2.3.2	Population

DEFINITIONS

Dilution Weight: A unitless parameter that adjusts the assigned point value for certain targets subject to potential contamination as a function of the flow or depth of the water body at the target.

Nearest Intake Factor: Factor for evaluating the maximally exposed intake. This factor is based on the presence of actual contamination or, for watersheds where no intake is subject to actual contamination, the flow or depth of the water body at the intake nearest to the PPE within the TDL.

Population for the Drinking Water Threat: Number of residents, students, and workers regularly served by surface water intakes that are located within the TDL for the surface water bodies evaluated for a given watershed. This population does not include transient populations, such as hotel and restaurant patrons, but may include seasonal populations (e.g., a resort area).

Students: Full- or part-time attendees of an educational institution or day care facility that is served by an intake located within the TDL.

Target Distance Limit (TDIL) for the Surface Water Migration Pathway: Distance over which the in-water segment of the hazardous substance migration path is evaluated. The TDIL extends 15 miles from the PPE in the direction of flow (or radially in lakes, oceans, or coastal tidal waters) or to the most distant sample point establishing an observed release, whichever is greater. In tidally influenced surface water bodies, an upstream TDIL is also determined. For some sites (e.g., sites with multiple PPEs), an overall target distance of greater than 15 miles may result.

Population for the Drinking Water Threat: ... but may include seasonal populations (e.g., a resort area or seasonal tribal camp or work area population).

Population for the Air Migration Pathway: ... but may include seasonal populations (e.g., a resort area or seasonal tribal camp or work area population).

Nearest Individual: Factor evaluated based on the presence of actual contamination or, for potential contamination, the shortest distance from any source at the site to any residence or regularly occupied building or area.

Population for the Air Migration Pathway: Number of residents, students, and workers regularly present within the TDL. This population does not include transient populations, such as hotel and restaurant patrons, but may include seasonal populations (e.g., a resort area).

Students: Full- or part-time attendees of an educational institution or day care facility located within the TDL.

Target Distance Limit for the Air Migration Pathway: Distance over which population and other targets are evaluated. The TDL generally is a 4-mile radius from the sources at the site. However, if a sampling point meeting the criteria for an observed release is located beyond the 4-mile radius, that point defines the outer boundary of the TDL. For example, if an observed release is established 6 miles from the source, the TDL is 6 miles.

Workers: Permanent employees (part-time or full-time) of a facility or business that is located within the TDL.

DETERMINING LEVEL OF ACTUAL CONTAMINATION

In order to evaluate level of actual contamination, an observed release should first be established (see Section 10.1 for establishing observed releases in the air pathway). If an observed release to air is established in or beyond a distance category, actual contamination is also established for that distance category and the level of contamination for the observed release location needs to be determined. The steps below explain how to determine if a location is evaluated as Level I or Level II.

- (1) **Determine whether an observed release can be established for any hazardous substance detected in air samples or based on direct observation.** See Section 10.1 for information on establishing an observed release.
 - If an observed release is established only by direct observation, Level I cannot be established and all locations for the direction observation are Level II. Continue with the guidance in the next subsection, Evaluating Sites with Actual Contamination.
 - If an observed release is established based on chemical analysis, continue to Step (2).
 - If no observed release can be established, evaluate the entire population within the 4-mile TDL for potential contamination.
- (2) **For each sample location, compare the concentration of each hazardous substance that meets the observed release criteria to its applicable benchmark(s).** When comparing sampling results to benchmarks, concentrations from longer collection times may be compared to shorter time-frame benchmarks, but concentrations from shorter collection times may not be compared to longer time-frame benchmarks. Sample concentrations tend to decrease as sampling time increases (e.g., 8-hour concentrations generally are lower than 3-hour concentrations). Applicable benchmarks (available in SCDM) for hazardous substances include:
 - NAAQS;
 - NESHAPs;
 - Screening concentrations for cancer, which correspond to the 10^{-6} individual cancer risk for inhalation exposure; and

Appendix 5

SCORING THE LIKELIHOOD OF EXPOSURE FACTOR CATEGORY

To score the likelihood of exposure factor category for the nearby population threat, determine the attractiveness/accessibility factor value and the area of contamination factor value for the areas of observed contamination as follows.

- (1) **Assign the attractiveness/accessibility factor value.** Assign each area of observed contamination a value for attractiveness/accessibility, excluding any area of observed contamination on a residential property. If an area falls into two or more categories, use the higher score. Select the highest value assigned to the areas evaluated and use it as the attractiveness/accessibility factor value for the site. If the attractiveness/accessibility factor value for a site is 0, the nearby population threat score will be 0.

Highlight 9-21, which is based on HRS Table 5-6, provides attractiveness/accessibility factor values along with examples of the types of areas that would receive a given value. Public recreation use can be activities such as walking, sports, fishing, air shows, and hayrides, and can occur on public or private lands. The examples presented in **Highlight 9-21** are not exhaustive. Select the best-fitting category and document why it was selected.

- (2) **Determine the area of contamination factor value.** The area of contamination factor value is based on the total area of all areas of observed contamination at the site with an attractiveness/accessibility factor value greater than 0. To determine the area of contamination factor value:

- Identify all areas of observed contamination with an attractiveness/accessibility value greater than 0.
- Determine their total area.
- Assign the approximate area of contamination factor value using HRS Table 5-7.

Section 9.1 provides instruction on identifying areas of observed contamination.

- (3) **Determine the likelihood of exposure factor category value.** The likelihood of exposure factor category value is based on the values assigned to the attractiveness/accessibility and area of contamination factors. Use HRS Table 5-8 to assign this value. The maximum value is 500.

SCORING WASTE CHARACTERISTICS FACTOR CATEGORY

The waste characteristics factor category for the nearby population threat is scored as it is scored for the resident population threat, except that the nearby threat considers only those areas of observed contamination that have an attractiveness/accessibility factor value greater than 0. The waste characteristic factor category value for the nearby population threat, therefore, will be equal to or less than that for the resident population threat. Section 9.2 provides guidance on scoring the waste characteristics factor.

SCORING TARGETS FACTOR CATEGORY

The targets factor category value for the nearby population threat is based on two factors: nearby individual and population within a one-mile travel distance from the site. Sum these two factor values for the targets factor category value.

Highlight 9-21, ... Public recreation use can be activities such as ...,
Native American pow wows, ...

HIGHLIGHT 9-21
EXAMPLES OF ATTRACTIVENESS/ACCESSIBILITY VALUES

Area of Observed Contamination	Assigned Value
Designated recreational areas Includes areas designed specifically to encourage recreational use. <ul style="list-style-type: none"> • Playground • Golf course (public or private) • Baseball field with backstop and maintained basepaths or infield • Areas with Improvements aimed at enabling people to view scenic attractions 	100
Areas regularly used for public recreation Includes areas used regularly for public recreation but not designated for such use. <ul style="list-style-type: none"> • Open fields where people play frisbee • Fields where people play baseball (provided that they are not maintained for such use) 	75
Accessible and unique recreational areas <ul style="list-style-type: none"> • Vacant lot in an urban area • Shoreline of stream in an urban area 	75
Moderately accessible areas with some public recreation use Includes areas used for recreation with some improvements that increase accessibility even if these improvements are not made specifically for the areas In question. <ul style="list-style-type: none"> • Undeveloped land along corridors to a recreational area where there are not thousands of acres of similarly undeveloped land (e.g., areas adjacent to a road or trail leading to a public lake or river) • Shoreline of public lakes or rivers that can be reached via moderately improved roads (e.g., gravel or dirt) 	50
Slightly accessible areas with some public recreation use Includes areas used for public recreation but with few improvements that increase accessibility to the areas. It can also include areas that have nothing unique about them relative to their surroundings. <ul style="list-style-type: none"> • Shorelines of relatively remote public lakes (e.g., lakes that cannot be reached by automobile) • Undeveloped land along corridors to a recreational area where there are thousands of other acres of similarly undeveloped land along the corridor 	25
Accessible areas with no public recreation use <ul style="list-style-type: none"> • Unfenced industrial or commercial site (guarded or not) with no vacant lots, sand piles, or other recreational attractions • Abandoned lagoons or other surface impoundments in an industrial area 	10
Areas surrounded by maintained fence or combination of maintained fence and natural barriers <ul style="list-style-type: none"> • Fenced, unguarded industrial or commercial sites 	5
Areas physically inaccessible to public, with no evidence of public recreation use Includes areas where (1) steps have been taken to absolutely preclude public access to the areas or (2) natural conditions make access physically impossible. <ul style="list-style-type: none"> • Area off-limits to unauthorized personnel at guarded and fenced military base or industrial complexes. 	0

Designated recreational areas...

- Community gathering areas, such as Native American pow wow grounds