FOURTH FIVE-YEAR REVIEW REPORT FOR KETCHIKAN PULP COMPANY SITE KETCHIKAN GATEWAY BOROUGH, ALASKA

SEPTEMBER 2020

Prepared by

U.S. Environmental Protection Agency
Region 10
Seattle, WA

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Calvin Terada, Director
Office of Environmental Cleanup

Date

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LIST OF ABBREVIATIONS & ACRONYMS

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ADNR	Alaska Department of Natural Resources
AMHS	Alaska Marine Highway System
AOC	Area of Concern
APDES	Alaska Pollutant Discharge Elimination System
ARAR	Applicable or Relevant and Appropriate Requirement
ASAOC	Administrative Settlement Agreement and Order on Consent
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CD	Consent Decree
COC	Contaminant of Concern
CoPC	Contaminant of Potential Concern
DOT&PF	Department of Transportation and Public Facilities
DRO	Diesel-Range Organics
ENR	Enhanced Natural Recovery
EPA	United States Environmental Protection Agency
FYR	Five-Year Review
HI	Hazard Index
HQ	Hazard Quotient
IC	Institutional Control
KGB	Ketchikan Gateway Borough
KPC	Ketchikan Pulp Company
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
NCP	National Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
OU	Operable Unit
PCB	Polychlorinated Biphenyl
PCDD/F	Polychlorinated Dibenzodioxins/ Polychlorinated Dibenzofurans
PAH	Polycyclic Aromatic Hydrocarbon
PRP	Potentially Responsible Party
PSSA	Power Systems & Supplies of Alaska LLC
RAO	Remedial Action Objective
RCRA	Resource Conservation & Recovery Act
ROD	Record of Decision
ROV	Remotely Operated Vehicle
RPM	Remedial Project Manager
RRO	Residual-Range Organics
RSL	Regional Screening Level
SVOC	Semi-Volatile Organic Compound
TCDD	Tetrachlorodibenzodioxin
TPH	Total Petroleum Hydrocarbon
TSCA	Toxic Substances Control Act
UU/UE	Unlimited Use and Unrestricted Exposure

I. INTRODUCTION

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) is preparing this FYR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP) (40 Code of Federal Regulations (CFR) Section 300.430(f)(4)(ii)), and considering EPA policy.

This is the fourth FYR for the Ketchikan Pulp Company site (the Site). The triggering action for this statutory review is the completion date of the previous FYR. The FYR has been prepared because hazardous substances, pollutants or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

The Site consists of two operable units (OUs). This FYR addresses both OUs. The uplands OU (OU1) covers an 85-acre area where the former pulp mill operated as well as the wood waste and ash disposal landfill. The 250-acre marine OU (OU2) includes the northern half of Ward Cove and other marine areas where there has been a migration of hazardous substances from the cove or the uplands OU.

EPA remedial project manager (RPM) Kathy Cerise led the FYR. Participants included Sally Schlichting and Evonne Reese from Alaska Department of Environmental Conservation (ADEC) and Treat Suomi and Kelly MacDonald from EPA support contractor Skeo. Ketchikan Pulp Company (KPC) (the potentially responsible party [PRP]), Alaska Marine Highway System (AMHS) and Power Systems & Supplies of Alaska LLC (PSSA) (current landowners) were notified of the initiation of the FYR. The review began on 6/18/2019.

Site Background

The Site is located on the shoreline of Ward Cove, about 5 miles north of Ketchikan, Alaska (Figure 1). KPC began operating a dissolving sulfite pulp mill in 1954 and discharged pulp mill effluent to Ward Cove until March 1997, when pulping operations ended. In November 1999, the KPC upland mill property (excluding the landfill and the pipeline and dam parcels) and tidelands in Ward Cove were sold from KPC to Gateway Forest Products, Inc. (Gateway). For a short time, Gateway operated a sawmill and veneer mill, producing lumber and veneer, chips for pulp, and hog fuel as a byproduct. Gateway initiated bankruptcy proceedings in 2001, and they no longer own or operate any property on the Site. PSSA, the current owner of the former mill upland property and adjacent tidelands, purchased the Site in April 2011. The other current landowner, Alaska Department of Transportation and Public Facilities (DOT&PF), took title to a parcel of real property that includes some of the submerged tidelands of the Marine OU in 2010. In 2019, there was a lot line adjustment between PSSA and DOT&PF. See Figure 2 for current site parcels and ownership.

Located on the north shoreline of Ward Cove, the uplands OU covers about 85 acres encompassing the pulp mill area, a wood waste and ash disposal landfill, a dredge spoil subarea, a former storage area along the water pipeline access road, and other land-based areas that may have been affected by mill operations. The pipeline previously provided water to the mill from Connell Lake; the pipeline access road area is now used as a recreational trail. The uplands OU currently includes the landfill, vacant former mill buildings and foundations, an active commercial building with multiple tenants, an AMHS Marine Engineering Facility, and forested areas. PSSA plans to further redevelop the former pulp mill property, shoreline, and parts of Ward Cove into a cruise ship dock with associated tourism facilities. See Figures 3 and D-1 in Appendix D for a draft map of the cruise dock location. Recently, PSSA completed construction of the cruise dock in Ward Cove over the marine OU. The area surrounding the former pulp mill is largely forested with pockets of industrial, commercial and residential

properties clustered along North Tongass Highway. Some properties are used for recreational purposes. The marine OU consists of about 250 acres in Ward Cove. Eighty acres of the marine OU have been designated as an Area of Concern (AOC) due to potential toxicity to benthic organisms from sediment affected by historical releases from the mill.

Pulp mill operations contaminated uplands soil, which was a source of contamination to the offshore marine environment. The release into Ward Cove of large quantities of organic material byproducts from wood-pulping activities at the mill changed the physical structure of the sediments in the cove. Degradation of the organic-rich pulping byproduct led to anaerobic conditions in the sediment and production of ammonia, sulfide and 4-methylphenol in quantities that are potentially toxic to benthic organisms.

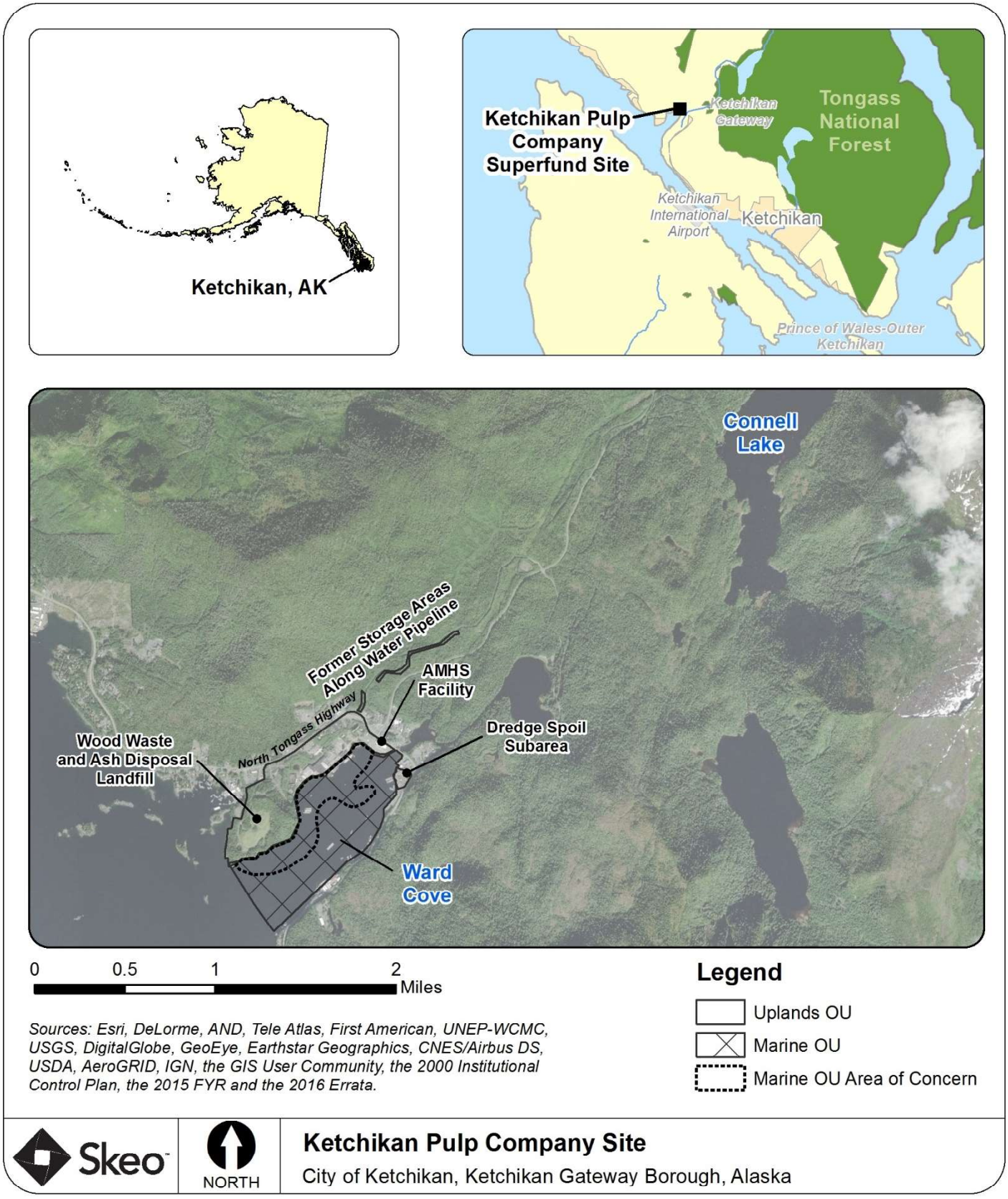
Groundwater in the uplands OU is considered Class III groundwater and, thus, non-potable. According to ADEC, the shallow aquifer and potential deeper aquifer are not considered reasonably expected future sources of drinking water. The groundwater is a mixture of rainfall infiltration and cyclic intrusion of seawater in shoreline areas.

Appendix A includes a list of documents reviewed during this FYR, and Appendix B includes a chronology of site events.

FIVE-YEAR REVIEW SUMMARY FORM

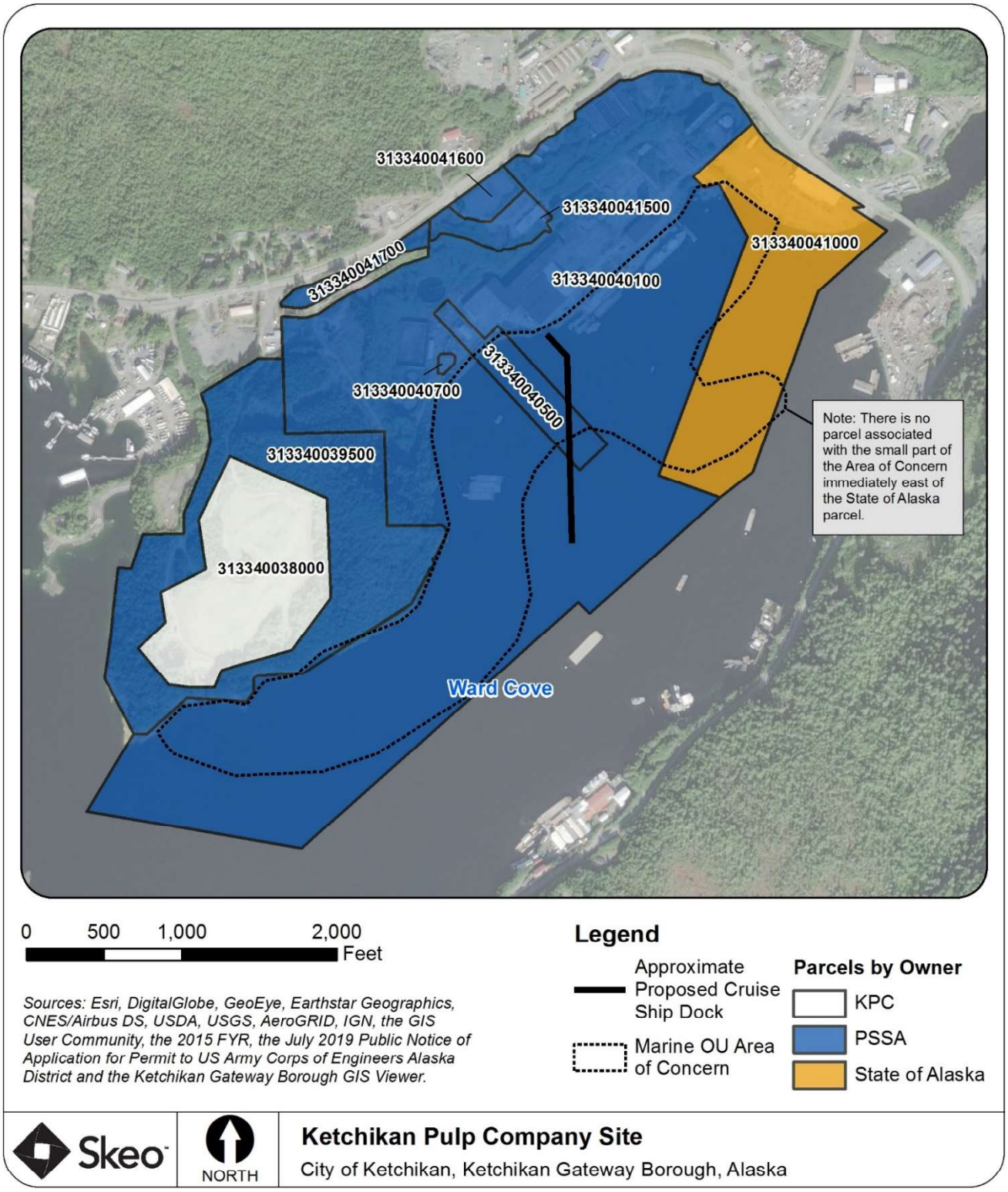
SITE IDENTIFICATION		
Site Name: Ketchikan Pulp Company		
EPA ID: AKD009252230		
Region: 10	**State:** AK	**City/County:** Ketchikan/Ketchikan Gateway
SITE STATUS		
NPL Status: Non-NPL		
Multiple OUs? Yes	**Has the Site achieved construction completion?** Yes	
REVIEW STATUS		
Lead agency: EPA		
Author name: Kathy Cerise, with additional support provided by Skeo		
Author affiliation: EPA Region 10		
Review period: 6/18/2019 – 9/21/2020		
Date of site inspection: 7/25/2019		
Type of review: Statutory		
Review number: 4		
Triggering action date: 9/21/2015		
Due date *(five years after triggering action date)*: 9/21/2020		

Figure 1: Vicinity Map



Disclaimer This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

Figure 2: Ownership Map[1]



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[1] During the last five years, ownership within part of the marine OU transferred between the State of Alaska and PSSA. PSSA released 11 acres of land for 6.5 acres of state land. This map reflects the current ownership.

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

Marine OU

For the marine OU, the 1999 baseline human health and ecological risk assessments evaluated the chemicals present in the surface sediments of Ward Cove to determine potential human health and ecological risks from direct exposure and exposure via the food web. The risk evaluations considered three main exposure pathways:

- Human exposure to chemicals of potential concern (CoPCs) through seafood consumption.
- Wildlife (bird and mammal) exposure to CoPCs through seafood consumption.
- Benthic organism exposure to CoPCs through direct contact.

The risks associated with human health and bird and mammal exposure types fell within EPA's acceptable limits. However, sediment toxicity to benthic organisms was determined to be present at levels that warranted consideration for sediment remediation. Toxic effects to benthic organisms appeared to be a result of pulping effluent discharges from the former mill. Sediment contaminants of concern (COCs) are listed below in Table 1.

Uplands OU

A baseline human health risk assessment and an ecological risk assessment were conducted in 1998 for the uplands OU to evaluate the potential for current and future impacts of site-related contaminants on human and ecological receptors. Complete pathways for ecological receptors were not present. The human health risk assessment indicated that some areas of the Site presented unacceptable risks. One site area, the paint shop/former maintenance shop area (part of the former pulp mill area), had a carcinogenic risk estimate and a non-carcinogenic hazard index (HI) for an on-site worker exceeding EPA's acceptable risk range, related primarily to polychlorinated biphenyls (PCBs). Recommended industrial soil concentrations for both PCBs and lead were exceeded at both the paint shop and the pipeline access road. State of Alaska soil standards were exceeded for benzo[a]pyrene at the former paint shop and for petroleum compounds at the railroad tracks, compressor and former bulk fuel areas (all parts of the former pulp mill area). In addition, based on sampling from local rock quarries, the potential existed for transport and on-site use of crushed rock and soil that could exceed acceptable risk levels. Soil COCs are listed below in Table 1.

Table 1: COCs, by Media

COC	Media
Ammonia	Sediment
Sulfide	
4-Methylphenol	
Arsenic	Soil
Dioxin (toxic equivalent concentration)	
Lead	
Benz(a)anthracene	
Benzo(b)fluroanthene	
Benzo(a)pyrene	
Dibenz(ah)anthracene	
Residual-range organics (RRO)	
Diesel-range organics (DRO)	
Total petroleum hydrocarbon (TPH)-oil	
PCBs	
Sources: 2000 Marine OU Record of Decision (ROD), Section 7.2.7 & 2000 Uplands OU ROD Section 11.1 and Table 1	

Response Actions

Marine OU

EPA issued a Record of Decision (ROD) for the marine OU in March 2000. The 2000 marine OU ROD set forth a remedy that addressed the 80-acre Area of Concern in Ward Cove. The remedial action objectives (RAOs) of the marine OU remedy are to:

- Reduce toxicity of surface sediments.
- Enhance recolonization of surface sediments to support a healthy marine benthic infaunal community with multiple taxonomic groups.

The marine OU ROD noted that a benefit of achieving these RAOs is that a healthy benthic infaunal community serves as a diverse food source to larger invertebrates and fishes.

The marine OU ROD called for:

- natural recovery on approximately 50 acres;
- removal of sunken logs, dredging and a thin-layer sand cap (i.e., enhanced natural recovery) for 21 acres[2];
- implementation of a long-term monitoring program for the remedial action until RAOs are achieved;
- institutional controls that would restrict future uses in Ward Cove to ensure the remedy would remain intact and protective of the environment. Specifically, the institutional controls require any post-remediation activities within the Ward Cove area of contamination that materially damage the thin-layer cap be redressed, at the direction of EPA; and

[2] The marine OU ROD also called for placement of clean sediment mounds in areas where thin-layer capping was either infeasible or impracticable, which is why the acreage of the natural recovery and thin layer capping areas do not add up to 80 acres. However, mounding was ultimately not implemented.

- subtidal investigation of sediments near the east end of the main dock, and subsequent dredging and disposal of contaminated sediments, as deemed appropriate by EPA.

Sand capping provides a new substrate for benthic organisms to inhabit, and natural recovery allows sedimentation/accretion to occur over time to slowly improve substrate conditions for benthic organisms. More details on the remedy selection and enforcement actions are available in Appendix C.

The marine OU ROD stated that chemical-specific bulk sediment criteria were not established as cleanup levels for the COCs at this Site (ammonia, sulfide and 4-methylphenol). These COCs are non-persistent products of organic matter degradation; the dissolved form of these chemicals is the toxic form, and dissolved concentrations are expected to vary considerably both spatially (horizontally and with depth) and over time. EPA concluded that the success of the remedy would be best measured by those indicators most directly representative of RAOs, i.e., sediment toxicity and the health of benthic infauna and was documented in the Long Term Monitoring Plan.

Uplands OU

KPC conducted removal actions from spring 1998 to summer 1999 and removed the most contaminated source material, eliminated unacceptable risks from direct contact with soils, eliminated soil transport to Ward Cove, eliminated leaching of surface soil contaminants to groundwater, and minimized potential future direct contact with subsurface soils at the Site. See Figure D-2 in Appendix D for a map of these early removal areas. These actions included the following:

- Removal and off-site disposal of soil/sediment from the paint shop/former maintenance shop, the access road ditch, railroad track areas, compressor area, the former bulk fuel area, and the former storage area along the water pipeline access road.
- PCB-, lead- and petroleum-contaminated soil was removed at the paint shop and water pipeline storage areas.
- Low level dioxin-containing sediments were removed from the access road ditch to accommodate widening of the road for large demolition equipment.
- Fuel-contaminated soils were removed from the other areas.
- Demolition activities have also been extensive, with removal of several buildings and structures and reconfiguration of others to prepare the Site for other future industrial and commercial activities.
- Cleaning out of cisterns (water and sediment) within the vicinity of the mill potentially impacted by past aerial deposition of stack emissions.

KPC closed the wood waste and ash disposal landfill in 1997 and constructed a new landfill cell on top of the wood waste disposal site that would require closure as part of the remedy.

EPA issued a ROD for the uplands OU in June 2000. The RAOs of the uplands OU remedy are to:

- Reduce cancer and noncancer risks to current and future workers from exposure to soil contaminants.
- Minimize future cancer and noncancer risks to off-site or future residents from contaminated soil or groundwater exposure.
- Minimize on-site workers' arsenic exposure from future use of imported rock products.
- Minimize potential migration of contaminants to Ward Cove from the landfill.

The early actions completed at the Site are a significant part of the final selected remedy. In the June 2000 uplands OU ROD, EPA selected the remedy outlined in Table 2 to ensure long-term protectiveness for three site areas (the former pulp mill area, the pipeline access road, and the wood waste and ash disposal landfill).

Table 2: Uplands OU Remedy Components

Uplands OU Site Area	Remedy Component
Former pulp mill area	Compliance with already-existing institutional controls to ensure that the use of the former pulp mill area remains commercial/industrial (see the institutional control section of this report for more detail).
Pipeline access road	• Compliance with the 1998 Management Plan for Arsenic and Rock and Soil. • Implementation of an easement and restrictive covenants document for pipeline access road areas that prohibits drilling of water wells or use of groundwater and grants access to regulatory agencies for inspections.
Wood waste and ash disposal landfill	• Landfill closure of the remaining open cell in accordance with applicable regulations. Closure requirements included placing a geomembrane cap over the closed cell, topping the area with topsoil, establishing vegetative cover, and maintenance and monitoring. • Compliance with the 1998 Management Plan for Arsenic and Rock and Soil. • Implementation of an easement and restrictive covenants document for the landfill with restrictions to a) prohibit any activities that may result in groundwater use, potential exposure of waste materials within the landfill, or potential interference with the integrity of the landfill cap and b) grant access to regulatory agencies for inspection.
All of uplands OU	Development and implementation by EPA, ADEC, KPC and Gateway of an enforceable institutional controls plan, which sets forth protocols to prevent or minimize the potential for future exposure of residual contamination at the Site (e.g. soils in the near-shore fill subarea, soils underneath paved areas or structures at the former pulp mill, and soils at the former pulp mill and at the pipeline road area that were not evaluated or characterized during the remedial investigation but that could be exposed in the future).

The early removal actions had cleanup goals, listed below in Table 3. Since the removal actions addressed most contaminants, the uplands OU ROD identified only one COC, PCBs, requiring additional remedial action. The soil cleanup goals from the ROD and the early removal actions are presented in Table 3.

Table 3: Summary of Upland OU ROD and Early Action Soil Cleanup Goals

		Cleanup Goal (mg/kg)	Cleanup Goal Basis
Early action cleanup goal	Arsenic[a]	7.6	Background arsenic concentration
	Dioxin[a]	0.000038 (for pulp mill area) 0.0000074 (for grit in residential yards and aerial deposition areas)	EPA risk-based concentrations for polychlorinated dibenzodioxins/ polychlorinated dibenzofurans (PCDD/F) in industrial soils (EPA 1998). Screening level for PCDD/F in grit based on background concentrations.
	Lead	1,000	EPA Office of Solid Waste and Emergency Response guidance for lead in nonresidential soils of 1,000 mg/kg (EPA 1989a)
	Benz(a)anthracene	9	Industrial health-based levels
	Benzo(b)fluroanthene	9	
	Benzo(a)pyrene	0.9	
	Dibenz(ah)anthracene	0.9	
	RRO	8,300	18 Alaska Administrative Code (AAC) 75 Oil and Other Hazardous Substances Pollution Control, as amended through October 27, 2018
	DRO	8,250	
	TPH-oil	9,700	
2000 uplands OU ROD cleanup goal	PCBs	10	Selected using both the NCP Nine Criteria and the Toxic Substances Control Act (TSCA) Remediation Waste Risk Based Disposal Approval at 40 CFR 761.61(c)

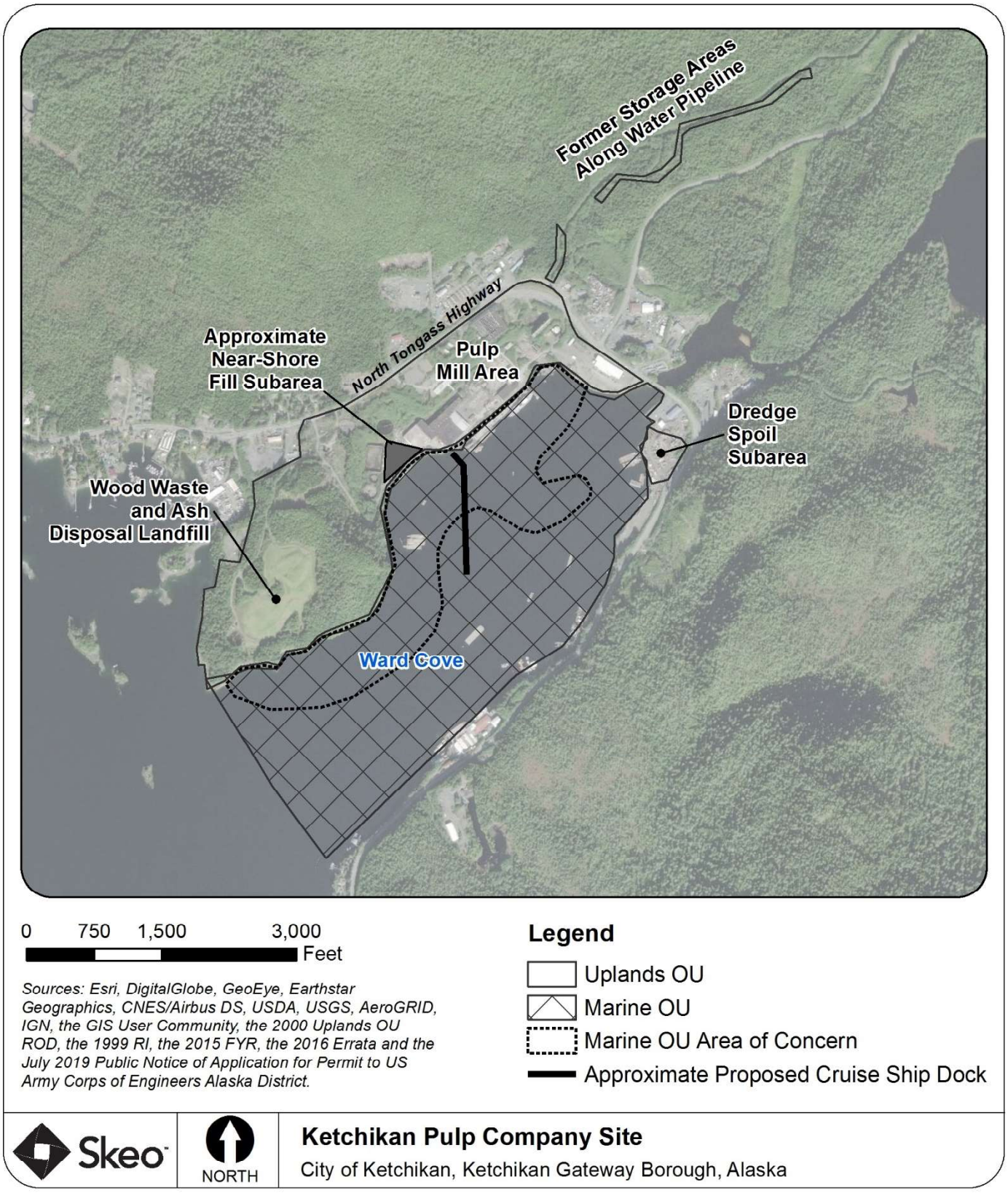
Notes:

a. In Table 1 of the 2000 Uplands OU ROD, arsenic and dioxin were identified as screening levels rather than cleanup goals.

mg/kg = milligrams per kilogram

Sources: 2000 Uplands OU ROD Section 11.1 and Table 1

Figure 3: Site Areas Map



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Status of Implementation

Marine OU

On November 30, 2000, EPA, Gateway Forest Products, KPC, and Louisiana-Pacific Corporation entered into a Consent Decree for performance of remedial design and remedial action, and reimbursement of response costs at the Site. Under EPA oversight, KPC performed the remedial action construction in Ward Cove between 2000 and 2001.[3] Remedy implementation included:

- Construction of a thin-layer (about 6 to 12 inches) placement of clean, sandy material over 27 acres.
- Removal of sunken logs (about 680 tons) from the bottom of Ward Cove in areas to be dredged.
- Dredging of about 8,701 cubic yards of bottom sediments from an area in front of the main dock and an area near the shallow draft barge berth area to accommodate navigational depths, with disposal of the dredged sediments at an upland location. After dredging, a thin layer placement of clean, sandy material was constructed in dredged areas where native sediments or bedrock was not reached.
- Monitored natural recovery for about 52 acres where thin-layer placement was not constructed.
- EPA approval of a long-term monitoring program for the remedial action, which was to be implemented until RAOs are achieved.
- Dredging of contaminated sediments along with other dredged materials. Submerged creosote-soaked pilings were also removed from the area of contaminated sediments.

A final inspection of the implemented remedy occurred in April 2001. See Figure 4 for the locations of dredging, thin layer placement, and piling removal. EPA approved a long-term monitoring and reporting plan in September 2001 for the marine OU. The monitoring program evaluated three major indicators of sediment quality: 1) sediment chemistry, 2) sediment toxicity, and 3) benthic macroinvertebrate communities. These were compared to pre-remedial conditions and to reference locations not impacted by the Site. The monitoring was conducted twice (in 2004 and 2007 monitoring events) to assess the major indicators.

The 2007 final monitoring report concluded that the thin layer placement area was successful in eliminating sediment toxicity and stimulating colonization of benthic macroinvertebrate species and that recovery was proceeding in the monitored natural recovery areas, such that all but one area had achieved healthy benthic communities with multiple taxonomic groups. The weight of evidence for the remaining monitored natural recovery area indicated that substantial recovery had occurred and was expected to continue to progress. Based on this expectation, the 2007 monitoring report concluded the RAOs have been achieved.

In May 2009, EPA approved the final 2007 monitoring report, concurring that the RAOs for the sediment remedy were achieved, the marine OU remedy was protective of human health and the environment, and that monitoring pursuant to the long-term monitoring and reporting plan was no longer necessary. EPA concluded that the RAOs were achieved using multiple lines of evidence, which included quantitative and qualitative evaluations of temporal and spatial trends in toxicity responses (amphipod toxicity tests) and benthic macroinvertebrate community characteristics (including statistical analyses comparing benthic metrics between remediated and reference areas), as well as supporting measurements of sediment chemistry (i.e., COCs and conventional variables). However, only two post-remediation monitoring events (in 2004 and 2007) were used to assess temporal trends. Until January 2020, no monitoring had been conducted for the marine OU since 2007. In January 2020, PSSA conducted a monitoring event to document pre-construction conditions of the marine OU prior to the cruise dock development.

PSSA's cruise ship dock project is located within the AOC and on the sediment cap. Therefore, EPA had (and has) significant concerns that the project could negatively impact the integrity of the Ward Cove remedy. EPA

[3] The implemented remedy deviated from the marine OU ROD in several minor ways, more fully discussed in Appendix C, including: 1) thin-layer placement occurred over a larger area than estimated in the ROD, 2) the ROD allowed for mounding if thin-layer placement could not be implemented, but this was not needed as thin-layer placement was effective in all areas, and 3) the dredging volume was less than was estimated in the ROD.

communicated that concern to PSSA, and offered to enter into an agreed order related to the project. See November 6, 2019 Letter from EPA to PSSA. PSSA decided to move forward with construction of its cruise ship dock project without the benefit of an EPA agreement. Therefore, EPA has no oversight over this project, which is ongoing. PSSA did receive a permit from the US Army Corps of Engineers, which required PSSA to conduct, and submit for ADEC review, a benthic sediment and water quality field study prior to and following cruise ship dock construction. ADEC shared the pre-construction monitoring data (conducted in January 2020) with EPA in June 2020, and EPA is currently reviewing it.

Alaska DOT&PF, the other landowner in the Marine OU, also anticipates constructing a project upon the submerged tidelands of Ward Cove, although its project will avoid the Sediment Cap. Alaska DOT&PF's Ward Cove Marine Facility will include long-term berthing for a maximum of five AMHS ferries, to be used for emergency or secondary passenger loading and unloading if the AMHS ferry terminal in downtown Ketchikan is unavailable. Although the AMHS proposed project is not located directly on the Sediment Cap, there is a possibility the construction and operation of the project could affect the integrity of the Sediment Cap. Therefore, on July 15, 2020, Alaska DOT&PF entered into an Administrative Settlement Agreement and Order on Consent (ASAOC) for Removal Action, which will give EPA direct oversight of that project, including approval of all plans. See Alaska DOT&PF ASAOC, CERCLA Docket No. 10-2020-0132.

Implementation of institutional controls for the marine OU will be discussed in the following section.

Uplands OU

KPC closed the remaining open cell of the landfill in 2001. All closure and post-closure activities of this landfill were conducted pursuant to ADEC solid waste and all other applicable state regulations, and the new cell is regulated by an ADEC Solid Waste Permit. The landfill cover was designed to prevent infiltration of rainwater, eliminate direct exposure to on-site workers or trespassers, prevent migration of leachate to surface waters and Ward Cove, and collect surface water runoff. The entire landfill is capped with a final cover consisting of a low permeability geomembrane, geotextiles, a rock drainage layer and a vegetated soil cover. Leachate from the landfill is treated by passive aeration, settling and a biofiltration swale that provides polishing of the effluent by filtration. Monitoring and maintenance are ongoing and will be discussed in the operation and maintenance (O&M) section of this FYR report. The remainder of the remedy implementation was conducted via implementation of institutional controls, which are discussed in the following section.

Institutional Control (IC) Review

Because waste was left in place that did not allow for UU/UE, institutional controls were required in the RODs and have been implemented for both the uplands and marine OUs. Several different instruments serve to make up the layered controls at the Site; the institutional control objectives are discussed below, and the institutional control instruments are summarized in Table 4. See Figures 3 and 4 for site areas where institutional controls apply. The 1998 Management Plan for Arsenic in Rock and Soil and the 2000 Institutional Control Plan are included in Appendix K; the remainder of the institutional controls are included in the 2015 FYR.

Marine OU Institutional Controls

The marine OU ROD and 2000 Consent Decree require that any future post-remediation activities within the area of contamination that materially damage the thin-layer cap or mounds must redress such damage, at the direction of EPA. The cleanup was developed assuming that future use would include normal vessel traffic and vessel anchoring. There were no remedial requirements for institutional controls on natural recovery areas, and none have been implemented.

The central legal mechanism in place to enforce the marine OU ROD's restriction on activities that damage the cap is through environmental/restrictive covenants placed on the affected tidelands. Before the remedial action at Ward Cove even began, an Environmental Protection Easement and Declaration of Restrictive Covenants for

KPC's property was recorded in 1999. After the remediation of the marine OU, a new environmental covenant was recorded in 2003 between Ketchikan Gateway Borough (KGB), KPC, and Gateway Forest Products. A subsequent covenant between the Borough and KPC was recorded in 2004, and it binds all future owners of the affected tidelands – which is now PSSA and the State of Alaska (DOT&PF).

In February 2010, the then-owner of the tidelands Ketchikan Gateway Borough requested that ADNR release some or all restrictions established in the 1999 Covenant with respect to certain marine tidelands within Alaska Tidelands Survey 1. Following negotiations in 2010 and 2011, the State of Alaska Department of Law agreed to a partial release, which only applied to the restriction set forth in Paragraph 8(g) of the 1999 Covenant. As noted above, Paragraph 8(g) stated: "Projects or activities that materially damage the cap applied to tide and submerged lands shall be required, at the direction of EPA, to redress such impacts, e.g., a dredging project that may erode or displace large portions of the cap will be required to repair or replace the cap." The Department of Law agreed to this release based on the language of the 1999 Covenant, which stated that the restriction set forth in Paragraph 8(g) only exists until EPA determines that healthy benthic communities exist in the submerged lands. The 2015 FYR notes the validity of Paragraph 8(g) of the 1999 Covenant is immaterial to the protectiveness of the remedy and that the 1999 Covenant was in place before the marine OU ROD was issued and was subsequently superseded by the July 2004 Environmental Easement and Declaration of Covenants. Ultimately, any activity that materially damages the thin-layer sediment cap at Ward Cove would be inconsistent with the marine OU ROD and a violation of the institutional controls, including the 2004 Covenant, and may also be considered a release of hazardous substances, subjecting the owner of the sediments to liability under Section 107(a) of CERCLA.

On June 16, 2010, the Borough sold Ward Cove uplands and submerged lands to DOT&PF, by warranty deed, subject to all development restrictions and encumbrances of record, including the 2004 Covenant. All of the Ward Cove submerged lands that were formerly owned by KPC are encumbered by the 2004 Covenants and are identified as Parcel 1 in that document. Parcel one is now subdivided and owned in part by PSSA and in part by Alaska DOT&PF. While the property currently owned by DOT&PF and PSSA is fully encumbered by the 2004 Covenant, the portion owned by DOT&PF will now also be encumbered by an additional conservation easement. The July 2020 ASAOC between EPA and DOT&PF related to its proposed Ward Cove Marine Facility, CERCLA Docket No. 10-2020-0132, calls for implementation of additional institutional controls on the state's property, provides conditions for the performance of work there, and provides a means to address potential material damage to the Sediment Cap that may result. The ASAOC also requires DOT&PF to record a Conservation Easement to ensure proper implementation of the additional institutional controls, to make those additional institutional controls run with the land, and to designate EPA as the third-party agency to enforce the provisions of the Conservation Easement. That conservation easement will be filed no later than September 2020.

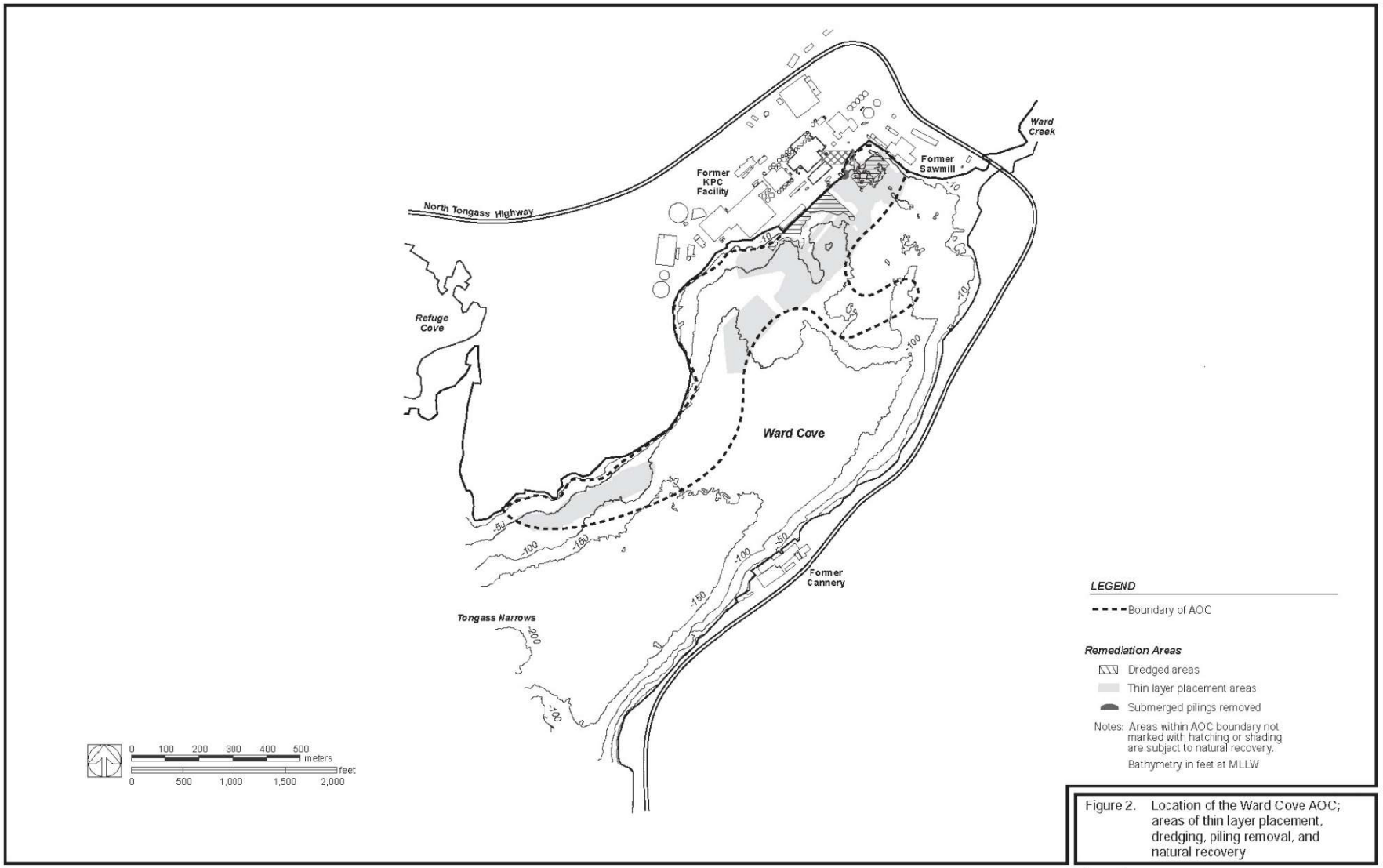
Upland OU Institutional Controls

The uplands OU ROD required institutional controls to prevent groundwater use or well installation, prevent use of the Site for habitation, establish procedures for soil handling in select site areas, establish practices for use of rock products that result in acceptable health protection for current and future workers at the facility, and prohibit any activities that may result in potential exposure of waste materials within the landfill or potential interference with the integrity of the landfill cap.

Recent events indicate communication issues between the site owner and regulatory agencies. PSSA installed a piling in Ward Cove during the last five years without providing notice to EPA or ADEC. During the site inspection, it also appeared that PSSA was conducting debris removal in the former mill area, though exact details of the activities are unknown. These events indicate the need for improved communication between the site owner and regulatory agencies, particularly to ensure compliance with institutional controls.

In addition, a local news story from March 10, 2020 indicated that earth-moving activities were occurring on the upland property. The implementation of these activities should be reviewed to evaluate institutional control compliance and ensure long-term remedy protectiveness.

Figure 4: Marine OU Remedial Features Map[4]



Disclaimer This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

[4] Map from Figure 3 of 2015 FYR.

Table 4: Summary of Implemented Institutional Controls (ICs)

Site Area Where ICs Apply	Media, Engineered Controls, and Areas That Do Not Support UU/UE Based on Current Conditions	ICs Needed	ICs Called for in the Decision Documents	Title of IC Instrument Implemented and Date (or planned)	Restrictions and/or Covenant Details
Marine OU: natural recovery areas	Sediment	Yes	No	None implemented	No restrictions in place.
Marine OU: sand capped areas	Sediment	Yes	Yes	2003 Environmental Easement and Declaration of Covenants, between Ketchikan Gateway Borough, KPC and Gateway	Covenants include: • The Borough covenants and agrees that it shall be liable for any damage to the Sand Cap arising out of the acts or omissions of the Borough, its employees or other associates. The Borough shall not be responsible or liable for damage to the Sand Cap to the extent such damage results from the activities or operations of KPC. The Borough agrees to impose appropriate contractual requirements and port use regulatory provisions regarding the capping materials on parties with which it does business, consistent with the requirements imposed in accordance with the terms of Appendix "1" (i.e., to not materially damage the cap).

Site Area Where ICs Apply	Media, Engineered Controls, and Areas That Do Not Support UU/UE Based on Current Conditions	ICs Needed	ICs Called for in the Decision Documents	Title of IC Instrument Implemented and Date (or planned)	Restrictions and/or Covenant Details
Marine OU: sand capped areas Uplands OU: former pulp mill area	Soil, groundwater and sediment	Yes	Yes	1999 Environmental Protection Easement and Declaration of Restrictive Covenants for KPC's property	Restrictions include: • (a) Uses of the property are limited to commercial or industrial use. • (b) The Property shall not, at any time, be used in whole or in part, for human habitation, schooling of children, hospital care, childcare or any purpose necessitating around-the-clock residence by humans. • (c) Drilling of drinking water wells is prohibited. • (d) Use of ground water for drinking is prohibited. • (e) Controls specified in the "Management Plan for Arsenic and Rock and Soil," prepared by Exponent for KPC, dated July 1998, to limit concentrations of arsenic from crushed rock shall be complied with. • (f) Soils in the nearshore fill area or soils underneath paved areas of structures at the pulp mill site that are exposed in the future, e.g., as the result of excavation or demolition activities, shall be properly characterized and managed in accordance with applicable disposal requirements. • (g) Projects or activities that materially damage the cap applied to tide and submerged lands shall be required, at the direction of EPA, to redress such impacts, e.g. a dredging project that may erode of displace large portions of the cap will be required to repair or replace the cap. Restrictions (a) through (f) above shall exist until 2099 or until concentrations of arsenic, dioxin, lead, petroleum, polycyclic aromatic hydrocarbons (PAHs), and PCBs no longer exceed site-specific, risk-based residential cleanup levels, whichever comes first. Restriction (g) shall exist until 2020 or until EPA determines that healthy benthic communities exist in the capped tide and submerged lands, whichever comes earlier.

Marine OU: sand capping areas
 	
Uplands OU: wood waste and ash landfill
	Sediment and soil	Yes	Yes	2004 Environmental Easement and Declaration of Covenants, between Ketchikan Gateway Borough and Ketchikan Pulp Company	Covenants include:
					• The Borough covenants and agrees that it shall comply with any Institutional Controls which are or may become applicable to the Ward Cove Property, including those imposed through, or under the Ward Cove Consent Decree, or otherwise.
					• The Borough covenants and agrees that it shall not, through any activities or operations at or in the Ward Cove Area, materially damage any cap or capping materials that may be applied to sediments in the Ward Cove Area under the Ward Cove Consent Decree. The Borough further covenants and agrees that if it damages such cap, it will immediately report the relevant circumstances to EPA and KPC and restore the cap to a condition and to specifications as directed by the EPA or by any governmental body having primary regulatory jurisdiction over the work undertaken by KPC under the Ward Cove Consent Decree, but the Borough and KPC will be under no obligation to restore the cap until directed to do so by the EPA or other governmental body having jurisdiction.
					• The Ward Cove Landfills are located within Lot 2, Tract 3004 ("Landfill Parcel") and are operated pursuant to a permit issued by the State of Alaska, Department of Environmental Conservation ("DEC"). Lot 1 of Tract 3004 surrounds the Landfill Parcel, which KPC agreed to donate to the Borough only upon the condition that use restrictions and other conditions would be implemented in order to ensure that neither the Borough nor its successors in interest would unreasonably interfere with the operation and maintenance of the Ward Cove Landfills. To accomplish those objectives, KPC and the Borough covenant and agree as follows:
					  • The future use of Lot 1, Tract 3004 by the Borough and its successors in interest shall be limited to commercial activities of an industrial nature which are compatible with operation in close proximity to an industrial landfill.
					  • The Borough and its successors in interest shall take all reasonable measures to protect against any interference with operation of the Ward Cove Landfills, including appropriate terracing of any rock extraction to preserve subjacent support.
					  • The Borough hereby fully and finally releases KPC from all liability arising from or in any way related to operation and maintenance of the Ward Cove Landfills, excepting only to the extent damages may occur from a violation of, or failure to obtain, the DEC permit for the landfills. This release extends to any and all claims and liabilities, whether arising from negligence, or other fault, or otherwise. The Borough shall require each of its successors in interest, whether by lease, deed, or otherwise, as a condition to acquisition of any interest in or to Lot 1, Tract 3004, to execute the same release in favor of KPC.
					
					The 2004 Environmental Easement and Declaration of Covenants also states that the restricted uses shall run with the land and be binding on all future owners, and the terms and conditions shall be for a period of twenty years, after which time the Covenant shall be automatically extended for successive periods of ten years unless an instrument signed by KPC has been recorded agreeing to terminate the restrictions.

Site Area Where ICs Apply	Media, Engineered Controls, and Areas That Do Not Support UU/UE Based on Current Conditions	ICs Needed	ICs Called for in the Decision Documents	Title of IC Instrument Implemented and Date (or planned)	Restrictions and/or Covenant Details
Uplands OU: wood waste and ash disposal landfill, former pulp mill area, and pipeline access road	Soil	Yes	Yes	1998 Management Plan for Arsenic in Rock and Soil	This plan developed guidelines for use of imported soil and rock products because rock products of various size fractions were stockpiled at the KPC facility or were predicted to be purchased in the future for use at the KPC site, and some of this rock contained elevated arsenic concentrations. The purpose of the plan was to 1) to evaluate the potential risks to onsite workers and the potential for arsenic to leach from the rock products and migrate to Ward Cove; and 2) to establish practices for use of rock products that result in acceptable health protection for current and future workers at the facility. The plan developed the following guidelines: if additional imported topsoil was needed for the landfill and the contractor needed to use mineral fines other than their current overburden, testing for arsenic was required. The topsoil arsenic concentration should be less than 275 mg/kg, which would result in a cancer risk estimate of 5×10^{-5}. Second, crushed rock products that contain fines (e.g., Dl, 1.5-in.-minus, and 3-in.-minus) should not be used as the final cover for ground surfaces at the Site if the arsenic concentration is greater than 700 mg/kg.
				2000 Institutional Control Plan, including Excavation and Soil Handling Procedures	This institutional control plan was developed to be implemented by the owner(s) of the properties to manage residual contamination as a result of KPC's use of the Site. This plan addresses characterization, management, and disposal of soils in the following areas: • Soils in the near-shore fill subarea. • Soils underneath paved areas or structures at the former pulp mill site. • Soils at the former pulp mill and at the pipeline road area that were not evaluated or characterized during the remedial investigation but that could be exposed in the future (e.g., as the result of excavation or demolition). For minor excavations, soil sampling and comparison of data to screening levels is required only if there is visible evidence of debris or contamination, or knowledge of past or present use of the area suggests that contamination may be present. The regulatory agencies will then determine appropriate actions. For major excavations, soil sampling and comparison of data to screening levels is required, and an excavation-specific sampling and analysis strategy will be developed in consultation with EPA and ADEC. Notification of ADEC and EPA is required if soil results exceed screening levels or if suspect debris is found. The regulatory agencies will then determine appropriate actions.

Site Area Where ICs Apply	Media, Engineered Controls, and Areas That Do Not Support UU/UE Based on Current Conditions	ICs Needed	ICs Called for in the Decision Documents	Title of IC Instrument Implemented and Date (or planned)	Restrictions and/or Covenant Details
Uplands OU: wood waste and ash disposal landfill and former pulp mill area	Soil and groundwater	Yes	Yes	Ketchikan Gateway Borough zoning restrictions	According to the Ketchikan Gateway Borough GIS Viewer, the uplands OU remains zoned for either commercial or industrial uses.[5]
Uplands OU: wood waste and ash disposal landfill	Soil and groundwater	Yes	Yes	2001 Environmental Easement between KPC and Alaska Department of Natural Resources (ADNR) regarding the Wood Waste and Ash Disposal Landfill at Dawson Point	Restrictions include: • Uses of the property are limited to commercial or industrial use. • The property shall not, at any time, be used, in whole or in part, for human habitation, schooling of children, hospital care, childcare or any purpose necessitating around-the-clock residence by humans. • Drilling of drinking water wells is prohibited. • Controls specified in the "Management Plan for Arsenic and Rock and Soil," prepared by Exponent for Grantor, dated July 1998, to limit concentrations of arsenic from crushed rock shall be complied with. • No activities shall be allowed on the property that involve use of groundwater, potential exposure of waste materials within the property (other than those activities constituting, or associated with, the already-in-place leachate treatment system), or potential interference with the integrity of the landfill cap. Waste Materials shall mean (i) any "hazardous substance" under Section 101(14) of CERCLA, 42 U.S.C. § 9601(14) or AS 46.03.826(5); (ii) any pollutant or contaminant under Section 101(33) of CERCLA, 42 U.S.C. § 9601(33); and (iii) any "solid waste" under Section 1004(27) of the Resource Conservation & Recovery Act ("RCRA"), 42 U.S.C. § 6903(27) or the State of Alaska Solid Waste Management Regulations, 18 AAC 60.

[5] Accessed on 11/18/19 at https://ketchikan.connectgis.com/Map.aspx.

Site Area Where ICs Apply	Media, Engineered Controls, and Areas That Do Not Support UU/UE Based on Current Conditions	ICs Needed	ICs Called for in the Decision Documents	Title of IC Instrument Implemented and Date (or planned)	Restrictions and/or Covenant Details
Uplands OU: pipeline access road	Soil and groundwater	Yes	Yes	2006 Equitable Servitude and Easements and Subordination Agreement for the Pipeline Parcels granted by the Ketchikan Gateway Borough in favor of the Alaska Department of Natural Resources	Restrictions include: • Uses of the Property are limited to commercial or industrial use. • The Property shall not, at any time, be used, in whole or in part, for human habitation, schooling of children, hospital care, childcare, or any purpose necessitating around-the-clock residence by humans. • Drilling of drinking water wells is prohibited. • Controls specified in the "Management Plan for Arsenic and Rock and Soil," prepared by Exponent for KPC, dated July 1998, to limit concentrations of arsenic from crushed rock shall be complied with. • No activities shall be allowed on the Property, without prior approval of ADEC in writing, that involve use of groundwater, or potential exposure of Waste Materials within the Property. Waste Materials shall mean (i) any "hazardous substance" under Section 101(14) of CERCLA, 42 U.S.C. § 9601(14) or AS 46.03.826(5); (ii) any pollutant or contaminant under Section 101(33) of CERCLA, 42 U.S.C. § 9601(33); and (iii) any "solid waste" under Section 1004(27) of the Resource Conservation & Recovery Act ("RCRA"), 42 U.S.C. § 6903(27), AS 46.03.900(26), or the State of Alaska Solid Waste Management Regulations, 18 AAC 60.

Systems Operations/ O&M

Marine OU

There is no O&M required or conducted for the marine OU. There are institutional controls in place for some of the marine OU that require continued communication with ADEC and EPA. The institutional control plan currently warrants updates to include the marine OU, map out all various instruments, and update compliance and communication procedures.

Uplands OU

For the uplands OU, KPC and its contractors conduct O&M for the wood waste and ash landfill per the 2018 Comprehensive Landfill Monitoring Plan. This plan includes visual monitoring via inspections, and monitoring of stormwater, treated leachate and surface water to assess any potential environmental impacts and trigger steps to correct any excursion. The landfill is permitted and regulated under both Alaska Pollutant Discharge Elimination System (APDES) and the ADEC Solid Waste Program. The APDES permit was renewed starting March 1, 2020 for a period of five years.

Leachate from the landfill is treated by passive aeration, settling and a biofiltration swale that provides polishing of the effluent by filtration. Treated effluent is conveyed via gravity to Outfall 001 from a collection sump at the downstream end of the swale (Figure 4). The leachate system is monitored weekly.

Landfill perimeter monitoring is conducted twice per year, and a final cover system inspection is conducted at least every other year. Settlement monuments are surveyed every five years. Landfill cap maintenance is performed every two years. Operating the landfill in a way that allows natural evolution of the cap vegetation is preferred for long-term success provided cap damage is minimal. On a basis of every other year, the trees will be cut and left on the cap surface to decompose.

III. PROGRESS SINCE THE PREVIOUS REVIEW

This section includes the protectiveness determinations and statements from the last FYR as well as the recommendations from the last FYR and the status of those recommendations.

Table 5: Protectiveness Determinations/Statements from the 2015 FYR

OU #	Protectiveness Determination	Protectiveness Statement
Marine	Protective	The remedy at the Marine OU is protective of human health and the environment.
Uplands	Protective	The remedy at the Uplands OU is protective of human health and the environment.
Sitewide	Protective	The remedy for the Site is protective of human health and the environment.

No issues and recommendations that affected current and/or future protectiveness were identified during 2015 FYR.

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Community Involvement and Site Interviews

A public notice was made available by newspaper posting in the *Ketchikan Daily News* on 7/19/2019. See full press notice in Appendix E. It stated that the FYR was underway and invited the public to submit any comments to EPA. The results of the review and the report will be made available at the Site's information repository, Ketchikan Library, located at 1110 Copper Ridge Lane, Ketchikan, Alaska.

During the FYR process, interviews were conducted to document any perceived problems or successes with the remedy that has been implemented to date. The interviews are summarized below and in full in Appendix F.

Evonne Reese and Sally Schlichting of ADEC expressed several concerns about the marine OU remedy, including: 1) the RAOs appear to not have envisioned the vessel activity being proposed with the cruise port; 2) the monitoring performed was insufficient to conclude that recovery had occurred and it was premature to halt monitoring in 2007; and 3) institutional controls do not clearly include the areas of contamination that were subject to enhanced natural recovery; only the portions where a sand cap was applied. ADEC stated that the enhanced natural recovery (ENR) and sand cap remedy for the marine OU was not adequately designed to accommodate the full range of potential future vessel sizes, propulsion systems and traffic now being envisioned by project developers and that modern cruise ships are much larger, with different propulsion systems than those in operation in the early 2000s. ADEC shared that members of the Ketchikan Indian Community and other Ketchikan citizens have voiced their concerns about impacts to fish and parts of the cove becoming a dead zone with continual operations of the mega cruise ships, as well as worries that any recovery that has been gained will be lost.

ADEC suggested creation of a document to formalize and clarify the institutional control requirements for the two different OUs that also cites the legal documents that provide the enforcement and legal authority for the Site. ADEC hoped that the FYR would be an opportunity for all parties involved to better understand the roles and responsibilities for the Site and memorialize site information. In addition, ADEC sent a letter to PSSA to document the FYR site inspection and clarify the institutional controls in place as related to the proposed redevelopment. This is included in Appendix F with the ADEC interview.

Samuel Naujokas, Ketchikan Indian Community Environmental Specialist, stated that he was aware of the Site primarily due to the recent proposal to develop a cruise ship port in Ward Cove. He noted that there is a need for communication about the Site to the broader community and suggested placing signage near the Site and using Facebook as a communication tool. Mr. Naujokas expressed concerns about the proposed cruise ship development because he is concerned the cruise ship thrusters will stir up the sediment and release contamination.

Mr. Naujokas also shared that he had a video from 2013 of a small area of the cove remediated via natural recovery that was filmed by a local oceanographer using a remotely operated vehicle (ROV). This video was shared with EPA during the FYR process, and the video showed no visible marine life but did show the presence of what appeared to be a bacterial or fungal mat over the sediments.

One resident was interviewed and expressed concerns about the development of the cruise ship port. The resident worried that allowing large ships in Ward Cove would stir up the fungal/bacterial mat layer associated with debris from original mill activities and redistribute it into the water column and potentially into Tongass Narrows.

Data Review

Marine OU

Prior to 2020, no monitoring had been conducted for the marine OU since 2007. In January 2020, PSSA conducted a monitoring event to document pre-construction conditions of the marine OU prior to the cruise dock development, per their US Army Corps of Engineers permit. EPA received this report in June 2020 and is currently reviewing the results.

Uplands OU

During this FYR period, Outfall 001 discharge and stormwater data have been collected to monitor the effectiveness of the wood waste and ash landfill closure and post-closure activities and are summarized below by

media. Monitoring is conducted in accordance with the APDES permit.[6] Parameters monitored and frequency of monitoring are outlined in Table 1 of Appendix I.

Outfall 001

Leachate is treated by passive aeration, settling, and a biofiltration swale and is then discharged through Outfall 001. Discharge results for semi-volatile organic compounds (SVOCs), metals, and priority pollutant sampling are included in full in Appendix I and summarized below.

SVOCs were sampled in 2013 and 2016, and metals were sampled from 2013 to 2017. All monitored constituents (SVOCs and metals) were within permit discharge effluent limits except for manganese, which has exceeded its water quality standard in effluent sampling (prior to mixing) eight times since 2013. The maximum exceedance from 2013 to 2017 was 0.775 milligrams per liter (mg/L) compared to the water quality standard of 0.05 mg/L. However, this standard is an aesthetic standard based on observance of brown color in drinking water and is not health-based. The 2017 permit application report notes that based on prior mixing-zone modeling results, this criterion will not be exceeded at the mixing-zone boundary.

Whole effluent toxicity is monitored for sea urchins and blue mussels, and no toxicity was observed above acceptable limits. Therefore, no toxicity is expected as a result of the discharges at Outfall 001.

Priority pollutant sampling was conducted for Outfall 001, as required by the APDES Permit, in 2014 and 2016. There were no detections of the priority pollutants above the laboratory's reporting limits.

Stormwater

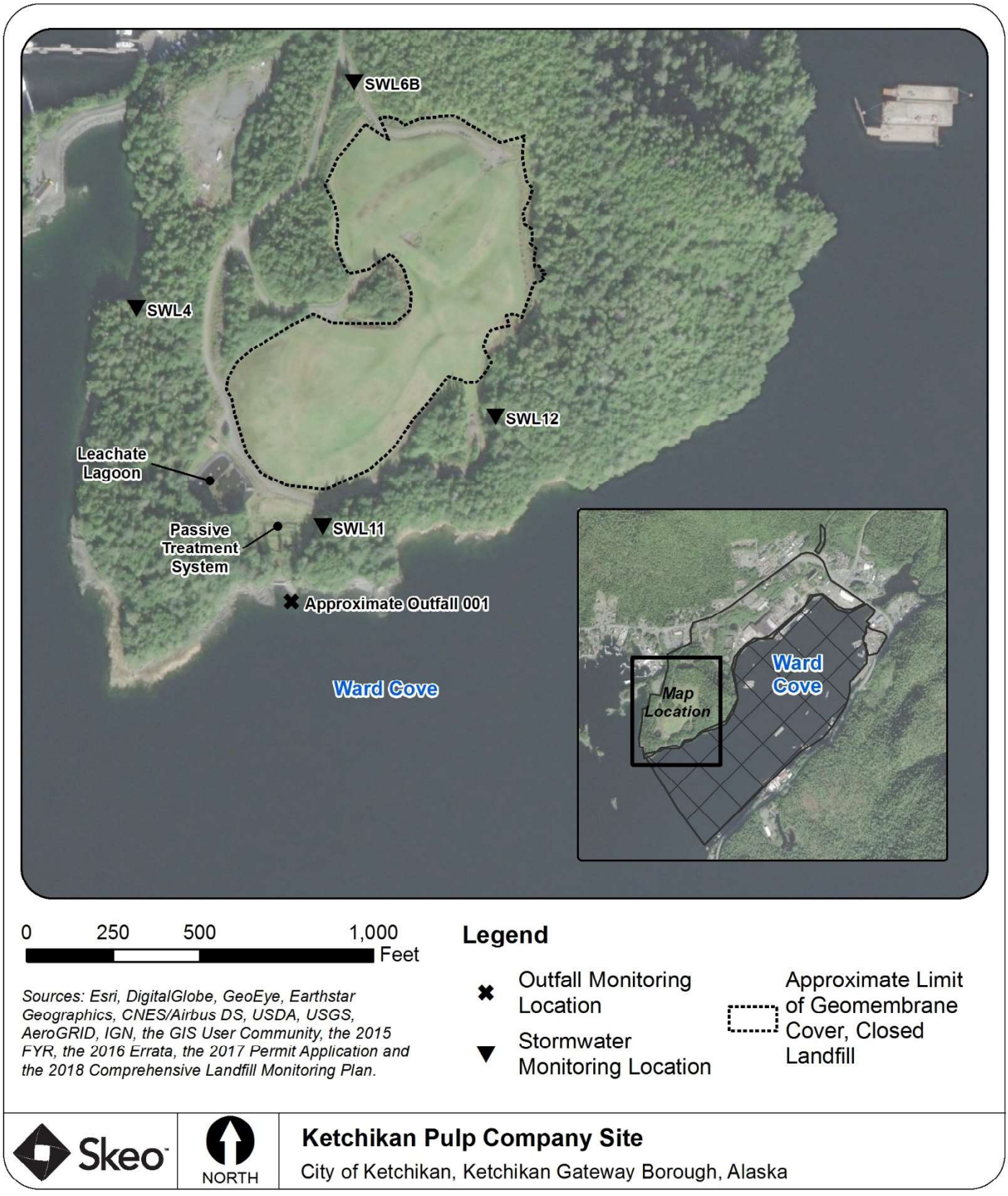
Stormwater is monitored to ensure a stabilized landfill. Stormwater results for metals from 2013 to 2017 are included in full in Appendix I and summarized below.

Stormwater runoff from the vegetated landfill cover is collected in a series of rock-lined ditches and conveyed directly to outfalls discharging into Ward Cove. Monitoring of four stormwater sampling locations (SWL4, SWL6B, SWL11 and SWL12) is required under the APDES permit (Figure 5).

Metals concentrations were all non-detect or below water quality standards except for total manganese. Total manganese exceeded its water quality standard at SWL11 (November 2013 and January 2014) and SWL12 (August 2013, November 2013, and July 2015). Since July 2015, concentrations at SWL11 and SWL12 were below the water quality standard. The 2017 permit application notes that SWL11 flows within the landfill property boundary. The permit also notes that portions of SWL12 flow across an adjacent property and are subject to restrictions that only allow development consistent with being near the landfill; therefore it is unlikely that these streams will be used for drinking water. Furthermore, ADEC has proposed that the manganese criterion will be revised from 0.05 milligrams per liter (mg/L) to 0.3 mg/L. With the manganese criterion revision, there would be no detections of manganese above water-quality criteria in stormwater. The 2017 permit application recommended discontinuing analytical stormwater monitoring, as the landfill is inactive and the stormwater sampling locations are not contaminated. The stormwater results support that the landfill remains stable.

[6] The 2017 permit application proposes reducing monitoring frequencies. See Table 1 in Appendix I.

Figure 5: Detailed Landfill Area Map



Disclaimer This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

Site Inspection

The site inspection took place on 7/25/2019. Participants included: EPA RPM Kathy Cerise, EPA attorney Kelly Cole, ADEC representatives Evonne Reese and Sally Schlichting, Christy Harrington from AMHS, Sean Lynch and Rick Welsh from the State of Alaska Department of Law, John Peterson and Phil Benning from KPC, Barry Hogarty from TECS-AK, Dave Spokely, Andrew Spokely, Caryn Homan, and Stephen Brandford from PSSA, and Treat Suomi and Kelly MacDonald from EPA support contractor Skeo. The purpose of the inspection was to assess the protectiveness of the remedy. The site inspection checklist and photographs are available in Appendices G and H, respectively.

The group began the tour at the former KPC dam, which was locked and gated. From the dam, participants were able to see the pipeline and associated walking trail. Next, the group toured the wood waste and ash landfill, which was in good condition. It was vegetated with grass and in some places small flowering plants; parts of the landfill were mowed while small vegetation grew on other parts. Passive gas vents are present throughout the landfill surface. Leachate is collected and held in the leachate lagoon, then treated in the associated passive treatment system. Leachate site features were inspected and appeared in good condition. Participants also inspected some piezometers and surface water sampling locations. One piezometer was found to have a rusted lock that requires repair.

Next, the group visited the AMHS-owned property on Ward Cove and looked at the location of the proposed AMHS ferry terminal. Lastly, the group visited the former mill property. The group convened at the AMHS headquarters building, owned by PSSA, which also houses a variety of other commercial uses. PSSA informs the lessees of property restrictions when entering into a lease in this building. The group then proceeded to the area where former mill property buildings and foundations remain currently vacant. Considerable debris and vegetation remain on some of the former mill property buildings; PSSA stated that they have been in the process of clearing vegetation that has grown in this area. PSSA hopes to convert this area to a commercial cruise port. The marine OU remedial features, such as the sand cap, are submerged and not observable from the uplands, but the group viewed Ward Cove. A ferry and several small boats were moored in the water by the former mill property. The group also viewed the location of the proposed cruise port.

Following the inspection, Skeo staff visited the site repository at the Ketchikan Library, located at 1110 Copper Ridge Lane, Ketchikan, Alaska. The most recent document available was the 2010 FYR, which was on a CD. EPA intends to send additional documents to the repository.

V. TECHNICAL ASSESSMENT

QUESTION A: Is the remedy functioning as intended by the decision documents?

Question A Summary:

The remedy is currently partially functioning as intended by the decision documents.

The remedy for the uplands OU has been implemented as called for in the decision documents. The wood waste and ash landfill has been closed, and the landfill cap is in good condition. KPC monitors and maintains the landfill surface. KPC also conducts leachate and stormwater monitoring, which support that the landfill remains stable. Leachate is treated by passive aeration, settling, and a biofiltration swale and is then discharged through Outfall 001. O&M procedures appear effective. An institutional control plan was developed for the uplands OU. Institutional controls have been implemented for the uplands OU and include commercial/industrial zoning restrictions, a management plan for arsenic, soil handling procedures for several site areas, restrictions on human habitation on the Site, and restrictions on activities that could potentially expose waste material on the property or interfere with the integrity of the landfill cap.

The remedy for the marine OU has been implemented. A thin layer of sand was placed over about 27 acres of the cove, some cove areas were dredged, and sunken logs were removed from the cove. The remedy implemented for about 52 acres was monitored natural recovery. Institutional controls were implemented to prevent material damage to any cap or capping materials that may be applied to sediments. The 2007 final monitoring report concluded that the thin layer placement area was successful in eliminating sediment toxicity and stimulating colonization of benthic macroinvertebrate species and that recovery was proceeding in the monitored natural recovery areas, such that all but one area had achieved healthy benthic communities with multiple taxonomic groups. The weight of evidence for the remaining monitored natural recovery area indicated that substantial recovery had occurred and was expected to continue to progress. In May 2009, EPA determined that the RAOs for the sediment remedy were achieved and that monitoring pursuant to the long-term monitoring and reporting plan was no longer necessary. The achievement of RAOs was based on multiple lines of evidence including quantitative and qualitative evaluations that included spatial and temporal trends. The temporal trends were based on two monitoring events, which may not be adequate to demonstrate achievement of RAOs.

There has been no marine OU monitoring conducted under EPA oversight since 2007. The monitoring data PSSA collected in January 2020 was gathered under a US Army Corps of Engineers permit, which required data be submitted to ADEC for review. The need for monitoring of the marine OU is underscored by the Alaska DOT&PF and PSSA marine OU developments, as both changes in property use have the potential to affect the integrity of the remedy. Implementation of an updated marine OU monitoring program conducted with EPA oversight is needed to determine if the remedy's RAOs are still achieved and if they can be sustained over time to ensure long-term protectiveness. This monitoring program may include an assessment of the resiliency of the thin layer cap if a new terminal is constructed and large cruise ships dock in the cap area.

Recent events indicate communication issues between the site owner and regulatory agencies. EPA and ADEC were not given advance notice of the cruise dock port permit application. Improved communication is required in the future for any land use changes to ensure land use remains protective of human health and the environment. PSSA installed a piling in Ward Cove without providing EPA or ADEC notice. In addition, during the site inspection, it also appeared that PSSA was conducting debris removal in the former mill area, though exact details of the activities are unknown. These events indicate the need for improved communication between the site owner and regulatory agencies, as well as compliance with institutional controls. An update to the institutional control plan is warranted to include the marine OU, accurately map out all of the various instruments, clarify changes to institutional controls since the 2000 institutional control plan was issued, and update and enforce procedures needed to ensure reuse activities at the Site comply with required and existing institutional controls. In addition, a local news story from March 10, 2020 indicated that earth-moving activities were occurring on the upland property. The implementation of these activities should be reviewed to evaluate institutional control compliance and ensure long-term remedy protectiveness.

Institutional controls were not required and have not been implemented for the natural recovery areas of the marine OU remedy. However, activities that disturb natural recovery areas have the potential to create a release of materials that increase toxicity to the benthic community and delay recovery. EPA will determine whether additional institutional controls are needed for natural recovery areas and record this remedial requirement if necessary.

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels and RAOs used at the time of the remedy selection still valid?

Question B Summary:

The Site's RAOs remain valid. No uplands OU Applicable or Relevant and Appropriate Requirements (ARARs) have changed (Appendix J). Cleanup levels used at the time of remedy selection were evaluated during this FYR (Appendix J). Although there have been changes in toxicity, the uplands OU cleanup goals correspond to risk below or within EPA's acceptable risk range, except for lead in one early action area (the former storage area

along the water pipeline road). EPA evaluates lead exposure by using blood-lead modeling and established a default industrial level of 800 mg/kg.[7] However, there is no exposure to residual concentrations exceeding 800 mg/kg because the early action remedy covered this area with either gravel or coarse fill material, and institutional controls are in place to the protect disturbance of the remedy.

For the marine OU, there were no promulgated federal or Alaska cleanup standards for marine sediments driving cleanup and, instead, the need for a response action is being driven by sediment toxicity to representative benthic infaunal organisms rather than numeric cleanup goals. Therefore, no ARARs were evaluated for the marine OU as part of this FYR.

The cruise ship dock and proposed associated facilities present new potential exposure pathways for both the uplands and marine OUs, and the proposed AMHS project (while not located directly on the Sediment Cap) could present potential new exposure pathways for the marine OU. Alaska DOT&PF entered into an ASAOC for Removal Action, which will give EPA direct oversight of that project, including approval of all plans. PSSA has not entered into an agreement with EPA regarding the cruise ship dock development.

The marine OU remedy was established to reduce toxicity of surface sediments to benthic organisms. The sand cap achieves this by providing a new substrate for benthic organisms to inhabit, and monitored natural recovery achieves this by allowing sedimentation to occur over time to slowly improve substrate conditions for benthic organisms. The current cruise dock plan has the potential to disrupt the marine remedy by resuspending wood waste, both through the construction and operation:

- Construction: Elements of construction overlap portions of the sand cap and monitored natural recovery areas of the area of contamination. The proposed drilling and pile construction plans included allowing drilling wastes to settle over the sand cap. Placement of dredged material on top of the Ward Cove remedy (both monitored natural recovery and ENR) should not occur, and this material should be instead removed from Ward Cove for disposal in an approved upland disposal facility so as to avoid resuspension of wood waste.
- Operation: The cleanup was developed assuming that future use would include normal vessel traffic and vessel anchoring. The proposed cruise ship dock would accommodate a new class of vessels for Ward Cove known as "Very Large Cruise Ships", Neo Panamax or mega cruise ships, such as the Norwegian Bliss operated by Norwegian Cruise Lines. Cruise ship operations will require vessel maneuvering (docking, etc.) in waters over sediment cap and natural recovery areas. Uncertainties remain about the impacts operation of these vessels will have on the sand capping areas and monitored natural recovery areas of the remedy.

While navigation and economic development activities in Ward Cove are anticipated, activities that materially damage the cap or monitored natural recovery areas have the potential to create a release of materials that increase toxicity to the benthic community and delay recovery. There is currently uncertainty regarding the impacts of the cruise dock construction and operation activities on the marine OU engineering controls. In order to determine whether resuspension of wood waste and degradation of benthic macroinvertebrate communities in Ward Cove occurs, pre- and post- construction monitoring and pre-operational and operational monitoring are needed. If monitoring indicates a degradation in restoration to benthic communities or an impact to engineering controls, additional evaluation of remedial performance and ability to achieve RAOs may be warranted. The specifics of any additional monitoring related to the cruise dock construction and operation will be determined during ongoing communication between regulatory agencies and the property owner and developers.

[7] The EPA has updated the lead risk assessment guidance and associated adult and child lead exposure models several times and as recently as 2017 based on updated toxicity information released by the Centers for Disease Control and prevention *(Transmittal of Update to the Adult Lead Methodology's Default Baseline Blood Lead Concentration and Geometric Standard Deviation Parameters. Office of Land and Emergency Management (OLEM) Directive 9285.6-56. May 17, 2017. Accessed on 8/30/17 at https://semspub.epa.gov/work/HQ/196766.pdf).* Based on this new information, the EPA is in the process of evaluating its lead policy; in the interim, use of the current policy is recommended until it is formally updated *(Updated Scientific Considerations for Lead in Soil Cleanups. OLEM Memorandum. December 22, 2016. Accessed on 8/30/2017 at https://www.documentcloud.org/documents/3525442-EPA-Memo-Updated-Scientific-Considerations-for.html).*

In addition, under the development plans there may be disruption to former mill soil. This development should follow the soil handling procedures outlined in the 2000 Institutional Control Plan to ensure continued protectiveness.

QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy?

Although monitoring of the marine OU under the Superfund program ended in 2007, additional information has come to light that may call into question the protectiveness of the marine OU remedy. PSSA installed a piling in Ward Cove during the last five years without providing EPA or ADEC notice; without monitoring before and after the insertion of the piling into the cap area, it is unclear whether damage to the cap has occurred. In addition, PSSA recently constructed the cruise dock over the marine OU, and the potential impacts of the construction on the marine OU engineering controls are unknown, as there is no available post-construction monitoring data of the impacts to the cap of the dock installation. Lastly, the 2013 underwater footage of a small area of the cove remediated via natural recovery showed no visible marine life but did show the presence of a bacterial or fungal mat over the sediments, potentially indicating sediment toxicity. Considering the recent cruise dock development, the unapproved piling installation, and the video, additional monitoring and multibeam bathymetry data are needed before a remedy protectiveness determination can be made regarding the marine OU.

Alaska DOT&PF anticipates constructing a project in Ward Cove that will include long-term berthing for a maximum of five AMHS ferries, to be used for emergency or secondary passenger loading and unloading if the AMHS ferry terminal in downtown Ketchikan is unavailable. Although the AMHS proposed project is not located directly on the Sediment Cap, there is a possibility the construction and operation of the project could affect the integrity of the Sediment Cap. Alaska DOT&PF entered into an ASAOC for Removal Action, which will give EPA direct oversight of that project, including approval of all plans.

VI. ISSUES/RECOMMENDATIONS

Issues/Recommendations
OU(s) without Issues/Recommendations Identified in the FYR:
None.

Issues and Recommendations Identified in the FYR:

OU(s): Marine	**Issue Category: Monitoring**			
	Issue: A piling and cruise dock were installed in the marine OU, and there is currently no post-construction data to evaluate any impacts to the marine OU engineering controls. A video from 2013 indicates recovery of the marine OU may not have occurred to the extent originally thought.			
	Recommendation: Evaluate the results of the January 2020 pre-construction sampling event and collect post-construction monitoring and multibeam bathymetry data to determine the current condition of the sand capped areas and the monitored natural recovery areas.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
Yes	Yes	PRP	EPA/State	9/21/2023

OU(s): Marine	Issue Category: Monitoring			
	Issue: Regular monitoring of Ward Cove with EPA oversight was discontinued in 2009. Long-term monitoring is needed to verify the long-term protectiveness of the remedy.			
	Recommendation: Implement an updated marine OU monitoring plan to ensure long-term protectiveness.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA/State	9/21/2023

OU(s): Marine and Uplands	Issue Category: Institutional Controls			
	Issue: Several recent events indicate the need for improved communication between the site owner and regulatory agencies, as well as compliance with institutional controls.			
	Recommendation: The following additions to the site institutional controls will be considered prior to the next FYR. Recommendations made will not be limited to this list. • Update the institutional control plan to include the marine OU. • Accurately map out all of the various institutional controls. • Clarify changes to institutional controls since the 2000 institutional control plan was issued, including the Conservation Easement that will be recorded by Alaska DOT&PF pursuant to its July 2020 ASAOC with EPA. • Enforce the existing institutional controls and restrictive covenants to ensure reuse activities at the Site do not damage the remedy in place. • Consider a regulated navigation area to inform users of the area that contamination exists at depth and/or a letter agreement with the USACE district office to consult with EPA for any 404 permits in this area.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA/State	9/21/2021

OU(s): Marine	Issue Category: Institutional Controls			
	Issue: Institutional controls were not required and have not been implemented for the natural recovery areas of the marine OU remedy.			
	Recommendation: Determine whether additional institutional controls are needed for natural recovery areas and record this remedial requirement if necessary.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA/State	EPA/State	9/21/2023

VII. PROTECTIVENESS STATEMENT

Protectiveness Statement(s)		
Operable Unit: Marine	*Protectiveness Determination:* Protectiveness Deferred	*Planned Addendum Completion Date:* 9/21/2023
Protectiveness Statement: A protectiveness determination of the remedy for the marine OU cannot be made at this time until further information is obtained. A piling and cruise dock were installed in the marine OU, but the impacts of this construction on the marine OU engineering controls are unknown. Further information will be obtained by evaluating the pre-construction monitoring data and collecting and evaluating post-construction monitoring and multibeam bathymetry data for the marine OU. It is expected that these actions will take approximately three years to complete, at which time a protectiveness determination will be made.		

Protectiveness Statement(s)	
Operable Unit: Uplands	*Protectiveness Determination:* Short-term Protective
Protectiveness Statement: The remedy at the uplands OU currently protects human health and the environment because early removal actions addressed immediate threats, the wood waste and ash landfill was closed and is monitored, and institutional controls are in place. However, in order for the remedy to be protective in the long-term, an update to the institutional control plan is needed.	

Sitewide Protectiveness Statement	
Protectiveness Determination: Protectiveness Deferred	*Planned Addendum Completion Date:* 9/21/2023
Protectiveness Statement: A protectiveness determination of the remedy for the marine OU cannot be made at this time until further information is obtained. A piling and cruise dock were installed in the marine OU, but the impacts of this construction on the marine OU engineering controls are unknown. Further information will be obtained by evaluating the pre-construction monitoring data and collecting and evaluating post-construction monitoring and multibeam bathymetry data for the marine OU. It is expected that these actions will take approximately three years to complete, at which time a protectiveness determination will be made.	

VIII. NEXT REVIEW

The next FYR Report for the Ketchikan Pulp Company site is required five years from the completion date of this review.

APPENDIX A – REFERENCE LIST

AMHS Replat. Surveyed by Menzies Engineering Group for AECOM/URS Alaska LLC. October 2018.

APDES Permit AK0053392 Reissuance Application, Ketchikan Pulp Company, Ward Cove Landfill. Maul Foster Alongi. October 2017.

CERCLA Remedial Design/Remedial Action Consent Decree. United States of America vs. Gateway Forest Products, Inc., Ketchikan Pulp Company, & Louisiana-Pacific Corporation. November 2000.

Comprehensive Landfill Monitoring Plan, Ward Cove Landfill, Ketchikan, Alaska. Prepared by Maul Foster & Alongi, Inc. for Ketchikan Pulp Company. September 2018.

Environmental Easement between KPC and ADNR regarding the Wood Waste and Ash Disposal Landfill at Dawson Point. August 2001.

Environmental Easement and Declaration of Covenants. July 2003.

Environmental Easement and Declaration of Covenants. July 2004.

Environmental Protection Easement and Declaration of Restrictive Covenants. October 1999.

EPA Approval of *2007 Monitoring Report for Sediment Remediation in Ward Cove, Alaska (April 2009)*, prepared for Ketchikan Pulp Company by Integral Consulting, Marine Operable Unit, Ketchikan Pulp Company (KPC), Consent Decree No. A00-225 CV (JKS). EPA Region 10. May 2009.

EPA Comments on Proposed Activities of POA-2019-00313 & POA-2017-00166. EPA Region 10. September 2019.

EPA Feedback to the Corps Re: Solstice Alaska's Responses to Comments on the Public Notice for the Proposed Ward Cove Cruise Ship Dock (POA-2019-00313), Ketchikan Pulp Company Site, Ketchikan, Alaska. EPA Region 10. October 2019.

Equitable Servitude and Easement and Subordination Agreement for the Pipeline Parcels. Ketchikan Gateway Borough. May 2006.

Errata for 2010 and 2015 Five-Year Reviews (FYR) for Ketchikan Pulp Company (KPC) Site, Ketchikan, AK. EPA Region 10. August 2016.

Final Remedial Action Report, Sediment Remediation in Ward Cove Marine Operable Unit, Ketchikan Pulp Company Site, Ketchikan, Alaska. Prepared by Integral for Ketchikan Pulp Company. September 2009.

Institutional Control Plan for the Ketchikan Pulp Company Site. Prepared by Exponent for Ketchikan Pulp Company. June 2000.

Management Plan for Arsenic in Rock and Soil. Prepared by Exponent for Ketchikan Pulp Company. July 1998.

Marine Operable Unit Record of Decision, Ketchikan Pulp Company Site, Ketchikan, Alaska. EPA Region 10. March 2000.

Partial Release of Environmental Protection Easement and Declaration of Restrictive Covenants. Department of Natural Resources, State of Alaska and Ketchikan Gateway Borough. November 2011.

Preliminary Close Out Report, Ketchikan Pulp Company (KPC) Ketchikan, Alaska. EPA Region 10. February 2005.

Public Notice of Application for Permit to US Army Corps of Engineers Alaska District. PSSA. July 2019.

Reuse and Remedy Compatibility Considerations for Comments on Proposed Cruise Ship Dock and Ward Cove Port Improvements at the Ketchikan Pulp Company Site, Ketchikan, Alaska. Skeo. September 2019.

Third Five-Year Review Report, Ketchikan Pulp Company Site, Ketchikan, Alaska. EPA Region 10. September 2015.

Tour of Development of Cruise Port in Ward Cove, Ketchikan, Alaska. Sit News. March 2020. http://www.sitnews.us/0320News/032020/032020_ward_cove_port.html

Underwater ROV Video. Sea Grant Alaska. Ward Cove at location: 55° 24' 19.67" N, and 131° 43' 45.36" W. May 2013.

Uplands Operable Unit Record of Decision, Ketchikan Pulp Company Site, Ketchikan, Alaska. EPA Region 10. June 2000.

Ward Cove Cruise Ship Dock Project, Ward Cove, Ketchikan, Alaska. Power Systems & Supplies of Alaska. June 2019.

APPENDIX B – SITE CHRONOLOGY

Table B-1: Site Chronology

Event	Date
KPC began pulp mill operations	1954
EPA conducted preliminary site investigation	1991 and 1993
EPA Clean Water Act and Clean Air Act Consent Decree entered for investigation and feasibility study work for the marine OU	September 19, 1995
Responsible party began sediment investigation and feasibility study work for the marine OU	September 1995
KPC ceased pulp mill operations	1997
EPA performed expanded site investigation	1997
EPA CERCLA Administrative Order on Consent between KPC, Louisiana-Pacific Corporation (the parent company of KPC), and ADEC, primarily for the uplands OU	June 1997
KPC/Louisiana-Pacific Corporation, per the Administrative Order on Consent, completed early pre-ROD actions focused on the uplands OU (removal of contaminated soil and upland sediment, building demolition, and cleaning out roof cisterns used for water collection and storage of drinking water)	Spring 1998 to summer 1999
Recording of "Environmental Protection Easement and Declaration of Restrictive Covenants"	October 28, 1999
Sale of KPC assets to Gateway Forest Products, Inc., including Ward Cove real property other than the landfill and the pipeline and dam parcels	November 5, 1999
Responsible party completed sediment investigation and feasibility study work for the marine OU	March 2000
EPA signed the marine OU ROD	March 29, 2000
EPA signed the uplands OU ROD	June 7, 2000
Field construction performed for the marine OU	October 2000 - February 2001
EPA/KPC/LP/Gateway Consent Decree (CERCLA) for responsible party performance of Remedial Design/Remedial Action for uplands and marine OUs entered by federal court	November 20, 2000
Final inspection performed for the marine OU	April 4, 2001
EPA approved final Long-Term Monitoring and Reporting Plan for marine OU	September 17, 2001
PRP installed final cap for last open cell in uplands OU landfill	2001
EPA approved addendum to the Long-Term Monitoring and Reporting Plan for the marine OU	January 3, 2002
Environmental Easement and Declaration of Covenants, by and between KPC, Ketchikan Gateway Borough (KGB), and Gateway	July 18, 2003
Environmental Easement and Declaration of Covenants, by and between KPC and KGB	July 15, 2004
Preliminary Close Out Report signed for marine OU	February 25, 2005
EPA completed first FYR	August 2, 2005
Institutional control documents for Ward Cove Pipeline Parcels approved	June 27, 2006
KPC submitted and EPA approved final 2007 Monitoring Report for Marine OU	2009
Final Remedial Action Report issued for marine OU	October 1, 2009
EPA issued Certification of Completion for Remedial Action for uplands OU	January 21, 2010
EPA issued Certification of Completion for Remedial Action for marine and uplands OUs	January 22, 2010
EPA completed second FYR	August 28, 2010
KGB requested that Alaska Department of Natural Resources issue a partial release from the 1999 Environmental Easement and Restrictive Covenants with respect to restrictions relating to certain marine tidelands with Alaska Tidelands Survey 1, as set forth in paragraph 8(g)	2010-2011
KGB notified EPA that PSSA purchased the former KPC mill site	April 18, 2011
KPC permitted under the individual APDES permit AK-005339-2, administered by ADEC	May 1, 2013
EPA completed third FYR	September 21, 2015
KPC applied for reissuance of the APDES permit AK-005339-2	October 24, 2017
PSSA submitted Public Notice of Application for Permit to US Army Corps of Engineers Alaska District for cruise ship dock	July 2019

APPENDIX C – DETAILED SITE BACKGROUND

Response Actions

Marine OU

The United States and KPC entered into a 1995 consent decree (CD) for KPC mill violations of the Clean Water Act and the Clean Air Act. Under the terms of the settlement, KPC agreed to pay a penalty of $3.1 million to implement requirements for mill operations and perform certain projects. One such project was to evaluate and remediate sediments, and the sediment remedial investigation/feasibility study (RI/FS) work was conducted under the CD.

The Site is not listed on the Superfund program's National Priorities List (NPL). EPA issued a ROD for the marine OU in March 2000.

The remedial action objectives (RAOs) of the marine OU remedy are to:

- Reduce toxicity of surface sediments.
- Enhance recolonization of surface sediments to support a healthy marine benthic infauna community with multiple taxonomic groups.

The ROD noted that a benefit of achieving these RAOs is that a healthy benthic infaunal community serves as a diverse food source to larger invertebrates and fishes.

The marine OU ROD selected the following remedy:

- Placement of a thin-layer cap (approximately 6 to 12 inches) of clean, sandy material where practicable (This is also known as ENR). Thin-layer capping is estimated to be practicable over approximately 21 acres within the area of contamination. Thin-layer capping is preferable over mounding.
- Placement of clean sediment mounds in areas where thin-layer capping is either infeasible or impracticable, and where mounding is considered to be practicable. Mounding was considered to be practicable in areas where the organic-rich sediments are less than 5 feet thick and have a bearing capacity that is greater than 6 pounds per square foot. Mounding is estimated to be practicable over approximately 6 acres within the area of contamination.
- Dredging of approximately 17,050 cubic yards of bottom sediments from an approximate 4-acre area in front of the main dock and dredging of approximately 3,500 cubic yards of bottom sediments from an approximate 1-acre area near the shallow draft barge berth area to accommodate navigational depths, with disposal of the dredged sediments at an upland location. After dredging, a thin-layer cap of clean, sandy material will be placed in dredged areas unless native sediments or bedrock is reached during dredging.
- Removal of sunken logs from the bottom of Ward Cove in areas to be dredged.
- Natural recovery in areas where neither capping nor mounding is practicable. Natural recovery allows sedimentation/accretion to occur over time to slowly improve substrate conditions for benthic organisms. Natural recovery is estimated to be the remedy for approximately 50 acres of the 80-acre area of contamination, as follows:
    - An 8-acre area in the center of Ward Cove and a 2-acre area near Boring Station 8 that exhibit a very high-density of sunken logs (>500 logs/10,000 m^2).
    - A 13.5-acre area where water depth to the bottom of the Cove is greater than -120 ft mean lower low water and the depth of the sediment is currently considered to be too great to cap.
    - A 14.5-acre area where slopes are estimated to be greater than 40 percent and are currently considered to be too steep for capping or mounding material to remain in place.
    - An 11-acre area where the organic-rich sediments do not have the bearing capacity (i.e., strength is less than 6 psf) to support a sediment cap and are too thick (i.e., thickness is greater than 5 ft) to practicably allow for placement of sediment mounds.
    - A 0.2-acre area near the sawmill log lift where maintenance dredging generally occurs on an annual basis.

- Institutional controls requiring that post-remediation activities within the area of contamination that materially damage the thin-layer cap or mounds will be required to redress such damage, at the direction of EPA.
- Implementation of a long-term monitoring program for the remedial action until RAOs are achieved, at the direction of EPA.
- Subtidal investigation of sediments near the east end of the main dock, and subsequent dredging and disposal of contaminated sediments, as deemed appropriate by EPA.

The marine OU ROD stated that chemical-specific bulk sediment criteria were not established as cleanup levels for the COCs at this Site (ammonia, sulfide and 4-methylphenol). These COCs are non-persistent products of organic matter degradation; the dissolved form of these chemicals is the toxic form, and dissolved concentrations are expected to vary considerably both spatially (horizontally and with depth) and over time. EPA concluded that the success of the remedy would be best measured by those indicators most directly representative of RAOs, i.e., sediment toxicity and the health of benthic infauna.

Uplands OU

In 1997, an administrative order on consent was negotiated between EPA, ADEC, KPC, and Louisiana-Pacific Corporation (the parent company of KPC) to address response actions for the uplands OU at the Site. Uplands OU RI and removal work were conducted under this order. The order also allowed for EPA's recovery of oversight costs for both the uplands and marine OUs.

Early removal actions were conducted and removed the most contaminated source material, eliminated unacceptable risks from direct contact with soils, eliminated soil transport to Ward Cove, eliminated leaching of surface soil contaminants to groundwater, and minimized potential future direct contact with subsurface soils at the Site. These actions included the following:

- Removal and off-site disposal of soil/sediment from the paint shop/former maintenance shop, the access road ditch, railroad track areas, compressor area, the former bulk fuel area, and the former storage area along the water pipeline access road.
- PCB-, lead- and petroleum-contaminated soil was removed at the paint shop and water pipeline storage areas.
- Low level dioxin-containing sediments were removed from the access road ditch to accommodate widening of the road for large demolition equipment.
- Fuel-contaminated soils were removed from the other areas.
- Demolition activities have also been extensive, with removal of several buildings and structures and reconfiguration of others to prepare the Site for other future industrial and commercial activities.
- Cleaning out of cisterns (water and sediment) within the vicinity of the mill potentially impacted by past aerial deposition of stack emissions.

The wood waste and ash disposal landfill was closed in 1997, and a new landfill cell was constructed on top of the wood waste disposal site. All closure and post-closure activities of this landfill were conducted pursuant to ADEC solid waste and all other applicable state regulations, and the new cell is regulated by an ADEC Solid Waste Permit. The closure activities conducted included placing a geomembrane cap over the closed landfill; placing topsoil over the cap and contouring the final grade to minimize erosion; establishing a vegetative cover; maintaining the final cover and upgrading the leachate collection and treatment system; and conducting long-term monitoring. The landfill cover was designed to prevent infiltration of rainwater, eliminate direct exposure to on-site workers or trespassers, prevent migration of leachate to surface waters and Ward Cove, and collect surface water runoff. Closure of the final landfill cell occurred in 2001.

EPA issued a ROD for the uplands OU in June 2000. The RAOs of the uplands OU remedy are to:

- Reduce cancer and noncancer risks to current and future workers from exposure to soil contaminants.
- Minimize future cancer and noncancer risks to off-site or future residents from contaminated soil or groundwater exposure.

- Minimize on-site workers' arsenic exposure from future use of imported rock products.
- Minimize potential migration of contaminants to Ward Cove from the landfill.

The early actions completed at the Site are a significant part of the final selected remedy. In the uplands OU ROD, EPA selected the following remedy to ensure long-term protectiveness for three site areas (the former pulp mill area, the pipeline access road, and the wood waste and ash disposal landfill):

Former Pulp Mill Area

- Compliance with already-existing institutional controls to ensure that the use of the former pulp mill area remains commercial/industrial. Such controls rely on the authorities of various regulatory agencies and include the following:
    - Compliance with zoning restrictions of the Ketchikan Gateway Borough. The Borough has zoned the former pulp mill area for industrial use only. No residential or retail use of the area will be allowed.
    - Compliance with an Environmental Protection Easement and Declaration of Restrictive Covenants recorded on October 28, 1999. This document includes restrictions on use of the former KPC mill property now owned by Gateway and is enforceable by the State of Alaska Department of Natural Resources. Such restrictions include the following:
        - The Site shall not, at any time, be used, in whole or in part, for human habitation, schooling of children, hospital care, childcare or any purpose necessitating around-the-clock residence by humans.
        - Drilling of drinking water wells is prohibited.
        - Use of groundwater for drinking water is prohibited.
- Compliance with the protocols and requirements set forth in the "Management Plan for Arsenic and Rock and Soil," prepared by Exponent for KPC, dated July 1998, to limit concentrations of arsenic from crushed rock.
- Development and implementation by EPA, ADEC, KPC and Gateway of an enforceable Institutional Controls Plan (IC Plan). The IC Plan will set forth procedures and protocols to prevent or minimize the potential for future exposure of residual contamination at the Site and will include the following elements:
    - Procedures to ensure that soils in the nearshore fill area, soils underneath paved areas or structures at the former pulp mill site, or soils that were not evaluated or characterized during the remedial investigation that are exposed in the future, e.g., as the result of excavation or demolition activities, are properly characterized and managed in accordance with applicable disposal requirements.
    - Coordination, notification, record-keeping and reporting requirements between KPC and Gateway and the appropriate regulatory agencies.

Pipeline Access Road

- Compliance with the protocols and requirements set forth in the "Management Plan for Arsenic and Rock and Soil," prepared by Exponent for KPC, dated July 1998, to limit concentrations of arsenic from crushed rock.
- Development and implementation by EPA, ADEC, KPC and Gateway of an enforceable Institutional Controls Plan (IC Plan). The IC Plan will set forth procedures and protocols to prevent or minimize the potential for future exposure of residual contamination at the Site and will include the following elements:
    - Procedures to ensure that soils that were not evaluated or characterized during the remedial investigation that are exposed in the future, e.g., as the result of excavation or demolition activities, are properly characterized and managed in accordance with applicable disposal requirements.
    - Coordination, notification, record-keeping and reporting requirements between KPC and Gateway and the appropriate regulatory agencies.
- KPC shall develop and record an easement and restrictive covenants document (or equitable servitude) for property owned by KPC, namely pipeline access road areas. The easement/restrictive covenants shall be

similar in nature to the Easement/Restriction Covenants for the pulp mill area and shall include the following elements:

- Prohibition of any activities that may result in drilling of water wells or use of groundwater.
- Access by authorized representatives of EPA, ADEC or ADNR to inspect the pipeline access road areas. The pipeline access road area may be available for recreational use.
- Conveyance of the easement/restrictive covenants to the State of Alaska Department of Natural Resources.

Wood Waste and Ash Disposal Landfill

- KPC shall close the remaining open cell at the landfill in accordance with ADEC Solid Waste Permit No. 9713-BA001 and all other applicable regulations. Closure activities include the following:
  - Placing a geomembrane cap over the closed cell.
  - Placing topsoil over the cap and contouring the final grade to minimize erosion.
  - Establishing a vegetative cover.
  - Maintaining the final cover, passive gas venting system, and leachate treatment system.
  - Conducting long-term monitoring, including visual and surface water monitoring. Surface water monitoring shall include collection of water samples to assess whether surface water leaving the Site could potentially endanger public health, ecological receptors, or cause a violation of water quality standards or permit conditions.
- Development and implementation of provisions in the IC Plan to ensure compliance with the above-described restrictions for the landfill.
- Compliance with the protocols and requirements set forth in the "Management Plan for Arsenic and Rock and Soil," prepared by Exponent for KPC, dated July 1998, to limit concentrations of arsenic from crushed rock.
- KPC shall develop and record an easement and restrictive covenants document (or equitable servitude) for property owned by KPC, namely the landfill. The easement/restrictive covenants shall be similar in nature to the Easement/Restriction Covenants for the pulp mill area and shall include the following elements:
  - Prohibition of any activities that may result in use of groundwater, potential exposure of waste materials within the landfill, or potential interference with the integrity of the landfill cap.
  - Access by authorized representatives of EPA, ADEC or ADNR to inspect the landfill.
  - Conveyance of the easement/restrictive covenants to the State of Alaska Department of Natural Resources.

APPENDIX D – SITE MAPS

Figure D-1: PSSA Cruise Ship Dock location, Public Notice of Application for Permit, POA-2019-00313

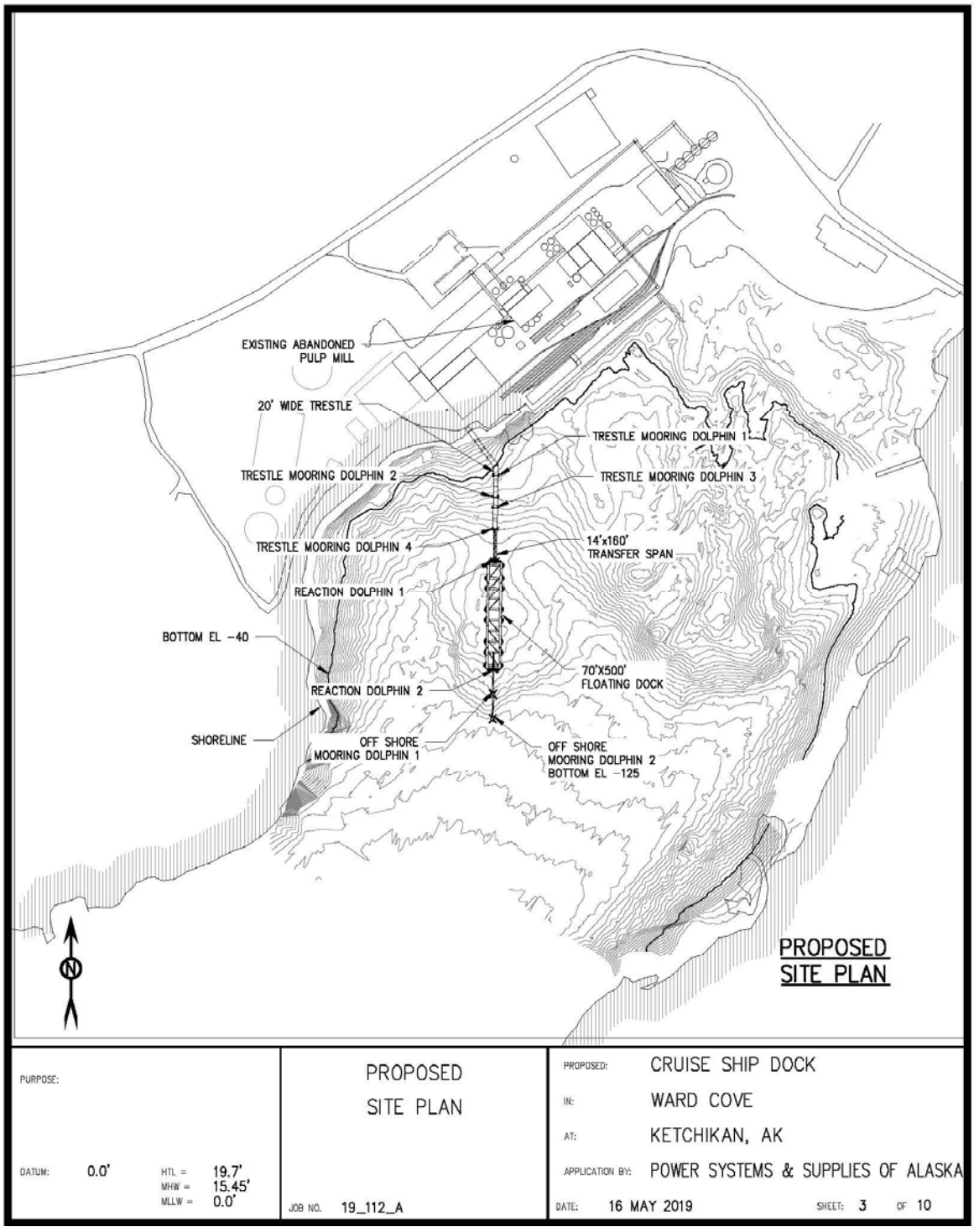
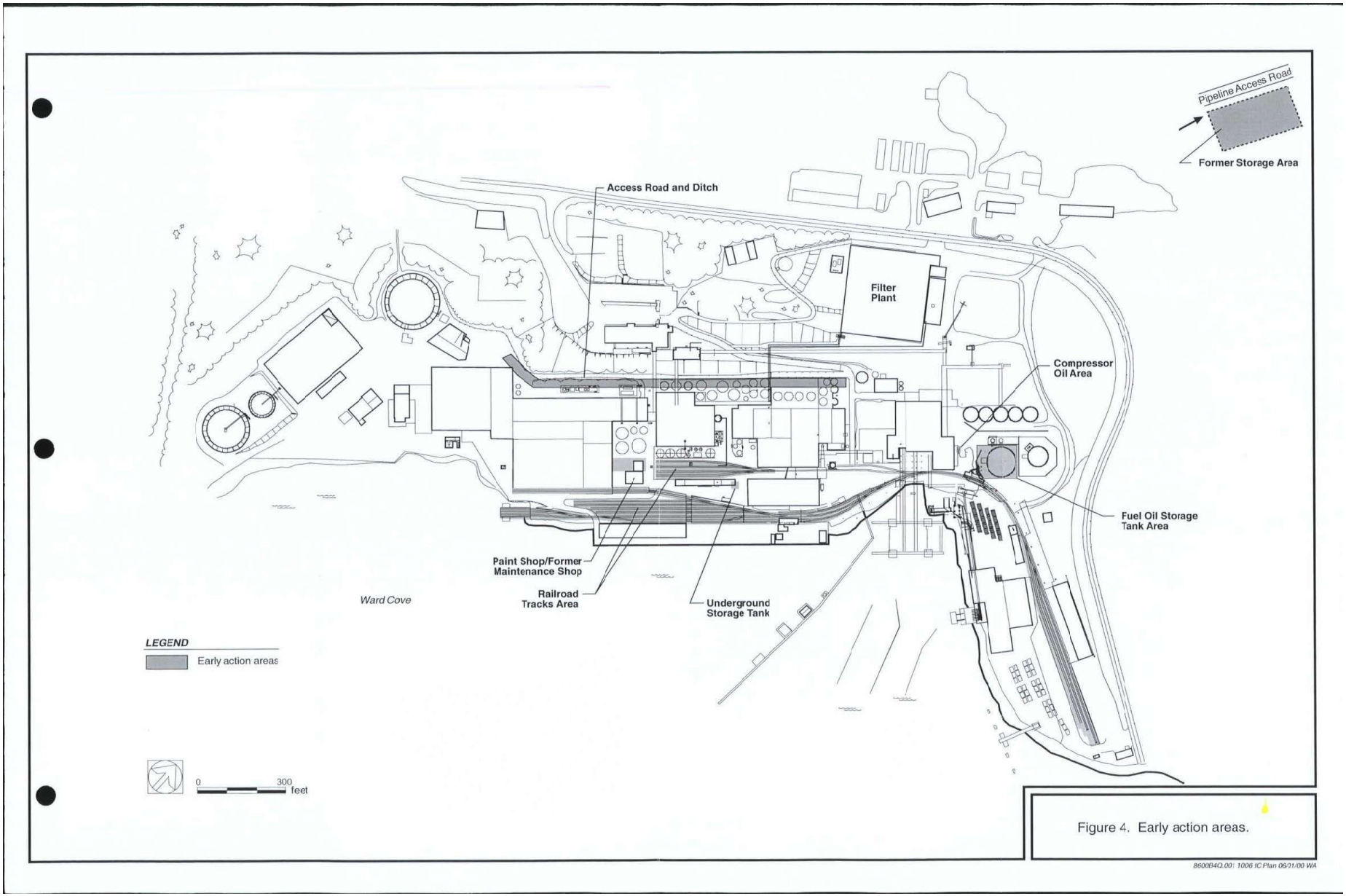


Figure D-2: Early Removal Action Areas for Uplands OU, from the 2000 Institutional Control Plan



APPENDIX E – PRESS NOTICE

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Cleanup Review for Ketchikan Pulp Superfund Site
Site Visit July 25, 2019

Site Visit July 25, 2019
As part of its five-year review process, EPA's site team will be visiting the Ketchikan Pulp Superfund Site on July 25, 2019.

We Want to Hear from You
EPA staff will be interviewing stakeholders and community members. If you have information or observations about the Site that can help our review team, have questions, or would like to participate in an interview, contact EPA project manager ***Kathy Cerise*** *at* ***cerise.kathryn@epa.gov*** *or* ***206-553-2589.***

For More Information
More information and site-related documents such as past five-year reviews are on EPA's website:
https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=1000020

Information is also available at:
Ketchikan Library
1110 Copper Ridge Lane
Ketchikan, AK 99901
907-225-3331
www.ketchikanpubliclibrary.org/

What and Why
The fourth Five-Year Review of the environmental cleanup at the Ketchikan Pulp Company Superfund Site is underway. EPA reviews Superfund sites every five years when contaminants remain on site. The purpose of the review is to make sure cleanup actions work as intended and continue to protect human health and the environment.

About the Superfund Site
The Site is on the shoreline of Ward Cove, about five miles north of Ketchikan, Alaska. Upland, wetlands, and marine areas are all part of the Site. Former mill operations, including wastewater and stormwater discharge, and wood waste and ash disposal in the landfill, contaminated the marine and uplands areas. Contaminants of concern for the site include ammonia, sulfide, 4-methylphenol, polychlorinated biphenyls (PCBs), heavy metals, polynuclear aromatic hydrocarbons (PAHs) and dioxins/furans.

About the Cleanup
The cleanup for the Site is complete. Sediment cleanup in Ward Cove consisted primarily of sediment capping (sealing contaminants by covering with a layer of clean sand). Projects or activities that materially damage the cap are required to repair or replace the cap. Groundwater use is prohibited. The most contaminated soils in the upland area were removed. The wood waste and ash landfill closed. A passive gas venting system and leachate treatment system were installed. A geomembrane cap seals the landfill with topsoil and vegetative cover, protecting the cap.

Current Activity
The site has been redeveloped and is being used by industrial and commercial businesses. Ward Cove is the proposed site for a marine facility for state ferries and National Oceanic and Atmospheric Administration ships. The Army Corps of Engineers has recently received a permit application for construction, beginning in September, for a cruise ship dock. EPA and Alaska Department of Environmental Conservation will coordinate on any development.

TDD and/or TTY users may call the Federal Relay Service at 800-877-8339.
Then please give the operator number 206-553-2589 to reach EPA project manager Kathy Cerise.

APPENDIX F – INTERVIEW FORMS

Ketchikan Pulp Company SITE FIVE-YEAR REVIEW INTERVIEW FORM	
Site Name: Ketchikan Pulp Company	
EPA ID: AKD009252230	
Interviewee name: Evonne Reese & Sally Schlichting	**Interviewee affiliation: ADEC Contaminated Sites Program – IC Unit**
Subject name: KPC Ward Cove	**Subject affiliation:**
Subject contact information:	
Interview date: 10/31/2019 and 11/18/2019	**Interview time:**
Interview location:	
Interview format (circle one): In Person Phone Mail **Email** Other:	
Interview category: State Agency	

1. **What is your overall impression of the project, including cleanup, maintenance and reuse activities (as appropriate)?**

Now that there are proposed development projects in the Ward Cove Uplands and Marine OUs, it appears that some of the RAOs may not have been as effective as intended, especially for the Marine OU. Specifically, it is not clear that the RAOs envisioned the type of vessel activity now being proposed. Also, the stipulations set forth in the Consent Decree do not clearly include the areas of the AOC [Area of Concern] that were subject to enhanced natural recovery; only the portions where a sand cap was applied. Furthermore, it would appear that the monitoring performed was insufficient to conclude that recovery had occurred and it was premature to halt monitoring in 2007. Video provided by university researchers of the post-monitoring conditions of the benthic environment raise significant concerns over the effectiveness of the remedy, even without the proposed cruise ship activity planned by developers.

Cleanup
Marine OU - optimally all of the contaminated sediment would have been dredged from the cove, even with the added expense in order to allow for unrestricted future development. Also the sediment sampling which was discontinued in 2007 should have been continued in order to provide more reliable data to base development decisions on.

Maintenance
To date we know of no notable maintenance to the remedies for the Marine or Uplands OU. Since actual development projects have never been proposed until recently, there has not been a need for site maintenance, especially with the Marine OU since the cove floor most likely benefitted from being left mostly alone.

Reuse activities
It is our view that the ENR and sand cap remedy for the Marine OU was not adequately designed to accommodate the full range of potential future vessel sizes, propulsion systems and traffic that is now being envisioned by project developers. If anything, there is ambiguity in the past record about what is allowed and to what degree specific vessels and activities can occur. Historical documents specifically mentioned that cruise ship operations in the cove were envisioned along with other marine navigation. However, modern cruise ships are so much larger, with different propulsion systems than what was in operation in the early 2000s, that additional work needs to be done to ensure that these vessels can operate without damage to the remedy and continued recovery of the cove.

Development on the Uplands OU should be more manageable since sampling and characterization of areas that require it will be more straightforward and can be thoroughly investigated prior to development.

2. What is your assessment of the current performance of the remedy in place at the Site?

See comments above. It is accurate to conclude that all parties lack a full assessment of current status of how the remedy in the Marine OU is performing. For the Marine OU remedy, at a minimum the institutional controls should have taken into account not only the sediment capped areas but also the areas that were left to naturally attenuate. The current proposed projects in both the Marine and Uplands OU will be the real test of the remedy performance; however, what is the recourse if the cruise ship dock in Ward Cove creates an ongoing release of waste left in place that impairs and degrades the benthic habitat? Once the facility is permitted and installed, what actions can be taken to address this? In our minds the only recourse is to require dredging of the contaminated sediments in vessel traffic areas.

3. Are you aware of any complaints or inquiries regarding site-related environmental issues or remedial activities from residents in the past five years?

The only comments and inquiries we have received have been from the public concerning the proposed cruise ship dock construction and operations. Members of the Ketchikan Indian Community and other citizens of Ketchikan have voiced their concerns about impacts to fish and parts of the cove becoming a dead zone with continual operations of the mega cruise ships. They worry that any recovery that has been gained will be lost.

4. Has your office conducted any site-related activities or communications in the past five years? If so, please describe the purpose and results of these activities.

Yes, in the past 10 years we have communicated about minor issues with PSSA (the landowners) such as updating tenant records for lessees on the Uplands property. Until recently there have not been any substantial changes to the Uplands property that could threaten the protectiveness of the ICs.

Recently we've been communicating with PSSA regarding future development of the Uplands associated with the proposed cruise ship dock.

5. Are you aware of any changes to state laws that might affect the protectiveness of the Site's remedy?

No, we are not aware of any regulations changes that could directly affect the protectiveness of the overall remedy. However, we have had several regulations and law changes since 1999 that include:

a) updated risk-based cleanup standards for multiple compounds listed in regulation for both soil and water; including arsenic, lead, PCBs;
b) change in how metals such as chromium and arsenic are managed
c) updated language for institutional controls;
d) repealed language that had previously allowed a risk range of 1×10^{-4} to 1×10^{-6}; and
e) passed a law in 2018 that adopted the Uniform Environmental Covenants Act which requires that a site that is closed with restrictions must have a covenant

6. Are you comfortable with the status of the institutional controls at the Site? If not, what are the associated outstanding issues?

The institutional controls for the Marine OU should be codified in a legal document, rather than in a pair of letters exchanged between the consultant for the RP [responsible party] and the EPA RPM. Perhaps one document could be created to formalize and clarify the IC requirements for the two different operable units which also cites the legal documents that provide the enforcement and legal authority with this Site. The IC compliance letter that we (ADEC) will be issuing to PSSA regarding IC compliance and the 2019 site inspection should help to clarify some of these details, but it would be preferred to have one that is formalized by both ADEC and EPA with input from agency attorneys.

7. Are you aware of any changes in projected land use(s) at the Site?

Recently we've been communicating with PSSA regarding future development of the Uplands associated with the proposed cruise ship dock. An environmental consultant has been contracted by PSSA and they understand that future project could require some site characterization and investigation dependent on the project's needs.

8. Do you have any comments, suggestions or recommendations regarding the management or operation of the Site's remedy?

The historical cleanup was not well documented in the ADEC database or electronic records, but this is probably due to the time period which was prior to the ease of electronic documentation and database technology. As part of this 2019 five-year review process we working to document the site record more thoroughly in our electronic records, making sure that our library of relevant historical documents is complete and the most pertinent documents are posted to the publicly facing database application.

As part of this entire 2020 five-year site inspection, we hope all parties involved will come away with a better understanding of everyone's defined roles and responsibilities for all the different stakeholders including agencies, so that we can memorialize the information and make it available to all parties involved.

9. Do you consent to have your name included along with your responses to this questionnaire in the FYR report?

Yes.

THE STATE of ALASKA
GOVERNOR MICHAEL J. DUNLEAVY

Department of Environmental Conservation
DIVISION OF SPILL PREVENTION AND RESPONSE
Contaminated Sites Program
P.O. Box 111800
Juneau, Alaska 99811-1800
Main: 907.465.5250
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www.dec.alaska

File: 1540.38.004

November 22, 2019

Transmitted via email

Dave Spokely
Power Systems & Supplies of Alaska
P.O. Box 772
Ward Cove, Alaska 99928

Re: Report of 5-Year Review Site Inspection and Institutional Controls verification for KPC Ward Cove Pulp Mill site

Dear Mr. Spokely:

The purpose of this letter is two-fold. One, it serves to document DEC's site inspection conducted July 25, 2019 in conjunction with EPA for the periodic review of institutional controls for the former KPC Ward Cove Pulp Mill Site. A physical inspection is conducted every five years and is part of the Five-Year Review requirement under CERCLA and the Record of Decision for the site. The inspection serves to provide information about the current status and uses of the site for EPA to consider in completing the Five Year Review. Secondly, this letter summarizes proposed development activities that you have described to us and provides clarification of the institutional controls currently in place, along with notification procedures.

The Ward Cove property is located at located at Mile 7.5 North Tongass Highway north of Ketchikan. The site consists of two CERCLA designated areas: the Uplands Operable Unit (Uplands OU) and the Marine Operable Unit (Marine OU). The July 2019 five-year review inspection covered the three main areas of the Uplands OU: Connell Lake, Dam and Pipeline; the closed wood waste landfill under KPC management; and the former mill area. In addition, the development and infrastructure along the shoreline and the AMHS property were inspected. The submerged portion of the Marine OU consists of the entire cove including the Area of Concern where the most significant impacts to the marine environment were documented, but beyond visual inspection from the shore, this area was not part of the inspection. During the site inspection, EPA and DEC Contaminated Sites Program staff were accompanied by representatives of Power Systems & Supplies of Alaska (PSSA), Ketchikan Pulp Company (KPC), and ADOT&PF/AMHS.

Background
At the time of closure, soil, marine sediment, and groundwater contamination remained at levels that require use restrictions for the upland property and in the cove. As far as DEC is aware, both the Marine OU and the Uplands OU are subject to institutional controls (ICs) established and enforced under a

2004 conservation easement and restrictive covenant signed by KPC and the Ketchikan Gateway Borough (KGB), a 2000 Consent Decree entered into by Ketchikan Pulp Company, Louisiana Pacific Corporation, and Gateway Forest Products and/or a 1999 Environmental Protection Easement and Declaration of Restrictive Covenants entered into between Ketchikan Pulp Company and the State of Alaska. These documents and their various restrictions run with the land and apply to all subsequent owners, successors and assigns. Current owners at the site are KPC, PSSA, and ADOT&PF/AMHS. KPC owns the landfill; PSSA owns the upland pulp mill site and a majority of the cove; and ADOT&PF owns a portion of the upland and a small portion of the cove. PSSA leases its property to Ward Cove Industries LLC.

Uplands OU Inspection

Conditions observed during the inspection of the various areas of the Uplands OU are discussed below. Institutional control requirements as detailed in the 2000 Institutional Controls Plan (Appendix C of the 2000 Consent Decree) for the Uplands OU consist of the following:

- Maintain acceptable risk levels for soils for industrial/commercial exposure scenarios;
- Comply with requirements identified in the *Management Plan for Arsenic in Rock and Soil* to reduce exposure to arsenic in soil and rock;
- Restrict residential land use (or similar non-industrial/commercial land use resulting in around the clock residence by people or daily use by children);
- Prohibit drilling of water wells and use of groundwater;
- Identify and address source areas (if any) during demolition and excavation activities using applicable or relevant and appropriate requirements such as current risk-based concentrations or standards and criteria; and
- Properly characterize and manage soils from the near-shore fill subarea or underneath paved areas or structures and from other locations not evaluated or characterized in the remedial investigation if those soils are excavated or exposed.

In addition, under state law, a person shall provide written notice to the department of any proposal to use the site in a manner that is inconsistent with a restrictive covenant or easement (18 AAC 75.375) and shall obtain approval before moving or disposing of soil subject to the site cleanup rules (18 AAC 75.370(b)).

Connell Lake, Dam, and Pipeline

Connell Lake is located about three miles east of Ward Cove. A large dam at Connell Lake (man-made) and the four-foot diameter pipeline supplied water to the former mill and now serve as a water source for fire prevention for the North Tongass Fire and Emergency Medical Services (EMS) Area and a sewage treatment plant on the former mill property. The habitat along the pipeline is heavily forested and since the pipeline is gravity fed, the general gradient is downward towards Ward Cove.

The wood stave pipeline built in 1954 still functions and runs from the Connell Lake Dam to Ward Cove. Water flows continuously through the pipeline at a rate of 49 million gallons per day, which helps to preserve its integrity. The water is currently used for wastewater treatment and fire hydrant water supply. The pipeline and adjacent service road are maintained yearly when the pipe is checked for integrity and the vegetation is cleared on both sides of the pipeline.

The pipeline, dam, and lake are zoned for recreational use, and the pipeline service road is also designated as a recreational foot trail by the United States Forest Service. The area sees up to 100 visitors per day during the tourist season, both pedestrians and bike riders. Vehicle access by the public is also allowed, but the dam itself is gated therefore not accessible to public use. This area is subject to the 2000 Institutional Controls plan because contamination from poly-chlorinated biphenyls (PCBs) was left in place in three areas along the pipeline road at levels above the residential soil cleanup level of 1.0 mg/kg, and lead was left in one area at levels as high as 2,300 mg/kg, in excess of both residential and commercial cleanup levels for lead. Levels of these contaminants remaining along the pipeline road have been deemed suitable for commercial/industrial and recreational uses only. At the time of the inspection, DEC finds that the current recreational use of the area and limited access are consistent with the institutional controls for the Upland OU.

Wood Waste and Ash Disposal Landfill

The landfill portion of the inspection was led by Phil Benning of KPC and Barry Hogarty of Technical Environmental Services, KPC's consultant. The closed landfill and leachate lagoon are continuously managed by KPC. The landfill contains wood waste and ash from mill operations removed from various locations in the Upland OU and dredged spoils from the Marine OU. In addition to any other requirements, the landfill is subject to post-closure monitoring under the DEC Solid Waste Program. The landfill is continuously maintained and mowed in order to control the vegetation and to discourage large tree growth which could damage the landfill membrane cap. The grass covering the landfill is well established and well maintained. Leachate from the landfill is collected in a geomembrane lined lagoon. The leachate treatment system consists of a settling pond with aerators. Currently the aerators do not run since the leachate flow has slowed down. The pond seeps into a thriving, constructed wetland that has an abundance of amphibians. The leachate discharges into an area in the woods adjacent to the wetland and is subject to an Alaska Pollutant Discharge Elimination System permit issued by the DEC Division of Water Quality. DEC found that the current use and status of the closed landfill remains consistent with the institutional controls for the Upland OU.

ADOT&PF/AMHS property

The AMHS property is located on the northeastern edge of Ward Cove. We briefly toured this property which will be used as a future dock and berthing facility and is referred to as the "Ward Cove Marine Facility." In February 2019, AMHS adjusted their lot line in a land exchange for submerged lands with PSSA in order to construct the vessel maintenance facility outside of the sand capped areas and partially outside of the Area of Concern. Prior to construction there may be a need to remove a high point at Bolles Ledge which is in the Area of Concern. At the time of the inspection, DEC found that the current use of the AMHS property is consistent with the institutional controls for the Upland OU.

Former mill area

Contaminants of concern identified at the former mill site were arsenic, lead, polycyclic aromatic hydrocarbons (PAHs), PCBs, and petroleum hydrocarbons. Areas where unacceptable risk levels were present (cancer risks > 1 in 10,000 or 1 X 10^{-4}) and other areas were remediated in accessible surface soils (those not covered by buildings) to levels that are acceptable for a commercial industrial exposure use (<1 X 10^{-4}). In addition, elevated concentrations of arsenic are present throughout the mill area in excess of 50 mg/kg.

There has not been any new building construction since the mill closure. The only remaining buildings are named Warehouse #1 (Lower brick building), Warehouse #2 (other brick building), Warehouse #3

(yellow metal building), the Roll Building, and the Administration Building. There are currently some tenants in the remaining structures, but most of the lease spaces are and will remain vacant to accommodate future development plans. All concrete foundations and roads associated with the former mill have been left in place. Based on discussions with you during the site inspection, Ward Cove Industries has no current plans to remove foundations or asphalt or concrete surfaces. During the site visit, an area off the road that leads down into the former pulp mill area was observed to be heavily disturbed and full of debris and overburden. Based on information from you provided on November 1, 2019, this area of the property was previously known as the Wood Room, where log bundles removed from the cove with a bundle crane were stored. The crane itself was removed at the time the mill was closed. The remaining infrastructure was taken down by a prior owner of the property, in 2008 or 2009. The site owner at the time demolished building but left the foundation slab intact along with large piles of brick rubble and a mound of debris which was observed during the site inspection. Since PSSA purchased the property, the area has been left undisturbed and has gradually revegetated.

Over the past summer, PSSA has consolidated the brick rubble into organized piles, which are situated on existing concrete slabs. No foundations have been removed or new ground surface exposed. The alders that have grown on both the brick rubble piles and the soils have been pulled out and placed in a pile for burning. No soil has been excavated or removed from the area.

DEC found that the current use and status of the former mill area remains consistent with the institutional controls for the Upland OU.

Marine OU Inspection

The inspection of the Marine OU was limited to the shoreline of the former mill area as a visual inspection of the seafloor of Ward Cove is beyond the scope of this 5-year review.

As described in the 2002 *Addendum to the Long-term Monitoring and Reporting Plan for Sediment Remediation in Ward Cove*, for any circumstances that are deemed to violate the institutional controls in the 2000 Consent Decree that could materially damage (e.g., erode or displace) any portion of the AOC that has a sediment cap, the following actions must be taken:

- The property owner of the tidelands will notify the EPA project coordinator for the Marine OU at least 3 months prior to initiation of such action. The property owner shall provide all information requested by EPA for EPA's evaluation of the proposed action.
- The property owner of the tidelands will notify the KPC/Louisiana-Pacific project coordinator for Ward Cove at least 3 months prior to initiation of such action.
- The EPA project coordinator will notify the appropriate contact at the State of Alaska Department of Natural Resources (which is delegated to DEC through a management rights assignment).
- EPA will determine the methods needed to assess the magnitude of the damage to or disruption of the cap.
- The property owner will assess the magnitude and scale of the cap disruption using the methods specified by EPA.
- EPA will determine the appropriate response action to address the damage.
- The property owner will ensure replacement of portions of the cap that are materially damaged, as specified by EPA.

- The property owner will submit two copies of a written report summarizing the completed action(s) to the EPA project coordinator for approval. The report shall describe all work performed (work completed, work dates, results of analyses, project personnel, problems encountered, and resolutions) and shall include as-built drawings of the completed construction work signed and stamped by a professional engineer registered in the State of Alaska. The report shall be revised in response to EPA comments.
- The property owner of the tidelands will be liable for EPA's costs associated with reviewing and overseeing the action or proposed action that is deemed by EPA to violate the institutional control.
- These procedures and requirements do not act to relieve current and future owners of any obligations under the CERCLA Consent Decree.

The shoreline area subject to the inspection is about ½ mile long and consists of marine infrastructure along the shoreline seawall, including a pier and a separate dock approximately 225 feet long with four support pilings. Attached to the dock are two green float houses for a local aquaculture business. When stored in Ward Cove there are no occupants and therefore no overnight lodging. When in use, the float houses are hauled out to various fish hatchery sites (outside of Ward Cove) for housing seasonal employees. South of the dock, two AMHS ferry vessels were moored at the pier. AMHS rents the pier for vessel storage from PSSA under a continuous layup agreement.

During the inspection, DEC and EPA learned from PSSA that the number of pilings for the 225-foot dock was increased from three to four a few years ago. The additional piling was installed through the sand cap in this area with a vibratory pile driver, under a permit by USCOE. EPA was not informed of the proposed change as required by the site's institutional controls. In addition, under state law, a person shall provide written notice to the department of any proposal to use the site in a manner that is inconsistent with a restrictive covenant or easement (18 AAC 75.375). As a result of this action, DEC and EPA will require PSSA to work with EPA and DEC to create a plan to assess the magnitude and scale of any cap disruption that may have occurred as a result. If any disruption has occurred, PSSA must ensure replacement of portions of the cap that are materially damaged, as approved by EPA and DEC.

Future Development Plans for the Uplands OU

As part of the institutional control requirements, DEC and EPA should be notified in advance of any development plans and permit applications that propose to use the site in a manner that is inconsistent with 18 AAC 75.375 and associated institutional controls described in the 2000 Institutional Control Plan. The plans that DEC is currently aware of are as follows:

Former Mill Area: On October 15, 2019 PSSA provided DEC with a written summary of future development plans for this area, to be renamed The Mill at Ward Cove.

- Relocation of the Full Cycle Alaska building and soil and rock from a parcel inside the Uplands OU to a vacant lot within the Uplands OU. In accordance with the 2000 Institutional Controls Plan, and 18 AAC 75.370, PSSA will submit a sampling and analysis plan to characterize the soil on the Full Cycle Alaska property for EPA and DEC's review and approval.

- Future plans for the mill area will support tourism traffic and include a boardwalk and upgrades of the current historic buildings to provide a welcome center, museum, and restrooms. Three 1970s-era metal buildings will be removed but the foundations will be left in place and used as patios and bus parking. The bus parking and staging area will initially be graded and capped with

gravel but may later be capped in concrete or asphalt. Road widening is planned for the entry road that runs along the side of the administrative building and parking lot. Utility and water line installations are also planned.

- PSSA has verbally described plans to establish a walk-in medical clinic at one of the historic buildings on the former mill site.

Please provide DEC and EPA with written notice and description of these and any other proposed projects/activities that may be subject to the requirements of the 2000 Institutional Controls Plan and the requirements of 18 AAC 75.375, so that they can be evaluated to determine necessary requirements such as work plans or sampling and analysis plans, prior to beginning work.

Future Development Plans for the Marine OU

- The Ward Cove Dock Group, LLC, comprised of the Spokelys and Godspeed, Inc., owned by the Binkley family, are currently proposing construction of a large cruise ship dock designed for post-Panamax vessels. This structure and vessel operation will occur in and near the Area of Concern in Ward Cove. This project is currently in the permitting process with the U.S. Army Corp of Engineers.

- Ward Cove Industries has proposed construction of a barge haul out dock near the northeast end of Ward Cove. This project is currently in the permitting process with the U.S. Army Corp of Engineers.

As described in our 9/19/2019 letter providing comments on the ACOE permit applications for these projects, DEC has requested and project developers have agreed to provide the following:

1. Prior to the commencement of construction activities, a pre-construction benthic seafloor survey and sampling/analysis plan be submitted for DEC and EPA approval to document baseline conditions prior to construction in the areas of the Marine OU where construction activities for both facilities are proposed to occur. The work plan objectives should mimic those described in the long-term monitoring and reporting plan submitted by Exponent in 2001 and reiterated in the 2007 Monitoring Report for Sediment Remediation in Ward Cove, Alaska, authored by Integral Consulting, Inc. and submitted in April 2009.

2. Submission of a benthic seafloor monitoring plan for DEC and EPA approval prior to the commencement of cruise vessel operations, which assesses conditions in the areas of the Marine OU where vessel activity will occur. The work plan objectives should mimic those described in the long-term monitoring and reporting plan submitted by Exponent in 2001 and reiterated in the *2007 Monitoring Report for Sediment Remediation in Ward Cove, Alaska*, authored by Integral Consulting, Inc. and submitted in April 2009. Monitoring under the approved plan will be conducted after the first season of operations and may be required for a second year, based on facility operations and results of the first year of monitoring.

3. Within 90 days prior to operation, submission to DEC, EPA, and other agencies (such as USCG) as appropriate, of a best management practices operation plan that is developed in coordination with cruise vessel pilots and tug operators along with the other users of Ward Cove. The plan should outline the general navigational route and docking locations for the types of vessels and

tugs and their propulsion systems. The plan should describe maneuvering scenarios under a variety of wind, current, and traffic conditions as well as location and depths of those activities and the potential for scour impacts (if any). The plan should describe how operations will occur to avoid impacts to the Marine OU under the scope of anticipated (wind, current, traffic) conditions. It should include but not necessarily be limited to procedures for documenting and reporting on adherence with the plan; measures for improvements; and signatories (participants) in the plan.

4. A work plan be submitted for DEC and EPA approval for the proposed upland excavation activities including sampling and analysis to:
   a. Comply with requirements identified in the Management Plan for Arsenic in Rock and Soil to reduce exposure to arsenic in soil and rock;
   b. Identify and address source areas (if any) during demolition and excavation activities using applicable or relevant and appropriate requirements such as current risk-based concentrations or standards and criteria; and
   c. Properly characterize and manage soils excavated from the near-shore fill subarea or underneath paved areas or structures and from other locations not evaluated or characterized in the remedial investigation.

Please note that the deliverables listed above do not necessarily satisfy all of EPA requirements, or shield you from federal Superfund liability. To ensure that your project complies with EPA requirements, please refer to EPA's November 6, 2019 letter.

DEC plans regarding future institutional control management

DEC anticipates that the pace of your company's development activities at the former mill property will increase in frequency and intensity going forward. To facilitate better coordination and ensure compliance with institutional controls, DEC will plan to conduct an inspection with PSSA on an annual basis or more frequently if needed. In addition, we are reiterating the Notification Procedures for routine and major excavations and demolitions. These activities are defined in the 2000 Institutional Controls Plan.

Notification Procedures

Notification procedures for the Upland OU are as follows (See Table 3 from the 2000 Institutional Controls Plan). The landowner (PSSA) will notify both DEC (Contaminated Sites Program) and EPA (Region 10 Remedial Project Manager) by email if any of the following occur:

- Major demolition activities are planned
- Any sampling is to be conducted during major demolition
- Any soil samples collected during routine excavations or demolition activities which exceed soil screening levels
- Suspect debris (e.g., buried drum or paint can) is found during routine excavations or demolition activities.

All sampling must be performed in accordance with the 2000 Institutional Controls Plan and a DEC approved sampling and analysis plan (18 AAC 75.355). Any offsite transport of soil or groundwater requires prior approval from DEC (18 AAC 75.325(i)). Offsite transport and disposal request forms can

be found here: http://dec.alaska.gov/media/12127/transport-treatment-disposal-approval-form-for-contaminated-media-fillable.pdf

For notification requirements concerning work in the Marine OU, refer to the Marine OU inspection section above.

In addition to the conditions described in this letter, you are required to notify the ADEC if there are any changes in land use or ownership that may be in conflict with the institutional controls for this site. Failure to maintain these requirements may result in re-opening the site by the Contaminated Sites Program, in which case, further remediation could be mandatory.

In accordance with 18 AAC 75.380(d)(2), ADEC may require additional site assessment, monitoring, remediation, and/or necessary actions at this facility should information become available that indicates contamination at this site may pose a threat to human health or the environment.

DEC's site information is a matter of public record and is available at ADEC's online database record at: http://dec.alaska.gov/Applications/SPAR/PublicMVC/CSP/SiteReport/412

If you have any questions regarding this site, please contact Evonne Reese of the Institutional Controls Unit at (907) 465-5229 or evonne.reese@alaska.gov.

Sincerely,

Sally Schlichting
Environmental Program Manager

Copy via email:
Kenda Conley, R&M Engineering - Ketchikan
Phil Benning, Ketchikan Pulp Corporation/Louisiana Pacific
Eric Fjelstad, Perkins Coie
Christen Harrington, ADOT&PF, AMHS Ketchikan
John Falvey, ADOT&PF, AMHS Ketchikan
Ward Mace, ADOT&PF, AMHS Ketchikan
Sean Lynch, Department of Law
Rick Welsh, Department of Law
Glenn Brown, Borough Attorney, Ketchikan Gateway Borough
Kathy Cerise, Remedial Project Manager, EPA Region 10
Jenn Currie, Department of Law
Jim Rypkema, DEC Division of Water
Christi Scott, DEC Solid Waste Program

Ketchikan Pulp Company SITE FIVE-YEAR REVIEW INTERVIEW FORM	
Site Name: Ketchikan Pulp Company	
EPA ID: AKD009252230	
Interviewer name: Treat Suomi	**Interviewer affiliation: Skeo**
Subject name: Samuel Naujokas	**Subject affiliation: Ketchikan Indian Community**
Subject contact information: snaujokas@kictribe.org	
Interview date: 10/3/2019	**Interview time: noon Alaska time**
Interview location: Phone	
Interview category: Local Government	

1. Are you aware of the former environmental issues at the Site and the cleanup activities that have taken place to date?

   Too well aware. We got involved with the current proposal to build mega cruise ships at the Site. That's what got us involved, but we know there was some environmental issue at the Site. I've read a lot of the documents on it (the ROD, institutional controls, etc.). That is my knowledge of it. Still don't know a lot as well.

2. Do you feel well-informed regarding the Site's activities and remedial progress? If not, how might EPA convey site-related information in the future?

   Personally, I am, but I know there is community confusion about whether the Site is a Superfund site. Is it technically Superfund or not because it's not on the NPL? That is the big information need: clarify what it means to be a Superfund/CERCLA site and not NPL.

   I've been involved with it for work, so I feel well informed. There is a need for broader community information about the Site.

   EPA has been communicative with the Ketchikan Indian Community. Kathy has been awesome.

3. Have there been any problems with unusual or unexpected activities at the Site, such as emergency response, vandalism or trespassing?

   Not that I am aware of. I'm sure there is some trespassing because it is an abandoned site but not too much to my knowledge.

4. Are you aware of any changes to state laws or local regulations that might affect the protectiveness of the Site's remedy?

   No, I am not.

5. Are you aware of any changes in projected land use(s) at the Site?

   Yes, land and water use. A couple of big concerns: for uplands OU, as part of cruise ship plan to build the dock, have a museum and food, etc. I understand there are some limitations on that when the site was remediated – so I'm concerned about that.

For the marine OU, with plans to put big cruise ships with powerful bow thrusters over the cap that would stir up toxic sediments, there is concern within the community even from people in the tourism industry. Concerned about releasing toxic sediment into waterways. That is an area for salmon, which are sensitive to contaminants. For migrating salmon out of Ward Creek.

I have a video of the cap. It is from a professor of oceanography. The video is not pretty. You can see just the small arms of the ROV stirring up a lot of the sediment, so you can only imagine what a larger propeller might do. I believe it was filmed in 2013.

6. Has EPA kept involved parties and surrounding neighbors informed of activities at the Site? How can EPA best provide site-related information in the future?

   Answered part 1 in earlier questions.

   Part 2: In the community setting, we need more work to be done. People don't know about the Site. Put up signage near area. Ketchikan is very Facebook centric. That is how all the local governments do communication here.

7. Do you have any comments, suggestions or recommendations regarding the project?

   I would definitely like to see more information about the steps for the FYR, so the community is involved.

   I want to see potential impacts of the proposed dock considered when additional remediation is considered.

   I want to know more about what the plan for long term monitoring is. In the last FYR, it said there was no future long-term monitoring plans. Where did that decision come from and why? Any plans for future monitoring to monitor changes on the cap with the dock potential use?

8. Do you consent to have your name included along with your responses to this questionnaire in the FYR report?

   Yes, but my opinions represent me as a staff person, not the tribe.

Ketchikan Pulp Company SITE FIVE-YEAR REVIEW INTERVIEW FORM	
Site Name: Ketchikan Pulp Company	
EPA ID: AKD009252230	
Interviewer name: Kelly MacDonald/Treat Suomi	**Interviewer affiliation:** Skeo
Subject name: Resident 1	**Subject affiliation:** Resident
Subject contact information:	
Interview date: 10/17/19	**Interview time:** 5:25pm
Interview format (circle one): In Person ***Phone*** Mail Email Other:	
Interview category: Resident	

1. Are you aware of the former environmental issues at the Site and the cleanup activities that have taken place to date?

   I know they did a sand cap over a large portion of the area. As far as marine life in most of the cove, I don't know. I see marine organisms at the surface. I don't know the water chemistry out there. I know there was a facility out there trying to raise oysters that was having difficulty, and it was proposed that water quality was part of the problem.

2. What is your overall impression of the project, including cleanup, maintenance and reuse activities (as appropriate)?

   I don't see much difference. I lived here when the mill was operational and beyond that point. I don't see a whole lot of difference except a lot more ship activity in there now because of AMHS ship storage. There has been construction on the land part of the Site. There is less mill-related stuff like wood.

3. What have been the effects of this Site on the surrounding community, if any?

   I don't see huge differences. There is improvement in the air because there is no more mill. I haven't seen a whole lot of changes in the environment. I don't know if people utilized the Site much for crabbing. It's certainly the only place in this whole region that I've done surveys where I see a distinct difference in the environment on the bottom compared to all other areas. The only thing I can associate that with is organic load or something. People aren't complaining and getting sick or anything.

4. Have there been any problems with unusual or unexpected activities at the Site, such as emergency response, vandalism or trespassing?

   I haven't heard of anything.

5. Has EPA kept involved parties and surrounding neighbors informed of activities at the Site? How can EPA best provide site-related information in the future?

   I haven't heard anything from EPA about this. I'm not a neighbor. I live on other side of Ketchikan. I haven't been privy to any direct contacts. I don't know how to improve it at this point.

6. Do you own a private well in addition to or instead of accessing city/municipal water supplies? If so, for what purpose(s) is your private well used?

   N/A

7. Do you have any comments, suggestions or recommendations regarding any aspects of the project?

   My only real opinion is if any large development will require work closer to the mill site and area they haven't capped, I'd be concerned about ships that go in there and stir that fungal/bacterial mat layer associated with debris from original mill activities. I'd be concerned it would get redistributed into the channel, because the currents and amount of water generated from thrusters on large ships would absolutely redistribute that. I am not sure if mats are there because of chemicals like dioxin. I'm not that worried about Ward Cove being disturbed, more about the redistribution of mats to the more pristine environment of Tongass Narrows.

APPENDIX G – SITE INSPECTION CHECKLIST

FIVE-YEAR REVIEW SITE INSPECTION CHECKLIST

I. SITE INFORMATION

Site Name: Ketchikan Pulp Company	**Date of Inspection:** 07/25/2019
Location and Region: Ketchikan, AK 10	**EPA ID: AKD009252230**
Agency, Office or Company Leading the Five-Year Review: EPA	**Weather/Temperature:** 55 degrees Farenheit; rainy

Remedy Includes: (Check all that apply)

- ☒ Landfill cover/containment
- ☐ Access controls
- ☒ Institutional controls
- ☐ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☒ Other: Enhanced natural remediation
- ☐ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☒ Inspection team roster attached ☒ Site map attached

II. INTERVIEWS (check all that apply)

1. **O&M Site Manager** _____ (Name) _____ (Title) _____ (Date)
   Interviewed ☐ at site ☐ at office ☐ by phone Phone: _____
   Problems, suggestions ☐ Report attached: _____

2. **O&M Staff** _____ (Name) _____ (Title) _____ (Date)
   Interviewed ☐ at site ☐ at office ☐ by phone Phone: _____
   Problems/suggestions ☐ Report attached: _____

3. **Local Regulatory Authorities and Response Agencies** (i.e., state and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices). Fill in all that apply.

   Agency ADEC
   Contact Evonne Reese and Sally Schlichting (Name) _____ (Title) 11/18/19 (Date) 907-465-5076 (Phone No.)
   Problems/suggestions ☐ Report attached: _____

   Agency Ketchikan Indian Community
   Contact Samuel Naujokas (Name) Environmental Specialist (Title) 10/3/2019 (Date) 907-228-9447 (Phone No.)
   Problems/suggestions ☐ Report attached: _____

   Agency _____
   Contact _____ (Name) _____ (Title) _____ (Date) _____ (Phone No.)
   Problems/suggestions ☐ Report attached: _____

   Agency _____
   Contact _____ (Name) _____ (Title) _____ (Date) _____ (Phone No.)
   Problems/suggestions ☐ Report attached: _____

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone No.
Problems/suggestions ☐ Report attached: _____

4. **Other Interviews** (optional) ☐ Report attached: _____

III. ON-SITE DOCUMENTS AND RECORDS VERIFIED (check all that apply)

1. **O&M Documents**

☒ O&M manual	☒ Readily available	☐ Up to date	☐ N/A
☐ As-built drawings	☐ Readily available	☐ Up to date	☒ N/A
☐ Maintenance logs	☐ Readily available	☐ Up to date	☒ N/A

Remarks: _____

2. **Site-Specific Health and Safety Plan** ☒ Readily available ☐ Up to date ☐ N/A
☐ Contingency plan/emergency response plan ☐ Readily available ☐ Up to date ☒ N/A

Remarks: _____

3. **O&M and OSHA Training Records** ☐ Readily available ☐ Up to date ☒ N/A

Remarks: _____

4. **Permits and Service Agreements**

☐ Air discharge permit	☐ Readily available	☐ Up to date	☒ N/A
☒ Effluent discharge	☒ Readily available	☐ Up to date	☐ N/A
☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	☒ N/A
☐ Other permits: _____	☐ Readily available	☐ Up to date	☒ N/A

Remarks: Permit renewal application submitted in 2017; draft permit was out for public review with the comment period closing December 6, 2019. A final permit is expected to follow.

5. **Gas Generation Records** ☐ Readily available ☐ Up to date ☒ N/A

Remarks: _____

6. **Settlement Monument Records** ☐ Readily available ☐ Up to date ☒ N/A

Remarks: _____

7. **Groundwater Monitoring Records** ☐ Readily available ☐ Up to date ☒ N/A

Remarks: _____

8. **Leachate Extraction Records** ☒ Readily available ☐ Up to date ☐ N/A

Remarks: _____

9. **Discharge Compliance Records**

☐ Air	☐ Readily available	☐ Up to date	☒ N/A
☒ Water (effluent)	☒ Readily available	☒ Up to date	☐ N/A

Remarks: _____

10. **Daily Access/Security Logs** ☐ Readily available ☐ Up to date ☒ N/A

Remarks: _____

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☐ Contractor for state

☒ PRP in-house ☐ Contractor for PRP

☐ Federal facility in-house ☐ Contractor for Federal facility

☐ _____

2. **O&M Cost Records**

☐ Readily available ☐ Up to date

☐ Funding mechanism/agreement in place ☒ Unavailable

Original O&M cost estimate: _____ ☐ Breakdown attached

Total annual cost by year for review period if available

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

3. **Unanticipated or Unusually High O&M Costs during Review Period**

Describe costs and reasons: _____

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing Damaged** ☐ Location shown on site map ☒ Gates secured ☐ N/A

Remarks: Fence intact and gates were secure around the landfill area and around the access to the Connell Lake Dam structure.

B. Other Access Restrictions

1. **Signs and Other Security Measures** ☐ Location shown on site map ☐ N/A

Remarks: Numerous signs for no trespassing and restricted access.

C. Institutional Controls (ICs)

1. **Implementation and Enforcement**

Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A

Site conditions imply ICs not being fully enforced ☒ Yes ☐ No ☐ N/A

Type of monitoring (e.g., self-reporting, drive by): self reporting and observation during the site inspection.

Frequency: ICs are reviewed with each new leasee at the Site; every five years ICs are reviewed as part of the FYR. See report for discussion of ICs. New piling was put in at the Ward Cove property by Ward Cove Industries. They indicated that ADEC approved this work, but we are awaiting the paperwork on the matter.

Responsible party/agency: Ward Cove Industries

Contact _____ _____ _____ _____

Name Title Date Phone no.

Reporting is up to date ☒ Yes ☐ No ☐ N/A

Reports are verified by the lead agency ☒ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met ☒ Yes ☐ No ☐ N/A

Violations have been reported ☐ Yes ☒ No ☐ N/A

Other problems or suggestions: ☒ Report attached

2. **Adequacy** ☐ ICs are adequate ☒ ICs are inadequate ☐ N/A

Remarks: A review of ICs is ongoing to determine if they are adequate and being followed as intended. A piling was installed in the cove without prior permission from regulatory agencies or a monitoring plan, which may indicate IC inadequancy.

D. General

1. **Vandalism/Trespassing** ☐ Location shown on site map ☒ No vandalism evident

Remarks: _____

2. **Land Use Changes On Site** ☐ N/A

Remarks: Ward Cove Industries is working to establish a cruise ship port and visitor center at the Site.

3. **Land Use Changes Off Site** ☒ N/A

Remarks: _____

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. **Roads Damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A

Remarks: _____

B. Other Site Conditions

Remarks: _____

VII. LANDFILL COVERS ☒ Applicable ☐ N/A

A. Landfill Surface

1. **Settlement** (low spots) ☐ Location shown on site map ☒ Settlement not evident

Area extent: _____ Depth: _____

	Remarks: _____		
2.	**Cracks**	☐ Location shown on site map	☒ Cracking not evident
	Lengths: _____	Widths: _____	Depths: _____
	Remarks: _____		
3.	**Erosion**	☐ Location shown on site map	☒ Erosion not evident
	Area extent: _____		Depth: _____
	Remarks: _____		
4.	**Holes**	☐ Location shown on site map	☒ Holes not evident
	Area extent: _____		Depth: _____
	Remarks: _____		
5.	**Vegetative Cover**	☐ Grass	☒ Cover properly established
	☐ No signs of stress	☐ Trees/shrubs (indicate size and locations on a diagram)	
	Remarks: _____		
6.	**Alternative Cover** (e.g., armored rock, concrete)		☒ N/A
	Remarks: _____		
7.	**Bulges**	☐ Location shown on site map	☒ Bulges not evident
	Area extent: _____		Height: _____
	Remarks: _____		
8.	**Wet Areas/Water Damage**	☒ Wet areas/water damage not evident	
	☐ Wet areas	☐ Location shown on site map	Area extent: _____
	☐ Ponding	☐ Location shown on site map	Area extent: _____
	☐ Seeps	☐ Location shown on site map	Area extent: _____
	☐ Soft subgrade	☐ Location shown on site map	Area extent: _____
	Remarks: _____		
9.	**Slope Instability**	☐ Slides	☐ Location shown on site map
	☒ No evidence of slope instability		
	Area extent: _____		
	Remarks: _____		
B. Benches		☐ Applicable ☒ N/A	
	(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)		
1.	**Flows Bypass Bench**	☐ Location shown on site map	☐ N/A or okay
	Remarks: _____		
2.	**Bench Breached**	☐ Location shown on site map	☐ N/A or okay
	Remarks: _____		
3.	**Bench Overtopped**	☐ Location shown on site map	☐ N/A or okay

Remarks: _____

C. Letdown Channels ☒ Applicable ☐ N/A

(Channel lined with erosion control mats, riprap, grout bags or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

1. **Settlement** (Low spots) ☐ Location shown on site map ☒ No evidence of settlement
   Area extent: _____ Depth: _____
   Remarks: _____

2. **Material Degradation** ☐ Location shown on site map ☒ No evidence of degradation
   Material type:_____ Area extent: _____
   Remarks: _____

3. **Erosion** ☐ Location shown on site map ☒ No evidence of erosion
   Area extent: _____ Depth: _____
   Remarks: _____

4. **Undercutting** ☐ Location shown on site map ☒ No evidence of undercutting
   Area extent: _____ Depth: _____
   Remarks: _____

5. **Obstructions** Type: _____ ☒ No obstructions
   ☐ Location shown on site map Area extent: _____
   Size: _____
   Remarks: _____

6. **Excessive Vegetative Growth** Type: _____
   ☐ No evidence of excessive growth
   ☒ Vegetation in channels does not obstruct flow
   ☐ Location shown on site map Area extent: _____
   Remarks: _____

D. Cover Penetrations ☒ Applicable ☐ N/A

1. **Gas Vents** ☐ Active ☒ Passive
   ☐ Properly secured/locked ☒ Functioning ☐ Routinely sampled ☐ Good condition
   ☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A
   Remarks: _____

2. **Gas Monitoring Probes**
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
   ☐ Evidence of leakage at penetration ☐ Needs maintenance ☒ N/A
   Remarks: _____

3. **Monitoring Wells** (within surface area of landfill)
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ Evidence of leakage at penetration ☐ Needs maintenance ☒ N/A

Remarks: _____

4. **Extraction Wells Leachate**

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ Evidence of leakage at penetration ☐ Needs maintenance ☒ N/A

Remarks: _____

5. **Settlement Monuments** ☒ Located ☐ Routinely surveyed ☐ N/A

Remarks: _____

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

1. **Gas Treatment Facilities**

☐ Flaring ☐ Thermal destruction ☐ Collection for reuse

☐ Good condition ☐ Needs maintenance

Remarks: _____

2. **Gas Collection Wells, Manifolds and Piping**

☐ Good condition ☐ Needs maintenance

Remarks: _____

3. **Gas Monitoring Facilities** (e.g., gas monitoring of adjacent homes or buildings)

☐ Good condition ☐ Needs maintenance ☐ N/A

Remarks: _____

F. Cover Drainage Layer ☒ Applicable ☐ N/A

1. **Outlet Pipes Inspected** ☒ Functioning ☐ N/A

Remarks: _____

2. **Outlet Rock Inspected** ☐ Functioning ☒ N/A

Remarks: _____

G. Detention/Sedimentation Ponds ☒ Applicable ☐ N/A

1. **Siltation** Area extent: _____ Depth: _____ ☐ N/A

☒ Siltation not evident

Remarks: _____

2. **Erosion** Area extent: _____ Depth: _____

☒ Erosion not evident

Remarks: _____

3. **Outlet Works** ☒ Functioning ☐ N/A

Remarks: _____

4. **Dam** ☐ Functioning ☒ N/A

Remarks: _____

H. Retaining Walls ☐ Applicable ☒ N/A

1. **Deformations** ☐ Location shown on site map ☐ Deformation not evident

Horizontal displacement: _____ Vertical displacement: _____

Rotational displacement: _____

Remarks: _____

2. **Degradation** ☐ Location shown on site map ☐ Degradation not evident

Remarks: _____

I. Perimeter Ditches/Off-Site Discharge ☒ Applicable ☐ N/A

1. **Siltation** ☐ Location shown on site map ☒ Siltation not evident

Area extent: _____ Depth: _____

Remarks: _____

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A

☒ Vegetation does not impede flow

Area extent: _____ Type: _____

Remarks: _____

3. **Erosion** ☐ Location shown on site map ☒ Erosion not evident

Area extent: _____ Depth: _____

Remarks: _____

4. **Discharge Structure** ☒ Functioning ☐ N/A

Remarks: _____

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident

Area extent: _____ Depth: _____

Remarks: _____

2. **Performance Monitoring** Type of monitoring: _____

☐ Performance not monitored

Frequency: _____ ☐ Evidence of breaching

Head differential: _____

Remarks: _____

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☒ N/A

A. Groundwater Extraction Wells, Pumps and Pipelines ☐ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing and Electrical**

☐ Good condition ☐ All required wells properly operating ☐ Needs maintenance ☐ N/A

Remarks: _____

2. **Extraction System Pipelines, Valves, Valve Boxes and Other Appurtenances**

☐ Good condition ☐ Needs maintenance

Remarks: _____

3. **Spare Parts and Equipment**

☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks: _____

B. Surface Water Collection Structures, Pumps and Pipelines ☐ Applicable ☐ N/A

1. **Collection Structures, Pumps and Electrical**

☐ Good condition ☐ Needs maintenance

Remarks: _____

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes and Other Appurtenances**

☐ Good condition ☐ Needs maintenance

Remarks: _____

3. **Spare Parts and Equipment**

☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks: _____

C. Treatment System ☐ Applicable ☐ N/A

1. **Treatment Train** (check components that apply)

☐ Metals removal ☐ Oil/water separation ☐ Bioremediation

☐ Air stripping ☐ Carbon absorbers

☐ Filters: _____

☐ Additive (e.g., chelation agent, flocculent): _____

☐ Others: _____

☐ Good condition ☐ Needs maintenance

☐ Sampling ports properly marked and functional

☐ Sampling/maintenance log displayed and up to date

☐ Equipment properly identified

☐ Quantity of groundwater treated annually: _____

☐ Quantity of surface water treated annually: _____

Remarks: _____

2. **Electrical Enclosures and Panels** (properly rated and functional)

☐ N/A ☐ Good condition ☐ Needs maintenance

Remarks: _____

3. **Tanks, Vaults, Storage Vessels**

☐ N/A ☐ Good condition ☐ Proper secondary containment ☐ Needs maintenance

Remarks: _____

4. **Discharge Structure and Appurtenances**

☐ N/A ☐ Good condition ☐ Needs maintenance

Remarks: _____

5. **Treatment Building(s)**

☐ N/A ☐ Good condition (esp. roof and doorways) ☐ Needs repair

☐ Chemicals and equipment properly stored

Remarks: _____

6. **Monitoring Wells** (pump and treatment remedy)

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ All required wells located ☐ Needs maintenance ☐ N/A

Remarks: _____

D. Monitoring Data

1. **Monitoring Data**

☐ Is routinely submitted on time ☐ Is of acceptable quality

2. **Monitoring Data Suggests:**

☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining

E. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ All required wells located ☐ Needs maintenance ☐ N/A

Remarks: _____

X. OTHER REMEDIES

If there are remedies applied at the site and not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is designed to accomplish (e.g., to contain contaminant plume, minimize infiltration and gas emissions).

The uplands OU remedy appears to be functioning as designed. Institutional controls are in place, and the landfill is closed, maintained and monitored. The effectiveness of the remedy for the marine OU has been called into question by an underwater video of the cap that indicates sediment toxicity. Further monitoring is warranted to determine whether the remedy still achieves RAOs.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

O&M at the landfill is adequate. Monitoring appears needed for the marine OU to determine current and long-term protectiveness.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

N/A

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

N/A

APPENDIX H – SITE INSPECTION PHOTOS

Entrance to dam at Connell Lake

Pipeline and trail near dam at Connell Lake

Dam at Connell Lake

Gas vents on wood waste and ash landfill

Leachate lagoon

Leachate lagoon with landfill in background

Leachate passive treatment system

Leachate flow meter

Leachate outfall location

Surface water sampling location SWL-12

Wood waste and ash landfill

Piezometer P-2

Gas vent

Wood waste and ash landfill

Wood waste and ash landfill

Alaska Marine Highway System Headquarters

View of proposed potential AMHS ferry terminal, looking southwest

Former mill property foundations and debris

Former mill property foundations and debris

Docks from the former mill property

Former mill property building

Former mill property building

Former mill property building

Potential proposed location of cruise ship terminal

APPENDIX I – MONITORING DATA[8]

Table 1
Permit Monitoring Frequencies
Ketchikan Pulp Company
Ketchikan, Alaska

Parameter	2013 Permit Frequency	Proposed 2017 Permit Renewal Frequency
Outfall 001		
Avg and Max Daily Flow	Continuous	None
Ammonia	Annually	Once during 4th year of permit
BOD	Twice per year	Once during 4th year of permit
Color	Quarterly	Twice per year
pH	Quarterly	None
TSS	Quarterly	None
Organic compounds (a-terpineol, benzoic acid, p-cresol, phenol)	Once during 4th year of permit	Once during 4th year of permit
Arsenic, Antimony, Beryllium, Cadmium, Chromium (hex- and total), Copper, Lead, Nickel, Silver, Selenium, Thallium	2nd and 4th years of permit	Once during 4th year of permit
Zinc	Twice per year	Once during 4th year of permit
Mercury	Quarterly during first year. All four samples were less than 0.000050 mg/l; monitoring was reduced to once in the 2nd and 4th years of permit.	Once during 4th year of permit
Manganese	Twice per year	Twice per year
Priority Pollutants	2nd and 4th years of permit	None
Chronic Toxicity	Annually	None
Stormwater		
Color	Annually	None
BOD	Annually	None
TSS	Annually	None
Hardness/pH	Twice per year	None
Metals besides Mn, Cd, and Hg	2nd and 4th years of permit	None
Cadmium and Mercury	Annually	None
Manganese	Twice per year	None
Receiving Water Body (Ward Cove)		
Metals	2nd and 4th years of permit	None
Note: mgd=million gallons per day.		

Table 4
Semivolatile Organic Compounds in Outfall 001 (ug/L)
Ketchikan Pulp Company
Ketchikan, Alaska

Date	4-Methylphenol (p-cresol)	alpha-Terpineol	Benzoic acid	Phenol
02/04/2013	9.5 U	9.5 U	24 U	9.5 U
09/07/2016	9.9 U	9.9 U	25 U	9.9 U
NOTES: J = estimated value. U = Analyte not detected at or above method reporting limit. ug/L = micrograms per liter.				

[8] Tables taken from October 2017 APDES Permit AK0053392 Reissuance Application.

Table 5
Metals in Outfall 001 (mg/L)
Ketchikan Pulp Company
Ketchikan, Alaska

Date		Antimony	Arsenic	Beryllium	Cadmium	Chromium	Chromium (Hexavalent)	Copper	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Thallium	Zinc
Effluent Limit	Average Monthly	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	0.086
	Maximum Daily	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	0.095
Water Quality Standard[1]		0.006	0.01	0.004	0.00048	0.10	0.05	0.018	0.0086	0.05	0.00005	0.10	0.005	0.016	0.0017	0.232
02/04/2013		--	--	--	--	--	--	--	--	0.0145	--	--	--	--	--	0.0012
05/08/2013		--	--	--	--	--	--	--	--	**0.322**	0.000001 U	--	--	--	--	0.0192
08/01/2013		--	--	--	--	--	--	--	--	--	0.000001 U	--	--	--	--	--
11/04/2013		--	--	--	--	--	--	--	--	**0.0634**	0.000001 U	--	--	--	--	0.0011
02/03/2014		0.0001	0.0005 U	0.00002 U	0.00002 U	0.0002	0.05 UJ	0.0008	0.00004	0.0317	0.000001 U	0.0017	0.001 U	0.00002 U	0.00002 U	0.0014
04/17/2014		--	--	--	--	--	--	--	--	--	0.0000007	--	--	--	--	--
08/14/2014		0.0001	0.0005 U	0.00002 U	0.00002 U	0.0002 U	0.0003 U	0.0005	0.00002 U	**0.211**	--	0.002	0.001 U	0.00003	0.00002 U	0.0005
04/21/2015		--	--	--	--	--	--	--	--	0.0268	--	--	--	--	--	0.0006
04/21/2015		--	--	--	--	--	--	--	--	0.0276	--	--	--	--	--	0.0006
05/12/2015		--	--	--	--	--	--	--	--	**0.531**	--	--	--	--	--	0.00106
07/27/2015		--	--	--	--	--	--	--	--	**0.775**	--	--	--	--	--	0.00403
01/11/2016		--	--	--	--	--	--	--	--	0.0221	--	--	--	--	--	0.00121
09/07/2016		0.000054	0.0006	0.00002 U	0.00002 U	0.0002 U	0.00001 U	0.0005	0.000038	**0.715**	0.0000009	0.00256	0.001 U	0.00002 U	0.00002 U	0.0106
01/10/2017		--	--	--	--	--	--	--	--	**0.117**	--	--	--	--	--	0.0021
07/11/2017		--	--	--	--	--	--	--	--	**0.218**	--	--	--	--	--	0.002 U

NOTES:

Bold indicates that result exceeds water quality standard.

-- = not collected/analyzed.

[1]The most stringent available water quality standards are applied.

J = estimated value.

mg/L = milligrams per liter.

U = Analyte not detected at or above method reporting limit.

Table 7
Priority Pollutant Compounds in Outfall 001
Ketchikan Pulp Company
Ketchikan, Alaska

Location: / Collection Date:	OUTFALL 001 02/03/2014	OUTFALL 001 09/07/2016
Asbestos (MFL)		
Total Asbestos	1 U	1 U
Dioxins (pg/L)		
2,3,7,8-TCDD	4.84 U	4.84 U
Cyanide (mg/L)		
Total Cyanide	0.010 U	0.0047 U
VOCs (ug/L)		
1,1,1-Trichloroethane	5 U	5 U
1,1,2,2-Tetrachloroethane	5 U	5 U
1,1,2-Trichloroethane	5 U	5 U
1,1-Dichloroethane	5 U	5 U
1,1-Dichloroethene	5 U	5 U
1,2-Dichlorobenzene	5 U	5 U
1,2-Dichloroethane	5 U	5 U
1,2-Dichloropropane	5 U	5 U
1,3-Dichlorobenzene	5 U	5 U
1,4-Dichlorobenzene	5 U	5 U
2-Chloroethylvinyl ether	10 U	10 U
Acrolein	50 U	50 UJ
Acrylonitrile	10 U	10 UJ
Benzene	5 U	5 U
Bromodichloromethane	5 U	5 U
Bromoform	5 U	5 U
Bromomethane	5 U	5 U
Carbon tetrachloride	5 U	5 U
Chlorobenzene	5 U	5 U
Chloroethane	5 U	5 U
Chloroform	5 U	5 U
Chloromethane	5 U	5 U
cis-1,3-Dichloropropene	5 U	5 U
Dibromochloromethane	5 U	5 U
Ethylbenzene	5 U	5 U
Methylene chloride	5 U	5 U
Tetrachloroethene	5 U	5 U
Toluene	5 U	5 U
trans-1,2-dichloroethene	5 U	5 U
trans-1,3-Dichloropropene	5 U	5 U
Trichloroethene	5 U	5 U
Trichlorofluoromethane	5 U	5 U
Vinyl chloride	5 U	5 U

Table 7
Priority Pollutant Compounds in Outfall 001
Ketchikan Pulp Company
Ketchikan, Alaska

Location: / Collection Date:	OUTFALL 001 02/03/2014	OUTFALL 001 09/07/2016
SVOCs (ug/L)		
1,2-Diphenylhydrazine	9.7 U	9.7 UJ
1,2,4-Trichlorobenzene	9.7 U	9.7 U
2,4,6-Trichlorophenol	9.7 U	9.7 U
2,4-Dichlorophenol	9.7 U	9.7 U
2,4-Dimethylphenol	9.7 U	9.7 U
2,4-Dinitrophenol	25 U	25 U
2,4-Dinitrotoluene	9.7 U	9.7 U
2,6-Dinitrotoluene	9.7 U	9.7 U
2-Chloronaphthalene	9.7 U	9.7 U
2-Chlorophenol	9.7 U	9.7 U
2-Nitrophenol	9.7 U	9.7 U
3,3-Dichlorobenzidine	25 U	25 U
4,6-Dinitro-2-methylphenol	25 U	25 U
4-Bromophenylphenyl ether	9.7 U	9.7 U
4-Chloro-3-methylphenol	9.7 U	9.7 U
4-Chlorophenylphenyl ether	9.7 U	9.7 U
4-Nitrophenol	25 U	25 U
Acenaphthene	9.7 U	9.7 U
Acenaphthylene	9.7 U	9.7 U
Anthracene	9.7 U	9.7 U
Benzidine	49 U	49 U
Benzo(a)anthracene	9.7 U	9.7 U
Benzo(a)pyrene	9.7 U	9.7 U
Benzo(b)fluoranthene	9.7 U	9.7 U
Benzo(ghi)perylene	9.7 U	9.7 U
Benzo(k)fluoranthene	9.7 U	9.7 U
Bis(2-chloroethoxy)methane	9.7 U	9.7 U
Bis(2-chloroethyl)ether	9.7 U	9.7 U
Bis(2-chloroisopropyl)ether	9.7 U	9.7 U
Bis(2-ethylhexyl)phthalate	9.7 U	9.7 U
Butylbenzylphthalate	9.7 U	9.7 U
Chrysene	9.7 U	9.7 U
Dibenzo(a,h)anthracene	9.7 U	9.7 U
Diethyl phthalate	9.7 U	9.7 U
Dimethyl phthalate	9.7 U	9.7 U
Di-n-butyl phthalate	9.7 U	9.7 U
Di-n-octyl phthalate	9.7 U	9.7 U
Fluoranthene	9.7 U	9.7 U
Fluorene	9.7 U	9.7 U
Hexachlorobenzene	9.7 U	9.7 U

Table 7
Priority Pollutant Compounds in Outfall 001
Ketchikan Pulp Company
Ketchikan, Alaska

Location: / Collection Date:	OUTFALL 001 02/03/2014	OUTFALL 001 09/07/2016
Hexachlorobutadiene	9.7 U	9.7 U
Hexachlorocyclopentadiene	9.7 U	9.7 U
Hexachloroethane	9.7 U	9.7 U
Indeno(1,2,3-cd)pyrene	9.7 U	9.7 U
Isophorone	9.7 U	9.7 U
Naphthalene	9.7 U	9.7 U
Nitrobenzene	9.7 U	9.7 U
N-Nitrosodimethylamine	25 U	25 U
N-Nitrosodiphenylamine	9.7 U	9.7 U
N-Nitrosodipropylamine	9.7 U	9.7 U
Pentachlorophenol	25 U	25 U
Phenanthrene	9.7 U	9.7 U
Phenol	9.7 U	9.7 U
Pyrene	9.7 U	9.7 U
PCB Aroclors (ug/L)		
Aroclor 1016	0.048 U	0.048 U
Aroclor 1221	0.096 U	0.095 U
Aroclor 1232	0.096 U	0.095 U
Aroclor 1242	0.096 U	0.095 U
Aroclor 1248	0.096 U	0.095 U
Aroclor 1254	0.096 U	0.095 U
Aroclor 1260	0.096 U	0.095 U

Table 7
Priority Pollutant Compounds in Outfall 001
Ketchikan Pulp Company
Ketchikan, Alaska

Location: / Collection Date:	OUTFALL 001 02/03/2014	OUTFALL 001 09/07/2016
Pesticides (ug/L)		
4,4'-DDD	0.0096 U	0.0095 U
4,4'-DDE	0.0096 U	0.0095 U
4,4'-DDT	0.0096 U	0.0095 U
Aldrin	0.0096 U	0.0095 U
alpha-BHC	0.0096 U	0.0095 U
beta-BHC	0.0096 U	0.0095 U
Chlordane	0.20 U	0.19 U
delta-BHC	0.0096 U	0.0095 U
Dieldrin	0.0096 U	0.0095 U
Endosulfan I	0.0096 U	0.0095 U
Endosulfan II	0.0096 U	0.0095 U
Endosulfan sulfate	0.0096 U	0.0095 U
Endrin	0.0096 U	0.0095 U
Endrin aldehyde	0.0096 U	0.0095 U
Heptachlor	0.0096 U	0.0095 U
Heptachlor epoxide	0.0096 U	0.0095 U
Lindane	0.0096 U	0.0095 U
Toxaphene	0.48 U	0.48 U

NOTES:
J = estimated value.
MFL = millions of fibers per liter.
mg/L = milligrams per liter.
PCB = polychlorinated biphenyl.
pg/L = picograms per liter.
SVOC = semivolatile organic compound.
VOC = volatile organic compound.
U = analyte not detected at or above method reporting limit.
ug/L = micrograms per liter.

Table 11
Hardness-Dependent Dissolved Metals in Stormwater
Ketchikan Pulp Company
Ketchikan, Alaska

Location	Date Collected	Average Hardness (as $CaCO_3$) (mg/L)	Hardness (as $CaCO_3$) (mg/L)	Cadmium					Chromium					Copper						
				Total Recoverable Calculation		Dissolved Criteria		Total Cadmium Result (ug/L)	Total Recoverable Calculation		Dissolved Criteria		Total Chromium Result (ug/L)	Total Recoverable Calculation		Total Recoverable Calculation (Using Average Hardness)		Dissolved Criteria		Total Copper Result (ug/L)
				Freshwater Acute (ug/L)	Freshwater Chronic (ug/L)	Freshwater Acute (ug/L)	Freshwater Chronic (ug/L)		Freshwater Acute (ug/L)	Freshwater Chronic (ug/L)	Freshwater Acute (ug/L)	Freshwater Chronic (ug/L)		Freshwater Acute (ug/L)	Freshwater Chronic (ug/L)	Freshwater Acute (ug/L)	Freshwater Chronic (ug/L)	Freshwater Acute (ug/L)	Freshwater Chronic (ug/L)	
SWL4	08/19/2013	272	129	2.76	0.33	2.58	0.29	0.020 U	--	--	--	--	--	--	--	--	--	--	--	--
	11/04/2013		150	3.22	0.37	2.99	0.33	0.020 U	--	--	--	--	--	--	--	--	--	--	--	--
	01/28/2014		74.8	1.59	0.22	1.52	0.20	0.020 U	1421	68	449	58	0.7	10.6	7.3	35.9	21.9	10.2	7.0	0.7
	04/17/2014		52.4	1.11	0.17	1.07	0.16	0.020 U	--	--	--	--	--	--	--	--	--	--	--	--
	07/27/2015		178	3.83	0.41	3.53	0.37	0.020 U	--	--	--	--	--	--	--	--	--	--	--	--
	01/11/2016		74.0	1.57	0.22	1.50	0.20	0.020 U	--	--	--	--	--	--	--	--	--	--	--	--
	04/18/2016		78.0	1.66	0.23	1.58	0.21	0.020 U	1471	70	465	60	0.23	11.1	7.5	35.9	21.9	10.6	7.2	1.37
SWL6B	08/19/2013	207	375	8.18	0.72	7.27	0.62	0.040	--	--	--	--	--	--	--	--	--	--	--	--
	01/28/2014		205	4.43	0.46	4.04	0.40	0.020	3246	155	1,026	133	0.6	27.5	17.2	27.8	17.4	26.4	16.5	2
	04/17/2014		99.2	2.12	0.27	2.00	0.24	0.020	--	--	--	--	--	--	--	--	--	--	--	--
	10/01/2015		360	7.84	0.70	6.98	0.60	0.027	--	--	--	--	--	--	--	--	--	--	--	--
	01/11/2016		115	2.46	0.30	2.31	0.27	0.020 U	--	--	--	--	--	--	--	--	--	--	--	--
	04/18/2016		86.4	1.84	0.24	1.75	0.22	0.020 U	1600	76	505	66	0.2 U	12.2	8.2	27.8	17.4	11.7	7.9	4.78
SWL11	08/19/2013	427	383	8.35	0.73	7.42	0.62	0.030	--	--	--	--	--	--	--	--	--	--	--	--
	11/04/2013		510	11.18	0.90	9.79	0.76	0.020 U	--	--	--	--	--	--	--	--	--	--	--	--
	01/28/2014		314	6.83	0.63	6.12	0.54	0.020 U	4602	220	1,454	189	0.6	41.1	24.8	55.0	32.3	39.5	23.8	2.6
	04/17/2014		116	2.48	0.30	2.33	0.27	0.020 U	--	--	--	--	--	--	--	--	--	--	--	--
	07/27/2015		1020	22.61	1.51	19.15	1.23	0.036	--	--	--	--	--	--	--	--	--	--	--	--
	07/27/2015		868	19.19	1.34	16.38	1.10	0.035	--	--	--	--	--	--	--	--	--	--	--	--
	01/11/2016		132	2.83	0.33	2.64	0.30	0.020 U	--	--	--	--	--	--	--	--	--	--	--	--
	04/18/2016		76.0	1.61	0.22	1.54	0.20	0.020 U	1440	69	455	59	0.27	10.8	7.4	55.0	32.3	10.4	7.1	7.94
SWL12	08/19/2013	316	417	9.11	0.78	8.05	0.66	0.050	--	--	--	--	--	--	--	--	--	--	--	--
	11/04/2013		432	9.44	0.80	8.34	0.68	0.020 U	--	--	--	--	--	--	--	--	--	--	--	--
	01/28/2014		259	5.61	0.55	5.08	0.48	0.020 U	3931	188	1,242	162	0.8	34.3	21.0	41.4	24.9	32.9	20.2	2.1
	04/17/2014		154	3.31	0.37	3.06	0.33	0.020 U	--	--	--	--	--	--	--	--	--	--	--	--
	07/27/2015		650	14.30	1.08	12.38	0.90	0.024	--	--	--	--	--	--	--	--	--	--	--	--
	01/11/2016		182	3.92	0.42	3.60	0.37	0.020 U	--	--	--	--	--	--	--	--	--	--	--	--
	04/18/2016		116	2.48	0.30	2.33	0.27	0.020 U	2036	97	643	84	0.2 U	16.1	10.6	41.4	24.9	15.5	10.2	3.06

Table 11
Hardness-Dependent Dissolved Metals in Stormwater
Ketchikan Pulp Company
Ketchikan, Alaska

Location	Date Collected	Average Hardness (as $CaCO_3$) (mg/L)	Hardness (as $CaCO_3$) (mg/L)	Lead					Silver			Nickel					Zinc				
				Total Recoverable Calculation		Dissolved Criteria		Total Lead Result (ug/L)	Total Recoverable Calculation	Dissolved Criteria	Total Silver Result (ug/L)	Total Recoverable Calculation		Dissolved Criteria		Total Nickel Result (ug/L)	Total Recoverable Calculation		Dissolved Criteria		Total Zinc Result (ug/L)
				Freshwater Acute (ug/L)	Freshwater Chronic (ug/L)	Freshwater Acute (ug/L)	Freshwater Chronic (ug/L)		Freshwater Acute (ug/L)	Freshwater Acute (ug/L)		Freshwater Acute (ug/L)	Freshwater Chronic (ug/L)	Freshwater Acute (ug/L)	Freshwater Chronic (ug/L)		Freshwater Acute (ug/L)	Freshwater Chronic (ug/L)	Freshwater Acute (ug/L)	Freshwater Chronic (ug/L)	
SWL4	08/19/2013	272	129	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	11/04/2013		150	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	01/28/2014		74.8	56	2.2	47	1.8	0.090	2.3	1.95	0.020 U	367	41	366	41	1.4	94	94	92	92	3.5
	04/17/2014		52.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	07/27/2015		178	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	01/11/2016		74.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	04/18/2016		78.0	60	2.3	49	1.9	0.131	2.47	2.1	0.020 U	380	42	379	42	1.27	97	97	95	96	3.99
SWL6B	08/19/2013	207	375	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	01/28/2014		205	204	7.9	140	5.4	0.140	13	11.1	0.020 U	861	96	859	95	6.9	220	220	215	217	2.4
	04/17/2014		99.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	10/01/2015		360	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	01/11/2016		115	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	04/18/2016		86.4	68	2.6	55	2.1	0.153	2.94	2.50	0.020 U	415	46	414	46	6.71	106	106	104	104	1.74
SWL11	08/19/2013	427	383	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	11/04/2013		510	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	01/28/2014		314	350	13.7	219	8.5	0.020 U	--	--	0.020 U	1235	137	1,233	137	7.4	316	316	309	311	4
	04/17/2014		116	--	--	--	--	--	4.89	4.15	--	--	--	--	--	--	--	--	--	--	--
	07/27/2015		1020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	07/27/2015		868	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	01/11/2016		132	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	04/18/2016		76.0	58	2.2	48	1.9	0.020 U	2.36	2.01	0.020 U	372	41	371	41	7.69	95	95	93	94	2.86
SWL12	08/19/2013	316	417	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	11/04/2013		432	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	01/28/2014		259	274	10.7	179	7.0	0.020 U	19.45	16.53	0.020 U	1050	117	1,047	116	4.6	268	268	262	265	1
	04/17/2014		154	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	07/27/2015		650	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	01/11/2016		182	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	04/18/2016		116	99	3.8	76	3.0	0.020 U	4.89	4.152	0.020 U	532	59	531	59	4.16	136	136	133	134	1.12

NOTES:
-- = not analyzed.
$CaCO_3$ = calcium carbonate.
mg/L = milligrams per liter.
U = Sample not detected above method reporting limit.
ug/L = micrograms per liter.

Table 10
Metals in Stormwater (mg/L)
Ketchikan Pulp Company
Ketchikan, Alaska

Location	Date	Antimony	Arsenic	Beryllium	Cadmium	Chromium	Chromium (Hexavalent)	Copper	Lead	Manganese (Dissolved)	Manganese (Total)	Mercury	Nickel	Selenium	Silver	Thallium	Zinc
Water Quality Standard[1]		0.006	0.01	0.004	0.00048	0.10	0.05	0.018	0.0086	NA	0.05	0.00005	0.10	0.005	0.016	0.0017	0.232
SWL4	08/19/2013	--	--	--	0.00002 U	--	--	--	--	--	0.0318	0.00000651	--	--	--	--	--
	11/04/2013	--	--	--	0.00002 U	--	--	--	--	--	0.0253	0.0000021	--	--	--	--	--
	01/28/2014	0.000080	0.0005 U	0.00002 U	0.00002 U	0.0007	0.05 U	0.0007	0.000090	--	0.0136	0.0000043	0.0014	0.001 U	0.00002 U	0.00002 U	0.0035
	04/17/2014	--	--	--	0.00002 U	--	--	--	--	--	0.0115	0.0000070	--	--	--	--	--
	07/27/2015	--	--	--	0.00002 U	--	--	--	--	--	0.0434	0.0000031	--	--	--	--	--
	10/01/2015	--	--	--	--	--	--	--	--	--	0.0376	--	--	--	--	--	--
	01/11/2016	--	--	--	0.00002 U	--	--	--	--	--	0.0169	0.0000031	--	--	--	--	--
	04/18/2016	0.000158	0.0005 U	0.00002 U	0.00002 U	0.00023	--	0.00137	0.000131	--	0.013	--	0.00127	0.001 U	0.00002 U	0.00002 U	0.00399
	01/26/2017	--	--	--	--	--	--	--	--	--	0.0133	--	--	--	--	--	--
	05/23/2017	--	--	--	0.00002 U	--	--	--	--	--	0.0112	0.0000068	--	--	--	--	--
SWL6B	08/19/2013	--	--	--	0.00004	--	--	--	--	--	0.0242	0.000001 U	--	--	--	--	--
	11/04/2013[2]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	01/28/2014	0.00012	0.0005 U	0.00002 U	0.00002	0.0006	0.05 U	0.002	0.00014	--	0.0369	0.000001 U	0.0069	0.001 U	0.00002 U	0.00002 U	0.0024
	04/17/2014	--	--	--	0.00002	--	--	--	--	--	0.00842	0.0000013	--	--	--	--	--
	07/27/2015[2]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	10/01/2015	--	--	--	0.000027	--	--	--	--	--	0.0273	0.000001	--	--	--	--	--
	01/11/2016	--	--	--	0.00002 U	--	--	--	--	--	0.0108	0.0000009	--	--	--	--	--
	04/18/2016	0.000064	0.0005 U	0.00002 U	0.00002 U	0.0002 U	--	0.00478	0.000153	--	0.00811	--	0.00671	0.001 U	0.00002 U	0.00002 U	0.00174
	01/26/2017	--	--	--	--	--	--	--	--	--	0.0065	--	--	--	--	--	--
	05/23/2017	--	--	--	0.00002 U	--	--	--	--	--	0.0125	0.0000009	--	--	--	--	--
SWL11	08/19/2013	--	--	--	0.00003	--	--	--	--	--	0.0198	0.000001 U	--	--	--	--	--
	11/04/2013	--	--	--	0.00002 U	--	--	--	--	--	**0.0939**	0.000001 U	--	--	--	--	--
	01/28/2014	0.00011	0.0005 U	0.00002 U	0.00002 U	0.0006	0.05 U	0.0026	0.00002 U	--	**0.0687**	0.0000015	0.0074	0.001 U	0.00002 U	0.00002 U	0.004
	04/17/2014	--	--	--	0.00002 U	--	--	--	--	--	0.00218	0.0000013	--	--	--	--	--
	07/27/2015	--	--	--	0.000036	--	--	--	--	--	0.0103	0.0000007	--	--	--	--	--
	07/27/2015	--	--	--	0.000035	--	--	--	--	--	0.00986	0.0000005	--	--	--	--	--
	10/01/2015	--	--	--	--	--	--	--	--	--	0.0079	--	--	--	--	--	--
	01/11/2016	--	--	--	0.00002 U	--	--	--	--	--	0.00246	0.0000005	--	--	--	--	--
	04/18/2016	0.000117	0.0005 U	0.00002 U	0.00002 U	0.00027	--	0.00794	0.00002 U	--	0.00325	--	0.00769	0.001 U	0.00002 U	0.00002 U	0.00286
	01/26/2017	--	--	--	--	--	--	--	--	0.000848	0.00139	--	--	--	--	--	--
	05/23/2017	--	--	--	0.00002 U	--	--	--	--	0.00166	0.00258	0.0000008	--	--	--	--	--
SWL12	08/19/2013	--	--	--	0.00005	--	--	--	--	--	**0.118**	0.000001 U	--	--	--	--	--
	11/04/2013	--	--	--	0.00002 U	--	--	--	--	--	**0.0515**	0.000001 U	--	--	--	--	--
	01/28/2014	0.000060	0.0005 U	0.00002 U	0.00002 U	0.0008	0.05 U	0.0021	0.00002 U	--	0.0222	0.000001 U	0.0046	0.001 U	0.00002 U	0.00002 U	0.001
	04/17/2014	--	--	--	0.00002 U	--	--	--	--	--	0.00896	0.0000020	--	--	--	--	--
	07/27/2015	--	--	--	0.000024	--	--	--	--	--	**0.0654**	0.0000006	--	--	--	--	--
	10/01/2015	--	--	--	--	--	--	--	--	--	0.023	--	--	--	--	--	--
	01/11/2016	--	--	--	0.00002 U	--	--	--	--	--	0.0174	0.0000008	--	--	--	--	--
	04/18/2016	0.000061	0.0005 U	0.00002 U	0.00002 U	0.0002 U	--	0.00306	0.00002 U	--	0.00578	--	0.00416	0.001 U	0.00002 U	0.00002 U	0.00112
	01/26/2017	--	--	--	--	--	--	--	--	0.0033	0.00497	--	--	--	--	--	--
	05/23/2017	--	--	--	0.00002 U	--	--	--	--	0.00752	0.0131	0.0000009	--	--	--	--	--

Table 10
Metals in Stormwater (mg/L)
Ketchikan Pulp Company
Ketchikan, Alaska

NOTES:
Bold indicates that result exceeds water quality standard.
-- = not analyzed/collected.
mg/L = milligrams per liter.
N/A = not applicable.
U = analyte not detected at or above method reporting limit.
[a] The most stringent available water quality standards are applied.
[b] No flow at sample location, no sample collected.

Table 12
Ward Cove Receiving Water (mg/L)
Ketchikan Pulp Company
Ketchikan, Alaska

Date	Antimony	Arsenic	Beryllium	Cadmium	Chromium	Chromium (Hexavalent)	Copper	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Thallium	Zinc
8/14/2014	0.00100 U	0.0011	0.00002 U	0.00006	0.0002	0.00030 U	0.0003	0.00003	0.00189	0.0000005 U	0.0014	0.00100 U	0.00002 U	0.00002 U	0.002
8/12/2016	0.0010 U	0.00096	0.000020 U	0.000057	0.00026	--	0.00033	0.000045	0.0015	0.0000005	0.00038	0.0010 U	0.000020 U	0.000020 U	0.00443

NOTES:
-- = not collected/analyzed.
mg/L = milligrams per liter.
U = Analyte not detected at or above method reporting limit.

APPENDIX J – CLEANUP GOAL REVIEW

Soil Cleanup Goal Screening-Level Risk Assessment

To determine if the early action soil cleanup goals remain valid, a screening-level risk evaluation was conducted by comparing the cleanup goals to EPA's 2019 Regional Screening Levels (RSLs) based on future commercial/industrial exposure for the former facility areas and residential exposure for the aerial deposition and residential yards containing grit. The RSLs incorporate current toxicity values and standard default exposure factors. As shown in Table J-1, except for lead, the cleanup goals equate to a cancer risk that is within or below EPA's risk management range of 1×10^{-6} to 1×10^{-4} or below the noncancer hazard quotient (HQ) threshold of 1.0. EPA has not established RSLs for lead since there is not a consensus on carcinogenic or noncarcinogenic toxicity values for inorganic lead. Therefore, EPA evaluates lead exposure by using blood-lead modeling and established a default industrial level of 800 mg/kg.[9] This level was exceeded at only one early action area, the former storage area along the water pipeline road. However, there is no exposure to residual concentrations exceeding 800 mg/kg because the early action remedy covered this area with either gravel or coarse fill material, and institutional controls are in place to the protect disturbance of the remedy. The residential screening-level evaluation (Table J-2) shows that the residential early action cleanup goals remain valid as the cancer risks fall within EPA's risk management range and are below the noncancer HQ of 1.0.

In addition, the early actions remediated total petroleum hydrocarbon (TPH) based on the ARARs established by ADEC for DRO, RRO and TPH-residual oil. The ARARs for these TPH groupings were reviewed and remain valid as the ADEC values have not changed.[10] The PCB cleanup goal was established as an ARAR under TSCA Remediation Waste Risk Based Disposal Approval at 40 CFR 761.61(c), and the ARAR has not changed.[11]

[9] The EPA has updated the lead risk assessment guidance and associated adult and child lead exposure models several times and as recently as 2017 based on updated toxicity information released by the Centers for Disease Control and prevention *(Transmittal of Update to the Adult Lead Methodology's Default Baseline Blood Lead Concentration and Geometric Standard Deviation Parameters. Office of Land and Emergency Management (OLEM) Directive 9285.6-56. May 17, 2017. Accessed on 8/30/17 at https://semspub.epa.gov/work/HQ/196766.pdf).* Based on this new information, the EPA is in the process of evaluating its lead policy; in the interim, use of the current policy is recommended until it is formally updated *(Updated Scientific Considerations for Lead in Soil Cleanups. OLEM Memorandum. December 22, 2016. Accessed on 8/30/2017 at https://www.documentcloud.org/documents/3525442-EPA-Memo-Updated-Scientific-Considerations-for.html).*

[10] Accessed 12/9/2019 at https://dec.alaska.gov/media/1055/18-aac-75.pdf.

[11] Accessed 12/9/2019 at https://www.ecfr.gov/cgi-bin/text-idx?SID=d5010a82b37c5825e9b1f5e508eb575a&mc=true&node=pt40.31.761&rgn=div5#se40.34.761_161.

Table J-1: Screening-Level Industrial Risk Evaluation of Upland OU Early Action Soil Cleanup Goals

COC	Early Action Cleanup Levels[a] (mg/kg)	Industrial RSL[b] (mg/kg)		Cancer Risk[c]	Noncancer HQ[d]
		1 x 10^{-6} Risk	HQ=1.0		
Arsenic	7.6	3.0	480	3 x 10^{-6}	0.02
Dioxin (PCDD/F)[e]	3.8 x 10^{-5} (0.000038)	2.2 x 10^{-5}	7.2 x 10^{-4}	2 x 10^{-6}	0.05
Lead	1000	800[e]		**>800[f]**	
Polycyclic Aromatic Hydrocarbons					
Benzo(a)anthracene	9	21	-	4 x 10^{-7}	-
Benzo(a)pyrene[g]	0.9	2.1	220	4 x 10^{-7}	0.004
Benzo(b)fluoranthene	9	21	-	4 x 10^{-7}	--
Dibenz(a,h)anthracene	0.9	2.1	-	4 x 10^{-7}	-

Notes:

a. 2000 Uplands OU ROD, Table 1.

b. Current EPA RSLs, dated November 2019, are available at http://www2.epa.gov/risk/risk-based-screening-table-generic-tables (accessed 12/9/2019).

c. Cancer risks were calculated using the following equation, based on the fact that RSLs are derived based on 1 x 10^{-6} risk: cancer risk = (cleanup level ÷ cancer-based RSL) × 10^{-6}.

d. The noncancer HQ was calculated using the following equation: HQ = cleanup level ÷ noncancer-based RSL.

e. RSL used for evaluation is tetrachlorodibenzodioxin (TCDD)-2,3,7,8.

f. EPA has no consensus on carcinogenic or noncarcinogenic toxicity values for inorganic lead, so it is not possible to calculate RSLs. Therefore EPA evaluates lead exposure by using blood-lead modeling and established a default industrial level of 800 mg/kg.

g. Benzo(a)pyrene toxicity was updated in the Integrated Risk Information System in January 2017.

mg/kg = milligrams per kilogram

– not applicable as COC toxicity criteria has not been established.

Bold = cleanup goal exceeds the RSL for lead.

Table J-2: Screening-Level Residential Risk Evaluation of Upland OU Early Action Soil Cleanup Goals

COC	Early Action Cleanup Levels[a] (mg/kg)	Residential RSL[b] (mg/kg)		Cancer Risk[c]	Noncancer HQ[d]
		1 x 10^{-6} Risk	HQ=1.0		
Arsenic	7.6	0.68	35	1 x 10^{-5}	0.2
Dioxin (PCDD/F)[e]	7.4 x 10^{-6} (0.0000074)	4.8 x 10^{-6}	5.1 x 10^{-5}	2 x 10^{-6}	0.2

Notes:

a. 2000 Uplands OU ROD, Table 1.

b. Current EPA RSLs, dated November 2019, are available at http://www2.epa.gov/risk/risk-based-screening-table-generic-tables (accessed 12/9/2019).

c. Cancer risks were calculated using the following equation, based on the fact that RSLs are derived based on 1 x 10^{-6} risk:
cancer risk = (cleanup level ÷ cancer-based RSL) × 10^{-6}.

d. The noncancer HQ was calculated using the following equation:
HQ = cleanup level ÷ noncancer-based RSL.

e. RSL used for evaluation is tetrachlorodibenzodioxin (TCDD)-2,3,7,8.

mg/kg = milligrams per kilogram

APPENDIX K – INSTITUTIONAL CONTROLS

This appendix includes the 1998 Management Plan for Arsenic in Rock and Soil and the 2000 Institutional Control Plan. The remainder of the institutional controls are included in the 2015 FYR.

Exponent™

Management Plan for Arsenic in Rock and Soil

Prepared for

Ketchikan Pulp Company
Ketchikan, Alaska

Exponent

Management Plan for Arsenic in Rock and Soil

Prepared for

Ketchikan Pulp Company
7559 North Tongass Highway
Ketchikan, Alaska 99901

Prepared by

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July 1998

Contract No.: 8600B4Q.001 2017

MANAGEMENT PLAN FOR ARSENIC IN ROCK AND SOIL

Exponent has conducted a focused evaluation to assess the potential risks associated with arsenic-bearing topsoil and rock products that are planned for use at the Ketchikan Pulp Company (KPC) facility. This management plan presents the results of the evaluation and recommended guidelines for using this material. Detailed information regarding the data presented in this document is included the following attachments:

- Attachment A—*Measurement of the Relative Absorption Factor for Arsenic in KPC Samples*
- Attachment B—*Identifying the Mineral Form of the Arsenic Source*
- Attachment C—*Quality Assurance Review Summary—Chemical Analyses of Solid and Aqueous Samples.*

The purposes of this management plan are 1) to evaluate the potential risks to onsite workers and the potential for arsenic to leach from the rock products and migrate to Ward Cove; and 2) to establish practices for use of rock products that result in acceptable health protection for current and future workers at the facility.

BACKGROUND

Rock products of various size fractions (D1 gravel to shot rock) have been stockpiled at the KPC facility or will be purchased in the future for use at the KPC site. Some of this rock contains elevated arsenic concentrations. Because of the elevated arsenic concentrations, some rock planned for use in filling the access road ditch had been stockpiled pending determination of the appropriate use of this material.

In addition, South Coast, Inc. was contracted to provide topsoil to cover the Dawson Point landfill. The topsoil is a blend of decomposed hog fuel from KPC and overburden from construction projects. As of April 1998, approximately 5,000 cubic yards (CY) have been stockpiled at the KPC site and another 6,000 CY have been placed on the landfill. South Coast, Inc. sampled some of the piles and analyzed the samples for arsenic. The result of the analysis was that arsenic concentrations ranged between 20 to 40 mg/kg.

Two filtered leachate samples collected from the KPC hog fuel pile on January 20, 1997, had soluble arsenic concentrations of 13 and 14 μg/L (CAS 1997).

APPROACH

The following tasks were completed in developing the management plan:

- Evaluate current and planned uses of topsoil and rock
- Determine leachability of arsenic from topsoil and crushed rock
- Determine bioaccessibility of arsenic from topsoil and crushed rock
- Prepare a risk assessment for crushed rock and topsoil at the facility
- Prepare draft guidelines for management of rock products.

CURRENT AND PLANNED USE OF IMPORTED SOIL AND ROCK PRODUCTS

Information about the topsoil used as landfill cover was obtained from Andy Maloy, KPC. Two contractors for KPC, Jeff Hegedus of Philip Services Corporation and Marty Gilliland of Ty-Matt, Inc. provided information about sand and rock products.

Topsoil

South Coast, Inc. fabricated topsoil from hog fuel and overburden from road building projects. This material was used as part of a landfill cap on the wood waste and ash disposal landfill. After the topsoil was spread on the landfill cap, it was planted with grass.

Sand

Very little sand has been used in the demolition project. Only one 10-CY load has been used during the past year. The sand, which was purchased from a Seattle-based company and barged to the KPC site, was used to backfill around a pipe.

Crushed Rock Containing Fines

1-in.-minus (D1) rock—One-in.-diameter and smaller material is the most common rock product used for the demolition project. D1 rock is produced at quarries by blasting the rock face, crushing the rock chunks, and passing the crushed rock through a series of shaking screens with increasingly smaller openings. All the material that passes through the 1-in.-diameter screen is considered D1 rock. D1 rock can be used for roadbeds because the finer particle sizes can be suitably compacted. D1 rock is also used for pipe ditch backfill, structural subgrade (i.e., foundations under a building), temporary surface ramps, and road resurfacing.

1.5-in.-minus rock—This material is like D1 except the largest diameter is 1.5-in. rather than 1-in. This rock can also be used for roadbeds, especially in areas of heavier or more frequent traffic.

3-in.-minus rock—This material is used for structural subgrade and for temporary surface ramps for heavy equipment. This is the least used of the three types of rock products that contain fines.

Crushed Rock without Fines

Washed rock—Screened and washed rock products are used occasionally when free water drainage is needed for certain subgrades. Small quantities of washed rock in the 1.5-, 3-, and 8-in.-diameter classes have been or may be used at the KPC facility.

Riprap—This material is 3 in. in diameter and larger (usually 3 to 12 in.). Riprap is used for heavy structural fill (e.g., bridging a soft spot in a planned road) and for stabilizing slopes.

Shot Rock

Shot rock refers to rock that is blasted from a natural face of a quarry. It is used directly without crushing or screening. The rock fragments are sharp-edged and variable in size. Fines typically sift to the bottom of the pile as the rock is handled and stockpiled. Therefore, a truckload of shot rock has very few fine particles. Shot rock is used for seawall construction, slope stabilization, and ditch drainage.

LEACHABILITY OF TOPSOIL AND CRUSHED ROCK

Twelve topsoil and rock samples were collected on April 14, 1998, and analyzed for total and leachable (i.e., extractable by synthetic precipitation leaching procedure [SPLP]) arsenic (Table 1). Composite grab samples were collected from piles of recently purchased 3-in.-minus and D1 rock (three composites of each rock type). Three composite samples were also collected from the stockpiled topsoil and from the topsoil recently placed on the landfill. Each composite consisted of five subsamples collected at a depth of 0–6 in.

For total arsenic analyses, the following sample preparation methods were followed:

- The 3-in.-minus rock was washed, crushed, and sieved to 2 mm.
- The D1 rock was crushed and sieved to 2 mm.
- The topsoil samples were sieved to 2 mm.

TABLE 1. TOTAL AND SPLP-EXTRACTABLE ARSENIC AND BIOACCESSIBILITY OF SOIL AND ROCK SAMPLES

Sample Type/Sample ID	Total Arsenic[a] (mg/kg)	SPLP-Extractable Arsenic (mg/L)	Bioaccessibility (percent)
Topsoil (mixed hog fuel and overburden)			
LS0001	13.8	0.01 *U*	5.5
LS0002	26.1	0.01 *U*	24.1
LS0003	11.1	0.01 *U*	14.2
SS0001	23.1	0.01 *U*	39.8
SS0002	46.3	0.01 *U*	30.3 [b]
SS0003	20.9	0.01 *U*	35.6
Average	23.6		24.9
Maximum	46.3		39.8
D1 Rock (1-in. minus)			
R10001	105	0.01 *U*	1.6
R10002	162	0.01 *U*	9.6
R10003	312	0.01 *U*	8.4 [c]
Average	193		6.6
Maximum	312		9.6
Rock (3-in. minus)			
R30001	152	0.01 *U*	--
R30002	172	0.01 *U*	--
R30003	65.5	0.01 *U*	--
Average	130		
Maximum	172		
Onsite Soil			
NSFS-01	1,130 [d,e]	--	5.5 [c]
NSFS-02	280 [d,f]	--	5.1
WRLD-C1	230 [d,g]	--	2.4
Average	186	--	4.3
Maximum	259	--	5.5
Rock ("red shale" type from old pile at west end of access road)			
SHTR-1[h]	7 [i]	--	7.2

Note SPLP - simulated precipitation leaching procedure
-- - indicates no analysis performed

[a] Total arsenic concentration for the fraction that is less than 2 mm.

[b] Average bioaccessiblity of a triplicate analysis of this sample.

[c] Average bioaccessiblity of a duplicate analysis of this sample.

[d] The bulk soil was sieved to <2 mm, and this analytical result is for <2-mm fraction.

[e] 62 percent of the soil passed through the 2-mm sieve.

[f] 45 percent of the soil passed through the 2-mm sieve.

[g] 42 percent of the soil passed through the 2-mm sieve.

[h] The rock sample was crushed to <2-mm prior to analysis.

[i] The rock sample was first crushed until it passed through a 0.63-mm seive. The >0.63-mm fraction was archived and the remaining sample was passed through a 250-μm sieve. The analytical result presented here is for the 250 μm–0.63 mm fraction. The <250-μm fraction of this sample contained 6.98 mg/kg arsenic.

For SPLP analyses, the 3-in.-minus rock samples were washed to remove fines. The SPLP analyses were run on the bulk ("as is") samples of D1 rock (including fines) and topsoil.

The results of the total and SPLP analyses are shown in Table 1. Total arsenic ranged from 65 to 172 mg/kg in 3-in.-minus rock, 105 to 312 mg/kg in D1 rock, and 11 to 46 mg/kg in the topsoil samples. SPLP results were all at or below the detection limit of 0.01 mg/L, indicating that the arsenic is highly resistant to leaching.

This finding is consistent with the SPLP results of the quarry rock samples presented in the draft remedial investigation report (Exponent 1998a). Of the 28 quarry rock samples submitted for SPLP analysis, only one sample (the "red shale with quartz intrusion" sample with 4,150 mg/kg total arsenic) had detectable amounts of arsenic (1.26 mg/L) in the SPLP extract. Those quarry rock samples were crushed and the material (including fines) that passed through a 1-in.-diameter sieve was analyzed for SPLP-extractable arsenic.

The results of the SPLP analyses indicate that no significant leaching of soluble arsenic would be expected from topsoil used at the landfill or from crushed rock. Crushed rock used as road cover material will be subject to grinding and abrasion from vehicle traffic; however, the SPLP results indicate that very little soluble arsenic would be released under these conditions. The primary pathway for transport of arsenic from crushed rock would be surface water transport of fine particles containing arsenic. This form of arsenic is less susceptible to migration to groundwater or to marine waters.

BIOAVAILABILITY OF ARSENIC IN TOPSOIL AND CRUSHED ROCK

While leachability is a measure of potential transport of arsenic from soil or rock, bioavailability provides a measure of potential exposure from direct contact with arsenic in soil or rock. The degree to which arsenic is absorbed following ingestion has been found to vary depending on the mineral forms of arsenic and the characteristics of the matrix (e.g., particle size) in which the arsenic is found. Forms of arsenic with limited water solubility are generally poorly absorbed. Although little direct experimental evidence is available, dermal absorption of arsenic from solid matrices is also expected to be low when water solubility is low.

Differences in arsenic absorption from different matrices have been demonstrated in studies conducted in laboratory animals and in *in vitro* studies designed to mimic dissolution in the human gastrointestinal (GI) tract. Good agreement has been observed between the animal studies and the *in vitro* studies (Ruby et al. 1996). These studies have been used to derive relative absorption factors (RAFs) that provide a measure of the reduced bioavailability of arsenic from a solid matrix relative to the bioavailability of soluble arsenic forms dissolved in water.

Materials from the KPC facility were tested using an *in vitro* method that Exponent developed and termed the physiologically based extraction test (PBET). This method,

which has been published (Ruby et al. 1993; Ruby et al. 1996), is currently being validated by a consortium that includes representatives from government agencies, universities, and private companies. The PBET procedures were presented in SOP 312, which was included in Technical Memorandum No. 9 (Exponent 1998b).

The PBET provides a measure of the relative dissolution of arsenic in the GI tract, rather than a direct measure of relative absorption into the body. Consequently, the results of this test have been termed "relative bioaccessibility" to distinguish them from measures of relative bioavailability. Because bioavailability of an ingested compound is in large part limited by its solubility in GI tract, bioaccessibility provides a reliable estimate of relative bioavailability. Estimates of *in vitro* arsenic bioaccessibility and *in vivo* arsenic bioavailability (measured using animal models) in various solid matrices have been very similar (Ruby et al. 1996). Therefore, because the bioaccessibility estimates provide a conservative means to evaluate absorption in the GI tract and have produced similar estimates to those in animal studies, the bioaccessibility estimates are used here to derive RAFs. The RAFs are then used to assess risks from occupational exposure to arsenic in crushed rock and topsoil at the KPC facility.

The six topsoil samples and the three D1 rock samples that were analyzed for SPLP-extractable arsenic were also analyzed for bioaccessibility by the PBET. The crushed 3-in. rock samples were not tested because D1 rock has more associated fine-grained material and thus provides a protective means to evaluate D3 rock. The results of these tests (Table 1) were used in the risk assessment presented below to support guidelines for managing imported topsoil and crushed rock. Concurrent with these analyses, Exponent analyzed bioaccessibility of three onsite soil samples[1] and the "red shale" type rock that has been commonly used onsite.

As shown in Table 1, the D1 rock samples had very low bioaccessibility, ranging from 1.6 to 9.6 percent and averaging 6.6 percent. The arsenic in the rock samples is present as arsenopyrite (see Attachment B), a mineral with extremely low solubility, which is consistent with low observed bioaccessibility. The arsenic bioaccessibility of the topsoil samples ranged from 5.5 to approximately 40 percent with an average of 25 percent. On average, the topsoil values are substantially higher than bioaccessibility estimates for any other samples, including onsite soil samples. It is possible that the presence of hog fuel in the topsoil samples may either increase bioaccessibility of arsenic from added overburden or be a source of more bioaccessible arsenic forms. (As indicated previously, leachate from hog fuel had soluble arsenic concentrations ranging from 13 to 14 μg/L.) The variability in the bioaccessibility values of the topsoil samples may be related to the relative proportion of overburden and hog fuel.

[1] These soil samples (two from the nearshore fill area, NSFS-01 and NSFS-02, and one from the wood room/log deck area, WRLD-C1) were selected because they had the highest arsenic concentrations of any RI soil samples excluding samples from areas subject to early action.

RISK ASSESSMENT OF TOPSOIL AND CRUSHED ROCK PRODUCTS

Risk assessment methods and parameters developed in Section 6.0, *Baseline Risk Assessment* of the draft remedial investigation (Exponent 1998a) were used together with the results of the *in vitro* PBET analyses to derive risk estimates associated with various uses of rock and with the use of topsoil on the landfill. These risk calculations were in accordance with risk assessment guidance provided by the U.S. Environmental Protection Agency (EPA) and the Alaska Department of Environmental Conservation (ADEC) (U.S. EPA 1989a,b, 1991, 1996, 1997a,b,c; ADEC 1997). Risk assessments typically consist of the following four steps: data evaluation and identification of chemicals of potential concern (CoPCs), exposure assessment, toxicity assessment, and risk characterization. In this evaluation, arsenic is the only CoPC. Toxicity and risk characterization methods described in the draft risk assessment (Exponent 1998a) are applied here. A site-specific exposure assessment was conducted evaluating the means by which people may be exposed to arsenic in rock products or soil. With the exception of site-specific *in vitro* analyses, exposure assessment methods and parameters were those identified in the draft risk assessment (Exponent 1998a).

Potential for Exposure to Arsenic in Rock Products and Soil

Two types of materials were identified as potentially containing arsenic above background levels: 1) topsoil fabricated from hog fuel and overburden from road building, and 2) rock products. Human receptors could potentially be exposed to arsenic in these products either by direct contact (i.e., ingestion or dermal contact) or through transport to other media (e.g., surface water transport of arsenic-enriched particles from a roadbed to sediments in a drainage ditch). Transport of soluble arsenic is expected to be very limited (based on the SPLP results); thus, transport to groundwater and subsequently to marine waters would not be significant.

Future KPC site use is assumed to be occupational based on consideration of development plans underway. The potential for future workers to directly contact arsenic from rock or soil during various planned uses of these products is summarized as follows:

- **Sand**—Very little sand has been used and there is no reason to believe that arsenic concentrations are elevated because the sand is typically from a source outside of Southeast Alaska.
- **1-in.-minus (D1) rock**—Use of D1 rock for road beds, temporary surface ramps, and road resurfacing (maintenance) is the most likely way that people could be exposed to fines from crushed rock. Use in pipe ditch backfill or structural subgrade (i.e., foundations under a building) could result in limited contact during construction activities.
- **1.5-in.-minus rock**—Use of 1.5-in.-minus rock for building roads and parking lots could also result in exposure to arsenic from fines.

- **3-in.-minus rock**—This material is used for structural subgrade and for temporary surface ramps for heavy equipment. Potential for contact with arsenic in products would be limited to the time frame of the construction projects.
- **Washed rock**—Use of screened and washed rock products for free water drainage in certain subgrades is unlikely to result in human exposure because of the absence of fine-grained materials that result in direct contact exposure.
- **Riprap**—Use of riprap for heavy structural fill (e.g., bridging a soft spot in a planned road) and for stabilizing slopes is also unlikely to result in human exposure for the reasons identified for washed rock.
- **Soil**—Future workers performing maintenance at the landfill and trespassers could contact the topsoil used as cover at the landfill.

Thus, in the risk assessment, exposures to arsenic in D1 rock and in soils through ingestion and dermal contact were quantitatively evaluated. These calculations were carried out using the methods and the parameter estimates described in the draft risk assessment (see Tables 6-2, 6-3, and 6-4 of Exponent 1998a). Specifically, estimates were derived assuming that future workers might contact these materials 250 days per year over a 25-year period. Although exposures would be considerably less if the materials were used in small areas, the conservative assumptions were used here to determine whether the use of these materials should be restricted based on health concerns.

Risk estimates were derived using the maximum and mean concentration values for the topsoil used for landfill cover and D1 rock. In addition, the maximum and mean RAFs derived from the *in vitro* tests were used in risk estimates.

Toxicity Assessment and Risk Characterization

The toxicity values for arsenic were those identified by EPA in the Integrated Risk Information System database, i.e., a carcinogenic slope factor of 1.5 $(mg/kg\text{-}day)^{-1}$ and a reference dose of 0.0003 mg/kg-day. The risk characterization was conducted consistent with the approach in Section 6.0, *Baseline Risk Assessment*, of the draft remedial investigation (Exponent 1998a) and findings were compared with the decision risk levels identified in the remedial investigation. Although this management plan is not part of the remedial investigation and feasibility study (RI/FS) process, the RI/FS decision risk levels are also consistent with EPA guidance as applied at many other sites nationwide and with recent proposed guidelines identified by ADEC. The decision risk levels are as follows:

- Incremental cancer risks are less than 1 in 100,000 (1×10^{-5}) and/or the hazard indices for noncancer adverse effects are less than 1—No further action will be considered.

- Incremental cancer risks are between 1 in 100,000 (1×10^{-5}) and 1 in 10,000 (1×10^{-4}) for cumulative risk and/or hazard indices for noncancer adverse effects are between 1 and 10—CoPCs in this risk range will be identified as CoCs, and development of cleanup options (i.e., inclusion in the feasibility study) will be considered but may not be required.

- Incremental cancer risks are greater than 1 in 10,000 (1×10^{-4}) for pathways or for cumulative risks and/or hazard indices for noncancer adverse effects are greater than 10—CoPCs will be identified as CoCs, and cleanup options will be developed for this area/pathway (i.e., this area will be carried into the feasibility study).

Upper-bound excess cancer risk estimates calculated for ingestion and dermal contact were summed to derive total risk estimates (Table 2). None of the estimates were greater than the upper-bound decision risk level identified in the RI/FS as requiring additional consideration in the feasibility study (i.e., 1×10^{-4} for carcinogens and a hazard index of 10). The maximum risk estimate for topsoil (9×10^{-6}) indicates that even with the conservative assumptions of occupational exposure to these soils, risks are expected to be within acceptable levels.

Only the total risk estimates for the D1 rock (e.g., 4×10^{-5} based on maximum concentration and RAF values) fall within the range of estimates that would be considered for inclusion in the feasibility study. However, as shown in Table 2, these total risk estimates for D1 rock, like the other estimates for topsoil, are significantly influenced by the inclusion of highly conservative risk estimates for the dermal contact pathway. In calculating these risk estimates, dermal absorption of arsenic from these materials was assumed to be 3 percent, a value derived from a study that applied highly soluble arsenic acid (H_3AsO_4) to soil (Wester et al. 1993). Given that the results of the PBET analyses indicate significantly reduced oral bioaccessibility of the materials from the KPC facility relative to soluble forms of arsenic, the assumption of 3 percent dermal absorption is likely to significantly overestimate dermal exposures. For D1 rock, derived exposure estimates could be 10 times too high.

Arsenic Concentrations Associated with Decision Risk Levels

Concentrations of arsenic that would lead to risk estimates at 1×10^{-4} and 1×10^{-5} decision risk levels were calculated[2] to assist in decision-making regarding future use of rock and

[2] In calculating concentrations based on excess cancer risk, target risk levels of 1.49×10^{-5} and 1.49×10^{-4} were used. These values would result in a risk estimate of 1×10^{-4} or 1×10^{-5}, respectively, when following the standard procedure of showing risk estimates as one significant figure.

TABLE 2. RISK ESTIMATES FOR ARSENIC IN SOIL AND ROCK

Site Area	Concentration (mg/kg)	Relative Absorption Factor[a]	Upper Bound Excess Carcinogenic Risk Estimate			Upper Bound Noncancer Hazard Index		
			Soil Ingestion	Dermal Contact[b]	Total	Soil Ingestion	Dermal Contact[b]	Total
Topsoil								
Maximum	46	0.40	5×10^{-6}	4×10^{-6}	9×10^{-6}	0.03	0.03	0.06
Mean	24	0.25	2×10^{-6}	2×10^{-6}	4×10^{-6}	0.01	0.01	0.02
D1 rock (1-in.-minus)								
Maximum	312	0.10	8×10^{-6}	3×10^{-5}	4×10^{-5}	0.05	0.2	0.2
Mean	193	0.066	3×10^{-6}	2×10^{-5}	2×10^{-5}	0.02	0.1	0.1

[a] Relative absorption factor based on *in vitro* results, see text.

[b] Dermal absorption assumed to be 3.2 percent, see text.

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soil products. Using the assumptions described above for occupational exposure including ingestion and dermal contact, concentrations of 125 mg/kg in D1 rock and 75 mg/kg in soil would be associated with a 1×10^{-5} risk estimate (Table 3); concentrations as high as 1,200 mg/kg in D1 rock and 750 mg/kg in soil would be associated with a 1×10^{-4} risk level (Table 4).

If dermal absorption of arsenic is assumed to be negligible, and, therefore, risks are derived based on soil ingestion alone and the maximum RAF, arsenic concentrations of approximately 5,900 mg/kg in rock or 1,400 mg/kg in soil would result in cancer risk estimate of 1×10^{-4}. Similarly, arsenic concentrations of 592 mg/kg and 142 mg/kg were derived for rock and soil, respectively, associated with the maximum RAF and a cancer risk estimate of 1×10^{-5}.

DRAFT GUIDELINES FOR USE OF IMPORTED SOIL AND ROCK PRODUCTS

Imported Soil

The topsoil as it was fabricated by the landfill contractor can be used as a landfill cover without exceeding acceptable risk levels. If additional imported topsoil is needed, and the contractor needs to use mineral fines other than their current overburden, testing for arsenic should be required. The topsoil arsenic concentration should be less than 275 mg/kg, which would result in a cancer risk estimate of 5×10^{-5}. Although, this level allows for additional risk contributions from other chemicals, there would be no other apparent sources of cancer risk from site-related CoPCs on the final landfill cover.

Rock Products

Crushed rock products that contain fines (e.g., D1, 1.5-in.-minus, and 3-in.-minus) should not be used as the final cover for ground surfaces at the KPC site if the arsenic concentration is greater than 700 mg/kg. This would be equivalent to an excess cancer risk of 8×10^{-5}. A worker exposed to this amount of arsenic in rock products for 25 years could also be exposed to other site-related carcinogens (if any) at a risk equivalent to 2×10^{-5} before the worker's cumulative risk would exceed the trigger level of 1×10^{-4} (i.e., 8×10^{-5} and 2×10^{-5} would be 1×10^{-4}).

Arsenic screening is unnecessary for rock products that are not used for driving surfaces. The long-term exposure pathway is absent, even for rock products with fines, if the material is used for a subgrade or other use without direct surface exposure.

TABLE 3. ARSENIC CONCENTRATIONS IN SOIL ASSOCIATED WITH A DECISION RISK LEVEL OF 1×10^{-4}, OR HAZARD INDEX OF 1

	Concentrations Based on Excess Cancer Risk					Concentrations Based on Noncancer Endpoints				
		Soil Ingestion					Soil Ingestion			
Material Type	Decision Risk Level	Relative Absorption Factor[a]	Soil Ingestion (mg/kg)	Dermal Contact[b] (mg/kg)	Combined Pathways (mg/kg)	Decision Hazard Quotient	Relative Bioaccessibility[a] (percent)	Soil Ingestion (mg/kg)	Dermal Contact[b] (mg/kg)	Combined Pathways (mg/kg)
Soil spread on the landfill										
Maximum	1×10^{-4}	0.40	1,421	1,586	750	1	0.40	1,533	1,711	809
Mean	1×10^{-4}	0.25	2,274	1,586	934	1	0.25	2,453	1,711	1,008
D1 rock (1-in.-minus)										
Maximum	1×10^{-4}	0.096	5,922	1,586	1,251	1	0.096	6,388	1,711	1,349
Mean	1×10^{-4}	0.066	8,614	1,586	1,340	1	0.066	9,291	1,711	1,445

Note Decision risk levels are rounded to one significant figure, but represent a value of 1.49×10^{-4}.

[a] Relative absorption factor based on *in vitro* results, see text.

[b] Dermal absorption assumed to be 3.2 percent, see text.

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TABLE 4. ARSENIC CONCENTRATIONS IN SOIL ASSOCIATED WITH A DECISION RISK LEVEL OF 1×10^{-5}, OR HAZARD INDEX OF 1

	Concentrations Based on Excess Cancer Risk					Concentrations Based on Noncancer Endpoints				
		Soil Ingestion					Soil Ingestion			
Material Type	Decision Risk Level	Relative Absorption Factor[a]	Soil Ingestion (mg/kg)	Dermal Contact[b] (mg/kg)	Combined Pathways (mg/kg)	Decision Hazard Quotient	Relative Bioaccessibility[a] (percent)	Soil Ingestion (mg/kg)	Dermal Contact[b] (mg/kg)	Combined Pathways (mg/kg)
Topsoil										
Maximum	1×10^{-5}	0.40	142	159	75	1	0.40	1,533	1,711	809
Mean	1×10^{-5}	0.25	227	159	93	1	0.25	2,453	1,711	1,008
D1 rock (1-in.-minus)										
Maximum	1×10^{-5}	0.096	592	159	125	1	0.096	6,388	1,711	1,349
Mean	1×10^{-5}	0.066	861	159	134	1	0.066	9,291	1,711	1,445

Note: Decision risk levels are rounded to one significant figure, but represent a value of 1.49×10^{-5}.

[a] Relative absorption factor based on *in vitro* results, see text.

[b] Dermal absorption assumed to be 3.2 percent, see text.

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Attachment A

Measurement of the Relative Absorption Factor for Arsenic in KPC Samples

MEASUREMENT OF THE RELATIVE ABSORPTION FACTOR FOR ARSENIC IN KPC SAMPLES

In humans, an orally administered dose of a compound is seldom completely absorbed, and the extent of absorption of orally administered compounds differs among various exposure media. For most compounds, the toxicity values derived by the U.S. Environmental Protection Agency are not adjusted to absorbed dose (i.e., the dose response evaluation is based on the administered dose). This approach can lead to overly conservative estimates of risk of exposure to a particular chemical in a medium other than the one used in the toxicity or epidemiology studies on which the toxicity values are based. For example, both the cancer slope factor and reference dose used to assess the cancer risks and other adverse health effects, respectively, that might be associated with oral exposure to arsenic (U.S. EPA 1993) were derived from an epidemiological study that characterized health effects in a population of Taiwanese who consumed drinking water containing arsenic (Tseng 1977; Tseng et al. 1968). In contrast to arsenic in drinking water (soluble arsenic), arsenic in soil generally exists as mineral phases or soil-arsenic complexes that will be incompletely solubilized and absorbed during transit through the gastrointestinal (GI) tract. The solubility of these different forms of arsenic appears to be a critical factor controlling arsenic bioavailability (ATSDR 1993; U.S. EPA 1992). Therefore, a downward adjustment to arsenic bioavailability from soil should be made to reflect the difference between arsenic in drinking water and arsenic in soil.

For the purpose of this attachment, absolute bioavailability is defined as that fraction of the ingested element that is absorbed into systemic circulation. The term "relative bioavailability" is used to describe the bioavailability of the element in soil relative to the bioavailability of the element dissolved in water. Finally, bioaccessibility is defined as the fraction of the ingested element that dissolves in the GI tract and is available for absorption.

A relative absorption factor (RAF), which represents the relative bioavailability, is used to adjust the dose or intake of arsenic from soil so that it is comparable to the arsenic doses from water used to generate the toxicity values. Thus, for assessing oral exposure to arsenic in soil:

$$\text{RAF} = \frac{\text{fraction of element absorbed from soil}}{\text{fraction of element absorbed from dissolved form}}.$$

To assess the bioavailability of arsenic in the Ketchikan Pulp Company (KPC) soil samples, an approach that relies on previous work that Exponent has performed to assess the bioavailability of inorganic elements was used. An *in vitro* test system, termed the physiologically based extraction test (PBET), which replicates human GI-tract chemistry and function (Ruby et al. 1996), was used to determine the fraction of arsenic that would

be soluble and available for absorption in the GI tract (i.e., the fraction that is bioaccessible).

Differences in arsenic absorption from various matrices have been demonstrated in *in vivo* studies using animal models and in *in vitro* studies designed to mimic dissolution in the human GI tract. *In vivo* models assume that the fraction of arsenic mass absorbed by the animal from soil (relative to a soluble arsenic source) is similar to the fraction that would be absorbed by a human ingesting this same soil. While differences between animal and human physiology may limit the accuracy of this assumption, historically, animal studies were the only tool available for assessing the RAF. Only recently have *in vitro* procedures (i.e., the PBET) been available that can be used in this manner, and significant effort has been invested in validating the *in vitro* method for this application (Ruby et al. 1996).

The use of the PBET to estimate the bioavailability of inorganic elements is supported by good agreement between *in vivo* bioavailability data and *in vitro* bioaccessibility data for a series of arsenic- and lead-bearing samples tested in both kinds of studies (Ruby et al. 1996).

METHODS

The PBET is an extraction technique that uses a simulated GI fluid to measure the solubility of arsenic from soil under conditions that are similar to those found in the human GI tract. The details of this procedure were presented in Standard Operating Procedure 312 of Technical Memorandum No. 9 (Exponent 1998). Each time a sample is subjected to the PBET procedure, four extract samples are collected: two while the extract solution is maintained at pH 1.5, which simulates the stomach environment, and two while it is at pH 7.0, which simulates the intestinal environment. At each of these four sampling points, the extract pH is measured to ensure that it has not drifted more than 0.3 pH units away from the two target pH values of 1.5 and 7.0 (because the solubility of many minerals vary greatly with pH, tests are repeated if the pH values drift beyond ±0.3). Using this procedure, arsenic bioaccessibility was measured on six fabricated soil samples and three rock-product samples.

Bioaccessibility was also measured in three samples of onsite soil from the nearshore landfill and in an onsite rock sample of the red shale. Results of bioaccessibility analyses are summarized in Table 1 of the main text; detailed results will be described in a technical memorandum entitled *Results of Bioaccessibility and Mineralogical Analyses to Support the Baseline Human Health Risk Assessment.*

To ensure the quality of the PBET data, one soil sample was analyzed in triplicate (SS0002), and one rock sample (R10003) and one soil sample (NSFS-02) were analyzed in duplicate. In addition, two standard reference materials (Sums) were analyzed: National Institute for Standards and Technology (NIST) SRAM No. 2710 (in triplicate), and a soil sample from Butte, Montana (S-13) that was expected to contain arsenic with

similar mineralogy and relative bioavailability as the KPC rock samples. Finally, two samples of PBET extract solution spiked with 0.14 mg/L and 0.45 mg/L of arsenic were subjected to the PBET (in the absence of any soil) to quantify the arsenic recovery efficiency.

The results of the quality control sample analysis (Tables A-1 through A-3) indicate that:

1. Arsenic spike recoveries were 93 and 97 percent for the two samples tested, indicating that no significant adsorption of arsenic onto the test apparatus was occurring during the PBET (Table A-1).

2. The relative standard deviations for the two triplicate arsenic soil analyses (SS0002 and SRM2710) were 20 and 5 percent, respectively (Table A-2). These data indicate acceptable reproducibility.

3. The relative standard deviations for the two triplicate PBET extract arsenic analyses (SS0002 and SRM2710) were 14 and 22 percent, respectively (Table A-2). These data indicate acceptable reproducibility.

4. The relative percent difference between the duplicate soil arsenic analyses performed for R10003 was 28 percent (Table A-2), indicating that the replicate results were within control limits (i.e., the soil analyses had a relative percent difference of less than 35 percent).

5. The relative percent difference between the duplicate arsenic analysis of PBET extract from R10003 was 37 percent (Table A-2), which is not within control limits (i.e., the aqueous analyses had a relative percent difference of greater than 25 percent). This large difference among the replicate analyses of sample R10003 probably is due to heterogeneity's in this sample, and the relatively low arsenic concentration in this substrate (average of 30 mg/kg).

6. The measured arsenic concentrations in the triplicate NITS SRAM No. 2710 sample (575, 616, and 638 mg/kg) were all within 10 percent of the certified concentration of 588 mg/kg, indicating that the accuracy of the solids analysis were acceptable.

7. The measured arsenic concentrations in PBET extract from the NIST standard (2.06, 2.84, and 3.20 mg/L) were not significantly different (within a probability of 0.58) than the results obtained for this sample during previous studies (Table A-3), indicating that the accuracy of PBET procedure was acceptable, given the relatively small number of previous observations for this sample (n=3).

8. The bioaccessibility value obtained for the Butte soil (10 percent for SRM-S13) was similar to the value obtained previously for this substrate (8 percent) during the PBET validation study (Medlin 1997).

TABLE A-1. ARSENIC SPIKE RESULTS

	Time (hour)	pH (s.u.)	Concentration of Arsenic Spike (mg/L)	Concentration in Extract (mg/L)	Spike Recovery (percent)	Relative Percent Difference
Spiked stomach solution A	0.50	1.56	0.454	0.445	98	2
Spiked stomach solution A	1.00	1.55	0.454	0.445	98	2
Spiked stomach solution A	3.58	7.07	0.454	0.440	97	3
Spiked stomach solution A	5.58	6.98	0.454	0.425	94	7
Spiked stomach solution B	0.50	1.50	0.144	0.147	102	2
Spiked stomach solution B	1.00	1.48	0.144	0.149	103	3
Spiked stomach solution B	3.92	6.87	0.144	0.145	101	1
Spiked stomach solution B	5.92	7.13	0.144	0.145	101	1
Spiked intestinal solution	NA	NA	0.2	0.231	101	14

Note: NA - not applicable

TABLE A-2. ARSENIC RESULTS OF THE REPLICATE AND TRIPLICATE ANALYSIS PERFORMED DURING THE PBET PROCEDURE

	<250 μm Soil Fraction (mg/kg)	Maximum[a] PBET Extract (mg/L)
SS0002		
Replicate 1	31.0	0.120
Replicate 2	39.1	0.101
Replicate 3	46.9	0.134
Relative standard deviation[b]	20%	14%
NIST SRM 2710		
Replicate 1	575	2.06
Replicate 2	616	2.84
Replicate 3	638	3.20
Relative standard deviation[b]	5%	22%
R10003		
Replicate 1	25.7	0.032
Replicate 2	33.9	0.022
Relative percent difference[c]	28%	37%

Note: PBET - physiologically based extraction test

[a] Four extract samples were collected throughout the testing of each replicate, but only the maximum arsenic concentration observed among these four analyses is used to characterize the bioaccessibility value of this sample.

[b] Relative standard deviation = standard deviation / average

[c] Relative percent difference = |Replicate 1 - Replicate 2| / average

TABLE A-3. MAXIMUM ARSENIC CONCENTRATION IN THE PBET EXTRACTS FROM NIST SRM SOIL NO. 2710

Study Group/Sample ID	Maximum Concentration In PBET Extracts (mg/L)
Arsenic concentration in previous tests of NIST SRM No. 2710	
Site 1	2.03
Site 2	2.28
Site 3	2.99
Arsenic concentration in tests of the NIST SRM No. 2710 conducted during this study	
Replicate 1	2.06
Replicate 2	2.84
Replicate 3	3.20

Note: PBET - physiologically based extraction test

The good quality control performance achieved for the Sums (SRAM No. 2710 and SRM-S13) and the spike samples suggest that the analytical procedures were followed properly, and that the analytical data accurately characterized the arsenic content of both the soil samples and the PBET extracts (i.e., the analytical laboratory performed the analysis well).

RESULTS

The arsenic bioaccessibility values are calculated for each of the four extracts (Table A-4) by dividing the total mass of arsenic in the extract (extract concentration × extract volume) by the total mass of arsenic in the soil being extracted (soil concentration × soil mass). In general, the highest arsenic concentrations occurred in the intestinal-phase extracts. However, samples SS0002 B, LS0002, and LS0003 released more arsenic during the low pH stomach-phase extraction.

The bioaccessibility value for a given sample was conservatively assumed to be the highest bioaccessibility measured among the individual extracts from that sample (Table A-5). For example, the four extracts collected from SS0001 following 0.5, 1, 2.7, and 4.7 hours had arsenic bioaccessibilities of 18, 26, 38, and 40 percent, respectively. Therefore, the bioaccessibility value for this sample is assumed to be 40 percent (Table A-5). When replicate or triplicate PBETs were performed, the maximum bioaccessibility from each PBET was used to calculate the average among the repeated tests (Table A-5).

The arsenic bioaccessibility values observed in the rock-product samples ranged between 1.6 and 9.6 percent, averaging 6.6 percent. The arsenic bioaccessibility values observed in the fabricated topsoil samples ranged between 5.5 and 40 percent, averaging 25 percent.

On average, the topsoil values are substantially higher than bioaccessibility estimates for any other samples, including onsite soil samples. It is possible that the presence of hog fuel in the topsoil samples may either increase bioaccessibility of arsenic from added overburden or be a source of more bioaccessible arsenic forms. As indicated previously, leachate from hog fuel had soluble arsenic concentrations ranging from 13 to 14 μg/L. The variability in the bioaccessibility values may be related to the relative proportion of overburden and hog fuel. Conversely, arsenic occurs in the rock-product as arsenopyrite, which has extremely slow solubility.

TABLE A-4. PBET RESULTS FOR SOIL AND ROCK SAMPLES

Sample ID	Time (hours)	pH (s.u.)	Arsenic[a] Concentration of Substrate (mg/kg)	Mass of Soil Tested (g)	Concentration in Extract (mg/L)	Volume of Extract (L)	Calculated Mass of Arsenic in Soil (mg)	Calculated Mass of Arsenic in Extract (mg)	Arsenic Bioaccessibility (percent)
SS0001	0.50	1.41	38.1	1.5049	0.071	0.150	0.057	0.0107	18
SS0001	1.00	1.41	38.1	1.5049	0.101	0.150	0.057	0.0152	26
SS0001	2.67	7.03	38.1	1.5049	0.146	0.150	0.057	0.0219	38
SS0001	4.67	7.12	38.1	1.5049	0.152	0.150	0.057	0.0228	40
SS0002 A	0.50	1.40	31.0	1.5059	0.054	0.150	0.047	0.0081	17
SS0002 A	1.00	1.39	31.0	1.5059	0.074	0.150	0.047	0.0111	24
SS0002 A	3.42	6.94	31.0	1.5059	0.113	0.150	0.047	0.0170	36
SS0002 A	5.42	7.07	31.0	1.5059	0.120	0.150	0.047	0.0180	39
SS0002 B	0.50	1.59	39.1	1.5009	0.073	0.150	0.059	0.0110	19
SS0002 B	1.00	1.59	39.1	1.5009	0.101	0.150	0.059	0.0152	26
SS0002 B	3.42	7.11	39.1	1.5009	0.047	0.150	0.059	0.0071	12
SS0002 B	5.42	7.10	39.1	1.5009	0.050	0.139	0.059	0.0070	12
SS0002 C	0.50	1.60	46.9	1.5035	0.056	0.150	0.071	0.0084	12
SS0002 C	1.00	1.55	46.9	1.5035	0.083	0.150	0.071	0.0125	18
SS0002 C	3.58	7.12	46.9	1.5035	0.124	0.150	0.071	0.0186	26
SS0002 C	5.58	7.01	46.9	1.5035	0.134	0.130	0.071	0.0174	25
SS0003	0.50	1.50	42.8	1.5055	0.079	0.150	0.064	0.0119	18
SS0003	1.00	1.51	42.8	1.5055	0.106	0.150	0.064	0.0159	25
SS0003	3.42	6.88	42.8	1.5055	0.140	0.150	0.064	0.0210	33
SS0003	5.42	7.10	42.8	1.5055	0.153	0.150	0.064	0.0230	36
LS0001	0.50	1.43	217	1.5031	0.064	0.150	0.326	0.0096	3
LS0001	1.00	1.42	217	1.5031	0.095	0.150	0.326	0.0143	4
LS0001	2.67	6.99	217	1.5031	0.117	0.150	0.326	0.0176	5
LS0001	4.67	7.03	217	1.5031	0.120	0.150	0.326	0.0180	6
LS0002	0.50	1.57	40.2	1.5029	0.072	0.150	0.060	0.0108	18
LS0002	1.00	1.56	40.2	1.5029	0.097	0.150	0.060	0.0146	24
LS0002	3.42	7.14	40.2	1.5029	0.034	0.150	0.060	0.0051	8
LS0002	5.42	7.08	40.2	1.5029	0.034	0.126	0.060	0.0043	7
LS0003	0.50	1.53	35.2	1.5018	0.030	0.150	0.053	0.0045	9
LS0003	1.00	1.53	35.2	1.5018	0.050	0.150	0.053	0.0075	14

TABLE A-4. (cont.)

Sample ID	Time (hours)	pH (s.u.)	Arsenic[a] Concentration of Substrate (mg/kg)	Mass of Soil Tested (g)	Concentration in Extract (mg/L)	Volume of Extract (L)	Calculated Mass of Arsenic in Soil (mg)	Calculated Mass of Arsenic in Extract (mg)	Arsenic Bioaccessibility (percent)
LS0003	3.42	7.10	35.2	1.5018	0.033	0.150	0.053	0.0050	9
LS0003	5.42	7.11	35.2	1.5018	0.038	0.148	0.053	0.0056	11
R10001	0.50	1.61	237	1.5006	0.027	0.150	0.356	0.0041	1
R10001	1.00	1.57	237	1.5006	0.034	0.150	0.356	0.0051	1
R10001	3.58	7.13	237	1.5006	0.039	0.150	0.356	0.0059	2
R10001	5.58	7.20	237	1.5006	0.042	0.126	0.356	0.0053	1
R10002	0.50	1.59	38.2	1.5063	0.021	0.150	0.058	0.0032	5
R10002	1.00	1.60	38.2	1.5063	0.027	0.150	0.058	0.0041	7
R10002	3.58	6.99	38.2	1.5063	0.037	0.150	0.058	0.0056	10
R10002	5.58	7.05	38.2	1.5063	0.040	0.128	0.058	0.0051	9
R10003 A	0.50	1.59	25.7	1.5021	0.016	0.150	0.039	0.0024	6
R10003 A	1.00	1.59	25.7	1.5021	0.019	0.150	0.039	0.0029	7
R10003 A	3.42	7.00	25.7	1.5021	0.019	0.150	0.039	0.0029	7
R10003 A	5.42	7.14	25.7	1.5021	0.032	0.133	0.039	0.0043	11
R10003 B	0.50	1.55	33.9	1.5002	0.013	0.150	0.051	0.0020	4
R10003 B	1.00	1.54	33.9	1.5002	0.017	0.150	0.051	0.0026	5
R10003 B	3.42	6.93	33.9	1.5002	0.019	0.150	0.051	0.0029	6
R10003 B	5.42	7.10	33.9	1.5002	0.022	0.132	0.051	0.0029	6
SRM 2701 A[b]	0.50	1.59	575	1.5044	1.5	0.150	0.865	0.2250	26
SRM 2701 A[b]	1.00	1.56	575	1.5044	1.84	0.150	0.865	0.2760	32
SRM 2701 A[b]	3.42	6.97	575	1.5044	2.06	0.150	0.865	0.3090	36
SRM 2701 A[b]	5.42	7.15	575	1.5044	2.05	0.130	0.865	0.2665	31
SRM 2710 B[b]	0.50	1.52	616	1.5008	2.62	0.150	0.924	0.3930	43
SRM 2710 B[b]	1.00	1.52	616	1.5008	2.84	0.150	0.924	0.4260	46
SRM 2710 B[b]	3.92	6.83	616	1.5008	2.83	0.150	0.924	0.4245	46
SRM 2710 B[b]	5.92	7.07	616	1.5008	2.82	0.140	0.924	0.3948	43
SRM 2710 C[b]	0.50	1.55	638	1.5021	2.80	0.150	0.958	0.4200	44
SRM 2710 C[b]	1.00	1.55	638	1.5021	3.20	0.150	0.958	0.4800	50
SRM 2710 C[b]	3.92	6.82	638	1.5021	3.14	0.150	0.958	0.4710	49
SRM 2710 C[b]	5.92	7.12	638	1.5021	3.00	0.145	0.958	0.4350	45

TABLE A-4. (cont.)

Sample ID	Time (hours)	pH (s.u.)	Arsenic[a] Concentration of Substrate (mg/kg)	Mass of Soil Tested (g)	Concentration in Extract (mg/L)	Volume of Extract (L)	Calculated Mass of Arsenic in Soil (mg)	Calculated Mass of Arsenic in Extract (mg)	Arsenic Bioaccessibility (percent)
SRM S13[c]	0.50	1.51	215	1.5042	0.196	0.150	0.323	0.0294	9
SRM S13[c]	1.00	1.48	215	1.5042	0.213	0.150	0.323	0.0320	10
SRM S13[c]	3.42	7.04	215	1.5042	0.027	0.150	0.323	0.0041	1
SRM S13[c]	5.42	7.14	215	1.5042	0.030	0.140	0.323	0.0042	1

Note: *U* - not detected; value represents detection limit
-- - no analysis performed

[a] Arsenic concentration of substrate sieved to 250 μm.

[b] NIST SRM No. 2170 Montana soil.

[c] Butte, Montana, soil.

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TABLE A-5. SUMMARY OF PBET RESULTS

Sample Type/ Sample ID	Bioaccessibility (Percent)
Fabricated Topsoil	
LS0001	5.5
LS0002	24.1
LS0003	14.2
SS0001	39.8
SS0002	30.3 [a]
SS0003	35.6
Average	25
Maximum	39.8
Rock Product	
R10001	1.6
R10002	9.6
R10003	8.4 [b]
Average	6.6
Maximum	9.6

Note: PBET - physiologically based extraction test

[a] Average bioaccessiblity of a triplicate analysis of this sample.

[b] Average bioaccessiblity of a duplicate analysis of this sample.

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Attachment B

Identifying the Mineral Form of the Arsenic Source

IDENTIFYING THE MINERAL FORM OF THE ARSENIC SOURCE

ELECTRON MICROPROBE ANALYSIS

The solubility of arsenic from soil or rock is controlled to a large extent by the mineral form in which the arsenic occurs. Because the relative bioavailability of arsenic in different matrices is related to its solubility (see Attachment A), determination of the arsenic mineralogy may provide an explanation of variations in relative bioavailability estimates among samples.

The primary tool that is used to assess the arsenic mineralogy of soil and rock samples is electron microprobe analysis (EMPA). This technology is particularly useful in assessing the mineralogy of samples that contain too few arsenic-bearing minerals to be detected by x-ray diffraction techniques. EMPA uses a variety of x-ray spectroscopic tools to generate microscopic images of individual soil or rock particles, determine their composition (i.e., mineralogy), and measure their arsenic content. This information is used to determine the distribution of arsenic among the various mineral phases of a sample.

METHODS

One sample, R10003, was analyzed using EMPA.[1] This sample, which contains 30 mg/kg arsenic, is a random sample from the D1 quarried rock that is used to prepare the top soil. The sample was processed by crushing it in a stainless-steel shatter box until the entire crushed sample passed through a 250-μm sieve. The crushed sample was then used in the EMPA.

The EMPA data for sample R10003 are provided in Table B-1, including an assessment of the mineralogy of each mineral grain evaluated, and its size based on the long-axis length. These data, together with the arsenic concentration and specific gravity of each mineral phase encountered, and the methods described in Technical Memorandum No. 9 (Exponent 1998), were used to calculate the distribution of arsenic mass among the minerals within this sample (Table B-2).

[1] Three onsite soil samples were also analyzed using EMPA. These results will be presented in Technical Memorandum No. 14, *Results of Bioaccessibility and Mineralogical Analyses to Support the Baseline Human Health Risk Assessment.*

TABLE B-1. RAW DATA FROM THE ELECTRON MICROPROBE ANALYSIS OF KPC SAMPLE R10003

Particle No.	Mineral Phase	Mode of Occurrence	Long-Axis Dimension (μm)	Particle No.	Mineral Phase	Mode of Occurrence	Long-Axis Dimension (μm)
1	Arsenopyrite	Liberated	20	39	Pyrite	Attached	15
2	Arsenopyrite	Liberated	24	40	Pyrite	Attached	15
3	Arsenopyrite	Rimming	3	41	Pyrite	Attached	15
4	Arsenopyrite	Rimming	5	42	Pyrite	Attached	15
5	Arsenopyrite	Liberated	50	43	Pyrite	Attached	15
6	Arsenopyrite	Attached	5	44	Pyrite	Attached	15
7	Arsenopyrite	Liberated	55	45	Pyrite	Attached	15
8	Arsenopyrite	Liberated	3	46	Pyrite	Attached	15
9	Arsenopyrite	Liberated	8	47	Pyrite	Attached	15
10	Arsenopyrite	Liberated	10	48	Pyrite	Attached	15
11	Arsenopyrite	Liberated	30	49	Pyrite	Attached	15
12	Arsenopyrite	Attached	10	50	Pyrite	Liberated	20
13	Arsenopyrite	Liberated	20	51	Pyrite	Liberated	20
14	Pyrite	Liberated	25	52	Pyrite	Liberated	20
15	Pyrite	Liberated	30	53	Pyrite	Liberated	20
16	Pyrite	Liberated	75	54	Pyrite	Liberated	20
17	Pyrite	Liberated	75	55	Pyrite	Liberated	20
18	Pyrite	Liberated	75	56	Pyrite	Liberated	20
19	Pyrite	Liberated	100	57	Pyrite	Liberated	20
20	Pyrite	Liberated	100	58	Pyrite	Liberated	20
21	Pyrite	Liberated	100	59	Pyrite	Liberated	20
22	Pyrite	Liberated	100	60	Pyrite	Liberated	5
23	Pyrite	Liberated	50	61	Pyrite	Liberated	5
24	Pyrite	Liberated	50	62	Pyrite	Liberated	5
25	Pyrite	Liberated	50	63	Pyrite	Liberated	5
26	Pyrite	Liberated	50	64	Pyrite	Liberated	5
27	Pyrite	Liberated	50	65	Pyrite	Liberated	55
28	Pyrite	Liberated	50	66	Pyrite	Liberated	2
29	Pyrite	Liberated	50	67	Pyrite	Liberated	2
30	Pyrite	Liberated	50	68	Pyrite	Liberated	2
31	Pyrite	Liberated	50	69	Pyrite	Liberated	2
32	Pyrite	Liberated	50	70	Pyrite	Liberated	1
33	Pyrite	Liberated	50	71	Pyrite	Liberated	1
34	Pyrite	Liberated	50	72	Pyrite	Liberated	1
35	Pyrite	Attached	15	73	Pyrite	Liberated	1
36	Pyrite	Attached	15	74	Pyrite	Liberated	1
37	Pyrite	Attached	15	75	Pyrite	Liberated	1
38	Pyrite	Attached	15	76	Pyrite	Liberated	1

TABLE B-2. ELECTRON MICROPROBE ANALYSIS RESULTS

	Frequency Percent		Arsenic Mass Distribution	
Sample Type/ID	Arsenopyrite (percent)	Pyrite (percent)	Arsenopyrite[a] (percent)	Pyrite[b] (percent)
Crushed rock, sieved to <250 μm				
R10003	0.3	99.7	96.3	3.7

[a] The mass distribution was calculated using a specific gravity of 6 and an arsenic concentration of 46 percent.

[b] The average arsenic concentration in the pyrite phase is 60 mg/kg. This concentration, together with the specific gravity for pyrite, 5, was used to calculate the mass distribution.

ELECTRON MICROPROBE ANALYSIS RESULTS

EMPA results typically are reported in two ways: the frequency with which the arsenic-bearing particles occur in a sample, and the arsenic mass distribution among the mineral phases (Table B-2). The frequency-of-occurrence values are used to calculate the arsenic mass distribution, as discussed in Technical Memorandum No. 9. The arsenic mass in sample R10003 is distributed among two similar minerals—arsenopyrite (arsenic sulfide, or FeAsS) and pyrite (iron sulfide) containing trace amounts of arsenic—with 99 percent of the arsenic mass occurring in the arsenopyrite phase. Arsenopyrite and pyrite had arsenic concentrations of 46 and 0.006 percent, respectively, and specific gravities of 6 and 5 g/cm^3, respectively. Because both of these minerals have very low solubilities under GI-tract conditions (Davis et al. 1996), they are therefore likely to have very low bioavailabilities. This observation is supported by the physiologically based extraction test (PBET) data, which indicate that the bioaccessibility of sample R10003 is 8 percent (relative absorption factor = 0.08).

Because it was thought that the mineralogy and relative bioavailability of arsenic in sample R10003 would be similar to arsenic in Butte, Montana, soils (both R10003 and the Butte, Montana, soil were originally derived from sulfide-rich mineral deposits), a sample of the Butte, Montana, soil was included in the PBET procedure. This sample was included to provide an internal quality control sample for which both mineralogy and relative bioavailability data estimates are available (Casteel et al. 1997; Drexler 1998). The Butte, Montana, soil contains iron arsenic sulfate, a weathering product of pyrite and arsenopyrite. The relative bioavailability of this sample has been estimated to be 0.10, which is very similar to the relative bioavailability estimate of 0.08 for sample R10003. As the arsenic in the crushed rock on KPC site weathers, its mineralogy may become more like that of the Butte, Montana, soil, but its relative bioavailability is likely to remain very low.

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Attachment C

Quality Assurance Review Summary—Chemical Analyses of Solid and Aqueous Samples

QUALITY ASSURANCE REVIEW SUMMARY— CHEMICAL ANALYSES OF SOLID AND AQUEOUS SAMPLES

INTRODUCTION

Exponent performed a quality assurance review of data for chemical analyses of total metals and metals extractable by synthetic precipitation leaching procedure (SPLP). The chemical analyses for total arsenic were completed on 62 aqueous samples; 2 of which were additionally analyzed for total cadmium and lead; and 26 solid samples, 12 of which were additionally analyzed for SPLP-extractable arsenic. The quality assurance review was conducted to verify that the laboratory quality assurance and quality control procedures were completed and documented as specified in the quality assurance project plan (Appendix B in PTI 1997) and that the quality of the data is sufficient to meet the project data quality objectives (DQOs) and support the use of the data for its intended purposes. The results of the quality assurance review are presented in this report.

DATA VALIDATION PROCEDURES

Data validation was completed in accordance with U.S. Environmental Protection Agency (EPA) Level 3 specifications (U.S. EPA 1994a; PSEP 1991). During the quality assurance review, 26 results were qualified as estimated; no results were rejected.

Data validation procedures were based on EPA Contract Laboratory Program national functional guidelines for inorganic data review (U.S. EPA 1994a). Data validation procedures were modified, as appropriate, to accommodate project-specific DQOs and quality control requirements that are not specifically addressed by the national functional guidelines. The following laboratory deliverables were reviewed during the data validation process:

- Chain-of-custody documentation to verify completeness of the data
- Case narratives discussing analytical problems (if any) and procedures
- Data summary sheets to verify analytical holding times
- Method blanks associated with each sample delivery group (SDG) to check for laboratory contamination

- Results for all laboratory quality control samples used to check analytical accuracy, including matrix spikes, and laboratory control samples (LCSs)
- Results for all quality control samples used to check analytical precision, including duplicate sample analyses
- Instrument and method detection limits for all target analytes.

SAMPLE SET AND ANALYTICAL METHODS

The sample set consisted of 62 solid samples and 26 aqueous samples. The samples were analyzed for total metals by EPA Method 6020 (U.S. EPA 1994b) and SPLP-extractable arsenic by EPA Method 6010A (U.S. EPA 1992).

All analyses were completed by North Creek Analytical in Portland, Oregon.

SAMPLE DELIVERY GROUPS

All soil samples were analyzed in two SDGs. The data packages for these SDGs contained all documentation and data necessary to conduct a complete quality assurance review.

DATA QUALITY ASSESSMENT

The results of the quality control procedures used during sample analysis are discussed below. The laboratory data were evaluated in terms of completeness, holding times and sample preservation, instrument performance, method blanks, accuracy, precision, and method reporting limits.

Completeness

The results reported by the laboratory were 100 percent complete.

Holding Times

Analytical holding times were met for all samples and analyses.

Instrument Performance

The performance of the analytical instruments, as documented by the laboratory, was acceptable.

Mass Spectrometer Tuning

The mass spectrometer tuning checks conducted by the laboratory prior to sample analyses were acceptable, as documented by the laboratory.

Initial and Continuing Calibrations

Initial and continuing calibrations were completed at the required frequency and met control limits for all target analytes, as documented by the laboratory.

Contract-Required Detection Limit Standards

Contract-required detection limit standards met the criteria for acceptable performance.

Initial and Continuing Calibration Blanks

The initial and continuing calibration blank (ICB and CCB) met the criteria for acceptable performance and frequency of analysis, as documented by the laboratory.

Method Blank Analyses

Method blank analyses were completed for all target analytes and met the criteria for acceptable performance and frequency of analysis.

Accuracy

The accuracy of the analytical results is evaluated in the following sections in terms of matrix spike and LCS recoveries.

Matrix Spike Recoveries

The recoveries reported by the laboratory for matrix spike analyses met the criteria for acceptable performance and frequency of analysis, with the following exceptions. The matrix spike recoveries for arsenic associated with the solids data in both SDGs exceeded the upper control limit of 125 percent. A total of 26 results for total arsenic in solids were

qualified as estimated and may exhibit a high bias. The percent recoveries for arsenic and lead in one of two matrix spike recoveries associated with the standard reference material were outside of the control limits of 75–125 percent. No data were qualified because arsenic and lead recoveries in a second matrix spike were in control and all other associated quality control sample results were acceptable.

Laboratory Control Sample Recoveries

The recoveries reported by the laboratory for all LCSs met the criteria for acceptable performance and frequency of analysis.

Precision

The results reported by the laboratory for laboratory duplicate analyses met the criteria for acceptable performance and frequency of analysis, with the following exceptions. Arsenic results in laboratory duplicates associated with solid samples exceeded the relative percent difference (RPD) control limit of 40 percent, in both SDGs. A total of 26 solid total arsenic results were qualified as estimated and may exhibit a high or low bias.

Method Reporting Limits

The method detection limits (MDLs) and method reporting limits (MRLs) provided by the laboratories met project DQOs (PTI 1997).

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Exponent™

Institutional Control Plan for the Ketchikan Pulp Company Site

Prepared for

Ketchikan Pulp Company
Ketchikan, Alaska

Exponent

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Acronyms and Abbreviations

ADEC	Alaska Department of Environmental Conservation
ARAR	applicable or relevant and appropriate requirement
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CoC	chemical of concern
CoPC	chemical of potential concern
Easement and Covenant	*Environmental Protection Easement and Declaration of Restrictive Covenants*
EPA	U.S. Environmental Protection Agency
Gateway	Gateway Forest Products
KPC	Ketchikan Pulp Company
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollutant Discharge Elimination System
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCDD/F	polychlorinated dibenzo-*p*-dioxin and polychlorinated dibenzofuran
ROD	record of decision
RPM	remedial project manager

1. Introduction

This plan describes the institutional controls for the Uplands Operable Unit of the Ketchikan Pulp Company (KPC) site, which was purchased by Gateway Forest Products (Gateway) in November 1999. Institutional controls are measures undertaken to limit or prohibit activities that may interfere with the integrity of a remedial action or potentially result in exposure to unacceptable levels of hazardous substances at a site. Institutional controls are legal or administrative controls, as opposed to engineering controls, and are not typically the sole remedy. At the Uplands Operable Unit, institutional controls were applied after the early actions to remove principal threats at the site were completed. Examples of institutional controls include legal or administrative controls for managing contaminated soil during development activities and property deed restrictions (e.g., to restrict the land use of a property). The intent of institutional controls is to ensure that remedial efforts are protective of human health and the environment over the long term. The use of institutional controls and the early actions conducted at the Uplands Operable Unit were presented to the public in the proposed plan (ADEC and U.S. EPA 1999) and will be documented in the record of decision (ROD), with consideration of any applicable public comments.

The former KPC site is located approximately 5 miles north of Ketchikan, Alaska (Figure 1), and is divided into two administrative units: the Marine Operable Unit and the Uplands Operable Unit. The Marine Operable Unit is being remediated under a consent decree with the U.S. Environmental Protection Agency (EPA) and includes all of Ward Cove and other marine areas where there has been migration of hazardous substances from Ward Cove or the Uplands Operable Unit in concentrations that potentially pose a threat to public health or the environment. The Uplands Operable Unit is being remediated under a consent order with joint oversight from EPA and the Alaska Department of Environmental Conservation (ADEC) and includes the pulp mill area (including the dredge spoil area), the wood waste and ash disposal landfill, and the former storage areas along the water pipeline road (pipeline road). The Uplands Operable Unit also includes other land-based areas that may have been affected by pulp mill operations (i.e., areas that received aerial deposition from the mill and residences where mill solids may have been used as soil amendments) (Figure 2). The boundary between the two operable units is defined as the mean higher high tide level.

The institutional controls described in this plan for the pulp mill area of the Uplands Operable Unit and institutional controls for the Marine Operable Unit are codified in the *Environmental Protection Easement and Declaration of Restrictive Covenants* (Easement and Covenant) document filed between KPC and the State of Alaska Department of Natural Resources for ADEC, with provisions for designating oversight authority to EPA (ADL 1999). The Easement and Covenant document is attached as Appendix A. Appropriate easement and covenant documents will also be prepared relating to

institutional controls for the wood waste and ash disposal landfill area and for the disposal areas along the pipeline road.

This institutional control plan applies only to the Uplands Operable Unit and addresses only contamination related to KPC's former use of the property. The investigation and remediation of the Marine Operable Unit are being conducted on a separate schedule from the Uplands Operable Unit. The Easement and Covenant document and the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) Consent Decree contain provisions for replacing the cap in those areas of the Marine Operable Unit to be capped by clean sediments in the event that any projects or activities cause large portions of the cap to be displaced or eroded. No additional institutional controls or other restrictions for the Marine Operable Unit are anticipated, but if any are identified, they will be addressed separately after the remedy for that unit is selected.

This institutional control plan is to be implemented by the owner(s) of the properties to manage residual contamination as a result of KPC's use of the site. Specifically, the institutional controls are specified in the Easement and Covenant document and the CERCLA Consent Decree, which stipulate management methods for contaminants of concern and areas of concern identified in the KPC remedial investigation and feasibility study or for these contaminants in any areas that might be identified in the future. This plan addresses characterization, management, and disposal of soils in the following areas: soils in the near-shore fill subarea, soils underneath paved areas or structures at the former pulp mill site, and soils at the former pulp mill and at the pipeline road area that were not evaluated[1] or characterized during the remedial investigation but that could be exposed in the future (e.g., as the result of excavation or demolition).

These institutional controls are conferred with the land regardless of the owner. The KPC former mill property was sold to Gateway effective November 1, 1999, for use as a light manufacturing facility. Gateway and any successor will have responsibility for implementing this institutional control plan for the pulp mill property. As part of the sale agreement between KPC and Gateway, a cost and work sharing arrangement has been formalized between the two parties. The agreement contains specific requirements for Gateway and any successors to provide KPC prior notice of any activities that are likely to expose historical contamination and to notify KPC if contamination is discovered; describes how the costs and responsibilities for investigating and managing the contamination will be shared between the two parties; and allocates responsibilities for directing any remedial efforts. In addition, Gateway and any subsequent owners will have responsibility for following all applicable laws including appropriate management of any chemicals used onsite.

[1] The remedial investigation for the upland site evaluated the entire site, but characterization through sampling and analyses was done only in areas where contaminant releases were suspected.

There are no plans for sale of the landfill property at this time. However, if the landfill property is purchased by another entity, then the ADEC solid waste permit for the landfill could be transferred to the new owner through an application to ADEC. Residual concentrations of chemicals of concern (CoCs) at the former storage areas along the water pipeline road are described in Technical Memorandum No. 23 (Exponent 2000a). The mostly likely future use of the pipeline road areas is recreational. Site concentrations were evaluated based on institutional use, however, because this provides a protective means to evaluate less frequent recreational exposure. During investigations of the pipeline road, five areas identified as potentially of concern were investigated: Area 1, Area 2, Drum Area 2, Area 3, and Area 4. In general, soil containing polychlorinated biphenyls (PCBs) greater than the 10 mg/kg cleanup level or lead greater than the 1,000 mg/kg cleanup level identified by EPA Region 10 was removed at all locations along with solid waste. At this time, there are three areas (Area 2, Drum Area 2, and Area 3) that have PCB concentrations greater than the 1 mg/kg cleanup level for residential soils identified by EPA. In addition, although lead concentrations were predominantly less than 100 mg/kg, Area 2 had four surface stations and two subsurface stations with detections of lead greater than 1,000 mg/kg (ranging up to 2,300 mg/kg). The subsurface stations (depths up to 12 ft) were filled to original grade with clean soil, and the entire area was covered with clean soil and seeded with grass. These areas are within a larger area that will be subject to institutional controls.

Area 1 was purchased by Gateway and is considered part of the pulp mill area, but as indicated above, this area does not have any chemicals at concentrations in excess of the residential cleanup levels. KPC is seeking ownership of Drum Area 2 and Areas 2, 3, and 4 (Figure 3). KPC will prepare an easement and covenant document to restrict residential development or digging along this entire corridor. Though there is no plan for sale of the landfill, or the areas along the pipeline road, any easement or covenant documents for these areas would be conferred with the land to any subsequent owners.

The remainder of this section provides background information regarding the KPC site and presents the purpose of this plan. Section 2 presents the objectives of the institutional controls. Section 3 presents the development of the institutional controls for the Uplands Operable Unit. Section 4 presents the record-keeping procedures for tracking activities related to the institutional controls. In addition, there are four documents included as appendices. Appendix A contains the Easement and Covenant document. Appendix B presents a sampling and analysis plan for future demolition/construction activities at the Uplands Operable Unit. Appendix C contains a list of screening levels derived by EPA Region 9 for industrial soils. Appendix D contains a plate depicting the areas that have been sampled at the KPC site.

1.1 Background

This section presents a summary of background information for the Uplands Operable Unit. Additional information regarding the site is included in the remedial investigation report (Exponent 1998e).

KPC operated a pulp mill at the site from its construction in 1954 until shutdown in 1997. The KPC landfill began operation in 1988 and has been used for the disposal of wood waste, flyash, and recovery and wood waste boiler bottom ash. In 1997, a consent order between KPC, Louisiana-Pacific Corporation, ADEC, and EPA was issued to address site contamination. The consent order required KPC to conduct a remedial investigation and clean up CoCs) found at levels determined to be a threat to human health or the environment.

The remedial investigation confirmed the presence of chemicals of potential concern (CoPCs) in soil at the site. The CoPCs were arsenic, lead, manganese, polycyclic aromatic hydrocarbons (PAHs), polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans (PCDDs/Fs), PCBs, and petroleum hydrocarbons (Table 1). After comparison with screening values and calculation of risk estimates, arsenic, lead, PAHs, PCBs, and petroleum hydrocarbons were identified as CoCs requiring consideration of remedial actions. To identify areas that exceed acceptable risk levels, a decision framework was developed together with EPA and ADEC, which is summarized below:

- **Incremental cancer risks are less than 1 in 100,000 (1×10^{-5}) and/or the hazard indices for noncancer adverse effects are less than 1—** No further action will be considered.

- **Incremental cancer risks are between 1 in 100,000 (1×10^{-5}) and 1 in 10,000 (1×10^{-4}) for cumulative risk and/or cumulative hazard indices for noncancer adverse effects are between 1 and 10—** Development of cleanup options will be considered but may not be required. The remedial project managers (RPMs) will consider additional factors other than only a numerical exceedance of these decision risk levels in deciding on the need for further assessment.

- **Incremental cancer risks are greater than 1 in 10,000 (1×10^{-4}) for pathways or for cumulative risks and/or hazard indices for noncancer adverse effects are greater than 10—**Cleanup options will be developed for this area/pathway (i.e., this area will be carried into a feasibility study unless it is addressed by early action).

During and immediately after the remedial investigation, early actions involving sampling and removal of contaminated soil were completed for the areas identified as having unacceptable risk levels for industrial and commercial uses. Additional areas were remediated as part of plant upgrades during closure, thereby also reducing concentrations of arsenic and PCDDs/Fs in site soils and sediments (i.e., access road ditch). These areas, the CoCs, and their screening levels are listed in Table 2 and shown on Figure 4. Completion of the early actions has resulted in surface soil (i.e., soil that is not covered by paving or buildings) at the mill site and pipeline areas meeting acceptable risk levels for industrial/commercial exposure scenarios. As described above, these exposure levels would also be protective for expected future recreational use of the pipeline road areas.

During the remedial investigation, it was determined that the potential site-related sources of arsenic (limited application of arsenical pesticides at Thorne Bay, possible use of rodenticides) did not fully account for the observed concentrations of arsenic onsite, (i.e., from undetected at 0.5 mg/kg to 670 mg/kg at the paint shop with widespread detections exceeding 50 mg/kg in many pulp mill areas). Moreover, similar concentrations were found in many offsite locations. Specifically, offsite concentrations ranged from undetected at 0.5 mg/kg in forest soil to 207 mg/kg at a gravel driveway near Wards Cove Cannery to more than 4,000 mg/kg at a local quarry. Onsite risk estimates for future workers exposed to arsenic in soil via ingestion and dermal contact ranged from 5×10^{-6} for the former bottom ash storage pile to 2×10^{-4} for paint shop soils with a number of other areas having risk estimates for arsenic between 1×10^{-5} and 5×10^{-5} (Table 1). The risk estimate for offsite residents in aerial deposition areas exposed to arsenic in soil via ingestion, dermal contact, and consumption of homegrown produce was 2×10^{-5}.

Additional investigations identified local rock quarries as a major source of onsite arsenic and determined that the arsenic present in soil is not readily absorbed from soil if ingested (i.e., the arsenic was identified as having low bioavailability), thus reducing possible exposure. These findings, together with procedures for safe use of arsenic-containing rock materials, were documented in an arsenic management plan (Exponent 1998d). EPA and ADEC reviewed this information and determined that soil with arsenic concentrations resulting in mid-range risk decision levels (i.e., incremental cancer risks between $1\times10^{-5}$and 1×10^{-4} and hazard indices between 1 and 10) could be left in place. EPA, ADEC, and KPC also determined that the procedures identified in the arsenic management plan to reduce exposure and risks (Exponent 1998d) should be applied at the site and made available to the community.

Concurrent with the remedial investigation, KPC conducted closure activities for the wood waste and ash disposal landfill in accordance with the solid waste permit administered by ADEC and all applicable regulations. Landfill closure activities conducted in 1997 and 1998 consisted of constructing a low-permeability cover system, including a geomembrane, over the landfill; placing a topsoil cover and vegetation on the landfill; constructing surface water drainage improvements throughout the landfill; and constructing a leachate treatment system adjacent to the landfill. A new cell was constructed in 1997 and is permitted (ADEC Solid Waste Permit No. 9713-BA001) to receive boiler bottom ash, flyash, and smaller volumes of wood waste, rock, and dirt, secondary sludge, and dredge spoils.

Upon completion of the remedial investigation in 1998, ADEC and EPA issued a proposed plan for the Uplands Operable Unit (ADEC and U.S. EPA 1999) that identified a preferred remedial action. Based on public comment on the proposed plan, the final remedies were stipulated in the ROD (ADEC and U.S. EPA 2000). The selected remedial actions for the pulp mill area and pipeline road areas include the following activities:

- Complete all early actions
- Implement institutional controls
- Continue to use the controls specified in the arsenic management plan (Exponent 1998d)
- Conduct sampling and evaluation during future demolition activities that result in exposure of soils not evaluated in the remedial investigation
- Establish a procedure to ensure that if, in the future, soils from the near-shore fill subarea or contaminated soils underneath paved areas or structures are excavated, those soils will be properly characterized and managed.

The preferred remedial action for the wood waste and ash disposal landfill includes the following activities:

- Close the remaining cell of the wood waste and ash disposal landfill in a manner similar to that of the other cells, which KPC has already closed (i.e., in accordance with the ADEC solid waste permit and all applicable regulations)
- Conduct long-term monitoring at the landfill in accordance with all applicable permits
- Implement institutional controls.

As previously mentioned, the early actions at the pulp mill and pipeline road have been completed. This institutional control plan addresses the other components of the preferred remedial action for the pulp mill and pipeline road areas. For the wood waste and ash disposal landfill, the remaining cell will be closed in the same manner as the other cells. In addition, long-term monitoring and institutional controls will be implemented in accordance with the ADEC solid waste permit, applicable ADEC solid waste regulations, and any National Pollutant Discharge Elimination System (NPDES) permit that may be in place at the time. Some landfill monitoring requirements are now being fulfilled through the existing NPDES permit for the Ward Cove facility. If the property owners request a permit modification or reissuance in the future, EPA and ADEC will be provided 30 days notice of any proposed changes to the landfill monitoring requirements. These institutional controls will also be a part of the CERCLA ROD for the site. This institutional control plan summarizes the institutional controls for the wood waste and ash disposal landfill.

1.2 Purpose of the Institutional Control Plan

The intent of the institutional controls is to ensure that remedial efforts are protective of human health and the environment over the long term at the KPC site. Institutional controls are part of the preferred remedial action for the Uplands Operable Unit to prevent residential use. These requirements are specified in the Easement and Covenant document for the pulp mill area and are conveyed with the property (regardless of the owner) until soil concentrations reach acceptable site-specific, risk-based concentrations for residential use or appropriate regulatory levels, or until 2099, whichever occurs first. Prior to 2099, the parties will evaluate the need to continue institutional controls beyond 2099. Covenants to stipulate appropriate controls for the wood waste and ash disposal landfill and the former disposal area along the pipeline road are in development. Although soil concentrations of CoCs are lower or within the acceptable range for industrial use as determined in the risk assessment (Table 1), concentrations in some areas of the KPC site are higher than risk-based concentrations identified for residential land use.[2] The institutional controls for the KPC site have several purposes:

- To address specific areas of the Uplands Operable Unit (i.e., the wood waste and ash disposal landfill) that are known to have CoCs in soil at concentrations greater than risk-based concentrations considered to be protective for residential use and that require ongoing maintenance or other controls to limit exposure and risk
- To address specific areas of the Uplands Operable Unit (e.g., the near-shore fill subarea and areas under buildings or structures) that may require characterization and or remediation if they are exposed during demolition or excavation activities
- To address area-wide concerns (i.e., the paint shop and much of the mill area and some areas along the pipeline road) regarding appropriate use of the site (e.g., maintaining industrial/commercial zoning for the site because of the CoCs present in soil at concentrations higher than those considered to be protective of residential use).

This institutional control plan will ensure coordinated and reliable implementation and maintenance of the institutional controls for the Uplands Operable Unit. It will also ensure that the objectives of land use restrictions or controls are being achieved and that

[2] Risk-based concentrations for soils were taken from EPA Region 3 and Region 9 and were derived using a target risk level of 1×10^{-6} and conservative assumptions based on contact with contaminants in soil in a residential or industrial setting. As indicated above, although arsenic concentrations in soil are within the mid-range of risk decision levels (i.e., higher than EPA risk-based concentrations for industrial soils), EPA and ADEC have agreed that it is appropriate to leave the soil in place because of demonstrated low bioavailability and because the arsenic is associated with native rock.

the tools and procedures that the facility uses to implement restrictions/controls are in place. In addition, this plan describes controls for areas where future excavations may modify site risks (e.g., the near-shore fill subarea and areas under roads and buildings).

To fulfill these goals, the institutional control plan:

- Develops appropriate institutional controls for the pulp mill site and areas along the pipeline road to maintain adequate short- and long-term protection of human health and the environment
- Summarizes the institutional controls for the landfill that are being conducted in accordance with the ADEC solid waste permit, applicable ADEC regulations, and any NPDES permit in place at the time.
- Identifies procedures for implementing the institutional controls, including procedures for tracking activities related to the institutional controls
- Serves as a one-source reference for other related activities, documents, and permits (however, this institutional control plan does not supersede any regulatory or permit requirements).

2. Institutional Control Objectives

Soils at the pulp mill area and pipeline road that contained chemicals at unacceptable risk levels for industrial/commercial use have been removed through early actions at the site. However, residual concentrations of chemicals remain in soils at the pulp mill area and at areas along the pipeline road above EPA risk-based concentrations for residential land use. EPA guidance regarding land use in the CERCLA remedy selection process states the following:

> The volume and concentration of contaminants left on-site, and thus the degree of residual risk at a site, will affect future land use. For example, a remedial alternative may include leaving in place contaminants in soil at concentrations protective for industrial exposures, but not protective for residential exposures. In this case, institutional controls should be used to ensure that industrial use of the land is maintained and to prevent risks from residential exposures. (U.S. EPA 1995)

The near-shore fill subarea was characterized during the site investigation, and no contaminants were found at levels exceeding applicable risk-based concentrations. In addition, migration of contaminants to Ward Cove was ruled out through evaluation of the potential volume of dissolved contaminants that could reach Ward Cove[3] and sampling results from Ward Cove. Due to the past use of the area as a fill area, however, there is uncertainty as to whether chemicals are present in soils in areas that were not directly characterized. Similarly, there is uncertainty about soils beneath the paved areas and structures at the mill because these areas were not sampled during the remedial investigation. Soils at the pipeline road were sampled where contamination was suspected, but some uncertainty remains regarding areas that were not sampled. Therefore, uncharacterized soils at the pipeline road and in the nearshore fill subarea and soils beneath paved areas and structures remaining at the pulp mill area will need to be further evaluated to determine the need for sampling if soils are exposed during

[3] PCB (Aroclor® 1254) was measured at concentrations (0.49 µg/L) near the analytical detection limit in unfiltered water in one of three test pits in the near-shore fill subarea. Only the dissolved portion would be able to migrate into Ward Cove. The dissolved portion in the groundwater was estimated to be approximately 0.013 µg/L, which is less than the ecological screening criterion of 0.030 µg/L in marine waters. PCB was therefore not considered a CoPC for ecological receptors. The EPA proposed PCB criterion for protecting human health (from fish consumption) is extremely low (i.e., 0.00017 µg/L) and is actually below analytical detection limits for PCBs (i.e., Aroclors®). Nevertheless, the potential for transport of PCBs from the groundwater into Ward Cove was evaluated. PCBs would be carried out into Ward Cove during ebbing tides and mixed with seawater along the shoreline of the near-shore fill subarea. Using conservative assumptions, PCB concentrations are predicted to be less than the proposed criterion of 0.00017 µg/L within 0.1 m of the shoreline. Because of the very low (probably less than background) concentrations and limited area of potential impact, PCBs are not considered CoPCs for human health for this pathway.

demolition or excavation activities. The institutional controls described in a subsequent section of this document address sampling and evaluation of soil for demolition activities at the pulp mill area and the pipeline road. In addition, the institutional controls address procedures for properly characterizing and managing excavated soils.

Closure and monitoring of the wood waste and ash disposal landfill in accordance with the ADEC solid waste permit and ADEC regulations, including institutional controls, is consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and the EPA NPDES permit. The NCP states that EPA expects to use engineering controls, such as containment, for waste that poses a relatively low long-term threat and to use institutional controls such as water use and deed restrictions to supplement the engineering controls as appropriate for short- and long-term management to prevent or limit exposure to hazardous substances, pollutants, or contaminants (40 CFR 300.430(a)(1)(iii)).

ADEC regulations also include requirements for institutional controls. In general, ADEC may require institutional controls on a site-specific basis where they are necessary to protect human health, safety, or welfare or the environment. The institutional controls may include deed restrictions or other measures that would be examined during a routine title search and that limit site use or site conditions over time or provide notice of any residual contamination. ADEC regulations that address institutional controls include 18 AAC 75.350(2)(C), 18 AAC 75.375, and 18 AAC 75.990 (54).

Based on the regulations and requirements presented above, the conditions at the Uplands Operable Unit, and the preferred remedial action presented in the proposed plan, the objectives for the institutional controls for the pulp mill site and the pipeline road are as follows:

- Maintain acceptable risk levels for soils for industrial/commercial exposure scenarios (which will also be protective of recreational use of the pipeline road)
- Comply with requirements identified in the *Management Plan for Arsenic in Rock and Soil* (Exponent 1998d) to reduce exposure to arsenic in soil and rock
- Restrict residential land use (or similar non-industrial/commercial land use resulting in around-the-clock residence by people or daily use by children)
- Prohibit drilling of water wells and use of groundwater
- Identify and address source areas (if any) during demolition and excavation activities using applicable or relevant and appropriate requirements (ARARs) such as current risk-based concentrations or standards and criteria

- Properly characterize and manage soils from the near-shore fill subarea or underneath paved areas or structures and from other locations not evaluated or characterized in the remedial investigation if those soils are excavated.

The objectives for the institutional controls for the wood waste and ash disposal landfill are to fulfill the requirements of any permits (e.g., the ADEC solid waste permit and the EPA NPDES permit) that may be active and in force at the time. Additional objectives are to restrict future use of the landfill property to preclude any of the following:

- Use of groundwater
- Activities that could result in exposure to landfill materials
- Activities that could compromise the integrity of the landfill cap, the leachate treatment system, or any ancillary equipment.

3. Development of Institutional Controls

Institutional controls are developed in this section for the pulp mill area, the pipeline road areas, and wood waste landfill to ensure that the objectives in the previous section are met. Consistent with the Easement and Covenant document (ADL 1999), the institutional controls will remain in place until 2099, or until site CoCs no longer exceed site-specific, risk-based residential cleanup levels, whichever comes first. The Easement and Covenant document allows for oversight by EPA and ADEC, in decisions regarding any future revisions to the controls to be determined by these agencies and the current owner. Project managers with EPA and ADEC may also identify and initiate appropriate changes to this institutional control plan to be consistent with future regulatory changes or changes in land use.

3.1 Institutional Control Program Administration

Respective roles of organizations responsible for administering the institutional control program are listed in Table 3 with their phone numbers and addresses. These organizations include KPC, Gateway, or subsequent owners (and other parties under the direction of site owners including contractors), the Ketchikan Gateway Borough, and appropriate regulatory agencies. KPC will be responsible for the institutional controls for the landfill property as long as KPC owns that property. There are no plans for sale of the landfill property at this time. Gateway and any successors will be responsible for institutional controls for the pulp mill property. A plan for institutional controls for the pipeline road is in development to restrict residential use of the areas with CoCs exceeding residential cleanup levels. KPC is seeking ownership of Drum Area 2 and Areas 2, 3, and 4 and will be responsible for administering institutional controls in these areas.

3.2 Pulp Mill Site and Pipeline Road

Institutional controls for the pulp mill site and for the pipeline road include zoning and deed restrictions, procedures for characterizing and managing soil during routine excavations, procedures for characterizing and managing soil during demolition activities, and notification procedures.

3.2.1 Zoning and Deed Restrictions

The Ketchikan Gateway Borough has zoned the pulp mill area for industrial use (i.e., industrial-heavy). There are no plans for the zoning designation to be revised, and it is unlikely that revision of the zoning designation would ever occur. The wood waste landfill area and the dredge spoil subarea are also zoned as industrial-heavy. No

construction is planned on the wood waste landfill area. Any construction would require substantiation that the proposed activity would not compromise the integrity of the landfill cap or leachate collection system in any manner.

As described previously, KPC and the Alaska Department of Law (ADL) prepared and filed the Easement and Covenant document for the pulp mill area. This document has been filed with the Ketchikan Gateway Borough and would be examined during a routine title search. It limits site use over time and provides notice of residual contamination on the property. KPC, along with ADL, is in the process of developing a similar document for the wood waste and ash landfill and will provide a draft of the deed restriction or other measure to ADEC and EPA for review prior to filing it. The former disposal areas along the water pipeline road are too small for residential development. Nevertheless, an easement and covenant agreement will be put into place for the pipeline road with stipulations similar to the agreement for the former pulp mill area (i.e., to prevent future residential use of this area).

3.2.2 Routine Excavations

Routine excavations are relatively minor excavations that may occur during normal maintenance or operational activities. A routine excavation is defined as an area of approximately 25 ft^2 or smaller or a volume of soil of approximately 3 yd^3 or less, and where excavated soils will remain onsite and not be transported offsite for disposal. A routine excavation may not include removal of a paved area or structure (limited to the area formerly mentioned). It is anticipated that soil sampling will not be required as part of routine excavations unless there is visible evidence of debris or contamination, or knowledge of past or present use of the area suggests that contamination may be present. If sampling is required, it will be carried out as described in the section below and in Appendix B (and in consultation with EPA and ADEC).

If sampling is required, analytical results for soil samples will be compared with screening levels. Specifically, risk-based concentrations derived by EPA and ADEC to identify possible CoCs and background concentrations will be applied where available. For constituents other than petroleum products, the results for the soil samples will be compared to screening levels derived by EPA Region 9 for industrial soils, which were identified by EPA as the appropriate screening levels for soil (included in Appendix C). (The EPA Region 9 risk-based concentrations will be used unless EPA Region 10 no longer recommends them for use in Region 10.) For petroleum products, soil sampling results will be compared with ADEC's soil cleanup levels for the protection of nonpotable groundwater, which will be calculated consistent with ADEC guidance (18 AAC 75, ADEC [1998]) or comparable applicable requirements in effect at the time of the demolition. Any possible CoCs identified will then be evaluated in comparison with ARARs presented in the ROD for the KPC Uplands Operable Unit to determine the need for remedial actions, if any.

The landowner will notify ADEC and EPA if any soil sample results exceed screening levels or if suspect debris is found. In addition, if soil sample results exceed screening

levels, then the landowner will coordinate with ADEC and EPA, and a decision will be made on a case-by-case basis as to whether additional excavation will be conducted. If soil sample results exceed screening levels (discussed above), then EPA and/or ADEC will determine the appropriate action (i.e., offsite disposal or a screening-level risk evaluation to determine the appropriate remedy). If the soil sample results do not exceed screening levels, then the excavated soil may be placed back into the excavated area or otherwise properly disposed. Any suspect debris will be removed for appropriate disposal in accordance with applicable regulations and landfill requirements. Any imported material for backfill or other purposes must meet the requirements of the arsenic management plan (Exponent 1998d). Records will be kept of the routine excavations as described in the record-keeping section of this plan.

3.2.3 Major Excavations and Demolitions

Demolition activities such as excavations larger than those defined in *Routine Excavations*, excavations that require removal of paved areas or structures, or excavation of portions of the near-shore fill subarea or the water pipeline storage area are addressed in this section. For major excavations, an excavation-specific sampling and analysis strategy will be developed in consultation with EPA and ADEC using the following guidance and the procedures described in Appendix B. Similar to the procedure used in the remedial investigation to determine the appropriate analytes for a given area, it is recommended that the need for confirmation sample collection and analysis be determined by the history of the area's use.

Soil underneath paved areas (i.e., railroad track areas), soil underneath structures, or soil in areas where petroleum products were stored or used would be analyzed for diesel- and residual-range organics and PAHs (and gasoline-range organics and benzene, toluene, ethylbenzene, and xylenes, if appropriate). PCB analyses may also be needed depending on site characterization. Soil from the flyash silo would be analyzed for PCDDs/Fs. Soil in the near-shore fill subarea and the water pipeline storage area would be analyzed for diesel- and residual-range organics, target analyte list metals, volatile organic compounds, semivolatile organic compounds, organochlorine pesticides and PCBs, and chlorinated herbicides. The analyte list for soils in other areas will be determined in consultation with EPA and ADEC. Excavated soil will be sampled and characterized as needed for appropriate disposal in accordance with all applicable regulations and/or landfill requirements. Soil sample results will be compared with the screening levels described above to identify CoCs. Any remediation of areas with CoCs would be discussed with RPMs and would include consideration of ARARs.

The landowner will notify ADEC and EPA if any soil sample results exceed screening levels or if suspect debris is found. The landowner will coordinate with ADEC and EPA, and a decision will be made on a case-by-case basis as to whether additional excavation will be conducted. Any soil that is excavated will be sampled and characterized as needed for appropriate disposal in accordance with applicable regulations and landfill requirements. If soil sample results are below state and federal EPA soil screening and cleanup levels, then the excavated soil may be used onsite as fill material. Any suspect

debris will be removed for appropriate disposal in accordance with applicable regulations and landfill requirements. Any imported material for backfill or other purposes must meet the requirements of the arsenic management plan (Exponent 1998d). Records will be kept of the excavation/demolition activities and onsite and offsite treatment or disposal as described in the record-keeping section of this plan.

3.2.4 Notification Procedures

The landowner will notify both ADEC (Contaminated Sites and Remediation Program) and EPA (Alaska Operations Office) by calling them at the telephone numbers listed in Table 3 or contacting appropriate agency personnel via e-mail if any of the following occur:

- Major demolition activities are planned
- Any sampling is to be conducted during major demolition
- Any soil samples collected during routine excavations or demolition activities exceed soil screening levels
- Suspect debris (e.g., buried drum or paint can) is found during routine excavations or demolition activities.

3.3 Wood Waste Landfill

The wood waste landfill is currently regulated by ADEC Solid Waste Permit No. 9713-BA001 (Figure 5). This section summarizes post-closure requirements for the landfill, including long-term restrictions and monitoring, that are included in the permit. This institutional control plan does not supersede any current or future permit requirements; it only summarizes the relevant requirements of the current permit. EPA has reviewed existing monitoring requirements and found them to be sufficient. KPC will allow at least 30 days notice of any proposed change in monitoring resulting from any future changes in permit requirements. Any permitting changes may result in the need for modifications in this plan to meet EPA requirements for institutional controls.

The ADEC solid waste permit requires long-term inspection and monitoring of the landfill. The current *Comprehensive Landfill Monitoring Plan* (KPC 1999) presents the inspections and monitoring that will be conducted throughout the post-closure care period of the landfill. Future inspections and monitoring of the landfill will be conducted in accordance with the current plan or subsequent plans that may be required for the landfill. Under the current plan, visual and surface water monitoring are conducted. Visual monitoring includes, but is not limited to, inspecting physical damage to the cover system, drainage structures, escape of waste or leachate, unauthorized waste disposal, erosion, and evidence of death or stress to fish, wildlife, or vegetation that might be caused by the facility. Surface water monitoring includes collecting water samples to

assess whether surface water leaving the site could potentially endanger public health or cause a violation of water quality standards.

Post-closure care will also include gas monitoring, leachate monitoring, maintenance of the final cover system (including prevention of tree growth on that system), maintenance of the appurtenances, operation of the passive gas venting system, and operation of the leachate collection system. Annual inspections for slippage of the cover system and for landfill subsidence will be conducted. An inventory of the volumes of landfill leachate collected and treated will be maintained.

The current NPDES permit also requires monitoring storm water at the landfill. This monitoring includes sampling and analysis of surface water in the major conveyances at the landfill. Groundwater monitoring wells have not been constructed. In general, groundwater at the landfill discharges to the small surface water drainages, all of which flow toward Refuge, "Dawson," or Ward coves. These drainages are being routinely monitored. In addition, routine monitoring of leachate provides a "worst-case" representation of potential groundwater contamination from the landfill that is not being detected by surface water monitoring (i.e., groundwater discharging directly to marine waters by underwater seeps, if occurring). Because local groundwater flow is determined by topography, contaminant transport toward the mainland (i.e., "uphill") is unlikely.

Permit requirements for deed restrictions or other measures for the landfill property include the following:

- KPC will prepare and submit to ADEC, upon closure of the facility, a survey as-built or record drawings that show the location, types, and volume of waste deposited at the facility. A copy will be provided to any purchaser or transferee at the time of property sale or lease.
- KPC will file the survey as-built or record drawings of the area as a landfill with the appropriate land records office within 60 days after the entire facility has been permanently closed to landfilling and will submit proof of such recording to ADEC.
- KPC will record a notation on the deed to the property notifying subsequent landowners of the type of waste that has been buried on the property and warning them that a water supply for drinking water purposes should not be developed. An additional notation will be made that warns subsequent owners or operators that a geosynthetic liner has been placed over the waste and that operations should be carried out in a way that does not rupture the liner. Rupture of the liner could be caused by the operation of heavy machinery or the construction of buildings or placement of any structure on the surface. In addition, an easement and covenant document similar to that developed for the pulp mill property will be prepared for the landfill.

- The locations where waste was deposited will not be subdivided from run-on diversion systems, leachate collection systems, or the margins of geosynthetic liners; when conveyed, they will be conveyed as one parcel.
- KPC will notify ADEC in accordance with the notification and reporting procedures identified in the ADEC solid waste permit.

4. Record-Keeping

Record-keeping will include documentation of field and sampling activities, analytical results including laboratory data sheets, disposal records, notification records, a written summary of each excavation or demolition event, and notation on a site map of activities involving sampling. Records related to KPC's former activities at the site will be kept by KPC in Ketchikan or by the parent corporation, Louisiana-Pacific in Portland, Oregon. Records related to Gateway will be kept by Gateway in Ketchikan. EPA and ADEC will be notified of any change in record locations.

Documentation of soil sampling activities is described in Appendix B. For routine excavations that do not involve sampling, only the documentation listed in Appendix B that is applicable to such excavations will be recorded. All analytical results, including laboratory data sheets, will be retained for excavation and demolition activities. Available laboratory quality assurance and quality control results will also be retained. The analytical results will be retained pertaining to site characterization as well as the profiling of excavated soil for disposal. Disposal records will be retained for any soil or debris disposed offsite. The records will include the amount and type of material disposed, the date shipped, the name and address of the disposal facility, and receipts from the disposal facilities. Notification records, such as telephone contact summary sheets, of contact between the landowner and the agencies will be retained.

A brief written summary of each excavation or demolition event will be prepared to document the activities and to provide appropriate information that is not in the project documentation records. This written summary will include a summary of onsite and offsite treatment or disposal locations. The written summary will likely range from a few sentences for some routine excavation events to a page or two for more extensive demolition activities. Each excavation or demolition area will also be documented on a site map (Appendix D) in a manner that cross references the location on the site map to the written documentation in the project files.

For the wood waste and ash disposal landfill, KPC will keep records regarding landfill post-closure activities in accordance with the requirements of the ADEC solid waste permit. These records will include inspection logs, surveying results, analytical results including laboratory sheets, and notification records between KPC and the agencies.

5. References

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ADEC and U.S. EPA. 2000. Ketchikan Pulp Company (KPC), Ketchikan, AK, Uplands Operable Unit, Record of Decision. Alaska Department of Environmental Conservation, Anchorage, AK, and U.S. Environmental Protection Agency, Anchorage, AK.

ADL. 1999. Environmental protection easement and declaration of restrictive covenants. Between Ketchikan Pulp Company and the State of Alaska Department of Natural Resources for use by Alaska Department of Environmental Conservation as represented by Alaska Department of Law. Effective October 28, 1999.

E&E. 1991. Draft site inspection report for Ketchikan Pulp Company. Prepared for Alaska Department of Environmental Quality. Ecology and Environment, Inc., Anchorage, AK.

Exponent. 1998a. Addendum no. 1 to the RI/FS work plan, supplemental sampling at the grit chamber, local rock quarries, and water pipeline storage area. Prepared for Ketchikan Pulp Company, Ketchikan, AK. Exponent, Bellevue, WA.

Exponent. 1998b. Addendum no. 4 to the RI/FS work plan, supplemental soil sampling at the paint shop area. Prepared for Ketchikan Pulp Company, Ketchikan, AK. Exponent, Bellevue, WA.

Exponent. 1998c. Addendum no. 5 to the RI/FS work plan, supplemental soil and sediment sampling at the pipeline road and railroad tracks area. Prepared for Ketchikan Pulp Company, Ketchikan, AK. Exponent, Bellevue, WA.

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Exponent. 1998e. Remedial investigation, Ketchikan Pulp Company site. Volumes I–IV. Prepared for Ketchikan Pulp Company, Ketchikan, AK. Exponent, Bellevue, WA.

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Exponent. 1999a. Addendum no. 6 to the RI/FS work plan, supplemental soil sampling at the railroad tracks and retaining wall areas. Prepared for Ketchikan Pulp Company, Ketchikan, AK. Exponent, Bellevue, WA.

Exponent. 1999b. Letter to D. Soderlund, U.S. Environmental Protection Agency, Anchorage, AK, and R. Klein, Alaska Department of Environmental Conservation, Anchorage, AK, dated July 28, 1999, regarding Ketchikan Pulp Company site, Uplands Operable Unit, early action for the pipeline road. Prepared for Ketchikan Pulp Company, Ketchikan, AK. Exponent, Bellevue, WA.

Exponent. 1999c. Letter to D. Soderlund, U.S. Environmental Protection Agency, Anchorage, AK, and R. Klein, Alaska Department of Environmental Conservation, Anchorage, AK, dated August 9, 1999, regarding Ketchikan Pulp Company site, Uplands Operable Unit, early action for the paint shop area. Prepared for Ketchikan Pulp Company, Ketchikan, AK. Exponent, Bellevue, WA.

Exponent. 1999d. Technical memorandum no. 11, early action plan for the pipeline storage area, Ketchikan Pulp Company site. Prepared for Ketchikan Pulp Company, Ketchikan, AK. Exponent, Bellevue, WA.

Exponent. 1999e. Technical memorandum no. 12, early action plan for the paint shop/former maintenance shop area, Ketchikan Pulp Company site. Prepared for Ketchikan Pulp Company, Ketchikan, AK. Exponent, Bellevue, WA.

Exponent. 1999f. Technical memorandum no. 13, early action plan for railroad tracks and compressor areas, Ketchikan Pulp Company site. Prepared for Ketchikan Pulp Company, Ketchikan, AK. Exponent, Bellevue, WA.

Exponent. 1999g. Technical memorandum no. 15, early action report for the access road ditch, Ketchikan Pulp Company site. Prepared for Ketchikan Pulp Company, Ketchikan, AK. Exponent, Bellevue, WA.

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Exponent. 1999i. Technical memorandum no. 18, early action plan for the bulk fuel tank area, Ketchikan Pulp Company site. Prepared for Ketchikan Pulp Company, Ketchikan, AK. Exponent, Bellevue, WA.

Exponent. 1999j. Technical memorandum no. 19, summary of supplemental sampling at the pipeline storage area. Prepared for Ketchikan Pulp Company, Ketchikan, AK. Exponent, Bellevue, WA.

Exponent. 1999k. Technical memorandum no. 20, early action report for the railroad tracks and compressors areas, Ketchikan Pulp Company site. Prepared for Ketchikan Pulp Company, Ketchikan, AK. Exponent, Bellevue, WA.

Exponent. 1999l. Technical memorandum no. 21, early action for the bulk fuel tank area, Ketchikan Pulp Company site. Prepared for Ketchikan Pulp Company, Ketchikan, AK. Exponent, Bellevue, WA.

Exponent. 1999m. Technical memorandum no. 22, early action report for the paint shop/former maintenance shop area, Ketchikan Pulp Company site. Prepared for Ketchikan Pulp Company, Ketchikan, AK. Exponent, Bellevue, WA.

Exponent. 2000a. Technical memorandum no. 23, early action report for the pipeline storage area, Ketchikan Pulp Company site. Prepared for Ketchikan Pulp Company, Ketchikan, AK. Exponent, Bellevue, WA.

Exponent. 2000b. Technical memorandum no. 24, early action report for the railroad tracks area, Ketchikan Pulp Company site. Prepared for Ketchikan Pulp Company, Ketchikan, AK. Exponent, Bellevue, WA.

KPC. 1999. Comprehensive landfill monitoring plan. Ketchikan Pulp Company, Ketchikan, AK.

U.S. EPA. 1989. Memorandum from H.L. Longest II, Director, Office of Emergency and Remedial Response, and B. Diamond, Director, Office of Waste Programs Enforcement, to Directors, Waste Management Division, Regions I, II, IV, V, VII, and VIII; Director, Emergency and Remedial Response Division, Region II; Directors, Hazardous Waste Management Division, Regions III and VI; Director, Toxic Waste Management Division, Region IX; and Director, Hazardous Waste Division, Region X, dated September 7, 1989, regarding interim guidance on establishing soil lead cleanup levels at Superfund sites. OSWER Directive #9355.4-02. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC.

U.S. EPA. 1995. Memorandum from E.P. Laws, Assistant Administrator, to Director, Waste Management Division, Regions I, IV, V, and VII; Director, Emergency and Remedial Response Division, Region II; Director, Hazardous Waste Management Division, Regions III, VI, VIII, and IX; Director, Hazardous Waste Division, Region X; and Director, Environmental Services Division, Regions I, VI, and VII, regarding land use in the CERCLA remedy selection process, dated May 25, 1995. OSWER Directive No. 9355.7-04. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC.

U.S. EPA. 1998. Memorandum from J. Hubbard to RBC Table mailing list, regarding updated risk-based concentration table, dated April 1, 1998. U.S. Environmental Protection Agency, Region 3, Philadelphia, PA.

U.S. EPA. 1999. National recommended water quality criteria—correction. EPA 822-Z-99-001. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

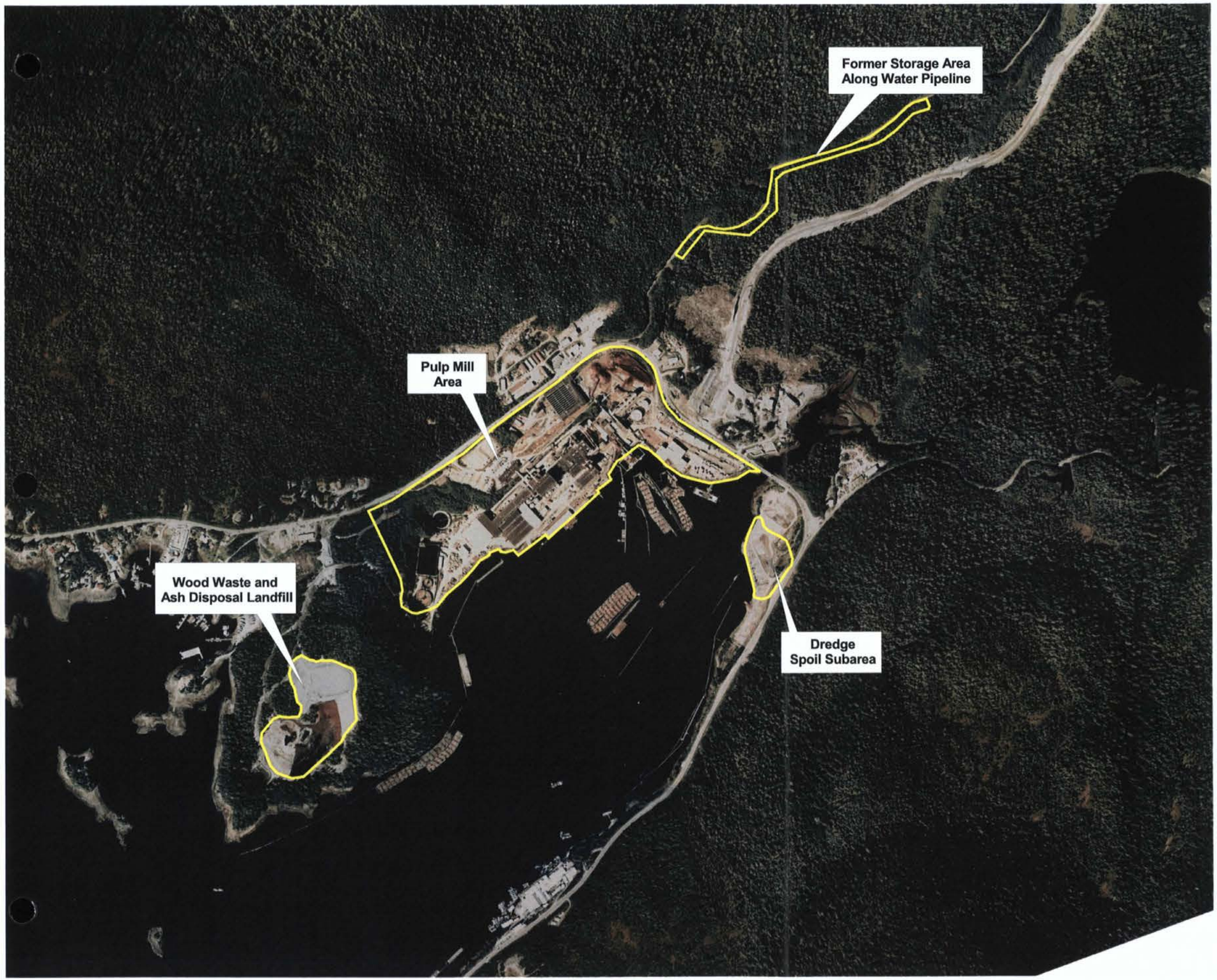
Figures

Source: NOAA (1995)

0 1/2 1 miles

0 1 2 kilometers

Figure 1. Location of Ward Cove and former KPC facility.



0 200 400 600 Meters

0 1000 2000 Feet

Figure 2. Important features of the KPC Uplands Operable Unit

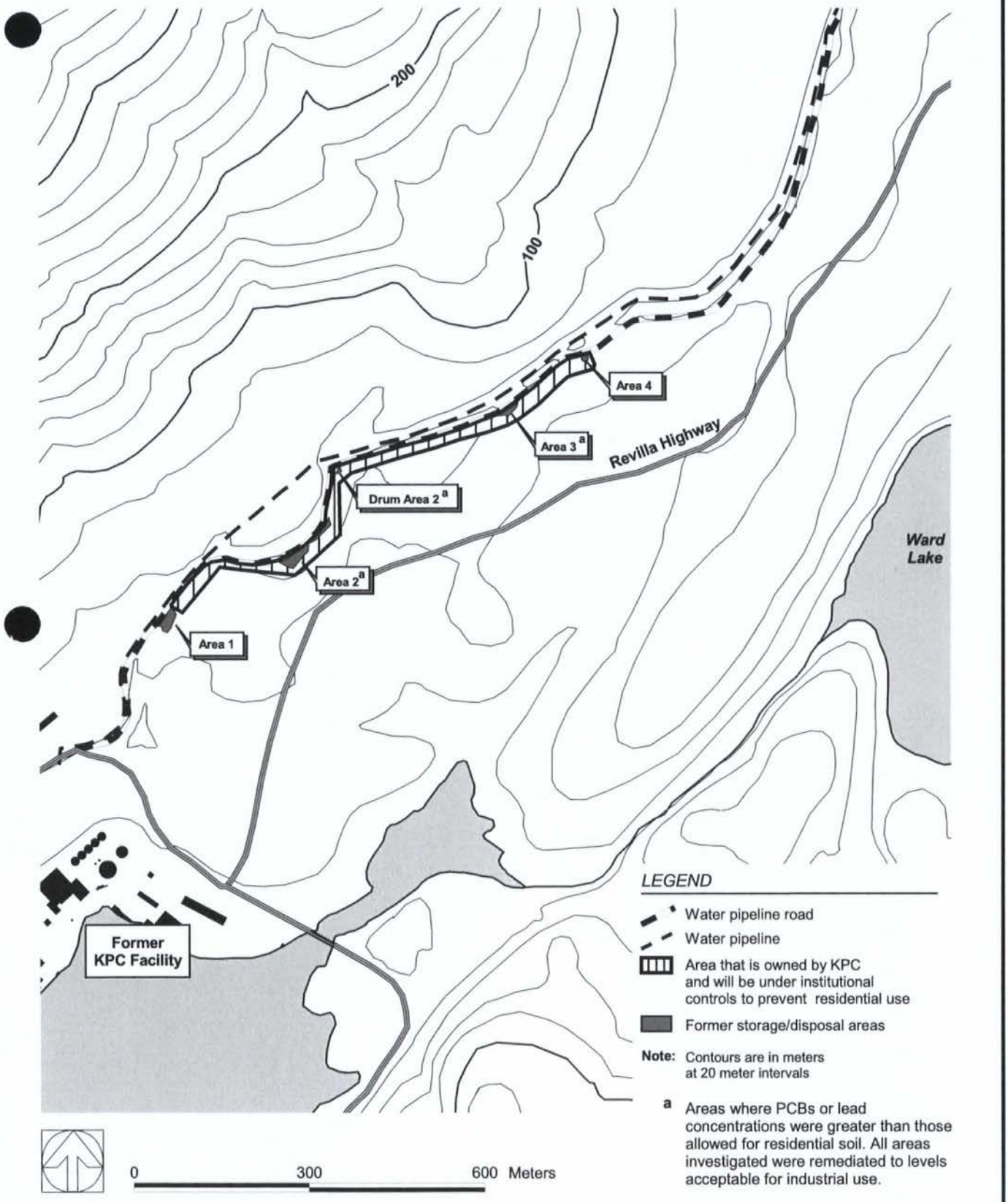


Figure 3. Water pipeline road.

8600B4Q.001 1006 | ICP | Jun 01,2000 | pipe storage | Fig 3 ICP | g:\kpc\projects\h20piplineareas.apr

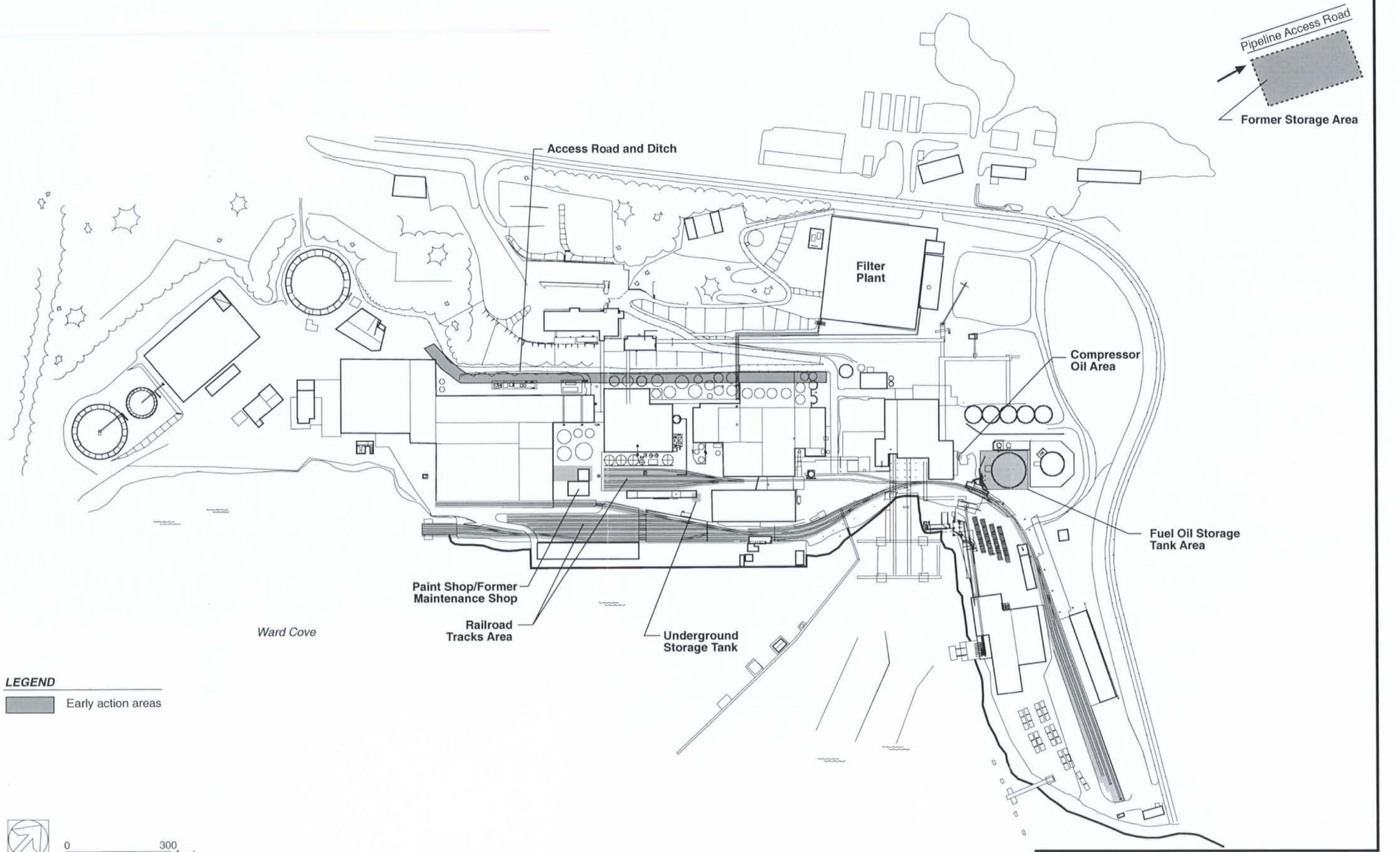


Figure 4. Early action areas.

8600B4Q.001 1006 IC Plan 06/01/00 WA

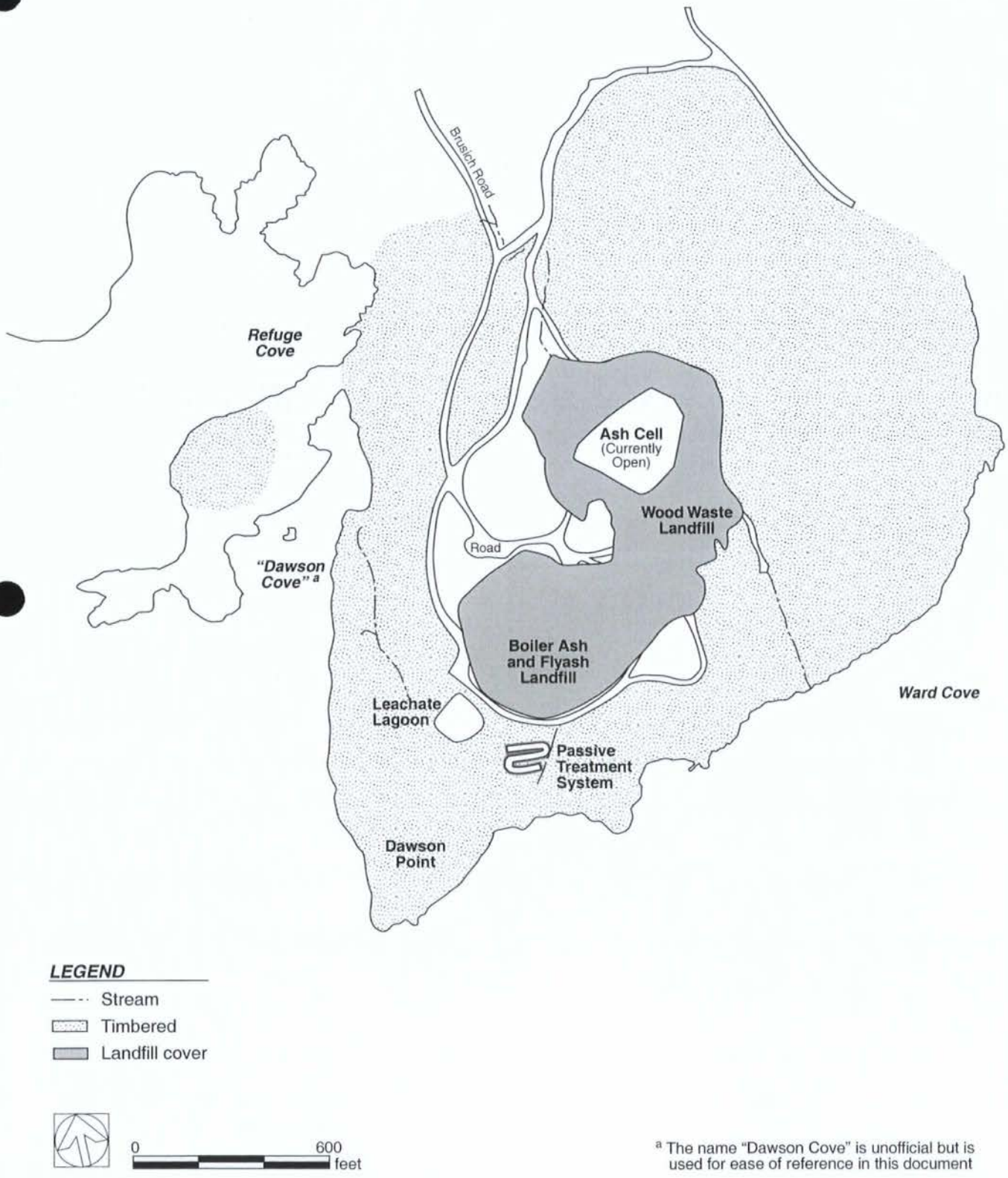


Figure 5. Wood waste and ash disposal landfill.

Tables

Table 1. Summary of chemical concentrations, risk estimates, early actions, and residual concentrations and risks

Area (scenario/pathways evaluated)	Chemicals above Screening Levels	Baseline: Concentration Range	Baseline: Screening Level[a]	Baseline: Excess Risk Estimate	Action or Note	Residual: Residual Concentration Range	Residual: Residual Risk
Pulp Mill Area							
Process Subarea							
Access Road and Ditch (occupational)	Arsenic[b]	56–182 mg/kg	7.6 mg/kg	4×10^{-5}	Ditch sediment removed in 1998 as part of early action, some fill added to road with regrading.	5.5–157 mg/kg	4×10^{-5}
	PCDD/F	5.5–162 ng/kg (TEC)	38 ng/kg (TEC)	5×10^{-6}	No Cleanup Level	8.2–30.2 ng/kg (TEC)	9×10^{-7}
Wood Room/Log Deck Area (occupational)	Arsenic[b]	84 mg/kg	7.6 mg/kg	2×10^{-5}		84 mg/kg	2×10^{-5}
Wood Room/Log Deck Seep Water (migration to Ward Cove)	Manganese	0.267 mg/L (seep water)	0.0285 mg/L background[c]		Hog fuel removed in spring 1998[c]	--	--
Soils near Evaporator No. 3 (occupational)	Arsenic[b]	65 mg/kg	7.6 mg/kg	1×10^{-5}		65 mg/kg	1×10^{-5}
Mill Support Subarea							
Aeration Basin Soils (occupational)	Arsenic[b]	1.3–90 mg/kg	7.6 mg/kg	2×10^{-5}		1.3–90 mg/kg	2×10^{-5}
Grit Chamber Soils (occupational)	Arsenic[b]	10–100 mg/kg	7.6 mg/kg	2×10^{-5}		10–100 mg/kg	2×10^{-5}
Paint Shop/Former Maintenance Shop (occupational)	Arsenic[b]	0.94–670 mg/kg	7.6 mg/kg	2×10^{-4}	Soil removed in 1999 as part of early action. Cleanup Levels:	1.53–33.9 mg/kg	8×10^{-6}
	Lead	<10–4,270 mg/kg	1,000 mg/kg		1,000 mg/kg	<10–274 mg/kg	--
	Benzo[a]pyrene (cPAH RPC)	<0.013–4.42 mg/kg	0.90 mg/kg	5×10^{-6}	0.90 mg/kg	0.0143–0.0444 mg/kg	1×10^{-7}
	PCBs	<0.050–499 mg/kg	10 mg/kg	1×10^{-4}	10 mg/kg	<0.067–8.46 mg/kg	8×10^{-6}[d]
Former Bottom Ash Storage Pile (occupational)	Arsenic[b]	4.9 and 44 mg/kg[e]	7.6 mg/kg	5×10^{-6}		4.9 and 44 mg/kg[e]	5×10^{-6}
Caustic Tanks and Pipeline (occupational)	None					None	--
Equipment Storage Area (occupational)	None					None	--
Filter Plant Soils (occupational)	None					None	--
Near-shore Fill Subarea (occupational)	Arsenic[b]	0.5–132 mg/kg	7.6 mg/kg	3×10^{-5}		0.5–132 mg/kg	3×10^{-5}
	PCBs	0.49 µg/L (undissolved)[f]	0.00017 µg/L[f]			0.49 µg/L (undissolved)[f]	--
Wood Waste and Sludge Disposal Area (occupational)	Arsenic[b]	1–22 mg/kg	7.6 mg/kg	5×10^{-6}		1–22 mg/kg	5×10^{-6}

Table 1. (cont.)

Area (scenario/pathways evaluated)	Chemicals above Screening Levels	Baseline: Concentration Range	Baseline: Screening Level[a]	Baseline: Excess Risk Estimate	Action or Note	Residual: Residual Concentration Range	Residual: Residual Risk
Petroleum Soils Areas							
Railroad Tracks Area (comparison with ADEC regulations)	Benz[a] anthracene	<0.007–56 mg/kg	9 mg/kg	--	Soil removed in 1999 as part of early action. Cleanup Level: 9,000 ug/kg	<0.0067–1.18 mg/kg	--
	Benzo[b] fluoranthene	<0.007–28 mμg/kg	9 mg/kg	--	9 mg/kg	<0.0067–1.2 mg/kg	--
	Benzo[a]pyrene	<.007–16 mg/kg	0.9 mg/kg	--	0.9 mg/kg	<0.0067–0.73 mg/kg	--
	Dibenz[a,h] anthracene	<.007–2 mg/kg	0.9 mg/kg	--	0.9 mg/kg	<0.0134–0.204 mg/kg	--
Compressor Area (comparison with ADEC regulations)	DRO	17,000–50,000 mg/kg	8,250 mg/kg	--	Soil removed in 1999 as part of early action. Cleanup Level: 8,250 mg/kg	885–8,960 mg/kg	--
	RRO	39,000–120,000 mg/kg	8,300 mg/kg	--	8,300 mg/kg	2,160–22,800 mg/kg	--
Bulk Fuel Tank Area (comparison with ADEC regulations)	DRO	8.4–31,000 mg/kg	8,250 mg/kg	--	Soil removed in 1999 as part of early action. Cleanup Level: 8,250 mg/kg	<25–14,500 mg/kg	--
	RRO	23–36,000 mg/kg	8,300 mg/kg	--	8,300 mg/kg	<50–14,200 mg/kg	--
	Benz[a] anthracene	0.120–24 mg/kg	9 mg/kg	--	9 mg/kg	0.00978 mg/kg	--
	Benzo[a]pyrene	0.110–19 mg/kg	0.9 mg/kg	--	0.9 mg/kg	0.0132–22.7 mg/kg	--
Dredge Spoils Area							
(occupational)	None					None	--
Wood Waste and Ash Disposal Landfill							
(occupational/recreational)	None					None	--
Former Storage Area along the Water Pipeline Road							
(occupational)	Arsenic[b]	1.21–72.6 mg/kg	7.6 mg/kg	6×10^{-6}	Soil removed in 1999 as part of early action.	<0.5–89.5 mg/kg	9×10^{-6}
	Lead	<10–2,210 mg/kg	1,000 mg/kg	--	Cleanup Level:1,000 mg/kg	<10–2,210 mg/kg	--
	PCBs	<0.400–6,410 mg/kg	10 mg/kg	1×10^{-5}	10 mg/kg	0.468–7.9 mg/kg	4×10^{-6}
	TPH–oil	1–34,000 mg/kg	9,700 mg/kg	--	9,700 mg/kg	None	--
Aerial Deposition Areas							
Forested and Developed Area Soils (residential/ingestion, dermal contact, produce consumption)	Arsenic[b]	2.4–138 mg/kg	7.6 mg/kg	2×10^{-5}		2.4–138 mg/kg	2×10^{-5}
	PCDD/F	0.89–137 ng/kg (TEC)	7.4 ng/kg	1×10^{-5}		0.89–137 ng/kg (TEC)	1×10^{-5}
Grit in Residential Yards							
(residential/ingestion, dermal contact, produce consumption)	Arsenic[b]	3.73–7.9 mg/kg	7.6 mg/kg	--		3.73–7.9 mg/kg	--
	PCDD/F	5.1–28.2 ng/kg (TEC)	7.4 ng/kg	2×10^{-6}		5.1–28.2 ng/kg (TEC)	2×10^{-6}

Footnotes continued on following page.

Table 1. (cont.)

Note: Boxes indicate those areas where soil has been removed.

--	-	not applicable
ADEC	-	Alaska Department of Environmental Conservation
cPAH	-	carcinogenic polycyclic aromatic hydrocarbon
DRO	-	diesel-range organics
EPA	-	U.S. Environmental Protection Agency
PAH	-	polycyclic aromatic hydrocarbon
PCB	-	polychlorinated biphenyl
PCDD/F	-	polychlorinated dibenzo-*p*-dioxin and polychlorinated dibenzofuran
RPC	-	relative potency concentration
RRO	-	residual-range organics
TEC	-	toxic equivalent concentration
TPH	-	total petroleum hydrocarbon

[a] Screening levels were as follows: EPA Region 10 PCB risk-based cleanup level for nonresidential soils of 10 mg/kg; EPA OSWER guidance for lead in nonresidential soils of 1,000 mg/kg (U.S. EPA 1989); ADEC TPH soil cleanup standard for protection of groundwater (18 AAC 75); EPA risk-based concentrations for PCDD/F in industrial soils (U.S. EPA 1998). Screening levels for arsenic onsite and offsite based on background concentrations. Screening level for PCDD/F in grit based on background concentrations.

[b] Arsenic levels are addressed in the arsenic management plan (Exponent 1998). Arsenic bioavailability estimates described in the arsenic management plan suggest that risks associated with exposure to arsenic in soil may be much lower than those shown here.

[c] Screening level based on background in Tongass Narrows (E&E 1991). Hog fuel was identified as a source of manganese. Removal of hog fuel from the site in spring of 1998 eliminated this source. In addition, manganese was not identified as a chemical of potential concern in the Ward Cove investigation. For these reasons, manganese was not carried through the risk assessment.

[d] Two additional samples with PCB concentrations of 60.2 and 13.5 mg/kg, which were collected from rock at the bottom of the excavation, were not included in the residual risk calculations given their inaccessibility and low volume.

[e] Field duplicate results.

[f] Screening level based on marine human health criteria (U.S. EPA 1999). During the remedial investigation, dissolved concentrations of PCBs were estimated to reach 0.00017 µg/L within 0.1 meter of the shoreline.

Table 2. Summary of early cleanup actions

Source	Cleanup Objectives	Cleanup Action	Reference
Access Road Ditch	Cleanup completed as part of site renovations, not as a result of contaminant levels	400 yd^3 of sediments excavated and disposed of at the KPC landfill.	Exponent (1998f, 1999g)
Railroad Tracks Area	DRO–8,250 mg/kg; RRO–8,300 mg/kg	320 yd^3 of soil excavated and disposed offsite.	Exponent (1998c, 1999a,f,k, 2000b)
Compressor Area	DRO–8,250 mg/kg; RRO–8,300 mg/kg	6 yd^3 of soil excavated and disposed offsite.	Exponent (1999f,k)
Paint Shop/Former Maintenance Shop	Benzo[a]pyrene–1.0 mg/kg; Lead–1,000 mg/kg; PCBs–10 mg/kg	480 yd^3 of soil excavated and disposed offsite.	Exponent (1998b, 1999c,e,h,m)
Former Bulk Fuel Area	DRO–8,250 mg/kg; RRO–8,300 mg/kg	440 yd^3 of soil excavated and disposed offsite.	Exponent (1999i.l)
Former Storage Area along Water Pipeline	PCBs–10 mg/kg; TPH (as RRO)–9,700 mg/kg; Lead–1,000 mg/kg	Approximately 300 yd^3 of soil,115 yd^3 of debris, one set of capacitors, and 43 drums excavated and disposed offsite.	Exponent (1998a,c, 1999b,d,j, 2000a)

Note: DRO - diesel-range organics
PCB - polychlorinated biphenyl
RRO - residual-range organics
TPH - total petroleum hydrocarbon

Table 3. Program organization and responsibilities

Organization	Responsibilities
Gateway Forest Products (current owner of pulp mill) 7559 North Tongass Highway Ketchikan, Alaska 99901 (907) 247-1647	May conduct routine maintenance that involves soil excavation; identifies demolition work to be conducted; oversees demolition contractors; notifies agencies as needed; ensures permits are current; maintains records; files deed restrictions. Responsible for institutional controls and any required monitoring at pulp mill area.
Ketchikan Pulp Company[a] P.O. Box 6600 Ketchikan, Alaska 99901	As landfill owner, responsible for institutional controls and any required monitoring of the landfill. As owner of former water pipeline storage Areas 2, 3, 4, and Drum Area 2, will be responsible for institutional controls.
Demolition Contractor (determined on a case-by-case basis)	Conducts demolition work, including providing or subcontracting for a qualified person responsible for collecting soil samples for characterization and profiling for disposal.
Contract Laboratory (determined on a case-by-case basis)	Analyzes soil samples for characterization and profiling for disposal.
Ketchikan Gateway Borough 344 Front Street Ketchikan, Alaska 99901 (907) 228-6610	Identifies and maintains land use zoning throughout the Borough.
ADEC Contaminated Sites and Remediation Program Division of Spill Prevention and Response 410 Willoughby Avenue, Suite 105 Juneau, Alaska 99801-1795 (907) 465-5390	Oversees the remediation of the pulp mill area(including characterization of soil beneath structures during demolition activities), the wood waste and ash disposal landfill, and the water pipeline storage area.
ADEC Hazardous Waste Notification Contaminated Sites and Remediation Program Division of Spill Prevention and Response 410 Willoughby Avenue, Suite 105 Juneau, Alaska 99801-1795 (907) 465-5390	Oversees characterization and disposal of hazardous waste.
ADEC Division of Environmental Health Solid Waste Program 410 Willoughby Avenue, Suite 105 Juneau, Alaska 99801-1795 (907) 465-5350	Oversees activities associated with the wood waste and ash disposal landfill.
U.S. EPA, Region 10 Alaska Operations Office 222 W. Seventh Avenue Rm. 537, Box 19 Anchorage, Alaska 99513-7588 (907) 271-5083	Oversees the remediation of the pulp mill area (including characterization of soil beneath structures during demolition activities), the wood waste and ash disposal landfill, and the water pipeline storage area.

[a] Parent company is Louisiana-Pacific Corporation, 111 SW Fifth Avenue, Portland, Oregon 97204, (503) 221-0800.

Appendix A

Easement and Covenant Document

ENVIRONMENTAL PROTECTION EASEMENT AND DECLARATION OF RESTRICTIVE COVENANTS

(1) This Environmental Protection Easement and Declaration of Restrictive Covenants ("Easement and Covenant") is made this 28 day of Oct., 1997, by and between Ketchikan Pulp Company ("Grantor"), having an address of P.O. Box 6600, Ketchikan, Alaska, 99901, and the State of Alaska Department of Natural Resources ("Grantee"), having an address of 3601 "C" Street, Suite 960, Anchorage, Alaska 99503, for use by the State of Alaska Department of Environmental Conservation (DEC), as represented by its State of Alaska Department of Law.

WITNESSETH:

(2) WHEREAS, Grantor is the owner of a parcel of land and tide and submerged lands located in the Ketchikan Gateway Borough, State of Alaska, more particularly described on **Exhibit A** attached hereto and made a part hereof ("the Property"); and

(3) WHEREAS, the U.S. Environmental Protection Agency (EPA) and the State of Alaska Department of Environmental Conservation (DEC) intend to select response actions for the Property in Records of Decision pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 U.S.C. 9601 *et seq.*, AS 46.03.822, and/or pursuant to a consent decree dated September 19, 1995, filed under U.S. v. Ketchikan Pulp Company, No. A92-587-CV (D. Alaska);

(4) WHEREAS, the parties hereto agree (a) to grant a permanent right of access over the Property to the Grantee for purposes of implementing, facilitating and monitoring the response actions; and (b) to impose on the Property use restrictions as covenants that will run with the land for the purpose of protecting human health and the environment; and

(5) WHEREAS, Grantor wishes to cooperate fully with the Grantee and EPA in the implementation of all response actions at the Property;

NOW, THEREFORE:

(6) Grant: Grantor, for good and sufficient consideration received, does hereby covenant and declare that the Property shall be subject to the restrictions on use set forth below, and does give, grant and convey to the Grantee, and its assigns, (a) a right to enforce said use restrictions for the duration of this Easement and Covenant as established in Paragraph (9) below, and (b) an environmental protection easement of the nature and character, and for the purposes hereinafter set forth, with respect to the Property.

(7) Purpose: It is the purpose of this instrument to convey to the Grantee real property rights, which will run with the land, to facilitate the remediation of past environmental contamination and to protect human health and the environment by reducing the risk of exposure to contaminants.

(8) Restrictions on use: The following covenants, conditions, and restrictions apply to the use of the Property, run with the land, and are binding on the Grantor:

(a) Uses of the Property are limited to commercial or industrial use.

(b) The Property shall not, at any time, be used, in whole or in part, for human habitation, schooling of children, hospital care, child care or any purpose necessitating around-the-clock residence by humans.

(c) Drilling of drinking water wells is prohibited.

(d) Use of ground water for drinking water is prohibited.

(e) Controls specified in the "Management Plan for Arsenic and Rock and Soil," prepared by Exponent for KPC, dated July 1998, to limit concentrations of arsenic from crushed rock shall be complied with.

(f) Soils in the nearshore fill area or soils underneath paved areas or structures at the pulp mill site that are exposed in the future, e.g., as the result of excavation or demolition activities, shall be properly characterized and managed in accordance with applicable disposal requirements.

(g) Projects or activities that materially damage the cap applied to tide and submerged lands shall be required, at the direction of EPA, to redress such impacts, e.g., a dredging project that may erode or displace large portions of the cap will be required to repair or replace the cap.

(9) Modification of restrictions: The restrictions for the Property set forth in Paragraphs (8)(a) through (f) above shall exist until 2099, or until concentrations of the contaminants set forth in **Exhibit B** attached hereto no longer exceed site-specific, risk-based, residential cleanup levels, whichever comes first. The restriction set forth in

Paragraph (8)(g) above for tide and submerged lands shall exist until 2020 or until EPA determines that healthy benthic communities exist in the capped tide and submerged lands, whichever comes earlier. The above restrictions may be terminated in whole or in part, in writing, by the Grantee. If requested by the Grantor, such writing will be executed by Grantee in recordable form.

(10) Environmental Protection Easement: Grantor hereby grants to the Grantee an irrevocable and continuing right of access under the terms and conditions of this instrument at all reasonable times to the Property for purposes of implementing the following activities pursuant to CERCLA, AS 46.03.822, or the above-referenced consent decree. Grantee, in its sole discretion, may relinquish this easement for right of access. Grantee may designate EPA as its authorized representative for the following activities:

(a) Implementing response actions for the Property selected by EPA and/or DEC in Records of Decision.

(b) Verifying any data or information submitted to EPA or the Grantee by the Grantor.

(c) Verifying that no action is being taken on the Property in violation of the terms of this instrument, CERCLA, AS 46.03.822, or the above-referenced consent decree.

(d) Monitoring response actions on the Property including, without limitation, sampling of air, water, sediments, soils, and specifically, without limitation,

obtaining split or duplicate samples.

(e) Conducting periodic reviews of any response action(s) selected by EPA and/or DEC, including but not limited to, reviews required by applicable statutes and/or regulations.

(f) Assessing the need for and implementing additional or new response actions authorized under CERCLA, AS 46.03.822, or the above-referenced consent decree.

(11) Reserve rights of Grantor: Grantor hereby reserves unto itself, its successors, and assigns, all rights and privileges in and to the use of the Property which are not contrary to the restrictions, rights and easements granted herein.

(12) Other Authorities. Nothing in this document shall limit or otherwise affect the State of Alaska's or EPA's rights of entry and access or their authority to take response actions under CERCLA, the National Contingency Plan (NCP), or other federal or state law.

(13) No Public Access and Use: No right of access or use by the general public to any portion of the Property is conveyed or authorized by this instrument nor are any such existing rights affected by this instrument.

(14) Notice requirement: Grantor agrees to include in any instrument conveying any interest in any portion of the Property, including but not limited to deeds, leases and mortgages, a notice which is in substantially the following form:

NOTICE: THE INTEREST CONVEYED HEREBY IS SUBJECT TO AN ENVIRONMENTAL PROTECTION EASEMENT AND DECLARATION OF RESTRICTIVE COVENANTS, DATED _____ _____, 19 ___, RECORDED IN THE KETCHIKAN RECORDING DISTRICT, FIRST JUDICIAL DISTRICT, STATE OF ALASKA, ON _____, 19 ___, IN BOOK ___, PAGE ___ THAT IS IN FAVOR OF, AND ENFORCEABLE BY, THE STATE OF ALASKA.

Within thirty (30) days of the date any such instrument of conveyance is executed, Grantor must provide Grantee with a certified true copy of said instrument and, if it has been recorded in the public land records, its recording reference.

(15) Administrative jurisdiction: The interests conveyed to the State of Alaska by this instrument are to its Department of Natural Resources, for administration by its Department of Environmental Conservation.

(16) Enforcement: The Grantee shall be entitled to enforce the terms of this instrument by resort to specific performance or legal process without regard to the existence or nonexistence of any dominant estate. Grantee or its authorized representative shall be entitled to enforce the rights of access set forth in Paragraph (10) above. All remedies available hereunder shall be in addition to any and all other remedies at law or in equity, including CERCLA and AS 46.03.822. Enforcement of the terms of this instrument shall be at the discretion of the Grantee; any forbearance, delay or omission to exercise its rights under this instrument in the event of a breach of any term of this instrument shall not be deemed to be a waiver by the Grantee of such term or of any subsequent breach of the same or any other term, or of any of the rights of the Grantee under this instrument.

(17) Damages: Grantee shall be entitled to recover damages for violations of the terms of this instrument.

(18) Waiver of certain defenses: Grantor hereby waives any defense of laches, estoppel, or prescription.

(19) Notices: Unless and until changed by Grantor or Grantee, any notice, demand, request, consent, approval, or communication that either party desires or is required to give to the other shall be in writing and shall either be served personally or sent by first class mail, postage prepaid, addressed as follows:

To Grantor:

Ketchikan Pulp Company
Attn: President and General Manager
c/o Louisiana-Pacific Corp.
111 SW 5th Avenue
Portland, Oregon 97204

To Grantee:

State of Alaska
Department of Natural Resources
Division of Mining, Land and Water
Realty Services Section
3601 "C" Street, Suite 960
Anchorage, Alaska 99503

AND

State of Alaska
Department of Environmental Conservation
Spill Prevention & Response
410 Willoughby Avenue, Suite 105
Juneau, Alaska 99801-1795

(20) General provisions:

(a) Controlling law: The interpretation and performance of this instrument shall be governed by the laws of the United States and the State of Alaska.

(b) Liberal construction: Any general rule of construction to the contrary

notwithstanding, this instrument shall be liberally construed in favor of the Grant of this instrument to effect the purpose of this instrument and policy and purpose of CERCLA, the above-referenced consent decree, and applicable state law. If any provision of this instrument is found to be ambiguous, an interpretation consistent with the purpose of this instrument that would render the provision valid shall be favored over any interpretation that would render it invalid.

(c) Severability: If any provision of this instrument, or the application of it to any person or circumstance, is found to be invalid, the remainder of the provisions of this instrument, or the application of such provisions to persons or circumstances other than those to which it is found to be invalid, as the case may be, shall not be affected thereby.

(d) Entire Agreement: This instrument sets forth the entire agreement of the parties with respect to rights and restrictions created hereby, and supersedes all prior discussions, negotiations, understandings, or agreements relating thereto, all of which are merged herein.

(e) No Forfeiture: Nothing contained herein will result in a forfeiture or reversion of Grantor's title in any respect.

(f) Successors: The covenants, terms, conditions, and restrictions of this instrument shall be binding upon, and inure to the benefit of, the parties

hereto and their respective personal representatives, heirs, successors, and assigns and shall continue as a servitude held by Grantee in gross without regard to the existence or absence of privity of estate with Grantor or its successors or assigns, and shall run with the Property for the duration of this Easement and Covenant as established in Paragraph (9) above. The term "Grantor", wherever used herein, and any pronouns used in place thereof, shall include the persons and/or entities named at the beginning of this document, identified as "Grantor" and their personal representatives, heirs, successors, and assigns. The term "Grantee", wherever used herein, and any pronouns used in place thereof, shall include the persons and/or entities named at the beginning of this document, identified as "Grantee" and their personal representatives, heirs, successors, and assigns. The rights of the Grantor under this instrument are freely assignable. The rights of the Grantee under this instrument are freely assignable to governmental bodies, subject to the notice provisions hereof. The term "EPA" shall include any successor agencies of EPA.

(g) Termination of Rights and Obligations: Grantor's rights and obligations under this instrument terminate upon transfer of the party's interest in the Easement or Property, except that liability for acts or omissions occurring prior to transfer shall survive transfer.

(h) Captions: The captions in this instrument have been inserted solely for convenience of reference and are not a part of this instrument and shall have no effect upon construction or interpretation.

(i) Counterparts: The parties may execute this instrument in two or more counterparts, which shall, in the aggregate, be signed by both parties; each counterpart shall be deemed an original instrument as against any party who has signed it. In the event of any disparity between the counterparts produced, the recorded counterpart shall be controlling.

TO HAVE AND TO HOLD unto the State of Alaska and its assigns forever.

IN WITNESS WHEREOF, Grantor has caused this Agreement to be signed in its name.

Executed this 28 Day of Oct., 1999.

By: _____
Chris Paulson
Its: President & General Manager
Ketchikan Pulp Company

STATE OF ALASKA)
: ss
FIRST JUDICIAL DISTRICT)

THIS IS TO CERTIFY that on this 28th day of Oct., 1999, at ~~Juneau~~ Ketchikan, Alaska, before me, the undersigned, a Notary Public in and for the State of Alaska, duly commissioned and sworn, personally appeared Chris Paulsen, known to me and known to me to be the person he represents himself to be, and the same identical person who executed the above and foregoing document regarding an Environmental Protection Easement and Declaration of Restrictive Covenants, and who acknowledged to me that he executed the same freely and voluntarily for the purposes and uses herein mentioned.

WITNESS my hand and official seal the day, month and year in this certificate first written above.

NOTARY PUBLIC STATE OF ALASKA

_____
Notary Public, State of Alaska
My Commission Expires: 9-19-2002

This easement and declaration is accepted this 27 day of October, 19 99.

STATE OF ALASKA DEPARTMENT
OF NATURAL RESOURCES

By: _____

_____

STATE OF ALASKA)
:SS
FIRST JUDICIAL DISTRICT)

THIS IS TO CERTIFY that on this 27 day of Oct, 1999, before me, the undersigned, a Notary Public in and for the State of Alaska, duly commissioned and sworn as such, personally appeared _____, known to me and to me known to be the _____, and he/she acknowledged to me that he/she signed as accepting the foregoing Environmental Protection Easement and Declaration of Restrictive Covenants, granting to the State of Alaska, those lands described therein, and he/she executed the foregoing instrument freely and voluntarily.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal, the day and year first written above.

(SEAL)

_____
Notary Public in and for the State of Alaska
My commission expires 5/11/03

AFTER RECORDING PLEASE RETURN ORIGINALS TO:

Carol Shobe, Chief
Realty Services Section
State of Alaska, Department of Natural Resources
Division of Mining, Land and Water
3601 "C" Street, Suite 960
Anchorage Alaska 99503

Location Index:
Sections 33 and 34, T. 74 S., R 90 E., CRM
Sections 3 and 4, T. 75 S., 90 E., CRM

STATE BUSINESS, NO CHARGE

M:\KPC\SUPERFUN\FINAL-IC.wpd

EXHIBIT A
To The Environmental Protection Easement
And Declaration of Restrictive Covenants

Description of "the Property"

PARCEL NO. 1:

ALASKA TIDELANDS SURVEY NO. 1 (CR 74S 90E), according to the recorded plat thereof, (mistakenly recorded in the Juneau Recording District as Plat No. 292), Ketchikan Recording District, First Judicial District, State of Alaska;

Excepting therefrom: That portion thereof taken by the State of Alaska, Department of Transportation and Public Facilities by that certain Declaration of Taking (filed under Ketchikan Superior Court Case No. 1KE-87-444 CI) recorded May 28, 1987 in Book 149 at Page 625.

PARCEL NO. 2:

U.S. Survey 1056, accepted by the General Land Office, in Juneau, Alaska on January 24, 1919, and located within the Ketchikan Recording District, First Judicial District, State of Alaska;

Excepting therefrom: Those portions of U.S.Survey 1056 situated upland (North) of the north Right-of-way line of the North Tongass Highway;

Excepting therefrom: That certain portion thereof conveyed to (b) (6) by Warranty Deed recorded January 27, 1950 in Volume "W" of Deeds at Page 614;

Also excepting therefrom: That certain portion conveyed to The United States of America by Right-of-Way Deed recorded April 28, 1949 in Volume "W" of Deeds at Page 397.

PARCEL NO. 13:

Lots 1-7, inclusive, Block 1, Lots 1-6, inclusive, Block 2, Lots 1-4, inclusive, Block 3 and Lots 1-16, inclusive Block

4, and the Unsubdivided Remainder, according to the subdivision plat of U.S. Survey 1754 recorded March 8, 1956 in Volume 1 of Plats at Packet 20, Ketchikan Recording District, First Judicial District, State of Alaska;

Excepting therefrom: Those portions of U.S.Survey 1754 situated upland (North) of the North Tongass Highway.

PARCEL NO. 15:

That portion of U.S. Survey 1862, according to the plat of survey approved by the Department of the Interior, General Land Office in Washington, D.C., on January 20, 1931 and located within the Ketchikan Recording District, First Judicial District, State of Alaska, more particularly described as follows: Beginning at U.S. Location Monument No. 2; thence North 32 degrees 27 minutes West a distance of 155.5 feet to Corner No. 1 of U.S. Survey 1862 and the true point of beginning of the portion herein described; thence North 0 degrees 25 minutes West a distance of 515 feet, more or less, to a point on the South Right of Way line of North Tongass Highway, which point is 50 feet from the center line of said highway and at right angles to Engineers Station 299+50; thence along that portion of a spiral curve to the left whose chord bears South 24 degrees 30 minutes East a distance of 114.65 feet; thence along the arc of a 527.46 foot radius curve the long chord of which bears South 36 degrees 35 minutes East a distance of 126.14 feet; thence along a spiral curve whose chord bears South 51 degrees 21 minutes East a distance of 210.05 feet; thence South 55 degrees 27 minutes East a distance of 316.97 feet; thence South 34 degrees 33 minutes West a distance of 50 feet; thence South 55 degrees 27 minutes East a distance of 137.00 feet; thence South 88 degrees 00 minutes West a distance of 535 feet more or less along Meander Line No. 11 of U.S. survey 1862; thence North 29 degrees 30 minutes West a distance of 155.50 feet along Meander Line No. 12 of U.S. Survey 1862 to Corner No. 1, which is the point of beginning;

ALSO: That portion of U.S. Survey 1862 lying with the North Tongass Highway Right of Way as created by a deed dated April 1, 1949 and recorded in Volume "W" of Deeds at Page 362, Ketchikan Recording District, First Judicial District,

State of Alaska, and as conveyed to Ketchikan Pulp Company by Quitclaim Deed recorded July 27, 1988 in Book 158 at Page 588.

Excepting therefrom: Those portions of U.S.Survey 1862 situated upland (north) of the north Right-of-way line of the North Tongass Highway.

Exhibit B to Environmental Protection Easement
and Declaration of Restrictive Covenants

Contaminants of Concern

Arsenic
Dioxin
Lead
Petroleum
Polycyclic aromatic hydrocarbons (benz(a)anthracene, benzo(b)fluroanthene, benzo(a)pyrene, and dibenz(a,h)anthracene)
Polychlorinated biphenyls

Appendix B

Sampling and Analysis Plan

1. Introduction

This sampling and analysis plan (SAP) describes the procedures for collecting data to characterize soils exposed during future demolition/construction activities at the Uplands Operable Unit of the Ketchikan Pulp Company site in Ketchikan, Alaska (Figure B-1). The sampling methods presented in this SAP are designed to meet the needs of the institutional control plan (see main text). The institutional control plan states that if future demolition activities, such as removal of paved areas or structures or excavation of portions of the near-shore fill subarea for construction, result in the exposure of soils not evaluated as part of the Uplands Operable Unit remedial investigation or early actions, then those soils will be properly characterized and managed. Specific areas previously characterized are presented in Figure B-2 and are described in detail in the remedial investigation report (Exponent 1998) and subsequent technical memoranda (Exponent 1999a–c). The SAP will be used as a reference for conducting all soil characterization activities; however, the specific sampling approach for each excavation will be developed in consultation with the U.S. Environmental Protection Agency (EPA) and the Alaska Department of Environmental Conservation (ADEC). Field sampling and analysis procedures for soil are included in this SAP. If groundwater or tidally intruding seawater (but not transitory accumulated rainwater) is encountered during demolition activities, specific water characterization procedures will be developed with EPA and ADEC. The soil sampling and analysis procedures presented in this SAP were developed in accordance with 18 AAC 75 and 18 AAC 78.

2. Field Sampling Methods

Soil sampling and analysis will be conducted whenever demolition or excavation activities result in the exposure of soils that were not characterized during the remedial investigation or early actions. The specific sampling approach for each excavation will be developed in consultation with EPA and ADEC, but the following general guidelines, as specified in 18 AAC 75 and 18 AAC 78, should be followed. For each discrete area exposed, if the surface area of the exposed soil is 250 ft^2 or less, three grab samples of soil will be collected from the bottom of the excavation. For each additional 250 ft^2 of exposed surface area, one additional grab sample will be collected from the bottom of the excavation. The actual location of the grab samples will be determined in the field, but will be spaced in such a way as to provide an accurate representation of site-specific conditions. In addition, if visually stained or texturally different areas within the exposed area are encountered, they will be sampled separately. Samples will be collected from a depth of 0–6 in. or to bedrock if it is encountered at less than 6 in. If the excavation is greater than 4 ft in depth, one soil sample will be collected from each sidewall of the excavation. Sidewall samples will be collected, to the extent possible, over the entire depth of excavation (e.g., a grab sample will be collected from the excavation equipment bucket after the bucket has swept a sample from the entire vertical extent of the sidewall).

The following steps will be taken to minimize sample collection errors:

- All samples will be collected with disposable or clean tools that have been decontaminated as outlined in Section 2.3, *Equipment Decontamination.*
- Disposable gloves will be worn and changed between sample collections.
- Precleaned sample containers supplied by the analytical laboratory will be used.
- Sample containers will be filled quickly.
- Samples will be placed in containers in the order of volatility of the analyte; for example, volatile organic compound (VOC) samples will be taken first, followed by the semivolatile organic compound (SVOC) samples and then metal samples.
- Containers will be quickly and adequately sealed, and rims will be cleaned before lids are tightened. Tape may be used only if known not to affect sample analysis.
- Sample containers will be labeled as outlined in Section 2.2, *Sample Labeling.*

- Samples will be immediately preserved according to procedures described in Section 3, *Laboratory Analysis*. Unless specified otherwise, immediately after sample containers are filled, they will be placed on ice in a cooler at 4°C. This temperature must be maintained throughout delivery to the laboratory and until samples are analyzed.

2.1 Documentation of Soil Sampling Activities

A field logbook or other type of field record will be used to document the collection of samples and site data. This record must include the following:

- The name of each person onsite supervising or conducting the sampling
- The date and time of sampling
- Weather conditions, including temperature, wind speed, humidity, and precipitation
- The name of each person who physically collected the samples
- Clear photographs of the site, bottom of excavation, and sampling locations
- A site sketch that, at a minimum, shows the following:
  - Distances from the excavation to nearby structures
  - Sampling locations and depth and corresponding sample ID numbers
  - Any visually stained soils or texturally different materials
  - Scale
  - North arrow.

When appropriate, the field record should also include the following:

- A description of the size of the excavation
- Location of stockpiled soils
- Amount and type of backfill material
- Soil types
- Utility trenches.

2.2 Sample Labeling

Indelible, waterproof ink will be used to label sample containers. Labels must be securely fastened to the container. All information entered onto the label must be duplicated in the field logbook. Information on the label must include the following:

- Unique identifying number (sample ID number) assigned to the sample for laboratory analysis
- Date and time of sample collection
- Name of person collecting the sample
- Each intended laboratory analysis for the sample
- Preservative (if applicable).

A chain-of-custody form(s) will accompany each shipment of samples to the analytical laboratory. The chain-of-custody form will contain sample ID number, date and time of collection, and requested analysis for each sample. The field team leader will also be identified. The chain-of-custody form will be completed in triplicate, with the original form sent to the laboratory along with the samples and one copy retained by the field team leader.

2.3 Equipment Decontamination

All sampling equipment must be decontaminated prior to sampling and between sampling locations. Clean, solvent-resistant gloves and appropriate protective equipment must be worn by persons decontaminating tools and equipment. At a minimum, soil sampling tools must be cleaned and decontaminated by scrubbing in an Alconox® (or equivalent laboratory-grade detergent) solution with a stiff brush, rinsing twice with clean site water, and finally rinsing with distilled or deionized water. If free product or highly contaminated soils are encountered during sampling, an appropriate solvent should be used to remove heavy residues from the sampling equipment, followed by the cleaning steps described above.

Wastewater and rinsate solutions must be collected in appropriate containers and disposed of properly in accordance with federal, state, and local regulations.

2.4 Health and Safety

All sampling activities will be conducted in accordance with both the current owner's and the sampling contractor's health and safety plans.

3. Laboratory Analysis

An excavation-specific set of analytes will be developed in consultation with EPA and ADEC; however, the following analytes are suggested for specific areas of the site. Soil underneath paved areas (i.e., railroad track areas) or other areas where petroleum products were stored or used will be analyzed for diesel- and residual-range organics and polycyclic aromatic hydrocarbons (PAHs) (and gasoline-range organics and benzene, toluene, ethylbenzene, and xylenes, if appropriate). Soil underneath structures will be analyzed for diesel- and residual-range organics, PAHs, and polychlorinated biphenyls (PCBs). Soil from the flyash silo will be analyzed for polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans. Soil in the near-shore fill subarea and the water pipeline storage area will be analyzed for diesel- and residual-range organics, target analyte list metals, VOCs, SVOCs, organochlorine pesticides and PCBs, and chlorinated herbicides. The analyte list for soils in other areas will be determined in consultation with EPA and ADEC. All analyses will be conducted in accordance with EPA, ADEC, American Society for Testing and Materials, or equivalent methods. The analytical methods presented in Table B-1, or updated versions of these methods, should be used if applicable. Sample preservation and handling requirements for these methods are also presented in Table B-1.

4. Data Reporting

For each characterization effort, a brief memorandum will be prepared after receipt of analytical results from the laboratory. The memorandum will contain a description of the sampling, including site photographs, a figure showing all sampling locations, and tabulated analytical results. The memorandum will be sent to EPA and ADEC within 60 days of the receipt of final results from the analytical laboratory.

5. References

ADEC. 1998. Alaska Department of Environmental Conservation, Storage Tank Program, underground storage tanks procedures manual. Guidance for remediation of petroleum-contaminated soil and water and standard sampling procedures. December 10, 1998. Alaska Department of Environmental Conservation, Juneau, AK.

ASTM. 1989. Annual book of ASTM standards. Volume 04.08, soil and rock; building stones; geotextiles. American Society for Testing and Materials, Philadelphia, PA.

Exponent. 1998. Remedial investigation, Ketchikan Pulp Company site. Prepared for Ketchikan Pulp Company, Ketchikan, AK. Exponent, Bellevue, WA.

Exponent. 1999a. Technical memorandum no. 19, summary of supplemental sampling at the pipeline storage area. Prepared for Ketchikan Pulp Company, Ketchikan, AK. Exponent, Bellevue, WA.

Exponent. 1999b. Technical memorandum no. 20, early action report for the railroad tracks and compressors areas, Ketchikan Pulp Company site. Prepared for Ketchikan Pulp Company, Ketchikan, AK. Exponent, Bellevue, WA.

Exponent. 1999c. Technical memorandum no. 21, early action for the bulk fuel tank area, Ketchikan Pulp Company site. Prepared for Ketchikan Pulp Company, Ketchikan, AK. Exponent, Bellevue, WA.

U.S. EPA. 1994. Method 1613: Tetra- through octa-chlorinated dioxins and furans by isotope dilution HRGC/HRMS. EPA 831-B-94-005. U.S. Environmental Protection Agency, Office of Water, Engineering and Analysis Division, Washington, DC.

U.S. EPA. 1997. Test methods for evaluating solid waste–physical chemical methods, SW-846. Version 2. U.S. Environmental Protection Agency, Washington, DC.

Figures

Source: NOAA (1995)

0 1/2 1 miles

0 1 2 kilometers

Figure B-1. Location of Ward Cove and former KPC facility.

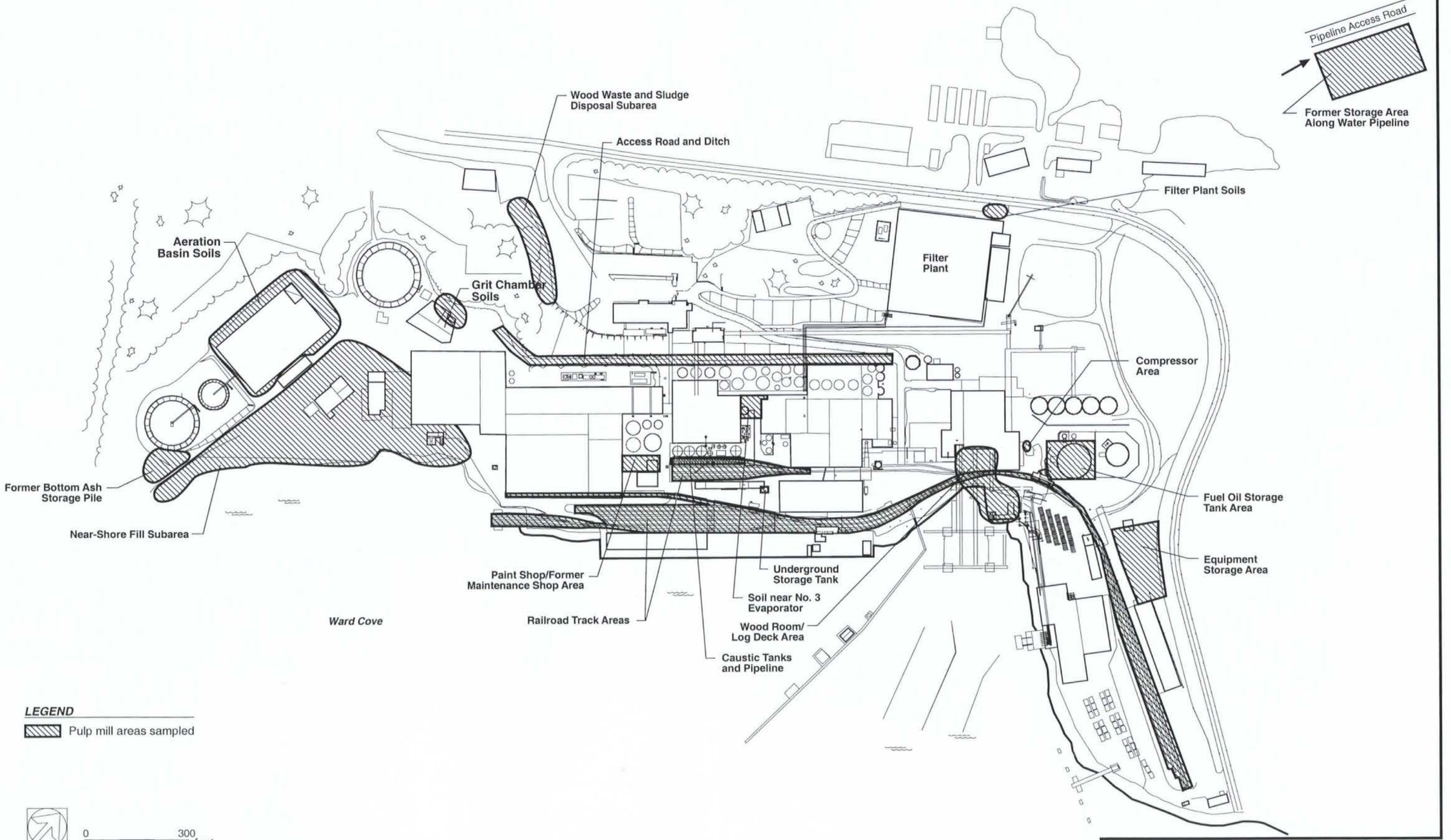


Figure B-2. Sampling areas at the pulp mill area.

8600B4Q.001 1006 IC Plan 06/01/00 WA

Tables

Table B-1. Summary of suggested analytical methods

Analysis	Method Reference	Method Reporting Limits[a]	Approximate Laboratory Subsample	Container	Preservation and Handling	Maximum Holding Times (days)[b]
VOCs	SW-846 Method 8260A (U.S. EPA 1997)	100–600 µg/kg	5 g	125-mL wide-mouth glass jar; Teflon-lined lid with septum	Methanol preservative, <25°C	28
SVOCs	SW-846 Method 8270B (U.S. EPA 1997)	60–700 µg/kg	30 g	250-mL wide-mouth glass jar; Teflon-lined lid	Keep in dark; cool (4°C)	14/40
PAHs	SW-846 Method 8310 or 8270 SIM (U.S. EPA 1997)	20–1,500 µg/kg	30 g	250-mL wide-mouth glass jar; Teflon-lined lid	Keep in dark; cool (4°C)	14/40
Organochlorine pesticides	SW-846 Method 8081 (U.S. EPA 1997)	5–200 µg/kg	30 g	250-mL wide-mouth glass jar; Teflon-lined lid	Keep in dark; cool (4°C)	14/40
PCBs	SW-846 Method 8082 (U.S. EPA 1997)	50–100 µg/kg	30 g	250-mL wide-mouth glass jar; Teflon-lined lid	Keep in dark; cool (4°C)	14/40
Chlorinated herbicides	SW-846 Method 8150 (U.S. EPA 1997)	10–1,000 µg/kg	30 g	250-mL wide-mouth glass jar; Teflon-lined lid	Keep in dark; cool (4°C)	14/40
PCDDs/Fs	EPA Method 1613A (U.S. EPA 1994)	1–10 ng/kg	30 g	250-mL wide-mouth glass jar; Teflon-lined lid	Keep in dark; cool (4°C)	30
Gasoline-range organics	ADEC Method AK101 (ADEC 1998)	20 mg/kg	10 g	125-mL wide-mouth glass jar; Teflon-lined lid with septum	Methanol preservative, <25°C	28
Diesel-range organics	ADEC Method AK102 (ADEC 1998)	20 mg/kg	30 g	125-mL wide-mouth glass jar; Teflon-lined lid	Keep in dark; cool (4°C)	14/40
Residual-range organics	ADEC Method AK103 (ADEC 1998)	100 mg/kg	30 g	125-mL wide-mouth glass jar; Teflon-lined lid	Keep in dark; cool (4°C)	14/40
Aliphatic/aromatic gasoline-range organics	ADEC Method AK101AA (ADEC 1998)	25–250 mg/kg	10 g	125-mL wide-mouth glass jar; Teflon-lined lid with septum	Methanol preservative, <25°C	28
Aliphatic/aromatic diesel-range organics	ADEC Method AK102AA (ADEC 1998)	4 mg/kg	30 g	125-mL wide-mouth glass jar; Teflon-lined lid	Keep in dark; cool (4°C)	14/40
Aliphatic/aromatic residual-range organics	ADEC Method AK103AA (ADEC 1998)	10 mg/kg	30 g	125-mL wide-mouth glass jar; Teflon-lined lid	Keep in dark; cool (4°C)	14/40
Metals	SW-846 Methods 6010A and 7000-series	0.05–50 mg/kg	5 g	125-mL wide-mouth HDPE jar	Keep in dark; cool (4°C)	180
Grain size	ASTM Method D422 (ASTM 1989)	0.1 percent	200 g	250-mL wide-mouth HDPE jar	Keep in dark; cool (4°C)	30
Total organic carbon	SW-846 Method 9060 (U.S. EPA 1997)	0.05 percent	1 g	250-mL wide-mouth HDPE jar	Keep in dark; cool (4°C)	30
pH	SW-846 Method 9045B (U.S. EPA 1997)	1 pH unit	20 g	125-mL wide-mouth HDPE jar	Keep in dark; cool (4°C)	NA

Note: HDPE - high-density polyethylene
NA - not applicable
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCDD/F - polychlorinated dibenzo-*p*-dioxin and polychlorinated dibenzofuran
SVOC - semivolatile organic compound
VOC - volatile organic compound

Table B-1. (cont.)

[a] The method reporting limits listed are expressed as ranges or method-specific limits consistent with the referenced method. Elevated method reporting limits may be reported if there is matrix interference or if dilutions are required.

[b] Sample collection to extraction holding time/sample extraction to analysis holding time.

Appendix C

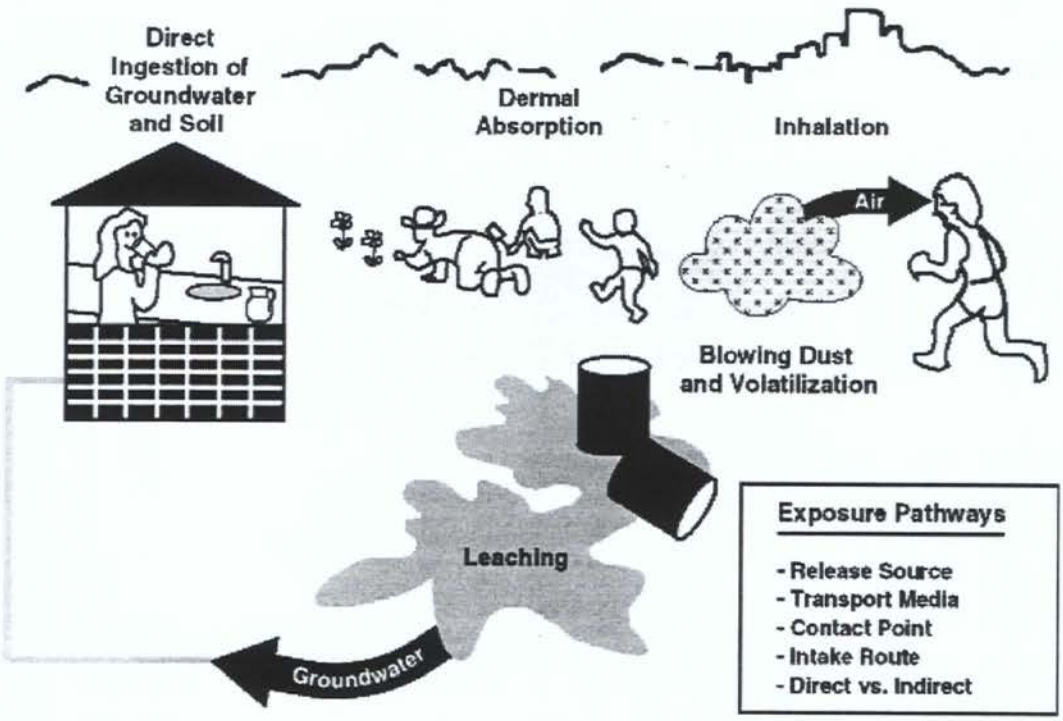
Screening Levels Derived by EPA Region 9 for Industrial Soils

EPA United States Environmental Protection Agency

Waste Programs

Region 9

Preliminary Remediation Goals (PRGs)



Introduction [This can also be downloaded in MS Word (225K) or WordPerfect (174K)]

R9 PRGs Table [A-Bu] [Ca-De] [Di-Fe]* [Fl-Mo]** [Na-Pu] [Py-Zi]

Soil PRGs [A-Bu] [Ca-De] [Di-Fe] [Fl-Mo] [Na-Pu] [Py-Zi]

Air-Water PRGs [A-Bu] [Ca-De] [Di-Fe] [Fl-Mo] [Na-Pu] [Py-Zi]

Toxicity Values [A-Bu] [Ca-De] [Di-Fe] Fl-Mo] [Na-Pu] [Py-Zi]

Phys-Chem Data [A-Di]* [Ep-Tr]*

All the tables above can be downloaded as a complete set in Excel* (751K) or Lotus 123* † (594K).

*** Indicates that the table was updated with missing values on November 29, 1999.**

**** Indicates that the table was updated with missing values on December 3, 1999.**

† **If your browser is having trouble downloading this file, click on it with your right mouse button and select "Save Link As ...".**

Go to: [Region 9 Waste Home] [Region 9 Home] [Superfund Home] [EPA Home]

Send questions and comments to: smucker.stan@epa.gov
Region 9 Office: 75 Hawthorne Street, San Francisco, California, 94105-3901

Updated: December 3, 1999

URL: http://www.epa.gov/region09/waste/sfund/prg/index.htm

EPA United States Environmental Protection Agency Waste Programs

Region 9 PRGs: Introduction

Region 9 Preliminary Remediation Goals (PRGs) are tools for evaluating and cleaning up contaminated sites. This page includes an explanation of the use of PRGs, key equations for computing PRGs and a table of PRG values.

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Download the Preliminary Remediation Goals Table in Excel or Lotus 123 and Text in MS Word or WordPerfect. Another available resource is EPA's Soil Screening Guidance.

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Letter to PRG Table Mailing List

October 1, 1999
Subject: Region 9 Preliminary Remediation Goals (PRGs) 1999

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Regional Toxicologist (SFD-8-B)
Technical Support Team

To: PRG Table Mailing List

Please find the annual update to the Region 9 PRG (Preliminary Remediation Goals) table. Risk-based PRGs presented in the "lookup" table are useful tools for evaluating and cleaning up contaminated sites. They are being used to streamline and standardize all stages of the risk decision-making process. If you are not currently on the PRG table mailing list but would like to be, please call

Lynn Trujillo (415.744.2419) or email her (Trujillo.Dianna@epa.gov) and leave your name, address, and phone number.

EPA Region 9 has established a homepage for the PRGs on the World Wide Web which you can find at http://www.epa.gov/region09/waste/sfund/prg/ . The PRG homepage presents additional information not available in the printed tables that are sent out to folks; including pathway-specific screening concentrations, non-cancer PRGs for carcinogenic substances, and physical-chemical information for volatile organic compounds (VOCs). This information may be viewed or downloaded at our website.

Region 9 risk-based PRGs are "evergreen" and have evolved as new methodologies and parameters have been developed. Changes to individual PRGs that have occurred from the 1998 table reflect either updates in toxicity information or a reclassification of a chemical's status as a VOC. These chemical-specific changes are identified by boldface type in the table. In addition, a more global change in the PRG numeric values reflects new exposure guidelines presented in "Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim Guidance" (USEPA 1999a, see Section 4.3).

Chemicals for which toxicity values have been revised or added include: **acetonitrile, aluminum, antimony trioxide, chlordane, chlorobenzene, chloroethane, chloroform, chloromethane, chromium VI, dichlorobenzene isomers, ethyl chloride, manganese, nitroglycerin, 4-nitrophenol, PCBs, 1,1,2,2-tetrachloroethane, and tetrahydrofuran**. Updates to EPA toxicity values were obtained from IRIS and the National Center for Environmental Assessment (NCEA) through August 1999.

Chemicals for which the VOC status has changed in an effort to reconcile differences among the regions include: **chloronitrobenzene isomers, cyanogen and its salts, methylcyclohexane, methylene bromide, and the nitrotoluene isomers**. The criteria for VOC status are taken from RAGS Part B. However, three "borderline chemicals" (**dibromochloromethane, 1,2-dibromochloropropane, and pyrene**) that do not strictly meet the RAGS criteria of volatility have also been included based upon discussions with other state and federal agencies and after a consideration of vapor pressure characteristics etc.

Before relying on any number in the table, it is recommended that the user verify the numbers with an agency toxicologist or risk assessor because the toxicity / exposure information in the table may contain errors or default assumptions that need to be refined based on further evaluation. If you find an error please send me a note via email at smucker.stan@epa.gov or fax at 415.744.1916.

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DISCLAIMER

Preliminary remediation goals (PRGs) focus on common exposure pathways and may not consider all exposure pathways encountered at CERCLA / RCRA sites (Exhibit 1-1). PRGs do not consider impact to groundwater or address ecological concerns. PRGs are specifically not intended as a (1) stand-alone decision-making tool, (2) as a substitute for EPA guidance for preparing baseline risk assessments, or (3) a rule to determine if a waste is hazardous under RCRA.

The guidance set out in this document is not final Agency action. It is not intended, nor can it be relied upon to create any rights enforceable by any party in litigation with the United States. EPA officials may decide to follow the guidance provided herein, or act at variance with the guidance, based on an analysis of specific circumstances. The Agency also reserves the right to change this guidance at any time without public notice.

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1.0 INTRODUCTION

Region 9 Preliminary Remediation Goals (PRGs) are risk-based tools for evaluating and cleaning up contaminated sites. They are being used to streamline and standardize all stages of the risk decision-making process.

The Region 9 PRG table combines current EPA toxicity values with "standard" exposure factors to estimate contaminant concentrations in environmental media (soil, air, and water) that are considered protective of humans, including sensitive groups, over a lifetime. Chemical concentrations above these levels would not automatically designate a site as "dirty" or trigger a response action. However, exceeding a PRG suggests that further evaluation of the potential risks that may be posed by site contaminants is appropriate. Further evaluation may include additional sampling, consideration of ambient levels in the environment, or a reassessment of the assumptions contained in these screening-level estimates (e.g. appropriateness of route-to-route extrapolations, appropriateness of using chronic toxicity values to evaluate childhood exposures, appropriateness of generic exposure factors for a specific site etc.).

The PRG concentrations presented in the table can be used to screen pollutants in environmental media, trigger further investigation, and provide an initial cleanup goal if applicable. When considering PRGs as preliminary goals, residential concentrations should be used for maximum beneficial uses of a property. Industrial concentrations are included in the table as an alternative cleanup goal for soils. In general, it is not recommended that industrial PRGs be used for screening sites unless they are used in conjunction with residential values.

Before applying PRGs as screening tools or initial goals, the user of the table should consider whether the exposure pathways and exposure scenarios at the site are fully accounted for in the PRG calculation. Region 9 PRG concentrations are based on exposure pathways for which generally accepted methods, models, and

assumptions have been developed (i.e. ingestion, dermal contact, and inhalation) for specific land-use conditions and do not consider impact to groundwater or ecological receptors (see Developing a Conceptual Site Model below).

EXHIBIT 1-1
TYPICAL EXPOSURE PATHWAYS BY MEDIUM
FOR RESIDENTIAL AND INDUSTRIAL LAND USES[a]

	EXPOSURE PATHWAYS, ASSUMING:	
MEDIUM	RESIDENTIAL LAND USE	INDUSTRIAL LAND USE
Ground Water	***Ingestion from drinking***	Ingestion from drinking
	Inhalation of volatiles	Inhalation of volatiles
	Dermal absorption from bathing	Dermal absorption
Surface Water	***Ingestion from drinking***	Ingestion from drinking
	Inhalation of volatiles	Inhalation of volatiles
	Dermal absorption from bathing	Dermal absorption
	Ingestion during swimming	
	Ingestion of contaminated fish	
Soil	***Ingestion***	***Ingestion***
	Inhalation of particulates	***Inhalation of particulates***
	Inhalation of volatiles	***Inhalation of volatiles***
	Exposure to indoor air from soil gas	Exposure to indoor air from soil gas
	Exposure to ground water contaminated by soil leachate	Exposure to ground water contaminated by soil leachate
	Ingestion via plant, meat, or dairy products	Inhalation of particulates from trucks and heavy equipment
	Dermal absorption	***Dermal absorption***

Footnote:

[a]Exposure pathways considered in the PRG calculations are indicated in boldface italics.

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2.0 READING THE PRG TABLE

2.1 General Considerations

With the exceptions described below, PRGs are chemical concentrations that correspond to fixed levels of risk (i.e. either a one-in-one million [10^{-6}] cancer risk or a noncarcinogenic hazard quotient of 1) in soil, air, and water. In most cases, where a substance causes both cancer and noncancer (systemic) effects, the 10^{-6} cancer risk will result in a more stringent criteria and consequently this value is presented in the hard copy of the table. PRG concentrations that equate to a 10^{-6} cancer risk are indicated by "ca". PRG concentrations that equate to a hazard quotient of 1 for noncarcinogenic concerns are indicated by "nc".

If the risk-based concentrations are to be used for site screening, it is recommended that both cancer and noncancer-based PRGs be used. Both carcinogenic and noncarcinogenic values may be obtained at the Region 9 PRG homepage at:

http://www.epa.gov/region09/waste/sfund/prg/

It has come to my attention that some users have been multiplying the cancer PRG concentrations by 10 or 100 to set "action levels" for triggering remediation or to set less stringent cleanup levels for a specific site after considering non-risk-based factors such as ambient levels, detection limits, or technological feasibility. This risk management practice recognizes that there may be a range of values that may be "acceptable" for carcinogenic risk (EPA's risk management range is one-in-a-million [10^{-6}] to one-in-ten thousand [10^{-4}]). However, this practice could lead one to overlook serious noncancer health threats and it is strongly recommended that the user consult with a toxicologist or regional risk assessor before doing this. For carcinogens, I have indicated by asterisk ("ca*") in the PRG table where the noncancer PRGs would be exceeded if the cancer value that is displayed is multiplied by 100. Two stars ("ca**") indicate that the noncancer values would be exceeded if the cancer PRG were multiplied by 10. There is no range of "acceptable" noncarcinogenic "risk" so that under no circumstances should noncancer PRGs be multiplied by 10 or 100, when setting final cleanup criteria.

In general, PRG concentrations in the table are risk-based but for soil there are two important exceptions: (1) for several volatile chemicals, PRGs are based on the soil saturation equation ("sat") and (2) for relatively less toxic inorganic and semivolatile contaminants, a non-risk based "ceiling limit" concentration is given as 10^{+5} mg/kg ("max").

Also included in the PRG table are California EPA PRGs ("CAL-Modified PRGs")

for specific chemicals where CAL-EPA screening values may be "significantly" more restrictive than the federal values; and, soil screening levels (SSLs) for protection of groundwater (see Section 2.3 below).

2.2 Toxicity Values

Heirarchy of Toxicity Values

EPA toxicity values, known as noncarcinogenic reference doses (RfD) and carcinogenic slope factors (SF) were obtained from IRIS, NCEA (formerly ECAO) through August 1999, and HEAST. The priority among sources of toxicological constants has changed since the last iteration of the table because the HEAST tables are no longer being updated. Therefore, the revised order of preference is as follows: (1) IRIS (indicated by "i"), (2) NCEA ("n"), (3) HEAST ("h"), (4) withdrawn from IRIS or HEAST and under review ("x") or obtained from other EPA documents ("o").

Inhalation Conversion Factors

As of January 1991, IRIS and NCEA databases no longer present RfDs or SFs for the inhalation route. These criteria have been replaced with reference concentrations (RfC) for noncarcinogenic effects and unit risk factors (URF) for carcinogenic effects. However, for purposes of estimating risk and calculating risk-based concentrations, inhalation reference doses (RfDi) and inhalation slope factors (SFi) are preferred. This is not a problem for most chemicals because the inhalation toxicity criteria are easily converted. To calculate an RfDi from an RfC, the following equation and assumptions may be used for most chemicals:

$$\text{RfDi}\ \frac{\text{mg}}{\text{(kg - day)}} = \text{RfC}\,(\text{mg}/\text{m}^3) \times \frac{20\text{m}^3}{\text{day}} \times \frac{1}{70\text{kg}}$$

Likewise, to calculate an SFi from an inhalation URF, the following equation and assumptions may be used:

$$\text{SFi}\ \frac{\text{(kg - day)}}{\text{(mg)}} = \text{URF}\,(\text{m}^3/\text{ug}) \times \frac{\text{day}}{20\text{m}^3} \times 70\text{kg} \times \frac{10^3\ \text{ug}}{\text{mg}}$$

Substances with New Toxicity Values

To help users rapidly identify substances with new toxicity values, these chemicals are printed in boldface type. This issue of the PRG table contains new or revised toxicity values for **acetonitrile, aluminum, antimony trioxide, chlordane, chlorobenzene, chloroethane, chloroform, chloromethane, chromium VI, dichlorobenzene isomers, ethyl chloride, manganese, nitroglycerin, 4-nitrophenol, PCBs, 1,1,2,2-tetrachloroethane, and tetrahydrofuran**.

Route-to-Route Methods

Route-to-route extrapolations ("r") were frequently used when there were no toxicity values available for a given route of exposure. Oral cancer slope factors ("SFo") and reference doses ("RfDo") were used for both oral and inhaled exposures for organic compounds lacking inhalation values. Inhalation slope factors ("SFi") and inhalation reference doses ("RfDi") were used for both inhaled and oral exposures for organic compounds lacking oral values. Route extrapolations were not performed for inorganics due to portal of entry effects and known differences in absorption efficiency for the two routes of exposure.

An additional route extrapolation is the use of oral toxicity values for evaluating dermal exposures. For many chemicals, a scientifically defensible data base does not exist for making an adjustment of an oral slope factor/RfD to estimate a dermal toxicity value. Based on the current guidance (USEPA 1999a), the only chemical for which an adjustment is recommended is cadmium. An oral absorption efficiency of 5% is assumed for cadmium which leads to an estimated dermal reference dose (RfDd) of 2.5E-05. Please note that the 1999 PRG calculations for cadmium are based on this adjustment.

Although route-to-route methods are a useful screening procedure, the appropriateness of these default assumptions for specific contaminants should be verified by a toxicologist or regional risk assessor. Please note that whenever route-extrapolated values are used to calculate risk-based PRGs, additional uncertainties are introduced in the calculation.

2.3 Soil Screening Levels

Generic, soil screening levels (SSLs) for the protection of groundwater have been included in the PRG table for 100 of the most common contaminants at Superfund sites. Generic SSLs are derived using default values in standardized equations presented in *Soil Screening Guidance* (available from NTIS as document numbers PB96-963502 and PB96-963505 or EPA/540/R-95/128 and EPA/540/R-96/018).

The SSLs were developed using a default dilution-attenuation factor (DAF) of 20 to account for natural processes that reduce contaminant concentrations in the subsurface. Also included are generic SSLs that assume no dilution or attenuation between the source and the receptor well (i.e., a DAF of 1). These values can be used at sites where little or no dilution or attenuation of soil leachate concentrations is expected at a site (e.g., sites with shallow water tables, fractured media, karst topography, or source size greater than 30 acres).

In general, if an SSL is not exceeded for the migration to groundwater pathway, the user may eliminate this pathway from further investigation.

2.4 Miscellaneous

Volatile organic compounds (VOCs) are indicated by "1" in the VOC column of the table and in general, are defined as those chemicals having a Henry's Law constant greater than 10^{-5} (atm-m^3/mol) and a molecular weight less than 200 g/mole). Three borderline chemicals (dibromochloromethane, 1,2-dibromochloropropane, and pyrene) which do not strictly meet these criteria of volatility have also been included based upon discussions with other state and federal agencies and after a consideration of vapor pressure characteristics etc. Volatile organic chemicals are evaluated for potential volatilization from soil/water to air using volatilization factors (see Section 4.1).

Chemical-specific dermal absorption values for contaminants in soil and dust are presented for arsenic, cadmium, chlordane, 2,4-D, DDT, lindane, TCDD, PAHs, PCBs, and pentachlorophenols as recommended in the "Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim Guidance" (USEPA 1999a). Otherwise, default skin absorption fractions are assumed to be 0.10 for nonvolatile organics. Please note that previous defaults of 0.01 and 0.10 for inorganics and VOCs respectively, have been withdrawn per new guidance.

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3.0 USING THE PRG TABLE

The decision to use PRGs at a site will be driven by the potential benefits of having generic risk-based concentrations in the absence of site-specific risk assessments. The original intended use of PRGs was to provide initial cleanup goals for individual chemicals given specific medium and land-use combinations (see RAGS Part B, 1991), however risk-based concentrations have several applications. They can also be used for:

- Setting health-based detection limits for chemicals of potential concern
- Screening sites to determine whether further evaluation is appropriate
- Calculating cumulative risks associated with multiple contaminants

A few basic procedures are recommended for using PRGs properly. These are briefly described below. Potential problems with the use of PRGs are also identified.

3.1 Developing a Conceptual Site Model

The primary condition for use of PRGs is that exposure pathways of concern and conditions at the site match those taken into account by the PRG framework. Thus, it is always necessary to develop a conceptual site model (CSM) to identify likely contaminant source areas, exposure pathways, and potential receptors. This information can be used to determine the applicability of PRGs at the site and the need for additional information. For those pathways not covered by PRGs, a risk

assessment specific to these additional pathways may be necessary. Nonetheless, the PRG lookup values will still be useful in such situations for focusing further investigative efforts on the exposure pathways not addressed.

To develop a site-specific CSM, perform an extensive records search and compile existing data (e.g. available site sampling data, historical records, aerial photographs, and hydrogeologic information). Once this information is obtained, CSM worksheets such as those provided in ASTM's *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites* (1995) can be used to tailor the generic worksheet model to a site-specific CSM. The final CSM diagram represents linkages among contaminant sources, release mechanisms, exposure pathways and routes and receptors. It summarizes our understanding of the contamination problem.

As a final check, the CSM should answer the following questions:

- Are there potential ecological concerns?
- Is there potential for land use other than those covered by the PRGs (that is, residential and industrial)?
- Are there other likely human exposure pathways that were not considered in development of the PRGs (e.g. impact to groundwater, local fish consumption, raising beef, dairy, or other livestock)?
- Are there unusual site conditions (e.g. large areas of contamination, high fugitive dust levels, potential for indoor air contamination)?

If any of these four conditions exist, the PRG may need to be adjusted to reflect this new information. Suggested references for evaluating pathways not currently evaluated by Region 9 PRG's are presented in Exhibit 3-1.

EXHIBIT 3-1
SUGGESTED READINGS FOR EVALUATING EXPOSURE PATHWAYS NOT CURRENTLY ADDRESSED BY REGION 9 PRGs

EXPOSURE PATHWAY	REFERENCE
Migration of contaminants to an underlying potable aquifer	*Soil Screening Guidance* (USEPA 1996a,b), *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites* (ASTM 1995)
Ingestion via plant uptake	*Soil Screening Guidance* (USEPA 1996a,b),
Ingestion via meat, dairy products, human milk	*Estimating Exposure to Dioxin-Like Compounds* (USEPA 1994a)
Inhalation of volatiles that have migrated into basements	*User's Guide for Johnson and Ettinger (1991) Model for Subsurface Vapor Intrusion into Buildings* (USEPA 1997a)
Ecological pathways	*Ecological Risk Assessment: Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments,* (USEPA 1997b), *Guidance for Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities* (CAL-EPA 1996)

3.2 Background Levels Evaluation

A necessary step in determining the usefulness of Region 9 PRGs is the consideration of background contaminant concentrations. EPA may be concerned with two types of background at sites: naturally occurring and anthropogenic. Natural background is usually limited to metals whereas anthropogenic (i.e. human-made) "background" includes both organic and inorganic contaminants. Before embarking on an extensive sampling and analysis program to determine local background concentrations in the area, one should first compile existing data on the subject. Far too often there is pertinent information in the literature that gets ignored, resulting in needless expenditures of time and money.

Generally EPA does not clean up below natural background. In some cases, the predictive risk-based models generate PRG levels that lie within or even below typical background. If natural background concentrations are higher than the risk-based PRGs, an adjustment of the PRG is probably needed. Exhibit 3-2 presents summary statistics for selected elements in soils that have background levels that may exceed risk-based PRGs. An illustrative example of this is naturally occurring arsenic in soils which frequently is higher than the risk-based concentration set at a one-in-one-million cancer risk (the PRG for residential soils is 0.39 mg/kg). After considering background concentrations in a local area, EPA Region 9 has at times used the non-cancer PRG (22 mg/kg) to evaluate sites recognizing that this value tends to be above background levels yet still falls within the range of soil concentrations (0.39-39 mg/kg) that equates to EPA's "acceptable" cancer risk range of 10E-6 to 10E-4.

Where anthropogenic "background" levels exceed PRGs and EPA has determined that a response action is necessary and feasible, EPA's goal will be to develop a comprehensive response to the widespread contamination. This will often require coordination with different authorities that have jurisdiction over the sources of contamination in the area.

EXHIBIT 3-2
BACKGROUND CONCENTRATIONS OF SELECTED ELEMENTS IN SOILS

TRACE	U.S. STUDY DATA[1]			CALIFORNIA DATA[2]		
ELEMENT	Range	GeoMean	ArMean	Range	GeoMean	ArMean
Arsenic	<.1-97	5.2 mg/kg	7.2 mg/kg	0.59-11	2.75 mg/kg	3.54 mg/kg
Beryllium	<1-15	0.63 "	0.92 "	0.10-2.7	1.14 "	1.28 "
Cadmium	<1-10	--	<1	0.05-1.7	0.26	0.36
Chromium	1-2000	37	54	23-1579	76.25	122.08
Nickel	<5-700	13	19	9.0-509	35.75	56.60

[1]Shacklette and Hansford, "Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States", USGS Professional Paper 1270, 1984.
[2]Bradford et. al, "Background Concentrations of Trace and Major Elements in California Soils", Kearney Foundation Special Report, UC-Riverside and CAL-EPA DTSC, March 1996.

3.3 Screening Sites with Multiple Pollutants

A suggested stepwise approach for PRG-screening of sites with multiple pollutants is as follows:

- Perform an extensive records search and compile existing data.
- Identify site contaminants in the PRG table. Record the PRG concentrations for various media and note whether PRG is based on cancer risk (indicated by "ca") or noncancer hazard (indicated by "nc"). Segregate cancer PRGs from non-cancer PRGs and exclude (but don't eliminate) non-risk based PRGs ("sat" or "max").
- For cancer risk estimates, take the site-specific concentration (maximum or 95 UCL) and divide by the PRG concentrations that are designated for cancer evaluation ("ca"). Multiply this ratio by 10^{-6} to estimate chemical-specific risk for a reasonable maximum exposure (RME). For multiple pollutants, simply add the risk for each chemical:

$$Risk = [(\frac{conc_x}{PRG_x}) + (\frac{conc_y}{PRG_y}) + (\frac{conc_z}{PRG_z})] \times 10^{6}$$

- For non-cancer hazard estimates. Divide the concentration term by its respective non-cancer PRG designated as "nc" and sum the ratios for multiple contaminants. The cumulative ratio represents a non-carcinogenic hazard index (HI). A hazard index of 1 or less is generally considered "safe". A ratio greater than 1 suggests further evaluation. **[Note that carcinogens may also have an associated non-cancer PRG that is not listed in the printed copy of the table sent to folks on the mailing list. To obtain these values, the user should view or download the PRG table at our website and display the appropriate sections.]**

$$Hazard\ Index = [(\frac{conc_x}{PRG_x}) + (\frac{conc_y}{PRG_y}) + (\frac{conc_z}{PRG_z})]$$

For more information on screening site risks, the reader should contact EPA Region 9's Technical Support Team.

3. 4 Potential Problems

As with any risk-based tool, the potential exists for misapplication. In most cases the root cause will be a lack of understanding of the intended use of Region 9 PRGs. In order to prevent misuse of PRGs, the following should be avoided:

- Applying PRGs to a site without adequately developing a conceptual site model that identifies relevant exposure pathways and exposure scenarios,
- Not considering background concentrations when choosing PRGs as cleanup goals,
- Use of PRGs as cleanup levels without the nine-criteria analysis specified in the National Contingency Plan (or, comparable analysis for programs outside of Superfund),
- Use of PRGs as cleanup levels without verifying numbers with a toxicologist or regional risk assessor,

- Use of antiquated PRG tables that have been superseded by more recent publications,
- Not considering the effects of additivity when screening multiple chemicals, and
- Adjusting PRGs upward by factors of 10 or 100 without consulting a toxicologist or regional risk assessor.

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4.0 TECHNICAL SUPPORT DOCUMENTATION

Region 9 PRGs consider human exposure hazards to chemicals from contact with contaminated soils, air, and water. The emphasis of the PRG equations and technical discussion are aimed at developing screening criteria for soils, since this is an area where few standards exist. For air and water, additional reference concentrations or standards are available for many chemicals (e.g. MCLs, non-zero MCLGs, AWQC, and NAAQS) and consequently the discussion of these media are brief.

4.1 Soils - Direct Ingestion

Calculation of risk-based PRGs for direct ingestion of soil is based on methods presented in RAGS HHEM, Part B (USEPA 1991a) and *Soil Screening Guidance* (USEPA 1996a,b). Briefly, these methods backcalculate a soil concentration level from a target risk (for carcinogens) or hazard quotient (for noncarcinogens).

A number of studies have shown that inadvertent ingestion of soil is common among children 6 years old and younger (Calabrese et al. 1989, Davis et al. 1990, Van Wijnen et al. 1990). To take into account the higher soil intake rate for children, two different approaches are used to estimate PRGs, depending on whether the adverse health effect is cancer or some effect other than cancer.

For carcinogens, the method for calculating PRGs uses an age-adjusted soil ingestion factor that takes into account the difference in daily soil ingestion rates, body weights, and exposure duration for children from 1 to 6 years old and others from 7 to 31 years old. This health-protective approach is chosen to take into account the higher daily rates of soil ingestion in children as well as the longer duration of exposure that is anticipated for a long-term resident. For more on this method, see USEPA RAGs Part B (1991a).

For noncarcinogenic concerns, the more protective method of calculating a soil PRG is to evaluate childhood exposures separately from adult exposures. In other words, an age-adjustment factor is not applied as was done for carcinogens. This approach is considered conservative because it combines the higher 6-year exposure for children with chronic toxicity criteria. In their analysis of the method, the Science Advisory Board (SAB) indicated that, for most chemicals, the approach may be overly protective. However, they noted that there are specific instances when the chronic RfD may be based on endpoints of toxicity that are specific to children (e.g. fluoride and nitrates) or when the dose-response is steep (i.e., the dosage difference between the no-observed-adverse-effects level [NOAEL] and an adverse effects level is

small). Thus, for the purposes of screening, EPA Region 9 has adopted this approach for calculating soil PRGs for noncarcinogenic health concerns.

4.2 Soils - Vapor and Particulate Inhalation

Agency toxicity criteria indicate that risks from exposure to some chemicals via inhalation far outweigh the risk via ingestion; therefore soil PRGs have been designed to address this pathway as well. The models used to calculate PRGs for inhalation of volatiles/particulates are updates of risk assessment methods presented in RAGS Part B (USEPA 1991a) and are identical to the *Soil Screening Guidance: User's Guide and Technical Background Document* (USEPA 1996a,b).

To address the soil-to-air pathways the PRG calculations incorporate volatilization factors (VF_s) for volatile contaminants and particulate emission factors (PEF) for nonvolatile contaminants. These factors relate soil contaminant concentrations to air contaminant concentrations that may be inhaled on-site. The VF_s and PEF equations can be broken into two separate models: an emission model to estimate emissions of the contaminant from the soil and a dispersion model to simulate the dispersion of the contaminant in the atmosphere.

It should be noted that the box model in RAGS Part B has been replaced with a dispersion term (Q/C) derived from a modeling exercise using meteorological data from 29 locations across the United States because the box model may not be applicable to a broad range of site types and meteorology and does not utilize state-of-the-art techniques developed for regulatory dispersion modeling. The dispersion model for both volatiles and particulates is the AREA-ST, an updated version of the Office of Air Quality Planning and Standards, Industrial Source Complex Model, ISC2. However, different Q/C terms are used in the VF and PEF equations. Los Angeles was selected as the 90th percentile data set for volatiles and Minneapolis was selected as the 90th percentile data set for fugitive dusts (USEPA 1996 a,b). A default source size of 0.5 acres was chosen for the PRG calculations. This is consistent with the default exposure area over which Region 9 typically averages contaminant concentrations in soils. If unusual site conditions exist such that the area source is substantially larger than the default source size assumed here, an alternative Q/C could be applied (see USEPA 1996a,b).

Volatilization Factor for Soils

Volatile chemicals, defined as those chemicals having a Henry's Law constant greater than
10^{-5} (atm-m^3/mol) and a molecular weight less than 200 g/mole, were screened for inhalation exposures using a volatilization factor for soils (VF_s). Please note that VF_s's are available at our website.

The emission terms used in the VF_s are chemical-specific and were calculated from

physical-chemical information obtained from several sources. The priority of these sources were as follows: *Soil Screening Guidance* (USEPA 1996a,b), *Superfund Chemical Data Matrix* (USEPA 1996c), *Fate and Exposure Data* (Howard 1991), *Subsurface Contamination Reference Guide* (EPA 1990a), and *Superfund Exposure Assessment Manual* (SEAM, EPA 1988). In those cases where Diffusivity Coefficients (Di) were not provided in existing literature, Di's were calculated using Fuller's Method described in SEAM. A surrogate term was required for some chemicals that lacked physico-chemical information. In these cases, a proxy chemical of similar structure was used that may over- or under-estimate the PRG for soils.

Equation 4-9 forms the basis for deriving generic soil PRGs for the inhalation pathway. The following parameters in the standardized equation can be replaced with specific site data to develop a simple site-specific PRG

- Source area
- Average soil moisture content
- Average fraction organic carbon content
- Dry soil bulk density

The basic principle of the VF_s model (Henry's law) is applicable only if the soil contaminant concentration is at or below soil saturation "sat". Above the soil saturation limit, the model cannot predict an accurate VF-based PRG. How these particular cases are handled, depends on whether the contaminant is liquid or solid at ambient soil temperatures (see Section 4.5).

Particulate Emission Factor for Soils

Inhalation of chemicals adsorbed to respirable particles (PM_{10}) were assessed using a default PEF equal to 1.316×10^9 m^3/kg that relates the contaminant concentration in soil with the concentration of respirable particles in the air due to fugitive dust emissions from contaminated soils. The generic PEF was derived using default values in Equation 4-11, which corresponds to a receptor point concentration of approximately 0.76 ug/m^3. The relationship is derived by Cowherd (1985) for a rapid assessment procedure applicable to a typical hazardous waste site where the surface contamination provides a relatively continuous and constant potential for emission over an extended period of time (e.g. years). This represents an annual average emission rate based on wind erosion that should be compared with chronic health criteria; it is not appropriate for evaluating the potential for more acute exposures.

The impact of the PEF on the resultant PRG concentration (that combines soil exposure pathways for ingestion, skin contact, and inhalation) can be assessed by accessing the Region 9 PRG website and viewing the pathway-specific soil concentrations. Equation 4-11 forms the basis for deriving a generic PEF for the inhalation pathway. For more details regarding specific parameters used in the PEF model, the reader is referred to *Soil Screening Guidance: Technical Background Document* (USEPA 1996a).

Note: the generic PEF evaluates windborne emissions and does not consider dust emissions from traffic or other forms of mechanical disturbance that could lead to greater emissions than assumed here.

4.3 Soils - Dermal Exposure

Dermal Contact Assumptions

Since the 1998 PRG table was issued, exposure factors for dermal contact with soil have changed in a few cases (USEPA 1999a). Recommended RME (reasonable maximum exposure) defaults for adult workers' skin surface areas (3300 cm^2/day) and soil adherence factors (0.2 mg/cm^2) now differ from the defaults recommended for adult residents (5700 cm^2/day, 0.07 mg/cm^2) as noted in Exhibit 4-1. This is due to differences in the range of activities experienced by workers versus residents.

Dermal Absorption

Chemical-specific skin absorption values recommended by the Superfund Dermal Workgroup were applied when available. Chemical-specific values are included for the following chemicals: arsenic, cadmium, chlordane, 2,4-D, DDT, lindane, TCDD, PAHs, PCBs, and pentachlorophenols.

The recently issued ARisk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim Guidance" (USEPA 1999a) recommends a default dermal absorption factor for semivolatile organic compounds of 10% as a screening method for the majority of SVOCs without dermal absorption factors. Default dermal absorption values for other chemicals (VOCs and inorganics) are not recommended in the new guidance. Therefore, the assumption of 1% for inorganics and 10% for volatiles is no longer included in the Region 9 PRG table. This change has minimal impact on the final risk-based calculations because human exposure to VOCs and inorganics in soils is generally driven by other pathways of exposure.

4.4 Soils - Migration to Groundwater

The methodology for calculating SSLs for the migration to groundwater was developed to identify chemical concentrations in soil that have the potential to contaminate groundwater. Migration of contaminants from soil to groundwater can be envisioned as a two-stage process: (1) release of contaminant in soil leachate and (2) transport of the contaminant through the underlying soil and aquifer to a receptor well. The SSL methodology considers both of these fate and transport mechanisms.

SSLs are backcalculated from acceptable ground water concentrations (i.e. nonzero MCLGs, MCLs, or risk-based PRGs). First, the acceptable groundwater concentration is multiplied by a dilution factor to obtain a target leachate concentration. For example, if the dilution factor is 10 and the acceptable ground

water concentration is 0.05 mg/L, the target soil leachate concentration would be 0.5 mg/L. The partition equation (presented in the *Soil Screening Guidance* document) is then used to calculate the total soil concentration (i.e. SSL) corresponding to this soil leachate concentration.

The SSL methodology was designed for use during the early stages of a site evaluation when information about subsurface conditions may be limited. Because of this constraint, the methodology is based on conservative, simplifying assumptions about the release and transport of contaminants in the subsurface. For more on SSLs, and how to calculate site-specific SSLs versus generic SSLs presented in the PRG table, the reader is referred to the *Soil Screening Guidance* document (USEPA 1996a,b).

4.5 Soil Saturation Limit

The soil saturation concentration "sat" corresponds to the contaminant concentration in soil at which the absorptive limits of the soil particles, the solubility limits of the soil pore water, and saturation of soil pore air have been reached. Above this concentration, the soil contaminant may be present in free phase, i.e., nonaqueous phase liquids (NAPLs) for contaminants that are liquid at ambient soil temperatures and pure solid phases for compounds that are solid at ambient soil temperatures.

Equation 4-10 is used to calculate "sat" for each volatile contaminant. As an update to RAGS HHEM, Part B (USEPA 1991a), this equation takes into account the amount of contaminant that is in the vapor phase in soil in addition to the amount dissolved in the soil's pore water and sorbed to soil particles.

Chemical-specific "sat" concentrations must be compared with each VF-based PRG because a basic principle of the PRG volatilization model is not applicable when free-phase contaminants are present. How these cases are handled depends on whether the contaminant is liquid or solid at ambient temperatures. Liquid contaminant that have a VF-based PRG that exceeds the "sat" concentration are set equal to "sat" whereas for solids (e.g., PAHs), soil screening decisions are based on the appropriate PRGs for other pathways of concern at the site (e.g., ingestion and dermal contact).

4.6 Ground Water/Surface Water - Ingestion and Inhalation

Calculation of PRGs for ingestion and inhalation of contaminants in domestic water is based on the methodology presented in RAGS HHEM, Part B (USEPA 1991a). Ingestion of drinking water is an appropriate pathway for all chemicals. For the purposes of this guidance, however, inhalation of volatile chemicals from water is considered routinely only for chemicals with a Henry's Law constant of 1×10^{-5} atm-m^3/mole or greater and with a molecular weight of less than 200 g/mole.

For volatile chemicals, an upperbound volatilization constant (VF_w) is used that is based on all uses of household water (e.g showering, laundering, and dish washing). Certain assumptions were made. For example, it is assumed that the volume of water used in a residence for a family of four is 720 L/day, the volume of the dwelling is

150,000 L and the air exchange rate is 0.25 air changes/hour (Andelman in RAGS Part B). Furthermore, it is assumed that the average transfer efficiency weighted by water use is 50 percent (i.e. half of the concentration of each chemical in water will be transferred into air by all water uses). Note: the range of transfer efficiencies extends from 30% for toilets to 90% for dishwashers.

4.7 Default Exposure Factors

Default exposure factors were obtained primarily from RAGS Supplemental Guidance Standard Default *Exposure Factors* (OSWER Directive, 9285.6-03) dated March 25, 1991 and more recent information from U.S. EPA's Office of Solid Waste and Emergency Response, U.S. EPA's Office of Research and Development, and California EPA's Department of Toxic Substances Control (see Exhibit 4-1).

Because contact rates may be different for children and adults, carcinogenic risks during the first 30 years of life were calculated using age-adjusted factors ("adj"). Use of age-adjusted factors are especially important for soil ingestion exposures, which are higher during childhood and decrease with age. However, for purposes of combining exposures across pathways, additional age-adjusted factors are used for inhalation and dermal exposures. These factors approximate the integrated exposure from birth until age 30 combining contact rates, body weights, and exposure durations for two age groups - small children and adults. Age-adjusted factors were obtained from RAGS PART B or developed by analogy (see derivations next page).

For soils only, noncarcinogenic contaminants are evaluated in children separately from adults. No age-adjustment factor is used in this case. The focus on children is considered protective of the higher daily intake rates of soil by children and their lower body weight. For maintaining consistency when evaluating soils, dermal and inhalation exposures are also based on childhood contact rates.

(1) ingestion([mg-yr]/[kg-d]:

$$IFS_{adj} = \frac{ED_c \times IRS_c}{BW_c} + \frac{(ED_r - ED_c) \times IRS_a}{BW_a}$$

(2) skin contact([mg-yr]/[kg-d]:

$$SFS_{adj} = \frac{ED_c \times AF \times SA_c}{BW_c} + \frac{(ED_r - ED_c) \times AF \times SA_a}{BW_a}$$

(3) inhalation ([m^3-yr]/[kg-d]):

$$InhF_{adj} = \frac{ED_c \times IRA_c}{BW_c} + \frac{(ED_r - ED_c) \times IRA_a}{BW_a}$$

EXHIBIT 4-1
STANDARD DEFAULT FACTORS

Symbol	Definition (units)	Default	Reference
CSFo	Cancer slope factor oral (mg/kg-d)-1	--	IRIS, HEAST, or NCEA
CSFi	Cancer slope factor inhaled (mg/kg-d)-1	--	IRIS, HEAST, or NCEA
RfDo	Reference dose oral (mg/kg-d)	--	IRIS, HEAST, or NCEA
RfDi	Reference dose inhaled (mg/kg-d)	--	IRIS, HEAST, or NCEA
TR	Target cancer risk	10^{-6}	--
THQ	Target hazard quotient	1	--
BWa	Body weight, adult (kg)	70	RAGS (Part A), EPA 1989 (EPA/540/1-89/002)
BWc	Body weight, child (kg)	15	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
ATc	Averaging time - carcinogens (days)	25550	RAGS(Part A), EPA 1989 (EPA/540/1-89/002)
ATn	Averaging time - noncarcinogens (days)	ED*365	
SAa	Exposed surface area, adult (cm^2/day)		Dermal Assessment, EPA 1998 (EPA/540/R-99/005)
	- adult resident	5700	
	- adult worker	**3300**	
SAc	Exposed surface area, child (cm^2/day)	2800	Dermal Assessment, EPA 1999 (EPA/540/R-99/005)
AFa	Adherence factor, adult (mg/cm^2)		Dermal Assessment, EPA 1999 (EPA/540/R-99/005)
	- adult resident	**0.07**	
	- adult worker	**0.2**	
AFc	Adherence factor, child (mg/cm^2)	0.2	Dermal Assessment, EPA 1999 (EPA/540/R-99/005)
ABS	Skin absorption (unitless):		
	-- semi-volatile organics	0.1	Dermal Assessment, EPA 1999 (EPA/540/R-99/005)
	-- volatile organics	--	Dermal Assessment, EPA 1999 (EPA/540/R-99/005)
	-- inorganics	--	Dermal Assessment, EPA 1999 (EPA/540/R-99/005)
IRAa	Inhalation rate - adult (m^3/day)	20	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
IRAc	Inhalation rate - child (m3/day)	10	Exposure Factors, EPA 1997 (EPA/600/P-95/002Fa)
IRWa	Drinking water ingestion - adult (L/day)	2	RAGS(Part A), EPA 1989 (EPA/540/1-89/002)
IRWc	Drinking water ingestion - child (L/day)	1	PEA, Cal-EPA (DTSC, 1994)
IRSa	Soil ingestion - adult (mg/day)	100	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
IRSc	Soil ingestion - child (mg/day),	200	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
IRSo	Soil ingestion - occupational (mg/day)	50	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
EFr	Exposure frequency - residential (d/y)	350	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
EFo	Exposure frequency - occupational (d/y)	250	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)

EDr	Exposure duration - residential (years)	30[a]	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
EDc	Exposure duration - child (years)	6	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
EDo	Exposure duration - occupational (years)	25	Exposure Factors, EPA 1991 (OSWER No. 9285.6-03)
	Age-adjusted factors for carcinogens:		
IFSadj	Ingestion factor, soils ([mg-yr]/[kg-d])	114	RAGS(Part B), EPA 1991 (OSWER No. 9285.7-01B)
SFSadj	Dermal factor, soils ([mg-yr]/[kg-d])	**361**	By analogy to RAGS (Part B)
InhFadj	Inhalation factor, air ([m3-yr]/[kg-d])	11	By analogy to RAGS (Part B)
IFWadj	Ingestion factor, water ([l-yr]/[kg-d])	1.1	By analogy to RAGS (Part B)
VFw	Volatilization factor for water (L/m3)	0.5	RAGS(Part B), EPA 1991 (OSWER No. 9285.7-01B)
PEF	Particulate emission factor (m3/kg)	See below	Soil Screening Guidance (EPA 1996a,b)
VFs	Volatilization factor for soil (m3/kg)	See below	Soil Screening Guidance (EPA 1996a,b)
sat	Soil saturation concentration (mg/kg)	See below	Soil Screening Guidance (EPA 1996a,b)

Footnote:

[a]Exposure duration for lifetime residents is assumed to be 30 years total. For carcinogens, exposures are combined for children (6 years) and adults (24 years).

4.8 Standardized Equations

The equations used to calculate the PRGs for carcinogenic and noncarcinogenic contaminants are presented in Equations 4-1 through 4-8. The PRG equations update RAGS Part B equations. The methodology backcalculates a soil, air, or water concentration level from a target risk (for carcinogens) or hazard quotient (for noncarcinogens). For completeness, the soil equations combine risks from ingestion, skin contact, and inhalation simultaneously. Note: the electronic version of the table also includes pathway-specific PRGs, should the user decide against combining specific exposure pathways; or, the user wants to identify the relative contribution of each pathway to exposure.

To calculate PRGs for volatile chemicals in soil, a chemical-specific volatilization factor is calculated per Equation 4-9. Because of its reliance on Henry's law, the VF_s model is applicable only when the contaminant concentration in soil is at or below saturation (i.e. there is no free-phase contaminant present). Soil saturation ("sat") corresponds to the contaminant concentration in soil at which the adsorptive limits of the soil particles and the solubility limits of the available soil moisture have been reached. Above this point, pure liquid-phase contaminant is expected in the soil. If the PRG calculated using VFs was greater than the calculated sat, the PRG was set equal to sat, in accordance with *Soil Screening Guidance* (USEPA 1996 a,b). The equation for deriving sat is presented in Equation 4-10.

PRG EQUATIONS

Soil Equations: For soils, equations were based on three exposure routes (ingestion, skin contact, and inhalation).

Equation 4-1: Combined Exposures to Carcinogenic Contaminants in Residential Soil

$$C(mg/kg) = \frac{TR \times AT_c}{EF_r \left[\left(\frac{IFS_{adj} \times CSF_o}{10^6 mg/kg}\right) + \left(\frac{SFS_{adj} \times ABS \times CSF_o}{10^6 mg/kg}\right) + \left(\frac{InhF_{adj} \times CSF_i}{VF_s^a}\right)\right]}$$

Equation 4-2: Combined Exposures to Noncarcinogenic Contaminants in Residential Soil

$$C(mg/kg) = \frac{THQ \times BW_c \times AT_n}{EF_r \times ED_c \left[\left(\frac{1}{RfD_o} \times \frac{IRS_c}{10^6 mg/kg}\right) + \left(\frac{1}{RfD_o} \times \frac{SA_c \times AF \times ABS}{10^6 mg/kg}\right) + \left(\frac{1}{RfD_i} \times \frac{IRA_c}{VF_s^a}\right)\right]}$$

Equation 4-3: Combined Exposures to Carcinogenic Contaminants in Industrial Soil

$$C(mg/kg) = \frac{TR \times BW_a \times AT_c}{EF_o \times ED_o \left[\left(\frac{IRS_o \times CSF_o}{10^6 mg/kg}\right) + \left(\frac{SA_a \times AF \times ABS \times CSF_o}{10^6 mg/kg}\right) + \left(\frac{IRA_a \times CSF_i}{VF_s^a}\right)\right]}$$

Equation 4-4: Combined Exposures to Noncarcinogenic Contaminants in Industrial Soil

$$C(mg/kg) = \frac{THQ \times BW_a \times AT_n}{EF_o \times ED_o \left[\left(\frac{1}{RfD_o} \times \frac{IRS_o}{10^6 mg/kg}\right) + \left(\frac{1}{RfD_o} \times \frac{SA_a \times AF \times ABS}{10^6 mg/kg}\right) + \left(\frac{1}{RfD_i} \times \frac{IRA_a}{VF_s^a}\right)\right]}$$

Footnote:

[a]Use VF_s for volatile chemicals (defined as having a Henry's Law Constant [atm-m^3/mol] greater than 10^{-5} and a molecular weight less than 200 grams/mol) or PEF for non-volatile chemicals.

Tap Water Equations:

Equation 4-5: Ingestion and Inhalation Exposures to Carcinogenic Contaminants in Water

$$C(ug/L) = \frac{TR \times AT_c \times 1000 ug/mg}{EF_r \left[\left(IFW_{adj} \times CSF_o\right) + \left(VF_w \times InhF_{adj} \times CSF_i\right)\right]}$$

Equation 4-6: Ingestion and Inhalation Exposures to Noncarcinogenic Contaminants in Water

$$C(ug/L) = \frac{THQ \times BW_a \times AT_n \times 1000ug/mg}{EF_r \times ED_r \left[\left(\frac{IRW_a}{RfD_o}\right) + \left(\frac{VF_w \times IRA_a}{RfD_i}\right)\right]}$$

Air Equations:

Equation 4-7: Inhalation Exposures to Carcinogenic Contaminants in Air

$$C(ug/m^3) = \frac{TR \times AT_c \times 1000ug/mg}{EF_r \times InhF_{adj} \times CSF_i}$$

Equation 4-8: Inhalation Exposures to Noncarcinogenic Contaminants in Air

$$C(ug/m^3) = \frac{THQ \times RfD_i \times BW_a \times AT_n \times 1000ug/mg}{EF_r \times ED_r \times IRA_a}$$

SOIL-TO-AIR VOLATILIZATION FACTOR (VF_s)

Equation 4-9: Derivation of the Volatilization Factor

$$VF_s(m^3/kg) = (Q/C) \times \frac{(3.14 \times D_A \times T)^{1/2}}{(2 \times \rho_b \times D_A)} \times 10^{-4}(m^2/cm^2)$$

where:

$$D_A = \frac{[(\Theta_a^{10/3} D_i H' + \Theta_w^{10/3} D_w)/n^2]}{\rho_B K_d + \Theta_w + \Theta_a H'}$$

Parameter	Definition (units)	Default
VF_s	Volatilization factor (m^3/kg)	--
D_A	Apparent diffusivity (cm^2/s)	--
Q/C	Inverse of the mean conc. at the center of a 0.5-acre square source (g/m^2-s per kg/m^3)	68.81
T	Exposure interval (s)	9.5×10^8
rho_b	Dry soil bulk density (g/cm^3)	1.5
$theta_a$	Air filled soil porosity (L_{air}/L_{soil})	0.28 or n- w
n	Total soil porosity (L_{pore}/L_{soil})	0.43 or 1 - (b/ s)
$theta_w$	Water-filled soil porosity (L_{water}/L_{soil})	0.15
rho_s	Soil particle density (g/cm^3)	2.65
Di	Diffusivity in air (cm^2/s)	Chemical-specific
H	Henry's Law constant (atm-m^3/mol)	Chemical-specific
H'	Dimensionless Henry's Law constant	Calculated from H by multiplying by 41 (USEPA 1991a)
D_w	Diffusivity in water (cm^2/s)	Chemical-specific
K_d	Soil-water partition coefficient (cm^3/g) = $K_{oc}f_{oc}$	Chemical-specific
K_{oc}	Soil organic carbon-water partition coefficient (cm^3/g)	Chemical-specific

	(cm^3/g)	
f_{oc}	Fraction organic carbon in soil (g/g)	0.006 (0.6%)

SOIL SATURATION CONCENTRATION (sat)

Equation 4-10: Derivation of the Soil Saturation Limit

$$sat = \frac{S}{\rho_b}\left(K_d \rho_b + \Theta_w + H'\Theta_a\right)$$

Parameter	Definition (units)	Default
sat	Soil saturation concentration (mg/kg)	--
S	Solubility in water (mg/L-water)	Chemical-specific
rho_b	Dry soil bulk density (kg/L)	1.5
n	Total soil porosity (L_{pore}/L_{soil})	0.43 or 1 - (b/ s)
rho_s	Soil particle density (kg/L)	2.65
Kd	Soil-water partition coefficient (L/kg)	K_{oc} x f_{oc} (chemical-specific)
k_{oc}	Soil organic carbon/water partition coefficient (L/kg)	Chemical-specific
f_{oc}	Fraction organic carbon content of soil (g/g)	0.006 or site-specific
$theta_w$	Water-filled soil porosity (L_{water}/L_{soil})	0.15
$theta_a$	Air filled soil porosity (L_{air}/L_{soil})	0.28 or n- w
w	Average soil moisture content (kg_{water}/kg_{soil} or L_{water}/kg_{soil})	0.1
H	Henry's Law constant (atm-m3/mol)	Chemical-specific
H'	Dimensionless Henry's Law constant	H x 41, where 41 is a units conversion factor

SOIL-TO-AIR PARTICULATE EMISSION FACTOR (PEF)

Equation 4-11: Derivation of the Particulate Emission Factor

$$PEF(m^3/kg) = Q/C \times \frac{3600 s/h}{0.036 \times (1-V) \times (U_m/U_t)^3 \times F(x)}$$

Parameter	Definition (units)	Default
PEF	Particulate emission factor (m3/kg)	1. 316 x 10^9
Q/C	Inverse of the mean concentration at the center of a 0.5-acre-square source (g/m2-s per kg/m3)	90.80
V	Fraction of vegetative cover (unitless)	0.5
Um	Mean annual windspeed (m/s)	4.69
Ut	Equivalent threshold value of windspeed at 7 m (m/s)	11.32
F(x)	Function dependent on Um/Ut derived using Cowherd (1985) (unitless)	0.194

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Key : i=IRIS n=NCEA h=HEAST x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where: nc < 100X ca) **(where: nc < 10X ca)

FOR PLANNING PURPOSES

TOXICITY INFORMATION											CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs)								SOIL SCREENING LEVELS	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)		V O C	skin abs. soils	CAS No.		Residential Soil (mg/kg)		Industrial Soil (mg/kg)		Ambient Air (ug/m^3)		Tap Water (ug/l)		Migration to Ground Water DAF 20 (mg/kg)	DAF 1 (mg/kg)
8.7E-03	i	4.0E-03	i	8.7E-03	r	4.0E-03	r	0	0.10	30560-19-1	Acephate	5.6E+01	ca**	2.8E+02	ca*	7.7E-01	ca*	7.7E+00	ca*		
				7.7E-03	i	2.6E-03	i	1		75-07-0	Acetaldehyde	1.1E+01	ca**	2.3E+01	ca**	8.7E-01	ca*	1.7E+00	ca		
		2.0E-02	i			2.0E-02	r	0	0.10	34256-82-1	Acetochlor	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		1.0E-01	i			1.0E-01	r	1		67-64-1	Acetone	1.6E+03	nc	6.2E+03	nc	3.7E+02	nc	6.1E+02	nc	2E+01	8E-01
		8.0E-04	h			8.0E-04	r	0	0.10	75-86-5	Acetone cyanohydrin	4.9E+01	nc	7.0E+02	nc	2.9E+00	nc	2.9E+01	nc		
		6.0E-03	x			**1.7E-02**	i	1		75-05-8	**Acetonitrile**	2.7E+02	nc	1.7E+03	nc	6.2E+01	nc	7.9E+01	nc		
		1.0E-01	i			5.7E-06	x	1		98-86-2	Acetophenone	4.9E-01	nc	1.6E+00	nc	2.1E-02	nc	4.2E-02	nc		
1.1E-01	o	1.3E-02	i	1.1E-01	r	1.3E-02	r	0	0.10	50594-66-6	Acifluorfen	4.4E+00	ca	2.2E+01	ca	6.1E-02	ca	6.1E-01	ca		
		2.0E-02	h			5.7E-06	i	1		107-02-8	Acrolein	1.0E-01	nc	3.4E-01	nc	2.1E-02	nc	4.2E-02	nc		
4.6E+00	i	2.0E-04	i	4.6E+00	i	2.0E-04	r	0	0.10	79-06-1	Acrylamide	1.1E-01	ca	5.4E-01	ca	1.5E-03	ca	1.5E-02	ca		
		5.0E-01	i			2.9E-04	i	0	0.10	79-10-7	Acrylic acid	2.9E+04	nc	1.0E+05	max	1.0E+00	nc	1.8E+04	nc		
5.4E-01	i	1.0E-03	h	2.4E-01	i	5.7E-04	i	1		107-13-1	Acrylonitrile	2.1E-01	ca*	5.1E-01	ca*	2.8E-02	ca*	3.9E-02	ca*		
8.1E-02	h	1.0E-02	i	8.0E-02	r	1.0E-02	r	0	0.10	15972-60-8	Alachlor	6.0E+00	ca	3.1E+01	ca	8.4E-02	ca	8.4E-01	ca		
		1.5E-01	i			1.5E-01	r	0	0.10	1596-84-5	Alar	9.2E+03	nc	1.0E+05	max	5.5E+02	nc	5.5E+03	nc		
		1.0E-03	i			1.0E-03	r	0	0.10	116-06-3	Aldicarb	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
		1.0E-03	i			1.0E-03	r	0	0.10	1646-88-4	Aldicarb sulfone	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
1.7E+01	i	3.0E-05	i	1.7E+01	i	3.0E-05	r	0	0.10	309-00-2	Aldrin	2.9E-02	ca*	1.5E-01	ca	3.9E-04	ca	4.0E-03	ca	1.2E+04	6E+02
		2.5E-01	i			2.5E-01	r	0	0.10	5585-64-8	Ally	1.5E+04	nc	1.0E+05	max	9.1E+02	nc	9.1E+03	nc		
		5.0E-03	i			5.0E-03	r	0	0.10	107-18-6	Allyl alcohol	3.1E+02	nc	4.4E+03	nc	1.8E+01	nc	1.8E+02	nc		
		5.0E-02	h			2.9E-04	i	0	0.10	107-05-1	Allyl chloride	3.0E+03	nc	4.3E+04	nc	1.0E+00	nc	1.8E+03	nc		
		1.0E+00	n			**1.4E-03**	n	0		7429-90-5	**Aluminum**	7.6E+04	nc	1.0E+05	max	5.1E+00	nc	3.6E+04	nc		
		4.0E-04	i					0		20859-73-8	Aluminum phosphide	3.1E+01	nc	8.2E+02	nc			1.5E+01	nc		
		3.0E-04	i			3.0E-04	r	0	0.10	67485-29-4	Amdro	1.8E+01	nc	2.6E+02	nc	1.1E+00	nc	1.1E+01	nc		
		9.0E-03	i			9.0E-03	r	0	0.10	834-12-8	Ametryn	5.5E+02	nc	7.9E+03	nc	3.3E+01	nc	3.3E+02	nc		
		7.0E-02	h			7.0E-02	r	0	0.10	591-27-5	m-Aminophenol	4.3E+03	nc	6.2E+04	nc	2.6E+02	nc	2.6E+03	nc		
		2.0E-05	h			2.0E-05	r	0	0.10	504-24-5	4-Aminopyridine	1.2E+00	nc	1.8E+01	nc	7.3E-02	nc	7.3E-01	nc		
		2.5E-03	i			2.5E-03	r	0	0.10	33089-61-1	Amitraz	1.5E+02	nc	2.2E+03	nc	9.1E+00	nc	9.1E+01	nc		
						2.9E-02	i			7664-41-7	Ammonia					1.0E+02	nc				
		2.0E-01	i					0	0.10	7773-06-0	Ammonium sulfamate	1.2E+04	nc	1.0E+05	max			7.3E+03	nc		
5.7E-03	i	7.0E-03	n	5.7E-03	r	2.9E-04	i	0	0.10	62-53-3	Aniline	8.5E+01	ca**	4.3E+02	ca*	1.0E+00	nc	1.2E+01	ca*		
		4.0E-04	i					0		7440-36-0	Antimony and compounds	3.1E+01	nc	8.2E+02	nc			1.5E+01	nc	5.0E+00	3E-01
		5.0E-04	h					0		1314-60-9	Antimony pentoxide	3.9E+01	nc	1.0E+03	nc			1.8E+01	nc		
		9.0E-04	h					0		28300-74-5	Antimony potassium tartrate	7.0E+01	nc	1.8E+03	nc			3.3E+01	nc		
		4.0E-04	h					0		1332-81-6	Antimony tetroxide	3.1E+01	nc	8.2E+02	nc			1.5E+01	nc		
		4.0E-04	h			**5.7E-05**	i	0		1309-64-4	**Antimony trioxide**	3.1E+01	nc	8.2E+02	nc	2.1E-01	nc	1.5E+01	nc		
		1.3E-02	i			1.3E-02	r	0	0.10	74115-24-5	Apollo	7.9E+02	nc	1.1E+04	nc	4.7E+01	nc	4.7E+02	nc		
2.5E-02	i	5.0E-02	h	2.5E-02	i	5.0E-02	r	0	0.10	140-57-8	Aramite	1.9E+01	ca	9.9E+01	ca	2.7E-01	ca	2.7E+00	ca		
		3.0E-04	i					0	0.03	7440-38-2	Arsenic (noncancer endpoint)	2.2E+01	nc	4.4E+02	nc						
1.5E+00	i	3.0E-04	i	1.5E+01	i			0	0.03	7440-38-2	Arsenic (cancer endpoint)	3.9E-01	ca*	2.7E+00	ca	4.5E-04	ca	4.5E-02	ca	2.9E+01	1E+00
						1.4E-05	i			7784-42-1	Arsine (see arsenic for cancer endpoint)					5.2E-02	nc				
		9.0E-03	i			9.0E-03	r	0	0.10	76578-12-6	Assure	5.5E+02	nc	7.9E+03	nc	3.3E+01	nc	3.3E+02	nc		
		5.0E-02	i			5.0E-02	r	0	0.10	3337-71-1	Asulam	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc		
2.2E-01	h	3.5E-02	h	2.2E-01	r	3.5E-02	r	0	0.10	1912-24-9	Atrazine	2.2E+00	ca	1.1E+01	ca	3.1E-02	ca	3.0E-01	ca		
		4.0E-04	i			4.0E-04	r	0	0.10	71751-41-2	Avermectin B1	2.4E+01	nc	3.5E+02	nc	1.5E+00	nc	1.5E+01	nc		
1.1E-01	i			1.1E-01	i			0	0.10	103-33-3	Azobenzene	4.4E+00	ca	2.2E+01	ca	6.2E-02	ca	6.1E-01	ca		
		7.0E-02	i			1.4E-04	h	0		7440-39-3	Barium and compounds	5.4E+03	nc	1.0E+05	max	5.2E-01	nc	2.6E+03	nc	1.6E+03	8E+01
		4.0E-03	i			4.0E-03	r	0	0.10	114-26-1	Baygon	2.4E+02	nc	3.5E+03	nc	1.5E+01	nc	1.5E+02	nc		
		3.0E-02	i			3.0E-02	r	0	0.10	43121-43-3	Bayleton	1.8E+03	nc	2.6E+04	nc	1.1E+02	nc	1.1E+03	nc		
		2.5E-02	i			2.5E-02	r	0	0.10	68359-37-5	Baythroid	1.5E+03	nc	2.2E+04	nc	9.1E+01	nc	9.1E+02	nc		
		3.0E-01	i			3.0E-01	r	0	0.10	1861-40-1	Benefin	1.8E+04	nc	1.0E+05	max	1.1E+03	nc	1.1E+04	nc		
		5.0E-02	i			5.0E-02	r	0	0.10	17804-35-2	Benomyl	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc		
		3.0E-02	i			3.0E-02	r	0	0.10	25057-89-0	Bentazon	1.8E+03	nc	2.6E+04	nc	1.1E+02	nc	1.1E+03	nc		
		1.0E-01	i			1.0E-01	r	0	0.10	100-52-7	Benzaldehyde	6.1E+03	nc	8.8E+04	nc	3.7E+02	nc	3.6E+03	nc		
2.9E-02	i	3.0E-03	n	2.7E-02	i	1.7E-03	n	1		71-43-2	Benzene	6.7E-01	ca*	1.5E+00	ca*	2.5E-01	ca*	4.1E-01	ca*	3.0E-02	2E-03
2.3E+02	i	3.0E-03	i	2.3E+02	i	3.0E-03	r	0	0.10	92-87-5	Benzidine	2.1E-03	ca	1.1E-02	ca	2.9E-05	ca	2.9E-04	ca		
		4.0E+00	i			4.0E+00	r	0	0.10	65-85-0	Benzoic acid	1.0E+05	max	1.0E+05	max	1.5E+04	nc	1.5E+05	nc	4.0E+02	2E+01

i=IRIS n=NCEA h=HEAST x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where: nc < 100X ca) **(where: nc < 10X ca)

FOR PLANNING PURPOSES

TOXICITY INFORMATION										CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs)								SOIL SCREENING LEVELS	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)		V O C	skin abs. soils	CAS No.		Residential Soil (mg/kg)		Industrial Soil (mg/kg)		Ambient Air (ug/m^3)		Tap Water (ug/l)		Migration to Ground Water DAF 20 (mg/kg)	DAF 1 (mg/kg)
1.3E+01	i			1.3E+01	r			0	0.10	98-07-7	Benzotrichloride	3.7E-02	ca	1.9E-01	ca	5.2E-04	ca	5.2E-03	ca		
		3.0E-01	h			3.0E-01	r	0	0.10	100-51-6	Benzyl alcohol	1.8E+04	nc	1.0E+05	max	1.1E+03	nc	1.1E+04	nc		
1.7E-01	i			1.7E-01	r			1		100-44-7	Benzyl chloride	8.9E-01	ca	2.3E+00	ca	4.0E-02	ca	6.6E-02	ca		
		2.0E-03	i	8.4E+00	i	5.7E-06	i	0		7440-41-7	Beryllium and compounds	1.5E+02	nc	2.2E+03	ca**	8.0E-04	ca*	7.3E+01	nc	6.3E+01	3E+00
		1.0E-04	i			1.0E-04	r	0	0.10	141-66-2	Bidrin	6.1E+00	nc	8.8E+01	nc	3.7E-01	nc	3.6E+00	nc		
		1.5E-02	i			1.5E-02	r	0	0.10	82657-04-3	Biphenthrin (Talstar)	9.2E+02	nc	1.3E+04	nc	5.5E+01	nc	5.5E+02	nc		
		5.0E-02	i			5.0E-02	r	1		92-52-4	1,1-Biphenyl	3.5E+02	sat	3.5E+02	sat	1.8E+02	nc	3.0E+02	nc		
1.1E+00	i			1.2E+00	i			1		111-44-4	Bis(2-chloroethyl)ether	2.1E-01	ca	6.2E-01	ca	5.8E-03	ca	9.8E-03	ca	4.0E-04	2E-05
7.0E-02	h	4.0E-02	i	3.5E-02	h	4.0E-02	r	1		108-60-1	Bis(2-chloroisopropyl)ether	2.9E+00	ca	8.1E+00	ca	1.9E-01	ca	2.7E-01	ca		
2.2E+02	i			2.2E+02	i			1		542-88-1	Bis(chloromethyl)ether	1.9E-04	ca	4.4E-04	ca	3.1E-05	ca	5.2E-05	ca		
7.0E-02	h			3.5E-02	h			0	0.10	108-60-1	Bis(2-chloro-1-methylethyl)ether	6.9E+00	ca	3.5E+01	ca	1.9E-01	ca	9.6E-01	ca		
1.4E-02	i	2.0E-02	i	1.4E-02	r	2.2E-02	r	0	0.10	117-81-7	Bis(2-ethylhexyl)phthalate (DEHP)	3.5E+01	ca*	1.8E+02	ca	4.8E-01	ca	4.8E+00	ca		
		5.0E-02	i			5.0E-02	r	0	0.10	80-05-7	Bisphenol A	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc		
		9.0E-02	i			5.7E-03	h	0	0.10	7440-42-8	Boron	5.5E+03	nc	7.9E+04	nc	2.1E+01	nc	3.3E+03	nc		
						2.0E-04	h	0	0.10	7637-07-2	Boron trifluoride					7.3E-01	nc				
		2.0E-02	n			2.9E-03	n	1		108-86-1	Bromobenzene	2.8E+01	nc	9.2E+01	nc	1.0E+01	nc	2.0E+01	nc		
6.2E-02	i	2.0E-02	i	6.2E-02	r	2.0E-02	r	1		75-27-4	Bromodichloromethane	1.0E+00	ca	2.4E+00	ca	1.1E-01	ca	1.8E-01	ca	6E-01	3E-02
7.9E-03	i	2.0E-02	i	3.9E-03	i	2.0E-02	r	0	0.10	75-25-2	Bromoform (tribromomethane)	6.2E+01	ca*	3.1E+02	ca*	1.7E+00	ca*	8.5E+00	ca*	8E-01	4E-02
		1.4E-03	i			1.4E-03	i	1		74-83-9	Bromomethane (Methyl bromide)	3.9E+00	nc	1.3E+01	nc	5.2E+00	nc	8.7E+00	nc	2E-01	1E-02
								0	0.10	101-55-3	4-Bromophenyl phenyl ether										
		5.0E-03	h			5.0E-03	r	0	0.10	2104-96-3	Bromophos	3.1E+02	nc	4.4E+03	nc	1.8E+01	nc	1.8E+02	nc		
		2.0E-02	i			2.0E-02	r	0	0.10	1689-84-5	Bromoxynil	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		2.0E-02	i			2.0E-02	r	0	0.10	1689-99-2	Bromoxynil octanoate	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
1.8E+00	r			1.8E+00	i			1		106-99-0	1,3-Butadiene	3.5E-03	ca	7.6E-03	ca	3.7E-03	ca	6.2E-03	ca		
		1.0E-01	i			1.0E-01	r	0	0.10	71-36-3	1-Butanol	6.1E+03	nc	8.8E+04	nc	3.7E+02	nc	3.6E+03	nc	2E+01	9E-01
		5.0E-02	i			5.0E-02	r	0	0.10	2008-41-5	Butylate	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc		
		1.0E-02	n			1.0E-02	r	1		104-51-8	n-Butylbenzene	1.4E+02	nc	2.4E+02	sat	3.7E+01	nc	6.1E+01	nc		
		1.0E-02	n			1.0E-02	r	1		135-9-88	sec-Butylbenzene	1.1E+02	nc	2.2E+02	sat	3.7E+01	nc	6.1E+01	nc		
		1.0E-02	n			1.0E-02	r	1		98-06-6	tert-Butylbenzene	1.3E+02	nc	3.9E+02	sat	3.7E+01	nc	6.1E+01	nc		
		2.0E-01	i			2.0E-01	r	0	0.10	85-68-7	Butyl benzyl phthalate	1.2E+04	nc	1.0E+05	max	7.3E+02	nc	7.3E+03	nc	9E+02	8E+02
		1.0E+00	i			1.0E+00	r	0	0.10	85-70-1	Butylphthalyl butylglycolate	6.1E+04	nc	1.0E+05	max	3.7E+03	nc	3.6E+04	nc		
		3.0E-03	h			3.0E-03	r	0	0.10	75-60-5	Cacodylic acid	1.8E+02	nc	2.6E+03	nc	1.1E+01	nc	1.1E+02	nc		
		5.0E-04	i	6.3E+00	i			0	0.001	7440-43-9	Cadmium and compounds	3.7E+01	nc	8.1E+02	nc	1.1E-03	ca	1.8E+01	nc	8E+00	4E-01
											"CAL-Modified PRG" (PEA, 1994)	9.0E+00									
		5.0E-01	i			5.0E-01	r	0	0.10	105-60-2	Caprolactam	3.1E+04	nc	1.0E+05	max	1.8E+03	nc	1.8E+04	nc		
8.6E-03	h	2.0E-03	i	8.6E-03	r	2.0E-03	r	0	0.10	2425-06-1	Captafol	5.7E+01	ca**	2.9E+02	ca**	7.8E-01	ca**	7.8E+00	ca**		
3.5E-03	h	1.3E-01	i	3.5E-03	r	1.3E-01	r	0	0.10	133-06-2	Captan	1.4E+02	ca*	7.0E+02	ca	1.9E+00	ca	1.9E+01	ca		
		1.0E-01	i			1.1E-01	r	0	0.10	63-25-2	Carbaryl	6.1E+03	nc	8.8E+04	nc	4.0E+02	nc	3.6E+03	nc		
2.0E-02	h			2.0E-02	r			0	0.10	86-74-8	Carbazole	2.4E+01	ca	1.2E+02	ca	3.4E-01	ca	3.4E+00	ca	6E-01	3E-02
		5.0E-03	i			5.0E-03	r	0	0.10	1563-66-2	Carbofuran	3.1E+02	nc	4.4E+03	nc	1.8E+01	nc	1.8E+02	nc		
		1.0E-01	i			2.0E-01	i	1		75-15-0	Carbon disulfide	3.6E+02	nc	7.2E+02	sat	7.3E+02	nc	1.0E+03	nc	3E+01	2E+00
1.3E-01	i	7.0E-04	i	5.3E-02	i	7.0E-04	r	1		56-23-5	Carbon tetrachloride	2.4E-01	ca**	5.3E-01	ca*	1.3E-01	ca*	1.7E-01	ca*	7E-02	3E-03
		1.0E-02	i			1.0E-02	r	0	0.10	55285-14-8	Carbosulfan	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
		1.0E-01	i			1.0E-01	r	0	0.10	5234-68-4	Carboxin	6.1E+03	nc	8.8E+04	nc	3.7E+02	nc	3.6E+03	nc		
		2.0E-03	i			2.0E-03	r	0	0.10	302-17-0	Chloral	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
		1.5E-02	i			1.5E-02	r	0	0.10	133-90-4	Chloramben	9.2E+02	nc	1.3E+04	nc	5.5E+01	nc	5.5E+02	nc		
4.0E-01	h			4.0E-01	r			0	0.10	118-75-2	Chloranil	1.2E+00	ca	6.1E+00	ca	1.7E-02	ca	1.7E-01	ca		
3.5E-01	i	5.0E-04	i	3.5E-01	i	**2.0E-04**	i	0	0.04	12789-03-6	**Chlordane**	1.6E+00	ca*	1.1E+01	ca*	1.9E-02	ca*	1.9E-01	ca*	1E+01	5E-01
		2.0E-02	i			2.0E-02	r	0	0.10	90982-32-4	Chlorimuron-ethyl	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		1.0E-01	i							7782-50-5	Chlorine							3.6E+03	nc		
						5.7E-05	i			10049-04-4	Chlorine dioxide					2.1E-01	nc				
								1		107-20-0	Chloroacetaldehyde										
		2.0E-03	h			2.0E-03	r	0	0.10	79-11-8	Chloroacetic acid	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
		8.6E-06	r			8.6E-06	i	1		532-27-4	2-Chloroacetophenone	3.3E-02	nc	1.1E-01	nc	3.1E-02	nc	5.2E-02	nc		
		4.0E-03	i			4.0E-03	r	0	0.10	106-47-8	4-Chloroaniline	2.4E+02	nc	3.5E+03	nc	1.5E+01	nc	1.5E+02	nc	7E-01	3E-02
		2.0E-02	i			**1.7E-02**	n	1		108-90-7	**Chlorobenzene**	1.5E+02	nc	5.4E+02	nc	6.2E+01	nc	1.1E+02	nc	1E+00	7E-02

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FOR PLANNING PURPOSES

TOXICITY INFORMATION											CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs)								SOIL SCREENING LEVELS	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)		V O C	skin abs. soils	CAS No.		Residential Soil (mg/kg)		Industrial Soil (mg/kg)		Ambient Air (ug/m^3)		Tap Water (ug/l)		Migration to Ground Water DAF 20 (mg/kg)	DAF 1 (mg/kg)
2.7E-01	h	2.0E-02	i	2.7E-01	h	2.0E-02	r	0	0.10	510-15-6	Chlorobenzilate	1.8E+00	ca	9.1E+00	ca	2.5E-02	ca	2.5E-01	ca		
		2.0E-01	h			2.0E-01	r	0	0.10	74-11-3	p-Chlorobenzoic acid	1.2E+04	nc	1.0E+05	max	7.3E+02	nc	7.3E+03	nc		
		2.0E-02	h			2.0E-02	r	0	0.10	98-56-6	4-Chlorobenzotrifluoride	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		2.0E-02	h			2.0E-03	h	1		126-99-8	2-Chloro-1,3-butadiene	3.6E+00	nc	1.2E+01	nc	7.3E+00	nc	1.4E+01	nc		
		4.0E-01	h			4.0E-01	r	1		109-69-3	1-Chlorobutane	4.8E+02	sat	4.8E+02	sat	1.5E+03	nc	2.4E+03	nc		
		1.4E+01	r			1.4E+01	i	1		75-68-3	1-Chloro-1,1-difluoroethane (HCFC-142b)	3.4E+02	sat	3.4E+02	sat	5.2E+04	nc	8.7E+04	nc		
		1.4E+01	r			1.4E+01	i	1		75-45-6	Chlorodifluoromethane	3.4E+02	sat	3.4E+02	sat	5.1E+04	nc	8.5E+04	nc		
2.9E-03	n	4.0E-01	n	**2.9E-03**	r	2.9E+00	i	1		75-00-3	**Chloroethane**	3.0E+00	ca	6.5E+00	ca	2.3E+00	ca	4.6E+00	ca		
								1		110-75-8	2-Chloroethyl vinyl ether										
6.1E-03	i	1.0E-02	i	8.1E-02	i	**8.6E-05**	n	1		67-66-3	**Chloroform**	2.4E-01	ca**	5.2E-01	ca**	8.4E-02	ca**	1.6E-01	ca**	6E-01	3E-02
1.3E-02	h			6.3E-03	h	**8.6E-02**	n	1		74-87-3	**Chloromethane**	1.2E+00	ca	2.7E+00	ca	1.1E+00	ca	1.5E+00	ca		
5.8E-01	h			5.8E-01	r			0	0.10	95-69-2	4-Chloro-2-methylaniline	8.4E-01	ca	4.3E+00	ca	1.2E-02	ca	1.2E-01	ca		
4.6E-01	h			4.6E-01	r			0	0.10	3165-93-3	4-Chloro-2-methylaniline hydrochloride	1.1E+00	ca	5.4E+00	ca	1.5E-02	ca	1.5E-01	ca		
		8.0E-02	i			8.0E-02	r	1		91-58-7	beta-Chloronaphthalene	4.9E+03	nc	2.7E+04	nc	2.9E+02	nc	4.9E+02	nc		
2.5E-02	h			2.5E-02	r			r	1	88-73-3	**o-Chloronitrobenzene**	8.1E+00	ca	2.3E+01	ca	2.7E-01	ca	4.5E-01	ca		
1.8E-02	h			1.8E-02	r			r	1	100-00-5	**p-Chloronitrobenzene**	1.1E+01	ca	3.2E+01	ca	3.7E-01	ca	6.2E-01	ca		
		5.0E-03	i			5.0E-03	r	1		95-57-8	2-Chlorophenol	6.3E+01	nc	2.4E+02	nc	1.8E+01	nc	3.0E+01	nc	4E+00	2E-01
		2.9E-02	r			2.9E-02	h	1		75-29-6	2-Chloropropane	1.7E+02	nc	5.9E+02	nc	1.0E+02	nc	1.7E+02	nc		
1.1E-02	h	1.5E-02	i	1.1E-02	r	1.5E-02	r	0	0.10	1897-45-6	Chlorothalonil	4.4E+01	ca*	2.2E+02	ca*	6.1E-01	ca*	6.1E+00	ca*		
		2.0E-02	i			2.0E-02	r	1		95-49-8	o-Chlorotoluene	1.6E+02	nc	5.7E+02	nc	7.3E+01	nc	1.2E+02	nc		
		2.0E-01	i			2.0E-01	r	0	0.10	101-21-3	Chlorpropham	1.2E+04	nc	1.0E+05	max	7.3E+02	nc	7.3E+03	nc		
		3.0E-03	i			3.0E-03	r	0	0.10	2921-88-2	Chlorpyrifos	1.8E+02	nc	2.6E+03	nc	1.1E+01	nc	1.1E+02	nc		
		1.0E-02	h			1.0E-02	r	0	0.10	5598-13-0	Chlorpyrifos-methyl	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
		5.0E-02	i			5.0E-02	r	0	0.10	64902-72-3	Chlorsulfuron	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc		
		8.0E-04	h			8.0E-04	r	0	0.10	60238-56-4	Chlorthiophos	4.9E+01	nc	7.0E+02	nc	2.9E+00	nc	2.9E+01	nc		
				4.2E+01	i			0			Total Chromium (1:6 ratio Cr VI:Cr III)	2.1E+02	ca	4.5E+02	ca	1.6E-04	ca			4E+01	2E+00
		1.5E+00	i							16065-83-1	Chromium III	1.0E+05	max	1.0E+05	max			5.5E+04	nc		
		3.0E-03	i	2.9E+02	i			0		18540-29-9	**Chromium VI**	3.0E+01	ca**	6.4E+01	ca	2.3E-05	ca	1.1E+02	nc	4E+01	2E+00
											"CAL-Modified PRG" (PEA, 1994)	2.0E-01						2E-01			
		6.0E-02	n							7440-48-4	Cobalt	4.7E+03	nc	1.0E+05	max			2.2E+03	nc		
				2.2E+00	i			0		8007-45-2	Coke Oven Emissions					3.1E-03	ca				
		3.7E-02	h					0		7440-50-8	Copper and compounds	2.9E+03	nc	7.6E+04	nc			1.4E+03	nc		
1.9E+00	h			1.9E+00	r			1		123-73-9	Crotonaldehyde	5.3E-03	ca	1.1E-02	ca	3.5E-03	ca	5.9E-03	ca		
		1.0E-01	i			1.1E-01	i	1		98-82-8	Cumene (isopropylbenzene)	1.6E+02	nc	5.2E+02	nc	4.0E+02	nc	6.6E+02	nc		
8.4E-01	h	2.0E-03	h	8.4E-01	r	2.0E-03	r	0	0.10	21725-46-2	Cyanazine	5.8E-01	ca	2.9E+00	ca	8.0E-03	ca	8.0E-02	ca		
										n/a	Cyanides										
		1.0E-01	h					0	0.10	542-62-1	Barium cyanide	6.1E+03	nc	1.0E+05	max			3.6E+03	nc		
		4.0E-02	i					0	0.10	592-01-8	Calcium cyanide	2.4E+03	nc	3.5E+04	nc			1.5E+03	nc		
		5.0E-03	i					0	0.10	544-92-3	Copper cyanide	3.1E+02	nc	4.4E+03	nc			1.8E+02	nc		
		2.0E-02	i					0	0.10	57-12-5	Free cyanide	1.2E+03	nc	1.8E+04	nc			7.3E+02	nc	4E+01	2E+00
		2.0E-02	i			8.6E-04	i	1		74-90-8	Hydrogen cyanide	1.1E+01	nc	3.5E+01	nc	3.1E+00	nc	6.2E+00	nc		
		5.0E-02	i					0	0.10	151-50-8	Potassium cyanide	3.1E+03	nc	4.4E+04	nc			1.8E+03	nc		
		2.0E-01	i					0	0.10	506-61-6	Potassium silver cyanide	1.2E+04	nc	1.0E+05	max			7.3E+03	nc		
		1.0E-01	i					0	0.10	506-64-9	Silver cyanide	6.1E+03	nc	8.8E+04	nc			3.6E+03	nc		
		4.0E-02	i					0	0.10	143-33-9	Sodium cyanide	2.4E+03	nc	3.5E+04	nc			1.5E+03	nc		
		5.0E-02	i					0	0.10	557-21-1	Zinc cyanide	3.1E+03	nc	4.4E+04	nc			1.8E+03	nc		
		4.0E-02	i			4.0E-02	r	1		460-19-5	**Cyanogen**	1.3E+02	nc	4.3E+02	nc	1.5E+02	nc	2.4E+02	nc		
		9.0E-02	i			9.0E-02	r	1		506-68-3	**Cyanogen bromide**	2.9E+02	nc	9.7E+02	nc	3.3E+02	nc	5.5E+02	nc		
		5.0E-02	i			5.0E-02	r	1		506-77-4	**Cyanogen chloride**	1.6E+02	nc	5.4E+02	nc	1.8E+02	nc	3.0E+02	nc		
		5.0E+00	i			5.0E+00	r	0	0.10	108-94-1	Cyclohexanone	1.0E+05	max	1.0E+05	max	1.8E+04	nc	1.8E+05	nc		
		2.0E-01	i			2.0E-01	r	0	0.10	108-91-8	Cyclohexylamine	1.2E+04	nc	1.0E+05	max	7.3E+02	nc	7.3E+03	nc		
		5.0E-03	i			5.0E-03	r	0	0.10	68085-85-8	Cyhalothrin/Karate	3.1E+02	nc	4.4E+03	nc	1.8E+01	nc	1.8E+02	nc		
		1.0E-02	i			1.0E-02	r	0	0.10	52315-07-8	Cypermethrin	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
		7.5E-03	i			7.5E-03	r	0	0.10	66215-27-8	Cyromazine	4.6E+02	nc	6.6E+03	nc	2.7E+01	nc	2.7E+02	nc		
		1.0E-02	i			1.0E-02	r	0	0.10	1861-32-1	Dacthal	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
		3.0E-02	i			3.0E-02	r	0	0.10	75-99-0	Dalapon	1.8E+03	nc	2.6E+04	nc	1.1E+02	nc	1.1E+03	nc		

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FOR PLANNING PURPOSES

TOXICITY INFORMATION											CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs)								SOIL SCREENING LEVELS	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)		V O C	skin abs. soils	CAS No.		Residential Soil (mg/kg)		Industrial Soil (mg/kg)		Ambient Air (ug/m^3)		Tap Water (ug/l)		Migration to Ground Water DAF 20 (mg/kg)	DAF 1 (mg/kg)
		2.5E-02	i			2.5E-02	r	0	0.10	39515-41-8	Danitol	1.5E+03	nc	2.2E+04	nc	9.1E+01	nc	9.1E+02	nc		
2.4E-01	i			2.4E-01	r			0	0.03	72-54-8	DDD	2.4E+00	ca	1.7E+01	ca	2.8E-02	ca	2.8E-01	ca	2E+01	8E-01
3.4E-01	i			3.4E-01	r			0	0.03	72-55-9	DDE	1.7E+00	ca	1.2E+01	ca	2.0E-02	ca	2.0E-01	ca	5E+01	3E+00
3.4E-01	i	5.0E-04	i	3.4E-01	i	5.0E-04	r	0	0.03	50-29-3	DDT	1.7E+00	ca*	1.2E+01	ca*	2.0E-02	ca*	2.0E-01	ca*	3E+01	2E+00
		1.0E-02	i			1.0E-02	r	0	0.10	1163-19-5	Decabromodiphenyl ether	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
		4.0E-05	i			4.0E-05	r	0	0.10	8065-48-3	Demeton	2.4E+00	nc	3.5E+01	nc	1.5E-01	nc	1.5E+00	nc		
6.1E-02	h			6.1E-02	r			0	0.10	2303-16-4	Diallate	8.0E+00	ca	4.0E+01	ca	1.1E-01	ca	1.1E+00	ca		
		9.0E-04	h			9.0E-04	r	0	0.10	333-41-5	Diazinon	5.5E+01	nc	7.9E+02	nc	3.3E+00	nc	3.3E+01	nc		
		4.0E-03	x			4.0E-03	r	1		132-64-9	Dibenzofuran	2.9E+02	nc	5.1E+03	nc	1.5E+01	nc	2.4E+01	nc		
		1.0E-02	i			1.0E-02	r	0	0.10	106-37-6	1,4-Dibromobenzene	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
8.4E-02	i	2.0E-02	i	8.4E-02	r	2.0E-02	r	1		124-48-1	**Dibromochloromethane**	1.1E+00	ca	2.7E+00	ca	8.0E-02	ca	1.3E-01	ca	4E-01	2E-02
1.4E+00	h	5.7E-05	r	2.4E-03	h	5.7E-05	i	1		96-12-8	**1,2-Dibromo-3-chloropropane**	4.5E-01	ca**	4.0E+00	ca**	2.1E-01	nc	4.8E-02	ca**		
											"CAL-Modified PRG" (PEA, 1994)	6.0E-02				9.6E-04		4.7E-03			
8.5E+01	i	5.7E-05	r	7.7E-01	i	5.7E-05	h	1		106-93-4	1,2-Dibromoethane	6.9E-03	ca	4.8E-02	ca*	8.7E-03	ca*	7.6E-04	ca		
		1.0E-01	i			1.0E-01	r	0	0.10	84-74-2	Dibutyl phthalate	6.1E+03	nc	8.8E+04	nc	3.7E+02	nc	3.6E+03	nc	2E+03	3E+02
		3.0E-02	i			3.0E-02	r	0	0.10	1918-00-9	Dicamba	1.8E+03	nc	2.6E+04	nc	1.1E+02	nc	1.1E+03	nc		
		9.0E-02	i			5.7E-02	h	1		95-50-1	1,2-Dichlorobenzene	3.7E+02	sat	3.7E+02	sat	2.1E+02	nc	3.7E+02	nc	2E+01	9E-01
		9.00E-04	n			**9.00E-04**	r	1		541-73-1	**1,3-Dichlorobenzene**	1.3E+01	nc	5.2E+01	nc	3.3E+00	nc	5.5E+00	nc		
2.4E-02	h	**3.00E-02**	n	2.2E-02	n	3.00E-02	i	1		106-46-7	**1,4-Dichlorobenzene**	3.4E+00	ca	8.1E+00	ca	3.1E-01	ca	5.0E-01	ca	2E+00	1E-01
4.5E-01	i			4.5E-01	r			0	0.10	91-94-1	3,3-Dichlorobenzidine	1.1E+00	ca	5.5E+00	ca	1.5E-02	ca	1.5E-01	ca	7E-03	3E-04
9.3E+00	r			9.3E+00	h			1		764-41-0	1,4-Dichloro-2-butene	7.9E-03	ca	1.8E-02	ca	7.2E-04	ca	1.2E-03	ca		
		2.0E-01	i			5.7E-02	h	1		75-71-8	Dichlorodifluoromethane	9.4E+01	nc	3.1E+02	nc	2.1E+02	nc	3.9E+02	nc		
		1.0E-01	h			1.4E-01	h	1		75-34-3	1,1-Dichloroethane	5.9E+02	nc	2.1E+03	nc	5.2E+02	nc	8.1E+02	nc	2E+01	1E+00
9.1E-02	i	3.0E-02	n	9.1E-02	i	1.4E-03	n	1		107-06-2	1,2-Dichloroethane (EDC)	3.5E-01	ca*	7.6E-01	ca*	7.4E-02	ca*	1.2E-01	ca*	2E-02	1E-03
6.0E-01	i	9.0E-03	i	1.8E-01	i	9.0E-03	r	1		75-35-4	1,1-Dichloroethylene	5.4E-02	ca	1.2E-01	ca	3.8E-02	ca	4.6E-02	ca	6E-02	3E-03
		1.0E-02	h			1.0E-02	r	1		156-59-2	1,2-Dichloroethylene (cis)	4.3E+01	nc	1.5E+02	nc	3.7E+01	nc	6.1E+01	nc	4E-01	2E-02
		2.0E-02	i			2.0E-02	r	1		156-60-5	1,2-Dichloroethylene (trans)	6.3E+01	nc	2.1E+02	nc	7.3E+01	nc	1.2E+02	nc	7E-01	3E-02
		3.0E-03	i			3.0E-03	r	0	0.10	120-83-2	2,4-Dichlorophenol	1.8E+02	nc	2.6E+03	nc	1.1E+01	nc	1.1E+02	nc	1E+00	5E-02
		8.0E-03	i			8.0E-03	r	0	0.10	94-82-6	4-(2,4-Dichlorophenoxy)butyric Acid (2,4-DB)	4.9E+02	nc	7.0E+03	nc	2.9E+01	nc	2.9E+02	nc		
		1.0E-02	i			1.0E-02	r	0	0.05	94-75-7	2,4-Dichlorophenoxyacetic Acid (2,4-D)	6.9E+02	nc	1.2E+04	nc	3.7E+01	nc	3.6E+02	nc		
6.8E-02	h	1.1E-03	r	6.8E-02	r	1.1E-03	i	1		78-87-5	1,2-Dichloropropane	3.5E-01	ca*	7.7E-01	ca*	9.9E-02	ca*	1.6E-01	ca*	3E-02	1E-03
1.8E-01	h	3.0E-04	i	1.3E-01	h	5.7E-03	i	1		542-75-6	1,3-Dichloropropene	8.2E-02	ca	1.8E-01	ca	5.2E-02	ca	8.1E-02	ca	4E-03	2E-04
		3.0E-03	i			3.0E-03	r	0	0.10	616-23-9	2,3-Dichloropropanol	1.8E+02	nc	2.6E+03	nc	1.1E+01	nc	1.1E+02	nc		
2.9E-01	i	5.0E-04	i	2.9E-01	r	1.4E-04	i	0	0.10	62-73-7	Dichlorvos	1.7E+00	ca*	8.5E+00	ca*	2.3E-02	ca*	2.3E-01	ca*		
4.4E-01	x			4.4E-01	r			0	0.10	115-32-2	Dicofol	1.1E+00	ca	5.6E+00	ca	1.5E-02	ca	1.5E-01	ca		
		3.0E-02	h			5.7E-05	h	1		77-73-6	Dicyclopentadiene	5.4E-01	nc	1.8E+00	nc	2.1E-01	nc	4.2E-01	nc		
1.6E+01	i	5.0E-05	i	1.6E+01	i	5.0E-05	r	0	0.10	60-57-1	Dieldrin	3.0E-02	ca	1.5E-01	ca	4.2E-04	ca	4.2E-03	ca	4E-03	2E-04
		5.7E-03	r			5.7E-03	h	0	0.10	112-34-5	Diethylene glycol, monobutyl ether	3.5E+02	nc	5.0E+03	nc	2.1E+01	nc	2.1E+02	nc		
		2.0E+00	h			2.0E+00	r	0	0.10	111-90-0	Diethylene glycol, monoethyl ether	1.0E+05	max	1.0E+05	max	7.3E+03	nc	7.3E+04	nc		
		1.1E-02	h			1.1E-02	r	0	0.10	617-84-5	Diethylformamide	6.7E+02	nc	9.7E+03	nc	4.0E+01	nc	4.0E+02	nc		
1.2E-03	i	6.0E-01	i	1.2E-03	r	6.0E-01	r	0	0.10	103-23-1	Di(2-ethylhexyl)adipate	4.1E+02	ca	2.1E+03	ca	5.6E+00	ca	5.6E+01	ca		
		8.0E-01	i			8.0E-01	r	0	0.10	84-66-2	Diethyl phthalate	4.9E+04	nc	1.0E+05	max	2.9E+03	nc	2.9E+04	nc		
4.7E+03	h			4.7E+03	r			0	0.10	56-53-1	Diethylstilbestrol	1.0E-04	ca	5.2E-04	ca	1.4E-06	ca	1.4E-05	ca		
		8.0E-02	i			8.0E-02	r	0	0.10	43222-48-6	Difenzoquat (Avenge)	4.9E+03	nc	7.0E+04	nc	2.9E+02	nc	2.9E+03	nc		
		2.0E-02	i			2.0E-02	r	0	0.10	35367-38-5	Diflubenzuron	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		1.1E+01	r			1.1E+01	i	1		75-37-6	1,1-Difluoroethane					4.2E+04	nc	6.9E+04	nc		
		8.0E-02	i			8.0E-02	r	0	0.10	1445-75-6	Diisopropyl methylphosphonate	4.9E+03	nc	7.0E+04	nc	2.9E+02	nc	2.9E+03	nc		
		2.0E-02	i			2.0E-02	r	0	0.10	55290-64-7	Dimethipin	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		2.0E-04	i			2.0E-04	r	0	0.10	60-51-5	Dimethoate	1.2E+01	nc	1.8E+02	nc	7.3E-01	nc	7.3E+00	nc		
1.4E-02	h			1.4E-02	r			0	0.10	119-90-4	3,3'-Dimethoxybenzidine	3.5E+01	ca	1.8E+02	ca	4.8E-01	ca	4.8E+00	ca		
		5.7E-06	r			5.7E-06	x	1		124-40-3	Dimethylamine	6.7E-02	nc	2.5E-01	nc	2.1E-02	nc	3.5E-02	nc		
		2.0E-03	i			2.0E-03	r	0	0.10	121-69-7	N-N-Dimethylaniline	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
7.5E-01	h			7.5E-01	r			0	0.10	95-68-1	2,4-Dimethylaniline	6.5E-01	ca	3.3E+00	ca	9.0E-03	ca	9.0E-02	ca		
5.8E-01	h			5.8E-01	r			0	0.10	21436-96-4	2,4-Dimethylaniline hydrochloride	8.4E-01	ca	4.3E+00	ca	1.2E-02	ca	1.2E-01	ca		
9.2E+00	h			9.2E+00	r			0	0.10	119-93-7	3,3'-Dimethylbenzidine	5.3E-02	ca	2.7E-01	ca	7.3E-04	ca	7.3E-03	ca		
2.6E+00	x			3.5E+00	x			0	0.10	57-14-7	1,1-Dimethylhydrazine	1.9E-01	ca	9.5E-01	ca	1.9E-03	ca	2.6E-02	ca		

Key: i=IRIS n=NCEA h=HEAST x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where: nc < 100X ca) **(where: nc < 10X ca)

FOR PLANNING PURPOSES

TOXICITY INFORMATION										CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs)								SOIL SCREENING LEVELS	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)		V O C	skin abs. soils	CAS No.		Residential Soil (mg/kg)		Industrial Soil (mg/kg)		Ambient Air (ug/m^3)		Tap Water (ug/l)		Migration to Ground Water DAF 20 (mg/kg)	DAF 1 (mg/kg)
3.7E+01	x			3.7E+01	x			0	0.10	540-73-8	1,2-Dimethylhydrazine	1.3E-02	ca	6.7E-02	ca	1.8E-04	ca	1.8E-03	ca		
		1.0E-01	h			8.6E-03	i	0	0.10	68-12-2	N,N-Dimethylformamide	6.1E+03	nc	8.8E+04	nc	3.1E+01	nc	3.6E+03	nc		
		1.0E-03	n			1.0E-03	r	0	0.10	122-09-8	Dimethylphenethylamine	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
		2.0E-02	i			2.0E-02	r	0	0.10	105-67-9	2,4-Dimethylphenol	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc	9E+00	4E-01
		6.0E-04	i			6.0E-04	r	0	0.10	576-26-1	2,6-Dimethylphenol	3.7E+01	nc	5.3E+02	nc	2.2E+00	nc	2.2E+01	nc		
		1.0E-03	i			1.0E-03	r	0	0.10	95-65-8	3,4-Dimethylphenol	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
		1.0E+01	h			1.0E+01	r	0	0.10	131-11-3	Dimethyl phthalate	1.0E+05	max	1.0E+05	max	3.7E+04	nc	3.6E+05	nc		
		1.0E-01	i			1.0E-01	r	0	0.10	120-61-6	Dimethyl terephthalate	6.1E+03	nc	8.8E+04	nc	3.7E+02	nc	3.6E+03	nc		
		2.0E-03	i			2.0E-03	r	0	0.10	131-89-5	4,6-Dinitro-o-cyclohexyl phenol	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
		4.0E-04	h			4.0E-04	r	0	0.10	528-29-0	1,2-Dinitrobenzene	2.4E+01	nc	3.5E+02	nc	1.5E+00	nc	1.5E+01	nc		
		1.0E-04	i			1.0E-04	r	0	0.10	99-65-0	1,3-Dinitrobenzene	6.1E+00	nc	8.8E+01	nc	3.7E-01	nc	3.6E+00	nc		
		4.0E-04	h			4.0E-04	r	0	0.10	100-25-4	1,4-Dinitrobenzene	2.4E+01	nc	3.5E+02	nc	1.5E+00	nc	1.5E+01	nc		
		2.0E-03	i			2.0E-03	r	0	0.10	51-28-5	2,4-Dinitrophenol	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc	3E-01	1E-02
6.8E-01	i			6.8E-01	r			0	0.10	25321-14-6	Dinitrotoluene mixture	7.2E-01	ca	3.6E+00	ca	9.9E-03	ca	9.9E-02	ca	8E-04	4E-05
		2.0E-03	i			2.0E-03	r	0	0.10	121-14-2	2,4-Dinitrotoluene (also see Dinitrotoluene mixture)	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc	8E-04	4E-05
		1.0E-03	h			1.0E-03	r	0	0.10	606-20-2	2,6-Dinitrotoluene (also see Dinitrotoluene mixture)	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc	7E-04	3E-05
		1.0E-03	i			1.0E-03	r	0	0.10	88-85-7	Dinoseb	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
		2.0E-02	h			2.0E-02	r	0	0.10	117-84-0	di-n-Octyl phthalate	1.2E+03	nc	1.0E+04	sat	7.3E+01	nc	7.3E+02	nc	1E+04	1E+04
1.1E-02	i			1.1E-02	r			0	0.10	123-91-1	1,4-Dioxane	4.4E+01	ca	2.2E+02	ca	6.1E-01	ca	6.1E+00	ca		
1.5E+05	h			1.5E+05	h			0	0.03	1746-01-6	Dioxin (2,3,7,8-TCDD)	3.9E-06	ca	2.7E-05	ca	4.5E-08	ca	4.5E-07	ca		
		3.0E-02	i			3.0E-02	r	0	0.10	957-51-7	Diphenamid	1.8E+03	nc	2.6E+04	nc	1.1E+02	nc	1.1E+03	nc		
		2.5E-02	i			2.5E-02	r	0	0.10	122-39-4	Diphenylamine	1.5E+03	nc	2.2E+04	nc	9.1E+01	nc	9.1E+02	nc		
8.0E-01	i			7.7E-01	i			0	0.10	122-66-7	1,2-Diphenylhydrazine	6.1E-01	ca	3.1E+00	ca	8.7E-03	ca	8.4E-02	ca		
		9.0E-03	n			9.0E-03	r	0	0.10	127-63-9	Diphenyl sulfone	5.5E+02	nc	7.9E+03	nc	3.3E+01	nc	3.3E+02	nc		
		2.2E-03	i			2.2E-03	r	0	0.10	85-00-7	Diquat	1.3E+02	nc	1.9E+03	nc	8.0E+00	nc	8.0E+01	nc		
8.6E+00	h			8.6E+00	r			0	0.10	1937-37-7	Direct black 38	5.7E-02	ca	2.9E-01	ca	7.8E-04	ca	7.8E-03	ca		
8.1E+00	h			8.1E+00	r			0	0.10	2602-46-2	Direct blue 6	6.0E-02	ca	3.0E-01	ca	8.3E-04	ca	8.3E-03	ca		
9.3E+00	h			9.3E+00	r			0	0.10	16071-86-6	Direct brown 95	5.2E-02	ca	2.7E-01	ca	7.2E-04	ca	7.2E-03	ca		
		4.0E-05	i			4.0E-05	r	0	0.10	298-04-4	Disulfoton	2.4E+00	nc	3.5E+01	nc	1.5E-01	nc	1.5E+00	nc		
		1.0E-02	i			1.0E-02	r	0	0.10	505-29-3	1,4-Dithiane	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
		2.0E-03	i			2.0E-03	r	0	0.10	330-54-1	Diuron	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
		4.0E-03	i			4.0E-03	r	0	0.10	2439-10-3	Dodine	2.4E+02	nc	3.5E+03	nc	1.5E+01	nc	1.5E+02	nc		
		6.0E-03	i			6.0E-03	r	0	0.10	115-29-7	Endosulfan	3.7E+02	nc	5.3E+03	nc	2.2E+01	nc	2.2E+02	nc	2E+01	9E-01
		2.0E-02	i			2.0E-02	r	0	0.10	145-73-3	Endothall	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		3.0E-04	i			3.0E-04	r	0	0.10	72-20-8	Endrin	1.8E+01	nc	2.6E+02	nc	1.1E+00	nc	1.1E+01	nc	1E+00	5E-02
9.9E-03	i	2.0E-03	h	4.2E-03	i	2.9E-04	i	1		106-89-8	Epichlorohydrin	7.6E+00	nc	2.6E+01	nc	1.0E+00	nc	2.0E+00	nc		
		5.7E-03	r			5.7E-03	i	0	0.10	106-88-7	1,2-Epoxybutane	3.5E+02	nc	5.0E+03	nc	2.1E+01	nc	2.1E+02	nc		
		2.5E-02	i			2.5E-02	r	0	0.10	759-94-4	EPTC (S-Ethyl dipropylthiocarbamate)	1.5E+03	nc	2.2E+04	nc	9.1E+01	nc	9.1E+02	nc		
		5.0E-03	i			5.0E-03	r	0	0.10	16672-87-0	Ethephon (2-chloroethyl phosphonic acid)	3.1E+02	nc	4.4E+03	nc	1.8E+01	nc	1.8E+02	nc		
		5.0E-04	i			5.0E-04	r	0	0.10	563-12-2	Ethion	3.1E+01	nc	4.4E+02	nc	1.8E+00	nc	1.8E+01	nc		
		4.0E-01	h			5.7E-02	i	0	0.10	110-80-5	2-Ethoxyethanol	2.4E+04	nc	1.0E+05	max	2.1E+02	nc	1.5E+04	nc		
		3.0E-01	h			3.0E-01	r	0	0.10	111-15-9	2-Ethoxyethanol acetate	1.8E+04	nc	1.0E+05	max	1.1E+03	nc	1.1E+04	nc		
		9.0E-01	i			9.0E-01	r	1		141-78-6	Ethyl acetate	1.9E+04	nc	3.7E+04	sat	3.3E+03	nc	5.5E+03	nc		
4.8E-02	h			4.8E-02	r			1		140-88-5	Ethyl acrylate	2.1E-01	ca	4.5E-01	ca	1.4E-01	ca	2.3E-01	ca		
		1.0E-01	i			2.9E-01	i	1		100-41-4	Ethylbenzene	2.3E+02	sat	2.3E+02	sat	1.1E+03	nc	1.3E+03	nc	1E+01	7E-01
2.9E-03	n	4.0E-01	n	**2.9E-03**	r	2.9E+00	i	1		75-00-3	**Ethyl chloride**	3.0E+00	ca	6.5E+00	ca	2.3E+00	ca	4.6E+00	ca		
		3.0E-01	h			3.0E-01	r	0	0.10	109-78-4	Ethylene cyanohydrin	1.8E+04	nc	1.0E+05	max	1.1E+03	nc	1.1E+04	nc		
		2.0E-02	h			2.0E-02	r	0	0.10	107-15-3	Ethylene diamine	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		2.0E+00	i			2.0E+00	r	0	0.10	107-21-1	Ethylene glycol	1.0E+05	max	1.0E+05	max	7.3E+03	nc	7.3E+04	nc		
		5.7E-03	r			5.7E-03	h	0	0.10	111-76-2	Ethylene glycol, monobutyl ether	3.5E+02	nc	5.0E+03	nc	2.1E+01	nc	2.1E+02	nc		
1.0E+00	h			3.5E-01	h			1		75-21-8	Ethylene oxide	1.4E-01	ca	3.6E-01	ca	1.9E-02	ca	2.4E-02	ca		
1.1E-01	h	8.0E-05	i	1.1E-01	r	8.0E-05	r	0	0.10	96-45-7	Ethylene thiourea (ETU)	4.4E+00	ca**	2.2E+01	ca**	6.1E-02	ca**	6.1E-01	ca**		
		2.0E-01	i			2.0E-01	r	1		60-29-7	Ethyl ether	1.8E+03	sat	1.8E+03	sat	7.3E+02	nc	1.2E+03	nc		
		9.0E-02	h			9.0E-02	r	1		97-63-2	Ethyl methacrylate	1.4E+02	sat	1.4E+02	sat	3.3E+02	nc	5.5E+02	nc		
		1.0E-05	i			1.0E-05	r	0	0.10	2104-64-5	Ethyl p-nitrophenyl phenylphosphorothioate	6.1E-01	nc	8.8E+00	nc	3.7E-02	nc	3.6E-01	nc		
		3.0E+00	i			3.0E+00	r	0	0.10	84-72-0	Ethylphthalyl ethyl glycolate	1.0E+05	max	1.0E+05	max	1.1E+04	nc	1.1E+05	nc		

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FOR PLANNING PURPOSES

TOXICITY INFORMATION										CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs)								SOIL SCREENING LEVELS	
																			Migration to Ground Water	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)		V O C	skin abs. soils	CAS No.		Residential Soil (mg/kg)		Industrial Soil (mg/kg)		Ambient Air (ug/m^3)		Tap Water (ug/l)		DAF 20 (mg/kg)	DAF 1 (mg/kg)
		8.0E-03	I			8.0E-03	r	0	0.10	101200-48-0	Express	4.9E+02	nc	7.0E+03	nc	2.9E+01	nc	2.9E+02	nc		
		2.5E-04	I			2.5E-04	r	0	0.10	22224-92-6	Fenamiphos	1.5E+01	nc	2.2E+02	nc	9.1E-01	nc	9.1E+00	nc		
		1.3E-02	I			1.3E-02	r	0	0.10	2164-17-2	Fluometuron	7.9E+02	nc	1.1E+04	nc	4.7E+01	nc	4.7E+02	nc		
		6.0E-02	I					0	0.10	16984-48-8	Flouride	3.7E+03	nc	5.3E+04	nc			2.2E+03	nc		
		8.0E-02	I			8.0E-02	r	0	0.10	59756-60-4	Fluoridone	4.9E+03	nc	7.0E+04	nc	2.9E+02	nc	2.9E+03	nc		
		2.0E-02	I			2.0E-02	r	0	0.10	56425-91-3	Flurprimidol	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		6.0E-02	I			6.0E-02	r	0	0.10	66332-96-5	Flutolanil	3.7E+03	nc	5.3E+04	nc	2.2E+02	nc	2.2E+03	nc		
		1.0E-02	I			1.0E-02	r	0	0.10	69409-94-5	Fluvalinate	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
3.5E-03	I	1.0E-01	I	3.5E-03	r	1.0E-01	r	0	0.10	133-07-3	Folpet	1.4E+02	ca*	7.0E+02	ca	1.9E+00	ca	1.9E+01	ca		
1.9E-01	I			1.9E-01	r			0	0.10	72178-02-0	Fomesafen	2.6E+00	ca	1.3E+01	ca	3.5E-02	ca	3.5E-01	ca		
		2.0E-03	I			2.0E-03	r	0	0.10	944-22-9	Fonofos	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
		1.5E-01	I	4.6E-02	I			0	0.10	50-00-0	Formaldehyde	9.2E+03	nc	1.0E+05	nc	1.5E-01	ca	5.5E+03	nc		
		2.0E+00	h			2.0E+00	r	0	0.10	64-18-6	Formic Acid	1.0E+05	max	1.0E+05	max	7.3E+03	nc	7.3E+04	nc		
		3.0E+00	I			3.0E+00	r	0	0.10	39148-24-8	Fosetyl-al	1.0E+05	max	1.0E+05	max	1.1E+04	nc	1.1E+05	nc		
		1.0E-03	I			1.0E-03	r	1		110-00-9	Furan	2.5E+00	nc	8.5E+00	nc	3.7E+00	nc	6.1E+00	nc		
3.8E+00	h			3.8E+00	r			0	0.10	67-45-8	Furazolidone	1.3E-01	ca	6.5E-01	ca	1.8E-03	ca	1.8E-02	ca		
		3.0E-03	I			1.4E-02	h	0	0.10	98-01-1	Furfural	1.8E+02	nc	2.6E+03	nc	5.2E+01	nc	1.1E+02	nc		
5.0E+01	h			5.0E+01	r			0	0.10	531-82-8	Furium	9.7E-03	ca	4.9E-02	ca	1.3E-04	ca	1.3E-03	ca		
3.0E-02	I			3.0E-02	r			0	0.10	60568-05-0	Furmecyclox	1.6E+01	ca	8.2E+01	ca	2.2E-01	ca	2.2E+00	ca		
		4.0E-04	I			4.0E-04	r	0	0.10	77182-82-2	Glufosinate-ammonium	2.4E+01	nc	3.5E+02	nc	1.5E+00	nc	1.5E+01	nc		
		4.0E-04	I			2.9E-04	h	0	0.10	765-34-4	Glycidaldehyde	2.4E+01	nc	3.5E+02	nc	1.0E+00	nc	1.5E+01	nc		
		1.0E-01	I			1.0E-01	r	0	0.10	1071-83-6	Glyphosate	6.1E+03	nc	8.8E+04	nc	3.7E+02	nc	3.6E+03	nc		
		5.0E-05	I			5.0E-05	r	0	0.10	69806-40-2	Haloxyfop-methyl	3.1E+00	nc	4.4E+01	nc	1.8E-01	nc	1.8E+00	nc		
		1.3E-02	I			1.3E-02	r	0	0.10	79277-27-3	Harmony	7.9E+02	nc	1.1E+04	nc	4.7E+01	nc	4.7E+02	nc		
4.5E+00	I	5.0E-04	I	4.6E+00	I	5.0E-04	r	0	0.10	76-44-8	Heptachlor	1.1E-01	ca	5.5E-01	ca	1.5E-03	ca	1.5E-02	ca	2E+01	1E+00
9.1E+00	I	1.3E-05	I	9.1E+00	I	1.3E-05	r	0	0.10	1024-57-3	Heptachlor epoxide	5.3E-02	ca*	2.7E-01	ca*	7.4E-04	ca*	7.4E-03	ca*	7E-01	3E-02
		2.0E-03	I			2.0E-03	r	0	0.10	87-82-1	Hexabromobenzene	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
1.6E+00	I	8.0E-04	I	1.6E+00	I	8.0E-04	r	0	0.10	118-74-1	Hexachlorobenzene	3.0E-01	ca	1.5E+00	ca	4.2E-03	ca	4.2E-02	ca	2E+00	1E-01
7.8E-02	I	2.0E-04	h	7.8E-02	I	2.0E-04	r	0	0.10	87-68-3	Hexachlorobutadiene	6.2E+00	ca**	3.2E+01	ca**	8.6E-02	ca**	8.6E-01	ca**	2E+00	1E-01
6.3E+00	I			6.3E+00	I			0	0.04	319-84-6	HCH (alpha)	9.0E-02	ca	5.9E-01	ca	1.1E-03	ca	1.1E-02	ca	5E-04	3E-05
1.8E+00	I			1.8E+00	I			0	0.04	319-85-7	HCH (beta)	3.2E-01	ca	2.1E+00	ca	3.7E-03	ca	3.7E-02	ca	3E-03	1E-04
1.3E+00	h	3.0E-04	I	1.3E+00	r	3.0E-04	r	0	0.04	58-89-9	HCH (gamma) Lindane	4.4E-01	ca*	2.9E+00	ca	5.2E-03	ca	5.2E-02	ca	9E-03	5E-04
1.8E+00	I			1.8E+00	I			0	0.04	608-73-1	HCH-technical	3.2E-01	ca	2.1E+00	ca	3.8E-03	ca	3.7E-02	ca	3E-03	1E-04
		7.0E-03	I			2.0E-05	h	0	0.10	77-47-4	Hexachlorocyclopentadiene	4.2E+02	nc	5.9E+03	nc	7.3E-02	nc	2.6E+02	nc	4E+02	2E+01
6.2E+03	I			4.6E+03	I			0	0.10	19408-74-3	Hexachlorodibenzo-p-dioxin mixture (HxCDD)	7.8E-05	ca	4.0E-04	ca	1.5E-06	ca	1.1E-05	ca		
1.4E-02	I	1.0E-03	I	1.4E-02	I	1.0E-03	r	0	0.10	67-72-1	Hexachloroethane	3.5E+01	ca**	1.8E+02	ca**	4.8E-01	ca**	4.8E+00	ca**	5E-01	2E-02
		3.0E-04	I			3.0E-04	r	0	0.10	70-30-4	Hexachlorophene	1.8E+01	nc	2.6E+02	nc	1.1E+00	nc	1.1E+01	nc		
1.1E-01	I	3.0E-03	I	1.1E-01	r	3.0E-03	r	0	0.10	121-82-4	Hexahydro-1,3,5-trinitro-1,3,5-triazine	4.4E+00	ca*	2.2E+01	ca	6.1E-02	ca	6.1E-01	ca		
		2.9E-06	r			2.9E-06	i	0	0.10	822-06-0	1,6-Hexamethylene diisocyanate	1.7E-01	nc	2.5E+00	nc	1.0E-02	nc	1.0E-01	nc		
		6.0E-02	h			5.7E-02	i	1		110-54-3	n-Hexane	1.1E+02	sat	1.1E+02	sat	2.1E+02	nc	3.5E+02	nc		
		3.3E-02	I			3.3E-02	r	0	0.10	51235-04-2	Hexazinone	2.0E+03	nc	2.9E+04	nc	1.2E+02	nc	1.2E+03	nc		
3.0E+00	I			1.7E+01	I			0	0.10	302-01-2	Hydrazine, hydrazine sulfate	1.6E-01	ca	8.2E-01	ca	3.9E-04	ca	2.2E-02	ca		
						5.7E-03	I			7647-01-0	Hydrogen chloride					2.1E+01	nc				
		3.0E-03	I			2.9E-04	I			7783-06-4	Hydrogen sulfide					1.0E+00	nc	1.1E+02	nc		
		4.0E-02	h			4.0E-02	r	0	0.10	123-31-9	p-Hydroquinone	2.4E+03	nc	3.5E+04	nc	1.5E+02	nc	1.5E+03	nc		
		1.3E-02	I			1.3E-02	r	0	0.10	35554-44-0	Imazalil	7.9E+02	nc	1.1E+04	nc	4.7E+01	nc	4.7E+02	nc		
		2.5E-01	I			2.5E-01	r	0	0.10	81335-37-7	Imazaquin	1.5E+04	nc	1.0E+05	max	9.1E+02	nc	9.1E+03	nc		
		4.0E-02	I			4.0E-02	r	0	0.10	36734-19-7	Iprodione	2.4E+03	nc	3.5E+04	nc	1.5E+02	nc	1.5E+03	nc		
		3.0E-01	n					0		7439-89-6	Iron	2.3E+04	nc	1.0E+05	max			1.1E+04	nc		
		3.0E-01	I			3.0E-01	r	1		78-83-1	Isobutanol	1.3E+04	nc	4.0E+04	sat	1.1E+03	nc	1.8E+03	nc		
9.5E-04	I	2.0E-01	I	9.5E-04	r	2.0E-01	r	0	0.10	78-59-1	Isophorone	5.1E+02	ca*	2.6E+03	ca*	7.1E+00	ca	7.1E+01	ca	5E-01	3E-02
		1.5E-02	I			1.5E-02	r	0	0.10	33820-53-0	Isopropalin	9.2E+02	nc	1.3E+04	nc	5.5E+01	nc	5.5E+02	nc		
		1.0E-01	I			1.1E-01	r	0	0.10	1832-54-8	Isopropyl methyl phosphonic acid	6.1E+03	nc	8.8E+04	nc	4.0E+02	nc	3.6E+03	nc		
		5.0E-02	I			5.0E-02	r	0	0.10	82558-50-7	Isoxaben	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc		
1.8E+01	n			1.8E+01	r			0	0.10	143-50-0	Kepone	2.7E-02	ca	1.4E-01	ca	3.7E-04	ca	3.7E-03	ca		
		2.0E-03	I			2.0E-03	r	0	0.10	77501-63-4	Lactofen	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		

Key: i=IRIS n=NCEA h=HEAST x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where: nc < 100X ca) **(where: nc < 10X ca)

FOR PLANNING PURPOSES

TOXICITY INFORMATION										CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs)								SOIL SCREENING LEVELS	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)		V O C	skin abs. soils	CAS No.		Residential Soil (mg/kg)		Industrial Soil (mg/kg)		Ambient Air (ug/m^3)		Tap Water (ug/l)		Migration to Ground Water DAF 20 (mg/kg)	DAF 1 (mg/kg)
PRGs Based on EPA Models, IEUBK (1994) and TRW (1996)										7439-92-1	Lead	4.0E+02	nc	1.0E+03	nc						
		1.0E-07	i					0	0.10	78-00-2	Lead (tetraethyl)	6.1E-03	nc	8.8E-02	nc			3.6E-03	nc		
		2.0E-03	i			2.0E-03	r	0	0.10	330-55-2	Linuron	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
		2.0E-02	x					0		7439-93-2	Lithium	1.6E+03	nc	4.1E+04	nc			7.3E+02	nc		
		2.0E-01	i			2.0E-01	r	0	0.10	83055-99-6	Londax	1.2E+04	nc	1.0E+05	max	7.3E+02	nc	7.3E+03	nc		
		2.0E-02	i			2.0E-02	r	0	0.10	121-75-5	Malathion	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		1.0E-01	i			1.0E-01	r	0	0.10	108-31-6	Maleic anhydride	6.1E+03	nc	8.8E+04	nc	3.7E+02	nc	3.6E+03	nc		
		5.0E-01	i			5.0E-01	r	1		123-33-1	Maleic hydrazide	1.7E+03	nc	2.4E+03	sat	1.8E+03	nc	3.0E+03	nc		
		2.0E-05	h			2.0E-05	r	0	0.10	109-77-3	Malononitrile	1.2E+00	nc	1.8E+01	nc	7.3E-02	nc	7.3E-01	nc		
		3.0E-02	h			3.0E-02	r	0	0.10	8018-01-7	Mancozeb	1.8E+03	nc	2.6E+04	nc	1.1E+02	nc	1.1E+03	nc		
6.0E-02	o	5.0E-03	i	6.0E-02	r	5.0E-03	r	0	0.10	12427-38-2	Maneb	8.1E+00	ca*	4.1E+01	ca	1.1E-01	ca	1.1E+00	ca		
		2.4E-02	**I**			1.4E-05	I	0		7439-96-5	**Manganese and compounds**	1.8E+03	nc	3.2E+04	nc	5.1E-02	nc	8.8E+02	nc		
		9.0E-05	h			9.0E-05	r	0	0.10	950-10-7	Mephosfolan	5.5E+00	nc	7.9E+01	nc	3.3E-01	nc	3.3E+00	nc		
		3.0E-02	i			3.0E-02	r	0	0.10	24307-26-4	Mepiquat	1.8E+03	nc	2.6E+04	nc	1.1E+02	nc	1.1E+03	nc		
2.9E-02	n	1.0E-01	n	2.9E-02	r	1.0E-01	r	0	0.10	149-30-4	2-Mercaptobenzothiazole	1.7E+01	ca	8.5E+01	ca	2.3E-01	ca	2.3E+00	ca		
		3.0E-04	i					0		7487-94-7	Mercury and compounds	2.3E+01	nc	6.1E+02	nc			1.1E+01	nc		
						8.6E-05	i			7439-97-6	Mercury (elemental)					3.1E-01	nc				
		1.0E-04	i					0	0.10	22967-92-6	Mercury (methyl)	6.1E+00	nc	8.8E+01	nc			3.6E+00	nc		
		3.0E-05	i			3.0E-05	r	0	0.10	150-50-5	Merphos	1.8E+00	nc	2.6E+01	nc	1.1E-01	nc	1.1E+00	nc		
		3.0E-05	i			3.0E-05	r	0	0.10	78-48-8	Merphos oxide	1.8E+00	nc	2.6E+01	nc	1.1E-01	nc	1.1E+00	nc		
		6.0E-02	i			6.0E-02	r	0	0.10	57837-19-1	Metalaxyl	3.7E+03	nc	5.3E+04	nc	2.2E+02	nc	2.2E+03	nc		
		1.0E-04	i			2.0E-04	h	1		126-98-7	Methacrylonitrile	2.1E+00	nc	8.8E+00	nc	7.3E-01	nc	1.0E+00	nc		
		5.0E-05	i			5.0E-05	r	0	0.10	10265-92-6	Methamidophos	3.1E+00	nc	4.4E+01	nc	1.8E-01	nc	1.8E+00	nc		
		5.0E-01	i			5.0E-01	r	0	0.10	67-56-1	Methanol	3.1E+04	nc	1.0E+05	max	1.8E+03	nc	1.8E+04	nc		
		1.0E-03	i			1.0E-03	r	0	0.10	950-37-8	Methidathion	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
		2.5E-02	i			2.5E-02	r	1		16752-77-5	Methomyl	4.4E+01	nc	1.5E+02	nc	9.1E+01	nc	1.5E+02	nc		
		5.0E-03	i			5.0E-03	r	0	0.10	72-43-5	Methoxychlor	3.1E+02	nc	4.4E+03	nc	1.8E+01	nc	1.8E+02	nc	2E+02	8E+00
		1.0E-03	h			5.7E-03	i	0	0.10	109-86-4	2-Methoxyethanol	6.1E+01	nc	8.8E+02	nc	2.1E+01	nc	3.6E+01	nc		
		2.0E-03	h			2.0E-03	r	0	0.10	110-49-6	2-Methoxyethanol acetate	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
4.6E-02	h			4.6E-02	r			0	0.10	99-59-2	2-Methoxy-5-nitroaniline	1.1E+01	ca	5.4E+01	ca	1.5E-01	ca	1.5E+00	ca		
		1.0E+00	h			1.0E+00	r	1		79-20-9	Methyl acetate	2.2E+04	nc	9.6E+04	nc	3.7E+03	nc	6.1E+03	nc		
		3.0E-02	h			3.0E-02	r	1		96-33-3	Methyl acrylate	7.0E+01	nc	2.3E+02	nc	1.1E+02	nc	1.8E+02	nc		
2.4E-01	h			2.4E-01	r			0	0.10	95-53-4	2-Methylaniline (o-toluidine)	2.0E+00	ca	1.0E+01	ca	2.8E-02	ca	2.8E-01	ca		
1.8E-01	h			1.8E-01	r			0	0.10	636-21-5	2-Methylaniline hydrochloride	2.7E+00	ca	1.4E+01	ca	3.7E-02	ca	3.7E-01	ca		
		1.0E+00	x			1.0E+00	r	0	0.10	79-22-1	Methyl chlorocarbonate	6.1E+04	nc	1.0E+05	max	3.7E+03	nc	3.6E+04	nc		
		5.0E-04	i			5.0E-04	r	0	0.10	94-74-6	2-Methyl-4-chlorophenoxyacetic acid	3.1E+01	nc	4.4E+02	nc	1.8E+00	nc	1.8E+01	nc		
		1.0E-02	i			1.0E-02	r	0	0.10	94-81-5	4-(2-Methyl-4-chlorophenoxy) butyric acid	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
		1.0E-03	i			1.0E-03	r	0	0.10	93-65-2	2-(2-Methyl-4-chlorophenoxy) propionic acid	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
		1.0E-03	i			1.0E-03	r	0	0.10	16484-77-8	2-(2-Methyl-1,4-chlorophenoxy) propionic acid	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
		8.6E-01	r			8.6E-01	h	1		108-87-2	**Methylcyclohexane**	2.6E+03	nc	8.8E+03	nc	3.1E+03	nc	5.2E+03	nc		
2.5E-01	h			2.5E-01	r			0	0.10	101-77-9	4,4'-Methylenebisbenzeneamine	1.9E+00	ca	9.9E+00	ca	2.7E-02	ca	2.7E-01	ca		
1.3E-01	h	7.0E-04	h	1.3E-01	h	7.0E-04	r	0	0.10	101-14-4	4,4'-Methylene bis(2-chloroaniline)	3.7E+00	ca*	1.9E+01	ca*	5.2E-02	ca*	5.2E-01	ca*		
4.6E-02	i			4.6E-02	r			0	0.10	101-61-1	4,4'-Methylene bis(N,N'-dimethyl)aniline	1.1E+01	ca	5.4E+01	ca	1.5E-01	ca	1.5E+00	ca		
		1.0E-02	h			1.0E-02	r	1		74-95-3	**Methylene bromide**	6.7E+01	nc	2.4E+02	nc	3.7E+01	nc	6.1E+01	nc		
7.5E-03	i	6.0E-02	i	1.6E-03	i	8.6E-01	h	1		75-09-2	Methylene chloride	8.9E+00	ca	2.1E+01	ca	4.1E+00	ca	4.3E+00	ca	2E-02	1E-03
		1.7E-04	r			1.7E-04	i	0	0.10	101-68-8	4,4'-Methylene diphenyl diisocyanate	1.0E+01	nc	1.5E+02	nc	6.2E-01	nc	6.2E+00	nc		
		6.0E-01	i			2.9E-01	i	1		78-93-3	Methyl ethyl ketone	7.3E+03	nc	2.8E+04	nc	1.0E+03	nc	1.9E+03	nc		
1.1E+00	h			1.1E+00	r			0	0.10	60-34-4	Methyl hydrazine	4.4E-01	ca	2.2E+00	ca	6.1E-03	ca	6.1E-02	ca		
		8.0E-02	h			2.3E-02	h	1		108-10-1	Methyl isobutyl ketone	7.9E+02	nc	2.9E+03	nc	8.3E+01	nc	1.6E+02	nc		
		5.7E-04	r			5.7E-04	n	0	0.10	74-93-1	Methyl Mercaptan	3.5E+01	nc	5.0E+02	nc	2.1E+00	nc	2.1E+01	nc		
		1.4E+00	i			2.0E-01	i	1		80-62-6	Methyl methacrylate	2.2E+03	nc	2.7E+03	sat	7.3E+02	nc	1.4E+03	nc		
3.3E-02	h			3.3E-02	r			0	0.10	99-55-8	2-Methyl-5-nitroaniline	1.5E+01	ca	7.5E+01	ca	2.0E-01	ca	2.0E+00	ca		
		2.5E-04	i			2.5E-04	r	0	0.10	298-00-0	Methyl parathion	1.5E+01	nc	2.2E+02	nc	9.1E-01	nc	9.1E+00	nc		
		5.0E-02	i			5.0E-02	r	0	0.10	95-48-7	2-Methylphenol	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc	2E+01	8E-01
		5.0E-02	i			5.0E-02	r	0	0.10	108-39-4	3-Methylphenol	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc		
		5.0E-03	h			5.0E-03	r	0	0.10	106-44-5	4-Methylphenol	3.1E+02	nc	4.4E+03	nc	1.8E+01	nc	1.8E+02	nc		

Key: i=IRIS n=NCEA h=HEAST x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where: nc < 100X ca) **(where: nc < 10X ca)

FOR PLANNING PURPOSES

TOXICITY INFORMATION										CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs)								SOIL SCREENING LEVELS	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)		V O C	skin abs. soils	CAS No.		Residential Soil (mg/kg)		Industrial Soil (mg/kg)		Ambient Air (ug/m^3)		Tap Water (ug/l)		Migration to Ground Water DAF 20 (mg/kg)	DAF 1 (mg/kg)
		2.0E-02	n			2.0E-02	r	0	0.10	993-13-5	Methyl phosphonic acid	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		6.0E-03	h			1.1E-02	h	1		25013-15-4	Methyl styrene (mixture)	1.3E+02	nc	5.6E+02	nc	4.2E+01	nc	6.0E+01	nc		
		7.0E-02	h			7.0E-02	r	1		98-83-9	Methyl styrene (alpha)	6.8E+02	sat	6.8E+02	sat	2.6E+02	nc	4.3E+02	nc		
						8.6E-01	i	1		1634-04-4	Methyl tertbutyl ether (MTBE)					3.1E+03	nc	2.0E+01	nc/ca		
		1.5E-01	i			1.5E-01	r	0	0.10	51218-45-2	Metolaclor (Dual)	9.2E+03	nc	1.0E+05	max	5.5E+02	nc	5.5E+03	nc		
		2.5E-02	i			2.5E-02	r	0	0.10	21087-64-9	Metribuzin	1.5E+03	nc	2.2E+04	nc	9.1E+01	nc	9.1E+02	nc		
1.8E+00	x	2.0E-04	i	1.8E+00	r	2.0E-04	r	0	0.10	2385-85-5	Mirex	2.7E-01	ca*	1.4E+00	ca	3.7E-03	ca	3.7E-02	ca		
		2.0E-03	i			2.0E-03	r	0	0.10	2212-67-1	Molinate	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
		5.0E-03	h					0		7439-98-7	Molybdenum	3.9E+02	nc	1.0E+04	nc			1.8E+02	nc		
		1.0E-01	h			1.0E-01	h	0	0.10	10599-90-3	Monochloramine	6.1E+03	nc	8.8E+04	nc	3.7E+02	nc	3.6E+03	nc		
		2.0E-03	i			2.0E-03	r	0	0.10	300-76-5	Naled	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
		1.0E-01	i			1.0E-01	r	0	0.10	15299-99-7	Napropamide	6.1E+03	nc	8.8E+04	nc	3.7E+02	nc	3.6E+03	nc		
		2.0E-02	i					0		7440-02-0	Nickel (soluble salts)	1.6E+03	nc	4.1E+04	nc			7.3E+02	nc	1E+02	7E+00
											"CAL-Modified PRG" (PEA, 1994)	1.5E+02									
				8.4E-01	i			0			Nickel refinery dust					8.0E-03	ca				
				1.7E+00	i			0		12035-72-2	Nickel subsulfide			1.1E+04	ca	4.0E-03	ca				
		1.5E-03	x			1.5E-03	r	0	0.10	1929-82-4	Nitrapyrin	9.2E+01	nc	1.3E+03	nc	5.5E+00	nc	5.5E+01	nc		
Tap Water PRG Based on Infant NOAEL (see IRIS)										14797-55-8	Nitrate							1.0E+04	nc		
		1.0E-01	x							10102-43-9	Nitric Oxide	7.8E+03	nc	1.0E+05	max			3.6E+03	nc		
Tap Water PRG Based on Infant NOAEL (see IRIS)										14797-65-0	Nitrite							1.0E+03	nc		
		5.7E-05	r			5.7E-05	h	0	0.10	88-74-4	2-Nitroaniline	3.5E+00	nc	5.0E+01	nc	2.1E-01	nc	2.1E+00	nc		
		5.0E-04	i			5.7E-04	h	1		98-95-3	Nitrobenzene	2.0E+01	nc	1.1E+02	nc	2.1E+00	nc	3.4E+00	nc	1E-01	7E-03
		7.0E-02	h			7.0E-02	r	0	0.10	67-20-9	Nitrofurantoin	4.3E+03	nc	6.2E+04	nc	2.6E+02	nc	2.6E+03	nc		
1.5E+00	h			9.4E+00	h			0	0.10	59-87-0	Nitrofurazone	3.2E-01	ca	1.6E+00	ca	7.2E-04	ca	4.5E-02	ca		
1.4E-02	**n**			**1.4E-02**	**r**			0	0.10	55-63-0	**Nitroglycerin**	3.5E+01	ca	1.8E+02	ca	4.8E-01	ca	4.8E+00	ca		
		1.0E-01	i			1.0E-01	r	0	0.10	556-88-7	Nitroguanidine	6.1E+03	nc	8.8E+04	nc	3.7E+02	nc	3.6E+03	nc		
		8.0E-03	**n**			**8.00E-03**	**r**	0	0.10	100-02-7	**4-Nitrophenol**	4.9E+02	nc	7.0E+03	nc	2.9E+01	nc	2.9E+02	nc		
9.4E+00	r	5.7E-03	r	9.4E+00	h	5.7E-03	i	1		79-46-9	2-Nitropropane					7.2E-04	ca	1.2E-03	ca		
5.4E+00	i			5.6E+00	i			1		924-16-3	N-Nitrosodi-n-butylamine	2.4E-02	ca	6.1E-02	ca	1.2E-03	ca	2.0E-03	ca		
2.8E+00	i			2.8E+00	r			0	0.10	1116-54-7	N-Nitrosodiethanolamine	1.7E-01	ca	8.8E-01	ca	2.4E-03	ca	2.4E-02	ca		
1.5E+02	i			1.5E+02	i			0	0.10	55-18-5	N-Nitrosodiethylamine	3.2E-03	ca	1.6E-02	ca	4.5E-05	ca	4.5E-04	ca		
5.1E+01	i			4.9E+01	i			0	0.10	62-75-9	N-Nitrosodimethylamine	9.5E-03	ca	4.8E-02	ca	1.4E-04	ca	1.3E-03	ca		
4.9E-03	i			4.9E-03	r			0	0.10	86-30-6	N-Nitrosodiphenylamine	9.9E+01	ca	5.0E+02	ca	1.4E+00	ca	1.4E+01	ca	1E+00	6E-02
7.0E+00	i			7.0E+00	r			0	0.10	621-64-7	N-Nitroso di-n-propylamine	6.9E-02	ca	3.5E-01	ca	9.6E-04	ca	9.6E-03	ca	5E-05	2E-06
2.2E+01	i			2.2E+01	r			0	0.10	10595-95-6	N-Nitroso-N-methylethylamine	2.2E-02	ca	1.1E-01	ca	3.1E-04	ca	3.1E-03	ca		
2.1E+00	i			2.1E+00	i			0	0.10	930-55-2	N-Nitrosopyrrolidine	2.3E-01	ca	1.2E+00	ca	3.1E-03	ca	3.2E-02	ca		
		1.0E-02	h			1.0E-02	r	1		99-08-1	**m-Nitrotoluene**	3.7E+02	nc	1.00E+03	sat	3.7E+01	nc	6.1E+01	nc		
		1.0E-02	h			1.0E-02	r	1		99-08-1	**o-Nitrotoluene**	3.7E+02	nc	1.00E+03	sat	3.7E+01	nc	6.1E+01	nc		
		1.0E-02	h			1.0E-02	r	1		99-99-0	**p-Nitrotoluene**	3.7E+02	nc	1.00E+03	sat	3.7E+01	nc	6.1E+01	nc		
		4.0E-02	i			4.0E-02	r	0	0.10	27314-13-2	Norflurazon	2.4E+03	nc	3.5E+04	nc	1.5E+02	nc	1.5E+03	nc		
		7.0E-04	i			7.0E-04	r	0	0.10	85509-19-9	NuStar	4.3E+01	nc	6.2E+02	nc	2.6E+00	nc	2.6E+01	nc		
		3.0E-03	i			3.0E-03	r	0	0.10	32536-52-0	Octabromodiphenyl ether	1.8E+02	nc	2.6E+03	nc	1.1E+01	nc	1.1E+02	nc		
		5.0E-02	i			5.0E-02	r	0	0.10	2691-41-0	Octahydro-1357-tetranitro-1357- tetrazocine (HMX)	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc		
		2.0E-03	h			2.0E-03	r	0	0.10	152-16-9	Octamethylpyrophosphoramide	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
		5.0E-02	i			5.0E-02	r	0	0.10	19044-88-3	Oryzalin	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc		
		5.0E-03	i			5.0E-03	r	0	0.10	19666-30-9	Oxadiazon	3.1E+02	nc	4.4E+03	nc	1.8E+01	nc	1.8E+02	nc		
		2.5E-02	i			2.5E-02	r	0	0.10	23135-22-0	Oxamyl	1.5E+03	nc	2.2E+04	nc	9.1E+01	nc	9.1E+02	nc		
		3.0E-03	i			3.0E-03	r	0	0.10	42874-03-3	Oxyfluorfen	1.8E+02	nc	2.6E+03	nc	1.1E+01	nc	1.1E+02	nc		
		1.3E-02	i			1.3E-02	r	0	0.10	76738-62-0	Paclobutrazol	7.9E+02	nc	1.1E+04	nc	4.7E+01	nc	4.7E+02	nc		
		4.5E-03	i			4.5E-03	r	0	0.10	4685-14-7	Paraquat	2.7E+02	nc	4.0E+03	nc	1.6E+01	nc	1.6E+02	nc		
		6.0E-03	h			6.0E-03	r	0	0.10	56-38-2	Parathion	3.7E+02	nc	5.3E+03	nc	2.2E+01	nc	2.2E+02	nc		
		5.0E-02	h			5.0E-02	r	0	0.10	1114-71-2	Pebulate	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc		
		4.0E-02	i			4.0E-02	r	0	0.10	40487-42-1	Pendimethalin	2.4E+03	nc	3.5E+04	nc	1.5E+02	nc	1.5E+03	nc		
2.3E-02	h			2.3E-02	r			0	0.10	87-84-3	Pentabromo-6-chloro cyclohexane	2.1E+01	ca	1.1E+02	ca	2.9E-01	ca	2.9E+00	ca		
		2.0E-03	i			2.0E-03	r	0	0.10	32534-81-9	Pentabromodiphenyl ether	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
		8.0E-04	i			8.0E-04	r	0	0.10	608-93-5	Pentachlorobenzene	4.9E+01	nc	7.0E+02	nc	2.9E+00	nc	2.9E+01	nc		

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FOR PLANNING PURPOSES

TOXICITY INFORMATION										CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs)								SOIL SCREENING LEVELS	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)	V O C	skin abs. soils	CAS No.		Residential Soil (mg/kg)		Industrial Soil (mg/kg)		Ambient Air (ug/m^3)		Tap Water (ug/l)		Migration to Ground Water DAF 20 (mg/kg)	DAF 1 (mg/kg)
2.6E-01	h	3.0E-03	i	2.6E-01	r	3.0E-03	r 0	0.10	82-68-8	Pentachloronitrobenzene	1.9E+00	ca*	9.5E+00	ca	2.6E-02	ca	2.6E-01	ca		
1.2E-01	i	3.0E-02	i	1.2E-01	r	3.0E-02	r 0	0.25	87-86-5	Pentachlorophenol	3.0E+00	ca	1.1E+01	ca	5.6E-02	ca	5.6E-01	ca	3E-02	1E-03
		5.0E-04	x				0		7601-90-3	Perchlorate	3.9E+01	nc	1.0E+03	nc			1.8E+01	nc		
		5.0E-02	i			5.0E-02	r 0	0.10	52645-53-1	Permethrin	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc		
		2.5E-01	i			2.5E-01	r 0	0.10	13684-63-4	Phenmedipham	1.5E+04	nc	1.0E+05	max	9.1E+02	nc	9.1E+03	nc		
		6.0E-01	i			6.0E-01	r 0	0.10	108-95-2	Phenol	3.7E+04	nc	1.0E+05	max	2.2E+03	nc	2.2E+04	nc	1E+02	5E+00
		2.0E-03	n			2.0E-03	r 0	0.10	92-84-2	Phenothiazine	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
		6.0E-03	i			6.0E-03	r 0	0.10	108-45-2	m-Phenylenediamine	3.7E+02	nc	5.3E+03	nc	2.2E+01	nc	2.2E+02	nc		
		1.9E-01	h			1.9E-01	r 0	0.10	106-50-3	p-Phenylenediamine	1.2E+04	nc	1.0E+05	max	6.9E+02	nc	6.9E+03	nc		
		8.0E-05	i			8.0E-05	r 0	0.10	62-38-4	Phenylmercuric acetate	4.9E+00	nc	7.0E+01	nc	2.9E-01	nc	2.9E+00	nc		
1.9E-03	h			1.9E-03	r		0	0.10	90-43-7	2-Phenylphenol	2.5E+02	ca	1.3E+03	ca	3.5E+00	ca	3.5E+01	ca		
		2.0E-04	h			2.0E-04	r 0	0.10	298-02-2	Phorate	1.2E+01	nc	1.8E+02	nc	7.3E-01	nc	7.3E+00	nc		
		2.0E-02	i			2.0E-02	r 0	0.10	732-11-6	Phosmet	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		3.0E-04	h			8.6E-05	i 0	0.10	7803-51-2	Phosphine	1.8E+01	nc	2.6E+02	nc	3.1E-01	nc	1.1E+01	nc		
						2.9E-03	i		7664-38-2	Phosphoric acid					1.0E+01	nc				
		2.0E-05	i				0		7723-14-0	Phosphorus (white)	1.6E+00	nc	4.1E+01	nc			7.3E-01	nc		
		1.0E+00	h			1.0E+00	r 0	0.10	100-21-0	p-Phthalic acid	6.1E+04	nc	1.0E+05	max	3.7E+03	nc	3.6E+04	nc		
		2.0E+00	i			3.4E-02	h 0	0.10	85-44-9	Phthalic anhydride	1.0E+05	max	1.0E+05	max	1.2E+02	nc	7.3E+04	nc		
		7.0E-02	i			7.0E-02	r 0	0.10	1918-02-1	Picloram	4.3E+03	nc	6.2E+04	nc	2.6E+02	nc	2.6E+03	nc		
		1.0E-02	i			1.0E-02	r 0	0.10	23505-41-1	Pirimiphos-methyl	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
8.9E+00	h	7.0E-06	h	8.9E+00	r	7.0E-06	r 0	0.10		Polybrominated biphenyls	5.5E-02	ca**	2.8E-01	ca*	7.6E-04	ca*	7.6E-03	ca*		
2.0E+00	i			2.0E+00	i		0	0.14	1336-36-3	Polychlorinated biphenyls (PCBs)	2.2E-01	ca	1.0E+00	ca	3.4E-03	ca	3.4E-02	ca		
7.0E-02	**i**	7.0E-05	i	**7.0E-02**	**i**	7.0E-05	r 0	0.14	12674-11-2	**Aroclor 1016**	3.9E+00	nc	2.9E+01	ca**	9.6E-02	ca**	9.6E-01	ca**		
2.0E+00	**i**			**2.0E+00**	**i**		0	0.14	11104-28-2	**Aroclor 1221**	2.2E-01	ca	1.0E+00	ca	3.4E-03	ca	3.4E-02	ca		
2.0E+00	**i**			**2.0E+00**	**i**		0	0.14	11141-16-5	**Aroclor 1232**	2.2E-01	ca	1.0E+00	ca	3.4E-03	ca	3.4E-02	ca		
2.0E+00	**i**			**2.0E+00**	**i**		0	0.14	53469-21-9	**Aroclor 1242**	2.2E-01	ca	1.0E+00	ca	3.4E-03	ca	3.4E-02	ca		
2.0E+00	**i**			**2.0E+00**	**i**		0	0.14	12672-29-6	**Aroclor 1248**	2.2E-01	ca	1.0E+00	ca	3.4E-03	ca	3.4E-02	ca		
2.0E+00	**i**	2.0E-05	i	**2.0E+00**	**i**	2.0E-05	r 0	0.14	11097-69-1	**Aroclor 1254**	2.2E-01	ca**	1.0E+00	ca*	3.4E-03	ca*	3.4E-02	ca*		
2.0E+00	**i**			**2.0E+00**	**i**		0	0.14	11096-82-5	**Aroclor 1260**	2.2E-01	ca	1.0E+00	ca	3.4E-03	ca	3.4E-02	ca		
								0.13		Polynuclear aromatic hydrocarbons (PAHs)										
		6.0E-02	i			6.0E-02	r 1		83-32-9	Acenaphthene	3.7E+03	nc	3.8E+04	nc	2.2E+02	nc	3.7E+02	nc	6E+02	3E+01
		3.0E-01	i			3.0E-01	r 1		120-12-7	Anthracene	2.2E+04	nc	1.0E+05	max	1.1E+03	nc	1.8E+03	nc	1E+04	6E+02
7.3E-01	n			3.1E-01	n		0	0.13	56-55-3	Benz[a]anthracene	6.2E-01	ca	2.9E+00	ca	2.2E-02	ca	9.2E-02	ca	2E+00	8E-02
7.3E-01	n			3.1E-01	n		0	0.13	205-99-2	Benzo[b]fluoranthene	6.2E-01	ca	2.9E+00	ca	2.2E-02	ca	9.2E-02	ca	5E+00	2E-01
7.3E-02	n			3.1E-02	n		0	0.13	207-08-9	Benzo[k]fluoranthene	6.2E+00	ca	2.9E+01	ca	2.2E-01	ca	9.2E-01	ca	5E+01	2E+00
										"CAL-Modified PRG" (PEA, 1994)	6.1E-01									
7.3E+00	i			3.1E+00	n		0	0.13	50-32-8	Benzo[a]pyrene	6.2E-02	ca	2.9E-01	ca	2.2E-03	ca	9.2E-03	ca	8E+00	4E-01
										"CAL-Modified PRG" (PEA, 1994)							1.5E-03			
7.3E-03	n			3.1E-03	n		0	0.13	218-01-9	Chrysene	6.2E+01	ca	2.9E+02	ca	2.2E+00	ca	9.2E+00	ca	2E+02	8E+00
										"CAL-Modified PRG" (PEA, 1994)	6.1E+00									
7.3E+00	n			3.1E+00	n		0	0.13	53-70-3	Dibenz[ah]anthracene	6.2E-02	ca	2.9E-01	ca	2.2E-03	ca	9.2E-03	ca	2E+00	8E-02
		4.0E-02	i			4.0E-02	r 0	0.13	206-44-0	Fluoranthene	2.3E+03	nc	3.0E+04	nc	1.5E+02	nc	1.5E+03	nc	4E+03	2E+02
		4.0E-02	i			4.0E-02	r 1		86-73-7	Fluorene	2.6E+03	nc	3.3E+04	nc	1.5E+02	nc	2.4E+02	nc	6E+02	3E+01
7.3E-01	n			3.1E-01	n		0	0.13	193-39-5	Indeno[1,2,3-cd]pyrene	6.2E-01	ca	2.9E+00	ca	2.2E-02	ca	9.2E-02	ca	1E+01	7E-01
		2.0E-02	i			8.6E-04	i 1		91-20-3	Naphthalene	5.6E+01	nc	1.9E+02	nc	3.1E+00	nc	6.2E+00	nc	8E+01	4E+00
		3.0E-02	i			3.0E-02	r 1		129-00-0	Pyrene	2.3E+03	nc	5.4E+04	nc	1.1E+02	nc	1.8E+02	nc	4E+03	2E+02
1.5E-01	i	9.0E-03	i	1.5E-01	r	9.0E-03	r 0	0.10	67747-09-5	Prochloraz	3.2E+00	ca	1.6E+01	ca	4.5E-02	ca	4.5E-01	ca		
		6.0E-03	h			6.0E-03	r 0	0.10	26399-36-0	Profluralin	3.7E+02	nc	5.3E+03	nc	2.2E+01	nc	2.2E+02	nc		
		1.5E-02	i			1.5E-02	r 0	0.10	1610-18-0	Prometon	9.2E+02	nc	1.3E+04	nc	5.5E+01	nc	5.5E+02	nc		
		4.0E-03	i			4.0E-03	r 0	0.10	7287-19-6	Prometryn	2.4E+02	nc	3.5E+03	nc	1.5E+01	nc	1.5E+02	nc		
		7.5E-02	i			7.5E-02	r 0	0.10	23950-58-5	Pronamide	4.6E+03	nc	6.6E+04	nc	2.7E+02	nc	2.7E+03	nc		
		1.3E-02	i			1.3E-02	r 0	0.10	1918-16-7	Propachlor	7.9E+02	nc	1.1E+04	nc	4.7E+01	nc	4.7E+02	nc		
		5.0E-03	i			5.0E-03	r 0	0.10	709-98-8	Propanil	3.1E+02	nc	4.4E+03	nc	1.8E+01	nc	1.8E+02	nc		
		2.0E-02	i			2.0E-02	r 0	0.10	2312-35-8	Propargite	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		2.0E-03	i			2.0E-03	r 0	0.10	107-19-7	Propargyl alcohol	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
		2.0E-02	i			2.0E-02	r 0	0.10	139-40-2	Propazine	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		

Key: I=IRIS n=NCEA h=HEAST x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where: nc < 100X ca) **(where: nc < 10X ca)

FOR PLANNING PURPOSES

TOXICITY INFORMATION										CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs)								SOIL SCREENING LEVELS	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)		V O C	skin abs. soils	CAS No.		Residential Soil (mg/kg)		Industrial Soil (mg/kg)		Ambient Air (ug/m^3)		Tap Water (ug/l)		Migration to Ground Water DAF 20 (mg/kg)	DAF 1 (mg/kg)
		2.0E-02	I			2.0E-02	r	0	0.10	122-42-9	Propham	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		1.3E-02	I			1.3E-02	r	0	0.10	60207-90-1	Propiconazole	7.9E+02	nc	1.1E+04	nc	4.7E+01	nc	4.7E+02	nc		
		1.0E-01	I			1.1E-01	I	1		98-82-8	Isopropylbenzene (Cumene)	1.6E+02	nc	5.2E+02	nc	4.0E+02	nc	6.6E+02	nc		
		1.0E-02	n			1.0E-02	r	1		103-65-1	n-Propylbenzene	1.4E+02	nc	2.4E+02	sat	3.7E+01	nc	6.1E+01	nc		
		2.0E+01	h			2.0E+01	r	0	0.10	57-55-6	Propylene glycol	1.0E+05	max	1.0E+05	max	7.3E+04	nc	7.3E+05	nc		
		7.0E-01	h			7.0E-01	r	0	0.10	111-35-3	Propylene glycol, monoethyl ether	4.3E+04	nc	1.0E+05	max	2.6E+03	nc	2.6E+04	nc		
		7.0E-01	h			5.7E-01	I	0	0.10	107-98-2	Propylene glycol, monomethyl ether	4.3E+04	nc	1.0E+05	max	2.1E+03	nc	2.6E+04	nc		
2.4E-01	I	8.6E-03	r	1.3E-02	I	8.6E-03	I	1		75-56-9	Propylene oxide	1.9E+00	ca*	9.1E+00	ca*	5.2E-01	ca*	2.2E-01	ca		
		2.5E-01	I			2.5E-01	r	0	0.10	81335-77-5	Pursuit	1.5E+04	nc	1.0E+05	max	9.1E+02	nc	9.1E+03	nc		
		2.5E-02	I			2.5E-02	r	0	0.10	51630-58-1	Pydrin	1.5E+03	nc	2.2E+04	nc	9.1E+01	nc	9.1E+02	nc		
		1.0E-03	I			1.0E-03	r	0	0.10	110-86-1	Pyridine	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
		5.0E-04	I			5.0E-04	r	0	0.10	13593-03-8	Quinalphos	3.1E+01	nc	4.4E+02	nc	1.8E+00	nc	1.8E+01	nc		
1.2E+01	h			1.2E+01	r			0	0.10	91-22-5	Quinoline	4.1E-02	ca	2.1E-01	ca	5.6E-04	ca	5.6E-03	ca		
1.1E-01	I	3.0E-03	I	1.1E-01	r	3.0E-03	r	0	0.10	121-82-4	RDX (Cyclonite)	4.4E+00	ca*	2.2E+01	ca	6.1E-02	ca	6.1E-01	ca		
		3.0E-02	I			3.0E-02	r	0	0.10	10453-86-8	Resmethrin	1.8E+03	nc	2.6E+04	nc	1.1E+02	nc	1.1E+03	nc		
		5.0E-02	h			5.0E-02	r	0	0.10	299-84-3	Ronnel	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc		
		4.0E-03	I			4.0E-03	r	0	0.10	83-79-4	Rotenone	2.4E+02	nc	3.5E+03	nc	1.5E+01	nc	1.5E+02	nc		
		2.5E-02	I			2.5E-02	r	0	0.10	78587-05-0	Savey	1.5E+03	nc	2.2E+04	nc	9.1E+01	nc	9.1E+02	nc		
		5.0E-03	I					0	0.10	7783-00-8	Selenious Acid	3.1E+02	nc	4.4E+03	nc			1.8E+02	nc		
		5.0E-03	I					0		7782-49-2	Selenium	3.9E+02	nc	1.0E+04	nc			1.8E+02	nc	5E+00	3E-01
		5.0E-03	h					0	0.10	630-10-4	Selenourea	3.1E+02	nc	4.4E+03	nc			1.8E+02	nc		
		9.0E-02	I			9.0E-02	r	0	0.10	74051-80-2	Sethoxydim	5.5E+03	nc	7.9E+04	nc	3.3E+02	nc	3.3E+03	nc		
		5.0E-03	I					0		7440-22-4	Silver and compounds	3.9E+02	nc	1.0E+04	nc			1.8E+02	nc	3E+01	2E+00
1.2E-01	h	5.0E-03	I	1.2E-01	r	2.0E-03	r	0	0.10	122-34-9	Simazine	4.1E+00	ca*	2.1E+01	ca	5.6E-02	ca	5.6E-01	ca		
		4.0E-03	I			4.0E-03	r	0	0.10	26628-22-8	Sodium azide	2.4E+02	nc	3.5E+03	nc	1.5E+01	nc	1.5E+02	nc		
2.7E-01	h	3.0E-02	I	2.7E-01	r	3.0E-02	r	0	0.10	148-18-5	Sodium diethyldithiocarbamate	1.8E+00	ca	9.1E+00	ca	2.5E-02	ca	2.5E-01	ca		
		2.0E-05	I			2.0E-05	r	0	0.10	62-74-8	Sodium fluoroacetate	1.2E+00	nc	1.8E+01	nc	7.3E-02	nc	7.3E-01	nc		
		1.0E-03	h			1.0E-03	r	0	0.10	13718-26-8	Sodium metavanadate	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
		6.0E-01	I					0		7440-24-6	Strontium, stable	4.7E+04	nc	1.0E+05	max			2.2E+04	nc		
		3.0E-04	I			3.0E-04	r	0	0.10	57-24-9	Strychnine	1.8E+01	nc	2.6E+02	nc	1.1E+00	nc	1.1E+01	nc		
		2.0E-01	I			2.9E-01	I	1		100-42-5	Styrene	1.7E+03	sat	1.7E+03	sat	1.1E+03	nc	1.6E+03	nc	4E+00	2E-01
		2.5E-02	I			2.5E-02	r	0	0.10	88671-89-0	Systhane	1.5E+03	nc	2.2E+04	nc	9.1E+01	nc	9.1E+02	nc		
1.5E+05	h			1.5E+05	h			0	0.03	1746-01-6	2,3,7,8-TCDD (dioxin)	3.9E-06	ca	2.7E-05	ca	4.5E-08	ca	4.5E-07	ca		
		7.0E-02	I			7.0E-02	r	0	0.10	34014-18-1	Tebuthiuron	4.3E+03	nc	6.2E+04	nc	2.6E+02	nc	2.6E+03	nc		
		2.0E-02	h			2.0E-02	r	0	0.10	3383-96-8	Temephos	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		1.3E-02	I			1.3E-02	r	0	0.10	5902-51-2	Terbacil	7.9E+02	nc	1.1E+04	nc	4.7E+01	nc	4.7E+02	nc		
		2.5E-05	h			2.5E-05	r	0	0.10	13071-79-9	Terbufos	1.5E+00	nc	2.2E+01	nc	9.1E-02	nc	9.1E-01	nc		
		1.0E-03	I			1.0E-03	r	0	0.10	886-50-0	Terbutryn	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
		3.0E-04	I			3.0E-04	r	0	0.10	95-94-3	1,2,4,5-Tetrachlorobenzene	1.8E+01	nc	2.6E+02	nc	1.1E+00	nc	1.1E+01	nc		
2.6E-02	I	3.0E-02	I	2.6E-02	I	3.0E-02	r	1		630-20-6	1,1,1,2-Tetrachloroethane	3.0E+00	ca	7.0E+00	ca	2.6E-01	ca	4.3E-01	ca		
2.0E-01	I	**6.00E-02**	n	2.0E-01	I	**6.00E-02**	r	1		79-34-5	**1,1,2,2-Tetrachloroethane**	3.8E-01	ca	9.0E-01	ca	3.3E-02	ca	5.5E-02	ca	3E-03	2E-04
5.2E-02	n	1.0E-02	I	2.0E-03	n	1.1E-01	n	1		127-18-4	Tetrachloroethylene (PCE)	5.7E+00	ca*	1.9E+01	ca*	3.3E+00	ca	1.1E+00	ca	6E-02	3E-03
											"CAL-Modified PRG" (PEA, 1994)					3.2E-01					
		3.0E-02	I			3.0E-02	r	0	0.10	58-90-2	2,3,4,6-Tetrachlorophenol	1.8E+03	nc	2.6E+04	nc	1.1E+02	nc	1.1E+03	nc		
2.0E+01	h			2.0E+01	r			0	0.10	5216-25-1	p,a,a,a-Tetrachlorotoluene	2.4E-02	ca	1.2E-01	ca	3.4E-04	ca	3.4E-03	ca		
2.4E-02	h	3.0E-02	I	2.4E-02	r	3.0E-02	r	0	0.10	961-11-5	Tetrachlorovinphos	2.0E+01	ca*	1.0E+02	ca	2.8E-01	ca	2.8E+00	ca		
		5.0E-04	I			5.0E-04	r	0	0.10	3689-24-5	Tetraethyldithiopyrophosphate	3.1E+01	nc	4.4E+02	nc	1.8E+00	nc	1.8E+01	nc		
7.6E-03	n	**2.1E-01**	n	**6.8E-03**	n	8.6E-02	n	0	0.10	109-99-9	**Tetrahydrofuran**	6.4E+01	ca	3.2E+02	ca	9.9E-01	ca	8.8E+00	ca		
		7.0E-05	x					0		1314-32-5	Thallic oxide	5.5E+00	nc	1.4E+02	nc			2.6E+00	nc		
		9.0E-05	I					0		563-68-8	Thallium acetate	7.0E+00	nc	1.8E+02	nc			3.3E+00	nc	7E-01	4E-01
		8.0E-05	I					0		6533-73-9	Thallium carbonate	6.3E+00	nc	1.6E+02	nc			2.9E+00	nc	7E-01	4E-01
		8.0E-05	I					0		7791-12-0	Thallium chloride	6.3E+00	nc	1.6E+02	nc			2.9E+00	nc	7E-01	4E-01
		9.0E-05	I					0		10102-45-1	Thallium nitrate	7.0E+00	nc	1.8E+02	nc			3.3E+00	nc	7E-01	4E-01
		9.0E-05	x					0		12039-52-0	Thallium selenite	7.0E+00	nc	1.8E+02	nc			3.3E+00	nc	7E-01	4E-01
		8.0E-05	I					0		7446-18-6	Thallium sulfate	6.3E+00	nc	1.6E+02	nc			2.9E+00	nc	7E-01	4E-01
		1.0E-02	I			1.0E-02	r	0	0.10	28249-77-6	Thiobencarb	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		

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FOR PLANNING PURPOSES

TOXICITY INFORMATION										CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs)								SOIL SCREENING LEVELS	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)	V O C	skin abs. soils	CAS No.		Residential Soil (mg/kg)		Industrial Soil (mg/kg)		Ambient Air (ug/m^3)		Tap Water (ug/l)		Migration to Ground Water DAF 20 (mg/kg)	DAF 1 (mg/kg)
		1.0E-01	n			1.0E-01	r 0	0.10	N/A	Thiocyanate	6.1E+03	nc	1.0E+05	max	3.7E+02	nc	3.6E+03	nc		
		3.0E-04	h			3.0E-04	r 0	0.10	39196-18-4	Thiofanox	1.8E+01	nc	2.6E+02	nc	1.1E+00	nc	1.1E+01	nc		
		8.0E-02	i			8.0E-02	r 0	0.10	23564-05-8	Thiophanate-methyl	4.9E+03	nc	7.0E+04	nc	2.9E+02	nc	2.9E+03	nc		
		5.0E-03	i			5.0E-03	r 0	0.10	137-26-8	Thiram	3.1E+02	nc	4.4E+03	nc	1.8E+01	nc	1.8E+02	nc		
		6.0E-01	h				0			Tin (inorganic, see tributyltin oxide for organic tin)	4.7E+04	nc	1.0E+05	max			2.2E+04	nc		
		2.0E-01	i			1.1E-01	h 1		108-88-3	Toluene	5.2E+02	sat	5.2E+02	sat	4.0E+02	nc	7.2E+02	nc	1E+01	6E-01
3.2E+00	h			3.2E+00	r		0	0.10	95-80-7	Toluene-2,4-diamine	1.5E-01	ca	7.7E-01	ca	2.1E-03	ca	2.1E-02	ca		
		6.0E-01	h			6.0E-01	r 0	0.10	95-70-5	Toluene-2,5-diamine	3.7E+04	nc	1.0E+05	max	2.2E+03	nc	2.2E+04	nc		
		2.0E-01	h			2.0E-01	r 0	0.10	823-40-5	Toluene-2,6-diamine	1.2E+04	nc	1.0E+05	max	7.3E+02	nc	7.3E+03	nc		
2E-01	i			2E-01	r		0	0.10	106-49-0	p-Toluidine	2.6E+00	ca	1.3E+01	ca	3.5E-02	ca	3.5E-01	ca		
1.1E+00	i			1.1E+00	i		0	0.10	8001-35-2	Toxaphene	4.4E-01	ca	2.2E+00	ca	6.0E-03	ca	6.1E-02	ca	3E+01	2E+00
		7.5E-03	i			7.5E-03	r 0	0.10	66841-25-6	Tralomethrin	4.6E+02	nc	6.6E+03	nc	2.7E+01	nc	2.7E+02	nc		
		1.3E-02	i			1.3E-02	r 0	0.10	2303-17-5	Triallate	7.9E+02	nc	1.1E+04	nc	4.7E+01	nc	4.7E+02	nc		
		1.0E-02	i			1.0E-02	r 0	0.10	82097-50-5	Triasulfuron	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
		5.0E-03	i			5.0E-03	r 0	0.10	615-54-3	1,2,4-Tribromobenzene	3.1E+02	nc	4.4E+03	nc	1.8E+01	nc	1.8E+02	nc		
		3.0E-04	i				0	0.10	56-35-9	Tributyltin oxide (TBTO)	1.8E+01	nc	2.6E+02	nc			1.1E+01	nc		
3.4E-02	h			3.4E-02	r		0	0.10	634-93-5	2,4,6-Trichloroaniline	1.4E+01	ca	7.3E+01	ca	2.0E-01	ca	2.0E+00	ca		
2.9E-02	h			2.9E-02	r		0	0.10	33663-50-2	2,4,6-Trichloroaniline hydrochloride	1.7E+01	ca	8.5E+01	ca	2.3E-01	ca	2.3E+00	ca		
		1.0E-02	i			5.7E-02	h 1		120-82-1	1,2,4-Trichlorobenzene	6.5E+02	nc	3.00E+03	sat	2.1E+02	nc	1.9E+02	nc	5E+00	3E-01
		3.5E-02	n			2.9E-01	n 1		71-55-6	1,1,1-Trichloroethane	7.7E+02	nc	1.4E+03	sat	1.0E+03	nc	7.9E+02	nc	2E+00	1E-01
5.7E-02	i	4.0E-03	i	5.6E-02	i	4.0E-03	r 1		79-00-5	1,1,2-Trichloroethane	8.4E-01	ca*	1.9E+00	ca*	1.2E-01	ca	2.0E-01	ca	2E-02	9E-04
1.1E-02	n	6.0E-03	x	6.0E-03	n	6.0E-03	r 1		79-01-6	Trichloroethylene (TCE)	2.8E+00	ca**	6.1E+00	ca*	1.1E+00	ca*	1.6E+00	ca*	6E-02	3E-03
		3.0E-01	i			2.0E-01	h 1		75-69-4	Trichlorofluoromethane	3.9E+02	nc	2.00E+03	sat	7.3E+02	nc	1.3E+03	nc		
		1.0E-01	i			1.0E-01	r 0	0.10	95-95-4	2,4,5-Trichlorophenol	6.1E+03	nc	8.8E+04	nc	3.7E+02	nc	3.6E+03	nc	3E+02	1E+01
1.1E-02	i			1.1E-02	i		0	0.10	88-06-2	2,4,6-Trichlorophenol	4.4E+01	ca	2.2E+02	ca	6.2E-01	ca	6.1E+00	ca	2E-01	8E-03
		1.0E-02	i			1.0E-02	r 0	0.10	93-76-5	2,4,5-Trichlorophenoxyacetic Acid	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
		8.0E-03	i			8.0E-03	r 0	0.10	93-72-1	2-(2,4,5-Trichlorophenoxy) propionic acid	4.9E+02	nc	7.0E+03	nc	2.9E+01	nc	2.9E+02	nc		
		5.0E-03	i			5.0E-03	r 1		598-77-6	1,1,2-Trichloropropane	1.5E+01	nc	5.1E+01	nc	1.8E+01	nc	3.0E+01	nc		
7.0E+00	h	6.0E-03	i	7.0E+00	r	5.0E-03	r 1		96-18-4	1,2,3-Trichloropropane	1.4E-03	ca	3.1E-03	ca	9.6E-04	ca	1.6E-03	ca		
		5.0E-03	h			5.0E-03	r 1		96-19-5	1,2,3-Trichloropropene	1.2E+01	nc	3.9E+01	nc	1.8E+01	nc	3.0E+01	nc		
		3.0E+01	i			8.6E+00	h 1		76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	5.6E+03	sat	5.6E+03	sat	3.1E+04	nc	5.9E+04	nc		
		3.0E-03	i			3.0E-03	r 0	0.10	58138-08-2	Tridiphane	1.8E+02	nc	2.6E+03	nc	1.1E+01	nc	1.1E+02	nc		
		2.0E-03	r			2.0E-03	i 1		121-44-8	Triethylamine	2.3E+01	nc	8.8E+01	nc	7.3E+00	nc	1.2E+01	nc		
7.7E-03	i	7.5E-03	i	7.7E-03	r	7.5E-03	r 0	0.10	1582-09-8	Trifluralin	6.3E+01	ca**	3.2E+02	ca*	8.7E-01	ca*	8.7E+00	ca*		
		5.0E-02	n			1.7E-03	n 1		95-63-6	1,2,4-Trimethylbenzene	5.7E+00	sat	5.7E+00	sat	6.2E+00	nc	1.2E+01	nc		
		5.0E-02	n			1.7E-03	n 1		108-67-8	1,3,5-Trimethylbenzene	2.1E+01	nc	7.0E+01	nc	6.2E+00	nc	1.2E+01	nc		
3.7E-02	h			3.7E-02	r		0	0.10	512-56-1	Trimethyl phosphate	1.3E+01	ca	6.7E+01	ca	1.8E-01	ca	1.8E+00	ca		
		3.0E-02	i			3.0E-02	r 0	0.10	99-35-4	1,3,5-Trinitrobenzene	1.8E+03	nc	2.6E+04	nc	1.1E+02	nc	1.1E+03	nc		
		1.0E-02	h			1.0E-02	r 0	0.10	479-45-8	Trinitrophenylmethylnitramine	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
3E-02	i	5.0E-04	i	3E-02	r	5.0E-04	r 0	0.10	118-96-7	2,4,6-Trinitrotoluene	1.6E+01	ca**	8.2E+01	ca**	2.2E-01	ca**	2.2E+00	ca**		
		7.0E-03	h				0		7440-62-2	Vanadium	5.5E+02	nc	1.4E+04	nc			2.6E+02	nc	6E+03	3E+02
		9.0E-03	i				0		1314-62-1	Vanadium pentoxide	7.0E+02	nc	1.8E+04	nc			3.3E+02	nc	6E+03	3E+02
		2.0E-02	h				0		13701-70-7	Vanadium sulfate	1.6E+03	nc	4.1E+04	nc			7.3E+02	nc	6E+03	3E+02
		1.0E-03	i			1.0E-03	r 0	0.10	1929-77-7	Vernam	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
		2.5E-02	i			2.5E-02	r 0	0.10	50471-44-8	Vinclozolin	1.5E+03	nc	2.2E+04	nc	9.1E+01	nc	9.1E+02	nc		
		1.0E+00	h			5.7E-02	i 1		108-05-4	Vinyl acetate	4.3E+02	nc	1.4E+03	nc	2.1E+02	nc	4.1E+02	nc	2E+02	8E+00
1.1E-01	r	8.6E-04	r	1.1E-01	h	8.6E-04	i 1		593-60-2	Vinyl bromide (bromoethene)	1.9E-01	ca*	4.2E-01	ca*	6.1E-02	ca*	1.0E-01	ca*		
1.9E+00	h			3.0E-01	h		1		75-01-4	Vinyl chloride	2.2E-02	ca	4.9E-02	ca	2.2E-02	ca	2.0E-02	ca	1E-02	7E-04
		3.0E-04	i			3.0E-04	r 0	0.10	81-81-2	Warfarin	1.8E+01	nc	2.6E+02	nc	1.1E+00	nc	1.1E+01	nc		
		2.0E+00	i			2.0E-01	x 1	0.10	1330-20-7	Xylenes	2.1E+02	sat	2.1E+02	sat	7.3E+02	nc	1.4E+03	nc	2E+02	1E+01
		3.0E-01	i				0		7440-66-6	Zinc	2.3E+04	nc	1.0E+05	max			1.1E+04	nc	1E+04	6E+02
		3.0E-04	i				0		1314-84-7	Zinc phosphide	2.3E+01	nc	6.1E+02	nc			1.1E+01	nc		
		5.0E-02	i			5.0E-02	r 0	0.10	12122-67-7	Zineb	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc		

Appendix D

Plate 1. Areas Sampled at the Former KPC Pulp Mill

TARGET SHEET: Oversized Document

This document was not imaged due to the original being oversized. Oversized documents are located at the Superfund Records Center. Please contact the Records Center Help Desk at 206-553-4494 for assistance.

If this oversized material is part of another document, fill out below information:

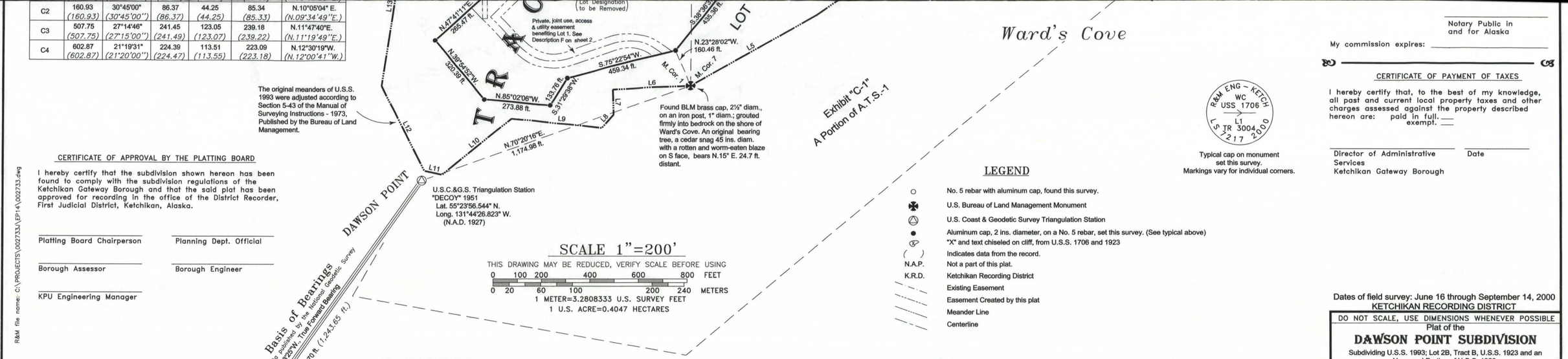
This oversized document is a part of Doc ID: 1109617

Oversized Document Title (if any):

3 OVERSIZES:
1-PLATE OF THE DAWSON POINT SUBDIVISION. 1 OF 2.
2-PLATE OF THE DAWSON POINT SUBDIVISION. 2 OF 2.
3-PLATE 1. AREAS SAMPLED AT THE FORMER KPC PULP MILL.

Region 10
1200 Sixth Ave.
Seattle, WA 98101

C2	160.93 *(160.93)*	30°45'00" *(30°45'00")*	86.37 *(86.37)*	44.25 *(44.25)*	85.34 *(85.33)*	N.10°05'04" E. *(N.09°34'49"E.)*
C3	507.75 *(507.75)*	27°14'46" *(27°15'00")*	241.45 *(241.49)*	123.05 *(123.07)*	239.18 *(239.22)*	N.11°47'40"E. *(N.11°19'49"E.)*
C4	602.87 *(602.87)*	21°19'31" *(21°20'00")*	224.39 *(224.47)*	113.51 *(113.55)*	223.09 *(223.18)*	N.12°30'19"W. *(N.12°00'41"W.)*



The original meanders of U.S.S. 1993 were adjusted according to Section 5-43 of the Manual of Surveying Instructions - 1973, Published by the Bureau of Land Management.

Found BLM brass cap, 2½" diam., on an iron post, 1" diam.; grouted firmly into bedrock on the shore of Ward's Cove. An original bearing tree, a cedar snag 45 ins. diam. with a rotten and worm-eaten blaze on S face, bears N.15° E. 24.7 ft. distant.

U.S.C.&G.S. Triangulation Station "DECOY" 1951
Lat. 55°23'56.544" N.
Long. 131°44'26.823" W.
(N.A.D. 1927)

U.S.C.&G.S. Triangulation Station "ABIDE" 1951
Lat. 55°23'46.541" N.
Long. 131°44'39.270" W.
(N.A.D. 1927)

SCALE 1"=200'

THIS DRAWING MAY BE REDUCED, VERIFY SCALE BEFORE USING

0 100 200 400 600 800 FEET

0 20 60 100 200 240 METERS

1 METER=3.2808333 U.S. SURVEY FEET

1 U.S. ACRE=0.4047 HECTARES

CERTIFICATE OF APPROVAL BY THE PLATTING BOARD

I hereby certify that the subdivision shown hereon has been found to comply with the subdivision regulations of the Ketchikan Gateway Borough and that the said plat has been approved for recording in the office of the District Recorder, First Judicial District, Ketchikan, Alaska.

Platting Board Chairperson

Planning Dept. Official

Borough Assessor

Borough Engineer

KPU Engineering Manager

SURVEYOR'S CERTIFICATE

I hereby certify that I am properly registered and licensed to practice land surveying in the State of Alaska, that this plat represents a survey made by me or under my direct supervision, that the monuments shown hereon actually exist as described, and that all dimensions and other details are correct.

Date _____ Registration Number: LS-7217

Registered Land Surveyor

PLAT NOTES

Number of lots before this plat: 3
Number of lots after this plat: 2
Present Zoning: IH & CG
Proposed Zoning: IH & CG
Area of subdivision: 65.554 Acres
Area dedicated to right-of-way: 0 Acres

LEGEND

- ○ No. 5 rebar with aluminum cap, found this survey.
- ✱ U.S. Bureau of Land Management Monument
- △ U.S. Coast & Geodetic Survey Triangulation Station
- ● Aluminum cap, 2 ins. diameter, on a No. 5 rebar, set this survey. (See typical above)
- "X" and text chiseled on cliff, from U.S.S. 1706 and 1923
- ( ) Indicates data from the record.
- N.A.P. Not a part of this plat.
- K.R.D. Ketchikan Recording District
- Existing Easement
- Easement Created by this plat
- Meander Line
- Centerline

R&M ENG – KETCH WC USS 1706 L1 TR 3004 LS 7217 2000

Typical cap on monument set this survey. Markings vary for individual corners.

Notary Public in and for Alaska

My commission expires: _____

CERTIFICATE OF PAYMENT OF TAXES

I hereby certify that, to the best of my knowledge, all past and current local property taxes and other charges assessed against the property described hereon are: paid in full. ___ exempt. ___

Director of Administrative Services
Ketchikan Gateway Borough

Date

Dates of field survey: June 16 through September 14, 2000

KETCHIKAN RECORDING DISTRICT

DO NOT SCALE, USE DIMENSIONS WHENEVER POSSIBLE

Plat of the

DAWSON POINT SUBDIVISION

Subdividing U.S.S. 1993; Lot 2B, Tract B, U.S.S. 1923 and an Unnamed Portion of U.S.S. 1923; Creating Tract 3004, composed of Lots 1 & 2

CLIENT: Ketchikan Pulp Co.
P.O. Box 6600
Ketchikan, AK 99901

R&M ENGINEERING–KETCHIKAN, INC.
P.O. BOX 9592 Phone: (907) 225–7917
KETCHIKAN, ALASKA 99901 Fax: (907) 225–3441

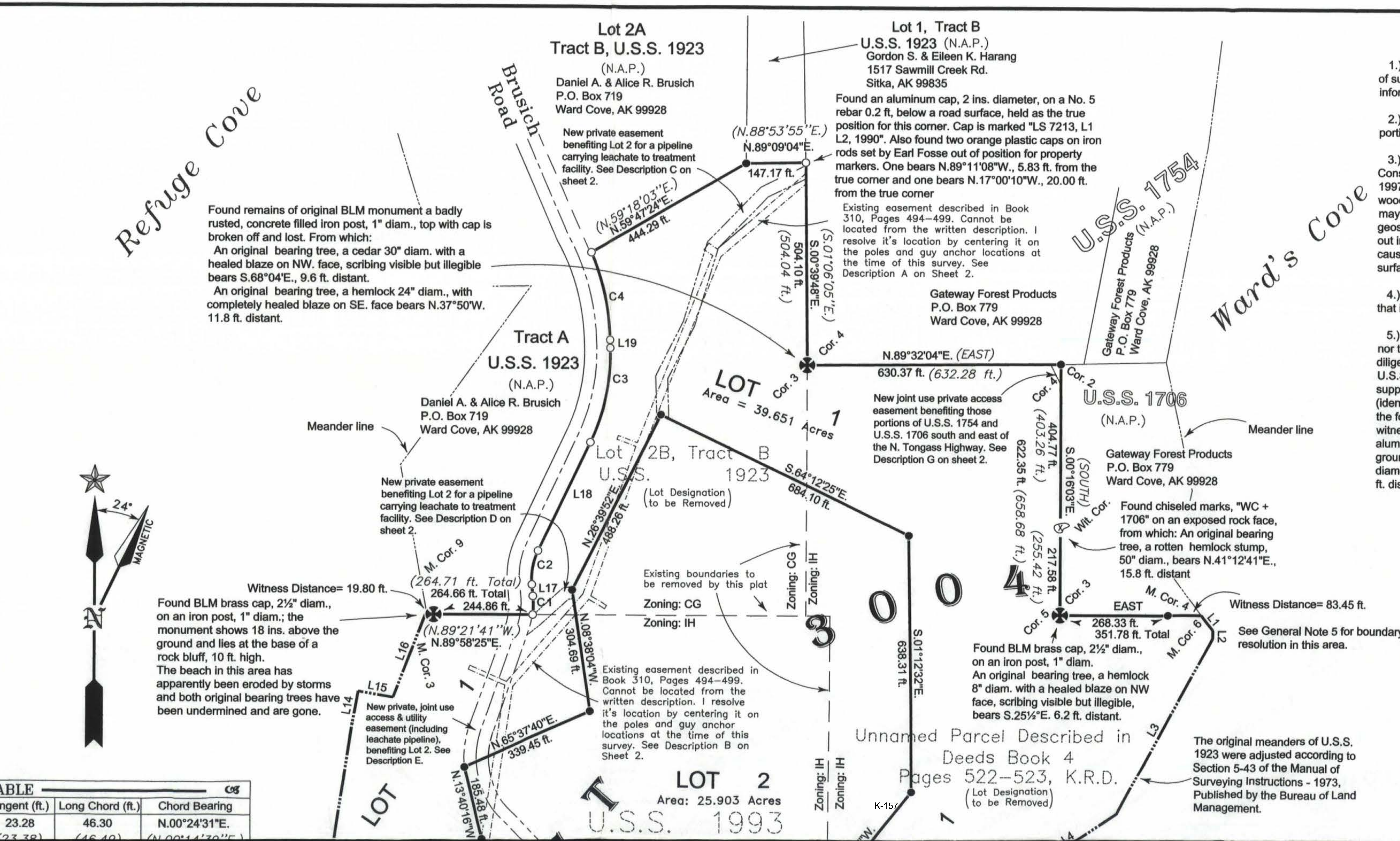
REVISION	DATE	DESCRIPTION	APPROVED
REVISIONS			

DATE: Sept. 19, 2000	DRAWN BY: J.P.P.	JOB NO. 002733
SCALE: 1 in. = 200 ft.	APPRVD BY:	SHEET 1 OF 2

R&M file name: C:\PROJECTS\002733\EP14\002733.dwg

C:\WINDOWS\DESKTOP\002733.dwg Thu Jan 11 17:02:00 2001 Little John's Workstation

LINE TABLE		
NUMBER	DIRECTION	DISTANCE
L1 Meander	S.39°01'46"E. (S.40°00'E.)	46.85 ft. (46.20 ft.)
L2 Meander	S.00°13'59"W. (SOUTH)	20.23 ft. (19.80 ft.)
L3 Meander	S.27°52'39"W. (S.28°15'W.)	498.74 ft. (488.40 ft.)
L4 Meander	S.55°56'01"W. (S.56°50'W.)	245.31 ft. (241.56 ft.)
L5 Meander	S.60°17'06"W. (S.61°15'W.)	595.77 ft. (587.40 ft.)
L6 Meander	S.86°54'42"W. (S.87°03'W.)	320.94 ft. (320.76 ft.)
L7 Meander	S.02°10'09"E. (S.02°12'E.)	105.86 ft. (105.60 ft.)
L8 Meander	S.41°00'39" W. (S.41°05'W.)	72.75 ft. (72.60 ft.)
L9 Meander	N.84°12'30" W. (N.84°04'W.)	376.27 ft (376.20 ft.)
L10 Meander	S.50°39'29"W. (S.50°45'W.)	368.98 ft. (368.28 ft.)
L11 Meander	N.77°52'31"W. (N.77°44'W.)	75.23 ft. (75.24 ft.)
L12 Meander	N.27°11'12"W. (N.27°06'W.)	391.93 ft. (392.70 ft.)
L13 Meander	N.08°12'41"E. (N.08°13'E.)	662.97 ft. (664.62 ft.)
L14 Meander	N.10°06'58"E. (N.10°07'E.)	82.30 ft. (82.50 ft.)
L15 Meander	S.79°51'28"E. (S.80°00'E.)	85.80 ft. (85.80 ft.)
L16 Meander	N.20°43'32"E. (N.20°42'E.)	227.14 ft. (227.70 ft.)
L17	N.05°26'21"W. (N.05°47'41"W.)	28.67 ft. (28.60 ft.)
L18	N.25°21'06"E. (N.24°57'19"E.)	298.57 ft. (298.70 ft.)
L19	N.01°50'09"W. (N.02°17'41"W.)	20.00 ft. (20.00 ft.)



NOTES

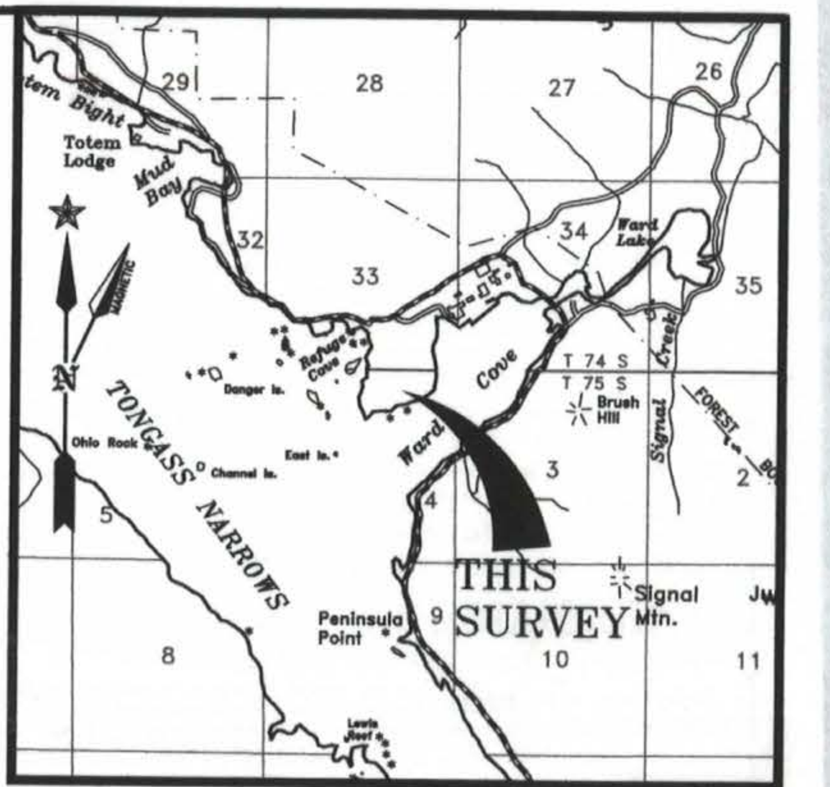
1.) The Alaska Dept. of Environmental Conservation has suspended their program of subdivision review at the time of this survey. Contact the Department for information about their requirements for development of lots within this subdivision.

2.) This plat combines U.S.S. 1993; Lot 2B, Tract B, U.S.S. 1923; and an unnamed portion of U.S.S. 1923 into Tract 3004; and then subdivides Tract 3004 into two lots.

3.) Lot 2 of Tract 3004 is subject to the terms of the Alaska Dept. of Environmental Conservation Solid Waste Disposal Permit No. 9713-BA001, dated September 8, 1997. Subsequent landowners are hereby notified that wastes, including boiler ash, woodwaste and dredged material have been buried on Lot 2 and are warned that it may be hazardous to develop a water supply for drinking water purposes. A geosynthetic liner has been placed over the waste and operations should be carried out in a way that does not rupture the integrity of the liner. Rupture of the liner can be caused by the operation of heavy machinery or the construction of buildings on the surface.

4.) Subsequent landowners of Lot 1 are hereby notified, due to its proximity to Lot 2, that it may be hazardous to develop a water supply for drinking water purposes.

5.) Neither the monument for the Witness Corner to Meander Corner 6, U.S.S. 1993 nor the monument for Meander Corner 4 of U.S.S. 1706 were found despite several diligent searches. The accessories described in the field notes of U.S.S. 1706 and U.S.S. 1993 were also not found. An apparent bearing tree was found, but it is not supported by the record. I restore the position of Meander Corner 4 of U.S.S. 1706 (identical to Meander Corner 6, U.S.S. 1993) at the record bearing and distance from the found position of Corner 5, U.S.S. 1993 (identical to Corner 3 U.S.S. 1706). A witness corner was set this survey, as shown on this plat. That witness corner is an aluminum cap, 2" in diameter, fixed to the top of a No. 5 rebar, 30" long, set 25 " in the ground, from which: An apparent old bearing tree, a rotted hemlock stump, 30" diameter, blazed and scribed on the NNW face "C4 S17...BT" bears S.55°27'E., 66.4 ft. distant.



VICINITY MAP

SCALE: 1 INCH = 1 MILE
SOURCE: U.S.G.S. Quadrangle Ketchikan B-6, Alaska

OWNER'S CERTIFICATE

I hereby certify that Ketchikan Pulp Co. is the owner of U.S.S. 1993; Lot 2B, Tract B of U.S.S. 1923; and that portion of U.S.S. 1923 described in Deeds Book 4, pages 522–523 as shown hereon and that I hereby approve the plat of this survey.

____
for Ketchikan Pulp Co.

NOTARY'S ACKNOWLEDGMENT

State of Alaska)
)SS
First Judicial District)

The foregoing instrument was acknowledged before me this ________ day of ______________, 20___ by:

CURVE TABLE						
NUMBER	Radius (ft.)	Delta	Length (ft.)	Tangent (ft.)	Long Chord (ft.)	Chord Bearing
C1	220.97 (220.97)	12°01'39" (12°04'40")	46.39 (46.58)	23.28 (23.38)	46.30 (46.49)	N.00°24'31"E. (N.00°14'39"E.)

COMMENCING at the Witness Corner to Meander Corner 3 of U.S.S. 1993, a BLM brass cap on an iron pipe;

Thence N.89°58'25"E., along line 8-9 of U.S.S. 1923, 244.86 ft. to an aluminum cap, 2 ins. diameter, on a No. 5 rebar, the southwest corner of Lot 2B of Tract B as shown on the plat recorded as Plat 90-25 in the Ketchikan Recording District.

Thence across Lot 1, Tract 3004, along the east boundary of the parcel described in Description E, on a curve to the right with a radius of 220.97 ft., through an arc of 1.74 ft., a central angle of 00°27'03", with a chord direction of S.06°38'52"W. and chord distance of 1.74 ft. to the POINT OF BEGINNING.

Thence N.51°31'58"E., 2.90 ft.

Thence N.47°19'08"E., 97.85 ft.

Thence N.80°56'38"E., 28.07 ft. to the boundary of Lot 2, Tract 3004.

Thence S.26°39'52"W., along the boundary of Lot 2, Tract 3004, 10.19 ft. to an aluminum cap, 2 ins. diameter, on a No. 5 rebar.

Thence S.08°38'04" E., continuing along the boundary of Lot 2, Tract 3004, 21.73 ft.

Thence S.80°56'38"W., across Lot 1, Tract 3004, 12.89 ft.

Thence S.47°19'08"W., 89.89 ft.

Thence S.51°31'58"W., 41.87 ft. to the east boundary of the parcel described in Description E.

Thence N.19°20'38"E., along the east boundary of the parcel described in Description E., 0.31 ft.

Thence continuing along the east boundary of the parcel described in Description E, on a curve to the left with a radius of 220.97 ft., through an arc of 48.41 ft., a central angle of 12°28'17", with a chord direction of N.13°06'33"E. and chord distance of 48.00 ft. to the POINT OF BEGINNING. This parcel is bounded on the north south and west by Lot 1, Tract 3004; on the east by Lot 2, Tract 3001 and contains 3,996 sq. ft., more or less.

Thence S.65°37'40"W. along the boundary of Lot 2, Tract 3004, 64.60 ft. to an aluminum cap, 2 ins. diameter, on a No. 5 rebar.

Thence across Lot 1, Tract 3004 on a curve to the right with a radius of 250.00 ft. through a central angle of 24°53'24", an arc of 108.60 ft., with a chord direction of N.06°53'59"E. and chord distance of 107.75 ft.

Thence N.19°20'38"E., tangent to the previous curve, 258.62 ft.

Thence on a curve to the left, tangent to the previous course, with a radius of 160.97 ft. through a central angle of 10°30'07" and an arc of 29.50 ft. with a chord direction of N.14°05'38"E. and a chord distance of 29.46 ft. to line 8-9 of U.S.S. 1923.

Thence N.89°58'25"E. along, line 8-9 of U.S.S. 1923, 60.53 ft. to the POINT OF BEGINNING. This parcel is bounded on the north by Brusich Road, on the east and west by Tract 1, Tract 3004 and on the south by Lot 2, Tract 3004 and contains 23,010 sq. ft., more or less.

DESCRIPTION G

All that parcel of land, entirely within Lot 1, Tract 3004 of the Dawson Point Subdivision, Ketchikan Recording District, Alaska; being more particularly described as follows.

COMMENCING at Corner 4 of U.S.S. 1923, identical to Corner 2 of U.S.S. 1706, which was relocated in the survey for the Dawson Point Subdivision and marked with an aluminum cap, 2 ins. diameter, on a No. 5 rebar set 2 ins. below the surface of a shot rock road, the POINT OF BEGINNING.

Thence S.00°16'03"E. along line 2-3 of U.S.S. 1706 and the boundary of Lot 1 of Tract 3004, 50.00 ft.

Thence N.26°52'19"W. across Lot 1 of Tract 3004, 55.82 ft. to line 4-5 of U.S.S. 1754

Thence N.89°32'04"E. along line 4-5 of U.S.S. 1754 and the boundary of Lot 1 of Tract 3004, 25.00 ft. to the POINT OF BEGINNING. This parcel is bounded on the north by U.S.S. 1754 on the east by U.S.S. 1706 and on the southwest by Lot 1 of Tract 3004, containing 625 sq. ft., more or less.

Thence S.70°17'34"W. tangent to the previous curve, 182.81 ft.

Thence on a curve to the right, tangent to the previous course, with a radius of 230.00 ft., through a central angle of 65°05'56" and an arc of 261.32 ft., with a chord direction of N.77°09'28"W. and a chord distance of 247.49 ft.

Thence N.44°36'30" W., tangent to the previous curve, 255.48 ft. to the boundary of Lot 1, Tract 3004.

Thence N.47°41'11"E., along the boundary of Lot 1, Tract 3004, 64.96 ft. to an aluminum cap, 2 ins. diameter, on a No. 5 rebar.

Thence N.13°40'16"W., continuing along the boundary of Lot 1, Tract 3004, 185.48 ft to an aluminum cap, 2 ins. diameter, on a No. 5 rebar.

Thence N.65°37'40"E. along the boundary of Lot 1, Tract 3004, and the boundary of the parcel described in Description E, 64.60 ft.

Thence, across Lot 2, Tract 3004, on a curve to the left not tangent to the previous course, with a radius of 190.00 ft., through a central angle of 45°21'46" and an arc of 150.43 ft., with a chord direction of S.21°55'37"E. and a chord distance of 146.53 ft.

Thence S.44°36'30"E., tangent to the previous curve, 110.94 ft.

Thence S.45°23'30"W. 104.37 ft.

Thence S.44°36'30"E., 143.49 ft.

Thence on a curve to the left, tangent to the previous course, with a radius of 170.00 ft., through a central angle of 65°05'56" and an arc of 193.15 ft., with a chord direction of S.77°09'28"E. and a chord distance of 182.93 ft.

Thence N.70°17'34"E., tangent to the previous curve, 182.81 ft.

Thence on a curve to the right, tangent to the previous course with a radius of 230.00 ft., through a central angle of 52°42'55" and an arc of 211.61 ft., with a chord direction of S.83°20'58"E. and a chord distance of 204.23 ft.

Thence S.56°59'31"E., 65.53 ft. to the POINT OF BEGINNING. This parcel is bounded on the northeast and south by Lot 2, Tract 3004, on the southeast by Lot 1, Tract 3004, and on the west and northwest by Lot 1, Tract 3004 and the parcel described in Description E, containing 75,806 sq. ft., more or less.

KETCHIKAN RECORDING DISTRICT

DO NOT SCALE, USE DIMENSIONS WHENEVER POSSIBLE

Plat of the

DAWSON POINT SUBDIVISION

Subdividing U.S.S. 1993; Lot 2B, Tract B, U.S.S. 1923 and an Unnamed Portion of U.S.S. 1923; Creating Lots 1 & 2 Tract 3004

CLIENT: Ketchikan Pulp Co.
P.O. Box 6600
Ketchikan, AK 99901

R&M ENGINEERING–KETCHIKAN, INC.
P.O. BOX 9592 Phone: (907) 225–7917
KETCHIKAN, ALASKA 99901 Fax: (907) 225–3441

REVISION	DATE	DESCRIPTION	APPROVED
REVISIONS			

DATE: Sept. 19, 2000	DRAWN BY: J.P.P.	JOB NO. 002733
SCALE: None	APPRVD BY:	SHEET 2 OF 2

DESCRIPTION A

All that parcel of land, centered on an existing system of utility poles and associated guy structures, entirely within Lot 2B, Tract B, U.S.S. 1923 as shown on the plat recorded as Plat 90-25 in the Ketchikan Recording District, Alaska; being more particularly described as follows.

COMMENCING at Corner 2 of U.S.S. 1923, a rusted iron pipe filled with concrete, the remains of the original monument;

Thence S.00°39'48"E., along line 3-4 of U.S.S. 1754, 351.25 ft to an aluminum cap, 2 ins. diameter, on a No. 5 rebar set 0.2 ft below the surface of a road, the northeast corner of Lot 2B, Tract B, U.S.S. 1923.

Thence S.00°39'48"E., continuing along line 3-4 of U.S.S. 1754, 26.65 ft. to the POINT OF BEGINNING.

Thence S.00°39'48"E., continuing along line 3-4 of U.S.S. 1754, 26.26 ft.

Thence S.48°57'00"W., across Lot 2B of Tract B, 277.09 ft.

Thence S.21°40'17"W., 511.03 ft.

Thence S.19°27'12"W., 391.97 ft.

Thence S.59°53'23"E., 45.76 ft.

Thence S.30°06'37"W., 10.00 ft.

Thence N.59°53'23"W., 45.76 ft.

Thence S.40°46'02"W., 50.50 ft. to line 2-3 of U.S.S. 1993

Thence S.89°58'25"W., along line 2-3 of U.S.S. 1993, 26.42 ft.

Thence across Lot 2B, Tract B, N.40°46'02"E., 69.08 ft.

Thence N.19°27'12"E., 388.68 ft.

Thence N.69°26'15"W., 50.00 ft.

Thence N.19°45'37"E., 10.00 ft.

Thence S.69°26'15"E., 50.14 ft.

Thence N.21°40'17"E., 500.98 ft.

Thence N.54°41'21"W., 25.54 ft.

Thence N.35°18'39"E., 20.00 ft.

Thence S.54°41'21"E., 25.54 ft.

Thence N.48°57'00"E., 288.67 ft. to the POINT OF BEGINNING. This parcel is bounded on the northeast by U.S.S. 1754, on the southeast and northwest by Lot 2B, Tract B, U.S.S. 1923 and on the south by U.S.S. 1923; containing 26,630 sq. ft., more or less.

DESCRIPTION D

All that parcel of land, centered on an existing pair of high density polyethylene pipelines, entirely within Lot 1, Tract 3004 of the Dawson Point Subdivision, Ketchikan Recording District, Alaska; being more particularly described as follows.

DESCRIPTION B

All that parcel of land, centered on an existing system of utility poles and associated guy structures, entirely within U.S.S. 1993, Ketchikan Recording District, Alaska; being more particularly described as follows.

COMMENCING at the Witness Corner to the Meander Corner 3 of U.S.S. 1993, a BLM brass cap, 2½ ins. diam., on an iron pipe, 1 in. diam.

Thence N.89°58'25"E., along line 8-9 of U.S.S. 1923, 244.86 ft. to an aluminum cap, 2 ins. diam. on a No. 5 rebar, the southwest corner of Lot 2B, Tract B of U.S.S. 1923 as shown on the plat recorded as Plat 90-25 in the Ketchikan Recording District.

Thence N.89°58'25"E., continuing along line 8-9 of U.S.S. 1923, 79.42 ft. to the POINT OF BEGINNING.

Thence N.89°58'25"E., continuing along line 8-9 of U.S.S. 1923, 26.42 ft.

Thence S.40°46'02"W., across U.S.S. 1923, 236.14 ft.

Thence S.08°09'04"W., 402.34 ft.

Thence S.00°49'04"E., 69.91 ft.

Thence S.89°10'56"W., 20.00 ft.

Thence N.00°49'04"W., 71.48 ft.

Thence N.08°09'04"E., 404.40 ft.

Thence N.66°24'20"W., 98.56 ft.

Thence N.24°03'48"E., 10.00 ft.

Thence S.66°24'20"E., 98.55 ft.

Thence N.40°46'02"E., 219.66 ft. to the POINT OF BEGINNING. This parcel is bounded on the north by Lot 2B, Tract B, U.S.S. 1923 and on the east, south and west by U.S.S. 1993; containing 1,657 sq. ft., more or less.

DESCRIPTION E

All that parcel of land, centered on an existing shot rock road, entirely within Lot 1, Tract 3004 of the Dawson Point Subdivision, Ketchikan Recording District, Alaska; being more particularly described as follows.

COMMENCING at the Witness Corner to Meander Corner 3 of U.S.S. 1993, a BLM brass cap on an iron pipe;

Thence N.89°58'25"E., along line 8-9 of U.S.S. 1923, 244.86 ft. to an aluminum cap, 2 ins. diameter, on a No. 5 rebar, the southwest corner of Lot 2B of Tract B as shown on the plat recorded as Plat 90-25 in the Ketchikan Recording District and the POINT OF BEGINNING of this parcel.

Thence across Lot 1, Tract 3004 on a curve to the right with a radius of 220.97 ft., through a central angle of 12°55'20", an arc of 49.84 ft. and a chord direction of S.12°53'01"W. and a chord distance of 49.73 ft.

Thence S.19°20'38"W., tangent to the previous curve, 258.62 ft.

Thence on a curve to the left, tangent to the previous course, with a radius of 190.00 ft., through a central angle of 18°35'25", an arc of 61.65 ft. and a chord direction of S.10°02'58"W. and a chord distance of 61.38 ft. to the boundary of Lot 2, Tract 3004.

DESCRIPTION C

All that parcel of land, centered on an existing pair of high density polyethylene pipelines, entirely within Lot 1, Tract 3004 of the Dawson Point Subdivision, Ketchikan Recording District, Alaska; being more particularly described as follows.

COMMENCING at Corner 2 of U.S.S. 1923, a rusted iron pipe filled with concrete, the remains of the original monument;

Thence S.00°39'48"E., along line 3-4 of U.S.S. 1754, 351.25 ft. to an aluminum cap, 2 ins. diameter, on a No. 5 rebar set 0.2 ft. below the surface of a road, the northeast corner of Lot 2B, Tract B, U.S.S. 1923, shown on the plat recorded as Plat 90-25 in the Ketchikan Recording District.

Thence continuing along line 3-4 of U.S.S. 1754, S.00°39'48"E., 7.04 ft.

Thence continuing along line 3-4 of U.S.S. 1754, S.00°39'48"E., 33.21 ft.

Thence across Lot 1, Tract 3004, S.63°57'01"W., 102.99 ft.

Thence S.43°52'19"W., 177.03 ft.

Thence S.16°29'28"W., 203.16 ft.

Thence S.26°38'34"W., 147.40 ft.

Thence S.01°50'17"E., 98.25 ft. to the boundary of Lot 2, Tract 3004, Dawson Point Subdivision.

Thence N.64°12'25"W., along the boundary of Lot 2, Tract 3004, 22.00 ft. to an aluminum cap, 2 ins. diam., on a No. 5 rebar.

Thence S.26°39'52"W., continuing along the boundary of Lot 2, Tract 3004, 22.03 ft.

Thence N.01°50'17"W., across Lot 1, Tract 3004, 115.02 ft.

Thence N.26°38'34"E., 152.35 ft.

Thence N.16°29'28"E., 207.80 ft.

Thence N.43°52'19"E, 189.65 ft.

Thence N.63°57'01"E., 122.54 ft. to the POINT OF BEGINNING. This parcel is bounded on the east by U.S.S. 1754, on the southeast and northwest by Lot 1, Tract 3004 and on the south by Lot 2, Tract 3004; it contains 22,500 sq. ft., more or less.

DESCRIPTION F

All that parcel of land, entirely within Lot 2, Tract 3004 of the Dawson Point Subdivision, Ketchikan Recording District, Alaska; being more particularly described as follows.

COMMENCING at the Meander Corner 1 of U.S.S. 1993, a BLM brass cap on an iron pipe;

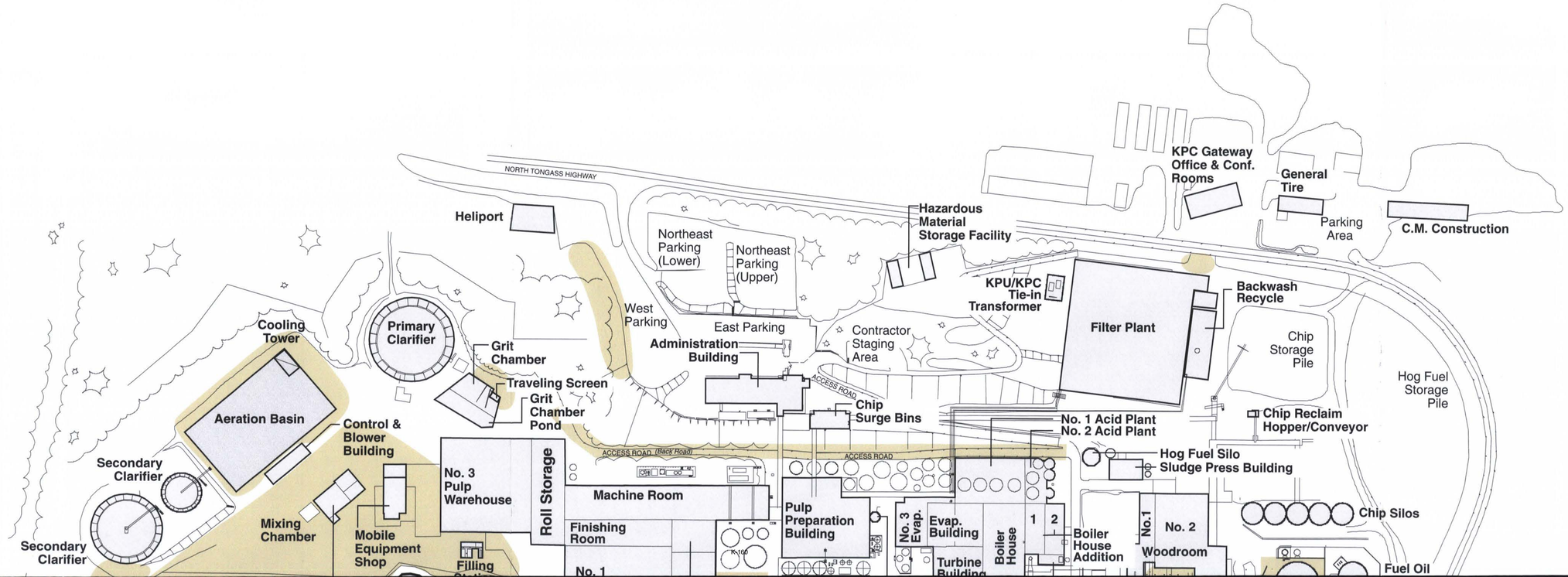
Thence N.23°28'02"W., across Lot 1, Tract 3004, 160.46 ft. to an aluminum cap, 2 ins. diameter, on a No. 5 rebar; a corner of Lot 2, Tract 3004.

Thence S.75°22'54"W. along the boundary of Lot 1, Tract 3004, 14.57 ft. to the POINT OF BEGINNING of this parcel.

Thence continuing along the boundary of Lot 1, Tract 3004, S.75°22'54"W., 81.22 ft.

Thence N.56°59'31"W., across Lot 2, Tract 3004, 10.80 ft.

Thence on a curve to the left, tangent to the previous course, with a radius of 170.00 ft. through a central angle of 52°42'55" and an arc


NORTH TONGASS HIGHWAY
Heliport
Northeast Parking (Lower)
Northeast Parking (Upper)
Hazardous Material Storage Facility
KPC Gateway Office & Conf. Rooms
General Tire
Parking Area
C.M. Construction
KPU/KPC Tie-in Transformer
Filter Plant
Backwash Recycle
West Parking
East Parking
Contractor Staging Area
Administration Building
Cooling Tower
Primary Clarifier
Grit Chamber
Traveling Screen
Grit Chamber Pond
Chip Storage Pile
Hog Fuel Storage Pile
ACCESS ROAD
Chip Surge Bins
Chip Reclaim Hopper/Conveyor
No. 1 Acid Plant
No. 2 Acid Plant
Aeration Basin
Control & Blower Building
ACCESS ROAD (Back Road)
Hog Fuel Silo
Sludge Press Building
Secondary Clarifier
No. 3 Pulp Warehouse
Roll Storage
Machine Room
Chip Silos
Mixing Chamber
Mobile Equipment Shop
Finishing Room
Pulp Preparation Building
No. 3 Evap.
Evap. Building
Boiler House
1
2
Boiler House Addition
No.1
No. 2
Woodroom
Secondary Clarifier
Filling
No. 1
Turbine Building
Fuel Oil

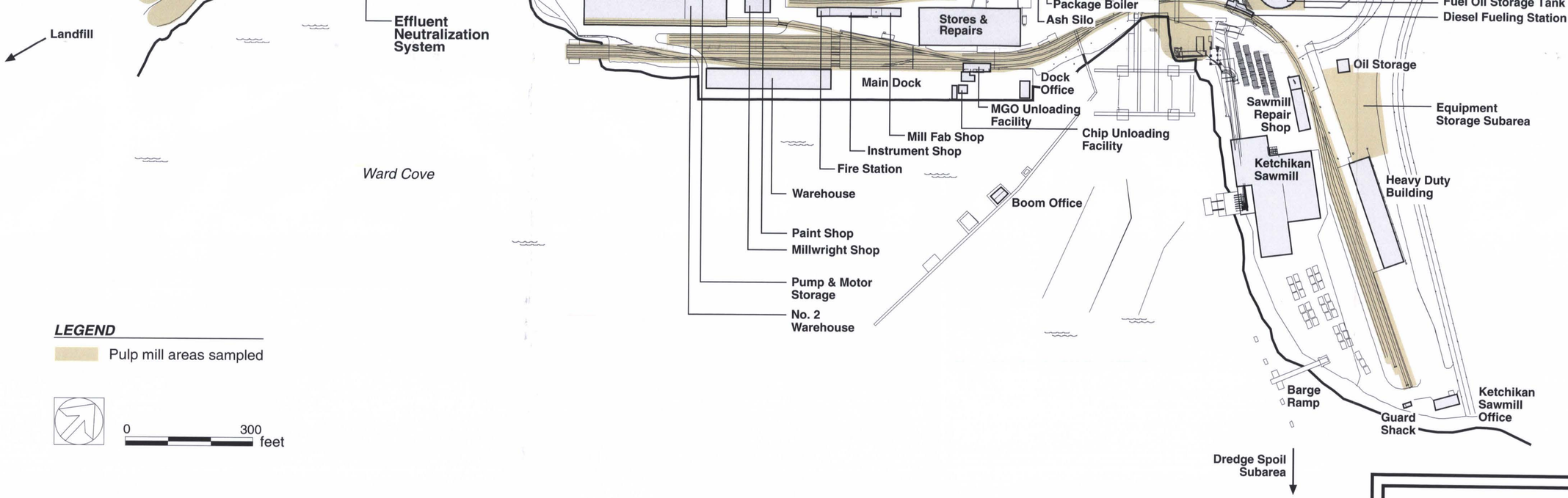


Plate 1. Areas sampled at the former KPC pulp mill.

8600B4Q.001 1006 IC Plan 06/01/00

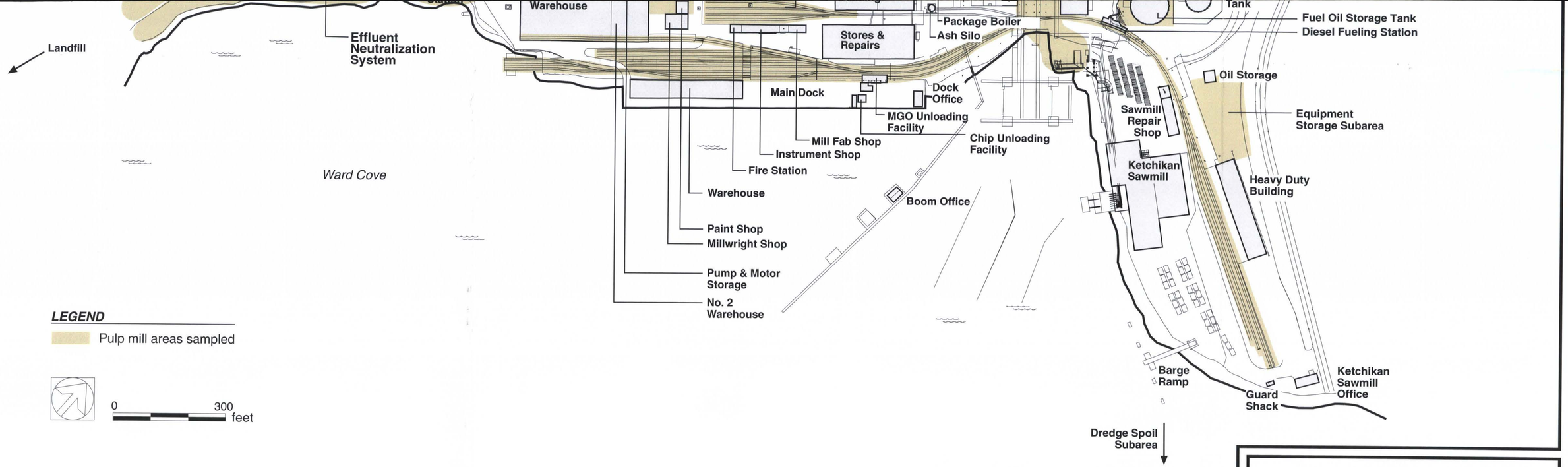
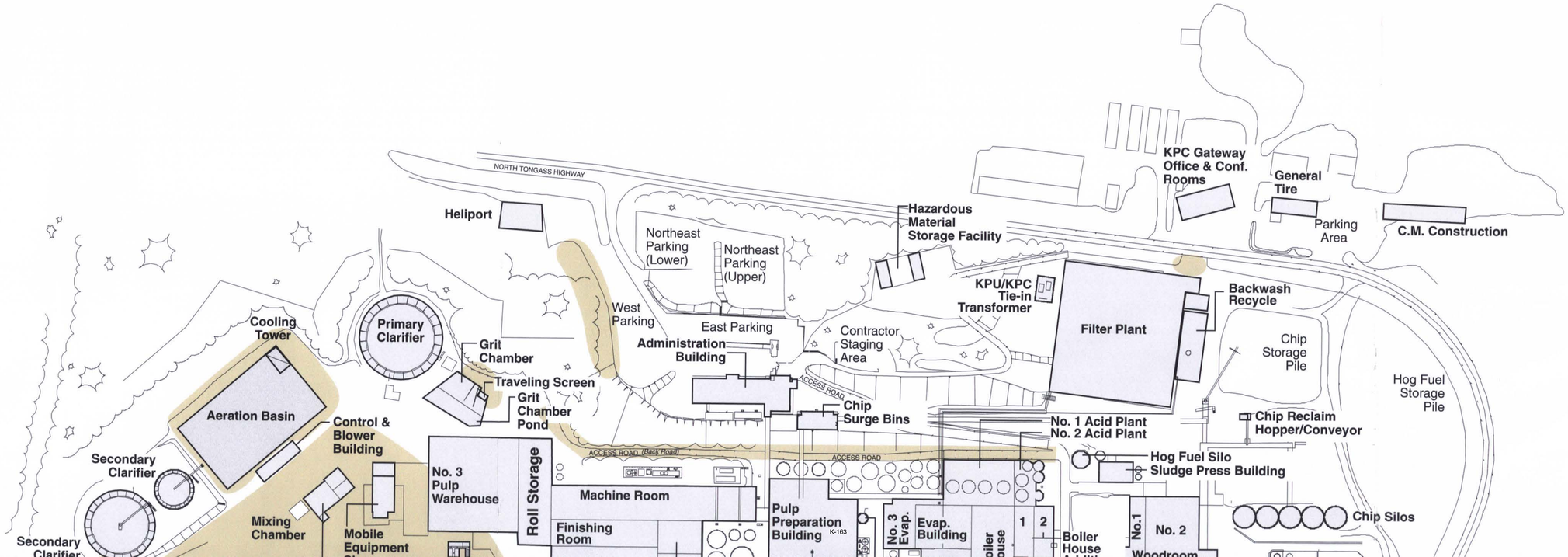


Plate 1. Areas sampled at the former KPC pulp mill.

8600B4Q.001 1006 IC Plan 06/01/00 WA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Contractor Staging Area
KPU/KPC Tie-in Transformer
Filter Plant
Backwash Recycle
Chip Storage Pile
Hog Fuel Storage Pile
Cooling Tower
Primary Clarifier
Grit Chamber
Traveling Screen
Grit Chamber Pond
Aeration Basin
Control & Blower Building
Secondary Clarifier
Secondary Clarifier
Mixing Chamber
Mobile Equipment
ACCESS ROAD
ACCESS ROAD (Back Road)
Chip Surge Bins
No. 1 Acid Plant
No. 2 Acid Plant
Chip Reclaim Hopper/Conveyor
Hog Fuel Silo
Sludge Press Building
Chip Silos
No. 3 Pulp Warehouse
Roll Storage
Machine Room
Finishing Room
Pulp Preparation Building
K-163
No. 3 Evap.
Evap. Building
Boiler House
1
2
Boiler House
No. 1
No. 2
Woodroom