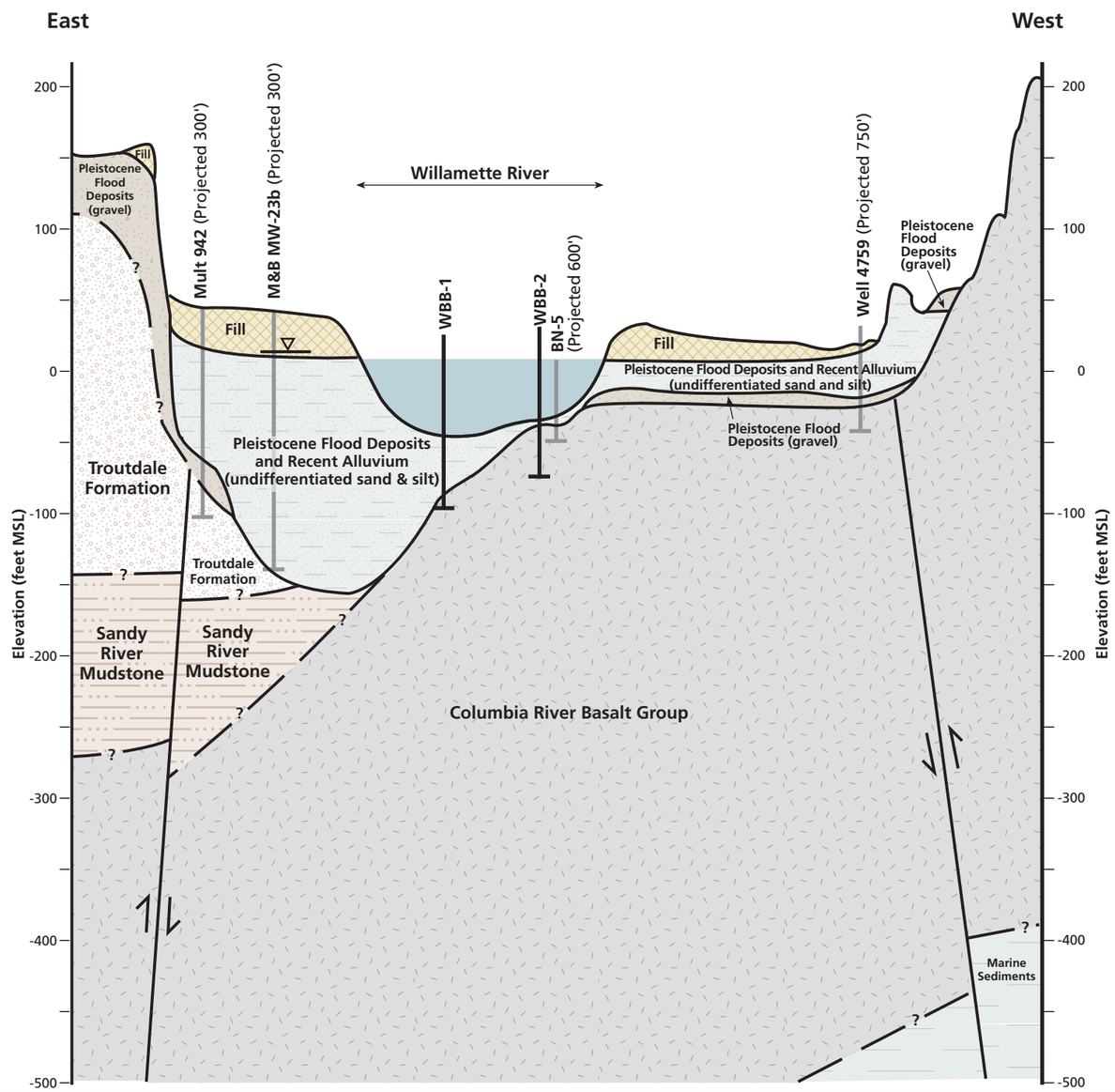
10/22/03 Generalized Geologic Section



LEGEND

0 1,000 2,000

HORIZONTAL SCALE IN FEET
VERTICAL EXAGGERATION = 10X

Notes: Scale and elevations are approximate.
Geologic information from City of Portland Force Main Project (URS 2000) (Beeson, et al. 1991)

Reference: Fault locations and orientation based on Wong (2001)

Mult 53996 — Boring/Well ID (WRD ID where available)

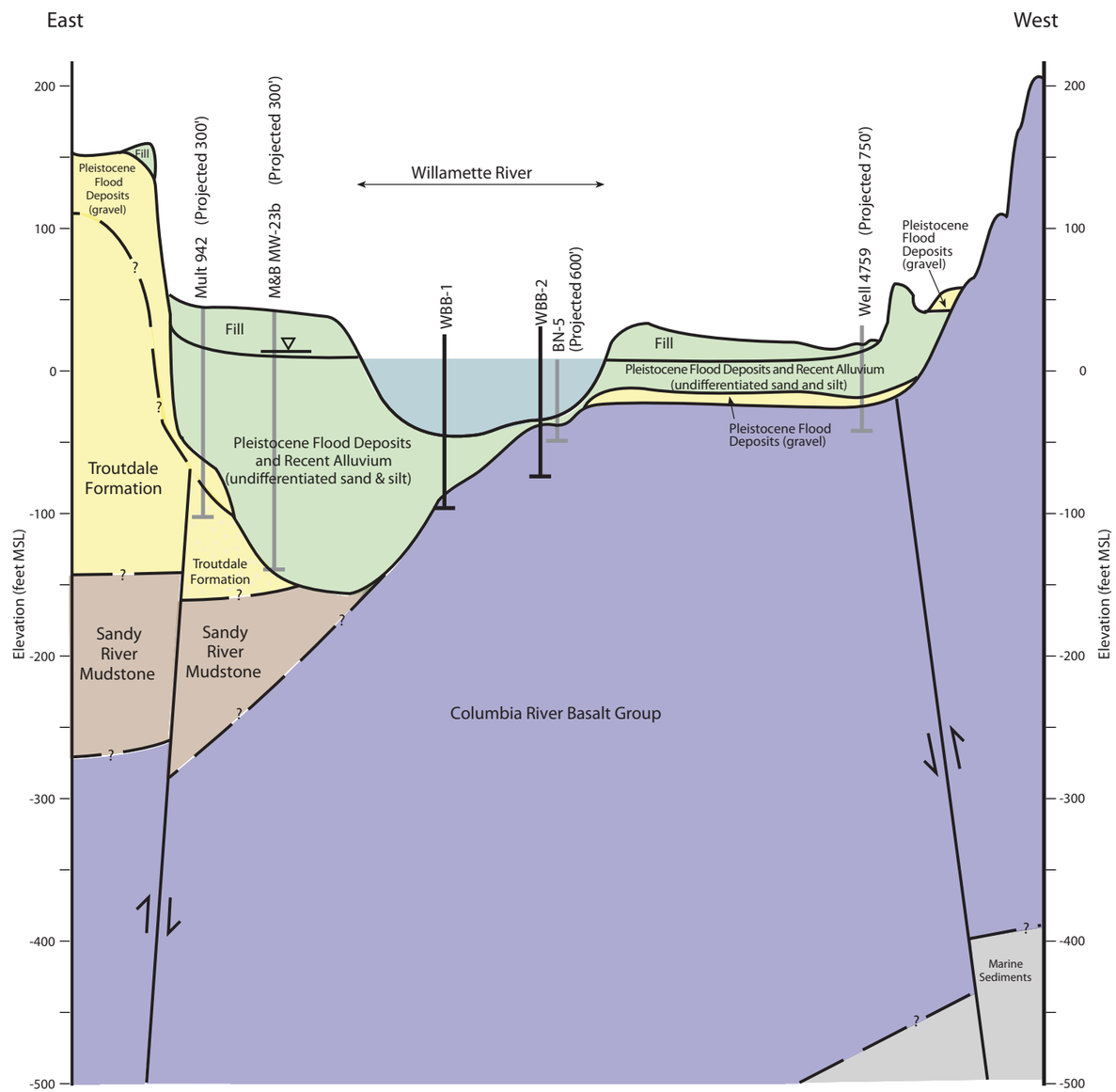
Surface elevation along profile

Boring/Well, Projected

Bottom of boring/well

- Fill
- Pleistocene Flood Deposits and Recent Alluvium (Sand and Silt)
- Pleistocene Flood Deposits (Gravel)
- Troutdale Formation
- Sandy River Mudstone
- Columbia River Basalt
- Marine Sediments

Figure 3.1-1
Portland Harbor RI/FS
Remedial Investigation Report
Generalized Geologic Section



LEGEND

0 1,000 2,000

HORIZONTAL SCALE IN FEET

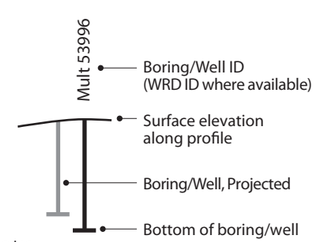
VERTICAL EXAGGERATION = 10X

Notes: Scale and elevations are approximate.

Geologic information from City of Portland Force Main Project (URS 2000) (Beeson, et al. 1991)

Reference: Fault locations and orientation based on Wong (2001)

Adapted from Figure 3.1-1 prepared by Groundwater Solutions Inc.



Hydrogeologic Unit Groupings

- FFA - Fill, Fine-grained Pleistocene Flood Deposits, and Recent Alluvium
- CGF - Coarse-grained Pleistocene Flood Deposits and Upper Troutdale Formation
- Lower Troutdale Formation/Sandy River Mudstone
- Columbia River Basalt Group

Figure 3.1-2
Portland Harbor RI/FS
Remedial Investigation Report
Generalized Hydrogeologic Section

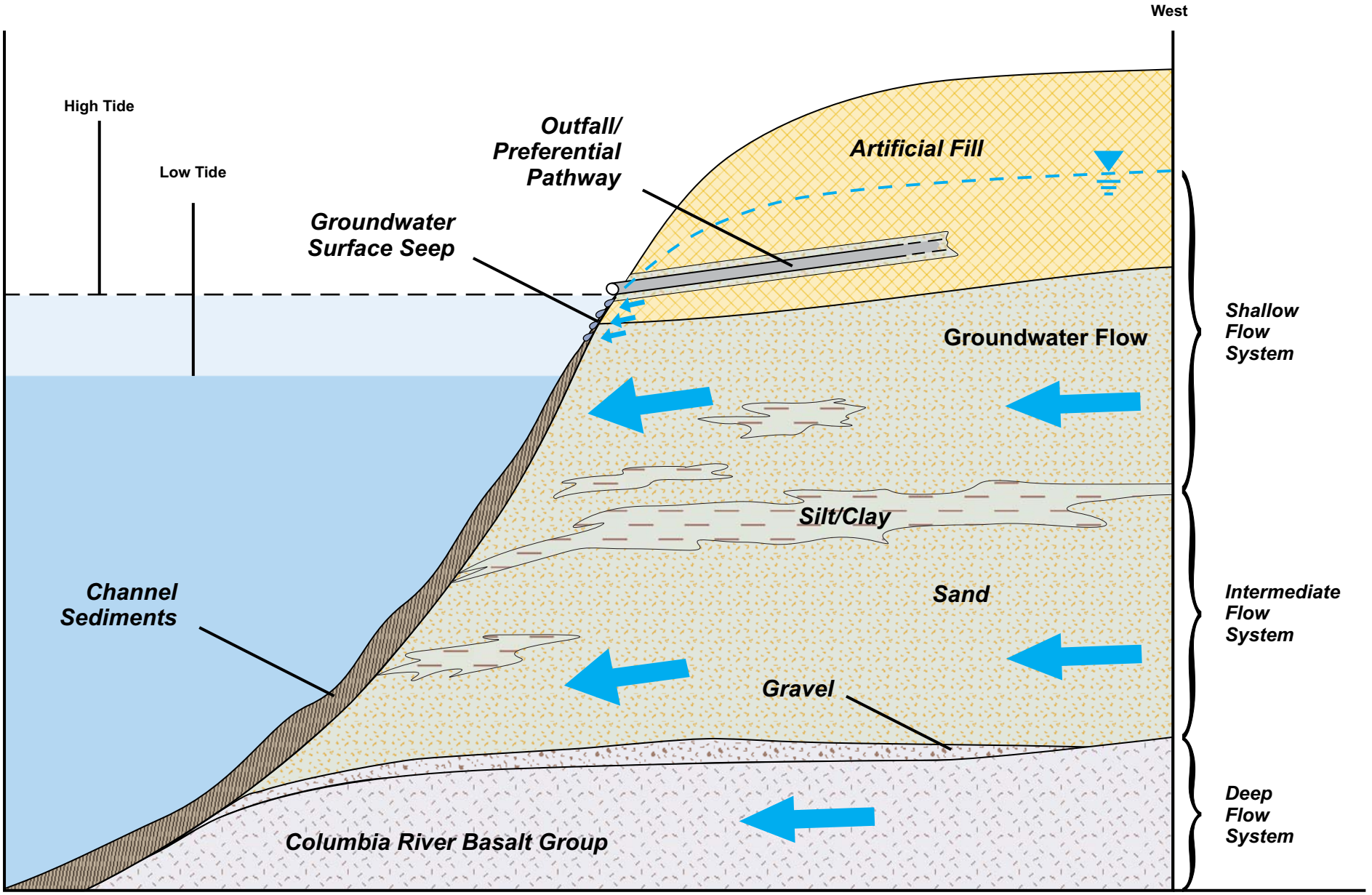


Figure 3.1-3
Portland Harbor RI/FS
Remedial Investigation Report
Conceptual Model of Groundwater Flow

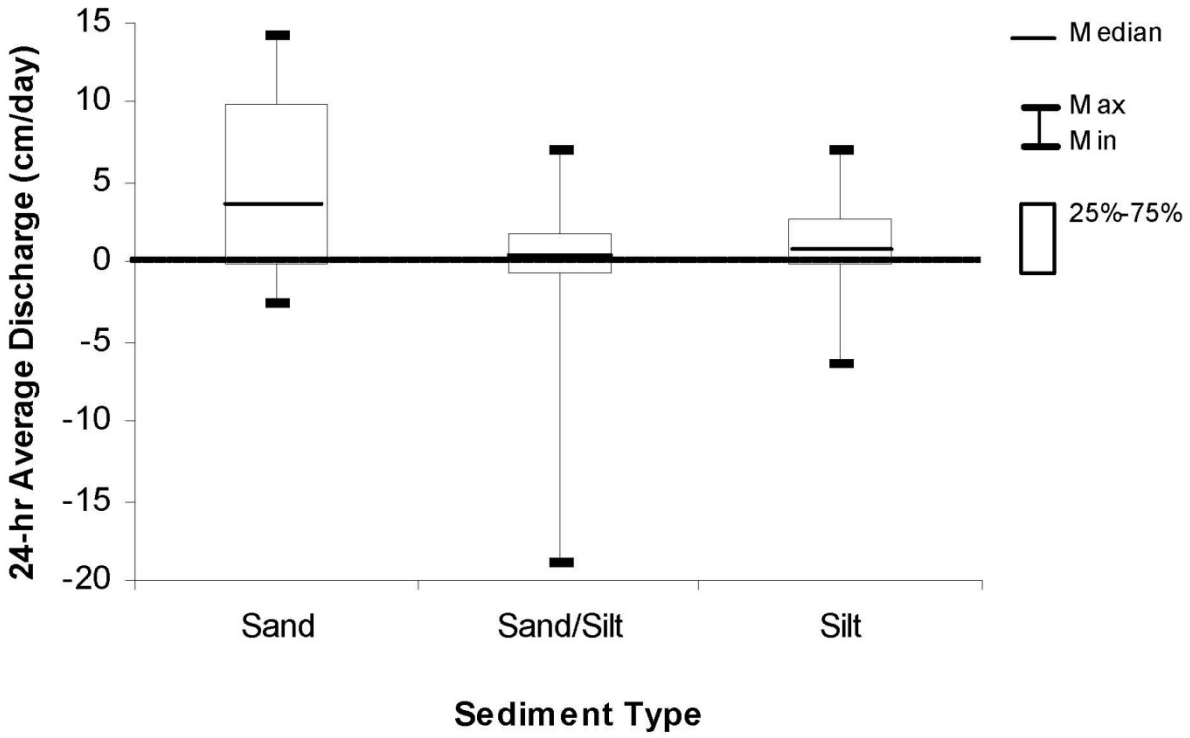
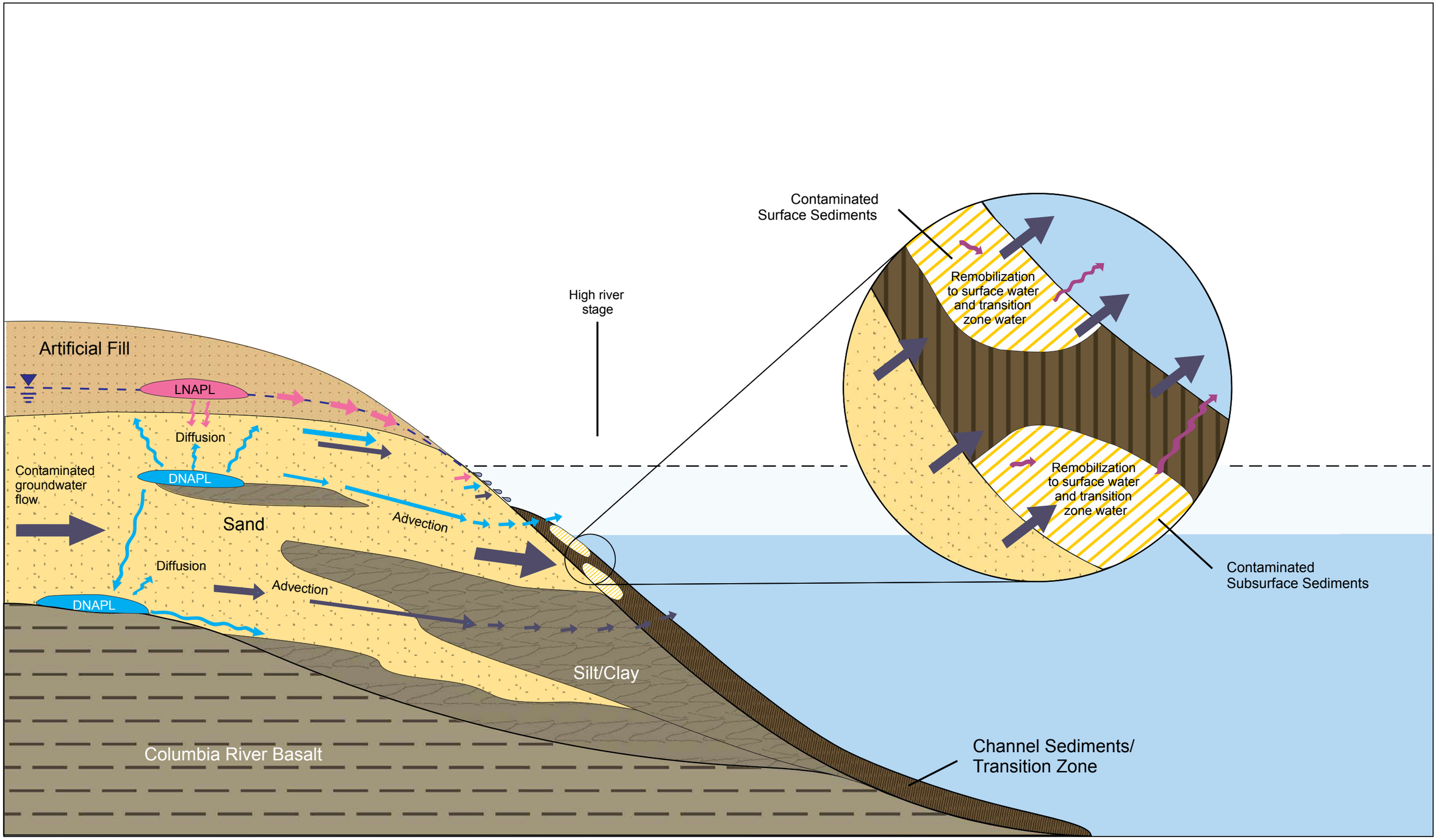


Figure 3.1-4
Portland Harbor RI/FS
Remedial Investigation Report
Box-Whisker Plot of Seepage Meter Results



Transport of LNAPL and dissolved LNAPL constituents
Transport of DNAPL
Groundwater flow paths

Figure 3.1-5
Portland Harbor RI/FS
Remedial Investigation Report
Physical Conceptual Model of Transport Processes to the River

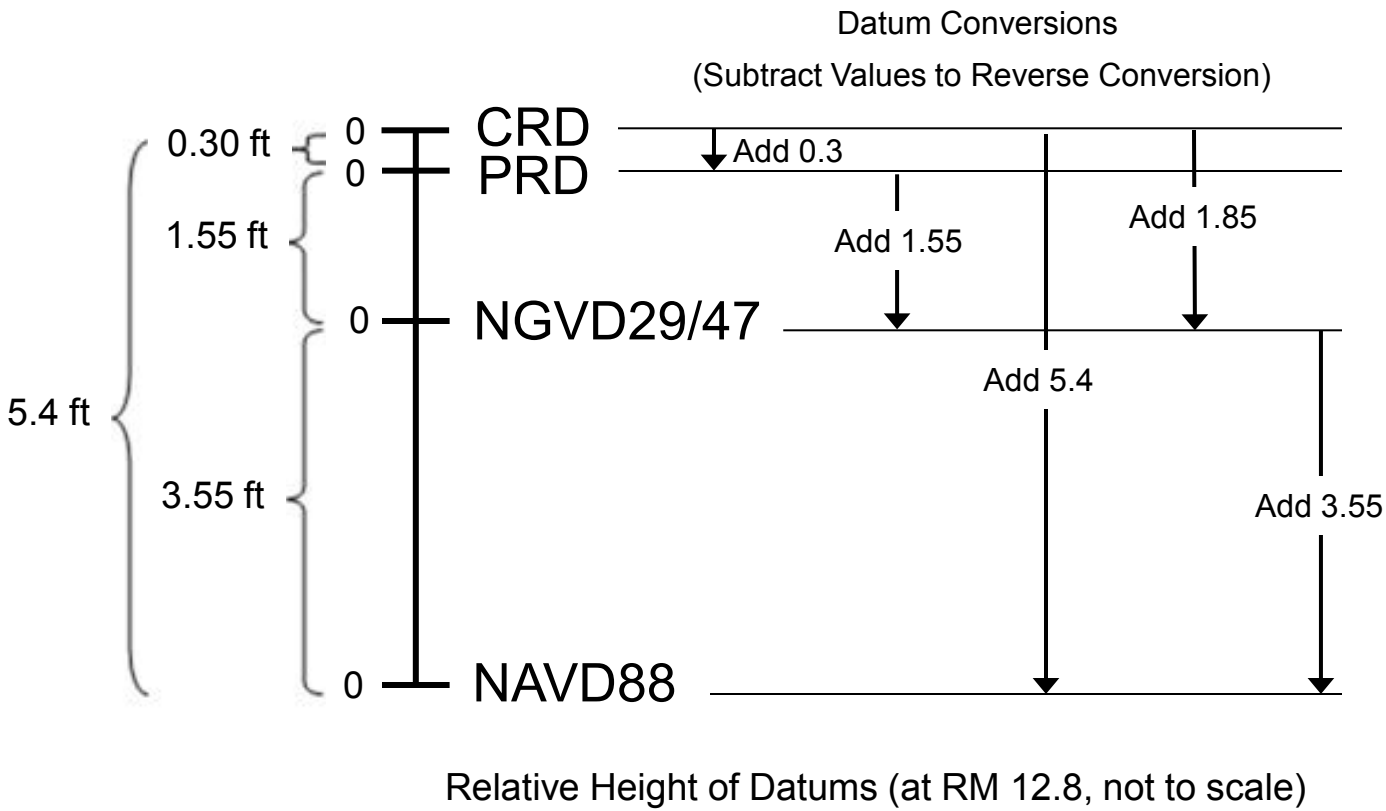
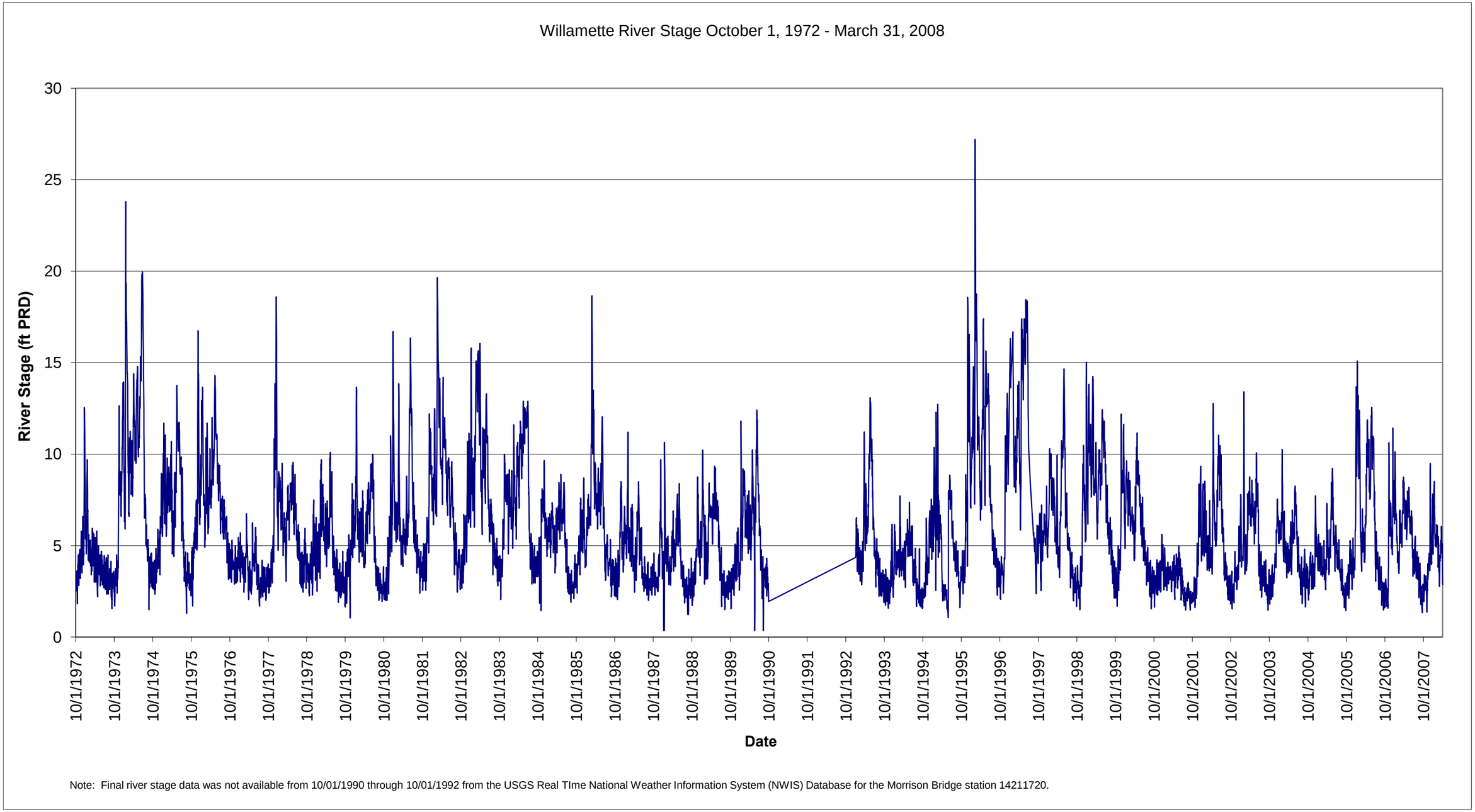


Figure 3.1-6
Portland Harbor RI/FS
Remedial Investigation Report
Datum Relationship for Portland Harbor



Note: Final river stage data was not available from 10/01/1990 through 10/01/1992 from the USGS Real TIme National Weather Information System (NWIS) Database for the Morrison Bridge station 14211720.

Figure 3.1-7
Portland Harbor RI/FS
Remedial Investigation Report
Willamette River Stage Data,
October 1972 - March 31, 2008

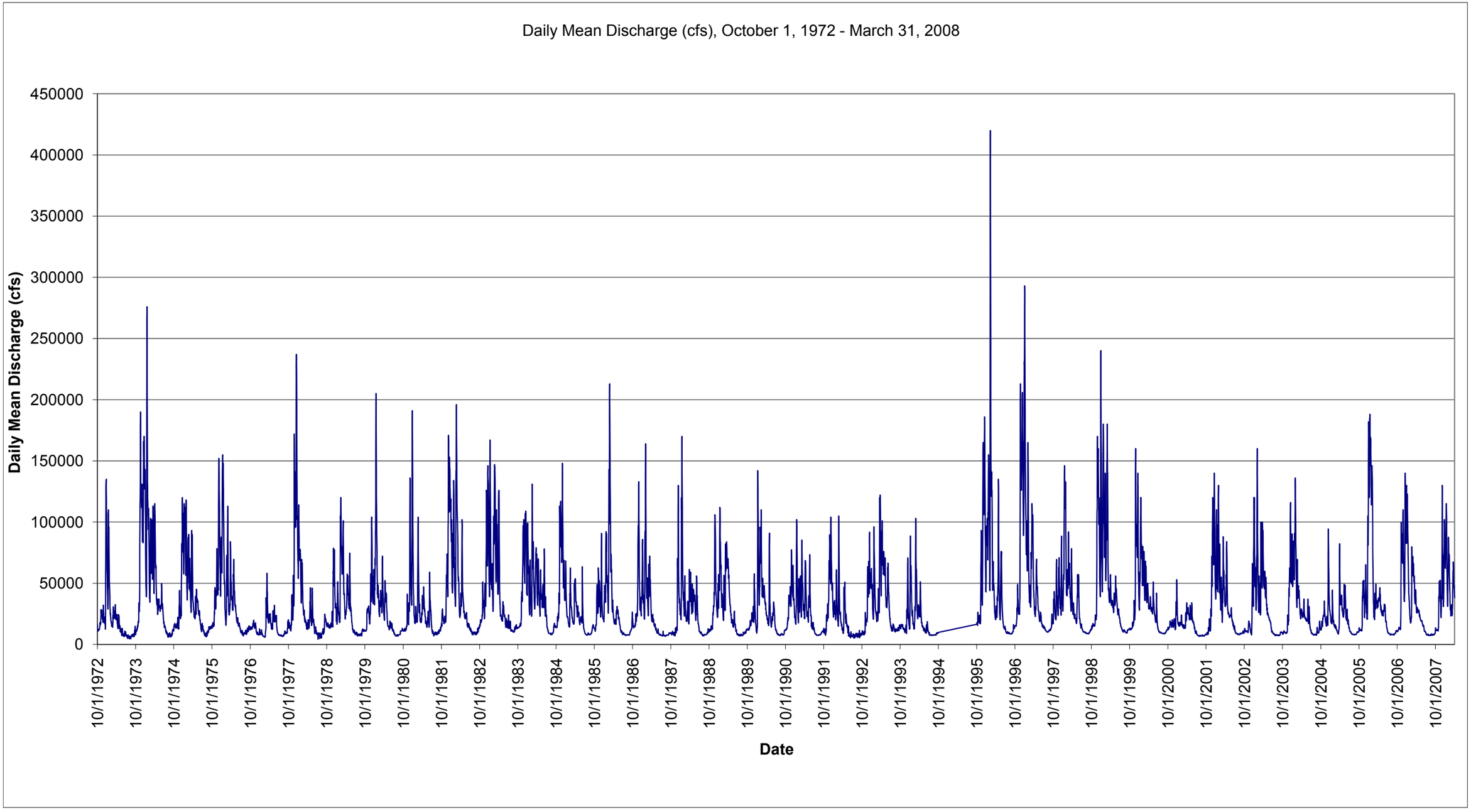


Figure 3.1-8
Portland Harbor RI/FS
Remedial Investigation Report
Daily Mean Discharge (cfs),
October 1, 1972 through March 31, 2008

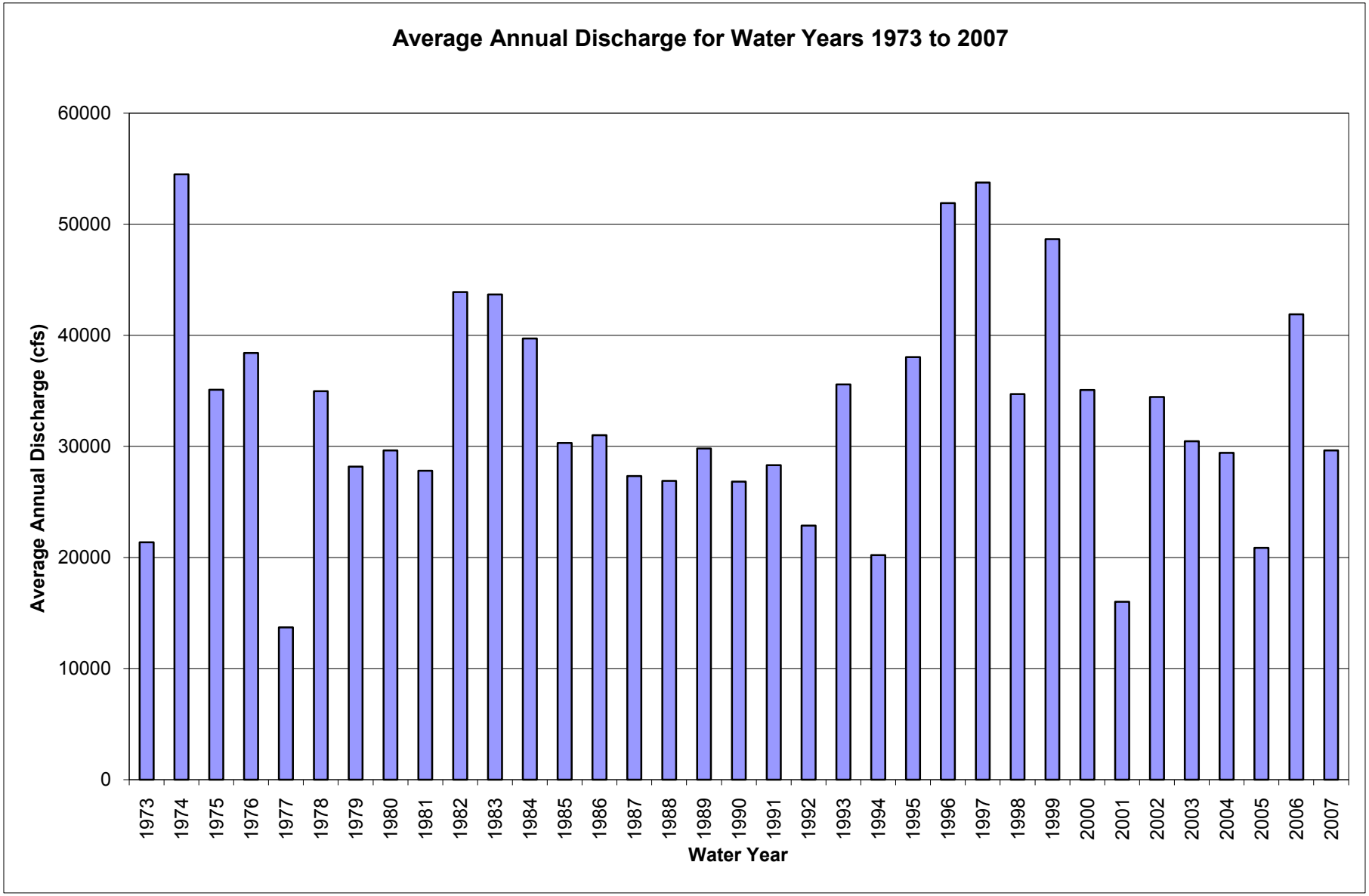


Figure 3.1-9
Portland Harbor RI/FS
Remedial Investigation Report
Average Annual Discharge for
Water Years 1973 to 2007

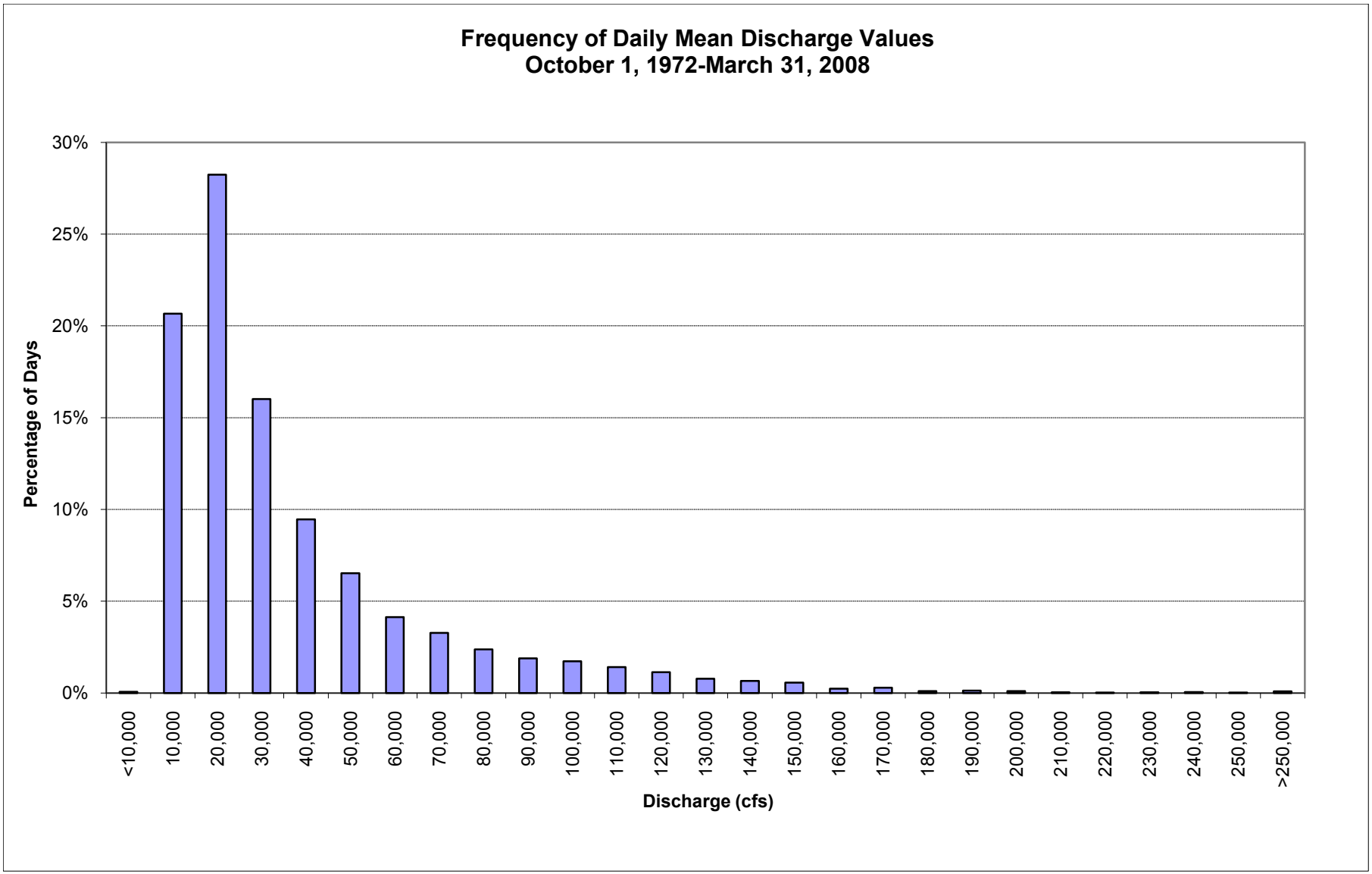


Figure 3.1-10
Portland Harbor RI/FS
Remedial Investigation Report
Frequency of Daily Mean Discharge Values,
October 1, 1972 - March 31, 2008

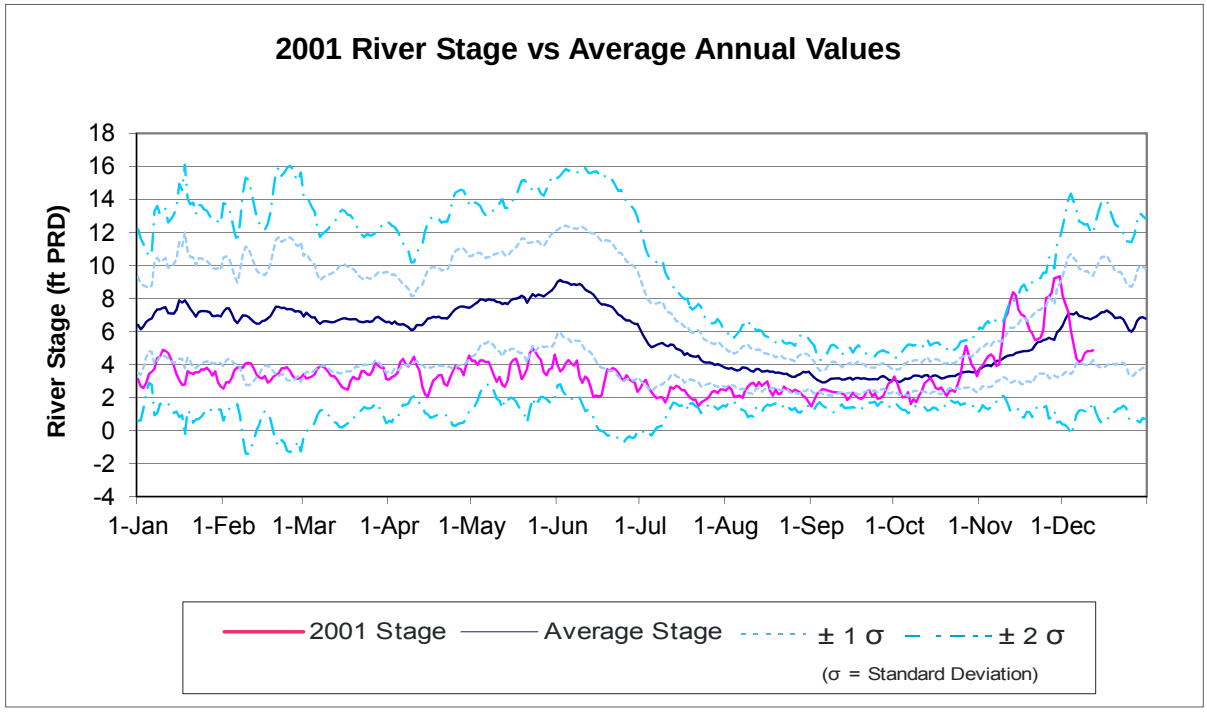


Figure 3.1-11a
2001 Willamette River Stage Data Versus
Average Annual Values (October 1972 – March 2008)

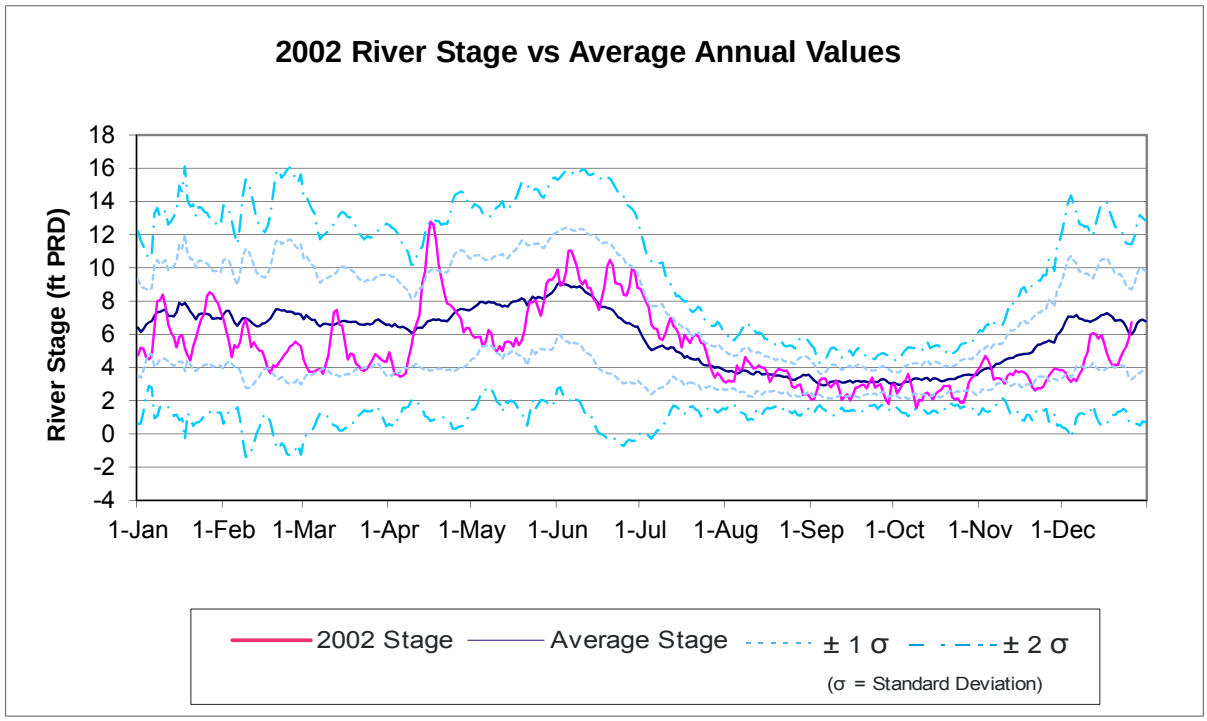


Figure 3.1-11b
2002 Willamette River Stage Data Versus
Average Annual Values (October 1972 – March 2008)

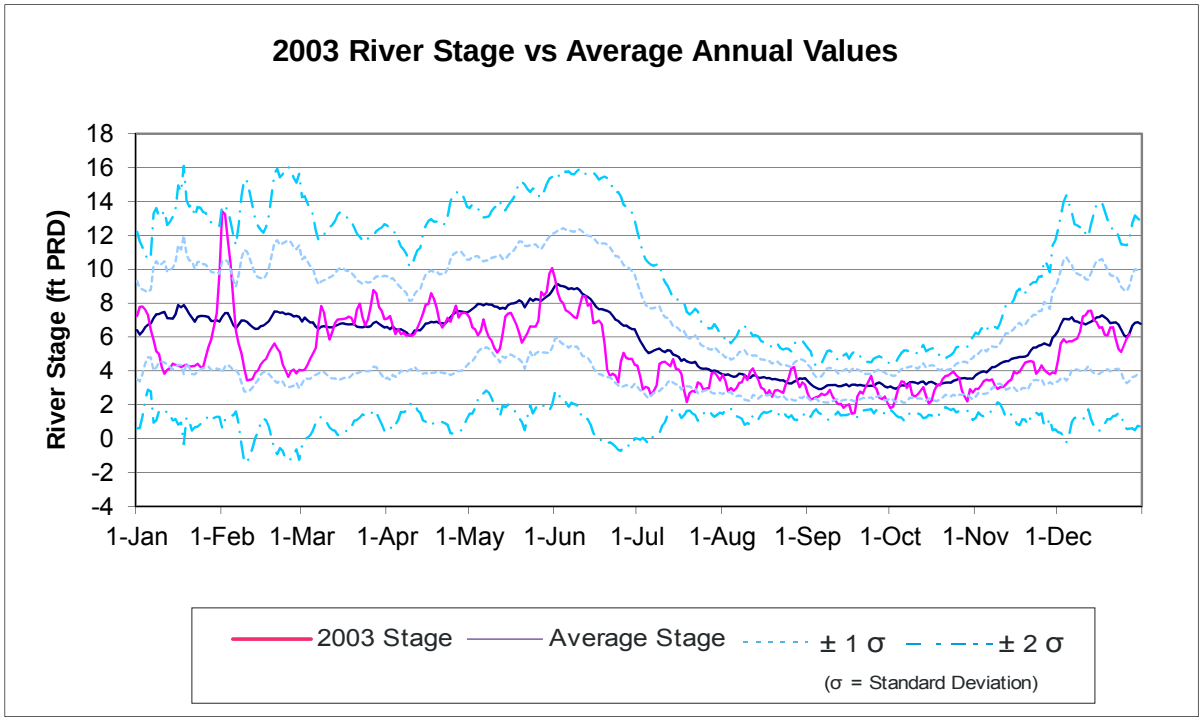


Figure 3.1-11c
2003 Willamette River Stage Data Versus
Average Annual Values (October 1972 – March 2008)

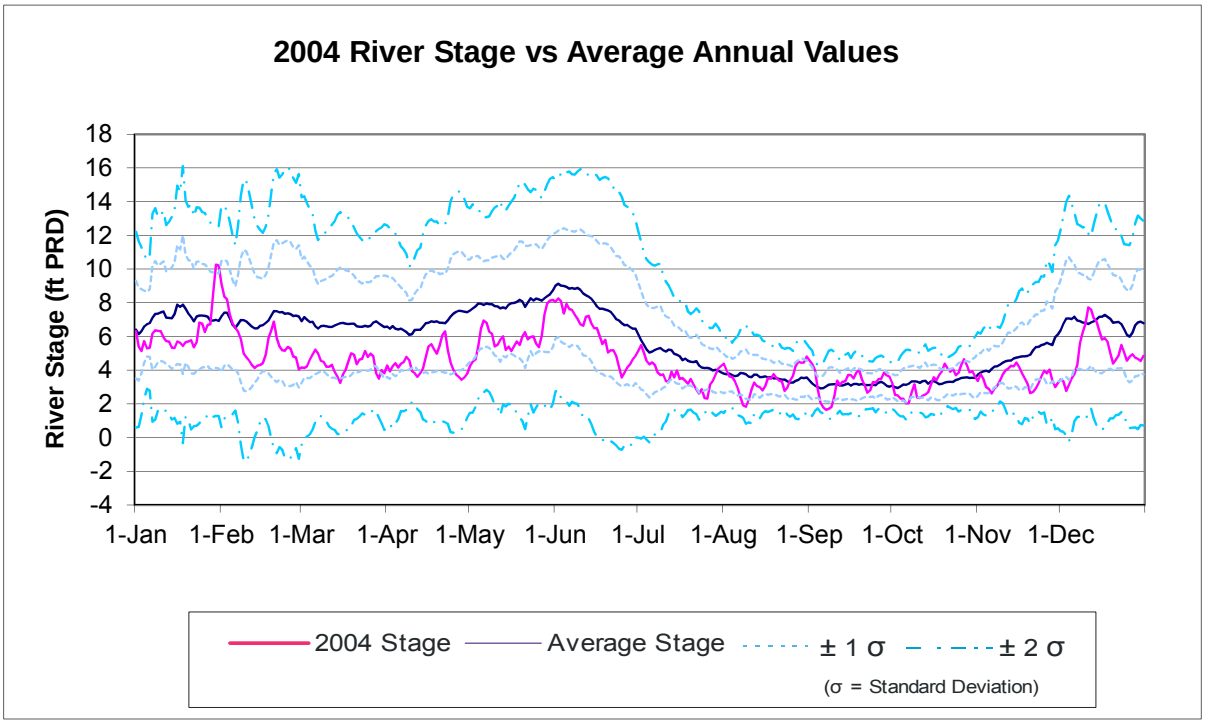


Figure 3.1-11d
2004 Willamette River Stage Data Versus
Average Annual Values (October 1972 – March 2008)

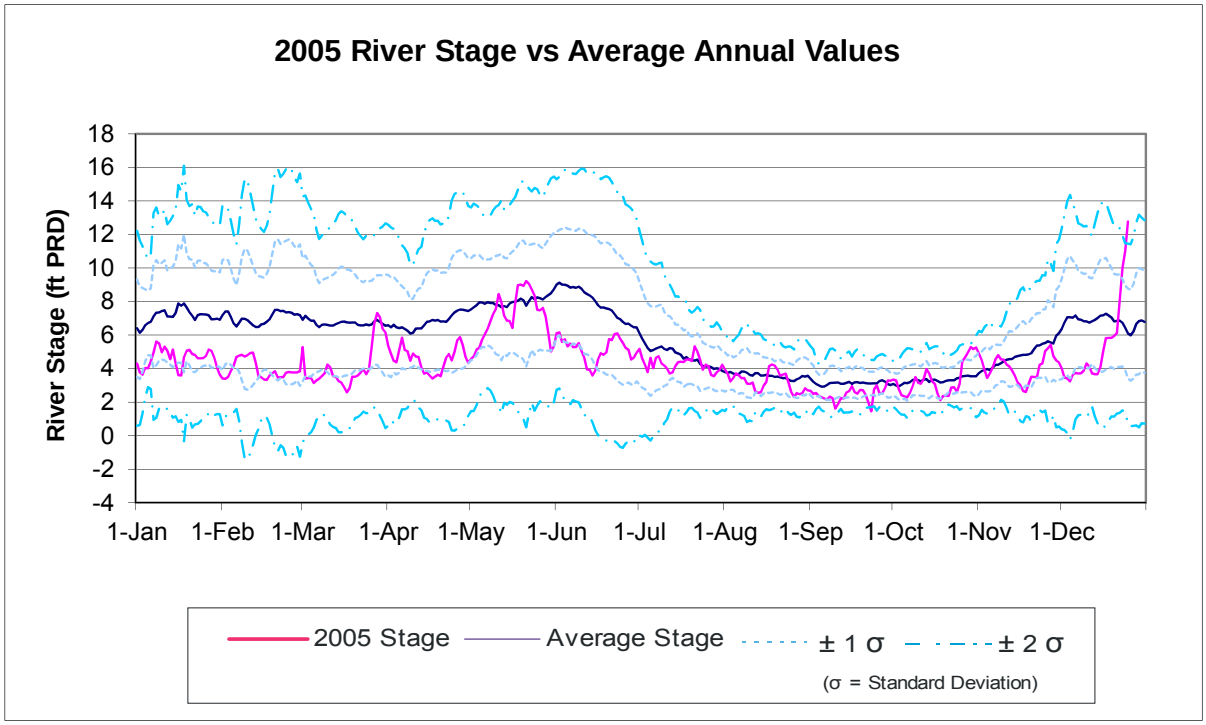


Figure 3.1-11e
2005 Willamette River Stage Data Versus
Average Annual Values (October 1972 – March 2008)

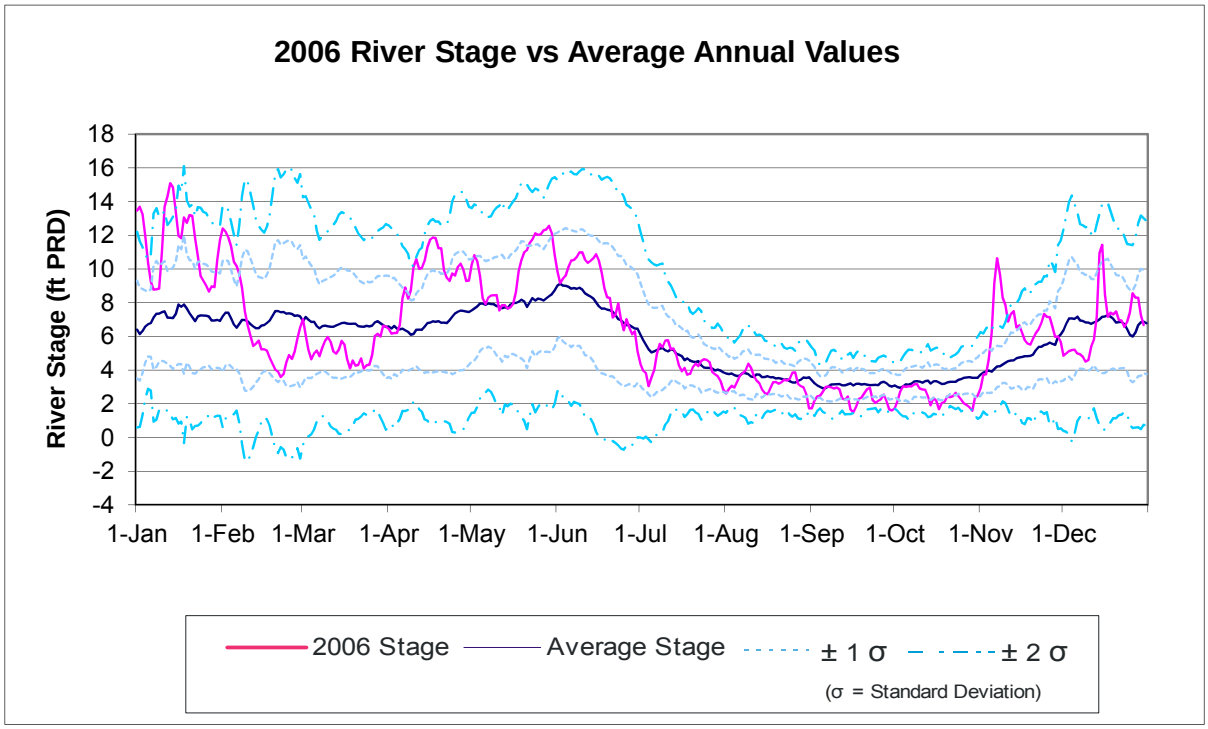


Figure 3.1-11f
2006 Willamette River Stage Data Versus
Average Annual Values (October 1972 – March 2008)

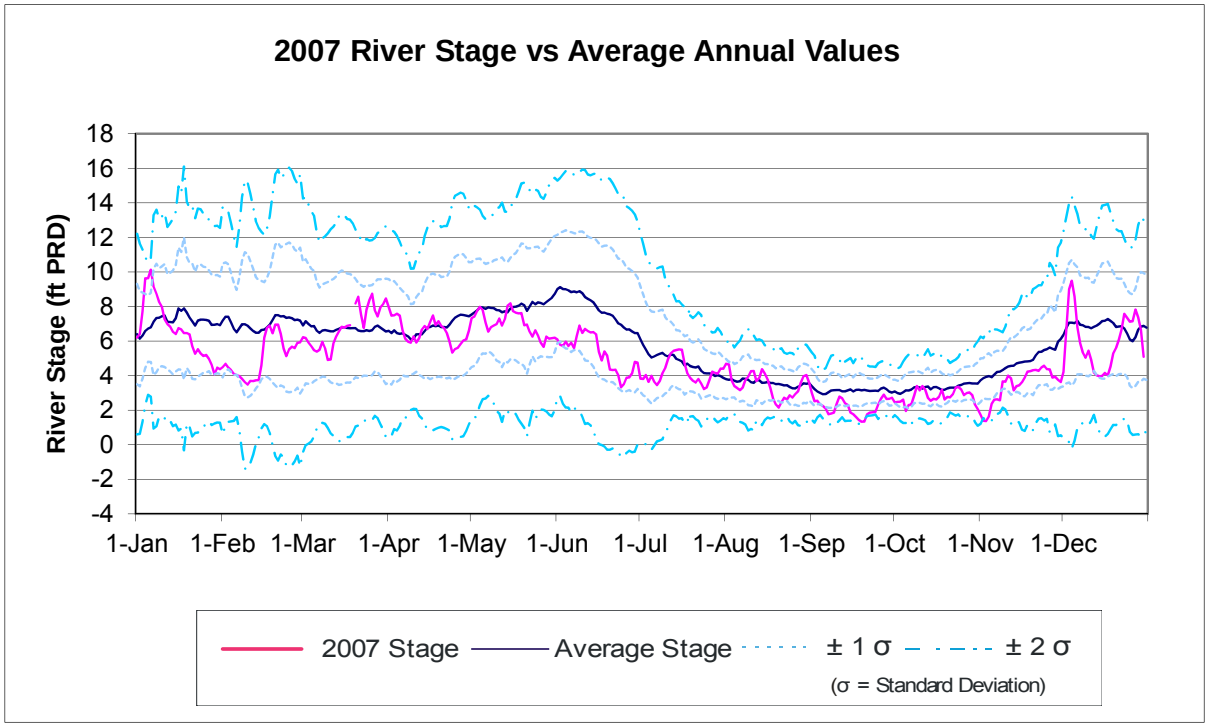


Figure 3.1-11g
2007 Willamette River Stage Data Versus
Average Annual Values (October 1972 – March 2008)

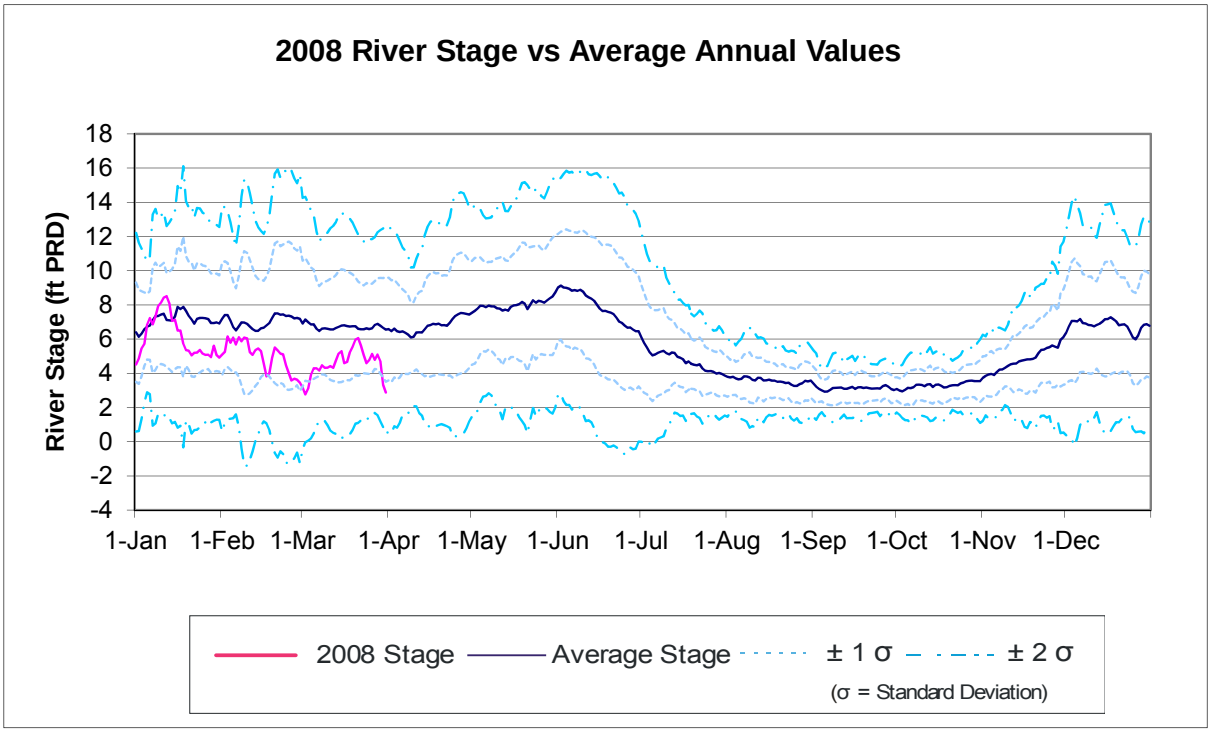


Figure 3.1-11h
2008 Willamette River Stage Data Versus
Average Annual Values (October 1972 – March 2008)

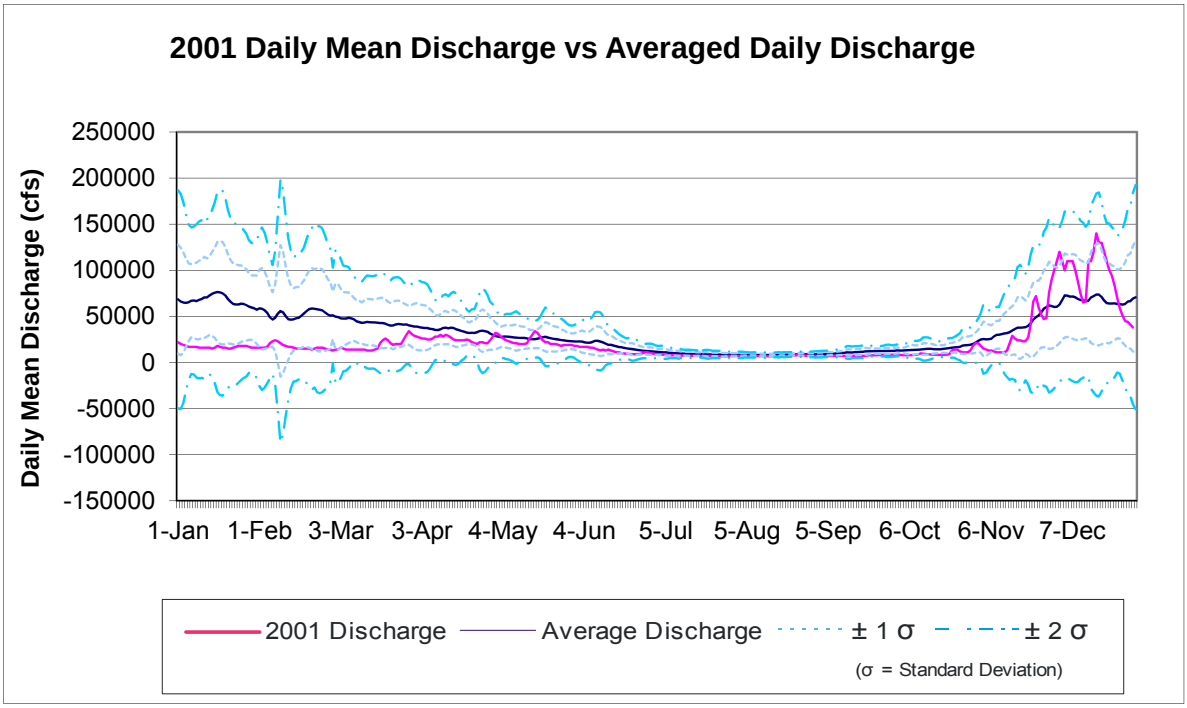


Figure 3.1-12a
2001 Willamette River Daily Mean Discharge Versus
Averaged Daily Discharge (October 1972 – March 2008)

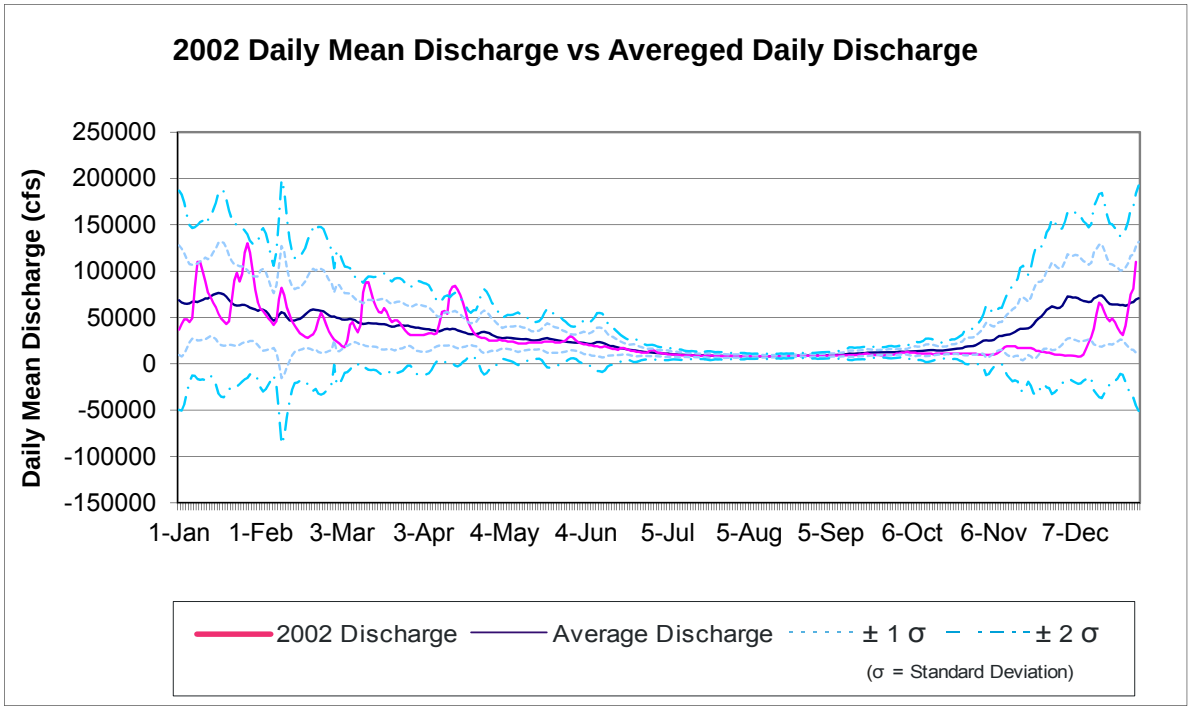


Figure 3.1-12b
2002 Willamette River Daily Mean Discharge Versus
Averaged Daily Discharge (October 1972 – March 2008)

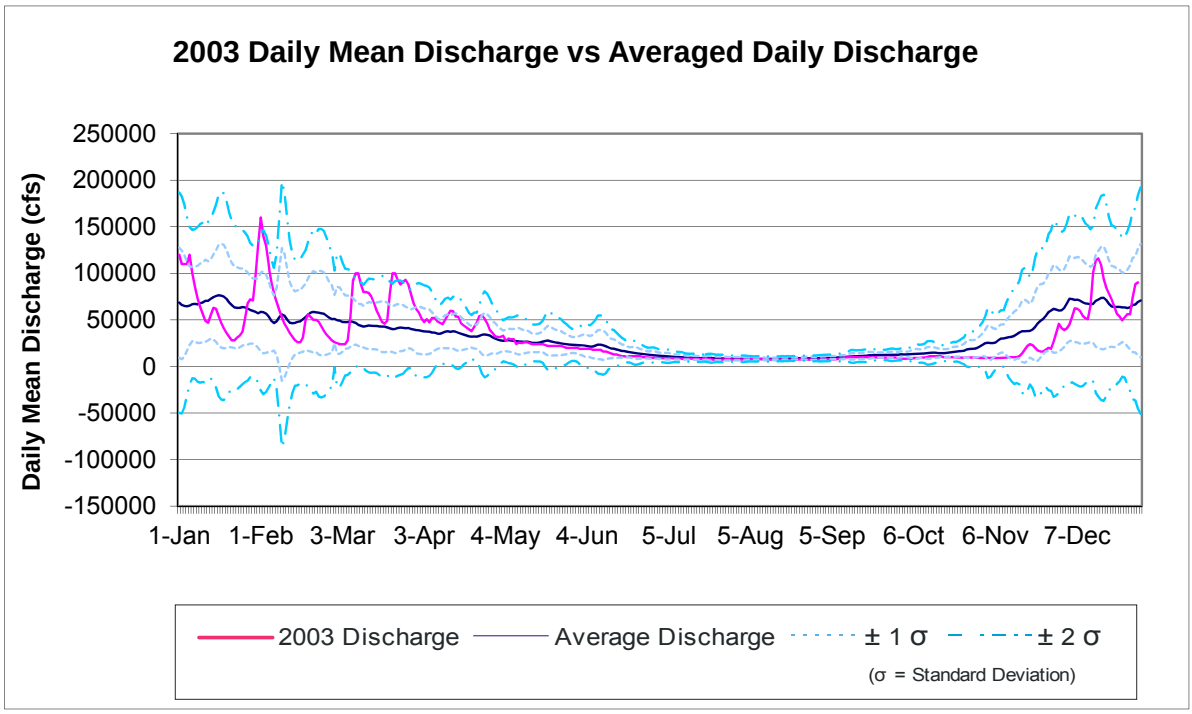


Figure 3.1-12c
2003 Willamette River Daily Mean Discharge Versus
Averaged Daily Discharge (October 1972 – March 2008)

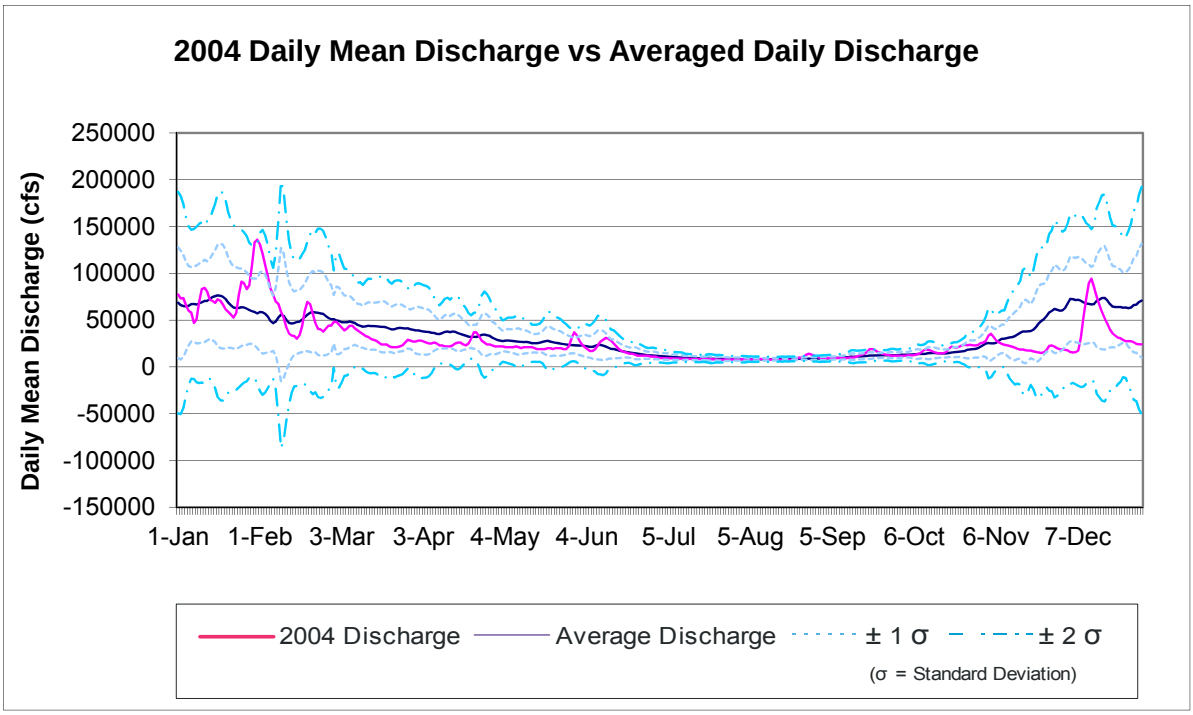


Figure 3.1-12d
2004 Willamette River Daily Mean Discharge Versus
Averaged Daily Discharge (October 1972 – March 2008)

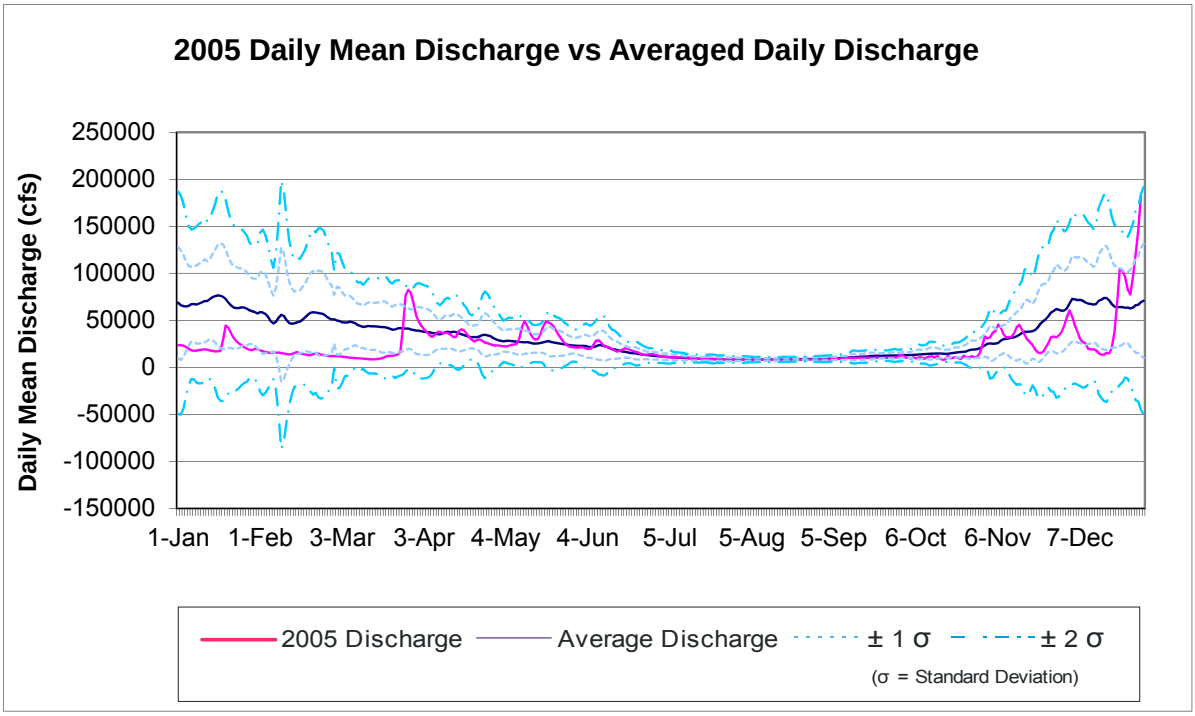


Figure 3.1-12e
2005 Willamette River Daily Mean Discharge Versus
Averaged Daily Discharge (October 1972 – March 2008)

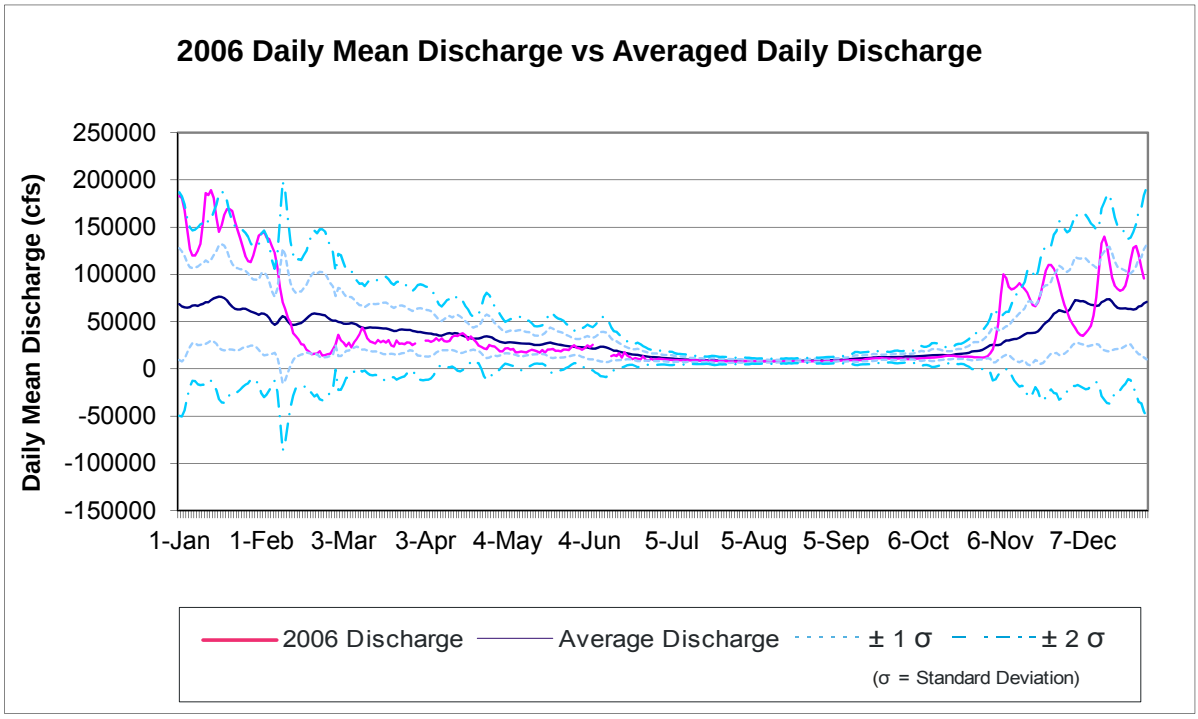


Figure 3.1-12f
2006 Willamette River Daily Mean Discharge Versus
Averaged Daily Discharge (October 1972 – March 2008)

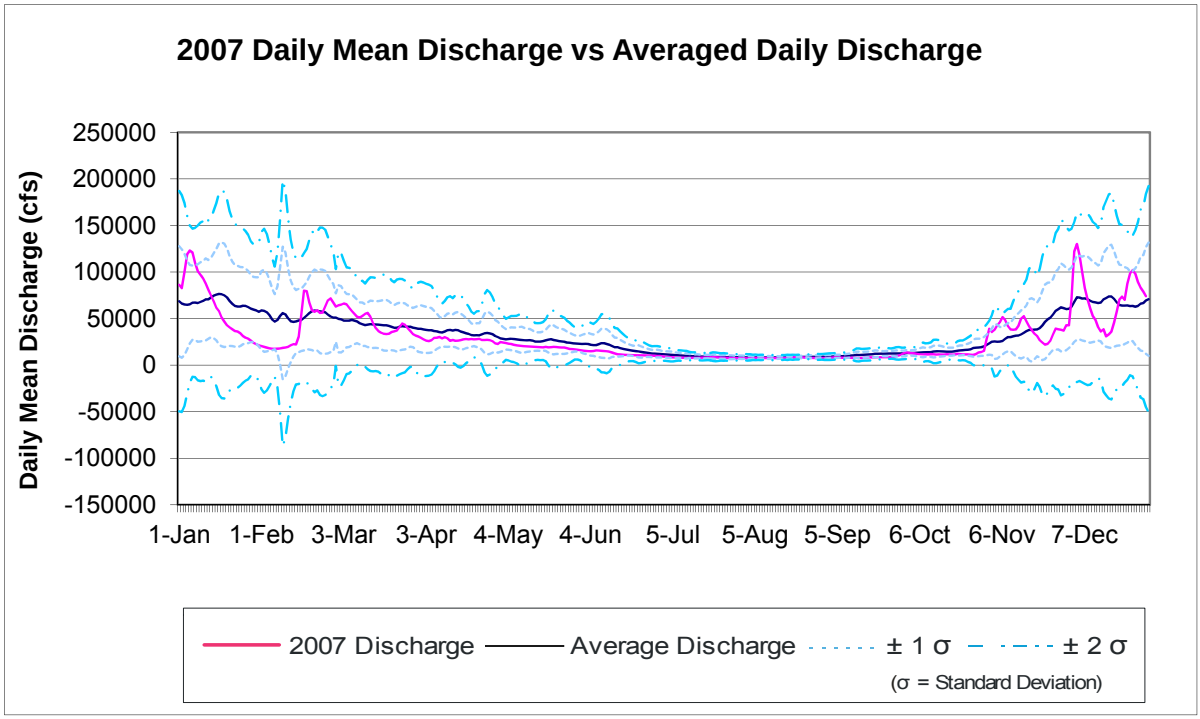


Figure 3.1-12g
2007 Willamette River Daily Mean Discharge Versus
Averaged Daily Discharge (October 1972 – March 2008)

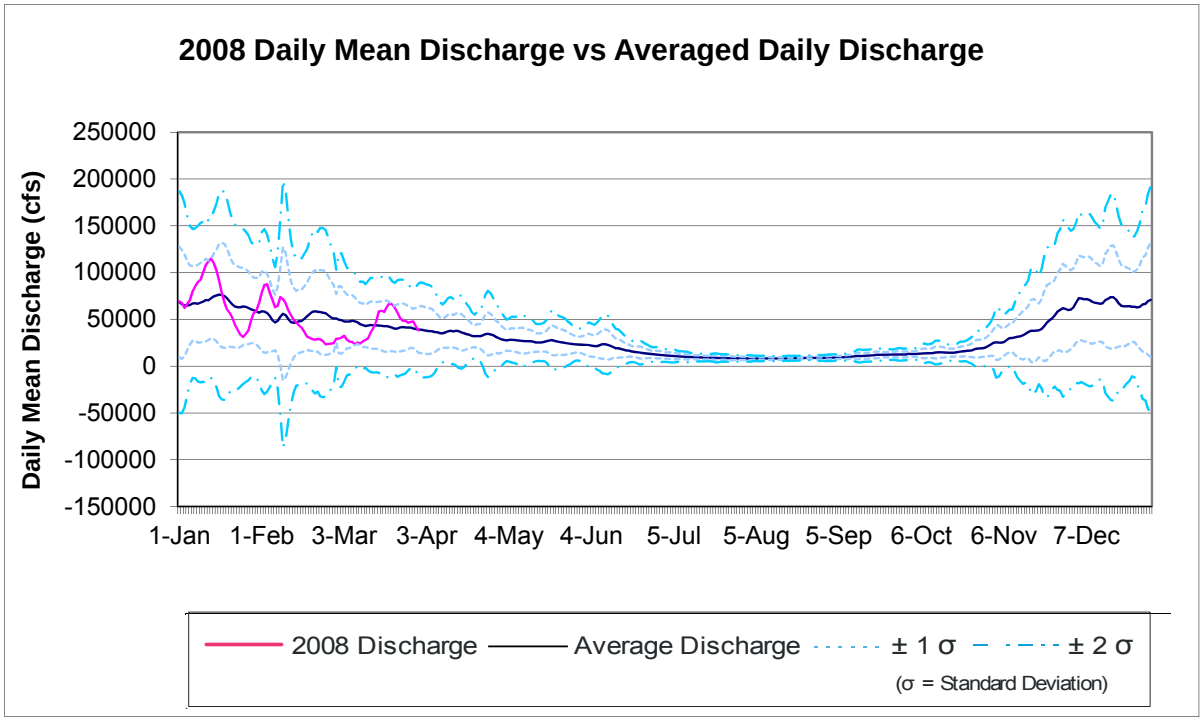
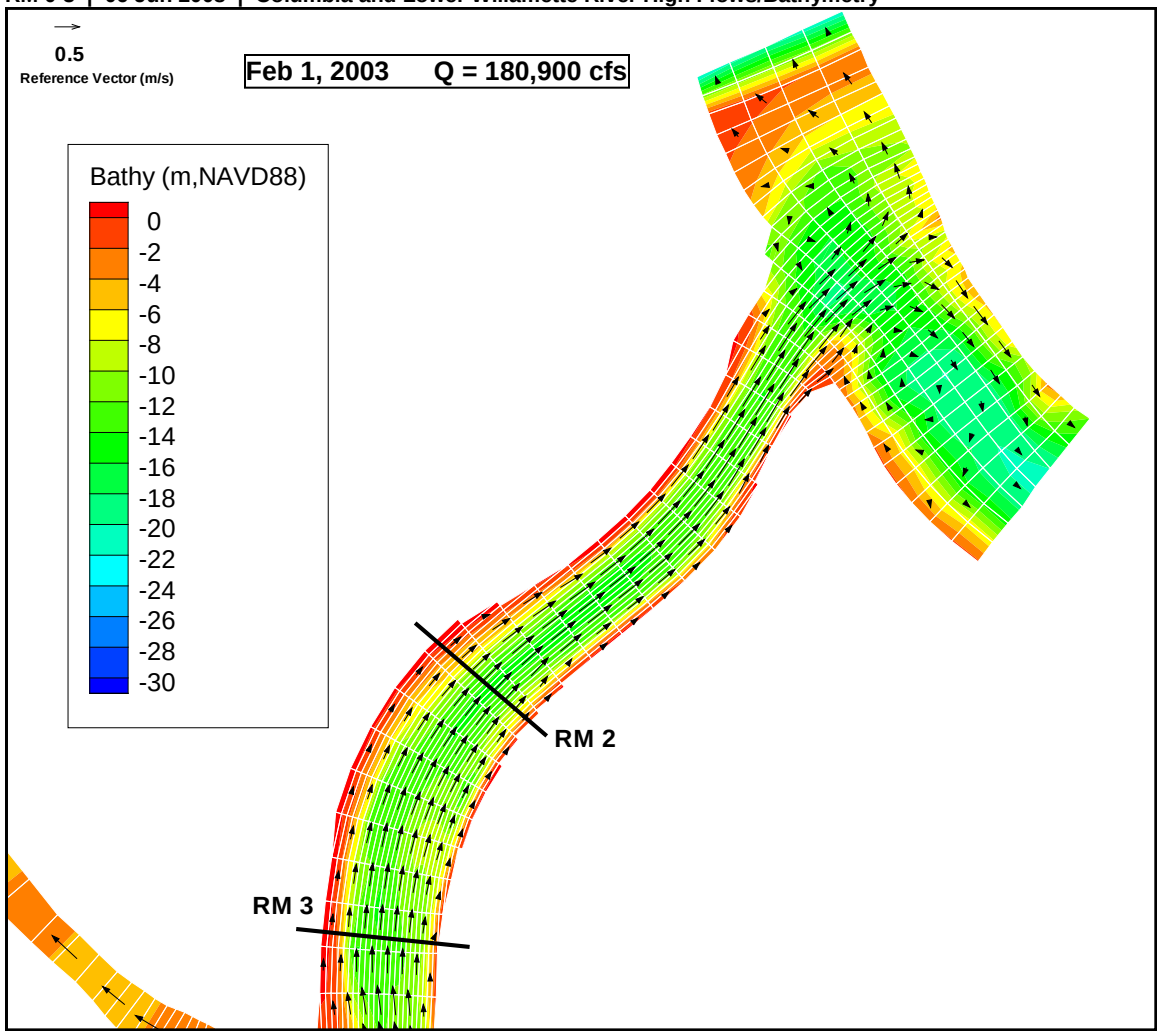


Figure 3.1-12h
2008 Willamette River Daily Mean Discharge Versus
Averaged Daily Discharge (October 1972 – March 2008)

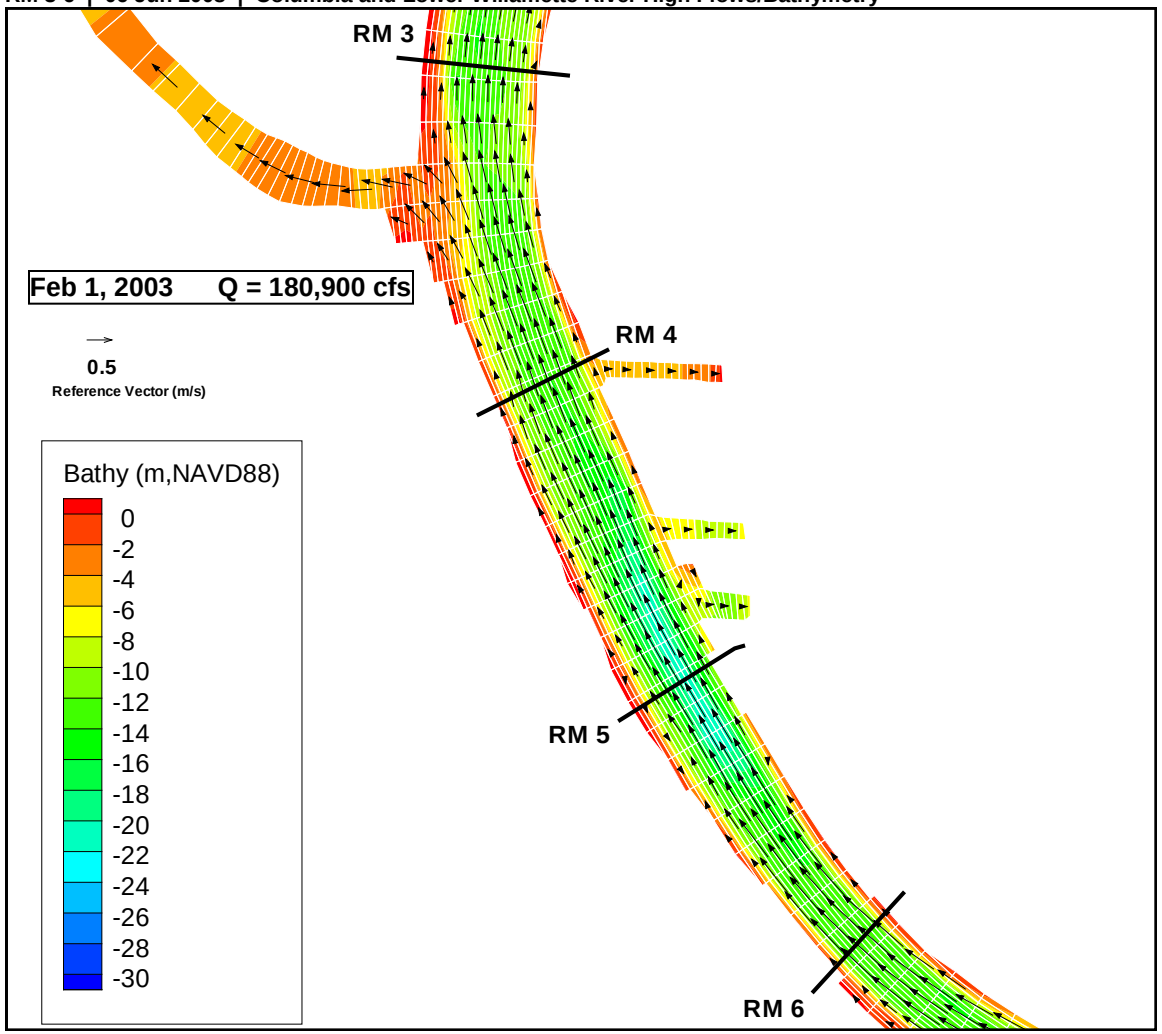
RM 0-3 | 06 Jun 2008 | Columbia and Lower Willamette River High Flows/Bathymetry



Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for February 1, 2003 at 0300hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 3.9 m NAVD88; river flow 180,900 cfs
Lower Columbia River conditions; stage at Vancouver: 5.4 m NAVD88, stage at St. Helens: 4.8 m NAVD88; river flow 170,000 cfs.

Figure 3.1-13a
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, High Flow
RM 0–3

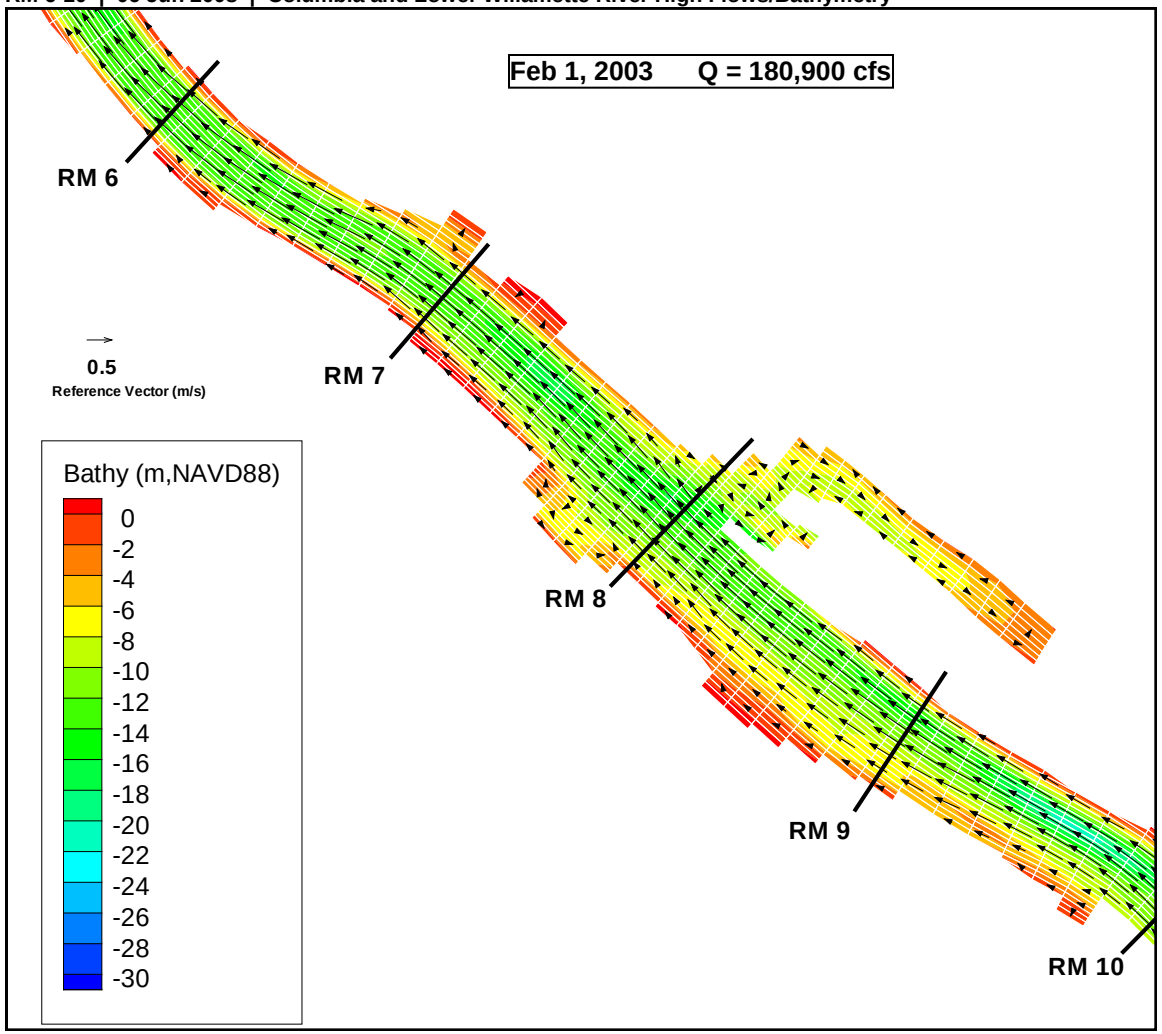
RM 3-6 | 06 Jun 2008 | Columbia and Lower Willamette River High Flows/Bathymetry



Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for February 1, 2003 at 0300hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 3.9 m NAVD88; river flow 180,900 cfs
Lower Columbia River conditions; stage at Vancouver: 5.4 m NAVD88, stage at St. Helens: 4.8 m NAVD88; river flow 170,000 cfs.

Figure 3.1-13b
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, High Flow
RM 3–6

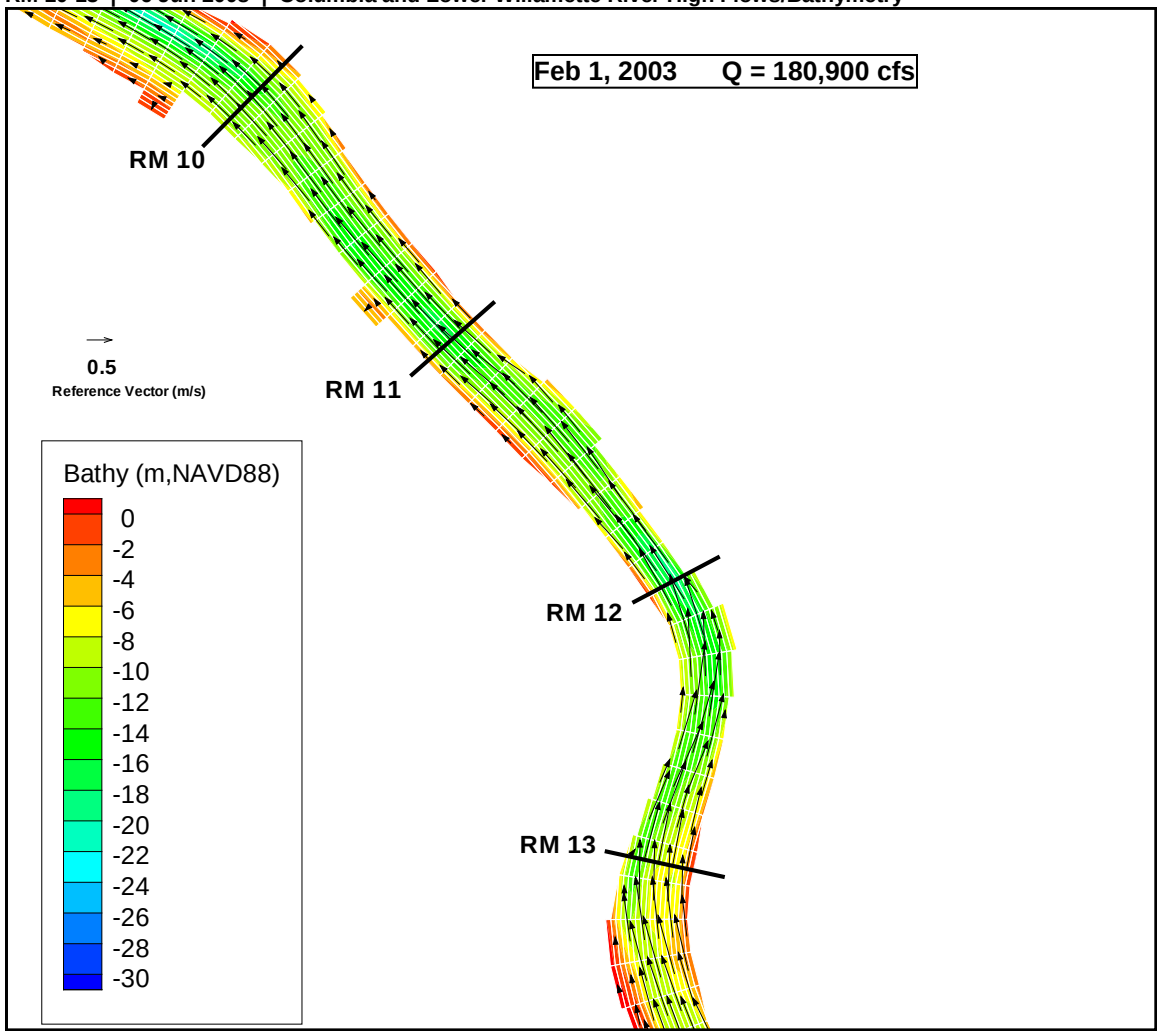
RM 6-10 | 06 Jun 2008 | Columbia and Lower Willamette River High Flows/Bathymetry



Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for February 1, 2003 at 0300hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 3.9 m NAVD88; river flow 180,900 cfs
Lower Columbia River conditions; stage at Vancouver: 5.4 m NAVD88, stage at St. Helens: 4.8 m NAVD88; river flow 170,000 cfs.

Figure 3.1-13c
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, High Flow
RM 6–10

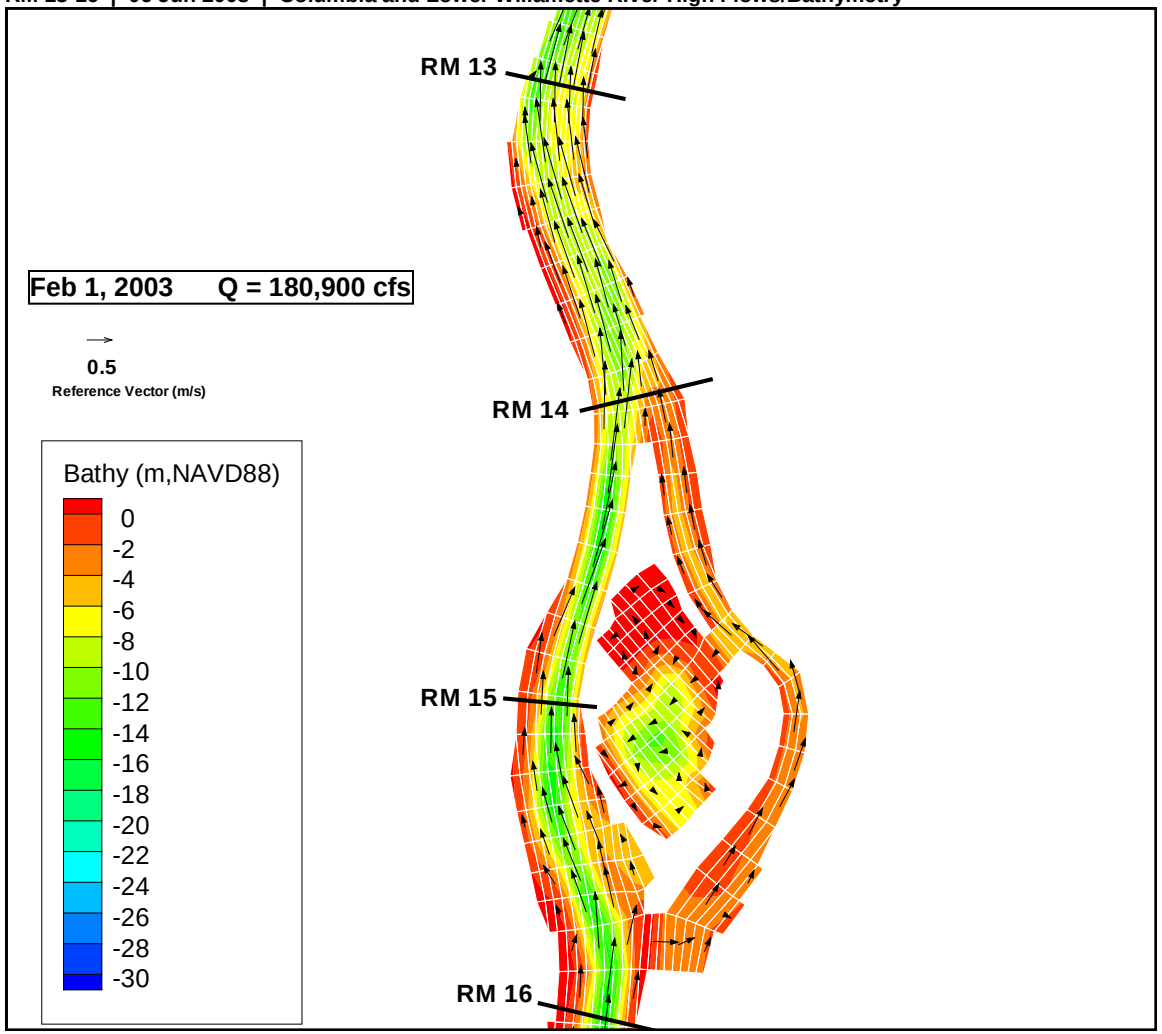
RM 10-13 | 06 Jun 2008 | Columbia and Lower Willamette River High Flows/Bathymetry



Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for February 1, 2003 at 0300hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 3.9 m NAVD88; river flow 180,900 cfs
Lower Columbia River conditions; stage at Vancouver: 5.4 m NAVD88, stage at St. Helens: 4.8 m NAVD88; river flow 170,000 cfs.

Figure 3.1-13d
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, High Flow
RM 10–13

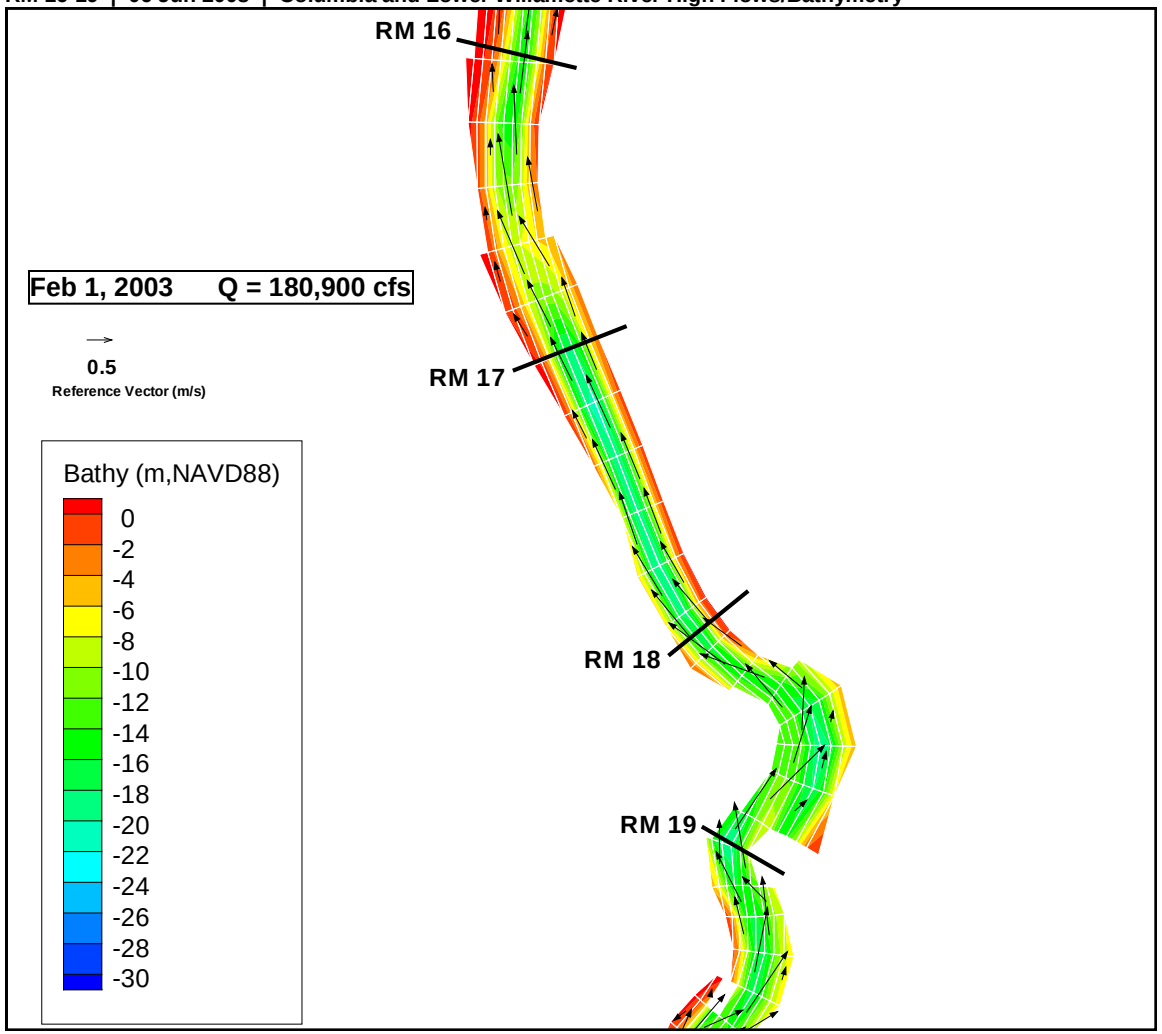
RM 13-16 | 06 Jun 2008 | Columbia and Lower Willamette River High Flows/Bathymetry



Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for February 1, 2003 at 0300hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 3.9 m NAVD88; river flow 180,900 cfs
Lower Columbia River conditions; stage at Vancouver: 5.4 m NAVD88, stage at St. Helens: 4.8 m NAVD88; river flow 170,000 cfs.

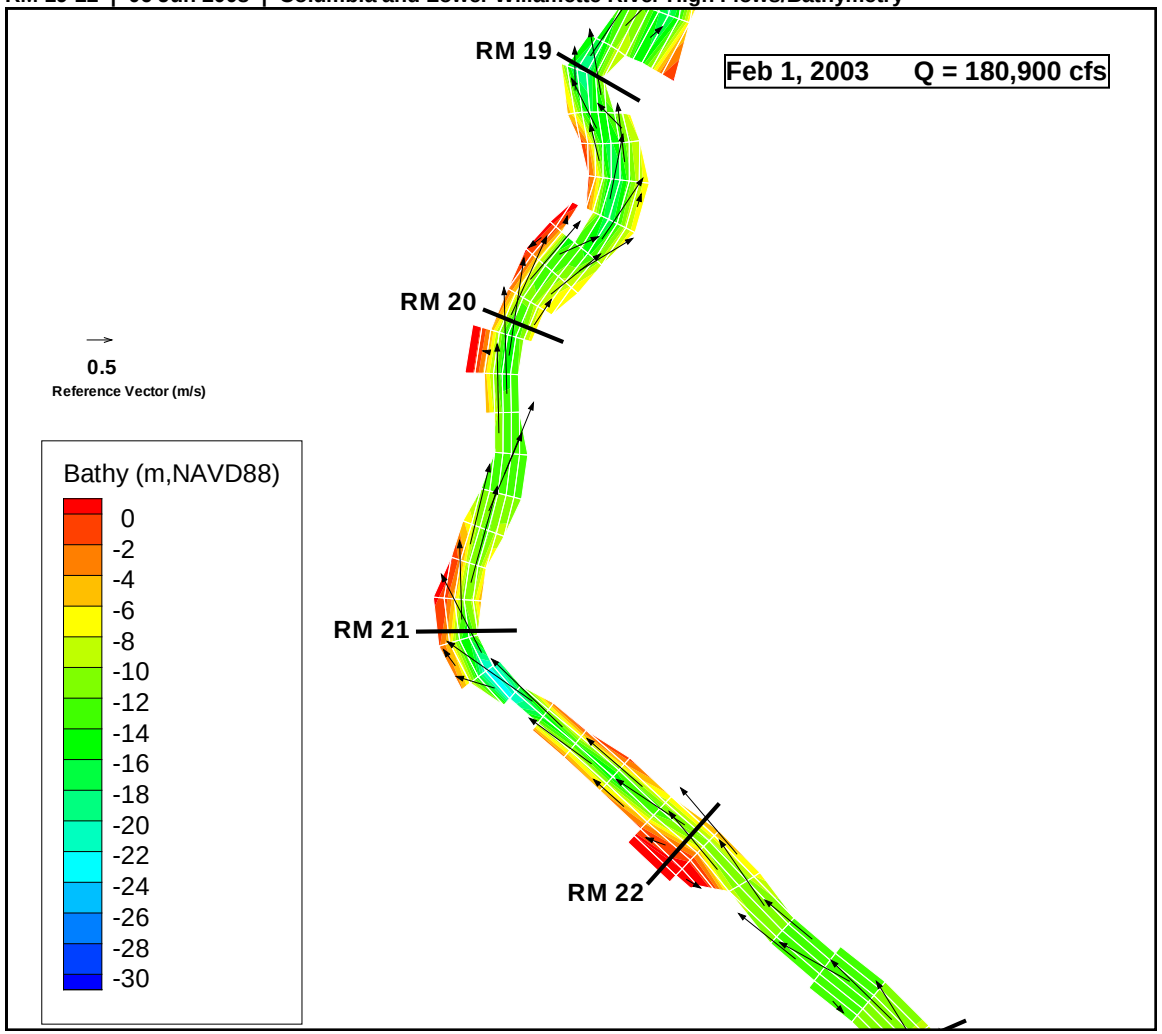
Figure 3.1-13e
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, High Flow
RM 13–16

RM 16-19 | 06 Jun 2008 | Columbia and Lower Willamette River High Flows/Bathymetry



Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for February 1, 2003 at 0300hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 3.9 m NAVD88; river flow 180,900 cfs
Lower Columbia River conditions; stage at Vancouver: 5.4 m NAVD88, stage at St. Helens: 4.8 m NAVD88; river flow 170,000 cfs.

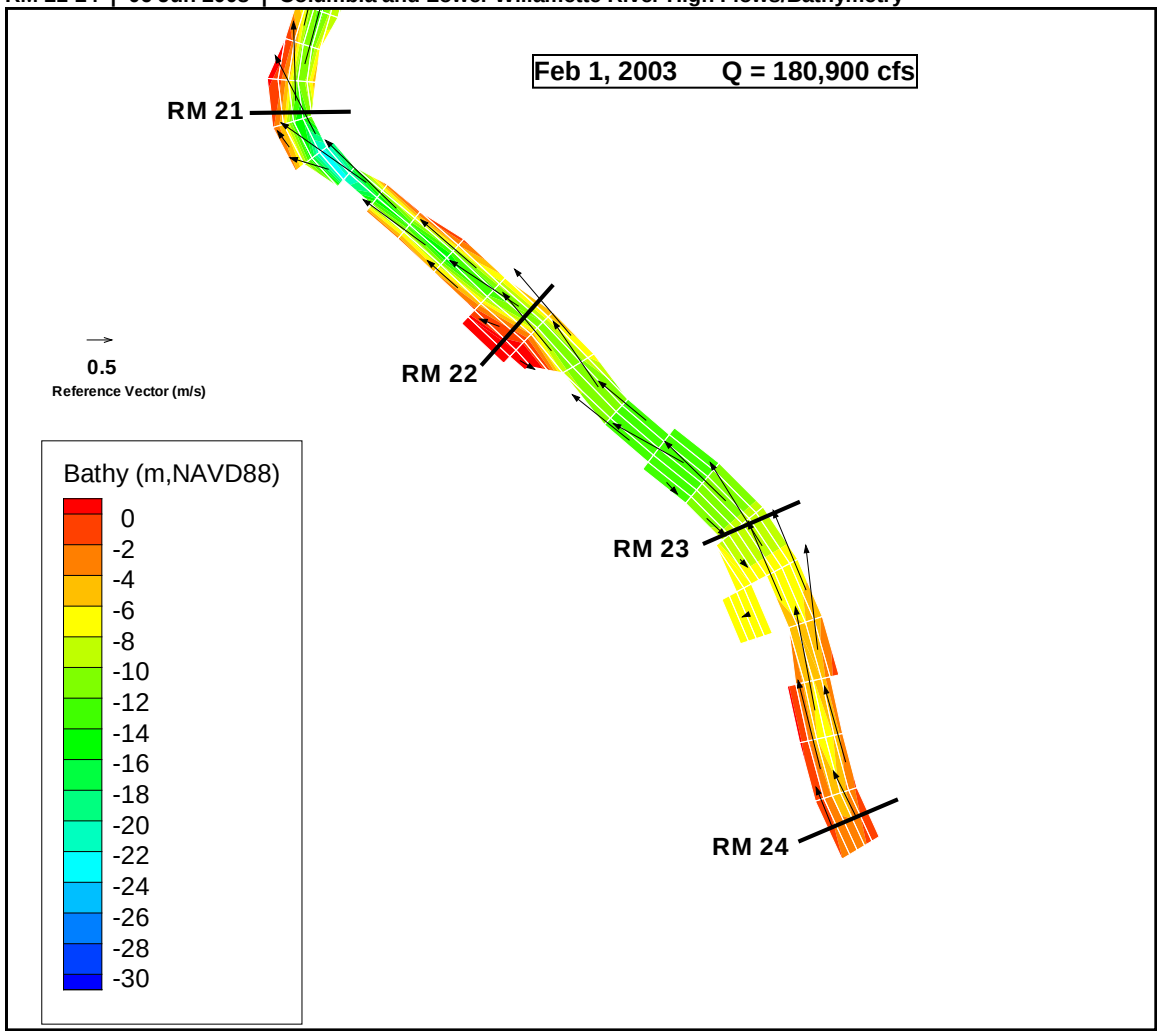
Figure 3.1-13f
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, High Flow
RM 16–19



Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for February 1, 2003 at 0300hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 3.9 m NAVD88; river flow 180,900 cfs
Lower Columbia River conditions; stage at Vancouver: 5.4 m NAVD88, stage at St. Helens: 4.8 m NAVD88; river flow 170,000 cfs.

Figure 3.1-13g
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, High Flow
RM 19–22

RM 21-24 | 06 Jun 2008 | Columbia and Lower Willamette River High Flows/Bathymetry



Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for February 1, 2003 at 0300hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 3.9 m NAVD88; river flow 180,900 cfs
Lower Columbia River conditions; stage at Vancouver: 5.4 m NAVD88, stage at St. Helens: 4.8 m NAVD88; river flow 170,000 cfs.

Figure 3.1-13h
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, High Flow
RM 21–24

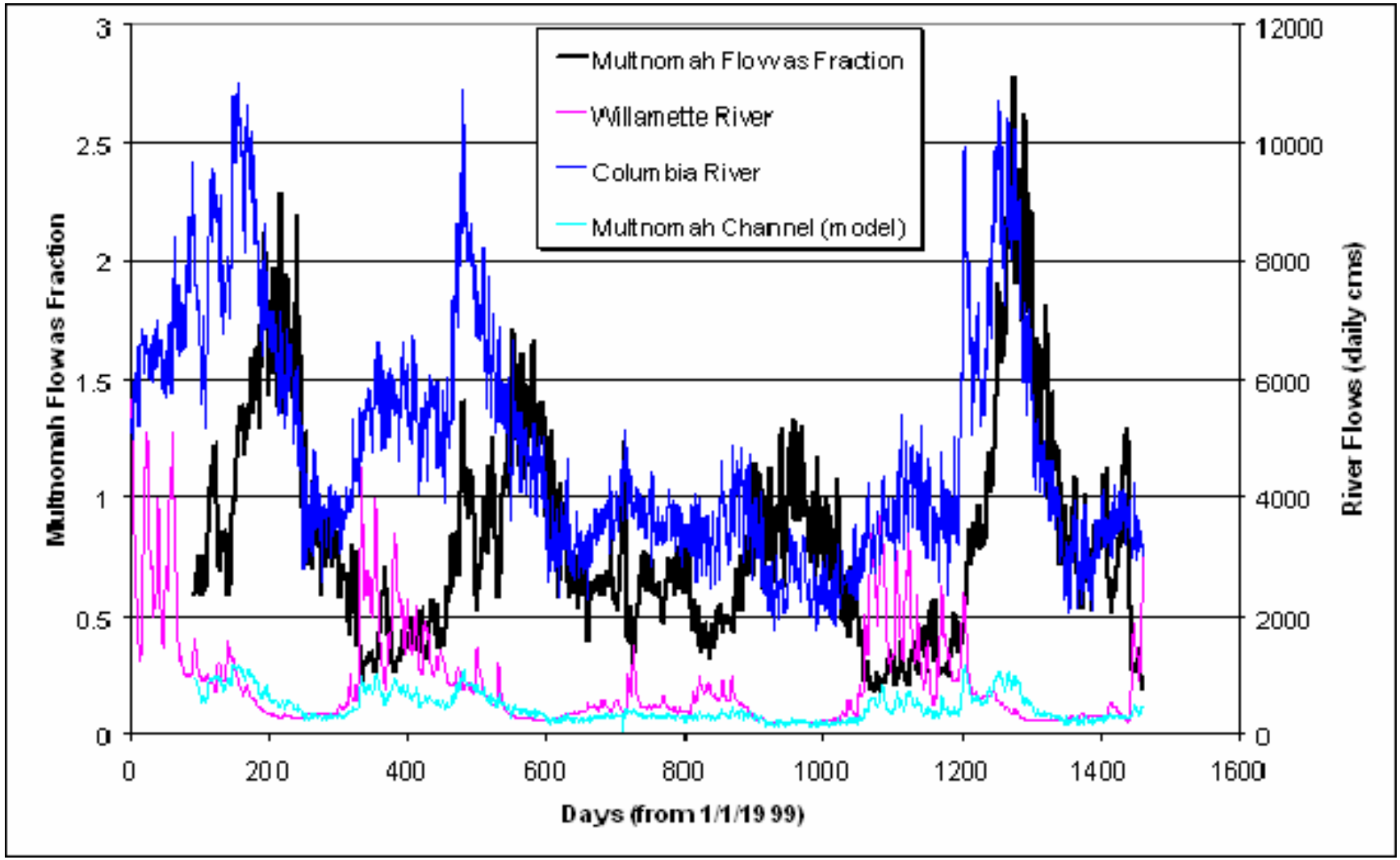
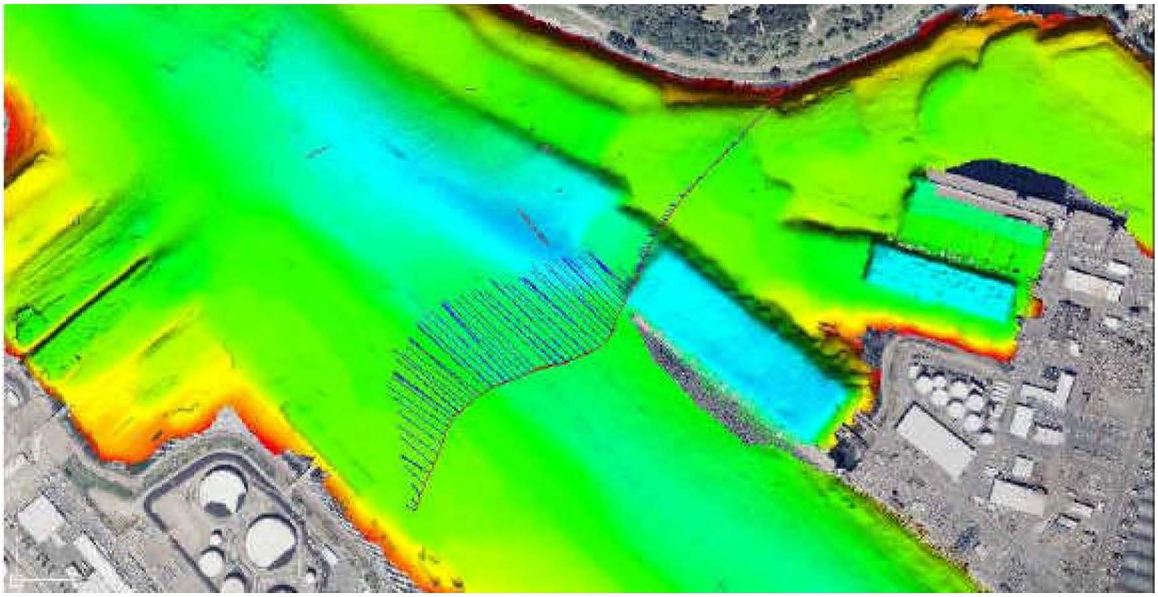
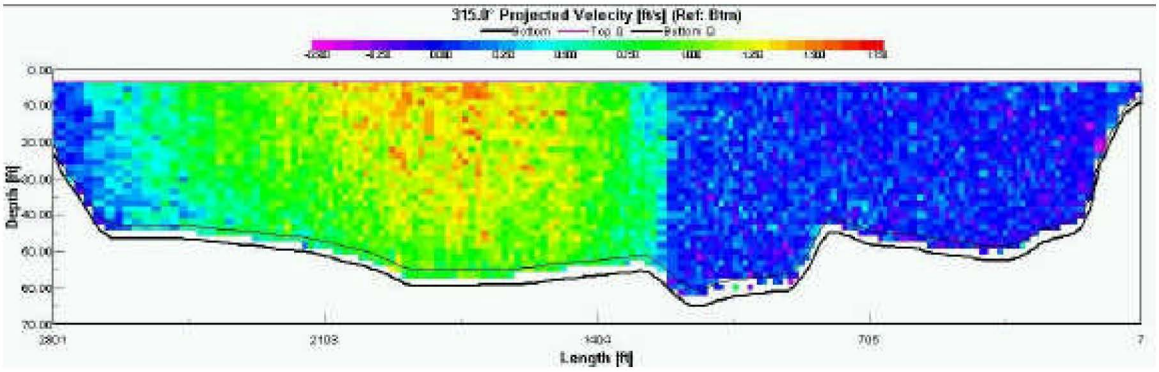


Figure 3.1-14
Portland Harbor RI/FS
Remedial Investigation Report
Willamette and Columbia River Flows and
Modeled Multnomah Channel Flows
as a Fraction of the Willamette Flow



a.

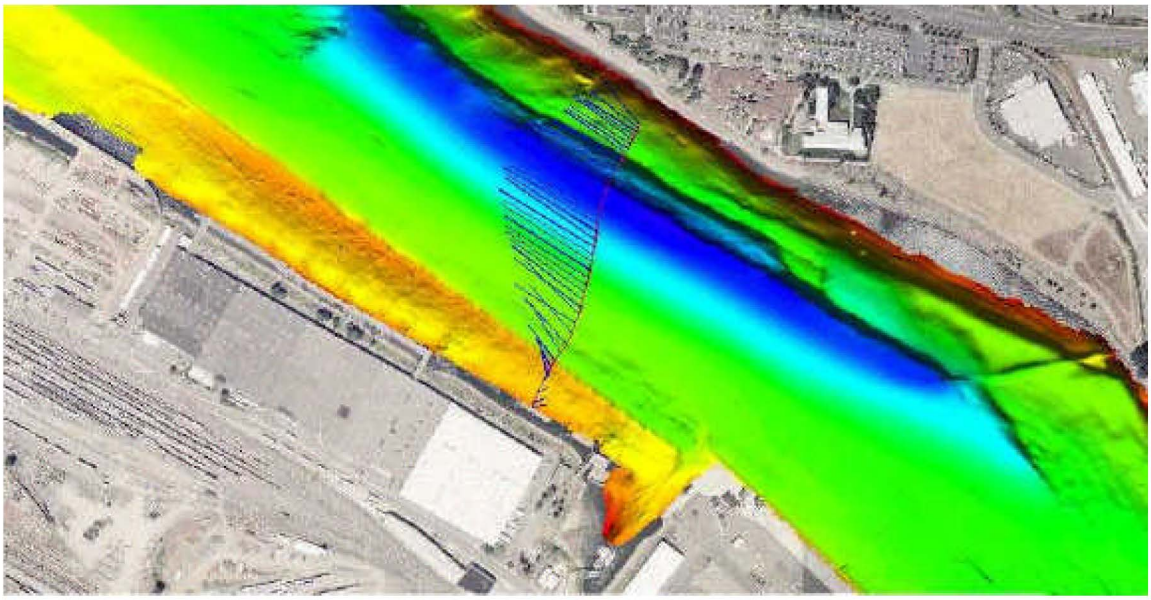
Vector Plot (ADCP Data) of the Water-column-averaged Velocity, Magnitude, and Direction at Transect 11, RM 8



b.

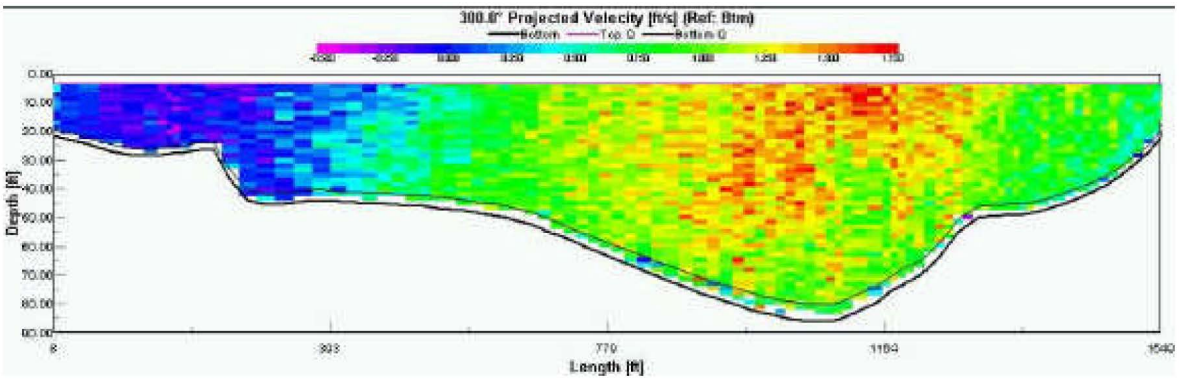
Vector Profile of the Velocity Measured Perpendicular to Transect 11 at RM 8 on April 19, 2002

Figure 3.1-15a-b
Portland Harbor RI/FS
Remedial Investigation Report
ADCP Data at Transect 11 at RM 8



a.

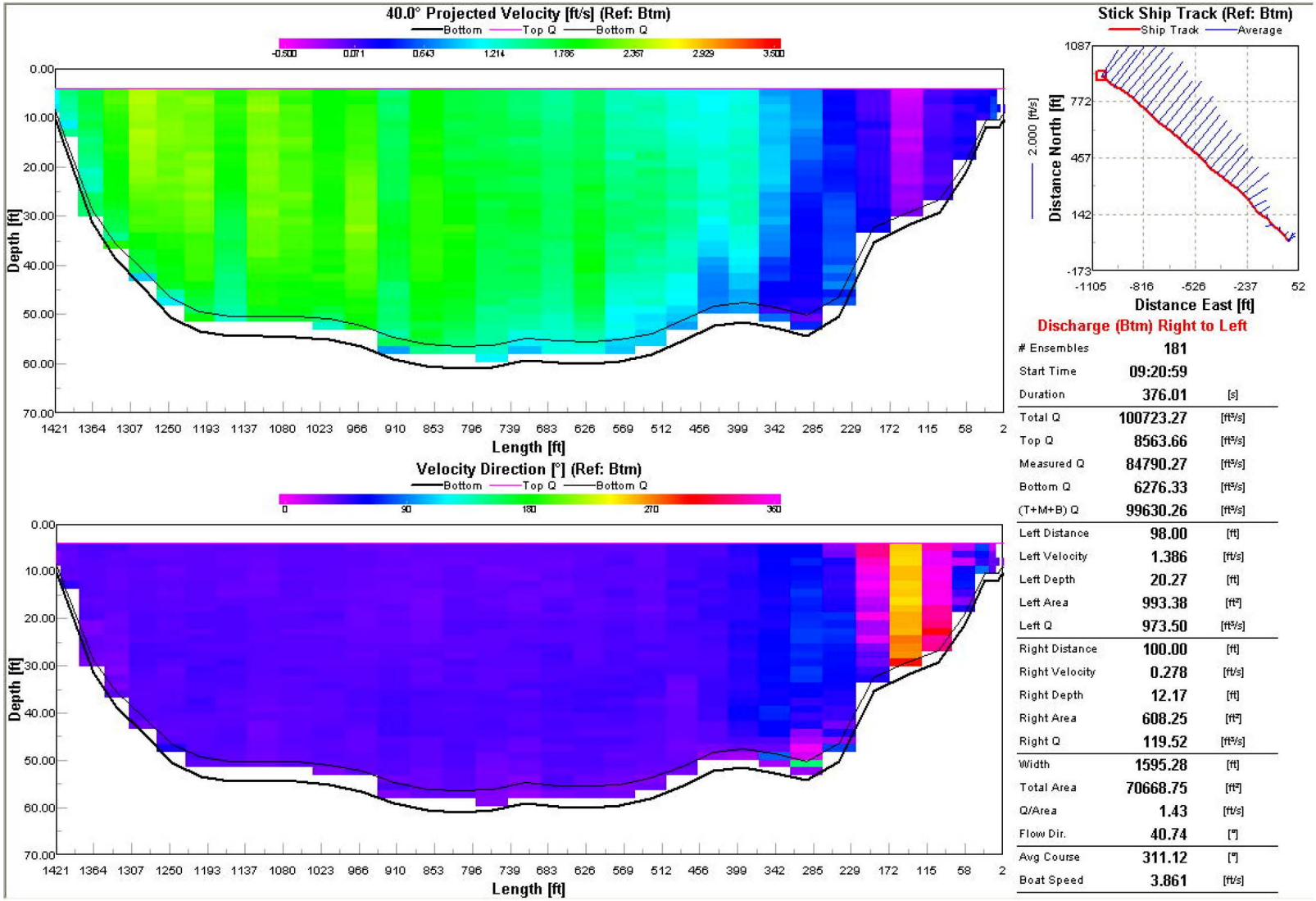
Vector Plot (ADCP Data) of the Water-column-averaged Velocity, Magnitude, and Direction at Transect 14, RM 9.6



b.

Vector Profile of the Velocity Measured Perpendicular to Transect 14 at RM 8 on April 19, 2002

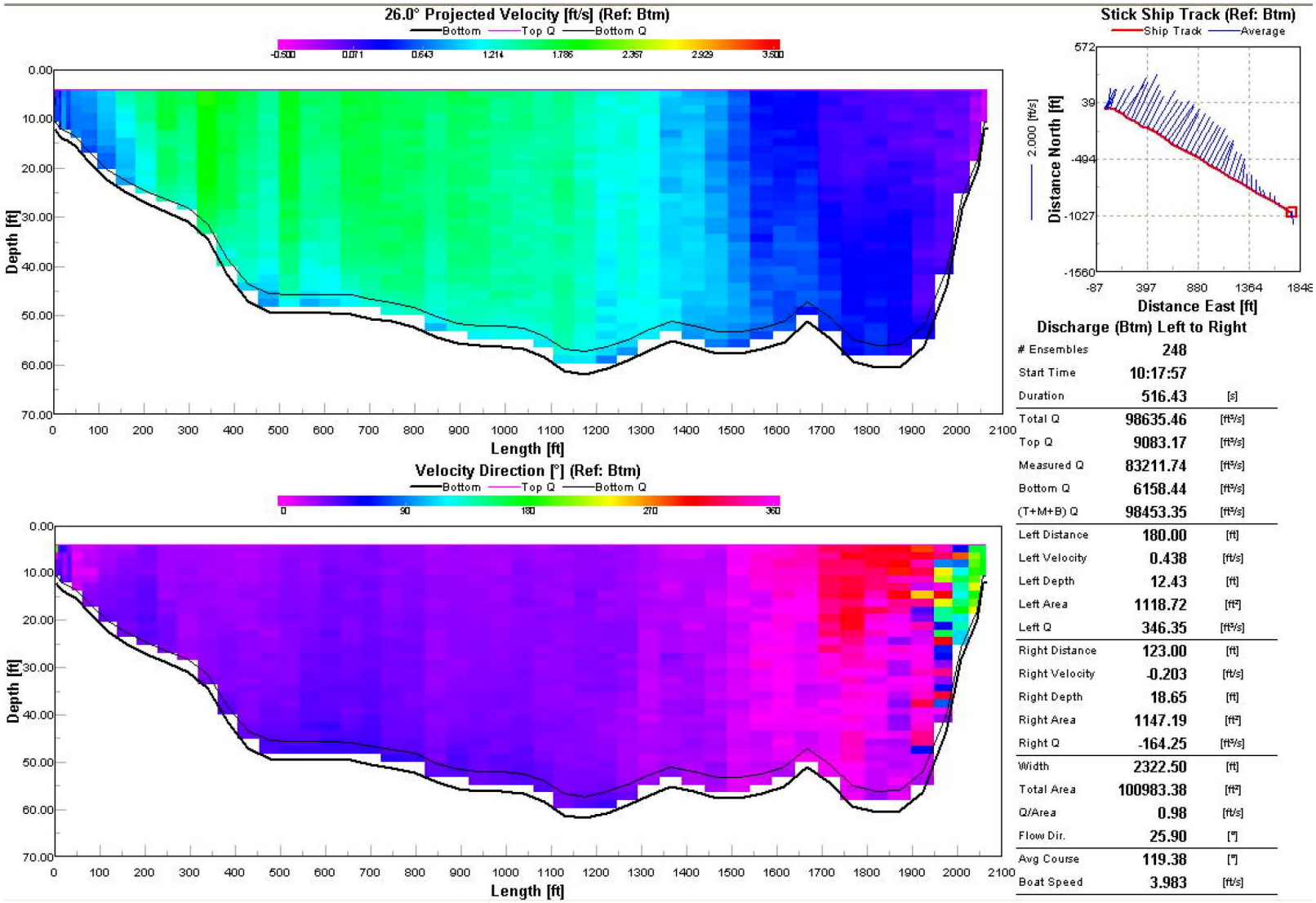
Figure 3.1-16a-b
Portland Harbor RI/FS
Remedial Investigation Report
ADCP Data at Transect 14 at RM 9.6



Transect 1 at 09:20 hours – River Mile 1.0

Source: DEA (2004b)

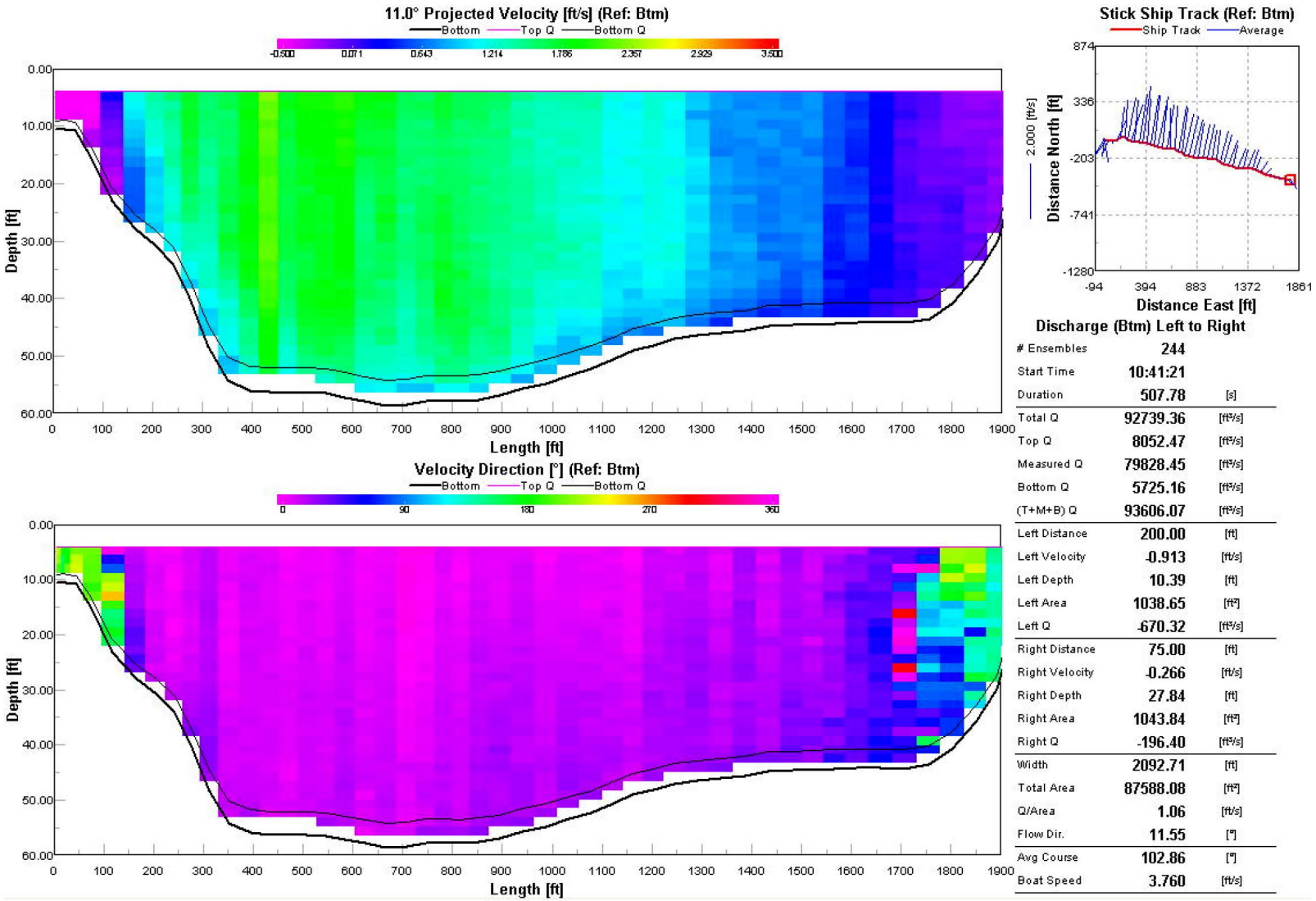
Figure 3.1-17a
Portland Harbor RI/FS
Remedial Investigation Report
ADCP Survey Winter 2004 Transect Data



Transect 2 at 10:18 hours – River Mile 2.0

Source: DEA (2004b)

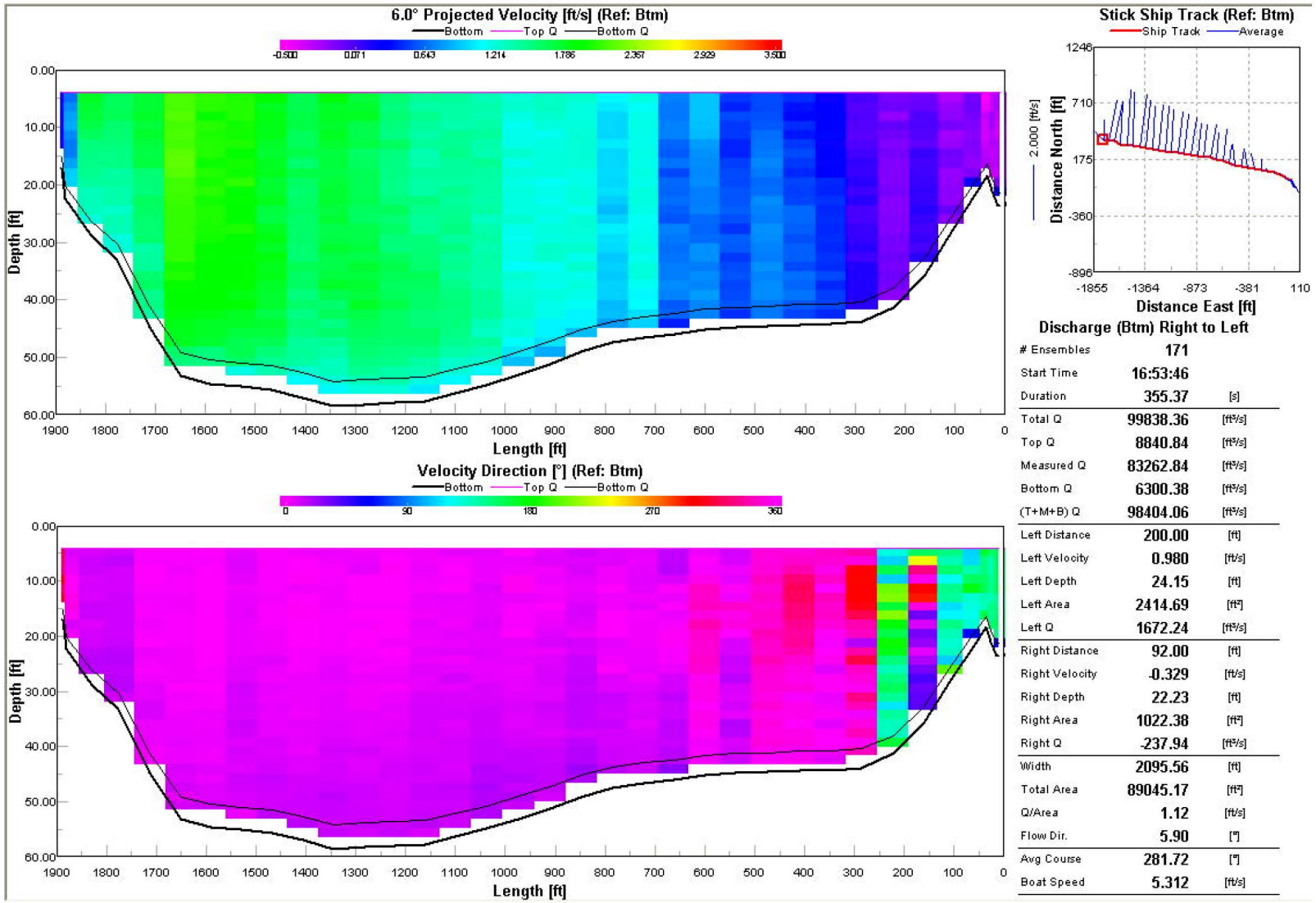
Figure 3.1-17b
Portland Harbor RI/FS
Remedial Investigation Report
ADCP Survey Winter 2004 Transect Data



Transect 3 at 10:41 hours – River Mile 2.5

Source: DEA (2004b)

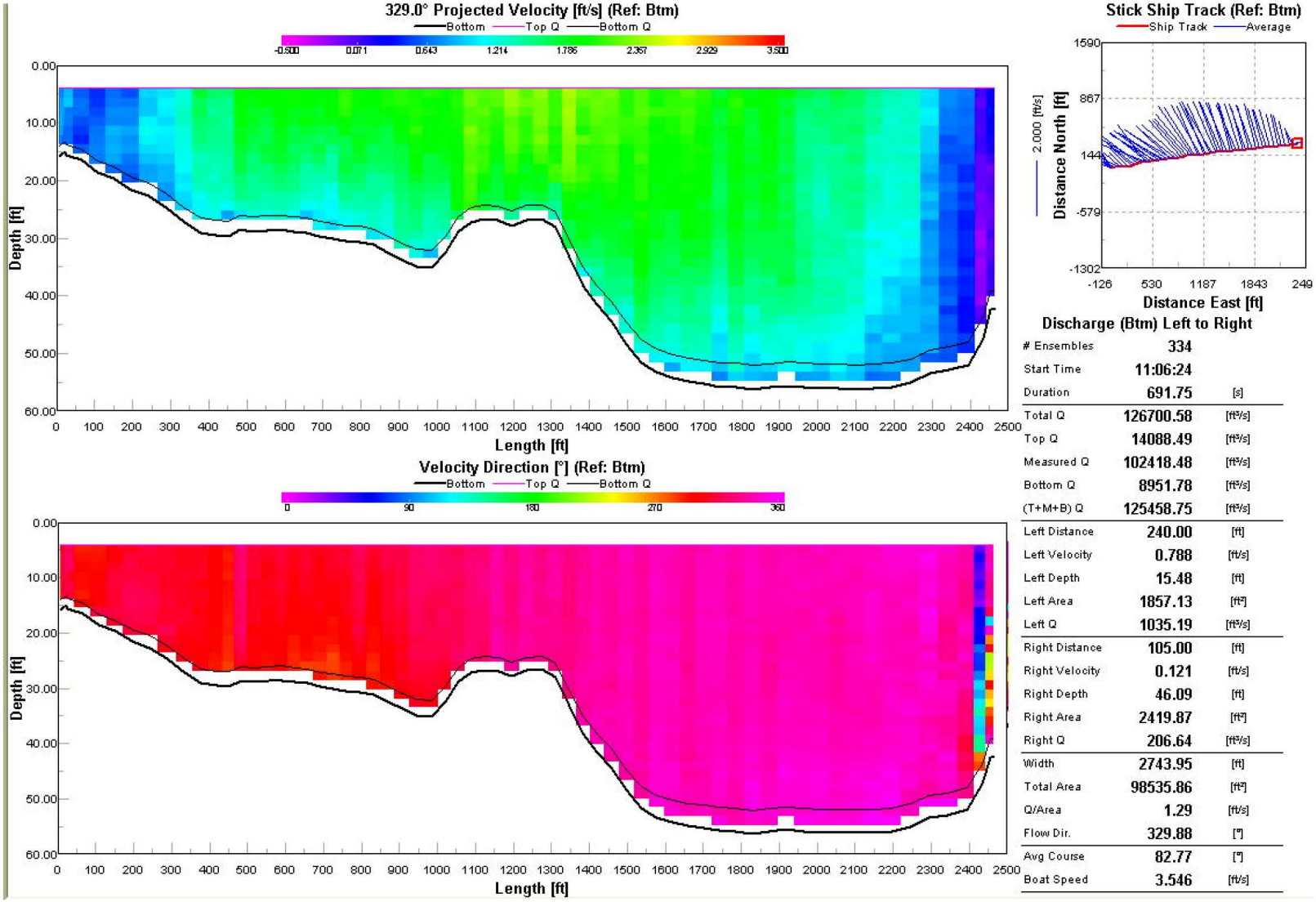
Figure 3.1-17c
Portland Harbor RI/FS
Remedial Investigation Report
ADCP Survey Winter 2004 Transect Data



Transect 3 at 16:53 hours – River Mile 2.5

Source: DEA (2004b)

Figure 3.1-17d
Portland Harbor RI/FS
Remedial Investigation Report
ADCP Survey Winter 2004 Transect Data



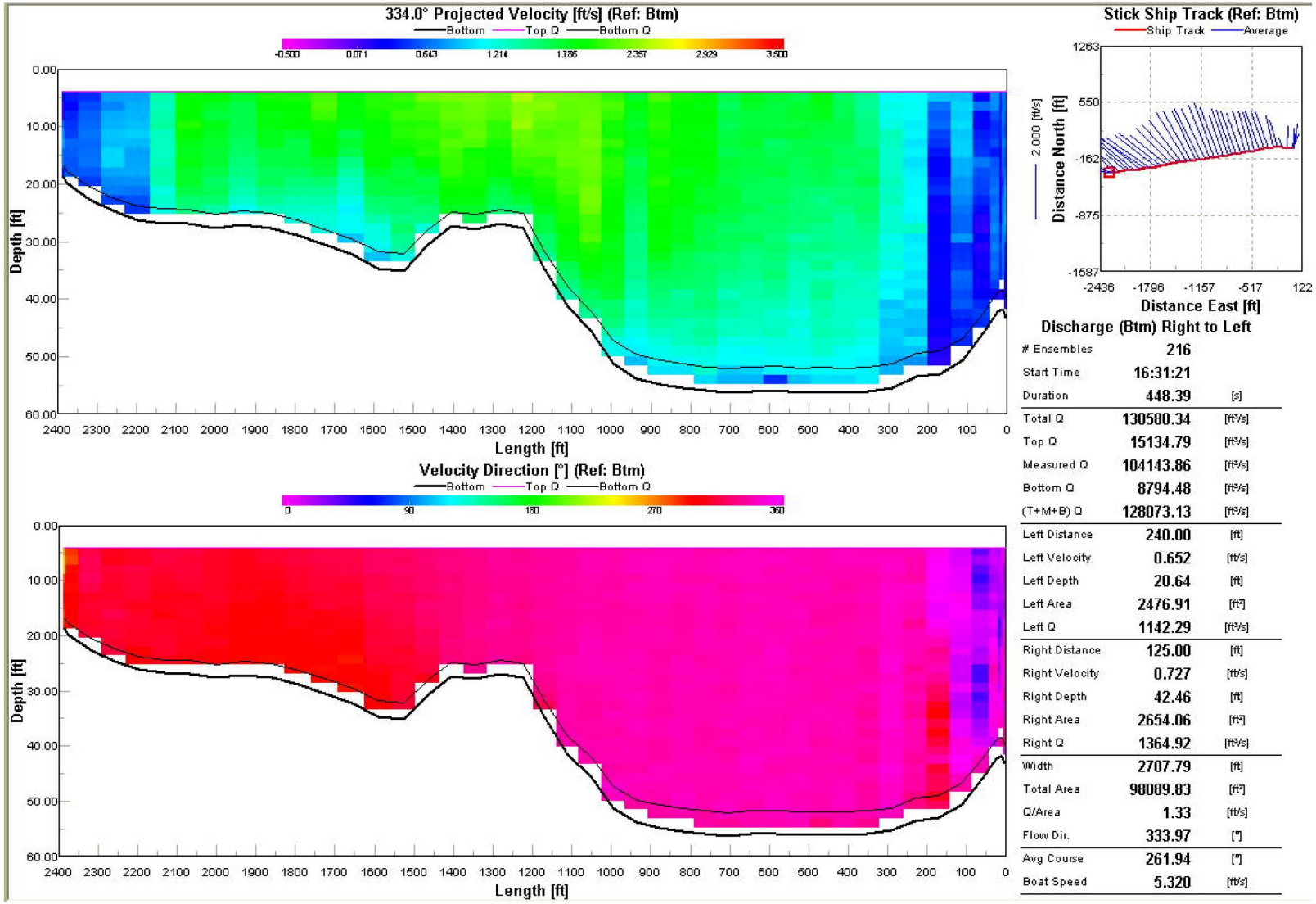
Discharge (Btm) Left to Right

# Ensembles	334	
Start Time	11:06:24	
Duration	691.75	[s]
Total Q	126700.58	[ft³/s]
Top Q	14088.49	[ft³/s]
Measured Q	102418.48	[ft³/s]
Bottom Q	8951.78	[ft³/s]
(T+M+B) Q	125458.75	[ft³/s]
Left Distance	240.00	[ft]
Left Velocity	0.788	[ft/s]
Left Depth	15.48	[ft]
Left Area	1857.13	[ft²]
Left Q	1035.19	[ft³/s]
Right Distance	105.00	[ft]
Right Velocity	0.121	[ft/s]
Right Depth	46.09	[ft]
Right Area	2419.87	[ft²]
Right Q	206.64	[ft³/s]
Width	2743.95	[ft]
Total Area	98535.86	[ft²]
Q/Area	1.29	[ft/s]
Flow Dir.	329.88	[°]
Avg Course	82.77	[°]
Boat Speed	3.546	[ft/s]

Transect 4 at 11:06 hours – River Mile 3.1 at Entrance to Multnomah Channel

Source: DEA (2004b)

Figure 3.1-17e
Portland Harbor RI/FS
Remedial Investigation Report
ADCP Survey Winter 2004 Transect Data



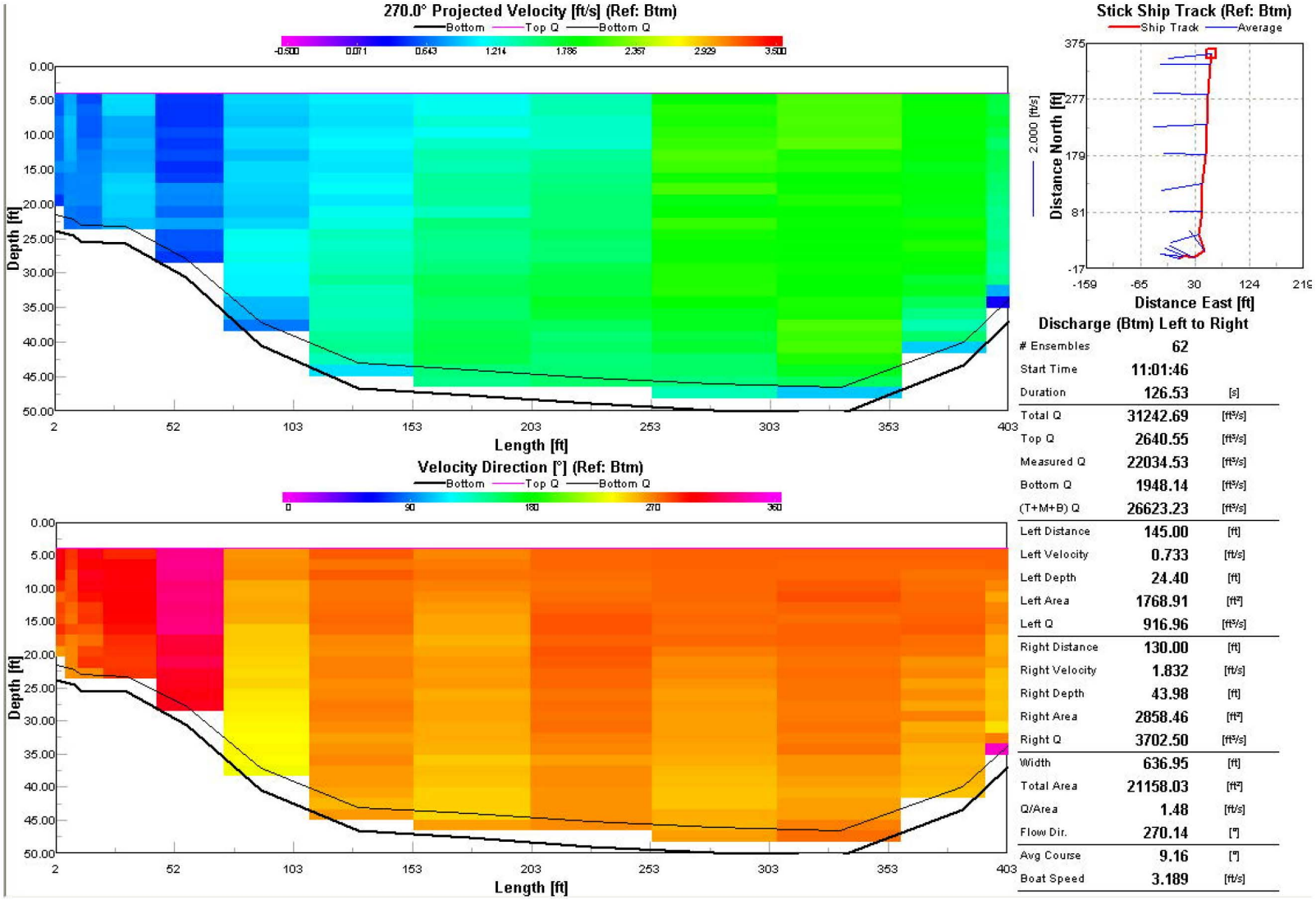
Discharge (Btm) Right to Left

# Ensembles	216	
Start Time	16:31:21	
Duration	448.39	[s]
Total Q	130580.34	[ft³/s]
Top Q	15134.79	[ft³/s]
Measured Q	104143.86	[ft³/s]
Bottom Q	8794.48	[ft³/s]
(T+M+B) Q	128073.13	[ft³/s]
Left Distance	240.00	[ft]
Left Velocity	0.652	[ft/s]
Left Depth	20.64	[ft]
Left Area	2476.91	[ft²]
Left Q	1142.29	[ft³/s]
Right Distance	125.00	[ft]
Right Velocity	0.727	[ft/s]
Right Depth	42.46	[ft]
Right Area	2654.06	[ft²]
Right Q	1364.92	[ft³/s]
Width	2707.79	[ft]
Total Area	98089.83	[ft²]
Q/Area	1.33	[ft/s]
Flow Dir.	333.97	[°]
Avg Course	261.94	[°]
Boat Speed	5.320	[ft/s]

Transect 4 at 16:31 hours – River Mile 3.1 at Entrance to Multnomah Channel

Source: DEA (2004b)

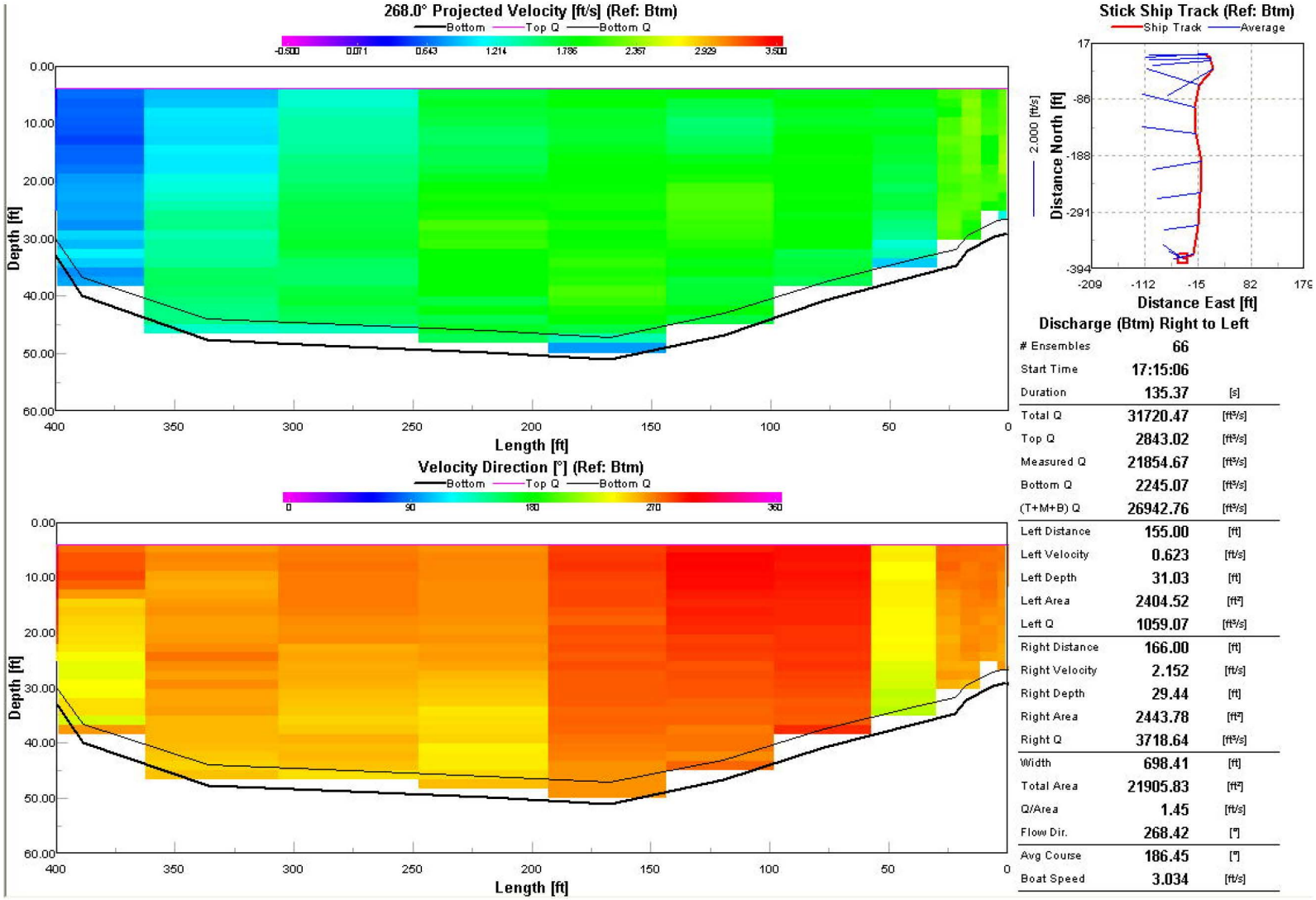
Figure 3.1-17f
Portland Harbor RI/FS
Remedial Investigation Report
ADCP Survey Winter 2004 Transect Data



Transect 17 at 11:01 hours – Multnomah Channel

Source: DEA (2004b)

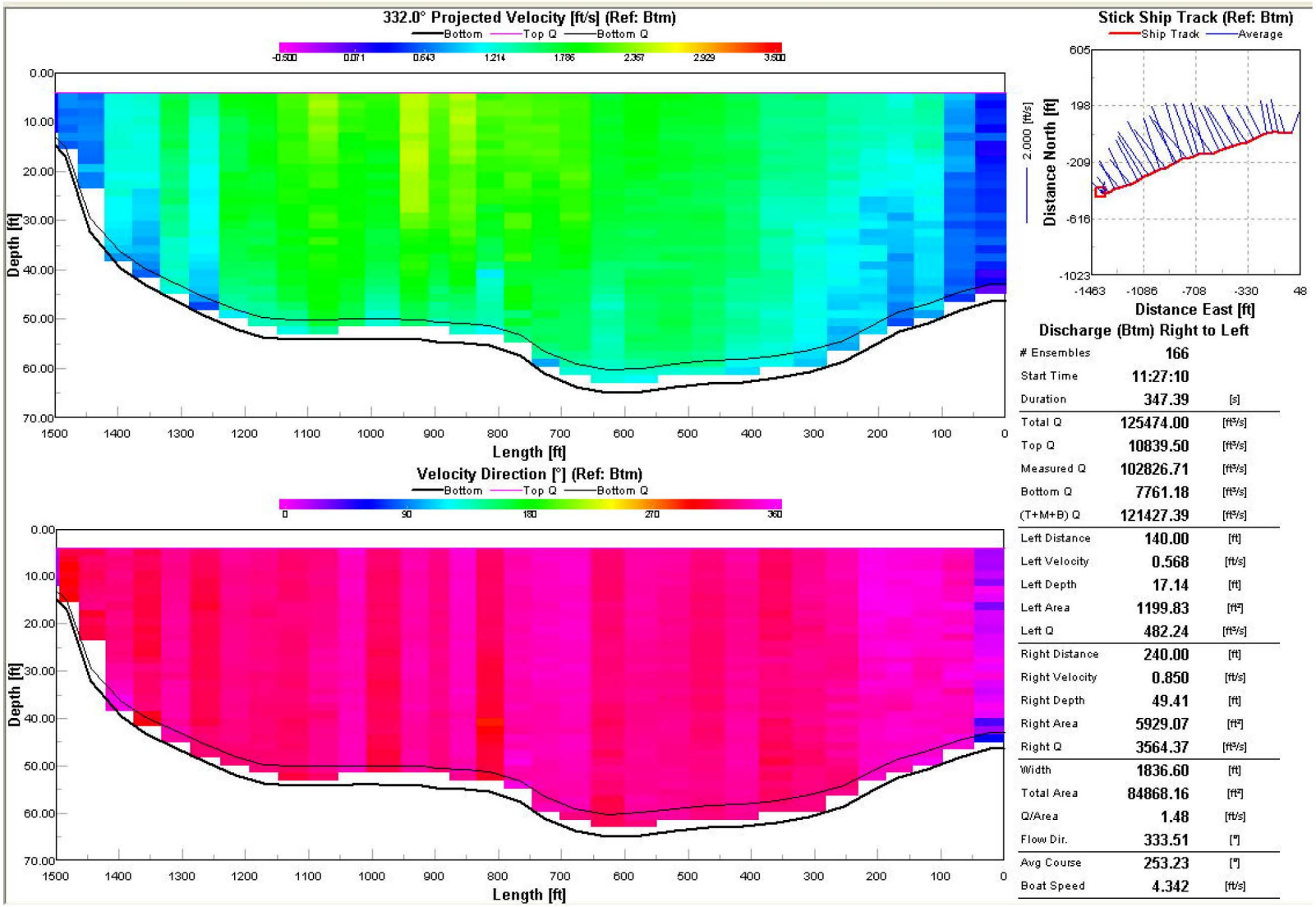
Figure 3.1-17g
Portland Harbor RI/FS
Remedial Investigation Report
ADCP Survey Winter 2004 Transect Data



Transect 17 at 17:15 hours – Multnomah Channel

Source: DEA (2004b)

Figure 3.1-17h
Portland Harbor RI/FS
Remedial Investigation Report
ADCP Survey Winter 2004 Transect Data



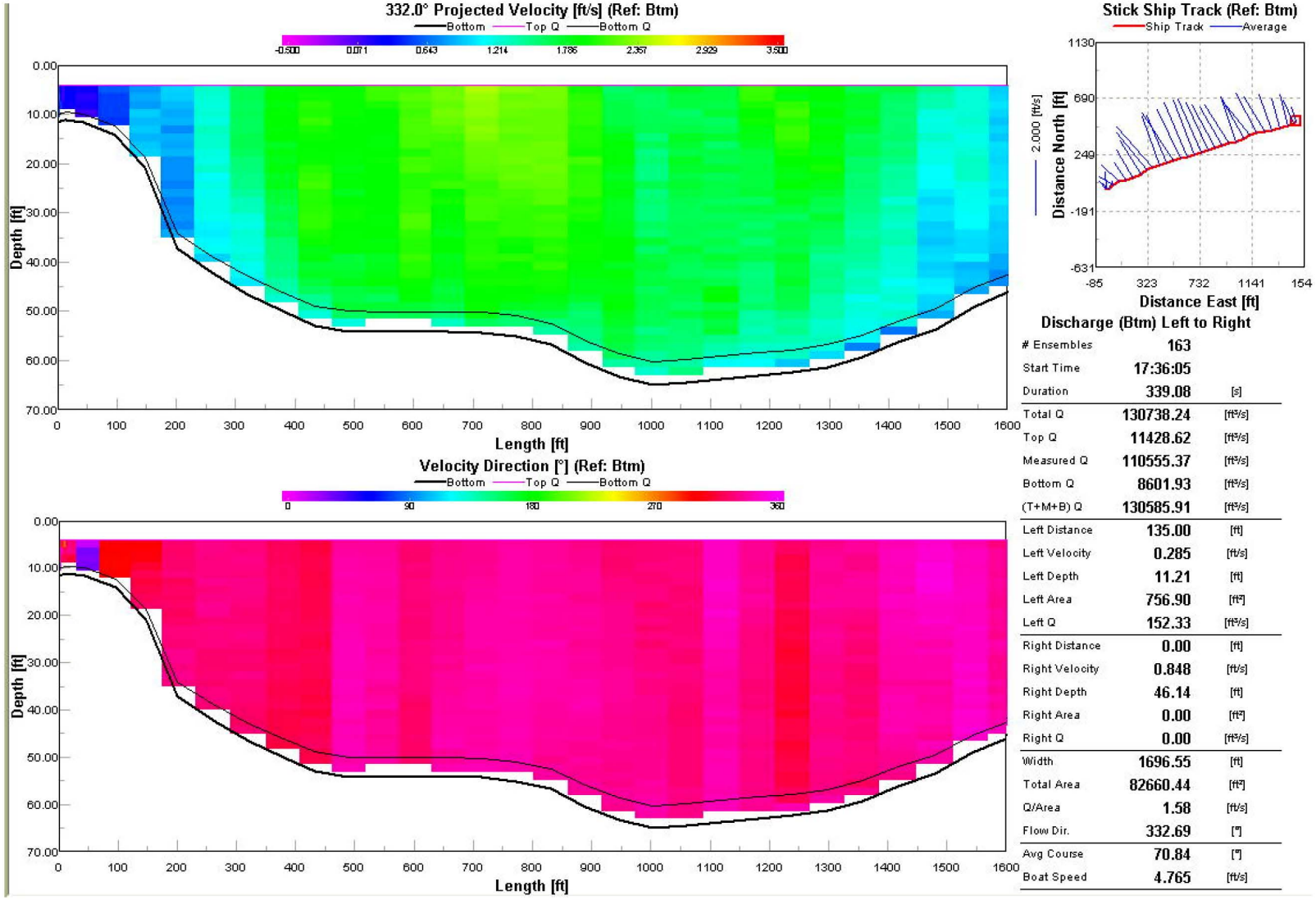
Discharge (Btm) Right to Left

# Ensembles	166	
Start Time	11:27:10	
Duration	347.39	[s]
Total Q	125474.00	[ft³/s]
Top Q	10839.50	[ft³/s]
Measured Q	102826.71	[ft³/s]
Bottom Q	7761.18	[ft³/s]
(T+M+B) Q	121427.39	[ft³/s]
Left Distance	140.00	[ft]
Left Velocity	0.568	[ft/s]
Left Depth	17.14	[ft]
Left Area	1199.83	[ft²]
Left Q	482.24	[ft³/s]
Right Distance	240.00	[ft]
Right Velocity	0.850	[ft/s]
Right Depth	49.41	[ft]
Right Area	5929.07	[ft²]
Right Q	3564.37	[ft³/s]
Width	1836.60	[ft]
Total Area	84868.16	[ft²]
Q/Area	1.48	[ft/s]
Flow Dir.	333.51	[°]
Avg Course	253.23	[°]
Boat Speed	4.342	[ft/s]

Transect 5 at 11:26 hours – River Mile 4.0

Source: DEA (2004b)

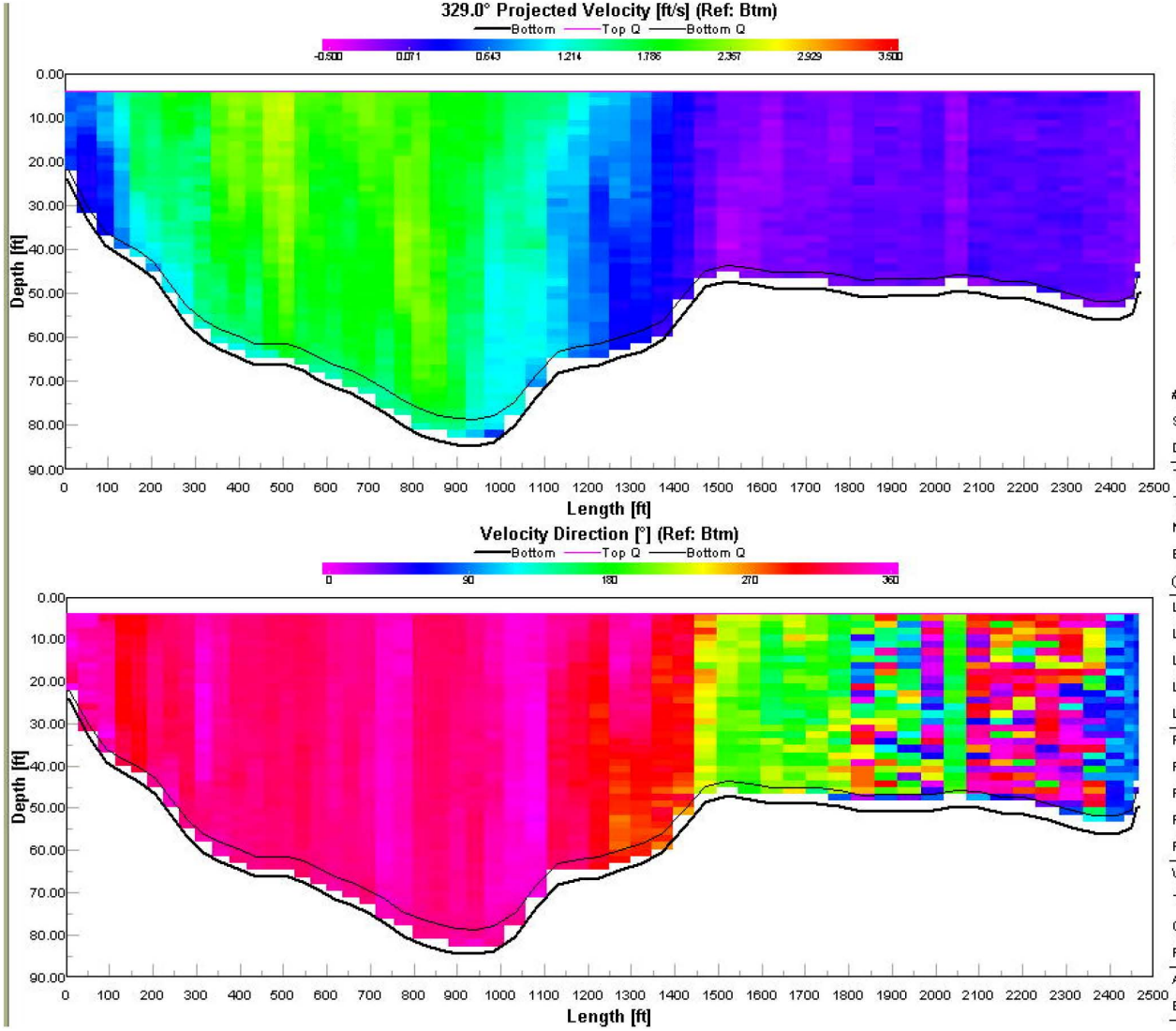
Figure 3.1-17i
Portland Harbor RI/FS
Remedial Investigation Report
ADCP Survey Winter 2004 Transect Data

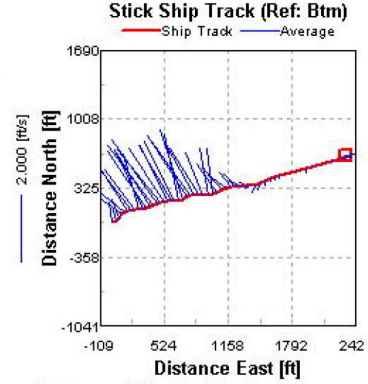


Transect 5 at 17:36 hours – River Mile 4.0

Source: DEA (2004b)

Figure 3.1-17j
Portland Harbor RI/FS
Remedial Investigation Report
ADCP Survey Winter 2004 Transect Data





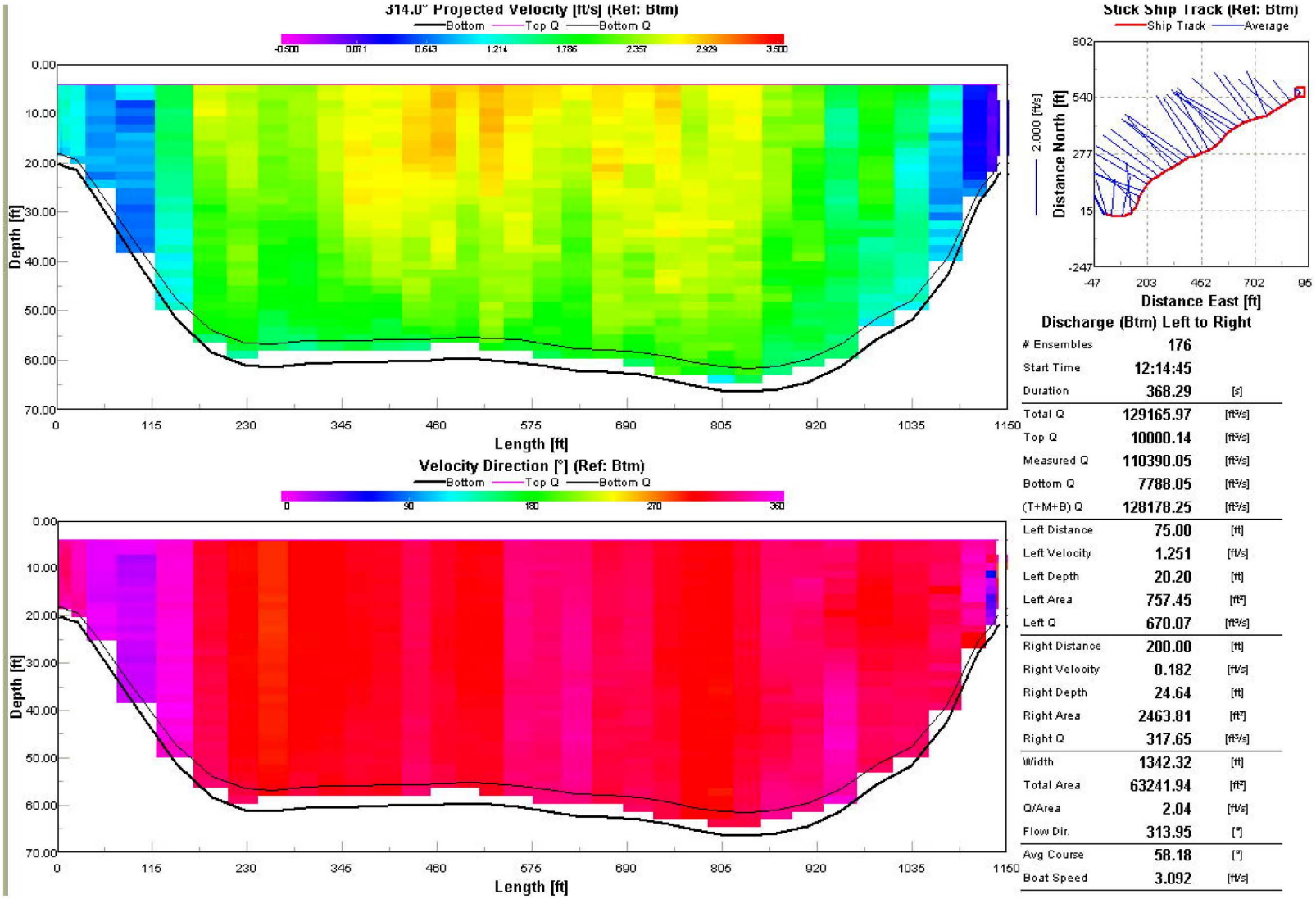
Discharge (Btm) Left to Right

# Ensembles	278	
Start Time	11:49:08	
Duration	586.26	[s]
Total Q	125897.15	[ft³/s]
Top Q	8381.45	[ft³/s]
Measured Q	109662.06	[ft³/s]
Bottom Q	7087.86	[ft³/s]
(T+M+B) Q	125131.37	[ft³/s]
Left Distance	200.00	[ft]
Left Velocity	0.466	[ft/s]
Left Depth	31.35	[ft]
Left Area	3135.38	[ft²]
Left Q	1033.14	[ft³/s]
Right Distance	65.00	[ft]
Right Velocity	-0.218	[ft/s]
Right Depth	53.31	[ft]
Right Area	1732.55	[ft²]
Right Q	-267.36	[ft³/s]
Width	2664.66	[ft]
Total Area	147133.84	[ft²]
Q/Area	0.86	[ft/s]
Flow Dir.	329.00	[°]
Avg Course	74.31	[°]
Boat Speed	4.196	[ft/s]

Transect 6 at 11:48 hours – River Mile 4.6

Source: DEA (2004b)

Figure 3.1-17k
Portland Harbor RI/FS
Remedial Investigation Report
ADCP Survey Winter 2004 Transect Data



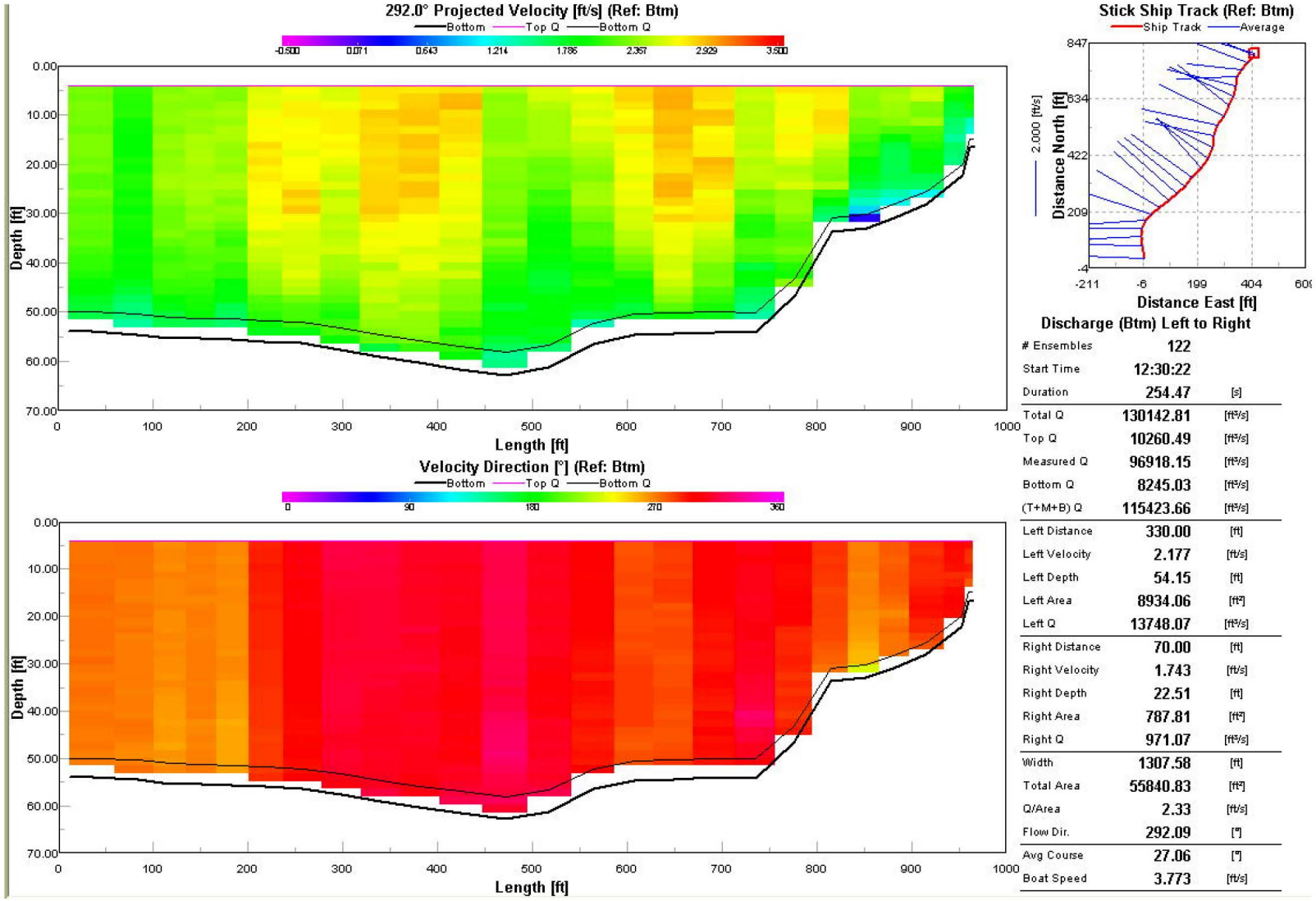
Discharge (Btm) Left to Right

# Ensembles	176	
Start Time	12:14:45	
Duration	368.29	[s]
Total Q	129165.97	[ft³/s]
Top Q	10000.14	[ft³/s]
Measured Q	110390.05	[ft³/s]
Bottom Q	7788.05	[ft³/s]
(T+M+B) Q	128178.25	[ft³/s]
Left Distance	75.00	[ft]
Left Velocity	1.251	[ft/s]
Left Depth	20.20	[ft]
Left Area	757.45	[ft²]
Left Q	670.07	[ft³/s]
Right Distance	200.00	[ft]
Right Velocity	0.182	[ft/s]
Right Depth	24.64	[ft]
Right Area	2463.81	[ft²]
Right Q	317.65	[ft³/s]
Width	1342.32	[ft]
Total Area	63241.94	[ft²]
Q/Area	2.04	[ft/s]
Flow Dir.	313.95	[°]
Avg Course	58.18	[°]
Boat Speed	3.092	[ft/s]

Transect 7 at 12:25 hours – River Mile 5.8

Source: DEA (2004b)

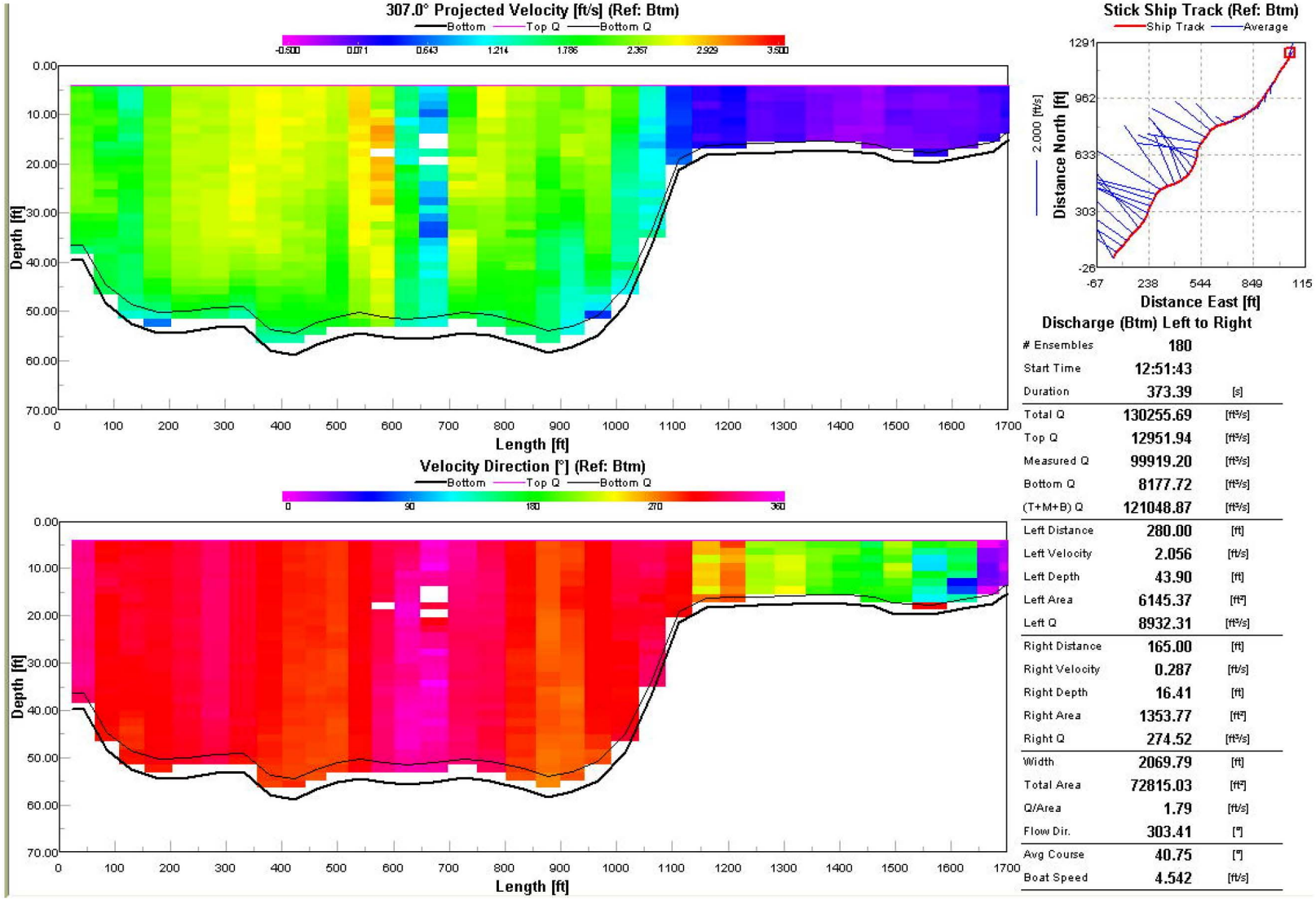
Figure 3.1-17l
Portland Harbor RI/FS
Remedial Investigation Report
ADCP Survey Winter 2004 Transect Data



Transect 8 at 12:29 hours – River Mile 6.3

Source: DEA (2004b)

Figure 3.1-17m
Portland Harbor RI/FS
Remedial Investigation Report
ADCP Survey Winter 2004 Transect Data



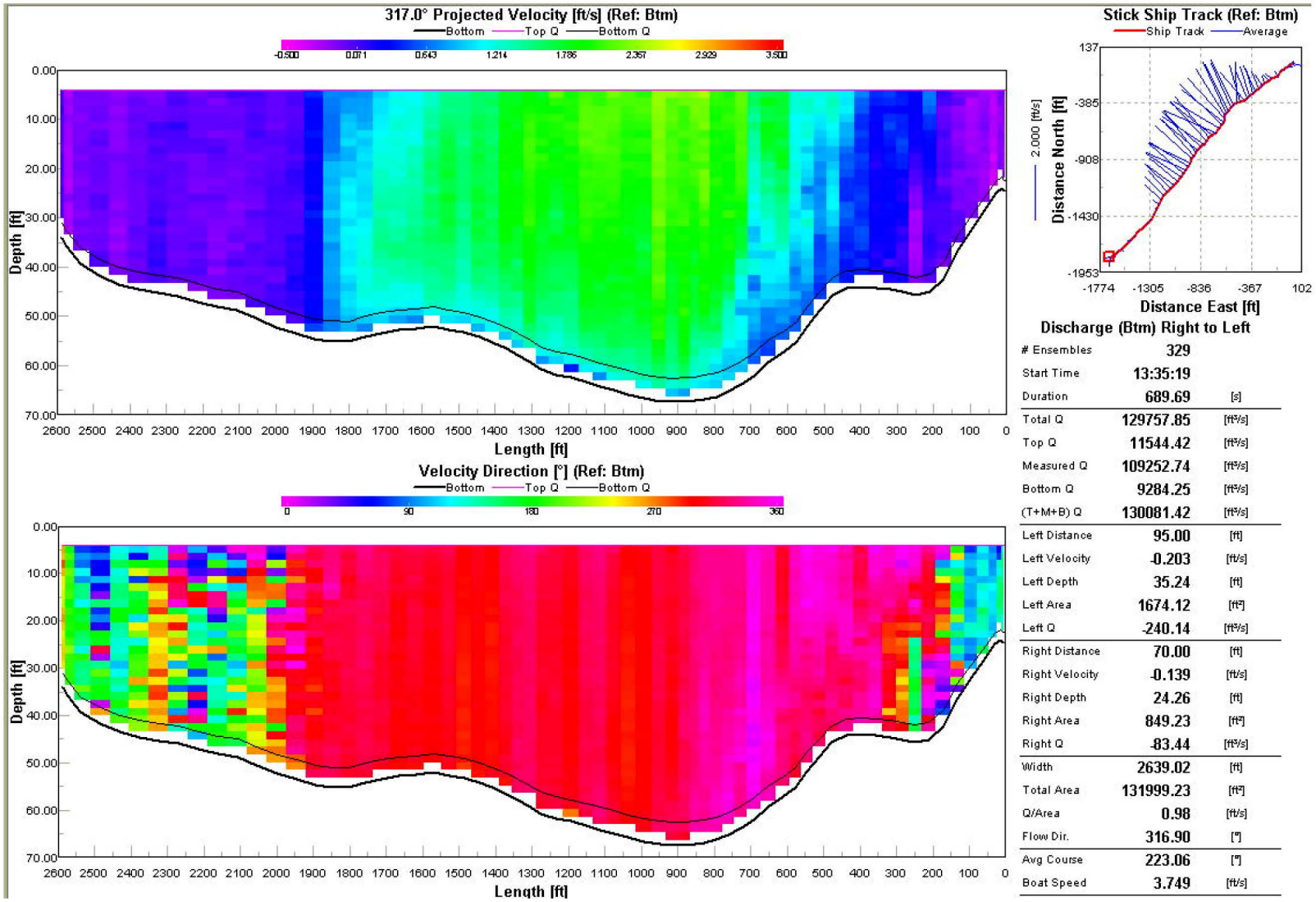
Discharge (Btm) Left to Right

# Ensembles	180	
Start Time	12:51:43	
Duration	373.39	[s]
Total Q	130255.69	[ft³/s]
Top Q	12951.94	[ft³/s]
Measured Q	99919.20	[ft³/s]
Bottom Q	8177.72	[ft³/s]
(T+M+B) Q	121048.87	[ft³/s]
Left Distance	280.00	[ft]
Left Velocity	2.056	[ft/s]
Left Depth	43.90	[ft]
Left Area	6145.37	[ft²]
Left Q	8932.31	[ft³/s]
Right Distance	165.00	[ft]
Right Velocity	0.287	[ft/s]
Right Depth	16.41	[ft]
Right Area	1353.77	[ft²]
Right Q	274.52	[ft³/s]
Width	2069.79	[ft]
Total Area	72815.03	[ft²]
Q/Area	1.79	[ft/s]
Flow Dir.	303.41	[°]
Avg Course	40.75	[°]
Boat Speed	4.542	[ft/s]

Transect 9 at 12:50 hours – River Mile 6.8

Source: DEA (2004b)

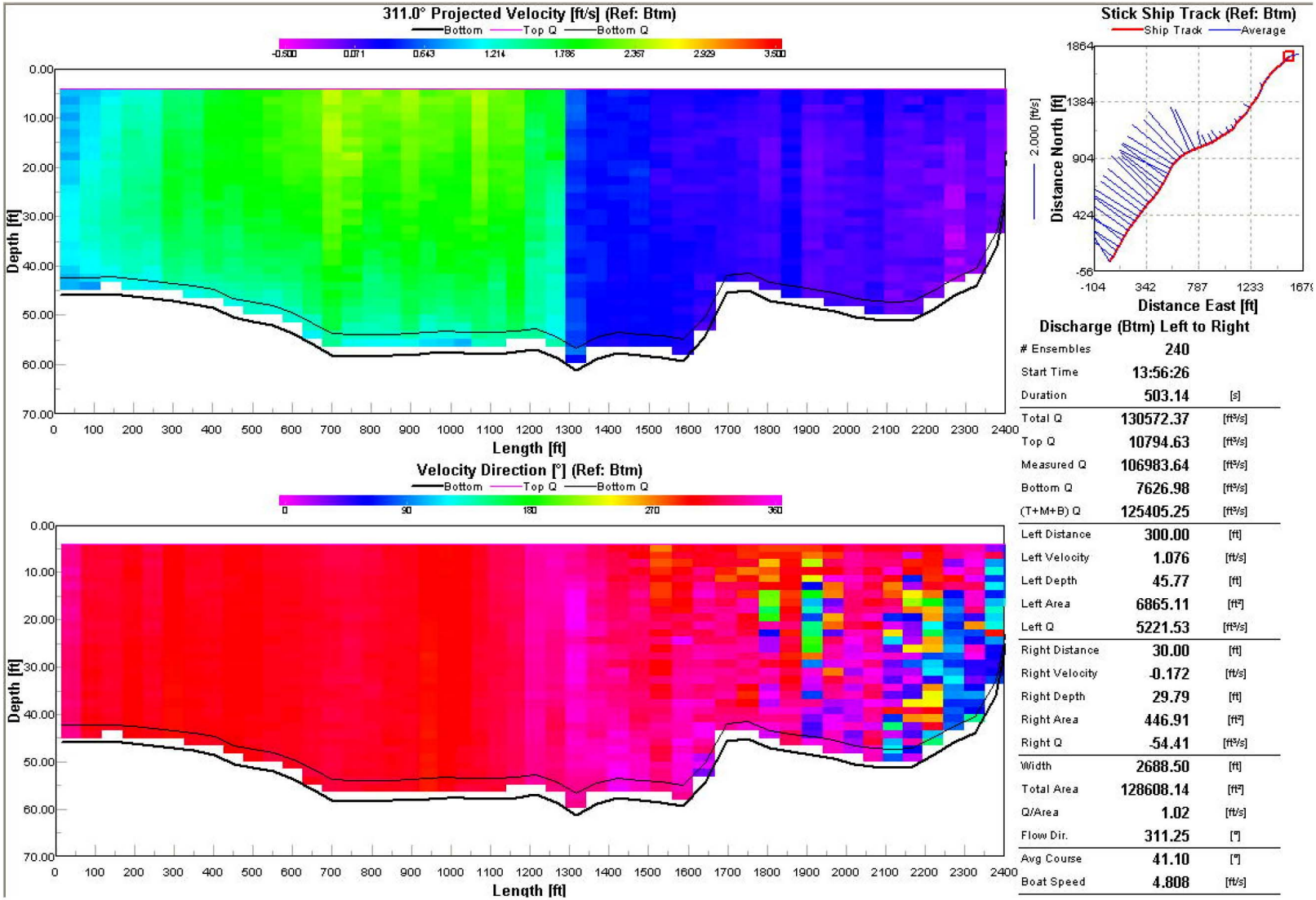
Figure 3.1-17n
Portland Harbor RI/FS
Remedial Investigation Report
ADCP Survey Winter 2004 Transect Data



Transect 10 at 13:35 hours – River Mile 7.8

Source: DEA (2004b)

Figure 3.1-17o
Portland Harbor RI/FS
Remedial Investigation Report
ADCP Survey Winter 2004 Transect Data



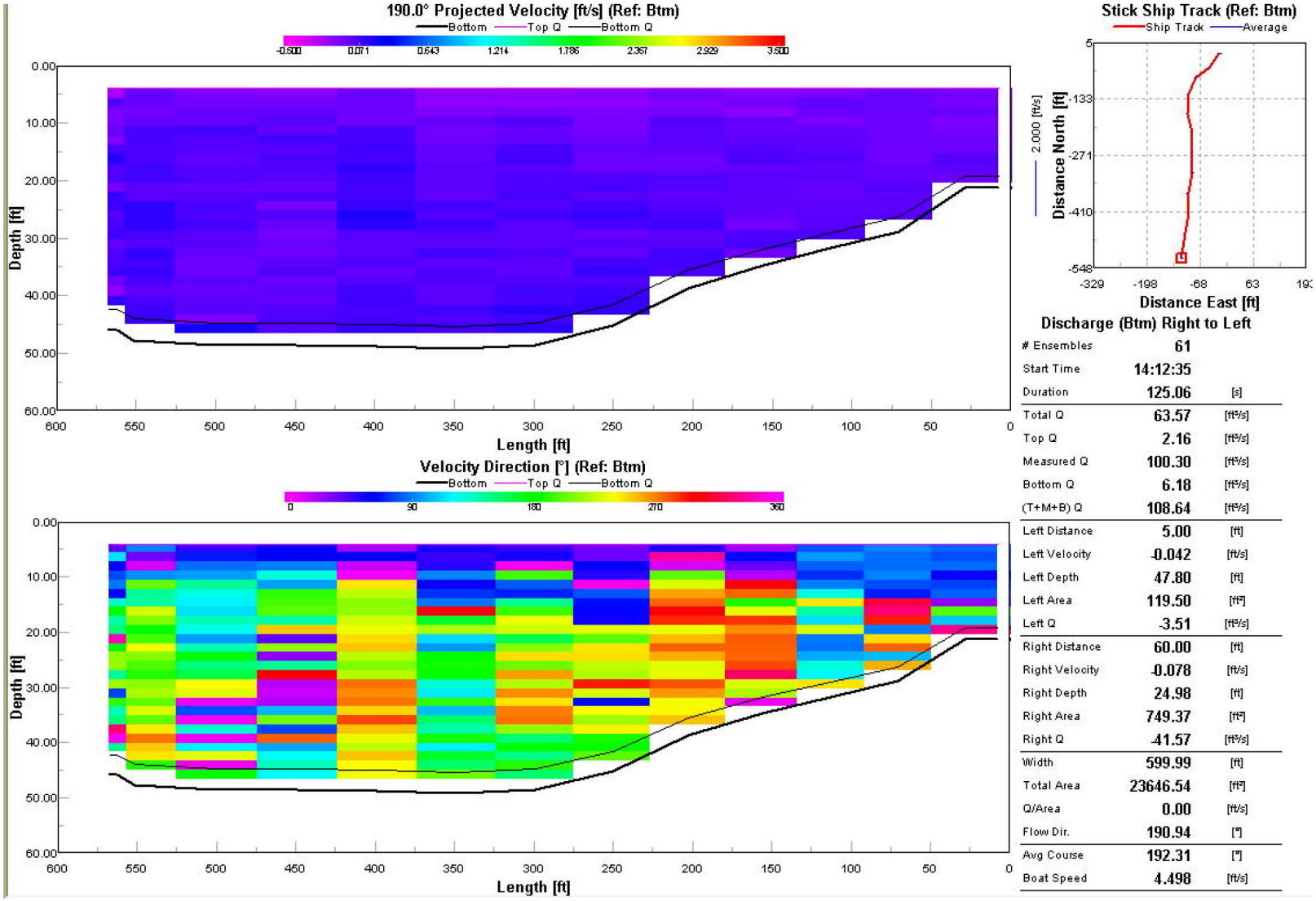
Discharge (Btm) Left to Right

# Ensembles	240	
Start Time	13:56:26	
Duration	503.14	[s]
Total Q	130572.37	[ft³/s]
Top Q	10794.63	[ft³/s]
Measured Q	106983.64	[ft³/s]
Bottom Q	7626.98	[ft³/s]
(T+M+B) Q	125405.25	[ft³/s]
Left Distance	300.00	[ft]
Left Velocity	1.076	[ft/s]
Left Depth	45.77	[ft]
Left Area	6865.11	[ft²]
Left Q	5221.53	[ft³/s]
Right Distance	30.00	[ft]
Right Velocity	-0.172	[ft/s]
Right Depth	29.79	[ft]
Right Area	446.91	[ft²]
Right Q	-54.41	[ft³/s]
Width	2688.50	[ft]
Total Area	128608.14	[ft²]
Q/Area	1.02	[ft/s]
Flow Dir.	311.25	[°]
Avg Course	41.10	[°]
Boat Speed	4.808	[ft/s]

Transect 11 at 13:55 hours – River Mile 8.0

Source: DEA (2004b)

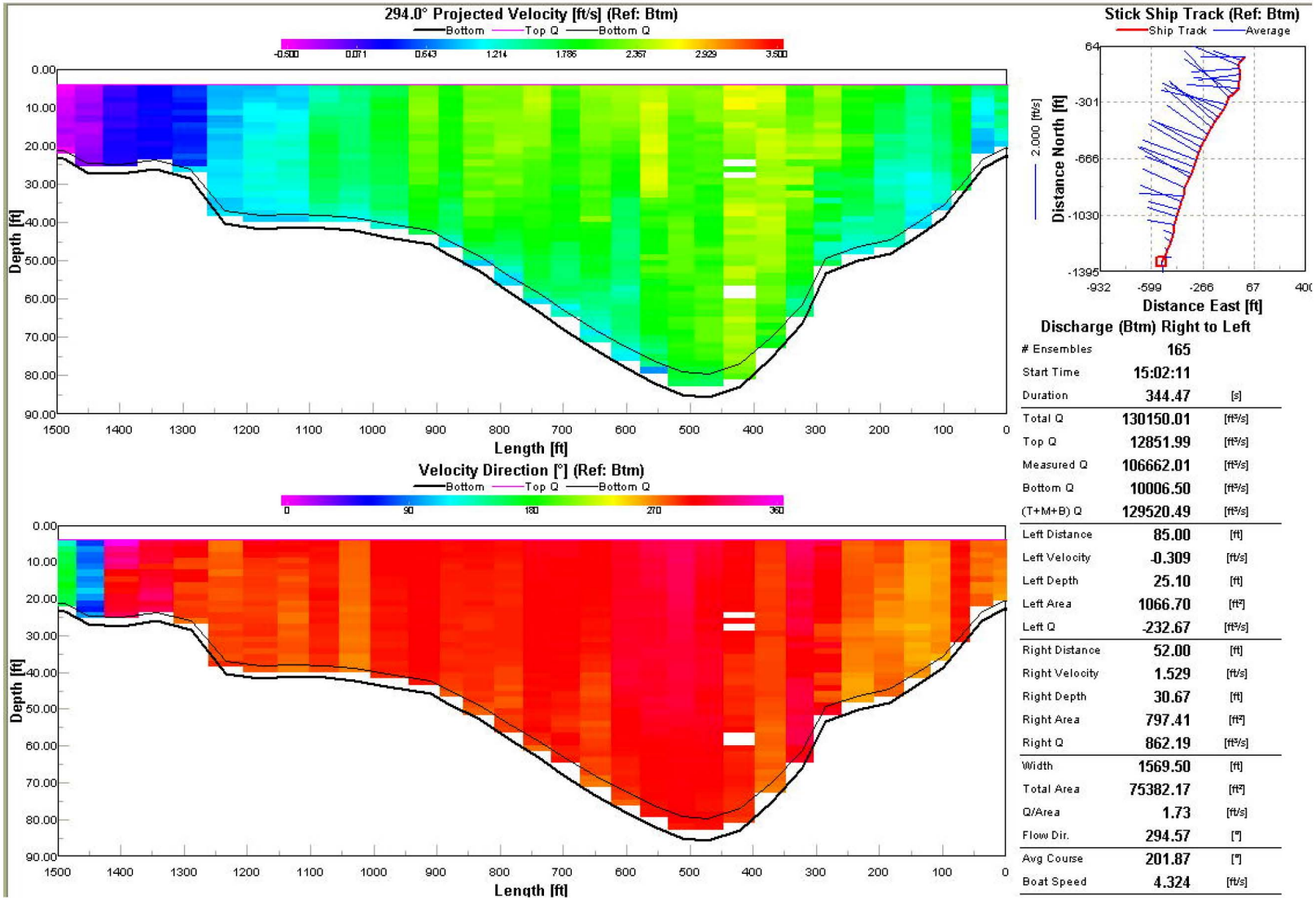
Figure 3.1-17p
Portland Harbor RI/FS
Remedial Investigation Report
ADCP Survey Winter 2004 Transect Data



Transect 12 at 14:11 hours – Entrance to Swan Island Lagoon

Source: DEA (2004b)

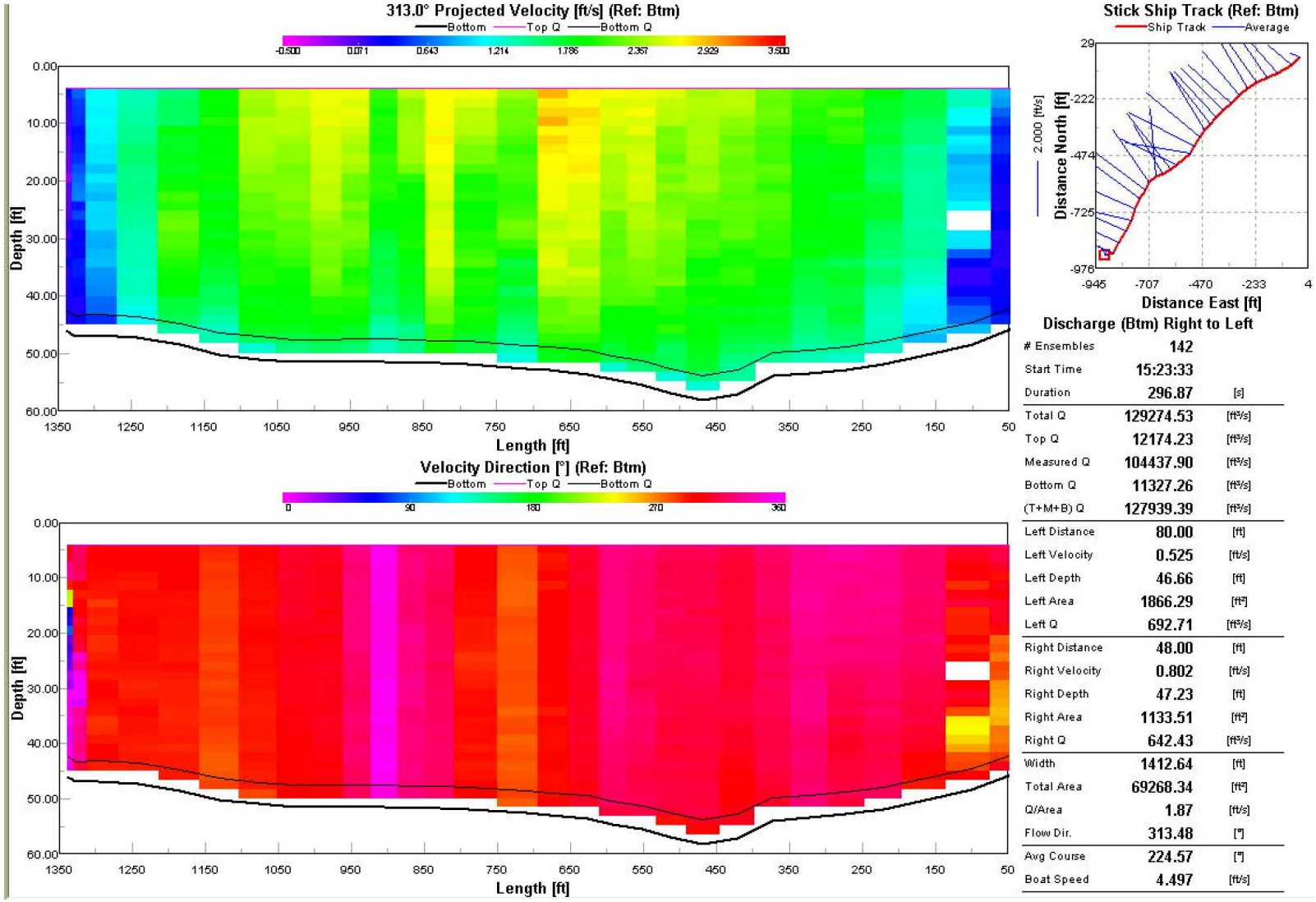
Figure 3.1-17q
Portland Harbor RI/FS
Remedial Investigation Report
ADCP Survey Winter 2004 Transect Data



Transect 14 at 15:01 hours – River Mile 9.6

Source: DEA (2004b)

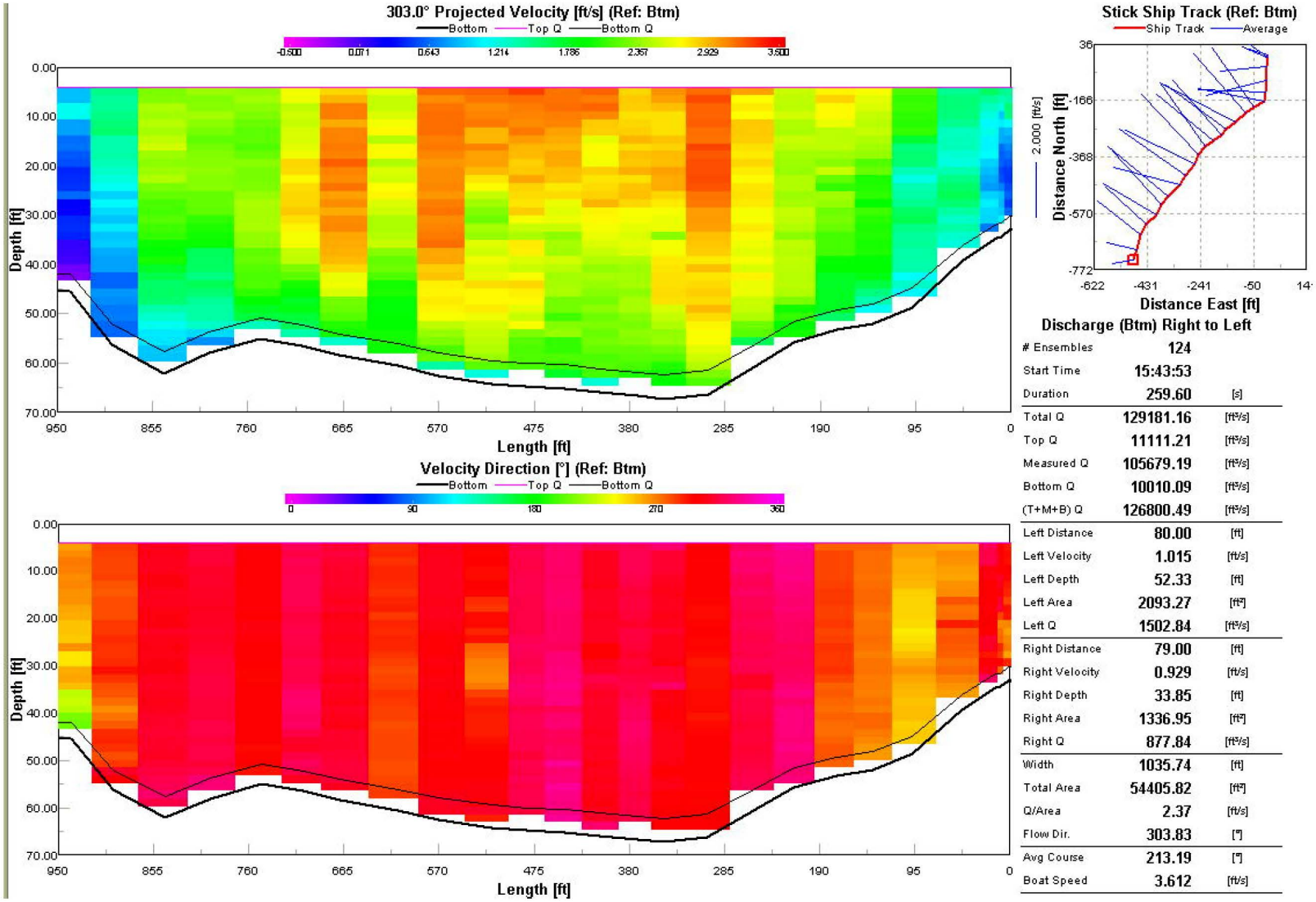
Figure 3.1-17r
Portland Harbor RI/FS
Remedial Investigation Report
ADCP Survey Winter 2004 Transect Data



Transect 15 at 15:22 hours – River Mile 10.0

Source: DEA (2004b)

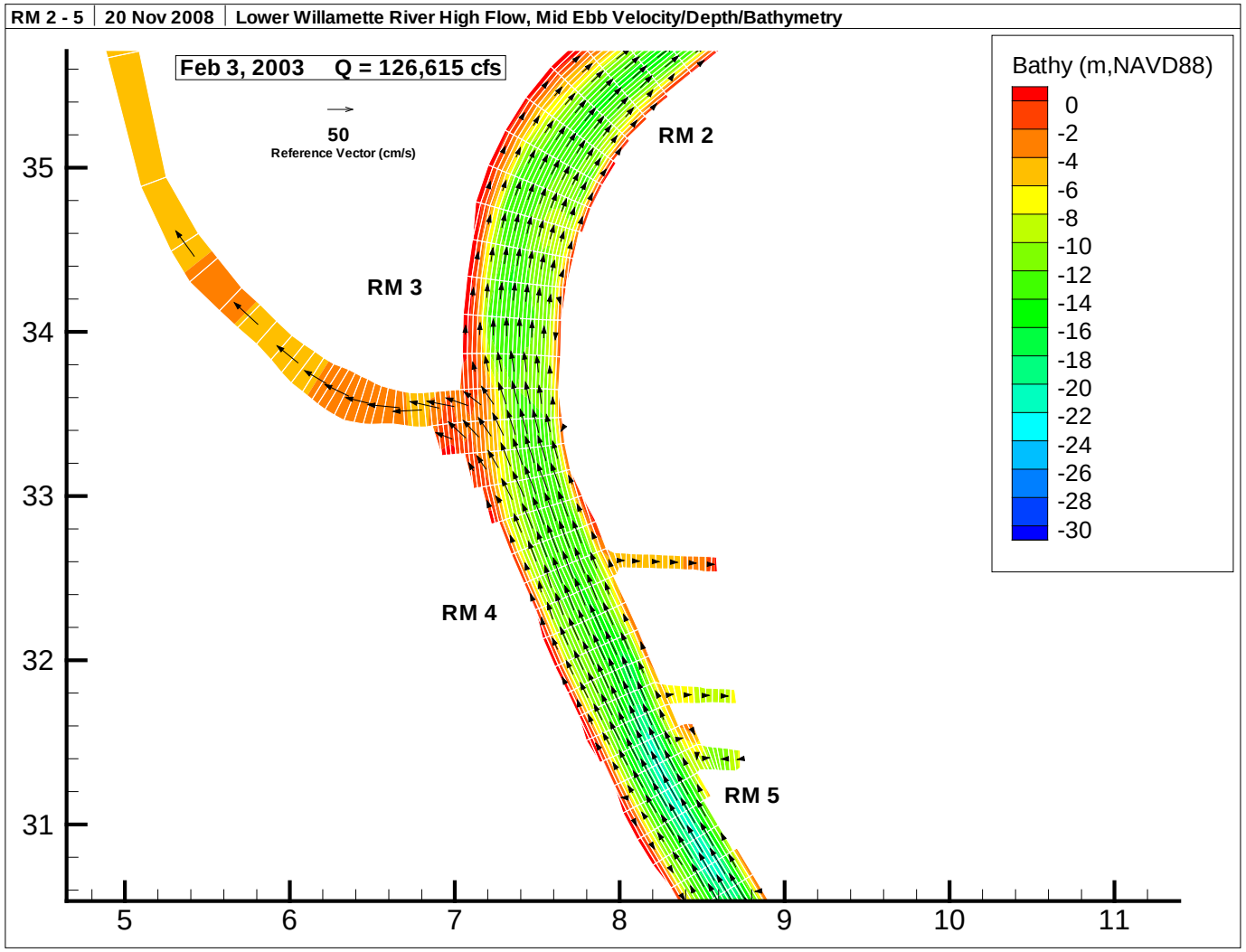
Figure 3.1-17s
Portland Harbor RI/FS
Remedial Investigation Report
ADCP Survey Winter 2004 Transect Data



Transect 16 at 15:43 hours – River Mile 11.0

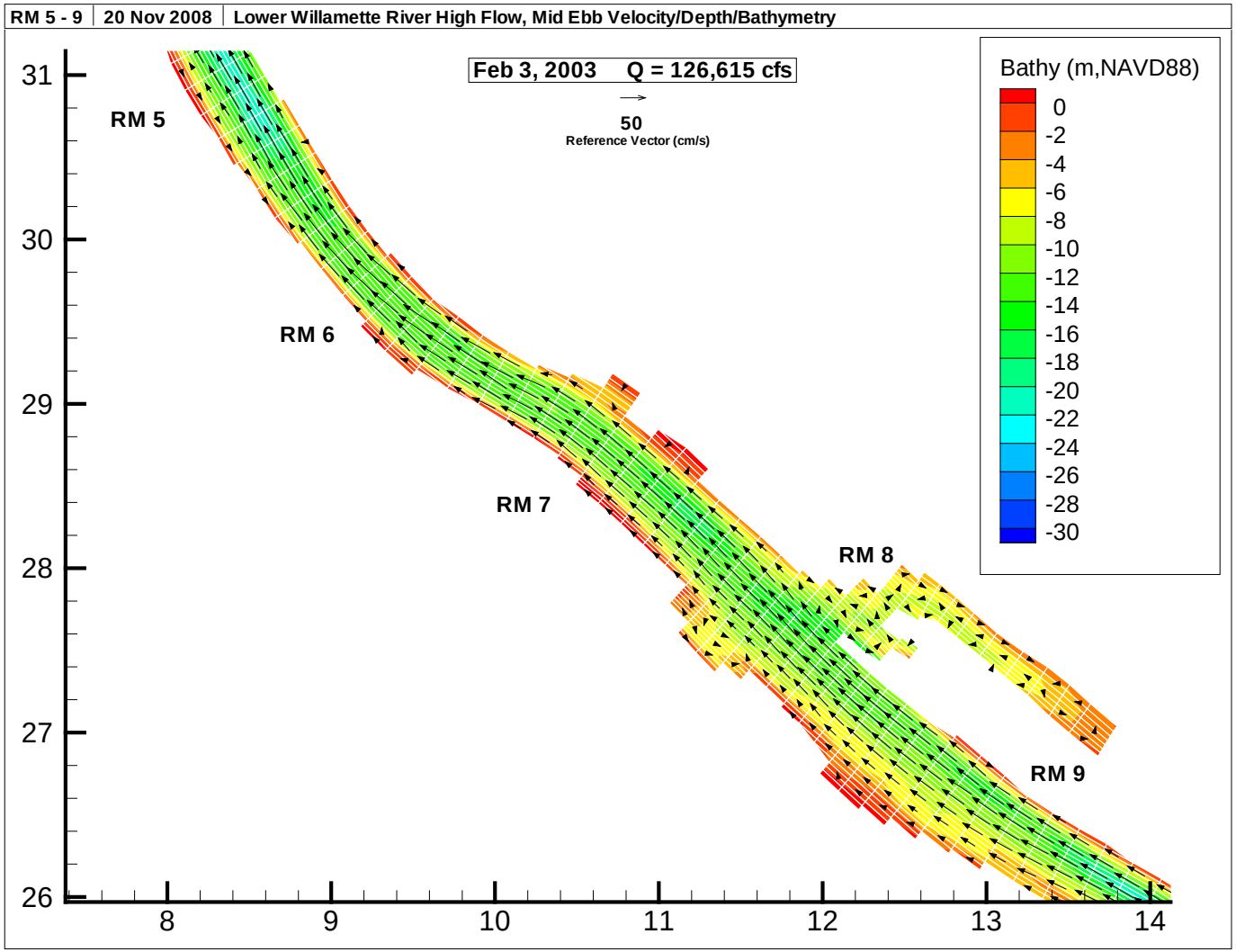
Source: DEA (2004b)

Figure 3.1-17t
Portland Harbor RI/FS
Remedial Investigation Report
ADCP Survey Winter 2004 Transect Data



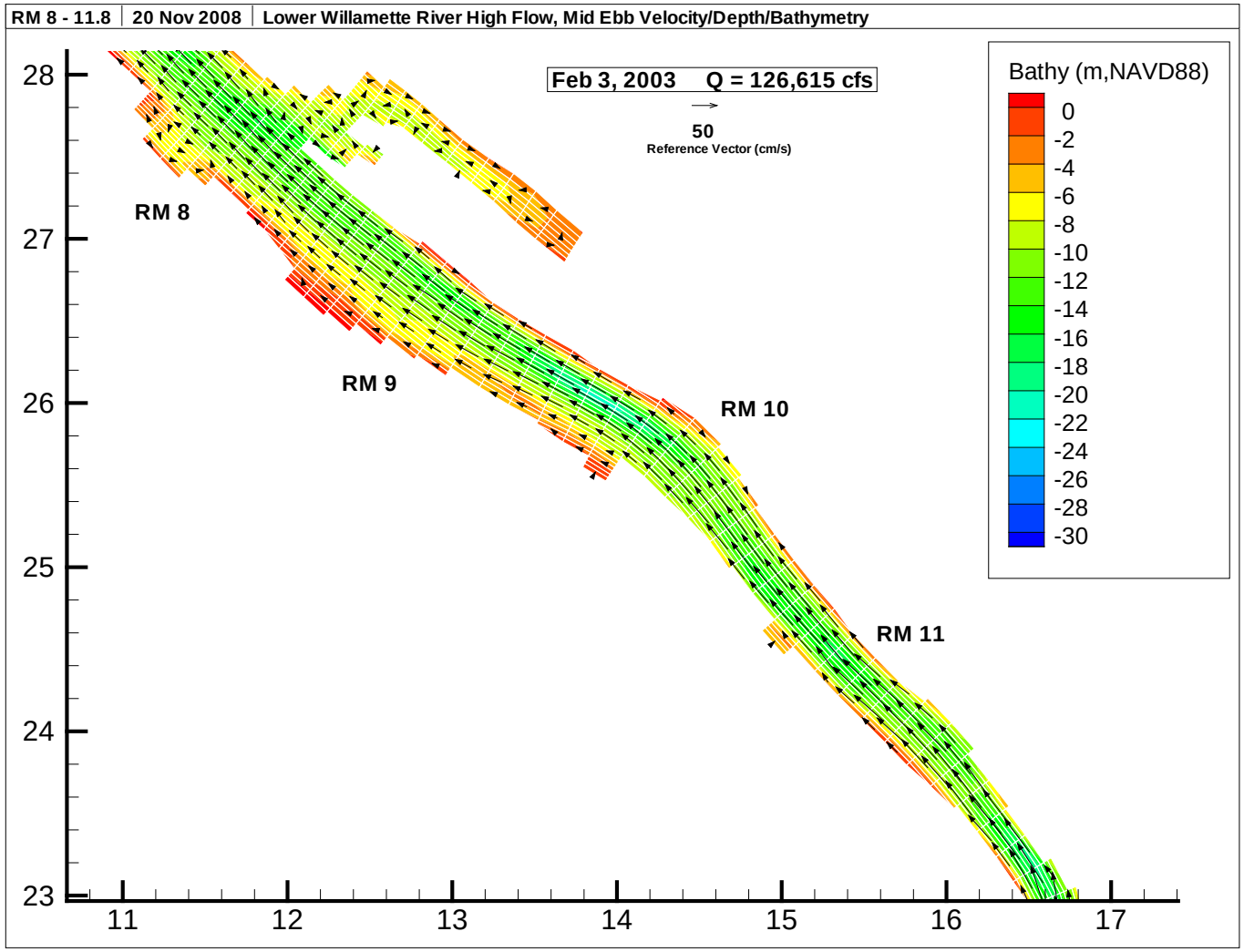
Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for February 3, 2003 at 1800hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 3.5 m NAVD88; river flow 126,615 cfs
Lower Columbia River conditions; stage at Vancouver: 5.0 m NAVD88, stage at St. Helens: 4.5 m NAVD88; river flow 178,000 cfs.

Figure 3.1-18a
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, High Flow
Mid Ebb, RM 2–5



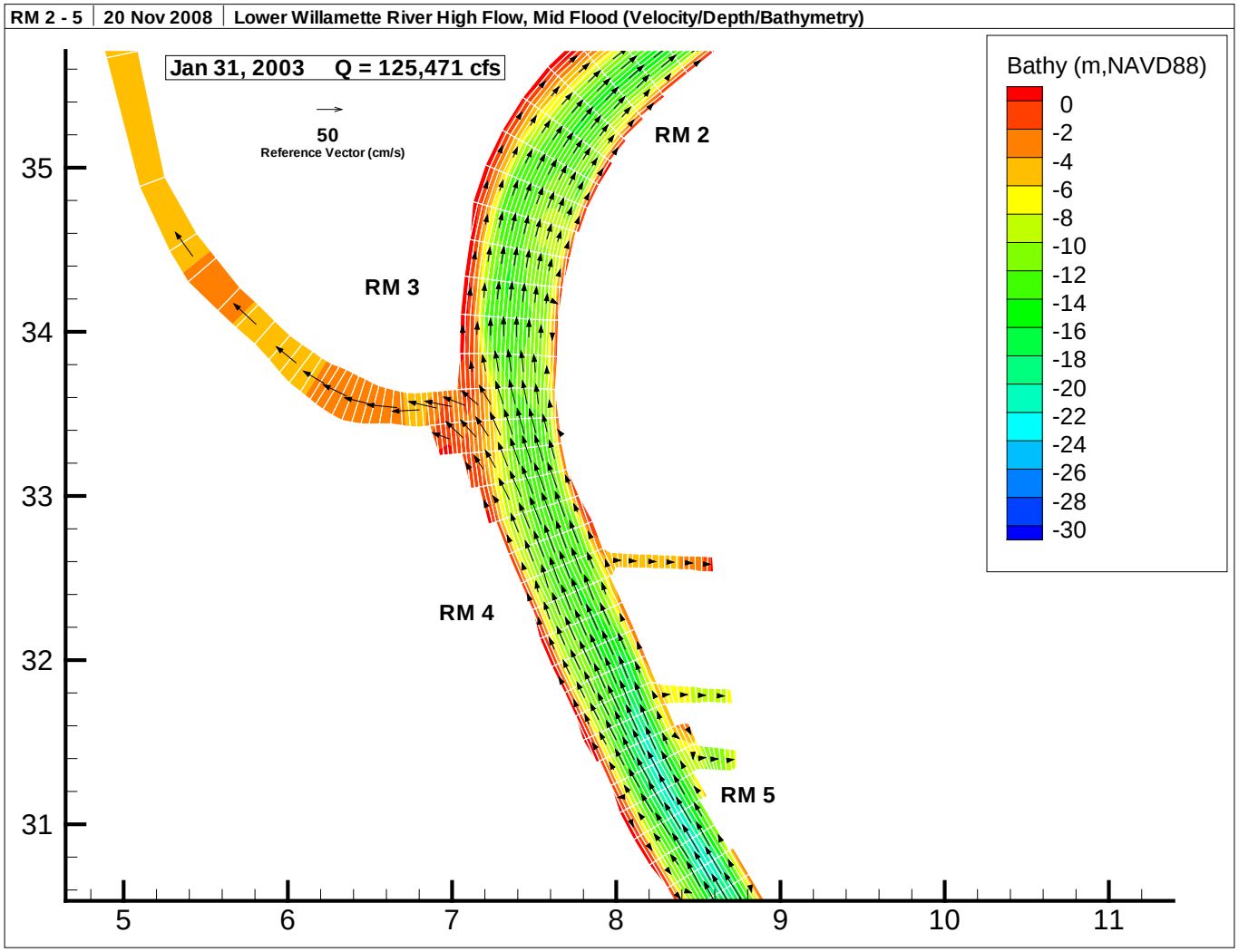
Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for February 3, 2003 at 1800hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 3.5 m NAVD88; river flow 126,615 cfs
Lower Columbia River conditions; stage at Vancouver: 5.0 m NAVD88, stage at St. Helens: 4.5 m NAVD88; river flow 178,000 cfs.

Figure 3.1-18b
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, High Flow
Mid Ebb, RM 5–9



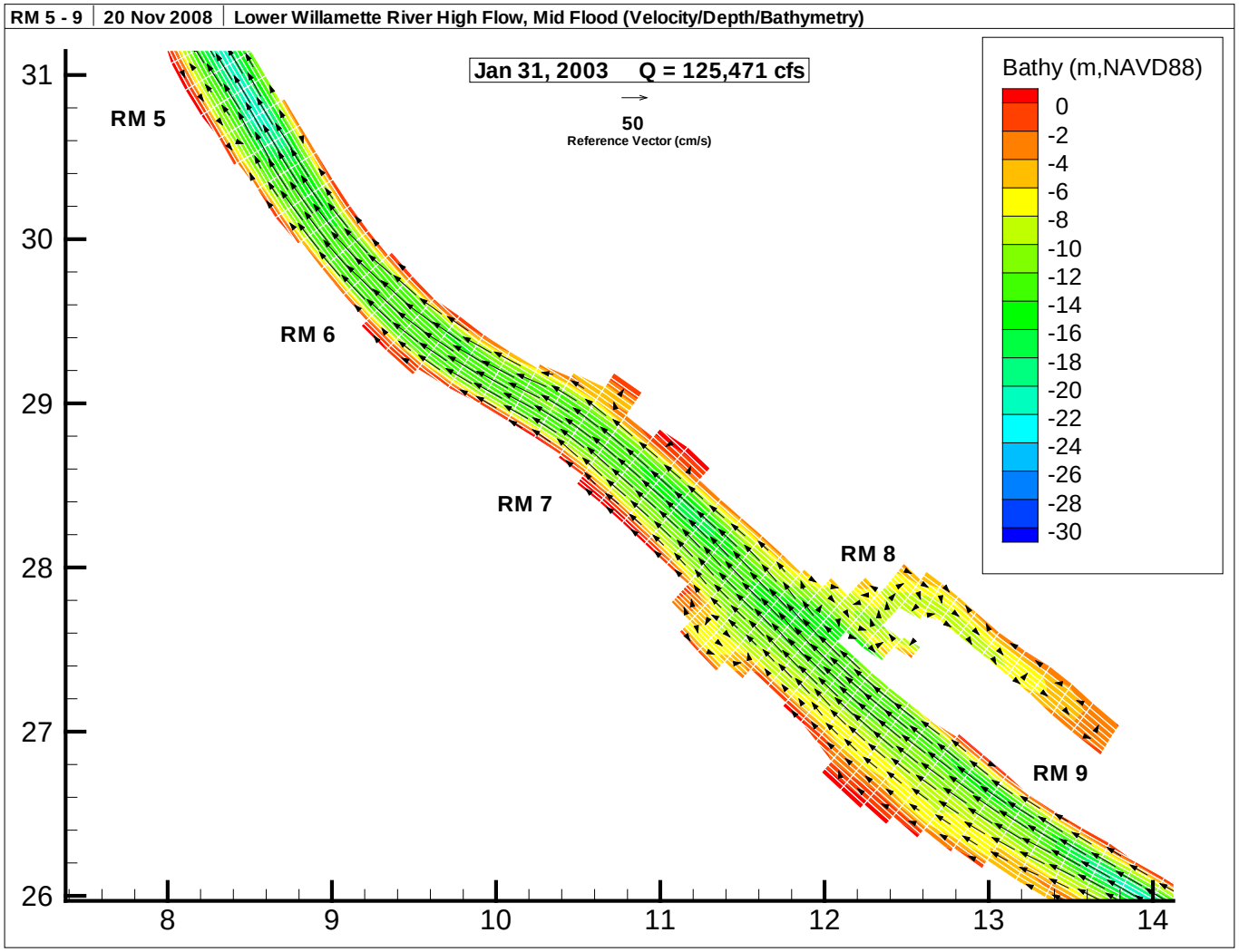
Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for February 3, 2003 at 1800hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 3.5 m NAVD88; river flow 126,615 cfs
Lower Columbia River conditions; stage at Vancouver: 5.0 m NAVD88, stage at St. Helens: 4.5 m NAVD88; river flow 178,000 cfs.

Figure 3.1-18c
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, High Flow
Mid Ebb, RM 8–11.8



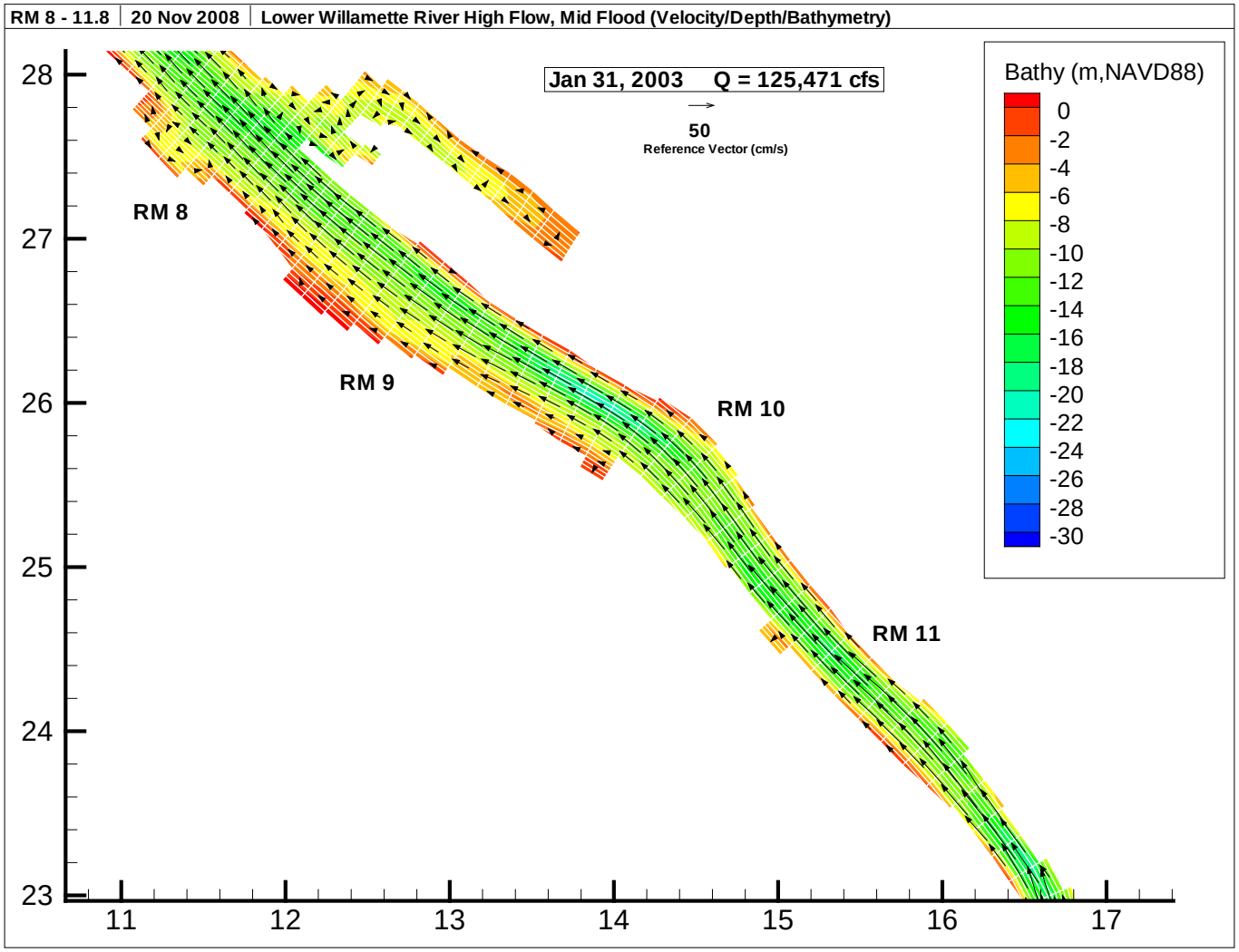
Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for January 31, 2003 at 0300hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 2.5 m NAVD88; river flow 125,471 cfs
Lower Columbia River conditions; stage at Vancouver: 4.1 m NAVD88, stage at St. Helens: 3.8 m NAVD88; river flow 150,000 cfs.

Figure 3.1-19a
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, High Flow
Mid Flood, RM 2–5



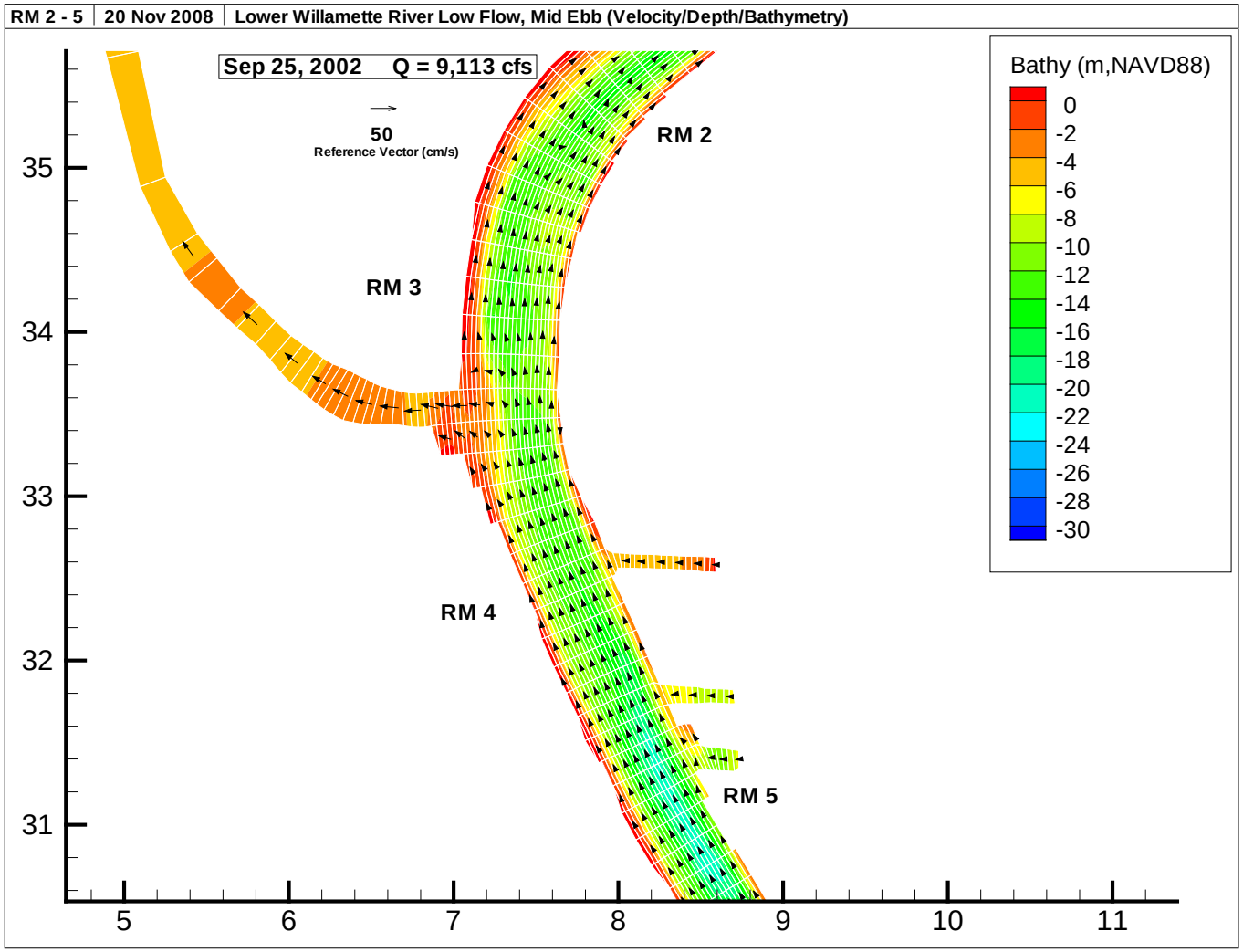
Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for January 31, 2003 at 0300hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 2.5 m NAVD88; river flow 125,471 cfs
Lower Columbia River conditions; stage at Vancouver: 4.1 m NAVD88, stage at St. Helens: 3.8 m NAVD88; river flow 150,000 cfs.

Figure 3.1-19b
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, High Flow
Mid Flood, RM 5–9



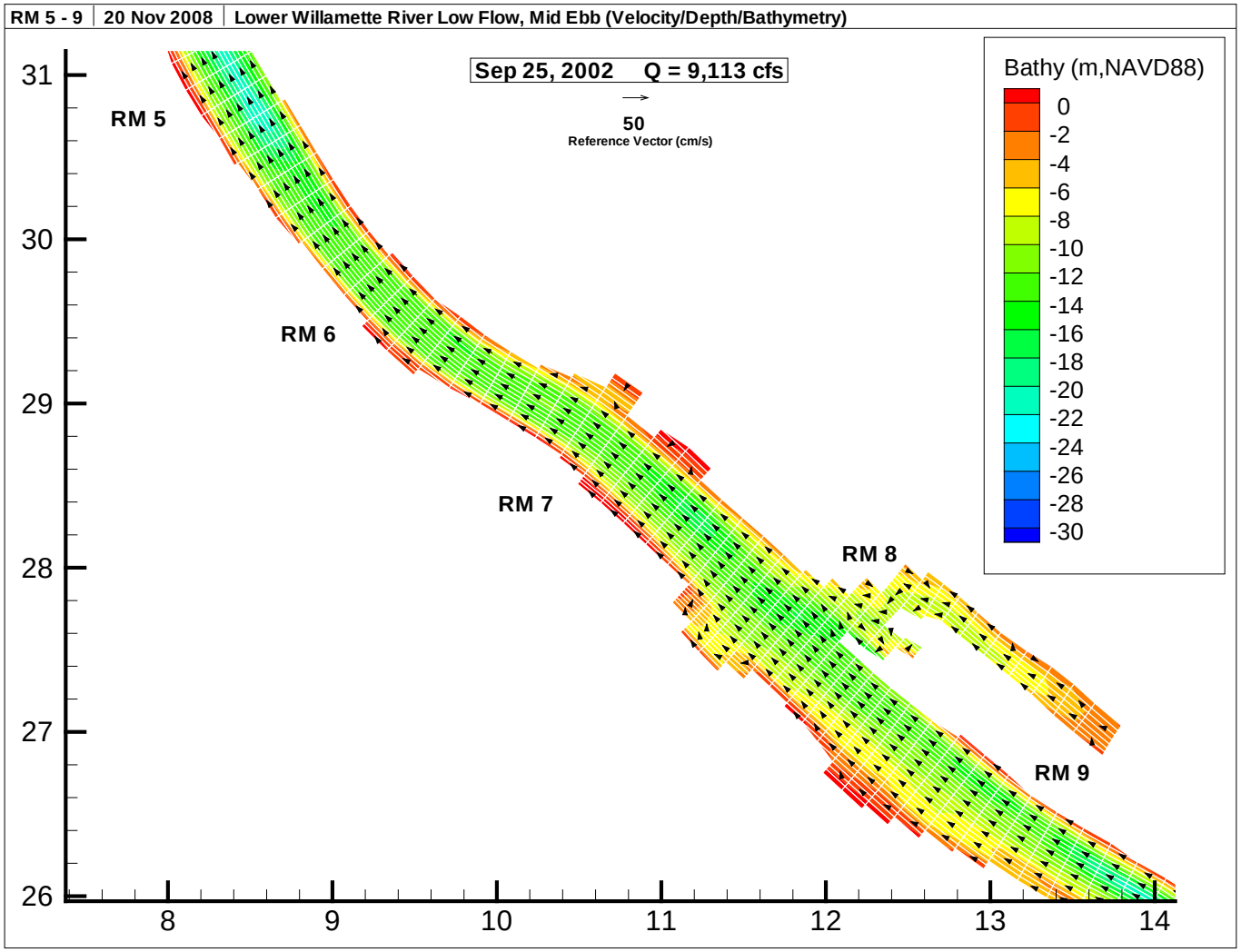
Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for January 31, 2003 at 0300hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 2.5 m NAVD88; river flow 125,471 cfs
Lower Columbia River conditions; stage at Vancouver: 4.1 m NAVD88, stage at St. Helens: 3.8 m NAVD88; river flow 150,000 cfs.

Figure 3.1-19c
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, High Flow
Mid Flood, RM 8–11.8



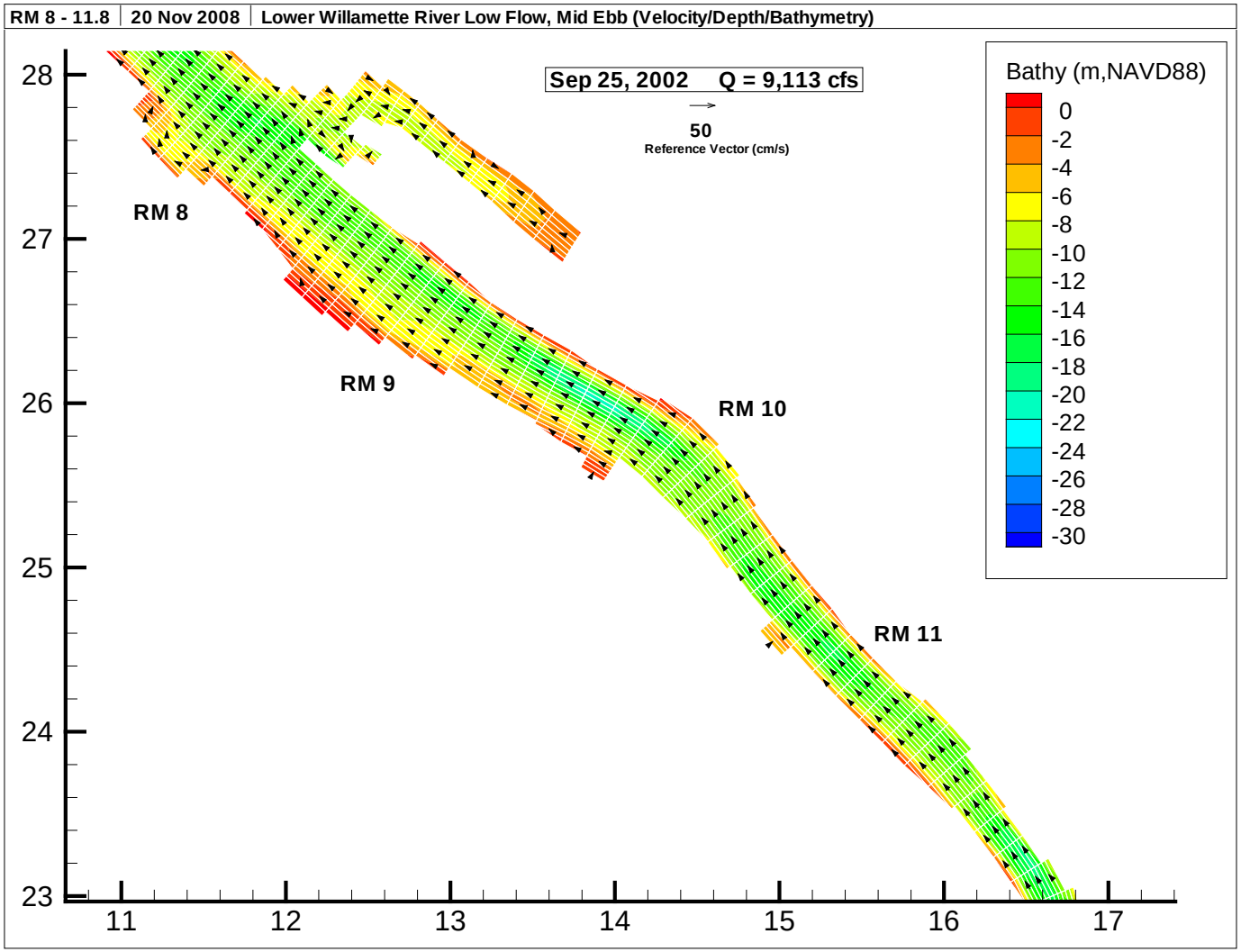
Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for September 25, 2002 at 1600hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 0.4 m NAVD88; river flow 9,113 cfs
Lower Columbia River conditions; stage at Vancouver: 2.1 m NAVD88, stage at St. Helens: 2.3 m NAVD88; river flow 130,000 cfs.

Figure 3.1-20a
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, Low Flow
Mid Ebb, RM 2–-5



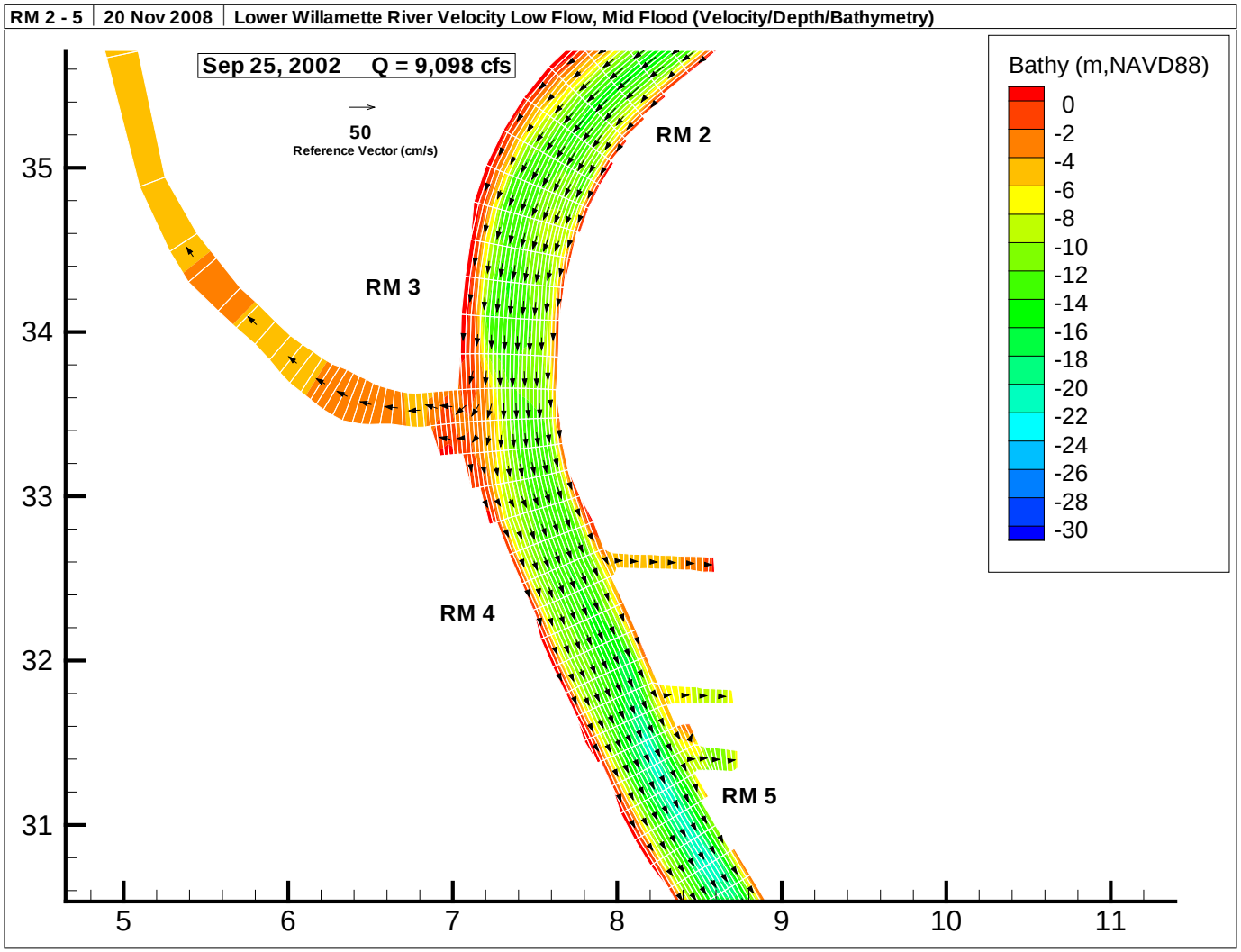
Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for September 25, 2002 at 1600hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 0.4 m NAVD88; river flow 9,113 cfs
Lower Columbia River conditions; stage at Vancouver: 2.1 m NAVD88, stage at St. Helens: 2.3 m NAVD88; river flow 130,000 cfs.

Figure 3.1-20b
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, Low Flow
Mid Ebb, RM 5–9



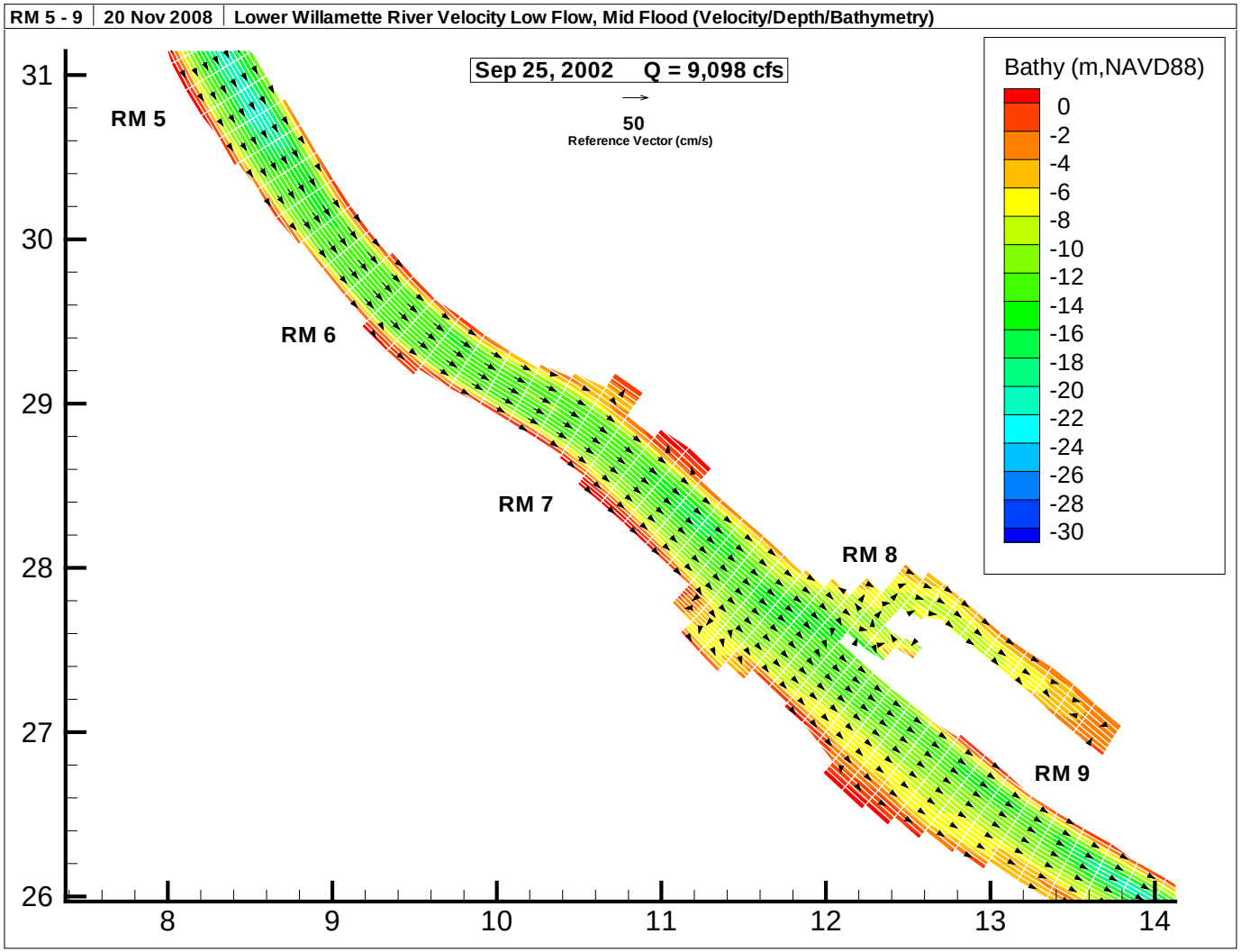
Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for September 25, 2002 at 1600hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 0.4 m NAVD88; river flow 9,113 cfs
Lower Columbia River conditions; stage at Vancouver: 2.1 m NAVD88, stage at St. Helens: 2.3 m NAVD88; river flow 130,000 cfs.

Figure 3.1-20c
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, Low Flow
Mid Ebb, RM 8–11.8



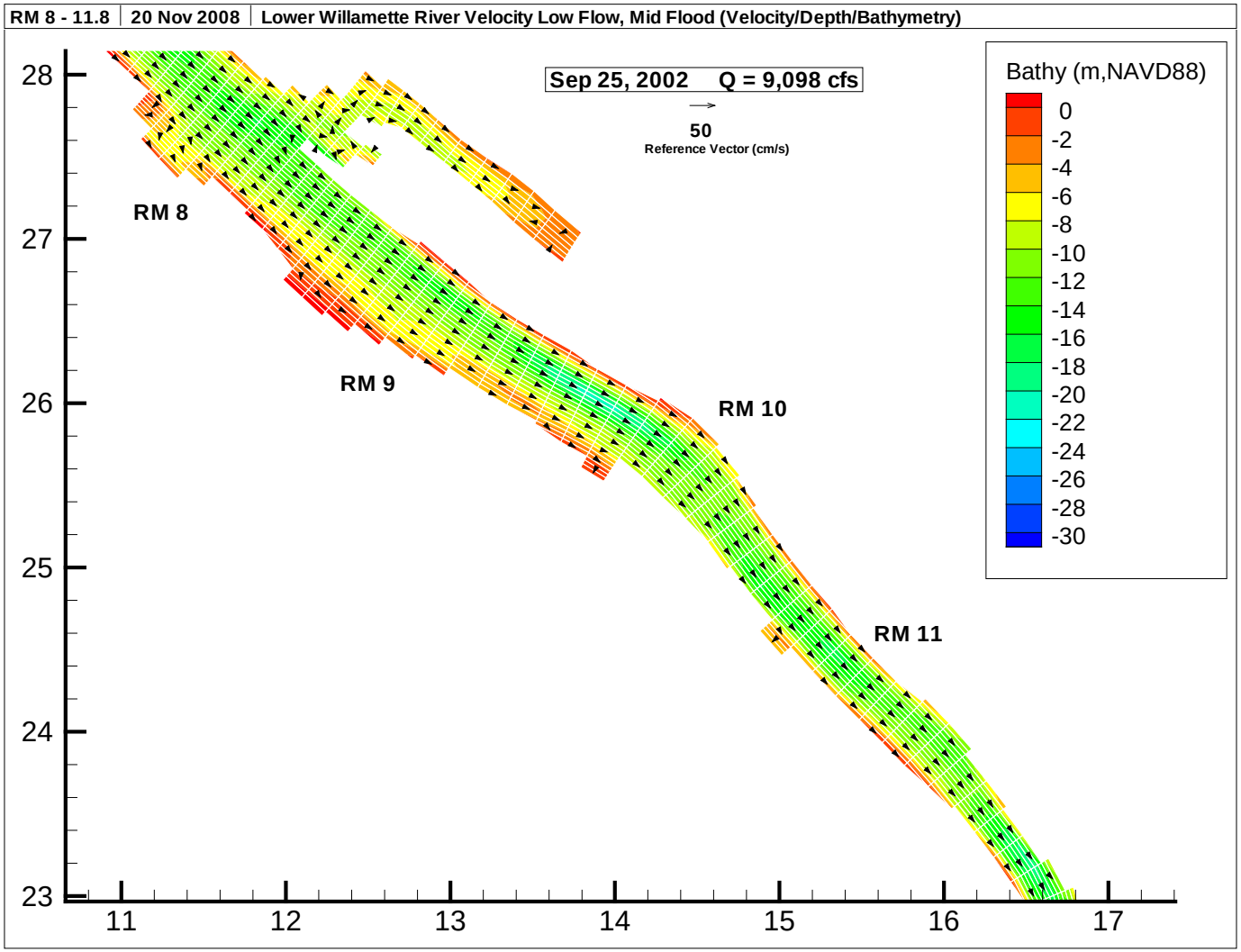
Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for September 25, 2002 at 1930hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 1.3 m NAVD88; river flow 9,098 cfs
Lower Columbia River conditions; stage at Vancouver: 3.0 m NAVD88, stage at St. Helens: 2.6 m NAVD88; river flow 130,000 cfs.

Figure 3.1-21a
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, Low Flow
Mid Flood, RM 2–5



Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for September 25, 2002 at 1930hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 1.3 m NAVD88; river flow 9,098 cfs
Lower Columbia River conditions; stage at Vancouver: 3.0 m NAVD88, stage at St. Helens: 2.6 m NAVD88; river flow 130,000 cfs.

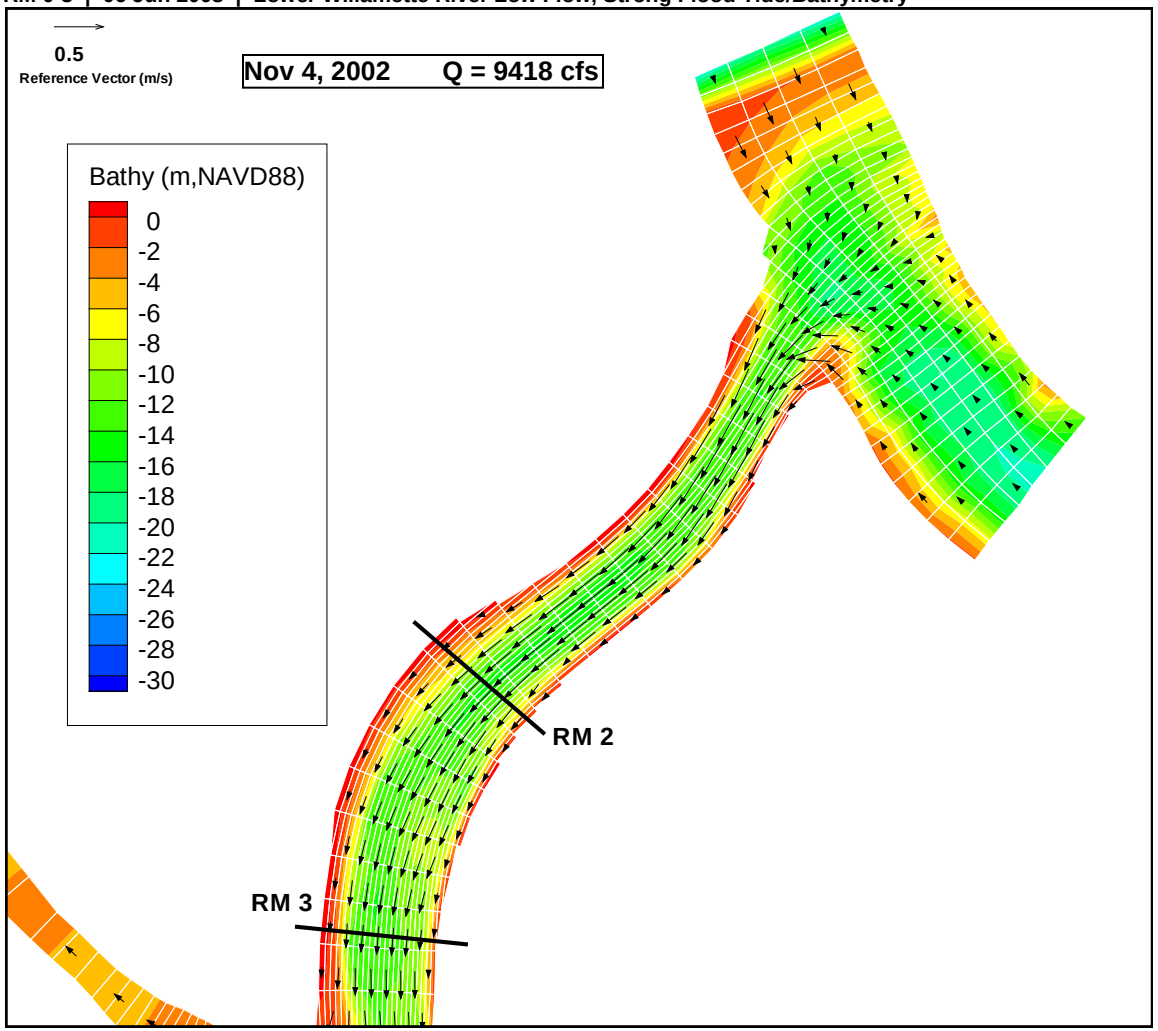
Figure 3.1-21b
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, Low Flow
Mid Flood, RM 5–9



Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for September 25, 2002 at 1930hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 1.3 m NAVD88; river flow 9,098 cfs
Lower Columbia River conditions; stage at Vancouver: 3.0 m NAVD88, stage at St. Helens: 2.6 m NAVD88; river flow 130,000 cfs.

Figure 3.1-21c
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, Low Flow
Mid Flood, RM 8–11.8

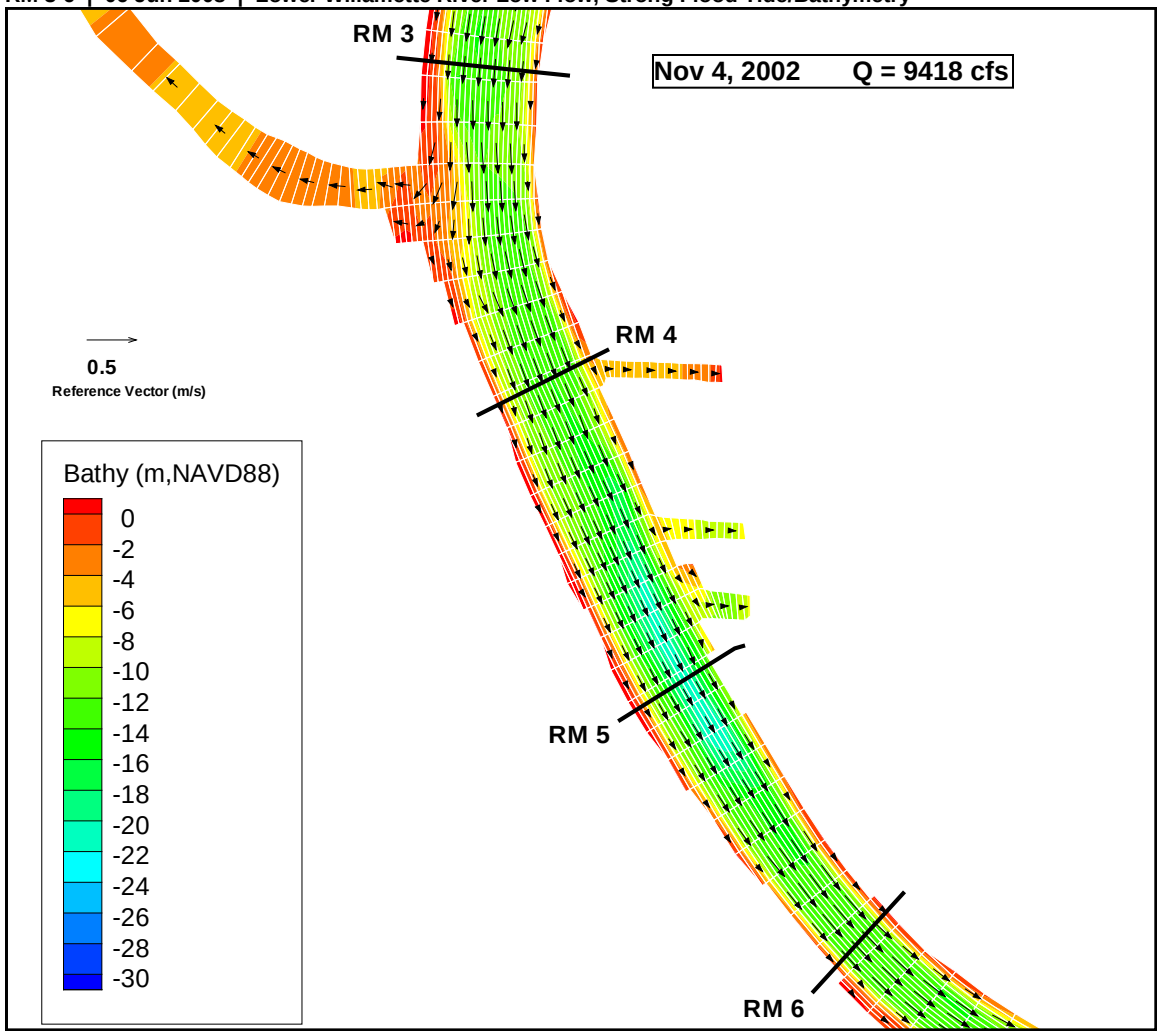
RM 0-3 | 06 Jun 2008 | Lower Willamette River Low Flow, Strong Flood Tide/Bathymetry



Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for November 4, 2002 at 1500hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 1.5 m NAVD88; river flow 9,418 cfs
Lower Columbia River conditions; stage at Vancouver: 2.8 m NAVD88, stage at St. Helens: 2.9 m NAVD88; river flow 130,000 cfs.

Figure 3.1-22a
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, Low Flow
Strong Flood, RM 0–3

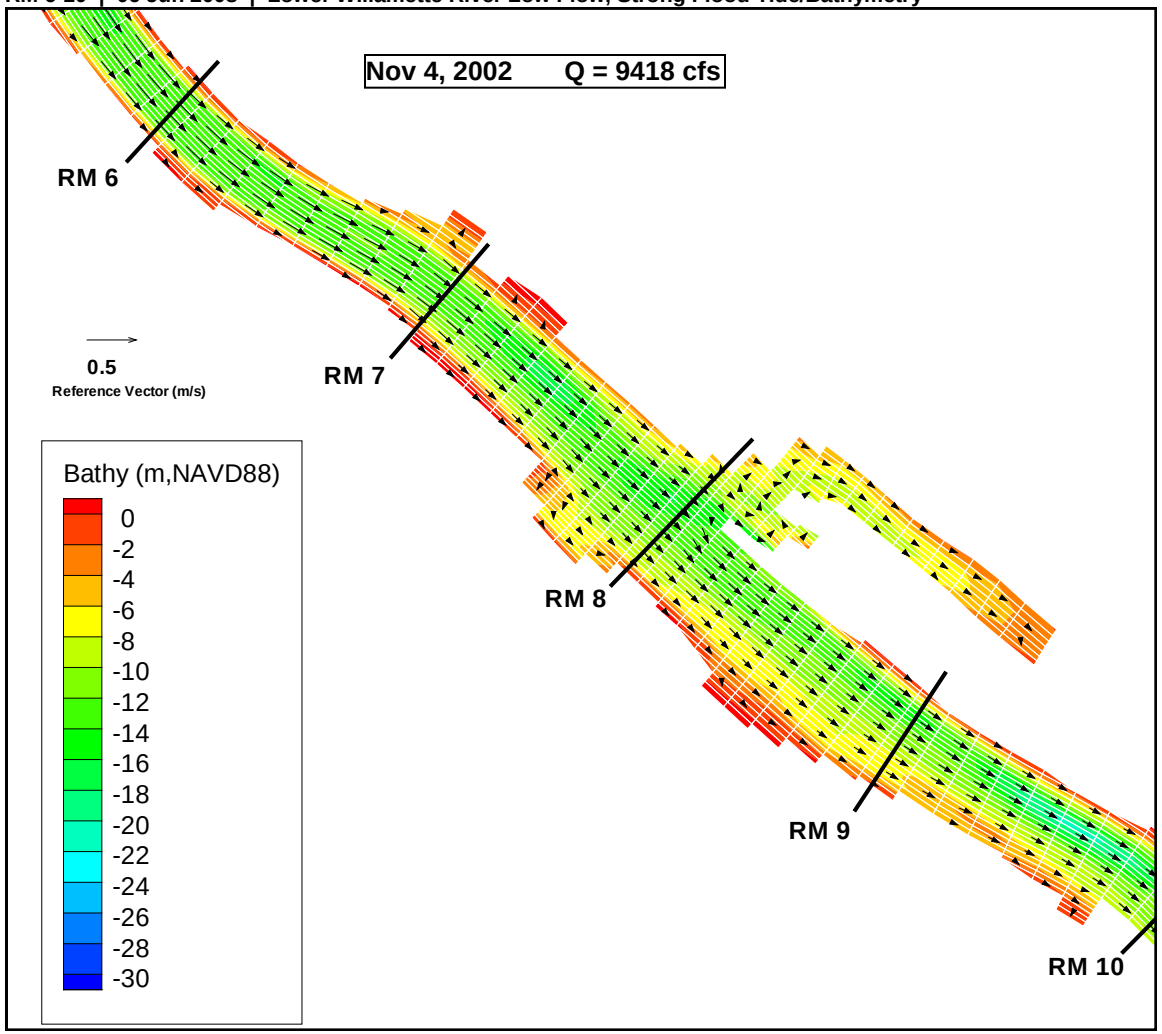
RM 3-6 | 06 Jun 2008 | Lower Willamette River Low Flow, Strong Flood Tide/Bathymetry



Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for November 4, 2002 at 1500hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 1.5 m NAVD88; river flow 9,418 cfs
Lower Columbia River conditions; stage at Vancouver: 2.8 m NAVD88, stage at St. Helens: 2.9 m NAVD88; river flow 130,000 cfs.

Figure 3.1-22b
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, Low Flow
Strong Flood, RM 3–6

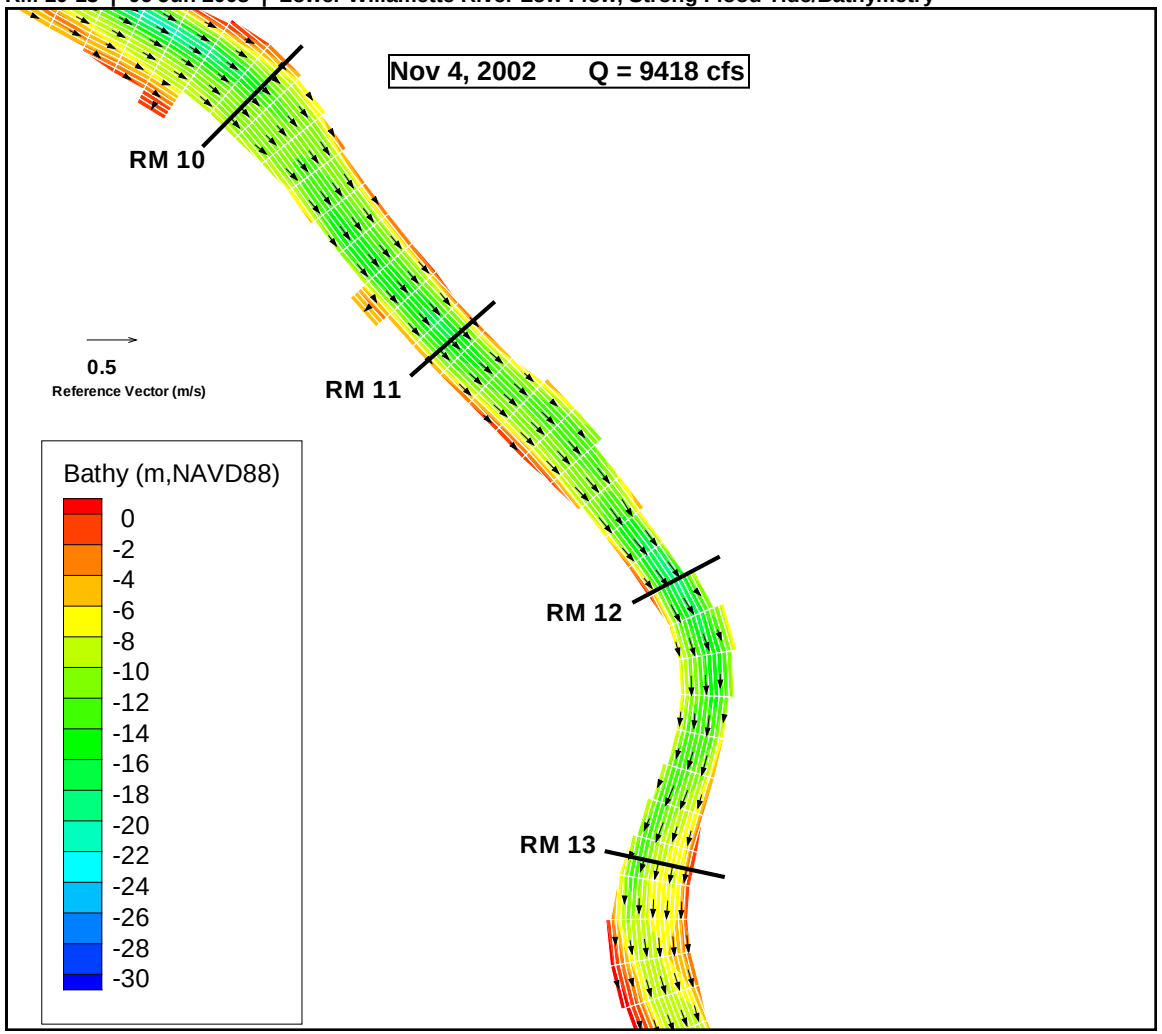
RM 6-10 | 06 Jun 2008 | Lower Willamette River Low Flow, Strong Flood Tide/Bathymetry



Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for November 4, 2002 at 1500hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 1.5 m NAVD88; river flow 9,418 cfs
Lower Columbia River conditions; stage at Vancouver: 2.8 m NAVD88, stage at St. Helens: 2.9 m NAVD88; river flow 130,000 cfs.

Figure 3.1-22c
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, Low Flow
Strong Flood, RM 6–10

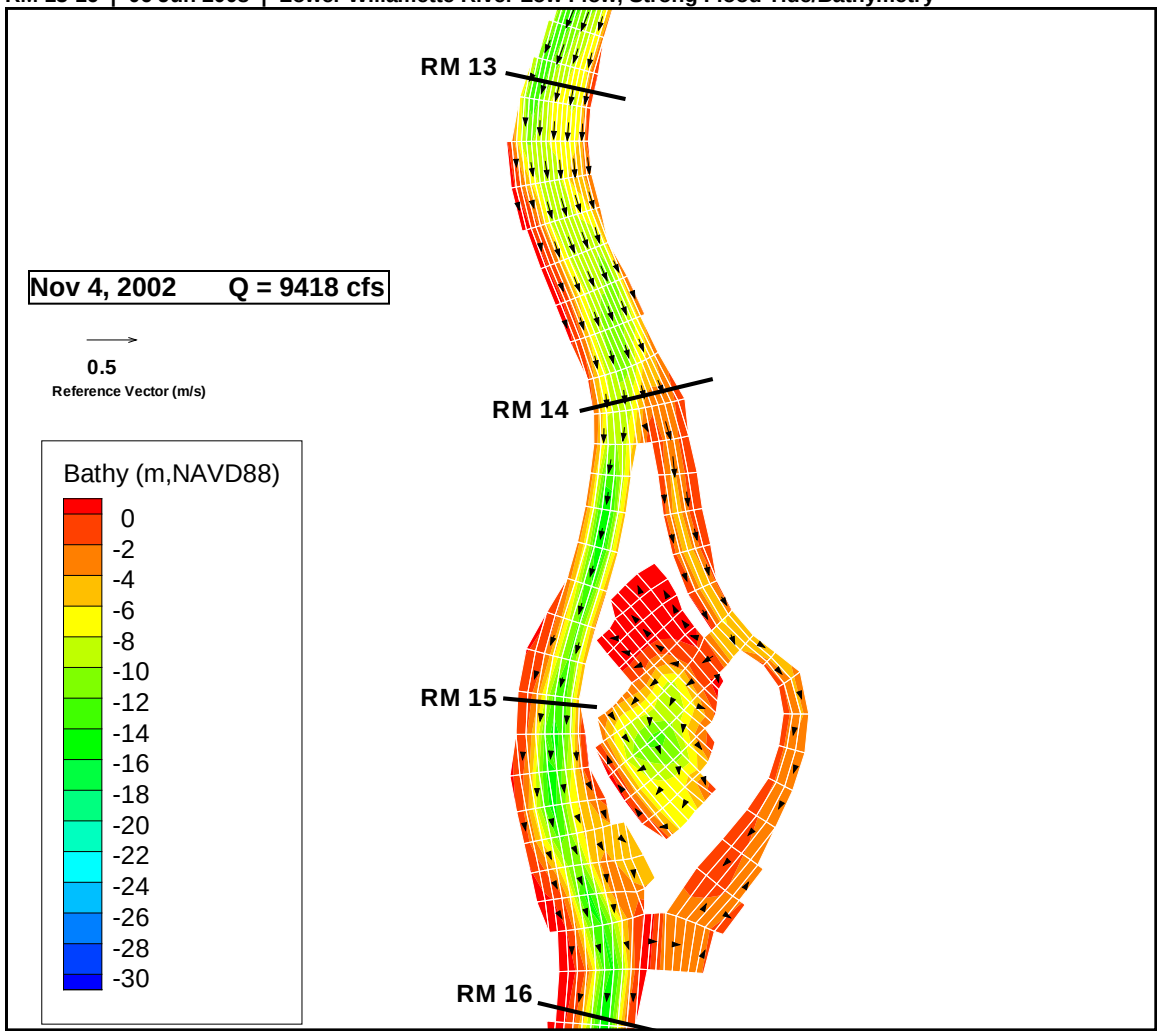
RM 10-13 | 06 Jun 2008 | Lower Willamette River Low Flow, Strong Flood Tide/Bathymetry



Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for November 4, 2002 at 1500hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 1.5 m NAVD88; river flow 9,418 cfs
Lower Columbia River conditions; stage at Vancouver: 2.8 m NAVD88, stage at St. Helens: 2.9 m NAVD88; river flow 130,000 cfs.

Figure 3.1-22d
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, Low Flow
Strong Flood, RM 10–13

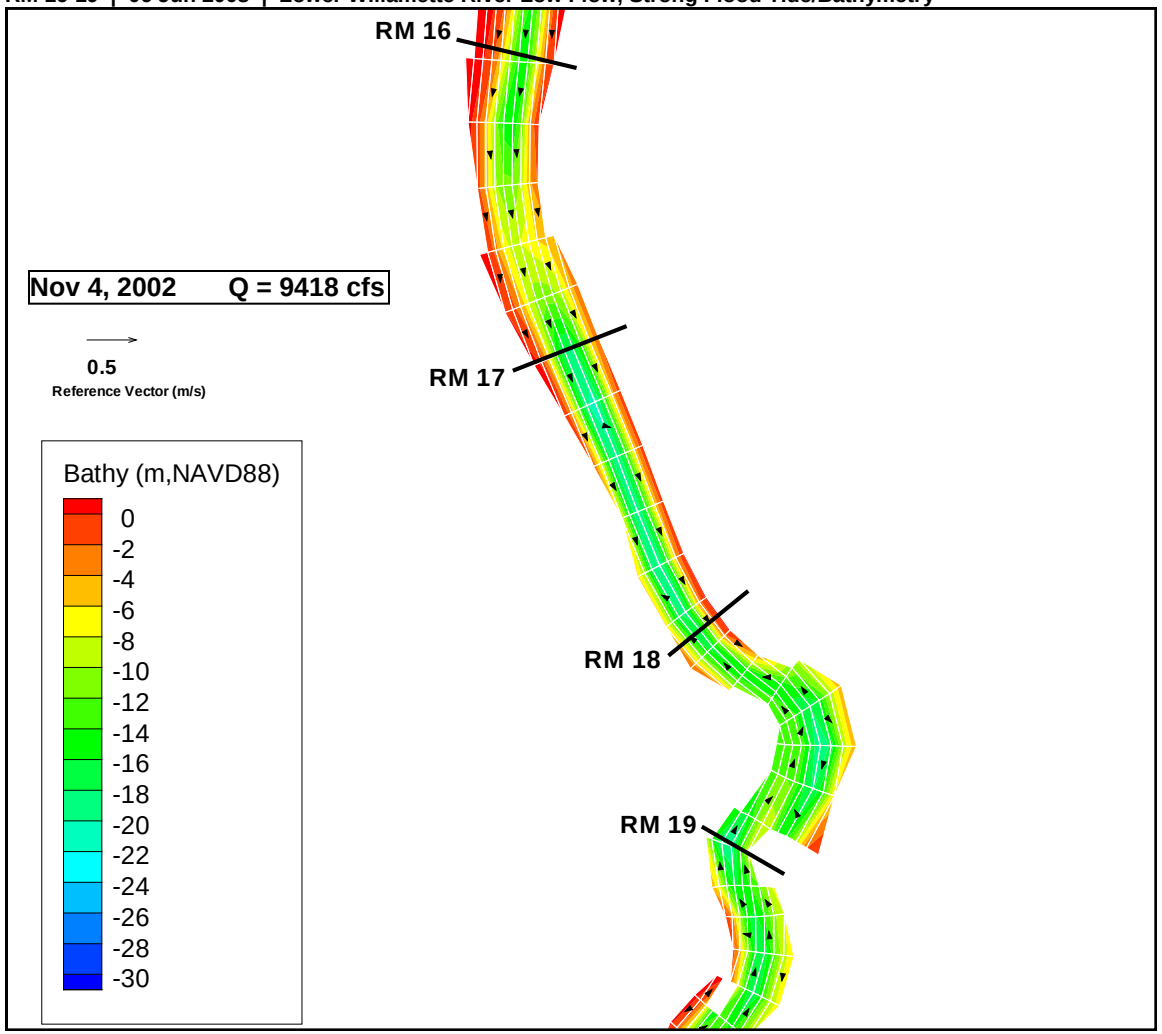
RM 13-16 | 06 Jun 2008 | Lower Willamette River Low Flow, Strong Flood Tide/Bathymetry



Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for November 4, 2002 at 1500hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 1.5 m NAVD88; river flow 9,418 cfs
Lower Columbia River conditions; stage at Vancouver: 2.8 m NAVD88, stage at St. Helens: 2.9 m NAVD88; river flow 130,000 cfs.

Figure 3.1-22e
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, Low Flow
Strong Flood, RM 13–16

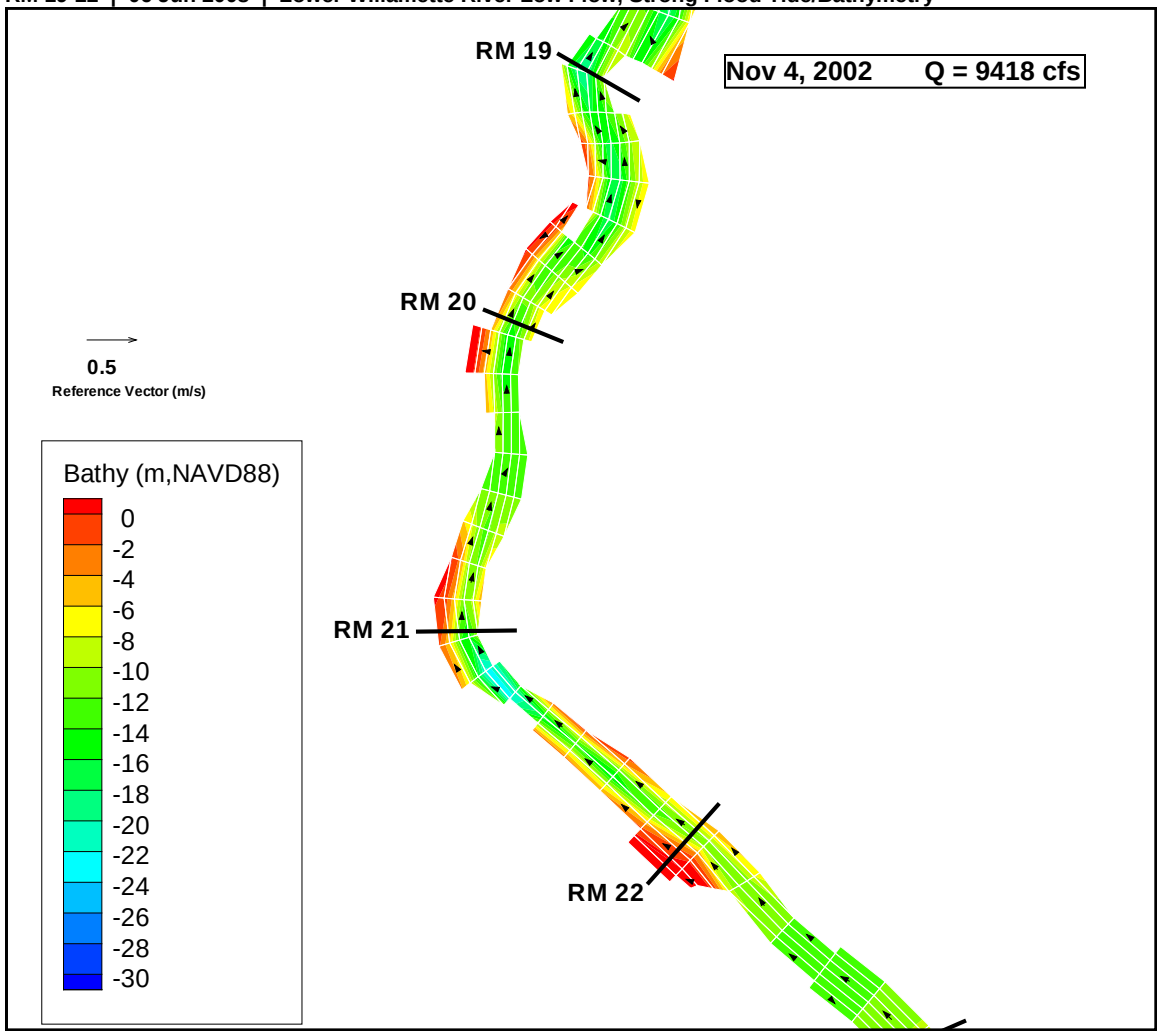
RM 16-19 | 06 Jun 2008 | Lower Willamette River Low Flow, Strong Flood Tide/Bathymetry



Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for November 4, 2002 at 1500hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 1.5 m NAVD88; river flow 9,418 cfs
Lower Columbia River conditions; stage at Vancouver: 2.8 m NAVD88, stage at St. Helens: 2.9 m NAVD88; river flow 130,000 cfs.

Figure 3.1-22f
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, Low Flow
Strong Flood, RM 16–19

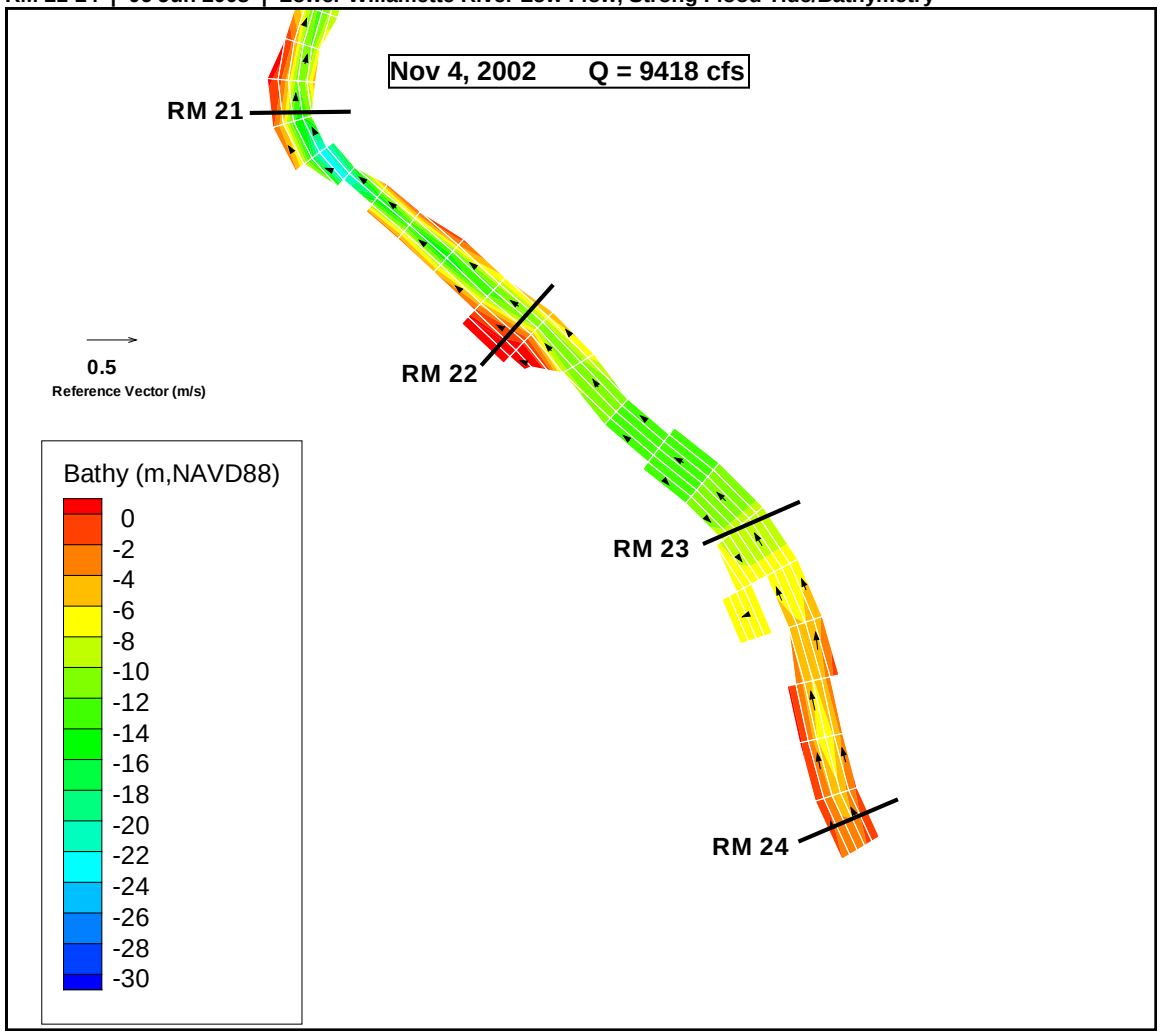
RM 19-22 | 06 Jun 2008 | Lower Willamette River Low Flow, Strong Flood Tide/Bathymetry



Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for November 4, 2002 at 1500hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 1.5 m NAVD88; river flow 9,418 cfs
Lower Columbia River conditions; stage at Vancouver: 2.8 m NAVD88, stage at St. Helens: 2.9 m NAVD88; river flow 130,000 cfs.

Figure 3.1-22g
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, Low Flow
Strong Flood, RM 19–22

RM 21-24 | 06 Jun 2008 | Lower Willamette River Low Flow, Strong Flood Tide/Bathymetry



Additional Notes: Bathymetric data collected in Feb 2004.
Time Series Data for November 4, 2002 at 1500hrs;
Lower Willamette River conditions; stage at Morrison St. Bridge: 1.5 m NAVD88; river flow 9,418 cfs
Lower Columbia River conditions; stage at Vancouver: 2.8 m NAVD88, stage at St. Helens: 2.9 m NAVD88; river flow 130,000 cfs.

Figure 3.1-22h
Portland Harbor RI/FS
Remedial Investigation Report
Vector Velocity Plot, Low Flow
Strong Flood, RM 21–24

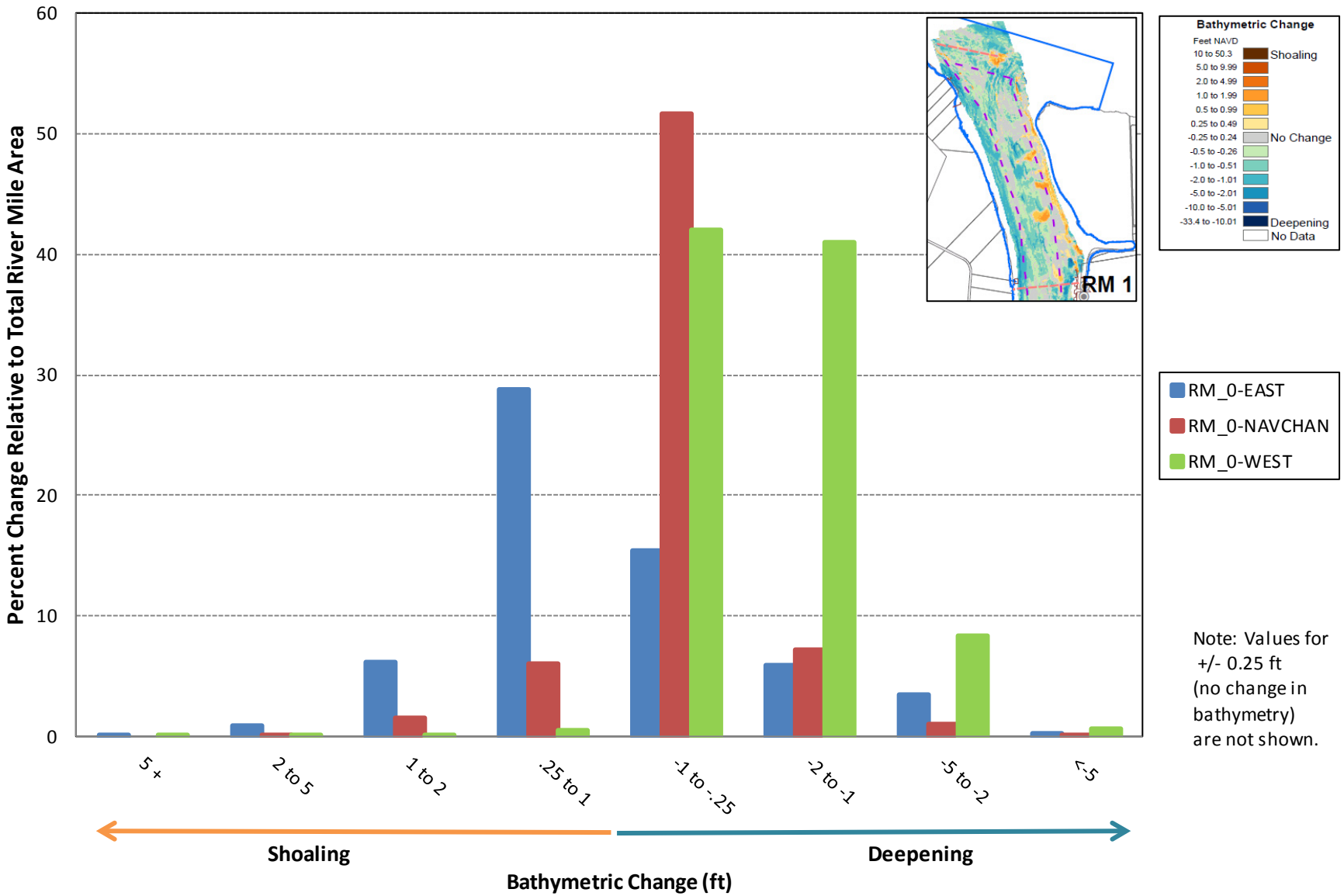


Figure 3.1-23a
Portland Harbor RI/FS
Remedial Investigation Report
Portland Harbor 2002–2009 Bathymetric Change
RM 0 to 1

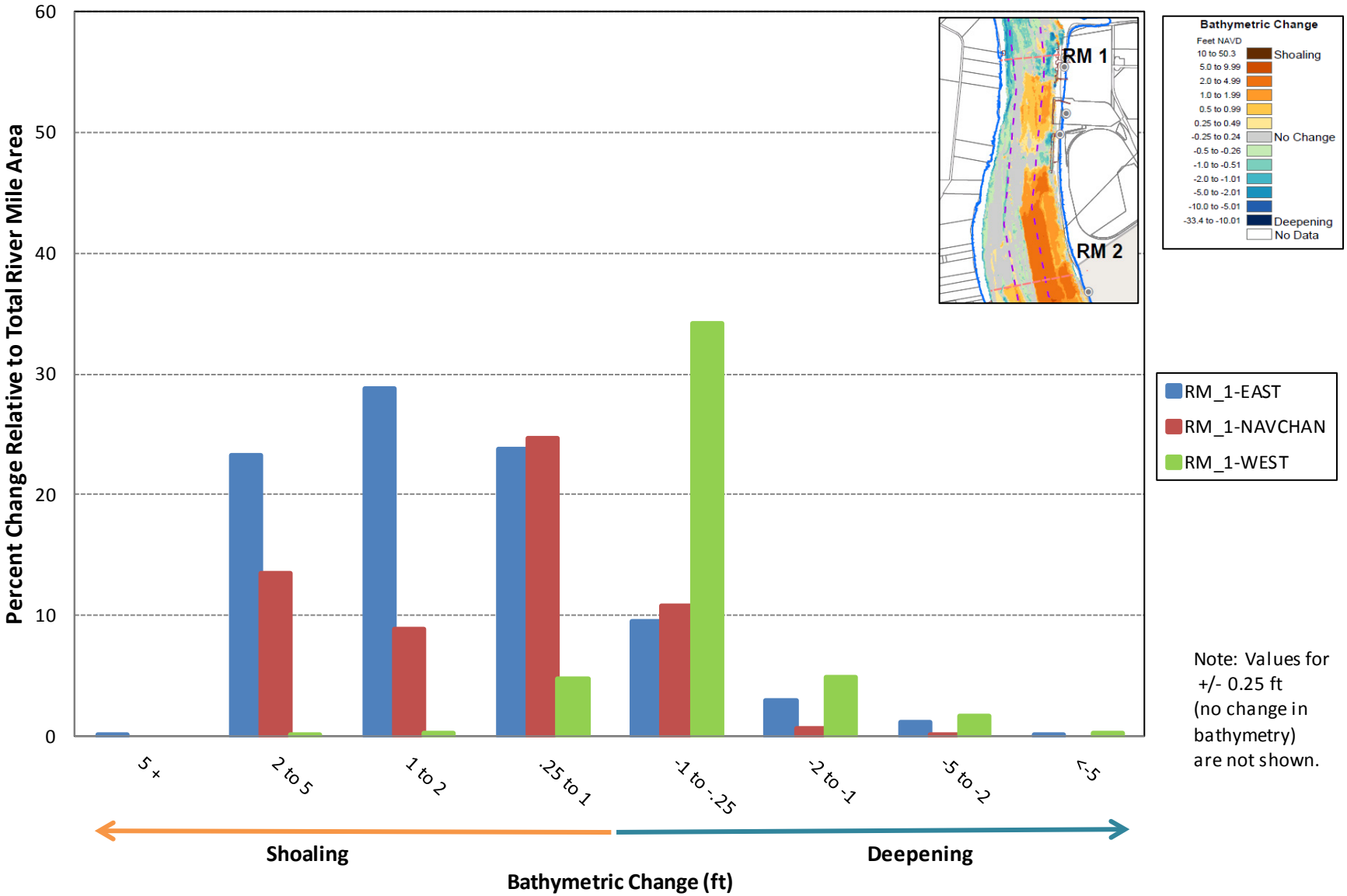


Figure 3.1-23b
Portland Harbor RI/FS
Remedial Investigation Report
Portland Harbor 2002–2009 Bathymetric Change
RM 1 to 2

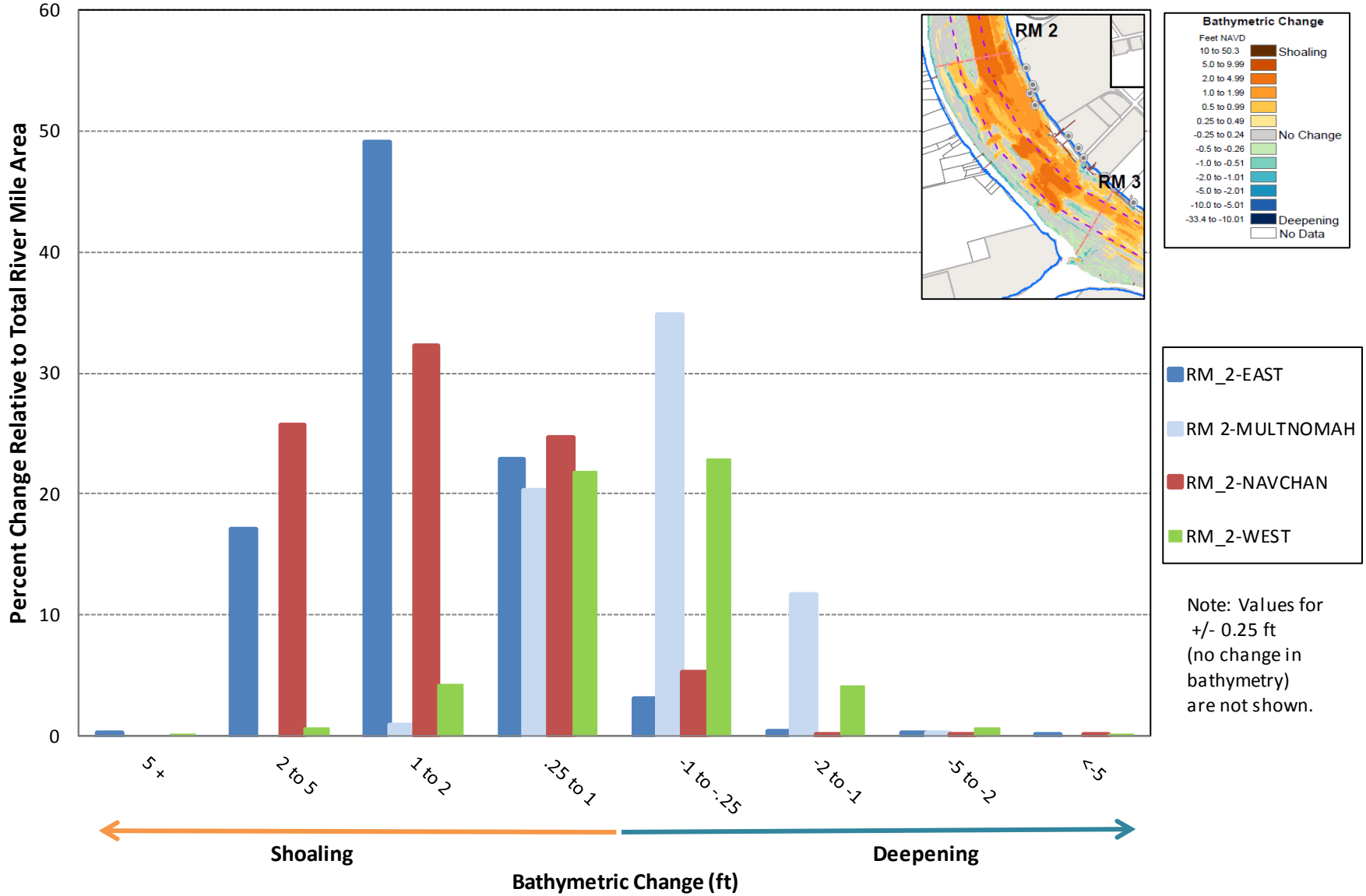


Figure 3.1-23c
Portland Harbor RI/FS
Remedial Investigation Report
Portland Harbor 2002–2009 Bathymetric Change
RM 2 to 3

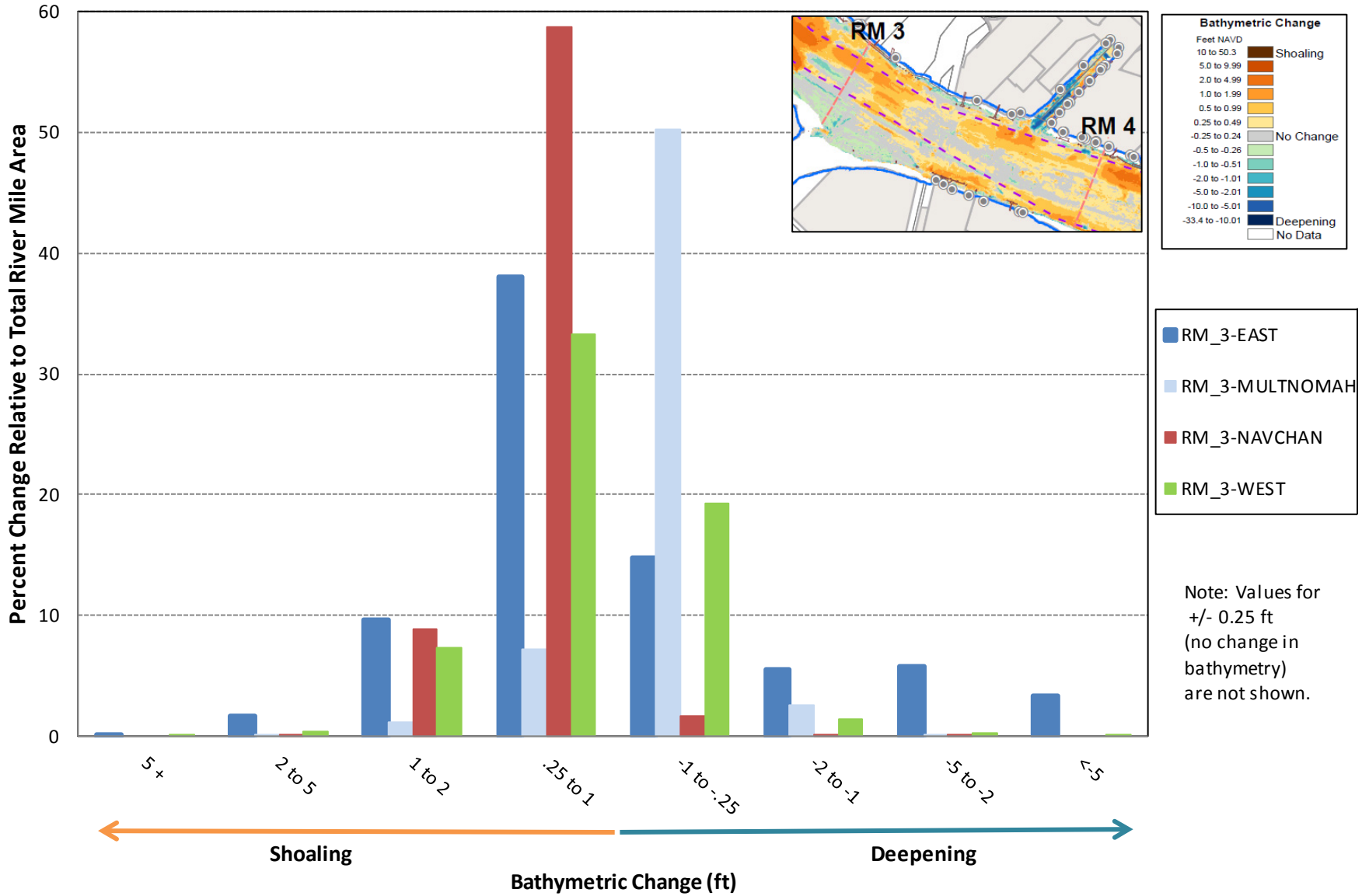


Figure 3.1-23d
Portland Harbor RI/FS
Remedial Investigation Report
Portland Harbor 2002–2009 Bathymetric Change
RM 3 to 4

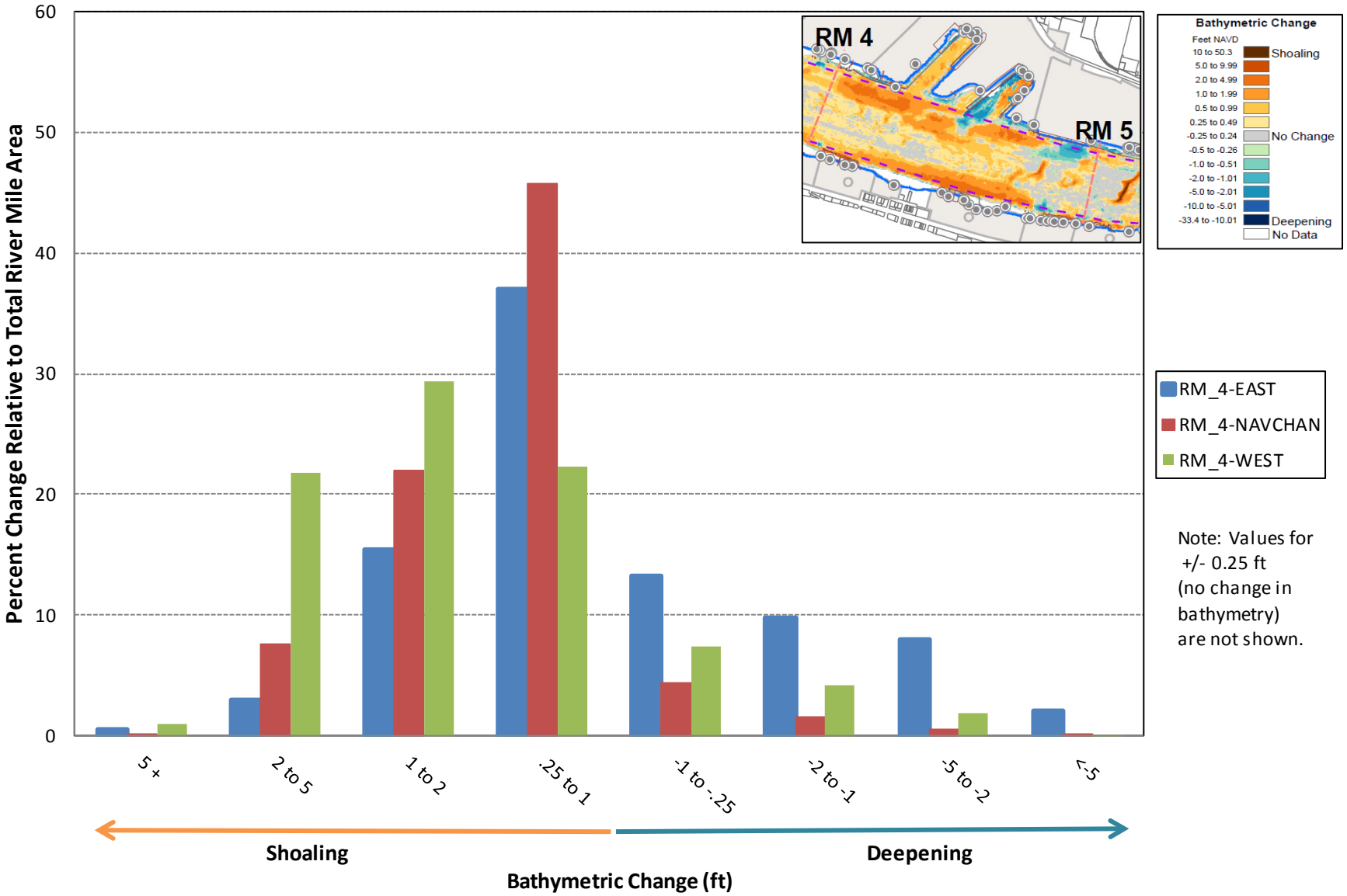


Figure 3.1-23e
Portland Harbor RI/FS
Remedial Investigation Report
Portland Harbor 2002–2009 Bathymetric Change
RM 4 to 5

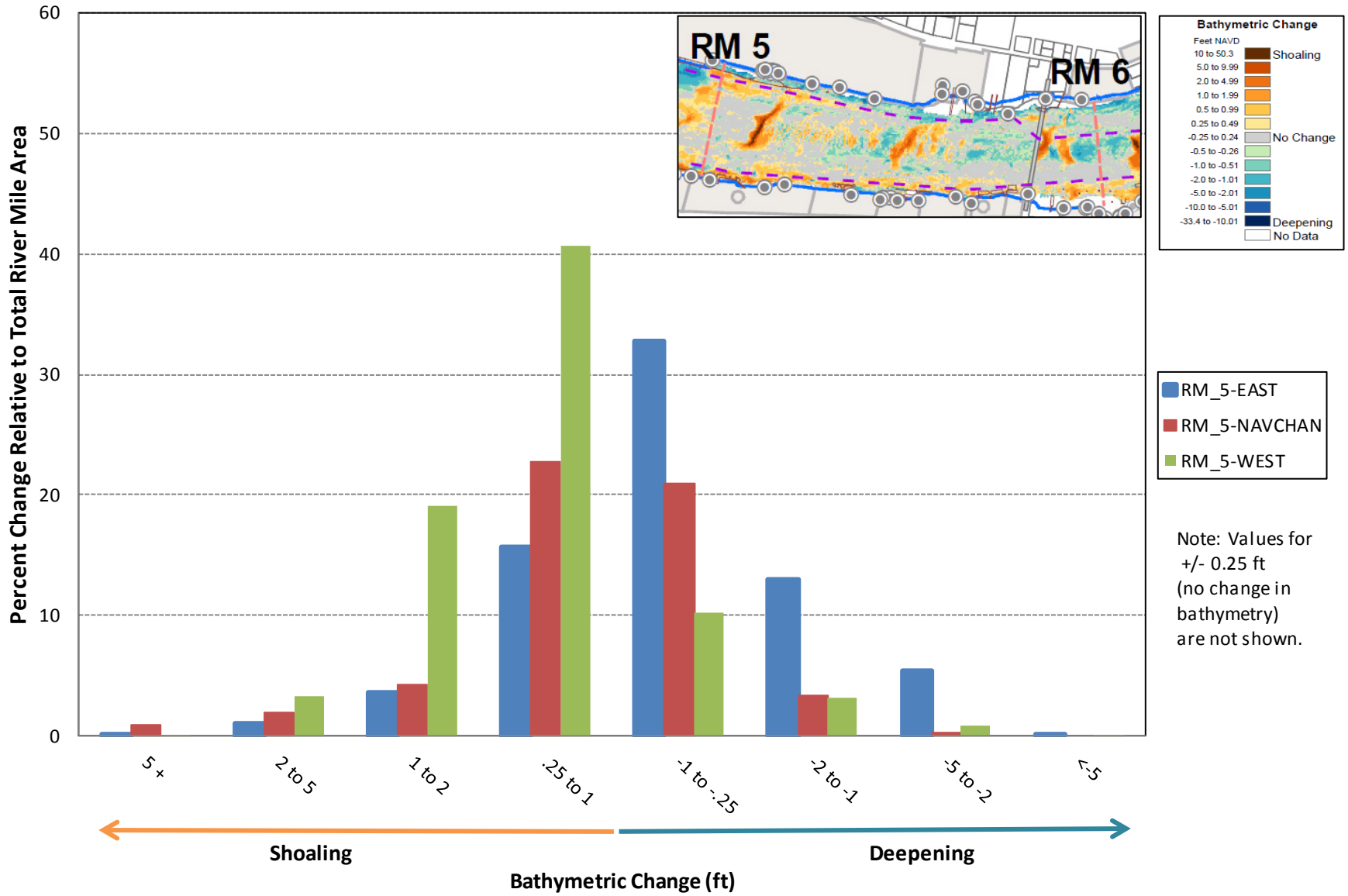


Figure 3.1-23f
Portland Harbor RI/FS
Remedial Investigation Report
Portland Harbor 2002–2009 Bathymetric Change
RM 5 to 6

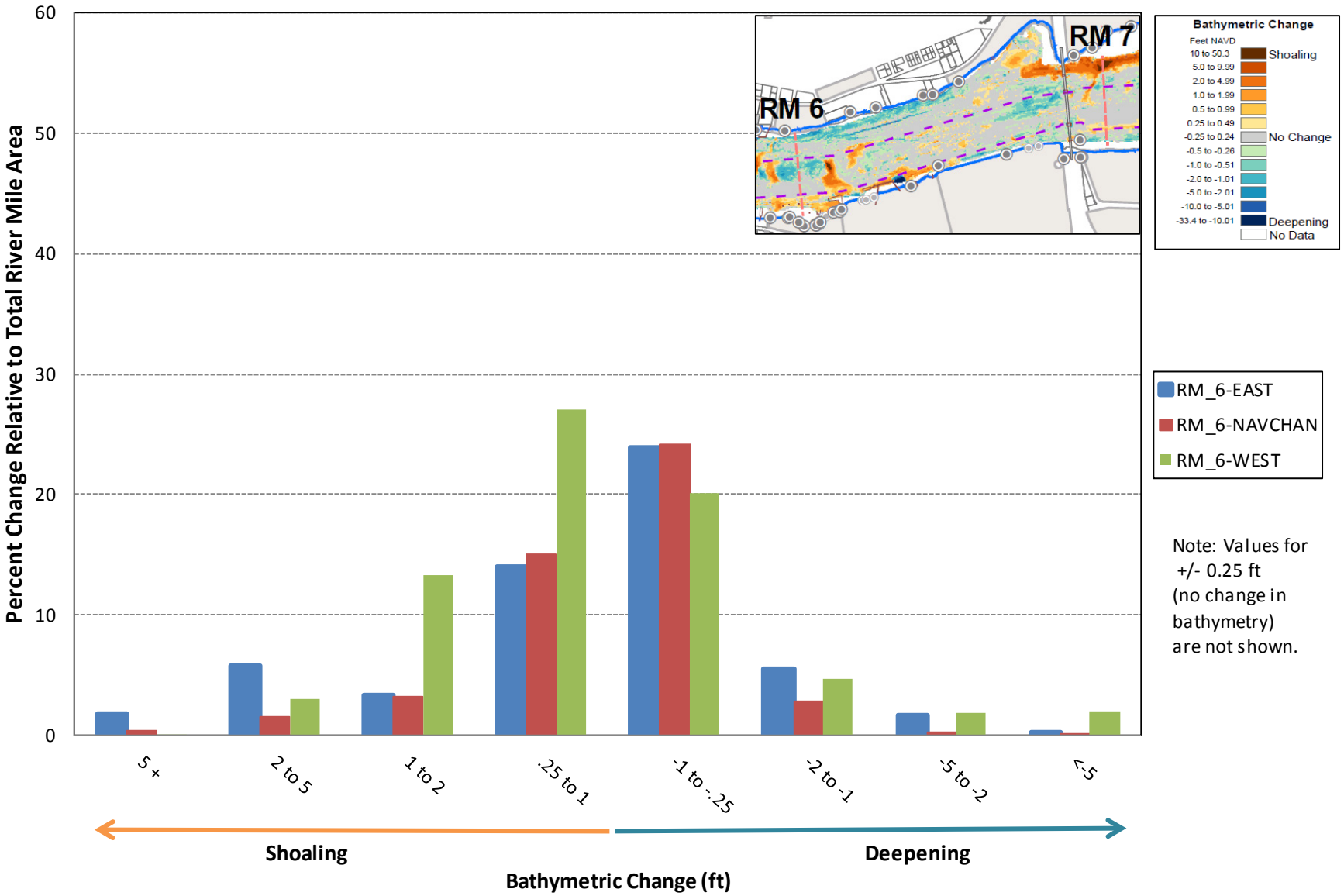


Figure 3.1-23g
Portland Harbor RI/FS
Remedial Investigation Report
Portland Harbor 2002–2009 Bathymetric Change
RM 6 to 7

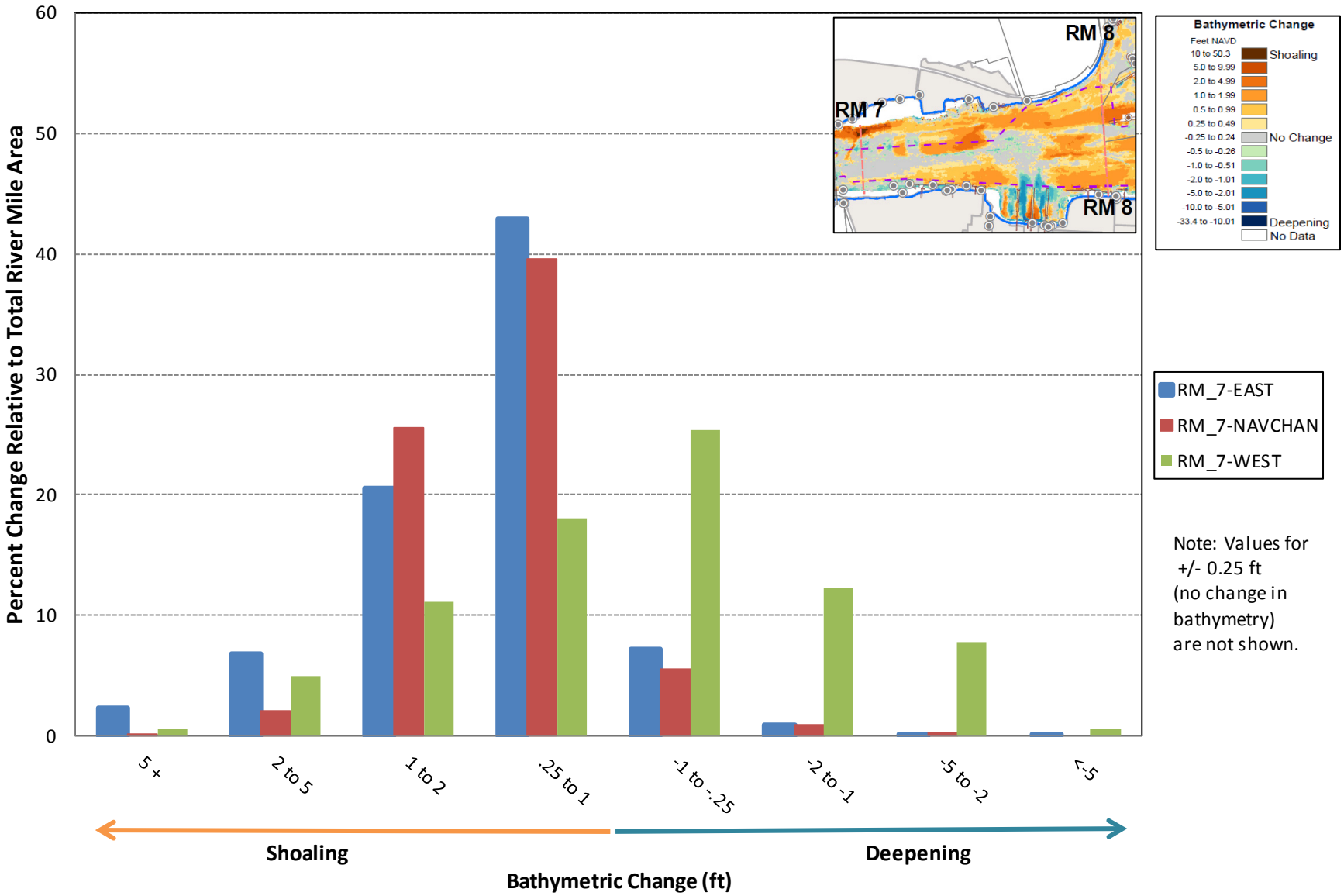


Figure 3.1-23h
Portland Harbor RI/FS
Remedial Investigation Report
Portland Harbor 2002–2009 Bathymetric Change
RM 7 to 8

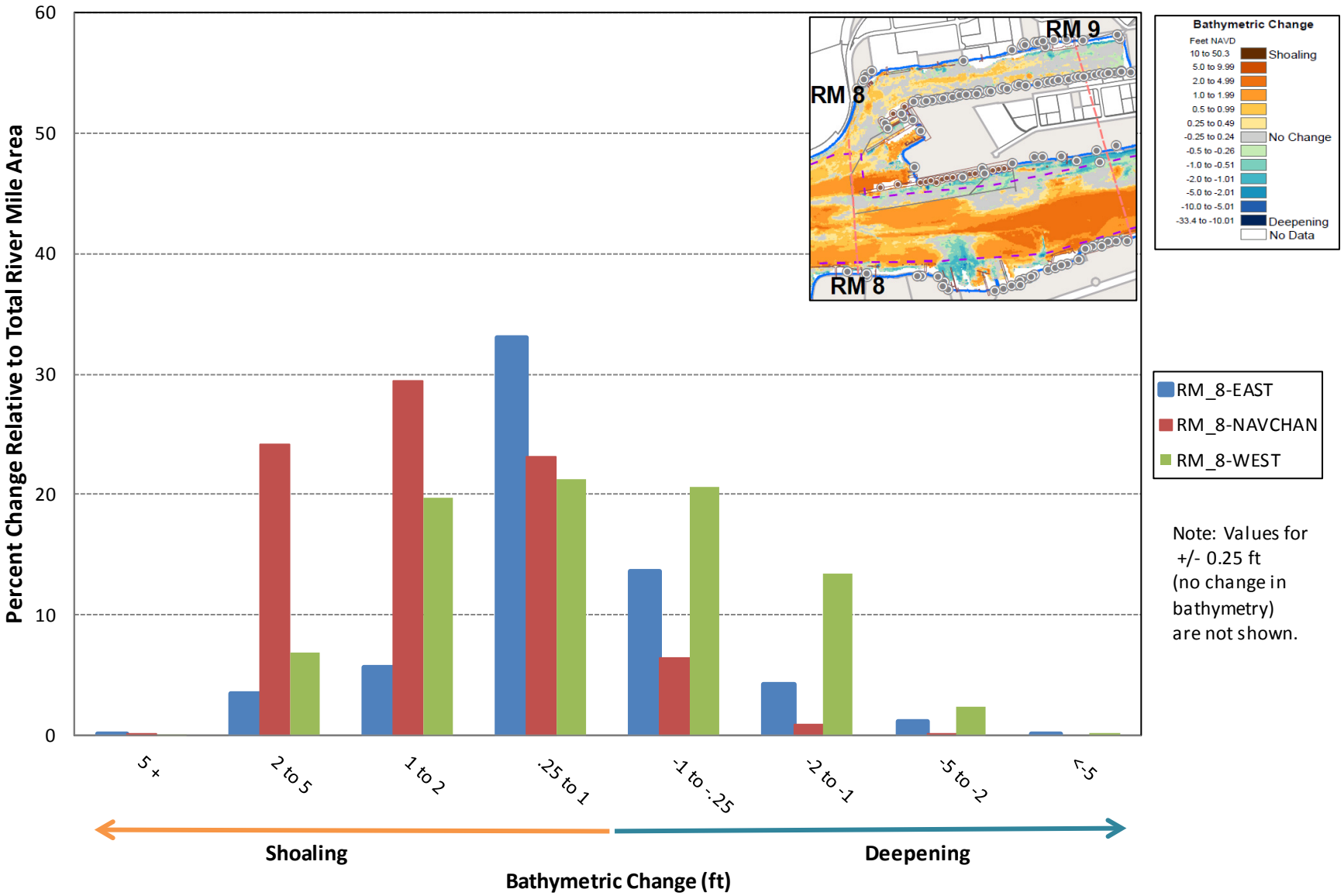


Figure 3.1-23i
Portland Harbor RI/FS
Remedial Investigation Report
Portland Harbor 2002–2009 Bathymetric Change
RM 8 to 9

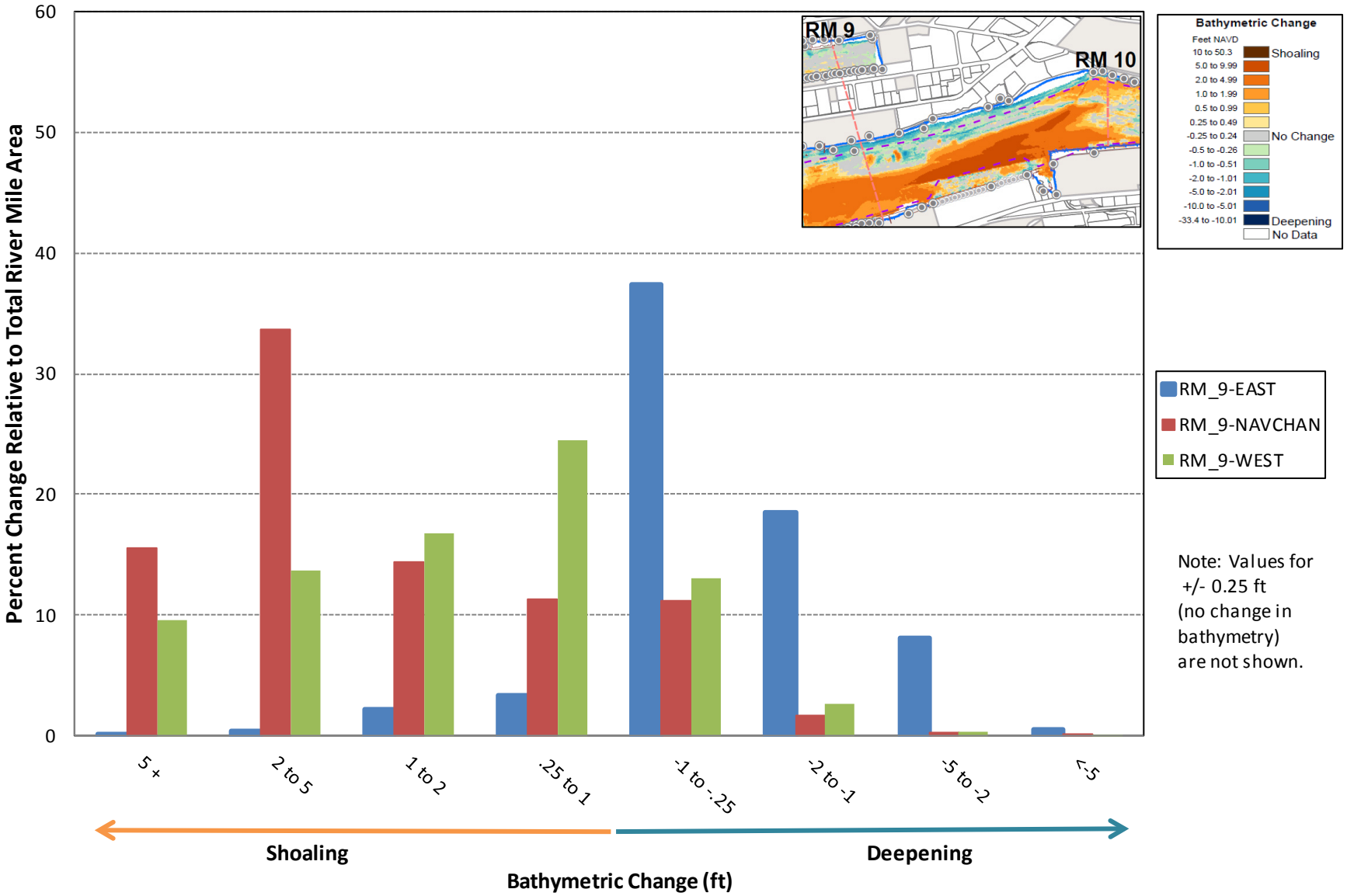


Figure 3.1-23j
Portland Harbor RI/FS
Remedial Investigation Report
Portland Harbor 2002–2009 Bathymetric Change
RM 9 to 10

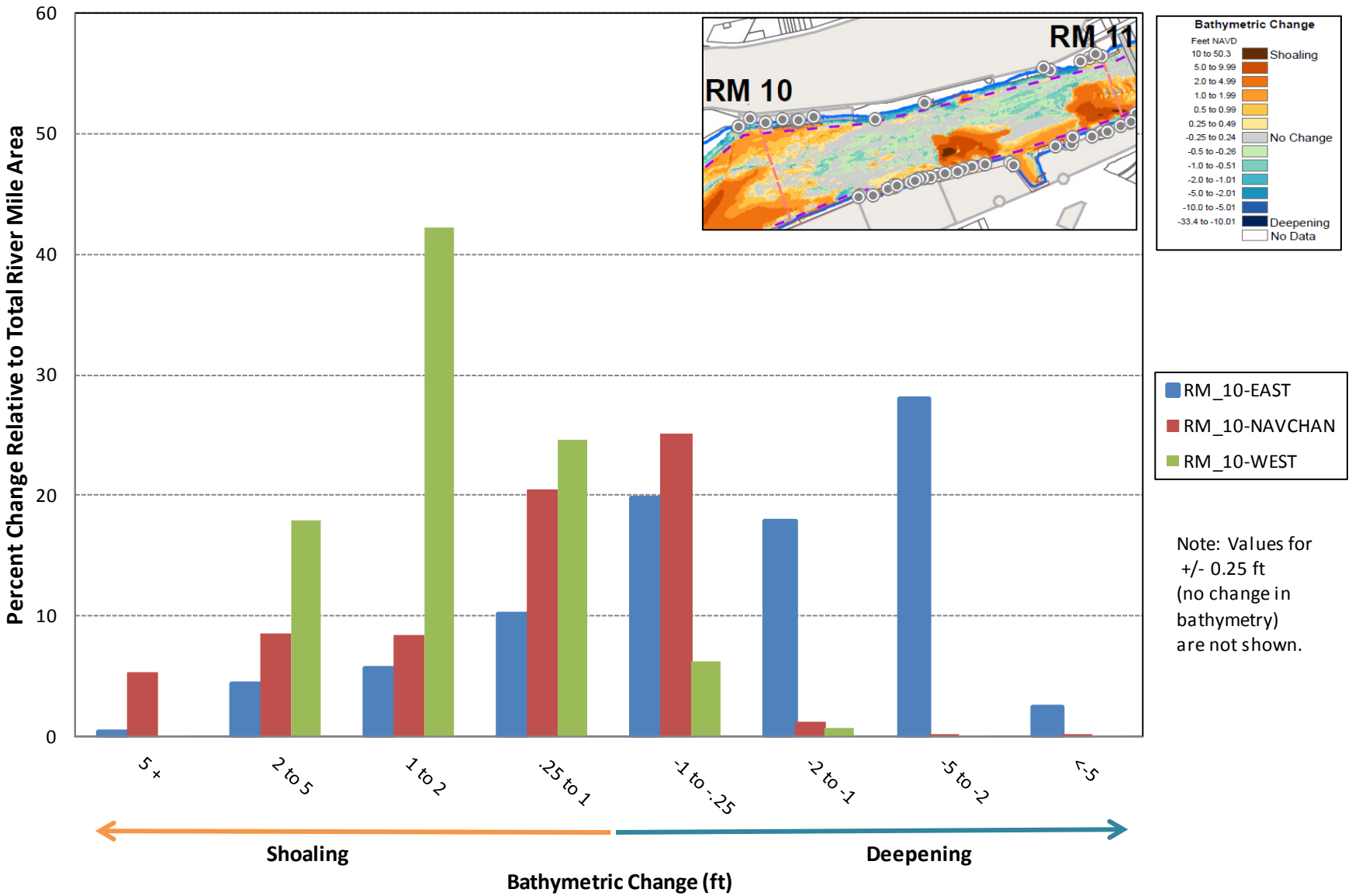


Figure 3.1-23k
Portland Harbor RI/FS
Remedial Investigation Report
Portland Harbor 2002–2009 Bathymetric Change
RM 10 to 11

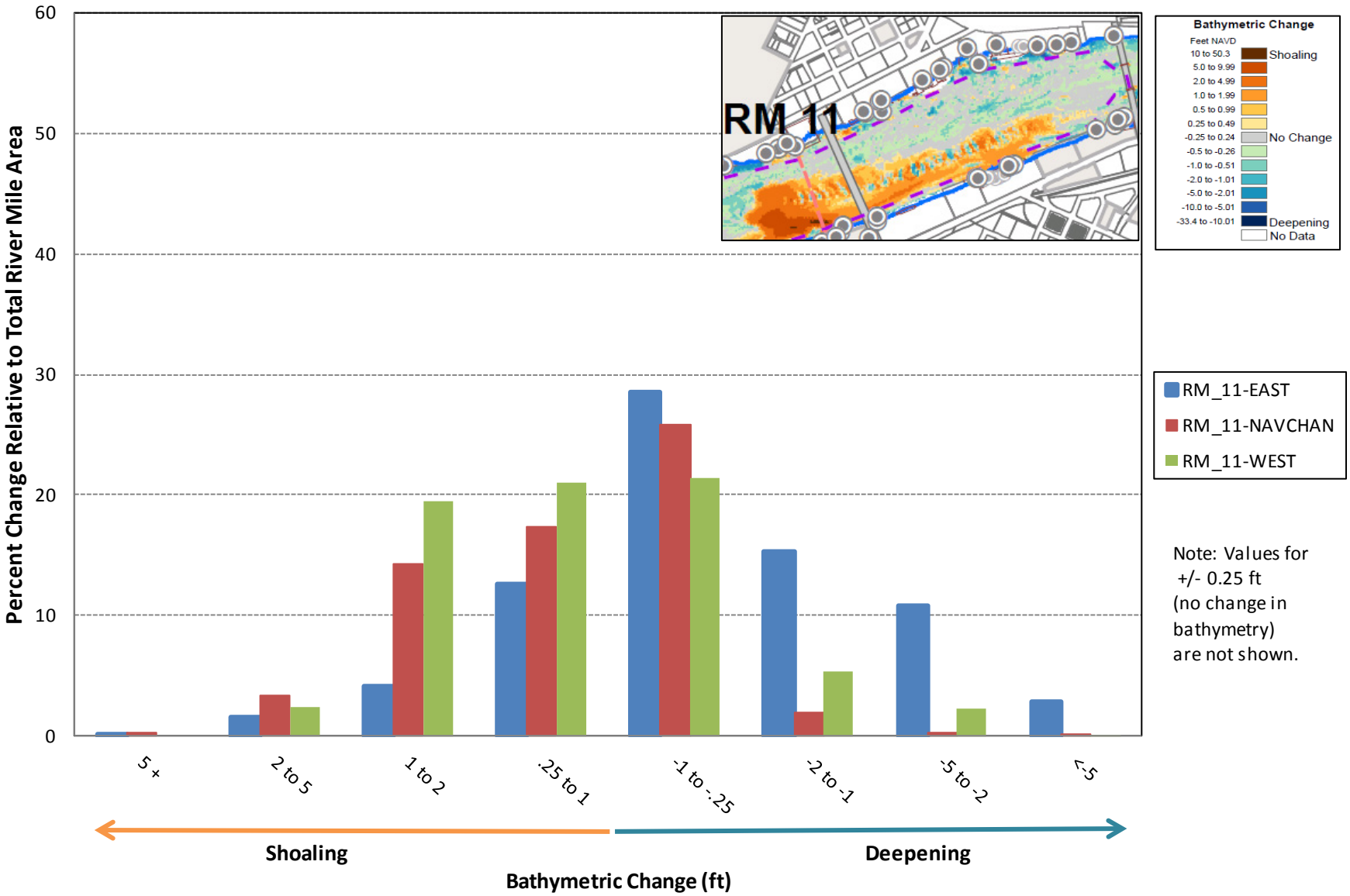


Figure 3.1-23I
Portland Harbor RI/FS
Remedial Investigation Report
Portland Harbor 2002–2009 Bathymetric Change
RM 11 to End of Navigation Channel

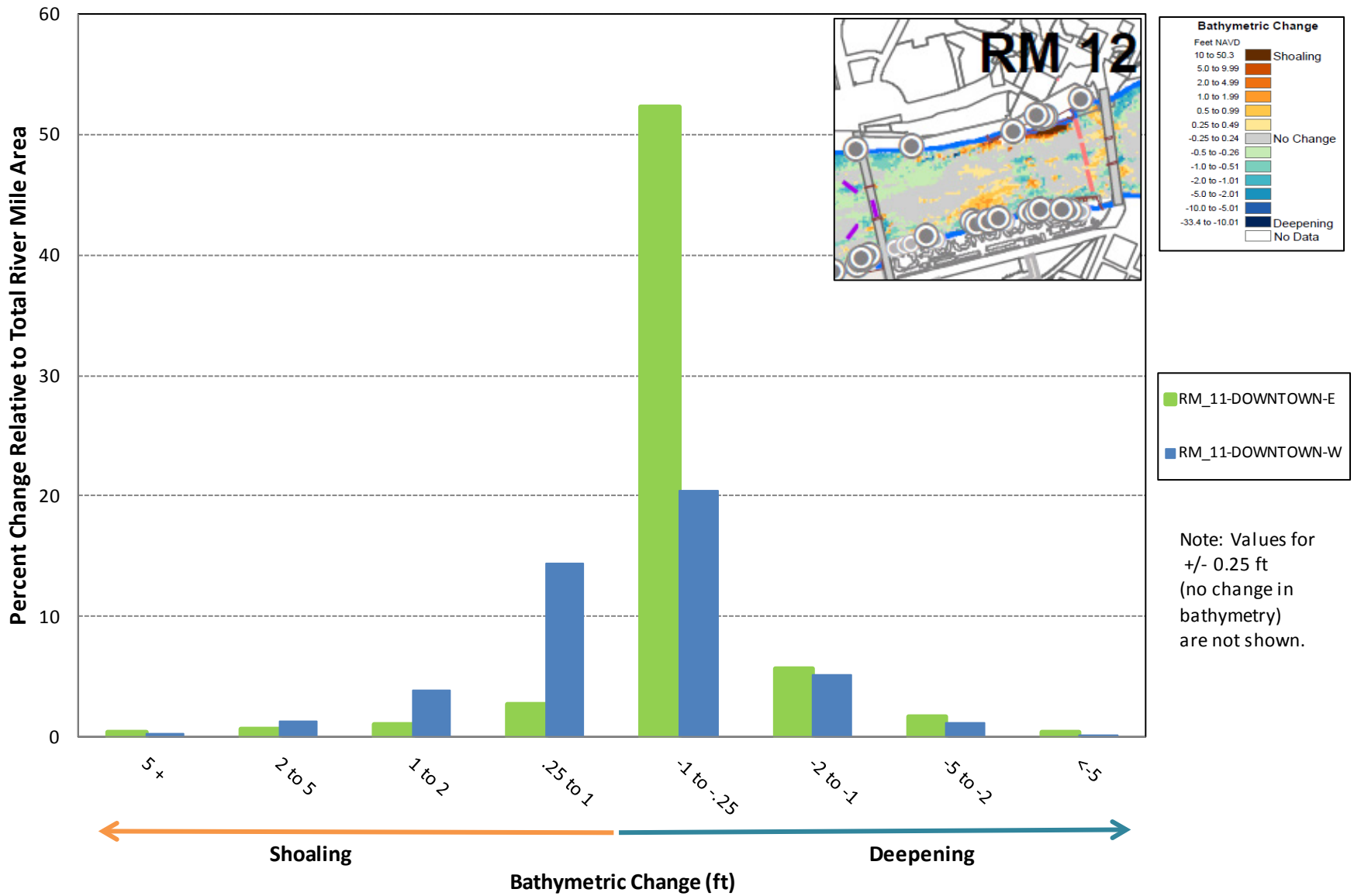


Figure 3.1-23m
Portland Harbor RI/FS
Remedial Investigation Report
Portland Harbor 2002–2009 Bathymetric Change
End of Navigation Channel to RM 11.8

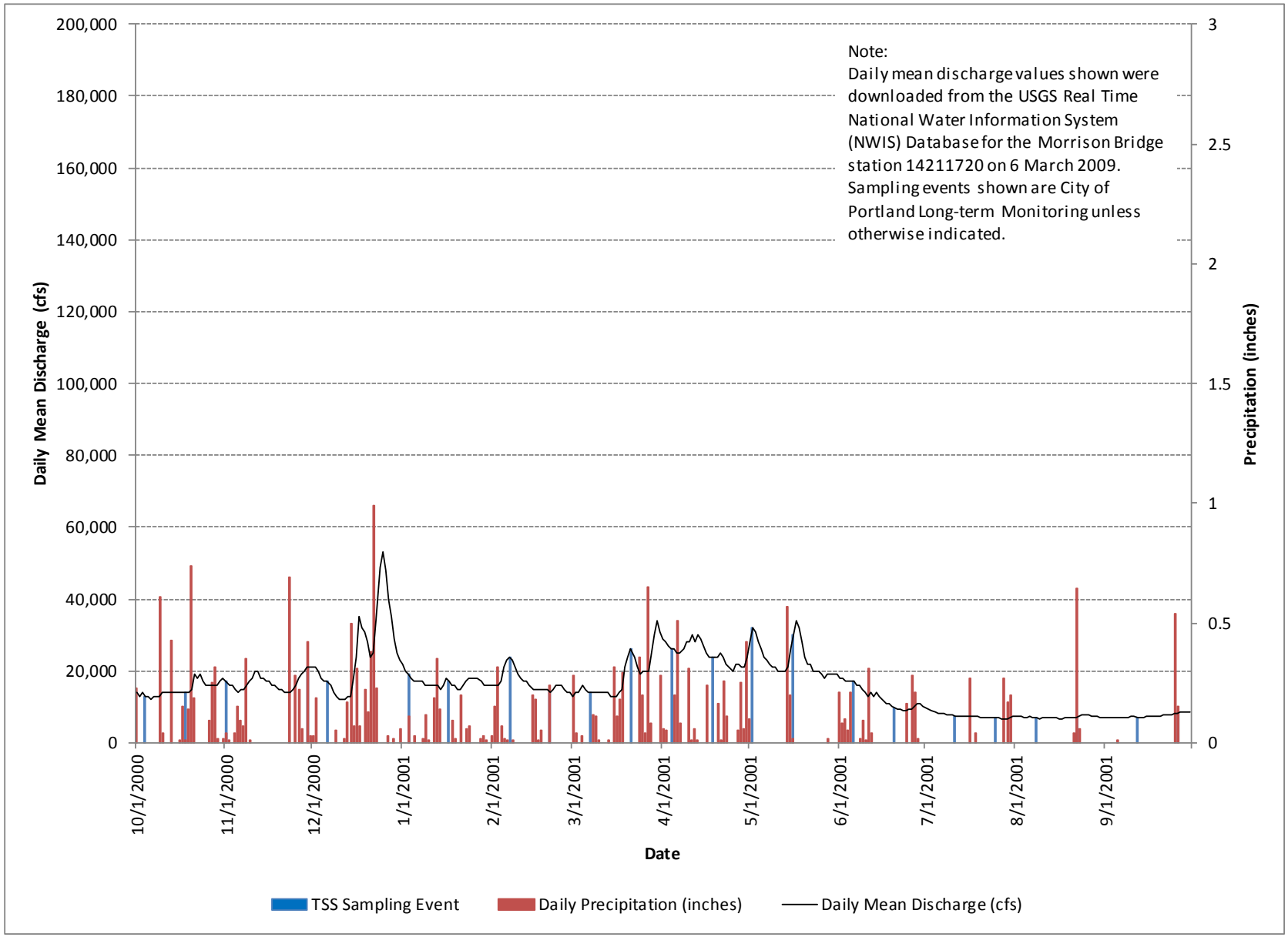


Figure 3.1-24a
Portland Harbor RI/FS
Remedial Investigation Report
Discharge Hydrograph, Precipitation, and
TSS Sampling Events, Water Year 2001

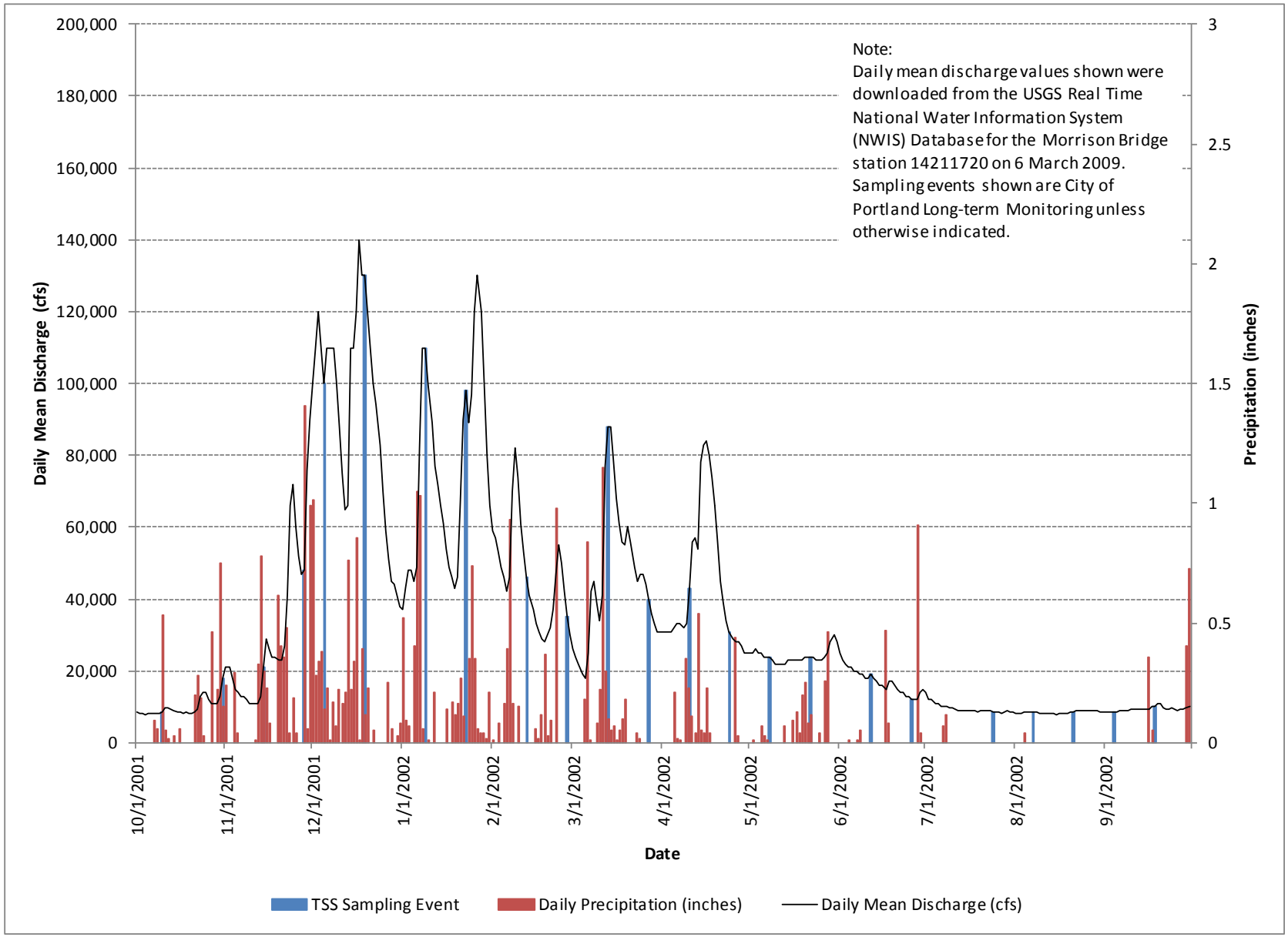


Figure 3.1-24b
Portland Harbor RI/FS
Remedial Investigation Report
Discharge Hydrograph, Precipitation, and
TSS Sampling Events, Water Year 2002

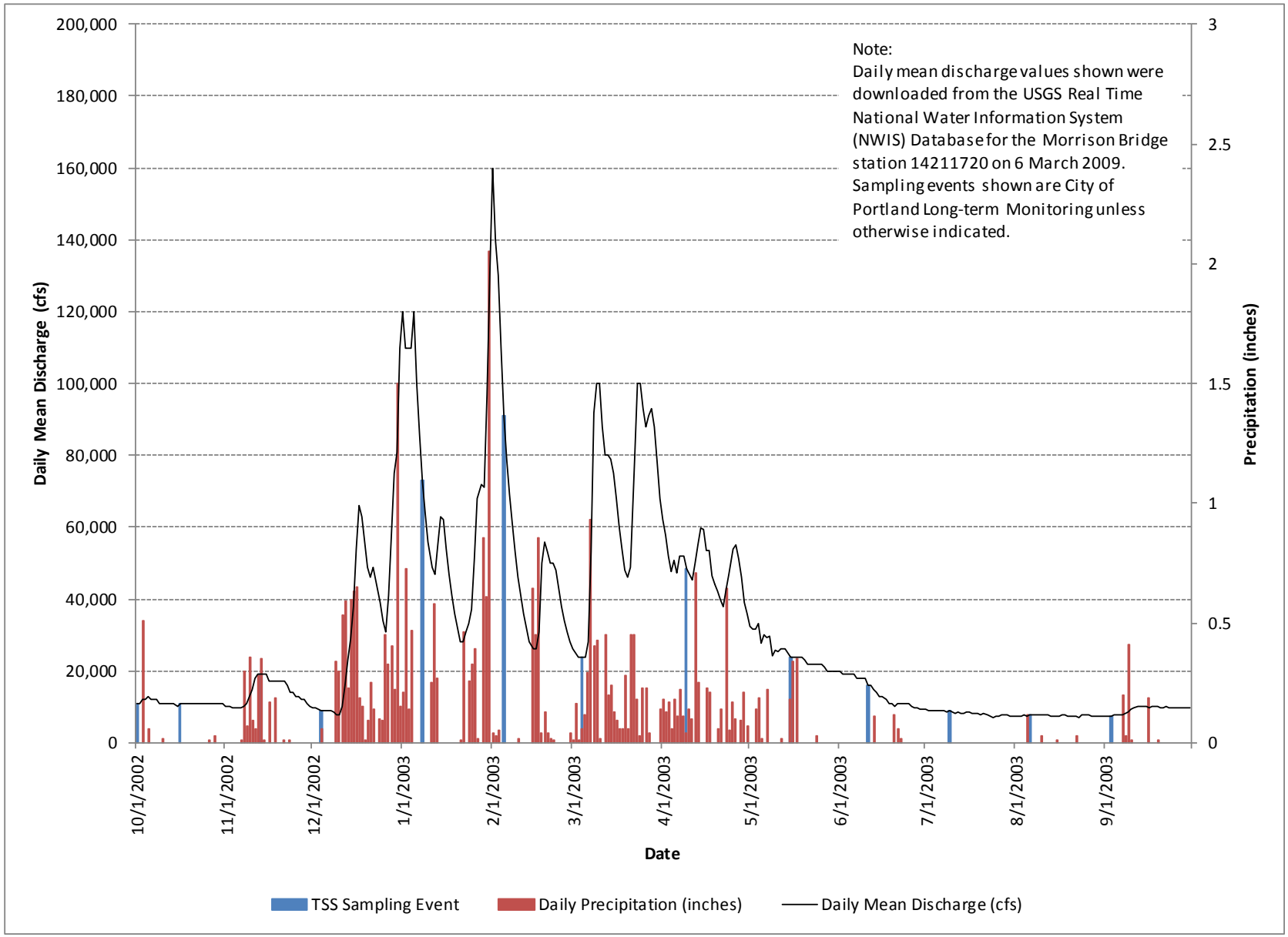


Figure 3.1-24c
Portland Harbor RI/FS
Remedial Investigation Report
Discharge Hydrograph, Precipitation, and
TSS Sampling Events, Water Year 2003

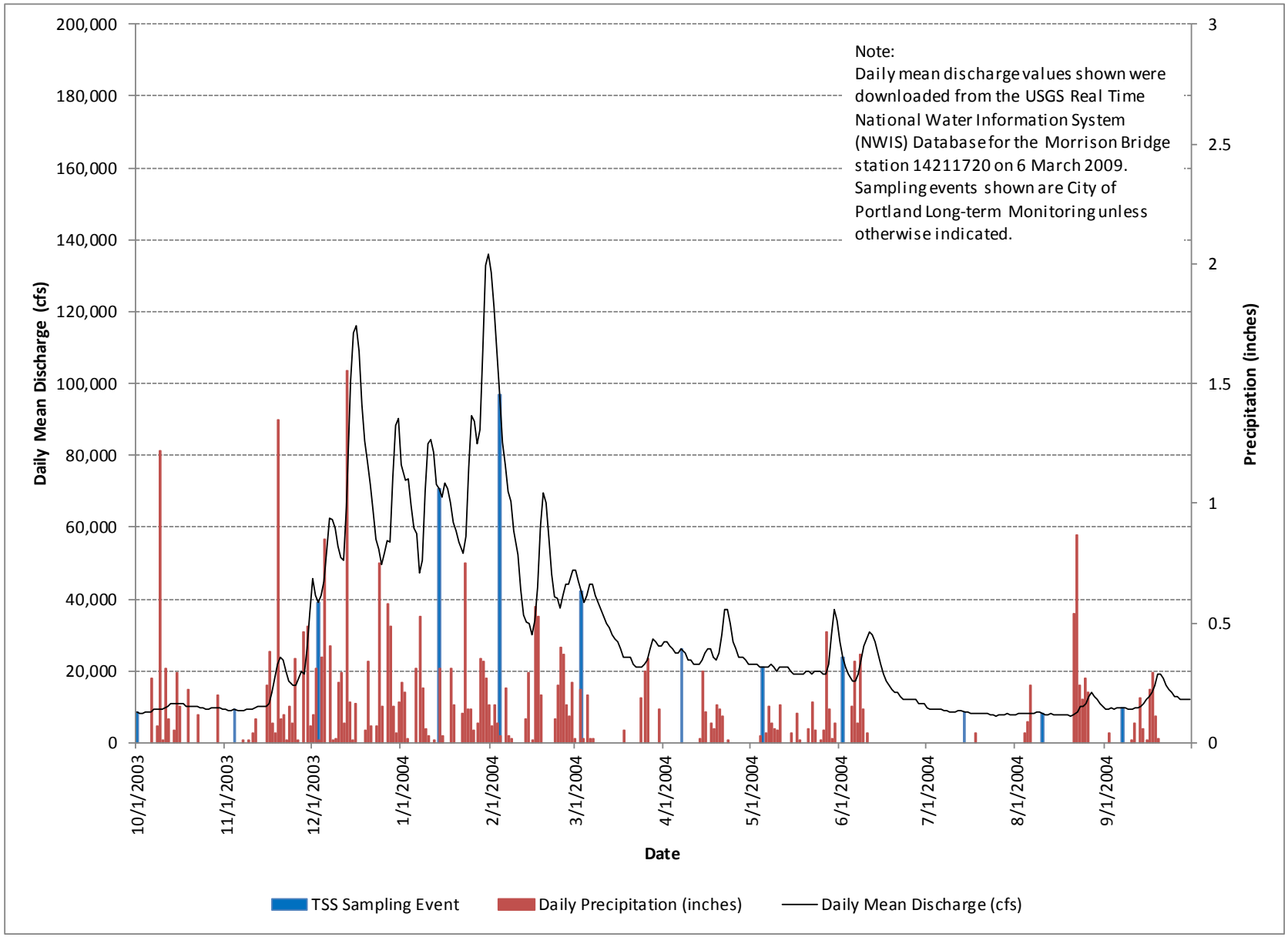


Figure 3.1-24d
Portland Harbor RI/FS
Remedial Investigation Report
Discharge Hydrograph, Precipitation, and
TSS Sampling Events, Water Year 2004

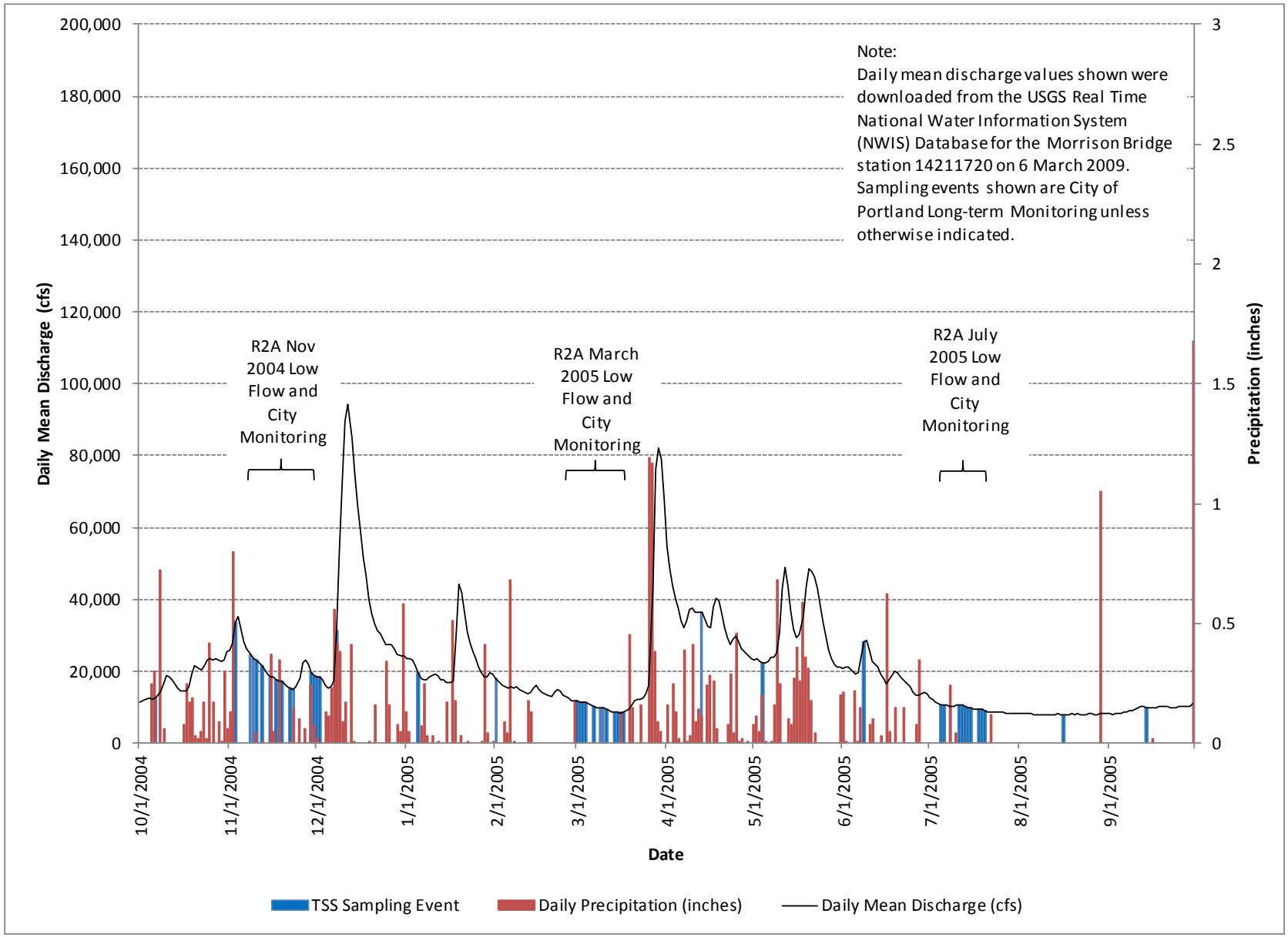


Figure 3.1-24e
Portland Harbor RI/FS
Remedial Investigation Report
Discharge Hydrograph, Precipitation, and
TSS Sampling Events, Water Year 2005

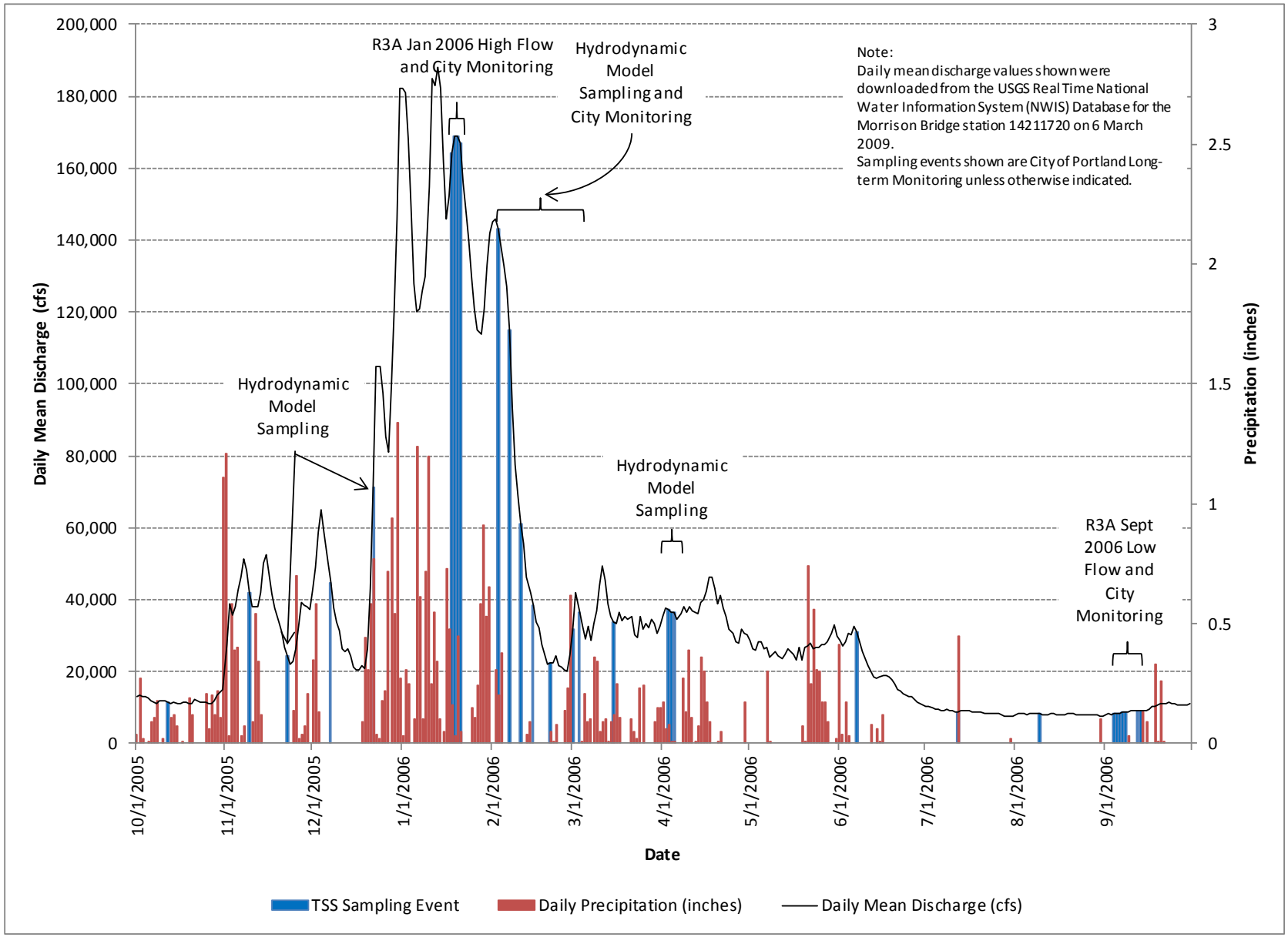


Figure 3.1-24f
Portland Harbor RI/FS
Remedial Investigation Report
Discharge Hydrograph, Precipitation, and
TSS Sampling Events, Water Year 2006

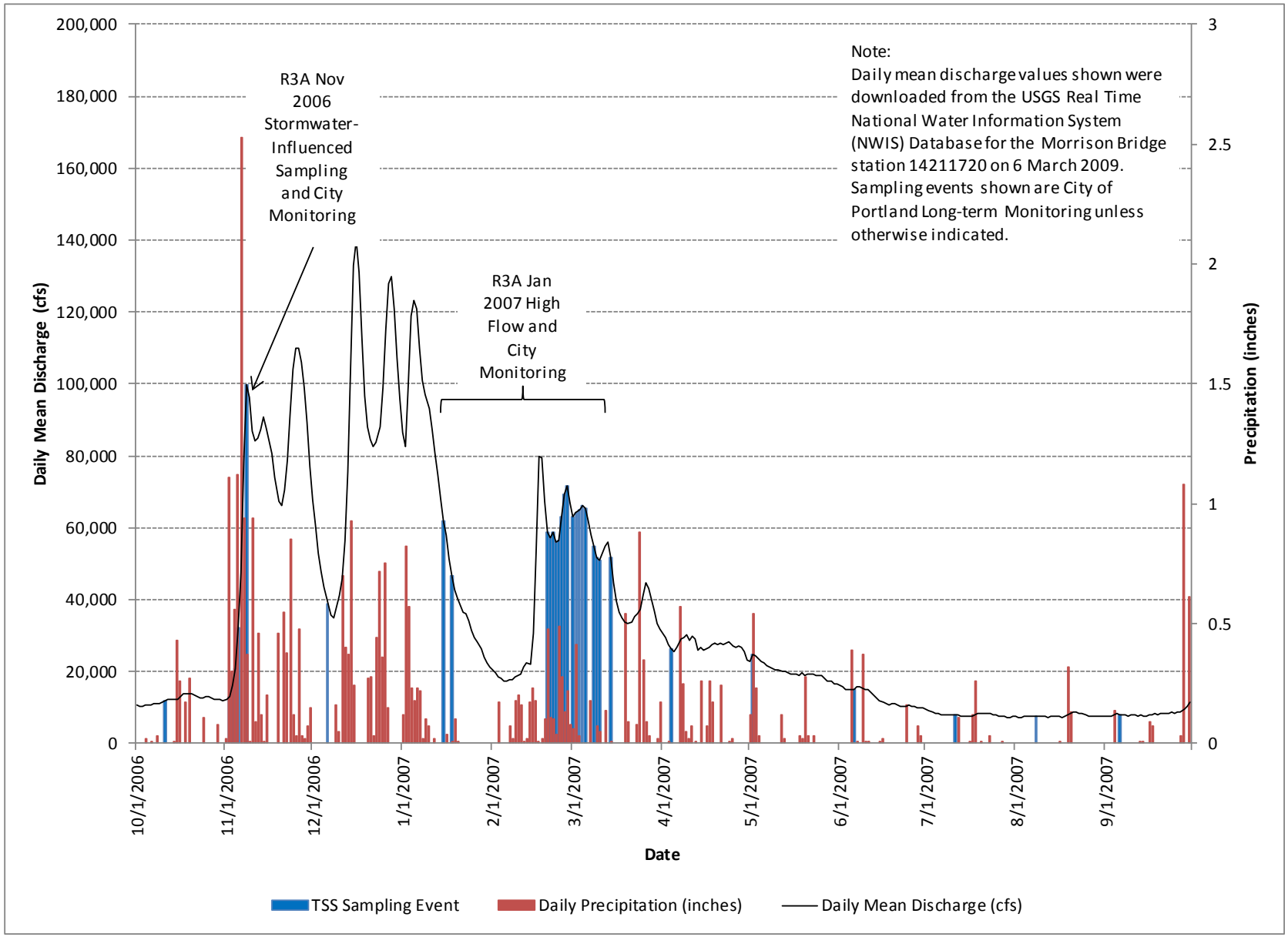


Figure 3.1-24g
Portland Harbor RI/FS
Remedial Investigation Report
Discharge Hydrograph, Precipitation, and
TSS Sampling Events, Water Year 2007

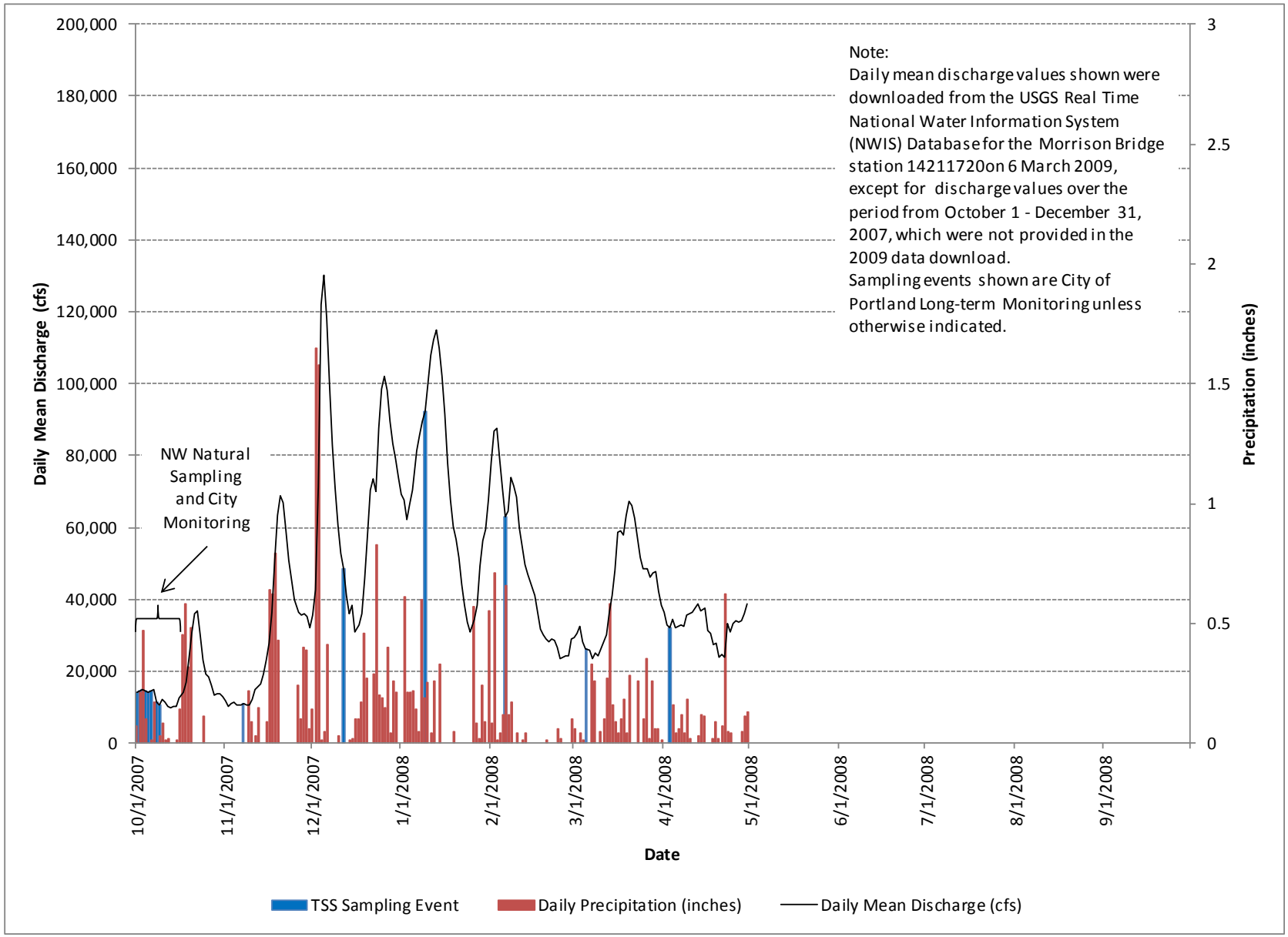


Figure 3.1-24h
Portland Harbor RI/FS
Remedial Investigation Report
Discharge Hydrograph, Precipitation, and
TSS Sampling Events, Water Year 2008

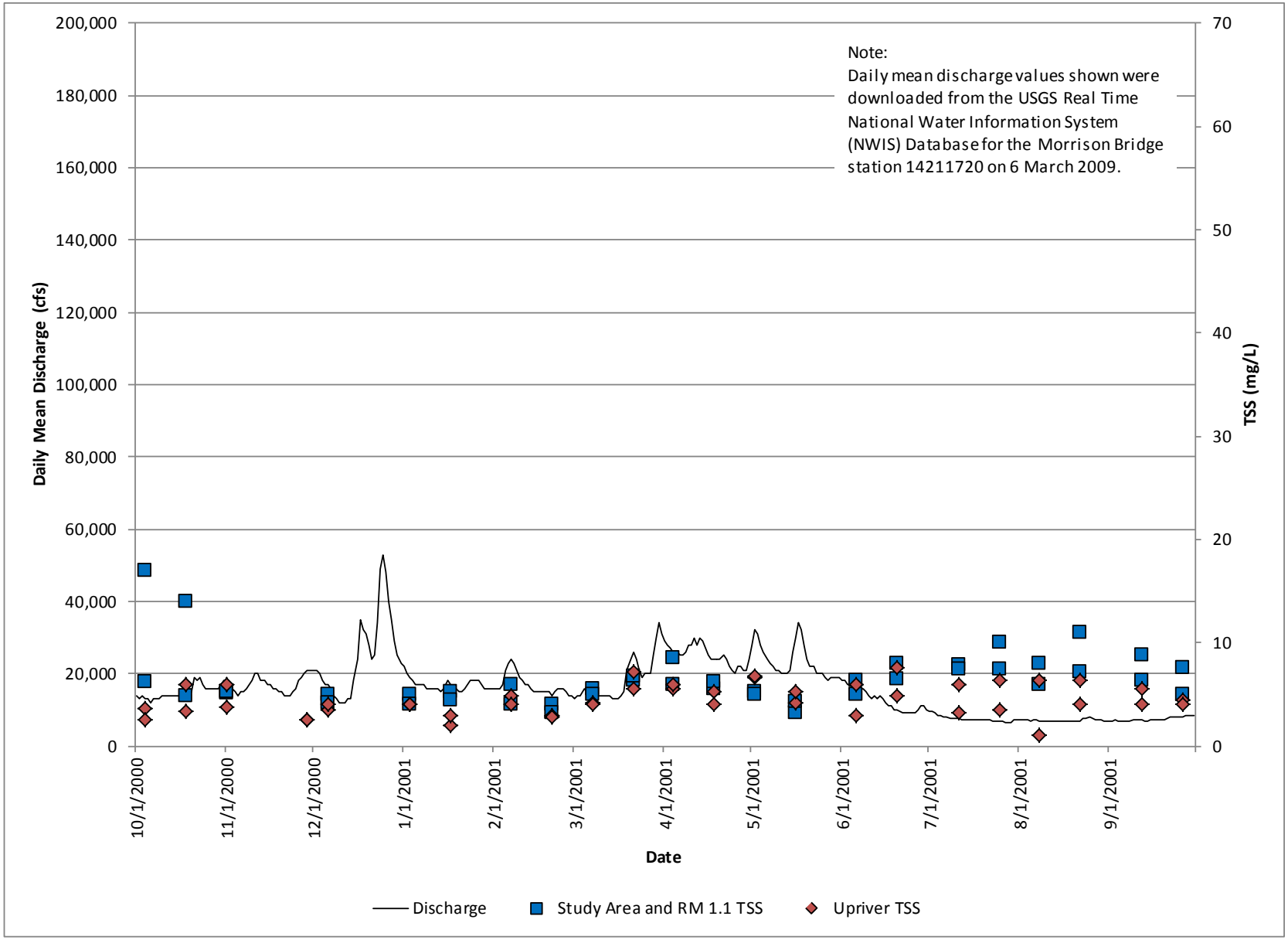


Figure 3.1-25a
Portland Harbor RI/FS
Remedial Investigation Report
Discharge Hydrograph and TSS Results,
Water Year 2001

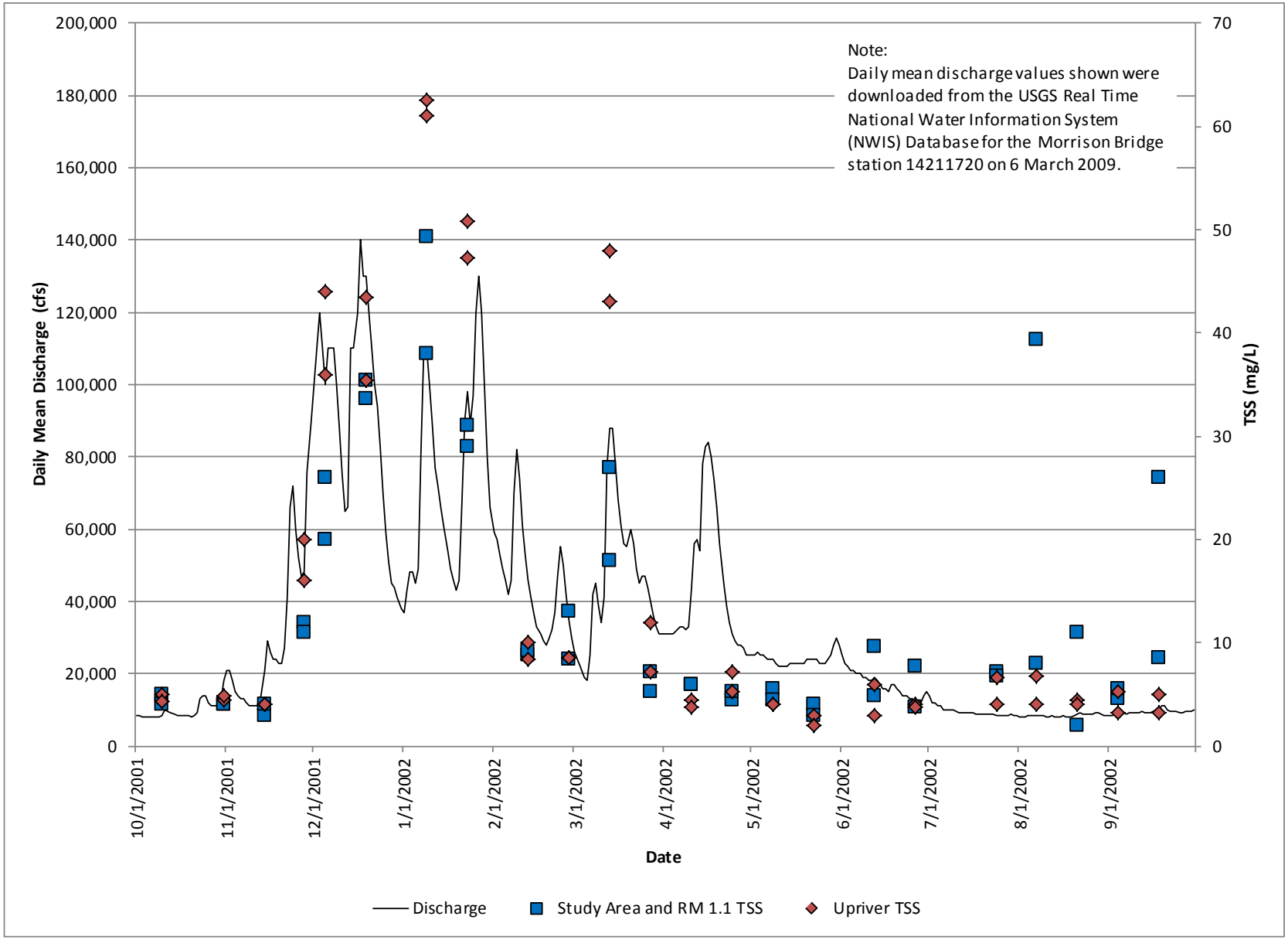


Figure 3.1-25b
Portland Harbor RI/FS
Remedial Investigation Report
Discharge Hydrograph and TSS Results,
Water Year 2002

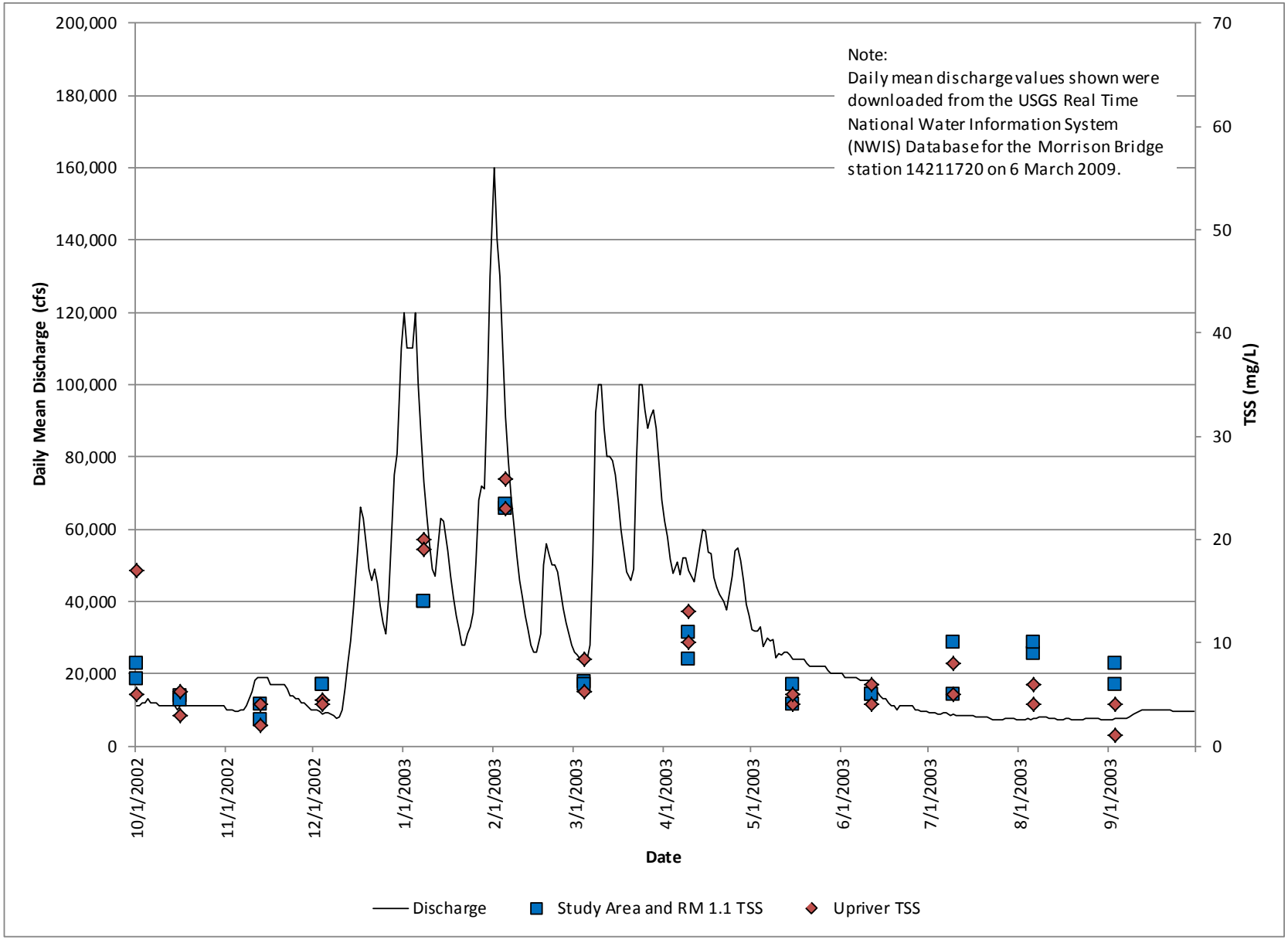


Figure 3.1-25c
Portland Harbor RI/FS
Remedial Investigation Report
Discharge Hydrograph and TSS Results,
Water Year 2003

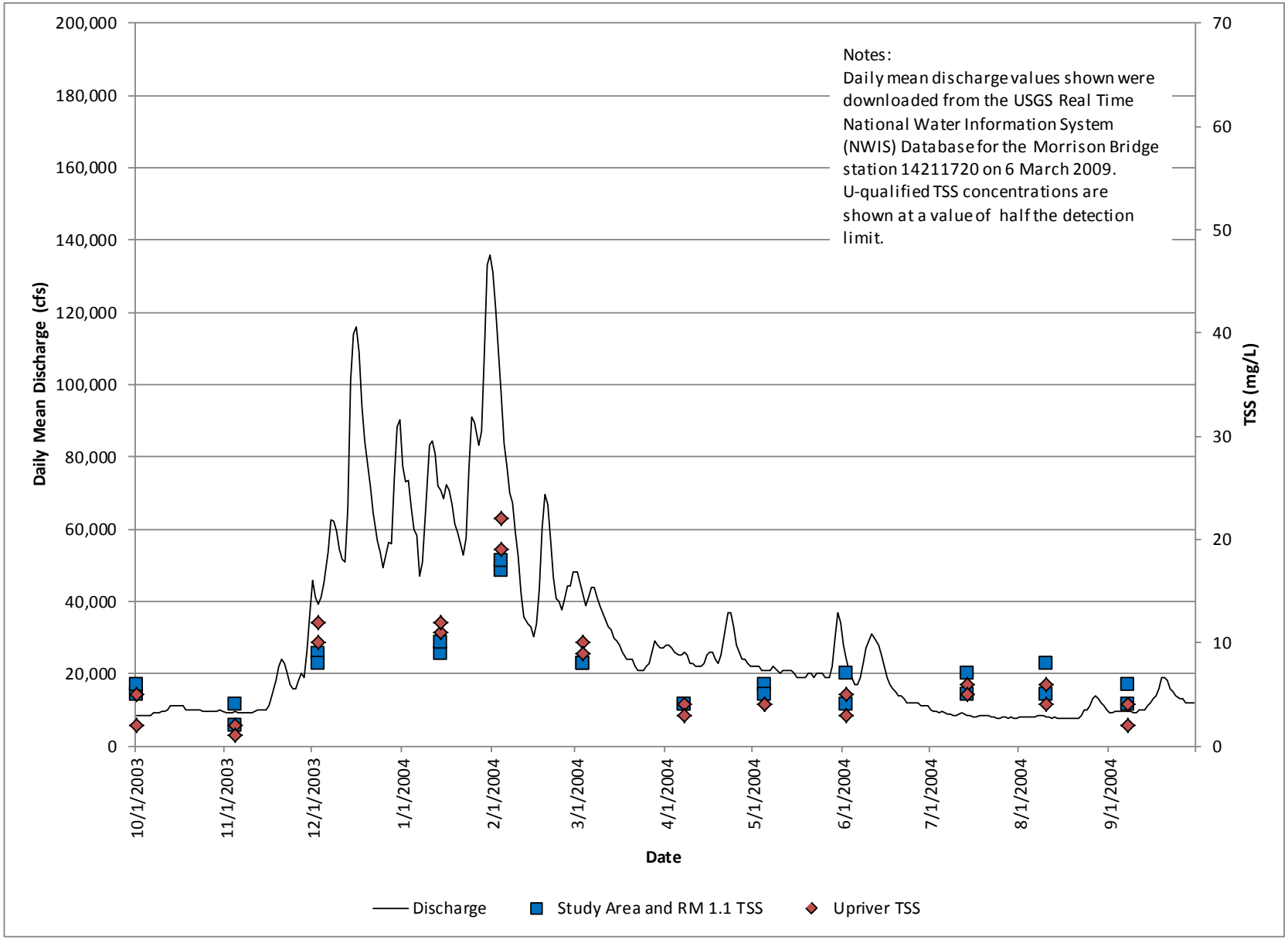


Figure 3.1-25d
Portland Harbor RI/FS
Remedial Investigation Report
Discharge Hydrograph and TSS Results,
Water Year 2004

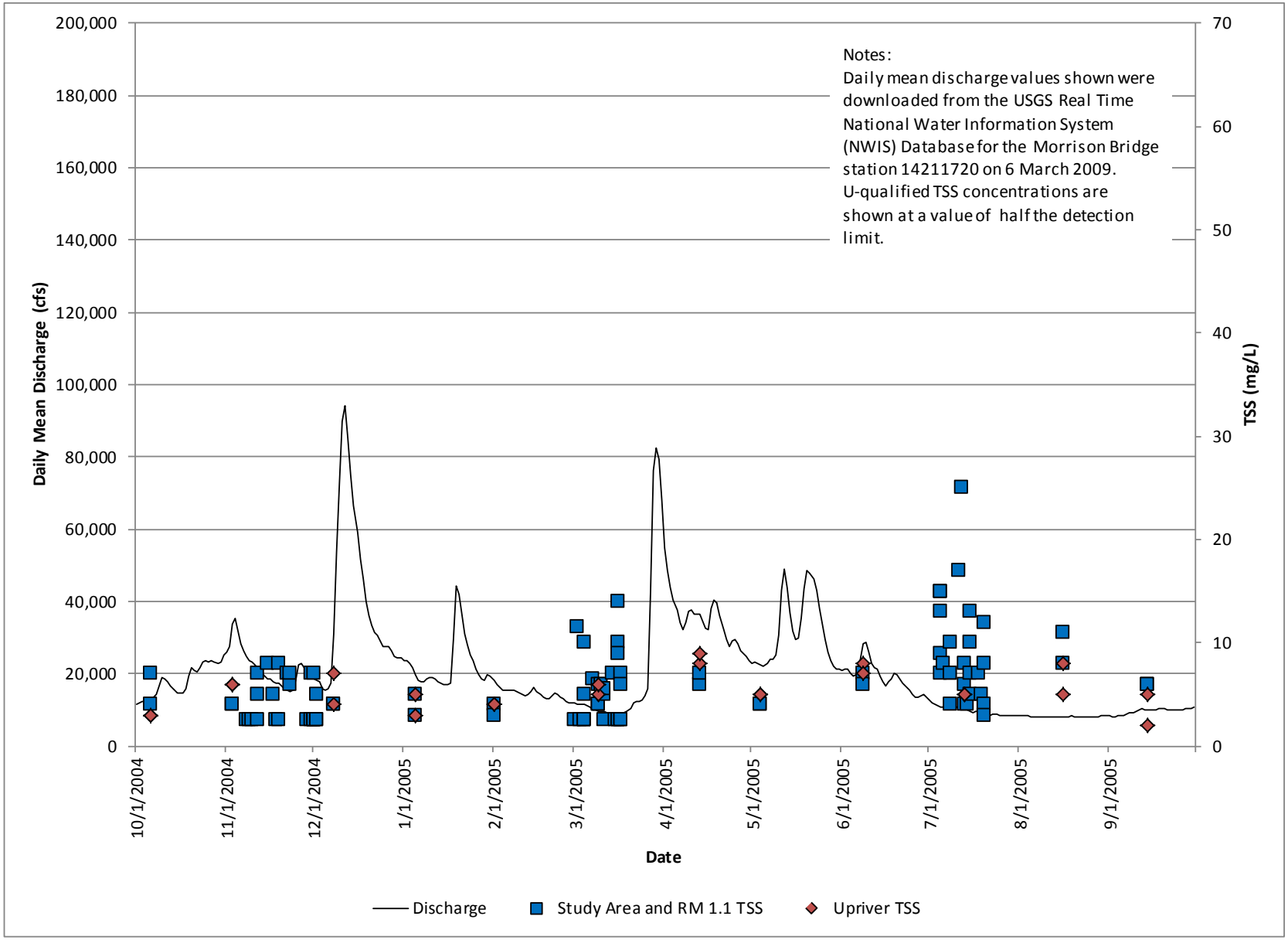


Figure 3.1-25e
Portland Harbor RI/FS
Remedial Investigation Report
Discharge Hydrograph and TSS Results,
Water Year 2005

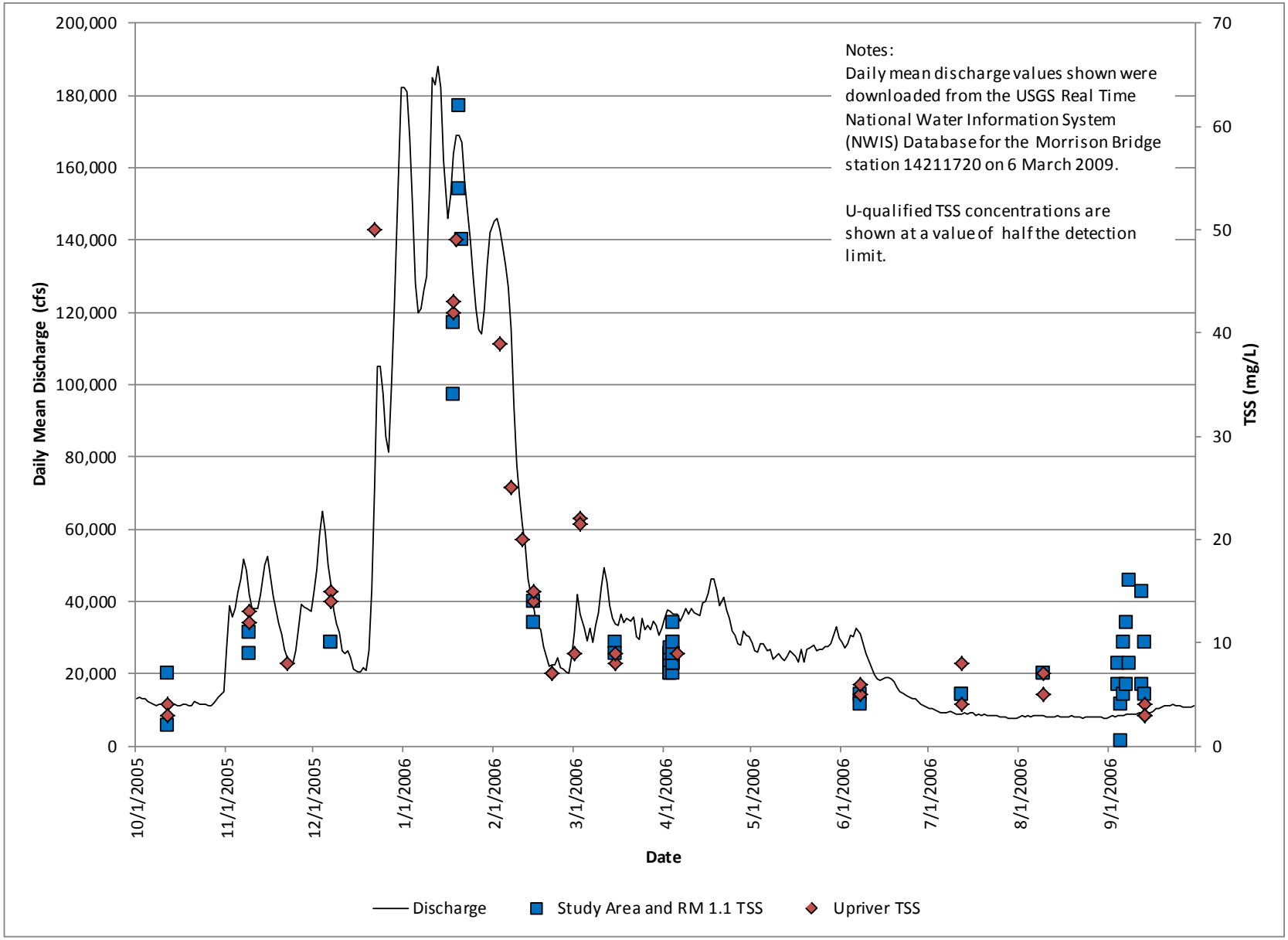


Figure 3.1-25f
Portland Harbor RI/FS
Remedial Investigation Report
Discharge Hydrograph and TSS Results,
Water Year 2006

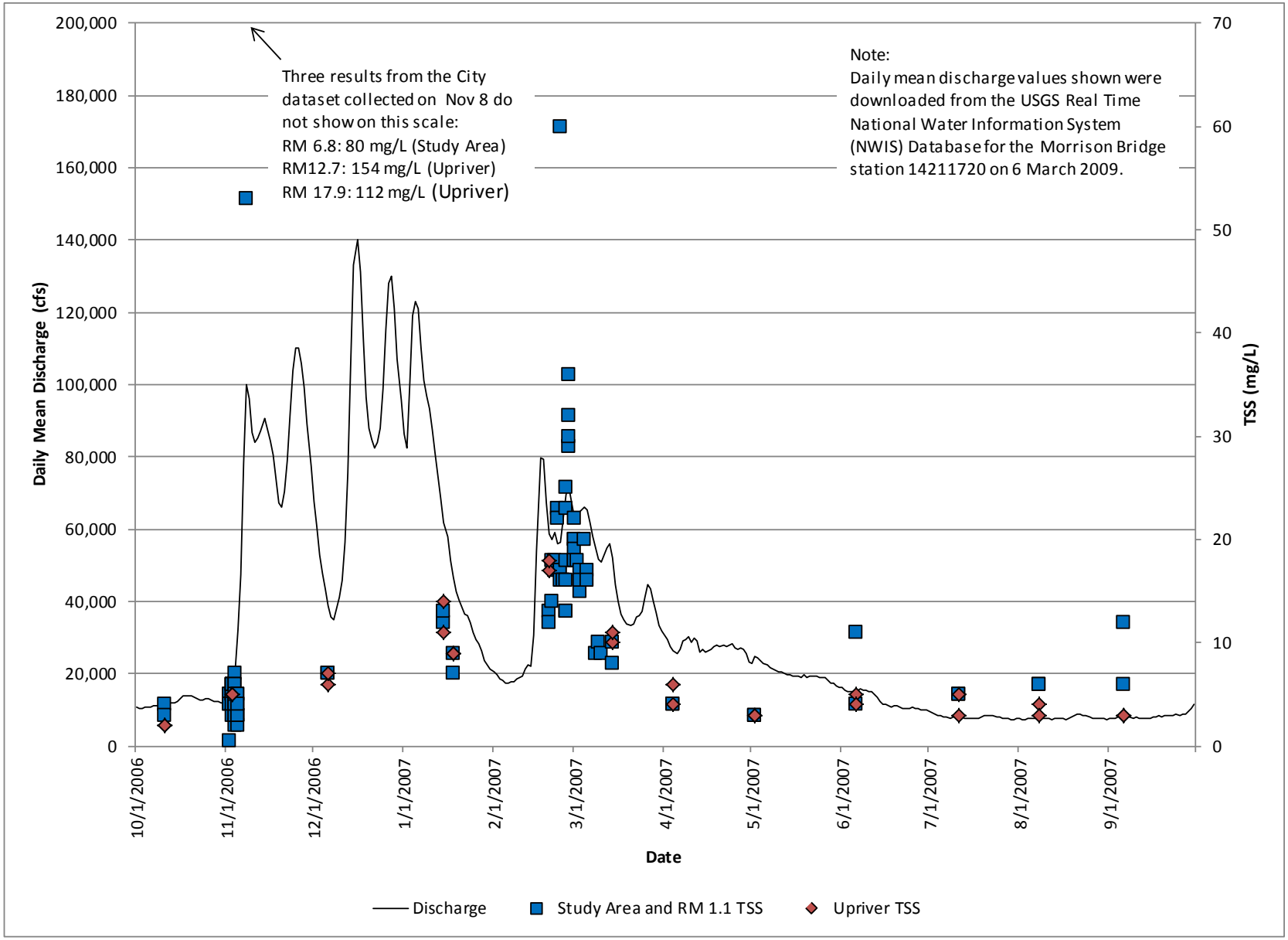


Figure 3.1-25g
Portland Harbor RI/FS
Remedial Investigation Report
Discharge Hydrograph and TSS Results,
Water Year 2007

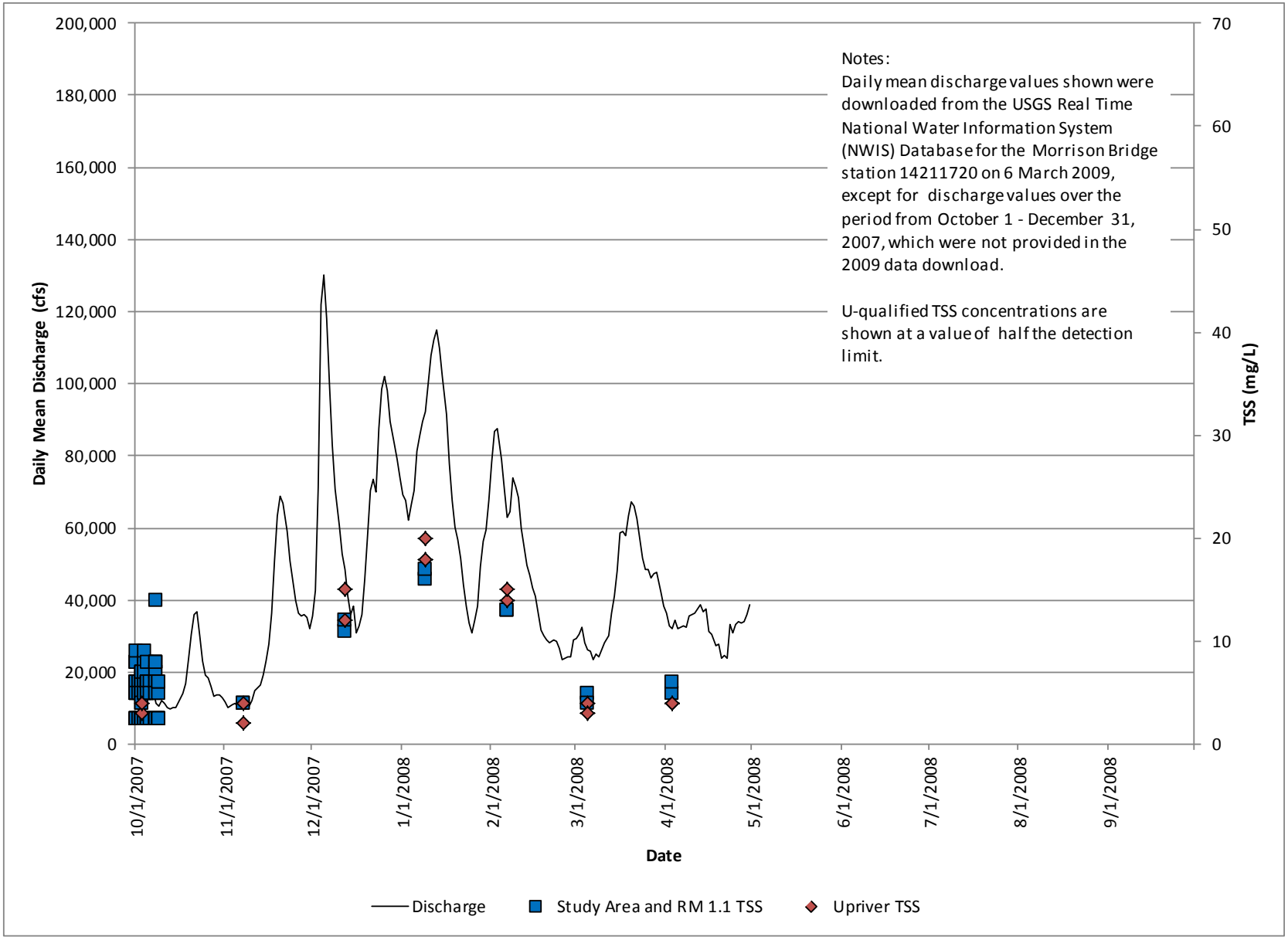


Figure 3.1-25h
Portland Harbor RI/FS
Remedial Investigation Report
Discharge Hydrograph and TSS Results,
Water Year 2008

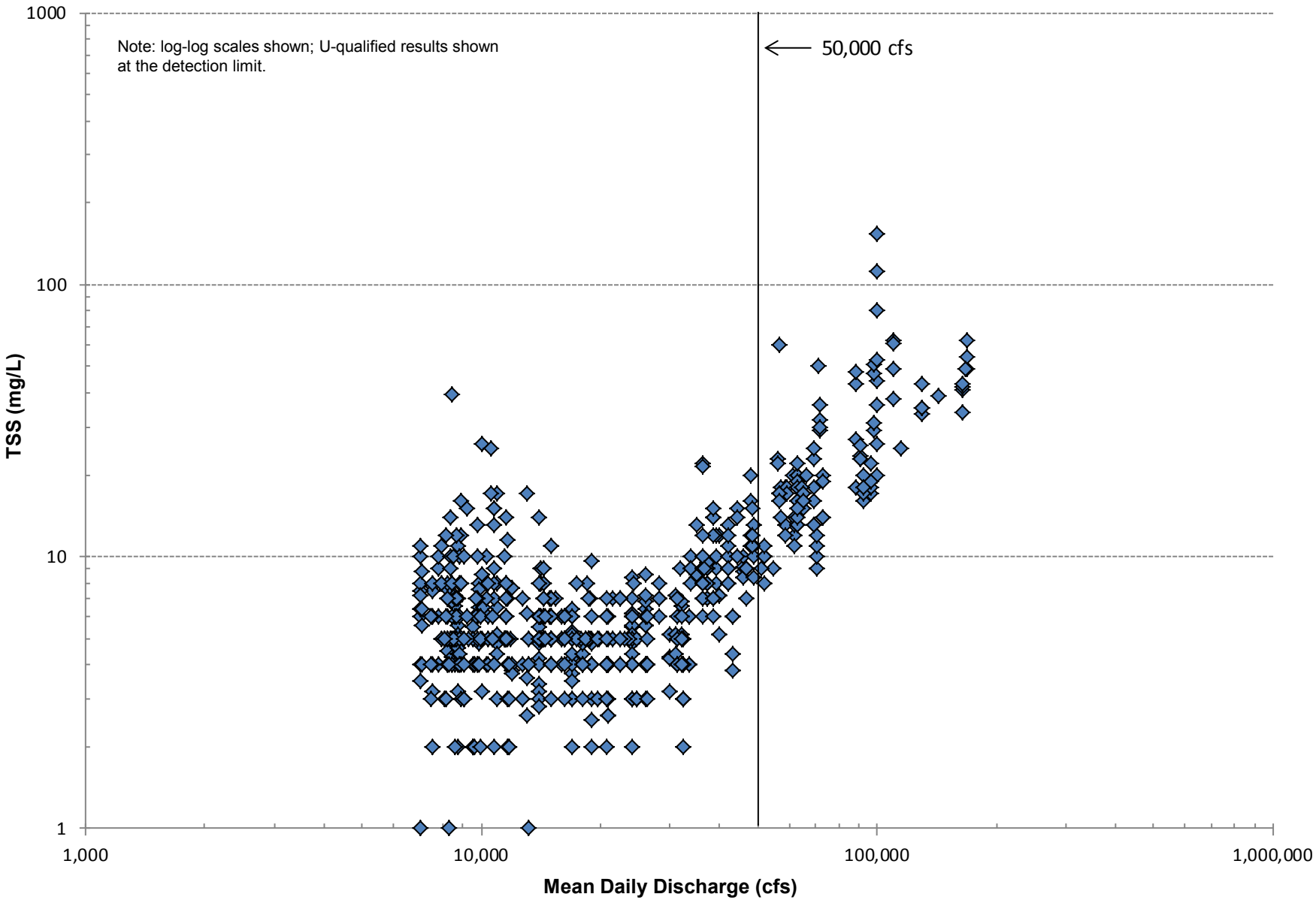


Figure 3.1-26
Portland Harbor RI/FS
Remedial Investigation Report
TSS vs. Discharge – All Data

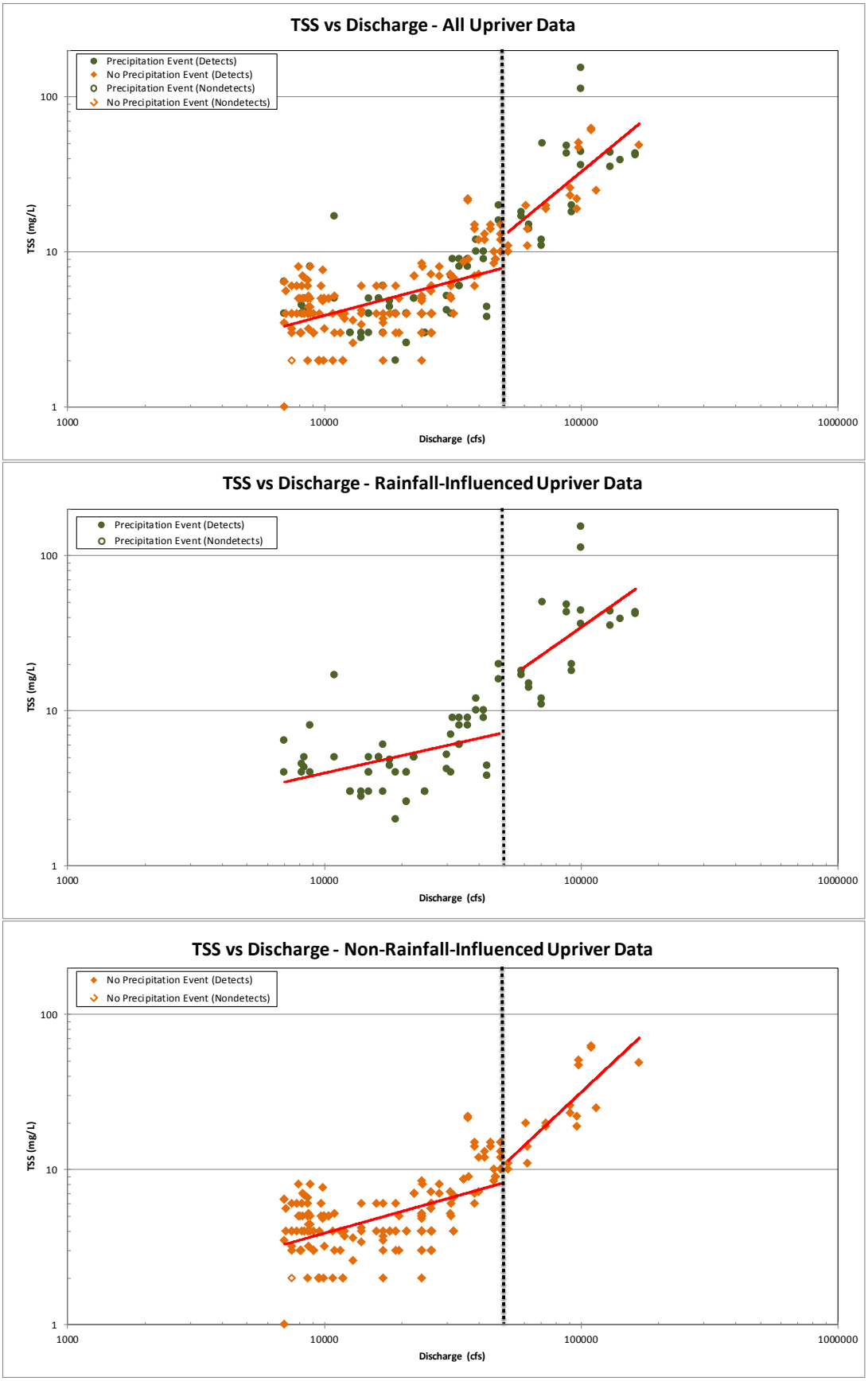


Figure 3.1-27
Portland Harbor RI/FS
Remedial Investigation Report
TSS vs. Discharge – Upriver Data

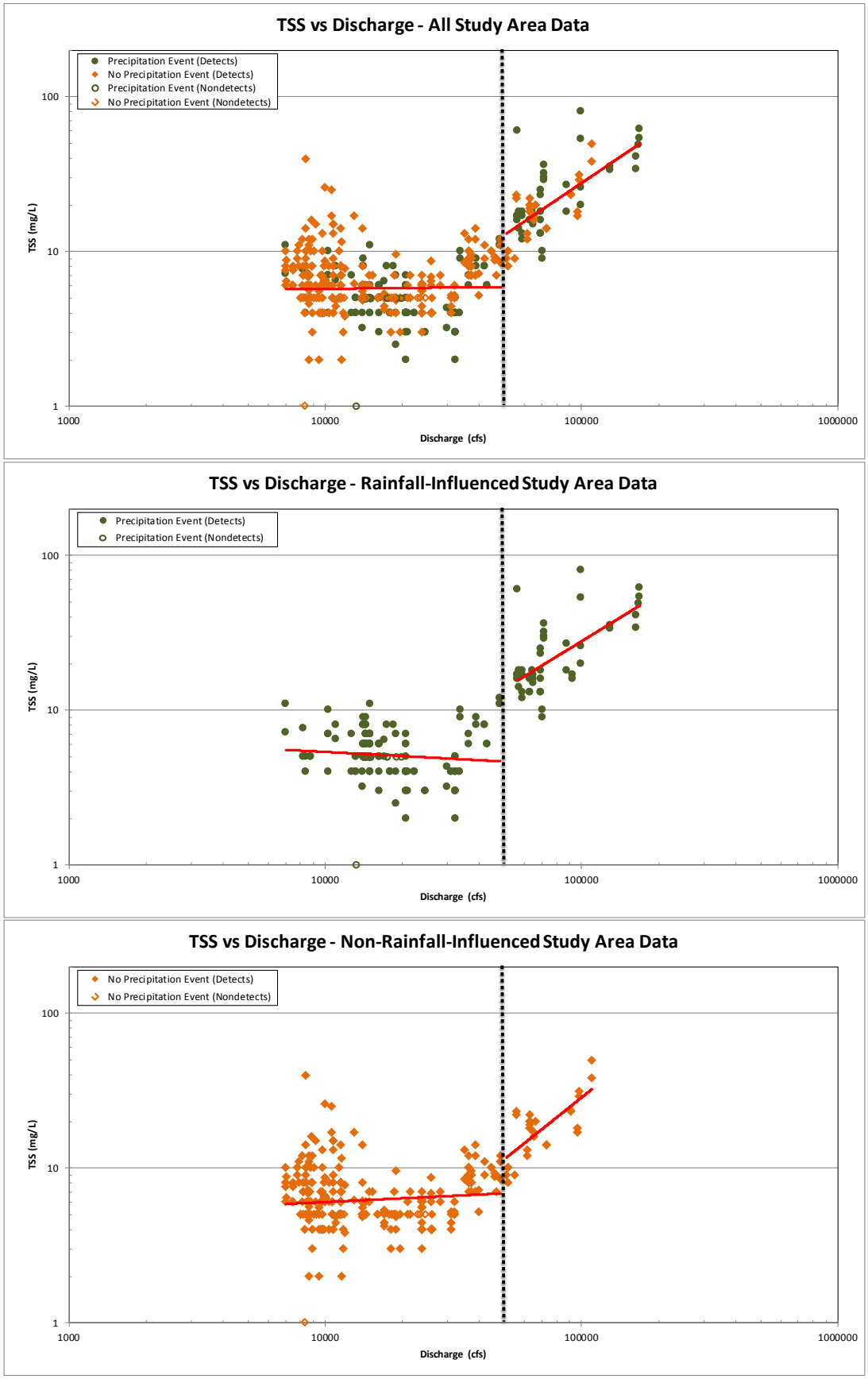


Figure 3.1-28
Portland Harbor RI/FS
Remedial Investigation Report
TSS vs. Discharge – Study Area Data

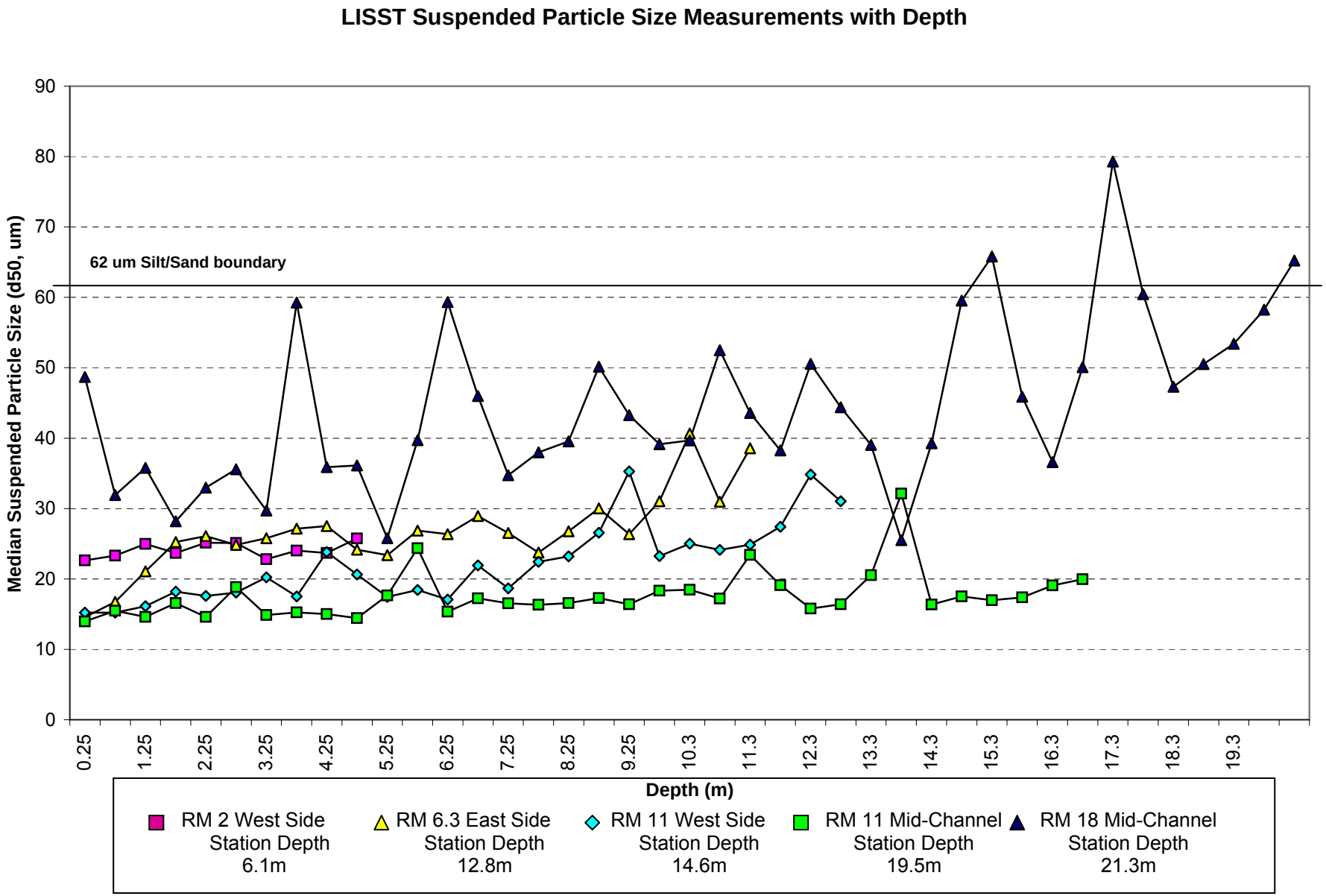


Figure 3.1-29
Portland Harbor RI/FS
Remedial Investigation Report
LISST Suspended Particle Size
Measurements with Depth

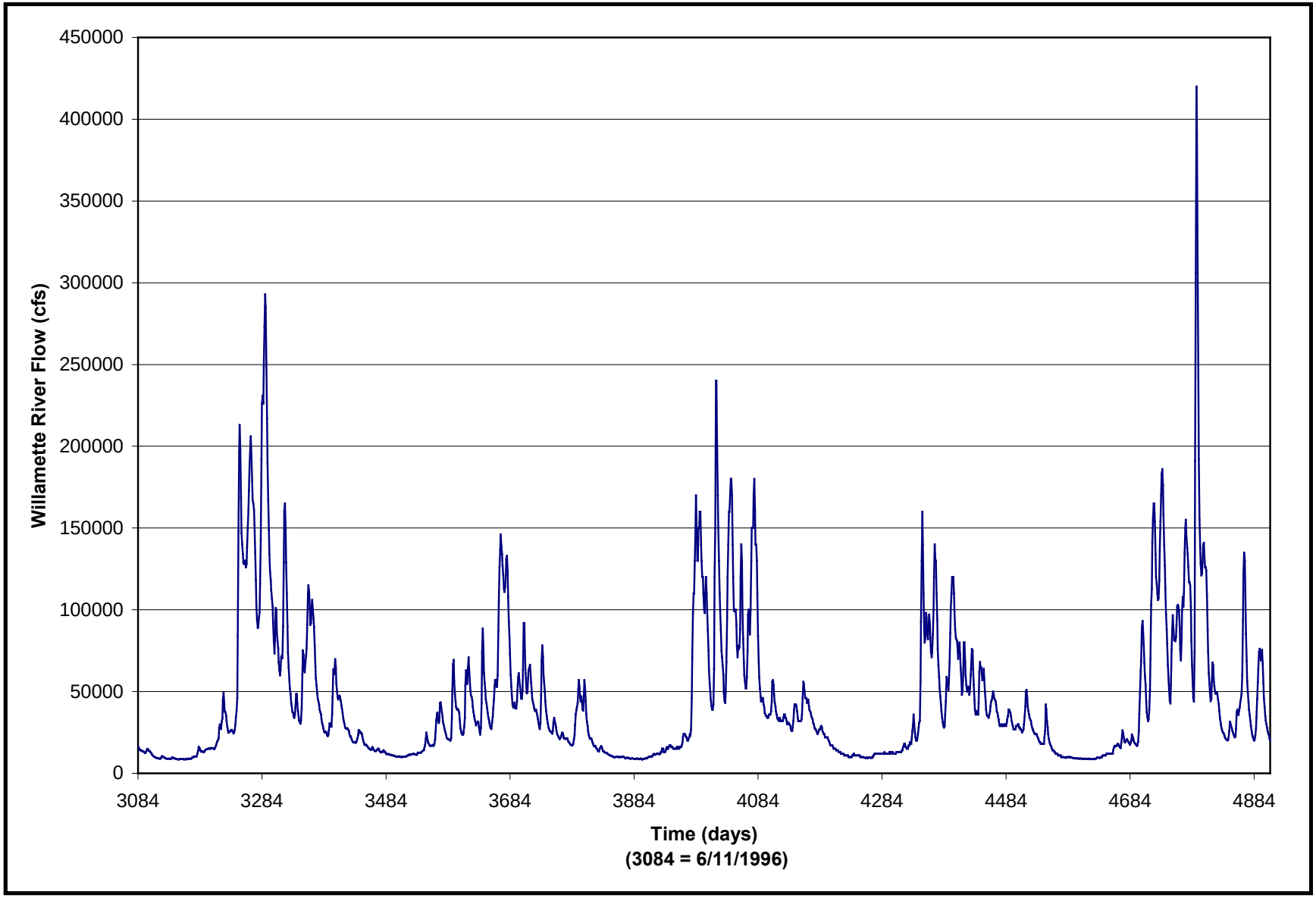
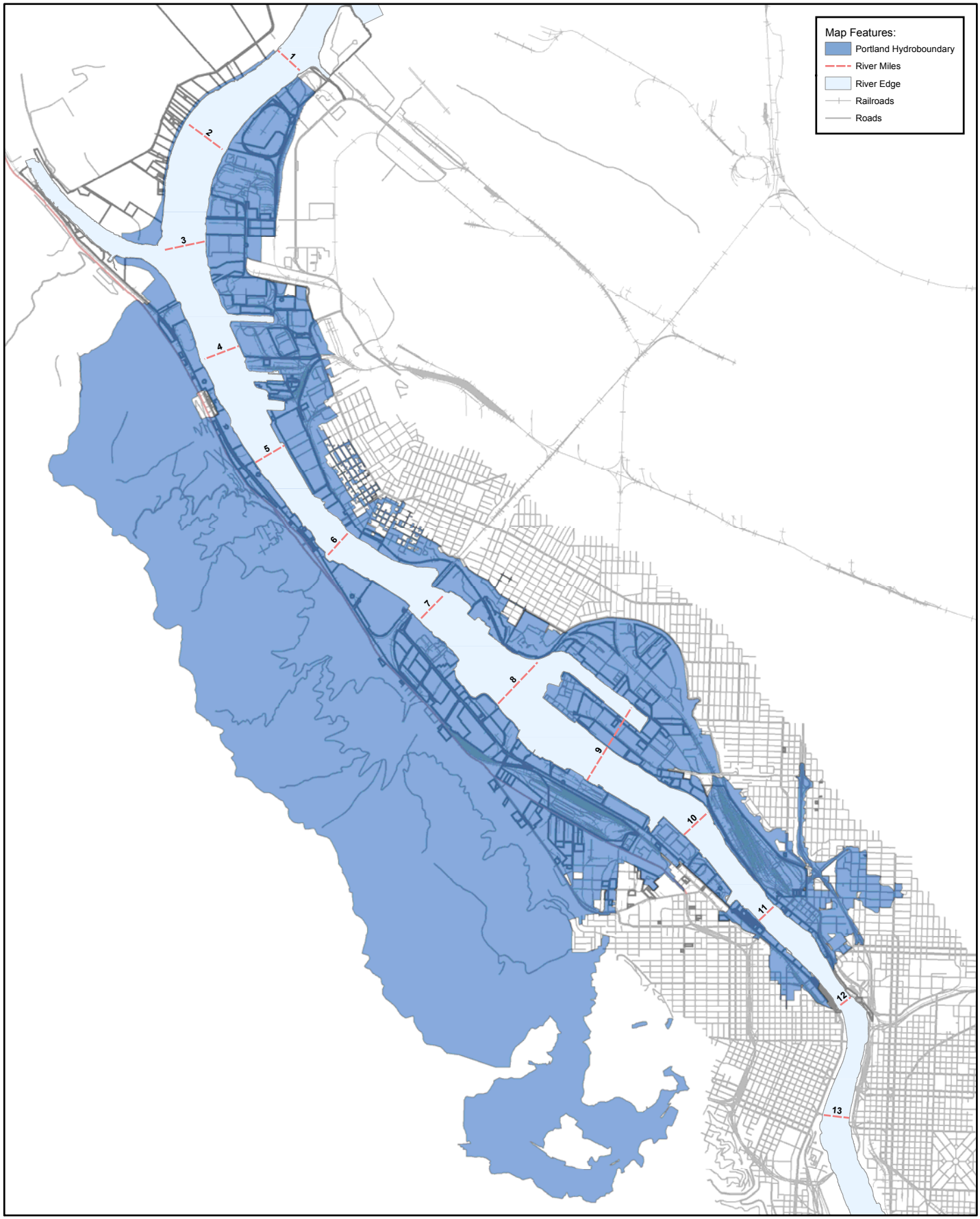


Figure 3.1-30
Portland Harbor RI/FS
Remedial Investigation Report
Five-year High-flow Flood Scenario Hydrograph



FEATURE SOURCES:
Land Use/Zoning, Streams, Water Bodies: Metro RLIS.
Channel & River miles: US Army Corps of Engineers.

N

0 3,000 6,000 Feet

Figure 3.2-1
Portland Harbor RI/FS
Remedial Investigation Report
Stormwater Basin Hydroboundary
River Miles 1-11.8

TYPES OF CONVEYANCE SYSTEMS

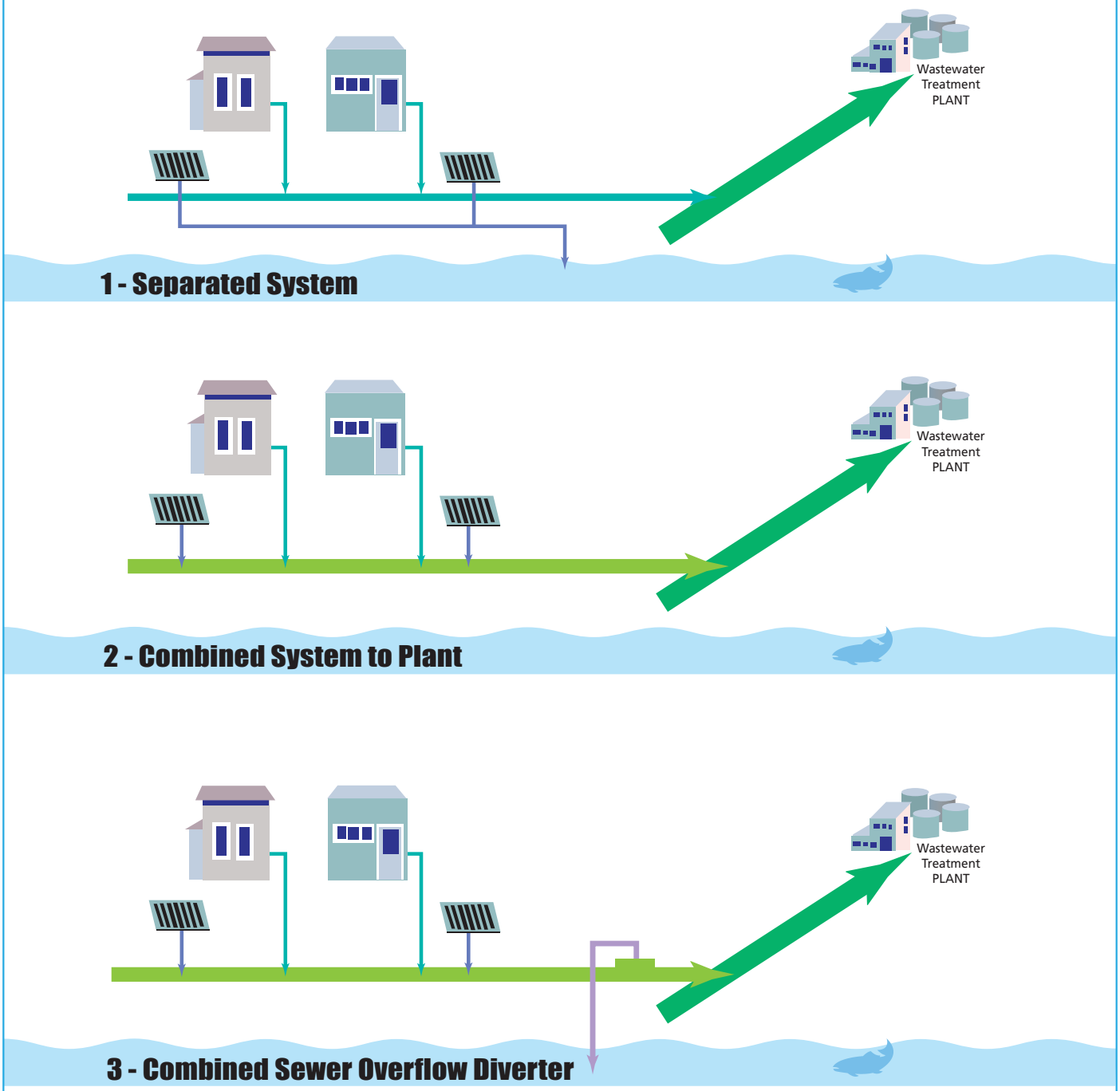


Figure 3.2-2
Portland Harbor RI/FS
Remedial Investigation Report
Types of Conveyance Systems

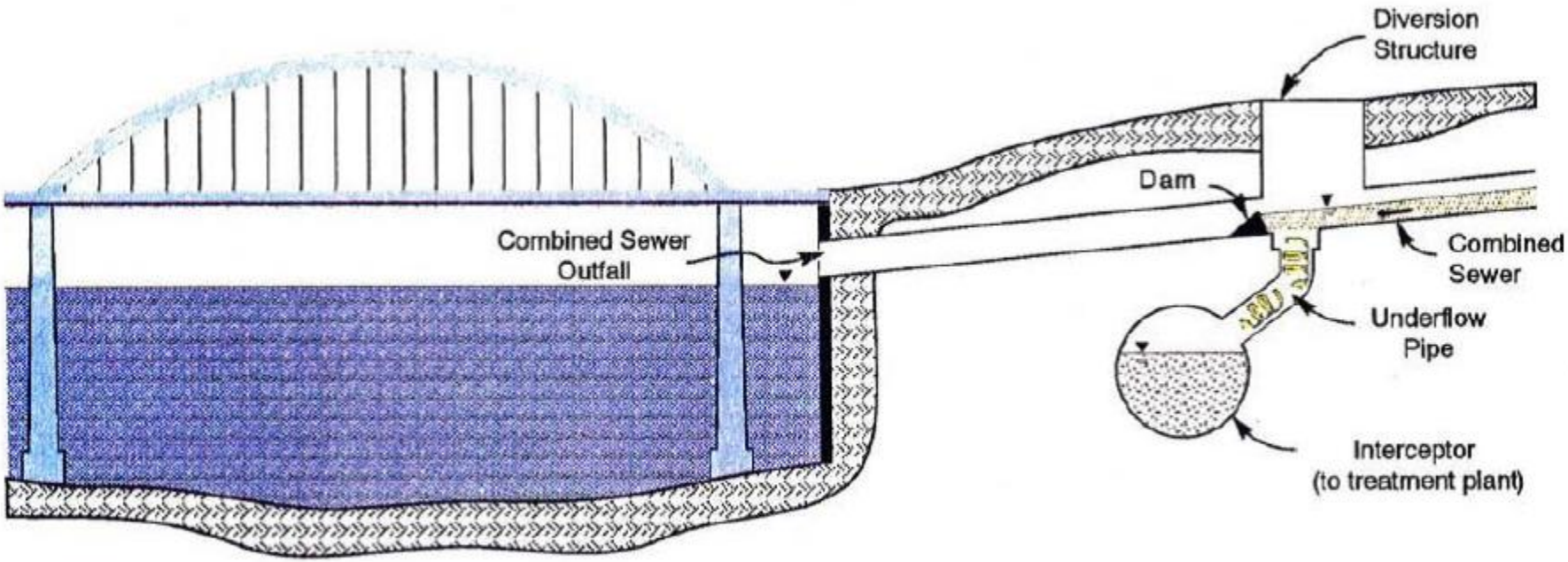


Figure 3.2-3
Portland Harbor RI/FS
Remedial Investigation Report
CSO Design

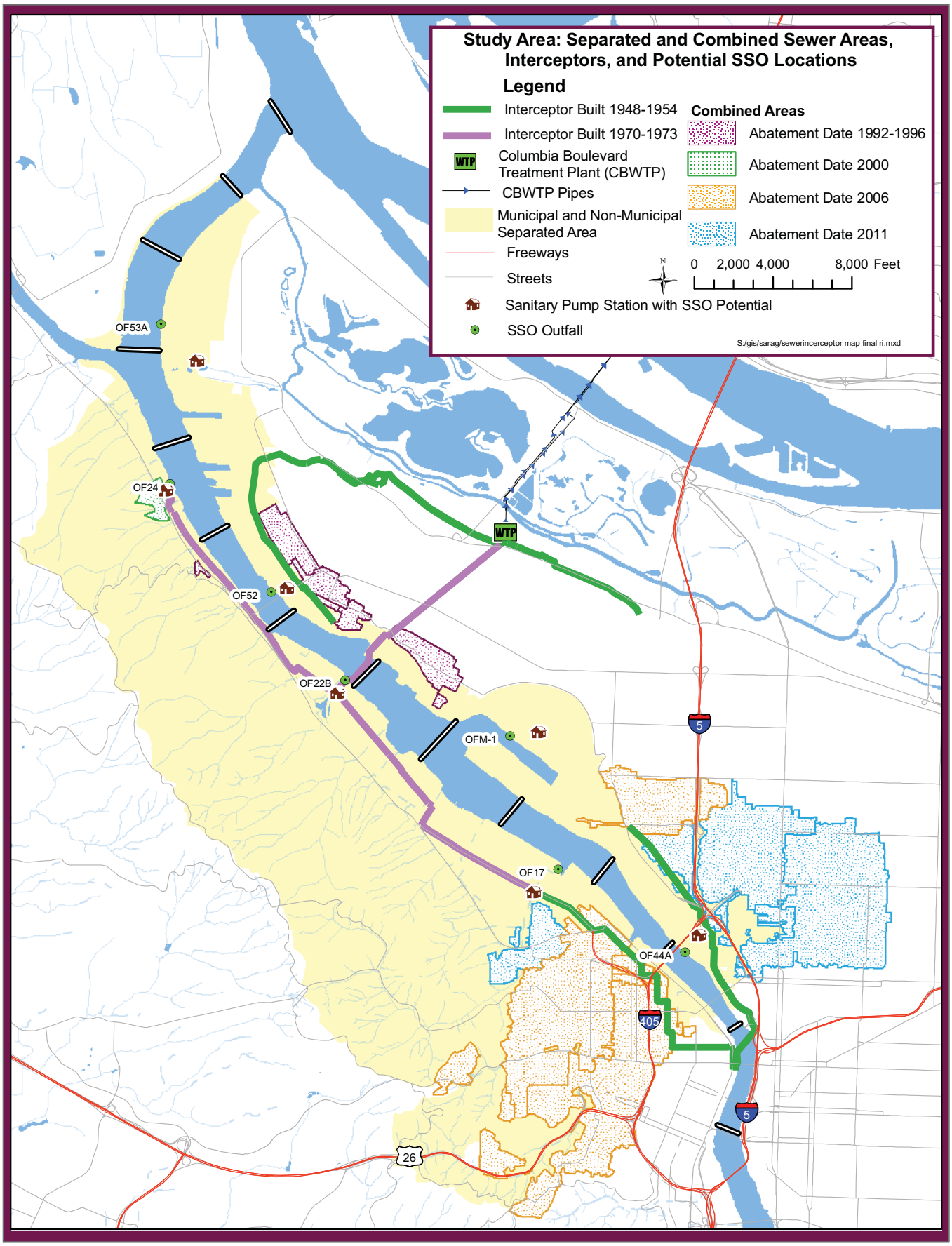


Figure 3.2-4
Portland Harbor RI/FS
Remedial Investigation Report
Separate and Combined Sewer Systems and
Interceptor Facilities and Potential SSO Locations

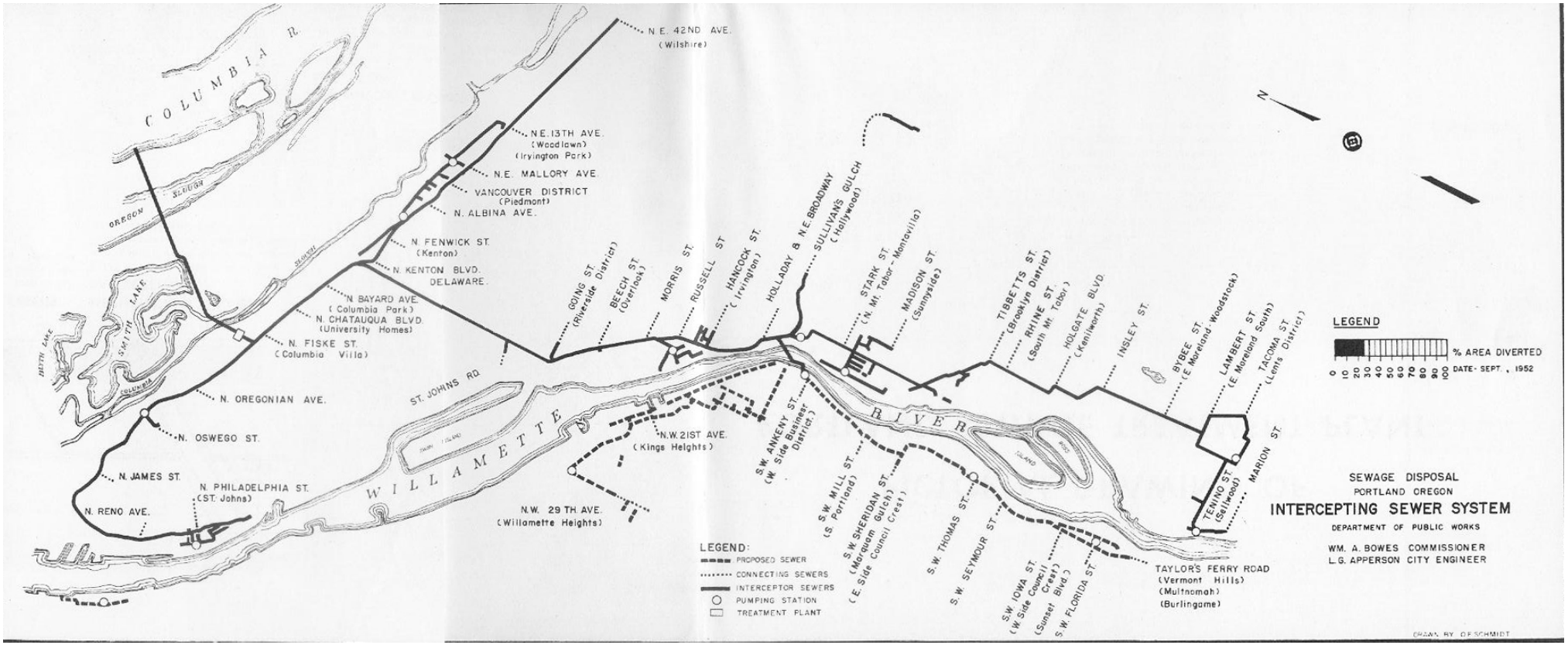


Figure 3.2-5
Portland Harbor RI/FS
Remedial Investigation Report
Intercepting Sewer System - 1952

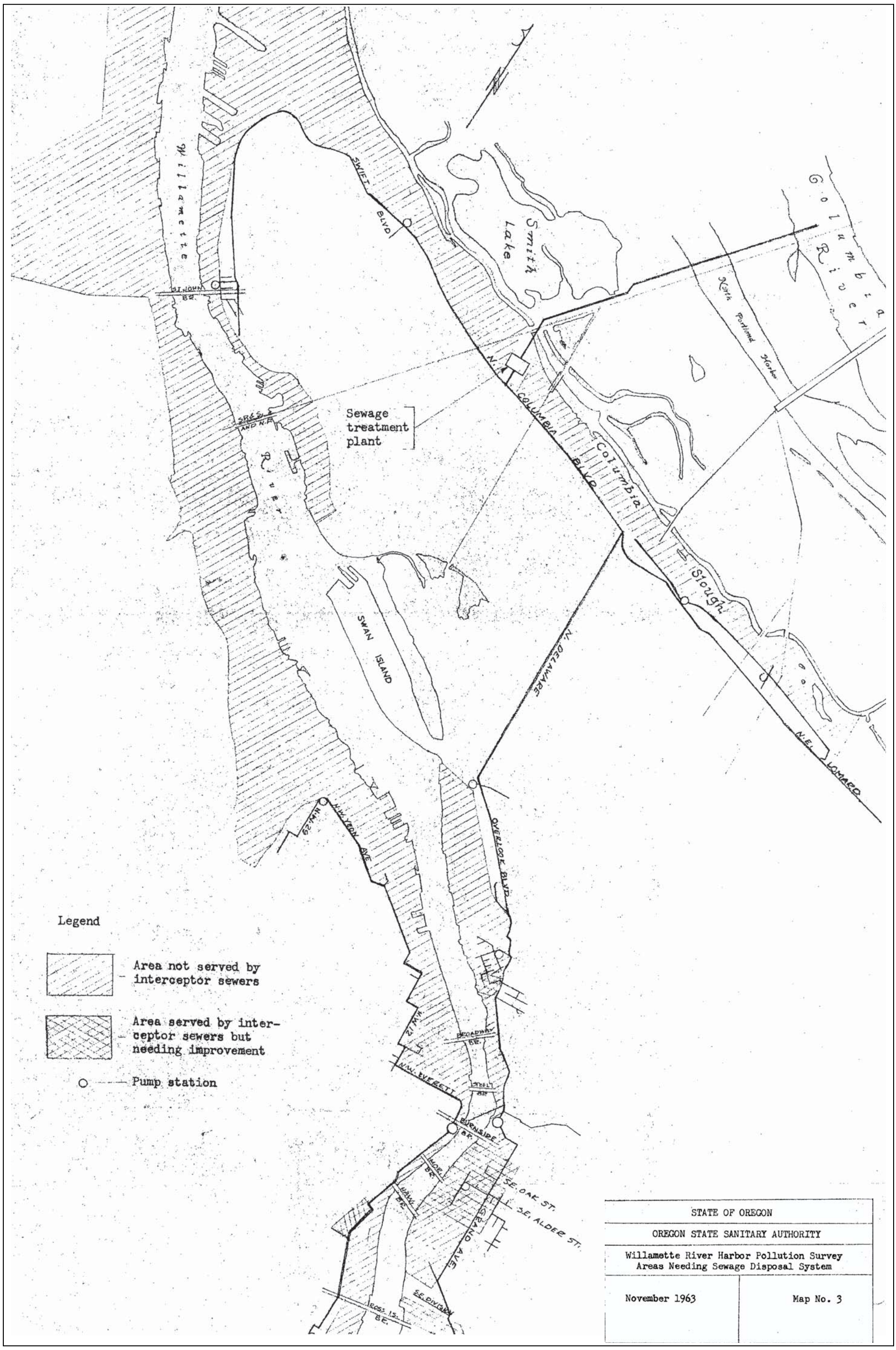


Figure 3.2-6
Portland Harbor RI/FS
Remedial Investigation Report
Willamette River Harbor Pollution Survey Areas
Needing Sewage Disposal System (OSSA 1963)