Lower Duwamish Waterway Group

Port of Seattle / City of Seattle / King County / The Boeing Company

Lower Duwamish Waterway Remedial Investigation

DATA REPORT: ROUND 2 SURFACE SEDIMENT SAMPLING FOR CHEMICAL ANALYSES AND TOXICITY TESTING MAP FOLIO –FINAL

For submittal to:

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

The Washington State Department of Ecology
Northwest Regional Office
Bellevue, WA

December 9, 2005

Prepared by: Windward environmental LLC

200 West Mercer Street, Suite 401 ♦ Seattle, Washington ♦ 98119

List of Figures

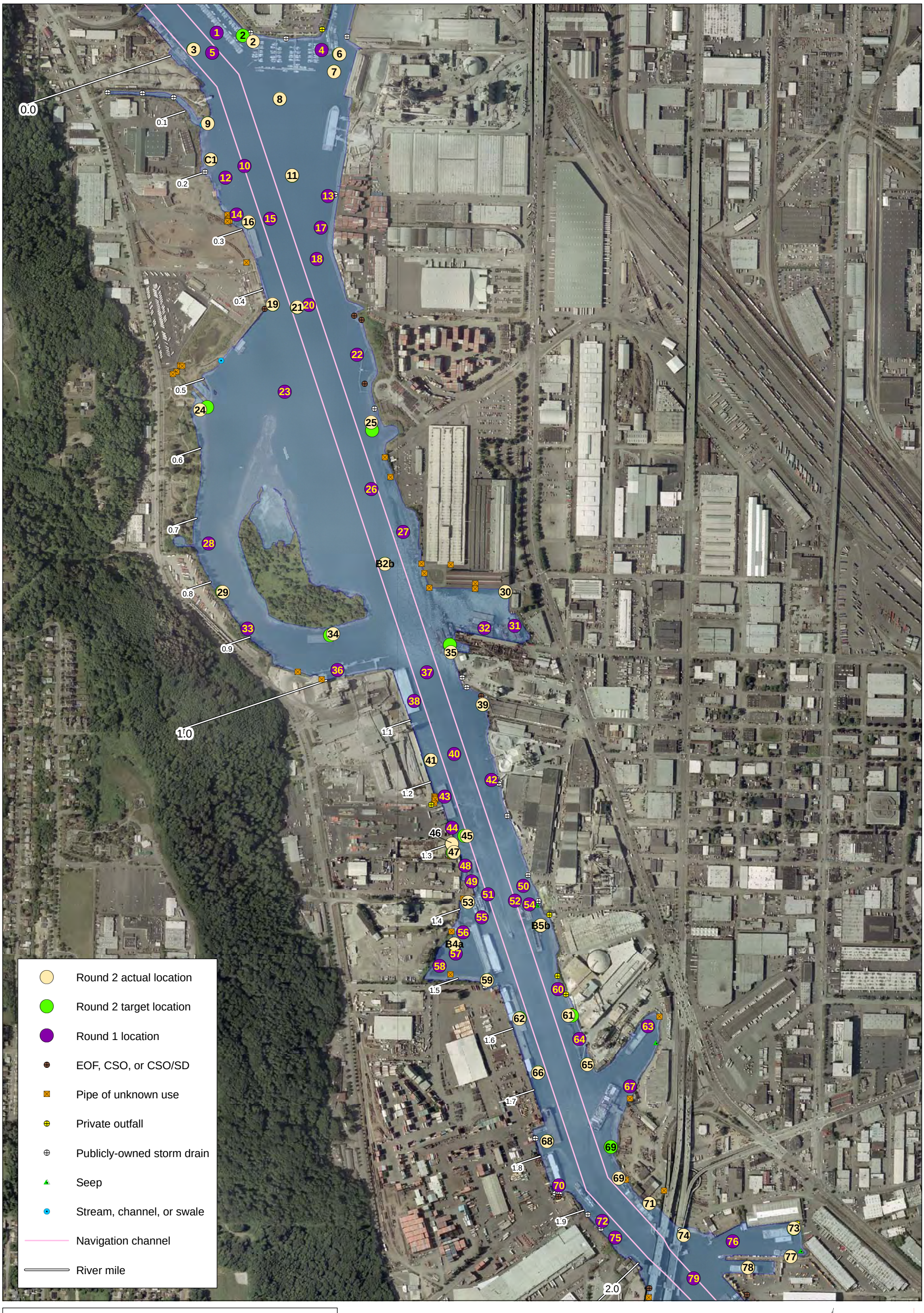


Figure 2-1a. Phase 2 (Rounds 1 and 2) target and actual surface sediment sampling locations (RM 0.0-2.0)

Prepared by STS 12/15/05 Map 1894

The locations of outfalls and other pipes shown on this figure were identified during a City of Seattle survey conducted during May-June 2003 (Herrera 2004). As part of the survey, the locations of permitted outfalls were first identified using available drainage and outfall maps for waterfront properties obtained from the Washington Department of Ecology National Pollutant Discharge Elimination System (NPDES) permit files. Outfalls and pipes that were observed in the field during low tides were then surveyed in the field to establish their locations. The status of permitted outfalls is currently being verified by the Lower Duwamish Waterway Group (LDWG) through interviews with agency personnel and individual LDWG members' staff, as appropriate. In the future, known outfalls will be designated as either "combined sewer overflow, combined sewer overflow/storm drains, or emergency overflows;" "publicly-owned storm drains;" or "private outfalls." Private outfalls will include two categories: 1) NPDES-permitted outfalls (e.g., storm drains, non-contact cooling water, process wastewater), and 2) other outfalls that are not included under an active NPDES permit. Outfalls whose discharge has been terminated and that are no longer included under an active NPDES permit will be identified as "formerly permitted outfalls." Pipes that cannot be identified as an outfall through agency permit file records review will be identified as "pipes of unknown use." A comprehensive survey of property owners will not be conducted.

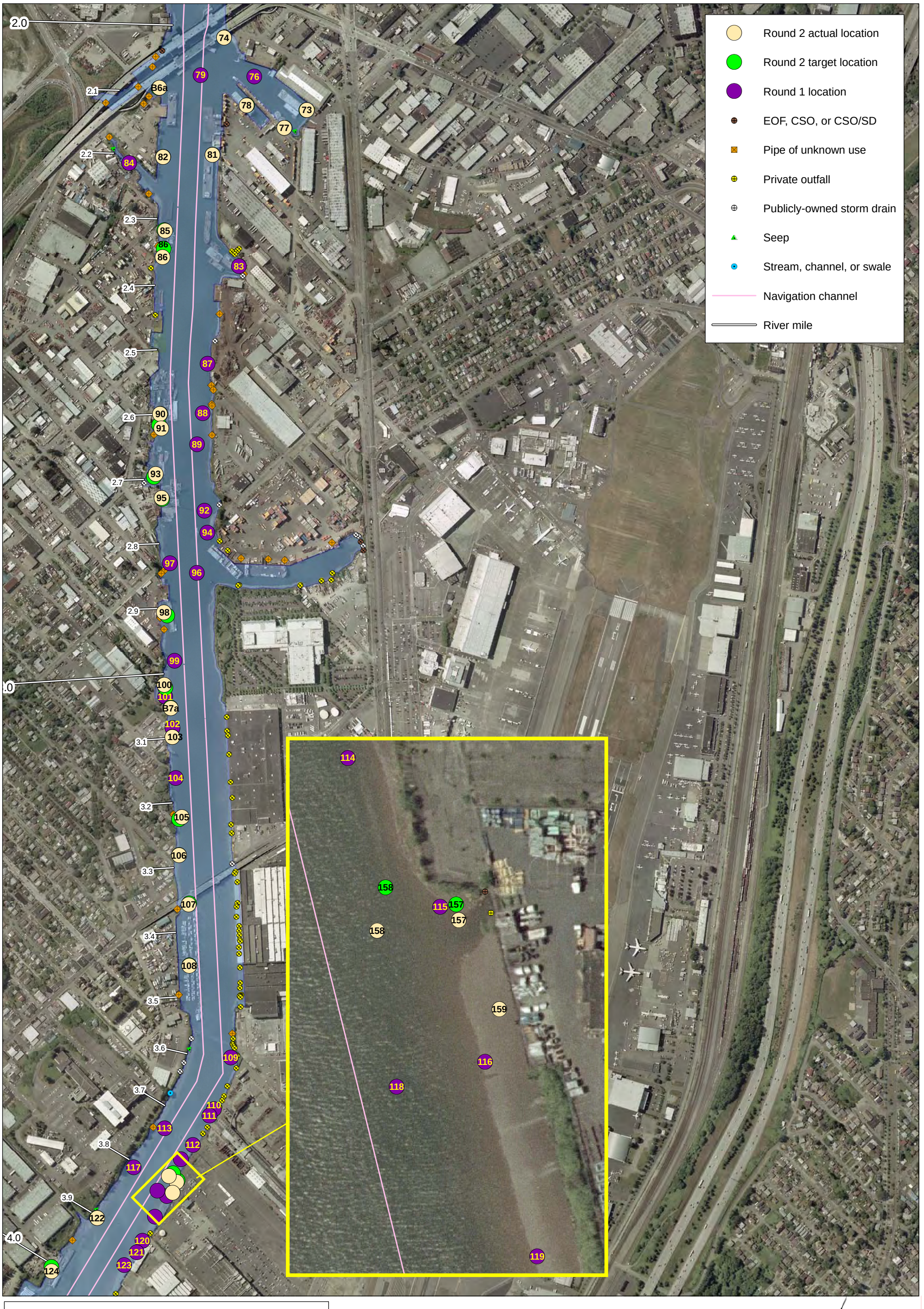


Figure 2-1b. Phase 2 (Rounds 1 and 2) target and actual surface sediment sampling locations (RM 2.0-4.0)

0 0.2 Miles

0 0.2 Kilometers

Wind Ward environmental LLC

Prepared by STS 12/15/05 Map 1894

The locations of outfalls and other pipes shown on this figure were identified during a City of Seattle survey conducted during May-June 2003 (Herrera 2004). As part of the survey, the locations of permitted outfalls were first identified using available drainage and outfall maps for waterfront properties obtained from the Washington Department of Ecology National Pollutant Discharge Elimination System (NPDES) permit files. Outfalls and pipes that were observed in the field during low tides were then surveyed in the field to establish their locations. The status of permitted outfalls is currently being verified by the Lower Duwamish Waterway Group (LDWG) through interviews with agency personnel and individual LDWG members' staff, as appropriate. In the future, known outfalls will be designated as either "combined sewer overflow, combined sewer overflow/storm drains, or emergency overflows;" "publicly-owned storm drains;" or "private outfalls." Private outfalls will include two categories: 1) NPDES-permitted outfalls (e.g., storm drains, non-contact cooling water, process wastewater), and 2) other outfalls that are not included under an active NPDES permit. Outfalls whose discharge has been terminated and that are no longer included under an active NPDES permit will be identified as "formerly permitted outfalls." Pipes that cannot be identified as an outfall through agency permit file records review will be identified as "pipes of unknown use." A comprehensive survey of property owners will not be conducted.

Figure 2-1c. Phase 2 (Rounds 1 and 2) target and actual surface sediment sampling locations (RM 4.0-5.8)

Prepared by STS 12/15/05 Map 1894

The locations of outfalls and other pipes shown on this figure were identified during a City of Seattle survey conducted during May-June 2003 (Herrera 2004). As part of the survey, the locations of permitted outfalls were first identified using available drainage and outfall maps for waterfront properties obtained from the Washington Department of Ecology National Pollutant Discharge Elimination System (NPDES) permit files. Outfalls and pipes that were observed in the field during low tides were then surveyed in the field to establish their locations. The status of permitted outfalls is currently being verified by the Lower Duwamish Waterway Group (LDWG) through interviews with agency personnel and individual LDWG members' staff, as appropriate. In the future, known outfalls will be designated as either "combined sewer overflow, combined sewer overflow/storm drains, or emergency overflows;" "publicly-owned storm drains;" or "private outfalls." Private outfalls will include two categories: 1) NPDES-permitted outfalls (e.g., storm drains, non-contact cooling water, process wastewater), and 2) other outfalls that are not included under an active NPDES permit. Outfalls whose discharge has been terminated and that are no longer included under an active NPDES permit will be identified as "formerly permitted outfalls." Pipes that cannot be identified as an outfall through agency permit file records review will be identified as "pipes of unknown use." A comprehensive survey of property owners will not be conducted.

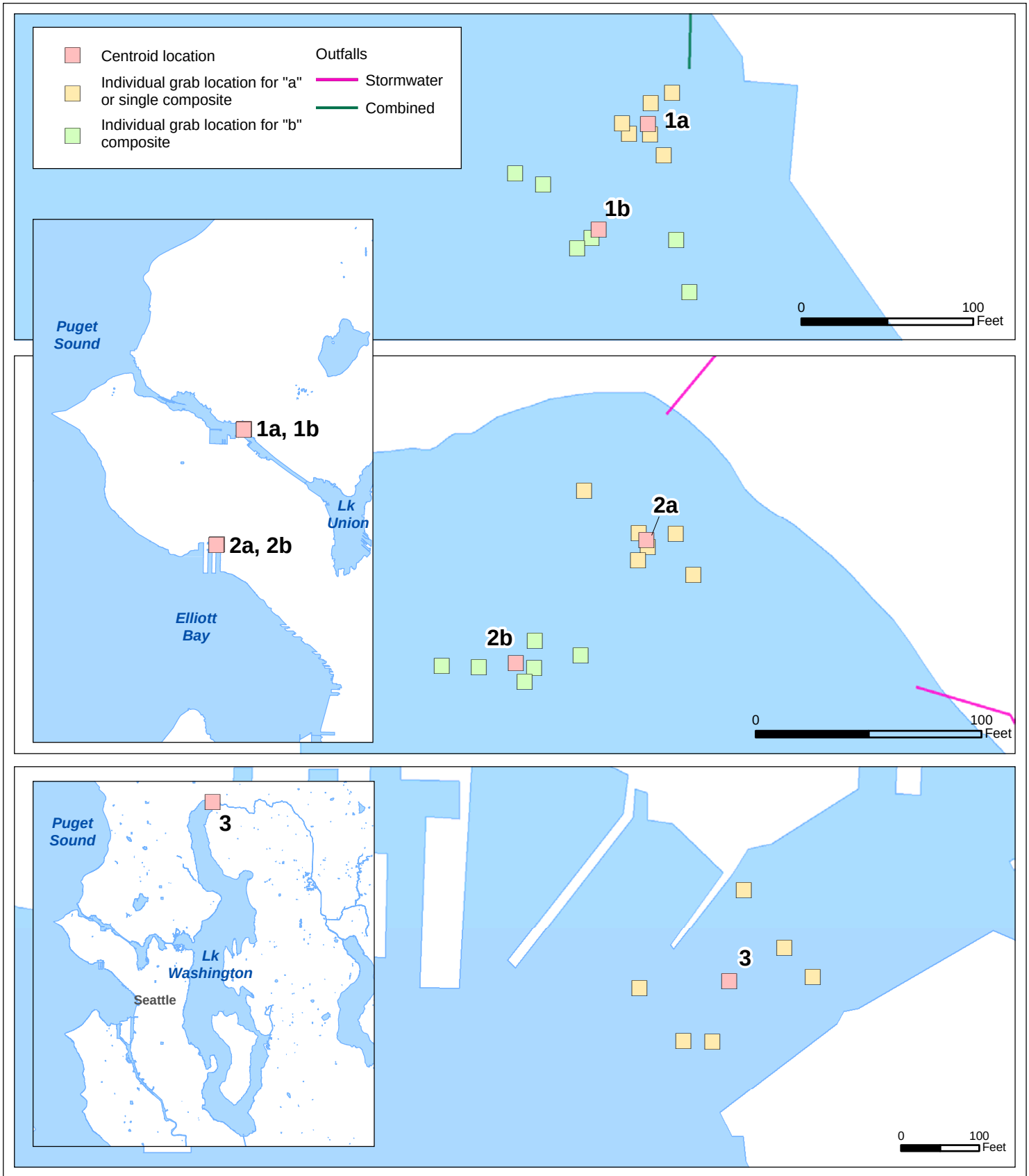


Figure 2-2a. Dioxin /furan sampling locations 1-3 in the greater Seattle area

N

Wind Ward environmental LLC

Prepared by STS 07/19/05, 22/09/05 Map 1916

W:\Projects\00-08-06_Duwamish_RI\data\gis\Surface Sediment\Dioxin furans\Background locations

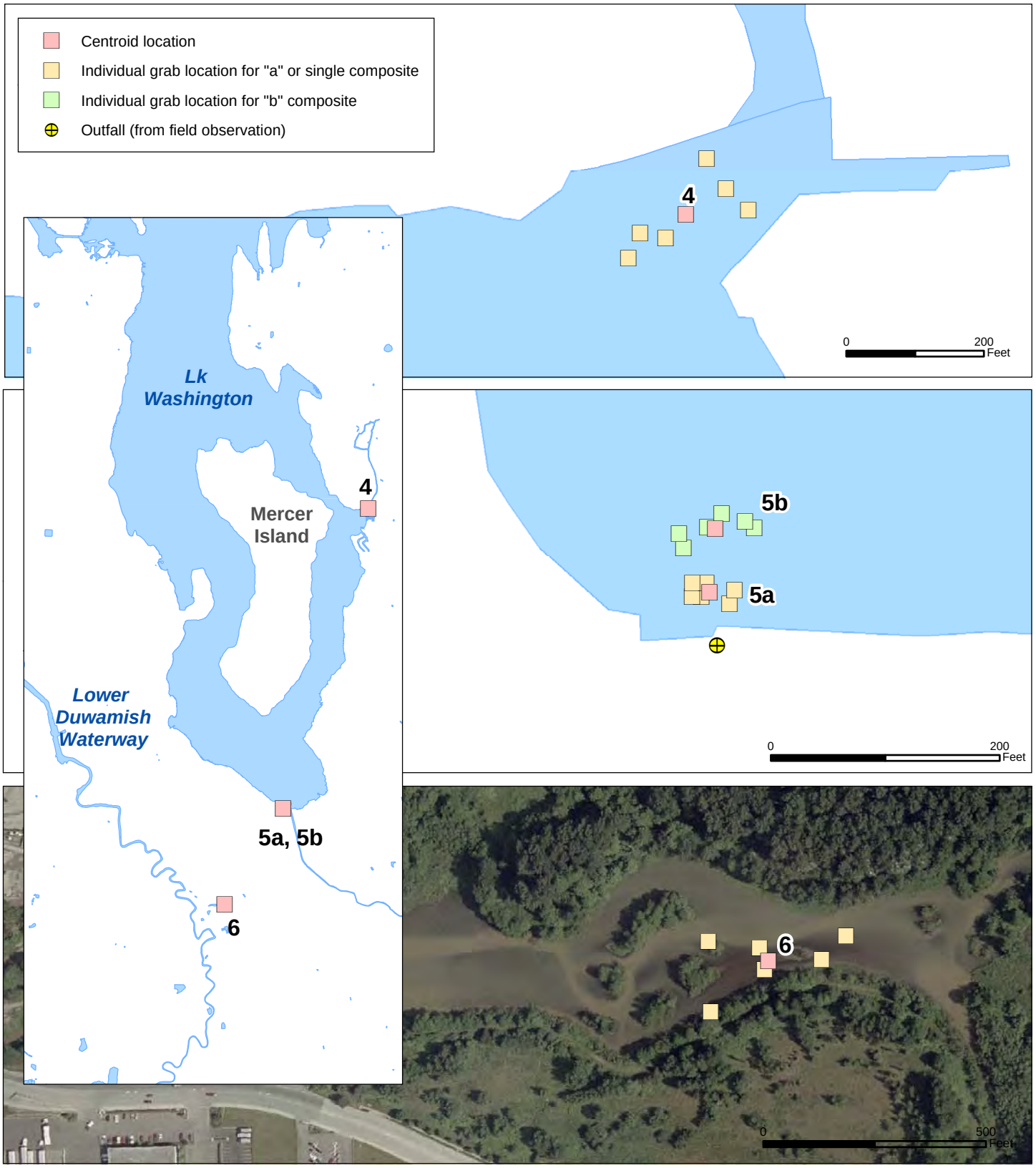


Figure 2-2b. Dioxin/furan sampling locations 4-6 in the greater Seattle area

Wind Ward environmental LLC

Prepared by STS 07/19/05,12/09/05 Map 1916

W:\Projects\00-08-06_Duwamish_RI\data\gis\Surface Sediment\Dioxin furans\Background locations

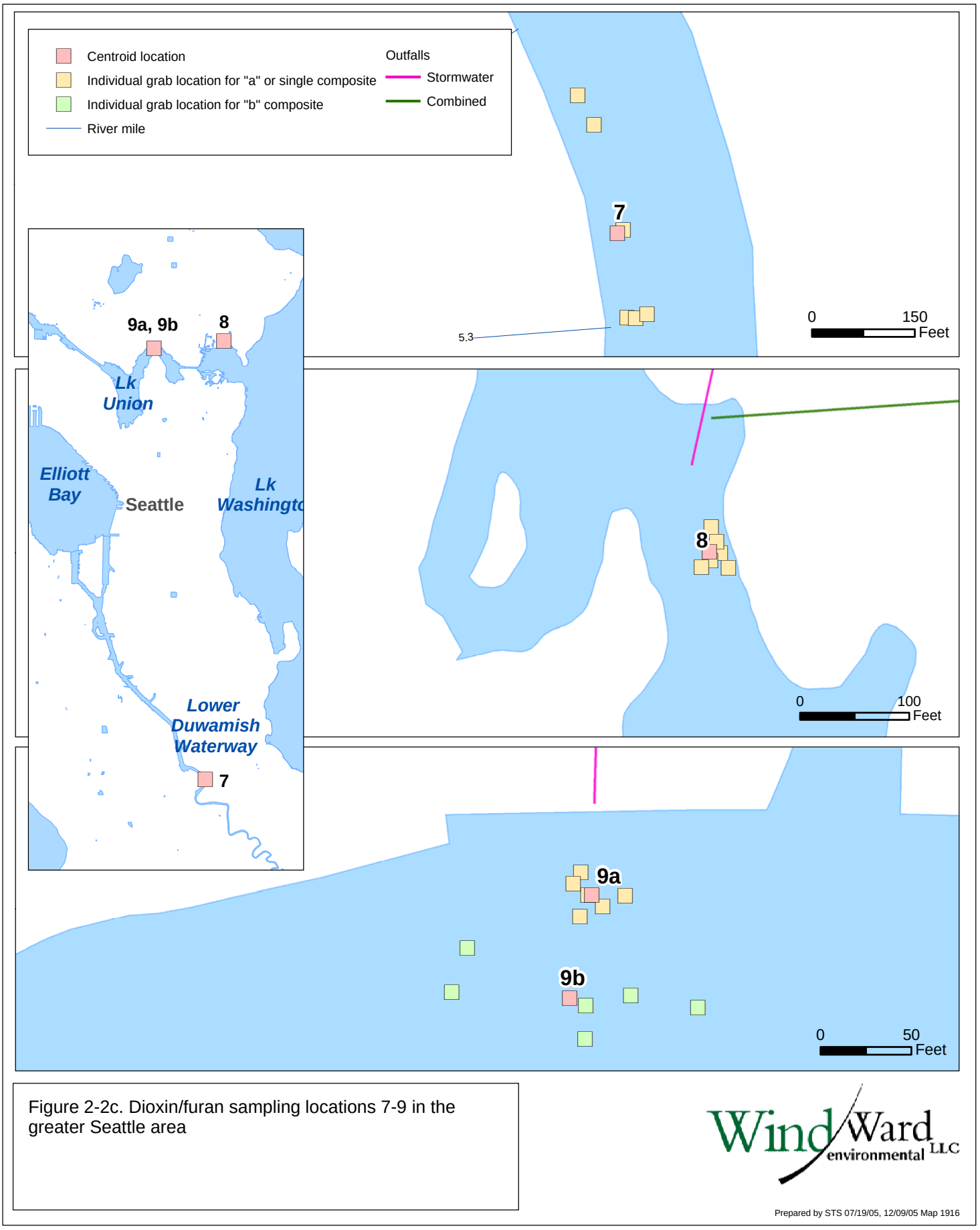


Figure 2-2c. Dioxin/furan sampling locations 7-9 in the greater Seattle area

Wind Ward environmental LLC

Prepared by STS 07/19/05, 12/09/05 Map 1916

W:\Projects\00-08-06_Duwamish_RI\data\gis\Surface Sediment\Dioxin furans\Background locations

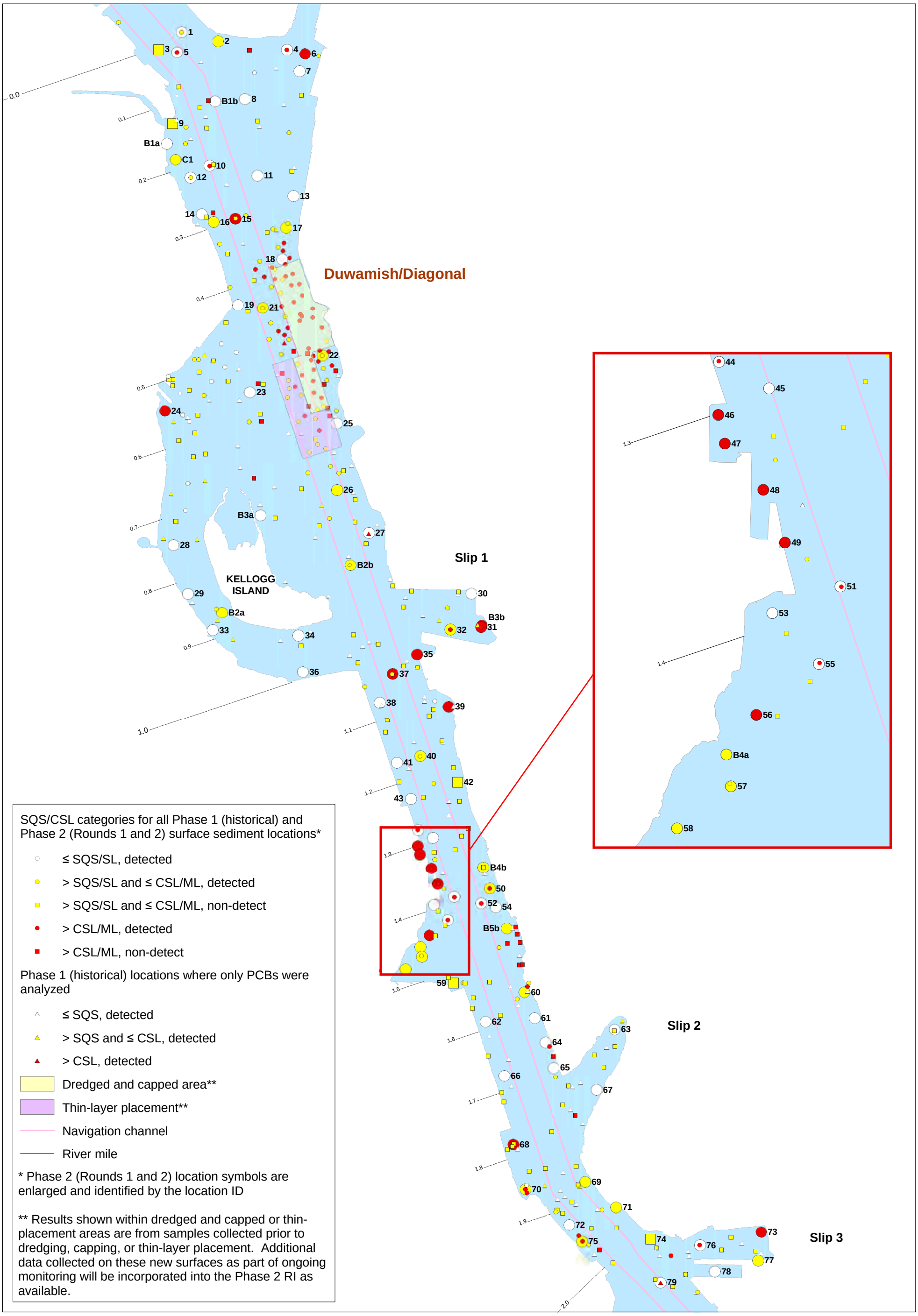


Figure 5-1a. Exceedances of SQS/SL or CSL/ML by all chemicals in surface sediments at Phase 1 (historical) and Phase 2 (Rounds 1 and 2) locations (RM 0.0-2.0)

W:\Projects\00-08-06_Duwamish_RI\data\gis\Surface Sediment\Rd1Rd2chemistry

Slip 3

Slip 4

SQS/CSL categories for all Phase 1 (historical) and Phase 2 (Rounds 1 and 2) surface sediment locations*

- ≤ SQS/SL, detected
- > SQS/SL and ≤ CSL/ML, detected
- > SQS/SL and ≤ CSL/ML, non-detect
- > CSL/ML, detected
- > CSL/ML, non-detect

Phase 1 (historical) locations where only PCBs were analyzed

- ≤ SQS, detected
- > SQS and ≤ CSL, detected
- > CSL, detected
- Navigation channel
- River mile

* Phase 2 (Rounds 1 and 2) location symbols are enlarged and identified by the location ID

Figure 5-1b. Exceedances of SQS/SL or CSL/ML by all chemicals in surface sediments at Phase 1 (historical) and Phase 2 (Rounds 1 and 2) locations (RM 2.0-4.0)

0 0.2 Miles

0 0.2 Kilometers

N

Wind Ward environmental LLC

Prepared by STS 12/07/05 Map 2018

W:\Projects\00-08-06_Duwamish_RI\data\gis\Surface Sediment\Rd1Rd2chemistry

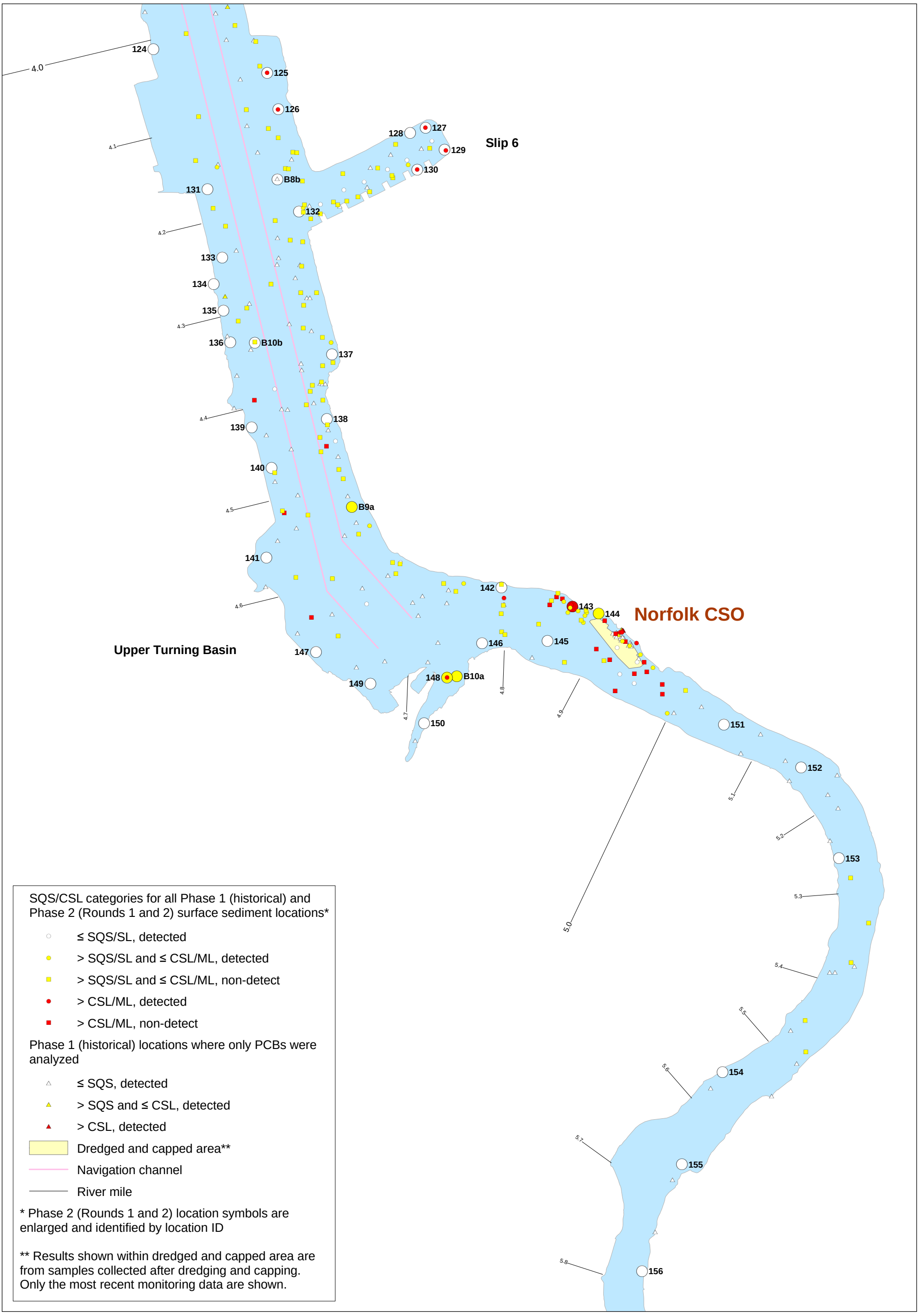


Figure 5-1c. Exceedances of SQS/SL or CSL/ML by all chemicals in surface sediments at Phase 1 (historical) and Phase 2 (Rounds 1 and 2) locations (RM 4.0-5.8)

0 0.2 Miles

0 0.2 Kilometers

N

Wind Ward environmental LLC

Prepared by STS 12/15/05 Map 2018

W:\Projects\00-08-06_Duwamish_RI\data\gis\Surface Sediment\Rd1Rd2chemistry

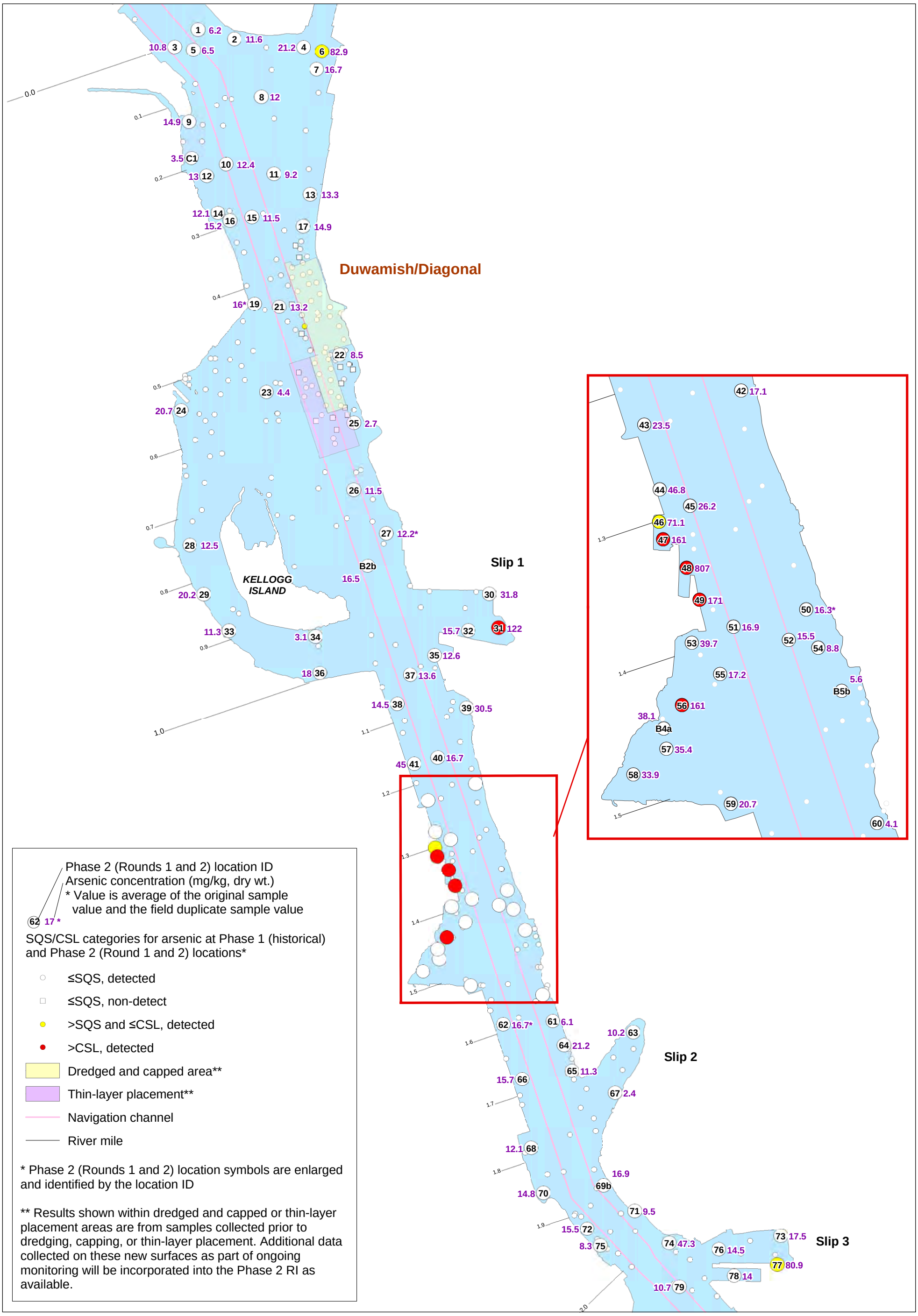


Figure 5-2a. Exceedances of SQS or CSL by arsenic concentrations in surface sediments at Phase 1 (historical) and Phase 2 (Rounds 1 and 2) locations (RM 0.0-2.0)

W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2\Surface Update 04-05\Arsenic

Slip 3

Slip 4

Phase 2 (Rounds 1 and 2) location ID
Arsenic concentration (mg/kg dry wt.)
* Value is average of the original sample value and the field duplicate sample value

62 17*

SQS/CSL categories for arsenic at Phase 1 (historical) and Phase 2 (Round 1 and 2) locations*

- ≤SQS, detected
- ≤SQS, non-detect
- >SQS and ≤CSL, detected
- >CSL, detected
- Navigation channel
- River mile

* Phase 2 (Rounds 1 and 2) location symbols are enlarged and identified by the location ID

Figure 5-2b. Exceedances of SQS or CSL by arsenic concentrations in surface sediments at Phase 1 (historical) and Phase 2 (Rounds 1 and 2) locations (RM 2.0-4.0)

0 0.2 Miles

0 0.2 Kilometers

Wind Ward environmental LLC

Prepared by STS 11/04/05, 12/07/05 (formerly 1964) Map 2037

W:\Projects\00-08-06_Duwamish_RI\data\gis\Surface Sediment\Arsenic

Slip 6

Norfolk CSO

Upper Turning Basin

4.0
4.8 124
8.6 125
7.3 126
4.1
128 127 13.2
26.2
129 10.6
15 130
10* 131
15.8 132
4.2
10 133
3.5 134
9.8 135
4.3
5.6 136
13.2 137
4.4
7.5 138
6.8 139
5 140
4.5
5.9 B9a
6.7 141
4.6
10.5 142
8.8 143
144
3.4
8.7 147
7.1 146
4.5 145
6.4 149
15.6 148
4.7
4.8
4.9
5.8 150
4.1 151
4.7 152
5.1
5.2
6.3 153
5.3
5.0
5.4
5.5
5.6
7.3 154
5.7
5.4 155
5.8
3.3 156

62 17*
Phase 2 (Rounds 1 and 2) location ID
Arsenic concentration (mg/kg, dry wt.)
* Value is average of the original sample value and the field duplicate sample value

SQS/CSL categories for arsenic at Phase 1 (historical) and Phase 2 (Rounds 1 and 2) surface sediment locations*

- ≤SQS, detected
- ≤SQS, non-detect
- >SQS and ≤CSL, detected
- >CSL, detected
- Dredged and capped area**
- Navigation channel
- River mile

* Phase 2 (Rounds 1 and 2) location symbols are enlarged and identified by the location ID

** Results shown within dredged and capped area are from samples collected after dredging and capping. Only the most recent monitoring data are shown.

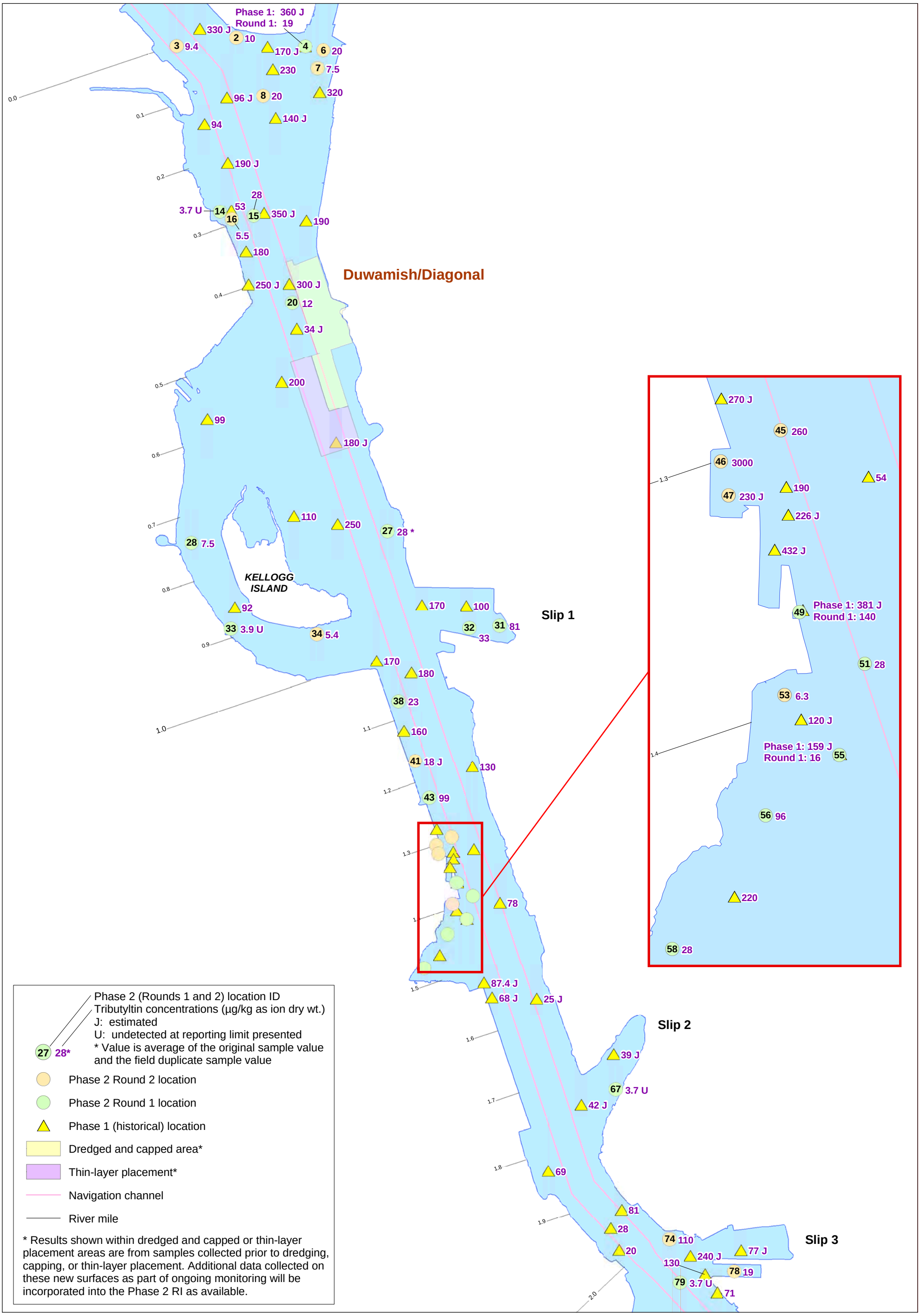
Figure 5-2c. Exceedances of SQS or CSL by arsenic concentrations in surface sediments at Phase 1 (historical) and Phase 2 (Rounds 1 and 2) locations (RM 4.0-5.8)

0 0.2 Miles
0 0.2 Kilometers
N

Wind Ward environmental LLC

Prepared by STS 12/15/05 (formerly 1964) Map 2037

W:\Projects\00-08-06_Duwamish_RI\data\gis\Surface Sediment\Arsenic



Phase 2 (Rounds 1 and 2) location ID
Tributyltin concentrations (µg/kg as ion dry wt.)
J: estimated
U: undetected at reporting limit presented
* Value is average of the original sample value and the field duplicate sample value

Phase 2 Round 2 location

Phase 1 (historical) location

Dredged and capped area*

Thin-layer placement*

Navigation channel

River mile

* Results shown within dredged and capped or thin-layer placement areas are from samples collected prior to dredging, capping, or thin-layer placement. Additional data collected on these new surfaces as part of ongoing monitoring will be incorporated into the Phase 2 RI as available.

Figure 5-3a. TBT concentrations in surface sediments at Phase 1 (historical) and Phase 2 (Rounds 1 and 2) locations (RM 0.0-2.0)

0 0.2 Miles

0 0.2 Kilometers

N

Wind Ward environmental LLC

Prepared by STS 12/15/05 Map 1898

W:\Projects\00-08-06_Duwamish_RI\data\gis\Surface Sediment\TBT

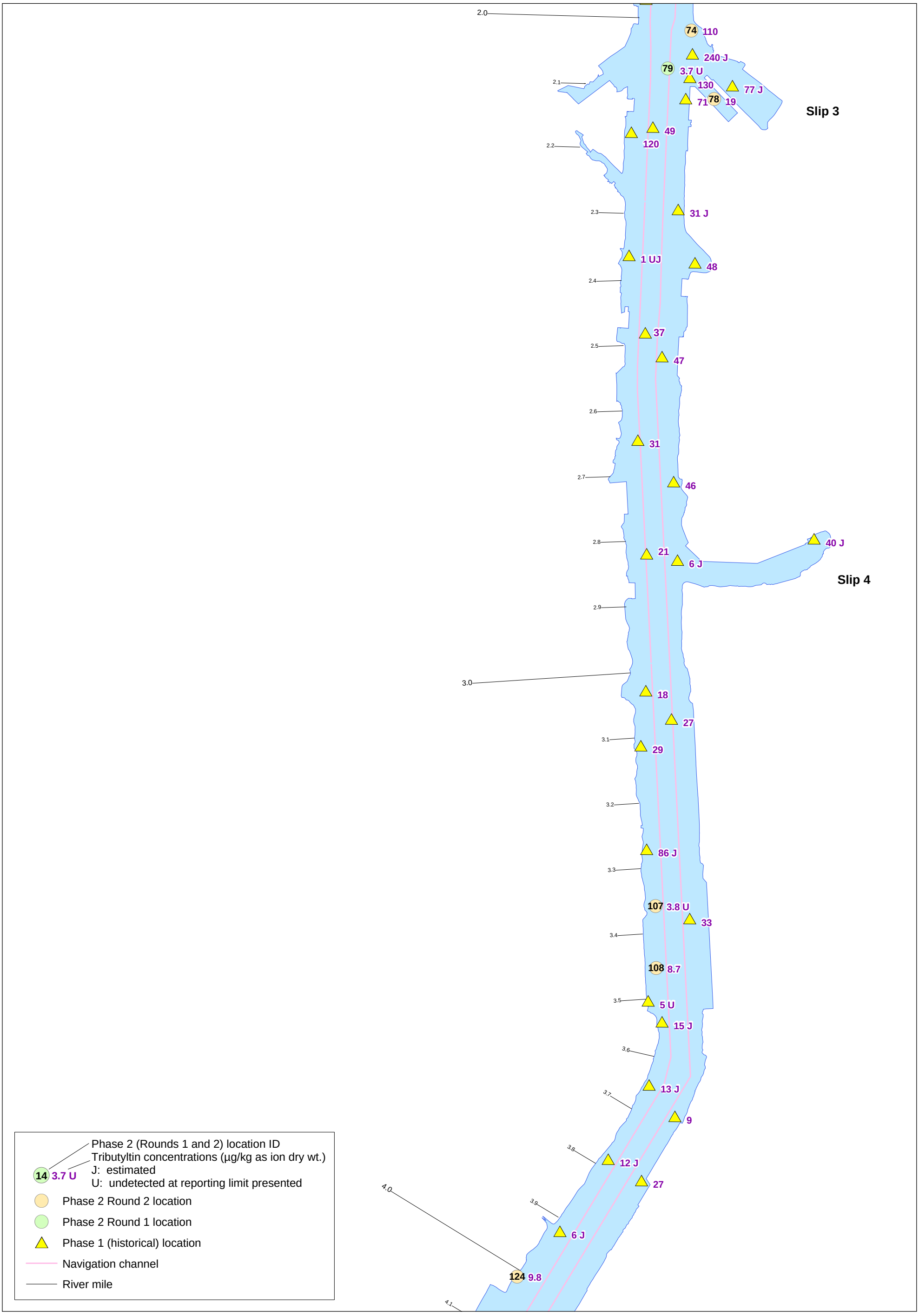


Figure 5-3b. TBT concentrations in surface sediments at Phase 1 (historical) and Phase 2 (Rounds 1 and 2) locations (RM 2.0-4.0)

W:\Projects\00-08-06_Duwamish_RI\data\gis\Surface Sediment\TBT

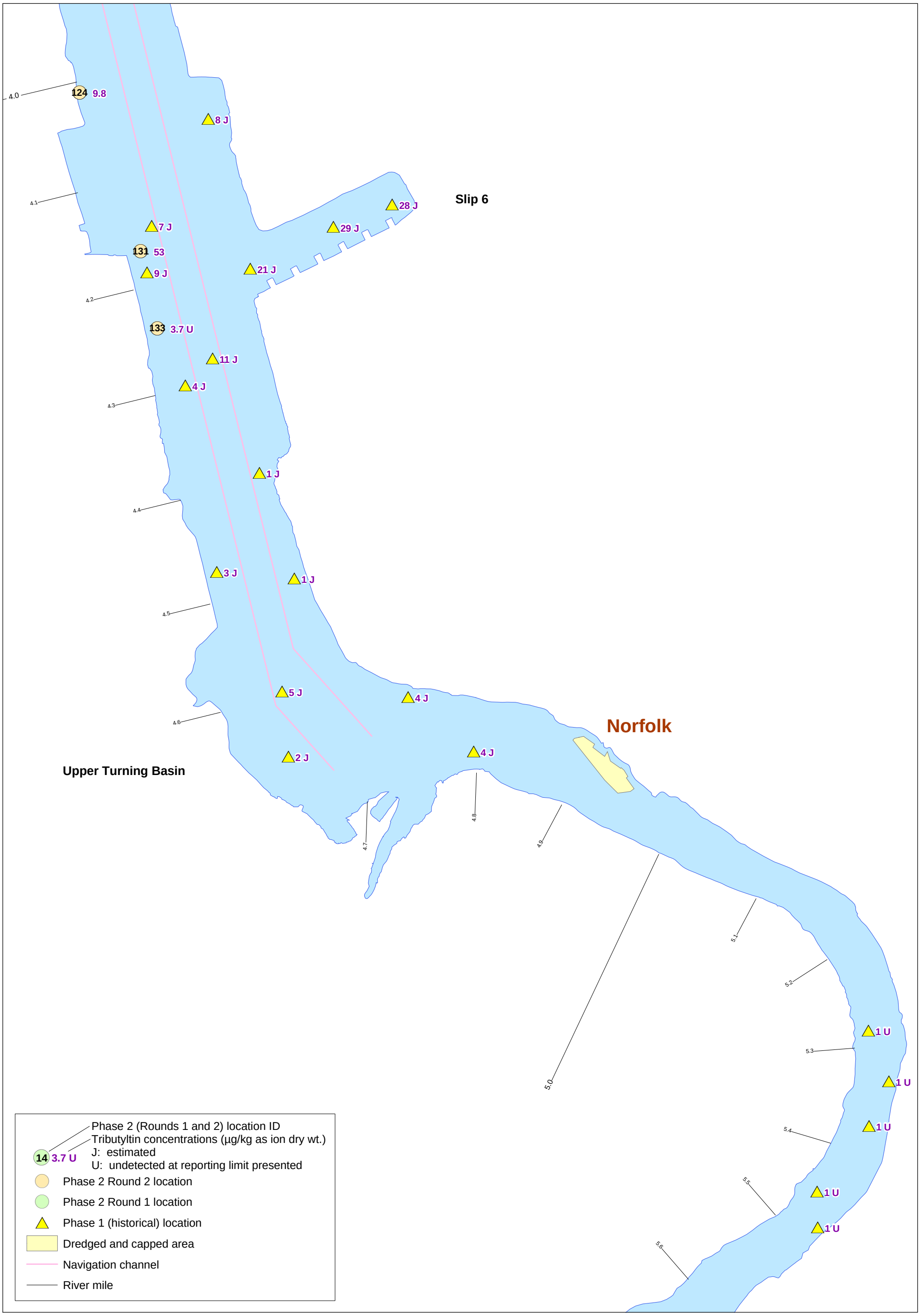


Figure 5-3c. TBT concentrations in surface sediments at Phase 1 (historical) and Phase 2 (Rounds 1 and 2) locations (RM 4.0-5.6)

Wind Ward environmental LLC

Prepared by STS 07/22/05, 12/07/05 Map 1898

W:\Projects\00-08-06_Duwamish_RI\data\gis\Surface Sediment\TBT

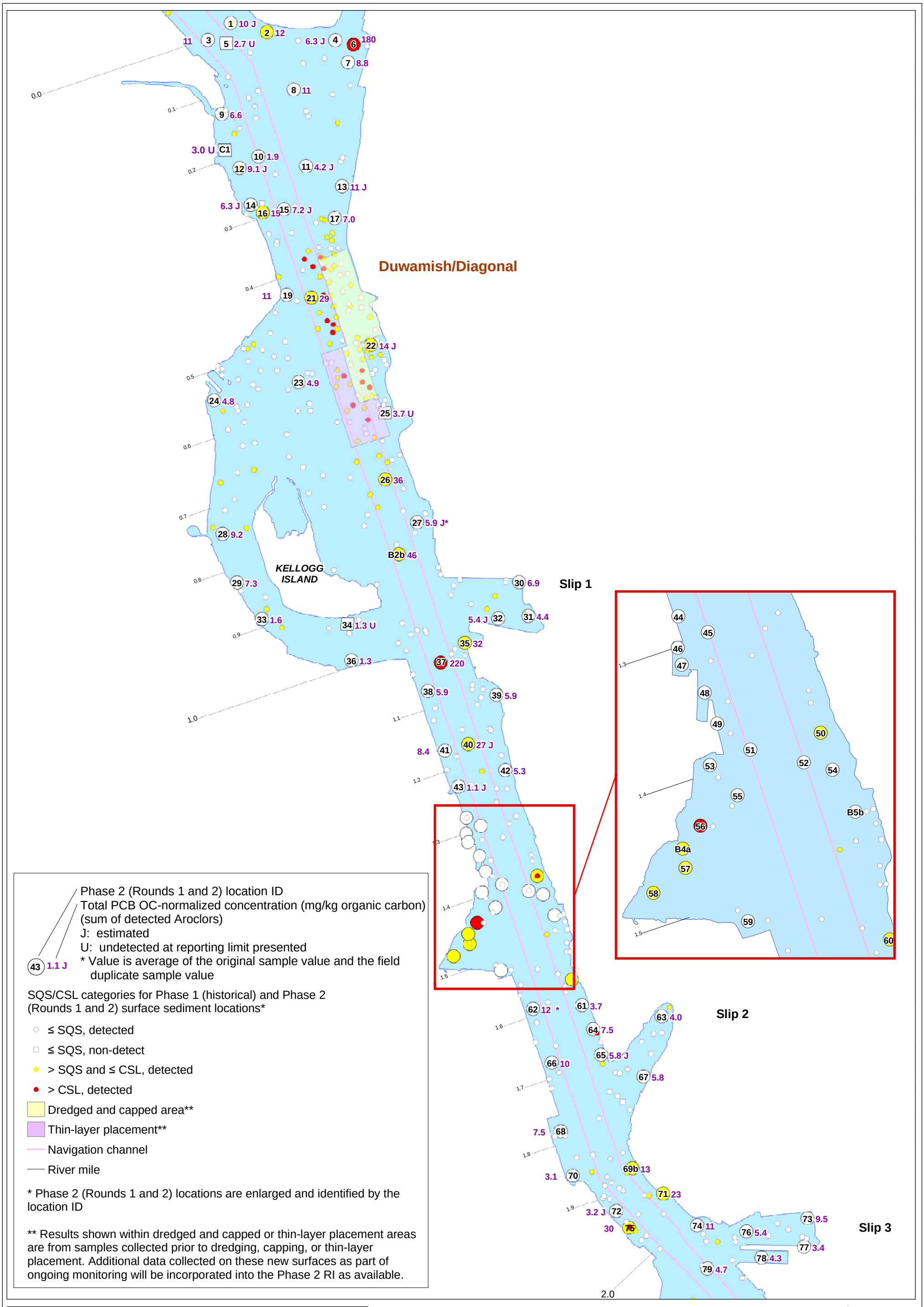


Figure 5-4a. Exceedances of SQS or CSL by total PCBs in surface sediments at Phase 1 (historical) and Phase 2 (Rounds 1 and 2) locations (RM 0.0-2.0)

W:\Projects\00-08-06_Duwamish_RI\data\gis\Surface Sediment\PCBs

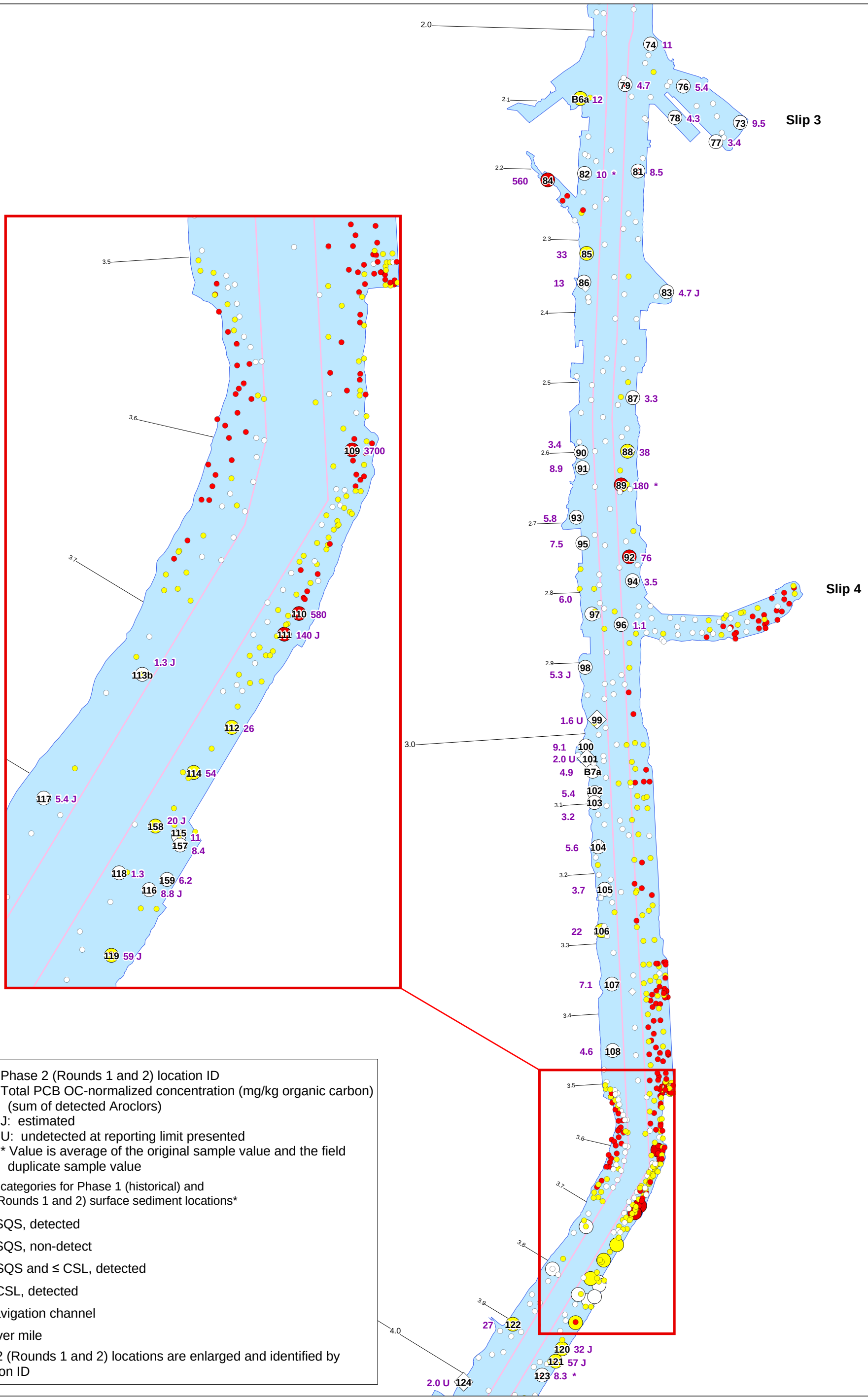
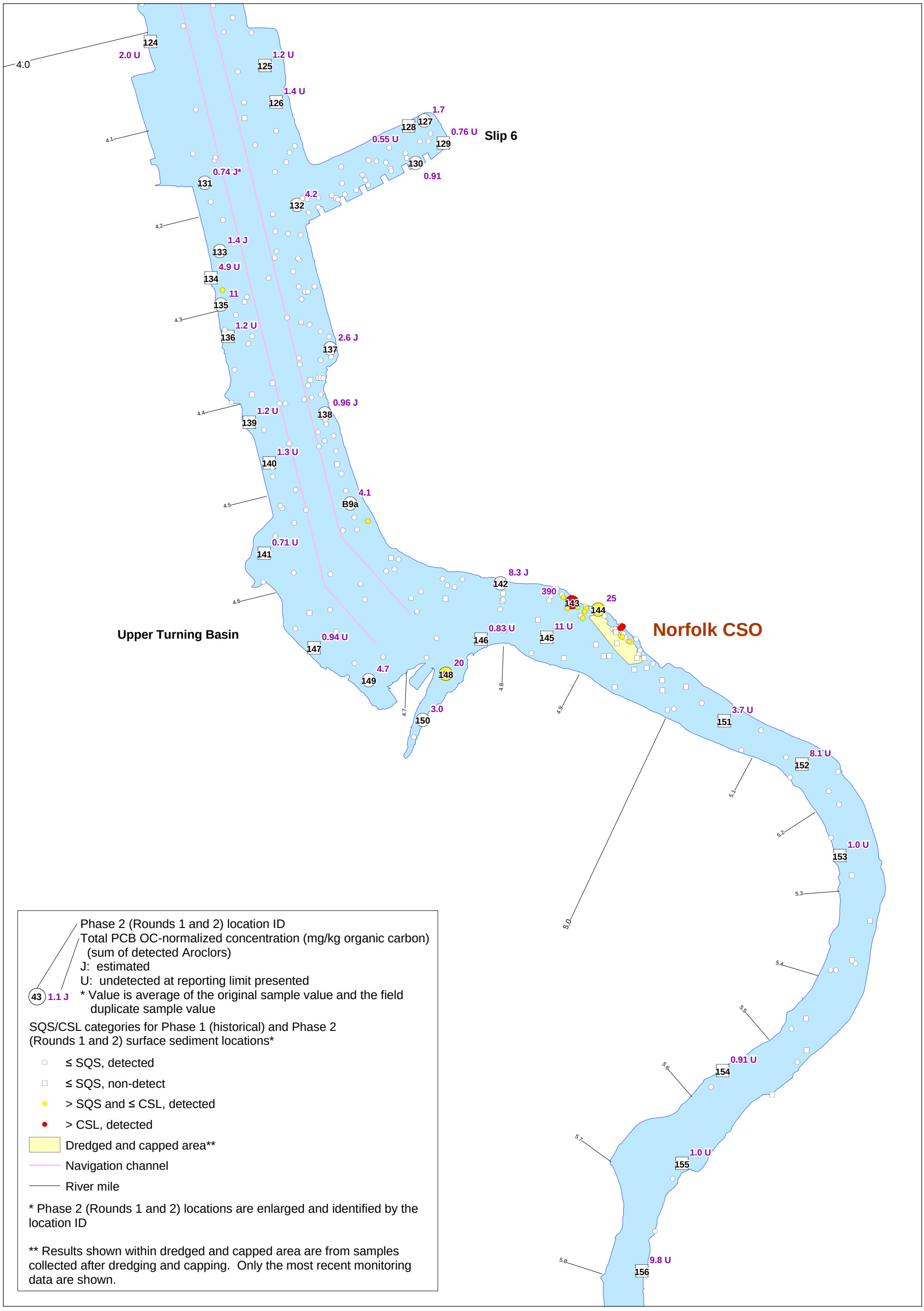


Figure 5-4b. Exceedances of SQS or CSL by total PCBs in surface sediments at Phase 1 (historical) and Phase 2 (Rounds 1 and 2) locations (RM 2.0-4.0)

Prepared by STS 12/21/05 (formerly 1897) Map 2035

W:\Projects\00-08-06_Duwamish_RI\data\gis\Surface Sediment\PCBs



Phase 2 (Rounds 1 and 2) location ID
Total PCB OC-normalized concentration (mg/kg organic carbon) (sum of detected Aroclors)
J: estimated
U: undetected at reporting limit presented
* Value is average of the original sample value and the field duplicate sample value

43 1.1 J

SQS/CSL categories for Phase 1 (historical) and Phase 2 (Rounds 1 and 2) surface sediment locations*

- ≤ SQS, detected
- ≤ SQS, non-detect
- > SQS and ≤ CSL, detected
- > CSL, detected
- Dredged and capped area**
- Navigation channel
- River mile

* Phase 2 (Rounds 1 and 2) locations are enlarged and identified by the location ID

** Results shown within dredged and capped area are from samples collected after dredging and capping. Only the most recent monitoring data are shown.

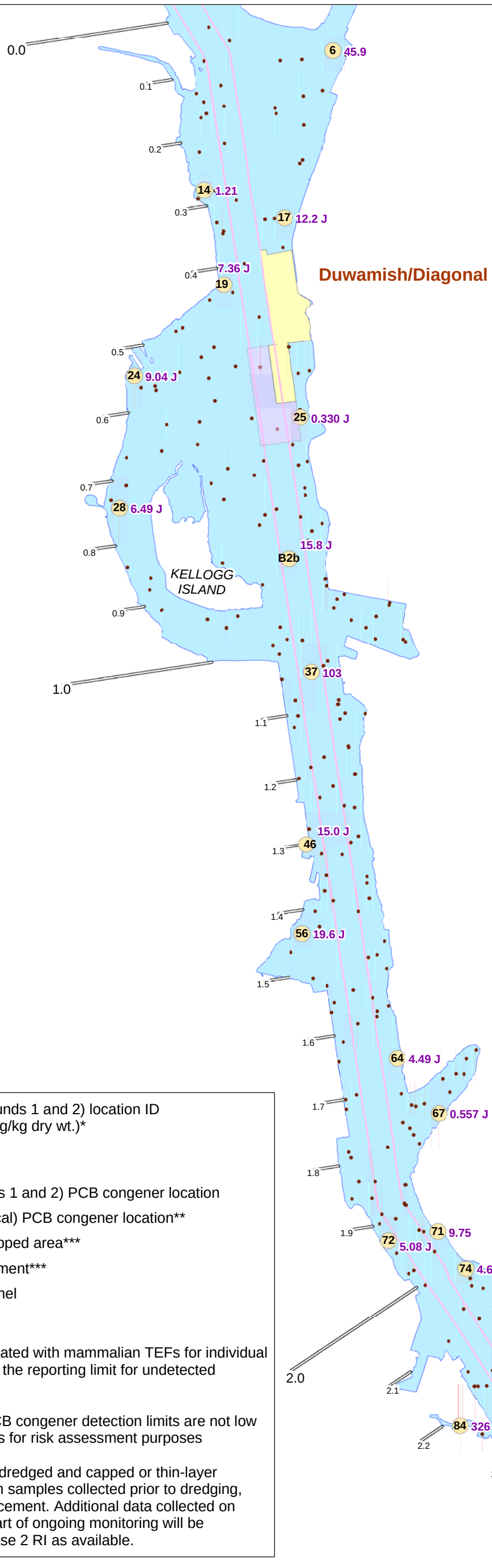
Figure 5-4c. Exceedances of SQS or CSL by total PCBs in surface sediments at Phase 1 (historical) and Phase 2 (Rounds 1 and 2) locations (RM 4.0-6.0)

0 0.2 Miles
0 0.2 Kilometers
N

Wind Ward environmental LLC

Prepared by STS 12/21/05 (formerly 1897) Map 2035

W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2\Surface Update 04-05\PCBs



Phase 2 (Rounds 1 and 2) location ID
TEQ value (ng/kg dry wt.)*
J: estimated

56 19.6 J

Phase 2 (Rounds 1 and 2) PCB congener location

Phase 1 (historical) PCB congener location**

Dredged and capped area***

Thin-layer placement***

Navigation channel

River mile

* TEQ values were calculated with mammalian TEFs for individual PCB congeners, using ½ the reporting limit for undetected congeners

** Phase 1 (historical) PCB congener detection limits are not low enough to calculate TEQs for risk assessment purposes

*** Results shown within dredged and capped or thin-layer placement areas are from samples collected prior to dredging, capping, or thin-layer placement. Additional data collected on these new surfaces as part of ongoing monitoring will be incorporated into the Phase 2 RI as available.

Figure 5-5a. TEQ values calculated from PCB congener concentrations in Phase 2 (Rounds 1 and 2) surface sediment samples (RM 0.0-2.4)

0 0.2 Miles

0 0.2 Kilometers

N

Wind Ward environmental LLC

Prepared by STS 12/15/05 Map 1921

W:\Projects\00-08-06_Duwamish_RI\data\gis\Surface Sediment\PCBs

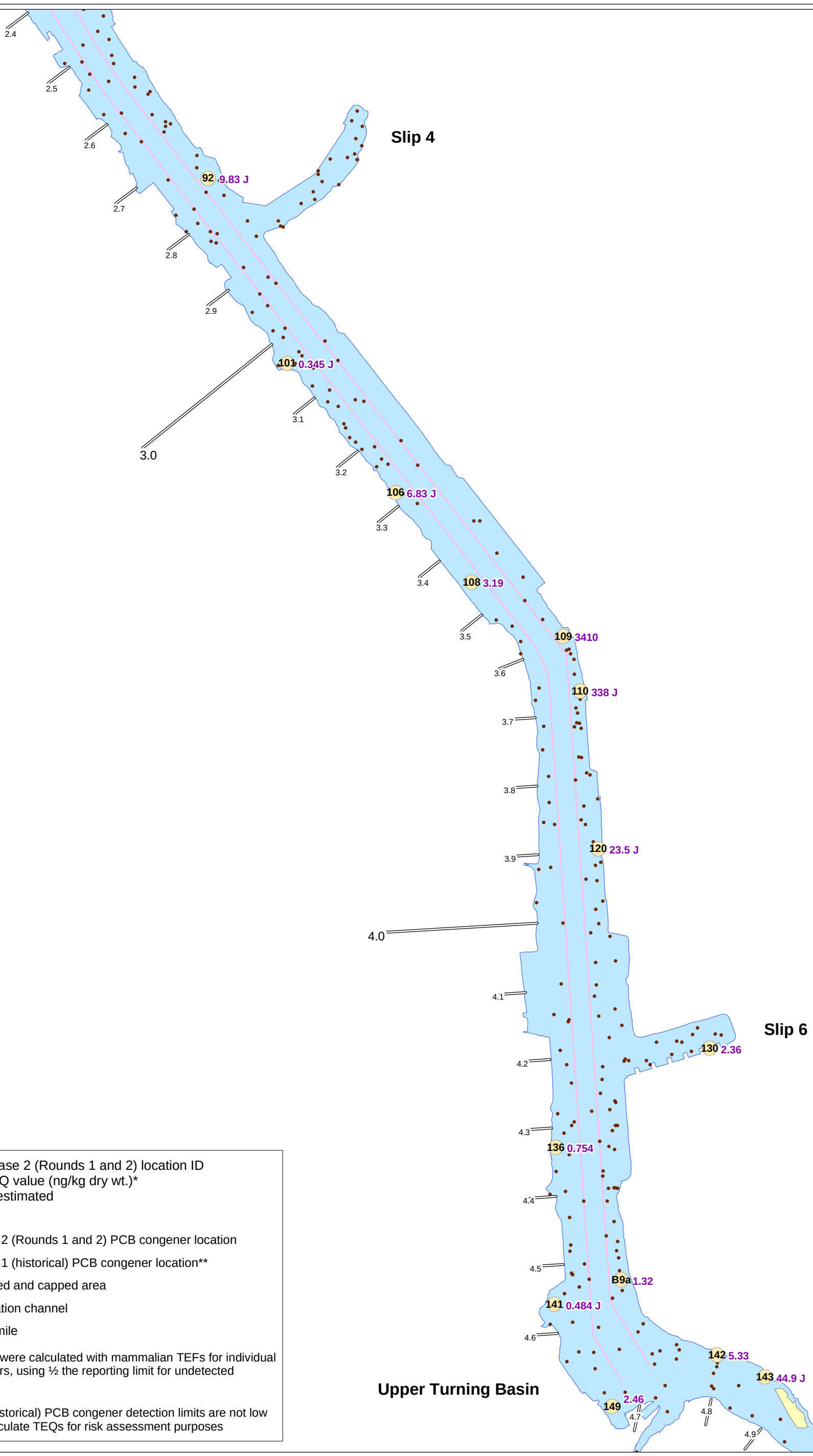


Figure 5-5b. TEQ values calculated from PCB congener concentrations in Phase 2 (Rounds 1 and 2) surface sediment samples (RM 2.4-4.8)

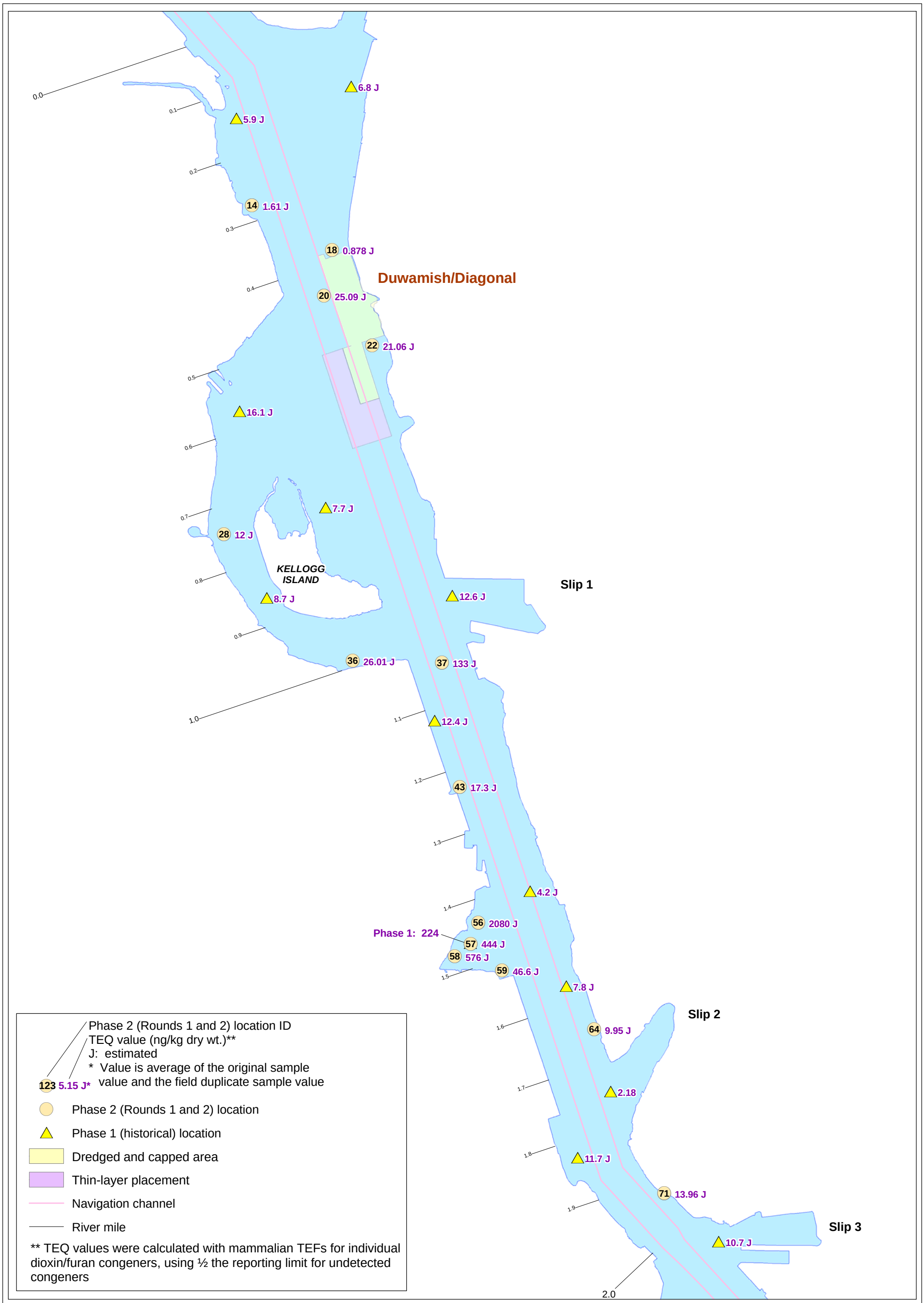


Figure 5-6a. TEQ values calculated from dioxin/furan concentrations in Phase 1 (historical) and Phase 2 (Rounds 1 and 2) surface sediment samples (RM 0.0-2.0)

W:\Projects\00-08-06_Duwamish_RI\data\gis\Surface Sediment\Dioxin furans

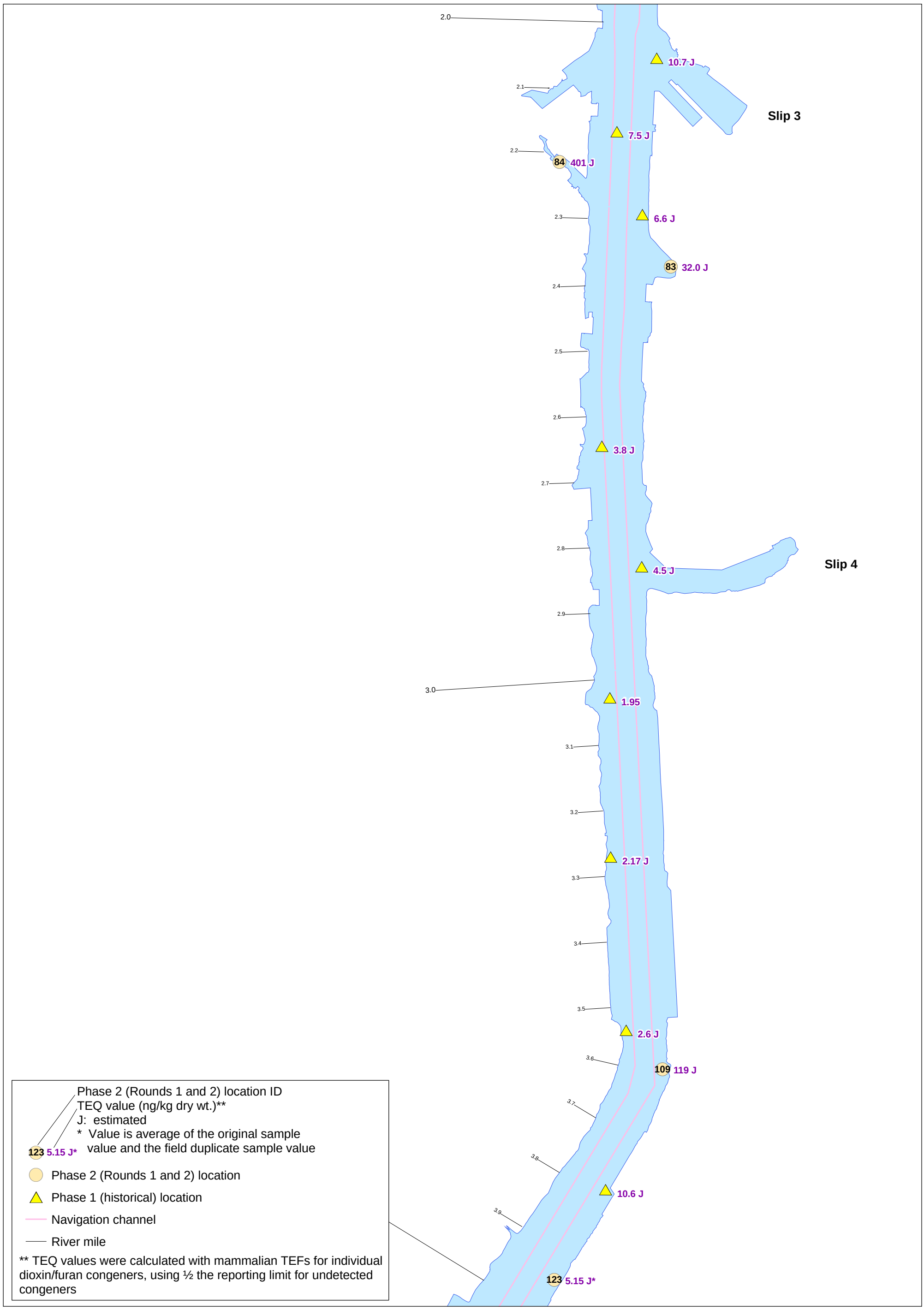


Figure 5-6b. TEQ values calculated from dioxin/furan concentrations in Phase 1 (historical) and Phase 2 (Rounds 1 and 2) surface sediment samples (RM 2.0-4.0)

Prepared by STS 12/15/05 Map 1897

W:\Projects\00-08-06_Duwamish_RI\data\gis\Surface Sediment\Dioxins

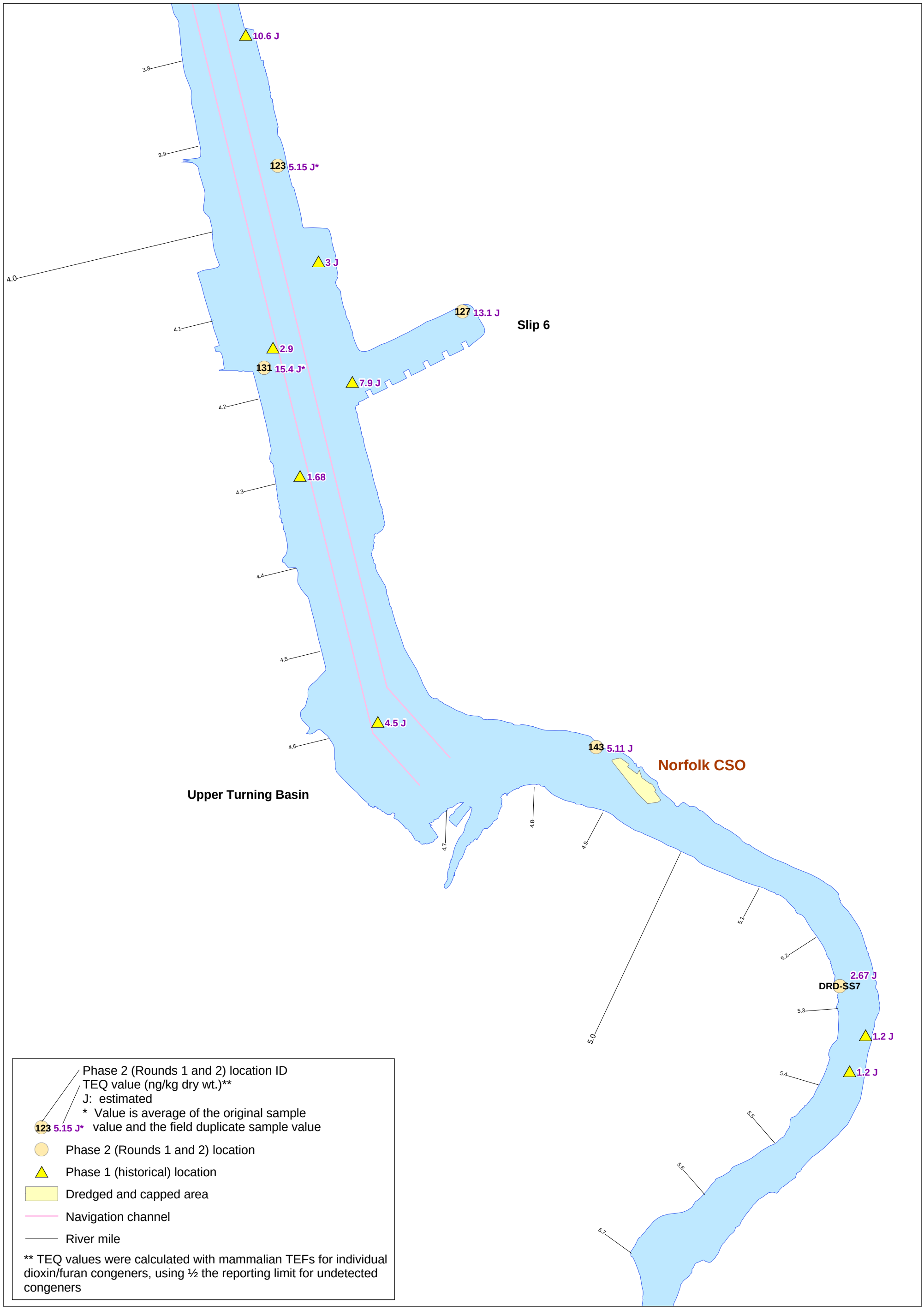


Figure 5-6c. TEQ values calculated from dioxin/furan concentrations in Phase 1 (historical) and Phase 2 (Rounds 1 and 2) surface sediment samples (RM 4.0-5.6)

W:\Projects\00-08-06_Duwamish_RI\data\gis\Surface Sediment\Dioxin furans

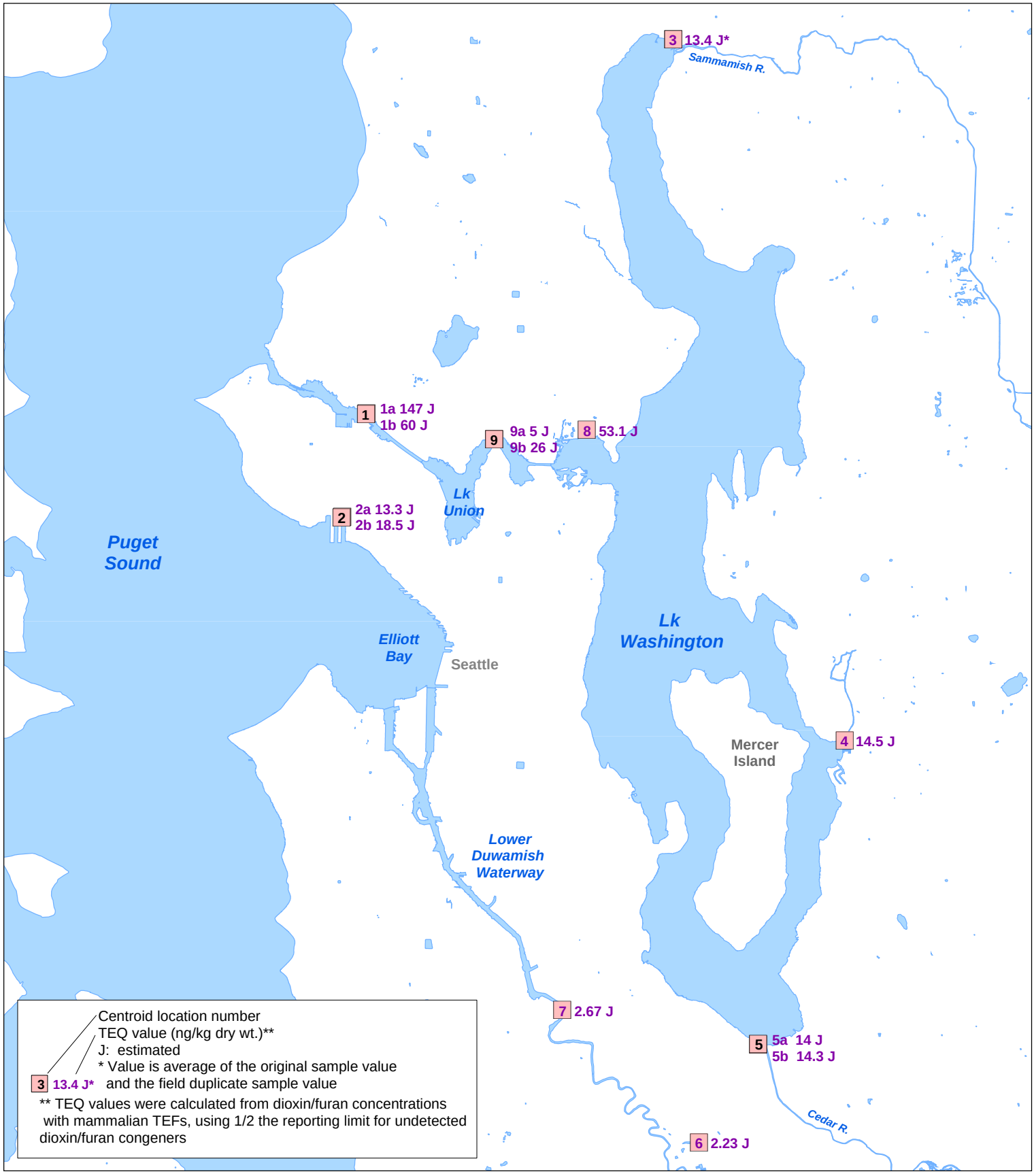


Figure 5-7. TEQ values calculated from dioxin/furan concentrations in Phase 2 (Rounds 1 and 2) surface sediment samples from the greater Seattle area

0 2 Miles

0 2 Kilometers

N

Wind Ward environmental LLC

Prepared by STS 07/22/05 (source Map 1836), 12/07/05 Map 1913

W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2\Surface Sediment\Dioxin furans\Background locations

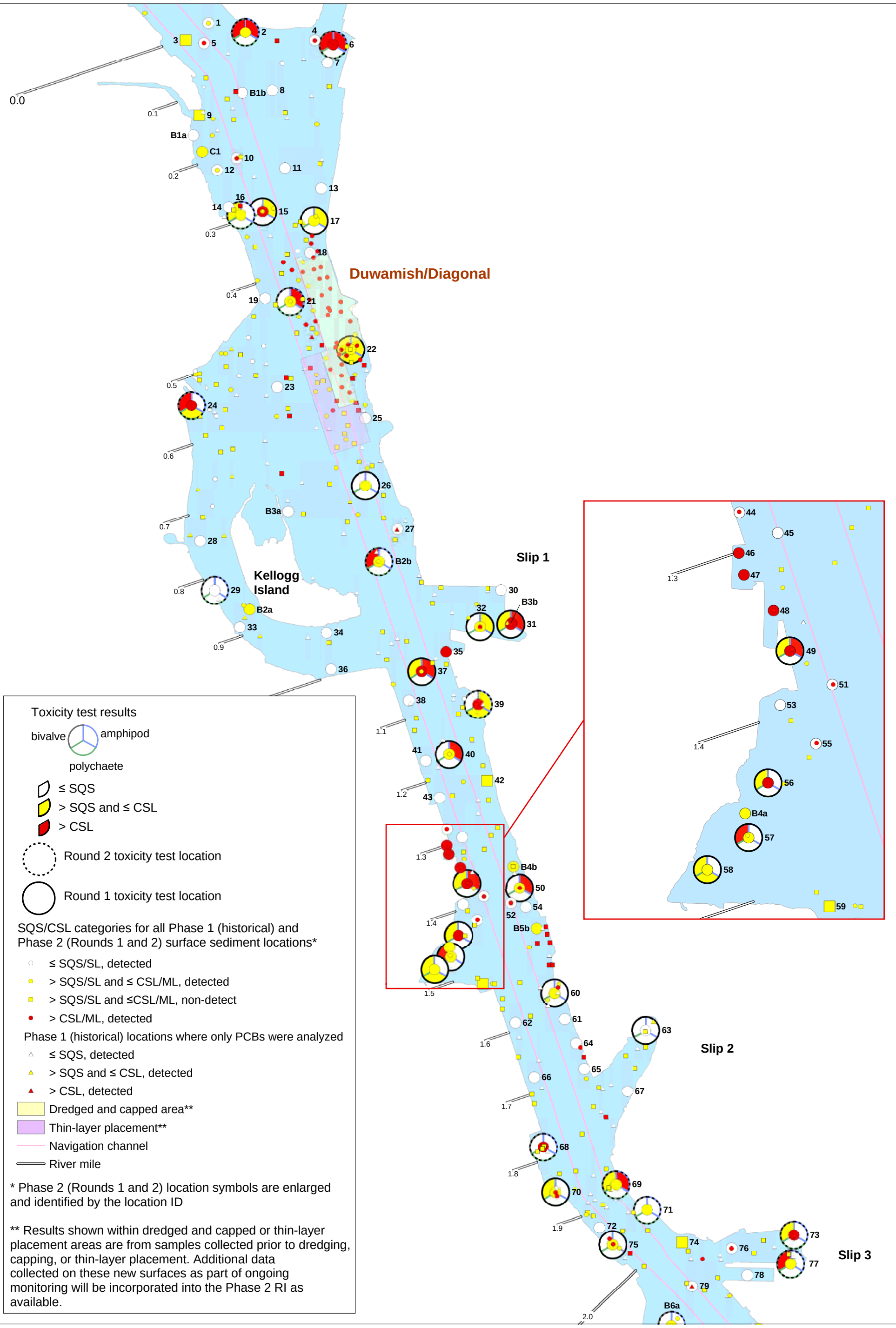


Figure 5-8a. Exceedances of SQS or CSL by toxicity test results in Phase 2 (Rounds 1 and 2) and SQS/SL or CSL/ML by all chemicals in surface sediment at Phase 1 (historical) and Phase 2 (Rounds 1 and 2) locations (RM 0.0-2.0)

Wind Ward environmental LLC

Prepared by STS 12/15/05 Map 1922

W:\Projects\00-08-06_Duwamish_RI\data\gis\Surface Sediment\Bioassay

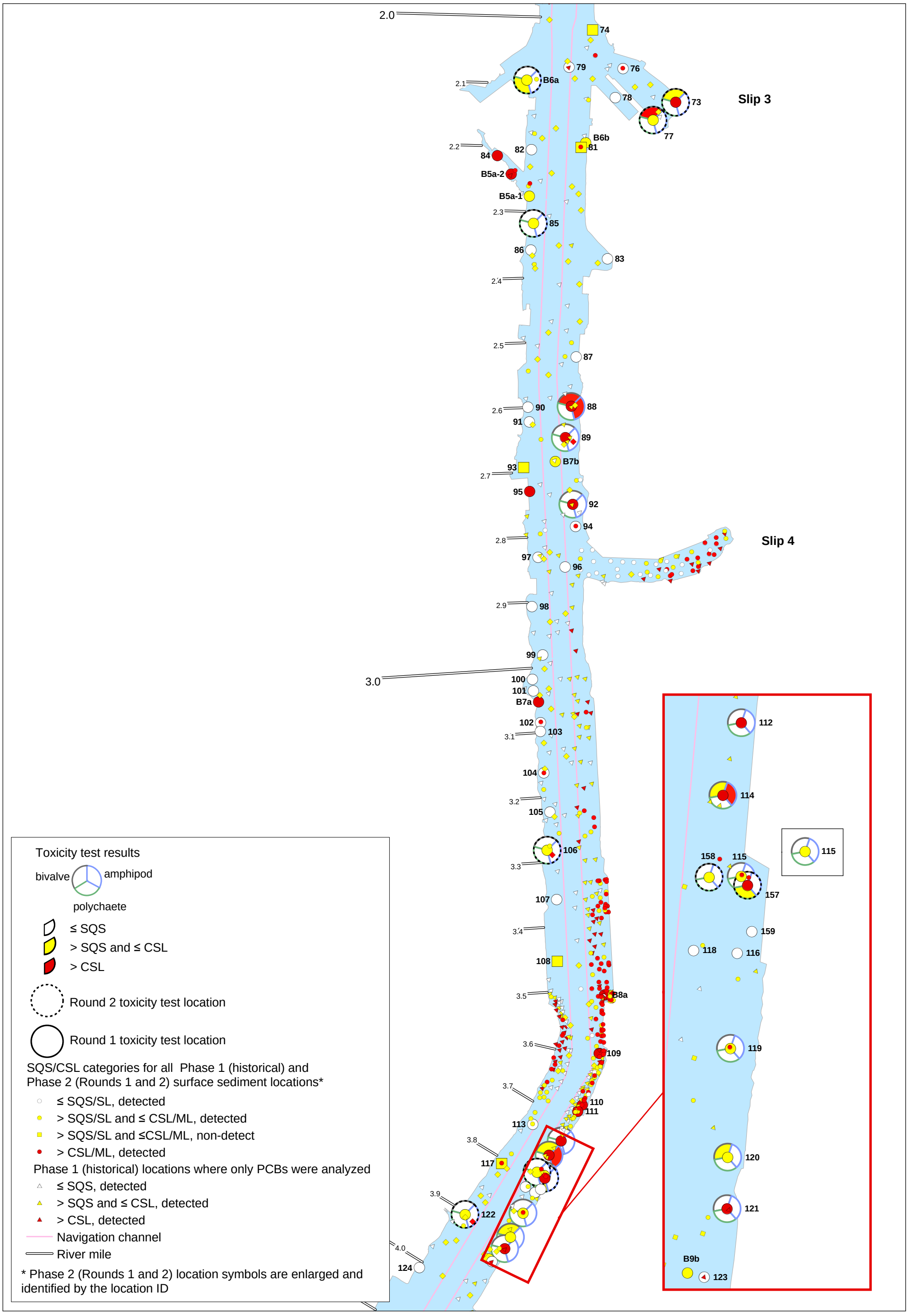


Figure 5-8b. Exceedances of SQS or CSL by toxicity test results in Phase 2 (Rounds 1 and 2) and SQS/SL or CSL/ML by all chemicals in surface sediment at Phase 1 (historical) and Phase 2 (Rounds 1 and 2) locations (RM 2.0-4.0)

Prepared by STS 12/15/05 Map 1922

W:\Projects\00-08-06_Duwamish_RI\data\gis\Surface Sediment\Bioassay

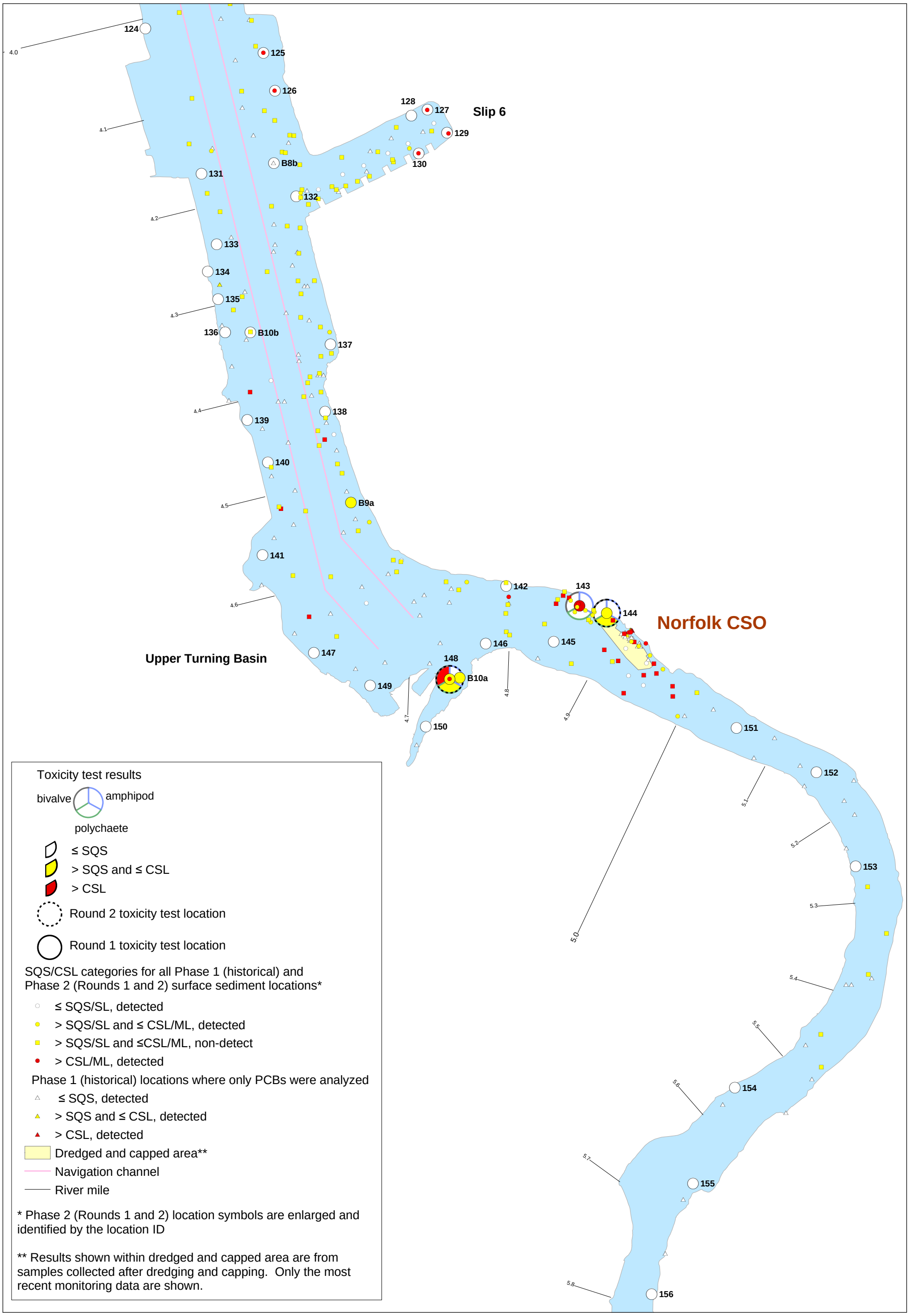


Figure 5-8c. Exceedances of SQS or CSL by toxicity test results in Phase 2 (Rounds 1 and 2) and SQS/SL or CSL/ML by all chemicals in surface sediment at Phase 1 (historical) and Phase 2 (Rounds 1 and 2) locations (RM 4.0-5.8)

Prepared by STS 12/15/05 Map 1922

W:\Projects\00-08-06_Duwamish_RI\data\gis\Surface Sediment\bioassay