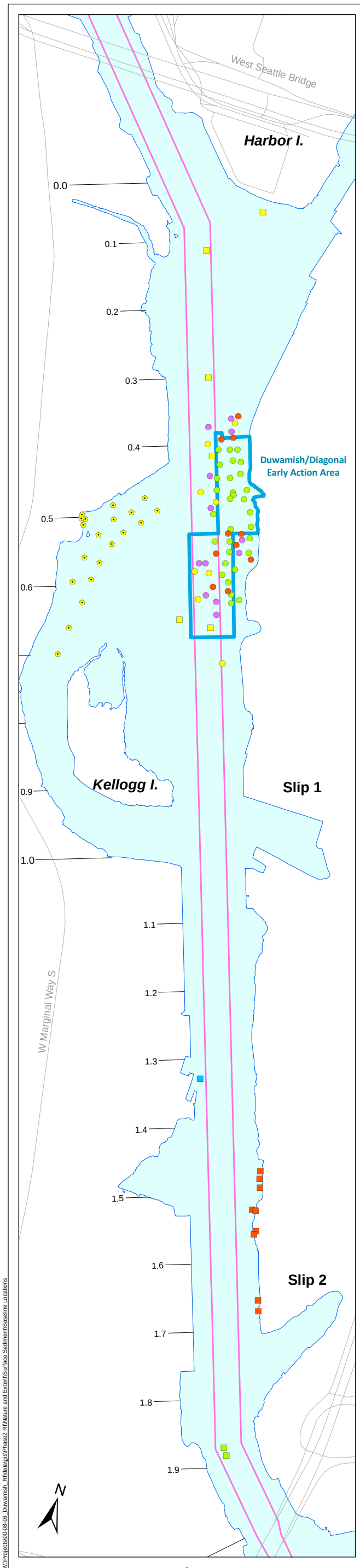
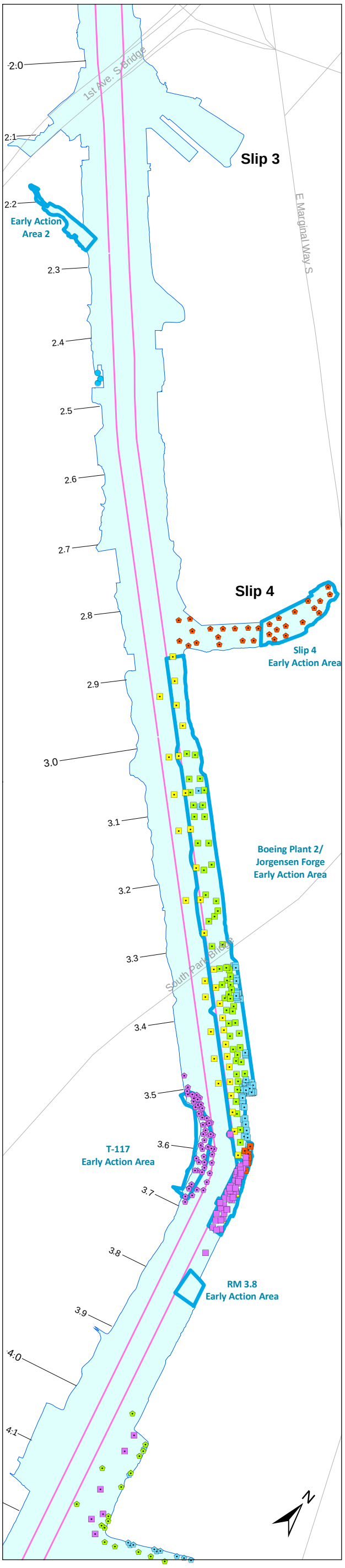
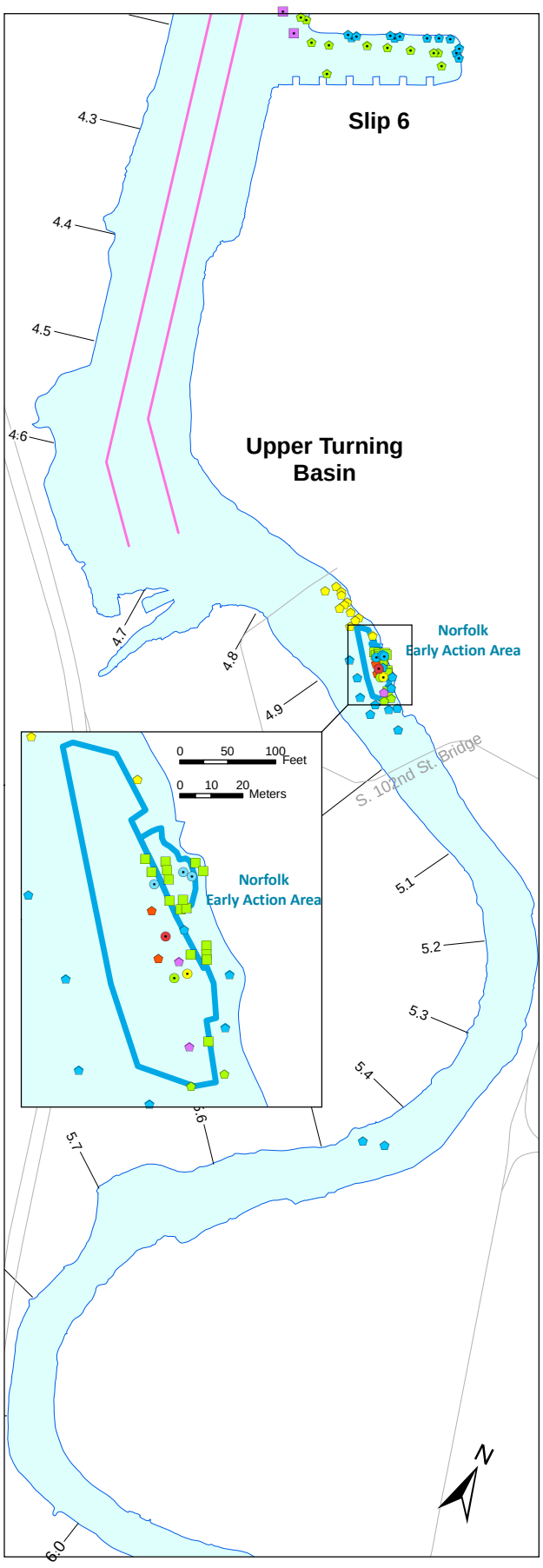






Surface sediment sampling event

- BoyerTowing (2004)
- Duw/Diag-1 (1994)
- Duw/Diag-1.5 (1995)
- Duw/Diag-2 (1996)
- DuwDiagonal (2003)
- DuwamishShipyard (1993)
- Ecology-Norfolk (2002)
- Harbor Island RI (1991)
- JamesHardieOutfall (2000)
- Jorgensen (2004)
- Norfolk-cleanup1 (1994)
- Norfolk-cleanup2 (1995)
- Norfolk-cleanup3 (1995)
- Norfolk-monit1 (1999)
- Norfolk-monit2a (1999)
- Norfolk-monit2b (2000)
- Norfolk-monit3 (2000)
- Norfolk-monit4 (2001)
- Norfolk-monit5 (2002)
- Plant 2 RFI-1 (1995)
- Plant 2 RFI-2a (1995)
- Plant 2 RFI-2b (1996)
- Plant 2-Transformer-Phase1 (2003)
- Rhône-Poulenc RFI-2 (1994)
- Rhône-Poulenc RFI-3 (1996)
- Rhône-Poulenc (2004)
- Seaboard-Ph2 (1996)
- Slip4-EarlyAction (2004)
- T117Boundary-Definition (2003)
- Early Action Area[a]
- Road
- Navigation channel
- River mile

[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2. For the Duwamish/Diagonal Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer capping in 2003 to 2005. For the Norfolk Early Action Area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

Wind Ward environmental LLC

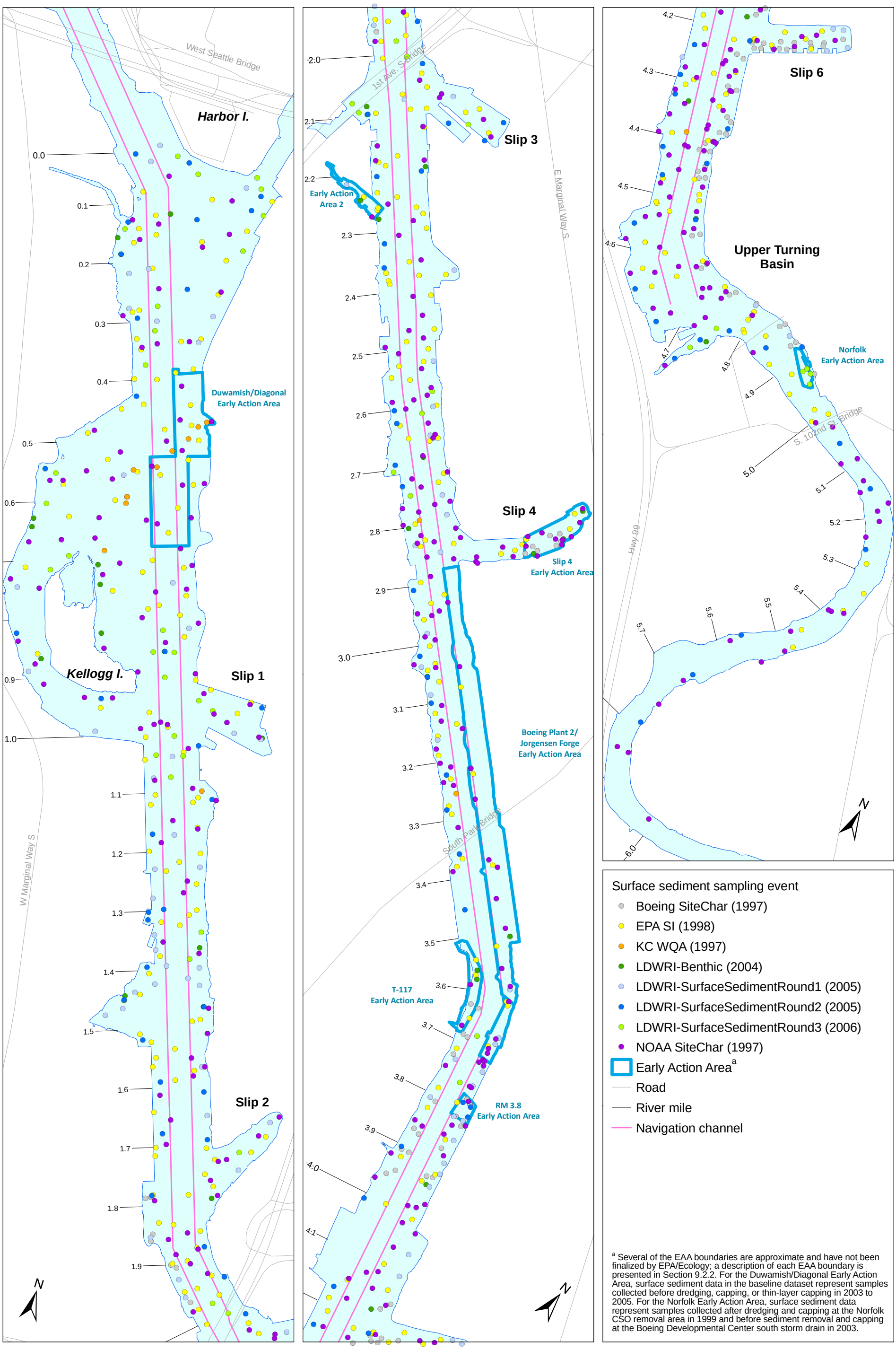
0 0.1 0.2 Miles

0 0.1 0.2 Kilometers

Scale is the same for each inset map

Map 4-1. Locations of surface sediment samples analyzed as part of discrete events

Prepared by CEH 07/13/2010; MAP #2674; W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\Baseline Locations



Surface sediment sampling event

- Boeing SiteChar (1997)
- EPA SI (1998)
- KC WQA (1997)
- LDWRI-Benthic (2004)
- LDWRI-SurfaceSedimentRound1 (2005)
- LDWRI-SurfaceSedimentRound2 (2005)
- LDWRI-SurfaceSedimentRound3 (2006)
- NOAA SiteChar (1997)
- Early Action Area[a]
- Road
- River mile
- Navigation channel

[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2. For the Duwamish/Diagonal Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer capping in 2003 to 2005. For the Norfolk Early Action Area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

Wind Ward environmental LLC

0 0.1 0.2 Miles

0 0.1 0.2 Kilometers

Scale is the same for each inset map

Map 4-2. Locations of surface sediment samples analyzed as part of LDW-wide events

Prepared by CEH, 07/13/2010; MAP 2685; W:\Projects\00-08-06 Duwamish, R\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\Baseline Locations

West Seattle Bridge

Harbor I.

Map 4-4a

Map 4-4b

Kellogg I.

Slip 1

Map 4-4c

Slip 2

Map 4-4d

W Marginal Way S

Slip 3

E Marginal Way S

Map 4-4e

1st Ave. S

Slip 4

Map 4-4f

South Park Bridge

Map 4-4g

Slip 6

Map 4-4h

Hwy 99

Map 4-4i

S. 102nd St. Bridge

Upper Turning Basin

Map 4-4j

- Surface sediment sampling location
- Road
- Navigation channel
- River mile

N

0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

Map 4-3. Surface sediment sampling location reference map

Prepared by CEH, 07/13/2010, W:\Projects\00-08-06 Duwamish River\data\gis\Phase 2 RI\Nature and Extent\Surface Sediment\Baseline Locations

PORT OF SEATTLE

HARBOR REAL ESTATE

PORT OF SEATTLE

0.0

PORT OF SEATTLE

LDW-SS1

LDW-SS3

LDW-SS5

LDW-SS301

LDW-SS2

LDW-SS303

LDW-SS302

K-10

LDW-SS4

LDW-SS304

EST227

LDW-SS6

DR001

EST228

DR055

DR032

LDW-SS7

LDW-SS305

PORT OF SEATTLE

K-06

B1b

DR077

LDW-SS8

DR002

WIT298

CH1040

EST230

ASH GROVE CEMENT WEST INC

LDW-SS9

DR033

LDW-SS306

DR066

DR056

LDW-SS307

EST229

WST373

B1a

DR034

PORT OF SEATTLE

DR003

C1

LDW-SSC1

ASH GROVE CEMENT WEST INC

LDW-SS10

DR078

LDW-SS12

EST232

LDW-SS11

DR004

CH1041

LDW-SS308

LDW-SS13

LDW-SS14

DR067

DR036

WIT299

LDW-SS15

K-04

LDW-SS16

LDW-SS309

PORT OF SEATTLE

DR005

DR057

EST231

LDW-SS17

DR037

CH1043

WST374

DR068

DUD200

DUD_12C

DUD043

GENERAL RECYCLING OF WASHINGTON LLC

DUD_10C

DUD_11C

DR006

LDW-SS310

DR058

DUD202

DUD201

Duwamish/Diagonal Early Action Area

DR080

DUD044

DUD028

DUD016

DUD002

DR038

EST221

K-03

DUD017

DUD003

DUD029

0.4

Surface sediment sampling location

- Duw/Diag-1
- Duw/Diag-1.5
- Duw/Diag-2
- DuwDiagonal-October2003
- EPA SI
- Harbor Island RI
- LDWRI-Benthic
- LDWRI Surface Sediment Round 1
- LDWRI Surface Sediment Round 2
- LDWRI Surface Sediment Round 3
- NOAA SiteChar
- Bridge
- Building
- Dock/Pier
- Marina
- Road
- Early Action Area[a]
- Navigation channel
- River mile
- Tax parcel[b]

[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2. For the Duwamish/Diagonal Early Action Area, surface sediment sampling locations in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005.

[b] Tax parcel information was provided in 2008 by Seattle Public Utilities and King County. Some tax parcel polygons were edited to conform to the LDW shoreline presentation. A comprehensive survey of property-owner records was not conducted.

Wind Ward LLC environmental

N

0 200 400 Feet

0 50 100 Meters

Map 4-4a. Surface sediment sampling locations, RM 0.0 to RM 0.4

Prepared by CEH 07/13/2010; MAP 2619; W:\Projects\00-08-06 Duwamish RI\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\Baseline Locations

Surface sediment sampling location
- Duw/Diag-1
- Duw/Diag-1.5
- Duw/Diag-2
- DuwDiagonal-October2003
- EPA SI
- Harbor Island RI
- KC WQA
- LDWRI-Benthic
- LDWRI-SurfaceSedimentRound1
- LDWRI-SurfaceSedimentRound2
- LDWRI-SurfaceSedimentRound3
- NOAA SiteChar
- Seaboard-Ph2

- Early Action Area[a]
- Tax parcel[b]
- Building
- Dock/Pier
- Road
- Navigation channel
- River mile

[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2. For the Duwamish/Diagonal Early Action Area, surface sediment sampling locations in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005.

[b] Tax parcel information was provided in 2008 by Seattle Public Utilities and King County. Some tax parcel polygons were edited to conform to the LDW shoreline presentation. A comprehensive survey of property-owner records was not conducted.

GENERAL RECYCLING OF WASHINGTON LLC
GENERAL RECYCLING OF WASHINGTON LLC
SEATTLE PARKS DEPT
PORT OF SEATTLE
PORT OF SEATTLE
PORT OF SEATTLE
PORT OF SEATTLE
PORT OF SEATTLE
PORT OF SEATTLE
LAFARGE CORP
KING
Duwamish/Diagonal Early Action Area
Kellogg Island
0.4
0.6
0.7
0.8
0.9
LDW-SS310 LDW-SS19 LDW-SS24 LDW-SS311 LDW-SS312 LDW-SS313 LDW-SS314 LDW-SS28 LDW-SS29 LDW-SS33 LDW-SS34 LDW-SS36 LDW-SS316 LDW-SS317 LDW-SS318 LDW-SS319 LDW-SS320 LDW-SS321 LDW-SS323 LDW-SS315 LDW-SS23 LDW-SS26 LDW-SS27 LDW-SS35
DR038 DR069 DR039 DR040 DR041 DR042 DR043 DR044 DR045 DR046 DR047 DR048 DR049 DR058 DR080 DR007 DR008 DR081 DR009 DR059 DR082 DR010 DR083 DR012 DR071 DR084 DR072 DR061 DR013 DR086 DR073 DR060 DR011 DR014 DR015 DR016 DR062
DUD_10C DUD_11C DR006 DUD202 DUD201 DUD044 DUD028 DUD016 DUD002 EST221 K-03 DUD017 DUD003 DUD029 DUD004 DUD_9C DUD030 DUD018 EST222 DUD019 DUD005 EIT092 DD-1 DUD031 DUD020 DUD045 DD-2 DUD032 DUD021 DUD006 DUD007 DUD_8C DD-3 DUD033 CH1038 DUD008 EST223 DD-4 DUD023 DUD203 DUD204 DUD009 DUD_1C DUD024 DUD035 DUD205 DUD_2C DUD010 CH1039 DD-5 DUD025 DUD207 DUD206 EIT094 DUD026 DUD_7C DUD_6C EST224 DUD011 DUD040 DUD038 DUD027 DUD012 DUD208 DUD209 DUD013 DUD014 DUD_5C DUD041 DUD_4C DUD015 EIT087 WST362 CH1035 DUD_3C K-02 K-02-1 EST217 EIT088 DUD037 CH1036 EST218 EST212 EST213 CH1033 CH1034 WST365 WST368 LDW-SSB2b B2b EST220 WST364
WST370 WST358 WST371 WST359 WST372 WIT282 WIT292 WIT293 WIT283 WIT286 WIT287 WIT288 WIT289 WIT290 WIT291 WIT297 WST366 WIT294 WST363 WIT295 WIT296 WST365
SD-6 SD-7 SD-17 SD-5 SD-20 SD-19 SD-16 SD-4 SD-8 SD-18 SD-9 SD-3 SD-10 SD-11 SD-12 SD-1 SD-2 SD-13 SD-14 SD-15
KI-1 KI-2 KI-3 KI-4 WQAKELL
C3-1 C3-2 C2-1 C2-2 B3a B2a CH1037
EST1 EST2 EST3 EST4 EST5 EST6 EST7 EST8 EST9 EST10 EST11 EST12 EST13 EST14 EST15 EST16 EST17 EST18 EST19 EST20 EST21 EST22 EST23 EST24 EST25 EST26 EST27 EST28 EST29 EST30 EST31 EST32 EST33 EST34 EST35 EST36 EST37 EST38 EST39 EST40 EST41 EST42 EST43 EST44 EST45 EST46 EST47 EST48 EST49 EST50 EST51 EST52 EST53 EST54 EST55 EST56 EST57 EST58 EST59 EST60 EST61 EST62 EST63 EST64 EST65 EST66 EST67 EST68 EST69 EST70 EST71 EST72 EST73 EST74 EST75 EST76 EST77 EST78 EST79 EST80 EST81 EST82 EST83 EST84 EST85 EST86 EST87 EST88 EST89 EST90 EST91 EST92 EST93 EST94 EST95 EST96 EST97 EST98 EST99 EST100 EST101 EST102 EST103 EST104 EST105 EST106 EST107 EST108 EST109 EST110 EST111 EST112 EST113 EST114 EST115 EST116 EST117 EST118 EST119 EST120 EST121 EST122 EST123 EST124 EST125 EST126 EST127 EST128 EST129 EST130 EST131 EST132 EST133 EST134 EST135 EST136 EST137 EST138 EST139 EST140 EST141 EST142 EST143 EST144 EST145 EST146 EST147 EST148 EST149 EST150 EST151 EST152 EST153 EST154 EST155 EST156 EST157 EST158 EST159 EST160 EST161 EST162 EST163 EST164 EST165 EST166 EST167 EST168 EST169 EST170 EST171 EST172 EST173 EST174 EST175 EST176 EST177 EST178 EST179 EST180 EST181 EST182 EST183 EST184 EST185 EST186 EST187 EST188 EST189 EST190 EST191 EST192 EST193 EST194 EST195 EST196 EST197 EST198 EST199 EST200 EST201 EST202 EST203 EST204 EST205 EST206 EST207 EST208 EST209 EST210 EST211 EST212 EST213 EST214 EST215 EST216 EST217 EST218 EST219 EST220 EST221 EST222 EST223 EST224 EST225 EST226 EST227 EST228 EST229 EST230 EST231 EST232 EST233 EST234 EST235 EST236 EST237 EST238 EST239 EST240 EST241 EST242 EST243 EST244 EST245 EST246 EST247 EST248 EST249 EST250 EST251 EST252 EST253 EST254 EST255 EST256 EST257 EST258 EST259 EST260 EST261 EST262 EST263 EST264 EST265 EST266 EST267 EST268 EST269 EST270 EST271 EST272 EST273 EST274 EST275 EST276 EST277 EST278 EST279 EST280 EST281 EST282 EST283 EST284 EST285 EST286 EST287 EST288 EST289 EST290 EST291 EST292 EST293 EST294 EST295 EST296 EST297 EST298 EST299 EST300 EST301 EST302 EST303 EST304 EST305 EST306 EST307 EST308 EST309 EST310 EST311 EST312 EST313 EST314 EST315 EST316 EST317 EST318 EST319 EST320 EST321 EST322 EST323 EST324 EST325 EST326 EST327 EST328 EST329 EST330 EST331 EST332 EST333 EST334 EST335 EST336 EST337 EST338 EST339 EST340 EST341 EST342 EST343 EST344 EST345 EST346 EST347 EST348 EST349 EST350 EST351 EST352 EST353 EST354 EST355 EST356 EST357 EST358 EST359 EST360 EST361 EST362 EST363 EST364 EST365 EST366 EST367 EST368 EST369 EST370 EST371 EST372 EST373 EST374 EST375 EST376 EST377 EST378 EST379 EST380 EST381 EST382 EST383 EST384 EST385 EST386 EST387 EST388 EST389 EST390 EST391 EST392 EST393 EST394 EST395 EST396 EST397 EST398 EST399 EST400 EST401 EST402 EST403 EST404 EST405 EST406 EST407 EST408 EST409 EST410 EST411 EST412 EST413 EST414 EST415 EST416 EST417 EST418 EST419 EST420 EST421 EST422 EST423 EST424 EST425 EST426 EST427 EST428 EST429 EST430 EST431 EST432 EST433 EST434 EST435 EST436 EST437 EST438 EST439 EST440 EST441 EST442 EST443 EST444 EST445 EST446 EST447 EST448 EST449 EST450 EST451 EST452 EST453 EST454 EST455 EST456 EST457 EST458 EST459 EST460 EST461 EST462 EST463 EST464 EST465 EST466 EST467 EST468 EST469 EST470 EST471 EST472 EST473 EST474 EST475 EST476 EST477 EST478 EST479 EST480 EST481 EST482 EST483 EST484 EST485 EST486 EST487 EST488 EST489 EST490 EST491 EST492 EST493 EST494 EST495 EST496 EST497 EST498 EST499 EST500 EST501 EST502 EST503 EST504 EST505 EST506 EST507 EST508 EST509 EST510 EST511 EST512 EST513 EST514 EST515 EST516 EST517 EST518 EST519 EST520 EST521 EST522 EST523 EST524 EST525 EST526 EST527 EST528 EST529 EST530 EST531 EST532 EST533 EST534 EST535 EST536 EST537 EST538 EST539 EST540 EST541 EST542 EST543 EST544 EST545 EST546 EST547 EST548 EST549 EST550 EST551 EST552 EST553 EST554 EST555 EST556 EST557 EST558 EST559 EST560 EST561 EST562 EST563 EST564 EST565 EST566 EST567 EST568 EST569 EST570 EST571 EST572 EST573 EST574 EST575 EST576 EST577 EST578 EST579 EST580 EST581 EST582 EST583 EST584 EST585 EST586 EST587 EST588 EST589 EST590 EST591 EST592 EST593 EST594 EST595 EST596 EST597 EST598 EST599 EST600 EST601 EST602 EST603 EST604 EST605 EST606 EST607 EST608 EST609 EST610 EST611 EST612 EST613 EST614 EST615 EST616 EST617 EST618 EST619 EST620 EST621 EST622 EST623 EST624 EST625 EST626 EST627 EST628 EST629 EST630 EST631 EST632 EST633 EST634 EST635 EST636 EST637 EST638 EST639 EST640 EST641 EST642 EST643 EST644 EST645 EST646 EST647 EST648 EST649 EST650 EST651 EST652 EST653 EST654 EST655 EST656 EST657 EST658 EST659 EST660 EST661 EST662 EST663 EST664 EST665 EST666 EST667 EST668 EST669 EST670 EST671 EST672 EST673 EST674 EST675 EST676 EST677 EST678 EST679 EST680 EST681 EST682 EST683 EST684 EST685 EST686 EST687 EST688 EST689 EST690 EST691 EST692 EST693 EST694 EST695 EST696 EST697 EST698 EST699 EST700 EST701 EST702 EST703 EST704 EST705 EST706 EST707 EST708 EST709 EST710 EST711 EST712 EST713 EST714 EST715 EST716 EST717 EST718 EST719 EST720 EST721 EST722 EST723 EST724 EST725 EST726 EST727 EST728 EST729 EST730 EST731 EST732 EST733 EST734 EST735 EST736 EST737 EST738 EST739 EST740 EST741 EST742 EST743 EST744 EST745 EST746 EST747 EST748 EST749 EST750 EST751 EST752 EST753 EST754 EST755 EST756 EST757 EST758 EST759 EST760 EST761 EST762 EST763 EST764 EST765 EST766 EST767 EST768 EST769 EST770 EST771 EST772 EST773 EST774 EST775 EST776 EST777 EST778 EST779 EST780 EST781 EST782 EST783 EST784 EST785 EST786 EST787 EST788 EST789 EST790 EST791 EST792 EST793 EST794 EST795 EST796 EST797 EST798 EST799 EST800 EST801 EST802 EST803 EST804 EST805 EST806 EST807 EST808 EST809 EST810 EST811 EST812 EST813 EST814 EST815 EST816 EST817 EST818 EST819 EST820 EST821 EST822 EST823 EST824 EST825 EST826 EST827 EST828 EST829 EST830 EST831 EST832 EST833 EST834 EST835 EST836 EST837 EST838 EST839 EST840 EST841 EST842 EST843 EST844 EST845 EST846 EST847 EST848 EST849 EST850 EST851 EST852 EST853 EST854 EST855 EST856 EST857 EST858 EST859 EST860 EST861 EST862 EST863 EST864 EST865 EST866 EST867 EST868 EST869 EST870 EST871 EST872 EST873 EST874 EST875 EST876 EST877 EST878 EST879 EST880 EST881 EST882 EST883 EST884 EST885 EST886 EST887 EST888 EST889 EST890 EST891 EST892 EST893 EST894 EST895 EST896 EST897 EST898 EST899 EST900 EST901 EST902 EST903 EST904 EST905 EST906 EST907 EST908 EST909 EST910 EST911 EST912 EST913 EST914 EST915 EST916 EST917 EST918 EST919 EST920 EST921 EST922 EST923 EST924 EST925 EST926 EST927 EST928 EST929 EST930 EST931 EST932 EST933 EST934 EST935 EST936 EST937 EST938 EST939 EST940 EST941 EST942 EST943 EST944 EST945 EST946 EST947 EST948 EST949 EST950 EST951 EST952 EST953 EST954 EST955 EST956 EST957 EST958 EST959 EST960 EST961 EST962 EST963 EST964 EST965 EST966 EST967 EST968 EST969 EST970 EST971 EST972 EST973 EST974 EST975 EST976 EST977 EST978 EST979 EST980 EST981 EST982 EST983 EST984 EST985 EST986 EST987 EST988 EST989 EST990 EST991 EST992 EST993 EST994 EST995 EST996 EST997 EST998 EST999 EST1000

Prepared by CEH, 07/13/2010, W:\Projects\00-08-06_Duwamish_R1\data\gis\Phase2 R1\Nature and Extent\Surface Sediment\Baseline Locations

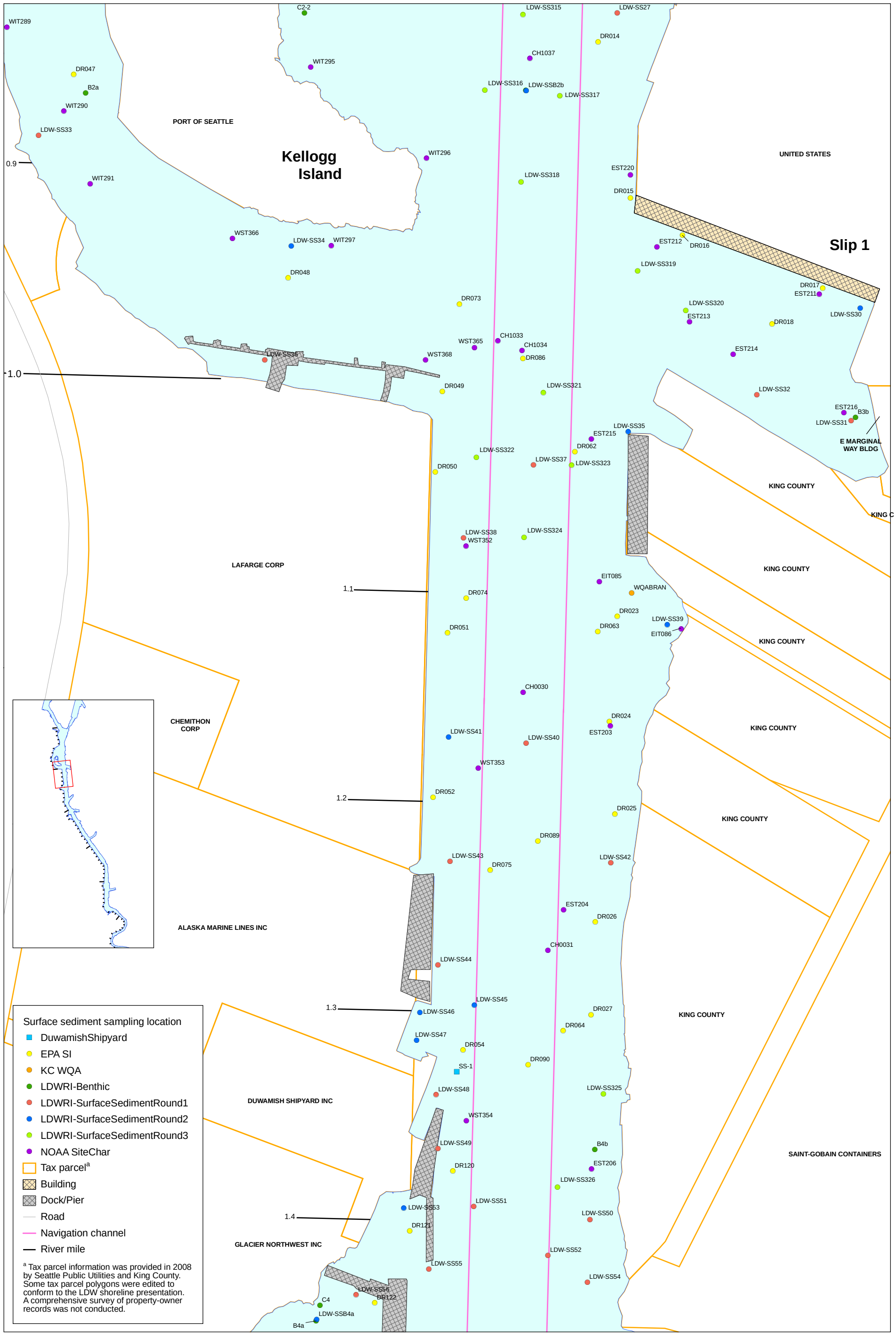
Wind Ward LLC environmental

N

0 200 400 Feet

0 50 100 Meters

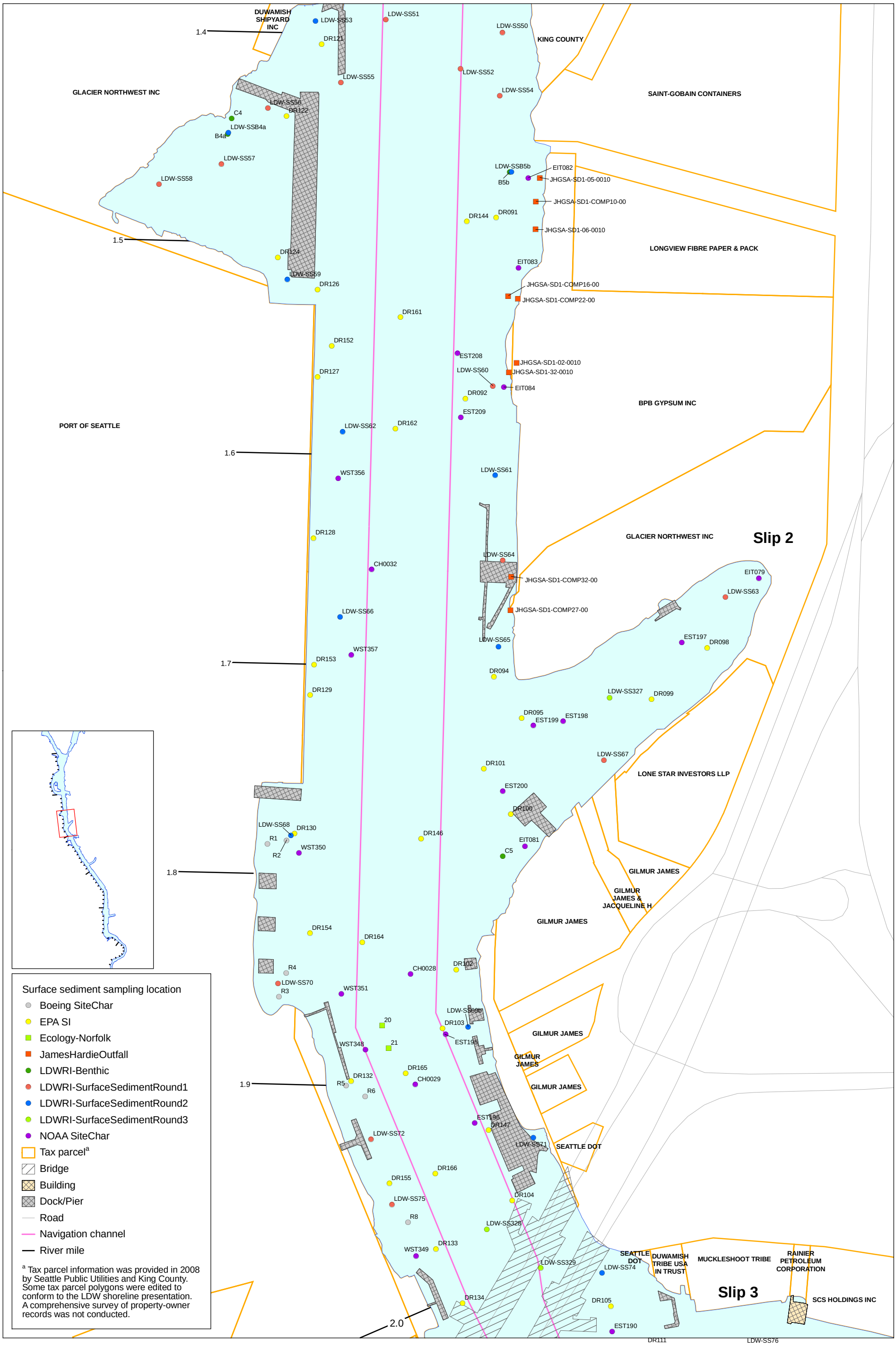
Map 4-4b. Surface sediment sampling locations, RM 0.4 to RM 0.9



Wind Ward environmental LLC

Map 4-4c. Surface sediment sampling locations, RM 0.9 to RM 1.4

Prepared by CEH, 07/13/2010; W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\Baseline Locations



Surface sediment sampling location
- Boeing SiteChar
- EPA SI
- Ecology-Norfolk
- JamesHardieOutfall
- LDWRI-Benthic
- LDWRI-SurfaceSedimentRound1
- LDWRI-SurfaceSedimentRound2
- LDWRI-SurfaceSedimentRound3
- NOAA SiteChar
- Tax parcel[a]
- Bridge
- Building
- Dock/Pier
- Road
- Navigation channel
- River mile

[a] Tax parcel information was provided in 2008 by Seattle Public Utilities and King County. Some tax parcel polygons were edited to conform to the LDW shoreline presentation. A comprehensive survey of property-owner records was not conducted.

Wind Ward environmental LLC

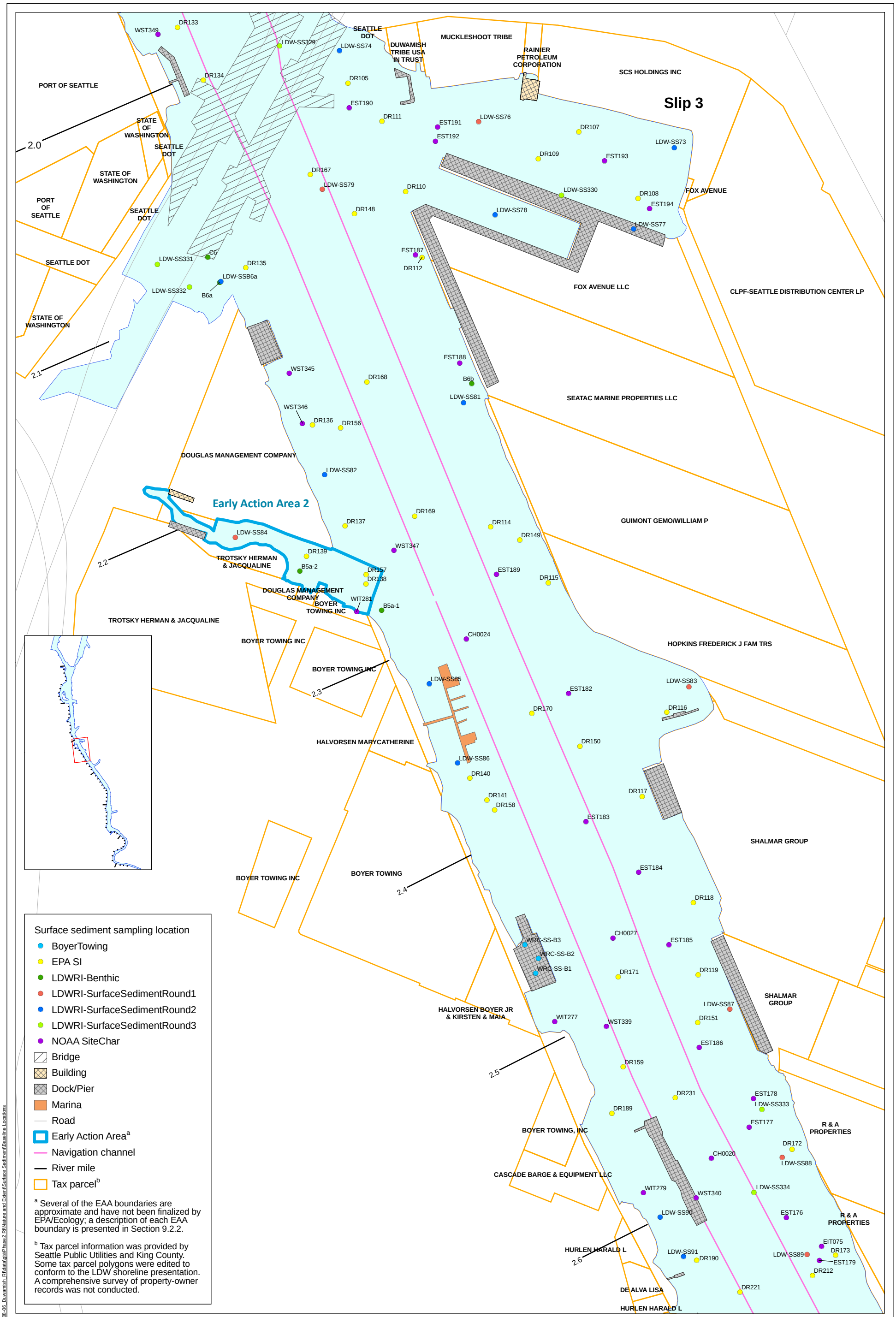
N

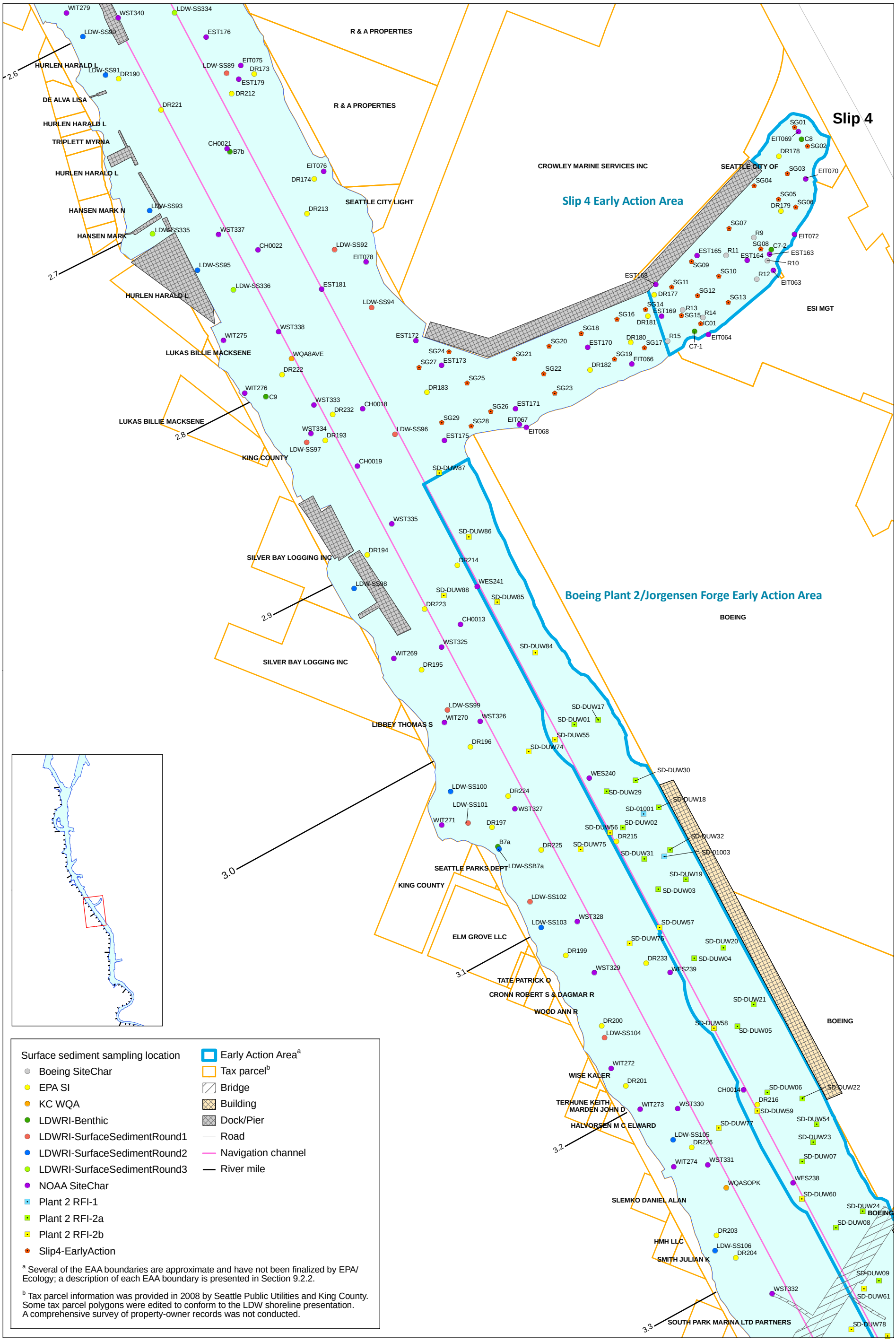
0 200 400 Feet

0 50 100 Meters

Map 4-4d. Surface sediment sampling locations, RM 1.4 to RM 2.0

Prepared by CEH, 07/13/2010; W:\Projects\00-08-06 Duwamish RI\data\gis\Phase 2 RI\Nature and Extent\Surface Sediment\Baseline Locations


Slip 3
Early Action Area 2
WST349
DR133
LDW-SS329
LDW-SS74
SEATTLE DOT
DUWAMISH TRIBE USA IN TRUST
MUCKLESHOOT TRIBE
RAINIER PETROLEUM CORPORATION
SCS HOLDINGS INC
PORT OF SEATTLE
DR134
DR105
EST190
DR111
EST191
LDW-SS76
DR107
EST192
LDW-SS73
DR109
EST193
STATE OF WASHINGTON
SEATTLE DOT
2.0
DR167
LDW-SS79
DR110
LDW-SS330
DR108
FOX AVENUE
EST194
DR148
LDW-SS78
LDW-SS77
PORT OF SEATTLE
SEATTLE DOT
EST187
DR112
C6
LDW-SS331
DR135
LDW-SSB6a
LDW-SS332
B6a
FOX AVENUE LLC
CLPF-SEATTLE DISTRIBUTION CENTER LP
STATE OF WASHINGTON
2.1
EST188
WST345
DR168
B6b
LDW-SS81
SEATAC MARINE PROPERTIES LLC
WST346
DR136
DR156
DOUGLAS MANAGEMENT COMPANY
LDW-SS82
DR169
DR137
DR114
GUIMONT GEMO/WILLIAM P
LDW-SS84
DR149
WST347
DR139
2.2
TROTSKY HERMAN & JACQUALINE
B5a-2
DR157
DR138
EST189
DR115
DOUGLAS MANAGEMENT COMPANY
BOYER TOWING INC
WIT281
B5a-1
TROTSKY HERMAN & JACQUALINE
CH0024
HOPKINS FREDERICK J FAM TRS
BOYER TOWING INC
BOYER TOWING INC
2.3
LDW-SS85
EST182
LDW-SS83
DR170
DR116
HALVORSEN MARYCATHERINE
DR150
LDW-SS86
DR140
DR117
DR141
DR158
EST183
SHALMAR GROUP
BOYER TOWING INC
BOYER TOWING
2.4
EST184
DR118
CH0027
EST185
WRC-SS-B3
WRC-SS-B2
WRC-SS-B1
DR171
DR119
SHALMAR GROUP
LDW-SS87
HALVORSEN BOYER JR & KIRSTEN & MAIA
WIT277
WST339
DR151
2.5
EST186
DR159
DR231
EST178
LDW-SS333
DR189
EST177
R & A PROPERTIES
BOYER TOWING, INC
DR172
CH0020
LDW-SS88
CASCADE BARGE & EQUIPMENT LLC
WIT279
WST340
LDW-SS334
LDW-SS90
EST176
R & A PROPERTIES
EIT075
DR173
HURLEN HARALD L
2.6
LDW-SS91
DR190
LDW-SS89
EST179
DR212
DE ALVA LISA
DR221
HURLEN HARALD L
Surface sediment sampling location
BoyerTowing
EPA SI
LDWRI-Benthic
LDWRI-SurfaceSedimentRound1
LDWRI-SurfaceSedimentRound2
LDWRI-SurfaceSedimentRound3
NOAA SiteChar
Bridge
Building
Dock/Pier
Marina
Road
Early Action Area[a]
Navigation channel
River mile
Tax parcel[b]
[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.
[b] Tax parcel information was provided by Seattle Public Utilities and King County. Some tax parcel polygons were edited to conform to the LDW shoreline presentation. A comprehensive survey of property-owner records was not conducted.
Wind Ward environmental LLC
N
0 200 400 Feet
0 50 100 Meters
Map 4-4e. Surface sediment sampling locations, RM 2.0 to RM 2.6
Prepared by CEH, 07/13/2010, W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\Baseline Locations



Surface sediment sampling location
- Boeing SiteChar
- EPA SI
- KC WQA
- LDWRI-Benthic
- LDWRI-SurfaceSedimentRound1
- LDWRI-SurfaceSedimentRound2
- LDWRI-SurfaceSedimentRound3
- NOAA SiteChar
- Plant 2 RFI-1
- Plant 2 RFI-2a
- Plant 2 RFI-2b
- Slip4-EarlyAction

- Early Action Area[a]
- Tax parcel[b]
- Bridge
- Building
- Dock/Pier
- Road
- Navigation channel
- River mile

[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/ Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[b] Tax parcel information was provided in 2008 by Seattle Public Utilities and King County. Some tax parcel polygons were edited to conform to the LDW shoreline presentation. A comprehensive survey of property-owner records was not conducted.

Wind Ward environmental LLC

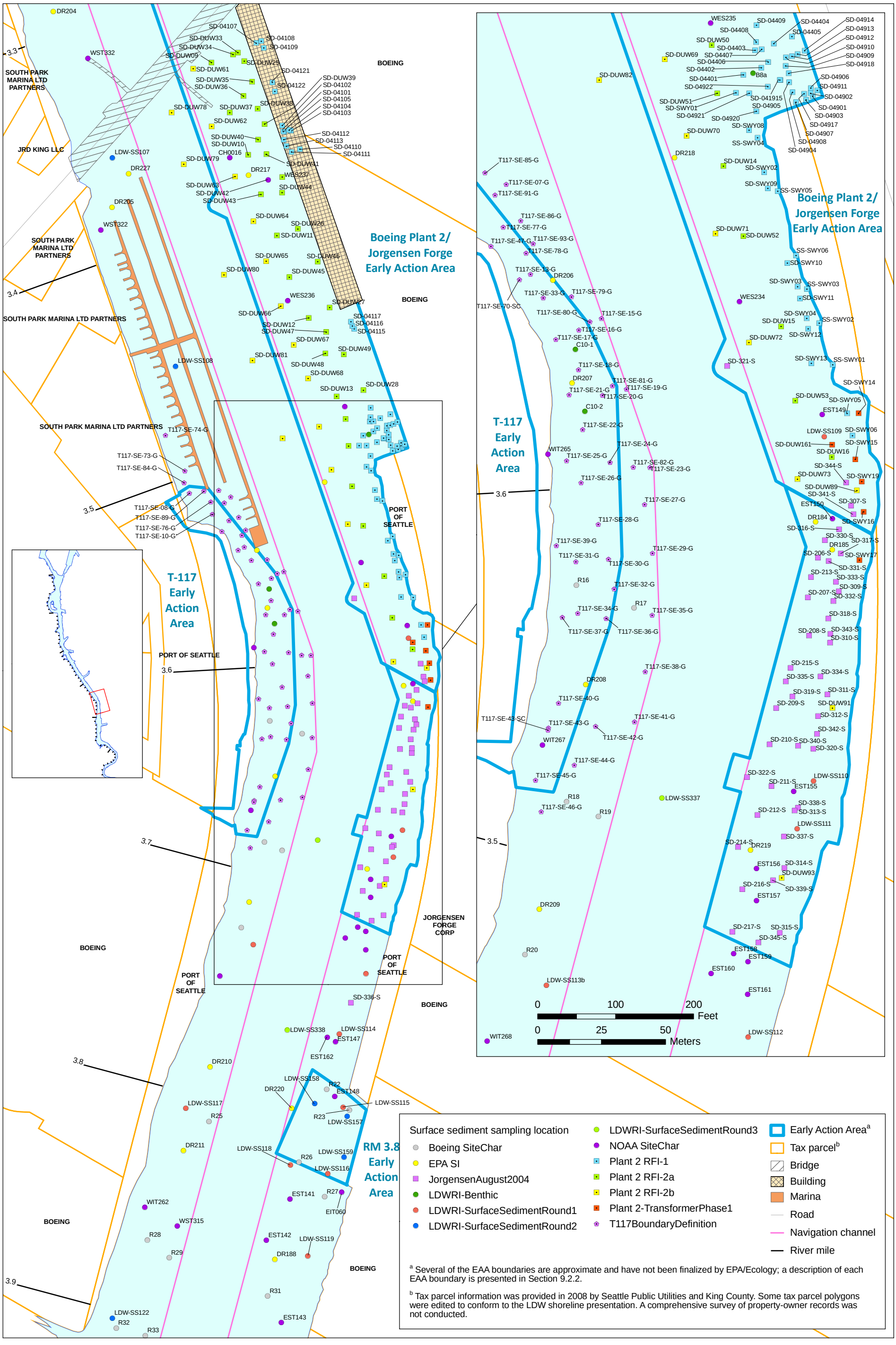
N

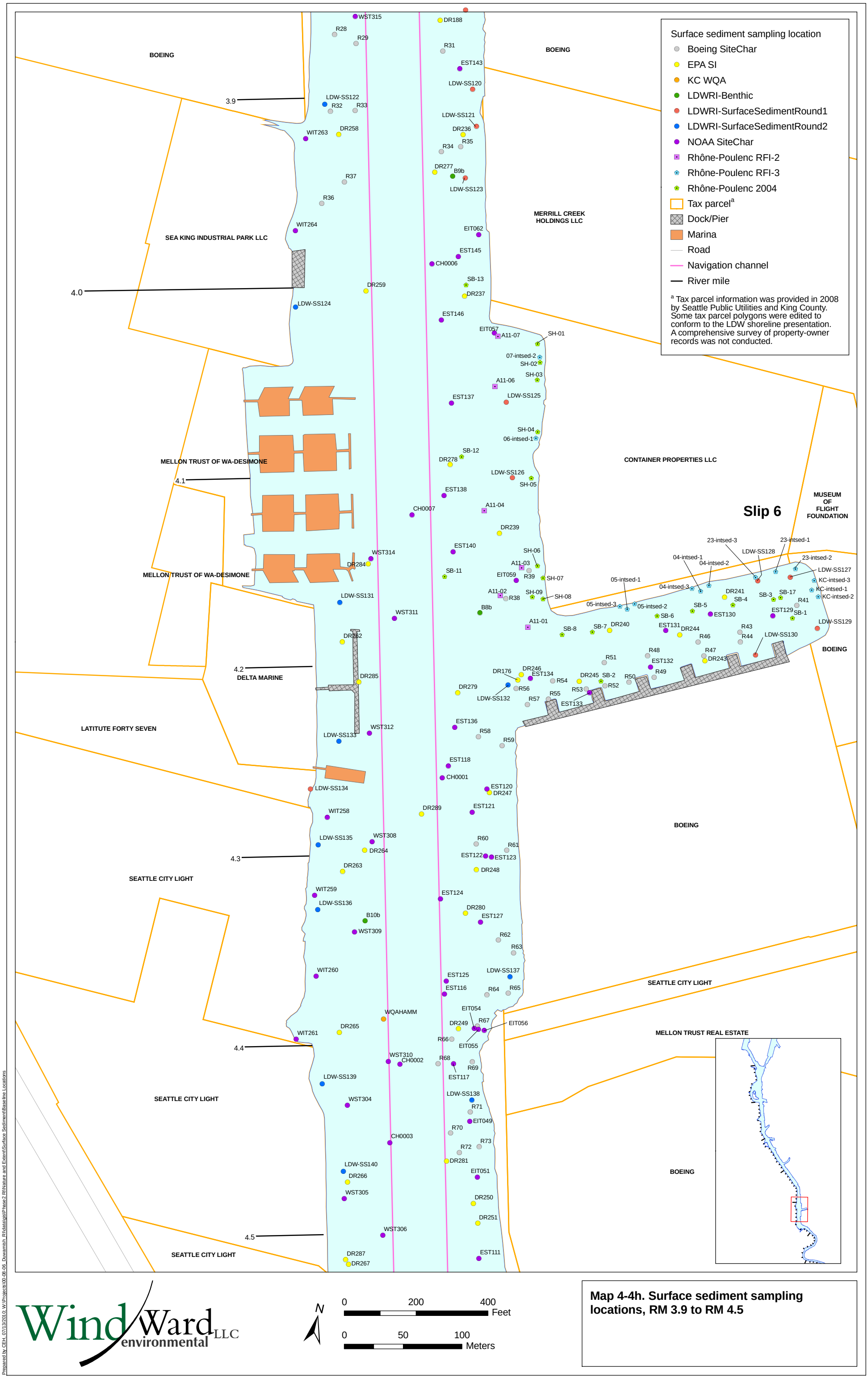
0 200 400 Feet

0 50 100 Meters

Map 4-4f. Surface sediment sampling locations, RM 2.6 to RM 3.3

Prepared by CEH, 07/13/2010; W:\Projects\00-08-06_Duwamish_R\Data\gis\Phase2 RI\Nature and Extent\Surface Sediment\Baseline Locations

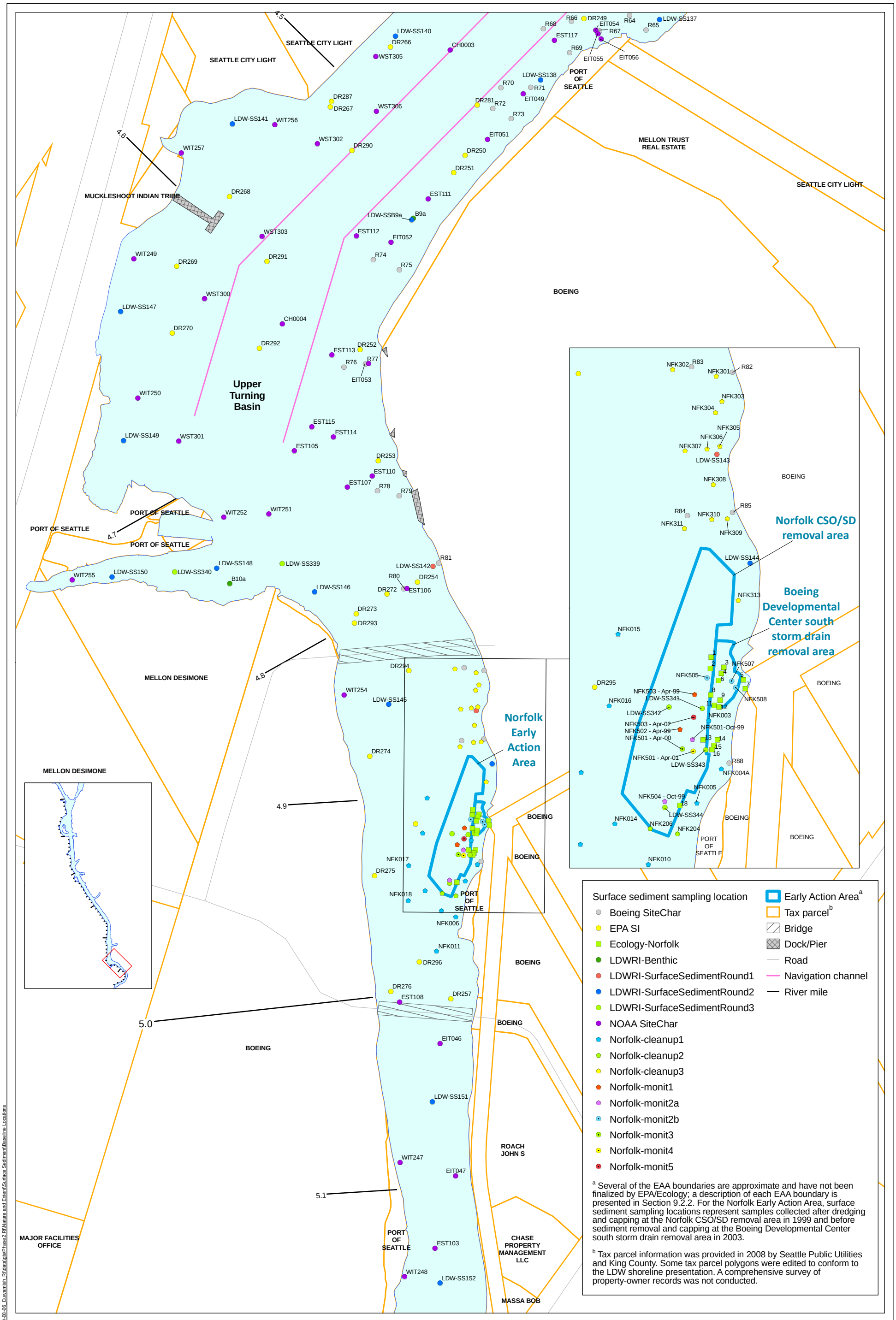

Boeing Plant 2/ Jorgensen Forge Early Action Area
T-117 Early Action Area
RM 3.8 Early Action Area
SOUTH PARK MARINA LTD PARTNERS
JRD KING LLC
BOEING
PORT OF SEATTLE
JORGENSEN FORGE CORP
3.3
3.4
3.5
3.6
3.7
3.8
3.9
Surface sediment sampling location
Boeing SiteChar
EPA SI
JorgensenAugust2004
LDWRI-Benthic
LDWRI-SurfaceSedimentRound1
LDWRI-SurfaceSedimentRound2
LDWRI-SurfaceSedimentRound3
NOAA SiteChar
Plant 2 RFI-1
Plant 2 RFI-2a
Plant 2 RFI-2b
Plant 2-TransformerPhase1
T117BoundaryDefinition
Early Action Area[a]
Tax parcel[b]
Bridge
Building
Marina
Road
Navigation channel
River mile
[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.
[b] Tax parcel information was provided in 2008 by Seattle Public Utilities and King County. Some tax parcel polygons were edited to conform to the LDW shoreline presentation. A comprehensive survey of property-owner records was not conducted.
0 100 200 Feet
0 25 50 Meters
0 200 400 Feet
0 50 100 Meters
Wind Ward environmental LLC
Map 4-4g. Surface sediment sampling locations, RM 3.3 to RM 3.9
Prepared by CEH, 07/13/2010; W:\Projects\00-08-06 Duwamish R\data\gis\Phase 2 R\Nature and Extent\Surface Sediment\Baseline Locations

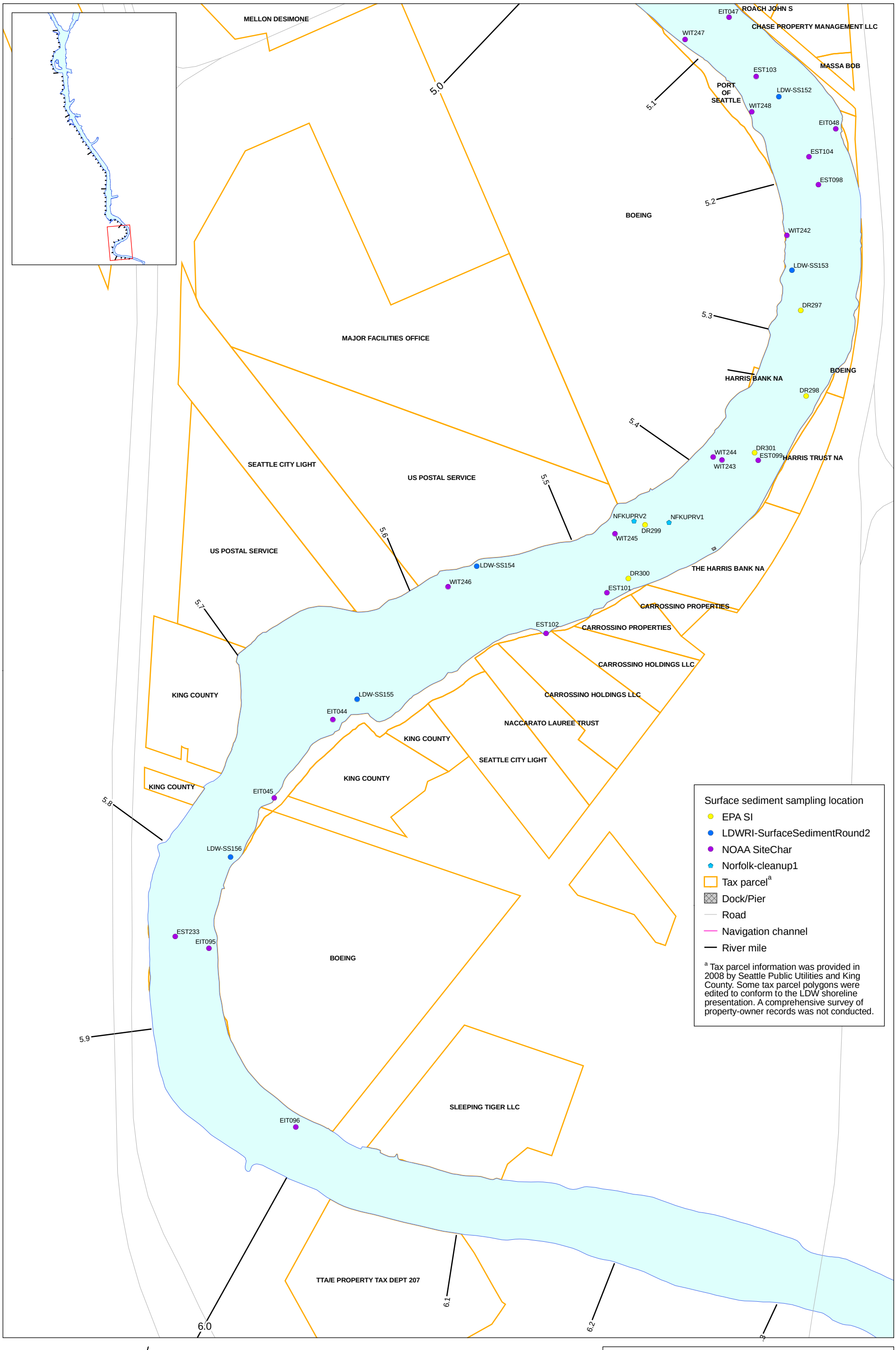


Wind Ward LLC environmental

Map 4-4h. Surface sediment sampling locations, RM 3.9 to RM 4.5

Prepared by CEH, 07/13/2010, W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase 2 RI\Nature and Extent\Surface Sediment\Baseline Locations

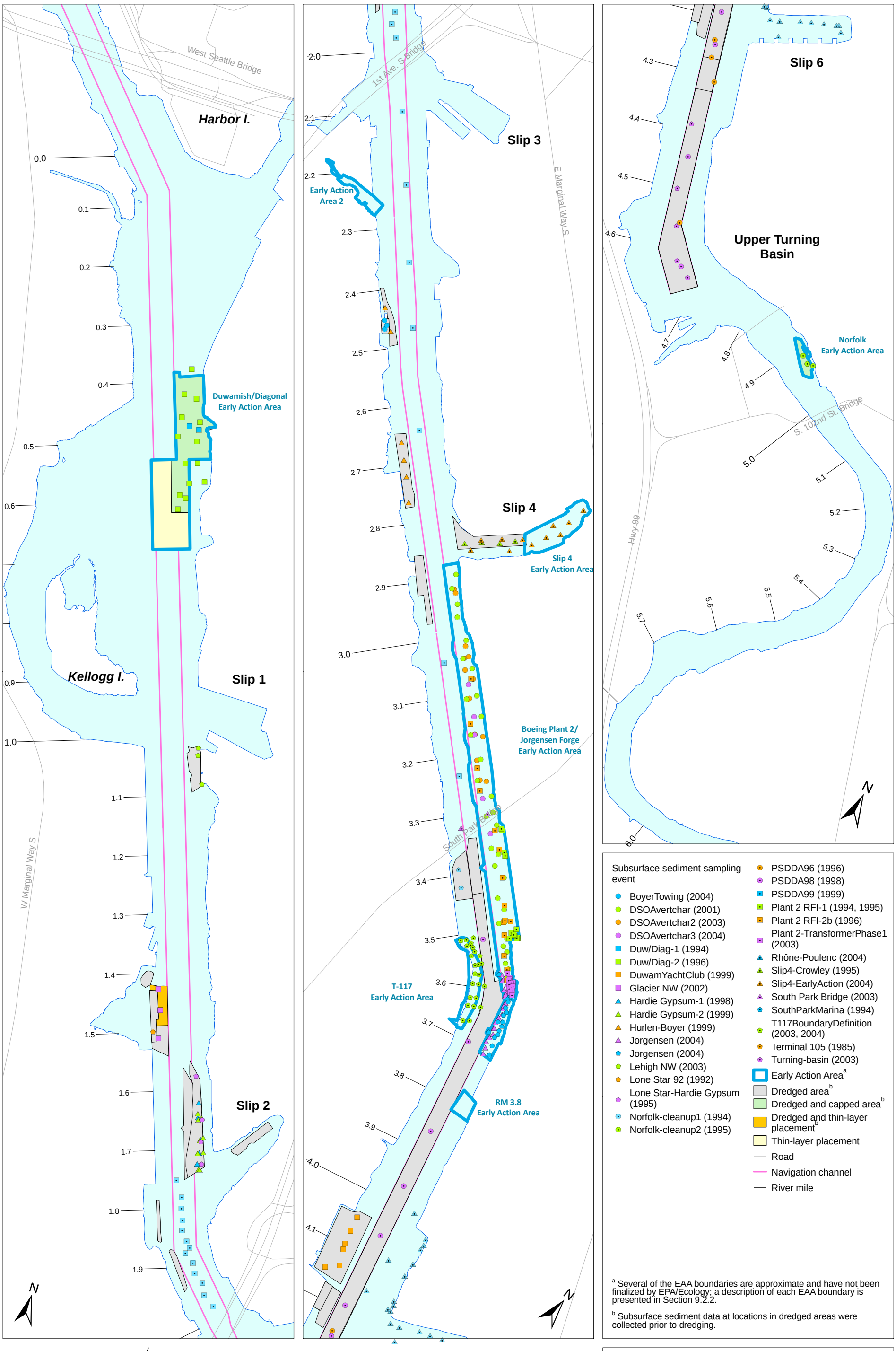

SEATTLE CITY LIGHT
MUCKLESHOOT INDIAN TRIBE
MELLON TRUST REAL ESTATE
PORT OF SEATTLE
BOEING
Upper Turning Basin
MELLON DESIMONE
Norfolk Early Action Area
Norfolk CSO/SD removal area
Boeing Developmental Center south storm drain removal area
ROACH JOHN S
CHASE PROPERTY MANAGEMENT LLC
MAJOR FACILITIES OFFICE
MASSA BOB
4.5
4.6
4.7
4.8
4.9
5.0
5.1
LDW-SS140
LDW-SS137
LDW-SS138
LDW-SS141
LDW-SS147
LDW-SS149
LDW-SS148
LDW-SS339
LDW-SS150
LDW-SS340
LDW-SS142
LDW-SS146
LDW-SSB9a
LDW-SS145
LDW-SS151
LDW-SS152
LDW-SS143
LDW-SS144
LDW-SS341
LDW-SS342
LDW-SS343
LDW-SS344
B9a
B10a
CH0003
CH0004
WST305
WST306
WST302
WST303
WST300
WST301
EST117
EST111
EST112
EST113
EST115
EST114
EST105
EST107
EST108
EST106
EST103
DR249
DR266
DR287
DR267
DR290
DR268
DR269
DR291
DR270
DR292
DR252
DR253
DR254
DR272
DR273
DR293
DR294
DR274
DR275
DR276
DR257
DR281
DR250
DR251
DR295
EIT054
EIT055
EIT056
EIT051
EIT052
EIT053
EIT049
EIT046
EIT047
WIT256
WIT257
WIT249
WIT250
WIT252
WIT251
WIT255
WIT254
WIT247
WIT248
R64
R65
R66
R67
R68
R69
R70
R71
R72
R73
R74
R75
R76
R77
R78
R79
R80
R81
R82
R83
R84
R85
R88
NFK302
NFK301
NFK303
NFK304
NFK305
NFK306
NFK307
NFK308
NFK310
NFK311
NFK309
NFK313
NFK015
NFK505
NFK507
NFK503 - Apr-99
NFK508
NFK016
NFK503 - Apr-02
NFK502 - Apr-99
NFK501 - Apr-00
NFK501-Oct-99
NFK003
NFK501 - Apr-01
NFK004A
NFK005
NFK504 - Oct-99
NFK014
NFK206
NFK204
NFK010
NFK017
NFK018
NFK006
NFK011
PORT OF SEATTLE
BOEING
Surface sediment sampling location
Boeing SiteChar
EPA SI
Ecology-Norfolk
LDWRI-Benthic
LDWRI-SurfaceSedimentRound1
LDWRI-SurfaceSedimentRound2
LDWRI-SurfaceSedimentRound3
NOAA SiteChar
Norfolk-cleanup1
Norfolk-cleanup2
Norfolk-cleanup3
Norfolk-monit1
Norfolk-monit2a
Norfolk-monit2b
Norfolk-monit3
Norfolk-monit4
Norfolk-monit5
Early Action Area[a]
Tax parcel[b]
Bridge
Dock/Pier
Road
Navigation channel
River mile
[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2. For the Norfolk Early Action Area, surface sediment sampling locations represent samples collected after dredging and capping at the Norfolk CSO/SD removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain removal area in 2003.
[b] Tax parcel information was provided in 2008 by Seattle Public Utilities and King County. Some tax parcel polygons were edited to conform to the LDW shoreline presentation. A comprehensive survey of property-owner records was not conducted.
Wind Ward environmental LLC
0 200 400 Feet
0 50 100 Meters
Map 4-4i. Surface sediment sampling locations, RM 4.5 to RM 5.0
Prepared by CEH, 07/13/2010, W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\Baseline Locations



Wind Ward environmental LLC

Map 4-4j. Surface sediment sampling locations, RM 5.1 to RM 6.0

Prepared by CEH, 07/13/2010, W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase 2 RI\Nature and Extent\Surface Sediment\Baseline Locations



Subsurface sediment sampling event

- BoyerTowing (2004)
- DSOAvertchar (2001)
- DSOAvertchar2 (2003)
- DSOAvertchar3 (2004)
- Duw/Diag-1 (1994)
- Duw/Diag-2 (1996)
- DuwamYachtClub (1999)
- Glacier NW (2002)
- Hardie Gypsum-1 (1998)
- Hardie Gypsum-2 (1999)
- Hurlen-Boyer (1999)
- Jorgensen (2004)
- Jorgensen (2004)
- Lehigh NW (2003)
- Lone Star 92 (1992)
- Lone Star-Hardie Gypsum (1995)
- Norfolk-cleanup1 (1994)
- Norfolk-cleanup2 (1995)
- PSDDA96 (1996)
- PSDDA98 (1998)
- PSDDA99 (1999)
- Plant 2 RFI-1 (1994, 1995)
- Plant 2 RFI-2b (1996)
- Plant 2-TransformerPhase1 (2003)
- Rhône-Poulenc (2004)
- Slip4-Crowley (1995)
- Slip4-EarlyAction (2004)
- South Park Bridge (2003)
- SouthParkMarina (1994)
- T117BoundaryDefinition (2003, 2004)
- Terminal 105 (1985)
- Turning-basin (2003)
- Early Action Area[a]
- Dredged area[b]
- Dredged and capped area[b]
- Dredged and thin-layer placement[b]
- Thin-layer placement
- Road
- Navigation channel
- River mile

[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

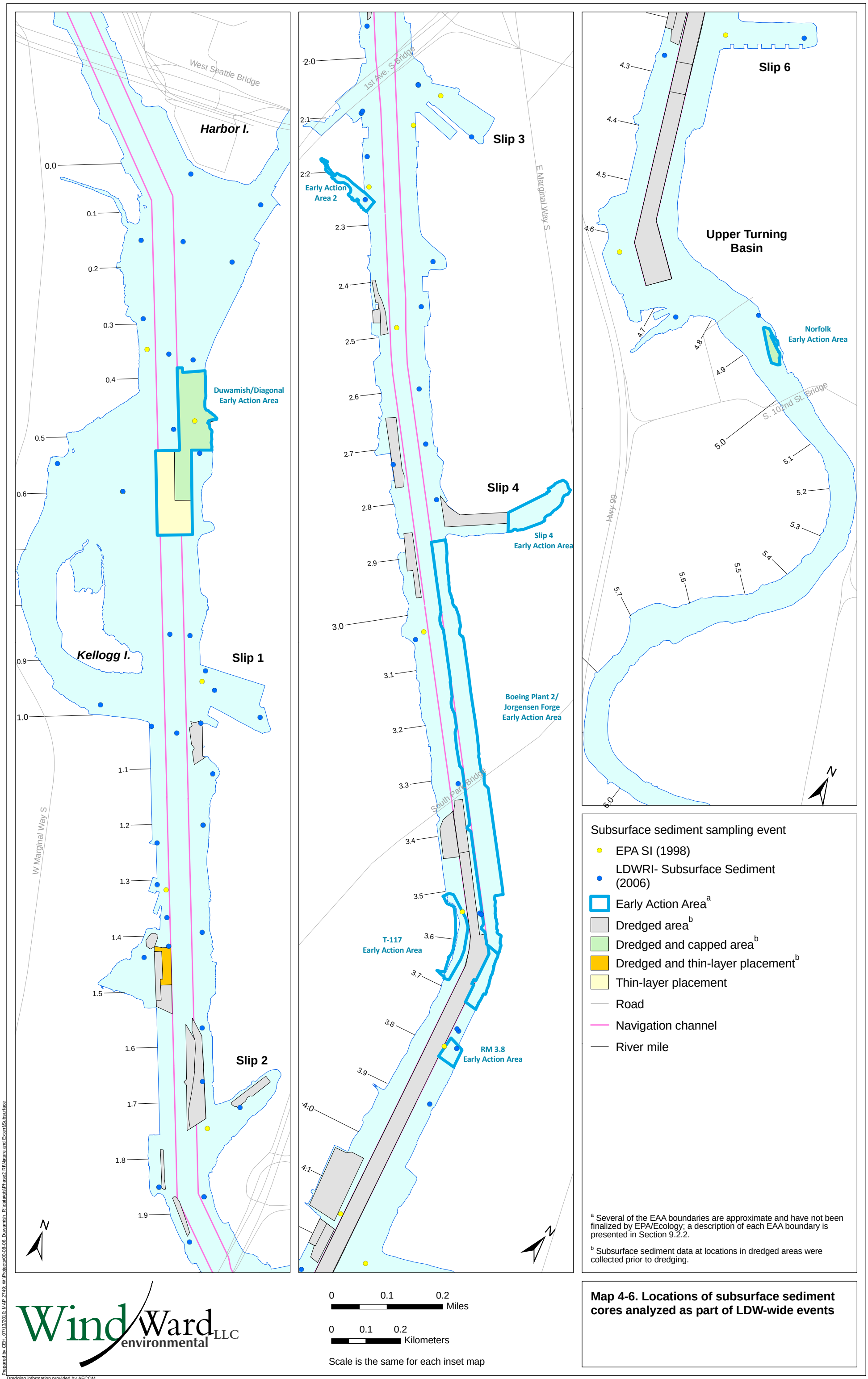
[b] Subsurface sediment data at locations in dredged areas were collected prior to dredging.

Map 4-5. Locations of subsurface sediment cores analyzed as part of discrete events

Wind Ward environmental LLC

Prepared by CEH, 07/13/2010, MAP 2750; W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Subsurface

Dredging information provided by AECOM.



Subsurface sediment sampling event

- EPA SI (1998)
- LDWRI- Subsurface Sediment (2006)
- Early Action Area[a]
- Dredged area[b]
- Dredged and capped area[b]
- Dredged and thin-layer placement[b]
- Thin-layer placement
- Road
- Navigation channel
- River mile

[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[b] Subsurface sediment data at locations in dredged areas were collected prior to dredging.

0 0.1 0.2 Miles

0 0.1 0.2 Kilometers

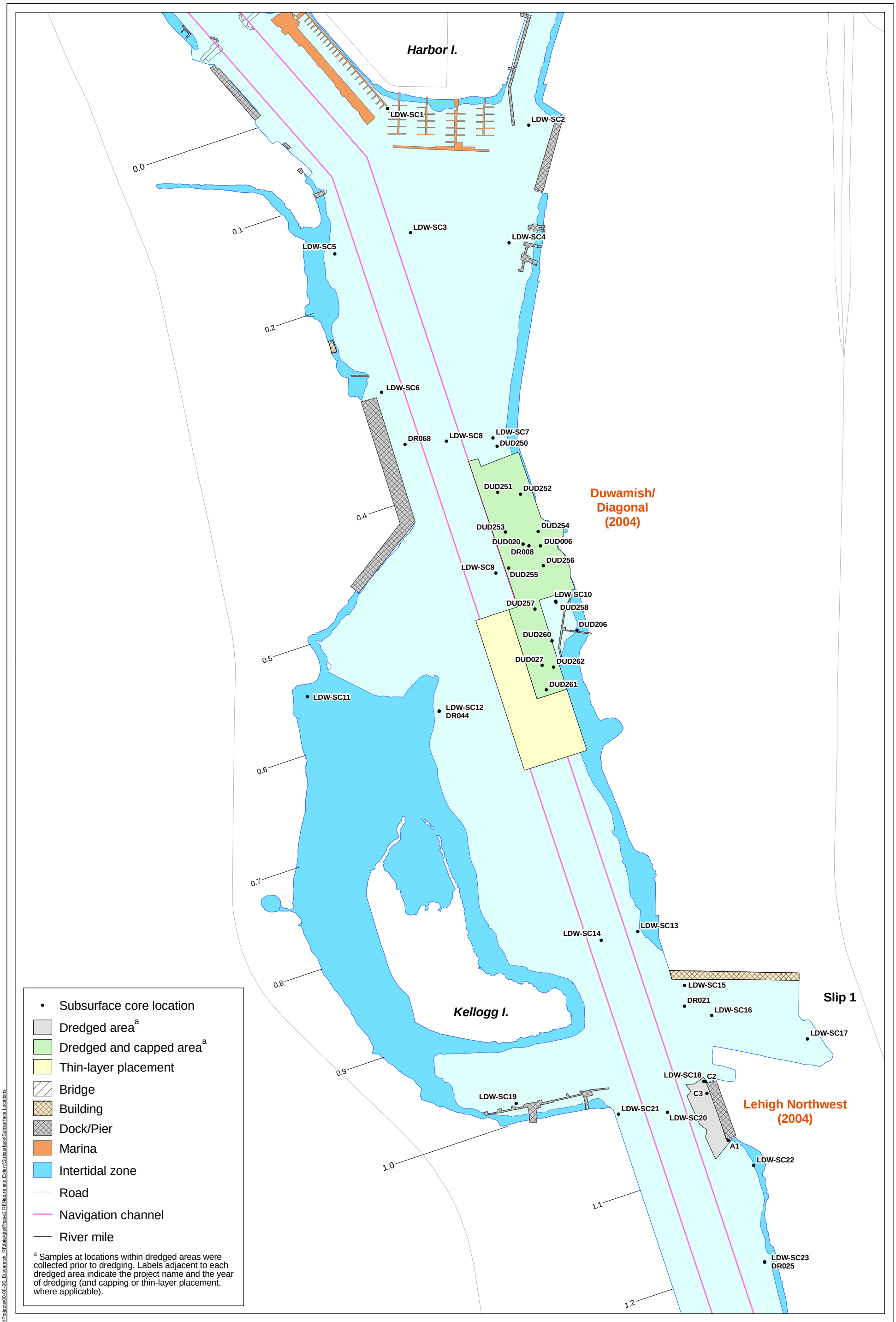
Scale is the same for each inset map

Map 4-6. Locations of subsurface sediment cores analyzed as part of LDW-wide events

Wind Ward environmental LLC

Prepared by CEH, 07/13/2010; MAP 2749; W:\Projects\00-08-06 Duwamish RI\data\gis\Phase2 RI\Nature and Extent\Subsurface

Dredging information provided by AECOM.



Map 4-7a. Subsurface sediment core locations and dredging events, RM 0.0 to RM 1.2

Wind Ward LLC environmental

Prepared by CEH 07/13/2010; MAP 2844; W:\Projects\00-08-06_Duwamish_R1\data\gis\Phase2 R1\Nature and Extent\Subsurface\Subsurface Locations

Dredging information provided by AECOM.

1.2
LDW-SC23
DR025
LDW-SC24
1.3
LDW-SC25
DR054
Duwamish Shipyard
LDW-SC26
LDW-SC27
1.4
LDW-SC28
SCDMMU3
SCDMMU3R
LDW-SC29
Lone Star Northwest
(1986 & 1993)
SCDMMU2R
SCDMMU2
Glacier NW
(2005)
1.5
C-1
SCDMMU1R
SCDMMU1
LDW-SC30
c-4
Lone Star-Hardie/
Kaiser (1996)
1.6
James Hardie
(1999)
Slip 2
1.7
LDW-SC32
Glacier Ready-Mix
(2001)
DR101
S1
S2
S3
S4
S5
1.8
LDW-SC203
S6
B1
LDW-SC201
Terminal 115
(1993)
S7
S8
1.9
S9
S10
S11
LDW-SC35
S12
LDW-SC202
LDW-SC36
DR106
Slip 3
2.0
LDW-SC37
B2
DR112
LDW-SC38a
LDW-SC38b
2.1
LDW-SC39
S13
DR137
2.2
LDW-SC40
2.3
LDW-SC41
S14
Boyer
(1998)
LDW-SC42
2.4
C5
S15
WRC-SS-B3
WRC-SS-B2
1
A
2
B
2b
c-3
LDW-SC31
C
3
3
c-2
4
D
5
c-1
5.2
0 50 Feet

- Subsurface core location
- Dredged area[a]
- Dredged and thin-layer placement[a]
- Bridge
- Building
- Dock/Pier
- Marina
- Intertidal zone
- Road
- Navigation channel
- River mile

[a] Samples at locations within dredged areas were collected prior to dredging. Labels adjacent to each dredged area indicate the project name and the year of dredging (and capping or thin-layer placement, where applicable).

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N

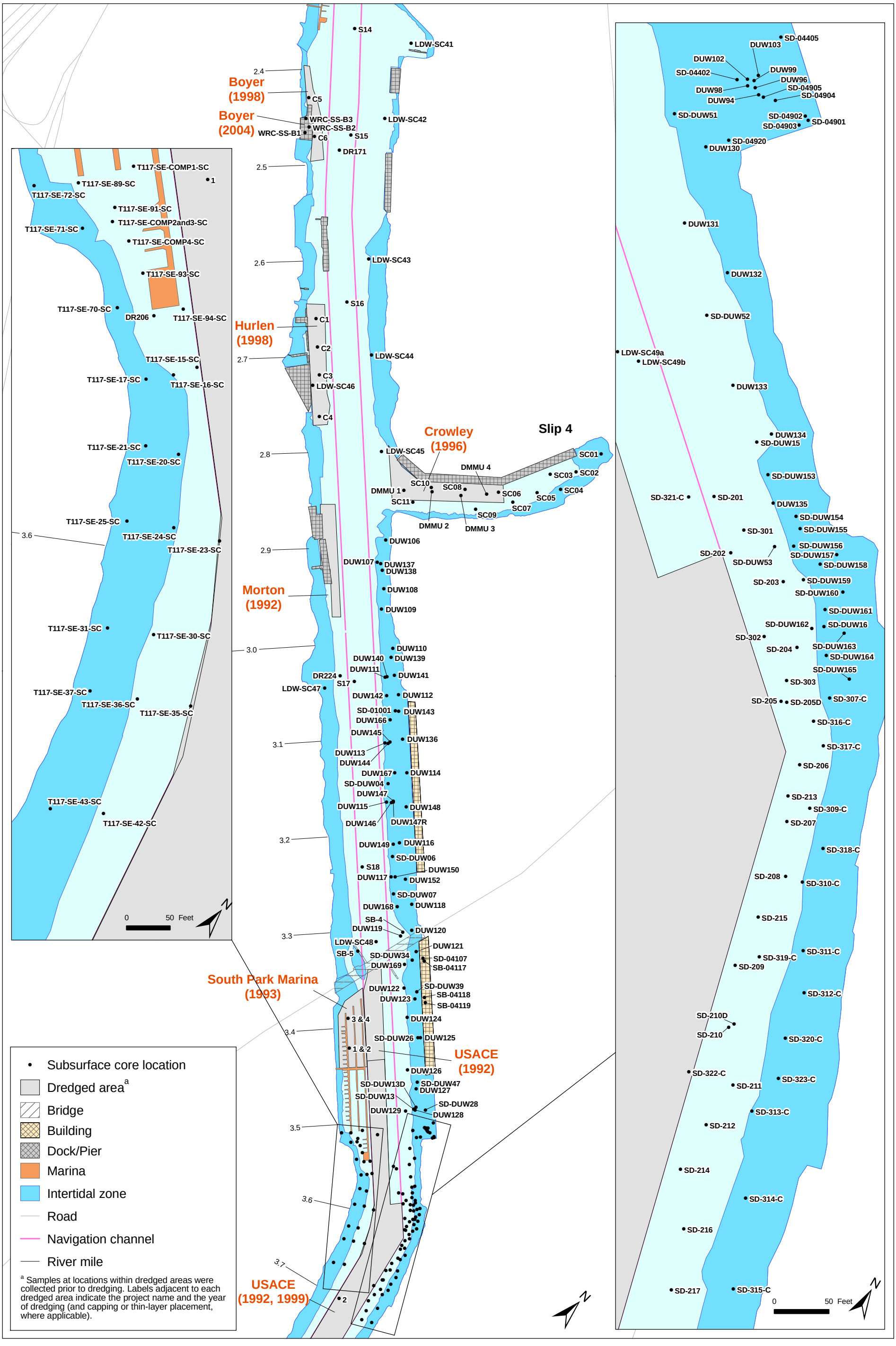
0 400 800 Feet

0 100 200 Meters

Map 4-7b. Subsurface sediment core locations and dredging events, RM 1.2 to RM 2.4

Prepared by CEH, 07/13/2010, MAP 2844, W:\Projects\00-08-06 Duwamish Rt\data\gis\Phase2 RI\Nature and Extent\Subsurface\Subsurface Locations

Dredging information provided by AECOM.

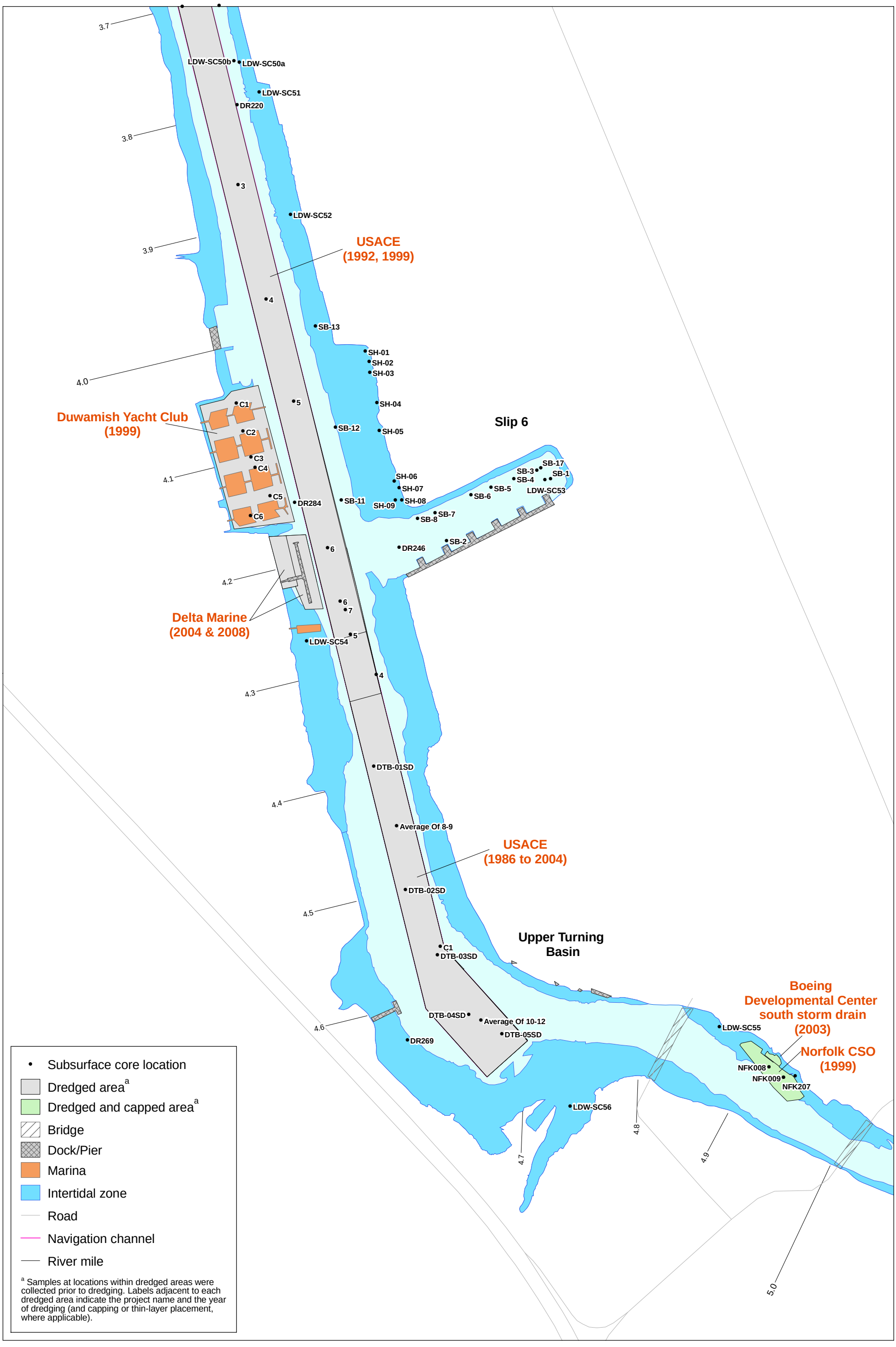


Wind Ward LLC environmental

Map 4-7c. Subsurface sediment core locations and dredging events, RM 2.4 to RM 3.7

Prepared by CEH, 07/13/2010, MAP 2844, W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Subsurface Locations

Dredging information provided by AECOM.

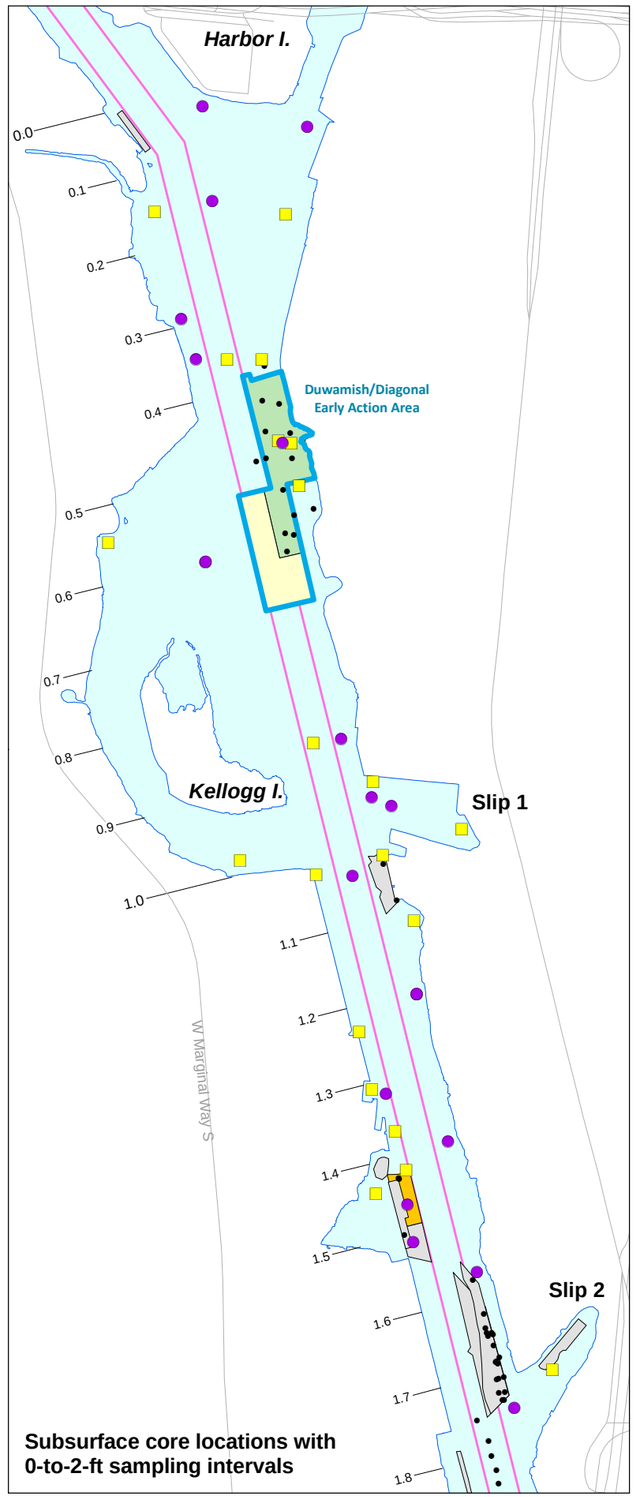


Map 4-7d. Subsurface sediment core locations and dredging events, RM 3.7 to RM 5.0

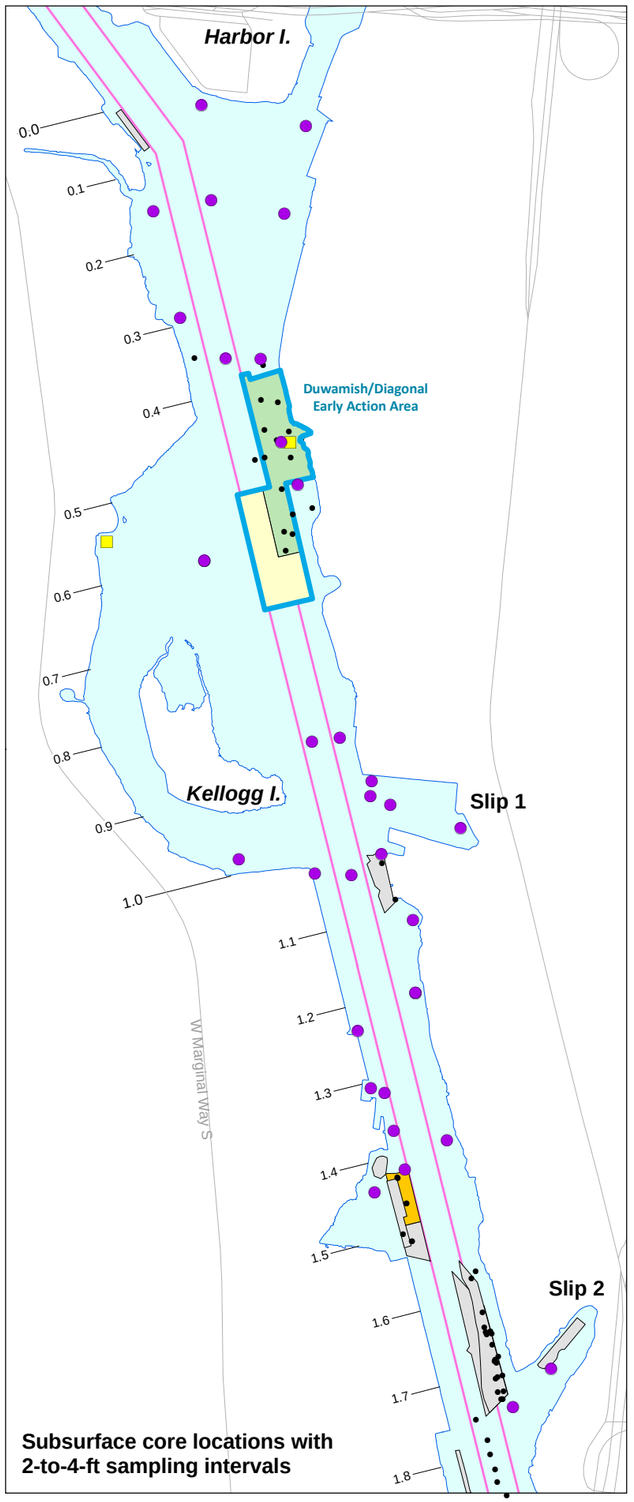
Wind Ward environmental LLC

Prepared by CEH, 07/13/2010; Map 2844; W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Subsurface\Subsurface Locations

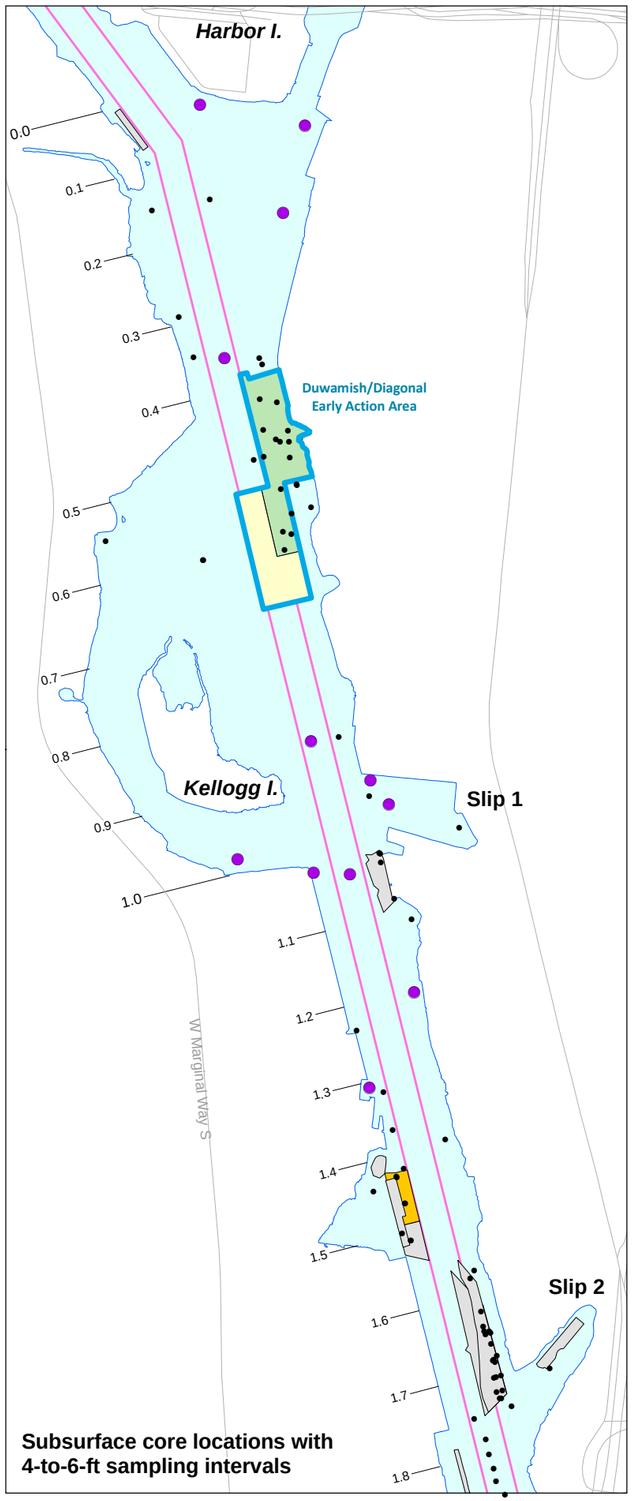
Dredging information provided by AECOM.



Subsurface core locations with 0-to-2-ft sampling intervals



Subsurface core locations with 2-to-4-ft sampling intervals



Subsurface core locations with 4-to-6-ft sampling intervals

- Subsurface core location with empirical data for specified core interval
- Subsurface core location with calculated data for specified core interval[a]
- Subsurface core location with no data for specified core interval
- Early Action Area[b]
- Dredged area[c]
- Dredged and capped area[c]
- Dredged and thin-layer placement[c]
- Thin-layer placement
- Road
- Navigation channel
- River mile

[a] If data were available for 1-foot intervals, concentrations were averaged for an estimated concentration in each 2-foot interval. The 0-to-2-foot interval was calculated from the 0-to-1-foot and 1-to-2-foot intervals, the 2-to-4-foot interval was calculated from the 2-to-3-foot and 3-to-4-foot intervals, and the 4-to-6-foot interval was calculated from the 4-to-5-foot and 5-to-6-foot intervals.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] Subsurface sediment data at locations in dredged areas were collected prior to dredging.

N

0 0.1 0.2 Kilometers

0 0.1 0.2 Miles

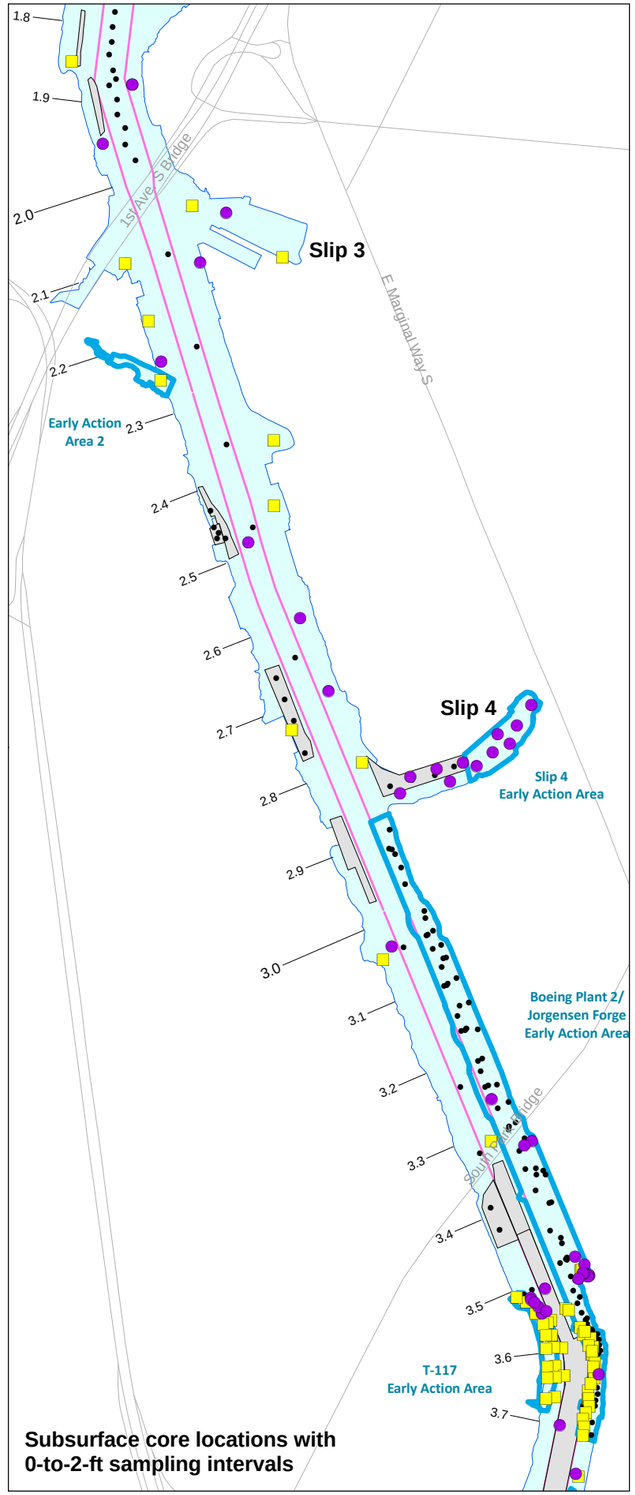
Scale is the same for each map frame

Map 4-8a. Locations with subsurface sediment data within the 0-to-2-ft, 2-to-4-ft, and 4-to-6-ft sampling intervals, RM 0.0 to RM 1.8

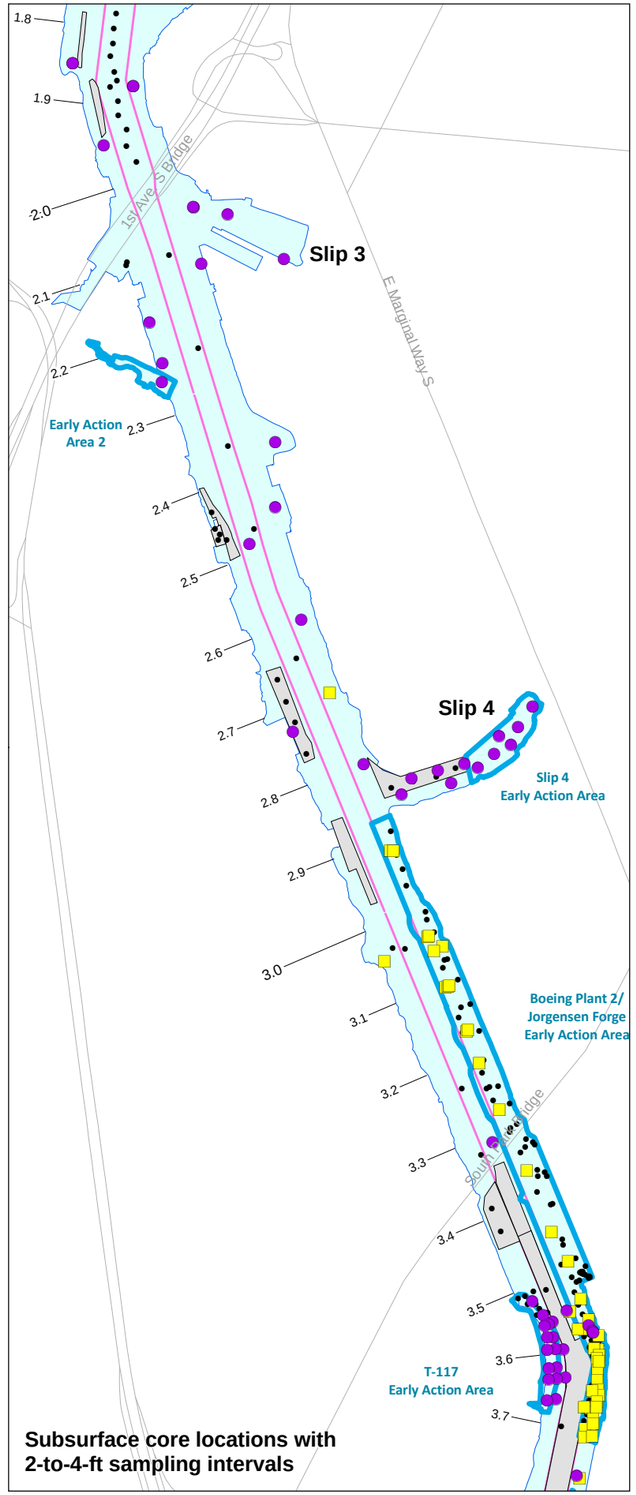
Wind Ward LLC environmental

Prepared by CEH, 07/13/2010, MAP 2488, W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Depth Interval

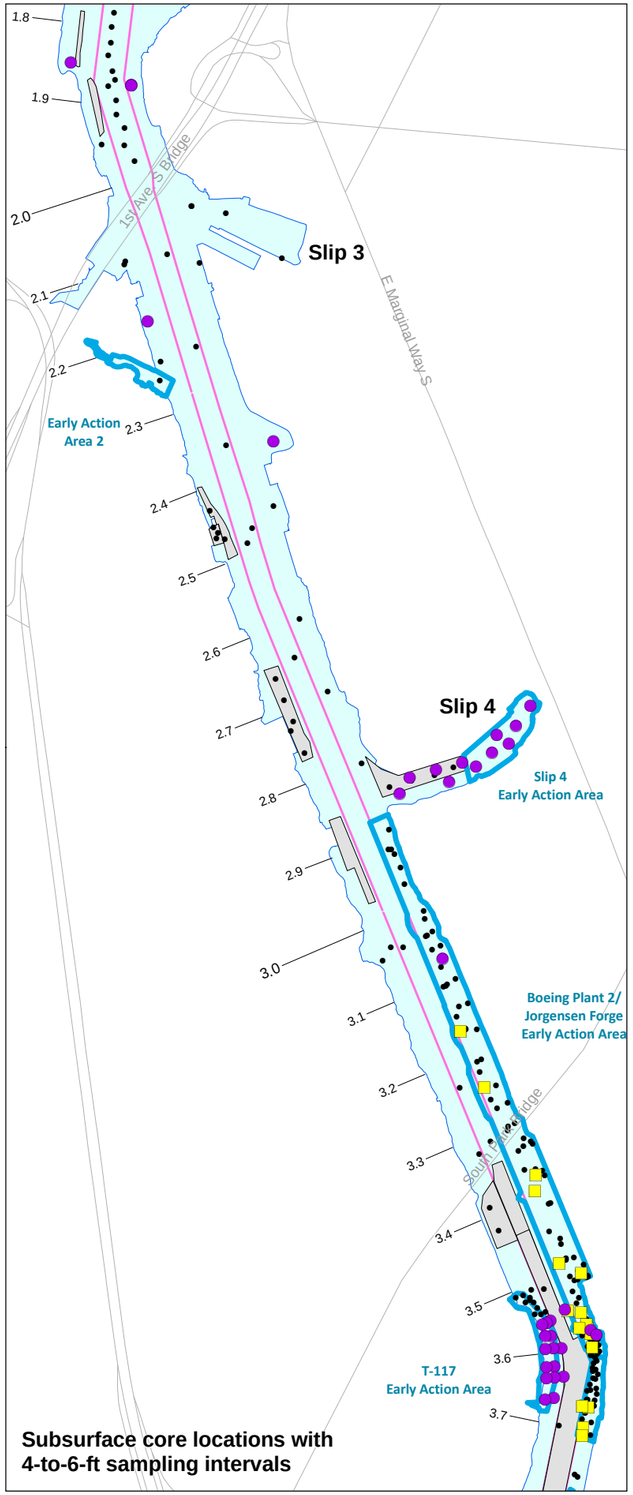
Dredging information provided by AECOM.



Subsurface core locations with 0-to-2-ft sampling intervals



Subsurface core locations with 2-to-4-ft sampling intervals



Subsurface core locations with 4-to-6-ft sampling intervals

- Subsurface core location with empirical data for specified core interval
- Subsurface core location with calculated data for specified core interval[a]
- Subsurface core location with no data for specified core interval
- Early Action Area[b]
- Dredged area[c]
- Road
- Navigation channel
- River mile

[a] If data were available for 1-foot intervals, concentrations were averaged for an estimated concentration in each 2-foot interval. The 0-to-2-foot interval was calculated from the 0-to-1-foot and 1-to-2-foot intervals, the 2-to-4-foot interval was calculated from the 2-to-3-foot and 3-to-4-foot intervals, and the 4-to-6-foot interval was calculated from the 4-to-5-foot and 5-to-6-foot intervals.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] Subsurface sediment data at locations in dredged areas were collected prior to dredging.

0 0.1 0.2 Kilometers

0 0.1 0.2 Miles

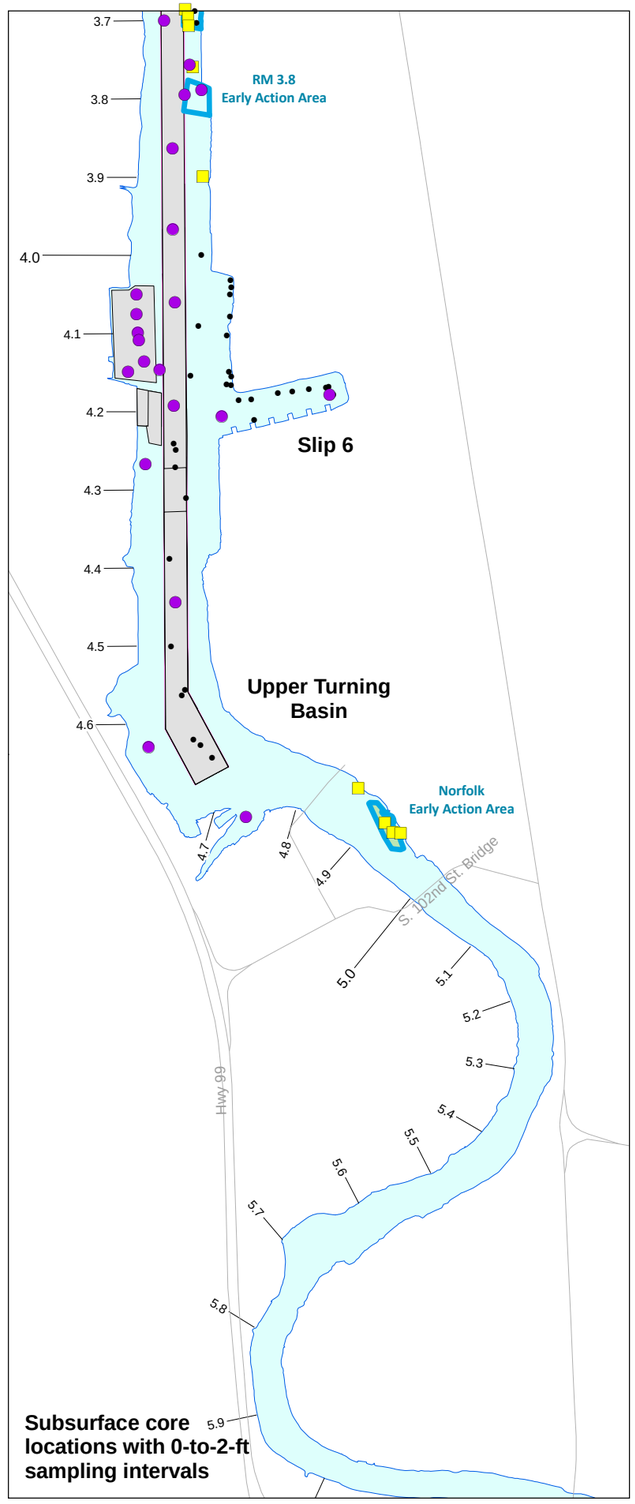
Scale is the same for each map frame

Map 4-8b. Locations with subsurface sediment data within the 0-to-2-ft, 2-to-4-ft, and 4-to-6-ft sampling intervals, RM 1.8 to RM 3.7

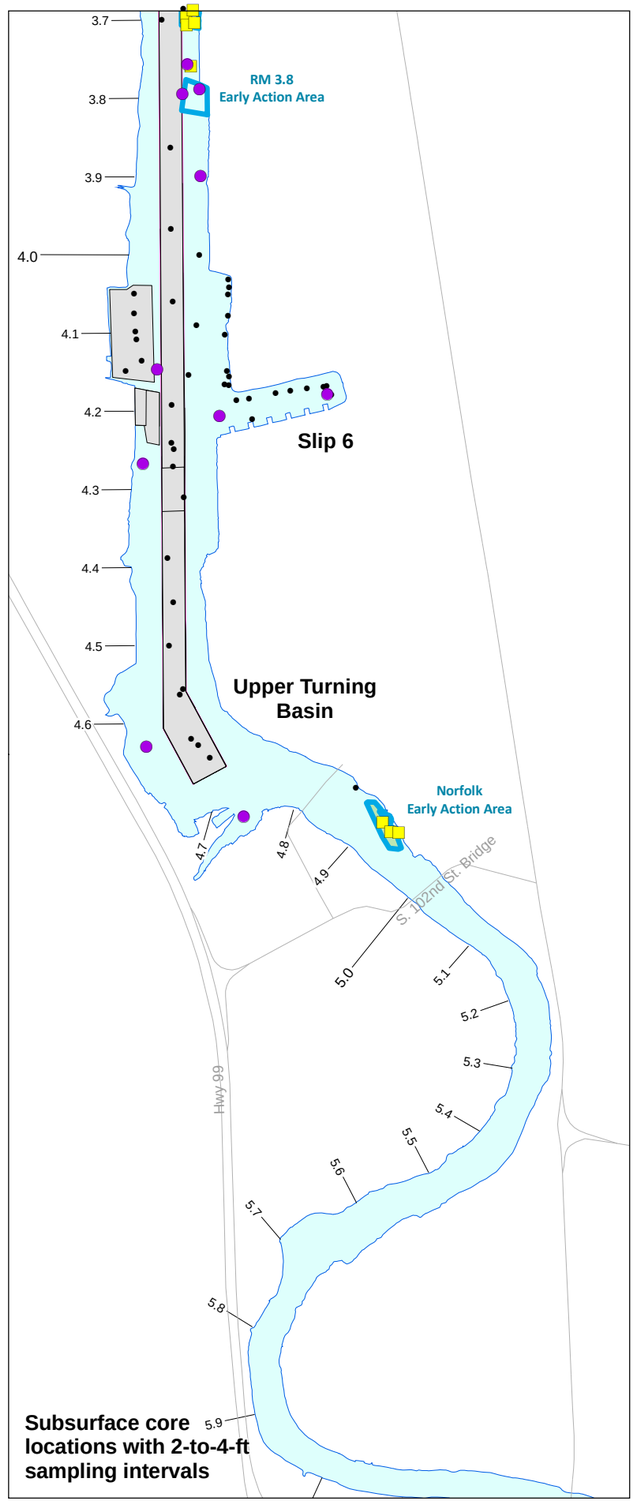
Wind Ward LLC environmental

Prepared by: CEH, 07/13/2010, MAP 2683, W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Depth Interval

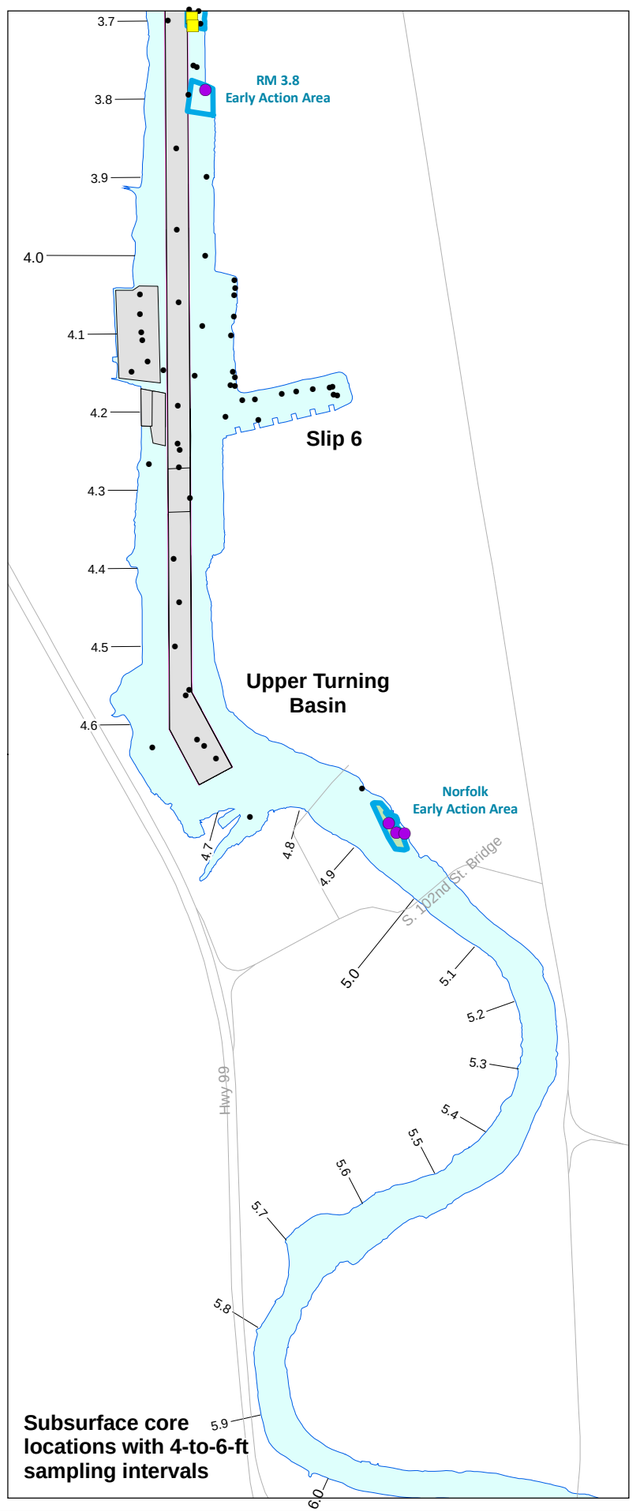
Dredging information provided by AECOM.



Subsurface core locations with 0-to-2-ft sampling intervals



Subsurface core locations with 2-to-4-ft sampling intervals



Subsurface core locations with 4-to-6-ft sampling intervals

- Subsurface core location with empirical data for specified core interval
- Subsurface core location with calculated data for specified core interval[a]
- Subsurface core location with no data for specified core interval
- Early Action Area[b]
- Dredged area[c]
- Dredged and capped area[c]
- Road
- Navigation channel
- River mile

[a] If data were available for 1-foot intervals, concentrations were averaged for an estimated concentration in each 2-foot interval. The 0-to-2-foot interval was calculated from the 0-to-1-foot and 1-to-2-foot intervals, the 2-to-4-foot interval was calculated from the 2-to-3-foot and 3-to-4-foot intervals, and the 4-to-6-foot interval was calculated from the 4-to-5-foot and 5-to-6-foot intervals.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] Subsurface sediment data at locations in dredged areas were collected prior to dredging.

N

0 0.1 0.2 Kilometers

0 0.1 0.2 Miles

Scale is the same for each map frame

Map 4-8c. Locations with subsurface sediment data within the 0-to-2-ft, 2-to-4-ft, and 4-to-6-ft sampling intervals, RM 3.7 to RM 6.0

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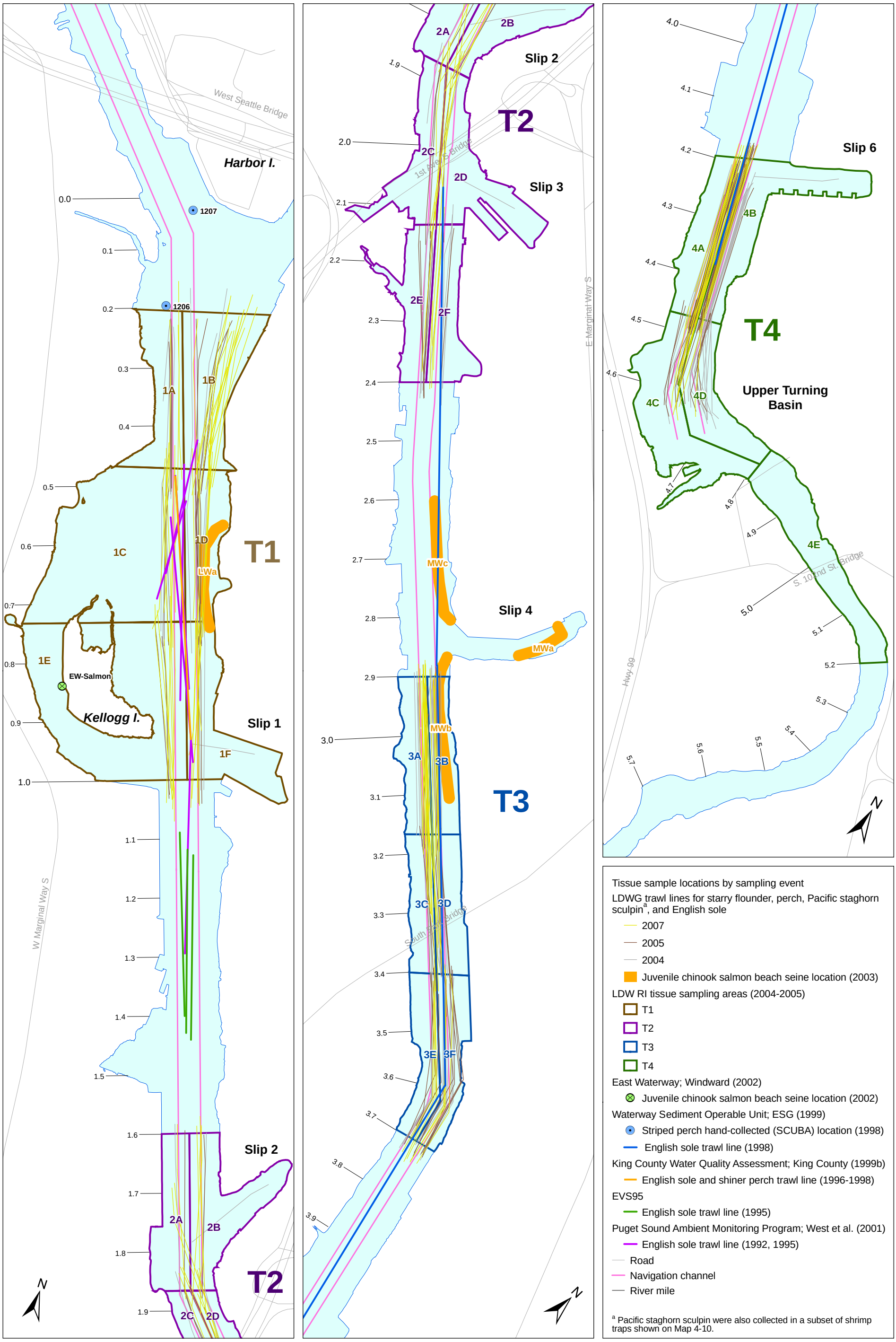
Prepared by CEH, 07/13/2010, MAP 2683, W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Subsurface\4Depth Interval

Dredging information provided by AECOM.



Tissue sample locations by sampling event

LDWG trawl lines for starry flounder, perch, Pacific staghorn sculpin[a], and English sole

- 2007
- 2005
- 2004
- Juvenile chinook salmon beach seine location (2003)

LDW RI tissue sampling areas (2004-2005)

- T1
- T2
- T3
- T4

East Waterway; Windward (2002)

- Juvenile chinook salmon beach seine location (2002)

Waterway Sediment Operable Unit; ESG (1999)

- Striped perch hand-collected (SCUBA) location (1998)
- English sole trawl line (1998)

King County Water Quality Assessment; King County (1999b)

- English sole and shiner perch trawl line (1996-1998)

EVS95

- English sole trawl line (1995)

Puget Sound Ambient Monitoring Program; West et al. (2001)

- English sole trawl line (1992, 1995)
- Road
- Navigation channel
- River mile

[a] Pacific staghorn sculpin were also collected in a subset of shrimp traps shown on Map 4-10.

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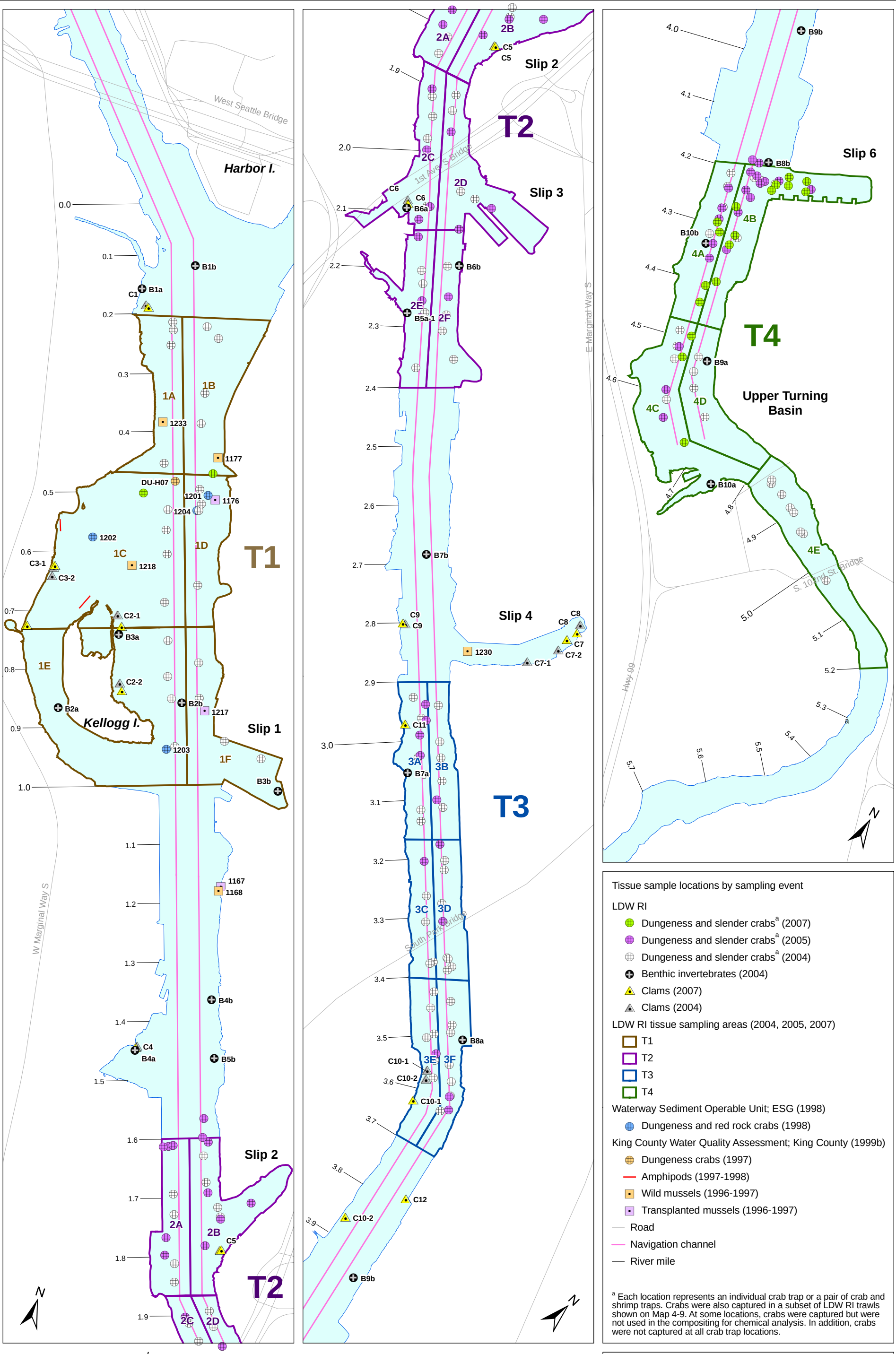
0 0.1 0.2 Miles

0 0.1 0.2 Kilometers

Scale is the same for each inset map

Map 4-9. Fish tissue sampling locations

Prepared by CEH, 07/13/2010, MAP 2665, W:\Projects\00-08-06 Duwamish_River\data\gis\Phase2 RI\Nature and Extent\Tissue



Tissue sample locations by sampling event

LDW RI

- Dungeness and slender crabs[a] (2007)
- Dungeness and slender crabs[a] (2005)
- Dungeness and slender crabs[a] (2004)
- Benthic invertebrates (2004)
- Clams (2007)
- Clams (2004)

LDW RI tissue sampling areas (2004, 2005, 2007)

- T1
- T2
- T3
- T4

Waterway Sediment Operable Unit; ESG (1998)

- Dungeness and red rock crabs (1998)

King County Water Quality Assessment; King County (1999b)

- Dungeness crabs (1997)
- Amphipods (1997-1998)
- Wild mussels (1996-1997)
- Transplanted mussels (1996-1997)
- Road
- Navigation channel
- River mile

[a] Each location represents an individual crab trap or a pair of crab and shrimp traps. Crabs were also captured in a subset of LDW RI trawls shown on Map 4-9. At some locations, crabs were captured but were not used in the compositing for chemical analysis. In addition, crabs were not captured at all crab trap locations.

0 0.1 0.2 Miles

0 0.1 0.2 Kilometers

Scale is the same for each inset map

Map 4-10. Benthic invertebrate and shellfish tissue sampling locations

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Prepared by CEH, 07/13/2010; MAP 2848; W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Tissue

West Seattle Bridge

Harbor I.

LTKE03

0.0

0.1

SP-71

0.2

0.3

DuwDiag-SPMD

0.4

2155 – Diagonal Avenue S CSO/SD (111), SPU, King County

0.5

SP-69

0.6

SP-75

0.7

Slip 1

0.8

Kellogg I.

SP-76

0.9

SP-64

Brandon-SPMD

1.0

BRN/W

2223 – S Brandon Street CSO (041), King County

1.1

BRN/C

BRN/E

1.2

W Marginal Way S

1.3

1.4

SP-62

SP-61

SP-80

1.6

Slip 2

1.7

SP-82

1.8

SWM/E

2502 – E Michigan Street CSO (039), King County

SWM/C

1.9

Slip 3

SWM/W

2506 – W Michigan Street CSO (042), King County

S Brighton St CSO/SD, SPU

2.0

2.1

SP-54

2.2

E Marginal Way S

2.3

2.4

Slip 4

2.5

2.6

SP-10

SP-12

2.7

2.8

2.9

SP-48

3.0

3.1

3.2

3.3

3.4

3.5

3.6

SP-20

3.7

Seep-1

3.8

3.9

4.0

SP-41

4.1

Slip 6

4.2

SP-39

4.3

4.4

4.5

4.6

Upper Turning Basin

NFK/E

2095 – Norfolk CSO/SD (044), KC/SPU/Boeing

NFK/W

4.7

4.8

4.9

5.0

5.1

5.2

5.3

5.4

5.5

S 102nd Street Bridge

Boeing Plant 2/Jorgenson Forge

SE-11001

SE-21002

SE-31003

SE-41004

SE-51005

SE-61006

SE-00801

SE-94105

SE-84102

SE-74101

LTUM03

3.2

3.3

3.4

SE-SWY01

SE-SWY02

SE-SWY03

SE-SWY04

SE-SWY05

SW-SWY01

SEEP_3

3.5

SEEP_2

SE-SWY06

SE-SWY07

3.6

SEEP_1

0 100 200 Feet

0 50 100 Meters

S-12

S-11

S-4

S-2

S-14

S-3

S-1

S-13

S-5

S-6

0 100 200 Feet

0 50 100 Meters

Rhône-Poulenc

07-SP

05-SP

04-SP

02-SP

06-SP

03-SP

01-SP

0 100 200 Feet

0 50 100 Meters

Seep sampling event

- Boeing Plant 2
- Great Western
- LDW RI
- Rhône-Poulenc
- T-117
- Boeing Isaacson

Surface water sampling event

- KC WQA
- KC PCB congener survey
- CSO[a]
- CSO/storm drain[a]
- Road
- Navigation channel
- River mile

[a] CSO or CSO/SDs are only shown if located near KC WQA stations.

N

0 0.2 0.4 Miles

0 0.2 0.4 Kilometers

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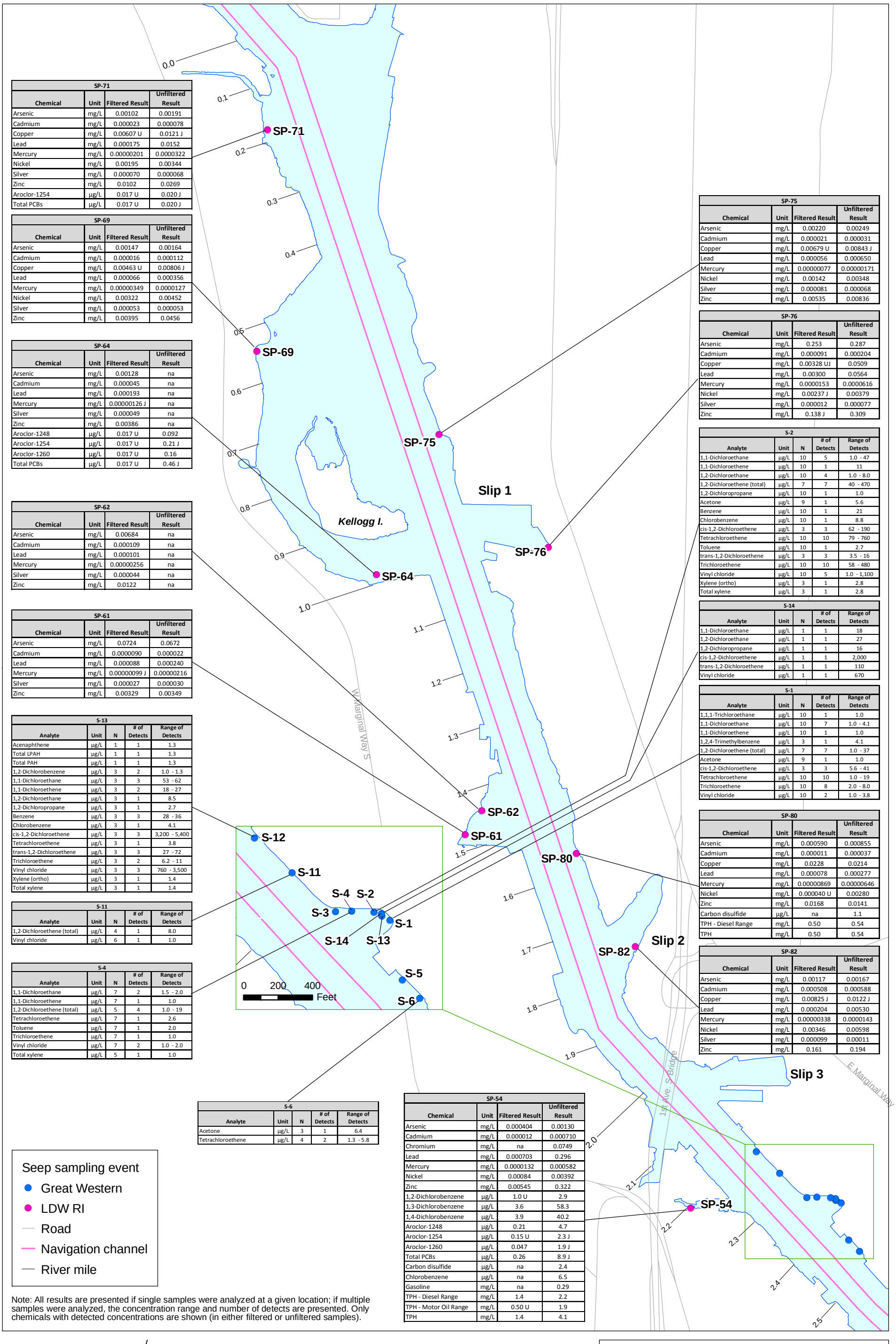
Map 4-11a. Seep water and surface water sampling locations

Prepared by CEH, 07/13/2010, Map 2809, W:\Projects\00-08-06_Duwamish_RI\data\GIS\Phase2 RI\Nature and Extent\Seeps and porewater



SP-71			
Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.00102	0.00191
Cadmium	mg/L	0.000023	0.000078
Copper	mg/L	0.00607 U	0.0121 J
Lead	mg/L	0.000175	0.0152
Mercury	mg/L	0.00000201	0.0000322
Nickel	mg/L	0.00195	0.00344
Silver	mg/L	0.000070	0.000068
Zinc	mg/L	0.0102	0.0269
Aroclor-1254	µg/L	0.017 U	0.020 J
Total PCBs	µg/L	0.017 U	0.020 J

SP-69			
Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.00147	0.00164
Cadmium	mg/L	0.000016	0.000112
Copper	mg/L	0.00463 U	0.00806 J
Lead	mg/L	0.000066	0.000356
Mercury	mg/L	0.00000349	0.0000127
Nickel	mg/L	0.00322	0.00452
Silver	mg/L	0.000053	0.000053
Zinc	mg/L	0.00395	0.0456

SP-64			
Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.00128	na
Cadmium	mg/L	0.000045	na
Lead	mg/L	0.000193	na
Mercury	mg/L	0.00000126 J	na
Silver	mg/L	0.000049	na
Zinc	mg/L	0.00386	na
Aroclor-1248	µg/L	0.017 U	0.092
Aroclor-1254	µg/L	0.017 U	0.21 J
Aroclor-1260	µg/L	0.017 U	0.16
Total PCBs	µg/L	0.017 U	0.46 J

SP-62			
Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.00684	na
Cadmium	mg/L	0.000109	na
Lead	mg/L	0.000101	na
Mercury	mg/L	0.00000256	na
Silver	mg/L	0.000044	na
Zinc	mg/L	0.0122	na

SP-61			
Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.0724	0.0672
Cadmium	mg/L	0.0000090	0.000022
Lead	mg/L	0.000088	0.000240
Mercury	mg/L	0.00000099 J	0.00000216
Silver	mg/L	0.000027	0.000030
Zinc	mg/L	0.00329	0.00349

S-13				
Analyte	Unit	N	# of Detects	Range of Detects
Acenaphthene	µg/L	1	1	1.3
Total LPAH	µg/L	1	1	1.3
Total PAH	µg/L	1	1	1.3
1,2-Dichlorobenzene	µg/L	3	2	1.0 - 1.3
1,1-Dichloroethane	µg/L	3	3	53 - 62
1,1-Dichloroethene	µg/L	3	2	18 - 27
1,2-Dichloroethane	µg/L	3	1	8.5
1,2-Dichloropropane	µg/L	3	1	2.7
Benzene	µg/L	3	3	28 - 36
Chlorobenzene	µg/L	3	1	4.1
cis-1,2-Dichloroethene	µg/L	3	3	3,200 - 5,400
Tetrachloroethene	µg/L	3	1	3.8
trans-1,2-Dichloroethene	µg/L	3	3	27 - 72
Trichloroethene	µg/L	3	2	6.2 - 11
Vinyl chloride	µg/L	3	3	760 - 3,500
Xylene (ortho)	µg/L	3	1	1.4
Total xylene	µg/L	3	1	1.4

S-11				
Analyte	Unit	N	# of Detects	Range of Detects
1,2-Dichloroethene (total)	µg/L	4	1	8.0
Vinyl chloride	µg/L	6	1	1.0

S-4				
Analyte	Unit	N	# of Detects	Range of Detects
1,1-Dichloroethane	µg/L	7	2	1.5 - 2.0
1,1-Dichloroethene	µg/L	7	1	1.0
1,2-Dichloroethene (total)	µg/L	5	4	1.0 - 19
Tetrachloroethene	µg/L	7	1	2.6
Toluene	µg/L	7	1	2.0
Trichloroethene	µg/L	7	1	1.0
Vinyl chloride	µg/L	7	2	1.0 - 2.0
Total xylene	µg/L	5	1	1.0

S-6				
Analyte	Unit	N	# of Detects	Range of Detects
Acetone	µg/L	3	1	6.4
Tetrachloroethene	µg/L	4	2	1.3 - 5.8

SP-54			
Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.000404	0.00130
Cadmium	mg/L	0.000012	0.000710
Chromium	mg/L	na	0.0749
Lead	mg/L	0.000703	0.296
Mercury	mg/L	0.0000132	0.000582
Nickel	mg/L	0.00084	0.00392
Zinc	mg/L	0.00545	0.322
1,2-Dichlorobenzene	µg/L	1.0 U	2.9
1,3-Dichlorobenzene	µg/L	3.6	58.3
1,4-Dichlorobenzene	µg/L	3.9	40.2
Aroclor-1248	µg/L	0.21	4.7
Aroclor-1254	µg/L	0.15 U	2.3 J
Aroclor-1260	µg/L	0.047	1.9 J
Total PCBs	µg/L	0.26	8.9 J
Carbon disulfide	µg/L	na	2.4
Chlorobenzene	µg/L	na	6.5
Gasoline	mg/L	na	0.29
TPH - Diesel Range	mg/L	1.4	2.2
TPH - Motor Oil Range	mg/L	0.50 U	1.9
TPH	mg/L	1.4	4.1

SP-75			
Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.00220	0.00249
Cadmium	mg/L	0.000021	0.000031
Copper	mg/L	0.00679 U	0.00843 J
Lead	mg/L	0.000056	0.000650
Mercury	mg/L	0.00000077	0.00000171
Nickel	mg/L	0.00142	0.00348
Silver	mg/L	0.000081	0.000068
Zinc	mg/L	0.00535	0.00836

SP-76			
Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.253	0.287
Cadmium	mg/L	0.000091	0.000204
Copper	mg/L	0.00328 UJ	0.0509
Lead	mg/L	0.00300	0.0564
Mercury	mg/L	0.0000153	0.0000616
Nickel	mg/L	0.00237 J	0.00379
Silver	mg/L	0.000012	0.000077
Zinc	mg/L	0.138 J	0.309

S-2				
Analyte	Unit	N	# of Detects	Range of Detects
1,1-Dichloroethane	µg/L	10	5	1.0 - 47
1,1-Dichloroethene	µg/L	10	1	11
1,2-Dichloroethane	µg/L	10	4	1.0 - 8.0
1,2-Dichloroethene (total)	µg/L	7	7	40 - 470
1,2-Dichloropropane	µg/L	10	1	1.0
Acetone	µg/L	9	1	5.6
Benzene	µg/L	10	1	21
Chlorobenzene	µg/L	10	1	8.8
cis-1,2-Dichloroethene	µg/L	3	3	62 - 190
Tetrachloroethene	µg/L	10	10	79 - 760
Toluene	µg/L	10	1	2.7
trans-1,2-Dichloroethene	µg/L	3	3	3.5 - 16
Trichloroethene	µg/L	10	10	58 - 480
Vinyl chloride	µg/L	10	5	1.0 - 1,100
Xylene (ortho)	µg/L	3	1	2.8
Total xylene	µg/L	3	1	2.8

S-14				
Analyte	Unit	N	# of Detects	Range of Detects
1,1-Dichloroethane	µg/L	1	1	18
1,2-Dichloroethane	µg/L	1	1	27
1,2-Dichloropropane	µg/L	1	1	16
cis-1,2-Dichloroethene	µg/L	1	1	2,000
trans-1,2-Dichloroethene	µg/L	1	1	110
Vinyl chloride	µg/L	1	1	670

S-1				
Analyte	Unit	N	# of Detects	Range of Detects
1,1,1-Trichloroethane	µg/L	10	1	1.0
1,1-Dichloroethane	µg/L	10	7	1.0 - 4.1
1,1-Dichloroethene	µg/L	10	1	1.0
1,2,4-Trimethylbenzene	µg/L	3	1	4.1
1,2-Dichloroethene (total)	µg/L	7	7	1.0 - 37
Acetone	µg/L	9	1	1.0
cis-1,2-Dichloroethene	µg/L	3	3	5.6 - 41
Tetrachloroethene	µg/L	10	10	1.0 - 19
Trichloroethene	µg/L	10	8	2.0 - 8.0
Vinyl chloride	µg/L	10	2	1.0 - 3.8

SP-80			
Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.000590	0.000855
Cadmium	mg/L	0.000011	0.000037
Copper	mg/L	0.0228	0.0214
Lead	mg/L	0.000078	0.000277
Mercury	mg/L	0.00000869	0.00000646
Nickel	mg/L	0.000040 U	0.00280
Zinc	mg/L	0.0168	0.0141
Carbon disulfide	µg/L	na	1.1
TPH - Diesel Range	mg/L	0.50	0.54
TPH	mg/L	0.50	0.54

SP-82			
Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.00117	0.00167
Cadmium	mg/L	0.000508	0.000588
Copper	mg/L	0.00825 J	0.0122 J
Lead	mg/L	0.000204	0.00530
Mercury	mg/L	0.00000338	0.0000143
Nickel	mg/L	0.00346	0.00598
Silver	mg/L	0.000099	0.00011
Zinc	mg/L	0.161	0.194

Seep sampling event
- Great Western
- LDW RI
- Road
- Navigation channel
- River mile

Note: All results are presented if single samples were analyzed at a given location; if multiple samples were analyzed, the concentration range and number of detects are presented. Only chemicals with detected concentrations are shown (in either filtered or unfiltered samples).

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N

0 750 1,500 Feet

0 200 400 Meters

Map 4-11b. Seep water sampling data (only detected chemicals), RM 0.0 to RM 2.5

Prepared by CEH, 07/13/2010; MAP #3794; W:\Projects\00-08-06 Duwamish_Rl\data\GIS\Phase 2 RI\Nature and Extent\Seeps and porewater

Seep sampling event
- Boeing Plant 2
- LDW RI
- Road
- Navigation channel
- River mile

2.5
2.6
2.7
2.8
2.9
3.0
3.1
3.2
3.3
3.4

SP-12

Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.000771	0.00113
Cadmium	mg/L	0.000107	0.000133
Copper	mg/L	0.0125 J	0.0158 J
Lead	mg/L	0.000129	0.000823
Mercury	mg/L	0.00000074	0.00000518
Nickel	mg/L	0.00424	0.00803
Silver	mg/L	0.000053	0.000033
Zinc	mg/L	0.0141	0.0161

SP-10

Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.000841	na
Cadmium	mg/L	0.000085	na
Copper	mg/L	0.00869 J	na
Lead	mg/L	0.000252	na
Mercury	mg/L	0.00000092	na
Nickel	mg/L	0.00132	na
Silver	mg/L	0.000021	na
Zinc	mg/L	0.01197	na

SE-11001

Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.01	0.012
Lead	mg/L	0.02 U	0.005
Vanadium	mg/L	0.004	0.02
Zinc	mg/L	0.008 U	0.02
cis-1,2-Dichloroethene	µg/L	na	40
Vinyl chloride	µg/L	na	36

SP-48

Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.000422	0.000618
Cadmium	mg/L	0.000101	0.000127
Copper	mg/L	0.0101 J	0.0111 J
Lead	mg/L	0.000154 J	0.00106
Mercury	mg/L	0.00000132	0.00000109
Nickel	mg/L	0.00156	0.00323
Silver	mg/L	0.000053	0.000054
Zinc	mg/L	0.0158	0.0177

SE-21002

Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.006	0.012
Vanadium	mg/L	0.01 U	0.01

SE-94105

Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.008	0.008
Copper	mg/L	0.008	0.03
Lead	mg/L	0.02 U	0.005
Vanadium	mg/L	0.002	0.01
Zinc	mg/L	0.035	0.05

SE-31003

Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.01	0.02
Copper	mg/L	0.002 U	0.03
Mercury	mg/L	0.00010 U	0.00020
Vanadium	mg/L	0.002 U	0.05
Zinc	mg/L	0.004 U	0.05

SE-41004

Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.008	0.009

SE-84102

Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	na	0.004
Chromium	mg/L	na	0.006
Copper	mg/L	na	0.013
Lead	mg/L	na	0.022
Nickel	mg/L	na	0.01
Vanadium	mg/L	na	0.022
Zinc	mg/L	na	0.061
Fluoranthene	µg/L	na	1.3
Phenanthrene	µg/L	na	1.0
Total HPAH	µg/L	na	1.3
Total LPAH	µg/L	na	1.0
Total PAH	µg/L	na	2.3
Aroclor-1260	µg/L	na	1.8
Total PCBs	µg/L	na	1.8

SE-51005

Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.008	0.01
Lead	mg/L	0.02 U	0.004
Vanadium	mg/L	0.002 U	0.01

SE-74101

Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	na	0.005
Chromium	mg/L	na	0.009
Copper	mg/L	na	0.014
Lead	mg/L	na	0.016
Vanadium	mg/L	na	0.015
Zinc	mg/L	na	0.052
cis-1,2-Dichloroethene	µg/L	na	1.2
Trichloroethene	µg/L	na	1.9

SE-61006

Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.01	0.01
Lead	mg/L	0.02 U	0.006
Vanadium	mg/L	0.002 U	0.02
Zinc	mg/L	0.004 U	0.02

SP-12
SP-10
SP-48
SE-11001
SE-21002
SE-31003
SE-41004
SE-51005
SE-61006
SE-00801
SE-94105
SE-84102
SE-74101

South Park Bridge

Note: Only chemicals with detected concentrations are shown (in either filtered or unfiltered samples). At some locations between RM 2.2 and RM 2.5, multiple samples were collected over time. At those locations, the range of concentrations is presented for detected chemicals.

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0 300 600 Feet
0 100 200 Meters

Map 4-11c. Seep water sampling data (only detected chemicals), RM 2.5 to RM 3.4

Prepared CEH 07/13/2010; MAP #3794; W:\Projects\00-08-06 Duwamish RI\data\GIS\Phase2 RI\Nature and Extent\Seeps and porewater

South Park Bridge

3.4

3.5

3.6

3.7

3.8

3.9

4.0

SE-SWY01

Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.008	0.02
Chromium	mg/L	0.02 U	0.018
Copper	mg/L	0.01 U	0.02 J
Lead	mg/L	0.001 U	0.03 J
Mercury	mg/L	0.00010 U	0.00020
Nickel	mg/L	0.05 U	0.01
Vanadium	mg/L	0.01 U	0.03 J
Zinc	mg/L	0.02 U	0.08 J
Aroclor-1260	µg/L	na	1.7 J
Total PCBs	µg/L	na	1.7 J
cis-1,2-Dichloroethene	µg/L	na	7.2
Vinyl chloride	µg/L	na	3.1

SE-SWY02

Chemical	Unit	Filtered Result	Unfiltered Result
Chromium	mg/L	na	0.02
Copper	mg/L	na	0.007
Lead	mg/L	na	0.104
Vanadium	mg/L	na	0.006
Zinc	mg/L	na	0.036
cis-1,2-Dichloroethene	µg/L	na	3.9
Trichloroethene	µg/L	na	13

SE-SWY03

Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.008	0.01
Chromium	mg/L	0.02 U	0.049
Copper	mg/L	0.01 U	0.06
Lead	mg/L	0.001 U	0.1
Mercury	mg/L	0.00010 U	0.00020
Nickel	mg/L	0.05 U	0.03
Vanadium	mg/L	0.01 U	0.026
Zinc	mg/L	0.03	0.1
Aroclor-1260	µg/L	na	4.6
Total PCBs	µg/L	na	4.6

SE-SWY04

Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.009	0.012
Chromium	mg/L	0.02 U	0.01
Copper	mg/L	0.01 U	0.052
Lead	mg/L	0.005 U	0.04
Nickel	mg/L	0.05 U	0.05
Vanadium	mg/L	0.01 U	0.02
Zinc	mg/L	0.09	0.2

SEEP_3

Chemical	Unit	Filtered Result	Unfiltered Result
Chromium	mg/L	0.00800 J	0.00700
Copper	mg/L	0.00400 J	0.00400
Aroclor-1260	µg/L	na	0.94 J
Total PCBs	µg/L	na	0.94 J

SEEP_2

Chemical	Unit	Filtered Result	Unfiltered Result
Chromium	mg/L	0.00900 J	0.00600
Copper	mg/L	0.00500 J	0.00250
BEHP	µg/L	na	8.9 J

SEEP_1

Chemical	Unit	Filtered Result	Unfiltered Result
Copper	mg/L	0.00500 J	0.00300
Zinc	mg/L	0.00600 UJ	0.00700 J

SE-SWY05

Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	na	0.008
Copper	mg/L	na	0.006
Lead	mg/L	na	0.005
Vanadium	mg/L	na	0.003
Zinc	mg/L	na	0.048
cis-1,2-Dichloroethene	µg/L	na	26
Trichloroethene	µg/L	na	2.7
Vinyl chloride	µg/L	na	3.5

SE-SWY06

Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	na	0.006
Copper	mg/L	na	0.002
Lead	mg/L	na	0.002
Vanadium	mg/L	na	0.002
Zinc	mg/L	na	0.038
cis-1,2-Dichloroethene	µg/L	na	16
Vinyl chloride	µg/L	na	32

SE-SWY07

Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	na	0.006
Lead	mg/L	na	0.001
Vanadium	mg/L	na	0.009
Zinc	mg/L	na	0.006
Benzene	µg/L	na	2.2

SW-SWY01

Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	na	0.002
Copper	mg/L	na	0.015
Lead	mg/L	na	0.002
Zinc	mg/L	na	0.059
Aroclor-1254	µg/L	na	0.93 J
Total PCBs	µg/L	na	0.93 J

SP-20

Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.00135	0.00158
Cadmium	mg/L	0.000111	0.000114
Copper	mg/L	0.00816 J	0.0102 J
Lead	mg/L	0.000096	0.00144
Mercury	mg/L	0.00000062	0.00000061
Nickel	mg/L	0.00525	0.00883
Silver	mg/L	0.000112	0.000086
Zinc	mg/L	0.00808	0.0108

SE-SWY01
SE-SWY02
SE-SWY03
SE-SWY04
SE-SWY05
SW-SWY01
SEEP_3
SE-SWY06
SE-SWY07
SEEP_2
SEEP_1
SP-20
SP-41

Seep sampling event
- Boeing Plant 2
- LDW RI
- T-117

Road
Navigation channel
River mile

Note: Only chemicals with detected concentrations are shown (in either filtered or unfiltered samples).

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N

0 200 400 Feet

0 50 100 Meters

Map 4-11d. Seep water sampling data (only detected chemicals), RM 3.4 to RM 4.0

Prepared by CEH, 07/13/2010; MAP #3794; W:\Projects\00-08-06_Duwamish_RI\data\GIS\Phase2 RI\Nature and Extent\Seeps and porewater

SP-41			
Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.000235	0.000230
Cadmium	mg/L	0.000133	0.000158
Lead	mg/L	0.000036	0.000080
Mercury	mg/L	0.00000062	0.00000112
Nickel	mg/L	0.00223	0.00471
Silver	mg/L	0.000036	0.000026
Zinc	mg/L	0.00607	0.00714

04-SP		
Chemical	Unit	Unfiltered Result
Vanadium	mg/L	0.0084

03-SP		
Chemical	Unit	Unfiltered Result
Vanadium	mg/L	0.0175

02-SP		
Chemical	Unit	Unfiltered Result
Arsenic	mg/L	0.0310
Cadmium	mg/L	0.0116
Chromium	mg/L	0.202
Copper	mg/L	0.203
Lead	mg/L	0.0441
Nickel	mg/L	0.0700
Vanadium	mg/L	0.400
Zinc	mg/L	0.223
BEHP	µg/L	27.0

07-SP		
Chemical	Unit	Unfiltered Result
Vanadium	mg/L	0.005663
BEHP	µg/L	13.8

01-SP		
Chemical	Unit	Unfiltered Result
Cadmium	mg/L	0.0021
Vanadium	mg/L	0.0101

05-SP		
Chemical	Unit	Unfiltered Result
Mercury	mg/L	0.00065
Vanadium	mg/L	0.0028

SP-39			
Chemical	Unit	Filtered Result	Unfiltered Result
Arsenic	mg/L	0.000054	0.000058
Cadmium	mg/L	0.000206	0.000272
Copper	mg/L	0.0101 J	0.0122 J
Lead	mg/L	0.000051	0.000161
Mercury	mg/L	0.00000087	0.00000094
Nickel	mg/L	0.00278	0.00643
Silver	mg/L	0.000028	0.000025
Zinc	mg/L	0.00830	0.00990
Heptachlor epoxide	µg/L	0.0090	0.0076

06-SP		
Chemical	Unit	Unfiltered Result
Vanadium	mg/L	0.0030

SP-41 SP-39 04-SP 02-SP 03-SP 06-SP 01-SP 07-SP 05-SP

4.0 4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9 5.0

S. 102nd St. Bridge

Seep sampling event
- LDW RI
- Rhône-Poulenc
- Road
- Navigation channel
- River mile

Note: Only chemicals with detected concentrations are shown (in either filtered or unfiltered samples).

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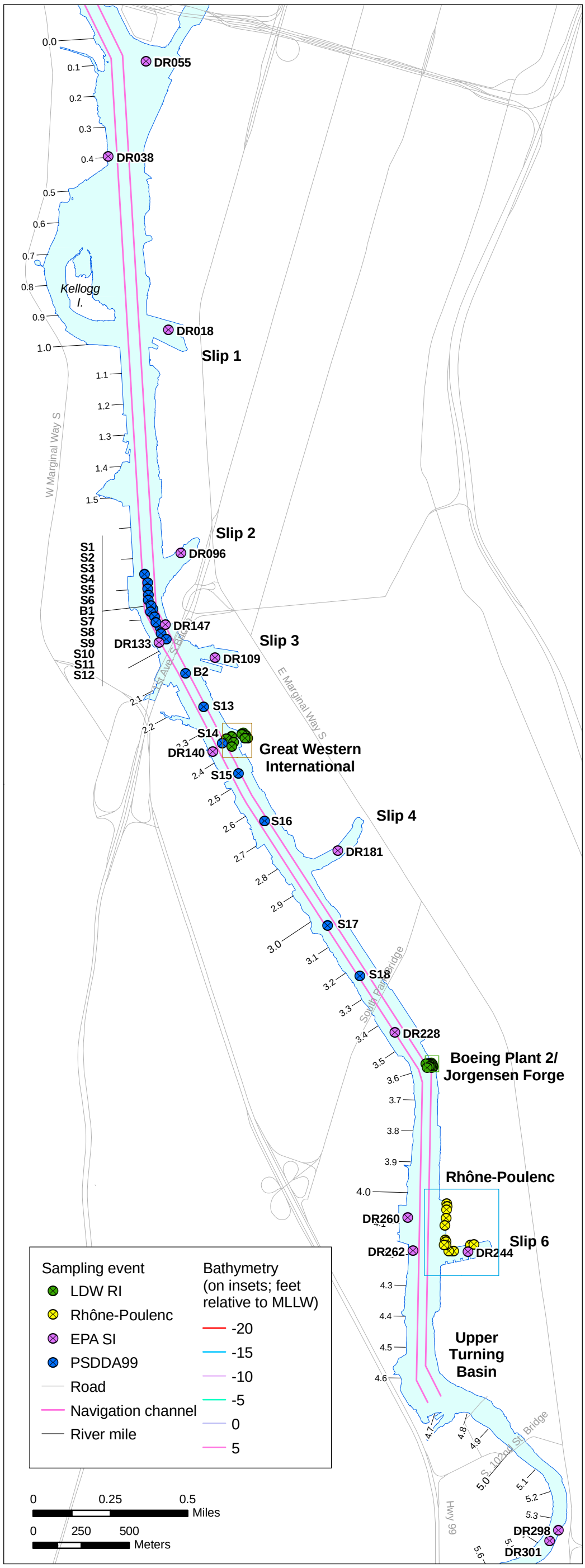
N

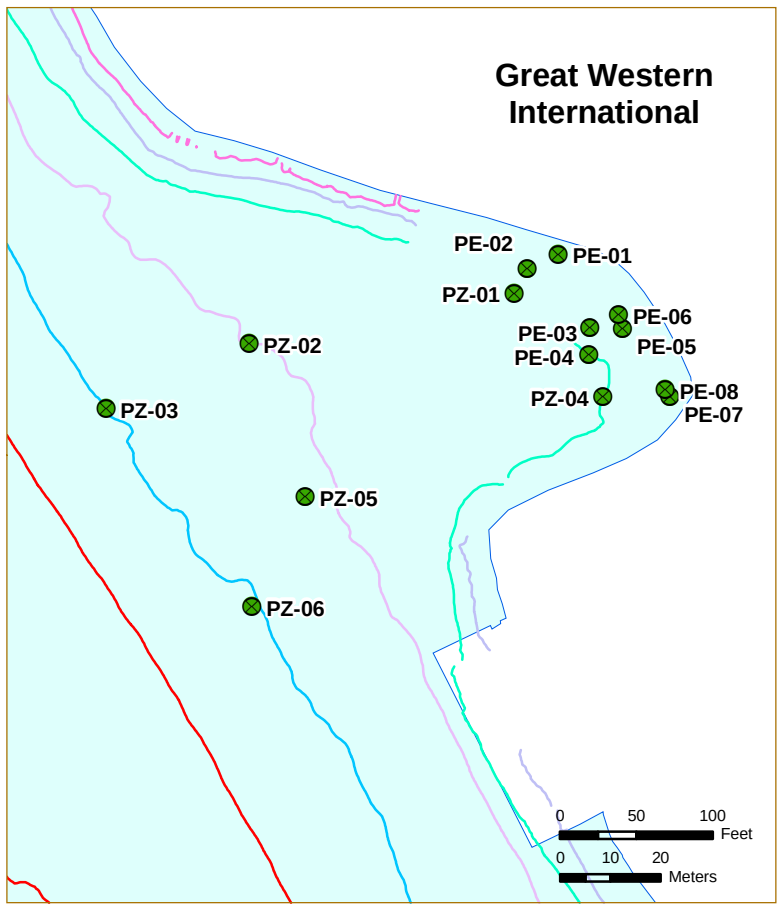
0 300 600 Feet

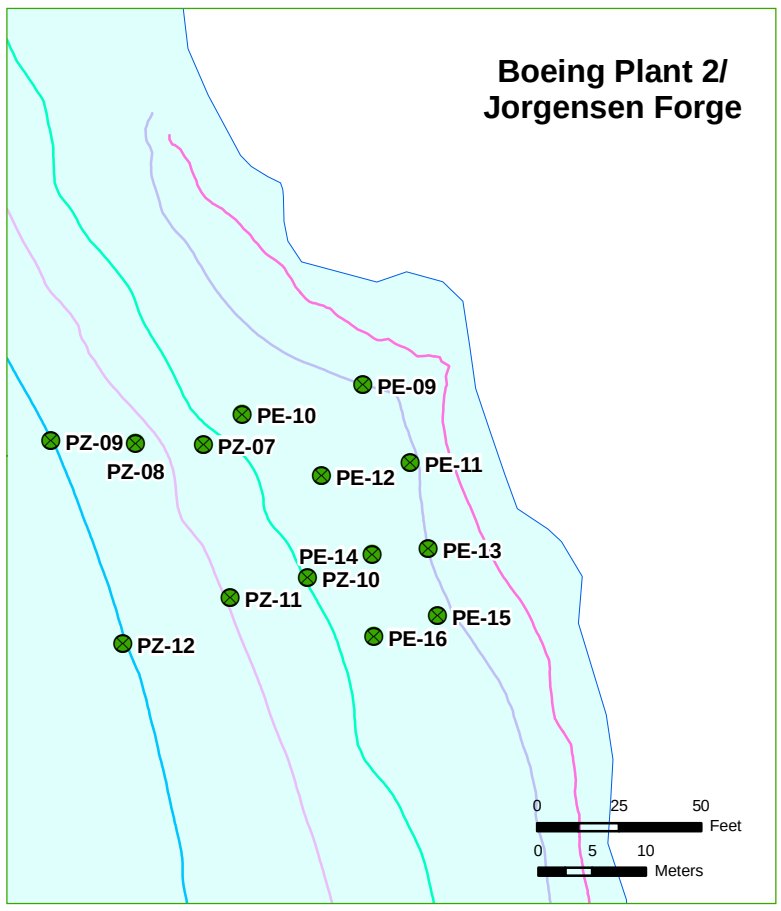
0 100 200 Meters

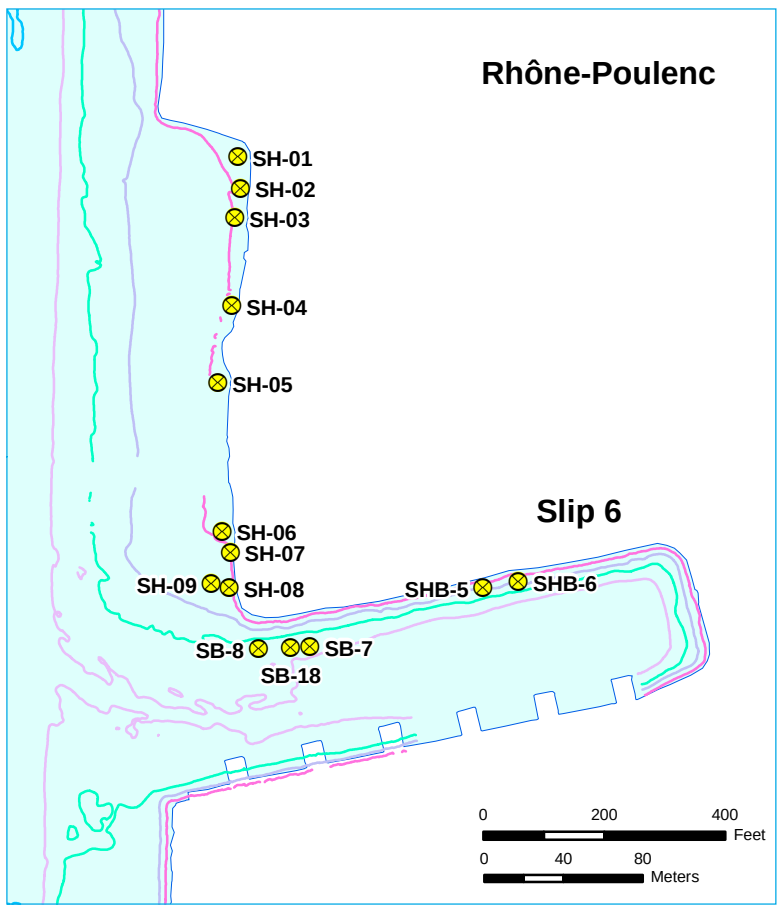
Map 4-11e. Seep water sampling data (only detected chemicals), RM 4.0 to RM 5.0

Prepared by CEH, 07/13/2010. MAP #3794. W:\Projects\00-08-06_Duwamish_R\data\GIS\Phase2 RI\Nature and Extent\Seeps and porewater



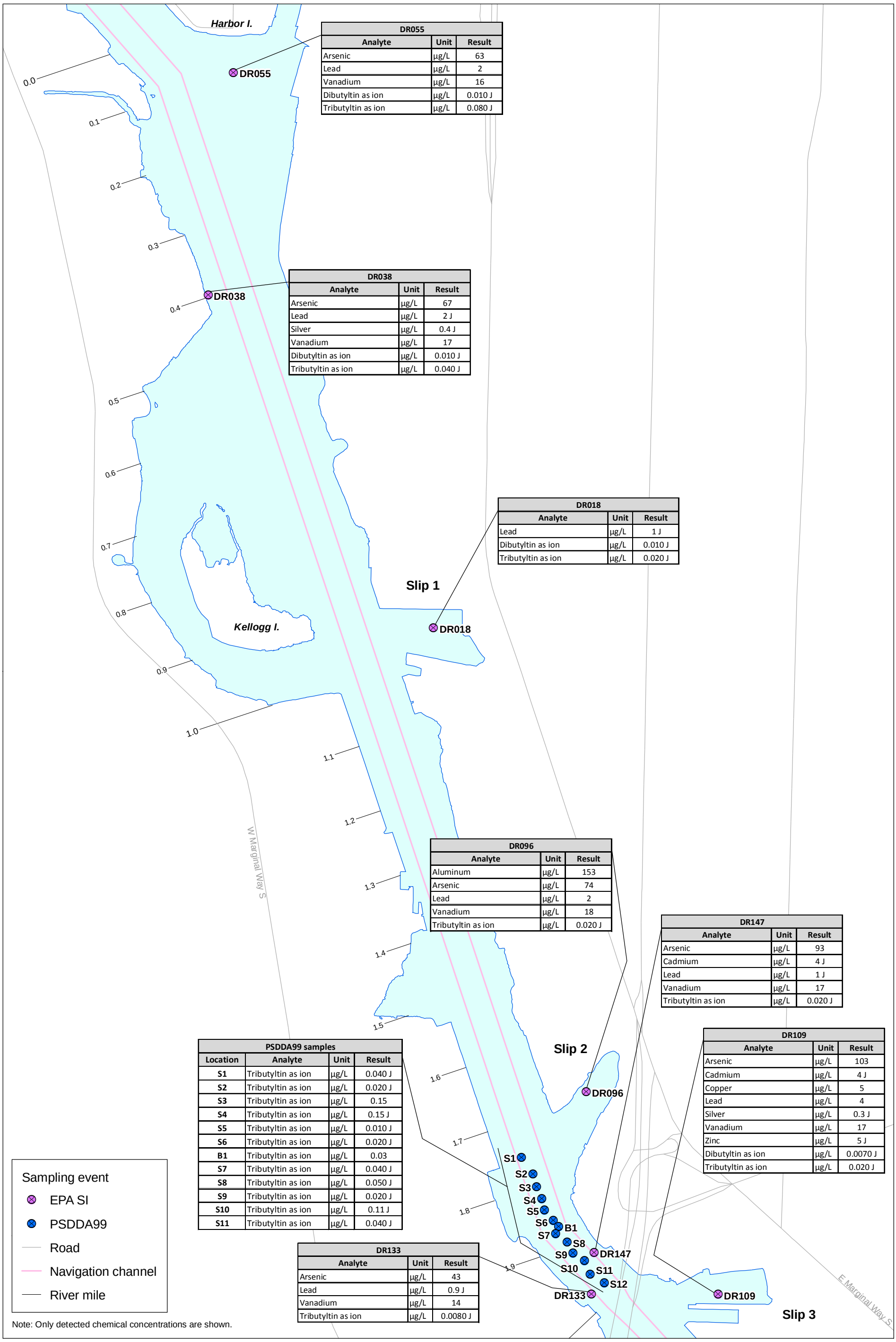






Map 4-12a. Porewater sampling locations

Prepared by CEH, 07/13/2010, MAP 2727: W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Porewater



DR055		
Analyte	**Unit**	**Result**
Arsenic	µg/L	63
Lead	µg/L	2
Vanadium	µg/L	16
Dibutyltin as ion	µg/L	0.010 J
Tributyltin as ion	µg/L	0.080 J

DR038		
Analyte	**Unit**	**Result**
Arsenic	µg/L	67
Lead	µg/L	2 J
Silver	µg/L	0.4 J
Vanadium	µg/L	17
Dibutyltin as ion	µg/L	0.010 J
Tributyltin as ion	µg/L	0.040 J

DR018		
Analyte	**Unit**	**Result**
Lead	µg/L	1 J
Dibutyltin as ion	µg/L	0.010 J
Tributyltin as ion	µg/L	0.020 J

DR096		
Analyte	**Unit**	**Result**
Aluminum	µg/L	153
Arsenic	µg/L	74
Lead	µg/L	2
Vanadium	µg/L	18
Tributyltin as ion	µg/L	0.020 J

DR147		
Analyte	**Unit**	**Result**
Arsenic	µg/L	93
Cadmium	µg/L	4 J
Lead	µg/L	1 J
Vanadium	µg/L	17
Tributyltin as ion	µg/L	0.020 J

DR109		
Analyte	**Unit**	**Result**
Arsenic	µg/L	103
Cadmium	µg/L	4 J
Copper	µg/L	5
Lead	µg/L	4
Silver	µg/L	0.3 J
Vanadium	µg/L	17
Zinc	µg/L	5 J
Dibutyltin as ion	µg/L	0.0070 J
Tributyltin as ion	µg/L	0.020 J

PSDDA99 samples			
Location	**Analyte**	**Unit**	**Result**
S1	Tributyltin as ion	µg/L	0.040 J
S2	Tributyltin as ion	µg/L	0.020 J
S3	Tributyltin as ion	µg/L	0.15
S4	Tributyltin as ion	µg/L	0.15 J
S5	Tributyltin as ion	µg/L	0.010 J
S6	Tributyltin as ion	µg/L	0.020 J
B1	Tributyltin as ion	µg/L	0.03
S7	Tributyltin as ion	µg/L	0.040 J
S8	Tributyltin as ion	µg/L	0.050 J
S9	Tributyltin as ion	µg/L	0.020 J
S10	Tributyltin as ion	µg/L	0.11 J
S11	Tributyltin as ion	µg/L	0.040 J

DR133		
Analyte	**Unit**	**Result**
Arsenic	µg/L	43
Lead	µg/L	0.9 J
Vanadium	µg/L	14
Tributyltin as ion	µg/L	0.0080 J

Note: Only detected chemical concentrations are shown.

Map 4-12b. Porewater sampling data (only detected chemicals), RM 0.0 to RM 2.0

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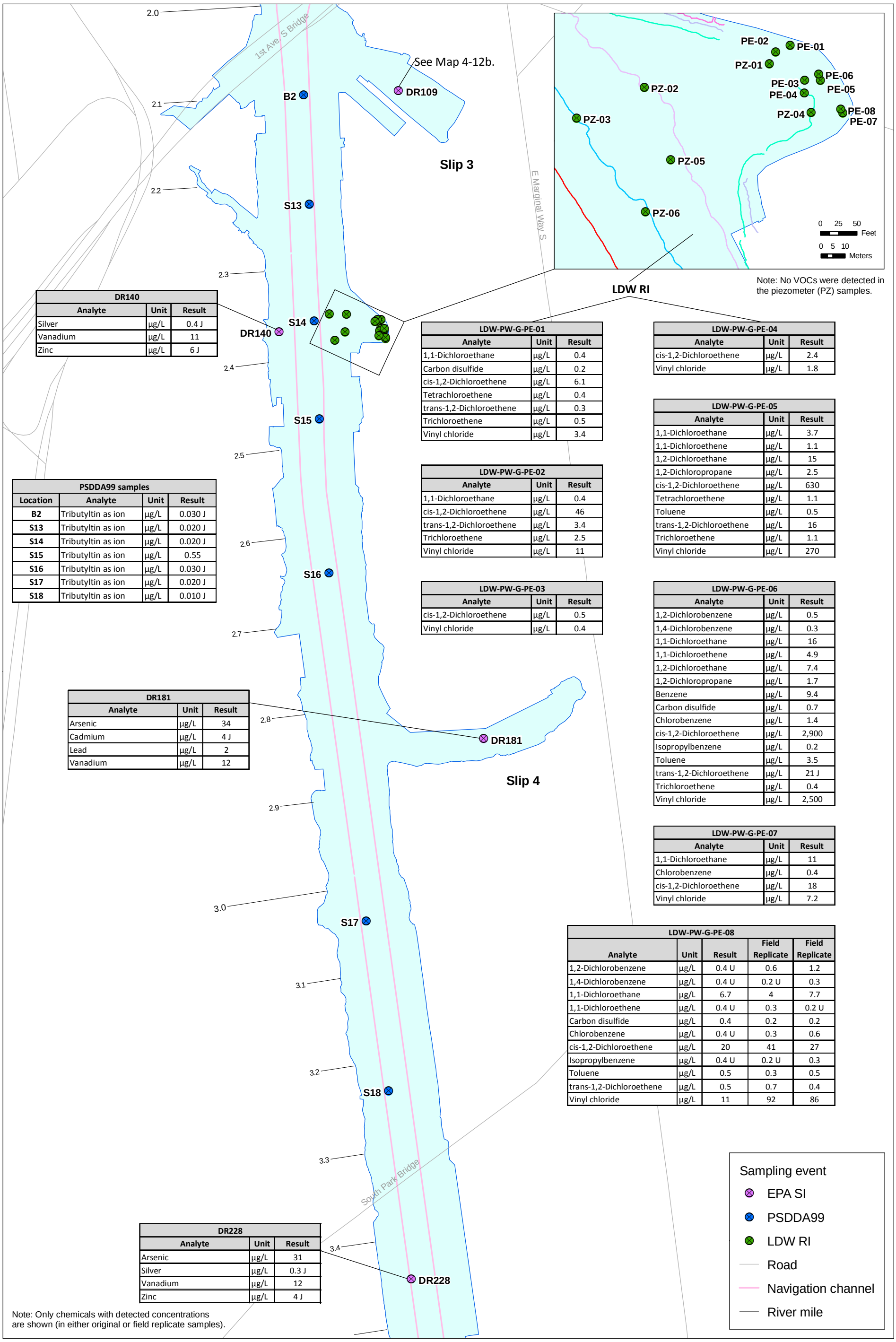
Prepared by CEH, 07/13/2010, MAP #3800, W:\Projects\00-08-06 Duwamish_Rl\data\GIS\Phase 2 RI\Nature and Extent\Segs and porewater



Note: No VOCs were detected in the piezometer (PZ) samples.

DR140		
Analyte	**Unit**	**Result**
Silver	µg/L	0.4 J
Vanadium	µg/L	11
Zinc	µg/L	6 J

PSDDA99 samples			
Location	**Analyte**	**Unit**	**Result**
B2	Tributyltin as ion	µg/L	0.030 J
S13	Tributyltin as ion	µg/L	0.020 J
S14	Tributyltin as ion	µg/L	0.020 J
S15	Tributyltin as ion	µg/L	0.55
S16	Tributyltin as ion	µg/L	0.030 J
S17	Tributyltin as ion	µg/L	0.020 J
S18	Tributyltin as ion	µg/L	0.010 J

DR181		
Analyte	**Unit**	**Result**
Arsenic	µg/L	34
Cadmium	µg/L	4 J
Lead	µg/L	2
Vanadium	µg/L	12

DR228		
Analyte	**Unit**	**Result**
Arsenic	µg/L	31
Silver	µg/L	0.3 J
Vanadium	µg/L	12
Zinc	µg/L	4 J

Note: Only chemicals with detected concentrations are shown (in either original or field replicate samples).

LDW-PW-G-PE-01		
Analyte	**Unit**	**Result**
1,1-Dichloroethane	µg/L	0.4
Carbon disulfide	µg/L	0.2
cis-1,2-Dichloroethene	µg/L	6.1
Tetrachloroethene	µg/L	0.4
trans-1,2-Dichloroethene	µg/L	0.3
Trichloroethene	µg/L	0.5
Vinyl chloride	µg/L	3.4

LDW-PW-G-PE-02		
Analyte	**Unit**	**Result**
1,1-Dichloroethane	µg/L	0.4
cis-1,2-Dichloroethene	µg/L	46
trans-1,2-Dichloroethene	µg/L	3.4
Trichloroethene	µg/L	2.5
Vinyl chloride	µg/L	11

LDW-PW-G-PE-03		
Analyte	**Unit**	**Result**
cis-1,2-Dichloroethene	µg/L	0.5
Vinyl chloride	µg/L	0.4

LDW-PW-G-PE-04		
Analyte	**Unit**	**Result**
cis-1,2-Dichloroethene	µg/L	2.4
Vinyl chloride	µg/L	1.8

LDW-PW-G-PE-05		
Analyte	**Unit**	**Result**
1,1-Dichloroethane	µg/L	3.7
1,1-Dichloroethene	µg/L	1.1
1,2-Dichloroethane	µg/L	15
1,2-Dichloropropane	µg/L	2.5
cis-1,2-Dichloroethene	µg/L	630
Tetrachloroethene	µg/L	1.1
Toluene	µg/L	0.5
trans-1,2-Dichloroethene	µg/L	16
Trichloroethene	µg/L	1.1
Vinyl chloride	µg/L	270

LDW-PW-G-PE-06		
Analyte	**Unit**	**Result**
1,2-Dichlorobenzene	µg/L	0.5
1,4-Dichlorobenzene	µg/L	0.3
1,1-Dichloroethane	µg/L	16
1,1-Dichloroethene	µg/L	4.9
1,2-Dichloroethane	µg/L	7.4
1,2-Dichloropropane	µg/L	1.7
Benzene	µg/L	9.4
Carbon disulfide	µg/L	0.7
Chlorobenzene	µg/L	1.4
cis-1,2-Dichloroethene	µg/L	2,900
Isopropylbenzene	µg/L	0.2
Toluene	µg/L	3.5
trans-1,2-Dichloroethene	µg/L	21 J
Trichloroethene	µg/L	0.4
Vinyl chloride	µg/L	2,500

LDW-PW-G-PE-07		
Analyte	**Unit**	**Result**
1,1-Dichloroethane	µg/L	11
Chlorobenzene	µg/L	0.4
cis-1,2-Dichloroethene	µg/L	18
Vinyl chloride	µg/L	7.2

LDW-PW-G-PE-08				
Analyte	**Unit**	**Result**	**Field Replicate**	**Field Replicate**
1,2-Dichlorobenzene	µg/L	0.4 U	0.6	1.2
1,4-Dichlorobenzene	µg/L	0.4 U	0.2 U	0.3
1,1-Dichloroethane	µg/L	6.7	4	7.7
1,1-Dichloroethene	µg/L	0.4 U	0.3	0.2 U
Carbon disulfide	µg/L	0.4	0.2	0.2
Chlorobenzene	µg/L	0.4 U	0.3	0.6
cis-1,2-Dichloroethene	µg/L	20	41	27
Isopropylbenzene	µg/L	0.4 U	0.2 U	0.3
Toluene	µg/L	0.5	0.3	0.5
trans-1,2-Dichloroethene	µg/L	0.5	0.7	0.4
Vinyl chloride	µg/L	11	92	86

Sampling event
- EPA SI
- PSDDA99
- LDW RI
- Road
- Navigation channel
- River mile

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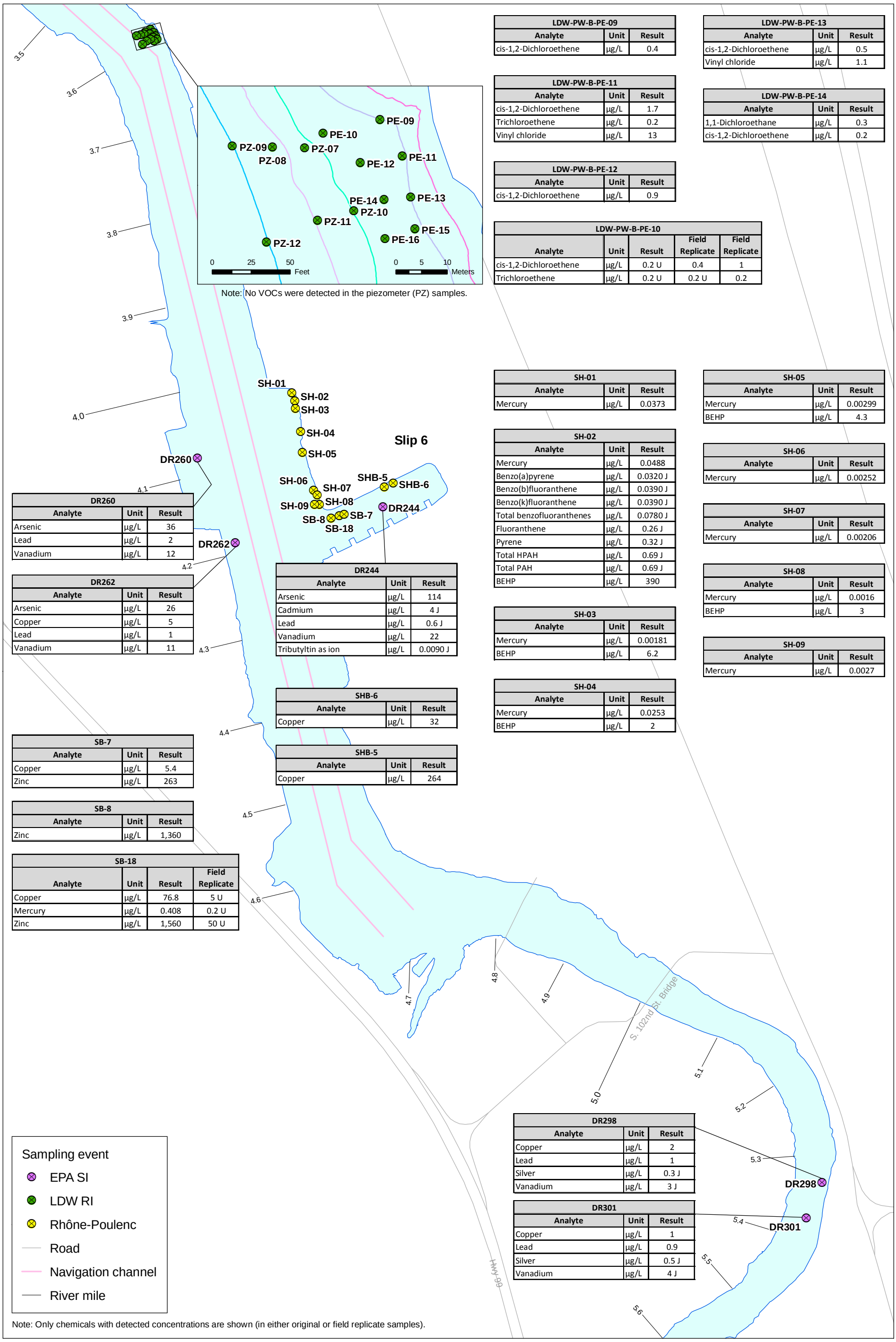
0 500 1,000 Feet
0 100 200 Meters

Map 4-12c. Porewater sampling data (only detected chemicals), RM 2.0 to RM 3.5

Prepared by CEH, 07/13/2010; MAP #3800; W:\Projects\00-08-06_Duwamish_RI\data\GIS\Phase 2 RI\Nature and Extent\Segs and porewater



Note: No VOCs were detected in the piezometer (PZ) samples.

LDW-PW-B-PE-09		
Analyte	Unit	Result
cis-1,2-Dichloroethene	µg/L	0.4

LDW-PW-B-PE-13		
Analyte	Unit	Result
cis-1,2-Dichloroethene	µg/L	0.5
Vinyl chloride	µg/L	1.1

LDW-PW-B-PE-11		
Analyte	Unit	Result
cis-1,2-Dichloroethene	µg/L	1.7
Trichloroethene	µg/L	0.2
Vinyl chloride	µg/L	13

LDW-PW-B-PE-14		
Analyte	Unit	Result
1,1-Dichloroethane	µg/L	0.3
cis-1,2-Dichloroethene	µg/L	0.2

LDW-PW-B-PE-12		
Analyte	Unit	Result
cis-1,2-Dichloroethene	µg/L	0.9

LDW-PW-B-PE-10				
Analyte	Unit	Result	Field Replicate	Field Replicate
cis-1,2-Dichloroethene	µg/L	0.2 U	0.4	1
Trichloroethene	µg/L	0.2 U	0.2 U	0.2

SH-01		
Analyte	Unit	Result
Mercury	µg/L	0.0373

SH-05		
Analyte	Unit	Result
Mercury	µg/L	0.00299
BEHP	µg/L	4.3

SH-02		
Analyte	Unit	Result
Mercury	µg/L	0.0488
Benzo(a)pyrene	µg/L	0.0320 J
Benzo(b)fluoranthene	µg/L	0.0390 J
Benzo(k)fluoranthene	µg/L	0.0390 J
Total benzofluoranthenes	µg/L	0.0780 J
Fluoranthene	µg/L	0.26 J
Pyrene	µg/L	0.32 J
Total HPAH	µg/L	0.69 J
Total PAH	µg/L	0.69 J
BEHP	µg/L	390

SH-06		
Analyte	Unit	Result
Mercury	µg/L	0.00252

SH-07		
Analyte	Unit	Result
Mercury	µg/L	0.00206

SH-08		
Analyte	Unit	Result
Mercury	µg/L	0.0016
BEHP	µg/L	3

SH-09		
Analyte	Unit	Result
Mercury	µg/L	0.0027

SH-03		
Analyte	Unit	Result
Mercury	µg/L	0.00181
BEHP	µg/L	6.2

SH-04		
Analyte	Unit	Result
Mercury	µg/L	0.0253
BEHP	µg/L	2

DR260		
Analyte	Unit	Result
Arsenic	µg/L	36
Lead	µg/L	2
Vanadium	µg/L	12

DR262		
Analyte	Unit	Result
Arsenic	µg/L	26
Copper	µg/L	5
Lead	µg/L	1
Vanadium	µg/L	11

DR244		
Analyte	Unit	Result
Arsenic	µg/L	114
Cadmium	µg/L	4 J
Lead	µg/L	0.6 J
Vanadium	µg/L	22
Tributyltin as ion	µg/L	0.0090 J

SHB-6		
Analyte	Unit	Result
Copper	µg/L	32

SHB-5		
Analyte	Unit	Result
Copper	µg/L	264

SB-7		
Analyte	Unit	Result
Copper	µg/L	5.4
Zinc	µg/L	263

SB-8		
Analyte	Unit	Result
Zinc	µg/L	1,360

SB-18			
Analyte	Unit	Result	Field Replicate
Copper	µg/L	76.8	5 U
Mercury	µg/L	0.408	0.2 U
Zinc	µg/L	1,560	50 U

DR298		
Analyte	Unit	Result
Copper	µg/L	2
Lead	µg/L	1
Silver	µg/L	0.3 J
Vanadium	µg/L	3 J

DR301		
Analyte	Unit	Result
Copper	µg/L	1
Lead	µg/L	0.9
Silver	µg/L	0.5 J
Vanadium	µg/L	4 J

Sampling event
- EPA SI
- LDW RI
- Rhône-Poulenc
- Road
- Navigation channel
- River mile

Note: Only chemicals with detected concentrations are shown (in either original or field replicate samples).

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N

0 500 1,000 Feet

0 100 200 Meters

Map 4-12d. Porewater sampling data (only detected chemicals), RM 3.5 to RM 5.5

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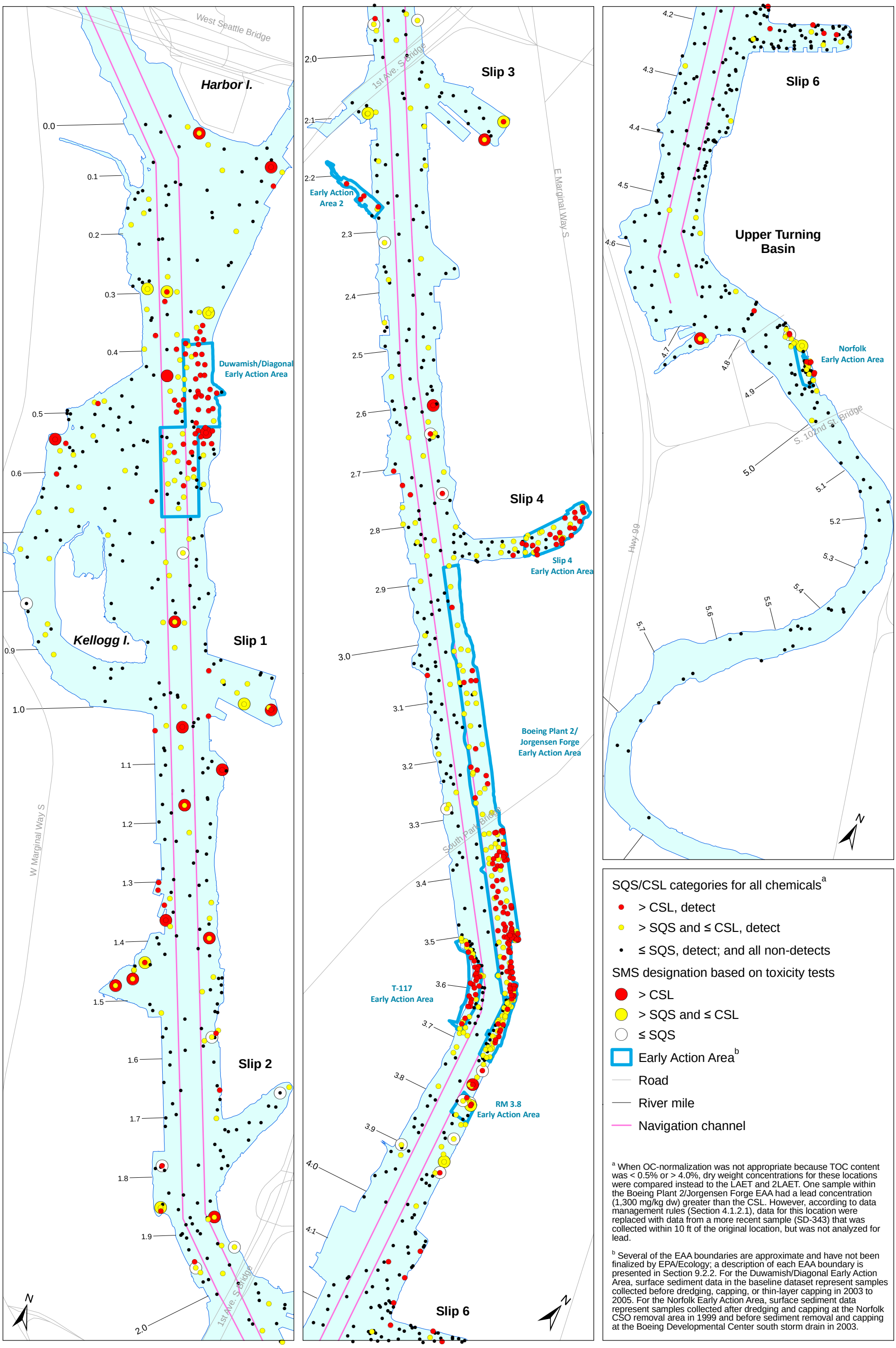

SQS/CSL categories for all chemicals[a]

- > CSL, detect
- > SQS and ≤ CSL, detect
- ≤ SQS, detect; and all non-detects

SMS designation based on toxicity tests

- > CSL
- > SQS and ≤ CSL
- ≤ SQS
- Early Action Area[b]
- Road
- River mile
- Navigation channel

[a] When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations were compared instead to the LAET and 2LAET. One sample within the Boeing Plant 2/Jorgensen Forge EAA had a lead concentration (1,300 mg/kg dw) greater than the CSL. However, according to data management rules (Section 4.1.2.1), data for this location were replaced with data from a more recent sample (SD-343) that was collected within 10 ft of the original location, but was not analyzed for lead.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2. For the Duwamish/Diagonal Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer capping in 2003 to 2005. For the Norfolk Early Action Area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

Map 4-13. Exceedances of SQS and CSL criteria for all chemicals with SMS criteria in the RI baseline surface sediment dataset

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Analyte	Exceedance Factor	
	SQS	CSL
PCBs	15	2.8

Chemicals in red exceeded CSL. The EF has no regulatory relevance and is presented here to provide an indication of the general magnitude of the concentration. Sampling locations represented by circles or squares were analyzed for all SMS chemicals. Surface sediment samples were collected at depths ≤15 cm below mudline. "ne" = not exceeded.

Only locations with detected exceedances outside the Duwamish/Diagonal dredged and capped or thin-layer placement areas are shown with exceedance factors. Colored symbols within these areas represent samples collected prior to dredging, capping, or thin-layer placement.

SQS/CSL categories for all SMS chemicals at surface sediment locations[a]

- > CSL, detect
- > SQS and ≤ CSL, detect
- > CSL, non-detect
- > SQS and ≤ CSL, non-detect
- ≤ SQS, detect and non-detect

SQS/CSL categories for PCBs at locations where only PCBs were analyzed[a]

- > CSL, detect
- > SQS and ≤ CSL, detect
- ≤ SQS, detect and non-detect

SMS designation based on toxicity tests

- > CSL
- > SQS and ≤ CSL
- ≤ SQS

Outfall classification[b]

- CSO/storm drain
- EOF
- Permitted private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale

- Early Action Area[c]
- Navigation channel
- River mile
- Dredged and capped area[d]
- Thin-layer placement[d]

[a] When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations were compared instead to the LAET and 2LAET.

[b] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

[c] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[d] For the Duwamish/Diagonal Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005.

HARBOR ISLAND

KELLOGG ISLAND

Duwamish/ Diagonal (2004)

Duwamish/Diagonal Early Action Area

Fluoranthene	1.4	ne

LDW-SS301

Mercury	1.3	ne
Chrysene	1.1	ne
Benzo(g,h,i)perylene	1.0	ne
Indeno(1,2,3-cd)pyrene	1.0	ne

LDW-SS2

LDW-SS302

PCBs	15	2.8
Lead	1.3	1.1
BEHP	1.7	1.0
Arsenic	1.5	ne
Zinc	1.3	ne

LDW-SS6

Mercury	1.4	ne
PCBs	1.2	ne

DR055

Arsenic	1.4	ne

DR001

PCBs	1.6	ne

0.1

LDW-SS305

Arsenic	2.2	1.3
PCBs	1.7	ne

PCBs	1.1	ne

DR003

Fluoranthene	2.3	ne
Phenanthrene	1.5	ne
Fluorene	1.4	ne
Indeno(1,2,3-cd)pyrene	1.3	ne
Chrysene	1.3	ne
Benzo(g,h,i)perylene	1.2	ne
Acenaphthene	1.1	ne
Total HPAH	1.1	ne
PCBs	1.1	ne

DR033

DR034

PCBs	1.6	ne

C1

Phenol	1.4	ne

0.2

PCBs	1.3	ne

Phenol	1.5	ne
Mercury	1.5	1.0

PCBs	1.3	ne

LDW-SS308

Mercury	3.8	2.6
PCBs	1.5	ne

LDW-SS16

K-04

LDW-SS15

LDW-SS309

Fluorene	1.9	ne
Phenanthrene	1.7	ne
Acenaphthene	1.7	ne
Dibenzofuran	1.3	ne
Fluoranthene	1.1	ne

DR037

Mercury	4.4	3.1
PCBs	1.9	ne

LDW-SS310

Fluoranthene	1.9	ne
Phenanthrene	1.4	ne
PCBs	1.1	ne

DR038

0.4

Fluoranthene	1.7	1.2
PCBs	6.0	ne
Chrysene	1.5	ne
Total HPAH	1.0	ne

Zinc	1.0	ne

DR005

EST231

LDW-SS17

DUD200

DUD_12C

DUD043

DUD_11C

DUD_10C

DR006

DUD044

K-03

DUD_9C

DUD045

DUD031

DR081

DUD032

DUD_8C

DUD033

CH1038

DUD204

DR059

DUD009

DUD_1C

DUD205

DUD010

DUD_2C

DR010

DUD014

Fluoranthene	2.3	1.6
PCBs	2.8	ne
Chrysene	1.3	ne
Total HPAH	1.2	ne
Pyrene	1.1	ne

Benzyl alcohol	12	9.2
Fluoranthene	3.1	2.1
Indeno(1,2,3-cd)pyrene	2.0	1.7
Benzo(a)anthracene	2.0	1.6
Benzo(g,h,i)perylene	1.6	1.5
Total HPAH	2.0	1.4
Chrysene	2.6	1.3
Pyrene	1.7	1.3
Mercury	1.5	1.1
Benzofluoranthenes	1.2	1.1
PCBs	2.2	ne
Dibenzo(a,h)anthracene	1.5	ne
Benzo(a)pyrene	1.3	ne
Phenanthrene	1.3	ne
Zinc	1.1	ne

SD-17

WST370

DR040

PCBs	1.4	ne

SD-10

Zinc	1.1	ne

LDW-SS24

LDW-SS311

Indeno(1,2,3-cd)pyrene	2.7	2.3
Benzo(g,h,i)perylene	2.4	2.2
Fluoranthene	2.9	2.0
Total HPAH	2.2	1.5
Pyrene	1.8	1.5
Benzo(a)anthracene	1.7	1.4
Benzofluoranthenes	1.5	1.3
Chrysene	2.1	1.1
Benzo(a)pyrene	2.0	1.1
PCBs	7.8	1.0
Mercury	1.5	1.0
Phenanthrene	2.3	ne
Dibenzo(a,h)anthracene	1.4	ne

WIT282

DR042

PCBs	1.4	ne
PCBs	5.9	ne

DR044

LDW-SS312

PCBs	2.1	ne
BBP	1.6	ne

DR043

Fluoranthene	6.9	ne
Total HPAH	2.6	ne
Chrysene	2.0	ne
Phenanthrene	1.4	ne

K-02

WIT283

PCBs	1.6	ne

WIT286

PCBs	1.5	ne

Cadmium	1.4	1.1
Phenol	2.4	ne

DR083

0.7

Phenol	1.1	ne

C2-1

DUD037

PCBs	1.5	ne

WIT287

PCBs	2.0	ne
BEHP	1.0	ne

LDW-SS26

PCBs	1.7	ne

WIT288

PCBs	2.1	ne
BEHP	1.1	ne

CH1036

BBP	3.9	ne
PCBs	3.0	ne

DR084

PCBs	1.1	ne

PCBs	2.3	ne
BEHP	1.0	ne

0.8

PCBs	3.8	ne
PCBs	4.6	ne

LDW-SSB2b

B2b

LDW-SS316

PCBs	1.8	ne

LDW-SS317

Phenol	1.8	ne
Fluoranthene	1.1	ne

DR047

Fluoranthene	3.9	ne
PCBs	1.4	ne
Total HPAH	1.1	ne

PCBs	2.7	ne

WIT290

PCBs	3.2	ne

0.9

WIT291

LDW-SS318

PCBs	1.1	ne

DR005	BEHP	1.6 ne
	BBP	1.1 ne
LDW-SS17	BEHP	1.4 ne
EST231	PCBs	1.1 ne
DUD200	4-Methylphenol	1.1 1.1
	BEHP	1.5 ne
	BBP	1.1 ne
	PCBs	1.1 ne
DUD_12C	PCBs	1.7 ne
	BEHP	1.6 ne
DUD043	BEHP	2.6 1.5
	PCBs	2.3 ne
	BBP	1.3 ne
DR006	BEHP	2.1 1.3
	BBP	1.5 ne
DUD_11C	BEHP	2.5 1.5
	PCBs	2.3 ne
	BBP	1.4 ne
DUD_10C	PCBs	3.1 ne
DUD044	PCBs	28 5.1
	BEHP	4.5 2.7
	HCB	1.4 ne
	BBP	1.2 ne
K-03	Phenol	1.3 ne
	PCBs	1.1 ne
DUD_9C	BEHP	1.3 ne
	PCBs	1.1 ne
DUD031	PCBs	2.2 ne
	BEHP	1.1 ne
DUD045	PCBs	2.3 ne
	BBP	1.3 ne
	BEHP	1.2 ne
DUD032	Mercury	1.5 1.0
	PCBs	3.0 ne
	BEHP	1.3 ne
DR081	PCBs	6.9 1.3
	BEHP	1.8 1.1
DUD_8C	PCBs	21 3.9
	BEHP	2.8 1.7
	Mercury	2.1 1.5
	Silver	1.0 1.0
	Cadmium	1.0 ne
DUD033	PCBs	1.5 ne
	BEHP	1.3 ne
CH1038	PCBs	6.8 1.2
DUD204	BEHP	2.1 1.3
	4-Methylphenol	1.1 1.1
	BBP	2.7 ne
DUD009	BEHP	2.3 1.4
	Fluoranthene	2.3 ne
	BBP	2.2 ne
	Total HPAH	1.1 ne
DUD_1C	BEHP	3.8 2.3
	PCBs	1.5 ne
DR059	BEHP	2.0 1.2
	BBP	1.1 ne
DUD205	4-Methylphenol	2.1 2.1
	BEHP	1.8 1.1
	PCBs	1.3 ne
	BBP	1.2 ne
DUD010	N-Nitrosodiphenylamine	3.9 2.8
	BEHP	3.7 2.5
	Fluoranthene	1.8 1.2
	PCBs	6.6 ne
	BBP	4.9 ne
	Chrysene	1.4 ne
	Total HPAH	1.2 ne
	Benzo(a)anthracene	1.2 ne
	Benzofluoranthenes	1.0 ne
DUD_2C	BEHP	2.3 1.4
	PCBs	1.4 ne
DR010	BEHP	1.1 ne
DUD014	BBP	3.7 ne

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N

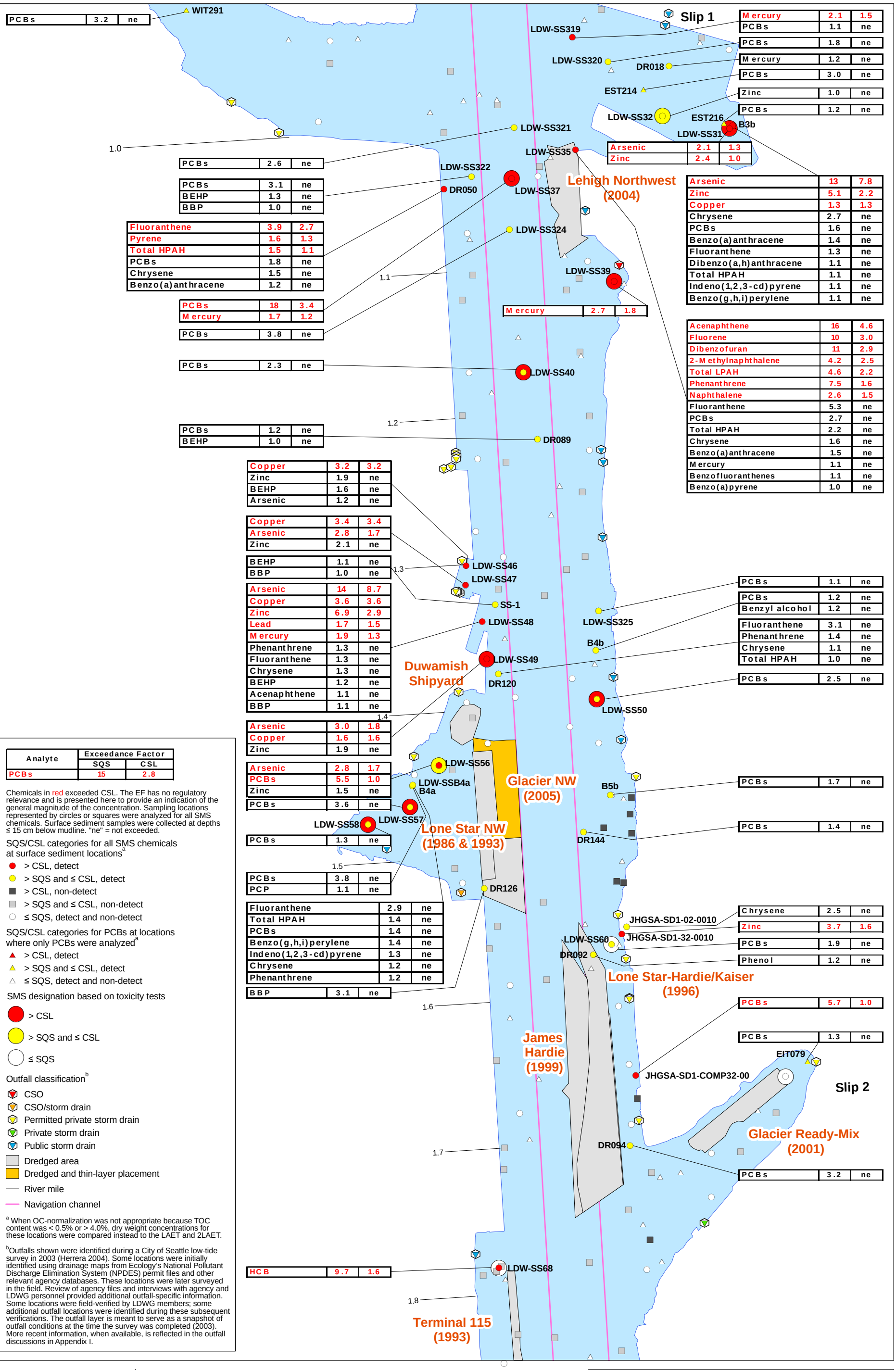
0 250 500 Feet

0 75 150 Meters

Map 4-14a. Chemical and toxicity test results compared to SMS criteria for baseline surface sediment sampling locations, RM 0.0 to RM 0.9

Prepared by CEH, 07/14/2010; Map 2896; W:\Projects\00-08-06 Duwamish Rl\data\GIS\Phase2 Rl\Nature and Extent\Surface Sediment\SMS

Dredging information provided by AECOM.



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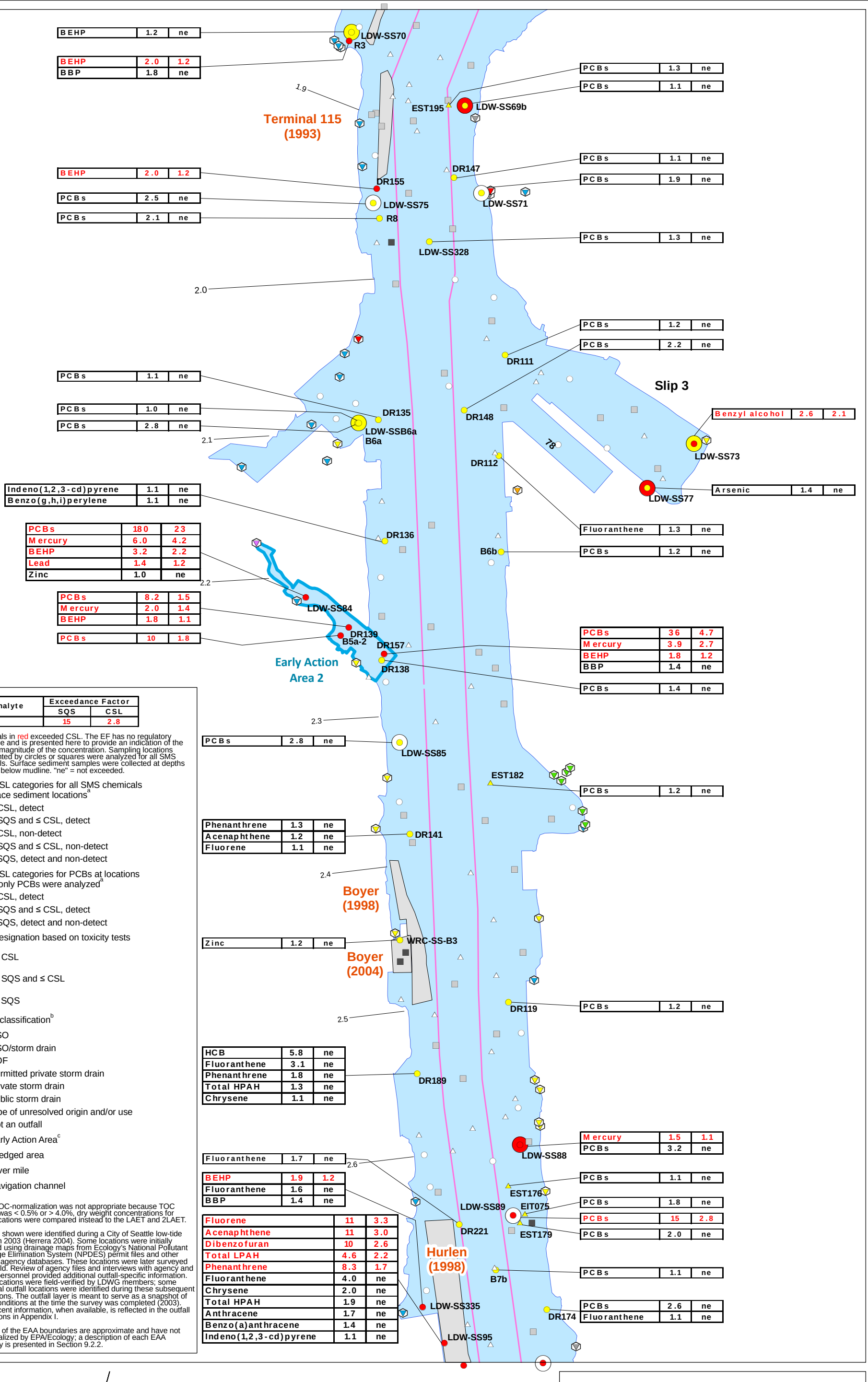
Map 4-14b. Chemical and toxicity test results compared to SMS criteria for baseline surface sediment sampling locations, RM 0.9 to RM 1.8

Prepared by CEH, 07/14/2010; Map 2886; W:\Projects\00-08-06_Duwamish_Rl\data\GIS\Phase2 RI\Nature and Extent\Surface Sediment\SMS

Dredging information provided by AECOM.



Analyte	Exceedance Factor	
	SQS	CSL
PCBs	15	2.8

Chemicals in red exceeded CSL. The EF has no regulatory relevance and is presented here to provide an indication of the general magnitude of the concentration. Sampling locations represented by circles or squares were analyzed for all SMS chemicals. Surface sediment samples were collected at depths ≤ 15 cm below mudline. "ne" = not exceeded.

SQS/CSL categories for all SMS chemicals at surface sediment locations[a]

- > CSL, detect
- > SQS and ≤ CSL, detect
- > CSL, non-detect
- > SQS and ≤ CSL, non-detect
- ≤ SQS, detect and non-detect

SQS/CSL categories for PCBs at locations where only PCBs were analyzed[a]

- > CSL, detect
- > SQS and ≤ CSL, detect
- ≤ SQS, detect and non-detect

SMS designation based on toxicity tests

- > CSL
- > SQS and ≤ CSL
- ≤ SQS

Outfall classification[b]

- CSO
- CSO/storm drain
- EOF
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Not an outfall
- Early Action Area[c]
- Dredged area
- River mile
- Navigation channel

[a] When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations were compared instead to the LAET and 2LAET.

[b] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and LDWG personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

[c] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

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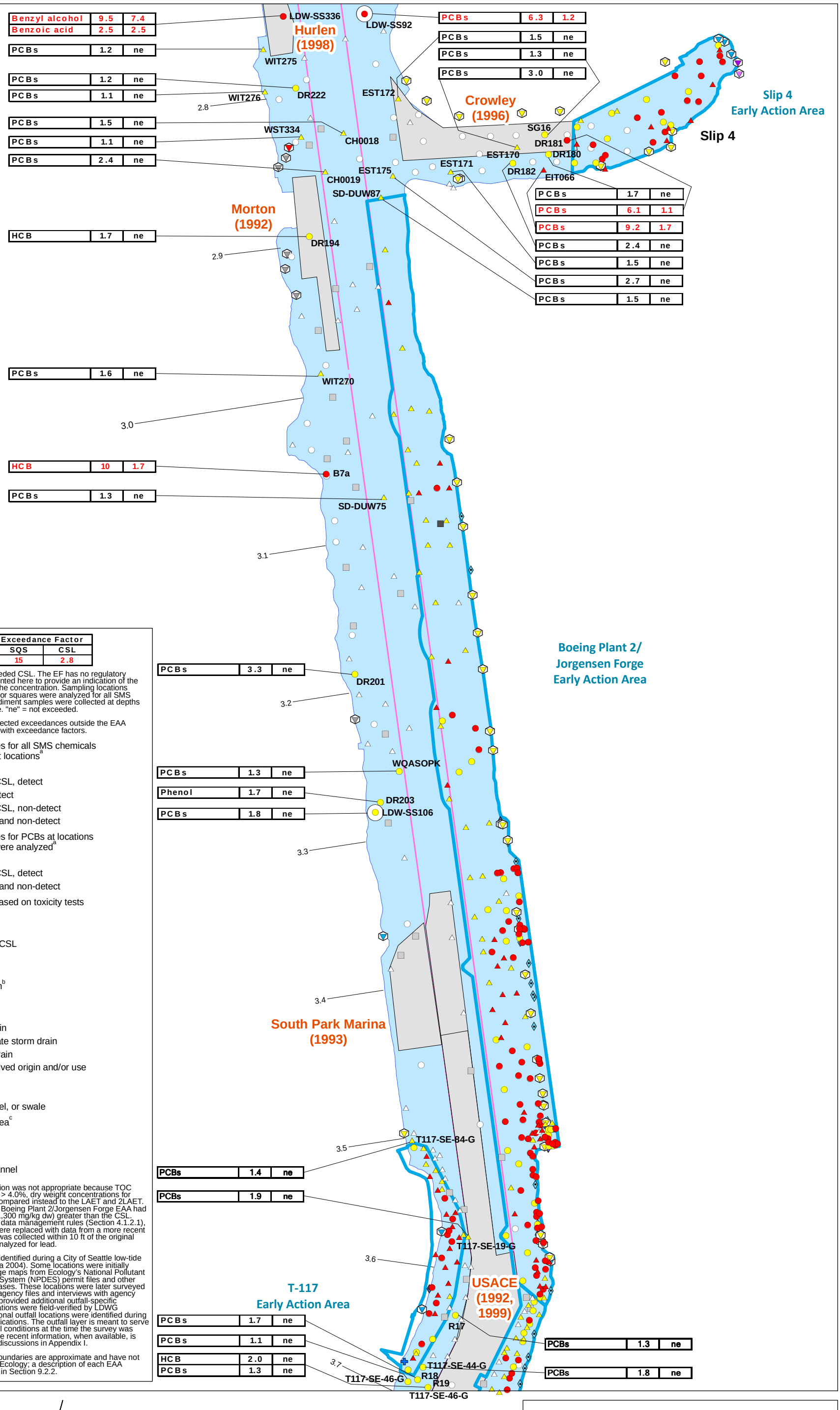
0 250 500 Feet
0 75 150 Meters

Map 4-14c. Chemical and toxicity test results compared to SMS criteria for baseline surface sediment sampling locations, RM 1.8 to RM 2.7

Prepared by CEH, 07/14/2010; Map 2896; W:\Projects\00-08-06_Duwamish_R\data\GIS\Phase2 R\Nature and Extent\Surface Sediment\SMS

Dredging information provided by AECOM.



Analyte	Exceedance Factor	
	SQS	CSL
PCBs	15	2.8

Chemicals in red exceeded CSL. The EF has no regulatory relevance and is presented here to provide an indication of the general magnitude of the concentration. Sampling locations represented by circles or squares were analyzed for all SMS chemicals. Surface sediment samples were collected at depths ≤ 15 cm below mudline. "ne" = not exceeded.

Only locations with detected exceedances outside the EAA boundaries are shown with exceedance factors.

SQS/CSL categories for all SMS chemicals at surface sediment locations[a]
- > CSL, detect
- > SQS and ≤ CSL, detect
- > CSL, non-detect
- > SQS and ≤ CSL, non-detect
- ≤ SQS, detect and non-detect

SQS/CSL categories for PCBs at locations where only PCBs were analyzed[a]
- > CSL, detect
- > SQS and ≤ CSL, detect
- ≤ SQS, detect and non-detect

SMS designation based on toxicity tests
- > CSL
- > SQS and ≤ CSL
- ≤ SQS

Outfall classification[b]
- CSO
- EOF
- EOF/storm drain
- Permitted private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale
- Early Action Area[c]
- Dredged area
- River mile
- Navigation channel

[a] When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations were compared instead to the LAET and 2LAET. One sample within the Boeing Plant 2/Jorgensen Forge EAA had a lead concentration (1,300 mg/kg dw) greater than the CSL. However, according to data management rules (Section 4.1.2.1), data for this location were replaced with data from a more recent sample (SD-343) that was collected within 10 ft of the original location, but was not analyzed for lead.

[b] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and LDWG personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

[c] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

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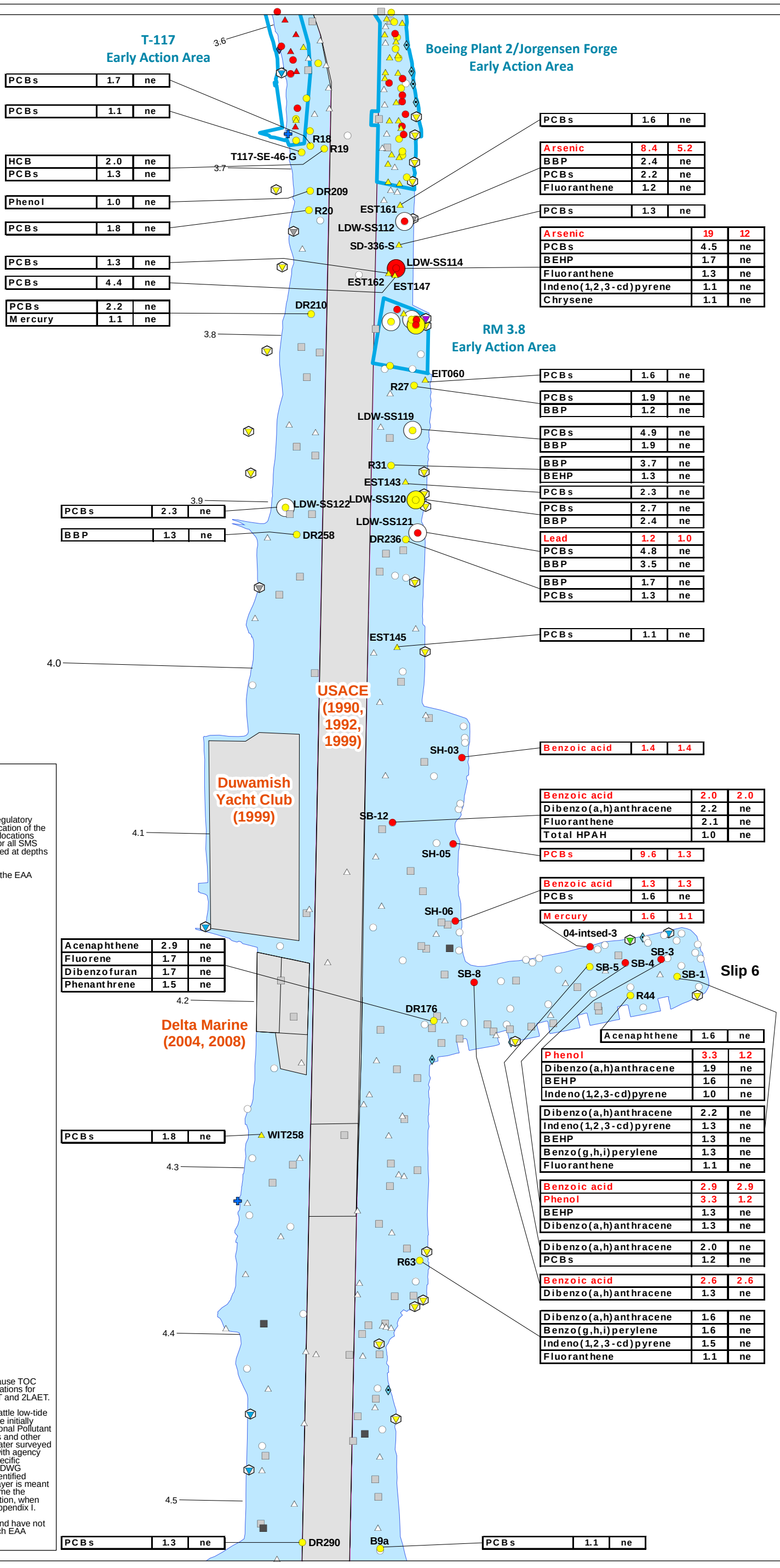
0 250 500 Feet

0 75 150 Meters

Map 4-14d. Chemical and toxicity test results compared to SMS criteria for baseline surface sediment sampling locations, RM 2.8 to RM 3.7

Prepared by CEH, 07/14/2010; Map 2886; W:\Projects\00-08-06_Duwamish_R\Data\GIS\Phase2 R\N\ature and Extent\Surface Sediment\SMS

Dredging information provided by AECOM.



Wind Ward LLC environmental

N

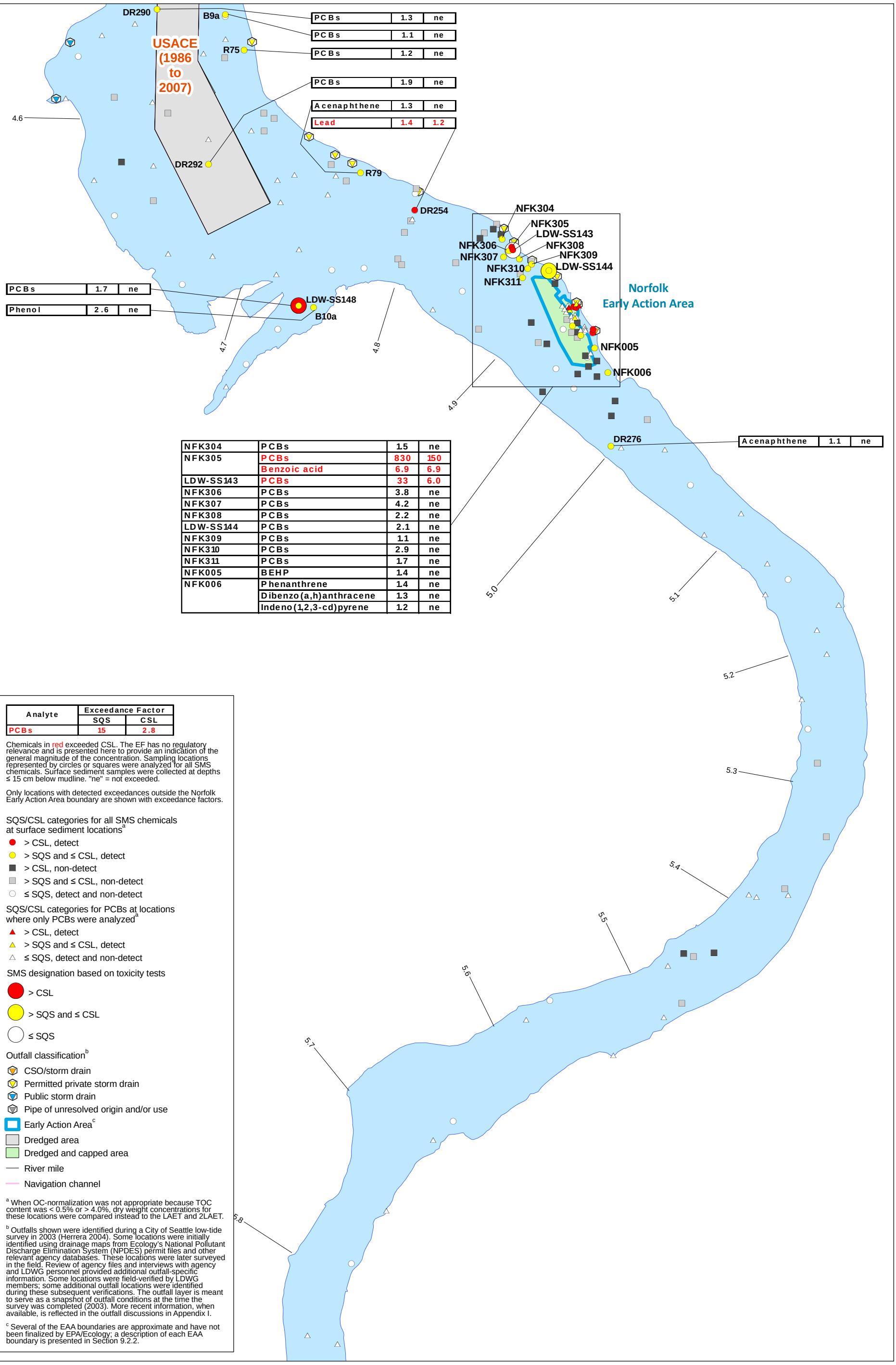
0 250 500 Feet

0 75 150 Meters

Map 4-14e. Chemical and toxicity test results compared to SMS criteria for baseline surface sediment sampling locations, RM 3.7 to RM 4.5

Prepared by:CEH, 07/14/2010; Map 2886; W:\Projects\00-08-06_Duwamish_RI\data\GIS\Phase2 RI\Nature and Extent\Surface Sediment\SMS

Dredging information provided by AECOM.



NFK304	PCBs	15	ne
NFK305	PCBs	830	150
	Benzoic acid	6.9	6.9
LDW-SS143	PCBs	33	6.0
NFK306	PCBs	3.8	ne
NFK307	PCBs	4.2	ne
NFK308	PCBs	2.2	ne
LDW-SS144	PCBs	2.1	ne
NFK309	PCBs	1.1	ne
NFK310	PCBs	2.9	ne
NFK311	PCBs	1.7	ne
NFK005	BEHP	1.4	ne
NFK006	Phenanthrene	1.4	ne
	Dibenzo(a,h)anthracene	1.3	ne
	Indeno(1,2,3-cd)pyrene	1.2	ne

Analyte	Exceedance Factor	
	SQS	CSL
PCBs	15	2.8

Chemicals in red exceeded CSL. The EF has no regulatory relevance and is presented here to provide an indication of the general magnitude of the concentration. Sampling locations represented by circles or squares were analyzed for all SMS chemicals. Surface sediment samples were collected at depths ≤ 15 cm below mudline. "ne" = not exceeded.

Only locations with detected exceedances outside the Norfolk Early Action Area boundary are shown with exceedance factors.

SQS/CSL categories for all SMS chemicals at surface sediment locations[a]
- > CSL, detect
- > SQS and ≤ CSL, detect
- > CSL, non-detect
- > SQS and ≤ CSL, non-detect
- ≤ SQS, detect and non-detect

SQS/CSL categories for PCBs at locations where only PCBs were analyzed[a]
- > CSL, detect
- > SQS and ≤ CSL, detect
- ≤ SQS, detect and non-detect

SMS designation based on toxicity tests
- > CSL
- > SQS and ≤ CSL
- ≤ SQS

Outfall classification[b]
- CSO/storm drain
- Permitted private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use

Early Action Area[c]
Dredged area
Dredged and capped area
River mile
Navigation channel

[a] When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations were compared instead to the LAET and 2LAET.

[b] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and LDWG personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

[c] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

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N

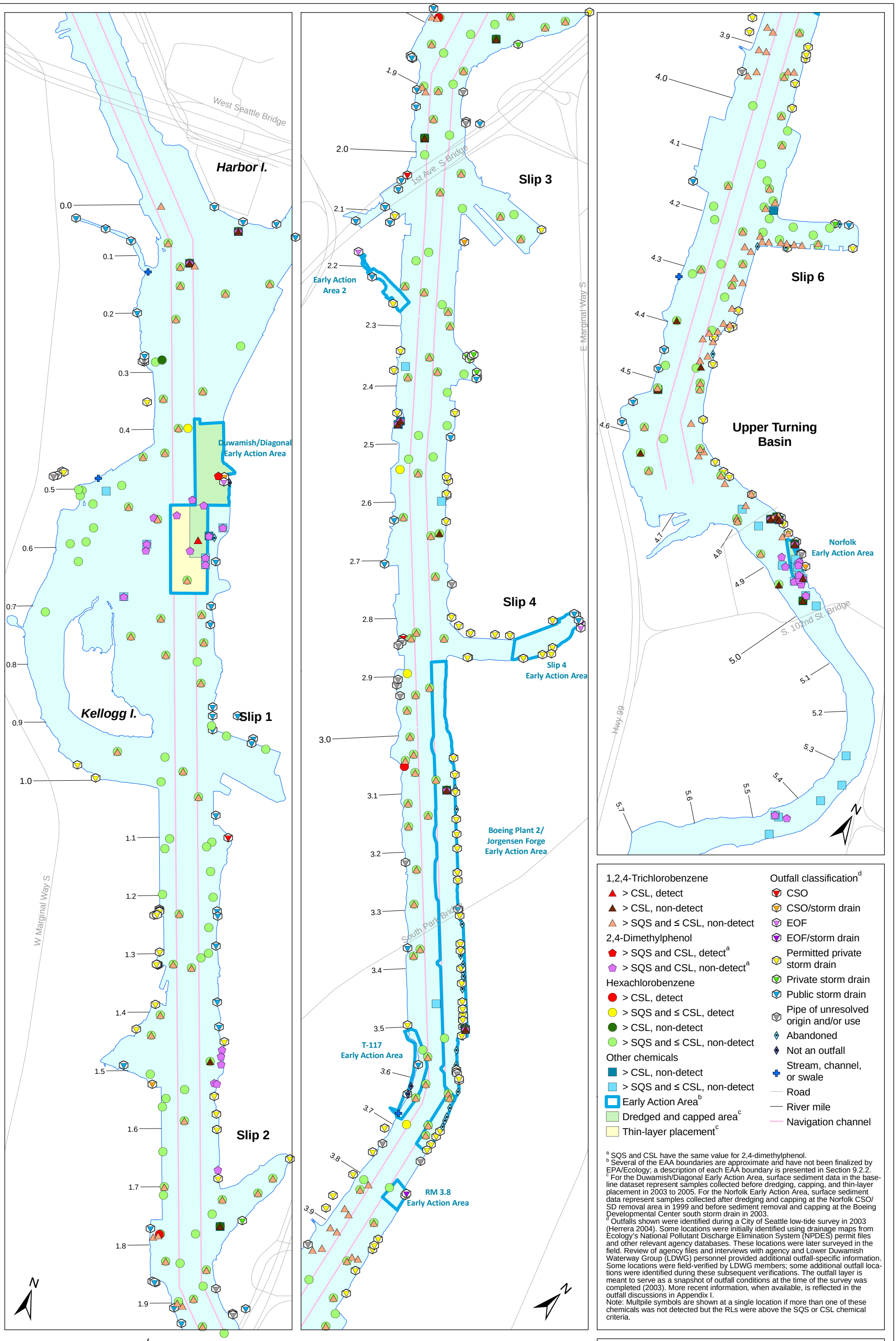
0 250 500 Feet

0 75 150 Meters

Map 4-14f. Chemical and toxicity test results compared to SMS criteria for baseline surface sediment sampling locations, RM 4.5 to RM 5.8

Prepared by CEH, 07/14/2010; Map 2886; W:\Projects\00-08-06_Duwamish_RI\data\GIS\Phase2 RI\Nature and Extent\Surface Sediment\SMS

Dredging information provided by AECOM.



[a] SQS and CSL have the same value for 2,4-dimethylphenol.
[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.
[c] For the Duwamish/Diagonal Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, and thin-layer placement in 2003 to 2005. For the Norfolk Early Action Area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO/SD removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.
[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time of the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.
Note: Multpile symbols are shown at a single location if more than one of these chemicals was not detected but the RLs were above the SQS or CSL chemical criteria.

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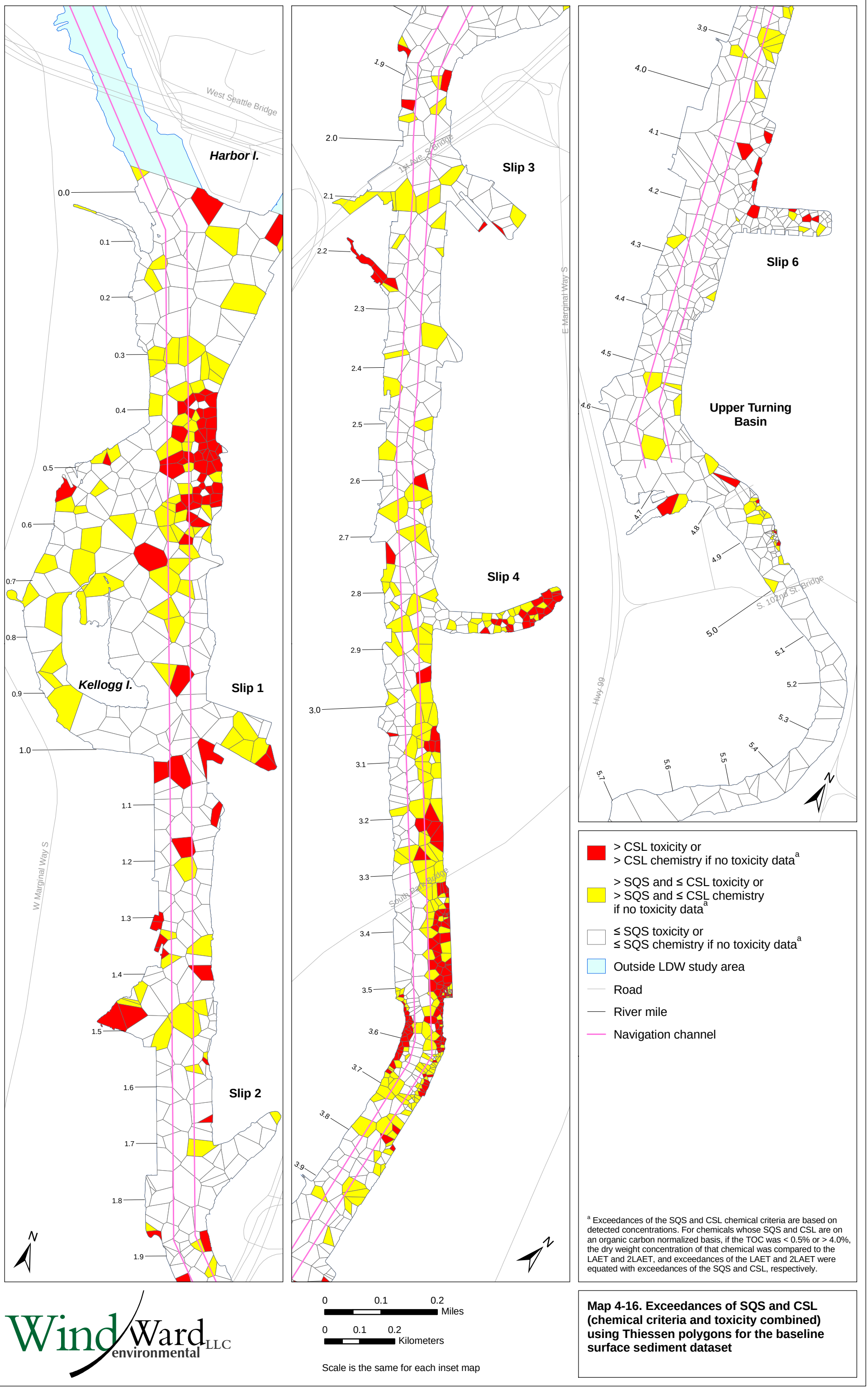
Map 4-15. Surface sediment sampling locations with non-detect RLs greater than SQS or CSL chemical criteria (and no detected exceedances) and locations with detected 1,2,4-trichlorobenzene, 2,4-dimethylphenol, and hexachlorobenzene

Prepared by CEH, 07/14/2010. MAP #2417. W:\Projects\00-08-06_Duwamish_RI\data\GIS\Phase2 RI\Nature and Extent\Surface Sediment\SMS



[a] Exceedances of the SQS and CSL chemical criteria are based on detected concentrations. For chemicals whose SQS and CSL are on an organic carbon normalized basis, if the TOC was < 0.5% or > 4.0%, the dry weight concentration of that chemical was compared to the LAET and 2LAET, and exceedances of the LAET and 2LAET were equated with exceedances of the SQS and CSL, respectively.

Map 4-16. Exceedances of SQS and CSL (chemical criteria and toxicity combined) using Thiessen polygons for the baseline surface sediment dataset

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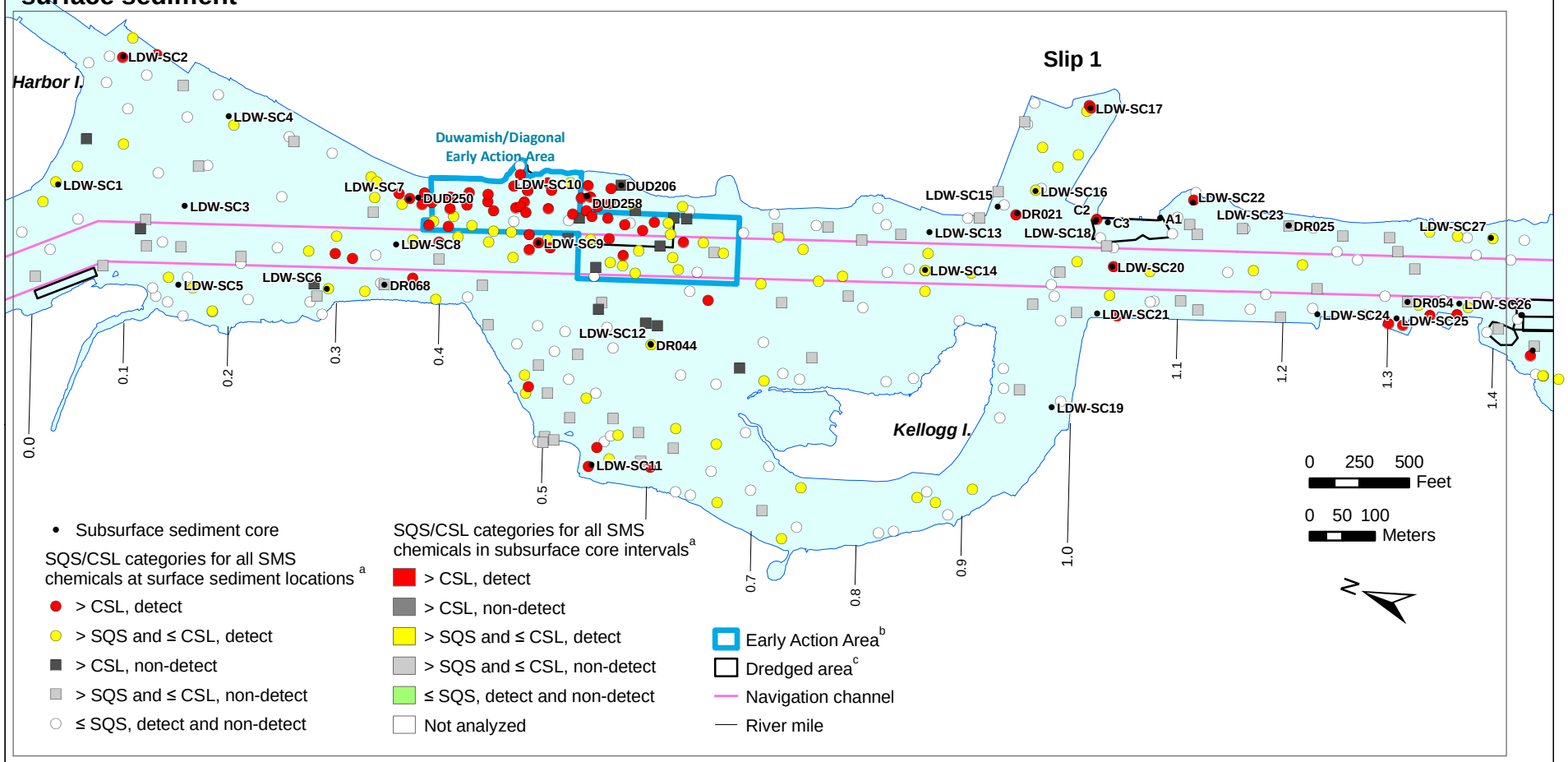
Prepared by CEH, 07/14/2010. MAP #2383. W:\Projects\00-08-06_Duwamish_R\data\GIS\Phase2 RI\Nature and Extent\Surface Sediment\SMS

Subsurface sediment core locations and exceedances of SQS and CSL (chemical criteria and toxicity combined) in surface sediment



[a] When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations were compared instead to the LAET and 2LAET.

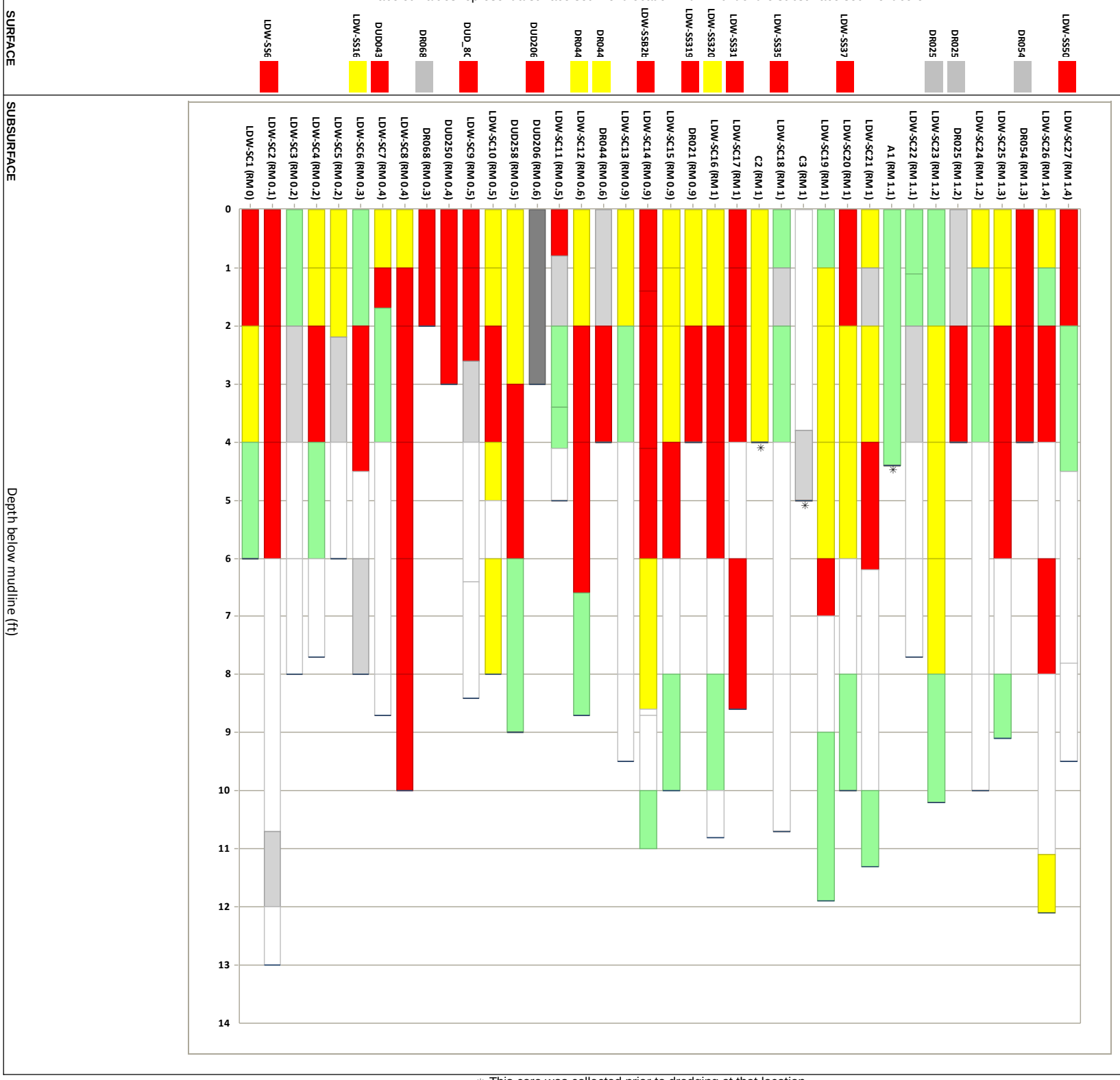
[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] Subsurface sediment data in the Duwamish/Diagonal Early Action Area were collected prior to dredging and capping or thin-layer placement. In other dredged areas subsurface data were collected prior to dredging.

Note: This map does not include samples in the Duwamish/Diagonal dredged and capped area.

Exceedances of SQS and CSL in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment location within 10 ft of the subsurface sediment core.



✳ This core was collected prior to dredging at that location.

Map 4-17a. Comparisons of concentrations of all SMS chemicals to SMS criteria (SQS or CSL) in subsurface sediment cores, RM 0.0 to RM 1.4

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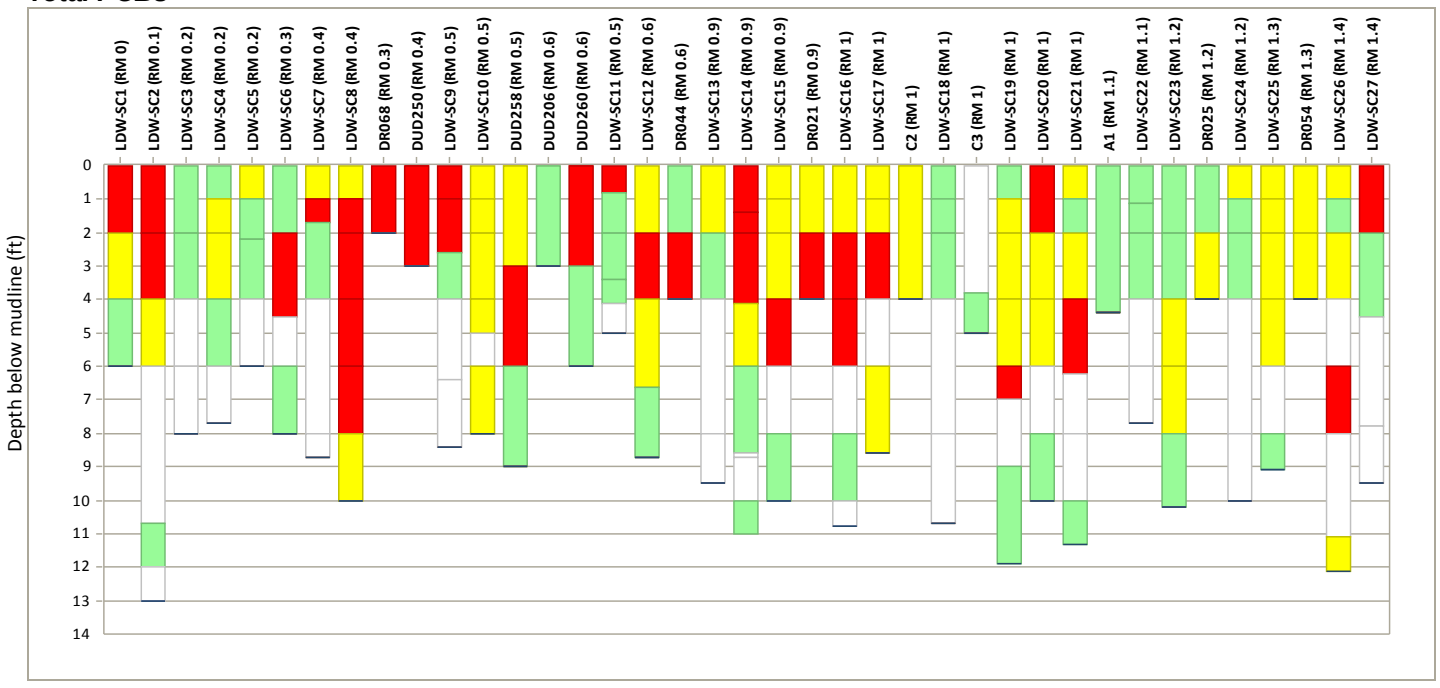
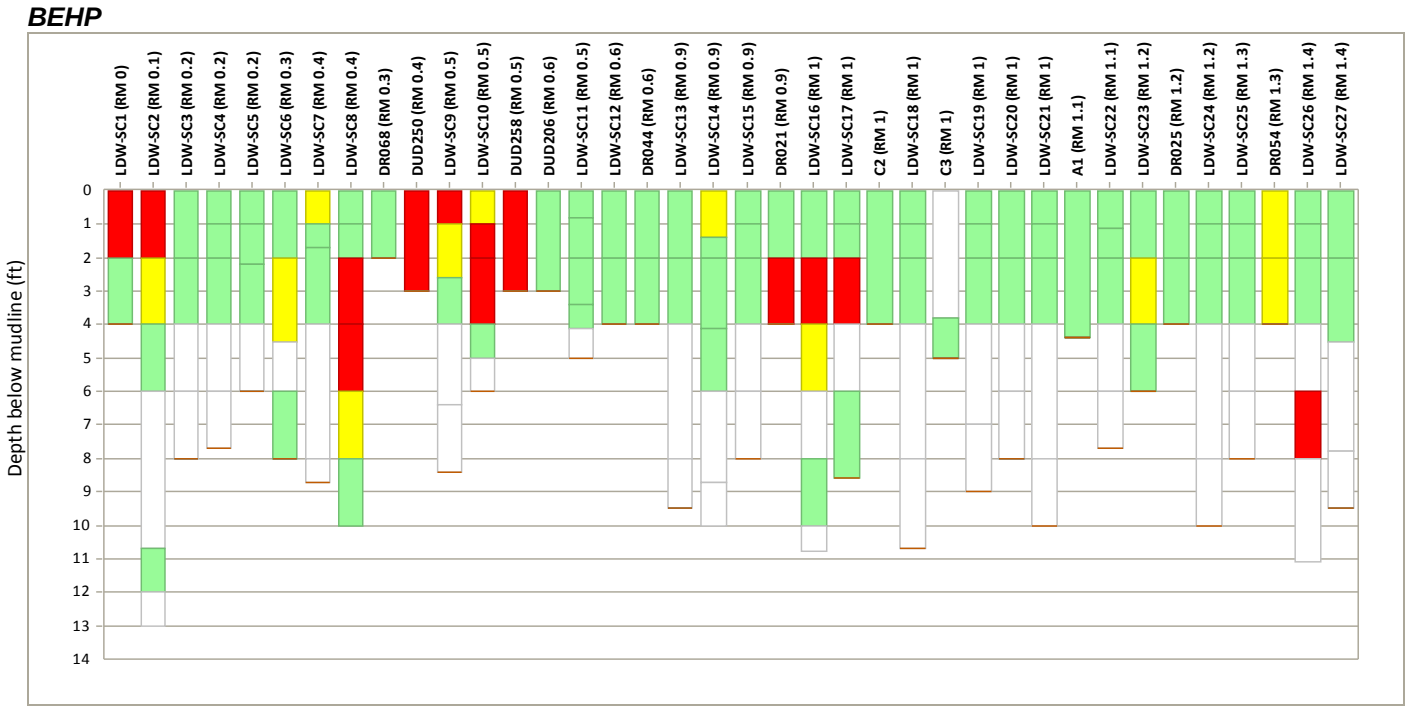
Prepared by CEH, 07/14/2010, MAP 2984, W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

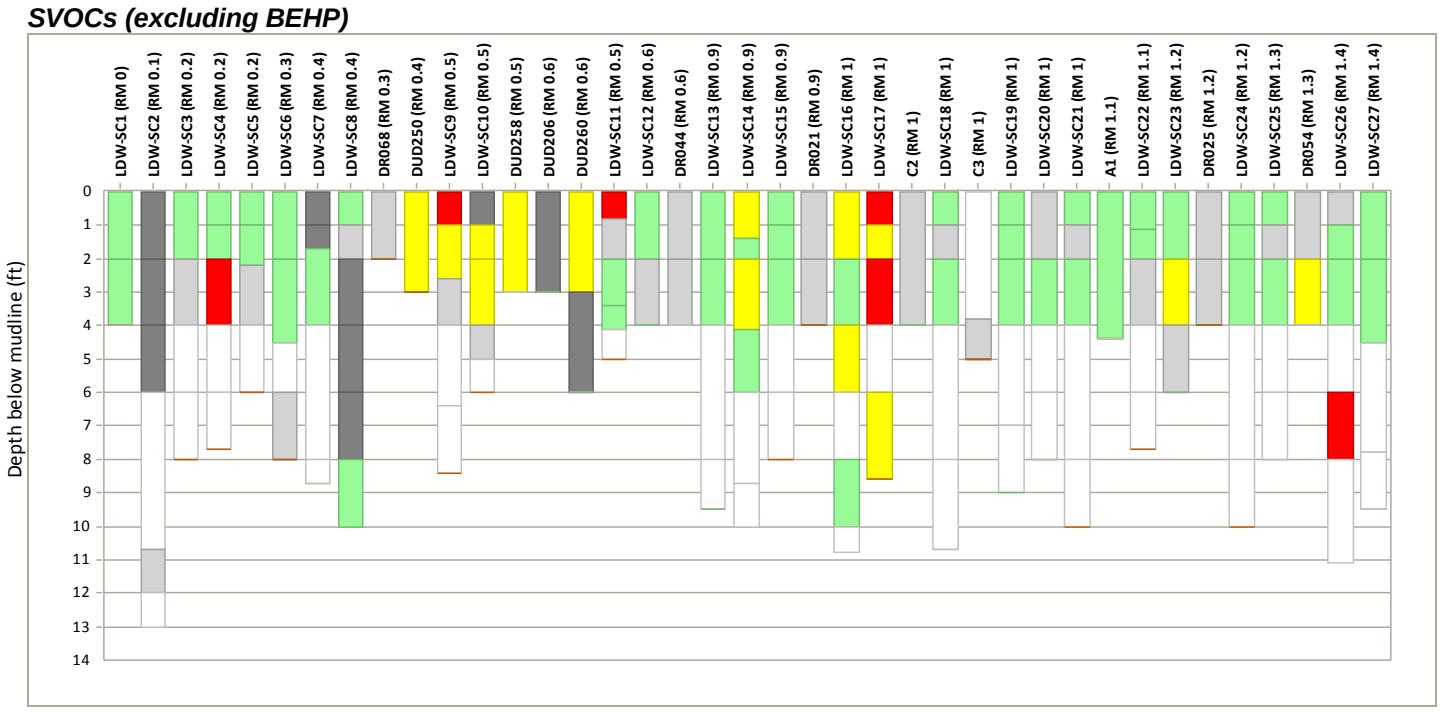
Total PCBs



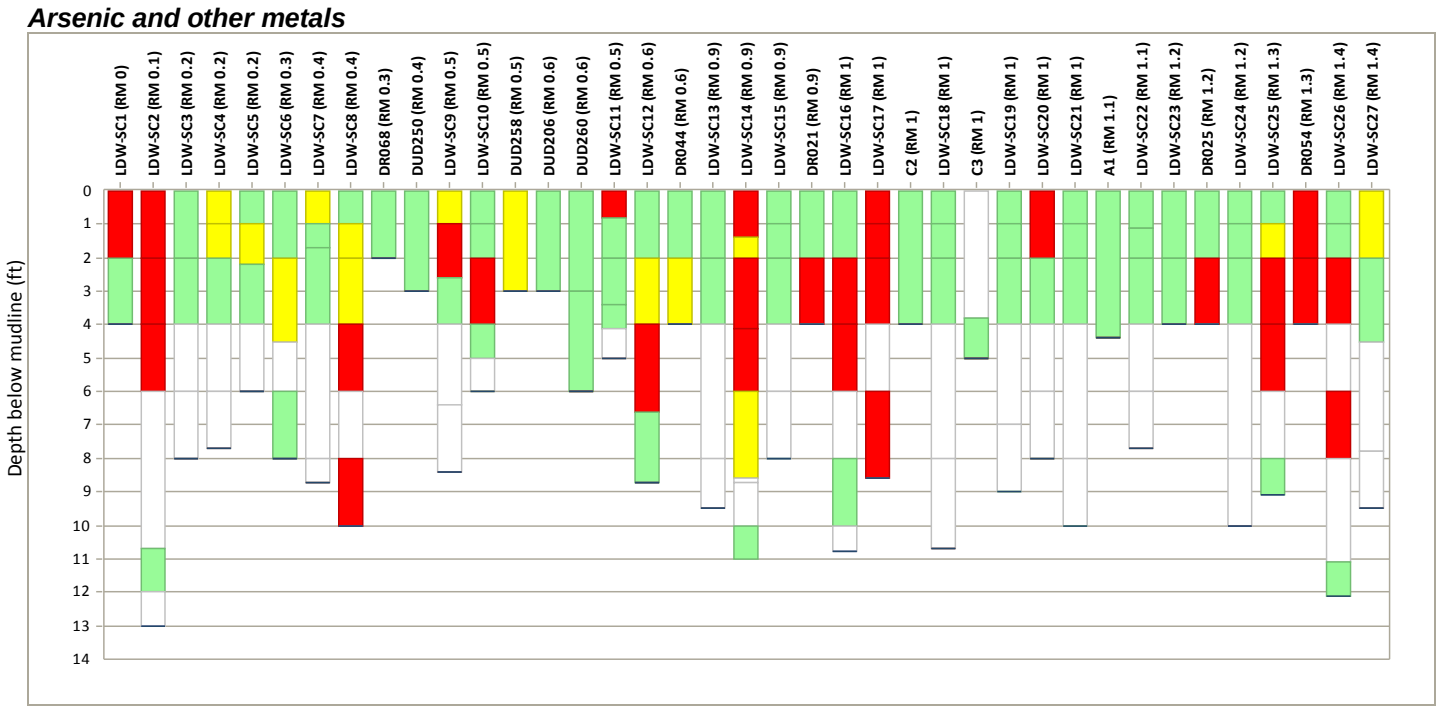
BEHP



SVOCs (excluding BEHP)



Arsenic and other metals



Prepared by CEH, 07/14/2010; MAP 2984; W:\Projects\00-08-06 Duwamish_Rl\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

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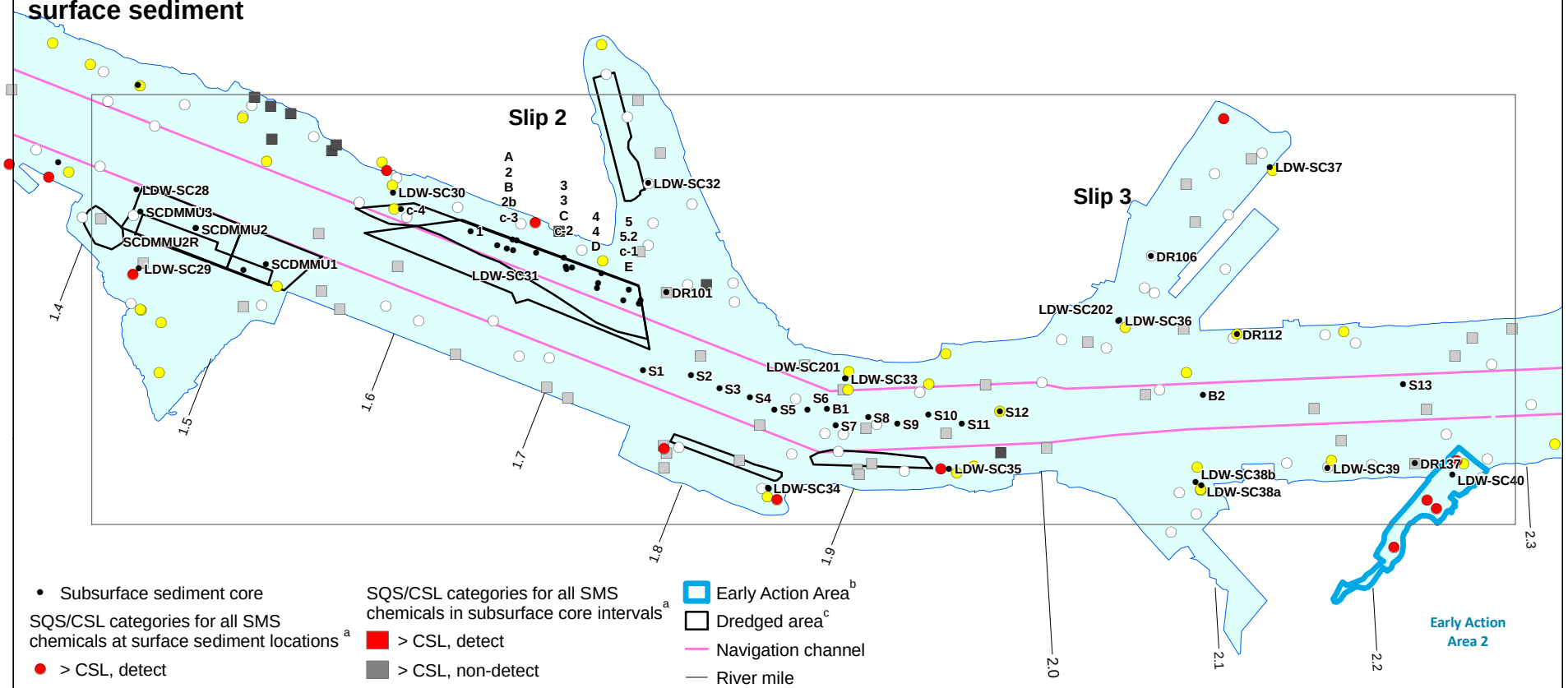
SQS/CSL categories for SMS chemicals in subsurface core intervals[a]

- > CSL, detected
- > SQS and ≤ CSL, detected
- > CSL, non-detect
- > SQS and ≤ CSL, non-detect
- ≤ SQS, detect and non-detect
- Not analyzed

[a] When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations were compared instead to the LAET and 2LAET.

Map 4-17b. Comparisons of concentrations of total PCBs, BEHP, SVOCs, and metals to SMS criteria (SQS or CSL) in subsurface sediment cores, RM 0.0 to RM 1.4

Subsurface sediment core locations and exceedances of SQS and CSL (chemical criteria and toxicity combined) in surface sediment



- Subsurface sediment core

SQS/CSL categories for all SMS chemicals at surface sediment locations [a]
- > CSL, detect
- > SQS and ≤ CSL, detect
- > CSL, non-detect
- > SQS and ≤ CSL, non-detect
- ≤ SQS, detect and non-detect

SQS/CSL categories for all SMS chemicals in subsurface core intervals [a]
- > CSL, detect
- > CSL, non-detect
- > SQS and ≤ CSL, detect
- > SQS and ≤ CSL, non-detect
- ≤ SQS, detect and non-detect
- Not analyzed

- Early Action Area [b]
- Dredged area [c]
- Navigation channel
- River mile

0 250 500 Feet

0 50 100 Meters

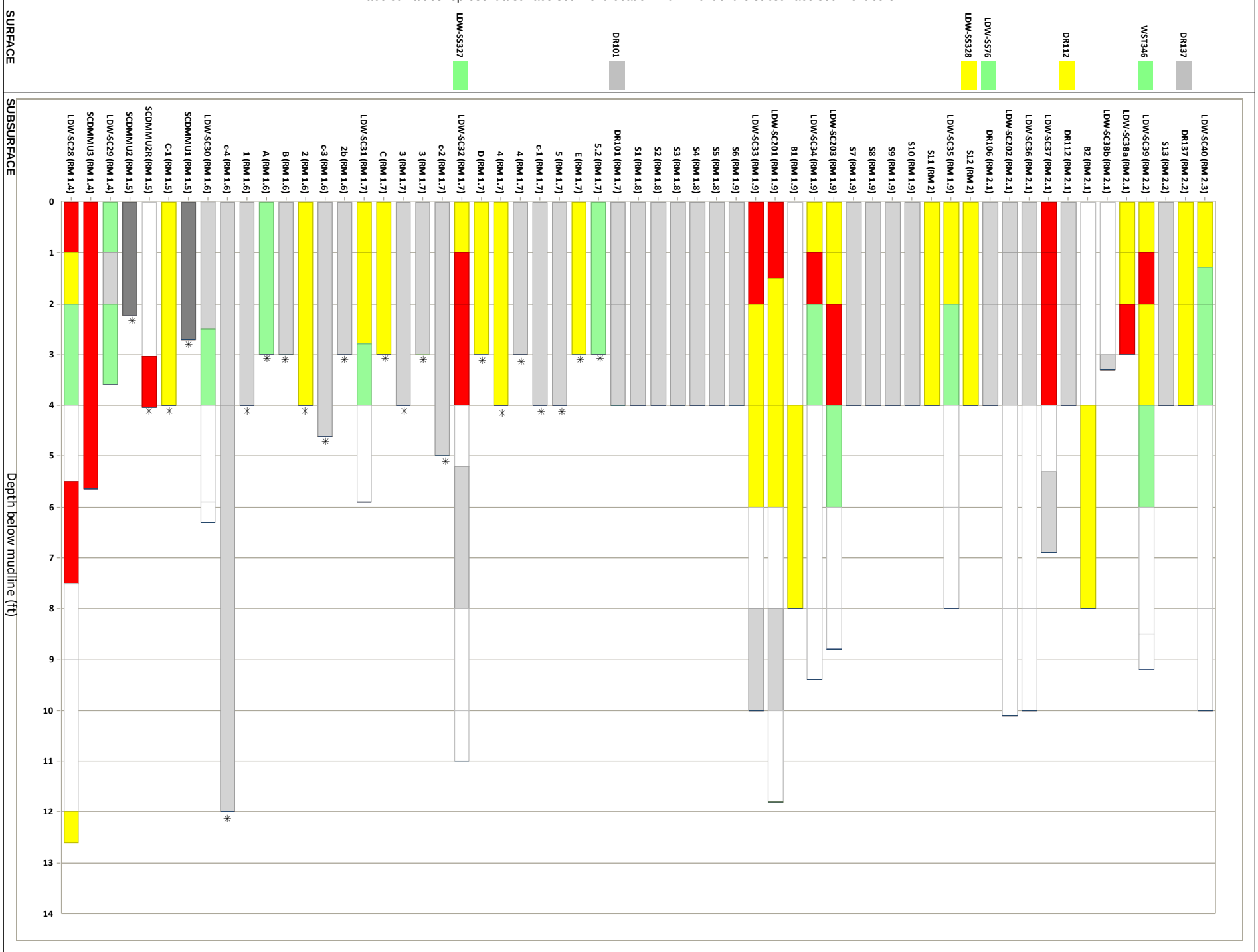
[a] When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations were compared instead to the LAET and 2LAET.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] Subsurface sediment data in dredged areas were collected prior to dredging.

Exceedances of SQS and CSL in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment location within 10 ft of the subsurface sediment core.



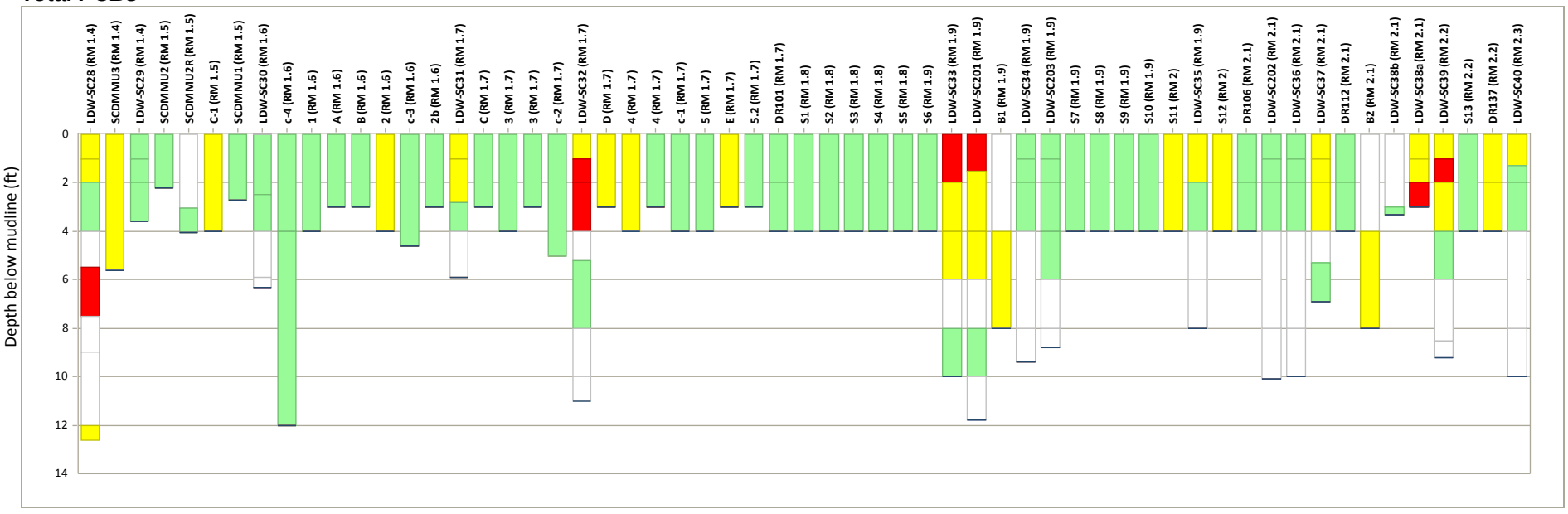
✳ This core was collected prior to dredging at that location.

Map 4-17c. Comparisons of concentrations of all SMS chemicals to SMS criteria (SQS or CSL) in subsurface sediment cores, RM 1.4 to RM 2.3

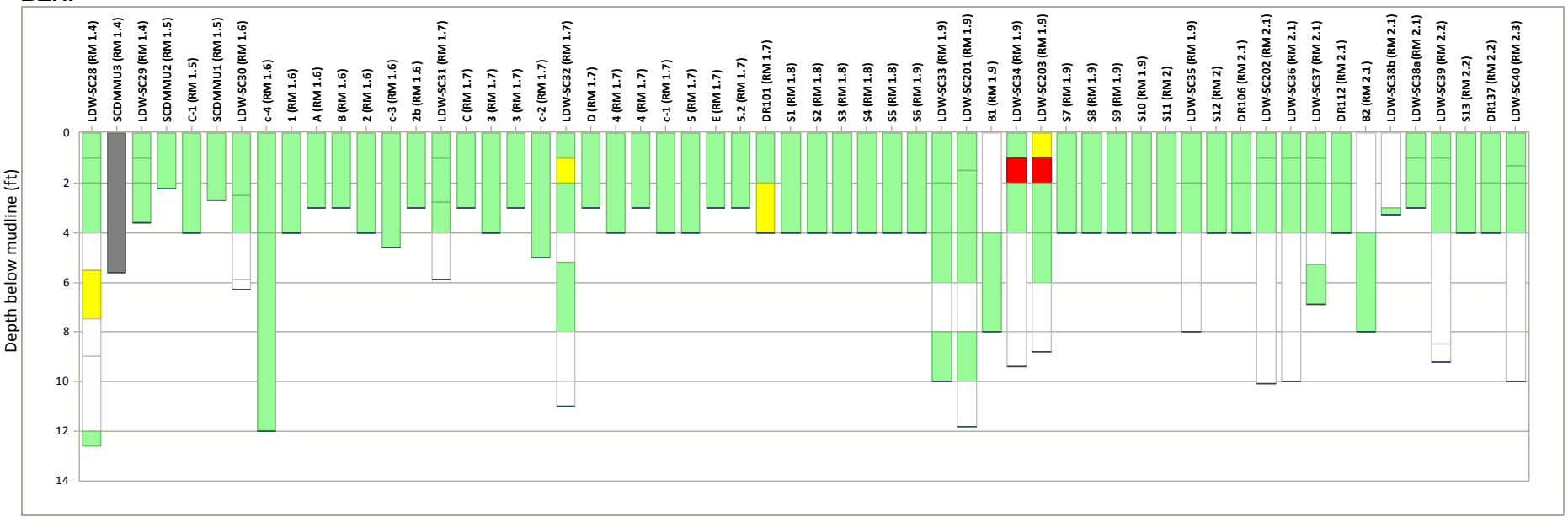
Prepared by CEH, 07/14/2010; MAP 2984; W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

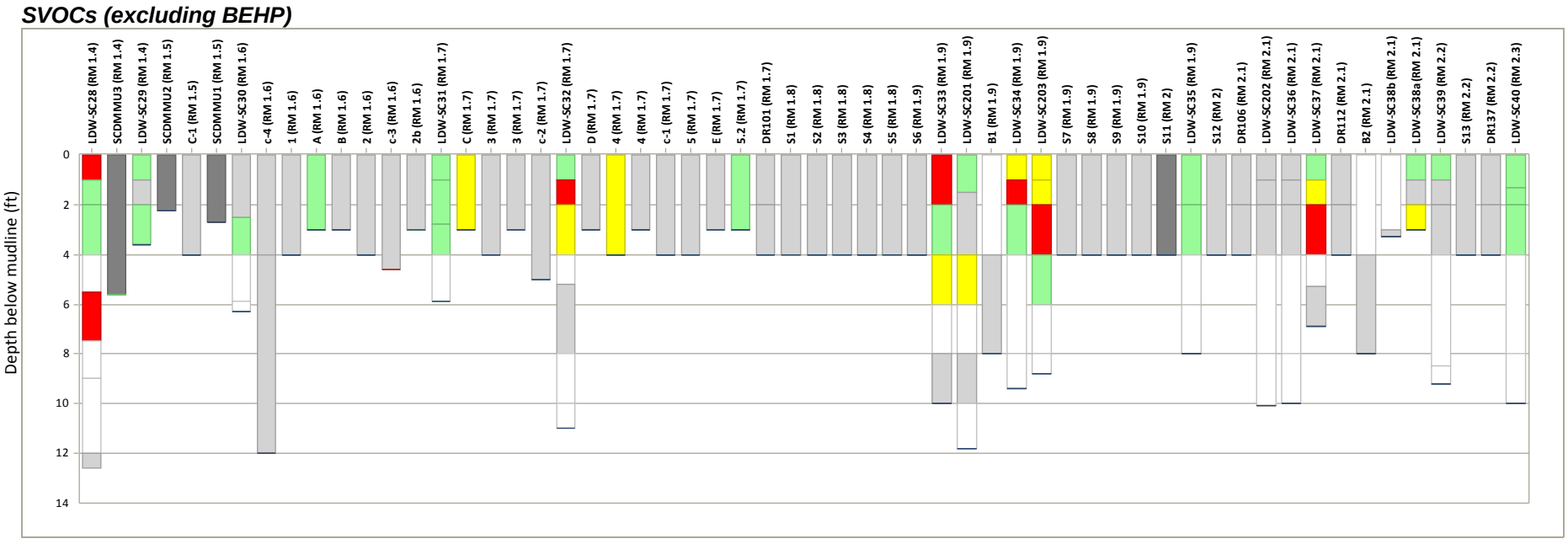
Total PCBs



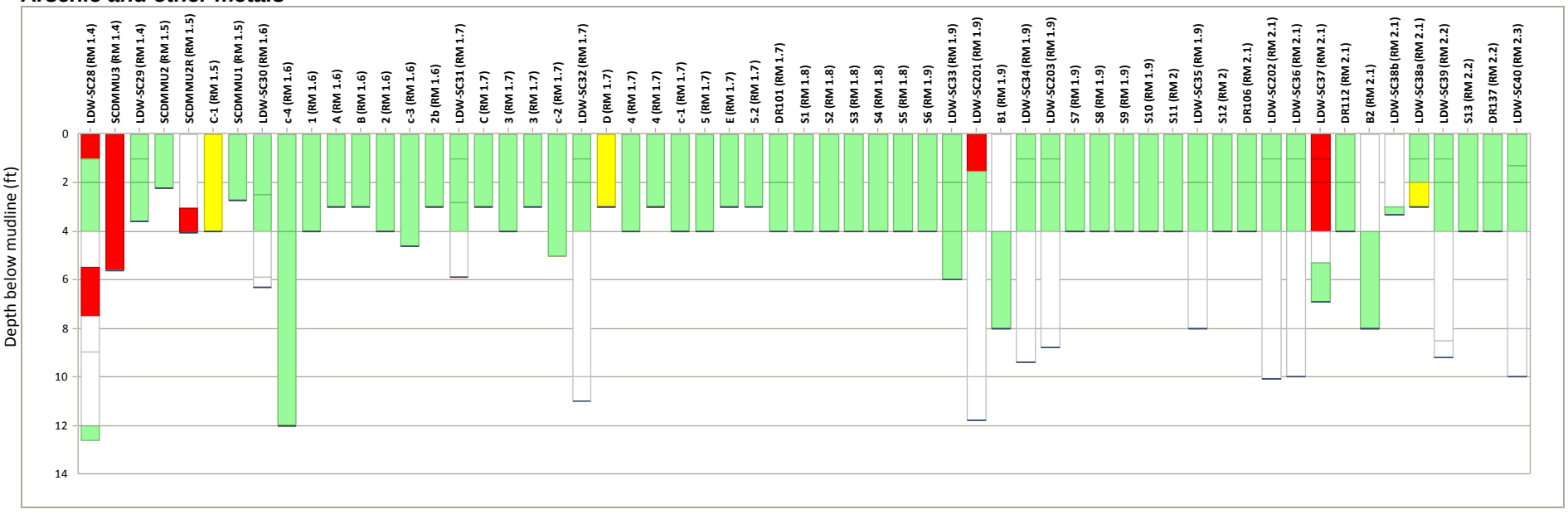
BEHP



SVOCs (excluding BEHP)



Arsenic and other metals



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SQS/CSL categories for SMS chemicals in subsurface core intervals[a]

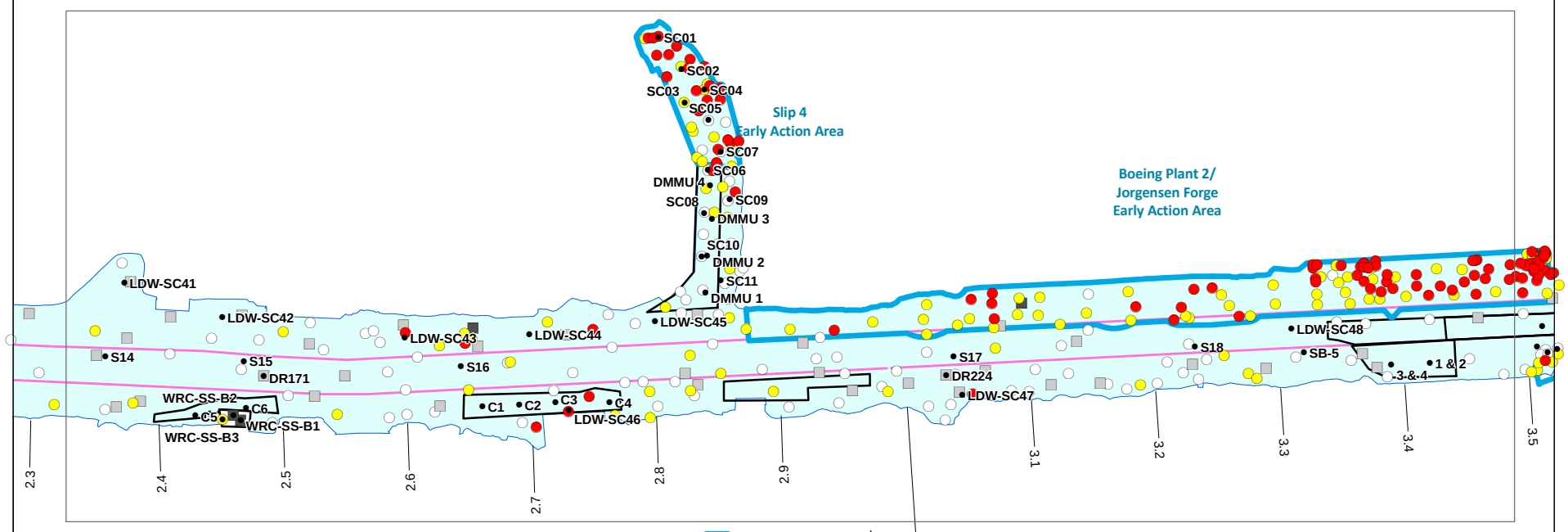
- > CSL, detected
- > SQS and ≤ CSL, detected
- > CSL, non-detect
- > SQS and ≤ CSL, non-detect
- ≤ SQS, detect and non-detect
- Not analyzed

[a] When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations were compared instead to the LAET and 2LAET.

Map 4-17d. Comparisons of concentrations of total PCBs, BEHP, SVOCs, and metals to SMS criteria (SQS or CSL) in subsurface sediment cores, RM 1.4 to RM 2.3

Prepared by CEH, 07/14/2010, MAP 2984, W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Subsurface sediment core locations and exceedances of SQS and CSL (chemical criteria and toxicity combined) in surface sediment



- • Subsurface sediment core

SQS/CSL categories for all SMS chemicals at surface sediment locations [a]

- > CSL, detect
- > SQS and ≤ CSL, detect
- > CSL, non-detect
- > SQS and ≤ CSL, non-detect
- ≤ SQS, detect and non-detect

SQS/CSL categories for all SMS chemicals in subsurface core intervals [a]

- > CSL, detect
- > CSL, non-detect
- > SQS and ≤ CSL, detect
- > SQS and ≤ CSL, non-detect
- ≤ SQS, detect and non-detect
- Not analyzed

- Early Action Area [b]
- Dredged area [c]
- Navigation channel
- River mile

N

0 250 500 Feet

0 50 100 Meters

[a] When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations were compared instead to the LAET and 2LAET.

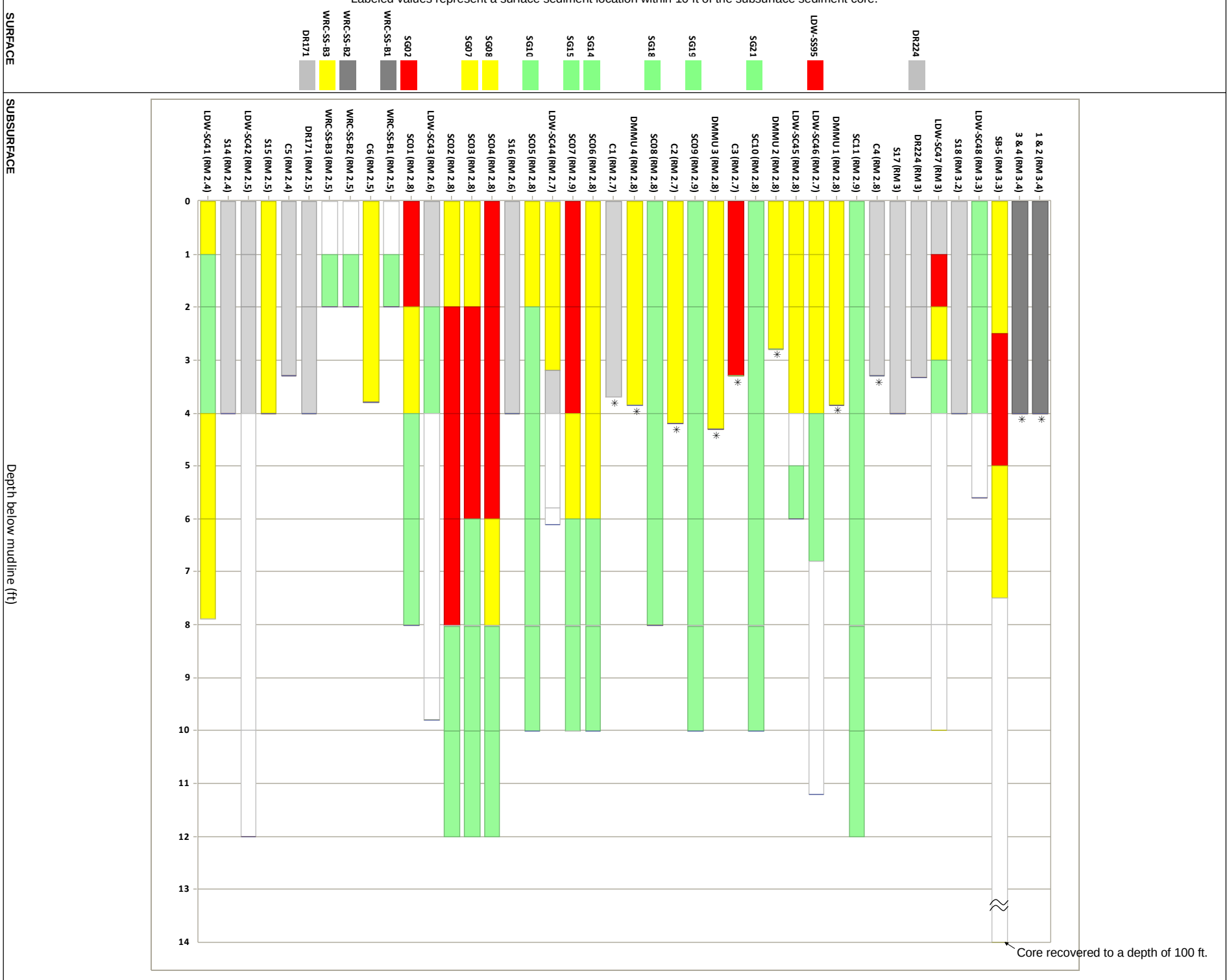
[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] Subsurface sediment data in dredged areas were collected prior to dredging.

Note: This map does not include samples in the Boeing Plant 2/Jorgensen Forge Early Action Area.

Exceedances of SQS and CSL in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment location within 10 ft of the subsurface sediment core.



✳ This core was collected prior to dredging at that location.

Map 4-17e. Comparisons of concentrations of all SMS chemicals to SMS criteria (SQS or CSL) in subsurface sediment cores, RM 2.3 to RM 3.5

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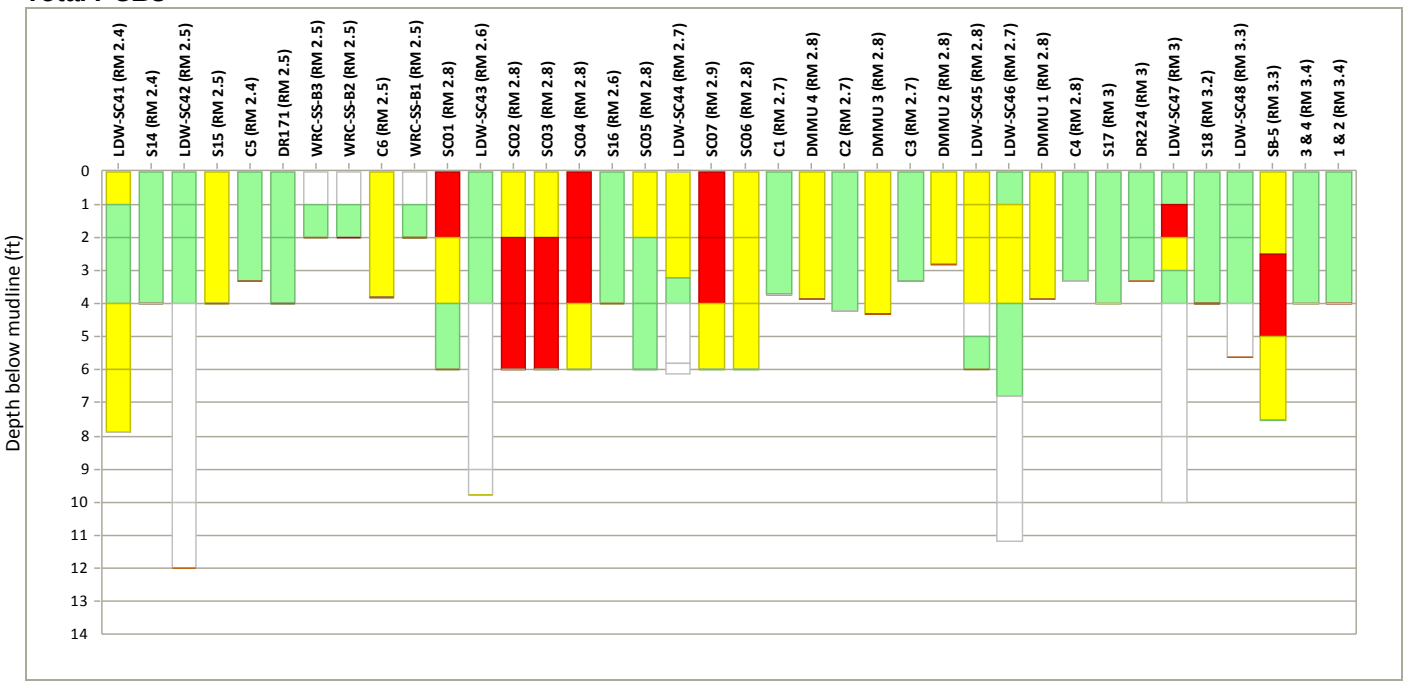
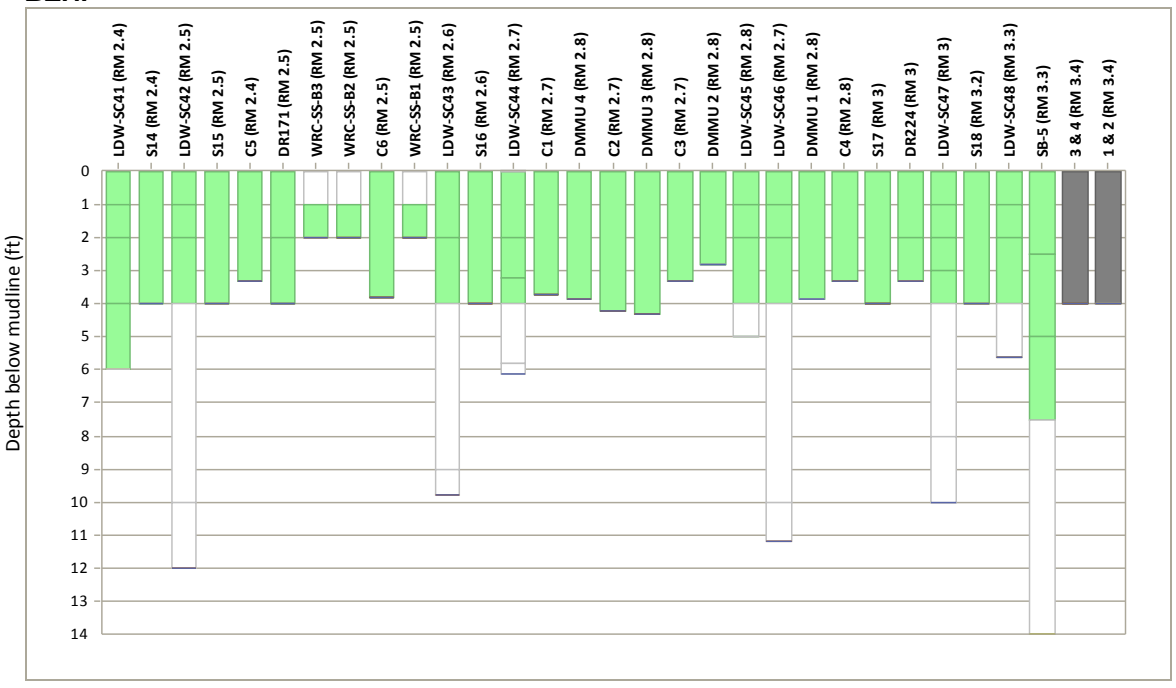
Prepared by CEH, 07/14/2010; MAP 2984; W:\Projects\00-08-06 Duwamish RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

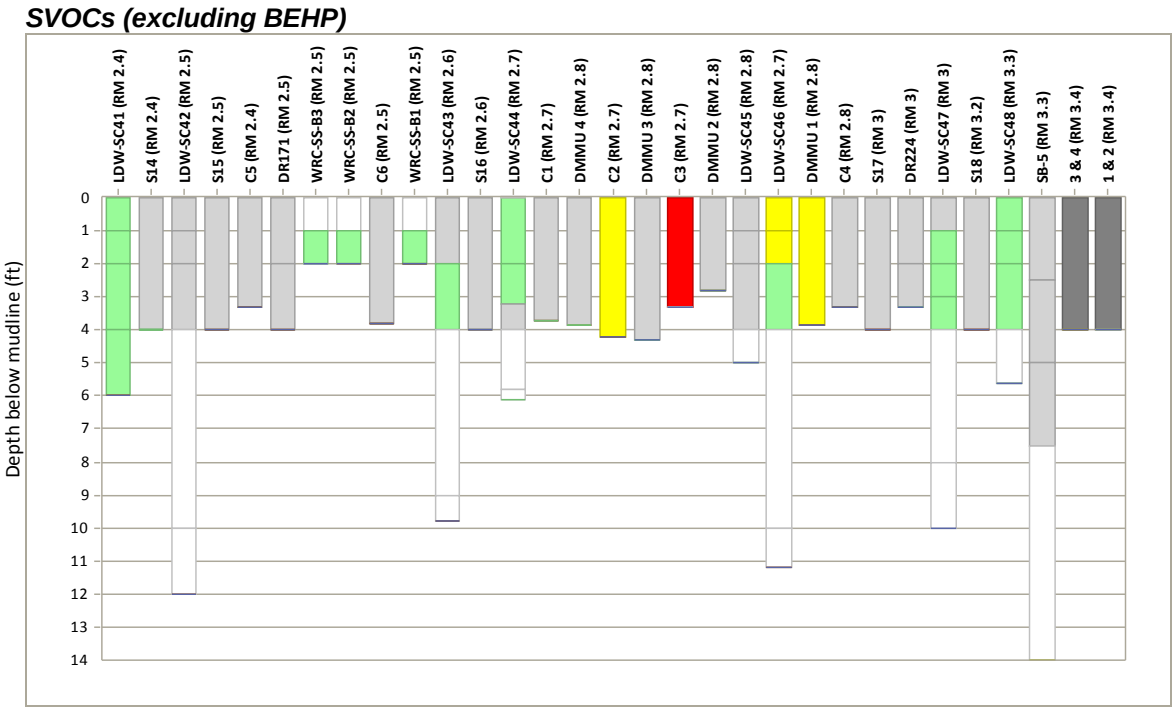
Total PCBs



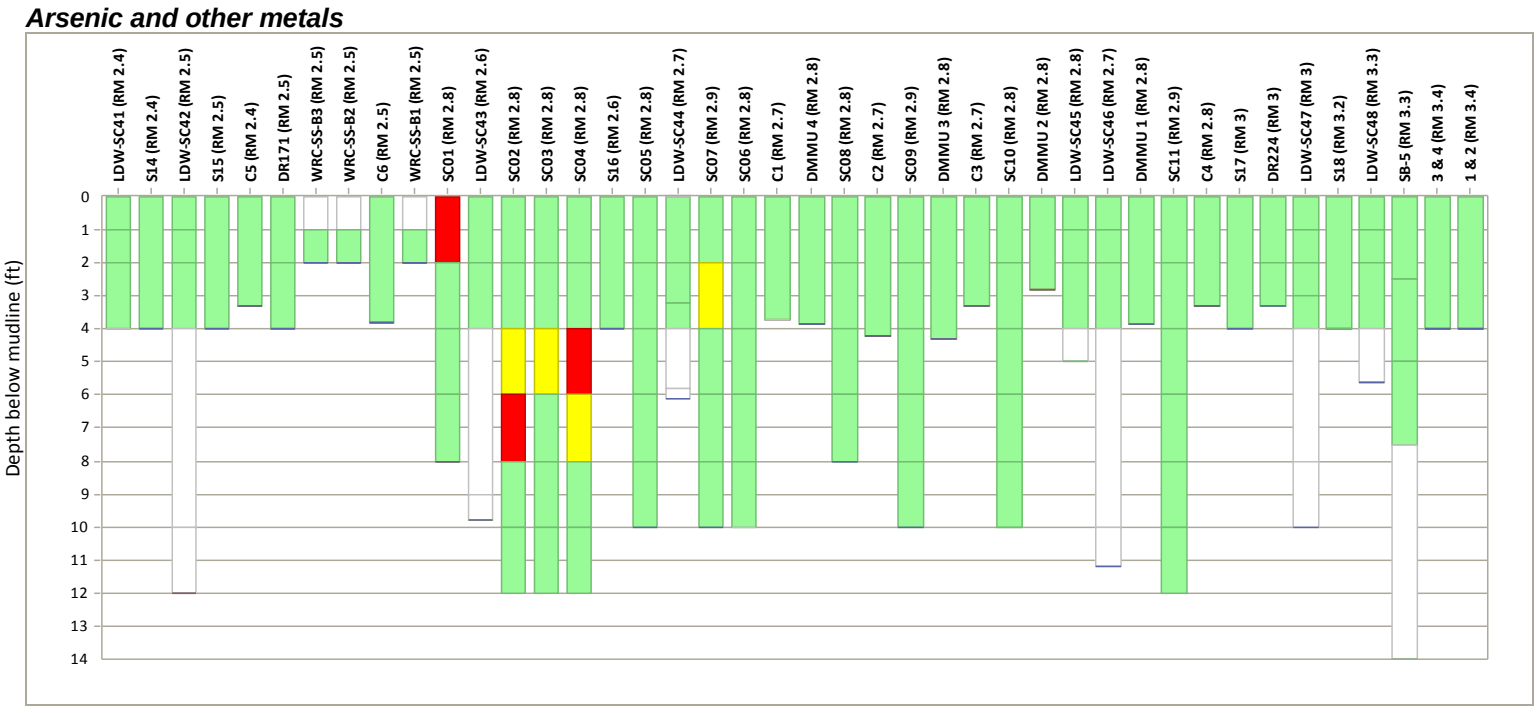
BEHP



SVOCs (excluding BEHP)



Arsenic and other metals



Prepared by CEH, 07/14/2010; MAP 2984; W:\Projects\00-08-06 Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

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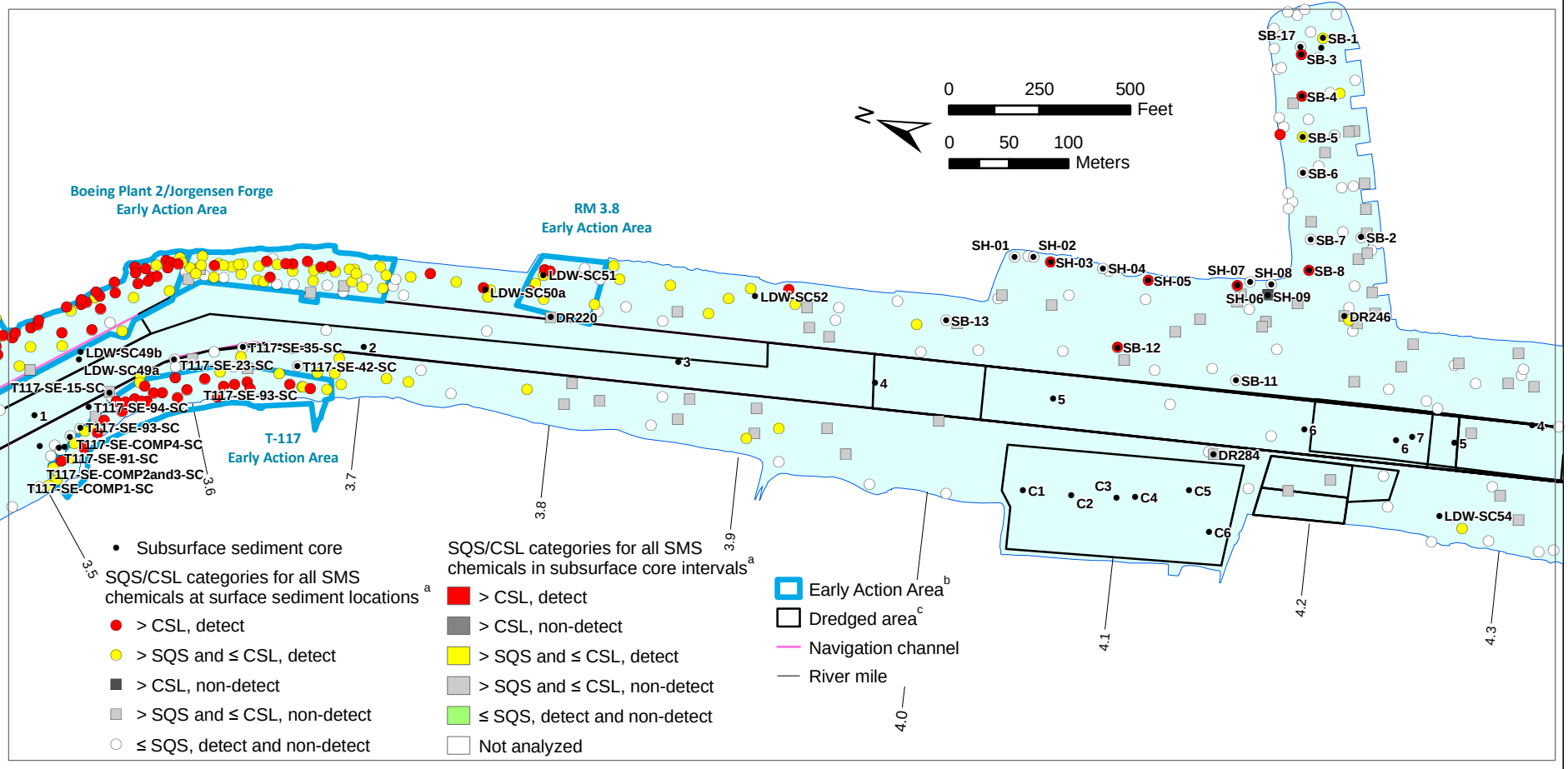
SQS/CSL categories for SMS chemicals in subsurface core intervals[a]

- > CSL, detected
- > SQS and ≤ CSL, detected
- > CSL, non-detect
- > SQS and ≤ CSL, non-detect
- ≤ SQS, detect and non-detect
- Not analyzed

[a] When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations were compared instead to the LAET and 2LAET.

Map 4-17f. Comparisons of concentrations of total PCBs, BEHP, SVOCs, and metals to SMS criteria (SQS or CSL) in subsurface sediment cores, RM 2.3 to RM 3.5

Subsurface sediment core locations and exceedances of SQS and CSL (chemical criteria and toxicity combined) in surface sediment



[a] When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations were compared instead to the LAET and 2LAET.

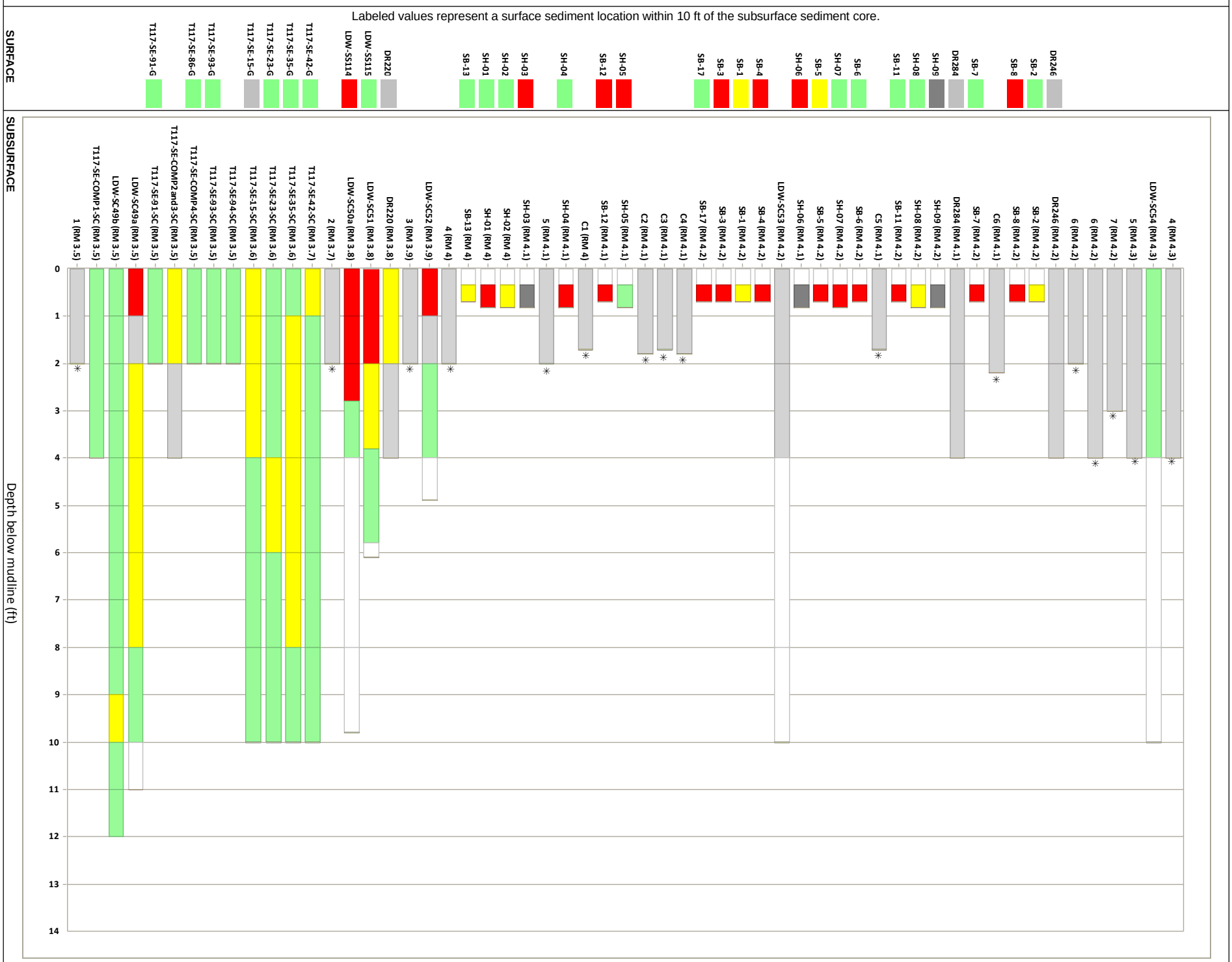
[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] Subsurface sediment data in dredged areas were collected prior to dredging.

Note: This map does not include samples in the Boeing Plant 2/Jorgensen Forge or T-117 Early Action Areas.

Exceedances of SQS and CSL in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment location within 10 ft of the subsurface sediment core.



✳ This core was collected prior to dredging at that location.

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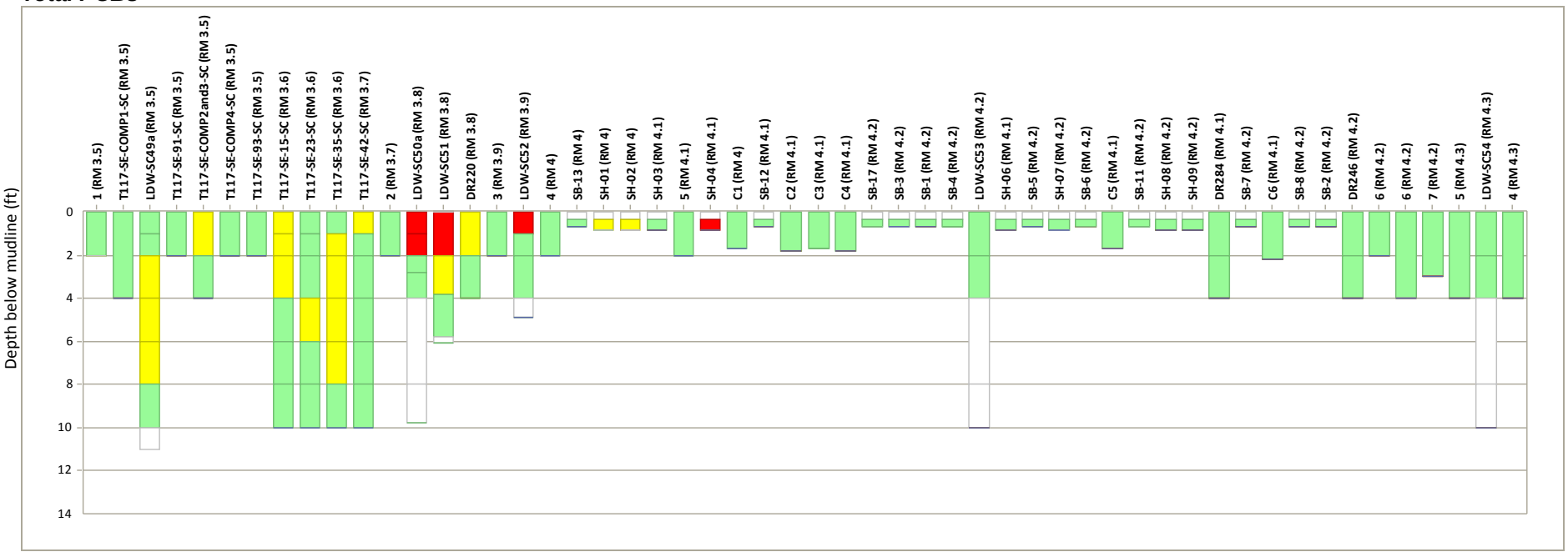
Map 4-17g. Comparisons of concentrations of all SMS chemicals to SMS criteria (SQS or CSL) in subsurface sediment cores, RM 3.5 to RM 4.3

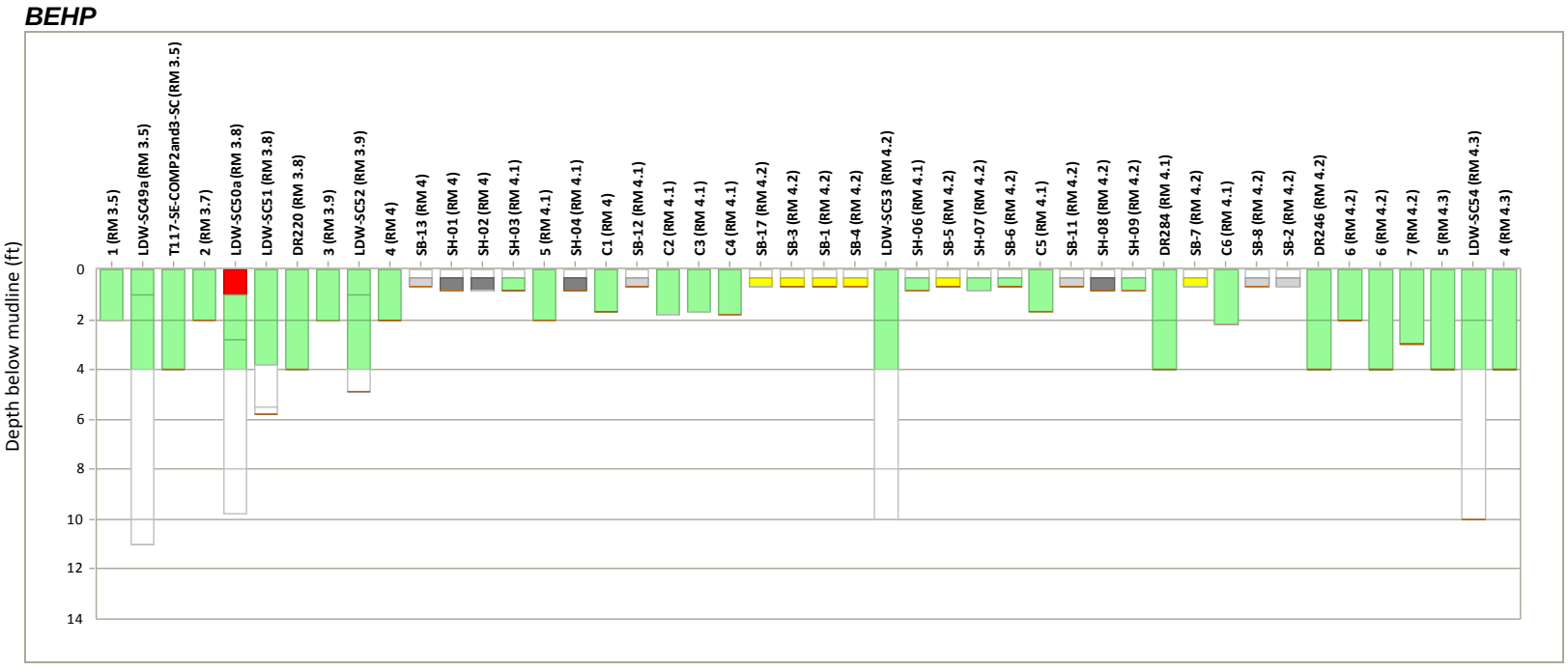
Prepared by CEH, 07/14/2010; MAP 2984; W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

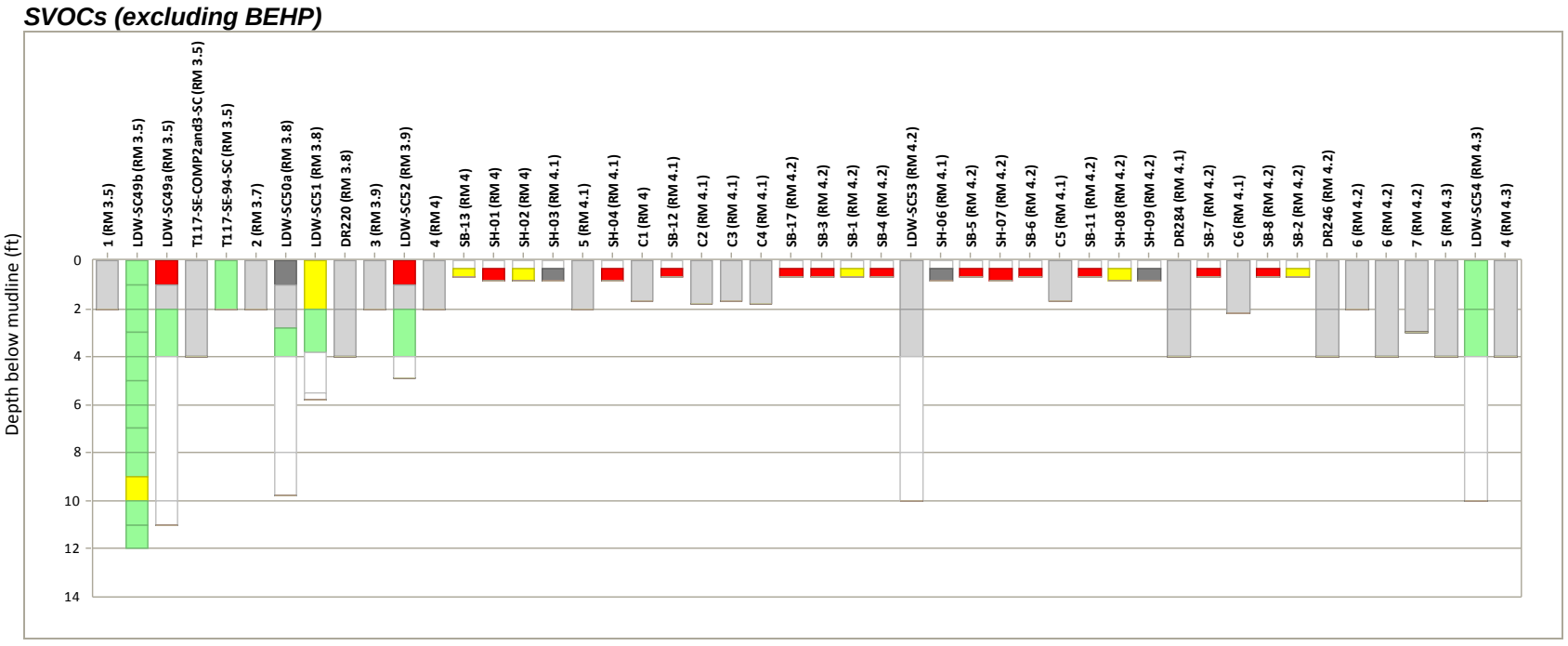
Total PCBs



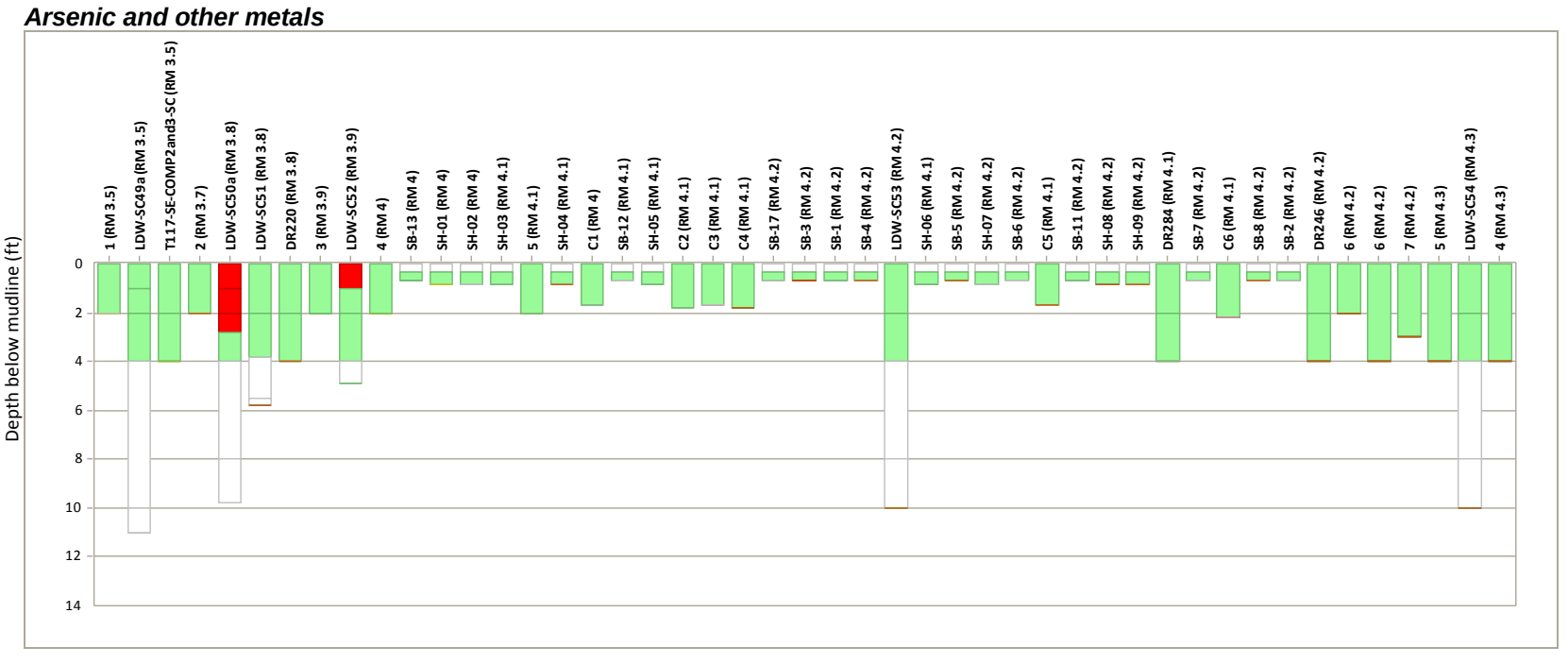
BEHP



SVOCs (excluding BEHP)



Arsenic and other metals



Prepared by CEH, 07/14/2010; MAP 2984; W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

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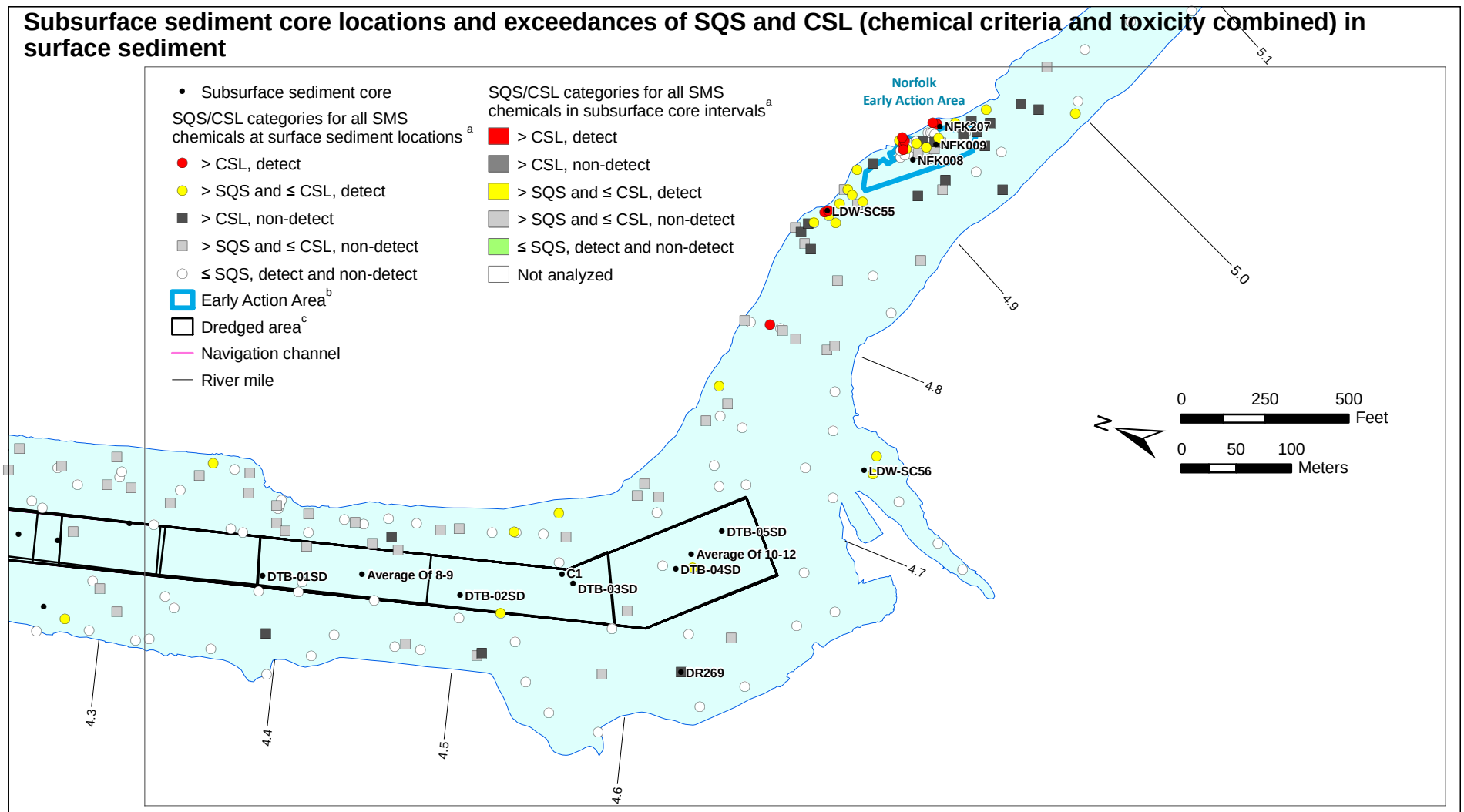
SQS/CSL categories for SMS chemicals in subsurface core intervals[a]

- > CSL, detected
- > SQS and ≤ CSL, detected
- > CSL, non-detect
- > SQS and ≤ CSL, non-detect
- ≤ SQS, detect and non-detect
- Not analyzed

[a] When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations were compared instead to the LAET and 2LAET.

Map 4-17h. Comparisons of concentrations of total PCBs, BEHP, SVOCs, and metals to SMS criteria (SQS or CSL) in subsurface sediment cores, RM 3.5 to RM 4.3

Subsurface sediment core locations and exceedances of SQS and CSL (chemical criteria and toxicity combined) in surface sediment



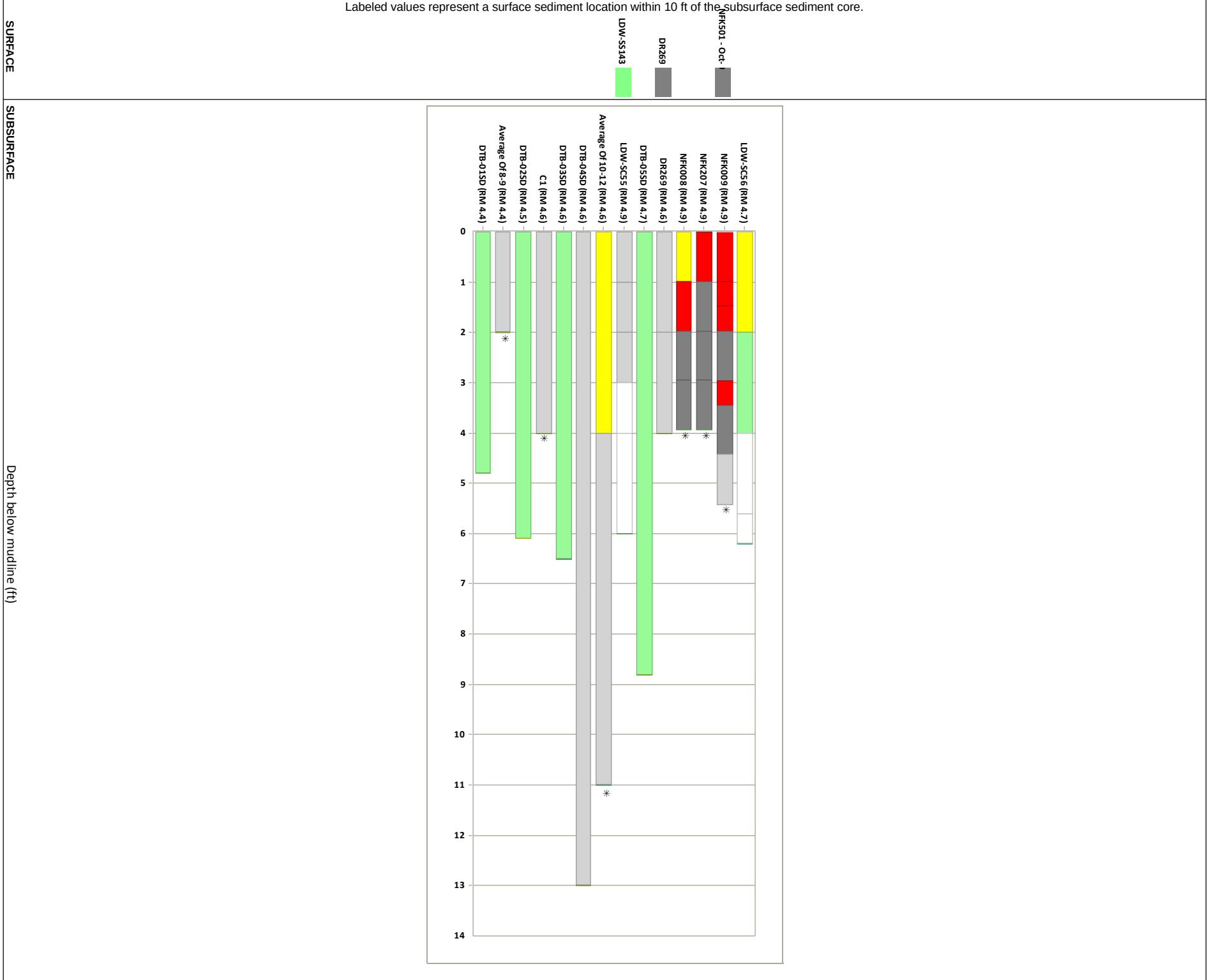
[a] When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations were compared instead to the LAET and 2LAET.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] Subsurface data in the Norfolk Early Action Area were collected prior to dredging and capping. In other dredged areas, subsurface data were collected prior to dredging.

Exceedances of SQS and CSL in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment location within 10 ft of the subsurface sediment core.



✳ This core was collected prior to dredging at that location.

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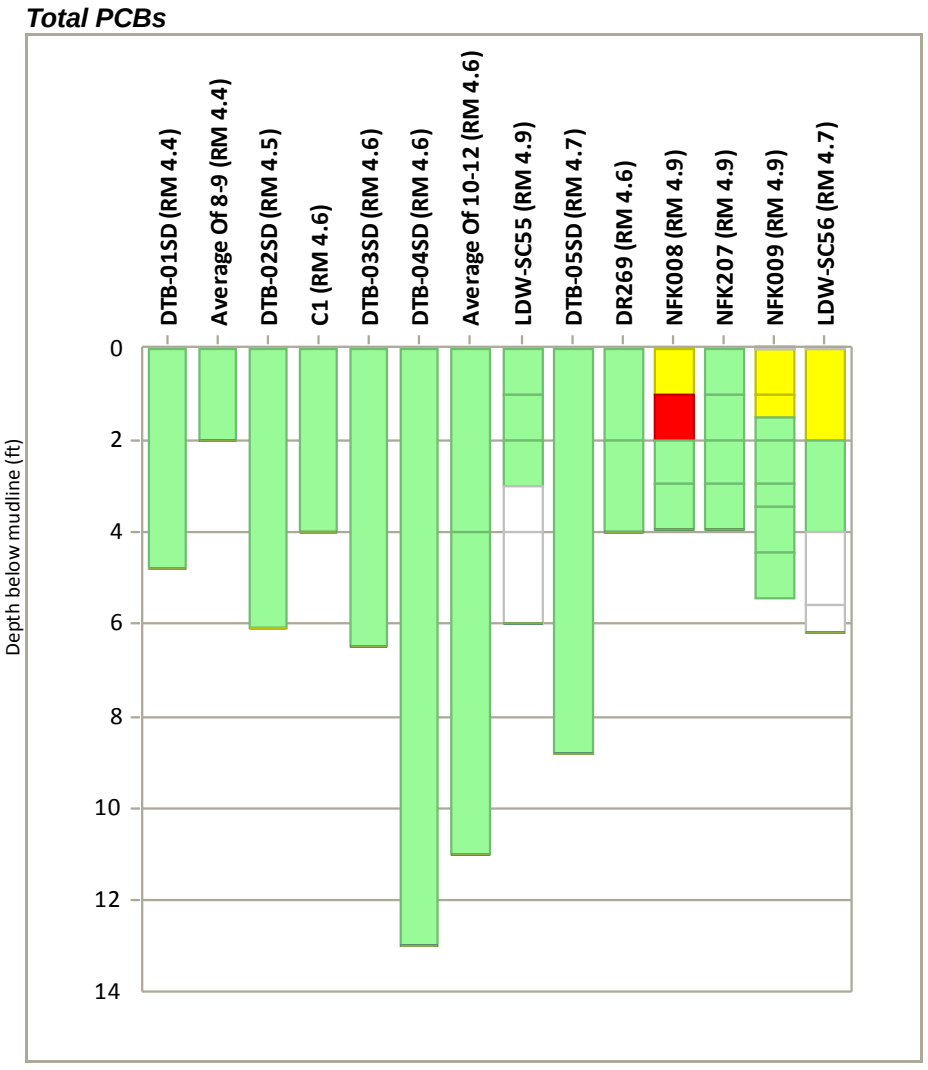
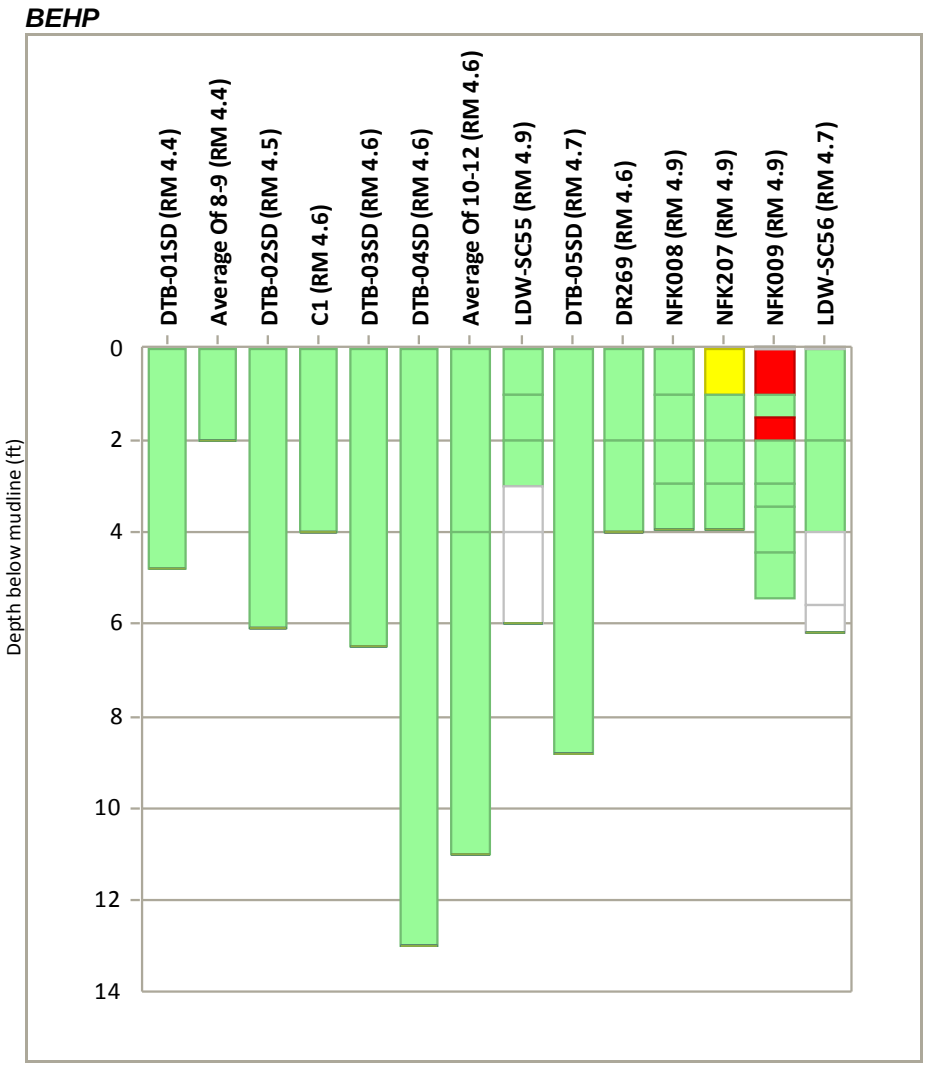
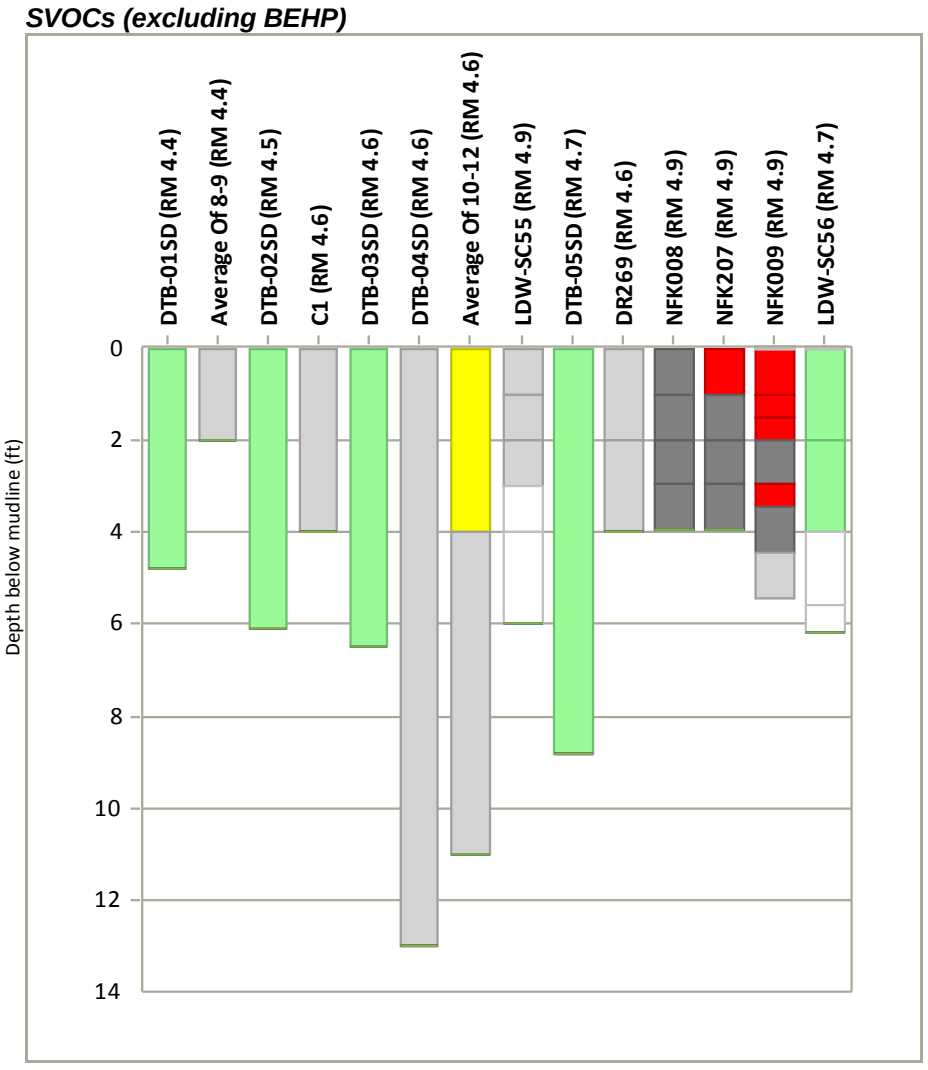
Map 4-17i. Comparisons of concentrations of all SMS chemicals to SMS criteria (SQS or CSL) in subsurface sediment cores, RM 4.3 to RM 5.0

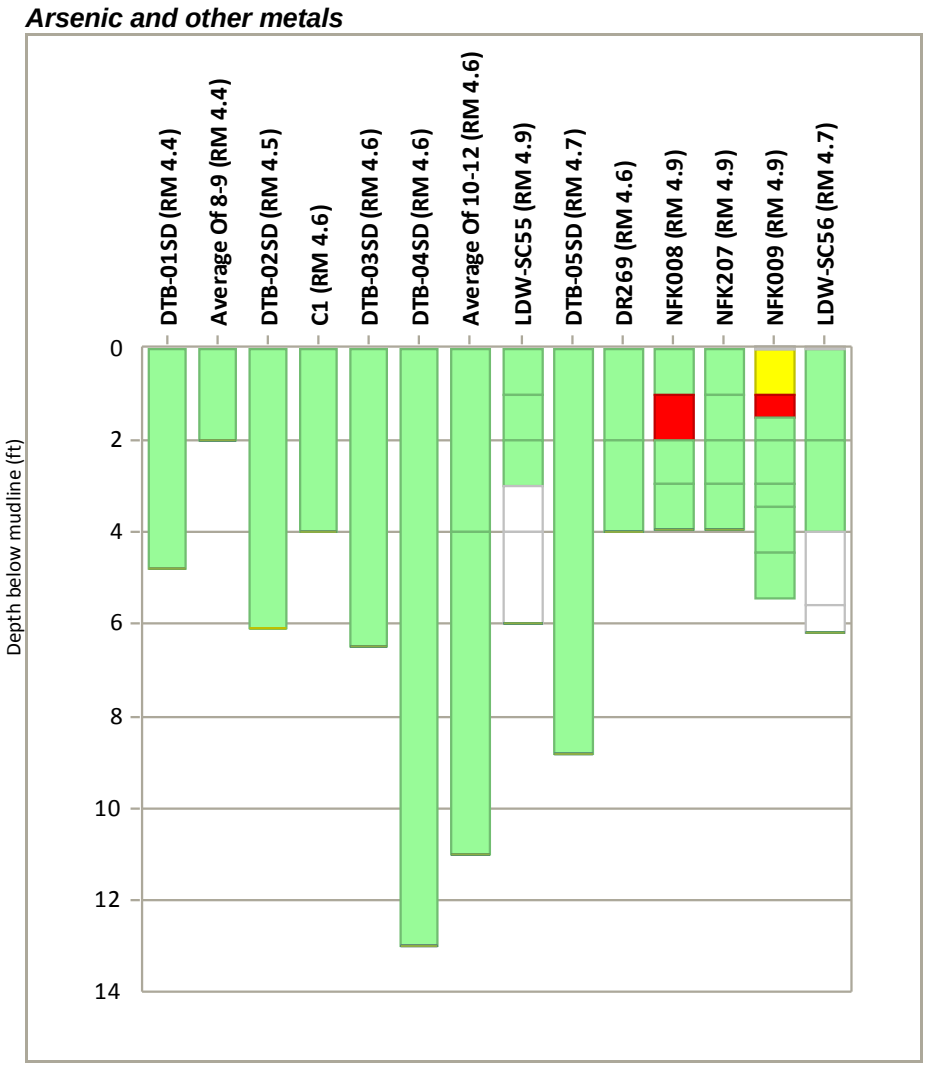
Prepared by CEH, 07/14/2010; MAP 2984; W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.









Prepared by:CEH, 07/14/2010; MAP 2984; W:\Projects\00-08-06_Duwamish_Rt\data\gis\Phase2 Rt\Nature and Extent\Subsurface\Bar charts

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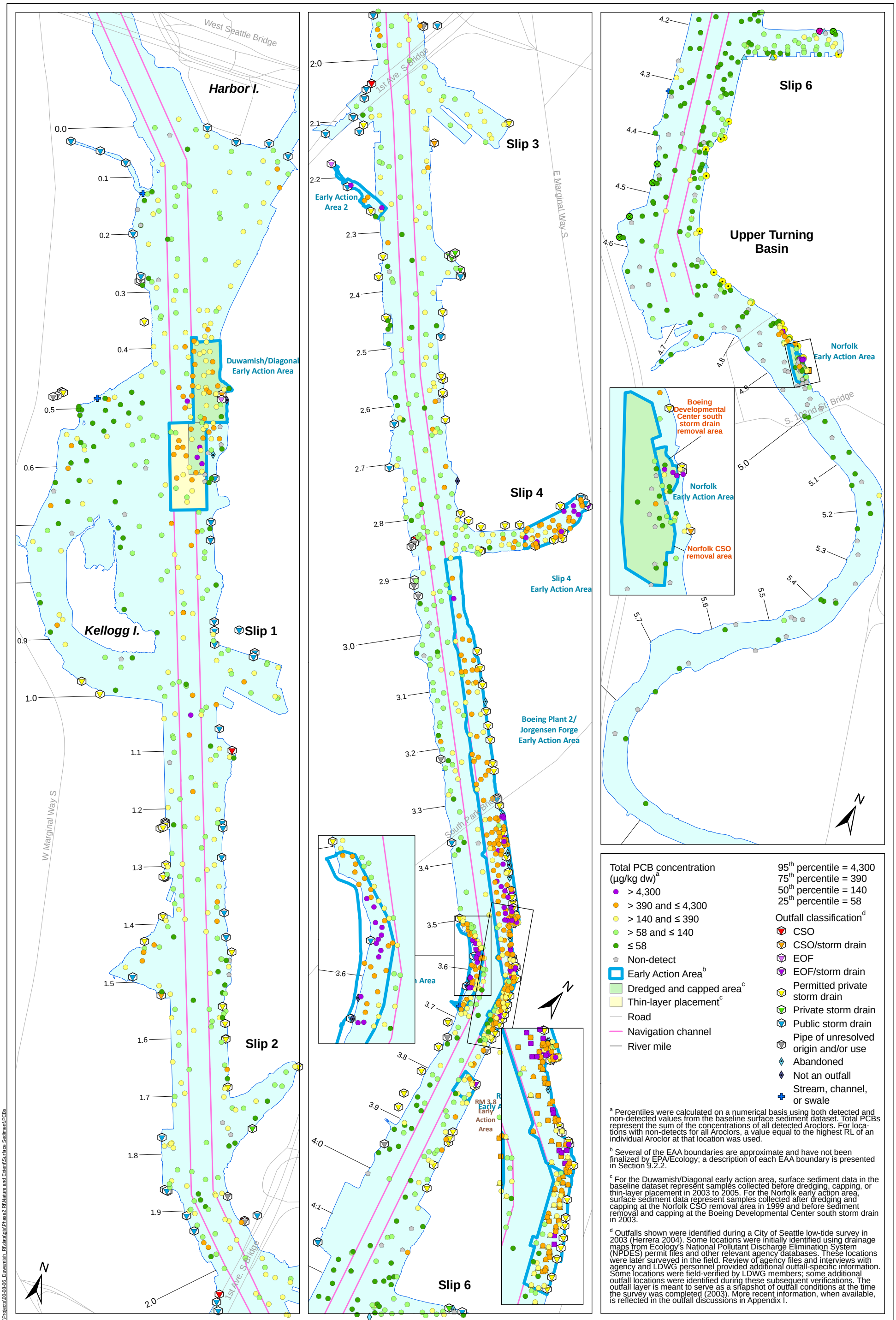
SQS/CSL categories for SMS chemicals in subsurface core intervals[a]

- > CSL, detected
- > SQS and ≤ CSL, detected
- > CSL, non-detect
- > SQS and ≤ CSL, non-detect
- ≤ SQS, detect and non-detect
- Not analyzed

[a] When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations were compared instead to the LAET and 2LAET.

Map 4-17j. Comparisons of concentrations of total PCBs, BEHP, SVOCs, and metals to SMS criteria (SQS or CSL) in subsurface sediment cores, RM 4.5 to RM 5.0



Total PCB concentration (µg/kg dw)[a]
- > 4,300
- > 390 and ≤ 4,300
- > 140 and ≤ 390
- > 58 and ≤ 140
- ≤ 58
- Non-detect
- Early Action Area[b]
- Dredged and capped area[c]
- Thin-layer placement[c]
- Road
- Navigation channel
- River mile

95th percentile = 4,300
75th percentile = 390
50th percentile = 140
25th percentile = 58

Outfall classification[d]
- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. Total PCBs represent the sum of the concentrations of all detected Aroclors. For locations with non-detects for all Aroclors, a value equal to the highest RL of an individual Aroclor at that location was used.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] For the Duwamish/Diagonal early action area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005. For the Norfolk early action area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and LDWG personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

Map 4-18. Total PCB concentrations in surface sediment

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Prepared by CEH, 07/14/2010, MAP 2808, W:\Projects\00-08-06 Duwamish Rl\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\PCBs

West Seattle Bridge

Harbor I.

0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2.0

Duwamish/Diagonal Early Action Area

Kellogg I.

Slip 1

Slip 2

W Marginal Way S

1st Ave. S. Bridge

2.0
2.1
2.2
2.3
2.4
2.5
2.6
2.7
2.8
2.9
3.0
3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4.0
4.1

Slip 3

Early Action Area 2

E Marginal Way S

Slip 4

Slip 4 Early Action Area

Boeing Plant 2/ Jorgensen Forge Early Action Area

South Park Bridge

T-117 Early Action Area

RM 3.8 Early Action Area

Slip 6

4.2
4.3
4.4
4.5
4.6
4.7
4.8
4.9
5.0
5.1
5.2
5.3
5.4
5.5
5.6
5.7

Slip 6

Upper Turning Basin

Norfolk Early Action Area

S. 102nd St. Bridge

Hwy 99

Interpolated total PCB concentration (µg/kg dw)[a]

- > 810
- > 210 and ≤ 810
- > 110 and ≤ 210
- > 48 and ≤ 110
- ≤ 48
- Early Action Area[b]
- Navigation channel
- River mile

95th percentile = 810
75th percentile = 210
50th percentile = 110
25th percentile = 48

[a] Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 810 µg/kg dw). Total PCBs represent the sum of the concentrations of all detected Aroclors. For locations with non-detects for all individual Aroclors, a value equal to the highest RL of an individual Aroclor at that location was used.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2. For the Duwamish/Diagonal Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer capping in 2003 to 2005. For the Norfolk Early Action Area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

N

0 0.1 0.2 Miles

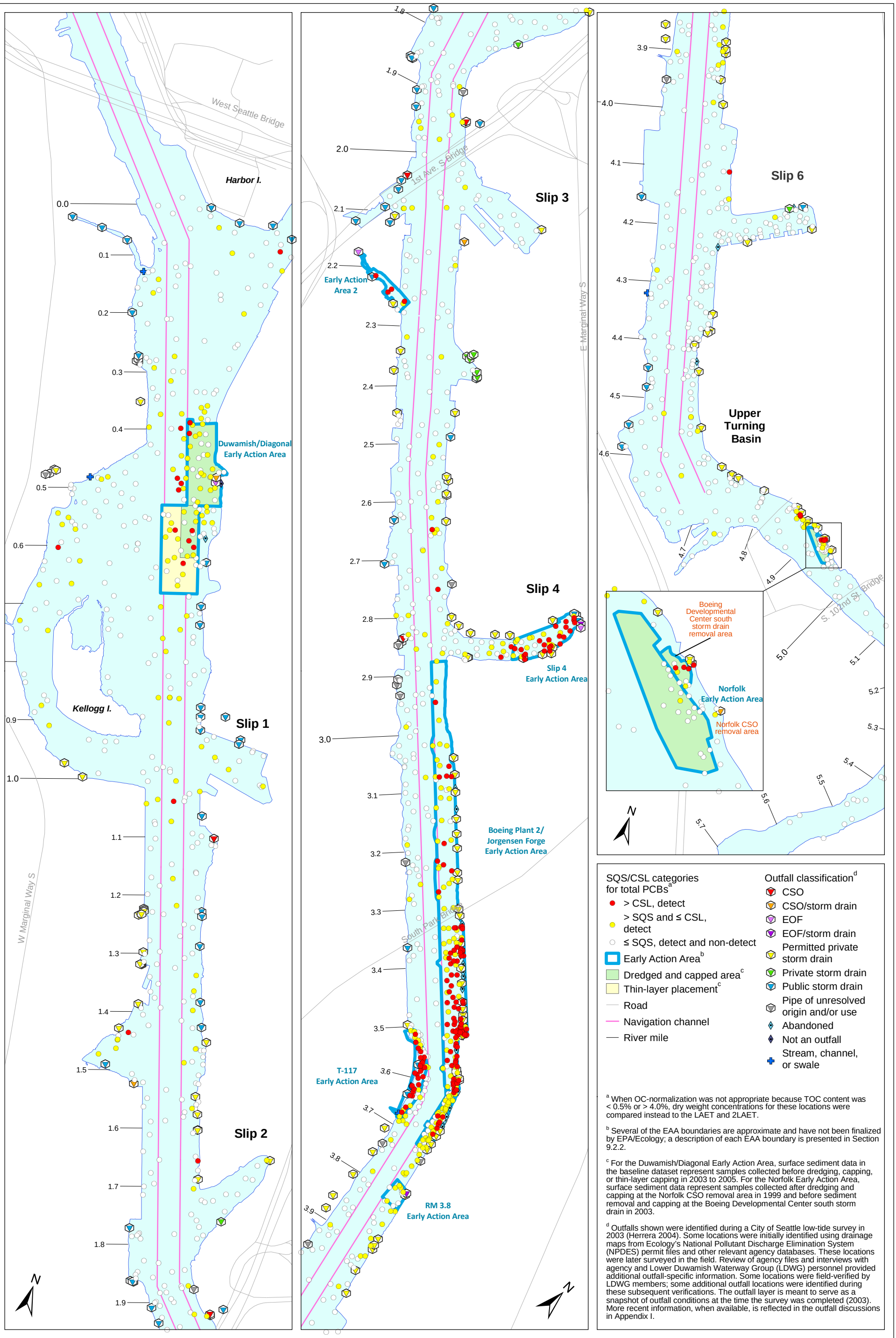
0 0.1 0.2 Kilometers

Scale is the same for each inset map

Wind Ward environmental LLC

Map 4-19. IDW interpolation of total PCB concentrations in surface sediment

Prepared by CEH, 07/14/2010; MAP 2991; W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\PCBs



[a] When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations were compared instead to the LAET and 2LAET.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

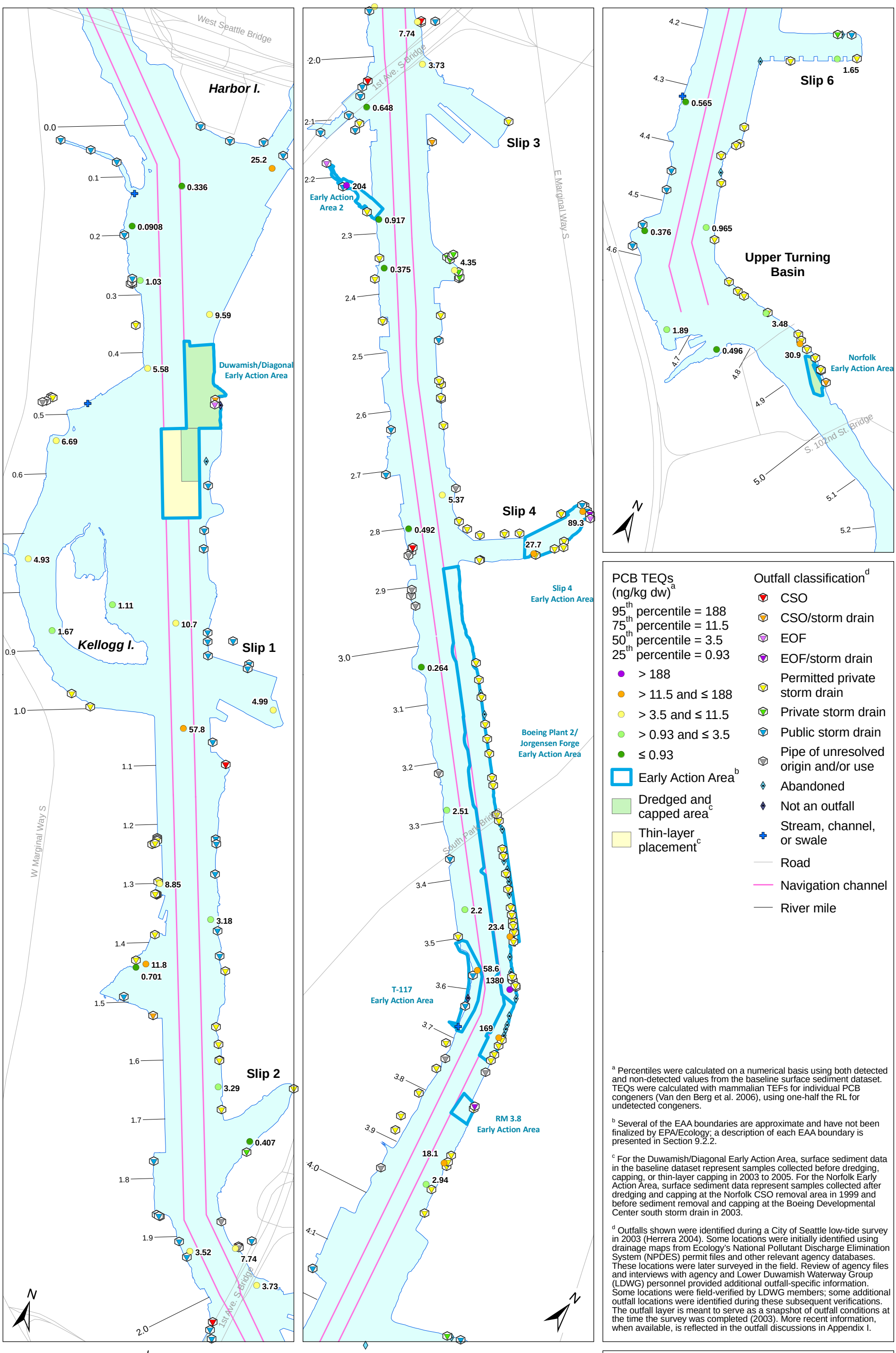
[c] For the Duwamish/Diagonal Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer capping in 2003 to 2005. For the Norfolk Early Action Area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

Scale is the same for each inset map

Map 4-20. Exceedances of SMS criteria (SQS or CSL) for total PCBs in surface sediment

Prepared by CEH, 07/14/2010, MAP 2660, W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\PCBs



PCB TEQs (ng/kg dw)[a]

95th percentile = 188
75th percentile = 11.5
50th percentile = 3.5
25th percentile = 0.93

- > 188
- > 11.5 and ≤ 188
- > 3.5 and ≤ 11.5
- > 0.93 and ≤ 3.5
- ≤ 0.93
- Early Action Area[b]
- Dredged and capped area[c]
- Thin-layer placement[c]

Outfall classification[d]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale
- Road
- Navigation channel
- River mile

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. TEQs were calculated with mammalian TEFs for individual PCB congeners (Van den Berg et al. 2006), using one-half the RL for undetected congeners.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

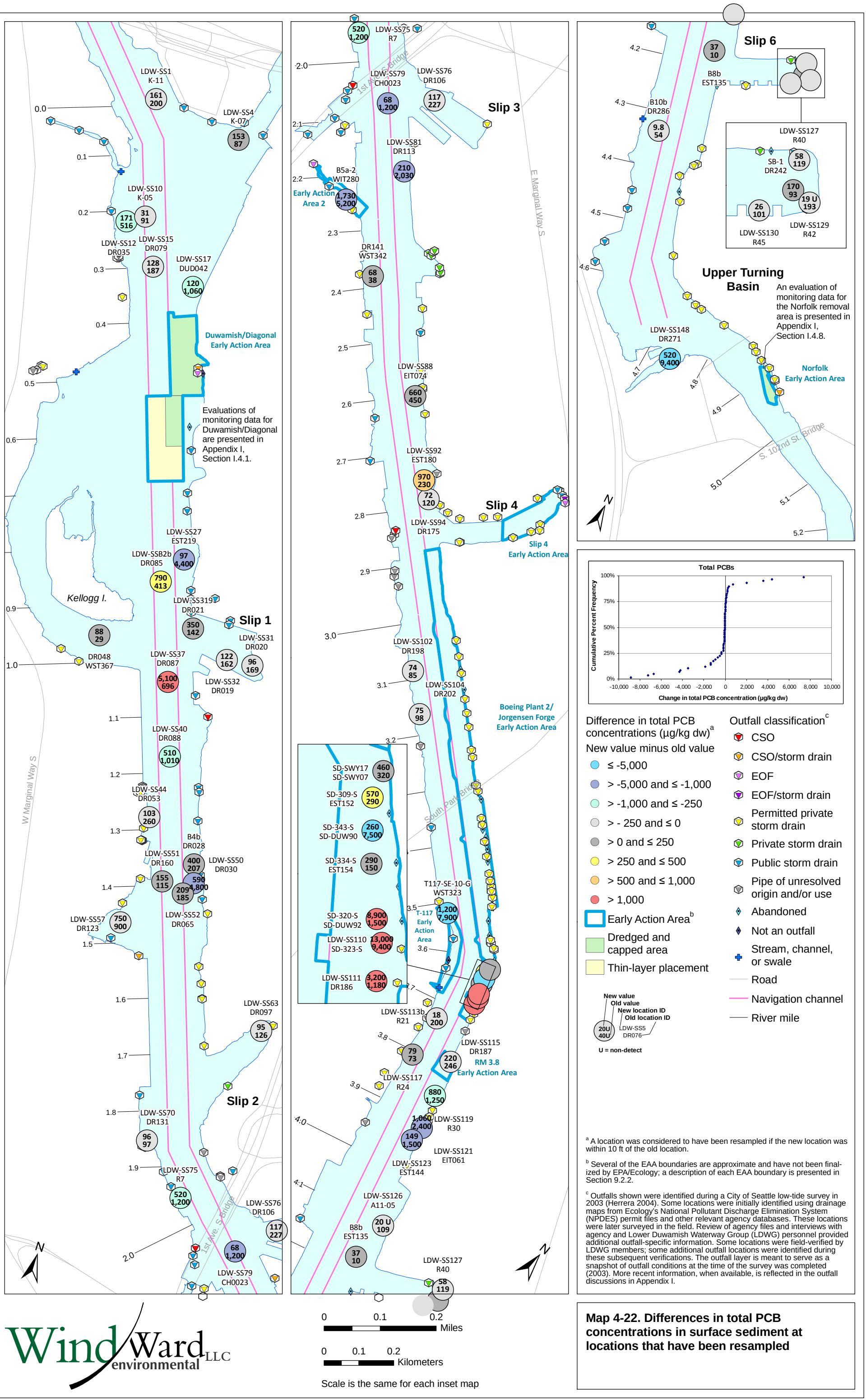
[c] For the Duwamish/Diagonal Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer capping in 2003 to 2005. For the Norfolk Early Action Area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

Scale is the same for each inset map

Map 4-21. PCB TEQ values in surface sediment

Prepared by CEH, 07/14/2010, MAP 2785; W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\PCBs



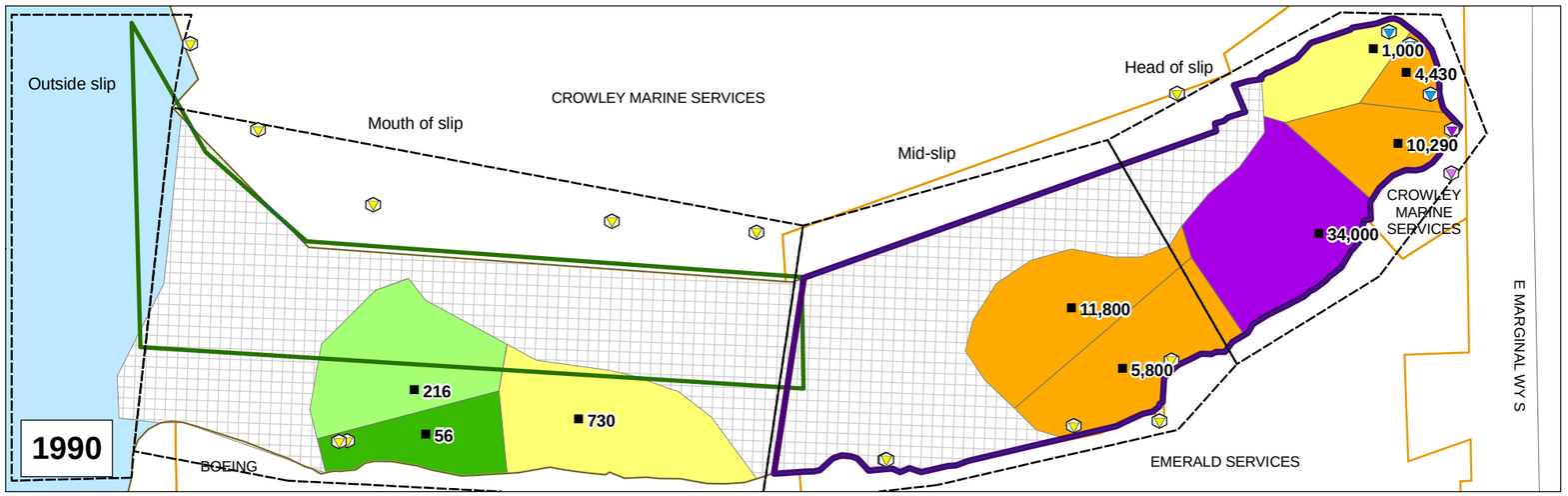
[a] A location was considered to have been resampled if the new location was within 10 ft of the old location.

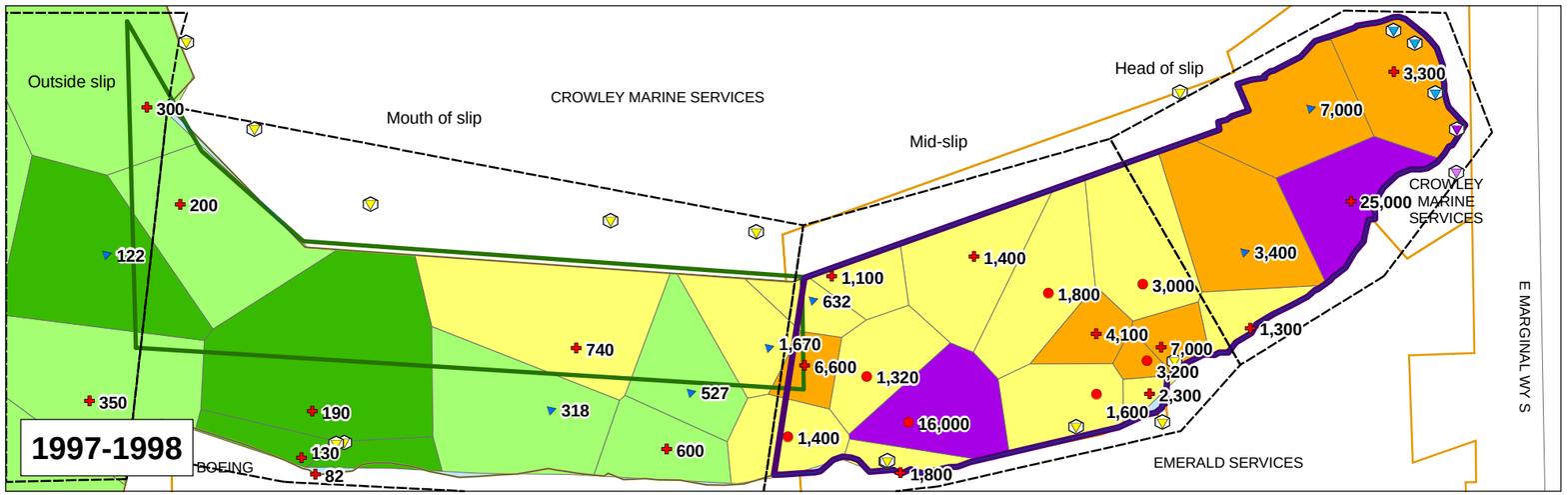
[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

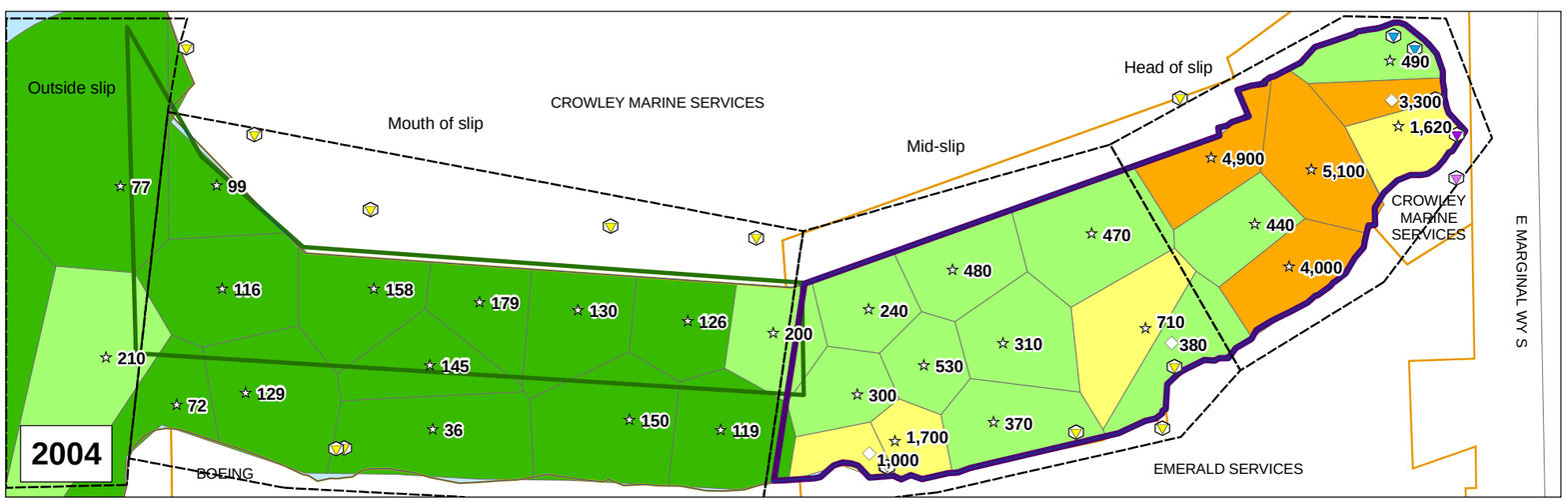
[c] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time of the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

Map 4-22. Differences in total PCB concentrations in surface sediment at locations that have been resampled

Prepared by CEH, 07/14/2010. MAP 2679: W:\Projects\00-08-06 Duwamish_Rivdata\gis\Phase2 RI\Nature and Extent\Round3 Trumping







Event Name

- Landau (1990)
- Boeing SiteChar (1997)
- NOAA SiteChar (1997)
- EPA SI (1998)
- LDWRI-Benthic (2004)
- Slip4-EarlyAction (2004)

Total PCB concentration (µg/kg dw)[a]
95th percentile = 13,000
75th percentile = 3,100
50th percentile = 620
25th percentile = 200

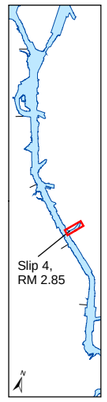
- > 13,000
- > 3,100 and ≤ 13,000
- > 620 and ≤ 3,100
- > 200 and ≤ 620
- ≤ 200
- Insufficient data for interpolation[b]
- Slip 4 early action area
- Crowley dredged area (1996)
- Areas evaluated in Section 4.2.3.1

Outfall classification[c]

- EOF
- EOF/storm drain
- Permitted private storm drain
- Public storm drain

Tax parcel[d]

Road



[a] Percentiles were calculated on a numerical basis for the Slip 4 area using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects for all Aroclors, a value equal to the highest RL of an individual Aroclor at that location was used.

[b] Area with insufficient data was estimated visually based on density of existing data points.

[c] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time of the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

[d] Tax parcel information was provided in 2008 by Seattle Public Utilities and King County. Some tax parcel polygons were edited to conform to the LDW shoreline presentation. A comprehensive survey of property-owner records was not conducted.

0 75 150 300 Feet

0 25 50 100 Meters

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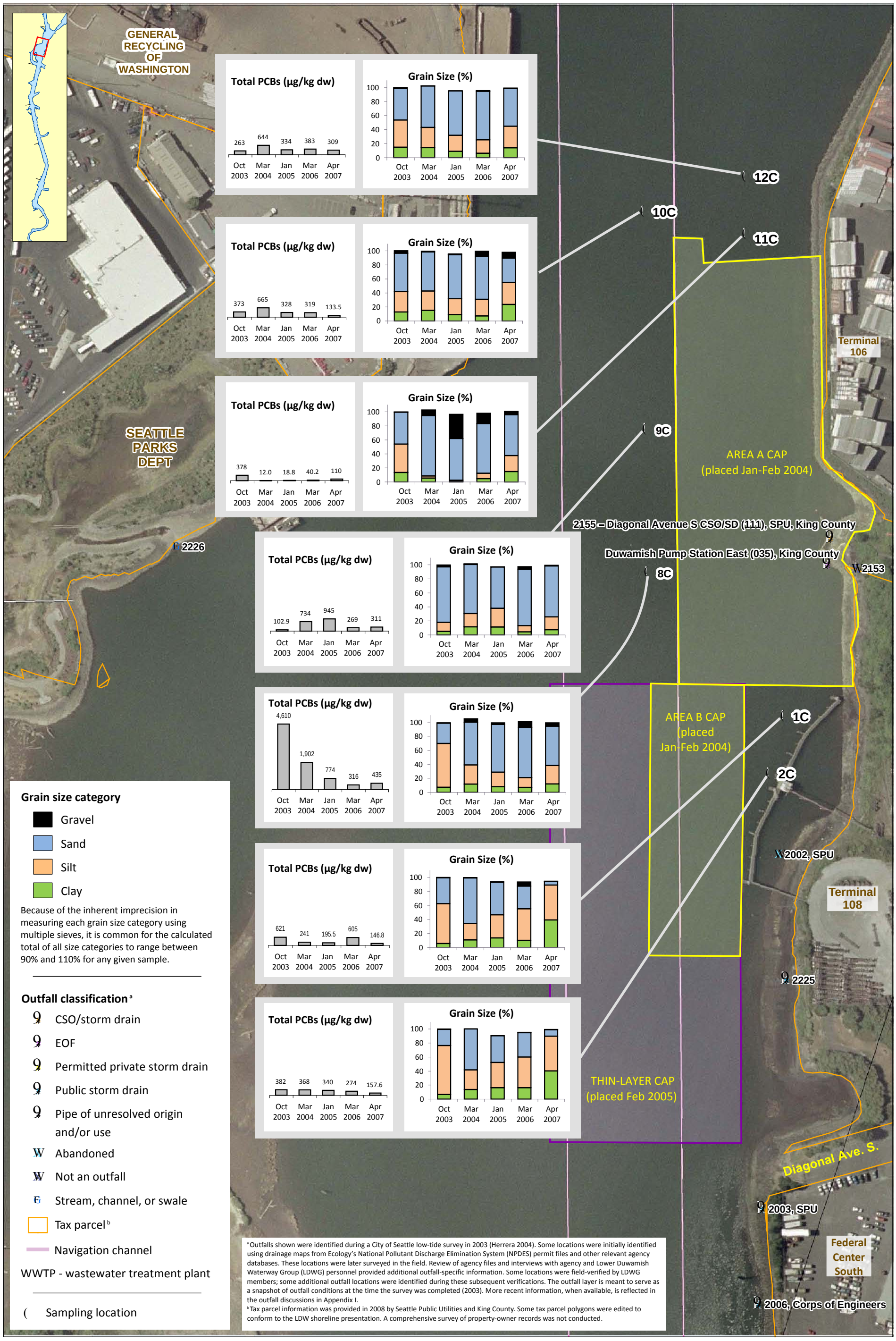
Map 4-23. Total PCB concentrations in surface sediment from Slip 4 in 1990, 1997-1998, and 2004

Prepared by CEH, 07/14/2010; Map 2651; W:\Projects\00-08-06_Duwamish_Rkl\data\GIS\Phase2 RI\Nature and Extent\Trends and Trumpet\Slip4



Grain size category

- Gravel
- Sand
- Silt
- Clay

Because of the inherent imprecision in measuring each grain size category using multiple sieves, it is common for the calculated total of all size categories to range between 90% and 110% for any given sample.

Outfall classification [a]

- CSO/storm drain
- EOF
- Permitted private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale
- Tax parcel [b]
- Navigation channel

WWTP - wastewater treatment plant

(Sampling location

[a] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

[b] Tax parcel information was provided in 2008 by Seattle Public Utilities and King County. Some tax parcel polygons were edited to conform to the LDW shoreline presentation. A comprehensive survey of property-owner records was not conducted.

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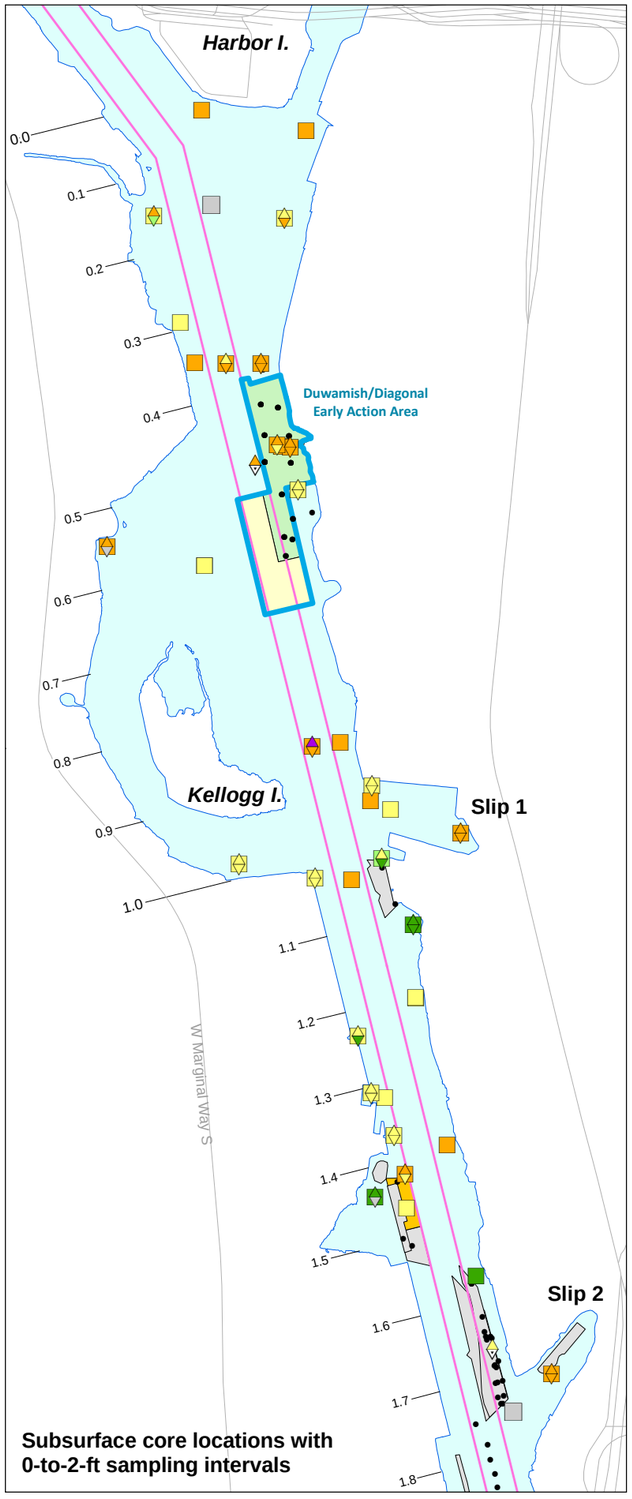
N

0 100 200 Feet

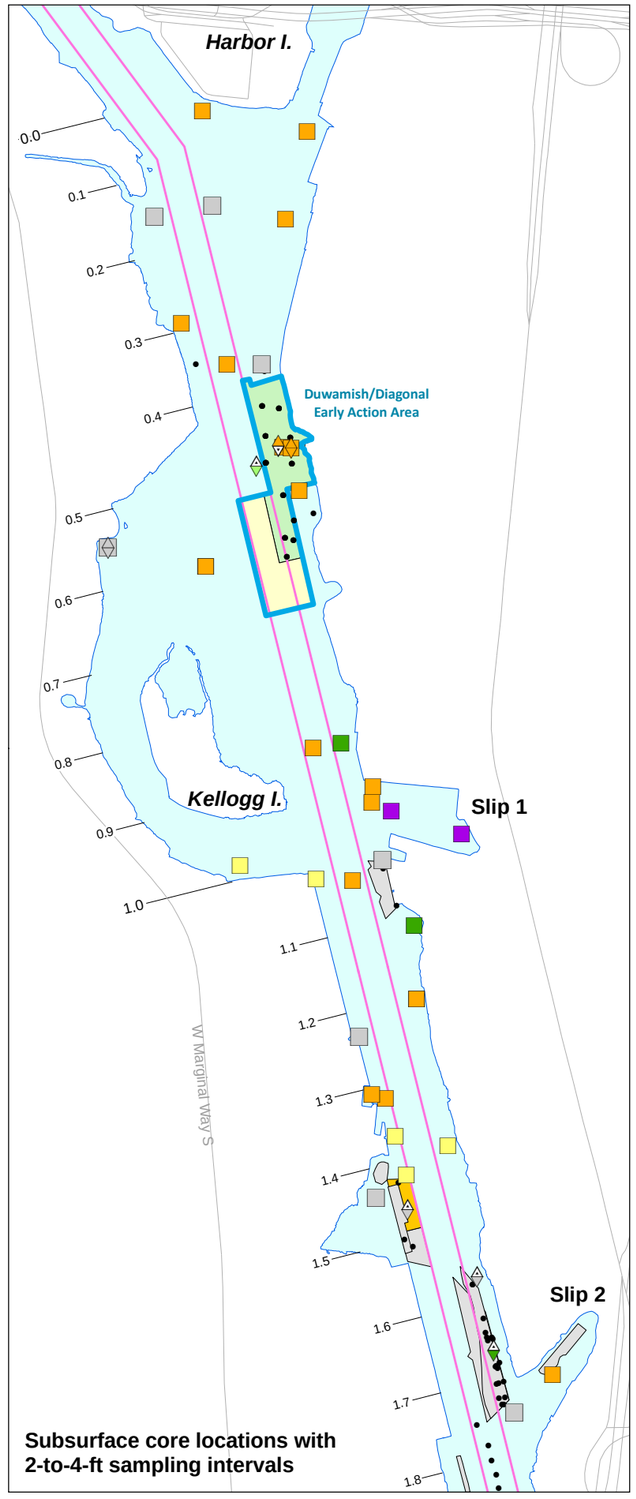
0 25 50 Meters

Map 4-24. Surface sediment data at Duwamish/Diagonal perimeter monitoring locations

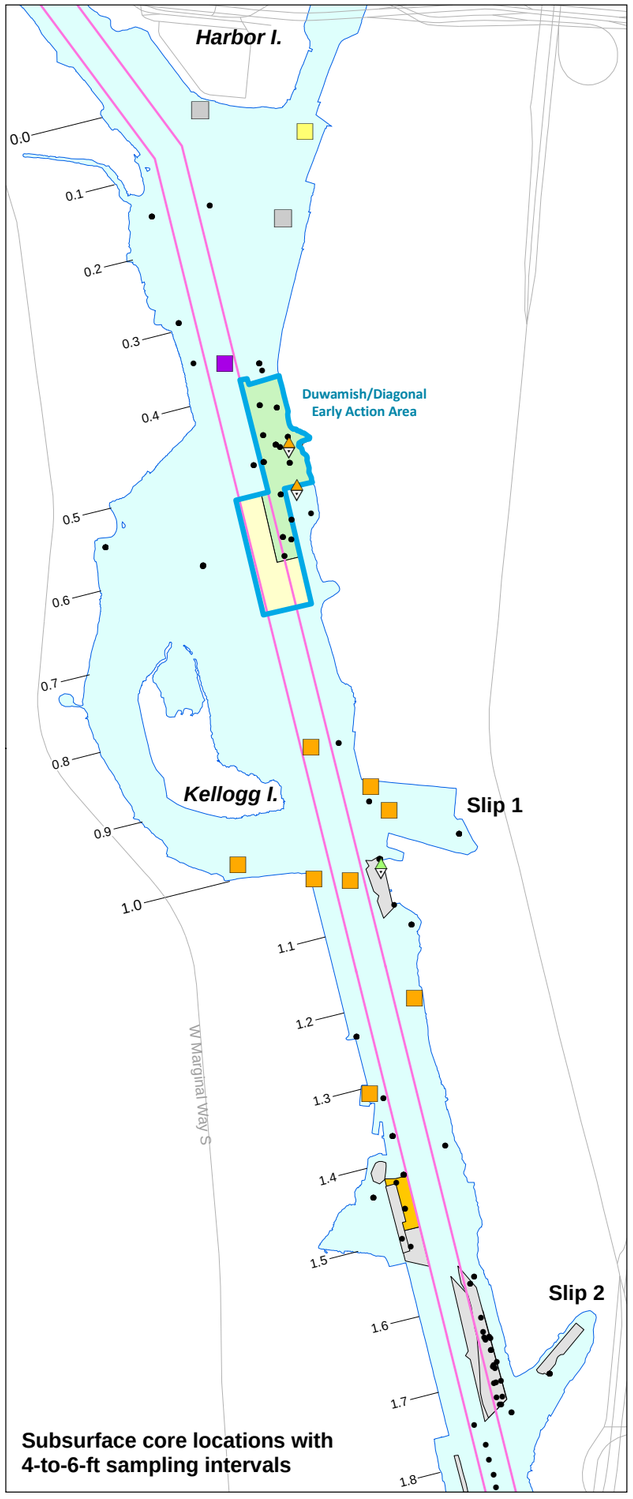
Modified by Zachariah from GIS Map 2853 | May 29, 2009 | Map 4-24 (2583).xar



Subsurface core locations with 0-to-2-ft sampling intervals



Subsurface core locations with 2-to-4-ft sampling intervals



Subsurface core locations with 4-to-6-ft sampling intervals

Total PCB concentration (µg/kg dw)[a]

> 4,300	95th percentile = 4,300
> 390 and ≤ 4,300	75th percentile = 390
> 140 and ≤ 390	50th percentile = 140
> 58 and ≤ 140	25th percentile = 58
≤ 58	
Non-detect	

Sampling interval

	Left panel	Middle panel	Right panel
☐	0-to-2-ft[b]	2-to-4-ft[b]	4-to-6-ft[b]
◇	0-to-1-ft[c]	2-to-3-ft[c]	4-to-5-ft[c]
◇	1-to-2-ft[c]	3-to-4-ft[c]	5-to-6-ft[c]

△ Not analyzed in that sampling interval

• Other subsurface sampling location analyzed for total PCBs, but not in the illustrated sampling interval

Early Action Area[d]

Dredged area[e]

Dredged and capped area[e]

Dredged and thin-layer placement[e]

Thin-layer placement

Road

Navigation channel

River mile

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. Total PCBs represent the sum of the concentrations of all detected Aroclors. For locations with non-detects for all Aroclors, a value equal to the highest RL of an individual Aroclor at that location was used.

[b] Data from 2-foot sampling intervals; some locations show an average of data from both 1-foot intervals within that 2-foot interval at a given location.

[c] Data from 1-foot sampling intervals are shown if available. If both 1-foot intervals within the 2-foot interval were collected, the average of the two intervals is also shown.

[d] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[e] Subsurface sediment data at locations in dredged areas were collected prior to dredging.

N

0 0.1 0.2 Kilometers

0 0.1 0.2 Miles

Scale is the same for each map frame

Map 4-25a. Total PCB concentrations in subsurface sediment within the 0-to-2-ft, 2-to-4-ft, and 4-to-6-ft sampling intervals, RM 0.0 to RM 1.8

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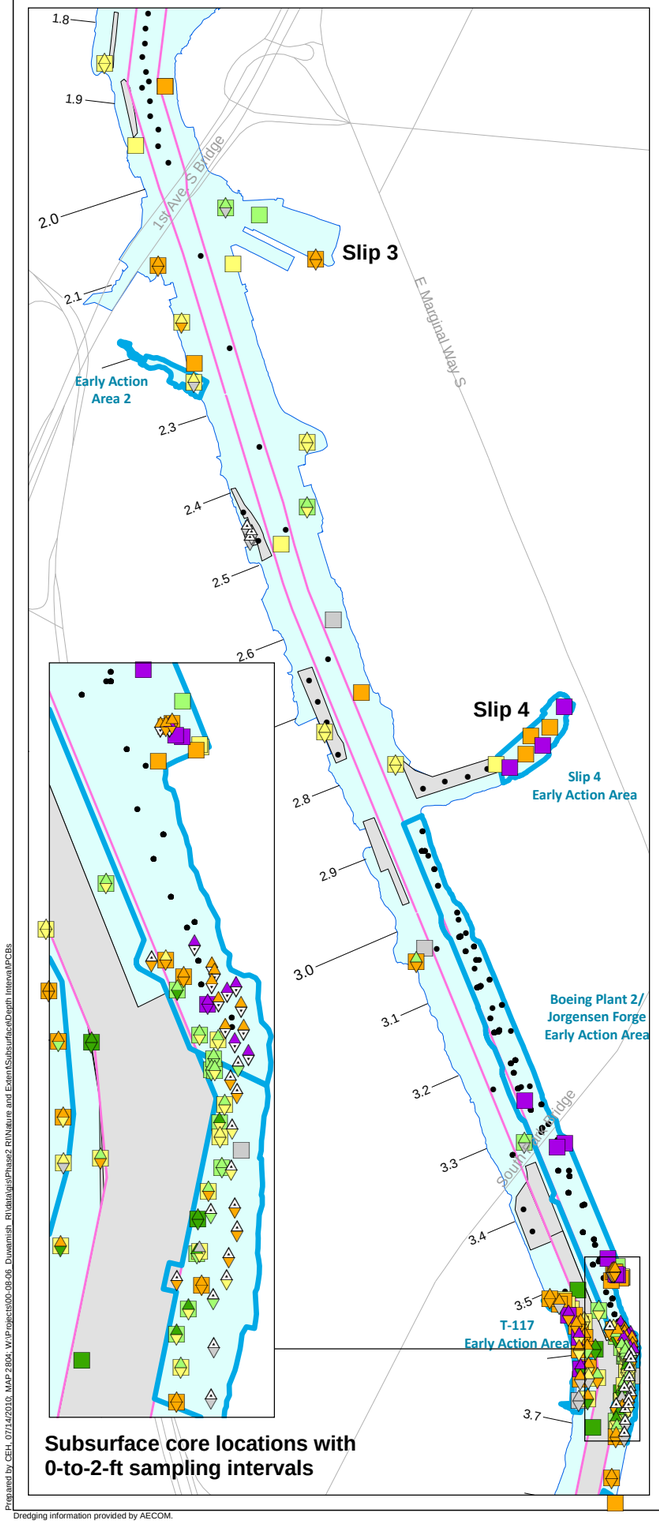
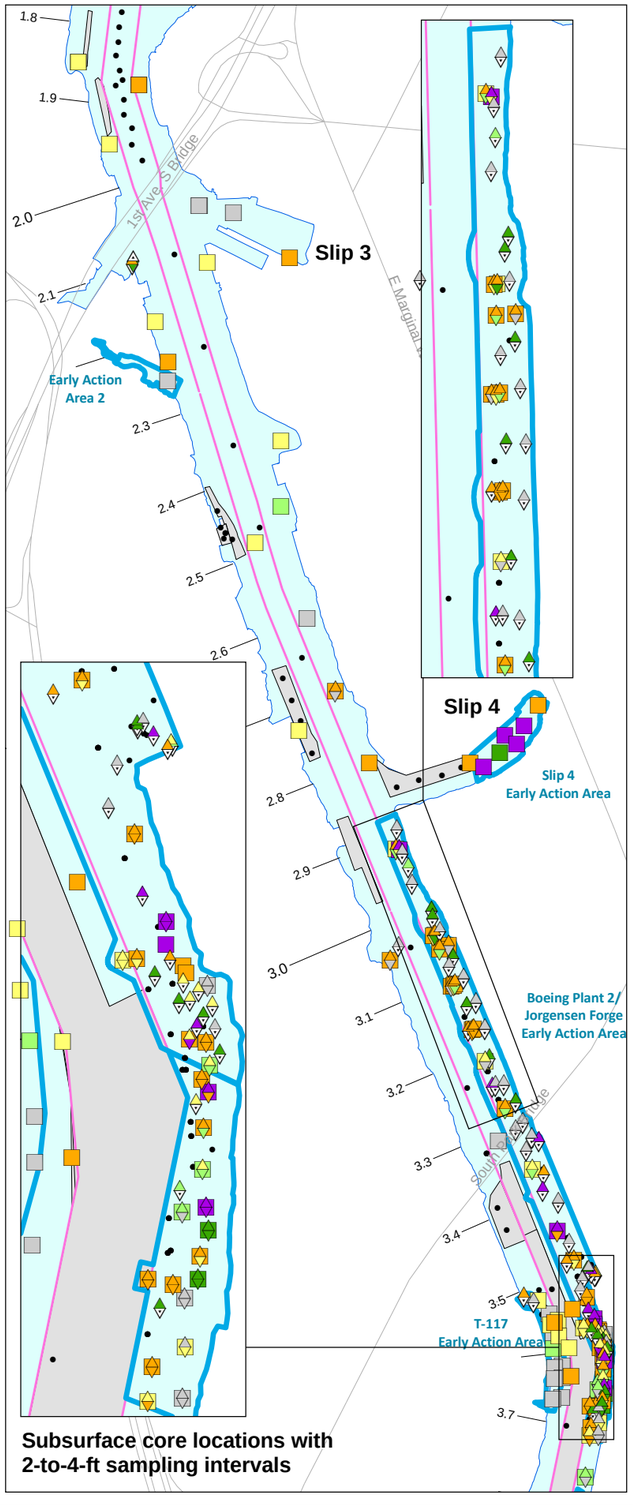
Prepared by CEH, 07/14/2016, MAP 2804, W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2_RI\Nature and Extent\Subsurface\Depth Interval\PCBs

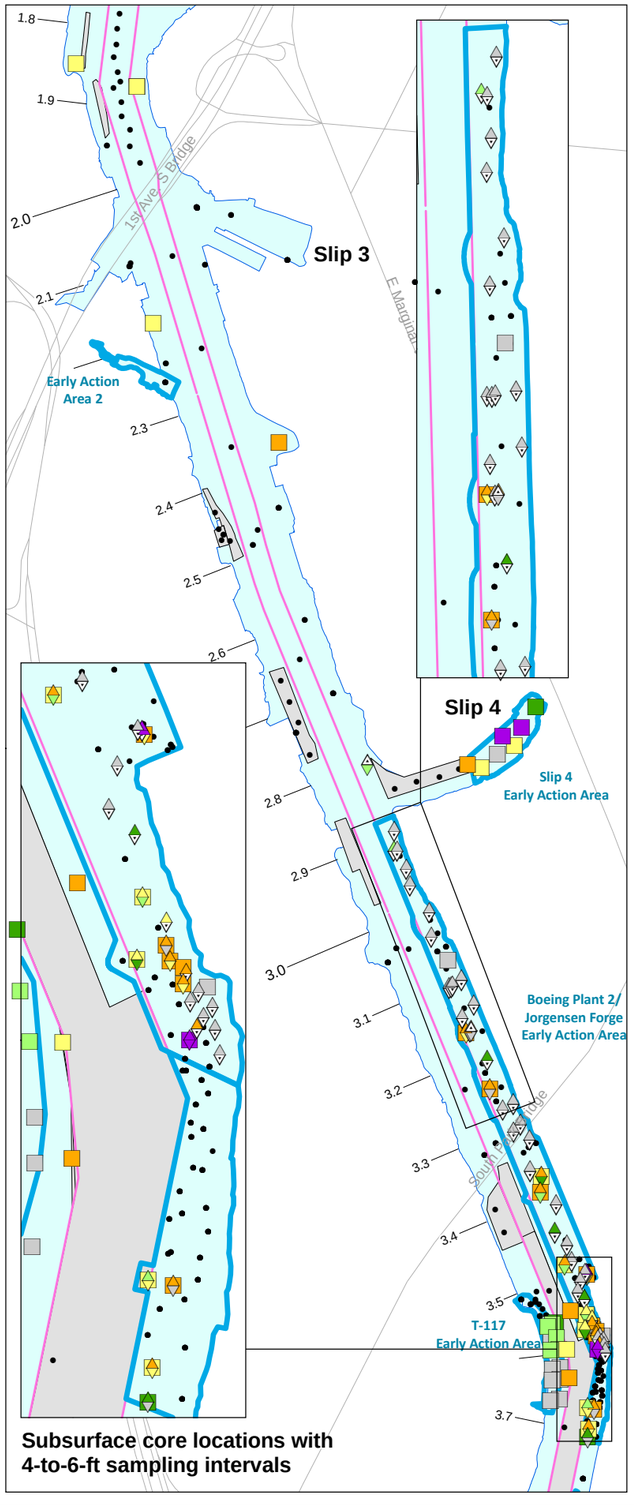
Dredging information provided by AECOM.



Subsurface core locations with 0-to-2-ft sampling intervals



Subsurface core locations with 2-to-4-ft sampling intervals



Subsurface core locations with 4-to-6-ft sampling intervals

Total PCB concentration (µg/kg dw)[a]

- > 4,300
- > 390 and ≤ 4,300
- > 140 and ≤ 390
- > 58 and ≤ 140
- ≤ 58
- Non-detect

95th percentile = 4,300
75th percentile = 390
50th percentile = 140
25th percentile = 58

Sampling interval

Left panel	Middle panel	Right panel
0-to-2-ft[b]	2-to-4-ft[b]	4-to-6-ft[b]
0-to-1-ft[c]	2-to-3-ft[c]	4-to-5-ft[c]
1-to-2-ft[c]	3-to-4-ft[c]	5-to-6-ft[c]

- Not analyzed in that sampling interval
- Other subsurface sampling location analyzed for total PCBs, but not in the illustrated sampling interval
- Early Action Area[d]
- Dredged area[e]
- Road
- Navigation channel
- River mile

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. Total PCBs represent the sum of the concentrations of all detected Aroclors. For locations with non-detects for all Aroclors, a value equal to the highest RL of an individual Aroclor at that location was used.

[b] Data from 2-foot sampling intervals; some locations show an average of data from both 1-foot intervals within that 2-foot interval at a given location.

[c] Data from 1-foot sampling intervals are shown if available. If both 1-foot intervals within the 2-foot interval were collected, the average of the two intervals is also shown.

[d] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[e] Subsurface sediment data at locations in dredged areas were collected prior to dredging.

0 0.1 0.2 Kilometers

0 0.1 0.2 Miles

Scale is the same for each map frame

Map 4-25b. Total PCB concentrations in subsurface sediment within the 0-to-2-ft, 2-to-4-ft, and 4-to-6-ft sampling intervals, RM 1.8 to RM 3.7

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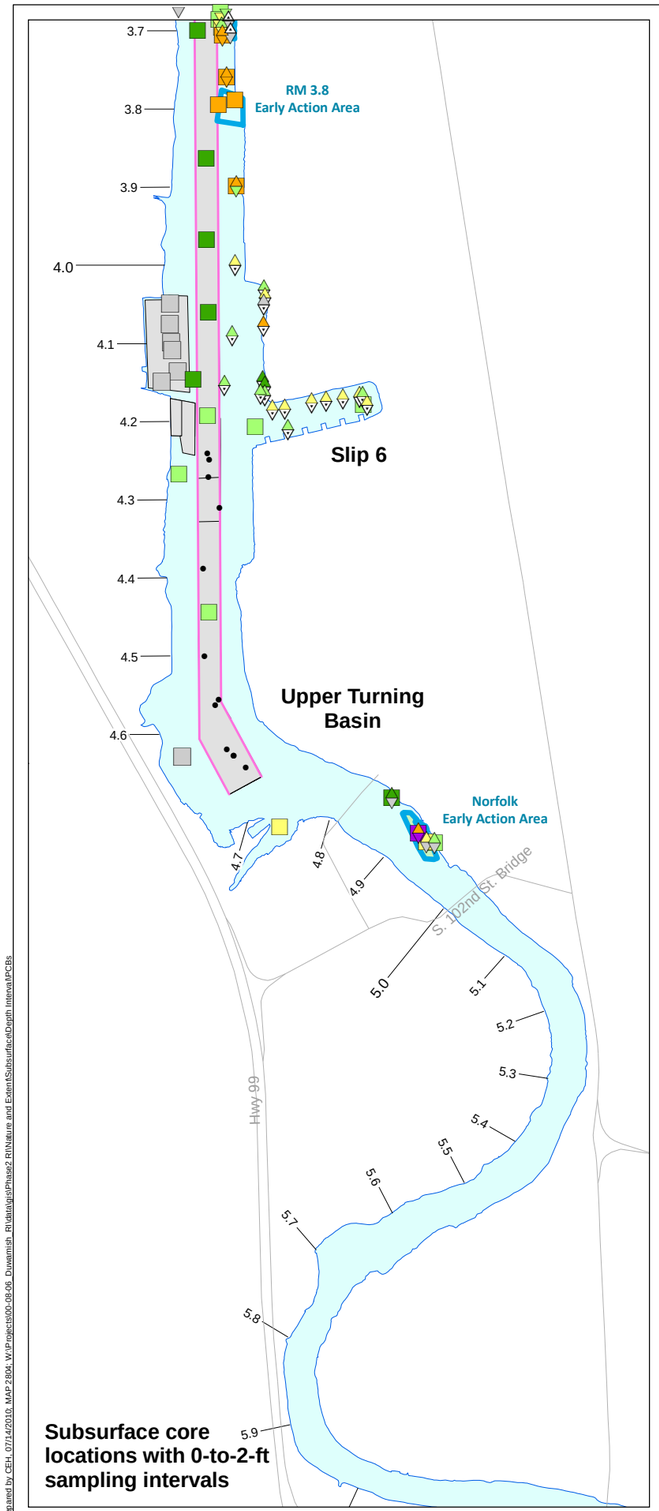
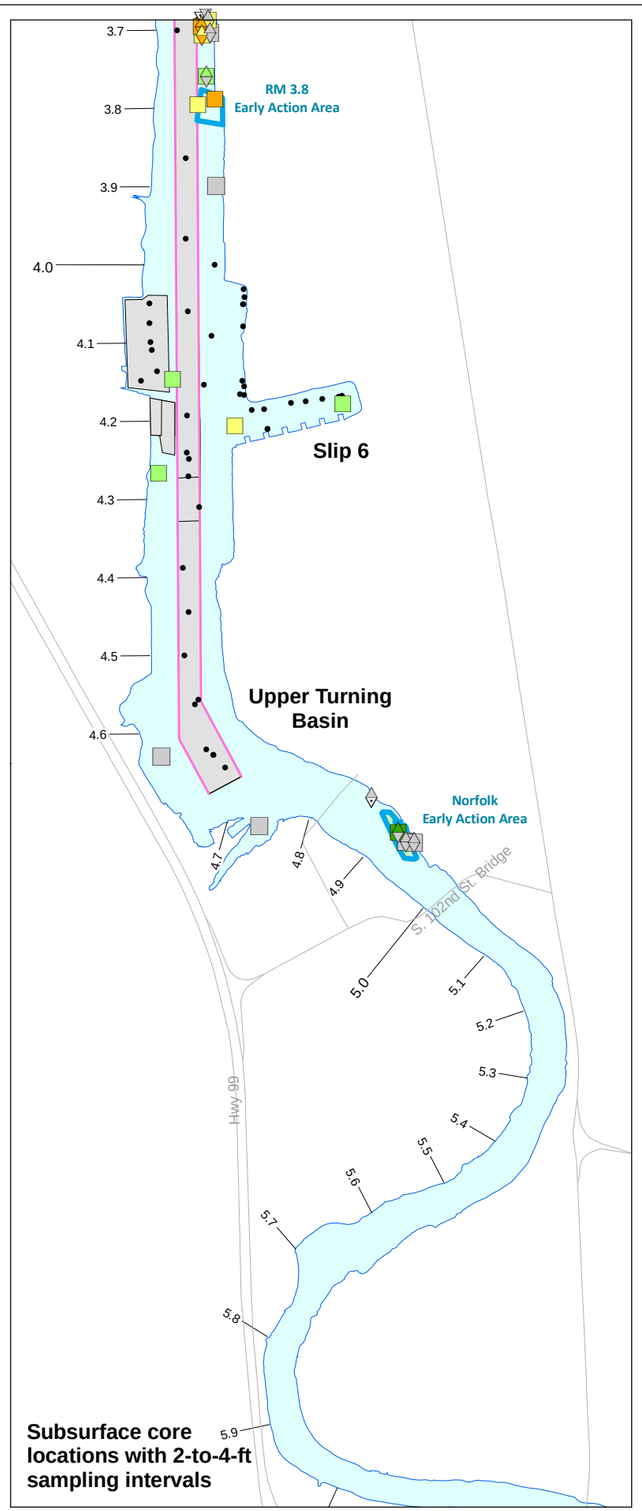
Prepared by: CEH, 07/14/2010, MAP 2804, W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Subsurface\Depth Interval\PCBs

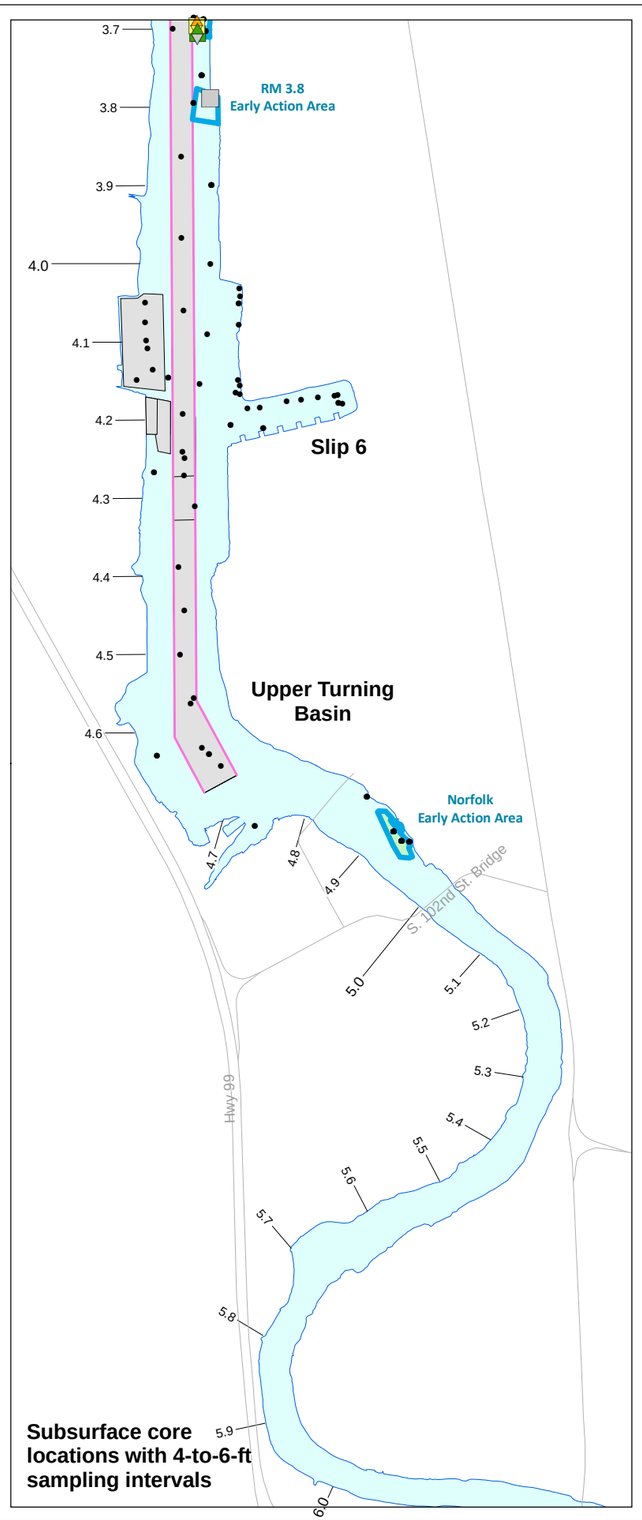
Dredging information provided by AECOM.



Subsurface core locations with 0-to-2-ft sampling intervals



Subsurface core locations with 2-to-4-ft sampling intervals



Subsurface core locations with 4-to-6-ft sampling intervals

Total PCB concentration (µg/kg dw)[a]

> 4,300	95th percentile = 4,300
> 390 and ≤ 4,300	75th percentile = 390
> 140 and ≤ 390	50th percentile = 140
> 58 and ≤ 140	25th percentile = 58
≤ 58	
Non-detect	

Sampling interval

Left panel	Middle panel	Right panel
0-to-2-ft[b]	2-to-4-ft[b]	4-to-6-ft[b]
0-to-1-ft[c]	2-to-3-ft[c]	4-to-5-ft[c]
1-to-2-ft[c]	3-to-4-ft[c]	5-to-6-ft[c]

Not analyzed in that sampling interval

Other subsurface sampling location analyzed for total PCBs, but not in the illustrated sampling interval

Early Action Area[d]

Dredged area[e]

Dredged and capped area[e]

Road

Navigation channel

River mile

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. Total PCBs represent the sum of the concentrations of all detected Aroclors. For locations with non-detects for all Aroclors, a value equal to the highest RL of an individual Aroclor at that location was used.

[b] Data from 2-foot sampling intervals; some locations show an average of data from both 1-foot intervals within that 2-foot interval at a given location.

[c] Data from 1-foot sampling intervals are shown if available. If both 1-foot intervals within the 2-foot interval were collected, the average of the two intervals is also shown.

[d] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[e] Subsurface sediment data at locations in dredged areas were collected prior to dredging.

N

0 0.1 0.2 Kilometers

0 0.1 0.2 Miles

Scale is the same for each map frame

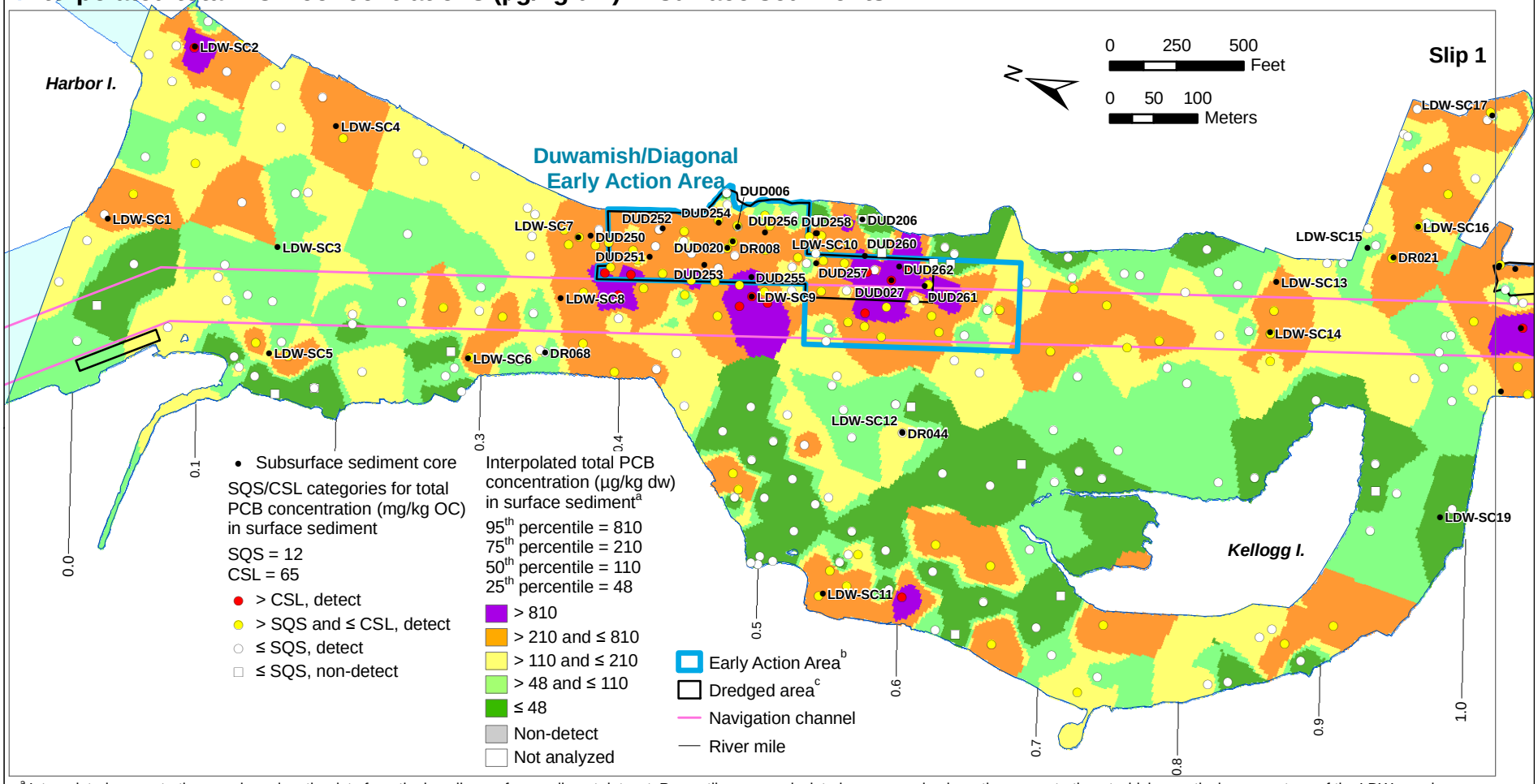
Map 4-25c. Total PCB concentrations in subsurface sediment within the 0-to-2-ft, 2-to-4-ft, and 4-to-6-ft sampling intervals, RM 3.7 to RM 6.0

Wind Ward LLC environmental

Prepared by CEH, 07/14/2010, MAP 2804, W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Depth Interval\PCBs.

Dredging information provided by AECOM.

Interpolated total PCB concentrations (µg/kg dw) in surface sediments



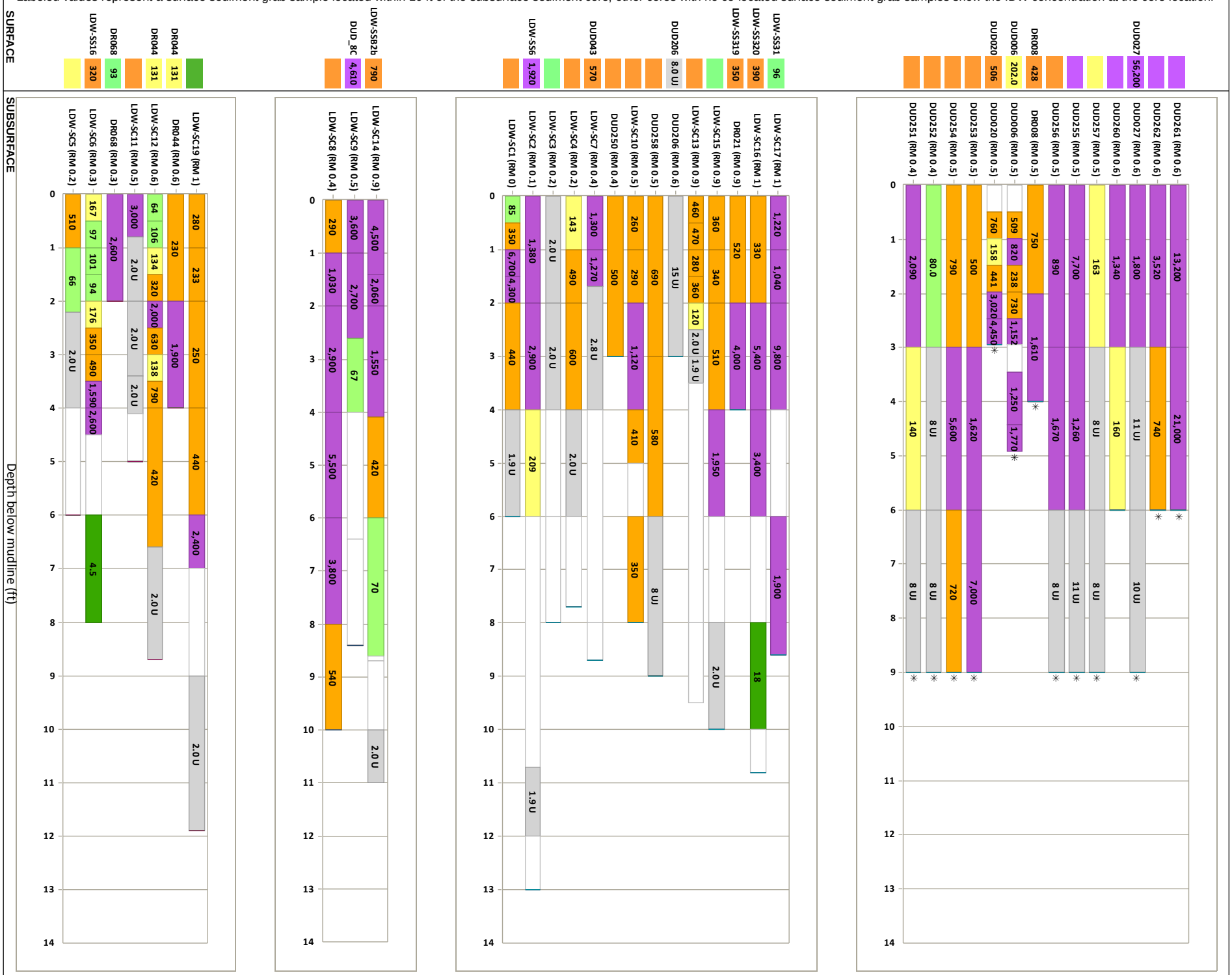
[a] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g. the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 810 µg/kg dw). Total PCBs represent the sum of the concentrations of all detected Aroclors. For locations with non-detects for all individual Aroclors, a value equal to the highest RL of an individual Aroclor at that location was used. Interpolated surface does not show non-detects.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] For the Duwamish/Diagonal Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, and thin-layer placement in 2003 to 2005. Subsurface sediment data in dredged areas were collected prior to dredging.

Total PCB concentrations (µg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the IDW concentration at the core location.



✳ This core was collected prior to dredging at that location.

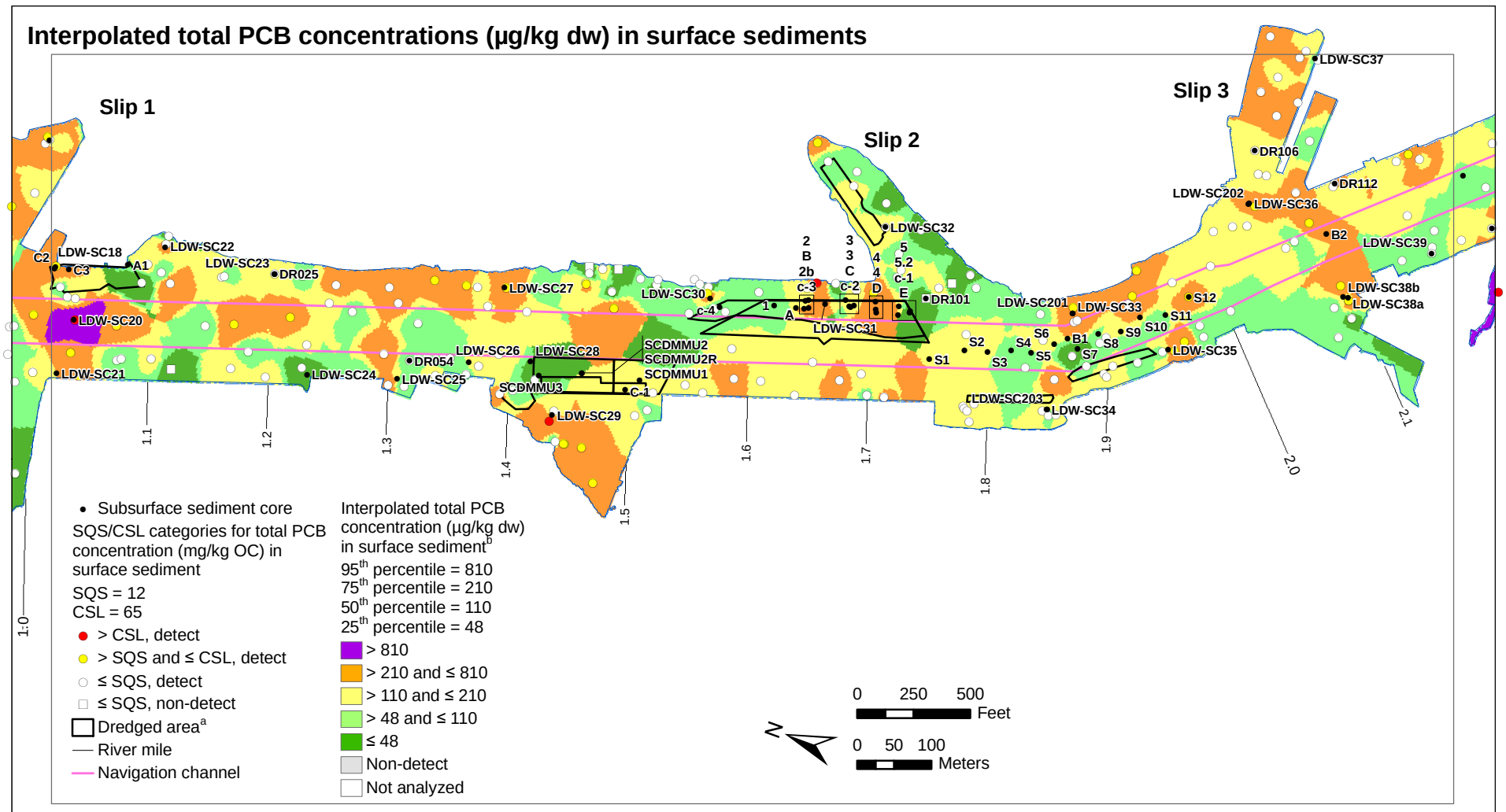
Map 4-26a. Total PCB concentrations in surface sediment and subsurface sediment cores, RM 0.0 to RM 1.0

Wind Ward environmental LLC

Prepared by CEH, 07/14/2010; MAP 30033; W:\Projects\00-08-06_Duwamish_Rl\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

Interpolated total PCB concentrations (µg/kg dw) in surface sediments

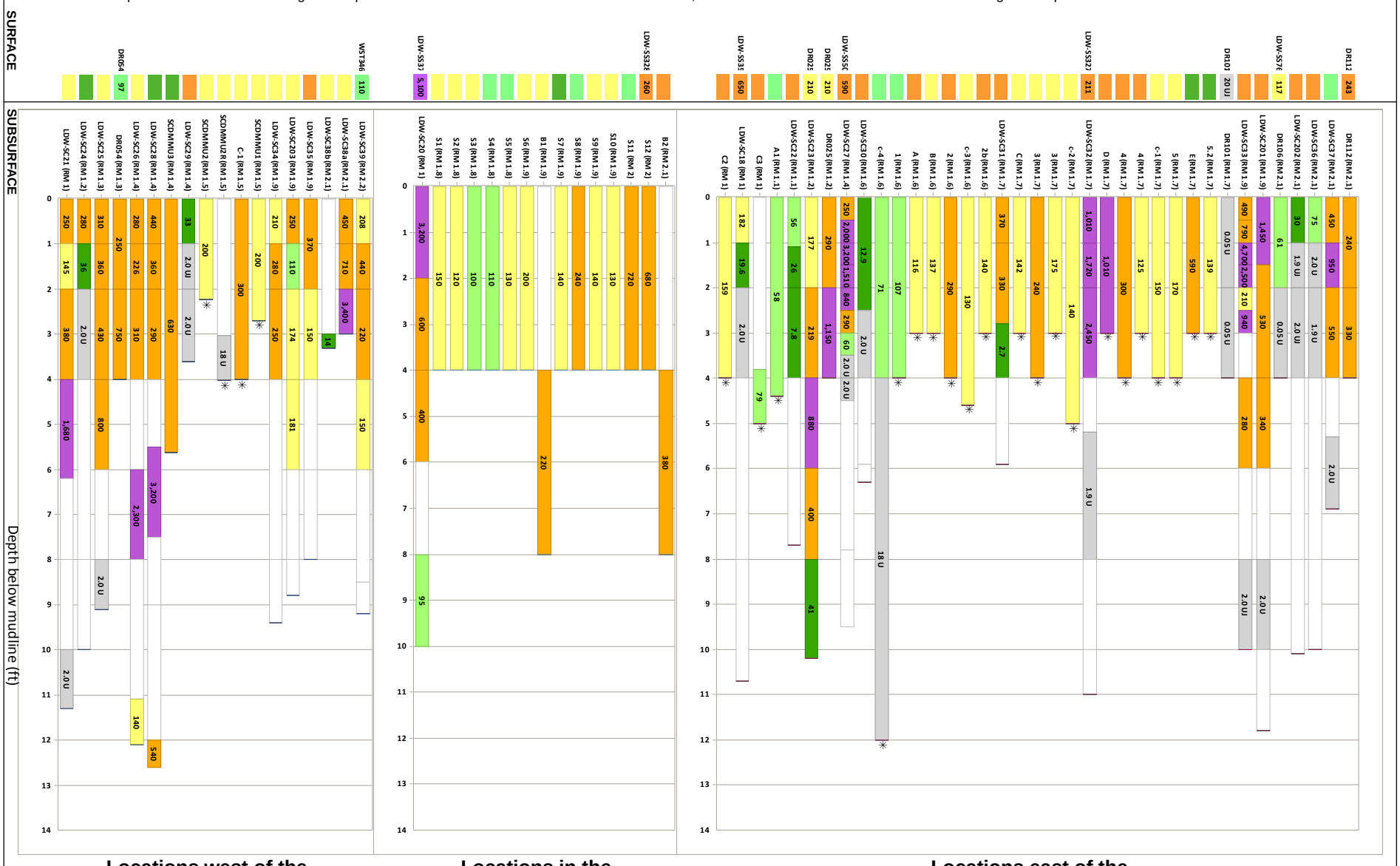


[a] Subsurface sediment data at locations in dredged areas were collected prior to dredging; surface sediment data were collected after dredging.

[b] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 810 µg/kg dw). Total PCBs represent the sum of the concentrations of all detected Aroclors. For locations with non-detects for all individual Aroclors, a value equal to the highest RL of an individual Aroclor at that location was used. Interpolated surface does not show non-detects.

Total PCB concentrations (µg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the IDW concentration at the core location.



✳ This core was collected prior to dredging at that location.

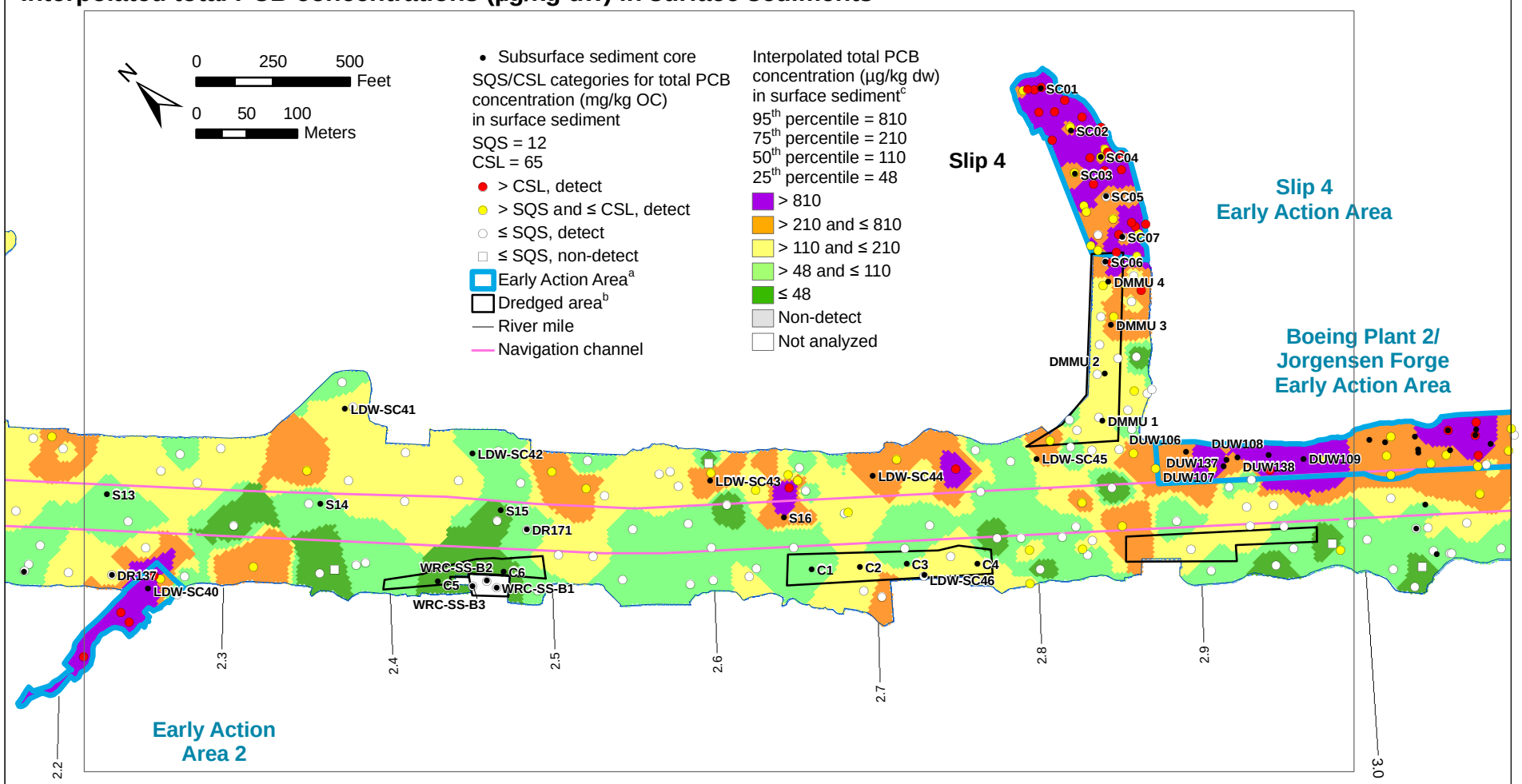
Map 4-26b. Total PCB concentrations in surface sediment and subsurface sediment cores, RM 1.0 to RM 2.2

Wind Ward LLC environmental

Prepared by CEH, 07/14/2010; MAP 3003; W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

Interpolated total PCB concentrations (µg/kg dw) in surface sediments



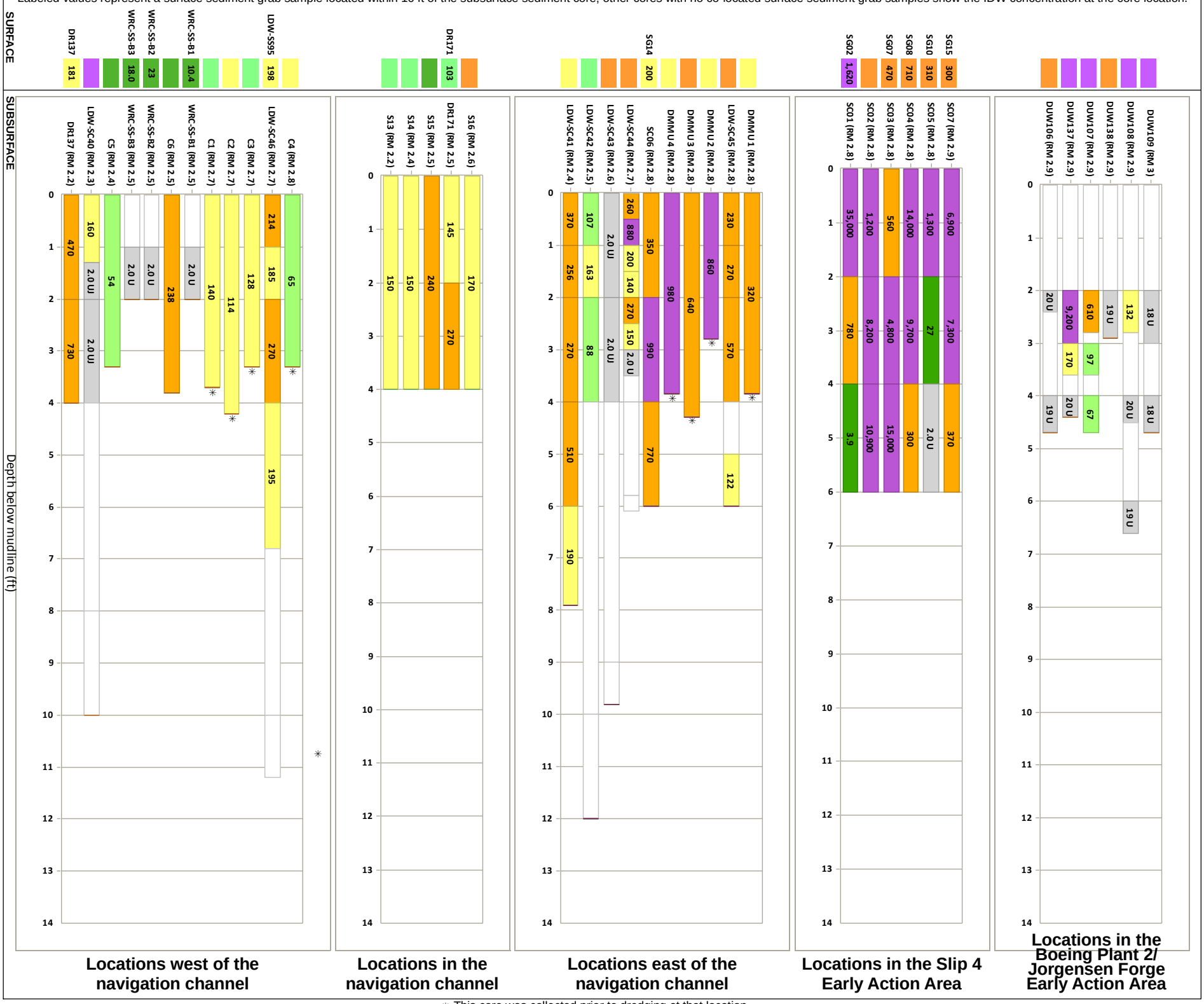
[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[b] Subsurface sediment data at locations in dredged areas were collected prior to dredging; surface sediment data were collected after dredging.

[c] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 810 µg/kg dw). Total PCBs represent the sum of the concentrations of all detected Aroclors. For locations with non-detects for all individual Aroclors, a value equal to the highest RL of an individual Aroclor at that location was used. Interpolated surface does not show non-detects.

Total PCB concentrations (µg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the IDW concentration at the core location.



Locations west of the navigation channel | Locations in the navigation channel | Locations east of the navigation channel | Locations in the Slip 4 Early Action Area | Locations in the Boeing Plant 2/ Jorgensen Forge Early Action Area

✳ This core was collected prior to dredging at that location.

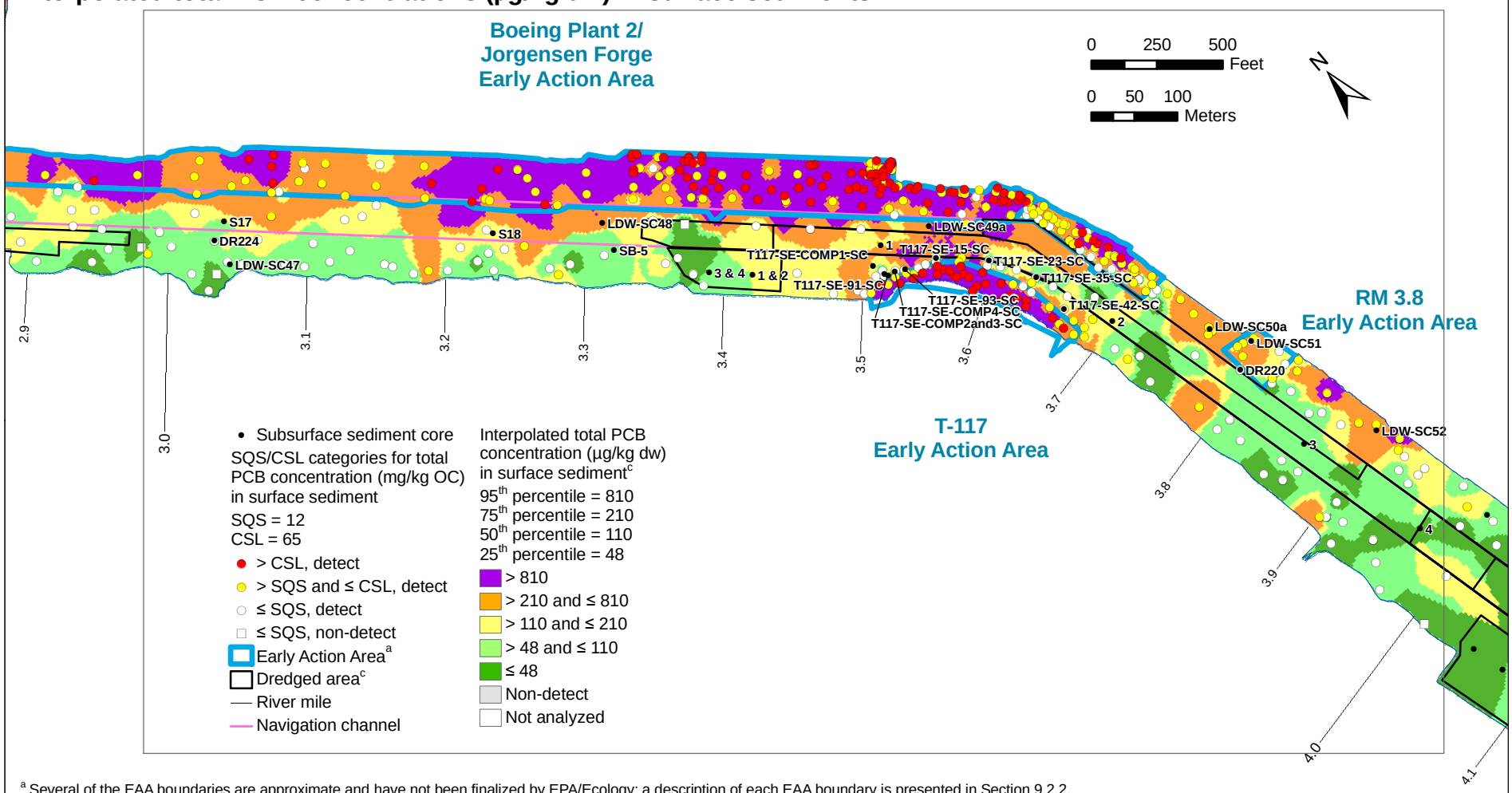
Map 4-26c. Total PCB concentrations in surface sediment and subsurface sediment cores, RM 2.2 to RM 3.0

Wind Ward environmental LLC

Prepared by CEH, 07/14/2010; MAP 30033; W:\Projects\00-08-06_Duwamish_Rt\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

Interpolated total PCB concentrations (µg/kg dw) in surface sediments



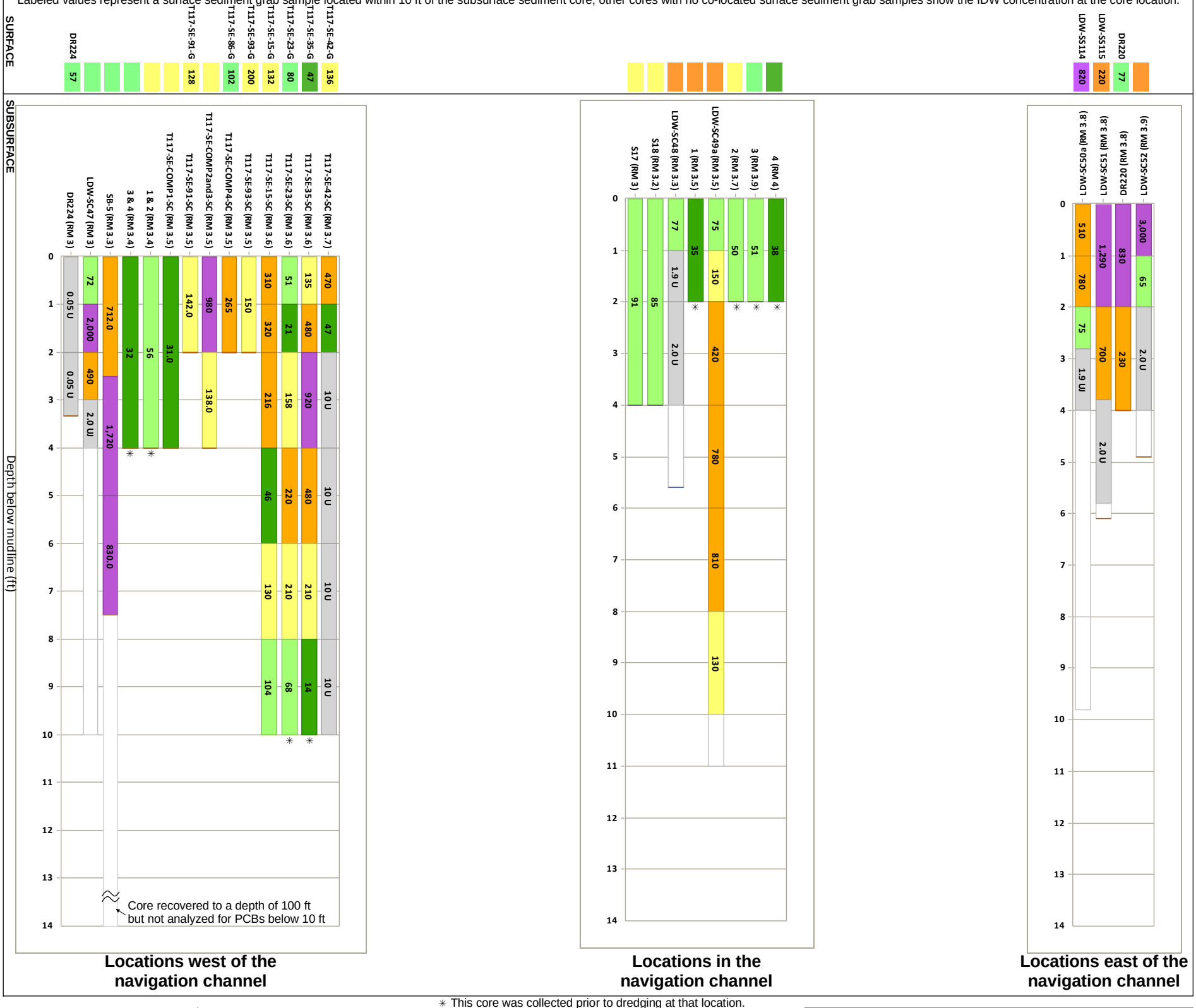
[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[b] Subsurface sediment data at locations in dredged areas were collected prior to dredging; surface sediment data were collected after dredging.

[c] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 810 µg/kg dw). Total PCBs represent the sum of the concentrations of all detected Aroclors. For locations with non-detects for all individual Aroclors, a value equal to the highest RL of an individual Aroclor at that location was used. Interpolated surface does not show non-detects.

Total PCB concentrations (µg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the IDW concentration at the core location.



Locations west of the navigation channel

Locations in the navigation channel

Locations east of the navigation channel

✳ This core was collected prior to dredging at that location.

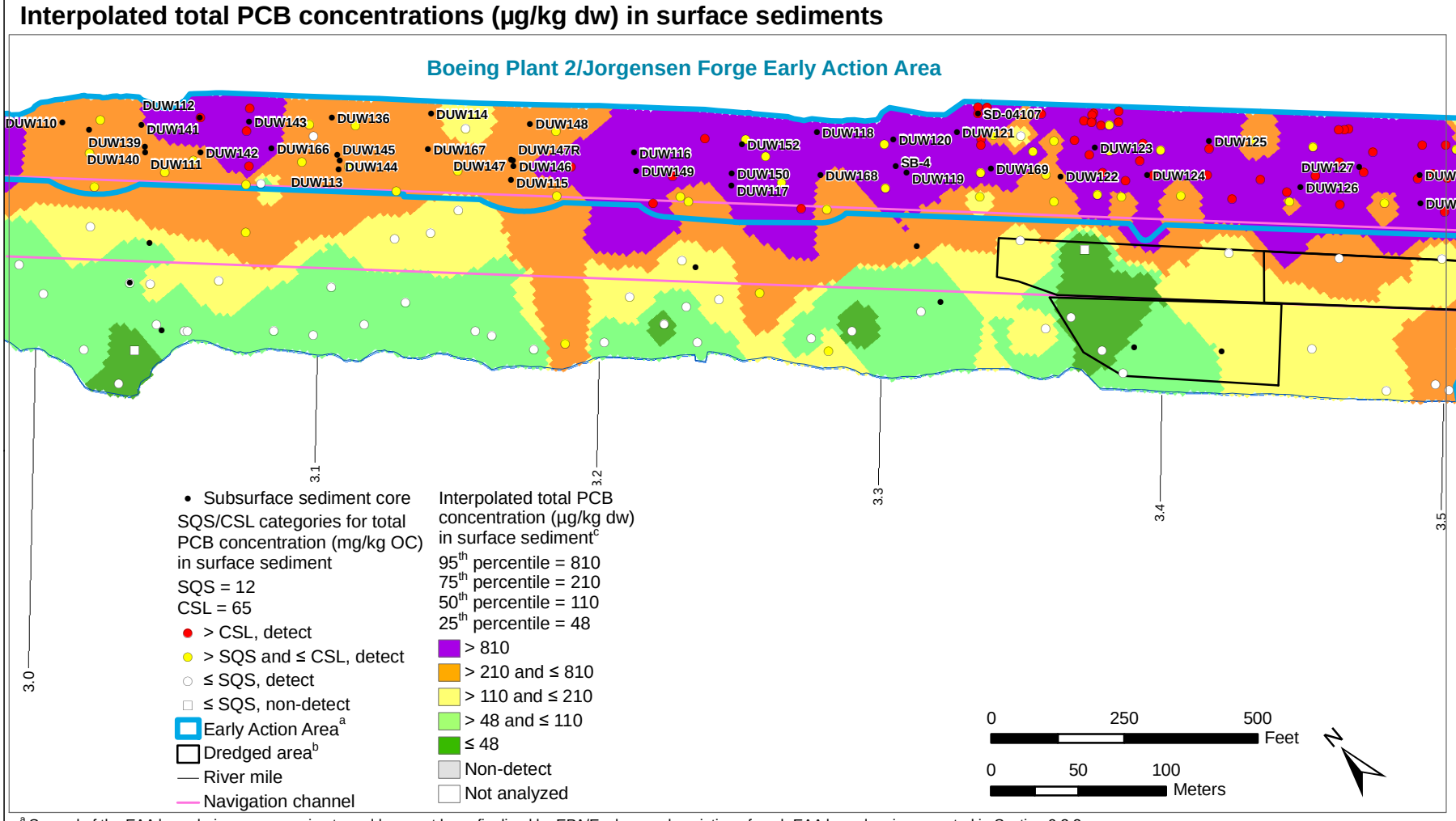
Wind Ward LLC environmental

Map 4-26d. Total PCB concentrations in surface sediment and subsurface sediment cores, RM 3.0 to RM 4.0

Prepared by CEH, 07/14/2010; MAP 3003; W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

Interpolated total PCB concentrations (µg/kg dw) in surface sediments



[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[b] Subsurface sediment data at locations in dredged areas were collected prior to dredging; surface sediment data were collected after dredging.

[c] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 810 µg/kg dw). Total PCBs represent the sum of the concentrations of all detected Aroclors. For locations with non-detects for all individual Aroclors, a value equal to the highest RL of an individual Aroclor at that location was used. Interpolated surface does not show non-detects.

Total PCB concentrations (µg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the IDW concentration at the core location.

Locations in the Boeing Plant 2/Jorgensen Forge Early Action Area

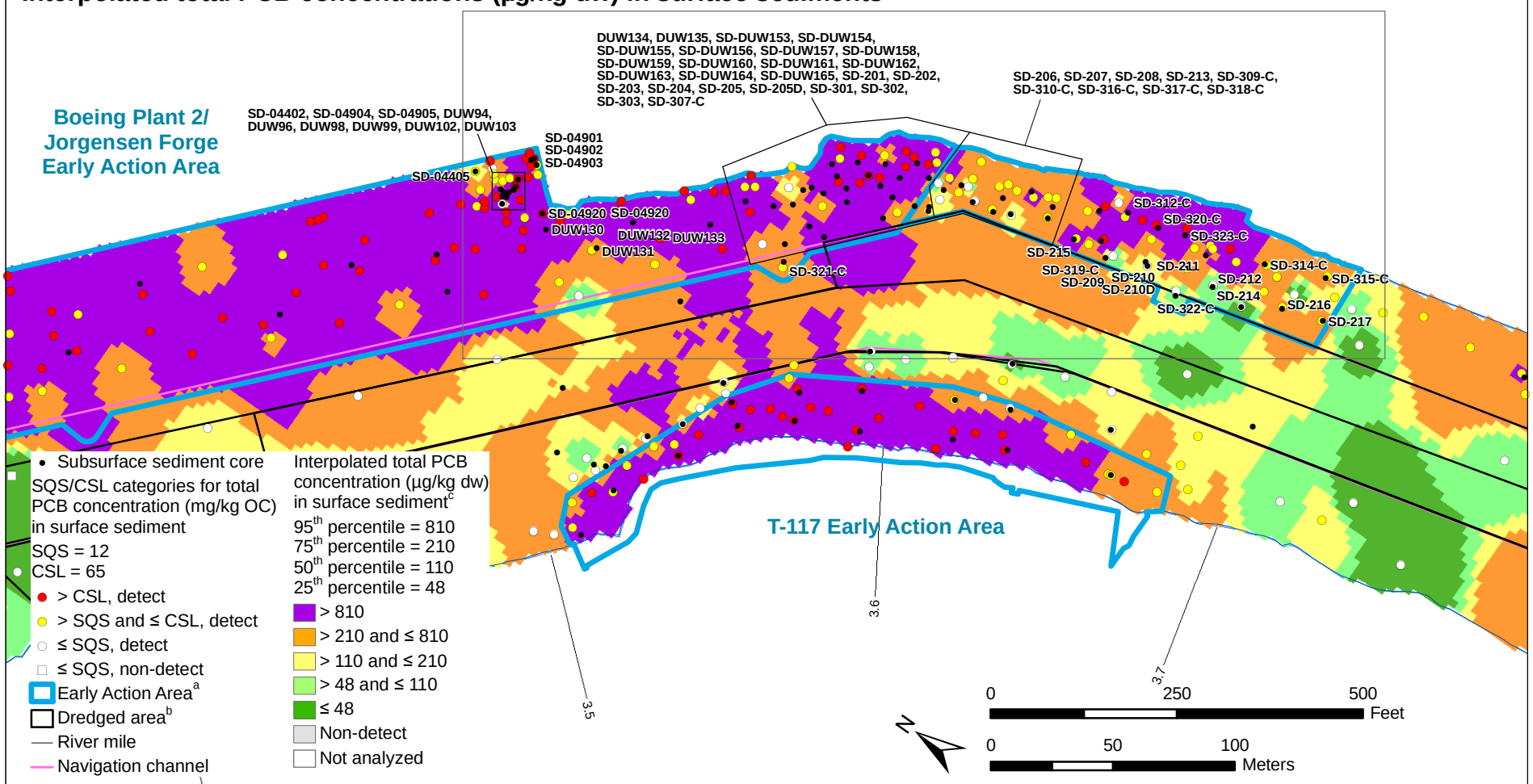
Map 4-26e. Total PCB concentrations in surface sediment and subsurface sediment cores from the Boeing Plant 2/Jorgensen Forge Early Action Area, RM 3.0 to RM 3.5

Wind Ward environmental LLC

Prepared by CEH, 07/14/2010; MAP 3003; W:\Projects\00-08-06_Duwamish_Rl\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

Interpolated total PCB concentrations (µg/kg dw) in surface sediments



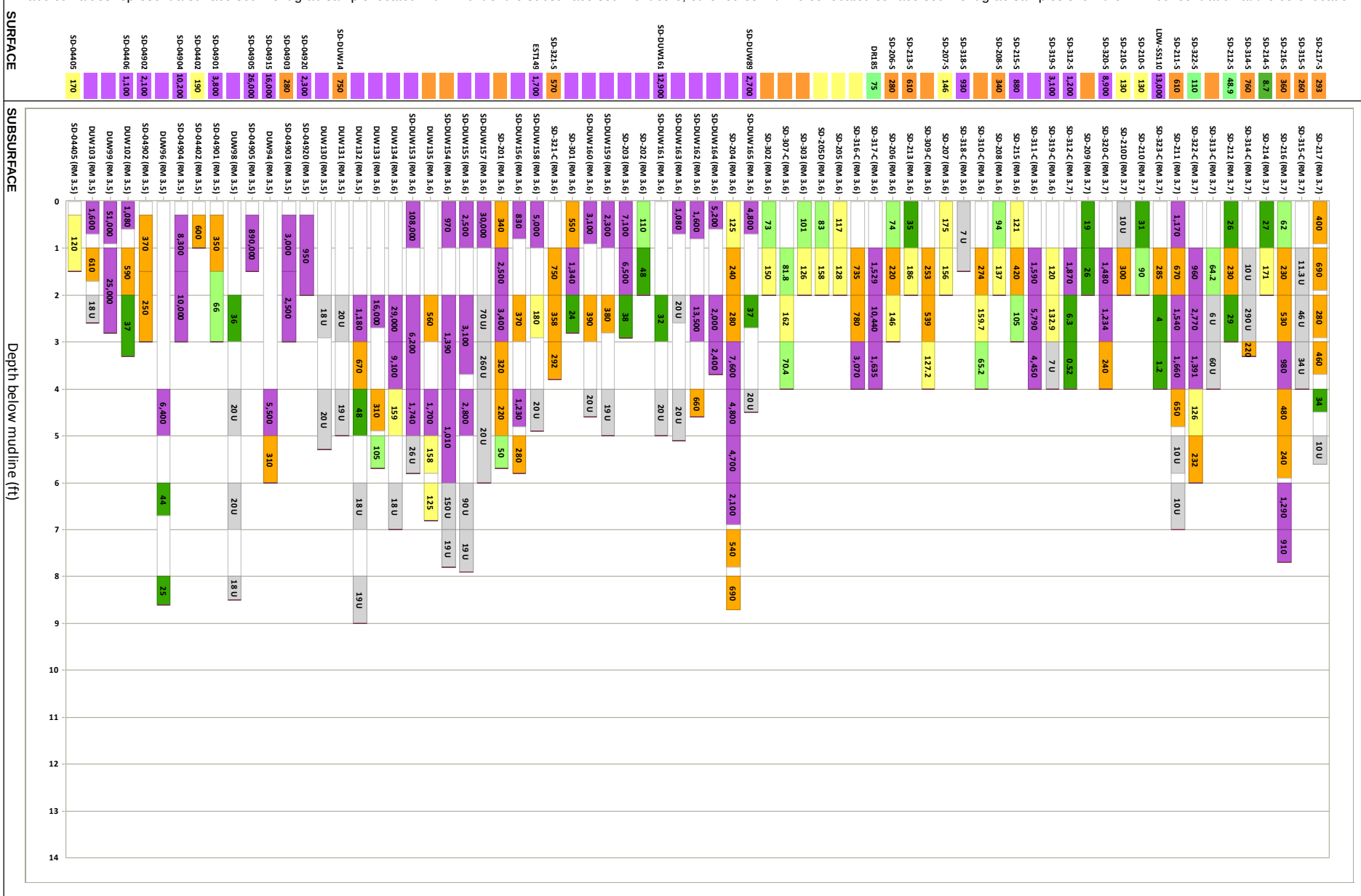
[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[b] Subsurface sediment data at locations in dredged areas were collected prior to dredging; surface sediment data were collected after dredging.

[c] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 810 µg/kg dw). Total PCBs represent the sum of the concentrations of all detected Aroclors. For locations with non-detects for all individual Aroclors, a value equal to the highest RL of an individual Aroclor at that location was used. Interpolated surface does not show non-detects.

Total PCB concentrations (µg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the IDW concentration at the core location.



Locations in the Boeing Plant 2/Jorgensen Forge Early Action Area

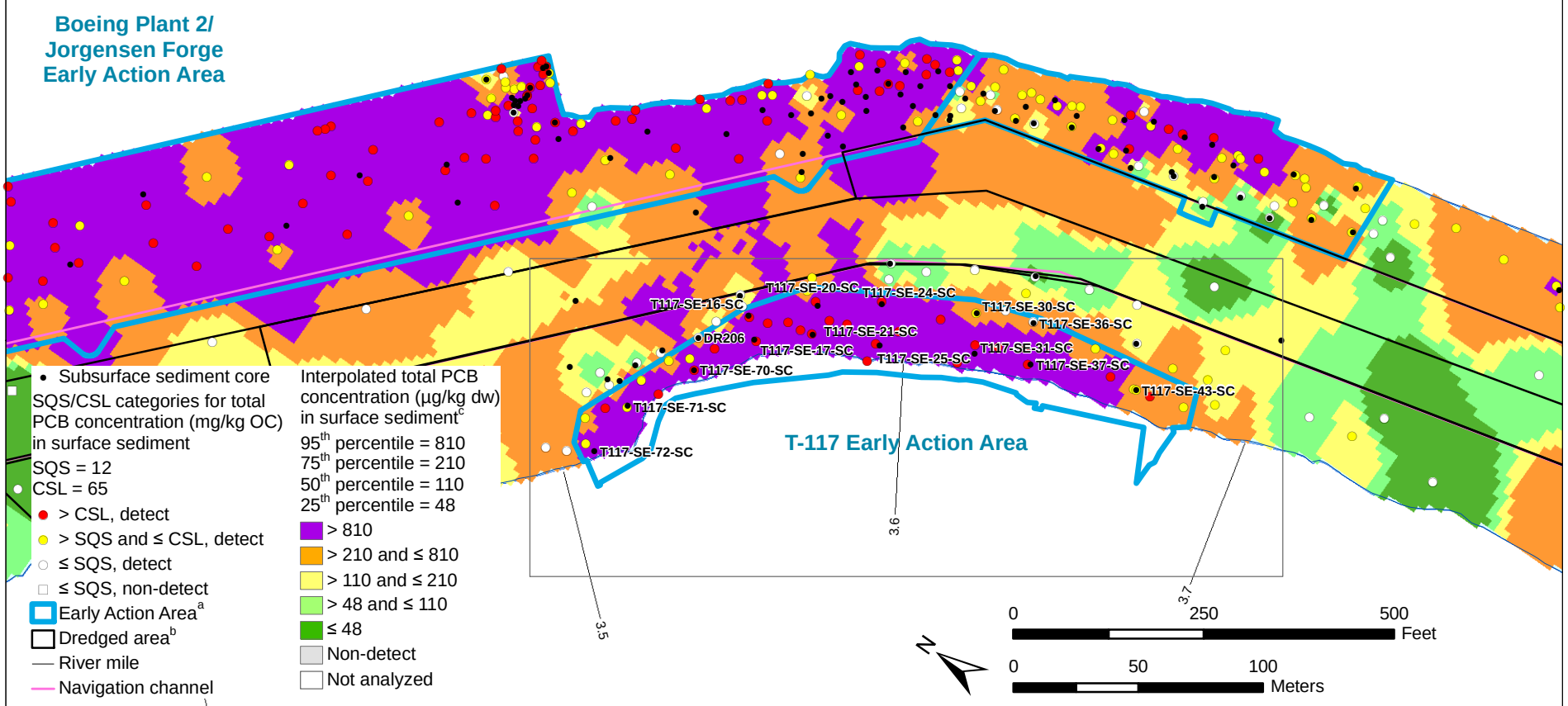
WindWard LLC environmental

Map 4-26f. Total PCB concentrations in surface sediment and subsurface sediment cores from the Boeing Plant 2/Jorgensen Forge Early Action Area, RM 3.5 to RM 3.7

Prepared by CEH, 07/14/2010. MAP 3003.W:\Projects\00-08-06 Duwamish Rl\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

Interpolated total PCB concentrations (µg/kg dw) in surface sediments



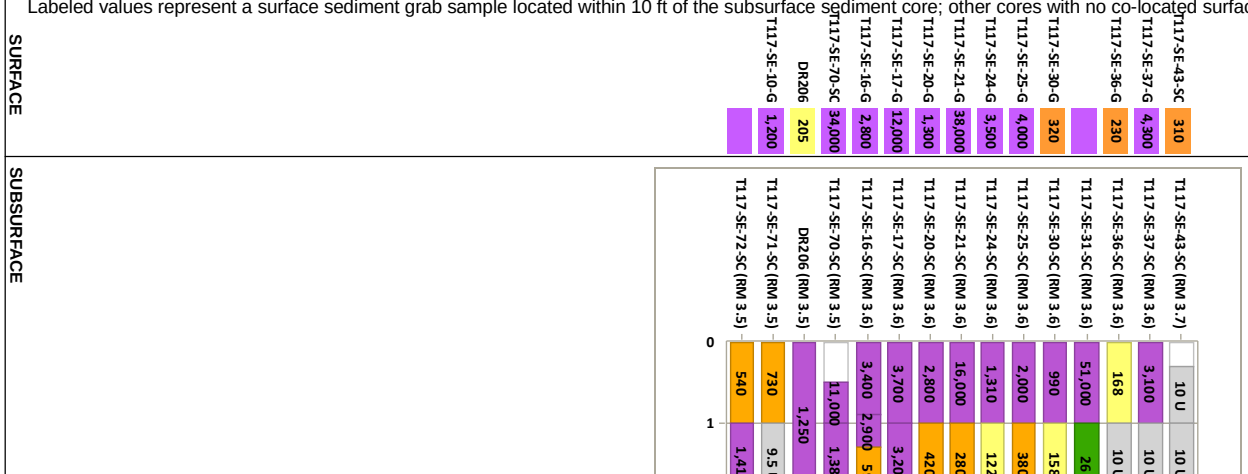
[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

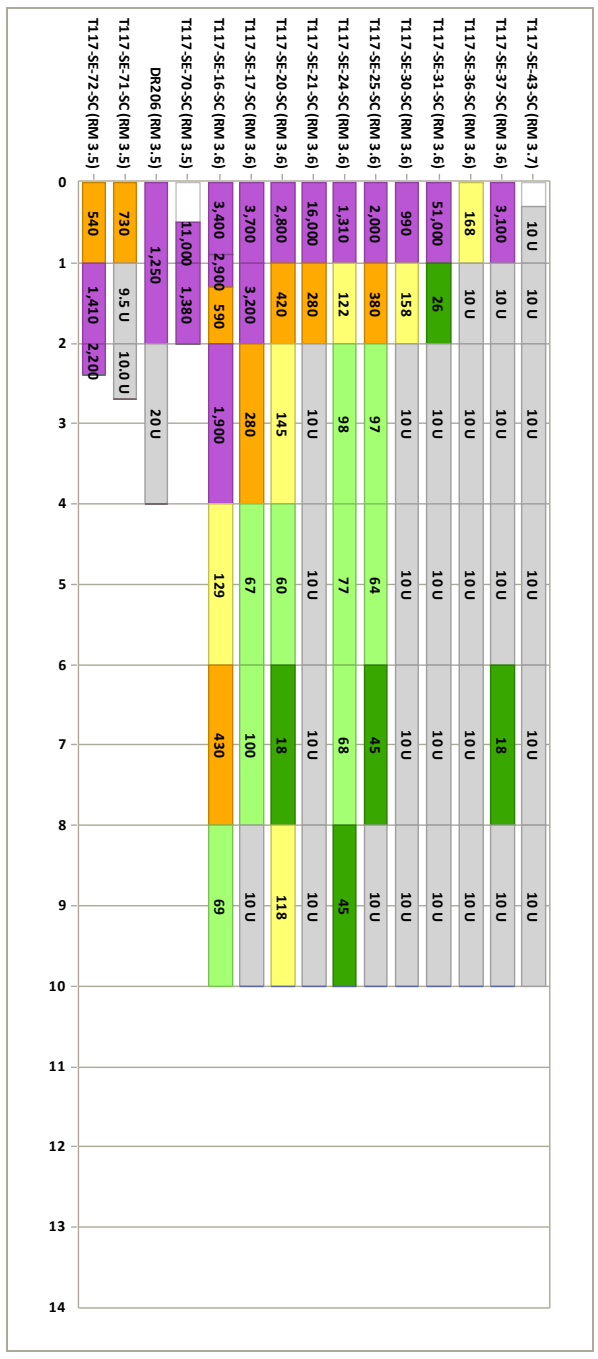
[b] Subsurface sediment data at locations in dredged areas were collected prior to dredging; surface sediment data were collected after dredging.

[c] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 810 µg/kg dw). Total PCBs represent the sum of the concentrations of all detected Aroclors. For locations with non-detects for all individual Aroclors, a value equal to the highest RL of an individual Aroclor at that location was used. Interpolated surface does not show non-detects.

Total PCB concentrations (µg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the IDW concentration at the core location.





Locations in the T-117 Early Action Area

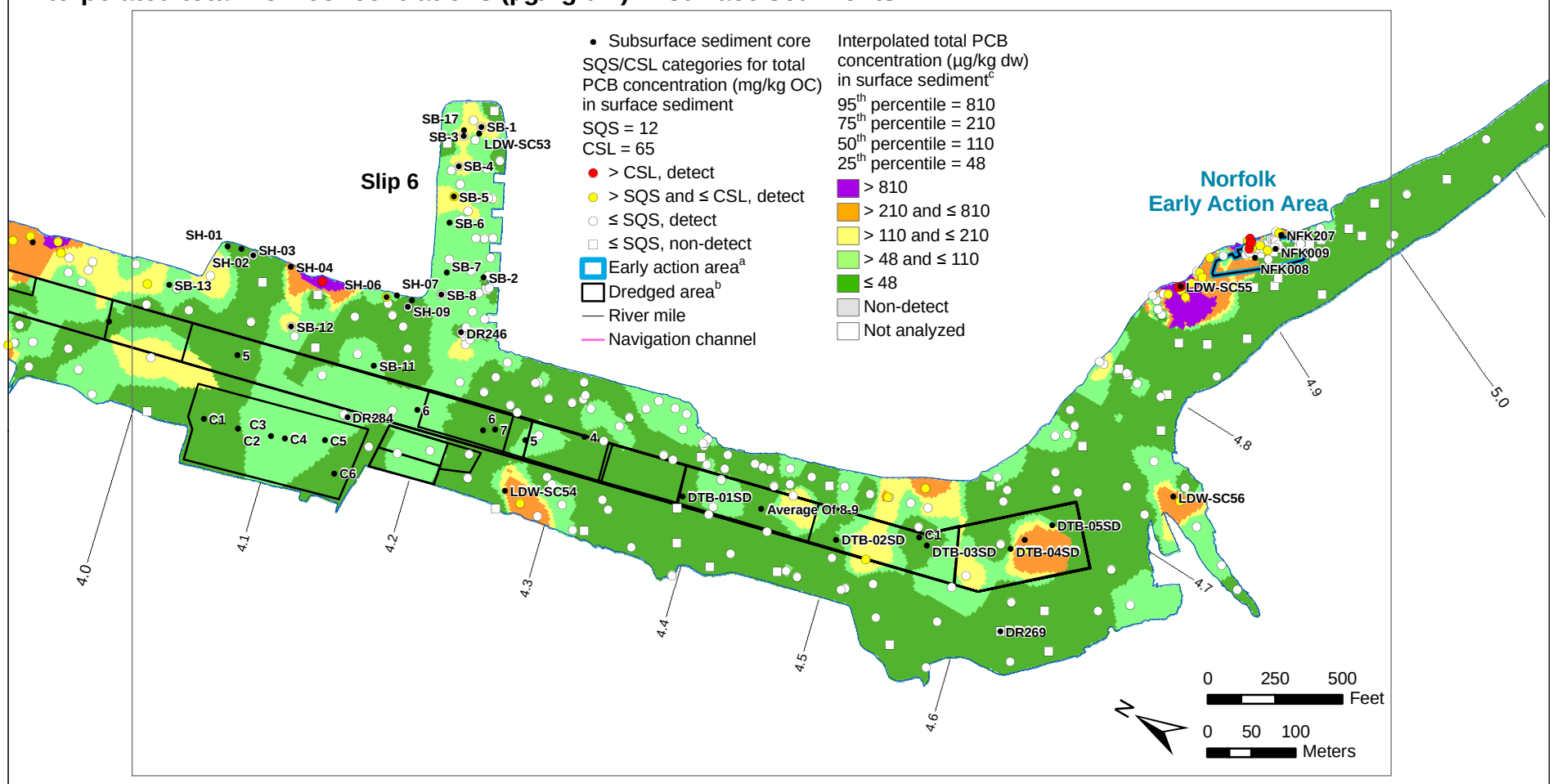
Map 4-26g. Total PCB concentrations in surface sediment and subsurface sediment cores from the T-117 Early Action Area

Wind Ward environmental LLC

Prepared by CEH, 07/14/2010; MAP 3003; W:\Projects\00-08-06_Duwamish_Rl\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

Interpolated total PCB concentrations (µg/kg dw) in surface sediments



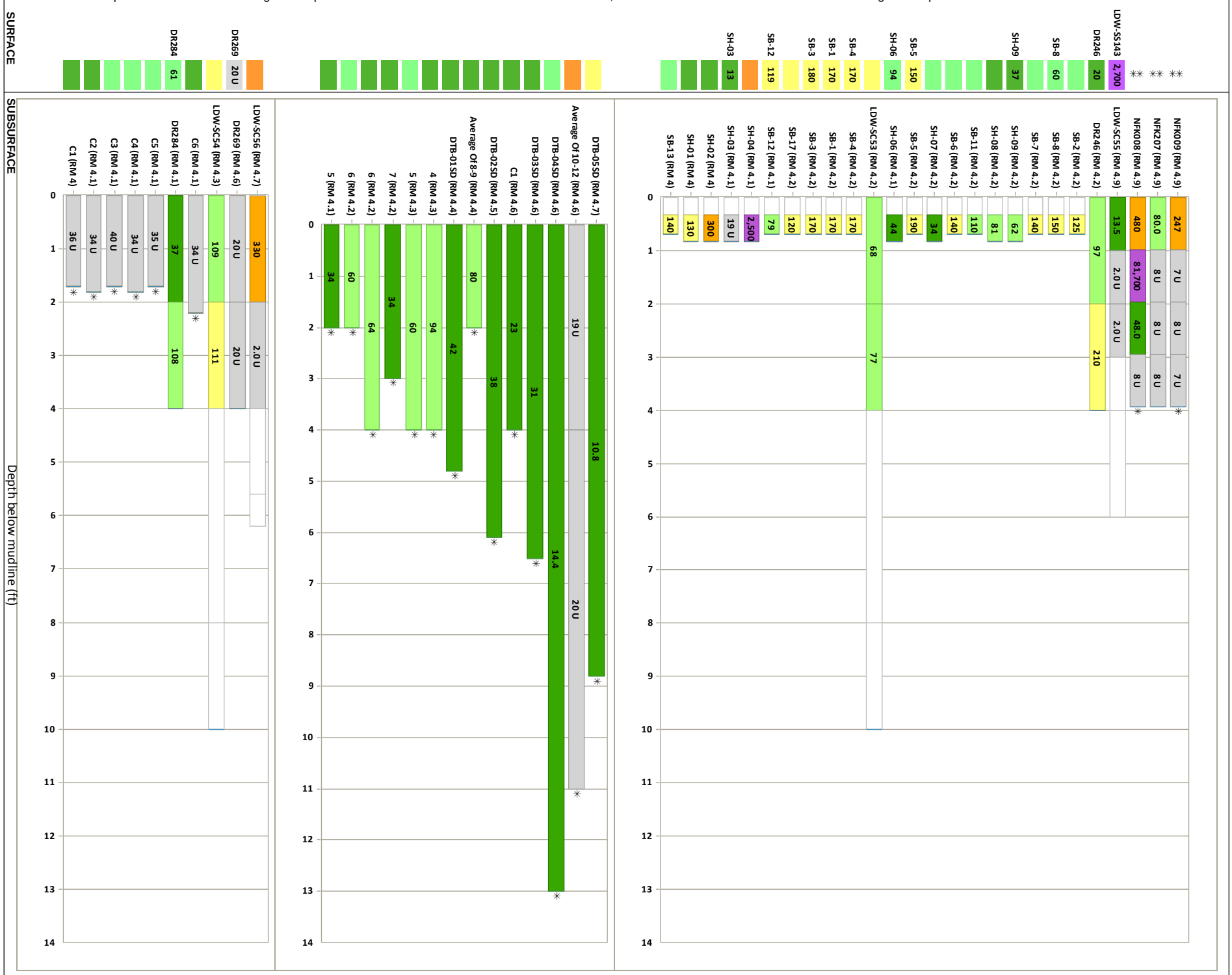
[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[b] For the Norfolk Early Action Area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO/SD removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003. Subsurface sediment data at locations in dredged areas were collected prior to dredging.

[c] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated values ≤ 810 µg/kg dw). Total PCBs represent the sum of the concentrations of all detected Aroclors. For locations with non-detects for all individual Aroclors, a value equal to the highest RL of an individual Aroclor at that location was used. Interpolated surface does not show non-detects.

Total PCB concentrations (µg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the IDW concentration at the core location.



Locations west of the navigation channel

Locations in the navigation channel

Locations east of the navigation channel

∗ This core was collected prior to dredging at that location.

∗∗ At the Norfolk EAA, surface sediment data, which were collected after the removal action at the Norfolk CSO area in 1999 but before the removal action at the BDC south storm drain outfall area in 2003, do not reflect conditions at the time subsurface cores were collected in 1995.

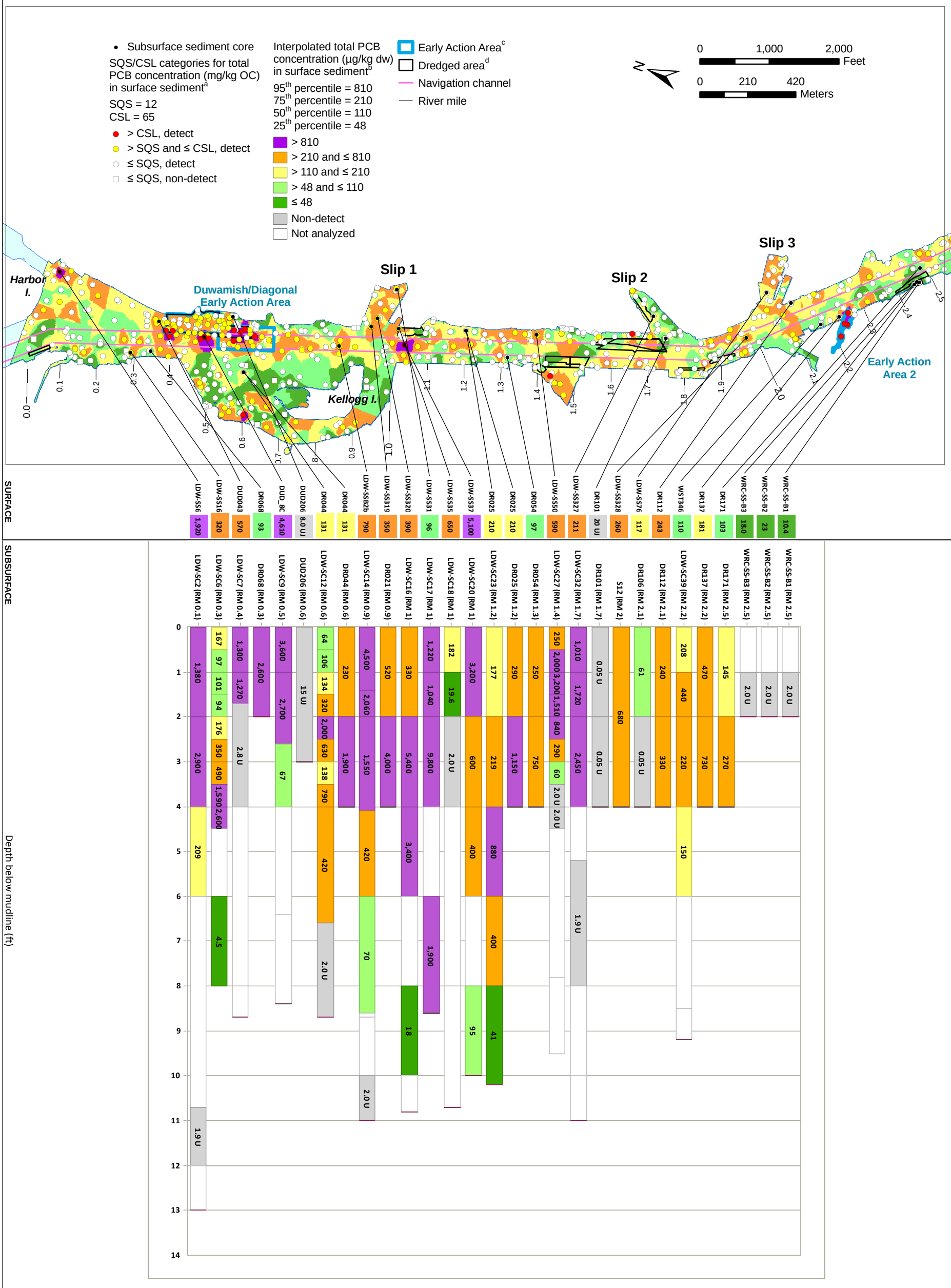
Map 4-26h. Total PCB concentrations in surface sediment and subsurface sediment cores, RM 4.0 to RM 5.0

Wind Ward environmental LLC

Prepared by CEH, 07/14/2010; MAP 3003; W:\Projects\00-08-06_Duwamish_Rt\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

Total PCB concentrations (µg/kg dw) in surface sediments, subsurface core data, and co-located (within 10 ft) surface sediment data



[a] When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations were compared instead to the LAET and 2LAET.

[b] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 810 µg/kg dw). Total PCBs represent the sum of the concentrations of all detected Aroclors. For locations with non-detects for all individual Aroclors, a value equal to the highest RL of an individual Aroclor at that location was used. Interpolated surface does not show non-detects.

[c] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

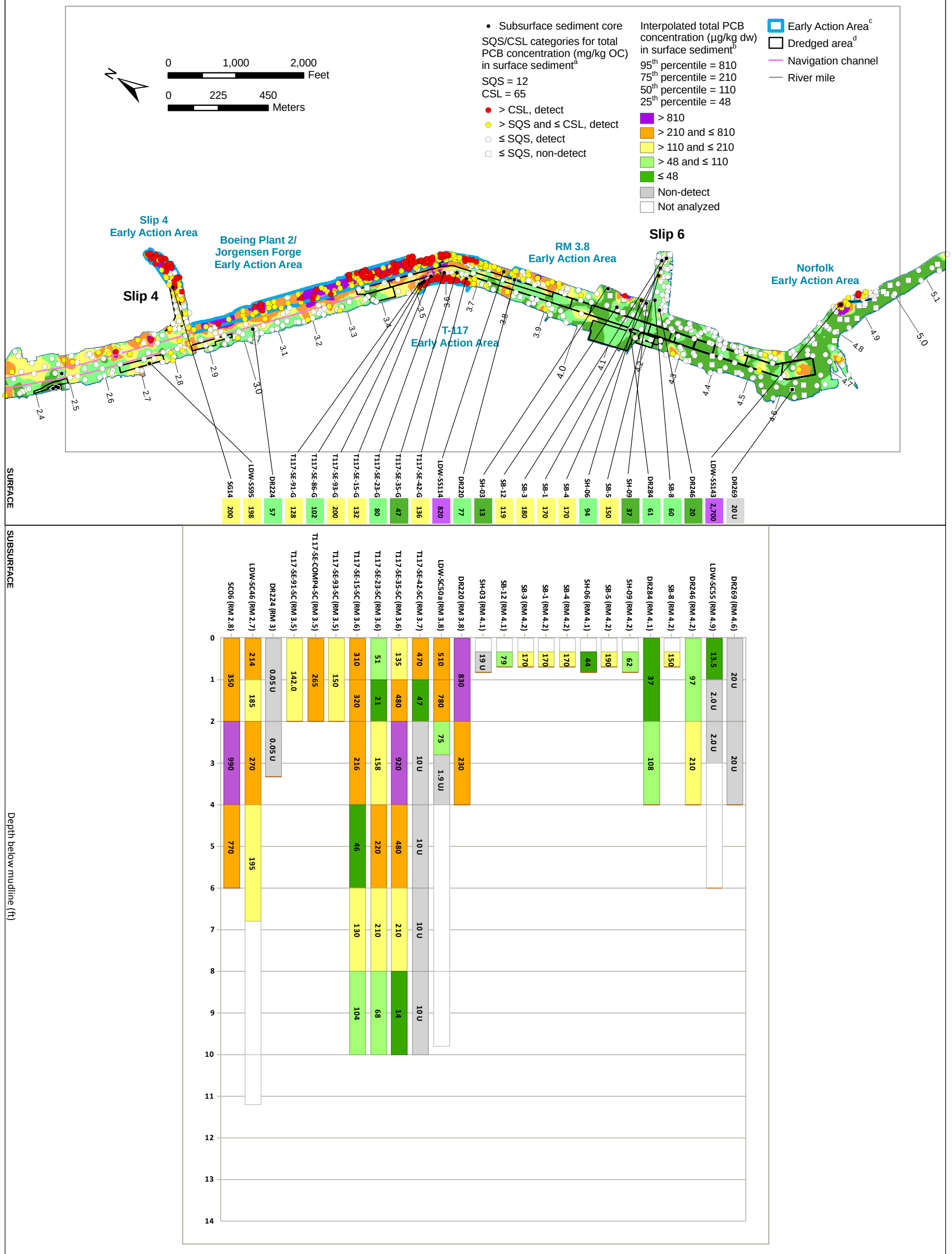
[d] For the Duwamish/Diagonal Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, and thin-layer placement in 2003 to 2005. Subsurface sediment data in dredged areas were collected prior to dredging.

Wind Ward LLC environmental

Map 4-27a. Comparison of PCB concentrations in subsurface cores to co-located surface sediment locations, RM 0.0 to RM 2.5

Prepared by CEH, 07/14/2010; MAP 3649; W:\Projects\00-08-06_Duwamish_RI\data\GIS\Phase2 RI\Nature and Extent\Subsurface\Colocation
Dredging information provided by AECOM.

Total PCB concentrations (µg/kg dw) in surface sediments, subsurface core data, and co-located (within 10 ft) surface sediment data



[a] When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations were compared instead to the LAET and 2LAET.

[b] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 810 µg/kg dw). Total PCBs represent the sum of the concentrations of all detected Aroclors. For locations with non-detects for all individual Aroclors, a value equal to the highest RL of an individual Aroclor at that location was used. Interpolated surface does not show non-detects.

[c] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[d] For the Norfolk Early Action Area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003. Subsurface sediment data in dredged areas were collected prior to dredging.

Wind Ward environmental LLC

Map 4-27b. Comparison of PCB concentrations in subsurface cores to co-located surface sediment locations, RM 2.5 to RM 5.0

Prepared by CEH, 07/14/2010; MAP 3649; W:\Projects\00-08-06_Duwamish_R\data\GIS\Phase2 RI\Nature and Extent\Subsurface\Colocation

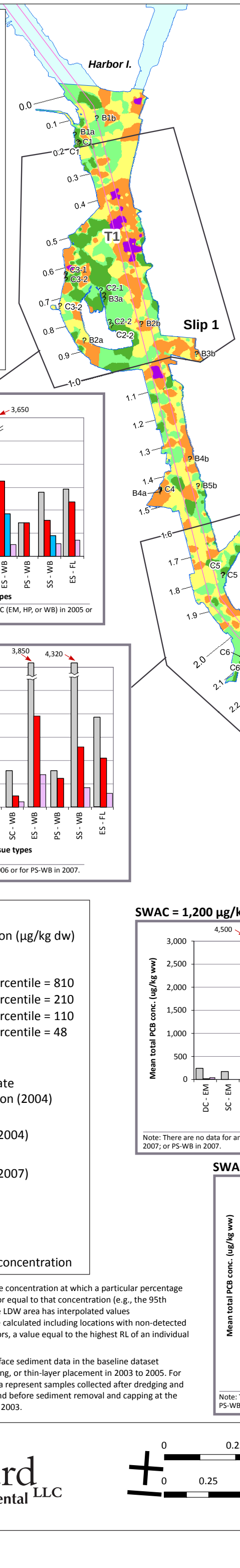
Dredging information provided by AECOM.

Graph Legend

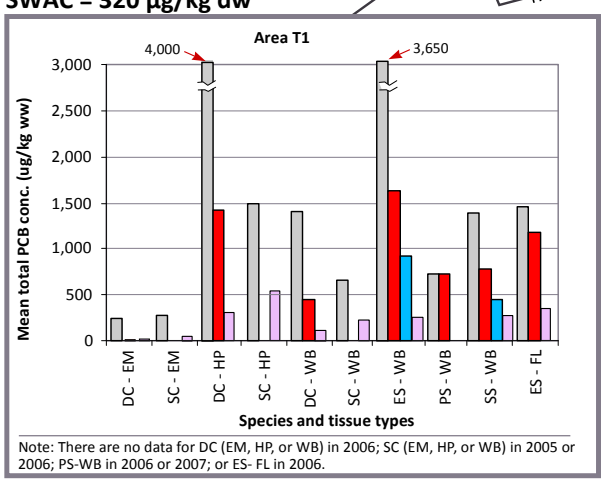
- 2004 fish or crab PCB concentration
- 2005 fish or crab PCB concentration
- 2006 fish or crab PCB concentration
- 2007 fish or crab PCB concentration
- 2004 softshell clam, benthic invertebrate, or salmon PCB concentration
- 2007 softshell clam PCB concentration
- 2004 co-located PCB concentration in sediment

Acronyms for species and tissue type

DC - Dungeness crab
SC - Slender crab
ES - English sole
PS - Pacific staghorn sculpin
SS - Shiner surfperch
EM - Edible meat
FL - Fillet with skin
HP - Hepatopancreas
WB - Whole body

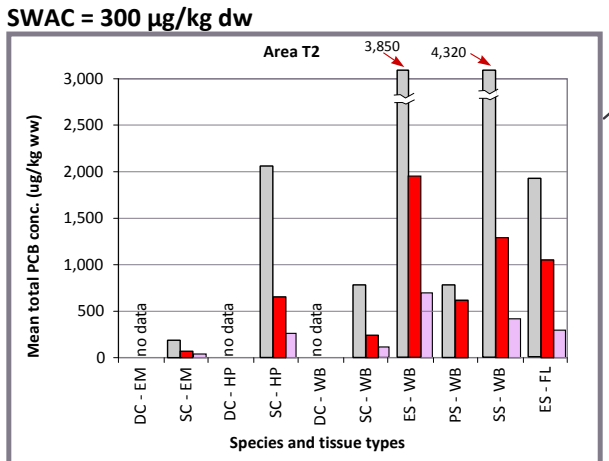


SWAC = 320 µg/kg dw



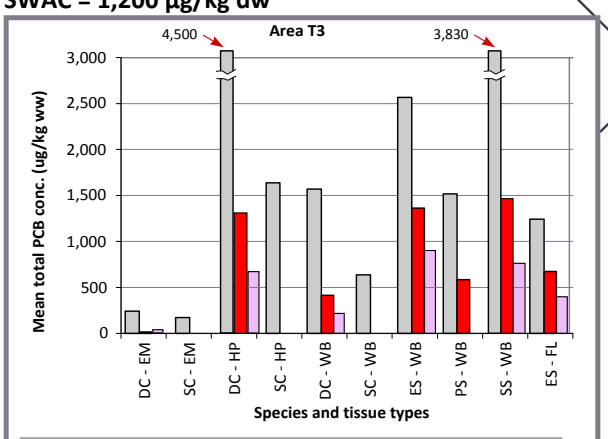
Note: There are no data for DC (EM, HP, or WB) in 2006; SC (EM, HP, or WB) in 2005 or 2006; PS-WB in 2006 or 2007; or ES- FL in 2006.

SWAC = 300 µg/kg dw



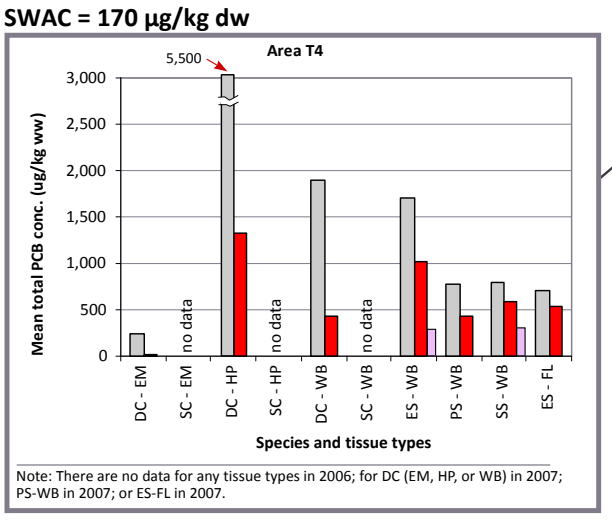
Note: There are no data for any tissue types in 2006 or for PS-WB in 2007.

SWAC = 1,200 µg/kg dw

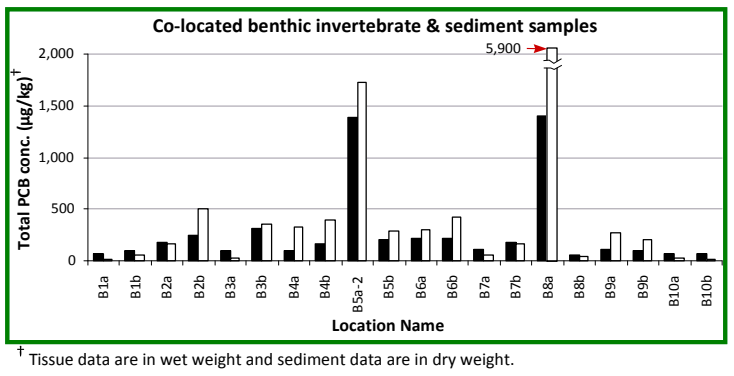


Note: There are no data for any tissue types in 2006; for SC (EM, HP, or WB) in 2005 or 2007; or PS-WB in 2007.

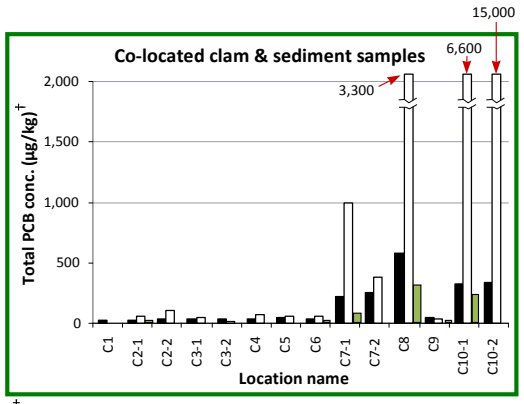
SWAC = 170 µg/kg dw



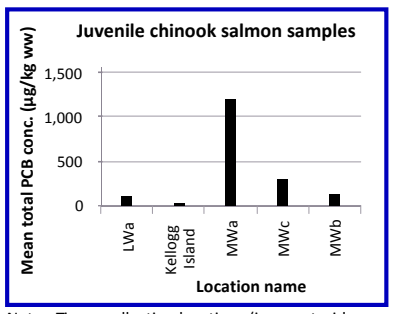
Note: There are no data for any tissue types in 2006; for DC (EM, HP, or WB) in 2007; PS-WB in 2007; or ES-FL in 2007.



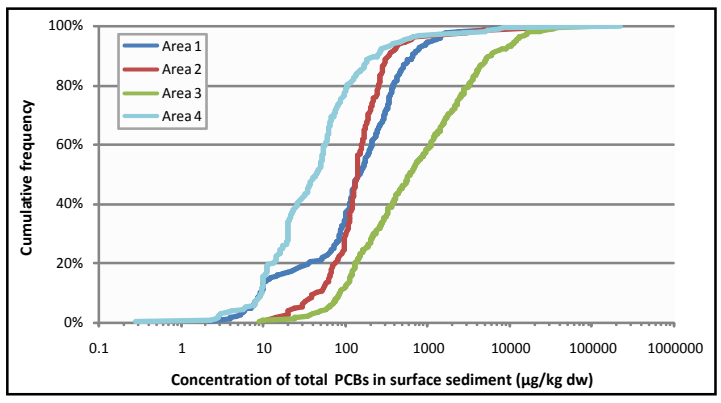
† Tissue data are in wet weight and sediment data are in dry weight.



† Tissue data are in wet weight and sediment data are in dry weight.
Note: Clams were only analyzed for total PCBs at sitx locations in 2007 (C2-1, C6, C7, C8, C9, and C10-1). Depurated clam samples were also analyzed for total PCBs in 2007 but are not shown on this figure.



Note - Tissue collection locations (i.e., centroid points of collection areas) are shown on Map 4-9 of the LDW RI.



Map Legend

Interpolated total PCB concentration (µg/kg dw) in surface sediment [a,b]

- > 810
- > 210 and ≤ 810
- > 110 and ≤ 210
- > 48 and ≤ 110
- ≤ 48

95th percentile = 810
75th percentile = 210
50th percentile = 110
25th percentile = 48

- ? Co-located benthic invertebrate and sediment sampling location (2004)
- ? Co-located softshell clam and sediment sampling location (2004)
- ? Co-located softshell clam and sediment sampling location (2007)
- Tissue sampling area
- Navigation channel
- River mile

SWAC - spatially weighted average concentration

[a] Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated values ≤ 810 µg/kg dw). Interpolated concentrations were calculated including locations with non-detected values. For locations with non-detects for all Aroclors, a value equal to the highest RL of an individual Aroclor at that location was used.

[b] For the Duwamish/Diagonal early action area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005. For the Norfolk early action area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

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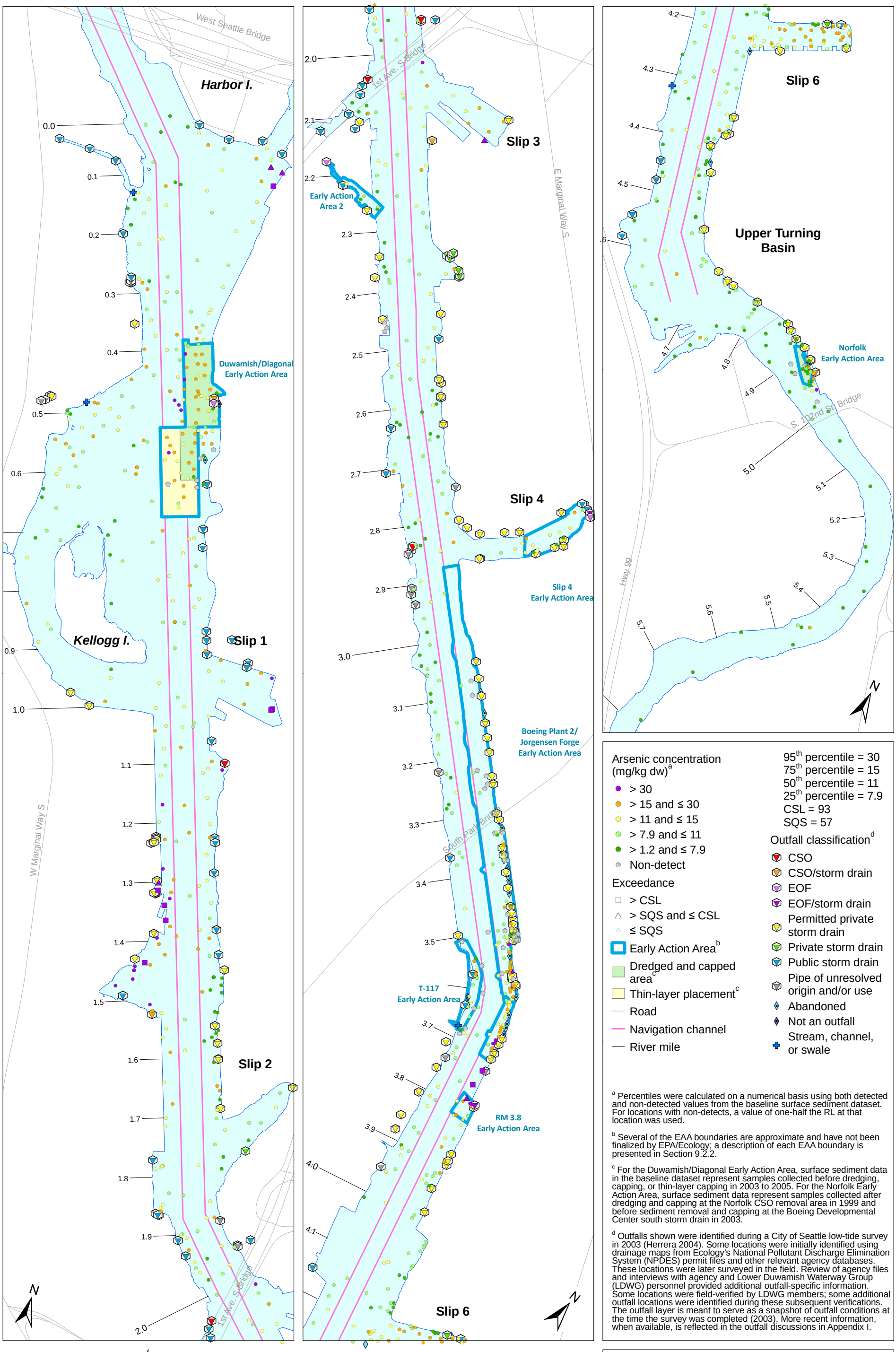
0 0.25 0.5 Miles
0 0.25 0.5 Kilometers

Map 4-28. Total PCB concentrations in composite tissue samples from 2004, 2005, 2006, and 2007 and the IDW interpolation of total PCB concentrations in surface sediment

Modified by Zachariah from GIS Map 2742 | June 30, 2009 | Map 4-28 PCB IDW (2742).xar



Arsenic concentration (mg/kg dw)[a]

- > 30
- > 15 and ≤ 30
- > 11 and ≤ 15
- > 7.9 and ≤ 11
- > 1.2 and ≤ 7.9
- Non-detect

Exceedance

- □ > CSL
- △ > SQS and ≤ CSL
- ○ ≤ SQS
- Early Action Area[b]
- Dredged and capped area[c]
- Thin-layer placement[c]
- Road
- Navigation channel
- River mile

95th percentile = 30
75th percentile = 15
50th percentile = 11
25th percentile = 7.9
CSL = 93
SQS = 57

Outfall classification[d]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, a value of one-half the RL at that location was used.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] For the Duwamish/Diagonal Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer capping in 2003 to 2005. For the Norfolk Early Action Area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

Map 4-29. Arsenic concentrations in surface sediment

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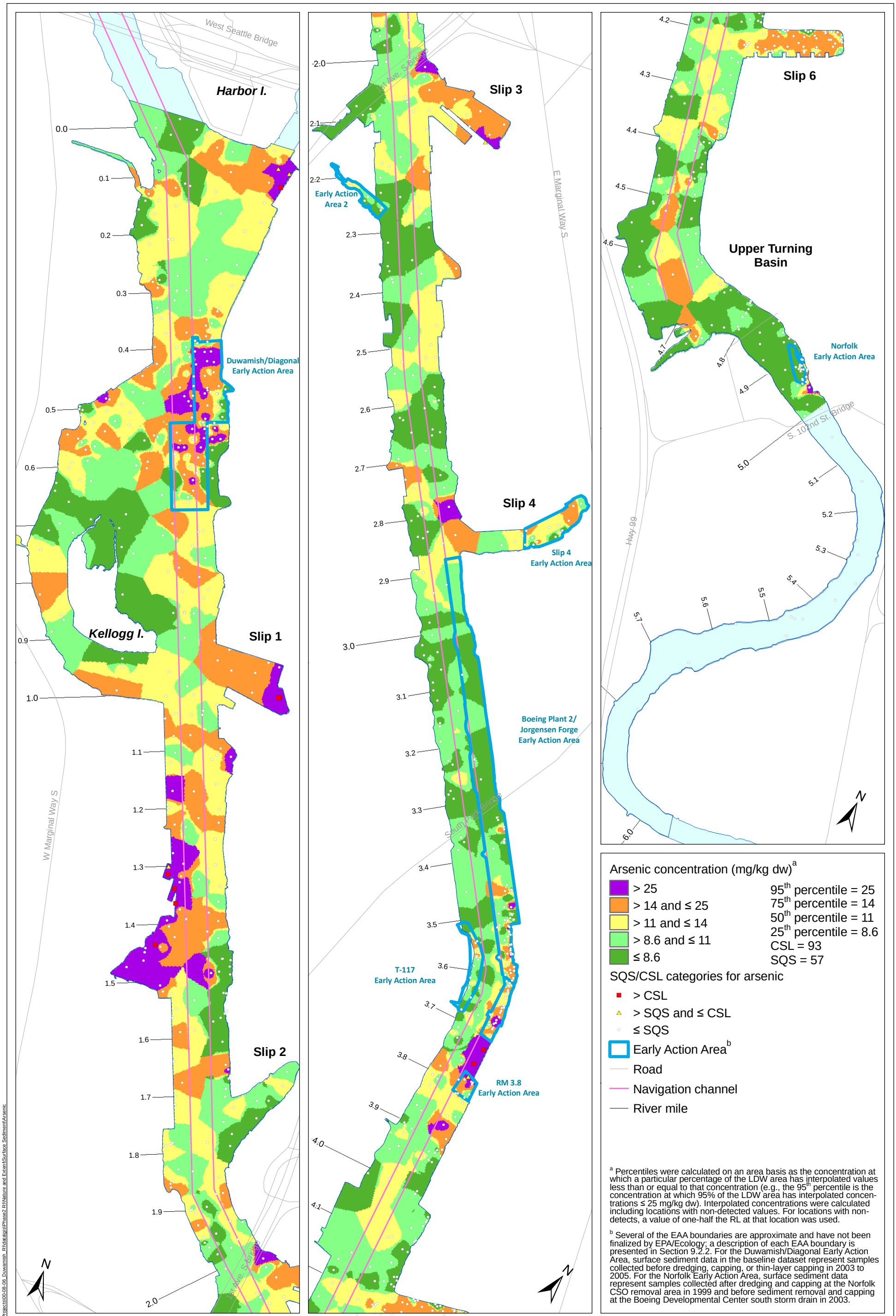
Prepared by:CEH, 07/15/2010; MAP 2747.W:\Projects\00-08-06_Duwamish_Rt\data\gis\Phase2 Rt\Nature and Extent\Surface Sediment\Arsenic



Arsenic concentration (mg/kg dw)[a]

- > 25
- > 14 and ≤ 25
- > 11 and ≤ 14
- > 8.6 and ≤ 11
- ≤ 8.6

95th percentile = 25
75th percentile = 14
50th percentile = 11
25th percentile = 8.6
CSL = 93
SQS = 57

SQS/CSL categories for arsenic

- > CSL
- > SQS and ≤ CSL
- ≤ SQS

- Early Action Area[b]
- Road
- Navigation channel
- River mile

[a] Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 25 mg/kg dw). Interpolated concentrations were calculated including locations with non-detected values. For locations with non-detects, a value of one-half the RL at that location was used.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2. For the Duwamish/Diagonal Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer capping in 2003 to 2005. For the Norfolk Early Action Area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

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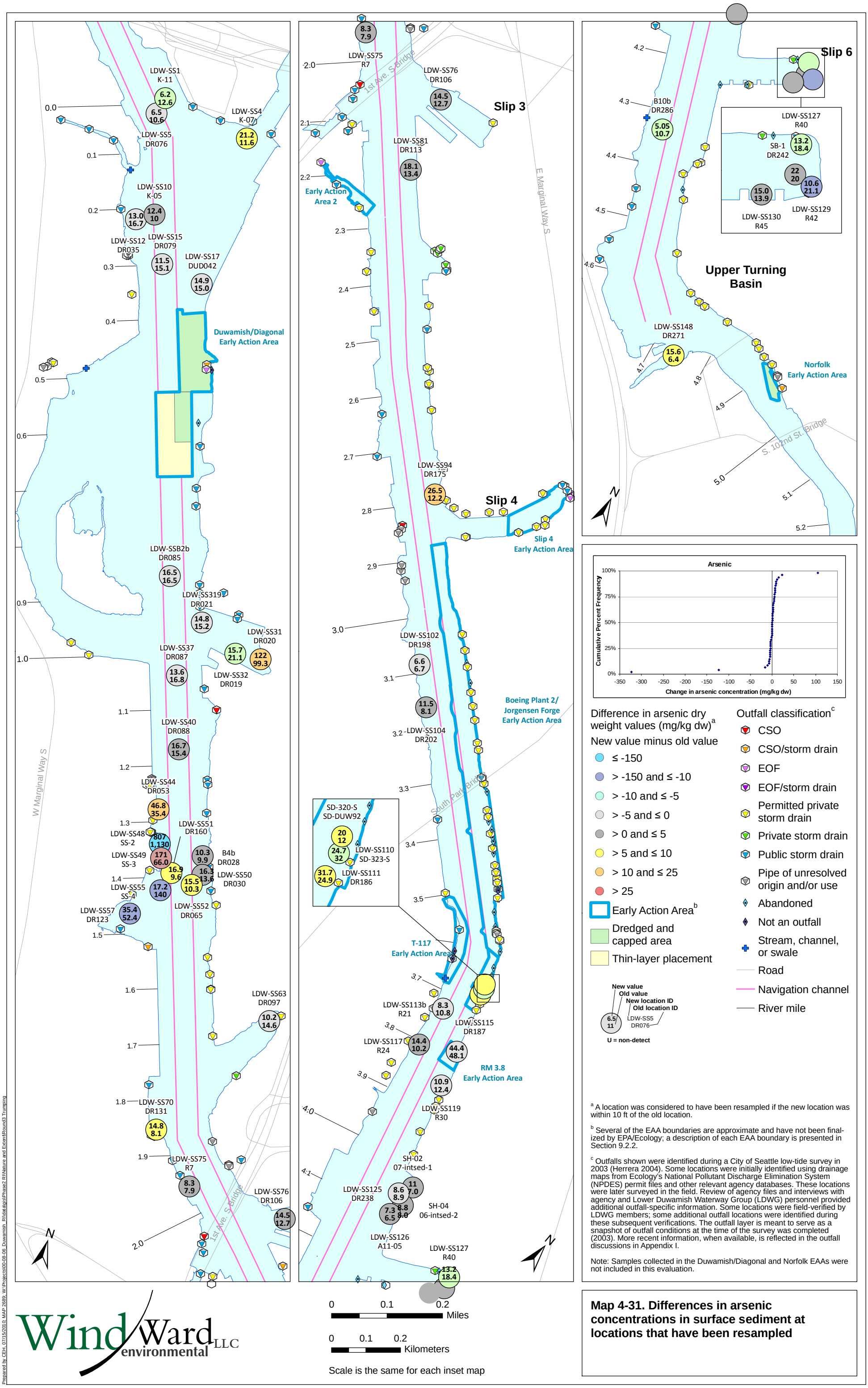
0 0.1 0.2 Miles

0 0.1 0.2 Kilometers

Scale is the same for each inset map

Map 4-30. IDW interpolation of arsenic concentrations in surface sediment

Prepared by CEH, 07/15/2010, MAP 2708; W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\Arsenic



Difference in arsenic dry weight values (mg/kg dw)[a]

New value minus old value

- ≤ -150
- > -150 and ≤ -10
- > -10 and ≤ -5
- > -5 and ≤ 0
- > 0 and ≤ 5
- > 5 and ≤ 10
- > 10 and ≤ 25
- > 25
- Early Action Area[b]
- Dredged and capped area
- Thin-layer placement

New value
Old value
New location ID
Old location ID
6.5 / 11 — LDW-SS5 DR076
U = non-detect

Outfall classification[c]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale
- Road
- Navigation channel
- River mile

[a] A location was considered to have been resampled if the new location was within 10 ft of the old location.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time of the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

Note: Samples collected in the Duwamish/Diagonal and Norfolk EAAs were not included in this evaluation.

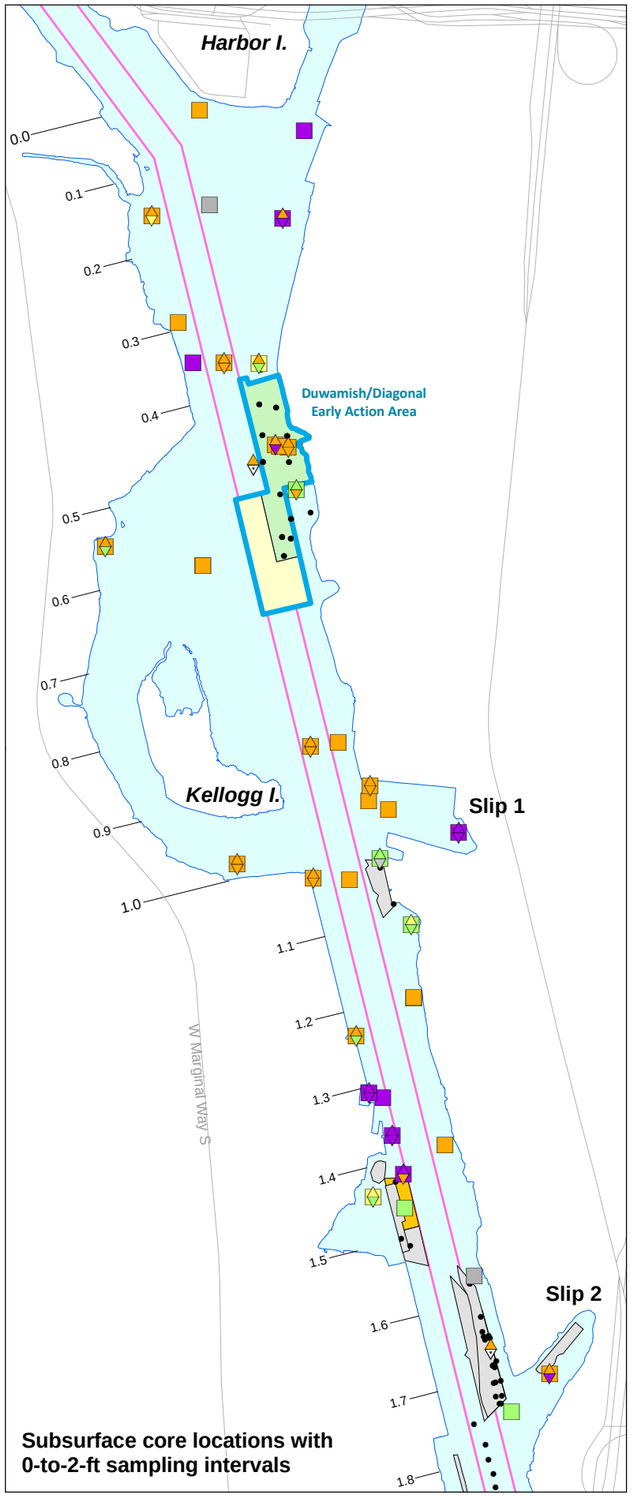
0 0.1 0.2 Miles

0 0.1 0.2 Kilometers

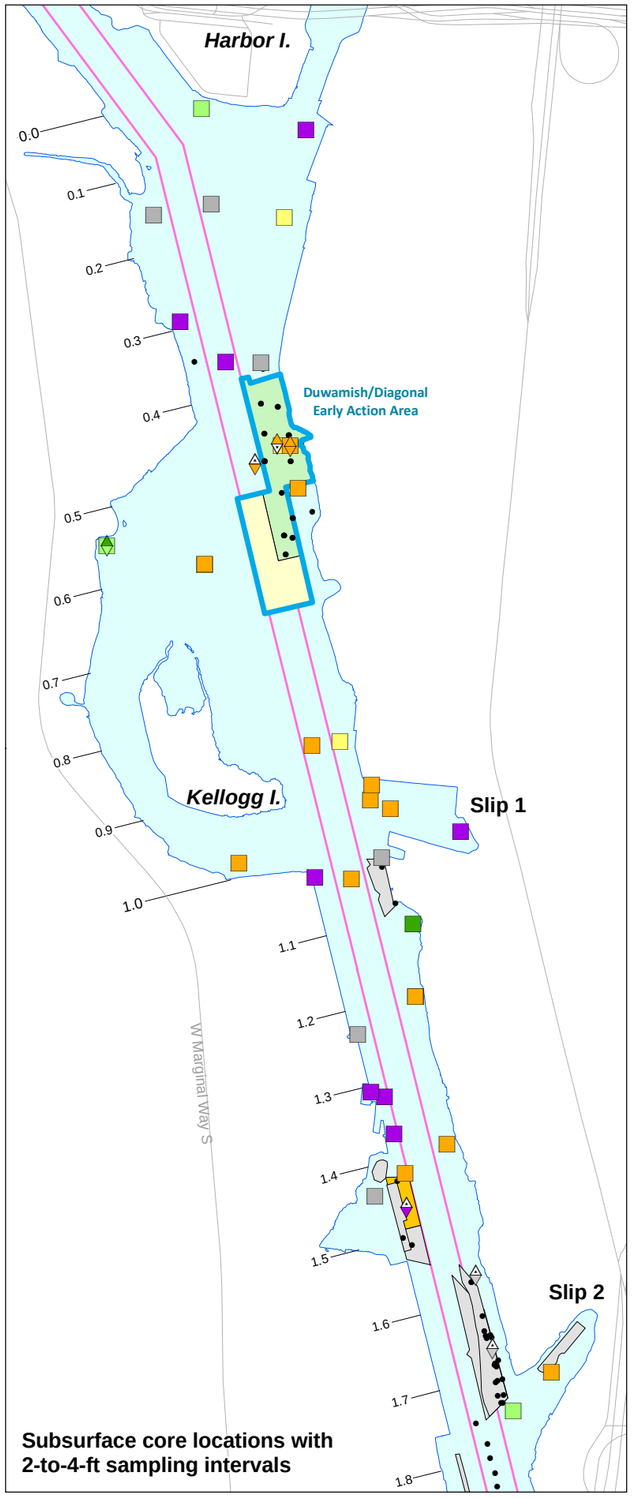
Scale is the same for each inset map

Map 4-31. Differences in arsenic concentrations in surface sediment at locations that have been resampled

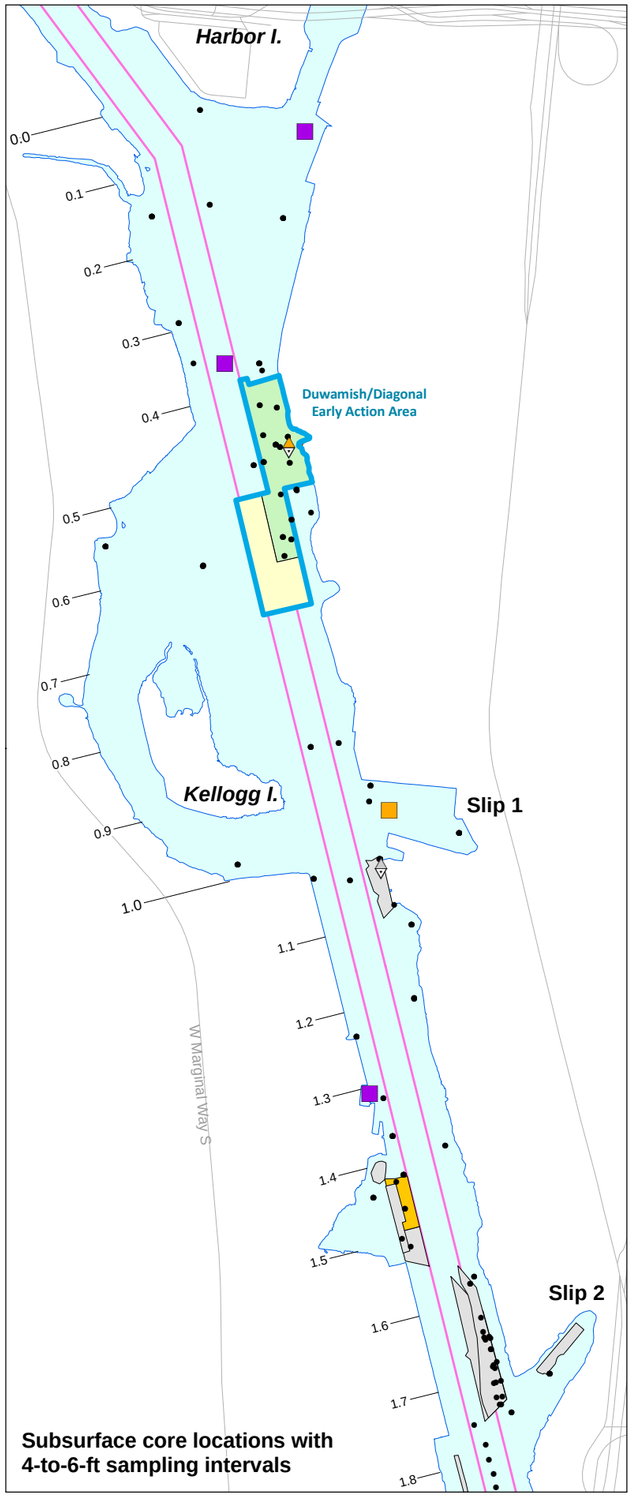
Prepared by CEH, 07/15/2010; MAP 2689; W:\Projects\00-08-06_Duwamish_RI\fate&gis\Phase2 RI\Nature and Extent\Round3 Trumping



Subsurface core locations with 0-to-2-ft sampling intervals



Subsurface core locations with 2-to-4-ft sampling intervals



Subsurface core locations with 4-to-6-ft sampling intervals

Arsenic concentration (mg/kg dw)[a]

- > 30
- > 15 and ≤ 30
- > 11 and ≤ 15
- > 7.9 and ≤ 11
- ≤ 7.9
- Non-detect

95th percentile = 30
75th percentile = 15
50th percentile = 11
25th percentile = 7.9

Sampling interval

	Left panel	Middle panel	Right panel
□	0-to-2-ft[b]	2-to-4-ft[b]	4-to-6-ft[b]
◇	0-to-1-ft[c]	2-to-3-ft[c]	4-to-5-ft[c]
◇	1-to-2-ft[c]	3-to-4-ft[c]	5-to-6-ft[c]

△ Not analyzed in that sampling interval

• Other subsurface sampling location analyzed for arsenic, but not in the illustrated sampling interval

- Early Action Area[d]
- Dredged area[e]
- Dredged and capped area[e]
- Dredged and thin-layer placement[e]
- Thin-layer placement
- Road
- Navigation channel
- River mile

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, a value of one-half the RL at that location was used.

[b] Data from 2-foot sampling intervals; some locations show an average of data from both 1-foot intervals within that 2-foot interval at a given location.

[c] Data from 1-foot sampling intervals are shown if available. If both 1-foot intervals within the 2-foot interval were collected, the average of the two intervals is also shown.

[d] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[e] Subsurface sediment data at locations in dredged areas were collected prior to dredging.

N

0 0.1 0.2 Kilometers

0 0.1 0.2 Miles

Scale is the same for each map frame

Map 4-32a. Arsenic concentrations in subsurface sediment within the 0-to-2-ft, 2-to-4-ft, and 4-to-6-ft sampling intervals, RM 0.0 to RM 1.8

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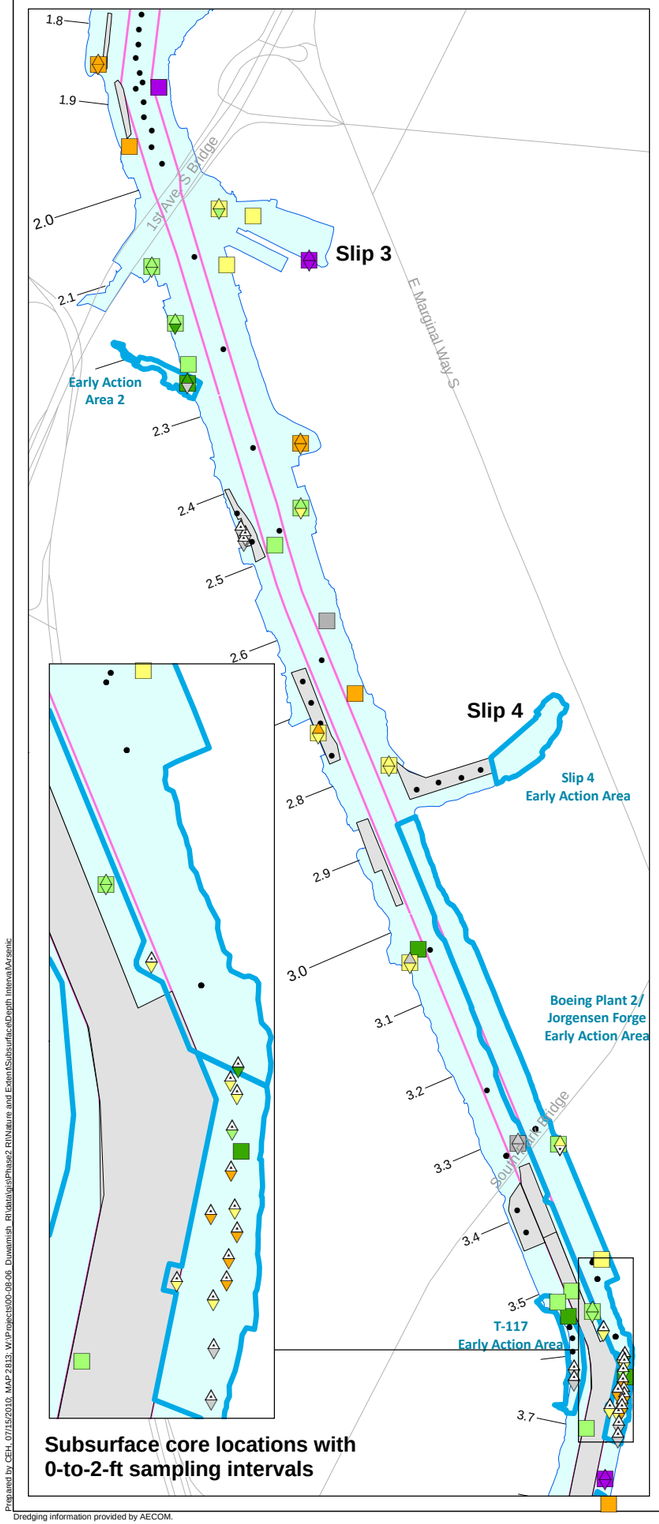
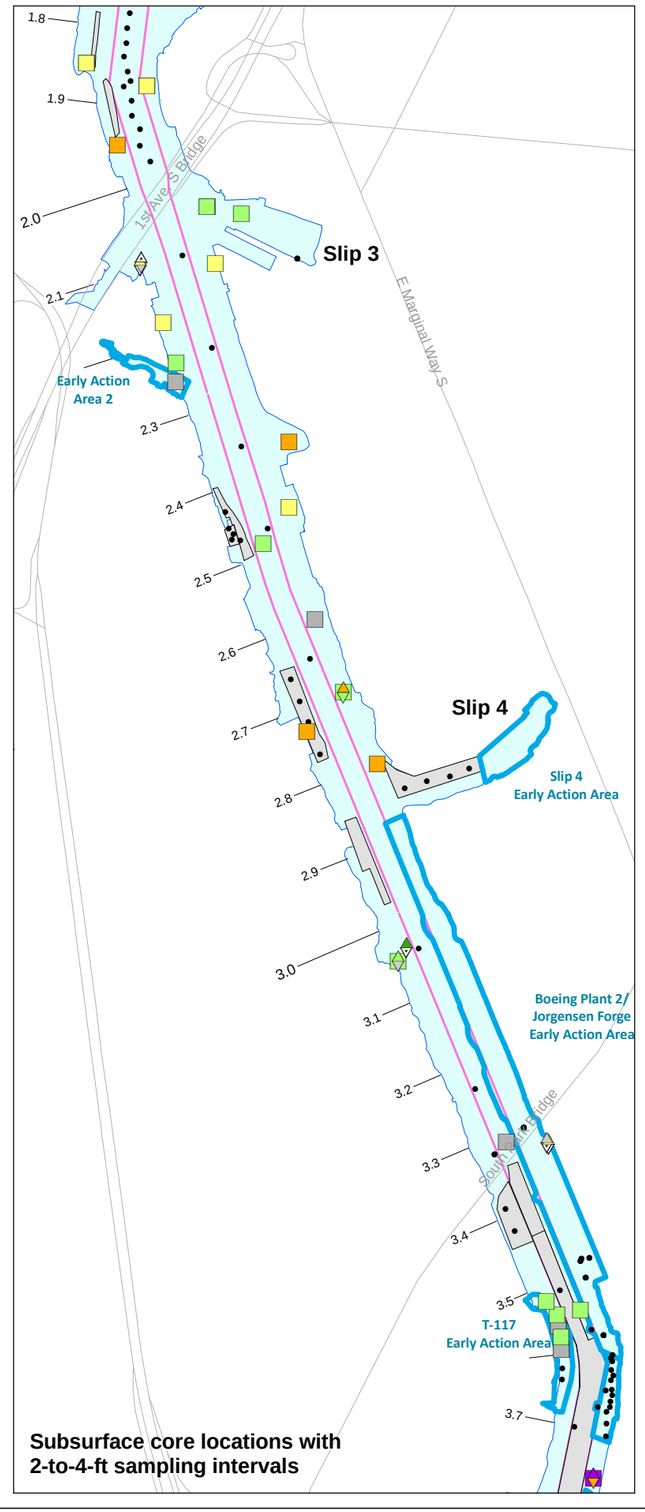
Prepared by CEH, 07/15/2010, MAP 2813, W:\Projects\00-08-06_Duwamish_R\Data\gis\Phase2 RI\Nature and Extent\Subsurface\Depth Interval\Arsenic

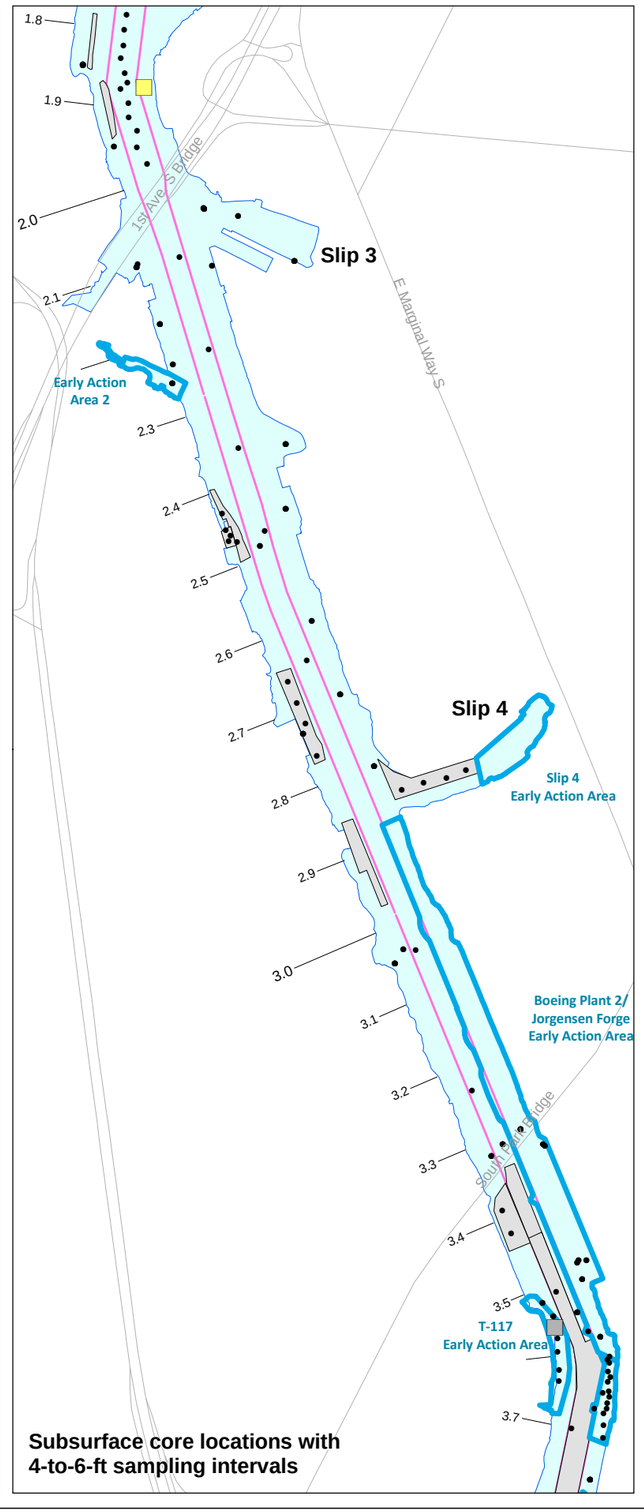
Dredging information provided by AECOM.



Subsurface core locations with 0-to-2-ft sampling intervals



Subsurface core locations with 2-to-4-ft sampling intervals



Subsurface core locations with 4-to-6-ft sampling intervals

Arsenic concentration (mg/kg dw)[a]

- > 30
- > 15 and ≤ 30
- > 11 and ≤ 15
- > 7.9 and ≤ 11
- ≤ 7.9
- Non-detect

95th percentile = 30
75th percentile = 15
50th percentile = 11
25th percentile = 7.9

Sampling interval

	Left panel	Middle panel	Right panel
□	0-to-2-ft[b]	2-to-4-ft[b]	4-to-6-ft[b]
◇	0-to-1-ft[c]	2-to-3-ft[c]	4-to-5-ft[c]
	1-to-2-ft[c]	3-to-4-ft[c]	5-to-6-ft[c]

△ Not analyzed in that sampling interval

• Other subsurface sampling location analyzed for arsenic, but not in the illustrated sampling interval

Early Action Area[d]

Dredged area[e]

Road

Navigation channel

River mile

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, a value of one-half the RL at that location was used.

[b] Data from 2-foot sampling intervals; some locations show an average of data from both 1-foot intervals within that 2-foot interval at a given location.

[c] Data from 1-foot sampling intervals are shown if available. If both 1-foot intervals within the 2-foot interval were collected, the average of the two intervals is also shown.

[d] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[e] Subsurface sediment data at locations in dredged areas were collected prior to dredging.

0 0.1 0.2 Kilometers

0 0.1 0.2 Miles

Scale is the same for each map frame

Map 4-32b. Arsenic concentrations in subsurface sediment within the 0-to-2-ft, 2-to-4-ft, and 4-to-6-ft sampling intervals, RM 1.8 to RM 3.7

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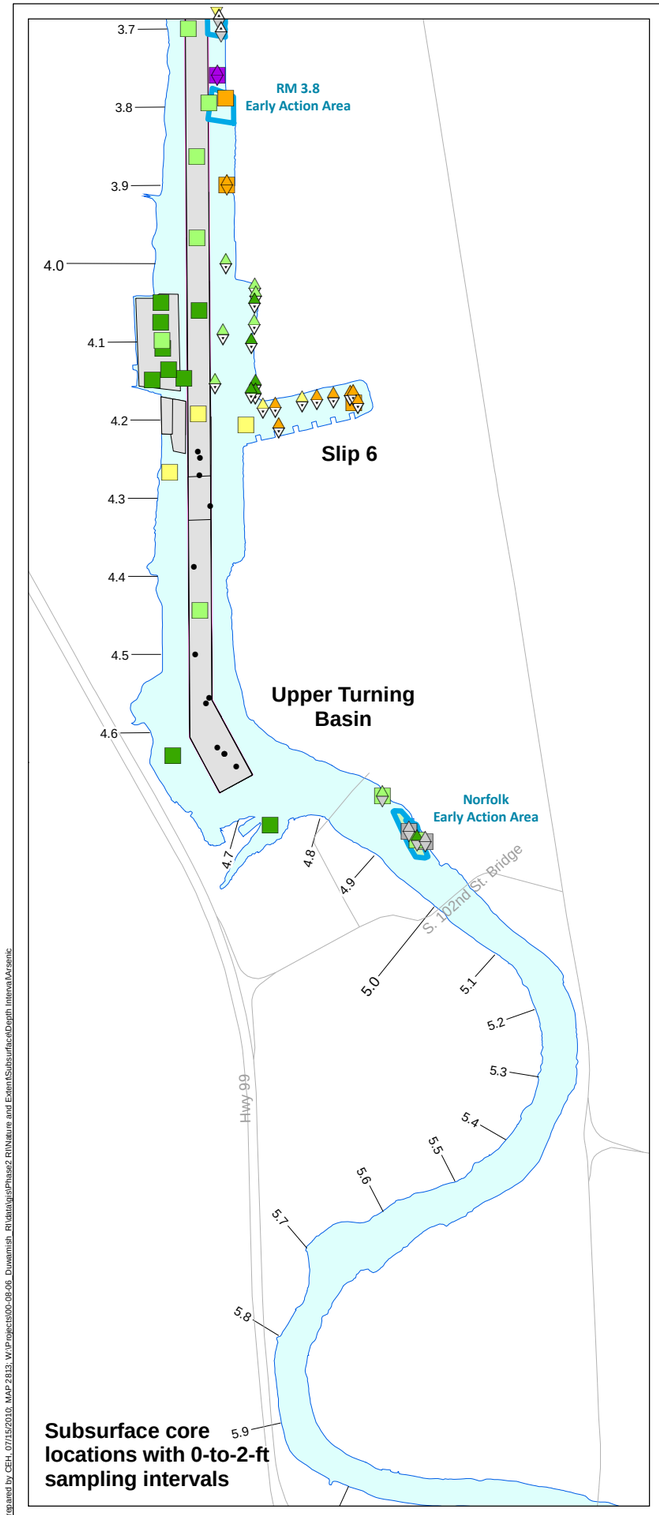
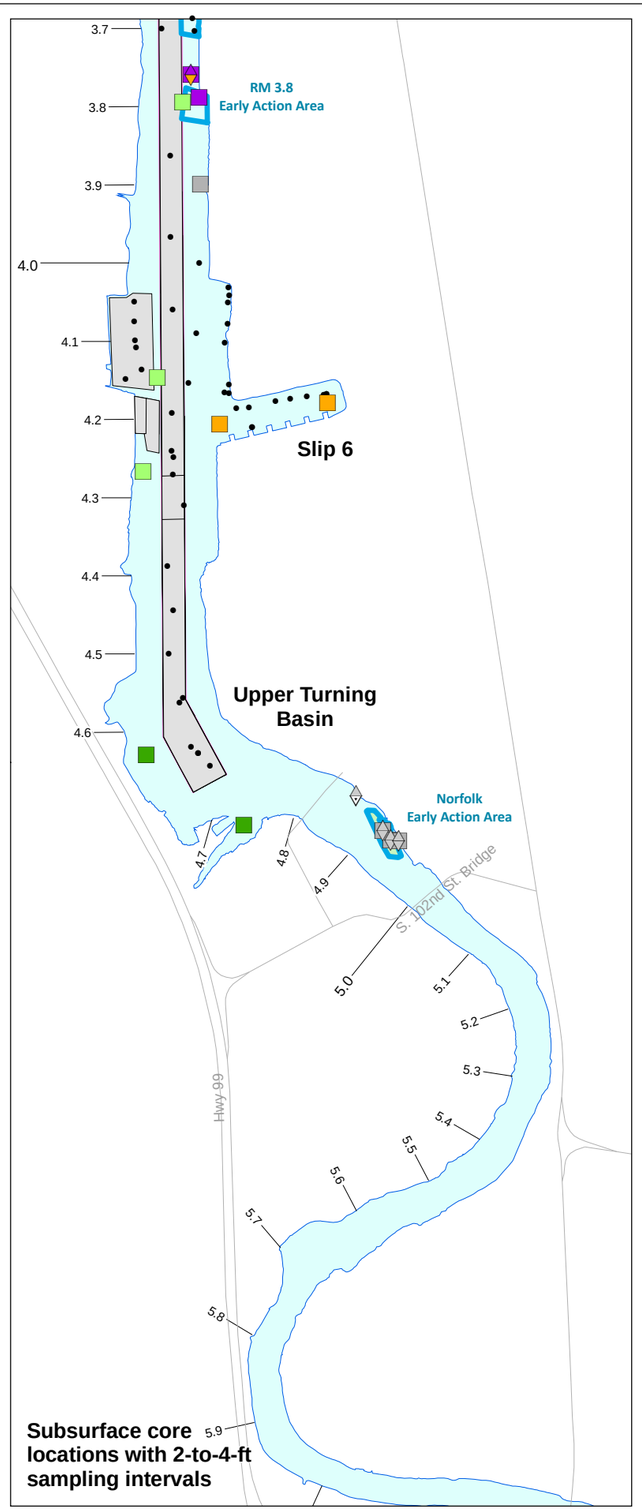
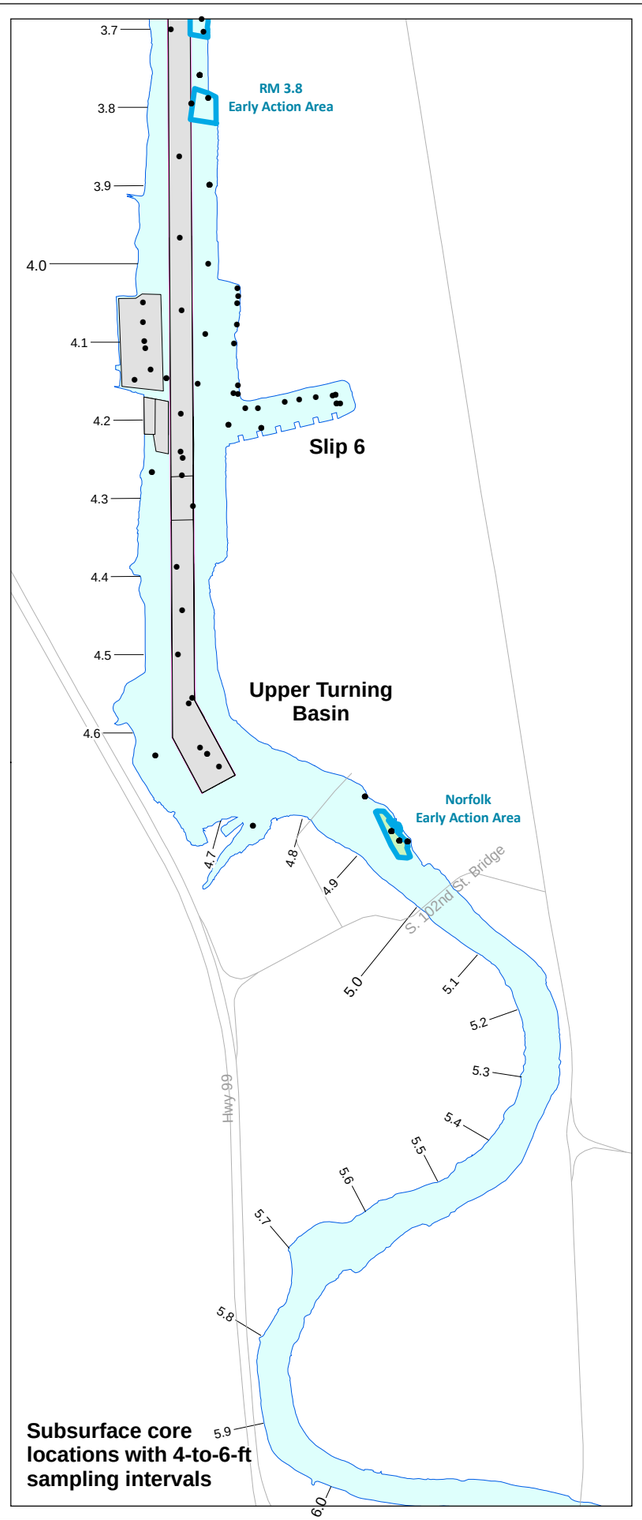
Prepared by: CEH, 07/15/2010, MAP 2813, W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Subsurface\Depth Interval\Arsenic

Dredging information provided by AECOM.







Arsenic concentration (mg/kg dw)[a]

- > 30 — 95th percentile = 30
- > 15 and ≤ 30 — 75th percentile = 15
- > 11 and ≤ 15 — 50th percentile = 11
- > 7.9 and ≤ 11 — 25th percentile = 7.9
- ≤ 7.9
- Non-detect

Sampling interval

	Left panel	Middle panel	Right panel
□	0-to-2-ft[b]	2-to-4-ft[b]	4-to-6-ft[b]
◇	0-to-1-ft[c]	2-to-3-ft[c]	4-to-5-ft[c]
◇	1-to-2-ft[c]	3-to-4-ft[c]	5-to-6-ft[c]

△ Not analyzed in that sampling interval

• Other subsurface sampling location analyzed for arsenic, but not in the illustrated sampling interval

Early Action Area[d]

Dredged area[e]

Dredged and capped area[e]

Road

Navigation channel

River mile

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, a value of one-half the RL at that location was used.

[b] Data from 2-foot sampling intervals; some locations show an average of data from both 1-foot intervals within that 2-foot interval at a given location.

[c] Data from 1-foot sampling intervals are shown if available. If both 1-foot intervals within the 2-foot interval were collected, the average of the two intervals is also shown.

[d] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[e] Subsurface sediment data at locations in dredged areas were collected prior to dredging.

N

0 0.1 0.2 Kilometers

0 0.1 0.2 Miles

Scale is the same for each map frame

Map 4-32c. Arsenic concentrations in subsurface sediment within the 0-to-2-ft, 2-to-4-ft, and 4-to-6-ft sampling intervals, RM 3.7 to RM 6.0

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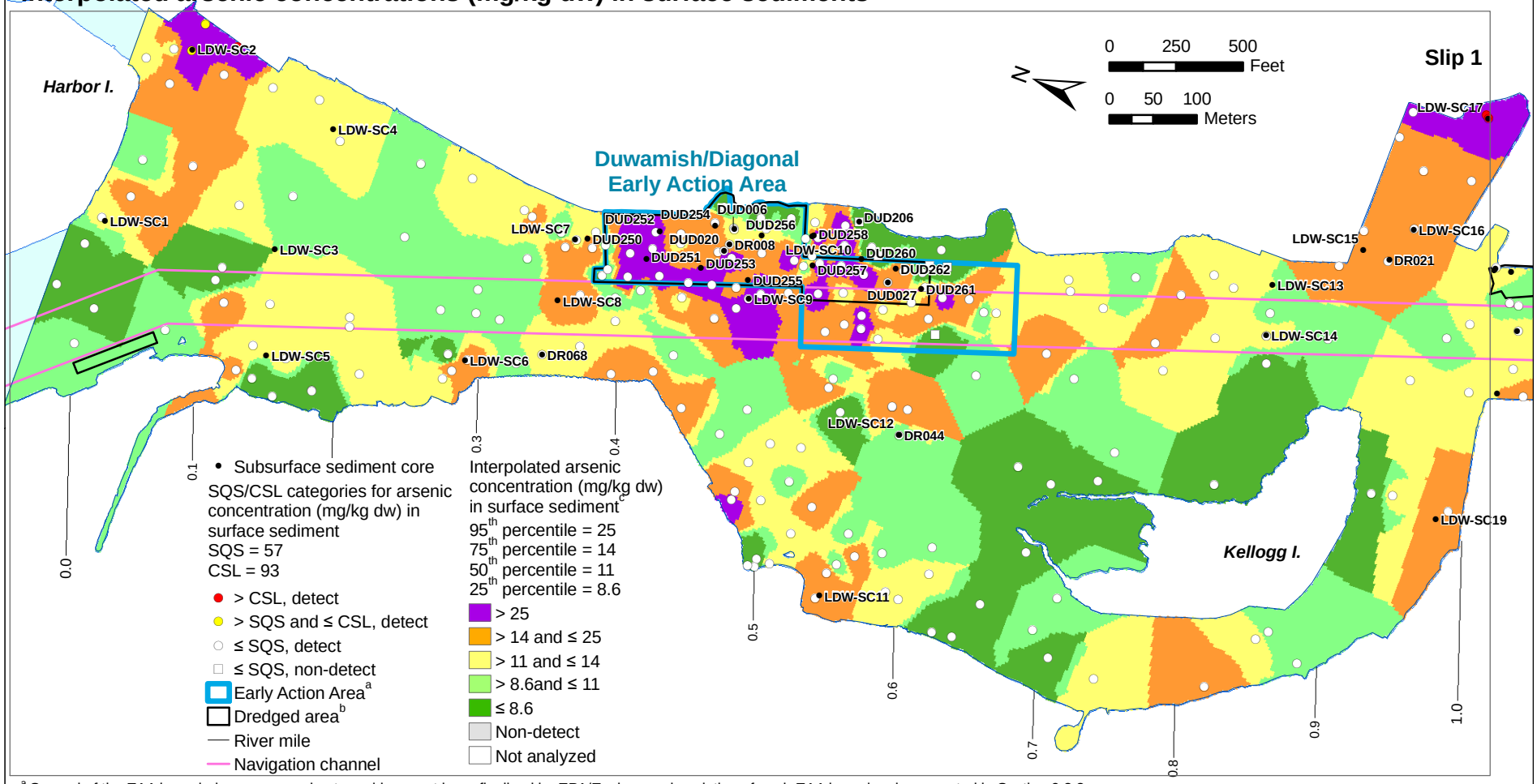
Prepared by: CEH, 07/15/2010, MAP 2813, W:\Projects\00-08-06_Duwamish_R\Data\gis\Phase2 R\Nature and Extent\Subsurface\Depth Interval\Arsenic

Dredging information provided by AECOM.

Interpolated arsenic concentrations (mg/kg dw) in surface sediments



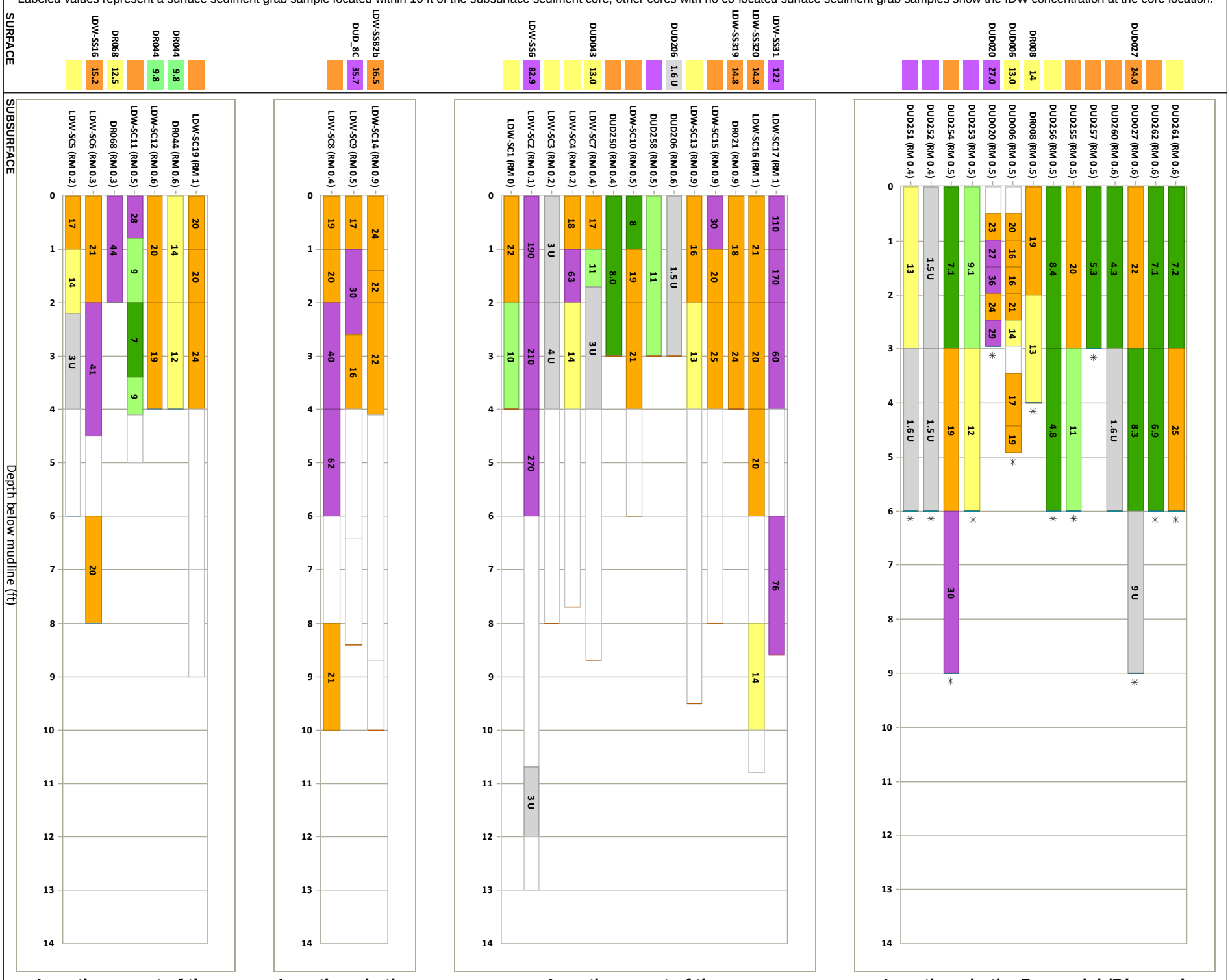
[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[b] For the Duwamish/Diagonal Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, and thin-layer placement in 2003 to 2005. Subsurface sediment data in dredged areas were collected prior to dredging.

[c] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 25 mg/kg dw). Interpolated concentrations were calculated including locations with non-detected values. For locations with non-detects, a value of one-half the RL at that location was used. Interpolated surface does not show non-detects.

Arsenic concentrations (mg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the IDW concentration at the core location.



Locations west of the navigation channel

Locations in the navigation channel

Locations east of the navigation channel

Locations in the Duwamish/Diagonal Early Action Area

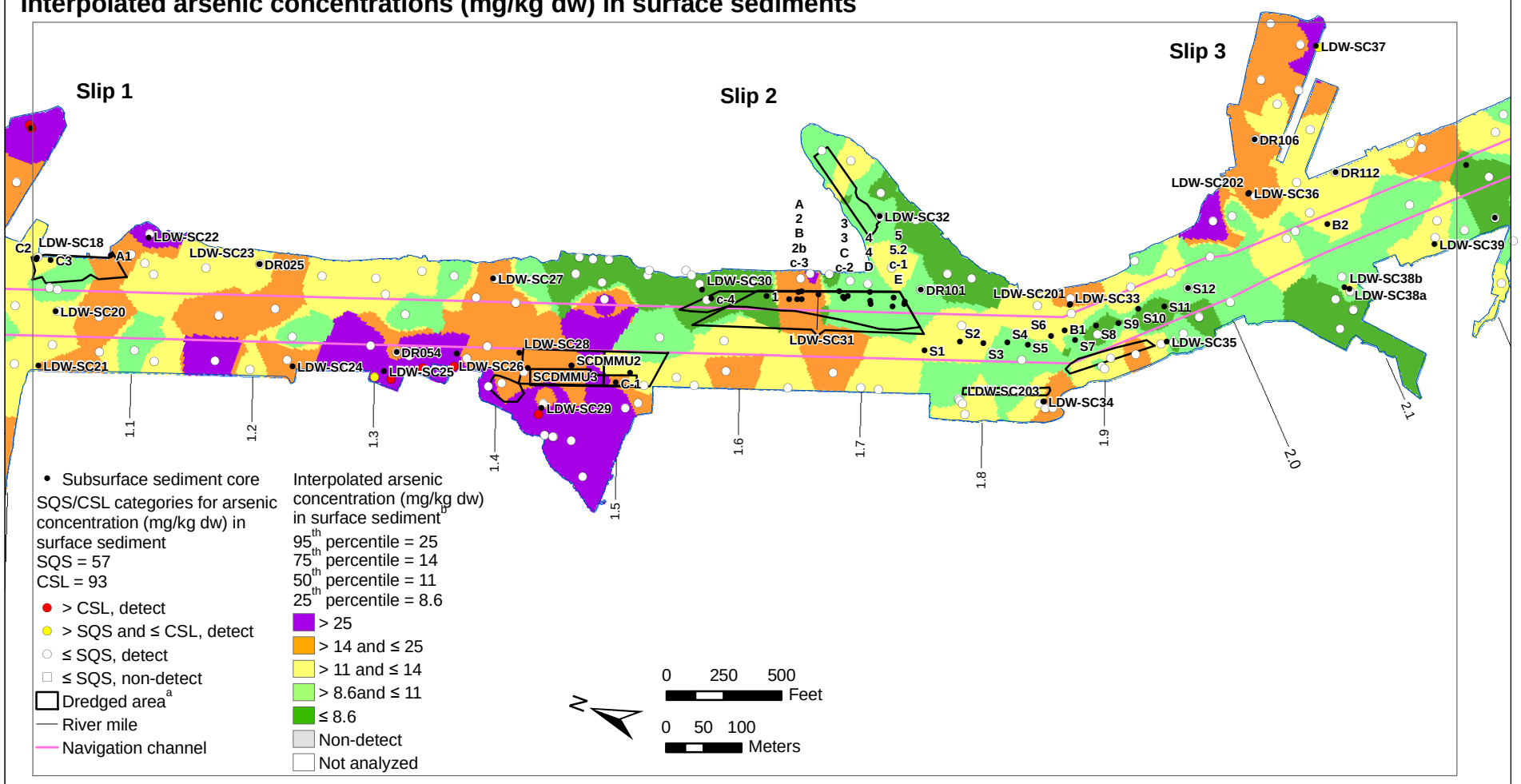
✳ This core was collected prior to dredging at that location.

Map 4-33a. Arsenic concentrations in surface sediment and subsurface sediment cores, RM 0.0 to RM 1.0

Prepared by CEH, 07/15/2010. MAP 2988. W:\Projects\00-08-06 Duwamish Rl\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

Interpolated arsenic concentrations (mg/kg dw) in surface sediments

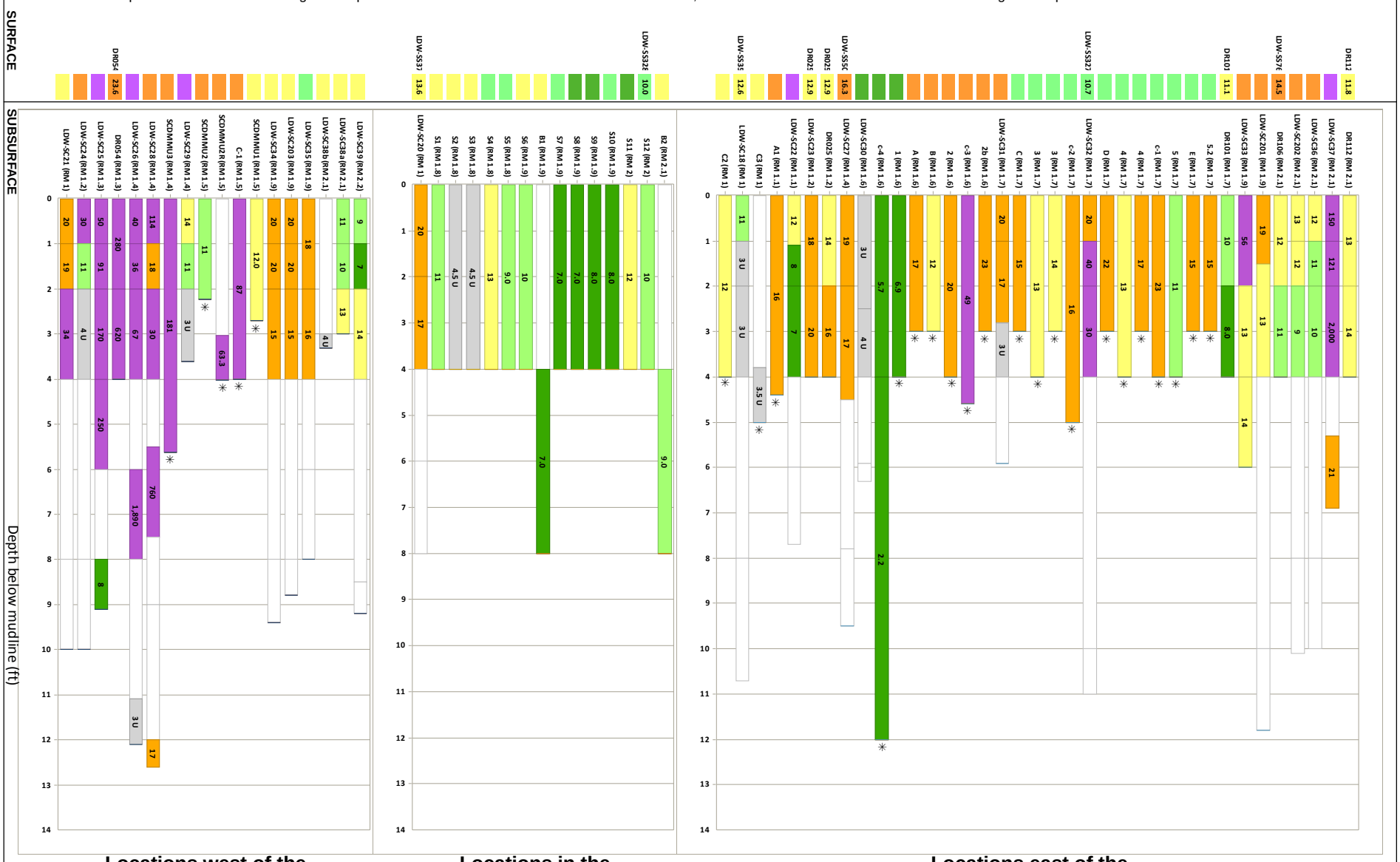


[a] Subsurface sediment data at locations in dredged areas were collected prior to dredging; surface sediment data were collected after dredging.

[b] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 25 mg/kg dw). Interpolated concentrations were calculated including locations with non-detected values. For locations with non-detects, a value of one-half the RL at that location was used. Interpolated surface does not show non-detects.

Arsenic concentrations (mg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the IDW concentration at the core location.



✳ This core was collected prior to dredging at that location.

Map 4-33b. Arsenic concentrations in surface sediment and subsurface sediment cores, RM 1.0 to RM 2.2

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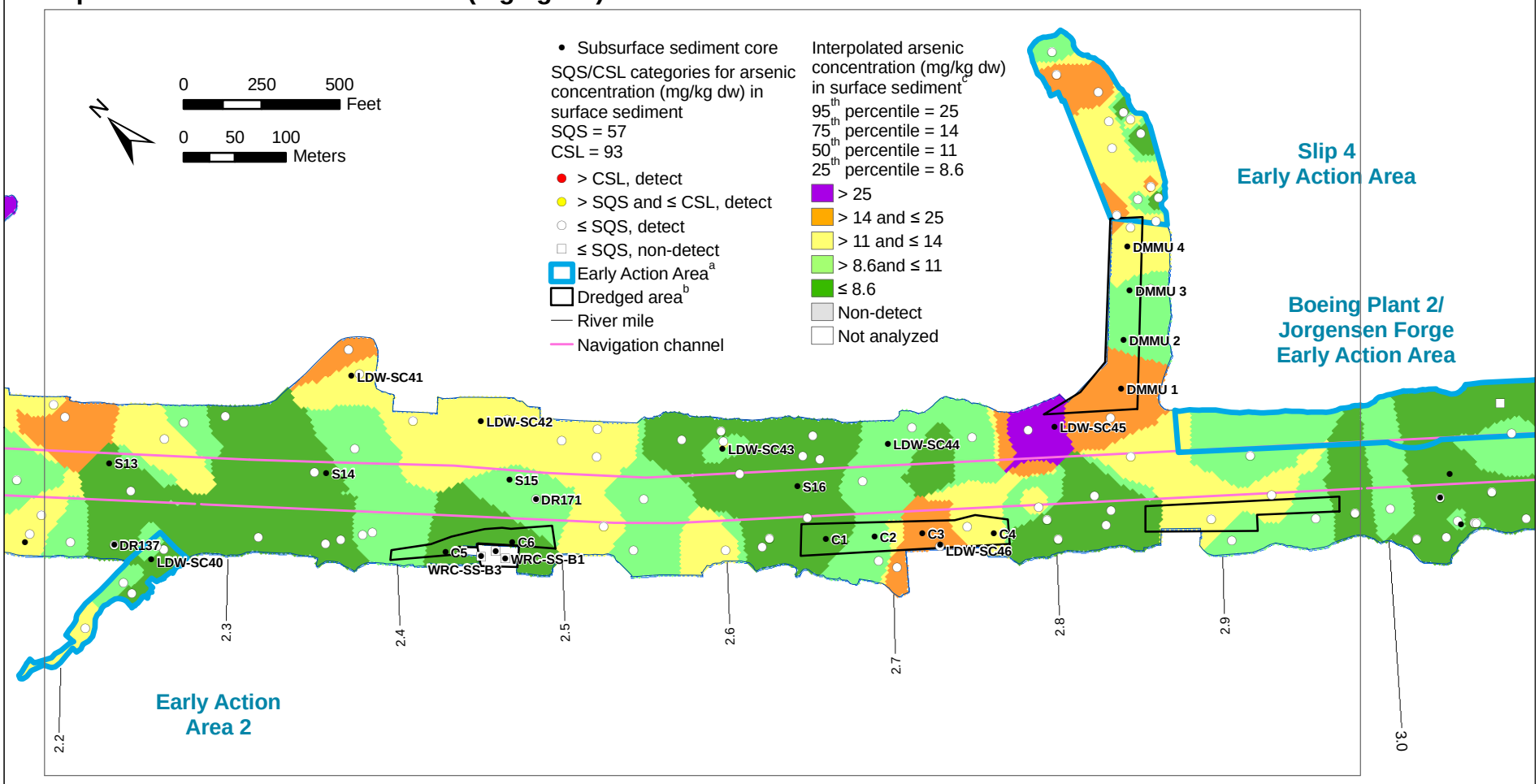
Prepared by:CEH, 07/15/2010; MAP 2988; W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

Interpolated arsenic concentrations (mg/kg dw) in surface sediments



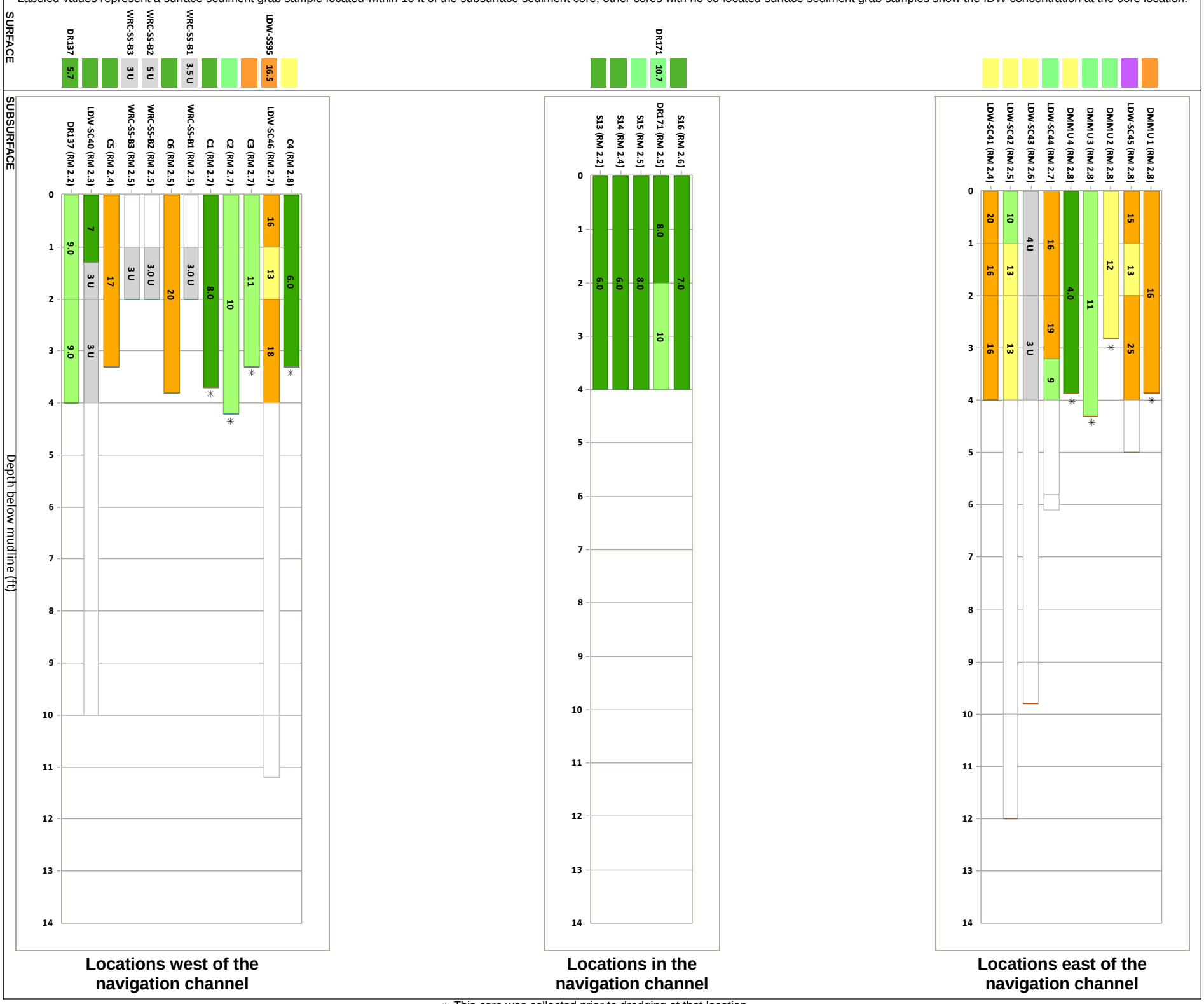
[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[b] Subsurface sediment data at locations in dredged areas were collected prior to dredging; surface sediment data were collected after dredging.

[c] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 25 mg/kg dw). Interpolated concentrations were calculated including locations with non-detected values. For locations with non-detects, a value of one-half the RL at that location was used. Interpolated surface does not show non-detects.

Arsenic concentrations (mg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the IDW concentration at the core location.



Locations west of the navigation channel

Locations in the navigation channel

Locations east of the navigation channel

✳ This core was collected prior to dredging at that location.

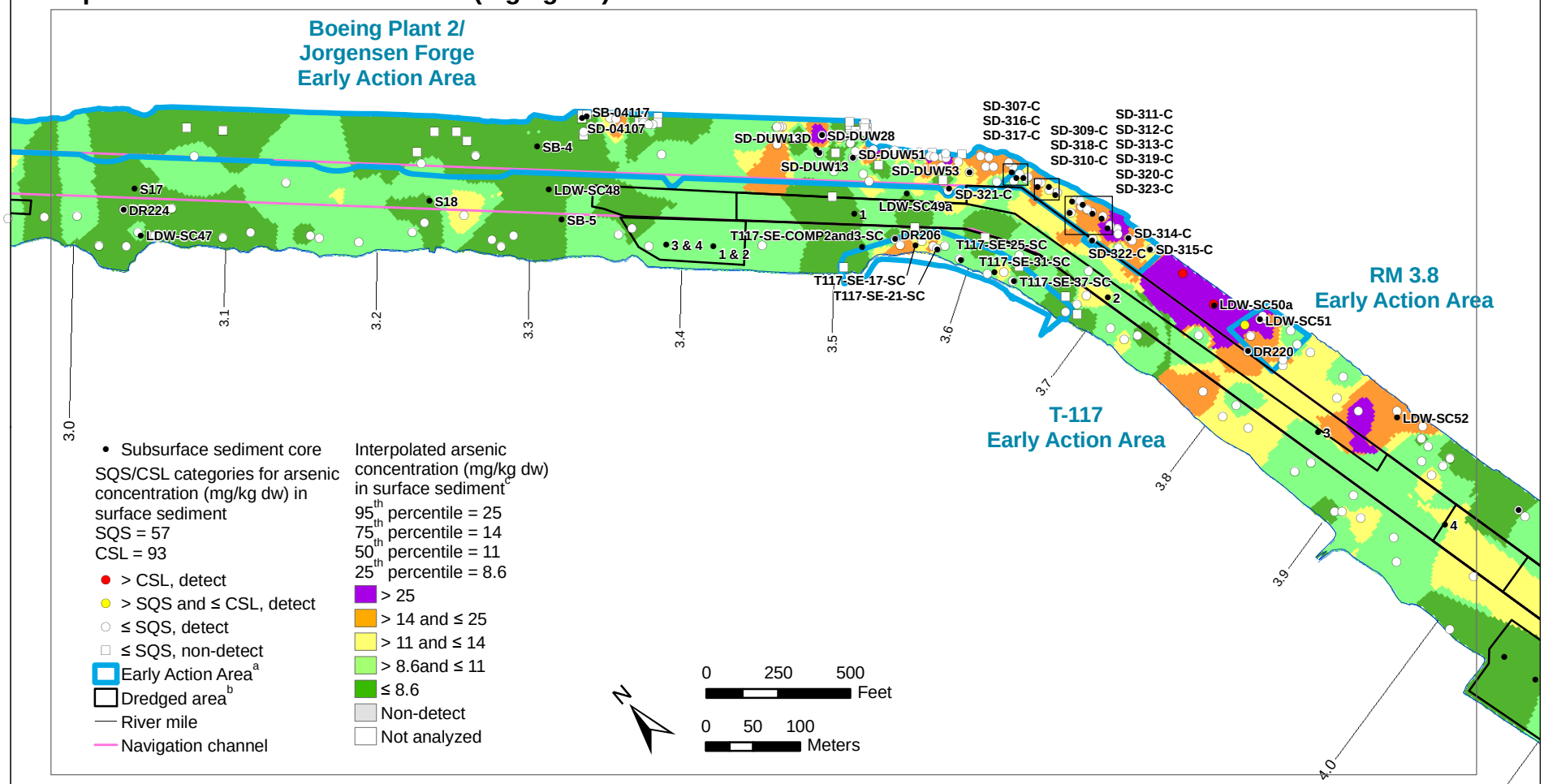
Map 4-33c. Arsenic concentrations in surface sediment and subsurface sediment cores, RM 2.2 to RM 3.0

Wind Ward environmental LLC

Prepared by CEH, 07/15/2010; MAP 2988; W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

Interpolated arsenic concentrations (mg/kg dw) in surface sediments



[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[b] Subsurface sediment data at locations in dredged areas were collected prior to dredging; surface sediment data were collected after dredging.

[c] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 25 mg/kg dw). Interpolated concentrations were calculated including locations with non-detected values. For locations with non-detects, a value of one-half the RL at that location was used. Interpolated surface does not show non-detects.

Arsenic concentrations (mg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the IDW concentration at the core location.

Locations west of the navigation channel | **Locations in the navigation channel** | **Locations east of the navigation channel** | **Locations in the Boeing Plant 2/ Jorgensen Forge Early Action Area** | **Locations in the T-117 Early Action Area**

✳ This core was collected prior to dredging at that location.

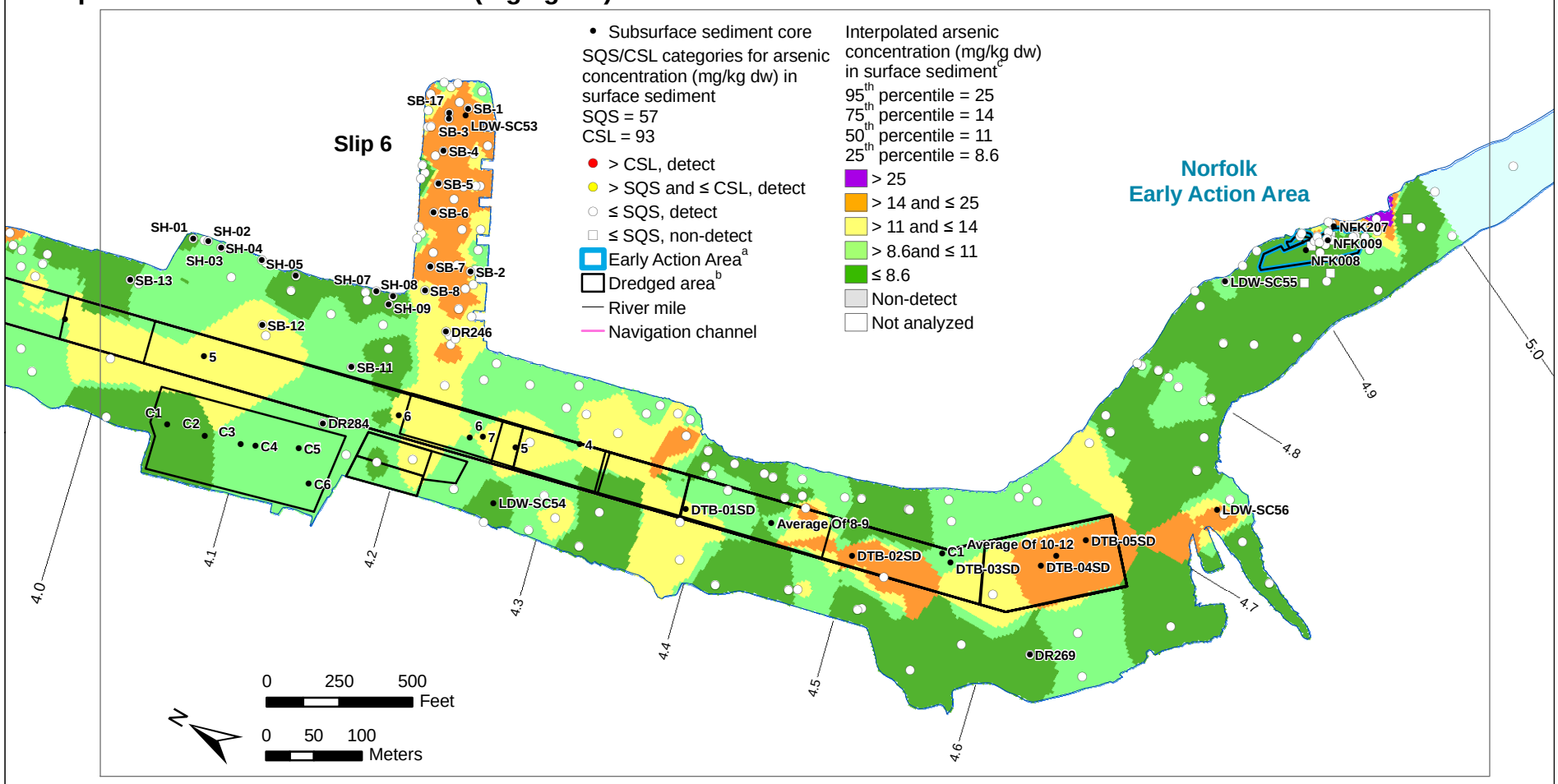
Map 4-33d. Arsenic concentrations in surface sediment and subsurface sediment cores, RM 3.0 to RM 4.0

Wind Ward LLC environmental

Prepared by CEH, 07/15/2010; MAP 2988; W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

Interpolated arsenic concentrations (mg/kg dw) in surface sediments



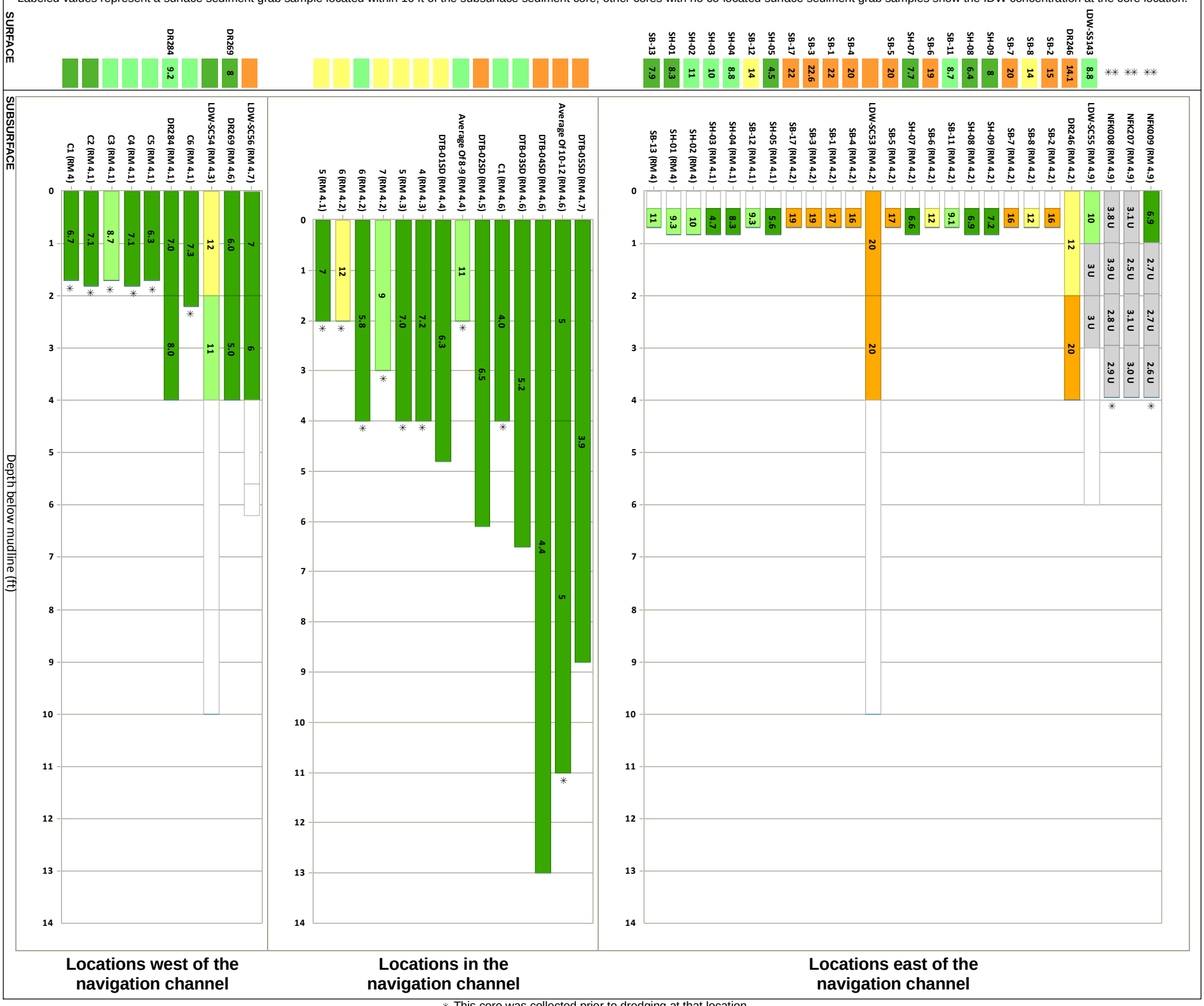
[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[b] For the Norfolk Early Action Area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO/SD removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003. Subsurface sediment data at locations in dredged areas were collected prior to dredging.

[c] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 25 mg/kg dw). Interpolated concentrations were calculated including locations with non-detected values. For locations with non-detects, a value of one-half the RL at that location was used. Interpolated surface does not show non-detects.

Arsenic concentrations (mg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the IDW concentration at the core location.



Locations west of the navigation channel

Locations in the navigation channel

Locations east of the navigation channel

✳ This core was collected prior to dredging at that location.

✳✳ At the Norfolk EAA, surface sediment data, which were collected after the removal action at the Norfolk CSO area in 1999 but before the removal action at the BDC south storm drain outfall area in 2003, do not reflect conditions at the time subsurface cores were collected in 1995.

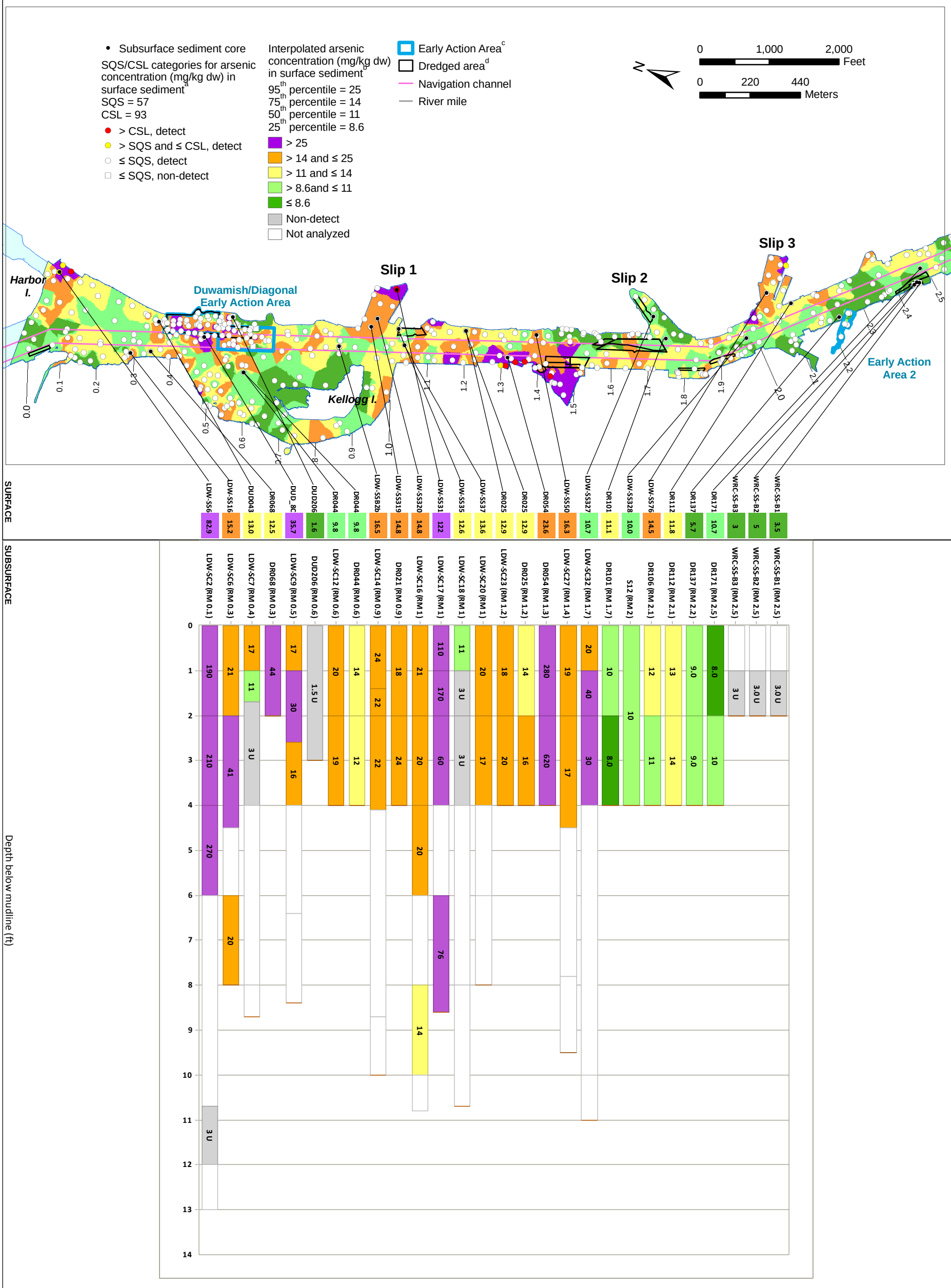
Map 4-33e. Arsenic concentrations in surface sediment and subsurface sediment cores, RM 4.0 to RM 5.0

Wind Ward environmental LLC

Prepared by CEH, 07/15/2010; MAP 2988; W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

Arsenic concentrations (mg/kg dw) in surface sediments, subsurface core data, and co-located (within 10 ft) surface sediment data



[a] When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations were compared instead to the LAET and 2LAET.

[b] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 25 mg/kg dw). Interpolated concentrations were calculated including locations with non-detected values. For locations with non-detects, a value of one-half the RL at that location was used.

[c] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[d] For the Duwamish/Diagonal Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, and thin-layer placement in 2003 to 2005. Subsurface sediment data in dredged areas were collected prior to dredging.

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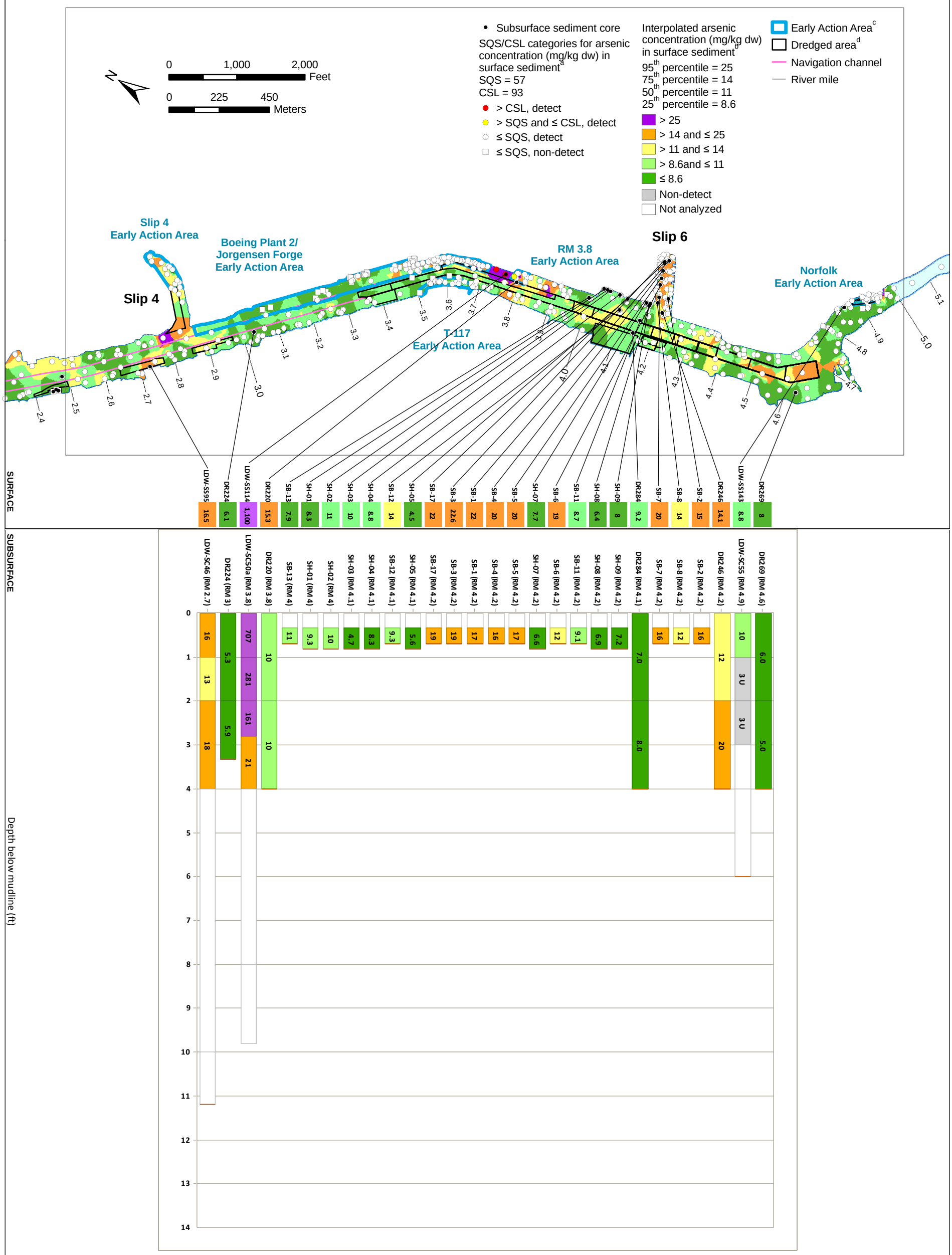
Map 4-34a. Comparison of arsenic concentrations in subsurface cores to co-located surface sediment locations, RM 0.0 to RM 2.5

Prepared by CEH, 07/15/2010; MAP 3795; W:\Projects\00-08-06_Duwamish_RI\data\GIS\Phase2 RI\Nature and Extent\Subsurface\Colocation

Dredging information provided by AECOM.

Arsenic concentrations (mg/kg dw) in surface sediments, subsurface core data, and co-located (within 10 ft) surface sediment data



[a] When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations were compared instead to the LAET and 2LAET.

[b] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 25 mg/kg dw). Interpolated concentrations were calculated including locations with non-detected values. For locations with non-detects, a value of one-half the RL at that location was used.

[c] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[d] For the Norfolk Early Action Area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003. Subsurface sediment data in dredged areas were collected prior to dredging.

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Map 4-34b. Comparison of arsenic concentrations in subsurface cores to co-located surface sediment locations, RM 2.5 to RM 5.0

Prepared by CEH, 07/15/2010; MAP 3795; W:\Projects\00-08-06_Duwamish_Rt\data\GIS\Phase2 RI\Nature and Extent\Subsurface\Colocation

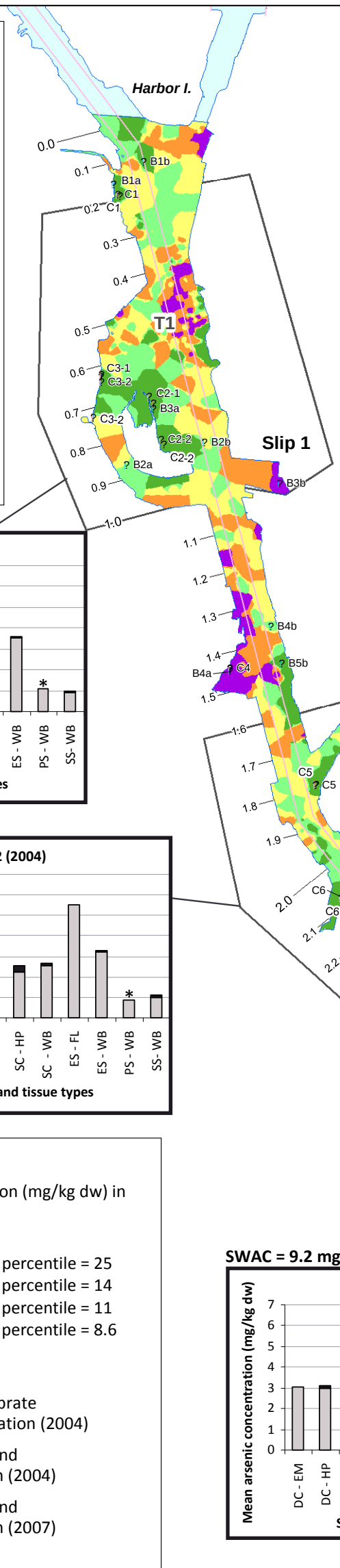
Dredging information provided by AECOM.

Graph Legend

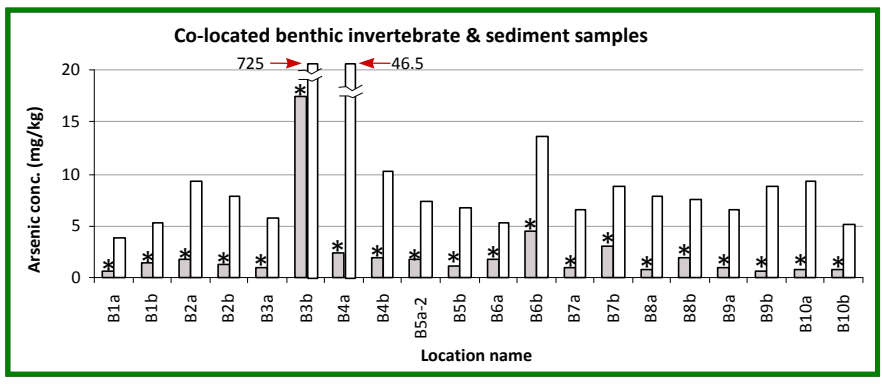
- Total arsenic concentration in co-located sediment
- Total arsenic concentration in tissue (inorganic arsenic concentration is shown in black)
- * Sample not analyzed for inorganic arsenic

Acronyms for species and tissue type

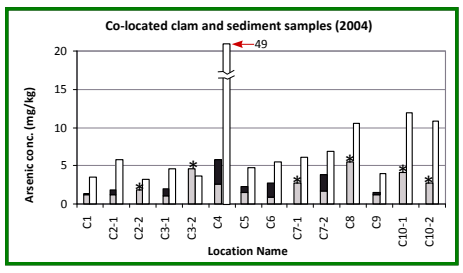
- DC - Dungeness crab
- SC - Slender crab
- ES - English sole
- PS - Pacific staghorn sculpin
- SS - Shiner surfperch
- EM - Edible meat
- FL - Fillet with skin
- HP - Hepatopancreas
- WB - Whole body



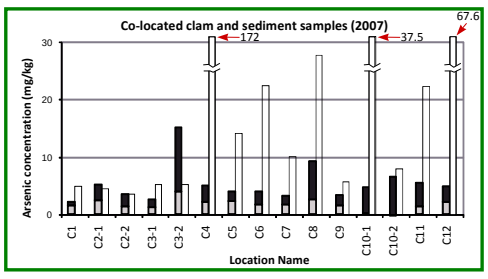
Co-located benthic invertebrate & sediment samples



Co-located clam and sediment samples (2004)

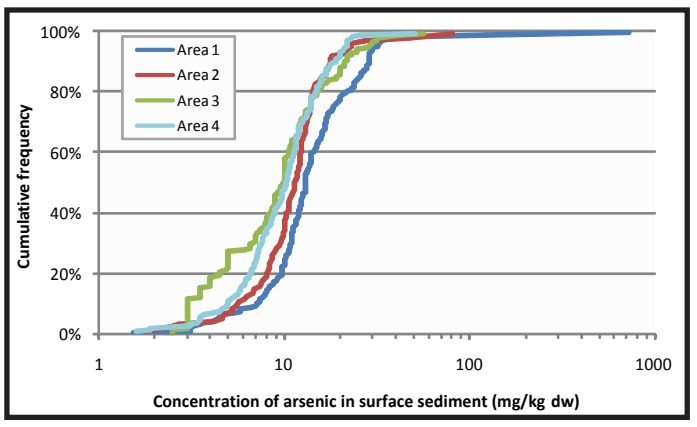


Co-located clam and sediment samples (2007)



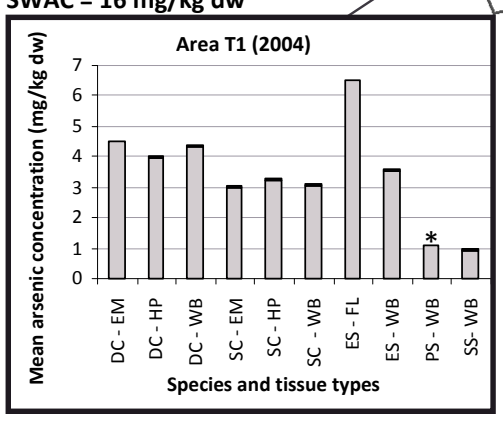
Note: Clam and benthic invertebrate tissue concentrations are in wet weight and sediment concentrations are in dry weight. Depurated clam samples were also analyzed for arsenic in 2007 but are not shown on this figure.

Cumulative frequency



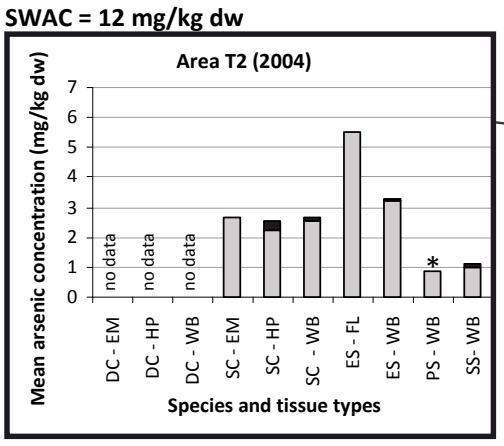
SWAC = 16 mg/kg dw

Area T1 (2004)



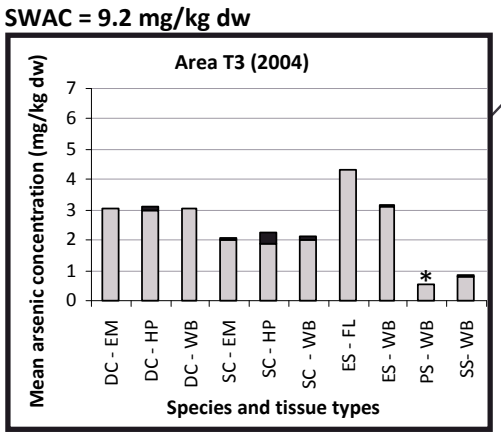
SWAC = 12 mg/kg dw

Area T2 (2004)



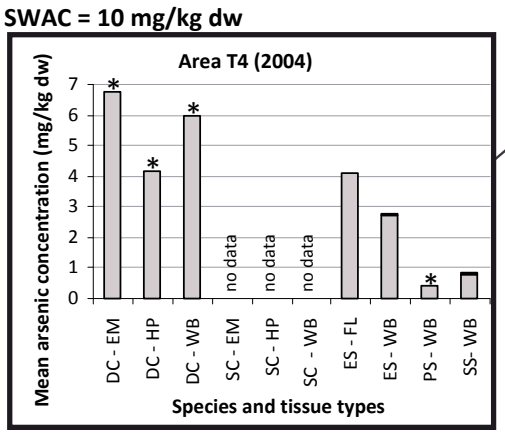
SWAC = 9.2 mg/kg dw

Area T3 (2004)



SWAC = 10 mg/kg dw

Area T4 (2004)



Map Legend

Interpolated arsenic concentration (mg/kg dw) in surface sediment [a,b]

- > 25
- > 14 and ≤ 25
- > 11 and ≤ 14
- > 8.6 and ≤ 11
- ≤ 8.6

95th percentile = 25
75th percentile = 14
50th percentile = 11
25th percentile = 8.6

- ? Co-located benthic invertebrate and sediment sampling location (2004)
- ? Co-located softshell clam and sediment sampling location (2004)
- ⊗ Co-located softshell clam and sediment sampling location (2007)
- Tissue sampling area
- Navigation channel
- River mile

SWAC - spatially weighted average concentration

[a] Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated values ≤ 25 mg/kg dw). Interpolated concentrations were calculated including locations with non-detected values. For locations with non-detects, a value of one-half the RL at that location was used.

[b] For the Duwamish/Diagonal early action area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005. For the Norfolk early action area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

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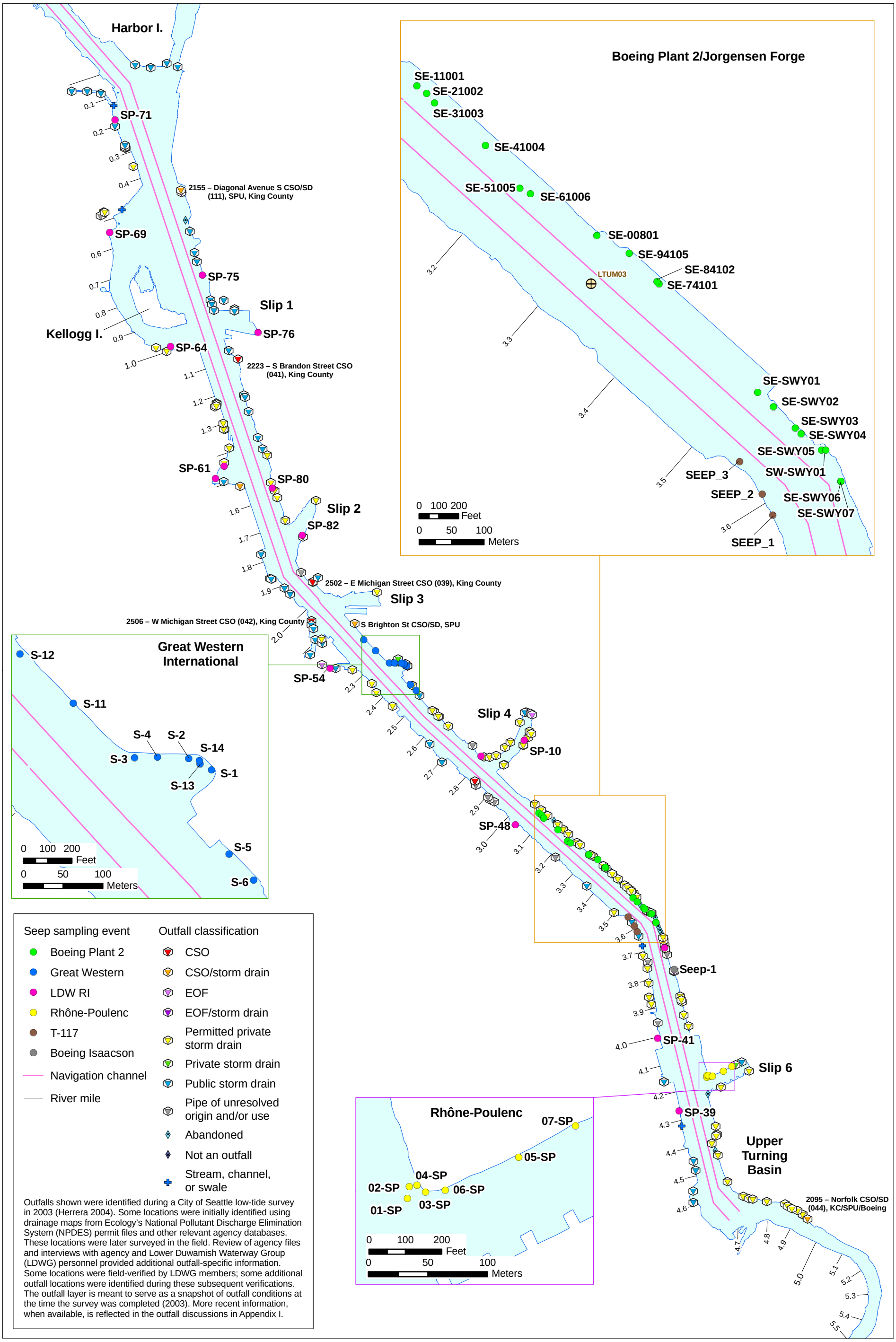
0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

Map 4-35. Total and inorganic arsenic concentrations in composite tissue samples and the IDW interpolation of total arsenic concentrations in surface sediment

Modified by Zachariah from GIS Map 2748 | June 30, 2009 | Map 4-35 (2748).xar



Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

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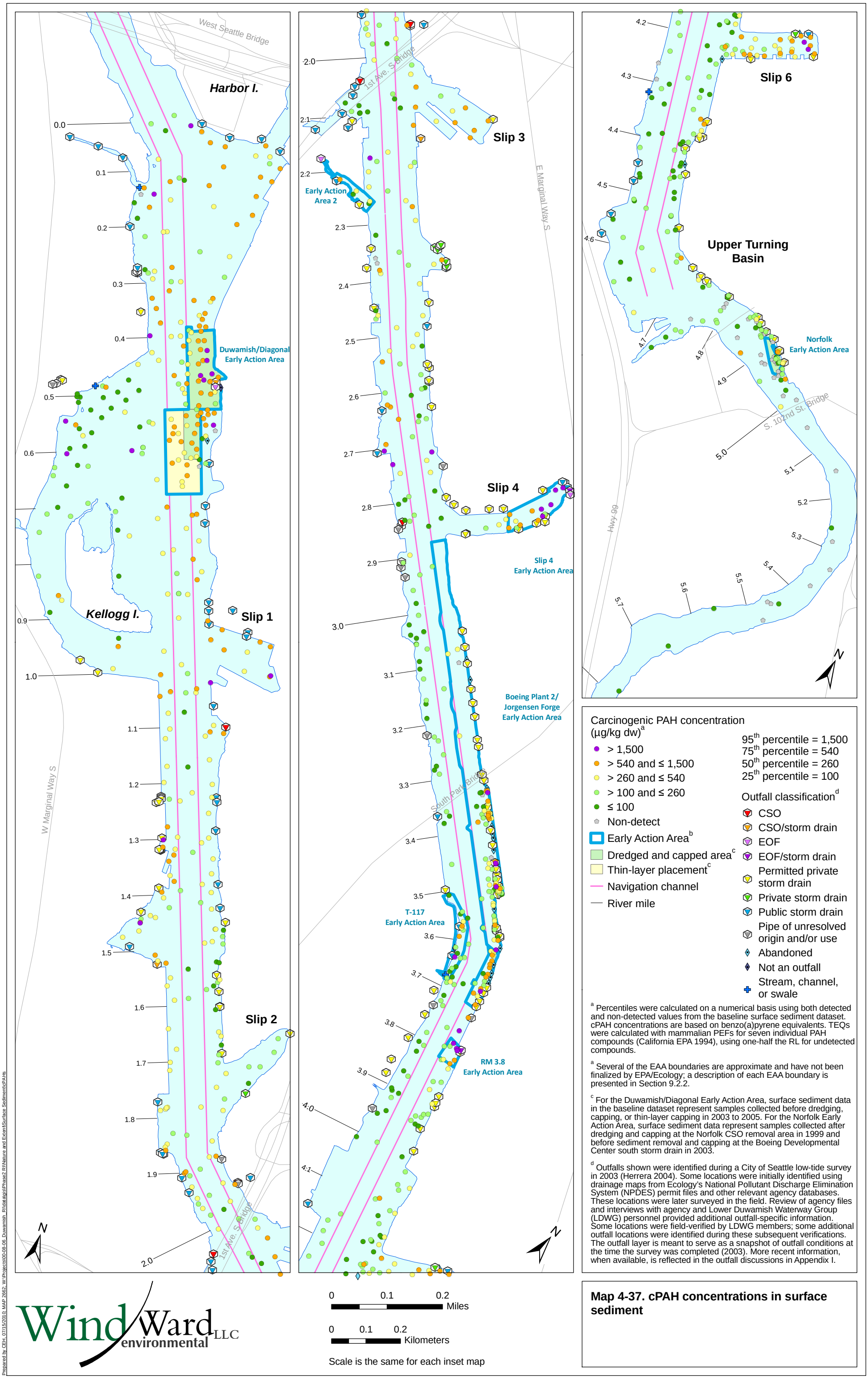
N

0 0.2 0.4 Miles

0 0.2 0.4 Kilometers

Map 4-36. Seep sampling locations with dissolved metals concentrations that were greater than acute water quality standards

Prepared by CEH, 07/15/2010, Map 2809, W:\Projects\00-08-06_Duwamish_R\data\GIS\Phase2 RI\Nature and Extent\Seeps and porewater



Carcinogenic PAH concentration (µg/kg dw)[a]

- > 1,500
- > 540 and ≤ 1,500
- > 260 and ≤ 540
- > 100 and ≤ 260
- ≤ 100
- Non-detect
- Early Action Area[b]
- Dredged and capped area[c]
- Thin-layer placement[c]
- Navigation channel
- River mile

95th percentile = 1,500
75th percentile = 540
50th percentile = 260
25th percentile = 100

Outfall classification[d]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. cPAH concentrations are based on benzo(a)pyrene equivalents. TEQs were calculated with mammalian PEFs for seven individual PAH compounds (California EPA 1994), using one-half the RL for undetected compounds.

[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] For the Duwamish/Diagonal Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer capping in 2003 to 2005. For the Norfolk Early Action Area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

Map 4-37. cPAH concentrations in surface sediment

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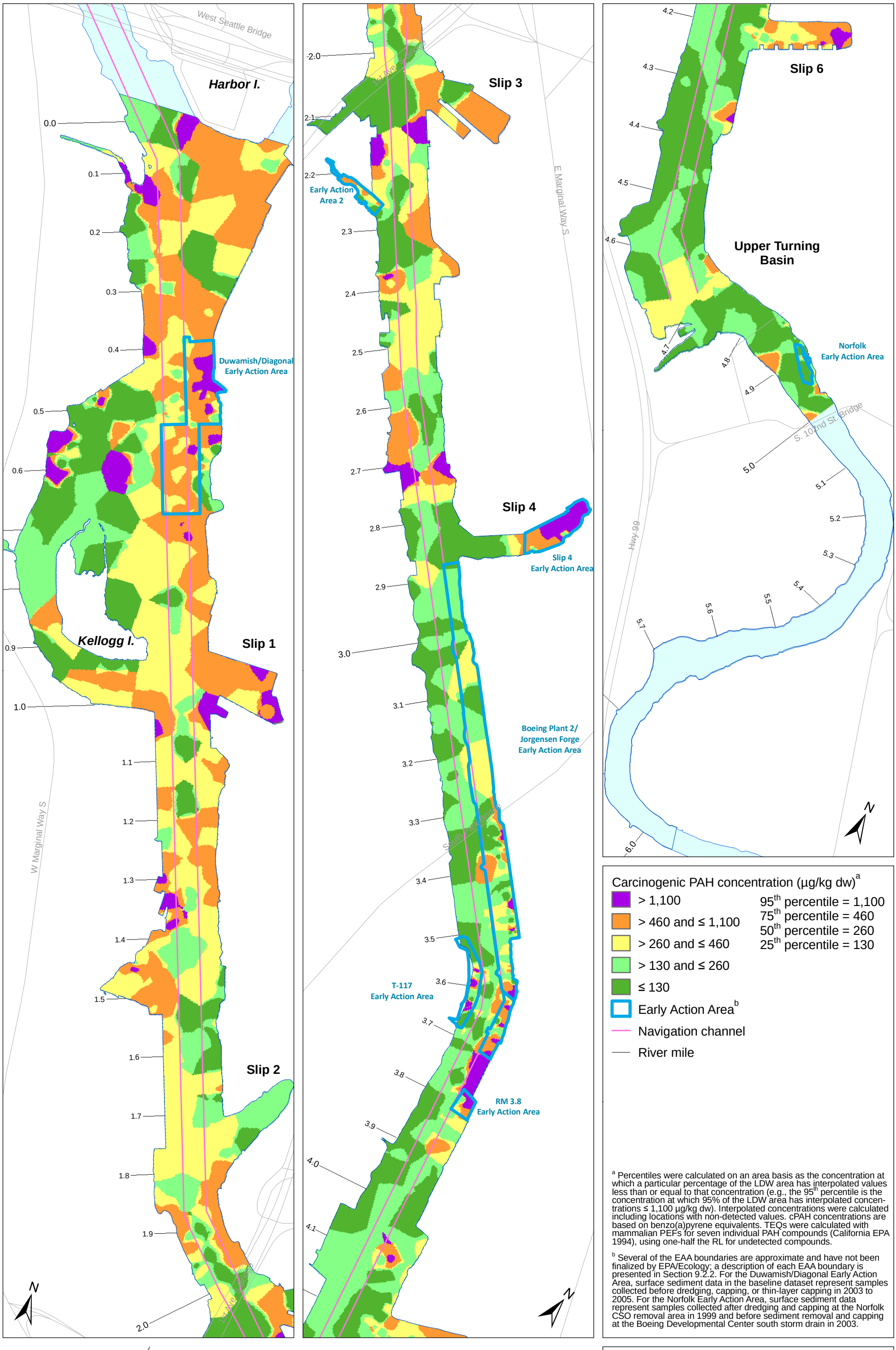
Prepared by CEH, 07/15/2010; MAP 2662; W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 R\Nature and Extent\Surface Sediment\cPAHs



Carcinogenic PAH concentration (µg/kg dw)[a]

- > 1,100
- > 460 and ≤ 1,100
- > 260 and ≤ 460
- > 130 and ≤ 260
- ≤ 130
- Early Action Area[b]
- Navigation channel
- River mile

95th percentile = 1,100
75th percentile = 460
50th percentile = 260
25th percentile = 130

[a] Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 1,100 µg/kg dw). Interpolated concentrations were calculated including locations with non-detected values. cPAH concentrations are based on benzo(a)pyrene equivalents. TEQs were calculated with mammalian PEFs for seven individual PAH compounds (California EPA 1994), using one-half the RL for undetected compounds.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2. For the Duwamish/Diagonal Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer capping in 2003 to 2005. For the Norfolk Early Action Area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

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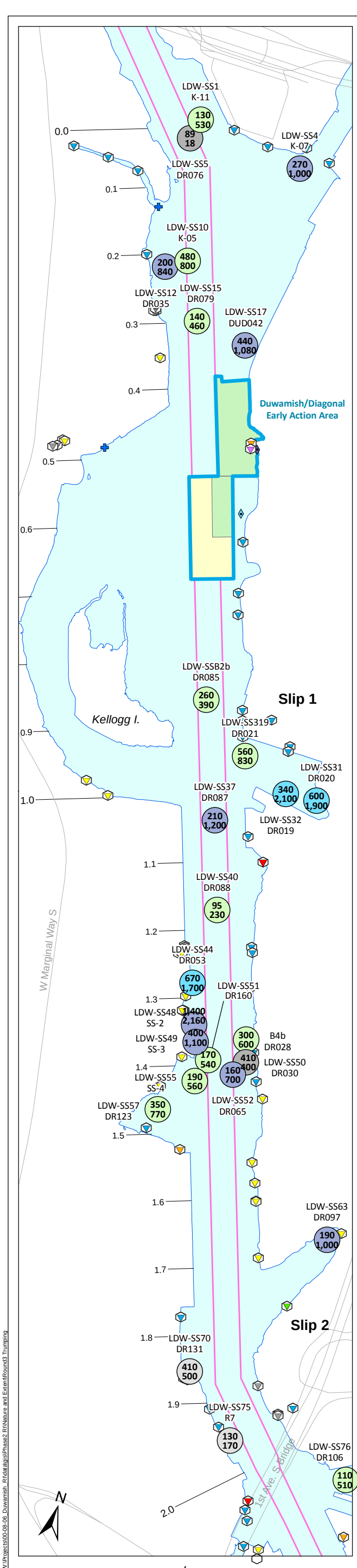
0 0.1 0.2 Miles

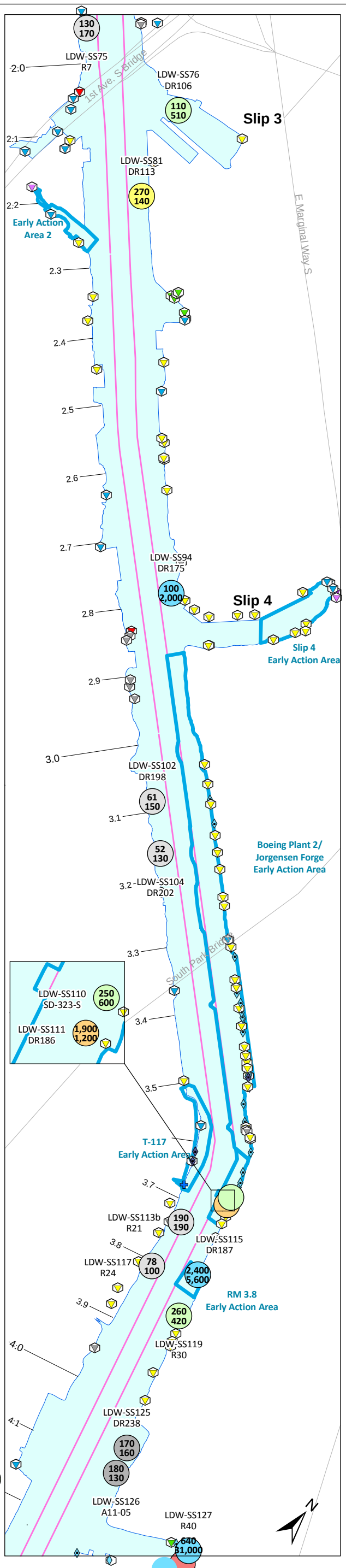
0 0.1 0.2 Kilometers

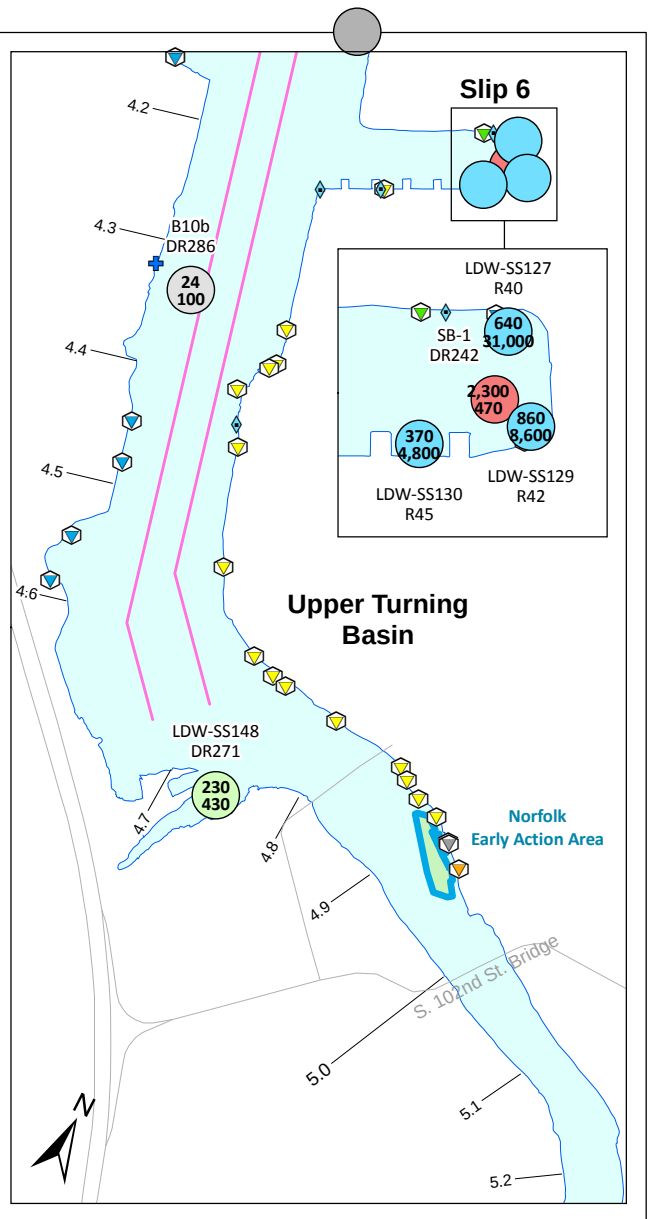
Scale is the same for each inset map

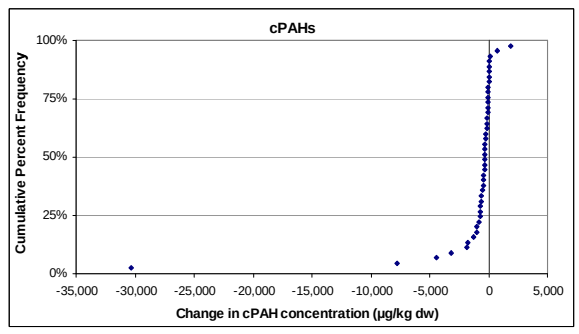
Map 4-38. IDW interpolation of cPAH concentrations in surface sediment

Prepared by CEH, 07/15/2010, MAP 2780, W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\cPAHs





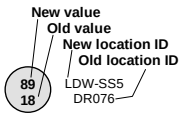




Difference in cPAH concentrations (µg/kg dw)[a]

New value minus old value

- ≤ -1,000
- > -1,000 and ≤ -500
- > -500 and ≤ -100
- > -100 and ≤ 0
- > 0 and ≤ 100
- > 100 and ≤ 500
- > 500 and ≤ 1,000
- > 1,000
- Early Action Area[b]
- Dredged and capped area
- Thin-layer placement



U = non-detect

Outfall classification[c]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale
- Road
- Navigation channel
- River mile

[a] A location was considered to have been resampled if the new location was within 10 ft of the old location. TEQs were calculated with mammalian PEFs for seven individual PAH compounds (California EPA 1994), using one-half the RL for undetected compounds.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time of the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

Note: Samples collected in the Duwamish/Diagonal and Norfolk EAAs were not included in this evaluation.

0 0.1 0.2 Miles

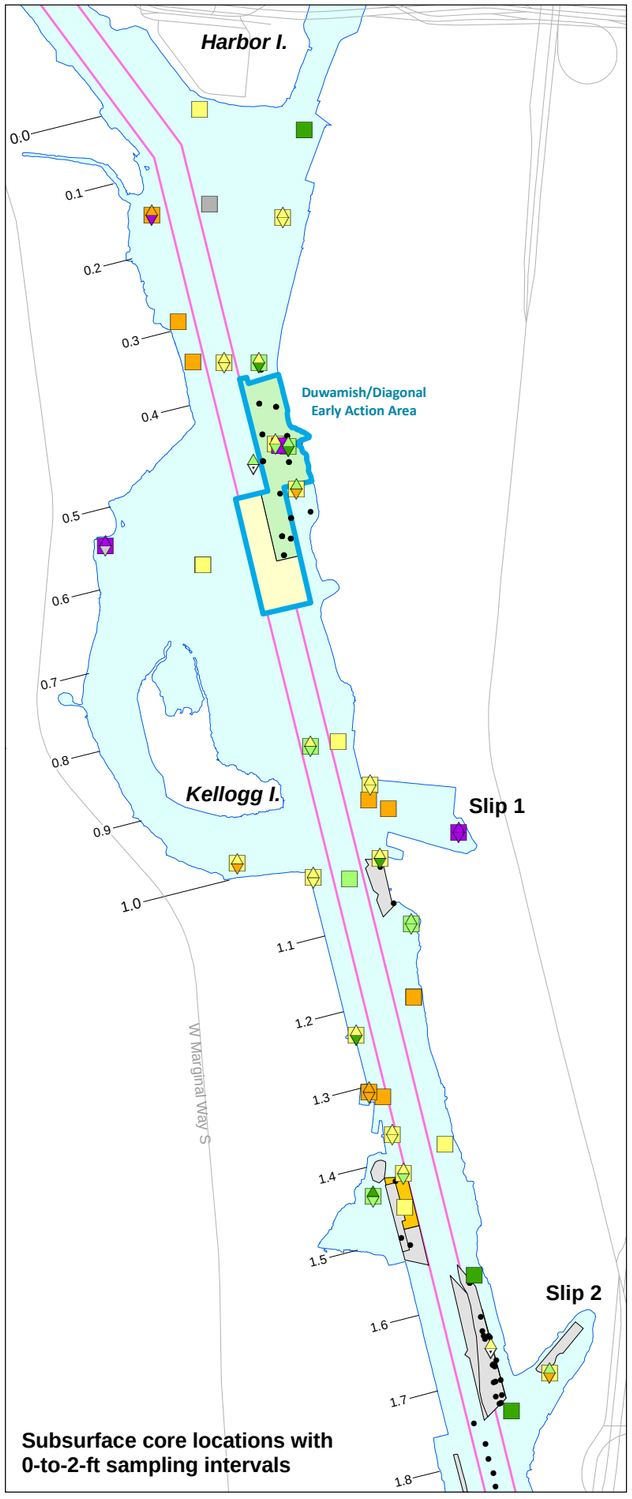
0 0.1 0.2 Kilometers

Scale is the same for each inset map

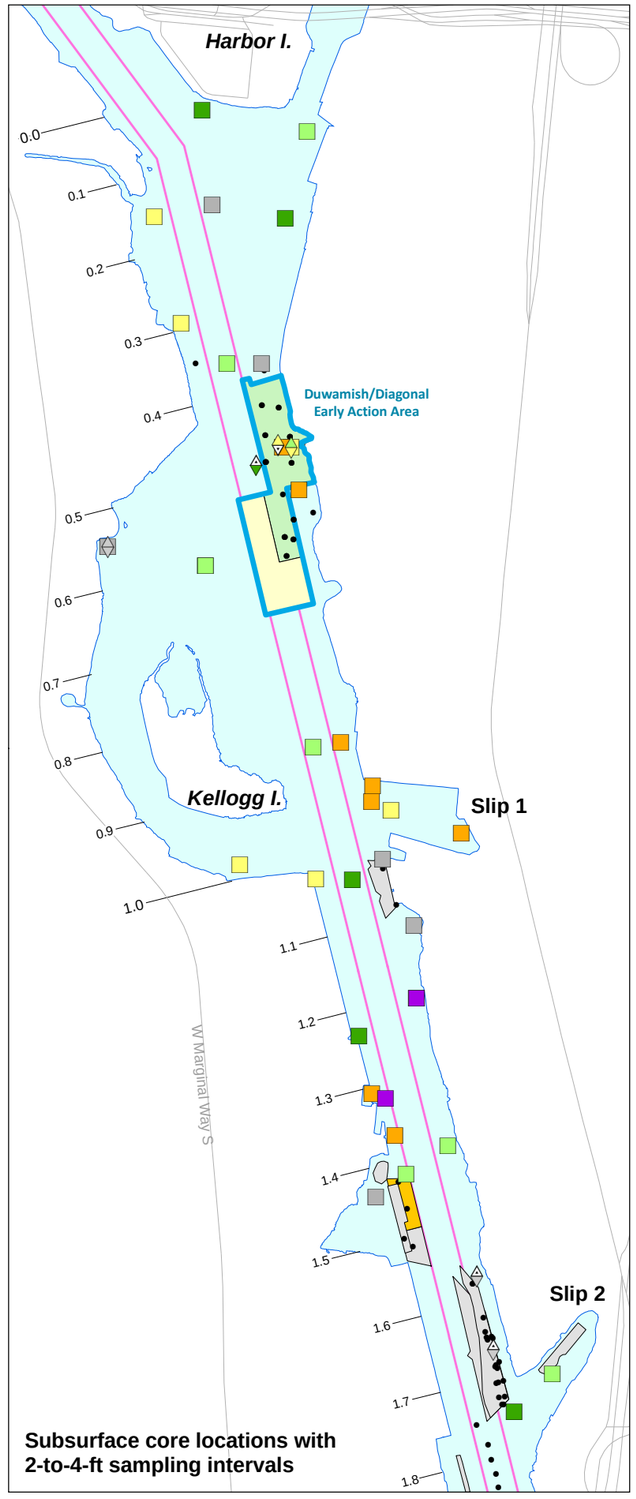
Map 4-39. Differences in cPAH concentrations in surface sediment at locations that have been resampled

Wind Ward LLC environmental

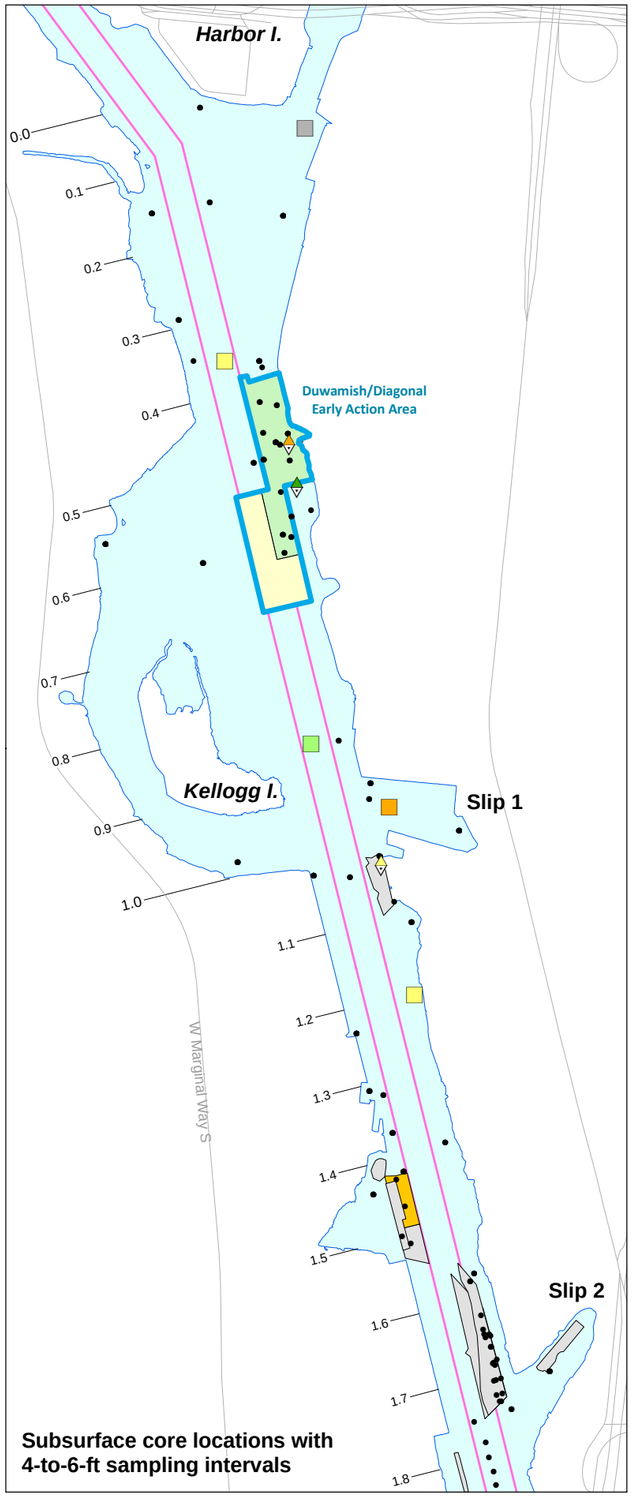
Prepared by CEH, 07/15/2010, MAP 2746; W:\Projects\00-08-06 Duwamish_R\data\gis\Phase2 R\Nature and Extent\Round3 Trumping



Subsurface core locations with 0-to-2-ft sampling intervals



Subsurface core locations with 2-to-4-ft sampling intervals



Subsurface core locations with 4-to-6-ft sampling intervals

cPAH concentration (µg/kg dw)[a]

- > 1,500 — 95th percentile = 1,500
- > 540 and ≤ 1,500 — 75th percentile = 540
- > 260 and ≤ 540 — 50th percentile = 260
- > 100 and ≤ 260 — 25th percentile = 100
- ≤ 100
- Non-detect

Sampling interval

	Left panel	Middle panel	Right panel
□	0-to-2-ft[b]	2-to-4-ft[b]	4-to-6-ft[b]
◇	0-to-1-ft[c]	2-to-3-ft[c]	4-to-5-ft[c]
◇	1-to-2-ft[c]	3-to-4-ft[c]	5-to-6-ft[c]

△ Not analyzed in that sampling interval

• Other subsurface sampling location analyzed for cPAH, but not in the illustrated sampling intervals

Early Action Area[d]

Dredged area[e]

Dredged and capped area[e]

Dredged and thin-layer placement[e]

Thin-layer placement

Navigation channel

River mile

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. cPAH concentrations are based on benzo(a)-pyrene equivalents. TEQs were calculated with mammalian PEFs for seven individual PAH compounds (California EPA 1994), using one-half the RL for undetected compounds.

[b] Data from 2-foot sampling intervals; some locations show an average of data from both 1-foot intervals within that 2-foot interval at a given location.

[c] Data from 1-foot sampling intervals are shown if available. If both 1-foot intervals within the 2-foot interval were collected, the average of the two intervals is also shown.

[d] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[e] Subsurface sediment data at locations in dredged areas were collected prior to dredging.

N

0 0.1 0.2 Kilometers

0 0.1 0.2 Miles

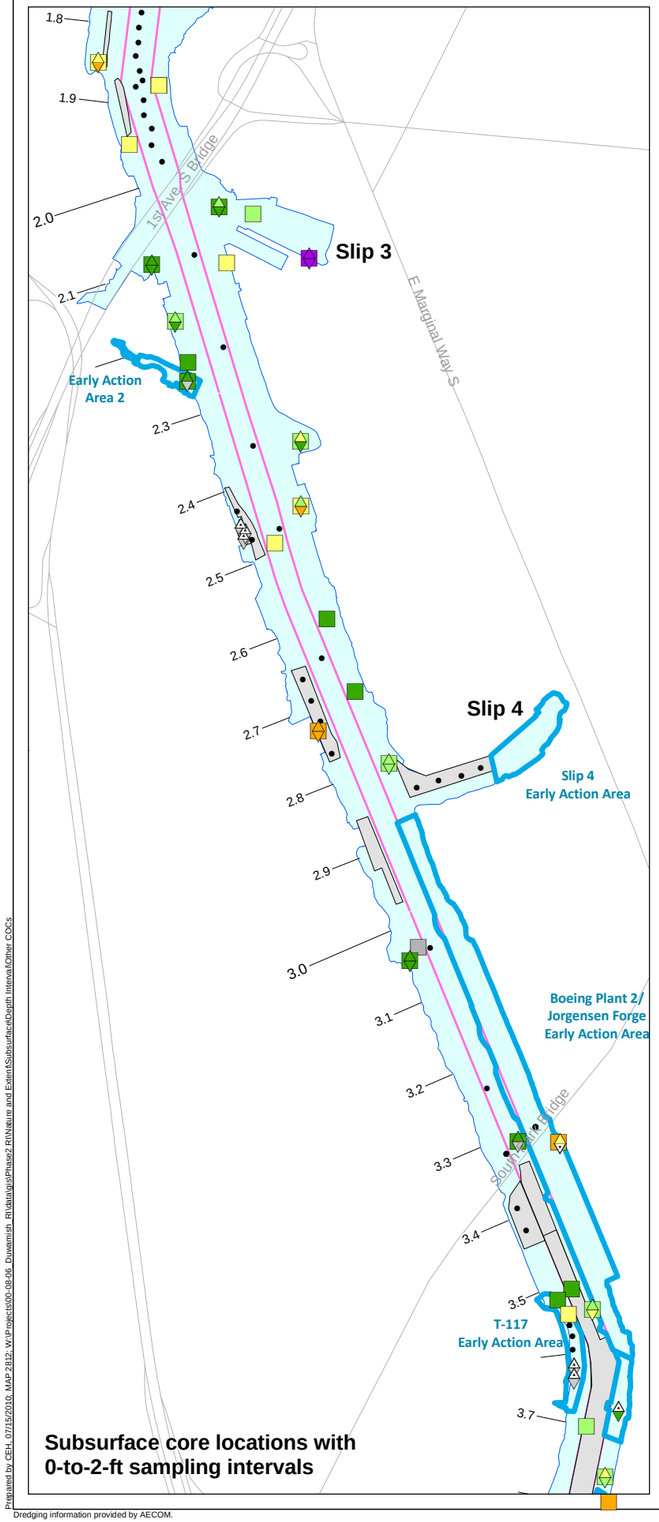
Scale is the same for each map frame

Map 4-40a. cPAH concentrations in subsurface sediment within the 0-to-2-ft, 2-to-4-ft, and 4-to-6-ft sampling intervals, RM 0.0 to RM 1.8

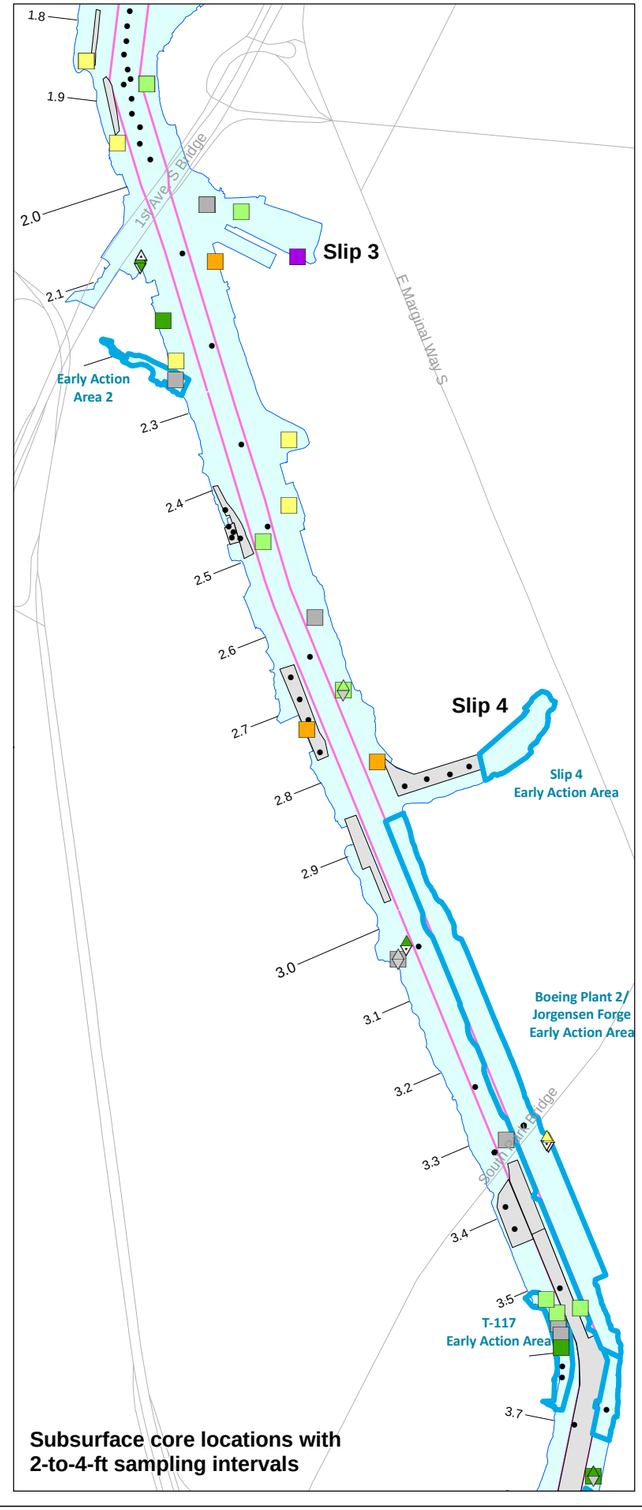
Wind Ward LLC environmental

Prepared by: CEH, 07/15/2010, MAP 2812, W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Subsurface\Depth Interval\Other COCs

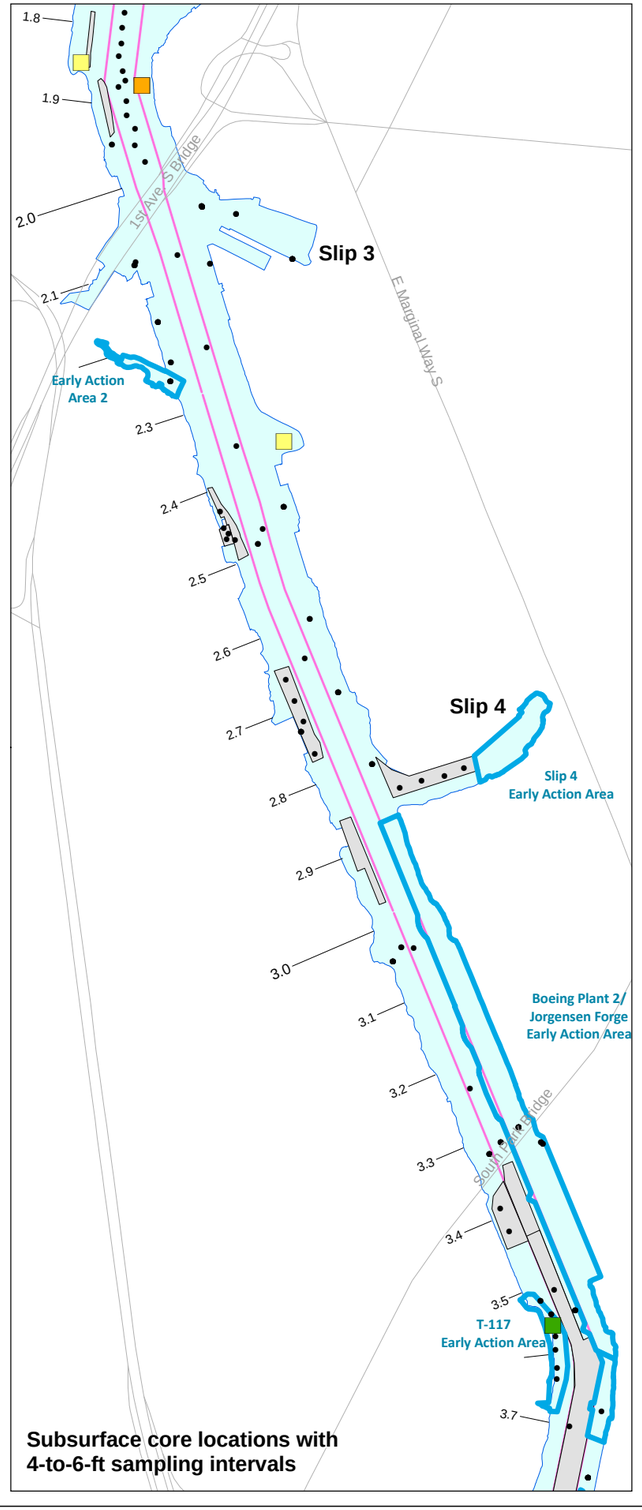
Dredging information provided by AECOM.



Subsurface core locations with 0-to-2-ft sampling intervals



Subsurface core locations with 2-to-4-ft sampling intervals



Subsurface core locations with 4-to-6-ft sampling intervals

cPAH concentration (µg/kg dw)[a]

- > 1,500
- > 540 and ≤ 1,500
- > 260 and ≤ 540
- > 100 and ≤ 260
- ≤ 100
- Non-detect

95th percentile = 1,500
75th percentile = 540
50th percentile = 260
25th percentile = 100

Sampling interval

	0-to-2-ft[b]	2-to-4-ft[b]	4-to-6-ft[b]
	0-to-1-ft[c]	2-to-3-ft[c]	4-to-5-ft[c]
	1-to-2-ft[c]	3-to-4-ft[c]	5-to-6-ft[c]

Not analyzed in that sampling interval

Other subsurface sampling location analyzed for cPAH, but not in the illustrated sampling intervals

Early Action Area[d]

Dredged area[e]

Navigation channel

River mile

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. cPAH concentrations are based on benzo(a)-pyrene equivalents. TEQs were calculated with mammalian PEFs for seven individual PAH compounds (California EPA 1994), using one-half the RL for undetected compounds.

[b] Data from 2-foot sampling intervals; some locations show an average of data from both 1-foot intervals within that 2-foot interval at a given location.

[c] Data from 1-foot sampling intervals are shown if available. If both 1-foot intervals within the 2-foot interval were collected, the average of the two intervals is also shown.

[d] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[e] Subsurface sediment data at locations in dredged areas were collected prior to dredging.

0 0.1 0.2 Kilometers

0 0.1 0.2 Miles

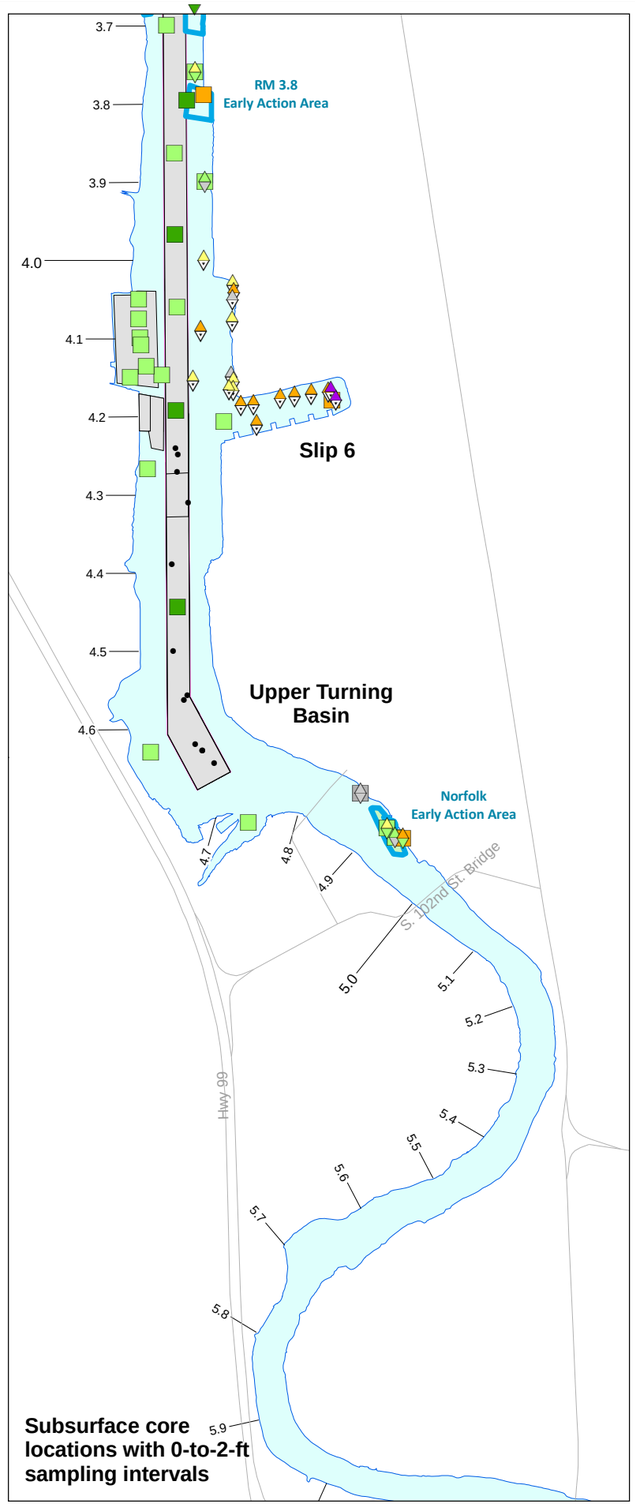
Scale is the same for each map frame

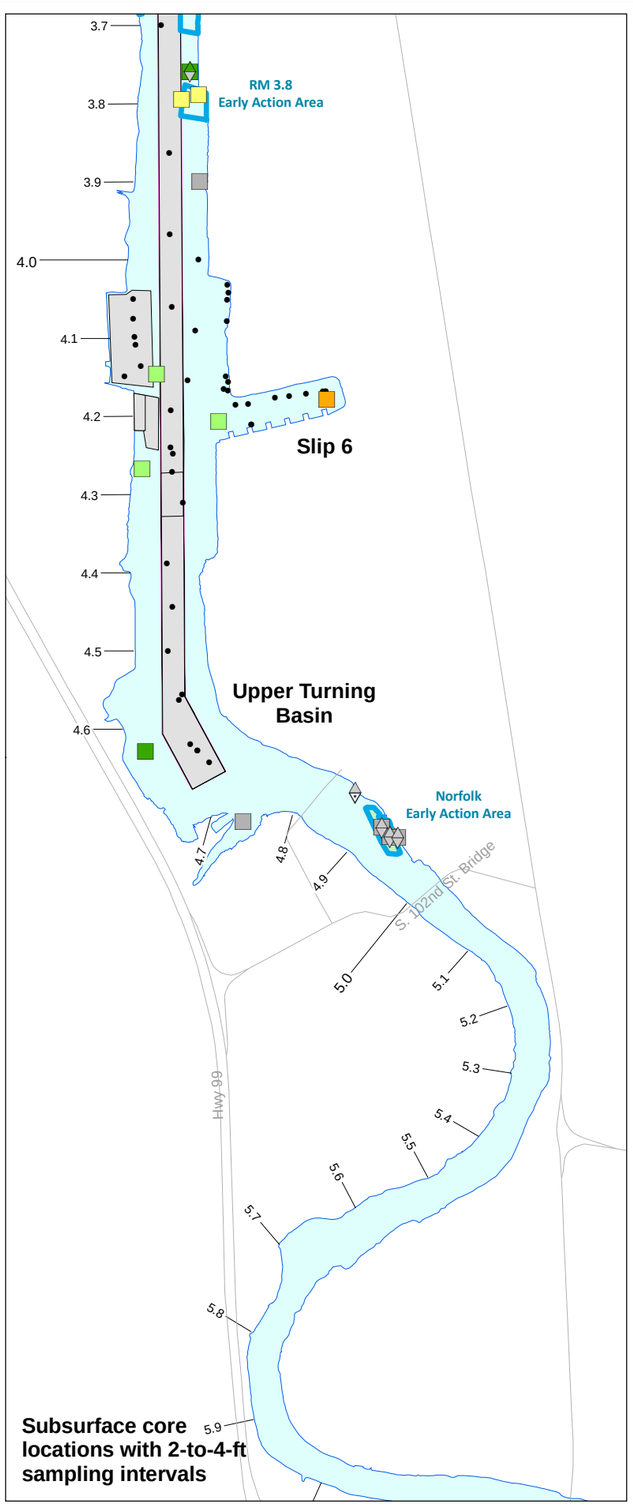
Map 4-40b. cPAH concentrations in subsurface sediment within the 0-to-2-ft, 2-to-4-ft, and 4-to-6-ft sampling intervals, RM 1.8 to RM 3.7

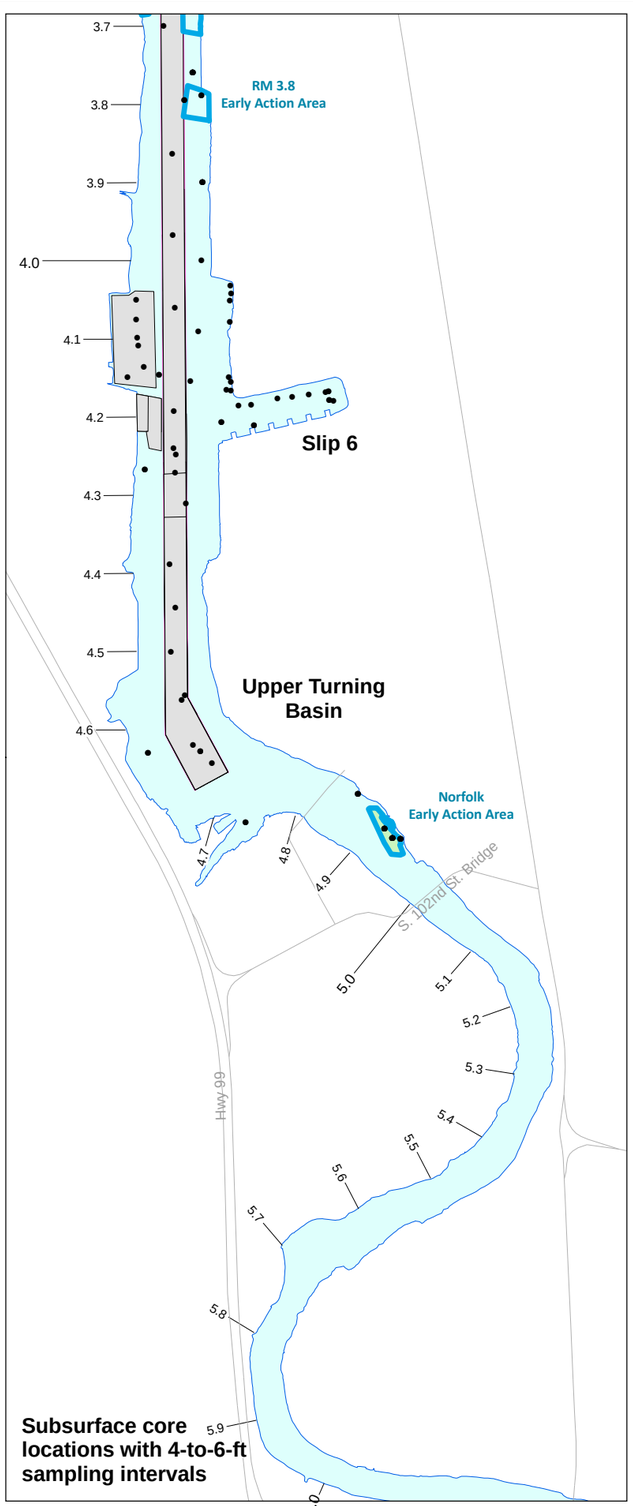
Wind Ward environmental LLC

Prepared by: CEH, 07/15/2010, MAP 2812, W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Subsurface\Depth Interval\Other COCs

Dredging information provided by AECOM.







cPAH concentration (µg/kg dw)[a]

- > 1,500
- > 540 and ≤ 1,500
- > 260 and ≤ 540
- > 100 and ≤ 260
- ≤ 100
- Non-detect

95th percentile = 1,500
75th percentile = 540
50th percentile = 260
25th percentile = 100

Sampling interval

	Left panel	Middle panel	Right panel
□	0-to-2-ft[b]	2-to-4-ft[b]	4-to-6-ft[b]
◇	0-to-1-ft[c]	2-to-3-ft[c]	4-to-5-ft[c]
◇	1-to-2-ft[c]	3-to-4-ft[c]	5-to-6-ft[c]

△ Not analyzed in that sampling interval

• Other subsurface sampling location analyzed for cPAH, but not in the illustrated sampling intervals

Early Action Area[d]

Dredged area[e]

Dredged and capped area[e]

Navigation channel

River mile

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. cPAH concentrations are based on benzo(a)-pyrene equivalents. TEQs were calculated with mammalian PEFs for seven individual PAH compounds (California EPA 1994), using one-half the RL for undetected compounds.

[b] Data from 2-foot sampling intervals; some locations show an average of data from both 1-foot intervals within that 2-foot interval at a given location.

[c] Data from 1-foot sampling intervals are shown if available. If both 1-foot intervals within the 2-foot interval were collected, the average of the two intervals is also shown.

[d] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[e] Subsurface sediment data at locations in dredged areas were collected prior to dredging.

N

0 0.1 0.2 Kilometers

0 0.1 0.2 Miles

Scale is the same for each map frame

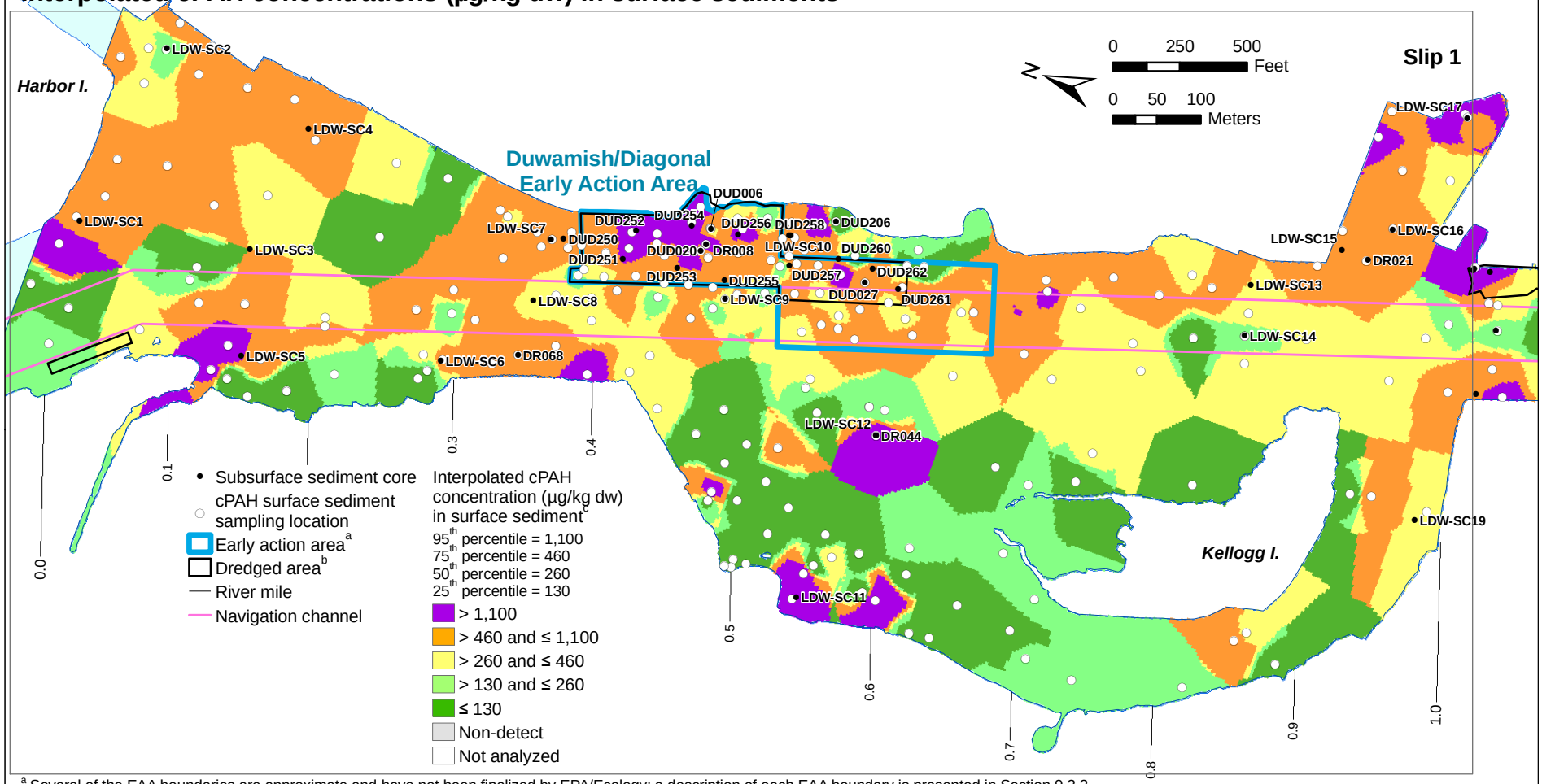
Map 4-40c. cPAH concentrations in subsurface sediment within the 0-to-2-ft, 2-to-4-ft, and 4-to-6-ft sampling intervals, RM 3.7 to RM 6.0

Wind Ward LLC environmental

Prepared by: CEH, 07/15/2010, MAP 2832, W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Subsurface\4Depth Interval\2Other COCs

Dredging information provided by AECOM.

Interpolated cPAH concentrations (µg/kg dw) in surface sediments



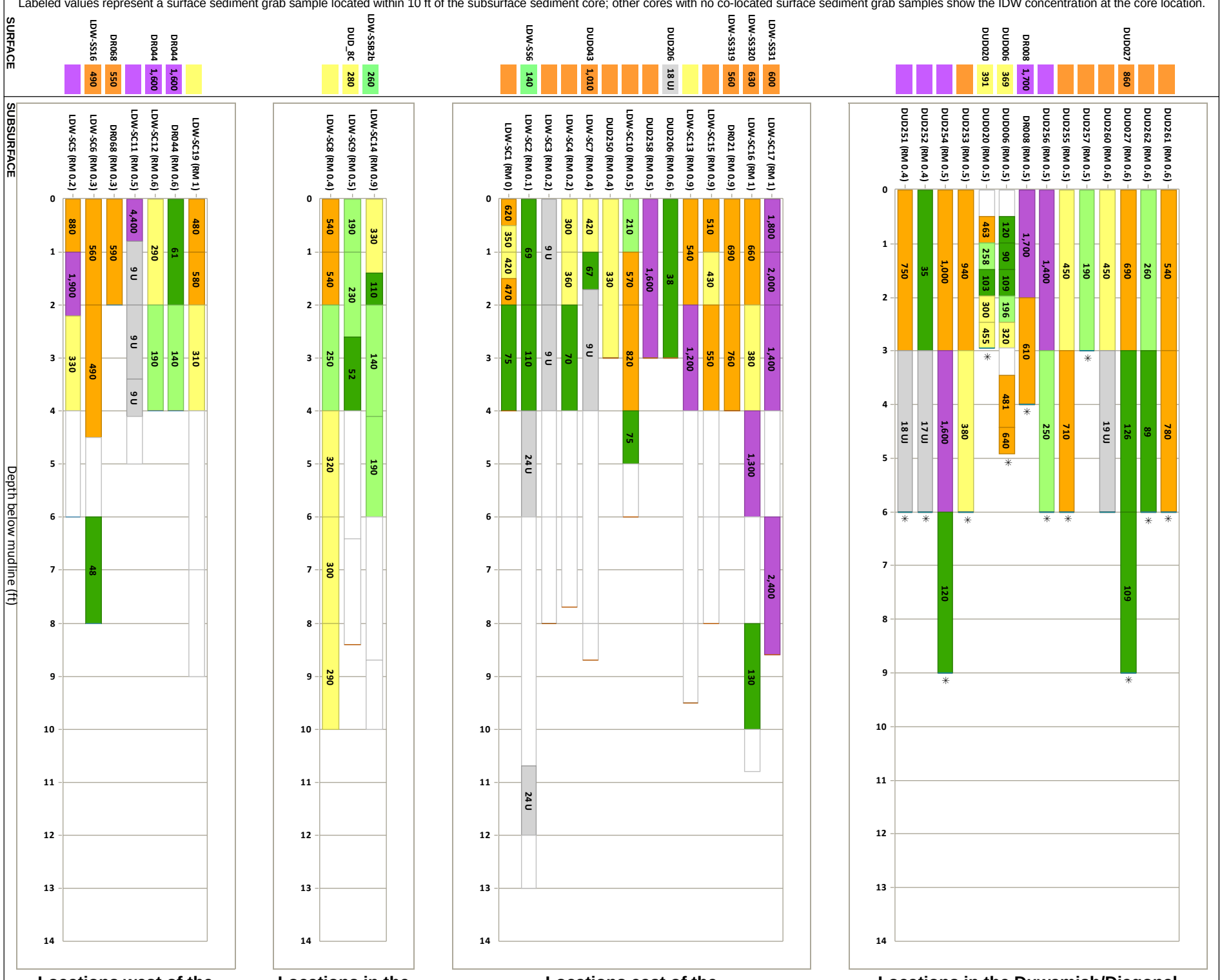
[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[b] For the Duwamish/Diagonal Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, and thin-layer placement in 2003 to 2005. Subsurface sediment data in dredged areas were collected prior to dredging.

[c] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 1,100 µg/kg dw). Interpolated concentrations were calculated including locations with non-detected values. TEQs were calculated with mammalian PEFs for seven individual PAH compounds (California EPA 1994), using one-half the RL for undetected compounds. Interpolated surface does not show non-detects.

cPAH concentrations (µg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the IDW concentration at the core location.



Locations west of the navigation channel

Locations in the navigation channel

Locations east of the navigation channel

Locations in the Duwamish/Diagonal Early Action Area

✳ This core was collected prior to dredging at that location.

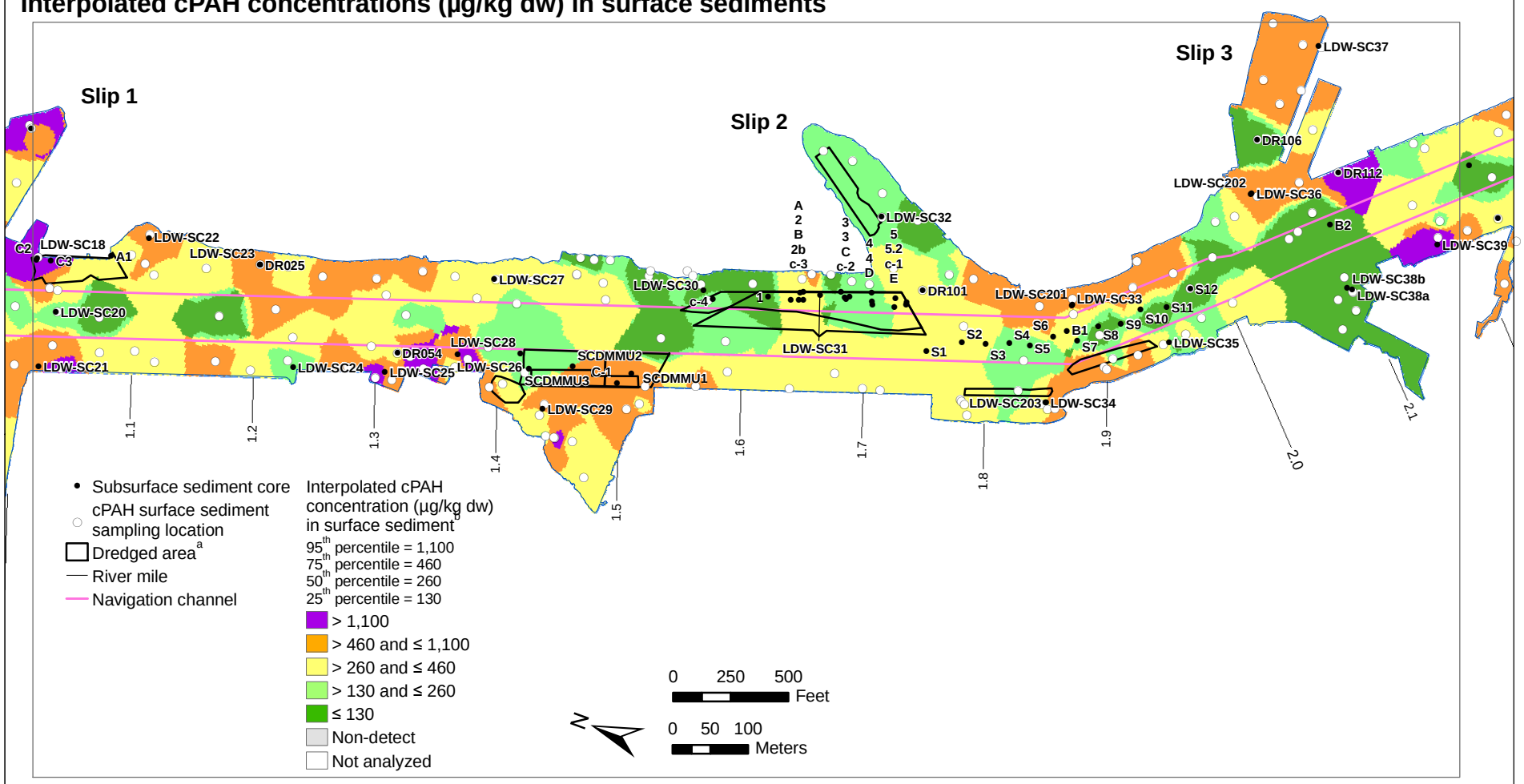
Map 4-41a. cPAH concentrations in surface sediment and subsurface sediment cores, RM 0.0 to RM 1.0

Wind Ward environmental LLC

Prepared by CEH, 07/15/2010; MAP 2994; W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

Interpolated cPAH concentrations (µg/kg dw) in surface sediments

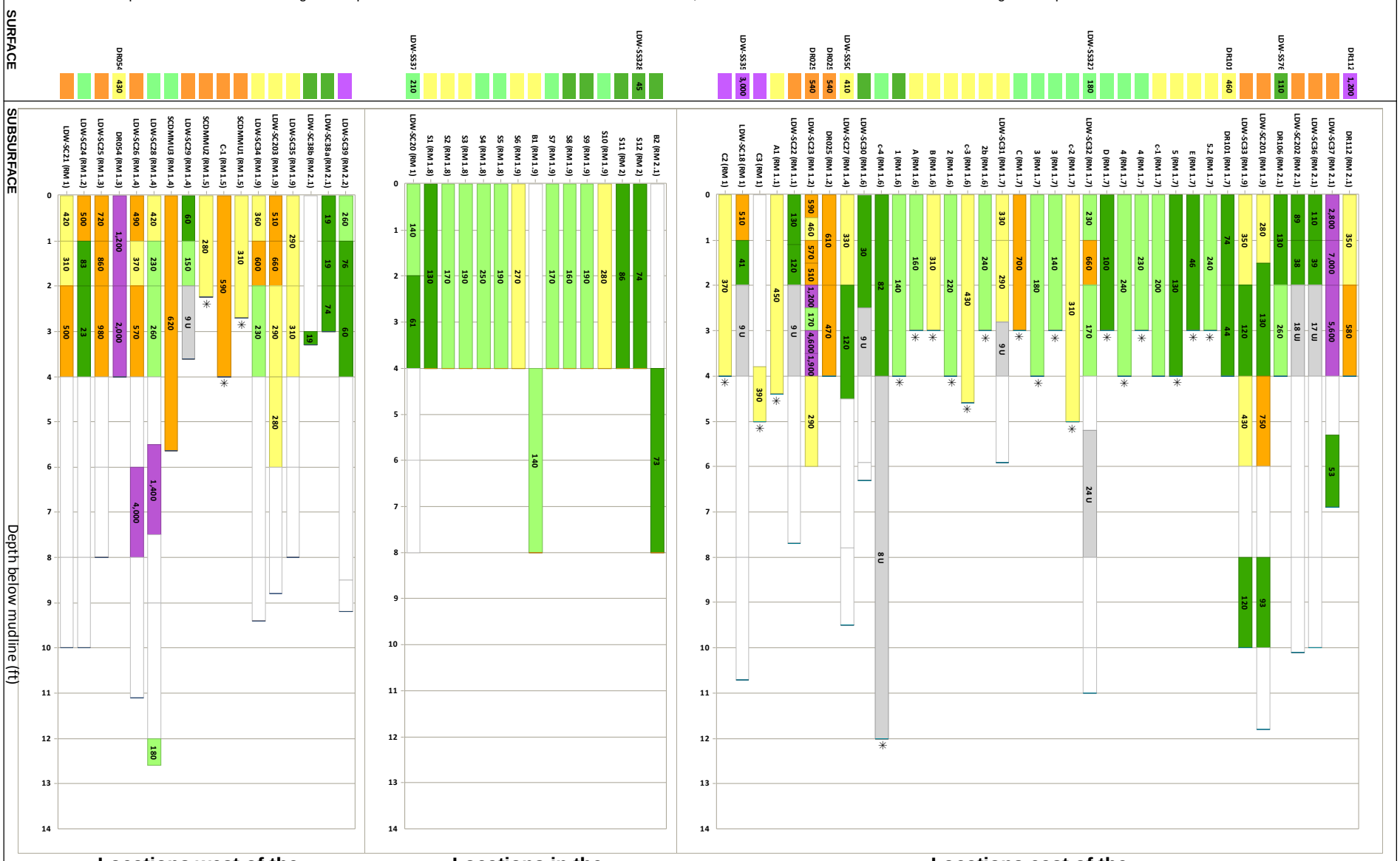


[a] Subsurface sediment data at locations in dredged areas were collected prior to dredging; surface sediment data were collected after dredging.

[b] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 1,100 µg/kg dw). Interpolated concentrations were calculated including locations with non-detected values. TEQs were calculated with mammalian PEFs for seven individual PAH compounds (California EPA 1994), using one-half the RL for undetected compounds. Interpolated surface does not show non-detects.

cPAH concentrations (µg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the IDW concentration at the core location.



Locations west of the navigation channel

Locations in the navigation channel

Locations east of the navigation channel

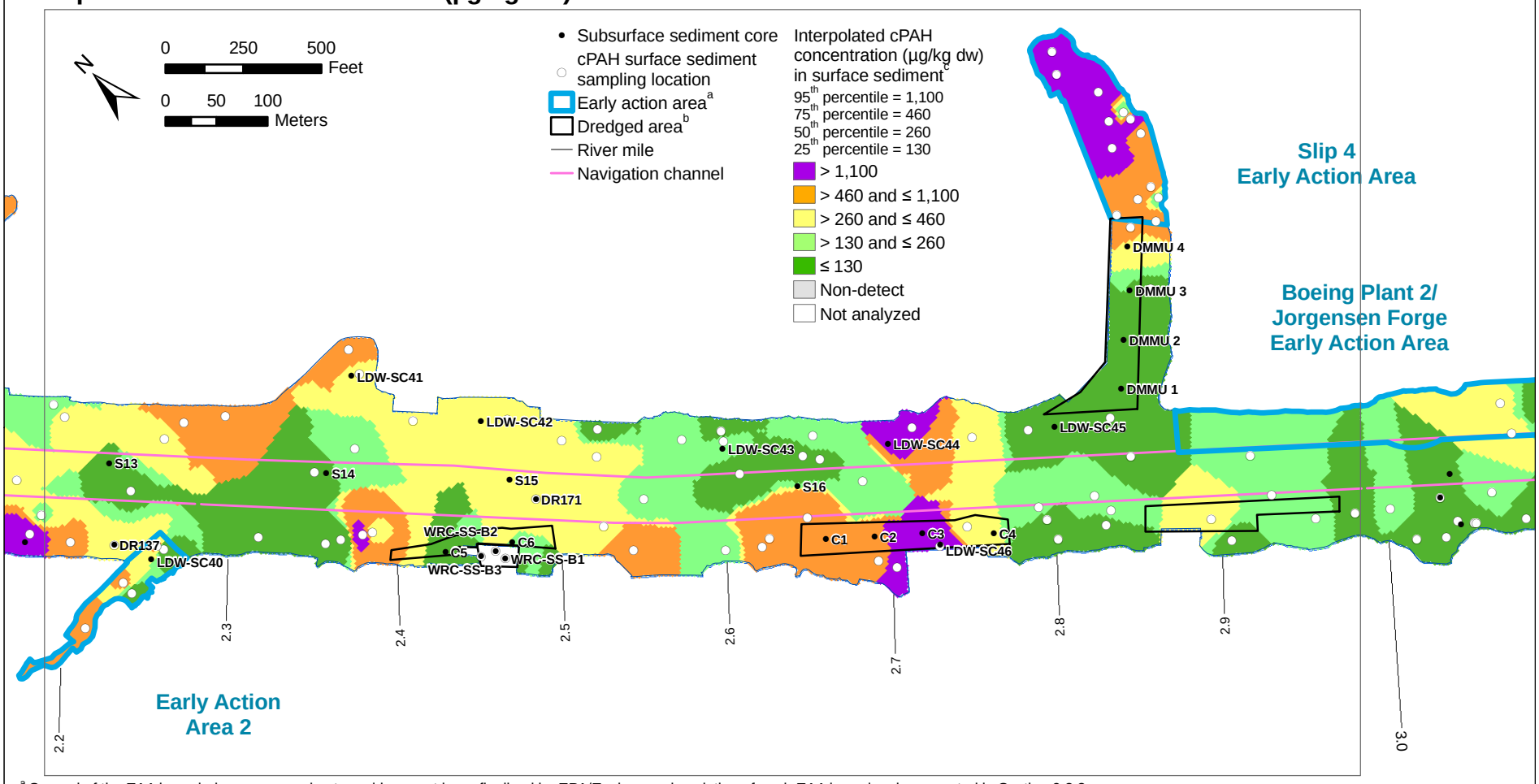
✳ This core was collected prior to dredging at that location.

Prepared by CEH, 07/15/2010; MAP 2994; W:\Projects\00-08-06_Duwamish_Rl\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

Map 4-41b. cPAH concentrations in surface sediment and subsurface sediment cores, RM 1.0 to RM 2.2

Interpolated cPAH concentrations (µg/kg dw) in surface sediments



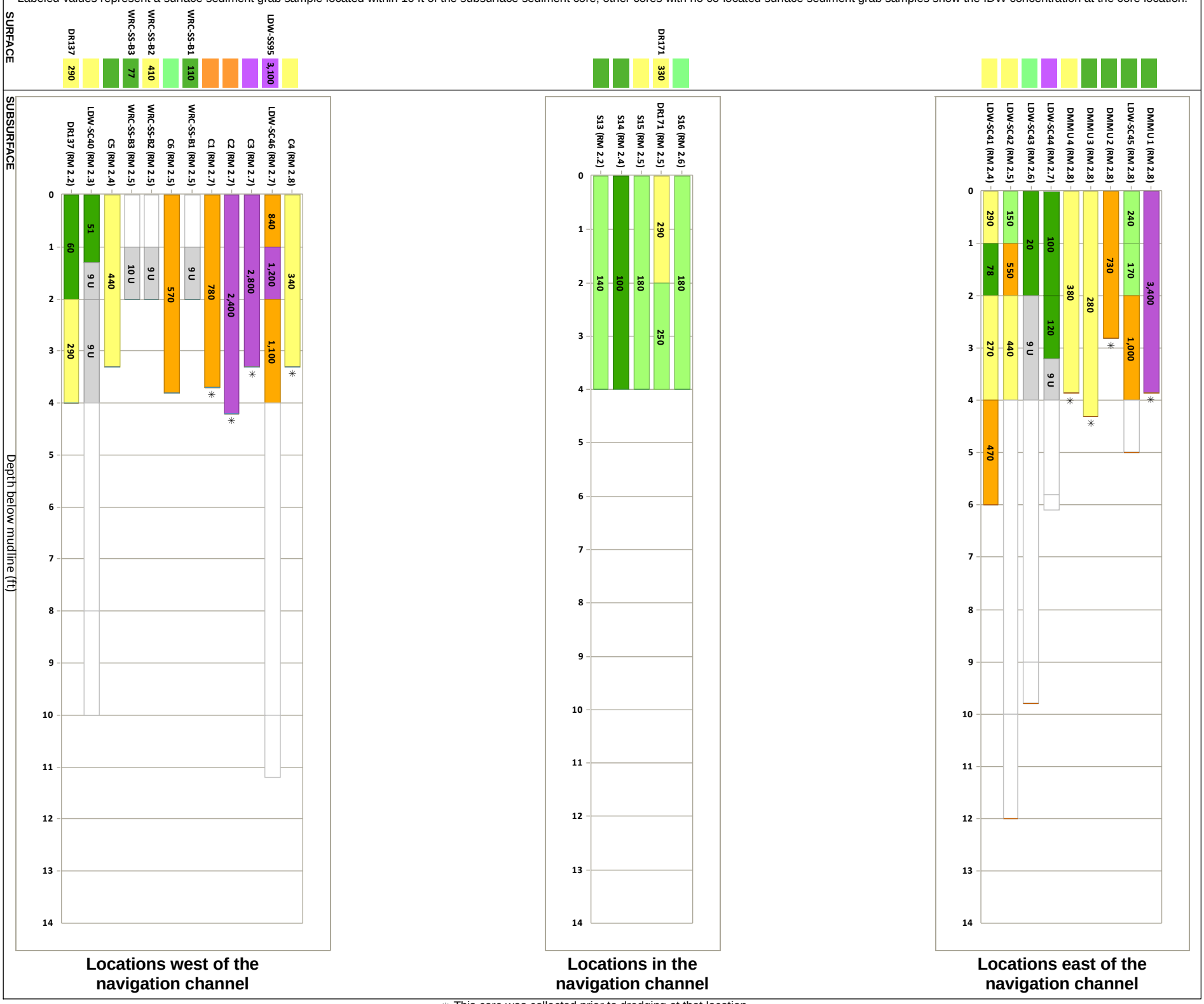
[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[b] Subsurface sediment data at locations in dredged areas were collected prior to dredging; surface sediment data were collected after dredging.

[c] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 1,100 µg/kg dw). Interpolated concentrations were calculated including locations with non-detected values. TEQs were calculated with mammalian PEFs for seven individual PAH compounds (California EPA 1994), using one-half the RL for undetected compounds. Interpolated surface does not show non-detects.

cPAH concentrations (µg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the IDW concentration at the core location.



Locations west of the navigation channel

Locations in the navigation channel

Locations east of the navigation channel

✳ This core was collected prior to dredging at that location.

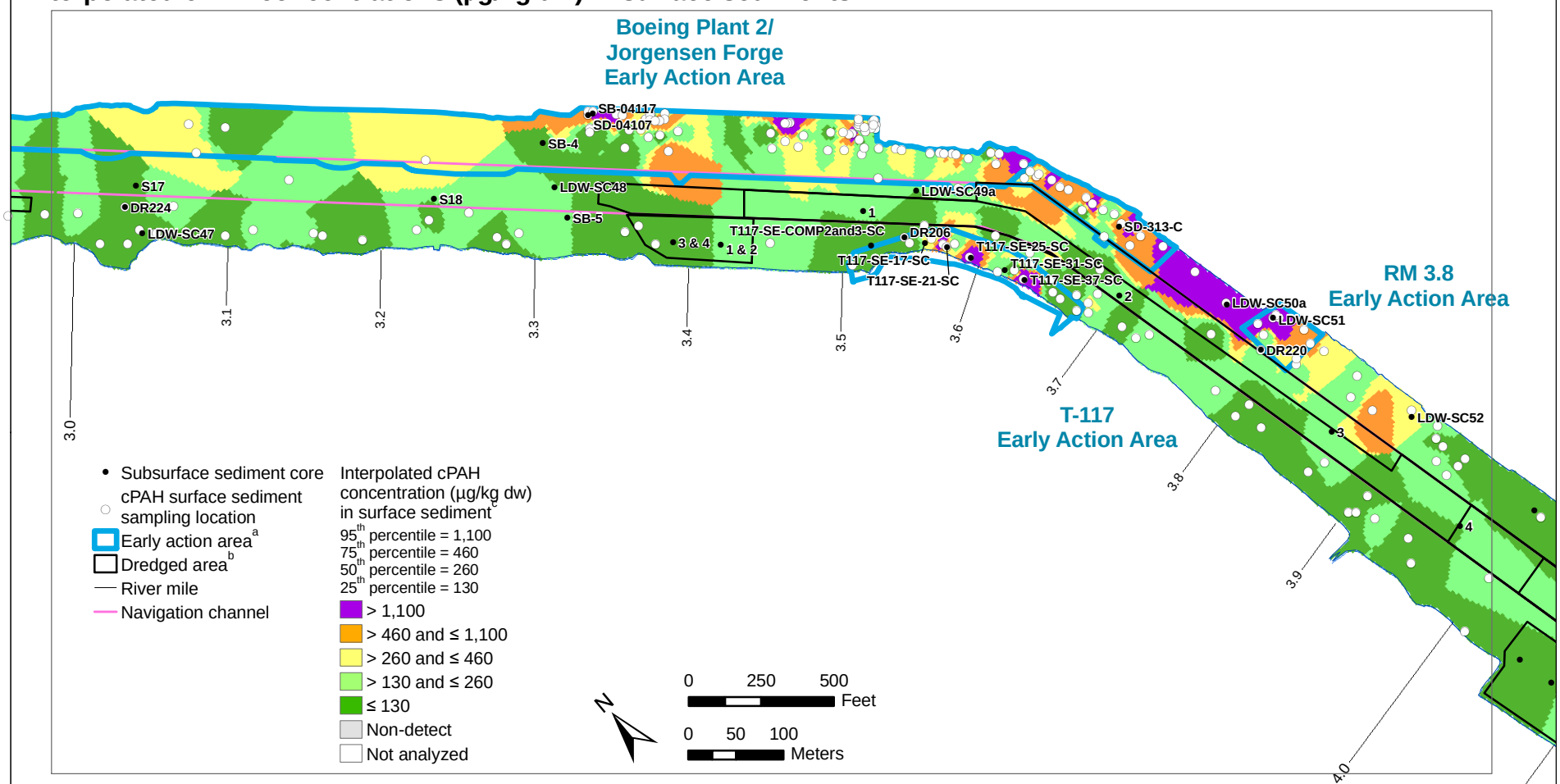
Map 4-41c. cPAH concentrations in surface sediment and subsurface sediment cores, RM 2.2 to RM 3.0

Wind Ward LLC environmental

Prepared by CEH, 07/15/2010; MAP 2994; W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

Interpolated cPAH concentrations (µg/kg dw) in surface sediments



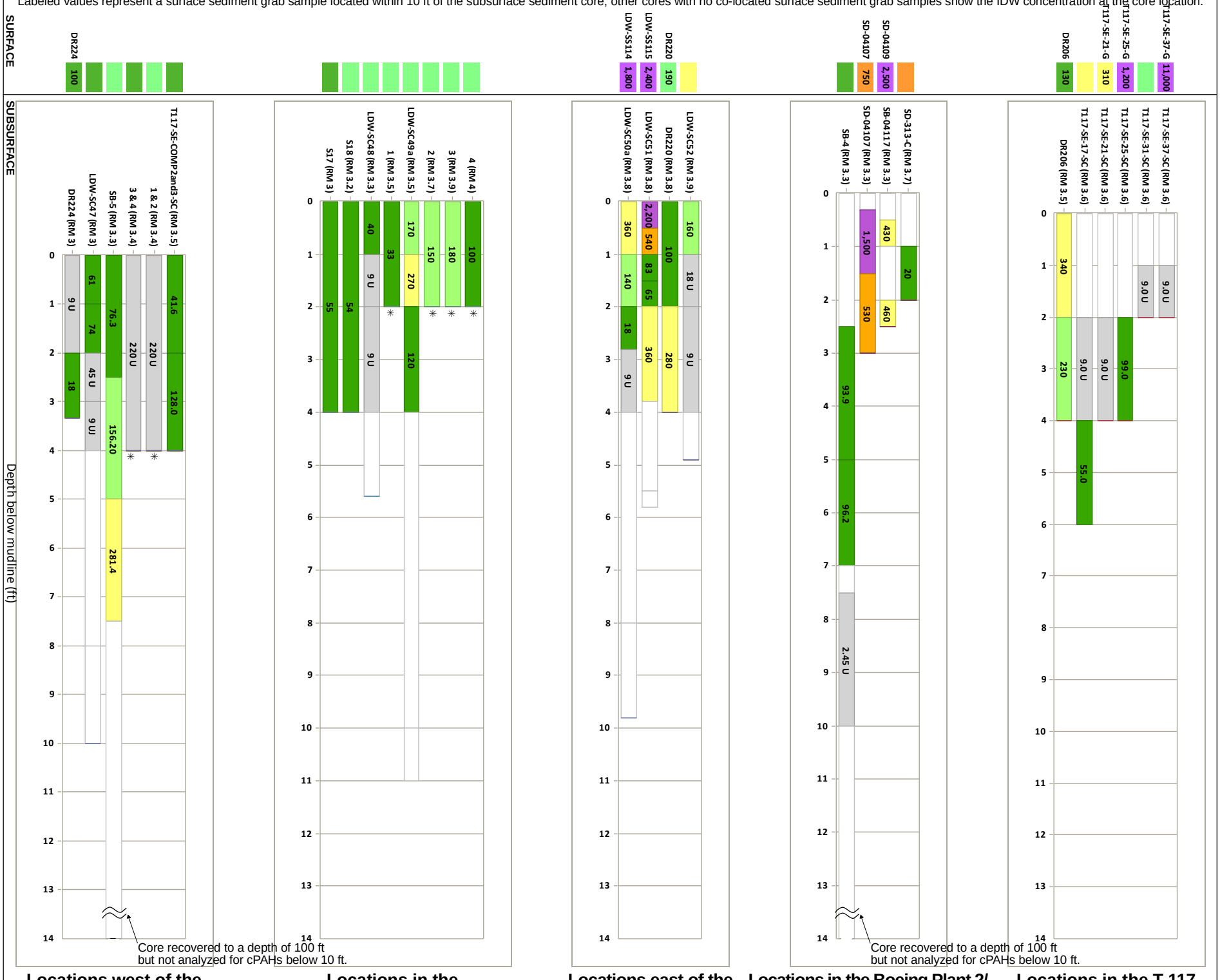
[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[b] Subsurface sediment data at locations in dredged areas were collected prior to dredging; surface sediment data were collected after dredging.

[c] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 1,100 µg/kg dw). Interpolated concentrations were calculated including locations with non-detected values. TEQs were calculated with mammalian PEFs for seven individual PAH compounds (California EPA 1994), using one-half the RL for undetected compounds. Interpolated surface does not show non-detects.

cPAH concentrations (µg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the IDW concentration at the core location.



Locations west of the navigation channel | **Locations in the navigation channel** | **Locations east of the navigation channel** | **Locations in the Boeing Plant 2/ Jorgensen Forge Early Action Area** | **Locations in the T-117 Early Action Area**

✳ This core was collected prior to dredging at that location.

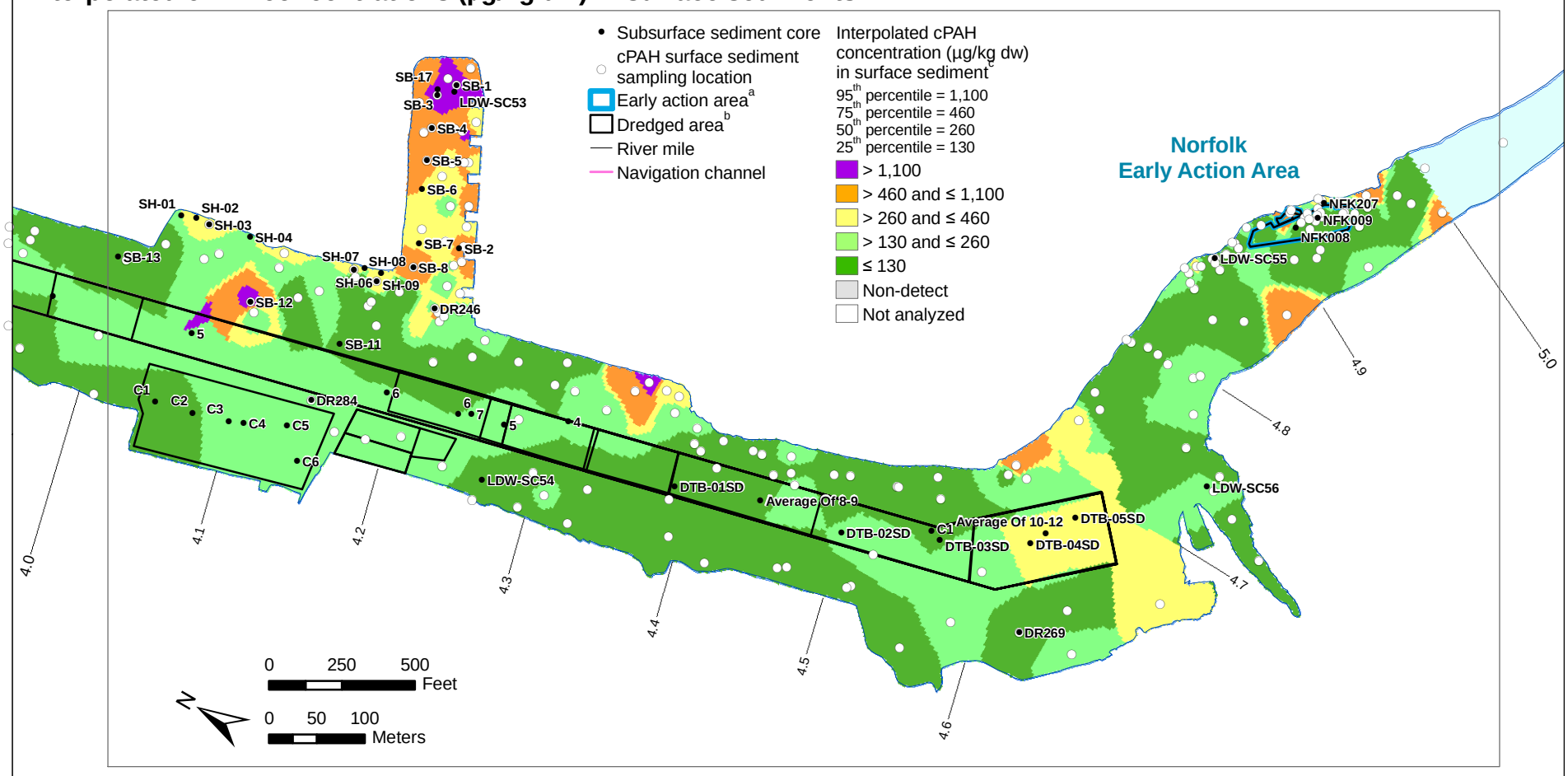
Map 4-41d. cPAH concentrations in surface sediment and subsurface sediment cores, RM 3.0 to RM 4.0

Wind Ward LLC environmental

Prepared by CEH, 07/15/2010; MAP 2994; W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

Interpolated cPAH concentrations (µg/kg dw) in surface sediments



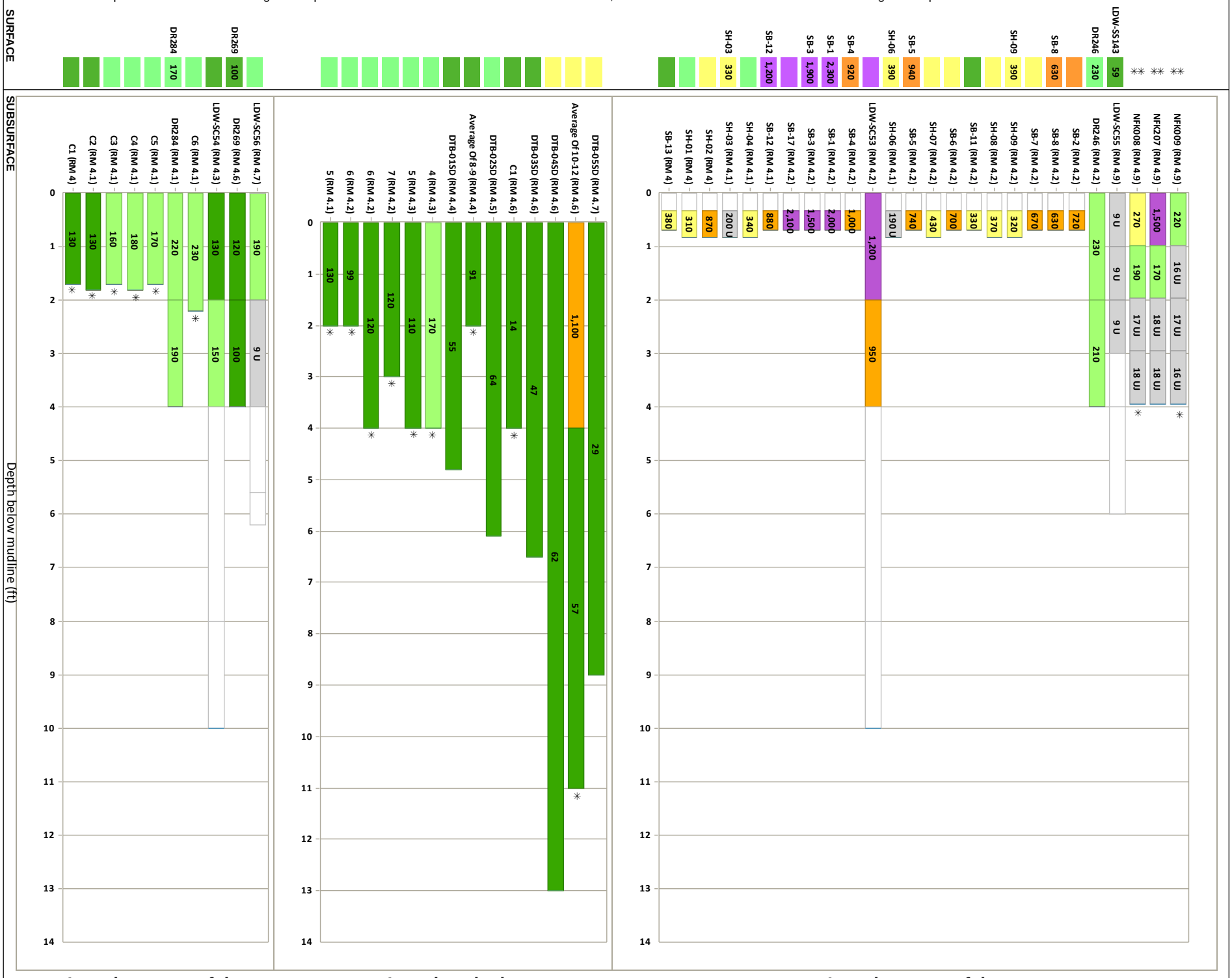
[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[b] For the Norfolk Early Action Area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO/SD removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003. Subsurface sediment data at locations in dredged areas were collected prior to dredging.

[c] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 1,100 µg/kg dw). Interpolated concentrations were calculated including locations with non-detected values. TEQs were calculated with mammalian PEFs for seven individual PAH compounds (California EPA 1994), using one-half the RL for undetected compounds. Interpolated surface does not show non-detects.

cPAH concentrations (µg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the IDW concentration at the core location.



✳ This core was collected prior to dredging at that location.

✳✳ At the Norfolk EAA, surface sediment data, which were collected after the removal action at the Norfolk CSO area in 1999 but before the removal action at the BDC south storm drain outfall area in 2003, do not reflect conditions at the time subsurface cores were collected in 1995.

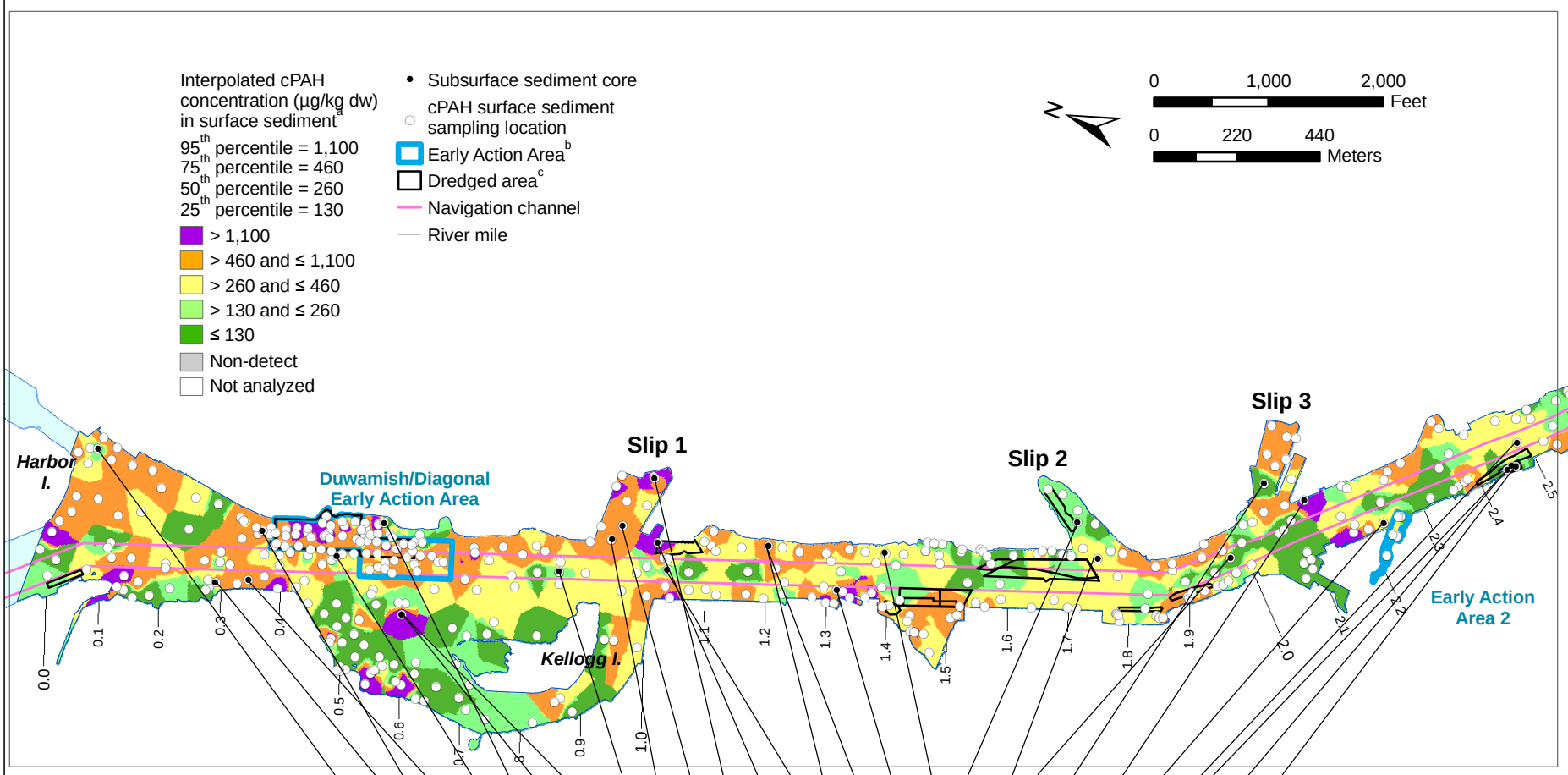
Map 4-41e. cPAH concentrations in surface sediment and subsurface sediment cores, RM 4.0 to RM 5.0

Wind Ward LLC environmental

Prepared by CEH, 07/15/2010; MAP 2994; W:\Projects\00-08-06 Duwamish R\\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

cPAH concentrations (µg/kg dw) in surface sediments, subsurface core data, and co-located (within 10 ft) surface sediment data



[a] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 1,100 µg/kg dw). Interpolated concentrations were calculated including locations with non-detected values. TEQs were calculated with mammalian PEFs for seven individual PAH compounds (California EPA 1994), using one-half the RL for undetected compounds. Interpolated surface does not show non-detects.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

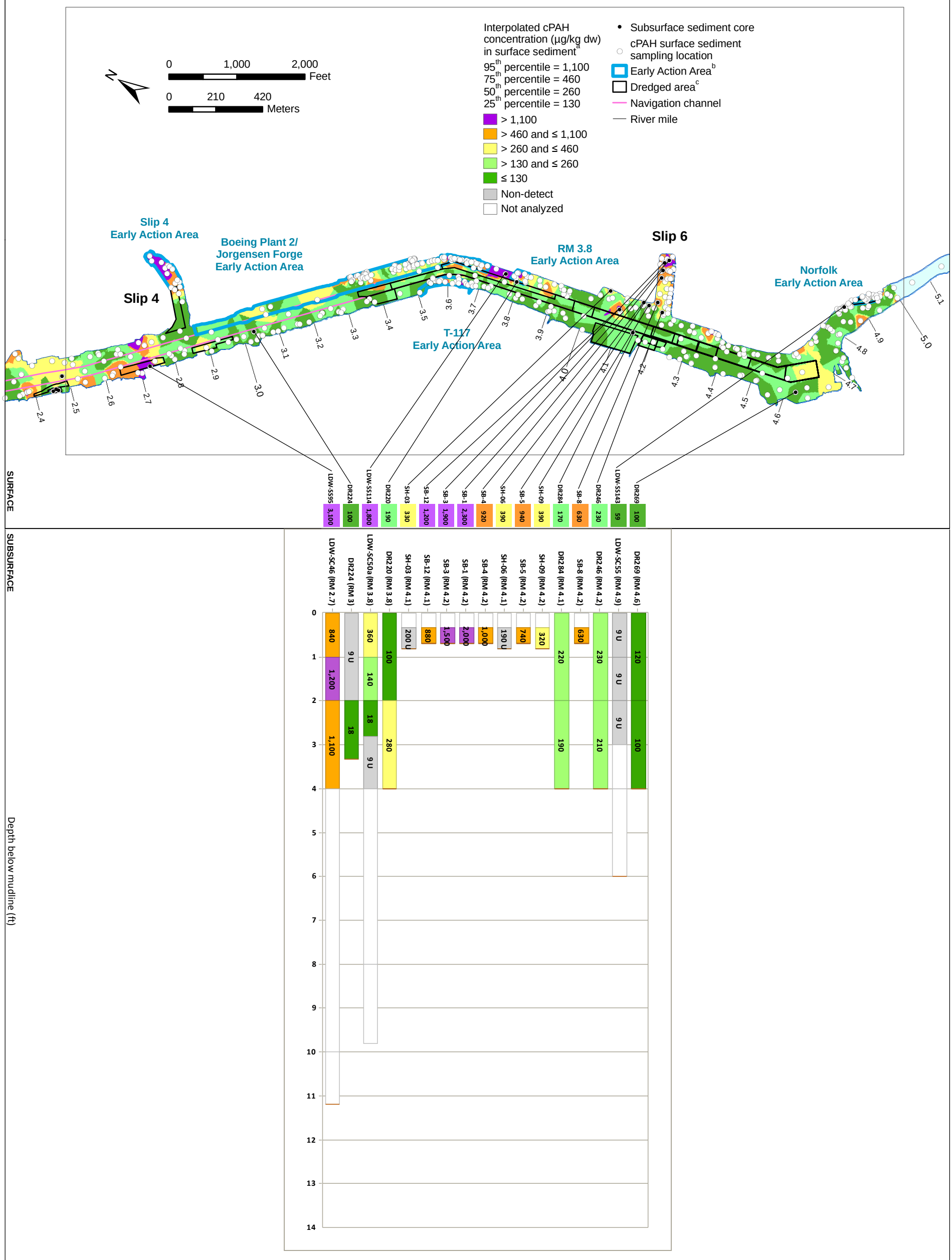
[c] For the Duwamish/Diagonal Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, and thin-layer placement in 2003 to 2005. Subsurface sediment data in dredged areas were collected prior to dredging.

Wind Ward LLC environmental

Map 4-42a. Comparison of cPAH concentrations in subsurface cores to co-located surface sediment locations, RM 0.0 to RM 2.5

Prepared by CEH, 07/16/2010; MAP 3796; W:\Projects\00-08-06_Duwamish_Rl\data\GIS\Phase2 RI\Nature and Extent\Subsurface\Colocation
Dredging information provided by AECOM.

cPAH concentrations (µg/kg dw) in surface sediments, subsurface core data, and co-located (within 10 ft) surface sediment data



[a] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 1,100 µg/kg dw). Interpolated concentrations were calculated including locations with non-detected values. TEQs were calculated with mammalian PEFs for seven individual PAH compounds (California EPA 1994), using one-half the RL for undetected compounds. Interpolated surface does not show non-detects.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] For the Norfolk Early Action Area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003. Subsurface sediment data in dredged areas were collected prior to dredging.

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Map 4-42b. Comparison of cPAH concentrations in subsurface cores to co-located surface sediment locations, RM 2.5 to RM 5.0

Prepared by CEH, 07/16/2010; MAP 3796; W:\Projects\00-08-06_Duwamish_R\data\GIS\Phase2 R\\Nature and Extent\Subsurface\Colocation

Dredging information provided by ENSR.

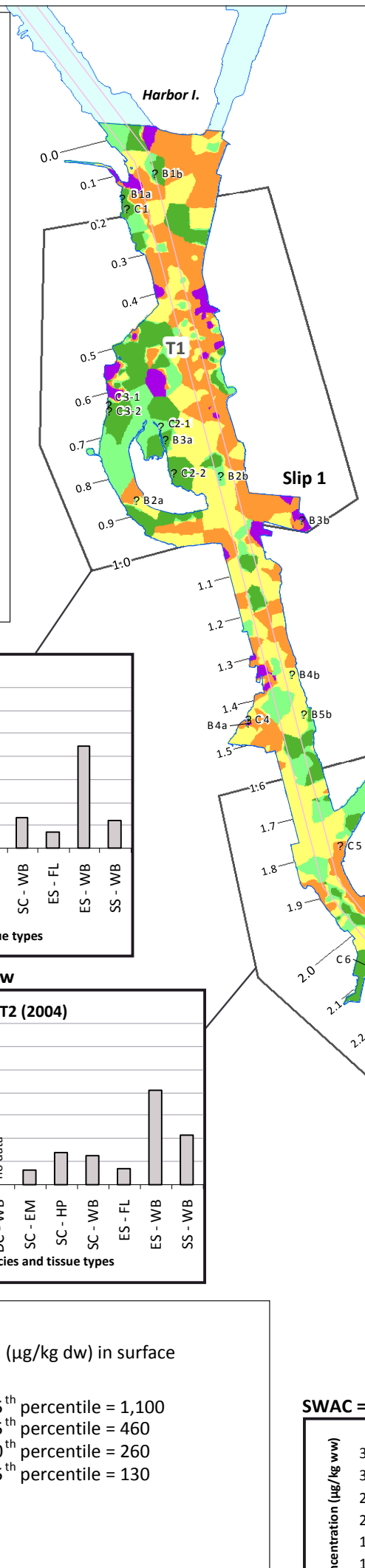
Graph Legend

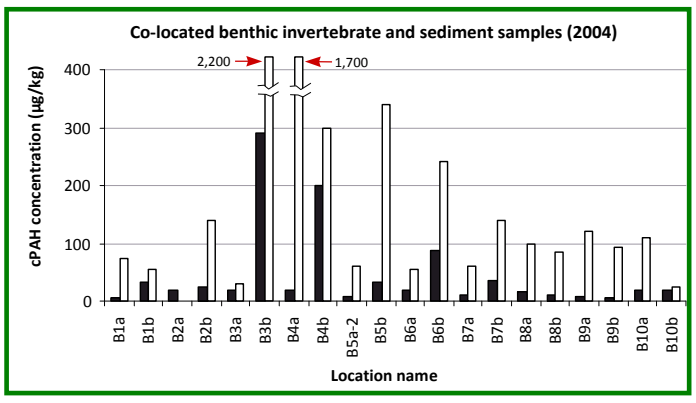
- Co-located cPAH concentration in sediment
- Co-located cPAH concentration in benthic invertebrate or clam tissue
- Mean cPAH concentration in tissue
- ∗ cPAHs were not detected for this tissue type in this area; half the RL was used

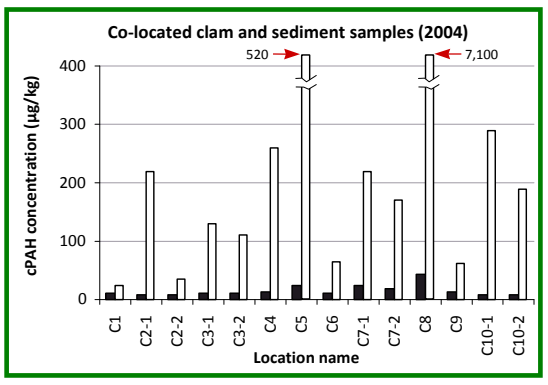
Acronyms for species and tissue type

DC - Dungeness crab
SC - Slender crab
ES - English sole
SS - Shiner surfperch
EM - Edible meat
FL - Fillet with skin
HP - Hepatopancreas
WB - Whole body

Note: Results for Pacific staghorn sculpin and English sole fillet without skin are not presented because of the low detection frequency and high reporting limits (see Section 4.2.3.4).

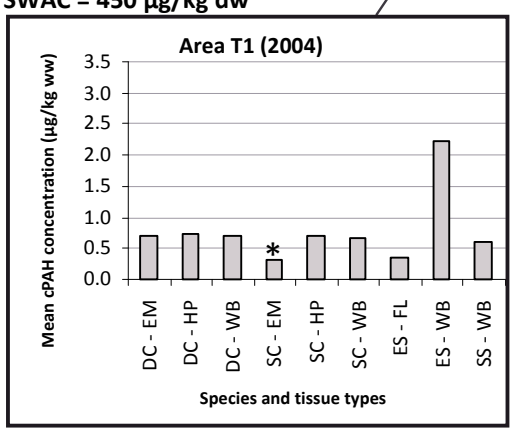




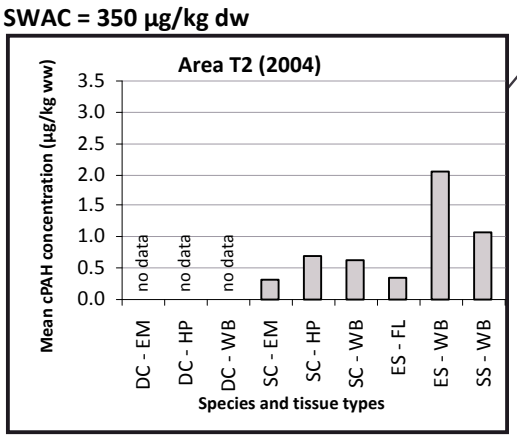


Note: Clam and benthic invertebrate tissue concentrations are in wet weight and sediment concentrations are in dry weight. Depurated clam samples were also analyzed for cPAHs in 2007 but are not shown on this figure.

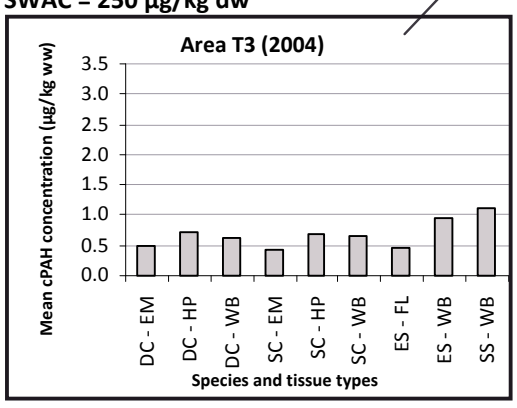
SWAC = 450 µg/kg dw



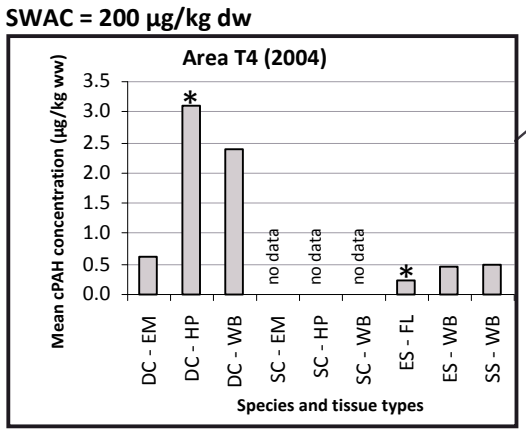
SWAC = 350 µg/kg dw



SWAC = 250 µg/kg dw



SWAC = 200 µg/kg dw



Map Legend

Interpolated cPAH concentration (µg/kg dw) in surface sediment[a,b]

- > 1,100
- > 460 and ≤ 1,100
- > 260 and ≤ 460
- > 130 and ≤ 260
- ≤ 130

95th percentile = 1,100
75th percentile = 460
50th percentile = 260
25th percentile = 130

- Co-located benthic invertebrate and sediment sampling location
- Co-located softshell clam and sediment sampling location
- Tissue sampling area
- Navigation channel
- River mile

SWAC - spatially weighted average concentration

[a] Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated values ≤ 1,100 µg/kg dw). Interpolated concentrations were calculated including locations with non-detected values. TEQs were calculated with mammalian PEFs for seven individual PAH compounds (California EPA 1994), using one-half the RL for undetected compounds.

[b] For the Duwamish/Diagonal early action area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005. For the Norfolk early action area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

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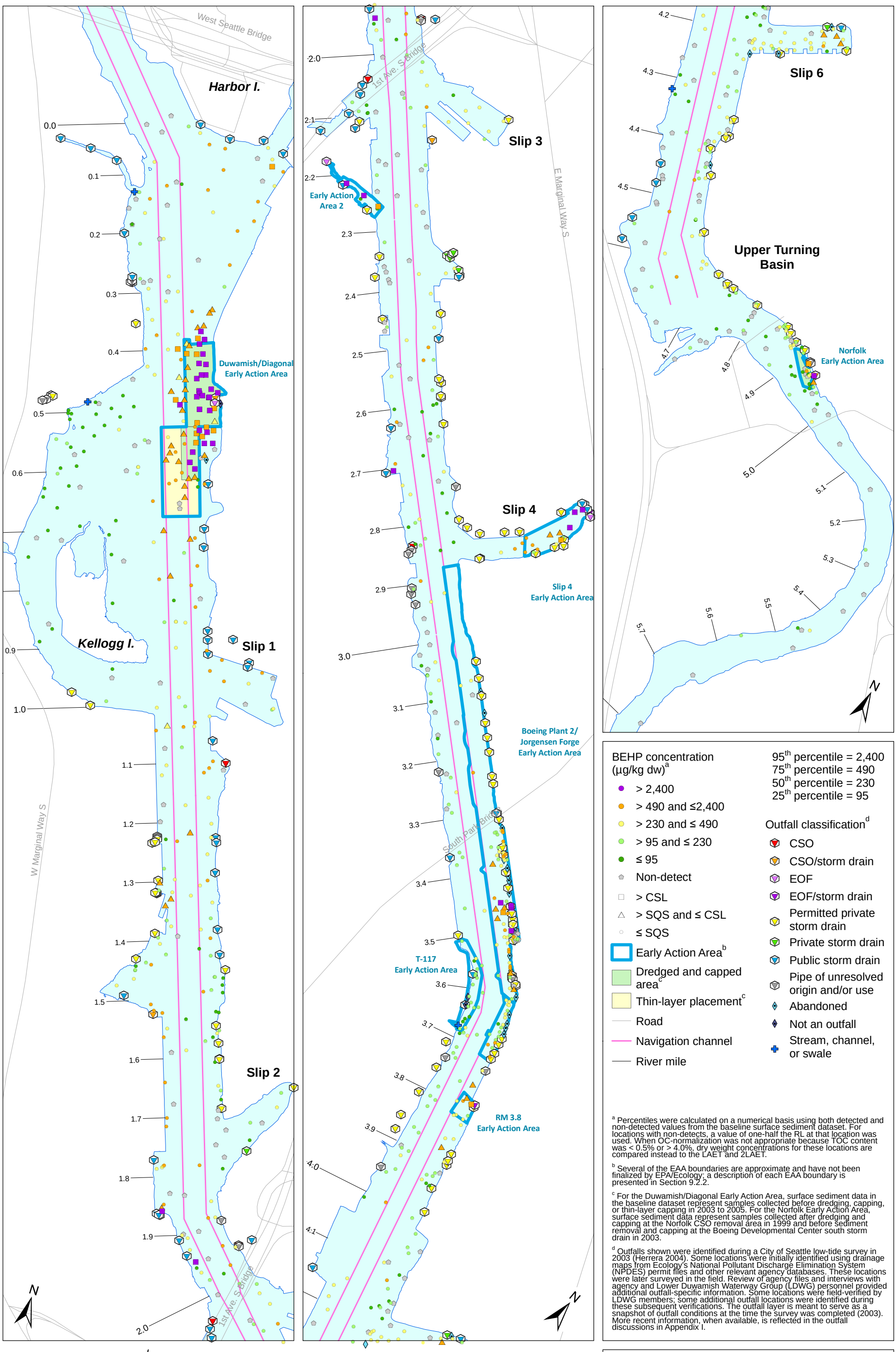
0 0.25 0.5 Miles
0 0.25 0.5 Kilometers

Map 4-43. cPAH concentrations in composite tissue samples of fish, crabs, clams, and benthic invertebrate community superimposed on the IDW interpolation of cPAH concentrations in surface sediment

Modified by Zachariah from GIS Map 2760 | July 16, 2009 | Map 4-43 (2760).xar



BEHP concentration (µg/kg dw)[a]

- > 2,400
- > 490 and ≤2,400
- > 230 and ≤ 490
- > 95 and ≤ 230
- ≤ 95
- Non-detect
- > CSL
- > SQS and ≤ CSL
- ≤ SQS
- Early Action Area[b]
- Dredged and capped area[c]
- Thin-layer placement[c]
- Road
- Navigation channel
- River mile

95th percentile = 2,400
75th percentile = 490
50th percentile = 230
25th percentile = 95

Outfall classification[d]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, a value of one-half the RL at that location was used. When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations are compared instead to the LAET and 2LAET.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] For the Duwamish/Diagonal Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer capping in 2003 to 2005. For the Norfolk Early Action Area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

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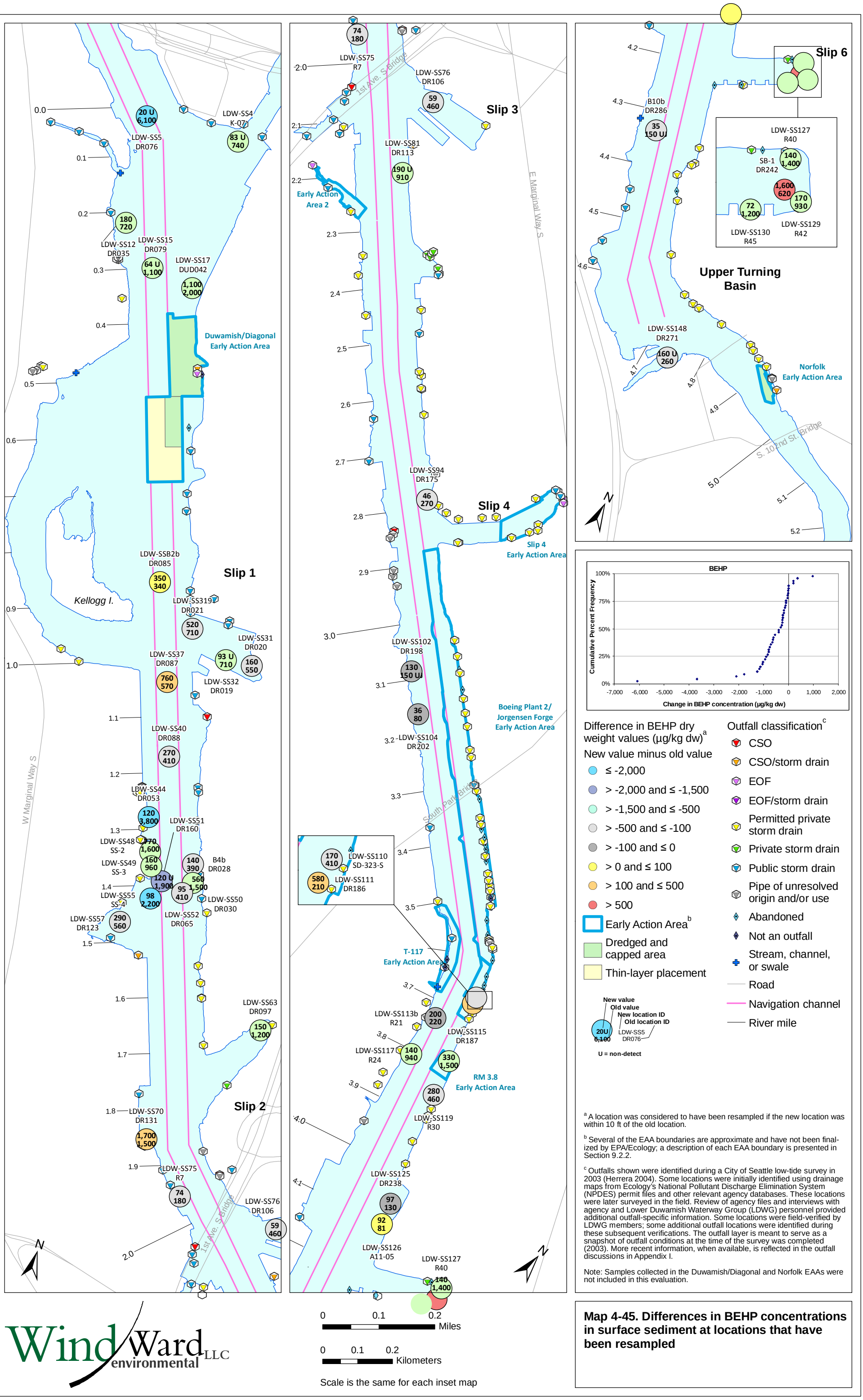
0 0.1 0.2 Miles

0 0.1 0.2 Kilometers

Scale is the same for each inset map

Map 4-44. BEHP concentrations in surface sediment

Prepared by CEH, 07/15/2010; MAP 2771; W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 R\Nature and Extent\Surface Sediment\Other COCs



Difference in BEHP dry weight values (µg/kg dw)[a]

New value minus old value

- ≤ -2,000
- > -2,000 and ≤ -1,500
- > -1,500 and ≤ -500
- > -500 and ≤ -100
- > -100 and ≤ 0
- > 0 and ≤ 100
- > 100 and ≤ 500
- > 500
- Early Action Area[b]
- Dredged and capped area
- Thin-layer placement

New value / Old value / New location ID / Old location ID — 20U 6,100 — LDW-SS5 DR076

U = non-detect

Outfall classification[c]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale
- Road
- Navigation channel
- River mile

[a] A location was considered to have been resampled if the new location was within 10 ft of the old location.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

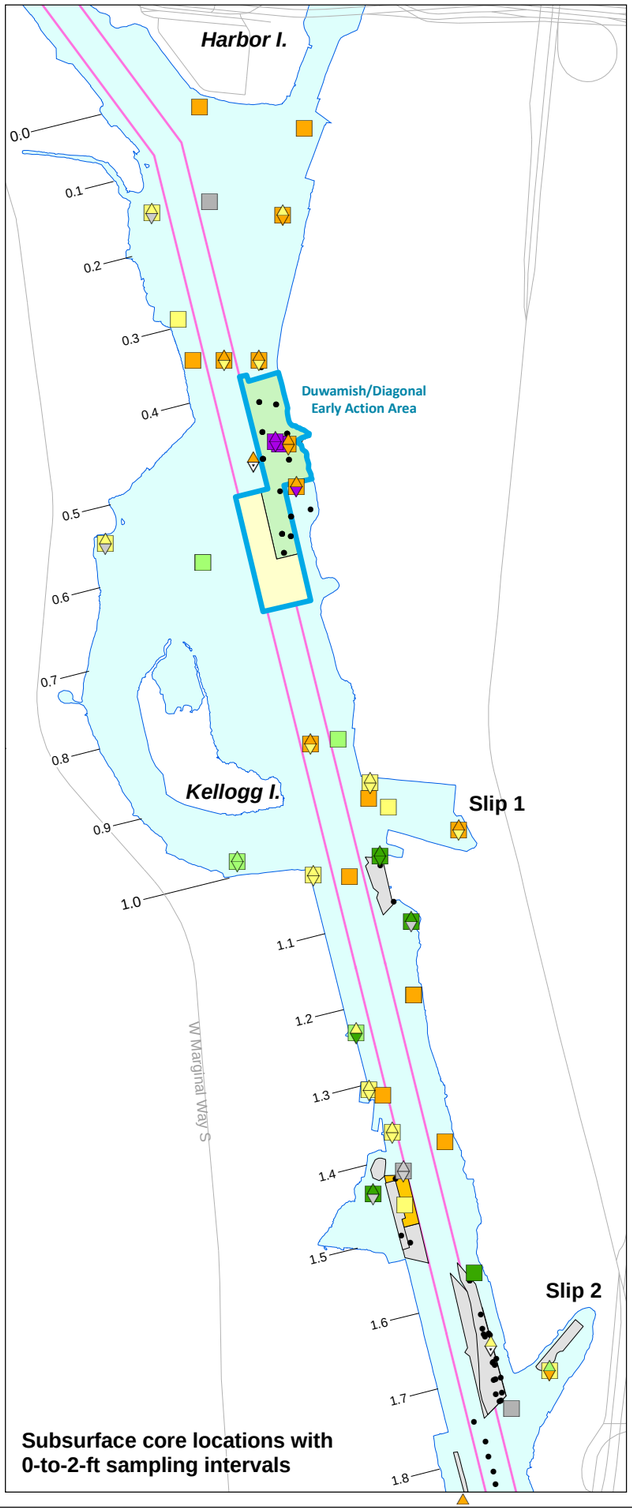
[c] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time of the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

Note: Samples collected in the Duwamish/Diagonal and Norfolk EAAs were not included in this evaluation.

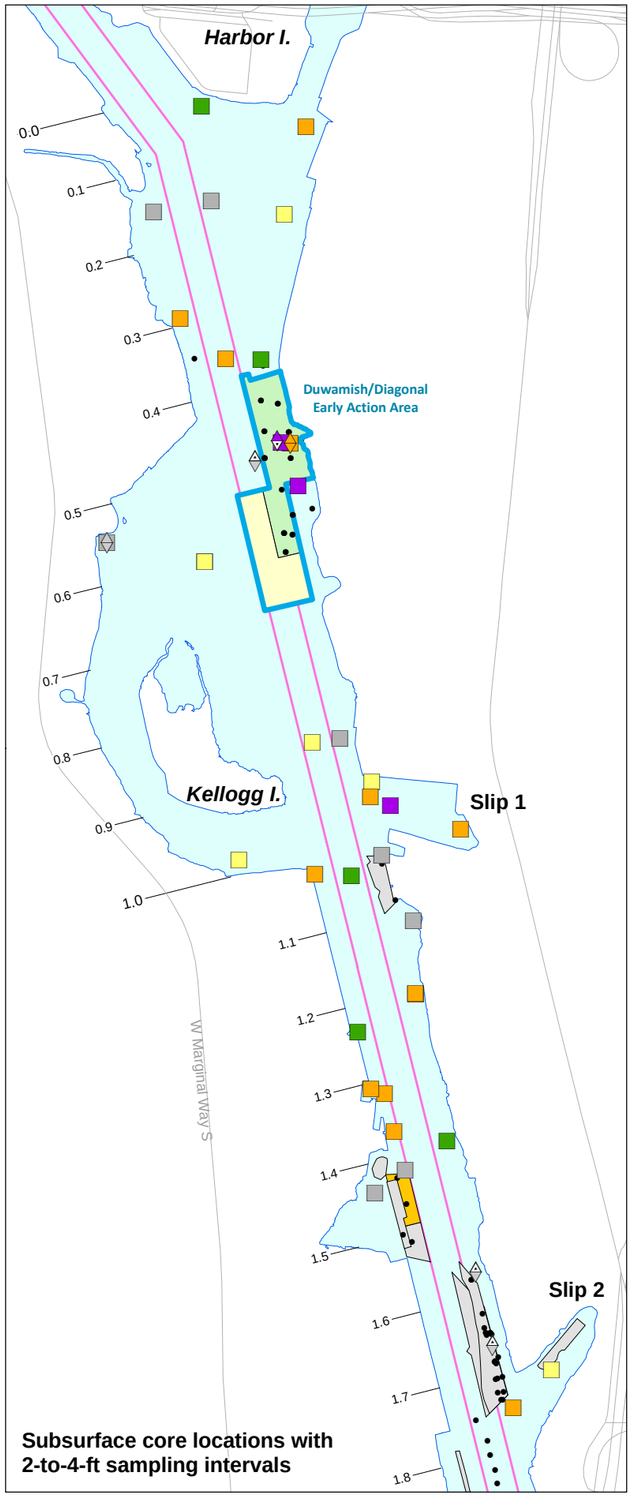
Scale is the same for each inset map

Map 4-45. Differences in BEHP concentrations in surface sediment at locations that have been resampled

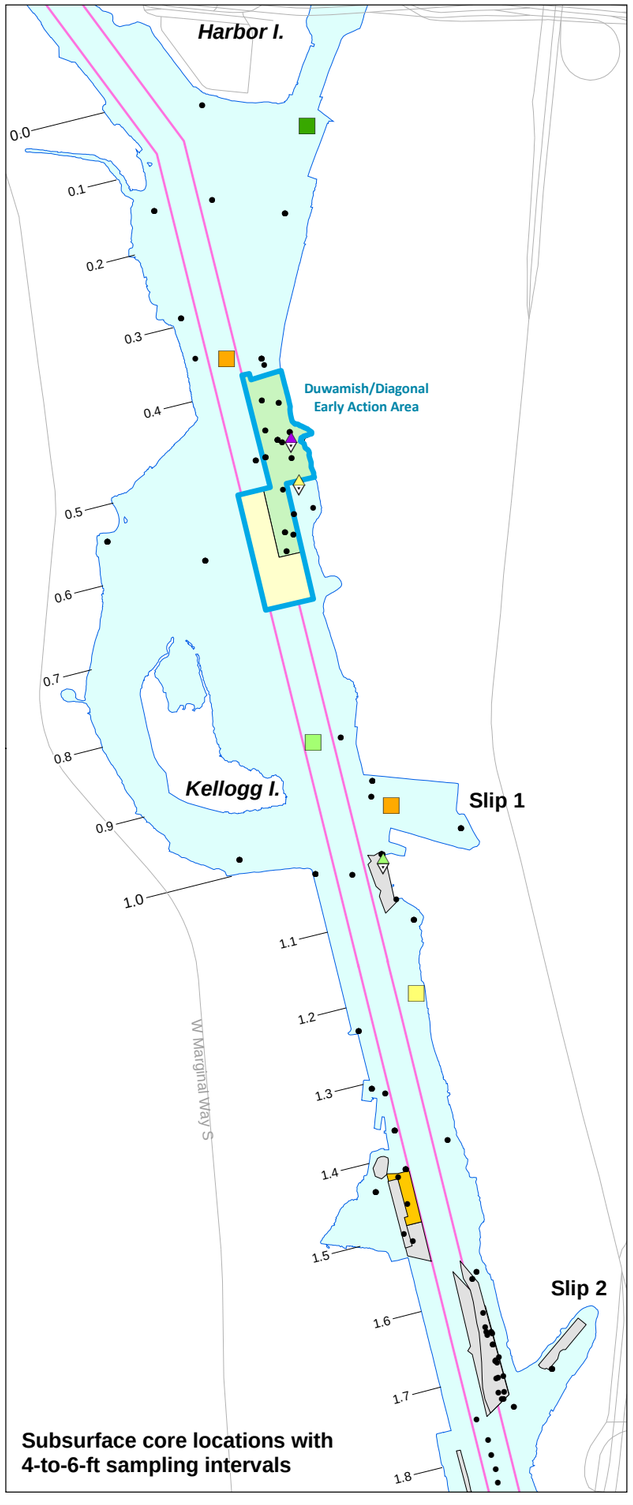
Prepared by CEH, 07/15/2010, MAP 2734: W:\Projects\00-08-06 Duwamish_Riv\data\gis\Phase2 RI\Nature and Extent\Round3 Trumping



Subsurface core locations with 0-to-2-ft sampling intervals



Subsurface core locations with 2-to-4-ft sampling intervals



Subsurface core locations with 4-to-6-ft sampling intervals

BEHP concentration (µg/kg dw)[a]

> 2,400	95th percentile = 2,400
> 490 and ≤ 2,400	75th percentile = 490
> 230 and ≤ 490	50th percentile = 230
> 95 and ≤ 230	25th percentile = 95
≤ 95	
Non-detect	

Sampling interval

	Left panel	Middle panel	Right panel
	0-to-2-ft[b]	2-to-4-ft[b]	4-to-6-ft[b]
	0-to-1-ft[c]	2-to-3-ft[c]	4-to-5-ft[c]
	1-to-2-ft[c]	3-to-4-ft[c]	5-to-6-ft[c]

△ Not analyzed in that sampling interval

Other subsurface sampling locations
• analyzed for BEHP but not in the illustrated sampling intervals

Early Action Area[d]
Dredged area[e]
Dredged and capped area[e]
Dredged and thin-layer placement[e]
Thin-layer placement
Navigation channel
River mile

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, a value of one-half the RL at that location was used.

[b] Data from 2-foot sampling intervals; some locations show an average of data from both 1-foot intervals within that 2-foot interval at a given location.

[c] Data from 1-foot sampling intervals are shown if available. If both 1-foot intervals within the 2-foot interval were collected, the average of the two intervals is also shown.

[d] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[e] Subsurface sediment data at locations in dredged areas were collected prior to dredging.

N

0 0.1 0.2 Kilometers

0 0.1 0.2 Miles

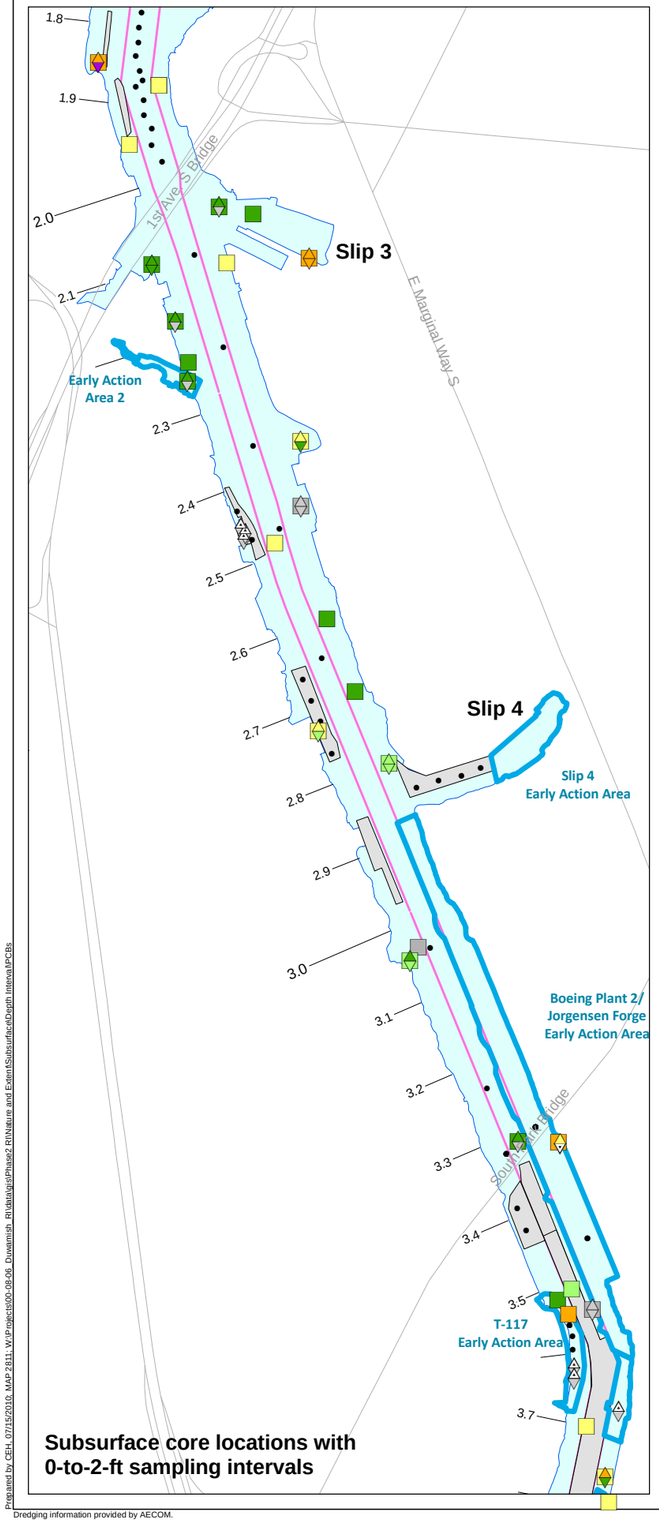
Scale is the same for each map frame

Map 4-46a. BEHP concentrations in subsurface sediment within the 0-to-2-ft, 2-to-4-ft, and 4-to-6-ft sampling intervals, RM 0.0 to RM 1.8

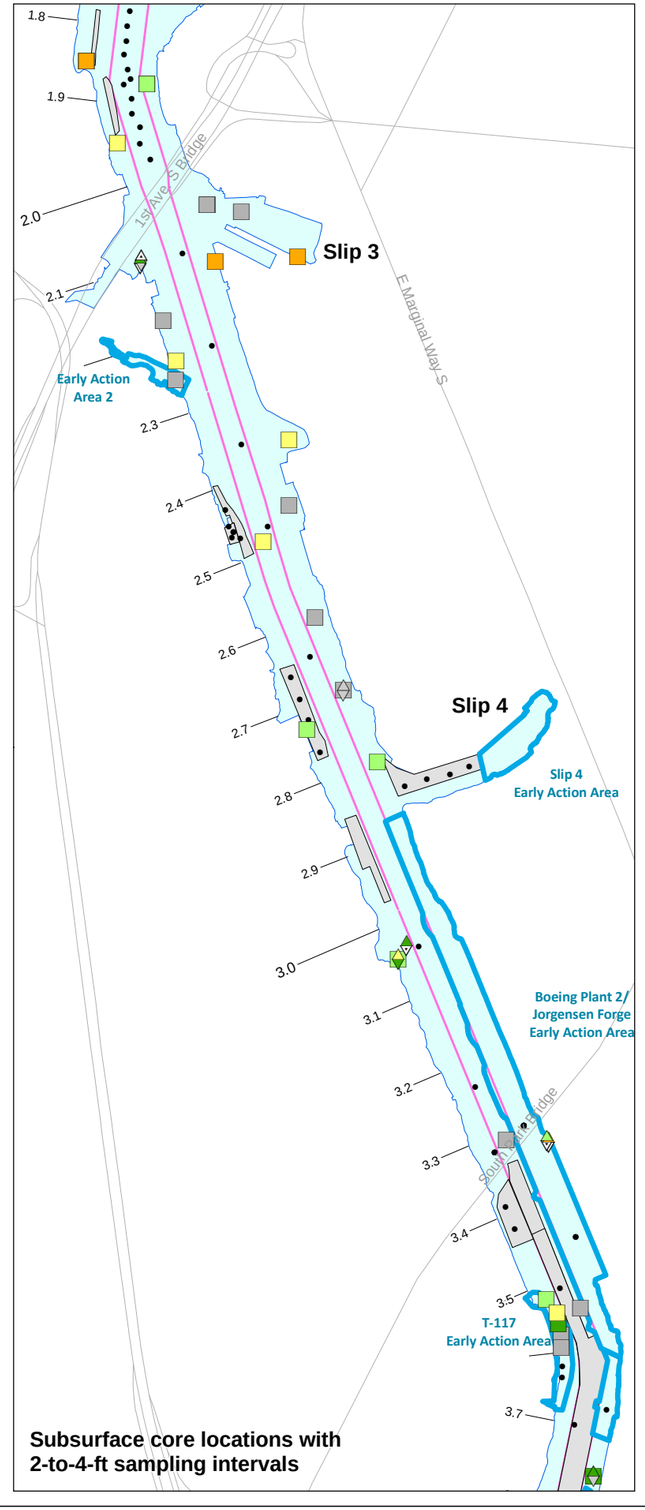
Wind Ward LLC environmental

Prepared by CEH, 07/15/2010, MAP 2811, W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\cDepth Interval\PCBs

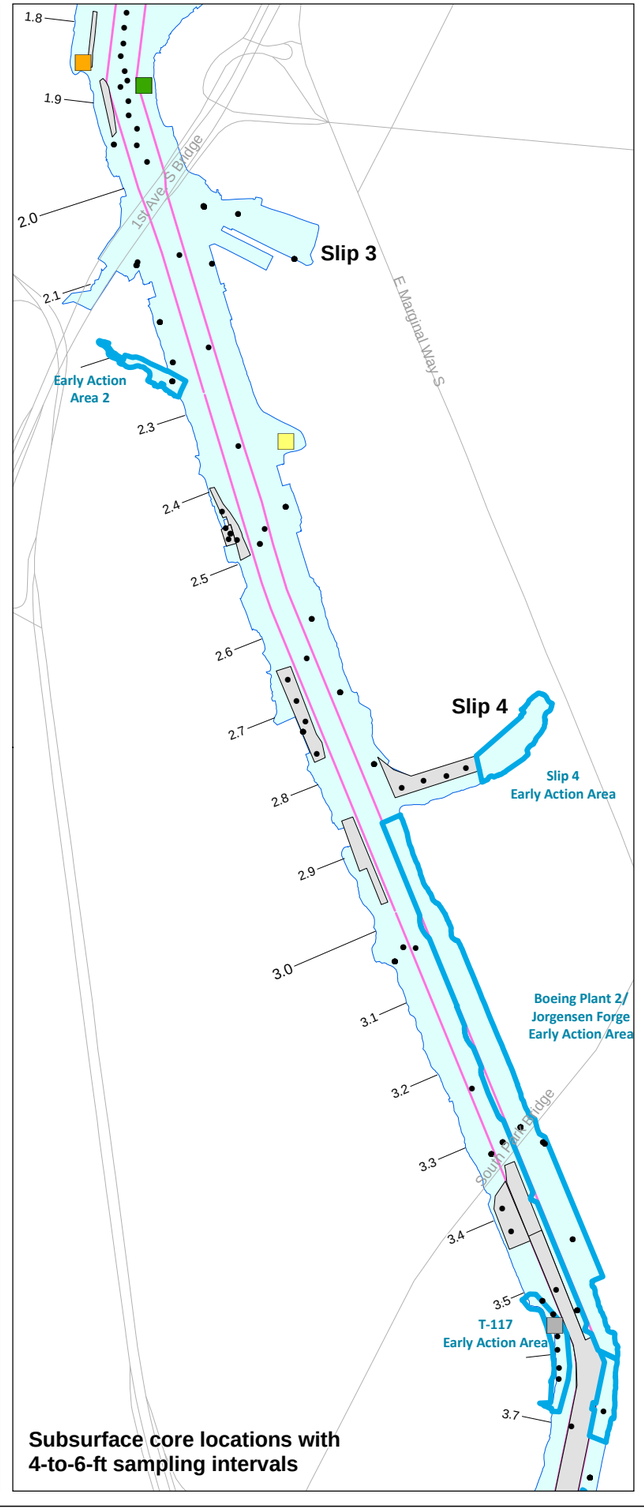
Dredging information provided by AECOM.



Subsurface core locations with 0-to-2-ft sampling intervals



Subsurface core locations with 2-to-4-ft sampling intervals



Subsurface core locations with 4-to-6-ft sampling intervals

BEHP concentration (µg/kg dw)[a]

- > 2,400
- > 490 and ≤ 2,400
- > 230 and ≤ 490
- > 95 and ≤ 230
- ≤ 95
- Non-detect

95th percentile = 2,400
75th percentile = 490
50th percentile = 230
25th percentile = 95

Sampling interval

	Left panel	Middle panel	Right panel
□	0-to-2-ft[b]	2-to-4-ft[b]	4-to-6-ft[b]
◇	0-to-1-ft[c]	2-to-3-ft[c]	4-to-5-ft[c]
◇	1-to-2-ft[c]	3-to-4-ft[c]	5-to-6-ft[c]

△ Not analyzed in that sampling interval

Other subsurface sampling locations
• analyzed for BEHP but not in the illustrated sampling intervals

Early Action Area[d]

Dredged area[e]

Navigation channel

River mile

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, a value of one-half the RL at that location was used.

[b] Data from 2-foot sampling intervals; some locations show an average of data from both 1-foot intervals within that 2-foot interval at a given location.

[c] Data from 1-foot sampling intervals are shown if available. If both 1-foot intervals within the 2-foot interval were collected, the average of the two intervals is also shown.

[d] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[e] Subsurface sediment data at locations in dredged areas were collected prior to dredging.

0 0.1 0.2 Kilometers

0 0.1 0.2 Miles

Scale is the same for each map frame

Map 4-46b. BEHP concentrations in subsurface sediment within the 0-to-2-ft, 2-to-4-ft, and 4-to-6-ft sampling intervals, RM 1.8 to RM 3.7

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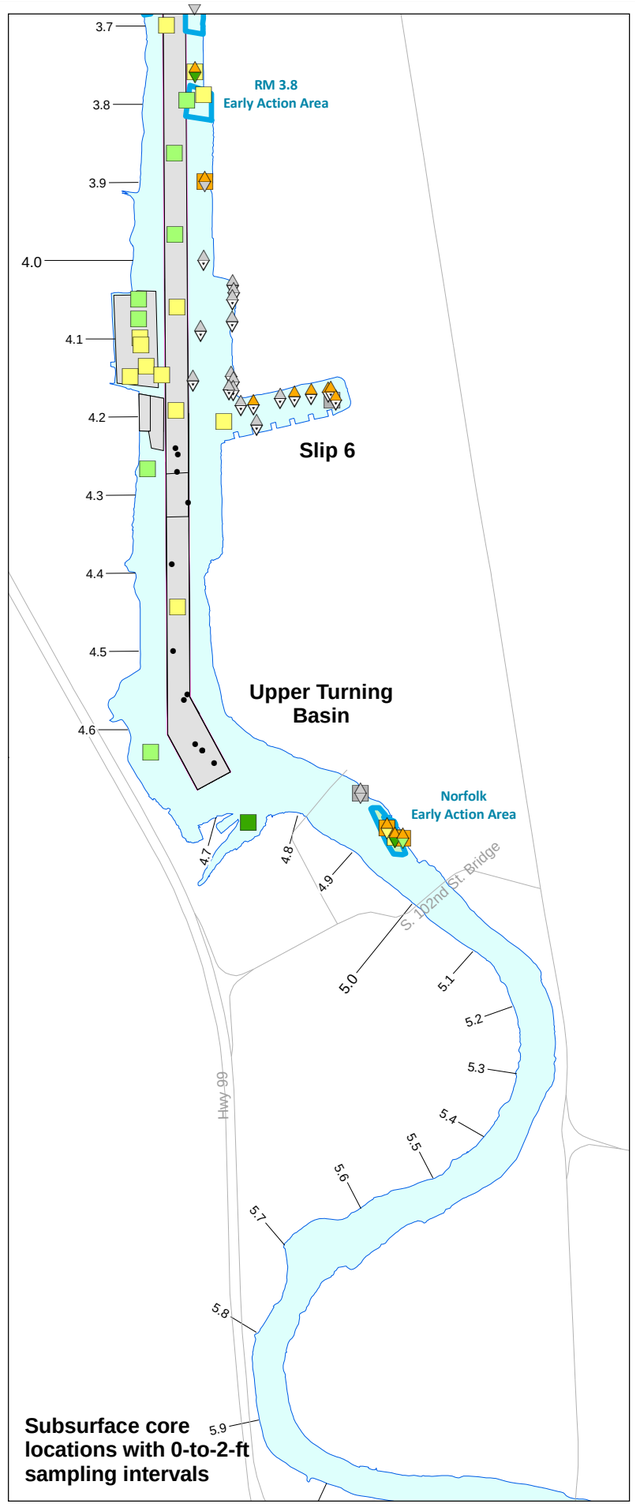
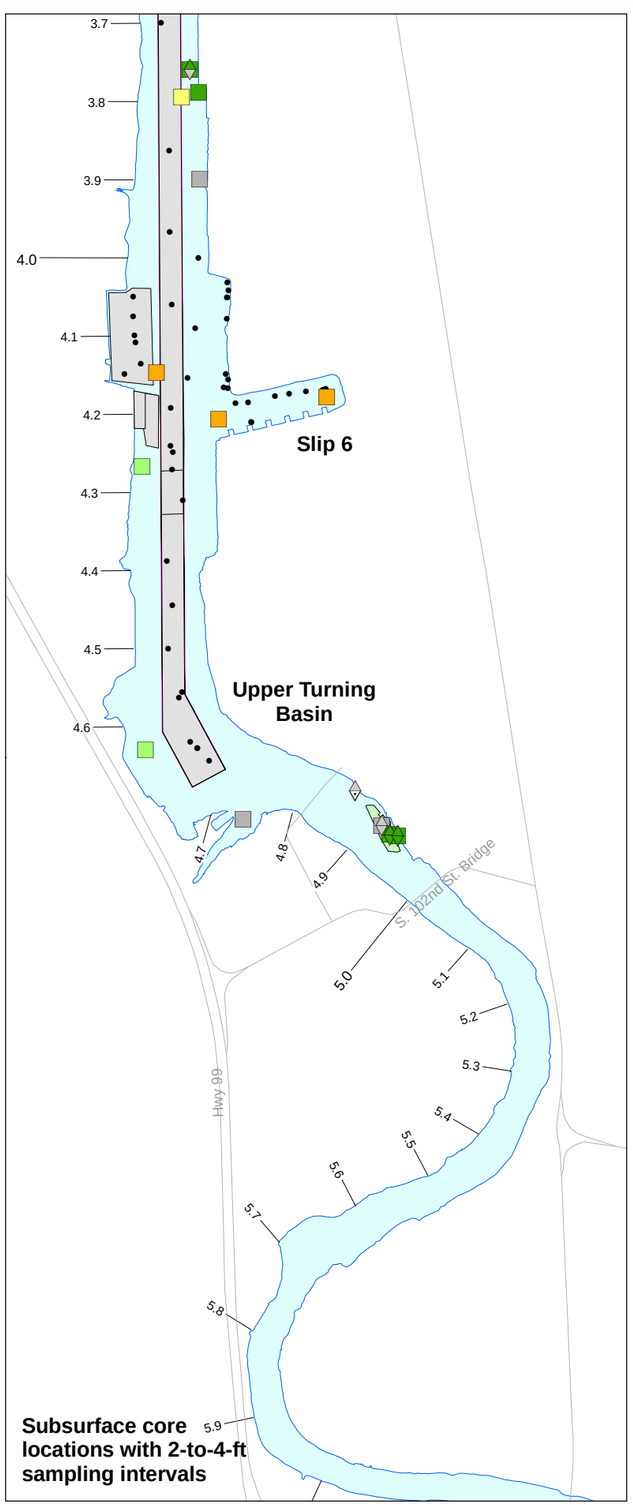
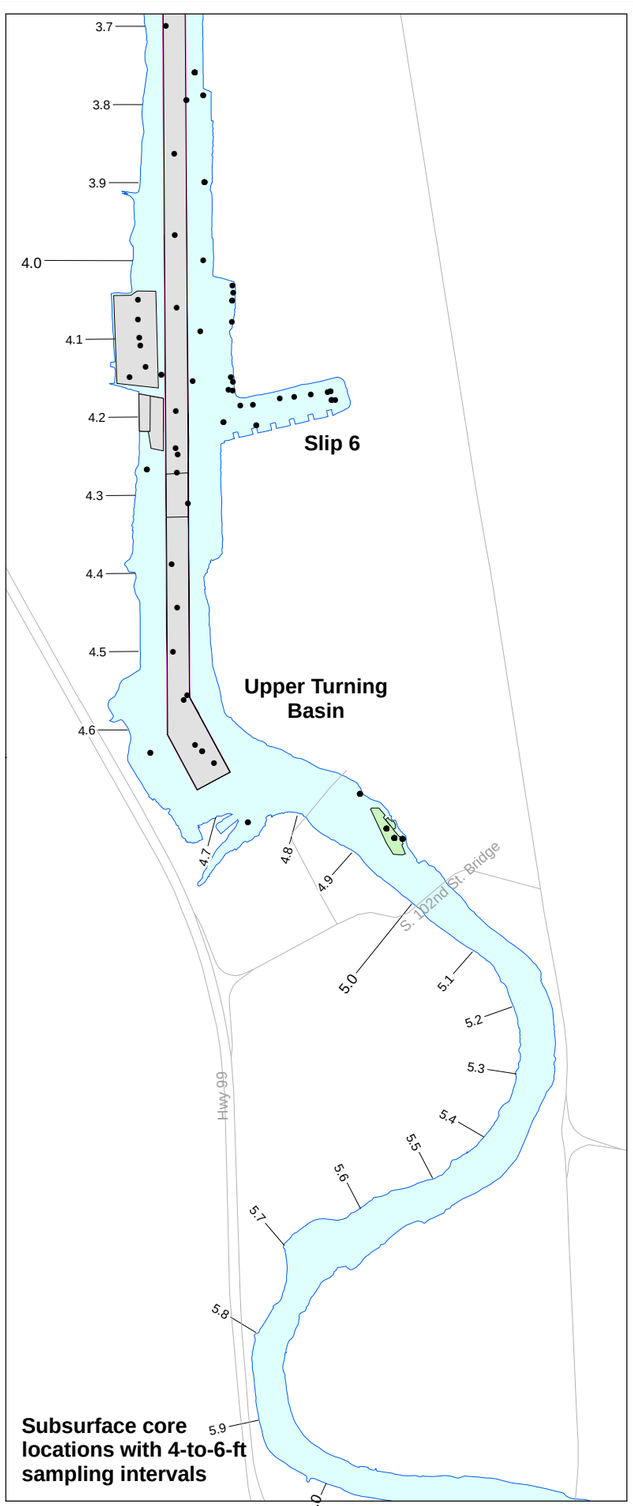
Prepared by: CEH, 07/15/2010, MAP 2811, W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Subsurface\Depth Interval\PCBs

Dredging information provided by AECOM.







BEHP concentration (µg/kg dw)[a]

- > 2,400
- > 490 and ≤ 2,400
- > 230 and ≤ 490
- > 95 and ≤ 230
- ≤ 95
- Non-detect

95th percentile = 2,400
75th percentile = 490
50th percentile = 230
25th percentile = 95

Sampling interval

	Left panel	Middle panel	Right panel
□	0-to-2-ft[b]	2-to-4-ft[b]	4-to-6-ft[b]
◇	0-to-1-ft[c]	2-to-3-ft[c]	4-to-5-ft[c]
◇	1-to-2-ft[c]	3-to-4-ft[c]	5-to-6-ft[c]

△ Not analyzed in that sampling interval

Other subsurface sampling locations
• analyzed for BEHP but not in the illustrated sampling intervals

- Early Action Area[d]
- Dredged area[e]
- Dredged and capped area[e]
- Navigation channel
- River mile

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, a value of one-half the RL at that location was used.

[b] Data from 2-foot sampling intervals; some locations show an average of data from both 1-foot intervals within that 2-foot interval at a given location.

[c] Data from 1-foot sampling intervals are shown if available. If both 1-foot intervals within the 2-foot interval were collected, the average of the two intervals is also shown.

[d] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[e] Subsurface sediment data at locations in dredged areas were collected prior to dredging.

0 0.1 0.2 Kilometers

0 0.1 0.2 Miles

N

Scale is the same for each map frame

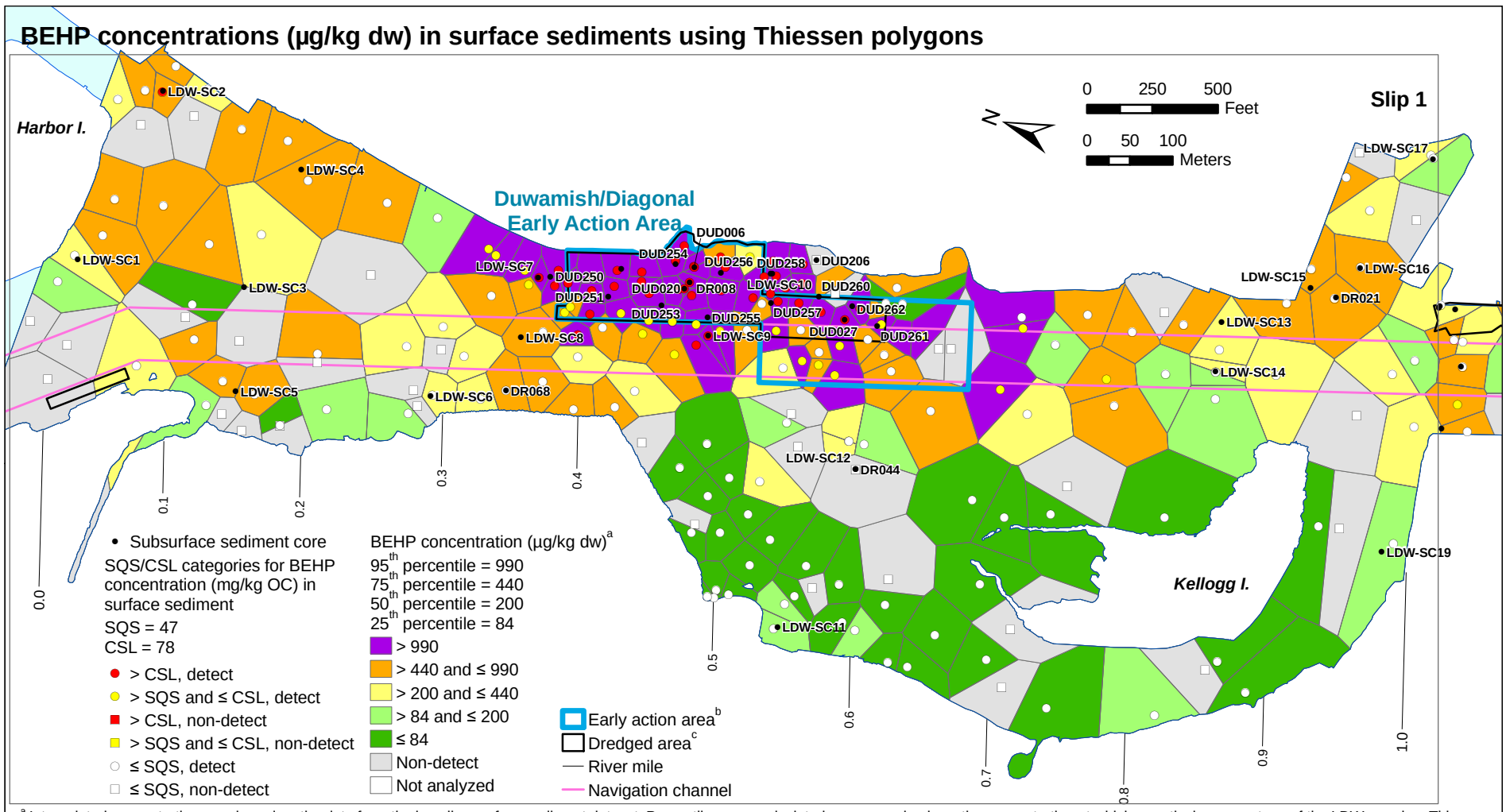
Map 4-46c. BEHP concentrations in subsurface sediment within the 0-to-2-ft, 2-to-4-ft, and 4-to-6-ft sampling intervals, RM 3.7 to RM 6.0

Wind Ward LLC environmental

Prepared by: CEH, 07/15/2010, MAP 2811, W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Subsurface\4Depth Interval

Dredging information provided by AECOM.

BEHP concentrations (µg/kg dw) in surface sediments using Thiessen polygons



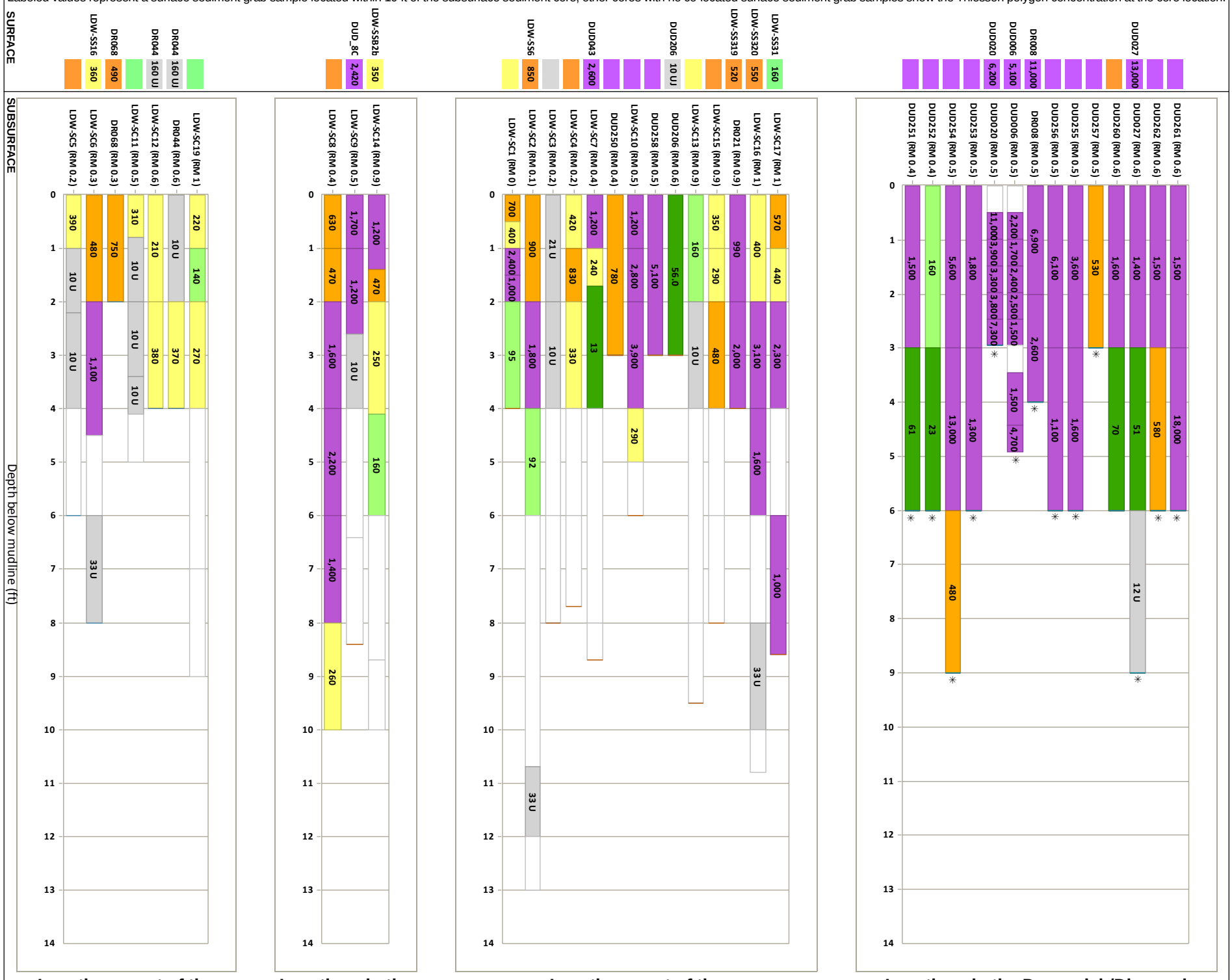
[a] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has Thiessen polygon values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has Thiessen polygon concentrations ≤ 990 µg/kg dw). Thiessen polygon concentrations were calculated including locations with non-detected values. For locations with non-detects, a value of one-half the RL at that location was used.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] For the Duwamish/Diagonal Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, and thin-layer placement in 2003 to 2005. Subsurface sediment data in dredged areas were collected prior to dredging.

BEHP concentrations (µg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the Thiessen polygon concentration at the core location.



✳ This core was collected prior to dredging at that location.

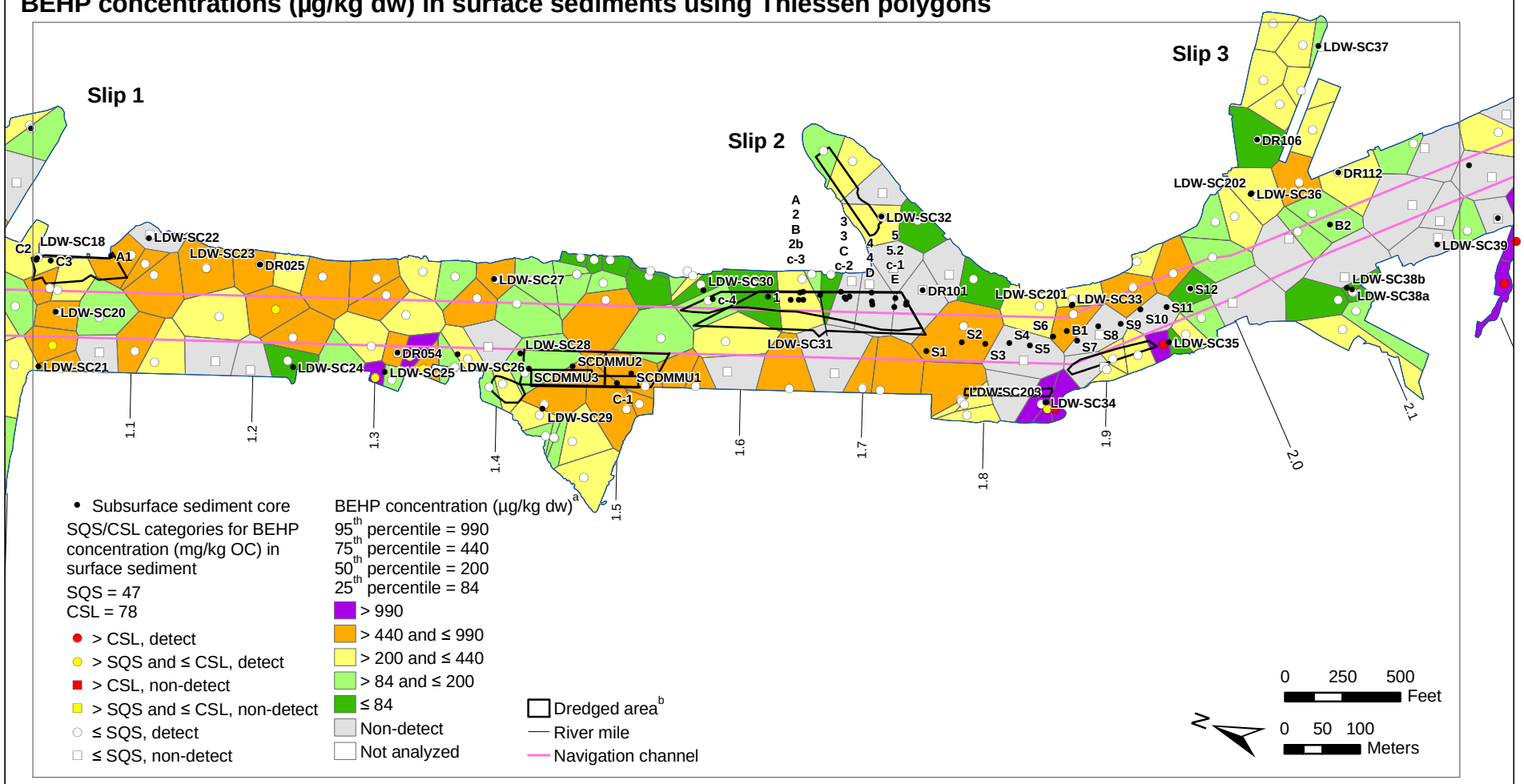
Map 4-47a. BEHP concentrations in surface sediment and subsurface sediment cores, RM 0.0 to RM 1.0

Wind Ward LLC environmental

Prepared by CEH, 07/15/2010. MAP 3303. W:\Projects\00-08-06 Duwamish Rl\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

BEHP concentrations (µg/kg dw) in surface sediments using Thiessen polygons

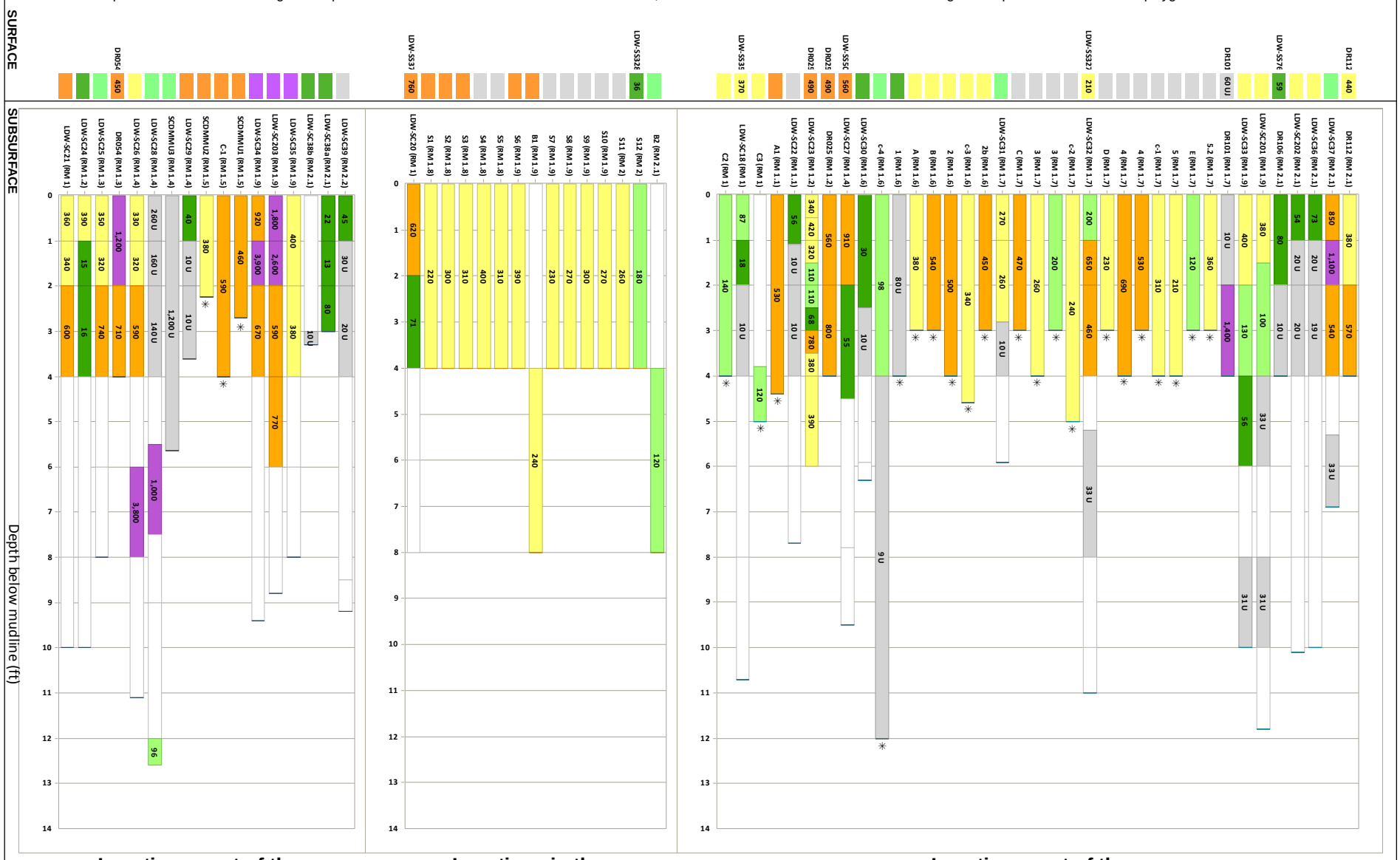


[a] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has Thiessen polygon values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has Thiessen polygon concentrations ≤ 990 µg/kg dw). Thiessen polygon concentrations were calculated including locations with non-detected values. For locations with non-detects, a value of one-half the RL at that location was used.

[b] Subsurface sediment data at locations in dredged areas were collected prior to dredging; surface sediment data were collected after dredging.

BEHP concentrations (µg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the Thiessen polygon concentration at the core location.



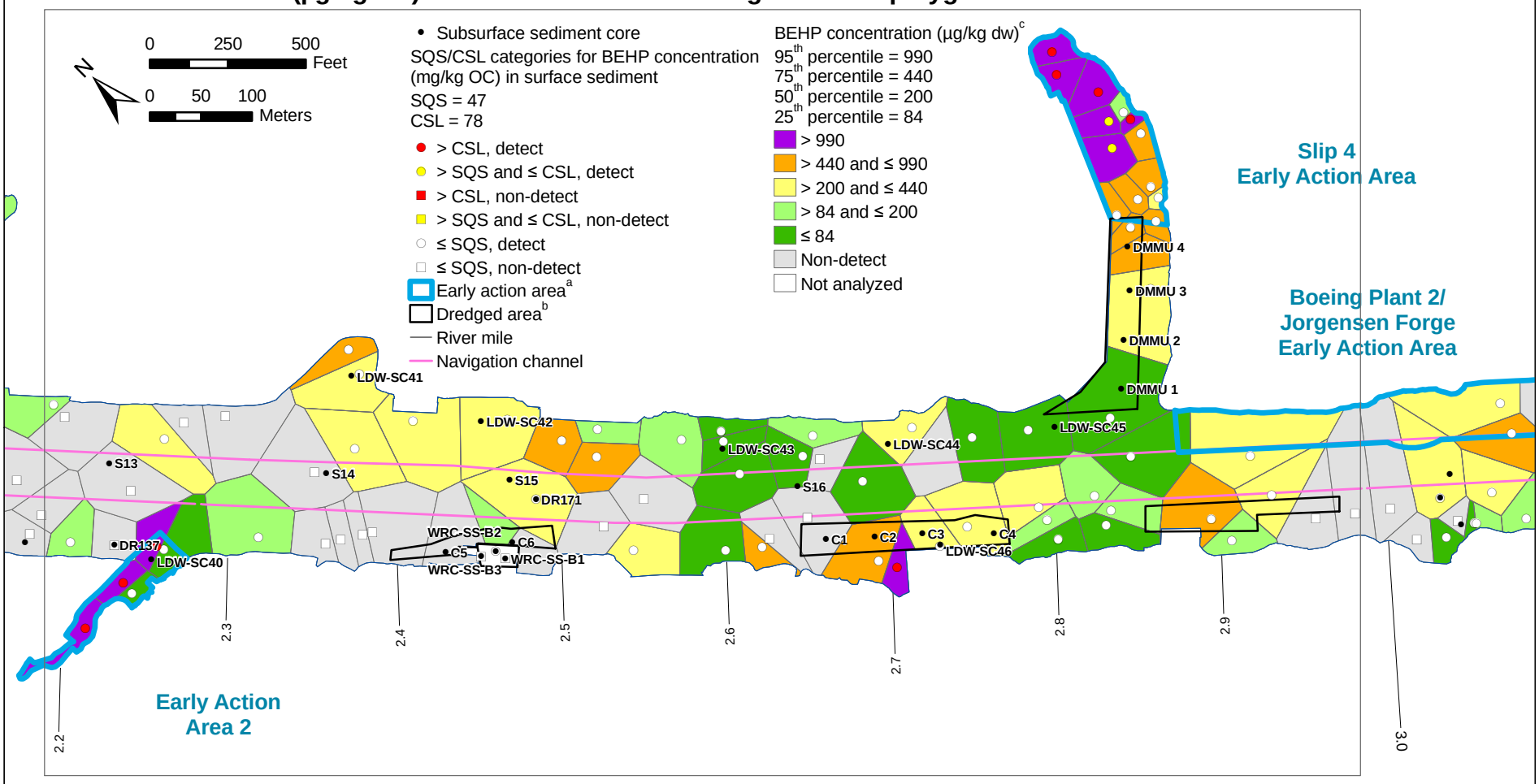
✳ This core was collected prior to dredging at that location.

Map 4-47b. BEHP concentrations in surface sediment and subsurface sediment cores, RM 1.0 to RM 2.2

Prepared by CEH, 07/15/2010; MAP 3303; W:\Projects\00-08-06_Duwamish_Rl\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

BEHP concentrations (µg/kg dw) in surface sediments using Thiessen polygons



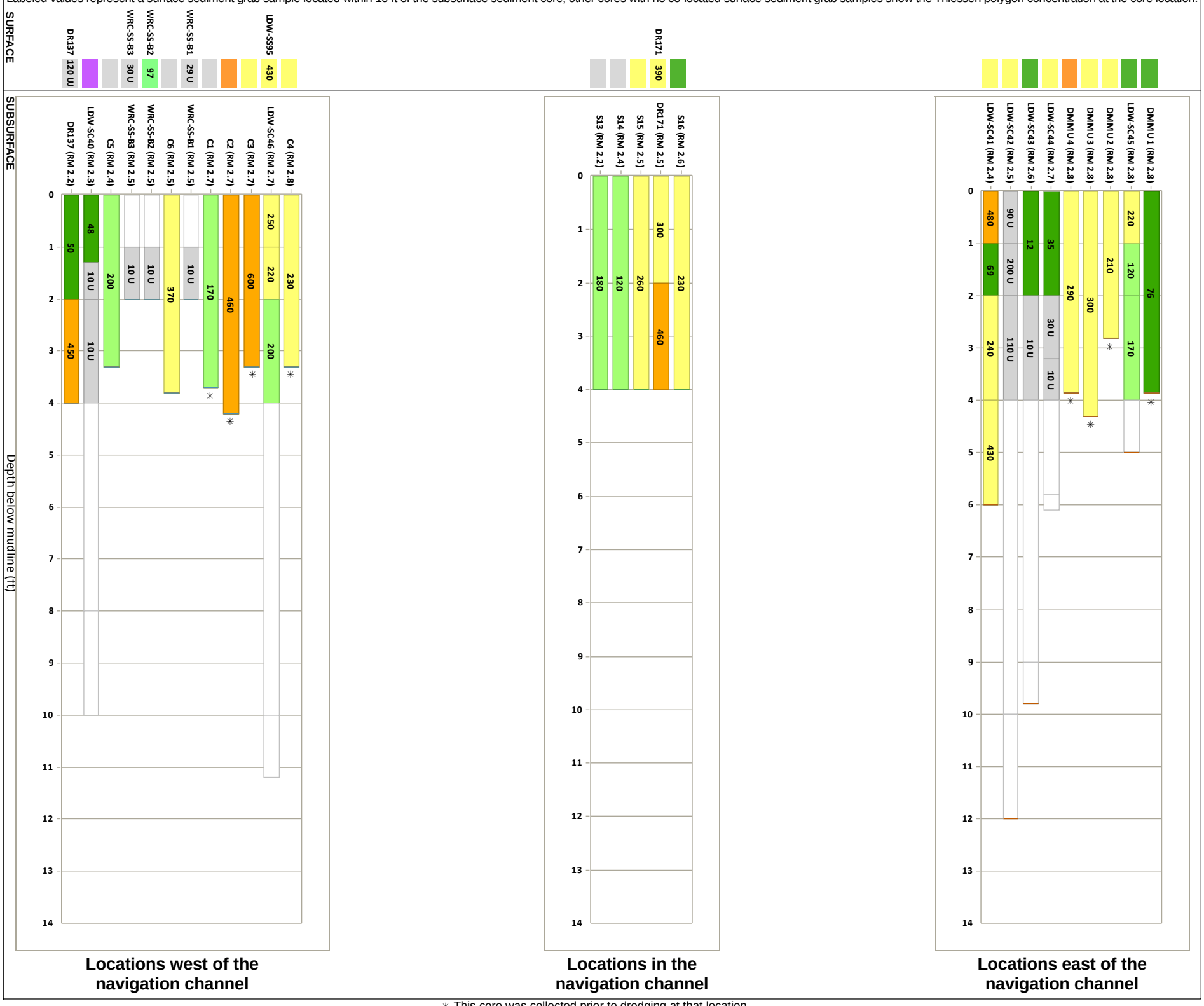
[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[b] Subsurface sediment data at locations in dredged areas were collected prior to dredging; surface sediment data were collected after dredging.

[c] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has Thiessen polygon values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has Thiessen polygon concentrations ≤ 990 µg/kg dw). Thiessen polygon concentrations were calculated including locations with non-detected values. For locations with non-detects, a value of one-half the RL at that location was used.

BEHP concentrations (µg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the Thiessen polygon concentration at the core location.



Locations west of the navigation channel

Locations in the navigation channel

Locations east of the navigation channel

✳ This core was collected prior to dredging at that location.

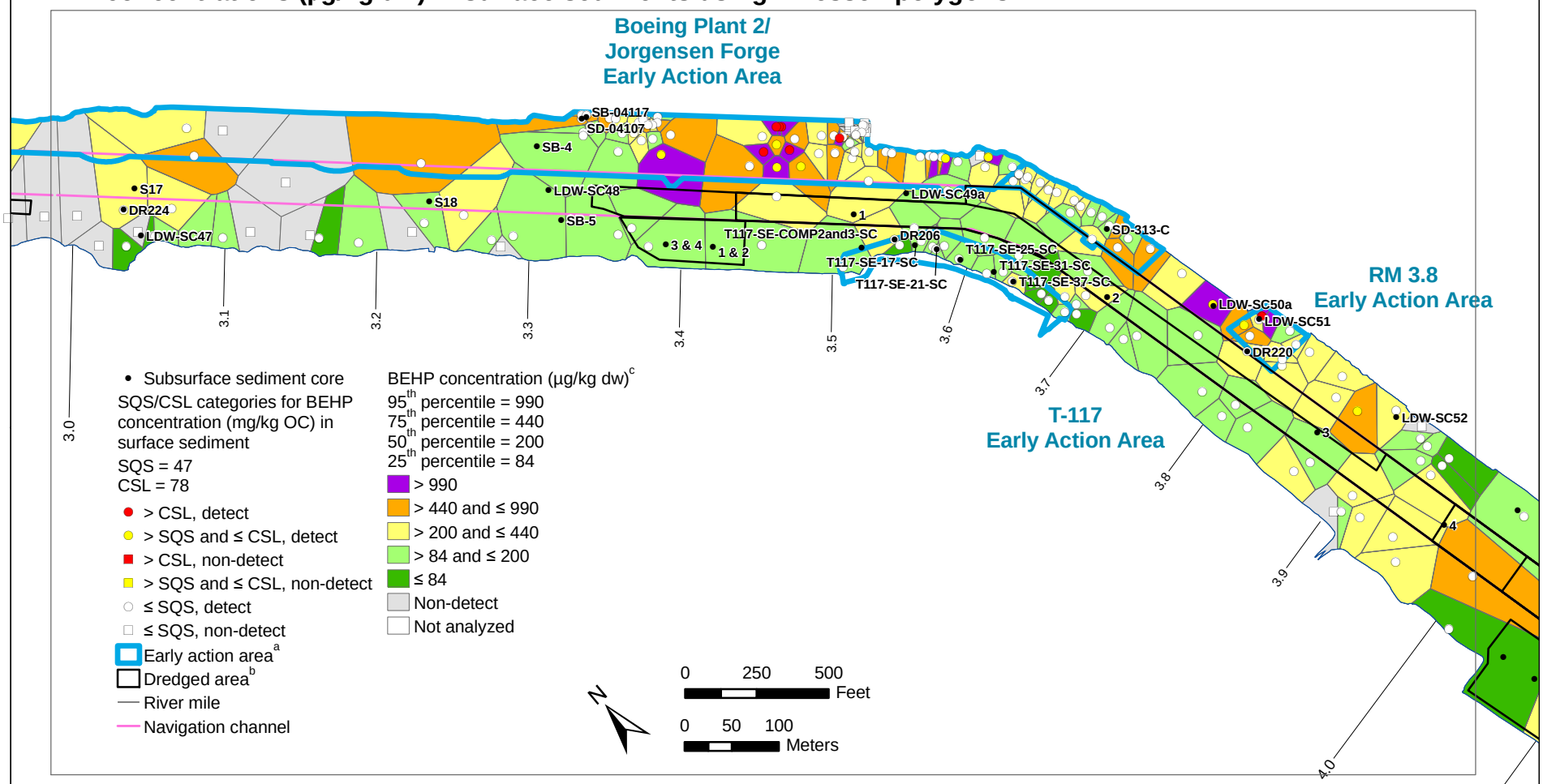
Map 4-47c. BEHP concentrations in surface sediment and subsurface sediment cores, RM 2.2 to RM 3.0

Wind Ward environmental LLC

Prepared by CEH, 07/15/2010; MAP 3303; W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

BEHP concentrations (µg/kg dw) in surface sediments using Thiessen polygons



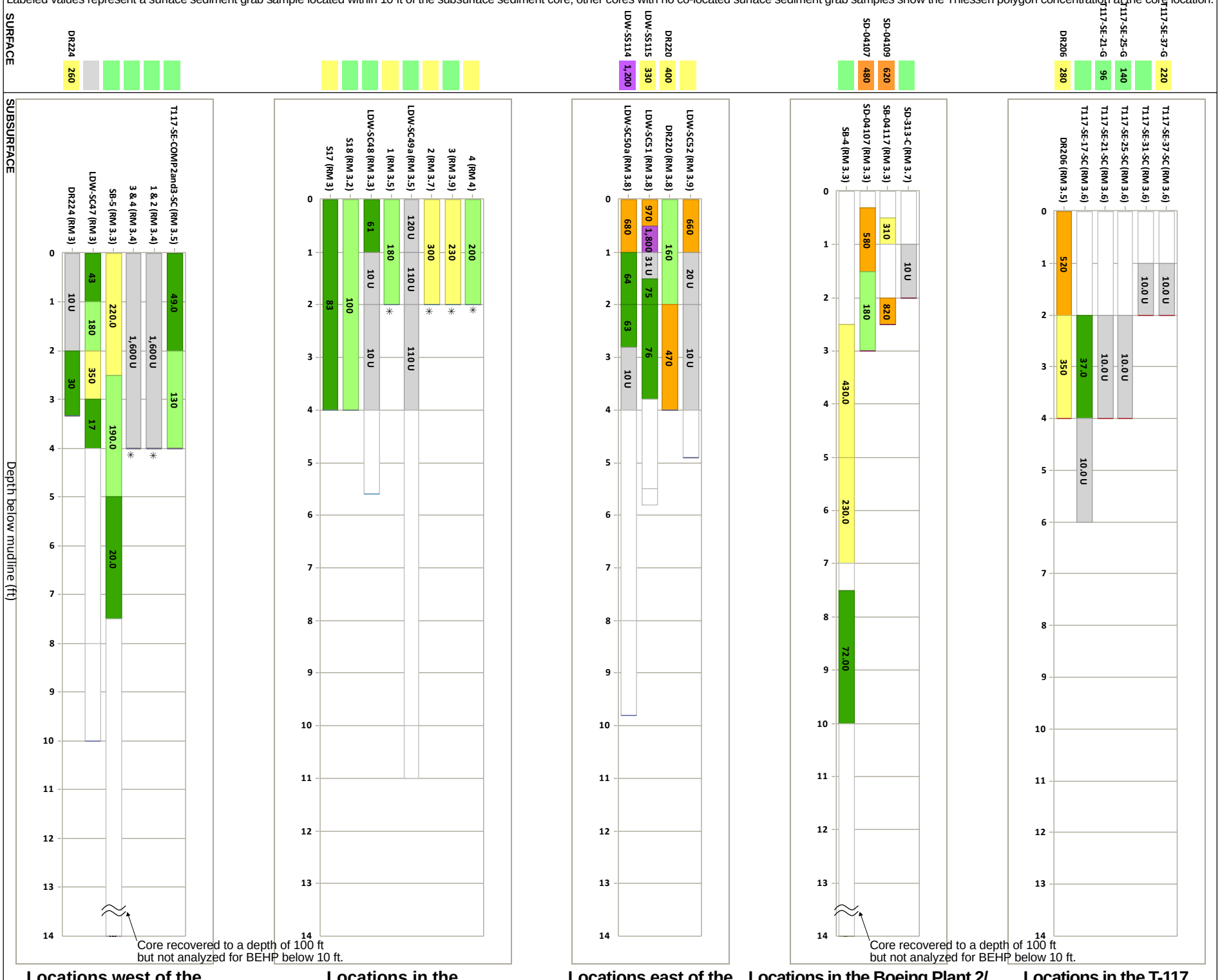
[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[b] Subsurface sediment data at locations in dredged areas were collected prior to dredging; surface sediment data were collected after dredging.

[c] Interpolated concentrations are based on data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has Thiessen polygon values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has Thiessen polygon concentrations ≤ 990 µg/kg dw). Thiessen polygon concentrations were calculated including locations with non-detected values. For locations with non-detects, a value of one-half the RL at that location was used.

BEHP concentrations (µg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the Thiessen polygon concentration at the core location.



Locations west of the navigation channel | **Locations in the navigation channel** | **Locations east of the navigation channel** | **Locations in the Boeing Plant 2/ Jorgensen Forge Early Action Area** | **Locations in the T-117 Early Action Area**

✳ This core was collected prior to dredging at that location.

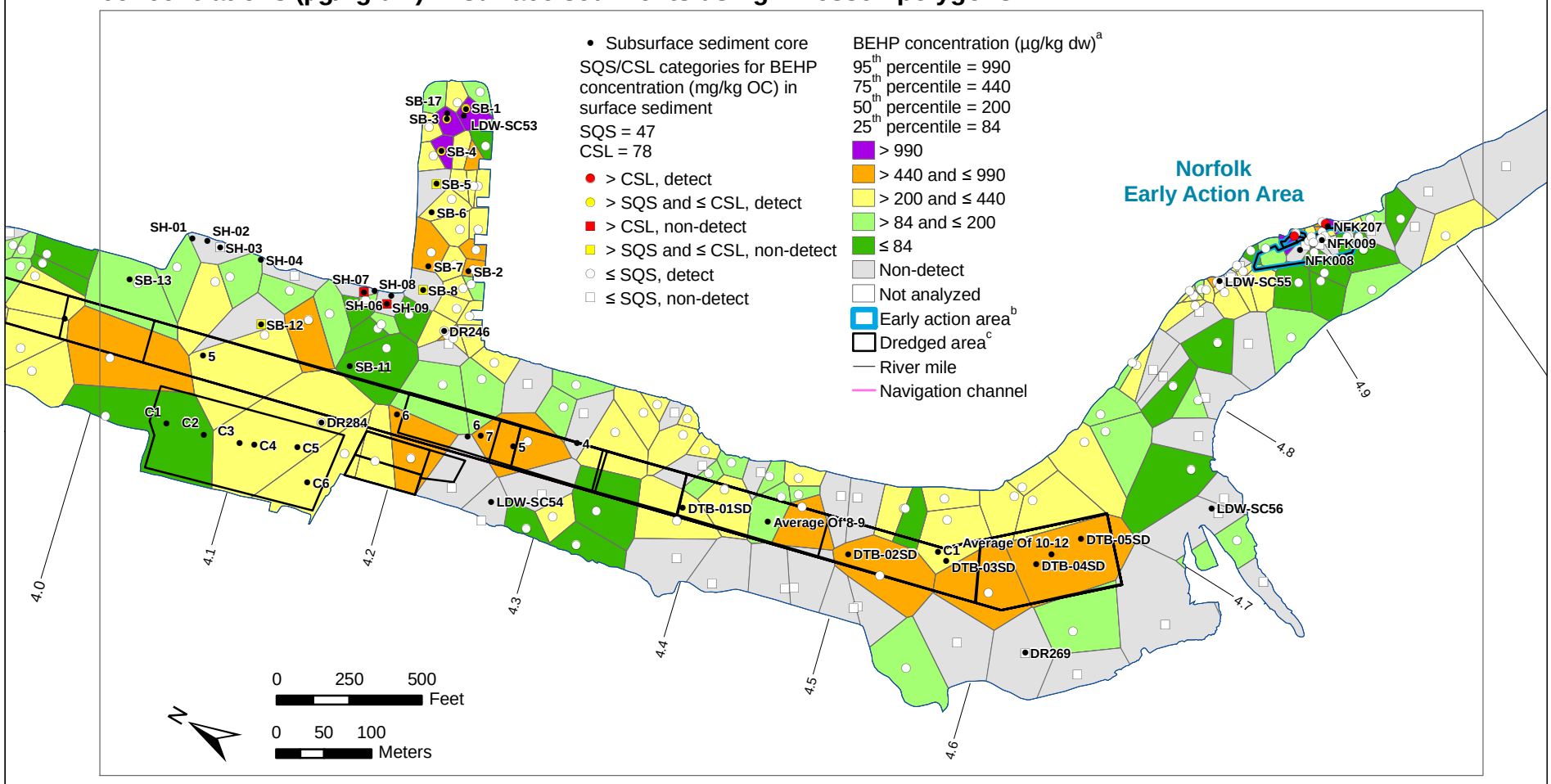
Map 4-47d. BEHP concentrations in surface sediment and subsurface sediment cores, RM 3.0 to RM 4.0

Wind Ward LLC environmental

Prepared by CEH, 07/15/2010, MAP 3303; W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

BEHP concentrations (µg/kg dw) in surface sediments using Thiessen polygons



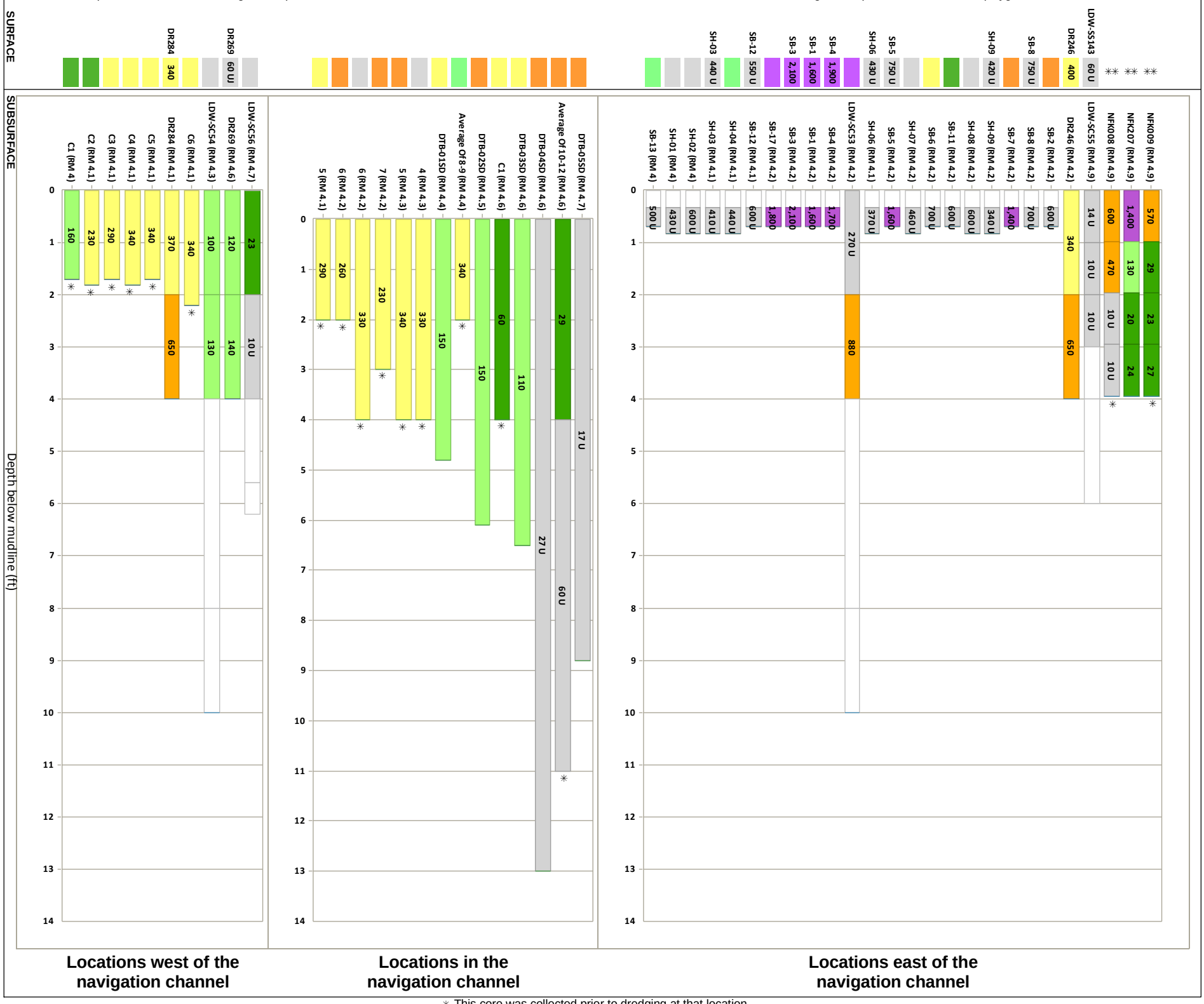
[a] Interpolated concentrations are based on data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has Thiessen polygon values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has Thiessen polygon concentrations ≤ 990 µg/kg dw). Thiessen polygon concentrations were calculated including locations with non-detected values. For locations with non-detects, a value of one-half the RL at that location was used.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] For the Norfolk Early Action Area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO/SD removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003. Subsurface sediment data at locations in dredged areas were collected prior to dredging.

BEHP concentrations (µg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the Thiessen polygon concentration at the core location.



Locations west of the navigation channel

Locations in the navigation channel

Locations east of the navigation channel

✳ This core was collected prior to dredging at that location.

✳✳ At the Norfolk EAA, surface sediment data, which were collected after the removal action at the Norfolk CSO area in 1999 but before the removal action at the BDC south storm drain outfall area in 2003, do not reflect conditions at the time subsurface cores were collected in 1995.

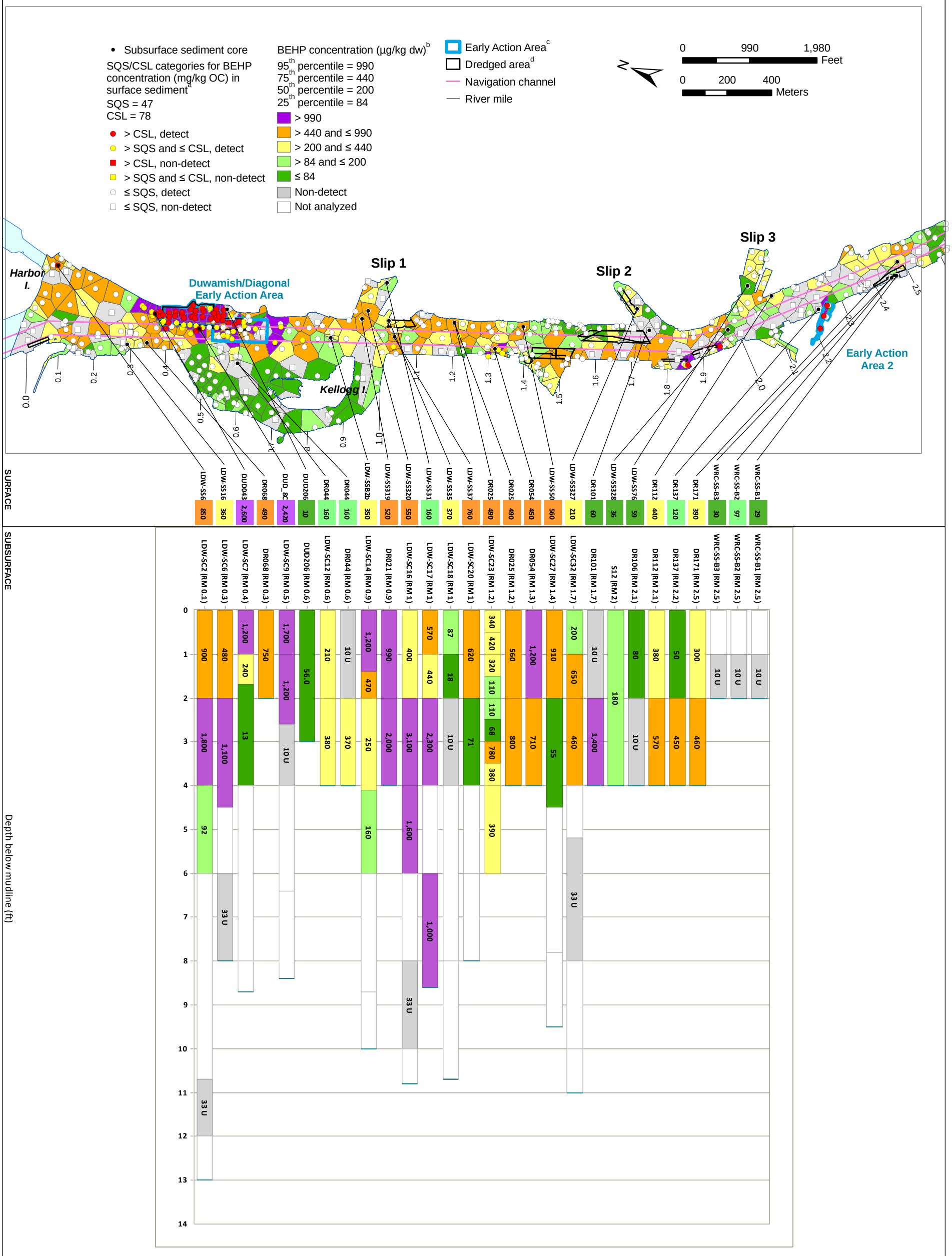
Map 4-47e. BEHP concentrations in surface sediment and subsurface sediment cores, RM 4.0 to RM 5.0

Wind Ward environmental LLC

Prepared by CEH, 07/15/2010; MAP 3303; W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.

BEHP concentrations (µg/kg dw) in surface sediments, subsurface core data, and co-located (within 10 ft) surface sediment data



[a] When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations were compared instead to the LAET and 2LAET.

[b] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has Thiessen polygon values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has Thiessen polygon concentrations ≤ 990 µg/kg dw). Thiessen polygon concentrations were calculated including locations with non-detected values. For locations with non-detects, a value of one-half the RL at that location was used.

[c] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[d] For the Duwamish/Diagonal Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, and thin-layer placement in 2003 to 2005. Subsurface sediment data in dredged areas were collected prior to dredging.

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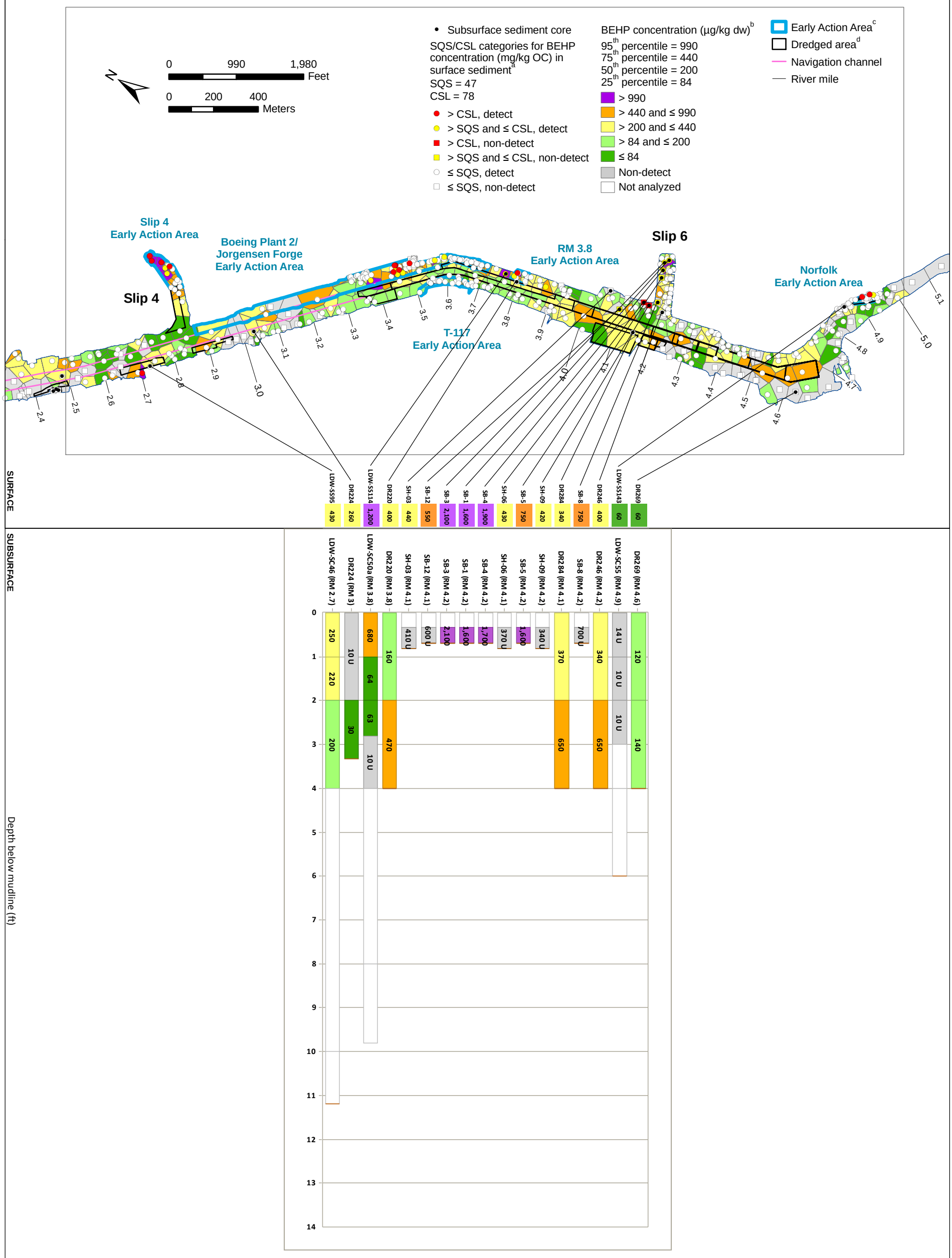
Map 4-48a. Comparison of BEHP concentrations in subsurface cores to co-located surface sediment locations, RM 0.0 to RM 2.5

Prepared by CEH, 07/15/2010; MAP 3797; W:\Projects\00-08-06_Duwamish_R\data\GIS\Phase2 RI\Nature and Extent\Subsurface\Colocation

Dredging information provided by AECOM.

BEHP concentrations (µg/kg dw) in surface sediments, subsurface core data, and co-located (within 10 ft) surface sediment data



[a] When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations were compared instead to the LAET and 2LAET.

[b] Interpolated concentrations are based on the data from the baseline surface sediment dataset. Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has Thiessen polygon values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has Thiessen polygon concentrations ≤ 990 µg/kg dw). Thiessen polygon concentrations were calculated including locations with non-detected values. For locations with non-detects, a value of one-half the RL at that location was used.

[c] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[d] For the Norfolk Early Action Area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003. Subsurface sediment data in dredged areas were collected prior to dredging.

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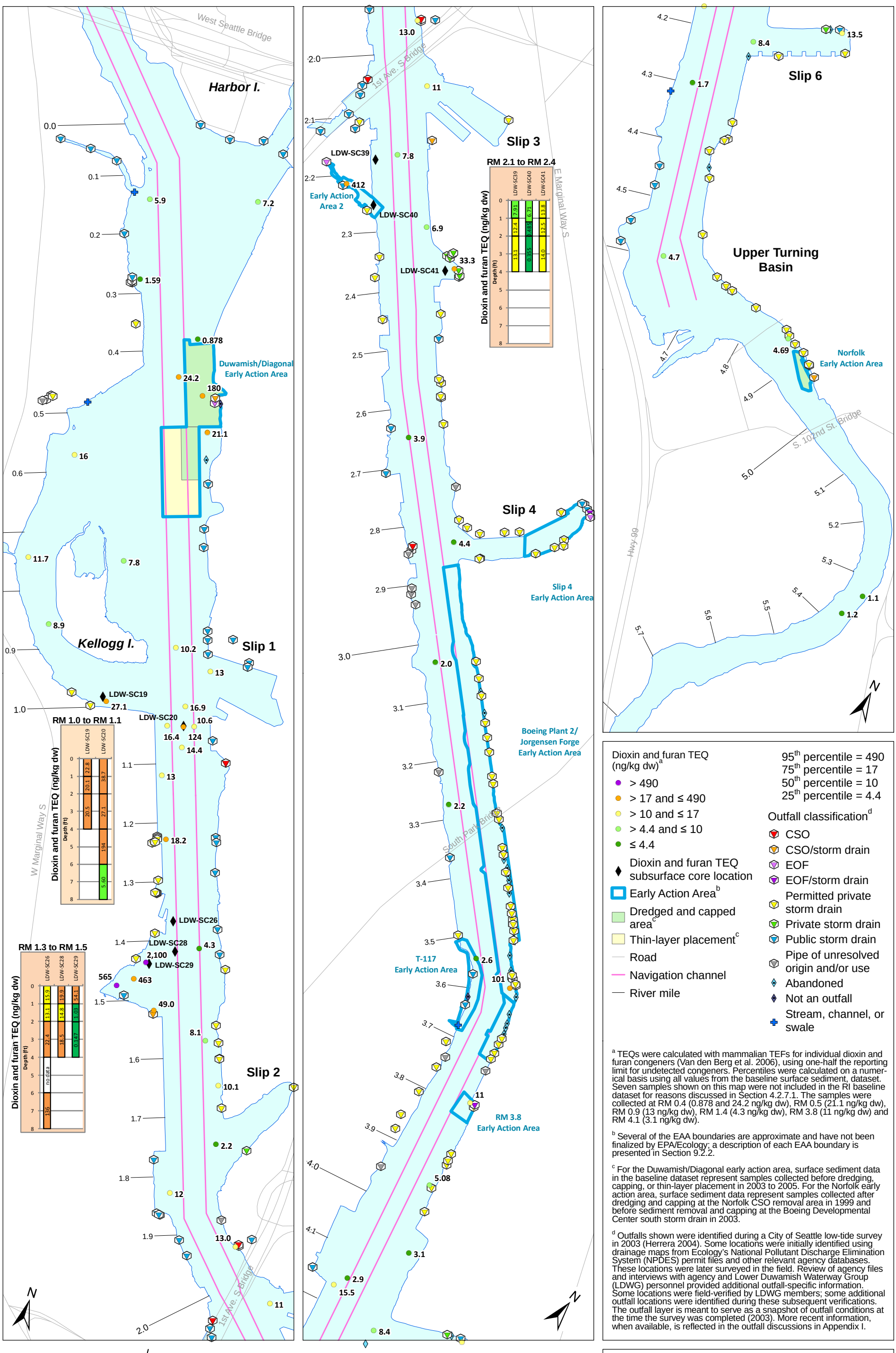
Map 4-48b. Comparison of BEHP concentrations in subsurface cores to co-located surface sediment locations, RM 2.5 to RM 5.0

Prepared by CEH, 07/15/2010; MAP 3797; W:\Projects\00-08-06_Duwamish_R\data\GIS\Phase2 R1\Nature and Extent\Subsurface\Colocation

Dredging information provided by AECOM.



Dioxin and furan TEQ (ng/kg dw)[a]

- > 490
- > 17 and ≤ 490
- > 10 and ≤ 17
- > 4.4 and ≤ 10
- ≤ 4.4

95th percentile = 490
75th percentile = 17
50th percentile = 10
25th percentile = 4.4

- Dioxin and furan TEQ subsurface core location
- Early Action Area[b]
- Dredged and capped area[c]
- Thin-layer placement[c]
- Road
- Navigation channel
- River mile

Outfall classification[d]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale

[a] TEQs were calculated with mammalian TEFs for individual dioxin and furan congeners (Van den Berg et al. 2006), using one-half the reporting limit for undetected congeners. Percentiles were calculated on a numerical basis using all values from the baseline surface sediment, dataset. Seven samples shown on this map were not included in the RI baseline dataset for reasons discussed in Section 4.2.7.1. The samples were collected at RM 0.4 (0.878 and 24.2 ng/kg dw), RM 0.5 (21.1 ng/kg dw), RM 0.9 (13 ng/kg dw), RM 1.4 (4.3 ng/kg dw), RM 3.8 (11 ng/kg dw) and RM 4.1 (3.1 ng/kg dw).

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

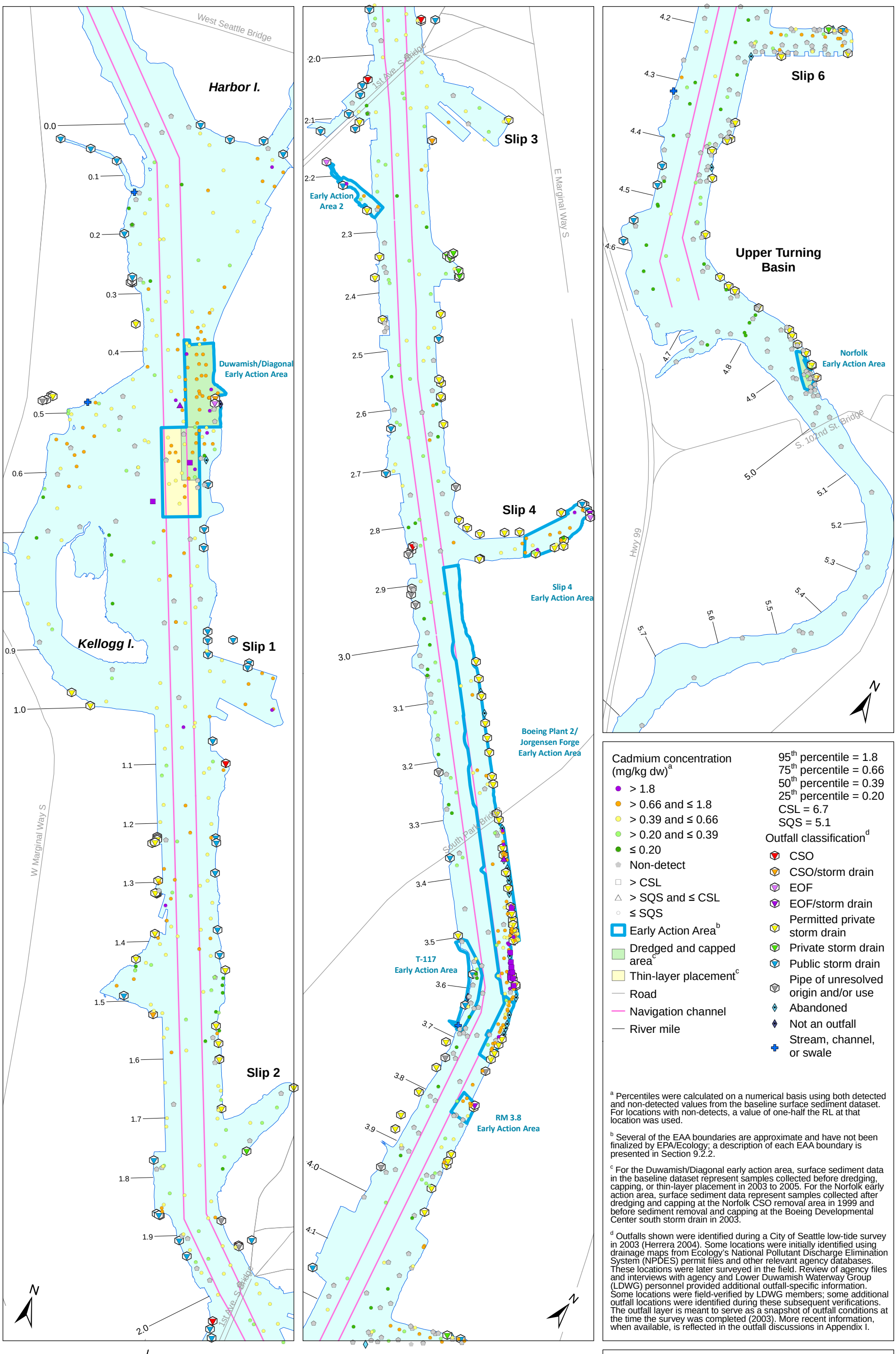
[c] For the Duwamish/Diagonal early action area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005. For the Norfolk early action area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

Map 4-49. Dioxin and furan TEQs in surface sediment and subsurface sediment cores

Wind Ward environmental LLC

Prepared by CEH, 07/15/2010; MAP 2663; W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\Other COCs



Cadmium concentration (mg/kg dw)[a]

- > 1.8
- > 0.66 and ≤ 1.8
- > 0.39 and ≤ 0.66
- > 0.20 and ≤ 0.39
- ≤ 0.20
- Non-detect
- > CSL
- > SQS and ≤ CSL
- ≤ SQS
- Early Action Area[b]
- Dredged and capped area[c]
- Thin-layer placement[c]
- Road
- Navigation channel
- River mile

95th percentile = 1.8
75th percentile = 0.66
50th percentile = 0.39
25th percentile = 0.20
CSL = 6.7
SQS = 5.1

Outfall classification[d]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, a value of one-half the RL at that location was used.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

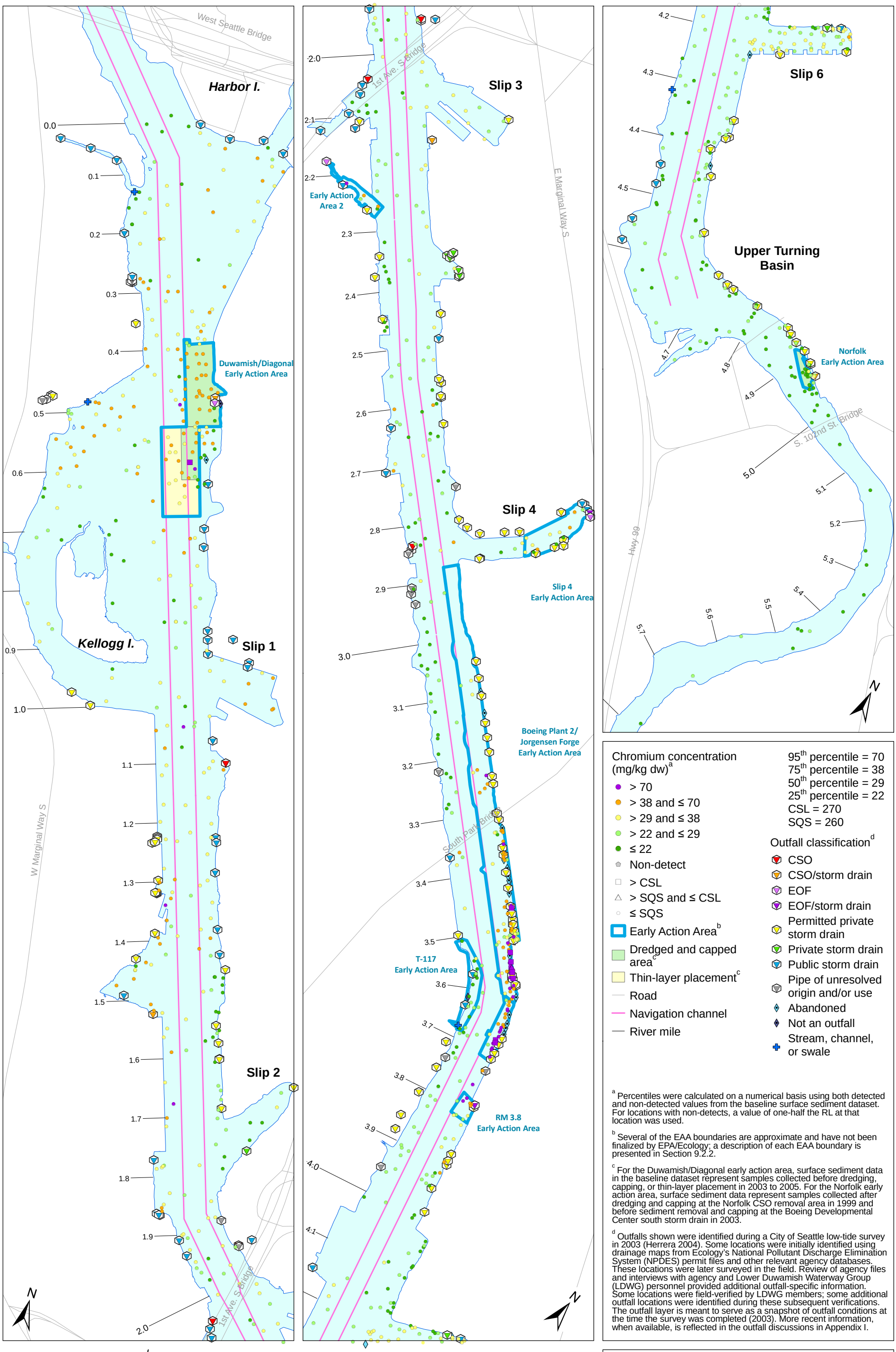
[c] For the Duwamish/Diagonal early action area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005. For the Norfolk early action area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

Map 4-50. Cadmium concentrations in surface sediment

Wind Ward environmental LLC

Prepared by CEH, 07/15/2010; MAP 2773; W:\Projects\00-08-08 Duwamish RI\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\Other COCs



Chromium concentration (mg/kg dw)[a]

- > 70
- > 38 and ≤ 70
- > 29 and ≤ 38
- > 22 and ≤ 29
- ≤ 22
- Non-detect
- > CSL
- > SQS and ≤ CSL
- ≤ SQS
- Early Action Area[b]
- Dredged and capped area[c]
- Thin-layer placement[c]
- Road
- Navigation channel
- River mile

95th percentile = 70
75th percentile = 38
50th percentile = 29
25th percentile = 22
CSL = 270
SQS = 260

Outfall classification[d]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, a value of one-half the RL at that location was used.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] For the Duwamish/Diagonal early action area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005. For the Norfolk early action area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

0 0.1 0.2 Miles

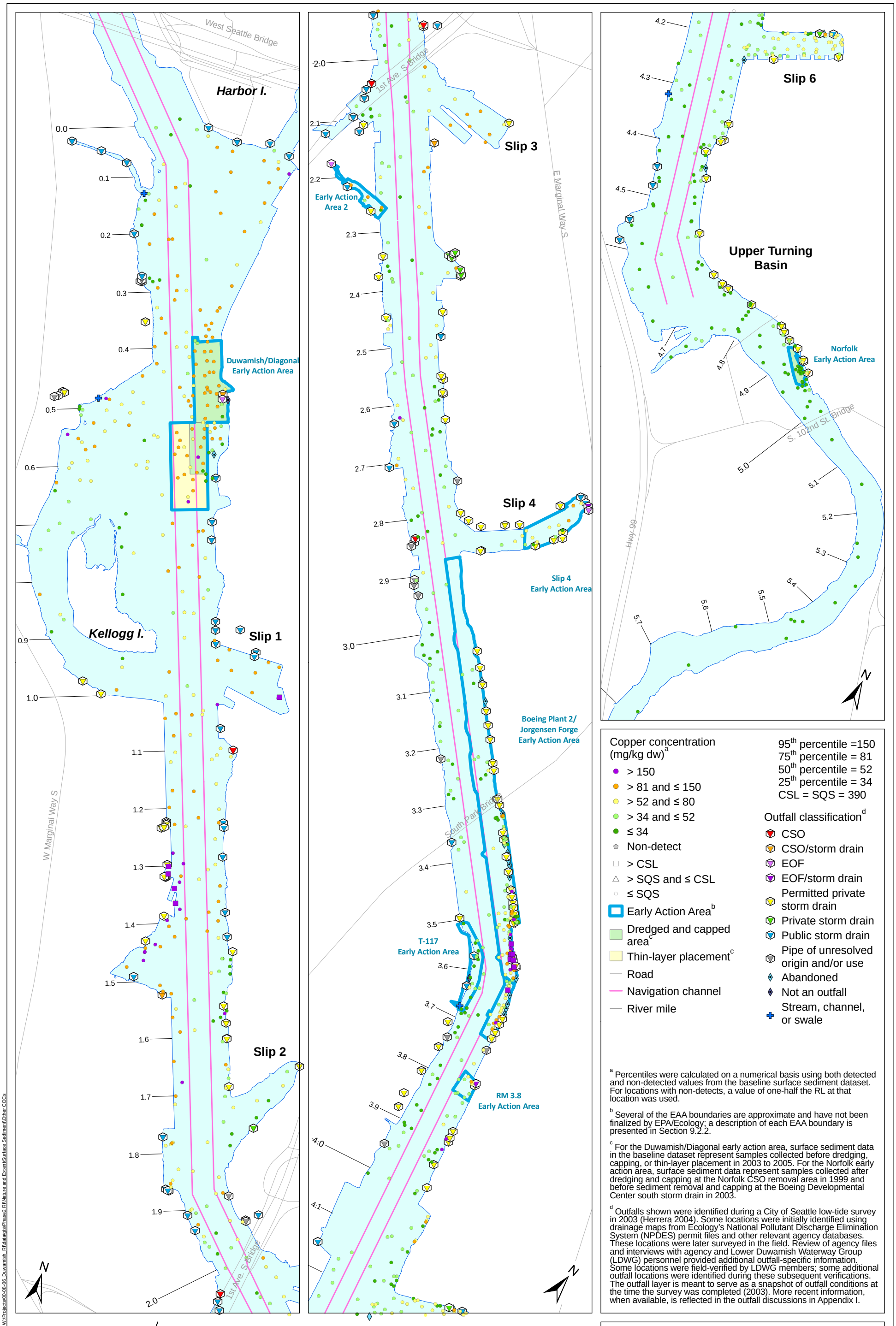
0 0.1 0.2 Kilometers

Scale is the same for each inset map

Map 4-51. Chromium concentrations in surface sediment

Wind Ward environmental LLC

Prepared by CEH, 07/15/2013, MAP 2774, W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\Other COCs



Copper concentration (mg/kg dw)[a]

- > 150
- > 81 and ≤ 150
- > 52 and ≤ 80
- > 34 and ≤ 52
- ≤ 34
- Non-detect
- > CSL
- > SQS and ≤ CSL
- ≤ SQS
- Early Action Area[b]
- Dredged and capped area[c]
- Thin-layer placement[c]
- Road
- Navigation channel
- River mile

95th percentile =150
75th percentile = 81
50th percentile = 52
25th percentile = 34
CSL = SQS = 390

Outfall classification[d]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, a value of one-half the RL at that location was used.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] For the Duwamish/Diagonal early action area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005. For the Norfolk early action area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

Wind Ward environmental LLC

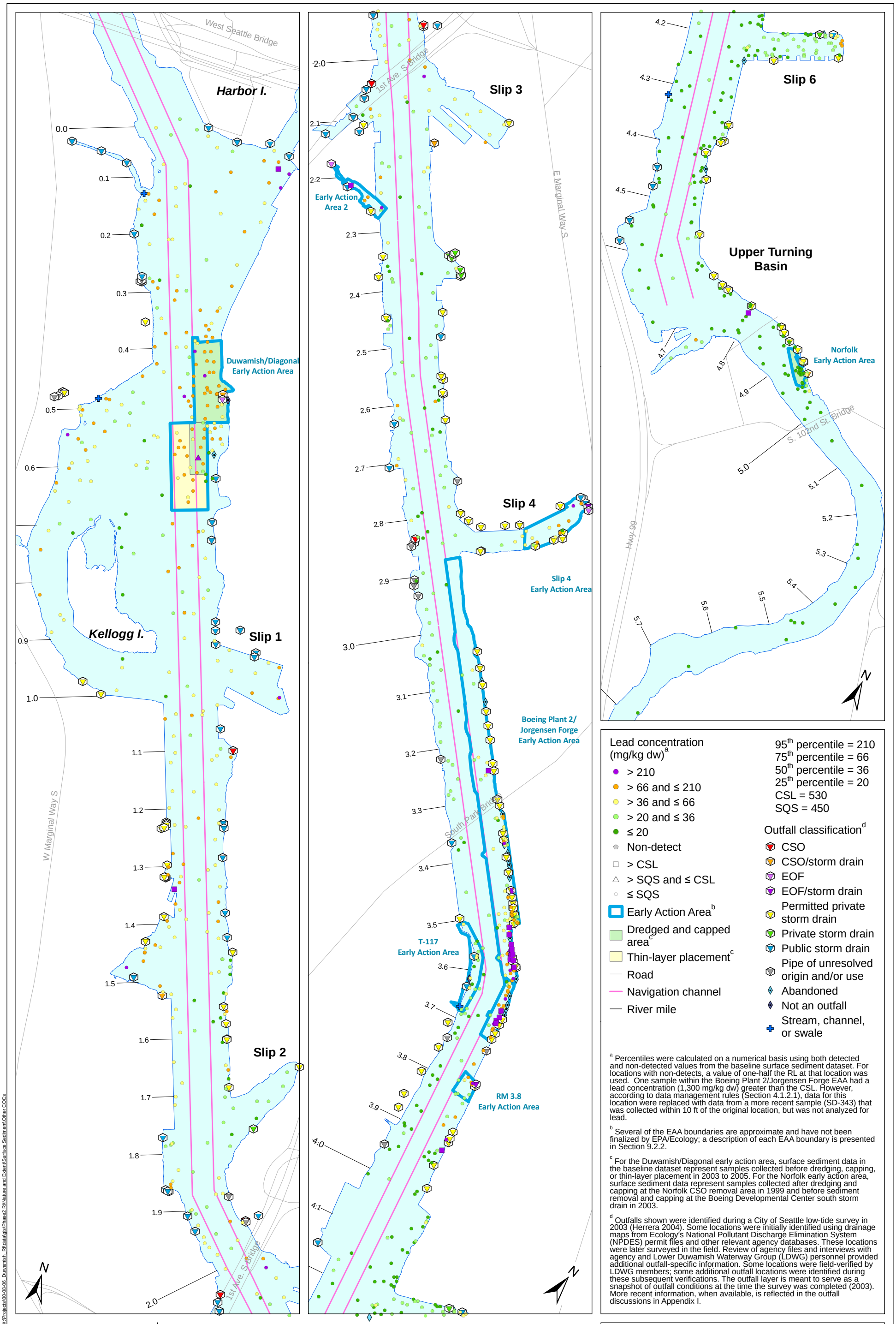
0 0.1 0.2 Miles

0 0.1 0.2 Kilometers

Scale is the same for each inset map

Map 4-52. Copper concentrations in surface sediment

Prepared by CEH, 07/15/2010; MAP 2775; W:\Projects\00-08-06 Duwamish RI\fate&gis\Phase2 RI\Nature and Extent\Surface Sediment\Other COCs



Lead concentration (mg/kg dw)[a]

- > 210
- > 66 and ≤ 210
- > 36 and ≤ 66
- > 20 and ≤ 36
- ≤ 20
- Non-detect
- > CSL
- > SQS and ≤ CSL
- ≤ SQS
- Early Action Area[b]
- Dredged and capped area[c]
- Thin-layer placement[c]
- Road
- Navigation channel
- River mile

95th percentile = 210
75th percentile = 66
50th percentile = 36
25th percentile = 20
CSL = 530
SQS = 450

Outfall classification[d]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, a value of one-half the RL at that location was used. One sample within the Boeing Plant 2/Jorgensen Forge EAA had a lead concentration (1,300 mg/kg dw) greater than the CSL. However, according to data management rules (Section 4.1.2.1), data for this location were replaced with data from a more recent sample (SD-343) that was collected within 10 ft of the original location, but was not analyzed for lead.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] For the Duwamish/Diagonal early action area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005. For the Norfolk early action area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

Wind Ward environmental LLC

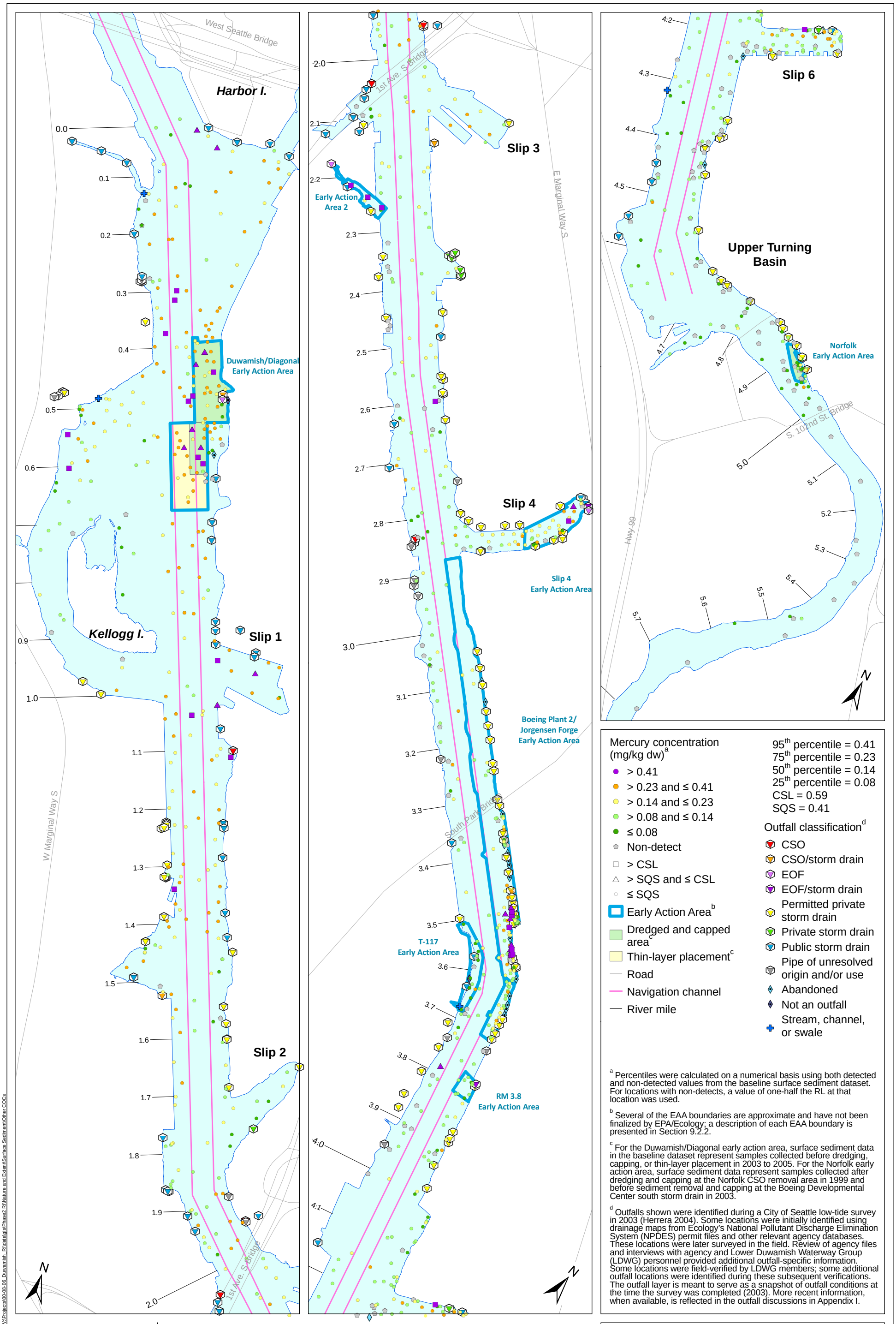
0 0.1 0.2 Miles

0 0.1 0.2 Kilometers

Scale is the same for each inset map

Map 4-53. Lead concentrations in surface sediment

Prepared by CEH, 07/15/2010; MAP 2776; W:\Projects\00-08-06 Duwamish R\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\Other COCs



Mercury concentration (mg/kg dw)[a]

- > 0.41
- > 0.23 and ≤ 0.41
- > 0.14 and ≤ 0.23
- > 0.08 and ≤ 0.14
- ≤ 0.08
- Non-detect
- > CSL
- > SQS and ≤ CSL
- ≤ SQS
- Early Action Area[b]
- Dredged and capped area[c]
- Thin-layer placement[c]
- Road
- Navigation channel
- River mile

95th percentile = 0.41
75th percentile = 0.23
50th percentile = 0.14
25th percentile = 0.08
CSL = 0.59
SQS = 0.41

Outfall classification[d]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, a value of one-half the RL at that location was used.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] For the Duwamish/Diagonal early action area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005. For the Norfolk early action area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

Wind Ward environmental LLC

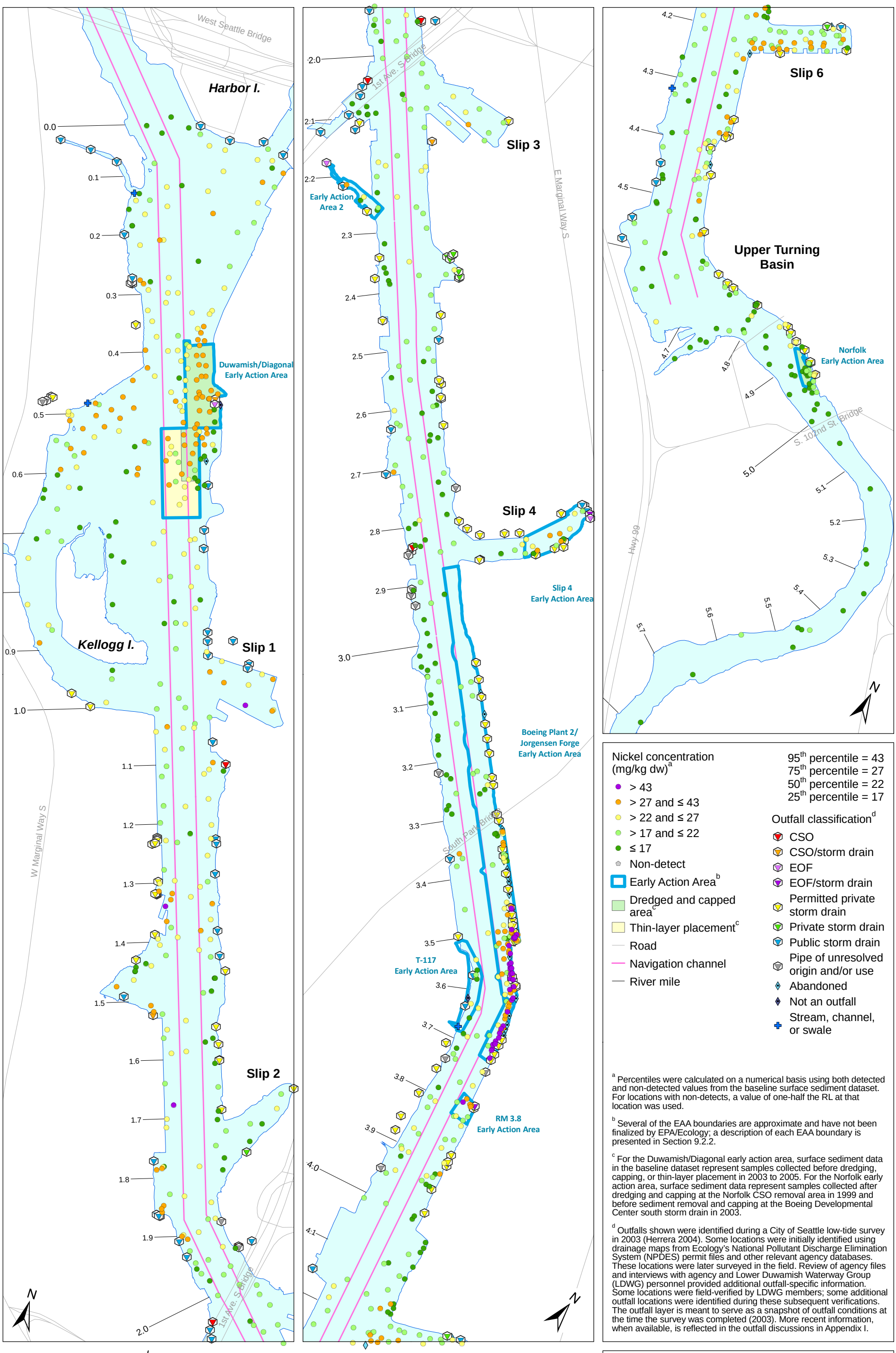
0 0.1 0.2 Miles

0 0.1 0.2 Kilometers

Scale is the same for each inset map

Map 4-54. Mercury concentrations in surface sediment

Prepared by CEH, 07/15/2010. MAP 2777: W:\Projects\00-08-06 Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\Other COCs



Nickel concentration (mg/kg dw)[a]

- > 43
- > 27 and ≤ 43
- > 22 and ≤ 27
- > 17 and ≤ 22
- ≤ 17
- Non-detect
- Early Action Area[b]
- Dredged and capped area[c]
- Thin-layer placement[c]
- Road
- Navigation channel
- River mile

95th percentile = 43
75th percentile = 27
50th percentile = 22
25th percentile = 17

Outfall classification[d]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, a value of one-half the RL at that location was used.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] For the Duwamish/Diagonal early action area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005. For the Norfolk early action area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

Wind Ward LLC environmental

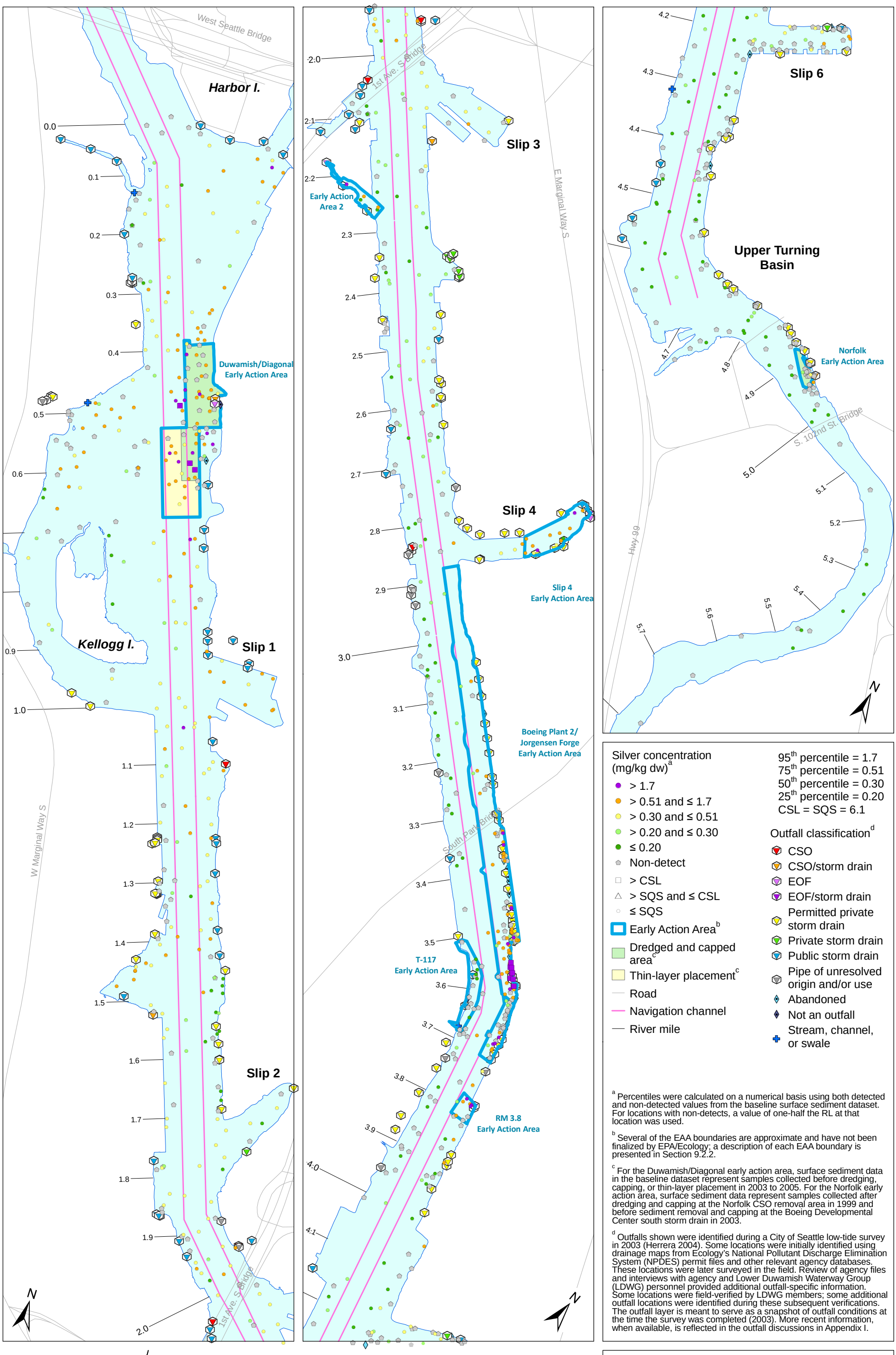
0 0.1 0.2 Miles

0 0.1 0.2 Kilometers

Scale is the same for each inset map

Map 4-55. Nickel concentrations in surface sediment

Prepared by CEH, 07/15/2010; MAP 2788; W:\Projects\00-08-06 Duwamish RI\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\Other COCs



Silver concentration (mg/kg dw)[a]

- > 1.7
- > 0.51 and ≤ 1.7
- > 0.30 and ≤ 0.51
- > 0.20 and ≤ 0.30
- ≤ 0.20
- Non-detect
- > CSL
- > SQS and ≤ CSL
- ≤ SQS
- Early Action Area[b]
- Dredged and capped area[c]
- Thin-layer placement[c]
- Road
- Navigation channel
- River mile

95th percentile = 1.7
75th percentile = 0.51
50th percentile = 0.30
25th percentile = 0.20
CSL = SQS = 6.1

Outfall classification[d]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, a value of one-half the RL at that location was used.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] For the Duwamish/Diagonal early action area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005. For the Norfolk early action area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

Wind Ward LLC environmental

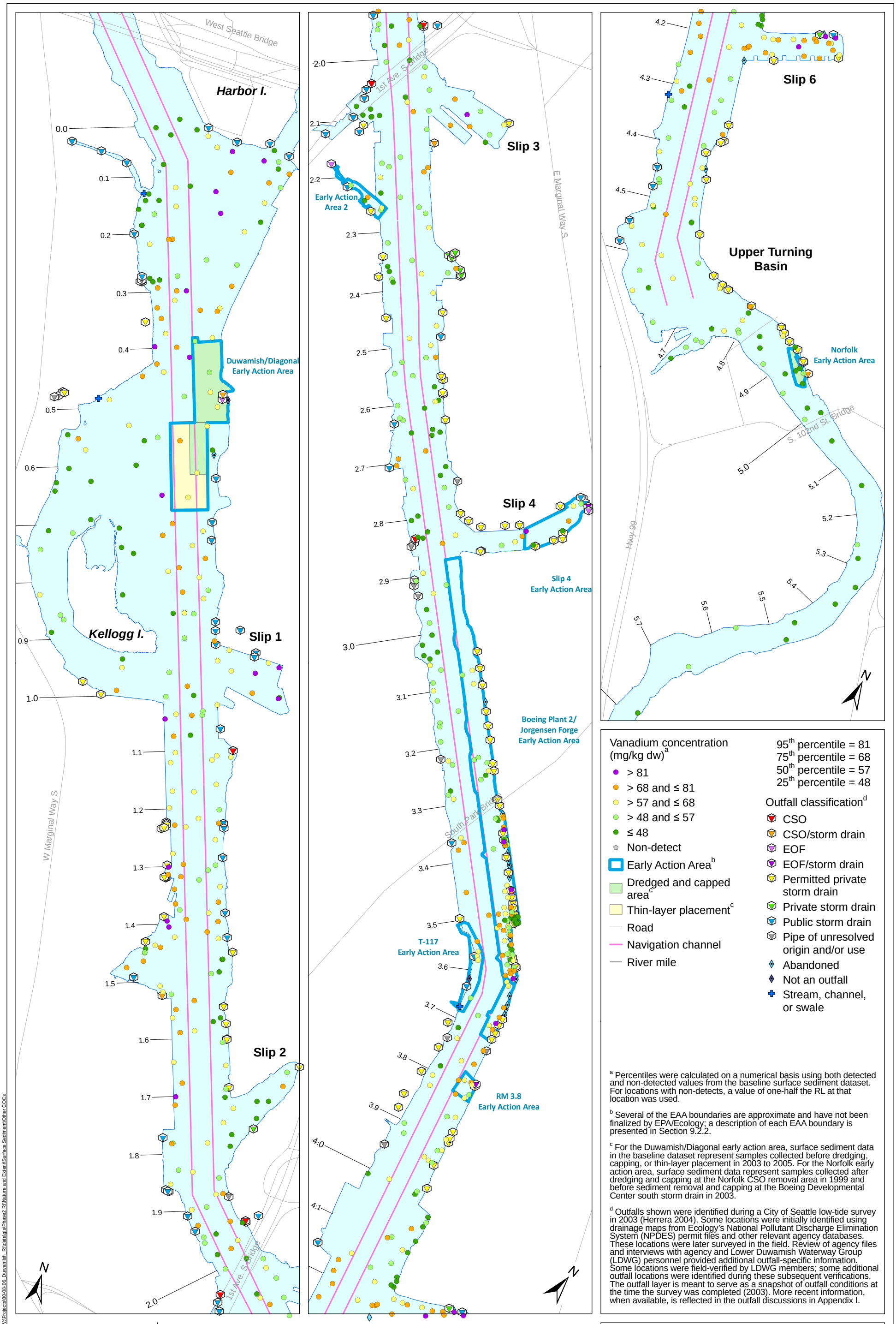
0 0.1 0.2 Miles

0 0.1 0.2 Kilometers

Scale is the same for each inset map

Map 4-56. Silver concentrations in surface sediment

Prepared by CEH, 07/15/2010; MAP 2789; W:\Projects\00-08-06 Duwamish RI\fate&gis\Phase2 RI\Nature and Extent\Surface Sediment\Other COCs



Vanadium concentration (mg/kg dw)[a]

- > 81
- > 68 and ≤ 81
- > 57 and ≤ 68
- > 48 and ≤ 57
- ≤ 48
- Non-detect
- Early Action Area[b]
- Dredged and capped area[c]
- Thin-layer placement[c]
- Road
- Navigation channel
- River mile

95th percentile = 81
75th percentile = 68
50th percentile = 57
25th percentile = 48

Outfall classification[d]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, a value of one-half the RL at that location was used.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

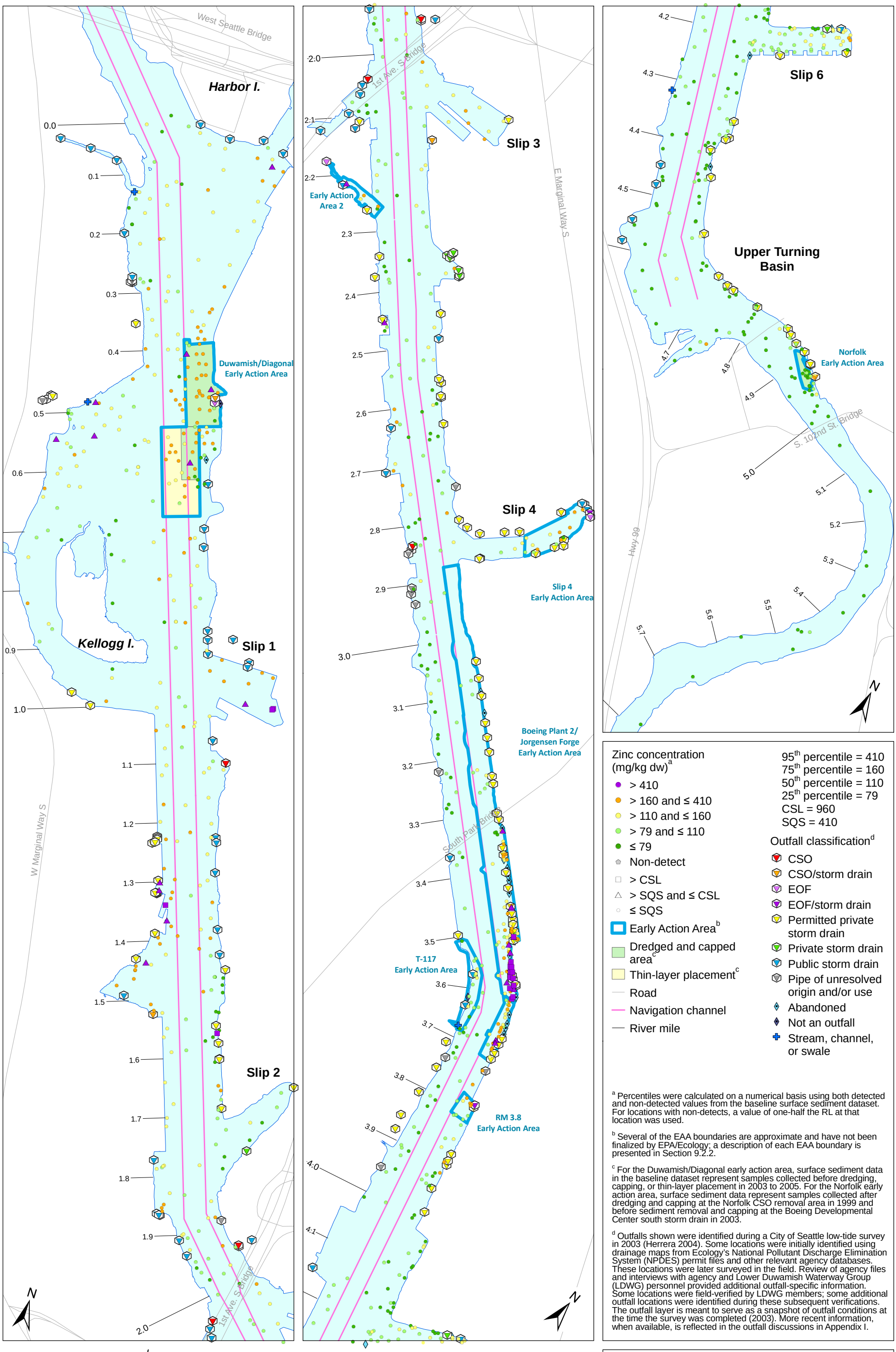
[c] For the Duwamish/Diagonal early action area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005. For the Norfolk early action area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

Map 4-57. Vanadium concentrations in surface sediment

Wind Ward environmental LLC

Prepared by CEH, 07/15/2010; MAP 2778; W:\Projects\00-08-06 Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\Other COCs



Zinc concentration (mg/kg dw)[a]

- > 410
- > 160 and ≤ 410
- > 110 and ≤ 160
- > 79 and ≤ 110
- ≤ 79
- Non-detect
- > CSL
- > SQS and ≤ CSL
- ≤ SQS
- Early Action Area[b]
- Dredged and capped area[c]
- Thin-layer placement[c]
- Road
- Navigation channel
- River mile

95th percentile = 410
75th percentile = 160
50th percentile = 110
25th percentile = 79
CSL = 960
SQS = 410

Outfall classification[d]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, a value of one-half the RL at that location was used.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] For the Duwamish/Diagonal early action area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005. For the Norfolk early action area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

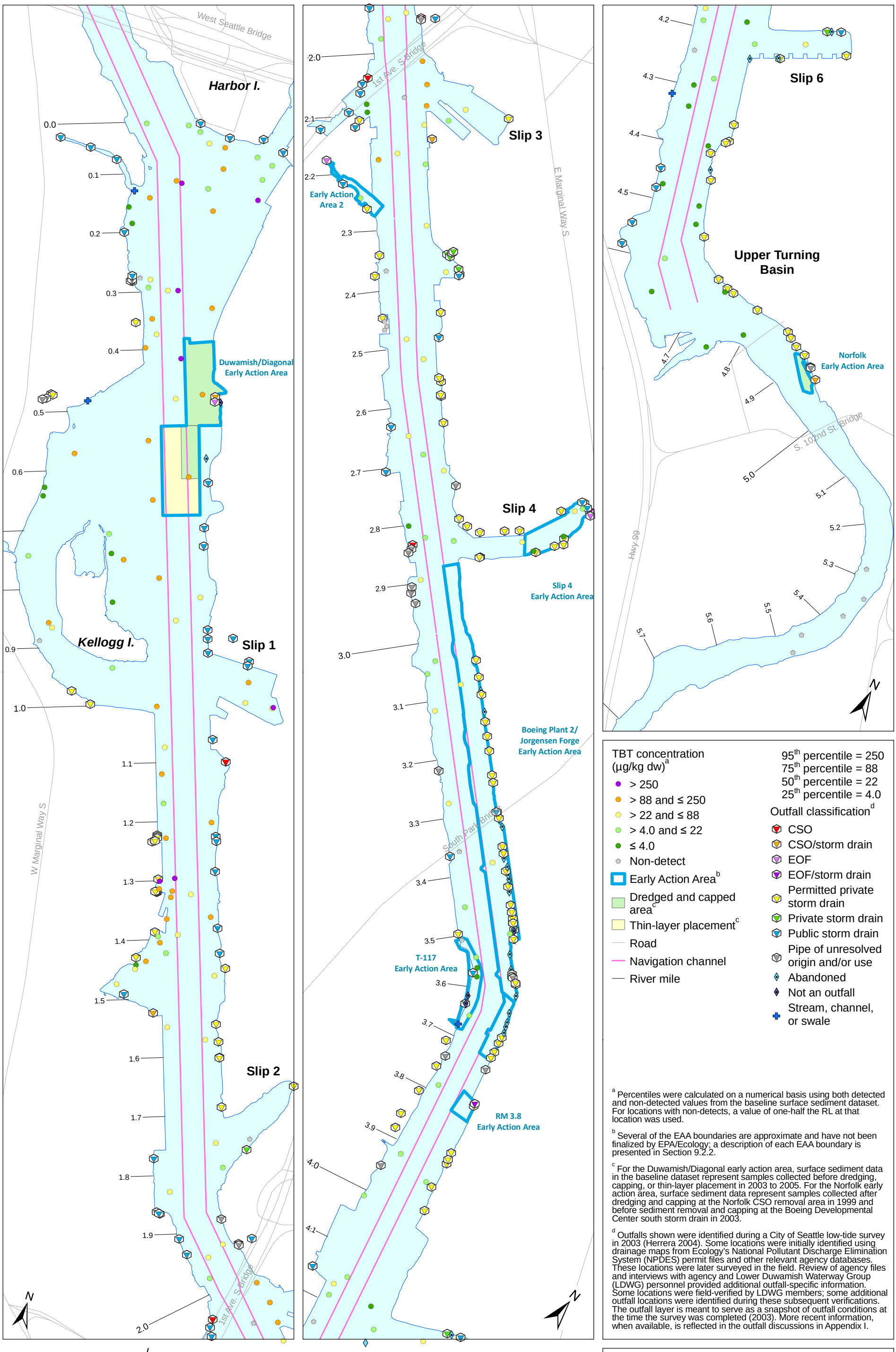
[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

Wind Ward LLC environmental

Scale is the same for each inset map

Map 4-58. Zinc concentrations in surface sediment

Prepared by CEH, 07/15/2013, MAP 2790, W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\Other COCs



TBT concentration (µg/kg dw)[a]

- > 250
- > 88 and ≤ 250
- > 22 and ≤ 88
- > 4.0 and ≤ 22
- ≤ 4.0
- Non-detect
- Early Action Area[b]
- Dredged and capped area[c]
- Thin-layer placement[c]
- Road
- Navigation channel
- River mile

95th percentile = 250
75th percentile = 88
50th percentile = 22
25th percentile = 4.0

Outfall classification[d]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, a value of one-half the RL at that location was used.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] For the Duwamish/Diagonal early action area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005. For the Norfolk early action area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

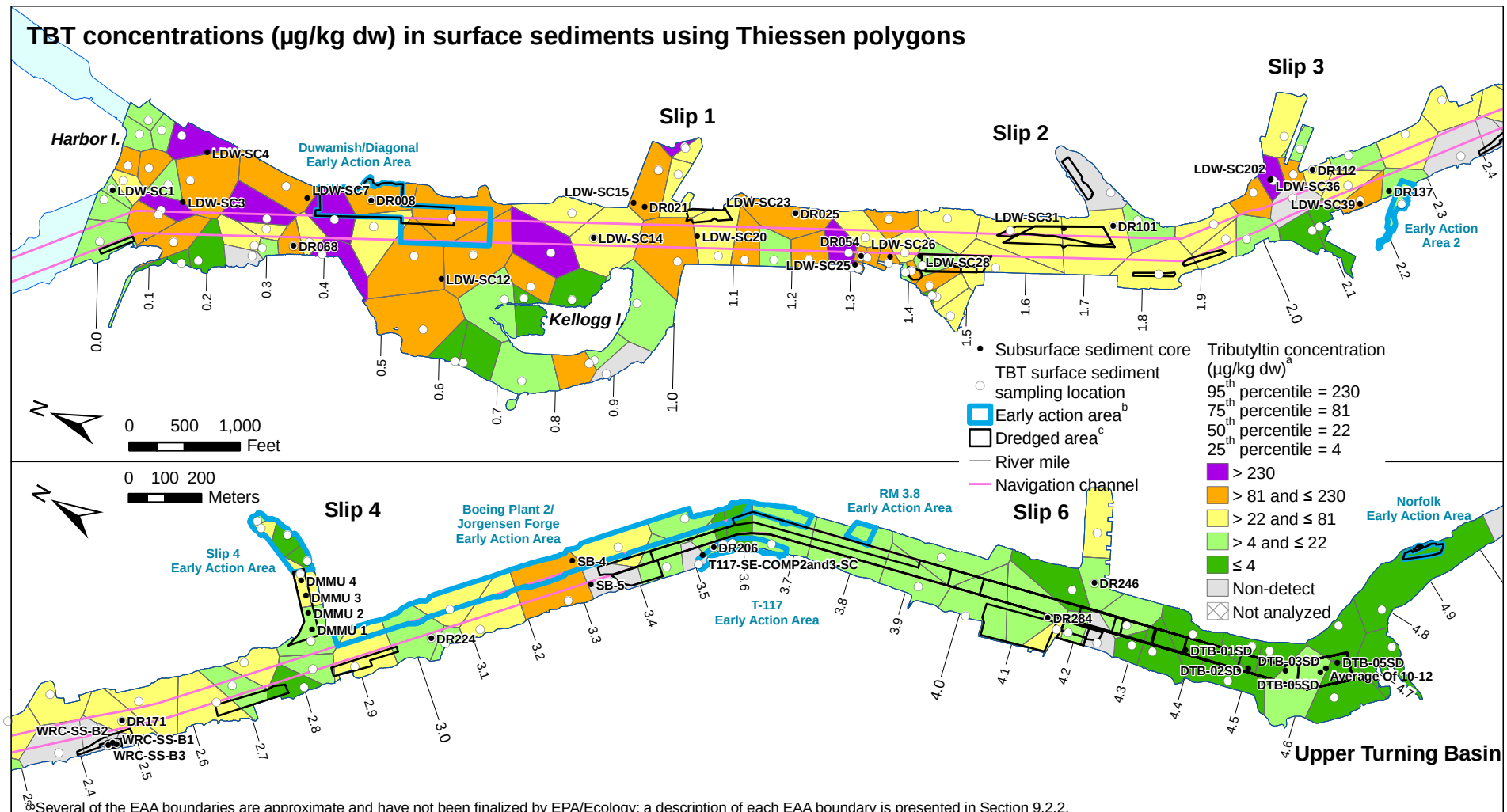
[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

Map 4-59. TBT concentrations in surface sediment

Wind Ward environmental LLC

Prepared by CEH, 07/15/2010, MAP 2779, W:\Projects\00-08-06_Duwamish_R\Data\gis\Phase2 RI\Nature and Extent\Surface Sediment\Other COCs

TBT concentrations (µg/kg dw) in surface sediments using Thiessen polygons



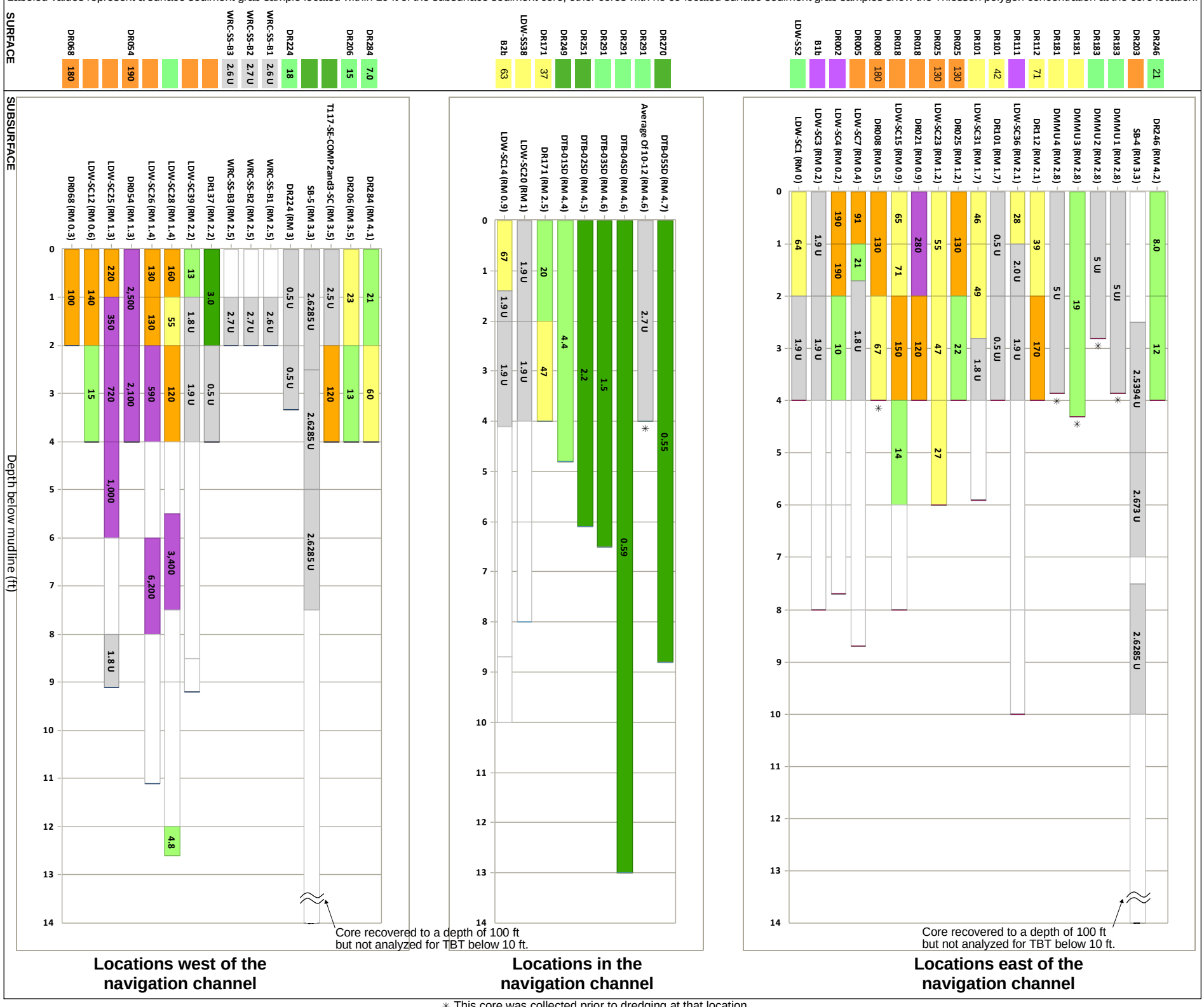
[a] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[b] For the Duwamish/Diagonal Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, and thin-layer placement in 2003 to 2005. For the Norfolk Early Action Area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO/SD removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003. Subsurface sediment data at locations in dredged areas were collected prior to dredging.

[c] Interpolated concentrations are based on data from the baseline surface sediment dataset. Percentiles were calculated on an area-basis as the concentration at which a particular percentage of the LDW area has Thiessen polygon values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has interpolated concentrations ≤ 230 µg/kg dw). Thiessen polygon concentrations were calculated including locations with non-detected values. For locations with non-detects, a value of one-half the RL at that location was used.

TBT concentrations (µg/kg dw) in subsurface sediment cores and co-located (within 10 ft) surface sediment samples

Labeled values represent a surface sediment grab sample located within 10 ft of the subsurface sediment core; other cores with no co-located surface sediment grab samples show the Thiessen polygon concentration at the core location.



Locations west of the navigation channel | **Locations in the navigation channel** | **Locations east of the navigation channel**

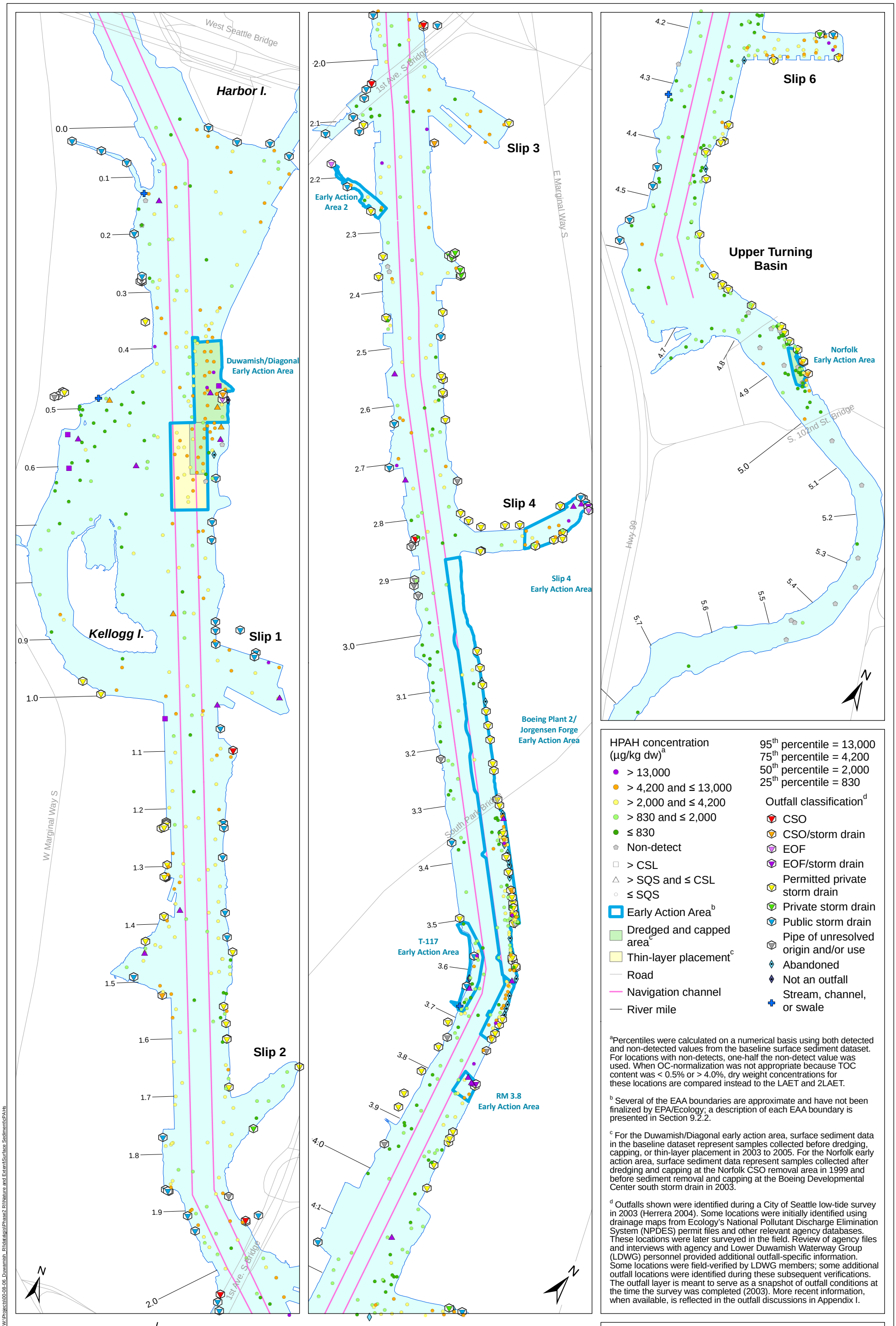
✳ This core was collected prior to dredging at that location.

Map 4-60. TBT concentrations in surface sediment and subsurface sediment cores

Wind Ward LLC environmental

Prepared by CEH, 07/15/2010; MAP 3378; W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Bar charts

Dredging information provided by AECOM.



HPAH concentration (µg/kg dw)[a]

- > 13,000
- > 4,200 and ≤ 13,000
- > 2,000 and ≤ 4,200
- > 830 and ≤ 2,000
- ≤ 830
- Non-detect
- > CSL
- > SQS and ≤ CSL
- ≤ SQS
- Early Action Area[b]
- Dredged and capped area[c]
- Thin-layer placement[c]
- Road
- Navigation channel
- River mile

95th percentile = 13,000
75th percentile = 4,200
50th percentile = 2,000
25th percentile = 830

Outfall classification[d]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale

[a]Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, one-half the non-detect value was used. When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations are compared instead to the LAET and 2LAET.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

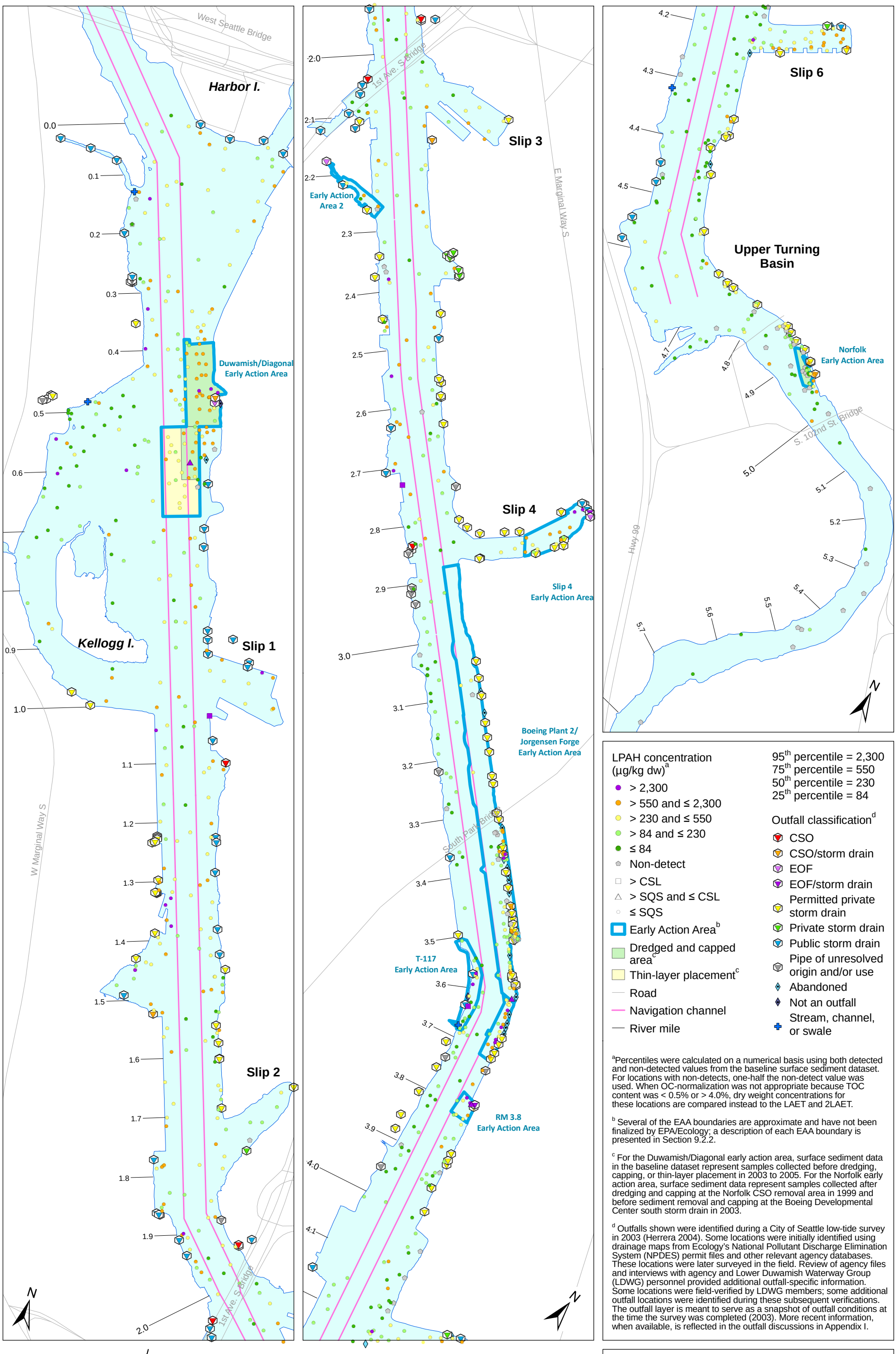
[c] For the Duwamish/Diagonal early action area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005. For the Norfolk early action area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

Map 4-61. Total HPAH concentrations in surface sediment

Wind Ward environmental LLC

Prepared by CEH, 07/15/2010, MAP 2767, W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\cPAHs



LPAH concentration (µg/kg dw)[a]

- > 2,300
- > 550 and ≤ 2,300
- > 230 and ≤ 550
- > 84 and ≤ 230
- ≤ 84
- Non-detect
- > CSL
- > SQS and ≤ CSL
- ≤ SQS
- Early Action Area[b]
- Dredged and capped area[c]
- Thin-layer placement[c]
- Road
- Navigation channel
- River mile

95th percentile = 2,300
75th percentile = 550
50th percentile = 230
25th percentile = 84

Outfall classification[d]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale

[a]Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, one-half the non-detect value was used. When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations are compared instead to the LAET and 2LAET.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] For the Duwamish/Diagonal early action area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005. For the Norfolk early action area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

Wind Ward LLC environmental

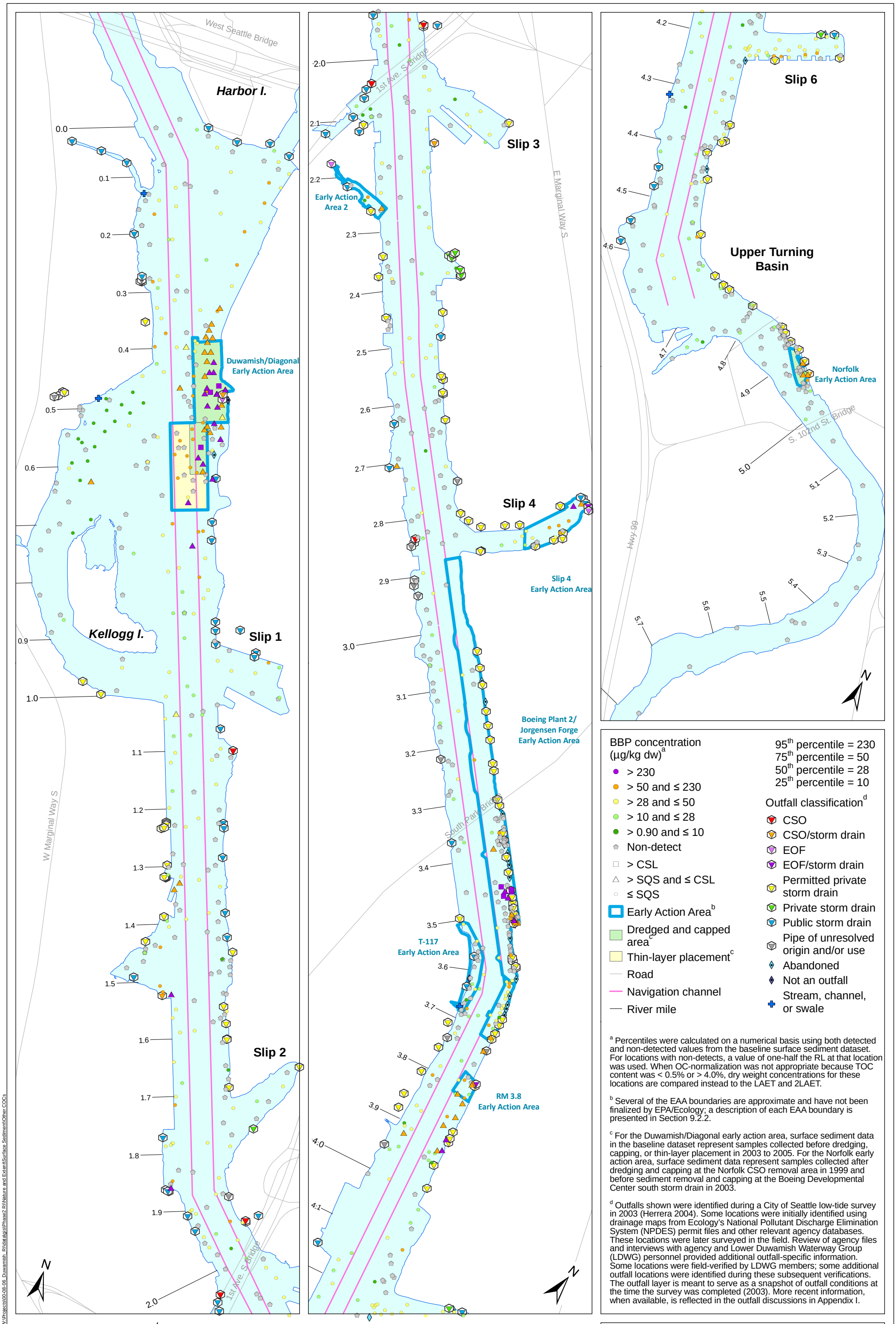
0 0.1 0.2 Miles

0 0.1 0.2 Kilometers

Scale is the same for each inset map

Map 4-62. Total LPAH concentrations in surface sediment

Prepared by CEH, 07/15/2010; MAP 2766; W:\Projects\00-08-06 Duwamish RI\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\cPAHs



BBP concentration (µg/kg dw)[a]

- > 230
- > 50 and ≤ 230
- > 28 and ≤ 50
- > 10 and ≤ 28
- > 0.90 and ≤ 10
- Non-detect
- > CSL
- > SQS and ≤ CSL
- ≤ SQS
- Early Action Area[b]
- Dredged and capped area[c]
- Thin-layer placement[c]
- Road
- Navigation channel
- River mile

95th percentile = 230
75th percentile = 50
50th percentile = 28
25th percentile = 10

Outfall classification[d]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, a value of one-half the RL at that location was used. When OC-normalization was not appropriate because TOC content was < 0.5% or > 4.0%, dry weight concentrations for these locations are compared instead to the LAET and 2LAET.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

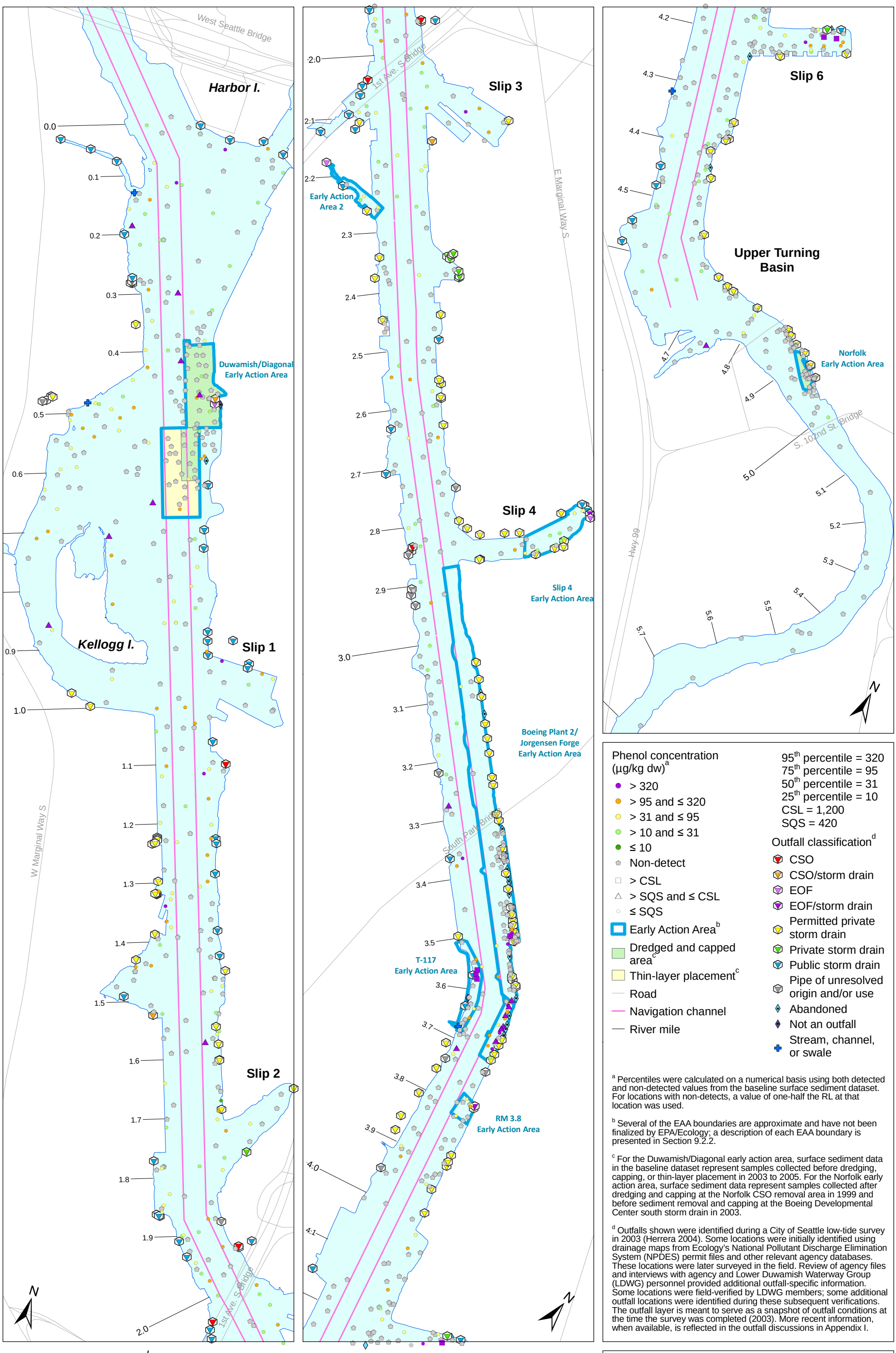
[c] For the Duwamish/Diagonal early action area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005. For the Norfolk early action area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

Map 4-63. BBP concentrations in surface sediment

Wind Ward LLC environmental

Prepared by CEH, 07/15/2010; MAP 2772; W:\Projects\00-08-06 Duwamish RI\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\Other COCs



Phenol concentration (µg/kg dw)[a]

- > 320
- > 95 and ≤ 320
- > 31 and ≤ 95
- > 10 and ≤ 31
- ≤ 10
- Non-detect
- > CSL
- > SQS and ≤ CSL
- ≤ SQS
- Early Action Area[b]
- Dredged and capped area[c]
- Thin-layer placement[c]
- Road
- Navigation channel
- River mile

95th percentile = 320
75th percentile = 95
50th percentile = 31
25th percentile = 10
CSL = 1,200
SQS = 420

Outfall classification[d]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, a value of one-half the RL at that location was used.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] For the Duwamish/Diagonal early action area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005. For the Norfolk early action area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

Map 4-64. Phenol concentrations in surface sediment

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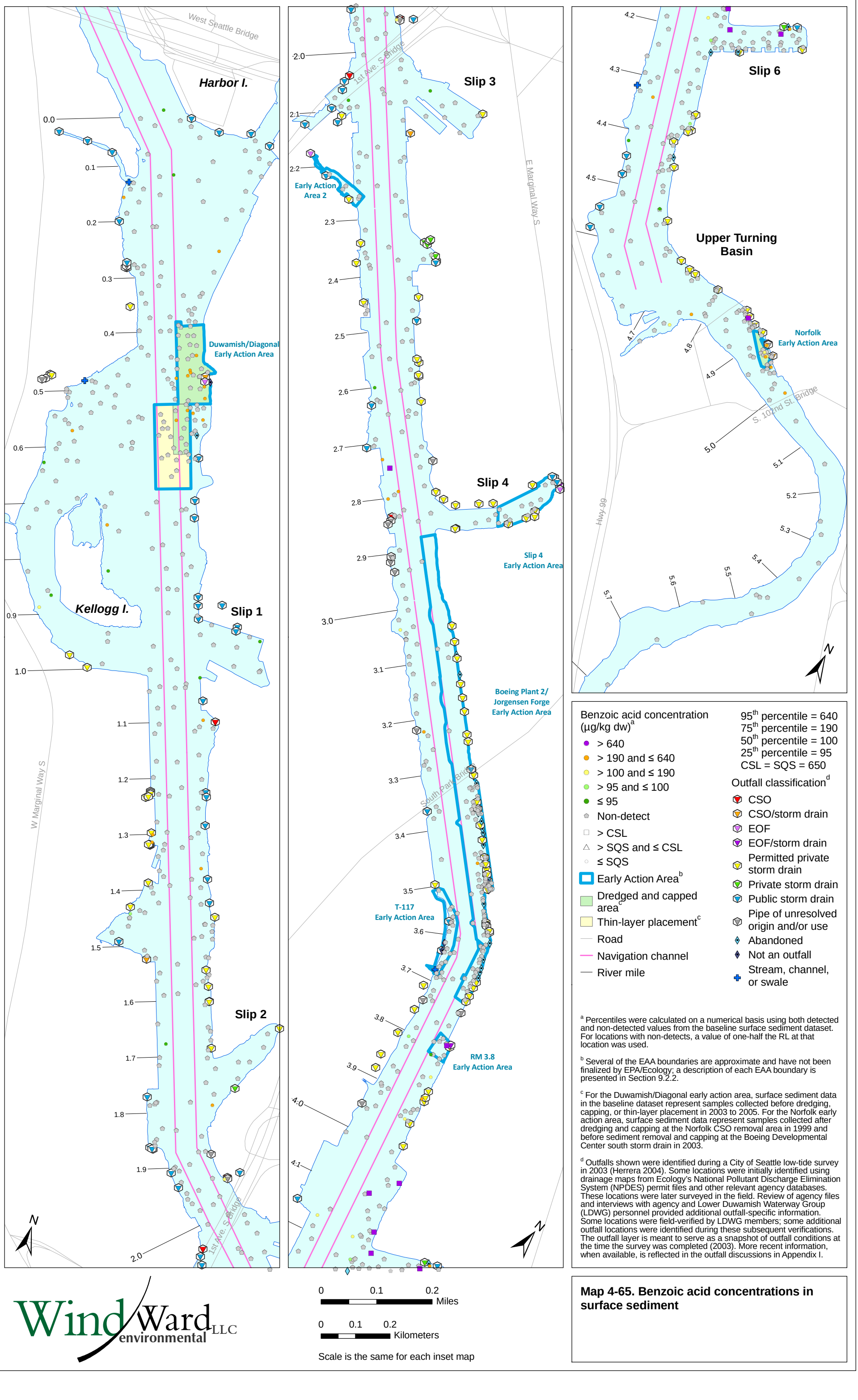
Prepared by CEH, 07/15/2010. MAP 2787. W:\Projects\00-08-06 Duwamish_Riv\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\Other COCs



Benzoic acid concentration (µg/kg dw)[a]

- > 640
- > 190 and ≤ 640
- > 100 and ≤ 190
- > 95 and ≤ 100
- ≤ 95
- Non-detect
- > CSL
- > SQS and ≤ CSL
- ≤ SQS
- Early Action Area[b]
- Dredged and capped area[c]
- Thin-layer placement[c]
- Road
- Navigation channel
- River mile

95th percentile = 640
75th percentile = 190
50th percentile = 100
25th percentile = 95
CSL = SQS = 650

Outfall classification[d]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, a value of one-half the RL at that location was used.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

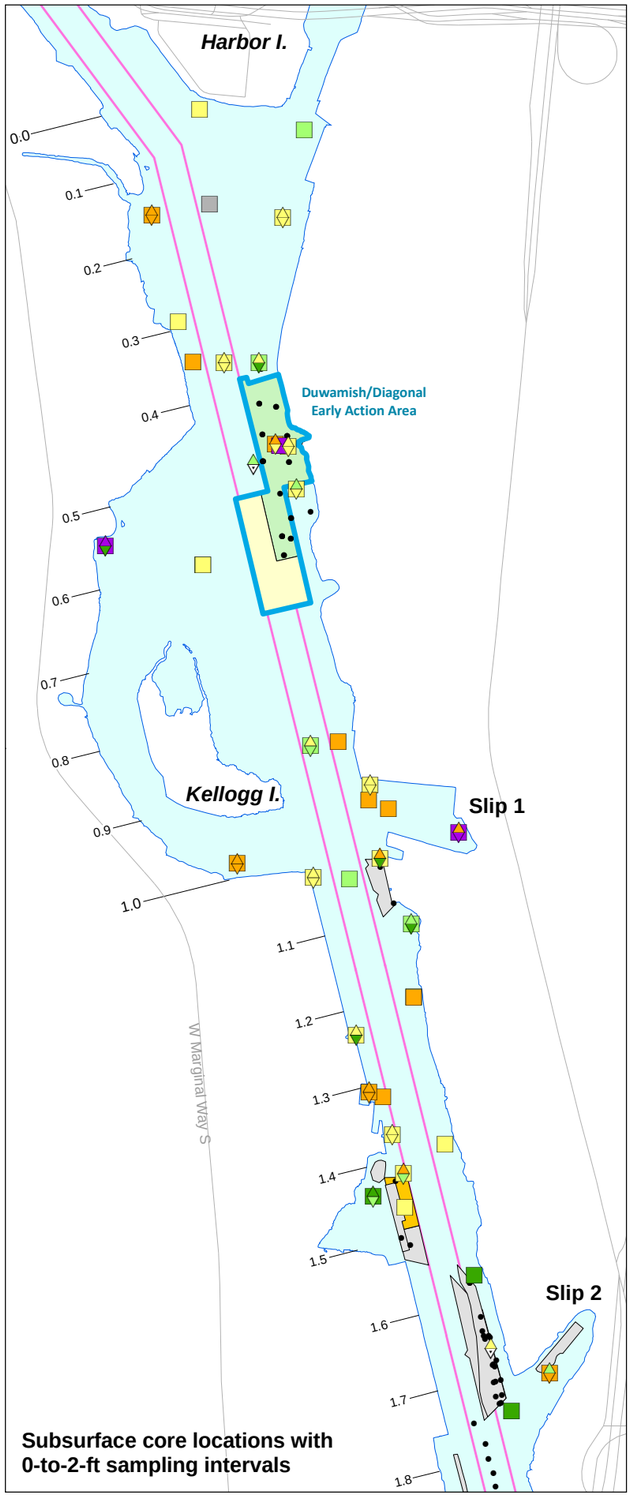
[c] For the Duwamish/Diagonal early action area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005. For the Norfolk early action area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

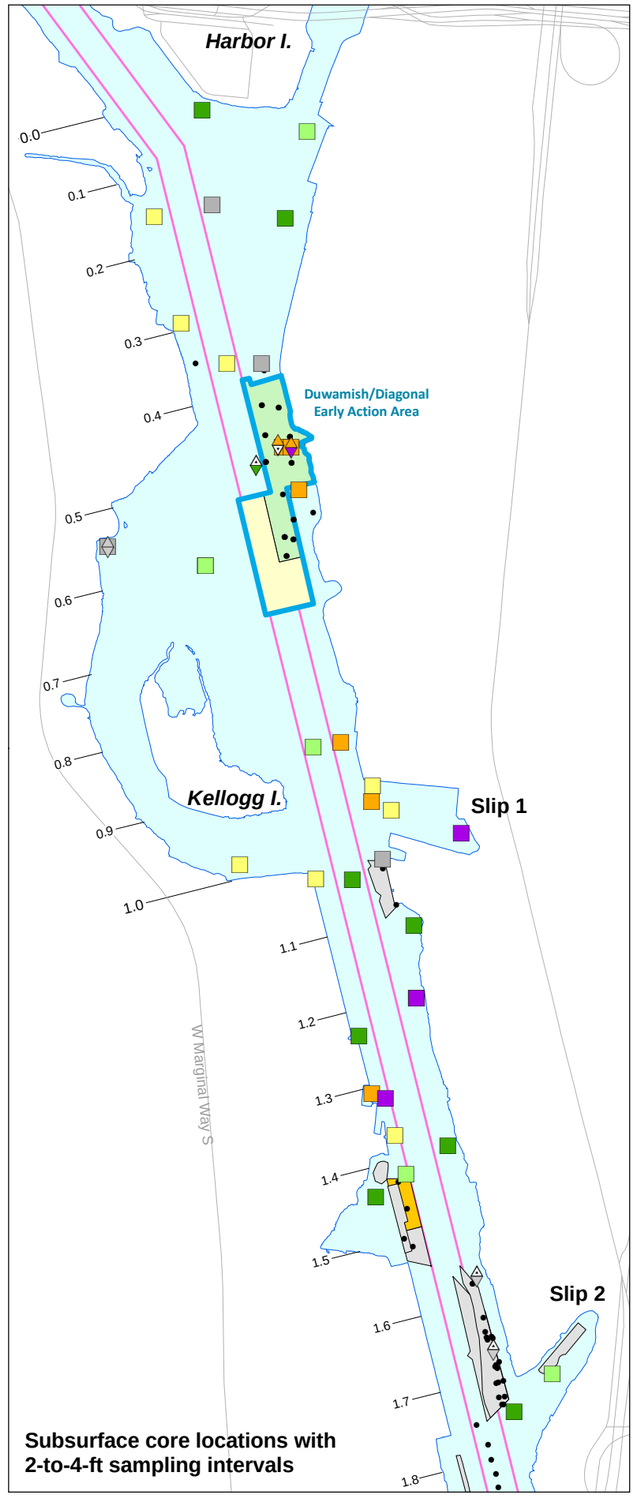
Map 4-65. Benzoic acid concentrations in surface sediment

Wind Ward LLC environmental

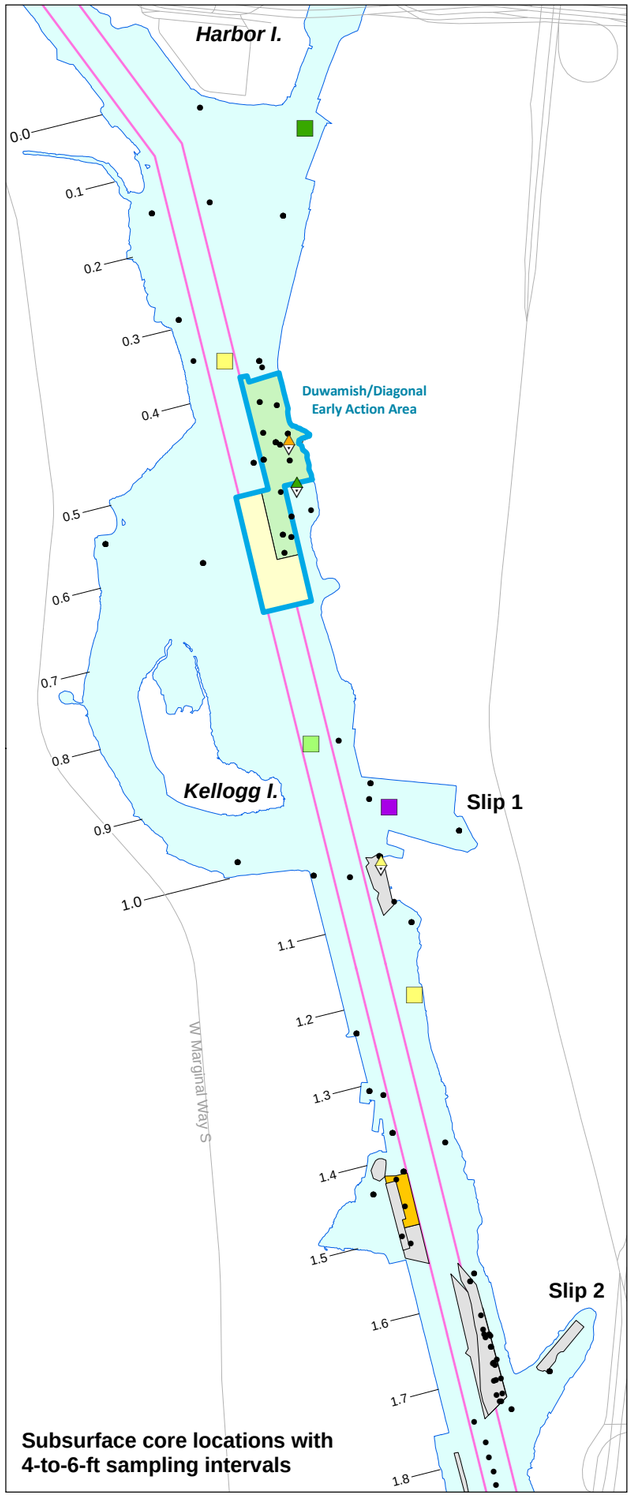
Prepared by CEH, 07/15/2010, MAP 2786, W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 R\Nature and Extent\Surface Sediment\Other COCs



Subsurface core locations with 0-to-2-ft sampling intervals



Subsurface core locations with 2-to-4-ft sampling intervals



Subsurface core locations with 4-to-6-ft sampling intervals

Total HPAH concentration (µg/kg dw)[a]

> 13,000	95th percentile = 13,000
> 4,200 and ≤ 13,000	75th percentile = 4,200
> 2,000 and ≤ 4,200	50th percentile = 2,000
> 830 and ≤ 2,000	25th percentile = 830
≤ 830	
Non-detect	

Sampling interval

Left panel	Middle panel	Right panel
0-to-2-ft[b]	2-to-4-ft[b]	4-to-6-ft[b]
0-to-1-ft[c]	2-to-3-ft[c]	4-to-5-ft[c]
1-to-2-ft[c]	3-to-4-ft[c]	5-to-6-ft[c]

△ Not analyzed in that sampling interval

• Other subsurface sampling location analyzed for HPAHs, but not in the illustrated sampling intervals

Early Action Area[d]

Dredged area[e]

Dredged and capped area[e]

Dredged and thin-layer placement[e]

Thin-layer placement

Navigation channel

River mile

[a] In accordance with the Washington State SMS, Total HPAH represents the sum of the concentrations of detected HPAH compounds. Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, one-half the non-detect value was used.

[b] Data from 2-foot sampling intervals; some locations show an average of data from both 1-foot intervals within that 2-foot interval at a given location.

[c] Data from 1-foot sampling intervals are shown if available. If both 1-foot intervals within the 2-foot interval were collected, the average of the two intervals is also shown.

[d] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[e] Subsurface sediment data at locations in dredged areas were collected prior to dredging.

N

0 0.1 0.2 Kilometers

0 0.1 0.2 Miles

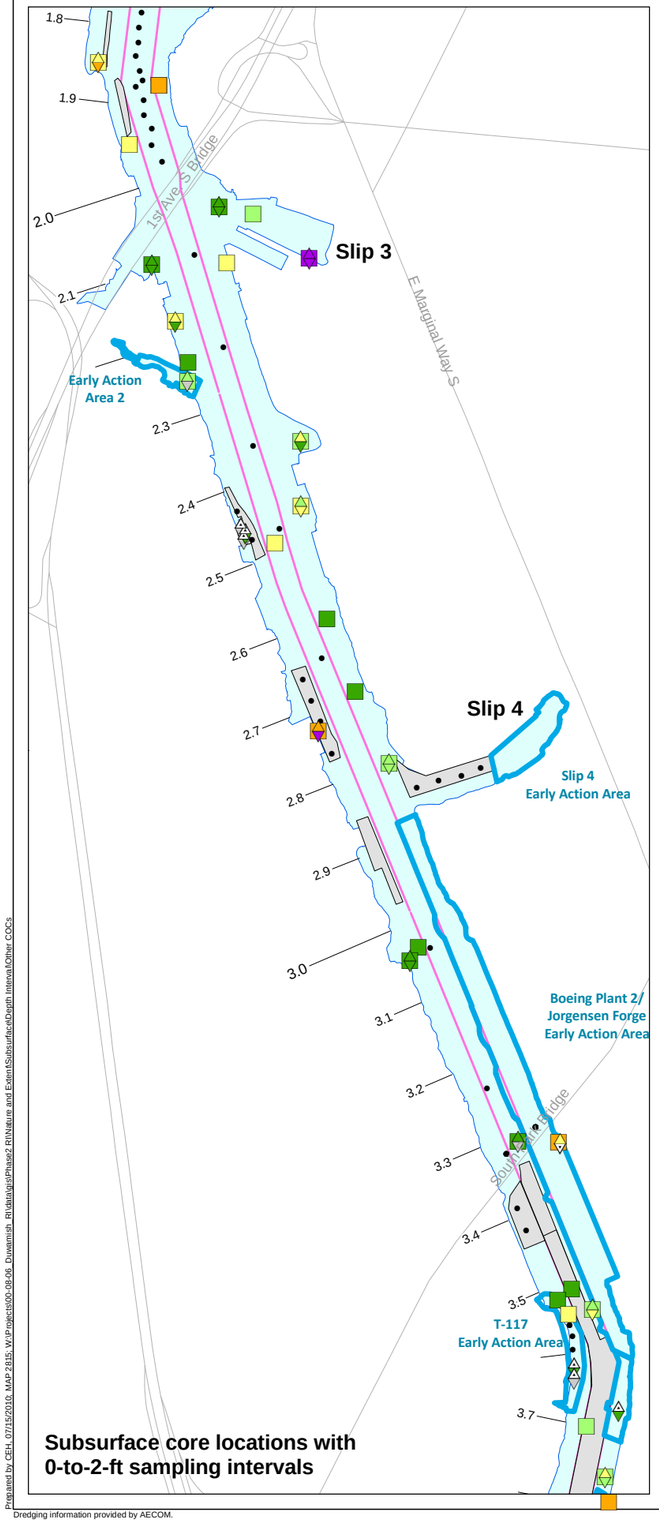
Scale is the same for each map frame

Map 4-66a. Total HPAH concentrations in subsurface sediment within the 0-to-2-ft, 2-to-4-ft, and 4-to-6-ft sampling intervals, RM 0.0 to RM 1.8

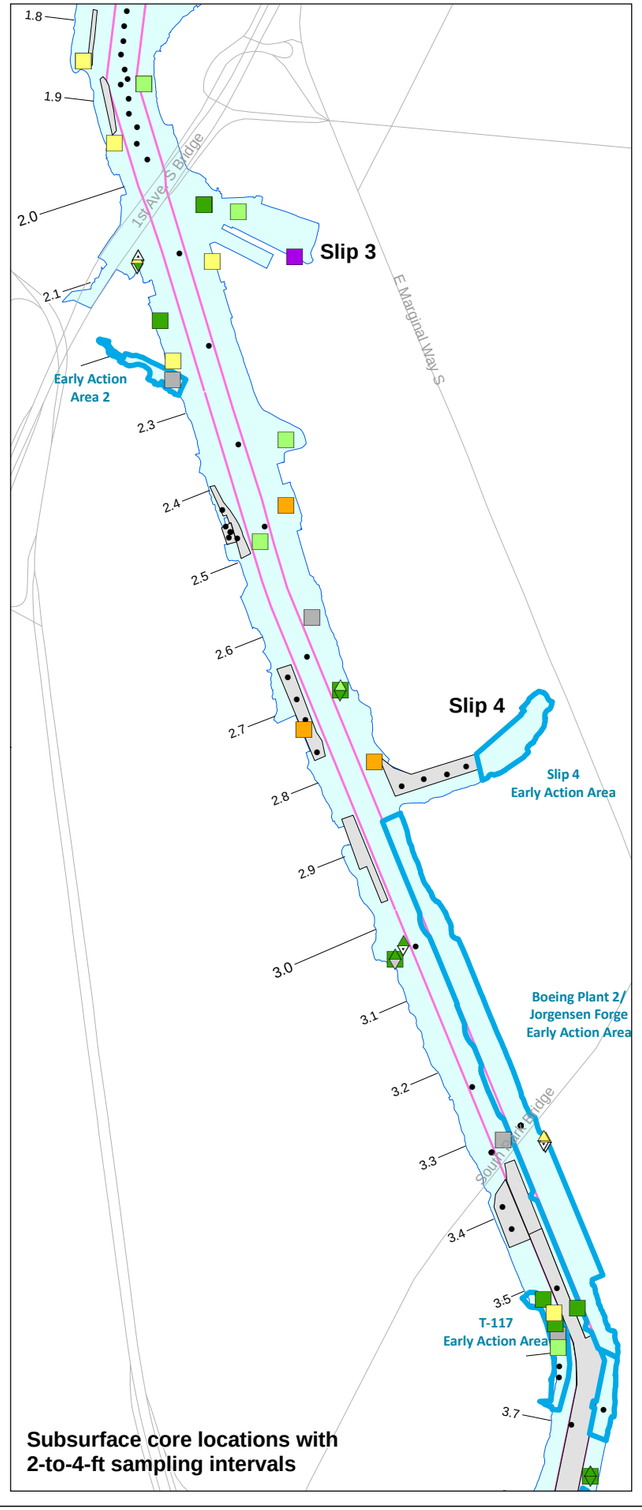
Wind Ward LLC environmental

Prepared by: CEH, 07/15/2010, MAP 2815, W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Subsurface\Depth Interval\Other COCs

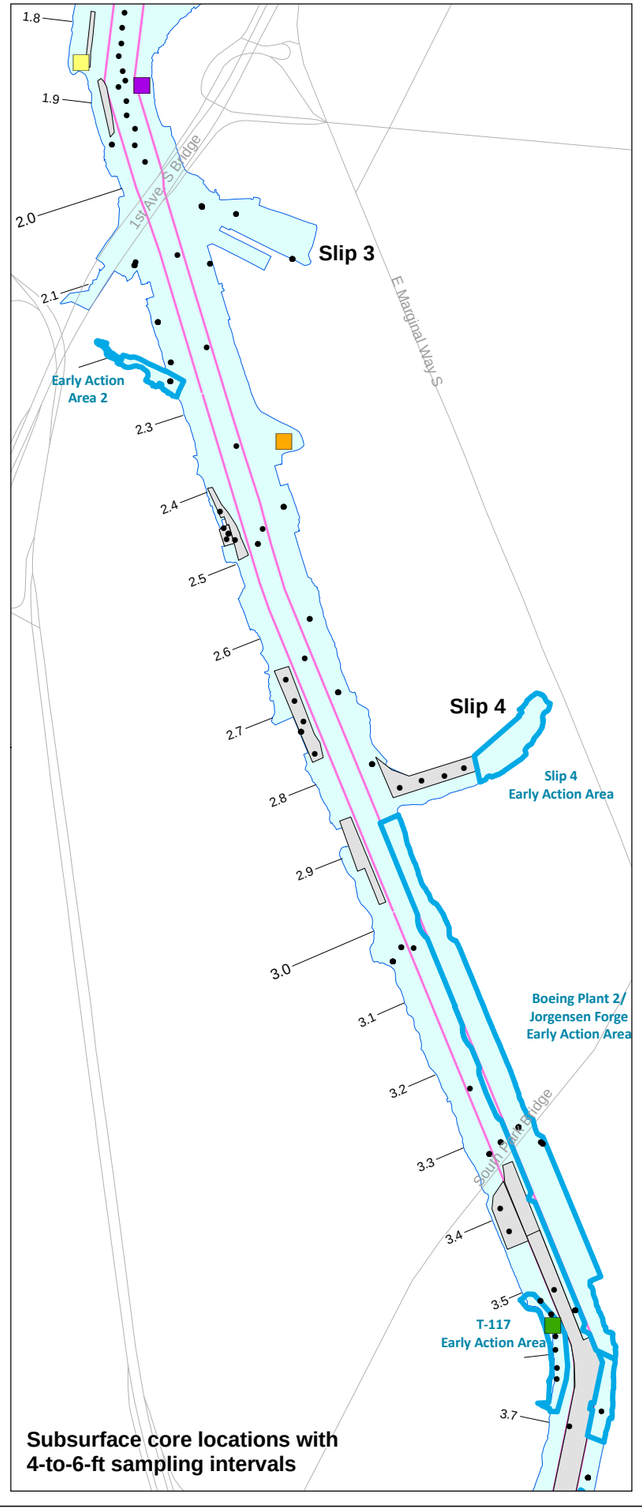
Dredging information provided by AECOM.



Subsurface core locations with 0-to-2-ft sampling intervals



Subsurface core locations with 2-to-4-ft sampling intervals



Subsurface core locations with 4-to-6-ft sampling intervals

Total HPAH concentration (µg/kg dw)[a]

- > 13,000 — 95th percentile = 13,000
- > 4,200 and ≤ 13,000 — 75th percentile = 4,200
- > 2,000 and ≤ 4,200 — 50th percentile = 2,000
- > 830 and ≤ 2,000 — 25th percentile = 830
- ≤ 830
- Non-detect

Sampling interval

	Left panel	Middle panel	Right panel
□	0-to-2-ft[b]	2-to-4-ft[b]	4-to-6-ft[b]
◇	0-to-1-ft[c]	2-to-3-ft[c]	4-to-5-ft[c]
◇	1-to-2-ft[c]	3-to-4-ft[c]	5-to-6-ft[c]

△ Not analyzed in that sampling interval

• Other subsurface sampling location analyzed for HPAHs, but not in the illustrated sampling intervals

Early Action Area[d]

Dredged area[e]

Navigation channel

River mile

[a] In accordance with the Washington State SMS, Total HPAH represents the sum of the concentrations of detected HPAH compounds. Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, one-half the non-detect value was used.

[b] Data from 2-foot sampling intervals; some locations show an average of data from both 1-foot intervals within that 2-foot interval at a given location.

[c] Data from 1-foot sampling intervals are shown if available. If both 1-foot intervals within the 2-foot interval were collected, the average of the two intervals is also shown.

[d] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[e] Subsurface sediment data at locations in dredged areas were collected prior to dredging.

0 0.1 0.2 Kilometers

0 0.1 0.2 Miles

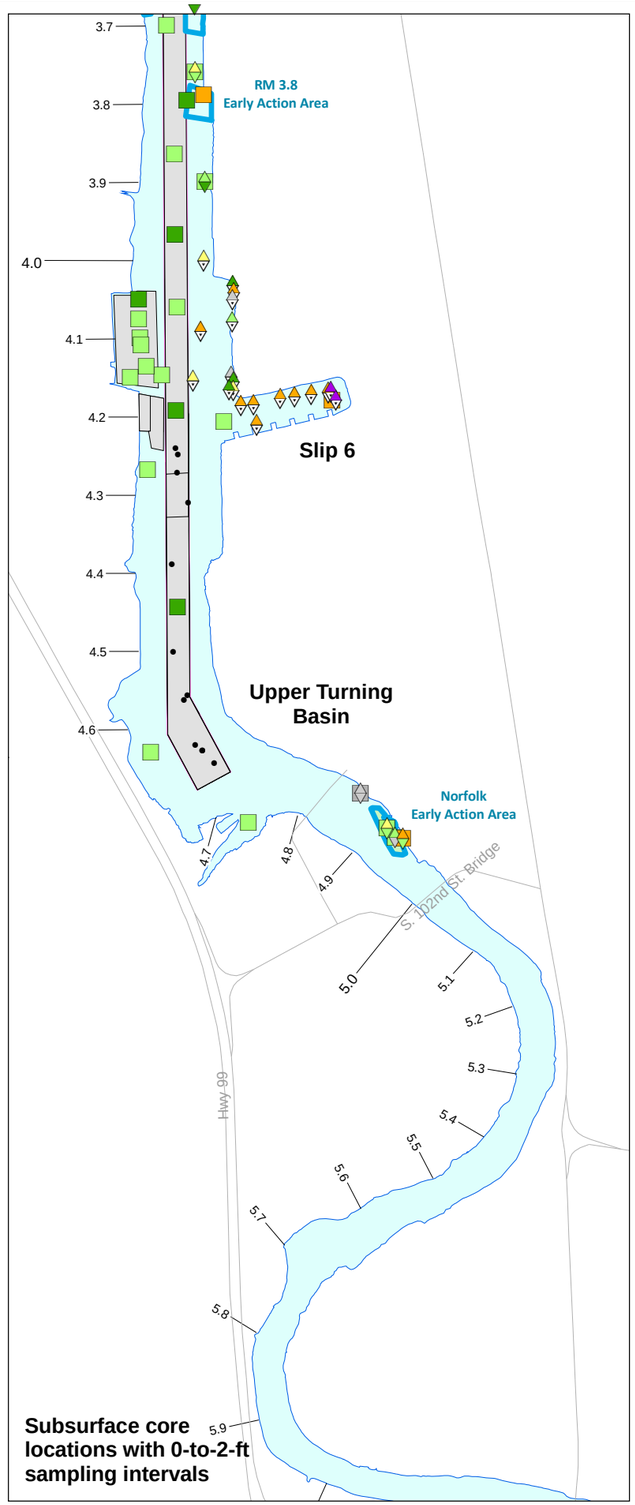
Scale is the same for each map frame

Map 4-66b. Total HPAH concentrations in subsurface sediment within the 0-to-2-ft, 2-to-4-ft, and 4-to-6-ft sampling intervals, RM 1.8 to RM 3.7

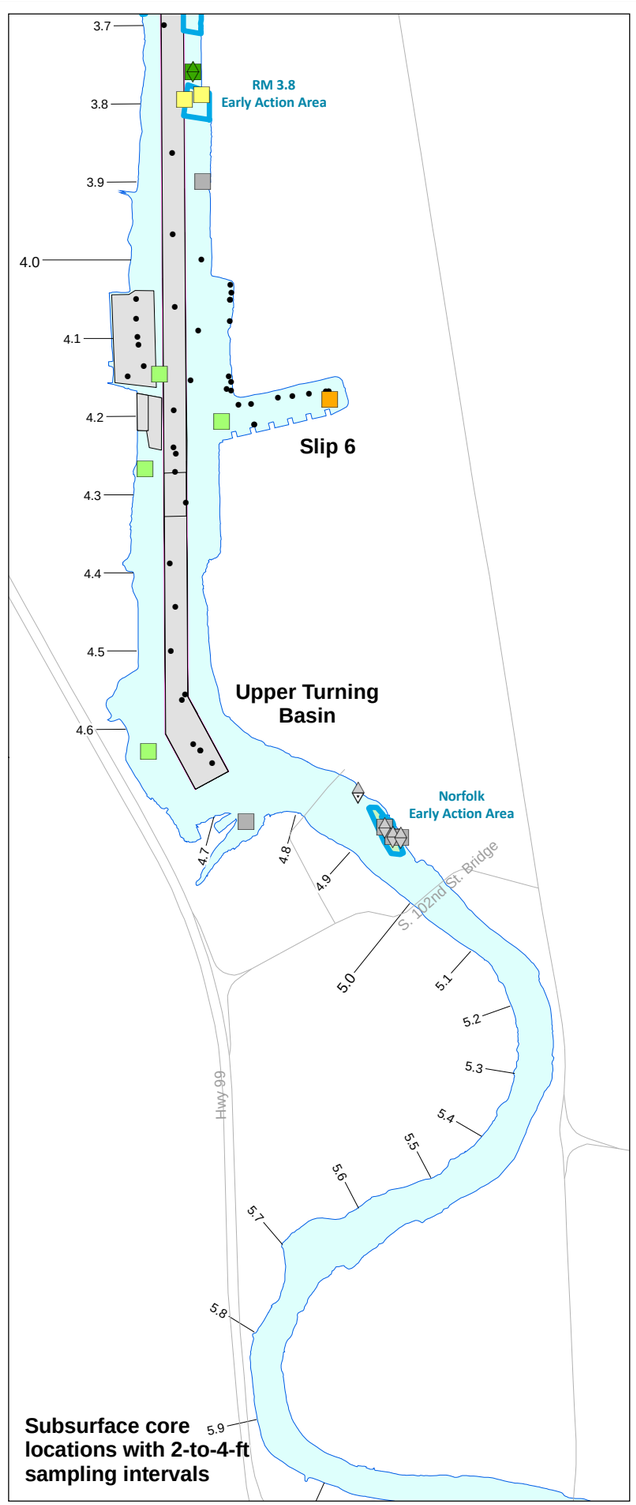
Wind Ward environmental LLC

Prepared by: CEH, 07/15/2010, MAP 2815, W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Subsurface\Depth Interval\Other COCs

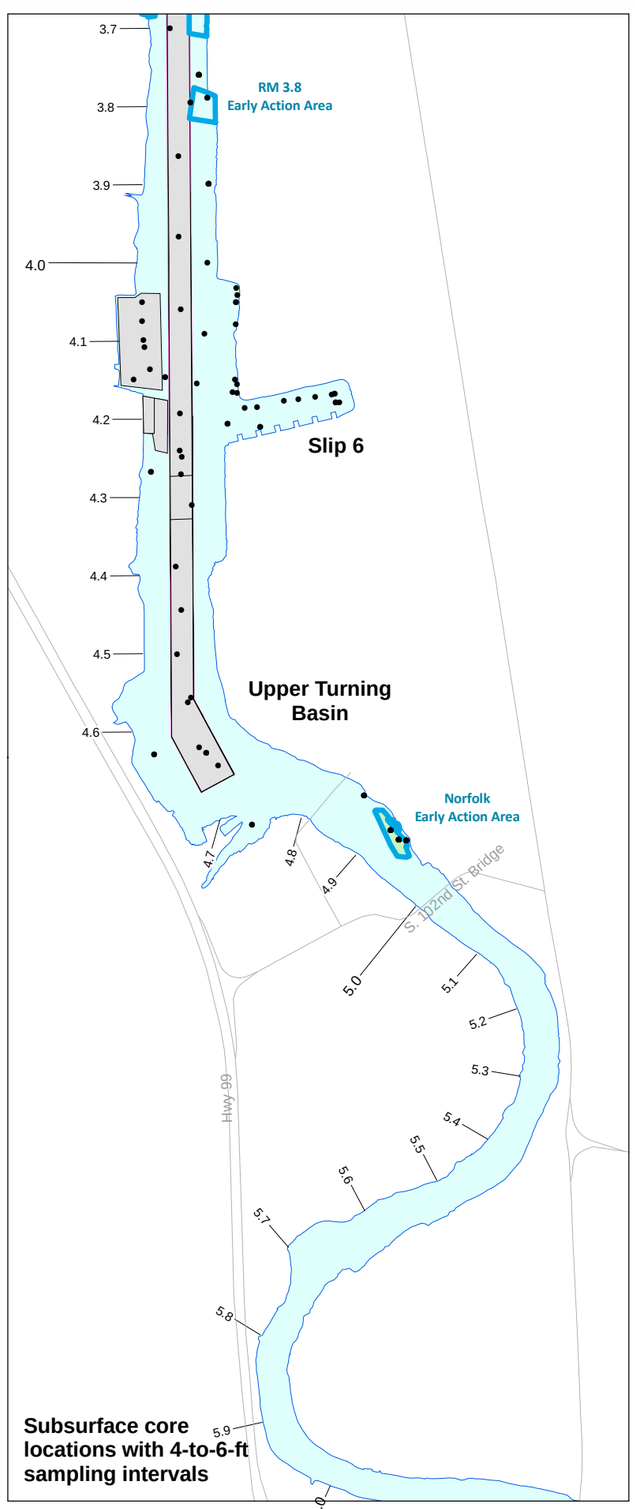
Dredging information provided by AECOM.



Subsurface core locations with 0-to-2-ft sampling intervals



Subsurface core locations with 2-to-4-ft sampling intervals



Subsurface core locations with 4-to-6-ft sampling intervals

Total HPAH concentration (µg/kg dw)[a]

- > 13,000
- > 4,200 and ≤ 13,000
- > 2,000 and ≤ 4,200
- > 830 and ≤ 2,000
- ≤ 830
- Non-detect

95th percentile = 13,000
75th percentile = 4,200
50th percentile = 2,000
25th percentile = 830

Sampling interval

Left panel	Middle panel	Right panel
0-to-2-ft[b]	2-to-4-ft[b]	4-to-6-ft[b]
0-to-1-ft[c]	2-to-3-ft[c]	4-to-5-ft[c]
1-to-2-ft[c]	3-to-4-ft[c]	5-to-6-ft[c]

△ Not analyzed in that sampling interval

• Other subsurface sampling location analyzed for HPAHs, but not in the illustrated sampling intervals

Early Action Area[d]

Dredged area[e]

Dredged and capped area[e]

Navigation channel

River mile

[a] In accordance with the Washington State SMS, Total HPAH represents the sum of the concentrations of detected HPAH compounds. Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, one-half the non-detect value was used.

[b] Data from 2-foot sampling intervals; some locations show an average of data from both 1-foot intervals within that 2-foot interval at a given location.

[c] Data from 1-foot sampling intervals are shown if available. If both 1-foot intervals within the 2-foot interval were collected, the average of the two intervals is also shown.

[d] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[e] Subsurface sediment data at locations in dredged areas were collected prior to dredging.

N

0 0.1 0.2 Kilometers

0 0.1 0.2 Miles

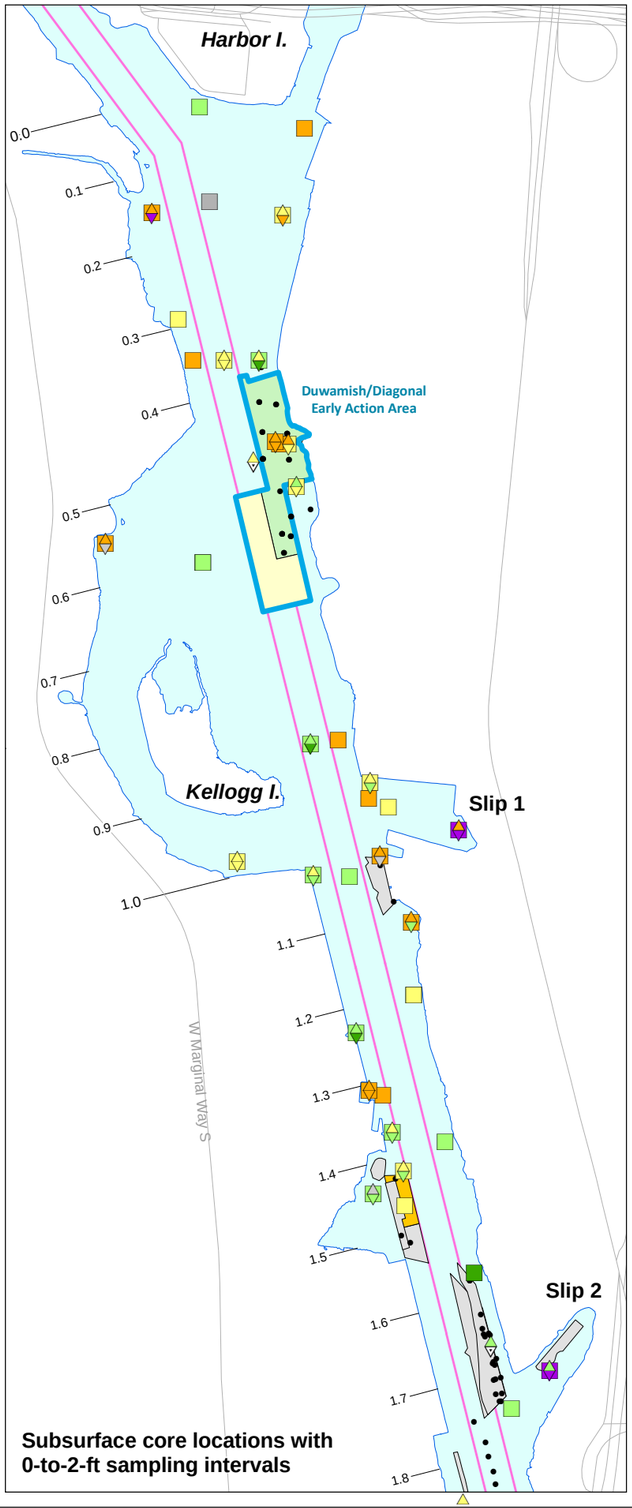
Scale is the same for each map frame

Map 4-66c. Total HPAH concentrations in subsurface sediment within the 0-to-2-ft, 2-to-4-ft, and 4-to-6-ft sampling intervals, RM 3.7 to RM 6.0

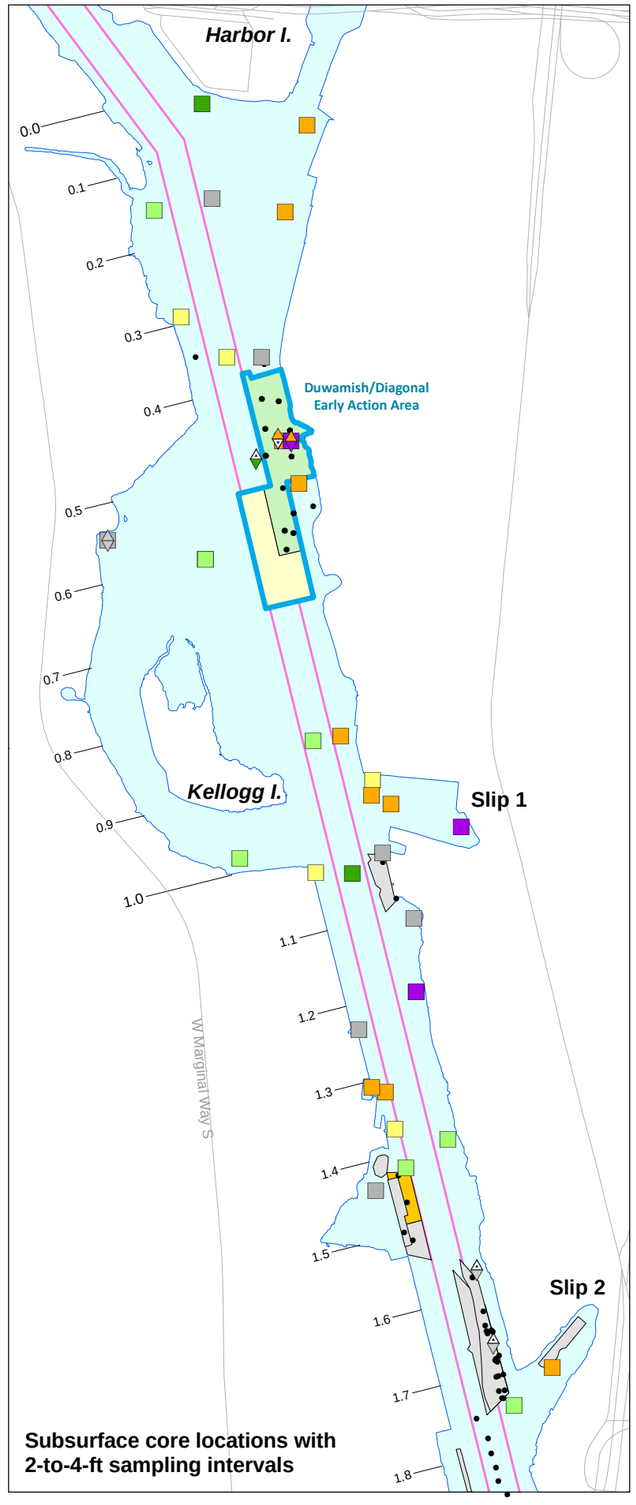
Wind Ward LLC environmental

Prepared by: CEH, 07/15/2010, MAP 2835, W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Subsurface\4Depth Interval\2Other COCs

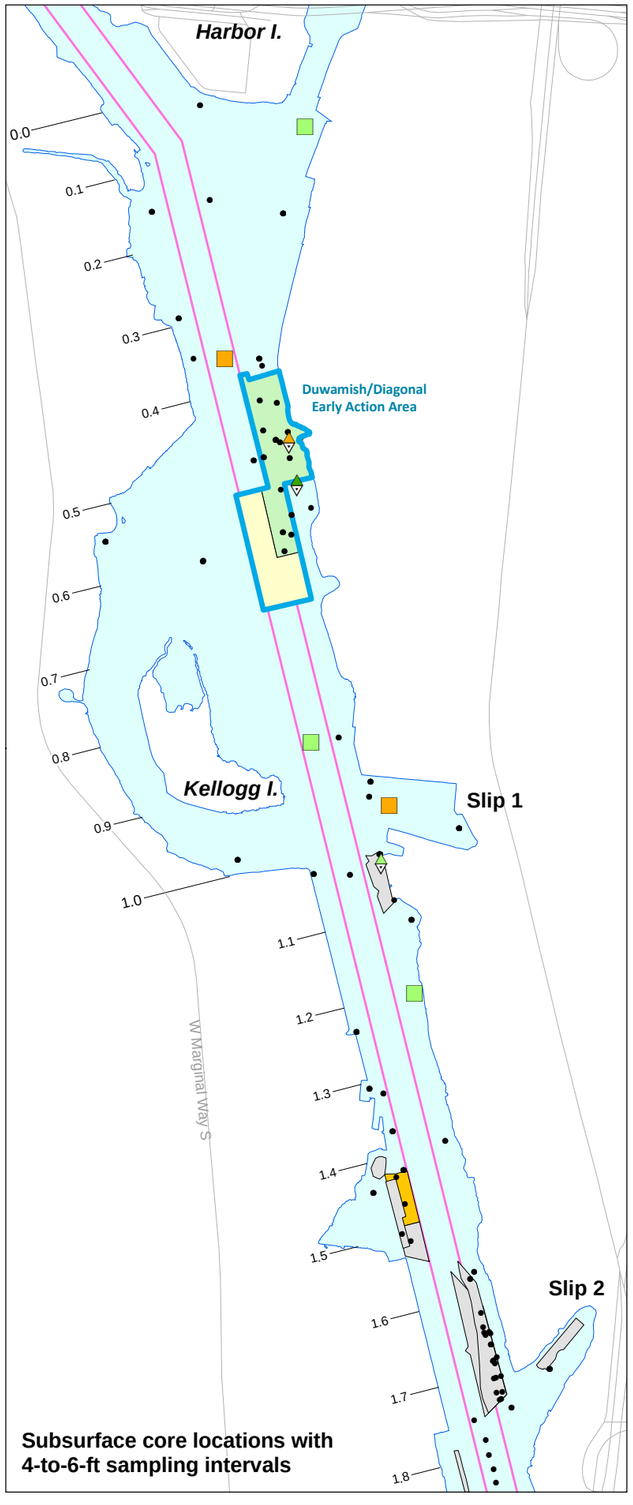
Dredging information provided by AECOM.



Subsurface core locations with 0-to-2-ft sampling intervals



Subsurface core locations with 2-to-4-ft sampling intervals



Subsurface core locations with 4-to-6-ft sampling intervals

Total LPAH concentration (µg/kg dw)[a]

> 2,300	95th percentile = 2,300
> 550 and ≤ 2,300	75th percentile = 550
> 230 and ≤ 550	50th percentile = 230
> 84 and ≤ 230	25th percentile = 84
≤ 84	
Non-detect	

Sampling interval

	Left panel	Middle panel	Right panel
□	0-to-2-ft[b]	2-to-4-ft[b]	4-to-6-ft[b]
◇	0-to-1-ft[c]	2-to-3-ft[c]	4-to-5-ft[c]
◇	1-to-2-ft[c]	3-to-4-ft[c]	5-to-6-ft[c]

△ Not analyzed in that sampling interval

• Other subsurface sampling location analyzed for LPAHs, but not in the illustrated sampling intervals

Early Action Area[d]

Dredged area[e]

Dredged and capped area[e]

Dredged and thin-layer placement[e]

Thin-layer placement

Navigation channel

River mile

[a] In accordance with the Washington State SMS, Total LPAH represents the sum of the concentrations of detected LPAH compounds. Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, one-half the non-detect value was used.

[b] Data from 2-foot sampling intervals; some locations show an average of data from both 1-foot intervals within that 2-foot interval at a given location.

[c] Data from 1-foot sampling intervals are shown if available. If both 1-foot intervals within the 2-foot interval were collected, the average of the two intervals is also shown.

[d] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[e] Subsurface sediment data at locations in dredged areas were collected prior to dredging.

N

0 0.1 0.2 Kilometers

0 0.1 0.2 Miles

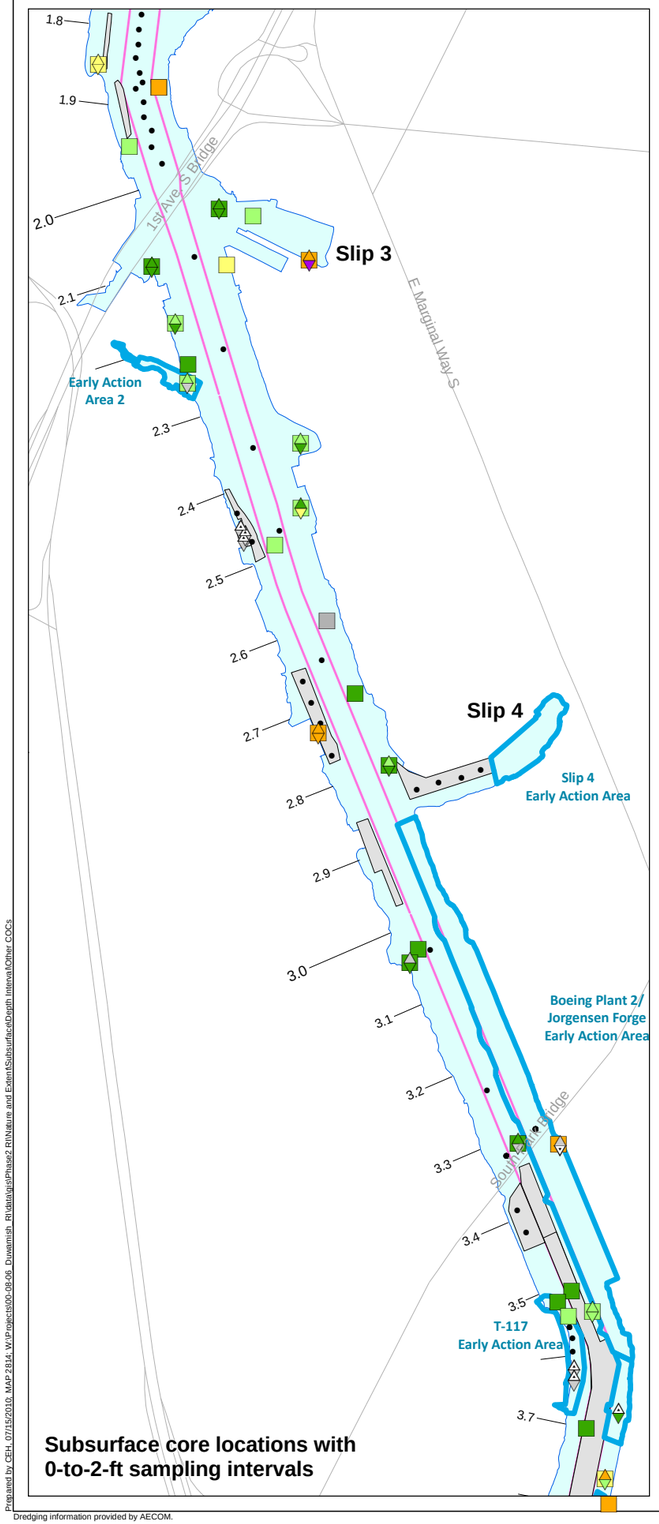
Scale is the same for each map frame

Map 4-67a. Total LPAH concentrations in subsurface sediment within the 0-to-2-ft, 2-to-4-ft, and 4-to-6-ft sampling intervals, RM 0.0 to RM 1.8

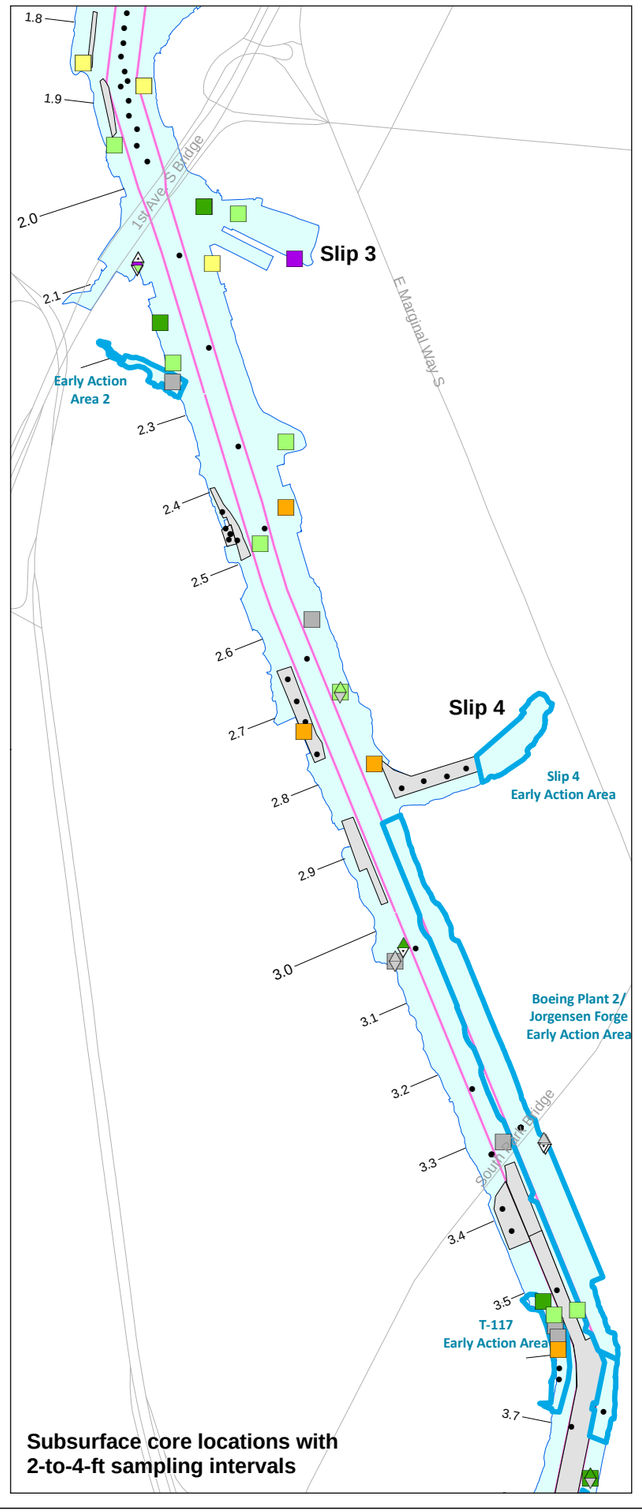
Wind Ward LLC environmental

Prepared by: CEH, 07/15/2010, MAP 2814, W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Subsurface\Depth Interval\Other COCs

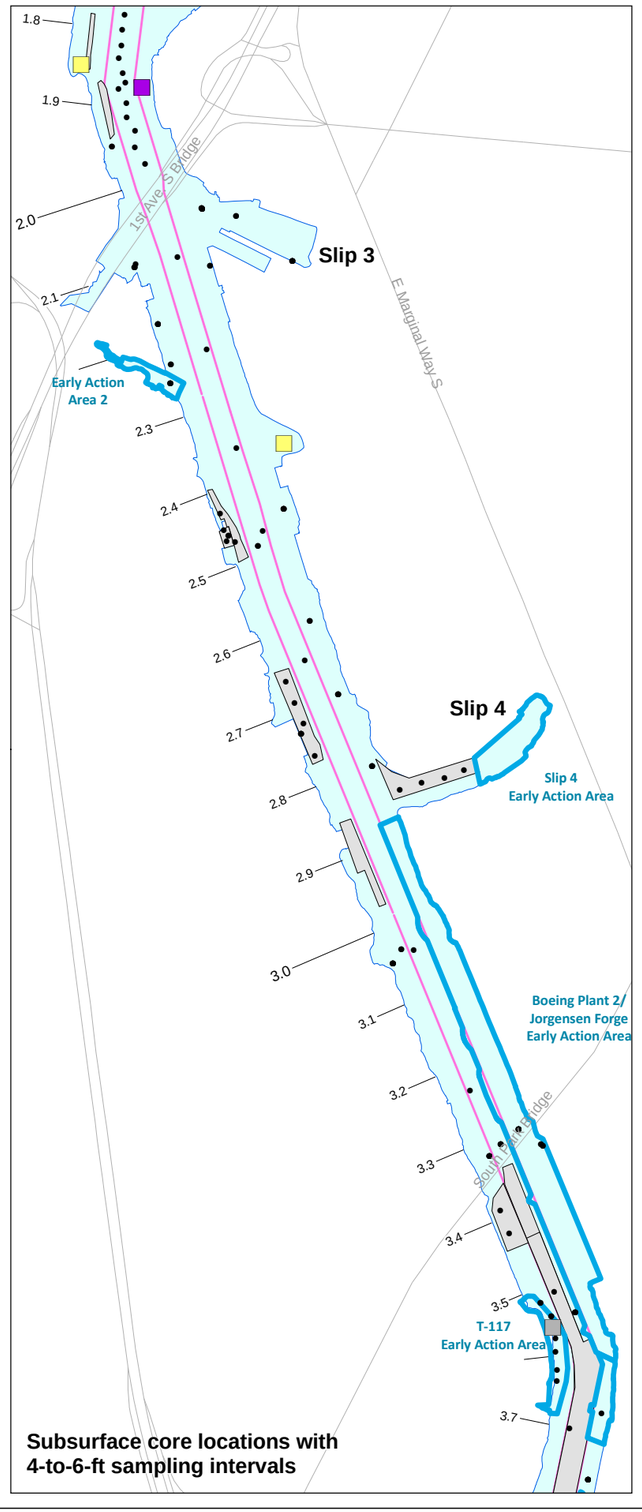
Dredging information provided by AECOM.



Subsurface core locations with 0-to-2-ft sampling intervals



Subsurface core locations with 2-to-4-ft sampling intervals



Subsurface core locations with 4-to-6-ft sampling intervals

Total LPAH concentration (µg/kg dw)[a]

- > 2,300 — 95th percentile = 2,300
- > 550 and ≤ 2,300 — 75th percentile = 550
- > 230 and ≤ 550 — 50th percentile = 230
- > 84 and ≤ 230 — 25th percentile = 84
- ≤ 84
- Non-detect

Sampling interval

	Left panel	Middle panel	Right panel
□	0-to-2-ft[b]	2-to-4-ft[b]	4-to-6-ft[b]
◇	0-to-1-ft[c]	2-to-3-ft[c]	4-to-5-ft[c]
◇	1-to-2-ft[c]	3-to-4-ft[c]	5-to-6-ft[c]

△ Not analyzed in that sampling interval

• Other subsurface sampling location analyzed for LPAHs, but not in the illustrated sampling intervals

Early Action Area[d]

Dredged area[e]

Navigation channel

River mile

[a] In accordance with the Washington State SMS, Total LPAH represents the sum of the concentrations of detected LPAH compounds. Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, one-half the non-detect value was used.

[b] Data from 2-foot sampling intervals; some locations show an average of data from both 1-foot intervals within that 2-foot interval at a given location.

[c] Data from 1-foot sampling intervals are shown if available. If both 1-foot intervals within the 2-foot interval were collected, the average of the two intervals is also shown.

[d] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[e] Subsurface sediment data at locations in dredged areas were collected prior to dredging.

0 0.1 0.2 Kilometers

0 0.1 0.2 Miles

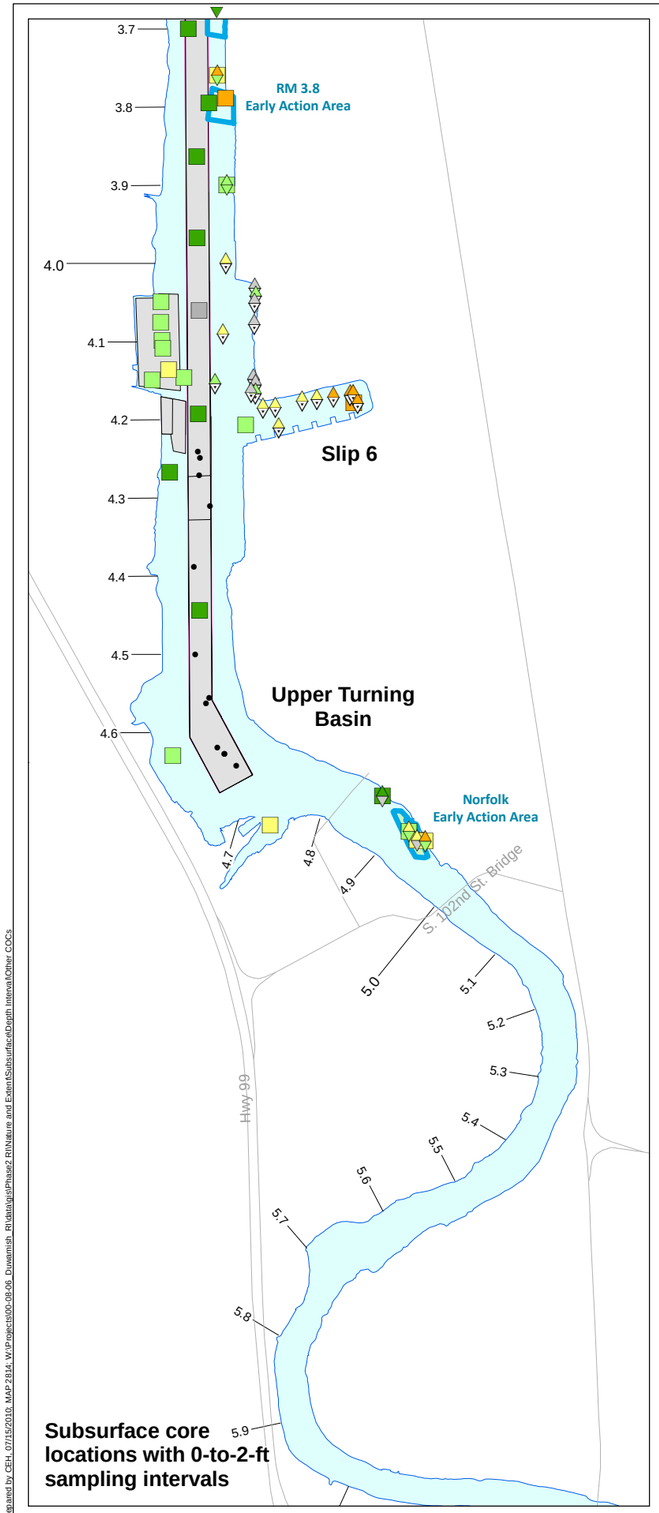
Scale is the same for each map frame

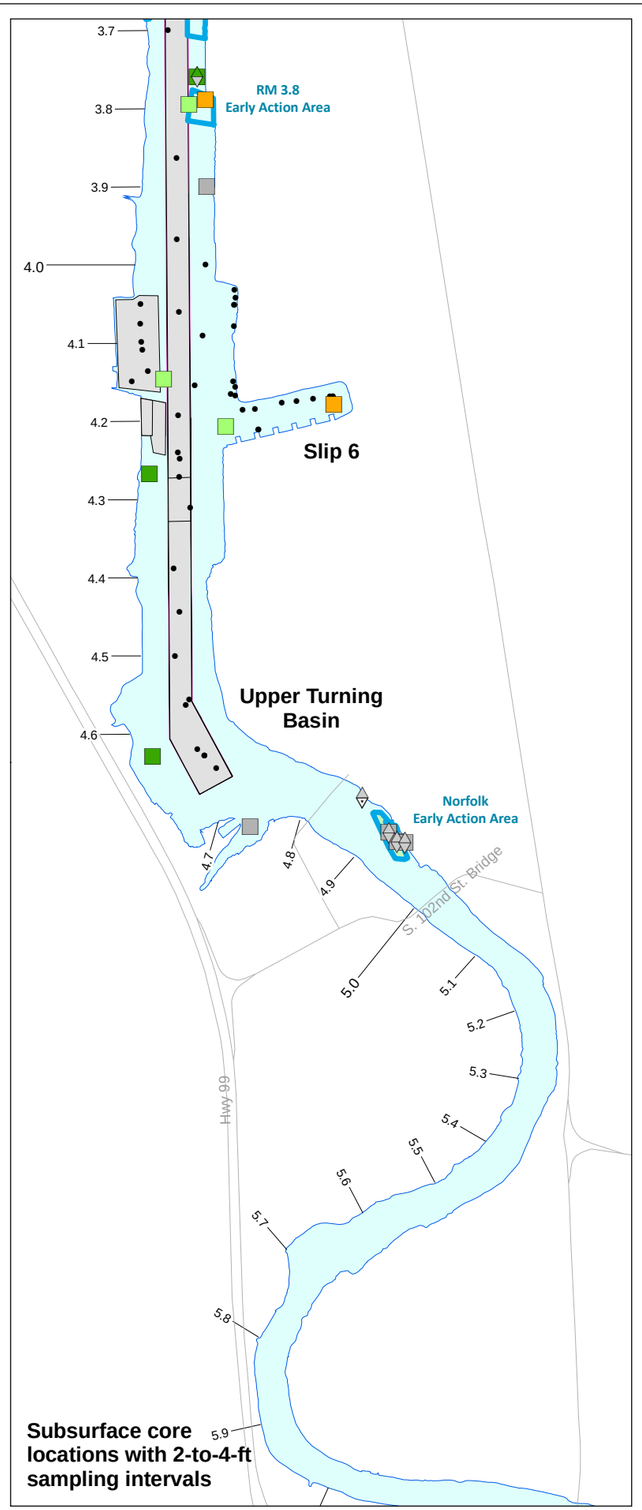
Map 4-67b. Total LPAH concentrations in subsurface sediment within the 0-to-2-ft, 2-to-4-ft, and 4-to-6-ft sampling intervals, RM 1.8 to RM 3.7

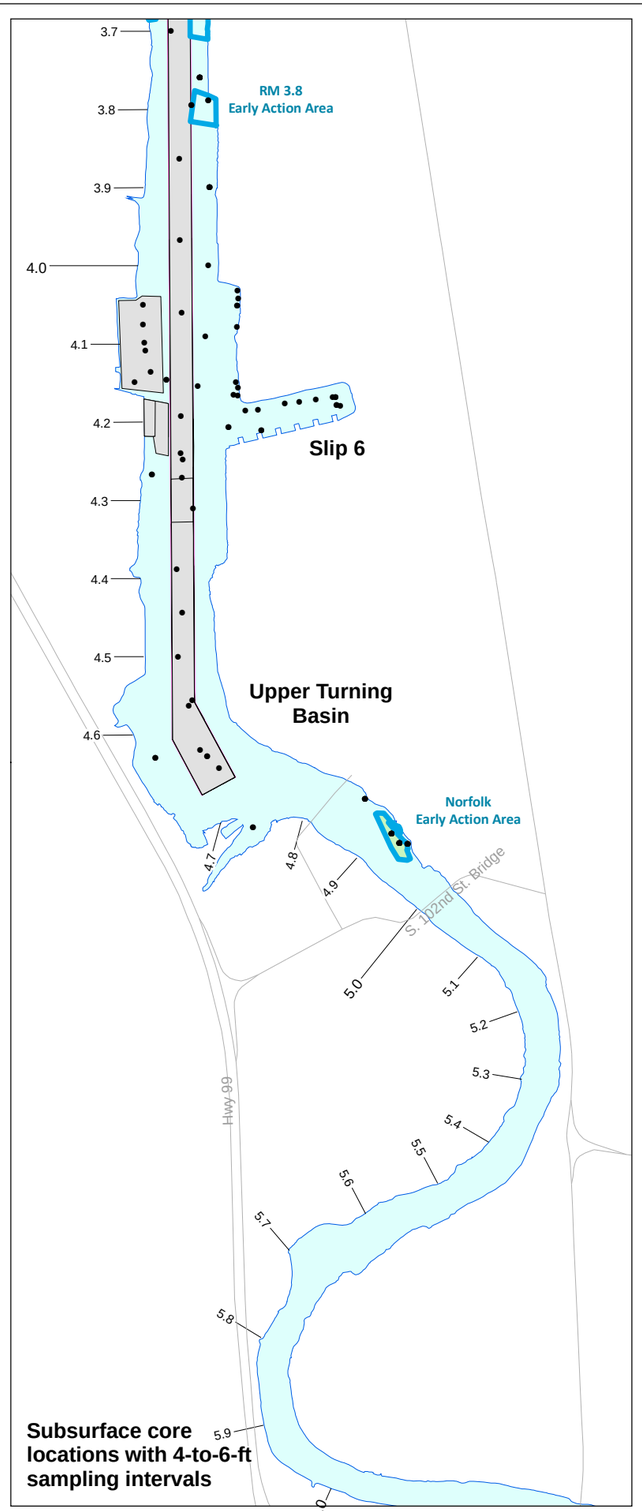
Wind Ward environmental LLC

Prepared by: CEH, 07/15/2010, MAP 2814, W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Subsurface\Depth Interval\Other COCs

Dredging information provided by AECOM.







Total LPAH concentration (µg/kg dw)[a]

- > 2,300
- > 550 and ≤ 2,300
- > 230 and ≤ 550
- > 84 and ≤ 230
- ≤ 84
- Non-detect

95th percentile = 2,300
75th percentile = 550
50th percentile = 230
25th percentile = 84

Sampling interval

	Left panel	Middle panel	Right panel
□	0-to-2-ft[b]	2-to-4-ft[b]	4-to-6-ft[b]
◇	0-to-1-ft[c]	2-to-3-ft[c]	4-to-5-ft[c]
◇	1-to-2-ft[c]	3-to-4-ft[c]	5-to-6-ft[c]

△ Not analyzed in that sampling interval

• Other subsurface sampling location analyzed for LPAHs, but not in the illustrated sampling intervals

Early Action Area[d]

Dredged area[e]

Dredged and capped area[e]

Navigation channel

River mile

[a] In accordance with the Washington State SMS, Total LPAH represents the sum of the concentrations of detected LPAH compounds. Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. For locations with non-detects, one-half the non-detect value was used.

[b] Data from 2-foot sampling intervals; some locations show an average of data from both 1-foot intervals within that 2-foot interval at a given location.

[c] Data from 1-foot sampling intervals are shown if available. If both 1-foot intervals within the 2-foot interval were collected, the average of the two intervals is also shown.

[d] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[e] Subsurface sediment data at locations in dredged areas were collected prior to dredging.

N

0 0.1 0.2 Kilometers

0 0.1 0.2 Miles

Scale is the same for each map frame

Map 4-67c. Total LPAH concentrations in subsurface sediment within the 0-to-2-ft, 2-to-4-ft, and 4-to-6-ft sampling intervals, RM 3.7 to RM 6.0

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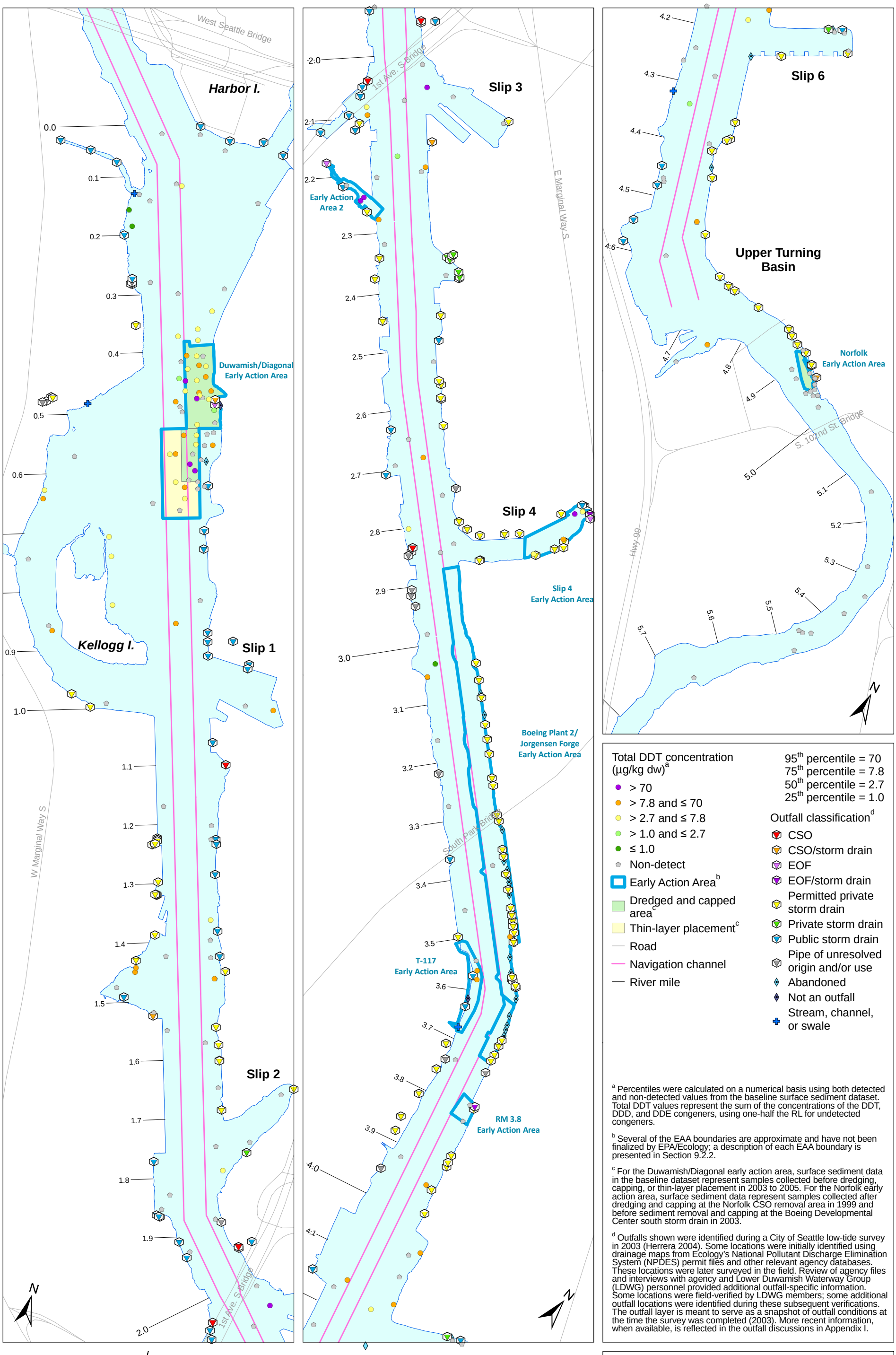
Prepared by: CEH, 07/15/2010, MAP 2834, W:\Projects\50-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\4Depth Interval\Other COCs

Dredging information provided by AECOM.



Total DDT concentration (µg/kg dw)[a]

- > 70
- > 7.8 and ≤ 70
- > 2.7 and ≤ 7.8
- > 1.0 and ≤ 2.7
- ≤ 1.0
- Non-detect
- Early Action Area[b]
- Dredged and capped area[c]
- Thin-layer placement[c]
- Road
- Navigation channel
- River mile

95th percentile = 70
75th percentile = 7.8
50th percentile = 2.7
25th percentile = 1.0

Outfall classification[d]

- CSO
- CSO/storm drain
- EOF
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Stream, channel, or swale

[a] Percentiles were calculated on a numerical basis using both detected and non-detected values from the baseline surface sediment dataset. Total DDT values represent the sum of the concentrations of the DDT, DDD, and DDE congeners, using one-half the RL for undetected congeners.

[b] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[c] For the Duwamish/Diagonal early action area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005. For the Norfolk early action area, surface sediment data represent samples collected after dredging and capping at the Norfolk CSO removal area in 1999 and before sediment removal and capping at the Boeing Developmental Center south storm drain in 2003.

[d] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

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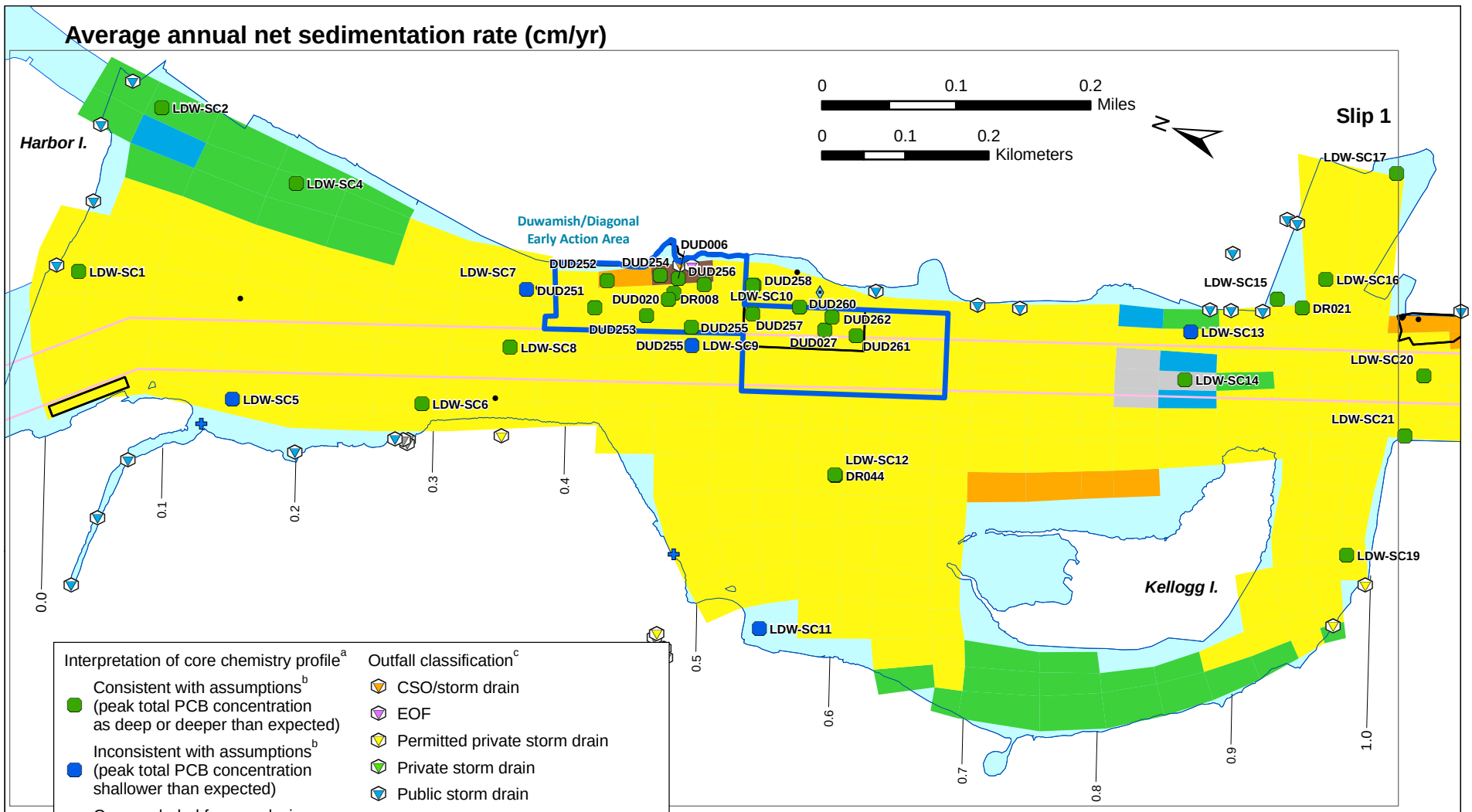
Map 4-68. Total DDT concentrations in surface sediment

Prepared by CEH, 07/15/2010, MAP 2576; W:\Projects\00-08-06_Duwamish_R\data\gis\Phase2 RI\Nature and Extent\Surface Sediment\Other COCs

Average annual net sedimentation rate (cm/yr)



Interpretation of core chemistry profile[a]

- Consistent with assumptions[b] (peak total PCB concentration as deep or deeper than expected)
- Inconsistent with assumptions[b] (peak total PCB concentration shallower than expected)
- Core excluded from analysis

Average annual net sedimentation rate from STM (cm/yr)

- Net sediment loss
- 0.1 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0
- Outside of STM modeling area

Outfall classification[c]

- CSO/storm drain
- EOF
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Stream, channel, or swale
- Early action area[d]
- Dredged area[e]
- River mile
- Navigation channel

[a] Cores from the RI surface sediment dataset were excluded from this analysis if at least one of the following conditions was met: 1) only one core interval was analyzed for total PCBs, 2) no core interval was analyzed within the depth range of the expected peak, 3) PCBs were not detected, or 4) dredging occurred prior to sampling.

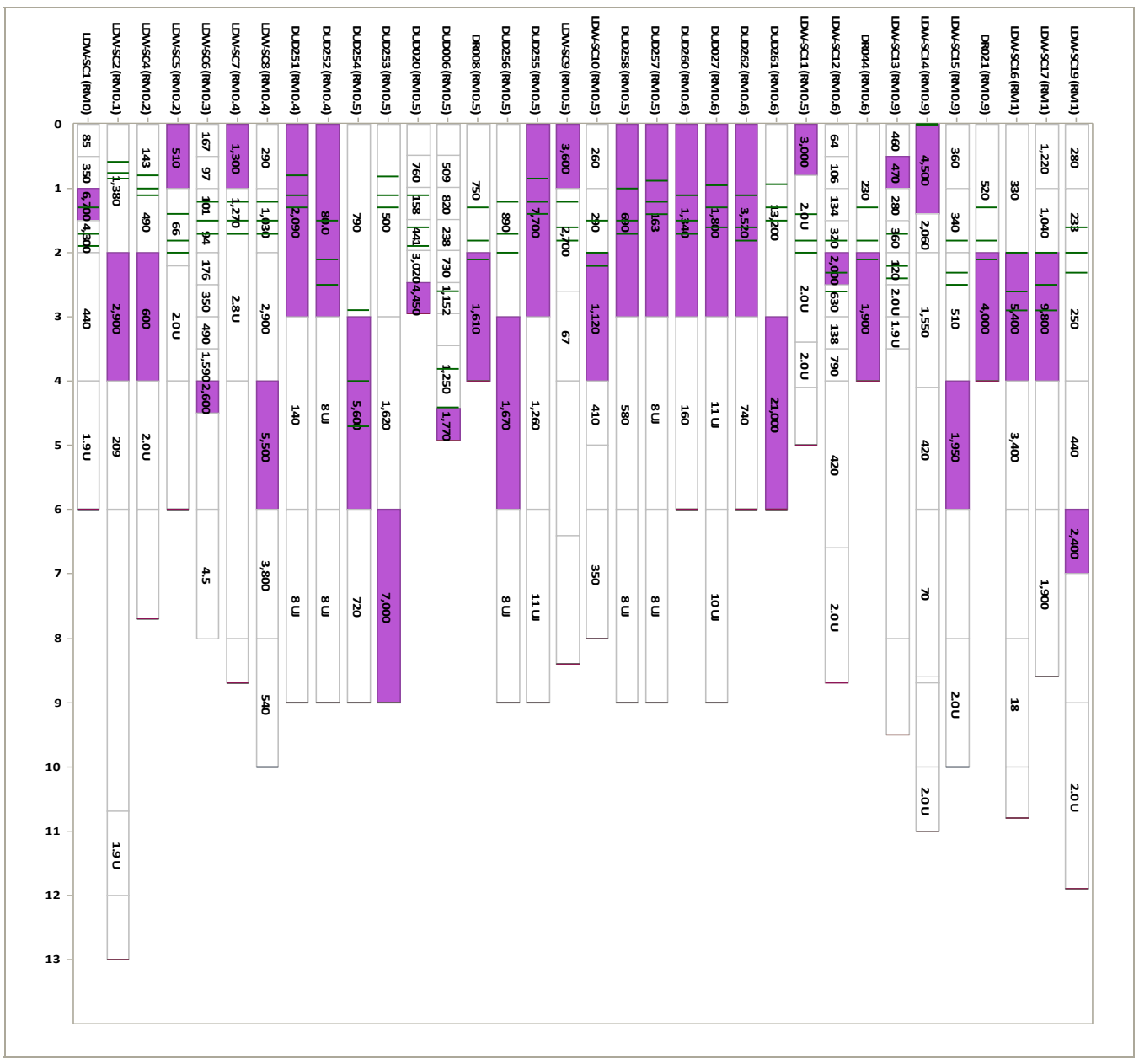
[b] Analysis assumptions
- Annual average net sedimentation rates are from the STM report (QEA 2008)
- Peak usage and release of PCBs assumed to be 1960, 1965, or 1974
- No localized disturbances (e.g., dredging, tug maneuvering)

[c] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

[d] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[e] Cores located within dredged areas were collected prior to dredging.

Peak total PCB concentrations in subsurface cores

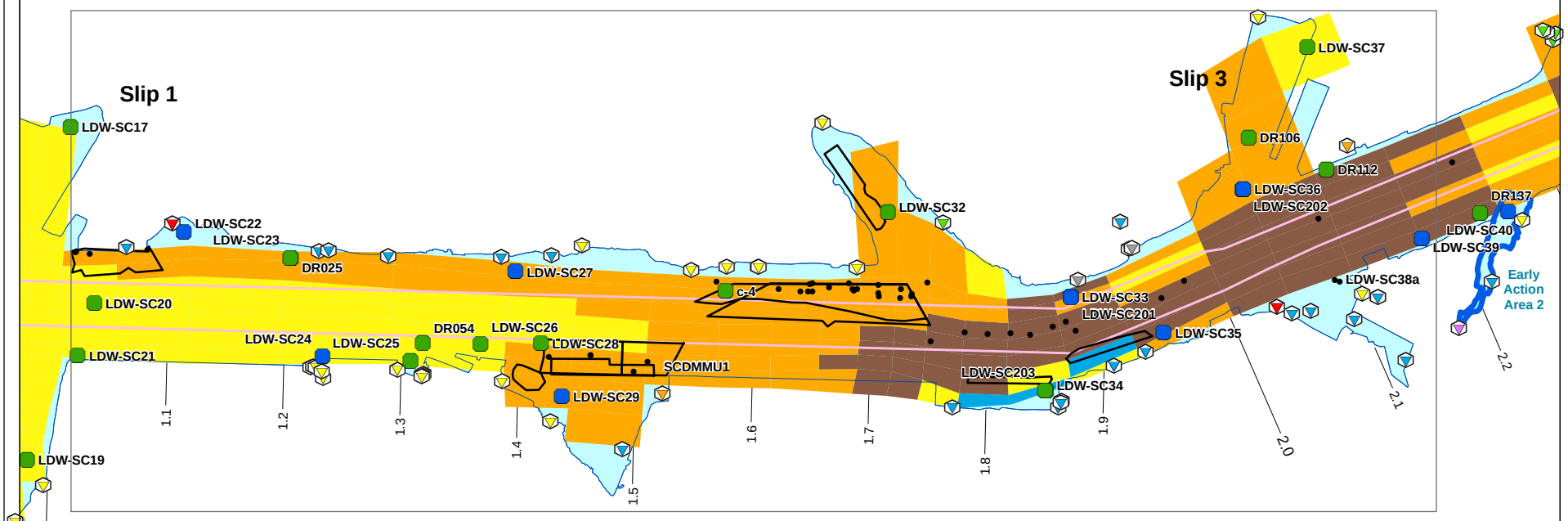


Prepared by CEH, 07/15/2010; MAP 3068; W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Core Analysis

Wind Ward environmental LLC

Map 4-69a. Comparison of actual and estimated depths of peak total PCB concentrations in cores based on annual average net sedimentation rates and source assumptions, RM 0.0 to RM 1.0

Average annual net sedimentation rate (cm/yr)



Interpretation of core chemistry profile[a]

- Consistent with assumptions[b] (peak total PCB concentration as deep or deeper than expected)
- Inconsistent with assumptions[b] (peak total PCB concentration shallower than expected)
- Core excluded from analysis

Average annual net sedimentation rate from STM (cm/yr)

- Net sediment loss
- 0.1 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0
- Outside of STM modeling area

Outfall classification[c]

- CSO
- CSO/storm drain
- EOF
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Early action area[d]
- Dredged area[e]
- River mile
- Navigation channel

0 0.1 0.2 Miles

0 0.1 0.2 Kilometers

N

[a] Cores from the RI surface sediment dataset were excluded from this analysis if at least one of the following conditions was met: 1) only one core interval was analyzed for total PCBs, 2) no core interval was analyzed within the depth range of the expected peak, 3) PCBs were not detected, or 4) dredging occurred prior to sampling.

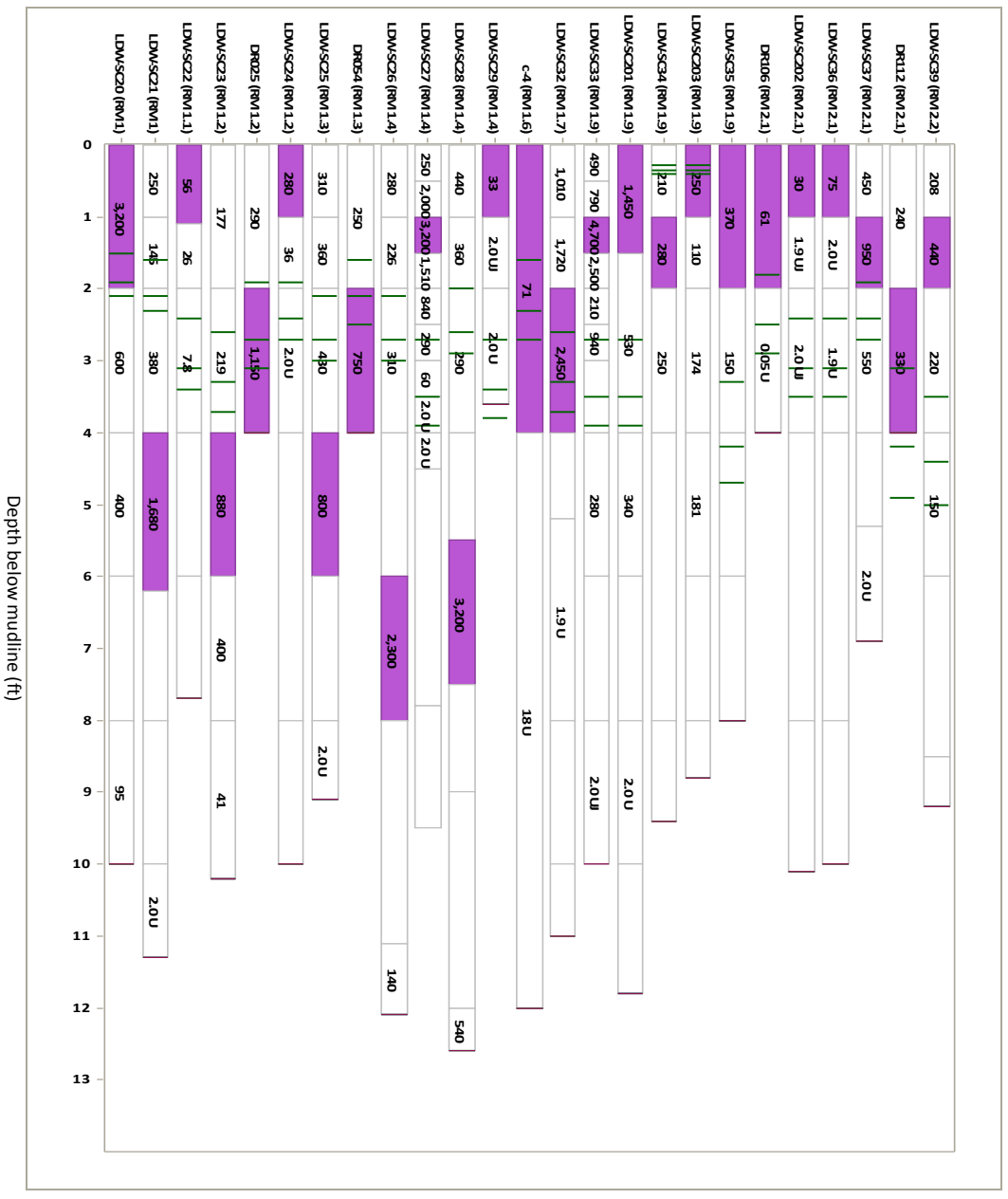
[b] Analysis assumptions
- Annual average net sedimentation rates are from the STM report (QEA 2008)
- Peak usage and release of PCBs assumed to be 1960, 1965, or 1974
- No localized disturbances (e.g., dredging, tug maneuvering)

[c] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

[d] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[e] Cores located within dredged areas were collected prior to dredging.

Peak total PCB concentrations in subsurface cores



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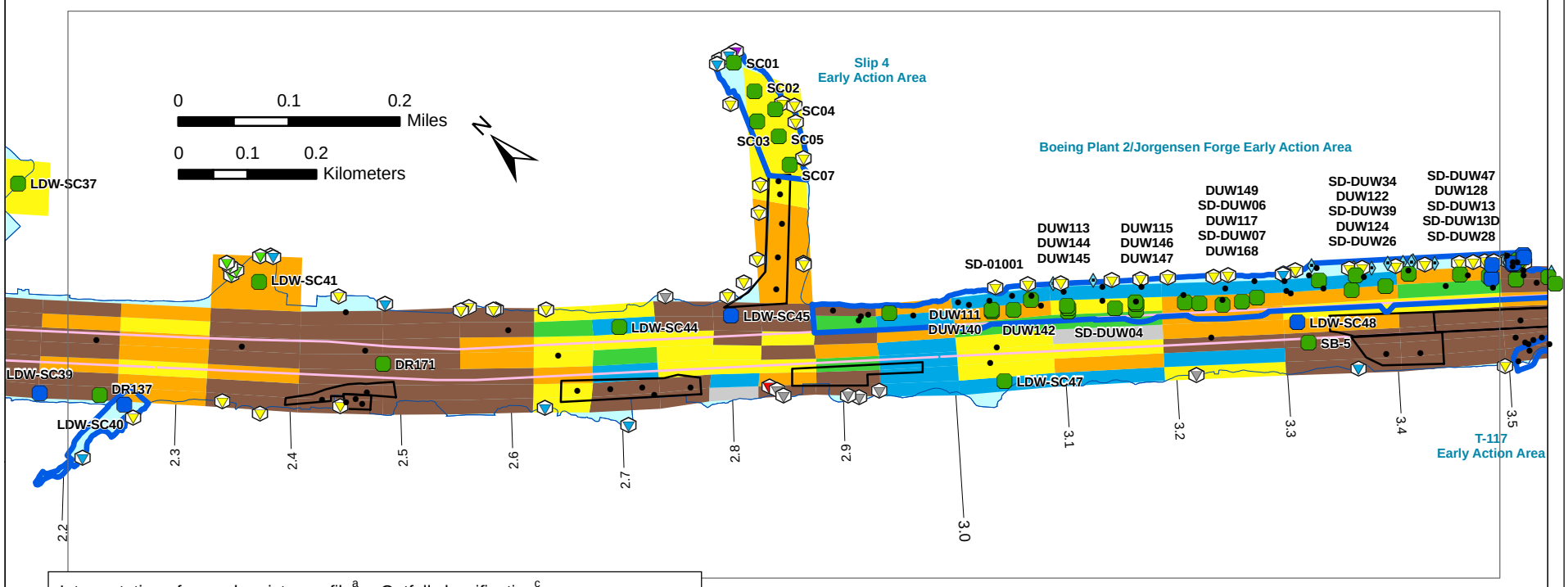
Map 4-69b. Comparison of actual and estimated depths of peak total PCB concentrations in cores based on annual average net sedimentation rates and source assumptions, RM 1.0 to RM 2.2

Average annual net sedimentation rate (cm/yr)



Interpretation of core chemistry profile[a]

- Consistent with assumptions[b] (peak total PCB concentration as deep or deeper than expected)
- Inconsistent with assumptions[b] (peak total PCB concentration shallower than expected)
- Core excluded from analysis

Average annual net sedimentation rate from STM (cm/yr)

- Net sediment loss
- 0.1 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0
- Outside of STM modeling area

Outfall classification[c]

- CSO
- EOF/storm drain
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Not an outfall
- Early action area[d]
- Dredged area[e]
- River mile
- Navigation channel

[a] Cores from the RI surface sediment dataset were excluded from this analysis if at least one of the following conditions was met: 1) only one core interval was analyzed for total PCBs, 2) no core interval was analyzed within the depth range of the expected peak, 3) PCBs were not detected, or 4) dredging occurred prior to sampling.

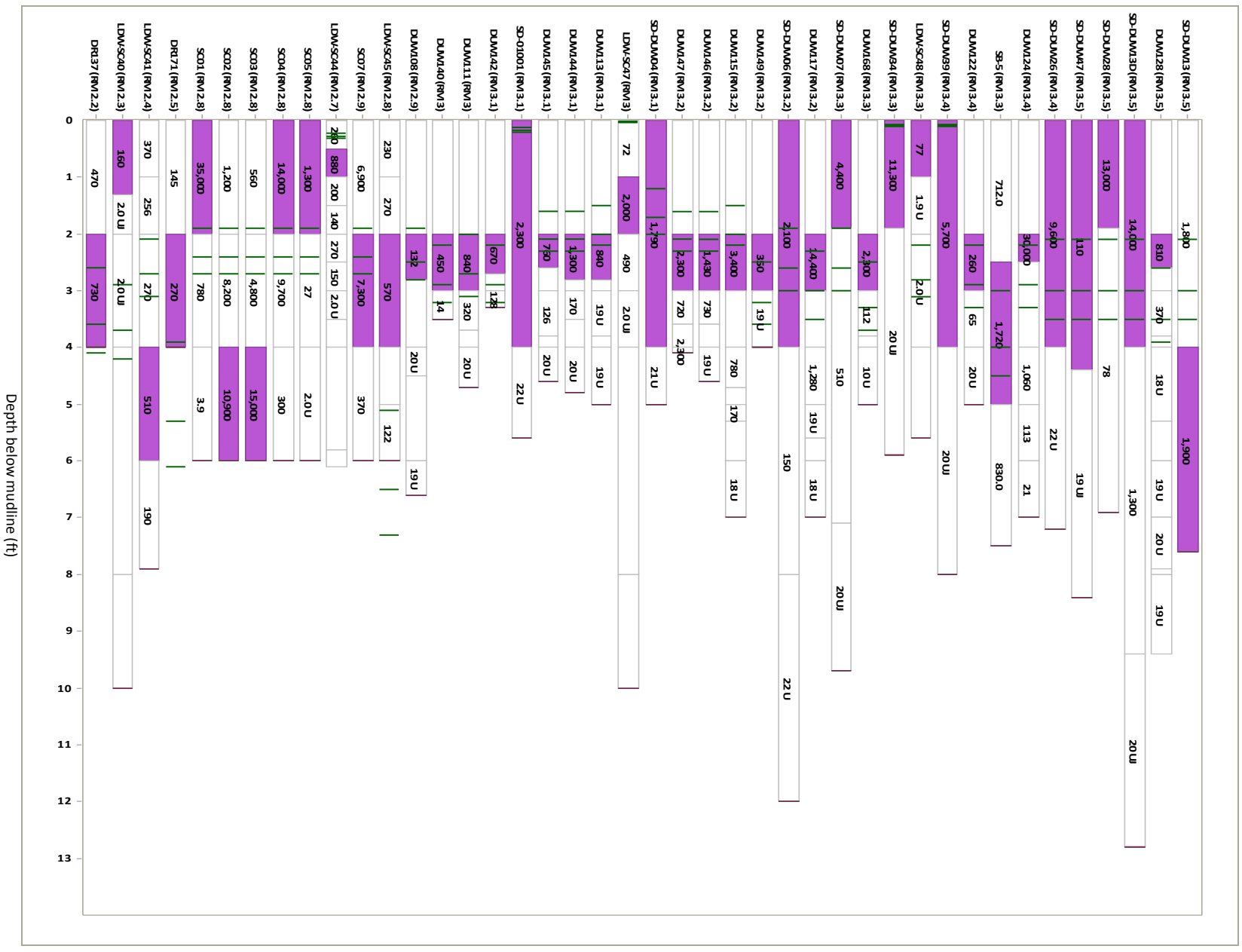
[b] Analysis assumptions
- Annual average net sedimentation rates are from the STM report (QEA 2008)
- Peak usage and release of PCBs assumed to be 1960, 1965, or 1974
- No localized disturbances (e.g., dredging, tug maneuvering)

[c] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

[d] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[e] Cores located within dredged areas were collected prior to dredging.

Peak total PCB concentrations in subsurface cores



Prepared by CEH, 07/15/2010; MAP 3088; W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Core Analysis

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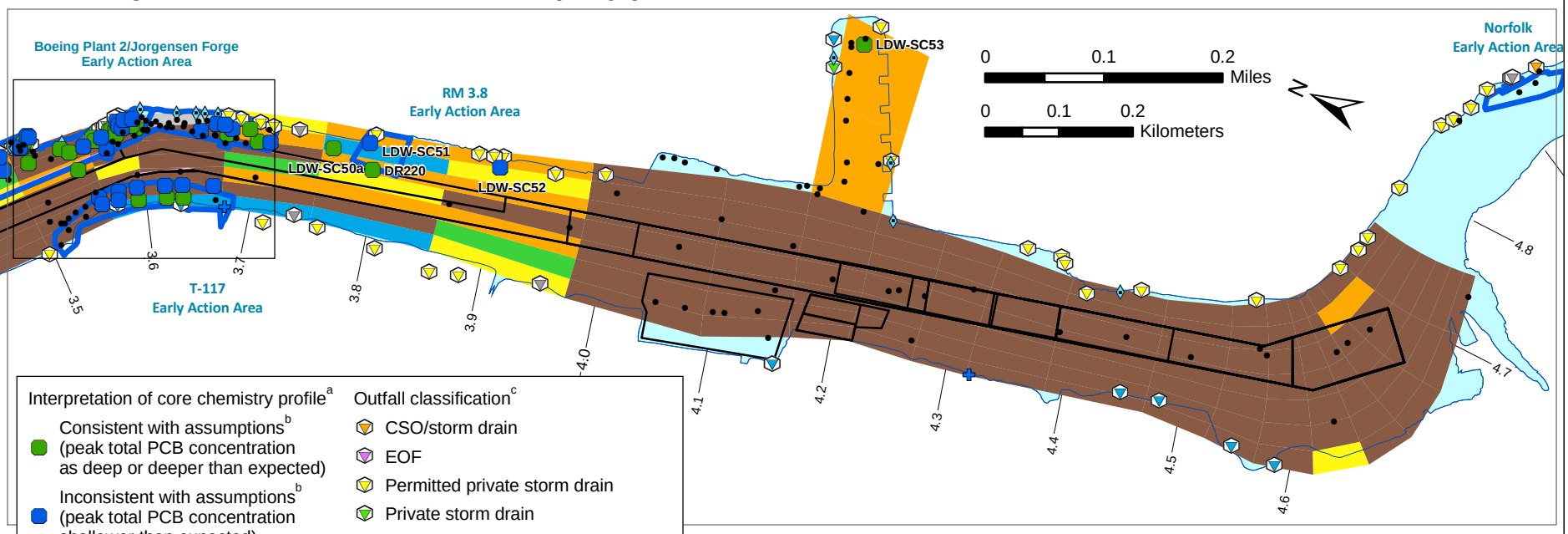
Map 4-69c. Comparison of actual and estimated depths of peak total PCB concentrations in cores based on annual average net sedimentation rates and source assumptions, RM 2.2 to RM 3.5

Average annual net sedimentation rate (cm/yr)



Interpretation of core chemistry profile[a]

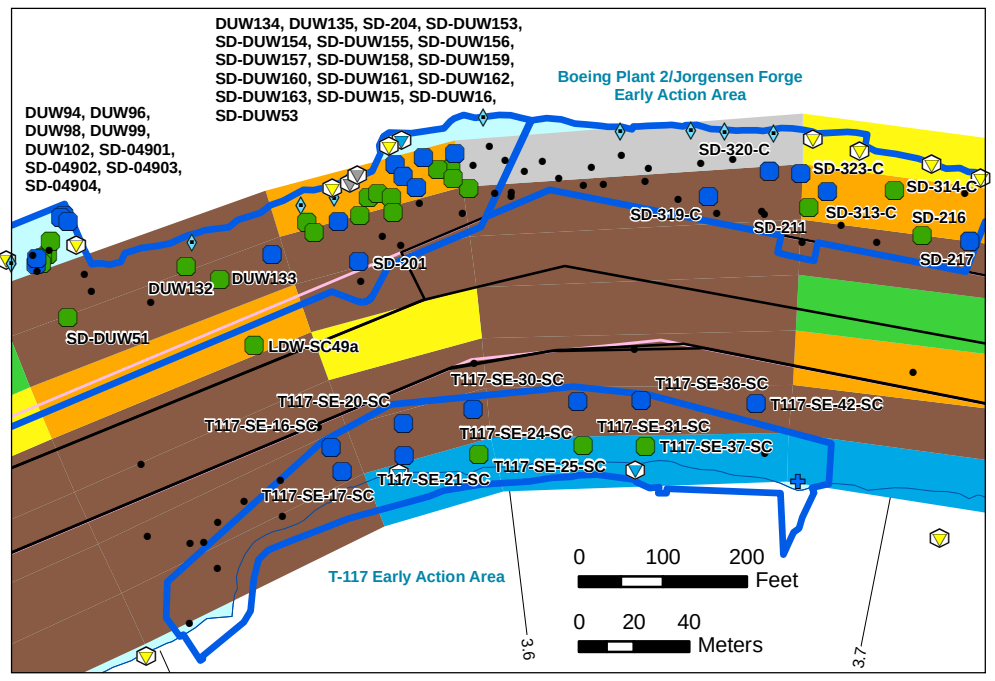
- Consistent with assumptions[b] (peak total PCB concentration as deep or deeper than expected)
- Inconsistent with assumptions[b] (peak total PCB concentration shallower than expected)
- Core excluded from analysis

Average annual net sedimentation rate from STM (cm/yr)

- Net sediment loss
- 0.1 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0
- Outside of STM modeling area

Outfall classification[c]

- CSO/storm drain
- EOF
- Permitted private storm drain
- Private storm drain
- Public storm drain
- Pipe of unresolved origin and/or use
- Abandoned
- Stream, channel, or swale
- Early action area[d]
- Dredged area[e]
- River mile
- Navigation channel



[a] Cores from the RI surface sediment dataset were excluded from this analysis if at least one of the following conditions was met: 1) only one core interval was analyzed for total PCBs, 2) no core interval was analyzed within the depth range of the expected peak, 3) PCBs were not detected, or 4) dredging occurred prior to sampling.

[b] Analysis assumptions
- Annual average net sedimentation rates are from the STM report (QEA 2008)
- Peak usage and release of PCBs assumed to be 1960, 1965, or 1974
- No localized disturbances (e.g., dredging, tug maneuvering)

[c] Outfalls shown were identified during a City of Seattle low-tide survey in 2003 (Herrera 2004). Some locations were initially identified using drainage maps from Ecology's National Pollutant Discharge Elimination System (NPDES) permit files and other relevant agency databases. These locations were later surveyed in the field. Review of agency files and interviews with agency and Lower Duwamish Waterway Group (LDWG) personnel provided additional outfall-specific information. Some locations were field-verified by LDWG members; some additional outfall locations were identified during these subsequent verifications. The outfall layer is meant to serve as a snapshot of outfall conditions at the time the survey was completed (2003). More recent information, when available, is reflected in the outfall discussions in Appendix I.

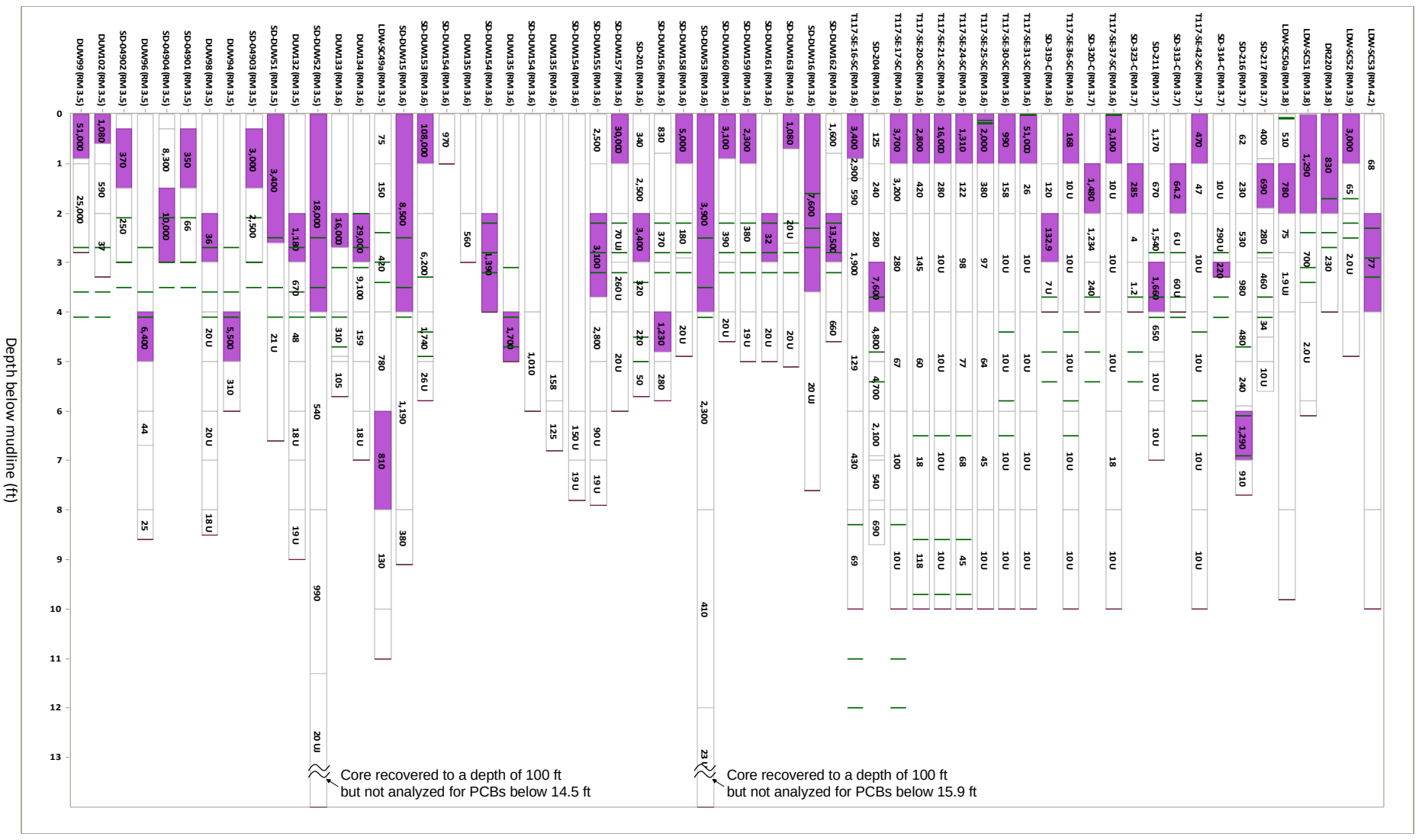
[d] Several of the EAA boundaries are approximate and have not been finalized by EPA/Ecology; a description of each EAA boundary is presented in Section 9.2.2.

[e] Cores located within dredged areas were collected prior to dredging.

Peak total PCB concentrations in subsurface cores

Estimated depth of peak total PCB concentration: 1974 / 1965 / 1960

Analyzed core interval with actual peak total PCB concentration



Prepared by CEH, 07/15/2010; MAP 3088; W:\Projects\00-08-06_Duwamish_RI\data\gis\Phase2 RI\Nature and Extent\Subsurface\Core Analysis

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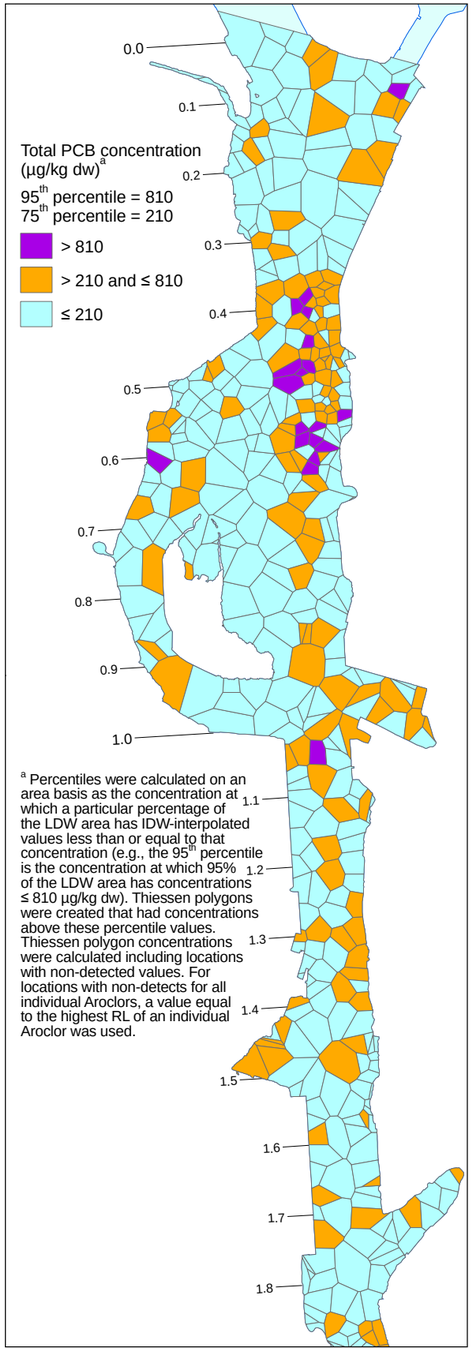
Map 4-69d. Comparison of actual and estimated depths of peak total PCB concentrations in cores based on annual average net sedimentation rates and source assumptions, RM 3.5 to RM 4.8

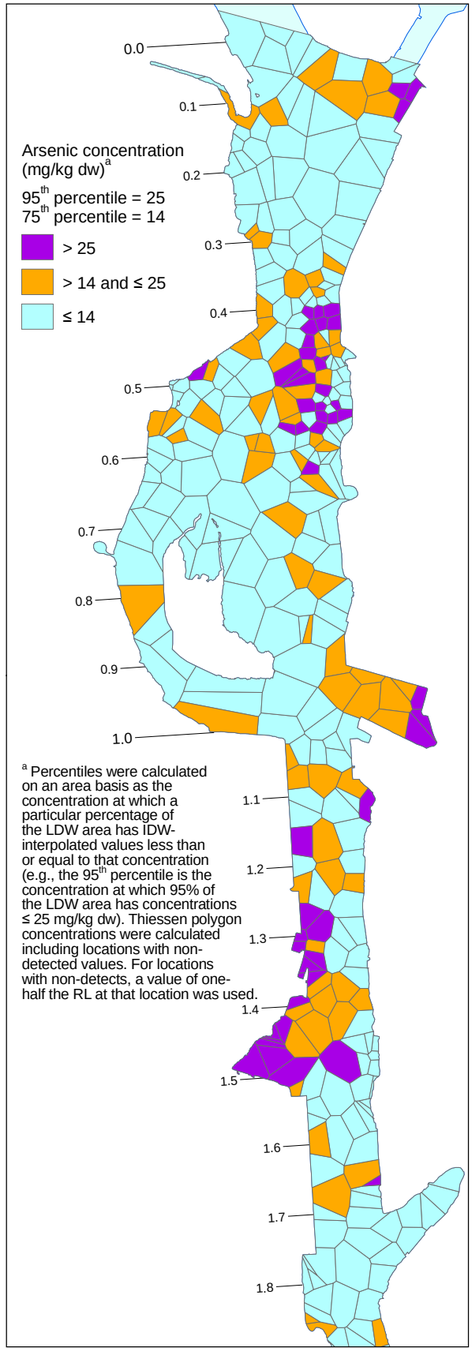


Total PCB concentration (µg/kg dw)[a]

95th percentile = 810
75th percentile = 210

- > 810
- > 210 and ≤ 810
- ≤ 210

[a] Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has IDW-interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has concentrations ≤ 810 µg/kg dw). Thiessen polygons were created that had concentrations above these percentile values. Thiessen polygon concentrations were calculated including locations with non-detected values. For locations with non-detects for all individual Aroclors, a value equal to the highest RL of an individual Aroclor was used.

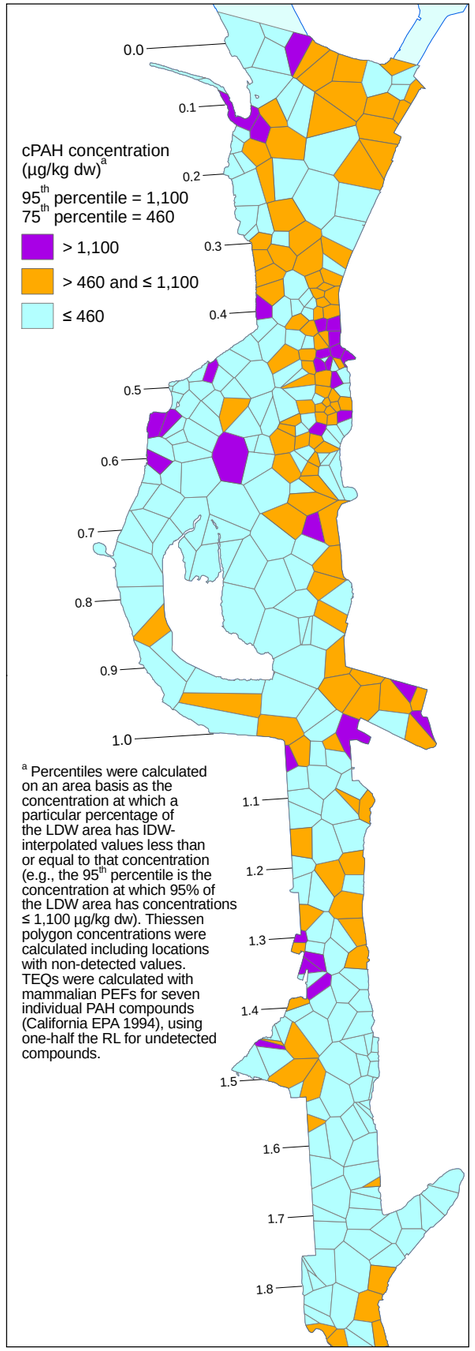


Arsenic concentration (mg/kg dw)[a]

95th percentile = 25
75th percentile = 14

- > 25
- > 14 and ≤ 25
- ≤ 14

[a] Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has IDW-interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has concentrations ≤ 25 mg/kg dw). Thiessen polygon concentrations were calculated including locations with non-detected values. For locations with non-detects, a value of one-half the RL at that location was used.

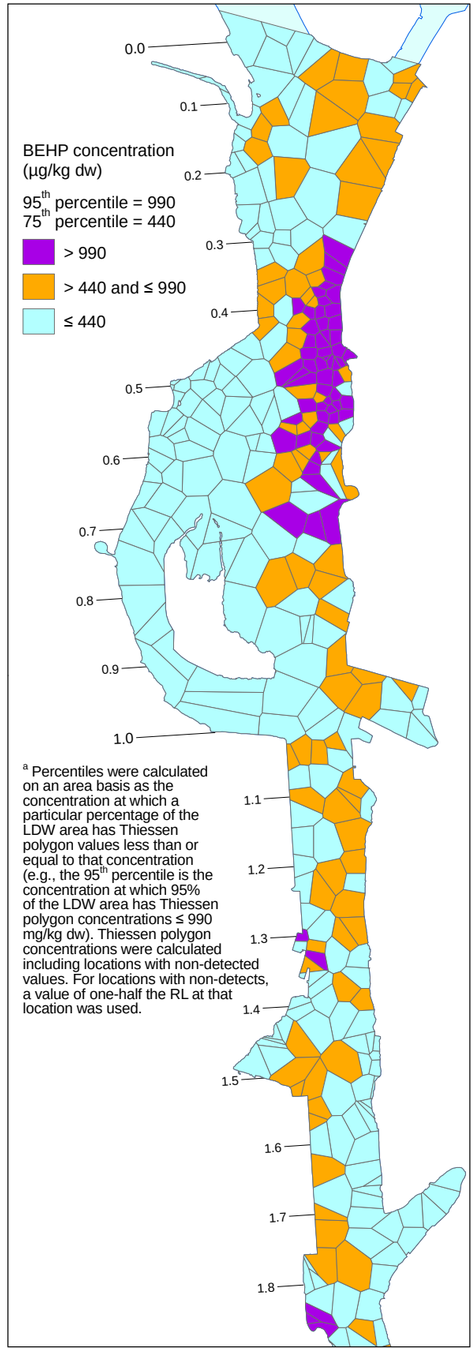


cPAH concentration (µg/kg dw)[a]

95th percentile = 1,100
75th percentile = 460

- > 1,100
- > 460 and ≤ 1,100
- ≤ 460

[a] Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has IDW-interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has concentrations ≤ 1,100 µg/kg dw). Thiessen polygon concentrations were calculated including locations with non-detected values. TEQs were calculated with mammalian PEFs for seven individual PAH compounds (California EPA 1994), using one-half the RL for undetected compounds.

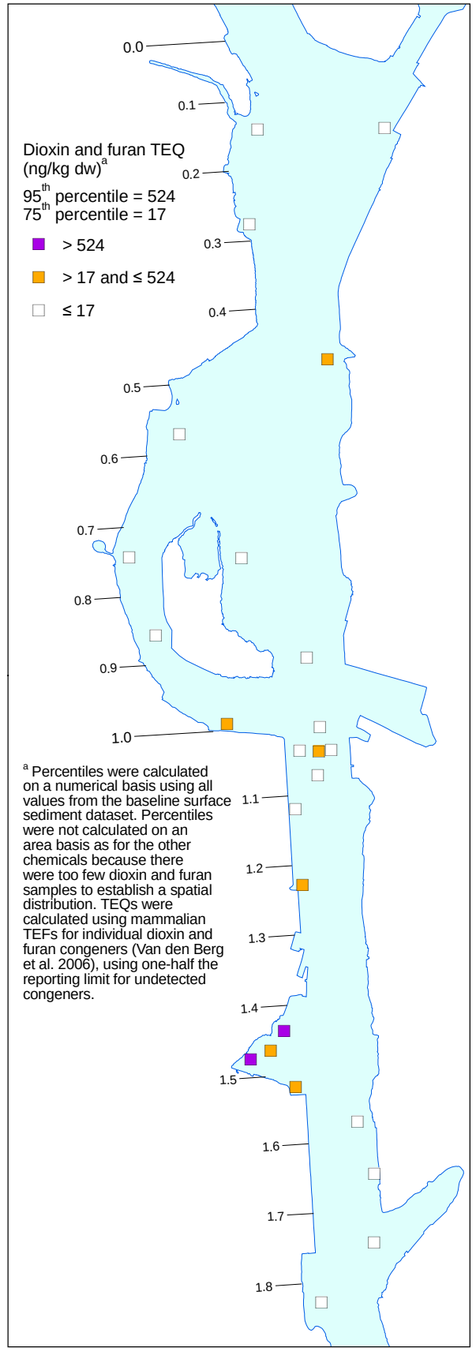


BEHP concentration (µg/kg dw)

95th percentile = 990
75th percentile = 440

- > 990
- > 440 and ≤ 990
- ≤ 440

[a] Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has Thiessen polygon values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has Thiessen polygon concentrations ≤ 990 mg/kg dw). Thiessen polygon concentrations were calculated including locations with non-detected values. For locations with non-detects, a value of one-half the RL at that location was used.



Dioxin and furan TEQ (ng/kg dw)[a]

95th percentile = 524
75th percentile = 17

- > 524
- > 17 and ≤ 524
- ≤ 17

[a] Percentiles were calculated on a numerical basis using all values from the baseline surface sediment dataset. Percentiles were not calculated on an area basis as for the other chemicals because there were too few dioxin and furan samples to establish a spatial distribution. TEQs were calculated using mammalian TEFs for individual dioxin and furan congeners (Van den Berg et al. 2006), using one-half the reporting limit for undetected congeners.

Produced by CEH, 07/15/2010; MAP 3056; W:\Projects\00-09-06_Duwamish_Report\data\GIS\Phase2 RI\Nature and Extent\Surface Sediment\Baseline Locations

WindWard environmental LLC

0 1,000 2,000 Feet

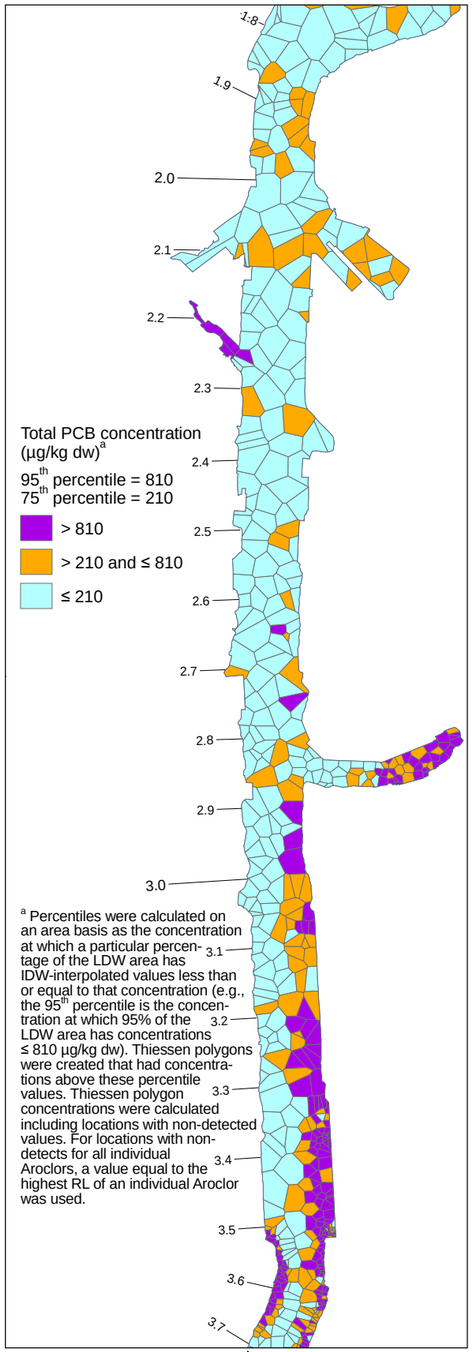
0 250 500 Meters

Scale is the same for each inset map

N

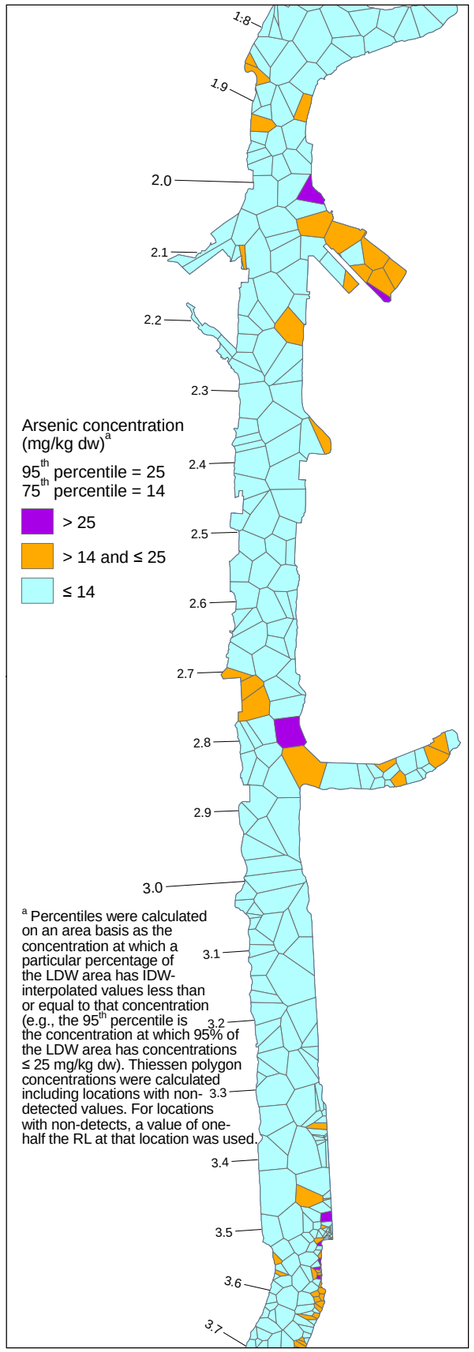
Map 4-70a. 95th and 75th Percentiles of risk driver chemicals, RM 0.0 to RM 1.8

For the Duwamish/Diagonal Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 to 2005.



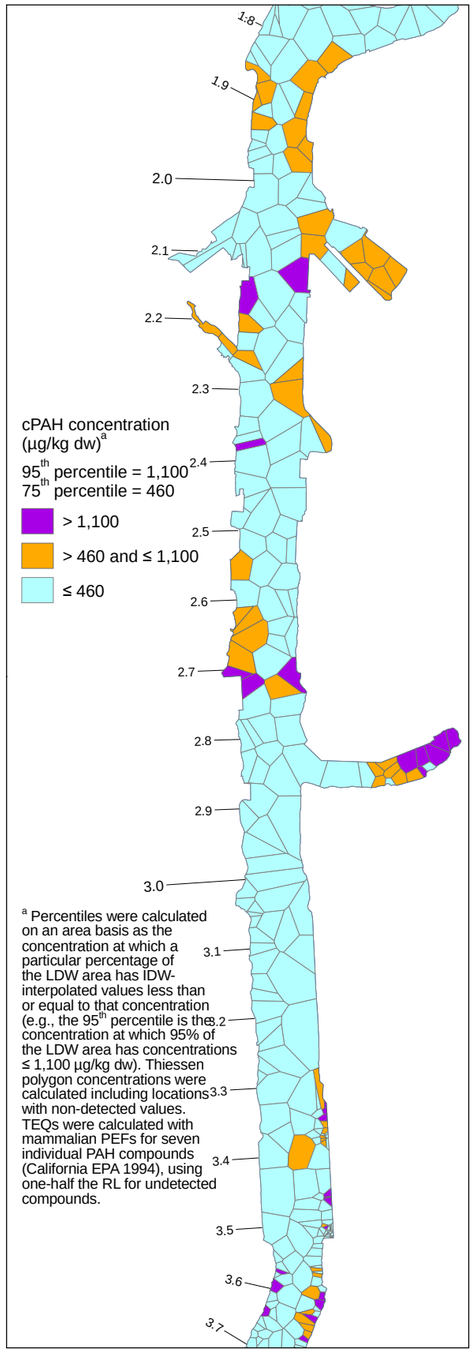
Total PCB concentration (µg/kg dw)[a]
95th percentile = 810
75th percentile = 210
- > 810
- > 210 and ≤ 810
- ≤ 210

[a] Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has IDW-interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has concentrations ≤ 810 µg/kg dw). Thiessen polygons were created that had concentrations above these percentile values. Thiessen polygon concentrations were calculated including locations with non-detected values. For locations with non-detects for all individual Aroclors, a value equal to the highest RL of an individual Aroclor was used.



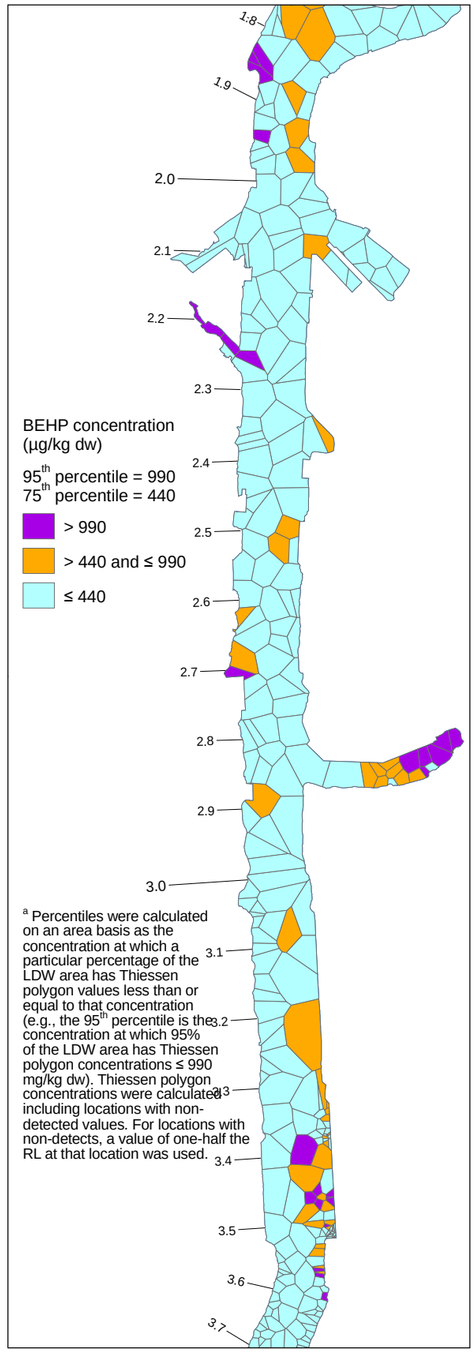
Arsenic concentration (mg/kg dw)[a]
95th percentile = 25
75th percentile = 14
- > 25
- > 14 and ≤ 25
- ≤ 14

[a] Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has IDW-interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has concentrations ≤ 25 mg/kg dw). Thiessen polygon concentrations were calculated including locations with non-detected values. For locations with non-detects, a value of one-half the RL at that location was used.



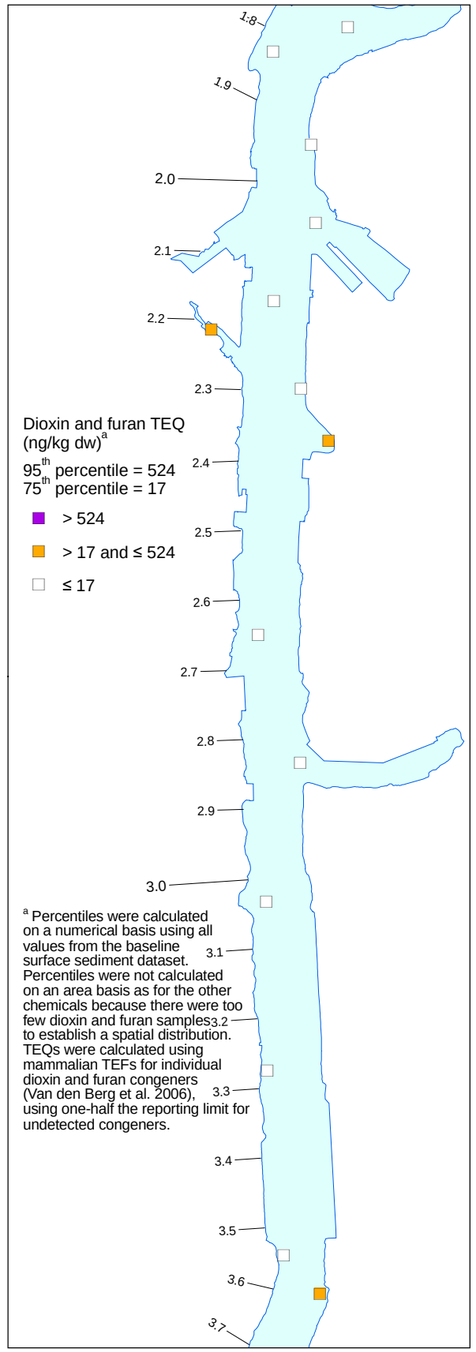
cPAH concentration (µg/kg dw)[a]
95th percentile = 1,100
75th percentile = 460
- > 1,100
- > 460 and ≤ 1,100
- ≤ 460

[a] Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has IDW-interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has concentrations ≤ 1,100 µg/kg dw). Thiessen polygon concentrations were calculated including locations with non-detected values. TEQs were calculated with mammalian PEFs for seven individual PAH compounds (California EPA 1994), using one-half the RL for undetected compounds.



BEHP concentration (µg/kg dw)
95th percentile = 990
75th percentile = 440
- > 990
- > 440 and ≤ 990
- ≤ 440

[a] Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has Thiessen polygon values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has Thiessen polygon concentrations ≤ 990 mg/kg dw). Thiessen polygon concentrations were calculated including locations with non-detected values. For locations with non-detects, a value of one-half the RL at that location was used.



Dioxin and furan TEQ (ng/kg dw)[a]
95th percentile = 524
75th percentile = 17
- > 524
- > 17 and ≤ 524
- ≤ 17

[a] Percentiles were calculated on a numerical basis using all values from the baseline surface sediment dataset. Percentiles were not calculated on an area basis as for the other chemicals because there were too few dioxin and furan samples to establish a spatial distribution. TEQs were calculated using mammalian TEFs for individual dioxin and furan congeners (Van den Berg et al. 2006), using one-half the reporting limit for undetected congeners.

Wind Ward environmental LLC

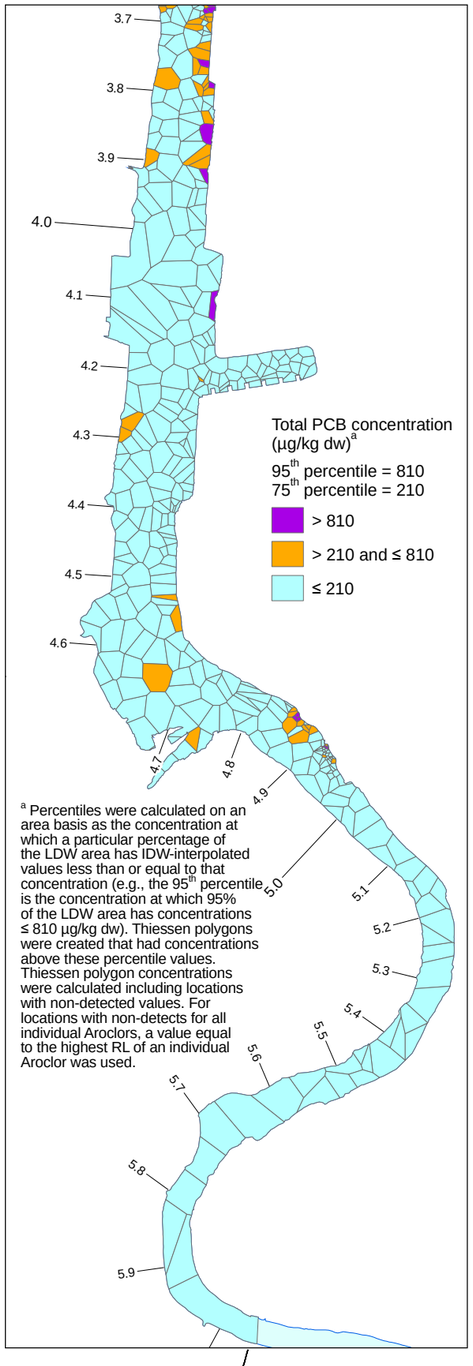
0 1,000 2,000 Feet

0 250 500 Meters

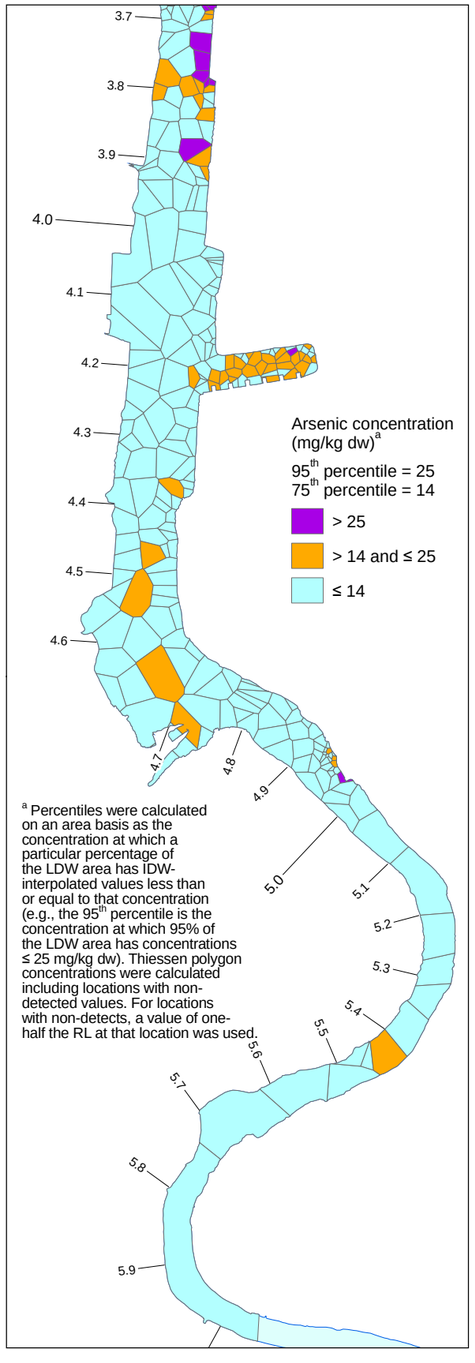
Scale is the same for each inset map

Map 4-70b. 95th and 75th Percentiles of risk driver chemicals, RM 1.8 to RM 3.7

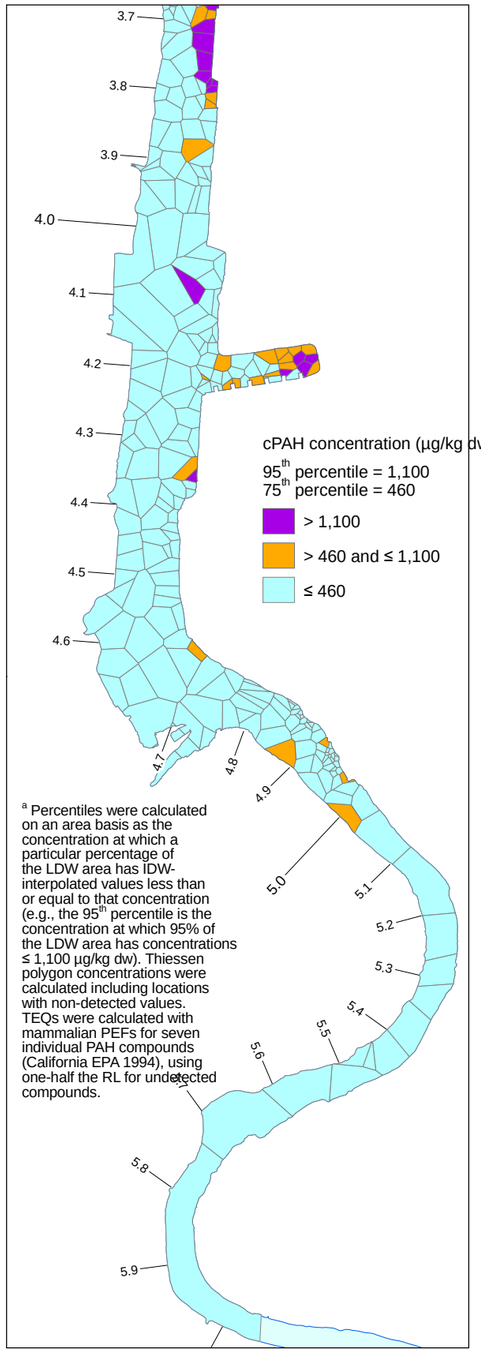
Produced by CEH, 07/15/2010, MAP 3056, W:\Projects\100-09-08_Duwamish_Rl\data\GIS\Press2 RI\Nature and Extent\Surface Sediment\Baseline Locations



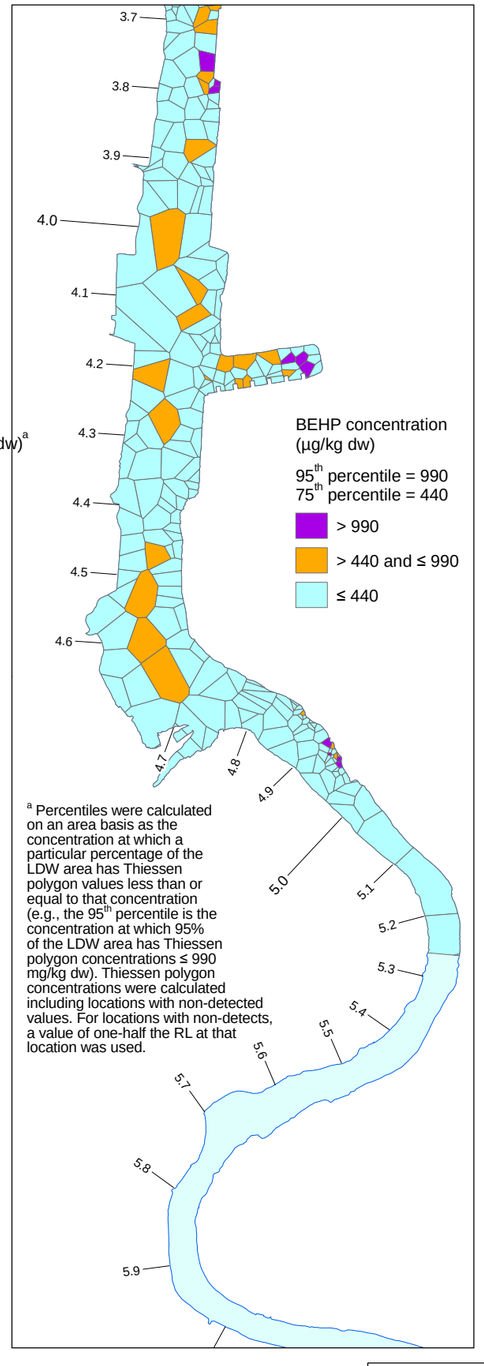
[a] Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has IDW-interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has concentrations ≤ 810 µg/kg dw). Thiessen polygons were created that had concentrations above these percentile values. Thiessen polygon concentrations were calculated including locations with non-detected values. For locations with non-detects for all individual Aroclors, a value equal to the highest RL of an individual Aroclor was used.



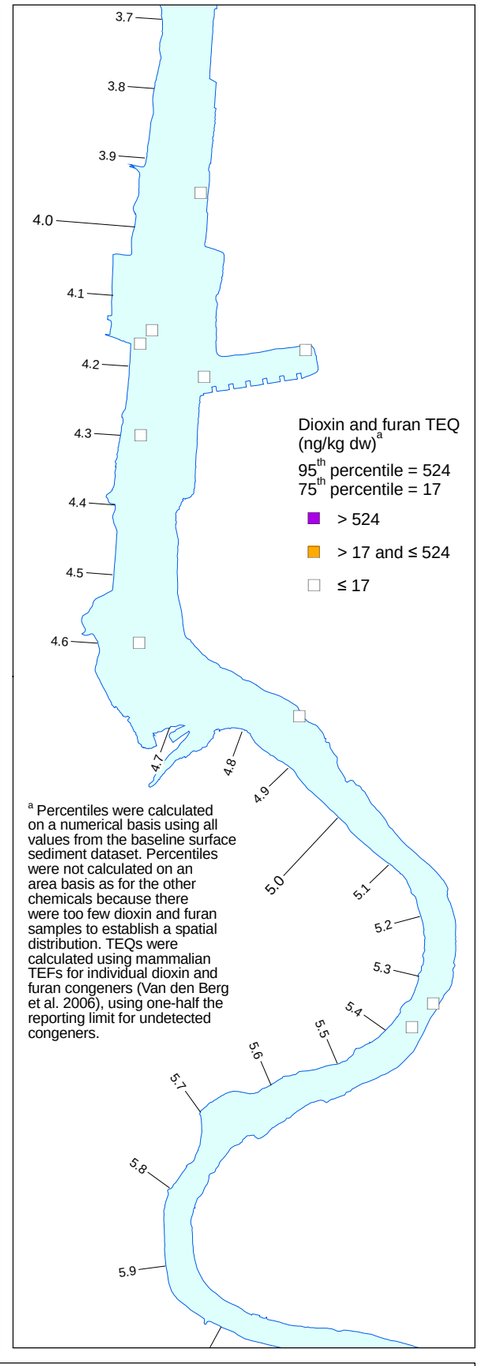
[a] Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has IDW-interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has concentrations ≤ 25 mg/kg dw). Thiessen polygon concentrations were calculated including locations with non-detected values. For locations with non-detects, a value of one-half the RL at that location was used.



[a] Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has IDW-interpolated values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has concentrations ≤ 1,100 µg/kg dw). Thiessen polygon concentrations were calculated including locations with non-detected values. TEQs were calculated with mammalian PEFs for seven individual PAH compounds (California EPA 1994), using one-half the RL for undetected compounds.



[a] Percentiles were calculated on an area basis as the concentration at which a particular percentage of the LDW area has Thiessen polygon values less than or equal to that concentration (e.g., the 95th percentile is the concentration at which 95% of the LDW area has Thiessen polygon concentrations ≤ 990 mg/kg dw). Thiessen polygon concentrations were calculated including locations with non-detected values. For locations with non-detects, a value of one-half the RL at that location was used.



[a] Percentiles were calculated on a numerical basis using all values from the baseline surface sediment dataset. Percentiles were not calculated on an area basis as for the other chemicals because there were too few dioxin and furan samples to establish a spatial distribution. TEQs were calculated using mammalian TEFs for individual dioxin and furan congeners (Van den Berg et al. 2006), using one-half the reporting limit for undetected congeners.

Wind Ward environmental LLC

0 1,000 2,000 Feet

0 250 500 Meters

Scale is the same for each inset map

N

Map 4-70c. 95th and 75th Percentiles of risk driver chemicals, RM 3.7 to RM 6.0

For the Norfolk Early Action Area, surface sediment data in the baseline dataset represent samples collected before dredging, capping, or thin-layer placement in 2003 and 2004.

Produced by CEH, 07/15/2010, MAP 3056, W:\Projects\00-09-06_Duwamish_Rfi\data\GIS\Phase2 RI\Nature and Extent\Surface Sediment\Baseline Locations