DEPARTMENT OF
ECOLOGY
State of Washington

2010 Addendum to Quality Assurance Project Plan

The Puget Sound Assessment and Monitoring Program: Sediment Monitoring Component

August 2010

Publication No. 09-03-121-Addendum1

Publication Information

Addendum

This addendum is an annual addition and update to an original Quality Assurance Project Plan. The addendum is not a correction (errata) to the original plan.

This addendum is available on the Department of Ecology's website at www.ecy.wa.gov/biblio/0903121Addendum1.html.

Original Publication

Quality Assurance Project Plan: The Puget Sound Assessment and Monitoring Program: Sediment Monitoring Component

Publication No. 09-03-121.

The Quality Assurance Project Plan is available on the Department of Ecology's website at www.ecy.wa.gov/biblio/0903121.html.

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DEPARTMENT OF ECOLOGY

Environmental Assessment Program

August 31, 2010

TO: Puget Sound Assessment and Monitoring Program Sediment Component E-mail List

THROUGH: Robert F. Cusimano, Section Manager, Environmental Assessment Program
Carol Maloy, Unit Supervisor, Environmental Assessment Program

FROM: Margaret Dutch, Environmental Assessment Program

SUBJECT: 2010 Addendum to Quality Assurance Project Plan for: The Puget Sound Assessment and Monitoring Program: Sediment Monitoring Component

Project Code: Project Tracker (99-510); Activity Tracker (01-900)
Publication No: 09-03-121-Addendum1

The Washington State Department of Ecology's Marine Sediment Monitoring Team (MSMT) conducted sediment sampling in April and June, 2010, as part of their annual Puget Sound Assessment and Monitoring Program (PSAMP) and Ecology's Urban Water's Initiative (UWI) Monitoring Program.

Extra sediment samples were collected in April at both PSAMP and UWI stations to measure concentrations of Personal Care Products and Pharmaceuticals (PCPP) and Perfluorinated Chemicals (PFC) in each sample. Additional samples were also collected in June to measure dioxin and furan concentrations in Bellingham Bay sediments for Ecology's Toxic Cleanup Program (FY11 EAP Project No. 3733).

This addendum to the 2009 PSAMP Sediment Monitoring Component Quality Assurance Project Plan (Dutch et. al, 2009) provides details regarding all sampling locations, parameters, quality assurance, and sampling/analysis schedules for each of the four projects conducted in 2010. Additionally, the post-cruise navigation reports, including the target and actual latitude and longitude for each station and grab sample taken in April and June, are attached as an appendix.

All data, data summaries, and reports generated from the PSAMP, UWI, and PPCP projects will be posted to the MSMT website (www.ecy.wa.gov/programs/eap/psamp/index.htm) and Ecology's EIM database (www.ecy.wa.gov/eim/). Any questions regarding this work can be directed to me at margaret.dutch@ecy.wa.gov or 360-407-6021. The dioxin and furan data will be posted to the EIM database. Questions regarding this project can be directed to Tom Gries at tgri461@ecy.wa.gov.

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On-going Monitoring Programs

April 2010 - Ecology-PSAMP Long-Term Temporal Monitoring

Station Locations: 10 historical PSAMP stations throughout Puget Sound (Figure 1, Table 1).

Parameters Sampled: Field measurements, macroinvertebrate abundance, grain size, total organic carbon, metal and organic chemical contaminants (Table 2).

Project Schedule: Outlined in Table 3.

Post-cruise Navigation Report: Appendix A

Link to further information about this long-term program:
www.ecy.wa.gov/programs/eap/psamp/TemporalMonitoring/Temporal.htm.

June 2010 - Ecology's Urban Waters Initiative (UWI) Monitoring

Station Locations: 30 randomly selected locations (18 previously sampled in 1997, 11 previously sampled in 2006, 1 new) in Bellingham Bay (Figure 2, Table 4). If a station location could not be sampled, an alternate location was available (Figure 3, Table 5).

Parameters Sampled: Field measurements, toxicity, macroinvertebrate abundance, grain size, total organic carbon, metals, and organic chemical contaminants (Table 6).

Project Schedule: Outlined in Table 7.

Post-cruise Navigation Report: Appendix B

Link to further information about this long-term program:
www.ecy.wa.gov/programs/eap/psamp/UrbanWaters/urbanwaters.htm.

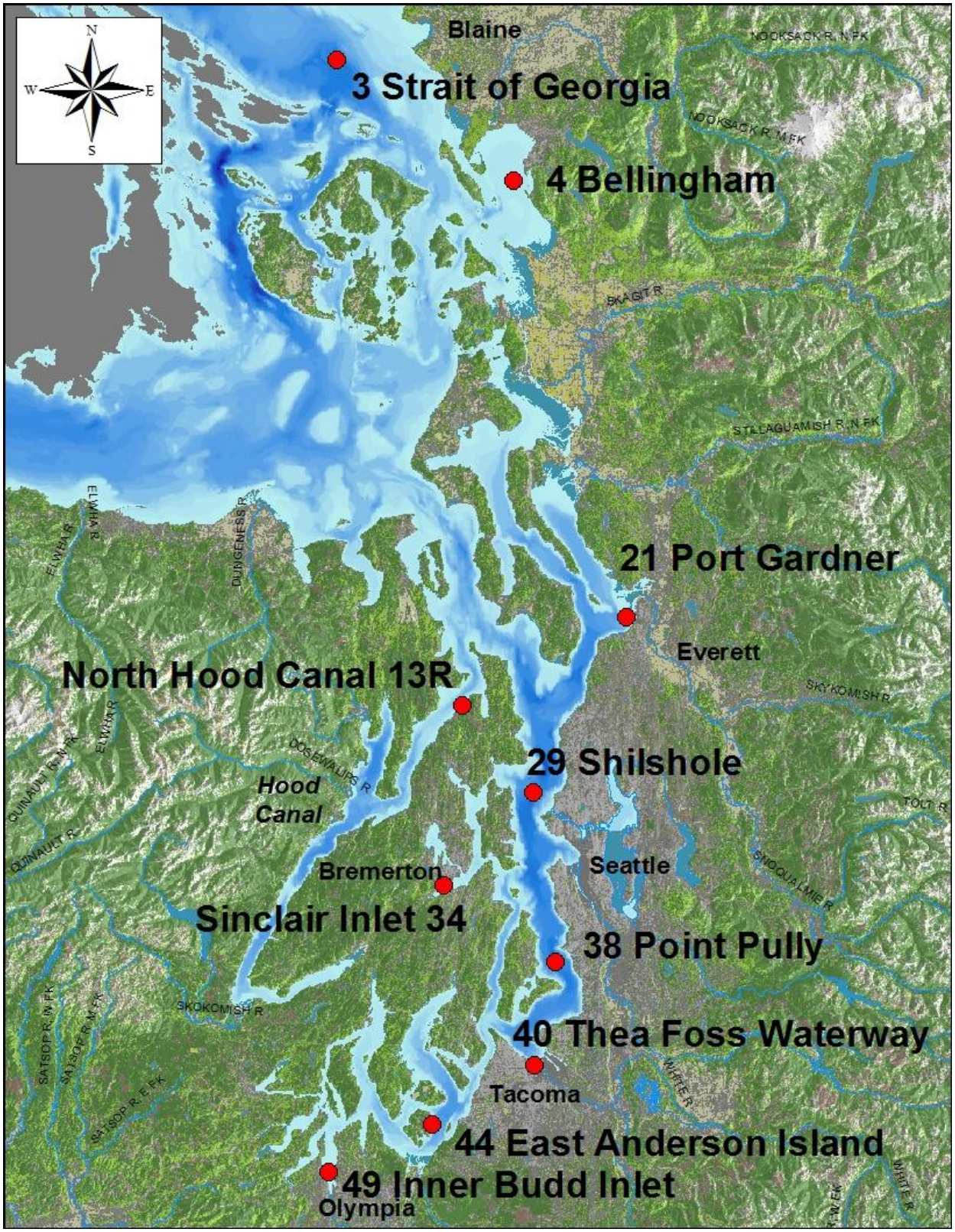

Figure 1. Ecology-PSAMP 10 long-term temporal sediment monitoring stations in Puget Sound.

Table 1. Location (latitude/longitude) for Ecology-PSAMP 10 long-term temporal sediment monitoring stations in Puget Sound.

Station	Location	Target (NAD 83, decimal degrees)	
		Longitude	Latitude
3	Strait of Georgia	122.97842	48.87025
4	Bellingham	122.53820	48.68397
21	Everett	122.24283	47.98547
29	Shilshole	122.45403	47.70075
34	Sinclair Inlet	122.66208	47.54708
38	Point Pully	122.39363	47.42833
40	Commencement Bay	122.43730	47.26130
44	East Anderson Island	122.67358	47.16133
49	Budd Inlet	122.91347	47.07997
13R	North Hood Canal	122.62895	47.83758

Table 2. Parameters measured in Puget Sound sediments for the 2010 PSAMP Sediment Component Long-term/Temporal Monitoring Element.

Field Measurements

Sediment temperature
Salinity of overlying water

Macroinvertebrate Abundance

Total Abundance
Major Taxa Abundance
Taxa Richness
Pielou's Evenness
Swartz's Dominance Index

Related Parameters

Grain Size
Total organic carbon

Metals

Priority Pollutant Metals
Arsenic
Cadmium
Chromium
Copper
Lead
Mercury
Nickel
Selenium
Silver
Zinc

Organics

Chlorinated Alkenes
Hexachlorobutadiene

Chlorinated and Nitro-Substituted Phenols
Pentachlorophenol

Chlorinated Aromatic Chemicals
1,2,4-trichlorobenzene
1,2-dichlorobenzene
1,3-dichlorobenzene
1,4-dichlorobenzene
2-chloronaphthalene
Hexachlorobenzene

Chlorinated Pesticides
2,4'-DDD
2,4'-DDE
2,4'-DDT
4,4'-DDD
4,4'-DDE
4,4'-DDT
Aldrin
Alpha-chlordane
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan sulfate
Endrin
Endrin aldehyde
Endrin ketone
Gamma-BHC (Lindane)
Heptachlor
Heptachlor epoxide
Toxaphene
Trans-Chlordane (Gamma)

Polynuclear Aromatic Hydrocarbons
LPAHs
1-Methylnaphthalene
2-Methylnaphthalene
Acenaphthene
Acenaphthylene
Anthracene
Fluorene
Naphthalene
Phenanthrene
Retene
Calculated values:
LPAHs
HPAHs
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
Chrysene
Dibenzo(a,h)anthracene
Fluoranthene
Indeno(1,2,3-c,d)pyrene
Perylene
Pyrene
Calculated values:
HPAH
Total Benzofluoranthenes

Miscellaneous Extractable Chemicals
Benzoic acid
Benzyl alcohol
Beta-coprostanol
Cholesterol
Dibenzofuran
Isophorone

Organonitrogen Chemicals
9(H)carbazole
Caffeine
N-nitroso-diphenylamine

Phenols
2,4-dimethylphenol
2-methylphenol
4-methylphenol
Phenol
Phenol, 4-Nonyl-

Phthalate Esters
Bis(2-ethylhexyl)phthalate
Butylbenzylphthalate
Diethylphthalate
Dimethylphthalate
Di-N-butylphthalate
Di-n-octylphthalate

Polychlorinated Biphenyls
PCB Aroclor 1016
PCB Aroclor 1221
PCB Aroclor 1232
PCB Aroclor 1242
PCB Aroclor 1248
PCB Aroclor 1254

PCB Aroclor 1260
PCB congener 8
PCB congener 18
PCB congener 28
PCB congener 44
PCB congener 52
PCB congener 66
PCB congener 77
PCB congener 101
PCB congener 105
PCB congener 118
PCB congener 126
PCB congener 128
PCB congener 138
PCB congener 153
PCB congener 169
PCB congener 170
PCB congener 180
PCB congener 187
PCB congener 195
PCB congener 206
PCB congener 209

Polybrominated Diphenylethers
PBDE- 47
PBDE– 49
PBDE- 66
PBDE- 71
PBDE- 99
PBDE-100
PBDE- 138
PBDE-153
PBDE-154
PBDE- 183
PBDE- 184
PBDE- 191
PBDE-209

Recently added
Bisphenol A
Tri(2-chloroethyl)phosphate
Triclosan
Triethyl citrate

Table 3. Proposed schedule for completing the 2010 PSAMP long-term/temporal monitoring field and laboratory work, EIM data entry, and reports.

Field and laboratory work		
Field work completed		April 2010
Laboratory analyses completed		TOC – July 2010 Grain size – September 2010 Taxonomy – March 2011 Chemistry – March 2011
Environmental Information System (EIM) system		
Product	Due date	Lead Staff
EIM data loaded	April 2011	Sandra Weakland
EIM QA	May 2011	Maggie Dutch
EIM complete	June 2011	Sandra Weakland
Final report: 2010 PSAMP Long-Term/Temporal Monitoring		
Author lead		Maggie Dutch
Schedule		
Summary statistics, graphics, and text generated and posted to web		June 2011
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Final (all reviews done) due to publications coordinator (Joan)		November 2011
Final report due on web		January 2012

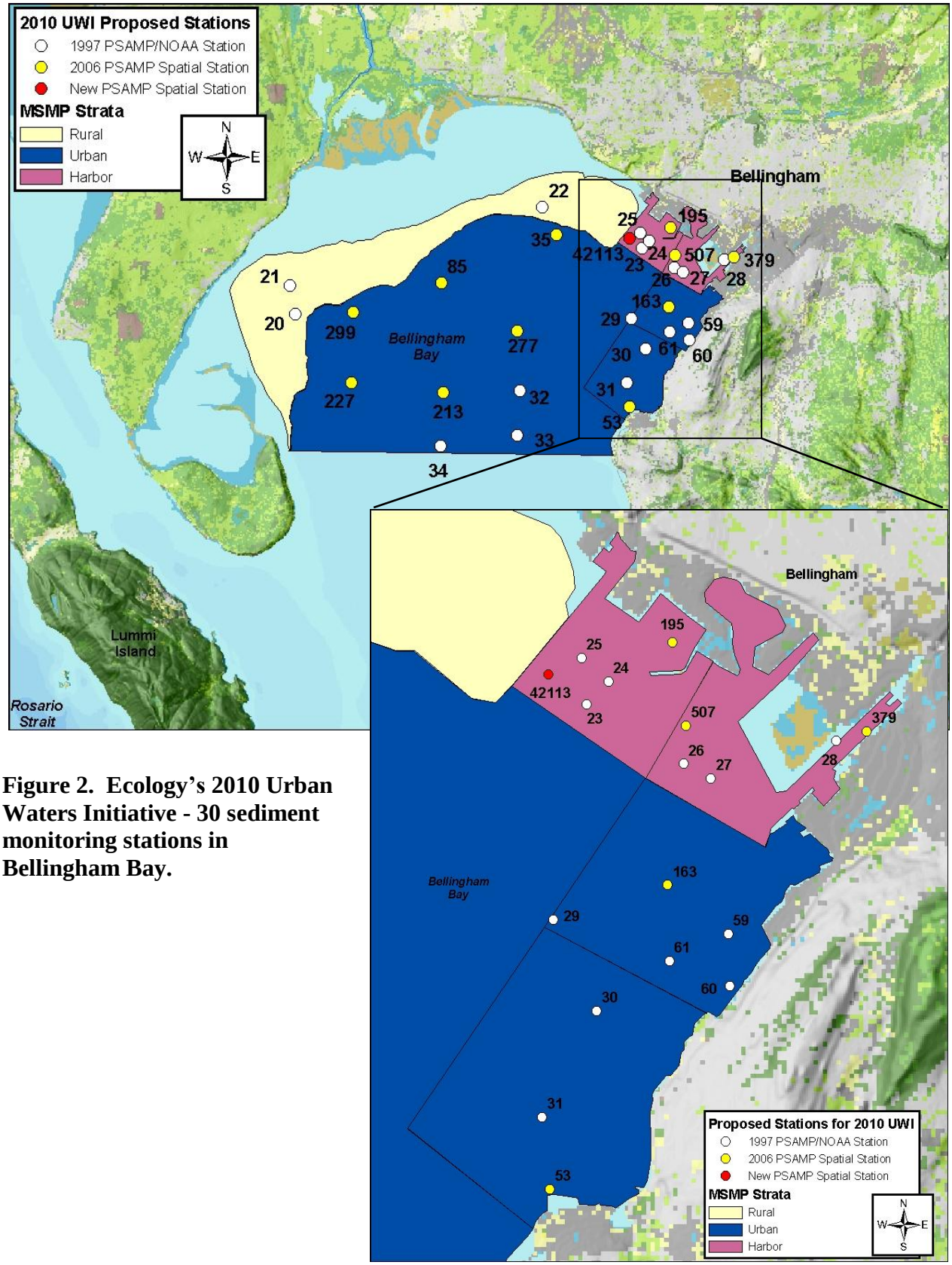

Figure 2. Ecology's 2010 Urban Waters Initiative - 30 sediment monitoring stations in Bellingham Bay.

Table 4. Location (latitude/longitude) for Ecology's 2010 Urban Waters Initiative - 30 sediment monitoring stations in Bellingham Bay.

Station	Strata	Target (NAD 83, decimal degrees)	
		Longitude	Latitude
20	Rural	122.60723	48.73778
21	Rural	122.60890	48.74305
22	Rural	122.54028	48.75833
23	Harbor	122.51278	48.75142
24	Harbor	122.51083	48.75280
25	Harbor	122.51332	48.75415
26	Harbor	122.50388	48.74805
27	Harbor	122.50138	48.74723
28	Harbor	122.49022	48.74965
29	Urban	122.51528	48.73862
30	Urban	122.51113	48.73328
31	Urban	122.51582	48.72693
32	Urban	122.54525	48.72500
33	Urban	122.54548	48.71693
34	Urban	122.56645	48.71473
35	Urban	122.53629	48.75337
53	Urban	122.51494	48.72268
59	Urban	122.49947	48.73805
60	Urban	122.49922	48.73498
61	Urban	122.50470	48.73635
85	Urban	122.56741	48.74414
163	Urban	122.50506	48.74085
195	Harbor	122.50514	48.75521
213	Urban	122.56615	48.72436
227	Urban	122.59123	48.72574
277	Urban	122.54621	48.73590
299	Urban	122.59135	48.73842
379	Harbor	122.48746	48.75025
507	Harbor	122.50374	48.75032
42113	Harbor	122.51627	48.75312

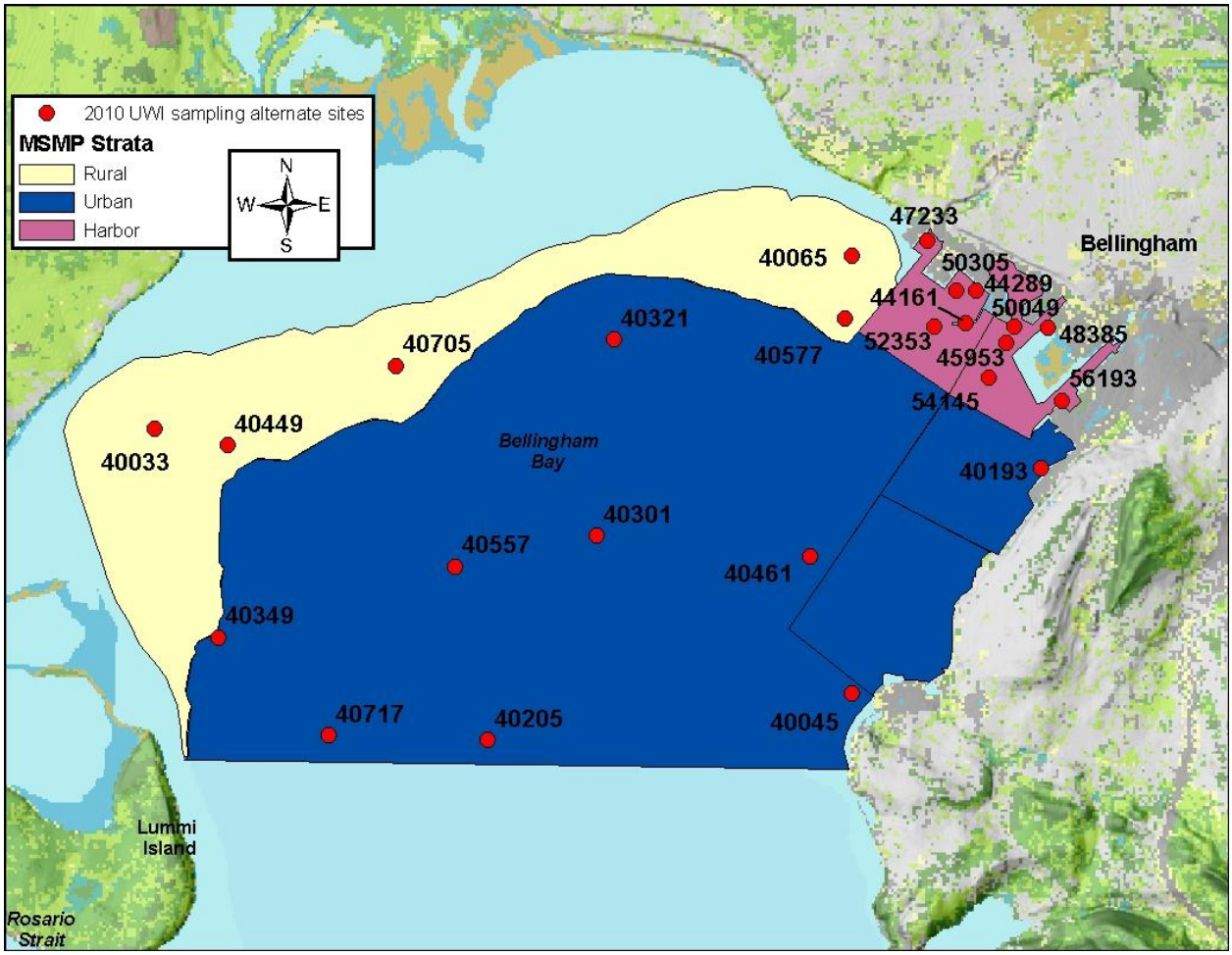

Figure 3. Ecology's 2010 Urban Waters Initiative – 24 alternate sediment monitoring stations in Bellingham Bay.

Table 5. Location (latitude/longitude) for Ecology's 2010 Urban Waters Initiative - 24 alternate sediment monitoring stations in Bellingham Bay.

Station	Strata	Target (NAD 83, decimal degrees)	
		Longitude	Latitude
44161	Harbor	122.505264	48.75340
44289	Harbor	122.503920	48.75624
45953	Harbor	122.499789	48.75175
47233	Harbor	122.510596	48.76059
48385	Harbor	122.494293	48.75319
50049	Harbor	122.498748	48.75317
50305	Harbor	122.506598	48.75620
52353	Harbor	122.509451	48.75298
54145	Harbor	122.501933	48.74863
56193	Harbor	122.492194	48.74674
40033	Rural	122.613036	48.74223
40065	Rural	122.520724	48.75903
40449	Rural	122.603280	48.74090
40577	Rural	122.521392	48.75349
40705	Rural	122.581100	48.74833
40045	Urban	122.519202	48.72049
40193	Urban	122.494625	48.74072
40205	Urban	122.567592	48.71553
40301	Urban	122.553759	48.73378
40321	Urban	122.552091	48.75111
40349	Urban	122.603811	48.72396
40461	Urban	122.525214	48.73247
40557	Urban	122.572510	48.73075
40717	Urban	122.588787	48.71558

Table 6. Parameters measured in Puget Sound sediments for the 2010 Urban Waters Initiative.

Field Measurements

Sediment temperature
Salinity of overlying water

Toxicity Parameters

Amphipod Survival (solid phase)
Urchin Fertilization (porewater)

Macroinvertebrate Abundance

Total Abundance
Major Taxa Abundance
Taxa Richness
Pielou's Evenness
Swartz's Dominance Index

Related Parameters

Grain Size
Total organic carbon

Metals

Priority Pollutant Metals

Arsenic
Cadmium
Chromium
Copper
Lead
Mercury
Nickel
Selenium
Silver
Zinc

Element

Tin

Organics

Chlorinated Alkenes

Hexachlorobutadiene

Chlorinated and Nitro-Substituted Phenols

Pentachlorophenol

Chlorinated Aromatic Chemicals

1,2,4-Trichlorobenzene
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
2-Chloronaphthalene
Hexachlorobenzene

Chlorinated Pesticides

2,4'-DDD
2,4'-DDE
2,4'-DDT
4,4'-DDD
4,4'-DDE
4,4'-DDT
Aldrin
Cis-Chlordane (Alpha-Chlordane)
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan Sulfate
Endrin
Endrin Aldehyde
Endrin Ketone
Gamma-BHC (Lindane)
Heptachlor
Heptachlor Epoxide
Mirex
Oxychlordane
Toxaphene
Trans-Chlordane (Gamma)

Polynuclear Aromatic Hydrocarbons

LPAHs

1,6,7-Trimethylnaphthalene
1-Methylnaphthalene
1-Methylphenanthrene
2,6-Dimethylnaphthalene
2-Methylnaphthalene
2-Methylphenanthrene
Acenaphthene
Acenaphthylene
Anthracene
Biphenyl
Dibenzothiophene
Fluorene
Naphthalene
Phenanthrene
Retene
Calculated values:
  total LPAHs

HPAHs

Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(e)pyrene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
Chrysene
Dibenzo(a,h)anthracene
Fluoranthene
Indeno(1,2,3-c,d)pyrene
Perylene
Pyrene
Calculated values:
  total HPAH
  total Benzofluoranthenes

Miscellaneous Extractable Chemicals

Benzoic Acid
Benzyl Alcohol
Beta-coprostanol
Carbazole
Cholesterol
Dibenzofuran
Isophorone

Organonitrogen Chemicals

Caffeine
N-Nitrosodiphenylamine

Phenols

2,4-Dimethylphenol
2-Methylphenol

4-Methylphenol
Phenol
Phenol, 4-Nonyl-

Phthalate Esters
Bis(2-Ethylhexyl)phthalate
Butylbenzylphthalate
Diethylphthalate
Dimethylphthalate
Di-N-Butylphthalate
Di-N-Octylphthalate
Polybrominated Diphenylethers
PBDE- 47
PBDE– 49
PBDE- 66
PBDE- 71
PBDE- 99
PBDE-100
PBDE- 138
PBDE-153
PBDE-154
PBDE- 183
PBDE- 184
PBDE-191
PBDE-209

Polychlorinated Biphenyls
PCB Aroclor 1016
PCB Aroclor 1221
PCB Aroclor 1232
PCB Aroclor 1242
PCB Aroclor 1248
PCB Aroclor 1254
PCB Aroclor 1260
PCB Aroclor 1262
PCB Aroclor 1268
PCB congener 8
PCB congener 18
PCB congener 28
PCB congener 44
PCB congener 52
PCB congener 66
PCB congener 77
PCB congener 101
PCB congener 105
PCB congener 118
PCB congener 126
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PCB congener 138
PCB congener 153
PCB congener 169
PCB congener 170
PCB congener 180
PCB congener 187
PCB congener 195
PCB congener 206
PCB congener 209

Recently added
Bisphenol A
Tri(2-chloroethyl)phosphate
Triclosan
Triethyl citrate

Table 7. Proposed schedule for completing the 2010 Urban Waters Initiative field and laboratory work, data entry into EIM, and reports.

Field and laboratory work		
Field work completed		June 2010
Laboratory analyses completed		TOC – July 2010 Grain size – September 2010 Toxicity – March 2011 Taxonomy – March 2011 Chemistry – March 2011
Environmental Information System (EIM) system		
Product	Due date	Lead Staff
EIM data loaded	April 2011	Sandra Weakland
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Final report: 2010 Urban Waters Initiative: Bellingham Bay		
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Final (all reviews done) due to publications coordinator (Joan)		November 2011
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Special Projects

April 2010 – Concentrations of Personal Care Products and Pharmaceuticals (PPCPs), and Perfluorinated Chemicals (PFCs) in Puget Sound sediments

Purpose: To establish baseline data of the concentrations of PPCPs and PFCs in Puget Sound sediments in both urban and nonurban locations.

Sampling Details: 1 sediment sample (top 2-3cm) collected from each station sampled with a $0.1m^2$ double vanVeen grab.

Station Locations: 40 stations, including the 10 PSAMP Long-Term Temporal and 30 Urban Waters Initiative Monitoring locations described above.

Parameters Sampled: Field measurements, 119 PPCPs, 13 PFCs (Table 8).

Sample volumes and preservation for laboratory analysis: Outlined in Table 9.

Laboratory analysis and reporting requirements: Outlined in Table 10.

Field and laboratory Measurement Quality Objectives: Outlined in Table 11.

Project Schedule: Outlined in Table 12.

Post-cruise Navigation Report: Appendix A, Appendix C

Table 8. Parameters measured in Puget Sound sediments in April 2010 for concentrations of personal care products and pharmaceuticals (PPCPs), and perfluorinated chemicals (PFCs), in Puget Sound sediments.
(Includes the 5 lists of 119 PPCPs and full suite of 13 PFCs offered by AXYS Analytical Laboratories, Inc, Sydney, BC, Canada.)

Field Measurements

Sediment temperature
Salinity of overlying water

Personal Care Products and Pharmaceuticals

List 1 - Acid Extraction in Positive Ionization
Acetaminophen
Ampicillin 1
Azithromycin
Caffeine
Carbadox
Carbamazapine
Cefotaxime
Ciprofloxacin
Clarithromycin
Clinafloxacin
Cloxacillin
Dehydronifedipine
Digoxigenin
Digoxin
Diltiazem
1,7-Dimethylxanthine
Diphenhydramine
Enrofloxacin
Erythromycin-H20
Flumequine
Fluoxetine
Lincomycin
Lomefloxacin
Miconazole
Norfloxacin
Norgestimate
Ofloxacin
Ormetoprim
Oxacillin
Oxolinic acid
Penicillin G
Penicillin V
Roxithromycin
Sarafloxacin
Sulfachloropyridazine
Sulfadiazine
Sulfadimethoxine
Sulfamerazine
Sulfamethazine
Sulfamethizole
Sulfamethoxazole
Sulfanilamide
Sulfathiazole
Thiabendazole
Trimethoprim
Tylosin
Virginiamycin

List 2 - Tetracyclines in Positive Ionization
Anhydrochlortetracycline
Anhydrotetracycline
Chlortetracycline
Demeclocycline
Doxycycline
4-Epianhydrochlortetracycline
4-Epianhydrotetracycline
4-Epichlortetracycline
4-Epioxytetracycline
4-Epitetracycline
Isochlortetracycline
Minocycline
Oxytetracycline
Tetracycline

List 3 - Acid Extraction in Negative Ionization
Bisphenol A
Furosemide
Gemfibrozil
Glipizide
Glyburide
Hydroclorothiazide
2-hydroxy-ibuprofen
Ibuprofen
Naproxen
Triclocarban
Triclosan
Warfarin

List 4 - Basic Extraction in Positive Ionization
Albuterol
Amphetamine
Atenolol
Atorvastatin
Cimetidine
Clonidine
Codeine
Cotinine
Enalapril
Hydrocodone
Metformin
Oxycodone
Ranitidine
Triamterene

List 5 - Acid Extraction in Positive Ionization
Alprazolam
Amitriptyline
Amlodipine
Benzoylecgonine

Benztropine
Betamethasone
Cocaine
DEET
Desmethyldiltiazem
Diazepam
Fluocinonide
Fluticasone propionate
Hydrocortisone
10-hydroxy-amitriptyline
Meprobamate
Methylprednisolone
Metoprolol
Norfluoxetine
Norverapamil
Paroxetine
Prednisolone
Prednisone
Promethazine
Propoxyphene
Propranolol
Sertraline
Simvastatin
Theophylline
Trenbolone
Trenbolone acetate
Valsartan
Verapamil

Perfluorinated Chemicals

Carboxylic Acids

Perfluorobutanoate (PFBA)
Perfluoropentanoate (PFPeA)
Perfluorohexanoate (PFHxA)
Perfluoroheptanoate (PFHpA)
Perfluorooctanoate (PFOA)
Perfluorononanoate (PFNA)
Perfluorodecanoate (PFDA)
Perfluoroundecanoate (PFUnA)
Perfluorododecanoate (PFDoA)

Sulphonic Acids

Perfluorobutanesulfonate (PFBS)
Perfluorohexanesulfonate (PFHxS)
Perfluorooctanesulfonate (PFOS)
Perfluorooctane sulfonamide (PFOSA)

Table 9. Sample volumes and preservation for laboratory analysis for pharmaceuticals and personal care products (PPCPs) and perfluorinated chemicals (PFCs).

Parameter	Size of Sample	Container	Preservation	Maximum Holding Time
Pharmaceuticals and Personal Care Products (PPCPs)	8 oz	8 oz HDPE internally certified by contract lab	Wrap in aluminum foil and place in ice chest with dry ice immediately after field collection. Freeze as soon as possible. Store in dark at less than -10°C until analyzed	* Freezing encouraged to minimize degradation. Extract within 48 hours if not frozen or within 7 days of collection if frozen. Extract within 48 hours of removal from freezer. Analyze extracts within 40 days of extraction.
Perfluorinated Chemicals (PFCs)	8 oz	8 oz HDPE internally certified by contract lab	Refrigerate at 4ºC±2ºC (CAS)	* 14 days to extraction (CAS)

* These are suggested holding times only. Formal holding time studies have not been performed or published for this analysis.

Table 10. Laboratory analysis and reporting requirements for pharmaceuticals and personal care products (PPCPs) and perfluorinated chemicals (PFCs) for the PSAMP sediment component.

Parameter	Expected Range of Results	Extraction Method	Clean-Up Method	Analysis Method	Technique/ Instrument	Required Reporting Limit
Pharmaceuticals and Personal Care Products (PPCPs)	Unknown	Sonication with aqueous buffered acetonitrile and pure acetonitrile, concentrate then dilute with ultra pure water.	Solid-phase extraction cartridge then filtered	USEPA 1694	HPLC/ESI-MS/MS. High performance liquid chromatography with triple quadrupole mass spectrometer in positive and negative electrospray ionization modes using isotope dilution and internal standard quantitation techniques	1-1,000 µg/kg dry weight
Perfluorinated Chemicals (PFCs)	Unknown	Shake extraction with dilute acetic acid solution then methanolic ammonium hydroxide solution. Combine supernatants and treat with ultra pure carbon powder and diluted with ultra pure water.	Weak anion exchange sorbent solid-phase extraction	MLA-041. Internal Axys method	HPLC/ESI-MS/MS. High performance liquid chromatography with triple quadrupole mass spectrometer in negative electrospray ionization mode using internal standard.	0.1 µg/kg dry weight

Table 11. Field and laboratory measurement quality objectives for sediment grain size, total organic carbon, and chemistry analyses.

Parameter	Field Blank	Field Replicate (Split Sample)	Analytical (Laboratory) Replicate	Laboratory Control Sample	Reference Material	Method Blank	Matrix Spike (and Matrix Spike Duplicates)	Surrogate Spike
Measurement Frequency	Conducted in 1997	Duplicate analysis for 5% of samples	Triplicate analysis/batch of 20 samples for grain size and TOC. Duplicate analysis/batch for metals and organics samples.	1/batch of 20	1/batch of 20	1/batch of 20	1/batch of 20	every organics sample, blank, and QC sample (minimum of 3 for neutrals, 3 for acids)
MQO measured	RPD	RPD	RSD or RPD	% recovery limits	% recovery limits	comparison of analyte concentration in blank to quantification limit	% recovery limits	% recovery limits
Base/Neutral/ Acid Organic Compounds (BNAs)	RPD $\leq$ 20%	RPD $\leq$ 20%	Compound specific RPD $\leq$ 40%	50-150	50-150	Analyte concentration <MDL; if $\geq$ MDL, lowest analyte concn. must be $\geq$ 10x method blank concn.	50-150	20-150 [2]
Pharmaceuticals and Personal Care Products (PPCPs)	RPD $\leq$ 20%	RPD $\leq$ 20%	Compound specific RPD $\leq$ 40%	Compound specific	NA	Analyte concentration <MDL; if $\geq$ MDL, lowest analyte concn. must be $\geq$ 10x method blank concn.	NA	Compound specific
Perfluorinated Chemicals (PFCs)	RPD $\leq$ 20%	RPD $\leq$ 20%	Compound specific RPD $\leq$ 40%	Compound specific	NA	Analyte concentration <MDL; if $\geq$ MDL, lowest analyte concn. must be $\geq$ 10x method blank concn.	Recovery Compound specific; RPDs < 40	Compound specific

Method Blanks - analyzed to assess possible laboratory contamination of samples associated with all stages of preparation and analysis of sample extracts.

Surrogate Spike Compounds - a type of check standard that is added to each sample in a known amount prior to extraction or purging.

Analytical replicates - provide precision information on the actual samples; useful in assessing potential samples heterogeneity and matrix effects.

Matrix Spikes - percent recoveries of matrix spikes are reported, should include a wide range of representative analyte types, compounds should be spiked about 5x the concentration of compounds in the sample or 5x the quantification limit.

Laboratory Control Samples - sometimes called check standards or laboratory control samples, are method blanks spiked with surrogate compounds and analytes; useful in verifying acceptable method performance prior to and during routine analysis of samples.

Reference Materials - a material or substance whose property values are sufficiently well established to be used for calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials

Certified Reference Material - a reference material, provided by standard setting organizations such as NIST, CRM, etc., accompanied by or traceable to a certificate or other documentation that is issues by a certifying body.

Table 12. Proposed schedule for completing the 2010 Urban Waters Initiative field and laboratory work, data entry into EIM, and reports.

Field and laboratory work		
Field work completed		April 2010
Laboratory analyses completed		Chemistry – September 2010
Environmental Information System (EIM) system		
Product	Due date	Lead Staff
EIM data loaded	April 2011	Sandra Weakland
EIM QA	May 2011	Maggie Dutch
EIM complete	June 2011	Sandra Weakland
Final report: 2010 Urban Waters Initiative: Bellingham Bay		
Author lead		Maggie Dutch
Schedule		
Summary statistics, graphics, and text generated and posted to web		June 2011
Draft due to supervisor		September 2011
Draft due to client/peer reviewer		October 2011
Draft due to external reviewer		October 2011
Final (all reviews done) due to publications coordinator (Joan)		November 2011
Final report due on web		January 2012

June 2010 – Dioxin and Furan Concentrations in Bellingham Bay (FY11 EAP Project No. 3733, client: Lucy McInerney, Toxic Cleanup Program, NWRO; EAP project lead: Tom Gries)

Purpose: To establish baseline data for the concentrations of dioxin and furan chemicals in Bellingham Bay sediments.

Sampling Details: 1 sediment sample (top 12cm) collected from each station sampled with a $0.1m^2$ double vanVeen grab. Sample depth sometimes <12cm, depending on grain size and level of consolidation of bottom sediments.

Station Locations: 21 locations (9 UWI stations, 12 newly selected stations) in Bellingham Bay (Figure 4, Table 13).

Parameters Sampled: Field measurements, grain size, total organic carbon, dioxins, furans (Table 14).

Sample volumes and preservation for laboratory analysis: Outlined in Table 15.

Laboratory analysis and reporting requirements: Outlined in Table 16a, b.

Field and laboratory Measurement Quality Objectives: Outlined in Table 17.

Project Schedule: Outlined in Table 18.

Post-cruise Navigation Report: Appendix B and Appendix D

Link to further information about toxic cleanup work in Bellingham Bay: www.ecy.wa.gov/programs/tcp/sites/blhm_bay/sites/bel_bay_sites.html.

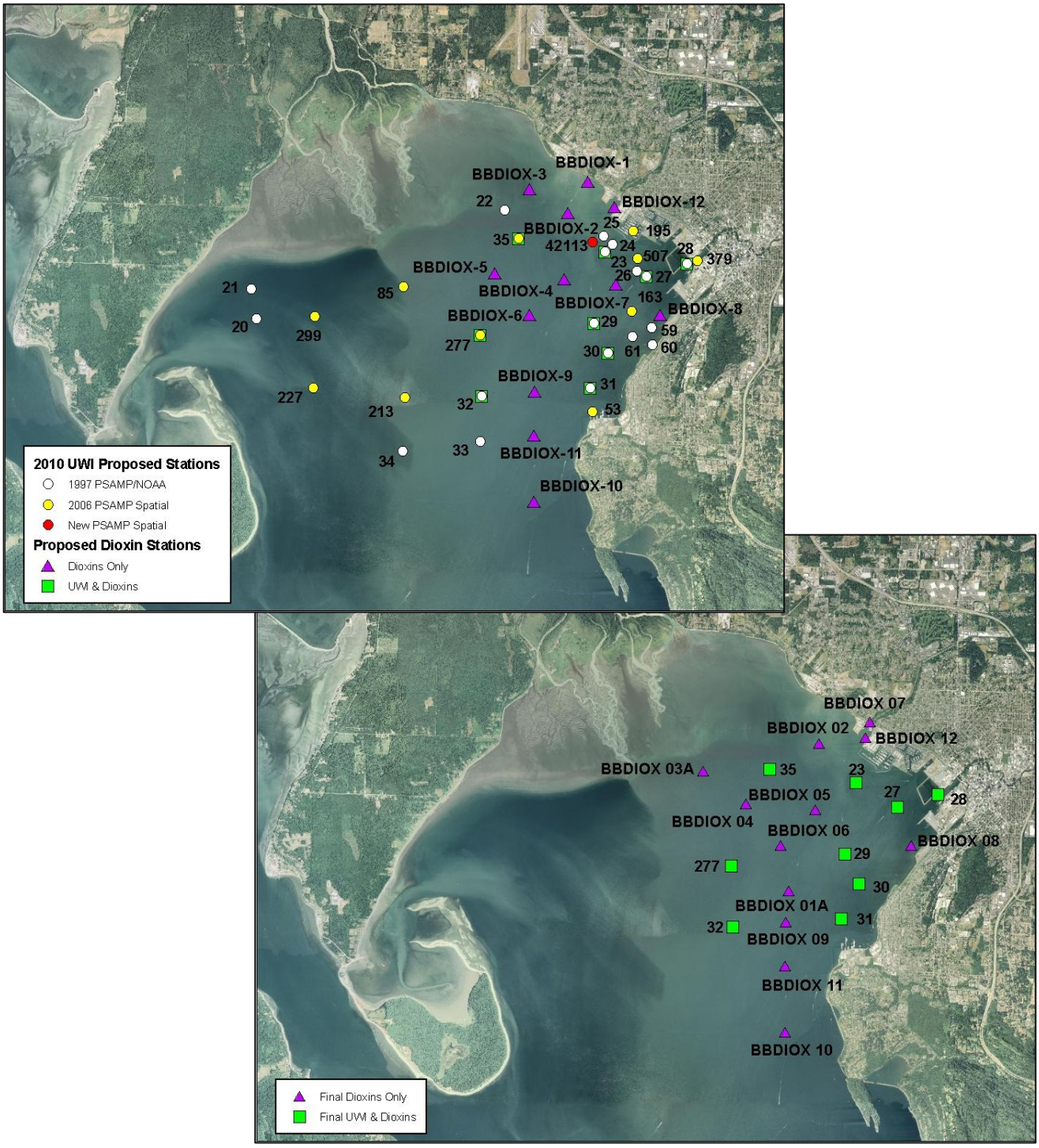

Figure 4. Dioxin and furan concentrations in Bellingham Bay. Target sampling locations (top, indicates overlap with 2010 UWI proposed stations) and final sampling locations (bottom). (Station BBDIOX 01 and BBDIOX 03 were sampled and discarded due to high sand content. They were replaced with BBDIOX 01A and BBDIOX03A.)

Table 13. Target location (latitude/longitude) for sampling dioxin and furan concentrations in Bellingham Bay.

Station	Target (NAD 83, decimal degrees)	
	Longitude	Latitude
UWI 23	122.51278	48.75142
UWI 27	122.50138	48.74723
UWI 28	122.49022	48.74965
UWI 29	122.51528	48.73862
UWI 30	122.51113	48.73328
UWI 31	122.51582	48.72693
UWI 32	122.54525	48.72500
UWI 35	122.53629	48.75337
UWI 277	122.54621	48.73590
BBDIOX-1	122.51785	48.76382
BBDIOX-2	122.52311	48.75807
BBDIOX-3	122.53360	48.76216
BBDIOX-4	122.54252	48.74697
BBDIOX-5	122.52362	48.74622
BBDIOX-6	122.53272	48.73967
BBDIOX-7	122.50940	48.74561
BBDIOX-8	122.49724	48.74027
BBDIOX-9	122.53090	48.72604
BBDIOX-10	122.53030	48.70642
BBDIOX-11	122.53068	48.71816
BBDIOX-12	122.51039	48.75941

Table 14. Parameters measured in Bellingham Bay sediments to determine dioxin and furan concentrations.

Field Measurements

Sediment temperature
Salinity of overlying water

Related Parameters

Grain size
Total organic carbon

Organics

Dioxin and Furan congeners

PCDD
2,3,7,8-TCDD
1,2,3,7,8-PeCDD
1,2,3,4,7,8-HxCDD
1,2,3,6,7,8-HxCDD
1,2,3,7,8,9-HxCDD
1,2,3,4,6,7,8-HpCDD
1,2,3,4,6,7,8,9-OCDD

PCDF
2,3,7,8-TCDF
1,2,3,7,8-PeCDF
2,3,4,7,8-PeCDF
1,2,3,4,7,8-HxCDF
1,2,3,6,7,8-HxCDF
1,2,3,7,8,9-HxCDF
2,3,4,6,7,8-HxCDF
1,2,3,4,6,7,8-HpCDF
1,2,3,4,7,8,9-HpCDF
1,2,3,4,6,7,8,9-OCDF

Table 15. Sample volumes and preservation for laboratory analysis for dioxin and furan samples.

Parameter	Size of Sample	Container	Preservation	Maximum Holding Time
Dioxins and Furans	8 oz	8 oz certified organic-free wide-mouth glass jar with Teflon-lined lid	Refrigerate at 4°C or freeze at -18°C	1 year pre-extraction 1 year post-extraction

Table 16a. Laboratory analysis and reporting requirements for dioxin and furan samples.

Parameter	Expected Range of Results	Extraction Method	Clean-Up Method	Analysis Method	Technique/ Instrument	Required Reporting Limit
Dioxins and Furans (ng/kg)	< 0.5 – < 500	As specified by method	All necessary (silica, alumina, carbon)	SW846 Method 1613B (EPA, 1994; especially Sections 11-14)	HRGC / HRMS	Varies – See Table 16b

Table 16b. Target estimated quantitation limits (EQLs) for sediment samples collected from Bellingham Bay.

PCDD/F congener	Sediment Target EQL (ng/Kg dry weight)	Field Blank (Water) Target EQL (pg/L)
PCDD		
2,3,7,8-TCDD	1.0	10
1,2,3,7,8-PeCDD	1.0	50
1,2,3,4,7,8-HxCDD	2.5	50
1,2,3,6,7,8-HxCDD	2.5	50
1,2,3,7,8,9-HxCDD	2.5	50
1,2,3,4,6,7,8-HpCDD	2.5	50
1,2,3,4,6,7,8,9-OCDD	5.0	100
PCDF		
2,3,7,8-TCDF	1.0	10
1,2,3,7,8-PeCDF	2.5	50
2,3,4,7,8-PeCDF	1.0	50
1,2,3,4,7,8-HxCDF	2.5	50
1,2,3,6,7,8-HxCDF	2.5	50
1,2,3,7,8,9-HxCDF	2.5	50
2,3,4,6,7,8-HxCDF	2.5	50
1,2,3,4,6,7,8-HpCDF	2.5	50
1,2,3,4,7,8,9-HpCDF	2.5	50
1,2,3,4,6,7,8,9-OCDF	5.0	100

Table 17. Measurement quality objectives for field and laboratory quality control samples (per batch ≤ 20 samples).

Parameter	Initial Calibration (r)	Continuing calibration (% recovery)	EQL	Field blanks		Laboratory blanks/batch		Lab duplicates &/or matrix spikes/batch (% RPD)		LCS or SRM (% recovery)	
			MQO	No.	MQO	No.	MQO	No.	MQO	No.	MQO[3]
Dioxins/furans Individual congeners (ng/kg dry weight)	See Method (EPA, 1994)	See Method (EPA, 1994)	Varies 1.0-5.0	--	--	1	<0.5RL	1	< 50	1	Specified by method or within 2 standard deviations of actual

Table 18. Proposed schedule for completing the 2010 Urban Waters Initiative field and laboratory work, data entry into EIM, and reports.

Field and laboratory work		
Field work completed		June 2010
Laboratory analyses completed		TOC – July 2010 Grain size – September 2010 Chemistry – September 2010
Environmental Information System (EIM) system		
Product	Due date	Lead Staff
EIM data loaded	March 2011	Tom Gries
EIM QA	April 2011	David Osterberg
EIM complete	May 2011	Tom Gries
Final report: 2010 Urban Waters Initiative: Bellingham Bay		
Author lead		Tom Gries
Schedule		
Draft due to supervisor		November 2010
Draft due to client/peer reviewer		December 2010
Draft due to external reviewer		January 2010
Final (all reviews done) due to publications coordinator (Joan)		March 2010
Final report due on web		April 2010

Future Sediment Monitoring

Future monitoring locations and sampling dates for the PSAMP and UWI programs listed above are indicated in the schedule in Table 19.

For further information or comments, contact Maggie Dutch at 360-407-6021 or margaret.dutch@ecy.wa.gov.

Table 19. PSAMP spatial/temporal, PSAMP long term/temporal, focus, and Urban Waters Initiative sediment sampling schedule (1997-2025).

	Number of Samples Collected												Minimum number of samples required, by year																
year sampled:	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Spatial/Temporal Monitoring																													
San Juan Archipelago						**90 (81 new +9 old)**											**30**										**30**		
Eastern Strait of Juan de Fuca																		**30**										**30**	
Admiralty Inlet																			**30**										**30**
Strait of Georgia and Bellingham	**100**									**40**										**30**									
Whidbey Basin											**40**										**30**								
Central Sound (north)		**100**										**30**										**30**							
Central Sound (south)													**30**										**30**						
South Sound			**100**												**30**										**30**				
Hood Canal																**30**										**30**			
Focus Study								**30**						**30**										**30**					
Long Term/Temporal Monitoring*				**30+**	**30**	**30**	**30**	**30**	**30+**	**30**	**30**	**30**	**30**	**30+**	**30**	**30**	**30**	**30**	**30+**	**30**	**30**	**30**	**30**	**30+**	**30**	**30**	**30**	**30**	**30+**
Urban Waters Initiative																													
Elliott Bay/Lower Duwamish											**30**						**30**						**30**						**30**
Commencement Bay												**30**						**30**						**30**					
Bainbridge Basin, including Sinclair and Dyes Inlets													**30**						**30**						**30**				
Bellingham Bay														**30**						**30**						**30**			
Budd Inlet															**30**						**30**						**30**		
Everett Harbor/Port Gardner																**30**						**30**						**30**	

Reporting Level and Frequency																													
Spatial/Temporal - Regional	x	x	x				x			x	x		x		x	x	x	x	x	x	x		x		x	x	x	x	x
Spatial/Temporal - Whole sound/strata			x				x												x										x
Focus Study								x						x										x					
Long Term/Temporal Monitoring				x					x					x					x					x					x
Urban Waters Initiative											x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

*** 30 = Grain Size/Total Organic Carbon/Benthos collected; 30+ = Grain Size/Total Organic Carbon/Benthos/Chemistry collected**

Appendices

A. Field Navigation Report, including final sampling coordinates, for 10 April 2010 PSAMP long-term temporal monitoring stations in Puget Sound. These 10 stations were additionally sampled for concentrations of personal care products and pharmaceuticals (PPCPs) and perfluorinated chemicals (PFCs).

B. Field Navigation Report, including final sampling coordinates, for 30 June 2010 Urban Waters Initiative monitoring stations in Bellingham Bay. Nine of these stations (highlighted in orange) were also samples for concentrations of dioxins and furans (FY11 EAP Project No. 3733).

C. Field Navigation Report, including final sampling coordinates, for 30 April 2010 Urban Waters Initiative (UWI) monitoring stations in Bellingham Bay sampled for concentrations of personal care products and pharmaceuticals (PPCPs) and perfluorinated chemicals (PFCs).

D. Field Navigation Report, including final sampling coordinates, for 12 additional stations chosen for June 2010 – dioxin and furan concentrations in Bellingham Bay (FY11 EAP Project No. 3733).

Appendix A. Field Navigation Report, including final sampling coordinates, for 10 April 2010 PSAMP long-term temporal monitoring stations in Puget Sound. These 10 stations were additionally sampled for concentrations of personal care products and pharmaceuticals (PPCPs) and perfluorinated chemicals (PFCs).

APRIL, 2010					B = Benthos	MSMP / PSAMP: Temporal Component										ORDERED BY DATE & TIME
WDOE / EILS					C = Chemistry											
						Station Target NAD 1983		DGPS Location Trimble NT300D (2-m. accuracy)		Dist. to		Meter Wheel	Predicted Tide (m.):	Predicted Mudline	GPS Status	
Station No.	Sta. Rep.	Sta. No.		Grab No.	Date	Decimal Minutes Latitude	Longitude	NAD 1983, Decimal Minutes Latitude	Longitude	Target m.	GPS Time	Depth m.	Nearest Station	Depth, m. (MLLW)	HDOP <2 good	Comments
Station 49	1	49-1	C, B	1	14-Apr-10	47 04.7980	122 54.8080	47 04.7980	122 54.8080	0.0	0821	8.1	3.1	-5.0	1.0	unwt. grab
Inner Budd	4	49-1	C, B	2		47 04.7980	122 54.8080	47 04.7978	122 54.8077	0.0	0838	8.2	2.9	-5.4	1.0	
Inlet	2	49-2	C, B	3		47 04.7943	122 54.8173	47 04.7936	122 54.8167	1.0	0915	7.5	2.3	-5.2	0.9	
	3	49-3	C, B	4		47 04.8017	122 54.8173	47 04.8020	122 54.8170	1.0	0938	7.0	1.9	-5.1	0.9	
	5	49-1	DNA	5		47 04.7980	122 54.8080	47 04.7990	122 54.8067	3.0	1001	6.8	1.5	-5.3	1.0	
Station 44	1	44-1	C, B	1	14-Apr-10	47 09.6800	122 40.4150	47 09.6801	122 40.4144	1.0	1213	21.0	0.0	-21.0	1.7	
East Ander-	4	44-1	C, B	2		47 09.6800	122 40.4150	47 09.6807	122 40.4157	2.0	1222	21.0	0.0	-21.0	1.7	weighted
son Island	3	44-3	C, B	3		47 09.7106	122 40.4410	47 09.7105	122 40.4404	1.0	1253	16.8	0.1	-16.8	1.6	grab
	2	44-2	C	4		47 09.6189	122 40.3631	47 09.6189	122 40.3638	1.0	1308	31.7	0.1	-31.6	1.4	
	2	44-2	B	5		47 09.6189	122 40.3631	47 09.6187	122 40.3632	0.0	1319	32.0	0.2	-31.8	1.4	
	5	44-1	DNA	6		47 09.6800	122 40.4150	47 09.6794	122 40.4151	1.0	1327	20.9	0.3	-20.6	1.9	
Station 40	1	40-1	C, B	1	14-Apr-10	47 15.6780	122 26.2380	47 15.6778	122 26.2376	1.0	1632	12.9	2.8	-10.1	1.3	
Entrance to	4	40-1	C, B	2		47 15.6780	122 26.2380	47 15.6780	122 26.2382	0.0	1642	12.9	2.9	-10.0	1.3	weighted
Thea Foss	2	40-2	C, B	3		47 15.6746	122 26.2466	47 15.6747	122 26.2448	2.0	1706	13.0	3.1	-10.0	1.8	grab
Waterway	3	40-3	C, B	4		47 15.6814	122 26.2294	47 15.6807	122 26.2291	1.0	1733	13.6	3.2	-10.4	1.0	
	5	40-1	DNA	5		47 15.6780	122 26.2380	47 15.6784	122 26.2376	1.0	1806	13.6	3.3	-10.3	1.3	
Station 38	1	38-1	C, B	1	15-Apr-10	47 25.7000	122 23.6180	47 25.7006	122 23.6187	1.0	0821	202	2.2	-200	1.0	
Pt. Pully	4	38-1	C, B	2		47 25.7000	122 23.6180	47 25.7003	122 23.6187	1.0	0838	202	2.0	-200	1.1	weighted
(3-Tree Pt.)	2	38-2	C, B	3		47 25.6866	122 23.6522	47 25.6863	122 23.6513	1.0	0906	202	1.6	-200	1.8	grab
	3	38-3	C, B	4		47 25.6733	122 23.6180	47 25.6726	122 23.6182	1.0	0927	201	1.3	-200	1.5	
	5	38-1	DNA	5		47 25.7000	122 23.6180	47 25.7005	122 23.6195	2.0	0949	201	1.0	-200	1.3	
Station 34	1	34-1	C, B	1	15-Apr-10	47 32.8250	122 39.7250	47 32.8249	122 39.7231	2.0	1229	9.1	-0.3	-9.4	1.7	
Sinclair Inlet	4	34-1	C, B	2		47 32.8250	122 39.7250	47 32.8250	122 39.7248	0.0	1241	9.0	-0.2	-9.2	2.6	unwt. grab
	2	34-2	C, B	3		47 32.8212	122 39.7348	47 32.8214	122 39.7329	2.0	1255	9.2	-0.2	-9.4	3.4	
	3	34-3	C, B	4		47 32.8288	122 39.7152	47 32.8288	122 39.7151	0.0	1328	9.3	-0.1	-9.4	2.0	
	5	34-1	DNA	5		47 32.8250	122 39.7250	47 32.8248	122 39.7234	2.0	1352	9.8	0.1	-9.7	1.8	

Appendix A, continued.

APRIL, 2010					B = Benthos	MSMP / PSAMP: Temporal Component								ORDERED BY DATE & TIME			
WDOE / EILS					C = Chemistry												
						Station Target		DGPS Location		Dist.		Meter	Predicted	Predicted	GPS	
						NAD 1983		Trimble NT300D (2-m. accuracy)		to		Wheel	Tide (m.):	Mudline	Status	
Station	Sta.	Sta.		Grab	Date	Decimal Minutes		NAD 1983, Decimal Minutes		Target	GPS	Depth	Nearest	Depth, m.	HDOP	Comments
No.	Rep.	No.		No.		Latitude	Longitude	Latitude	Longitude	m.	Time	m.	Station	(MLLW)	<2 good	
Station 29	1	29-1	C, B	1	15-Apr-10	47 42.0450	122 27.2420	47 42.0447	122 27.2438	2.0	1623	203	2.2	-201	1.0	
Shilshole	4	29-1	C, B	2		47 42.0450	122 27.2420	47 42.0449	122 27.2405	2.0	1638	203	2.4	-201	1.3	weighted
	2	29-2	C, B	3		47 42.0322	122 27.2091	47 42.0315	122 27.2099	2.0	1708	203	2.7	-200	1.8	grab
	3	29-3	C, B	4		47 42.0578	122 27.2749	47 42.0570	122 27.2762	2.0	1729	203	2.9	-200	1.0	
	5	29-1	DNA	5		47 42.0450	122 27.2420	47 42.0451	122 27.2416	1.0	1804	204	3.1	-201	1.3	
Station 21	1	21-1	C, B	1	20-Apr-10	47 59.1280	122 14.5700	47 59.1280	122 14.5696	1.0	0854	23.7	2.8	-20.9	0.9	
Everett	4	21-1	C, B	2		47 59.1280	122 14.5700	47 59.1280	122 14.5706	1.0	0906	23.9	2.8	-21.1	0.9	weighted
	4	21-1	C	3		47 59.1280	122 14.5700	47 59.1282	122 14.5696	1.0	0921	23.3	2.8	-20.5	0.9	grab
	2	21-2	C, B	4		47 59.1237	122 14.5585	47 59.1238	122 14.5594	1.0	1000	23.5	2.6	-20.9	1.0	
	3	21-3	C, B	5		47 59.1237	122 14.5812	47 59.1234	122 14.5806	1.0	1022	28.0	2.5	-25.5	0.9	
	5	21-1	DNA	6		47 59.1280	122 14.5700	47 59.1284	122 14.5709	1.0	1039	23.2	2.4	-20.8	0.8	
Sta. 13R	1	13R-1	C, B	1	20-Apr-10	47 50.2550	122 37.7370	47 50.2550	122 37.7369	0.0	1408	21.0	0.3	-20.7	1.5	
North Hood	4	13R-1	C, B	2		47 50.2550	122 37.7370	47 50.2552	122 37.7368	0.0	1418	21.2	0.2	-21.0	1.1	weighted
Canal	2	13R-2	C, B	3		47 50.2593	122 37.7482	47 50.2595	122 37.7486	1.0	1442	22.4	0.0	-22.4	1.1	grab
	3	13R-3	C, B	4		47 50.2507	122 37.7482	47 50.2508	122 37.7488	1.0	1514	21.4	-0.2	-21.6	1.6	1 reject
	5	13R-1	DNA	5		47 50.2550	122 37.7370	47 50.2553	122 37.7376	1.0	1526	21.1	-0.2	-21.3	1.5	
Station 4	1	04-1	C, B	1	22-Apr-10	48 41.0380	122 32.2920	48 41.0374	122 32.2921	1.0	0925	25.9	1.8	-24.1	1.0	unwt. grab
Bellingham	4	04-1	C, B	2		48 41.0380	122 32.2920	48 41.0380	122 32.2920	0.0	0938	25.9	1.9	-24.1	1.0	
	2	04-2	C, B	3		48 41.0425	122 32.3037	48 41.0425	122 32.3034	0.0	1012	25.8	1.9	-23.9	0.9	
	3	04-3	C, B	4		48 41.0469	122 32.2920	48 41.0475	122 32.2914	1.0	1039	26.0	1.9	-24.1	0.7	
	5	04-1	DNA	5		48 41.0380	122 32.2920	48 41.0379	122 32.2917	0.0	1105	25.8	1.9	-23.9	0.8	
Station 3	1	03-1	C, B	1	25-Apr-10	48 52.2150	122 58.7050	48 52.2175	122 58.7010	7.0	1515	224	2.0	-222.0	1.4	weighted
Straits of	4	03-1	C, B	2		48 52.2150	122 58.7050	48 52.2178	122 58.7096	7.0	1549	224	2.1	-221.9	1.4	grab
Georgia	3	03-2	C, B	3		48 52.1797	122 58.7050	48 52.2206	122 58.7110	13.0	1629	224	2.1	-221.9	1.1	
	2	03-3	C, B	4		48 52.1974	122 58.7515	48 52.1947	122 58.7628	14.0	1711	224	2.0	-222.0	1.3	High
	5	03-1	DNA	5		48 52.2150	122 58.7050	48 52.2000	122 58.7670	NA	1743	225	1.9	-223.1	1.3	current

B. Field Navigation Report, including final sampling coordinates, for 30 June 2010 Urban Waters Initiative Monitoring stations in Bellingham Bay. Nine of these stations (highlighted in orange) were also samples for concentrations of dioxins and furans (FY11 EAP Project No. 3733).

Bellingham Bay Urban Waters Initiative — **ORDERED BY DATE & TIME**

2010

WDOE / EAP

Sampled in 1997

Sampled in 2006

Sampled in 2010 for dioxins and furans

Surface Sediments sampled with double Van Veen

Station No.	Date	Station Target NAD 1983 Decimal Minutes Latitude	Station Target NAD 1983 Decimal Minutes Longitude	DGPS Location Trimble NT300D (1-m. accuracy) NAD 1983, Decimal Minutes Latitude	DGPS Location Trimble NT300D (1-m. accuracy) NAD 1983, Decimal Minutes Longitude	GPS Time	Dist. to Target m.	Meter Wheel Depth m.	Predicted Tide (m.): Nearest Station	Predicted Mudline Depth, m. (MLLW)	Depth from prev. study (MLLW)	GPS Status HDOP <2 good	Comments
020	8-Jun-10	48 44.2670	122 36.4330	48 44.2668	122 36.4312	0921	2.2	8.3	0.06	-8.2	-7.9	1.4	
				48 44.2670	122 36.4331	0933	0.1	8.0	0.07	-7.9		1.4	
				48 44.2668	122 36.4314	0943	2.0	8.2	0.08	-8.1		1.8	
				48 44.2672	122 36.4331	0951	0.4	8.5	0.10	-8.4		1.5	
021	8-Jun-10	48 44.5830	122 36.5330	48 44.5832	122 36.5323	1015	0.9	6.3	0.16	-6.1	-6.2	1.8	
				48 44.5826	122 36.5323	1023	1.1	6.4	0.19	-6.2		1.8	
				48 44.5830	122 36.5334	1044	0.5	6.3	0.27	-6.0		1.6	
				48 44.5823	122 36.5317	1116	2.1	6.7	0.43	-6.3		1.0	
299	8-Jun-10	48 44.3049	122 35.4809	48 44.3049	122 35.4809	1140	0.0	13.4	0.56	-12.8	-11.9	1.3	
				48 44.3048	122 35.4810	1155	0.2	13.0	0.65	-12.4		1.4	
				48 44.3038	122 35.4803	1205	2.2	13.2	0.72	-12.5		1.2	
227	8-Jun-10	48 43.5441	122 35.4737	48 43.5443	122 35.4721	1342	2.0	24.3	1.38	-22.9	-22.6	1.0	
				48 43.5449	122 35.4730	1355	1.7	24.3	1.48	-22.8		1.0	
				48 43.5447	122 35.4736	1406	1.1	24.3	1.54	-22.8		1.0	
213	8-Jun-10	48 43.4614	122 33.9692	48 43.4615	122 33.9688	1434	0.5	28.5	1.62	-26.9	-26.8	1.3	
				48 43.4610	122 33.9695	1455	0.8	29.0	1.72	-27.3		1.3	
				48 43.4619	122 33.9680	1506	1.7	29.2	1.77	-27.4		1.3	
034	8-Jun-10	48 42.8830	122 33.9830	48 42.8833	122 33.9822	1534	1.1	31.0	1.87	-29.1	-29.0	1.0	
				48 42.8829	122 33.9829	1547	0.2	31.3	1.91	-29.4		1.0	
				48 42.8826	122 33.9831	1604	0.8	31.3	1.96	-29.3		1.0	
029	9-Jun-10	48 44.3170	122 30.9170	48 44.3170	122 30.9157	0847	1.6	13.4	-0.12	-13.5	-13.7	1.3	
				48 44.3170	122 30.9166	0857	0.5	13.9	-0.15	-14.1		1.6	
				48 44.3167	122 30.9162	0908	1.1	13.8	-0.18	-14.0		1.6	
				48 44.3174	122 30.9168	0920	0.8	13.7	-0.20	-13.9		1.4	dioxin/furan station
030	9-Jun-10	48 44.0000	122 30.6670	48 44.0007	122 30.6665	0944	1.4	14.1	-0.22	-14.3	-14.5	1.5	
				48 44.0001	122 30.6678	0954	1.0	14.4	-0.22	-14.6		1.7	
				48 43.9996	122 30.6659	1011	1.5	14.2	-0.20	-14.4		1.8	dioxin/furan station
031	9-Jun-10	48 43.6170	122 30.9500	48 43.6168	122 30.9497	1100	0.5	17.7	-0.05	-17.8	-17.4	1.0	
				48 43.6176	122 30.9502	1110	1.1	17.9	0.00	-17.9		1.0	dioxin/furan station
				48 43.6171	122 30.9498	1124	0.3	17.8	0.07	-17.7		1.0	
033	9-Jun-10	48 43.0170	122 32.7330	48 43.0161	122 32.7324	1154	1.8	30.5	0.24	-30.3	-30.2	1.5	
				48 43.0167	122 32.7332	1203	0.6	30.5	0.29	-30.2		1.5	
				48 43.0167	122 32.7324	1213	0.9	30.7	0.37	-30.3		1.4	

Appendix B, continued.

085	9-Jun-10	48 44.6483	122 34.0446	48 44.6483	122 34.0446	1358	0.0	17.5	1.15	-16.4	-15.7	1.0	
				48 44.6483	122 34.0440	1408	0.7	17.5	1.23	-16.3		1.2	
				48 44.6478	122 34.0443	1417	1.0	17.6	1.31	-16.3		1.2	
277	9-Jun-10	48 44.1538	122 32.7727	48 44.1538	122 32.7726	1441	0.1	24.3	1.50	-22.8	-21.9	1.3	
				48 44.1538	122 32.7729	1452	0.2	24.3	1.58	-22.7		1.3	
				48 44.1539	122 32.7733	1503	0.8	24.6	1.65	-23.0		1.2	dioxin/furan station
053	10-Jun-10	48 43.3609	122 30.8965	48 43.3607	122 30.8955	0848	1.3	12.4	-0.17	-12.6	-12.0	1.6	ship yard
				48 43.3602	122 30.8966	0859	1.3	12.2	-0.24	-12.4		1.6	
				48 43.3622	122 30.8958	0908	2.6	12.0	-0.30	-12.3		1.6	
				48 43.3613	122 30.8962	0920	0.8	12.1	-0.35	-12.5		1.4	
060	10-Jun-10	48 44.1000	122 29.9500	48 44.1001	122 29.9499	0946	0.2	5.9	-0.44	-6.3	-6.5	1.6	
				48 44.1000	122 29.9503	0958	0.4	5.8	-0.46	-6.3		1.7	
				48 44.0998	122 29.9503	1008	0.5	5.7	-0.47	-6.2		1.8	
061	10-Jun-10	48 44.1830	122 30.2830	48 44.1835	122 30.2828	1141	1.0	10.7	-0.23	-10.9	-10.7	1.4	
				48 44.1832	122 30.2830	1152	0.4	10.8	-0.17	-11.0		1.5	
				48 44.1823	122 30.2816	1207	2.2	10.8	-0.08	-10.9		1.4	
032	10-Jun-10	48 43.5000	122 32.7170	48 43.5000	122 32.7174	1414	0.5	28.6	0.94	-27.7	-27.6	1.1	
				48 43.5004	122 32.7172	1430	0.8	28.7	1.09	-27.6		1.3	
				48 43.4992	122 32.7169	1442	1.5	28.9	1.21	-27.7		1.4	dioxin/furan station
022	10-Jun-10	48 45.5000	122 32.4170	48 45.5002	122 32.4174	1527	0.6	3.3	1.62	-1.7	-5.4	1.0	-7.2 m. on chart
				48 45.5002	122 32.4174	1541	0.6	3.3	1.72	-1.6		1.0	
				48 45.5003	122 32.4170	1549	0.6	3.2	1.79	-1.4		1.0	
				48 45.5002	122 32.4172	1557	0.4	3.4	1.85	-1.6		1.0	
379	11-Jun-10	48 45.0152	122 29.2478	48 45.0152	122 29.2481	0820	0.4	7.8	0.25	-7.6	-7.9	1.7	Whatcom Wtry.
				48 45.0148	122 29.2476	0837	0.8	7.5	0.07	-7.4		1.3	
				48 45.0148	122 29.2478	0946	0.7	7.3	-0.01	-7.3		1.3	
028	11-Jun-10	48 44.9800	122 29.4100	48 44.9799	122 29.4109	0917	1.1	5.2	-0.28	-5.5	-5.6	1.4	Moved, '97 sample
				48 44.9801	122 29.4102	0928	0.3	5.2	-0.36	-5.6		1.8	dioxin/furan station
				48 44.9804	122 29.4099	0937	0.8	5.8	-0.42	-6.2		1.5	
				48 44.9802	122 29.4087	0951	1.6	5.8	-0.50	-6.3		1.7	
059	11-Jun-10	48 44.2830	122 29.9670	48 44.2830	122 29.9677	1158	0.9	7.5	-0.53	-8.0	-8.2	1.4	
				48 44.2830	122 29.9673	1212	0.4	7.6	-0.45	-8.1		1.0	
				48 44.2834	122 29.9677	1222	1.1	7.7	-0.39	-8.1		1.0	
				48 44.2836	122 29.9674	1231	1.2	7.7	-0.33	-8.0		1.0	
163	11-Jun-10	48 44.4512	122 30.3037	48 44.4509	122 30.3040	1433	0.7	10.0	0.70	-9.3	-9.2	1.3	
				48 44.4506	122 30.3037	1447	1.1	10.0	0.85	-9.2		1.3	
				48 44.4513	122 30.3031	1501	0.8	10.5	0.99	-9.5		1.2	

Appendix B, continued.

035	11-Jun-10	48 45.2021	122 32.1773	48 45.2024	122 32.1765	1541	1.1	11.9	1.39	-10.5	-10.6	1.0	
				48 45.2029	122 32.1783	1551	1.9	11.8	1.50	-10.3		1.0	
				48 45.2020	122 32.1785	1603	1.5	12.0	1.63	-10.4		1.0	dioxin/furan station
195	14-Jun-10	48 45.3127	122 30.3086	48 45.3131	122 30.3138	1011	6.4	4.2	0.35	-3.9	-4.1	1.8	Boat on sta.
				48 45.3119	122 30.3135	1025	6.2	4.1	0.19	-3.9		1.6	
				48 45.3128	122 30.3144	1039	7.1	4.0	0.03	-4.0		1.0	
023	14-Jun-10	48 45.0830	122 30.7670	48 45.0829	122 30.7673	1135	0.4	6.0	-0.50	-6.5	-6.9	1.6	
				48 45.0831	122 30.7669	1150	0.2	6.0	-0.61	-6.6		1.4	
				48 45.0825	122 30.7669	1203	0.9	5.9	-0.69	-6.6		1.0	dioxin/furan station
				48 45.0825	122 30.7664	1221	1.2	5.9	-0.78	-6.7		1.0	
024	14-Jun-10	48 45.1670	122 30.6500	48 45.1668	122 30.6489	1356	1.4	4.9	-0.75	-5.7	-5.8	1.3	
				48 45.1670	122 30.6497	1410	0.4	4.9	-0.68	-5.6		1.3	
				48 45.1663	122 30.6489	1420	1.9	4.8	-0.62	-5.4		1.0	
				48 45.1664	122 30.6512	1442	1.8	4.9	-0.50	-5.4		1.0	
				48 45.1679	122 30.6511	1459	2.1	5.0	-0.31	-5.3		1.2	
025	15-Jun-10	48 45.2500	122 30.8000	48 45.2498	122 30.7998	0829	0.4	6.6	1.86	-4.7	-4.9	1.3	
				48 45.2491	122 30.7991	0842	2.0	6.4	1.76	-4.6		1.6	
				48 45.2504	122 30.8000	0854	0.7	6.6	1.68	-4.9		1.4	
42113	15-Jun-10	48 45.1872	122 30.9762	48 45.1870	122 30.9755	0920	0.9	8.0	1.50	-6.5		1.5	New station
				48 45.1868	122 30.9748	0933	1.9	8.0	1.31	-6.7		1.6	
				48 45.1867	122 30.9760	0947	1.0	8.0	1.21	-6.8		1.8	
				48 45.1870	122 30.9757	1002	0.7	7.8	1.10	-6.7		1.7	
026	15-Jun-10	48 44.8830	122 30.2330	48 44.8833	122 30.2324	1049	0.9	6.1	0.56	-5.5	-6.0	1.0	
				48 44.8828	122 30.2339	1100	1.2	6.2	0.45	-5.8		1.0	
				48 44.8839	122 30.2333	1114	1.7	6.0	0.24	-5.8		1.3	
				48 44.8836	122 30.2323	1125	1.4	6.0	0.14	-5.9		1.4	
027	15-Jun-10	48 44.8330	122 30.0830	48 44.8330	122 30.0835	1316	0.6	5.1	-0.67	-5.8	-5.8	1.0	
				48 44.8335	122 30.0824	1328	1.2	5.0	-0.70	-5.7		1.0	
				48 44.8331	122 30.0828	1340	0.3	5.0	-0.72	-5.7		1.0	
				48 44.8326	122 30.0823	1358	1.1	5.0	-0.74	-5.7		1.0	dioxin/furan station
507	15-Jun-10	48 45.0194	122 30.2245	48 45.0191	122 30.2242	1454	0.7	4.7	-0.57	-5.3	-4.8	1.1	
				48 45.0190	122 30.2244	1506	0.8	4.8	-0.52	-5.3		1.0	
				48 45.0190	122 30.2248	1521	0.8	4.8	-0.45	-5.3		1.0	

Appendix C. Field Navigation Report, including final sampling coordinates, for 30 April 2010 Urban Waters Initiative (UWI) monitoring stations in Bellingham Bay sampled for concentrations of personal care products and pharmaceuticals (PPCPs) and perfluorinated chemicals (PFCs).

2010			MSMP / PSAMP: Bellingham Bay Urban Waters										ORDERED BY DATE & TIME		
WDOE / EAP												Surface Sediments sampled with unweighted double Van Veen			
		Station Target		DGPS Location			Dist.	Meter	Predicted	Predicted	Depth	GPS		
		NAD 1983		Trimble NT300D (1-m. accuracy)			to	Wheel	Tide (m.):	Mudline	from	Status		
Station	Date	Decimal Minutes		NAD 1983, Decimal Minutes		GPS	Target	Depth	Nearest	Depth, m.	prev.	HDOP	penetration	Comments
No.		Latitude	Longitude	Latitude	Longitude	Time	m.	m.	Station	(MLLW)	study	<2 good	cm.	
020	22-Apr-10	48 44.2670	122 36.4330	48 44.2673	122 36.4334	1252	0.7	9.0	1.8	-7.3	-7.9	1.8	4.5	
021	22-Apr-10	48 44.5830	122 36.5330	48 44.5833	122 36.5340	1319	1.3	7.3	1.6	-5.7	-6.2	1.8	5	
227	22-Apr-10	48 43.5441	122 35.4737	48 43.5441	122 35.4735	1349	0.2	24.0	1.5	-22.5	-22.6	1.8	17	
299	22-Apr-10	48 44.3049	122 35.4809	48 44.3050	122 35.4805	1424	0.5	13.2	1.3	-12.0	-11.9	1.1	14	
085	22-Apr-10	48 44.6483	122 34.0446	48 44.6484	122 34.0446	1454	0.2	16.5	1.0	-15.5	-15.7	1.4	17	
213	22-Apr-10	48 43.4614	122 33.9692	48 43.4617	122 33.9687	1626	0.8	27.6	0.4	-27.2	-26.8	1.3	17	
034	22-Apr-10	48 42.8830	122 33.9830	48 42.8832	122 33.9835	1647	0.7	29.2	0.3	-28.9	-29.0	1.2	17	
033	22-Apr-10	48 43.0170	122 32.7330	48 43.0169	122 32.7336	1708	0.8	29.8	0.2	-29.6	-30.2	0.9	17	
032	22-Apr-10	48 43.5000	122 32.7170	48 43.5002	122 32.7172	1734	0.4	27.5	0.2	-27.4	-27.6	1.1	17	
277	22-Apr-10	48 44.1538	122 32.7727	48 44.1534	122 32.7725	1757	0.8	22.2	0.1	-22.1	-21.9	1.1	17	
022	23-Apr-10	48 45.5000	122 32.4170	48 45.5008	122 32.4173	0932	1.5	2.6	1.4	-1.2	-5.4	1.0	4.5	-7.2 m. on chart
035	23-Apr-10	48 45.2021	122 32.1773	48 45.2019	122 32.1776	1000	0.5	11.8	1.4	-10.4	-10.6	0.9	8	
42113	23-Apr-10	48 45.1872	122 30.9762	48 45.1876	122 30.9761	1033	0.8	7.8	1.5	-6.3		0.7	7	New station
025	23-Apr-10	48 45.2500	122 30.8000	48 45.2503	122 30.7985	1052	1.9	6.0	1.6	-4.4	-4.9	0.9	7	
024	23-Apr-10	48 45.1670	122 30.6500	48 45.1662	122 30.6502	1308	1.5	6.9	1.8	-5.1	-5.8	2.3	9	
023	23-Apr-10	48 45.0830	122 30.7670	48 45.0826	122 30.7674	1328	0.9	8.3	1.8	-6.5	-6.9	1.8	8.5	
507	23-Apr-10	48 45.0194	122 30.2245	48 45.0193	122 30.2239	1347	0.8	6.8	1.7	-5.1	-4.8	1.6	9	
026	23-Apr-10	48 44.8830	122 30.2330	48 44.8829	122 30.2328	1412	0.3	7.2	1.7	-5.5	-6.0	0.9	7	
027	23-Apr-10	48 44.8330	122 30.0830	48 44.8329	122 30.0822	1437	1.0	7.1	1.6	-5.5	-5.8	1.0	8	
030	23-Apr-10	48 44.0000	122 30.6670	48 44.0002	122 30.6668	1531	0.4	15.0	1.3	-13.7	-14.5	1.0	12	
031	23-Apr-10	48 43.6170	122 30.9500	48 43.6172	122 30.9497	1548	0.5	18.8	1.3	-17.6	-17.4	1.0	17	
029	23-Apr-10	48 44.3170	122 30.9170	48 44.3164	122 30.9171	1613	1.1	14.2	1.1	-13.1	-13.7	1.4	10	
061	23-Apr-10	48 44.1830	122 30.2830	48 44.1831	122 30.2825	1632	0.6	11.2	1.0	-10.2	-10.7	1.0	10	
059	23-Apr-10	48 44.2830	122 29.9670	48 44.2828	122 29.9665	1649	0.7	8.5	0.9	-7.6	-8.2	1.0	13	
053	26-Apr-10	48 43.3609	122 30.8965	48 43.3605	122 30.8966	0846	0.8	12.6	0.4	-12.2	-12.0	1.1	17	ship yard
060	26-Apr-10	48 44.1000	122 29.9500	48 44.0998	122 29.9497	0907	0.5	6.8	0.3	-6.5	-6.5	1.1	17	
163	26-Apr-10	48 44.4512	122 30.3037	48 44.4515	122 30.3038	0923	0.6	9.7	0.3	-9.5	-9.2	1.1	9	
028	26-Apr-10	48 44.9800	122 29.4100	48 44.9805	122 29.4101	0940	0.9	6.5	0.2	-6.3	-5.6	1.1	15	Moved, '97 sample
379	26-Apr-10	48 45.0152	122 29.2478	48 45.0153	122 29.2479	1000	0.2	7.7	0.1	-7.6	-7.9	1.1	17	Whatcom Wtry.
195	26-Apr-10	48 45.3127	122 30.3086	48 45.3127	122 30.3090	1018	0.5	3.8	0.1	-3.7	-4.1	1.0	8	In the marina

Sampled in 1997
Sampled in 2006

D. Field Navigation Report, including final sampling coordinates, for 12 additional stations chosen for June 2010 – dioxin and furan concentrations in Bellingham Bay (FY11 EAP Project No. 3733).

2010 — **Ordered by Station Number**

WDOE / EAP

Surface Sediments sampled with double Van Veen

Station No.	Date	Station Target NAD 1983 Decimal Minutes Latitude	Station Target NAD 1983 Decimal Minutes Longitude	DGPS Location Trimble NT300D (1-m. accuracy) NAD 1983, Decimal Minutes Latitude	DGPS Location Trimble NT300D (1-m. accuracy) NAD 1983, Decimal Minutes Longitude	GPS Time	Dist. to Target m.	Meter Wheel Depth m.	Predicted Tide (m.): Nearest Station	Predicted Mudline Depth, m. (MLLW)	GPS Status HDOP <2 good	Comments
BBDIOX 01	11-Jun-10	48 45.8292	122 31.0710	48 45.8138	122 31.0836	1703	32.5	2.4	2.14	-0.3	1.0	all sand, reject
BBDIOX 01	11-Jun-10	48 45.8292	122 31.0710	48 45.7603	122 31.1356	1717	151.0	2.7	2.24	-0.5	1.0	all sand, reject
BBDIOX 01A	15-Jun-10	48 43.9027	122 31.8131	48 43.9032	122 31.8125	1552	1.2	21.8	-0.22	-22.0	1.3	
BBDIOX 02	10-Jun-10	48 45.4842	122 31.3866	48 45.4839	122 31.3859	1630	1.0	5.2	2.08	-3.1	1.0	
BBDIOX 03	11-Jun-10	48 45.7296	122 32.0160	48 45.7294	122 32.0143	1648	2.1	2.5	2.02	-0.5	1.0	all sand, reject
BBDIOX 03A	15-Jun-10	48 45.1608	122 33.2692	48 45.1615	122 33.2689	1627	1.3	11.1	0.13	-11.0	1.2	
BBDIOX 04	11-Jun-10	48 44.8182	122 32.5512	48 44.8186	122 32.5514	1120	0.8	14.8	-0.66	-15.5	1.3	
BBDIOX 05	15-Jun-10	48 44.7732	122 31.4172	48 44.7733	122 31.4169	1156	0.4	12.0	-0.15	-12.2	1.0	
BBDIOX 06	11-Jun-10	48 44.3802	122 31.9632	48 44.3804	122 31.9623	1057	1.2	17.8	-0.69	-18.5	1.0	
BBDIOX 07	14-Jun-10	48 45.7366	122 30.5640	48 45.7373	122 30.5645	1554	1.4	8.6	0.19	-8.4	0.9	
BBDIOX 08	10-Jun-10	48 44.4162	122 29.8344	48 44.4161	122 29.8344	1057	0.2	7.3	-0.42	-7.7	0.9	
BBDIOX 09	10-Jun-10	48 43.5624	122 31.8540	48 43.5624	122 31.8543	1342	0.4	26.4	0.67	-25.7	1.0	
BBDIOX 10	9-Jun-10	48 42.3852	122 31.8180	48 42.3851	122 31.8171	1538	1.1	32.0	1.96	-30.0	1.0	
BBDIOX 11	9-Jun-10	48 43.0896	122 31.8408	48 43.0895	122 31.8408	1555	0.2	32.0	1.97	-30.0	1.0	
BBDIOX 12	15-Jun-10	48 45.5640	122 30.6230	48 45.5643	122 30.6234	1651	0.7	9.2	0.32	-8.9	1.1	extra sample-Squalicum WW