Mussel Watch Sampling for Sinclair and Dyes Inlets Sampling Plan for Winter 2018

1. Overview of Bivalve Sampling in Sinclair and Dyes Inlets

A network of monitoring stations has been established near the Puget Sound Naval Shipyard & Intermediate Maintenance Facility and Naval Base Kitsap-Bremerton (Shipyard) and at representative locations within Sinclair and Dyes Inlets, Port Orchard and Rich Passages (including Liberty Bay) to characterize environmental conditions within the Inlets (Johnston et al. 2010, 2011, 2017). Water, sediment, and biota monitoring locations will be selected that are co- located near suspected sources (industrial, waste water, and stormwater outfalls, marinas, stream mouths, and other sources) and stations that are representative of ambient conditions for periodic sampling. Water stations will be sampled seasonally, mussel watch sampling will be conducted at two-year intervals, and sediment monitoring will be conducted every three to five years to establish trends associated with environmental quality within the Inlets. The sampling will be coordinated with local stakeholders and with ongoing local and regional sampling being conducted within Sinclair/Dyes Inlet and Puget Sound ecosystem.

Key questions to be addressed by the monitoring program include:

- 1. Are beneficial uses of Sinclair Inlet being protected?
- 2. Are discharges from all sources of contamination into Sinclair and Dyes Inlets impacting the quality of water, sediment, and biota in the Inlets?
- 3. What is the status and trend of water, stormwater, sediment, and biota residue quality in Sinclair and Dyes Inlets?

2. Design for Bivalve Sampling

Bivalve samples will be collected from a small boat and/or from along the shoreline using procedures recommended by the NOAA Mussel Watch Program (NOAA 2008, SCMRC 2009b, Lanksbury et al. 2011). Samples of bivalves at selected stations will be collected semiannually during even years at stations where ambient marine water samples are collected. The sampling will be initiated on or following Dec 1, 2017 and will continue until all sampling objectives are met. The analysis and data report will most likely be completed by December 2018. Data will be collected from water, biota, and sediments collected from the Inlets. Any deviations from this plan will be documented in writing and appended to the sampling plan. A scientific collection permit (SCP) issued by the Washington Department of Fish and Wildlife will be obtained to support this effort. Results from previous monitoring were summarized in Johnston et al. (2011, 2014, 2015, and 2017a,b).

At the mussel watch stations (Table 1) indigenous bivalves will be collected for chemical residue analysis using procedures recommended by the NOAA Mussel Watch Program (NOAA 2008, Johnson 2009, Lanksbury et al. 2011). The target species for collection are blue mussels, Mytilus spp. (*Mytilus trossulus, M. californianus*, or *M. galloprovincialis*). If mussels are not available, because suitable substrate is not present, other alternative species

include Manila clams (*Venerupis philippinarum*), hard clams (*Mercenaria mercenaria*), horse clam (*Tresus nuttallii* or *T. capax*), butter clams (*Saxidomus giganteus*), softshell clam (*Mya arenaria*), Macoma clams (*Macoma nasuta* or *Macoma brota*), oysters (*Crassostrea gigas*, *Ostrea conchaphila* > 2.5 inches), or Frilled dogwinkle, (*Nucella lamellosa*). So far adequate numbers of mussels (*Mytilus* spp.) have been found at all the sites sampled.

Briefly, at each sampling location about 30-50 live specimens (> 1.5 inches) will be collected at three replicate locations within a 150 ft radius of the station location. The mussels will collected by cutting their byssus threads, brushing off sediment, barnacles, or other debris, and placing the mussels into labeled Ziploc bags along with water proof labels (station #, bag #, and collectors). Depending on size, about 90-150 specimens will be collected for each station location. The specimens will be kept on ice until they can be transferred to the laboratory for processing. The following information will be recorded on the chain of custody sheet: station id, replicate number, date, time, and GPS coordinates of sampling location. A site description will also be prepared that describes, at a minimum, substrate type, habitat characteristics, presence/absence of creosote pilings, visible sheen of oil, and any other important factors associated with the collection. In the event divers are used to collect specimens, water depth from where the mussels are collected will also be recorded. Table 1 lists the sampling stations and the sampling locations are shown in Figures 1 and 2. The list of analytical parameters is provided in Table 2. The detailed quality assurance project plans (Johnston et al. 2010, 2011, 2017) are available upon request.

The list of sampling sites, locations, and jurisdictions are provided in Table 3. A tentative sampling schedule for Winter 2018 is provide in Attachment 1. Sampling will be conducted pending funding and logistics coordination. A Scientific Collection Permit from the Washington Department of Fish and Wildlife (WDFW) JOHNSTON 17-317 has been obtained to support this work.

References:

- Johnson, Amy, 2008. Mussel Watch Monitoring Protocols. Snohomish County Marine Resources Committee September 2008
- Johnston, RK, GH Rosen, JM Bandenberger, J.M. Wright, E. Mollerstuen, J. Young, and T. Tompkins 2010. Sampling and Analysis Plan for Ambient Monitoring and Toxicity Testing for Sinclair and Dyes Inlets, Puget Sound, Washington. Prepared for Project ENVVEST, Puget Sound Naval Shipyard & Intermediate Maintenance Facility, Bremerton, WA. Revised Sept. 18, 2010.
- Johnston, RK, GH Rosen, JM Bandenberger, LJ Kuo, C. Suslick, E. Mollerstuen, J. Young, C. Gebhart, E. Beckley, and M. Hardiman 2011. Sampling and Analysis Plan for Ambient Monitoring and Toxicity Testing for Sinclair and Dyes Inlets, Puget Sound, Washington. Prepared for Project ENVVEST, Puget Sound Naval Shipyard & Intermediate Maintenance Facility, Bremerton, WA. Revised Nov. 23, 2011.
- Johnston, R.K. Rosen G.H., J.M. Brandenberger, E.W. Mollerstuen, J.M. Young, and B. Beckwith, 2011. Monitoring water, sediment, and biota to assess protection of beneficial uses for Sinclair Inlet. Proceedings of the Salish Sea Ecosystems Conference 2011,

Vancouver, BC, Canada http://www.verney.ca/assets/O2AProceedings_Johnston.pdf

- Johnston, R.K., Jill Brandenberger, Li-Jung Kuo, Carolyn Suslick, Eric Mollerstuen, Eric Beckley, 2014. Mussel Watch monitoring to assess status, tends, and continuous process improvement of environmental protection and restoration initiatives for Sinclair and Dyes Inlets, Liberty Bay, and Port Orchard, Rich and Agate Passages of the Puget Sound, WA. Proceedings of the 2014 Salish Sea Ecosystems Conference, April 30 – May 2, 2014, Seattle, WA. <u>http://www.wwu.edu/salishseaconference/</u> <u>https://event.crowdcompass.com/ssec2014/activity/kmuGu3CxPZ</u>
- Johnston, Robert K., C. Gebhart, M. Aylward, E. Mollerstuen, A. Thurman, E. Beckley, Jill Brandenberger, J. Strivens, L.J. Kuo, Bart Chadwick, V. Kirtay, and G. Rosen, 2015. Results from the West Sound Mussel Watch Monitoring AND Effectiveness Monitoring of an Activated Carbon Sediment Amendment at a Contaminated Site. Presentation for West Sound Local Science Seminar, March 5, 2015, Poulsbo, WA. <u>http://static1.squarespace.com/static/54945a33e4b0edcae6dd64f5/t/54ff6f95e4b0eaf2d71d</u> <u>2cb3/1426026389610/5.+Johnston_WestSoundSciSem.pdf</u>
- Johnston, Robert K. 2017a. ENVVEST Mussel Watch Project: Monitoring Environmental Quality in Local Waters. Presentation for All Ports Meeting, Brownsville, WA, Jan. 23, 2017.
- Johnston, R.K., Gunther Rosen, Marienne Colvin, Jill M Brandenberger, Jonathan E Strivens, Nicholas J Schlafer, Michelle J Aylward and Rory W Lee, 2017b. Assessing Environmental Quality and Protecting Beneficial Uses in Sinclair and Dyes Inlets, Puget Sound, WA. Platform presentation, CERF 2017, Coastal and Estuarine Research Federation, Nov 5-7, 2017, Providence, RI.
- Johnston, RK, GH Rosen, M. Colvin, J. Strivens, N. Schlafer, J. Brandenberger, M. Aylward, and P. Caswell, 2017. Sampling and Analysis Plan for Ambient Monitoring and Toxicity Testing for Sinclair and Dyes Inlets, Puget Sound, Washington: Water Year 2018 Update. Prepared for Project ENVVEST, Puget Sound Naval Shipyard & Intermediate Maintenance Facility, Bremerton, WA. Revised Nov. 29, 2017.
- Lanksbury J., J. West, K. Herrmann, A. Hennings, K. Litle, and A. Johnson, 2011. Washington State 2009/10 Mussel Watch Pilot Project A Collaboration between National, State and Local Partners. Washington State Department of Fish and Wildlife
- NOAA 2007. Monitoring Data Mussel Watch, Center for Coastal Monitoring and Assessment http://www8.nos.noaa.gov/cit/nsandt/download/mw_monitoring.aspx
- (SCMRC) Snohomish County Marin Resources Committee (SCMRC) 2009b. Marine Water Quality Monitoring. <u>http://www1.co.snohomish.wa.us/Departments/Public_Works/Divisions/SWM/Work_Ar</u> <u>eas/Habitat/Marine/MarineWaterQuality.htm</u>

Site:	Site Code:	Latitude:	Longitude:
Manchester Lab Pier	MLPIER	47.5736500	-122.5450900
Sinclair Inlet Waterman Point	SIWP	47.5844700	-122.5704400
Sinclair Inlet Ross Point	SIRP	47.5399200	-122.6619000
PSNS NAVSTA Mid	PS04	47.5544920	-122.6472150
PSNS NAVSTA West	PS03	47.5559300	-122.6513720
PSNS CIA West	PS06	47.5529760	-122.6426140
PSNS CIA Mid West	PS08	47.5580000	-122.6385000
PSNS CIA Mid East	PS09	47.5601000	-122.6363000
PSNS CIA East	PS11	47.5605000	-122.6299000
PSNS Pier 7	PIER7	47.5588680	-122.6288380
Sinclair Inlet Sinclair Marina	SISIM	47.5408000	-122.6420500
Sinclair Inlet Port Orchard Marina	SIPOM	47.5431000	-122.6355000
Port Orchard Passage Illahee State Park	POPISP	47.5996000	-122.5942700
Port Orchard Passage Illahee Port Dock	POPIPD	47.6126550	-122.5953650
Port Washington Narrows Lions Park	PWNLP	47.5841610	-122.6438430
Dyes Inlet Old Town Silverdale	DYOTS	47.6432000	-122.6950000
PSNS Inactive Fleet Callow Ave OF	PS01	47.5536960	-122.6574460
Sinclair Inlet head at Gorst	SIGST	47.5330000	-122.6800600
Dyes Inlet Ostrich Bay Ammo Pier	DYOBAP	47.5864000	-122.6868900
Port Orchard Passage Brownsville	POPBWN	47.6524610	-122.6125100
Keyport Lagoon	KPTLAG	47.6967751	-122.6190390
Keyport NUWC Pier	KPTPIER	47.7049500	-122.6186800
Liberty Bay SEA Discovery Center	LBPMSC	47.7323010	-122.6487550
Agate Pass Kiana Lodge	APKIANA	47.7017600	-122.5812100
Agate Pass BI Hidden Cove Beach	APBIHCB	47.6908440	-122.5662080

Table 1. List of mussel watch stations to be sampled within WRIA15 Area 10:

Compound	Abbreviation	Compound Abbreviation		
· · · · · · · · · · · · · · · · · · ·		Polycyclic Aromatic Hydrocarbons (PAHs ng/g wet		
Metals (ug/g dry weight)		weight)		
Silver	Ag	Naphthalene	NAPH	
Arsenic	As	CH ₃ -Naphthalenes	NAPH-C1	
Cadmium	Cd	2(CH ₃)-Naphthalenes	NAPH-C2	
Chromium	Cr	3(CH ₃)-Naphthalenes	NAPH-C3	
Copper	Cu	4(CH ₃)-Naphthalenes	NAPH-C4	
Mercury	Hg	Biphenyl	BIPHEN	
Nickel	Ni	Acenaphthylene	ACENAPY	
Lead	Pb	Acenaphthene	ACENAPE	
Zinc	Zn	Fluorene	FLUOR	
Polychlorinated Biphenyls (PCBs ng/g	wet weight)	CH ₃ -Fluorenes	FLUOR-C1	
2,4',dichlorobiphenyl	PCB008	2(CH ₃)-Fluorenes	FLUOR-C2	
2,2',5,trichlorobiphenyl	PCB018	3(CH ₃)-Fluorenes	FLUOR-C3	
2,4,4',trichlorobiphenyl	PCB028	Anthracene	ANTH	
2,2',3,5',tetrachlorobiphenyl	PCB044	Phenanthrene	PHEN	
2,2',5,5',tetrachlorobiphenyl	PCB052	CH ₃ -Phenanthrenes/Anthracenes	PHAN-C1	
2,3',4,4',tetrachlorobiphenyl	PCB066	2(CH ₃)-Phenanthrenes/Anthracenes	PHAN-C2	
3,3',4,4',tetrachlorobiphenyl	PCB077	3(CH ₃)-Phenanthrenes/Anthracenes	PHAN-C3	
2,2',4,5,5',pentachlorobiphenyl	PCB101	4(CH ₃)-Phenanthrenes/Anthracenes	PHAN-C4	
2,3,3',4,4',pentachlorobiphenyl	PCB105	Dibenzothiophene	DIBENZO	
2,3,4,4',5,pentachlorobiphenyl	PCB118	CH ₃ -Dibenzothiophenes	DIBENZO-C1	
3,3',4,4',5,pentachlorobiphenyl	PCB126	2(CH ₃)-Dibenzothiophenes	DIBENZO-C2	
2,2',3,3',4,4',hexachlorobiphenyl	PCB128	3(CH ₃)-Dibenzothiophenes	DIBENZO-C3	
2,2',3,4,4',5',hexachlorobiphenyl	PCB138	4(CH ₃)-Dibenzothiophenes	DIBENZO-C4	
2,2',4,4',5,5',hexachlorobiphenyl	PCB153	Fluoranthene	FLRN	
2,2',3,3',4,4',5,heptachlorobiphenyl	PCB170	Pyrene	PYR	
2,2',3,4,4',5,5',heptachlorobiphenyl	PCB180	CH ₃ -Fluoranthenes/Pyrenes FLRNPYR-C		
2,2',3,4',5,5',6,heptachlorobiphenyl	PCB187	2(CH ₃)-Fluoranthenes/Pyrenes	FLRNPYR-C2	
2,2',3,3',4,4',5,6,octachlorobiphenyl	PCB195	3(CH ₃)-Fluoranthenes/Pyrenes	FLRNPYR-C3	
2,2',3,3',4,5,6,6',octachlorobiphenyl	PCB200	Benz(a)anthracene	BAA	
2,2',3,3',4,4',5,5',6,nonachlorobiphenyl	PCB206	Chrysene	CHRY	
decachlorophiphenyl	PCB209	CH ₃ -Chrysenes	CHRY-C1	
Total PCB = Σ PCB congeners * 2	ТРСВ	2(CH ₃)-Chrysenes	CHRY-C2	
Stable Isotopes (mass fraction)		3(CH ₃)-Chrysenes	CHRY-C3	
Carbon (δ13C)	d13C	4(CH ₃)-Chrysenes	CHRY-C4	
Nitrogen (δ15N)	d15N	Benzo(b)fluoranthene	BBFLRN	
Percent Carbon	%C	Benzo(k)fluoranthene	BKFLRN	
Percent Nitrogen	%N	Benzo(e)pyrene	BEP	
Other		Benzo(a)pyrene	BAP	
Percent lipid content	LIPID	Perylene	PERY	
Percent moisture content	MOIS	Indeno(1,2,3-cd)pyrene	IN123PRY	
Shell length (mm)	LEN	Dibenz(a,h)anthracene	DIBAH	
Navigable distance from PS08 (mi)	NavDis	Benzo(g,h,i)perylene	BGHIPERY	
		∑PAH compounds	SUMPAH	

Table 2. Parameters to be measured in the ENVVEST mussel watch samples.

Date*	Site Code	Location	Jurisdiction
	SISIM	Sinclair Inlet Sinclair Marina	Port of Bremerton
	SIPOM	Sinclair Inlet Port Orchard Marina	Port of Bremerton
	SIWP	Sinclair Inlet Waterman Point	Private Landowner
	SIGST	Sinclair Inlet head at Gorst	Navy
	SIRP	Sinclair Inlet Ross Point	WDFW
	PWNLP	Port Washington Narrows Lions Park	City of Bremerton Parks
	POPIPD	Port Orchard Passage Illahee Port Dock	Port of Illahee
	POPISP	Port Orchard Passage Illahee State Park	State Parks
	PS04	PSNS NAVSTA Mid	Navy
	PS03	PSNS NAVSTA West	Navy
	PS06	PSNS CIA West	Navy
	PS08	PSNS CIA Mid West	Navy
	PS09	PSNS CIA Mid East	Navy
	PS11	PSNS CIA East	Navy
	PIER7	PSNS Pier 7	Navy
	PS01	PSNS Inactive Fleet	Navy
	DYOBAP	Dyes Inlet Ostrich Bay Ammo Pier	Navy
	DYOTS	Dyes Inlet Old Town Silverdale	Port of Silverdale
	MLPIER	Manchester Lab Pier	USEPA
	KPTLAG	Keyport Lagoon	Navy
	KPTPIER	Keyport NUWC Pier	Navy
	POPBWN	Port Orchard Passage Brownsville	Port of Brownsville
	АРВІНСВ	Agate Pass BI Hidden Cove Beach	City of Bainbridge Island
	LBPMSC	Liberty Bay Poulsbo Marine Science Center	Port of Poulsbo
	APKIANA	Agate Pass Kiana Lodge	Suquamish Tribe
	make up sampling date		

Table 3. Winter 2018 Tentative Mussel Watch Sampling Schedule

*To be determined



Figure 1. ENVVEST Mussel Watch station in Sinclair Inlet, Dyes Inlet, Port Orchard Passage, Rich Passage and Liberty Bay.



Figure 2. Mussel Watch Stations in Sinclair Inlet, Port Washington Narrows, and Ostrich Bay.

Attachment 1. Tentative Schedule for Winter 2018 ENVVEST Mussel Watch Sampling.

Tentative Date	Site Code	Site Name	Jurisdiction
20-Feb	MLPIER	Manchester Lab Pier	US EPA
20-Feb	SIWP	Sinclair Inlet Waterman Point	Private Land Owner
20-Feb	PS08	PSNS CIA (DD5 dive barge)	Navy
20-Feb	PS09	PSNS CIA (DD4 OF18A)	Navy
20-Feb	PS11	PSNS CIA (DD1 Pier 7)	Navy
20-Feb	PIER7CB05	PSNS Pier 7 South West Corner	Navy
20-Feb	PIER7FE46	PSNS Pier 7 East Side	Navy
20-Feb	PIER7RB30	PSNS Pier 7 West Side	Navy
21-Feb	PS01	PSNS Inactive Fleet (Mooring G)	Navy
21-Feb	SIPOM	Sinclair Inlet Port Orchard Marina	Port of Bermerton
21-Feb	SISM	Sinclair Inlet Sinclair Marina	Port of Bermerton
21-Feb	SIGST	Sinclair Inlet head at Gorst	Navy
21-Feb	SIRP	Sinclair Inlet Ross Point	WDFW
21-Feb	PS03	PSNS NBK West (Pier D)	Navy
21-Feb	PS04	PSNS NBK Mid (Pier C)	Navy
21-Feb	PS06	PSNS CIA West (Pier 9 DD6)	Navy
22-Feb	POPIPD	Port Orchard Passage Illahee Port Dock	Port of Illahee
22-Feb	POPISP	Port Orchard Passage Illahee State Park	WA State Parks
23-Feb	KPTLAG	Keyport Lagoon	Navy
23-Feb	KPTPIER	Keyport NUWC Pier	Navy
23-Feb	POPBWN	Port Orchard Passage Brownsville	Port of Brownsville
24-Feb	АРНСВ	Agate Pass BI Hidden Cove Beach	WDFW/City of Bainbridge Is
24-Feb	APKIANA	Agate Pass Kiana Lodge	Suquamish Tribe
24-Feb	LBPMSC	Liberty Bay Poulsbo Port	Port of Poulsbo
25-Feb	PWNLP	Port Washington Narrows Lions Park	Bremerton Parks & Rec
25-Feb	DYOTS	Dyes Inlet Old Town Silverdale	Port of Silverdale
27-Feb	DYOBAP	Dyes Inlet Ostrich Bay Ammo Pier	Navy
3-Mar	PKPLPC	Pike Place Market Seattle (Penn Cove)	