Portland Harbor Superfund Site Phase 3 Subyearling Chinook Sampling and Analysis

Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP)

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Acronyms and abbreviations

ANOVA	Analysis of variance
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Chain of custody
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DIVER	Data Integration Visualization Exploration and Reporting
DNA	Deoxyribonucleic acid
EPA	U.S. Environmental Protection Agency
FSP	Field sampling plan
GC/MS	Gas chromatography/ mass spectrometry
HASP	Health and safety plan
IAEA	International Atomic Energy Agency
IGF	Insulin-like growth factor
LC-MS/MS	Liquid chromatography-tandem mass spectrometry
LOD	Limit of detection
LOQ	Limit of quantification
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NRDA	Natural Resource Damage Assessment
NWFSC	Northwest Fisheries Science Center
OH-PAH	Hydroxylated PAH metabolite
ORR	Office of Response and Restoration
OSHA	U.S. Occupational Safety and Health Administration
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
POP	Persistent organic pollutant
RSD	Relative standard deviation
QA	Quality assurance
QC	Quality control
QAPP	Quality assurance project plan
SPE	Solid phase extraction
SRM	Standard reference material
TBT	Tributyltin
UPLC	Ultra-performance liquid chromatography
USGS	U.S. Geological Survey
UWR	Upper Willamette River

1 Abstract

The Upper Willamette River (UWR) Chinook salmon Ecologically Significant Unit (ESU) includes naturally spawned Chinook salmon originating from the Clackamas River and from the Willamette River and its tributaries above Willamette Falls, as well as Chinook salmon from six artificial propagation programs. UWR Chinook salmon migrate through highly industrialized Portland Harbor (an active Superfund site) in the lower Willamette River, despite historical contamination. Juvenile salmon may be especially vulnerable to toxicant exposures. The purpose of this study is to evaluate the growth of naturally spawned UWR juvenile Chinook salmon within the area of Portland Harbor compared to upstream reference sites, and to evaluate relationships between fish growth and tissue concentrations of legacy persistent organic pollutants (POPs), such as polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and dichlorodiphenyltrichloroethanes (DDTs), and tributyltin (TBT). Previous research has demonstrated a distinctive DDT signature in the UWR juvenile Chinook salmon out-migrating through an area of known historical DDT contamination (~ river mile 7). Sampling for this study will include a broader geographic representation within the contaminated area of the river than previous efforts, which will provide a more comprehensive understanding of the tissue contaminant levels in Willamette River salmonids, including DDTs, PCBs, PAHs, and TBT. Evaluating the association of tissue contaminant levels with indicators of skeletal growth will provide a metric of associated injury to this salmon population. UWR juvenile Chinook salmon will be collected by beach seine from select sites within Portland Harbor during the spring outmigration. Individual fish will have genetic confirmation of stock. Whole body, liver, and stomach content composites for UWR juvenile Chinook salmon will be analyzed for persistent organic pollutant (POP) concentrations including PCBs and DDTs, among others. Additionally, otolith analysis will be conducted to measure and quantify recent growth. The samples and related data from this study will support restoration and recovery efforts including projects specifically aimed at addressing and compensating the public for injuries to juvenile salmon from contaminant exposures.

2 Background: Rationale for generating or acquiring the data

2.1 History of the study area

The Willamette River flows through the highly industrialized Portland Harbor prior to its confluence with the lower Columbia River. For more than a century, this harbor has functioned as a commercial shipping port and working waterfront. Over the decades, numerous industries have released toxic chemicals into the river. Common sources of pollution have included permitted and non-permitted end-of-pipe discharges, accidental spills during cargo transfers, and stormwater and groundwater transport from upland areas (Trustee Council 2007). Extensive legacy pollution in harbor sediments eventually led the U.S. Environmental Protection Agency (EPA) to add Portland Harbor to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List (i.e., designated Superfund

site) in December 2000. At present, the Superfund site extends from river mile 2 to 11 (Figure 1), inclusive of upland areas.

2.2 Contaminants of concern

Priority contaminants of concern include polychlorinated biphenyls (PCBs), organochlorine pesticides including dichlorodiphenyltrichloroethanes (DDTs) and related metabolites, polycyclic aromatic hydrocarbons (PAHs), and antifouling agents such as butyltins (e.g., tributyltin (TBT)).

2.3 Results from previous studies

Estimates of contaminant exposure in the form of tissue residues (body burdens) were obtained from previous field collections of juvenile Chinook salmon at multiple sites throughout Portland Harbor (DIVER 2017). In May 2005 subyearlings were captured by beach seine from three locations within the Superfund site as well as an upstream reference site. Seining was selective for fish in the 50-80 mm fork length size range. Three replicate composite samples of 30 whole-fish (stomach contents removed) were collected, along with 1-2 composite samples of stomach contents, per site.

In addition, as part of a separate longitudinal study, juvenile Chinook salmon from the lower Willamette and Columbia Rivers were collected for chemical analyses. Monthly sampling from 2005-2009 yielded 1,200 juveniles, primarily of fork length < 100 mm, from thirty separate sampling events at 15 sites, for a total of 122 composite samples (3-10 individual fish per composite) (Johnson et al. 2013). Stock of origin for all fish was confirmed by conventional genetic analysis, as described by Teel et al. (Teel et al. 2009); two sampling events below the Columbia-Willamette confluence yielded enough fish for whole body composite sample analysis of UWR juvenile Chinook salmon (Campbell Slough, May 2007; Ryan Island, May 2009). Stomach content samples were composited by site of collection, not genetic stock of juvenile Chinook salmon. Stomach contents from juvenile Chinook salmon collected from Campbell Slough were composited into three samples; no data on stomach contents were available from Ryan Island. The Morrison Street Bridge location, just upstream from Portland Harbor, was sampled in 2005 and 2013 (April, May, and June) (Johnson et al. 2013; Johnson and Ylitalo 2013). These two collection efforts upstream of the Superfund site each produced four whole body composite samples of genetically confirmed Upper Willamette juvenile Chinook salmon, and, collectively, 8 site-based stomach composite samples.

All sites sampled within Portland Harbor (T01-T03) showed accumulated juvenile Chinook salmon tissue concentrations of PCBs above concentrations associated with adverse sublethal effects (2,400 ng/g lipid) (Meador et al. 2002). Samples within Portland Harbor (T02) demonstrated DDT levels above protective concentrations associated no or low effects (6,000 ng/g lipid) reinforcing the likely lethality for these juveniles (Beckvar et al. 2005). A more recent analysis of smolt-to-adult return (SAR) rates for 230 million hatchery-reared Chinook salmon released between 1972-2008 in Puget Sound found approximately 40% lower survival rates for

juvenile Chinook salmon outmigrating through and rearing in contaminated estuaries with similar COCs as the Willamette River (SAR = 0.48%) versus relatively clean estuaries (SAR = 0.87%) (Meador 2013).

2.4 Regulatory criteria

In March 2017, the U.S. EPA issued the Record of Decision for clean-up of the site to include active remediation of contaminated sediment and river banks to reduce risks to human health and the environment, which will take an estimated 13 years to complete (EPA 2017).

3 Project description

3.1 Project purpose

The purpose of this study is to evaluate the growth of juvenile Chinook salmon in Portland Harbor, an established Superfund site with high levels of legacy pollutants. Individual fish collected across select sites from upstream, downstream, and within Portland Harbor will be evaluated for growth using microstructural analysis of otoliths. The concentrations of priority contaminants of concern, PCBs, PAHs, DDTs, and TBT, in composite samples of whole fish (with stomach contents, livers, a fin clip, and otoliths removed), liver samples, and stomach contents will also be measured to evaluate the association of tissue contaminant levels with growth.

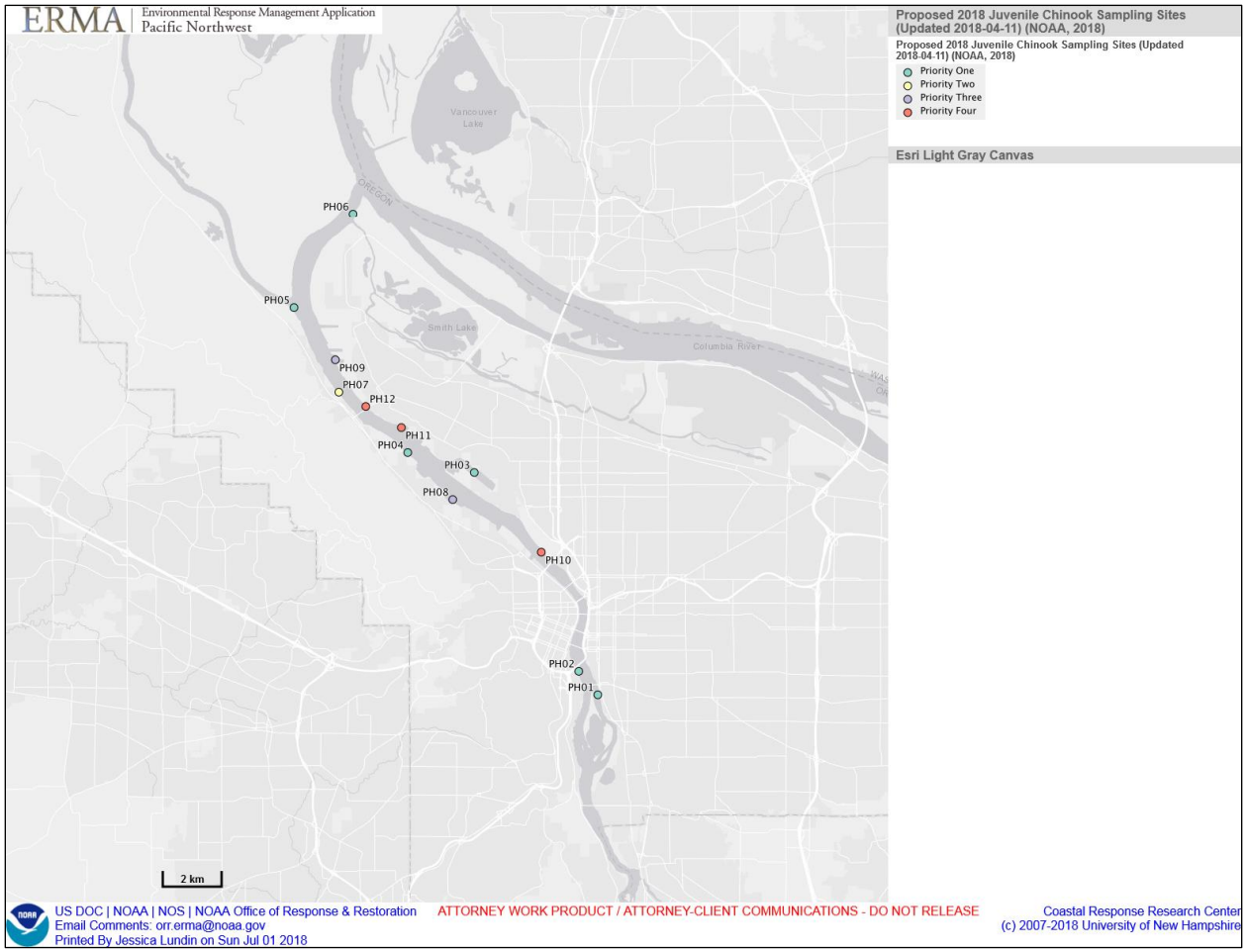
3.2 Target population

The target population is juvenile Chinook salmon, genetically confirmed to be Upper Willamette River Chinook salmon ESU. The sampling will target unmarked, presumably wild juvenile Chinook salmon. Fin clips will be taken for genetic analyses.

3.3 Study location and sampling sites

The study will take place in the lower Willamette River, between river mile 0 and 14 (Figure 1). A **total of 6-10 sites** will be sampled, 2-6 within central Portland Harbor (distributed between the east and west banks; PH03-04, PH07-12), 2 at the downstream end of Portland Harbor (1 on the east bank, PH06; 1 on the west bank, PH05), and 2 upstream at less contaminated reference sites (1 on the east bank, PH01; 1 on the west bank, PH02). Sites were selected to capture site-specific sediment contamination information. The priority rankings in Figure 1 designate the general order in which sites will be sampled. Depending on conditions precluding access to some of these sites (e.g., high river flows), alternate sites will be considering based on these priority rankings.

Figure 1. Locations of planned sampling sites for this study



3.4 Tasks required

Tasks involved in this study include:

- Collect juvenile Chinook salmon from 6-10 sites, including 2 upstream reference sites
- Take fin clips for genotyping analysis for stock identification
- Extract otoliths, livers, and stomach contents
- Create composite samples of stomach contents by collection site
- Submit tissue, stomach content, and liver samples to the NOAA NWFSC lab for chemical analyses
- If tissue mass is sufficient for TBT analysis, submit tissue to contract lab
- Submit otolith to the NOAA NWFSC lab for microstructural analysis
- Create composite samples of whole bodies (less otoliths, livers, a fin clip, and stomach contents) by site from fish genetically confirmed to be Upper Willamette River Chinook salmon ESU
- Create composite samples of liver tissue by site from fish genetically confirmed to be Upper Willamette River Chinook salmon ESU using same fish for each liver composites as for whole body composites

- Swab the inside lining of the stomach tissue (with contents previously removed) for possible genetic analysis of prey species
- QA/QC review of data
- Make publicly available documentation on activities and data related to sample collection and laboratory analyses, and results of data verification and validation activities, available on NOAA's Data Integration, Visualization, Exploration and Reporting (DIVER) tool (see Section 12)
- Analyze data for report and peer-review publication

3.5 Practical constraints

The most pertinent practical constraint is the availability of fish. Migration timing is well known for this species, but abundance varies annually and across a relatively short window of opportunity.

Multiple stocks of Chinook salmon that either migrate through or rear in the lower Willamette River are listed species under the U. S. Endangered Species Act, including UWR Chinook salmon, which constrains the number of fish allowed for collection. The current permit (NMFS Section 10 permit # 20713; Oregon permit (OR-STP) # 21914) is written to collect 320 juvenile Chinook salmon with the expectation that 201 will be UWR Chinook salmon (based on stock proportions reported by Teel et al., 2009).

The composite goal is 3 whole body composites per site, with a minimum of 2 g of tissue mass per composite (3.5 g prior to homogenization of tissue). Previous sampling (Johnson et al. 2013; LCREP 2007) demonstrated UWR juvenile Chinook salmon in spring have a mass (prior to dissections) that varied from 0.5 g to 3 g. Prevous sampling required 3-7 whole fish (minus stomach contents) per composite to reach the minimum required mass for chemistry analysis. The current protocol excludes livers, stomach contents, a fin clip, and otoliths from the whole body composites, and therefore the final mass will be modified from that listed above where the liver and otoliths were retained with the whole body composite sample. Planned collection of fish per site is modified from the estimated stock proportions reported in Teel et al. 2009 as listed in Table 3. A minimum collection of UWR Chinook salmon will be required to ensure 3 whole body composites.

4 Organization and schedule

4.1 Key individuals and their responsibilities

Table 1. Organization of project staff and responsibilities

Name	Title	Phone #	Email	Responsibilities
Robert Neely	Assessment Manager	206.617.5443	robert.neely@noaa.gov	Oversee technical work, ensure objectives of project are achieved, and coordinate activities
Jessica Lundin	Principal Investigator	206.860.3310	jessica.lundin@noaa.gov	Study planning and design, field coordination, permitting, preparing samples, data analysis, preparation of reports and publications
Nick Eckhardt	Data Manager	206.526.4821	nicolas.eckhardt@noaa.gov	Work with field and laboratory personnel to ensure dataset is complete and in correct format, maintain integrity and completeness of dataset
Gina Ylitalo	Laboratory Project Manager	206.860.3325	gina.ylitalo@noaa.gov	Environmental Chemistry Program Manager, Analytic chemistry lead
Jennie Bolton	Laboratory QA Officer	206.860.3359	jennie.bolton@noaa.gov	Provide quality assurance on chemistry sample data
Ali Bahrami-Bayeh	Health and Safety Officer	206.526.4364	ali.bahrami-bayeh@noaa.gov	Provide project safety related guidance
Sean Sol	Field Task Leader	206.860.3348	sean.sol@noaa.gov	Captain of research vessel with responsibility for directing and overseeing all on water operations
Adam Pfundt	Site Health and Safety Representative	360.303.7191	adam.pfundt@noaa.gov	On site point of contact for safety related issues

4.2 Project schedule: sampling timeframe and field dates

Two 7-day sampling events are planned to occur between April and June 2018, with a two week break in between (see Table 2). During the two week break the genetics will be run on the collected fish to allow for focused sampling efforts on the second session. A third sampling session in early June is scheduled as a backup sampling event in the circumstance the fish sampling goals are not met in the prior sampling events.

Juvenile Chinook salmon field work is planned to occur between April and June 2018. In the circumstance a second year of sampling is necessary to complete the study objectives, sampling will occur in the second requested permit year (2019). A circumstance that would lead to deferring to the second requested permit year would be to accommodate high water flows (i.e., flows resulting in water levels sufficiently high to submerge and otherwise block suitable access to beaches for beach seining).

Table 2. Proposed schedule for completing field and laboratory work

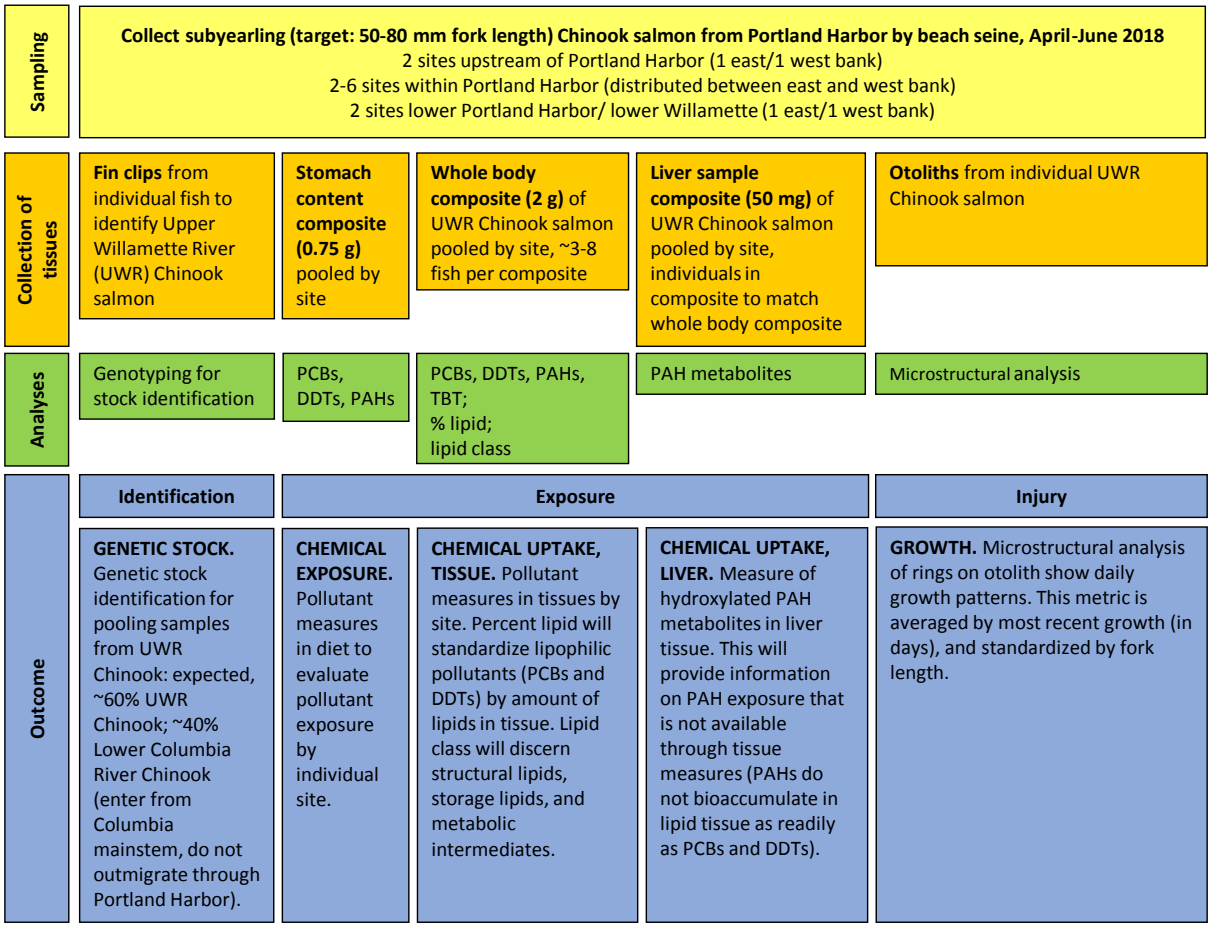
Task	Dates	Lead staff (all NOAA)
Field work	April - June 2018. Two 7-day sampling events, with a two week break in between. During the two week break the genetics will be run on the collected fish to allow for focused sampling efforts on the second session. A third sampling event in early June may occur if the sampling goals are not achieved in the first two planned sampling events.	Jessica Lundin Sean Sol Rob Neely
Laboratory work - genetics	May - June 2018	Jessica Lundin Krista Nichols
Laboratory work - chemistry	August - October 2018	Jessica Lundin Gina Ylitalo
Laboratory work - otoliths	November 2018 - January 2019	Jessica Lundin Paul Chittaro
Report draft	March 2019	Jessica Lundin Rob Neely Mary Baker Others to be determined
Report final	May 2019	Same as above

5 Overall study design

The sampling will target unmarked, presumably wild, UWR juvenile Chinook salmon outmigrating through the lower Willamette River. Fish will be collected by beach seine (Section 6) from planned sample locations (Section 5.1; Figure 1). Fish will be transported from the research vessel or beach directly to a field laboratory for fish dissection/necropsy (Section 7). In the field laboratory, fin clips will be collected for genotyping analysis for stock identification. Otoliths will be extracted for microstrucutal analysis (a primary metric of growth). Whole body (minus liver, stomach contents, a fin clip, and otoliths) and liver tissue will be prepared for compositing by site once genotyping results identify which fish are UWR Chinook salmon. Stomach contents will be composited by site. The whole body, liver, and stomach content composite samples will undergo chemical contaminant analysis. Stomach linings will be

swabbed to quantitatively estimate composition of the diet through genotyping of prey species present. Proper handling and storage of all tissue will be maintained prior to and upon delivery to the receiving laboratory (Section 7). Analytic methods and quality assurance protocols are described in Sections 8 and 9, respectively. Chain of custody will be intiated when fish are collected and maintained throughout the study (Section 10). Data evaluation and interpretation techniques are described in Section 11. Documentation and records management are described in Section 12. The overall study study design is summarized in Figure 2.

Figure 2. Schematic of overall study design



5.1 Sampling locations and number of fish/composites

All samples will be collected during the juvenile Chinook salmon spring outmigration. Sampling is anticipated to occur between April and June 2018. Specific sampling areas have been selected based on: (a) historical records of contaminants in sediment and/or juvenile Chinook salmon samples; (b) expected migration pattern of juvenile Chinook salmon; (c) accessibility and suitability of the shoreline for beach seining. Juvenile Chinook salmon will be collected by

NOAA staff and partners. All juvenile Chinook salmon sampled for this study, by all field personnel, will be taken following the fish sampling plan outlined in this document.

The success of the first sampling effort in terms of number of fish, and the proportions of fish determined to be UWR juvenile Chinook salmon based on the genetics data, will dictate what sites will be re-sampled or what additional sites will be sampled in the second sampling effort. The sampling priorities are to collect enough fish for 3 tissue composites from the 1st and 2nd priority sites listed in Table 3, and shown on Figure 1. The 3rd and 4th priority sites will be sampled in the event the higher priority sites are not accessible, are posing too many challenges to seine (net snags, property access permission, etc.), or if fish are not successfully collected at the site.

Table 3. Planned sample locations and projected number of fish for collection. Estimated proportions of UWR juvenile Chinook salmon modified from Teel et al. 2009 based on previous years' spawner abundance data

Site ID	Site Descriptor	Priority	River mile (approx)	Numer of projected stomach content composites	Numer of projected whole body composites	Fish per composite	# projected UWR fish	Expected % UWR	Expected % UWR (10% less expected as a buffer)	Planned # of juvenile Chinook collected per site, 1st priority sites	Additional fish if conditions warrant all fish to be caught at first session (e.g., waters exceptionally high)	Alternate sites	Alternate sites
PH01	Ross Island Bridge E	1	14	2	3	5	15	0.5	0.45	33	3		
PH02	I-5 Bridge W	1	13.5	2	3	5	15	0.5	0.45	33	3		
PH10	Fremont Bridge E	4	10.5	2	3	5	15	0.5	0.45				33
PH08	Opposite Swan Lagoon W	3	8.5	2	3	5	15	0.4	0.36			42	
PH03	Swan Lagoon E	1	8.5	2	3	5	15	0.4	0.36	42			
PH04	Railroad Bridge W	1	7	2	3	5	15	0.4	0.36	42			
PH11	Willamette Cove E	4	6.5	2	3	5	15	0.4	0.36				42
PH12	Cathedral Park E	4	5.5	2	3	5	15	0.4	0.36				42
PH07	Linnton W	2	5	2	3	5	15	0.4	0.36	14	30		
PH09	Opposite Linnton E	3	4.5	2	3	5	15	0.3	0.27			56	
PH05	Multnomah Channel W	1	3	2	3	5	15	0.3	0.27	56	3		
PH06	Kelley Point Park E	1	0.5	2	3	5	15	0.3	0.27	56	3		
TOTAL										**275**	**42**		
										275	**317**		

Permit allows 320 fish

5.2 Parameters to be determined

Parameters to be determined in this study include:

- Sampling information
    - Location; latitude, longitude
    - Date/time
    - Habitat
    - Weather
    - River flow (cubic feet per second, cfs; meters per second, m/s)
    - River temperature (deg C)
    - River height (gage height, feet)
- Biological metrics
    - Fish fork length (mm)
    - Fish body mass (g)
    - Fish liver mass (g)
    - Fish stomach fullness (weight of individual stomach contents, g)
    - Maturation (parr, smolt markings)
- Genetics
    - Stock identification (genotyping; fin clip)
- Chemical analyses
    - PCBs, DDTs, PAHs, % lipids, and lipid class (wax ester and sterol esters, triglycerides, free fatty acids, cholesterol, phospholipids and other polar lipids) in whole body (minus livers, stomach contents, a fin clip, and otoliths)
    - TBT if tissue mass is sufficient
    - PCBs, DDTs, and PAHs in stomach contents
    - OH-PAHs in liver tissue
- Growth metrics
    - Otoliths (microstructural analysis)
- Other metrics
    - Genetic analysis of prey species composition in stomachs may be performed

5.3 Field measurements

Measurements to be taken in the field.

- Sampling information
    - Fish collection date, time,
    - Location (latitude, longitude)
        - GPS set to Decimal Degrees; datum = “WGS 84”
        - Recorded down to nearest 0.000001 decimal degree (Latitude, *XX.XXXXXX*; Longitude, *YYY.YYYYYY*)
        - GPS measurement taken at beginning of first deployment of net
    - Habitat characteristics
    - Weather
- Biological metrics (see above)

Measurements to be obtained from USGS National Water Information System, 14211720 Willamette River at Portland, Oregon (daily averages). Data files obtained from the USGS system will be stored in a DIVER File Collection for future reference and use.

- River flow (discharge; cubic feet per second, meters per second)
- River temperature (temperature, water, deg C)
- River height (gage height, feet)

5.4 Laboratory analyses and deliverables

The following laboratory analyses and deliverables will be included as components of this study.

Genetic analysis for stock assignment of individual fish. Genetic stock identification will be completed from fin clips from all individual fish collected. The analysis will be completed by the NOAA NWFSC Conservation Biology Division (Seattle, Washington).

Chemical analyses. Chemical analyses of whole body fish tissue composites (minus livers, stomach contents, a fin clip, and otoliths), stomach contents, and liver samples will be completed by the NOAA Northwest Fisheries Science Center (NWFSC) Environmental and Fisheries Sciences Division (Seattle, Washington). The TBT analysis of whole body fish tissue composites, if performed, will be conducted at ALS Environmental (formerly, Columbia Analytical Services; Kelso, WA).

Otolith analysis. Otolith microstructural analysis will be completed by the NOAA NWFSC Environmental and Fisheries Sciences Division (Seattle, Washington).

Genetic analysis of stomach swabs from individual fish. Genetic analysis of stomach swabs to quantitatively estimate composition of the diet. If performed, the analysis will be completed by the NOAA NWFSC Conservation Biology Division (Seattle, Washington).

Details of analytic methods can be found in Section 8. Details of quality assurance procedures from all analyses listed above can be found in Section 9.

5.5 Assumptions underlying study design

The following assumptions underlie the study design.

a. Sampling across the peak of the outmigration run of salmon is sufficient to represent conditions in the system from which they were sampled.
b. Tissue residues of contaminants (including stomach contents) are correlated with exposure to contaminants, so that tissue residues are a reasonable proxy for contaminant conditions in fish prey and their environment.
c. Removing stomach contents for contaminant analyses has a negligible effect on contaminant concentrations in whole bodies, and measured contaminants accumulated in tissue.

d. Removing liver samples for analysis of PAH metabolites has a negligible effect on contaminant concentrations in whole bodies.

6 Field sampling plan: fish collection procedures and record keeping

The field sampling plan (FSP) outlined below describes the gear and procedures to be employed to catch juvenile Chinook salmon for this study, including handling of fish between the field and the lab, and records management.

6.1 Field sampling equipment and supplies

6.1.1 General supplies

- Boat with motor
- Coolers – for sample storage and transport
- Ice packs − for storage temperature regulation (if ambient temperature exceeds 4°C)
- Thermometer or temperature logger (1 per cooler)
- Nets:
    - Short-handled dip net − for handling live fish, one per field team, but have extras in case of net damage or loss
    - Beach seine net (see details of net/s below)
- Large tub or buckets (several)
- Measuring boards
- Battery powered aerators − for maintaining live fish
- Waterproof pens, waterproof labels, markers
- Nitrile exam gloves, talc-free (small, medium, large)
- Sorbent pads
- Fish Field Data Sheet – SEINE LOG (Appendix A) (waterproof paper, e.g. Rite-in-the-Rain®)
- NRDA Sample Collection Form – FISH DATA (Appendix A) (waterproof paper, e.g. Rite-in-the-Rain®)
- Fish identification field guides/charts
- Field log book (waterproof paper, e.g. bound Rite-in-the-Rain®)
- GPS, digital camera (with spare batteries)

6.2 Collecting juvenile Chinook salmon

NOAA staff, and trained biologists and technicians, will conduct all fish handling and analysis. Chinook salmon will be collected from the lower Willamette River using a 37 m × 2.4 m (10 mm mesh size) floating "Puget Sound" beach seine (with 20 m polypropylene lines attached at either end). Beach seine sets will be deployed using a 17 ft. (5.2 m) Boston Whaler. The total number of fish captured will be counted and recorded (See Appendix A; Seine Log Form).

The target fish will be juvenile Chinook salmon (target range: 50- to 80-mm fork length). Other species present, as well as juvenile Chinook salmon outside of the fork length range, will be identified, counted (See Appendix A; Field Fish Collection Form), and quickly released.

Target fish will be placed in an aerated bucket filled with site water from the river and transported from the research vessel or beach to the field laboratory. Temperature of the water will be maintained at a temperature range of 7 to 17 deg C using cooling bottles (frozen polypropylene bottle filled with water) (Carter 2005). Water temperature in the bucket will be monitored using a hand held thermometer in 30 min intervals, or more often if needed. Any exceedance greater than 20 deg C will be recorded in the field log book. Euthanasia will occur at the field laboratory station. Field staff will wear nitrile gloves where feasible to minimize potential contamination of whole bodies.

6.3 Documentation

The fish collection information must be documented by: 1) the field log book; 2) photographs of the sites sampled; 3) the Fish Field Data Sheet; and 4) the NRDA Sample Collection Form. Details on management of the data provided in this documentation can be found in Section 12.

6.3.1 Field log book

The lead scientist for each day in the field will maintain a field log with detailed notes for each day's activities.

The field log book should be a bound, waterproof log book with consecutively numbered pages and should be completed using indelible ink. No erasures should be made; all corrections should consist of a single line-out deletion, followed by the processor's initials and the date. The processor should initial and date each page of the dissection notebook. The processor should sign and date the last page at the end of each day, and a ("z"-ing out) line should be drawn through the remainder of the page.

Information may include:

- Name and location of project
- Date, time field work begins
- Weather conditions
- Field personnel
- Sequence of events
    - Sites sampled, number of nets deployed per station
    - Date, time, location name and/or coordinates
    - Samples collected: SampleIDs and description of samples
- Gear used and description of fishing activity
- Any deviations from the field sampling plan, along with the reason for the changes
- Unusual circumstances that may affect interpretation of results

6.3.2 Fish Field Data Sheet – SEINE LOG

- See Appendix A for sheet
- The total number of fish captured will be counted and recorded
- The target fish will be juvenile Chinook salmon within the 50- to 80-mm target fork length will be kept in an aerated bucket of site water
- Other species present, as well as juvenile Chinook salmon outside of the fork length range, will be identified, counted, and quickly released

6.3.3 NRDA Sample Collection Form – FISH DATA

- See Appendix A for sheet
- A list of each juvenile Chinook salmon collected, with sample number, collection location (SiteID and GPS coordinates), and date and time of collection

6.3.4 Photographs

Georeferenced photographs will be taken at each site for a given sampling period. The site will be photographed again when sampled on a different day, or if a site is re-sampled on a given day. The number of photographs should not be excessive, but enough to capture the ”scene” at a given site, on a given sampling period, on a given day. Additional photos will be taken under circumstances that may affect the interpretation of results.

Photographs will be taken in accordance to the NOAA Office of Response and Restoration (ORR) Guidelines for Collecting Ephemeral Data in the Arctic: FIELD PHOTOGRAPHY. This document provides the standard protocols used to take photographs in the field, and adapted for non-Arctic conditions as appropriate. See Appendix E for document. All photos will be taken on a digital camera. The associated memory card will be retained by the Data Manager following the sampling event. The Photologger form will be filled out to document all photographs that were taken. Descriptions and keywords will be included for the photographs. The photograph number (ex: IMG_2345 or DSC_7890) will be recorded on the form. See Appendix E for Photologger form. Photographs will be loaded into NOAA’s DIVER File Collections and available to be queried following the sampling event. See Section 12 and Appendix D for data management details.

6.4 Fish collection equipment cleaning procedure and decontamination

All dip nets, buckets, measuring boards, and coolers used to retrieve and store fish will be thoroughly rinsed three times using river water when arriving at a new sampling site. The beach seine will be rinsed in site water prior to leaving a site to remove any debris and rinsed again at a new site prior to sampling to reduce site cross-contamination.

6.5 Health and safety

See Appendix C.

7 Field sampling plan: fish dissection, sample handling and processing, and record keeping

The FSP outlined below describes the gear and procedures to be employed for dissection of juvenile Chinook salmon in preparation for chemical analyses, and collection of tissue for other metrics.

7.1 Equipment, reagents and supplies

General

- PTFE (polytetrafluoroethylene) cutting boards or boards covered with aluminum foil rinsed in isopropyl alcohol
- Meter measuring board with 1 mm divisions − for measuring fish, two per field team
- Portable electronic balance accurate to 0.01g, recently calibrated− for fish wet weight
- Portable electronic balance accurate to 0.001g, recently calibrated− for liver weight and stomach contents weight
- Weigh boats
- Paper towels
- Kimwipes
- Dissection kit with stainless steel scalpel, scissors, and forceps (all, x3), plus additional scalpel blades (enough to change between each site) for collection of liver samples and fin clips
- Magnifying glass on stand, with light
- Tap water
- Deionized water
- Isopropyl alcohol
- Dry ice
- Aluminum foil – heavy duty
- Teflon squeeze bottles (4)
- Ziploc bags
- Micro brand soap for cleaning lab surfaces and instruments
- Thin tip black Sharpies (x10)
- Lab tape, different colors
- Waterproof pens, waterproof labels, markers
- Sample tube labels -- cryogenic, laser ready
- Nitrile exam gloves, talc-free (small, medium, large)
- Chain of custody tape
- Laboratory notebook (bound Rite-in-the-Rain®-type)
- Sample Processing Form (Appendix A) (waterproof paper, e.g. Rite-in-the-Rain®)
- NRDA Chain of Custody Forms (Appendix B)

- 20 mL jars, I-CHEM Certified 0200-0250 series, Type III glass (solvent rinsed) with Teflon-lined polypropylene lids (for rinsate blanks if there is concern of cross contamination from reuse of sampling equipment)

Whole body tissue and stomach contents for analytical chemistry

- Sampling jars – 20 mL jars, I-CHEM Certified 0200-0250 series, Type III glass (solvent rinsed) with Teflon-lined polypropylene lids [for whole bodies and stomach contents]
- Packaging materials for glass jars (e.g., bubble wrap, sorbent pads, tape)

Swab of stomach tissue for genetic analysis of prey species

- 1.5 mL polypropylene SnapTop tubes [no preservative or solvent needed]
- Synthetic swabs with plastic stem

Liver samples for analytic chemistry

- 1.5 mL polypropylene SnapTop tubes [no preservative or solvent needed]

Fin clips

- 1.5 mL polypropylene SnapTop tubes
- 1.2 mL, 98% non-denatured ethanol (prefilled and prelabeled by NOAA NWFSC Conservation Biology Division, Molecular Genetics Team)

Otolith

- 1.5 mL polypropylene SnapTop tubes [no preservative or solvent needed]

7.2 Field lab setup and preparation

The lab will be set up with 4 stations, plus data collection

Station 1	**Station 2**	**Station 3**	**Station 4**
Length Weight	Fin clip Otoliths	Liver Stomach contents Stomach swab	Place whole body and remaining tissue in sample container

Fish will be placed on a small paper towel with sample number and passed to each station sequentially. Details of protocol at each station are provided below.

7.3 Fish sample number (SampleID)

All juvenile Chinook salmon caught in the field will be assigned a unique Sample number (SampleID). The number will consist of four digit year and sample number with no dashes, periods, etc (e.g., 20180001, 20180002).

7.4 Documentation

The fish dissection information must be documented by: 1) the sample identification labels; 2) the laboratory notebook; 3) the Sample Processing Form; and 4) the NRDA Chain of Custody (COC) Form. Details on management of the data provided in this documentation can be found in Section 12.

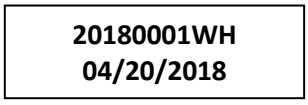
7.4.1 Sample identification labels

To facilitate identification of samples containers (stomach composites, whole bodies) and micro-tubes (liver samples, fin clips), corresponding labels will be attached to the side of the container. All labels will be cryogenic, laser printer ready labels written on using permanent marker or preprinted. The side label will have the date and SampleID printed on it. The lids of all sample containers will have the SampleID only printed in permanent marker. The lid of the fin clip sample will have a three-digit number that corresponds with the SampleID (#001 corresponds with 20180001, #002 corresponds with 20180002, etc.); the fin clip will also have a project code designated by the Molecular Genetics Team that will be running the samples. The side label of stomach content composite samples will have the Date, Site, and SampleID.

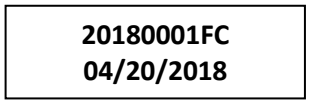
A sequential numbering system will be used to identify each fish that is a 4-digit year followed by a 4-digit sequential number (i.e., 20180001, … 20180201, …). The sample number will be followed by a letter qualifying the type of tissue (WH: whole body minus stomach contents, otoliths, a fin clip, and liver; FC: fin clip; OTO: Otoliths, LI: Liver). Stomach swabs will be labeled as "Stomach swab" followed by the SampleID. Capitalization (or non-capitalization) must be maintained when recording SampleIDs on field/sample data sheets.

Label examples:

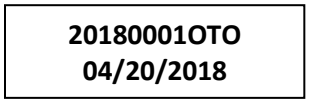
- Whole body label example:



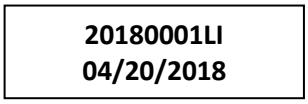
- Fin clip label example:



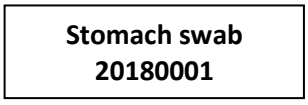
- Otolith label example:



- Liver label example:



- Stomach swab label example:



- Stomach contents composite sample labels will include: date, site, and unique composite number (the numbering system will be sequential across all sites)
- Stomach content label example:

PH01_STCOMP01 **04/20/2018**

7.4.2 Laboratory notebook

The lead field laboratory scientist for each day in the field laboratory will maintain a bound field log with detailed notes for each day's activities.

The laboratory notebook should be a bound, waterproof logbook with consecutively numbered pages and should be completed using indelible ink. No erasures should be made; all corrections should consist of a single line-out deletion, followed by the processor's initials and the date. The processor should initial and date each page of the dissection notebook. The processor should sign and date the last page at the end of each day, and a ("z"-ing out) line should be drawn through the remainder of the page.

The laboratory notebook will have entries as follows:

- Date and time
- Sample dissection team names
- Description of activity and method
- Time of beginning and end of activity (each batch of fish delivered from the research vessel)
- Sample identification numbers as on the labels for the individual fish tissue samples
- Fish dissection comments (general comments only, specific comments will be on sample processing forms)
- Any deviations from the fish processing, along with the reason for the changes
- Unusual circumstancs that may affect interpretation of results

7.4.3 Sample Processing Form

The Sample Processing Form will contain detailed information (e.g., length, weight) on the individual fish. See Appendix A for form.

The forms will be printed on waterproof paper to facilitate use in the field lab environment. The following information will be captured in the Field Sample Processing Form

- Survey information
    - SampleID
    - Sample location
    - Collection date
    - Processor name
- Sample information
    - Whole body weight (g)

- Total fork length (mm)
- Otoliths (how many)
- Fin clip (yes/no)
- Whole liver weight (g)
- Stomach contents, weight (g) and description
- Maturation of fish (parr marks, silver, or other)

- Observations

7.4.4 NRDA Chain of Custody Form

See Section 10.

7.5 Fish processing, handling, and storage

The subheadings below outline the procedures and methods used to process the target juvenile Chinook salmon. Fish will be transported from the research vessel or beach directly to the field laboratory in a cool oxygenated container of river water. Field coolers/buckets will be inspected by lab personnel upon receipt. Staff will record the weight and length of the fish, take a fin clip, extract the otoliths, and remove and weigh stomach contents and liver as described below.

7.5.1 Fish dissection/ necropsy overview

Dissection of fish will be conducted by or under the supervision of an experienced fisheries biologist. Fish will be processed on a "clean" work-surface with "clean" instruments as described in Section 7.6, Field lab equipment cleaning and decontamination procedure. Separate tools (scissors and forceps) will be designated for use on outer tissue ("outside") and use on internal tissue ("inside") in order to minimize cross-contamination.

7.5.2 Euthanasia

Target fish will be euthanized with a blunt force to the back of the head between the eyes.

7.5.3 Length and weight

- **Equipment/supples**
  - Measuring board
  - Scale
- **Protocol/procedures**
  - Target fish will be weighed (to the nearest 0.01 g)
  - Fork length will be measured by placing fish flat on a measuring board
    - The measurement will be from the tip of the snout to the posterior end of the middle caudal ray (to the nearest mm)
  - Both measurements will be recorded on the Sample Processing Form
- **Decontamination protocol**
  - Between fish, rinse with water, as needed

- Between sites, follow instrument and work area decontamination protocol below

7.5.4 Collection of fin clip for genetic stock identification

- **Equipment/supplies**
  - Scissors
  - Forceps
  - Clean towels for wiping tools
  - Distilled water for rinsing tools
  - Ethanol for rinsing tools
  - 1.5mL polypropylene SnapTop tube, pre-labeled by the NOAA NWFSC Conservation Biology, Molecular Genetics Team
  - 98% non-denatured ethanol
    - tubes will be pre filled with 1.2 ml of ethanol from the Molecular Genetics Team
- **Protocol/procedures**
  - Individual fin clip taken from entire dorsal fin, 3mm x 3mm minimum size
    - Clip taken from caudal fin lobe, if necessary
  - Clips will be taken using scissors, stabilizing clip with tweezers
  - Fin clip placed in 98% non-denatured ethanol in 1.5 mL labeled micro-centrifuge tube
  - Record clip on the Sample Processing Form
- **Decontamination protocol**
  - Between fish, wipe tools, and rinse them with ethanol and distilled water
  - Between sites, follow instrument and work area decontamination protocol below
- **Storage and handling of samples**
  - Store fish tissues in 98% non-denatured ethanol in 1.5 mL labeled micro-centrifuge tube provided by Molecular Genetics Team
  - Store at room temperature

7.5.5 Collection of otoliths

- **Equipment/supplies**
  - Scalpel
  - Fine tipped forceps
  - Magnifying glass with light
  - 1.5 mL polypropylene SnapTop tubes
- **Protocol/procedures**
  - Make a dorsal to ventral cut from top of operculum, about half way down
  - Extend head forward to expose tissue
  - Extract both of the biggest otoliths (sagittae) from each fish using forceps

- Place both otoliths in the same vial (just 1 sagittal otolith will be used in the analysis, but in the event it is cracked the other sagittal otolith will be available)
- Place 1.5 mL SnapTop tube with label on the inside of the tube, no solvent required
- Record on the Sample Processing Form

- **Decontamination protocol**
  - Between fish, rinse with water, as needed
  - Between sites, follow instrument and work area decontamination protocol below
- **Storage and handling of samples**
  - Store in a dry microtube at room temperature

7.5.6 Access to internal organs

- **Equipment/Supplies**
  - "outside" scissors and "outside" forceps
  - "inside" scissors and "inside" forceps
- **Protocol/procedures**
  - Internal organs will be accessed by opening the fish with a pair of fine scissors
  - Use "outside" scissors to make incision just anterior to anus and cut straight towards gills
  - Using the "outside" scissors and "outside" forceps, cut out a "window" in the flesh by cutting an arch dorsally beginning and ending at the edges of the incision – try to keep the tissue attached for ease in transferring to the sample container for chemistry analysis
  - The internal organs will be gently removed from the internal cavity onto a clean cutting board using "inside" scissors and "inside" forceps
  - The liver and stomachs will be isolated

7.5.7 Collection of liver for chemical analysis

- **Equipment/supplies**
  - "inside" scissors and "inside" forceps
  - 1.5 mL polypropylene SnapTop tubes
  - Scale
- **Protocol/procedures**
  - Isolate liver with cleaned "inside" forceps and remove from other internal organs with scissors or scalpel blade
  - If the gall bladder can be identified, do not include it with the liver sample, place it with the whole body composite
  - Tare the 1.5 mL SnapTop tube
  - Place the liver in the 1.5 mL SnapTop tube, no solvent or preservative necessary
  - Weigh the liver to the nearest 0.001 g
  - Close tube securely (audible snap)

- Record on the Sample Processing Form

- **Decontamination protocol**
  - Between fish, wipe any tissue from tools with Kimwipe, rinse thoroughly with ethanol, rinse thoroughly with de-ionized water, and dry with clean Kimwipe
  - Between sites, follow instrument and work area decontamination protocol below
- **Storage and handling of samples**
  - Samples will be placed on ice until being transferred to a cooler with dry ice (within 6 hours)
  - Samples will be stored on dry ice until delivery to the laboratory

7.5.8 Collection of stomach contents for chemical analysis; Swab of stomach lining for genetic analysis of prey species

- **Equipment/supplies**
  - "inside" scissors and "inside" forceps (x2)
  - Composite vial
  - Scale
  - 1.5 mL polypropylene SnapTop tubes
  - Synthetic swabs with plastic stem
- **Protocol/procedures**
  - The stomach will be gently separated from the other organs
  - The stomach will be lifted using designated "inside" forceps
  - Using a second "inside" forceps, the contents will be expelled into a tared composite vial for a given site and kept on ice
  - The stomach contents will be weighed to the nearest 0.001 g
  - The weight of the stomach contents will be recorded on the Sample Processing Form noting the composite vial into which the stomach contents were placed
  - Once a vial reaches 0.75 g it will be capped and transferred to dry ice, and a new stomach composite vial for that site will be started as total stomach content mass allows (A minimum mass of 0.75 g sample is needed for contaminant analysis, per G Ylitalo)
  - The remaining stomach tissue will be swabbed for genetic analysis of prey species using a synthetic swab
  - The plastic stem of swab will be snapped off and placed in a labeled 1.5 mL polypropylene tube
  - The stomach tissue (i.e., empty, scraped out stomach) will be returned into the body cavity and included with the rest of the fish tissue sample (see Section 7.5.9)
- **Decontamination protocol**
  - Between fish, wipe any tissue from tools with Kimwipe, rinse thoroughly with ethanol, rinse thoroughly with de-ionized water, and dry with clean Kimwipe
  - Between sites, follow instrument and work area decontamination protocol below

- **Storage and handling of samples**
    - Stomach content samples and swabs of stomach tissue will be placed on ice until being transferred to a cooler with dry ice (within 6 hours)
    - Stomach content samples and swabs of stomach tissue will be stored on dry ice until delivery to the laboratory

7.5.9 Remaining whole bodies minus stomach contents, livers, a fin clip, and otoliths put in separate labeled containers

- **Equipment/supplies**
    - "outside" scissors and "outside" forceps
    - Composite vial
- **Protocol/procedures**
    - Remaining whole body, including stomach tissue minus the stomach contents, will be placed in individual sampling containers and labeled with the SampleID number
- **Decontamination protocol between fish**
    - Between fish, wipe any tissue from tools with Kimwipe, rinse thoroughly with ethanol, rinse thoroughly with de-ionized water, and dry with clean Kimwipe
    - Between sites, follow instrument and work area decontamination protocol below
- **Storage and handling of samples**
    - Samples will be placed on ice until being transferred to a cooler with dry ice (within 6 hours)
    - Samples will be stored on dry ice until delivery to the laboratory

7.6 Field lab equipment cleaning and decontamination procedure

When processing specimens for contaminant analysis, anything (work-surfaces, instruments, etc.) that may contact those portions of a specimen that are subject to contaminant analysis must be cleaned according to the sequence below before each site is processed.

Between sites:
A "clean" work-surface (lab counter, cutting board, sorting tray, etc.) and "clean" instruments (stainless steel dissection tools) means they have been:

- wiped and cleared of any tissue or residue
- washed in warm soapy water (Micro brand soap)
- thoroughly rinsed three times using running tap water
- solvent rinsed using isopropyl alcohol (held in a Teflon squeeze bottle)

Lab personnel must change nitrile gloves between sites**.**

Between fish from the same site:
The work surface is wiped of any tissue or residue and rinsed with water as needed. Tools should be wiped with a Kimwipe to remove any tissue. Tools used for fin clips or extraction of liver tissue should be rinsed thoroughly with ethanol and de-ionized water. All other tools should be rinsed thoroughly with de-ionized water, and dried with a clean Kimwipe.

Gloves: Gloves will be worn whenever handling fish. Lab personnel must change nitrile gloves between sites, or more often as needed. Gloves will be talc- or dust-free nitrile.

Quality assurance/control. Rinsate blanks should be collected if there is a risk of cross contamination from reuse of sampling equipment. After cleaning the equipment in accordance with the procedures described in this method, rinse the clean equipment with solvent or cleaning solution and collect the rinsate in a sample jar (20 mL jars, I-CHEM Certified 200-250 series). Note on the field sample form when, from which site, and how rinsate blanks were collected.

7.7 Sample handling and storage procedures

- **Whole fish tissue, stomach contents, and liver samples for chemistry.** Tissues will be kept on ice during processing, and frozen by dry ice immediately following processing (never to exceed 6 hours). When samples are delivered from the field NOAA staff to the analytic laboratory staff, they will be placed in a locked -80 deg C freezer until processed. Whole body fish tissue composite samples for TBT analysis will be placed in a locked -80 deg C freezer until transfer.
- **Swabs of stomach tissue.** Swabs will be kept on ice during processing, and frozen by dry ice immediately following processing (never to exceed 6 hours). When samples are delivered from the field NOAA staff to the laboratory staff, they will be placed in a locked -80 deg C freezer until processed.
- **Fin clips**. Fin clips will be placed in ethanol and kept at room temperature. When samples are delivered from the field NOAA staff to the NWFSC laboratory staff, they will be placed in a locked drawer at room temperature until processed.
- **Otoliths**. Otoliths will be placed in dry microtube and kept at room temperature. When samples are delivered from the field NOAA staff to the NWFSC laboratory staff, they will be placed in a locked drawer at room temperature until processed.
- **Sample archiving.** All excess sample material remaining after laboratory analysis will be archived. The laboratory will maintain COC procedures and sample integrity for the entire time the samples are in their possession. The laboratory will store the excess samples until otherwise notified by the Assessment Manager.

7.8 Health and safety

See Appendix C.

8 Analytic methods

The methods used for genotyping to assign fish stock of origin, contaminant analysis of tissues (whole body, stomach contents, and liver), and otolith microstructural analysis is described below.

8.1 Genetic analysis for stock assignment of individual fish

Genotyping. Genomic deoxyribonucleic acid (DNA) will be extracted from the fin tissue and amplified for 192 single nucleotide polymorphism (SNP) markers using standard methods as previously outlined (Campbell et al. 2015). SNP sequencing will be carried out using a Miseq (Illumina) platform and genotypes will be generated using custom perl scripts developed from Campbell et al. (2015).

Stock assignment. For the genetic analyses, standard GSI (Genetic Stock Identification) methods (Anderson et al. 2008; Manel et al. 2005) will be used to assign individuals to their genetic stock of origin. A genetic baseline for Chinook salmon compiled from the FishGen database (www.fishgen.net) consisting of 79 populations and 185 SNP loci (Hess et al. 2014) will be used. Stock assignments of individual fish will be made using the computer program ONCOR (Kalinowski et al. 2007), which employs the likelihood model of Rannala and Mountain (Rannala and Mountain 1997). Allocations to individual baseline populations are summed to estimate contributions of regional genetic stock groups. Ten genetic reporting groups for Chinook salmon will be used (Willamette River spring, West Cascade spring, West Cascade fall, Spring Creek Group spring, Middle/Upper Columbia spring, Snake River spring, Deschutes River fall, Upper Columbia River summer/fall, Snake River fall, Rogue River) representing known genetic lineages within the Columbia River basin, as described in Teel et al. (Teel et al. 2014) excluding Washington and the Oregon Coast. Power analyses indicate that the 185 locus SNP database can be used to estimate the proportions of Columbia River basin stock groups in estuary mixtures of 200 fish. From this the assignments have >99% accuracy for Upper Willamette River spring, and 98% accuracy for other stocks (with the exception of Mid and Upper Columbia River Spring at 93%), similar to the findings in (Hess et al. 2014). Individuals with an assignment probability of 0.8 have been shown to have a 98% accuracy of stock assignment (Moran et al. 2014). For this study, an assignment probability of 0.8 or greater will be used to assign a fish to a designated genetic reporting group.

8.2 Chemical analysis, fish tissue and stomach contents

Whole body tissue composites will be created from Chinook salmon identified to be UWR spring Chinook salmon through the genetic analysis. The goal is a minimum of 3 whole body composite samples for POPs and PAH contaminant analysis from each site. If tissue mass is available, TBT analysis will also be considered.

The mass requested by the NOAA NWFSC analytic lab for POPs and PAH analysis is a minimum of 3.5 g of fish in each whole body composite. This mass is to ensure 2 g is available for extraction after potential mass loss following the necropsy and homogenization. Fish greater

than 3.5 g will be considered to have sufficient mass to be analyzed for POPs/PAHs as a single fish, without compositing. When multiple fish > 3.0 g are available from the same site (or from both reference sites), a 10 g composite will be assigned. The 10 g composite will be subsampled for POPs/PAH contaminant analysis, as well as for TBT analysis. The remaining fish will distributed between composites by site; multiple composites from each site will represent field replicates. All stomach content samples will be composited during the fish dissections in the field. As such, the stomach content composites will be by site only since the genetic information will not be known at the time of the compositing.

All measurements of PCBs, DDTs, and PAHs in fish tissue and stomach content composites for this study will be conducted by NOAA NWFSC (Seattle, WA) according to Sloan et al. (2004; 2014). In brief, Chinook salmon bodies with stomach contents, livers, a fin clip, and otoliths removed will be homogenized and extracted with dichloromethane, using an accelerated solvent extractor. The sample extracts will be precleaned on an alumina–silica column, and then further cleaned using size-exclusion liquid chromatography. The sample extracts will be analyzed by low-resolution gas chromatography/mass spectrometry. Measured concentrations in fish tissue will include 45 PCBs (PCBs 17, 18, 28, 31, 33, 44, 49, 52, 66, 70, 74, 82, 87, 95, 99, 101/90, 105, 110, 118, 128, 138/163/164, 149, 151, 153/132, 156, 158, 170/190, 171, 177, 180, 183, 187, 191, 194, 195, 199, 205, 206, 208, and 209), six DDTs (o,p'-DDD; o,p'-DDE; o,p'-DDT; p,p'-DDD; p,p'-DDE; p,p'-DDT), and 24 PAHs [naphthalene, 1-methylnaphthalene, 2-methylnaphthalene, biphenyl, 2,6-dimethylnaphthalene, acenaphthylene, 2,3,5-trimethylnaphthalene, acenaphthene, fluorene, retene, phenanthrene, 1-methylphenanthrene, anthracene, fluoranthene, pyrene, chrysene + triphenylene (coelute), benzo[*a*]pyrene, benzo[*e*]pyrene, perylene, dibenz[*a,c+a,h*]anthracene (coelute), benzo[*b*]fluoranthene, benzo[*j+k*]fluoranthene (coelute), indeno[1,2,3-*cd*]pyrene, benzo[*g,h,i*]perylene]. Percent lipids will be measured gravimetrically following extraction in dichloromethane, and lipid class determinations will be conducted using thin-layer chromatography/flame ionization detection (Iatroscan). Stomach content composite samples will be analyzed for PCBs, DDTs, and PAHs using analytical methods as described above for whole bodies.

The TBT analysis requires a minimum of 5 g of tissue. If fish mass is sufficient, composites for TBT analysis will be prepared. The analysis will be conducted at ALS Environmental (formerly, Columbia Analytical Services; Kelso, WA). Method details and quality assurance criteria will be reported with findings.

8.3 Chemical analysis, liver tissue

Liver composites will be created using the same fish and composite assignments as used for the whole body composites, including any 10 g composites. The mass required for each liver tissue composite is 50 mg. Liver tissue removed from juvenile Chinook salmon will be analyzed for hydroxylated PAH metabolites (OH-PAHs) by NOAA NWFSC using a modified method described in Ylitalo at al. (Ylitalo et al. 2017). The list of the 31 individual OH-PAHs are shown in Table 4. Liver samples will be mixed with water, spiked with surrogate standard, then extracted using methanol by agitation. Liver mixtures will then be centrifuged and supernatant added to a

phospholipid removal cartridge, in order to remove proteins and highly polar lipids. Subsequently, a buffer solution containing β-glucuronidase and sulfatase will be added to the treated liver extract in order to cleave the phase II conjugate from the PAH metabolite, transforming them into phase I metabolites to be measured. The hydrolyzed liver solution will be cleaned and the targeted OH-PAHs will be extracted via solid phase extraction (SPE) using methanol/diethylether as the final solvent. The SPE extract will be concentrated and an aliquot of the final methanolic extraction will be injected into the LC-MS/MS (liquid chromatography-tandem mass spectrometry). The 31 individual OH-PAHs will be separated through a reverse-phase column (150mm x 2.1mm, 1.7µm particle size) using water and methanol as the mobile-phase in a linear gradient. The 31 analytes will be detected using electrospray ionization in negative mode and monitored/quantified using multiple-reaction monitoring of molecular fragments in negative mode. The final LC-MS/MS analysis will be conducted using an ultra-performance liquid chromatography (UPLC) system (Waters Acquity UPLC) for the separation and a triple quadrupole mass spectrometer (AB Sciex QTRAP 5500) equipped with Turbo-V ion source for the OH-PAH detection and quantitation.

Table 4. List of individual hydroxylated PAH metabolites (OH-PAHs) analyzed by LC-MS/MS

Individual OH-PAHs	Abbreviation
2-hydroxynaphthalene	2-OHNPH
1-hydroxynaphthalene	1-OHNPH
6-methyl-2-hydroxynaphthalene	6-CH3-2-OHNPH
1-methyl-2-hydroxynaphthalene *(a)*	1-CH3-2-OHNPH
2-methyl-1-hydroxynaphthalene *(a)*	2-CH3-1-OHNPH
4,4'-Dihydroxybiphenyl	4,4'-OHBPH
2-hydroxydibenzothiophene	2-OHDBT
3-hydroxyfluorene	3-OHFLU
2-hydroxyfluorene	2-OHFLU
trans-9,10-dihydroxy-9,10-dihydrophenanthrene	9,10-OH-9,10-HPHN
trans-1,2-dihydroxy-1,2-dihydrophenanthrene	1,2-OH-1,2-HPHN
3-hydroxyphenanthrene *(b)*	3-OHPHN
2-hydroxyphenanthrene *(b)*	2-OHPHN
9-hydroxyphenanthrene	9-OHPHN
1-hydroxyphenanthrene	1-OHPHN
4-hydroxyphenanthrene	4-OHPHN
1,8-*bis*(hydroxymethyl)anthracene	1,8-OHMeANT
2-hydroxy-9,10-anthraquinone	2-OH-9,10-ATQ
1,5-dihydroxy-1,2-dihydro-9,10-anthraquinone	1,5-OH-9,10-ATQ
trans-2,3-dihydroxy-2,3-dihydrofluoranthene	2,3-OHFLA
trans-5,6-dihydroxy-5,6-dihydrochrysene	5,6-OHCHR
trans-3,4-dihydroxy-3,4-dihydrochrysene	3,4-OHCHR

Individual OH-PAHs	Abbreviation
trans-1,2-dihydroxy-1,2-dihydrochrysene	1,2-OHCHR
cis-5,6-dihydroxy-5,6-dihydrobenz[a]anthracene	5,6-OHBaA
trans-8,9-dihydroxy-8,9-dihydrobenz[a]anthracene (c)	8,9-OHBaA
trans-10,11-dihydroxy-10,11-dihydrobenz[a]anthracene (c)	10,11-OHBaA
trans-3,4-dihydroxy-3,4-dihydro-7,12-dimethylbenz[a]anthracene	7,12-Me-3,4-OHBaA
cis-4,5-dihydroxy-4,5-dihydrobenzo[a]pyrene	4,5-OHBaP
cis-7,8-dihydroxy-7,8-dihydrobenzo[a]pyrene	7,8-OHBaP
r-7,*t*-8,*t*-9,*c*-10-tetrahydroxy-*r*-7,*t*-8,*t*-9,*c*-10-tetrahydrobenzo[a]pyrene (+/-)	7,8,9,10-OHBaP
trans-4,5-dihydroxy-4,5-dihydrobenzo[e]pyrene	4,5-OHBeP

8.4 Otolith analysis

Otolith microstructure will be analyzed to estimate recent somatic growth using methods described previously (Chittaro et al. 2018). Sagittal otoliths will be embedded in crystal bond and polished in a sagittal plane using slurries (Buehler©'s 600 grit silicon carbide, 5.0 alumina oxide and 1.0 micropolish) and a grinding wheel with Buehler©'s 1500 micropolishing pads. Polishing will cease when the core of the otolith is exposed and daily increments are visible under a light microscope. Otoliths will be photographed using a digital camera (Leica DFC450) mounted on a compound microscope (Zeiss©). Using Image Pro Plus© (version 7, Mediacybernetics), measurements will be taken from each otolith, including distance from otolith core to edge (i.e., otolith radius at the time of capture) and distance from otolith core to daily increments in from the otolith edge (i.e., otolith radius measured at n days before capture).

8.5 Genetic analysis of prey species in stomach

Genetic analysis of stomach swabs from individual fish may be performed to quantitatively estimate composition of the diet through genotyping of prey species present. If this analysis is performed, method details and quality assurance criteria will be reported with findings.

9 Quality assurance project plan

9.1 Field collection requirements

The following field collection requirements will be used for this study.

Table 5. Quality assurance procedures, field collection requirements

Tissue	Requirement	Criteria	Corrective Action
Juvenile Chinook salmon	Completed sites (number of juvenile Chinook salmon as per Table 3).	At least 6 sites (two reference, 2 mid-Harbor, and 2 at end of Harbor). Minimum number of fish per sampling location as specified in Table 3.	At a given site, repeat seine at least 3 times. Move location 50 m up or down stream. If projected number of fish is not collected, then select alternate location from location alternates list.
Whole body composite	Minimum mass for contaminant analysis, percent lipids, and lipid class analysis.	2 g per composite, three composites per sampling location.	If, after genetic analysis, insufficient numbers of UWR juvenile Chinook salmon are identified to meet minimum composite size of three composites per sampling location, fewer composites will be used.
Stomach contents composite	Minimum mass for contaminant analysis.	0.75 g per composite, number per sampling location will be dictated by amount of mass in fish stomachs.	Stomach contents will be added to collection container until target mass is achieved. Additional collection containers will be used as mass allows.
Liver tissue composite	Minimum mass for contaminant analysis, percent lipids, and lipid class analysis.	50 mg per composite, three composites per sampling location.	If, after genetic analysis, insufficient numbers of UWR juvenile Chinook salmon are identified to meet minimum composite size of three composites per sampling location, fewer composites will be used.
Otolith	Minimum number of otoliths for microstructural analysis.	At least 1 otolith per fish. Target collection of both otoliths per fish.	If otolith can not be extracted during necropsy, the fish will be excluded from the growth analysis.

9.2 Field quality assurance

The sampling design incorporates multiple composites (replicates) per sampling location, therefore additional field duplicates are not required and there are no relative percent difference criteria for duplicates.

As noted in Section 7.6, rinsate blanks may be collected if there are concerns about cross-contamination from reuse of sampling equipment. In general, risks of cross-contamination are low, due to the decontamination procedures noted. If unusual odors or sheens are noticed on fish prior to dissection, extra care will be taken with cleaning and a rinsate blank will be collected as specified in Section 7.6.

Temperature is an important criteria for sample preservation for this sampling plan. Temperatures in fish handling buckets will be maintained at temperatures between 7 and 17 deg C, verified by a thermometer submerged in the water. Ice and coolers will be used as necessary to maintain the temperature in this range. Fish and associated tissues will remain on ice during the dissection process. Once fish are dissected, the samples for chemical analysis will be immediately placed in coolers containing dry ice and will remain frozen until transferred to a -80 deg C freezer at the NWFSC. These coolers will be monitored regularly throughout the day (at least once every two hours) to ensure adequate dry ice is present to maintain samples as frozen. In the event the temperatures are unable to be maintained and the samples start to thaw, these samples will be flagged for potential degradation.

9.3 Laboratory quality assurance

9.3.1 Genetic analysis for stock assignment of individual fish

Precision and accuracy (genotyping)

Fin clip genomic DNA extracts will be sequenced for individuals with a known stock identification (positive controls) along with negative controls and replicate samples. Error rates in the genotyping will be derived from positive controls (n=59) to estimate accuracy, and replicate genotyping of 20% of the fish collected for this study to estimate precision. For both measures, a percent error of <0.1% is considered acceptable. Any sample with a high percent error will be investigated to determine the cause of the mis-match. All genotype error rates will be reported.

Accuracy (stock assignments)

Power analyses indicate that the 185 locus SNP database can be used to estimate the proportions of Columbia River Basin stock groups in estuary mixtures of 200 fish. From this the assignments have >99% accuracy for Upper Willamette River spring lineage. Individuals with an assignment probability of 0.80 or greater to a reporting group will be allocated to their genetic reporting group (Moran et al. 2014). This assignment probability criterion has been demonstrated to result in 98% accuracy in individual assignment.

A second check is the 'leave one out' test, which evaluates how well fish within the baseline can be assigned to their population and reporting group of origin. Each fish with a complete genotype is sequentially removed from the baseline and its origin is assigned using the rest of the baseline. The summary output estimates the within and without reporting groups assignments to each baseline and reporting group. This method is described in Anderson et al. (2008) and Kalinowski et al. (2007) (Anderson et al. 2008; Kalinowski et al. 2007). The 'leave one out' self-assignment results for the Willamette River Spring lineage was > 99.9%.

Completeness

The circumstances of incomplete data for genotyping analysis are most often related to a low quality sample collected in the field (degraded, or too small), rather than instrumentation or genetic laboratory protocols. Great care will be taken to collect fin clips of adequate size, and to follow the protocol for sample handling and storage. Within the laboratory, samples are tracked through all steps including extraction, concentration, amplification, the addition of primers for the loci of interest, and addition of the index library.

Representativeness

Representativeness is the degree to which data represent a characteristic of an environmental condition. In the field, this is addressed in the sampling design by the selection of sampling sites and the sample collection procedures. In the laboratory this is ensured by the proper handling and storage of samples and initiation of analysis within holding times. The sample collection procedures for this study will collect fish at a given site by beach seine, with selection of target species only restricted by size [target fork length: 50-80 mm]. This will ensure representativeness of the distribution of fish stocks at a given site.

Comparability

Comparability is the similarity among different datasets for use in combining or comparing data. The methods used in this analysis follow similar protocols with previous studies, including use of similar juvenile Chinook salmon baseline and reporting groups (Teel et al. 2009). As such, the genetic data and stock identification will be comparable to other datasets derived from juvenile Chinook salmon in this region.

9.3.2 Chemical analysis, fish tissue and stomach contents

Analytical quality assurance criteria

Quality assurance criteria for persistent organic pollutants (POPs; i.e., PCBs and DDTs) and PAHs analyzed in salmon whole body and stomach contents samples for this study are summarized (Table 6; taken from Sloan et al., 2006, Table 8). Details on the quality assurance criteria for TBT analysis in salmon whole body composite samples will be reported with findings if tissue mass is sufficient for analysis.

Table 6. Minimum analytical quality assurance criteria for POPs and PAHs by gas chromatography/mass spectrometry (from Sloan et al. 2006)

Quality assurance element	Minimum frequency	Acceptance criteria
Instrument calibration	Each calibration standard is analyzed at the start of every batch of samples, or once every two batches in one continuous analytical sequence.	Analyte concentrations are to be calculated using point-to-point calibration with at least four concentration levels of calibration standards.

Quality assurance element	Minimum frequency	Acceptance criteria
Continuing calibration	One at start and end of every analytical sequence and between every 10 or fewer for field samples.	The relative standard deviation (RSD) of the analyte responses relative to the internal standard must be ≤15% for the repetitions.
Reference material: National Institute of Standards and Technology (NIST) standard reference material (SRM) 1946, 1947, 1974c	One with every batch of 20 or fewer for field samples.	The concentrations ≥70% of individual analytes must be within 30% of either end of the 95% confidence interval range of the reference values. These criteria do not apply to analytes with concentrations below their lower limit of quantification (LOQ) when the lower LOQ is within or greater than the 95% confidence interval, nor to those analytes known to have coeluting compounds.
Laboratory method blank	One with every batch of 20 or fewer for field samples.	No more than 5 analytes in a method blank are to exceed 2 x lower LOQ. Samples are not corrected for analytes found in the blank.
Laboratory sample replicates (i.e., duplicates or triplicates)	One with every 20 or fewer for field samples.	The RSDs of analyte concentrations must be ≤15% for triplicates, or percent differences must be ≤30% for duplicates, for ≥90% of the analytes that have concentrations ≥ 1 ng/g.
Surrogates (internal standards)	At least one internal standard/ surrogate is added to every sample.	The surrogate recoveries must be 60–130%.
Interlaboratory comparison	Responsive to all NIST/ International Atomic Energy Agency (IAEA) requests to participate.	In conjunction with NIST or the IAEA, accuracy-based solutions, sample extracts, and representative matrices are analyzed. Acceptance criteria are the same as those for reference material. All results are sent back to NIST or IAEA for comparison across laboratories.

Measurement quality objectives for bias associated with measurement of percent lipids are that each NIST standard reference material (SRM) result should be within its control limits (Sloan et al, 2006):

- Upper control limit = [1.35 × (certified concentration + uncertainty value for 95% confidence)]
- Lower control limit = [0.65 × (certified concentration – uncertainty value for 95% confidence)]

Precision

Precision represents the reproducibility of the individual measurements from the same sample. Precision is monitored and controlled within batches using laboratory replicates of field samples and across batches by analyzing SRM of applicable matrix i.e., tissue. For this study, a National Institute of Standards and Technology (NIST) mussel SRM 1974c will be used as the reference material for PAH analyses, and a NIST fish tissue SRM 1947 will be used for POPs analyses [Note, SRM 1974b was previously used, but is no longer available from NIST]. Cross-batch precision is expressed as the relative standard deviation (RSD) for repeated measurements. The RSD of analyte responses relative to the internal standard must be ≤ 15% for the repetitions.

Bias (Accuracy)

Bias demonstrates the degree to which the measured value represents the true value. Bias or accuracy of samples is evaluated by comparing measured SRM values with NIST certified values. Concentrations of ≥70% of individual analytes are to be within 30% of either end of the 95% confidence interval of the reference values. Results of QA analysis will be reviewed by the Laboratory QA Officer.

Sensitivity

The lower limit of quantitation (LOQ) for all organic chemicals in this study is "the concentration that would be calculated if that analyte had a GC/MS response area equal to its area in the lowest level calibration standard used in that calibration. When an analyte is not detected in a sample or it has a response area that is smaller than its area in the lowest level calibration standard used, the concentration of the analyte in that sample is reported to be less than the value of its lower LOQ." (Sloan et al. 2006). Typically LOQ values in 2 g fish whole-body composites range from 0.65 to 1.5 ng/g wet weight for PAHs and 0.15 to 0.50 ng/g wet weight for POPs, while LOQs for 0.7 g fish stomach content composites range from 1.0 to 2.5 ng/g wet weight for PAHs and 0.20 to 1.0 ng/g wet weight for POPs.

Representativeness

Representativeness is the degree to which data represent a characteristic of an environmental condition. In the field, this is addressed in the sampling design by the selection of sampling sites and the sample collection procedures. In the laboratory this is ensured by the proper handling and storage of samples and initiation of analysis within holding times. The sample collection procedures for this study will collect fish at a given site by beach seine, with selection of target species only restricted by size. This will ensure representativeness of the contamination across target species collected at a given site.

Comparability

Comparability is the similarity among different datasets for use in combining or comparing data. The methods used in this analysis follow similar protocols with previous studies, with comparable or lower limits of detection. One distinction in the protocol described in this study will be chemistry measures on whole bodies minus stomach contents, otoliths, a fin clip, and

livers, whereas previous studies have retained the liver and otoliths in the whole body analyses. This may bias study samples to underrepresent the contamination profiles of the fish sampled. The extent to which removing the livers may modify the contaminant concentration of the whole body fish composites is not known at this time.

9.3.3 Chemical analysis, liver tissue

Analytical quality assurance criteria

The minimum analytical quality assurance criteria for salmon liver analysis for hydroxylated polycyclic aromatic hydrocarbon metabolites (OH-PAH) are summarized in Table 7.

Table 7. Minimum analytical quality assurance criteria for OH-PAHs by liquid chromatography-triple-quadrupole mass spectrometry

Quality assurance element	Minimum frequency	Acceptance criteria
Instrument calibration	Each calibration standard is analyzed at the start of every batch of samples.	Analyte concentrations must be calculated using a Wagner calibration curve with at least five concentration levels of calibration standards.
Continuing calibration verification	One at start and end of every analytical sequence and between every 15 or fewer for field samples.	The RSD of each analyte's responses relative to the internal standard must be ≤20% for the repetitions.
Reference material: NIST SRM 3672—smokers' urine	One with every batch of 20 or fewer for field samples analyzed for OH-PAHs.	The concentrations ≥70% of individual OHPAHs must be within 15% of either end of the 95% confidence interval range of the reference values. These criteria do not apply to analytes with concentrations below their lower LOQ when the lower LOQ is within or greater than the 95% confidence interval.
Spiked matrix	One with every batch of 20 or fewer for field samples.	The recoveries of spiked analytes must be 60–130%.
Laboratory method blank	One with every batch of 20 or fewer for field samples.	No more than 10% of the analytes' concentrations can exceed 2 × lower LOQ in a method blank.
Laboratory sample replicates (i.e., duplicates or triplicates)	One with every 26 or fewer for field samples, as amount of sample available allows.	The RSDs of analyte concentrations must be ≤15% for triplicates, or percent differences must be ≤30% for duplicates, for ≥90% of the analytes that have concentrations >LOQ.
Surrogates (internal standards)	At least one internal standard/ surrogate is added to every sample.	The surrogate recoveries must be 60–130%.
Interlaboratory comparison	No intercomparison studies are available at present.	

Precision

Precision represents the reproducibility of the individual measurements from the same sample. Precision is monitored and controlled within batches using laboratory replicates of field samples and across batches by analyzing SRM. For this study NIST SRM 3672 (human smoker's urine) will be used as the reference material for OH-PAH analyses. Cross-batch precision is expressed as the RSD for repeated measurements. The RSD of analyte responses relative to the internal standard must be ≤ 15% for the repetitions.

Bias (accuracy)

Bias demonstrates the degree to which the measured value represents the true value. Bias or accuracy of samples is evaluated by comparing measured NIST SRM 3672 values with NIST certified values. Concentrations of ≥70% of individual analytes are to be within 30% of either end of the 95% confidence interval of the reference values. Results of QA analysis will be reviewed by the Laboratory QA Officer.

Sensitivity

The LOQ for this method is compound dependent and ranges from 0.15 – 4.5 ng/g of liver. Each LOQ was calculated based on LC-MS/MS limit of detection (LOD) for each analyte in ng/mL of methanol (lowest concentration of the calibration curve that produced a signal-to-noise ratio of approximately 3-5) and converted to concentration in liver using the regular volume of final extract and amount (wet weight) of liver extract. The conversion is performed according to the following equation: LOQ = LOD (ng/mL MeOH) x $V_{extract}$ / V_{sample}, where $V_{extract}$ is the final volume of extract in MeOH and V_{sample} is the wet weight of each liver sample extracted. This LOQ provides a representation of the lowest amount of a particular OH-PAH that would be in a specific liver sample that the applied method would be able to detect in the final extract. When an analyte is not detected in a sample or it has a response area that is smaller than its area in the lowest level calibration standard used, the concentration of the analyte in that sample is reported to be less than the value of its lower LOQ.

Representativeness

Representativeness is the degree to which data represent a characteristic of an environmental condition. In the field, this is addressed in the sampling design by the selection of sampling sites and the sample collection procedures. In the laboratory this is ensured by the proper handling and storage of samples and initiation of analysis within holding times. The sample collection procedures for this study will collect fish at a given site by beach seine, with selection of target species only restricted by size. This will ensure representativeness of the contamination across target species collected at a given site.

Comparability

No previous data for OH-PAHs in liver of field caught fish are available. However, the analytical method used in this analysis is a modification of the method reported by Ylitalo et al. to measure hydroxylated PAH metabolites in bile of visibly oiled and unoiled sea turtles collected after the Deepwater Horizon oil spill (Ylitalo et al. 2017), as well as in previous studies to determine OH-PAHs in fish embryos exposed to PAHs (NWFSC unpubl. data). Similar sensitivity is expected for analysis of liver samples, however levels of chemical contaminants in liver samples are usually found to be lower than levels in bile (Varanasi et al. 1989).

9.3.4 Otolith analysis

Precision

Precision represents the reproducibility of the individual measurements from the same sample. Precision is monitored and controlled by having the same person read each otolith, and a minimum of 10% of the otoliths two times, with each reading occurring on a different day. If the distance from the otolith core to the edge of the otolith (i.e., otolith radius at the time of capture) and distance from otoliths core to seven daily increments in from the otolith edge (i.e., otolith radius measured at 7 days before capture) match then the associated data is assigned to that otolith. A match is considered a RSD ≤ 15% for the measurements from the same otolith. If the readings do not match then all otoliths will be read twice, and a third reading will be performed for any otolith where the repeated measurement RSD is > 15%. If none of the three readings match then the otolith will be excluded from the statistical analyses.

Bias (accuracy)

Bias demonstrates the degree to which the measured value represents the true value. Each otolith will be read without any knowledge of fish sample site. Bias of samples will be minimized through consistency in the measurement protocols, ensuring the increment being measured is in optimum focus, and ensuring the otolith is mounted so that the incremental plane is as close to horizontal as possible.

Completeness

Completeness is the ratio of usable data from the otolith analyses. It is fully expected that all otoliths will be processed and read, producing a reliable data point from each fish.

Representativeness

Representativeness is the degree to which data represent a characteristic of an environmental condition. In the field, this is addressed in the sampling design by the selection of sampling sites and the sample collection procedures. In the laboratory this is ensured by the proper handling and storage of samples and initiation of analysis within holding times. The sample collection procedures for this study will collect fish at a given site by beach seine, with selection of target species only restricted by size. This will ensure representativeness of the growth across target species collected at a given site.

Comparability
Comparability is the similarity among different datasets for use in combining or comparing data. The methods used in this analysis follow similar protocols with previous studies. The average daily growth will be comparable to similar data derived from juvenile Chinook salmon otoliths.

10 Chain of custody procedures

A Chain of Custody (COC) Form will be initiated when fish are collected to track location, disposition, entity responsible for each fish, and, subsequently, individual or composite tissue containers. The COC Form will be completed in indelible ink, scanned, and a copy will accompany the shipment to the laboratory (COC Form, Appendix B). The COC Forms will be enclosed in resealable plastic bags and taped to the inside lip of coolers. The information on this Form will be used to track all samples from field collection to receipt at the analytic laboratory. Upon delivery and receipt of coolers, the COC Forms must be signed and dated by the recipient (analytical laboratory) and the individual (field NOAA staff) that relinquishes the samples. The laboratory is required to log in samples and note non-conformances. Temperature exceedances will be immediately reported to the Laboratory QA Office and Field Coordinator. Sample processing and analysis will not proceed until permission from the Chemistry QA Manager or Field Coordinator is given.

Chain of custody procedures are followed to authenticate a sample from the time it is taken until the results are introduced as evidence. For the purposes of litigation, agencies must be able to prove the legal integrity of all samples and data introduced as evidence. This means that it is necessary to have an accurate written record to track possession, handling, and location of samples and data from collection through reporting. Chain of custody facilitates this verification process. Failure to follow COC procedures in this guideline does not necessarily render data unusable; however the Assessment Manager should be notified of any deviations from the COC guidelines. Assuring that proper COC guidelines are followed is vital to assuring the integrity of the samples, and the data generated by the analysis of those samples.

Samples are considered to be in custody if they are 1) in the custodian's possession or view; 2) in a secured location and in a locked compartment; or 3) in a container that is secured with an official seal(s) such that the samples cannot be reached without breaking the seal(s). The sample custodian will check that all COC Forms are filled out properly and completely, and that the samples are stored in the appropriate conditions.

11 Description of the interpretation techniques to be used, including statistical analyses

The purpose of this study, as described in Section 3, is to evaluate the growth of juvenile Chinook salmon in Portland Harbor, an established Superfund site with high levels of legacy pollutants. Individual fish collected across select sites from upstream, downstream, and within Portland Harbor will be evaluated for growth using microstructural analysis of otoliths. The concentrations of priority contaminants of concern, PCBs, PAHs, DDTs, and TBT, in composite samples of whole fish (with stomach contents, livers, a fin clip, and otoliths removed), liver samples, and stomach contents will also be measured to evaluate the association of tissue contaminant levels with growth.

11.1 Analysis objectives

1. Evaluate growth as fish outmigrate through Portland Harbor, measured using otolith microstructural analysis
2. Evaluate the association of tissue contaminant levels with growth

11.2 Variables for analysis

11.2.1 Site and region variables

The following groupings will be used for site and region variables:

- Individual sampling sites
- Sampling sites pooled into sub-regions
- Sampling sites pooled by bank (east vs west)

11.2.2 Response metrics

The following metrics will be analyzed in the collected fish:

- Whole bodies of salmon (minus the stomach contents, otoliths, a fin clip, and liver) tested for PCBs, DDTs, PAHs, TBT (if sufficient mass), percent lipids, and lipid class
- Stomach contents tested for PCBs, DDTs, and PAHs
- Liver tissue tested for PAH metabolites
- Otolith microstructural analysis

11.2.3 Covariates

The following covariates will be considered in statistical tests employed:

- Collection date (categorical and continuous)
- Fish collected during sampling session 1 or 2 (categorical)
- River flow on the day of collection (cfs and m/s) (continuous)
- River temperature on the day of collection (deg C) (continuous)
- River height on the day of collection (gage height, feet) (continuous)
- Whole liver weight (g) (proxy for nutritional status) (continuous)
- Body condition (Fulton's condition factor (K)= weight (g)/ Length^3 (cm); continuous)

- River mile of collection (categorical, ordinal)
- Gut fullness (continuous, based on weight of individual stomach contents)
- Prey composition of the diet as determined through genetic analysis of stomach swabs (categories to be determined and will be reported with findings if this analysis is performed)
- Maturation (fry, parr, other) (categorical)
- Habitat at collection site (e.g., sand bottom, vegetated, mud, cobble, etc.) (categorical [bins to be defined])
- Time of day at fish collection (continuous, categorical [bins to be defined])

11.3 Descriptive data evaluation

Estimates of the effect size of the response metrics by site and region variables will be described using mean values, median values, and confidence intervals. Differences in whole body, stomach content, and liver sample contaminant concentrations and otolith microstructural analysis growth per day, averaged for the most recent 7, 14, and 21-days, by site and region variables will be determined by analysis of variance (ANOVA) and the Tukey-Kramer multiple range test (or a non-parametric equivalent, as appropriate). Separate analyses will be run using pooled and unpooled data from the two upstream reference sites. PCB and DDT values will be adjusted for the percent lipid in the sample.

11.4 Analysis 1: evaluate growth as fish outmigrate through Portland Harbor, measured using otolith microstructural analysis

Otolith microstructural analysis will be evaluated as a growth metric in UWR Chinook salmon. Differences in average growth per day, averaged for the most recent 7, 14, and 21-days, measured using otolith microstructural analysis on individual UWR juvenile Chinook salmon by site and region variables, will be determined by ANOVA and the Tukey-Kramer multiple range test (or a non-parametric equivalent, as appropriate). Separate analyses will be run using pooled and unpooled data from the two upstream reference sites. Linear regression models (or a non-parametric equivalent, as appropriate) will be used to further evaluate the association, using growth rate as the response variable and site and region variables as the predictor variable. Other hypotheses will be explored by running models with the listed covariates. Best fit models will be explored. Final model selection will be based on AIC (Akaike Informational Criterion) score.

11.5 Analysis 2: evaluate the association of tissue contaminant levels with growth

The purpose of this objective is to evaluate the association of growth and tissue contaminant concentrations in juvenile Chinook salmon. The correlation of average growth per day, averaged for the most recent 7, 14, and 21-days, and contaminant values will be tested using a Pearson's correlation coefficient if the data is parametric, and Spearman's rank correlation coefficient if the data is non-parametric. Linear regression models (or a non-parametric

equivalent, as appropriate) will be used to further evaluate the association, with growth as the response variable and whole body, stomach content, or liver contaminant concentration as the predictor variable. PCB and DDT values will be adjusted for the percent lipid in the sample. Other hypotheses will be explored by running models with the listed covariates. Final model selection will be based on AIC (Akaike Informational Criterion) score.

12 Data management

12.2 Documentation and records management

Records will be maintained documenting all activities and data related to sample collection as well as to laboratory analyses. Results of data verification and validation activities will also be documented. All publicly available documentation will be available through NOAA's DIVER tool (https://www.diver.orr.noaa.gov/). The public can access these data using the DIVER Explorer query tool that allows users to search, filter, and download data. Details on the documentation of these data records are outlined below.

12.3 Data records available in DIVER

A key objective of DIVER is to accommodate the querying of sample data along with associated non-sample data (e.g., field measurements, continuous-read instruments, photos). To pursue this objective, DIVER data managers identify the overlapping concepts generally implicit in each data set, defined as the core fields (listed in Appendix D, Table D1). The core field information makes the related data available for searching and download.

12.3.1 Field data documentation

For fish sampling/field sampling efforts, all data will be stored electronically. Upon the return of the field sampling team to the field lab, data intake and processing will occur for the all cameras, GPS units, and field forms used during the field sampling. In addition, all field lab processing forms will be scanned and uploaded into DIVER. See Appendix D for details of data intake and processing.

Accurate transcription and review of field information is critical for data usability. Data transcription will be reviewed by a second party on at least ten percent of forms to verify accurate transcription. Valid values ranges will be identified for key fields and values outside of those ranges will be flagged for field or processing team review. Any changes will be noted on the raw data sheets with a line through the original, initials of the editor, and the corrected value noted. Validation comments should be noted on the data sheet. Revised sheets will be re-scanned and added to the appropriate DIVER file collection.

Information on the field forms (Fish Field Data Sheet and Sample Processing Form) will be transcribed into ORR Electronic Data Delivery (EDD) template formats. These template formats allow the data to be integrated and queried in DIVER. These templates also have functions that

allow for QA/QC of the data and additional error checking. A list of the templates that could be used can be found in Table D2, Appendix D.

12.3.2 Laboratory data documentation

The data management team will assemble all of the information reported by the laboratories once the chemical, genetic, and otolith data has been appropriately validated. The laboratory data and documentation will be included in DIVER's project file collection for data archiving, data analyses, and use with GIS using the chemistry/toxicity results template and biological and other non-chemistry laboratory analysis template (Table D2; Appendix D). References and/or links to the following types of data set documentation, if available, will include: all quality assurance documentation for the original data set; validation reports; laboratory analytical reports; and final project reports summarizing the data. The database structure (Table D3) and database rules and specifications (Table D4) are further described in Appendix D.

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Appendix A. Field sampling forms

- Print the form on weather-resistant paper (if available). Make more than enough copies of the form before going into the field.
- Fill out forms with indelible ink.
- Make any additional notes that do not fit on the form in a field notebook and indicate the presence of associated additional notes on the field data form.
- Fill in blanks with "N/A" if data are not applicable or not available. Avoid leaving blank values on data forms.
- Do not erase or black out erroneous entries on the field data forms. Errors should be corrected by crossing out the entry with a single line and signing and dating the strike-through.
- The identification label on the fish tissue in the cooler must match the identification number in the forms
- Special notes about each form:
    - **1. Fish Field Data Sheet – SEINE LOG**
        - This will keep track of fish counts (collected and released) for our fishing records and permit reportings
        - A new sheet must be filled out for every seine deployed. The GPS coordinates must remain consistent for a single SiteID. Seine number designates a count of how many seines are deployed at a given site for a given day. Revisiting the site on a later date will start the seine count over.
    - **2. & 3. NRDA Sample Collection Form – FISH DATA sheet (Form #2, top sheet; #3 additional sheets)**
        - This will maintain a list of juvenile Chinook kept for analysis.
        - A new sheet must be started for each site for each day. A re-visit to a site on a given day would also require to start a new sheet.
        - Each fish collected will need the following rows completed:
            - SampleID (e.g., 20180031)
            - SampleID for whole fish (e.g., 20180031WH)
            - SampleID for otoliths (e.g., 20180031OTO)
            - SampleID for fin clips (e.g., 20180031FC)
            - SampleID for liver sample (e.g., 20180031LI)
            - SampleID for stomach contents composite sample (e.g., PH01_STCOMP01), the stomach contents are composited in the field by site, the composite sample number each individual stomach contents sample is added to will be reported.
    - **4. & 5. Sample Processing Form (Form #4, top sheet; #5 additional sheets)**
        - This will record specific information obtained from each fish such as weight, number of otoliths collected, etc.
        - A new sheet must be started for each site for each day, similar to the NRDA Sample Collection Form – FISH DATA sheet. A re-visit to a site on a given day would also require to start a new sheet.

Included Forms:
- Fish Field Data Sheet – SEINE LOG
- NRDA Sample Collection Form – FISH DATA
- Sample Processing Form

1. Fish Field Data Sheet – SEINE LOG

1 Date (mm/dd/2018): _____ / _____/ 2018 Time (24-hr clock): _____ SiteID: _____

2 Data recorder / Affiliation: _____

3 Other team members (initials): _____

4 Site characterization

Seine Number _____ *Latitude (DD.DDDDDD): __ *Longitude (-DDD.DDDDDD): _____

Sampling method (check one): **Beach seine** Line out: _____ % Spread: _____

Other (Describe)

Habitat (circle one): Nearshore / Lagoon / Estuary

Benthic Habitat (circle one): Cobble / Sand Bottom / Vegetated / Mud / Other:_____

Water Depth (m): _____

Weather Conditions: _____

Photos: _____

5

Species	Total Number Counted		Number Collected		Notes
	Juvenile	Adult	#Kept	#Released	
Chinook, Wild, <100mm FL					
Chinook, Wild					
Chinook, Hatchery					
Coho, Wild					
Coho, Hatchery					

--- continued on page 2 ---

*These coordinates correspond to the first seine set at the site. All subsequent seines at the site, even if they occur on different days, should use the same coordinates. If the field crew needs to set a seine that is outside of the site, enter the coordinates in the Notes section below.

Notes:

Species	Total Number Counted		Number Collected		Notes
	Juvenile	Adult	#Kept	#Released	

Species that may be encountered:

Chinook salmon	Bullhead. yellow	Dace, Speckled	Pumpkinseed	Trout, Rainbow
Chum salmon	Bullhead, brown	Eulachon	Cottids	Walleye
Coho salmon	Carp, Common	Goldfish	Shad, America	Weatherfish, oriental
Sockeye salmon	Chub, Chiselmouth	Kilifish, Banded	Shiner, golden	Whitefish, Mountain
Steelhead	Chub, Lake	Lamprey (unk)	Shiner, Redside	
Sturgeon, green	Chub, Tui	Mosquitofish	Stickleback, Threesprine	
Bass, Largemouth	Crappie, Black	Peamouth	Sucker, Bridgelip	
Bass, Smallmouth	Crappie, White	Perch, Yellow	Sucker, Largescale	
Bluegill	Dace, Longnose	Pikeminnow, Northern	Trout, Cutthroat	

SiteID	***Site Descriptor***	***SiteID***	***Site Descriptor***	***SiteID***	***Site Descriptor***
PH01	Ross Island Bridge E	**PH03**	Swan Lagoon E	**PH07**	Linnton W
PH02	I-5 Bridge W	**PH04**	Railroad Bridge W	**PH09**	Opposite Linnton E
PH10	Fremont Bridge E	**PH11**	Willamette Cove E	**PH05**	Multnomah Channel W
PH08	Opposite Swan Lagoon W	**PH12**	Cathedral Park E	**PH06**	Kelley Point Park E

Sign Off:

Federal Representative/Affiliation: _____

Date: _____ Time (24 hr): _____

2. NRDA Sample Collection Form – FISH DATA

Lead Sampler's Name/Phone __Jessica Lundin/ 206.810.3310____ Study Name _ Portland Harbor Superfund Site Phase 3 Subyearling Chinook Sampling and Analysis __
Lead Sampler's Affiliation ___NOAA NMFS NWFSC_____ **Sample date (mm/dd/yyyy) _____/_____/2018**
NRDA Contact/Phone _Robert Neely/ 206.526.6617_

Location	Seine Number	Sample Number	Sample Time	Collection Latitude	Collection Longitude	Tissue Type	Composite Number	Species	Sample Notes	Sample Photos
SiteID from Seine Log form	*Seine # from Seine Log*	*Sample # (20180001 – 20180320)*	*(24-hr clock, local time)*	*Latitude in DD XX.XXXXXX*	*Longitude in DD -YYY.YYYYYY*	*Tissue type*	*Composite Sample # for individual fish*	*Species common name*	*Any documentation regarding a specific fish sample.*	*Photo # for any photo taken of individual fish*
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		

Form filled out by: _____ Field lab team Initials: _____ Page: _____ of _____
Sign Off:
Federal Representative/Affiliation: _____ Date: _____ Time (24 hr): _____

SiteID	*Site Descriptor*	*SiteID*	*Site Descriptor*	*SiteID*	*Site Descriptor*
PH01	Ross Island Bridge E	**PH03**	Swan Lagoon E	**PH07**	Linnton W
PH02	I-5 Bridge W	**PH04**	Railroad Bridge W	**PH09**	Opposite Linnton E
PH10	Fremont Bridge E	**PH11**	Willamette Cove E	**PH05**	Multnomah Channel W
PH08	Opposite Swan Lagoon W	**PH12**	Cathedral Park E	**PH06**	Kelley Point Park E

Tissue Types

OTO – Otolith **WH** – Whole Body **LI** – Liver **FC** – Fin Clip **ST** – Stomach

Composite Column: **SITEID_STCOMP##** For stomach composite samples, the naming convention should be SiteID + "_STCOMP" + consecutive number (double digits). The consecutive numbers are used once for the entire study and do not repeat.

Survey Notes - (weather, wildlife, field team composition, sampling design changes, photos, etc.):

Form filled out by: _____ Field lab team Initials: _____ Page: _____ of _____

Sign Off:

Federal Representative/Affiliation: _____ Date: _____ Time (24 hr): _____

3. NRDA Sample Collection Form – FISH DATA

Lead Sampler's Name/Phone __Jessica Lundin/ 206.810.3310____ Study Name _ Portland Harbor Superfund Site Phase 3 Subyearling Chinook Sampling and Analysis __
Lead Sampler's Affiliation ___NOAA NMFS NWFSC_____ **Sample date (mm/dd/yyyy) _____/_____/2018**
NRDA Contact/Phone _Robert Neely/ 206.526.6617_

Location	Seine Number	Sample Number	Sample Time	Collection Latitude	Collection Longitude	Tissue Type	Composite Number	Species	Sample Notes	Sample Photos
SiteID from Seine Log form	*Seine # from Seine Log*	*Sample # (20180001 – 20180320)*	*(24-hr clock, local time)*	*Latitude in DD XX.XXXXXX*	*Longitude in DD -YYY.YYYYYY*	*Tissue type*	*Composite Sample # for individual fish*	*Species common name*	*Any documentation regarding a specific fish sample.*	*Photo # for any photo taken of individual fish*
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		
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		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		

Form filled out by: _____ Field lab team Initials: _____ Page: _____ of _____
Sign Off:
Federal Representative/Affiliation: _____ Date: _____ Time (24 hr): _____

3. NRDA Sample Collection Form – FISH DATA

Lead Sampler's Name/Phone __Jessica Lundin/ 206.810.3310____ Study Name _ Portland Harbor Superfund Site Phase 3 Subyearling Chinook Sampling and Analysis ___
Lead Sampler's Affiliation ___NOAA NMFS NWFSC_____ **Sample date (mm/dd/yyyy) _____/_____/2018**
NRDA Contact/Phone _Robert Neely/ 206.526.6617_

Location	Seine Number	Sample Number	Sample Time	Collection Latitude	Collection Longitude	Tissue Type	Composite Number	Species	Sample Notes	Sample Photos
SiteID from Seine Log form	*Seine # from Seine Log*	*Sample # (20180001 – 20180320)*	*(24-hr clock, local time)*	*Latitude in DD XX.XXXXXX*	*Longitude in DD -YYY.YYYYYY*	*Tissue type*	*Composite Sample # for individual fish*	*Species common name*	*Any documentation regarding a specific fish sample.*	*Photo # for any photo taken of individual fish*
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		
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		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		
		2018						juvenile Chinook		

Form filled out by: _____ Field lab team Initials: _____ Page: _____ of _____
Sign Off:
Federal Representative/Affiliation: _____ Date: _____ Time (24 hr): _____

4. Sample Processing Form

Lead Sampler's Name/Phone __Jessica Lundin/ 206.810.3310____ Study Name _ Portland Harbor Superfund Site Phase 3 Subyearling Chinook Sampling and Analysis ___
Lead Sampler's Affiliation ___NOAA NMFS NWFSC_____ **Sample date (mm/dd/yyyy) _____/_____/2018**
NRDA Contact/Phone _Robert Neely/ 206.526.6617_

Sample Number	**Time Begin Processing**	**Maturation**	**Fork Length (mm)**	**Fish weight (g to 0.01)**	**Fin Clip**	**Oto-liths (#)**	**Liver Weight (g to 0.001)**	**Stomach Contents Weight (g to 0.001)**	**Stomach Contents summed by vial # (cap at >0.75 g)**	**Stomach Contents Vial #**	**Notes & Sample Photos**
Sample # (20180001 – 20180320)	*(24-hr clock, local time)*	*Parr marks, silver, other*	*Fork length of sample fish*	*Total weight of sample fish*	*Y/N*	*Number of otoliths collected*	*Weight of the liver collected*	*Weight of the stomach contents*	*Sum of the weight for a composite sample*	*Composite sample vial #*	*Notes and photos of individual fish*

Form filled out by: _____ Field lab team Initials: _____ Page: _____ of _____

Sign Off:

Federal Representative/Affiliation: _____ Date: _____ Time (24 hr): _____

SiteID	***Site Descriptor***	***SiteID***	***Site Descriptor***	***SiteID***	***Site Descriptor***
PH01	Ross Island Bridge E	**PH03**	Swan Lagoon E	**PH07**	Linnton W
PH02	I-5 Bridge W	**PH04**	Railroad Bridge W	**PH09**	Opposite Linnton E
PH10	Fremont Bridge E	**PH11**	Willamette Cove E	**PH05**	Multnomah Channel W
PH08	Opposite Swan Lagoon W	**PH12**	Cathedral Park E	**PH06**	Kelley Point Park E

Notes:

Form filled out by: _____ Field lab team Initials: _____ Page: _____ of _____

Sign Off:

Federal Representative/Affiliation: _____ Date: _____ Time (24 hr): _____

5. Sample Processing Form

Lead Sampler's Name/Phone __Jessica Lundin/ 206.810.3310____ Study Name _ Portland Harbor Superfund Site Phase 3 Subyearling Chinook Sampling and Analysis __
Lead Sampler's Affiliation ___NOAA NMFS NWFSC_____ **Sample date (mm/dd/yyyy) _____/_____/2018**
NRDA Contact/Phone _Robert Neely/ 206.526.6617_

Sample Number	**Time Begin Processing**	**Maturation**	**Fork Length (mm)**	**Fish weight (g to 0.01)**	**Fin Clip**	**Oto-liths (#)**	**Liver Weight (g to 0.001)**	**Stomach Contents Weight (g to 0.001)**	**Stomach Contents summed by vial # (cap at >0.75 g)**	**Stomach Contents Vial #**	**Notes & Sample Photos**
Sample # (20180001 – 20180320)	*(24-hr clock, local time)*	*Parr marks, silver, other*	*Fork length of sample fish*	*Total weight of sample fish*	*Y/N*	*Number of otoliths collected*	*Weight of the liver collected*	*Weight of the stomach contents*	*Sum of the weight for a composite sample*	*Composite sample vial #*	*Notes and photos of individual fish*

Form filled out by: _____ Field lab team Initials: _____ Page: _____ of _____

Sign Off:

Federal Representative/Affiliation: _____ Date: _____ Time (24 hr): _____

5. Sample Processing Form

Lead Sampler's Name/Phone __Jessica Lundin/ 206.810.3310____ Study Name _ Portland Harbor Superfund Site Phase 3 Subyearling Chinook Sampling and Analysis __
Lead Sampler's Affiliation ___NOAA NMFS NWFSC_____ **Sample date (mm/dd/yyyy) _____/_____/2018**
NRDA Contact/Phone _Robert Neely/ 206.526.6617_

Sample Number	**Time Begin Processing**	**Maturation**	**Fork Length (mm)**	**Fish weight (g to 0.01)**	**Fin Clip**	**Oto-liths (#)**	**Liver Weight (g to 0.001)**	**Stomach Contents Weight (g to 0.001)**	**Stomach Contents summed by vial # (cap at >0.75 g)**	**Stomach Contents Vial #**	**Notes & Sample Photos**
Sample # (20180001 – 20180320)	*(24-hr clock, local time)*	*Parr marks, silver, other*	*Fork length of sample fish*	*Total weight of sample fish*	*Y/N*	*Number of otoliths collected*	*Weight of the liver collected*	*Weight of the stomach contents*	*Sum of the weight for a composite sample*	*Composite sample vial #*	*Notes and photos of individual fish*

Form filled out by: _____ Field lab team Initials: _____ Page: _____ of _____

Sign Off:

Federal Representative/Affiliation: _____ Date: _____ Time (24 hr): _____

Appendix B. NRDA Chain of Custody Form

- Print the form on weather-resistant paper (if available). Make more than enough copies of the form before going into the field.
- Fill out forms with waterproof pen or permanent marker.
- Fill in blanks with "N/A" if data are not applicable or not available. Avoid leaving blank values on data forms.
- Do not erase or black out erroneous entries on the field data forms. Errors should be corrected by crossing out the entry with a single line and signing and dating the strike-through.
- Every transfer of samples should have 2 signatures, "Relinquished by" and "Received by." If the same person transfers the samples they need to provide both signatures on the form.
- Original Chain of Custody Forms should always stay with the samples. Make a copy of the Chain of Custody Form before sending it with the samples.

Included form:
- NRDA Chain of Custody Form

NRDA Chain of Custody Form

Sampler Information		NOAA Contact Information	
Contact/Phone/Email:		Contact/Phone/Email:	
Affiliation:		Sample Questions:	
Incident Name:			

Special Instructions:	Lab Name:	
	Waybill Number:	
	Lab Use Only — Lab Report #:	
	# of Coolers:	
Turn Around Time:	Cooler Temp:	

Sample ID	Sample Date	Sample Time	Matrix	Analyses requested	# of containers	Comments
	mm/ddyyyy	(24-hr local)		Enter Analyses above, with preservative specified, if needed. Enter x's in boxes below.		

Relinquished by				Received by			
Date	**Time**	**Signature**	**Printed Name/Org.**	**Date**	**Time**	**Signature**	**Printed Name/Org.**

Page 1 of 2

Organics Analyses
Aliphatics
Alkylated PAH Homologues
Chlorinated Herbicides (8151)
Dioxins and Furans (8290)
OC Pesticides (8081)
OP Pesticides (8141)
PAH (8270)
PCB Aroclors (8082)
PCB Congeners (680)
Phenols (8041)
PIANO (Volatile Paraffins, IsoParaffins, Aromatics, Naphthenes, & Olefins)
Semivolatile Organics (8270)
Steranes/Triterpanes
Volatile Organics (8260)
[any other analyses or method as needed]
Nutrients (EPA 300.0, 350.1, 353.2, 365.3) - CWVP

Petroleum Hydrocarbons
BTEX
Extractable Petroleum Hydrocarbons (EPH)
Petroleum Hydrocarbons (8015)
Saturated Hydrocarbons
TPH Oil & Grease (418.1)
TPH-Diesel
TPH-Gas
NWTPH-Dx (NW method)
NWTPH-Gx (NW method)
[any other analyses or method as needed]

Inorganic Analyses
Ammonia
Grain Size
Total Dissolved Solids
Total Kjeldahl Nitrogen (TKN)
Total Organic Carbon (TOC)
Total Solids
Total Suspended Solids
[any other analyses or method as needed]
pH / Salinity (EPA 9040, SM 2520B 18th edition) - CWVP
Soil Organic Matter - CWVP

Metals Analyses
CLP Metals
Low Level Arsenic
Low Level Mercury (1631)
Mercury (7470/7471)
MTCA Metals (As, Cd, Cr, Pb, Hg)
PP Metals (Ag, As, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, Tl, Zn)
RCRA Metals (As, Ba, Cd, Cr, Pb, Se, Ag, Hg)
TCLP Metals
[any individual metal or list of metals as needed]
Metals (EPA 200.7/6010: Al, Ba, B, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Na, Zn) - CWVP

Bio Analyses
Amphipod survival test
Bivalve bioaccumulation test (chronic)
Gonad Condition Index
Infaunal Analysis
Larval Bivalve development test
Larval Echinoderm development test
Length Frequency
Mysid survival test
PCR/DNA

Appendix C. Health and safety plan

- This site-specific health and safety plan (HASP) provides the general health and safety provisions to protect workers from potential hazards during field activities associated with the *Quality Assurance Project Plan and Field Sampling Plan, Portland Harbor* under the study of juvenile Chinook salmon exposure to contaminants in Portland Harbor Superfund Site in the lower Willamette River, Portland, Oregon.
- All field personnel must review the HASP prior to beginning work, and must sign the HASP acknowledgement form consenting to adhere to its policies, procedures, and guidelines while participating in this project.

Included document:

- Portland Harbor Superfund Site Phase 3 Subyearling Chinook Sampling and Analysis, Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP) Appendix C Health and Safety Plan

PORTLAND HARBOR SUPERFUND SITE PHASE 3
SUBYEARLING CHINOOK SAMPLING AND ANALYSIS

QUALITY ASSURANCE PROJECT PLAN (QAPP) AND FIELD SAMPLING PLAN (FSP)

Appendix C
HEALTH AND SAFETY PLAN

HEALTH AND SAFETY PLAN APPROVAL

This appendix to Portland Harbor Superfund Site Phase 3 Subyearling Chinook Sampling and Analysis: Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP) (NMFS 2018) has been reviewed and approved for juvenile Chinook fish collection in area of Portland Harbor, Portland, Oregon. This site health and safety plan (HASP) has been written for the use of NOAA personnel and its subcontractors. NOAA claims no responsibility for its use by others. The plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if these conditions change.

PLAN PREPARED BY: LT Adam Pfundt, NOAA
DATE: April 13, 2018

REVIEWED BY:

_____

Ali Bahrami-Bayeh, NOAA Date
Project Health and Safety Officer

HEALTH AND SAFETY PLAN ACKNOWLEDGEMENT

I have reviewed the site-specific HASP prepared by NOAA, dated April 13, 2018, for Portland Harbor Superfund Site Phase 3 Subyearling Chinook Sampling and Analysis fieldwork. I understand the purpose of the plan, and I consent to adhere to its policies, procedures, and guidelines while participating in this project.

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HEALTH AND SAFETY PLAN ACKNOWLEDGEMENT (Continued)

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LIST OF ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
BEI	Biological exposure indices
CFR	Code of federal regulations
DOT	U.S. Department of Transportation
FSP	Field sampling plan
HASP	Health and safety plan
HSO	Health and Safety Officer
IARC	International Agency for Research on Cancer
IATA	International Air Transport Association
MSU	Marine Safety Unit
NIOSH	National Institute of Occupational Safety and Health
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NTP	National Toxicology Program
NWS	National Weather Service
OMAO	Office of Marine and Aviation Operations
OOD	Officer of the Deck
OSHA	U.S. Occupational Safety and Health Administration
PAH	Polycyclic aromatic hydrocarbon
PFD	Personal flotation device
PI	Principal Investigator
PPE	Personal protective equipment
QAPP	Quality assurance project plan
SARA	Superfund Amendments and Reauthorization Act
SDS	Safety data sheet
SHSR	Site Health and Safety Representative
STEL	Short-term exposure limit
TLV	Threshold limit value
TWA	Time-weighted average
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey

HEALTH AND SAFETY PLAN

Project Title: Portland Harbor Superfund Site Phase 3 Subyearling Chinook Sampling and Analysis

Site Name: Lower Willamette River / Portland Harbor and U.S. Coast Guard (USCG) Marine Safety Unit (MSU) Portland – Portland, OR

Dates of Proposed Activities: April 16, 2018 – April 24, 2018
May 7, 2018 – May 15, 2018

Introduction:

This site-specific health and safety plan (HASP) provides the general health and safety provisions to protect workers from potential hazards during field activities associated with the study of juvenile Chinook exposure to contaminants in Portland Harbor Superfund Site in the lower Willamette River, Portland, Oregon. The field activities include:

- Capture and transport of subyearling juvenile Chinook
- Otolith sampling
- Fish liver sampling
- Fish stomach contents composite sampling
- Whole body composite sampling

It is the policy of NOAA and all its line offices to provide a safe and healthful work environment. No aspect of the work is more important than protecting the health and safety of all workers.

This plan may be modified at any time based on the judgment of the Principal Investigator (PI), Field Task Leader, Site Health and Safety Representative (SHSR) or the NOAA Health and Safety Officer (HSO). Any modification will be presented to the onsite team during a safety briefing and will be entered in Form 1 (Appendix C, Section 7), which will be placed or posted in a designated area in the field vehicle or on the vessel.

Failure to comply with the requirements of the HASP is grounds for immediate dismissal from the project.

1. EMERGENCY PROCEDURES

1.1 Medical Evacuation Procedures

In the event it is determined that an individual is in need of medical attention call **911**.

On water operations will occur at various sites along the lower Willamette River. During on the water operations, in addition to 911, VHF-FM Channel 16 can be used as radio channel for hailing or distress calls. To make a VHF Channel 16 distress call:

1. Make sure the radio is ON
2. Select VHF **Channel 16**
3. Press and hold the transmit button
4. Clearly say: **MAYDAY, MAYDAY, MAYDAY**
5. Provide vessel name (R/V Stickleback) and/or other identifying information
6. Provide your position and/or location
7. Provide nature of emergency (e.g., injury, flooding, sinking, mechanical failure)
8. Provide number of persons impacted
9. Release transmit button
10. Wait 10 seconds; if no response repeat steps 3 through 10.

Majority of shore side operations and sample processing will occur at USCG MSU Portland. If medical emergency occurs at USCG MSU Portland contact base Officer of the Deck (OOD) at (503) 849-1984 **and** 911 to mobilize base medical resources and enable base personnel to coordinate access for local EMS.

1.2 Nearest Medical Emergency Room

Emergency room name/address: **Legacy Emanuel Medical Center**
2801 North Gantenbein Avenue
Portland, OR 97227

Emergency room telephone number: (503) 413-2200

Ambulance/police/fire emergency: 911

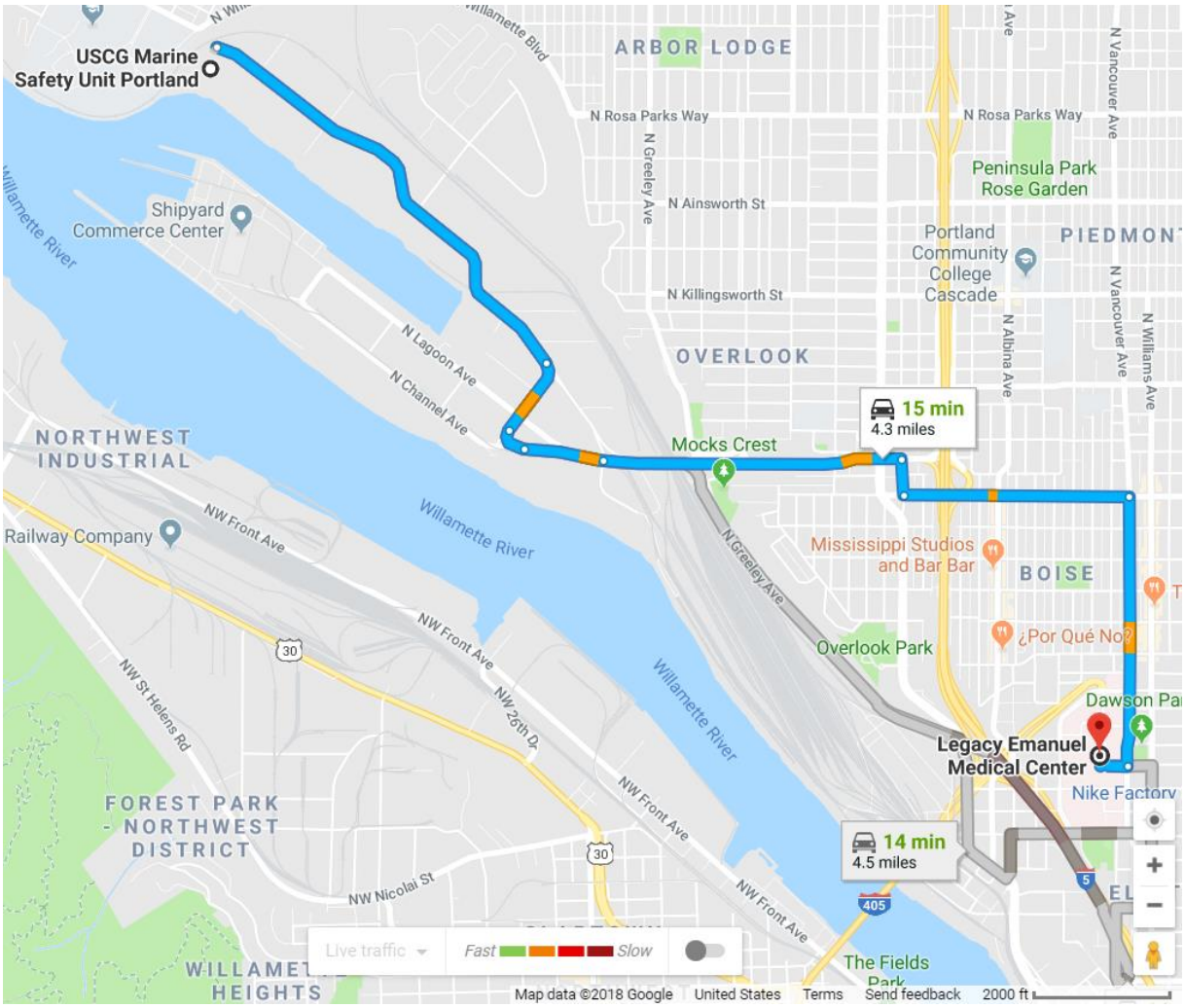
USCG MSU Portland Base OOD: (503) 849-1984

Directions from MSU Portland Base to hospital are included below and map to the hospital is also provided in figure that follows.

Driving Directions to Legacy Emanuel Medical Center from USCG MSU Portland Base

Take N Basin Ave to N Channel Ave (1.6 miles)
Take N Going St, N Skidmore St and N Vancouver Ave to N Stanton St (2.5 miles)
Turn right onto N Stanton St (456 feet)
Legacy Emanuel Medical Center will be on your right

Figure. Map of driving directions to nearest hospital from USCG MSU Portland



2. ORGANIZATION

Project personnel have been identified to fill specific roles to include authority, responsibility, and communication pertaining to project health and safety functions (table below). The overall organization of project staff and responsibilities are included in Portland Harbor Superfund Site Phase 3 Subyearling Chinook Sampling and Analysis: QAPP and FSP.

Table. Names and contact information for project personnel with specific roles pertaining to health and safety.

Name	Title	Phone #	Email	Responsibilities
Ali Bahrami-Bayeh	Health and Safety Officer	206.526.4364	ali.bahrami-bayeh@noaa.gov	Provide pre-project safety related guidance and approve HASP
Jessica Lundin	Principal Investigator	206.860.3310	jessica.lundin@noaa.gov	Principal Investigator, Field coordinator, Lead author on reports and publications
Sean Sol	Field Task Leader	206.860.3348	sean.sol@noaa.gov	Captain of research vessel with responsibility for directing and overseeing all on water operations
Adam Pfundt	Site Health and Safety Representative	360.303.7191	adam.pfundt@noaa.gov	On site point of contact for safety related issues

2.1 Roles and Responsibilities

All personnel and visitors involved with sampling operations must comply with requirements of this HASP. Specific responsibilities and authority of management, safety and health, and other personnel are detailed in the Portland Harbor Superfund Site Phase 3 Subyearling Chinook Sampling and Analysis: QAPP and FSP (NMFS 2018).

2.2 Site Workers

Site workers are responsible for complying with this HASP, using the proper personal protective equipment (PPE), reporting unsafe acts and conditions, and following the work and safety and health instructions of the Field Task Leader, HSO, SHSR, and Principal Investigator.

In the event of urgent medical emergency during on the water operations transfer ashore may occur at location other than USCG MSU Portland and alternative evacuation route may be preferred to expedite arrival at medical facility.

Emergency room telephone number: (503) 413-2200

Ambulance/police/fire emergency: 911

USCG MSU Portland Base OOD: (503) 849-1984

NOAA cannot guarantee the health or safety of any person entering the Site or involved in the research activities. Because of the potentially hazardous nature of this Site and the activity occurring thereon, it is not possible to discover, evaluate, and provide protection for all possible

hazards that may be encountered. Strict adherence to the health and safety guidelines set forth herein will reduce, but not eliminate, the potential for injury and illness at the Site. The health and safety guidelines in this plan were prepared specifically for this site and should not be used on any other site without prior evaluation by trained health and safety personnel.

This HASP has been prepared in accordance with federal safety regulations [U.S. Occupational Safety and Health Administration (OSHA), 29 CFR 1910 and 29 CFR 1926 (OSHA 1994)].

A copy of this HASP will be maintained in the field laboratory, field vehicles, and in a designated area on the sampling vessels at all times. All individuals performing fieldwork must read, understand, and comply with this plan. Visitors to the field laboratory and on sampling vessels must also read and comply with the plan. The plan must be read before a participant undertakes field activities. If any part of this HASP is unclear, then the individual should seek clarification from Site Health and Safety Representative, Field Task Leader, or Health and Safety Officer prior to commencing fieldwork. Once the information has been read and understood, the individual must sign the Acknowledgment Form provided above, which will then be placed in the project file.

Similarly, all involved subcontractors to NOAA, must prepare their own HASPs that are at least as protective as this plan or they may adopt this plan as their own. If a subcontractor to NOAA elects to prepare its own HASP, copies of the plan and a signed acknowledgment similar to NOAA's Acknowledgment Form (see above) must be given to the HSO prior to the subcontractor's involvement in any field activities.

3. SCOPE OF WORK

Initial sampling will be conducted during two periods of six successive days mid-April to mid-June 2018 to capture sufficient sub-yearling Chinook to yield viable samples. Initial sampling will be planned for April, however should river flow or other environmental factor prevent safe or effective sampling, activities will be conducted in May and June. Information on the sampling plan and procedures as well as a detailed site map can be found in Portland Harbor Superfund Site Phase 3 Subyearling Chinook Sampling and Analysis: QAPP and FSP. A brief description of each field activity is provided below.

3.1 Fish Capture and Transport

Fish capture will be conducted using beach seine at designated sampling sites accessed from Willamette River via boat. Seine net will be deployed from R/V Stickleback, a 5.2m long Boston Whaler, and hauled to shore by a two-person crew. The beach seine measures 37m long with a max depth of 2.4m and a mesh size of 10mm. Personnel performing fish capture will be experienced in these activities. Vessel operator will be Sean Sol of NOAA or other qualified operator. Sean Sol has previously operated this vessel in this locale. NOAA vessels and their operation are subject to the NOAA Small Boat Standards and Procedures Manual administered by NOAA Small Boat Program, part of NOAA's Office of Marine and Aviation Operations (OMAO). On water operations will only be conducted during daylight hours. Prior to any on the water operations, river discharge and associated weather will be monitored using real time and forecast data available via appropriate U.S. Geological Survey (USGS) and National Weather Service (NWS) websites. Vessel will return and be moored at USCG MSU Portland small boat pier at the end of each sampling day.

3.2 Fish Sample Processing and Storage

During sampling operations a temporary field lab will be erected on the grounds of USCG MSU Portland to accept delivery of captured sub-yearling Chinook for further sample processing. All personnel performing fish sample processing will be experienced in these activities.

Laboratory equipment used to process fish will be dedicated to fish processing and will be decontaminated before use. PTFE (polytetrafluoroethylene) cutting boards or boards covered with aluminum foil and stainless steel dissection tools will be used for processing fish. Separate sets of cutting boards and dissection tools will be used for cutting fish and for excising the stomachs.

Decontamination of laboratory equipment and laboratory fish handling will follow the instructions of the Portland Harbor Superfund Site Phase 3 Subyearling Chinook Sampling and Analysis: QAPP and FSP.

Once collected, samples will be preserved and packaged for storage and eventual transport. Preservation will involve use of non-denatured ethanol and dry ice.

4. JOB HAZARD ANALYSIS

This section describes the health and safety hazards associated with NOAA's efforts to collect and sample subyearling Chinook on Lower Willamette River and control measures selected to protect workers. Purpose of job hazard analysis is to identify and quantify health and safety hazards associated with each site location, task, and operation; and to evaluate the risk to workers. Using this information, we select appropriate control methods to eliminate the

identified risks if possible, or to effectively control them. Potential hazards and corresponding control methods are provided in Section 4.2.

4.1 Site Description and Site Access

Lower Willamette River flows through Portland, OR and specifically Portland Harbor. This is an iconic river in the area with flowing current but is generally considered protected waters. This section of the waterway is highly developed with significant industrial activity and vessel traffic. Sample sites are located throughout this area of the river and will be accessed by boat. Personnel involved in seining operations at sample sites will be operating on or adjacent to the river and will not utilize any upland areas. During on the water operations all applicable maritime laws and safety regulations will be followed.

Shore side sample processing will occur in a temporary field lab erected at:

Unites States Coast Guard Marine Safety Unit Portland
6767 N Basin Ave
Portland, OR 97217

Sample vessel will also be stored at this location when not in use. Daily travel to and from this location will require operating motor vehicles on private and public roadways.

4.2 Potential Hazards and Mitigation

Drowning

Fish capture activities will be conducted while on or very near the water, include flowing river water with current present. As such, the potential for drowning will always be present. The risk of drowning is greatest while vessel is in motion or when deploying or retrieving sampling.

Mitigating Action: Personnel will wear USCG-approved Type II person floatation device (PFD) at all times while aboard the vessel and whenever working adjacent to the water. PFD will fit properly and be in good condition (e.g. no rips or holes, straps and hardware in working order) prior to being on the water. PFDs must be worn when working on docks, ramps, or other water adjacent structures. PFDs will be worn outside of clothing or any other PPE. PFDs will be worn with all straps, zippers, and ties fastened. Loose strap ends should be tucked in to avoid getting snagged while working.

Vessel Traffic during Sampling

Collisions between boats are one of the most dangerous and frequent boating accidents. Sampling will likely be conducted in areas used by other vessels. The lower Willamette River is a navigable river with significant vessel traffic as well as river current. As such, there is risk of collision or accident with either the sampling vessel and/or deployed sampling gear.

Mitigating Action: Only knowledgeable and qualified vessel operators will operate sample vessel as per NOAA Small Boat Program policy. Vessel operator will abide by USCG boating right-of-way rules. All personnel onboard should maintain lookout using both sight and hearing, and communicate any hazard to vessel operator. Vessel will travel at speeds where proper and effective actions can be taken to avoid collisions, given the prevailing circumstances and conditions.

Boat will remain visible at all times while on the water, using running lights at low-light conditions. When deployed, sampling gear should be visible to other vessels. This may require the use of buoys or brightly colored or retro-reflective flagging or markings.

If sampling in active shipping channels or in areas with heavy vessel traffic, gear deployment and retrieval should be conducted in an expedient and deliberate manner. If applicable port authorities should be notified of proposed sampling times and locations before sampling activities begin. If other vessels are in the area, sampling vessel will maintain communication with other vessel captains. In accordance with NOAA Small Boat Program policy a working VHF radio will be available on board for ship to ship and emergency communication if necessary.

Contact with Biologically Contaminated Water

Waterborne, disease-causing organisms (pathogens) are found in nearly all surface water systems. Pathogens enter surface water through untreated sewage discharges and bypasses, storm and agricultural runoff, and direct contact. Pathogens may enter the body when contaminated media are ingested or exposed to open cuts or abrasions.

Mitigating Action: Use caution and extra protection when working in or around water with known or suspected contamination. Communicate known or suspected contamination to all personnel who could come into contact with a contaminated sample. Pathogens can enter the body from open wounds and be transferred from the environment to the mouth by eating, drinking, or smoking after potential exposure. To reduce the risk of infection, use antibacterial soap or hand cleaner throughout the day.

Immune-challenged personnel should notify the HSO or SHSR prior to sampling so that additional health and safety requirements such as additional PPE can be provided.

Contact with Chemically Contaminated Environmental Media during Project Activities

The location of Sample Site H, Terminal 4, has been identified as associated with higher concentrations of pollutants and greater potential for PAH exposure.

Mitigating Action: Sampling at this site has included advance communication with EPA. All personnel embarked at this site have completed HAZWOPER training and are up to date on any required annual refresher training. PPE use at this site is mandatory and strictly enforced to

include nitrile gloves and waterproof boots and/or waders. Particular caution will be exercised to minimize disturbance of wet or dry sediments while sampling at this or other sites where contamination is known or suspected to exist.

PPE used at this site will be cleaned of any evident soiling before continuing to other sampling sites. As is practicable, beach seine net will be rinsed using river water between sites or whenever net appears soiled or to have retained any residue or debris. Personnel will dispose of or decontaminate/wash clothing and PPE with known or suspected exposure to contaminants at the end of each day. Soap and water will be available for hand washing. Personnel will also avoid eating, drinking, or smoking at a sampling site. If personnel have been exposed to site contaminants while sampling, proper sanitary precautions (i.e., washing) must occur prior to eating, drinking, or smoking. If an adverse exposure reaction occurs, the affected individual will immediately notify the SHSR, avoid any additional contact with contaminated media, and seek appropriate medical attention.

Personnel will communicate known or suspected contamination to all research team members who could come into contact with contamination or be exposed to chemical hazards.

Cold Stress

While cold weather conditions are not anticipated, the risk of cold stress may be a factor if personnel are wet from rain or field sampling activities and exposed to wind.

Mitigating action: Protect exposed skin surfaces with appropriate clothing (such as face masks, gloves, and footwear) that insulates, stays dry, and blocks wind. Use adequate insulating clothing to maintain a body core temperature above 96.8°F. Have extra insulating clothing onsite. If wind is an issue, shield the work area with windbreaks to reduce the cooling effects of wind.

All field staff should be aware of hypothermia warning signs. These signs include uncontrolled shivering, stiffness of joints, loss of coordination, slurred speech, shallow breathing, and unconsciousness. If any of these warning signs are observed, move the affected person(s) to a warm, dry location as soon as possible. If symptoms remain or progress, seek medical attention.

Automobile Traffic in Parking Lots and Near Roadways

Some activities may require operation of automobiles in public and private parking lots and roadways. With these activities there is the risk of being involved in an automobile accident while moving or parked.

Mitigating action: All personnel operating or riding in vehicles will wear their seatbelt at all times. Drivers will obey all posted traffic signs, speed limits, and local rules of vehicle operation and avoid traveling on unfamiliar roadways, especially at night. Use of alcohol, prescription/illegal drugs, or a cellular telephone (including both texting and talking, hand-held

or hands-free) while operating employer-owned, leased, or rented vehicles or equipment is a direct violation of NOAA policy and is not permitted. Drivers will not operate a motor vehicle if drowsy or sleepy. Always park vehicles in designated parking areas. Off roadway parking with good fore and aft visibility should be considered. If temporarily parked in a loading zone or off a roadway, turn on the vehicle's flashers. Cross roadways in designated crossings or in locations where you are clearly visible to oncoming traffic. Do not assume that as a pedestrian you have the right-of-way.

Exposure to Chemical Products Used for Sampling Purposes

Potentially hazardous chemicals may be used for equipment decontamination and sample processing. Chemical products used for decontamination and sample processing purposes include, but may not be limited to, ethanol, isopropyl alcohol, and dry ice.

Mitigating Action: Only personnel trained and familiar with the use of chemical products will use these products. Appropriate PPE should be worn at all times when working with hazardous or unknown chemical products (including appropriate gloves and safety glasses). Wear appropriate PPE at all times during decontamination procedures as there may be an exposure hazard to contaminants in the rinsing/wash waters.

Safety data sheets (SDS) will be available to personnel for each chemical product. The SDS sheets for ethanol, isopropyl alcohol, and dry ice can be found in Appendix C, Section 7.

Unused or spent chemicals will be appropriately labeled and stored so that the risk of accidental exposure is limited. When used, respective samples should also be labeled so that the contents are readily identified. Both unused and spent chemicals should be stored so that if sample containers break, there is secondary containment of the chemical. Absorbent material such as paper towels should also be used to contain any potential leakage.

Proper decontamination materials should be available to address accidental exposure and spills. Tap or raw water and soap will be available for hand washing. Personnel will also avoid unnecessary exposure to site chemicals by not eating, drinking, or smoking at a site or after leaving the site without taking proper sanitary precautions. An eye wash bottle will be on hand at all times while working with chemicals. An eyewash station is also available at MSU Portland. If an adverse exposure reaction occurs, the affected individual will immediately notify the SHSR, avoid any additional contact with contaminated media, and seek appropriate medical attention.

Slip, Trip, and Fall Hazards

These hazards may be present in all areas at all times; however, there is a particular risk of falling when entering or departing the boat or working on the deck of the boat while out on the water.

Mitigating Action: Keep all walkways clear of obstructions. Survey the area for any of these hazards upon entering an area. Clean up liquid spills immediately. Avoid clutter in work areas. Ensure that footwear is sturdy and slip-resistant and that clothing is properly fitted and in good condition. When on the boat, maintain three points of contact and use handrails if available.

Cuts, Abrasions, and Pinch Points

Risk of cuts, abrasions, and pinch points could be present during collection and processing of samples, decontamination of equipment, and other general activities on or around the boat or field lab. Sample instruments are very sharp and are a significant hazard.

Mitigating Action: Take care when working with sharp equipment and glassware to avoid possible puncture and abrasion wounds. Maintain control of doors/hatches; and keep fingers and feet clear of lines/ropes, rigging/blocks, and docks/piers. Wear appropriate PPE. Puncture and abrasion wounds can be painful and are a risk for infection. Keep steady pressure on bleeding wounds until the bleeding stops. Seek emergency medical treatment in the event of a serious wound that requires care beyond basic first aid treatment (see Appendix C, Section 1.1, Evacuation Procedures, for transport procedures in event of medical emergency). First Aid Kit will be available on board vessel and ashore. Clean minor wounds with soap and clean water, dress with antibacterial ointment, and monitor for infection. Use appropriate hard-sided containers designated for disposal of any sharps or broken glass.

Exposure to Human Blood and Bodily Fluids (biological hazards)

If an injury results in loss of blood or when needle-stick or sharps-related injuries occur, workers may be exposed to blood borne pathogens. Blood borne pathogens are pathogenic microorganisms that are present in human blood and can cause disease in humans. Pathogens include, but are not limited to, human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV).

Mitigating Action: Avoid direct contact with blood or any other bodily fluids. Treat all blood and body fluid spills as if they were infectious. After removing PPE, wash hands or other affected body parts with soap and warm water. Vigorously scrub all areas to remove all potentially infectious contamination. If affected, eyes should be irrigated with clean water and/or saline. If you have an open wound that is exposed, squeeze gently to make it bleed, then wash with soap and warm water. After any exposure to bodily fluids (other than your own), seek emergency medical treatment.

Lifting Heavy Objects

Proposed field work will require lifting and moving heavy objects such as coolers, nets, and other sampling or laboratory equipment.

Mitigating Action: Solicit help when lifting items exceeding 50 pounds. Support the weight with your knees and avoid twisting your body while lifting any object. Use a furniture dolly or hand truck when moving heavy boxes and equipment. Pay particular care if lifting wet or saturated items that may have increased in weight due to water retention.

Inclement Weather

During spring, weather conditions in the Pacific Northwest can vary greatly. Rain is frequent and at times heavy. Both wind and rain can arise with little warning. Non-local weather including heavy rainfall or warmer temperatures can have significant impact on river discharge and conditions encountered in the field. Overall weather and river conditions can change throughout the day.

Mitigating Action: The Field Task Leader and the SHSR will monitor current weather and river discharge as well as forecasts prior to beginning each day's activities and will continue to monitor weather conditions during all field work. Field activities will be halted and appropriate shelter will be sought if weather conditions present a threat to personnel.

Indigenous Wildlife

While most field sampling activities will occur on a boat and in an urbanized area, there is still risk of exposure to potentially dangerous or bothersome terrestrial and aquatic wildlife and insects.

Mitigating action: All personnel will remain aware of their surroundings and monitor for the presence of wildlife. Contact with wildlife will be avoided if encountered. Gloves will be worn whenever handling fish. When handling or processing catch specific care should be taken with those fish species known to have spines or potentially sharp teeth. Personnel being stung or bitten will immediately seek appropriate medical attention, if necessary.

5. PPE AND GENERAL SITE SAFETY

5.1 PPE Selection and Use

Site safety and health hazards will be eliminated or reduced to the greatest extent possible through engineering controls and work practices. Where hazards are still present, a combination of engineering controls, work practices, and PPE will be used to protect employees.

An initial level of PPE (i.e., Level D) will be assigned to each task to provide an adequate barrier to hazardous exposures and other risks. Initial PPE ensembles are selected based on the anticipated route(s) of entry of chemicals onsite and their suspected concentration, as well as risk from physical hazards. When necessary, multiple layers of protection will be used to

accommodate the range of hazards that may be encountered. Final PPE ensembles will be determined by the SHSR after assessment of field conditions. PPE Level D for this project includes:

- PFD (Type I or II, properly fit and in good condition)
- Sturdy, closed toe shoes that are non-slip
- Sun protection (e.g., hat, sunscreen)
- Insect repellent (if necessary)
- Nitrile gloves when presented with a risk of encountering contaminants or handling fish or chemicals
- Long pants that cover the ankle
- Foul weather gear (if necessary)

5.2 PPE Decontamination

All disposable sampling equipment, clothing, and PPE must be carefully placed into a sealable plastic bag (e.g., trash bag) for disposal. Reusable clothing exposed to contamination may be washed with detergent at the end of each day or appropriately disposed of. All sampling equipment and exposed reusable PPE (e.g., boots, rubber gloves) must be decontaminated as soon as possible. Proper decontamination procedures for reusable PPE and sampling equipment include:

- Rinse the affected equipment/PPE with a mixture of phosphate-free detergent and distilled/tap water
- Scrub the affected equipment/PPE with a dedicated decontamination brush
- Rinse the brushed equipment/PPE with tap water

All personnel are to thoroughly wash all exposed flesh with distilled/tap water and a detergent prior to leaving the site. Tap water will be available onboard for decontamination purposes. It is the responsibility of each individual to also thoroughly shower upon their arrival at their point of lodging and machine wash (with detergent) any reusable clothing or garments that were worn during that day and exposed to contamination. Contaminated reusable garments are to be machine washed separately from other clothing items.

5.3 Safety Requirements

Prior to the start of work, all team members that work with or are potentially exposed to hazardous chemicals must:

- Complete 24-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training (at a minimum)
- Review and sign off on the HASP

6. REFERENCES

EPA. 1992. Standard Operating Safety Guides. United States Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC.

OMAO. United States Department of Commerce, National Oceanic and Atmospheric Administration, Office of Marine and Aviation Operations, Small Boat Program. 2017. "The NOAA Small Boat Standards and Procedures Manual, 4th Edition."

OSHA. United States Department of Labor, Occupational Safety and Health Administration. 29 CFR Parts 1910 and 1926. Hazardous Waste Operations and Emergency Response. https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9765 (accessed on March 26, 2018)

7. ATTACHMENTS

The listed attachments can be found in the pages that follow.

- Form 1 Modification to Health and Safety Plan
- Safety Data Sheets (dry ice, ethanol, and isopropyl alcohol)

FORM 1
MODIFICATION TO HEALTH AND SAFETY PLAN
DATE ___ / ___ / _____

Project _____

Modification

_____
_____
_____
_____
_____

Reasons for Modification

_____
_____
_____
_____
_____

Site Personnel Briefed

Name: _____ Date: _____

Name: _____ Date: _____

Name: _____ Date: _____

Name: _____ Date: _____

Name: _____ Date: _____

Name: _____ Date: _____

Name: _____ Date: _____

Name: _____ Date: _____

Name: _____ Date: _____

Approvals

Field Task Leader: _____

Principle Investigator: _____

Site Health and Safety Representative: _____

Health and Safety Officer: _____

SAFETY DATA SHEET: Dry ice

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Dry ice
Product Number : 93508
CAS-No. : 124-38-9

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Simple Asphyxiant,
For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram None
Signal word Warning
Hazard statement(s) May displace oxygen and cause rapid suffocation.
Precautionary statement(s) None

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS

Contact with liquid or refrigerated gas can cause cold burns and frostbite.

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Formula : CO2
Molecular weight : 44.01 g/mol
CAS-No. : 124-38-9

Hazardous components

Component	Classification	Concentration
Carbon dioxide		
	SA ;	<= 100%

4. FIRST AID MEASURES

4.1 Description of first aid measures

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration.

In case of skin contact
Wash off with soap and plenty of water.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

No data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture

No data available

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information

No data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Avoid dust formation. Avoid breathing vapours, mist or gas.
For personal protection see section 8.

6.2 Environmental precautions

No special environmental precautions required.

6.3 Methods and materials for containment and cleaning up

Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Further processing of solid materials may result in the formation of combustible dusts.
The potential for combustible dust formation should be taken into consideration before additional processing occurs.
Provide appropriate exhaust ventilation at places where dust is formed.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.
Recommended storage temperature -70 °C
Storage class (TRGS 510): Non Combustible Solids

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control Parameters	Basis
Carbon dioxide	124-38-9	TWA	5,000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Asphyxia		
		TWA	5,000.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Asphyxia		
		STEL	30,000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Asphyxia		

		STEL	30,000.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Asphyxia		
		TWA	5,000.000000 ppm 9,000.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		TWA	5,000.000000 ppm 9,000.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		Normal constituent of air (about 300 ppm)		
		ST	30,000.000000 ppm 54,000.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		Normal constituent of air (about 300 ppm)		
		TWA	5,000 ppm 9,000 mg/m3	USA. NIOSH Recommended Exposure Limits
		Normal constituent of air (about 300 ppm)		
		ST	30,000 ppm 54,000 mg/m3	USA. NIOSH Recommended Exposure Limits
		Normal constituent of air (about 300 ppm)		
		TWA	5,000 ppm 9,000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		PEL	5,000 ppm 9,000 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		STEL	30,000 ppm 54,000 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)

8.2 Exposure controls

Appropriate engineering controls
General industrial hygiene practice.

Personal protective equipment
Eye/face protection
Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Body Protection
Choose body protection in relation to its type, to the concentration and amount of dangerous substances, andto the specific work-place., the type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Respiratory protection is not required. Where protection from nuisance levels of dusts are desired, use type N95 (US) or type P1 (EN 143) dust masks. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
No special environmental precautions required.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: solid Color: opaque white
b)	Odor	No data available
c)	Odor Threshold	No data available
d)	pH	3.7
e)	Melting point/freezing point	-78.49 °C (-109.28 °F)
f)	Initial boiling point and boiling range	No data available
g)	Flash point	Not applicable
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapor pressure	57,300 hPa (42,979 mmHg)
l)	Vapor density	No data available

m) Relative density 1.562 g/cm3

n) Water solubility No data available

o) Partition coefficient: n-octanol/water No data available

p) Auto-ignition temperature No data available

q) Decomposition temperature No data available

r) Viscosity No data available

s) Explosive properties No data available

t) Oxidizing properties No data available

9.2 Other safety information
No data available

10. STABILITY AND REACTIVITY

10.1 Reactivity
No data available

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
No data available

10.4 Conditions to avoid
No data available

10.5 Incompatible materials
Strong oxidizing agents

10.6 Hazardous decomposition products
Hazardous decomposition products formed under fire conditions. - Carbon oxides
Other decomposition products - No data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
No data available

Inhalation: No data available
Dermal: No data available

Skin corrosion/irritation
Causes skin burns.

Serious eye damage/eye irritation
No data available

Respiratory or skin sensitization
No data available

Germ cell mutagenicity
No data available

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity
No data available
No data available

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

Additional Information
RTECS: FF6400000
Difficulty in breathing, Unconsciousness, death

12. ECOLOGICAL INFORMATION

12.1 Toxicity
No data available

12.2 Persistence and degradability
No data available

12.3 Bioaccumulative potential
No data available

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects
No data available

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product
Offer surplus and non-recyclable solutions to a licensed disposal company.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 1845 Class: NONE Packing group: III
Proper shipping name: A. W. Dry ice
Reportable Quantity (RQ):
Poison Inhalation Hazard: No

IMDG
UN number: 1845 Class: 9 Packing group: III EMS-No: F-C, S-V
Proper shipping name: DRY ICE

IATA
UN number: 1845 Class: 9
Proper shipping name: Dry ice

15. REGULATORY INFORMATION

SARA 302 Components
No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Carbon dioxide	124-38-9	1993-04-24

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Carbon dioxide	124-38-9	1993-04-24

New Jersey Right To Know Components

	CAS-No.	Revision Date
Carbon dioxide	124-38-9	1993-04-24

California Prop. 65 Components
This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

May displace oxygen and cause rapid suffocation.
SA Simple Asphyxiant

HMIS Rating
Health hazard: 0

Chronic Health Hazard:	
Flammability:	0
Physical Hazard	0

NFPA Rating

Health hazard:	0
Fire Hazard:	0
Reactivity Hazard:	0

SAFETY DATA SHEET: Ethanol, pure

1. PRODUCT IDENTIFICATION

1.1 Product identifiers

Product name	:	Ethanol, pure
Product Number	:	459836
Index-No.	:	603-002-00-5
CAS-No.	:	64-17-5

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses: Laboratory chemicals, Manufacture of substances

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Flammable liquids (Category 2), H225
For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word Danger

Hazard statement(s)
H225 Highly flammable liquid and vapour.

Precautionary statement(s)
P210 Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P233 Keep container tightly closed.
P240 Ground/bond container and receiving equipment.
P241 Use explosion-proof electrical/ ventilating/ lighting/ equipment.
P242 Use only non-sparking tools.
P243 Take precautionary measures against static discharge.
P280 Wear protective gloves/ protective clothing/ eye protection/ face protection.

P303 + P361 + P353 IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower.
P370 + P378 In case of fire: Use dry sand, dry chemical or alcohol-resistant foam for extinction.
P403 + P235 Store in a well-ventilated place. Keep cool.
P501 Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Synonyms : Absolute alcohol
Formula : C2H6O
Molecular Weight : 46.07 g/mol
CAS-No. : 64-17-5
EC-No. : 200-578-6
Index-No. : 603-002-00-5

Hazardous components

Component	Classification	Concentration
Ethanol		
	Flam. Liq. 2; H225	-

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.
Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration.
Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
no data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media
Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
no data available

5.3 Advice for firefighters
Wear self contained breathing apparatus for fire fighting if necessary.

5.4 Further information
Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas. For personal protection see section 8.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up
Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

6.4 Reference to other sections
For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
Use explosion-proof equipment.Keep away from sources of ignition - No smoking.Take measures to prevent the build up of electrostatic charge.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.
Hygroscopic.

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control Parameters	Basis
Ethanol	64-17-5	TWA	1,000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Upper Respiratory Tract irritation Confirmed animal carcinogen with unknown relevance to humans		
		TWA	1,000 ppm 1,900 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate		
		TWA	1,000 ppm 1,900 mg/m3	USA. NIOSH Recommended Exposure Limits

8.2 Exposure controls

Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection
Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: butyl-rubber
Minimum layer thickness: 0.3 mm
Break through time: 480 min
Material tested:Butoject® (KCL 897 / Aldrich Z677647, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.2 mm
Break through time: 38 min
Material tested:Dermatril® P (KCL 743 / Aldrich Z677388, Size M)
data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
impervious clothing, Flame retardant antistatic protective clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multipurpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls.
If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: liquid, clear
b)	Odor	no data available
c)	Odor Threshold	no data available
d)	pH	no data available
e)	Melting point/freezing point	Melting point/range: -114 °C (-173 °F)
f)	Initial boiling point and boiling range	78 °C (172 °F)
g)	Flash point	14.0 °C (57.2 °F) - closed cup
h)	Evaporation rate	no data available
i)	Flammability (solid, gas)	no data available
j)	Upper/lower flammability or explosive limits	Upper explosion limit: 19 %(V) Lower explosion limit: 3.3 %(V)
k)	Vapor pressure	59.5 hPa (44.6 mmHg) at 20.0 °C (68.0 °F)
l)	Vapor density	no data available
m)	Relative density	0.789 g/mL at 25 °C (77 °F)
n)	Water solubility	completely soluble
o)	Partition coefficient n-octanol/water	no data available
p)	Auto-ignition temperature	363.0 °C (685.4 °F)
q)	Decomposition temperature	no data available
r)	Viscosity	no data available
s)	Explosive properties	no data available
t)	Oxidizing properties	no data available

9.2 Other safety information
no data available

10. STABILITY AND REACTIVITY

10.1 Reactivity
no data available

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
Vapours may form explosive mixture with air.

10.4 Conditions to avoid
Heat, flames and sparks. Extremes of temperature and direct sunlight.

10.5 Incompatible materials
Alkali metals, Ammonia, Oxidizing agents, Peroxides

10.6 Hazardous decomposition products
Other decomposition products - no data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects
Acute toxicity
LD50 Oral - rat - 7,060 mg/kg
Remarks: Lungs, Thorax, or Respiration: Other changes.
LC50 Inhalation - rat - 10 h - 20000 ppm
Dermal: no data available
no data available

Skin corrosion/irritation
Skin - rabbit
Result: No skin irritation - 24 h
(OECD Test Guideline 404)

Serious eye damage/eye irritation
Eyes - rabbit
Result: Mild eye irritation - 24 h
(OECD Test Guideline 405)

Respiratory or skin sensitisation
no data available

Germ cell mutagenicity
no data available

Carcinogenicity
Carcinogenicity - mouse - Oral
Tumorigenic:Equivocal tumorigenic agent by RTECS criteria. Liver:Tumors.
Blood:Lymphomas including Hodgkin's disease.

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity
no data available

Reproductive toxicity - Human - female - Oral
Effects on Newborn: Apgar score (human only). Effects on Newborn: Other neonatal measures or effects. Effects on
Newborn: Drug dependence.

Specific target organ toxicity - single exposure
no data available

Specific target organ toxicity - repeated exposure
no data available

Aspiration hazard
no data available

Additional Information
RTECS: KQ6300000
Central nervous system depression, narcosis, Damage to the heart., To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Heart - Irregularities - Based on Human Evidence
Stomach - Irregularities - Based on Human Evidence

12. ECOLOGICAL INFORMATION

12.1 Toxicity
no data available

12.2 Persistence and degradability
no data available

12.3 Bioaccumulative potential
no data available

12.4 Mobility in soil
no data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects
no data available

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product
Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 1170 Class: 3 Packing group: II
Proper shipping name: Ethanol
Reportable Quantity (RQ):
Marine pollutant: No
Poison Inhalation Hazard: No

IMDG
UN number: 1170 Class: 3 Packing group: II EMS-No: F-E, S-D
Proper shipping name: ETHANOL
Marine pollutant: No

IATA
UN number: 1170 Class: 3 Packing group: II
Proper shipping name: Ethanol

15. REGULATORY INFORMATION

SARA 302 Components
SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards
Fire Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Ethanol	64-17-5	2007-03-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Ethanol	64-17-5	2007-03-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Ethanol	64-17-5	2007-03-01

California Prop. 65 Components
This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Flam. Liq.	Flammable liquids
H225	Highly flammable liquid and vapor.

HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	3
Physical Hazard	0

NFPA Rating

Health hazard:	2

Fire Hazard: 3
Reactivity Hazard: 0

SAFETY DATA SHEET: Isopropyl alcohol

1. PRODUCT IDENTIFICATION

1.1 Product identifiers

Product name : Isopropyl alcohol
Product Number : W292912
Index-No. : 603-117-00-0
CAS-No. : 67-63-0

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses: Laboratory chemicals, Synthesis of substances

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Flammable liquids (Category 2), H225
Eye irritation (Category 2A), H319
Specific target organ toxicity - single exposure (Category 3), Central nervous system, H336
For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word Danger

Hazard statement(s)
H225 Highly flammable liquid and vapour.
H319 Causes serious eye irritation.
H336 May cause drowsiness or dizziness.

Precautionary statement(s)
P210 Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P233 Keep container tightly closed.
P240 Ground/bond container and receiving equipment.

P241 Use explosion-proof electrical/ ventilating/ lighting/ equipment.
P242 Use only non-sparking tools.
P243 Take precautionary measures against static discharge.
P261 Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P264 Wash skin thoroughly after handling.
P271 Use only outdoors or in a well-ventilated area.
P280 Wear protective gloves/ eye protection/ face protection.
P303 + P361 + P353 IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304 + P340 + P312 IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/doctor if you feel unwell.
P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P337 + P313 If eye irritation persists: Get medical advice/ attention.
P370 + P378 In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P403 + P233 Store in a well-ventilated place. Keep container tightly closed.
P403 + P235 Store in a well-ventilated place. Keep cool.
P405 Store locked up.
P501 Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Synonyms	:	2-Propanol sec-Propyl alcohol IPA Isopropanol
Formula	:	C_3H_8O
Molecular weight	:	60.1 g/mol
CAS-No.	:	67-63-0
EC-No.	:	200-661-7
Index-No.	:	603-117-00-0

Hazardous components

Component	Classification	Concentration
2-Propanol		
	Flam. Liq. 2; Eye Irrit. 2A; STOT SE 3; H225, H319, H336	<= 100%

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.
Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration.
Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person.
Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
No data available

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Use personal protective equipment. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapors accumulating to form explosive concentrations. Vapors can accumulate in low areas.
For personal protection see section 8.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up
Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

6.4 Reference to other sections
For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
Use explosion-proof equipment. Keep away from sources of ignition - No smoking.
Take measures to prevent the build up of electrostatic charge.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control Parameters	Basis
2-Propanol	67-63-0	TWA	200.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices Not classifiable as a human carcinogen		
		TWA	200 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices Not classifiable as a human carcinogen		
		STEL	400 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices Not classifiable as a human carcinogen		
		STEL	400.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Upper Respiratory Tract irritation Eye irritation Substances for which there is a Biological Exposure Index or Indices Not classifiable as a human carcinogen		
		TWA	400.000000 ppm 980.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		TWA	400.000000 ppm 980.000000 mg/m3	USA. NIOSH Recommended Exposure Limits

		ST	500.000000 ppm 1,225.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		PEL	480 ppm 980mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		STEL	500 ppm 1,225 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
2-Propanol	67-63-0	Acetone	40.0000 mg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift at end of work week			

8.2 Exposure controls

Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Eye/face protection
Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Body Protection
Impervious clothing, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multipurpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls.
If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: liquid Color: colorless
b)	Odor	alcohol-like
c)	Odor Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	-89.49 °C (-129.08 °F)
f)	Initial boiling point and boiling range	81.0 - 83.0 °C (177.8 - 181.4 °F)
g)	Flash point	12.0 °C (53.6 °F) - closed cup
h)	Evaporation rate	3.0
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	Upper explosion limit: 12.7 %(V) Lower explosion limit: 2 %(V)
k)	Vapour pressure	43.2 hPa (32.4 mmHg) at 20.0 °C (68.0 °F) 58.7 hPa (44.0 mmHg) at 25.0 °C (77.0 °F)
l)	Vapour density	No data available
m)	Relative density	0.78 g/cm3
n)	Water solubility	completely soluble

o)	Partition coefficient: n-octanol/water	log Pow: 0.05
p)	Auto-ignition temperature	425.0 °C (797.0 °F)
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information

Surface tension	20.8 mN/m at 25.0 °C (77.0 °F)

10. STABILITY AND REACTIVITY

10.1 Reactivity
No data available

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
Vapors may form explosive mixture with air.

10.4 Conditions to avoid
Heat, flames and sparks.

10.5 Incompatible materials
Oxidizing agents, Acid anhydrides, Aluminum, Halogenated compounds, Acids

10.6 Hazardous decomposition products
Other decomposition products - No data available
Hazardous decomposition products formed under fire conditions. - Carbon oxides
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - Rat - 5,045 mg/kg
Remarks: Behavioral:Altered sleep time (including change in righting reflex). Behavioral: Somnolence (general depressed activity).

LC50 Inhalation - Rat - 8 h - 16000 ppm

LD50 Dermal - Rabbit - 12,800 mg/kg

No data available

Skin corrosion/irritation
Skin - Rabbit
Result: Mild skin irritation

Serious eye damage/eye irritation
Eyes - Rabbit
Result: Eye irritation - 24 h

Respiratory or skin sensitisation
No data available

Germ cell mutagenicity
No data available

Carcinogenicity

This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification.

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity
No data available
No data available

Specific target organ toxicity - single exposure
Inhalation, Oral - May cause drowsiness or dizziness.

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

Additional Information
RTECS: Not available

Central nervous system depression, prolonged or repeated exposure can cause:, Nausea, Headache, Vomiting, narcosis, Drowsiness, Overexposure may cause mild, reversible liver effects., Aspiration may lead to:, Lung oedema, Pneumonia
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Kidney - Irregularities - Based on Human Evidence
Kidney - Irregularities - Based on Human Evidence

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish LC50 - Pimephales promelas (fathead minnow) - 9,640.00 mg/l - 96 h
Toxicity to daphnia EC50 - Daphnia magna (Water flea) - 5,102.00 mg/l - 24 h
And other aquatic invertebrates
Immobilization EC50 - Daphnia magna (Water flea) - 6,851 mg/l - 24 h
Toxicity to algae EC50 - Desmodesmus subspicatus (green algae) -> 2,000.00 mg/l - 72 h
EC50 - Algae - > 1,000.00 mg/l - 24 h

12.2 Persistence and degradability
No data available

12.3 Bioaccumulative potential
No bioaccumulation is to be expected (log Pow <= 4).

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

No data available

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)

UN number: 1219 Class: 3 Packing group: II
Proper shipping name: Isopropanol
Reportable Quantity (RQ):
Poison Inhalation Hazard: No

IMDG

UN number: 1219 Class: 3 Packing group: II EMS-No: F-E, S-D
Proper shipping name: ISOPROPANOL

IATA

UN number: 1219 Class: 3 Packing group: II
Proper shipping name: Isopropanol

15. REGULATORY INFORMATION

SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
2-Propanol	67-63-0	1987-01-01

Massachusetts Right To Know Components

	CAS-No.	Revision Date
2-Propanol	67-63-0	1987-01-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
2-Propanol	67-63-0	1987-01-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
2-Propanol	67-63-0	1987-01-01

California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Eye Irrit.	Eye irritation
Flam. Liq.	Flammable liquids
H225	Highly flammable liquid and vapour.
H319	Causes serious eye irritation.
H336	May cause drowsiness or dizziness.
STOT SE	Specific target organ toxicity - single exposure

HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	3
Physical Hazard	0

NFPA Rating

Health hazard:	2
Fire Hazard:	3
Reactivity Hazard:	0

Appendix D. Data management

- This document contains supplemental material for the data management aspect of the field study.
    - Data intake and processing protocol outline used upon the return of the field sampling team to the field lab for the all cameras, GPS units, and field forms used during the field sampling
    - The NOAA OR&R field data electronic folder structure and example file names of folders and files used to process and store field collected data and information
    - Table D1. DIVER environmental data specifications – core fields
    - Table D2. A list of the templates that may be used to transcribe the data from the Fish Data and Sample Processing Forms
    - Table D3. Database table types and descriptions
    - Table D4. Laboratory data and documentation: database rules and specifications

Data intake and processing

Upon the return of the field sampling team to the field lab, data intake and processing will occur for the all cameras, GPS, and field forms used during the field sampling as well as the field lab processing forms are entered in NOAA's Data Management systems. This involves scanning all field forms and notebooks and uploading to DIVER File Collections.

Field crews and lab crews should remain available to the Data Management Team in order to answer any questions or address any issues that are discovered during processing.

Below is an outline of the Data Intake Protocols performed on a daily basis throughout the sampling event. Information about the folder structure and example file names are also included.

Post-field data intake protocols

- ☐ Preparation
  - Obtain all devices and forms from the field teams. A team member must be present during the data intake process to answer any questions that may come up.
  - If multiple camera and GPS units are used by a single team, make sure that they are paired correctly.
- ☐ Review the Photologger Form & Sign COC
  - Photo and GPS Metadata
    Ensure the photographer filled out all fields and provided key photos, descriptions, and keywords
  - Chain of Custody
    Ensure the photographer signs the COC when releasing the data to you. Once the steps below are completed and the data are in DIVER, sign the final paragraph on the Photologger Form.
- ☐ Download Photos to Computer in appropriate folders
  - See the appendix below for complete data intake folder structure
  - Download the photos directly to the Original_Image_Files folder. These will serve as the original copies taken from the camera and need to be preserved. They should not be opened, edited, deleted. Create a zip file that will be uploaded to DIVER as the archive.
  - Copy these original photos to the Photologger_Photos folder.
- ☐ Extract Tracks and Waypoints from GPS Unit
  - Connect GPS unit to computer (remember your cables)
  - Start Garmin MapSource
    1) Click on the "Receive from Device" icon.
    2) Click Find Device (the name of your GPS unit will appear)
    3) Under "What to Receive" > Click only Waypoints and Tracks
    4) Click "Receive" (you will now see the tracks/waypoints for that day)
  - Save .gdb and .gpx files and .txt, then zip all 3 files into one zip file.
- ☐ Scan Field Forms

- Retain all field form originals. Make sure all information is filled out. The note taker's name and date should be on every page.
- Scan all field forms for each team into separate PDFs.

☐ Samples and COC

- Check SampleIDs on the Field Sample Form and confirm they are an exact match to the sample COC and Sample Labels. The original COC form remains with the samples.

☐ Upload Photos, GPS Files, and Photologger Form and other docs (field forms, notebooks, and COCs) to DIVER

- In the DIVER Workspace, upload all field files to a new DIVER File Collection for the specific day.

NOAA OR&R field data electronic folder structure and example file names of folders and files

- Incident or Case Name
  - Spatial_Data *(working GIS data, projects)*
  - Documents *(general reports, maps, weather, etc., not part of field data collection)*
    - Contact List
    - Daily Reports
    - IAP
    - Trajectories
      - YYYY_MMDD
    - Weather
  - Photologger_Photos *(processing space for Photologger and GeoJot, output files)*
    - PhotologgerDatabase.mdb *(master MDB at root level)*
    - Working
      - YYYY_MMDD
        - LastName_FirstName
          - IMG_001.jpg
    - Output_Photologger *(auto-generated by APL for ERMA)*
      - 20151008_12345_SmithM
        - ERMAPhotoUpload_20151008.zip (Uploads to ERMA)
    - ResponseLink *(auto-generated by APL for ResponseLink)*
      - RLinkUpload_20151008_1234.zip (Uploads to ResponseLink)
  - Field_Data_Files *(files to be uploaded to DIVER)*
    - TWG Name *(ex. Sea_Turtle, SCAT)*
      - YYYY_MMDD_LastName_FirstName *(Field team lead)* – OR:
      - YYY_MMDD_FieldTeamName *(Designated field team name)*
      - *Ex. 2015_1008_RIA1*
        - COC *(Chain of Custody form)*
          - COC_YYYY_MMDD_TeamName.pdf
          - *Ex. COC_2015_1008_RIA1.pdf*
        - GPS *(GPS track)*
          - GPS_YYYY_MMDD_AssociatedCamera#_TeamName.gpx
          - *Ex. GPS_2015_1008_Cam3_RIA1.gpx*
        - Maps *(Final field observation map)*
          - FieldMap_YYYY_MMDD_TeamName.pdf
          - *Ex. FieldMap_2015_1008_RIA1.pdf*
        - Notes *(Field notes)*
          - Notes_YYYY_MMDD_TeamName.pdf
          - *Ex. Notes_2015_1008_RIA1.pdf*
        - ObservationForms *(Observation form)*
          - Observationform_YYYY_MMDD_TeamName.pdf
          - *Ex. ObservationForm_2015_1008_RIA1.pdf*
        - Original_Image_Files *(Original image files)*
          - Photos_YYYY_MMDD_Camera#_GPS#_TeamName.zip
          - *Ex. Photos_2015_1008_Cam1_GPS2_RIA1.zip*
        - PhotoLoggerDocument *(Photologger Form)*
          - PhotologgerForm_YYYY_MMDD_TeamName.pdf
          - *Ex. PhotoForm_2015_1008_RIA1.pdf*
        - SampleForms *(Field sample form)*
          - SampleForm_YYYY_MMDD_TeamName.pdf
          - *Ex. SampleForm_2015_1008_RIA1.pdf*

Table D1. DIVER environmental data specifications – core fields

The core fields identify overlapping concepts generally implicit in each data set. The core field information makes the related data within DIVER available for searching and download. If a specific core data field is not applicable to a particular data set, it is assigned a default value (typically "Not Defined") so that comprehensive data searches return full results.

Field Name	Field Definition	Field Set Within DIVER Explorer	Field Value Source
Case/Activity	The name of the case incident or the activity used to collect data.	Case/Activity Overview	User-Generated
Collection Workplan	The workplan under which the field data were collected.	Case/Activity Overview	User-Generated
Region	Region	Case/Activity Overview	User-Generated
Workgroup	The Technical Working Group under which the field data were collected.	Case/Activity Overview	User-Generated
Workplan Topic Area	The main resources of focus of a Collection Workplan.	Case/Activity Overview	User-Generated
Workspace Name	Name of the Portal Workspace where data were entered.	Case/Activity Overview	User-Generated
Collection Form	The type of the data submission form used by the field team to submit raw field data.	Collection Summary	User-Generated
Collection Study Name	The name of the study under which the field data were collected.	Collection Summary	User-Generated
Data Category	General category of data collection (e.g., Instruments, Photographs, Samples, or Visual Observations).	Collection Summary	User-Generated
Data Classification	The purpose for which data was collected within the case incident or activity.	Collection Summary	User-Generated
Data Source	The originating owner of the dataset.	Collection Summary	User-Generated
Source Type	General owner/source of the data (e.g., NRDA, Response, Responsible Party).	Collection Summary	User-Generated
Collection Matrix	The type of sample or record collected (e.g., Sediment, Water, Photograph, Wipe).	Field Data	User-Generated
SampleID	Unique ID assigned to each sample by the field sampler.	Field Data	User-Generated

Field Name	Field Definition	Field Set Within DIVER Explorer	Field Value Source
Station/Site	Station or site identifier. This is often defined by the workplan and/or recorded by the field team, but may be standardized to database requirements.	Field Data	User-Generated
Date	Data collection date, as year, month, and day.	Location/Date/Time	User-Generated
End Latitude	End Latitude	Location/Date/Time	User-Generated
End Longitude	End Longitude	Location/Date/Time	User-Generated
Start Latitude	Start Latitude	Location/Date/Time	User-Generated
Start Longitude	Start Longitude	Location/Date/Time	User-Generated
State	The state where the field event took place.	Location/Date/Time	User-Generated
Analysis Category	General category of analysis performed (e.g., Plankton_Nekton, Visual Observation, Contaminant Chemistry). For additional detail, see Analysis Type and/or Analysis.	Results: All Data Types	User-Generated
Analysis Status	Status of samples in the analysis process as reported by laboratories or through results (e.g., Archived, Results Available, In Analysis Queue etc.).	Results: All Data Types	User-Generated
Analysis Type	Subcategory (i.e., type) of analysis performed, such as Biomass, Hematology, Genetics, etc. For additional detail, see Analysis.	Results: All Data Types	User-Generated
Review Status	Extent of data quality review performed.	Results: All Data Types	User-Generated
Sharing Status	Identifies extent of data distribution (e.g., Publicly Available).	Results: All Data Types	User-Generated
Region ID	Region ID	Case/Activity Overview	DIVER-Created
Station Group List	Predefined sets of grouped stations/locations	Case/Activity Overview	DIVER-Created
DIVER Dataset	DIVER's internal database table name	Collection Summary	DIVER-Created
File Collection ID	Record identifier for the corresponding DIVER file collection.	Collection Summary	DIVER-Created
Record ID	Identifier for each observation data sheet entered into the DIVER database.	Collection Summary	DIVER-Created

Field Name	Field Definition	Field Set Within DIVER Explorer	Field Value Source
Trip ID	Identifier for tracking field collection events and the way data files were provided to the Data Management Team (one Trip ID per file collection or zip file).	Collection Summary	DIVER-Created
Image Id	Record identifier for a particular photograph.	Results: All Data Types	DIVER-Created
Link to Related Files	Link to source files for related data	Results: All Data Types	DIVER-Created
Photo URL - Midsize	Mid-sized image	Results: Photographs	DIVER-Created
Photo URL - Original	Original image	Results: Photographs	DIVER-Created
Photo URL - Thumbnail	Thumbnail sized image	Results: Photographs	DIVER-Created
QM Site ID	Identifier for a site in the Query Manager database.	Results: Samples	DIVER-Created

Table D2. A list of the templates that may be used to transcribe the data from the Fish Data and Sample Processing Forms.

Information on the field forms (Fish Data, and Sample Processing Form) are transcribed into ORR Electronic Data Delivery templates. These templates are set up to allow the data to be arranged in a format that allows a streamlined workflow to be integrated in DIVER. These templates also have functions that allow for QA/QC of the data and additional error checking.

Descriptive name	Name for Reference	Example data	File name	Description
TEMPLATES				
Chemistry/Toxicity Results	ChemTox	Tissue chemistry	NOAA_Template_ChemTox_Excel_V3.0_20180301.xlsx	Laboratory or field results for contaminant chemistry. Toxicity data from studies conducted in a laboratory.
Biological and other non-chem laboratory analysis (sample-based)	BioLab	Fish measurements and samples	NOAA_Template_BioLab_V1.2_20180301.xlsx	Measurements related to biological activity (either individual organism or community metrics), using field-collected or lab-derived samples and measured in a laboratory.
ANCILLARY FILES				
Study Notes tool	NA	Study meta-data	NOAA_StudyNotes_V2.8_20170320.accdb	A stand-alone Study Note application has been developed to assist the Template user in developing study meta-data. This application can be opened in another instance of MS Access while working on the template population.
Template Tester	Tester	NA	NOAA_Tester_V3.0_20180301.accdb	The Template Tester is a Microsoft Access VBA (Visual Basic for Applications) application that has been designed with the objective of identifying errors and omissions in completed Template files.
Template Guidance	NA	NA	NOAA_Templates_Guidance_20180301.xlsx	Guidance and instructions on the different templates, and their interoperability.

Table D3. Database table types and descriptions (bold text indicates main data tables; other tables are supplementary tables)

The database structure will have a five-tier hierarchy, i.e., five major table types that are split into a relational structure. The five types include the study table, station table, sample tables, chemistry tables, and bioassay tables. Data captured will adhere to rules and specifications listed in Table D4, "Laboratory Data and Documentation: Database Rules and Specifications."

Table Type	Description
study	The study table provides basic information regarding the study (e.g. name, contact, etc.) and identify the multiple sample collection events. Each study is assigned a unique, two-character StudyID, which is used to link to tables in the other tiers of the database hierarchy. **studynot** Contains information regarding the document(s) associated with the study and data. **studyref** Contains study-specific meta-data for specific topics.
station	The station table identifies locations for samples that were submitted for chemical and/or toxicological analyses. Each record of the table has a unique combination of SiteID + StudyID + StationID. Stations are defined for each study by a unique set of geographic coordinates reported as latitude and longitude. **stnlist** Contains a list of stations in each Station Group inlcuding historical Query Manager Watersheds **stnxtra** Contains additional attribute data for stations.
smpmaster	The sample tables provide information about the samples collected for chemical and/or toxicological analyses, including collection date, depth (if relevant for the matrix type), and sample type (e.g., field sample, field duplicate, composite sample). The master sample table stores all matrix types. Each record within the sample tables is unique based on SiteID + StudyID + StationID + SmpCode. **smpxtcoord** Contains additional coordinates associated with a sample, for example composited sub-sample locations. **smpxtra** Contains additional attribute data for samples. **tissrep** Sample information for part samples that make up composited tissue samples. **sedrep** Sample information for part samples that make up composited sediment samples.

chemmaster	The chemistry tables store the results for chemical analyses, for all matrix types. Supplementary chemistry tables store additional information related to analytical chemistry results. Each record is unique, based on SiteID + StudyID + StationID + SampleID + Labrep + Chemcode. Chemcodes are ten-character codes assigned to analytes. Using chemcodes eliminates the potential confusion associated with the multiple ways in which an analyte name might be written (e.g., dibenzo(a,h)anthracene versus dibenzo[a,h]anthracene) or with chemical synonyms used by different laboratories (e.g., 2-methylphenol versus o-cresol). Different Labrep codes are used for results where a duplicate chemical record might otherwise occur in the chemistry table. For example, if a sample was analyzed by the same analytical method and two different laboratories, the results may be distinguished by Labrep. **chemqc** Stores quality control samples, such as field blanks, that are not included in the chemmaster table. **chemns** Stores Tentatively Identified chemicals (TICS) and originally reported sums that are not included in the chemmaster table.
biosumm	Mean of sediment bioassay results, with one record per sample tested. **biorep** Contains replicate data from the sediment bioassay results.

Table D4. Laboratory data and documentation: database rules and specifications

Laboratory data will adhere to the following rules and specifications:

- For consistency and compatibility with legacy systems (based on an Xbase format), the tables are created with a structure requiring that the key fields used to link related tables have matching field sizes and the content of these fields must match between tables, in terms of upper and lower case lettering.
- In the station table, each record of the table is unique, based on SiteID + StudyID + StationID. Furthermore, within a study, each unique set of coordinates (as latitude/longitude) must have a unique StationID. No two StationIDs for the same study may have the same coordinates. Two sets of coordinates expressed as decimal degrees (the database standard format) are deemed to be the same when they match after rounding to six decimal places.
- If two or more organisms of the same species are collected for the same study at the same location (lat/long coordinates) and share the same matrix they are assigned different field SampleIDs. The samples will be assigned a unique composite ID number if combined as a composite. Thus, two field SampleIDs may be merged into a single unique Composite ID so that all chemical analyses are associated with a single sample record in the sample table. If not, these samples will maintain unique Sample IDs.
- If two or more samples share the same matrix, study, and location (lat/long coordinates), but are subjected to different chemical analyses, the reviewer will assign them the same StudyID + StationID and SampleID.
- As noted, a lab may split one fish into different components. In the laboratory EDD, the different components are distinguished by a suffix added to the original client sample ID. Within the NOAA Chemistry/Toxicity database, the resulting samples of different matrices will be assigned different sample IDs.
- A suffix will be added to a SampleID to relate a sample that has been split into different fractions or components. All samples are assigned the same StudyID and StationID. The component parts are assigned the SampleID with letters qualifying the type of tissue (WH: whole body minus stomach contents and liver; FC: fin clips; OTO: otoliths; LI: liver) such that SampleID 20180001 would be split into 20180001WH (whole body minus stomach contents and liver), 20180001FC (fin clip), and so on.

Appendix E. NOAA OR&R photography protocols

- This document contains the guidelines used to process field collected photograph information, and the instructions needed to process photographs and store the information.
- The guidelines and instructions were original written for a different project, but the protocols and procedures are comparable. The document titled, “Guidelines for Collecting Ephemeral Data in the Arctic: FIELD PHOTOGRAPHY” dated September 2014 is enclosed in this Appendix.

Guidelines for Collecting Ephemeral Data in the Arctic: FIELD PHOTOGRAPHY

September 2014

Note: These guidelines are limited data collection aides that do not necessarily consider all possible scenarios under which photographs are taken. Use best professional judgment to modify these guidelines according to area-specific field conditions.

Guideline objectives

The primary objective of this document is to provide guidelines on procedures for taking photographs and recording videos for ephemeral data and samples collected in the field during the early stages of an oil spill in the Arctic to support NRDA exposure and injury evaluations.

Background

Photographs and video are taken in the field to document the pre-oiling and oiling conditions, and are key pieces of information that can be introduced as evidence. Each photograph should tell a specific part of the story. Before taking a photograph you should consider what critical information you are trying to convey. Did the photograph capture the details you need? Are there key images (data) that you have missed? In the first case, you should take a better photograph. In the second case, you should look for photographs that will fill in the gaps.

Document the incident, the location and the staff

- Photographs are taken to visually communicate what happened at a specific location or sampling site.
- Because photographs can be later viewed by various audiences (e.g., upper level management, Congressional hearings, court, the USCG National Pollution Fund Center, public hearings, training talks, outreach events, etc.) try to capture photographs for all types of audiences.
- Take as many photographs as needed. You may not get a second chance.
- The following is a partial list of subjects to always document:
  - How the oil spill happened – including oil source
  - Oil on the water surface, stranded on the shoreline, and in direct contact or over sensitive areas such as seagrass, shellfish, or kelp
  - Oiled wildlife
  - Oil recovery and cleanup operations (Response)
  - Staff working, sampling (NRDA)
  - Species presence and habitat use
  - Site use by humans (fishing, hunting)
  - Site documentation, such as overviews alongshore and locations of stakes or other site markers

- Time series of photographs are helpful to document exposure or changes in oiling over time. Repeat photographs for a time series by standing in the same spot (using GPS coordinates or a print of the previous photograph).

Document the injury and cause of the injury

- Photographs are an effective way to document injuries caused by oil or response actions, but opportunities to capture these may be short lived. The NRDA team must be prepared to act quickly and decisively.
- Haphazard photography will fail to capture critical information.

Directly Observable Injury

- Photographing and video recording direct injury can be very effective. Take photographs and make videos that clearly show conditions that are or may be caused by oil exposure and response actions, including but not limited to:
  - Oil on biota
  - Dead animals and plants
  - Aberrant behavior (best capture with a video recording)
  - Impacts of cleanup operations
  - Ephemeral evidence of injury: necrosis, bleaching, gaping bivalves, etc.

Causation of injury

- Photographs and video are good for documenting visible oil exposure and impacts to recreation and human use:
  - When taking photographs of oiled shoreline, include perspective shots that show the degree of oiling as oiling occurs. Repeat day-to-day and tide-to-tide, if possible. Do not rely solely on SCAT to record the presence of oil
  - It is important to document response actions that impact biota (e.g., removing, crushing, re-oiling, hazing) and other resources (e.g., sediment disturbances, etc.)
  - Also document closures of beaches, waterways, access points for fishing or recreation, including but not limited to photographs of official closures (e.g., posted closure signs), congestion effects (e.g., response taking over boat ramps), and popular use areas showing little or no recreational or subsistence use

Qualitative and quantitative approach

- Using a systematic photographic process to document oiled areas, reference areas, and the transitions between them can be an effective approach for documenting direct exposure.
- Rigorous photo transect and photo quadrat techniques may be appropriate depending on the assessment.
  - Use the sampling designs used for manual transect and quadrat surveys
  - Include oiled and non-oiled sites, or gradients in a continuum from most heavily oiled to non-oiled

Before going to the field

- Use field data forms included in the work plan, if one is available. Otherwise, use forms in Appendix F. Coordinate data form development/modification with the data management group.
- Make sure you have assembled a full photography kit appropriate for NRDA field work (See Appendix F- Full Gear and Field Gear checklists).
- Make sure all photographic gear is ready and complete before going to the field. This includes having:
  - Fully charged batteries
  - Memory cards (SD cards) (see below)
  - Clean lenses
- It is extremely important than the designated photographer and all personnel taking a camera into the field are knowledgeable of key camera settings. The recommended camera settings are as follows:
  - Resolution – MAX
  - ISO – Auto (avoid higher than 400 unless you are an experienced photographer)
  - Mode – Program (P)
  - Time stamp – off, especially if you are using GSP-Photo Link. Unlike film, there is no need to clutter photographs and use up pixel space with a time stamp. That information is automatically recorded in "EXIF" data—which is part of the image file
  - Time – local time
  - Continuous picture numbering – Set to use a running count for file names even after changing or formatting memory cards
  - Daily folders – Set camera to create a new folder each day
  - Advanced settings (e.g., spot metering, custom white balance, etc.) – reset. It is a good idea to return these advance settings to auto or a general setting before you go into the field
  - Camera reset – Most cameras have a way to return all settings to the factory default values. This is useful if images are poor, you have been experimenting with different camera settings and you cannot determine what setting may be causing the problem
- Make sure there are sufficient memory cards. Prior to going into the field, keep in mind the following recommendations:
  - Use high-quality memory cards with large storage capacity. Get enough capacity for a whole day's shooting
  - Be sure all memory cards are working properly and are compatible with the camera being used
  - Changing cards in the field risks getting moisture, salt, and dirt on the memory card contacts and inside the camera
  - Format memory card regularly. It's better to format than to delete all photographs
  - Older cameras may have issues with new cards, but updating firmware may fix the problem

  - At all times protect the electric contacts of memory cards from dirt and mechanical deformation
  - NEVER take out a memory card when the camera is still writing to it. Turn off the camera before changing memory cards
  - Use a quality memory card reader
- Follow this simple recommendations when taking photographs/videos in the Arctic:
  - Battery efficiency is greatly reduced in cold temperatures. Make sure sufficient batteries are taken to the field and, if possible, carry a set of spare batteries close to your body to maintain battery efficiency. When not in use, turn the camera off to save battery life
  - Electronic components of the camera are affected by cold ambient temperatures, but functions return to normal as the camera warms up
  - When snow is present, the camera's exposure meter can be easily confused creating under-exposed images. Set the exposure +0.5 to +1, which will force the camera to expose longer. Use the “snow and ice” mode if available on the camera
  - Never breathe or blow on a cold lens. Instead, dust or brush off snow and debris with a soft cloth
  - NEVER change lenses outdoors when in cold weather or when snow and sleet are present. Moisture or condensation inside the camera can quickly reduce the quality of the photographs and compromise the long-term integrity of the camera
  - While not in use, and prior to bringing cameras indoors after taking photographs in the field, cameras should be placed inside a polypropylene freezer bag, loosely twisted and placed inside the camera bag. Proper storage of the camera will help minimize the condensation that occurs during temperature changes

Learn basic camera functions

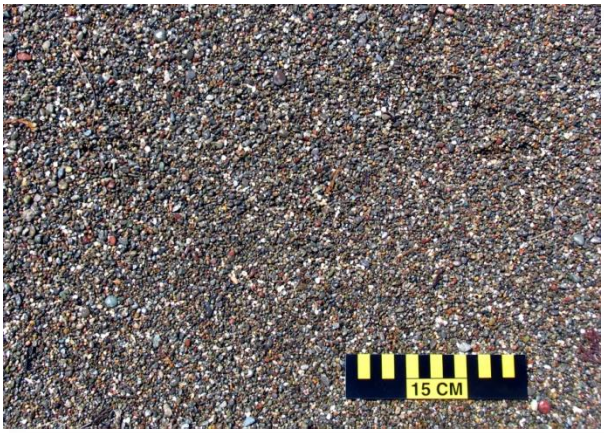
- Remember that each digital camera is different. It is absolutely critical that all camera-users know how to use their assigned camera before going into the field.
- For most field purposes and weather conditions, compact (aka “point-and-shoot”) cameras are cheaper, easier to use, more portable, and more resistant to salt, moisture, sand, and other factors. If you are an experienced photographer, can wait for favorable weather conditions, or require photographs for quantitative analyses, single lens reflex (SLR) cameras can provide higher resolution and better quality photographs. SLR cameras generally perform well under freezing temperatures.
- Under some circumstances, and when taking photographs or video of underwater habitats and resources, small drop cameras (e.g., GoPro) or other underwater cameras may be necessary to document these areas.
- Cameras with 7-10 megapixels are recommended.
- The following are some basic functions that everyone should know. Many cameras require you to be in “P” (program) mode (not “A” [auto]) to use these:
  - **Light metering**: Spot. At this setting the camera meters the exposure at a designated spot in the photo frame. Most cameras show the “spot” as a box or circle in the center of the viewfinder. Spot metering is helpful when photographing a subject is much darker or lighter than the rest of the frame

  - **Light metering**: Exposure compensation (+/-) adjustment. This feature tells the camera to make the photograph lighter or darker. It works like the lighter-darker adjustment on most copy machines
  - **White balance adjustments**: White balance settings help the camera adjust the colors in the photographs based on the type of light (fluorescent, incandescent, sunny, cloudy, etc.). Most of the time Auto White Balance (AWB) works fine, but sometimes the camera does not adjust correctly. Manually choosing the type of light can fix the problem
  - **Review photographs**: Know how to use the camera display to review a photograph. Know how to zoom in on the photograph in the display screen to check focus, exposure, and other key details
  - **Forced flash**: In dim light or harsh shadows you may need to force the camera to use the flash to avoid losing details
  - **Continuous shooting**: Most cameras will shoot consecutive photographs while you hold down the shutter. This is sometimes helpful when trying to capture moving wildlife
- Some cameras may have GPS capabilities. The use of these cameras reduce location errors when labeling photographs as the location information is attached to the photo data. Basic GPS capability is essential for all field work, including photography. There are a number of key functions you need to set including (see Appendix F for detail):
  - Local time zone
  - Datum
  - Track (wrap, interval)
  - WAAS (on), etc.

  Note: When the GPS recording is enabled, the camera battery life is shortened considerably.

While in the Field

- At each sampling location or site where photographs are taken, use the GPS to record waypoints. This will help with GPS-photo synchronization and processing (see below).
- At each sampling location or site where photographs are taken, use the GPS to record waypoints. This will help with GPS-photo synchronization and process (see below).
- It is important to take photographs of a sampling site using labeled photo scales (e.g., 15 cm, 6 inches). The photo scale should be in one of the corners, preferably the lower right (see photograph). When necessary because of oiling conditions, disposable scales of standard length, such as wooden tongue depressors, can be used (with proper disposal).



- Scales (and quadrat frames) should have intermediate reflectance, not bright white. A bright scale object can cause the camera to underexpose the rest of the photograph.
- Use spot metering or camera flash to eliminate harsh shadows that can obscure details. Use

one of each if you're not sure which is better. Remember that setting the exposure for shadows may wash out and lose detail in bright areas of the photograph.

- Every close up should be followed by one or more wider-angle shots that will show the close up in the context of the rest of the environment. The closer the initial shot the more perspective shots are needed.
- Use the following distances as a guideline:
  - Macro (field of view ≤12"), useful for species identification, fine detail, or injury documentation
  - Close-Up (<1 m^2), useful for general documentation of oiled biota and resources
  - Mid-Level (1-2 m^2 – angled), useful when documenting groups of biota and oiling
  - Distant/landscape (>10 m^2), useful when documenting habitats and spatial patterns of oiling; it is best to have a person in the photograph for scale (see photograph)
- It is important to constantly take photographs in the same sequence to document pre-oiling and oiling conditions, and to keep photographs organized. For example:
  - Start each new location with panorama shots or a narrative video
  - Always photograph subjects from the most close-up to the most zoomed out
- Change batteries before they lose power just as you are taking a critical photograph.
- Use the review feature to ensure that photographs show what you need.
- Use the zoom in function to see if you captured necessary details.
- Note key photographs and important details in the field notebook.

- Record basic information - locations, times, photographer, team members, including descriptions of GPS locations or waypoints.

Taking photographs of quadrats

- It may be necessary to take high-resolution photographs of sampling quadrats for quantitative analysis.
- Quadrats should not be bright white. Make quadrats out of grey PVC or wrap white quadrats in colored duct tape (see photograph).
- All photographs of quadrats must include a label containing the location name, transect, quadrat.
- Take high-resolution vertical photographs of each quadrat, if possible using a tripod or quadrapod, and record GPS coordinates. When taking photographs:

- Ideally, photographs should be taken during the lowest tide and best light conditions (e.g., closest to midday or when overcast). Avoid shooting into the sun and avoid including sky, ocean, or tidepools in the view
- High-resolution photographs must include all four sides of the quadrat as these will be used to digitally count individuals and measure their coverage on a computer screen
- When photographing highly dense quadrats, quadrat frames can be split into 2-sided frames to facilitate computer-based analyses

- Photographs need to be relatively flat so that the entire quadrat falls within a similar focal plane, with minimal shadowing from crevices or projections. Photographs should be directly perpendicular to the quadrat
- If possible, use a quadrapod apparatus to support the camera at a constant height (1 m with a 35 mm lens) from the quadrat, and positioned to capture all four corners of the quadrat:
  - A quadrapod consists of a gray PVC or gray Schedule 80 PVC pipe frame with a photoplot-size bottom (0.5 m^2 or 1.0 m^2 internal dimensions) connected by 4 poles to the frame supporting the digital camera
  - Strobes mounted laterally and away from the camera can enhance lighting of the quadrats and reduce shadows
- The best quality photographs are obtained by optimizing the ISO, aperture, and shutter speed
- Remember that all quadrat images must be of sufficient quality to allow a positive identification and enumeration of the species in the quadrats

Taking panoramic photographs

- Panoramas are often un-necessary but if you need a wide, detailed photograph do the following
  - Keep photo edges parallel
  - Do not change “zoom” factor
  - Overlap photographs by about 30%
  - Place a scale or natural distinctive feature in each overlap area for accurate alignment
  - Do not move the photo scale
  - Use manual mode to set shutter and aperture if you are comfortable with this
  - Note which photographs are part of the panorama
  - Lock your elbows against your sides for stability and pan as close to horizontally as you can. Use a tripod or monopod if you have one

Taking video

- A short video synopsis of a location can be very helpful later for relaying or reviewing the general layout of a location.

- It is important to take video recordings documenting ice scour, presence of ice, wave regimes, etc. as these can have impacts on oil fate.
- Take 30-45 seconds to slowly pan through a site while narrating key features.

Taking photographs while flying

- Taking photographs from a plane or helicopter can be difficult and requires additional skills. Point and shoot cameras can take good photographs from the air but SLR's typically perform better.
- When taking photographs from a plane or helicopter:
  - Do not wear bright clothing as these may reflect in the windows of the aircraft
  - Use manual focus to set cameras to infinity (∞). This avoids accidentally focusing on the window
  - Using image-stabilized cameras or lenses will help take good quality photographs
  - To prevent transmitting aircraft vibration to the camera, do not rest the camera on an aircraft window frame or other part of the aircraft structure. Instead, hold the camera with your arms braced against your legs or torso, or the camera held against your face

  - Avoid shooting through a bubble window
  - Smaller aircraft often have sliding windows, or easily removable windows or doors (see photograph). Make arrangements with your pilot before take-off
  - Avoid taking photographs towards the sun
  - Consider using one zoom level. Survey flights often are directed to maintain a specific altitude. By maintaining a constant zoom level you will be able to compare items in successive photographs. Remember there are no scales in aerial photographs
  - Record on the field notebook the basic flight plan including altitude and distance from shore, aircraft type, pilot and passenger names, port or starboard

Taking underwater photographs

- When taking underwater photographs:
  - Ensure that the camera is set on the underwater mode, which is design to filter some wavelengths
  - If possible, include a scale with each photograph (described above)

- Underwater photographs or video may be the only form of documenting underwater quadrats. Take photographs/video of each entire quadrat from an angle as vertical as practical. Photographs or video should include:
  - The general station location and setting, showing permanent stakes (if any)
  - Examples of subtidal resources and habitats (e.g., kelp field, eelgrass bed)
  - Sites where samples were collected
  - Representative examples of the extent and degree of oiling
  - Examples of services provided by subtidal resources and habitats
- Underwater cameras may be the only way to document impacts, if direct sampling of subtidal resources is unpractical or unsafe. A high-definition underwater camera can be deployed from a vessel, but this type of sampling requires previous training. Briefly:
  - Mount the underwater camera in a 'down-looking' orientation on a towfish deployed directly off the stern of the vessel
  - Allow the camera to follow the contour of the desired subtidal habitat
  - Maintain the field of view as constant as possible (1 m^2)
  - The vessel speed should be held as constant as possible (about 1 m/s) to facilitate estimation of distances
  - Conduct straight-line underwater video transects (randomly selected) perpendicular to the shoreline and encompassing the width of the subtidal habitat (e.g., kelp field, eelgrass bed)
  - Carefully catalogue all underwater videos and ship to the appropriate laboratory for processing and interpretation
- Underwater cameras may be the only way to document impacts to water column resources underneath ice sheets. A high-definition underwater camera can be deployed from vessel, but this type of sampling requires previous training. Briefly:
  - Mount a small drop camera (GoPro or other underwater camera) on a pole and send down a hole on the ice to take pictures of the surrounding ice and ice/water interface
  - Carefully catalogue all underwater videos and ship to the appropriate laboratory for processing and interpretation

Upon Returning from the Field

Legally defensible photographs

- Creating a legally defensible photograph record requires:
  - Maintaining a complete photograph record. DO NOT delete photographs from the camera or from your computer before the official archive is created
  - Keep one set of photographs that are never opened. In practice this means transferring one copy of the photographs from the camera memory card to a computer and then to a DVD-R or CD-R (non-editable) without ever opening them. The resulting continuous set of photograph files that have not been opened will demonstrate that that you have a full, un-edited, photograph record for the court
- When return from the field download all photographs to a computer. Before reviewing photographs on the computer (review = open):

- Create a copy in the "*Working*" directory and one copy in the "*Archive*" directory
- The "*Working*" directory is used to process photographs through GPS-linking software and to log all photographs. DO NOT rename files in the "*Working*" directory
- The *"Archive*" directory MUST include unopened, un-editable copy of all photographs. Burn the "*Archive*" directory to DVD-R. Do this when you have enough to fill a CD/DVD or at some set interval (every 2 days), and make a copy of the CD/DVD
- NEVER open the files stored in the "*Archive*" directory
- Make additional backup copies can be made to portable hard drives

Locate photographs – GPS linking

- Field photographers should always collect a GPS track while in the field.
- Be sure to take a clear photograph of the operating GPS screen showing the date and time to synchronize the photographs with the GPS track (see photograph). The ideal GPS photograph should clearly show, with no clear, the GPS clock in Hours, Minutes, and Seconds
- With the synch photo and a track file, all photographs can be linked to a specific Lat/Long/Time using special software (GSP-Photo Link or OziPhotoTool). However, a different team would likely be responsible for processing GPS-camera information. They will the synch photo and downloaded track file (using the software that came with the GPS) to GPS-link these photographs.

Photograph logging

- Locating photographs in space and time is a good first step to ensure that photographs become data and not useless files. This can be achieved by creating photograph logs.
- A log can be a simple spreadsheet that captures basic information about each photograph. It can also be a photo database that stores more information and provides additional functionality. A photograph log should include:
  - Photographer name
  - Date
  - Case/incident
  - Note/Caption

Process: Image analysis

- Software like SigmaScan Pro can be used to process photographs. Photo analysis applications can quantify area, percent cover, counts of objects, etc. and it is usually faster and more accurate than manual methods. Consider this if you plan to obtain quantitative data from photographs.

Appendix F. Supporting documentation, photography checklist and forms

- Print the form on weather-resistant paper (if available). Make more than enough copies of the form before going into the field
- Fill out forms with waterproof pen or permanent marker
- Fill in blanks with “N/A” if data are not applicable or not available. Avoid leaving blank values on data forms
- Do not erase or black out erroneous entries on the field data forms. Errors should be corrected by crossing out the entry with a single line and signing and dating the strike-through
- Special notes about the Photologger Form:
    - This needs to be filled out at the end of each day, noting the pictures taken on the camera and noting the SiteID, SampleID, or significance of photo

Included forms:
- Photography gear checklist
- Photograph and GPS checklist
- PhotoLogger Form

Photography gear checklist

Photography - complete gear list; F indicates field gear

☐	Camera ***F***	With neck strap
☐	Camera case ***F***	Sized to hold all camera gear; plus polypropylene freezer bag, if appropriate
☐	Memory cards ***F***	1-2 extra depending on size – (e.g., 200-300 high resolution photographs, each)
☐	Rechargeable batteries ***F***	Camera batteries: 2 is OK, 3 is better. AA's two sets of rechargeable are OK – extra alkaline or lithium for GPS etc.
☐	Battery charger	Appropriate for each type of rechargeable batteries
☐	Lens cleaning kit ***F***	(e.g., soft cloth)
☐	Card reader	One that accepts many types of cards is preferred
☐	Cable – Camera to PC	
☐	Camera manual	Paper and pdf
☐	Underwater housing/kit ***F***	Optional - useful in rough weather and small boat ops.
☐	Photo scale ***F***	15 cm waterproof, 15 cm disposable. Avoid white or light colors. Grey is best
☐	Image viewing software	All PC's and many cameras have software for reviewing photographs
☐	Image editing software	Optional. Good for processing photographs for presentations etc.
☐	External hard drives	
☐	PhotoLogger database	
☐	GPS-Photo Link software	
☐	DVD-R's – NOT RW's	
☐	Waterproof bag ***F***	Dry sack or heavy duty zip-lock bags
☐	Polarizing lens ***F***	Optional – reduces glare and reflections
☐	GPS ***F***	
☐	Field notebook ***F***	

Photograph and GPS checklist

The following checklist will help ensure that ALL NRDA photographs and GPS photographs are successfully processed and included in the larger photography database.

Pre-field:

- ☐ GPS/camera must be set to local time (Set to 24-hour Military Time)
  Garmin GPS: Turn GPS Unit ON> Menu > Setup > Time > Time Format = "24 hours"
- ☐ Datum = "WGS 84"
  Turn On GPS > Menu > Setup > Units > Map Datum = "WGS 84"
- ☐ Set Track Log to "Wrap When Full"
  Turn On GPS > Menu > Tracks > Track Log (Track Log = "On") > Setup > Check "Wrap When Full"
- ☐ Set GPS to Decimal Degrees
  Garmin GPS: Menu> Menu > Setup> Units > Position Format > hdd.ddddd

In-field:

- ☐ Ensure GPS unit has acquired a satellite signal
  The device may momentarily lose its signal if you are traveling quickly, if you have placed it in an obstructed location (backpack, field kit, etc.), or it is not facing upwards in a secure location. Attaching the GPS to the outside of your pack can be helpful
- ☐ Take a photograph of the GPS unit showing the Date and current Time of day (with seconds) – NOT a waypoint time. <u>See examples below</u>
  At the beginning of the day, take a photograph of the GPS unit with the display screen showing the current date and time (with seconds). DO NOT take a photograph showing the time that a waypoint was taken since this is not the real-time GPS time. To display date/time on Garmin units, press the "Menu" button twice. Make sure the screen is clearly visible and then take a photo (double-checking the photo to make sure the information is captured)
- ☐ Do not delete any photographs in the field!
  Cameras typically auto-number photographs – any gaps in the number sequence may suggest that the camera was tampered with, rising legal defensibility concerns
- ☐ Do not open photographs before zipping – may change metadata
  Original photographs MUST NOT be opened at any time (beyond viewing them on the camera's LCD screen). Only copies may be viewed. Opening the photographs prior to uploading to the NRDA site changes the Date/Time in which the photograph was "modified." This suggests that the photo collection may have been tampered with, thus potentially rendering the collection indefensible
- ☐ Take informative photographs that tell the story
  Photographs of the GPS unit after the beginning of the trip, compass settings, trip preparation, equipment cleansing, sediment mixing, and other sample preparation procedures are helpful, but do not need to be photographed extensively. If such photographs are taken they do not require photograph-specific comments in the Photologger form
- ☐ <u>DO NOT</u> turn the GPS unit off at anytime
  DO NOT turn off the GPS unit at any time during the day, even during rest periods. This causes a break in the track log and leads to difficulties in processing the photographs

Post-field:

- ☐ Extract tracks and waypoints from the GPS unit
  Tracks and Waypoints are stored in the GPS unit. These are requisite inputs for the photo processing software.
- ☐ Connect the GPS unit to a computer (remember your cables)
- ☐ Start Garmin MapSource (or similar)
  1) Click on the "Receive from Device" icon.
  2) Click Find Device (the name of the GPS unit will appear)
  3) Under "What To Receive" > Click only Waypoints and Tracks
  4) Click "Receive" (you will now see the tracks/waypoints for that day)

- ☐ Save .gdb and .gpx files
  1) > Save As… > "YYYY_MMDD_LastName_FirstName" (Save as type: .gdb)
  2) File > Save As… > "YYYY_MMDD_LastName_FirstName" (Save as type: .gpx)
- ☐ Complete the PhotoLogger Form (see below)
- ☐ Identify key photographs

  In the photograph-specific comments section, write the photograph name or number for each key picture and "key photograph" as the comment. Key photographs are those which document the effects of the spill and aid in the NRDA process. These include pictures of: samples, tarballs, oil sheens/slicks, oiled vegetation, oiled wildlife, etc. If several pictures are taken of the same oiling observation, pick the best one and mark it a key photograph. Non-key photographs are those taken of the GPS unit showing the time and date at the beginning of the trip (this should be the 1st photograph in the set), directional photographs (N, E, S, W), and the background landscape (unless it is covered in oil). **Non-key photographs do not require photograph-specific comments**
- ☐ Process photographs using GeoJot, see GeoJot training document
- ☐ Import photographs to desktop Photologger
- ☐ Upload photographs to on-line Photologger
- ☐ Upload photograph to ERMA

NOAA OR&R PhotoLogger Form & Chain of Custody

This form must be filled out to accompany photos taken in the field, either filled out in the field or upon return to Data Intake.

Photographer Name: _____

Agency Name: _____ Cell Phone Number: _____

Study Name _ Portland Harbor Superfund Site Phase 3 Subyearling Chinook Sampling and Analysis __

Date of Photos (MM/DD/YYYY): _____ Photo Range: _____

Camera Time Zone: AST/ADT PST/PDT MST/MDT CST/CDT EST/EDT Other Time Zone: _____

Camera Date (MM/DD/YYYY): _____ Camera Time (HH:MM:SS): _____ Camera Model: _____

Camera Time Zone: AST/ADT PST/PDT MST/MDT CST/CDT EST/EDT Other Time Zone: _____

GPS Date (MM/DD/YYYY): _____ GPS Time (HH:MM:SS): _____ GPS Model: _____

Location and State where photos were taken - G*eographic area where the field work was completed (ex. Neah Bay, WA)*

General description of all photos - *If you have photos from significantly different sites / missions in the same group of photos being submitted, please fill out this form separately for each*

Keywords that describe ALL photos being submitted - *Specific keywords that describe ALL the photos this form addresses. If you choose to fill out the next section or review your photos in the PhotoLogger database you can add keywords for unique photos.*

Enter photo-specific comments here – *Provide more details to key photos of high value in the Comment section. You may also use this section if you need to identify specific photos of sample locations or photos that are data themselves (e.g. photo plots).*

Photo Number	Comment *(ex. SiteID, SampleID, significance)* and Photo-Specific Keywords

Suggested Keywords – *These are suggested keywords to describe your key photos. You can add others to the side. Keywords are used when importing the photos to PhotoLogger, where they will be queried by field staff, management, or outreach staff in the days and years to come. Please select keywords that are general enough to represent the photos in future queries (ex. Put species in the Comment field). More specific details can be entered into the above Comment section or later in PhotoLogger.*

Barge	Fish Kill	Oil-Sheen/Rainbow	Sediment Core
Barrel	GPS Unit	Oil-Dark	Shellfish
Barrier Island	Gravel Beach	Oil-Emulsified	Shoreline
Beach	Grounding	Oil-Tarball	Small Boat
Birds	Ice	Oil-Tarmat/Tarpatty	Snow
Boat	In-Situ Burn	Oil-Surface Residue	Source Oil
Boom	Intertidal	Oil-Stain/Coat	SAV
Container	Jar	Outreach	Subtidal
Chemical	Kelp Bed	Overflight	Sunken Vessel
Cleanup Operations	Lagoon	Pipeline	Tank
Coral	Managed Area	Pits and Trenches	Tanker/Ship
Crab	Mangrove	Quadrat	Terrestrial Turtle
Dead Wildlife	Marine Debris	Response Vessel	Transect
Dispersant	Marine Mammal	Riprap	Tundra
Dolphin	Marsh	Rocky Shoreline	Waste Site
Dredging	Mudflat	Sampling	Wetland
Drilling Platforms	NRDA	Sargassum	Wildlife
Eelgrass	Oil	SCAT	Whale
Fish	Oil-Metallic	Sea Turtle	

Required Chain of Custody Filled Out Upon Data Intake	
Photos & GPS Data Relinquished By	**Photos & GPS Data Received By**
Name Signature:	Name Signature:
Name Printed:	Name Printed:
Agency Name Printed:	Agency Name Printed:
Date/Time:	Date/Time:

I, _____ *[**Data Intake Manager print name**]*, without modification, downloaded the photographs referenced on this form in accordance with the NOAA OR&R Data Intake Protocols and uploaded without modification to DIVER in the File Collection ID number_____ with the following Photo Zip file named _____ and GPS Zip file named _____.

_____ _____

Signature *Date/Time*