Prepared by:
Dredged Material Management Office
Seattle District, US Army Corps of Engineers

Memorandum for Record **February 12, 2024**

Subject: Suitability Determination for the USACE Navigation Operations & Maintenance Dredging of the Swinomish Federal Channel, Skagit County, Washington.

Introduction

This suitability determination memorandum (SDM) documents the consensus regarding the suitability of the proposed dredged material for unconfined aquatic disposal as determined by the Dredged Material Management Program (DMMP) agencies (U.S. Army Corps of Engineers, Washington Departments of Ecology and Natural Resources, and the U.S. Environmental Protection Agency).

Project Description

The Swinomish Channel is a federally maintained shallow-draft navigation channel, approximately 11-miles long, that connects northern Skagit Bay to Padilla Bay and is utilized by both commercial and recreational boat traffic. The channel is dredged every two to four years to maintain safe and reliable navigation. The full dredge prism includes the authorized depth of -12 mean lower low water (MLLW) plus 2 feet (ft) of potential overdepth for a total channel depth of -14 ft MLLW.

Proposed dredged material settles out from the Skagit River at the southern end of the channel and from Padilla Bay at the northern end of the channel. Tidal fluctuations distribute sediments along the channel bed. This sediment then settles into shoals where flow slows, and forms sand waves where material is mobilized by tidal exchanges. Sediment in the Swinomish Channel consists predominantly of medium to coarse sand.

The 2023 Swinomish Channel dredged material characterization followed a new sampling strategy which was designed to standardize sampling for this site, independent of available volume in a given year (DMMP, 2023). This new strategy separated the channel into four reaches, each representing an area of similar use and typical shoaling: Southern Entrance, Southern Main Channel, Main Channel, and Northern Entrance (Figure 1). The reaches each represent one DMMU and will require, at a minimum, three surface samples targeting current shoals or potential areas of concern in future sampling events.

In critical and/or fast-shoaling areas, USACE may also perform advance maintenance dredging (AMD) to increase the length of time between dredging cycles at critical projects, and avoid redredging fast-shoaling areas in any given cycle. This ensures the least overall cost of maintaining the project. Typical advance maintenance dredging is two feet beyond authorized depth and does not include the 2 ft of overdepth dredging. Thus, the total allowable dredging depth for Swinomish Channel routine maintenance dredging (when including AMD) is -12 feet + 2 ft AMD + 2 ft OverDepth (OD) (-16 ft MLLW).

Project Summary

Waterbody	Swinomish Channel
Water classification	Estuarine (Marine Evaluation Procedures)
Project rank	Project-specific: Low, Homogenous
Total proposed dredging volume (cy)	Up to 400,000 cy per dredge event
Authorized dredging depth	- 12 feet MLLW
Max. proposed dredging depth (includes 2 feet allowed OD and 2 feet AMD)	- 16 feet MLLW

Proposed disposal location(s)	DMMP open-water dispersive and/or non-dispersive disposal sites, or approved in-water beneficial use or upland placement
Dredged Material Management Units (DMMUs): No. of stations	4 DMMUs: 24 grab samples
DMMO tracking number	SWINC-1-A-F-453
EIM Study ID	SWINC23
USACE Reference Number	PMP-18-15
Sampling and Analysis Plan (SAP) Approval Date	August 2023 (EcoAnalysts, 2023)
Sampling Date	September 1, 2023
Sediment Characterization Report Approval Date	February 2024 (EcoAnalysts, 2024)
Testing Parameters	DMMP standard marine COCs
Biological Testing	Not required
Recency Expiration (10 Years)	September 2033
Suitability Outcome	All material found suitable for in-water placement; beneficial use of material subject to other permitting authorities
Antidegradation Assessment	In compliance

Sampling and Analysis Description

Power grab sampling was conducted on September 1, 2023, from a contracted sampling vessel provided by Research Support Services, Inc. (RSS). Samples were collected from 24 stations within shoals identified in a March 2023 bathymetric survey (Table 1). Horizontal station positioning was accomplished using a Trimble R1 and TerraSync data logger software. The antenna for the Global Positioning System (GPS) receiver was located at the top of the A-frame in the bow and directly above the sampling location. Vertical positioning was determined using the NOAA La Connor Station (9448558), except for the Northern Entrance samples, which used the NOAA Swinomish Channel Entrance Padilla Bay Station (9448682). The sampling crew was not able to locate tide boards in the Swinomish Channel to correct the tide height, so mudline elevations are estimated.

Samples were composited on the vessel and submitted to Analytical Resource, Inc. and Eurofins for physical and chemical analysis.

Tables 2 through 5 provide the sample collection details. Figures 2 through 17 show the actual sampling locations. All samples were collected within 10ft of the target location except for SM-01, which was 15ft from target.

Data Validation

EcoChem conducted an EPA Stage 2B review and validation of all DMMP chemistry data. The validation process resulted in some additional J and UJ qualified data (estimated values) and U qualified data (associated with method blank detections) beyond those assigned by the lab, based on specified protocol or technical advisory. Due to laboratory quality assurance/quality control (QA/QC) issues, some analyses were re-extracted and/or re-analyzed to meet project data quality objectives (DQOs). In these instances, the data associated with passing QA/QC were used and the original results were qualified as "Do Not Report" to provide just one reportable result per sample parameter. Completeness was 100%; all reported data are usable as qualified.

Table 6 provides definitions of the various qualifiers used by the laboratory and data validator.

Analytical Testing Results

Grain size results showed predominately sand (84-99%) and low fines (1.3 to 16.1%). TOC results were all below 0.5%. Tables 7 and 8 summarize the analytical results for the 4 DMMUs alongside the DMMP marine guidance (DMMP, 2021) and marine Apparent Effects Thresholds [AETs], respectively.

Samples had non-detects or very low concentrations of COCs. There were no detected or non-detected exceedances of the marine screening levels or AETs.

DMMP Determinations

Suitability Determination

The DMMP agencies have concluded that all characterized material from the Swinomish Navigation Channel is suitable for open-water disposal at a dispersive or non-dispersive DMMP disposal site, or at an approved beneficial use site.

Removal of sediment within the characterized dredging prism of up to 400,000 cy per year is authorized as long as there are no significant changes to the project scope or identification of new contaminant sources. Coordination with the Seattle District DMMO is required prior to each dredging cycle to determine if there are any changed conditions.

The DMMP does not make specific beneficial use determinations. However, these data are available for the assessment of project-specific beneficial use by the project proponent, permitting agencies, local health jurisdictions and/or the owner of a receiving property.

Recency Determination

This suitability determination is valid through September 2033 (10 years from last previous sampling event). A Tier 1 analysis (review of current information) must be done prior to every dredge event to evaluate whether conditions have changed for any part of the channel. Changes could include spills, potential new contaminant sources, or addition of new chemicals of concern. A sampling event or project modification will be pursued as necessary should the Tier 1 evaluation indicate the need for more information in any part of the channel.

Antidegradation Determination

The sediment to be exposed by dredging must either meet the State of Washington Sediment Management Standards (SMS) or the State's Antidegradation Standard (Ecology, 2013) as outlined by DMMP guidance (DMMP, 2008). Concentrations of all DMMP chemicals of concern were below the DMMP SLs, and there is no reason to believe that a new exposed surface would be contaminated relative to the overlying materials; therefore, this project is in compliance with the State of Washington Antidegradation Standard.

Debris Management

Based on project history, site location, dredging frequency, and results of this sediment characterization, the DMMP did not identify a reason-to-believe that debris might be a significant concern or require any specific debris assessment or management practices/techniques for use on this project. This issue may be revisited in subsequent years via DMMP coordination, should new information arise that indicates debris could be a concern at this location.

Notes and Clarifications

The decisions documented in this memorandum do ***not*** constitute final agency approval of the project. During the public comment period that follows a public notice, resource agencies will provide input on the overall project. A final decision will be made after full consideration of agency input, and after an alternatives analysis is done under section 404(b)(1) of the Clean Water Act.

References

DMMP, 2008. *Quality of Post-Dredge Sediment Surfaces (Updated).* A Clarification Paper Prepared by David Fox (USACE), Erika Hoffman (EPA) and Tom Gries (Ecology) for the Dredged Material Management Program, June 2008.

DMMP, 2021. *Dredged Material Evaluation and Disposal Procedures (User Manual)*. Dredged Material Management Program, July 2021.

DMMP, 2023. *DMMP Ranking Revision Determination for Characterization of the Swinomish Federal Navigation Channel.* Prepared by the Dredged Material Management Program, 29 June 2023.

EcoAnalysts, 2023. *Swinomish Federal Navigation Channel, Sampling and Analysis Plan, Skagit County, WA*. Final Plan submitted to the USACE, August 2023.

EcoAnalysts, 2023. *Swinomish Federal Navigation Channel Dredged Material Characterization Report, Skagit County, WA*. Final Report submitted to the USACE, February 2024.

Ecology, 2013. *Sediment Management Standards – Chapter 173-204 WAC*. Washington State Department of Ecology, February 2013.

Agency Signatures

The signed copy is on file in the Dredged Material Management Office, Seattle District U.S. Army Corps of Engineers

_____	_____
Date	Joy Dunay – U.S. Army Corps of Engineers, Seattle District
_____	_____
Date	Justine Barton – U.S. Environmental Protection Agency, Region 10
_____	_____
Date	Laura Inouye, PhD. – Washington State Department of Ecology
_____	_____
Date	Shannon Soto – Washington State Department of Natural Resources

Copies Furnished:
DMMP agencies
Heather Fourie, USACE Navigation PM
Regina Edwards, EcoAnalysts
DMMO File

Tables

Table 1 DMMU and Sample Requirements

Reach	Rank	Type of Material	Estimated volume (cy)	# Grab Samples	# DMMUs
Southern Entrance	Low	homogenous	44,500	3	1
Southern Main Channel	Low	homogenous	8,296	5	1
Main Channel	Low	homogenous	33,373	8	1
Northern Entrance Channel	Low	homogenous	34,878	8	1
Totals			**121,047**	**24**	**4**

Table 2. Actual Station Information

Reach	DMMU	Sample ID	Date	Time	Attempt	Latitude	Longitude	Northing	Easting	Distance from Target (ft)
Southern Entrance	DMMU-01	SE-01	09/01/23	10:56	1 of 1	48.361889	-122.553703	501456	1222222	2
		SE-02	09/01/23	11:16	1 of 1	48.364010	-122.544029	502178	1224591	2
		SE-03	09/01/23	11:29	1 of 1	48.367008	-122.530006	503196	1228022	6
Southern Main Channel	DMMU-02	SM-01	09/01/23	11:53	2 of 2	48.369511	-122.517998	504045	1230961	**15**
		SM-02	09/01/23	12:02	1 of 1	48.370831	-122.511299	504491	1232599	4
		SM-03	09/01/23	12:13	1 of 1	48.377918	-122.507919	507058	1233476	2
		SM-04	09/01/23	12:23	1 of 1	48.381630	-122.506920	508405	1233749	0
		SM-05	09/01/23	12:32	1 of 1	48.385098	-122.505379	509663	1234151	4
Main Channel	DMMU-03	MC-01	09/01/23	13:22	1 of 1	48.400005	-122.496849	515055	1236340	6
		MC-02	09/01/23	13:34	1 of 1	48.406136	-122.496567	517289	1236458	4
		MC-03	09/01/23	13:44	1 of 1	48.409744	-122.496422	518604	1236521	8
		MC-04	09/01/23	13:56	1 of 1	48.414669	-122.497971	520409	1236184	4
		MC-05	09/01/23	14:16	2 of 2	48.426975	-122.500458	524910	1235677	4
		MC-06	09/01/23	14:32	1 of 1	48.430161	-122.498688	526062	1236133	1
		MC-07	09/01/23	14:51	3 of 3	48.436646	-122.500809	528440	1235668	6
		MC-08	09/01/23	15:01	1 of 1	48.438290	-122.502090	529046	1235371	2
Northern Entrance	DMMU-04	NE-01	09/01/23	15:36	2 of 2	48.454166	-122.514404	534901	1232508	2
		NE-02	09/01/23	15:44	1 of 1	48.456573	-122.514580	535781	1232485	2
		NE-03	09/01/23	15:52	1 of 1	48.460678	-122.516472	537288	1232059	5
		NE-04	09/01/23	16:06	1 of 1	48.468189	-122.522537	540059	1230648	3
		NE-05	09/01/23	16:20	1 of 1	48.478214	-122.530464	543758	1228807	4
		NE-06	09/01/23	16:32	1 of 1	48.483925	-122.534981	545864	1227756	7
		NE-07	09/01/23	16:54	1 of 1	48.496521	-122.545029	550513	1225423	6
		NE-08	09/01/23	17:10	1 of 1	48.506031	-122.552818	554023	1223613	1

Table 3. Sample Information

Reach	DMMU	Sample ID	Estimated Mudline Elevation (MLLW)	Water Depth (ft)	Tidal Stage (ft)[1]	Actual Mudline (MLLW)	Penetration (cm)	Volume Collected (L)
Southern Entrance	DMMU-01	SE-01	-9	7.0	1.8	-5.2	27	3
		SE-02	-7	8.3	1.1	-7.2	24	3
		SE-03	-13	12.8	0.7	-12.1	19	3
Southern Main Channel	DMMU-02	SM-01	-11	12.6	-0.1	-12.7	24	2
		SM-02	-11	13.5	-0.2	-13.7	21	2
		SM-03	-10	12.5	-0.5	-13.0	13	2
		SM-04	-13	13.0	-0.6	-13.6	15	2
		SM-05	-8	8.1	-0.8	-8.9	22	2
Main Channel	DMMU-03	MC-01	-11	13.2	-0.7	-13.9	23	1
		MC-02	-8	11.6	-0.5	-12.1	24	1
		MC-03	-7	7.8	-0.5	-8.3	25	1
		MC-04	-8	11.9	0.0	-11.9	22	1
		MC-05	-9	13.8	0.4	-13.4	17	1
		MC-06	-13	15.0	1.0	-14.0	19	1
		MC-07	-8	13.2	1.7	-11.5	15	1
		MC-08	-8	14.1	2.1	-12.0	15	1
Northern Entrance	DMMU-04	NE-01	-7	13.8	3.6	-10.2	16	1.5
		NE-02	-11	18.6	3.8	-14.8	24	1.5
		NE-03	-8	12.6	4.2	-8.4	21	1.5
		NE-04	-10	15.0	4.5	-10.5	25	1.5
		NE-05	-10	15.8	5.0	-10.8	21	1.5
		NE-06	-11	18.1	5.4	-12.7	21	1.5
		NE-07	-13	20.8	6.1	-14.7	26	1.5
		NE-08	-11	19.3	6.6	-12.7	17	1.5

[1] Northern Entrance tide height taken from Swinomish Channel Entrance Padilla Bay tide station, all other reaches taken from the La Connor tide station

Table 4. DMMU Composite Plan and Chemical Analysis

Reach	DMMU	Sample ID	Physical & Chemical Analysis		Archive Samples	
			Sediment Conventionals	DMMP COC	DMMU Comp.	Bioassay
Southern Entrance	DMMU-01	SE-01	X	X	X	X
		SE-02				
		SE-03				
Southern Main Channel	DMMU-02	SM-01	X	X	X	X
		SM-02				
		SM-03				
		SM-04				
		SM-05				
Main Channel	DMMU-03	MC-01	X	X	X	X
		MC-02				
		MC-03				
		MC-04				
		MC-05				
		MC-06				
		MC-07				
		MC-08				
Northern Entrance	DMMU-04	NE-01	X	X	X	X
		NE-02				
		NE-03				
		NE-04				
		NE-05				
		NE-06				
		NE-07				
		NE-08				

Table 5. Comprehensive Sampling Attempts

Reach	DMMU	Sample ID	Attempt	Volume Collected (L)	Notes
Southern Entrance	DMMU-01	SE-01	1 of 1	3	Fine sand with some clay. Seaweed present
		SE-02	1 of 1	3	Medium sand
		SE-03	1 of 1	3	Fine and medium sand. Large and small sticks in grab
Southern Main Channel	DMMU-02	SM-01	1 of 2	0	Grab malfunctioned
		SM-01	2 of 2	2	Medium to coarse sand
		SM-02	1 of 1	2	Medium to coarse sand
		SM-03	1 of 1	2	Fine and medium sand
		SM-04	1 of 1	2	Fine and medium sand
		SM-05	1 of 1	2	Fine to medium sand
Main Channel	DMMU-03	MC-01	1 of 1	1	Medium to coarse sand with some sticks. Fish present
		MC-02	1 of 1	1	Medium to coarse sand
		MC-03	1 of 1	1	Medium to coarse sand
		MC-04	1 of 1	1	Fine to medium sand
		MC-05	1 of 2	0	Rock in grab jaws
		MC-05	2 of 2	1	Fine sand with wood debris and shell hash
		MC-06	1 of 1	1	Fine to medium sand
		MC-07	1 of 3	0	Grab malfunctioned
		MC-07	2 of 3	0	Grab malfunctioned
		MC-07	3 of 3	1	Fine, medium, and coarse sand with shell hash. Fish present
		MC-08	1 of 1	1	Fine to medium sand with wood debris. Fish present
Northern Entrance	DMMU-04	NE-01	1 of 2	0	Grab malfunctioned
		NE-01	2 of 2	1.5	Fine sand with a little shell hash
		NE-02	1 of 1	1.5	Fine sand with shell hash. Wood debris
		NE-03	1 of 1	1.5	Fine to medium sand with shell hash
		NE-04	1 of 1	1.5	Fine to medium sand
Northern Entrance	DMMU-04	NE-05	1 of 1	1.5	Very fine sand
		NE-06	1 of 1	1.5	Very fine sand. Tube worms present
		NE-07	1 of 1	1.5	Silty sand. Tube worms & polychaetes present
		NE-08	1 of 1	1.5	Sandy silt. Shrimp & polychaete present

Table 6. Laboratory and Validator Qualifier Definitions

Laboratory Qualifier Definitions			
J	Results is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.		
U	Not Detected at the RL (or MDL if shown).		
F1	MS and/or MSD recovery exceeds control limits.		
Validator Qualifier Definitions			
U	The analyte was analyzed but was not detected above the reported sample quantitation limit.		
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.		
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.		
Abbreviations			
SL	Screening Level	MDL	Method Detection Limit
BT	Bioaccumulation Trigger	µg/kg	microgram/kilogram
ML	Maximum Level	mg/kg	milligram/kilogram
RL	Reporting Limit	SCO	Sediment Cleanup Objective
VQ	Validated Qualifier	CSL	Cleanup Screening Level

Table 7. Sediment Conventionals and Analytical COC Results compared to DMMP Guidelines

Parameter	DMMP Marine Guidelines			DMMU-01					DMMU-02					DMMU-03					DMMU-04				
	SL	BT	ML	Result	RL	MDL	Qualifier		Result	RL	MDL	Qualifier		Result	RL	MDL	Qualifier		Result	RL	MDL	Qualifier	
							Lab	VQ				Lab	VQ				Lab	VQ				Lab	VQ
SEDIMENT CONVENTIONALS																							
Total solids (%)				65.15	0.04	0.04			81.31	0.04	0.04			76.98	0.04	0.04			71.59	0.04	0.04		
Total volatile solids (TVS) (%)				1.82	0.01	0.01			0.83	0.01	0.01			0.89	0.01	0.01			1.48	0.01	0.01		
Total organic carbon (%)				0.45	0.20	0.0097			0.13	0.20	0.0097	J	U	0.12	0.20	0.0097	J	U	0.28	0.20	0.0097		U
Total Sulfides (mg/kg)				58.0	6.92	6.92		J	1.23	1.23	1.23	U	UJ	1.19	1.19	1.19	U	UJ	48.4	6.95	6.95		J
Ammonia (mg/kg NH3-N)				34	34	14	U	UJ	32	32	13	U	UJ	31	31	13	U	UJ	35	35	14	U F1	UJ
Particle/Grain Size, Gravel (%)				0.10					0.20					1.0					0.20				
Particle/Grain Size, Sand (%)				84					99					98					90				
Particle/Grain Size, Silt (%)				13					0.40					0.30					7.8				
Particle/Grain Size, Clay (%)				3.1					0.90					1.1					2.4				
Percent Fines (Silt + Clay)				16.1					1.3					1.4					10.2				
METALS (mg/kg dry weight)																							
Antimony	150	---	200	0.11	0.24	0.027	J	J	0.090	0.25	0.028	J	J	0.082	0.22	0.025	J	J	0.099	0.31	0.035	J	J
Arsenic	57	507.1	700	3.8	0.20	0.039			3.3	0.21	0.042			2.4	0.19	0.037			4.5	0.26	0.052		
Cadmium	5.1	--	14	0.054	0.31	0.030	J	J	0.034	0.33	0.032	J	J	0.30	0.30	0.029	U	U	0.088	0.42	0.040	J	J
Chromium	260	--	---	20	0.39	0.025			21	0.42	0.026			16	0.37	0.024			25	0.52	0.033		
Copper	390	--	1,300	9.0	0.39	0.087			6.4	0.42	0.092			5.3	0.37	0.082			8.1	0.52	0.11		
Lead	450	975	1,200	2.1	0.20	0.019			1.6	0.21	0.020			1.6	0.19	0.018			2.2	0.26	0.025		
Mercury	0.41	1.5	2.3	0.014	0.037	0.011	J	J	0.033	0.033	0.0099	U	U	0.027	0.027	0.0082	U	U	0.012	0.032	0.0096	J	J
Selenium	---	3	---	0.31	0.31	0.16	U	U	0.30	0.30	0.15	U	U	0.31	0.31	0.16	U	U	0.32	0.32	0.16	U	U
Silver	6.1	--	8.4	0.028	0.079	0.0079	J	J	0.013	0.084	0.0084	J	J	0.075	0.075	0.0075	U	U	0.021	0.10	0.010	J	J
Zinc	410	--	3,800	27	2.0	0.63			25	2.1	0.67			24	1.9	0.60			32	2.6	0.84		
ORGANICS																							
PAHs (µg/kg dry weight)																							
LPAH																							
Naphthalene	2,100	---	2,400	19.9	19.9	4.2	U	U	20.0	20.0	4.2	U	U	20.0	20.0	4.2	U	U	20.0	20.0	4.2	U	U
Acenaphthylene	560	---	1,300	19.9	19.9	6.2	U	U	20.0	20.0	6.2	U	U	20.0	20.0	6.2	U	U	20.0	20.0	6.2	U	U
Acenaphthene	500	---	2,000	19.9	19.9	5.2	U	U	20.0	20.0	5.2	U	U	20.0	20.0	5.2	U	U	6.4	20.0	5.2	J	J
Fluorene	540	---	3,600	19.9	19.9	14.5	U	U	20.0	20.0	14.6	U	U	20.0	20.0	14.6	U	U	20.0	20.0	14.6	U	U
Phenanthrene	1,500	---	21,000	19.9	19.9	8.7	U	U	20.0	20.0	8.7	U	U	20.0	20.0	8.7	U	U	20.0	20.0	8.7	U	U
Anthracene	960	---	13,000	19.9	19.9	7.2	U	U	20.0	20.0	7.2	U	U	20.0	20.0	7.2	U	U	12.4	20.0	7.2	J	J

Table 7. Sediment Conventionals and Analytical COC Results compared to DMMP Guidelines

Parameter	DMMP Marine Guidelines			DMMU-01					DMMU-02					DMMU-03					DMMU-04				
	SL	BT	ML	Result	RL	MDL	Qualifier		Result	RL	MDL	Qualifier		Result	RL	MDL	Qualifier		Result	RL	MDL	Qualifier	
							Lab	VQ				Lab	VQ				Lab	VQ				Lab	VQ
2-Methylnaphthalene	670	---	1,900	19.9	19.9	4.5	U	U	20.0	20.0	4.5	U	U	20.0	20.0	4.5	U	U	20.0	20.0	4.5	U	U
Total LPAH	5,200	---	29,000	19.9			U	U	20.0			U	U	20.0			U	U	18.8			J	J
HPAH																							
Fluoranthene	1,700	4,600	30,000	19.9	19.9	6.1	U	U	20.0	20.0	6.1	U	U	20.0	20.0	6.1	U	U	20.0	20.0	6.1	U	U
Pyrene	2,600	11,980	16,000	19.9	19.9	5.7	U	U	20.0	20.0	5.7	U	U	20.0	20.0	5.7	U	U	9.1	20.0	5.7	J	J
Benz(a)anthracene	1,300	---	5,100	19.9	19.9	5.9	U	U	20.0	20.0	6.0	U	U	20.0	20.0	6.0	U	U	20.0	20.0	6.0	U	U
Chrysene	1,400	---	21,000	19.9	19.9	6.0	U	U	20.0	20.0	6.1	U	U	20.0	20.0	6.1	U	U	20.0	20.0	6.1	U	U
Benzofluoranthenes (b, j ,k)	3,200	---	9,900	39.8	39.8	20.9	U	U	40.0	40.0	21.0	U	U	40.0	40.0	21.0	U	U	40.0	40.0	21.0	U	U
Benzo(a)pyrene	1,600	---	3,600	19.9	19.9	4.2	U	U	20.0	20.0	4.2	U	U	20.0	20.0	4.2	U	U	20.0	20.0	4.2	U	U
Indeno(1,2,3-c,d)pyrene	600	---	4,400	19.9	19.9	14.6	U	U	20.0	20.0	14.6	U	U	20.0	20.0	14.6	U	U	20.0	20.0	14.7	U	U
Dibenz(a,h)anthracene	230	---	1,900	19.9	19.9	17.2	U	U	20.0	20.0	17.2	U	U	20.0	20.0	17.2	U	U	20.0	20.0	17.2	U	U
Benzo(g,h,i)perylene	670	---	3,200	19.9	19.9	13.5	U	U	20.0	20.0	13.6	U	U	20.0	20.0	13.6	U	U	20.0	20.0	13.6	U	U
Total HPAH	12,000	---	69,000	39.8			U	U	40.0			U	U	40.0			U	U	9.1			J	J
CHLORINATED HYDROCARBONS (µg/kg dry weight)																							
1,4-Dichlorobenzene	110	---	120	0.7	5.0	0.6	J	J	5.0	5.0	0.6	U	U	5.0	5.0	0.6	U	U	0.9	5.0	0.6	J	J
1,2-Dichlorobenzene	35	---	110	5.0	5.0	0.7	U	U	5.0	5.0	0.7	U	U	5.0	5.0	0.7	U	U	0.8	5.0	0.7	J	J
1,2,4-Trichlorobenzene	31	---	64	5.0	5.0	2.7	U	U	5.0	5.0	2.7	U	U	5.0	5.0	2.7	U	U	5.0	5.0	2.7	U	U
Hexachlorobenzene (HCB)	22	168	230	5.0	5.0	0.7	U	U	5.0	5.0	0.7	U	U	5.0	5.0	0.7	U	U	5.0	5.0	0.7	U	U
PHTHALATES (µg/kg dry weight)																							
Dimethyl phthalate	71	---	1,400	19.9	19.9	4.4	U	U	20.0	20.0	4.4	U	U	20.0	20.0	4.4	U	U	20.0	20.0	4.4	U	U
Diethyl phthalate	200	---	1,200	50.0	50.0	19.7	U	U	27.9	50.0	19.7	J	U	32.3	49.9	19.7	J	U	50.0	50.0	19.7	U	U
Di-n-butyl phthalate	1,400	---	5,100	19.9	19.9	5.6	U	U	20.0	20.0	5.6	U	U	20.0	20.0	5.6	U	U	20.0	20.0	5.6	U	U
Butyl benzyl phthalate	63	---	970	19.9	19.9	9.4	U	U	20.0	20.0	9.4	U	U	20.0	20.0	9.4	U	U	20.0	20.0	9.4	U	U
Bis(2-ethylhexyl) phthalate	1,300	---	8,300	49.8	49.8	14.0	U	U	50.0	50.0	14.1	U	U	49.9	49.9	14.1	U	U	50.0	50.0	14.1	U	U
Di-n-octyl phthalate	6,200	---	6,200	19.9	19.9	4.4	U	U	20.0	20.0	4.4	U	U	20.0	20.0	4.4	U	U	20.0	20.0	4.4	U	U
PHENOLS (µg/kg dry weight)																							
Phenol	420	---	1,200	5.1	19.9	4.4	J	J	9.4	20.0	4.4	J	J	20.0	20.0	4.4	U	U	20.0	20.0	4.4	U	U
2-Methylphenol	63	---	77	19.9	19.9	6.6	U	U	20.0	20.0	6.7	U	U	20.0	20.0	6.7	U	U	20.0	20.0	6.7	U	U
4-Methylphenol	670	---	3,600	19.9	19.9	7.4	U	U	20.0	20.0	7.4	U	U	20.0	20.0	7.4	U	U	20.0	20.0	7.4	U	U
2,4-Dimethylphenol	29	---	210	19.9	19.9	2.2	U	U	19.9	19.9	2.2	U	U	19.9	19.9	2.2	U	U	20.0	20.0	2.2	U	U
Pentachlorophenol	400	504	690	99.6	99.6	31.1	U	UJ	100.0	100	31.2	U	UJ	99.9	99.9	31.2	U	UJ	100	100	31.3	U	UJ

Table 7. Sediment Conventionals and Analytical COC Results compared to DMMP Guidelines

Parameter	DMMP Marine Guidelines			DMMU-01					DMMU-02					DMMU-03					DMMU-04				
	SL	BT	ML	Result	RL	MDL	Qualifier		Result	RL	MDL	Qualifier		Result	RL	MDL	Qualifier		Result	RL	MDL	Qualifier	
							Lab	VQ				Lab	VQ				Lab	VQ				Lab	VQ
MISCELLANEOUS EXTRACTABLES (µg/kg dry weight)																							
Benzyl alcohol	57	---	870	19.9	19.9	16.2	U	U	20.0	20.0	16.3	U	U	20.0	20.0	16.2	U	U	20.0	20.0	16.3	U	U
Benzoic acid	650	---	760	199	199	38.9	U	UJ	49.1	200	39.0	J	J	200	200	39.0	U	UJ	200	200	39.1	U	UJ
Dibenzofuran	540	---	1,700	19.9	19.9	14.1	U	U	20.0	20.0	14.1	U	U	20.0	20.0	14.1	U	U	20.0	20.0	14.1	U	U
Hexachlorobutadiene	11	---	270	5.0	5.0	0.7	U	U	5.0	5.0	0.7	U	U	5.0	5.0	0.7	U	U	0.8	5.0	0.7	J	J
N-Nitrosodiphenylamine	28	---	130	5.0	5.0	1.3	U	U	5.0	5.0	1.3	U	U	5.0	5.0	1.3	U	U	5.0	5.0	1.3	U	U
PESTICIDES([1]) & PCBs (µg/kg dry weight)																							
4,4'-DDD	16	---	---	0.61	5.3	0.61	U	U	0.58	5.0	0.58	U	U	0.028	0.25	0.028	U	U	0.65	5.6	0.65	U	U
4,4'-DDE	9	---	---	0.99	5.3	0.99	U	U	0.93	5.0	0.93	U	U	0.046	0.25	0.046	U	U	1.0	5.6	1.0	U F1	U
4,4'-DDT	12	---	---	0.99	5.3	0.99	U	U	0.93	5.0	0.93	U	U	0.046	0.25	0.046	U	U	1.0	5.6	1.0	U	U
Total DDT	---	50	69	0.99			U	U	0.93			U	U	0.046			U	U	1.0			F1 U	U
Aldrin	9.5	---	---	1.0	8.0	1.0	U	U	0.95	7.5	0.95	U	U	0.047	0.37	0.047	U	U	1.1	8.4	1.1	U	U
cis-Chlordane				2.0	5.3	2.0	U	U	1.9	5.0	1.9	U	U	0.093	0.25	0.093	U	U	2.1	5.6	2.1	U F1	U
cis-Nonachlor				2.3	13	2.3	U	U	2.1	13	2.1	U	U	0.11	0.62	0.11	U	U	2.4	14	2.4	U	U
Oxychlordane				2.1	11	2.1	U	U	1.9	10	1.9	U	U	0.095	0.50	0.095	U	U	2.2	11	2.2	U	U
trans-Chlordane				0.85	8.0	0.85	U	U	0.8	7.5	0.8	U	U	0.040	0.37	0.040	U	U	0.90	8.4	0.90	U	U
trans-Nonachlor				2.3	11	2.3	U	U	2.1	10	2.1	U	U	0.11	0.50	0.11	U	U	2.4	11	2.4	U	U
Total Chlordane	2.8	37	---	2.3			U	U	2.1			U	U	0.11			U	U	2.4			U	U
Dieldrin	1.9	---	1700	0.93	5.3	0.93	U	U	0.88	5.0	0.88	U	U	0.043	0.25	0.043	U	U	0.98	5.6	0.98	U F1	U
Heptachlor	1.5	---	270	0.51	8.0	0.51	U	U	0.48	7.5	0.48	U	U	0.024	0.37	0.024	U	U	0.53	8.4	0.53	U	U
PCB-aroclor 1016				27	27	9.9	U	U	24	24	8.8	U	U	25	25	9.1	U	U	27	27	9.9	U	U
PCB-aroclor 1221				27	27	16	U	U	24	24	14	U	U	25	25	15	U	U	27	27	16	U	U
PCB-aroclor 1232				27	27	6.5	U	U	24	24	5.8	U	U	25	25	6.0	U	U	27	27	6.6	U	U
PCB-aroclor 1242				27	27	11	U	U	24	24	9.5	U	U	25	25	9.8	U	U	27	27	11	U	U
PCB-aroclor 1248				27	27	9.3	U	U	24	24	8.3	U	U	25	25	8.6	U	U	27	27	9.4	U	U
PCB-aroclor 1254				27	27	12	U	U	24	24	11	U	U	25	25	11	U	U	27	27	12	U	U
PCB-aroclor 1260				27	27	9.9	U	U	24	24	8.8	U	U	25	25	9.1	U	U	27	27	9.9	U	U
Total PCBs (Aroclors)	130	38([2])	3,100	27			U	U	24			U	U	25			U	U	27			U	U

(1) Non-detect results reported at MDL

(2) This value is normalized to TOC and expressed in mg/kg carbon

Table 8. COC Analysis Results Compared to Marine Sediment AET

(Results not TOC normalized due to low TOC)

Parameter	Marine Sediment AETs		DMMU-01			DMMU-02			DMMU-03			DMMU-04		
	SCO	CSL	Result	Qualifier		Result	Qualifier		Result	Qualifier		Result	Qualifier	
				Lab	VQ		Lab	VQ		Lab	VQ		Lab	VQ
Total organic carbon (% decimal)			0.0045			0.0013	J	U	0.0012	J	U	0.0028		U
METALS (mg/kg dry weight)														
Arsenic	57	93	3.8			3.3			2.4			4.5		
Cadmium	5.1	6.7	0.054	J	J	0.034	J	J	0.30	U	U	0.088	J	J
Chromium	260	270	20			21			16			25		
Copper	390	390	9.0			6.4			5.3			8.1		
Lead	450	530	2.1			1.6			1.6			2.2		
Mercury	0.41	0.59	0.014	J	J	0.033	U	U	0.027	U	U	0.012	J	J
Silver	6.1	6.1	0.028	J	J	0.013	J	J	0.075	U	U	0.021	J	J
Zinc	410	960	27			25			24			32		
ORGANICS														
PAHs (µg/kg dry weight)														
LPAH														
Naphthalene	2,100	2,100	19.9	U	U	20.0	U	U	20.0	U	U	20.0	U	U
Acenaphthylene	1,300	1,300	19.9	U	U	20.0	U	U	20.0	U	U	20.0	U	U
Acenaphthene	500	500	19.9	U	U	20.0	U	U	20.0	U	U	6.4	J	J
Fluorene	540	540	19.9	U	U	20.0	U	U	20.0	U	U	20.0	U	U
Phenanthrene	1,500	1,500	19.9	U	U	20.0	U	U	20.0	U	U	20.0	U	U
Anthracene	960	960	19.9	U	U	20.0	U	U	20.0	U	U	12.4	J	J
2-Methylnaphthalene	670	670	19.9	U	U	20.0	U	U	20.0	U	U	20.0	U	U
Total LPAH	5,200	5,200	19.9	U	U	20.0	U	U	20.0	U	U	18.8	J	J
HPAH														
Fluoranthene	1,700	2,500	19.9	U	U	20.0	U	U	20.0	U	U	20.0	U	U
Pyrene	2,600	3,300	19.9	U	U	20.0	U	U	20.0	U	U	9.1	J	J
Benz(a)anthracene	1,300	1,600	19.9	U	U	20.0	U	U	20.0	U	U	20.0	U	U
Chrysene	1,400	2,800	19.9	U	U	20.0	U	U	20.0	U	U	20.0	U	U
Benzofluoranthenes (b, j ,k)	3,200	3,600	39.8	U	U	40.0	U	U	40.0	U	U	40.0	U	U
Benzo(a)pyrene	1,600	1,600	19.9	U	U	20.0	U	U	20.0	U	U	20.0	U	U
Indeno(1,2,3-c,d)pyrene	600	690	19.9	U	U	20.0	U	U	20.0	U	U	20.0	U	U
Dibenz(a,h)anthracene	230	230	19.9	U	U	20.0	U	U	20.0	U	U	20.0	U	U

Table 8. COC Analysis Results Compared to Marine Sediment AET

(Results not TOC normalized due to low TOC)

Parameter	Marine Sediment AETs		DMMU-01			DMMU-02			DMMU-03			DMMU-04		
	SCO	CSL	Result	Qualifier		Result	Qualifier		Result	Qualifier		Result	Qualifier	
				Lab	VQ		Lab	VQ		Lab	VQ		Lab	VQ
Benzo(g,h,i)perylene	670	720	19.9	U	U	20.0	U	U	20.0	U	U	20.0	U	U
Total HPAH	12,000	17,000	39.8	U	U	40.0	U	U	40.0	U	U	9.1	J	J
CHLORINATED HYDROCARBONS (µg/kg dry weight)														
1,4-Dichlorobenzene	110	110	0.7	J	J	5.0	U	U	5.0	U	U	0.9	J	J
1,2-Dichlorobenzene	35	50	5.0	U	U	5.0	U	U	5.0	U	U	0.8	J	J
1,2,4-Trichlorobenzene	31	51	5.0	U	U	5.0	U	U	5.0	U	U	5.0	U	U
Hexachlorobenzene (HCB)	22	70	5.0	U	U	5.0	U	U	5.0	U	U	5.0	U	U
PHTHALATES (µg/kg dry weight)														
Dimethyl phthalate	71	160	19.9	U	U	20.0	U	U	20.0	U	U	20.0	U	U
Diethyl phthalate	200	>1,200	50.0	U	U	27.9	J	U	32.3	J	U	50.0	U	U
Di-n-butyl phthalate	1,400	1,400	19.9	U	U	20.0	U	U	20.0	U	U	20.0	U	U
Butyl benzyl phthalate	63	900	19.9	U	U	20.0	U	U	20.0	U	U	20.0	U	U
Bis(2-ethylhexyl) phthalate	1,300	1,900	49.8	U	U	50.0	U	U	49.9	U	U	50.0	U	U
Di-n-octyl phthalate	6,200	6,200	19.9	U	U	20.0	U	U	20.0	U	U	20.0	U	U
PHENOLS (µg/kg dry weight)														
Phenol	420	1,200	5.1	J	J	9.4	J	J	20.0	U	U	20.0	U	U
2-Methylphenol	63	63	19.9	U	U	20.0	U	U	20.0	U	U	20.0	U	U
4-Methylphenol	670	670	19.9	U	U	20.0	U	U	20.0	U	U	20.0	U	U
2,4-Dimethylphenol	29	29	19.9	U	U	19.9	U	U	19.9	U	U	20.0	U	U
Pentachlorophenol	360	690	99.6	U	UJ	100.0	U	UJ	99.9	U	UJ	100	U	UJ
MISCELLANEOUS EXTRACTABLES (µg/kg dry weight)														
Benzyl alcohol	57	73	19.9	U	U	20.0	U	U	20.0	U	U	20.0	U	U
Benzoic acid	650	650	199	U	UJ	49.1	J	J	200	U	UJ	200	U	UJ
Dibenzofuran	540	540	19.9	U	U	20.0	U	U	20.0	U	U	20.0	U	U
Hexachlorobutadiene	11	120	5.0	U	U	5.0	U	U	5.0	U	U	0.8	J	J
N-Nitrosodiphenylamine	28	40	5.0	U	U	5.0	U	U	5.0	U	U	5.0	U	U
PCBs (µg/kg dry weight)														
Total PCBs (Aroclors)	130	1000	27	U	U	24	U	U	25	U	U	27	U	U

FIGURES

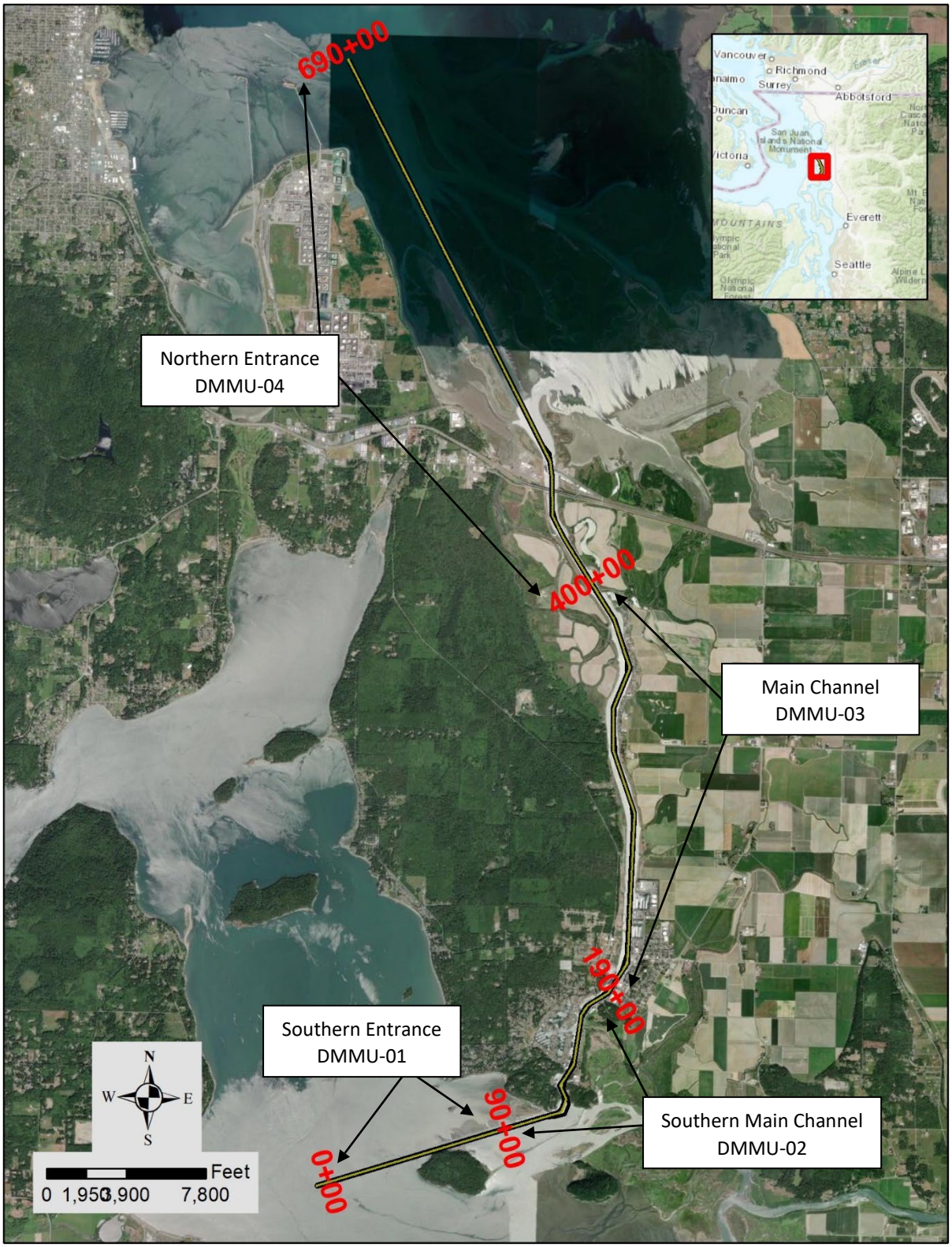

Figure 1. Proposed Dredge Area

Figure 2. Southern Entrance Overview DMMU-01

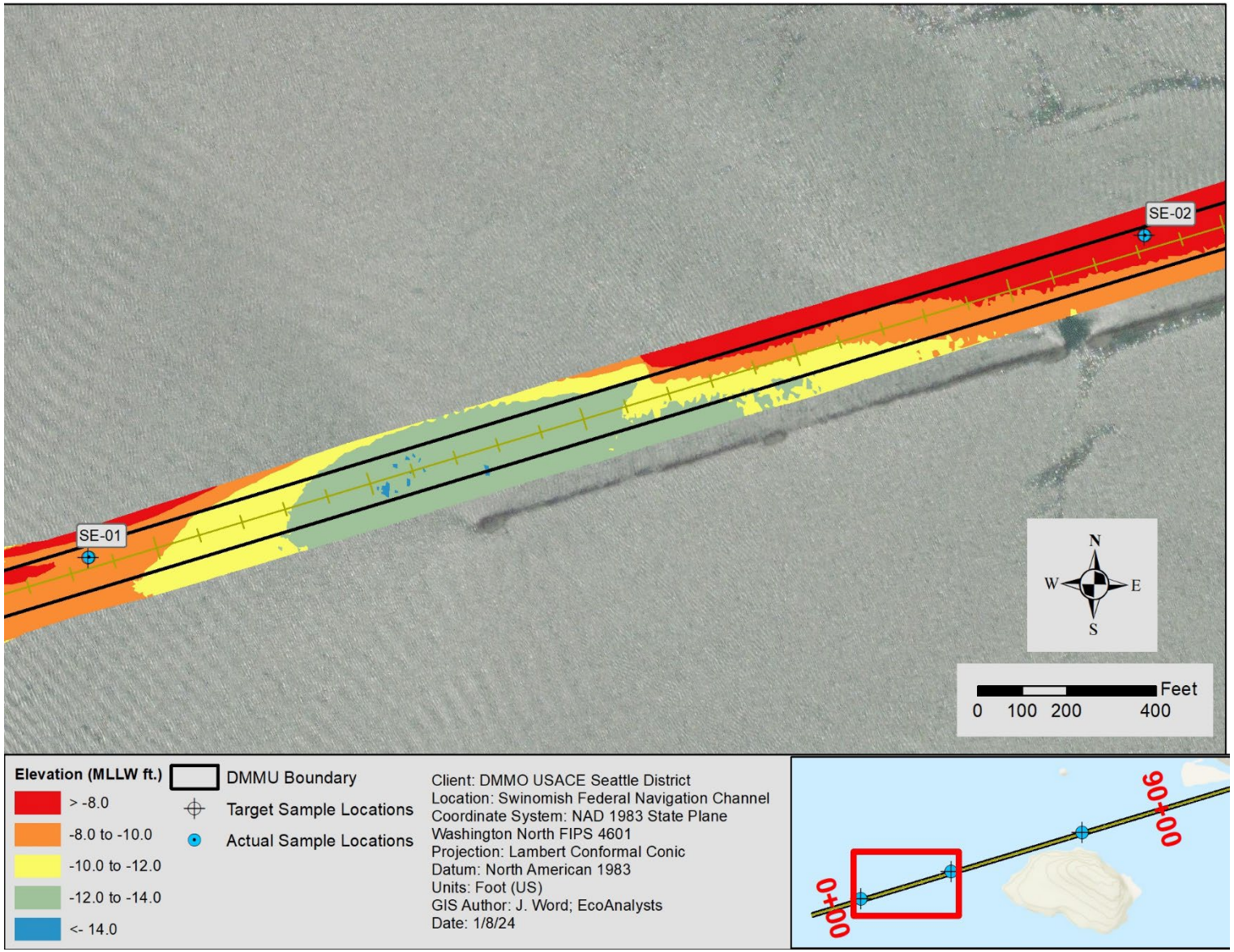

Figure 3. Southern Entrance DMMU Target and Actual Sampling Locations (SE-01, SE-02)

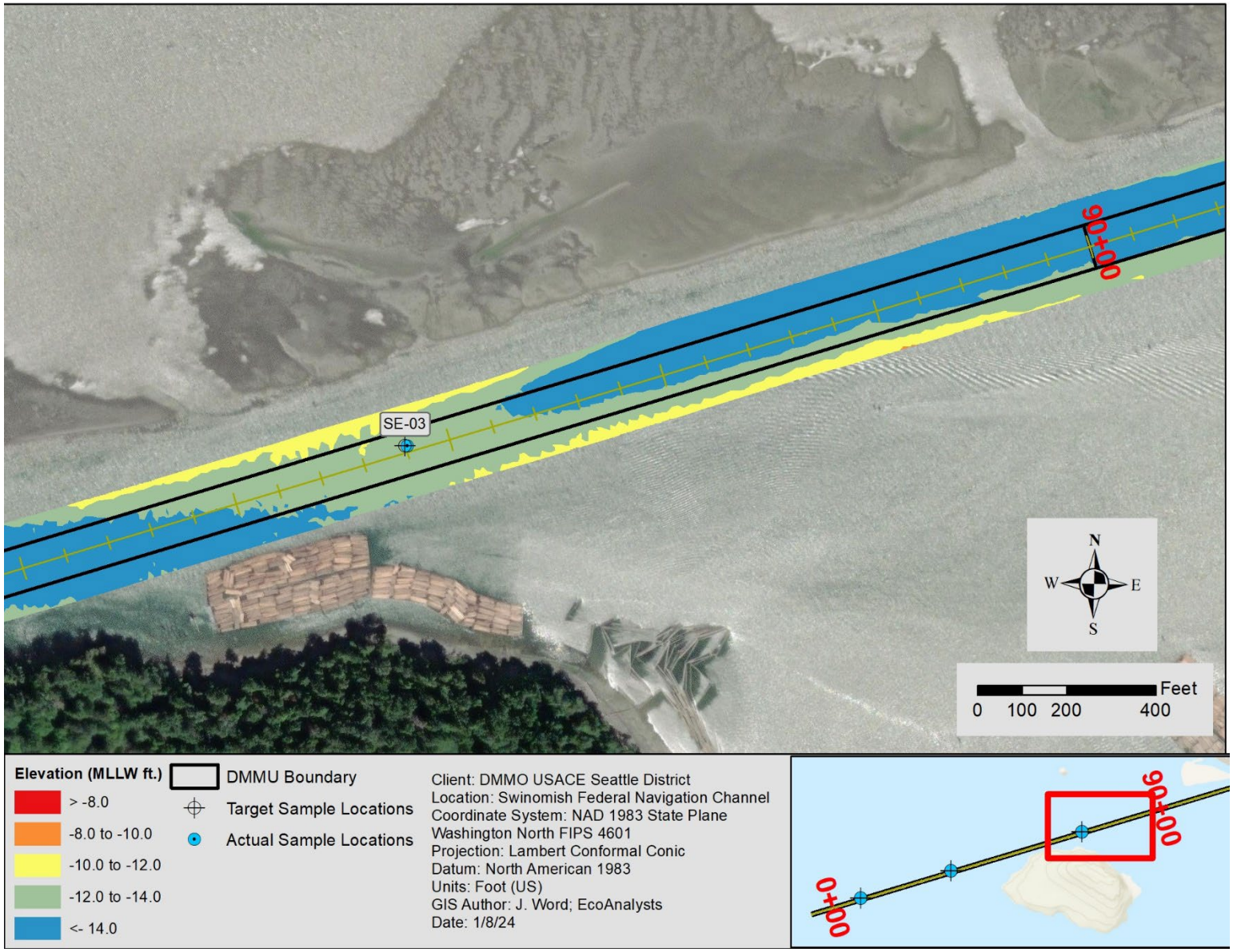

Figure 4. Southern Entrance DMMU Target and Actual Sampling Locations (SE-03)

Figure 5. Southern Main Channel Overview DMMU-02

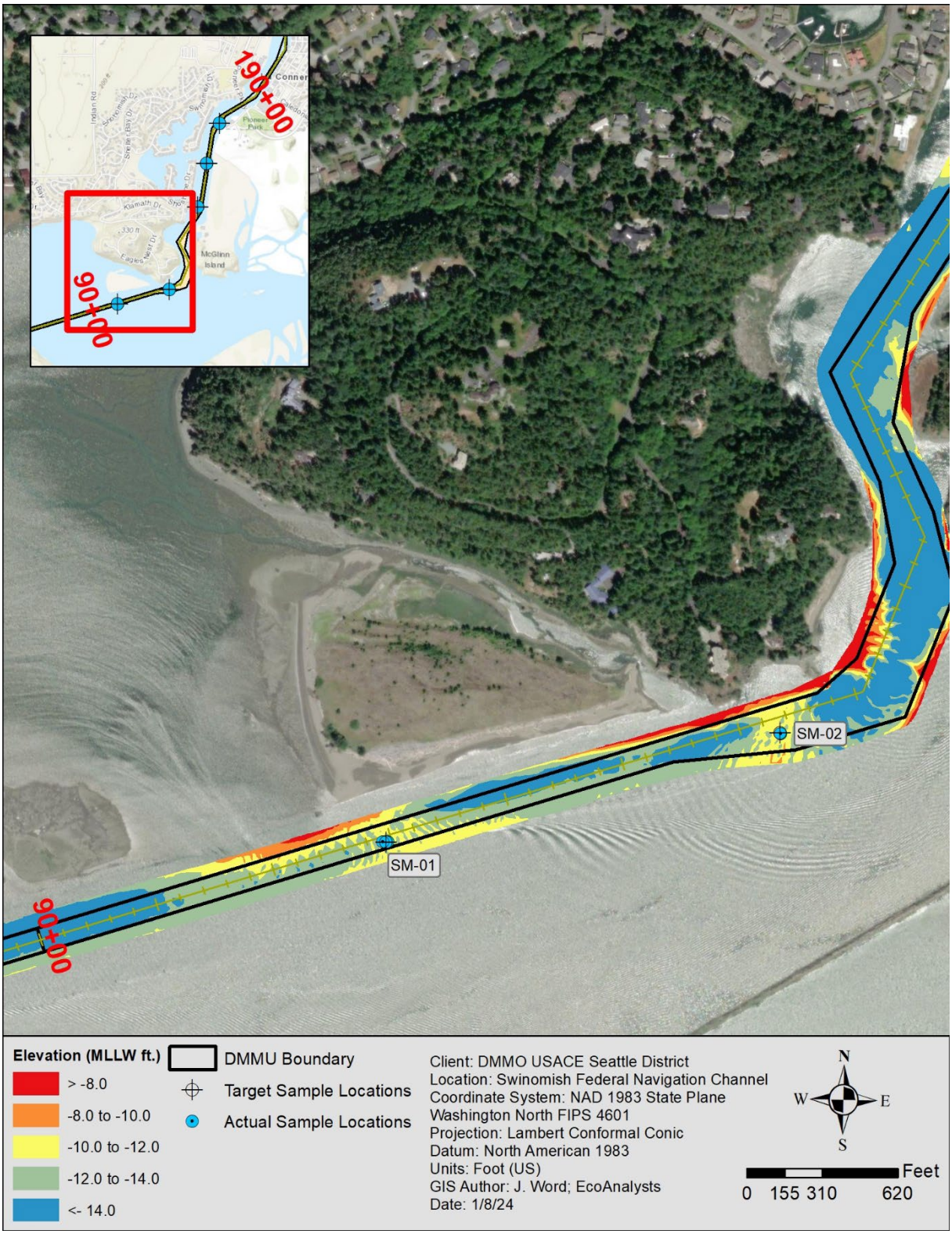

Figure 6. Southern Main Channel Target and Actual Sampling Locations (SM-01, SM-02)

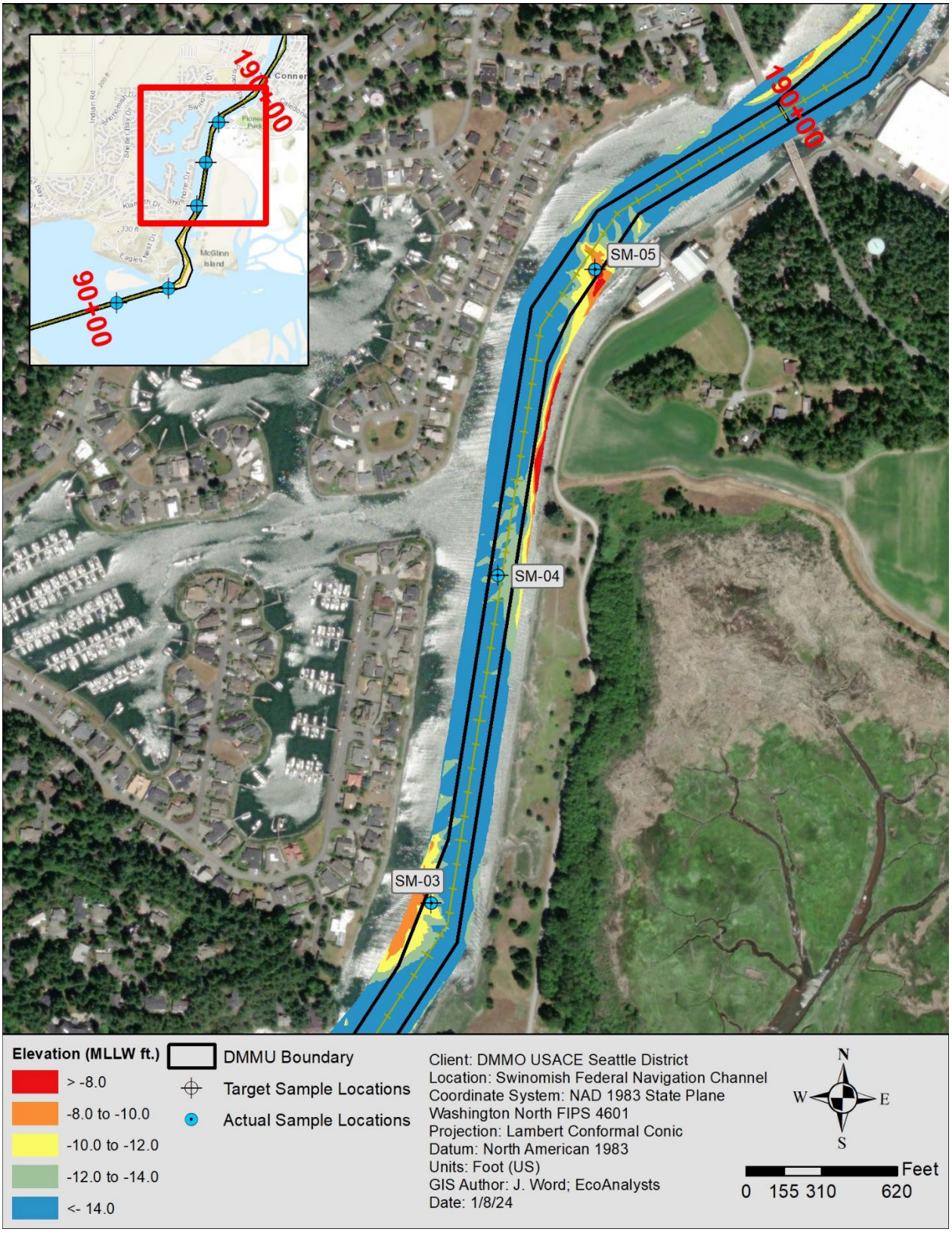

Figure 7. Southern Main Channel Target and Actual Sampling Locations (SM-03 – SM-05)

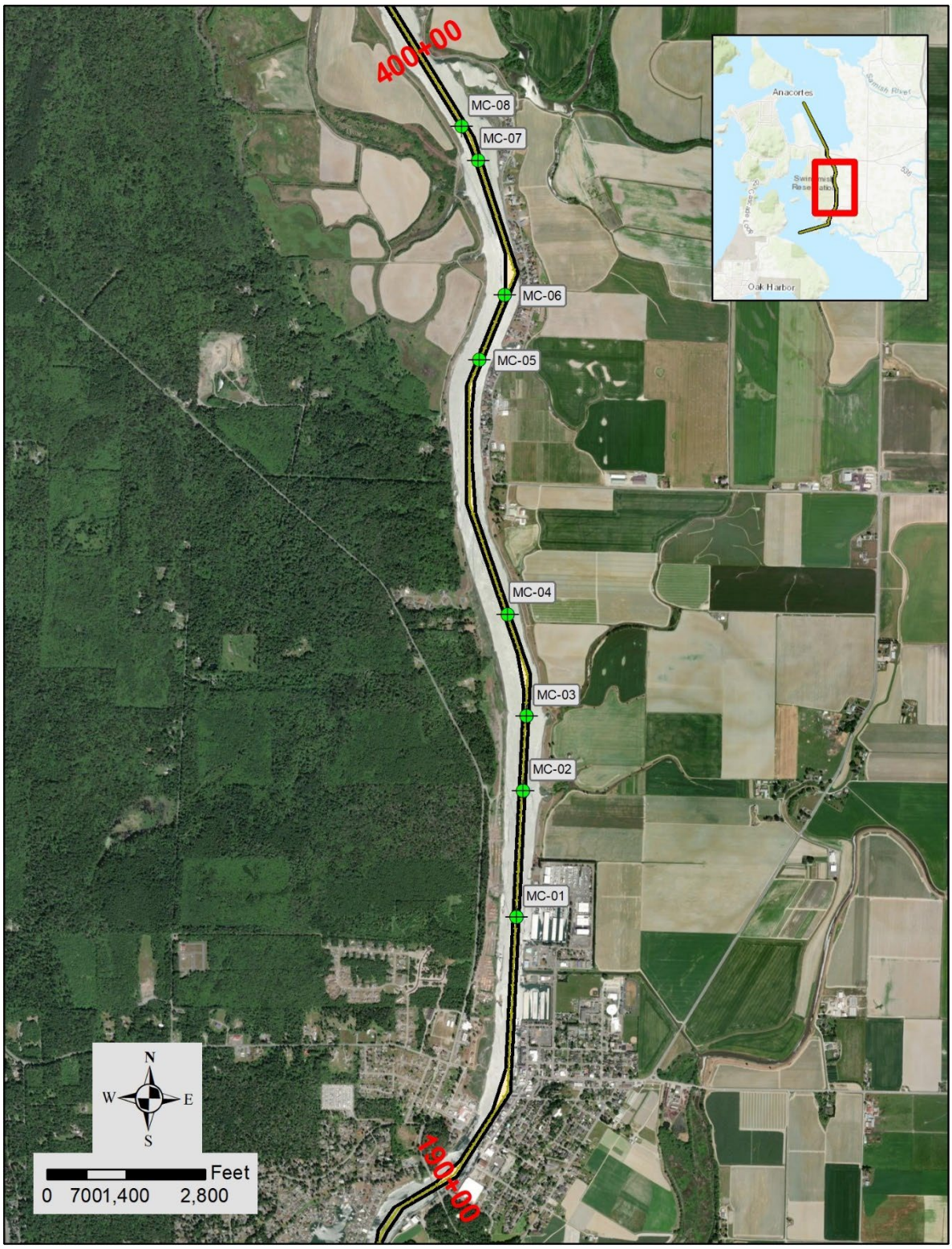

Figure 8. Main Channel Overview DMMU-03

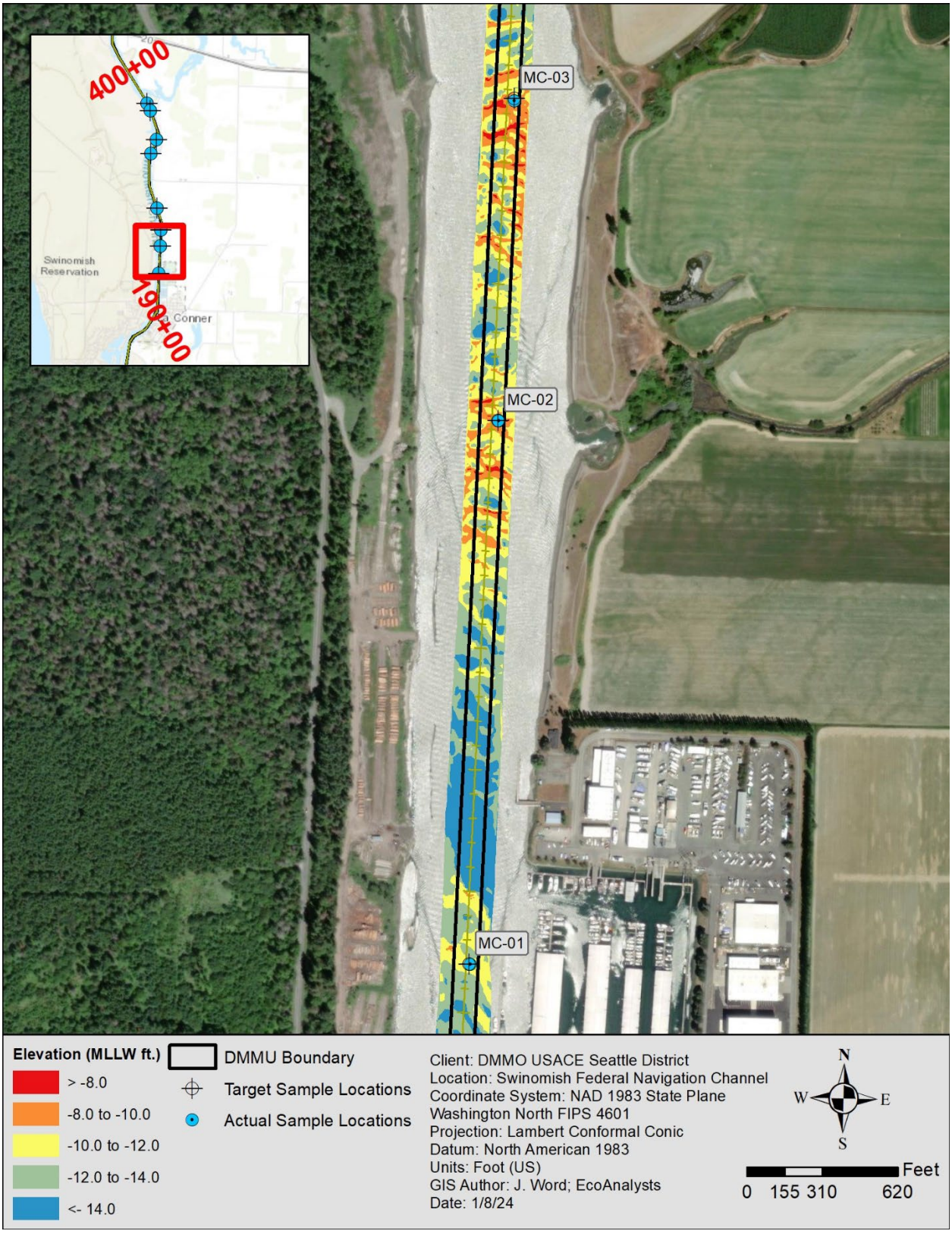

Figure 9. Main Channel Target and Actual Sampling Locations (MC-01 - MC-03)

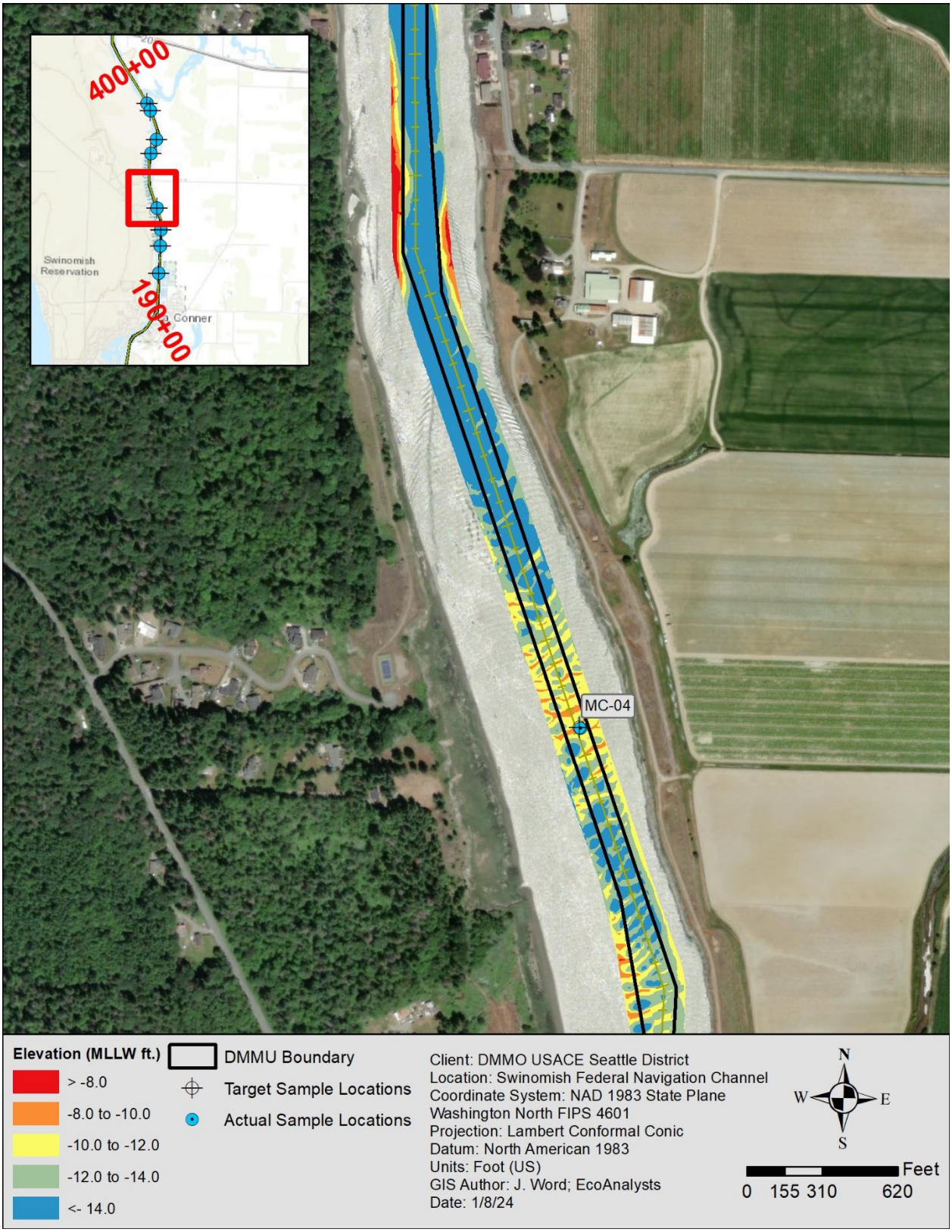

Figure 10. Main Channel Target and Actual Sampling Locations (MC-04)

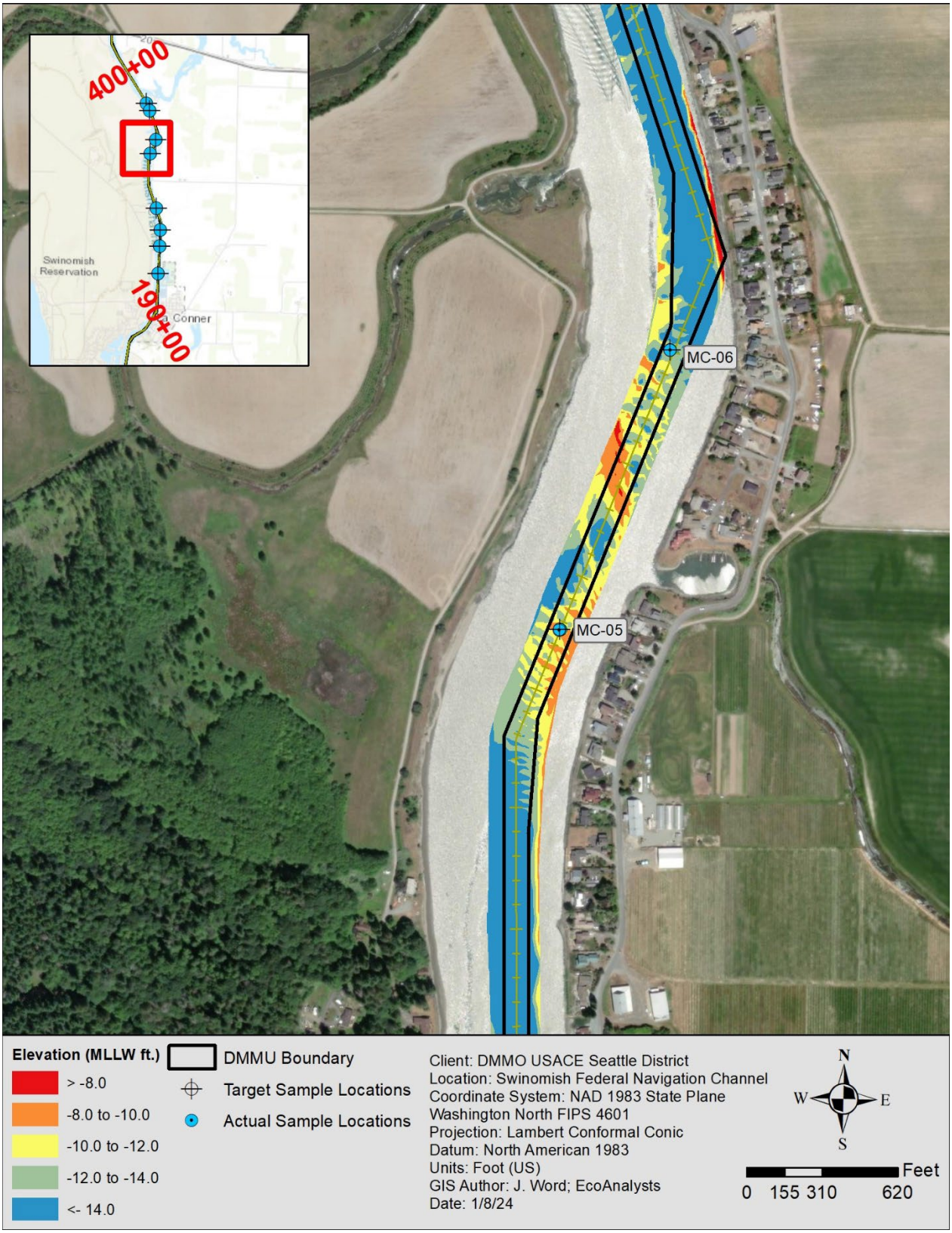

Figure 11. Main Channel Target and Actual Sampling Locations (MC-05, MC-06)

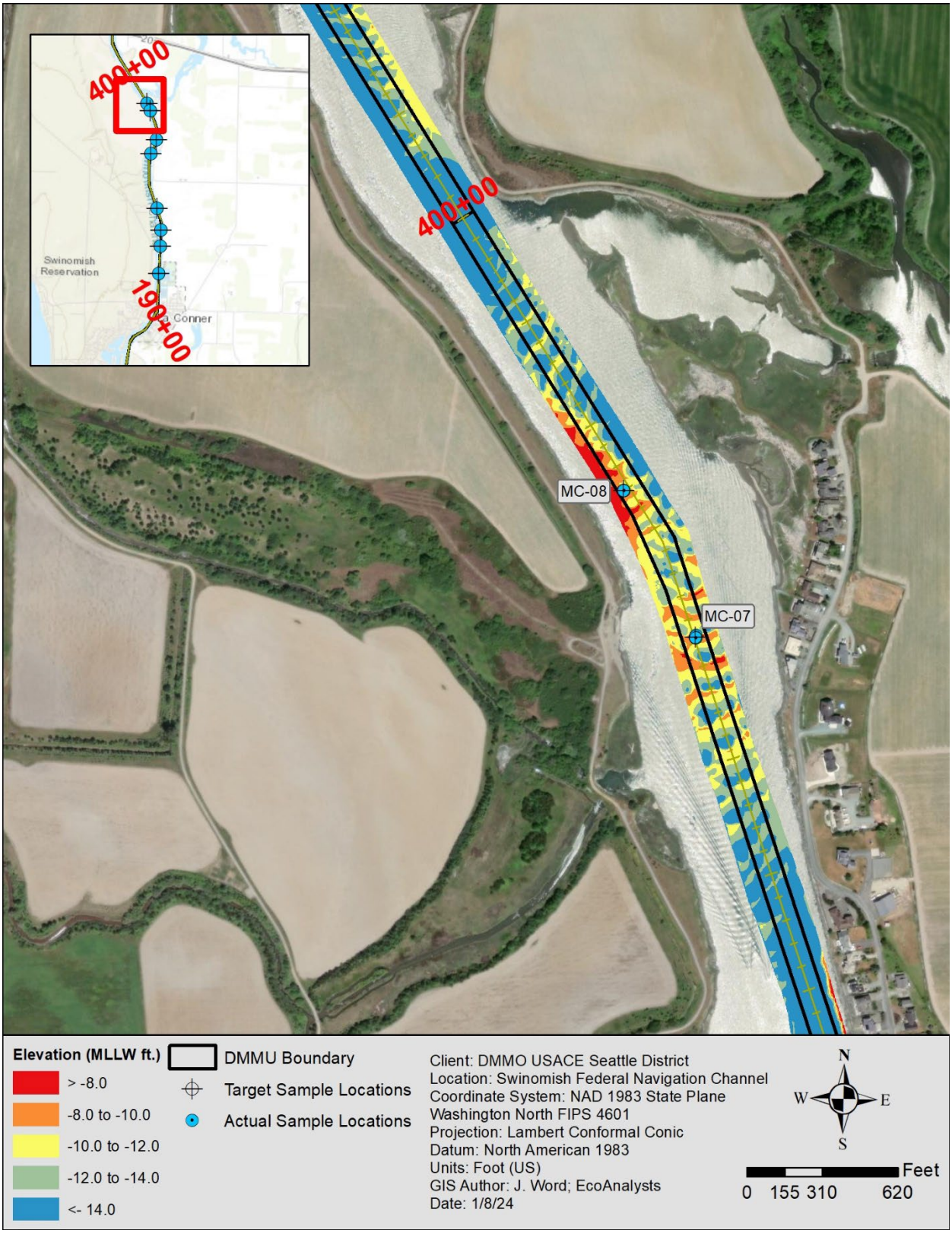

Figure 12. Main Channel Target and Actual Sampling Locations (MC-07, MC-08)

Figure 13. North Entrance Overview DMMU-04

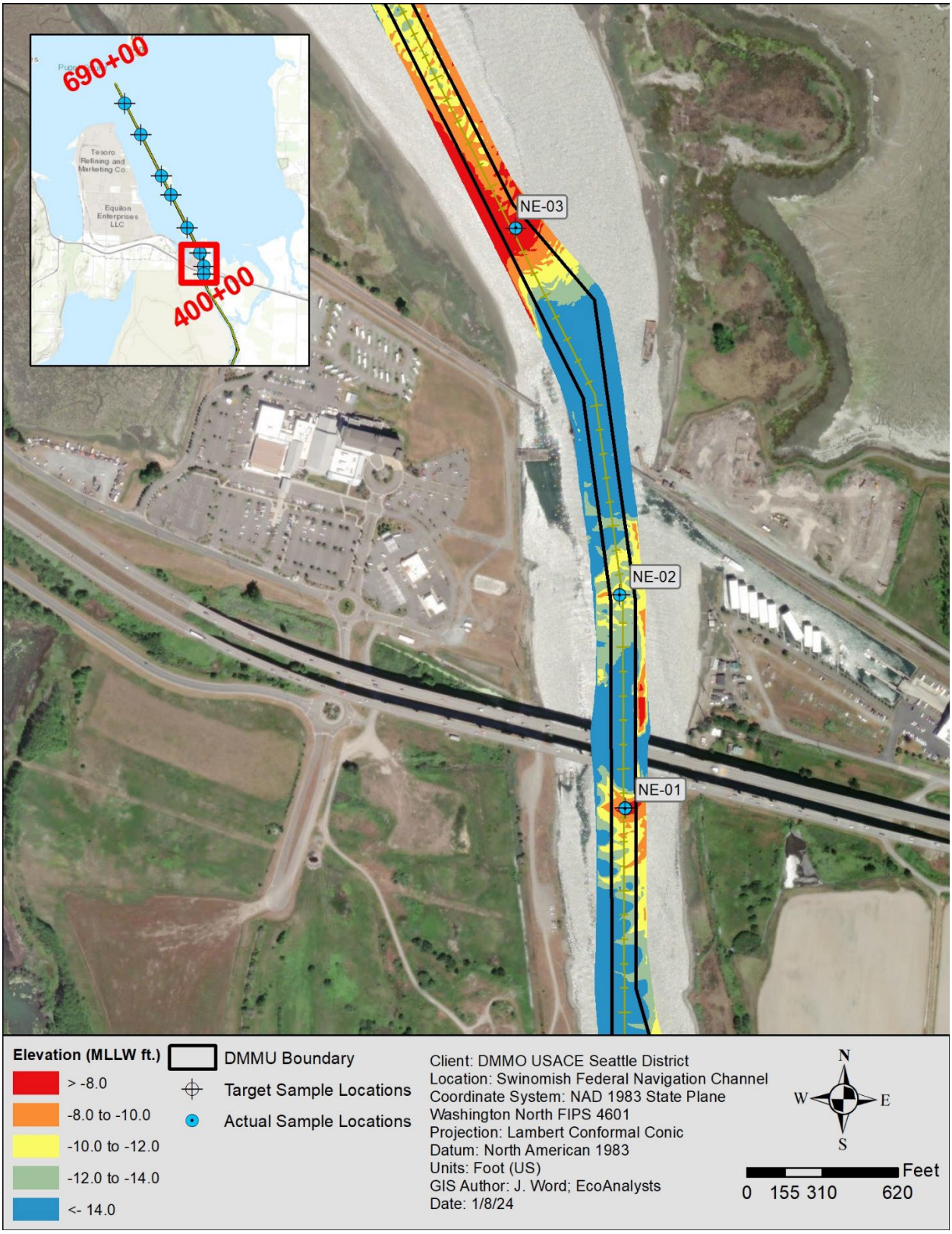

Figure 14. North Entrance Target and Actual Sampling Locations (NE-01 – NE-03)

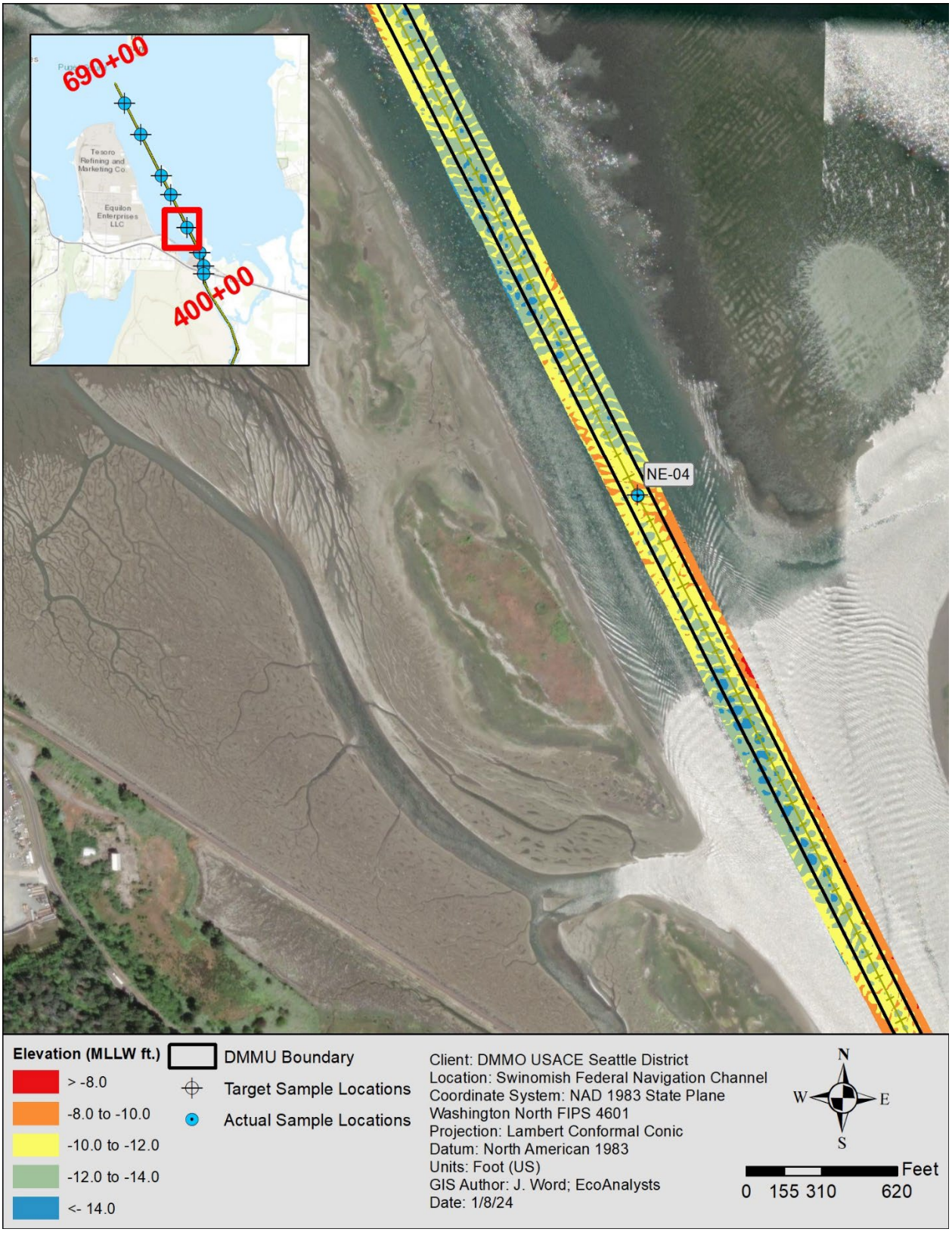

Figure 15. North Entrance Target and Actual Sampling Locations (NE-04)

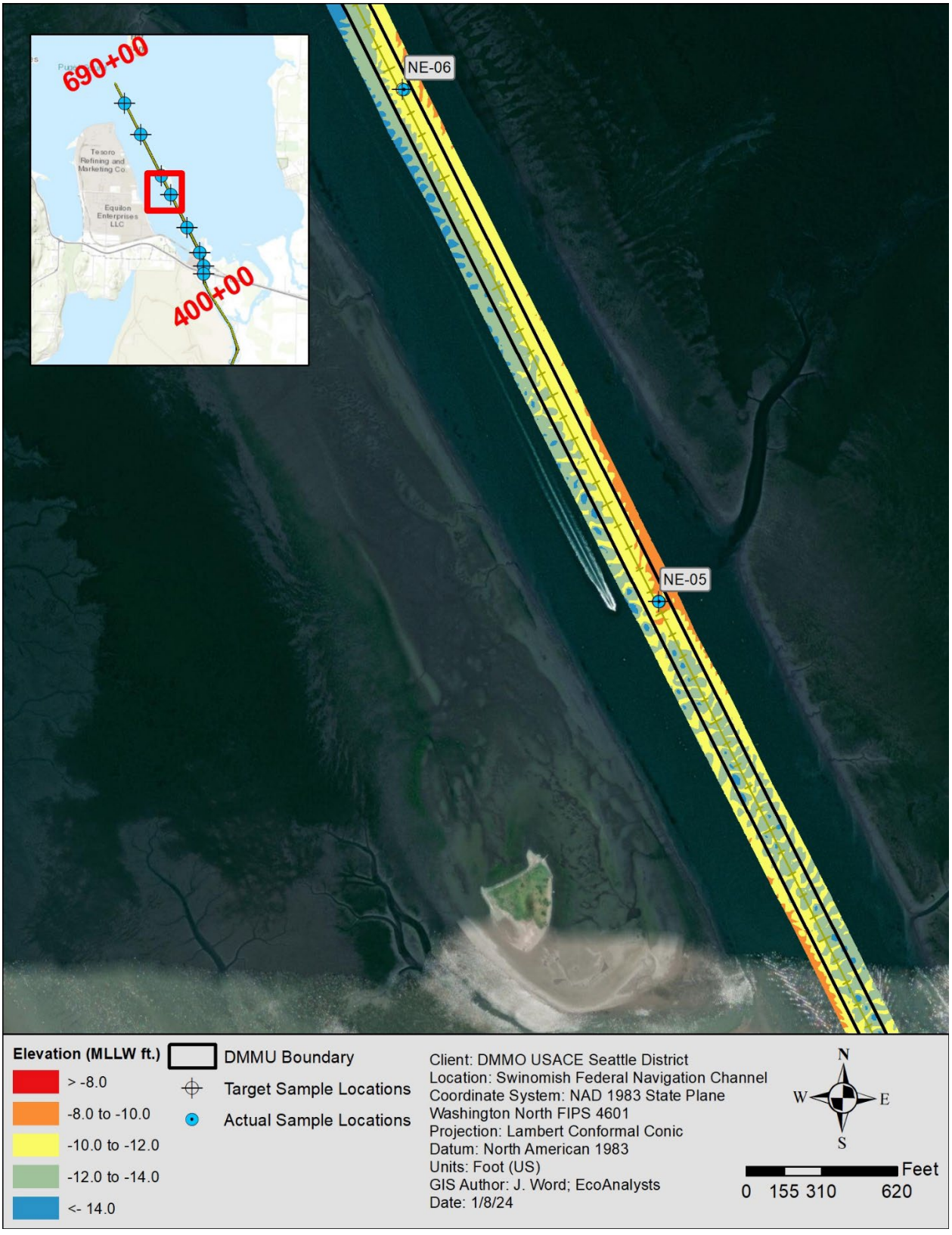

Figure 16. North Entrance Target and Actual Sampling Locations (NE-05, NE-06)

Figure 17. North Entrance Target and Actual Sampling Locations (NE-07, NE-08)