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ANCHOR QEA

Memorandum

March 11, 2019

To: Joyce Mercuri, Washington State Department of Ecology

From: Eli Patmont, John Laplante, Greg Brunkhorst, and Clay Patmont, Anchor QEA, LLC

cc: Jerry Enslow and Dave McEntee, Simpson Timber Company

Re: Northern Shelton Harbor Interim Action: Water Quality Monitoring and Cap Construction Status

This memorandum summarizes water quality monitoring as well as cap thickness and geotechnical evaluations completed during Season 1 interim sediment cleanup actions in the northern portion of the Shelton Harbor Sediment Cleanup Unit (SCU). All Season 1 in-water construction activities were performed during the period from October 30, 2018, to January 25, 2019. Water quality and cap thickness verification monitoring were conducted consistent with the *Water Quality Monitoring Plan* (WQMP) and the *Construction Quality Assurance Plan* (CQAP), respectively, as approved by the Washington State Department of Ecology (Ecology), and included as appendices to the September 2018 *Shelton Harbor Interim Action Basis of Design Report* (BODR; Anchor QEA 2018). Both the CQAP and WQMP were prepared to support project compliance with the requirements of the Model Toxics Control Act (MTCA; Revised Code of Washington 70.105D) as administered by Ecology under the MTCA Cleanup Regulation (Washington Administrative Code [WAC] 173-340), the Sediment Management Standards (WAC 173-204), and Washington State Surface Water Quality Standards (WAC 173-201A).

Construction activities during Season 1 included removal of creosote-treated and untreated timber pilings, demolition of a sheetpile wall, and sediment cap construction. All construction activities were performed in accordance with the BODR, CQAP, and technical specifications. Water quality monitoring was performed throughout in-water construction (Table 1). The turbidity standard, described in the WQMP, was exceeded during two events as described in this memorandum; all other water quality monitoring data were compliant.

Cap thickness was verified using the following three complementary lines of evidence:

- Electronic tracking (bucket maps) to verify material coverage across the placement area
- Comparison of bathymetric surveys before and after material placement
- Cap thickness probing

All three lines of evidence described in this memorandum confirmed that minimum cap thicknesses set forth in the BODR and CQAP were successfully achieved throughout northern Shelton Harbor cap areas A, C, and D. A section of cap area B remains incomplete because the remedial contractor—

Quigg Bros, Inc. (Quigg)—intentionally left a section of the cap unconstructed to allow access to the uplands staging area to support capping planned for the southern portion of the Shelton Harbor SCU in summer 2019. Completion of all interim action caps is scheduled for summer/fall 2019.

Water Quality Monitoring

In accordance with the WQMP, water quality monitoring was performed along transects radiating from in-water construction operations. Monitoring stations were selected based on the tide, current, and visual observations of turbidity. Each monitoring event consisted of measuring turbidity at background, early warning, and compliance stations at designated depths. The schedule of water quality monitoring during in-water work periods was as follows:

- **Intensive:** Turbidity measurements were initially collected twice daily for four consecutive days during each phase of in-water work (e.g., piling removal or capping); if no confirmed exceedances were measured during the intensive monitoring period, the schedule shifted to routine monitoring for the remaining phase of in-water work.
- **Routine:** Collection of turbidity measurements occurred twice daily 1 day per week during in-water work.

Water quality monitoring was conducted during 20 days of in-water construction, with 10 intensive monitoring events and 10 routine monitoring events. During early piling removal operations on November 2 and 6, 2018, turbidity exceeded the standard at one monitoring location (Table 1). After the turbidity exceedance was confirmed, Quigg and Ecology were notified of the exceedance, and Quigg subsequently modified their piling removal operations to meet the turbidity standard. A corrective action report was submitted to Ecology. Modifications to piling removal operations included slowing vessel speeds in shallow water conditions. No further exceedance of the turbidity standard occurred during the remainder of piling removal operations, and no exceedances occurred during capping.

Cap Placement Verification

As discussed in the BODR, a minimum cap design thickness of 18 inches accounts for the following:

- A 6-inch thickness to provide chemical isolation and filtering
- An overlying 12-inch thickness to provide armoring

The project specifications provided Quigg with an additional 6-inch overplacement allowance (i.e., a total placed cap thickness of 24 inches) to account for equipment accuracy and the potential for mobilization and winnowing of finer-grained cap material.

In accordance with the BODR, CQAP, and technical specifications, cap construction in areas A through D was initiated on November 9, 2018, and was completed on January 24, 2019. Based on

bucket maps and a calibrated bucket volume of 3.5 cubic yards (cy; 5.9 tons), Quigg placed approximately 32,700 cy (bucket counts) to 35,000 cy (delivery tickets), including at least 24 inches of blended filter and armor material throughout the targeted capping areas and at least 36 inches of blended filter and armor material along the thickened cap edges (Figures 1 through 5). The average thickness of cap materials placed in areas A through D ranged between 31 and 39 inches (2.6 to 3.2 feet; Table 2).

Based on a comparison of pre- and post-construction bathymetric survey data as summarized on Figure 1, cap placement resulted in a net in situ volume increase in areas A through D of approximately 23,500 cy, roughly 67% to 72% of the placed volume. The difference between placed and in situ volumes is attributable to subgrade consolidation settlement, which averaged approximately 1.0 feet, consistent with BODR estimates.

As set forth in the BODR and CQAP, the minimum cap design thickness of 18 inches must be achieved across at least 95% of the cap surface area. This performance criterion was assessed based on direct cap thickness probing measurements to account for subgrade settlement observed below the cap. Because cap probing was impractical in the thickened edges, and probe refusal was encountered at some cap locations, probing measurements were supplemented with pre- versus post-construction bathymetric survey data. As depicted in Figure 1, the combined probing data and bathymetric surveys verified that at least 24 inches of cap material was successfully placed across more than 95% of the cap areas, exceeding the minimum cap design thickness of 18 inches.

As discussed above, a section of cap area B remains incomplete to allow access to the upland staging area to support capping planned for the southern portion of the Shelton Harbor SCU in summer 2019. Completion of all interim action caps is scheduled for summer/fall 2019.

Geotechnical Evaluations

This section summarizes geotechnical evaluations of both the interim action caps and future habitat restoration projects that are proposed for the capped areas.

Interim Action Capping Evaluations

Geotechnical explorations and evaluations were conducted in the interim action cap areas summarized previously, including evaluating bearing capacity of sediments to support the weight of the cap, and estimation of consolidation settlement of subgrade sediments under the load of the cap discussed previously. These evaluations are presented in BODR Appendix B (Anchor QEA 2018). In summary, the evaluations concluded that the bearing capacity of site sediments is enough to support loads from capping. The interim action caps were successfully placed using controlled construction techniques, including limiting initial placed lift thickness to minimize the potential for

subgrade bearing capacity failures. No bearing capacity failures (which would be indicated by a mud wave) were observed during cap construction.

Future Habitat Restoration Project

The Northern Shelton Harbor habitat restoration project will include construction of a habitat embankment along the shoreline overlapping the cap. This fill is envisioned to be placed at low tide using upland equipment. Anticipated fill thicknesses range from more than 15 feet along the shoreline, and taper to the embankment edge at a 7 horizontal to 1 vertical slope.

In areas where the habitat embankment will be placed on top of an interim action cap, and potentially also in areas where the habitat embankment will be placed on native sediments, initial lifts of material will be placed at a controlled thickness. The contractor will closely observe the behavior of the subgrade and further modify their approach if they observe mud waves developing at the edge of the placement area, or if there appears to be excessive "loss" of embankment fill after placement. These construction best management practices have been incorporated into the technical specifications for the restoration project habitat embankments, which are anticipated to be constructed beginning summer 2019.

References

Anchor QEA (Anchor QEA, LLC), 2018. *Shelton Harbor Interim Action Basis of Design Report*. Oakland Bay and Shelton Harbor Sediments Cleanup Site. Prepared for Washington State Department of Ecology. September 2018.

Tables

Table 1
Water Quality Monitoring Summary

Date	Activity	Monitoring Round	Station	Time	Water Depth (feet)	Actual Distance from Active Work (feet)	Coordinates (degree decimal minutes)		Turbidity Reading (NTU)			Turbidity Elevation at EW	Turbidity Exceedance at CS	Confirmed Exceedance at CS	Elevation/Exceedance Discussed with Client and Contractor	Notes	Response Actions Taken and Best Management Practices Applied
							Latitude	Longitude	Surface	Mid-Depth	Bottom						
10/30/2018	Pile removal	1	BG-1	13:57	9	1000	47.210612	-123.085888	3.1	NA	3.5	--	--	--	--	Two elevated turbidity readings at EW	Potential role of vessel propwash to generate turbidity at EW was discussed. Reviewed operational control BMPs and suggested the Contractor restrict speeds to minimum necessary for maneuvering the barge.
			100EW-1	14:31	9	107	47.213011	-123.089894	7.6	NA	15.2	Yes	No	No	Yes		
			150C-1	14:42	9	147	47.212933	-123.089695	5.2	NA	7.3	No	No	No	No		
		2	BG-2	15:41	7	1000	47.211211	-123.086255	2.4	NA	3.4	--	--	--	--		
			100EW-2	15:50	6	111	47.212849	-123.088829	34.0	NA	42.0	Yes	No	No	Yes		
			150C-2	16:10	6	150	47.212756	-123.088664	4.5	NA	4.7	No	No	No	No		
10/31/2018	Pile removal	1	BG-1	11:40	12	1230	47.210645	-123.084611	0.9	3.1	3.1	--	--	--	--	NA	NA
			100EW-1	11:56	11	109	47.212683	-123.088132	5.3	4.9	4.8	No	No	No	No		
			150C-1	11:47	10	165	47.212755	-123.087936	4.0	4.6	4.7	No	No	No	No		
		2	BG-2	13:32	15	1206	47.210948	-123.084196	2.2	2.2	2.5	--	--	--	--		
			100EW-2	13:48	11	148	47.212439	-123.088036	5.1	4.5	4.6	No	No	No	No		
			150C-2	13:46	11	109	47.212471	-123.088171	3.3	3.6	3.5	No	No	No	No		
11/1/2018	Pile removal	1	BG-1	11:35	10	1239	47.210687	-123.084234	1.9	NA	3.5	--	--	--	--	NA	NA
			100EW-1	11:56	8	105	47.211718	-123.090450	5.1	NA	4.9	No	No	No	No		
			150C-1	11:54	9	155	47.211746	-123.090295	4.9	NA	5.8	No	No	No	No		
		2	BG-2	14:03	12	1150	47.211195	-123.086921	1.1	1.3	1.3	--	--	--	--		
			100EW-2	14:21	11	107	47.211100	-123.091486	2.4	2.0	2.3	No	No	No	No		
			150C-2	14:18	11	147	47.211184	-123.091416	3.6	3.1	3.0	No	No	No	No		
11/2/2018	Pile removal	1	BG-1	10:50	5	1384	47.212093	-123.086037	1.8	NA	2.2	--	--	--	--	One confirmed short-term exceedance of turbidity elevation at CS	The FL observed that maneuvering of the skiff was occurring in shallow waters (total depth of five feet at the time of the exceedance), and the vessel movement was the suspected cause of the exceedance. In addition, shallow water restricted the mixing zone. Reviewed operational control BMPs and suggested the Contractor restrict speeds to minimum necessary for maneuvering in shallow waters. Following application of BMPs, turbidity measurements returned to background levels within an hour and no further exceedances were observed.
			150C-1	11:02	5	150	47.212554	-123.090834	13.6	NA	13.3	No	Yes	No	Yes		
			150C-2	11:07	5	149	47.212554	-123.090834	12.0	NA	11.4	No	Yes	Yes	Yes		
			BG-2	11:32	7	1384	47.212092	-123.086063	3.2	NA	3.0	--	--	--	--		
			100EW-1	12:06	8	96	47.212447	-123.090845	5.8	NA	9.1	No	No	No	No		
			150C-3	12:01	8	144	47.212251	-123.090900	11.8	NA	12.7	No	No	No	No		
		2	BG-3	14:54	14	1039	47.210796	-123.084973	3.2	3.1	3.6	--	--	--	--		
			100EW-2	15:02	16	95	47.213396	-123.086377	7.0	6.0	4.7	No	No	No	No		
			150C-4	15:12	15	144	47.213246	-123.086225	4.2	3.9	3.6	No	No	No	No		
11/5/2018	Pile install	1	BG-1	8:28	6	1140	47.211292	-123.085129	2.2	NA	2.1	--	--	--	--	One elevated turbidity reading at EW	Contractor ended in-water work following elevated measurement.
			BG-2	11:35	4	1230	47.211917	-123.084191	NA	2.2	NA	--	--	--	--		
			100EW-1	12:31	4	103	47.212788	-123.088564	NA	16.8	NA	Yes	No	No	Yes		
			150C-3	12:46	4	157	47.212813	-123.088395	NA	7	NA	No	No	No	No		
11/6/2018	Sheetpile demo	1	BG-1	8:32	7	1152	47.211005	-123.085230	2.3	NA	2.4	--	--	--	--	One visual observation of a turbidity plume at the CS	Visual observations were conducted from shore due to safety concerns during low tides. A visual observation of a turbidity plume within the CS was recorded, and presumed to be attributed to hammer-strikes from demolition activity. While the FL discussed the turbidity observations with Simpson and the Contractor, the Contractor completed demolition and stopped work. Once the team was able to monitor from the water, the plume was not visible and all measurements were within compliance. Reducing hammer-strike rate was suggested if similar work takes place.
			BG-2	12:33	4	1290	47.211123	-123.084568	NA	2.4	NA	--	--	--	--		
			100EW-1	13:25	4	104	47.212776	-123.088654	NA	8	NA	No	No	No	No		
			150C-1	13:18	4	147	47.212846	-123.088455	NA	6	NA	No	No	No	No		
		2	BG-3	13:48	5	1187	47.210552	-123.085698	NA	2.7	NA	--	--	--	--		
			100EW-2	14:48	8	94	47.212931	-123.088821	9.4	NA	4.9	No	No	No	No		
			150C-2	14:38	8	151	47.212794	-123.088846	5.5	NA	4.4	No	No	No	No		
11/9/2018	Material placement	1	BG-1	10:25	9	1738	47.210833	-123.085239	3.8	NA	3.9	--	--	--	--	Three elevated turbidity readings at EW	Material placement rate is suspected source of elevation. Discussed reducing material placement rate to avoid potential exceedances.
			500EW-1	10:38	6	492	47.212159	-123.089746	26	NA	29	Yes	No	No	Yes		
			500EW-2	10:51	6	505	47.212142	-123.089800	11.7	NA	24.5	Yes	No	No	Yes		
			900C-1	10:31	10	879	47.212175	-123.088105	6.9	4.7	9.4	No	No	No	No		
			BG-2	10:57	6	1515	47.210644	-123.086459	16.6	NA	8.0	--	--	--	--		
			BG-3	11:07	7	1939	47.209730	-123.085143	7.2	NA	3.9	--	--	--	--		
		2	BG-4	11:58	6	1915	47.209759	-123.085200	12	NA	11.8	--	--	--	--		
			500EW-3	12:13	6	488	47.211998	-123.089814	25	NA	15.3	Yes	No	No	Yes		
			900C-2	12:07	6	870	47.212146	-123.087889	14.7	NA	14	No	No	No	No		

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Date	Activity	Monitoring Round	Station	Time	Water Depth (feet)	Actual Distance from Active Work (feet)	Coordinates (degree decimal minutes)		Turbidity Reading (NTU)			Turbidity Elevation at EW	Turbidity Exceedance at CS	Confirmed Exceedance at CS	Elevation/Exceedance Discussed with Client and Contractor	Notes	Response Actions Taken and Best Management Practices Applied
							Latitude	Longitude	Surface	Mid-Depth	Bottom						
11/12/2018	Material placement	1	BG-1	9:21	11	1468	47.210660	-123.086325	3.6	3.1	2.8	--	--	--	--	Two elevated turbidity readings at EW	Suspected that elevations at EW could be influenced by tide water leaving the work zone during a falling tide. Afternoon measurement, still on a falling tide, did not corroborate this assumption. Continue to observe before suggesting a BMP.
			500EW-1	9:30	12	495	47.212181	-123.089584	6.3	15	6.5	Yes	No	No	Yes		
			500EW-2	9:36	10	504	47.212213	-123.089572	5.0	18.5	7.7	Yes	No	No	Yes		
			900C-1	9:21	10	909	47.211457	-123.088248	5.2	5.5	5.0	No	No	No	No		
		2	BG-2	12:20	8	1517	47.210684	-123.086420	5.3	NA	5.0	--	--	--	--		
			500EW-3	12:33	9	503	47.212333	-123.089444	8.7	NA	10.4	No	No	No	No		
			900C-2	12:36	5	895	47.211865	-123.088317	13.6	NA	12	No	No	No	No		
11/13/2018	Material placement	1	BG-1	9:42	10	1646	47.210566	-123.086047	3.1	3.5	3.8	--	--	--	--	One elevated turbidity reading at EW	Elevated turbidity at EW seems to be tidally influenced, suggest that work during rising tides may be optimal.
			500EW-1	10:01	9	494	47.212197	-123.089668	9.6	NA	13.5	No	No	No	No		
			900C-1	9:49	12	904	47.211559	-123.088206	6.7	8.0	4.9	No	No	No	No		
		2	BG-2	12:35	8	1450	47.210560	-123.086441	4.5	NA	3.3	--	--	--	--		
			500EW-2	12:54	9	493	47.211817	-123.089727	7.1	NA	16.5	Yes	No	No	Yes		
			900C-2	12:45	8	896	47.211265	-123.088202	2.5	NA	6.2	No	No	No	No		
11/14/2018	Material placement	1	BG-1	9:30	8	1625	47.210275	-123.085723	2.4	NA	2.7	--	--	--	--	NA	NA
			500EW-1	9:40	8	511	47.211798	-123.089719	3.9	NA	4.0	No	No	No	No		
			900C-1	9:45	10	915	47.211296	-123.088189	7.4	NA	6.5	No	No	No	No		
		2	BG-2	12:29	9	1450	47.210333	-123.086357	3.9	NA	3.2	--	--	--	--		
			500EW-2	12:42	10	493	47.212170	-123.089657	5.5	NA	13.1	No	No	No	No		
			900C-2	12:50	9	896	47.211166	-123.088299	3.6	NA	4.4	No	No	No	No		
11/21/2018	Material placement	1	BG-1	15:00	11	1690	47.210149	-123.085581	1.6	1.7	2.2	--	--	--	--	NA	NA
			500EW-1	15:12	13	499	47.212262	-123.089521	2.2	1.8	2.2	No	No	No	No		
			900C-1	15:20	10	900	47.211732	-123.088099	1.4	1.8	2.5	No	No	No	No		
		2	BG-2	15:35	11	1579	47.210308	-123.086017	1.5	1.8	2.0	--	--	--	--		
			500EW-2	15:42	13	503	47.212047	-123.089795	3.1	2.5	2.0	No	No	No	No		
			900C-2	15:49	13	898	47.211471	-123.088427	3.3	4.7	5.2	No	No	No	No		
11/28/2018	Material placement	1	BG-1	9:18	12	1603	47.210165	-123.085547	2.9	3.1	3.5	--	--	--	--	NA	NA
			500EW-1	9:36	12	504	47.211708	-123.089294	4.5	4.7	4.6	No	No	No	No		
			900C-1	9:27	12	904	47.211366	-123.087743	5.2	5.3	4.8	No	No	No	No		
		2	BG-2	14:47	7	1512	47.210559	-123.085840	3.4	NA	3.5	--	--	--	--		
			500EW-2	15:06	9	495	47.212433	-123.088975	4.9	NA	11.7	No	No	No	No		
			900C-2	14:59	6	890	47.211893	-123.087587	2.8	NA	3.8	No	No	No	No		
12/6/2018	Material placement	1	BG-1	9:18	11	1680	47.210697	-123.083788	2.7	2.7	2.2	--	--	--	--	One elevated turbidity reading at EW	The Contractor was notified of the early warning elevation. Based on water quality observations, water quality appears to be in steady-state. Therefore, the contractor is advised to continue at the current production rate to avoid potential exceedances.
			500EW-1	10:18	11	515	47.212107	-123.087962	9.3	NA	16.1	Yes	No	No	No		
			900C-1	11:18	8	904	47.212100	-123.086413	2.0	6.5	7.3	No	No	No	No		
		2	BG-2	12:18	9	1380	47.210343	-123.085697	1.6	1.4	1.6	--	--	--	--		
			500EW-2	13:18	10	492	47.212147	-123.088474	9.5	3.2	2.8	No	No	No	No		
			900C-2	14:18	11	891	47.211346	-123.087239	6.2	4.5	3.5	No	No	No	No		
12/13/2018	Material placement	1	BG-1	8:58	13	1494	47.210528	-123.084827	4.3	4.8	4.9	--	--	--	--	NA	NA
			500EW-1	9:40	13	496	47.211791	-123.088463	5.8	8.3	7.7	No	No	No	No		
			900C-1	9:10	12	896	47.211626	-123.086680	4.6	4.4	4.7	No	No	No	No		
		2	BG-2	12:09	12	1397	47.210600	-123.085054	4.9	4.7	3.6	--	--	--	--		
			500EW-2	12:35	12	495	47.211675	-123.088089	5.9	9.0	11.6	No	No	No	No		
			900C-2	12:20	12	911	47.211362	-123.086556	7.7	5.6	5.6	No	No	No	No		
12/19/2018	Material placement	1	BG-1	14:03	25	1600	47.212320	-123.082052	5.3	3.5	3.3	--	--	--	--	NA	NA
			500EW-1	14:16	12	510	47.211350	-123.087199	4.3	4.0	2.6	No	No	No	No		
			900C-1	14:10	13	890	47.211050	-123.086030	4.1	3.6	2.1	No	No	No	No		
		2	BG-2	15:19	16	1550	47.210391	-123.083384	3.9	3.3	2.9	--	--	--	--		
			500EW-2	15:31	10	493	47.211002	-123.088125	5.2	12.7	10.3	No	No	No	No		
			900C-2	15:26	12	916	47.210675	-123.086181	4.6	4.3	3.1	No	No	No	No		

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Date	Activity	Monitoring Round	Station	Time	Water Depth (feet)	Actual Distance from Active Work (feet)	Coordinates (degree decimal minutes)		Turbidity Reading (NTU)			Turbidity Elevation at EW	Turbidity Exceedance at CS	Confirmed Exceedance at CS	Elevation/Exceedance Discussed with Client and Contractor	Notes	Response Actions Taken and Best Management Practices Applied
							Latitude	Longitude	Surface	Mid-Depth	Bottom						
12/28/2018	Material placement	1	BG-1	9:05	12	1382	47.210287	-123.084286	3.0	3.0	3.3	--	--	--	--	NA	NA
			500EW-1	9:20	11	505	47.211865	-123.087329	5.3	4.2	3.8	No	No	No	No		
			900C-1	9:15	11	903	47.211580	-123.085739	2.6	2.7	2.9	No	No	No	No		
		2	BG-2	11:15	15	1383	47.209818	-123.084818	4.4	3.2	2.9	--	--	--	--		
			500EW-2	11:36	15	500	47.212066	-123.087419	3.9	4.0	3.4	No	No	No	No		
			900C-2	11:22	15	900	47.211778	-123.085790	2.8	2.5	2.6	No	No	No	No		
1/2/2019	Material placement	1	BG-1	13:47	12	1427	47.210423	-123.084739	1.2	1.2	1.3	--	--	--	--	NA	NA
			500EW-1	14:06	12	509	47.212577	-123.086961	8.6	1.5	1.4	No	No	No	No		
			900C-1	13:59	13	891	47.212438	-123.085439	8.6	8.6	1.3	No	No	No	No		
		2	BG-2	15:27	13	1242	47.210450	-123.084699	1.5	1.4	1.3	--	--	--	--		
			500EW-2	15:39	14	505	47.211849	-123.086939	10.6	10.5	2.5	No	No	No	No		
			900C-2	15:32	13	890	47.211611	-123.085345	2.5	1.4	1.3	No	No	No	No		
1/11/2019	Material placement	1	BG-1	10:50	13	1559	47.210030	-123.085232	2.0	2.1	2.3	--	--	--	--	NA	NA
			500EW-1	11:01	13	505	47.213387	-123.087237	1.7	1.7	1.8	No	No	No	No		
			900C-1	11:06	23	895	47.213302	-123.085655	1.6	2.0	2.8	No	No	No	No		
		2	BG-2	12:14	18	2003	47.210210	-123.082692	2.0	1.8	1.9	--	--	--	--		
			500EW-2	12:19	11	499	47.213207	-123.087258	2.8	2.3	2.0	No	No	No	No		
			900C-2	12:25	21	915	47.213408	-123.085708	2.5	2.2	2.5	No	No	No	No		
1/17/2019	Material placement	1	BG-1	11:35	11	1280	47.209897	-123.085324	1.0	1.0	1.2	--	--	--	--	NA	NA
			500EW-1	11:49	13	499	47.212498	-123.086849	5.4	3.3	2.5	No	No	No	No		
			900C-1	11:44	11	899	47.212321	-123.085205	2.0	1.9	1.5	No	No	No	No		
		2	BG-2	13:40	23	1560	47.210751	-123.082583	1.4	0.8	1.3	--	--	--	--		
			500EW-2	13:52	29	502	47.213396	-123.085427	4.3	2.9	2.2	No	No	No	No		
			900C-2	13:47	24	888	47.213212	-123.083882	2.8	1.6	1.4	No	No	No	No		
1/24/2019	Material placement	1	BG-1	8:37	17	1349	47.210245	-123.083661	5.9	5.5	5.5	--	--	--	--	NA	NA
			500EW-1	8:49	14	510	47.211505	-123.086608	6.9	5.8	5.6	No	No	No	No		
			900C-1	8:44	15	890	47.210867	-123.085322	5.7	5.4	5.4	No	No	No	No		
		2	BG-2	10:24	15	1761	47.210259	-123.084230	5.2	5.2	5.5	--	--	--	--		
			500EW-2	10:40	11	501	47.212732	-123.088498	6.4	5.0	9.0	No	No	No	No		
			900C-2	10:31	13	893	47.212503	-123.086884	5.0	5.0	6.7	No	No	No	No		

Notes:
Accecptable turbidity measurements
Turbitity exceedance measured
-- : No applicable comparison
BMP: best management practice
CS: Compliance Station
EW: Early Warning Station
FL: Field Lead
NA: not applicable
NTU: nephelometric turbidity unit

Table 2
Cap Placement Monitoring Summary

	Unit of Measurement	Cap A	Cap B	Cap C	Cap D
Design Criteria					
Project Volume[1]	cy	14,882	14,074	1,240	1,900
Project Area	sy	20,954	18,374	1,278	2,163
Average Required Minimum Thickness	ft	2.1	2.3	2.9	2.6
Construction Quantities					
Construction Time	days	28	23	3	4
Average Mass Per Bucket Load	tons/bucket	5.9	5.9	5.9	5.9
Bucket Volume	cy/bucket	3.5	3.5	3.5	3.5
Bulk Density	tons/cy	1.68	1.68	1.68	1.68
Total Buckets	ea	5,123	3,264	420	525
Total Tonnage Placed	tons	30,174	19,225	2,474	3,092
Total Volume Placed	cy	17,931	11,424	1,470	1,838
Daily Production Rate	cy/day	640	497	490	459
	tons/day	1,078	836	825	773
Construction Calculations					
Area Covered in Bucket Maps[2]	sf	182,547	120,696	11,918	16,592
	sy	20,283	13,411	1,324	1,844
Average Placed Thickness	ft	2.7	2.6	3.3	3.0

Notes:

1: Assumes 2-foot minimum thickness for cap area and 3-foot minimum thickness for thickened edges

2: See Figures 2 through 5

cy: cubic yards

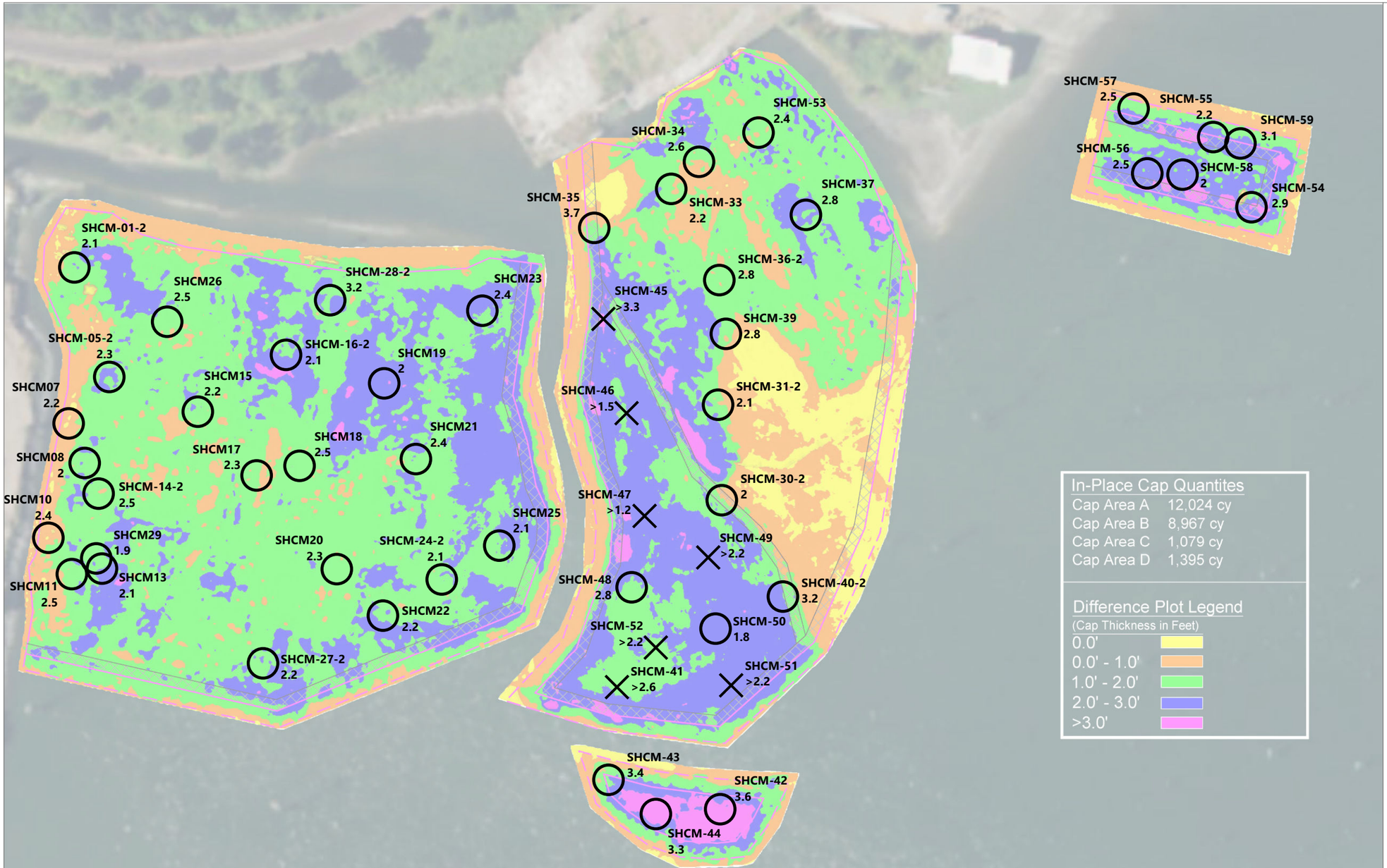
ea: each

ft: feet

sf: square feet

sy: square yards

Figures



Successful Cap Thickness Location
(Thickness in feet)

Refusal Cap Thickness Location[1]
(Thickness in feet)

NOTES:
1. Locations encountered refusal prior to reaching the bottom of the cap. Results from these locations are reported as greater than the measurement value.
2. In-place cap quantities and cap thickness interpolations were calculated from the difference in pre- and post-construction bathymetry.

0 100
Feet

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Figure 1
Cap Thickness and Probing Locations
Northern Shelton Harbor Interim Action: Water Quality and Cap Thickness Status
Oakland Bay and Shelton Harbor Sediments Cleanup Site

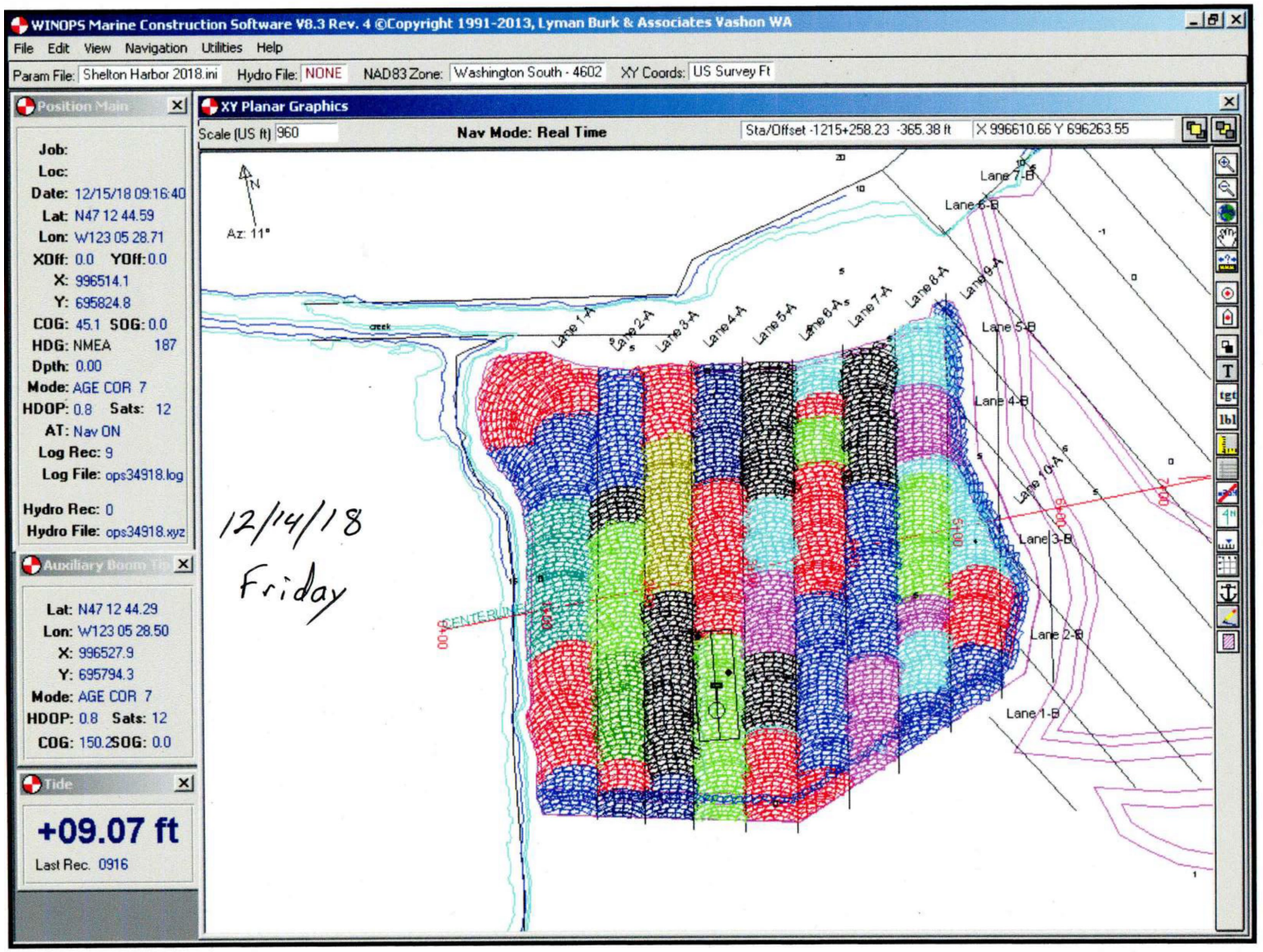

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Figure 2
Contractor Bucket Map – Cap A
Northern Shelton Harbor Interim Action: Water Quality and Cap Thickness Status
Oakland Bay and Shelton Harbor Sediments Cleanup Site

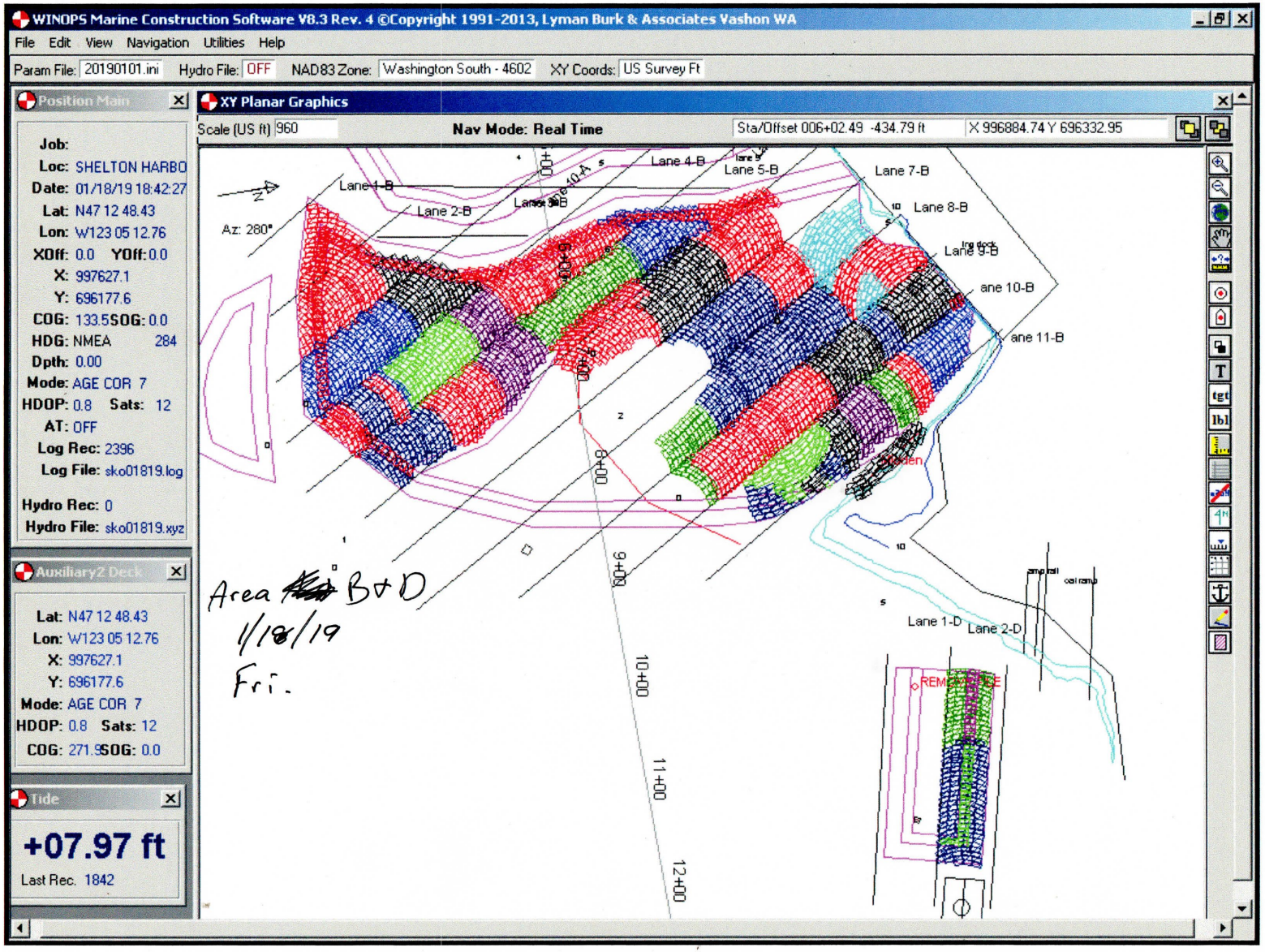

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Figure 3
Contractor Bucket Map – Cap B
Northern Shelton Harbor Interim Action: Water Quality and Cap Thickness Status
Oakland Bay and Shelton Harbor Sediments Cleanup Site

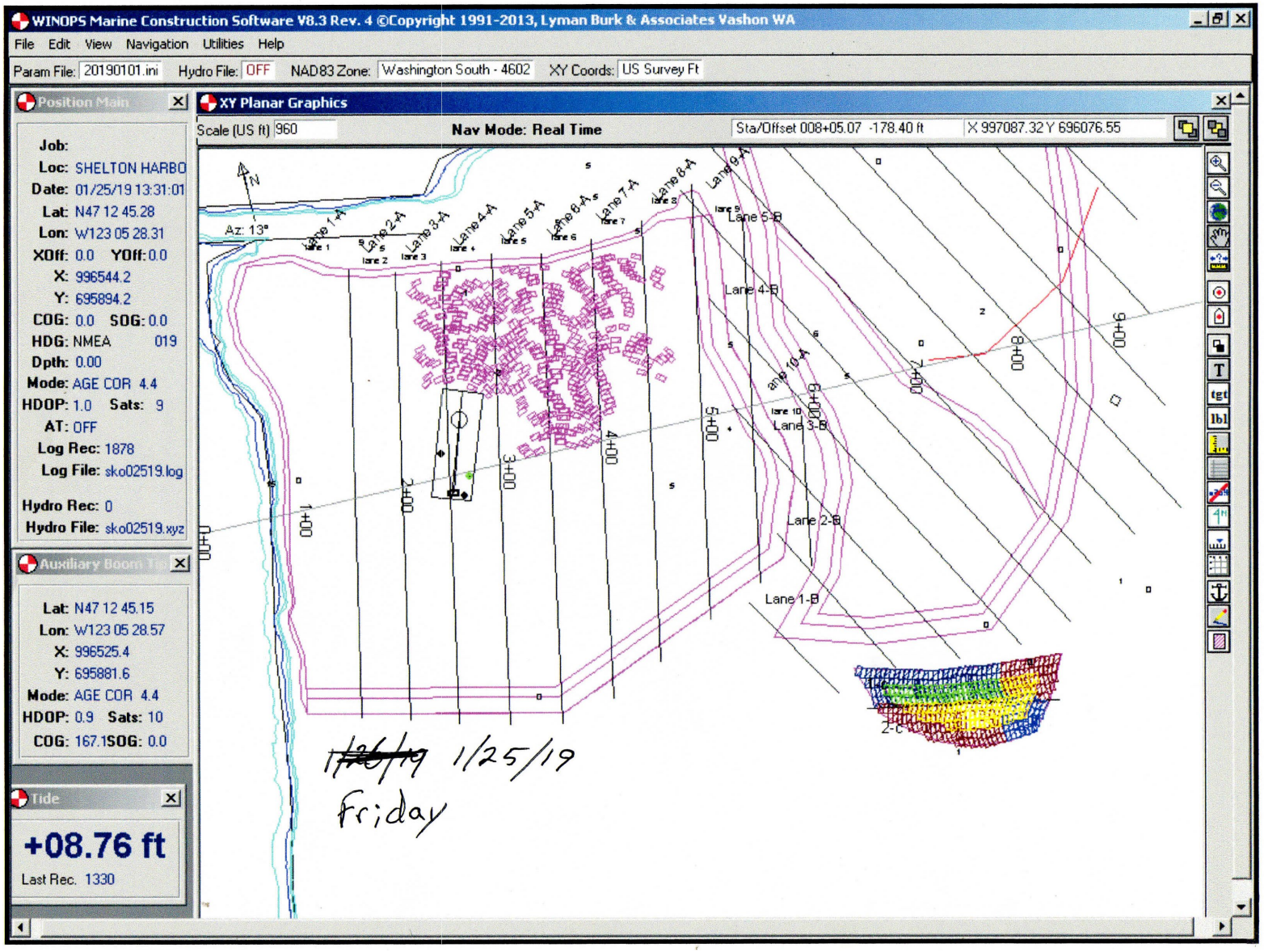

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Figure 4
Contractor Bucket Map – Cap C
Northern Shelton Harbor Interim Action: Water Quality and Cap Thickness Status
Oakland Bay and Shelton Harbor Sediments Cleanup Site

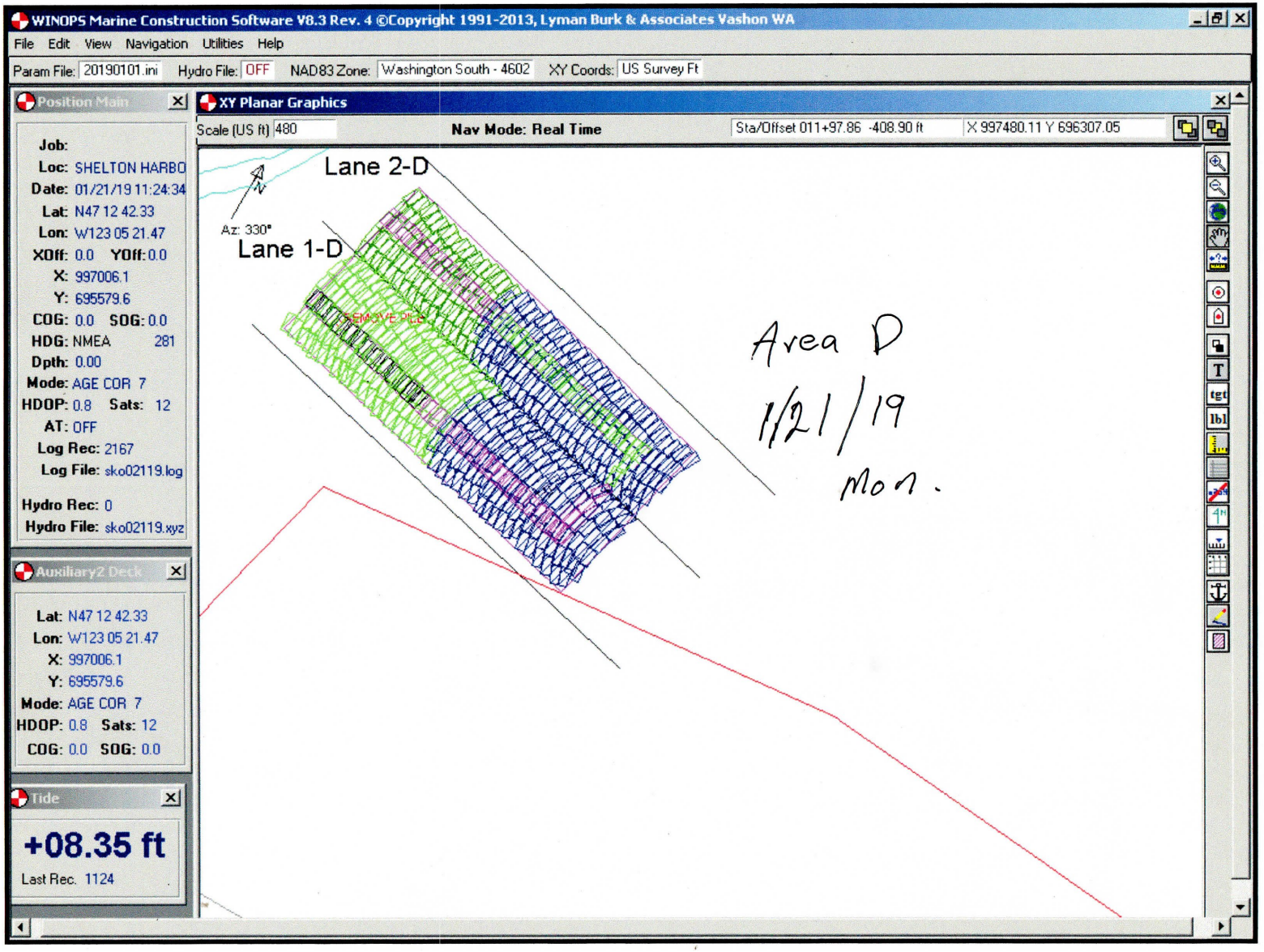

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Figure 5
Contractor Bucket Map – Cap D
Northern Shelton Harbor Interim Action: Water Quality and Cap Thickness Status
Oakland Bay and Shelton Harbor Sediments Cleanup Site