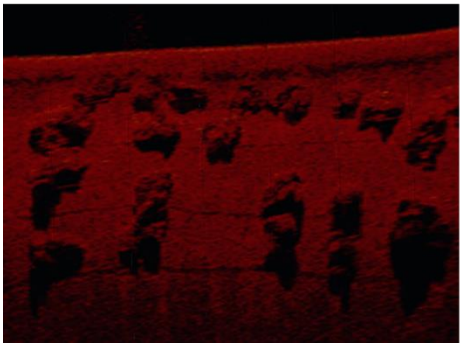
Marine Survey Report

For

Port of Illahee Tire Reef / Fish Haven

November 8, 2023



Prepared For:

Dr. Seth Abelson (Program Director Washington Autonomous Vehicle Cluster)

abelson@kitsapeda.org

(360) 946-2636

Prepared By:

Dustin Teuton (Program Manager SERCO North America)

dustin.teuton@serco-na.com

(619) 916-1647

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1. Introduction

1.1 Background and Project description

During the 1970s and 1980s numerous tire reefs, other wise known as “Fish Havens”, were installed in the waters of Puget Sound. At the time it was believed that the tires would not release any pollutants into the water and would therefore be a net ecological gain to the environment. It has since been discovered that these tires do in fact cause harm to the ecosystem through the release of harmful chemicals, prevention of sediment transport and disruption of natural habitat.

The Illahee community dock (Port of Illahee) Fish Haven is well known to local fishermen and divers as a relatively shallow area of interest, but it is built upon existing oyster beds and prevents normal along-shore flow of sediment from the neighboring streams. SERCO conducted a high- resolution hydrographic survey of the reef to scope the project of removal and remediation required by the Washington Department of Natural Resources (WA DNR) as part of the Port of Illahee’s lease renewal.

1.2 Purpose of Investigation and Scope of Work

The hydrographic survey and Remotely Operated Vehicle inspection will provide the following metrics to support the analysis needed for the remediation project mentioned above:

Impacted area: The total area disturbed by the tire reef and boundaries of its extent.

Total Tire Number Estimate: the quantity of tires present on the site and any clustering or grouping of the tires.

Total Tire Mass Estimate: Based on the quantity estimate and a high/ low estimate of tire weight this metric will provide minimum and maximum estimates of the tire component of the reef (used in the calculations needed for disposal)

Total water Depth range of the reef site: Used in determining best recovery mechanism to employ when executing future remediation activities.

Geodetic Positions of Observed impact: Latitude Longitude Pairs for all observed manmade impacts within the reef boundaries.

2. Methods

Figure 1: Methods of Data Collection USV Hydrographic Survey and ROV Inspection

2.1 Uncrewed Surface Vehicle Hydrographic Survey

A Hydrographic survey was completed using the Archer USV to localize tire clump locations and other bottom features. The Archer is an Uncrewed Surface Vehicle that has an overall length of 15 feet and weighs approximately 500 LBS. The Archer uses two (2) small trolling motors to maneuver the vehicle at a speed of 3kts and is powered by four (4) 100 Amp hour sealed lead acid batteries. Archer utilized a commercial off-the-shelf side imaging Sonar that transmits at 455K Hz with 6-inch resolution. Deployment of the Archer was completed from a local boat launch approximately 1 nautical mile from the survey location.

Prior to deployment, the Operator uploads a pre-planned mission with waypoints for the USV to follow and collect data needed for the survey. The of survey was completed using an overlapping “lawnmower” pattern. This pattern ensured 100% coverage of the charted area. The survey was completed in approximately 20 minutes. Following the survey, the USV was manually piloted to the boat ramp for recovery and data download. Sonar data was processed using the Sonar TRX and Google Earth Pro software suites.

2.2 Remotely Operated Vehicle Inspection

a JW Fisher, Sealion-2 ROV was used for visual confirmation of sonar returns and close inspection of tire clumps. The Sealion-2 is a completely mobile underwater camera systems that was controlled from the surface and capable of staying submerged indefinitely. The team used a gasoline generator to provide power for the ROV and its controlling station due to the services available adjacent to the survey location. The ROV inspection dramatically reduced the risk and high cost associated with diving operations normally used to complete similar inspections.

Figure 2: Remotely Operated Vehicle and Controlling Station

The Sea Lion 2 has four high performance thrusters that allow for smooth operations while performing during inspections. The ROV was attached to a 100-foot tether, which allows the operator to control the ROV from the surface. Other features include front and rear facing color cameras with pan and tilt. Illumination for the front camera is provided by two, fully adjustable, 2200 lumen LED lights. Lighting for the rear camera is provided by a ring of high intensity LEDs. Although these lighting capabilities were available, they were not needed due to the shallow water depth, and clarity of the water near the pier.

System controls for the Sealion-2 are cleanly laid out in a high impact waterproof case with an ultra-bright 15-inch flat screen monitor built into the lid. Command of the ROV's thrusters, cameras, and lights are managed with a compact hand-held controller. An internal video amplifier adjusts picture quality to optimize the video for water clarity. There is an external DVR recorder mounted inside the case to record the underwater survey.

Figure 3: Example ROV Imagery

2.3 Field Conditions during Data collection

Weather conditions during the surveys were as follows. There was light to moderate rain for the entirety of the survey. Winds were to the south at approximately 3-5 kts with gusts up to 15 kts. The wind was not a limiting factor for this survey. The operational period for the USV was from 1100-1300. Tides during the survey consisted of 4.10 feet to 9 feet. Water clarity was between 8-10 feet throughout the survey.

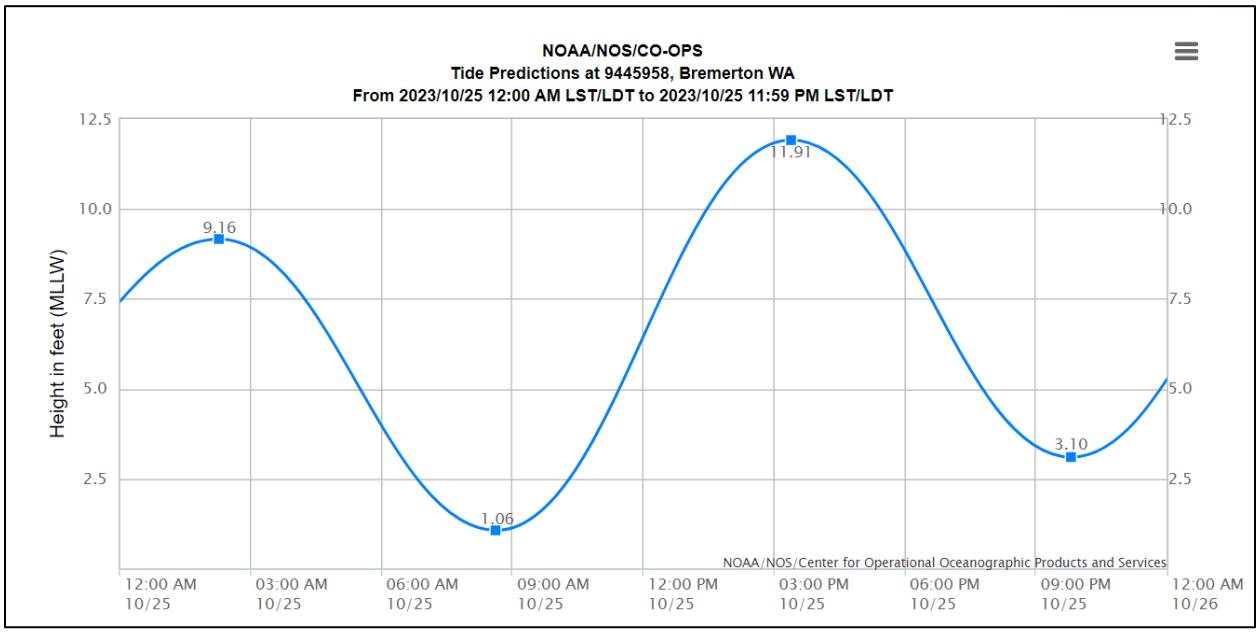

Figure 4: Tide Predictions for 25 October 2023 (source NOAA)

3. Results

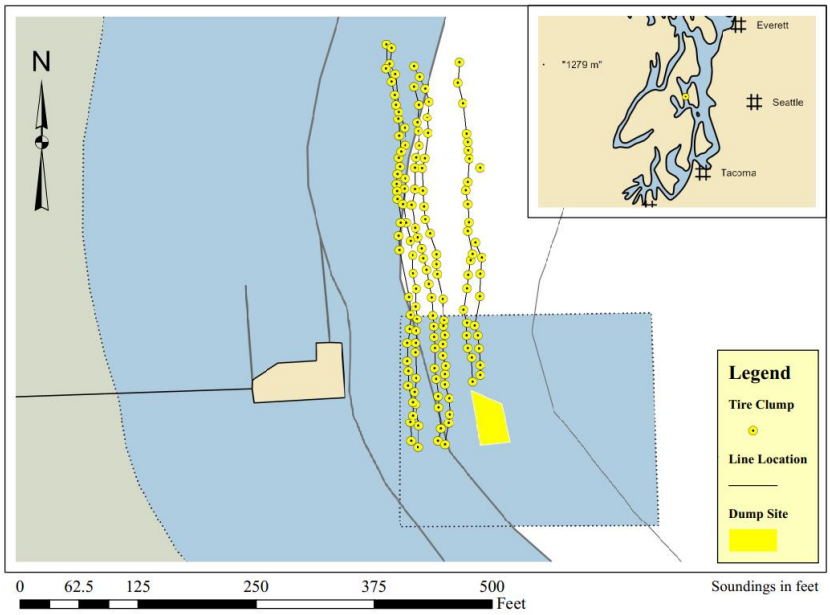

Figure 5: Tire Clump Locations

Figure 6: Tire Clump with analysis

3.1 General Survey findings

Through the methods described above a survey was conducted on October 25th, 2023, of the charted tire reef/ fish haven location plus additional buffer to account for charting errors. During this survey six parallel strings of approximately 25 tire bundles were discovered arranged in a north south orientation extending beyond the charted area to the north by approximately 200 ft.

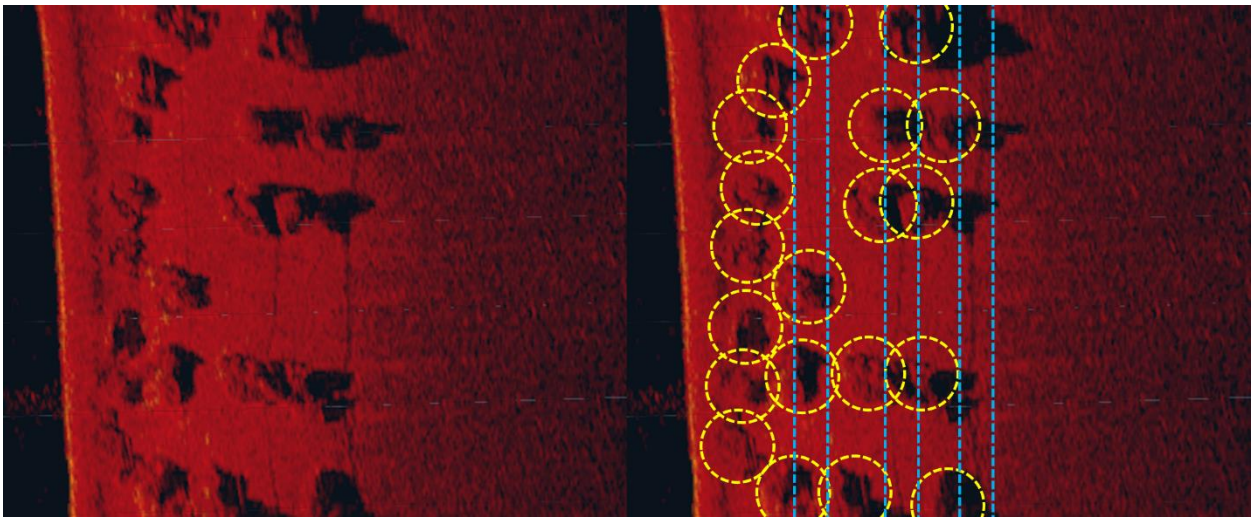

Figure 7: Sonar Return with Analysis

3.2 Minimum Maximum Reef Depths

Total charted water depth in the area occupied by the tire reef varies between 20 and 30ft with the shallow area to the west and deeper water located near strings 5 and 6 in the east. Bathymetry was verified with both sonar readings and direct ROV observations in the area.

Figure 8: Tire Clump inspection (depth 19ft)

3.3 Reef Footprint

The charted footprint of the tire reef/ fish haven is rectangular 84m by 68m with the long axis-oriented East/ West. During analysis of the data collected the actual dimensions are approximately 90m by 20m

with the long axis orientation of 355/175 (roughly North/South). The reef footprint is approximately 1.127acres in this area.

3.4 Tire Burial

Through inspection by the Sealion-2 ROV there is evidence of at least some tire burial in the survey area as can be seen in figure X. the bottom make up in the area is primarily silt or sandy silt and while further inspection is warranted it is the opinion of the survey team that each tire clump contains some either partially or fully buried tires and our overall estimates for tire numbers and mass reflect this supposition.

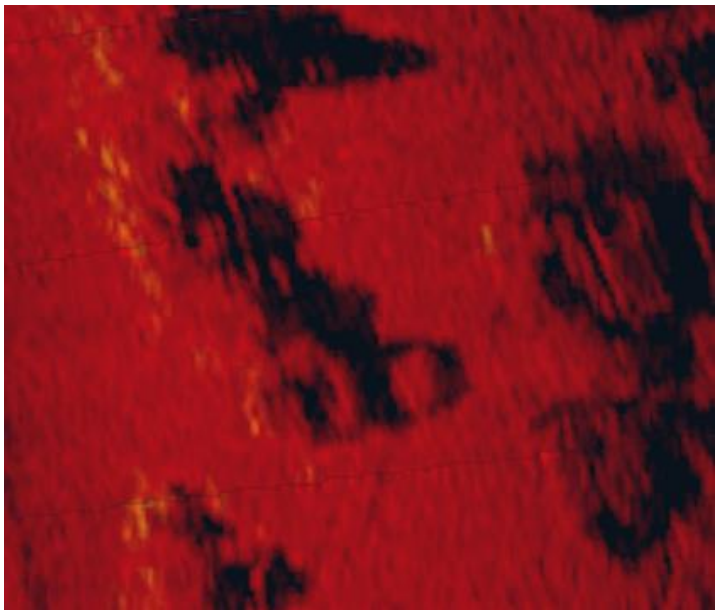

Figure 9: Sonar Imagery showing both partially buried and upright tires

3.5 Minimum / Maximum Tire Estimate

Through analysis of the collected sonar imagery and ROV inspection video the survey team estimates a total of 138 tire clumps each with between 12 and 20 tires along with an additional large tire “dump site in the southeast corner of the survey area containing between 600 and 1000 additional tires. Based on this analysis Estimate of the tire quantities are contained in the following table.

String pair	Number of clumps	Low Estimate	High Estimate
1/2	52	624	1040
3/4	54	648	1080
5/6	32	384	640
*Dump Site	N/A	600	1000
Total	138	2256	3760
This feature was only imaged with sonar and further investigation is warranted.			

Table 1: Site overview estimates

3.6 Minimum / Maximum Mass of Tires

Tire mass is estimated by multiplying the higher and lower tire quantities by an average weight of 27 pounds per tire (assuming a mixture of passenger car and light truck tires as the predominate reef component). Using this formula and the data from table 1 mass estimates for the entire reef are between 60,912-101,520lbs (27,629-46,048kg).

4. Discussion

The described in this report were successful in the all-project goals and the data produced was of the fidelity required to proceed into the planning and scoping of the remediation phase of the project. Our analysis shows an established and unnecessary impact to the waters east of the Illahee pier. Additionally, the charted location of the fish haven was found to be grossly inaccurate presenting potential danger to deeper drafting vessels in the area.

4.1 Additional Inspection Recommendations

Though we are confident in our estimates in section 3 we were unable to observe the apparent “dump site” in the southeast corner of the impacted area. Our estimate of tire quantities and weight of this feature are therefore of less accuracy than the other areas observed. We recommend a dedicated inspection of this feature be scheduled to further refine our findings.

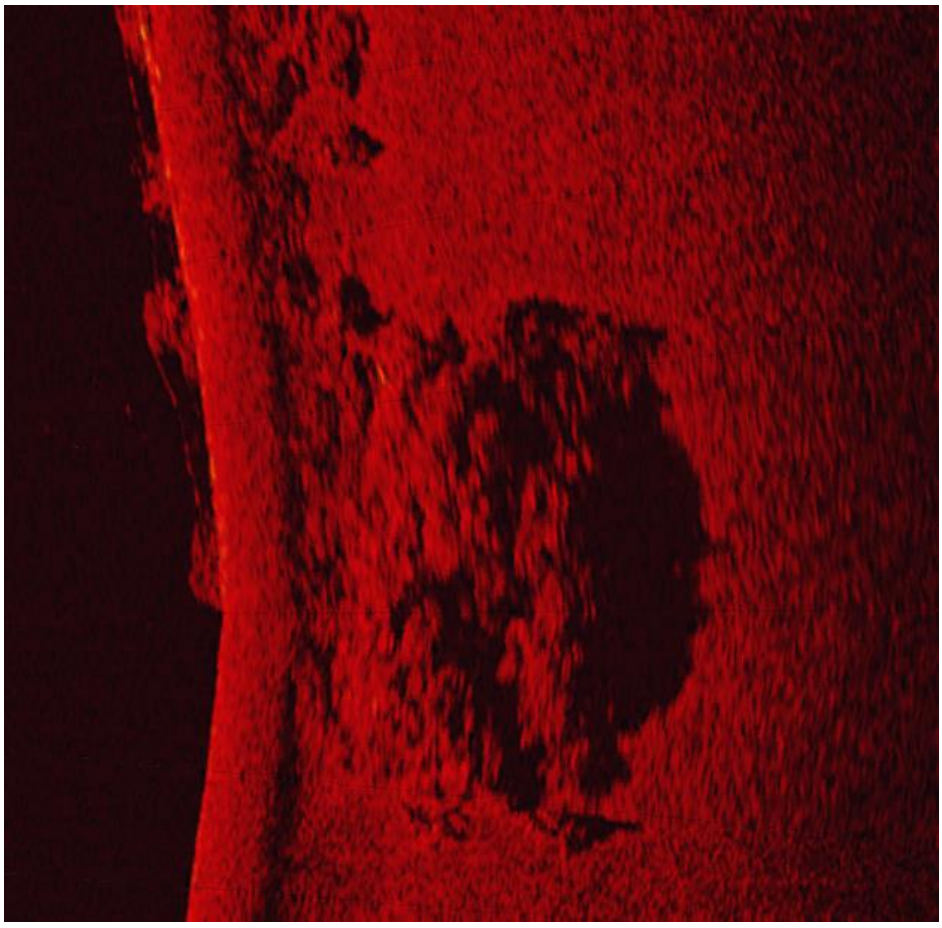

Figure 10: "Dump Site" (Dimensions 36ft x 17ft)

Appendix A Tire Bundle locations

Bundle ID	Latitude	Longitude
1	47° 36' 45.810"" N	122° 35' 40.616"" W
2	47° 36' 45.858"" N	122° 35' 40.536"" W
3	47° 36' 45.927"" N	122° 35' 40.535"" W
4	47° 36' 45.980"" N	122° 35' 40.623"" W
5	47° 36' 46.048"" N	122° 35' 40.666"" W
6	47° 36' 46.136"" N	122° 35' 40.675"" W
7	47° 36' 46.223"" N	122° 35' 40.674"" W
8	47° 36' 46.318"" N	122° 35' 40.707"" W
9	47° 36' 46.413"" N	122° 35' 40.541"" W
10	47° 36' 46.468"" N	122° 35' 40.673"" W
11	47° 36' 46.569"" N	122° 35' 40.536"" W
12	47° 36' 46.561"" N	122° 35' 40.660"" W
13	47° 36' 46.684"" N	122° 35' 40.521"" W
14	47° 36' 46.664"" N	122° 35' 40.637"" W
15	47° 36' 46.708"" N	122° 35' 40.615"" W
16	47° 36' 46.789"" N	122° 35' 40.585"" W
17	47° 36' 46.868"" N	122° 35' 40.664"" W
18	47° 36' 46.928"" N	122° 35' 40.651"" W
19	47° 36' 47.059"" N	122° 35' 40.663"" W
20	47° 36' 47.157"" N	122° 35' 40.686"" W
21	47° 36' 47.216"" N	122° 35' 40.666"" W
22	47° 36' 47.315"" N	122° 35' 40.532"" W
23	47° 36' 47.379"" N	122° 35' 40.649"" W
24	47° 36' 47.437"" N	122° 35' 40.661"" W
25	47° 36' 47.494"" N	122° 35' 40.664"" W
26	47° 36' 47.552"" N	122° 35' 40.678"" W
27	47° 36' 47.775"" N	122° 35' 40.712"" W
28	47° 36' 47.918"" N	122° 35' 40.765"" W
29	47° 36' 48.063"" N	122° 35' 40.750"" W
30	47° 36' 46.042"" N	122° 35' 40.547"" W
31	47° 36' 46.136"" N	122° 35' 40.561"" W
32	47° 36' 46.203"" N	122° 35' 40.595"" W

Bundle ID	Latitude	Longitude
33	47° 36' 45.392"" N	122° 35' 40.973"" W
34	47° 36' 45.364"" N	122° 35' 40.904"" W
35	47° 36' 45.477"" N	122° 35' 40.942"" W
36	47° 36' 45.516"" N	122° 35' 40.866"" W
37	47° 36' 45.580"" N	122° 35' 40.858"" W
38	47° 36' 45.630"" N	122° 35' 40.974"" W
39	47° 36' 45.696"" N	122° 35' 40.862"" W
40	47° 36' 45.708"" N	122° 35' 40.976"" W
41	47° 36' 45.792"" N	122° 35' 40.906"" W
42	47° 36' 45.830"" N	122° 35' 40.998"" W
43	47° 36' 45.863"" N	122° 35' 40.907"" W
44	47° 36' 45.906"" N	122° 35' 41.012"" W
45	47° 36' 45.922"" N	122° 35' 40.898"" W
46	47° 36' 45.993"" N	122° 35' 40.929"" W
47	47° 36' 46.045"" N	122° 35' 41.008"" W
48	47° 36' 46.074"" N	122° 35' 40.925"" W
49	47° 36' 46.137"" N	122° 35' 40.908"" W
50	47° 36' 46.125"" N	122° 35' 41.017"" W
51	47° 36' 46.199"" N	122° 35' 41.019"" W
52	47° 36' 46.203"" N	122° 35' 40.924"" W
53	47° 36' 46.243"" N	122° 35' 40.914"" W
54	47° 36' 46.277"" N	122° 35' 41.029"" W
55	47° 36' 46.393"" N	122° 35' 40.924"" W
56	47° 36' 46.404"" N	122° 35' 41.042"" W
57	47° 36' 46.499"" N	122° 35' 41.069"" W
58	47° 36' 46.597"" N	122° 35' 41.096"" W
59	47° 36' 46.566"" N	122° 35' 40.984"" W
60	47° 36' 46.637"" N	122° 35' 40.994"" W
61	47° 36' 46.679"" N	122° 35' 41.127"" W
62	47° 36' 46.705"" N	122° 35' 40.992"" W
63	47° 36' 46.748"" N	122° 35' 41.147"" W
64	47° 36' 46.823"" N	122° 35' 41.184"" W
65	47° 36' 46.852"" N	122° 35' 41.060"" W
66	47° 36' 46.892"" N	122° 35' 41.211"" W

Bundle ID	Latitude	Longitude
67	47° 36' 46.951"" N	122° 35' 41.106"" W
68	47° 36' 47.043"" N	122° 35' 41.121"" W
69	47° 36' 47.054"" N	122° 35' 41.251"" W
70	47° 36' 47.165"" N	122° 35' 41.220"" W
71	47° 36' 47.154"" N	122° 35' 41.134"" W
72	47° 36' 47.316"" N	122° 35' 41.217"" W
73	47° 36' 47.311"" N	122° 35' 41.142"" W
74	47° 36' 47.388"" N	122° 35' 41.204"" W
75	47° 36' 47.380"" N	122° 35' 41.113"" W
76	47° 36' 47.469"" N	122° 35' 41.174"" W
77	47° 36' 47.572"" N	122° 35' 41.182"" W
78	47° 36' 47.559"" N	122° 35' 41.077"" W
79	47° 36' 47.632"" N	122° 35' 41.193"" W
80	47° 36' 47.672"" N	122° 35' 41.087"" W
81	47° 36' 47.762"" N	122° 35' 41.173"" W
82	47° 36' 47.786"" N	122° 35' 41.066"" W
83	47° 36' 47.890"" N	122° 35' 41.221"" W
84	47° 36' 47.877"" N	122° 35' 41.109"" W
85	47° 36' 47.959"" N	122° 35' 41.165"" W
86	47° 36' 48.034"" N	122° 35' 41.221"" W
87	47° 36' 46.178"" N	122° 35' 41.273"" W
88	47° 36' 46.251"" N	122° 35' 41.193"" W
89	47° 36' 46.282"" N	122° 35' 41.262"" W
90	47° 36' 46.341"" N	122° 35' 41.207"" W
91	47° 36' 46.406"" N	122° 35' 41.280"" W
92	47° 36' 46.464"" N	122° 35' 41.203"" W
93	47° 36' 46.572"" N	122° 35' 41.235"" W
94	47° 36' 46.926"" N	122° 35' 41.309"" W
95	47° 36' 46.927"" N	122° 35' 41.361"" W
96	47° 36' 46.800"" N	122° 35' 41.262"" W
97	47° 36' 46.835"" N	122° 35' 41.381"" W
98	47° 36' 46.735"" N	122° 35' 41.375"" W
99	47° 36' 46.699"" N	122° 35' 41.239"" W
100	47° 36' 45.837"" N	122° 35' 41.207"" W

Bundle ID	Latitude	Longitude
101	47° 36' 45.885"" N	122° 35' 41.284"" W
102	47° 36' 45.954"" N	122° 35' 41.297"" W
103	47° 36' 46.017"" N	122° 35' 41.215"" W
104	47° 36' 46.082"" N	122° 35' 41.296"" W
105	47° 36' 46.082"" N	122° 35' 41.211"" W
106	47° 36' 46.169"" N	122° 35' 41.205"" W
107	47° 36' 47.384"" N	122° 35' 41.382"" W
108	47° 36' 47.324"" N	122° 35' 41.369"" W
109	47° 36' 47.271"" N	122° 35' 41.395"" W
110	47° 36' 47.240"" N	122° 35' 41.318"" W
111	47° 36' 47.200"" N	122° 35' 41.405"" W
112	47° 36' 47.169"" N	122° 35' 41.325"" W
113	47° 36' 47.152"" N	122° 35' 41.400"" W
114	47° 36' 47.097"" N	122° 35' 41.395"" W
115	47° 36' 47.060"" N	122° 35' 41.341"" W
116	47° 36' 47.712"" N	122° 35' 41.387"" W
117	47° 36' 47.979"" N	122° 35' 41.422"" W
118	47° 36' 47.926"" N	122° 35' 41.462"" W
119	47° 36' 47.831"" N	122° 35' 41.430"" W
120	47° 36' 47.762"" N	122° 35' 41.417"" W
121	47° 36' 47.657"" N	122° 35' 41.388"" W
122	47° 36' 47.595"" N	122° 35' 41.319"" W
123	47° 36' 47.538"" N	122° 35' 41.379"" W
124	47° 36' 45.654"" N	122° 35' 41.209"" W
125	47° 36' 45.345"" N	122° 35' 41.185"" W
126	47° 36' 45.390"" N	122° 35' 41.255"" W
127	47° 36' 45.494"" N	122° 35' 41.181"" W
128	47° 36' 45.520"" N	122° 35' 41.263"" W
129	47° 36' 45.575"" N	122° 35' 41.241"" W
130	47° 36' 45.667"" N	122° 35' 41.240"" W
131	47° 36' 45.738"" N	122° 35' 41.221"" W
132	47° 36' 45.782"" N	122° 35' 41.290"" W
133	47° 36' 48.186"" N	122° 35' 41.513"" W
134	47° 36' 48.161"" N	122° 35' 41.460"" W

Bundle ID	Latitude	Longitude
135	47° 36' 48.051"" N	122° 35' 41.481"" W
136	47° 36' 48.017"" N	122° 35' 41.516"" W
137	47° 36' 47.472"" N	122° 35' 41.317"" W
138	47° 36' 47.427"" N	122° 35' 41.360"" W

Table 2: Tire Bundle Locations

Appendix B Site Maps

Hydrographic Survey overview and detail maps are provided below to supplement geodetic positions provided in appendix A.

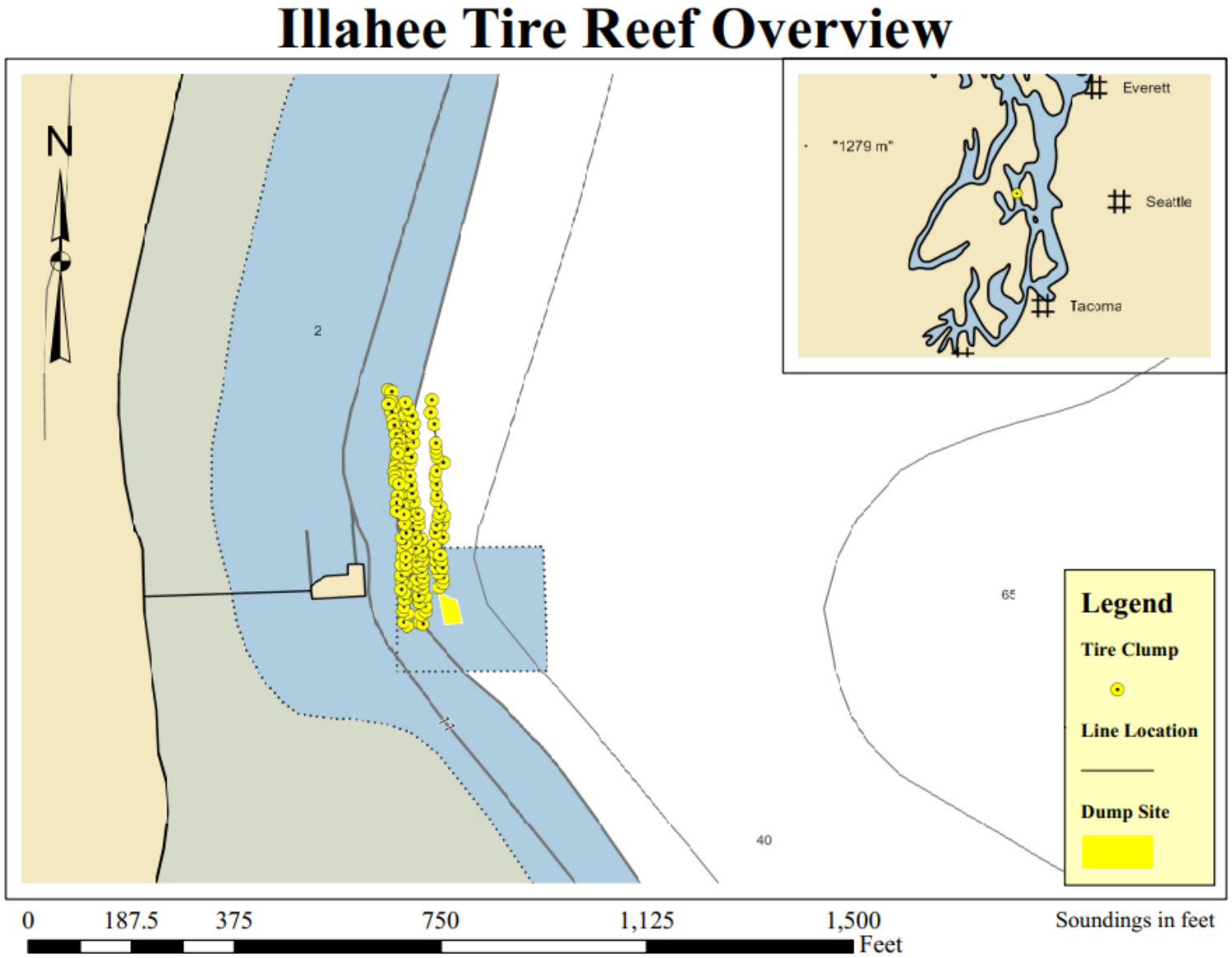

Figure 11 site overview

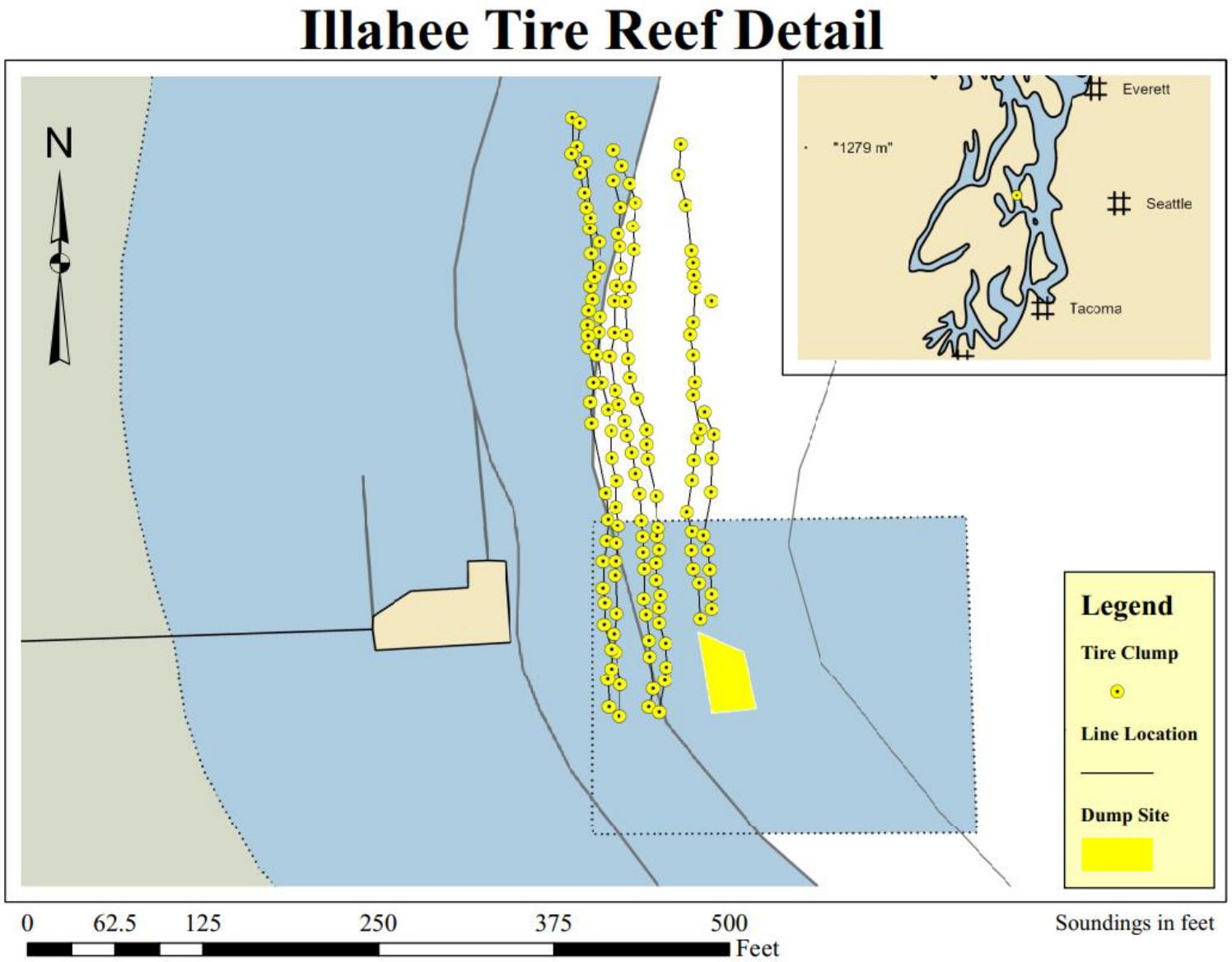

Figure 12 site detail