

APPENDIX C

Technical Memorandum: Tidal Influence Assessment Uplands Work Plan, Rayonier Pulp Mill Facility

REMEDIAL INVESTIGATION FOR THE UPLANDS ENVIRONMENT OF THE FORMER RAYONIER MILL SITE

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Public Review Draft



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Tidal Influence Assessment Uplands Work Plan Rayonier Pulp Mill Facility

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This memorandum provides a review of the existing data regarding tidal influence assessments for the mill site. The Uplands RI/FS Management Plans¹ include a tidal influence assessment task (Volume II, Section 5.5.6). This task includes measurement of water levels in the 20 RI groundwater monitoring wells for a 24-hour period, followed by detailed 14-day measurements for 12 wells that show greater than 0.2 feet of water level change during the 24-hour period.

A 24-hour tidal assessment was conducted in 1993². The following sections describe the 1993 assessment and provide recommendations for the Uplands RI/FS groundwater investigation.

1993 Tidal Assessment

The 1993 tidal assessment was conducted on eleven piezometer wells PZ-2 through PZ-7 and PZ-9 through PZ-13 (see attached figure). The distribution of the wells provide an adequate representation of the different elevations at the site, with top-of-casing elevations (approximate ground surface elevation) ranging from 8.8 to 30.2 feet.

¹ Integral Consulting, Inc., and Foster Wheeler Environmental Corporation. 2003. *Management Plans for the Remedial Investigation – Feasibility Study of the Uplands Environment, Former Rayonier Mill, Port Angeles, Washington*. Prepared for Rayonier, Jacksonville, FL. April 2003.

² Harding Lawson Associates (HLA). 1993. *Draft Field Investigation Report ITT Quantitative Environmental Survey Program*. ITT Rayonier Pulp Division, Port Angeles, Washington. October 28.

A review of the boring logs showed that with the exception of PZ-11, the aquifer materials across the screened intervals is silty sand and gravel fill except at the material at PZ-11 is native silty sand and sandy silt.

A 24-hour tidal assessment was conducted on August 15 and 16, 1993. Water level measurements began at approximately 10:00 pm on August 15 and ended at approximately 10:00 pm on August 16. The maximum difference in tidal elevations for the monitored period was 7.9 feet³. The five water level measurements approximately coincided with the tidal extremes for the period. The tidal extremes, water level data, and other pertinent well information are provided in Table 1.

The maximum difference in groundwater elevations in the wells ranged from 0.00 to 1.52 feet. Three wells had maximum differences greater than 0.2 feet, PZ-2 (0.29 feet), PZ-3 (1.57 feet) and PZ-4 (0.23 feet). The trends in water elevation at PZ-3 generally agreed with the tidal elevations. Similar trends are discernable at PZ-2 and PZ-4.

Discussion

The wells sampled during the 1993 tidal assessment showed that response to tidal fluctuations are limited to low-lying wells in the western portion of the site. Piezometer wells PZ-2, PZ-3, and PZ-4 are located in the western portion of the mill and had maximum differences ranging from 0.23 to 1.52 feet. The maximum differences for all other site wells, excluding PZ-9, ranged from 0 to 0.06 feet. PZ-9 is located on the east side of the facility, within 100 feet of the shoreline. The maximum difference water elevations in this well was 0.13 feet. The maximum in tide extremes during the assessment was 8 feet. The maximum anticipated extreme during the upcoming 14-day event is estimated at 11 feet. This well is likely to have a 0.2 foot response during the 14-day assessment.

The 1993 assessment shows that the wells likely to have a significant tidal response are located near the shoreline and interior main processes area. These trends are expected given the configuration and topography of the site.

Recommendations

³ <http://www.mobilegeo.com>:81

The 1993 tidal assessment provides the information that would be obtained from the 24-hour portion of the upcoming Uplands RI/FS groundwater tidal assessment. The 1993 tidal assessment data and the distribution of the wells to be sampled for the Uplands RI/FS provide the information needed to identify the 12 wells that should be monitored during the 14-day tidal assessment proposed in the Uplands RI/FS Management Plans. I recommend the following wells be included in the 14-day tidal study:

- MW-52, PZ-2, MW-55, MW-51, MW-56, PZ-9, and MW-59 are located near, and will provide average conditions for, the perimeter shoreline.
- MW-23, MW-57, MW-58, and PZ-4 are located in the low-lying process area and are expected to be influenced, but to a lesser degree than the shoreline wells.
- PZ-5 is located near Ennis Creek. Although a minimal response was measured in 1993, this well should be included in the tidal assessment to evaluate conditions near this water body.

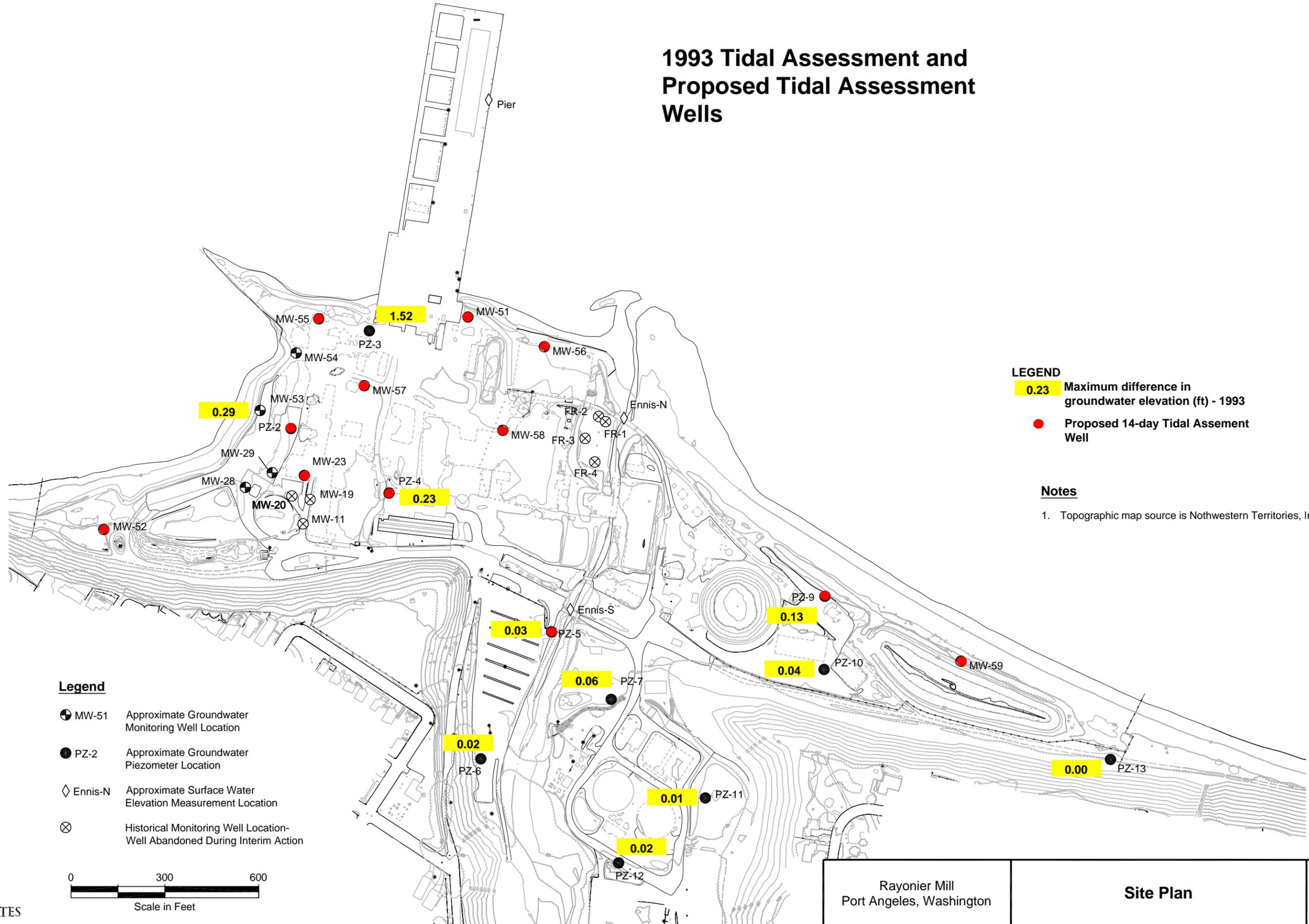
Finally, I recommend a stilling well and transducer be installed in an area with minimal wave action (i.e., near the mouth of Ennis Creek) to measure sea level changes concurrently with the 14-day assessment.

Attachments: Table 1. 1993 Tidal Monitoring
Figure 1. 1993 Tidal Assessment

TABLE 1
1993 Tidal Monitoring
Rayonier Pulp Mill
Port Angeles, Washington

Piezometer Numer	Groundwater Surface Elevation (feet)										Maximum Elevation	Minimum Elevation	Difference	Mean Elevation
	August 15, 1993		August 16, 1993											
	Time	Elevation	Time	Elevation	Time	Elevation	Time	Elevation	Time	Elevation				
TIDAL EXTEMES	18:47	Low 4.0'	0:40	High 6.8'	8:30	Low -1.2'	15:29	High 4.8'	19:58	Low 3.5				
PZ-1	-	-	-	-	-	-	-	-	-	-				
PZ-2	20:52	3.45	2:53	3.70	8:55	3.41	-	-	20:16	3.55	3.70	3.41	0.29	3.55
PZ-3	21:08	1.62	3:01	2.21	9:31	0.69	14:35	1.04	20:30	1.43	2.21	0.69	1.52	1.34
PZ-4	21:04	5.62	2:58	5.46	9:28	5.42	14:31	5.40	20:23	5.39	5.62	5.39	0.23	5.42
PZ-5	21:16	5.91	2:22	5.91	9:03	5.90	14:06	5.88	19:36	5.88	5.91	5.88	0.03	5.89
PZ-6	20:06	10.17	2:20	10.18	9:01	10.18	14:02	10.17	19:29	10.16	10.18	10.16	0.02	10.17
PZ-7	20:27	11.01	2:35	11.07	9:14	11.04	14:15	11.03	19:47	11.01	11.07	11.01	0.06	11.04
PZ-9	20:46	2.07	2:46	2.14	9:24	2.15	14:25	2.08	20:02	2.02	2.15	2.02	0.13	2.10
PZ-10	20:40	3.02	2:43	3.05	9:21	3.05	14:22	3.01	19:57	3.01	3.05	3.01	0.04	3.03
PZ-11	20:22	20.24	2:31	20.24	9:11	20.24	14:12	20.24	19:40	20.23	20.24	20.23	0.01	20.24
PZ-12	20:17	15.30	2:27	15.29	9:09	15.29	14:10	15.29	19:38	15.28	15.30	15.28	0.02	15.29
PZ-13	20:32	-	2:39	1.13	9:18	-	14:18	-	19:50	-	1.13	1.13	0.00	1.13

1993 Tidal Assessment and Proposed Tidal Assessment Wells



LEGEND

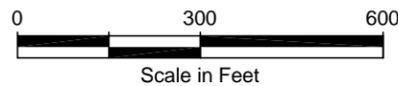
- 0.23 Maximum difference in groundwater elevation (ft) - 1993
- Proposed 14-day Tidal Assessment Well

Notes

1. Topographic map source is Northwestern Territories, Inc.

Legend

- ⊕ MW-51 Approximate Groundwater Monitoring Well Location
- PZ-2 Approximate Groundwater Piezometer Location
- ◇ Ennis-N Approximate Surface Water Elevation Measurement Location
- ⊗ Historical Monitoring Well Location- Well Abandoned During Interim Action



Rayonier Mill
Port Angeles, Washington

Site Plan