DEPARTMENT OF ECOLOGY
State of Washington

Port Angeles Rayonier Mill Site: Under-dock and Nearshore Areas Pre-Remedial Design Analysis and Decision Framework

To: Rayonier Mill Site Potentially Liable Persons

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1.0 Purpose

Pre-remedial design data will be used to determine whether dredging, thin layer capping, enhanced monitored natural recovery (EMNR), or no action will be a sufficiently protective remedy for the under-dock and nearshore areas of the Rayonier Mill site.

The purpose of this decision framework memorandum is to:

1) **identify pre-remedial design sediment data needs** in the under-dock and nearshore areas
    a. **to inform best management practices** for removing in-water structures (i.e., dock, jetty, treated timbers and pilings), and
    b. **to inform remedy selection** for the under-dock and nearshore areas after structure removal
2) **outline a process for collecting the pre-remedial design data**
3) **provide a decision framework** using new data collected to determine appropriate remedies for the under-dock and nearshore areas that are effective after structure removal

A site visit conducted by Ecology, NewFields, and Moffatt & Nichol on June 15, 2022 informed this decision framework memorandum. Attachment A provides a summary of the site visit.

While not the intended purpose, the decision framework may also support design decisions for other sediment remediation areas within the sediment cleanup unit based on remedial design data. Remedial design data needs are not identified in this decision framework memorandum.

2.0 Background

The recommended remedy included in the Interim Action Report Volume III: Alternatives Evaluation Report (Volume III) includes EMNR[1] for sediments under the dock, and no remedy is recommended for sediments in the nearshore areas. There is uncertainty in the effectiveness of these recommended remedies due to limited sediment chemistry characterization (both lateral and vertical) and limited modeling of sediment bed movement post removal of the in-water structures (i.e., dock, jetty, treated timbers, and pilings). Figure 1 shows the Volume III recommended alternative and the limited extent of sampling data under the dock and in the nearshore data gap area outlined in yellow.

In a January 13, 2022 letter, Ecology proposed selecting the Volume III recommended alternative with the modification of dredging the under-dock sediments. The Ecology proposed remedy for contaminated sediments included:

- Dredge intertidal and nearshore portion of sediment management area (SMA)-2 (the log pond)
- Dredge shoreline portion of SMA-1 (the Mill Dock Landing on the shoreline adjacent to the dock)
- Dredge sediments in the under-dock area (Proposed by Ecology in place of EMNR recommended in Volume III)
- Fill previously dredged berth and approach areas with clean fill to surrounding substrate depth gradient.
- EMNR in the remainder (i.e., subtidal portion) of SMA-2 (the log pond) and the remainder of SMA-1

Figure 3 shows the sediment management areas (SMAs).

Ecology proposed dredging the under-dock sediments as a more protective remedy as it reduces the potential for contaminated sediments to spread to other areas of the harbor and ensures the cleanup levels in the sediment cleanup unit are achieved in a reasonable restoration timeframe.

Sediments in the under-dock area (surface or at depth) may be potentially contaminated due to the presence of approximately 4000 creosote pilings and the discharge from former outfalls beneath the dock of untreated wastewater for decades. The numerous dock pilings have protected the underlying sediments from erosional forces. Once the dock is removed, there is a potential that the underlying contaminated sediments will erode and possibly spread contamination to other areas of the harbor.

[1] Enhanced Monitored Natural Recovery and Enhanced Natural Recovery refer to the same remedial technique. Rayonier's Volume III report used the terminology Enhanced Natural Recovery. Ecology prefers to use Enhanced Monitored Natural Recovery because it highlights the monitoring component which is an integral part of this remedy regardless of which terminology is used.

Ecology and Rayonier held several meetings in 2022. To support selecting an effective remedy (e.g., dredging, EMNR, thin-layer capping), additional sediment data and modeling is needed. Ecology agreed to identify pre-remedial design data needs and develop a decision framework for using new data collected to determine appropriate remedies for the under-dock area that are effective after removal of the large in-water structures. In developing this decision framework, Ecology determined the nearshore area should be included as there is limited data in the nearshore area and no remedy was recommended (Figure 1).

3.0 Proposed Remedial Design

Ecology's proposed remedy (Figure 2) for contaminated sediments now includes:

- Remove any treated timbers and pilings in contact with marine water or sediment
- Dredge intertidal and nearshore portion of SMA-2 (the log pond)
- Dredge shoreline portion of SMA-1 (the Mill Dock Landing on the shoreline adjacent to the dock)
- Contingent remedy for SMA-3 (under-dock area) and SMA-4 (nearshore areas) will include EMNR, thin-layer cap, dredge, no-action, or a combination of these remedial options.
- Fill previously dredged berth and approach areas with clean fill to surrounding substrate depth gradient to create suitable benthic habitat and eliminate prominent bottom features that could affect localized deposition (i.e., suppressions) or erosion (i.e., slopes or mounds).
- EMNR in the non-dredged areas of SMA-2 (the log pond) and outside of the dock berths and approaches of SMA-1

This decision framework will be integrated into the Interim Action Plan for the Study Area. As outlined in this decision framework, the pre-remedial design data collection, hydrodynamic/sediment transport modeling, and pre-remedial design data analysis and application of the framework to select the appropriate remedy must be completed before any structures are removed. The decision framework will be used to determine the appropriate remedies for the under-dock and nearshores areas that meet the requirements of the Model Toxics Control Act (WAC 173-340).

4.0 Definitions

The following definitions are set for the purposes of this decision framework memorandum.

Dredging is the removal of contaminated sediment from the aquatic environment. Removal of subtidal sediment is typically conducted with a barge-mounted clamshell dredge, while intertidal sediment can be excavated under lower-tide conditions using upland-based equipment. Dredging can be conducted in erosive or non-erosive environments.

Enhanced monitored natural recovery (EMNR) involves active measures, such as the placement of a thin layer of suitable sand or sediment, to accelerate the natural recovery process. EMNR is often applied in areas where natural recovery may appear to be an appropriate remedy, yet the rate of sedimentation or other natural processes is insufficient to reduce potentially unacceptable risks within an acceptable timeframe. EMNR can only be used in non-erosive environments.

Erosive is defined as a net annual loss of sediment following removal of structures.

In-water structures includes the dock, jetty, treated timbers and pilings.

Nearshore areas are defined as areas where: 1) no remedy is proposed; 2) there is limited sampling data; and 3) removal of existing structures (i.e., dock and jetty) will likely cause sediment bed changes.

Non-erosive is defined as a static equilibrium or net annual deposition of sediment following removal of structures.

Pre-remedial design data – data collected to support decision making. This decision framework memorandum identifies the pre-remedial design data needs for determining appropriate remedies in the under-dock and nearshore areas.

Remedial design data – data collected to design a remedy. Remedial design data requirements are not discussed in this decision framework memorandum.

Sediment Management Area (SMA) – an area within the larger site that can be managed differently in terms of the remedy and monitoring.

Thin-layer capping is the placement of a thin layer (e.g., 6 inches) of clean sediment to physically isolate the underlying contaminated sediment. The cap must be designed to contain contaminants and prevent migration via pore water or bioturbation. The cap must support a productive benthic community and provide adequate isolation from the material contained by the cap. Thin-layer capping can be used in non-erosive or erosive environments if designed to withstand the erosive forces.

5.0 Identified Pre-Remedial Design Data Needs

The following pre-remedial design data needs were identified for sediment under the dock (both intertidal and subtidal) and in the nearshore areas. As noted in Section 7 below, these areas may be impacted after the in-water structures are removed. Figure 2 shows the under-dock and nearshore areas. The nearshore areas include the areas east of the jetty along the shoreline and east of the dock.

5.1 Sediment Characterization

- Pre-removal of in-water structures:
  - Surface and subsurface sediment chemistry including the SMS benthic suite, Total Organic Carbon, PCB congener (sum TEQ), cPAHs (sum TEQ), and dioxins/furans (sum TEQ)

        - Chemical characterization to support the structure and piling removal plan.
    - Depth of depositional sediment overlying native substrate beneath the dock
        - To assess sediments with potential for erosion, subsequent redistribution of contaminated sediment, and inform appropriate remedies.
    - Grain size distribution of sediments (surface and subsurface)
        - To assess sediment with potential for erosion, subsequent redistribution of contaminated sediment, and inform appropriate remedies.

5.2 Hydrodynamics & Sediment Transport of Post Removal Conditions

- Site assessment & physical processes conceptual site model (CSM) that evaluates the localized system with the structures removed and incorporates the shoreline regrade and stabilization planned.
- Scour/erosion and deposition analysis.
- Fate of existing bed material.
- Remedy analysis.

6.0 Filling Identified Pre-Remedial Design Data Needs

The following section includes recommendations for data collection and analyses to fill the identified pre-remedial design data needs before removal of the in-water structures. Specific sampling details will need to be developed in workplans for Ecology review and approval prior to proceeding.

6.1 Sediment Characterization

Removal of the in-water structures including the approximately 4000 pilings will disturb surface and subsurface sediment and alter current sediment conditions both under the dock (e.g., sediment chemistry, grain size, erosion potential) and surrounding environment (sediment deposition and chemistry in subtidal and nearshore, and nearshore processes). The surface and subsurface sediments in the under-dock and nearshore areas must be adequately characterized to inform best management practices to remove the in-water structures, to minimize redistribution of contaminated sediment, and to inform appropriate remedies. In addition, the susceptibility of increased erosion once the structures and pilings are removed is unknown and must be understood to determine the appropriate protective remedy.

The removal of the in-water structures and remediation of contaminated sediments must be a part of the same project. Ecology must select and approve the design of a protective remedy before the structures are removed. Therefore, the pre-removal sediment sampling will be used to prepare a piling removal plan, as well as select protective remedies for the under-dock area and nearshore areas.

Pre-removal of structures and pilings

Prior to removal of the in-water structures, surface sediment grab samples (0 to 10 cm; 0-45 cm in intertidal areas) and subsurface sediment cores (0 to 8 feet) should be collected from representative and spatially distributed locations from the under-dock area, including intertidal and subtidal locations, and nearshore areas (see Figure 2). Approximately nine to twelve grab samples and collocated sediment core samples should be sufficient to address pre-remedial design data needs in the under-dock area, and six to eight locations west of the dock and three locations east of the dock in the nearshore areas. The surface sediment samples should be submitted for chemical analysis (Table 1) to assess potential risk for benthic receptors and human health.

Subsurface cores should be advanced to a minimum of eight feet below the sediment surface (or refusal) to determine the depth and nature of sediment deposition. Collect sediment samples at 6”, 12”, and 18” of depth at coring locations to characterize material physical properties (grain size distribution) which will support a scour assessment. Subsurface sediment cores should also be collected and sampled in one-foot interval composites (e.g., 0-1’, 1-2’, 2-3’, and 3-4’) for the first four feet, and two-foot intervals for the remainder of the core (e.g., 4-6’ and 6-8’). The depth of depositional material (surface to native material) should be determined for each core collected.

The upper two subsurface sediment core intervals (0-1’ and 1-2’) and any subsurface intervals within the depositional horizon, as well as any intervals with visual indications that potential contaminants may be present (e.g., sheen), should be submitted for chemical analysis. The deeper intervals below the depositional horizon will be archived for potential chemical analysis as needed to determine extent of vertical contamination. The chemical analysis for subsurface sediment will consist of the same chemistry as the surface sediment samples (Table 1). If either of the upper two core intervals have higher concentrations of contaminants than one or both of the surface samples at the same location or exceed the Sediment Management Standards Sediment Cleanup Objective (SMS SCO) benthic criteria, additional intervals may need to be analyzed.

6.2 Hydrodynamics & Sediment Transport

A site visit was conducted on June 15, 2022, during an extreme low tide to observe the intertidal areas within the project site. Active movement of gravelly-sand material within the upper intertidal area was observed within most of the project site. The under-dock area had varying size and type of material depending on exposure to waves and currents. Fine sand was observed within the interior of the dock; the finest material observed anywhere on the project site within the intertidal areas. A summary of the site visit is outlined in Attachment A.

The previously conducted coastal engineering and geomorphologic analysis (Integral Consulting, Inc March 1, 2019, Hydrodynamics & Sediment Transport Investigation) should be reviewed to supplement the future grain size data set and understand post-removal conditions.

The existing nearshore system experiences seasonal beach profile changes and longshore transport of large gravely sand material, which was observed and noted as part of our site visit and review of historical photos. Once the in-water structures are removed, the sediment accumulated within the footprint of the dock and areas of reduced wave energy will have higher erosion potential. A more refined evaluation of the nearshore intertidal areas with a focus on shoreline change relative to nearshore processes (e.g., erosion, sediment transport and deposition, wave action, storm events) is needed to understand post removal impacts.

The numerical model area and grid scale covers an area greater than 7,000 ft of shoreline. Model resolution and input parameters (detailed upper intertidal beach contour survey, sediment grain sizes for existing conditions) should be reviewed relative to the focused, smaller areas being evaluated. The review should include the intertidal and shallow subtidal zones of the dock and jetty (See Figure 1). A higher resolution nearshore model or other analytic tool is needed for a more refined analysis in these areas to assess post structure removal scour potential (erosive versus non erosive).

The removal of the in-water structures will result in changes in nearshore littoral processes, which could result in the following:

1. Scour of fine sand under the dock.
2. Scour of upper beach and berm.
3. Sediment transport of eroded under-dock and nearshore sediment.

The nearshore areas that have a potential risk of scour post-removal are lacking sediment data at depth to understand the potential risks of redistribution of contaminated sediment. It is unknown if there are finer-grained materials underlying the naturally armored surface that could create a potential for increased erosion or whether clean sand or gravel covers any contaminants of concern. For example, a 3-inch layer of clean fine sand over contaminated sediment represents a different risk profile than a 3-inch layer of sandy gravel over a contaminated layer in an area proposed for no action or EMNR.

An area of potential bed change resulting from removal of nearshore structures including the shoreline regrade and stabilization has not been documented. An assessment of littoral processes and evaluation of the corresponding proposed changes would assist in outlining those areas of potential risk of scour or shoreline change.

Climate change should be considered during the evaluation and selection of appropriate remedies. Sea level rise is projected to increase the severity of storm events which can exacerbate effects from wave action in both the subtidal and intertidal zones, therefore increasing erosion potential.

To address the issues above, conduct the following hydrodynamic modeling:

6.2.1 Nearshore Analysis

- A conceptual site model for project site physical processes (nearshore coastal geomorphology) needs to be developed for both existing and the post modification conditions.
- Evaluate and determine the extent of potential bed change as a result of the proposed action within a boundary area. Assess scour risks and extents within that boundary area.
- Conduct additional coastal engineering analysis and assessment work to evaluate scour potential and post project shoreline change with consideration of the

variability of sediment size on the project site and post project geomorphologic processes.

- Confirm if a nested, more refined model was used for the nearshore assessment work. If not, develop a higher resolution model to evaluate pre- and post- project changes to evaluate shoreline change and bed scour using grain size data that is representative of the material present in the nearshore zone.
- Evaluate climate change impacts including sea level rise and severe storm events in accordance with Ecology's Publication 17-09-052 – Sustainable Remediation: Climate Change Resiliency and Green Remediation.
- Several areas shown in the upper intertidal do not have a proposed remedy to address potential for scour due to changes in the littoral system. Further analysis is needed to determine a remedy in the Nearshore SMA.

6.2.2 Geomorphologic Analysis

- Assess nearshore coastal processes (longshore sediment transport, influence of existing structures, etc.) to aid in explaining existing conditions and the current littoral processes/system.
- Evaluate the degree to which anthropogenic change (installation of jetty, dock, dredged berth, beach nourishment, etc…) has occurred within the drift cell(s) to be a basis for assessing the expected post structure removal and shoreline regrade and stabilization equilibrium conditions.
- Evaluate long term (multiyear) changes to the upper intertidal littoral processes for post shoreline removal.
- Develop a summary assessment and conceptual estimates (Conceptual Site Model) of shoreline/beach planform and profile changes relative to proposed alterations (removal of jetty, dock, shoreline regrade and stabilization).

6.2.3 Wave Analysis

- Conduct nearshore numerical wave modeling to demonstrate outcomes planned for remedial design and representative of post-shoreline structure removal nearshore littoral processes. Demonstrate relationship to the geomorphologic analysis results.
- Numerical analysis without shoreline structures (dock or jetty) for any proposed remedy. Those scenarios should be evaluated for a 2- and 100-year return period event at varying water levels that includes sea level rise (e.g., MLLW, MHHW) and increased severity of storm events.
- Assess changes to the conceptual site model. This could include a change in long shore sediment transport to evaluate potential for undermining of existing revetments or scour of existing bed material (exposing unknown underlying material) or scour of an EMNR (if proposed). Assess the potential for shoreline change (upper intertidal, prior to implementing cap material).
- Assess scour potential for fine sand substrate within interior of the dock and nearshore upper beach berm.
- Evaluate changes to the upper intertidal littoral processes – not an event analysis but a long-term morphologic analysis.

- Update Conceptual Site Model based on results of hydrodynamic and geomorphologic analysis and sediment grain size data analysis. A recommendation based on the results of a conceptual site model for the changes to the littoral system with supporting analysis results.

Development of modeling criteria to occur as part of a multi-step process as follows:

- Step 1. Develop summary conceptual site model using combination of the following:
  - Conduct site visit technical meeting.
  - Summarize and describe all prior analysis, modeling and data collection pertaining to nearshore processes and modeling work relative to the remedial design alternative.
  - Relate conceptual site model conclusions to the decision framework and outline data and analysis gaps for development of remedial action concept.
- Step 2. Technical meeting to discuss results and comments on conceptual site model conclusions developed in Step 1.
- Step 3. Develop criteria and associated modeling and analysis scenarios to finalize the interim action plan preferred design concept based on the results of Steps 1 and 2.
- Step 4. Conduct additional data collection, analysis, and modeling needed for the remedial design as outlined at the conclusion of Step 3.

7.0 Decision Framework for Identifying Remedial Action Options

The removal of the in-water structures and remediation of contaminated sediments must be a part of the same project. We must select and design a protective remedy before the structures are removed. The data results from the pre-removal sediment sampling and the modeling efforts will be used to inform the best management practices for removal of in-water structures, and the selection of protective remedies. This includes the area under the current dock structure, as well as any nearshore areas that may be subject to significant changes in shoreline morphology, specifically due to increased erosion. While the data may be useful for the remedial design, that is not the intended purpose of the data. Additional data may be necessary to complete the remedial design.

Guidance for best management practices recommended for removal of in-water structures is included in Chapter 16 of Ecology's Sediment Cleanup User's Manual (SCUM) – Removal of Creosote-Treated Pilings and In-Water Structures.

The decision framework for the protection of benthic organisms and human health is outlined in Tables 2 and 3, respectively, based on the pre-remedial design sampling results. The order of preference for the potential remedial options, based on permanence, is 1. dredging, 2. thin-layer capping, 3. EMNR. For example, if the potential remedial option for benthic considerations is dredging, but the potential remedial option for human health considerations is EMNR, then dredging would be the overall recommended remedial option.

Potential remedial options include:

- Dredging – removal of sediment through excavation or barge-mounted dredge with disposal at appropriate facility.
- Thin-layer Cap – isolation of contaminated sediment with a thin layer (e.g., nominal 6 inches) of clean material that is proven to be non-erosive, effective over the long-term, and appropriate habitat.
- EMNR – placement of thin layer of suitable material to accelerate the natural recovery process.

7.1 Under-dock SMA

The under-dock sediments should be treated as their own SMA for the purposes of this decision evaluation. The under-dock environment differs from surrounding sediments due to the long-term presence of the dock structure and pilings. The berth areas adjacent to the dock were deepened by dredging to accommodate ship access, and the deeper, subtidal substrate further afield from the dock was largely left undisturbed from physical disruptions. However, the area under the dock was potentially impacted by the large number of creosote-preserved pilings, changes in offshore currents and wave energy that would have created a different depositional regime than the berths and undisturbed offshore sediments. Therefore, the under-dock area should be assessed as its own SMA for sediment chemistry to inform the best management practices for piling removal and the potential for erosion and redistribution of contaminated sediment.

Benthic Protection

The results of the hydrodynamic modeling and pre-removal surface sediment chemistry will be used to determine the appropriate remedy to protect the benthic community (Table 2). If the hydrodynamic modeling indicates the potential for erosion after removal of the in-water structures, a sediment dredging remedy is appropriate. EMNR is not an appropriate remedy in erosional areas. EMNR may be an appropriate remedy for areas predicted to be non-erosional and where the surface sediment chemistry is less than 1.5 times the SMS SCO benthic criteria for intertidal sediments, or 3 times the SMS SCO benthic criteria for subtidal sediments. In non-erosional areas where surface sediment chemistry is greater than 1.5 times the SMS SCO benthic criteria for intertidal sediments, or 3 times the SMS SCO benthic criteria for subtidal sediments, then dredging is the appropriate remedy.

Human Health Protection

The results of the hydrodynamic modeling and surface sediment chemistry for cPAHs, dioxins/furans congeners, and PCB congeners will be used to determine the appropriate remedy for protecting human receptors (Table 3). Surface sediment chemistry should be evaluated using spatially weighted average concentration (SWAC) for these chemicals within the SMA.

If the hydrodynamic modeling indicates the potential for erosion after removal of the in-water structures, and the SMA SWAC is statistically significantly higher than the sediment cleanup unit (SCU) SWAC, then a sediment dredging remedy is appropriate. If the SMA SWAC is not higher than the SCU SWAC, then dredging or thin layer capping are appropriate remedies. A thin layer cap may be appropriate if effective over the long-term and the cap-material used is proven to be non-erosive and provides appropriate habitat. EMNR is not an appropriate remedy in erosional areas.

If the hydrodynamic modeling indicates the SMA is not erosional and the SMA SWAC is statistically significantly higher than the SCU SWAC, then dredging or EMNR are appropriate remedies. Statistical significant difference is to be determined by comparison between the two populations of data used to develop the SMA and the SCU SWACs. Dredging may be more appropriate to reduce SCU SWAC below the cleanup levels in a reasonable restoration timeframe. If surface sediment chemistry SWAC within the SMA footprint is similar to the SCU SWAC, then EMNR should be considered as an appropriate remedy.

7.2 Nearshore SMA

The nearshore areas, as defined above and shown on Figure 1, should be treated as a SMA. The same decision criteria for benthic protection and human health protection apply to the nearshore SMA.

7.3 SMA Remedy Consideration

The SMAs defined in this Decision Framework may be subdivided into sediment remediation subareas (SRS), as warranted and practicable, based on the hydrodynamic modeling and chemistry results to support remedy selection. Overall remedy preference would be based on both appropriateness as determined by the Decision Framework and permanence of remedy (e.g., 1. dredging, 2. thin-layer capping, 3. EMNR) for a given SRS.

Table 1. Sediment Chemistry Analytes

Analytes			
Conventional Parameters			
Grain Size Distribution	Total Solids (%)	Total Sulfides	Total organic carbon (%)
Metals (mg/kg DW)			
Arsenic	Cadmium	Chromium	Copper
Lead	Mercury	Selenium	Silver
Zinc			
cPAHs (µg/kg DW)			
Benzo(a)pyrene	Benz(a)anthracene	Benzo(b)fluoranthene	Benzo(k)fluoranthene
Chrysene	Dibenz(a,h)anthracene	Indeno(1,2,3-cd)pyrene	
PAHs (µg/kg DW)			
Total LPAH	Napthalene	Acenaphthylene	Acenaphthene
Fluorene	Phenanthrene	Anthracene	2-Methylnaphthalene
Total HPAH	Fluoranthene	Pyrene	Benzo(a)anthracene
Chrysene	Total Benzofluoranthenes	Benzo(b)fluoranthene	Benzo(k)fluoranthene
Benzo(a)pyrene	Benzo(g,h,i)perylene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene
Dioxins/Furans Congeners (ng/kg DW)			
2,3,7,8-TCDD	1,2,3,7,8-PeCDD	1,2,3,4,7,8-HxCDD	1,2,3,6,7,8-HxCDD
1,2,3,7,8,9-HxCDD	1,2,3,4,6,7,8-HpCDD	OCDD	
2,3,7,8-TCDF	1,2,3,7,8-PeCDF	2,3,4,7,8-PeCDF	1,2,3,4,7,8-HxCDF
1,2,3,6,7,8-HxCDF	1,2,3,7,8,9-HxCDF	2,3,4,6,7,8-HxCDF	1,2,3,4,6,7,8-HpCDF
1,2,3,4,7,8,9-HpCDF	OCDF		
PCB Congeners and Congener Pairs (ng/kg DW)			
PCB-1	PCB-48	PCB-110/115	PCB-164
PCB-2	PCB-50/53	PCB-111	PCB-165
PCB-3	PCB-52	PCB-112	PCB-167
PCB-4	PCB-54	PCB-113/90/101	PCB-169
PCB-5	PCB-55	PCB-114	PCB-170
PCB-6	PCB-56	PCB-117/116/85	PCB-171/173
PCB-7	PCB-57	PCB-118	PCB-172
PCB-8	PCB-58	PCB-120	PCB-174
PCB-9	PCB-59/62/75	PCB-121	PCB-175
PCB-10	PCB-60	PCB-122	PCB-176
PCB-11	PCB-61/70/74/76	PCB-123	PCB-177
PCB-12/13	PCB-63	PCB-126	PCB-178
PCB-14	PCB-64	PCB-127	PCB-179
PCB-15	PCB-66	PCB-128/166	PCB-180/193
PCB-16	PCB-67	PCB-130	PCB-181
PCB-17	PCB-68	PCB-131	PCB-182
PCB-19	PCB-69/49	PCB-132	PCB-183/185
PCB-21/33	PCB-72	PCB-133	PCB-184
PCB-22	PCB-73	PCB-134/143	PCB-186
PCB-23	PCB-77	PCB-136	PCB-187
PCB-24	PCB-78	PCB-137	PCB-188
PCB-25	PCB-79	PCB-138/163/129/160	PCB-189
PCB-26/29	PCB-80	PCB-139/140	PCB-190
PCB-27	PCB-81	PCB-141	PCB-191

Analytes			
PCB-28/20	PCB-82	PCB-142	PCB-192
PCB-30/18	PCB-83/99	PCB-144	PCB-194
PCB-31	PCB-84	PCB-145	PCB-195
PCB-32	PCB-88/91	PCB-146	PCB-196
PCB-34	PCB-89	PCB-147/149	PCB-197/200
PCB-35	PCB-92	PCB-148	PCB-198/199
PCB-36	PCB-94	PCB-150	PCB-201
PCB-37	PCB-95/100/93/102/98	PCB-151/135/154	PCB-202
PCB-38	PCB-96	PCB-152	PCB-203
PCB-39	PCB-103	PCB-153/168	PCB-204
PCB-41/40/71	PCB-104	PCB-155	PCB-205
PCB-42	PCB-105	PCB-156/157	PCB-206
PCB-43	PCB-106	PCB-158	PCB-207
PCB-44/47/65	PCB-107/124	PCB-159	PCB-208
PCB-45/51	PCB-108/119/86/97/125/87	PCB-161	PCB-209
PCB-46	PCB-109	PCB-162	--

Table 2. Decision Framework Outline for Benthic Protection

Benthic Protection			
Erosion Modeling Results[1, 2]	**Surface Sediment Chemistry[3]**	**Subsurface Chemistry Results**	**Potential Remedial Consideration[4]**
Erosive	Surface Sediment Chemistry ≥SCO	NA	Dredging[5]
	Surface Sediment Chemistry < SCO	Subsurface[5] > SCO	Dredging or thin layer cap[6]
		Subsurface < SCO	No action
Non-Erosive	Surface Sediment Chemistry ≥ 3X SCO (subtidal) or 1.5X SCO (intertidal)[7]	NA	Dredging
	3X SCO (subtidal) or 1.5X SCO (intertidal) > Surface Sediment Chemistry ≥ SCO	Subsurface > surface	EMNR or Dredging[8]
		Subsurface < surface	EMNR
	Surface Sediment Chemistry < SCO	Subsurface > surface	No action or EMNR[9]
		Subsurface < surface	No action

Notes:
1: Erosive is defined as a net annual loss of sediment following removal of structures.
2: Non-erosive is defined as a static equilibrium or net annual deposition of sediment following removal of structures.
3: The surface sediment point of compliance for benthic protection is 10 cm.
4: Remedy preference order based on permanence: 1. dredging, 2. thin-layer capping, 3.EMNR
5: Potential new surface after erosion.
6: Erosive. EMNR not appropriate in erosive areas; a thin layer cap may be considered an appropriate remedy if the cap material creates a non-erosive surface overlying the in-situ subsurface sediments.
7: This is a site-specific remediation level. The 3X SCO applies only to subtidal sediment areas. For intertidal areas use 1.5X SCO. EPA 2014.
8: If higher contamination at depth will remain buried below the biologically active zone, then EMNR. If higher contamination at depth may be exposed or carried upwards through bioturbation or other disturbance, then dredging.
9: If higher contamination at depth may be exposed or carried upwards through bioturbation or other disturbance, then EMNR

SCO: Sediment Cleanup Objective for benthic protection
EMNR: Enhanced Monitored Natural Recovery
NA: Not Applicable

Table 3. Decision Framework Outline for Human Health Protection

Human Health Protection[3]			
Erosion Modeling Results[1,2]	**SMA SWAC[4] compared to SCU SWAC[5]**	**Subsurface Chemistry Results**	**Potential Remedial Consideration[6]**
Erosive	SMA SWAC ≥ SCU SWAC[7]	NA	Dredging[8]
	SMA SWAC < SCU SWAC	Subsurface > Surface	Dredging or thin layer cap[9]
		Surface > Subsurface > Clean	Dredging or thin layer cap[9]
		Clean Subsurface	Dredging or thin layer cap[9]
Non-Erosive	SMA SWAC ≥ SCU SWAC	Subsurface > Surface	Dredging[10] or EMNR
		Surface > Subsurface > Clean	Dredging[10] or EMNR
		Clean Subsurface	Dreding[10] or EMNR
	SMA SWAC < SCU SWAC	Subsurface > Surface	EMNR
		Surface > Subsurface > Clean	EMNR
		Clean Subsurface	EMNR

Notes:
1: Erosive is defined as a net annual loss of sediment following remedial activities.
2: Non-erosive is defined as a static equilibrium or net annual deposition of sediment following remedial activities.
3: The surface sediment point of compliance for intertidal areas is 45 cm and 10 cm for subtidal areas.
4: SMA SWAC is SWAC of sediment management areas (e.g., under-dock footprint or nearshore areas)
5: SCU SWAC is SWAC of sediment cleanup unit
6: Remedy preference order based on permanence: 1. dredging, 2. thin-layer capping, 3. EMNR
7: SMA SWAC is statistically significantly higher than SCU SWAC; statistical difference is to be determined by comparison between the two populations of data used to develop the SWAC.
8: Erosive. EMNR not appropriate in erosive areas.
9: Thin layer cap may be appropriate given the SMA SWAC is less than the SCU SWAC, and deeper sediments are less contaminated than the surface sediments. Thin layer cap material must be proven to be non-erosive, effective over the long-term, and appropriate habitat.
10: Dredging may be more appropriate to reduce SCU SWAC below Cleanup Levels in reasonable restoration timeframe.

SWAC: Spatially Weighted Average Concentration
EMNR: Enhanced Monitored Natural Recovery
NA: Not Applicable

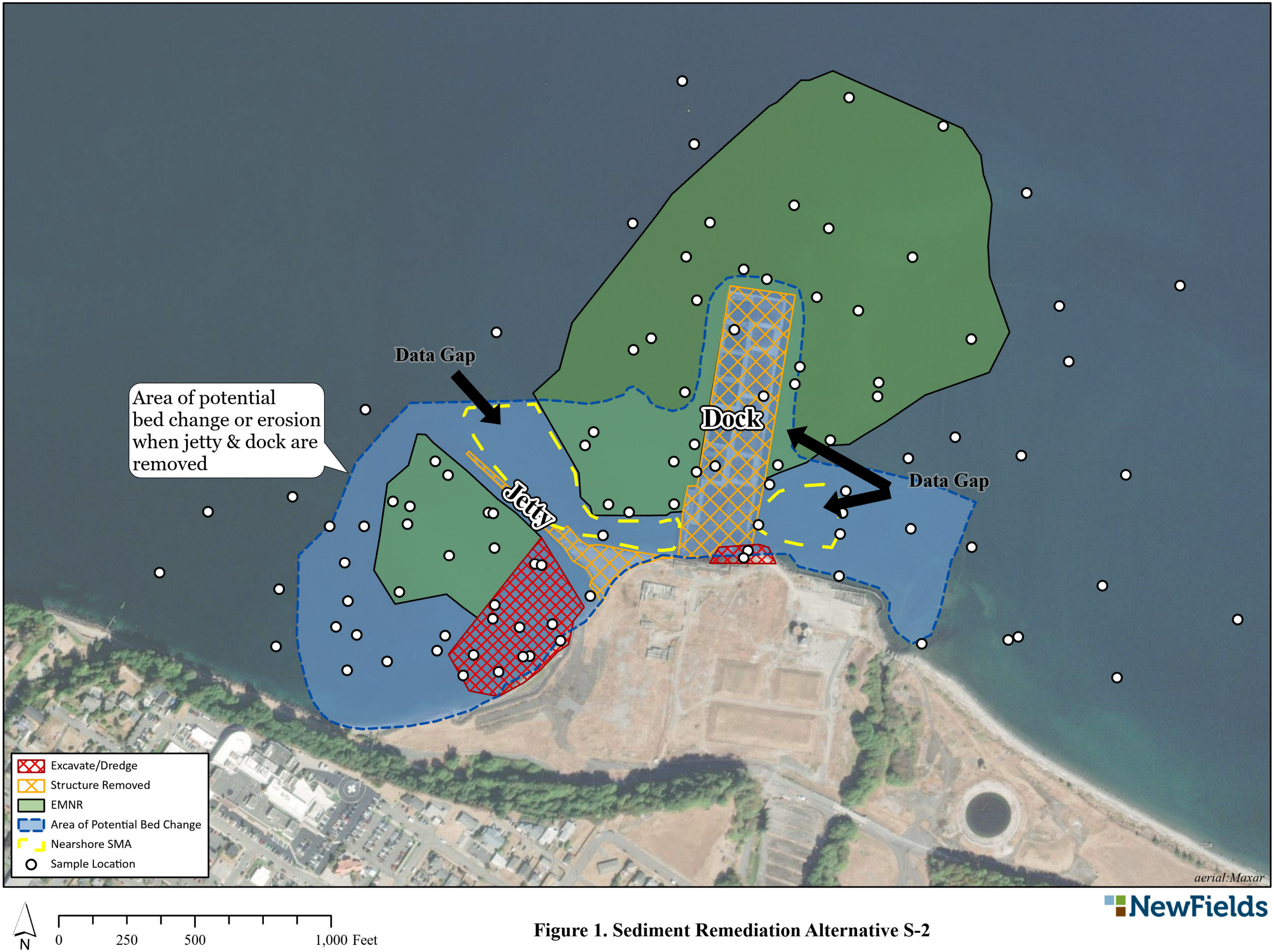


Figure 1. Sediment Remediation Alternative S-2

Path: D:\Projects\Rayonier_Mill\Rayonier_Mill.aprx

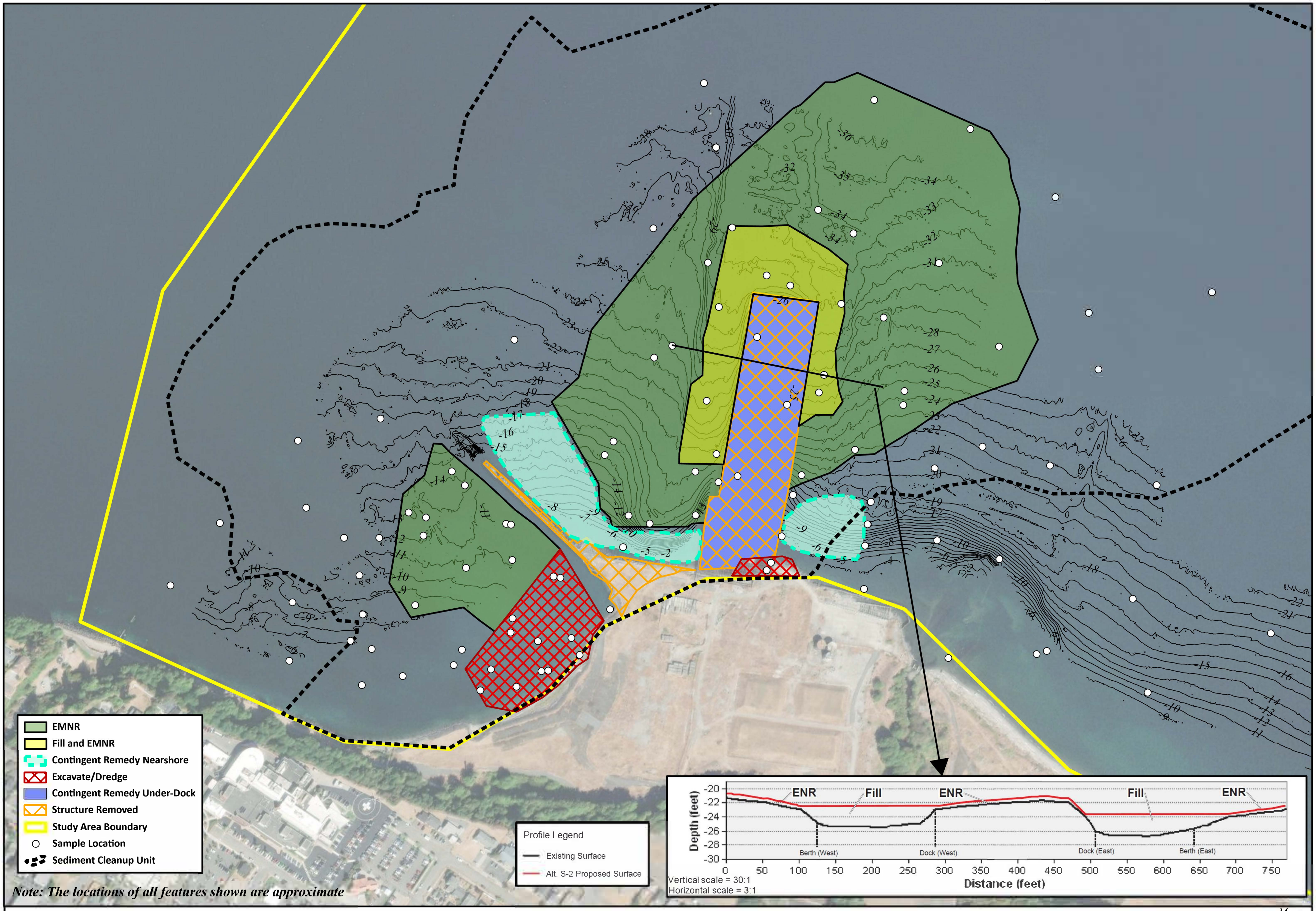


Figure 2 Sediment Selected Remedy

0 350 700 1,400 Feet

N

NewFields

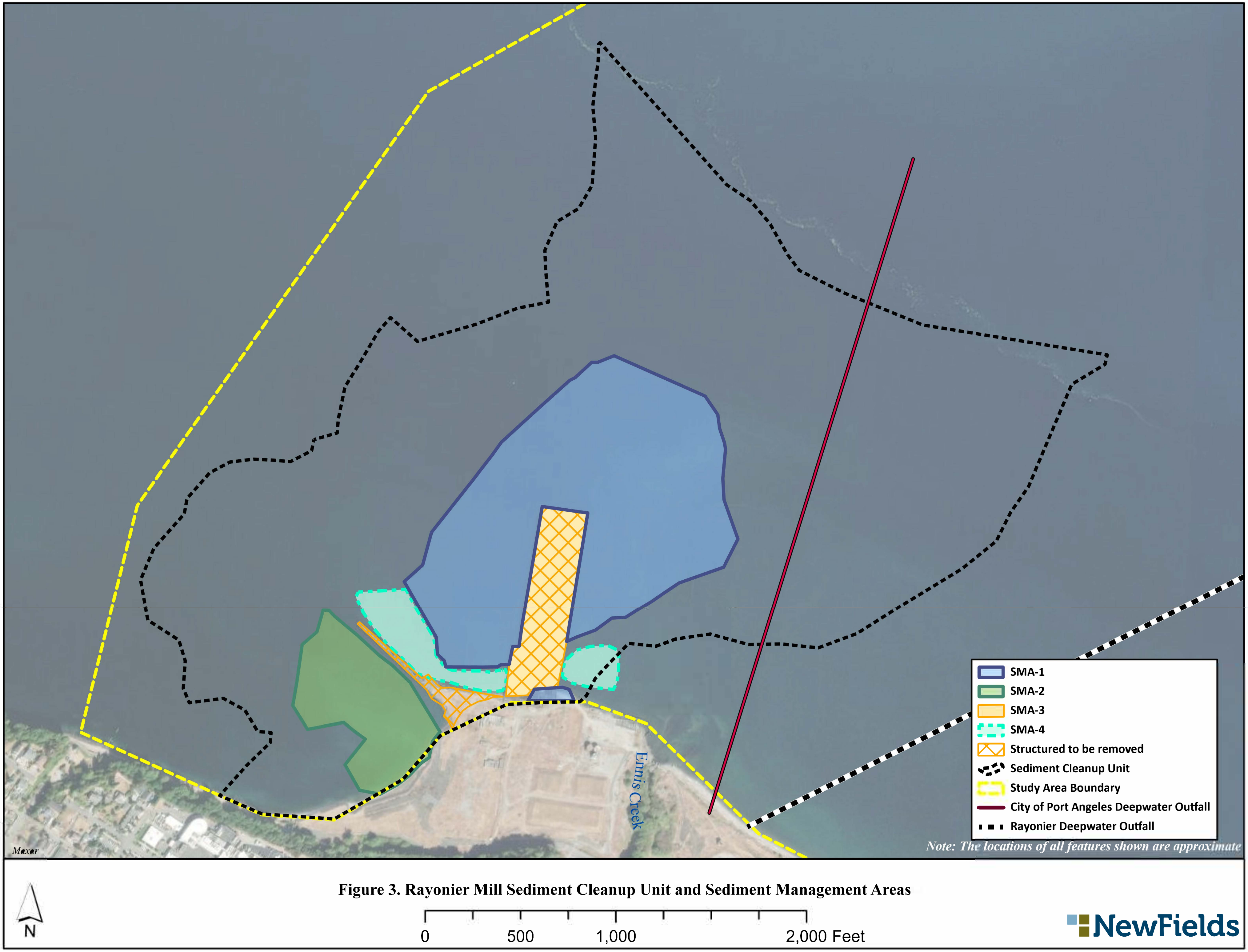


Figure 3. Rayonier Mill Sediment Cleanup Unit and Sediment Management Areas

NewFields

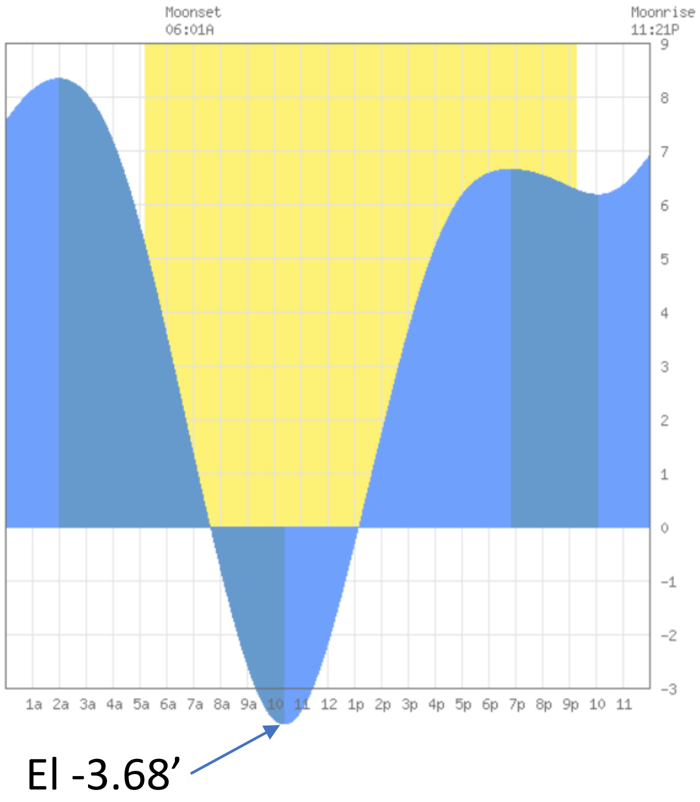
Attachment A: Site Visit Summary

June 28,2022

Moffatt & Nichol

SITE VISIT – JUNE 15, 2022

- Purpose. Review site conditions during low tide to observe substrate variability on the site with the remedial action area.
- Time of Site Assessment. 9:30 to 11:30 am; time of low tide (-3.68’).



SITE OBSERVATIONS – JUNE 15, 2022

LEGEND

Sandy Gravel
Gravel Cobble
Large Rock & Cobble
Fine Sand w/ Silt

Photo # & Orientation 1

At extreme low tide (-3.6’; lowest tide in >10 years), intertidal beach outside of pier was observed to be either sandy gravel or gravel cobble. Only location of observed fine sand w/ silt was on the interior of the pier where waves are partially attenuated by the pile field.

SITE OBSERVATIONS – JUNE 15, 2022

1 East Sandy Gravel Beach at toe of revetment

Longshore Sediment flow thru and under the pier

2 Longshore Sediment in upper profile **"A"** and coarser "B"

Coarser Lower Beach – 3" minus gravel/sand

Gravely Sand Upper Beach

Coarser Lower Beach – 5" minus Gravel, Cobble

SITE OBSERVATIONS – JUNE 15, 2022

3 Fine Sand interior to coarse rock bands on the outer edges of the pier

SITE OBSERVATIONS – JUNE 15, 2022

4 Upper Intertidal Beach Berm under pier (nearshore zone only) – gravelly sand

SITE OBSERVATIONS – JUNE 15, 2022

5 Upper Intertidal Beach Berm under pier (nearshore zone only) – gravelly sand, looking west