EXECUTIVE SUMMARY

This remedial investigation (RI) report is prepared for the uplands environment of the former Rayonier mill site (Site), located in Port Angeles, Washington, in accordance with the provisions of an Agreed Order between the Washington Department of Ecology (Ecology) and Rayonier Properties LLC and its predecessor companies (Rayonier). The RI has been conducted according to the requirements promulgated under the State of Washington's Model Toxics Control Act (MTCA), Chapter 173-340 WAC, and represents a collaborative effort between Rayonier, Ecology, and the Lower Elwha Klallam Tribe (Tribe) to establish the nature and extent of contamination associated with the Uplands Environment of the Site.

The Site is located within the Port Angeles city limits and is bordered to the south by residential and commercial areas on the high bluff, to the north by Port Angeles Harbor, and to the west and east by a pedestrian pathway following the old railway right-of-way and additional commercial/residential areas. Port Angeles Harbor has a high level of urban, commercial, industrial, and recreational use. Ennis Creek flows through the Site.

The mill operated between 1930 and 1997, using an acid sulfite process to produce dissolving grade pulps from wood chips. Operations ceased in 1997, and dismantling activities were completed in October 1999. Prior to closure, the mill was subject to routine regulatory compliance inspections by the City of Port Angeles, Ecology, and the U.S. Environmental Protection Agency (EPA), including a multi-media compliance investigation in 1993. After closure of the mill, the EPA initiated a site assessment and hazard ranking scoring process to determine if the mill should be recommended for the National Priorities List under the Comprehensive Environmental Response, Compensation, and Liability Act. An expanded site investigation (ESI) was conducted in support of this effort (E&E 1998). EPA opted to defer the listing and allow cleanup to proceed under Ecology's direction.

Rayonier has conducted interim cleanup and removal actions at five different areas on the Site to address known or suspected contamination associated with various mill operations. In each case, the contamination was identified, characterized, and addressed through various cleanup activities. The resultant conditions following completion of the cleanup actions are representative of current Site conditions in these areas and, thus, pertinent to the evaluation of the nature and extent of contamination.

Investigation and cleanup of the Site is being managed under two separate units — the Uplands Environment and the Marine Environment. This report presents the findings of the RI for the Uplands Environment. The objective of the RI is to determine the nature and extent of chemicals of potential concern (COPCs) at the Site. This evaluation draws on data and information collected during the RI field investigation conducted in 2003, and, where appropriate, on previous Site investigations and interim cleanup and removal actions.

The Uplands RI addressed the following media:

- **Soil**—Surface and subsurface soil samples were collected from boreholes at up to 60 locations. The soil data supplement previous investigations and filled spatial and analytical data gaps to refine the nature and extent of Site-related chemicals. Offsite soil data collected during the ESI are also discussed and interpreted.
- **Ennis Creek Sediments**—Samples were collected at one location to augment previous investigations.
- **Groundwater**—The groundwater monitoring network was sampled in June 2003. Analytical methods were modified to lower detection limits to enhance the understanding of the nature and extent of Site-related chemicals.

Soil

The Site lies in an area composed of fill material, alluvium deposited by Ennis Creek, and beach deposits related to the Strait of Juan de Fuca. Materials in many portions of the Site most likely consist of soils modified through grading, dredging, filling, or facility operations, and may vary considerably between locations. In addition to dredged harbor sediment, sand and gravel, wood waste, ash, and demolition debris were used as fill materials. During the Site dismantling (1997 through 1999), crushed concrete rubble was distributed across the western portion of the Site. In 1999, fill material consisting of gravel, rock, and riprap was imported to prevent further beach and Site erosion along the former log pond area beach wall.

Soil results were compared to criteria protective of human health and consistent with the MTCA. These criteria include the MTCA Method B criteria for unrestricted and MTCA Method C criteria for restricted (industrial) land uses. An assessment of ecological risk is the subject of a separate report. Inorganic chemicals were also compared to background concentrations from a study performed by Ecology (1994). Certain organic chemical concentrations were compared to concentrations found in the literature that may reflect the impacts on soils of several different land uses (Ecology 1999, Bradley et al. 1994).

The soil data demonstrated that there are few occurrences of chemicals at concentrations above criteria for industrial land use. Chemical concentrations in two corners of the Site are below criteria for unrestricted use. The different areas of the Site are summarized as follows:

Bone Yard (Used Equipment Storage)—Chemical concentrations in soils from the bone yard were low, generally below unrestricted criteria. At the six locations sampled during the ESI and RI, only arsenic (27.5 ppm at one ESI sampling location) and various polycyclic aromatic hydrocarbon (PAH) compounds were detected at concentrations above unrestricted criteria. Subsequent reanalysis of arsenic in soil near the high ESI detection during the RI was below background concentration. Elevated PAH concentrations are attributed to historical stack emissions (see discussion for the east side of the Site, below).

Chlorine Dioxide Generator and Pre-fab Area—Chemical concentrations in soils from this area were, with the exception of copper, below unrestricted criteria. At the six locations sampled during the ESI and RI, only copper was elevated (9,370 ppm at one ESI sampling location). Subsequent reanalysis of copper during the RI near the high ESI detection yielded a concentration of 43.6 ppm, below the unrestricted criterion.

Spent Sulfite Liquor (SSL) Lagoon—Chemical concentrations in surface and subsurface soils from this area were low, below unrestricted criteria or, in the case of arsenic, below background.

Wood Mill Area—Chemical concentrations at the two locations sampled during the RI in this area were below unrestricted criteria or background (Station WM21), or were indicative of petroleum releases and other contamination associated with development of the facility (Station WM20). PAH concentrations at WM20 were above unrestricted criteria. Polychlorinated biphenyls (PCBs) and polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (collectively, PCDD/Fs) also exceeded unrestricted criteria at this location, but were below industrial criteria.

Log Yard—The industrial criteria were exceeded at only one of the 23 locations sampled during the ESI and RI (Station LY21). Carcinogenic polycyclic aromatic hydrocarbons (cPAHs), diesel-range organics (DRO), and residual-range organics (RRO) exceeded industrial criteria at LY21. No individual PCDD/Fs exceeded their industrial criteria. PAH, DRO, and RRO are measures of petroleum constituents, and this station was located next to a historic fuel tank and hog fuel boiler ash storage area. Concentrations at most locations were below unrestricted criteria and background metals levels, with the exception of arsenic, lead, and PAHs, several individual PCDD/Fs which were above the unrestricted criteria.

Main Process Area—Several samples were collected in the main process area. ESI sampling evaluated 53 discrete samples collected from 49 locations and RI sampling evaluated 56 samples collected from 27 locations. Several chemicals exceeded unrestricted criteria at more than one sampling location, including arsenic, lead, cPAH, and PCDD/Fs. Five chemicals (cadmium, thallium, vanadium, pentachlorophenol, and pyrene) exceeded unrestricted criteria at a single location and total chromium exceeded its unrestricted criterion at two locations. A single sample collected during the ESI exceeded the industrial criterion for one PCDD/F. This location was resampled during the RI and the concentration was less than the industrial criterion.

East Side of Site—The east side of the Site includes the bone yard and the SSL lagoon (discussed above). Portions of the east side were influenced by particulate deposition from the stack in the main process area. Concentrations of cPAHs were generally below unrestricted criteria. Individual PCDD/F concentrations were well below the industrial criterion at all nine sampling locations, but exceeded unrestricted criteria at two locations.

Offsite Residential Soil—Twenty residential soil samples were collected south of the Site during the ESI. Concentrations of all analytes were generally low. Interpretation of residential soils is complicated by numerous other sources—both regional and localized

domestic releases—that can influence chemical concentrations. Air dispersion and deposition modeling was used to interpret residential soil data and to assess the potential link to historical stack releases from the Site. While there were localized exceedences of unrestricted criteria for arsenic, lead, heptachlor epoxide, 2,3,7,8-TCDD, 2,3,4,7,8-PeCDF, and cPAH, there were no patterns that can be entirely attributed to historical stack emissions and the modeled particulate deposition from the Site. The Agency for Toxic Substances and Disease Registry (ATSDR) performed a public health evaluation based, in part, on the information from these samples and concluded none of the contaminants detected in offsite soil would be expected to produce adverse health effects in potentially exposed residents (ATSDR 2004).

Ennis Creek Sediments

Ennis Creek, which runs through the Site, is the only source of freshwater sediments within the Site boundary. The creek discharges directly into Port Angeles Harbor on the Strait of Juan de Fuca. As a result of tidal changes, surface water elevation varies daily at the mouth of Ennis Creek. The section of Ennis Creek that flows through the mill property is confined to a channel lined with large riprap rock, creating a relatively fast-flowing stream during high rainfall events.

Eight sediment samples were collected from Ennis Creek during the ESI and RI. These samples were compared to freshwater sediment criteria published by the State of Washington and to levels from an upstream station. With a single exception, chemical concentrations were below freshwater sediment criteria or upstream station levels at all locations sampled. The concentration of manganese at one location was elevated above the upstream freshwater station level, but below the background concentration in soil in the Puget Sound region.

In 2002, an interim remedial action to address releases of petroleum hydrocarbons (DRO and RRO) and PCBs from the Ennis Creek-Finishing Room Area resulted in the removal of 1,248 tons of soil from the west bank and the west half of the creek bed. The excavation was backfilled with suitable clean material obtained from an outside source.

Groundwater

Since 1989, fifty-one groundwater monitoring wells and piezometers have been installed on the Site to assess groundwater conditions in the shallow water-bearing zone beneath the Site and/or to monitor the effectiveness of interim remedial actions. Groundwater conditions observed during the RI and previous investigations indicate the presence of unconfined groundwater beneath the Site in a shallow water-bearing zone consisting of fill and alluvial deposits. Groundwater elevations are influenced by precipitation, tides and, to a lesser degree, by surface water fluctuations in Ennis Creek. The shallow water-bearing zone is variable in thickness; the base varies from 12 ft below ground surface (bgs) to greater than 30 ft bgs.

Groundwater analytical results were screened against marine aquatic water quality criteria for aquatic organisms and for human consumption of organisms because 1) the

water-bearing zone does not currently serve as a drinking water supply, and the former Rayonier Mill Site does not meet Washington State minimum requirements for construction of drinking water supply wells [WAC 173-160-171 (i.e., depth to groundwater and location outside the 100-year floodplain)], and 2) the marine environment is the discharge point for Site groundwater. This comparison is environmentally conservative for several reasons:

- The volume of groundwater seepage into the marine environment represents a very small fraction of ambient marine water conditions.
- Some marine criteria are lower than freshwater criteria. It is possible that a pristine river could be out of compliance with marine water quality criteria.
- Groundwater is in intimate contact with aquifer material, which contains naturally occurring metals, including arsenic, chromium, copper, nickel, and mercury.
- Geochemical conditions in the aquifer (pH, oxygen content, organic content, conductivity) are more variable and distinctly different than those in seawater.

Analytical detection limits were a particular challenge for evaluating conditions in groundwater. To achieve the project data quality objectives, the laboratory typically extracted 2 times the volume normally used for the method and concentrated the final extract volume by a factor of 2. The number of nondetected analytes with detection limits above screening criteria was reduced from 48 in the RI Work Plan (Integral 2004) to nine for the June 2003 data, primarily due to the lower detection limits achieved for the 2003 sampling event.

Chemicals with maximum detections (or maximum detection limits for samples with no detections) above marine water quality criteria were identified as COPCs. Chemicals identified as COPCs solely on the basis of one or more detection limits that exceed criteria were classified as COPCs to be environmentally conservative; there is no scientific evidence that chemical concentrations in the groundwater samples actually exceed criteria.

Groundwater samples were collected from a total of 20 wells and piezometers during the 2003 sampling event. Of the 20 wells and piezometers sampled, arsenic, chromium, nickel, lead, and mercury concentrations were elevated above marine water quality criteria at one to three locations each. Copper exceeded criteria at 11 locations and ammonia exceeded criteria at seven locations.

Semivolatile organic compounds were only sporadically detected across the Site and nearly always at levels below screening criteria. The one exception was phthalates, which were detected at most locations, but at levels below screening criteria. Concentrations of 2,4,6-trichlorophenol, pentachlorophenol, benzo(a)anthracene, and chrysene exceeded screening criteria at three wells.

Pesticides and PCBs that exceeded screening criteria include those COPCs with detected concentrations above screening criteria and COPCs with no detections, but with detection limits above screening criteria. The pesticides, 4,4′-DDD, 4,4′-DDE, 4,4′-DDT,

alphachlordane, dieldrin, endrin, and heptachlor, had at least one detection above screening criteria. 4,4′-DDD had the most widespread exceedence of screening criteria, exceeding screening levels at nine locations. PCB (Aroclor 1260) exceeded screening criteria at a single location. The screening level criterion for total PCBs was exceeded at the same location. Aldrin, heptachlor epoxide, and toxaphene were identified as COPCs due to nondetections greater than screening criteria.

Distributions of groundwater COPCs were patchy; no groundwater plumes were observed. The areas with the highest concentrations of groundwater COPCs included the former SSL area and the area immediately east of the dock.

Fate and Transport

The fate and transport of COPCs in soil and groundwater are governed by physical and chemical properties, including volatilization, degradation, erosion, leaching, and transport with groundwater flow. Volatilization is not expected to be an important fate and transport parameter with Site chemicals. Degradation via photodegradation, hydrolysis, abiotic, and biotic process is also not expected to be an important process for most Site COPCs; however, ammonia is very susceptible to redox transformations and is likely to oxidize at the shoreline mixing zone between seawater and groundwater and upon discharge to the oxygen-rich marine waters. Erosion may have some capacity to distribute Site COPCs in surface or near-surface soil in areas not covered with asphalt, concrete, or concrete debris. Leaching of Site soil COPCs to groundwater is not expected to be a significant future transport mechanism. The majority of soil COPCs onsite have been present for many years, and monitoring following Site closure in 1997 has shown 1) a general lack identifiable soil sources for observed groundwater detections, and 2) decreasing or stable concentrations in groundwater COPCs.

In general, historical groundwater data indicate that metals concentrations are decreasing or stable. Spatial distributions and comparison to soil data indicate no identifiable source in soil and no downgradient migration patterns or migration plumes. Metals distribution patterns can be partially explained by some of the unusual chemical conditions that are present in Site groundwater. Locations with elevated total organic carbon (TOC) and lignin/tannin also have elevated concentrations of arsenic, chromium, copper, and nickel.

Wells with unusually high pH (i.e., MW-56 and MW-29) also tended to have elevated metals concentrations. In general, patchy concentration distributions of groundwater COPCs may be due to the highly variable geochemical conditions (pH, dissolved oxygen, conductivity, TOC content) in Site groundwater.

A loading evaluation of groundwater transport was conducted for Ennis Creek and Port Angeles Harbor. Analyses of Ennis Creek sediments indicated that no Site COPCs were detected above screening criteria. Loading of dissolved COPCs to the harbor was calculated based on estimates of groundwater flow from the Site to the harbor and average concentrations of COPCs at shoreline wells. This evaluation estimated metals loading at less than 1/1000th of a pound per day and 2 to 4 orders of magnitude less for

organic compounds. The loading calculations are conservative in that geochemical processes or mixing with seawater were not included in the evaluation.