



## Case Study 2

<b>West Coast Phytoremediation Case Study</b>	
<b>Name and Location</b>	<p><b>Site Name:</b> A West Coast Refinery</p> <p><b>Site Location:</b> Refinery Effluent Treatment System</p>
<b>Site Description</b>	<p>Briefly describe site history; i.e., historical uses and current uses (or current uses prior to cleanup. You may want to insert a picture, aerial photograph, etc.) If sending this via e-mail you may want to send the picture separately.</p> <p>The refinery effluent treatment system (ETS) consisted of a primary facultative lagoon (No 1 Ox Pond), followed by an aerated lagoon, and ending with a secondary facultative lagoon. The 120 acre primary facultative lagoon served as an equalization basin and a pre-treatment lagoon for refinery process waters to be biologically treated in the aerated lagoon. The primary facultative lagoon was constructed in 1963 from a tidal salt marsh by building a dike around the 120 acre area. Interior baffles and dividers were added to create 5 sections ranging from 30 acres down to 5 acres. This primary lagoon was operated until approximately 1985, when it was drained.</p> <p>The first section of No 1 Ox Pond was excavated to create a clean storm water holding basin. The sediments from the storm water basin was distributed over the sections 2 – 5 of the remaining land of the No 1 Ox Pond, filling in most of it. Except for the storm water basin, the No 1 Ox Pond has remained dry since 1985.</p> <p>Is the project located in an urban/suburban setting or rural/agricultural? Briefly describe the area – is it located in a predominantly residential, commercial or industrial area?</p> <p>This site is within a refinery that is near an urban area.</p> <p>What is the size of the property? Refinery is ~ 500 acres and the No 1 Ox Pond is approximately 120 acres.</p>

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**Site Reuse Description**

Briefly describe how ecological enhancements will be or have been incorporated into the site restoration project. If the site will have multiple uses; i.e., recreational, ecological, etc, you may want to include this information as well.

Site reuse plan is for continued use as a clean stormwater holding basin (~30 acres) and to remediate and cover the remaining No. 1 Ox Pond with natural vegetation, grasses, bushes, and trees as a vegetative cap (~90 acres).

The No 1 Ox Pond was a site for the USEPA/RTDF petroleum hydrocarbon phytoremediation study. A 0.8 acre study area was set up on part of the No 1 Ox Pond to look at phytoremediation of the oil in the sediments and to determine if phytoremediation was an alternative bioremediation method for clean-up of the No. 1 Ox Pond.

What type of ecological restoration is being sought (wetland, prairie, etc.)?  
Native grasses, bushes, and trees for the area.

Is the community involved in the end use decision making process? No, because it is part of the refinery ETS with restricted access by the public.

**Stakeholder Involvement**

Who were the stakeholders/partners in this site and were their roles/contributions?

Regional Water Quality Control Board has regulatory control over the site



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<b>t</b>	<p>because it is part of the ETS and NPDES permit.</p> <p>The Department of Toxic Substance Control because of oil and metals in the sediments from early operation as part of the ETS.</p> <p>USEPA/RTDF general oversight of the phytoremediation study.</p> <p>The site is part of the ETS and the refinery has the responsibility to clean up and restore site when it is no longer used as part of the ETS. There was no mandated action at the time by the RWQCB or DTSC to clean up the site.</p> <p><b>What were the concerns of these stakeholders and how were these resolved?</b></p> <p>Developing a closure plan appropriate for the site that is protective of human health and the environment in the area. The refinery wanted to find a cost/effective closure plan that if possible, provided ecological upgrade of the No. 1 Ox Pond to natural habitat consistent with the area.</p> <p>The RTDF study was one part of this effort to understand the effectiveness of phytoremediation for clean up and closure of the No. 1 Ox Pond and the focus of this case study.</p> <p><b>Did any of these stakeholders/partners make a financial contribution to the project?</b> Only the RTDF by providing the data analysis and project support. Funding for the project was from the Refinery.</p> <p><b>Were any local, state, federal funding sources used?</b> No.</p>
<b>Site Assessment Approach and Cleanup</b>	<p><b>Briefly state the results of the site assessment. Did the site assessment approach take into account end use?</b> The site assessment included soil core analysis, environmental risk evaluation, determining acceptable clean up levels for the site, potential clean up alternatives and land uses.</p> <p><b>What is/were the sources of contamination? What are/were the contaminants of concern?</b></p> <p>The sources of contamination were from the refinery effluent treatment system 1963 – 1985. The contaminants of concern are petroleum hydrocarbons and some metals.</p> <p><b>Under what specific legal authority(ies) is the cleanup being performed (CERCLA/RCRA/OUST or other)?</b> This site is an inactive unit that contains hazardous waste. The No 1 Ox Pond stopped operation as a primary lagoon prior to "primary sludge" hazardous waste rules, which is at this location, was listed as a hazardous waste.</p>



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The refinery worked with USEPA and the RWQCB and DTSC) to gain permission to do a phytoremediation demonstration at the site. The process required a complex coordination of letters by USEPA to state agencies, who then gave written permission to conduct the phytoremediation study without subjecting the site to hazardous waste permit requirements. The agencies supported this effort, as the data would help provide information for making decisions on this type of application at other sites in the future.

**Briefly summarize the corrective action taken on site. If corrective action/remedy still in place please describe.**

The refinery is working with the RWQCB and DTSC to develop a voluntary corrective action plan for the site.

An evaluation was performed to assess the potential feasibility of phytoremediation at the No. 1 Ox Pond. This evaluation was based on the following steps:

1. Identify risk based screening limits for constituents in soil
2. Use site data to calculate the 95% Upper Confidence Limit (UCL) for the concentration of constituents of concern.
3. Compare the proposed limits to the 95% UCL.
4. For constituents with  $UCL > \text{risk limit}$ , calculate the extent of treatment required to meet the limit.
5. Compare the required treatment to the amount of treatment expected by the remedial alternative.

**Please describe any barriers encountered in employing remedy selected.**

One barrier encountered in the site assessment of phytoremediation was the doing the right contaminant characterization to understand the state of the contaminants present. The total hydrocarbon analysis did not give a clear picture of the degree of biodegradation that has already occurred at the site prior to starting the phytoremediation study.

The results from the first year's sampling and analysis indicated that the surface hydrocarbons were already weathered and almost completely biodegraded. Addition biodegradation in the near surface levels would be minimal by phytoremediation. The deeper layers had some biodegradation potential remaining, and as the plant roots reached the lower levels some phytoremediation would be expected.

**Describe any long term controls (e.g., institutional controls) associated with the site.**

Groundwater movement through the site is contained by a slurry water containment wall and recovers wells around the site. Migration of groundwater



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	<p>down is contained by a natural clay liner of bay mud along the bottom of No 1 Ox Pond.</p> <p>The surface of the No 1 Ox Pond is planted in grasses to control erosion and rainwater run off or migration into the sediments. The area also has restricted to the public.</p> <p>Was a closure letter obtained for the site? If so what was issued and when? If not, are you currently seeking a closure letter? No, the site is still in the process of assessing and developing a closure plan. The RTDF Phytoremediation Study is completed.</p>
<b>Reuse</b>	<p>Describe the end use of the site. What are the benefits of the end use of the site (for the community, regulatory agency, etc.)?</p> <p>The end use of the site would be added habitat of approximately 90 acres if a vegetative cap is selected as part of the closure alternative.</p> <p>What has been the added value to the site? Natural vegetation and habitat.</p>
<b>Costs and Funding</b>	<p>How was this project funded, i.e., were there any redevelopment funds or other resources used? Project funded by the refinery. A PERF agreement with other oil companies to join the RTDF Phytoremediation Study provided \$20,000 in founding.</p> <p>What was the total cost of the project? Phytoremediation study was ~ \$100,000.</p> <p>If an ecological enhancement was used in the remediation, were there cost savings associated with the selection of this remedy.</p> <p>A phytoremediation/green cap closure of the site would save ~ \$3 – 5 MM over a tradition RCRA cap.</p>
<b>Time</b>	<p>How long did it take for this project to be completed?</p> <p>3 years for the Phytoremediation Study</p> <p>If the project has not yet been completed, is there a time estimate for completion</p>
<b>Other</b>	<p>List any other information that may be of value for this case study. This can be used to insert a “lessons learned” section, or highlight other information of interest.</p> <ul style="list-style-type: none"> <li>• Proper characterization of hydrocarbons is important to assess the effectiveness of bioremediation and phytoremediation as clean up alternatives.</li> <li>• Bioremediation and phytoremediation methods are effective clean up methods if there is sufficient biodegradation potential of the remaining hydrocarbons to meet the clean up level.</li> <li>• Health plant germination and growth was seen in soils with biodegraded/weathered 1-3% TPH.</li> </ul>



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