FINDINGS OF COMPLIANCE

DREDGED MATERIAL DISPOSAL ACTIVITIES

YAQUINA BAY AND RIVER FEDERAL NAVIGATION CHANNEL

June 1980

1. Synopsis. Sediment samples were obtained for elutriate, benthos, and/or physical analyses from the Yaquina River and Bay navigation channel at river miles (RM) 0, 1.2, 1.5, 1.6, 1.7, 2.0, 2.8, 6.3, 8.6, 9.0, 11.0, 13.4, 13.8, 14.0, and from Depoe Slough at RM .25 and 1.5. Water was collected and chemically analyzed for comparison with the elutriate from Yaquina RM 14.0 and from the ocean access channel 2,000 feet seaward of the north jetty.

BACKGROUND

2. The Yaquina River outlet is located on the Oregon Coast in Lincoln County (figure 1). Yaquina Bay is the fourth largest estuary in Oregon. The river and its tributaries drain an area of 253 square miles. Riverflows are estimated to be 1,078 cfs during normal conditions.

3. The diurnal tidal range in the estuary is 7.9 feet with an extreme of 11.5 feet. Tidal influences extend up to Yaquina River mile (YRM) 26.

4. The U.S. Army Corps of Engineers is responsible for maintaining a navigation channel in Yaquina Bay, Yaquina River, and Depoe Slough. A 7,000-foot north jetty and an 8,600-foot south jetty protect the entrance channel. This channel is 40 feet deep and 400 feet wide. It narrows to 300 feet wide and 30 feet deep at YRM 2 where a turning basin 30 feet deep and 900 to 1,200 feet wide is maintained. From the turning basin (YRM 2.4), a channel 18 feet deep and 200 feet wide extends up to YRM 4. From here, a channel 150 feet wide and

10 feet deep is maintained to the end of the project at YRM 14. In addition to the main channel, there is a side channel at Depoe Slough (YRM 13.2), 200 feet wide and 10 feet deep up to Depoe Slough river mile (DSRM) 0.25.

5. Sediments deposited each year in the bay by the tributaries of Yaquina River total an estimated 30,000 to 50,000 tons.[1] Also, littoral drift enters the estuary with the tides causing shoaling in the entrance bar area. Approximately 700,000 cubic yards of sediment is dredged from the channel and turning basin up to YRM 2.4 annually with over 90 percent of this material coming from the entrance bar area. Dredging in the Yaquina River upstream of YRM 2.4 occurs no more often than once every 5 years. Hopper dredges generally perform the majority of the dredging but pipeline dredges may be used upstream of the bar area.

6. In the future, it is proposed that sediments removed from Yaquina River and Depoe Slough be deposited at designated upland disposal sites; in designated inwater disposal sites; along the sides of the navigation channel (flow lane disposal/side-casting), or in designated interim ocean disposal sites. Alternatively, dredged sediment extracted from the entrance channel may be used for beach nourishment.

7. Section 404 of the Clean Water Act, EPA guidelines (40 CFR 230), and Portland District, Corps of Engineers' guidelines specify that sediment from the dredging and disposal sites must be evaluated prior to dredging to determine if significant physical, chemical, or biological impacts will result from disposal operations. If sediment consists of fine-grained material (i.e., 20 percent by weight of particles smaller than 0.074mm in diameter) and contains more than 6 percent organic material or volatile solids, chemical data is obtained to determine if harmful levels of contaminants are present.[2]

8. Areas of particular concern in regards to disposal operations impacts are parks, national and historical monuments, national seashores, wilderness areas, research sites, municipal and private water supplies, fisheries, sanctuaries, refuges, wetlands, mudflat, recreational areas, and vegetated shallows. Also of concern are a disposal project's impacts on esthetics.

9. There are seven recognized natural areas in the Yaquina Bay watershed.[3] Five of these are located in the tributaries and sloughs associated with the river and are not affected by the navigation project. However, the Oregon State University Marine Science Center and Yaquina Bay are natural areas which overlap into the project area. In addition to these, the navigation channel is bordered by wetlands, mudflats, and marshes.[1] These areas include extensive eelgrass beds, commercial oyster rearing areas, known herring spawning areas, hardshell and softshell clams habitats, and Dungeness crab nursery areas.

10. Yaquina Bay and River are extensively used for recreational purposes. Major activities are fishing, clamming, and waterfowl hunting. River water, however, is not used by the cities of Newport or Toledo for municipal water supplies.[4]

11. Past studies have indicated that Yaquina Bay sediments are contaminated with mercury, oil and grease, and nitrogenous compounds.[1] The primary point source polluters to the bay are in the city of Newport and include fish processing industries, boat moorage areas, and municipal wastes (table 1).

12. The primary point source polluters of Yaquina River are located in the City of Toledo (table 2). Toledo is the hub of the forest and wood processing industry for the entire mid-coast basin. A study of the effects of logging on the water quality of natural waters in the Pacific Northwest indicates that current logging and log-handling practices contribute measurably to water pollution problems.[1] Sunken bark provides a food source for microorganisms and decomposition of the bark creates a demand for dissolved oxygen. The logs may also leach various organic compounds into the water further increasing oxygen demand and decreasing water quality. Above Toledo, the nearest point source polluters of consequence are in Elk City (RM 22.2) or Eddyville (RM 36.31). Since the navigation channel only extends to RM 14 and these cities are small and far upstream, impacts to sediment quality in the navigation channel from them are expected to be minimal.

13. The elutriate analyses which were performed include all significant contaminants which would normally be released by the point sources listed in tables 1 and 2.

METHODS

14. Sediment samples for elutriate tests were collected in the navigation channel at YRM 1.2, 2.8, 6.3, 8.6, 9.0, 11.0, 13.4, 13.8, and DSRM 0.25 and 1.5. These sampling sites represent areas of the river where shoaling and sedimentation occur and which are the most likely areas to be dredged. Included in the sampling were two sites (YRM 1.7 and 2.0) where sediment was collected outside the navigation channel in areas which are not dredged. Data from these sites are discussed in the report, but are not representative of Yaquina Bay dredged material.

15. When possible, sediments were sampled for chemical analyses using a 220-pound, 9-foot-long, gravity corer which was equipped to obtain 2-foot cores in detachable 2-5/8 inch diameter, acid cleaned, core liners. The core liners are made of transparent cellulose butyrate acetate and were sealed with polyethylene caps. The full core lines were stored in ice for transport to the analytical laboratory, thus providing relatively undisturbed and well preserved sediment samples.

16. The gravity corer does not operate well in coarse sands or sediments containing large amounts of wood chips or rubble. In such substrate, a Ponar grab sampler was used in place of the gravity corer (see table 3 for methodologies used at the various stations). The samples obtained with the Ponar sampler were also stored for transport to the laboratory in core liners.

17. Sediments to undergo physical and benthic analyses were also sampled with the Ponar sampler. The benthos samples were sieved through 30-mesh wire. The retained fraction was preserved with formaldehyde and stored for future analysis if such is desired. Sediments were stored in 1-quart plastic jars and sent to the Division Materials Laboratory for physical analysis.

18. The chemical analyses were performed by the U.S. Geological Survey (USGS) using the methods detailed in their publication, "Methods for Determination of Inorganic Substances in Water and Fluvial Sediments."[5] These methods were coordinated with and are approved by the U.S. Environmental Protection Agency (EPA).

19. Elutriate analyses were performed using both salt and freshwater. The saltwater was a composite water sample collected with a Van Dorn water sampler from 16-, 8-, and 1-meter depths in the middle of the navigation channel, 2,000 feet seaward of the harbor's north jetty (the ocean disposal site). The freshwater was obtained at YRM 14, approximately 100 feet from the north shore of the river with an 8-liter Van Dorn water sampler. Since the river was only 4.4 meters deep in this area, water samples were all taken at 2-meter depths rather than composited from more than one depth.

20. A Hydrolab 8000 water quality testing instrument was used to measure dissolved oxygen, pH, ORP, conductivity, and temperature at various sites in the river, bay, and ocean on 14 June 1980. On 11 June, Hydrolab measurements were made to evaluate the water quality at the two areas where water was collected.

RESULTS AND DISCUSSION

Physical Characteristics

21. The physical characteristics of Yaquina Bay, Yaquina River, and Depoe Slough sediments are presented in table 4 and figures 2 through 4. The physical analyses include density of median solids, void ratio, percent volatile solids, roundness grade, and grain size.

22. The density of median solids represents the dry weight of the sediment divided by the weight of an equal volume of water. Depoe Slough sediments were least dense with values ranging between 2,326 g/l and 2,403 g/l. Sediment density increased and was uniform between YRM 6.3 and 13.4 (2,651 to 2,672 g/l). Density was highest in the estuary from YRM 0 to 2.8 (2,667 to 2,742 g/l).

23. The void ratio measures the porosity of sediments. Depoe Slough sediments were extremely porous with void ratios between 3.56 and 8.42. The void ratios between YRM 6.3 and 13.4 were much lower (0.97 to 1.87). The porosity of the sediments decreased downstream and at YRM 0 the void ratio was 0.596.

24. The percent volatile solids represents the amount of organic material in sediments and is a rough indicator of the degree of contamination. Sediments from Yaquina Bay and Yaquina River contained between 0.5 and 3.9 percent volatile solids. Depoe Slough levels ranged from 17.5 to 25.7 percent and were three to four times greater than the 6 percent guideline stipulated by Portland District. These levels indicate that large amounts of organic material such as wood fiber, oil, or grease are present which can adversely affect water quality.

25. Depoe Slough is surrounded by paper mills, plywood mills, and lumber mills which discharge effluents into the slough. Many log rafts are moored in the area. Under these conditions, it is not surprising that values for volatile solids are high.

26. The roundness grade is a measure of sharpness of the corners of sediment particles. Angular material resists displacement and is likely to be close to its place of origin. Sediments from Depoe Slough and Yaquina River miles 6.3 through 13.8 were angular to subangular. These sediments were formed recently, were close to their point of origin, and will maintain a steeper slope than rounded material. Particles which have been transported in a riverbed are more rounded and have less resistance to displacement as was the case with sediments between YRM 0.0 and 2.8.

27. The grain size distribution curves indicate that sediment at YRM 0, 1.2, 1.7, 2.8, 9.0 contain no silt or clay and have a uniform grain size. The amount of silt and clay at other sampling locations in the river range between 2 and 16 percent, which is below the Corps' Portland District guideline of 20 percent. Depoe Slough sediments contain 27 to 83 percent silt, clay and organic material which greatly exceeds the guideline. This type of material settles slowly, has a large surface area for absorption or desorption of contaminants, and can cause excessive turbidity.

28. Sediments from the Yaquina River and Depoe Slough can be classified into three distinct categories which correspond readily to location. Depoe Slough sediments are loosely compacted, very porous, and contain high amounts of organic material, silt, and clay. If this material is dredged and discharged

at an inwater disposal site it could adversely affect water quality by causing short-term impacts of excessive turbidity, reducing light penetration, covering benthic organisms, and creating unesthetic conditions. Upland disposal of this material would remove it from the river system. However, unless the outflow was regulated, a portion of the supernatant water would flow back into the river carrying the fine-grained silt, clay, and organic material. If this material were dredged and discharged at a designated ocean disposal site, a Section 103 evaluation, as required by the Marine Protection Reserach, and Sanctuaries Act (P.L. 92-532), would be needed to assess impacts.

29. Sediments collected between YRM 6.3 and 13.4 are moderately compacted, porous, angular to subangular, contain up to 16 percent silt and clay, and 4 percent volatile solids. The physical characteristics suggest that these sediments have a minimal potential for containing excessive amounts of contaminants. Inwater or ocean disposal of these sediments would not be expected to change the sediment characteristics at the disposal site. However, the material would cover benthic organisms at the inwater disposal site.

30. Sediments collected between YRM 0.0 and 2.8 are compact, have a low porosity, are subangular to subrounded, contain no silt or clay, and less than 1.5 percent volatile solids. These sediments are very clean. Upland, beach inwater, or ocean disposal would not be expected to cause adverse impacts.

Chemical Characteristics

31. Water Quality. Water quality data (i.e., dissolved oxygen (DO), conductivity, temperature, pH, and oxidation/reduction potential) measured in Yaquina Bay, Yaquina River, Depoe Slough, and offshore are presented in table 5. Between YRM 0.0 and 14, the various parameters ranged between 13.8 to 17.2^{o} C for temperature, 7.03 to 8.01 for pH, and 7.28 to 9.33 mg/l for dissolved oxygen. The temperature and turbidity increased with distance upstream. The DO concentration, pH, and conductivity decreased with distance upstream. The DO levels were 95 percent to 100 percent of the saturation point at all locations except YRM 8.6 where it was 81 percent saturated. The

values for pH and oxygen were within the ranges specified by the guidelines and, in general, water quality was good in the Yaquina River.

32. Water quality in Depoe Slough was poor. The pH at DSRM 0.25 and DSRM 1.5 ranged between 6.54 and 6.75. A slightly acidic pH of 6.5 is the minimum value accepted by the Oregon Department of Environmental Quality.[6] The DO concentration of Depoe Slough surface water was only 59 percent saturated at DSRM 0.25 and 66 percent saturated at DSRM 1.5. Additionally, the DO concentration at a depth of 1.2 m for DSRM 0.25 was 3.58 mg/l which was only 38 percent saturated. These values were less than guideline criteria which stipulate that the DO should not be less than 90 percent of saturation or not less than 5 mg/l. A combination of factors account for these low values. Measurements were taken on a very low tide (-2.3 feet mllw) and at the beginning of summer when the amount of water in the slough was minimal. Also, the sediments contained high concentrations of organic material. The process of decomposition of organic material by bacteria requires oxygen which is depleted from the water column. However, the DO is expected to increase during flood tides when oxygenated water enters the slough.

33. The low DO and pH indicate that Depoe Slough sediment would have an adverse effect on water quality if it were removed and deposited at an inwater disposal site. Changes at the receiving site might include decreased pH and DO, changes in the population structure of benthic organisms, and increased turbidity. Removal of sediments through upland disposal would improve the water quality of the slough, providing that the overflow water at the upland Depoe Slough was closely regulated.

34. Chemical Analyses. The results of the chemical analyses for water samples collected in Yaquina Bay, Yaquina River, and Depoe Slough are presented in table 6. The results of the bulk sediment analyses are presented in table 7. The water and elutriate data are compared to EPA guidelines[7,8,9] which provide for the protection and propagation of fish and other aquatic life and for recreation in and on the water in accordance with the 1983 goals of Public Law 92-500. There are no National or State standards for bulk sediment analyses. However, Region V of the EPA established guidelines in the publication, "Guideline for Pollutional Classification of Great Lakes Harbor Sediment."[10]

35. EPA guidelines are not established for all of the substances measured. In such cases, the results are compared to guidelines established by Portland District, Corps of Engineers.[2] It should be remembered that the District and EPA guidelines are not rigid standards and are used only for purposes of comparison.

a. Yaquina Bay and River. Since there are fewer contaminants of concern in Yaquina River sediments than in Depoe Slough sediments, the two areas are discussed separately. The contaminants of concern in Yaquina Bay and River sediments are arsenic, manganese, mercury, phenols, phosphorus, and zinc.

(1) Arsenic. On the basis of the bulk sediment guidelines, sediments at YRM 2.0 are "moderately polluted" with arsenic. As previously mentioned, this sampling site is not in the Yaquina navigation channel but is discussed for completeness. Arsenic is toxic to aquatic organisms, but is not concentrated in the food chain. Compounds of arsenic are insoluable in water and are not readily released during elutriate testing. Since elutriate samples contained only trace amounts of arsenic, it can be assumed that the arsenic is tightly bound to organic and inorganic compounds which would not be released upon disposal. Normal disposal methods (i.e., inwater, flow lane, ocean, or upland) would not increase the ambient arsenic concentration at the disposal site.

(2) Manganese. The concentration of manganese in seawater eluate was very high (40 to 10,000 ug/l) compared to ocean receiving water (30 ug/l). The highest manganese concentrations were in samples collected at the upstream end of the project (YRM 13.4 and 13.8). Eluates with freshwater had relatively low manganese concentrations (40 to 194 ug/l).

Manganese is a micro-nutrient required by both plants and animals. It is highly soluble and is frequently released in significant concentrations during elutriate tests and dredging operations.[11] Manganese readily combines with oxygen to form MnO_2 which rapidly precipitates out of the water column. The tolerance levels of aquatic organisms are quite high, ranging between 1,500 and 1,000,000 ug/l. For these reasons, manganese is not considered to be a problem in freshwater. Upland, inwater, and flow lane disposal of sediments from the upper project area on the Yaquina River would cause a short-term increase in the dissolved manganese concentration considerably above ambient levels (30 ug/l). Rapid precipitation and dilution would remove manganese from the water column and adverse impacts to water quality would not result. However, manganese is concentrated by marine mollusks, such as oysters, which are reared in the Yaquina River (between YRM 6 and 8) for commercial distribution. A concentration of 100 ug/l is a guideline value suggested by the EPA to protect against a possible health hazard to humans who consume shellfish. Inwater, upland, or flow lane disposal of Yaquina River sediments would result in a short-term release of manganese well above 100 ug/l. Since many of the dredging areas are close to oyster rearing facilities it is possible that oysters could accumulate manganese. Ocean disposal of sediments from the upper project area (YRM 2.8 to 14.0) could present similar problems since the closest designated disposal site (DS) is only 2,000 feet offshore of the Yaquina Bay jetty (see figure 1).

(3) Mercury. The concentration of mercury in freshwater eluate was 0.1 ug/l at YRM 1.7, 9.0, and 11.0. This exceeded the guideline value of 0.0017 ug/l. The other eluate samples collected at the various sampling stations contained no mercury. Mercury is highly toxic and is bioaccumulated by aquatic organisms. Fish are particularly sensitive and chronic exposure to concentrations less than 1 ug/l can effect behavior or spawning ability.[9]

Although the mercury concentration exceeds guideline values at three sampling sites, there are many factors which indicate that these values are not abnormally high. The detection limit for mercury in the current study was 0.1 $\pm$ 0.05 ug/l which is higher than the guideline of .0017 ug/l for mercury. As stated in the preface to the guidelines,[8] the criteria do not take into account the technical feasibility of measuring small concentrations of the various substances, and detecting mercury below concentrations of 0.1 ug/l is not generally feasible.

The three values of 0.1 ug/l mercury, detected at YRM 1.7, 9, and 11 represent the smallest concentration that can be detected and are consistent with ambient levels measured elsewhere. STORET data,[12] maintained by the EPA shows that from 33 measurements on the Columbia River between RM 0.0 and

335.2, the mean mercury concentration was 0.18 ug/l. This suggests that the mercury concentration of Yaquina River is not unusual.

Finally, elutriate data represent the maximum concentration of dissolved mercury which might be released during disposal of dredged material. This initial concentration would be rapidly diluted to amounts below guideline values.

If material from YRM 1.7, 9.0, and 11.0 were dredged and deposited inwater, a short-term increase in the dissolved mercury levels would result and would be rapidly diluted. If dredging and disposal takes place in oyster rearing areas, there is a possibility that the oysters will concentrate dissolved mercury in their tissues. Flow lane disposal of dredged material would have a similar effect. Upland disposal would remove mercury-containing sediments from the river, but overflowing water might return dissolved mercury to the river. Ocean disposal would be the best solution and have no adverse impact because the initial concentration of mercury (0.1 to 0.2 ug/l) is well below the marine guideline value of 3.7 ug/l. Additionally, the larger dilution potential of the ocean would reduce the dissolved mercury concentration below detectable limits.

(4) Phenols. The phenolic concentration in Yaquina River seawater eluate ranged between 1 and 17 ug/l at all stations except YRM 6.3 and 11.0 where it was 195 and 172 ug/l, respectively. Similarly, the phenolic concentration in freshwater eluate varied between 1 and 51 ug/l at all stations except YRM 6.3 where it was 200 ug/l. These values exceed the 1976 EPA guidelines for phenolic compounds; however, it is unlikely that they exceed the updated 1980 EPA guidelines.[8] The analysis for phenols measures not phenol alone but a whole variety of organic compounds sometimes referred to as "phenolics." The 1980 guidelines do not contain a criterion for phenols that can be used for direct comparison. Instead, the phenols are identified separately and the toxicity of the various components range between 30 and 500,000 ug/l as is shown below.

EPA Water Quality Criteria for Various Phenolic Compounds
(Federal Register, 28 November 1980)

Phenolic	Suggested Freshwater Max. Concentration ug/l	Suggested Seawater Max. Concentration ug/l
Chlorinated Phenols	30-500,000	440 - 29,700
2-chlorophenol	4,380	---
2,4-dichlorophenol	2,020	---
2,4-dimethylphenol	2,120	---
Nitrophenols	230	4,850
Pentachlorophenol	55	53
Phenol	10,200	5,800

A comparison between the Yaquina River phenolic values and the seven separate criteria for phenols listed in the guidelines shows that the elutriate samples are much lower than the criteria. The Yaquina River phenolic values do exceed the guidelines for one chlorinated phenol at YRM 6.3 and 11.0.

The presence of high background levels of phenolic compounds in the Pacific Northwest is associated with decaying vegetation, log rafting, forest product wastes, and livestock. Phenols are highly soluble in water and in strong solutions are used as bactericides while in weaker concentrations phenols are rapidly degraded by bacteria. The process of degrading phenols uses up oxygen which can lead to anoxic conditions. The toxicity of phenols are enhanced by low dissolved oxygen concentrations, increased salinity, and high temperatures. Fish seem to be much more sensitive to phenols than other aquatic organisms. Phenols can affect fish by direct toxicity or, when present in more dilute concentrations, by imparting an objectionable odor and taste to the fish flesh.

Inwater and flow lane disposal of Yaquina River sediments would cause a short-term increase in dissolved phenols considerably above ambient levels

(1 ug/l). The phenols would rapidly be biodegraded and diluted. The former activity might slightly lower dissolved oxygen levels. If disposal operations were conducted during periods of low water flow, the combination of increased water temperatures, decreased dissolved oxygen levels, decreased dilution, and brackish water would enhance the potential toxicity of the phenols and, thus, should be avoided. Upland disposal would remove phenolic-containing sediments from the water and, if bacteria were allowed to degrade the sediment and water slurry before overflow water was returned to the river, potential adverse affects due to dissolved phenols would not occur. Ocean disposal of Yaquina River sediments would cause a short-term increase in phenolics above background levels (less than 1 ug/l) which would rapidly be diluted.

(5) Phosphorus. The concentration of phosphate phosphorous was excessive at YRM 2.0 where freshwater eluate contained 233 ug/l and seawater eluates contained 135 ug/l phosphorus. Samples were not collected in the main channel at YRM 2.0. They were collected on the extreme southern fringe of the dredging area because the channel depth was much greater than the length of the cable used to operate the sampler. Since this was the only station where phosphate phosphorus was excessive, it is probable that this sample is not characteristic of dredged sediments.

Inwater, flow lane, upland, or ocean disposal of YRM 2.0 sediment would not cause adverse, phosphate-related impacts. Phosphorous is generally the growth limiting chemical element in freshwater and releasing large amounts of it could result in water quality deterioration. However, the Yaquina River is not a freshwater system. Additionally, the amount of sediment which might be dredged at YRM 2.0 represents only a small percentage of the total dredging area.

(6) Zinc. The bulk sediment analysis shows that the concentration of zinc in sediments collected at YRM 2.0 is 7,600 mg/kg. EPA Region V guidelines suggest that sediments containing more than 200 mg/kg zinc are "heavily polluted." Zinc is an essential element required for metabolic processes by most organisms. In higher concentrations it is toxic to aquatic life. Toxicity increases with temperature and low dissolved oxygen levels.

As mentioned above, sediments collected at YRM 2 are not characteristics of the navigation channel. If Yaquina River sediment were dredged and deposited at an ocean, inwater, or upland disposal location, there would be no zinc-related adverse impacts. The concentration of zinc in freshwater and seawater eluates was very small suggesting that zinc is tightly bound to the sediments and relatively insoluble.

b. Depoe Slough. Contaminants of concern in Depoe Slough indicated by elutriate analyses are iron, manganese, and phenols. Bulk sediment analyses indicate that 10 substances are present in Depoe Slough sediments at concentrations considered moderately or heavily polluted. The large number of contaminants of concern in Depoe Slough sediments corroborate the physical and water quality data presented earlier. It should be remembered that bulk sediment analyses measure the total level of acid-digested constituents in sediment, including the chemically unavailable and minerologically bound components. However, this type of analysis is very useful in evaluating long-term impacts.

(1) Arsenic. The arsenic concentration in sediments from DSRM 0.25 was 12 mg/kg and "heavily polluted" according to guideline values. Dissolved arsenic is toxic to aquatic organisms, and oysters and other mollusks are able to concentrate arsenic if it is present in seawater. However, compounds of arsenic are insoluble in water. Since elutriate samples contained only trace quantities of arsenic, it can be assumed that arsenic is tightly bound to Depoe Slough sediment and would not be released under normal conditions. Therefore, any normal method of disposal for Depoe Slough dredged sediments would not cause arsenic-related impacts to water quality.

(2) Barium. Sediments from DSRM 0.25 contain 30 mg/kg barium and are "moderately polluted" with this element. Barium is precipitated so rapidly that it is considered insoluble and non-toxic by the EPA.[9] Additionally, very little barium was present in the freshwater and seawater eluates. Inwater, flow lane, or ocean disposal of Depoe Slough sediments would increase the barium concentration in existing disposal site sediments, but not the barium concentration in the water column. Upland disposal would improve sediment quality by removing the barium-containing material from the slough.

(3) Chromium. The amount of chromium in sediment from DSRM 0.25 is 30 mg/kg; a value considered to represent "moderately polluted" sediment. Chromium is a micro-nutrient and, in human populations, chromium deficiency is of more concern than overexposure. However, aquatic organisms are sensitive to it and toxicity varies with pH and valence. Seawater and freshwater eluates contained no dissolved chromium showing that it is tightly bound to the sediment and would not be released during disposal operations. Normal disposal methods of Depoe Slough sediment would not result in chromium-related water quality impacts.

(4) Copper. Sediment from DSRM 0.25 is "moderately polluted" with copper. Copper is commonly used in paint and wood preservatives to prevent fouling and damage caused by marine organisms. It is a micro-nutrient required by most organisms, but is toxic to aquatic life and plants in higher concentrations. Since only trace amounts of copper were present in eluate water, the copper in Depoe Slough sediment is tightly bound to the substrate and would not cause adverse impacts during disposal activities.

(5) Iron. The concentration of iron at DSRM 0.25 is 4 mg/l in the seawater eluate and .77 mg/l in the freshwater eluate. This exceeds the guideline values of 1 mg/l for iron. Additionally, the bulk sediment concentration of iron is 31 g/kg which indicates that Depoe Slough sediments are "heavily polluted" with iron. Dissolved iron is present in the water column only during anaerobic conditions. When oxygen is present iron rapidly oxidizes to form hydrous ferric oxides which precipitate out of the water column.[11] Iron is a micro-nutrient and one of the least toxic of heavy metals. However, if large amounts are released into a water system, the precipitating iron forms flocs which can coat the surface of fish gills or cover benthic invertebrates. Another effect of iron is that it is one of the few heavy metals readily taken up into the tissues of marine organisms from the surrounding sediment.[13]

Inwater disposal of Depoe Slough sediments would release large amounts of dissolved iron at an initial concentration many times greater than background levels of 20 ug/l. The iron would rapidly precipitate out of the water column which could result in the formation of detrimental iron flocs.

Inwater disposal would also increase the iron concentrations in disposal site sediments. Ocean disposal would have a similar impact, except that a much greater dilution potential exists to disperse the precipitating iron, and the ambient iron concentration (100 ug/l) is much greater than freshwater background levels. Upland disposal of Depoe Slough dredged sediments appears to be the best method. This would result in a net improvement of the Depoe Slough sediments because the iron-containing material would be removed from the river system. Additionally, the water-sediment slurry could be retained at the disposal site until the iron concentration was reduced, through precipitation, to acceptable levels.

(6) Lead. Sediment from DSRM 0.25 was "moderately polluted" with lead. Lead is a highly toxic element that accumulates in the tissues of most organisms. The toxicity varies with pH and water hardness. The seawater and freshwater eluate contained only trace amounts of lead indicating that it is tightly bound to the sediments and would not be released during disposal activities. Normal disposal methods of Depoe Slough sediment would not increase the dissolved lead concentration in disposal site receiving water. Removing the sediment (upland disposal) would improve Depoe Slough sediment quality.

(7) Manganese. The concentration of manganese in freshwater eluate from Depoe Slough RM 0.25 was 1,300 ug/l. In seawater eluate the manganese concentration was 3,600 ug/l. These values are extremely high compared to ambient levels (20 - 30 ug/l) but are not cause for concern. As discussed earlier in this report, manganese is a micro-nutrient, highly soluble in water and one of the least toxic of the elements. It rapidly precipitates to manganese oxide under aerobic conditions and is removed from the water column. Therefore, normal disposal methods (i.e., inwater, flow lane, ocean, upland) would cause a short-term increase in the dissolved water concentration which would greatly exceed background values. Precipitation and dilution would remove the manganese from the water and the initial concentration would rapidly diminish to ambient levels.

As mentioned earlier, manganese can be concentrated in the tissues of marine mollusks, such as oyster which are reared in the Yaquina River for commercial distribution. If inwater disposal takes place in the immediate vicinity of oyster rearing areas, the oysters will be exposed to high concentrations of manganese which could be taken up into their tissues. However, other types of dredging activities such as flowlane disposal or upland disposal are unlikely to adversely affect oysters because Depoe Slough is located several miles upstream of the rearing areas.

(8) Nickel. The nickel concentrations in sediment from DSRM 0.25 was 20 mg/kg which is considered "moderately polluted" by guideline standards. Nickel is soluble in water but relatively nontoxic. Only a trace amount of nickel was present in seawater eluate and no nickel was present in the freshwater eluate. This indicates that it is tightly bound to the sediment and would not be released during dredging and disposal operations. Normal disposal methods would not result in nickel-related adverse impacts.

(9) Nitrogen (Ammonia). The concentration of ammonia in sediment from DSRM 0.25 was 210 mg/kg; a value considered to represent "heavily polluted" sediment. Ammonia results from biological degradation of nitrogenous organic matter. Since sediment from Depoe Slough consists of 85 percent silt, clay, and organic matter, it is not surprising that the ammonia concentration is high. However, freshwater and seawater eluates did not exceed guideline values for dissolved ammonia indicating that it would not be released into the water column during dredging and disposal operations. Normal disposal methods would not cause adverse impacts in the water column due to a high concentration of ammonia in the sediment. Inwater disposal would increase the amount of nitrogenous material in disposal site sediments which could affect the benthic organisms. Upland disposal of Depoe Slough dredged sediment would remove ammonia-containing material and upgrade sediment quality in the navigation channel.

(10) Phenols. The phenolic concentration at DSRM 0.25 was 95 ug/l for freshwater eluate and 188 ug/l for seawater eluate. These values exceed the 1976 EPA guidelines for phenolic compounds; however, it is unlikely that they exceed the updated 1980 EPA criteria where phenols are identified

separately (see "Yaquina Bay and River" section for a discussion on phenols). As previously discussed, upland disposal would be the best method of removing phenolic-containing material because it would prevent impacts to the sediment in the river.

(11) Phosphorous. Sediment from Depoe Slough was "heavily polluted" with phosphorous. If large amounts of it were released from sediment, the resulting eutrophication could cause water quality deterioration. However, the high amount of iron in Depoe Slough sediment will effectively prevent the release of phosphorous. Under aerobic conditions, iron is released from sediment which immediately oxidize to form ferric oxides.[11] These oxides scavenge phosphorous from the water column as they precipitate out of the water column. The fact that fresh- and salt water eluates did not contain high amounts of phosphate tends to corroborate this process.

Inwater and ocean disposal of Depoe Slough sediment would increase the phosphorous concentration in disposal site sediment without affecting water quality. Upland or flow lane disposal of Depoe Slough sediments would not affect water or sediment quality.

(12) Zinc. The zinc concentration in sediments from DSRM 0.25 is 31,000 mg/kg or 3 percent of the total sample. Depoe Slough sediment contains 155 times more zinc than the guideline value of 200 mg/kg for "heavily polluted" material. It is possible that the sediment sample is atypical for zinc, but this is not supportable. The concentration of zinc at YRM 2.0 is 7,600 mg/kg indicating that elevated levels may be characteristic of the area. Zinc is an essential element for metabolic processes but is toxic to aquatic life in high concentrations.

If Depoe Slough dredged sediment were deposited at an inwater or ocean disposal location, there would be no zinc-related adverse impacts. The concentration of zinc in freshwater and seawater eluates was minimal suggesting that it is tightly bound to the sediment and insoluble. Both methods of disposal would significantly increase the amount of zinc in disposal site sediment. Upland or flow lane disposal would not add dissolved zinc to the water and would not have an impact. Upland disposal would have the advantage of removing the zinc from the dredging area which would improve the sediments.

Individually, the contaminants of concern in Depoe Slough sediments cause only minor water quality problems associated with dredging activities. When all factors (i.e., water quality data, physical characteristics, and contaminants of concern) are considered together, more serious problems present themselves. The potential for adverse impacts resulting from Depoe Slough sediment is high because there are ten elements present at concentrations considered "moderately" to "heavily" polluted. Comparatively, Yaquina River sediments contain only two of these elements. Elutriate tests show that most of the contaminants of concern in Depoe Slough are tightly bound to the sediment and would not be released during normal disposal conditions (i.e., neutral pH and saturated DO). The solubility of most of the contaminants of concern, however, are affected by pH and dissolved oxygen. A decrease in pH and/or DO shifts the equilibrium of most of these elements such that they dissolve into the water column or become more toxic to aquatic organisms. For example, the toxicity and solubility of manganese, phenolics and zinc are inversely related to the dissolved oxygen concentration. The solubility and toxicity of chromium, copper, lead, manganese, and nickel increases as the pH decreases. Iron, which is insoluble at neutral pH becomes soluble as pH decreases. This has two effects. One, iron dissolves into the water column instead of precipitating and, two, the scavenging effect whereby iron removes phosphorous from the water column is inactivated and phosphorous dissolves into the water column.

All the elements mentioned above are present in high concentrations in Depoe Slough sediment. Conditions of low pH and low dissolved oxygen are also present. At DSRM 0.25 the DO concentration was only 38 percent of saturated levels at a depth of 1.2m and 59 percent of saturation levels at a depth of 0.5m. The pH was 6.7 which is slightly acidic and very close to the minimum acceptable level of 6.5. If these sediments were disturbed during late summer when water temperatures are high and inflowing water and tidal flushing are minimal, severe water quality deterioration could result.

Other detrimental conditions exist in Depoe Slough which also affect water quality. Sediment from DSRM 0.25 consisted of 85 percent silt, clay, and organic material. The high percentage of silt and clay can cause turbidity problems during dredging operations and the high organics are responsible for the excessive concentration of ammonia in the sediments. There are polychlorinated biphenyls (PCB) present in concentrations within guideline values but in the upper 20th percentile for all sediments tested by the USGS.[14] Finally, the presence of high amounts of dissolved iron and manganese, such as occurred in the Depoe Slough eluate, is indicative of anaerobic conditions.

The evidence concerning Depoe Slough sediment indicates that the dredging and disposal of these sediments should be conducted carefully. Inwater disposal is unacceptable because high concentrations of potentially toxic material would affect disposal site sediments and benthic organisms. The fine-grained material would not settle immediately and would be distributed over a large area. Flow lane disposal would present similar problems. Ocean disposal would require a Section 103 evaluation and would involve bioassays because the predominance of silt and clay does not comply with exclusion criteria. Upland disposal in a confined disposal facility is the best alternative because it would remove Depoe Slough sediments from the water and result in a net improvement to sediment and water quality.

CONCLUSIONS

36. Sediments in the Yaquina Bay estuary between RM 0.0 and 2.8 are very clean, consisting of sand without organic material, heavy metals, or other toxic substances. The open-water disposal of this material would cause no adverse chemical impacts.

37. Sediments between YRM 6.3 and 14.0 are removed approximately every 5 years and benthic organisms have had time to re-colonize the navigation channel. These sediments contain silt, clay, and organic material. They are less compact and more porous than downstream sediments, contain significant amounts of soluble manganese and phenols, and small amounts of mercury. Extraction of this material would resuspend the fine-grained material and

increase turbidity, manganese, phenolic and mercury concentrations above ambient levels. If dredging is conducted during periods of high flow (generally October to May)[1], dilution, water currents, and biodegradation will combine to minimize impacts to water quality. Conversely, dredging during low water flow (July and August) will aggravate existing conditions (high water temperature, low D.O., low dilution potential) and reduce water quality. Dredging in the immediate vicinity of oyster rearing areas (YRM 6-8) could increase the concentration of mercury and manganese in oyster tissues.

38. Sediments in Depoe Slough contain significant amounts of insoluble heavy metals and soluble iron, manganese and phenols. Water quality is poor, particularly during low waterflows and sediments consist predominantly of fine-grained material which is loosely compacted, highly porous, and easily suspended. If dredging is not conducted carefully, short-term impacts including high turbidity, release of soluble iron, dispersal of contaminated sediments, and unesthetic water conditions will result.

39. Inwater Disposal. Currently, there are no designated inwater disposal sites at the Yaquina River or Depoe Slough. Therefore, only general impacts can be assessed.

40. Inwater disposal of sediment from YRM 0.0 to 2.8 would cover benthic organisms at the disposal site. Since this sediment is predominantly clean sand, no other adverse impacts are expected.

41. Inwater disposal of sediment between YRM 6.3 and 14.0 would cause short-term impacts of increased turbidity, release of manganese, mercury and phenols in concentrations exceeding ambient levels, and would cover benthic organisms at the disposal site. If disposal sites were located near oyster rearing areas, manganese and mercury could be concentrated in oyster tissues. Long-term impacts might include decreased sediment quality at the disposal site and downstream distribution of sediments containing manganese, mercury, and phenols.

42. Inwater disposal of Depoe Slough sediment would result in severe sediment and water quality deterioration at the disposal site. Impacts would include

excessive turbidity, unesthetic conditions, reduced light penetration, decreased DO, reduced pH, release of iron flocs, release of manganese, phenols and organic material, and significant degradation of sediment quality at the disposal site. Long-term impacts include dispersal of contaminated sediments throughout the estuary which could affect benthic organisms and other aquatic life.

43. Flow Lane Disposal. Flow lane disposal (sidecasting) of Yaquina River sediment would cause impacts similar to inwater disposal. In addition to the impacts discussed above, flow lane disposal would cover benthic communities of ecological and commercial importance.[1] Eel grass beds are present along both sides of the navigation channel up to YRM 9.0. Subtidal and intertidal clam beds extend from YRM 0.0 to 12.0, oyster beds from YRM 5 to 10, and herring spawning areas between YRM 0.0 and 12.5. Flow lane disposal would impact the benthic environment by causing turbidity, reducing light penetration, siltation of spawning areas, and releasing manganese and phenols. The degree of impact in each area of the estuary would be dependent upon current velocity, amount of sediment being dredged, the grain size of the dredged material, and the ability of the benthic communities to withstand the changes.

44. Ocean Disposal. The disposal of dredged material from YRM 0.0 through 11.0 at a designated, interim, ocean disposal site would have advantages over the disposal methods discussed above. The greater dilution potential of the ocean and mixing zones allowed by law would reduce the soluble metals to concentrations below guideline values and the insoluble metals would not affect the environment outside the disposal area. Since Yaquina River sediment is not highly porous or loosely compacted, contains less than 20 percent silt and clay, and less than 4 percent organic material, it would rapidly settle out of the water column.

45. Sediment from YRM 13.4 and 13.8 could have a negative impact at the ocean disposal site because excessive quantities of soluble manganese would be released. Disposal at the designated site 2,000 feet west of the jetty during an incoming tide might bring manganese back into the estuary. Marine mollusks would be exposed to the manganese and they could ingest and incorporate it into their tissues.

46. Depoe Slough dredged sediment could cause adverse impacts at an ocean disposal site. The high organic, silt and clay content of the sediments would cause excessive turbidity and, depending on the water currents, contaminated sediments could be transported outside the disposal area. Disposal of Depoe Slough sediment would be accompanied by the release of large quantities of iron which could precipitate to form a floc. The floc would coat areas of the benthos and have a detrimental affect on bottom-dwelling organisms. Sediments and floc could wash up on nearby shores, thus causing negative esthetic impacts.

47. Dredged material between YRM 0.0 and 2.8 meets the exclusion criteria in Section 103 of Public Law 92-532[15] and does not require any other evaluations. Dredged material between YRM 2.8 and 14.0 does not satisfy the exclusion requirements for ocean dumping and will require additional evaluation prior to the release of public notices.

48. Upland Disposal. Upland disposal of Yaquina River sediment would remove slightly contaminated material from the estuary. If water is allowed to flow back into the Yaquina River from the upland site unchecked, soluble manganese, phenols, and mercury will be released which could result in short-term impacts to aquatic life as previously discussed. If the upland outflowing water is discharged under controlled conditions, manganese will precipitate out of the water, phenols will be degraded by bacteria, and no adverse impacts will result.

49. If Depoe Slough dredged material is disposed at an upland disposal site without special facilities, several types of negative impacts could occur. Overflowing water from the disposal site would re-enter the Yaquina River or Depoe Slough. This water would contain large amounts of iron, manganese, and phenols along with a low concentration of dissolved oxygen and a low pH. This discharge would have a short-term impact on aquatic life and water quality. Fine-grained material would be suspended in the overflow and cause high turbidity, transport of contaminated material downstream, and be unsightly.

50. Long-term impacts could also result from the heavy concentration of toxic substances in the sediment. At an upland disposal site, Depoe Slough dredged

material and water would become anaerobic. This could cause some of the sediment-bound heavy metals to become soluble. Unless otherwise prevented, toxic substances could leach into the groundwater, flow through the sides of the dike, or overflow directly into the Yaquina River at Depoe Slough. Another long-term impact might result from the redistribution of Depoe Slough dredged material when the upland disposal site is no longer used. If this material was used for agricultural purposes, the high lead and manganese content could adversely affect crops. Additionally, PCB's in the sediment would be dispersed through the area.

51. Miscellaneous Impacts. Municipal water intakes for the cities of Toledo and Newport, Oregon, are not located on the Yaquina River or Depoe Slough and would not be affected by dredging activities. There are two natural wildlife areas located in the immediate vicinity of the Yaquina Bay navigation channel. These areas would not be disrupted by disposal operations. Except as noted (see 'Flowlane Disposal' Section), wetlands would not be affected by the proposed activities.

RECOMMENDATIONS

52. Yaquina River sediments between river miles 0.0 and 2.8 are very clean. The extraction and disposal of these sediments, using any appropriate method, at ocean, estuary, or upland disposal sites, would not cause significant adverse biological, chemical, or environmental impacts and would be in compliance with EPA guidelines (40 CFR, 230). This material could be used for beach nourishment. However, certain areas (i.e., YRM 1.2) contain large quantities of shell fragments.

53. Dredged sediments between YRM 2.8 and 14.0 can be discharged at an inwater disposal site. Soluble manganese in this material is relatively nontoxic and would be rapidly diluted upon disposal. Phenols and mercury would also be released but these substances are ubiquitous in Pacific Northwest sediment and water samples. Ambient concentrations commonly exceed guideline values and a study is being initiated to assess their impacts. If inwater disposal is considered, all disposal sites must be coordinated through EPA and

other resource agencies. Site inspections for wetlands, submerged vegetation, or human use characteristics should be performed at all proposed discharge areas.

54. Flow lane (sedcasting) of sediments between YRM 2.8 and 14.0 would physically impact areas of commercial and ecological concern and should not be attempted (see Flow Lane Disposal Section). Upland disposal in a diked confinement area where overflow water is discharged outside the vicinity of oyster rearing areas (YRM 6 to 8) is expected to meet compliance guidelines. Disposal at a designated, interim ocean disposal site might be the best alternative. The soluble components in the sediments would not exceed marine water quality guidelines. However, this will require a Section 103 evaluation.

55. Oyster tissue samples should be collected before and immediately following dredging operations (within 5 days) when dredging is conducted between YRM 6 and 9. The tissue samples should be obtained from commercial oyster growers in the immediate vicinity of the dredging operation, should be analyzed for mercury and manganese, and should be compared to tissues of oysters collected outside the estuary (i.e., Tillamook Bay) or oysters collected near the mouth of the Yaquina estuary. Since uptake of heavy metals by oysters can be seasonally dependent, the latter comparison is necessary to accurately assess bioaccumulation.

56. Sediments from Depoe Slough have a high potential to cause adverse sediment and water quality impacts. This material is not suitable for inwater or flowlane disposal. Ocean disposal would require a Section 103 evaluation and probably entail bioassays. Upland disposal in a confined disposal facility (CDF) would improve water and sediment quality in Depoe Slough and is the best environmental alternative. The dike and bottom of the upland site should be constructed with an impermeable clay core to prevent the leaching of toxic substances into the groundwater. The disposal site should have an adjustable weir to control the outflow, and the weir outflow rates should be monitored. A flocculant should be added to the discharging sediment and water mixture to facilitate the settling of fine-grained and organic materials. An oil boom should be placed above the discharge area to prevent flocculant and other

light weight material from passing over the weir. The discharge pipe from the dredge should be elevated to aerate the incoming dredged material. The ph, DO, and turbidity of the overflow water should be monitored. Suspended solids levels should be measured entering and leaving the disposal facility. If the pH drops below 6.5 or if the DO drops below 5.0 mg/l, supernatant water should not be discharged. Similarly, if the turbidity exceeds the ambient level by 50 JTU, the supernatant water should not be discharged. Finally, a water sample should be collected 100 feet downstream from the overflowing discharge water one week after dredging is initiated (a simple method for determining the best sampling location would be to release a small amount of dye into the discharge water). This sample should be analyzed for heavy metals to determine if they are being released into the water column.

57. The upland disposal sites for containment of Depoe Slough sediment should be surveyed before they are used to insure that historical landmarks or archeological artifacts are not present.

58. When the Depoe Slough upland disposal sites are no longer used, the dredged sediments should be capped with 3 feet of clean fill to prevent the dissemination of polluted sediment.

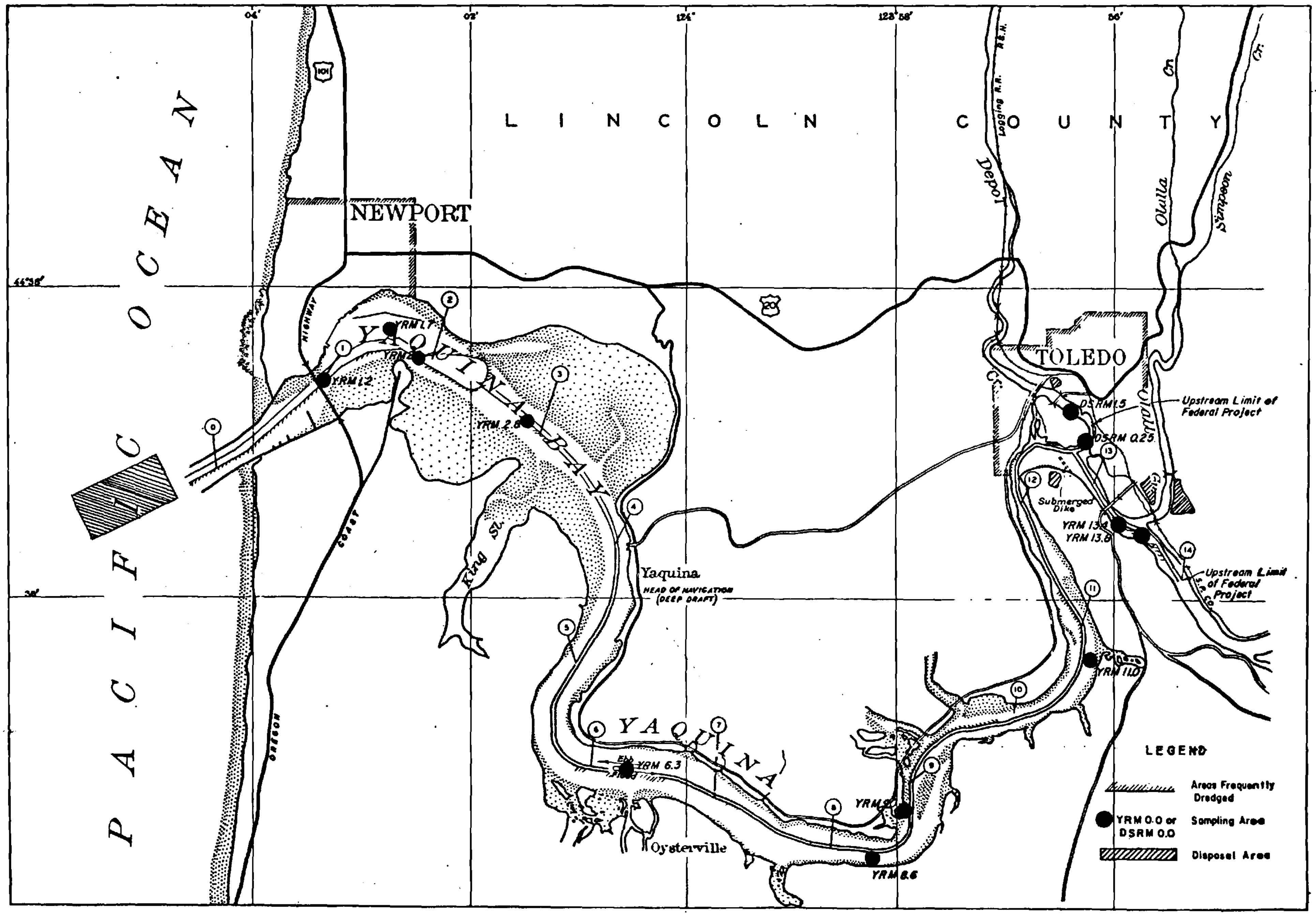
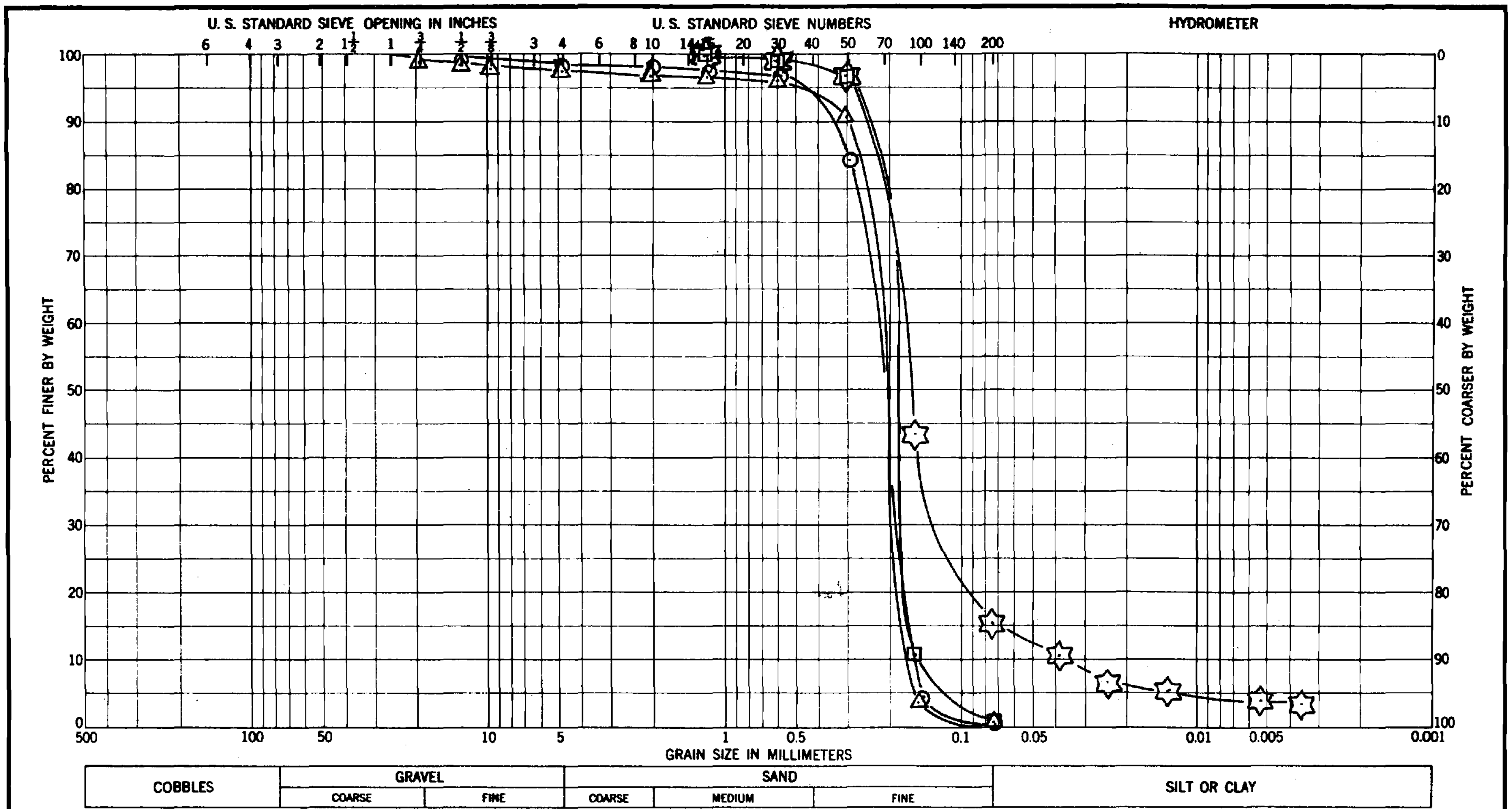


Figure 1. Map of Yaquina Bay, Yaquina River, and Depoe Slough showing sampling stations, disposal sites, and the areas most likely to require dredging.



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
△ YRM 0.0	13 Jun 80	Silty SAND (SP-SM)				
⊙ YRM 1.2	12 Jun 80	SAND (SP)				
⊡ YRM 1.7	12 Jun 80	SAND (SP)				
✡ YRM 2.0	12 Jun 80	Silty SAND (SM)				

Project RIVER SEDIMENT ANALYSIS

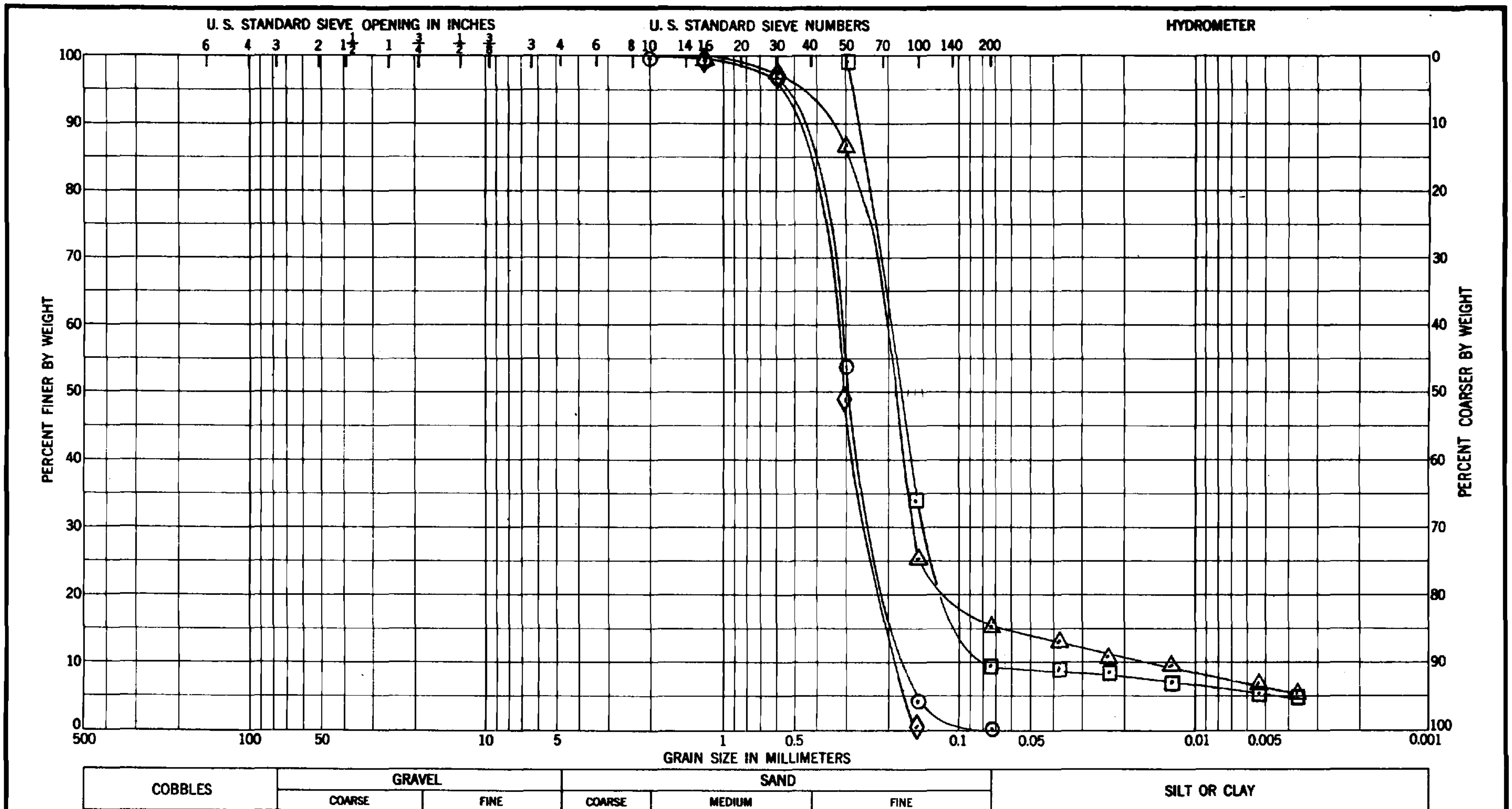
Area Yaquina River

Boring No.

Date

GRADATION CURVES

Figure 2. Gradation curves for sediment samples collected in Yaquina Bay (YRM - Yaquina River Mile).



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
⊙ YRM 2.8	12 Jun 80	SAND (SP)				
△ YRM 6.3	12 Jun 80	Silty SAND (SM)				
⊡ YRM 8.6	13 Jun 80	Silty SAND (SP-SM)				
◇ YRM 9.0	13 Jun 80	SAND (SP)				

GRADATION CURVES NPD

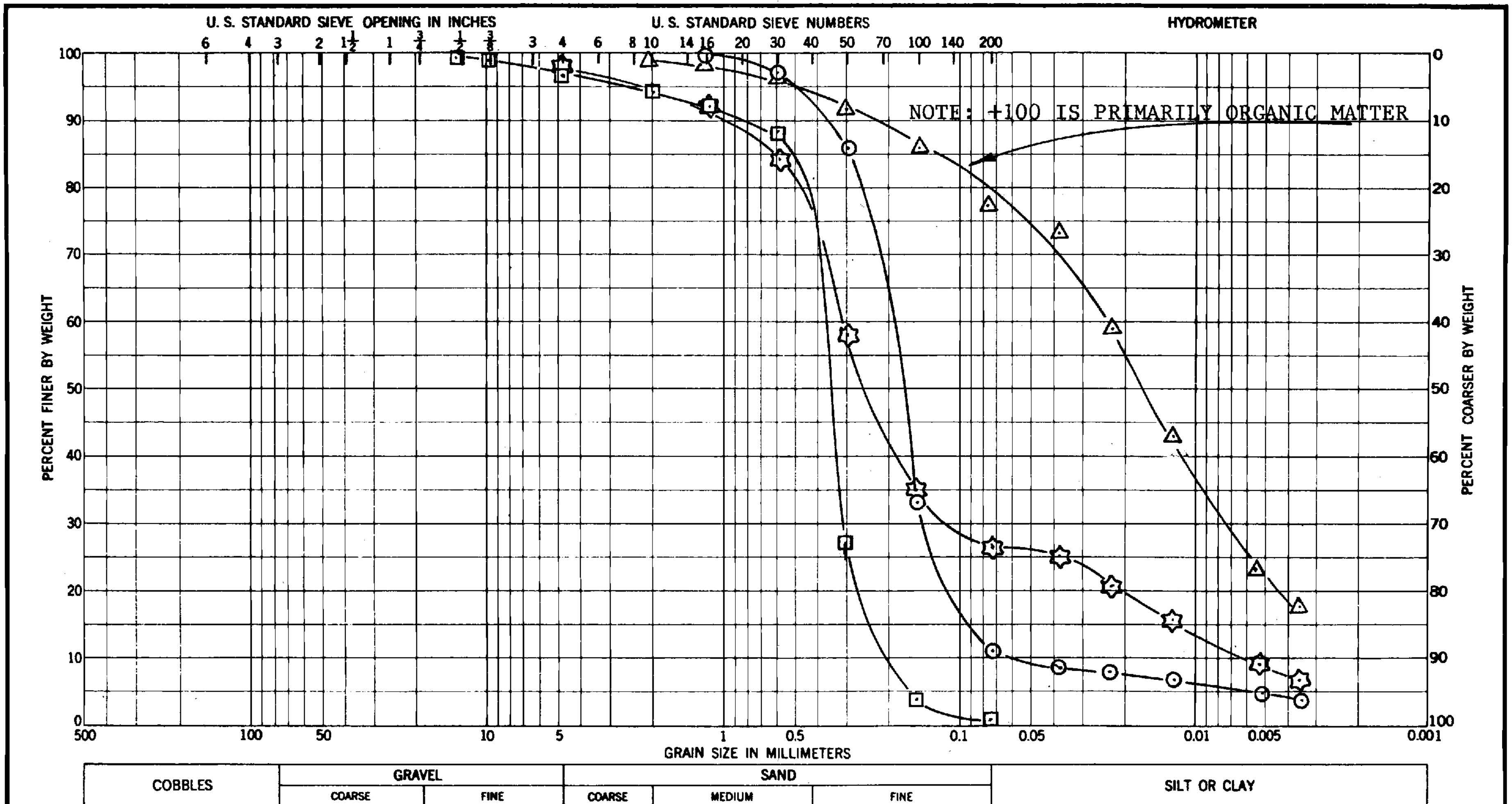
Project: RIVER SEDIMENT ANALYSIS

Area: Yaquina River

Boring No.

Date: 25 June 1980 (80-S-649)

Figure 3. Gradation curves for sediment samples collected in the Yaquina River (YRM - Yaquina River Mile).



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
⊡ YRM 11.0	11 Jun 80	SAND (SP)				
⊙ YRM 13.4	10 Jun 80	Silty SAND (SP-SM)				
△ DSRM 0.25	10 Jun 80	Organic Sandy SILT (ML)				
✡ DSRM 1.5	10 Jun 80	Organic Silty SAND (SM)				

Project RIVER SEDIMENT ANALYSIS

Area Yaquina River

Boring No.

Date

GRADATION CURVES

Figure 4. Gradation curves for sediment samples collected in the Yaquina River and Depoe Slough (YRM - Yaquina River Mile, DSRM - Depoe Slough River Mile).

TABLE 4
RIVER SEDIMENT ANALYSIS FOR YAQUINA RIVER AND DEPOE SLOUGH

Sample	Identification	Specific Gravity of Water	Density of Mat'l in place gms/liter	Density of Median Solids gms/liter	Void Ratio	Percent Volatile Solids	Percent Wtr Content in place	Roundness grade
YRM 0.0	13 Jun 80	1.000	2,045	2,667	0.596	0.97	22.3	Subangular to Subrounded
YRM 1.2	12 Jun 80	1.0146	2,023	2,719	0.690	0.53	25.8	Subangular to Subrounded
YRM 1.7	12 Jun 80	1.0146	2,040	2,742	0.684	0.60	25.3	Subangular to Subrounded
YRM 2.0	12 Jun 80	1.0146	1,805	2,710	1.144	2.64	42.8	Subangular to Subrounded
YRM 2.8	12 Jun 80	1.0146	1,980	2,716	0.762	1.51	28.5	Subangular to Subrounded
YRM 6.3	12 Jun 80	1.0135	1,585	2,669	1.896	3.85	72.0	Angular to Subangular
YRM 8.6	13 Jun 80	1.0135	1,699	2,669	1.413	2.91	53.7	Angular to Subangular
YRM 9.0	13 Jun 80	1.0135	1,837	2,672	1.013	1.56	38.4	Angular to Subangular
YRM 13.4	10 Jun 80	1.0053	1,735	2,651	1.255	3.44	47.6	Angular to Subangular
YRM 11.0	11 Jun 80	1.00	1,848	2,670	0.968	2.09	36.3	Subangular to Subrounded
DSRM 0.25	10 Jun 80	1.00	1,149	2,403	8.415	17.48	350.1	Angular to Subangular
DSRM 1.5	10 Jun 80	1.0058	1,295	2,326	3.556	25.73	153.8	Angular to Subangular

TABLE 1
PRIMARY POLLUTANT SOURCES FOR YAQUINA BAY

Newport

New England Fish Company	Fish processing
Yaquina Bay Fish Company	Fish packaging
Point Adams Packing	Crab processing
Newport Seafood Inc.	Fish processing
Bumble Bee Seafood	Fish processing
Alaska Packers Inc.	Fish packaging
Depoe Bay Fish Company	Fish processing
Mo's Newport Seafood	Fish packaging
City of Newport	Municipal wastes
Boat Moorage	
Newport News-Times	Newspaper and commercial printing

TABLE 2
PRIMARY POLLUTANT SOURCES FOR YAQUINA RIVER AND DEPOE SLOUGH

<u>Toledo</u>

Georgia-Pacific Corporation	Paperboard mill
Georgia-Pacific Corporation	Plywood sheathing & lumber
Cascadia Lumber Company	Lumber
Boat Moorage	
Toledo Shingle Company	Shingles & shakes
Guy Roberts Lumber	Sawmill/planer mill
Toledo Port Dock	
Toledo Products	Wooden pallets & fish boxes
Newport-News Publishing	Newspaper & job printing
City of Toledo	Municipal wastes

<u>Eddyville</u>

WOW Lumber Company	Lumber
Three B's Logging	Logging

TABLE 3. FIELD NOTES FOR QUINA BAY AND RIVER

Purpose of Sampling 404/103 Evaluation

Date 6/10/80 **Wind** Very slight

Water Conditions (Wave heights & Direction, Tides, Currents) Smooth

Weather Overcast, dry, app. 15^{o} air temperature **Sampling Vessel** Fort Stevens

Sampling Personnel Pam Moore, Frank Rinella, Mike Moore, Bob Christensen **Sampling Gear**

Analytical Laboratory USGS

Comments (Wildlife, Sampling Difficulties, etc.)

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
Upstream R.	**	0930		Water temperature $17^{o}C$
Depoe Slough		1030	Large corer	YRM 12.8
DSRM 0.25				Core sample for 'B' analysis at dolphin, near
				west bank, black, slightly oily, axle grease.
				Got a grain size and benthos sample with corer.
				Material appeared to be unstratified but the
				corer never went down further than 1'. Samples
				were composite. Lumber mills and log rafts all
				around. Lots of wood chips.

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)
'A' analysis is not as complete as 'B'. Benthic samples were obtained using a ponar at all stations save DSRM 0.25 and DSRM 1.5 on 6-13-80.

** Depths were taken at stations with a Hydrolab on 6-11 and 6-14.

FIELD REPORT

YAQUINA BAY AND RIVER

Purpose of Sampling 404/103 Evaluation

Date 6-10-80 Wind Very slight

Water Conditions (Wave heights & Direction, Tides, Currents) Smooth

Weather Overcast, dry, 15^{o} air temperature Sampling Vessel Fort Stevens

Sampling Personnel Pam Moore, Frank Rinella, Mike Moore, Bob Christensen Sampling Gear

Analytical Laboratory USGS

Comments (Wildlife, Sampling Difficulties, etc.)

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
Depoe Slough		1100	Large corer	Core sample for 'A' analysis. Sediment fine
DSRM 1.5				to coarse and with detritus. Composite of 5
				droppings (for chemistry). Sediment wasn't
				as 'greasy' as DSRM 0.25. 250' downstream of
				a small bridge.
YRM 13.8				200' upstream of Ollala River. 100' off west
				bank. Fine sand, uniform. Little stratification,
				small wood fiber. Lumber plant 0.2 miles upstream.
				Opposite residences. Sampled for 'A' analyses
				composite sample.

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)

DSRM = Depoe Slough River Mile
YRM = Yaquina River Mile

FIELD REPORT

YAQUINA BAY A. RIVER

Purpose of Sampling

Date 6-10-80 Wind

Water Conditions (Wave heights & Direction, Tides, Currents)

Weather Sampling Vessel

Sampling Personnel Sampling Gear

Analytical Laboratory

Comments (Wildlife, Sampling Difficulties, etc.)

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
YRM 13.4		1440	Large corer	Immediately downstream of Ollala River.
				Stratified--bottom 5" sandy muck; top 10"
				fine, clean sand. Sampled for 'A' analysis.
YRM 11.0		1530	Large corer	Sampled for 'A' analysis. ¼" silt on top, rest
				was fine sand. Lots of wood chips. Sampled
				next to log raft.
			Ponar	Grain size and benthos in mid-channel on
				6-13-80.

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)

FIELD REPORT

YAQUINA BAY AND RIVER

Purpose of Sampling Took water samples for 404/103 analyses

Date 6-11-80 Wind Slight

Water Conditions (Wave heights & Direction, Tides, Currents) Gentle 1' to 2' swells in ocean

Weather Fair Sampling Vessel Fort Stevens

Sampling Personnel Pam Moore, Frank Rinella, Mike Moore Sampling Gear

Analytical Laboratory

Comments (Wildlife, Sampling Difficulties, etc.)

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
Ocean		0900-1100	Van Dorn (black rubber connector)	Over disposal site. Midchannel 2,000' seaward of north jetty. Hydrolab data was obtained. Each cubitainer had water from 16, 8, and 1 meter depths. Maximum depth was 17 meters.
Yaquina R.		1400-1500	Van Dorn	Ollala River YRM 14.0. Off of bank 75' to 100'. Maximum depth 4.4 meters. Water samples were from 2 meters deep.

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)

FIELD REPORT

YAQUINA BAY . J RIVER

Purpose of Sampling 404/103 Evaluation

Date 6-12-80 Wind Slight

Water Conditions (Wave heights & Direction, Tides, Currents)
Overcast, dry

Weather At 0900 air temp = 18.2°C; river water = 15.6°C Sampling Vessel Fort Stevens

Sampling Personnel Pam Moore, Frank Rinella, Mike Moore Sampling Gear

Analytical Laboratory

Comments (Wildlife, Sampling Difficulties, etc.)

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
YRM 6.3		0915	Large corer	Sampled for 'A' analysis. Approximately 200' off north bank. Two core composite. Silty sand with lots of shells. 'Clean'. Grain size was taken with corer.
YRM 2.0		1230	Ponar	Water was too deep opposite McLean Point close to YRM 2.0 (mid-channel) and YRM 1.7 (100' off south bank) to sample, so did the following.
				Against dolphin at south, downstream end of turning basin. Took sample for 'B' analysis. Fine sand and mud with numerous benthic organisms. Benthos and grain size were taken in one sample and split since sampling was very difficult here.

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)

FIELD REPORT

YAQUINA BAY AND RIVER

Purpose of Sampling 404/103 Evaluation

Date 6-12-80 Wind Slight

Water Conditions (Wave heights & Direction, Tides, Currents)
Overcast, dry

Weather At 0800 air temp = 18.2°C; river temp = 15.6°C Sampling Vessel Fort Stevens

Sampling Personnel Pam Moore, Frank Rinella, Mike Moore Sampling Gear

Analytical Laboratory

Comments (Wildlife, Sampling Difficulties, etc.)

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
YRM 2.8		1430	Ponar	Sampled for 'A' analysis. Fine sand with silt. Benthos was a whole ponar sample. Grain size was taken.
YRM 1.7		1455		Sampled for 'A' analysis. 150' from breakwater, opposite Embarcadero. Shallow area. Lots of snails. Fine sand with rocks and kelp. Station was not in channel since that was too busy to sample.
YRM 2.0 *		1500	Surface	Temperature = 17.7°C DO = 9.1
In new boat launch/				
mooreage at Embarcadero		1500		Temperature = 15.1°C DO = 10.6

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)

* Data given by Frank Rinella in process of performing IOD measurements.

FIELD REPORT

YAQUINA BAY A. RIVER

Purpose of Sampling 404/103 Evaluation

Date 6-12-80 Wind Slight

Water Conditions (Wave heights & Direction, Tides, Currents)
Overcast, dry

Weather At 0900 air temp = 18.2°C; river water = 15.6°C Sampling Vessel Fort Stevens

Sampling Personnel Pam Moore, Frank Rinella, Mike Moore Sampling Gear

Analytical Laboratory

Comments (Wildlife, Sampling Difficulties, etc.)

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
YRM 1.2		1605	Ponar	Fine sand with a lot of shells sampled for analysis near Buoy 9.
YRM 1.6			Ponar	Off south bank. Lots of kelp and isopods. Discarded sample as non-representative of channel.

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)

Purpose of Sampling 404/103 Evaluation

Date 6-13-80 Wind None

Water Conditions (Wave heights & Direction, Tides, Currents) Very low tide when we started

Weather Rained; at 0845 air temp was 13°C Sampling Vessel

Sampling Personnel Sampling Gear

Analytical Laboratory

Comments (Wildlife, Sampling Difficulties, etc.)

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
YRM 0		0845	Ponar	(Tried near south jetty but got stone with very little sand.) Mid-channel was too deep and busy. Fine sand with a shrimp and some snails. Water temp = 16°C. Sampled for grain size and benthos. North side opposite entrance range (Buoy 11). Some clams in sample. Was full ponar sample.
YRM 8.6		1100	Large corer	Sample for 'A' analysis. Fine sand--one drop for core sample. Streaked with black material (but only a little).
		1300	Ponar	Full ponar benthos sample and a grain size sample.

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)

Ash fallout from Mount St. Helens eruption at 2100 on 6-12-80.

FIELD REPORT

YAQUINA BAY AI RIVER

Purpose of Sampling 404/103 Evaluation

Date 6-13-80 Wind None

Water Conditions (Wave heights & Direction, Tides, Currents) Very low tide when we started.

Weather Rained; at 0845 air temp was 13^{o}C Sampling Vessel

Sampling Personnel Sampling Gear

Analytical Laboratory

Comments (Wildlife, Sampling Difficulties, etc.)

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
YRM 9.0		1115	Large corer and ponar	Sampled for 'A' analysis. Core was full. 1/3 of a ponar sample was added to fill it. Some streaks of dark material. Some small wood particles.
YRM 14.0		1130	Ponar	Benthos--full sample. Grain size. Lots of wood and detritus.
YRM 13.8		1130	Ponar	Fine sand with some silt and detritus. Full benthos/ponar sample. Grain size was obtained.
YRM 11.0		1200	Ponar	Fine to medium sand. Different from sample obtained on 6-10-80 at side of channel. This was from mid-channel. Full ponar/benthos sample.

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)

FIELD REPORT

YAQUINA BAY AND RIVER

Purpose of Sampling 404/103 Evaluation

Date 6-13-80 Wind None

Water Conditions (Wave heights & Direction, Tides, Currents) Very low tide when we started

Weather Rained; at 0845 air temp was 13°C Sampling Vessel

Sampling Personnel Sampling Gear

Analytical Laboratory

Comments (Wildlife, Sampling Difficulties, etc.)

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
YRM 9.0		1245	Ponar	Full ponar/benthos sample and a grain size.
YRM 8.6		1300	Ponar	Grain size was 1/3 of ponar. Benthos was 2/3 of the same sample.

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)

TABLE 5 (con't)
WATER QUALITY DATA
YAQUINA RIVER AND BAY

DATE: 6-14-80

SAMPLING PERSONNEL: Pam Moore, Frank Rinella, Mike Moore, Bob Christenso

WEATHER CONDITIONS: Fair

COMMENTS: (Wildlife, vessel traffic, completion status of training jetty, sampling gear difficulties, sampling vessel, etc.) DO would calibrate only to 8.52, not 8.99.

Parameter	**Station**								
	YRM 2.0	YRM 2.0	YRM 1.5	Ocean	YRM 1.1 Mouth	YRM 1.1	YRM 1.3	YRM 2.2	YRM 2.2
Depth	10.4	.6	.6	1.2	8.9	.4		Surface	Bottom
Dissolved Oxygen	13.85	10.22	14.02	15.58	11.01	8.89	--	--	--
Conductivity	.470	.424	.479	.487	.486	.468	--	--	--
Salinity	--	--	--	--	--	--	--	--	--
ORP	417+	412+	395	386 (steady)	378	341	--	--	--
Temperature	14.0	15.4	13.8	13.5	13.5	14.1	--	--	--
pH	7.94	7.83	8.01	8.18	8.04	8.05	--	--	--
Turbidity*					5.0		11.0	6.5	9.89
Time	1026			1050	1102	1115			

YRM 2.2 = Off McLean Point (cement barge)
YRM 1.1 Mouth = Inside new boat basin approximately 200'
YRM 1.1 = At far southeast corner

* Turbidity measurements were made approximately 2 days after collection on chilled samples.

TABLE 5

WATER QUALITY DATA

YAQUINA RIVER, YAQUINA BAY, AND DEPOE SLOUGH

DATE: 6-11-80

SAMPLING PERSONNEL: Pam Moore, Frank Rinella, Mike Moore, Bob Christenson

WEATHER CONDITIONS: 0530 Yaquina Bay Coast Guard - Bar 773, 53°, 59° sea temperature

COMMENTS: (Wildlife, vessel traffic, completion status of training jetty, sampling gear difficulties, sampling vessel, etc.) DO probe would calibrate only to 8.55, not 9.03. Conductivity (.256) standard read .255.

Parameter	Station							
	Ocean			Yaquina RM 14		Yaquina RM 11		
Depth	15.4	8.2	Surface	3.1	Surface	3.2	Surface	1.8
Dissolved Oxygen	15.4	13.91	12.42	8.92	9.14	10.10	9.33	7.15
Conductivity	.512	.503	.408	.191	.178	.234	.218	.117
Salinity	--	--	--	--	--	--	--	--
ORP	541	523	492	350	343	345	336	542+
Temperature	12.1	12.6	14.4	17.0	17.2	16.9	17.0	16.0
pH	8.19	8.23	8.22	7.37	7.49	7.45	7.54	6.92
Turbidity			1.2		20.0		30.0	30.0
Time	0903			1425	1430	1540	1548	0831

Ocean disposal site = 2,000' seaward of north jetty light. From this point, 1,000' south and 3,000' seaward

RM = River mile

TABLE 5 (con't)
WATER QUALITY DATA
YAQUINA RIVER AND BAY

DATE: 6-14-80 **SAMPLING PERSONNEL:** Pam Moore, Mike Moore, Frank Rihella, Bob Christenson

WEATHER CONDITIONS: Bar 775.2, air temperature 53°, water temperature 55° (0556), 0820 low tide -2.3'

COMMENTS: **(Wildlife, vessel traffic, completion status of training jetty, sampling gear difficulties, sampling vessel, etc.)** DO would calibrate only to 8.52, not 8.97. Conductivity (.256) standard read .253. Depth at surface was .1. ORP kept dropping.

Parameter	Station							
	DSRM 1.5	DSRM .25	DSRM .25	YRM 9	YRM 8.6	YRM 6.3	YRM 2.3	YRM 2.3
Depth	.8	1.2	.5	1.9	.6	.7	2.4	.5
Dissolved Oxygen	6.94	3.58	6.24	8.19	7.28	7.70	10.93	8.93
Conductivity	.036	.136	.130	.168	.188	.265	.432	.413
Salinity	--	--	--	--	--	--	--	--
ORP	578	510	484	542+	474+	488+	457+	450+
Temperature	13.8	15.8	15.8	16.4	16.4	16.4	15.1	15.4
pH	6.54	6.77	6.75	7.03	7.11	7.33	7.83	7.79
Turbidity	50.0		17.0	37.0	28.0		7.0	
Time	0805	0812	0815	0847	0855	0909	0925	0921
	Cond. at bottom was .074			Cond. at bottom was .169	Cond. was .189 at bottom	Cond. was .274 at bottom	Cond. was .454	

Table 6a. Results of freshwater elutriate tests from sediments collected in the Yaquina River and Depoe Slough (YRM - Yaquina River Mile, DSRM - Depoe Slough River Mile).

PARAMETERS	YRM 14.0 (RECEIVING WATER)	YRM 1.7 RIVER ELUATE	YRM 2.0 RIVER ELUATE	YRM 2.8 RIVER ELUATE	YRM 6.3 RIVER ELUATE	YRM 8.6 RIVER ELUATE	YRM 9.0 RIVER ELUATE	YRM 11.0 RIVER ELUATE	DSRM 0.25 RIVER ELUATE	DSRM 1.5 RIVER ELUATE	FRESH-WATER GUIDE-LINES
ARSENIC, UG/L	0		5						2		440
BARIUM, UG/L	0		0						100		1,000
BERYLLIUM, UG/L	0		0						0		130
CADMIUM, UG/L	.11	.41	.41	.05	.25	.18	.14	.08	.15	.06	1.5
CARBON, ORGANIC MG/L	4.5	6.9	15	11	27	5.3	3.4	5.9	12	8.7	
CHROMIUM, UG/L		0			0	0	0	0		0	2,200
COPPER, UG/L	3	2	1	4	6	1	2	0	3	2	12
CYANIDE, UG/L	1		2						2		52
IRON, UG/L	20	40	40	60	40	50	40	40	770	70	1,000
LEAD, UG/L	0	2	0	0	0	0	2	0	3	0	74
MANGANESE, UG/L	20	60	40	180	160	80	110	194	1300	410	
MERCURY, UG/L	0	.1	0	0	0	0	.1	.1	0	0	.0017
NICKEL, UG/L	2		2						2		1,100
NITROGEN, AMMONIA MG/L	.08	1.7	1.8	2.3	5.3	.54	.3	.9	12	.98	.02
NITROGEN, ORGANIC MG/L	.42		1.8						1.9		
PHENOLS, UG/L	0	42	51	0	200	11	1	0	95	1	
PHOSPHORUS, TOTAL UG/L	30		233						38		
ORTHOPHOSPHATE,UG/L	22	116	76	16	87	9	8	43	18	22	
ZINC, UG/L	3.3	1.8	5.4	2.6	1.7	3.5	3.5	1.17	4.1	1.3	180
ALDRIN, UG/L	0		0						0		3
AMETRYNE, UG/L	0		0						0		
ATRATONE	0		0						0		
ATRAZINE, UG/L	0		0						0		
CHLORDANE, UG/L	0		0						0		2.4
CYPRAZINE, UG/L	0		0						0		
DDD, UG/L	0		0						0		
DDE, UG/L	0		0						0		1,050
DDT, UG/L	0		0						0		1.1
DIELDRIN, UG/L	0		0						0		2.5
ENDOSULFAN, UG/L	0		0						0		.22
ENDRIN, UG/L	0		0						0		.18
HEPT EPOX, UG/L	0		0						0		
HEPTACHLOR, UG/L	0		0						0		.5
LINDANE, UG/L	0		0						0		2
METHOXYCHLOR, UG/L	0		0						0		.03
MIREX, UG/L	0		0						0		.001
PCB, UG/L	0		0						0		2
PCN, UG/L	0		0						0		
PERTHANE, UG/L	0		0						0		
PROMETONE, UG/L	0		0						0		
PROMETRYNE, UG/L	0		0						0		
PROPAZINE, UG/L	0		0						0		
SIMAZINE, UG/L	0		0						0		
SIMETONE,UG/L	0		0						0		
SIMETRYNE, UG/L	0		0						0		
SILVEX, UG/L	0		0						0		10
TOXAPHENE, UG/L	0		0						0		1.6
2,4-D, UG/L			0						.04		100
2,4-DP, UG/L	0		0						0		
2,4,5-T, UG/L	0		0						0		

Table 6b. Results of saltwater elutriate tests from sediments collected in the Yaquina River and Depoe Slough (YRM - Yaquina River Mile, DSRM - Depoe Slough River Mile).

PARAMETERS	OCEAN RECEIVING WATER	YRM 1.2 OCEAN ELUATE	YRM 1.7 OCEAN ELUATE	YRM 2.0 OCEAN ELUATE	YRM 2.8 OCEAN ELUATE	YRM 6.3 OCEAN ELUATE	YRM 8.6 OCEAN ELUATE	YRM 9.0 OCEAN ELUATE	YRM 11.0 OCEAN ELUATE	YRM 13.4 OCEAN ELUATE	YRM 13.8 OCEAN ELUATE	DSRM .25 OCEAN ELUATE	DSRM 1.5 OCEAN ELUATE	MARINE GUIDE-LINE
ARSENIC, UG/L	1			4								4		508
BARIUM, UG/L				100								500		
BERYLLIUM, UG/L				10								0	.01	
CADMIUM, UG/L	1.3	.88	.09	.12	.32	.01	.08	.11	.05	.01	.26	.47	.01	59
CARBON, ORGANIC MG/L	6.4	3.7	3.2	7.4	10	19	4	3	4.5	5.6	.5	14	6.3	
CHROMIUM, UG/L		0	0		0		0	0	0.	0	0	0	0	44
COPPER, UG/L	2	1	1	3	3	2	3	2	4	11	1	2	0	
CYANIDE, UG/L	1			2								2		30
IRON, UG/L	100	120	120	130	160	110	120	110	126	110	143	4000	120	
LEAD, UG/L	2	0	0	0	0	1	1	0	0	0	0	2	0	668
MANGANESE, UG/L	30	40	140	90	380	410	200	230	485	10000	5500	3600	630	
MERCURY, UG/L	0	0	0	0	.2	.2	0	0	0	.1	0	.2	0	3.7
NICKEL, UG/L	0			4								3		140
NITROGEN, AMMONIA MG/L	.13	1.8	1.1	2.1	2.4	6.8	.53	.49	1.3	5.8	1.7	18	1.8	
NITROGEN, ORGANIC MG/L	.32			1.3								0	23	
PHENOLS, UG/L	0	9	0	12	7	195	10	17	172	1	0	188	23	
PHOSPHORUS, TOTAL UG/L	33			135								63		
ORTHOPHOSPHATE,UG/L	14	19	64	77	19	67	8	12	38	26	28	19	13	
ZINC, UG/L	11	1.8	1.2	0	3.4	5.4	8.3	4.8	2.72	2.7	2.53	12	3.7	170
ALDRIN, UG/L	0			0					0		3	0		1.3
AMETRYNE, UG/L	0			0					0			0		
ATRATONE,UG/L	0			0					0			0		
ATRAZINE, UG/L	0			0					0			0		
CHLORDANE, UG/L	0			0								0		.09
CYANAZINE, UG/L	0			0					0			0		
DDD, UG/L	0			0					0			0		
DDE, UG/L	0			0					0			0		14
DDT, UG/L	0			0								0		.13
DIELDRIN, UG/L	0			0					0		1.1	0		.71
ENDOSULFAN, UG/L	0			0					0		2.5	0		.034
ENDRIN, UG/L	0			0					0		.22	0		.037
HEPT EPOX, UG/L	0			0								0		
HEPTACHLOR, UG/L	0			0					0			0		.053
LINDANE, UG/L	0			0					0		.5	0		.004
METHOXYCHLOR, UG/L	0			0					0		2	0		.03
MIREX, UG/L	0			0								0		.001
PCB, UG/L	0			0					0		.001	0		10
PCN, UG/L	0			0					0		2	0		
PERTHANE, UG/L	0			0					0			0		
PROMETONE, UG/L	0			0								0		
PROMETRYNE, UG/L	0			0					0			0		
PROPAZINE, UG/L	0			0					0			0		
SIMAZINE, UG/L	0			0					0			0		
SIMETONE,UG/L	0			0								0		
SIMETRYNE, UG/L	0			0					0			0		
SILVEX, UG/L	0			0					0			0		10
TOXAPHENE, UG/L	0			0					0		10	0		.07
2,4-D, UG/L	0			0								0		100
2,4-DP, UG/L	.01			0					.04		100	0		
2,4,5-T, UG/L	0			0					0			0		

TABLE 7

Results of Bulk Sediment Analyses from Samples Collected at Yaquina River and Depoe Slough

LOCATION

PARAMETERS	Yaquina River RM 2.0	Depoe Slough RM .25	EPA Region V Guidelines
Aldrin (ug/kg) ppb	~~0.0~~ <0.1	~~0.0~~ <0.1	--
Arsenic (mg/kg)	6	12	>8 HP
Barium (mg/kg)	10	30	20-60 MP
Beryllium (mg/kg)	2	5	0
Cadmium (mg/kg)	1	1	>6 HP
Carbon Inorg. (g/kg)	1.2	0.4	--
Carbon Org. (g/kg)	6.6	77	--
Chlordane (~~mg/kg~~) ug/kg	~~0~~ <1	~~0~~ <1	--
Chromium (mg/kg)	10	30	25-75 MP
Copper (mg/kg)	8	39	25-50 MP
Cyanide (mg/kg)	0	0	.10-.25 MP
DDD (ug/kg)	~~0~~ <0.1	~~0.0~~ <0.1	--
DDE (ug/kg)	~~0.0~~ <0.1	0.0 <0.1	--
DDT (ug/kg)	~~0.0~~ <0.1	0.0 <0.1	--
Dieldrin (ug/kg)	~~0.0~~ <0.1	0.5	--
Endosulfan (ug/kg)	~~0.0~~ <0.1	~~0.0~~ <0.1	--
Endrin (ug/kg)	~~0.0~~ <0.1	~~0.0~~ <0.1	--
Hept Epox (ug/kg)	~~0.0~~ <0.1	~~0.0~~ <0.1	--
Heptachlor (ug/kg)	~~0.0~~ <0.1	~~0.0~~ <0.1	--
Iron (mg/kg)	7,200	31,000	>25,000 HP
Lead (mg/kg)	10	40	40-60 MP
Lindane (ug/kg)	~~0.0~~ <0.1	~~0.0~~ <0.1	--
Manganese (mg/kg)	50	270	300-500 MP
Mercury (mg/kg)	0.02	0.03	>1 HP
Mirex (ug/kg)	~~0.0~~ <0.1	~~0.0~~ <0.1	--
Mthxyclr. (ug/kg)	~~0.0~~ <0.1	~~0.0~~ <0.1	--
Nickel (~~ug/kg~~) mg/kg	10	20	20-50 MP
NH_4 + NH_3 (mg/kg)	36	210	>200 HP
Nitrogen Organic (mg/kg)	530	1,090	--
PCB (ug/kg)	26	34	>10,000 HP
PCN (ug/kg)	~~0.0~~ <1	<1	--
Perthane (ug/kg)	~~0.0~~ <0.1	~~0.0~~ <0.1	--
Phosph. Tot-P (mg/kg)	250	890	>650 HP
Silvex (ug/kg)	~~0~~ <0.1	~~0~~ <0.1	--
Toxaphene (ug/kg)	~~0~~ <1 *	~~0~~ <1 *	--
Zinc (mg/kg)	~~7,600~~ 40	~~31,000~~ 120	>200 HP
2,4-D (ug/kg)	~~0~~ <0.1	~~0~~ <0.1	--
2,4-DP (ug/kg)	~~0~~ <0.1	~~0~~ <0.1	--
2,4,5-T (ug/kg)	~~0~~ <0.1	~~0~~ <0.1	--

* corrected after phone call to Greg Fuhrer, USGS who informed me that those values for zinc were in error. All other changes made in this table are from tables 24E and 24F, p 129-130, USGS Openfile Report 82-922.

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NANCY

FINDINGS OF COMPLIANCE
DREDGED MATERIAL DISPOSAL ACTIVITIES

YAQUINA BAY AND RIVER FEDERAL NAVIGATION CHANNEL

June 1980

1. Synopsis. Sediment samples were obtained for elutriate, benthos, and/or physical analyses from the Yaquina River and Bay navigation channel at river miles (RM) 0, 1.2, 1.5, 1.6, 1.7, 2.0, 2.8, 6.3, 8.6, 9.0, 11.0, 13.4, 13.8, 14.0, and from Depoe Slough at RM .25 and 1.5. Water was collected and chemically analyzed for comparison with the elutriate from Yaquina RM 14.0 and from the ocean access channel 2,000 feet seaward of the north jetty.

BACKGROUND

2. The Yaquina River outlet is located on the Oregon Coast in Lincoln County (figure 1). Yaquina Bay is the fourth largest estuary in Oregon. The river and its tributaries drain an area of 253 square miles. Riverflows are estimated to be 1,078 cfs during normal conditions.

3. The diurnal tidal range in the estuary is 7.9 feet with an extreme of 11.5 feet. Tidal influences extend up to Yaquina River mile (YRM) 26.

4. The U.S. Army Corps of Engineers is responsible for maintaining a navigation channel in Yaquina Bay, Yaquina River, and Depoe Slough. A 7,000-foot north jetty and an 8,600-foot south jetty protect the entrance channel. This channel is 40 feet deep and 400 feet wide. It narrows to 300 feet wide and 30 feet deep at YRM 2 where a turning basin 30 feet deep and 900 to 1,200 feet wide is maintained. From the turning basin (YRM 2.4), a channel 18 feet deep and 200 feet wide extends up to YRM 4. From here, a channel 150 feet wide and

10 feet deep is maintained to the end of the project at YRM 14. In addition to the main channel, there is a side channel at Depoe Slough (YRM 13.2), 200 feet wide and 10 feet deep up to Depoe Slough river mile (DSRM) 0.25.

5. Sediments deposited each year in the bay by the tributaries of Yaquina River total an estimated 30,000 to 50,000 tons.[1] Also, littoral drift enters the estuary with the tides causing shoaling in the entrance bar area. Approximately 700,000 cubic yards of sediment is dredged from the channel and turning basin up to YRM 2.4 annually with over 90 percent of this material coming from the entrance bar area. Dredging in the Yaquina River upstream of YRM 2.4 occurs no more often than once every 5 years. Hopper dredges generally perform the majority of the dredging but pipeline dredges may be used upstream of the bar area.

6. In the future, it is proposed that sediments removed from Yaquina River and Depoe Slough be deposited at designated upland disposal sites; in designated inwater disposal sites; along the sides of the navigation channel (flow lane disposal/side-casting), or in designated interim ocean disposal sites. Alternatively, dredged sediment extracted from the entrance channel may be used for beach nourishment.

7. Section 404 of the Clean Water Act, EPA guidelines (40 CFR 230), and Portland District, Corps of Engineers' guidelines specify that sediment from the dredging and disposal sites must be evaluated prior to dredging to determine if significant physical, chemical, or biological impacts will result from disposal operations. If sediment consists of fine-grained material (i.e., 20 percent by weight of particles smaller than 0.074mm in diameter) and contains more than 6 percent organic material or volatile solids, chemical data is obtained to determine if harmful levels of contaminants are present.[2]

8. Areas of particular concern in regards to disposal operations impacts are parks, national and historical monuments, national seashores, wilderness areas, research sites, municipal and private water supplies, fisheries, sanctuaries, refuges, wetlands, mudflat, recreational areas, and vegetated shallows. Also of concern are a disposal project's impacts on esthetics.

9. There are seven recognized natural areas in the Yaquina Bay watershed.[3] Five of these are located in the tributaries and sloughs associated with the river and are not affected by the navigation project. However, the Oregon State University Marine Science Center and Yaquina Bay are natural areas which overlap into the project area. In addition to these, the navigation channel is bordered by wetlands, mudflats, and marshes.[1] These areas include extensive eelgrass beds, commercial oyster rearing areas, known herring spawning areas, hardshell and softshell clams habitats, and Dungeness crab nursery areas.

10. Yaquina Bay and River are extensively used for recreational purposes. Major activities are fishing, clamming, and waterfowl hunting. River water, however, is not used by the cities of Newport or Toledo for municipal water supplies.[4]

11. Past studies have indicated that Yaquina Bay sediments are contaminated with mercury, oil and grease, and nitrogenous compounds.[1] The primary point source polluters to the bay are in the city of Newport and include fish processing industries, boat moorage areas, and municipal wastes (table 1).

12. The primary point source polluters of Yaquina River are located in the City of Toledo (table 2). Toledo is the hub of the forest and wood processing industry for the entire mid-coast basin. A study of the effects of logging on the water quality of natural waters in the Pacific Northwest indicates that current logging and log-handling practices contribute measurably to water pollution problems.[1] Sunken bark provides a food source for microorganisms and decomposition of the bark creates a demand for dissolved oxygen. The logs may also leach various organic compounds into the water further increasing oxygen demand and decreasing water quality. Above Toledo, the nearest point source polluters of consequence are in Elk City (RM 22.2) or Eddyville (RM 36.31). Since the navigation channel only extends to RM 14 and these cities are small and far upstream, impacts to sediment quality in the navigation channel from them are expected to be minimal.

13. The elutriate analyses which were performed include all significant contaminants which would normally be released by the point sources listed in tables 1 and 2.

METHODS

14. Sediment samples for elutriate tests were collected in the navigation channel at YRM 1.2, 2.8, 6.3, 8.6, 9.0, 11.0, 13.4, 13.8, and DSRM 0.25 and 1.5. These sampling sites represent areas of the river where shoaling and sedimentation occur and which are the most likely areas to be dredged. Included in the sampling were two sites (YRM 1.7 and 2.0) where sediment was collected outside the navigation channel in areas which are not dredged. Data from these sites are discussed in the report, but are not representative of Yaquina Bay dredged material.

15. When possible, sediments were sampled for chemical analyses using a 220-pound, 9-foot-long, gravity corer which was equipped to obtain 2-foot cores in detachable 2-5/8 inch diameter, acid cleaned, core liners. The core liners are made of transparent cellulose butyrate acetate and were sealed with polyethylene caps. The full core lines were stored in ice for transport to the analytical laboratory, thus providing relatively undisturbed and well preserved sediment samples.

16. The gravity corer does not operate well in coarse sands or sediments containing large amounts of wood chips or rubble. In such substrate, a Ponar grab sampler was used in place of the gravity corer (see table 3 for methodologies used at the various stations). The samples obtained with the Ponar sampler were also stored for transport to the laboratory in core liners.

17. Sediments to undergo physical and benthic analyses were also sampled with the Ponar sampler. The benthos samples were sieved through 30-mesh wire. The retained fraction was preserved with formaldehyde and stored for future analysis if such is desired. Sediments were stored in 1-quart plastic jars and sent to the Division Materials Laboratory for physical analysis.

18. The chemical analyses were performed by the U.S. Geological Survey (USGS) using the methods detailed in their publication, "Methods for Determination of Inorganic Substances in Water and Fluvial Sediments."[5] These methods were coordinated with and are approved by the U.S. Environmental Protection Agency (EPA).

19. Elutriate analyses were performed using both salt and freshwater. The saltwater was a composite water sample collected with a Van Dorn water sampler from 16-, 8-, and 1-meter depths in the middle of the navigation channel, 2,000 feet seaward of the harbor's north jetty (the ocean disposal site). The freshwater was obtained at YRM 14, approximately 100 feet from the north shore of the river with an 8-liter Van Dorn water sampler. Since the river was only 4.4 meters deep in this area, water samples were all taken at 2-meter depths rather than composited from more than one depth.

20. A Hydrolab 8000 water quality testing instrument was used to measure dissolved oxygen, pH, ORP, conductivity, and temperature at various sites in the river, bay, and ocean on 14 June 1980. On 11 June, Hydrolab measurements were made to evaluate the water quality at the two areas where water was collected.

RESULTS AND DISCUSSION

Physical Characteristics

21. The physical characteristics of Yaquina Bay, Yaquina River, and Depoe Slough sediments are presented in table 4 and figures 2 through 4. The physical analyses include density of median solids, void ratio, percent volatile solids, roundness grade, and grain size.

22. The density of median solids represents the dry weight of the sediment divided by the weight of an equal volume of water. Depoe Slough sediments were least dense with values ranging between 2,326 g/l and 2,403 g/l. Sediment density increased and was uniform between YRM 6.3 and 13.4 (2,651 to 2,672 g/l). Density was highest in the estuary from YRM 0 to 2.8 (2,667 to 2,742 g/l).

23. The void ratio measures the porosity of sediments. Depoe Slough sediments were extremely porous with void ratios between 3.56 and 8.42. The void ratios between YRM 6.3 and 13.4 were much lower (0.97 to 1.87). The porosity of the sediments decreased downstream and at YRM 0 the void ratio was 0.596.

24. The percent volatile solids represents the amount of organic material in sediments and is a rough indicator of the degree of contamination. Sediments from Yaquina Bay and Yaquina River contained between 0.5 and 3.9 percent volatile solids. Depoe Slough levels ranged from 17.5 to 25.7 percent and were three to four times greater than the 6 percent guideline stipulated by Portland District. These levels indicate that large amounts of organic material such as wood fiber, oil, or grease are present which can adversely affect water quality.

25. Depoe Slough is surrounded by paper mills, plywood mills, and lumber mills which discharge effluents into the slough. Many log rafts are moored in the area. Under these conditions, it is not surprising that values for volatile solids are high.

26. The roundness grade is a measure of sharpness of the corners of sediment particles. Angular material resists displacement and is likely to be close to its place of origin. Sediments from Depoe Slough and Yaquina River miles 6.3 through 13.8 were angular to subangular. These sediments were formed recently, were close to their point of origin, and will maintain a steeper slope than rounded material. Particles which have been transported in a riverbed are more rounded and have less resistance to displacement as was the case with sediments between YRM 0.0 and 2.8.

27. The grain size distribution curves indicate that sediment at YRM 0, 1.2, 1.7, 2.8, 9.0 contain no silt or clay and have a uniform grain size. The amount of silt and clay at other sampling locations in the river range between 2 and 16 percent, which is below the Corps' Portland District guideline of 20 percent. Depoe Slough sediments contain 27 to 83 percent silt, clay and organic material which greatly exceeds the guideline. This type of material settles slowly, has a large surface area for absorption or desorption of contaminants, and can cause excessive turbidity.

28. Sediments from the Yaquina River and Depoe Slough can be classified into three distinct categories which correspond readily to location. Depoe Slough sediments are loosely compacted, very porous, and contain high amounts of organic material, silt, and clay. If this material is dredged and discharged

at an inwater disposal site it could adversely affect water quality by causing short-term impacts of excessive turbidity, reducing light penetration, covering benthic organisms, and creating unesthetic conditions. Upland disposal of this material would remove it from the river system. However, unless the outflow was regulated, a portion of the supernatant water would flow back into the river carrying the fine-grained silt, clay, and organic material. If this material were dredged and discharged at a designated ocean disposal site, a Section 103 evaluation, as required by the Marine Protection Reserach, and Sanctuaries Act (P.L. 92-532), would be needed to assess impacts.

29. Sediments collected between YRM 6.3 and 13.4 are moderately compacted, porous, angular to subangular, contain up to 16 percent silt and clay, and 4 percent volatile solids. The physical characteristics suggest that these sediments have a minimal potential for containing excessive amounts of contaminants. Inwater or ocean disposal of these sediments would not be expected to change the sediment characteristics at the disposal site. However, the material would cover benthic organisms at the inwater disposal site.

30. Sediments collected between YRM 0.0 and 2.8 are compact, have a low porosity, are subangular to subrounded, contain no silt or clay, and less than 1.5 percent volatile solids. These sediments are very clean. Upland, beach inwater, or ocean disposal would not be expected to cause adverse impacts.

Chemical Characteristics

31. Water Quality. Water quality data (i.e., dissolved oxygen (DO), conductivity, temperature, pH, and oxidation/reduction potential) measured in Yaquina Bay, Yaquina River, Depoe Slough, and offshore are presented in table 5. Between YRM 0.0 and 14, the various parameters ranged between 13.8 to 17.2° C for temperature, 7.03 to 8.01 for pH, and 7.28 to 9.33 mg/l for dissolved oxygen. The temperature and turbidity increased with distance upstream. The DO concentration, pH, and conductivity decreased with distance upstream. The DO levels were 95 percent to 100 percent of the saturation point at all locations except YRM 8.6 where it was 81 percent saturated. The

values for pH and oxygen were within the ranges specified by the guidelines and, in general, water quality was good in the Yaquina River.

32. Water quality in Depoe Slough was poor. The pH at DSRM 0.25 and DSRM 1.5 ranged between 6.54 and 6.75. A slightly acidic pH of 6.5 is the minimum value accepted by the Oregon Department of Environmental Quality.[6] The DO concentration of Depoe Slough surface water was only 59 percent saturated at DSRM 0.25 and 66 percent saturated at DSRM 1.5. Additionally, the DO concentration at a depth of 1.2 m for DSRM 0.25 was 3.58 mg/l which was only 38 percent saturated. These values were less than guideline criteria which stipulate that the DO should not be less than 90 percent of saturation or not less than 5 mg/l. A combination of factors account for these low values. Measurements were taken on a very low tide (-2.3 feet mllw) and at the beginning of summer when the amount of water in the slough was minimal. Also, the sediments contained high concentrations of organic material. The process of decomposition of organic material by bacteria requires oxygen which is depleted from the water column. However, the DO is expected to increase during flood tides when oxygenated water enters the slough.

33. The low DO and pH indicate that Depoe Slough sediment would have an adverse effect on water quality if it were removed and deposited at an inwater disposal site. Changes at the receiving site might include decreased pH and DO, changes in the population structure of benthic organisms, and increased turbidity. Removal of sediments through upland disposal would improve the water quality of the slough, providing that the overflow water at the upland Depoe Slough was closely regulated.

34. Chemical Analyses. The results of the chemical analyses for water samples collected in Yaquina Bay, Yaquina River, and Depoe Slough are presented in table 6. The results of the bulk sediment analyses are presented in table 7. The water and elutriate data are compared to EPA guidelines[7,8,9] which provide for the protection and propagation of fish and other aquatic life and for recreation in and on the water in accordance with the 1983 goals of Public Law 92-500. There are no National or State standards for bulk sediment analyses. However, Region V of the EPA established guidelines in the publication, "Guideline for Pollutional Classification of Great Lakes Harbor Sediment."[10]

35. EPA guidelines are not established for all of the substances measured. In such cases, the results are compared to guidelines established by Portland District, Corps of Engineers.[2] It should be remembered that the District and EPA guidelines are not rigid standards and are used only for purposes of comparison.

a. Yaquina Bay and River. Since there are fewer contaminants of concern in Yaquina River sediments than in Depoe Slough sediments, the two areas are discussed separately. The contaminants of concern in Yaquina Bay and River sediments are arsenic, manganese, mercury, phenols, phosphorus, and zinc.

(1) Arsenic. On the basis of the bulk sediment guidelines, sediments at YRM 2.0 are "moderately polluted" with arsenic. As previously mentioned, this sampling site is not in the Yaquina navigation channel but is discussed for completeness. Arsenic is toxic to aquatic organisms, but is not concentrated in the food chain. Compounds of arsenic are insoluable in water and are not readily released during elutriate testing. Since elutriate samples contained only trace amounts of arsenic, it can be assumed that the arsenic is tightly bound to organic and inorganic compounds which would not be released upon disposal. Normal disposal methods (i.e., inwater, flow lane, ocean, or upland) would not increase the ambient arsenic concentration at the disposal site.

(2) Manganese. The concentration of manganese in seawater eluate was very high (40 to 10,000 ug/l) compared to ocean receiving water (30 ug/l). The highest manganese concentrations were in samples collected at the upstream end of the project (YRM 13.4 and 13.8). Eluates with freshwater had relatively low manganese concentrations (40 to 194 ug/l).

Manganese is a micro-nutrient required by both plants and animals. It is highly soluble and is frequently released in significant concentrations during elutriate tests and dredging operations.[11] Manganese readily combines with oxygen to form MnO_2 which rapidly precipitates out of the water column. The tolerance levels of aquatic organisms are quite high, ranging between 1,500 and 1,000,000 ug/l. For these reasons, manganese is not considered to be a problem in freshwater. Upland, inwater, and flow lane disposal of sediments from the upper project area on the Yaquina River would cause a short-term increase in the dissolved manganese concentration considerably above ambient levels (30 ug/l). Rapid precipitation and dilution would remove manganese from the water column and adverse impacts to water quality would not result. However, manganese is concentrated by marine mollusks, such as oysters, which are reared in the Yaquina River (between YRM 6 and 8) for commercial distribution. A concentration of 100 ug/l is a guideline value suggested by the EPA to protect against a possible health hazard to humans who consume shellfish. Inwater, upland, or flow lane disposal of Yaquina River sediments would result in a short-term release of manganese well above 100 ug/l. Since many of the dredging areas are close to oyster rearing facilities it is possible that oysters could accumulate manganese. Ocean disposal of sediments from the upper project area (YRM 2.8 to 14.0) could present similar problems since the closest designated disposal site (DS) is only 2,000 feet offshore of the Yaquina Bay jetty (see figure 1).

(3) Mercury. The concentration of mercury in freshwater eluate was 0.1 ug/l at YRM 1.7, 9.0, and 11.0. This exceeded the guideline value of 0.0017 ug/l. The other eluate samples collected at the various sampling stations contained no mercury. Mercury is highly toxic and is bioaccumulated by aquatic organisms. Fish are particularly sensitive and chronic exposure to concentrations less than 1 ug/l can effect behavior or spawning ability.[9]

Although the mercury concentration exceeds guideline values at three sampling sites, there are many factors which indicate that these values are not abnormally high. The detection limit for mercury in the current study was 0.1 $\pm$ 0.05 ug/l which is higher than the guideline of .0017 ug/l for mercury. As stated in the preface to the guidelines,[8] the criteria do not take into account the technical feasibility of measuring small concentrations of the various substances, and detecting mercury below concentrations of 0.1 ug/l is not generally feasible.

The three values of 0.1 ug/l mercury, detected at YRM 1.7, 9, and 11 represent the smallest concentration that can be detected and are consistent with ambient levels measured elsewhere. STORET data,[12] maintained by the EPA shows that from 33 measurements on the Columbia River between RM 0.0 and

335.2, the mean mercury concentration was 0.18 ug/l. This suggests that the mercury concentration of Yaquina River is not unusual.

Finally, elutriate data represent the maximum concentration of dissolved mercury which might be released during disposal of dredged material. This initial concentration would be rapidly diluted to amounts below guideline values.

If material from YRM 1.7, 9.0, and 11.0 were dredged and deposited inwater, a short-term increase in the dissolved mercury levels would result and would be rapidly diluted. If dredging and disposal takes place in oyster rearing areas, there is a possibility that the oysters will concentrate dissolved mercury in their tissues. Flow lane disposal of dredged material would have a similar effect. Upland disposal would remove mercury-containing sediments from the river, but overflowing water might return dissolved mercury to the river. Ocean disposal would be the best solution and have no adverse impact because the initial concentration of mercury (0.1 to 0.2 ug/l) is well below the marine guideline value of 3.7 ug/l. Additionally, the larger dilution potential of the ocean would reduce the dissolved mercury concentration below detectable limits.

(4) Phenols. The phenolic concentration in Yaquina River seawater eluate ranged between 1 and 17 ug/l at all stations except YRM 6.3 and 11.0 where it was 195 and 172 ug/l, respectively. Similarly, the phenolic concentration in freshwater eluate varied between 1 and 51 ug/l at all stations except YRM 6.3 where it was 200 ug/l. These values exceed the 1976 EPA guidelines for phenolic compounds; however, it is unlikely that they exceed the updated 1980 EPA guidelines.[8] The analysis for phenols measures not phenol alone but a whole variety of organic compounds sometimes referred to as "phenolics." The 1980 guidelines do not contain a criterion for phenols that can be used for direct comparison. Instead, the phenols are identified separately and the toxicity of the various components range between 30 and 500,000 ug/l as is shown below.

EPA Water Quality Criteria for Various Phenolic Compounds
(Federal Register, 28 November 1980)

Phenolic	Suggested Freshwater Max. Concentration ug/l	Suggested Seawater Max. Concentration ug/l
Chlorinated Phenols	30-500,000	440 - 29,700
2-chlorophenol	4,380	---
2,4-dichlorophenol	2,020	---
2,4-dimethylphenol	2,120	---
Nitrophenols	230	4,850
Pentachlorophenol	55	53
Phenol	10,200	5,800

A comparison between the Yaquina River phenolic values and the seven separate criteria for phenols listed in the guidelines shows that the elutriate samples are much lower than the criteria. The Yaquina River phenolic values do exceed the guidelines for one chlorinated phenol at YRM 6.3 and 11.0.

The presence of high background levels of phenolic compounds in the Pacific Northwest is associated with decaying vegetation, log rafting, forest product wastes, and livestock. Phenols are highly soluble in water and in strong solutions are used as bactericides while in weaker concentrations phenols are rapidly degraded by bacteria. The process of degrading phenols uses up oxygen which can lead to anoxic conditions. The toxicity of phenols are enhanced by low dissolved oxygen concentrations, increased salinity, and high temperatures. Fish seem to be much more sensitive to phenols than other aquatic organisms. Phenols can affect fish by direct toxicity or, when present in more dilute concentrations, by imparting an objectionable odor and taste to the fish flesh.

Inwater and flow lane disposal of Yaquina River sediments would cause a short-term increase in dissolved phenols considerably above ambient levels

(1 ug/l). The phenols would rapidly be biodegraded and diluted. The former activity might slightly lower dissolved oxygen levels. If disposal operations were conducted during periods of low water flow, the combination of increased water temperatures, decreased dissolved oxygen levels, decreased dilution, and brackish water would enhance the potential toxicity of the phenols and, thus, should be avoided. Upland disposal would remove phenolic-containing sediments from the water and, if bacteria were allowed to degrade the sediment and water slurry before overflow water was returned to the river, potential adverse affects due to dissolved phenols would not occur. Ocean disposal of Yaquina River sediments would cause a short-term increase in phenolics above background levels (less than 1 ug/l) which would rapidly be diluted.

(5) Phosphorus. The concentration of phosphate phosphorous was excessive at YRM 2.0 where freshwater eluate contained 233 ug/l and seawater eluates contained 135 ug/l phosphorus. Samples were not collected in the main channel at YRM 2.0. They were collected on the extreme southern fringe of the dredging area because the channel depth was much greater than the length of the cable used to operate the sampler. Since this was the only station where phosphate phosphorus was excessive, it is probable that this sample is not characteristic of dredged sediments.

Inwater, flow lane, upland, or ocean disposal of YRM 2.0 sediment would not cause adverse, phosphate-related impacts. Phosphorous is generally the growth limiting chemical element in freshwater and releasing large amounts of it could result in water quality deterioration. However, the Yaquina River is not a freshwater system. Additionally, the amount of sediment which might be dredged at YRM 2.0 represents only a small percentage of the total dredging area.

(6) Zinc. The bulk sediment analysis shows that the concentration of zinc in sediments collected at YRM 2.0 is 7,600 mg/kg. EPA Region V guidelines suggest that sediments containing more than 200 mg/kg zinc are "heavily polluted." Zinc is an essential element required for metabolic processes by most organisms. In higher concentrations it is toxic to aquatic life. Toxicity increases with temperature and low dissolved oxygen levels.

As mentioned above, sediments collected at YRM 2 are not characteristics of the navigation channel. If Yaquina River sediment were dredged and deposited at an ocean, inwater, or upland disposal location, there would be no zinc-related adverse impacts. The concentration of zinc in freshwater and seawater eluates was very small suggesting that zinc is tightly bound to the sediments and relatively insoluble.

b. Depoe Slough. Contaminants of concern in Depoe Slough indicated by elutriate analyses are iron, manganese, and phenols. Bulk sediment analyses indicate that 10 substances are present in Depoe Slough sediments at concentrations considered moderately or heavily polluted. The large number of contaminants of concern in Depoe Slough sediments corroborate the physical and water quality data presented earlier. It should be remembered that bulk sediment analyses measure the total level of acid-digested constituents in sediment, including the chemically unavailable and minerologically bound components. However, this type of analysis is very useful in evaluating long-term impacts.

(1) Arsenic. The arsenic concentration in sediments from DSRM 0.25 was 12 mg/kg and "heavily polluted" according to guideline values. Dissolved arsenic is toxic to aquatic organisms, and oysters and other mollusks are able to concentrate arsenic if it is present in seawater. However, compounds of arsenic are insoluble in water. Since elutriate samples contained only trace quantities of arsenic, it can be assumed that arsenic is tightly bound to Depoe Slough sediment and would not be released under normal conditions. Therefore, any normal method of disposal for Depoe Slough dredged sediments would not cause arsenic-related impacts to water quality.

(2) Barium. Sediments from DSRM 0.25 contain 30 mg/kg barium and are "moderately polluted" with this element. Barium is precipitated so rapidly that it is considered insoluble and non-toxic by the EPA.[9] Additionally, very little barium was present in the freshwater and seawater eluates. Inwater, flow lane, or ocean disposal of Depoe Slough sediments would increase the barium concentration in existing disposal site sediments, but not the barium concentration in the water column. Upland disposal would improve sediment quality by removing the barium-containing material from the slough.

(3) Chromium. The amount of chromium in sediment from DSRM 0.25 is 30 mg/kg; a value considered to represent "moderately polluted" sediment. Chromium is a micro-nutrient and, in human populations, chromium deficiency is of more concern than overexposure. However, aquatic organisms are sensitive to it and toxicity varies with pH and valence. Seawater and freshwater eluates contained no dissolved chromium showing that it is tightly bound to the sediment and would not be released during disposal operations. Normal disposal methods of Depoe Slough sediment would not result in chromium-related water quality impacts.

(4) Copper. Sediment from DSRM 0.25 is "moderately polluted" with copper. Copper is commonly used in paint and wood preservatives to prevent fouling and damage caused by marine organisms. It is a micro-nutrient required by most organisms, but is toxic to aquatic life and plants in higher concentrations. Since only trace amounts of copper were present in eluate water, the copper in Depoe Slough sediment is tightly bound to the substrate and would not cause adverse impacts during disposal activities.

(5) Iron. The concentration of iron at DSRM 0.25 is 4 mg/l in the seawater eluate and .77 mg/l in the freshwater eluate. This exceeds the guideline values of 1 mg/l for iron. Additionally, the bulk sediment concentration of iron is 31 g/kg which indicates that Depoe Slough sediments are "heavily polluted" with iron. Dissolved iron is present in the water column only during anaerobic conditions. When oxygen is present iron rapidly oxidizes to form hydrous ferric oxides which precipitate out of the water column.[11] Iron is a micro-nutrient and one of the least toxic of heavy metals. However, if large amounts are released into a water system, the precipitating iron forms flocs which can coat the surface of fish gills or cover benthic invertebrates. Another effect of iron is that it is one of the few heavy metals readily taken up into the tissues of marine organisms from the surrounding sediment.[13]

Inwater disposal of Depoe Slough sediments would release large amounts of dissolved iron at an initial concentration many times greater than background levels of 20 ug/l. The iron would rapidly precipitate out of the water column which could result in the formation of detrimental iron flocs.

Inwater disposal would also increase the iron concentrations in disposal site sediments. Ocean disposal would have a similar impact, except that a much greater dilution potential exists to disperse the precipitating iron, and the ambient iron concentration (100 ug/l) is much greater than freshwater background levels. Upland disposal of Depoe Slough dredged sediments appears to be the best method. This would result in a net improvement of the Depoe Slough sediments because the iron-containing material would be removed from the river system. Additionally, the water-sediment slurry could be retained at the disposal site until the iron concentration was reduced, through precipitation, to acceptable levels.

(6) Lead. Sediment from DSRM 0.25 was "moderately polluted" with lead. Lead is a highly toxic element that accumulates in the tissues of most organisms. The toxicity varies with pH and water hardness. The seawater and freshwater eluate contained only trace amounts of lead indicating that it is tightly bound to the sediments and would not be released during disposal activities. Normal disposal methods of Depoe Slough sediment would not increase the dissolved lead concentration in disposal site receiving water. Removing the sediment (upland disposal) would improve Depoe Slough sediment quality.

(7) Manganese. The concentration of manganese in freshwater eluate from Depoe Slough RM 0.25 was 1,300 ug/l. In seawater eluate the manganese concentration was 3,600 ug/l. These values are extremely high compared to ambient levels (20 - 30 ug/l) but are not cause for concern. As discussed earlier in this report, manganese is a micro-nutrient, highly soluble in water and one of the least toxic of the elements. It rapidly precipitates to manganese oxide under aerobic conditions and is removed from the water column. Therefore, normal disposal methods (i.e., inwater, flow lane, ocean, upland) would cause a short-term increase in the dissolved water concentration which would greatly exceed background values. Precipitation and dilution would remove the manganese from the water and the initial concentration would rapidly diminish to ambient levels.

As mentioned earlier, manganese can be concentrated in the tissues of marine mollusks, such as oyster which are reared in the Yaquina River for commercial distribution. If inwater disposal takes place in the immediate vicinity of oyster rearing areas, the oysters will be exposed to high concentrations of manganese which could be taken up into their tissues. However, other types of dredging activities such as flowlane disposal or upland disposal are unlikely to adversely affect oysters because Depoe Slough is located several miles upstream of the rearing areas.

(8) Nickel. The nickel concentrations in sediment from DSRM 0.25 was 20 mg/kg which is considered "moderately polluted" by guideline standards. Nickel is soluble in water but relatively nontoxic. Only a trace amount of nickel was present in seawater eluate and no nickel was present in the freshwater eluate. This indicates that it is tightly bound to the sediment and would not be released during dredging and disposal operations. Normal disposal methods would not result in nickel-related adverse impacts.

(9) Nitrogen (Ammonia). The concentration of ammonia in sediment from DSRM 0.25 was 210 mg/kg; a value considered to represent "heavily polluted" sediment. Ammonia results from biological degradation of nitrogenous organic matter. Since sediment from Depoe Slough consists of 85 percent silt, clay, and organic matter, it is not surprising that the ammonia concentration is high. However, freshwater and seawater eluates did not exceed guideline values for dissolved ammonia indicating that it would not be released into the water column during dredging and disposal operations. Normal disposal methods would not cause adverse impacts in the water column due to a high concentration of ammonia in the sediment. Inwater disposal would increase the amount of nitrogenous material in disposal site sediments which could affect the benthic organisms. Upland disposal of Depoe Slough dredged sediment would remove ammonia-containing material and upgrade sediment quality in the navigation channel.

(10) Phenols. The phenolic concentration at DSRM 0.25 was 95 ug/l for freshwater eluate and 188 ug/l for seawater eluate. These values exceed the 1976 EPA guidelines for phenolic compounds; however, it is unlikely that they exceed the updated 1980 EPA criteria where phenols are identified

separately (see "Yaquina Bay and River" section for a discussion on phenols). As previously discussed, upland disposal would be the best method of removing phenolic-containing material because it would prevent impacts to the sediment in the river.

(11) Phosphorous. Sediment from Depoe Slough was "heavily polluted" with phosphorous. If large amounts of it were released from sediment, the resulting eutrophication could cause water quality deterioration. However, the high amount of iron in Depoe Slough sediment will effectively prevent the release of phosphorous. Under aerobic conditions, iron is released from sediment which immediately oxidize to form ferric oxides.[11] These oxides scavenge phosphorous from the water column as they precipitate out of the water column. The fact that fresh- and salt water eluates did not contain high amounts of phosphate tends to corroborate this process.

Inwater and ocean disposal of Depoe Slough sediment would increase the phosphorous concentration in disposal site sediment without affecting water quality. Upland or flow lane disposal of Depoe Slough sediments would not affect water or sediment quality.

(12) Zinc. The zinc concentration in sediments from DSRM 0.25 is 31,000 mg/kg or 3 percent of the total sample. Depoe Slough sediment contains 155 times more zinc than the guideline value of 200 mg/kg for "heavily polluted" material. It is possible that the sediment sample is atypical for zinc, but this is not supportable. The concentration of zinc at YRM 2.0 is 7,600 mg/kg indicating that elevated levels may be characteristic of the area. Zinc is an essential element for metabolic processes but is toxic to aquatic life in high concentrations.

If Depoe Slough dredged sediment were deposited at an inwater or ocean disposal location, there would be no zinc-related adverse impacts. The concentration of zinc in freshwater and seawater eluates was minimal suggesting that it is tightly bound to the sediment and insoluble. Both methods of disposal would significantly increase the amount of zinc in disposal site sediment. Upland or flow lane disposal would not add dissolved zinc to the water and would not have an impact. Upland disposal would have the advantage of removing the zinc from the dredging area which would improve the sediments.

Individually, the contaminants of concern in Depoe Slough sediments cause only minor water quality problems associated with dredging activities. When all factors (i.e., water quality data, physical characteristics, and contaminants of concern) are considered together, more serious problems present themselves. The potential for adverse impacts resulting from Depoe Slough sediment is high because there are ten elements present at concentrations considered "moderately" to "heavily" polluted. Comparatively, Yaquina River sediments contain only two of these elements. Elutriate tests show that most of the contaminants of concern in Depoe Slough are tightly bound to the sediment and would not be released during normal disposal conditions (i.e., neutral pH and saturated DO). The solubility of most of the contaminants of concern, however, are affected by pH and dissolved oxygen. A decrease in pH and/or DO shifts the equilibrium of most of these elements such that they dissolve into the water column or become more toxic to aquatic organisms. For example, the toxicity and solubility of manganese, phenolics and zinc are inversely related to the dissolved oxygen concentration. The solubility and toxicity of chromium, copper, lead, manganese, and nickel increases as the pH decreases. Iron, which is insoluble at neutral pH becomes soluble as pH decreases. This has two effects. One, iron dissolves into the water column instead of precipitating and, two, the scavenging effect whereby iron removes phosphorous from the water column is inactivated and phosphorous dissolves into the water column.

All the elements mentioned above are present in high concentrations in Depoe Slough sediment. Conditions of low pH and low dissolved oxygen are also present. At DSRM 0.25 the DO concentration was only 38 percent of saturated levels at a depth of 1.2m and 59 percent of saturation levels at a depth of 0.5m. The pH was 6.7 which is slightly acidic and very close to the minimum acceptable level of 6.5. If these sediments were disturbed during late summer when water temperatures are high and inflowing water and tidal flushing are minimal, severe water quality deterioration could result.

Other detrimental conditions exist in Depoe Slough which also affect water quality. Sediment from DSRM 0.25 consisted of 85 percent silt, clay, and organic material. The high percentage of silt and clay can cause turbidity problems during dredging operations and the high organics are responsible for the excessive concentration of ammonia in the sediments. There are polychlorinated biphenyls (PCB) present in concentrations within guideline values but in the upper 20th percentile for all sediments tested by the USGS.[14] Finally, the presence of high amounts of dissolved iron and manganese, such as occurred in the Depoe Slough eluate, is indicative of anaerobic conditions.

The evidence concerning Depoe Slough sediment indicates that the dredging and disposal of these sediments should be conducted carefully. Inwater disposal is unacceptable because high concentrations of potentially toxic material would affect disposal site sediments and benthic organisms. The fine-grained material would not settle immediately and would be distributed over a large area. Flow lane disposal would present similar problems. Ocean disposal would require a Section 103 evaluation and would involve bioassays because the predominance of silt and clay does not comply with exclusion criteria. Upland disposal in a confined disposal facility is the best alternative because it would remove Depoe Slough sediments from the water and result in a net improvement to sediment and water quality.

CONCLUSIONS

36. Sediments in the Yaquina Bay estuary between RM 0.0 and 2.8 are very clean, consisting of sand without organic material, heavy metals, or other toxic substances. The open-water disposal of this material would cause no adverse chemical impacts.

37. Sediments between YRM 6.3 and 14.0 are removed approximately every 5 years and benthic organisms have had time to re-colonize the navigation channel. These sediments contain silt, clay, and organic material. They are less compact and more porous than downstream sediments, contain significant amounts of soluble manganese and phenols, and small amounts of mercury. Extraction of this material would resuspend the fine-grained material and

increase turbidity, manganese, phenolic and mercury concentrations above ambient levels. If dredging is conducted during periods of high flow (generally October to May)[1], dilution, water currents, and biodegradation will combine to minimize impacts to water quality. Conversely, dredging during low water flow (July and August) will aggravate existing conditions (high water temperature, low D.O., low dilution potential) and reduce water quality. Dredging in the immediate vicinity of oyster rearing areas (YRM 6-8) could increase the concentration of mercury and manganese in oyster tissues.

38. Sediments in Depoe Slough contain significant amounts of insoluble heavy metals and soluble iron, manganese and phenols. Water quality is poor, particularly during low waterflows and sediments consist predominantly of fine-grained material which is loosely compacted, highly porous, and easily suspended. If dredging is not conducted carefully, short-term impacts including high turbidity, release of soluble iron, dispersal of contaminated sediments, and unesthetic water conditions will result.

39. Inwater Disposal. Currently, there are no designated inwater disposal sites at the Yaquina River or Depoe Slough. Therefore, only general impacts can be assessed.

40. Inwater disposal of sediment from YRM 0.0 to 2.8 would cover benthic organisms at the disposal site. Since this sediment is predominantly clean sand, no other adverse impacts are expected.

41. Inwater disposal of sediment between YRM 6.3 and 14.0 would cause short-term impacts of increased turbidity, release of manganese, mercury and phenols in concentrations exceeding ambient levels, and would cover benthic organisms at the disposal site. If disposal sites were located near oyster rearing areas, manganese and mercury could be concentrated in oyster tissues. Long-term impacts might include decreased sediment quality at the disposal site and downstream distribution of sediments containing manganese, mercury, and phenols.

42. Inwater disposal of Depoe Slough sediment would result in severe sediment and water quality deterioration at the disposal site. Impacts would include

excessive turbidity, unesthetic conditions, reduced light penetration, decreased DO, reduced pH, release of iron flocs, release of manganese, phenols and organic material, and significant degradation of sediment quality at the disposal site. Long-term impacts include dispersal of contaminated sediments throughout the estuary which could affect benthic organisms and other aquatic life.

43. Flow Lane Disposal. Flow lane disposal (sidecasting) of Yaquina River sediment would cause impacts similar to inwater disposal. In addition to the impacts discussed above, flow lane disposal would cover benthic communities of ecological and commercial importance.[1] Eel grass beds are present along both sides of the navigation channel up to YRM 9.0. Subtidal and intertidal clam beds extend from YRM 0.0 to 12.0, oyster beds from YRM 5 to 10, and herring spawning areas between YRM 0.0 and 12.5. Flow lane disposal would impact the benthic environment by causing turbidity, reducing light penetration, siltation of spawning areas, and releasing manganese and phenols. The degree of impact in each area of the estuary would be dependent upon current velocity, amount of sediment being dredged, the grain size of the dredged material, and the ability of the benthic communities to withstand the changes.

44. Ocean Disposal. The disposal of dredged material from YRM 0.0 through 11.0 at a designated, interim, ocean disposal site would have advantages over the disposal methods discussed above. The greater dilution potential of the ocean and mixing zones allowed by law would reduce the soluble metals to concentrations below guideline values and the insoluble metals would not affect the environment outside the disposal area. Since Yaquina River sediment is not highly porous or loosely compacted, contains less than 20 percent silt and clay, and less than 4 percent organic material, it would rapidly settle out of the water column.

45. Sediment from YRM 13.4 and 13.8 could have a negative impact at the ocean disposal site because excessive quantities of soluble manganese would be released. Disposal at the designated site 2,000 feet west of the jetty during an incoming tide might bring manganese back into the estuary. Marine mollusks would be exposed to the manganese and they could ingest and incorporate it into their tissues.

46. Depoe Slough dredged sediment could cause adverse impacts at an ocean disposal site. The high organic, silt and clay content of the sediments would cause excessive turbidity and, depending on the water currents, contaminated sediments could be transported outside the disposal area. Disposal of Depoe Slough sediment would be accompanied by the release of large quantities of iron which could precipitate to form a floc. The floc would coat areas of the benthos and have a detrimental affect on bottom-dwelling organisms. Sediments and floc could wash up on nearby shores, thus causing negative esthetic impacts.

47. Dredged material between YRM 0.0 and 2.8 meets the exclusion criteria in Section 103 of Public Law 92-532[15] and does not require any other evaluations. Dredged material between YRM 2.8 and 14.0 does not satisfy the exclusion requirements for ocean dumping and will require additional evaluation prior to the release of public notices.

48. Upland Disposal. Upland disposal of Yaquina River sediment would remove slightly contaminated material from the estuary. If water is allowed to flow back into the Yaquina River from the upland site unchecked, soluble manganese, phenols, and mercury will be released which could result in short-term impacts to aquatic life as previously discussed. If the upland outflowing water is discharged under controlled conditions, manganese will precipitate out of the water, phenols will be degraded by bacteria, and no adverse impacts will result.

49. If Depoe Slough dredged material is disposed at an upland disposal site without special facilities, several types of negative impacts could occur. Overflowing water from the disposal site would re-enter the Yaquina River or Depoe Slough. This water would contain large amounts of iron, manganese, and phenols along with a low concentration of dissolved oxygen and a low pH. This discharge would have a short-term impact on aquatic life and water quality. Fine-grained material would be suspended in the overflow and cause high turbidity, transport of contaminated material downstream, and be unsightly.

50. Long-term impacts could also result from the heavy concentration of toxic substances in the sediment. At an upland disposal site, Depoe Slough dredged

material and water would become anaerobic. This could cause some of the sediment-bound heavy metals to become soluble. Unless otherwise prevented, toxic substances could leach into the groundwater, flow through the sides of the dike, or overflow directly into the Yaquina River at Depoe Slough. Another long-term impact might result from the redistribution of Depoe Slough dredged material when the upland disposal site is no longer used. If this material was used for agricultural purposes, the high lead and manganese content could adversely affect crops. Additionally, PCB's in the sediment would be dispersed through the area.

51. Miscellaneous Impacts. Municipal water intakes for the cities of Toledo and Newport, Oregon, are not located on the Yaquina River or Depoe Slough and would not be affected by dredging activities. There are two natural wildlife areas located in the immediate vicinity of the Yaquina Bay navigation channel. These areas would not be disrupted by disposal operations. Except as noted (see 'Flowlane Disposal' Section), wetlands would not be affected by the proposed activities.

RECOMMENDATIONS

52. Yaquina River sediments between river miles 0.0 and 2.8 are very clean. The extraction and disposal of these sediments, using any appropriate method, at ocean, estuary, or upland disposal sites, would not cause significant adverse biological, chemical, or environmental impacts and would be in compliance with EPA guidelines (40 CFR, 230). This material could be used for beach nourishment. However, certain areas (i.e., YRM 1.2) contain large quantities of shell fragments.

53. Dredged sediments between YRM 2.8 and 14.0 can be discharged at an inwater disposal site. Soluble manganese in this material is relatively nontoxic and would be rapidly diluted upon disposal. Phenols and mercury would also be released but these substances are ubiquitous in Pacific Northwest sediment and water samples. Ambient concentrations commonly exceed guideline values and a study is being initiated to assess their impacts. If inwater disposal is considered, all disposal sites must be coordinated through EPA and

other resource agencies. Site inspections for wetlands, submerged vegetation, or human use characteristics should be performed at all proposed discharge areas.

54. Flow lane (sedcasting) of sediments between YRM 2.8 and 14.0 would physically impact areas of commercial and ecological concern and should not be attempted (see Flow Lane Disposal Section). Upland disposal in a diked confinement area where overflow water is discharged outside the vicinity of oyster rearing areas (YRM 6 to 8) is expected to meet compliance guidelines. Disposal at a designated, interim ocean disposal site might be the best alternative. The soluble components in the sediments would not exceed marine water quality guidelines. However, this will require a Section 103 evaluation.

55. Oyster tissue samples should be collected before and immediately following dredging operations (within 5 days) when dredging is conducted between YRM 6 and 9. The tissue samples should be obtained from commercial oyster growers in the immediate vicinity of the dredging operation, should be analyzed for mercury and manganese, and should be compared to tissues of oysters collected outside the estuary (i.e., Tillamook Bay) or oysters collected near the mouth of the Yaquina estuary. Since uptake of heavy metals by oysters can be seasonally dependent, the latter comparison is necessary to accurately assess bioaccumulation.

56. Sediments from Depoe Slough have a high potential to cause adverse sediment and water quality impacts. This material is not suitable for inwater or flowlane disposal. Ocean disposal would require a Section 103 evaluation and probably entail bioassays. Upland disposal in a confined disposal facility (CDF) would improve water and sediment quality in Depoe Slough and is the best environmental alternative. The dike and bottom of the upland site should be constructed with an impermeable clay core to prevent the leaching of toxic substances into the groundwater. The disposal site should have an adjustable weir to control the outflow, and the weir outflow rates should be monitored. A flocculant should be added to the discharging sediment and water mixture to facilitate the settling of fine-grained and organic materials. An oil boom should be placed above the discharge area to prevent flocculant and other

light weight material from passing over the weir. The discharge pipe from the dredge should be elevated to aerate the incoming dredged material. The ph, DO, and turbidity of the overflow water should be monitored. Suspended solids levels should be measured entering and leaving the disposal facility. If the pH drops below 6.5 or if the DO drops below 5.0 mg/l, supernatant water should not be discharged. Similarly, if the turbidity exceeds the ambient level by 50 JTU, the supernatant water should not be discharged. Finally, a water sample should be collected 100 feet downstream from the overflowing discharge water one week after dredging is initiated (a simple method for determining the best sampling location would be to release a small amount of dye into the discharge water). This sample should be analyzed for heavy metals to determine if they are being released into the water column.

57. The upland disposal sites for containment of Depoe Slough sediment should be surveyed before they are used to insure that historical landmarks or archeological artifacts are not present.

58. When the Depoe Slough upland disposal sites are no longer used, the dredged sediments should be capped with 3 feet of clean fill to prevent the dissemination of polluted sediment.

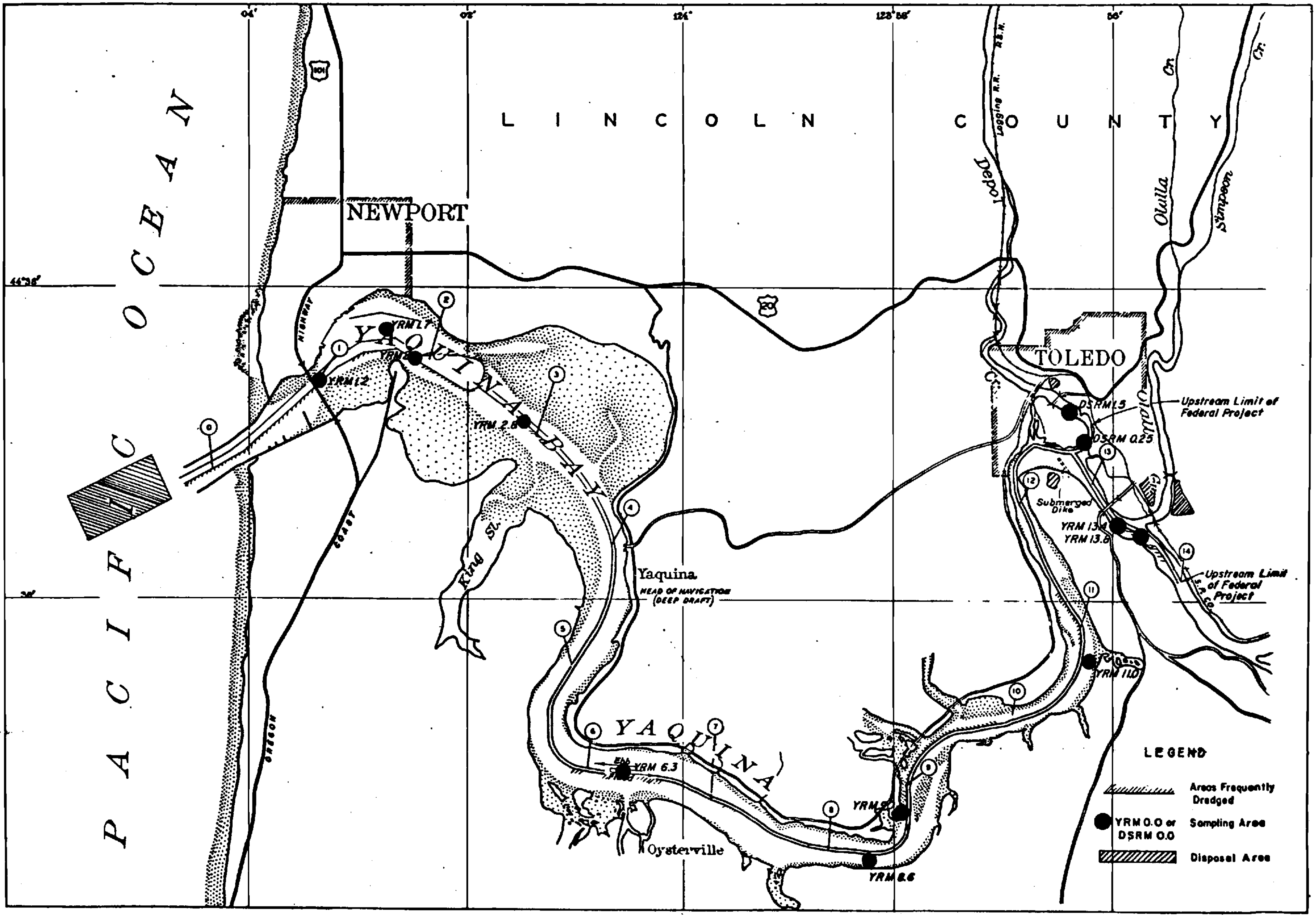
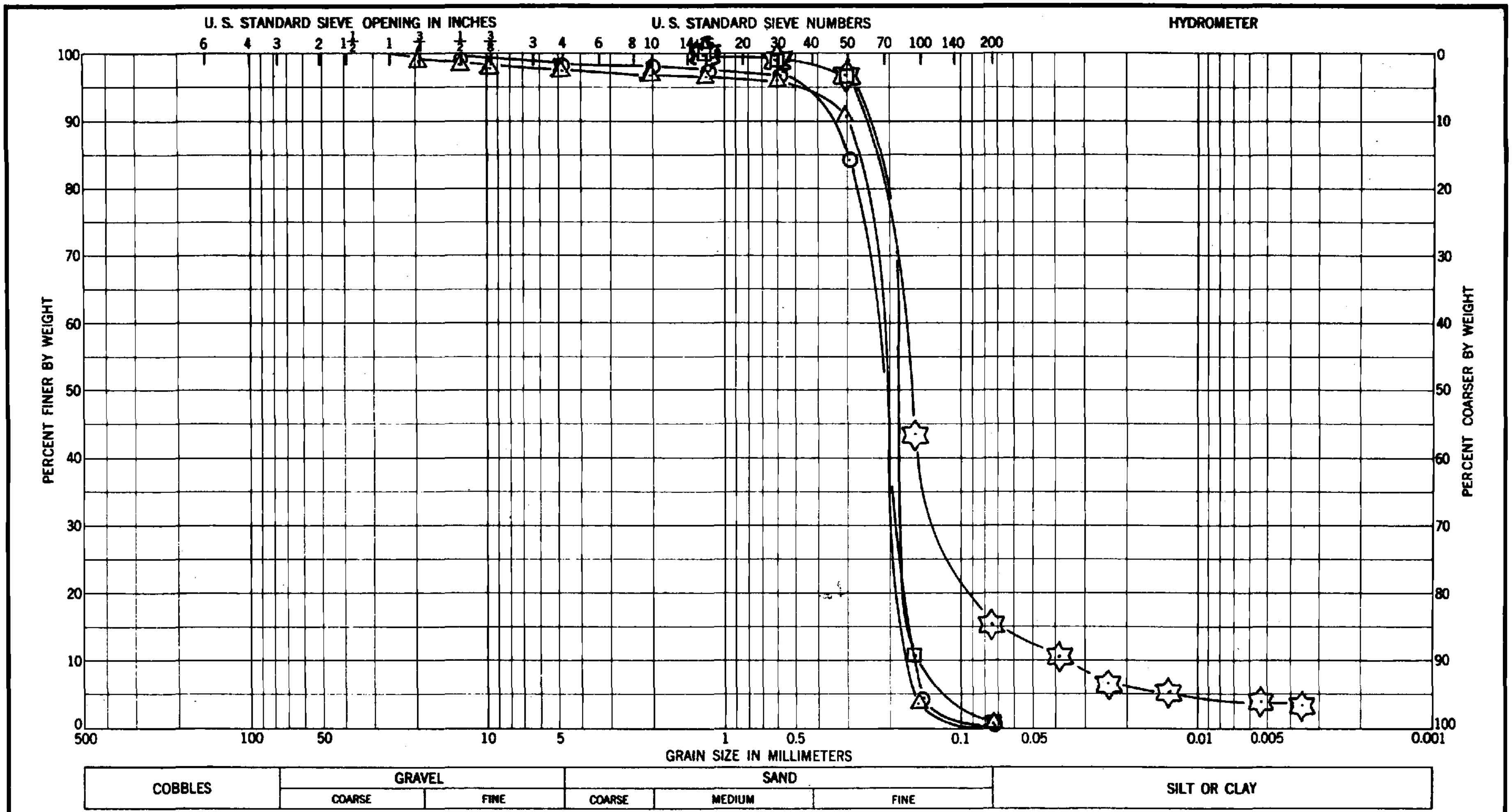


Figure 1. Map of Yaquina Bay, Yaquina River, and Depoe Slough showing sampling stations, disposal sites, and the areas most likely to require dredging.



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
△ YRM 0.0	13 Jun 80	Silty SAND (SP-SM)				
⊙ YRM 1.2	12 Jun 80	SAND (SP)				
⊡ YRM 1.7	12 Jun 80	SAND (SP)				
✡ YRM 2.0	12 Jun 80	Silty SAND (SM)				

Project: RIVER SEDIMENT ANALYSIS

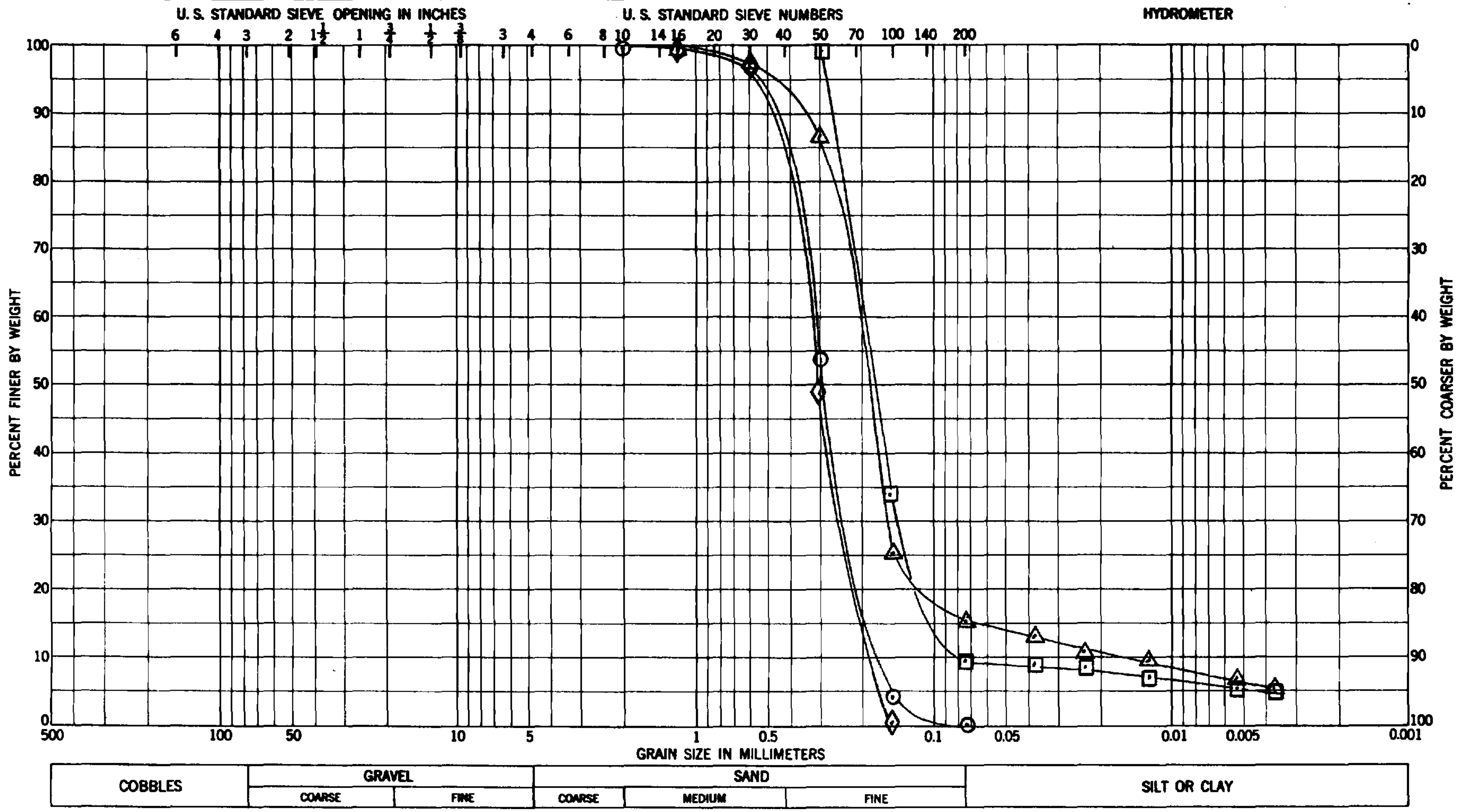
Area: Yaquina River

Boring No.

Date

GRADATION CURVES

Figure 2. Gradation curves for sediment samples collected in Yaquina Bay (YRM - Yaquina River Mile).

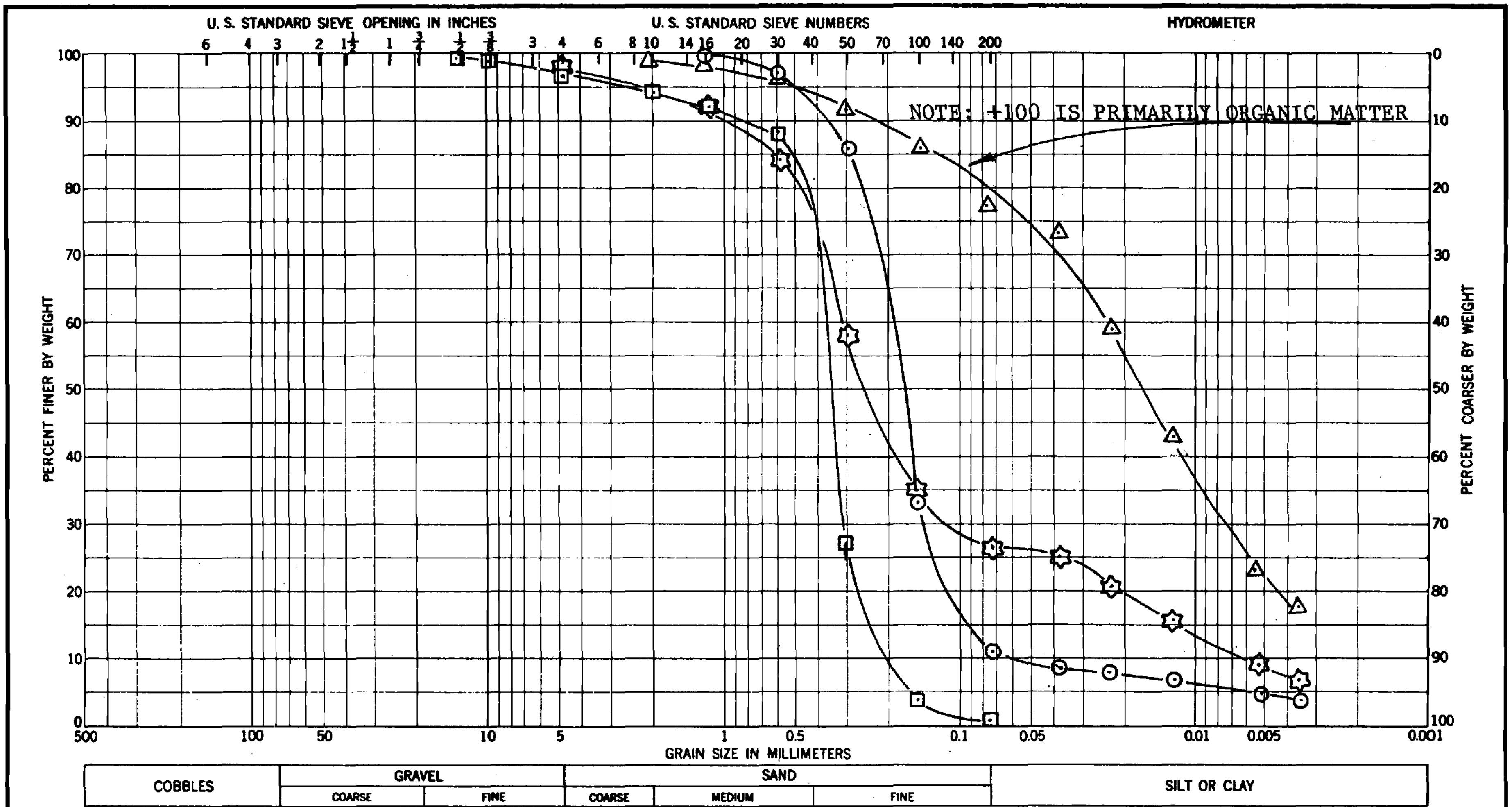


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
⊙YRM 2.8	12 Jun 80	SAND (SP)				
△YRM 6.3	12 Jun 80	Silty SAND (SM)				
⊡YRM 8.6	13 Jun 80	Silty SAND (SP-SM)				
◇YRM 9.0	13 Jun 80	SAND (SP)				

Project	RIVER SEDIMENT ANALYSIS
Area	Yaquina River
Boring No.	
Date	25 June 1980 (80-S-649)

GRADATION CURVES NPD

Figure 3. Gradation curves for sediment samples collected in the Yaquina River (YRM - Yaquina River Mile).



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
⊡ YRM 11.0	11 Jun 80	SAND (SP)				
⊙ YRM 13.4	10 Jun 80	Silty SAND (SP-SM)				
△ DSRM 0.25	10 Jun 80	Organic Sandy SILT (ML)				
✡ DSRM 1.5	10 Jun 80	Organic Silty SAND (SM)				

Project RIVER SEDIMENT ANALYSIS

Area Yaquina River

Boring No.

Date

GRADATION CURVES

Figure 4. Gradation curves for sediment samples collected in the Yaquina River and Depoe Slough (YRM - Yaquina River Mile, DSRM - Depoe Slough River Mile).

TABLE 1
PRIMARY POLLUTANT SOURCES FOR YAQUINA BAY

Newport

New England Fish Company	Fish processing
Yaquina Bay Fish Company	Fish packaging
Point Adams Packing	Crab processing
Newport Seafood Inc.	Fish processing
Bumble Bee Seafood	Fish processing
Alaska Packers Inc.	Fish packaging
Depoe Bay Fish Company	Fish processing
Mo's Newport Seafood	Fish packaging
City of Newport	Municipal wastes
Boat Moorage	
Newport News-Times	Newspaper and commercial printing

TABLE 2
PRIMARY POLLUTANT SOURCES FOR YAQUINA RIVER AND DEPOE SLOUGH

Toledo	
Georgia-Pacific Corporation	Paperboard mill
Georgia-Pacific Corporation	Plywood sheathing & lumber
Cascadia Lumber Company	Lumber
Boat Moorage	
Toledo Shingle Company	Shingles & shakes
Guy Roberts Lumber	Sawmill/planer mill
Toledo Port Dock	
Toledo Products	Wooden pallets & fish boxes
Newport-News Publishing	Newspaper & job printing
City of Toledo	Municipal wastes
Eddyville	
WOW Lumber Company	Lumber
Three B's Logging	Logging

FIELD REPORT

TABLE 3. FIELD NOTES FO AQUINA BAY AND RIVER

Purpose of Sampling 404/103 Evaluation

Date 6/10/80 Wind Very slight

Water Conditions (Wave heights & Direction, Tides, Currents) Smooth

Weather Overcast, dry, app. 15° air temperature Sampling Vessel Fort Stevens

Sampling Personnel Pam Moore, Frank Rinella, Mike Moore, Bob Christensen Sampling Gear -

Analytical Laboratory USGS

Comments (Wildlife, Sampling Difficulties, etc.)

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
Upstream R.	**	0930		Water temperature 17°C
Depoe Slough		1030	Large corer	YRM 12.8
DSRM 0.25				Core sample for 'B' analysis at dolphin, near
				west bank, black, slightly oily, axle grease.
				Got a grain size and benthos sample with corer.
				Material appeared to be unstratified but the
				corer never went down further than 1'. Samples
				were composite. Lumber mills and log rafts all
				around. Lots of wood chips.

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)
'A' analysis is not as complete as 'B'. Benthic samples were obtained using a ponar at all stations save DSRM 0.25 and DSRM 1.5 on 6-13-80.

** Depths were taken at stations with a Hydrolab on 6-11 and 6-14.

FIELD REPORT

YAQUINA BAY AND RIVER

Purpose of Sampling 404/103 Evaluation

Date 6-10-80 Wind Very slight

Water Conditions (Wave heights & Direction, Tides, Currents) Smooth

Weather Overcast, dry, 15° air temperature Sampling Vessel Fort Stevens

Sampling Personnel Pam Moore, Frank Rinella, Mike Moore, Bob Christensen Sampling Gear

Analytical Laboratory USGS

Comments (Wildlife, Sampling Difficulties, etc.)

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
Depoe Slough		1100	Large corer	Core sample for 'A' analysis. Sediment fine
DSRM 1.5				to coarse and with detritus. Composite of 5
				droppings (for chemistry). Sediment wasn't
				as 'greasy' as DSRM 0.25. 250' downstream of
				a small bridge.
YRM 13.8				200' upstream of Ollala River. 100' off west
				bank. Fine sand, uniform. Little stratification,
				small wood fiber. Lumber plant 0.2 miles upstream.
				Opposite residences. Sampled for 'A' analyses
				composite sample.

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)

DSRM = Depoe Slough River Mile
YRM = Yaquina River Mile

FIELD REPORT

YAQUINA BAY ... RIVER

Purpose of Sampling

Date 6-10-80 Wind

Water Conditions (Wave heights & Direction, Tides, Currents)

Weather Sampling Vessel

Sampling Personnel Sampling Gear

Analytical Laboratory

Comments (Wildlife, Sampling Difficulties, etc.)

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
YRM 13.4		1440	Large corer	Immediately downstream of Ollala River.
				Stratified--bottom 5" sandy muck; top 10"
				fine, clean sand. Sampled for 'A' analysis.
YRM 11.0		1530	Large corer	Sampled for 'A' analysis. ¼" silt on top, rest
				was fine sand. Lots of wood chips. Sampled
				next to log raft.
			Ponar	Grain size and benthos in mid-channel on
				6-13-80.

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)

FIELD REPORT

YAQUINA BAY AND RIVER

Purpose of Sampling: Took water samples for 404/103 analyses

Date: 6-11-80 Wind: Slight

Water Conditions (Wave heights & Direction, Tides, Currents): Gentle 1' to 2' swells in ocean

Weather: Fair Sampling Vessel: Fort Stevens

Sampling Personnel: Pam Moore, Frank Rinella, Mike Moore Sampling Gear:

Analytical Laboratory:

Comments (Wildlife, Sampling Difficulties, etc.):

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
Ocean		0900-1100	Van Dorn (black rubber connector)	Over disposal site. Midchannel 2,000' seaward of north jetty. Hydrolab data was obtained. Each cubitainer had water from 16, 8, and 1 meter depths. Maximum depth was 17 meters.
Yaquina R.		1400-1500	Van Dorn	Ollala River YRM 14.0. Off of bank 75' to 100'. Maximum depth 4.4 meters. Water samples were from 2 meters deep.

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)

FIELD REPORT

YAQUINA BAY AND RIVER

Purpose of Sampling 404/103 Evaluation

Date 6-12-80 Wind Slight

Water Conditions (Wave heights & Direction, Tides, Currents)
Overcast, dry

Weather At 0900 air temp = 18.2°C; river water = 15.6°C Sampling Vessel Fort Stevens

Sampling Personnel Pam Moore, Frank Rinella, Mike Moore Sampling Gear

Analytical Laboratory

Comments (Wildlife, Sampling Difficulties, etc.)

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
YRM 6.3		0915	Large corer	Sampled for 'A' analysis. Approximately 200' off north bank. Two core composite. Silty sand with lots of shells. 'Clean'. Grain size was taken with corer.
YRM 2.0		1230	Ponar	Water was too deep opposite McLean Point close to YRM 2.0 (mid-channel) and YRM 1.7 (100' off south bank) to sample, so did the following.
				Against dolphin at south, downstream end of turning basin. Took sample for 'B' analysis. Fine sand and mud with numerous benthic organisms. Benthos and grain size were taken in one sample and split since sampling was very difficult here.

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)

FIELD REPORT

YAQUINA BAY AND RIVER

Purpose of Sampling 404/103 Evaluation

Date 6-12-80 Wind Slight

Water Conditions (Wave heights & Direction, Tides, Currents)
Overcast, dry

Weather At 0800 air temp = 18.2°C; river temp = 15.6°C Sampling Vessel Fort Stevens

Sampling Personnel Pam Moore, Frank Rinella, Mike Moore Sampling Gear

Analytical Laboratory

Comments (Wildlife, Sampling Difficulties, etc.)

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
YRM 2.8		1430	Ponar	Sampled for 'A' analysis. Fine sand with silt.
				Benthos was a whole ponar sample. Grain size
				was taken.
YRM 1.7		1455		Sampled for 'A' analysis. 150' from breakwater,
				opposite Embarcadero. Shallow area. Lots of
				snails. Fine sand with rocks and kelp.
				Station was not in channel since that was too
				busy to sample.
YRM 2.0 *		1500	Surface	Temperature = 17.7°C DO = 9.1
In new boat	launch/			
mooreage at	Embarcadero	1500		Temperature = 15.1°C DO = 10.6

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)

* Data given by Frank Rinella in process of performing IOD measurements.

FIELD REPORT

YAQUINA BAY A... RIVER

Purpose of Sampling 404/103 Evaluation

Date 6-12-80 Wind Slight

Water Conditions (Wave heights & Direction, Tides, Currents)
Overcast, dry

Weather At 0900 air temp = $18.2^{o}C$; river water = $15.6^{o}C$ Sampling Vessel Fort Stevens

Sampling Personnel Pam Moore, Frank Rinella, Mike Moore Sampling Gear

Analytical Laboratory

Comments (Wildlife, Sampling Difficulties, etc.)

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
YRM 1.2		1605	Ponar	Fine sand with a lot of shells sampled for analysis near Buoy 9.
YRM 1.6			Ponar	Off south bank. Lots of kelp and isopods. Discarded sample as non-representative of channel.

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)

Purpose of Sampling 404/103 Evaluation

Date 6-13-80 Wind None

Water Conditions (Wave heights & Direction, Tides, Currents) Very low tide when we started

Weather Rained; at 0845 air temp was 13°C Sampling Vessel

Sampling Personnel Sampling Gear

Analytical Laboratory

Comments (Wildlife, Sampling Difficulties, etc.)

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
YRM 0		0845	Ponar	(Tried near south jetty but got stone with very little sand.) Mid-channel was too deep and busy. Fine sand with a shrimp and some snails. Water temp = 16°C. Sampled for grain size and benthos. North side opposite entrance range (Buoy 11). Some clams in sample. Was full ponar sample.
YRM 8.6		1100	Large corer	Sample for 'A' analysis. Fine sand--one drop for core sample. Streaked with black material (but only a little).
		1300	Ponar	Full ponar benthos sample and a grain size sample.

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)
Ash fallout from Mount St. Helens eruption at 2100 on 6-12-80.

FIELD REPORT

YAQUINA BAY A RIVER

Purpose of Sampling 404/103 Evaluation

Date 6-13-80 Wind None

Water Conditions (Wave heights & Direction, Tides, Currents) Very low tide when we started.

Weather Rained; at 0845 air temp was 13^{o}C Sampling Vessel

Sampling Personnel Sampling Gear

Analytical Laboratory

Comments (Wildlife, Sampling Difficulties, etc.)

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
YRM 9.0		1115	Large corer and ponar	Sampled for 'A' analysis. Core was full. 1/3 of a ponar sample was added to fill it. Some streaks of dark material. Some small wood particles.
YRM 14.0		1130	Ponar	Benthos--full sample. Grain size. Lots of wood and detritus.
YRM 13.8		1130	Ponar	Fine sand with some silt and detritus. Full benthos/ponar sample. Grain size was obtained.
YRM 11.0		1200	Ponar	Fine to medium sand. Different from sample obtained on 6-10-80 at side of channel. This was from mid-channel. Full ponar/benthos sample.

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)

YAQUINA BAY AND RIVER

Purpose of Sampling 404/103 Evaluation

Date 6-13-80 Wind None

Water Conditions (Wave heights & Direction, Tides, Currents) Very low tide when we started

Weather Rained; at 0845 air temp was 13°C Sampling Vessel

Sampling Personnel Sampling Gear

Analytical Laboratory

Comments (Wildlife, Sampling Difficulties, etc.)

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
YRM 9.0		1245	Ponar	Full ponar/benthos sample and a grain size.
YRM 8.6		1300	Ponar	Grain size was 1/3 of ponar. Benthos was
				2/3 of the same sample.

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)

TABLE 4
RIVER SEDIMENT ANALYSIS FOR YAQUINA RIVER AND DEPOE SLOUGH

Sample	Identification	Specific Gravity of Water	Density of Mat'l in place gms/liter	Density of Median Solids gms/liter	Void Ratio	Percent Volatile Solids	Percent Wtr Content in place	Roundness grade
YRM 0.0	13 Jun 80	1.000	2,045	2,667	0.596	0.97	22.3	Subangular to Subrounded
YRM 1.2	12 Jun 80	1.0146	2,023	2,719	0.690	0.53	25.8	Subangular to Subrounded
YRM 1.7	12 Jun 80	1.0146	2,040	2,742	0.684	0.60	25.3	Subangular to Subrounded
YRM 2.0	12 Jun 80	1.0146	1,805	2,710	1.144	2.64	42.8	Subangular to Subrounded
YRM 2.8	12 Jun 80	1.0146	1,980	2,716	0.762	1.51	28.5	Subangular to Subrounded
YRM 6.3	12 Jun 80	1.0135	1,585	2,669	1.896	3.85	72.0	Angular to Subangular
YRM 8.6	13 Jun 80	1.0135	1,699	2,669	1.413	2.91	53.7	Angular to Subangular
YRM 9.0	13 Jun 80	1.0135	1,837	2,672	1.013	1.56	38.4	Angular to Subangular
YRM 13.4	10 Jun 80	1.0053	1,735	2,651	1.255	3.44	47.6	Angular to Subangular
YRM 11.0	11 Jun 80	1.00	1,848	2,670	0.968	2.09	36.3	Subangular to Subrounded
DSRM 0.25	10 Jun 80	1.00	1,149	2,403	8.415	17.48	350.1	Angular to Subangular
DSRM 1.5	10 Jun 80	1.0058	1,295	2,326	3.556	25.73	153.8	Angular to Subangular

TABLE 5
WATER QUALITY DATA
YAQUINA RIVER, YAQUINA BAY, AND DEPOE SLOUGH

DATE: 6-11-80

SAMPLING PERSONNEL: Pam Moore, Frank Rinella, Mike Moore, Bob Christenson

WEATHER CONDITIONS: 0530 Yaquina Bay Coast Guard - Bar 773, 53°, 59° sea temperature

COMMENTS: (Wildlife, vessel traffic, completion status of training jetty, sampling gear difficulties, sampling vessel, etc.) DO probe would calibrate only to 8.55, not 9.03. Conductivity (.256) standard read .255.

Parameter	**Station**							
	Ocean			Yaquina RM 14		Yaquina RM 11		
Depth	15.4	8.2	Surface	3.1	Surface	3.2	Surface	1.8
Dissolved Oxygen	15.4	13.91	12.42	8.92	9.14	10.10	9.33	7.15
Conductivity	.512	.503	.408	.191	.178	.234	.218	.117
Salinity	--	--	--	--	--	--	--	--
ORP	541	523	492	350	343	345	336	542+
Temperature	12.1	12.6	14.4	17.0	17.2	16.9	17.0	16.0
pH	8.19	8.23	8.22	7.37	7.49	7.45	7.54	6.92
Turbidity			1.2		20.0		30.0	30.0
Time	0903			1425	1430	1540	1548	0831

Ocean disposal site = 2,000' seaward of north jetty light. From this point, 1,000' south and 3,000' seaward

RM = River mile

TABLE 5 (con't)
WATER QUALITY DATA
YAQUINA RIVER AND BAY

DATE: 6-14-80

SAMPLING PERSONNEL: Pam Moore, Mike Moore, Frank Rinella, Bob Christenson

WEATHER CONDITIONS: Bar 775.2, air temperature 53°, water temperature 55° (0556), 0820 low tide -2.3'

COMMENTS: (Wildlife, vessel traffic, completion status of training jetty, sampling gear difficulties, sampling vessel, etc.) DO would calibrate only to 8.52, not 8.97. Conductivity (.256) standard read .253. Depth at surface was .1. ORP kept dropping.

Parameter	Station							
	DSRM 1.5	DSRM .25	DSRM .25	YRM 9	YRM 8.6	YRM 6.3	YRM 2.3	YRM 2.3
Depth	.8	1.2	.5	1.9	.6	.7	2.4	.5
Dissolved Oxygen	6.94	3.58	6.24	8.19	7.28	7.70	10.93	8.93
Conductivity	.036	.136	.130	.168	.188	.265	.432	.413
Salinity	--	--	--	--	--	--	--	--
ORP	578	510	484	542+	474+	488+	457+	450+
Temperature	13.8	15.8	15.8	16.4	16.4	16.4	15.1	15.4
pH	6.54	6.77	6.75	7.03	7.11	7.33	7.83	7.79
Turbidity	50.0		17.0	37.0	28.0		7.0	
Time	0805	0812	0815	0847	0855	0909	0925	0921
	Cond. at bottom was .074			Cond. at bottom was .169	Cond. was .189 at bottom	Cond. was .274 at bottom	Cond. was .454	

TABLE 5 (cont)
WATER QUALITY DATA
YAQUINA RIVER AND BAY

DATE: 6-14-80

SAMPLING PERSONNEL: Pam Moore, Frank Rinella, Mike Moore, Bob Christenso

WEATHER CONDITIONS: Fair

COMMENTS: (Wildlife, vessel traffic, completion status of training jetty, sampling gear difficulties, sampling vessel, etc.) DO would calibrate only to 8.52, not 8.99.

Parameter	Station								
	YRM 2.0	YRM 2.0	YRM 1.5	Ocean	YRM 1.1 Mouth	YRM 1.1	YRM 1.3	YRM 2.2	YRM 2.2
Depth	10.4	.6	.6	1.2	8.9	.4		Surface	Bottom
Dissolved Oxygen	13.85	10.22	14.02	15.58	11.01	8.89	--	--	--
Conductivity	.470	.424	.479	.487	.486	.468	--	--	--
Salinity	--	--	--	--	--	--	--	--	--
ORP	417+	412+	395	386 (steady)	378	341	--	--	--
Temperature	14.0	15.4	13.8	13.5	13.5	14.1	--	--	--
pH	7.94	7.83	8.01	8.18	8.04	8.05	--	--	--
Turbidity*					5.0		11.0	6.5	9.89
Time	1026			1050	1102	1115			

YRM 2.2 = Off McLean Point (cement barge)
YRM 1.1 Mouth = Inside new boat basin approximately 200'
YRM 1.1 = At far southeast corner

* Turbidity measurements were made approximately 2 days after collection on chilled samples.

Table Results of saltwater elutriate tests from sediments collected in the Yaqu River and Depoe Slough (YRM - Yaquina River Mile, DSRM - Depoe Slough River Mile).

PARAMETERS	OCEAN RECEIVING WATER	YRM 1.2 OCEAN ELUATE	YRM 1.7 OCEAN ELUATE	YRM 2.0 OCEAN ELUATE	YRM 2.8 OCEAN ELUATE	YRM 6.3 OCEAN ELUATE	YRM 8.6 OCEAN ELUATE	YRM 9.0 OCEAN ELUATE	YRM 11.0 OCEAN ELUATE	YRM 13.4 OCEAN ELUATE	YRM 13.8 OCEAN ELUATE	DSRM .25 OCEAN ELUATE	DSRM 1.5 OCEAN ELUATE	MARINE GUIDE-LINE
ARSENIC, UG/L	1			4								4		508
BARIUM, UG/L				100								500		
BERYLLIUM, UG/L				10								0	.01	
CADMIUM, UG/L	1.3	.88	.09	.12	.32	.01	.08	.11	.05	.01	.26	.47	.01	59
CARBON, ORGANIC MG/L	6.4	3.7	3.2	7.4	10	19	4	3	4.5	5.6	.5	14	6.3	
CHROMIUM, UG/L		0	0		0		0	0	0	0	0	0	0	44
COPPER, UG/L	2	1	1	3	3	2	3	2	4	11	1	2	0	
CYANIDE, UG/L	1			2								2		30
IRON, UG/L	100	120	120	130	160	110	120	110	126	110	143	4000	120	
LEAD, UG/L	2	0	0	0	0	1	1	0	0	0	0	2	0	668
MANGANESE, UG/L	30	40	140	90	380	410	200	230	485	10000	5500	3600	630	
MERCURY, UG/L	0	0	0	0	.2	.2	0	0	0	.1	0	.2	0	3.7
NICKEL, UG/L	0			4								3		140
NITROGEN, AMMONIA MG/L	.13	1.8	1.1	2.1	2.4	6.8	.53	.49	1.3	5.8	1.7	18	1.8	
NITROGEN, ORGANIC MG/L	.32			1.3								0	23	
PHENOLS, UG/L	0	9	0	12	7	195	10	17	172	1	0	188	23	
PHOSPHORUS, TOTAL UG/L	33			135								63		
ORTHOPHOSPHATE,UG/L	14	19	64	77	19	67	8	12	38	26	28	19	13	
ZINC, UG/L	11	1.8	1.2	0	3.4	5.4	8.3	4.8	2.72	2.7	2.53	12	3.7	170
ALDRIN, UG/L	0			0					0		3	0		1.3
AMETRYNE, UG/L	0			0					0			0		
ATRATONE,UG/L	0			0					0			0		
ATRAZINE, UG/L	0			0					0			0		
CHLORDANE, UG/L	0			0								0		.09
CYANAZINE, UG/L	0			0					0			0		
DDD, UG/L	0			0					0			0		
DDE, UG/L	0			0					0			0		14
DDT, UG/L	0			0								0		.13
DIELDRIN, UG/L	0			0					0		1.1	0		.71
ENDOSULFAN, UG/L	0			0					0		2.5	0		.034
ENDRIN, UG/L	0			0					0		.22	0		.037
HEPT EPOX, UG/L	0			0								0		
HEPTACHLOR, UG/L	0			0					0			0		.053
LINDANE, UG/L	0			0					0		.5	0		.004
METHOXYCHLOR, UG/L	0			0					0		2	0		.03
MIREX, UG/L	0			0								0		.001
PCB, UG/L	0			0					0		.001	0		10
PCN, UG/L	0			0					0		2	0		
PERTHANE, UG/L	0			0					0			0		
PROMETONE, UG/L	0			0								0		
PROMETRYNE, UG/L	0			0					0			0		
PROPAZINE, UG/L	0			0					0			0		
SIMAZINE, UG/L	0			0					0			0		
SIMETONE,UG/L	0			0								0		
SIMETRYNE, UG/L	0			0					0			0		
SILVEX, UG/L	0			0					0			0		10
TOXAPHENE, UG/L	0			0					0		10	0		.07
2,4-D, UG/L	0			0								0		100
2,4-DP, UG/L	.01			0					.04		100	0		
2,4,5-T, UG/L	0			0					0			0		

Table 6b. Results of saltwater elutriate tests from sediments collected in the Yaquina River and Depoe Slough (YRM - Yaquina River Mile, DSRM - Depoe Slough River Mile).

PARAMETERS	OCEAN RECEIVING WATER	YRM 1.2 OCEAN ELUATE	YRM 1.7 OCEAN ELUATE	YRM 2.0 OCEAN ELUATE	YRM 2.8 OCEAN ELUATE	YRM 6.3 OCEAN ELUATE	YRM 8.6 OCEAN ELUATE	YRM 9.0 OCEAN ELUATE	YRM 11.0 OCEAN ELUATE	YRM 13.4 OCEAN ELUATE	YRM 13.8 OCEAN ELUATE	DSRM .25 OCEAN ELUATE	DSRM 1.5 OCEAN ELUATE	MARINE GUIDE-LINE
ARSENIC, UG/L	1			4								4		508
BARIUM, UG/L				100								500		
BERYLLIUM, UG/L				10								0	.01	
CADMIUM, UG/L	1.3	.88	.09	.12	.32	.01	.08	.11	.05	.01	.26	.47	.01	59
CARBON, ORGANIC MG/L	6.4	3.7	3.2	7.4	10	19	.4	3	4.5	5.6	.5	14	6.3	
CHROMIUM, UG/L		0	0		0		0	0	0	0	0	0	0	44
COPPER, UG/L	2	1	1	3	3	2	3	2	4	11	1	2	0	
CYANIDE, UG/L	1			2								2		30
IRON, UG/L	100	120	120	130	160	110	120	110	126	110	143	4000	120	
LEAD, UG/L	2	0	0	0	0	1	1	0	0	0	0	2	0	668
MANGANESE, UG/L	30	40	140	90	380	410	200	230	485	10000	5500	3600	630	
MERCURY, UG/L	0	0	0	0	.2	.2	0	0	0	.1	0	.2	0	3.7
NICKEL, UG/L	0			4								3		140
NITROGEN, AMMONIA MG/L	.13	1.8	1.1	2.1	2.4	6.8	.53	.49	1.3	5.8	1.7	18	1.8	
NITROGEN, ORGANIC MG/L	.32			1.3								0	23	
PHENOLS, UG/L	0	9	0	12	7	195	10	17	172	1	0	188	23	
PHOSPHORUS, TOTAL UG/L	33			135								63		
ORTHOPHOSPHATE,UG/L	14	19	64	77	19	67	8	12	38	26	28	19	13	
ZINC, UG/L	11	1.8	1.2	0	3.4	5.4	8.3	4.8	2.72	2.7	2.53	12	3.7	170
ALDRIN, UG/L	0			0					0		3	0		1.3
AMETRYNE, UG/L	0			0					0			0		
ATRATONE,UG/L	0			0					0			0		
ATRAZINE, UG/L	0			0					0			0		
CHLORDANE, UG/L	0			0								0		.09
CYANAZINE, UG/L	0			0					0			0		
DDD, UG/L	0			0					0			0		
DDE, UG/L	0			0					0			0		14
DDT, UG/L	0			0								0		.13
DIELDRIN, UG/L	0			0					0		1.1	0		.71
ENDOSULFAN, UG/L	0			0					0		2.5	0		.034
ENDRIN, UG/L	0			0					0		.22	0		.037
HEPT EPOX, UG/L	0			0								0		
HEPTACHLOR, UG/L	0			0					0			0		.053
LINDANE, UG/L	0			0					0		.5	0		.004
METHOXYCHLOR, UG/L	0			0					0		2	0		.03
MIREX, UG/L	0			0								0		.001
PCB, UG/L	0			0					0		.001	0		10
PCN, UG/L	0			0					0		2	0		
PERTHANE, UG/L	0			0					0			0		
PROMETONE, UG/L	0			0								0		
PROMETRYNE, UG/L	0			0					0			0		
PROPAZINE, UG/L	0			0					0			0		
SIMAZINE, UG/L	0			0					0			0		
SIMETONE,UG/L	0			0								0		
SIMETRYNE, UG/L	0			0					0			0		
SILVEX, UG/L	0			0					0			0		10
TOXAPHENE, UG/L	0			0					0		10	0		.07
2,4-D, UG/L	0			0								0		100
2,4-DP, UG/L	.01			0					.04		100	0		
2,4,5-T, UG/L	0			0					0			0		

TABLE 7

Results of Bulk Sediment Analyses from Samples Collected at Yaquina River and Depoe Slough

	LOCATION		
PARAMETERS	Yaquina River RM 2.0	Depoe Slough RM .25	EPA Region V Guidelines
Aldrin (ug/kg)	0.0	0.0	--
Arsenic (mg/kg)	6	12	>8 HP
Barium (mg/kg)	10	30	20-60 MP
Beryllium (mg/kg)	2	5	0
Cadmium (mg/kg)	1	1	>6 HP
Carbon Inorg. (g/kg)	1.2	0.4	--
Carbon Org. (g/kg)	6.6	77	--
Chlordane (mg/kg)	0	0	--
Chromium (mg/kg)	10	30	25-75 MP
Copper (mg/kg)	8	39	25-50 MP
Cyanide (mg/kg)	0	0	.10-.25 MP
DDD (ug/kg)	0	0.0	--
DDE (ug/kg)	0.0	0.0	--
DDT (ug/kg)	0.0	0.0	--
Dieldrin (ug/kg)	0.0	0.5	--
Endosulfan (ug/kg)	0.0	0.0	--
Endrin (ug/kg)	0.0	0.0	--
Hept Epox (ug/kg)	0.0	0.0	--
Heptachlor (ug/kg)	0.0	0.0	--
Iron (mg/kg)	7,200	31,000	>25,000 HP
Lead (mg/kg)	10	40	40-60 MP
Lindane (ug/kg)	0.0	0.0	--
Manganese (mg/kg)	50	270	300-500 MP
Mercury (mg/kg)	0.02	0.03	>1 HP
Mirex (ug/kg)	0.0	0.0	--
Mthxyclr. (ug/kg)	0.0	0.0	--
Nickel (ug/kg)	10	20	20-50 MP
$NH_4 + NH_3$ (mg/kg)	36	210	>200 HP
Nitrogen Organic (mg/kg)	530	1,090	--
PCB (ug/kg)	26	34	>10,000 HP
PCN (ug/kg)	0.0		--
Perthane (ug/kg)	0.0	0.0	--
Phosph. Tot-P (mg/kg)	250	890	>650 HP
Silvex (ug/kg)	0	0	--
Toxaphene (ug/kg)	0	0	--
Zinc (mg/kg)	7,600	31,000	>200 HP
2,4-D (ug/kg)	0	0	--
2,4-DP (ug/kg)	0	0	--
2,4,5-T (ug/kg)	0	0	--

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