STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

P.O. Box 47600 • Olympia, Washington 98504-7600
(360) 407-6000 • TDD Only (Hearing Impaired) (360) 407-6006

CERTIFIED MAIL

June 5, 2000

Mr. Jon Gornick
Portland District Corps of Engineers
Waterways Maintenance Section
P.O. Box 2946
Portland, OR 97208-2946

RE: Section 401 Certification and Water Quality Modification
Public Notice No. NWPOP-CLA-F00-003
Maintenance Dredging of lower Columbia River (RM 3 to 106.5)

Dear Mr. Gornick:

The above referenced public notice has been reviewed in accordance with all pertinent rules and regulations. The activity proposed in the public notice is the continuation of maintenance dredging of the mainstem navigation channel of the lower Columbia River by the Corps of Engineers and the disposal of the resulting dredged material. The navigation channel falls variously within the state boundaries of Washington and Oregon. Dredging is to be done by hopper, pipeline or clamshell dredges. Dredged material is to be disposed of at in-water, shoreline, or upland sites located in the two states. Approximately 4-6 million cubic yards of sediment is to be dredged every year.

On behalf of the State of Washington, the department certifies there is a reasonable assurance the activity proposed in the public notice will be conducted in a manner that will not violate applicable State water quality standards. This water quality certification, with modification, is subject to the conditions contained in the enclosed Order and may be appealed by following the procedures described in the Order. If you have any questions about this certification or the Order, please call Rick Vining at (360) 407-6944.

Sincerely,

Paula Ehlers

Paula Ehlers, Section Manager
Environmental Coordination Section
Shorelands and Environmental Assistance Program
Department of Ecology

cc:	WDFW	EPA	NW Environmental Advocates
	WDNR	NMFS	CDOG
	ODEQ	USFWS	Pacific County
	CREST	CRCFA	Port of Ilwaco

DEPARTMENT OF ECOLOGY

In the Matter of Granting a Water Quality Certification/Modification to: Portland District Corps of Engineers **In Accordance with 33 U.S.C. 1341 [FWPCA § 401], RCW 90.48.260, and WAC 173-201A**	))))))	**ORDER No. NWPOP-CLA-F00-003** Maintenance dredging of lower Columbia River navigation channel w/ disposal at flow lane, near-shore or upland sites.

TO: Mr. Jon Gornick
Portland District

On February 11, 2000, the Portland District Corps of Engineers submitted a request for water quality certification from the States of Washington for the above-referenced project pursuant to the provisions of 33 U.S.C. 1341 (FWPCA § 401). The request for certification was made available for public review and comment by inclusion in Corps Public Notice No. NWPOP-CLA-F00-003. A revision to the public notice was circulated on April 28, 2000 clarifying aspects of the project related to flow lane disposal, ocean disposal, sediment quality and the Caspian Tern /salmon predation problem.

I. Project Description. The proposed project involves the annual maintenance dredging of the lower Columbia River navigation channel from river mile (RM) 3.0 at the mouth to RM 106.5 at Vancouver, WA. Maintenance of the lower Willamette River channel is not included in this certification as it is noted as an "Other Navigation Project" and is to be "coordinated separately" (page 3 of the public notice).

An average volume of 4 to 6 million cubic yards of sediment is dredged every year from shoals that reoccur at numerous locations in the mainstem navigation channel. The channel is to be dredged to the authorized depth of -40 feet CRD [plus up to 5 feet of over-depth dredging] and authorized width of 600 feet [plus up to 100 feet of over-width dredging in high volume shoal areas]. Dredging is to be done by either hopper, pipeline or clamshell dredge depending upon the availability of disposal sites and timing restrictions.

Dredged material is to be disposed of at one or a combination of the following sites: [1] in-water sites, such as re-handling and flow-lane sites located in or near the mainstem reaches of the river; [2] shoreline or beach nourishment sites and [3] upland sites. The use of ocean disposal sites (designated by EPA) to dispose of sediments dredged in the estuarine reach (RM 3 – 28) is described in the public notice as a possibility depending upon the capacity restraints placed upon existing estuary disposal sites. This certification does not authorize such disposal at the as yet to be designated Deepwater site, but will be reconsidered upon separate request. The use of Expanded Site E (a dispersive shallow water ocean site) is authorized for disposal of estuarine channel sediments provided the sediments meet applicable screening guidelines and are of a grain size compatible to a dispersive disposal site.

II. Project Evaluation. In exercising its authority under 33 U.S.C. 1341 and RCW 90.48.260, the department has evaluated this application pursuant to the following:

1. Conformance with the state water quality standards as provided for in Chapter 173-201A WAC authorized by 33 U.S.C. 1313 and by Chapter 90.48 RCW, and with other appropriate requirements of state law, and

2. Conformance with the provision of using all known, available and reasonable methods to prevent and control pollution of state waters as required by RCW 90.48.010.

The evaluation of the Corps' maintenance dredging program includes the following considerations: Section 303(d) of the Clean Water Act; Sediment Characteristics; and the Letter of Approval from WDFW.

II. (con't) Section 303(d) Listing of lower Columbia River. The lower Columbia River is included in Ecology's latest edition of the CWA Section 303(d) listing, dated March 2, 2000. The lower river is included on the list as a result of water and/or sediment samples or surveys that reported an exceedance of the following parameters: temperature; arsenic; fecal coliform; and a sediment bioassay. With respect to the listing, the department finds there is a reasonable assurance that the Corps' maintenance dredging program will not contribute to an increase of these water quality parameters. This finding is based upon the following factors:

(A) **Temperature.** Exceedances of the temperature criteria for the lower Columbia River were reported at two locations in 1996 - Skamania and Washougal. The flow regime in the main channel of the lower Columbia River is of such high velocity and volume that dredging operations would not be expected to cause any detectable increase in water temperature over background. Furthermore, the very low levels of organic material found in the sediments, as indicated by an average volatile solids content of less then 1.0% (Siipola, 1997), would not generate any noticeable biochemical oxygen demand and thus, not contribute to an increase in temperature or a decrease in dissolved oxygen.

(B) **Arsenic.** The inclusion of arsenic on the 303(d) list resulted from the reported analysis of sturgeon tissue obtained from fish taken from the Oregon side of the river. The tissues had levels of arsenic that exceed EPA's criteria for human health consumption. The report does not indicate pathway(s) through which the sturgeon may have accumulated arsenic. However, as noted in USGS Report 95-4294, arsenic is primarily transported in the lower Columbia River in a dissolved form versus in a form associated (bound) with suspended sediments. Furthermore, USGS noted that the origin of dissolved arsenic to the lower river segment appeared to be from sources upriver of Bonneville Dam, such as the discharge of the Yakima River.

There is no reason to believe the maintenance dredging program will contribute to any increase in the arsenic that was detected in sturgeon. Dredging and disposal will cause a temporary resuspension of some sediment, some of which may have arsenic bound to it. However, a review of the most recent survey of sediments from the navigation channel (Siipola, 1997) indicates that the levels of arsenic found in the navigation channel are at or below background values for the lower Columbia River. The background value for sediment-associated arsenic is 9.7 ppm (plus/minus 2.6) (Johnson, 1988). Levels of arsenic in channel sediments were found to average 1.9 ppm with a maximum value of 3.0 ppm. This data set included 23 stations located between river miles 11 to 106.

The arsenic values detected in channel sediments are also considerably below the screening level of 57 ppm adopted by the sediment evaluation guidelines applied to the lower Columbia River (see Section 2 below). The screening level (or SL) is the level at which any detection at or below that level has been found to not cause any unacceptable adverse effects due to toxicity and thus, qualifies the sediment for unconfined inwater disposal.

(C) **Fecal Coliform.** The exceedance of fecal coliform reported in the 303(d) list is not evaluated in great detail in this section because the origin of the exceedance is from an inspection and analysis of the effluent waters discharged by a paper mill into the lower Columbia River. Thus the industrial discharge was contaminated by excess fecal coliform, not the river per se. In contrast, as noted in USGS Report 95-4294, fecal coliform data collected from 1976-1994 indicate that the lower Columbia River consistently exhibits low levels of fecal coliform. Given this information, and the high current flow and coarse nature of sediments found in the navigation channel, there is no reason to believe that the maintenance dredging program will cause an increase in fecal coliform.

(D) **Sediment Bioassay.** Similar to the situation presented above, the failure of a sediment bioassay reported in the 303(d) list is not evaluated in great detail in this section. The origin of the failure is related to an inspection of a creosote treating facility and an analysis of sediment directly impacted by stormwater discharges from the facility. In addition, the water body so impacted by the discharge is River Lake, which is a tributary to the lower Columbia River.

II. (con't) Sediment Characteristics. A qualitative assessment of sediments is necessary to determine the suitability of the sediments for the disposal options that result in discharges to waters of the State. The disposal options include flow-lane, beach nourishment and upland disposal (when effluent water from the upland site is discharged back into waters of the State).

The sediments to be dredged from the navigation channel have been determined to be suitable for the above disposal options based upon the results of past, and the most recent, sediment sampling surveys. The most recent sediment survey of the channel was undertaken for the proposed

Deepening Project (Siipola, 1997) and was done in conformance with the sediment evaluation guidelines developed for application to the lower Columbia River, the *Dredged Material Evaluation Framework* dated December 1998.

II. (con't) WDFW - HPA Letter of Approval.

In correspondence dated April 25, 2000 (enclosed), the Department of Fish and Wildlife (WDFW) requested that provisions and recommendations be included in the State's coordinated response to the Corp's maintenance dredging program.

(A) Provisions.

(1) Provisions 1 through 5 are incorporated by reference into this certification. These provisions relate to the operational aspects of dredging that can be managed to minimize potential water quality effects.

(2) Provision 6 pertains to the protection of a characteristic use of waters of the state (salmon migration) and the potential effects of beach nourishment. This provision is not included as a condition of certification for the following reasons:

(a) Only one beach nourishment location is proposed for continued use in the State of Washington, that being the upstream end of Puget Island, designated as W-46.0 and W-46.3. The placement of clean sandy dredged material at this location is considered highly beneficial in that it will help nourish the downstream/south side of Puget Island, which is now experiencing fairly significant erosion.

(b) There is a critical need to maintain fexibility in the timing of disposal at this beach nourishment location. This reach of the navigation channel, known as the Westport Bar (RM 44.5-48.2), experiences some of the highest volumes of annual shoaling anywhere along the entire navigation channel.

(c) There is no reason to believe that the use of one beach nourishment location, for a period of one to two weeks per year, will have a significant impact on the overall populations of migrating juvenile salmon. The use of the site was not restricted as such by the National Marine Fishery Service (NMFS), the federal agency charged with evaluating the project with respect to ESA-listed salmon. As indicated in their Biological Opinion dated Sept 15, 1999, NMFS found the existing beach nourishment sites to be of low (benthic) density and of little value to juvenile salmon.

(d) As to the potential turbidity caused by beach nourishment, NMFS found that "water quality will not be adversely affected by slight increases in turbidity" and

that "the lack of fine grained material in the channel (sediments) decreases the potential for any toxics to be resuspended as a part of the dredging process".

(3) Provision 7 calls for a restriction of dredging equipment (clamshell only) downstream of the Lewis River confluence between January 1st and June 1st for the purpose of protecting Columbia River smelt. In consultation with WDFW, this provision is hereby revised to the following: *7. To address concerns about dredging and its potential impacts to fishery resources during the timeframe of January 1st to June 1st of any year, the Corps shall establish a procedure to coordinate with and solicit input from WDFW and Ecology prior to the start of dredging during said timefrane.*

B. Recommendations. The recommendations proposed by WDFW in their letter of approval are hereby forwarded to the Corps for their review and consideration. Recommendations 1, 2 and 3 pertain to white sturgeon and smelt. Given the higher degree of concern for these fishery resources, the department reserves the right to modify this certification to address new information to be derived from new studies about these fishery resources.

In view of the foregoing and in accordance with 33 U.S.C. 1341, 90.48.260 RCW and Chapter 173-201A WAC, a combined certification/modification is granted to the Portland District Corps of Engineers subject to the following conditions:

1. Short-term Modification to the Water Quality Criteria.

The maintenance dredging of the lower Columbia River navigation channel may result in the temporary exceedance of certain state water quality criteria or special conditions specified in Chapter 173-201A WAC. Per Section 173-201A-110, the Department may grant a "Short-term Modification " to allow for such exceedances of the criteria on a short-term basis when necessary to accommodate essential activities, respond to emergencies, or to otherwise protect the public interest". The department finds that maintaining the navigation channel is an activity essential for the safe and efficient movement of large commercial vessels to upriver ports. In granting the following modifications, the department finds that supporting information clearly indicates the granting of mixing zones would not have a reasonable potential to: (1) cause a loss of sensitive or important habitat; (2) substantially interfere with the existing or characteristic uses of the lower Columbia River; (3) result in damage to the ecosystem; or (4) adversely affect public health.

(A) The project reach of the lower Columbia river is classified as Class A waters; thus, Class A water quality standards of 173-201A-030(2) apply, except as specifically modified by this order. Temporary dilution zones, or mixing zones, are authorized for dredging and/or disposal to allow for temporary exceedances of certain water quality standards as a result of disturbing in-place sediments. Within the mixing zones, except as noted, water quality criteria are modified as follows:

(1) **Turbidity.** Class A water quality standards for turbidity are waived within the specified mixing zones, provided the turbidity plumes that result do not exceed 15% of the width of the river.

(2) **Dissolved Oxygen.** Class A water quality standards for dissolved oxygen are waived within the specified dilution zones, provided that total dissolved oxygen levels are not be caused to drop below 6.0 mg/L.

(B) **Mixing Zones.** Mixing zones and other applicable conditions are specified below under the separate categories of dredging and disposal included in the subject Public Notice. The mixing zones are considered reasonably sufficient to allow for the temporary impacts of the dredging and/or disposal operations. All other applicable water quality standards shall remain in effect in the mixing zones and all water quality standards are expected to be met outside of the mixing zones.

(C) **Duration of the Modification.** "Modifications" may be issued for indefinite periods of time. For the maintenance dredging of the navigation channel, modifications are granted for the same duration as the water quality certification, that being for a period of five years. However, the intent of a "modification to the standards" as a means to temporarily waive a water quality criteria needs to be elaborated upon given the extended period of approval.

Per WAC 173-201A-110, a modification of a water quality criteria (such as turbidity) within a mixing zone is intended for short-term periods of time, *such as for hours or days rather than weeks or months*. The maintenance of the entire 103-mile navigation channel occurs over a period of 3-4 months every year. In this case, the department finds that the effects of maintenance dredging are short-term in that dredging/disposal occurs at discrete and separate shoal locations (the entire channel does not need annual dredging) and that dredging at each shoal location is completed in a matter of days. However, within the context of this certification, no degradation of water quality will be allowed if such degradation is found to significantly interfere with or become injurious to characteristic water uses or cause long-term harm to the environment of the lower Columbia River.

The modification does not authorize any in-water work during closure periods specified by the Department of Fish and Wildlife. This modification is also granted on condition that all reasonable and appropriate "best management practices" are being undertaken to reduce the impacts that may cause exceedances of the water quality criteria.

2. Dredging.

(A) Dredging operations shall be conducted in a manner that minimizes the disturbance or siltation of adjacent waters and prevents the accidental discharge of petroleum products, chemicals or other toxic or deleterious substance into waters of the State.

(B) **Dredging by Others.** As provided for in the public notice, other individuals and/or corporations will be allowed to dredge [mine] commercial-grade sediments from the navigation channel at the discretion of the Portland District Corps of Engineers. Such work by others is subject to the conditions contained in this certification and to the leasing and royalty requirements of the Department of Natural Resources.

(C) **Clamshell Dredging:**

(1) **Dilution Zone:** 150 feet radially and 600 feet downcurrent from the point of dredging.

(2) Each pass of a clamshell bucket shall be complete with no stockpiling done in the water. Dredged material shall not be stockpiled on a temporary or permanent basis below the ordinary high water line.

(3) Large debris picked up by a clamshell dredge shall be removed from the dredged sediments prior to disposal at a flow lane disposal site. Large debris includes old pilings or sinker logs [longer then three feet or greater than one foot in diameter], tree stumps, and man-made materials such as scrap metals, car bodies, broken concrete or asphalt and the like.

(D) **Hopper and Pipeline Dredging:**

(1) **Dilution Zone for Pipeline Dredging:** 150 feet radially from the point of dredging and 300 feet downcurrent.

(2) **Dilution Zone for Hopper Dredging with Bin Overflow:** 300 feet radially and 900 feet downcurrent from the point of dredging.

(3) Hopper and pipeline dredges shall be operated with the intake at or below the surface of the sediments being removed during all periods of operation. Reverse purging of the intake line shall be held to an absolute minimum. Should purging be necessary, the intake line shall be raised no more than three feet above the bottom.

(4) The dragheads on a hopper dredge shall be lowered to at least 20 feet below the surface of the river if water is pumped through the dragheads to flush out the hopper bins.

3. Dredged Material Disposal.

(A) Flow Lane Disposal:

(1) Mixing Zone [for disposal by hopper, bottom dump scow, or down spout]: 150 feet radially from the point of discharge and 900 feet downcurrent.

(2) Flow lane disposal by a hopper dredge or a bottom dump scow is approved provided the disposal sites are located:

(a) waterward of the minus 20-foot contour, Columbia River Datum (CRD) and

(b) to the greatest extent practicable, flow lane disposal sites shall be selected so that disposal material (i) disperses into or immediately adjacent to the mainstem navigational channel; (ii) is not likely to cause significantly increased shoaling in downstream side channels or to shoreline facilities such as docks, wharfs, vessel slips and marinas; and (iii) is not likely to cause a significant adverse alteration of bottom habitats critical to the life history of white sturgeon.

(3) Use of alternative methods for flow lane disposal, such as a flat-topped barge unloaded by a small earth mover, will be considered by the department but shall require special review and approval under this certification.

(4) Flow lane sites may be used for the disposal of sediments dredged by pipeline provided the dredged material is discharged through a downspout that is lowered at least 20 feet into the water column.

(B) Shoreline Disposal by Pipeline Dredge:

The following conditions pertain to pipeline dredging operations that involve the unconfined or partially confined disposal of dredged material on or immediately adjacent to the shoreline. Historically, this manner of disposal has been used primarily for erosion control, such as to protect property or structures, to nourish actively eroding beaches, and to fill fish stranding sites. Shoreline disposal may also be done to enhance, restore or create various riverine habitat features such as a spit or lagoon.

Beach nourishment is the most common shoreline disposal activity and is done by pumping a slurry of sand and water directly onto an actively eroding beach. The sand settles out on the beach while the turbid water or runoff flows back into the river.

(1) Dilution Zone: 150 feet radially from the point of discharge and 900 feet downcurrent.

(2) Shoreline disposal operations, and particularly beach nourishment, may result in the placement of dredged material waterward of the ordinary high water mark. In such cases, the area waterward of OHW shall be regraded to an approximate slope of 9 feet horizontal to 1 foot vertical or steeper.

(3) Impacts to riparian vegetation at shoreline disposal sites shall be avoided or minimized whenever possible.

(4) Erosion control measures shall be carried out to prevent the wind erosion of dredged material back into the channel.

(5) Natural habitat features of Columbia River shorelines include large woody debris (LWD) such as trees, logs and stumps. Trees and logs are considered to be LWD if longer than 4 feet and greater than 12 inches in diameter. Whenever feasible, LWD shall be removed and set aside prior to the start of a shoreline disposal operation and then relocated on the shoreline or beach after the disposal area is regraded to a 9 to 1 slope or steeper. Consideration should be given to the placement of imported LWD to enhance habitat value and to help slow future erosion of the site.

(C) Upland Disposal by Pipeline Dredge:

The following conditions pertain to pipeline operations that pump dredged material to an upland site or confined disposal facility (CDF). Typically, a CDF consists of the following design features: [1] Earthen dikes that form the perimeter of the facility. [2] A weir structure that provides flow control and retention of the solid fraction of dredged material. [3] An outlet structure that conveys the turbid water fraction of dredged material [effluent] to a single point of discharge. The point of discharge may be a nearby surface water, wetland or bare ground.

(1) **Dilution Zone [for Single-point Effluent Discharge]:** 150 feet radially from the point of discharge and 600 feet downcurrent.

(2) **CDF Design and Operation.** The following "best management practices" pertain to the design and operation of a CDF:

(a) The CDF should be designed to provide the maximum practical degree of solids retention during operation, and for the entire life of the site.

(b) The outfall should be located so as to provide the maximum amount of dilution or dispersion of the effluent and to minimize any potential scour or erosion effects to more sensitive aquatic resources such as small tributaries and sloughs, shallow tide flats, and wetlands.

(c) To the greatest extent practicable, CDF sites shall be stabilized to prevent significant offsite erosion of the dredged material by either water or wind transport.

4. Emergency and/or Contingency Measures.

If dredging/disposal operations are found not to be in compliance with the provisions of this order, or result in conditions causing distressed or dying fish, the operator shall immediately take the following actions:

(A) Cease operations.

(B) Assess the cause of the water quality problem and take appropriate measures to correct the problem and/or prevent further environmental damage.

(C) In the event of finding distressed or dying fish, the operator shall collect fish specimens and water samples in the affected area and, within the first hour of such conditions, make every effort to have the water samples analyzed for dissolved oxygen and total sulfides. The department may require such sampling and analyses before allowing the work to resume.

(D) Notify the Department of Ecology and the Department of Fish and Wildlife of the nature of the problem, any actions taken to correct the problem, and any proposed changes in operations to prevent further problems.

5. Spill Prevention and Control.

(A) Any discharge of oil, fuel, or chemicals into state waters, or onto land with a potential for entry into state waters, is prohibited.

(B) Fuel hoses, oil drums, oil or fuel transfer valves and fittings, etc., shall be checked regularly for drips or leaks, and shall be maintained and stored properly to prevent spills into state waters. Proper security shall be maintained to prevent vandalism.

(C) In the event of a discharge of oil, fuel, or chemicals into state waters, or onto land with a potential for entry into state waters, containment and cleanup efforts shall begin immediately and be completed as soon as possible, taking precedence over normal work. Cleanup shall include proper disposal of any spilled substances and used cleanup materials.

(D) Spills into state waters, spills onto land with a potential for entry into state waters, or other significant water quality impacts, shall be reported immediately to the department's Southwest Regional Office at (360) 407-6300 (a 24-hour phone number).

6. Duration of Water Quality Certification (WQC). This WQC shall remain in effect for a period of five years from date of issuance. However, the department reserves the option to reassess the terms of this WQC and amend or revoke, as necessary, in the event that:

(A) new sources of potential contamination are discharged or otherwise stand to significantly affect the quality of sediments dredged from the lower Columbia River navigation channel, or

(B) new information indicates that dredging and/or disposal activities are having a significant adverse impact on water quality or characteristic uses of the lower Columbia River.

7. Notification

The Portland District or their designated contractor shall notify the department at least 14 days prior to the scheduled start of dredging in any year. The Ecology person to contact is Rick Vining at (360) 407-6944.

8. Other Requirements.

(A) Copies of this Order shall be kept on the job site and readily available for reference by the Corps of Engineers, Ecology personnel, the contractor, and other appropriate state and local government inspectors.

(B) The Department of Ecology retains jurisdiction to make modifications hereto through supplemental order, if it appears necessary to protect the public interest during the construction and monitoring of this project.

(C) This certification does not exempt and is provisional upon compliance with other statutes and codes administered by federal, state, and local agencies.

9. Penalties. Failure to comply with this Order may result in the issuance of civil penalties or other actions, whether administrative or judicial, to enforce the terms of this Order.

10. Appeal Process. Any person aggrieved by this Order may obtain review thereof by appeal. The applicant can appeal up to 30 days after receipt of the permit, and all others can appeal up to 30 days from the postmarked date of the permit. The appeal shall be sent to the Washington Pollution Control Hearings Board, PO Box 40903, Olympia WA 98504-0903.

Concurrently, a copy of the appeal shall be sent to the Department of Ecology, Enforcement Section, PO Box 47600, Olympia WA 98504-7600. These procedures are consistent with the provisions of Chapter 43.21B RCW and the rules and regulations adopted thereunder.

Dated 6 · 7 · 00 at Lacey, Washington

Paula Ehlers

Paula Ehlers, Section Manager
Environmental Coordination Section
Shorelands and Environmental Assistance Program
Department of Ecology
State of Washington

References:

Johnson (1988) - Screening Survey for Chemical Contaminants and Toxicity in Sediments at Five Columbia River Ports, September 22-24, 1987, Ecology Report 26-00-01, 1988

NMFS (National Marine Fisheries Service) - Biological Opinion on Corps of Engineers' Columbia River Channel Operation and Maintenance Program, September 15, 1999

Siipola (1997) - Technical Reports, Appendix B, Columbia River Sediment Quality, Final Integrated Feasibility Report for Channel Improvements and EIS, August 1999.

USGS Report 95-4294 - Water Quality of the lower Columbia River Basin: Analysis of Current and Historical Water Quality Data through 1994, 1996