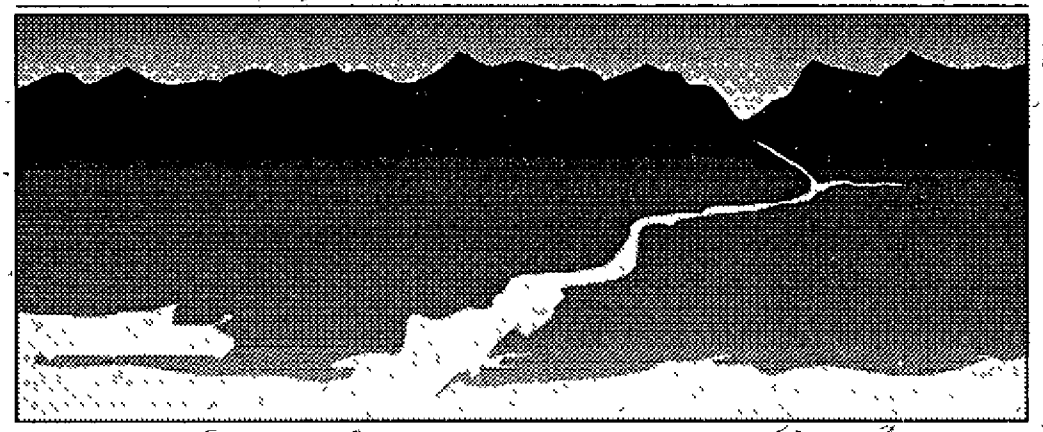
FINAL REPORT

LOWER COLUMBIA RIVER



BI-STATE PROGRAM

RECONNAISSANCE SURVEY OF THE LOWER COLUMBIA RIVER

TASK 5 SUMMARY REPORT: BENEFICIAL USES AND SENSITIVE AREAS

MAY 1992

Prepared By:

TETRA TECH

In Association With:

DAVID EVANS & ASSOCIATES
EVS CONSULTANTS

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NON-TECHNICAL SUMMARY

This is the summary of the Task 5 report, Beneficial Use Descriptions and Locations,which is part of the Reconnaissance Survey of the lower Columbia River. This survey was initiated by the lower Columbia River Bi-State Water Quality Program to assess the water quality of the lower Columbia River from the mouth to Bonneville Dam.

The Columbia River provides many different uses to the people and animals that live within and along its shores. These uses are referred to by government agencies as "beneficial uses" (by the state of Oregon) or "characteristic uses" (by the state of Washington). Laws and regulations exist in both Washington and Oregon to ensure that water quality is maintained to specified standards that will protect beneficial/characteristic uses.

The work of this task was to review the designated beneficial/characteristic uses and map the general locations where they occur. The purpose was to help decide locations for the in-river sampling that would occur in Task 6 as well as providing a general reference document on beneficial/characteristic uses. Five main groups of beneficial/characteristic uses occur within the lower Columbia River: water supply, agriculture, fish/wildlife species and habitat, recreation, and commercial.

Water supply from the Columbia River is extracted by domestic, municipal, and industrial users for a variety of purposes. The water is withdrawn directly from surface waters or from wells (groundwater) adjacent to the River. This water is used primarily for industrial processes (cooling, heat exchange, etc.), fire protection, irrigation, and drinking water supply. The suitability of water supply for non-drinking water uses is relatively insensitive to changes in water quality. Where used for drinking water, its suitability is very sensitive to changes in water quality of the River.

Agricultural users take water from the Columbia River to irrigate crops and provide water for livestock. The majority of the diverted water is used for irrigating crops and orchards, while only a small volume is extracted for watering livestock. The process of bioaccumulation of chemicals in soil and plant/animal tissue, makes water quality for agricultural uses along the River highly sensitive.

Numerous species of **fish** and aquatic invertebrates inhabit the lower Columbia River. Some of the more common species are salmon, steelhead, smelt, herring, Dungeness crab, crayfish, and sand shrimp. These species tend to concentrate in productive areas of the River, such as the estuary, embayments, and at mouths of tributary rivers. Some species use the River during certain seasons to migrate to and from spawning areas; others are year-round residents. Threatened and endangered species are present in the lower Columbia System. Some have seen drastic reductions in numbers over time (for example, Dolly Varden trout and Snake River sockeye). Most species of fish and aquatic invertebrates are very sensitive to changes in water quality.

Large numbers of **wildlife** also inhabit the Columbia River system. Some of the common wildlife are several species of waterfowl, other birds, otters, seals, frogs, and turtles. Each type of wildlife usually occupies a specific type of habitat and often on a seasonal basis. Several wildlife refuges are located along the River. They provide excellent habitat for a diversity of wildlife. Some threatened and endangered wildlife species are also of special concern because their populations have declined (for example, bald eagle, harbor seal, and painted turtle). Many species of wildlife are very sensitive to changes in water quality while others are more tolerant.

There are a variety of **recreational** uses occur along the Columbia River, such as hunting, fishing, boating, water contact sports (wind surfing, swimming), and aesthetic quality (sightseeing, beachcombing). Most of these recreational activities are concentrated at specific locations and are seasonal. All of these activities are sensitive to some degree to changes in water quality.

Several **commercial** uses take place along the Columbia River, including: power production, navigation, transportation, commercial fisheries, marinas, and tour boats. These uses typically provide a service (shipping) or product (fish, electricity) to the public. These activities are year-round and occur along the entire length of the lower Columbia River. Some of the commercial uses are highly sensitive to changes in water quality (commercial fisheries), while others are less sensitive (navigation, transportation).

The information described in this report was used in the development of the Task 6 sampling plan and should be useful in developing any future ongoing monitoring program.

1.0 INTRODUCTION

1.1 The Bi-State Program

The Lower Columbia River Bi-State Water Quality Program was established to assess the water quality of the lower Columbia River from the mouth to Bonneville Dam [River Mile (RM) 146]. The Bi-State Program was established at the direction of the legislatures from the states of Oregon and Washington. The states formed an Interstate Agreement that directs a four-year water quality program to characterize water quality in the lower Columbia River. The goals of the Bi-State Program for managing the lower Columbia River are:

- To identify water quality problems;
- To determine if beneficial/characteristic uses are impaired;
- To develop solutions to problems; and
- To make recommendations on a long term Bi-State framework.

The goal of the first year studies is to establish the technical framework for determining the water quality of the lower Columbia River. This technical framework, designated as the Reconnaissance Survey of the Lower Columbia River, will serve as the basis for directing further study efforts in the following years.

1.2 Task Objectives

The objective of Task 5 was to define, describe and locate in consistent terms the beneficial and characteristic uses and sensitive areas of Columbia River waters within the identified study area. Definitions were based on Oregon Administrative Rules (Chapter 340, Division 41, Sections 202, 442 and 482 including proposed amendments under triennium review) for the North Coast-Lower Columbia River Basin, and proposed Washington Administrative Code (Chapter 173-203) as established in Draft Surface Water Quality Standards. (Note: WAC 173-203 as proposed will replace WAC 173-201 as established in the Water Quality Standards.) Use descriptions and locations included identification of beneficial use occurrence, extent, frequency or concentration, user group involvement, seasonality, and sensitivity to water quality changes. The location of each beneficial use was mapped using a Geographic Information System (GIS). This task also provides a discussion of data gaps, data quality, and recommendations for additional data collection and analysis.

1.3 RELATIONSHIP OF TASK 5 TO OTHER TASKS

In order to complete the first year's work, the Reconnaissance Survey of the Lower Columbia River was divided into the following tasks:

Task 1: Existing Data Review;

Task 2: Pollution Sources;

Task 3: Hydrologic and Physical Characterization;

Task 4: Biological Characterization;

Task 5: Beneficial Uses;

Task 6: Screening Survey; and

Task 7: Technical Framework and Recommendations.

Initially Task 5, beneficial/characteristic use descriptions and locations, was closely coordinated with Task 1 as literature was gathered and reviewed. Team members for both tasks worked jointly to identify and obtain specific documents. Tasks 2, 3, and 4 all required close coordination during the GIS mapping effort, especially Task 2. In order to determine the correlations between beneficial uses and pollution loading areas, the team members of Tasks 2 and 5 worked together. GIS personnel helped determine which data layers for beneficial uses and pollution loadings would best support the analysis. Recommendations resulting from the comparative analysis of Tasks 2 and 5 were directly involved in preparation of Task 6, the Survey Sampling Plan. The resulting products of Task 5, including beneficial use descriptions, site locations maps, tables and graphs, and literature citations, will ultimately be compiled into Task 7.

2.0 SUMMARY OF PREVIOUS REPORTS IN TASK 5

Task 5 was composed of two previous reports: (1) Identification of Beneficial Uses and Sensitive Areas and (2) Beneficial Use Descriptions and Locations. The first report was written to precisely identify the beneficial and characteristic uses along the lower Columbia River as defined by both Oregon and Washington. Based on these definitions the defined uses from both states were quantified and grouped into five categories. The identified beneficial uses provided the basis for the second report that described and mapped these uses based on an extensive literature review, as well as numerous agency and organization interviews.

2.1 Subtask 1: Identification of Beneficial Uses and Sensitive Areas

The identification of beneficial uses is critical to the development of a comprehensive understanding of the lower Columbia River system. The surface waters of the River are used for many purposes, all of which require water quality appropriate to the use. Provisions have been established in both Washington and Oregon to ensure the conformance of quality criteria with reasonable present and potential uses of surface waters.

Oregon Administrative Rules issued through the Department of Environmental Quality have established Water Quality Standards in the Lower Columbia River Basin according to three separate reaches of the River. The water quality in Oregon is managed to protect these beneficial uses.

The State of Washington has classified surface waters based on water quality and characteristic uses. Since the lower Columbia River is classified as "Class A" (excellent), the water quality must meet or exceed the requirements for the specific characteristic uses.

For the Bi-State Program the beneficial/characteristic uses from both states have been compiled and organized into the five main groupings: (1) Water Supply, (2) Agricultural, (3) Fish/Wildlife Habitat, (4) Recreation, and (5) Commercial. The specific uses comprising each of these five groupings are listed in Table 1.

The analysis of these beneficial/characteristic uses forms the content of the second report of Task 5.

BENEFICIAL USE DESCRIPTIONS FOR THE LOWER COLUMBIA RIVER
Table 1

1. Water Supply:

   - All domestic water supply systems including private wells, small private water systems, public utility districts and municipal public systems, withdrawal rights, and other surface water extractions used for domestic supply; and

   - Industrial supply including direct withdrawals for manufacturing, processing, or other industrial activity.

2. Agriculture:

   - All private or public withdrawals for the purpose of irrigating agricultural crops, orchards, or public lands;

   - All withdrawals for the purpose of supplying water to commercial livestock operations; and

   - Areas of concentrated withdrawals by private landowners to supply livestock.

3. Fish/Wildlife:

   - Areas supporting anadromous fish passage, salmonid fish rearing, salmonid fish spawning, resident fish, and aquatic wildlife use including national and state refuges;

   - Significant riparian habitats such as backwater marshes and island nesting areas; and

   - Unique marine or freshwater habitats, and Natural Heritage Sites.

4. Recreation:

   - Hunting, fishing, and boating;

   - Primary contact recreation, in general where contact with the water is submergence such as skin diving, swimming, water skiing, jet skiing, and wind surfing;

   - Secondary contact recreation, in general where water contact is limited, such as wading or fishing; and

   - Aesthetic quality where senses are involved (i.e., scenic overlooks, unique botanical areas, birdwatching areas, etc.).

5. Commercial:

   - Hydropower production;

   - Navigation and transportation;

   - Marinas and other commercial activities associated with the River; and

   - Commercial fisheries.

2.2 Subtask 2: Beneficial Use Descriptions and Locations

In order to identify and map the beneficial/characteristic uses of the lower Columbia River the following four steps were taken: (1) literature search/review, (2) agency and organization interviews, (3) use descriptions, and (4) GIS mapping.

Literature search was initiated from the studies identified in the 1990 McConnell report as provided through Task 1. Approximately 41 documents were obtained, closely reviewed, and cited in the subtask 2 report. To supplement the literature review and to ensure comprehensive review of beneficial uses, approximately 100 telephone and personal interviews were conducted with individuals, researchers, and citizen's groups, as well as agency, industry, government, and special district personnel. Questionnaires were designed for the interviews to ensure consistent and thorough data collection. The questions asked pertain to the location of the beneficial use, frequency or seasonality of the use, who or what is involved in the use, and perceived sensitivity of the use to changes in water quality.

Based on the information gathered in the literature search and the interviews, each beneficial use was qualitatively, and where appropriate, quantitatively described. Each identified beneficial use was reported by river mile and mapped using GIS. The study area was divided into four map sections to cover the 196 miles under study.

The beneficial/characteristic uses were organized into five main groupings: (1) water supply, (2) agriculture, (3) fish/wildlife, (4) recreation, and (5) commercial. These beneficial uses are summarized as follows.

2.2.1 Water Supply

Water is withdrawn from both surface sources and wells along the Columbia River for a variety of domestic, municipal, and industrial uses. These withdrawals provide water supply for: (1) domestic uses including private wells and systems, public utility districts PUD and municipal systems, Indian withdrawals (unpermitted), and other (unpermitted) extractions; and (2) commercial and industrial uses. Information regarding use type, withdrawal rate, total annual withdrawal amount, source type and location was provided by the Oregon Water Resources Department (1991) and the Washington Department of Ecology (1991). The general nature and inconsistency of some of the information resulted in annual usage figures that are estimates and locations that are approximate within a given river mile.

A total of approximately 564,922 gallons per minute (GPM) of water is withdrawn from surface sources or wells in the Study Area. Approximately 45% of the withdrawal is from surface sources and the remainder (55%) is withdrawn from wells. The sensitivity of most of these uses to water quality is expected to be low as they are primarily used for non-consumptive purposes. Where water from wells and surface sources is used for domestic and municipal drinking water, the sensitivity to water quality changes is high. However, deep-seated wells located away from the river, are likely to be protected to some degree from water quality changes in the lower Columbia River.

2.2.2 Agriculture

Two types of agricultural users extract water from the Columbia River: farmers who use the water to irrigate crops and ranchers who use the water for livestock. There are 27 recorded diversion points along the Columbia River within the study area, 19 along the Washington side of the river and seven on the Oregon side.

The majority of the water diversion data indicate that the water is used for irrigating crops and orchards. A total of nearly 2,155 acres of land and 26 irrigation users are reported to be withdrawing water during the irrigation season from approximately May 1 through September 30 each year.

Only four water rights permits indicate water use for livestock, and three of these also indicate crop irrigation withdrawal rights. All four users are on the Washington side of the river and use approximately 64 acres of land for livestock production on a year-round basis. Agricultural activities along the Columbia River would potentially be highly sensitive to drastic changes in water quality because some of these crops and animals could be used for human consumption. If contaminated, they could pose a public health risk. This risk is greatest with bacterial and organic pollutants.

2.2.3 Fish/Wildlife Species and Habitat

Fish use of the lower Columbia River is limited primarily by salinity gradient, and prey distribution and abundance. More than 92 fish species and as many as 71 aquatic invertebrate species are known to inhabit the lower Columbia River during some part of their life cycle. The largest numbers of fish occur between RM 8 and RM 20 and in associated bays, where food is most abundant.

Approximately 11 species of anadromous fish (e.g., spring, summer and fall chinook; winter and summer steelhead; shad; lamprey; and smelt) use the lower Columbia River system for seasonal access to and from spawning and/or rearing habitats. Eight species of salmonids frequent the study area for some aspect of their life histories. Anadromous fish species, their location, seasonal occurrence, and abundance within the lower Columbia River study area is described in greater detail in the full report.

Approximately 23 common resident fishes are numerous within the lower Columbia River System and occupy preferred habitat zones. Only four species have economic value as commercial or recreational catches: northern anchovy, Pacific herring, English sole and starry flounder.

The spatial distribution, seasonal distribution, salinity tolerance, and relative abundance of aquatic invertebrates varies considerably depending on habitat requirements and availability within the estuary. Common invertebrate species are Dungeness crab, eastern soft-shell clam, sand shrimp, red crayfish, and blue mussel.

In addition, there are 11 fish species of special concern within the system (examples are: Dolly Varden trout, sandroller, Snake River sockeye, fall chinook, and summer/spring chinook). National concerns are aligned with the Endangered Species Act which defines animal species of special concern as federally endangered, threatened, or candidate. Administrative rules of Oregon and administrative codes of Washington define the criteria for state concerns. The two states use the same categories as the federal listing, but have added sensitive and monitor categories. Changes directed at preservation could affect other beneficial uses such as navigation and power production.

Significant riparian habitats, plant species and communities, wildlife species of concern, national and state wildlife refuges, and other unique wildlife habitats exist along the lower Columbia River. Several riparian habitats are considered unique and significant as breeding grounds since they support not only common wildlife species (e.g., mallards and Canada geese), but also threatened and endangered species, such as bald eagles and Columbia white-tailed deer. During the winter months these riparian habitats, which lie along the Pacific Flyway, also provide important roosting grounds for a variety of resident and migrating waterfowl.

Significant plant and/or plant communities were identified within the lower Columbia River study area through the Natural Heritage Programs of Washington and Oregon and the U.S. Fish and Wildlife Service. Currently listed and proposed threatened, endangered, and candidate species for both plants and plant communities are defined, located and prioritized in the Task 5 report (examples are: bolandra, pygmy-weed, Sitka spruce/salal community, and low intertidal, low salinity sandy marsh communities).

Wildlife species of special concern were also identified within the study area. These species include Oregon and Washington State listed species, federally listed threatened and endangered species, and species particularly suspectable to changes in water quality (examples are: bald eagle, osprey, great blue heron, harbor seal and painted turtle).

Three wildlife refuges and one wildlife management area occur within the lower Columbia River study area, as well as several unique habitat sites. These include: the Lewis and Clark National Wildlife Refuge, Julia Butler Hanson National Wildlife Refuge, Ridgefield National Wildlife Refuge, Sauvie Island Wildlife Management Area, mouth of the Sandy River, the Columbia River Estuary, Sturgeon Lake, lower Columbia Slough, and shallow bays of the estuary. These areas provide diverse habitat features for all types of wildlife. These areas all have the potential to be affected by changes in water quality which in turn could possibly effect the life cycles of the wildlife they support.

2.2.4 Recreation

Beneficial uses involving recreation include: hunting, fishing, boating, water contact activities, and aesthetic quality. Hunting activity on the lower Columbia River is predominately for migratory waterfowl. Hunting is seasonal, occurring in fall and winter, and most often on weekends. This activity is limited to certain designated areas and the season. Local agencies control limits and licensing.

Fishing is an individual activity that takes place along the whole length of the study area, although certain locations are more popular. Fishing occurs throughout the year with heavier use during upstream migrations.

Boating along the lower Columbia River is correlated to fishing and recreational activities. Boating related to fishing takes place along the whole length of the lower Columbia River and at all times of the year. Recreational boating occurs mostly along shorelines, in protected lagoons of various islands, and is primarily a warm weather activity.

Water contact activities, including: windsurfing, water skiing, swimming, and wading, occur in varying degrees in the Columbia River. These activities are concentrated at specific locations and particular seasons depending on the desired conditions relative to the activity (i.e., windsurfing requires windy areas and can be done most of the year, whereas, water skiing is best in calmer water and during warmer weather).

Aesthetic qualities abound along the lower Columbia River in the form of scenic viewpoints, panoramic vistas, sandy beaches, and historical and cultural sites. Activities that center around these locations include sightseeing, bird watching, hiking, sunbathing, picnicking, and beachcombing. People enjoy aesthetic qualities throughout the year, but more activity is noticeable in the summer and on weekends.

All recreational beneficial uses are affected to some degree by changes in water quality. Many uses are interrelated, for example, degradation of water quality could potentially affect waterfowl and fish populations which would directly affect hunting and fishing activities. Water contact activities have a grater sensitivity to water quality changes than other recreational activities. Excessive algal growths, bacteria or toxic chemical contamination, and unpleasant odors would result in a health hazard and a decrease in water contact activities.

2.2.5 Commercial

Commercial beneficial uses along the lower Columbia River include: power production, navigation, transportation, commercial fisheries, marinas, port districts, and tourism. These uses typically provide a service or product and/or some economic incentive to the participant and/or the public.

Power production occurs at Portland General Electric's Trojan Nuclear Power Plant (RM 72.5) and Bonneville Lock and Dam Project (RM 146). Trojan provides approximately 1,700,000 kilowatts (kw) of power daily for use by industry and homeowners belonging to the Northwest power grid. Trojan has been temporarily closed for maintenance between March 1991 and February 1992. This means that Trojan was closed during the sample survey that was conducted in the Fall of 1991 for this project. Bonneville produces roughly 600,000 kw hours of electricity daily. Additional beneficial uses associated with Bonneville Dam include: regulation of water to control floods and fish passage systems; and facilitation and navigation of vessels up and down the River. Hydropower generation can potentially alter the water quality of the lower Columbia River and adversely affect fish by creating high water temperatures, high spill flows, low dissolved oxygen levels, and high total dissolved gas saturation.

Navigation is maintained along the lower Columbia River by creating and/or maintaining dredged channels and basins. Three federal projects exist within the study area: (1) near the mouth of the Columbia; (2) around the lower Willamette River; and (3) between Vancouver, Washington and the Dalles, Oregon. Federal laws require that dredging and disposal of sediments produce no unacceptable adverse environmental impacts.

Foreign import and export make up the bulk of shipping traffic in the lower Columbia River. The primary cargos exported during 1990 were wheat, corn, logs, and soda ash. Domestic shipping is carried primarily by barge. Barges carry grain, paper and chips from upstream ports for foreign export. Fuel barges carry petroleum products upstream to interior ports.

Primarily nontreaty commercial fisheries use the lower Columbia River, mainly below RM 40. Salmon, steelhead, sturgeon, smelt, and shad are the principal species harvested commercially. The number of fishing days, allowable catch of certain species, and number of boats permitted to be in a certain location is regulated by the Columbia River Compact. The beneficial uses associated with the commercial fishing industry are jobs for fishermen and related businesses, and a source of food for consumers world-wide.

Of all the commercial uses along the lower Columbia River, commercial fishing is the most sensitive to water quality changes. If water quality is altered to intolerable levels for fish, then mortality and disease increase, and fish runs are diminished. Fewer fish directly affects the commercial fishing industry because fishing seasons are shortened and the allowable catch is reduced.

Eleven port districts operate on or adjacent to the lower Columbia River and provide a variety of commercial facilities and services including: marinas, docks, fuel facilities, boat launches, cargo handling facilities, fishing, picnicking, and swimming. These diverse activities are all affected by changes in water quality in different ways and to different degrees. Often the actions of one activity can directly affect the successful actions of another activity, therefore they all depend to some degree on each other for continued survival.

Three tour-boat companies, operating from Portland, run cruises on the lower Columbia River. Typically less than 20 cruises occur in a year and mostly during the summer tourist season. The success of the tour-boat industry depends on the public's perception of the aesthetic quality of the lower Columbia River, which is closely tied to water quality changes.

3.0 DATA AVAILABILITY AND GAPS

A large volume of literature exists on the Columbia River. However, most of the literature reviewed is not specific to actually dealing with beneficial uses, and few address the relationship of beneficial uses to changes in water quality. The following comments describe the data that was available, as well as the data gaps that were discovered in preparing Task 5 reports.

- There was a lack of precise information on water supply permits for withdrawals and discharges on both sides of the Columbia River. It was often difficult to determine the number of withdrawals, the exact location, the permitted rate, and the type of use.

- No information was found on use trends of water withdrawal for agriculture. There was also no information on the types of crops grown along the Columbia River study area.

- There was a tremendous amount of data on fish, wildlife, plants, and invertebrate species that use or inhabit the lower Columbia River. However, there was little scientific data on these same species sensitivity to changes in water quality.

- There was a general lack of scientific water quality impact studies on migrating waterfowl and resident birds using the lower Columbia River. This type of information is essential since so many birds use this area for feeding, wintering and breeding activities.

- No scientific information was found which relates the sensitivity of fishing, boating, and hunting to changes in water quality.

- Several studies exist on the relation between hydropower dam operation and fish survival and migration. Both physical (e.g., fish passage) and chemical (e.g., nitrogen supersaturation) aspects of this relationship are addressed in these studies.

- No specific information was found relating commercial activities, except commercial fisheries, to changes in water quality.

- Intensity of beneficial uses is difficult to determine without detailed study. A correlation between intensity of use and water quality cannot be made at this level of reconnaissance.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The goal of Task 5 was to identify and describe the beneficial uses along the lower Columbia River, location of the use, frequency and season of the use, who or what is involved in the use and how sensitive the use is to water quality changes. The beneficial uses of the lower Columbia River are sensitive to water quality changes in different ways and in varying degrees. In order to document the current health of the Columbia River within the study area, the water, fish, sediment, and benthic invertebrates were sampled in designated locations as prescribed in the Reconnaissance Survey Sampling Plan for the lower Columbia River. The data gathered in Task 5 led to recommendations concerning each of the beneficial uses and how they apply toward developing this Sampling Plan. The recommendations from Task 5 are presented below.

Under **water supply** the major users of the Columbia River for municipal, industrial, and domestic purposes were identified. The Cities of Vancouver (RM 105) and Camas (RM 120) use wells along the River for municipal water. Alcoa (RM 102) is the largest private user for domestic and heat exchange supply. Whenever water sources are used for drinking water and other municipal domestic uses there is concern for human health. The major concerns for drinking water are contamination by fecal coliform and other pathogens, nitrates, and toxic levels of metals and/or organic chemicals. Well water is less likely to be contaminated, because it is naturally filtered before being withdrawn for use. Two of the largest industrial users of both surface and well water are Weyerhauser (RM 63) and Reynolds (RM 62).

There are few of agricultural lands along the lower Columbia River. The largest **agricultural** user of the River is the Bachelor Island Ranch (RM 87-88). Depending on the use of the water (for irrigation or livestock), diminished water quality could affect crop production rates and quality, soil chemistry, and potentially the health of livestock. Conversely, a large agricultural area has the potential to alter the quality of the river water by adding excess amounts of fertilizer, pesticide and herbicide residues, sediment, and fecal coliform.

Fish use occurs along the entire length of the lower Columbia River. Fish species are year-round residents or migratory. Several areas of the River provide prime habitat for fish and shellfish and are known as popular fishing and crabbing locations. The mouth of the Columbia River (Buoy 10) contains large concentrations of fish and Dungeness crabs (RM 0-6). The Cowlitz River (RM 68), Kalama River (RM 73) and Sandy River (RM 120-122) are also popular places for recreational fishing. With increased opportunity for human and wildlife consumption of fish from these areas the quality of the water and bottom sediment becomes a concern. Toxic substances are known to accumulate in sediment and fatty tissue. Since fish contain a large percentage of fatty tissue per body weight they have the ability to bioaccumulate any excess toxins. These pollutants can cause disease and cancerous lesions in the fish and, in turn, these diseased fish can contaminate consumers. Pollutants of major concern are metals and organic chemicals.

Wildlife use is prevalent throughout the river but particular locations (refuges and river mouths) support large concentrations of a wide range of species. Sampling focused on known bald eagle/osprey/raptor and sensitive amphibian usage areas. Because their main food staple comes from the River, these species are susceptible to changes in water and sediment quality. Bald eagles and other raptors primarily feed on fish from the river. The U.S. Fish and Wildlife Service has indicated that peamouth chub are a common prey species of the bald eagle. Several sensitive amphibians (i.e., red-legged frog and Olympic salamander) reside at the mouth of the Sandy River (RM 120-122). Because they absorb toxins through their skin they are vulnerable to water quality

and sediment degradation, especially high levels of metals and phosphorus. Not only can these substances be fatal to the amphibian, but also can cause problems to the predators who consume them. Amphibians, like fish, can store excess toxins in their fatty tissue. This can lead to bioaccumulation of toxins in the food chain and ultimately affect many creatures.

Many **recreational uses** occur in and along the lower Columbia River. Primary contact sports are of particular concern because humans come in direct contact with the water. Swimming, wind surfing, water skiing, and fishing areas are locations important to monitor for water quality problems. Areas that are heavily used are Jones Beach (RM 45) for wind surfing, Youngs Bay (RM 12) for primary contact activities, and Skamokawa (RM 33) for primary contact activities and fishing. Degradation of water quality could potentially affect waterfowl and fish populations which would directly affect hunting and fishing activities. Excess nutrients can produce algai blooms which would hamper boating and contact activities. Pathogens and toxic chemicals that come in contact with the skin, or are ingested by humans, can cause skin irritations or illness. Accumulations of oil and grease on the water surface, unpleasant odors due to anaerobic conditions, discoloration of the water due to excess sedimentation, and a spill or a discharge plume can affect the visual appearance of the River and diminish the aesthetic qualities normally associated with a healthy riparian system.

Of all the commercial uses along the lower Columbia River, commercial fishing is by far the most sensitive to water quality changes. The open season for **commercial fishing** is regulated by the number of days, season, location and species caught. Most of the commercial fishing takes place from the mouth to RM 40 and especially between RM 25-35. Tongue Point, Youngs Bay and the Cowlitz River are also regularly fished for certain species. Fish species that are of economic importance are salmon, steelhead, sturgeon, smelt and shad. If water quality is altered to intolerable levels for fish, then mortality and disease increase, and fish runs are reduced. Fewer fish directly affects the commercial fishing industry because fishing seasons are shortened and the allowable catch is reduced. Fish are highly sensitive to changes in water temperature, dissolved oxygen, dissolved gas saturation, sediment loading, and high concentrations of metals and organic compounds.