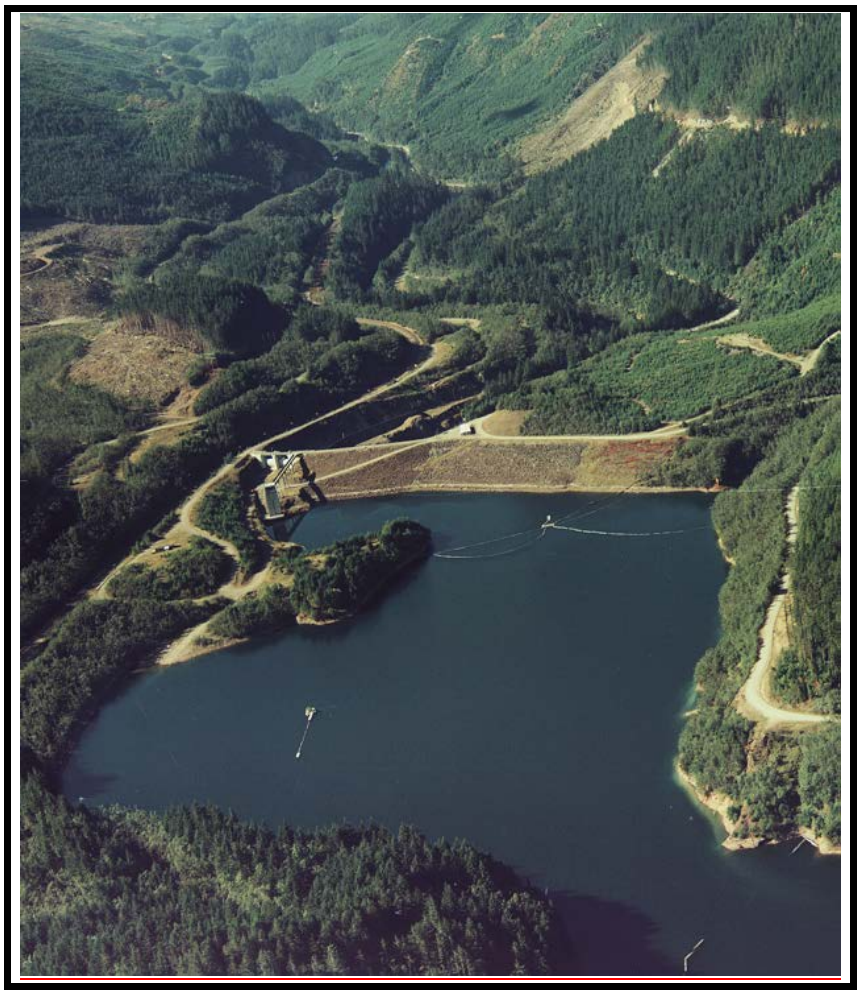
Design Memorandum No. 27

HOWARD A. HANSON DAM MASTER PLAN



US Army Corps
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Seattle District

AUGUST 1999

VALIDATION

The Howard Hanson Dam Master Plan, Design Memorandum No. 27, prepared by Engineering/Construction Division, has been coordinated with all pertinent elements of Seattle District, including Operations and Real Estate Divisions.
August 1999.

Chief, Engineering/Construction Division

Chief, Operations Division

Chief, Real Estate Division

It is recommended that the Howard Hanson Dam Master Plan be adopted as a guide to the orderly use, development and management of the natural and related resources of the Howard Hanson Dam project, administered by the Seattle District of the US Army Corps of Engineers. Land classifications and resource objectives recommended in the plan will provide for sound resource use, development, and management consistent with the authorized project purpose and based on the determination of the highest and best use.

Approved:

James M. Rigsby
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ACKNOWLEDGMENTS

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Cover Photo: Howard Hanson Dam and adjacent lands, looking downstream in a northerly direction. September 24, 1984.

EXECUTIVE SUMMARY

The Howard A. Hanson Dam–Eagle Gorge Reservoir Project Master Plan, Design Memorandum No. 27, has been prepared in accordance with Engineer Regulation 1130-2-550 to guide the use and development of the natural and manmade resources. Howard Hanson Dam and Eagle Gorge Reservoir are operated and maintained by the Seattle District, US Army Corps of Engineers.

This master plan is a tool for the responsible stewardship of the natural resources to benefit present and future generations, and to promote the awareness of environmental values as well as the need for protection, conservation and restoration. It identifies and assigns the resource management practices being considered and implemented, and when approved, will provide the basis for the preparation of the Operational Management Plan (OMP) that will achieve the objectives outlined in this plan. Descriptive information about the Howard Hanson Dam project is covered in Sections 1 through 4. Resource objectives and management actions for specific areas are covered in Sections 5 through 7. Design criteria and recommendations can be found in Sections 8 and 9.

Howard Hanson Dam and Eagle Gorge Reservoir are the primary components of a comprehensive flood control plan for the Green River in King County, in the state of Washington. Lands administered by the Corps of Engineers have been classified according to their authorized purposes of flood control and water storage for river flow regulation. These classifications are Operations: Project Operations, Operations: Multiple Resources Management – Vegetation, and Operations: Easements.

Projectwide resource use objectives fall into five broad categories – project operation for flood control; natural resource management for present and future generations; habitat management for fish, wildlife and timber; energy conservation and management efficiency; and coordination with appropriate groups for proper management. These categories are covered more fully in Section 1.

In addition to the management actions listed in this plan, the following overall actions should be taken to assure orderly use, development, and management of the project resources: (1) periodic re-evaluation of the identified resource objectives and updating of the master plan as appropriate, (2) development and implementation of a project sign plan that is responsive to official visitors entering the area, (3) preparation of an Operational Management Plan, and (4) preparation of a Historic Properties Management Plan.

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SECTION 1

INTRODUCTION

SECTION 1 – INTRODUCTION

1.1 PURPOSE

The Howard A. Hanson Dam–Eagle Gorge Reservoir Project Master Plan, hereafter referred to as the master plan, will guide and direct the future use, development and management of the natural resources, recreational, and cultural resources management programs of Howard Hanson Dam, which also includes the lands of Eagle Gorge Reservoir. Lands managed by the Corps of Engineers, including fee owned and easements, may be referred to as project lands in this document. This master plan does not evaluate operational aspects of the project for flood control, nor is it within the scope to do so. All Corps of Engineers' Civil Works projects and other fee owned lands are required by Engineer Regulation (ER) 1130-2-550, *Project Operations - Recreation Operations and Maintenance Policies*, to have master plans. The ER also provides for periodic review and update. This master plan, Design Memorandum No. 27, is the first to be prepared for the project.

This master plan is a formal land use planning document which identifies and assigns the management practices being considered and implemented on Corps lands. It is the basic document guiding the Corps of Engineers' responsibilities, pursuant to federal laws, to preserve, conserve, restore, maintain, manage, and develop lands, waters, and related resources associated only with Corps lands on and around Howard Hanson Dam. Subsequent planning, design, development and management decisions, including outgrants, will be consistent with the land use classifications and resource objectives assigned and established in this master plan. The master plan is both flexible and conceptual by design and is subject to revision and updating as indicated by changing needs and conditions. An operational management plan (OMP) will be developed and implemented to translate the concepts of this master plan into operational terms, and to achieve the objectives within the approved master plan.

1.2 SCOPE

This master plan assesses project resources in order to develop guidelines that provide for their best and highest use, development, and management. Evaluation is focused specifically on lands administered by the Corps of Engineers and includes consideration of scenic, cultural, historic, and biological values. The primary scope is to prescribe an overall land and water management plan for the natural resources, recreational, and cultural resources management programs; establish resource objectives for these programs; and present associated design and management concepts. It provides a guide for the best possible combination of responses to regional needs, resource capabilities and suitability, and expressed public interests and desires consistent with the project's authorized purposes, historic designation, and other institutional policies and directives. It is based on a thorough understanding of the operation of the project and of project operations land and facility

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requirements. Land classifications and resource management prescriptions are formulated to be in harmony with these requirements.

1.3 PLAN FORMULATION

This master plan has been formulated utilizing the study framework depicted in Figure 1-1. The process was developed in the Northwestern Division as a means to improve the quality and usefulness of Corps master plans and to reduce the long-term cost of the master planning program. Major outputs of the process include the elements listed below that are in accordance with the intent of chapter 3 of Engineering Regulation (ER) and Engineering Pamphlet (EP) 1130-2-550.

1.3.1 Establishment of Howard Hanson Dam resource use goals which are listed in Section 1.4 below.

1.3.2 Assignment of land classifications and restricted water use zones to dam lands (Section 4).

1.3.3 Establishment of resource objectives for areas in which land classifications has been assigned (Sections 5 through 7).

1.3.4 Identification of management and development measures for accomplishing resource objectives (Sections 5 through 7).

1.3.5 Identification of major constraints that might hinder accomplishment of resource objectives (Sections 5 through 7).

1.3.6 Specification of design criteria to be considered in future design phases of plan implementation (Section 8).

1.3.7 Recommendations for subsequent aspects of planning for use, development, and management of project resources (Section 9).

1.4 HOWARD HANSON DAM RESOURCE USE GOALS

Resource goals provide the overall framework which guides the use of resources administered by the Corps of Engineers at a project site. Goals, and later objectives in this master plan, are specific to the Howard Hanson Dam project and individual areas, and specify attainable options for resource development and management. They have been developed through study and analysis of regional needs, expressed public desires, and resource capabilities and potentials, and are formulated to guide and direct the overall natural resources management program.

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1.4.1 Project Operation. To maintain and operate Howard Hanson Dam in order to provide flood control and low flow augmentation for the lower Green River as a primary purpose.

1.4.2 Natural and Cultural Resource Management. To manage the natural and cultural resources in order to ensure their continued availability to present and future generations.

1.4.3 Habitat Management.

a) To preserve, protect, and enhance existing fish and wildlife habitat on dam lands, including wetlands and water areas, through a cooperative effort involving federal, tribal, state, local, and citizen interests.

b) To permit timber harvesting only when required in order to improve wildlife habitat, or on an individual tree basis in order to remove diseased or other trees which may pose a safety hazard.

c) To maintain a sustaining level of snags and logs for cavity nesters in order to ensure their continued population.

1.4.4 Energy Conservation and Management Efficiency. To emphasize conservation of energy resources and seek means to increase management efficiency in all resource management activities.

1.4.5 Coordination. To maintain close, ongoing coordination with interested federal agencies, Native American tribes, state and local agencies, and citizen groups and organizations in order to properly manage the natural and manmade resources associated with Howard Hanson Dam and Eagle Gorge Reservoir.

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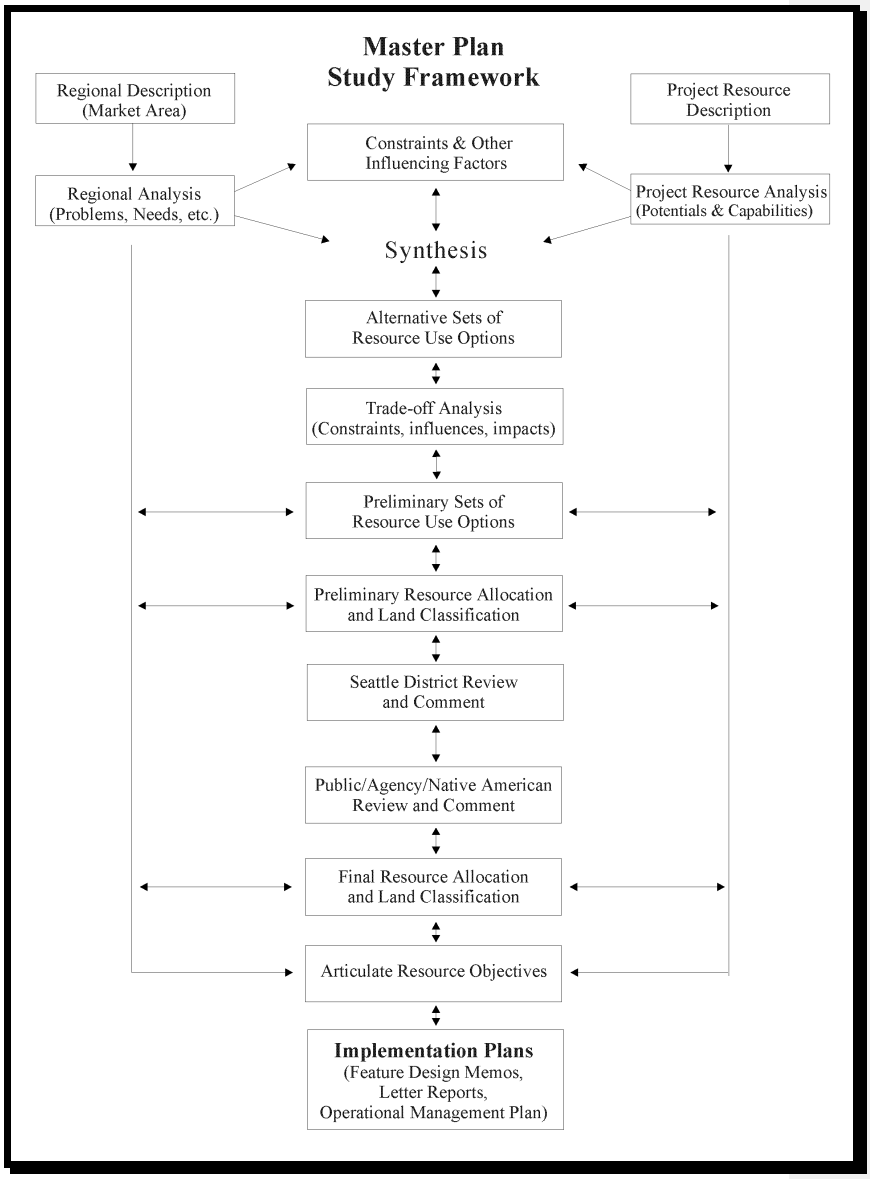

Figure 1-1: Master plan study framework.

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SECTION 2

PROJECT DESCRIPTION

SECTION 2 – PROJECT DESCRIPTION

2.1 AUTHORIZATION

The Flood Control Act of 1950 authorized the construction, repair, and preservation of certain public works on rivers and harbors for navigation, flood control, and for other purposes. Authorization for the creation of the Eagle Gorge Reservoir, including a flood control dam, on the Green River in Washington State was provided for under this Act dated May 17, 1950 (Public Law 81-516, Section 204), and in accordance with the recommendations of the Chief of Engineers in House Document 271 (81st Congress, 1st Session). In July 1951, during the Korean War, President Truman issued a directive prohibiting new starts for planning or construction unless they were certified as necessary for national defense. A brief was forwarded in November 1951 indicating that flood control was needed in the Green River valley to provide government and private industry building sites to support the war effort. President Truman approved the construction of Howard Hanson Dam on May 14, 1952 to satisfy this need.

Legislation to name the dam being constructed as part of the Eagle Gorge Reservoir project to Howard A. Hanson Dam was signed August 6, 1958 (PL 85-592). The dam was named after the prominent attorney and civic leader in recognition of his active sponsorship of the project. Utility relocations were initiated in 1955. Construction of the dam began in 1959 with completion in April 1962.

2.2 AUTHORIZED PURPOSES

Recommendations by the Chief of Engineers in 1949, and with concurrence from local interests, were to develop the Green River basin in the interest of (1) flood control, (2) fish conservation (low flow augmentation), (3) municipal water supply, (4) irrigation, and (5) water quality benefits, as described below. This included construction of a dam and creation of a reservoir on the Green River. Of the three sites considered in the early studies, the deep valley section in the vicinity of Eagle Gorge was the cheapest and only site situated far enough upstream to serve the combined purposes.

2.2.1 Flood Control and Fish Conservation. Howard Hanson Dam primarily operates for flood control with a secondary purpose of low flow water augmentation. Flood control for the Green River valley is managed through the impoundment of water from streams and tributaries in the upper watershed into Eagle Gorge Reservoir during the peak flood season, generally November through February. In the spring, the lower volume of incoming water sets into motion the compatible secondary use of storage in the reservoir. Snowmelt still present in the upper watershed is stored to bring the reservoir up to its summer conservation pool for low stream flow augmentation of the Green

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River for fish conservation. Regulated releases ensure downstream stability and provide for ample storage throughout the year.

2.2.2 Municipal Water Supply. The city of Tacoma diverts its principal municipal water supply from the Green River by means of a diversion dam that was constructed in 1912 (Photo 2-1). The diversion dam is located three miles downstream from Howard Hanson Dam. At the present time, Howard Hanson Dam does not operate Eagle Gorge Reservoir directly for water supply, although waterflows are regulated in a manner that considers the city's water supply system. An *Additional Water Storage Project* feasibility study (authorized under Section 216, PL 91-611—Title II-Flood Control Act of 1970) is underway of current water supply needs that could be served by the dam and reservoir.

Photo 2-1: City of Tacoma Headworks' diversion dam. September 18, 1994.

2.2.3 Irrigation in the valley is no longer a priority. Much of the original agricultural lands have been eliminated due to area developments.

2.2.4 Water quality improvement is primarily associated with the waterflows released for fish during the summer and fall. These supplemental flows tend to improve the water temperature regime in the river relative to that which would occur without Howard Hanson Dam and other development in the basin.

Additional past use considerations discussed expansion of navigation on the Green River, recreation, hydropower, and industrial development. Modifications for navigation on the Green River were not implemented with the exception of expansion for the Duwamish waterway closer to the city of Seattle. There were, and continues to be, no plans to develop the reservoir area for recreation since the area lies entirely

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within the watershed of the Tacoma municipal water supply system. It is certain the city of Tacoma would protest development that might contaminate their water supply. Hydropower was not considered favorable because operation of the reservoir for its primary purpose of flood control eliminates the possibility of storage for power when it is most needed. During this time the reservoir must be kept low or empty to allow for storage of floodwaters. With the control of flooding came industrial expansion in the Green River valley, including Boeing complexes and other industry in the Southcenter, Kent and Auburn areas. This expansion followed with an increase in available housing for area workers and new residents.

2.3 LOCATION

Howard Hanson Dam is located in King County, Washington, on the upper reach of the Green River, 64.3 river miles above the mouth of the Green-Duwamish River system; 45 miles southeast of Seattle, 35 miles east of Tacoma, and six miles upstream from Kanaskat (Figure 2-1).

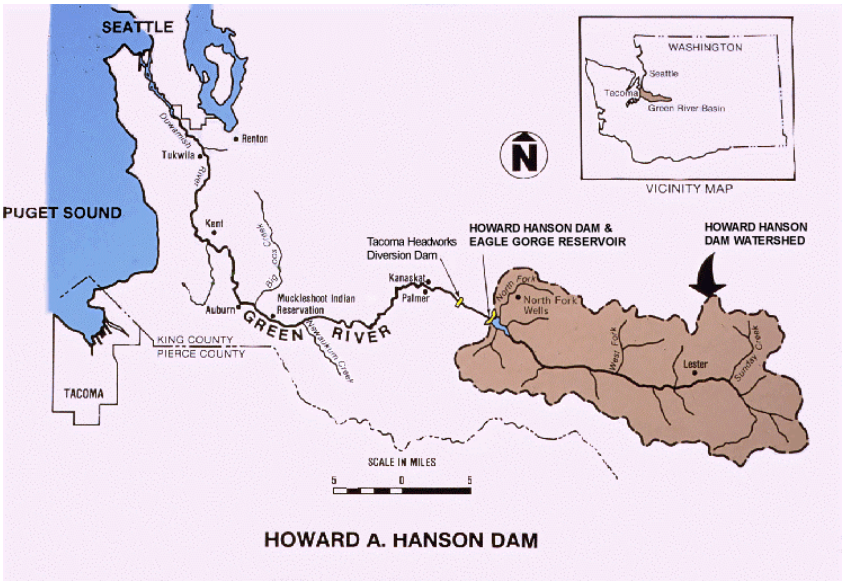

Figure 2-1: Site of Howard Hanson Dam and Eagle Gorge Reservoir.

2.4 PERTINENT DATA

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Construction of Howard Hanson Dam was initiated in 1959 with completion in 1962. It became operational for flood control in 1961. The dam is earth-filled with rock, sand and gravel. It is 235 feet high and 450 feet long (top length). There is no powerhouse as the project does not generate power. A description of the dam and its structures can be found in Section 5. Pertinent project data is included in Appendix A. General information about Howard Hanson Dam can also be found on the World Wide Web at http://www.nws.usace.army.mil/opdiv/hanson/hanson.htm. Topics include *Why The Dam Was Built, The Dam in Operation, A Dam in a Protected Area, Inspections, Dam Named to Honor Civic Leader,* and *Project Location and Information*.

2.5 HISTORY

Howard Hanson Dam collects excess runoff from a 221 square-mile upper drainage area in the Cascade mountain range (Figure 2-2). The entire Green-Duwamish River drainage basin encompasses 483 square miles. Until 1906, the Green River was a major tributary to the White River, the latter flowing northwest from the glacial headwaters of Mount Rainier to Elliott Bay. In November 1906, floodwaters from the White River broke through a low point at the junction of the Green River south of the city of Auburn. This diverted the White River's primary flow southwest, through the existing floodplain, and into the Stuck River, a tributary to the Puyallup River which is now obsolete. In an attempt to reduce flooding in the lower Green-Duwamish valley, King and Pierce counties agreed to construct a diversion to make the new route of the White River permanent. The White River no longer contributed main stem flows to the Duwamish River.

Outflows from the south end of Lake Washington formed the Black River. Prior to November 1906, this river flowed south, then west to join the White River. The junction was just east of the city of Tukwila at a point north of Fort Dent Park. Throughout 1907, the White River was unofficially referred to as the Duwamish River from this junction north to Elliott Bay. Later, the White River south of this junction was renamed the Green River. In 1912, the Cedar River, which flowed into the Black River in the city of Renton, was diverted to flow north into Lake Washington. In 1916, the hydrology of the basin was further changed by the opening of the Hiram M. Chittenden Locks and the Lake Washington Ship Canal into Puget Sound. When the ship canal was opened, the level of Lake Washington dropped about nine feet, cutting outflows to the Black River. The loss of Cedar River inflows and outflows from Lake Washington converted the Black River to a drainage basin that principally collected floodwaters. Since that time, channelization and diking within the lower Green River valley has occurred, further altering the Green-Duwamish River's natural course.

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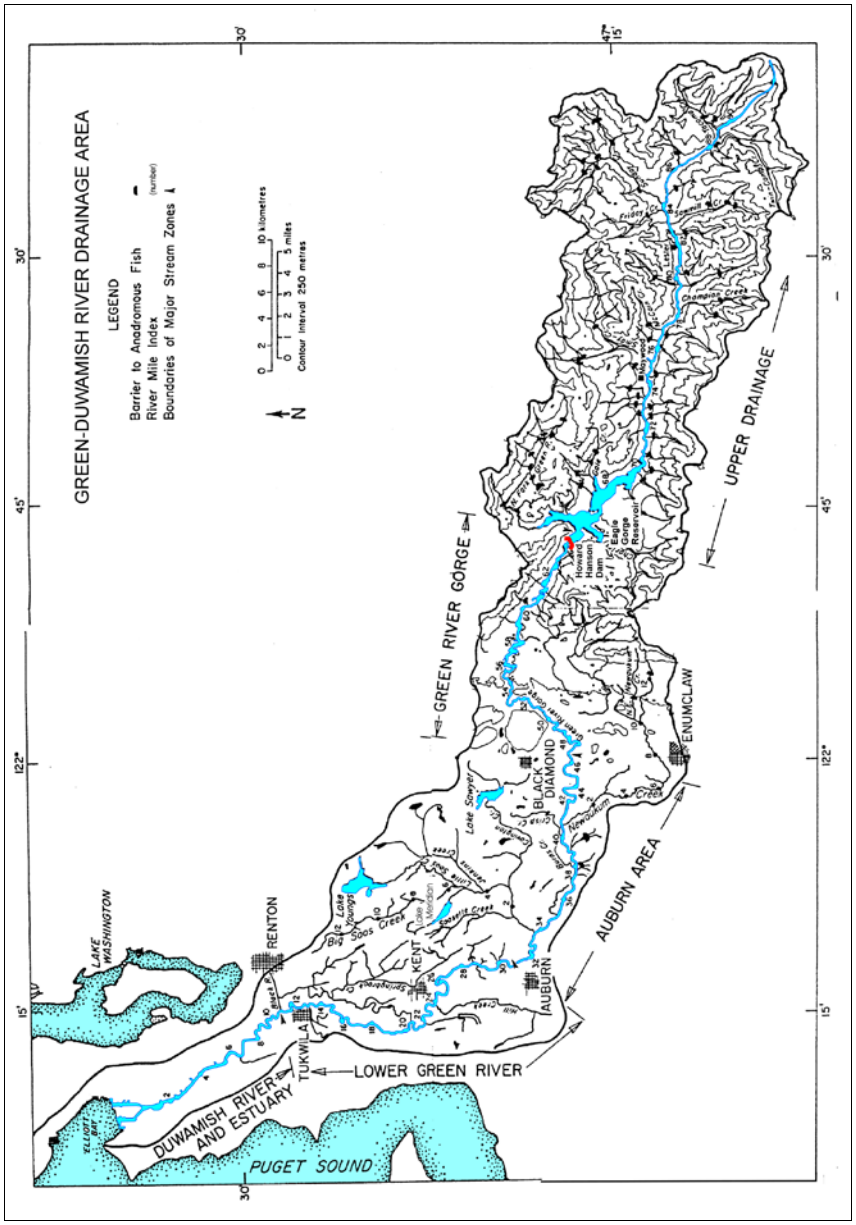

Figure 2-2: Green-Duwamish River drainage basin. Howard Hanson Dam and Eagle Gorge Reservoir are on the east end of the Green River Gorge. Operations HHdrainmap.gif.

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Prior to the 1850s, the Green River valley was inhabited by Native Americans subsisting by hunting, gathering, and fishing. They left the valley floor essentially undisturbed since they did not practice agriculture. Euro-American settlements in the valley began in the 1850s. Encouraged by the Homestead Act of 1862, pioneers cleared land for subsistence farming and constructed levees to control river and tributary waters from flooding their land. Most of the forests on the valley floor had been cleared for agriculture by 1894. Flooding was an ongoing problem, especially in the lower Green River valley and the area from the city of Auburn to the Black River near Tukwila. In 1912, a water supply diversion system for the city of Tacoma was built on the Green River approximately three miles downstream from Eagle Gorge. This became the main source for Tacoma's municipal water supply.

Farming continued but constant efforts were required to control flooding. In June 1936, the Flood Control Act was passed authorizing a preliminary examination and survey for flood control. In November 1937, a public hearing was held jointly by the Departments of War and Agriculture in Seattle. Local interests stressed the need for flood control. A survey report was ordered by the Corps of Engineers, Seattle District, in June of 1938. In October 1948, the Chief Engineer approved the submission of a combined navigation and flood control survey report. Different possible means for flood control were considered including channel improvements, storage, or some combination of the two. After detailed studies and cost estimates, rectification through channel improvements alone was disregarded as a possibility. Thus began the search for the best location for a flood storage dam.

2.5.1 Site Selection and Construction. Three sites were investigated by the Corps' District Engineer in 1933. This investigation concluded that a dam six miles upstream from Auburn was not feasible due to potential loss of salmon spawning area. Of the proposed sites, Eagle Gorge was found to be the most cost effective and the only site situated far enough upstream (beyond the upstream barrier for anadromous fish runs) to serve the combined function of flood control, storage, irrigation, and conservation.

Before any construction of the dam could begin, 13 miles of the Northern Pacific Railway main line (now Burlington Northern and Sante Fe Railway Company) that ran through rough mountainous terrain had to be relocated. The difficult job of relocation began in January 1956. The new section of track took its first traffic on June 28, 1959. Costs to relocate the railway exceeded the total cost to build Howard Hanson Dam.

Construction of the dam, including spillway and stilling basin, intake tower, outlet works, and low flow bypass, was completed between 1959 and 1962. Prior to completion, the last major flood in the Green River valley occurred in 1959, causing approximately $4 million in damage. The dam held back the first potential flood in 1962. The first significant flood pool, which

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briefly attained elevation 1,161.9 feet National Geodetic Vertical Datum (NGVD), occurred in February 1965. At that time, a spring abruptly broke out at elevation 1,134 feet about 350 feet downstream from the downstream right abutment toe. The spring was controlled by a gravel blanket supported by a crib wall. In 1968, a drainage tunnel was constructed at elevation 1,100 feet, extending 650 feet into the right bank, adjacent to the dam. Twelve relief wells were drilled to intersect and extend 20 feet below the tunnel floor. This system appears to have adequately controlled abutment seepage during the flood pools experienced to date. Flood control measures were completed with construction of drainage channels in the valley, planned by the former Soil Conservation Service (now the Natural Resources Conservation Service), in 1966 to eliminate backwater and pooling.

2.5.2 Subsequent Development. The floor of the lower Green River valley has little gradient. Natural levees create slight gradients away from the river, causing runoff water to drain toward the edges of the valley. When the river overflowed, the runoff drained down these natural levees inundating the valley floor. The Green River is most prone to flooding between the months of November and February as a result of high rainfall and snowmelt. Severe floods, inundating a majority of the valley floor, occurred at intervals of 8 to 16 years. Smaller scale floods took place at two-year intervals. This flooding added a layer of nutrient-rich silt to the valley floor which led to “luxuriant” vegetation consisting of bushes, sedges, or grasses at the lower elevations. Thickets of maples, cottonwood, ash, and alder, with intermittent fir, cedar, and spruce, grew on higher ground.

The Green River system strongly reflects the social change and economic growth that has occurred over the past century in King County and the Puget Sound region. It is a valuable economic, cultural, recreational and ecological resource. Intrinsically, the value of the river resource is directly related to the quality of the water, which is used for a variety of purposes. The Green River is the main source of water supply for the city of Tacoma and is used for municipal and industrial purposes. It supports a valuable fishery used by commercial, tribal, and recreational interests. It is used extensively for recreational boating, rafting, swimming, and other activities. Despite all of the physical changes to the river and within the river valley, water quality has generally remained good to excellent. Historically, water quality problems existed within the lower watershed during the low flow periods of the summer months. Water quality has generally improved in the lower river because of low flow augmentation from Howard Hanson Dam and the completion of sewage treatment plants and storm water control facilities in the region.

Landowners and local governments in the Green River valley benefit from the reduction in flood damages due to Howard Hanson Dam. Throughout

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the 1960s, the valley transformed from agriculture to major industrial, commercial, and residential uses. By the early 1970s, farming in the valley was substantially reduced—much of the land was either left vacant or converted to industrial/commercial use. During the 1980s, land use in the valley further diversified to include not only industrial, manufacturing, and warehousing uses, but service industries and commercial offices. Today, the Green River valley is primarily classified as industrial with some residential, commercial, and farmland areas. The elimination of flooding in the Green River valley has been the single overriding impact of Howard Hanson Dam.

2.6 SETTING

Howard Hanson Dam lies entirely within the protected city of Tacoma municipal watershed and is closed to the public. Upstream from the reservoir the river generally falls over steep, mountainous terrain, restricted by narrow valley walls to its headwaters on Blowout Mountain near Stampede Pass. Except for the dam, there is no streamside development upstream. Aside from the Tacoma watershed, the rest of the area is owned by private timber companies, the Burlington Northern and Sante Fe Railway Company, the Washington State Department of Natural Resources, and the US Forest Service (USFS). It is managed as part of the Snoqualmie National Forest. Plate 2-1 show the various parcel ownership.

Two distinct environments exists—the upper watershed or upstream, and the lower watershed or downstream. For this master plan, only those lands managed by the Corps of Engineers are being addressed, essentially those within the upper watershed. For analysis of the lower watershed areas, refer to the *Howard A. Hanson Dam Final Environmental Impact Statement for Operation and Maintenance* (January 1997), and the *Section 1135 Fish & Wildlife Restoration Project – Final Project Modification Report/Environmental Assessment* (September 1996).

Howard Hanson Dam controls runoff from approximately 221 square miles of the Green River watershed. During April the reservoir begins to fill to its summer conservation pool level of 1,141 feet (Photo 2-2). At this elevation, the reservoir extends 4.5 miles southeasterly up the Green River from the dam, and 2.5 miles northerly up the North Fork of the Green River. From the end of October to the end of March the reservoir is normally maintained at a minimum level of 1,070 feet to allow for later flood control storage space.

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Photo 2-2: Summer conservation pool (top inset) and winter pool (bottom inset). 1997.

During the summer conservation pool, the reservoir's usable storage is 25,400 acre-feet with a surface area of 780 acres. The reservoir operational goal (rule curve) is to prevent winter flooding and provide additional water for low flow periods in the summer and fall for fishery enhancement.

In the event of a flood and high watershed runoff, Eagle Gorge Reservoir has the capacity to provide 106,000 acre-feet of water storage at the maximum design flood pool elevation of 1,206 feet. At this elevation, the reservoir extends seven miles southeasterly up the Green River from the dam, and 4 miles northerly up the North Fork of the Green River. Maximum pool levels reached to date have been at elevations 1,176.2 feet on December 4, 1975; 1,173.4 feet on December 4, 1977; and 1,183 feet on February 10, 1996 (Photo 2-3).

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Photo 2-3: Winter low pool in June (elev. 1,070 feet, top inset), summer conservation pool in August (elev. 1,133 feet, middle inset), and record flood pool February 10, 1996 (elev. 1,183 feet, bottom inset).

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2.7 LANDS ADMINISTERED BY THE CORPS OF ENGINEERS

Corps of Engineers real estate interests surrounding Howard Hanson Dam consists of 2,271.97 acres (refer to Plate 2-1 for ownership). Of these, 419.33 acres are owned in fee, 66.00 acres are held by license, 1,786.63 acres are held by easement, and 0.01 acre is leased. Fee-owned lands are at the dam itself and its surrounding areas, plus the old railway grade upstream from the dam. Lands beneath the reservoir are owned by others. The Corps obtained easements to flood up to a maximum reservoir elevation of 1,206 feet as part of the project's authorization. Further real estate information is provided in Appendix B.

2.8 ACCESS

Howard Hanson Dam is not open to general public access. From Interstate 405, via the Maple Valley Highway (State Route 169), local roads lead to the town of Kanaskat from which Headwaters Road follows the Green River up to the Tacoma diversion dam, then up to the controlled security gate which allows access to the watershed. The security gate is operated by the city of Tacoma.

2.9 RESERVOIR OPERATIONS

2.9.1 General. Howard Hanson Dam exists for the control and management of water in the Green-Duwamish watershed, and continually evolves. Since project completion in 1962, population of the Green River valley and the entire Puget Sound region has greatly increased. Land use in the lower valley has shifted from primarily rural and agricultural to a mix of urban and industrial uses. Roles of tribal governments, and state and local agencies in the management of the Green River and its resources have changed significantly. The Corps of Engineers has undergone a general shift to a more adaptive management approach and is currently involved with other agencies in their resource management activities.

Since the time of the original authorization, priorities have changed in the watershed (such as the social and economic importance of recreational uses) and new information is available about the life cycle and habitat needs of many fish species. Additional considerations that were not in place when the project was authorized have also been placed on the river, such as balancing tribal rights and development pressure. The new information and the new demands on the Green River now play an important role in current water management decisions. Water management of Eagle Gorge Reservoir is a complex task involving decisions that directly involve many issues of local and regional importance. It relies heavily on input from several outside agencies and interested parties. The demands for water between species, resources, and water users is often

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competitive. While they are not necessarily mutually exclusive or conflicting, they increase the complexity of water management.

2.9.2 Operations Responsibility. Responsibility for operation of the dam is held by various departments in the Corps of Engineers, Seattle District. Below is a list of the general responsibilities.

a) Engineering/Construction Division.

- Technical Services Branch. Provides structural and operational guidance, emergency action planning, safety inspections, safety systems, and hazardous and toxic waste assessments.

- Hydrology and Hydraulics Section. Responsible for the amount, timing, and quality of water in the reservoir. Regulates Eagle Gorge Reservoir refill rates based on the rule curve in effect and available information. Responds to requests for changes in operation from outside entities and must deal with multiple, sometimes competing, interest groups and unpredictable weather situations.

- Environmental Resources Section. Provides technical support for fish and wildlife issues, cultural resources requirements, and Native American coordination, as well as for compliance with laws and regulations for environment and historic preservation.

b) Programs and Project Management Division.

- Civil Projects and Planning Branch. Provides technical and planning support for dam and river operations, habitat restoration and enhancement projects for fish and wildlife (such as Section 1135 activities which are further supported by the Environmental Resources Section), and coordinates resource studies and other issues. Not always directly involved with operations.

c) Operations Division.

- Chief of Operations Division. Assures staffing and safety of dam personnel.

- Howard Hanson Dam personnel. Operate and maintain the dam on a day-to-day basis, including the physical dam structure, roads, equipment, and reservoir area. Under normal conditions, respond to requests for changes in release rates from the Hydrology and Hydraulics Section.

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- Technical Support Branch. Coordinates budgetary resources and management of the natural resources. Not directly involved with actual operations of the dam.

2.9.3 Dam Operations and Water Management. Water management activities involving Howard Hanson Dam are coordinated through the Hydrology and Hydraulics Section in the Seattle District. Reservoir regulators determine hourly dam releases primarily for the authorized purposes of flood control and low flow fishery enhancement.

The reservoir is kept near empty during the flood season so runoff from the watershed above the dam can be impounded as needed. In normal years the reservoir is drawn down in November to the approximate elevation of 1,070 feet to provide flood storage capacity. During much of the winter, the Green River flows relatively unimpeded through the outlet tunnel in the dam's left abutment. As the river approaches the control flow of 12,000 cubic feet per second (cfs) at Auburn during storm events, discharge from the dam is reduced and water is impounded in the reservoir. As reservoir inflow returns to normal following a storm, the impounded water is released at a rate within the downstream channel capacity to minimize damage to downstream levees. Flood control operations are within the parameters of the project's authorization, leaving little operational flexibility during the flood season.

Eagle Gorge Reservoir fills to its summer conservation pool of elevation 1,141 feet beginning in the spring when the flood threat has passed. There is operational flexibility during late spring, summer, and early fall. Timing and rate of refill is coordinated with federal, state, local, tribal, and public interest groups. Special fishery operations are coordinated to augment flows in the lower Green River primarily for juvenile salmonids in the spring/summer and adult salmon throughout the fall.

Two studies underway by the Corps will affect the way Howard Hanson Dam is operated. A two-phase *Additional Water Storage Project* (AWS; authorized under PL 91-611, Title II-Flood Control Act of 1970, Section 216) was initiated by the Seattle District Corps of Engineers in August 1989 at the request of the Tacoma Public Utilities. This project addresses how the dam can meet the water supply needs of Puget Sound residents. If both phases are approved and implemented, the summer conservation pool will be raised to a maximum elevation of 1,177 feet. A *Section 1135 Fish & Wildlife Restoration Project* (authorized under PL 99-662, Water Resources Development Act of 1986, Section 1135) was initiated by the Corps in 1996. This project will restore natural river functions to enhance fish and wildlife. The Project Modification Report was approved April 1997. Plans and

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specifications are currently being written. It is not the intent of this master plan to describe these two plans in detail; copies of the draft AWS and final Section 1135 projects are on file with the Seattle District Corps of Engineers.

Water managers have a range of operational choices within the parameters of the authorized uses for Howard Hanson Dam. Changes in regional fishery priorities, land use, recreation, and environmental awareness have occurred since the dam was built. These external influences have resulted in operational changes and manipulations, primarily manifested in the refill timing of the conservation pool and providing for instream flow needs. The intent of water managers is to provide the most responsive and equitable utilization of water among sometimes competing uses.

2.9.4 Debris Collection and Disposal. Floating debris collects during periods of high water against three stationary booms at the dam. Smaller floating or sunken debris passes through the outlet tunnel and downstream, although it may lodge against the intake structure trash rack where it is removed periodically. Debris collecting against the stationary booms is removed when conditions permit and is towed by barge to temporary holding areas. When the reservoir is at its maximum elevation the debris is towed from the holding areas to burn areas until the pool level is lowered. Booms and salvageable material are removed, the rest is sawed and piled for burning. Some collected debris has been used in environmental restoration projects and is likely to increase in the future. See Section 7 for more detail of this management unit.

2.10 CLIMATE

The western Washington area in the vicinity of Howard Hanson Dam and Eagle Gorge Reservoir has a typical west coast maritime climate characterized by mild winters and cool summers. Weather in the project area is influenced by the nearby Cascade mountain range, Mount Rainier, and Puget Sound.

Average temperatures for July are 51°F (low) and 72°F (high); the mean annual temperature is 48°F. Frost can occur in early October and as late as June. Under normal conditions the growing season lasts 150 to 180 days. Average annual precipitation is 54 inches, 75 percent of it occurring between October and March. December is typically the wettest month of the year with an average of 6.8 inches of precipitation, while July is the driest month with an average rainfall of 1.6 inches. Annual snowfall averages 15 inches. Prevailing winds from the southwest bring in moist air; winds from the north and northwest generally bring clearer weather.

2.11 GEOLOGY

Howard Hanson Dam spans a narrow rock canyon located five miles inside the western Cascade margin. The Green River channel beneath the dam has been eroded in

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bedrock to approximately elevation 1,000 feet. The project lies within a series of western Cascade Tertiary volcanic rocks. These rocks are predominantly andesite flows, andesitic tuffs, and breccias with subordinate amounts of basalt and basaltic, pyroclastic, and felsitic rocks. Eocene sandstones of the Puget Group dip beneath the volcanic rocks at the mountain front, about five miles west of the dam.

The Green River valley at the dam site presently consists of a post-glacial canyon. Based on geologic mapping, pre-construction investigations, and observations during construction, Corps geologists postulate the presence of a deeper, older buried channel immediately north of the dam, beneath the dam's right abutment. The buried channel is deeply incised in rock and was filled, eroded, and partially refilled with glacial, fluvial and lacustrine related material. Subsequently, the north wall of the valley collapsed, creating a large rock slide mass that covered the older valley floor and forced the Green River against the south valley side where the present canyon is located. Landslide debris overlies the bedrock surface at the dam site, and forms the upper portion of the right abutment. The left abutment is bedrock.

The complex geologic conditions in the right abutment create a complicated reservoir seepage problem, which is not totally understood from the standpoint of hydrogeology. At least two major aquifers are present with the possibility that others may exist. The lower aquifer with base elevation of about 1,006 feet is found within the buried valley's alluvial materials. Pervious zones in the overlying glacial and slide materials form the upper aquifer, the probable source of the seepage problem on the downstream slope of the right abutment.

From the dam, the reservoir area extends approximately seven miles eastwardly up the Green River and four miles northerly up the North Fork. Reservoir slope stability has not been a serious problem since water was first impounded to the conservation pool at elevation 1,141 feet in December 1961. The only large slide was a quarter-mile-long slump/block failure of a terrace in glaciolacustrine sediments along the east side of the North Fork shortly after the reservoir was initially impounded. The slide was in a remote area and caused no damage to Howard Hanson Dam or private facilities. A recent slide of significance occurred in early December 1995 following a period of intense rainfall (Photo 2-4). Cause of the slide was man-induced; the crest had been loaded with rock and soil debris trucked from an area further upstream. This rotational slide occurred on flowage easement land 1.7 miles upstream from the dam at the downstream end of a rock canyon. The city of Tacoma has since cleared the area.

In 1995, the Corps completed a slope stability reconnaissance of the shoreline and indicated zones of current and potential instability. Throughout the reconnaissance study, no unstable slopes were observed that would negatively impact project safety. The maximum pool to date has been to elevation 1,183.24 feet which occurred on February 10, 1996.

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Considering the steepness of the slopes surrounding the reservoir, and the geologic character of slope materials, the reservoir has been remarkably free from slides other than small failures of colluvium. Between mid-May and mid-June, slides from apparent saturation are noticeable between Charley Creek and the upper reservoir. These slides have not affected operation of Howard Hanson Dam, but may affect future debris removal.

Photo 2-4: December 1995 landslide following an intense rainfall.

Much of the gently sloping land adjacent to the Green River has historically been, and continues to be, flooded. Two sites along the reservoir are old farmsteads, with soils formed by sedimentation left behind by flood events. These soils are generally not well suited for crop farming, but are excellent for pasturing, being primarily fine, sandy loam.

2.12 VEGETATION AND WILDLIFE

This section addresses the general types of vegetation and wildlife found in the Green River watershed and on lands for which the Corps has a real estate interest. Lists of common and scientific names of vegetation and wildlife species known and

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suspected to occur on project lands are included in Appendix C. A map delineating habitat and vegetation zones is found in Plate 2-2.

Howard Hanson Dam is located in the low elevation portion of the watershed—lands below the 1,500-foot elevation. The majority of the vegetation is broadly classified in the western hemlock zone, as described by Franklin and Dyrness in *Natural Vegetation of Oregon and Washington* (1973). If left to grow for hundreds of years without logging, most of this zone would be dominated by western hemlock, a shade-tolerant, long-lived species. However, because the lands have been managed for timber production for nearly a century, the area is dominated by Douglas fir, and thus old growth forests do not exist near Howard Hanson Dam. Douglas fir is planted because it is the wood of choice by timber companies and it dominates younger forests under natural conditions.

Several vegetative zones can be found around Howard Hanson Dam. A list of all the habitat types can be found in Appendix C. Below are the descriptions of the more major zones.

a) Coniferous (Evergreen) Forest. Douglas fir, western hemlock, western red cedar, and Sitka spruce are the predominant evergreen trees throughout most of the project lands. Both Douglas fir and western hemlock grow best on drier, well-drained soils. Western red cedar and Sitka spruce grow in moister soil conditions. Evergreen forests are home to a set of animals adapted to the needle leaves, cones, deep shade, moss, and litter-covered forest floor unique to these forests. Such species include, but are not limited to, the red crossbill, chestnut-backed chickadee, red-breasted nuthatch, golden-crowned kinglet, winter wren, Townsend's warbler, black-throated gray warbler, varied thrush, Swainson's thrush, olive-sided flycatcher, Vaux's swift, northern pygmy owl, and northern goshawk. Mammals include the Boreal red-backed vole, northern flying squirrel, Douglas squirrel, Townsend's chipmunk, pine marten, dusky shrew, elk, black bear, and raccoon.

b) Deciduous Forest. Deciduous forests dominate in moist soil conditions and tend to be much brighter than coniferous forests due to the better light transmissivity of the leaves. As a result the understory vegetation tends to be more diverse and much denser than in a coniferous forest. Deciduous forest habitat types occur along the eastern half of the reservoir upstream from Eagle Gorge, along much of the southern reservoir edge, and along the Green River main stem, North Fork main stem, and most of the larger reservoir tributaries.

Dominant trees include red alder, black cottonwood, vine maple, and big leaf maple. Cottonwood is an especially valuable wildlife tree that is most common along the edge of the Green River. Understory trees, shrubs and forbs include cascara, Pacific willow, bitter cherry, Pacific dogwood, madrona, red

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elderberry, hazelnut, salmonberry, thimbleberry, trailing blackberry, red huckleberry, evergreen huckleberry, devil's club, Indian plum, sword fern, bracken fern, and pig-a-back plant. Characteristic birds include the spotted towhee, black-headed grosbeak, western tanager, MacGillivray's warbler, orange-crowned warbler, Hutton's vireo, hairy woodpecker, western screech owl, and Cooper's hawk.

c) Deciduous Forest - Riparian (Alder/Cottonwood). This habitat warrants a separate description because of the tendency for alder and cottonwood to form monotypic stands in various locations. Alder tends to be one of the pioneer species (first to colonize) following clear-cutting or fire and may form nearly monotypic stands for a few years until shade-tolerant trees (such as western hemlock) outgrow the alders or the alders die off (alder is a short-lived species usually living less than 100 years). Stands of alders are scattered near the upper end of the reservoir. Cottonwoods commonly grow alongside rivers, occasionally forming dense stands called overflow forests. These forests provide excellent riparian habitat for numerous species of animals. In the project area, these dense stands are rare, occurring primarily at the extreme upper end of the reservoir.

d) Mixed Coniferous Forest. A mixed forest includes both the coniferous and deciduous tree species described above. It is generally a seral stage that, if left to succeed, will often become a mature coniferous forest (although soil and hydrologic conditions may keep some stands in a mixed species condition virtually forever). Douglas fir reportedly comprises 40 to 60 percent of the canopy within this habitat type. Western red cedar, western hemlock, big leaf maple, and red alder comprise the remainder of the overstory canopy. Oregon grape, trailing blackberry, salmonberry and sword fern are dominant understory species in this habitat type.

Animals using mixed forests are primarily those of deciduous forests, as well as those that use many vegetation types. Many animals freely move from one vegetation type to another while other animals are restricted to a single habitat type and seldom use other habitats. Birds and mammals with a broad ecological niche that utilize several vegetation types include the song sparrow, dark-eyed junco, yellow-rumped warbler, black-capped chickadee, Bewick's wren, Steller's jay, Pacific slope flycatcher, western wood pewee, great-horned owl, red-tailed hawk, black-tailed deer, Rocky Mountain elk (Photo 2-5), black bear, snowshoe hare, deer mouse, raccoon, mountain beaver (especially in moist banks), coyote, and mink (especially along stream courses).

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Photo 2-5: Elk herd seen in Lester. May 1998.

Photo 2-6: Grassland meadow at the old McDonald field, looking downstream (top inset) and upstream (bottom inset). September 19, 1994.

e) Grassland. Grasses and weedy forbs occur along portions of the old railway embankment above elevation 1,140 feet and in the upper areas of McDonald field (Photo 2-6). Grass species include timothy, red fescue, quackgrass, and redtop bentgrass. Other plant species include Indian thistle and tansy ragwort. These areas are heavily browsed by elk and also support

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populations of meadow mice and red-tailed hawks, which prey on the mice and nest in large trees in the surrounding forests.

f) Wetlands. Wetland inventories have been prepared in several jurisdictions along the Green River, including in the 1970s by Marc Boule of Shapiro and Associates for the lower Green River, in the early 1980s by the city of Auburn, and by the Corps of Engineers for Auburn's Mill Creek in 1990/1991. A detailed survey conducted for habitat mapping of wetlands and upland habitats was conducted in the early 1980s by Shapiro and Associates within the upper watershed, specifically in the vicinity of the reservoir and surrounding lands up to elevation 1,220 feet. National Wetland Inventory maps compiled by the US Fish and Wildlife Service (USFWS) and satellite photos are other sources of reference.

Prior to construction of the dam, the Green River flowed unobstructed through Eagle Gorge in the upper watershed. The river gradient was steep compared to much of the lower watershed. Because of these topographic conditions, wetland distribution was likely limited to the few flatter riparian areas adjacent to the river. Based on the topography, there were probably fewer wetlands in the upper watershed prior to construction of the dam and the subsequent formation of the reservoir than what currently exists. However, unlike present conditions, water level fluctuations were not as extreme and thus wetland hydrologic regimes were likely to have been more stable.

Six wetland types covering 327 acres have been identified in the upper watershed below elevation 1,220 feet—mudflats, forested swamp, moss, emergent marsh, shrub swamp, and open water and stream. The presence of surface water during the summer is the main difference distinguishing some wetlands from some uplands (ponds, marshes, swamps versus meadows or moist-soil forests).

- Mudflats. Unvegetated mudflats occupy lower elevations around the perimeter of the reservoir. These areas are exposed for short periods only during the lowest reservoir pool levels. Occasional patches of algae are supported on mudflats found along much of the perimeter of the reservoir downstream from Eagle Gorge. These mudflats receive little wildlife use.

- Forested swamp. Most of the wooded wetland habitat in the project area occurs just below the upland deciduous forest along the banks and gravel bars of the main stem Green River and the North Fork of the Green River, as well as along the larger creeks, and at Page Mill Pond. Swamps usually have areas of open water some time during late winter and early spring (sometimes year round), frequently have moist, spongy soil, and are dominated by woody trees such as red alder, black cottonwood, Sitka

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spruce, and western red cedar. Willows, salmonberry, Pacific water parsley and Colt's-foot are common understory species.

These wooded swamps (Photo 2-7) tend to produce a relatively large number of snags, or deadwood, which provide valuable and irreplaceable habitat for animals that live in vacated cavities. Some species that nest in cavities but don't excavate them include the wood duck, Barrow's goldeneye, hooded merganser, western screech owl, tree swallow, black-capped chickadee, Vaux's swift, Douglas squirrel, northern flying squirrel, silver-haired bat, and pine marten. Cavities are almost never made in live trees as the wood is harder to excavate and because sap will flow into the cavity, gumming feathers and fur. Some birds, however, can excavate cavities, namely woodpeckers and nuthatches. Snags also provide an abundant source of insects, which become prey for numerous species, both cavity nesters and non-cavity nesters. Users of snags for feeding include the sharp-shinned hawk, Hammond's flycatcher, osprey, woodpeckers, western screech owl, brown creeper, belted kingfisher, Douglas squirrel, and deer mouse.

Photo 2-7: Wooded swamp at Page Mill Pond. February 13, 1996.

Wooded swamps are also important for a variety of amphibians, which lay their eggs in the still, protected waters that provides a refuge for the larval stage. Elk and bear drink from and feed on aquatic vegetation, which also provides them with a thermal and visual cover.

- Moss Dominated Wetlands. Moss dominated wetlands occur below the emergent marsh zone (elevation 1,120 feet and lower). On project

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lands, these areas are typically inundated with water from about June through September. Algae, bentgrass, and aquatic mosses grow in this habitat. Sparse patches of quackgrass and creeping buttercup up to elevation 1,130 feet exhibit stunted growth patterns due to the short growing season and being under water much of the time–a pretty harsh environment for non-aquatic plants. Few small mammals use these wetlands due to the summer flooding from the reservoir. However, Canada geese and mallards utilize these areas for nesting and foraging.

- Emergent Marsh. Emergent marsh habitat around Eagle Gorge Reservoir occurs primarily between elevations 1,120 and 1,141 feet. Between elevations 1,130 and 1,141 feet, vegetation is sparse, consisting primarily of quackgrass and creeping buttercup. Woolgrass and soft rush are the dominant species at elevation 1,141 feet, with common velvetgrass, redtop bentgrass, quackgrass, bluegrass, creeping buttercup and sedges intermixed within the areas of soft rush. Quackgrass is reportedly heavily grazed by elk. Muskrat also benefit from this habitat.

- Shrub Swamp. Wooded swamps are distinguished from emergent marshes by the presence of woody versus herbaceous vegetation, respectively. Also referred to as scrub-shrub wetland, shrub swamp is located in small patches adjacent to and slightly above the emergent marsh zone (above elevation 1,141 feet) at the northeast section of the reservoir upstream from Eagle Gorge, along the shoreline at the mouth of Cottonwood Creek, and along the upper shoreline of the old cedar swamp area in the northwest portion of the reservoir downstream from Eagle Gorge. This habitat type includes monotypic stands of willow supporting a sparse, patchy understory of woolgrass and bentgrass. Wildlife benefit more from larger patches of habitat.

- Open Water/Stream. There is only one small pond on project lands—Page Mill Pond. It was created in the 1930s to store logs for Page Mill log operation. A timber crib dam was built across Page Creek to form the pond. The dam and pond are still there but the dam is partially broken and the pond does not effectively hold the same quantity of water. Eagle Gorge Reservoir provides the most open water but is reduced when the reservoir is drawn down.

Open water, ponds, and creeks provide habitat for a variety of animals. Page Mill Pond is surrounded by dense vegetation which reduces predation on animals seeking water. In addition, this pond provides food in the form of aquatic plants and insects to other forms of wildlife, such as waterfowl, mink, river otters, swallows, flycatchers, and others. Amphibians also find homes in such protected environments.

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A pair of common loons have been present on Eagle Gorge Reservoir since 1991 and are one of fewer than 10 nesting pairs statewide. Common loons typically nest on large secluded lakes surrounded by forested habitats. It wasn't until 1994 this pair of loons attempted to nest. There hasn't been a nesting in King County possibly since before World War II. The nesting was successful in producing young in 1997 when two chicks hatched. Two more young were fledged in 1998.

One osprey nest is documented near the Green River about two miles downstream from Howard Hanson Dam. Another pair began constructing a nest on the shore of Eagle Gorge Reservoir at the west end of Eagle Gorge in 1998. The nest was completed too late in the season for nesting. Osprey feed primarily on fish. The Green River and Eagle Gorge Reservoir provide potential primary hunting areas for these birds.

Several streams flow into the Green River and the North Fork of the Green River on project lands, including Charley Creek, Elder Creek, Gale Creek, Piling Creek, Page Mill Creek, Cottonwood Creek, and McDonald Creek. The riverbed is confined within the river channel and consists of exposed river bars that are within the ordinary high watermark. These areas are unvegetated with a substrate consisting of cobble, gravel, and some sand (Photo 2-8). Gravel bars are an important habitat for several species of wildlife, primarily as feeding habitat. The spotted sandpiper and killdeer nest on gravel bars though they can't do this around Eagle Gorge Reservoir because of inundation during the summer months. Only in areas upstream from the reservoir and downstream from the dam can these species nest without their nests being inundated. Insects and other invertebrate animals live in gravel bars, providing a food source for spotted sandpipers, killdeer, American pipits (which utilize the drawn down reservoir area in the winter), American crows, harlequin ducks, American dippers, savannah sparrows, and small mammals such as shrews, voles, and mice. Some birds, such as the northern rough-winged swallow and willow flycatchers, aerial feed over gravel bars on flying insects that hatch from eggs deposited on the gravel bars.

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Photo 2-8: Gravel bar in main stem above reservoir. February 13, 1996.

g) Summary. None of the communities discussed above are independent. Each community depends on adjacent communities to be viable and healthy. For example, deer need the exposed higher elevations of slopes for their summer habitat but utilize the lowest areas, especially riparian areas, during the winter. Habitats between the summer and winter ranges are necessary to provide deer with food and cover as well as safe migration pathways. Few animals are completely tied to a specific community but rather need the resources provided by a variety of communities to survive through all four seasons of the year. Interdependence of the vegetative communities on project lands and the wildlife they support should be considered whenever manipulation of a particular area is proposed.

2.13 HUNTING

Hunting on Howard Hanson Dam fee lands is not permitted. The watershed is closed to the public, but the city of Tacoma and other landowners in the watershed allow hunting by permit only for deer and elk as regulated by the Washington Department of Fish and Wildlife (WDFW). In the fall of 1997, the WDFW closed the area to elk hunting due to a declining population, and the closure was also in effect through 1998.

2.14 FISHERIES

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2.14.1 General. Wild anadromous and resident fish were present in the area until 1911 when a water diversion dam was constructed for the city of Tacoma. Since Howard Hanson Dam is built above this upstream limit of fish migration, fish passage facilities were not included during construction of the dam. Green River fish populations affected by Corps operations and facilities include those that rear both above and below Howard Hanson Dam. Natural spawning of fish above the reservoir is limited to resident cutthroat, rainbow, and steelhead trout. These species are transported by a tanker truck into the upper watershed from the Green River and released into non-Corps waters by state and tribal hatchery personnel. It is not the responsibility of the Corps to provide or maintain structures or roads for this activity. The AWS and Section 1135 projects will influence future fisheries management.

Shoreline and instream fish habitats of the Green River through the Howard Hanson Dam project include clear cold water that feeds a gravel- and boulder-bottomed river bordered by cottonwood, alder, and second growth coniferous trees. Reservoir substrates are primarily sand and mud. Shoreline habitat is largely shaped through water fluctuations—during high pool, reservoir waters rise to meet the hardwood and coniferous tree stands along the banks. During low pool, fish habitat is relegated to a gravel-bottomed stream bordered by an unbroken shoreline of mud and sand. Upstream from the reservoir, fish habitats are shaped by annual changes in water flows and include gravel- and boulder-bottomed substrates shaded by hardwood and coniferous trees and associated understory.

Instream cover within the main stem and tributaries is provided by logs and woody debris, but somewhat reduced in quantity due to prelogging conditions. Cold-water fishes of the Green River rely on instream cover and shade provided by shoreline vegetation for proper regulation of water temperatures and as a substrate for food production, particularly terrestrial insects. Geological and hydrological processes provide backwater and off-channel habitats as well as the formation of undercut banks, gravel bars, and pool/riffle complexes. This fish habitat variation is necessary for the proper survival of juvenile and adult anadromous and resident fishes.

2.14.2 Reservoir Environment. Large reservoir tributaries, which contribute late summer flows of at least 10 cfs, include the Green River main stem, North Fork Green River, Charley Creek, Gale Creek and Page Mill Creek. These five streams provide most of the available fish habitat. Four smaller tributaries (Cottonwood Creek, Piling Creek, McDonald Creek, and WRIA Stream #90212[1]) also contribute to available fisheries habitat.

Starting around May 1 the reservoir begins to fill from elevation 1,070 feet to 1,141 feet by storing water from spring runoff. This water is used for water supply to the city of Tacoma and summer low flow augmentation. By

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late fall stored water is depleted and the reservoir is drawn down to its low pool level of 1,070 feet where it is maintained to provide storage for floodwaters. At low pool, the surface area of the reservoir is 100 acres and the reservoir volume is approximately 1,600 acre-feet. When the reservoir reaches the conservation pool level (elevation 1,141 feet), storage increases to 732 acres containing approximately 25,400 acre-feet of water.

2.14.3 Fisheries Resources. The Green River system currently supports populations of four anadromous salmonid species—coho salmon, steelhead, chinook salmon, chum salmon—and two resident species of trout—cutthroat and rainbow. With the exception of chum salmon these species were present in the area until the construction of the Tacoma Headworks' diversion dam in 1911. Construction of Howard Hanson Dam further altered basin fish populations through reservoir operations and dam passage difficulties. A brief description of the life cycle and current status of common anadromous salmonid species is provided below.

a) Coho Salmon. Juvenile coho salmon rear in freshwater for approximately 15 months prior to migrating downstream to the ocean, but may extend their rearing time for up to two years (Sandercock, 1991[2]). Peak downstream passage of juvenile outmigrants usually occurs in May (Laufle et al., 1986[3]). Adult coho migrate upstream in the Green River from early August through late January. Spawning occurs from mid-November through late January (Caldwell, 1994[4]). Two coho stocks have been identified in the Green River basin (WDFW, 1994[5])—the Green River/Soos Creek stock and the Newaukum Creek stock.

b) Steelhead. Steelhead are typically differentiated into two types—winter steelhead and summer steelhead (Barnhart, 1991[6]). Winter and summer steelhead are differentiated by timing of adult return but share common juvenile behavior patterns. Both winter and summer steelhead rear in freshwater for one or two years before migrating to the ocean. Juvenile downstream migration occurs April through July with peak migration in mid-April (Wydoski and Whitney, 1979[7]).

Winter steelhead return to the Green River November through early June, and summer adults from April through November (Caldwell, 1994). Summer steelhead spawning occurs mid-January through early April; winter steelhead spawn early February through June. Unlike Pacific salmon adults which all die after spawning, some adult steelhead may survive spawning and return to the sea to spawn again in subsequent years. Repeat spawning in Washington ranges

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from 4.4 to 14.0 percent of total spawning runs (Wydoski and Whitney, 1979).

Green River summer steelhead stock is of non-native hatchery origin (WDFW, 1994). Skamania steelhead smolts were introduced in 1965. Winter steelhead are of native stock. In addition to the native stock of wild winter steelhead, hatchery steelhead are also released to provide tribal and sport harvest.

c) Chinook Salmon. Chinook salmon are differentiated into two types—ocean-type and stream-type. Juvenile ocean-type chinook salmon migrate to the marine environment in the first year of life, generally within three to four months of emergence (Lister and Genoe, 1970[8]). Juvenile stream-type chinook salmon rear in freshwater for an extended period of one or more years prior to migrating to the ocean. Spring chinook salmon are classified as stream-type chinook. Summer/fall chinook salmon are classified as ocean-type chinook.

The Green River supports a population of summer/fall chinook salmon. Green River adult summer/fall chinook migrate upstream late June to mid-November. Spawning takes place mid-September through mid-November. Juveniles rear in the river for few months then migrate downstream mid-April through mid-July. (Caldwell, 1994). Green River chinook stock is of mixed origin with production supplemented by hatchery releases from the Green River Hatchery on Soos Creek.

d) Chum Salmon. Juvenile chum salmon rear in freshwater for less than 1 week prior to traveling through the dam (outmigration). Downstream migration in the Green River occurs mid-February through late July (Caldwell, 1994). Chum salmon adults migrate upstream in the Green River early November through December, in the main stem Green River below Howard Hanson Dam from Burns Creek to Crisp Creek (WDFW, 1994).

Two chum stocks are recognized in the Green River system (WDFW, 1994). The Crisp (Keta) Creek fall chum stock originated from releases of Quilcene and Hood Canal stocks from the Keta Creek Hatchery in the early 1980s and is considered healthy. The Duwamish-Green River stock may be a remnant native stock. Origin of this stock is unknown.

e) Cutthroat Trout. Cutthroat trout in the upper reservoir exhibit a non-migratory form found in many Pacific Northwest systems. Resident cutthroat trout juveniles frequently spend their first year of life in the small headwater streams in which they were spawned, then

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generally move downstream to large tributaries during their second year (Wydoski and Whitney, 1979). A stable stream environment is critical to resident cutthroat trout since they establish a home territory, usually a gravelly pool, in which they may spend their entire lives (Miller, 1957; Osborn, 1981[9]).

f) Other resident species. Common resident species in many Pacific Northwest rivers are mountain whitefish, largescale sucker, and various cottids such as the torrent sculpin and prickly sculpin. Life history information on other resident fish species potentially inhabiting the Green River can be found in Wydoski and Whitney (1979).

2.14.4 Current Fisheries and Hatchery Production. The Green River supports tribal, recreational, and commercial harvest of anadromous fish stocks, as well as being an important northwest fisheries resource. Green River fisheries are co-managed by the Muckleshoot Indian Tribe and the Washington Department of Fish and Wildlife.

Stocking of the watershed above Howard Hanson Dam is conducted as a cooperative effort between the Muckleshoot Tribe and the WDFW. Stocking of salmon and steelhead fry are part of an ongoing effort to reintroduce several stocks of Green River fish. Fall chinook salmon are reared to fingerling size at Keta Creek Hatchery which is owned and operated by the Muckleshoot Tribe. Chinook fry are outplanted into larger tributaries above the dam. Fall coho salmon are reared to fingerling size at the Soos Creek Hatchery, owned and operated by the WDFW, then transferred to the Crisp Creek rearing ponds, also owned by the WDFW but operated by the Muckleshoot Tribe. Coho fry are outplanted into most perennial streams above the dam. Winter steelhead adults are collected at both the city of Tacoma's diversion dam by Trout Unlimited and by hook and line from the middle Green River. Wild fish taken by hook and line are taken to the Keta Creek Hatchery for spawning. Their progeny are released into the larger tributaries in the upper watershed as fry. Adult steelhead collected at the diversion dam are released above Howard Hanson Dam and allowed to spawn naturally. The WDFW plans to release steelhead fry, from brood stock collection, between the diversion dam and Howard Hanson Dam in 1999. All other Pacific salmon are currently excluded from the upper watershed due to cost, stock management considerations, and survival rate of downstream migrants. Resident fish production of rainbow and cutthroat trout is unknown; a study of trout abundance will be conducted in the next two years under the *Additional Water Storage Project*. Brook trout, an exotic species once stocked in Page Mill Pond, are presumed to still be resident in the pond and outlet stream.

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2.14.5 Juvenile Migration and Mortality. Juvenile salmon migrating downstream from the upper watershed must negotiate the reservoir prior to passage downstream. Predation from large trout, mink, common loons and other predators is possible. Larger sculpin and resident trout may prey on fingerling anadromous salmonids, but it is likely that only larger resident trout prey on yearling outmigrants (Hatfield, 1986[10]). The reservoir is drawn down to riverine conditions each winter, which may hinder the establishment of large predatory fish populations. Additional studies by the US Fish and Wildlife Service indicate juvenile salmon and steelhead are more affected by reservoir operations which can delay outmigration and increase mortality during dam passage (Dilley and Wunderlich, 1992 and 1993[11]; *Additional Water Storage Project Final EIS*, August 1998).

Most juvenile salmonids travel through the dam between March and July. During this outmigration period the reservoir is filled, causing potential delay (or entrapment within the reservoir) from the inability of smolts to locate and dive (sound) through the existing outlets. The radial gate on the dam becomes submerged to depths exceeding 72 feet (up to a maximum 112 feet) as the pool rises during refill. Since juvenile coho and steelhead are surface-oriented they have been shown to have difficulty finding the submerged outlet. Submerged reservoir outlets can halt or delay the exit of outmigrating smolts (Dilley and Wunderlich, 1992 and 1993).

Smolts that do find the outlet may be forced to travel through a 48-inch low flow water bypass when the project stops operating the radial gate due to low inflows. Survival rates differ between the radial gate and the bypass—the USFWS and the WDFW showed in a series of studies that juvenile salmonids passing through radial gates have low injury rates and mortality rates of less than one percent (Seiler and Neuhauser, 1985[12]; Dilley and Wunderlich, 1992 and 1993). The low flow bypass, however, appears to have a much higher mortality rate with annual mortality exceeding 30 percent and short-term mortality rates exceeding 80 percent (Dilley and Wunderlich, 1993).

2.15 THREATENED AND ENDANGERED SPECIES

A list provided by the USFWS of proposed and listed threatened and endangered species identifies the bald eagle, gray wolf, grizzly bear, marbled murrelet, and the northern spotted owl as possibly occurring within a two-mile radius of Eagle Gorge Reservoir. The gray wolf is federally listed as an endangered species while the other four species are federally listed as a threatened species. The northern goshawk and harlequin duck are federal candidate species for listing as threatened or endangered. Bull trout are a federally proposed threatened species in the Puget Sound region. On March 16, 1999, chinook salmon were listed as threatened by the National Marine Fisheries Service (NMFS) under the Endangered Species Act. No threatened,

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endangered or sensitive plant species have been identified at present by the USFWS as occurring in the vicinity of the reservoir (USFWS, 1996[13]).

2.15.1 Bald Eagles. Bald eagles, federally listed as a threatened species, nest in dominant overstory trees along marine and freshwater shorelines where there are stable populations of fish and or waterfowl for prey (American Ornithologists Union, 1983; Anderson et al., 1986[14]). Principal features of bald eagle breeding habitat are nest sites, perch trees, and available prey. Nest trees are located in predominantly uneven-aged coniferous stands that have old-growth components (Anthony et al., 1982[15]). Perch trees are typically large conifers occurring in close proximity to nests and or foraging sites. Some eagles may remain in breeding territories year-round while others migrate up major river drainages to feed on anadromous fish species during and after spawning. Wintering birds frequently use communal night roosts in stands of large coniferous trees in the vicinity of foraging areas (Rodrick and Milner, 1991[16]).

The bald eagle is the only species of the five species listed by the USFWS (1996) that has actually been observed in the reservoir area. This species is primarily a winter resident in the reservoir area, although bald eagles have been observed in the reservoir area year-round. Bald eagles are regularly observed flying over the reservoir as well as feeding. Available food resources in the reservoir are waterfowl and fish. It is likely that waterfowl are the most readily available winter food source with up to several hundred ducks present on the reservoir at any time. Perch sites are available in mature deciduous, mixed and coniferous forest stands around the reservoir. No more than four bald eagles have been seen in the vicinity of the reservoir at any one time during the winter suggesting that food source availability may be a limiting factor. During the summer, waterfowl populations are much reduced due to the limited nesting habitat. Waterfowl present during the winter disperse to other areas for nesting. Fish abundance is also limited. It seems likely that lack of food during late spring and summer is the primary reason eagles and osprey have not nested near the reservoir.

2.15.2 Gray Wolf. Gray wolves, federally listed as an endangered species, can utilize a broad spectrum of habitats as long as there is an abundance of prey, suitable denning and rendezvous sites, and minimal exposure to humans (USFWS, 1984[17]). Availability of prey may be the primary factor in determining habitat suitability (Stevens and Lofts, 1988[18]). Ungulate species are the gray wolf's primary food source but small mammals are also part of their diet. Den sites are most commonly burrows in sandy soils but can be located in a variety of settings, from downed logs and hollow trees to rock caves. Rendezvous sites tend to be near a source of open water in small meadows with limited visibility.

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No gray wolves have been observed in the reservoir area. The closest known surveys to be conducted for gray wolves have been in selected areas on Huckleberry Ridge between the Green and White River drainages in 1993. During these surveys no wolves were heard and evidence of wolf use of the area was not observed.

2.15.3 Grizzly Bear. The grizzly bear is federally listed as a threatened species. No grizzly bear or sign of grizzly bear has been reported in the Eagle Gorge Reservoir area. The closest reported sightings of grizzly bears have been 12 miles from the reservoir (Almack, pers. comm., Feb 1993[19]). Grizzly bears have large home ranges, up to 1,004 square miles having been reported. They commonly move down to lower elevations after emerging from their high elevation denning areas in the spring between March and May. Foraging is done in areas that support emergent vegetation in the spring, such as south facing chutes and shrub fields, and bear feed in higher elevations as the season progresses.

2.15.4 Marbled Murrelet. The marbled murrelet, federally listed as a threatened species, feeds in shallow marine waters and nest in mature old-growth trees (Hamer and Cummins, 1991; Rodway et al., 1991[20]). Ralph, et al. (1994[21]) reported that marbled murrelets have been found in Washington up to 52 miles inland from marine waters; however, most sightings (90 percent) occur within 40 miles of marine waters (Hamer et al., 1994[22]). Marbled murrelet nests have been located in stands as small as approximately seven acres (Hamer and Nelson, 1995[23]). Suitable marbled murrelet nesting habitat consists of large coniferous trees ($\geq$ 32-inch-diameter at breast height, dbh) within 50 miles of marine water that provide limbs of at least five to seven inches in diameter or other suitable nesting platforms. Murrelet detections have been found to increase in areas where old-growth and mature habitat comprise over 30 percent of the landscape and decline when clear-cut and open meadow habitat occur over 25 percent of the landscape (Hamer and Cummins, 1990[24]). Murrelet abundance has been shown to be positively associated with the occurrence of Douglas-fir, western hemlock and western red cedar, and negatively associated with the presence of silver fir (Hamer and Cummins, 1991).

A query of the Washington Department of Fish and Wildlife Priority Habitats and Species database (WDFW PHS) in December 1995 revealed no record of any known marbled murrelet activity in the vicinity of Eagle Gorge Reservoir. During 1994 marbled murrelet surveys were conducted in the reservoir area within three stands identified by the WDFW and Corps biologists as marginally suitable for murrelet nesting. No marbled murrelets were detected during the surveys. Marbled murrelet surveys were also

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conducted in a 5- to 10-acre stand located north of the Tacoma Headworks diversion dam in 1994 and 1995 following protocol developed by the Pacific Seabird Group (Ralph et al., 1994). This stand supported approximately four to six conifers per acre, larger than 50 inches dbh, with several trees supporting moss covered branches and limbs at least seven inches in diameter. No marbled murrelet activity was detected during either survey year (Beak, 1994; Beak, 1995[25]). Numerous surveys have also been conducted over the past three years by timberland owners and the USFS in the upper Green River drainage and the Huckleberry Ridge area. No detection's were recorded during these surveys. On the other hand, the forest lands owned by Tacoma near the reservoir are approaching 100 years of age since last cut. Tacoma plans to not clear-cut these lands again so that the forest will attain features necessary for marbled murrelet nesting. Some thinning and other individual cuts may occur on a small scale probably within the next 25 years.

2.15.5 Northern Spotted Owl. Federally listed as a threatened species, the northern spotted owl can be found throughout the Washington Cascades below the 4,200-foot elevation. Preferred habitat consists of closed-canopy coniferous forest with multi-layered canopies dominated by mature and or old growth trees. Suitable habitat provides opportunities for spotted owls to nest, roost or forage. In western Washington, spotted owls nest most often in cavities of trees with a dbh greater than 20 inches. Nesting habitat also provides roosting and foraging habitat. Not all suitable roosting and foraging habitat provides suitable nesting habitat. Roosting and foraging habitat consists of coniferous forests with closed canopies that are sufficiently open to allow spotted owl movement through and below the canopy while providing limbs large enough for comfortable roost sites. Depending on the site and stand history, a forest stand with an average dbh of 11 inches can provide adequate roosting and foraging habitat for this species. Northern flying squirrels and other small mammals are the primary food of northern spotted owls. Median annual home range for spotted owls in the western Cascade Mountains of Washington is 6,657 acres (defined by a 1.8-mile radius circle for management purposes; Frederick, 1994[26]).

The December 1995 WDFW PHS database search did not identify any northern spotted owl sighting or critical habitat within a two-mile radius of the reservoir. In 1989 and 1990, a single spotted owl was detected in the Charley Creek drainage approximately one mile from the reservoir. However, surveys conducted by the Washington State Department of Natural Resources between 1990 and 1994 did not detect any further spotted owl activity within the Charley Creek drainage. Subsequently, this sighting has been downgraded to historic. Spotted owls have been documented in several locations within the

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Green River watershed above the upper watershed boundaries out of the range of influence of the operation of Howard Hanson Dam.

2.15.6 Northern Goshawk. The northern goshawk is a federal candidate species for listing as threatened or endangered. Habitat conditions in the upper watershed are potentially suitable for goshawk nesting. Northern goshawks have been documented in several locations of the Green River watershed above the upper watershed boundaries out of the range of influence of the operation of Howard Hanson Dam, and on several occasions calling hawks suspected of being goshawks have been heard but not seen near McDonald field in each year since 1994.

2.15.7 Harlequin Duck. The harlequin duck is a federal candidate species for listing as threatened or endangered. Harlequin duck breeding areas have been documented in the free flowing portions of the Green River and some tributary streams immediately above Eagle Gorge Reservoir. During early spring harlequin ducks are sometimes observed in the reservoir.

2.15.8 Bull Trout. Puget Sound stocks of bull trout are proposed for listing as threatened under the Endangered Species Act; a decision is expected in June 1999. Found in the interior and some coastal drainages from northern California to southeast Alaska (Bjornn, 1991[27]), bull trout have been documented in many systems within western Washington, including the Green River (F. Goetz, 1994[28]). Bull trout characteristically occupy high quality habitat areas, often in less disturbed portions of a drainage. Key habitat features include channel stability, clean spawning substrate, abundant and complex cover, cold water temperatures, and lack of barriers which inhibit movement and habitat connectivity (Rieman and McIntyre, 1993[29]). Ground water and close proximity to cover are important factors influencing spawning site selection.

Bull trout were reported in the Green River in 1964. In 1994, the Muckleshoot Indian Tribe documented bull trout in the Duwamish River. Plum Creek Timber Company conducted surveys in the main stem and selected tributaries above Howard Hanson Dam, but was unable to find evidence of bull trout. General surveys conducted by the USFS in the upper Green River did not encounter any bull trout. Habitat in the project area is considered degraded due to past timber harvests. This human disturbance may cause stream temperatures to be warmer than temperatures required by bull trout in the late summer (F. Goetz, 1994). However, stream analyses in the project area has not yet confirmed a problem with water temperatures.

2.15.9 Chinook Salmon. Puget Sound/Strait of Georgia chinook salmon stocks were listed as threatened under the Endangered Species Act on

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March 16, 1999. Summer/fall chinook of the Green-Duwamish River basin are distinguished from other Puget Sound chinook stocks by geographic isolation. Adult returns to the Green River and its tributaries averaged 7,600 from 1987 to 1992. The runs have met escapement goals (5,800 fish) for numbers of spawners in the recent past but harvest has been severely curtailed due to lower than expected smolt-to-adult survival rates. Stock status is rated healthy.

Historically, an unknown number of chinook salmon spawned in the watershed prior to construction of the Tacoma Headworks. An estimated 100 to 400 adult chinook were captured from 1911 to 1913 at the headworks after the diversion dam was constructed. Since 1982, hatchery fingerlings have been planted above Howard Hanson Dam. The historical information on anadromous fish in the headwaters and the potential number of returning adults comes from trapping the adults at the Tacoma Headworks in the early 1900s. The authors researched Washington Department of Game records (now WDFW) and concluded that harvest and seasonal blockages below the trap could have resulted in underestimates of total chinook returns.

The WDFW or the Muckleshoot Tribe has established no spawner escapement goal for the upper watershed. Since 1982, juvenile chinook have been planted throughout the upper Green River. Fry-to-smolt survival rates are probably a result of high stocking rates and low survival rates of smolts migrating through Howard Hanson Dam.

Wild chinook salmon occur outside the range of influence from daily operations of Howard Hanson Dam. Only juvenile chinook salmon of hatchery origin are allowed to rear in the upper watershed; wild chinook salmon are excluded from reservoir waters as well as the upper watershed. This is because a wild salmon's life cycle includes spawning and the Tacoma Water Department would have to mitigate the effects of decaying spawned salmon carcasses in the city water supply.

2.16 CULTURAL RESOURCES

Cultural resources are considered historic properties under the National Historic Preservation Act. A historic property means any prehistoric or historic district, site, building, structure, or object included or eligible for inclusion, in the National Register of Historic Places.

Four cultural resources studies have been conducted around Howard Hanson Dam and Eagle Gorge Reservoir. The first was a general overview of the upper Green River drainage. The second was primarily a reconnaissance of the existing operations

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pool, but included a quick search of the watershed up to elevation 1,206 feet to support a pool raise study. The third examined and evaluated historic sites in the proposed pool raise study. The forth was a survey and evaluation of the prehistoric resources within the existing operations pool. Each study is described below.

In 1978, the Washington Archaeological Research Center (Hedlund, Ross and Sutton, 1978[30]) conducted a reconnaissance as preparation for a cultural resource overview of the Tacoma watershed. The area covered was from the headwaters of the Green River to the Eagle Gorge Reservoir. Several historical sites were identified, including four sites within the area of the anticipated pool raise—Garibaldi, Eagle Gorge, and Humphrey settlements, and the Koss homestead.

In 1985, the first archeological reconnaissance of the project area was performed. This work was carried out by Benson and Moura (1985) for the Seattle District Corps of Engineers. The primary purpose was to provide baseline data on cultural resources in the reservoir, and to assess the effects of the reservoir on these resources. The survey area covered the drawdown zone above the dam (elevations 1,100 to 1,141 feet), and portions of the reservoir that would be impacted by raising the summer conservation pool level to elevation 1,206 feet as recommended in the Section 216 *Additional Water Storage Project* under study by Tacoma Public Utilities in 1985.

Benson and Moura identified 14 prehistoric hunter-gatherer sites between elevations 1,100 and 1,141 feet, primarily clustered at the confluence of the main stem Green River and the North Fork of the Green River. These sites suffered varying degrees of erosion, deflation, and redeposition by siltation. Effects of the operations impacts were unknown at that time. Several other sites were recorded, literally, as they were being inundated by the seasonal pool raise, leading archaeologists to surmise there might be sites below the 1,100-foot elevation. Likewise, archaeologists were unable to survey those portions of the reservoir that were buried in silt, alluvium, logs, and driftwood to depths of one meter or more. No prehistoric sites were recorded between elevation 1,141 and 1,206 feet (the area that would be impacted by Tacoma's originally proposed Section 216 pool raise project).

In the 1985 survey, the Garibaldi settlement, identified in the 1978 study, was determined to have no integrity of condition. The report recommended that the historic Humphrey settlement and Koss homestead be further evaluated by a historical archaeologist to determine significance. Benson and Moura also determined the Eagle Gorge settlement was a historic component of site 45KI280. A technical report detailing the archeological resources identified, entitled *An Archaeological Reconnaissance of Howard A. Hanson Dam Project*, by James R. Benson with contributions by Guy F. Moura, was submitted to the Corps of Engineers in September 1985. Although identified, the archeological sites reported remained unevaluated for their National Register eligibility.

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In 1995, a third survey was completed by Larson Anthropological/ Archaeological Services, entitled *Cultural Resources Survey of the Additional Water Storage Project Area, Howard A. Hanson Dam, King County, Washington*. This survey identified resources of cultural or historic significance within the impact zone of the dam if the pool raises 36 feet (from 1,141 to 1,177 feet), as proposed under Tacoma's *Additional Water Storage Project*. Cultural resources examined during this survey included the historic Page/Buffelin Lumber Mill, portions of the previously identified historic settlements of Garibaldi and Humphrey, portions of the historic Koss homestead, a complex of farming/ranching material associated with the McDonald family, isolated cryptocrystalline silica flakes, and a 1950s refuse disposal area adjacent to a logging railroad grade. All of these sites are located above elevation 1,147 feet. The four historic sites were evaluated for potential listing on the National Register of Historic Places. In the opinion of the contractor none of the historic sites had sufficient integrity to meet the criteria of eligibility. Lost integrity was due to the extensive disturbance resulting from river erosion, historic period razing and demolition activity, recent demolition and construction activities, and removal of standing structures.

In November 1998, Archeological and Historical Services of Eastern Washington University conducted a survey to relocate the identified prehistoric archeological sites reported by Benson and Moura (1985), assess their physical condition, and recommend their National Register eligibility. Thirteen of the 14 archeological sites recorded were relocated, but many had been severely damaged by the effects of water fluctuation during successive reservoir drawdowns. Whereas important new information is available for these recorded sites, it will be some time before they can be fully evaluated.

At present, all identified cultural resource sites are located on easement lands in which the Corps of Engineers holds less than fee title ownership. The prehistoric sites identified in the existing operation and maintenance pool are on easement lands under the Corps' jurisdiction. The historic settlements and homestead, also on easement lands, are presently outside of most operation and maintenance pool effects. Therefore, the District Commander will give full consideration in planning for the preservation of cultural properties that are affected by Corps activities, but not for those historic sites that are not presently within Corps jurisdiction or affected by Corps operations. The Corps is empowered to acquire necessary real estate interests in order to carry out the intent of Congress in mitigating adverse impacts to historic properties resulting from Corps activities. Mitigation for sites eligible under the National Register might include data recovery. Data and material from affected sites should be recovered and preserved under a Memorandum of Agreement with the Advisory Council on Historic Preservation. Specific guidance on archeological collection management is provided in EP 1130-2-540. For a discussion about environmental compliance on cultural resources, refer to Section 3.5.

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2.17 NATIVE AMERICAN USE OF THE AREA

Native American tribes that once inhabited the upper Green River included the Coastal Salish-speaking Skopahmish, Skatehlmish, Smulkamish, and the Stakamish bands. Under the Medicine Creek Treaty of 1854, these Indians ceded their lands to the government and moved to reservations established for them. Most of these groups moved to the Muckleshoot Reservation near the present city of Auburn, Washington, and took on a new identity known as the Muckleshoot Indian Tribe. Other Native American tribes frequently passed through and utilized the upper Green River valley, including the Duwamish, Nisqually, Puyallup, Snoqualmie, and Yakama. The Suquamish Tribe has a fishery interest in the Green River-Duwamish River system in Elliott Bay under the Point Elliott Treaty of 1855. The Yakama Tribe changed the spelling of its name about five years ago, from Yakima, to conform to the language in the Walla Walla Treaty of 1855.

As a federally recognized treaty tribe, the Muckleshoot's enjoy off-reservation fishing, hunting, and water rights. These rights have been challenged from time to time by agencies of the state of Washington, but have been upheld by the federal courts and are now generally recognized under former Governor Spellman's 1989 Centennial Accord with Indian Tribes.

The Muckleshoot Tribe and the WDFW are co-managers for fishery resources and are directly involved in the operation of Howard Hanson Dam and Eagle Gorge Reservoir. Technical staff represent the tribe each year during pre-season forecasting, seasonal refill, and summer flow augmentation coordination of reservoir operations. Input from both groups has dramatically altered refill and release operations.

Along with providing input to the Corps of Engineers for reservoir operations, the Muckleshoot Tribe currently maintains an important role in the management of fish resources in the upper Green River. In the last few years the tribe has taken over most stocking of hatchery-reared juvenile fish above the dam. Stocking of juvenile fish is the first step in recovery and restoration of anadromous salmon and steelhead. Since Howard Hanson Dam was not built for juvenile fish passage, reservoir refill operations have seen a dramatic shift to accommodate the passage of these juvenile migratory fish. The Muckleshoot's are leading the recovery efforts but see the dam and existing conditions as an impediment to permanent recovery.

In 1996, Tacoma Public Utilities (through the mayor of Tacoma) and the Muckleshoot Tribe signed a mitigation agreement to restore anadromous fish in the upper Green River. These provisions include (1) a fish restoration facility—a naturalized rearing facility for re-establishing salmon and steelhead, (2) a fish ladder and adult collection facility available to provide adult fish passage above the Tacoma diversion dam, or around the diversion dam and Howard Hanson Dam, and (3) higher, guaranteed minimum flows to protect instream resources. This agreement developed

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new, higher minimum flows (at Auburn) over the Washington Department of Ecology (WDOE) requirements.

Tacoma's AWS project at Howard Hanson Dam will raise Eagle Gorge Reservoir in two phases—from the existing 1,141-foot elevation to 1,162 feet (low), 1,167 feet (high), in Phase 1, and to elevation 1,177 feet in Phase 2. The AWS project has gone through feasibility. Plans for Phase 1 may be implemented within the next two or three years. In the interim, Tacoma has agreed to sponsor the Section 1135 project which will raise the reservoir six feet, from elevation 1,141 to 1,147. This will provide 5,000 acre-feet of water to be stored in drought years for additional augmentation in meeting the higher minimum flows for the existing reservoir. A range of restoration projects will further enhance fish and wildlife habitats. The Corps of Engineers is not an active party to the agreement, but is in a position to maintain support to both parties and typically acts as a facilitator in water management discussions on the Green River. Therefore, like Tacoma, the Corps of Engineers has an active relationship with the Muckleshoot Tribe, and yet, unlike Tacoma, the Corps has a federal trust responsibility with Native Americans. This trust responsibility puts more stringent requirements on Corps actions as far as protecting the rights and resources of Native Americans, especially those relating to anadromous fish.

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[28]Goetz, F.A., 1994. Distribution and juvenile ecology of bull trout (*Salvelinus confluentus*) in the Cascade Mountains. MS thesis, Oregon State University, 173 pp.

[29]Rieman, B.E. and J.D. McIntyre, 1993. Demographic and habitat requirements for conservation of bull trout. General Technical Report INT-302. Intermountain Research Station, Ogden, UT. Forest Service, US Department of Agriculture.

[30]Hedlund, G.C., J.A. Ross and R.K. Sutton, 1978. A Cultural Resource Overview of the Green River Watershed Area. Project Reports No. 39. Washington Archeological Research Center, Washington State University, Pullman.

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SECTION 3

FACTORS INFLUENCING RESOURCE USE, DEVELOPMENT, AND MANAGEMENT

SECTION 3 – FACTORS INFLUENCING RESOURCE USE, DEVELOPMENT, AND MANAGEMENT

3.1 GENERAL

A variety of physical, social, economic, and institutional factors influence the options for future use, development, and management of Howard Hanson Dam and Eagle Gorge Reservoir resources. These factors include project access, topography and hydrology of project lands, areas of influence, socioeconomic characteristics, historical significance, and coordination with Native American tribes.

3.2 PROJECT VISITATION

All lands surrounding Howard Hanson Dam are closed to public access. Visitation is limited to some hunters (see Section 2.13), escorted visitors, agency and logging personnel. The dam and reservoir are far enough away from encroaching towns and cities to not have to worry about pressure for developing the area. Other state and federal facilities are within a reasonable distance outside the watershed area.

3.3 AREAS OF INFLUENCE

There are no internal influences within the Corps of Engineers towards public visitation on lands surrounding the dam and reservoir. Visitors are not allowed in the area other than for limited hunting, and this is not for the general public. Much of the ownership is by the city of Tacoma. Since Eagle Gorge Reservoir is a prime source for Tacoma's municipal water supply, any development that might contaminate the water would be widely protested. As such, the area is fenced, clearly signed, and monitored for entry 24 hours a day.

Howard Hanson Dam is in King County with Pierce County to its south. These are the two largest counties in the state in terms of population. King County's population is divided between the county seat of Seattle (pop. 516,259), unincorporated areas (pop. 513,298), and 30 small cities, towns, and communities (pop. 477,762). It has increased nearly nine percent from 1,384,600 persons in 1980 to 1,507,319 persons in 1990. Pierce County also had an increase of nine percent from 538,000 to 586,203 for the same years. Just over the last 25 years the average population density of people per square mile in the entire state increased from 51 to 82 in 1995. King County's density of 736 people per square mile and 372 in Pierce County illustrate that employment opportunities center in the large cities, not far from Howard Hanson Dam.[1] It's no wonder 83 percent of Washington's residents

[1] 1994 County and City Data Book and 1996 Statistical Abstract of the US, US Dept. of Commerce, Economics and Statistics Administration, Bureau of the Census.

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in metropolitan areas (1994), especially since unemployment rates have dropped since the 1980s. Given the amount of land still available for developing and the moderate cost of living in the Pacific Northwest, individuals and business ventures will continue to consider Washington State for a permanent move, and encroach closer to the dam.

3.4 SOCIOECONOMIC CHARACTERISTICS

When Howard Hanson Dam was constructed, the economy of the region, particularly King and Pierce Counties, was heavily dependent on forests for logging and lumber mills, water resources for transportation and industrial uses, and an agricultural base. Since the late 1970s, western Washington has experienced considerable growth that is placing more pressure on land and water resources. Expansion of communities into towns, then incorporation into cities is shifting large segments of the agriculture base to eastern Washington in order to make room for housing, roadways, manufacturing, wholesale, and retail sectors.

The timber base continues to give way to large commercial enterprises that support city lifestyles, but continues to play an important role in the upper watershed area of the dam and downstream to about River Mile 46. Ongoing operations by the US Army Corps of Engineers, combined with the city of Tacoma's watershed preservation program and US Forest Service practices, supply only a small economic contribution to this area.

Below River Mile 46, the Green River system falls into two King County Community Planning Areas—Enumclaw and the Green River valley. In the 1980s the local economy began to diversify. Export trade, forest products, and computer software industries became increasingly important.

3.5 ENVIRONMENTAL COMPLIANCE

Civil works projects operated by the Corps of Engineers, such as Howard Hanson Dam, must be in compliance with environmental laws, executive orders, and regulations. *The Environmental Assessment and Management (TEAM) Guide* is a Corps manual to guide compliance requirements. As a land use management document, activities cited in this master plan are subject to the environmental laws described below.

3.5.1 NEPA. The National Environmental Policy Act of 1969 (PL 91-190) requires federal agencies to study and consider the environmental impacts of their proposed actions. Consideration begins in the planning stages and continues through design, construction, and operation of the project. An *Environmental Impact Statement (EIS) for Operations and Maintenance of Howard Hanson Dam* was published January 1997. It was prepared pursuant

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to the Council on Environmental Quality Regulations (40 Code of Federal Regulations, parts 1500-1508) and the Corps of Engineers' Procedures for Implementing NEPA (33 CFR, parts 230 and 325).

3.5.2 ESA. The Endangered Species Act of 1973, as amended (PL 93-205), Section 7, requires federal agencies to ensure their actions do not jeopardize endangered or threatened species or their critical habitat. Consultations with the NMFS, the USFWS, the WDFW, the Muckleshoot Indian Tribe, and others ensure that such species and their critical habitats are conserved. Information about threatened and endangered species around Howard Hanson Dam can be found under Section 2.15 of this master plan.

3.5.3 Clean Water Act. Provisions of the Clean Water Act, as amended (PL 95-217), are implemented through various agencies. The Corps is responsible for Section 404 relating to discharge of dredged or fill material into waters of the United States. The master plan for Howard Hanson Dam does not propose actions that require permitting under Section 404. Other provisions of the Act are implemented by the WDOE, the agency that sets water quality standards. All federal actions must conform to the applicable state regulations and standards for use.

3.5.4 NHPA. The National Historic Preservation Act of 1966, as amended (PL 89-665), requires federal agencies to consider the effect of their actions on historic properties. Compliance requirements for cultural resources are derived from Sections 106 and 110. These provisions require completion of an inventory survey to identify potential sites; evaluation of identified sites for the National Register of Historic Places; measures for stabilization or data recovery for sites determined eligible for the National Register; curation of the archeological collections recovered; and consultation with affected Indian tribes throughout this process.

In 1997, an environmental compliance assessment was conducted at Howard Hanson Dam as a requirement of *The Environmental Assessment and Management (TEAM) Guide.* Three findings for cultural resources were made. Two of these findings state there are cultural resources that have not been evaluated for eligibility for the National Register. The four historic sites evaluated in Section 2.16 of this master plan are not believed to be eligible. This should be confirmed by coordination with the Washington State Historic Preservation Office (Office of Archaeology and Historic Preservation). Because of their location on easement lands, sites above the summer conservation pool elevation of 1,147 feet are presently outside the Corps of Engineers' jurisdiction. Several prehistoric sites within the existing pool area have not yet been evaluated. These are impacted by reservoir operations in the drawdown zones and are accessible only during low water periods. Since

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historic properties have been identified within the existing drawdown area, a Cultural Resources Management Plan needs to be developed. Specific guidance on the content and format of the plan is presented in EP 1130-2-540.

3.6 COORDINATION WITH NATIVE AMERICAN TRIBES

Executive Order 13084, "Consultation and Coordination with Indian Tribal Governments," dated May 14, 1998, requires federal agencies to work closer with affected tribal governments. Corps of Engineers environmental technical staff are in routine contact with the Muckleshoot Fisheries Department. Reservoir operations and cooperative planning studies for the additional water storage and the restoration of fish habitat are routinely coordinated with the Muckleshoot Indian Tribe, Tacoma Public Utilities, and other involved federal and state agencies as described in Section 2.17.

On December 10, 1998, Corps of Engineers cultural resources staff met with the Muckleshoot Culture Committee for the second time in 25 years. Committee members were briefed on the status of Section 106 (National Historic Preservation Act) compliance activities undertaken by the Corps at Howard Hanson Dam (refer to Section 2.16). Members expressed an interest in the cultural properties and pointed out the traditional seasonal usage of the area into historic times. They appreciated the opportunity to learn about the sites identified and would like to visit them. They were pleased with the briefing and requested a continuing dialogue with Corps technical staff regarding cultural resources preservation at Eagle Gorge Reservoir at least on an annual basis.

3.7 AMERICANS WITH DISABILITIES ACT

On July 26, 1990, the Americans with Disabilities Act (ADA; PL 101-336) became law. It extends the principles of Section 504 of the Rehabilitation Act of 1973 (as amended, 29 USC 794) and requires many federal departments and agencies to develop implementation regulations that prohibit discrimination on the basis of disability. Regulations include compliance with design and construction standards as expressed in the *ADA Accessibility Guidelines for Building and Facilities* (1991). A memorandum signed by the Secretary of Defense on October 20, 1993, subject, "Access for People with Disabilities," changed the Department of Defense (DOD) policy by directing the DOD to meet not only the *Uniform Federal Accessibility Standards (UFAS)*, but also to meet the requirements of the accessibility guidelines in facilities subject to the federal standards whenever the accessibility guidelines provide equal or greater accessibility than the federal standards.

Corps of Engineers divisions and districts were notified of the change in the DOD policy through a memorandum initiated by the chief of the engineering division—Directorate of Military Programs (CEMP-EA), and the chief of the

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engineering division—Directorate of Civil Works (CECW-EP), dated January 25, 1994, subject, "Access for People with Disabilities." With the Howard Hanson Dam project closed to the public, compliance with the ADA and UFAS apply on an as needed basis for site and facility access. Section 8.2 provides information on accessibility requirements.

3.8 PUBLIC COORDINATION OF DRAFT MASTER PLAN

This master plan has been reviewed by appropriate public, private, and tribal agencies during the review process. A distribution list is provided in Appendix D. Comments received have been addressed by the Corps of Engineers and are included in Appendix E.

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SECTION 4

LAND ALLOCATION AND CLASSIFICATIONS

SECTION 4 – LAND ALLOCATION AND CLASSIFICATIONS

4.1. GENERAL

The purpose of this section is to assign those lands administered by the Corps of Engineers to standard Corps land allocation and land classification categories. It is important to note that only a small amount of land is owned in fee title around Howard Hanson Dam and Eagle Gorge Reservoir. The majority of land utilized by this project has been acquired through various easements, mostly from the city of Tacoma. Plate 2-1 shows the ownership parcels. Two studies may affect future land usage—the *Additional Water Storage Project* and the *Section 1135 Fish & Wildlife Restoration Project.* Both projects involve raising the level of the reservoir which could change the land classifications.

4.2 LAND ALLOCATION

Lands owned in fee by the United States and managed by the Corps of Engineers are allocated to one of four categories depending upon the purpose for which they were acquired. Chapter 3 of Engineering Pamphlet (EP) 1130-2-550 defines these categories as Operations, Recreation, Fish and Wildlife, and Mitigation. All Howard Hanson Dam fee lands, totaling 419.33 acres, are allocated to Operations.

4.3 LAND USE CLASSIFICATIONS

The above allocated lands are broken down further into classifications. Activities conflicting with the intent of the land classifications are not allowed. EP 1130-2-550 land classification categories include Project Operations, Recreation, Mitigation, Environmentally Sensitive Areas, Multiple Resource Management, and Easement Lands. Appendix B provides a breakdown of real estate.

Plate 4-1 maps the approximate land classification boundaries for Howard Hanson Dam. Plates 4-2 and 4-3 provide further detail to the land classification areas. Descriptions of each land classification are listed below.

4.3.1 Project Operations. Lands that are needed solely for the daily operation of the project are classified as Project Operations lands. At Howard Hanson Dam, these lands are used for flood control structures, an operations center, administration office, and a maintenance compound. Flood control is the primary purpose of Howard Hanson Dam and takes precedence over all other land use classifications in time of need. Section 5 provides a full discussion of these lands totaling 298.19 acres.

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4.3.2 Recreation. These lands are managed for intensive recreational activities by the visiting public, including developed recreation areas and areas for concessions, resorts and quasi-public development. Howard Hanson Dam is not open for general public access, therefore no land is managed for recreation.

4.3.3 Mitigation Lands. These are lands acquired or designated for mitigation to offset losses associated with development of the project. At Howard Hanson Dam, there are no lands acquired or designated specifically for mitigation purposes. Neither the original authorization of 1950 for Howard Hanson Dam, or subsequent Congressional actions, have provided for mitigation of the dam's original construction and continued operation's adverse impacts on the environment, including fishery and wildlife resources. During the original authorization process Congress did not receive mitigation recommendations from any of the involved agencies. However, through continued consultation with resource agencies, the Muckleshoot Tribe, and other stakeholders, the Corps continues to seek ways to operate in a manner so as to reduce impacts. New planning authorities will result in the Corps and local sponsors implementing restorative measures in the Green River basin as described in Sections 2.9.3, 2.14.1, and 7.1.

4.3.4 Environmentally Sensitive Areas (ESA). These lands are described as environmentally fragile and specifically designated as having ecological, scientific, cultural and or aesthetic significance. They are restricted to use activities that do not conflict with preserving them. ESAs are limited to lands the Corps finds unique or significant from a fish, wildlife, vegetative, or cultural perspective and are on lands controlled by the Corps. Such areas might include sensitive, threatened or endangered species, special vegetative stands, or unique wetland complexes. If threatened and endangered species are present on easement lands, the Corps has responsibility for land management. Activities would be coordinated with appropriate agencies. Currently, none of the small amount of fee lands are significant enough to be designated environmentally sensitive. There are, however, culturally sensitive lands located on easement lands that are potentially impacted by dam operations and the activities of landowners. Sections 2.16, 3.5 and 7.2.1 discuss the past studies on cultural resources and the significance of these lands.

4.3.5 Multiple Resource Management (MRM). Lands under this classification are managed for one or more uses but with compatibility to the primary land allocation. Use may include the following subcategories—low density recreation, general fish and wildlife management, vegetative management, and or inactive/future recreation areas. Currently, all Howard Hanson Dam MRM lands totaling 121.14 acres are managed for vegetation with the intent to protect and enhance fish and wildlife habitat. Specific fish

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and wildlife management of areas near the dam and reservoir is generally the responsibility of the city of Tacoma and various state resource agencies. Changes in management to restore or enhance fish and wildlife habitat must be handled through studies with approval from authorities other than those that guide the operations of Howard Hanson Dam. With the implementation of the *Section 1135 Fish & Wildlife Restoration Project*, fish and wildlife management will be added. Section 6 describes lands classified under vegetative management.

4.3.6 Easement Lands. Lands in which the Corps holds an easement interest but not fee title are classified as easement lands. Use and management is in strict accordance with the terms and conditions of the easement agreement. The majority of easement lands around Howard Hanson Dam are used for flowage or inundation; the rest primarily for road and utility right-of-ways. Culturally sensitive lands are also located on these easement lands. A discussion on easement lands, totaling 1,786.63 acres, is found in Section 7.

4.4 RESTRICTED WATER USE ZONES

River areas directly upstream and downstream from the dam facilities are normally considered hazardous zones. Since the area is not open to the public, no areas have been designated as restricted.

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SECTION 5

OPERATIONS:
PROJECT OPERATIONS

SECTION 5 – OPERATIONS: PROJECT OPERATIONS

5.1. GENERAL

Section 5 describes and analyzes lands and associated facilities and structures required for daily operation and maintenance of Howard Hanson Dam in accordance with the authorized project purpose. These lands are classified Project Operations for the primary purpose of providing flood control to the Green River floodplain area downstream from the dam, and low flow augmentation for fisheries.

The Project Operations area covers approximately 298.19 acres and includes the dam and appurtenant structures as well as buildings, support structures, roadways, and miscellaneous lands. Of the total acres, 98.41 acres are lands in the vicinity of the dam above the summer conservation pool elevation of 1,141 feet, and 199.78 acres are lands below the 1,141-foot elevation.

This section includes a brief description of each management area under the Project Operations land classification, its resource objectives and rationale, development and management actions, and identification of major constraints to its current or future resource use, development, or management. Refer to Plates 4-1 through 4-3 and Photo 6-2 for the location of each area.

It is not the purpose of this master plan to recommend objectives or actions for the daily operations of the dam. Objectives and actions listed focus, instead, on dam operation with regards to natural resources impacts. A number of other reference documents are used by the project staff to conduct daily operations and maintenance, including physical security and emergency plans, operations and maintenance manuals and inspection reports, and safety and health requirements manuals.

5.2 DAM AND APPURTENANT STRUCTURES

5.2.1 Description. The Project Operations area includes those structures and facilities listed below.

a) Dam. Howard Hanson Dam is an earth-filled structure composed of rolled rock fill, an inclined sand and gravel core, drain zones, and rock shell protection (Photo 5-1). The dam is a zoned embankment 235 feet high with a 450-foot-long crest at elevation 1,228 feet. It is 960 feet thick at the base decreasing to 23 feet thick at the crest. Total length is 675 feet. Because of the high permeability of portions of the right abutment, a 560-foot-long semi-impervious blanket was placed on the upstream side to minimize seepage.

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Photo 5-1: Howard Hanson Dam. Intake tower is in the upper left corner with the spillway in the upper right. August 1998.

Photo 5-2: Intake tower on the left abutment.

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b) Intake structure. The intake structure (tower) for the dam includes trash rack bars, a deck for debris removal, one tractor-type emergency gate, and gate hoist equipment located in the tower (Photo 5-2).

c) Outlet works. The outlet works consists of a gate tower transitioning from an intake, through two sluiceways and a tunnel, and exiting into a stilling basin. The tunnel is located in rock through the dam's left abutment (Photo 5-3). Concrete-lined, it is a 19-foot-wide arched tunnel 900 feet in length. Normal flows passing through this tunnel are regulated by two tainter gates at the intake tunnel entrance, elevation 1,035 feet.

Photo 5-3: Outlet works showing tunnel and stilling basin discharging over 7,200 cfs at 1,183-foot pool, highest pool to date. The 48-inch bypass pipe is located on the left. February 10, 1996.

Low waterflow releases during the summer pass through a 48-inch-diameter steel bypass pipe (Photo 5-3). The bypass is used during the conservation pool period for regulating releases below 550 cfs. A 36-inch-diameter bypass extension is provided for use when inspection and repairs of the stilling basin are being made.

The spillway is a separate unit but discussed as part of the outlet works. It is anchored in rock on the left bank. The intake is controlled by two large tainter gates to permit storage to elevation 1,206 feet without spillway discharge. Spillway discharge capacity at this

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elevation is 115,000 cfs. The downstream chute has a curved alignment and is 830 feet in length (Photo 5-4).

Photo 5-4: Spillway tainter gates (top) and chute (bottom).

d) Instrumentation. Numerous piezometers to measure the ground water level and flow rates have been installed within the dam embankment and abutments. These are wired to a microcomputer for monitoring in the administration building; some are monitored via phone line transmittal of data to the Seattle District Office. A program to maintain, upgrade and install new instruments continues on a regular basis.

e) Seepage tunnel. This tunnel is located on the right bank. It is used to relieve the ground water pressure in the upper aquifer.

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5.2.2 Resource Objectives.

a) To conduct daily operations and maintenance functions of Howard Hanson Dam and related structures.

b) To maintain, upgrade and install new instruments on a regular basis.

c) To provide responsive and equitable utilization of water among competing resources.

5.2.3 Rationale.

a) Land and structures are required for flood control and low flow augmentation for the lower Green River as a primary purpose of the project.

b) Properly working instruments and equipment are vital for monitoring the water level and movement within the dam.

c) Changes in management practices and land use which determine current and future water management decisions require increased agency interaction.

5.2.4 Development and Management Actions.

a) Continue regular installation, maintenance and upgrades of instruments and equipment for accurate monitoring.

b) Continue an adaptive management approach with other agency resource management activities and downstream user needs.

5.2.5 Major Constraints. None.

5.3 BUILDINGS, ROADWAYS, AND MISCELLANEOUS LANDS

5.3.1 Description. This portion of the Project Operations area includes three buildings and miscellaneous lands as described below. *Acreage's listed are approximate.*

a) Administration Building (2,160 sq ft). Also referred to as the project office, this building is located in a fenced compound on the

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right dam abutment off Road 5500. It is used for daily operations of the dam and reservoir.

Photo 5-5: Administration building (project office).

b) Fuel Dispensing Station and Flammable Materials Storage Building (320 sq ft). This facility is located approximately 200 feet north of the administration building off Road 5500.

c) Quonset Hut Storage (1,120 sq ft) and Staging Area (2.7 acres). This area is adjacent to Access Road No. 6, about 472 feet south of the intake tower (Photo 5-6). Revegetation of the area has been through natural succession. In the event of future construction, the area can be cleared for staging equipment and materials. Until a staging area is no longer needed, it remains under the Project Operations classification.

Photo 5-6: Quonset hut storage and staging area. August 22, 1998.

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d) Left Bank Hillside (3.5 acres). This stretch of land is located on the left bank adjacent to the intake tower, from the upper Access Road 6 down to the conservation pool elevation of 1,141 feet. It remains devoid of trees and shrubs to retain stabilization of the rock fill (Photo 5-7).

Photo 5-7: Left bank hillside adjacent to the intake tower. The quonset hut storage and staging area is just left of center. May 15, 1998.

e) Upstream Forested Knoll (1.10 acres). This knoll is located along Access Road 10 on the left bank adjacent to the quonset hut storage and staging area (Photo 5-8). It is directly over the old Northern Pacific Railway tunnel used prior to construction of the dam. A boat moorage tailhold and crossboom tailhold are anchored at elevation 1,206 feet.

Since construction of the dam, vegetation has been allowed to naturally regrow. The knoll is completely forested in Douglas fir. Brush growing on the dirt road is cut down regularly to keep access open to the tailholds. Only small wildlife and birds use the area due to the small acreage, the steep slopes to the reservoir, and human interaction. Harvesting mature timber would only be considered inside the loop road, but the cost of harvesting such a small area would not be financially sound. Harvesting growth along the perimeter of the knoll would not be considered as it helps stabilize the steep slopes. This area is classified under Project Operations for the purpose of accessing the tailholds.

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Photo 5-8: Upstream forested knoll at elevation 1,141 feet (top) and 1,063 feet (bottom). Top of the old Northern Pacific Railway tunnel is visible in the lower center. February 29, 1996.

f) Roadways. Various dirt and gravel roads provide access to the dam, intake and outlet structures, stilling basin, and reservoir.

5.3.2 Resource Objective. To maintain lands and facilities as directed for operations and maintenance.

5.3.3 Rationale.

a) Lands and structures are required for daily operations and maintenance of the dam.

b) Lands are used for access and management purposes.

5.3.4 Development and Management Actions.

a) Prevent vegetative regrowth on the Left Bank Hillside adjacent to the tower while taking precautions to prevent erosion problems.

b) Allow the Quonset Hut area and the upstream forested knoll to remain in a successional state of growth until needed for project operations purposes.

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5.3.5 Major Constraints. None.

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SECTION 6

OPERATIONS: MULTIPLE RESOURCE MANAGEMENT

SECTION 6 – OPERATIONS: MULTIPLE RESOURCE MANAGEMENT

6.1 GENERAL

Lands under the Multiple Resource Management (MRM) classification are managed for one or more uses but with compatibility to the primary land allocation. Use may include low density recreation, general fish and wildlife management, vegetative management, and or inactive/future recreation areas.

Currently, all remaining land parcels that are held in fee title but not associated with the daily operations of Howard Hanson Dam are MRM lands and account for approximately 121.14 acres. These areas have been left in their natural state and are managed under the Multiple Resource Management classification.

This section includes a brief description of the downstream and upstream vegetative areas, their resource objectives and rationale, development and management actions, and identification of major constraints to their current or future resource use, development or management. Refer to Plates 4-1 through 4-3 and Photo 6-2 for the location of each area. *Acreage's listed are approximate.*

6.2 DOWNSTREAM VEGETATIVE AREAS

6.2.1 Description. There are three areas downstream from the dam that are identified for vegetative management—a forested stretch of land between the 3- and 4-Mile road markers, and two parcels on both the left and right banks downstream from the stilling basin.

a) 3-Mile Forested Area (11.9 acres). This strip of forested land is located downstream from the dam on the right bank. It follows Road 5500 on the uphill side from the 4-Mile road marker downstream to the 3-Mile road marker at the Section 21 post, and up to the project's north boundary. Tree species on this parcel include western hemlock (the climax species), Douglas fir, and vine maple. No vegetative management has been conducted on this land, but logging and road work are impending by other agencies and private enterprises on lands bordering Corps property. It is crucial that boundary delineation be made clear prior to this activity.

b) Right Bank Vegetative Area (34.9 acres). This area encompasses two parcels of land on the right bank. The upper parcel of land (19.7 acres) is sandwiched between Road 5500 and Access Road B. It extends from the seepage tunnel to the junction of Road 5500 for a total distance of approximately $1^{1}/_{8}$ mile. Tree species include western

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hemlock, Douglas fir, big leaf maple, and alder. It remains in a natural vegetative state to control erosion on the steep hillside.

The lower parcel of land (15.2 acres) is sandwiched between Access Road B and the Green River. It extends from just below the stilling basin to the junction of Road 5500 for a total distance of about $1^{1}/_{8}$ mile. This strip of land, primarily alder, remains in a natural vegetative state to control erosion on the short but steep banks, and to provide shade along the river for fish protection.

c) Left Bank Vegetative Area (4.1 acres). This parcel of land is directly opposite the Right Bank Vegetative Area. It extends from just below the stilling basin downstream to the project's west boundary, and from the river up to the project's south boundary. Tree species include western hemlock, Douglas fir, big leaf maple, and alder which have been left in a natural state to control erosion on the steep bank, and to provide shade along the river for fish protection.

6.2.2 Resource Objectives.

a) To preserve, protect, and enhance existing fish and wildlife habitat.

b) To maintain a sustained level of snags and logs for cavity nesters.

c) To minimize erosion and sloughing along steep hillsides.

6.2.3 Rationale.

a) Proper management of these natural resources ensures their continued availability to present and future generations.

b) Erosion and sloughing along steep hillsides affect water quality, fish and wildlife habitat, and adjacent access roads.

6.2.4 Development and Management Actions.

a) Identify Corps property boundaries and post boundary monuments to prevent accidental encroachment by other agencies and or private enterprises.

b) Allow the 3-Mile Forested Area and the Left and Right Bank Vegetative Areas to remain in their natural state, subject to

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successional changes, but enhance habitat quality, when needed, by planting appropriate species.

6.2.5 Major Constraints. None.

6.3 UPSTREAM VEGETATIVE AREAS

6.3.1 Description. There are two areas upstream from the dam that are identified for vegetative management—a forested stretch of land at the 5-Mile road marker, and a section of land the old Northern Pacific Railway use to run along prior to it being moved.

a) 5-Mile Forested Area (4 acres). This is the only parcel of land upstream from the dam that is currently identified for vegetative management. It is located on the right bank following Road 5500 on the uphill side for a short distance in both directions of the 5-Mile road marker, and up to the project boundary (see Photo 6-1). Tree species include western hemlock and Douglas fir that are subject to severe blowdown due to the area being exposed to the wind blowing along the open water surface (a phenomenon known as a fetch). Left in a natural state, this area will provide for wildlife habitat as well as prevent erosion of the steep hillside, thus, preventing mudslides onto Road 5500.

Photo 6-1: The 5-Mile multiple resource management area stabilizes the steep right bank, protecting Road 5500 from mudslides. September 24, 1984.

b) Old Railway Grade (63.64 acres). The majority of the 13 2/3-miles of Northern Pacific Railway, that was relocated prior to construction of the dam, lies under the reservoir. A 1¼-mile-section of

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this land is above the 1,141-foot summer conservation pool elevation at the southeast boundary of the Howard Hanson Dam fee lands. It follows the right bank of the Green River and ends just downstream from Bridge 71. A road crossing this area provides access to the reservoir for surveys as well as an alternate access to the Upper Basin Debris Storage. Deciduous trees and saplings mixed with coniferous grass and shrubs cover the area. The natural vegetation is left intact except when road access become obstructed.

6.3.2 Resource Objectives.

a) To preserve, protect, and enhance existing wildlife habitat.

b) To maintain a sustaining level of snags and logs for cavity nesters.

c) To minimize erosion and sloughing along exposed and steep hillsides.

6.3.3 Rationale.

a) Proper management of the natural resource ensures its continued availability to present and future generations.

b) Erosion and sloughing along exposed and steep hillsides affect wildlife habitat and adjacent access roads.

c) Lands are used for access, research studies, and management purposes.

6.3.4 Development and Management Actions.

a) Identify Corps property boundaries and post boundary monuments to prevent accidental encroachment by other agencies and or private enterprises.

b) Allow the 5-Mile Forested Area and the Old Railway Grade to remain in a natural state, subject to successional changes.

6.3.5 Major Constraints. None.

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Photo 6-2: Lands and facilities required for operation and maintenance of Howard Hanson Dam. Placement of the yellow project boundary line is approximate but emphasizes the small amount of land in fee title by the Corps of Engineers. Refer to Sections 5, 6 and 7 for a full discussion of these areas. September 20, 1994.

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SECTION 7

OPERATIONS: EASEMENT LANDS

SECTION 7 – OPERATIONS: EASEMENT LANDS

7.1 GENERAL

Of the 2,271.97 acres that comprise the Howard Hanson Dam project, 1,786.63 acres are classified as easement lands (refer to Plates 4-1 through 4-3 and Photo 6-2 for the location of these areas). There are numerous owners of the various parcels of easement properties, but the majority of these lands are owned by the city of Tacoma (see Plate 2-1 for ownership). Corps of Engineers' easements are primarily for flowage and inundation as part of project operations. Remaining easements are held for road and utility rights-of-way and debris control. Use and management of easement lands are prescribed by the terms of the easement estate acquired for the project. Details on individual easements are available through the Real Estate office at the Seattle District Corps of Engineers.

The *Additional Water Storage Project* for Howard Hanson Dam will raise the existing pool in two phases—from the existing 1,141-foot elevation to elevation 1,162-1,167 feet in Phase 1, and to elevation 1,177 feet in Phase 2. The *Feasibility Study* is complete and Phase 1 could be implemented within two or three years.

The Water Resources Development Act of 1986 (Title XI, Section 1135) allows for environmental restoration resulting from a construction project. A Section 1135 project has been approved within the Eagle Gorge Reservoir area to restore natural river functions for fish habitat improvement, as recommended in the *Section 1135 Fish & Wildlife Restoration Project* (September 1996). The local sponsor (city of Tacoma) has responsibility for management of the restoration and is planning to pay the Corps for their management regardless of location on Tacoma or Corps lands. Both fee and easement lands would be involved under the Section 1135 project and the more encompassing AWS project.

7.2 FLOWAGE AND INUNDATION LANDS

7.2.1 Description. In 1955, the Corps acquired perpetual flowage easements in the reservoir area to overflow, flood, and submerge the land lying between elevations 1,035 and 1,206 feet for construction, operations and maintenance of the dam and reservoir. Culturally sensitive lands within elevations 1,100 and 1,140 feet are subject to damage due to dam operations and the activities of landowners (refer to Sections 2.16 and 3.5 for a discussion of the past studies on cultural resources). Continued communication, primarily with the city of Tacoma, and other appropriate landowners is important to protecting these resources.

7.2.2 Resource Objectives.

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a) To continue to monitor embankments for the protection of natural and cultural resources.

b) To continue to monitor easement lands for unauthorized activity.

c) To routinely consult with the Muckleshoot Tribe to discuss fisheries, water management, and cultural resources issues at least on an annual basis.

d) To determine significance of known cultural resource sites.

e) To report inadvertent discoveries of archeological or human remains within the Corps jurisdiction that meet requirements of Section 3 of the Native American Graves Protection and Repatriation Act.

7.2.3 Rationale.

a) Areas for waterflow and storage from the Green River are necessary for flood control.

b) Monitoring is necessary to detect recent slides and erosion, and to insure timely protection of the natural and cultural resources.

c) Tribal coordination is necessary to meet federal treaty trust responsibilities and Indian consultation requirements of Sections 106 and 110 of the National Historic Preservation Act, and the Native American Graves Protection and Repatriation Act.

d) Cultural resource sites may be eligible for registration under the National Register of Historic Places. Corps of Engineers regulation 1130-2-540 requires that effects to cultural resource sites be addressed, and notification be given to appropriate Indian tribes and or landowners.

7.2.4 Development and Management Actions.

a) Continue communication with the city of Tacoma and other appropriate landowners.

b) Continue cultural resource site evaluations.

c) Develop a Cultural Resources Management Plan that describes historic properties, site evaluation efforts, and priority for treatment,

Field Code Changed

including data recovery of significant features, specimens, and scientific samples, in-place protection, and curation of collections.

d) Begin routine tribal coordination with affected Indian tribes.

e) Prepare a Memorandum of Agreement with the Advisory Council on Historic Preservation that addresses operations effects on historic properties.

f) Develop a Standard Operating Procedure for reporting inadvertent discoveries of human skeletal remains within the Corps' jurisdiction.

7.2.5 Major Constraints. None.

7.3 ROAD AND UTILITY RIGHT-OF-WAY LANDS

7.3.1 Description. Puget Sound Energy provides primary commercial power to Howard Hanson Dam along a right-of-way from the Tacoma Headworks to the dam. A meter owned by the Corps is located at the headworks where the primary power is stepped down to a 13 kilovolt, three-phase, three-wire delta service. The poles and powerline are owned and serviced by the Corps of Engineers. Maintenance of the right-of-way is also performed by the Corps.

7.3.2 Resource Objectives. To maintain the right-of-way and powerline for daily operations of Howard Hanson Dam.

7.3.3 Rationale. Power is necessary for daily dam operations.

7.3.4 Development and Management Actions. Continue to maintain the right-of-way and powerline.

7.3.5 Major Constraints. None.

7.4 UPSTREAM DEBRIS STORAGE AREAS

Field Code Changed

7.4.1 Description. Three debris storage areas are located on the reservoir—the Temporary Debris Storage at the boat moorage area just upstream from the dam on the left embankment (Photo 7-1), the North Fork Debris Storage on the right embankment about two miles upstream towards the North Fork of the Green River (Photo 7-2), and the Upper Basin Debris Storage about four miles upstream on the left embankment (Photo 7-3).

Photo 7-1: The Temporary Debris Storage at the boat moorage area during the winter drawdown at elevation 1,070 feet. Photo shows the crossbooms in place. January 1998.

Photo 7-2: The North Fork Debris Storage at elevation 1,177.8 feet. February 9, 1996.

Crossbooms at the dam trap floating debris which is contained at a temporary holding area during the year. During the high summer pool, collected debris is towed to the Upper Basin Debris Storage. When the reservoir lowers, salvageable material is removed and the remaining debris is sawed, piled, and burned, or used for environmental restoration projects.

Field Code Changed

Photo 7-3: A sweepboom surrounds collected debris and is towed (top) to the Upper Basin Debris Storage (bottom).

7.4.2 Resource Objective. To continue storage of collected debris.

7.4.3 Rationale. Collection of debris on the reservoir provides several advantages:

a) Allows unobstructed waterflows through the intake and outlet structures.

b) Reduces damage to the intake and outlet structures caused by debris hitting against the interior during passage.

c) Can be used for environmental restoration projects such as fish habitat structures.

d) Can be salvaged by other agencies or private enterprises for use elsewhere.

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7.4.4 Development and Management Actions. Continue a regular collection of floating debris.

7.4.5 Major Constraints. Due to channel changes as a result of high water events, repair and relocation of the storage area access roads are occasionally necessary.

Field Code Changed

SECTION 8

DESIGN CRITERIA

SECTION 8 - DESIGN CRITERIA

8.1 GENERAL

General policies and procedures for the planning, design, operation, and maintenance of recreation facilities at Corps of Engineers Civil Works projects are provided in engineering manuals, regulations, and pamphlets. Even though the Howard Hanson Dam project is not accessible to the general public, reference information is provided in this section for applicability to visitor and employee safety and accommodation. Design principles and criteria particularly appropriate to the Howard Hanson Dam and Eagle Gorge Reservoir are discussed in subsequent paragraphs.

ER 200-2-3, Environmental Compliance Policies

EP 200-2-3, Environmental Compliance Guidance and Procedures

EP 310-1-6, US Army Corps of Engineers Graphic Standards Manual

EP 310-1-6a and b, US Army Corps of Engineers Sign Standards Manual

ER 1110-2-400, Design of Recreation Sites, Areas, and Facilities

ER 1130-2-500, Partners and Support (Work Management Policies)

EP 1130-2-500, Partners and Support (Work Management Guidance and Procedures)

ER 1130-2-540, Environmental Stewardship Operations and Maintenance Policies

EP 1130-2-540, Environmental Stewardship Operations and Maintenance Guidance and Procedures

ER 1130-2-550, Recreation Operations and Maintenance Policies

EP 1130-2-550, Recreation Operations and Maintenance Guidance and Procedures

ER 1165-2-400, Recreational Planning, Development, and Management Policies

Uniform Federal Accessibility Standard

Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)

Universal Access to Outdoor Recreation: A Design Guide

Field Code Changed

8.2 ACCESSIBILITY STANDARDS

As defined in Section 3.8, Department of Defense (DOD) policy requires all DOD facilities, which includes Corps of Engineers water resources projects such as Howard Hanson Dam, to be at least as accessible as state and local government facilities and public accommodations in the private sector that are subject to the Americans with Disabilities Act (ADA). Buildings and facilities shall be designed, constructed and altered to meet or exceed the *ADA Accessibility Guidelines for Buildings and Facilities (ADAAG)* which was developed by the United States Architectural and Transportation Barriers Compliance Board, of which the DOD is a member, and the *Uniform Federal Accessibility Standards*. For existing buildings and facilities, physical barriers to entering and using the facilities must be removed when readily achievable. It is the Corps' policy to incorporate accessibility considerations in all planning, design, new construction, and renovation activity at water resources projects. ADA requirements may be summarized as follows.

8.2.1 Remove architectural and structural barriers in existing facilities where readily achievable. Readily achievable means easily accomplishable and able to be carried out without undue difficulty or expense.

8.2.2 Provide readily achievable alternative measures when removal of physical barriers is not readily achievable. Legitimate safety requirements may be considered in determining what is readily achievable so long as they are based on actual risks and are necessary for safe operation.

8.2.3 Maintain accessible features and equipment.

8.2.4 Design and construct new facilities and, when undertaking alterations, alter existing facilities in accordance with the ADAAG.

8.3 SITING

Development should be sensitive to the natural landscape character of the site and area. The landscape character of each site and its natural factors should be fully analyzed so the most scenic parts of the site or area remain undisturbed so as to be enjoyed in their most natural condition. Facilities should be sited to blend with the existing landscape rather than compete with it. Only the most adaptable terrain will be used for siting of facilities. Cuts and fills should be minimized.

If endangered or threatened species are present, further consultation with the US Department of Fish and Wildlife Service or other appropriate agencies will occur.

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8.4 SITE PREPARATION

Detailed information on the site should be obtained before design begins. Vegetation to be preserved should be selected early in the design phase. All vegetation to be preserved shall be fenced off during construction work. No stockpiling of materials or disturbance to root zones shall be allowed within fenced areas.

Grading for construction of facilities should be minimized. Necessary cuts and fills should blend uniformly with existing natural contours. Their edges should be neatly finished to blend with the natural landform and vegetation. Careful consideration should be given to how and where excess material is to be used. Excess material may often be used to create landforms such as mounds or berms of earth to separate and screen use areas.

8.5 LANDSCAPE RESTORATION

Predominantly native plant material should be used for landscaping for ease of plant adaptability and maintenance. Use of native rock and forest litter should be considered to increase the natural regeneration process and appearance. Disturbance of the natural environment shall be minimized. Planting should be informal in character and emphasize natural landforms with groupings of native trees and an understory of shrubs and ground covers.

8.6 LANDSCAPE ARCHITECTURAL FEATURES

Design and materials of landscape features, such as shelters, fences, flagpoles, walls, etc., should reflect the character of the natural landscape and, when applicable, the established architectural style of the project. Design of all elements should be compatible with each other to establish visual unity for the project.

8.7 STRUCTURES

New structures should be sited to avoid visual competition in the landscape. Architectural treatment should be sensitive to established architectural style of the project, and should be sited to reflect local ground forms and vegetative patterns and surroundings. Increased use of natural materials, natural colors, and earth and landscape screening is recommended. Paints and stains should be consistently applied to structures as well as landscape features to aid in establishing the visual unity of Corps project sites.

Field Code Changed

8.8 ELECTRICAL DISTRIBUTION

Existing power lines are located underground with the exception of the high tension lines. Future electrical utilities, excepting high tension lines, should also be located underground to maintain a clean, uncluttered appearance.

8.9 SIGNS

Project signs shall be in accordance with criteria stated in the US Army Corps of Engineers Graphic Standards Manual (EP 310-1-6), US Army Corps Engineers Sign Standards Manual (EP 310-1-6a and 6b), and applicable regulations with consideration to the following elements.

8.9.1 Location of signs on project lands shall be set in a fully coordinated sign plan to aid in effective placement and to eliminate unnecessary duplication. Sign inventories reflect current conditions and recommendations of this master plan. Presently, a sign inventory of the Howard Hanson Dam project has not been completed.

8.9.2 Sign design shall be as consistent as possible within the project area and in accordance with the national sign standards.

8.9.3 Entrance signs shall be highly visible to major facilities.

8.9.4 Highway signs shall be designed to effectively direct and inform project visitors regarding facilities.

8.9.5 Sign design and material shall be as vandal-resistant as practicable.

8.9.6 Project signs shall be properly maintained, including rehabilitation, removal, or prompt replacement, as needed or when required.

Field Code Changed

SECTION 9

CONCLUSIONS AND RECOMMENDATIONS

SECTION 9 – CONCLUSIONS AND RECOMMENDATIONS

9.1 CONCLUSIONS

This master plan presents recommendations for the preservation, conservation, restoration, maintenance, management, and development of project lands, waters, and associated resources, consistent with the authorized project purpose. Lands were acquired in accordance with the authorizing documents for the operation of Howard Hanson Dam and Eagle Gorge Reservoir for flood control on the Green River.

Resource development and management actions should be measured against the projectwide resource use goals and specific management area objectives as identified in Sections 1, 5, 6 and 7. This plan serves as the foundation to the follow-up Operational Management Plan as prescribed by Engineer Regulation 1130-2-550, Chapter 3.

9.2 RECOMMENDATIONS

It is recommend that the Howard Hanson Dam Master Plan be adopted as a guide to the orderly use, development and management of the natural and manmade resources of the Howard Hanson Dam and Eagle Gorge Reservoir, as administered by the US Army Corps of Engineers, Seattle District. Land classifications and resource objectives described in Sections 4, 5, 6, and 7 provide a balanced plan for sound resource use, development, and management consistent with the authorized project purpose, and are based on the determination of the highest and best use.

Periodic re-evaluation of the identified resource objectives, accompanied by possible modification of some objectives and or established priorities, will be necessary. Accordingly, updating of this master plan shall be scheduled as recommended in Engineer Regulation (ER) and Engineer Pamphlet (EP) 1130-2-550. Specific recommendations are identified below.

9.2.1 Historic Properties Management Plan (also called Cultural Resources Management Plan). The environmental compliance assessment conducted in 1997 indicated that cultural resource sites had been identified, but not yet evaluated for their National Register eligibility due to access being available only during a reservoir drawdown. Once these sites have been evaluated and the necessary reports written, a Historic Properties Management Plan shall be developed and fully implemented as prescribed by ER/EP 1130-2-540. Data and material from affected sites should be recovered and preserved under a Memorandum of Agreement with the Advisory Council on Historic Preservation. Refer to Sections 2.16, 3.5, 3.6 and 7.2.4 for detailed cultural resources information.

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9.2.2 Operational Management Plan (OMP). Complete an OMP according to ER/EP 1130-2-550, Chapters 3, to provide the detail necessary for accomplishing the projectwide and management area objectives discussed in Sections 1, 5, 6, and 7.

9.2.3 Communication.

a) Continue regular communication with landowners, Indian tribes, and downstream users when major changes occur in daily operations. Communication and flexibility is important in order to complement other agency resource management activities and downstream user needs (reference Sections 3.6, 5.2.4 and 7.2.4).

b) Culturally sensitive lands above the elevation of existing Corps activity at elevation 1,147 feet may be impacted by the activities of neighboring landowners. Communication, coordination and scheduling of resource activities with the city of Tacoma, the Muckleshoot Indian Tribe, and other appropriate landowners is vital for protection of the natural and cultural resources (reference Sections 3.6 and 7.2.4).

9.2.4 Equipment Maintenance.

a) Continue regular installation, maintenance and upgrades of instruments and equipment for accurate monitoring of the piezometers (reference Section 5.2.4).

b) Continue to maintain the right-of-way and powerline to insure necessary power for daily operation of the dam (reference Section 7.3.4).

9.2.5 Quonset Hut Storage and Staging Area. Determine if this area will still be considered as a staging area for future construction. It currently resides under the Project Operations land classification. Because the area has been allowed to revegetate naturally due to lack of use, it may need to be transferred to the Multiple Resource Management—Vegetation classification and managed as such (reference Sections 5.3.1c and 5.3.4).

9.2.6 Downstream Vegetative Areas. Allow these areas to remain in their natural state in order to provide for fish and wildlife habitat, as well as to control dust and erosion along the steep hillsides, but plant appropriate species, when needed, to enhance the habitat quality (reference Section 6.2.4b).

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9.2.7 3-Mile Forested Area. Determine and post Corps of Engineers boundary lines to prevent accidental use by other agencies and or private enterprises (reference Sections 6.2.1a and 6.2.4).

9.2.8 5-Mile Forested Area. Allow this area to remain in its natural state in order to provide for wildlife habitat, as well as to control erosion along the steep hillside, but plant appropriate species, when needed, to enhance the habitat quality and to reduce blowdowns (reference Sections 6.3.1a and 6.3.4).

9.2.9 Debris Storage Areas.

a) A regular collection of floating debris insures unobstructed waterflow through the intake and outlet structures, reduces damage to these structures, and is used for environmental restoration projects or elsewhere by the Corps and other agencies or private enterprises (reference Section 7.4.4).

b) Continue to repair or relocate the debris storage area access roads when high water events change the river channel (reference Section 7.4.5).

9.2.10 Sign Plan. Establish a project sign plan as the foundation for future sign changes, as prescribed in ER/EP 210-1-6a and 6b. This plan should be responsive to personnel entering the project area where the Corps is responsible for maintenance (reference Section 8.9).

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APPENDIX A

PERTINENT DATA

HOWARD HANSON DAM
PERTINENT DATA

MISSION: Flood control and water storage. Flood control to prevent inundation and damage in the Green-Duwamish River Basin is accomplished by impounding excessive water runoff from the upper drainage area of the river and releasing under controlled conditions. After the annual winter flood season, water is stored to augment the low summer river flows in order to benefit fisheries, and municipal and other downstream water users.

PURPOSES:*

Operating Purposes	Authorized Purposes	Authorizing Laws
Flood Control	Flood Control (primary)	PL 81-516[a]
Fish Conservation	Fish Conservation (secondary)[b]	PL 81-516
	Water Quality[c]	PL 81-516
	Irrigation[d]	PL 81-516
	Water Supply[e]	PL 81-516
	Recreation[f]	PL 78-534[f]

* Extracted from *Authorized and Operating Purposes of Corps of Engineers Reservoirs, July 1992;* CEWRC-HEC Hydrologic Engineering Center, Davis California.

[a] Authorization of the project for the Eagle Gorge Reservoir on the Green River, Washington, is provided under PL 81-516, Title II-Flood Control Act of 1950 (Section 204; May 17, 1950). Specific authorization purposes are found in H. Doc 271 (81st Cong, 1st Sess; July 22, 1949).

[b] Specifically, low flow augmentation.

[c] Water quality benefits (called pollution abatement in H. Doc 271) are derived from flows released for fisheries.

[d] No proposal was submitted at time of authorization. Irrigators draw water from the river downstream of the dam.

[e] An Additional Water Storage study is underway of current water supply needs that could be served by the Howard Hanson Dam project.

[f] PL 78-534 is the Flood Control-Construction Act of 1944 (58 Stat 887; December 22, 1944) providing authority to add recreation as a purpose (Section 4), and to contract for use of surplus water for domestic and industrial purposes (Section 6). Howard Hanson Dam was never considered for recreational use.

GENERAL

Project Name	Howard A. Hanson Dam[1]
CWIS	07790
Project Number	CB328
Owner/Operator, Date	Seattle District US Army Corps of Engineers, Nov 1961
Date of Dam Construction	1955-1969[2]
Stream	Green River
County, State	King, Washington
USGS Quadrangle	Eagle Gorge, Cougar Mtn & Greenwater Quadrangles; 7.5 minutes series
Drainage Area	221 of 483 square miles
Location	Sec 28, T21N, R8E, W.M.

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	45 rd mi SE of Seattle, 35 mi E of Tacoma, 6 mi from Kanaskat, 24 mi from Mud Mountain Dam, 3 mi from Tacoma Headworks. In the Tacoma Municipal Watershed and closed to the public.

RESERVOIR

Name	Eagle Gorge Reservoir
Shoreline Miles	Data not available
Minimum Winter Pool:	
Normal Elevation	1,070 ft NGVD[3]
Surface Area	100 acres
Reservoir Volume	1,300 ac-ft[4]
Summer Conservation Pool:	
Normal Elevation	1,141 ft NGVD
Elevation During Possible Drought Years	1,147 ft NGVD
Length	4.5 miles (7.2 km) Green River , and 2.5 miles (4 km) North Fork Green River
Surface Area	780 acres
Usable Storage Capacity	25,400 ac-ft
Maximum Regulated Flood Pool:	
Elevation	1,183.24 ft NGVD, recorded Feb 10, 1996
Surface Area	1,344 acres
Storage Capacity	76,146 acre-feet
Maximum Design Flood Pool:	
Elevation	1,206 ft NGVD
Length	7 miles (11.3 km) Green River, and 4 miles (6.4 km) North Fork Green River
Surface Area	1,750 acres
Storage Capacity	106,000 ac ft
Maximum Depth	171 feet at the tunnel inlet
Total Drawdown	136 feet
Elev. 1,070 to 1,141 ft	71 feet
Elev. 1,141 to 1,206 ft	65 feet

DAM

River Mile	64.29 from mouth of Green-Duwamish Rivers
Dam Type	Earth-filled; rock, sand, gravel core
Elevation (top of dam)	1,228 ft NGVD
Height (above bedrock)	235 ft (71.6 m)
Width at Crest (thickness)	23 ft (7 m)
Width at Base (thickness)	960 feet (292.6 m)
Length at Crest (elev. 1,228 ft)	450 ft (137.2 m)
Total Length (incl. abutments & spillway)	675 ft (205.7 m)
Volume of Concrete (entire project)	48,000 cy

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Volume of Fill (incl. shell & core)	1,502,0000 cy

SPILLWAY

Spillway Type	Concrete, gated, ogee
Location	Left abutment
Elevation (at crest)	1,176 ft NGVD
Chute Length	656 feet long
Gates and Type	2, tainter, 45 x 30 ft each (13.7 x 9.1 m)
Design Capacity (outflow)	107,000 cfs (3,030 cm/s)
Use	Never used to date

OUTLET WORKS

Intake Tower Location	Left bank
Total Capacity	23,000 cfs
Tunnel Type	Concrete-lined, horseshoe shape
Tunnel Length	19 ft wide x 900 ft long (5.8 x 274.3 m)
Tunnel Gates, Type, Size	2, tainter, 10 ft x 12 ft (3.05 x 3.7 m)
Bypass	48-in dia steel pipe
Capacity (at max conservation pool)	500 cfs
Bypass Gates	1 48-in dia ball valve, 1 48-in x 48-in slide gate
Emergency Gate, Type, Size	1, tractor, 16.7 ft x 20 ft high
Stilling Basin	40.8 ft wide x 172 ft long

DRAINAGE TUNNEL

Construction Date (elev. 1,100 ft)	1968
Location	Right abutment
Type	Horseshoe, concrete-lined
Dimensions	5 ft wide x 8.5 ft high x 650 ft long

RECREATION None—not open to the public.

STAFF 3, provided from Mud Mountain Dam

BUILDINGS

Administration Building	2,160 sq ft
Quonset Hut Storage	1,120 sq ft
Fuel Dispensing Station	320 sq ft
	Total: 3,600 sq ft

[1] The project for the Eagle Gorge Reservoir was authorized at an estimated cost of $16,300,000. Name change for the dam was approved in PL 85-592 (85th Cong, 2nd Sess; August 6, 1958).
[2] Road, railroad, utility relocations initiated 1955. Dam started 1959, completed April 1962. Right bank drainage tunnel completed 1969.
[3] National Geodetic Vertical Datum. Same as mean sea level but a more accurate measurement.
[4] An acre-foot of water covers one acre to a depth of 1 foot and is equivalent to 325,872 gallons.

Field Code Changed

APPENDIX B

REAL ESTATE INTERESTS

HOWARD HANSON DAM -- LAND CLASSIFICATIONS, MANAGEMENT UNITS AND ACREAGE

REAL ESTATE LANDS	**ACREAGE**			hhd\acreages.xls 6/4/99 Bonnie Ecker
Fee title	419.33	*		
Leased	0.01			
Held by permit	0			
Held by license	66.00			
Held by easement	1,786.63			
TOTAL REAL ESTATE LANDS	2,271.97			
***LAND ALLOCATIONS** (breakdown of fee title lands)				
Operations	419.33			
Recreation	0		(Lands not open to public.)	
Fish and Wildlife	0		(Part of Operations.)	
Mitigation	0		(Tacoma's responsibility.)	
TOTAL ALLOCATED FEE LANDS	419.33	**		
****LAND CLASSIFICATIONS** (breakdown of allocated lands)			**MANAGEMENT UNITS**	**Sub Areas**
Opns: Project Operations	298.19		Dam and Appurtenant Structures:	Dam, intake structure, outlet works, instrumentation, seepage tunnel.
			Buildings, Roadways, and Misc Lands:	Admin bldg, fuel dispensing station/flammable materials storage bldg, quonset hut storage/staging (2.7 ac), left bank hillside adj to tower (3.5 ac), roadways, upstream forested knoll (1.10 ac).
Opns: Recreation	0			
Opns: Multiple Resource Management	121.14			
Recreation-Low Density	*0*			
Inactive and/or Future Rec Areas	*0*			
Wildlife Management General	*0*			
Vegetation Management	*121.14*		Vegetation Management:	5-Mile Forested Area (6.6 ac) 3-Mile Forested Area (11.9 ac) Left Bank Vegetative Area (4.1 ac) Right Bank Veg. Areas (upper 19.7, lower 15.2, total 34.9 ac) Old Railway Grade (63.64 ac)
Opns: Environmentally Sensitive Areas	0			
Opns: Mitigation	0			
TOTAL ALLOCATED FEE LANDS	419.33			
Opns: Easement Lands (Corps holds easement interest but not fee title)	1,786.63		Flowage and Inundation Lands:	Perpetual flowage between elevations 1,035 and 1,206 feet.
			Road and Utility Right-of-Way Lands:	Powerline right-of-way, poles and powerlines feeding dam.
			Upstream Debris Storage Areas:	Temporary Debris Storage; Upper Basin Debris Storage; North Fork Debris Storage.
TOTAL FEE & EASEMENT LANDS	2,205.96		+ licensed lands (66.00) + leased lands (0.01) = **2,271.97 TOTAL HOWARD HANSON DAM REAL ESTATE LANDS**	

CENPS-RE-RO (405a) 8 May 1997

MEMORANDUM FOR CENPS-EN-DB-AC ATTN: J. Tippett

SUBJECT: Howard Hanson Dam Project Master Plan

1. The following information is provided per your memo dated April 28, 1997, SAB.

2. The Corps of Engineers real estate interests at Howard A. Hanson Dam Project consist of 419.33 acres fee, 66.00 acres license, 1786.63 acres easement, and 0.01 of an acre lease. There are no plans to acquire or dispose of any property at this project as of this date.

3. Enclosed is a set of real estate project maps. The types of estates are depicted by the tract numbers (easement tracts have an E towards the end, lease tracts have an LE, license tracts have an L, the rest are fee). The acreage and type of estate for each tract are also shown on the tract register.

4. If you need any more information, please contact me at x3745.

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Encl
as

CINDY L. LUCIANO
Civil Works Program Manager
Real Estate Division

Field Code Changed

The Howard A. Hanson Dam was authorized by the Flood Control Act approved 17 May 1950. All lands were acquired for project operations from 1955 through 1968 as follows:

1955 - 1959 - relocation of Northern Pacific Railway Company's tracks
vested title upon abandonment of railroad right-of-way
relocation of Forest Service road
acquisition of access roads
acquisition of land for dam site
acquisition of reservoir area

1961- 1963 - more access roads
acquisition of land for log boom facilities
acquisition of land for Newaukum Creek Gauging Station

1964 - acquisition of land for piezometer installations

1968 - acquisition of land for right abutment seepage control

Summary of estates acquired:

1,258.56	Fee
69.90	License
56.45	Use Permit
0.00	(13 no-acre permits)
1,387.37	Easement
52.67	Lease
2,824.95	Total Acres acquired

Summary of disposals:

23.06 acres fee were conveyed to King County by quitclaim deed dated 7 April 1971, pursuant to Relocation Contract No. DA45-108-CIVENG-57-42.

608.91 acres fee and 0.58 of an acre easement were conveyed to Northern Pacific Railway Company pursuant to a relocation contract, by quitclaim deed dated 12 May 1969, reserving to the US a perpetual flowage easement over 192.58 acres.

207.26 acres fee were conveyed to the city of Tacoma by quitclaim deed dated 6 May 1991, reserving to the US a perpetual easement for power lines and poles and a perpetual non-exclusive easement for road use over 207.26 acres.

3.90 acres license terminated 4 December 1962.

56.45 acres use permit expired on own terms 31 December 1962.

Field Code Changed

0.00 Two of the no-acre permits acquired terminated between 1963 & 1969.

4.06 acres lease terminated 30 Jun 1959.

24.38 acres lease terminated 30 Jun 1960.

16.30 acres lease terminated 31 January 1962.

7.91 acres lease terminated 1 January 1963.

0.01 acre lease terminated 1 November 1969.

Totals: 839.23 fee
0.58 easement
56.45 use permit
0.00 (2 no-acre permits)
3.90 license
52.66 lease

952.82 Total Acres Disposed

Current acreage: 419.33 fee
66.00 license
0.00 permit (11 no-acres)
1,786.63 easement
0.01 lease

2,271.97 Total Current Acres

Other info:

Project Buildings info:	Administration Bldg	2,160 sq. ft.	
	Pump House	43 sq. ft.	*[ed. note: bldg. no longer here]*
	Quonset Hut	1,147 sq. ft.	*[ed. note: 1,120 sq. ft. (20 ft x 56 ft)]*
	Service Station	320 sq. ft.	

There are 23 current outgrants for use of project lands. All of these outgrants are for joint use of roads or rights-of-way.

Field Code Changed

APPENDIX C

SPECIES INVENTORY: VEGETATION, FISH AND WILDLIFE

PLANTS OF HOWARD HANSON DAM BY HABITAT TYPE

UPLAND HABITAT TYPES	COMMON NAME	SCIENTIFIC NAME
1. Deciduous Forest		
Trees	red alder	*Alnus rubra*
	cascara	*Rhamnus purshiana*
	western red cedar	*Thuja plicata*
	bitter cherry	*Prunus emarginata*
	black cottonwood	*Populus balsamifera*
	Pacific dogwood	*Cornus nuttallii*
	Douglas fir	*Pseudotsuga menziesii*
	western hemlock	*Tsuga heterophylla*
	madrona	*Arbutus menziesii*
	big-leaf maple	*Acer macrophyllum*
	vine maple	*Acer circinatum*
	Pacific willow	*Salix lasiandra*
Shrubs	trailing blackberry	*Rubus ursinus*
	devil's club	*Oploplanax horridum*
	red-osier dogwood	*Cornus stolonifera*
	red elderberry	*Sambucus racemosa*
	hazelnut (filbert)	*Corylus cornuta*
	evergreen huckleberry	*Vaccinium ovatum*
	red huckleberry	*Vaccinium parviflorum*
	Indian plum	*Oemleria cerasiformis*
	salmonberry	*Rubus spectabilis*
	thimbleberry	*Rubus parviflorus*
Forbs	bedstraw	*Galium spp.*
	bleeding heart	*Dicentra formosa*
	creeping buttercup	*Ranunculus repens*
	docks	*Rumex spp.*
	bracken fern	*Pteridium aquilinum*
	sword fern	*Polystichum munitum*
	grasses	*Poaceae*
	self-heal	*Prunella vulgaris*
	stinging nettle	*Urtica dioica*
	Pacific water parsley	*Oenanthe sarmentosa*
	cow parsnip	*Heracleum lanatum*
	pig-a-back	*Tolmiea menziesii*
	rushes	*Juncus spp.*
2. Deciduous Forest - Riparian (Alder/Cottonwood)		
Trees	red alder	*Alnus rubra*
	black cottonwood	*Populus balsamifera*
	vine maple	*Acer circinatum*
	western red cedar	*Thuja plicata*
	western hemlock	*Tsuga heterophylla*

Field Code Changed

	COMMON NAME	SCIENTIFIC NAME
Shrubs	Himalayan blackberry	*Rubus discolor*
	salmonberry	*Rubus spectabilis*
	thimbleberry	*Rubus parviflorus*
	red flowering current	*Ribes sanguineum*
	red-osier dogwood	*Cornus stolonifera*
	red elderberry	*Sambucus racemosa*
	Indian plum	*Oemleria cerasiformis*
Forbs	creeping buttercup	*Ranunculus repens*
	false lily-of-the-valley	*Maianthemum dilatatum*
	lady fern	*Athyrium filix-femina*
	sword fern	*Polystichum munitum*
	foam flower	*Tiarella trifoliata*
	grasses	*Poaceae*
	pig-a-back	*Tolmiea menziesii*
3. Deciduous Forest - Seedling/Sapling		
Trees	red alder	*Alnus rubra*
	vine maple	*Acer circinatum*
Shrubs	Himalayan blackberry	*Rubus discolor*
	trailing blackberry	*Rubus ursinus*
	salmonberry	*Rubus spectabilis*
Forbs	redtop bentgrass	*Agrostis alba*
	bracken fern	*Pteridium aquilinum*
	sword fern	*Polystichum munitum*
	fireweed	*Epilobium angustifolium*
	grasses	*Poaceae*
4. Coniferous Forest - Mature		
Trees	red alder	*Alnus rubra*
	western red cedar	*Thuja plicata*
	Douglas fir	*Pseudotsuga menziesii*
	western hemlock	*Tsuga heterophylla*
	vine maple	*Acer circinatum*
Shrubs	trailing blackberry	*Rubus ursinus*
	salmonberry	*Rubus spectabilis*
	thimbleberry	*Rubus parviflorus*
	devil's club	*Oplopanax horridum*
	red elderberry	*Sambucus racemosa*
	ocean spray	*Holodiscus discolor*
	tall Oregon grape	*Berberis aquifolium*
	salal	*Gaultheria shallon*

COMMON NAME SCIENTIFIC NAME

eld Code Changed

Forbs	cleavers	*Galium aparine*
	false lily-of-the-valley	*Maianthemum dilatatum*
	false Solomon's seal	*Smilacina racemosa*
	bracken fern	*Pteridium aquilinum*
	sword fern	*Polystichum munitum*
	grasses	*Poaceae*
	pig-a-back	*Tolmiea menziesii*
	twinflower	*Linnaea borealis*
	vanilla leaf	*Achlys triphylla*
	western spring beauty	*Montia sibirica*
5. Coniferous Forest - Seedling/Sapling		
Trees	None	
Shrubs	red alder (sapling)	*Alnus rubra*
	Himalayan blackberry	*Rubus discolor*
	trailing blackberry	*Rubus ursinus*
	salmonberry	*Rubus spectabilis*
	thimbleberry	*Rubus parviflorus*
	Douglas fir (sapling)	*Pseudotsuga menziesii*
	Indian plum	*Oemlaria cerasiformis*
Forbs	redtop bentgrass	*Agrostis alba*
	bracken fern	*Pterdium aquilinum*
	sword fern	*Polystichum munitum*
	fireweed	*Epilobium angustifolium*
	grasses	*Poaceae*
6. Mixed Coniferous Forest		
Trees	red alder	*Alnus rubra*
	Douglas fir	*Pseudotsuga menziesii*
	western red cedar	*Thuja plicata*
	western hemlock	*Tsuga heterophylla*
	big-leaf maple	*Acer macrophyllum*
Shrubs	trailing blackberry	*Rubus ursinus*
	salmonberry	*Rubus spectabilis*
	thimbleberry	*Rubus parviflorus*
	red elderberry	*Sambucus racemosa*
	tall Oregon grape	*Berberis aquifolium*
Forbs	cleavers	*Galium aparine*
	false lily-of-the-valley	*Maianthemum dilatatum*
	false Solomon's seal	*Smilacina racemosa*
	bracken fern	*Pteridium aquilinum*
	deer fern	*Blechnum spicant*
	sword fern	*Polystichum munitum*
	grasses	*Poaceae*
	COMMON NAME	SCIENTIFIC NAME
Forbs, con't.	pig-a-back	*Tolmiea menziesii*

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	vanilla leaf	*Achlys triphylla*
	western spring beauty	*Montia sibirica*
7. Upland Shrubland		
Trees	red alder	*Alnus rubra*
	Douglas fir	*Pseudotsuga menziesii*
	western hemlock	*Tsuga heterophylla*
	vine maple	*Acer circinatum*
Shrubs	Himalayan blackberry	*Rubus discolor*
	trailing blackberry	*Rubus ursinus*
	salmonberry	*Rubus spectabilis*
	red elderberry	*Sambucus racemosa*
	Scot's broom	*Cytisus scoparius*
	ocean spray	*Holodiscus discolor*
Forbs	creeping buttercup	*Ranunculus repens*
	docks	*Rumex spp.*
	bracken fern	*Pteridium aquilinum*
	sword fern	*Polystichum munitum*
	fireweed	*Epilobium angustifolium*
	grasses	*Poaceae*
	horsetail	*Equisetum arvense*
	common mullein	*Verbascum thapsus*
	pearly everlasting	*Anaphalis margaritacea*
	pig-a-back	*Tolmiea menziesii*
	Canadian thistle	*Cirsium arvense*
8. Grassland		
Trees	None	
Shrubs	trailing blackberry	*Rubus ursinus*
Forbs	clovers	*Trifolium spp.*
	dandelions	*Taraxacum spp.*
	docks	*Rumex spp.*
	Indian thistle	*Cirsium addule*
	Canadian thistle	*Cirsium arvense*
	redtop bentgrass	*Agrostis alba*
	Kentucky bluegrass	*Poa pratensis*
	red fescue	*Festuca rubra*
	quack grass (wheatgrass)	*Agropyron repens*
	western ryegrass	*Elymus glaucus*
	common velvet-grass	*Holcus lanatus*
	ragworts	*Senecio spp.*
	tansy ragwort	*Senecio jacobaea*
	timothy	*Phleum sp.*
	COMMON NAME	SCIENTIFIC NAME
9. Talus Slope/Rock		
Trees	None	

Field Code Changed

Shrubs	red alder (sapling)	*Alnus rubra*
	Douglas fir (sapling)	*Pseudotsuga menziesii*
	western hemlock (sapling)	*Tsuga heterophylla*
Forbs	redtop bentgrass	*Agrosta alba*
	clovers	*Trifolium spp.*
	fireweed	*Epilobium angustifolium*
	grasses	*Poaceae*
	common mullein	*Verbascum thapsus*
	unknown mustard	*Crucifer*
	pearly everlasting	*Anaphalis margaritacea*
	St. John's-wort	*Hypericum perfoliatum*
10. Roadway/Railroad		
Trees	None	
Shrubs	Himalayan blackberry	*Rubus discolor*
	salmonberry	*Rubus spectabilus*
Forbs	fireweed	*Epilobium angustifolium*
	grasses	*Poaceae*
	common mullein	*Verbascum thapsus*
	pearly everlasting	*Anaphalis margaritacea*
	ragworts	*Senecio spp.*
	Canadian thistle	*Cirsium arvense*
	yarrow	*Achillea millefolium*

WETLAND HABITAT TYPES

1. Forested Swamp (wooded wetland)		
Trees	red alder	*Alnus rubra*
	Oregon ash	*Fraxinus latifolia*
	western red cedar	*Thuja plicata*
	black cottonwood	*Populus balsamifera*
	western hemlock	*Tsuga heterophylla*
	Sitka spruce	*Picea sitchensis*
Shrubs	vine maple	*Acer circinatum*
	salmonberry	*Rubus spectabilis*
	willows	*Salix spp.*
Forbs	skunk cabbage	*Lysichitum americanum*
	coltsfoot	*Petasites frigiduc*
	mannagrass	*Glyceria sp.*
	Cow parsnip	*Heracleum lanatum*
	bulrush	*Scirpus spp.*
	COMMON NAME	SCIENTIFIC NAME
Forbs, con't.	soft rush	*Juncus effusus*
	Pacific water parsley	*Oenanthe sarmentosa*
	Watson's willow-herb	*Epilobium watsoni*

Field Code Changed

2. Shrub Swamp (scrub-shrub)		
Trees	None	
Shrubs	Hooker's willow	*Salix hookeriana*
	willow	*Salix spp.*
Forbs	bentgrass	*Agrostis sp.*
	wool-grass	*Scirpus cyperinus*
3. Emergent Marsh		
Trees	None	
Shrubs	None	
Forbs	creeping buttercup	*flammula*
	common cat-tail	*Typha latifolia*
	redtop bentgrass	*Agrostis alba*
	bluegrass	*Poa spp.*
	quack grass	*Agropyron repens*
	common velvet-grass	*Holcus lanatus*
	wool-grass	*Scirpus cyperinus*
	horsetail	*Equisetum spp.*
	soft rush	*Juncus effusus*
	spike-rush	*Eleocharis spp.*
	sedge	*Carex spp.*
4. Moss		
Trees	None	
Shrubs	None	
Forbs	redtop bentgrass	*Agrostis alba*
	quack grass	*Agropyron repens*
	creeping buttercup	*Ranunculus flammula*
	green algae	*Spirogyra sp.*
	green algae	*Zygnema sp.*
	mosses	*Bryophyta*
	stonewort	*Chara sp.*
5. Mudflat		
Trees	None	
Shrubs	None	
	COMMON NAME	SCIENTIFIC NAME
Forbs	green algae	*Spirogyra sp.*
	green algae	*Zygnema sp.*
	stonewort	*Chara sp.*

Field Code Changed

6. Riverbed		
Trees	None	
Shrubs	None	
Forbs	green algae	*Spirogyra sp.*
	green algae	*Zygnema sp.*
7. Open Water		
Trees	None	
Shrubs	None	
Forbs	floating algae	--
	phytoplankton	--

Field Code Changed

BIRDS OF HOWARD HANSON DAM

COMMON NAME	SCIENTIFIC NAME
Barrow's goldeneye	*Bucephala islandica*
bufflehead	*Bucephala albeola*
harlequin duck	*Histrionicus histrionicus*
ring-necked duck	*Aythya collaris*
wood duck	*Aix sponsa*
gadwall	*Anas strepera*
green-winged teal	*Anas crecca*
mallard	*Anas platyrhynchos*
American wigeon	*Anas americana*
western grebe	*Aechmophorus occidentalis*
lesser scaup	*Aythya affinis*
common loon	*Gavia immer*
common merganser	*Mergus merganser*
hooded merganser	*Lophodytes cucullatus*
great blue heron	*Ardea herodias*
green heron	*Butorides virescens*
Canada goose	*Branta canadensis*
turkey vulture	*Cathartes aura*
bald eagle	*Haliaeetus leucocephalus*
northern harrier	*Circus cyaneus*
common nighthawk	*Chordeiles minor*
red-tailed hawk	*Buteo jamaicensis*
northern goshawk	*Accipiter gentilis*
Cooper's hawk	*Accipiter cooperi*
sharp-shinned hawk	*Accipiter striatus*
American kestrel	*Falco sparverius*
merlin	*Falco columbarius*
osprey	*Pandion haliaetus*
blue grouse	*Dendragapus obscurus*
ruffed grouse	*Bonasa umbellus*
killdeer	*Charadrius vociferus*
greater yellowlegs	*Tringa melanoleuca*
solitary sandpiper	*Tringa solitaria*
spotted sandpiper	*Actitis macularia*
western sandpiper	*Calidris mauri*

COMMON NAME	SCIENTIFIC NAME
barred owl	*Strix varia*
spotted owl	*Strix occidentalis*
great horned owl	*Bubo virginianus*
northern pygmy owl	*Glaucidium gnoma*
western screech owl	*Otus asio kennicottii*
black swift	*Cypseloides niger*
Vaux's swift	*Chaetura vauxi*
belted kingfisher	*Ceryle alcyon*
red-breasted sapsucker	*Sphyrapicus ruber*
downy woodpecker	*Picoides pubescens*
hairy woodpecker	*Picoides villosus*
pileated woodpecker	*Dryocopus pileatus*
northern flicker	*Colaptes auratus*
Hammond's flycatcher	*Empidonax hammondi*
olive-sided flycatcher	*Contopus cooperi*
Pacific-slope flycatcher	*Empidonax difficilis*
willow flycatcher	*Empidonax traillii*
western wood pewee	*Contopus sordidulus*
northern shrike	*Lanius excubitor*
Cassin's vireo	*Vireo cassini*
Hutton's vireo	*Vireo huttoni*
red-eyed vireo	*Vireo olivaceus*
warbling vireo	*Vireo gilvus*
gray jay	*Perisoreus canadensis*
Steller's jay	*Cyanocitta stelleri*
American crow	*Corvus brachyrhynchos*
common raven	*Corvus corax*
purple martin	*Progne subis*
bank swallow	*Riparia riparia*
barn swallow	*Hirundo rustica*
cliff swallow	*Hirundo pyrrhonota*
northern rough-winged swallow	*Stelgidopteryx*

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			serripennis
common snipe	*Gallinago gallinago*	tree swallow	*Tachycineta bicolor*
California gull	*Larus californicus*	violet-green swallow	*Tachycineta thalassina*
band-tailed pigeon	*Columba fasciata*		
mourning dove	*Zenaida macroura*	rufous hummingbird	*Selasphorus rufus*

COMMON NAME	SCIENTIFIC NAME	COMMON NAME	SCIENTIFIC NAME
American robin	*Turdus migratorius*	house finch	*Carpodacus mexicanus*
hermit thrush	*Catharus guttatus*	purple finch	*Carpodacus purpureus*
Swainson's thrush	*Catharus ustulatus*	American goldfinch	*Carduelis tristis*
varied thrush	*Ixoreus naevius*	red crossbill	*Loxia curvirostra*
European starling	*Sturnus vulgaris*	pine siskin	*Carduelis pinus*
American pipit	*Anthus rubescens*		
cedar waxwing	*Bombycilla cedrorum*	golden-crowned sparrow	*Zonotrichia atricapilla*
		white-crowned sparrow	*Zonotrichia leucophrys*
black-throated gray warbler	*Dendroica nigrescens*	fox sparrow	*Passerella iliaca*
		house sparrow	*Passer domesticus*
hermit warbler	*Dendroica occidentalis*	savannah sparrow	*Passerculus sandwichensis*
MacGillivray's warbler	*Oporornis tolmiei*	song sparrow	*Melospiza melodia*
Nashville warbler	*Vermivora ruficapilla*		
orange-crowned warbler	*Vermivora celata*	black-capped chickadee	*Poecile atricapillus*
Townsend's warbler	*Dendroica townsendi*	chestnut-backed chickadee	*Poecile rufescens*
yellow warbler	*Dendroica petechia*	bushtit	*Psaltriparus minimus*
yellow-rumped warbler	*Dendroica coronata*	red-breasted nuthatch	*Sitta canadensis*
Wilson's warbler	*Wilsonia pusilla*	brown creeper	*Certhia americana*
common yellowthroat	*Geothlypis trichas*	Bewick's wren	*Thryomanes bewicki*
western tanager	*Piranga ludoviciana*	marsh wren	*Cistothorus palustris*
spotted towhee	*Pipilo maculatus*	winter wren	*Troglodytes troglodytes*
dark-eyed junco	*Junco hyemalis*	American dipper	*Cinclus mexicanus*
black-headed grosbeak	*Pheucticus*	golden-crowned kinglet	*Regulus satrapa*

Field Code Changed

	melanocephalus		
evening grosbeak	*Coccothraustes vespertinus*	ruby-crowned kinglet	*Regulus calendula*
Brewer's blackbird	*Euphagus*	Townsend's solitaire	*Myadestes townsendi*
red-winged blackbird	*Agelaius phoeniceus*		
western meadowlark	*Sturnella neglecta*		
brown-headed cowbird	*Molothrus ater*		

Field Code Changed

ANIMALS OF HOWARD HANSON DAM

MAMMALS

COMMON NAME	SCIENTIFIC NAME	FAMILY
big brown bat	*Eptesicus fuscus*	Vespertilionidae
California myotis	*Myotis californicus*	Vespertilionidae
hoary bat	*Lasiurus cinereus*	Vespertilionidae
keen myotis	*Myotis keeni*	Vespertilionidae
little brown bat	*Myotis lucifugus*	Vespertilionidae
long-eared myotis	*Myotis evotis*	Vespertilionidae
long-legged myotis	*Myotis volans*	Vespertilionidae
silver-haired myotis	*Lasionycteris noctivagans*	Vespertilionidae
Townsend's big-eared bat	*Plecotus townsendi*	Vespertilionidae
Yuma myotis	*Myotis yumanensis*	Vespertilionidae
Pacific jumping mouse	*Zapus trinotatus*	Zapodidae
deer mouse	*Peromyscus maniculatus*	Cricetidae
meadow mouse	*Microtus ssp.*	Cricetidae
boreal red-backed vole	*Clethrionomys gapperi*	Cricetidae
heather vole	*Phenacomys intermedius*	Cricetidae
longtail vole	*Microtus longicaudus*	Cricetidae
Oregon vole	*Microtus oregoni*	Cricetidae
Townsend vole	*Microtus townsendi*	Cricetidae
muskrat	*Ondatra zibethica*	Cricetidae
bushy-tailed woodrat	*Neotoma cinerea*	Cricetidae
dusky shrew	*Sorex obscurus*	Soricidae
marsh shrew	*Sorex bendirii*	Soricidae
northern water shrew	*Sorex palustris*	Soricidae
vagrant shrew	*Sorex vagrans*	Soricidae
coast mole	*Scapanus orarius*	Talpidae
shrew-mole	*Neurotrichus gibbsi*	Talpidae
Townsend's mole	*Scapanus townsendi*	Talpidae
Townsend's chipmunk	*Eutamias townsendi*	Sciuridae
Douglas squirrel	*Tamiasciurus douglasii*	Sciuridae
northern flying squirrel	*Glaucomys sabrinus*	Sciuridae
pika	*Ochotona princeps*	Leporidae
snowshoe hare	*Lepus americanus*	Leporidae
Virginia oppossum	*Didelphis virginiana*	Didelphidae
raccoon	*Procyon lotor*	Procyonidae
porcupine	*Erethizon dorsatum*	Erethizontidae

Field Code Changed

COMMON NAME	SCIENTIFIC NAME	FAMILY
pine marten	*Martes americana*	Mustelidae
mink	*Mustela vison*	Mustelidae
spotted skunk	*Spilogale putorius*	Mustelidae
striped skunk	*Mephitis mephitis*	Mustelidae
long-tailed weasel	*Mustela frenata*	Mustelidae
short-tailed weasel	*Mustela erminea*	Mustelidae
river otter	*Lutra canadensis*	Mustelidae
beaver	*Castor canadensis*	Castoridae
mountain beaver	*Aplodontia rufa*	Aplodontidae
common red fox	*Vulpes fulva*	Canidae
coyote	*Canis latrans*	Canidae
bobcat	*Lynx rufus*	Felidae
mountain lion	*Felis concolor*	Felidae
black-tailed deer	*Odocoileus hemionus*	Cervidae
Rocky Mountain elk	*Cervus canadensis*	Cervidae
black bear	*Ursus americanus*	Ursidae
REPTILES		
common garter snake	*Thamnophis sirtalis*	Colubridae
northwestern garter snake	*Thamnophis ordinoides*	Colubridae
western garter snake	*Thamnophis elegans*	Colubridae
northern alligator lizard	*Elgaria coerulea*	Anguidae
AMPHIBIANS		
long-toed salamander	*Ambystoma macrodactylum*	Ambystomidae
northwestern salamander	*Ambystoma gracile*	Ambystomidae
Escholtz's salamander	*Ensatina eschscholtzi*	Plethodonidae
larch mountain salamander	*Plethodon larselli*	Plethodonidae
western red-backed salamander	*Plethodon vehiculum*	Plethodonidae
rough-skinned newt	*Taricha granulosa*	Salmandridae
tailed frog	*Ascaphus truei*	Leiopelmatidae
Pacific treefrog	*Hyla regilla*	Hylinidae
Cascades frog	*Rana cascadae*	Ranidae
red-legged frog	*Rana aurora*	Ranidae
western toad	*Bufo boreas*	Bufonidae

Field Code Changed

FISH SPECIES OF HOWARD HANSON DAM

COMMON NAME	SCIENTIFIC NAME
longnose dace	*Rhynichthys cataractae*
speckled dace	*Rhynichthys osculus*
river lamprey	*Lampetra ayresi*
Pacific lamprey	*Lampetra tridentata*
chinook salmon	*Oncorhynchus tshawytscha*
chum salmon	*Oncorhynchus keta*
coho salmon	*Oncorhynchus kisutch*
prickly sculpin	*Cottus asper*
torrent sculpin	*Cottus rhotheus*
longfin smelt	*Spirinchus thaleichthys*
northern pikeminnow	*Ptychocheilus oregonensis*
threespine stickleback	*Gasterosteus aculeatus*
largescale sucker	*Catostomus macrocheilus*
brook trout	*Salvelinus fontinalis*
Bull trout	*Salvelinus confluentus*
cutthroat trout	*Oncorhynchus clarki*
steelhead/rainbow trout	*Oncorhynchus gairdneri*
mountain whitefish	*Prosopium williamsoni*

Field Code Changed

APPENDIX D

MASTER PLAN DISTRIBUTION LIST

HOWARD HANSON DAM MASTER PLAN—
PUBLIC/AGENCY REVIEW DISTRIBUTION LIST

Bonneville Power Admin. 5240 Trosper SW Olympia WA 98502	Trent Hudak Burlington Northern & Santa Fe Railway Company 2454 Occidental Av S, Ste 1A Seattle WA 98134-1451	Chamber of Commerce 950 Pacific Av Tacoma WA 98402
Champion International Corp. 31716 Camp I Road Orting WA 98360	Mr. John Lind CITIFOR Incorporated 1425 N Washington Olympia WA 98501	Public Works Director City of Auburn 25 W Main St Auburn WA 98001-4998
Marian Martelli Wetsch City of Fife 5411 23rd St E Fife WA 98424-2061	Don Wickstrom, Director City of Kent 220 4th Ave S Kent WA 98032	Allen Quynn City of Renton Surface Water Utility 200 Mill Ave S Renton WA 98055
Director, Public Works Dept. City of Tukwila 6300 Southcenter Blvd. Tukwila WA 98188	City of Tacoma 747 Municipal Bldg. Tacoma WA 98402-3793	PC Planning & Land Services County Public Services Bldg. 2401 S 35th St Tacoma WA 98409
Judy Nelson Covington Water District 18631 SE 300th Pl Kent WA 98042	Bonnie Bunning Regional Manager Dept. of Natural Resources PO Box 68 Enumclaw WA 98022-0068	Jennifer M. Belcher Dept. of Natural Resources PO Box 47000 Olympia WA 98504-7000
EPA - Regional Administrator 1200 - 6th Av Seattle WA 98101	Larry Bradbury, Manager King Cty Water Dist. No. 111 27224 - 144th Av SE Kent WA 98042	Jack Davis King County Conservation Dist. 935 Powell Av SW Renton WA 98055

Nancy Hansen King Cty Dept. of Natural Res. 400 Yesler Way, Rm 400 Seattle WA 98104-2637	William Stelle, Jr. Regional Administrator National Marine Fisheries Svc. 7600 Sand Point Way NE Seattle WA 98115	Gary Johnson Plum Creek Timber Co. PO Box 248 Enumclaw WA 98022
Pam Bissonnette, Director King Cty Dept. of Natural Res. 400 Yesler Way, Rm 700 Seattle, WA 98104-2637	John Dohrmann Puget Sound Water Quality Authority PO Box 40900 Olympia WA 98504-0900	Barry Gall Skykomish Ranger District Mt. Baker-Snoq National Forest PO Box 305 Skykomish WA 98288
Don Wright South King County Regional Water Association 27224 - 144th Av SE Kent WA 98042	Jim Doyle, Supervisor's Office Mt. Baker-Snoq National Forest 21905 - 6th Av W Mountlake Terrace WA 98043-2278	Ken Merry, Superintendent Water Department Tacoma Public Utilities PO Box 11007 Tacoma WA 98411
Karen Bergeron, Hydrologist US Forest Service North Bend Ranger Station 42404 SE North Bend Way North Bend WA 98045	Gwill Ging US Fish & Wildlife Service 510 Desmond Dr SE, Suite 101 Lacey WA 98503-1273	Erik Hansen Washington State Dept. of Transportation PO Box 330310 Seattle WA 98133-9710
US Forest Service North Bend Ranger Station 42404 SE North Bend Way North Bend WA 98045	Greg Laurie White River Ranger District Mt. Baker-Snoq National Forest 857 Roosevelt Av E Enumclaw WA 98022	Utilities & Transportation Commission PO Box 47250 Olympia WA 98504
Office of Archaeology & Historic Preservation State of Washington Dept. of Commercial Development PO Box 48343 Olympia WA 98504-8343	Director Environmental Review Section State of Washington Dept. of Ecology PO Box 47703 Olympia WA 98504-7703	Michael Rundlett Regional Director State of Washington Dept. of Ecology 3190 160th Ave. S.E. Bellevue, WA 98008-5452

Janet Thompson N.W. Regional Office State of Washington Dept. of Ecology 3190 160th Ave. S.E. Bellevue, WA 98008-5452	Doug Johnson State of Washington Dept. of Ecology P.O. Box 47600 Olympia, WA 98504-7600	R. Gary Engman State of Washington Dept. of Fish & Wildlife 16018 Mill Creek Blvd Mill Creek WA 98012
Bob Everitt Wildlife Area Manager State of Washington Dept. of Fish & Wildlife 16018 Mill Creek Blvd Mill Creek WA 98012	Phillip Schneider State of Washington Dept. of Fish & Wildlife c/o Dept. of Ecology 3190 160th Av SE Bellevue WA 98008-5452	Steve Ketz Weyerhaeuser Company 31002 Chinook Pass Hwy Enumclaw WA 98022
Auburn Public Library 808 Ninth St SE Auburn WA 98002	Fairwood Library 17009 - 140th SE Renton WA 98058	Kent Regional Library 201 Second Avenue N Kent WA 98032
Milton Memorial Library 1000 Laurel St Milton WA 98354	Puyallup Public Library 324 S Meridian Puyallup, WA 98371	Renton Public Library 200 Mill Avenue S Renton WA 98055
Tacoma Public Library 1102 Tacoma Av S Tacoma WA 98402	Tribal Council Muckleshoot Indian Tribe 39015 - 172nd Av SE Auburn WA 98002	Executive Director Northwest Indian Fisheries Commission 6730 Martin Way Olympia WA 98506-5540
Tribal Council Suquamish Indian Tribe PO Box 498 Suquamish WA 98392	US Senator Slade Gorton Washington, D.C. Office 730 Hart Senate Office Bldg. Washington, D.C. 20510	US Senator Patty Murray Washington, D.C. Office 111 Russell Senate Off. Bldg. Washington, D.C. 20510
Congresswoman Jennifer Dunn US House of Representatives 432 Cannon House Off. Bldg. Washington, DC 20515	Congressman Adam Smith US House of Representatives 116 Cannon House Off. Bldg Washington, D.C. 20515	Governor Gary Locke Office of the Governor PO Box 40002 Olympia WA 98504-0002

Washington State Senator Jim Horn 107 Irving R. Newhouse Bldg. PO Box 40482 Olympia WA 98504-0482	Washington State Senator Stephen L. Johnson 401-B Legislative Bldg. PO Box 40482 Olympia WA 98504-0482	Washington State Rep. Christopher Hurst 335 John L. O'Brien Bldg. PO Box 40600 Olympia WA 98504-0600
Washington State Rep. Jack Cairnes 425 John L. O'Brien Bldg. PO Box 40600 Olympia WA 98504-0600	Washington State Rep. Michael Stensen 315 John L. O'Brien Bldg. PO Box 40600 Olympia WA 98504-0600	Washington State Rep. Phil Fortunato 240 John L. O'Brien Bldg. PO Box 40600 Olympia WA 98504-0600
Washington State Senator Pam Roach 202 Irving R. Newhouse Bldg. PO Box 40482 Olympia WA 98504-0482	Seattle Mayor Paul Schell Municipal Bldg, 12 Fl. 600-4th Av Seattle, WA 98104-1873	King County Executive Ron Sims King County Courthouse 516 3rd Av, Rm 400 Seattle WA 98104
King County Council 516 3rd Av, Rm 402 Seattle WA 98104	Pierce County Commissioners County-City Building 930 Tacoma Av S Tacoma WA 98402	Mayor John Rants Tukwila City Hall 6200 Southcenter Blvd. Tukwila WA 98188

APPENDIX E

AGENCY AND PUBLIC COMMENTS

Jesse Tanner, Mayor

CITY OF RENTON

Planning/Building/Public Works Department
Gregg Zimmerman P.E., Administrator

March 29, 1999

Terri Taylor
Department of the Army
Seattle District, Corps of Engineers
U.S. Army Corps of Engineers
P.O. Box 3755
Seattle, WA 98124-9883

SUBJECT: HOWARD A. HANSON DAM MASTER PLAN - DESIGN MEMORANDUM NO. 27

Dear Ms. Taylor:

I have reviewed the draft submittal for the Howard A. Hanson Dam Master Plan-Design Memorandum No. 27 and have just one comment. I believe the document contains an incorrect statement in the first paragraph, second sentence of section 2.5 which reads "The White River joined the Black River and entered Lake Washington near the City of Tukwila". It should read "The Black River flowed out of Lake Washington and joined the White River just east of Tukwila in the City of Renton."

Thank you for the opportunity to review this document.

Sincerely,

Allen Quynn
Surface Water Utility

H:\DIVISION.S\UTILITIE.S\DOCS\1999\3\99-203.DOC

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-2255

REPLY TO
ATTENTION OF

Engineering/Construction Division
Design Branch

JUL 29 1999

Allen Quynn
City of Renton
Surface Water Utility
1055 South Grady Way
Renton, Washington 98055

Dear Mr. Quynn:

Thank you for reviewing the draft Howard Hanson Dam Project Master Plan-Design Memorandum No. 27. We have rewritten Section 2.5 to incorporate your correction about the Black River flowing out of Lake Washington and joining the White River just east of Tukwila in the city of Renton. We included additional historical information about the Green, White, and Duwamish Rivers for clarification.

Thank you for bringing this error to our attention.

Sincerely,

RZ Moshier

Rick Moshier,
Chief, Design Branch

USDA United States Department of Agriculture

Forest Service

Mt. Baker-Snoqualmie National Forest
North Bend Ranger District
42404 S.E. North Bend Way
North Bend, WA 98045

File Code:2500

Date:April 9, 1999

Ms. Terri Taylor
Project Manager
Department of the Army
Seattle District, Corps of Engineers
P.O. Box 3755
Seattle, Washington 98124-2255

Dear Ms. Taylor,

Thank you for the opportunity to comment on the draft master plan for Howard Hanson Dam. Given the proposed listing of bull trout as a threatened species by the U. S. Fish and Wildlife Service on June 6, 1999, I would like to clarify several statements in the document.

In Section 2.25.8, the document states, "Both the USFS and Plum Creek Timber Company have conducted bull trout surveys in the mainstem and selected tributaries above Howard Hanson Dam." The Forest Service has conducted fish surveys in the Upper Green River, however, the surveys were not specifically designed for bull trout and carry no statistical significance.

In the same section, the document states that "Stream temperatures in the survey area may be warmer than temperatures required by bull trout in the late summer (F.Goetz, 1994)." The Forest Service has monitored summer stream temperatures for several years in the Upper Green River and its tributaries. During our monitoring, temperatures did not exceed 60 degrees Fahrenheit in the mainstem and many of the tributaries remained cool (<57 degrees Fahrenheit) in the summer. The data is currently being analyzed and will be available by late summer.

If you have any further questions, please contact me at (425) 888-1421.

Karen Bergeron

KAREN BERGERON
Hydrologist

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-2255

REPLY TO
ATTENTION OF

Engineering/Construction Division
Design Branch

JUL 29 1999

Karen Bergeron, Hydrologist
Mt. Baker-Snoqualmie National Forest
North Bend Ranger Station
42404 Southeast North Bend Way
North Bend, Washington 98045

Dear Ms. Bergeron:

Thank you for reviewing the draft *Howard A. Hanson Dam Project Master Plan-Design Memorandum No. 27.* Corps of Engineers' responses to your letter are provided below.

Draft p. 2-33, Section 2.15.8 Bull Trout.

Concur. We have modified the document to reflect that the USFS surveys were for fish in general and not specific to bull trout. However, since no mention was made in your comment relative to the accuracy of the statement that no bull trout were found, we assume it is still true. We have also changed the document to state that excessive summer water temperature as a reason for bull trout absence has yet to be confirmed. The revised text is as follows:

"Bull trout were reported in the Green River in 1964. In 1994, the Muckleshoot Indian Tribe documented bull trout in the Duwamish River. Plum Creek Timber Company conducted surveys in the main stem and selected tributaries above Howard Hanson Dam, but was unable to find evidence of bull trout. General surveys conducted by the USFS in the upper Green River did not encounter any bull trout. Habitat in the project area is considered degraded due to past timber harvests. This human disturbance may cause stream temperatures to be warmer than temperatures required by bull trout in the late summer (F. Goetz, 1994). However, stream analyses in the project area has not yet confirmed a problem with water temperatures."

If you have questions regarding these responses, please contact the project manager, Ms. Terri Taylor, at (206) 764-6185 or through electronic mail at Terri.A.Taylor@usace.army.mil.

Sincerely,

Rick Moshier,
Chief, Design Branch

King County
Department of Natural Resources
Yesler Building
400 Yesler Way, Room 700
Seattle, WA 98104-2637
(206) 296-6500

April 19, 1999

Terri Taylor, Project Manager
Department of the Army
Seattle District, Corps of Engineers
Post Office Box 3755
Seattle, WA 98124-9883

Dear Ms. Taylor:

Thank you for the opportunity to comment on the United States Army Corps of Engineers' (Corps) draft master plan for Howard Hanson Dam, Design Memorandum No. 27. As local sponsor for the Howard Hanson Dam, King County has a unique and strong interest in this project. I apologize for the delay in responding to you.

The draft master plan provides a good deal of information and in final version will be a useful reference on the general operations of the Dam. In reviewing the draft, staff had a number of comments and questions. These are summarized below.

p. 2-1 Authorized Purposes. Is the fish conservation authorization limited to augmenting low flows?

p. 4-2 (4.3.4) Environmentally Sensitive Areas. It is surprising to note that it has been determined there are no lands having ecological significance at Howard Hanson Dam. This determination may need to be revisited in light of current watershed-wide efforts to recover salmon.

p. 4-2 (4.3.5) Multiple Resource Management (MRM). While currently these lands are managed for vegetation only, fish and wildlife management may be added in the future. It would seem favorable for the Corps to add fish and wildlife management immediately. It would be useful here to identify enhancement opportunities for all the various listed or to-be-listed species, including wildlife.

p. 7-1 General (2nd paragraph). The Additional Water Storage Project for Howard Hanson Dam "proposed by Tacoma Public Utilities" (TPU) is done in partnership with the Corps and the Corps involvement should be acknowledged here for clarity. Without this change the text suggests the project is solely a TPU effort.

p. 7-5 (7.4.3) Rationale (c). It is noted here that debris collected in the reservoir can be used for environmental restoration projects. Could the Corps give King County, the project's local sponsor, the first right of refusal for all appropriately sized debris (and wind throw) that is not being used by TPU as an element of Tacoma's HCP commitments for Green River restoration projects? King County river restoration projects often call for the addition of large woody debris - a beneficial ecological element often missing in this river system.

p. 9-3 Recommendations for Multiple Resource Management Lands (9.2.6, 9.2.7, 9.2.8). The plan could be more specific here by identifying the type of "typical enhancement projects" contemplated for the Multiple Resource Management lands. Additionally, it would be useful to include a schedule showing when enhancement projects might be done.

Appendix A (pp. A-I to A-3) Howard Hanson Dam Pertinent Data. This brief section provides an accessible summary of facts from the plan and is a very useful addition.

Appendix B Real Estate Interests - Land Classifications, Management Units and Acreages Table. In this table under the Land Allocations (breakdown of fee title lands) section it is noted that Fish and Wildlife purposes are not specifically authorized. However, the Table on p. A-I clearly states that the project is authorized for Fish and Wildlife operating purposes per PL 81-516. There seems to be an inconsistency here. If the project is authorized for Fish and Wildlife operating purposes (even secondarily), perhaps this use should be discussed in Section 4.3 of the plan under Land Use Classifications. If the Corps has not associated any land with this authority, but is so empowered to do so, perhaps it should be noted in the Section 9 recommendations that the agency will consider more clearly associating lands with this authority.

p. B-5 Summary of real estate disposals. It is noted here that 23.06 acres were conveyed to King County in 1971. Where is this parcel located? Was it dedicated to a specific Department of King County?

p. B-1 6 (2.) Project Estates. The first two paragraphs on page B-16 make reference to paragraph 4.3, Non-Standard Estates. However, this appendix document does not include a paragraph 4.3 - non-standard estates appear to be handled in paragraphs 4.1 and 4.2 a-d. If there is an additional set of non-standard estates in an un-printed paragraph 4.3, it should be included here.

p. B-1 8 4.2 (a-d) Modifications for Environmental Restoration and Mitigation. It is unclear where the Corps holds these easements. It would be useful to see the location of these properties if it has been determined. Additionally, it is unclear whether the Corps or Tacoma Public Utilities will hold these Easements.

King County Department of Natural Resources staff is dedicated to working with the Corps on the successful operation of Howard Hanson Dam. I hope these comments are helpful in developing the final draft master plan. Please feel free to call Dave Clark, Rivers Section Manager with the Water and Land Resources Division, at (206) 296-8388, if you have any questions.

Sincerely,

Pam Bissonnette

Pam Bissonnette
Director

PB:mm

cc: James M. Rigsby, Colonel, Corps of Engineers, District Engineer
Nancy Davidson, Regional Water Resources Manager, Department of Natural Resources (DNR)
Nancy Hansen, Manager, Water and Land Resources Division, DNR
Dave Clark, Manager, Rivers Section, Water and Land Resources Division, DNR

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-2255

REPLY TO
ATTENTION OF

Engineering/Construction Division
Design Branch

JUL 29 1999

Pam Bissonnette, Director
King County, Department of Natural Resources
400 Yesler Way, Room 700
Seattle, Washington 98104-2637

Dear Ms. Bissonnette:

We would like to thank you and your staff for reviewing the draft *Howard A. Hanson Dam Master Plan-Design Memorandum No. 27.* Corps of Engineers' responses to your letter of April 19, 1999, are provided below.

1. Draft p. 2-1, Section 2-2 Authorized Purposes.

Concur. Fish conservation authorization is limited to augmenting low flows as specifically defined in House Document 271 (81st Cong, 1st Sess; July 22, 1949). It is this document that provided the final construction authorization for Howard Hanson Dam (PL 81-516, Title II-Flood Control Act of 1950). The Corps has some flexibility to implement other methods to enhance fish and wildlife habitat providing they are within the parameters of the original authorized purposes of flood control and low flow augmentation for fish conservation. Projects which require operational changes outside the authorized purposes require high level Corps approval. For example, the *Section 1135 Fish & Wildlife Restoration Project* is designed to restore natural river functions and enhance fisheries. The alternative selected in the 1135 plan proposes additional summer conservation pool storage, a change in operations for fish flow augmentation, physical habitat improvements in the reservoir area, and minor modifications to the intake tower. The *Project Modification Report* for the Section 1135 project was approved by Corps of Engineers' headquarters in April 1997. Approval to begin the plans and specification phase has been attained and is currently underway.

2. Draft p. 4-2, Section 4.3.4 Environmentally Sensitive Areas.

Comment noted. It is important to clarify the meaning of environmentally sensitive areas (ESAs) as they relate to Corps of Engineers' master plans. ESAs are limited to lands the Corps finds unique or significant from a fish, wildlife, vegetative or cultural perspective and are on lands controlled by the Corps. The Corps has very little fee land at Howard Hanson Dam and none of this land has been identified as so significant that it is placed in a special category. ESAs would likely include areas with sensitive, threatened or endangered species, special vegetative stands, or unique wetland complexes. If threatened or endangered species are present on

easement land, the Corps has responsibility to manage that land and coordinate activities with appropriate agencies. Section 4.3.4. was revised to clarify the definition of the ESA land classification category.

3. Draft p. 4-2, Section 4.3.5 Multiple Resource Management (MRM).

Comment noted. The four MRM land classification subcategories identified in the Corps' Engineer Regulation 1130-2-550 were developed at a national level to help standardize the preparation of project master plans. There is some flexibility in how each district interprets and uses these categories. The Seattle District master plan team concurs that at Howard Hanson Dam, vegetation management and fish and wildlife management are so closely related that using one category (vegetation management) is sufficient. This is with the understanding that preserving, protecting, and enhancing fish and wildlife habitat is inherent in the goals of vegetation management. Your question did bring to our attention the need to clarify this category and Section 4.3.5 has been revised accordingly.

General enhancement opportunities are discussed under "Development and Management Actions" in Section 6.2 Downstream Vegetative Areas and 6.3 Upstream Vegetative Areas. The master plan is conceptual by nature and does not include detailed implementation of management actions; they are instead included in the Corps' *Operational Management Plan* (OMP). Once the master plan is approved, an OMP for Howard Hanson Dam will be prepared.

4. Draft p. 7-1, Section 7-1 General.

Comment noted. Our first reference to the *Additional Water Storage Project* in the master plan (Section 2.9.3) has been corrected to acknowledge the involvement of both the Corps of Engineers and the Tacoma Public Utilities.

5. Draft p. 7-5, Section 7.4.3, Rationale (c)- comment regarding woody debris.

Comment noted. The Corps currently has an agreement with the city of Tacoma regarding the use of woody debris. The Corps believes, from an operations point of view, that this agreement is open to change. However, any changes would need to be worked out with the city of Tacoma, the Corps, and King County.

6. Draft p. 9-3, Sections 9.2.6 and 9.2.8.

Comment noted. See the last paragraph in response number 3 above.

7. Appendix A, Pertinent Data.

Comment noted, thank you.

8. Appendix B, Real Estate Interests—Land Classifications, Management Units and Acreage Table.

Comment noted. The operating purpose "Fish and Wildlife" noted in the Pertinent Data on A-1 is a general category. For the purpose of the *Howard A. Hanson Dam Master Plan* this has been clarified to read "Fish Conservation." Currently, there are two *operating* purposes at Howard Hanson Dam—flood control and fish conservation. However, the specific *authorized* purposes, found in House Document 271, states fish conservation rather than fish and wildlife

conservation. As stated previously, the Corps manages for wildlife when it is within the parameters of the authorized purposes. Also see response numbers 1 and 2 above.

9. Draft p. B-5, Summary of real estate disposals.

Comment noted. When the dam was constructed, the Corps acquired portions of King County roads in the vicinity and were subsequently obligated to reroute/relocate the county roads. Under Relocation Contract No. DA45-108-CIVENG-57-42 the Corps entered into an agreement with King County to reroute and construct the new portions of the roads (portions of King County Road No's. 191, 381, 1044, 1099, and 1224). The new portions (23.06 acres) were then conveyed to King County on April 7, 1971, by quitclaim deed. The existing documentation of this action did not include a specific department. Perhaps the King County, Transportation Department, Road Services Division could be contacted if you are interested in further information.

10. Draft p. B-16, Project Estates, and p. B-18, 4.2 (a-d).

Comment noted. There were typographical errors in the section on Project Estates; there are no additional non-standard estates.

In responding to your comments, we were reminded that it is not the purpose of this master plan to include specifics on the *Additional Water Storage Project* (AWS). To avoid confusion regarding master plan real estate information versus AWS information, pages B-7 through B-19 have been deleted from the final master plan. Please refer to *Appendix G: Real Estate Assessment: Additional Water Storage Project*, April 1998, on file at Seattle District Corps of Engineers for revised AWS real estate data.

If you have questions regarding these responses, please contact the project manager, Ms. Terri Taylor, at (206) 764-6185 or through electronic mail at Terri.A.Taylor@usace.army.mil.

Sincerely,

Rick Moshier,
Chief, Design Branch

STATE OF WASHINGTON
DEPARTMENT OF FISH AND WILDLIFE
16018 Mill Creek Boulevard • Mill Creek, Washington 98012 • (206) 775-1311 FAX (206) 338-1066

April, 27, 1999

Rick L. Moshier, Chief
Design Branch
Seattle District
U. S. Army Corps of Engineers
P. O. Box 3755
Seattle, Washington 98124-2255

Re: Draft Howard A. Hanson Dam Master Plan

Dear Mr. Moshier:

We have reviewed the above referenced document and have the following comments.

As stated on page 1-1, "This master plan is a formal land use planning document...." concerning management of Corps project lands. We appreciate the efforts being made to preserve, protect, and enhance existing wildlife values of Corps lands. However, there was and is no mitigation to offset the project's significant original and continuing impacts to wildlife. We believe this should be acknowledged in the master plan.

Specific Comments

2.2 Authorized Purposes, p. 2-2. The manor in which the summer conservation pool is described, "....for later uses, such as low stream flow augmentation...." ".... for fish conservation." implies this pool may be used for purposes other than fish conservation. We do not believe that is the case.

2.9.3 Dam Operations and Water Management. p. 2-13. In describing the Section 1135 Fish and Wildlife Restoration Project and the Additional Water Storage Project (AWSP), it is stated both projects "....would raise the summer conservation pool to a total maximum elevation of 1,177 feet." That would only be true if both phases of the AWSP were implemented, which at this time, is far from certain.

2.14 Fisheries, p. 2-25. It is said that fish populations residing in and above Howard Hanson Dam are most affected by Corps operations and facilities. While resources both above and below the project are affected, those residing below are by far the most affected, in both positive and negative ways.

2.14.4 Current Fisheries and Hatchery Production, p. 2-28. Upper watershed salmon and steelhead releases are a cooperative effort between Muckleshoot Tribe and the Department of Fish and Wildlife (WDFW). Steelhead fry released into the watershed are wild origin, not hatchery brood stock. Chinook and coho out-plants have been scaled back significantly in recent years; steelhead fry plants have never been large, averaging between 30 and 40 thousand. Steelhead brood stock for the upper watershed have been predominantly collected from the middle river by hook and line, not from the diversion dam trap. Virtually all steelhead collected at the trap have been passed upstream to spawn naturally. In 1999, we do not intend to plant steelhead fry to the upper watershed. Rather, fry produced from brood stock collection are planned to be released between the Tacoma diversion and Howard Hanson dams.

Adult salmon releases to the upper watershed are not prohibited due to water quality concerns. To date, adult salmon release has not been implemented due to cost, stock management considerations, and poor survival of downstream migrants passing through the existing project.

2.15.9 Chinook Salmon, p. 2-34. We are not aware of any mitigation or additional water quality treatment that would be necessary as a consequence of passing adult salmon above Howard Hanson Dam. See previous comment.

2.17 Native American Use of the Area, p. 2-37. The Muckleshoot Tribe and WDFW are co-managers of Green River fisheries resources. Whichever entity "takes over" any particular logistical activity is a matter of efficient use of available resources, not delegation of management.

Many years ago, we did try to accommodate outmigration through the project, by delaying spring refill. However, we soon discovered such operation resulted in substantial damages to wild steelhead spawning below the project through exposure of spawning sites and desiccation of incubating eggs and alevins. In recent years, WDFW policy is to assure protection of downstream resources.

Unfortunately, the tribe and WDFW do not "....have the most direct impact on the numbers of adult salmon and steelhead that ultimately spawn in the river below the dam, and or that could reach the dam for passage into the upper watershed." More than 99% of all production is lost to

natural causes, habitat degradation, and human actions beyond our control.

Thank you for the opportunity to comment.

Sincerely,

R. Gary Engman
Mitigation and Restoration Division

c: Bob Everitt
David Mudd

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-2255

REPLY TO
ATTENTION OF

Engineering/Construction Division
Design Branch

JUL 29 1999

R. Gary Engman
Mitigation and Restoration Division
State of Washington Department of Fish and Wildlife
16018 Mill Creek Boulevard
Mill Creek, Washington 98102

Dear Mr. Engman:

Thank you for reviewing the draft *Howard A. Hanson Dam Project Master Plan-Design Memorandum No. 27*. The Corps of Engineers' responses to your comments follow.

General comment

1. Comment regarding the need to acknowledge lack of wildlife mitigation for project.

Concur. Neither the original authorization for Howard Hanson Dam or subsequent Congressional actions have provided for mitigation of the dam's construction and continued operation's adverse impacts on the environment, including fishery and wildlife resources. During the original authorization process Congress did not receive mitigation recommendations from any of the involved agencies. Mitigation was not authorized (on the fisheries side primarily) because the city of Tacoma's diversion dam had already blocked anadromous runs.

Over the years the Corps, in consultation with the Muckleshoot Tribe, resource agencies, and other stakeholders, has continually sought ways, whenever and however possible within the project's authorization, to operate in a manner which reduces impacts and improves the inherent situation. Initiatives by the Corps and its local sponsors under new planning authorities will result in implementation of a variety of restorative measures in the Green River basin, including fish passage at Howard Hanson Dam and habitat improvement sites both above and below the project. While these do not constitute mitigation for the original project's effects, they will provide for better future conditions. Original project mitigation per se would require separate, specific Congressional authorization. A revision has been made to Section 4.3.3 Mitigation to include this information.

Specific Comments

2. Draft p. 2-1, Section 2-2 Authorized Purposes (second paragraph).

Concur. We have reworded the paragraph to clarify that the authorized purpose of fish conservation is limited to low stream flow augmentation. We agree the authorized purposes of flood control and fish-conservation are narrowly defined and we have reworded some sections to make this clearer. However, please note that adaptive management by the Corps, the Muckleshoot Tribe, the city of Tacoma, and resource agencies is possible if actions are within the parameters of the original authorized purposes for Howard Hanson Dam. Please refer to Section 2.9.3. Dam Operations and Water Management, last paragraph.

3. Draft p. 2-13, Section 2.9.3 Dam Operations and Water Management (paragraph four).

Concur. We have corrected paragraph four to clarify the difference between the *Additional Water Storage Project* and the *Section 1135 Fish and Wildlife Restoration Project* in regards to the summer conservation pool. Clarification was also made to paragraph six, Section 2-17 Native American Use of the Area (draft p. 2-38).

4. Draft p. 2-25, Section 2.14 Fisheries.

Concur. The Howard Hanson Dam Master Plan focuses on the use of facilities and lands owned by the Corps rather than operation of the dam, and as such, tends to affect resident fish within the reservoir more than downstream fish resources. However, operational affects on downstream fisheries are arguably as significant and should be mentioned. This section has been rewritten to remove reference to upstream populations being more affected than downstream fisheries.

5. Draft p. 2-28, Section 2.14.4 Current Fisheries and Hatchery Production.

Comment noted. The cooperative nature of fish releases in the Green River between the Muckleshoot Indian Tribe and the Washington Department of Fish and Wildlife has been added to the document. Clarification of the disposition and origin of steelhead fry plants has also been noted in the document. In addition, the document has been updated to include stock management considerations by WDFW as a consideration for restricting chinook and coho adult releases above the reservoir.

6. Draft p. 3-34, Section 2.15.9 Chinook Salmon.

Comment noted. The degree to which water quality would suffer as a result of releasing adult salmon into the city of Tacoma's water supply is still an unanswered question. Additional treatment of the water due to anadromous fish spawning above the water supply would depend on the number of fish released and conditions within the reservoir at the time. It may be argued that the number of fish released above the reservoir will not cause a detectable difference at the diversion dam but the risk still exists and if detected, mitigation would be necessary.

7. Draft p. 2.37, Section 2.17 Native American Use of the Area.

Comment noted. The WDFW and Muckleshoot Indian Tribe are currently co-managers of the fisheries resources of the Green River and the document has been changed to reflect it. The statement pointing to the amount of control that WDFW has over fish spawning numbers above and below the project has been eliminated.

If you have questions regarding these responses, please contact the project manager, Ms. Terri Taylor, at (206) 764-6185 or through electronic mail at Terri.A.Taylor@usace.army.mil.

Sincerely,

Rick Moshier,
Chief, Design Branch

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
Northwest Regional Office, 3190 - 160th Ave S.E. • Bellevue, Washington 98008-5452 • (425) 649-7000

April 30, 1999

Colonel Rigsby
Department of the Army
Seattle District, Corps of Engineers
P.O. Box 3755
Seattle, WA 98124-2255

Dear Colonel Rigsby:

Thank you for your letter of March 3, 1999 to Governor Locke. I have been asked to coordinate the review of the Howard A. Hanson Dam Master Plan Document Design Memorandum No, 27. We are pleased with the focus of the masterplan as a tool for the responsible stewardship of the natural resources to benefit present and future generations. Our comments have focused on two primary areas of concern, water quality and quantity. They are provided below.

The draft plan should contain specific details on the management of the dam from a water supply and in-stream flow management perspective. It does not adequately discuss nor reference the agreements that exist between the Corp of Engineers and the City of Tacoma and the City of Tacoma and the Muckleshoot Indian Tribe on water supply and in-stream flows. The master plan should address how these agreements effect the operational management of the Howard Hanson Dam.

The draft plan should discuss the daily operations of the dam. We recommend that the management plan include daily operation and refill protocols. The plan should include information about the role and procedures associated with the stakeholder committee that regularly meets to discuss reservoir refill strategies.

The draft plan should include information on dam maintenance and safety inspections. The plan should discuss state and federal requirements for periodic inspection of the dam and emergency preparedness.

The document provides that there has been an improvement in water quality in the valley as a result of the dam. While two wastewater treatment plant discharges into the Green (due to the expansion of the King County collection system) have been eliminated, and several modest

storm water treatment facilities have been installed, it is not clear that these actions have resulted in sustainable improvements in water quality. Rapid urbanization encouraged by the presence of the flood protection provided by the dam may have resulted in more urban runoff pollutant discharges than the pollutants previously eliminated.

Thank you for the opportunity to comment on this document. We are available to answer any questions or discuss our comments with your staff. You may contact Janet Thompson at (425) 649-7128 if you wish to pursue the points we've raised.

Sincerely,

Michael Rundlett
Regional Director

cc: Janet Thompson

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-2255

REPLY TO
ATTENTION OF

Engineering/Construction Division
Design Branch

JUL 29 1999

Michael Rundlett
Regional Director
Northwest Regional Office
State of Washington Department of Ecology
3190 160th Avenue S.E.
Bellevue, Washington 98008-5452

Dear Mr.Rundlett:

Thank you for reviewing the draft Howard A. Hanson Dam Project Master Plan-Design Memorandum No. 27. The Corps of Engineers' responses to your comments are provided below.

1. a. Paragraphs 2-4. Regarding providing more details on water supply and in-stream flow management, daily dam operations, and dam maintenance and safety inspections.

General comment. Please refer to 1.1 Purpose and 1.2 Scope for a description of the content of the master plan. In summary, a master plan is a formal *land use* planning document. It is not within the scope of a master plan to provide detailed information on reservoir levels, daily dam operations, dam maintenance and safety inspections.

b. Paragraph 2

Comment noted. See number 1.a. above. Sections 2.2, 2.6, 2.9, and 2.17 provide information on water management at Howard Hanson Dam. Detailed information on water supply and in-stream flows will be covered in the Howard A. Hanson Dam Water Control Manual, which is currently under preparation.

c. Paragraph 3

Comment noted. See number 1.a above. Detailed information on water supply and in-stream flows will be covered in the *Howard A. Hanson Dam Water Control Manual*, which is currently under preparation.

d. Paragraph 4

Comment noted. See number 1.a above. Dam maintenance and safety inspections are covered in *Howard A. Hanson Dam Periodic Inspection Reports.*

2. Paragraph 5. Regarding water quality.

Comment noted. Water quality improvement attributable to the Howard Hanson Dam project is primarily associated with the water flows released during the summer and fall. The supplemental flows tend to improve the water temperature regime in the river relative to that which would occur without the dam or other development in the basin. Section 2.2 will be revised to clarify this point.

If you have questions regarding these responses, please contact the project manager, Ms. Terri Taylor, at (206) 764-6185 or through electronic mail at Terri.A.Taylor@usace.army.mil.

Sincerely,

Rick Moshier,
Chief, Design Branch