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MASTER

Case Studies of the Legal and Institutional Obstacles and Incentives to the Development of Small-Scale Hydroelectric Power

Bull Run, Portland, Oregon

Prepared by:
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The National Conference of State Legislatures is the official representative of the nation's 7,600 state legislators and their staffs. NCSL is funded by the states and governed by a 43-member Executive Committee. The NCSL headquarters are in Denver, Colorado, with an Office of State-Federal Reglations located in Washington, D.C.

The National Conference of State Legislatures has three basic objectives:

- To improve the quality and effectiveness of state legislatures;
- To assure states a strong, cohesive voice in the federal decision-making process; and
- To foster interstate communication and cooperation.

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Foreword

The National Conference of State Legislatures' Small-Scale Hydroelectric Policy Project is designed to assist selected state legislatures in looking at the benefits that a state can derive from the development of small-scale hydro, and in carrying out a review of state laws and regulations that affect the development of the state's small-scale hydro resources. The successful completion of the project should help establish state statutes and regulations that are consistent with the efficient development of small-scale hydro.

As part of the project's work with state legislatures, seven case studies of small-scale hydro sites were conducted to provide a general analysis and overview of the significant problems and opportunities for the development of this energy resource. The case study approach was selected to expose the actual difficulties and advantages involved in developing a specific site. Such an examination of real development efforts will clearly reveal the important aspects about small-scale hydro development which could be improved by statutory or regulatory revision. Moreover, the case study format enables the formulation of generalized opportunities for promoting small-scale hydro based on specific development experiences.

This case study was conducted for NCSL by the Program in Social Management of Technology of the University of Washington. The subcontractor was selected from a group of responses to NCSL's request for proposal solicitation. The subcontractor and NCSL jointly selected the case study site which reflects a varied type of developer and site developemnt scenario. Upon selection of the site, the subcontractor conducted comprehensive studies of the site which were developed into this case study report. Additional copies of this case study report can be obtained from the National Technical Information Service.

While the approach of the case studies seems an effective way of developing information useful to state legislators and staff, the following qualifications should be noted. While reasonably accurate generalizations about the environment for hydroelectric development can be drawn from the examination of the case study, the case study provides a limited sample and cannot exhaustively reveal all the potentially significant issues involved in hydroelectric development. In addition, a case study is not a perfect substitute for the actual experiences of a particular developer. Nevertheless, it would seem that the conclusions derived from this study should be useful in identifying and illustrating possible remedies for at least some of the more significant problems confronting hydroelectric developers. At a minimum, the information here should crystalize some legislative hydro policy options and suggest areas in need of additional inquiry.

The National Conference of State Legislatures' Small-Scale Hydroelectric Policy Project would like to express its appreciation to the individuals of the Program in Social Management of Technology of the University of Washington in the preparation of this document. Additionally, NCSL and the subcontractor wish to thank the developer of the project studied, the regulators and governmental officials in this state, and numerous other persons without whose cooperation this report would not have been possible.

TABLE OF CONTENTS

PREFACE

The University of Washington's Program in Social Management of Technology (SMT) is a problem-oriented interdisciplinary research and teaching unit affiliated with the College of Engineering which examines technology-intensive public policy issues. In addition to engineering and the physical sciences, SMT draws on economics, political science, law, business and public administration in working with the public policymaking process.

SMT's Small-Scale Hydropower Project, formed for the purpose of this study, consisted primarily of two faculty members and two graduate students:

Larry Schwartz, Principal Investigator and Faculty Research Associate
John G. Douglass, Faculty Research Associate
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Mr. Schwartz, a specialist in energy policy and its impacts, and Mr. Douglass, a specialist in energy technologies, may be contacted directly for any questions or comments regarding this study at the Program in Social Management of Technology, University of Washington, Seattle, Washington 98195. The telephone number is (206) 543-7029.

The study team assumes sole responsibility for the content and findings of this report. The study team wishes to thank the Program in Social Management of Technology at the University of Washington, the National Conference of State Legislators and the U.S. Department of Energy for its support of this research effort as well as the large number of people who freely gave of their time and experience to add depth to these case studies.

INTRODUCTION

The City of Portland, Oregon is located on the Willamette River in northwestern Oregon at the western edge of the Cascade mountain range. It was incorporated in 1851 and named after Portland, Maine, the hometown of one of its founders. Until 1895, the city's water supply came from local wells, creeks and the Willamette River. As the area grew in population and many nearby sources of water became polluted and local residents began searching for future sounces of pure drinking water supplies.

Portland receives quite a bit of rain each year from moisture-laden Pacific winds. Each winter, large amounts of water are stored as snow in the Cascade Mountains to the west of the city which result in many fast-flowing streams and clear mountain lakes. It was natural that the residents of Portland should look toward these sources of fresh water to supply the city's future needs. In 1888, Bull Run Lake and the Bull Run River were selected as the most preferable future water source for the city; on January 1, 1895, Bull Run water traveled the 35 miles to enter Portland for the first time.

This case study examines the small-scale hydroelectric project under development at the City of Portland's water reserve in the Bull Run Forest Reserve. Foresighted planners recognized that the water works might be useful sources of hydropower when they were constructed so the two water storage dams at the watershed were equipped with penstocks when they were built. Portland had only to wait until the need for electricity made the sites economically feasible and its water supply system could also become a small hydroelectric power station.

Under the supervision of the Portland Bureau of Water Works, construction is currently underway on the project and is proceeding on schedule. The Bureau plans to begin power generation on January 1, 1982, selling the average 100 million kw of power to Portland General Electric Company (PGE), a private utility which serves about 3,350 square miles of northwestern Oregon including Salem and about half of Portland.

Given the serious electricity shortages forecast for the Pacific Northwest in the 1980s, this case study demonstrates that small hydropower generation at existing sites such as water storage dams can make a contribution to the area's resource availability through the more complete utilization of structures also used to store drinking water.

The particular concerns of this case study are the economic institutional, political and regulatory problems of harnessing the energy at the two Bull Run water storage dams in an attempt to offer legislators, their staffs and interested individuals the opportunity to consider the problems of small hydroelectric power developments at existing sites.

1.0 HISTORY OF BULL RUN, PORTLAND AND ITS WATER UTILITY

1.1 Geologic History of the Site

An appropriate starting point for describing the natural history of the Bull Run site is the mid-Miocene Epoch, some 20 million years ago. Up to that time the region had been stable for about 20 million years and had been worn to a low rolling plane.[1] At about this time an uplift began that raised the strata thousands of feet high over the period of a few million years.[2] The net elevation gain was less due to erosion.[3]

After the uplife began a period of cataclysmic basaltic lava flows began in the Columbia Basin to the east which contined throughout Miocene epoch. Giant fissures many miles long would open in the earth and the lava would flow northward over the Columbia Basin and westward across the rising southern Cascades and the present site of Portland and the Bull Run River. Tsunami-like walls of white-hot lava up to 200 feet high roared across the landscape at speeds up to 30 miles per hour. Up to 20,000 square miles are known to have been covered in a single eruption.[4] Scores of outpourings occurred throughout this period of several million years with peaceful intervals of hundreds and even thousands of years sometimes intervening between flows. All total, over 200,000 square miles were covered with over 25,000 cubic miles of lava.[5] The region was flattened as the periodic flows filled in its valleys; and reforestation occurred during the periods between outpourings. Net surface elevation was increased by the outpourings even though there was sinking of the substrata from the weight of many basalt layers.

Subsequent to the Miocene epoch the axis of the Cascades continued to rise. In the 12 million years since the Miocene Epoch, their elevation has been raised about 2800 feet in the vicinity of the case study sites.[6]

Dominating the landscape near the case study site is 11,230 ft. Mt. Hood, a dormant volcano, whose summit is about 20 miles east-southeast of dam no. 1. The present cone was built up in the Quaternary period-- the last 2 or 3 million years. The latest known eruption of Mt. Hood occurred only about 2000 years ago although its maximum height was attained before the last glacial advance.

Local glaciers grew on Mt. Hood during all of the glacial advances but the vast Cordilleran ice sheet never reached as far south as the Portland area. Glacial erosion and mud flows originating on Mt. Hood have been deposited near the Bull Run site throughout the millenia. However, no glacial meltwater or other runoff from Mt. Hood enters the Bull Run River today. The ridges above the site form a crude "V" with its apex toward Mt. Hood and the Bull Run watershed situated between its "legs." The Mt. Hood drainage toward the Bull Run site is diverted north into the west fork of the Hood River and west into the Sandy River *en route* to the Columbia.

1.2 Portland: Brief History and Development

The City of Portland is in northwestern Oregon at the confluence of the Willamette and the Columbia Rivers, the latter forming the boundary between the States of Oregon and Washington in that area. East of Portland are the Cascade Mountains, and to the west is the coastal range. The Pacific Ocean is 86 miles due west from the city, Seattle is 173 miles to the north, and San Francisco is 639 miles to the south.

The City was incorporated in 1851-- predating Oregon's statehood by eight years. Clackamas County was formed in 1843 and named after an Indian nation and a river as recorded in the journals of Lewis and Clark. Multnomah County was formed in 1854 by the Territorial Legislature; Multnomah was the Indian name for the Willamette River below the falls at Oregon City to its mouth, and also the name of a tribe principally found on an island near the mouth of the Columbia River.

Local stories recount that a flip of a coin determined the City of Portland's name. The new city was to be named Portland after Portland, Maine-- the hometown of one of its founders-- or Boston for Boston, Massachusetts-- the home of another founder. The resources of its hinterland, early trading companies, its location at the confluence of two major navigable rivers, the Indian wars, the extension of stagecoach-- and later the Northern Pacific Railroad in 1883-- and telegraph lines all contributed to steady growth for Portland. After the Lewis and Clark Exposition held in 1905 the city's population doubled to nearly a quarter million. Other large population increases followed World Wars I and II.

The Willamette River divides Portland into east and west sections. The west section is a narrow shelf sloping to the southwest and ending it at the West Hills. The east section is also slightly sloping but broken with buttes and mounts. The city's average elevation is 175 feet over an area of about 88 square miles.

The Portland area climate is moderate, so extremes of temperature are both unusual and of short duration. The average summer temperature is about 65° F, and winters-- extending from 180 to 250 days per year-- are mild and frost-free with an average temperature of 43° F. Snowfall is infrequent and brief in the city, but rainfall occurs during all seasons-- principally from mid-November through March for an average of 38 inches per year.

Portland is mostly within Multnomah County-- for which it is the county seat-- but there are also some portions of the city in Clackamas and Washington Counties. In 1974 the estimated population of the city was 372,000. The Portland Standard Metropolitan Statistical Area (SMSA)-- covering urbanized areas of the above counties as well as Clark County in Washington state-- had an estiamted population of 1,071,500 people. By 1976 the SMSA population was estimated to have increased by about 3.5 percent to 1,109,000.[7] The combined population of Clackamas, Multnomah, and Washington Counties comprise about 40 percent of the entire population of Oregon.

The 1970 census revealed a population density of 262 persons per square mile-- somewhat low for a metropolitan area od this size. Only about 3 percent of the population was non-white, most of that being Oriental- and Spanish-American, Negro, and Indian.

The 1976 population of Multnomah and Clackamas Counties was 758,000 with an estimated labor force of 378,700. The 1975 personal income in the two counties totaled $4.973 billion, or a per capita income of $6,730-- 14 percent higher than the U.S. average of $5,903, and higher than the Oregon state per capita income of $5,752. Bonneville Power Administration projections for the two counties to 1995 point to increases in future population and employment. The approximate average annual population growth rate is expected to be 1 percent (799,000 in 1980 and 921,000 in 1995); employment will increase at an average annual rate of about 1.4 percent (368,200 in 1980 to 454,700 in 1995). Most of the employment growth will be in Multnomah County, but Clackamas County has been predicted to be growing faster from 1985 to 1995.[8]

In the Portland SMSA all cities and two of the four counties are home rule agencies-- that is, they have the authority to pass ordinances regulating matters of local concern.[9] Portland is one of the few remaining major cities in the nation retaining the commission form of government. A mayor and five commissioners are elected, with each of the latter serving as an administrative head of one of the city's municipal departments. Francis J. Ivancie is presently the Commissioner of Public Utilities.

To supervise the planning efforts of the cities and counties in the Portland area, the Columbia Region Association of Governments (CRAG) has been formed. Tri-Met is a public transportation district which provides mass transportation throughout the region. Portland's mayor, Neil Goldschmidt, was recently appointed U.S. Secretary of Transportation by President Carter, partly on the strength of his successes with promoting Tri-Met. Regional solid waste and flood control, and sewage treatment are to be provided by a Metropolitan Service District. Additional oversight is provided in Multnomah County by a tax supervising and conservation commission (for Portland area government budgets) and a local boundary commission which attempts to ensure orderly development and rational control over the maze of local governments.

Much of Portland's historical growth has resulted from its role as a transportation hub. Today it has a major world seaport, is served by four railroads, ten air passenger and cargo carriers, and a network of interstate highways.

At Portland, the port district owns and operates the major shipping facilities. This includes airports, two industrial parks, and a ship repair yard in addition to the traditional dock facilities. Located 110 miles inland from the sea, the Port of Portland is the third largest port in tonnage on the Pacific coast of the United States (behing Los Angeles and Long Beach). Upriver Columbia River traffic was mostly petroleum products, and downriver to the port it was mostly agricultural products. About two thirds of all river tonnages in Oregon passed through the Port of Portland. In 1975, about 46 percent of all Pacific Northwest ocean-going grain movements were from the port.[10]

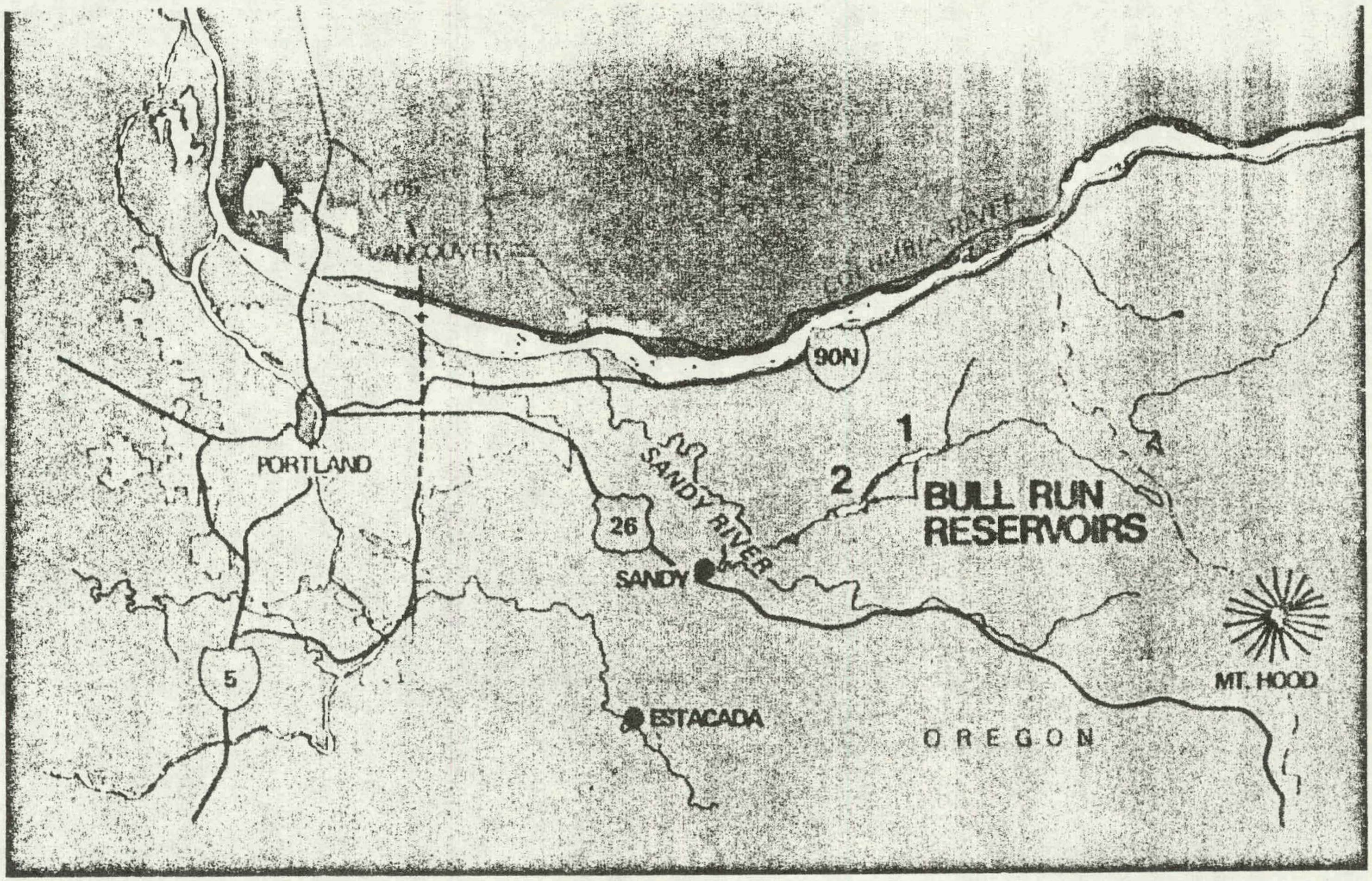
Portland is important as a commercial center for the handling of farm and forest products-- the grain, orchard produce, vegetables, and timber-- of the Columbia Basin, Cascade Range, and Willamette Valley. There has been significant industrial development in the Portland area, primarily in five basic industries: metal working; food products; lumber, furniture, and timber; chemicals and related products; and electronics. Retail sales in the Portland SMSA grew by about 20 percent from 1974 to 1976 when they reached about $3.64 billion dollars. The area's foreign trade in tonnage decreased by about 15 percent from 1974 to 1975-- following a pattern seen at all west coast ports during the period. But by 1978, tonnage was 20 percent higher than it had been in 1974.[11] Trade, services, manufacturing, and government are the largest payrolls.[12]

1.3 Development of the Bull Run River Watershed

The use of the Bull Run River for Portland's water supply began when the Oregon State Legislature passed an act in 1885 creating the Portland Water Committee and authorizing the construction and maintenance of a public water system. During 1886 the Committee put together a financial package which enabled them to purchase the Portland Water Company which had served the City since 1862, supplying water from local creeks, wells and the Willamette River. The Water Committee spent additional funds in that same year to improve, maintain, and extend the City's existing distribution system. By proclamation of President Benjamin Harrison in 1892 the Bull Run Reserve was set aside to protect the water supply of the City.

Although the Committee also studied the possibility of obtaining water from Eagle Creek and the Clackamas River they decided that the Bull Run River was the most preferential water source, a decision that was the object of much criticism at the time. Apart from the obvious cost involved in bringing water more than 35 miles over rugged countryside it was believed that Bull Run water was glacial (which it is not) and therefore possibly unhealthy. Later that year the river was documented to be spring fed and supplied from the rains and snow in a watershed from 750 feet to 4700 feet in elevation. The precipitation over the area averages about 72 inches at the headworks and 146 inches at Bull Run Lake which lies at an elevation of 3,140 feet. The water in the Bull Run watershed is now known to be of very high quality and no filtration is required for domestic use. Public officials like to boast that it is so free of minerals that it can be put directly into automobile batteries without prior distillation.

PORTLAND HYDROELECTRIC PROJECT



A contract to construct the headworks was awarded on September 2, 1886 but all action was suspended until a $2.5 million bond issue was authorized in 1891. Construction on the headworks and conduits began in 1891 and water from Bull Run entered the City of Portland through Conduit No. 1 for the first time on January 1, 1895. At about the same time, four reservoirs with a combined storage capacity of about 65 million gallons were constructed in the City.

Portland's rapid growth from 1900 to 1930 overtaxed the original capacity of the system drawing water from Bull Run Lake. Supplying the city's water needs required the construction of Conduit No. 2 (50 million gallon daily capacity) in 1911 and Conduit No. 3 (75 million gallon daily capacity) in 1925. Also in 1911, reservoir No. 5 and No. 6 were completed.

Six reservoirs and three conduits continue to supply Portland with water today, although a Conduit No. 4 retired the 1895 vintage Conduit No. 1 in 1953. Total system delivery capacity is 225 million gallons per day, however the need for further storage was recognized in the mid-1920s. From 1927-1929 a concrete gravity dam 200 feet high and approximately 900 feet long was built on the Bear Creek site, now known as Dam No. 1, which backed up Lake Ben Morrow. This provided a storage of 8.8 billion gallons. It was increased to 10 billion gallons in 1955 by installation of vertical lift gates adding 8 feet to the water level.

In the 1950s postwar suburban growth greatly accelerated. The outside demand on the Bull Run water supply dangerously overtaxed the existing system. In 1959 the Water Bureau went ahead with its plans to build Dam No. 2, an earth filled structure only a short distance upstream from the headworks. The dam cost $8 billion and took three years to complete. Its construction was plagued by a major washout from a flash flood and a default by the contractors on the job. It was finally completed in 1961 with an impoundment capacity of over 7 billion gallons.

In what today seems an amazing display of foresight by Portland's water resource planners, both Dam No. 1 (1929) and Dam No. 2 (1962) were constructed with the penstocks required for hydropower development, the expectation being that one day such development would become economically attractive.

Presently, the City of Portland has 21 billion gallons of stored water above the Bull Run headworks: 4 billion at Bull Run Lake, 10 billion at Lake Ben Morrow and 7 billion behind Dam No. 2. Long-range planning calls for additional storage since the area and population served is growing rapidly. Although the average water demand is over 111 million gallons/day, the actual demand fluctuates between 98 million gallons/day and the system's capacity of 225 million gallons/day.

The Bureau of Water Works supplies the city using a 1500 mile network of distribution lines, To regulate water flow and pressure, the Bureau maintains the six large storage reservoirs. At various locations around the city, 69 pumps are maintained to supply water in areas higher in elevation than the receiving reservoirs.

The Bureau maintains over 122,000 meters registering the quantities of water consumed in the city. Commercial and industrial users using large quantities of water are billed monthly; smaller users are billed quarterly. The revenues which the city receives from water sales is used for the system's operations and maintenance, for the payment on bonds and for the construction of new facilities.

As a safety precaution to protect the health of Portland's citizens, Congress passed the Bull Run Trespass Act of 1904, assigning the U.S. Forest Service responsibility to keep the people out of the area and keep forest fires under control. There have subsequently been several difficulties concerning access to and management of the watershed. These are discussed below. However, as part of the Mt. Hood National Forest, most of the land in the Bull Run Reserve is owned and administered by the Forest Service. The City of Portland owns 3,730 forested acres inside this area and another 1,300 acres near the reserve. Visits to the watershed are strictly monitored.

Long the topic of public debate, Portland's water is treated with a minimum amount of chlorine and ammonia compatible with public health and safety. The water is not fluoridated, although this may come about in the near future. The water is tested for purity an average of 500 times a month by the Multnomah County's Health Department at a laboratory established at the headworks to assure its high quality.

1.4 How Water Withdrawal Works

In order to understand the proposed hydroelectric development one must first understand the hydraulics and hydrology of the existing water works system. Bull Run Lake Dam No. 1 (upstream) and Dam No. 2 (downstream) are managed in series. Dam No. 1 impounds Ben Morrow Lake; Dam No. 2's reservoir has no proper name. Presently, no municipal water is drawn directly from either Bull Run Lake or Ben Morrow Lake. It is merely spilled through Dam No. 1 into the reservoir behind Dam No. 2 is filled not only from Ben Morrow Lake spillage but also from surface runoff and ground water. All of the domestic water for the City of Portland is withdrawn directly from behind Dam No. 2.

Water withdrawal is a complicated process. There are three separate water exits for the reservoir behind Dam No. 2. One is a spillway which bypasses the water system headworks to dump excess water from the reservoir into the downstream channel of the Bull Run River. The other two possible exits are the intake towers which feed the water supply headworks. The north tower feeds water through a 15-foot diameter tunnel to the old river channel stilling basin which has supplied the headworks intake since before Dams Nos, 1 and 2 were built. The south tower conducts water through a 7-foot tunnel to a cjunction where it can be routed directly into the municipal water supply conduits or indirectly into the conduits via the old stilling basin. When constructed, the north tower and tunnel were sized large to allow for future use of the site as a hydroelectric turbine intake and penstock.

All the water entering the stilling basin does not have to enter the water system intakes. It can also be spilled over the small diversion dam that forms the stilling basin and into the downstream river channel. Having several ways to route water into the municipal conduits allows water system operators to choose the one that minimizes water quality degradation for the prevailing weather and flow conditions.

Ny hydro power is presently generated in direct association with the two dams. However, the Water Bureau does sell some of its excess water (when available) to Portland General Electric (PGE) for generation at its Roslyn Lake plant. The city conduits pass near the Lake about five miles down the Bull Run River channel from Dam No. 2. The water PGE purchases is added to Roslyn Lake, the headwater for PGE's turbine generators at the river's edge some 300 feet below the lake level. The conduit runs from the Water Bureau's intakes only drops 100 feet in the five miles to Roslyn Lake, so there is little net head wasted by dumping water into Roslyn Lake as opposed to directly connecting to the PGE penstock there.

1.5 The Use of and Access to the Watershed

There have been a series of bitter conflicts over the use of the Bull Run watershed in recent years. This is partly due to the fact that only part of the land in the area is actually owned by the City of Portland. Since Congress passed the Bull Run Trespass Act of 1904, the U.S. Forest Service has had responsibility to keep people out of the federally owned part of the watershed and to keep forest fires under control. This generally worked well, until 1958 when private lumber comapnies offered to safeguard the watershed by means of what was called "protective logging." Although this method does not conform to any known hydrological principles, it was adopted and continued until 1976 when the U.S. District Court ruled that it was both illegal and an ineffective protective mechanism-- renewal of timber contracts was forbidden and access to the watershed was tightened, restricting access to individuals actually involved in supplying water to Portland.

By this time however, this logging activity had become a significant part of the local economy. The City of Portland, which did not stand to benefit significantly agreed to ask Congress to change the law. What went on illegally for almost two decades may continue legally, henceforth.

The Congressional action sought by the City of Portland was initiated in 1976 in the U.S. House of Representatives Committee on Interior and Insular Affairs. Many of the major issues that needed to be resolved were never seriously in dispute so PL 95-200, passed in November, 1977, articulated the agreement.

- Primary purpose: It was established that the principle management objective of the watershed would be the supplying of pure, clear potable water for the Portland Metropolitan Area. The principle resource management objective established the preservation of the watershed, preventing part of the Bull Run Forest Reserve from becoming a typical multiple use forest.

- Nondeterioration of water. It was established no activity would be allowed in the area that could adversely affect the quality of the water in the Reserve and lead to the need for a water filtration plant for Portland.
- Boundaries. All parties agreed to return to regular national forest uses about 45,000 acres within the official Bull Run Forest Reserve, but not in the drainage area from which the drinking water comes-- this was designated the Bull Run Watershed Management Unit. The former lands, including popular hiking trails and campgrounds, a geothermal exploration area and about a fourth of the reserves' timber, is open for the summer under temporary waiver. The watershed was defined to be the actual area draining into the reservoirs plus a safety/buffer zone of about 95,000 acres.
- Logging. Some level of commercial logging will be permitted to continue in the watershed. Before the federal court stopped new timber sales, the City and the Forest Service had agreed to let 21 million board-feet of timber be cut each year within the watershed, about half as much is now being cut. (Under the court ruling, loggers are now cutting trees bought under earlier contracts, which will run through 1978-79.)
- Hydroelectric Power. The City will be permitted access to the site to install and operate hydroelectric generators at the reservoirs. Until recently hydroelectric development of the Bull Run River has been neglected, even though the original dams were constructed with such a use in mind. The hydroelectric potential was not tapped in the past because the economics of such relatively small sites appeared unfavorable.
- Arbitration Board. In the event of a dispute between the city and the Forest Service with respect to the watershed, P.L. 95-200 set up an arbitration procedure by which a 3-person team of experts would be called upon for judgment.

A study had been produced in 1957 by engineering consultants Stevens and Thompson which concluded that hydroelectric power development would then be uneconomical. In the years since then, feasibility studies were periodically updated. However, in the period after the federal court decision barring all activities in the watershed not related to water supply and before the signing of P.L. 95-200, those studying the hydropower potential of the site were unable to approach the dams. As a result, the entire FERC license application was prepared from plans or from photographs and inspections of the site obtained from a helicopter, hovering above the ground.

2.0 SMALL-SCALE HYDROELECTRIC POWER AT THE BULL RUN WATERSHED

Interest in converting from the water passing through the Bull Run watershed to electricity is not recent. Hydroelectric generation has been contemplated for each of the dams since their construction--Dam No. 1 was built in the 1920s; Dam No. 2 was built in the late 1950s and completed in 1962. The City of Portland has contracted for a number of feasibility studies over the years, but it wasn't until the dimensions of the signs of looming electricity shortages before the region began to emerge that the economics of the site began to tip in favor of development.

2.1 The Commissioner's Initiative [1]

The 1975 feasibility study by the engineering consultant Van Gulick of Oswego, Oregon was the first in this long string of economic analyses which stated that the project could be viable. At about that time, Portland Commissioner Francis J. Ivancie, who is responsible for public utilities, approached the well-established engineering and technical services firm CH_2M-Hill with a number of questions about hydroelectric facility construction, licensing and financing. Ivancie apparently became convinced that Portland ought to generate hydroelectricity at the Bull Run watershed, because with the Van Gulick study in hand he sought and obtained approval from the Portland City Council in the spring of 1976 to begin the Bull Run Hydroelectric Project.

Working through the Bureau of Water Works, a city-owned utility, Portland developed requests for proposals (rfp) for the award of contracts to be funded by City general revenues. Rfps were circulated for both engineering support and financial advisory services to the project. The City Council convened a "blue ribbon" advisory and selection panel for the evaluation of the proposals it received. A contract for about 3 million in engineering fees was awarded to CH_2M-Hill on the basis of a proposal managed by William Waters and Robert Gillette. Smith, Barney, Harris, Upham & Co., Inc. was awarded a $60,000 contract to serve as financial advisor; Frank Schmidt of that firm's San Francisco office has been working with the City on the Bull Run hydroelectric development.

2.2 An Unanticipated Snag[2]

The City's contracts were signed with the engineering and financial advisors in November of 1976. At about that time James Doane, currently hydroelectric project manager for the Water Bureau, was first assigned to the project on a part-time basis. Also at about that time a Portland-area resident, Joseph Miller, filed suit in U.S. District Court charging that by permitting commercial logging in the area the U.S. Forest Service was violating federal legislation and President Harrison's proclamation restricting access to the Bull Run watershed for the protection of Portland's water supply. The suit created a large public uproar, since the purity of Portland's drinking water had become an object of intense local pride over the years-- even suggestions of fluoridation had been turned down by the voters. In the spring of 1977 Miller won the case and the Court prohibited all access to the watershed for hydropower development, commercial logging and any other activities which were not directly related to water supply management.

Undaunted, the Bureau of Water Works requested, and was granted, permission by the Court to inspect the site for hydroelectric development from the air, while the City of Portland approached the U.S. Congress in search of new legislation concerning the watershed. Using previously drawn plans of the sites in addition to photographs and site inspections from a helicopter which never touched the ground inside the watershed, CH_2M-Hill and the Water Bureau prepared and submitted the FERC license application in October of 1977. Simultaneously, the application was submitted to the State of Oregon for the necessary licenses and permits.

In November of 1977, the Congress passed PL 95-200 which resolved the tangle over access to Federal lands in the watershed. Water supply was established as the principal management objective of the watershed and no activity is to be allowed that could adversely affect the water's quality. The size of the Bull Run watershed Management Unit within the Mt. Hood National Forest was established for this purpose, returning 45,000 acres to regular national forest uses. Some level of commercial logging will be permitted in the waterhsed, along with hydroelectric development, as long as water quality is not disturbed. Finally, an arbitration board procedure was established in the event of future disputes between the City and the Forest Service.

Also in November of 1977, the City put an issue to the voters on Election Day which would permit it to enter into long-term power sales contracts-- forty years instead of the previous five-year limit. The issue was passed by the voters and aroused no organized opposition.

2.3 Progress to Date

Oregon has a "central clearinghouse" for the processing of permits. After filing with the State in October of 1977, permits "came around quickly," according to Jim Doane of the Bureau of Water Works. The project was cleared by the State agencies at interest, with the exception of the Oregon Department of Fish and Wildlife, by June of 1978. The Oregon Energy Facility Siting Council declared the project too small to fall under their authority.

There were two intervenors in the FERC licensing process: the N.W. Environmental Defense Center operating from the law school at Reed College, and the Oregon Department of Fish and Wildlife. Both of the interventions were settled without legal battles. The N.W. Environmental Defense Center was concerned about the water quality impact of the Bull Run hydro development. Their objection was withdrawn after the Water Bureau agreed to incorporate special language in the FERC license concerning the preservation of water quality. The Oregon Department of Fish and Wildlife insisted that before it would give its assent to the project the Water Bureau had to make restitution for the salmon run which was destroyed when Dam No. 1 was originally constructed without fish ladders in the 1920s. Although the Water Bureau felt the State was making an unreasonable demand, they agreed to place a half million dollars of the revenue to be generated by the electricity sales, together with annual payments of $30,000 over the entire life of the project, toward the State's salmon enhancement program. The Bureau beleived that the payments were preferable to the delays, the costs, and the bad publicity they would have had to endure if the case was litigated.

The Water Bureau was not going to pay the reparations without a contest, however. They expect to be assessed $11,000 to $12,000 per year by the State as a licensing fee to appropriate surface waters for hydroelectric generation. They have argued that because the City has been granted the use of the Bull Run waters on Federal lands-- a right originating in Federal legislation, a Presidential proclamation and a U.S. Forest Service special use permit-- and as such they should be exempt from State water rights regulations, and therefore from the fees State regulations impose. Ultimately this matter will be decided by the courts, should no agreement emerge.

In October 1978, the Water Bureau received bids for the construction of the turbines and generators according to the specifications developed by CH_2M-Hill. In January of 1979, a $4.5 million contract was awarded to Fuji Electric of Kawasaki, Japan, for the construction of a 24 mw Francis unit for Dam No. 1 and a 12 mw Kaplan unit for Dam No. 2.

With assistance from the State's congressional delegation, the FERC license was granted on March 28, 1979-- after an unusually short period of 15 months. This led the way to the finalizing of the power sales agreement the City had been negotiating with the Portland General Electric Co. in April, the City's selling of the tax-free industrial development bonds in May, and the beginning of actual construction shortly thereafter.

3.0 THE CURRENT ARRANGEMENTS FOR HYDROPOWER FROM BULL RUN

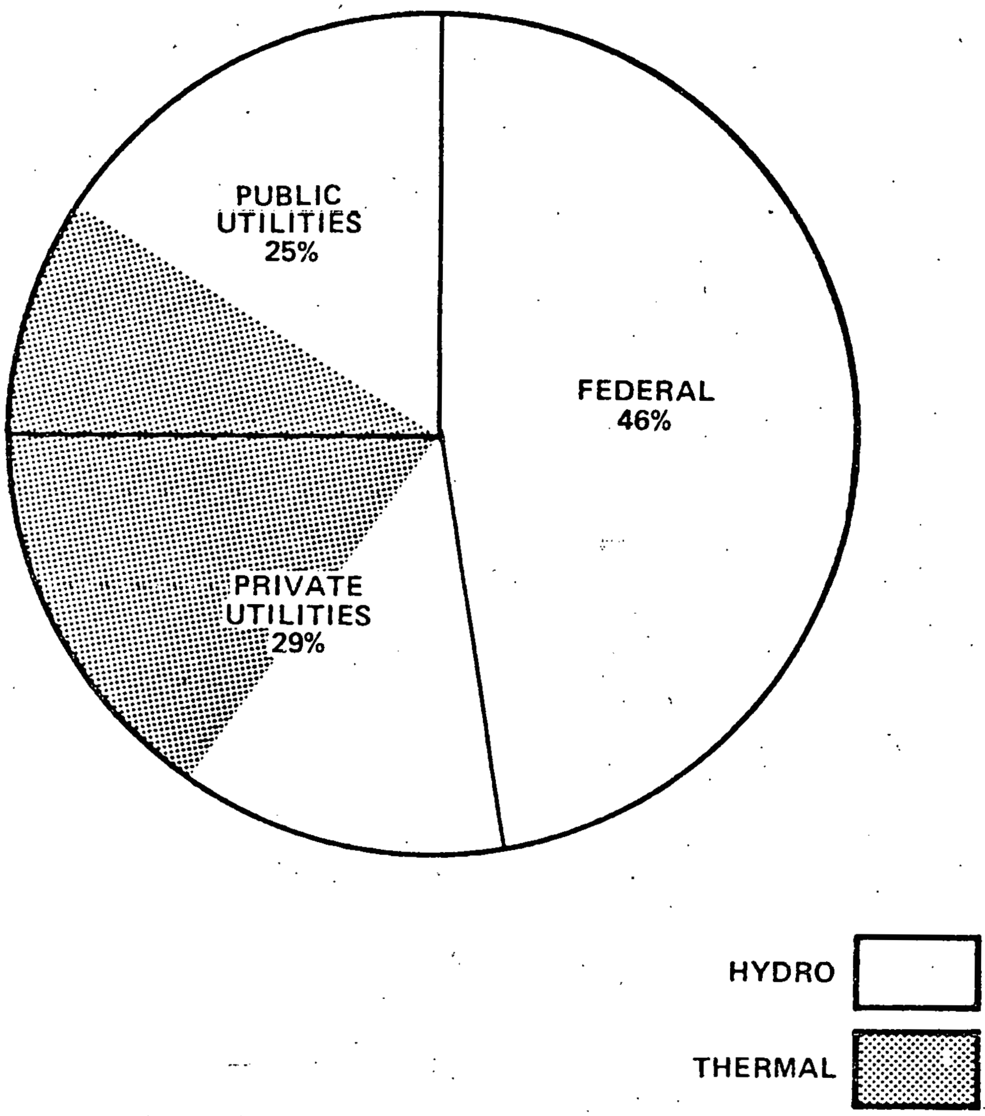
3.1. Federal Power Dries Up

The Pacific Northwest enjoys some of the least expensive electrical energy in the United States. The value of electricity has been heavily influenced by the Columbia River system and by the role of the Federal government's Bonneville Power Administration (BPA) as a major marketing agent for Federal power in the region. In 1977 BPA marketed over 69 million kwh of electricity from Federal coal, nuclear, and hydroelectric plants in the Northwest at fairly low prices. For example, BPA's "preference customer" rate for electricity sold to public utilities is about 7 mills/kwh. Power from the Bureau of Reclamation's Grand Coulee Dam is produced at the astonishingly low price of 1/2 mill/kwh, while the cost of new sources of thermal power (coal or nuclear) is presently between 30 - 50 mills/kwh.

Hydroelectric resource developments have provided a major share of the region's electrical energy needs to date. In addition to the several dams constructed by the Bureau of Reclamation, these resources have been privately- and publicly-owned utilities and have functioned well enough to have enjoyed an enormous amount of public approval. But the future is too problematic, since it seems that all of the large-scale hydroelectric resources in the region have been developed. Consequently, future hydroelectric generating capacity will have to be installed at smaller sites. In the meanwhile, the region's utilities are largely looking to conservation, coal and nuclear thermal power plants in an attempt to provide for future growth in electrical demand.

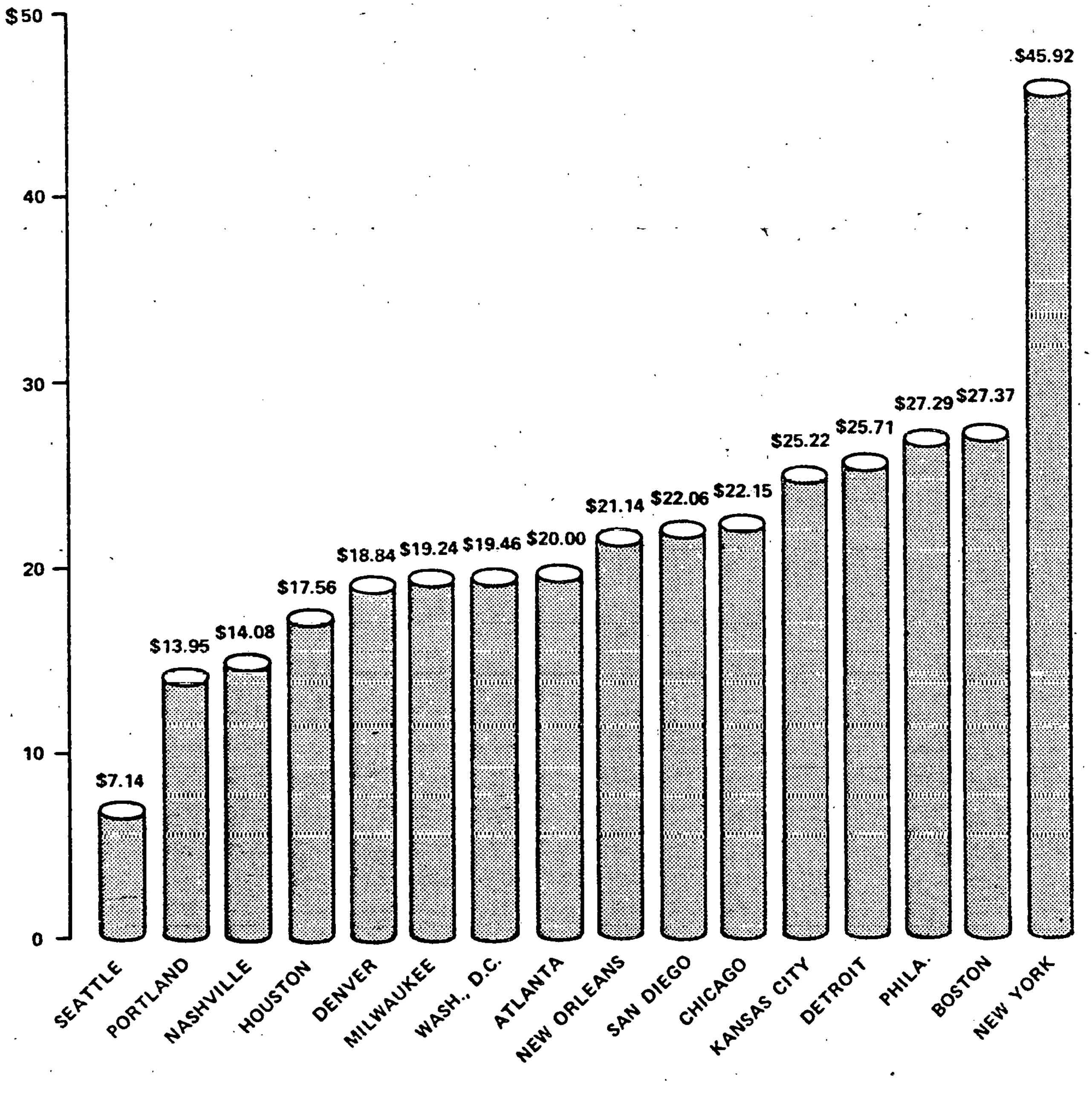
Publicly-owned power has a strong tradition in the Pacific Northwest. Both Seattle City Light and Tacoma City Light were formed in the early years of the century. For many years, BPA has been meeting the full requirements of all the region's public utilities above the resources they own themselves and selling some power to privately-owned utilities as well. But times are changing. BPA cannot purchase or create more power plants, it can only reallocate the resources it has been authorized to market from Federal projects. It also has agreements with various utilities to carry, or "wheel," power over its transmission lines. Because of dramatic increases in the demand for electricity, BPA has informed public utilities that its resources will not be sufficient to meet their growing needs after 1983. It has also notified

PACIFIC NORTHWEST REGION
EXISTING ELECTRIC POWER GENERATING CAPACITY



Comptroller General of the U.S.
Region at the Crossroads -- The Pacific Northwest Searches for New Sources of Electric Energy
EMD-78-76
US General Accounting Office
Washington, D.C. August 10 1978

COMPARATIVE ELECTRIC BILLS FOR SELECTED CITIES
(JANUARY 1977 BILL FOR 500 Kwh RESIDENTIAL USAGE – TAXES INCLUDED)



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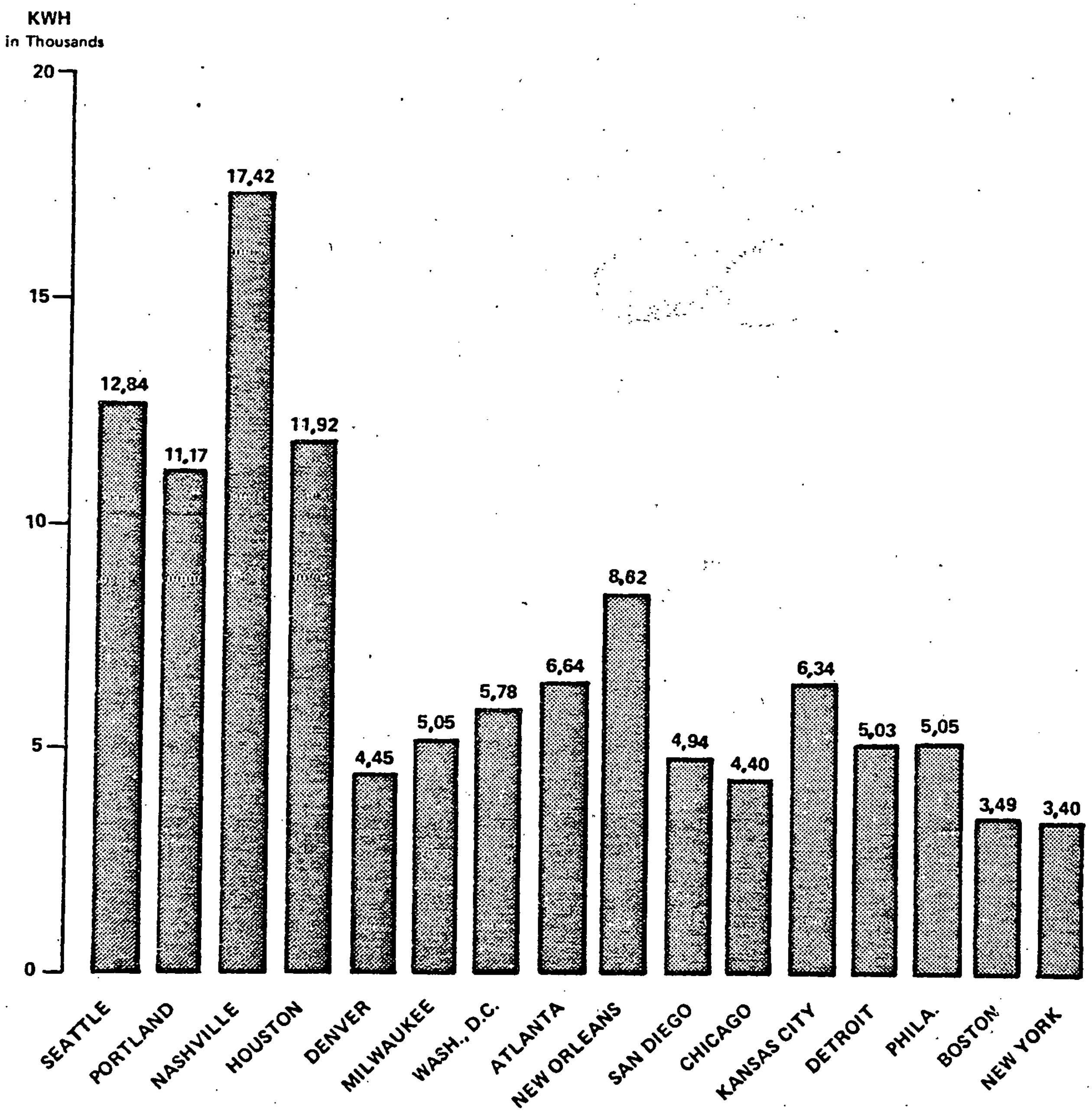
Region at the Crossroads -- The Pacific Northwest Searches for New Sources of Electric Energy
EMD-78-76, US General Accounting Office
Washington, D.C. August 10, 1978

COMPARATIVE AVERAGE ANNUAL ELECTRICAL
CONSUMPTION FOR C.Y. 1976 - RESIDENTIAL USAGE



SOURCE: FEDERAL POWER COMMISSION

Comptroller General of the U.S.
<u>Region at the Crossroads -- The Pacific Northwest Searches for New Sources of Electric Energy</u>
EMO-78-76
US General Accounting Office
Washington, D.C. August 10, 1978

several energy-intensive industries, primarily those producing aluminum, chemical, nickel, etc., that it will not be able to renew their current power contracts which begin to expire in the mid-1980s.

This bad news from BPA, although inevitable, has caused some concern among utilities in the Pacific Northwest. Many of them have their own hydroelectric and thermal electric resources, so the power producing business is not at all new to them. Nevertheless, the utilities and their customers have long been accustomed to receiving a substantial amount of low-cost Federal power. That era appears to be over. As the Federal power becomes increasingly dear, there is talk in Congress encouraged by private utilities and industry, about redistributing the balance once more among the competing potential customers. This is particularly threatening to the public utilities who have long had the priority access to BPA power.

3.2 The Situation of the Power Purchaser

Presented with the need to begin developing more of their own electric resources, with most of the best hydroelectric sites already developed and the rest politically or environmentally untouchable, the region's utilities have begun to look toward conservation and thermal power plants-- principally nuclear and coal fueled-- to provide future sources of electricity.

Portland General Electric (PGE) was incorporated in Oregon in 1930. The utility and its predecessors have been serving a large area in northwest Oregon since 1889 when the world's first "long distance" transmission of alternating current was accomplished-- a distance of fourteen miles from the "Dynamo House" at Willamette Falls in Oregon City to Portland.[1]

The utility is engaged in the generation, purchase, transmission, distribution, and sale of electricity in Oregon and it has a State-approved service allocation of 4250 square miles. Currently the utility is serving 3350 square miles which includes 54 incorporated municipalities-- the largest being Portland and Salem. The estimated population of the service area was one million at the end of 1978. The utility was serving about forty percent of the state's electric customers at the end of 1978.[2]

PGE had energy sales for the twelve months ending December 31, 1978, of 13,305,142 megawatt-hours. The breakdown for the source of operating revenue was:

Residential Service	48%
Commercial/Small Industrial	25%
Large Industrial	17%
Other	10%

The average use per residential customer during 1978 was 13,459 kilowatt-hours-- about 1.6 times the 1977 national average for investor-owned utilities. The average revenue per kilowatt-hour sold to residential customers was 2.68¢; the national average for 1977 was 4.06¢. Population growth has resulted in increased kilowatt-hour sales to residential customers each year during each of the past five years.[3]

The maximum hourly demand of 2.954 mw was experienced by the utility during the cold weather early in January, 1979-- the coldest January since 1949. On January 8 when this record system peak load occurred between 6 and 7 p.m., the utility also experienced a record total daily load of 60,723,000 kilowatt-hours.[4]

A declining percentage of PGE's electrical energy-- as evidenced by the following tabulation-- comes from hydroelectric facilities. Thermal generation and exhange agreements provide the balance.[5]

1974	96%
1975	94%
1976	87%
1977	53%*
1978	70%**

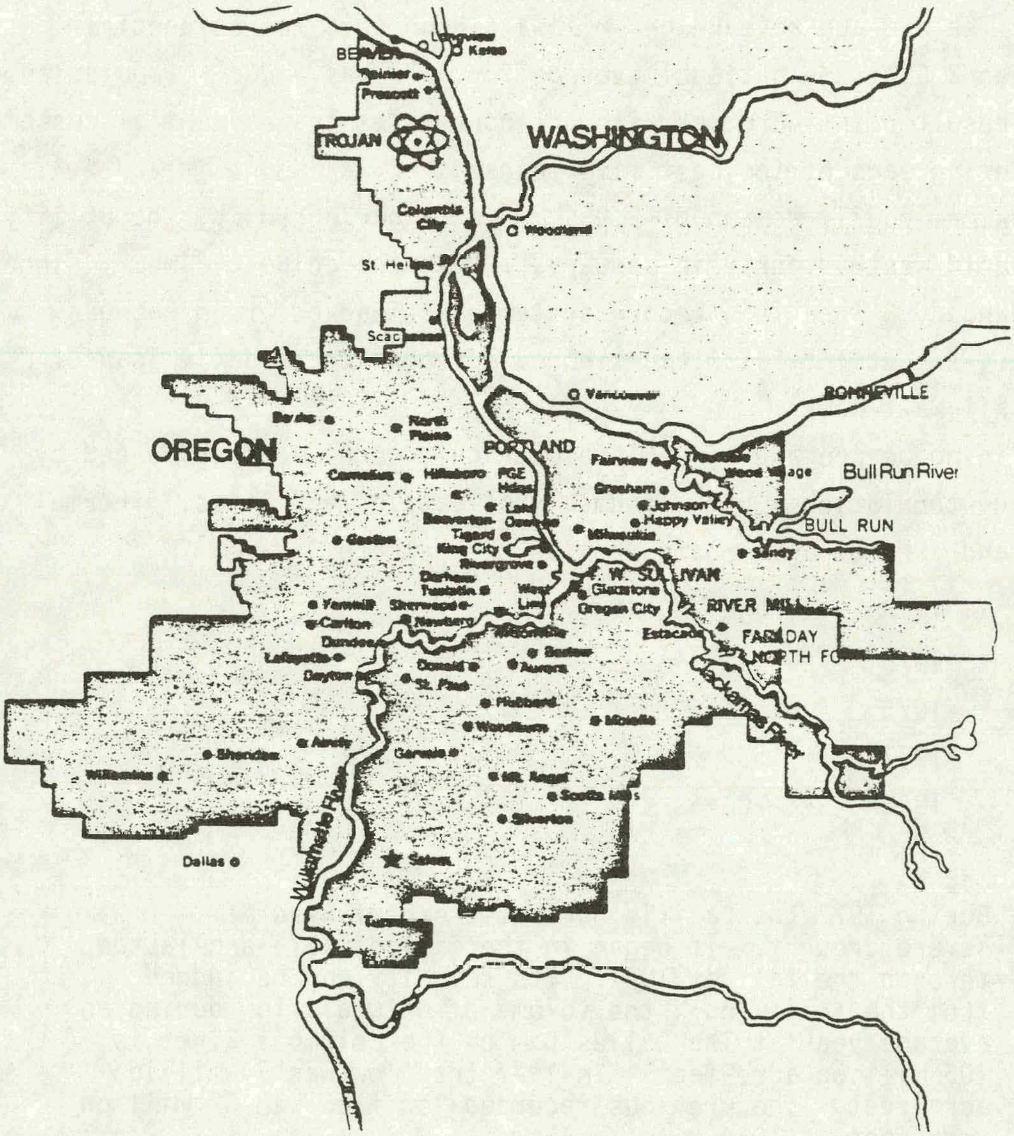
Notes:

* During 1977 the Pacific Northwest experienced a severe drought. It began in the fall of 1976 and lasted through the fall of 1977. Its severity can be judged from the following: the volume of natural flow during an average year at The Dalles Dam on the Columbia River is 106 million acre-feet. In 1977 the flow was 54 million acre-feet. The previous recorded low flow was 62 million acre-feet in 1944.[6]

** The Trojan Nuclear Plant was shut down from March 17, 1978 to January 2, 1979. It was originally shut down for scheduled annual refueling and maintenance-- anticipated to take eight weeks. During this period PGE was notified by the plant designer that the plant control building did not meet original design specifications for resistance to earthquakes. After hearings, the Nuclear Regulatory Commission issued a license amendment that permitted full power operation while the plant was modified.[7]

PORTLAND GENERAL ELECTRIC

SERVICE AREA



With the Trojan plant operating, PGE obtains its annual energy requirements from the sources discussed below. In addition to these sources, all future additions to PGE's owned capacity are coal and nuclear powered.

Hydroelectric	1/2
Nuclear	1/3
Purchase & PGE Fossil Fuel (Including secondary hydroelectric and/or thermal)	1/6

Trojan Nuclear Plant-- With 1130 mw of capacity, Trojan represents a large source of PGE's owned resources. Located 42 miles northwest of Portland, it is jointly owned by PGE (67.5%), Eugene Water & Electric Board (30%), and Pacific Power and Light (2.5%). The plant has a forty-year license from the NRC to operate at full power; all other presently required permits and certificates have been granted by other State and federal agencies.[8] During 1977 the plant was on-line 75% of the time, generating electricity at 69% capacity for net total generation of 6.5 billion kilowatt hours.[9]

Company Hydroelectric-- PGE owns eight hydroelectric plants with a net peaking capacity of 661 megawatts. All of the plants are licensed by FERC. Licenses for two of the plants have expired and they are being operated under annual licenses with the same terms and conditions as the original licenses; licenses for other plants expire between 2001 and 2006.[10]

Combustion Turbines-- PGE has six jet engine type combustion turbine-generator units having a capability of 385 megawatts; four of the units are located in the Portland area and two are near Salem. The utility also has an industrial-type combustion turbine-generator unit at Beaver on the Columbia River about 60 miles northwest of Portland. In 1977 PGE completed installation of a 150 megawatt steam-cycle addition to give the combined-cycle plant a total capability of 600 megawatts.[11] All of the turbines and generators are leased with the utility owning the balance of the installation; all operate on petroleum distillates but the jet engine-types can operate on natural gas if it is available. The turbines are used primarily to meet peaking or emergency requirements, but because of environmental regulations their operation is limited or prevented.[12]

Public Utility District (PUD) Hydroelectric-- PGE has long-term contracts with PUD's in Washington state which own hydroelectric plants on the Columbia

River. The utility receives portions of the plants' output in return for payments (including the debt service) of the same proportion of the annual cost:[13]

Dam	Capacity, MW (Nameplate)	PGE Share of Output Percentage	MW
Rocky Reach	1183	12.0%	142
Priest Rapids	788	19.7%*	156
Wanapum	831	24.5%*	204
Wells	774	31.5%**	244
		TOTAL	746

*May be reduced by August 1983

**May be reduced by 1988

The utility's obligation to pay continues whether or not the projects are operable. PGE has agreements with BPA for the transmission of power to PGE's system for the duration of the power purchase agreements with the PUD's.[14]

Bonneville Power Administration (BPA)-- BPA markets the power generated at federal facilities in the Pacific Northwest and provides most (about eighty percent) of the region's transmission capacity. Through agreements with BPA and other utilities, PGE receives about 20 MW of firm power; in 1980-- and until 1990-- the amount available to the utility under the terms of these agreements will increase to eighty megawatts of firm power. BPA and PGE are also parties to an agreement by which PGE receives ten percent of the output from the 800 MW Hanford (Washington) Nuclear Plant.

PGE has agreements with BPA to receive peaking capacity. These contracts which expire in 1993 provide for amounts increasing to 550 megawatts in 1980. In the past PGE has also been able to borrow or purchase surplus BPA hydroelectric power, and expects to be able to continue to do so to the extent possible. But existing laws promising priority sales to public utilities make it very unlikely that BPA and PGE will be able to enter into long term agreements for this power.[15]

Canadian Treaty Benefits-- PGE benefits both directly and indirectly from provisions in the Columbia River treaty concluded between the United

States and Canada in 1964. Release of water at Canadian storage dams provide power at Columbia River PUD dams from which PGE receives a proportion of the output.

The utility also receives a portion of the "Canadian entitlement" under a series of purchase and exhange agreements. This power will decrease over the next quarter century from an expected 246 MW of peak (100 MW average) in 1979-80 to 29 MW peak power (16 MW average) in 2002-2003.[16]

Coordination and Pooling-- PGE is a member of regional coordinating councils and power pools formed to promote reliable operation of interconnected systems for the delivery of shared energy and reserves. The utility also participates in the Pacific Northwest-Pacific Southwest extra high voltage intertie.[17]

3.3 Reallocation of Federal Power

Two different strategies which could change PGE's share of regional federal power have been developed. One-- the "Pacific Northwest Power Bill"-- is regional in scope; the other-- DRPA-- is an approach enacted by the Oregon legislature.

"Pacific Northwest Power Bill" is legislation which has been under consideration in the Congress. It is an attempt to reduce the disparity between the electric rates of investor-owned and publicly-owned utilities. Under the legislation BPA would make available to PGE and other regional investor-owned utilities at amount at BPA rates equal to the residential and small farm loads of the utility. In return, the utilities would make available to BPA an equal amount of energy at the utilities' average cost.

The legislation would also allow BPA to acquire the entire output of thermal generating plants; this feature would assure utilities that the construction and operating costs for new thermal plants (whether they become operable or not). Utilities generally believe that the BPA "backing" provided by the act would improve their own credit ratings and the marketability of securities issued to finance plant construction.[18,19,20,21,22]

DRPA stands for the Oregon Domestic and Rural Power Authority created by a 1977 Oregon law designed to obtain more low-cost federal hydroelectric power for the State. The Power Authority is intended to qualify as a BPA preference customer which would, in turn, resell power to residential and rural customers in the State.

Investor-owned utilities can be ordered by the Authority to supply power at "fair and reasonable rates" to the Authority which would then "own" the power. Its delivery to the customers, and the ownership and maintenance of the distribution system, would be the responsibility of the utilities operating under contract with the Authority. Customers not supplied with power purchased by the Authority would be supplied from the resources of the utilities.

Two conditions were required before the Power Authority can exercise its functions and powers. The first-- the failure of the 95th Congress to pass a regional power bill-- has been satisfied. The second-- a determination by the Oregon Public Utility Commission that the functions and powers would result in substantial benefits to Oregon residents-- has not as yet. The act expires July 1, 1981.[23]

3.4 The Power Purchase Agreement[24]

The city of Portland does not operate a municipal electric distribution system. It is served by Portland General Electric Company and Pacific Power and Light Company-- both investor-owned utilities. The city and Portland General Electric have entered into an agreement for the sale and purchase of energy and power from the Portland Hydroelectric Project (commonly referred to as Bull Run).

The energy produced by the City of Portland's Hydroelectric Project at Bull Run will represent less than one percent of the PGE energy sales. PGE's annual energy requirements are provided (with current nuclear facilities operating) one-half from hydroelectric facilities, one-third from nuclear, and one-sixth from purchase and fossil fuel generating plants.

The average cost of power from the Bull Run Project has been estimated by the city's consulting engineers at approximately 39 mills per KWH over the first five years of operation (1983-1987).

On April 12, 1979, Portland General Electric contracted with the City of Portland for the sale and purchase of electric power generated by the hydroelectric power generating facilities to be located on the Bull Run River in Multnomah and Clackamass Counties, Oregon. The agreement will run until August 30, 2017, or until the bonds are paid, whichever is later.

All power and energy generated, if any, will be delivered to PGE by the city. PGE will pay Annual Power Costs including debt service on the revenue bonds regardless of the amount of power or energy delivered, if any.

PAGES 29 to 35

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to the applicant for response. The project manager combines reports from FERC offices to create the Power Memorandum which is the Commission's decision-making document. The Power Memorandum is circulated among FERC offices for comment, then is sent to the Office of General Counsel for preparation of a Commission Order denying or granting the license. The Order, the Power Memorandum, and the EIS, if required, are forwarded to the Commissioners for a decision. The decision of the Commission may be appealed to the U.S. Circuit Court of Appeals.

4.6 "Minor" Project

FERC has developed a "short form" application to expedite "minor" hydro-electric project applications. The abbreviated application form requires a developer to submit basic information on the size, location, use and ownership of the project, as well as evidence of compliance with State water laws and other State laws, a brief description of environmental impacts and comments from other Federal agencies consulted prior to reviewing. No environmental impact statement is required for minor projects. Upon filing with the FERC a notice of application is published in the Federal Register and in news-papers which circulate in the area of development. The decision-making time for minor projects usually takes FERC about two years but this time span is expected to be reduced in the future. The license, if granted, cannot exceed fifty years. Parties or organizations wishing to object or intervene in the granting of the license are given the opportunity as part of the process. The decision of the Commission can be appealed to the U.S. Circuit Court of Appeals.

In licensing minor projects the Commission may, at its own discretion, waive many of the conditions usually associated with hydroelectric licenses, such as payment of annual dam charges. FERC usually charges licensees five cents per kilowatt of installed capacity, up to a capacity of two thousand kilowatts, as an annual license fee. Dams of greater than two thousand kilowatts, are changed on the basis of their capacity.

4.7 Federal Agencies

FERC is not the only Federal agency which has jurisdiction over the development of hydroelectric power plants. -- Other Federal agencies also participated in [illegible] decision-making process. Depending on the type, size, and predicted impacts, the U.S. Army Corps of Engineers, the Environmental Protection Agency (EPA), and divisions of the Department of Interior and Department of Commerce, can be asked to comment on proposed hydroelectric projects in their specific areas of expertise.

The U.S. Army Corps of Engineers revises all FERC license applications because of its authority to license dams in "navigable waterways" and to remove unlicensed obstacles to navigation, such as dams. The Federal Power Act also stipulates that hydroelectric facilities affecting navigable waters may not be licensed by FERC without first obtaining approval from the Corps.

The Corps also issues permits for the discharge of dredge and fill material under Section 404 of the Clean Water Act. The Corps' authority is expanded in the Clean Water Act to include not only navigable waterways but also any waters of the United States.

The protections and enhancement of the quality of U.S. waters is the primary responsibility of the Environmental Protection Agency under the Clean Water Act. However, EPA has no authority over the construction on operation of dams. Section 401 of the Clean Water Act requires any developer who applies for a Federal license for an activity which might result in a discharge into navigable waters to provide the licensing agency with certification from the State that the activity will comply with the limitations and standards it has established. Only in States not exercising certification authority pursuant to the Act will the EPA have a role in dam licensing. The "water quality certification" must be obtained prior to the filing of a license application with FERC.

EPA may become a major actor in the small hydropower licensing process under Section 402 of the Clean Water Act which established the National Pollution Discharge Elimination System (NPDES). This requires a permit for the discharge of any type of pollutant into navigable waterways. Although EPA previously was of the opinion that dams are not subject to NPDES regulation, recent court action has raised the possibility that small hydro developments at existing sites will become subject to NPDES regulation since it has been alleged that dams add trace metals and oxygen-deficient water to downstream waters. Although devleopers have denied that dams add pollutants to water, contending that any trace minerals are absorbed from the bottom land of reservoirs, should small scale hydroelectric projects become subject to EPA's

NPDES regulations, a significant new obstacle to their development will be raised.

The protection and preservation of fish, wildlife and endangered species in and around waterways is a major concern that needs to be addressed in the consideration of small hydroelectric development. The lead agencies with authority in this area are FERC, the Department of Interior's office, the Fish and Wildlife Serve and the Department of Commerce's National Marine Fisheries Service. The Departments are required by the Fish and Wildlife Coordination Act to manage the fish resources in given areas. Comments from these two agencies are evaluated by FERC and are incorporated into the final licensing requirements.

The protection of endangered species is handled by the Departments of Interior and Commerce under the Endangered Species Act. Any species in danger of extinction can be added to the Endangered Species List and regulations may be issued to protect it. The regulations may include the designation of a range or critical habitat in which commercial activity may not take place without permission of the Secretary.

Before FERC can license a project which will impound more than forty acres of water, or which may have some effect on historic or archeological materials, the project must be considered by the Department of Interior for the preservation of historic places, archeological sites and natural areas. A regulatory lengthy process has been established by which FERC must evaluate the effect of a hydroelectric site and negotiate agreements on methods to avoid or mitigate any historic site.

The National Wilderness Preservation System permits the designation for the purpose of protecting Federal wilderness areas. Commercial activity is generally prohibited in these areas. However, if the President finds that a dam and its associated power output is in the public interest then they may be allowed to proceed with construction although specific conditions can be attached to any permit.

Under the Wild and Scenic Rivers Act, the designation of a river as wild, scenic, or recreational, by the Department of Interior would prohibit the issuance of FERC license for any project on the river.

The National Wildlife Refuge System, administered by the Department of Interior's Fish and Wildlife Service is set up to protect and conserve fish and wildlife. The Department may permit activities in wildlife refuges which does not conflict with the purpose for which it was originally established. Regulations provide for permits for the construction of transmission lines and generating units in or through wildlife refuges.

Other Department of Interior agencies have advisory roles in FERC permitting process, including:

- The Bureau of Indian Affairs and Indian Lands
- The National Park Service
- The Bureau of Land Management
- The National Forest Service
- The Bureau of Reclamation. -- the Bureau constructs land reclamation and irrigation facilities. By permit, its facilities may be used by private developers for hydro-electric generations.

At present, any or all of these agencies may be called upon to review and commment on a proposed hydroelectric project in an effort to minimize or mitigate any adverse impacts that could be overlooked by the DEIS. When the comments or advice have been received by FERC they may be incorporated in the final license. However, from the outline of possible reviewing agencies and the maze of potential obstacles which may complicate the licensing process, it is not difficult to understand small hydropower developers' complaints that Federal regulations are a costly and expensive part of their business.

5.0 OREGON STATE LICENSES AND PERMITS

It has been suggested that one of the major barriers to the increased development of small-scale hydroelectric power at existing sites is the complicated and time-consuming state licensing process. This section outlines the licenses and permits which must be obtained by all prospective small-scale hydroelectric facility developers in Oregon and discusses the specific case of Portland's dams at the Bull Run watershed. It should be noted that according to the Bureau of Water Works, the State licensing process has been relatively swift, inexpensive and uncomplicated compared to Federal requirements. Consequently the obstacle to small hydro created by State regulations may be less troublesome than previously believed.

One of the significant developments that can be useful to Oregon's potential hydroelectric developers has been the formation of a central clearinghouse for state permits. The State Clearinghouse for State Licensing procedures is located in the Department of Intergovernmental Relations. Its purpose is to facilitate the regulatory process for potential developers by listing and organizing the permits, licenses, and approvals that are required by the State before construction can commence.

This Department has proved itself extremely helpful because it can organize the work in front of developers, reducing regulatory delays and therefore reduce the expenses incurred by delays. The developers of the Portland Hydroelectric Project were assisted by the Clearinghouse for this purpose and benefited from the type of information that they obtained. James Doane, the hydroelectric porject manager, told the study team that Portland submitted its FERC license application to the Clearinghouse which in turn was able to obtain most of the necessary State permits without any further action on the City's part.

5.1 The Department of Water Resources

In the State of Oregon, the Department of Water Resources (DWR) is a central authority with the power to grant all of the permits and licenses having to do with hydrolectric development-- after consultation with appropriate State agencies-- as provided by Section 543 of the Oregon Revised Statutes (ORS). Under the codes, the Director of the Department of Water Resources has the authority to issue licenses to any citizen or organization to appropriate, initiate, perfect, acquire and hold the right to use water within the State of Oregon-- including waters over which the State of Oregon has concurrent jurisdiction-- and to construct, operate and maintain dams, reservoirs, power houses, conduits, transmission lines, and all other works and structures necessary or convenient for the use of such waters in the generation and utilization of electricity. At any time DWR may examine all accounts, books of account and documents, and data of whatever nature pertaining to the business of a hydroelectric license. The Director can require the licensee to submit reports and statements under oath to obtain information concerning assets, liabilities, capitalization, gross receipts, interest, and dividend requirements, interest due and paid, amortization and other reserves, net investment, cost of any project constructed, maintained or operated, in whole or in part, cost of maintenance, operation, renewals, replacement, cost of production, transmission, distribution and sale of electricity, etc.

5.2 Permit to Appropriate Water

Appropriation of water for power purposes is governed by ORS 543.110. After February 26, 1931, the right to appropriate or to use the waters of Oregon for the generation of electricity requires the approval of the Director of Water Resources.

ORS 543.210 outlines the requirements for a preliminary permit to appropriate water: A preliminary permit may be issued by DWR to any person possessing the qualifications of a licensee. The application for a preliminary permit shall set forth the name and address of the applicant, the approximate site of any proposed dam or diversion, the amount of water to be used in cubic feet per second, the theoretical horse power, and such data as the director may, by regulation, prescribe.

The purpose of the preliminary permit is to enable the applicant to make necessary examination and surveys, and prepare maps, plans, specifications, and cost estimates, of the proposed project, and to make other preparations necessary to carry forward the work if a license is issued.

In essence the acquisition of a preliminary permit will reserve the water rights for the party submitting the preliminary permit, protecting him until the final license to appropriate water is completed.

Preliminary permits are broken down into two categories depending on the size of the proposed project. A minor project is one which does not exceed 100 theoretical horsepower; all other preliminary permit applications are considered major projects. Each major preliminary permit application must include the following information:

> A copy of the articles of incorporation or other organization papers certified by the secretary of the applicant corporation;
>
> A description of the location of the project, giving the county or coutnies within which it is located and the stream or streams from which water is to be appropriated;
>
> The quantity of water to be appropriated, and if water is to be used from two or more streams, the quantity to be taken from each stream shall be stated;
>
> If a reservoir is to be used is connection with the project, the application shall state the quantity of water to be stored;
>
> The head to be utilized and the number of theoretical horsepower to be developed;
>
> The approximate location of the point or points of diversion and if more than one point of diversion is to be used, the quantity of water to be taken at each point;
>
> The approximate length of the proposed canal, pipeline or other conduit, the approximate location of the proposed power plant and the point where water will be returned to some natural stream;
>
> The approximate height of diversion of storage dams and the material from which they will be constructed; and
>
> The length of time for which a preliminary permit is desired, (the law limits the time for which such a permit may be issued to a period not exceeding two years) with an extension up to one year if needed.

Once a preliminary permit is granted by DWR, the developers of a proposed project must start proceedings to license the hydroelectric project. In some cases, if the needed information is already obtained or if the water rights do not need to be protected from outside developers, a preliminary permit may not be required at all. However, in all cases an application to license a major project (those projects with greater than 100 theoretical horsepower) must be made to DWR. The application will contain all of the exhibits below" (the requirements for a license to appropriate water in Oregon bears remarkable similarity to the type of federal license required by FERC for major hydroelectric projects.)

Exhibit A A copy of articles of incorporation of other organizational papers certified by the secretary of the applicant corporation.

Exhibit B A copy of all minutes, resolutions of the stockholders or other representatives of the applicant properly attested.

Exhibit C An accurate description of the location of all dams, reservoirs, canals, pipelines, forebays, penstocks and other project works.

Exhibit D Evidence that the applicant has complied with the preliminary requirements of the laws of the State of Oregon with respect to the right to engage in the business of developing, transmitting and distributing power.

Exhibit E Statement of the nature and extent of the proposed appropriation of water.

Exhibit F A statement giving full details as to the applicant's plans for acquiring title to or the right to occupy and use lands other than those owned by the applicant or by the United States essential for carrying out the project covered by the application.

Exhibit G A statement showing financial ability of the applicant to carry out the project applied for.

Exhibit H A statement of the proposed operation of the project works during times of low, normal, and flood flows of the stream.

Exhibit I An estimate of the dependable power capacity and average annual energy output to be generated by each project accompanied by the complete data upon which such estimate is based.

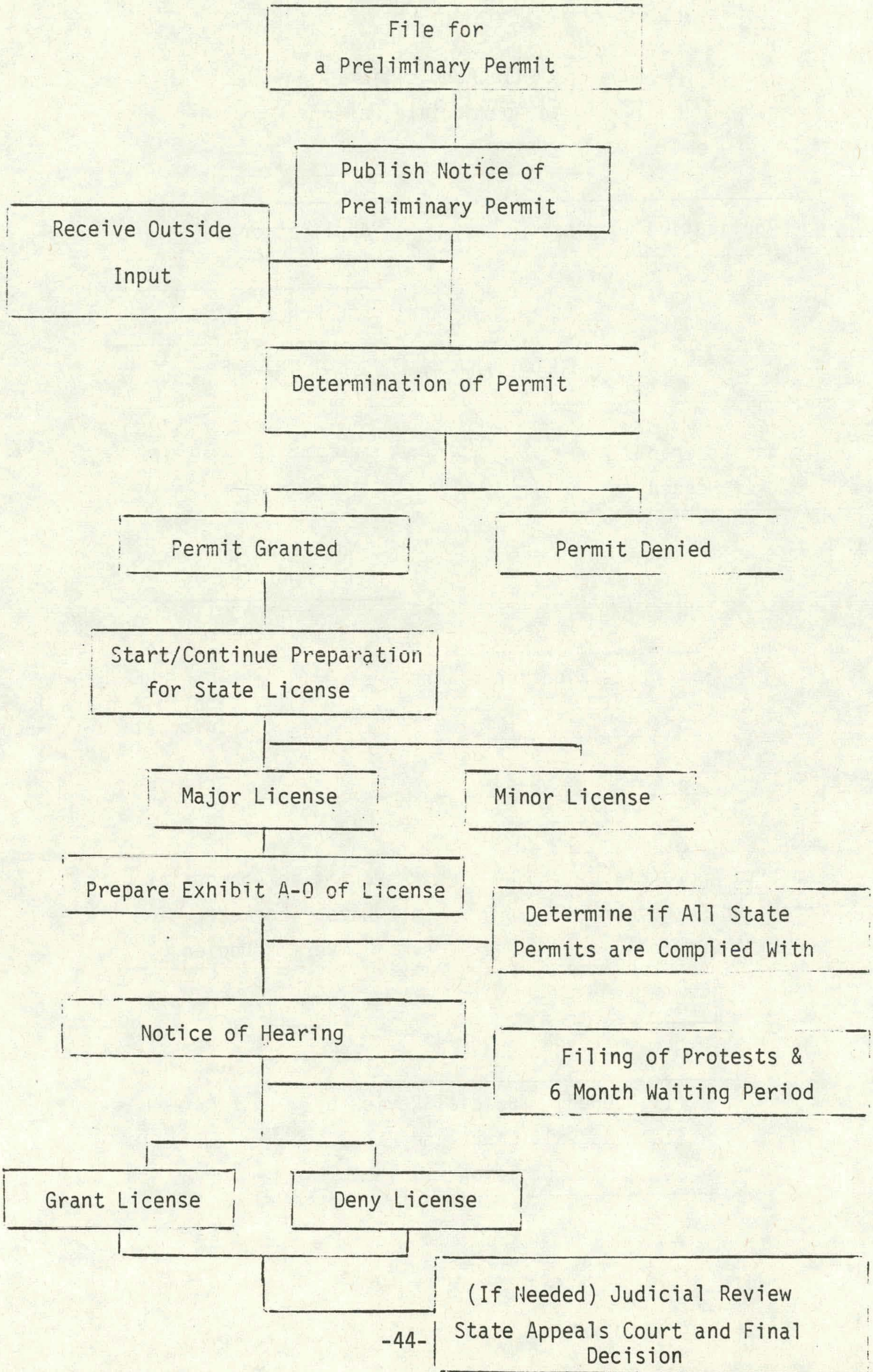
Exhibit J A general map covering the entire project showing principal structures, transmission lines, and any other pertinent features.

Exhibit K A detail map covering the entire project.

Exhibit L General design drawings showing plans, elevations, and sections, of all principal structures.

Exhibit M General description and general specifications of mechanical, electrical, and transmission equipment in sufficient detail to allow the director full understanding of the project.

DEPT. OF WATER RESOURCES PROCEDURES
FOR OBTAINING A PRELIMINARY PERMIT AND TO LICENCE A HYDROELECTRIC PROJECT



DEPT. OF WATER RESOURCES PROCEDURE FOR A PERMIT
TO APPROPRIATE WATER AND FOR A SECONDARY PERMIT
(RESERVOIR PERMIT)

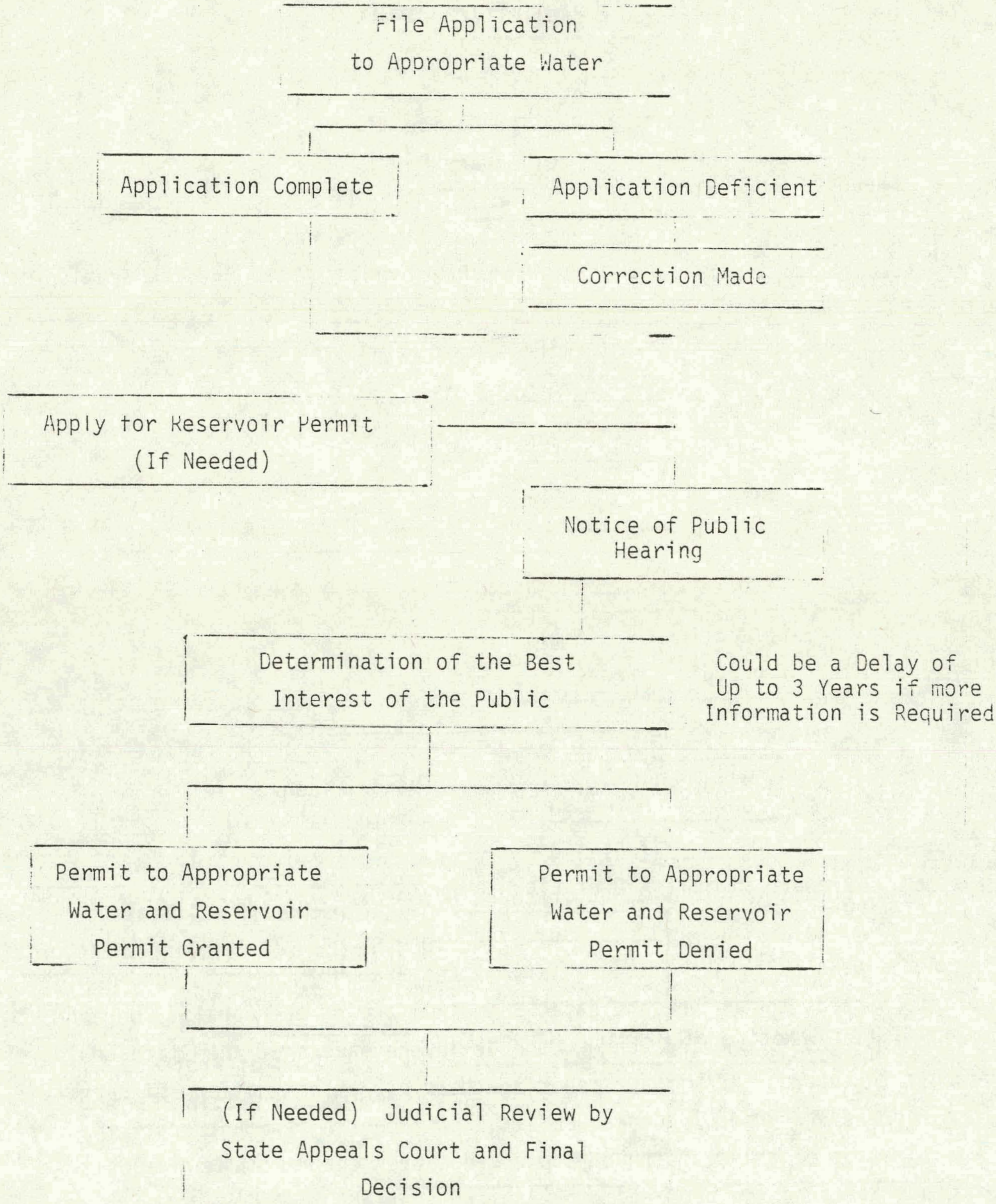


Exhibit N Estimate the cost of developing each project, segregated by principal features, showing quantities, unit costs, etc., in sufficient detail for understanding.

Exhibit O A detailed statement of the time desired for completing preliminary construction and for beginning and completing construction of the project works.

After receipt of an application for a license, DWR gives notice to all interested parties by publicizing the application as prescribed by ORS 543.220. If hearings are needed, the time and place of the hearings are fixed by DWR together with the interested parties.

No application for the appropriation or use of water for the development of 1000 theoretical horsepower or more of hydroelectricity may be granted until at least six (6) months after the application for the preliminary permit or license has been filed.

5.3 Reservoir Permit

A secondary permit, also known as a reservoir permit, is required of all facilities which propose to store water. The application must show by documentary evidence that an agreement has been entered into with the owners of the reservoir for a permanent and sufficient interest to impound enough water for the purposes set forth in the application. The final certificate of water appropriation refers to both the dam described in the primary license/permit and the reservoir described in the secondary permit.

5.4 Fill and Removal of Material Permit

Under ORS sections 541.605 through 541.990 the Director of the Division of State Lands has jurisdiction over the removal of material, from the beds and banks of the waters in the State of Oregon which might create hazards to the health, safety, and welfare of the people. Unregulated filling or removing land around or in the waters of the State could result in interfering with or injuring their public navigation, fishery, and recreational uses. Consequently, Oregon centralizes authority in the Director of the Division of State Lands over the removal or deposit of material from the beds and banks in the State.

In filing for such a permit, the Division of State Lands requires that information pertaining to the nature and amount of material to be removed or the amount of fill, the waters and the specific location from which it is to be removed or where the fill will be places, the method of removal or filling and the times during which removal or filling is to be conducted.

If DWR issues a permit, it may impose such conditions as it considers necessary to protect the State's waterways. In formulating such conditions DWR may consult with the State Geologist, the State Fish and Wildlife Director, the State Forester, the Director of the Department of Environmenal Quality, the Administrative Officer of the State Soil and Water Conservation Commission, the Director of Agriculture, the State Park Superintendent, the State Marine Director, the Water Policy Review Board, the State Highway Engineer or the Director of Economic Development Department.

5.5 Annual License for the Generation of Hydroelectric Power

For the development of hydroelectric power the State of Oregon requires that the developers of a hydroelectric proposed project pay to the Department of Water Resources a fee for power generation. This fee will be collected annually and shall be determined by the Water Resource Director and expressed in the license.

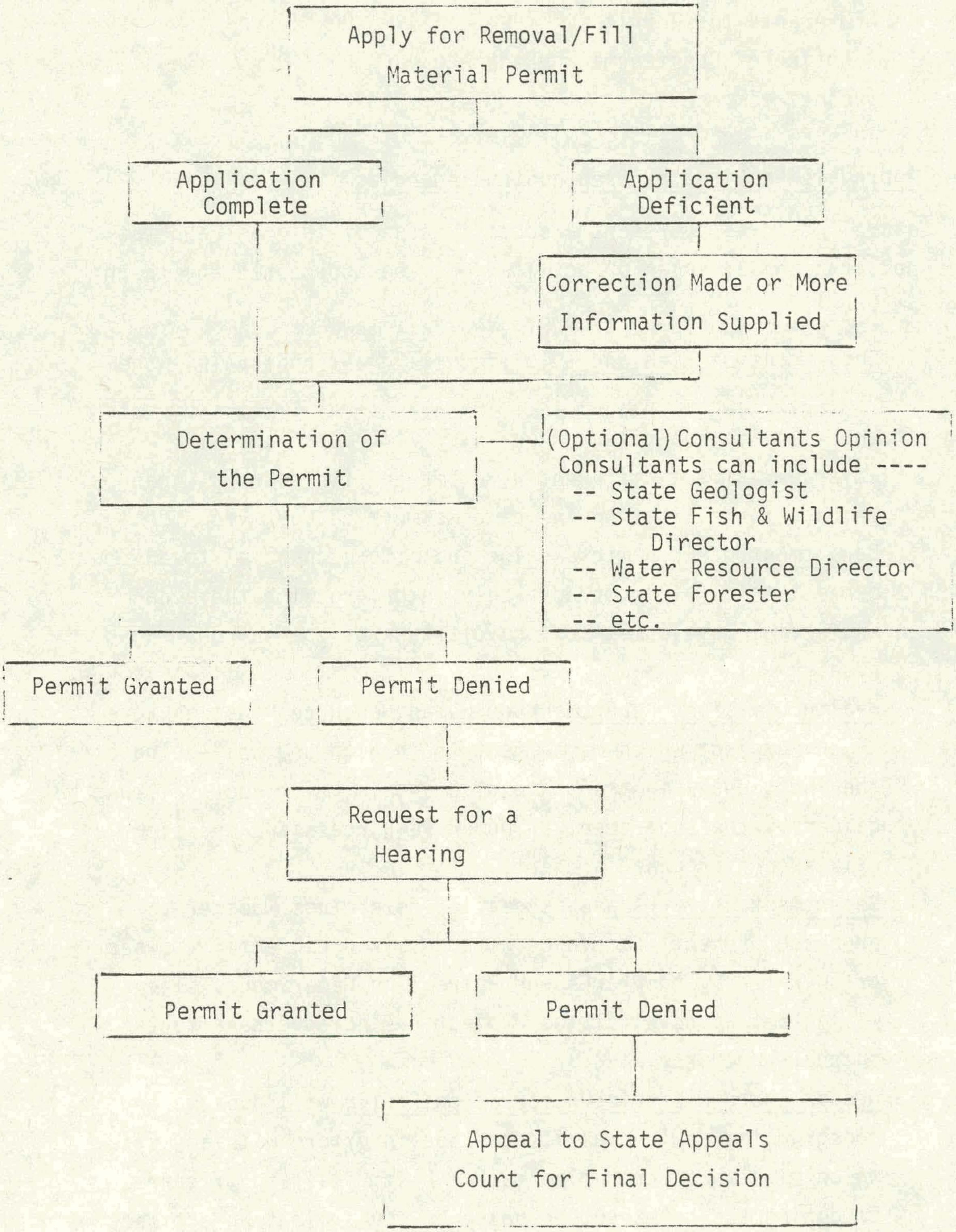
5.6 Permits Issued by the Department of Environmental Quality

From the Oregon Department of Environmental Quality (DEQ) three secondary permits which must be obtained by hydroelectric developers:

1) Water Pollution Control Facilities Permit to determine if the proposed action in any way will pollute the waters surrounding the project. This permit is essentially a water quality certificate and is granted if the quality of the water will not be significantly changed when the proposed project is actually constructed. This permit is Oregon's compliance with Section 401 of the Federal Water Pollution Control Act of 1972 (P.L. 95-217).

2) Air Contaminant Discharge Permit to determine whether air quality will be altered during construction and operation of

DIVISION OF STATE LANDS PROCEDURES FOR REMOVAL/FILL MATERIAL PERMIT



the proposed energy facility. If all the safeguards necessary to protect air quality in the area surrounding the project, then DEQ grants the permit.

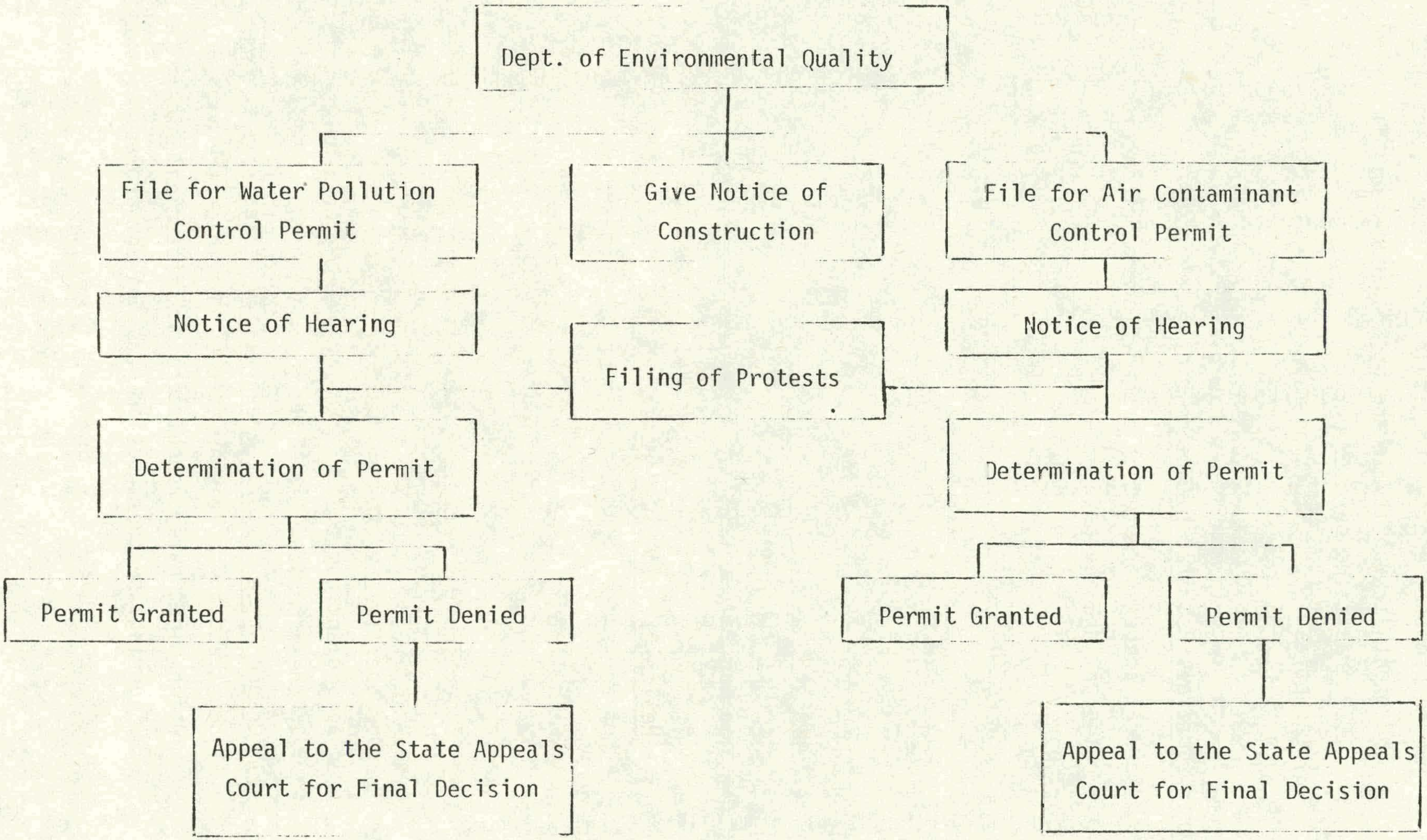
3) A Notice of Construction must be given to DEQ when the project commences.

5.7 Other Approvals Required by Oregon State Agencies

Several agencies represent a specific area of interest and they, while not granting licenses or permits, must be approached for their prior approval.

1) Department of Fish and Wildlife will grant approval if the project will not adversely interfere with the existing fish and wildlife inhabiting the area. If the project will adversely affect different wildlife or fish species, then methods for mitigating the damages must be approved.
2) Department of Economic Development offers approval to any project which will not adversely interfere with the economic and social development of the citizens of the surrounding area.
3) Health Division, Department of Human Resources must approve of any project which may affect the health and well-being of the individuals in the State of Oregon. Prior approval must be gained by the Department of Human Resources if a question exists on a proposed project.
4) Department of Parks and Recreation determines whether a proposed project interferes with any land or facility owned or operated by the Parks and Recreation Department. They will grant approval if the project has no adverse affects on their property.
5) Oregon State Historic Preservation Office will approve any construction so long as it does not interfere with any site which might have archeological of historical significance. If during the construction phase of any project an artifact

DEPARTMENT OF ENVIRONMENTAL QUALITY PROCEDURES
FOR WATER POLLUTION CONTROL FACILITIES PERMIT,
AIR CONTAMINANT CONTROL FACILITIES PERMIT, AND
NOTICE OF CONSTRUCTION



PERMITS, LICENSES, AND APPROVALS REQUIRED FOR HYDROELECTRIC DEVELOPMENT FOR THE STATE OF OREGON

- Dept. of Environmental Quality
  - Water Pollution Control Permit
  - Air Contaminant Control Permit
  - Notice of Construction
- Division of State Lands
  - Removal/Fill Material Permit
- Dept. of Water Resources
  - Water Appropriation Certificate
  - Secondary/Reservoir Permit
  - Preliminary Permit for Devel. of Hydro. Power
  - License for Development of Hydro. Power
  - Annual Fee Assessed for Hydro. Power

ADDITIONALLY, APPROVALS MUST BE SOUGHT FROM THESE STATE AGENCIES:

1. Dept. of Fish and Wildlife
2. Dept. of Economic Development
3. Health Division, Dept. of Human Resources
4. Dept. of Parks and Recreation
5. Historic Preservation Office
6. Energy Facility Siting Council

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6.0 ENVIRONMENT, GENERATING TECHNOLOGY AND ECONOMICS

6.1 Environmental Impact of Bull Run Hydroelectric Project

The City of Portland plans to install and operate hydroelectric turbine generators at its two water supply storage dams on the Bull Run River located 30 miles east of Portland in the Bull Run reserve, part of the Mt. Hood national forest. A 24 megawatt turbine generator will be installed at the upstream Dam No. 1. It will be operated to meet peak power demands. A 12 megawatt turbine generator will be installed at the downstream Dam No. 2. It will be operated to meet base load demands. Each dam was originally constructed with the intakes, tunnels, and penstocks for power generation. Because of foresighted planning, the conversion of these two existing damsites for power generation has substantially reduced the environmental impact that this project will have. In this section the major environmental impacts will be addressed.

The project will provide a new revenue source to Portland and savings to consumers because the energy generated will cost less to produce over the project's life cycle than alternate (coal or nuclear) power plants. The average cost of energy generated by this project will be 35-36 mills per kwh initially and about 40-50 mills by 1995.[1] There is a wide range in possible consumer savings as a result of the project, depending on the alternate energy source chosen as the basis of comparison. The Bonneville Power Administration estimates that the average power cost for a new private utility nuclear reactor in Oregon will be about 35.5 mills per kwh in 1982 and 66.5 mills in 1995 (at 75 percent load factor).[2] These estimates imply the consumers might save as much as $4 million by 1995.[3] It will also help meet projected future energy deficits for the utility and may decrease the need for other new sources of electricity in the region with higher environmental costs.[4] However, the project will have environmental impacts of its own. According to the City, these will be relatively small in scale and by nature non-polluting because of the design features, construction procedures, and operating constraints which will be described.

There are two major areas of environmental concern with any project of this size-- the environmental impacts associated with the construction phase of the project and the impacts associated with operations and maintenance of the project after completion must be accorded the same rigorous scrutiny.

Land requirements-- The boundaries of the project encompass the existing reservoirs (to the mean high waterline), dams, and spillways, as well as land required for the proposed powerhouses, transmission line, and a new access road to the bottom of Dam No. 1

PROJECT LANDS

CITY OF PORTLAND HYDROELECTRIC PROJECT

Use	Dimensions	Acres
Existing Dams and Reservoirs		944.8
Proposed Facilities		
Powerhouse No. 1	150 x 250 feet	Included above
Powerhouse No. 2	170 x 200 feet	Included above
Access Road (no. 1)	40 x 2100 feet	1.9
Transmission Line Right-of-way	100 feet x 9.5 miles	115.2
	Total Proposed Facilities	117.1
	TOTAL PROJECT LANDS	1061.9

Construction requirements-- There will be three construction staging areas. One will be on the north abutment of Dam No. 1 at the location of the original construction camp for the dam. It will be used for Powerhouse No. 1, the access road, and the transmission lines and will cover about 4 acres. The second staging area will be on the south abutment of Dam No. 2. This area is equivalent to about 2 acres and the Powerhouse No. 2 will be constructed there. A third staging area will be near Roslyn Lake and will be used for transmission line construction. This will require about 2 acres.

Transmission line requirements-- According to the Water Bureau, the transmission line right-of-way will be about 9.5 miles long and 100 feet wide. Except for short sections the route will follow existing roads. Most of the corridor follows one of Portland's municipal water supply conduits.

There is no dedicated water right-of-way because the city owns most of the land it crosses. Where the transmission line corridor crosses U.S. Forest Service land, the conduit exists under a use permit which reserves its right-of-way.

Land treatment of the transmission line right-of-way will require clearing and mechanically pruning roadside vegetation sufficiently to minimize environmental impacts and provide maximum safety requirements. Vegetation directly beneath the lines will be allowed to grow to a height of 20 feet. From that point out to 25 feet, branches and limbs will be trimmed at a slope of about 1:1. Beyond 25 feet and on the opposite side of the road, only danger trees (trees that could hit the line and that are unstable because of damage or disease) will be removed.[5] Branches on sound healthy trees will be allowed to extend above the level of transmission line where there is adequate vertical clearance.

Reservoir requirements--Reservoir No. 1 (also known as Lake Ben Morrow) is long and narrow with a maximum impoundment capacity of approximately 30,000 acre-feet at 1045 feet above sea level. The capacity below the spillway gates is nearly 27,000 acre-feet. At maximum impoundment elevation, the reservoir spans a length of 4 miles and covers a surface area of approximately 451 acres. The upper boundries of the reservoir are narrow and relatively shallow. At maximum capacity the water depth varies from approximately 20 feet in the upper end to 180 feet at the dam face.

Reservoir No. 2 is similar in geometry to Reservoir No. 1, although longer. It also has a similar capacity. At maximum capacity, storage is approximately 20,000 acre-feet at 860 feet above sea level. The reservoir covers an area of 418 acres at maximum impoundment elevation, and stretches 5 miles from the dam face to the head of Dam No. 1. The water depth varies from a few inches to almost 120 feet at the Dam No. 2 face.

Since the hydropower project must,above all,fulfill the requirements of not disturbing the quantity and quality of Portland's drinking water no activites are planned which will have a substantial environmental impact on the reservoirs themselves. The production of hydroelectric power generation will remain a secondary consideration to the drinking water criteria, and the reservoirs will then be operated as close to normal (pre-hydroelectric development) as possible. Even during the construction phase, according to the FERC license there will be no need for temporary interruption of flows of the city's water supply system. The Portland Water Bureau plans to make improvements in the water supply intake facilities prior to project construction, that will enable water to be channeled through another intake directly into the city's chlorination facility. This will allow the draining of the diversion pool and building dam around the construction site for Powerhouse No. 2.

Excavation and Disposal of Construction Waste Requirements --Excavating the tailrace below Powerhouse No. 1 will take about 1 month and require moving an estimated 40,000 cubic yards of material. The work began in the summer of 1979 after Reservoir No. 1 was drawn down at least 5 feet.

Minor amounts of excavation will be necessary for Powerhouse No. 2 and transmission line construction. About 4,000 cubic yards of soil and rock at Powerhouse No. 2 will be excavated and removed.

All clearing materials will be sold if a market exists for them. Non-merchantable wastes, timber, stumps, slash and combustible construction wastes will be hauled away to where they will be burned with Forest Service permission.

Oil and other liquid wastes will be stored in containers and removed from the project area for disposal. A cement truck washdown area will be established near each powerhouse site so as not to interfere with the drinking water in the area.

Operation and maintenance requirements-- The proposed mode of project operation is developed to meet local power needs within the constraints imposed by watershed hydrology, operation of the reservoirs for municipal water supply, water quality, the configuration of the reservoirs and the existing facilities, the operation characteristics of the powerhouses, and the need to preserve aquatic resources.[7]

Figure 1 shows the median monthly flows through the two Bull Run reservoirs. All of this water could be used to generate electricity at one or both powerhouses. However, Portland's existing and projected water supply needs, as shown on Figure 2, will require both reservoirs to be full at the beginning of each summer, withdrawing only enough water to meet municipal supply needs. Because these summer demands must be continuous and are insufficient to operate the generators, the amount of water that can be used to Powerhouse No. 2 will be limited.

FIGURE 1

MEDIAN STREAMFLOW

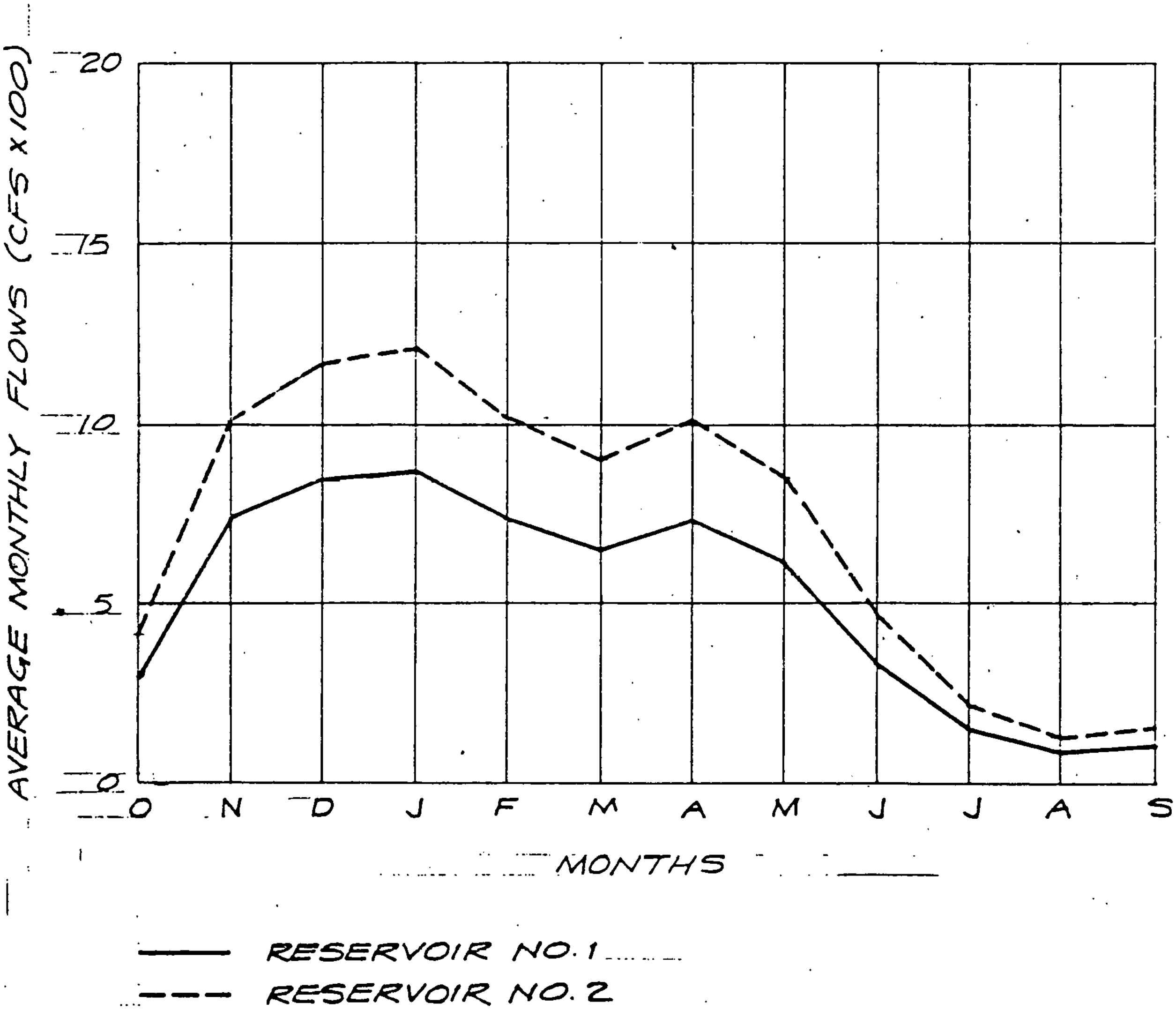
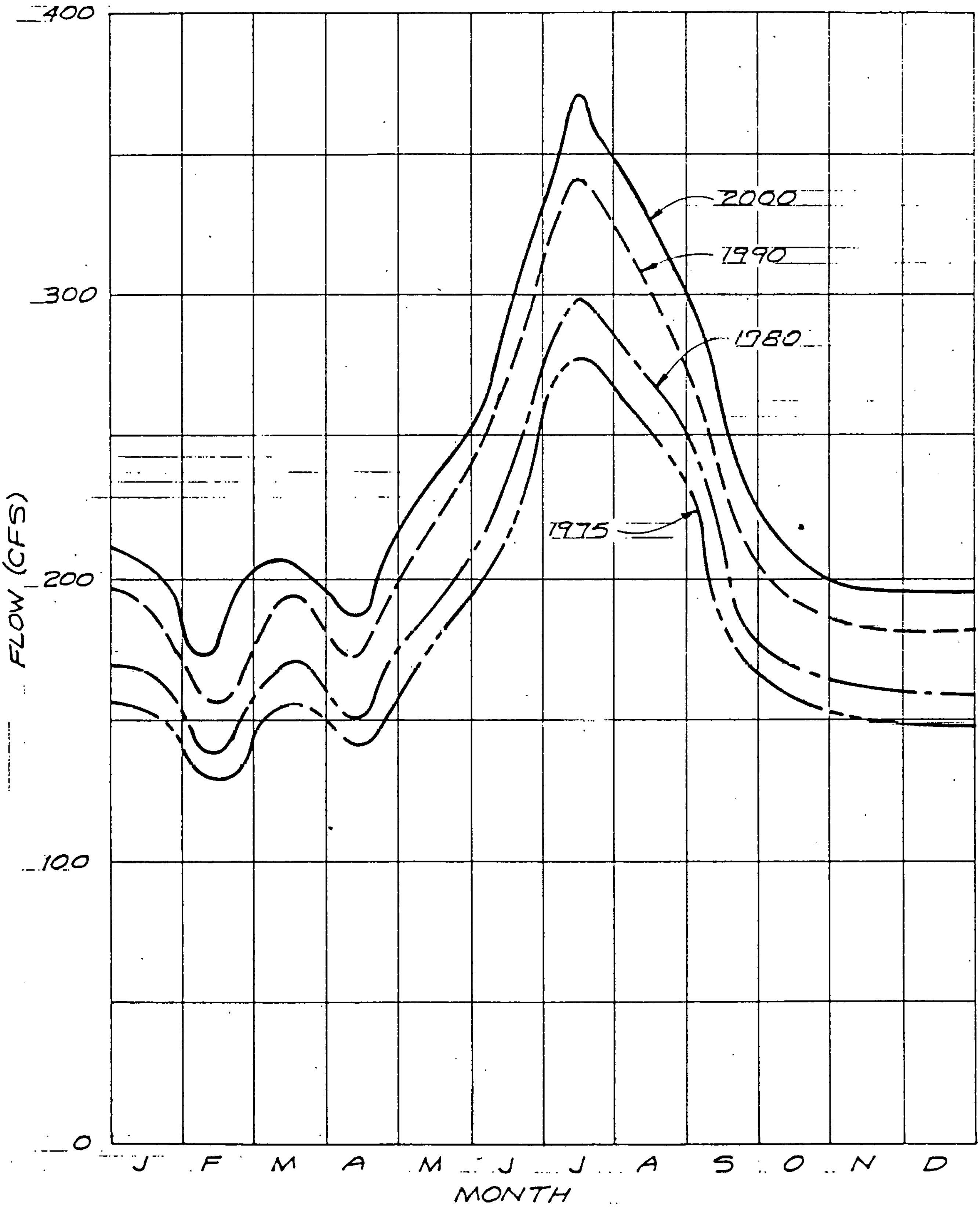


FIGURE 2

MUNICIPAL WATER SUPPLY USE



During the summer the reservoirs will be operated to meet municipal water supply needs. Following the summer drawdown period when the natural flows again exceed the municipal demand, the reservoirs can be operated for maximum power generation. Each fall the reservoirs will be refilled to within 10 to 20 feet of the top before much power generation takes place. This procedure will provide for maximum energy by keeping the head high, yet maintaining a minimum storage capacity to capture most of the peak storm runoff. In March, April, and May, depending on snow pack and moisture conditions, the minimum reservoir levels will be restricted to that which will allow the reservoir to refill before the summer municipal water supply drawdown season begins (usually occurring in the autumn months).

Currently, after Reservoir No. 2 is filled in the fall, the City maintains it at the elevation of the spillway until the spring, so that discharges to the Bull Run River equal reservoir inflow less municipal water supply diversions and diversions to PGE. The city currently sells water to PGE for use at its Bull Run hydroelectric project under a 5-year contract on an "as available" basis. Water is transferred to Roslyn Lake, as conduit capacity and flows permit via one of the municipal water supply conduits. When flows are adequate, Powerhouse No. 2 will operate continuously and discharges to the river will remain essentially unchanged except that rapid increases in flow from storm runoff will be tempered by operations. This will generally apply from late October or early November through January and from April to early June. Day-to-day fluctuations in streamflow caused by project operation will generally not occur during this period.

Project operation and water quality-- A computer simulation of the water temperature, dissolved oxygen, and biological oxygen demand of the Bull Run reservoirs and the outflows from Reservoir No. 2 were conducted by CH_2 M-Hill, the lead consulting engineering firm for the project.

The modeling exercise indicated that the project operation will slightly increase surface strata temperature in Reservoir No. 1 and slightly decrease outflow temperatures, but will otherwise have an insignificant effect. Warmer surface waters could cause increased algae blooms if nutrient levels are sufficient; however, nutrient levels are low, specifically phosphates, and because of this the reservoirs will probably not support an active biota.[8]

Dissolved oxygen is normally high in the entire system with concentrations rarely falling below 9 mg/l at any time or elevation.[9] Major contributors to the high dissolved oxygen level are the cool inflow waters and relatively complete mixing resulting from short flow-through time during most of the year. The dissolved oxygen content should not be disturbed by hydroelectric operations. Downstream water will remain high in dissolved oxygen.

The nutrient levels in the waters are very low by enthropic standards.[10] Some biological activity is measured in the two reservoirs, but existing biota are generally observed at concentrations of less than 70 micrograms (dry weight) per liter in the summer. The nitrogen cycle generally measures less than 80 micrograms per liter; the phosphorus level is less than 4 micrograms per liter. It is expected that these constituents will not change significantly with power operations.[11]

Hydroelectric facilities are by nature nonpolluting. No contaminants will be intentionally discharged during plant operations. Special precautions will be taken in the design, operation, and maintenance of the powerhouses to insure that no chemicals will escape into the reservoirs.

Fish and wildlife-- The two project reservoirs support populations of rainbow trout, cutthroat trout and mountain whitefish. Currently there are no anadromous fish at the dam sites. The Oregon Department of Fish and Wildlife (DFW) by letter and its petition to intervene, the National Marine Fisheries Service, and the Department of Interior noted that the city did not provide compensation for the loss of anadromous fish runs when it constructed Dam No. 1 in 1929. DFW requested that the city be required to provide fisheries impact mitigation in the form of hatchery facilities on the Clackamas River (at an estimated cost of $500.000).[12] The city stated in response to the request that it is not liable for fishery losses that occurred when the reservoirs were constructed because the Bull Run reserve was established for the sole purpose of providing water supply reservoirs. DFW and the city have since agreed to a separate proceeding of fish mitigation whereby the details of the proposed hatchery will be worked out to the satisfaction of both parties.

During field surveys to detect threatened or endangered wildlife species, white-tailed deer were sighted. Since the deer might have been the Columbian white-tailed deer, an endangered species, the U.S. FIsh and Wildlife Service was consulted and then determined that the project area was not a preferred habitat for this subspecies. The U.S. Fish and Wildlife Service also stated that the sighting was probably a misidentification, because herds of similar appearing white-tailed deer (not an endangered species) occur in nearby mountains. The U.S. Fish and Wildlife Service concluded that the proposed project would not pose a threat to the Columbian white-tailed deer.[13]

All other wildlife which occur naturally in the reserve do not include other endangered species or the proposed hydroelectric project would not interfere with any unsighted endangered species which could have gone unnoticed.

Vegetation-- The City of Portland conducted field studies of threatened and endangered vegetation,and found none. The city, however, admitted that the studies were conducted relatively early in the spring and its scope was limited. According to the Federal Energy Regulatory Commission (FERC) in the order issuing the license for the proposed project required that a further study would be desirable prior to the beginning of construction to guard against any adverse impact on any endangered plant species.[14] Article 40 of the FERC license requires this survey, and the results to be forwarded to FERC for final approval.

Domestic water supply-- In a petition to intervene, the Northwest Environmental Defense Center (NEDC) expressed concern that the project would adversely affect the quality of the municipal water supply. The city has consulted with NEDC and, as a result of the consultation, has modified the project to include a multiple-level intake tower at Dam No. 1.[15]

NEDC also requested that the City limit the drawdown of the reservoirs to two feet below the spillway crest except when necessary to ensure sufficient quality and quantity of Portland's water supply. The final agreement between the city and NEDC was reached and the provisions were included in the FERC license. This agreement is found in Article 12 of the license and it limits project operation to ensure that the water surface elevations of the reservoirs will be maintained generally at historic levels.

Finally, the Forest Service recommended numerous revisions which concerned themselves with insuring that during construction, operation, and maintenance of the project power facilities the water quality would not be degraded and the authority and responsibility of the Bull Run watershed would be handled by the Secretary of Agriculture under Public Law 95-200. In preparing the FERC license most of these provisions were included in Articles 12 and 36 which are addressed to the two issues.

Fluctuating river levels-- The Department of Interior and U.S. Forest Service were also concerned with the fluctuating river levels due to power plant start-up that could pose a safety hazard to recreation on the Bull Run River below the project. Fluctuations in flows from 4 CFS to 1200 CFS below Dam No. 2 would occur during the months of February, March, May and October. Although 3.3 miles of the Bull Run River immediately below the project are part of the Bull Run Reserve and closed to public access, there are no public restrictions on the remaining three miles of the river which lie outside the reserve. The Forest Service proposed a two-foot-per-hour limit on river level fluctuations. The City has agreed to the Forest Service request. Along with this requirement the city has also agreed to post signs along the river that warn of the possible rapid change in river levels to protect the public safety.

Air Quality-- The impact of the proposed project on air quality from operation and maintenance is negligible, the only fuel burning sources will be maintenance vehicles traveling to and from the sites. All other equipment will be electrical or hydraulic. State air quality standards will not be violated.

Noise abatement-- The proposed project will replace the present noise caused by the spillway, and needle valves with the lower hum of the generators and the transformers and the flowing water sounds from the tailraces. The tailrace noise will be similar to, but much lower than, that produced by the existing spillway; turbine and generator noises will be inside buildings. The overall noise levels should be lower than the noise which is produced now at the site.

6.2 Ecology of the Bull Run Watershed

The Bull Run watershed is considered to be an abundant site for all types of flora and fauna found in rain forests of the Pacific Northwest. Because of the closure to public entry, aquatic and terrestrial organisms usually considered recreationally or commercially important or valuable have only ecological importance in the Bull Run watershed. The plants and animals resources in the reserve are considered important in human terms because they comprise an unexploited, steady-state system potentially valuable for study.

I. Aquatic Biota

A. Lower Bull Run River-because fish passage is completely blocked by the diversion dam, anadromous fish are restricted to the lower 6 miles of the Bull Run River. Stream surveys conducted by the U.S. Forest Service in the Bull Run River below Dam No. 2 indicate the presence of rainbow trout (probably steelhead), cottids, dace, carp, and lamprey. Frogs were also reported. A seasonal increase in ichthyofauna may occur in the lower Bull Run River during periods of high flow. A few steelhead trout and chinook salmon have been reported to negotiate the reach between Dam No. 2 and the Little Sandy confluence. It is questionable whether successful spawning takes place in this reach because of the lack of abundant suitable spawning gravels. It is generally thought that anadromous fish above the Little Sandy confluence are strays from the Sandy and the Little Sandy rivers.

B. Reservoirs - information on aquatic resources in the two main reservoirs has been difficult to obtain because of the tresspassing restrictions placed on the watershed. It is known that both reservoirs have low biological productivity. Gillnet sampling conducted in the two reservoirs from 1957 to 1973 yielded cutthroat trout averaging 10 to 11 inches in length and 7 to 9 ounces in weight. Both sexes were about equally represented. In addition, one female whitefish measuring over 15 inches and weighing over 28 ounces was taken in reservoir No. 2 indicating a small population of this species in the system. It is assumed that whitefish are also inhabiting reservoir No. 1. Rainbow trout were found in the tailrace of Dam No. 1. It is possible that this species prefers the more riverine environment of the tailrace area and is not generally distributed throughout the lake. It is also possible, but as yet unconfirmed, that rainbow trout are in Reservoir No. 1.

C. Watershed above the project area - Bull Run Lake is thought to have been barren of fish until whitefish and cutthroat trout were introduced. Although cutthroat trout persist in the lake, it is not known if whitefish are still present. Eastern brook trout were introduced into the north fork of the Bull Run River, possibly in the 1920's or 30's, and persist in that portion of the watershed. Dace, frogs and cottids, and crayfish are also known to inhabit the upper reaches of the lakes and streams in the watershed.

II. Wildlife

A. Birds - aviary sitings have been performed in the Bull Run Reserve and they have indicated the predominant species but they are inconclusive on the population density of these avion communities.

A recent study had indicated that bird populations and communities on the east slope of the Coast Range (about 100 miles southwest of the Bull Run Watershed) found that bird density in coniferous forest is nearly 3.5 times higher than in rangeland bird density and that the highest density occurs during the late spring due to the influx of migratory birds. Density during the breeding season (early summer) is slightly lower and continues to decline to a fairly stable winter density.[16]

From the studies that have been conducted there appear to be no birds classified as "endangered" in the Bull Run Watershed. Birds presently classified as "threatened" by the Oregon Department of Fish and Wildlife include the Northern Spotted Owl and the Northern Bald Eagle. The Northern Bald Eagle use old snag trees for building nests and Northern Spotted Owl use cavities in old trees for their nest sites.

Birds classified as "status undetermined" or "unique" have a wide array of habitat requirements. The Harlequin Duck, Sharp-shinned Hawk, Goshawk, the Great Grey Owl, Pileated Woodpecker and the Osprey have all been sighted and all assumed to be residents of the Bull Run Reserve.

B. Herpetiles - information on herpetiles in the Bull Run Watershed is extremely limited. There is apparently no information on herpetile density or community structure in the reserve.

The herpetiles expected to occur, or those which have been sighted include the Western Spotted Frog, the Tailed Frog, the Oregon Slender Salamander, the Larch Mountain Salamander, and Cope's Salamander. The first three of these herpetiles are considered "threatened" while the last two are "status undetermined."

C. Mammals[17] - several studies of mammals in the Bull Run Reserve provide information on the small as well as the large animals. A few mammals in the watershed were limited to specific forest community types. For example, Mountain Pocket Gophers were captured only in dry meadows, Pikas were captured in communities, Shrew Moles were captured only in moist sites at low elevations and the Red Tree Mole were cap tured only in wet meadows.

However, most mammals in the Bull Run Reserve can be classed as generalists they are not limited to specific habitat types. For example, Black-tailed Deer and the Deer Mouse were abundant in recently logged areas but were also present in the old growth forests. Most, if not all of these species are not endangered or threatened by the proposed hydroelectric works.

Mammals classified as "threatened," "status undetermined" or "unique," which were sighted include, the Wolverine, the Red Fox, the Fisher, the Mountain Lion, the Western Grey Squirrel, and the Mountain Beaver.

III. Vegetation

The proposed powerhouse and transmission lines are located within the general vegetative zone known as the Western Hemlock zone. Broad vegetative categories in this zone is listed below:

1. Closed canopy forest
2. Wetlands (marshes, seepts, meadows, bogs)
3. Naturally nonvegetative areas (talus slopes, bare rock, flood plains)
4. Disturbed areas (burns, clear-cut, cut lines, roads)

Numerous major plant species likely to occur within these broad categories according to one study. There could be as many as four hundred and eighty distinct vascular plants in the Bull Run Reserve.[18]

Of the 480 species, thirty-one "rare," "threatened" or "endangered" plants species might occur along the proposed transmission route or near the power house sites. Since the transmission line corridor will probably disturb more vegetation than the rest of the construction that is to take place four routes were conceived. The route that was selected offered the advantage of disturbing the least amount of the natural vegetation.

IV. Summary

The ecology on the Bull Run Watershed is extremely complex, varied, and diversified. Combined with the fact that only limited studies have been conducted in the area (mostly because of the restricted entry requirements of the reserve) it is difficult to ascertain the true impacts the hydro-electric development will have on the aquatic biota, birds, herpetiles, mammals and vegetation. Caution is being taken by the city that the project will have a minimal impact on the natural flora and fauna of the area.

6.3 How is Hydroelectricity Generated?

There are several different types of turbines used in hydroelectric generating systems. Each different type has a regime of operation, i.e., a range of head or drop, within which it can be designed with high efficiency. Each specific turbine design within a type has a range of flow and head (sometimes broad, sometimes narrow) for which its operation is most efficient. A properly selected turbine will be of that type which is expected to offer the lowest life-cycle cost per kwh. This generally means a turbine that has high efficiency over the range of head and flow expected at the selected site.

Among those familiar with hydroelectric power generation the word "turbine" is used to denote a rotating runner which receives energy from the flowing water together with an entire arrangement including the runner, shaft, inlet, outlet, and generator mounting location. The type of runner used is the most significant factor in the selection of a hydroelectric turbine. With the materials and construction techniques presently available, the propeller turbine has become the best machine for most low head applications for small-scale generation. The key characteristic of the propeller turbine is its use of an axial flow reaction runner. More simply, it resembles a ship's propeller inside a pipe.

A disadvantage of the propeller turbine is that whatever its size, it has a narrow operating range of flow rate and head within which it will be highly efficient. Since many sites experience head and flow variations, two or more small units must be emplaced so that a certain combination of units can be operated near optimum flow for available head, for any total flow within a broad range.

Another solution to the problem involves use of a single Kaplan turbine. A Kaplan turbine is a propeller turbine with variable pitch blades. When the pitch is varied correctly, the Kaplan turbine has high efficiency over a much broader operating range than a fixed pitch propeller turbine. Kaplan turbine installations are available with automatic governing devices which continuously adjust blade pitch and generator field current to extract maximum power from changing water supplies while maintaining constant AC synchronous speed.

There are several turbine types within the generic propeller turbine category. These include vertical shaft, rim, tube, and bulb type turbines. All utilize a fixed pitch or Kaplan propeller runner and they are all hydraulically similar. Their differences involve mounting attitude, how and where the generator is attached, and the configuration of water inlet and outlet passages. These differences affect installation cost, power house size and configuration, maintenance accessibility and to some extent the efficiency of the overall installation.

Two other generic turbine types are worthy of mention for low head applications. These are the Francis turbine and the Ossberger turbine. Both can be designed for moderately low to intermediate head applications. The Francis turbine is an old and widely-used design for hydroelectric generation. It is a centripetal turbine utilizing a radial or mixed radial-axial flow runner. In principle and configuration it is like the centrifugal pump operating in reverse. It has a slightly lower maximum efficiency than propeller turbines and has a range of efficient operation somewhere between that of Kaplan turbines and the fixed pitch propeller turbines.

The Ossberger turbine has a cross flow runner and functions as an impulse machine, i.e., all the pressure head is converted to velocity head via nozzles before the water strikes the runner. Maximum efficiency is not high but moderate efficiency is maintained over a very broad range of flow rates. The minimum head an Ossberger turbine can be designed for is about 20 feet. Ossberger turbines may be somewhat less costly than higher efficiency Kaplan turbines for certain applications.

6.4 Hydroelectric Generation at Bull Run

The two dams on the Bull Run are different in construction and use. Moreover, their flow rates must be managed differently to satisfy water quality, downstream flow limitations and water conservation criteria. This has required differences in the equipment specified for each dam site.

At Dam No. 2 the unit must operate with tight limitations on discharge flow and rate of flow change rate. Extreme flow fluctuations cannot be tolerated in the downstream riverbed. The unit at Dam No. 1, by comparison, can be operated as a daily peaking unit with less restrictive limitations on short term flow rates. Other differences are that Dam No. 1 has a significantly higher available head and somewhat smaller streamflow than Dam No. 2. A rather complicated analysis has been done to develop rule curves* for the coordinated operation of the two reservoirs.

Operating according to the rule curve, the available head from Reservoir No. 1 will vary between 114 and 179 feet. A 24 megawatt Francis turbine rated for 160 feet of head was specified by Ch_2M-Hill. A Francis turbine is to be used at Dam No. 1 because it is the only turbine type which can be economically designed for high efficiency over the entire range from 114 feet to 179 feet. The specified turbine is to be a 34,000 horsepower machine. The capacity selected is consistent with criteria for Reservoir No. 1 which limit draw-down to 5 feet maximum in any 24-hour period.

The power house for Dam No. 1 will be located at the base of the dam on the north side of the stream channel near the point where penstocks emerge from the dam. The first photograph shows construction of the power house. One of the penstocks is visible at the extreme left of the picture. The three outlets visible at the base of the dam on the opposite side are needle valves which are currently used to spill through water for the Portland Water Bureau as it is required.

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*Reservoir "rule curves" are guides to the management of reservoir level throughout the annual cycle. Rule curves are developed to optimize coordinated operation of dams on a stream for energy production and peaking availability while meeting various other requirements such as flood control, water quality preservation, maintenance of safe reserve for low water years, fisheries enhancement, irrigation user rights, etc.

The third photo shows the intake towers at Dam No. 2 as seen from the top of the dam. The power house will be located on the north side of the stilling basin which is shown in the fourth photo. The stilling basin will be tailwater to the turbine. The 15-foot diameter north tower tunnel will be the turbine penstock. The tunnel was sized for this application when Dam No. 2 was built. The capped off end of the tunnel penstock is visible in the fourth and fifth photos.

A 12 megawatt Kaplan turbine has been specified for Dam No. 2. When the turbine is off, water can still enter the stilling basin from the north tower tunnel, as it does today, through the two 42" Howell Bunger valves shown with water outflowing in the fourth photo. During turbine operation water entering the basin from the tailrace will exceed the municipal water headworks intake requirements. The excess will be spilled over the diversion dam. Powerhouse No. 2 will not be operating during summer because streamflow is too low to permit draining water from Reservoir No. 2 in excess of municipal water requirements. Municipal requirements are expected to average less than 300 cubic feet per second during the summer throughout the 1980s. This is so much less than the turbine's design flow (1500 cubic feet per second) that the unit cannot be operated with a significant power output.

A supplier for turbine and generator has been selected. Turbines and generators for both dam sites are being supplied by Fuji Electric Co. of Kawasaki, Japan. Fuji was able to bid very competitively because they were already building very similar units for other customers.

6.5 Costs of Design and Construction: Costs per Kilowatt

The costs of design and construction are estimated based upon the project's schedule. Deviation from that schedule will affect costs primarily as a result of inflation. The estimated project costs are broken down on the next page. This is the cost estimate developed by CH_2M-Hill in its feasibility report and presented unchanged in the FERC application. The costs of permitting are wholly included within the "Total Indirect Costs" entry.

The bottom line figure is $28,160,000 in 1982 dollars for 36 megawatts of capacity from the two dams. This yields a figure of $782.22 per installed kilowatt, an impressive figure compared to the capital costs of the baseload thermal plants under construction today. The seasonal character of the availability of power from the site is quite unlike that of a thermal plant, however, so simple capital cost comparisons are less significant.

ESTIMATED CAPITAL COSTS

FOR BULL RUN SITES

	Powerhouse No. 1 (24-MW)	Powerhouse No. 2 (12-MW)
Hydraulic Production		
Land and Land Rights	$ -0-	$ -0-
Structures and Improvements	1,327,400	1,091,100
Reservoirs, Dams, and Waterways	449,800	229,900
Waterwheels, Turbines, and Generators	3,797,000	4,090,000
Accessory Electrical Equipment	365,000	300,000
Miscellaneous Power Plant Equipment	482,000	448,000
Roads, Railroads, and Bridges	635,800	120,000
Transmission Plant		
Land and Land Rights	-0-	-0-
Structures and Improvements	17,000	17,000
Station Equipment	268,000	172,000
Poles and Fixtures	342,000	76,000
Overhead Conductors and Devices	157,000	43,000
General Plant		
Communication Equipment	65,000	26,000
Construction Cost	$7,906,000	$6,613,000

Construction Cost (1977 Dollars) (Powerhouse Nos. 1 and 2, plus Transmission Line)	$14,519,000
Total Indirect Costs (i.e.; Inflation, Engineering, CMS, Administrative, Legal, Financing, Interest During Construction, and Contingencies)	13,641,000
Total Project Cost Estimate	$28,160,000

6.6 Annual Operating Costs

The consulting engineers have separated annual costs into two categories: "Operation and maintenance" actually includes operation, maintenance, administrative, and general cost of the project. "Renewals and replacements," includes the cost of replacing worn out or obsolete equipment. Renewal and replacement expenses occur one or more times during the project life but do not necessarily occur every year.

CH_2M-Hill estimated annual operating costs as follows for 1982 in their feasibility study, based on a 7% inflation factor.

Actual operation and maintenance	$246,000
City administration	35,000
Water quality tests	63,000
Special consulting	28,000
Operation and Maintenance, subtotal:	$372,000
Renewals and Replacements, subtotal:	$276,000
Total Annual Costs (excluding debt service)	$648,000

6.7 Costs, Benefits and Financing

The monetary benefit of any electrical generation resource is not trivial to compute. An appropriate method for valuing benefit is in terms of replacement cost. Replacement cost would be the cost to the user of providing the same energy and capacity at the same level of reliability according to the same seasonal and daily schedule from the next best alternative sources.

For the purpose of this analysis, in 1982, firm energy from coal plants is considered to be the next best firm energy alternative. Used in this manner, "firm" means energy which can be guaranteed over a specified time interval regardless of weather or competing demands. The value of firm coal energy in that year is estimated by PGE to be 28 mills per kwh. Secondary energy in 1982 will be worth at least 15 mills per kwh. Secondary energy is the surplus of energy from regional generation resources above that required to meet firm energy committments. It is generally associated with the excess of regional hydro energy over what would be available in a low water year.

When secondary energy is available, coal plants will not be operated. BPA is expected to sell capacity in 1982 at $24.00 per year per kilowatt. Capacity is the maximum rate at which energy can (physically or contracturally) be delivered during a brief temporary period of high demand. Large scale power users pay for the right to consume power at a certain short term rate in addition to paying the kilowatt-hour energy charge. It appears now that P.G.E. will have to pay even more than $24.00 because BPA power is not expected to be available to private utilities.

In valuing benefits for the FERC Application, CH_2M-Hill compared the schedule for secondary power availability in an average water year to the schedule of energy production from the Bull Run project in an average water year. The results are broken down as follows for 1982:

> The firm energy that could be replaced is 85,000,000 kwh. At the 0.028 mill/kwh marginal cost of coal generation, this is worth $2,380,000. Secondary energy replaced is 25,000,000 kwh. At 0.015 mill/kwh this is worth $375,000. Bull Run is not capable of delivering its full 36,000 kw capacity year round. However, it can deliver constantly at 36,000 kw during the season when regional demand is highest. Therefore it can replace 36,000 kw of capacity for all practical purposes of PGE. At $24 or more per year per kw, this is worth at least $864,000. Total monetary benefit for the year therefore equals at least $3,619,000.

A similar analysis has been done for each year from 1982 to 2016. The results are shown in the Table and compared to total annual costs including debt service at an annual rate of 6%. A positive net cash flow obtained for each year is shown.

It is not known what the actual costs will be or what annual inflation rate will be. However, the economic analysis has proven sufficiently convincing for the City of Portland to sign a sales contract with the Portland General Electric Co. It is the study team's impression (from interviews) that the City is extremely pleased with the contract terms.

FINANCIAL ANALYSIS CASH FLOWS

ear	(1) Debt Service $28,160,000 6%-35 years	(2) OMAR* High Estimate 5% interest/year	(3) Power Revenues 5% interest/year	(4) Net Cash Flow (3)-(1+2)
1982	$ 1,943,040	$ 648,000	$ 3,619,000	$ 1,027,960
1983	1,943,040	680,400	3,800,000	1,176,560
1984	1,943,040	714,400	3,989,900	1,332,460
1985	1,943,040	750,100	4,189,400	1,496,260
1986	1,943,040	787,600	4,398,900	1,668,260
1987	1,943,040	827,000	4,618,900	1,848,860
1988	1,943,040	868,400	4,849,800	2,038,360
1989	1,943,040	911,800	5,092,300	2,237,460
1990	1,943,040	957,400	5,346,900	2,446,460
1991	1,943,040	1,005,300	5,614,300	2,665,960
1992	1,943,040	1,055,500	5,895,000	2,896,460
1993	1,943,040	1,108,300	6,189,700	3,138,360
1994	1,943,040	1,163,700	6,499,200	3,392,460
1995	1,943,040	1,221,900	6,824,200	3,659,260
1996	1,283,000	1,283,000	7,165,400	3,939,360
1997	1,943,040	1,347,100	7,523,600	4,233,460
1998	1,943,040	1,414,500	7,899,800	4,542,260
1999	1,943,040	1,485,200	8,294,800	4,866,560
2000	1,943,040	1,559,500	8,709,600	5,207,060
2001	1,943,040	1,637,500	9,145,000	5,564,460
2002	1,943,040	1,719,300	9,602,300	5,939,960
2003	1,943,040	1,805,300	10,082,400	6,334,060
2004	1,943,040	1,895,600	10,586,500	6,747,860
2005	1,943,040	1,990,300	11,115,800	7,182,460
2006	1,943,040	2,089,900	11,671,600	7,638,660
2007	1,943,040	2,194,400	12,255,200	8,117,760
2008	1,943,040	2,304,100	12,868,000	8,620,860
2009	1,943,040	2,419,300	13,511,400	9,149,060
2010	1,943,040	2,540,200	14,186,900	9,703,660
2011	1,943,040	2,667,300	14,896,300	10,285,960
2012	1,943,040	2,800,600	15,641,100	10,897,460
2013	1,943,040	2,940,600	16,423,200	11,539,560
2014	1,943,040	3,087,700	17,244,300	12,213,560
2015	1,943,040	3,242,100	18,106,500	12,921,360
2016	1,943,040	3,404,200	19,011,900	13,664,660
TOTAL	$68,006,400	$58,527,500	$326,869,100	$200,340,000

Note: Ratio of total revenues to total costs is 2.58.

*OMAR - Operation, maintenance, administration, and replacements.

PORTLAND HYDROELECTRIC PROJECT

Year	Power Production Payment(1)	Debt Service	Payment For Share of the Savings (2)	Payment for Renewals and Replacement (3)	Payments for City's Reimbursable Expenses (4)	Total Annual Payments to City by Portland General Electric
1982	$146,705	$ 0	$ 987,956	$ 350,398	$ 130,351	$ 1,615,410
1983	305,000	2,899,663	0	378,430	271,000	3,854,093
1984	305,000	2,905,163	0	408,704	284,550	3,903,417
1985	305,000	2,909,038	0	441,401	298,778	3,954,217
1986	305,000	2,911,288	0	476,713	313,716	4,006,717
1987	305,000	2,911,913	0	514,850	329,402	4,061,165
1988	305,000	2,910,913	0	556,038	345,872	4,117,823
1989	305,000	2,933,288	603,063	600,521	363,166	4,805,038
1990	305,000	2,927,413	866,428	648,562	381,324	5,128,727
1991	305,000	2,919,913	936,769	700,447	400,390	5,262,519
1992	305,000	2,935,788	1,012,756	756,483	420,410	5,430,437
1993	305,000	2,923,413	1,094,811	817,002	441,430	5,581,656
1994	305,000	2,934,413	1,183,458	882,362	463,502	5,768,735
1995	305,000	2,917,163	1,279,193	952,951	486,677	5,940,984
1996	305,000	2,923,288	1,382,622	1,029,187	511,011	6,151,108
1997	305,000	2,926,163	1,494,329	1,111,522	536,561	6,373,575
1998	305,000	2,925,788	1,614,983	1,200,443	563,390	6,609,604
1999	305,000	2,947,163	1,745,304	1,296,479	591,559	6,885,505
2000	305,000	2,937,763	1,880,490	1,400,197	621,137	7,150,587
2001	305,000	2,925,063	2,038,988	1,512,213	652,194	7,433,458
2002	305,000	2,933,063	2,204,204	1,633,190	684,804	7,760,261
2003	305,000	2,935,500	2,382,908	1,763,845	719,044	8,106,297
2004	305,000	2,932,300	2,576,196	1,904,953	754,996	8,473,445
2005	305,000	2,949,000	2,784,942	2,057,349	792,746	8,889,037
2006	305,000	2,931,250	3,011,714	2,221,937	832,383	9,302,284
2007	305,000	2,933,250	3,256,589	2,399,692	874,002	9,768,533
2008	305,000	2,928,250	3,521,038	2,591,667	917,702	10,263,657
2009	305,000	2,916,250	3,806,619	2,799,001	963,587	10,790,457
2010	305,000	2,922,250	4,115,011	3,022,921	1,011,767	11,376,949
2011	305,000	2,919,500	4,448,060	2,264,755	1,062,355	11,999,670
2012	305,000	2,908,000	4,807,728	3,525,935	1,115,473	12,662,136
2013	305,000	2,912,750	5,196,130	3,808,010	1,171,246	13,393,136
2014	305,000	2,907,000	5,615,584	4,112,651	1,229,809	14,170,044
2015	305,000	2,890,750	6,068,560	4,441,663	1,291,299	14,997,273
2016	305,000	2,889,000	6,557,723	4,796,996	1,355,864	15,904,583

(1) Based on average water year and generation of 108,700,000 kWh.

(2) Based on estimated difference in cost per kWh between most recent PGE thermal plant and cost per kWh at Project escalated at 8% annually.

(3) Calculated at 1½% of direct project costs and 8% escalation in the Construction Cost Index.

(4) City's cost of administration, water quality testing and control, permit and license fees, and insurance, escalated at 5% per year.

Source: Official Statement Relating to $38,000,000 Hydroelectric Power Revenue Bonds.

LESSONS OF THE CASE STUDY

The development of two small hydroelectric power generation facilities in the City of Portland's Bull Run watershed is currently underway and proceeding on schedule.

Those of us participating in this case study found considerably fewer State-imposed regulatory and economic barriers than we had expected. The submission of documents used in the application for a FERC license was sufficient to obtain most State licenses and permits.

However, in both of the case studies, state and Federal processes, legislation and regulations created site-specific, unintended constraints or deadlocks in the developers' schedules. In an attempt to summarize what we have learned about small-scale hydropower and its future, the study team is presenting its observations, conclusions and recommendations below.

* <u>City water supply dams offer potentially useful small hydroelectric power</u> resources.

Urban areas, particularly those with growing populations and economies, may be able to add to their supply of available electricity by developing resources within easy reach that were previously thought to be economically unfeasible. In many cities, water for domestic consumption has to be brought long distances or held in reserve behind man-made structures. Equipping these structures and delivery systems for the generation of electricity may prove to be an excellent source of revenue for such cities, it may buffet their local economies from what may become drastic electricity shortages in the mid-1980s and it may offset the need to build expensive and potentially additional coal or nuclear thermal generating capacity nearby.

* <u>The work of farsighted planners during system/dam construction are largely responsible for the feasibility of developing small hydropower sites at Bull Run.</u>

When Dam No. 1 was completed in 1929 and Dam No. 2 was completed in 1962 each was equipped with the penstocks for the development of hydropower. Although the planners of each dam knew the sites were not economically feasible immediately, they had the foresight to envision a day when such developments would be both useful and worthwhile. The costs of constructing hydroelectric facilities at the sites will be considerably less than had the penstocks not been built. The cost savings may have been sufficient to have made the difference in assuring economic feasibility for the sites today, as Portland prepares for predicted future electrical energy shortfalls.

* The State of Oregon's permitting and licensing process posed no serious obstacles to small hydroelectric power development in this case. The central clearinghouse mechanism provided a useful guide through the State's regulations; the costs of permitting pose no particular threat to the developers.
The Bureau of Water Works submitted its FERC license application to the Oregon central clearinghouse for development regulations. After that, the State did much of the work in processing the application. Although requirements were placed on the developers due to interventions by the Department of Fish and Wildlife and an environmental group concerned about the quality of Bull Run water, the process itself moved with satisfactory speed according to Water Bureau officials.

The developers have reached a power purchase agreement with the Portland General Electric Co. (PGE) which will ultimately pay for all costs in the development and licensing process. But the State Legislature should review the fee schedule to determine whether it wishes to charge developers' fees in excess of costs to the State. Such fees are unnecessary at best for small hydroelectric facilities -- at worst they may pose a costly obstacle for marginally economic projects.

* The State Legislature should consider whether they feel it appropriate for the Department of Fish and Wildlife to intervene in licensing proceedings for developments at existing sites, holding such projects hostage until reparations are made for fish or wildlife disturbed during the original site construction.
In the case for Bull Run, the Department of Fish and Game was able to hold up licensing of the hydroelectric project until the Water Bureau promised to make restitution for the salmon runs destroyed during the construction of Dam No. 1 in 1927. Many people might consider this exchange proper because salmon are important to both the ecology and the economy of the region. However, the State Legislature should consider more specific policy guidance to the Department of Fish and Game on small hydroelectric matters. This may include, for example, guidance on the amount they may charge a prospective developer, if at all, for salmon runs destroyed many years previous. In some cases, those required to pay restitution may not be

the same individuals or organizations originally responsible for dam construction. The ensuing costs of such interventions both in terms of time lost and in terms of the rising costs of hatchery construction may prove prohibitive or counter-productive for some marginally economic sites during this period in which the need to develop future sources of electricity is so important.

* The overlapping of City, State and Federal jurisdictions in the Bull Run watershed area complicated and delayed development plans -- in one case until relief was obtained from Congress. State Legislatures should seek simpler ways to resolve such disputes in the future, such as the arbitration process set up by PL 95-100.

As a result of a Presidential proclamation and turn-of-the-century federal legislation, the Water Bureau was not permitted to enter the Bull Run watershed for purposes of hydroelectric development planning, by ruling of a U.S. Circuit Court judge. While awaiting action by the U.S. Congress to allow access for hydroelectric development at the sites, the developers prepared their entire FERC applications using existing plans and photographs taken from a helicopter hovering over the sites. Although the soot and exhaust of the helicopter probably caused more of an environmental impact on Portland's drinking water than a few trips to the watershed by automobile would have had the activity was technically acceptable within the terms of the law and was the only option short of project delay available to the Water Bureau.

Another question which has arisen as a result of jurisdictional overlaps was brought up by the City: Since the Bull Run watershed is a federal reserve set aside by law, is Portland obligated to pay licensing fees to the State of Oregon? The issue remains unresolved as this report is being completed.

In the next few years, the states and the federal government may need to settle a large number of jurisdictional disputes as the search for future energy resources continues. This is particularly true in western states where the federal Government owns so much land. The states should seek a mechanism which does not necessarily require going to Congress or the courts for the resolution of these disputes, such as the arbitration process set up by PL 95-100. Such problems appear to be part of what President Carter was referring to recently when speaking of the need to cut through the "red tape" unnecessarily delaying the development of important energy projects. However, the states should seek new ways to institutionalize this policy (without relinquishing) their key interests and the principle of local control over community affairs.

* The States should request that the U.S. Internal Revenue Service review its codes concerning the local furnishing and consumption of electricity.

The administratively-marked "two county rule" requires that when municipalities sell power to private utilities, the latter must see that all of that power is consumed within two counties, or the revenue bonds financing the project become taxable. Although technically it is impossible to "trace" electricity, PGE officials complain that they must take several unusual measures at additional cost to guarantee that all of the Bull Run power be consumed within two counties. Tax-free bonds save a considerable amount of money to the developers of small hydropower projects and therefore can make a difference in the cost of electricity to the consumer.

The States should ask the IRS to review the "two county rule". Whatever its intrinsic logic, there are many places in the United States where county lines are drawn in a manner which will unintentionally cause the rule to be invoked, adding an unnecessary additional cost to the power from small hydropower developments.

* The City of Portland was able to obtain highly favorable terms in the power purchase agreement with Portland General Electric because of the utility's unusually weak bargaining position.

Beset with an insufficiency of owned resources, with heavy reliance on the Trojan nuclear power plant to support their system, with charges of management problems in the development of new resources, BAA capital bond rating and with low public esteem, Portland General Electric is anxious to acquire electrical energy resources at almost any price. As a private utility they presently must take their place in line behind the region's many public utilities when vying for inexpensive Federal hydropower. (Although this may change if the Northwest Power Bill presently in Congress is enacted).

PGE's transmission lines run within six miles of the two dam sites on the Bull Run watershed, so they were the likely power purchasers from the start. But the utility was also anxious to acquire the rights to the power to improve their public relations by demonstrating an interest in environmentally benign sources of electricity (PGE's fondness for nuclear power has been widely publicized, because the city's better bond rating (non-taxable) permitted it to construct the facility more cheaply, and, perhaps most important, to cut off talk of using the Bull Run sites as the beginning of a publicly-owned power system in the City of Portland. Unlike several jurisdictions in the Pacific Northwest and elsewhere around the country, Portland's electric utility companies are privately-owned. Talk of beginning publicly-owned electric power systems -- no matter how serious -- are enough to send a chill through the heart of most private utility executives. The acquisition of power from the Bull Run site seemed to become very important to PGE.

Commissioner of Public Utilities Francis J. Ivancie led the bargaining for the City of Portland. Ivancie was instrumental in getting City approval for the Bull Run Hydroelectric project; as an elected commissioner he is also firmly grounded in local politics. By aggressively exploiting an unpopular utility's weaknesses, Ivancie seems to have felt he could not only get a good deal for Portland, but he could make political capital in his continuing quest to become its mayor. Well prepared and tough, Ivancie and the Water Bureau succeeded in getting PGE to purchase the electricity from the Bull Run sites, sharing equally the benefits from sites as compared to the cost of energy from the most recently constructed 500 mw or greater thermal base load generating facility which PGE uses.

This hard bargain for the relatively small amount of available power caused some resentment at PGE where the study team was told that "it will be a long day" before PGE agrees to "share-the-benefits" agreement again. Although such blustering may come to naught, it is clear that the Water Bureau is marketing its power, not entering into a "partnership" in development with the utility (such as the one into which Seattle City Light and Tacoma City Light have entered with the South Columbia Basin Irrigation District for the development of small hydropower sites.) Only time will tell whether this strategy of independence will be more useful or more harmful for the developers of small hydroelectric power facilities.

* Careful attention will be paid to the environmental effects of hydroelectric generation at these sites. Aside from this particular environmental concern, the Bull Runn Hydroelectric Project has enjoyed support from City and State institutions and the press. This may be the basis for cautious optimism for the future of similar projects.

Because of Portland's concern for the quality of its drinking water, strict tests will be performed to evaluate the impact of hydropower development on delivered water quality. The certainty of this testing was further guaranteed when the Water Bureau accepted special wording in its FERC license concerning water quality in order to satisfy an intervenor. The findings of these studies will be of considerable interest to those other cities contemplating similar developments.

The Water Bureau had to openly solicit voter approval of the project when an issue was placed on the ballot to permit the City to raise from five to forty years the maximum length of its sales agreements. The issue, which carried, was necessary before a power sales agreement could be reached. This example vividly demonstrates the belief of the study team that unintended, site-specific obstacles to small hydroelectric generation will emerge everywhere such projects are planned. Only through the cooperation of all the parties at interest will these obstacles be eliminated.

ENDNOTES

1.0 HISTORY OF BULL RUN, PORTLAND AND ITS WATER UTILITY

1. Bates McKee, Cascadia (New York: McGraw-Hill, 1972), p. 186.
2. Ibid.
3. Ibid.
4. Ibid., p. 275.
5. J. Hoover Mackin and Allan S. Carey, Origin of Cascade Landscapes, Information Circular No. 41 (Olympia, WA: Washington State Printing Plant, 1965), p. 17.
6. McKee, p. 186
7. City of Portland, Official Statement Relating to $38,000,000 Hydroelectric Power Revenue Bonds (Portland, OR: City of Portland, May 16, 1979), p. 27.
8. City of Portland, Before the Federal Power Commission: Application for License; Portland Hydroelectric Project, Exhibit W - Environmental Report (Portland OR: City of Portland, September, 1977, pp. 125, 129.
9. Anthony White, A Bibliographic Portrait of Portland, OR; Part II-Government (Monticello, IL: Council of Planning Librarians, March, 1976), p.2
10. Oregon [State] Department of Economic Development, Oregon Port Districts 1977 -- An Economic Profile (Portland, OR: Oregon State Printing Plant, N.D.), p. 10.
11. City of Portland. Official Statement ..., p. 27.
12. City of Portland. Before the F.P.C..., p. 124

2.0 SMALL SCALE HYDROELECTRIC POWER AT THE BULL RUN WATERSHED

1. The study team was unable to obtain an appointment with Commissioner Ivancie in either July or August of 1979, so the material in this section is largely drawn from the second-hand accounts of Bill Waters at CH_2M-Hill and James Doane at the Portland Bureau of Water Works and Manager, Portland Hydroelectric Project.
2. This section represents the understanding the study team was able to develop based on widely varying first hand accounts and press

items describing this particular conflict James Doane of the Bureau of Water Works and Manager, Portland Hydroelectric Project was the most informative individual on the project's history.

3.0 THE CURRENT ARRANGEMENTS FOR HYDROPOWER FROM BULL RUN

1. Portland General Electric Co., 1978 Portland General Electric Annual Report (Portland, OR: PGE, March, 1979), p. 1
2. Ibid. and City of Portland. Official Statement..., p. B-1.
3. Ibid., pp. 14 and B-8, respectively.
4. Portland General Electric Co., 1978...Annual Report, p. 9.
5. City of Portland. Official Statement..., p. B-8.
6. Portland General Electric Co., 1977 Portland General Electric Annual Report (Portland, OR: PGE, March, 1978), p. 2
7. Ibid., p. 2
8. City of Portland, Official Statement..., p. B-9.
9. Portland General Electric Co., 1977....Annual Report, p. 5
10. City of Portland, Official Statement..., p. B-9
11. Portland General Electric Co., 1977 Annual Report, p. 6
12. City of Portland, Official Statement..., p. B-10
13. Portland General Electric Co., 1978...Annual Report, p. 28
14. City of Portland, Official Statement..., p. B-10
15. Ibid, p. B-10
16. Ibid, p. B-10
17. Ibid., p. B-11
18. Ibid., p. B-11
19. Joel Connelly, "Regional Power Bill Gets an OK," Seattle Post-Intelligencer, August 4, 1979, p. A1
20. Joel Connelly, "Battle of Skagit Reflects U.S. Nuclear Pains," Seattle Post-Intelligencer, August 5, 1979, p. B-8

21. Dean Katz, "N.W. Power Bill--Good or Bad?"The Seattle Times, August 5, 1979, p. B8.

22. Dean Katz, "Senate Power Bill Arouses Skepticism," The Seattle Times, August 5, 1979, p. A20

23. City of Portland, Official Statement ..., p. B-11, B-12.

24. Ibid., and City of Portland, Trust Indenture: City of Portland, Oregon, to the United States National Bank of Oregon, Portland, Oregon as Trustee, June 1, 1979.

25. City of Portland, Official Statement..., p. 5.

6.0 ENVIRONMENT, GENERATING TECHNOLOGY AND ECONOMICS

1. City of Portland, Before the F.P.C..., Exhibit 10

2. John Martin, CH_2M-Hill, interview held in Portland, OR, August 14, 1979.

3. Ibid.

4. City of Portland, Before the F.P.C..., Exhibit 10

5. Ibid.

6. Ibid.

7. Ibid.

8. Arthur Smith, Water Analysis Supervisor, Portland Bureau of Water Works, in interview at Bull Run Water Analysis Laboratory, August 13, 1979.

9. Ibid.

10. Ibid.

11. Ibid.

12. James Doane, Manager of the Portland Hydroelectric Project, in interview, Portland, OR., August 13, 1979.

13. Federal Energy Regulatory Commission, FERC Order Issuing License (Major) Project No. 2821, March 22, 1979.

14. Ibid.

15. James Doane, August 13, 1979.

16. S.H. Anderson, "Ecological Relationships of Birds in Forests of Western Oregon" (unpublished thesis, Oregon State University, 1974).

17. E.M. Thatcher, "Mammals of the Bull Run" (unpublished thesis, Portland State University, 1976).

18. J.F. Franklin and C.T. Durness, "A Checklist of Vascular Plants on the H.J. Andrews Experimental Forest, Western Oregon" U.S. Forest Service Research Note PNW-138, 1971.

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