US Army Corps of Engineers®

DWORSHAK RESERVOIR LARGE BOAT MARINA SITE ANALYSIS

September 2004

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1. Background

This large boat marina analysis project is the result of congressionally-sponsored legislation designed to promote economic growth and development in and around Orofino, Idaho. United States Senator Mike Crapo (Republican, Idaho) began to champion the idea of creating a more viable recreation use for Dworshak Reservoir when lake levels are drawn down. Currently, under low-pool conditions, remote campsites accessible only by boat become nearly inaccessible. Large houseboats are a possible recreation opportunity, and could alleviate alternative access issues.

Various recreation users have long advocated the use of houseboats as a means of enjoying the entire reservoir without having to negotiate steep lakeshores or hiking in to remote campsites. Houseboats would also be a viable recreational alternative for individuals with disabilities or limited mobility, easily allowing them access to the entire reservoir. A new marina is desirable in order to accommodate the unique needs of such large boats.

A large boat marina, for purposes of this study, is considered to be docks able to accommodate boats of 28 feet [8.5 meters (m)] in length or larger. These docks must be accessible through the full-pool rotation of Dworshak Reservoir, which is 155 vertical feet (47.2 vertical m). For this site analysis, observations were limited to land already owned by the U.S. Army Corps of Engineers (Corps).

Dworshak Reservoir is a 54-mile-long [86.9 kilometers (km)] reservoir that was created when the waters behind Dworshak Dam were impounded. The dam is located on the North Fork of the Clearwater River, in central Idaho. Many diverse recreational opportunities are available in the area but, because of the lack of developed roads in the steeply-sloped canyons surrounding the reservoir, the 184 miles (296.1 km) of forested shoreline are accessed primarily by boat (photo 1).

The only existing marina on Dworshak Reservoir is located at Big Eddy, and is leased to Idaho Department of Parks and Recreation (IDPR) by the Corps, under Department of the Army Lease No. DACW68-1-96-18. This marina has a waiting list for small craft moorage, and lacks the moorage facilities necessary to accommodate large boats and/or houseboats.

Photo 1: Most recreation sites on the reservoir were designed for boat access only.

The IDPR has shown an interest in pursing the phased development of a large boat operation and destination facilities along the reservoir. Their wish is to develop temporary moorage facilities initially, with the intent of developing permanent facilities designed to accommodate large boats, as well as additional complimentary facilities.

Dworshak Reservoir provides unique recreation opportunities, in that its marketing appeal lies primarily in the undeveloped backcountry experience, the solitude, and the broad scope of fishing and hunting activities. Houseboat rentals have been quite popular at several other similar locations, and Dworshak provides a longer potential use season and more scenic beauty than many other areas. Because rental houseboats are often equipped with forced air heating and cooling, fireplaces, and hot tubs, the use season is extended far beyond the traditional summer recreation period. In addition, houseboat users are not severely impacted by drawn down lake levels, since a houseboat can be moored along the shoreline wherever there is adequate surface to land and tie-off.

Many houseboat rental resorts on federal facilities are stand-alone enterprises, and are developed entirely at the expense of the operator. This enhances the potential for a large operation with an experienced resort developer/operator. In these situations, the federal managing agency normally provides an area lease of both land and water surface, while the resort corporation develops and operates the facility under a long-term lease. On many lakes, drawdowns of larger magnitude than those regularly occurring at

Dworshak are common. Large rental resort operators have both the knowledge and engineering expertise to develop and operate marine facilities under significant drawdown operations.

2. Authority

The authority for this reconnaissance-level site analysis comes from Congressional funding allocated to the Corps, Walla Walla District, for the purpose of stimulating the economy of Orofino, Idaho. *Dworshak Final Environmental Impact Statement* (September, 1975), in referencing the section on Big Eddy marina, states: "Other marinas may be developed at other sites as future need may warrant."

3. Scope of Study

The Dworshak Reservoir Large Boat Marina Site Analysis consists of a land-based analysis of potential sites by a team of technical experts from the Corps, Walla Walla District, including personal from Dworshak Reservoir. The team analyzed lands along the shoreline of the reservoir, from Dworshak Dam to the Grandad boat launch, to determine their suitability for a large boat marina facility. The results of this analysis are presented in this report.

4. Site Evaluations

Eleven sites were initially analyzed for their suitability to support a large boat marina facility. The evaluations were two-tiered. Product Delivery Team (PDT) members evaluated each of the eleven sites for specific criteria, and the top six sites were then further evaluated for other criteria. Of those six sites, three were selected for further consideration: Big Eddy, Bruce's Eddy, and Freeman Creek. The results of this two-tiered evaluation were then combined in a final matrix (see table 1).

a. Tier I Evaluation

The Tier I evaluation consisted of those elements deemed most essential for a site to receive consideration as a large boat marina facility. It contained the following elements:

- Slope: How steep is the topography of the site? Sites of less than 15 percent are necessary for the development of a large boat marina.
- Access: How easy is it to get to the area? Are roads currently available to the site? If so, how suitable are those roads?

Table 1 - Dworshak Large Boat Marina Site Analysis												
Site	**Tier I**						**Tier II**					
	Slope	**Access**	**Utilities (existing & potential)**	**Cultural Properties**	**Aspect (wind/sheltered)**	**Total**	**Aesthetic Resources**	**Flat Land and Water**	**Capacity**	**Distance from Town**	**Potential for Future New Facilities**	**Total**
Freeman Creek	**4**	**4**	**5**	**4**	**5**	**22**	**4**	**4**	**3**	**2**	**5**	**18**
Big Eddy	**3**	**5**	**5**	**5**	**3**	**21**	**4**	**3**	**2**	**5**	**2**	**16**
Bruce's Eddy	**4**	**5**	**5**	**4**	**3**	**21**	**4**	**4**	**5**	**5**	**3**	**21**
Dent Acres	**4**	**4**	**5**	**1**	**2**	**16**	**4**	**3**	**2**	**3**	**3**	**15**
Canyon Creek	**2**	**3**	**1**	**2**	**5**	**13**	**3**	**2**	**4**	**3**	**1**	**13**
Merry's Bay	**3**	**3**	**1**	**2**	**3**	**12**	**2**	**2**	**3**	**4**	**2**	**13**
Rating Criteria— **1 = Least Suitable** ↓ **5 = Most Suitable**												

- Utilities: Are utilities already available to the site? If not, how difficult would it be to get water, electricity, *etc.*, to the site?
- Cultural Properties: Are there any known cultural properties in the area? Have they been evaluated for eligibility for the National Register of Historic Places? Is the site located in an area of cultural or historic significance? Is there a plan in place to deal with historic properties or other cultural items if found during development?
- Aspect: Will new marina facilities be sheltered, or will they be subject to prevalent wind from any certain direction?

b. Tier II Evaluation

The Tier II evaluation consisted of those elements considered important, but not essential, for a site to receive consideration as a large boat marina facility. This evaluation contained the following elements:

- Aesthetic Resources: Looking into and out from the site, how will the view be affected by development? Can additional facilities be placed at this location without significantly detracting from the natural beauty of the area?

- Flat Land and Water: Is there enough deep water and flat land to develop both a large moorage facility, parking, and resort buildings?
- Capacity: Can the site sustain a large moorage facility at all levels of reservoir drawdown?
- Distance from Town: How far is the site from Orofino in terms of miles? In terms of driving time?
- Potential for Future New Facilities: Does the site have the capacity for growth and expansion?

5. Sites Selected for Further Consideration

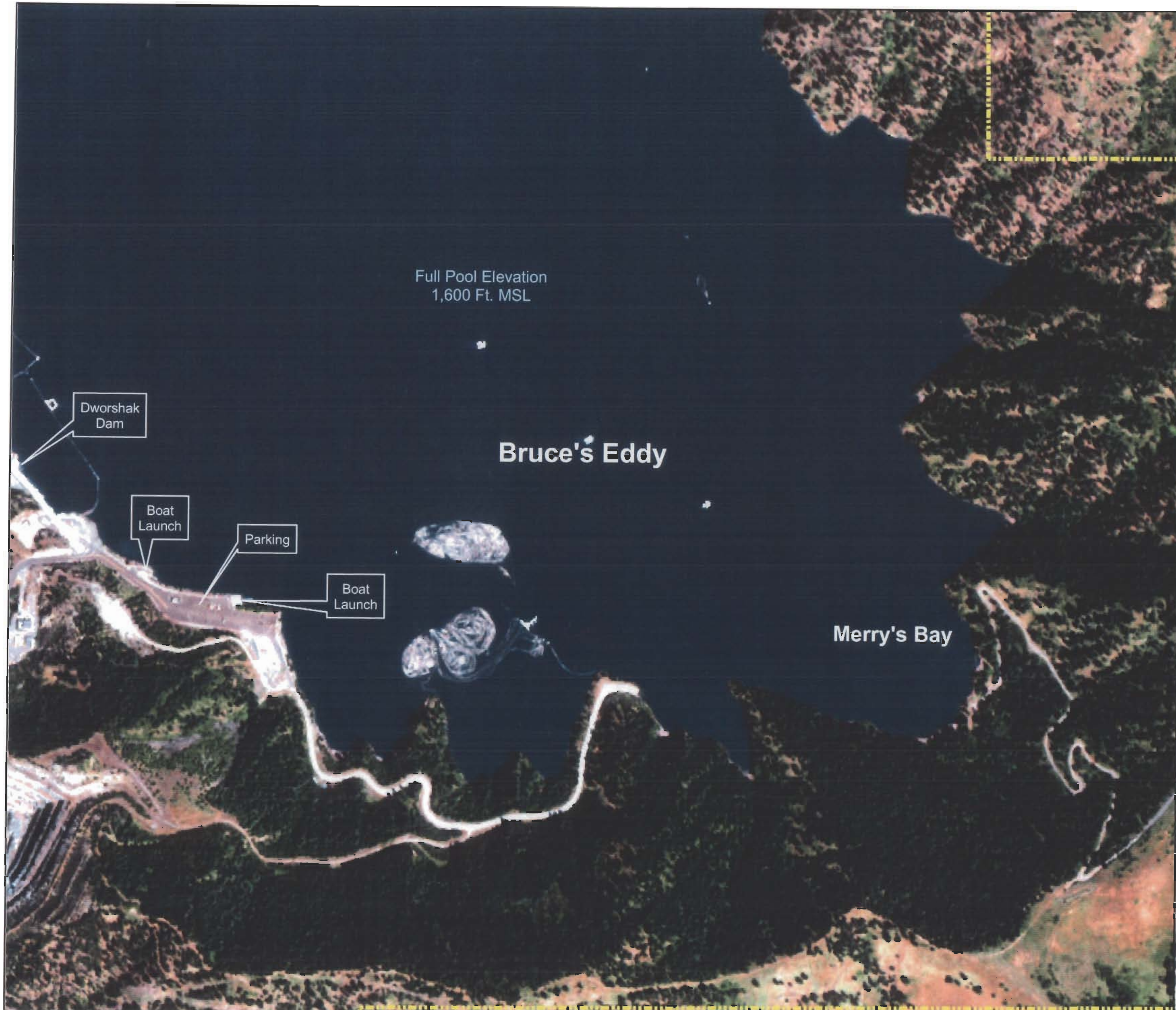
Based on evaluations made during the site visit in August 2004 and technical knowledge of the reservoir, the following sites are recommended for further consideration as a large boat marina facility: Bruce's Eddy, Freeman Creek, and Big Eddy. The following sections generally follow the matrix found in Table 1, but some criterion are closely related and not easily separated.

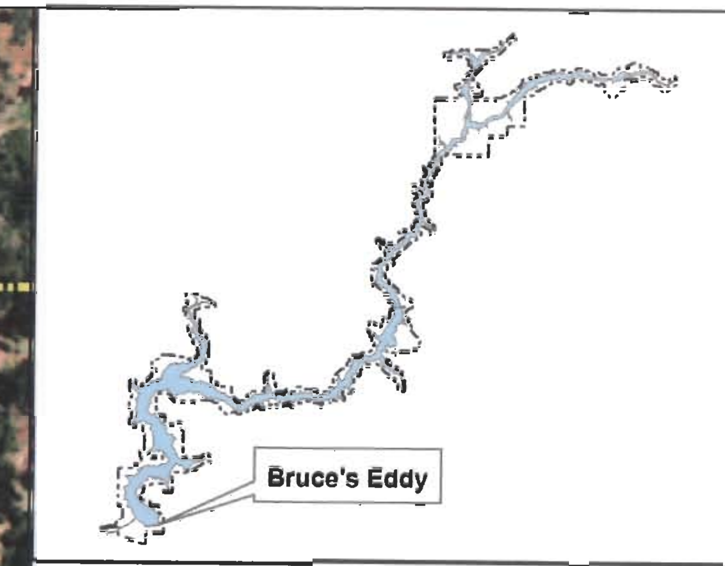
a. Bruce's Eddy

Bruce's Eddy (photos 2 and 3, and plate 1) is located approximately 1000 feet (304.8 m) southwest of Dworshak Dam, and is owned and operated by the Corps. The site's land classification is Public Recreation—General Access, and it is bordered by Project Operations and Industrial Use and Access land classifications. At present, the site contains two boat launches, flush toilets, parking, and a dual rail structure from the former log removal system. The rail structure extends to elevation 1440, and could potentially be used for a marina or mechanized lift down the bank. One of the boat launches is 42 feet wide (12.8 m) and extends to water surface elevation 1484, while the other launch is 60 feet wide (18.3 m) and extends to water surface elevation 1555.

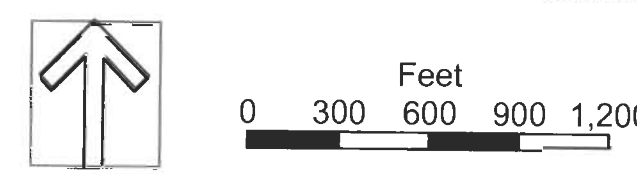
Photo 2: Looking towards Bruce's Eddy from Dworshak Dam

Photo 3: View of Bruce's Eddy (to the left) at full pool





Sources: June / July, 2002 Quickbird 2.4 meter satellite ortho-rectified multi-spectral imagery.



Dworshak Marina Bruce's Eddy Site

2004

PLATE 1

The Dworshak Master Plan (DM-10), approved in 1970, indicates that this area is a Future Log Handling Facility. A log handling facility was constructed and used for a period of time. Due to improvements in transportation methods and road construction in the backcountry, however, the Log Handler's Association no longer uses the reservoir for the transport of logs, nor does it utilize the log removal facilities. The large, flat area at the site is currently used for debris and log removal from the reservoir. This space may be used by future concessionaires for non-permanent facilities, but must be available for temporary use by the Corps during debris removal operations.

- **Soils**

Soils at Bruce's Eddy are from the Johnson and Fordcreek series, both of which are deep, well-drained soils formed in loess and alluvium over material from granitic or metamorphic rock. The majority of development would occur in Johnson soils, which occur on canyon breaks, benches, mountains, and hills; with slopes ranging from 5 to 75 percent. Fordcreek soils occur on canyon sides and benches. Permeability is moderate or moderately slow in both soil types. More information can be obtained at *http://ortho.ftw.nrcs.usda.gov/cgi-bin/osd/osdname.cgi*.

Soil investigations would have to be conducted to determine the feasibility of additional development at the site. The anchorage of the dock facility to the shoreline would be the primary consideration.

- **Access/Distance from Orofino**

Bruce's Eddy is approximately 5 miles (8.04 km) west of Orofino; and is accessed by the 'A' Road, a 24-foot-wide (7.3 m), 2-lane road operated and maintained by the Corps as a service and public access road. At one time, this road was used as a detour route for State Highway 7 (when traffic was allowed over Dworshak Dam). The existing rock outcropping could make any improvements difficult. The transport of large vessels on this road will require traffic control for oversize vehicles.

- **Slope/Aspect/Flat Land and Water**

Bruce's Eddy has steep underwater slopes and a deep bay, protected on three sides. There are approximately 6 acres (2.43 hectares) of relatively flat land available for development, now used as a partially paved parking lot. With the exception of the parking lot, the majority of slopes at this site are in excess of 15 percent. Several flat benches lie above the developed parking lot, and could be utilized for ancillary development.

- **Utilities**

Water, sewer, and electricity are available at Bruce's Eddy. However, electricity is supplied by Dworshak Dam and is at capacity already. Although a new line would have to be brought in, commercial power is available just over the ridge and an easement could be developed and outgranted for commercial sources of power.

Water, both potable and otherwise, is supplied by the Corps. At present, there is no regional water system available, but it would be advantageous to develop and outgrant an easement for commercial water as soon as a source becomes available. Another alternative might be for a concession operation to develop its own source of potable water.

The Ahsahka Water and Sewer Treatment Plant is located at the bottom of 'A' Road, and sewage from Bruce's Eddy is piped to this plant. However, it is likely that additional development at Bruce's Eddy will require a system upgrade in size and capacity to this plant. In addition, all the pipes to this system travel through the dam, and are tied to the existing Corps' sewage disposal system. This configuration may possibly cause problems in the future. An ideal situation would separate the utilities of water, sewer, and electric from government-owned or provided to private concession operation-provided utilities.

- **Cultural Resources**

Bruce's Eddy is located within the boundaries of the Nez Perce Indian Reservation. Cultural resources surveys in the vicinity have failed to discover cultural or historic properties. The land was extensively disturbed during construction of Dworshak Dam, and it is doubtful that any cultural deposits remain in the potential development area. Therefore, construction at Bruce's Eddy is unlikely to present major concerns regarding cultural resources.

- **Capacity/Potential for New Facilities**

The parking lot area, approximately 6 acres (2.43 hectares), is available for further development. The gentle slopes above the parking lot may also be suitable for development, but would require that a connecting road be upgraded to accommodate heavier traffic volumes. Utilities to these bench sites would need to be extended from the primary development location.

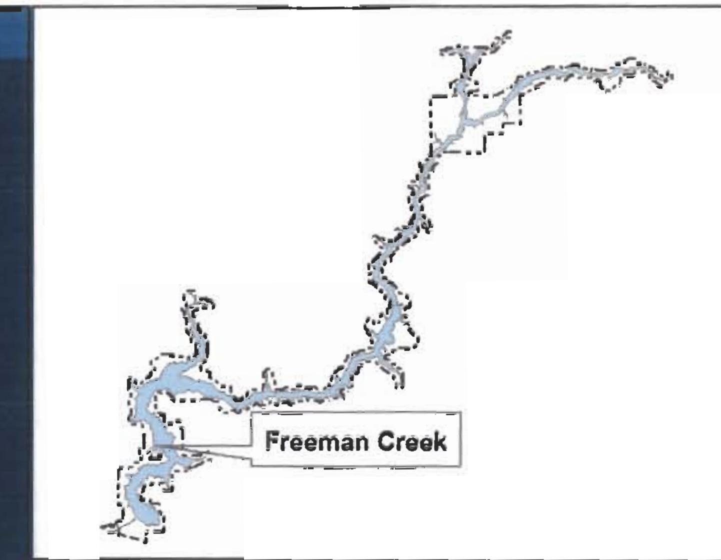
Bruce's Eddy is close to both the City of Orofino and US Highway 12; and the adjacent water area affords deep, open bays with good protection from the weather. Two embayments at Bruce's Eddy are suitable for boat moorage facilities. Both have a useable water surface area of 400 feet (121.9 m) by 400 feet (121.9 m) at minimum operating pool (elevation 1445). The downstream, or west, embayment would be preferable because of easier access to the docks and the existing parking area, but it is also in close proximity to the existing boat launch, which could cause interference problems.

b. Freeman Creek

Freeman Creek (photo 4 and plate 2) is located along the west shoreline of Dworshak Reservoir, approximately 6 miles (9.65 km) upstream of Dworshak Dam. Freeman Creek is situated on land owned by the Corps and leased to IDPR. Land use classification for the site, as defined by the Master Plan, is Recreation – Initial Development and Future Development. It is currently used for high-density recreation.

Currently, the site is known as Dworshak State Park. As such, it features extensive camping facilities and a maintenance building and yard. There is a campground with 105 sites, 25 of which are tent-only sites next to the reservoir; 4 cabins for reservation; and 3 group camps. All campsites have a fire grill and picnic table, and 46 sites have electrical and water hook-ups. A restroom with flush toilets and showers is centrally located in the park, and vault toilets and water fountains are scattered throughout the campground.

Photo 4: The shoreline at Freeman Creek is a long, gradual slope.
The proposed marina site at Freeman Creek is to the right, where there is a deeper bay.



Sources: June / July, 2002 Quickbird 2.4 meter satellite ortho-rectified multi-spectral imagery.

Feet
0 250 500 750 1,000

Dworshak Marina Freeman Creek Site

2004

PLATE 2

The day-use area includes a group picnic shelter that may be reserved, picnic tables, a swim beach, a playground, and adequate parking. Near the swim beach is a 38-foot (11.58 m) total-width boat launch. This launch is actually two launches about 16 feet (4.88 m) wide, separated by a dock. This structure is useable to water surface elevation 1510.

Three Meadows Group Camp is separated from the campground and day-use areas by dense woods. Walking trails provide access to the reservoir. The camp offers a lodge with modern kitchen and eight bunkhouse-style group cabins.

Future plans for the site, per the Master Plan, were to be based on need, but call for an additional 140 camp units, roads, parking areas, additional boat docks, an amphitheater, and a multiple-tent camp unit.

- **Soils**

Previous soil explorations conducted in the Freeman Creek area indicate that the soils are primarily clay, silty clay, or shale. More detailed information about soils in the area can be found at on the web, at *http://ortho.ftw.nrcs.usda.gov/cgi-bin/osd/osdname.cgi*. The following soil series are found in the area: Campra, Kruse, Aldermand, Teneb, Kauder, and Riswold.

- Campra Series soils are deep, well-drained soils formed in material weathered from basalt with a mantle of loess and minor amounts of volcanic ash. These soils occur on canyon side slopes, short escarpments, hills, and mountainsides, with slopes ranging from 10 to 75 percent. They are well-drained soils, with rapid to very rapid runoff and moderately slow permeability.

- Kruse Series soils are deep, well-drained soils found on mountain slopes, canyon sides, ridges, and hills. They are formed in residuum weathered from granite, gneiss, and mica schist with a mantle of mixed ash and loess. They occur on slopes ranging from 0 to 75 percent, and permeability is moderately slow.

- Aldermand Series soils are very deep, well-drained soils formed in mixed volcanic ash and material from granitic or metamorphic rock. Aldermand soils occur on mountains and canyons, with slopes ranging from 20 to 75 percent. Permeability is moderate in the upper part and rapid in the lower areas.

- Teneb Series soils are very deep, poorly drained soils formed in mixed alluvium in drainageways on plateaus or in mountains. They occur on slopes of 0 to 3 percent, and have moderately slow permeability.

- Kauder Series soils are moderately deep to a fragipan, moderately well-drained soils formed in loess and reworked loess, with a thin mantle of volcanic ash. These soils occur on hills, plateaus, benches, and broad ridges, with slopes of 5 to 35 percent. Permeability is slow.

- Riswold Series soils are very deep, well-drained soils formed in volcanic ash and loess over material weathered from basalt. Riswold soils occur on hills, plateaus, and escarpments, as well as side-slope and canyon benches with slopes of 5 to 70 percent. Permeability is moderately slow.

More soil investigations would have to be conducted to determine the feasibility of any additional development. The anchorage of a dock facility to the shoreline would be of primary concern. The existing Master Plan also indicates that there is some slide hazard in the Freeman Creek area.

- **Access/Distance from Orofino**

The Freeman Creek site is 24 miles (38.6 km) by road from Orofino – a drive of almost an hour over winding mountain roads – and the closest facilities for visitors are in Kendrick and Julietta, rather than Orofino. This site provides the most direct route to the reservoir from the Cities of Moscow and Lewiston, Idaho.

The site is accessed by a 24-foot-wide (7.3 m) paved, county-maintained road. The last 2 miles (3.22 km) contain tight switchbacks that would make it very difficult to maneuver a large boat to the site, although the tightest turns have been widened to 38 feet (11.58 m). The horizontal curve radius is less than 75 feet (22.86 m) in some places. Upon reaching the recreation area, the boat launch access road narrows to a width of 20 feet (6.1 m). Because of the steep terrain in the area, upgrades to the road could severely impact the surrounding area.

- **Slope/Aspect/Flat Land and Water**

Slopes in the developed area at Freeman Creek range from 0 to 15 percent. Outside of the developed area, slopes range from 15 percent to as much as 40 percent. The underwater slope just off the swim beach is gradual, and small islands are exposed at low water. Just downstream of the boat launch, however, the water is deeper, sheltered from the wind, and more typical of draws in a river canyon. Elevations in this area range from 1360 to 1520 feet.

- **Utilities**

Water, sewer, and electricity are all currently available at the Freeman Creek site, but would require upgrade and expansion for any additional development. The existing electricity is supplied by public power. Water is being pumped from the lake and treated before being pumped into a 24,000-gallon (90,849.88 liter) water storage tank. An onsite sewage treatment facility consists of a 3-inch [7.62 centimeter (cm)]-force main sewer line to the sewage lagoon. The lagoon is 134 feet (40.84 m) square, with 1:3 side slopes and a maximum depth of 5 feet (1.52 m).

- **Cultural Properties**

There are several recorded cultural properties located within or adjacent to the area of probable development of a large boat marina and its support facilities. Of these sites, two have been determined (through archaeological testing and monitoring programs) to be completely destroyed by erosion. Three others have been determined to be ineligible for listing on the National Register of Historic Places and, therefore, are not afforded “Historic Property” protection. The remaining two sites have been evaluated as potentially eligible.

The local landform indicates the potential for the presence of cultural deposits above the drawdown zone, but extensive development at the site has disturbed any shallow cultural deposits that may originally have existed. Any potential remaining deposits would likely be found at deeper locations than previous disturbances.

Excavation required for the development and construction of land-based facilities will require archaeological testing to determine whether cultural deposits exist. The Freeman Creek site, if chosen, will likely require significant time and expense to complete a cultural resource evaluation and compliance process.

- **Capacity/Potential for New Facilities**

The existing recreation area has room for expansion. Several overflow parking areas are rarely used, except on heavy-use weekends. Downstream of the existing recreation, there are approximately 5 to 10 acres of land with slopes of 10 to 15 percent. Other land in the area has slopes in excess of 15 percent.

c. Big Eddy

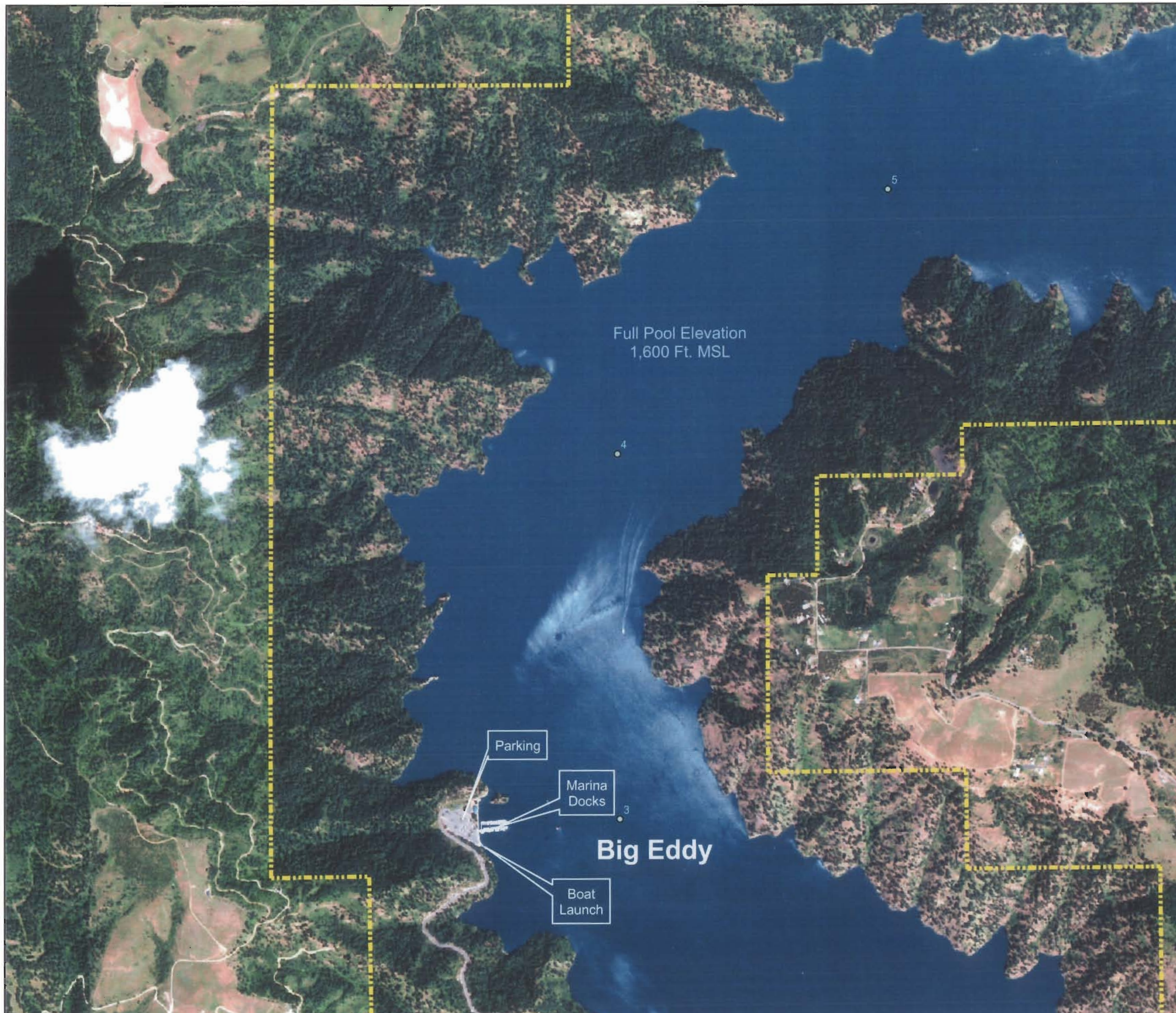
Big Eddy (photos 5 and 6, and plate 3) is located on the west shoreline of Dworshak Reservoir, approximately ¾ mile (1.21 km) northwest of Dworshak Dam, on land owned by the Corps. The area is partially under lease to IDPR for the marina and former restaurant building. Per the terms of the lease, the Corps maintains an obligation for damage claims to the marina in excess of $5,000 and is responsible for dock structures below the water surface. In the event that this site is further developed, the lease with the State could be amended to include all facilities on the site.

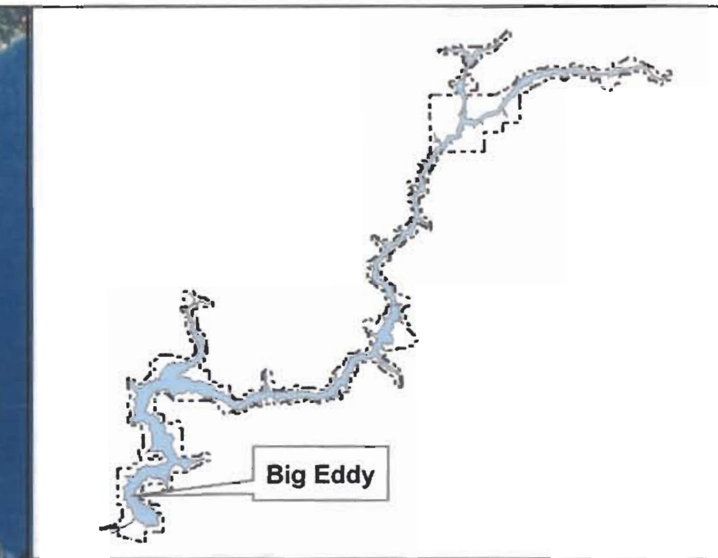
Photo 5: The marina at Big Eddy with pool elevation at 1520'

Photo 6: The Big Eddy boat launch is operable at all lake levels

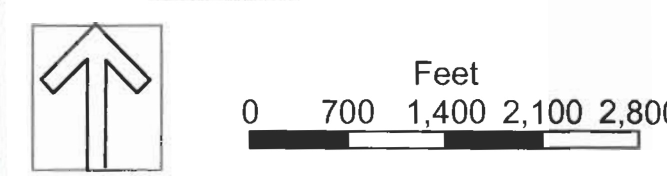
Big Eddy currently hosts a 2-lane boat launch, which is the only launch on the reservoir accessible at all stages of reservoir drawdown [155 vertical feet (47.24 m)]. The launch is 30 feet (9.14 m) wide to an elevation of 1538.2 feet, but varies from there to the end of the launch (elevation 1435 feet). The Marina also features 101 slips, a handling dock, tie-up dock, and floating fuel station. Day-use facilities at the site include a parking lot built to accommodate 68 car-trailer units, 23 car-only units, picnic tables, sun shelters, a playground, fish cleaning station, swim beach, hiking trail, and restrooms. A portion of the former restaurant is home to the IDPR offices.

Big Eddy was originally designed to accommodate day-use activities. Of the 166 acres (67.18 hectares) designated for use in the Master Plan, only 7 are developed because of slope constraints. These 7 acres (2.83 hectares) were created with fill material during the construction of Dworshak Dam and the road leading to Big Eddy. Because of the slope constraints, only limited future development was planned, including the expansion of the boat launch, more foot trails, and more picnic tables.





Sources: June / July, 2002 Quickbird 2.4 meter satellite ortho-rectified multi-spectral imagery.



Dworshak Marina Big Eddy Site

2004

PLATE 3

- **Soils**

Soils at the site consist of Uvi and Johnson series, both deep, well-drained soils. Uvi soils were formed in loess and material from granitic and/or metamorphic rocks with a mixture of volcanic ash. They occur on canyon sides and mountains, with slopes of 5 to 75 percent. They experience moderate to very rapid runoff rates, with moderate permeability.

Johnson soils were formed in loess and material weathered from granitic and metamorphic rocks; and permeability is moderate or moderately slow. These soils occur on canyon breaks, benches, mountains, and hills, and have slopes ranging from 6 to 75 percent. Further information on both soil types can be found at *http://ortho.ftw.nrcs.usda.gov/cgi-bin/osd/osdname.cgi*.

Soils investigations would need to be conducted to determine the feasibility of additional development. The major issue would be anchorage of the dock facility to the shoreline.

- **Access/Distance From Orofino**

Big Eddy is approximately 8 miles (12.87 km) from Orofino, and is accessed by a 2-lane road that is a continuation of Viewpoint Road. The final 3 miles (4.83 km) of this road are maintained by the Corps. The road is a minimum of 22 feet (6.71 m) wide, and has a maximum grade of 8 percent. The road has many turns, with the tightest curve having a horizontal curve radius of 100 feet (30.48 m). There are nine turns with a horizontal radius of less than 150 feet (45.72 m). The road is paved, but it is likely that improvements would have to be made to accommodate large boat access, or the road would have to be closed to other traffic during the transport of large boats.

Parking at the site would not be adequate for expanded facilities and moorage. Because of the existing topography in the area, it is unlikely that additional road access and parking would be developed for vehicular access to the area.

- **Slope/Aspect/Flat Land and Water**

The slopes at Big Eddy, with the exception of the immediate vicinity of the development marina and parking area, are generally above 15 percent. The Big Eddy Marina was constructed within a deep canyon draw, and the embayments just upstream of the Marina exhibit similar slopes and depth. The bay at the Marina drops from elevation 1600 to elevation 1400 within approximately 400 feet (121.92 m).

- **Utilities**

Power to existing facilities is provided from Dworshak Dam under terms of the lease, with an annual rental reimbursement payment to the Corps for electricity. If the operation were to be expanded, a source of commercial power would have to be obtained and an easement granted, as electrical power is already at capacity. The nearest existing commercial line is approximately 1 mile (1.61 km) from the site, although the available capacity of this line is unknown and would need to be investigated.

The potable water supply comes from a new surface water treatment plan operated by the Corps. The sewer system is a 4-inch (10.16 cm) force main line connected to the Ahsahka sewer treatment system.

- **Cultural Properties**

Big Eddy is located within the boundaries of the Nez Perce Indian Reservation. The site is unlikely to present major concerns regarding cultural resources, as no known cultural resources exist in the vicinity of potential development. The existing park and marina area was constructed in association with Dworshak Dam and, likewise, holds little potential for the presence of cultural resources. Upland areas around the developed flat area are steep, and hold little likelihood for the presence of cultural resources.

- **Capacity/Potential for New Facilities**

The existing flat land at Big Eddy was created using fill material. The 4 acres (1.62 hectares) of available land has already been developed; and includes a parking lot, picnic area, and a comfort station. During holiday weekends, the parking lot is filled to capacity. The only option for expansion of the parking area would be to pave the existing grass picnic area. In addition, there is little room available for new, land-based developments because of the steep topography adjacent to the site.

It is not possible to expand the existing boat moorage facility at Big Eddy in order to accommodate houseboat moorage. However, there are two nearby bays, one upstream and one downstream, that could possibly be used to develop a large boat marina. Both bays have a useable water surface area of 700 feet (213.36 m) by 500 feet (152.4 m) at minimum operating pool. This would provide a minimum water depth of 20 feet (6.09 m). Access to these two bays would be of paramount concern.

6. Climate

The climate in the North Central Canyons of the Clearwater River Basin is characterized by mild summers and long, cold winters. Typically, the average summer daily high and low temperatures range from 88 to 52 degrees Fahrenheit (31.1 to 11.1 degrees Celsius), while winter temperatures can fall below 0 degrees Fahrenheit (-17.8 degrees Celsius).

Most of the region's precipitation falls from November to January. Much of this precipitation is in the form of snow, particularly at the higher elevations. Snow in the high country begins to accumulate in late September or October, and frequently continues to accumulate until April or May.

Storms in the area are generally of fairly low intensity and duration, although some systems may last for several days. During the warmer months, precipitation occasionally takes the form of thunderstorms of short duration. Annual precipitation rates range from 24 inches (60.96 cm) near Dworshak Dam to nearly 80 inches (203.2 cm) near the summit of the Bitterroot Mountain Range. Regional climactic conditions are diverse, due largely to the extremes in topography. This diversity contributes greatly to the complex vegetation, soils, and wildlife in the region.

7. General Engineering Aspects of Soil Behavior in the Dworshak Area

The high slopes along the reservoir are covered with residual soils in many places. These soils are the product of weathering metamorphic rocks. Because of the instability associated with these soils and the weaker rock masses, particularly in the steeper areas, construction activity on the project is challenging.

In some locations along the reservoir, a fairly flat bench occurs between the steep mountainous terrain and the maximum pool elevation. These flat areas are generally associated with the clays and poorly-inundated shales mentioned above. The clay-deposited locations are typical of slide areas (photo 7); and have hummocky topography, seep areas, and ponded water.

Recreation development in many areas was initially delayed until the reservoir was cycled several times in order to observe possible slide areas after impoundment. Some of these areas showed little evidence of movement (or none at all), but others showed fresh slide scarps, cracks, and signs of recent movement. Sites identified as potentially dangerous landslide areas at that time included Dent Acres, Little Bay, and Elk Creek Meadows.

Photo 7: Rolling meadows often exhibit slumping, a characteristic of clay soils.

8. Water Quality

At full pool, Dworshak Reservoir covers 17,090 acres (6,916 hectares), is nearly 54 miles long [86.9 kilometers (km)], and has a usable storage capacity of approximately 2 million acre feet (2.467 million cubic meters). The average hydrologic residence time (HRT), the average length of time that water remains in the reservoir, is about 10 months.

Because the reservoir has low nutrient concentrations, a low buffer capacity, and relatively warm surface water temperatures, some of the common characteristics of marina operations must be carefully considered in order to prevent deterioration of the water quality. A much more detailed description of reservoir limnology and marine operations can be found in Appendix B. The following points highlight restraints that must be considered in determining the best site for the proposed large boat marina:

- New parking lots should be graded to slope away from the reservoir, and drainage should be collected in a storm water system and treated or filtered before possible discharge into the reservoir.
- Catchment drains should be installed at the top of launches and gutters, and at selected locations along the launches, to help capture surface runoff before it reaches the reservoir.
- Erosion-resistant vegetation should be planted in buffer zones and other green areas to filter nutrients and other particles from the runoff.

- Pest management practices should employ preventive, cultural, and biological methods to control pests in order to avoid using toxic lawn and garden chemicals that could migrate into the reservoir and harm the biota.
- Pet owners should be required to exercise their pets in designated areas away from the reservoir, and free dog waste disposal bags could be made available at those areas.
- Adequate fuel spill response equipment should be onsite and easily accessible. Additional steps outlined in Appendix B should be taken to contain minor spills and bilge water.
- Additional sewage pump-out facilities will need to be constructed. Particular attention should be given to educating the public and encouraging the use of chemical-free alternatives for disinfection.
- Boat-washing areas should be located where wash water can be directed to a sump, rather then back into the reservoir. In addition, boat owners should be encouraged to wash moored boats by hand above the waterline to minimize flushing materials overboard. Another option would be to construct a facility to recycle wash water after screening and filtering processes have been concluded.
- Dry-docked boats should be stored away from water, with drip pans placed under stern drive units and outboard engines. Moored boat owners should be encouraged to use tarpaulins or boat covers, as this will help minimize the amount of water that can enter the bilge.
- Proper facilities should be provided for the disposal of hazardous wastes from engine and hull maintenance and repair.
- Water conservation practices should be implemented in any future development to help reduce the volume of wastewater that must be treated.
- A fish waste management area similar to the one recently installed at Big Eddy should be constructed at any new marina site.
- Additional efforts must be made to encourage proper municipal waste disposal and recycling efforts.

9. Aesthetic Resources

The importance of managing the visual resources at Dworshak Dam and Reservoir lies in the premise that the majority of visitors to the area expect to find an aesthetically-pleasing environment. Visitor surveys taken in the 1990's support this, as sight-seeing was cited by visitors as the most frequent activity (photo 8).

Photo 8: Visitors enjoy viewing the abundant wildlife as well as the scenery at Dworshak.

For the purpose of this analysis, aesthetics were evaluated using the concepts developed by the US Forest Service for the evaluation of aesthetic resources. An analysis of aesthetics was not made during the Tier I portion of the evaluation but, during the Tier II portion of the evaluation, aesthetics were evaluated based on the following criteria:

- Potential degree of change to the landscape;
- impacts to the view shed looking out from the area of effect from the development;
- impacts from development to the views of the site looking in from the reservoir; and
- ability of the landscape to accept visual change.

Consideration was also given to the auditory effects of development, which may be amplified by the steep canyon walls.

10. Biological Considerations

Because the three sites selected for further consideration during this site analysis are already developed to some degree, cursory-level impacts to biologically sensitive species were reduced or eliminated. Once a site is selected as most feasible for a large boat marina facility, actual impacts to fish and wildlife resources at that site would have to be determined. The following paragraphs summarize the contents of the Biological Evaluation contained in Appendix C.

The species in the region listed under the Endangered Species Act (ESA) include Bald Eagle (*Haliaetus leucocephalus*), Gray Wolf *(Canis lupus)*, Canada Lynx (*Lynx Canadensis*), Bull Trout (*Salvelinus confluentus*), Snake River Basin Steelhead Evolutionarily Significant Unit (ESU) (*Oncorhynchus mykiss*), Snake River Sockeye Salmon ESU (*Oncorhynchus nerka*), Snake River Spring/Summer-Run Chinook Salmon ESU (*Oncorhynchus tshawytscha*), and Snake River Fall-Run Chinook Salmon ESU (*Oncorhynchus tshawytscha*).

Bald eagles become habituated to routine and repetitive human activities, and avoid areas of high human activity. Since each of the proposed sites is already disturbed in some way, it is unlikely that expansion at these sites will adversely impact bald eagles.

The Idaho population of gray wolves is classified as an experimental/non-essential population and, therefore, consultation under the ESA is only required if a proposed action may jeopardize the continued existence of the species. Based on the known range of existing populations, territoriality, adaptive nature, and lack of localized sightings, the proposed action would have no anticipated impact at any of the three sites.

Canada lynx generally frequent old-growth forests. All of the proposed project actions will take place either in already developed areas or in open water areas where it is unlikely that Canada lynx would be impacted.

The most difficult of the ESA-listed species to analyze are bull trout. The reservoir has an isolated sub-population of migratory bull trout, but the number of bull trout using the reservoir during the migratory period (April to May) is limited and not dependent on food sources derived from the littoral zone. However, the fish overwintering in the reservoir use habitat below drawdown levels, and could be impacted by marina expansion. While this impact is not expected to be significant, further analysis will be required once a large boat marina site has been chosen. It is likely that, given the current biological and siting information, the Corps would propose a determination of *may effect, but not likely to adversely affect*.

The Snake River Basin Steelhead ESU, listed as threatened under the ESA, has included wild Clearwater River steelhead since 1999. The most recent draft (2004) of the Federal River Columbia Power System Biological Opinion from National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries), now includes all North Fork Clearwater River steelhead. All members of the species *Oncorhynchus mykiss*, whether true steelhead or rainbow trout, that occupy Dworshak Reservoir are the only ESA-listed anadromous salmonids in the potentially affected areas of activity. All proposed actions will take place in developed areas in open water greater than

150 feet (45.72 m) deep. Therefore, given current biological information, the proposed project is not expected to impact Snake River steelhead. It is likely that, given the current biological and siting information, the Corps would propose a determination of *may effect, but not likely to adversely affect*.

The Snake River Sockeye Salmon ESU exist in Dworshak Reservoir only in the form of supplemented kokanee salmon, a local gamefish. No impacts to Snake River origin wild sockeye salmon are anticipated, because none are known to occupy Dworshak Reservoir. Given the current biological and siting information, the Corps would likely propose a determination of *no effect*.

As a consequence of historical destruction, the indigenous spring Chinook salmon stock of Clearwater River wild origin are legally considered extinct, and no Snake River Spring/Summer-Run Chinook Salmon occupy the reservoir. In all likelihood, based upon current biological and siting information, the Corps would propose a determination of *no effect*.

No Snake River Fall-Run Chinook Salmon occupy Dworshak Reservoir, and the proposed project is not expected to impact these salmon. Indigenous fall Chinook salmon stock of Clearwater River origin either never existed or are legally considered extinct. The current spawning segment of the population at Hog Island is believed to be a function of extended spawning of Snake River stock resulting from cold releases from the reservoir. The lowest reach of the Clearwater River has been designated by NOAA Fisheries as critical habitat for these salmonids. It is likely that, given current biological and siting information, the Corps would propose a determination of *no effect*.

11. The Planning Process and Environmental Considerations

From the beginning of this large boat marina study effort, it was recognized that the process should be structured to comply with both the procedural provisions of the National Environmental Policy Act (NEPA) and all applicable procedures found in the Six-Step Planning Process developed by the Corps. It is further recognized that this site analysis is only a small portion of the overall effort necessary to fully implement the six-step planning process and comply with NEPA as it relates to marina development. It is believed, however, that adherence to these guiding documents will ensure that the product and results produced by this analysis will provide a firm and suitable basis for any future efforts regarding marina development and/or updates to Design Memorandum 10, *Public Use Plan For Development and Management of Dworshak Reservoir, North Fork Clearwater River, Idaho*, and an associated supplemental environmental impact statement.

This current effort has focused on selecting a small group of sites suitable for large boat marina development. This task involved Step 1 of the Six-Step Planning Process, *Identification of the Problems and Opportunities*; and Step 3, *Formulation of Alternative Plans*. Adherence to these steps ensured that the PDT addressed procedures detailed in the Council on Environmental Quality's regulations governing the implementation of NEPA for the identification of underlying reasons for a particular action and the identification and evaluation of an array of alternatives to address those reasons.

The factors considered in the selection of sites warranting further study for a large boat marina is discussed throughout this report, and is detailed in Appendix A. The criteria developed by the PDT at the start of this process was used to narrow the list of potential sites down to those most physically suited to marina development. This information should be valuable if further studies are authorized.

If further analysis efforts are forthcoming, they will require, but not be limited to, the following:

- Documentation of the specific problems and opportunities associated with marina development;
- the identification of alternatives other than marina development to encourage economic growth in the Orofino area;
- an evaluation of the economic viability of a large boat marina; and
- an in-depth analysis of potential environmental impacts from marina development.

Environmental considerations that must be addressed in any future study include:

- Compliance with NEPA, the Clean Water Act, National Historic Preservation Act, ESA, Fish and Wildlife Coordination Act, and Sections of the Rivers and Harbors Act;
- compliance with other applicable environmental laws and Executive Orders, as well as Corps regulations; and
- analysis of the relationship and compatibility of a marina to designated land use classifications and established resource objectives.

Of equal importance to the overall process is a determination of whether it is acceptable to undertake marina development without the benefit of a reservoir-wide updated master plan and environmental impact statement, or whether marina plans may simply be amended to the master plan along with the development of an environmental assessment.

12. Economic Evaluation

The gradual loss of wood-related manufacturing jobs in Clearwater County has created economic disarray in the region. Employment declined by 153 jobs from 1992 to 2000, with the majority coming from the manufacturing arena. While service-related employment rose by 280 jobs during the same timeframe, it is well documented that six service-related jobs are required to replace one wood-related manufacturing job.

In 1992, per capita income in Clearwater County was 78.5 percent of the national average and 94.7 percent of the state average. In 2001, those percentages had dropped to 69.6 percent and 86.4 percent, respectively. In comparing the general economic health of Clearwater County to a random sampling of 21 other counties widely disbursed throughout the Pacific Northwest, Clearwater County ranks 18th. These communities are listed in Appendix D.

It is hoped that the natural beauty of Clearwater County, and Dworshak Dam and Reservoir in particular, can be developed to encourage increased tourism by creating additional recreational opportunities. The addition of a large boat marina and houseboat moorage facility could potentially encourage more recreationists to visit the area, thus giving a boost to the local economy.

At present, marketing statistics indicate that almost one-third of all visitors to Dworshak Reservoir come from nearby counties. If a large boat marina is developed, marketing efforts should focus on the two closest regional population centers (Boise, Idaho, and Spokane, Washington).

A detailed discussion of potential economic impacts to Clearwater County given the development of a large boat marina is developed are contained in Appendix D.

13. Conclusions

Dworshak is situated in a beautiful, forested setting with high scenic and recreational value. The fluctuation of the operating pool has necessitated that management explore recreation alternatives that will allow more people to access reservoir lands and waters, but were not considered in the original design memorandum. A large houseboat marina and rental facility would make the entire reservoir available to users and enable them to spend multiple days on the reservoir, something lost with the inaccessibility of the mini-camps during drawn down reservoir conditions.

This analysis has determined that three existing recreation sites, Big Eddy, Bruce's Eddy, and Freeman Creek, would be the most suitable for development of a large boat marina at Dworshak Reservoir. Each site offers differing development opportunities based on soils, slope, and aspect, but all of the sites have access roads, existing utilities (or available commercial utilities that can be brought to the site), established boat launches, parking, sanitary facilities, and are located within an hour's drive time from Orofino, Idaho.

The development of a large houseboat marina on federal land at Dworshak Reservoir would require a complete environmental review of any plans proposed by a concessionaire. The environmental review will include NEPA clearances for environmental and cultural impacts to the land base, a biological assessment, water quality analysis, and an evaluation of the cumulative impacts of the proposed action. A concessionaire would likely operate under a sublease to Idaho State Department of Parks and Recreation, and would be responsible for compliance with all laws and regulations applicable to lands owned by the Corps.

14. Recommendations

a. Big Eddy Marina Expansion

In this analysis, it became apparent that there is currently a lack of marina spaces available for recreational boaters on the reservoir. The possibility of expanding the marina at Big Eddy should be explored to accommodate more boats in the less than 26-foot-length class.

b. Market Analysis

A market analysis is recommended to determine the viability of commercial enterprises that would provide additional recreation opportunities. Close coordination between the Corps, Congressional representatives, the local community, IDPR, the Nez Perce Tribe, and interested businesses is necessary to adequately plan for future development on Dworshak Reservoir.

c. Site Visit and Request for Proposal

It is recommended that an invitation be offered to an extensive list of companies with houseboat rental/resort interest and experience to visit Dworshak Reservoir, with an eye to developing an enterprise in the area. A list, although by no means all-inclusive, of potentially interested and qualified operators is contained in Appendix E. After the completion of site visits, a Request for Proposal (RFP) should be sent to as many potential interested parties as possible.

d. Partnering Opportunities

There is a great deal of regional interest in this project, particularly by the State of Idaho, who is a lessee in the area, and by the Clearwater Economic Development Association. Grants may be available to assist in the development of such an enterprise.

Appendix A

Rationale For Site Selection

1. The Process

Once it was determined that a need existed for a site analysis for a large boat marina on Dworshak Reservoir, a Product Delivery Team (PDT) was formed. This PDT consisted of experts in engineering, landscape architecture, fisheries biology, wildlife biology, real estate, National Environmental Policy Act (NEPA) coordination, water quality, and cultural resources.

The PDT first met to determine criteria important to site selection for this undertaking. The two-tier process shown in table 1 was developed at this time, as were the initial areas of interest in each tier.

The Tier I evaluation consisted of those elements deemed most essential for a site to receive consideration as a large boat marina facility. It contained the following elements:

- Slope: How steep is the topography of the site? Sites of less than 15 percent are necessary for the development of a large scale marina.
- Access: How easy is it to get to the area? Are there roads available to the site currently? If so, how suitable are those roads?
- Utilities: Are utilities already available to the site? If not, how difficult would it be to get water, electricity, *etc.*, to the site?
- Cultural Properties: Are there any known cultural properties in the area? Have they been evaluated for eligibility for the National Register of historic Places? Is the site located in an area of cultural or historic significance? Is there a plan in place to deal with historic properties or other cultural items if found during development?
- Aspect: Will new marina facilities be sheltered, or will they be subjected to prevalent wind from any certain direction?

The Tier I evaluation originally contained elements about Endangered Species Act (ESA)-listed impacts and soils. However, after the initial site visit, it was determined that not enough information was readily available at that time to accurately evaluate those items.

Eleven sites were visited in August 2004. Those 11 sites are listed in Table 1. After this initial evaluation, the PDT rated the Tier I elements of each site from 1 to 5, with 1 being least desirable and 5 being most desirable. The

PDT then totaled the scores for each site, and narrowed the number of potential sites to six: Bruce's Eddy, Big Eddy, Dent Acres, Freeman Creek, Canyon Creek, and Merry's Bay.

Table 1 - Dworshak Large Boat Marina Site Analysis

Site	Tier I						Tier II					
	Slope	Access	Utilities (existing & potential)	Cultural Properties	Aspect (wind/sheltered)	Total	Aesthetic Resources	Flat Land and Water	Capacity	Distance from Town	Potential for Future New Facilities	Total
Freeman Creek	4	4	5	4	5	22						
Big Eddy	3	5	5	5	3	21						
Bruce's Eddy	4	5	5	4	3	21						
Dent Acres	4	4	5	1	2	16						
Canyon Creek	2	3	1	2	5	13						
Merry's Bay	3	3	1	2	3	12						
Little Bay	3	2	1	2	2	10						
Grandad	1	1	1	2	1	6						
Evans Creek	3	1	1	2	3	10						
Elk Creek Meadows	4	1	2	1	2	10						
Magnus Bay	4	1	1	1	2	9						

Rating Criteria—
1 = Least Suitable
↓
5 = Most Suitable

The PDT met again to evaluate and rate these six sites based on criteria established for Tier II, again using the same rating schema. Those numbers were totaled, and the top three sites were selected for detailed analysis. Those numbers can be found in Table 2.

The Tier II evaluation consisted of those elements considered important, but not essential, for a site to receive consideration as a large boat marina facility. This evaluation contained the following elements:

- Aesthetic Resources: Looking into and out of the site, how will the view be affected by development? Can additional facilities be placed at this location without significantly detracting from the natural beauty of the area?
- Flat Land and Water: Is there enough deep water and flat land to develop both a large moorage facility, parking, and resort buildings?
- Capacity: Can the site sustain a large moorage facility at all levels of reservoir drawdown?
- Distance from Town: How far is the site from Orofino in terms of miles? In terms of driving time?
- Potential for Future New Facilities: Does the site have the capacity for growth and expansion?

Table 2 - Dworshak Large Boat Marina Site Analysis

Site	Tier I						Tier II					
	Slope	Access	Utilities (existing & potential)	Cultural Properties	Aspect (wind/sheltered)	Total	Aesthetic Resources	Flat Land and Water	Capacity	Distance from Town	Potential for Future New Facilities	Total
Freeman Creek	4	4	5	4	5	22	4	4	3	2	5	18
Big Eddy	3	5	5	5	3	21	4	3	2	5	2	16
Bruce's Eddy	4	5	5	4	3	21	4	4	5	5	3	21
Dent Acres	4	4	5	1	2	16	4	3	2	3	3	15
Canyon Creek	2	3	1	2	5	13	3	2	4	3	1	13
Merry's Bay	3	3	1	2	3	12	2	2	3	4	2	13

Rating Criteria—
1 = Least Suitable
↓
5 = Most Suitable

2. The Rationale

As mentioned previously, each of the eleven sites was evaluated based on several criteria. The Tier I evaluation eliminated Little Bay, Grandad, Evans Creek, Elk Creek Meadows, and Magnus Bay from consideration as a large boat marina. The following explains the rationale that went into the elimination of these sites during the Tier I evaluation:

The Little Bay site has some level ground, but it can be accessed only by boat or on unimproved roads. No established hiking access or utilities are available onsite. The area is important for many species of birds and animals, including white-tail deer, elk, beaver, mink, striped skunk, coyote, various raptors, waterfowl, and upland game birds. Archaeological records indicate that the area around Dworshak has been inhabited for more than 10,000 years. Over 450 sites have already been recorded around the reservoir, and it is likely that potentially eligible historic and prehistoric sites exist at Little Bay.

The Grandad Creek site has very limited use for development because of its steep topography and lack of available land for expansion. In addition, it is not highly developed (ten primitive camping sites and a 1-lane boat launch), and there is a great potential for cultural deposits. Access to the site is difficult; as it is almost 66 miles [106.22 kilometers (km)] from Orofino, over many gravel roads with little or no directional signage.

The Grandad Creek boat launch under
80-foot (24.38 meters) drawdown conditions.

The Evans Creek site is also difficult to access. It is 46 miles (74 km) from Orofino, and the nearest road is roughly 6 miles (9.66 km) away. There is little Corps-owned land around the site, with only about 3 acres (1.21 hectares) available for development. There are no utilities onsite, none available nearby, and the potential for installation would be cost prohibitive. There is only a limited protected bay for marina development.

Elk Creek Meadows was identified in the Master Plan as a site for future recreation development. This has not occurred, primarily due to funding limitations and constraints. The open meadows and large, relatively level topography lends itself to major recreation development. However, the site is approximately 1.5 hours from Orofino, over limited road access that would require easements or rights-of-way to cross private lands. The distance from Orofino makes the site less attractive as part of this effort, as it is actually closer to Julietta and Kendrick, Idaho. There is no sewer or water available nearby, although electrical power is available within 1.5 miles (2.41 km). A full-pool-rotation marina would have to be located out in the main boating channel because of the gradual underwater slopes, and would have virtually no shelter from the wind.

Primitive roads provide the only access to the Magnus Bay site, and there are no utilities near the site. The slope of the bay is very gradual, so a dock would have to extend into the main channel for adequate depths for large boats and houseboats. The area collects high volumes of woody debris in the spring. There are also several environmental issues to contend with, as the area includes wetlands, ephemeral streams, and important wildlife habitat.

In springtime, large woody debris collects
in various bays around the reservoir.

Appendix B

Water Quality

1.0 INTRODUCTION

This section will examine some of the water quality and water use issues associated with marina development. Since specific plans have not been finalized regarding marina size, scope of operations, and anticipated patronage, some of the following is generic. It is, however, applicable to any of the potential alternatives. Similarly, the water-quality characteristics of the reservoir near the historical thalweg have been evaluated over the years, but nearshore data is lacking. Quantitative physical and chemical characterizations of the sediments, especially in the areas of interest, are also unavailable.

2.0 BACKGROUND LIMNOLOGY

The limnology of Dworshak Reservoir has been studied on several occasions since the project became operational for flood control in 1972. The reservoir covers 17,090 acres (6,916 hectares) at full pool, is almost 54 miles (86.9 kilometers) long, and has a usable storage capacity of approximately 2 million acre feet (2.467 million cubic meters). The average hydrologic residence time (HRT), the average length of time that water remains in the reservoir, is about 10 months. However, there are important spatial and temporal variations. During June, when inflows are close to their annual maximum yet discharge is kept to a minimum, the calculated HRT can be quite long. During July and August, when inflows are characteristically low and discharge increases [recent releases were close to 14,000 cubic feet per second (cfs) (396.44 cubic meters per second)] for downstream flow augmentation and temperature control, the instantaneous HRT may only be about 1 month. In addition, the reservoir is long and narrow with many inundated valleys, and this gives it a dendritic appearance [the calculated shoreline development is about 9.6 (the ratio of the length of the shoreline to the circumference of a circle of equal area to that of the reservoir)]. The consequence of this configuration is that water in sheltered bays may circulate less and have a longer HRT.

The majority of the reservoir is thermally stratified during the summer, and the relatively deep section of the pool near the potential marinas is typically monomictic (the water mixes vertically once a year), with turnover usually occurring in January or February. The epilimnion, or upper strata of warm water, typically occupies the top 13 to 23 feet (4 to 7 meters) of the reservoir during the summer. Water temperatures in this layer can reach, and even exceed, 77 degrees Fahrenheit (^{o}F) [25 degrees Celsius (^{o}C)] during July and August. This warm surface water, combined with low nutrient concentrations, can create an environment advantageous to blue-green algae during late summer and early fall. Nuisance algal blooms have been observed in some sections of the reservoir, including Merry's Bay and Bruce's Eddy. The hypolimnion, or deep strata of the reservoir, occupies a larger volume than the epilimnion; and temperatures there range from about 39.2 to 44.6 ^{o}F (4 ^{o} to 7 ^{o}C) year round.

Available data indicates that water columns at all of the historical sampling stations remained oxygenated when measurements were recorded. Percent saturation in the surface waters ranged from slightly below 100 percent to 120 percent. Anoxic conditions (lack of oxygen) were not detected in the hypolimnion at any time. However, percent saturation has decreased to about 40 at river mile 45 during summer drawdowns. This phenomenon suggests the presence of a sediment oxygen demand due to organic matter. It is unknown if a similar oxygen demand occurs in the bays identified for marina development.

One sampling location historically included in most water-quality surveys, and relatively close to the three potential marina sites, is at river mile 3 – offshore from Big Eddy where the water is about 650 feet (198.12 meters) deep at full pool. The summer-time specific conductance at this site is about 30 microSiemens per centimeter (µS/cm), a measurement equivalent to micromhos per centimeter, while the alkalinity is typically less than 30 milligrams per liter as calcium carbonate (mg $CaCO_3$/L) - reflecting the low buffer capacity of the reservoir water. The mean pH (the negative logarithm of the hydrogen ion concentration) is close to 7 units, but can exceed 8 units in the epilimnion during the summer as a result of algal productivity. The reservoir is phosphorus limited in the summer, with surface orthophosphate concentrations less than 0.001 milligrams per liter (mg/L). However, co-nutrient limitation with nitrogen can occur when soluble nitrogen concentrations are less than 0.01 mg/L.

The trophic state of the reservoir has fluctuated since the pool was created. These changes in the degree of nutrient enrichment are part of the reservoir's natural aging cycle, and the water body is currently classified as meso-oligotrophic. Individual bays have not been monitored, but data collection has occurred in the Elk Creek arm. This area represents the upper end of the trophic scale relative to the mainstem. It has been suggested in the past that nearshore primary productivity is higher than off-shore carbon uptake due to bank erosion that results from wave action and the fluctuating pool level. However, this hypothesis has not been fully tested to provide a definitive answer.

3.0 MARINA ACTIVITIES AND OPERATIONS

Due to the limnological characteristics outlined above (*e.g.*, low nutrient concentrations, low buffer capacity, and relatively warm surface water temperatures), some of the common characteristics of marina activities and operations need to be considered to prevent water-quality deterioration.

3.1 Parking Areas and Storm Water Runoff

Paved roads and parking lots for vehicles, boat trailers, and boats are frequently the main sources of surface water runoff into marinas. Paved areas already exist at all three potential marina locations, with the least amount found at Freeman Creek. In locations where development occurs, it is important to keep the amount of impervious area to a minimum and as far away from the reservoir as possible to reduce the chance for runoff and debris to reach the waterway. Carts or trailers may have to be provided to transport equipment and persons with disabilities to and from their boats. New parking lots should be graded to slope away from the reservoir, and drainage should be collected in a storm water system and treated or filtered before possible discharge into the reservoir.

There are several options available for managing parking lot, as well as rooftop, drainage. Water originating from parking lots is likely to include hydrocarbons, and should first be directed through oil/grit separators before entering any other management structure. Subsequent structural controls to consider include:

- Storm water pond systems that capture and slowly release the water. These ponds may be permanent (retention ponds), or may hold water only temporarily (detention ponds).
- Storm water wetland systems designed to mimic the ability of natural wetlands to cleanse and absorb storm flows. These systems also provide additional habitat for aquatic and terrestrial wildlife that can, in turn, impart a benefit to the entire project.
- Infiltration systems designed to take advantage of the natural infiltration capacity and pollutant removal characteristics of soil. A dry well is one example of an infiltration system designed to treat rooftop runoff. Water is collected in downspouts, and then directed into a filter composed of crushed stone and fabric. Bioretention areas planted with native vegetation and sited to collect storm water are another example. These gardens also provide shade and wildlife habitat, act as windbreaks, and muffle noise.

Alternatives to asphalt for parking lots and vessel storage areas should be considered. These alternatives include gravel, engineered porous pavement (also considered an infiltration system), and a non-toxic, organic soil binder such as the one derived from the *Plantago* plant family. When this binder is combined with crushed aggregate and soil, it creates a somewhat permeable surface that will not erode. This resilient material will not crack during winter freeze/thaw cycles, can be repaired by adding more material and tilling the surface, and can be dug up with a shovel to plant trees and shrubs.

Heavily used boat launches are typically constructed of asphalt or concrete, and constitute another impervious surface at marinas. The boat launches at Dworshak are long due to the annual water level fluctuation, and mitigating surface runoff can be challenging. However, the installation of catchment drains at the top of the launches and gutters at selected locations along the launches could help capture some of the runoff before it reaches the reservoir.

3.2 Buffer Zones

Buffer zones share many similarities with the storm water control measures identified above. They are typically placed between a paved area and the marina basin to reduce the amount of surface water runoff entering the waterway, prevent erosion, enhance the overall look of the marina, and provide additional leisure space. Healthy soil, grasses, and plants capture, treat, and slowly release storm water through a combination of microbial action, vegetative uptake, and evaporation/transpiration.

Grassy swales are one type of buffer zone frequently used in urban areas and can be adapted to marinas. Grassy swales consist of low-gradient channels planted with erosion-resistant vegetation. Water generally moves more slowly over a grassed swale than it would in a pipe or lined channel, and the plants can filter a variety of nutrients and particles.

In addition to grassy areas, green space can also include trees, shrubs, and flowerbeds to reduce the rate of surface water runoff and make the area more attractive. Vegetated areas should contain plants that require minimal care in terms of trimming, watering, and applications of fertilizer and pesticides. Indigenous plants demand little care since they are adapted to the local climate and soil types. Large plants may also shade out some weeds, and they do not need to be watered as frequently as grass due to their deeper root structure.

3.3 Pest Control

The use of vegetated buffer zones and bioretention areas also brings up the issue of "pest" control. Because a marina is in close proximity to water, it is important to avoid using toxic lawn and garden chemicals that could migrate into the reservoir and harm the biota. Instead, unwanted plants or animals should be deterred with integrated pest management practices that employ preventive, cultural, and biological methods to control pests while minimizing impacts to non-target species, wildlife, and water quality. Suggested practices include:

- Select disease- and insect-resistant plants that will out-compete common weeds when possible.
- Mow lawn areas properly to suppress weeds.
- Pull weeds by hand to reduce reliance on herbicides.
- Foster natural predators (*i.e.*, spiders, praying mantis, dragonflies, beetles, birds, bats, frogs, lizards, and certain snakes) by providing appropriate structures for the organisms to inhabit. When this

approach is taken, information should also be provided to marina clients regarding why these organisms are beneficial and their populations are being encouraged.

- Try to use organic alternatives to chemical pesticides first, and use chemical pesticides only after all other options have been exhausted. Purchase the least toxic chemical in the smallest amount practical.
- Apply pesticides directly to problem areas rather than utilizing broadcast measures.
- Treat only serious or threatening intolerable pest infestations.
- Do not use pesticides just before a rainfall or on a windy day.
- Do not apply pesticides near water (*e.g.*, the shore, wells, streams, ponds, bird baths, and swim areas).

3.4 Pet Waste Management

Pet waste can be just as detrimental to the aquatic environment as human waste, with respect to pathogens and nutrients. The marina should require pet owners to exercise their animals in designated areas away from the reservoir, and to “stoop-and-scoop.” The distribution of free dog waste disposal bags at the marina will also promote a cleaner environment and enhance public awareness.

3.5 Boat Maintenance and Operations

3.5.1 Fueling

The only publicly-available fuel source currently on the reservoir is at Big Eddy, but this would likely change with the addition of a new marina. Fuel spills are a concern, since they can result in the release of hydrocarbons (*e.g.*, gasoline, diesel, or oil) into the water, onto the ground, and into the atmosphere. Hydrocarbons are toxic to some aquatic species when they float on the water, while heavy petroleum products can settle to the bottom if they are attached to sediment particles. As such, adequate spill response equipment should be onsite and easily accessible so that spills can be prevented and properly dealt with when necessary.

Spill prevention during fuel transfer starts on the boat itself. An absorbent donut should be placed around the filler on the boat deck, and the attendant should always have a rag on hand to capture any fuel drips. After use, the rag should be placed in a vented container. Boaters should also be encouraged to install fuel/air separators on tank vents to prevent overflow from escaping. Customers with outboards should preferably carry a spare fuel tank rather than cans of fuel to reduce the chance of a spill.

Containment equipment should be stored at the fueling station. Booms and absorbent pads should be readily available. Marina staff must be trained (*e.g.*, safety issues, notification, cleanup, and disposal) to respond to a spill. The amount of boom needed will depend on the size of the largest fuel tank on board a vessel in the marina. Booms usually consist of 10-foot [3.05 meter (m)] floating sections that interconnect to encircle a spill, and the standard rule-of-thumb is that 3 feet (0.914 m) of boom is required for every 1 foot (0.305 m) of boat. There are generally two types of booms: containment booms and absorbing booms. A containment boom prevents spilled material from spreading on the surface by presenting a floating barrier. An absorbing boom prevents the material from spreading by absorbing the material.

One other item of boat operation that relates to petroleum products is the bilge. Engines and hydraulic components invariably leak petroleum products into the bilge water, which is ultimately pumped into the reservoir. The use of absorbent pads in engine compartments to contain small leaks or oil spills should be encouraged. Bilge switches that shut off when a floating oil layer is reached are also beneficial.

3.5.2 Pump-Out Services

The U.S. Army Corps of Engineers (Corps) currently provides a floating sewage pump-out facility at Big Eddy. The presence of this facility promotes a public perception of environmental responsibility, and ensures that most wastes will not be dumped into the reservoir. The addition of a new marina and houseboats could necessitate the addition of other similar platforms or land-based alternatives.

The presence of additional personal watercraft that would likely accompany marina development could also necessitate enhanced public education. There are still, unfortunately, some individuals who have no reservations about discarding human waste overboard if they believe no one is watching. This can be particularly true at the more remote areas of Dworshak Reservoir. However, sewage from boats is a threat to the environment when it is discharged into the reservoir, particularly if it occurs in one of the smaller bays where water circulation is limited. Nutrients from sewage can over-stimulate algal growth in the water, cause reduced dissolved oxygen levels, foster unpleasant odors, and present a health hazard.

One major concern with on-board holding tanks on any vessel is the use of chemicals (primarily formaldehyde and ammonia) for disinfection. Both of these compounds are toxic to organisms, and the marina should be encouraged to adopt a “no chemical” policy. If the marina has a septic system, a policy such as this will protect bacteria in the septic system and reduce maintenance costs. If the marina plans to discharge sewage to the municipal sewage system at Ahsahka, they should also be encouraged to adopt the chemical free policy to prevent disinfectants, which do not necessarily get treated at the wasterwater plant, from being released into the Clearwater River. As such, the marina should recommend the use of effective biological alternatives in place of chemical-based products. A list of products less harmful to the environment can be viewed at the "Marine Products" list at *http://www.environmentalchoice.com.*

3.5.3 Cleaning

Some private boat owners, as well as houseboat concessionaires, will invariably want to clean their vessels at the marina. Many cleaning products commonly used today contain phosphates and other chemicals that contribute to increased algal growth, reduced dissolved oxygen levels in the water and, in some cases, fish kills. The best way to prevent these products from getting into the reservoir is to restrict their use. Cleaners that contain ingredients such as ammonia, sodium, chlorinated solvents, petroleum distillates, or lye can be replaced by environmentally-friendly alternatives that are safer and just as effective.

At times, boats will be washed while they are moored in the reservoir. In these cases, they should be cleaned by hand above the waterline to minimize flushing material overboard. In the past, it was a common practice to allow the entire bottom-wash water, which contained algal growth and paint flecks, to be discharged directly into the waterway. A better alternative is to clean the hull after the boat is removed from the reservoir.

On-shore hull washing areas should be located where the wash water can be directed to a sump and not run back into the reservoir. Nothing should be washed on a planked or grated surface, or any other area where wash water cannot be contained. All visible solids should be removed from the wash water before being discharged back into the reservoir or sewer. If wash water is discharged into the sanitary sewer, it must meet the requirements of the local sewer authority. If an impervious surface is not available on which to clean, tarps should be placed under the vessel to collect water, paint chips, scrapings, or other wastes. Paint chips and scrapings may qualify as special waste and require disposal at an approved waste facility.

Another option that is somewhat more expensive, but should be considered at a new facility, is to recycle the wash water after it has been screened and filtered. The removal of contaminants from wastewater can be implemented in the following stepwise process, depending on the amount of pollutant removal desired or required:

- Settling: This process allows the contaminants to settle out of the wastewater as sediment, once it is allowed to stand undisturbed. This method is the least expensive, and the easiest to design and construct. However, it is only moderately effective at removing contaminants, because it will only remove particles that drop out during settling.

- Filtration: This step is completed by allowing the water to flow through one or more filters that screen out different-sized particles. Filtration can start at the washing platform, with the installation of filtration cloth over the wash water intake drain. This method is effective for straining visible particles. Additional filtration can be achieved by directing the water through a filter, or series of filters, with decreasing mesh sizes.
- Treatment: This method uses existing technologies from other industries to pre-treat the wastewater and remove contaminants. Treatment can include the removal of oil and grease, metals, or other contaminants, depending on the technology applied. For instance, agents can be introduced into the wastewater that encapsulate metals and force them to settle out of solution. This method is the most sophisticated level of wastewater treatment. However, once the wastewater has been treated, it can either be discharged back into the reservoir, discharged into a sanitary sewer system, or reused for pressure washing or other applications that require water.

3.5.4 Boat Storage

Boat storage space is a necessary amenity at any marina, for both private boat owners and houseboat concessionaires. Some boat owners will leave their vessels in the water for the entire season, while others will remove them more frequently. Boats that are dry-docked should be stored away from the water. When boats are stored on land, the potential exists for leakage from stern drive units and outboard engines. To prevent contamination from these types of leaks, drip trays should be placed under those units. Whether a boat is stored on land or moored at a dock, most owners use tarpaulins or reusable canvas boat covers to protect their investment. This practice should be encouraged, since it will help to minimize the amount of water that enters the bilge only to be subsequently pumped into the water.

3.5.5 Engine Maintenance and Repair

Marine engine maintenance and repair at Dworshak Reservoir would be more of a concern for houseboat owners than day-use boats due to their size. In either case, many wastes are generated while working on boat engines and hulls. Hazardous wastes at marinas include antifreeze (glycol), paint, solvents, oil, filters, bilge water, batteries, gasoline, and oily rags. Many of these products have historically been placed in the dumpster with everyday waste. Hazardous wastes should be kept segregated at all times, and should not be mixed or placed in containers with non-hazardous wastes. As such, clearly marked waste containers need to be available. It may be necessary for marina staff to monitor these activities to prevent cross contamination of the contents, or to collect the wastes directly from the customers' boats in order to assure proper handling. If the containers are located outdoors, they should be covered to prevent rainwater from collecting in them and ultimately leaking out as a contaminant.

3.5.6 Hull Repair – Painting and Sanding

With the presence of dry-dock facilities, houseboat operators, and possibly some personal watercraft owners, will want to sand and paint their boats. This can be an acceptable practice if the individual is aware of the environmental hazards involved in such tasks. Ideally, sanding should be undertaken in an enclosed facility where the grit can be contained and recovered. Working indoors or under cover in windy conditions will also prevent dust and paint from blowing into the open air. However, the reality is that at least some of this activity will occur outside. In these cases, the boat should be placed over a hard non-porous surface (*e.g.,* a concrete pad), a drop cloth should be placed beneath the hull to catch sanding dust and paint chips, and loose paint particles should be vacuumed or swept up instead of hosed away. Encouraging the use of dustless sanders, grinders, and closed-loop blasting systems can significantly reduce the amount of fine debris released into the environment. The marina may want to consider renting this equipment to their customers to promote their use and reduce contamination.

3.6 Washroom and Laundry Facilities

Marinas can play a very important role in water conservation in areas such as washrooms, showers, and laundry facilities. Restroom facilities are available at all three potential marina sites. Showers and laundry facilities are not currently present, but need to be considered in light of future development. The water supply for these facilities is currently pumped from groundwater or obtained from the dam. Wastewater is processed onsite at Freeman Creek, but diverted from Bruce's Eddy and Big Eddy to the Ahsahka wastewater treatment plant. Implementing water conservation practices with future development can significantly reduce the volume of wastewater that will need to be treated, lower operating costs, and provide environmental benefits.

Many practices can be implemented to reduce water use in restrooms. Adaptations that can be installed in toilet tanks to reduce the amount of water used in a flush cycle include water retention devices, water displacement devices, and alternate flushing devices. Another option is to replace the existing toilet with an ultra-low-volume (ULV) unit that not only uses less water, but also produces less wastewater. If the marina is located at Bruce's Eddy, the investment in water-efficient toilets could translate into a significant reduction in the combined water/sewer bill. Additionally, a smaller wastewater stream would provide downstream benefits. These include a smaller burden on the Ahsahka wastewater facility, which may have to be upgraded, and less discharge into the Clearwater River. The Freeman Creek location uses onsite septic drain fields. Integrating ULV toilets at that facility could translate into a smaller and/or longer-lasting drain field.

After toilets, shower and bath facilities in marinas consume the most water indoors. Conventional showerheads have flow rates of 3.96 to 5.28 gallons per minute (15 to 20 litres per minute). A properly designed, low-flow showerhead can reduce that flow by half, while still providing a good shower. A 5-minute shower with a standard showerhead uses 26.42 gallons (100 litres) of water, whereas the same shower with a low-flow showerhead uses only 9.25 gallons (35 litres) of water. Showerheads with a shut-off button should also be considered, since this feature allows the flow to be interrupted (*i.e.,* while user lathers up or shampoos), after which the flow will resume at the same rate and temperature (pay showers similarly have a positive effect on limiting water use). Conventional faucets have an average flow rate of about 3.57 gallons (13.5 litres) of water per minute. Low-flow aerators can reduce this flow to a rate of 0.53 gallons (2 litres) per minute, and spring-loaded faucets dramatically reduce water use as well.

If the marina plans to offer laundry facilities, decreasing the amount of water used in these machines is beneficial for the environment and can reduce operating costs. Most laundry machines can be programmed to eliminate the rinse or suds cycle to reduce water use. Marina users should be encouraged to reduce water levels to minimize water use, and to wash only full loads. The high-efficiency, front-loading washing machines currently available require only 25 percent of the energy and use half the water when compared to conventional top-loading machines.

3.7 Fish Waste Management

There are still some outdoor recreationists who believe fish wastes are biodegradable and can be eaten by other fish and birds. Too much fish waste in a small area (*e.g.*, an embayment of the reservoir) is not only unsightly and foul smelling, but may result in decreased dissolved oxygen levels in the water. The Corps recently installed a state-of-the-art fish cleaning facility at Big Eddy to manage the waste. This cleaning station includes a cutting table, wash-down basin, garbage disposal, and covered trash containers. Running water is provided, and a drain leads directly into the sewer main. This same type of arrangement should be included at any new marina.

3.8 Municipal Waste and Recycling

All marinas generate municipal-type waste. These wastes can impact human health, be hazardous to wildlife, and potentially impact water quality. The Corps currently provides plastic collection bags and a dumpster at the top of each boat launch. With the addition of a new marina and more recreationists, additional efforts will have to be made to encourage customers to help manage these wastes. Measures could include placing signage, putting waste containers at convenient locations, and even collecting wastes directly from the boats. Marina managers and employees should always set a good example by picking up waste and keeping the marina premises tidy.

Recycling is often not considered when designing a water quality management program. However, there are many benefits to implementing a well-run recycling program as part of a marina's overall waste management plan. It is a highly visible way to demonstrate environmental stewardship and promote environmental awareness. With the increased awareness of recycling in today's communities, many customers are likely to be in the habit of recycling already, and may expect to see recycling bins at the marina. In some rural areas, marina businesses are charged a fee for municipal waste disposal, whereas recycling pickup is free. Therefore, marinas can reduce the cost of waste disposal by ensuring that recyclable materials are separated from their municipal waste. Recyclable materials of interest would include spent batteries, used oil, antifreeze, shrink-wrap, dated propane tanks, scrap metal, glass, plastic, paper, and aluminum beverage cans.

3.9 Public Education

The need for public education has been mentioned previously in this section, but its importance cannot be over emphasized. Marina operators must educate both their customers and staff on environmental issues and the marina's policies and guidelines for operating an environmentally-friendly facility. Newsletters and contracts with tenants should be used as an educational method of informing them about environmental rules and regulations. Onsite bulletin boards and website postings are additional avenues for informing the recreating public of the environmental awareness of the facility, as well as the need to preserve the environmental integrity of the aquatic ecosystem and its surroundings. When marinas practice and promote environmentally-safe activities, they protect and preserve the water resource for themselves, and for future generations.

Appendix C

Biological Evaluation

1. Background

This large boat marina site analysis resulted from congressional funding allocated to study ways to stimulate the economy in Orofino, Idaho, by making Dworshak Reservoir a more viable recreational resource. When lake levels are drawn down, remote, boat-in campsites become almost inaccessible. Large boat owners and users have promoted the use of houseboats as a way to enjoy the entire reservoir without having to climb steep lakeshores to find a campsite. Large houseboats are also an attractive recreation alternative for persons with disabilities who may have difficulty hiking or negotiating the steep slopes along the reservoir shoreline. A new marina would be necessary to accommodate the unique needs of large boats. The Big Eddy Marina not only has a waiting list for small craft moorage, but also lacks the moorage facilities necessary to accommodate large boats and/or houseboats.

1.1 Project Description

The Dworshak large boat marina analysis employed a group of technical experts, called a Product Delivery Team (PDT), and Geographic Information Systems (GIS) analysis to document and determine appropriate sites along Dworshak Reservoir for the placement of a large boat marina. The analysis examined such landscape conditions (topography, soils, and vegetation) and cultural issues (cultural resources, infrastructure needs, and current land management requirements) to produce a matrix of suitable sites.

Eleven sites were initially analyzed by the PDT for their ability to support the development of a large boat marina facility. Team members evaluated each of the eleven sites for specific criteria, which were determined early in this process. The top six sites were then further evaluated for other criteria. These evaluations were combined in a final matrix, which is contained in the main report. Based on these multidisciplinary evaluations, it was felt that Bruce's Eddy, Freeman Creek, and Big Eddy warranted further consideration as potential sites for a large boat marina facility.

1.2 Analysis of Fish and Wildlife Resources

This evaluation concentrated on government-owned, already impacted sites. The sites were then further evaluated to consider access, utilities, distance from town, and other infrastructure, which biased the selection towards existing, developed sites at the downstream end of Dworshak Reservoir. This tended to avoid the most remote and valued natural areas, at the cursory level, and reduced or eliminated impacts to biologically sensitive species.

Once a site is selected for further analysis, a more in-depth evaluation utilizing site-specific evaluation methodology would have to be employed to determine actual impacts to fish and wildlife resources. One of the most difficult species to evaluate will be the bull trout, due to their widespread use of the reservoir during specific life cycle and annual needs. The following paragraphs contain a brief look at the Dworshak fishery.

1.2.1 Fish

1.2.1.1 General

The regional fish resource is composed of two different species types: 1) native riverine species that live either in the relatively inaccessible feeder streams of the reservoir, or downstream of the reservoir in the North Fork Clearwater River; and 2) native and introduced species that have adapted to the reservoir environment.

Within the riverine species, two life history strategies exist: resident and adfluvial. The resident strategies spend their entire lifetime within rivers of approximately the same size. Adfluvial strategies, on the other hand, spawn and rear as juveniles in a feeder stream, migrate seasonally to the reservoir to grow or get protection from overwintering mortality factors, and return to the river to spawn on a seasonal basis.

Downstream of the reservoir, the North Fork Clearwater River is inhabited by anadromous salmon (general of hatchery origin) and resident riverine prey and predator species. Within the reservoir environment, both resident coldwater and warmwater species abound. In general, these species have been introduced over time as gamefish, on top of resident prey fish that are usually native.

1.2.1.2 Habitat Characteristics

Dworshak Reservoir has been a relatively clear and coldwater lake environment, with high nutrients, since it was filled in 1971. Maiolie *et al.*, 1993, has since reported that the reservoir became more nutrient poor in the period following the impoundment. According to their work, the reservoir may still be declining in nutrient status, but nutrient input from the inundated vegetation and soils has stabilized.

Dworshak Reservoir is extremely deep, with a forebay over 600 feet in depth. As a result, the reservoir is thermally stratified, allowing for stratified sport fishery management. The shallower water zone produces a warmer temperature gradient that supports warmwater gamefish species, while the deep coldwater zone supports coldwater gamefish (salmonid) species.

Nearshore habitat has been altered since its initial stabilization during the first two decades following reservoir impoundment. The littoral zone along the shorelines is used by spawning warmwater gamefish and, historically, by coldwater gamefish. This zone has always been altered to some degree by natural wave and wind action and, more recently, has been severely altered as shoreline vegetation within the reservoir has been virtually eliminated due to fluctuating water levels. These fluctuating water levels are a result of regional requirements for utilizing Dworshak Reservoir as a primary source of augmentation water for increasing the average seasonal river flows in the lower Snake River for Endangered Species Act (ESA)-listed sockeye and Chinook salmon and steelhead. Cover and food production for littoral fish species have been adversely affected by this operation.

The most important habitat areas within the reservoir for fisheries management are the feeder streams at the upper end of the reservoir. These streams provide suitable spawning habitat for kokanee and high-density feeding habitat for rearing bull trout; and include Elk Creek, Meadow Creek, Reeds Creek, Doe Creek, Buck Creek, and other creeks connecting to the Little North Fork arm of the reservoir and the North Fork Clearwater River. These feeder streams are all relatively inaccessible by vehicles other than boats, and provide the greatest nutrient input to the reservoir for fish production and species composition maintenance. The deeper areas of the reservoir can be expected to make a smaller contribution to the overall nutrient budget of the reservoir.

The relatively fast water environment typically found at dam tailraces is found downstream of the dam. The channel has become incised, and is lined with riprap composed of large rocks. Depending on dam operation, water conditions may vary, from high velocity and turbulence (along with high dissolved gas concentrations when the dam is spilling or regulating outflow) to relatively slow and placid conditions (while passing inflow volumes or during periods of low turbine output).

1.2.1.3 Anadromous Fish

The Clearwater River subbasin and the lower Snake River Basin have substantial, though depleted, anadromous fish resources. These resources have historically been highly economical to the region; and have supported many sport, commercial, and tribal fisheries.

Anadromous fish spawn and rear for the first few years in freshwater, migrate to saltwater to mature into adults, and return to freshwater to spawn and die. Anadromous salmonids that migrate to and from Dworshak Reservoir include wild steelhead trout, hatchery steelhead trout, and hatchery spring Chinook salmon that end their journey at Dworshak National Fish Hatchery and Clearwater Hatchery (at the confluence of the North and South Forks of the Clearwater River).

Dworshak Reservoir contains supplemented kokanee salmon, a type of sockeye salmon considered local gamefish. If derived from true kokanee stock, they are not typically anadromous. However, they can express an anadromous life history if environmental conditions are suitable and individuals are safely entrained through the dam during high flow or augmentation flow evacuation of the reservoir. Kokanee are landlocked sockeye, due either to human intervention for sport fisheries or because stream access to a lake is blocked by natural geologic causes (*e.g.*, rock slides). Anadromous sockeye salmon need lakes for spawning and rearing, so they (or they kokanee forms) were not historically found in the Dworshak area prior to reservoir inundation. Anadromous non-salmonids in the Dworshak area include the parasitic pacific lamprey (which migrated on their own or on salmon hosts) and white sturgeon (principally landlocked by mainstem dams).

1.2.1.4 Resident Fish

- **Coldwater Gamefish**

  The cold waters of the area surrounding Dworshak Reservoir, including the reservoir itself, support a variety of coldwater gamefish. These include rainbow and lake trout, bull trout, kokanee salmon, and mountain whitefish.

  Kokanee salmon are probably the most economically important coldwater gamefish in Dworshak Reservoir. They are also managed extensively for production and abundance in support of the resident sport fishery. Both early and late spawning kokanee were introduced into the reservoir as early as 1972. Late spawning kokanee, which are primarily lake shoreline spawners, are no longer present in the reservoir. This is likely due to water level fluctuations during the spawning season, which limit the availability of good spawning habitat. Early spawning kokanee, which are primarily tributary spawners, have developed a self-sustaining population; and hatchery supplementation is either unnecessary or has been highly reduced. This population supports about 80 percent of the fishing pressure on the reservoir.

In response to reservoir drawdowns of Dworshak for lower Snake River augmentation water and spill, Idaho Department of Fish and Game (IDFG) suggests that culling the kokanee population through entrainment in augmented flow releases would be beneficial to the kokanee population in some years, and would allow them to grow at increased rates. Larger fish provide more satisfaction to anglers. Dworshak kokanee have annual survival rates that are much lower than other kokanee populations in Idaho. Over 80 percent of all yearling kokanee die before returning to the fishery the following year, and the loss of kokanee through Dworshak Dam can be responsible for high mortality rates during certain years. Low kokanee density has triggered good growth rates.

- **Warmwater Gamefish**

The warmer surface waters around the shoreline of Dworshak Reservoir also support a variety of warmwater gamefish, including smallmouth bass and black crappie. Smallmouth bass are an important predator of juvenile kokanee in the reservoir, as well as the Chinook salmon and steelhead trout smolts released from the hatcheries below the dam. Increased structure along the shoreline or in the pelagic waters of the reservoir increases the suitability of rearing and cover habitat for smallmouth bass, thus increasing their success in preying on smaller fish. Since the majority of bull trout that access the reservoir are subadults and adults, these fish are generally too large for smallmouth bass ingestion. It is possible that juvenile bull trout can be washed downstream out of the North Fork of the Clearwater River and/or other upper reservoir tributaries during high flow spates or other stressful subbasin conditions. These displaced juvenile bull trout may be exposed to upper reservoir smallmouth bass predators during their time in the reservoir.

Smallmouth bass have been the most abundant self-sustaining gamefish inhabiting the shallow-water areas of Dworshak Reservoir. Smallmouth bass are currently the principal warmwater gamefish in the reservoir following their rapid reservoir-wide expansion in response to thermal stratification of the reservoir, which allowed the stratified fishery management. With the rapid decline of the initial healthy population of redside shiners, the diet of smallmouth bass changed from redside shiner and crayfish (in the early years of the reservoir) to a more diverse diet that includes kokanee and aquatic and terrestrial invertebrates. The smallmouth bass harvest averaged less than 1,000 fish from 1988 to 1990.

During 1990, Maiolie *et al.* (1993) reported that 19,673 smallmouth bass were caught. The relative plumpness of smallmouth bass, from 4 to 12 inches (10.16 to 30.48 centimeters), suggests that this size range experiences the most competition for food.

- **Non-Gamefish**

  Non-game species (*i.e.,* northern chiselmouth, sculpin, redside shiner, largescale and bridgelip suckers, brown bullhead, and carp) support the prey base for gamefish, and are important for nutrient cycling processes connected with the reservoir. Some species (*e.g.,* Pacific lamprey) have been important subsistence food for Native Americans throughout history. Other species (*e.g.,* northern pikeminnow) are important predators on salmon smolts.

  The abundance of redside shiners, an important forage species, peaked only a few years after the initial impoundment of the reservoir. However, the species was in decline even before the reservoir-wide expansion of smallmouth bass. The collapse of the redside shiner population was probably a result of reduced reservoir productivity and the deterioration of nearshore habitat. Redside shiners are now virtually nonexistent in the reservoir.

1.2.1.5 Threatened and Endangered Taxa

As a result of historical destruction, the indigenous spring Chinook salmon stock of Clearwater River wild origin are legally considered extinct. However, the Snake River Basin Evolutionarily Significant Unit (ESU), listed as Threatened under ESA, has included wild steelhead since 1999. Clearwater River spring Chinook salmon stocks are derived from hatchery origins and, along with hatchery produced steelhead trout, are maintained through supplementation and augmentation practices at Dworshak National Fish Hatchery and Clearwater Fish Hatchery. The Nez Perce Tribe has recently produced coho salmon at Dworshak National Fish Hatchery. Before 2004, there had been no threatened or endangered anadromous salmonid stocks or critical designated habitat in the geographical subbasin region of the North Fork Clearwater River containing Dworshak Reservoir.

The most recent Draft Federal Columbia River Power System (FCRPS) consultation for the Snake and Columbia River hydrosystem now includes all North Fork Clearwater River steelhead in the ESA-protected ESU. All *Oncorhynchus mykiss* that occupy Dworshak Reservoir, whether true steelhead or rainbow trout, are the only ESA-listed anadromous salmonids in the action area proper.

Dworshak has been an instrumental component of Pacific Northwest regional efforts to recover ESA-listed wild Snake River spring/summer and fall Chinook and sockeye salmon. Federal ownership of Dworshak Dam, and its operational flood storage capacity to withhold and regulate cold spring runoff water, has allowed regional coordinators to prioritize Dworshak operation of water augmentation releases aimed at increasing seasonal inflows to the lower Snake River to meet a designated average river flow target equating to a maximized water velocity and minimized fish travel time.

Since 1992, the water level in the reservoir has been drawn down each year as much as 80 feet [24.38 meters (m)] during the primary recreation season (July 4 through August 31). During these drawdowns, water from the reservoir is released downstream to provide temperature-regulating flows in the Snake River. This drawdown is conducted in accordance with ESA consultations beginning with National Marine Fisheries Service's [now National Oceanic and Atmospheric Administration (NOAA) Fisheries] 1995 *Biological Opinion (BiOp) for the Re-initiation of Consultation on 1994-1998 Operation of the Federal Columbia River Power System and Juvenile Transportation Program in 1995 and Future Years,* and subsequent consultations resulting in BiOps in 2000 and 2004.

2. Project Impacts to ESA-Listed Species

A determination of effects of any Federal action on aquatic and terrestrial resources protected under ESA (as amended in 1988), and the Magnuson Fishery Conservation and Management Act of 1976 [which describes Essential Fish Habitat (EFH)], requires consultation with the US Fish and Wildlife Service (USFWS) and NOAA Fisheries.

Listed non-anadromous fish and terrestrial species were obtained from a letter, USFWS 1-4-04-SP-402, dated June 1, 2004. Listed anadromous fish species were obtained from *Draft Revised 2000 Biological Opinion (BiOp) on the Operation of the Federal Columbia River Power System and 19 Bureau of Reclamation Projects* (NOAA Fisheries, 2004), and the NOAA Fisheries websites, *www.nwr.noaa.gov/1salmon/salmesa/pubs/1pgr.pdf* and *http://research.nwfsc.noaa.gov/trt/trt_columbia.htm.*

The first-tier biological evaluation required for this level of study, to determine the effects a large boat marina may have on aquatic species, including bull trout and anadromous/resident steelhead/rainbow trout [collectively referred to as *O. mykiss* (for *Oncorhynchus mykiss*)], has been determined based on the following biological information:

- Bull trout originate from spawning and production areas located in major tributaries connecting the upper reaches of Dworshak reservoir, such as the North Fork Clearwater River and Little North Fork Clearwater River. These bull trout are adfluvial life forms of typically larger subadult or adult size, and are typically too large for predatory smallmouth bass or black crappie to feed on. They are distributed in depths greater than 60 feet (18.29 m), 20 to 40 feet (6.09 to 12.19 m) below the reservoir-defined photic zone. Bull trout are typically rare in the forebay of Dworshak Reservoir, even during high reservoir evacuation periods, due to water temperature gradients and abundance distribution of preferred forage (*e.g.*, kokanee). All three of the potential marina sites are located down-reservoir of Dent Bridge.

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- Conspecific with Dworshak bull trout, kokanee originate from spawning and production areas located in major tributaries connecting the upper reaches of Dworshak Reservoir, most specifically the protected Little North Fork Clearwater River and tributaries of the North Fork Clearwater River.

- The construction and operation of floating overwater structures like the proposed marina could result in hundreds of square feet of shading of the impact footprint as deep as the photic zone. Shading this large an area, along with increased cover provided by added structure at and below the water surface, would act as localized suitable predator habitat in the pelagic zone for smallmouth bass upon juvenile salmonids.

- At the three sites recommended for further study, the forebay photic zone fluctuates seasonally between about 15 feet (4.57 m) deep to a maximum of 30 feet (9.14 m) deep. This is at least 20 to 30 feet (6.09 to 9.14 m) above recorded bull trout distributions and 80 to 180 feet (24.38 to 54.86 m) above the substrate bottom of the reservoir when the reservoir is drawn down to minimum operating pool [elevation 145 mean sea level (msl)].

- Dworshak Reservoir is operated to provide seasonal water withdrawals for augmenting Snake River flows for listed salmonid migration in the spring and summer (as needed) under the 2000 and 2004 FCRPS BiOps (NMFS, 2000; and NOAA Fisheries, 2004). The construction and operation (including the incidental spill of inorganic compounds, runoff, *etc*.) of a large boat marina at one of the three forebay-associated sites recommended for further study would be designed to occupy a deep-water site. This site would be greater than 150 feet (45.72 m) deep and on a self-adjusting anchoring system, thus having no operational limitation on the ability to evacuate the reservoir for downriver flow augmentation. The design of the anchoring system is not yet developed, but is logically assumed to be a bulk weight system with self-adjusting cable through angels or sliding weights that are presently in place as remnants of the log buoys. These are currently being used for houseboat buoys. The critical evaluation criterion for the final biological effects determination analysis for ESA-listed species will be the number of anchors required and the size of each anchor in association with its footprint. At two of the sites, the substrate bottom was impacted during dam construction. After more than 30 years of log storage debris accumulation, this disturbed topography on steep, mountainous, hard substrate would provide little salmonid habitat. However, it would provide moderately suitable habitat for predatory smallmouth bass and other resident species. At the Freeman Creek site, because of the quality of the substrate bottom and the more protected side canyon defining this site, salmonid habitat quality would be higher and more productive. Before any final determination of a preferred site for a large boat marina is made, the Freeman Creek site would need to be specifically analyzed for fish habitat quality and species production contribution.

A Biological Assessment would have be prepared to assess the effects of a large boat marina on the aquatic and terrestrial species described in the following paragraphs after a final design is available. This final design will include proposed anchoring and buoy structure configuration and footprints of affected area (shading), including construction methods and sequencing. For bull trout, the analysis will also include kokanee production patterns and the effects of seasonal withdrawals for the downriver passage and ecology of ESA-listed anadromous salmonids.

2.1 Bald Eagle

The bald eagle is endemic to North America, and its breeding range historically included most of the continent. Eagles now nest primarily in Alaska, Canada, the Pacific Northwest, the Great Lake states, Florida, and the Chesapeake Bay area. The winter range of the bald eagle includes not only most of the breeding range, but extends from southern Alaska through Canada and southward to the southernmost areas of the United States. In 1978, the bald eagle was listed as endangered in most of the continental United States. Bald eagle numbers have steadily increased since then, due to changes in management practices and the restricted use of dichloro-diphenyl-trichloroethane (DDT). As a result, the species was downgraded to a threatened listing in 1994. Although USFWS proposed de-listing bald eagles in 1998, this has not yet officially occurred.

Bald eagles are predominately observed in Idaho as winter residents, but nesting populations do occur in three key areas: the North and South Forks of the Snake River, the Pend Oreille River drainage and the Kootenai Valley, and near

Cascade Reservoir. Over the past several years, Idaho's nesting bald eagle population has increased dramatically (Kaltenecker, 2000), but land managers must continue to provide suitable habitat and monitoring.

2.1.1 Inventories and Surveys

The bald eagle, although primarily a winter resident, is of major ecological and cultural importance at Dworshak Reservoir. Bald eagles can be found through the project area during most winters, but their usage varies greatly because of food availability and weather conditions.

Bald eagles feed mainly on fish (in open water) and on deer and elk carrion. When kokanee are discharged into the tailrace during reservoir drawdown, eagles are often concentrated in the tailrace area, perching on a group of conifers on the south bank. When eagles are present in the reservoir area, they can often be seen above the dam whenever fish and carrion are found, although there are no documented perch or roost sites habitually used by bald eagles above the dam (personal communication, D. Moore, Wildlife Biologist at Dworshak Dam and Reservoir, 1996). As part of the National Midwinter Bald Eagle Count, the Corps has conducted bald eagle counts during most winters between 1979 and 2001. Data collected were used to characterize winter eagle use of the reservoir. However, because of format and accessibility of earlier data, only the last seven survey years were tabulated and interpreted. During these last seven years, 193 bald eagles were observed. This averaged 28 eagles per year, with a low observation of 10 and a high observation of 51. The surveys have documented use of the Grandad boat launch area during winter months. A survey was also conducted during January 2002, and 48 bald eagles were observed at that time (personal communication with Paul Pence, Dworshak Resource Manager, August 2002).

Before 1999, there were no documented bald eagle nests within the Clearwater River drainage. In 1999, a nest was discovered near the Cold Springs campground on Dworshak Reservoir, and a pair of eagles attempted nesting in this location in both 1999 and 2000. Both nesting attempts failed, and were abandoned prior to hatching (personal communication with Dan Davis, Clearwater National Forest, August 2002). In 2002, two more nesting attempts occurred: one at Clearwater River Mile 13, in the Cold Springs area; and the other upstream of the Grandad boat launch (Clearwater River Mile 49). Neither nest was successful (personal communication with Paul Pence, Dworshak Resource Manager, August 2002).

In 2004, a successful eagle nesting occurred for the first time. Although specific information has not been published at this time, it is known that the site was located on the upstream portion of the reservoir. This site would not be located on or near any of the potential large boat marina sites selected.

2.1.2 Analysis of Effects

De-listing of bald eagles has been proposed and is imminent because of the dramatic increase of populations throughout the lower continental United States. Wintering activity is not localized, and no habitual perch or roost sites have been documented on Dworshak Reservoir.

2.1.3 Management Action

This review is preliminary and based on limited site-specific information. No significant concerns involving the proposed marina expansion sites are anticipated.

2.1.4 Conclusion

Eagles become habituated to routine and repetitive human activities (*i.e.,* automobile traffic or logging operations), while other activities like drift boating, fishing, and hunting, may cause eagles to flush from perches or feeding areas (Stalmaster, 1976). Humans approaching from the river channel caused the greatest disturbance to wintering bald eagles on the Nooksack River. These birds avoided areas of high human activity, and selected perches in areas of low to moderate activity. Since the proposed sites are already disturbed, further development is not anticipated to impact bald eagles.

2.2 Gray Wolf

The gray wolf is beginning to re-establish itself in the Clearwater River Basin as an experimental non-essential population in north central Idaho. Wolves typically exist in packs of 2 to 12 individuals. The two packs closest to the project are the Snow Creek pack and the Kelly Creek pack, both over 50 miles (80.47 kilometers) away. The Snow Creek pack consists of eight adults and, based on 1999 data, has a home range of 820 square miles (2,123.79 square kilometers). The Kelly creek pack as 12 adults and 4 pups, with a home range of 799 square miles (2,069.4 square kilometers) (RMWRT, 2000). Wolves generally reside within a very specific territory defined by their home range. Young wolves reach sexual maturity at the age of one, and may leave the pack at age two. They typically adopt a solitary lifestyle before pairing with a mate and establishing new territory (Wildlife Trust, 2000).

Wolves are highly adaptable animals, and have historically occupied a variety of biomes within North America. As a result, they are not considered to be limited to specific habitats (Wildlife Trust, 2000). The central Idaho packs exist primarily in temperate coniferous forests characterized by the absence of human habitation and access.

In the Rocky Mountains, wolves feed on elk, mule deer, beaver, and other small mammals; and also eat some insects, nuts, and berries. They may not eat for a week or more, but are capable of eating as much as 20 pounds (9.07 kilograms) of meat in a single meal (USFWS, 2000a).

2.2.1 Inventories and Surveys

There have been two gray wolves sighted in the vicinity of Dworshak Reservoir, both near Grandad. Wolf sightings around the reservoir have all occurred 30 to 40 miles (48.28 to 64.37 kilometers) northeast of the proposed stewardship project, and during the winter season. At that time of year, access is diminished and there is less likelihood for wolf-human interaction (personal communication with Steve Nadeau, Wildlife Biologist, IDFG, 2000). Wolf tracks were observed on snow-covered ice below Grandad Bridge in January 2001, indicating that animals may move lower on the reservoir to feed on big game during the winter.

2.2.2 Analysis of Effects

Based on the territorial nature of the gray wolf, the high level of recreational access and activity during the summer and fall months, and the absence of any sightings within the vicinity, it is very unlikely that wolves would inhabit or use the project area. Dispersing young represent the only plausible explanation for such an occurrence. Because gray wolves are so highly adaptive, the proposed changes to habitat conditions should have no long-term impacts to wolf habitation. Short-term impacts to wolves could affect the distribution of dispersing young in the unlikely event that a wolf is in the area.

2.2.3 Management Action

This is a preliminary review, and is based on limited site-specific information. No significant concerns involving the proposed marina expansion sites are anticipated.

2.2.4 Conclusion

The Idaho population of gray wolves is classed as an experimental/non-essential population and, as such, consultation under ESA is only required if a proposed action may jeopardize the continued existence of the species. Based on the known range of these animals, territoriality, adaptive nature, and lack of localized sightings, the proposed actions would have no anticipated impact.

2.3 Canada Lynx

The Canada lynx is a medium-sized cat with long legs; large, well-furred paws; long tufts on the ears; and a short, black-tipped tail. It is generally associated with old-growth forests, and its main prey is the snowshoe hare.

2.3.1 Inventories and Surveys

In 2001, the Corps contracted with IDFG to conduct a biological inventory of fungi, plants, and wildlife in the Dworshak area. No Canada lynx were discovered at that time.

2.3.2 Analysis of Effects

All of the project actions will take place in developed areas or in open water, where Canada lynx would not be found.

2.3.3 Management Action

No special management actions related to Canada lynx are required.

2.3.4 Conclusion

The proposed project is not expected to impact Canada lynx.

2.4 Bull Trout

Bull trout are native inhabitants of most major river drainages in the Pacific Northwest. They are widespread in streams throughout the Columbia River Basin, including many tributaries of the Snake River. However, populations have declined due to human impacts. Habitat components that appear to influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrates, and migratory corridors (Oliver, 1979; Pratt, 1984, 1992; Fraley and Shepard, 1989; Goetz, 1989).

Bull trout were listed as a threatened species by USFWS in July 1998. No critical habitat has yet been designated, but regional recovery planning has coordinated proposed critical habitat designations. Dworshak Reservoir is included in the Clearwater River Basin Recovery Unit in this recovery planning. The species spawns from August to November in tributaries off the primary inlet to Dworshak Reservoir, the North Fork of the Clearwater River (Corps, 1997). They can exhibit both resident and migratory life history stages. Migratory bull trout spawn in tributary streams, where juvenile fish rear from 1 to 4 years before migrating to either a lake (adfluvial) or river (fluvial) to reach maturity. Growth and maturity vary with environmental conditions, but the first spawning is often noted after four years of age (Rieman and McIntyre, 1993). Therefore, bull trout occurring in Dworshak Reservoir are either migratory juveniles or adults. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macro-zooplankton, and small fish. Adult migratory bull trout are a freshwater piscivore, an apex predator, and an opportunistic feeder, with a large proportion of the reservoir population's forage based on kokanee salmon production sustained in the reservoir. At all life history stages, bull trout need access to an adequate prey base. For adults, this necessitates habitats accessible through migratory corridors with suitable temperature, habitat complexity, and passage (USFWS, 1998).

Dworshak Dam is a barrier to upstream fish passage. The reservoir has an isolated sub-population of migratory bull trout from the larger metapopulation occupying the entire Clearwater River drainage. Migratory bull trout formerly linked resident bull trout to the overall gene pool for this species. Migration barriers have isolated these populations, potentially causing a loss of genetic diversity. In some cases, reservoirs such as Libby, Hungry Horse, and Dworshak provide habitat that is used by adfluvial populations of bull trout (USFWS, 2000b).

Watson and Hillman (1997) concluded that watersheds must have specific physical characteristics to provide habitat requirements for bull trout to successfully spawn and rear. Bull trout are found primarily in colder streams, although individual fish are found in larger river systems throughout the Columbia River Basin (Fraley and Shepard, 1989; Rieman and McIntyre, 1993; Buchanan and Gregory, 1997). Water temperatures above 59 degrees Fahrenheit (°F) [15 degrees Centigrade (°C)] are believed to limit bull trout distribution. However, the USFWS reported 37 records of bull trout in the lower Snake River since 1991. Most were noted at adult fish counting stations; and passed in April, May, or June (Hayley, 1999).

Bull trout typically spawn from August to September, during periods of decreasing water temperatures. Migratory bull trout frequently begin their spawning migration as early as April. They have been known to spawn as far upstream as 155 miles (249.4 kilometers). Temperatures during spawning generally range from 39 to 51 °F (4 to 10 °C), with redds often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz, 1989). Bull trout require spawning substrate consisting of loose, clean gravel that is relatively free of fine sediments.

2.4.1 Inventories and Surveys

In December 2000, the USFWS issued a Biological Opinion in response to a request by Bonneville Power Administration (BPA), the Corps, and the Bureau of Reclamation (BOR) regarding the effects of hydroelectric facilities to Kootenai River white sturgeon (*Acipenser transmontanus*), bull trout (*Salvelinus confluentus*), and bald eagles (*Haliaeetus leucocephalus*). Actions for implementation, such as increased monitoring and studies to evaluate distribution, timing, and usage of Dworshak Reservoir, would provide further information that may be beneficial. Spatial and temporal distribution, migration patterns, spawning sites, and basic life history information of bull trout in

Dworshak Reservoir are currently being investigated by IDFG. This investigation began in the spring of 2000, and it is expected to continue for at least one more year. To date, 21 adult bull trout have been captured, radio-tagged, and monitored. Of these individuals, three migrated to the Kelly Creek drainage, seven to the Upper North Fork drainage, one to the Weitas Creek drainage, three to the main North Fork drainage, two were unaccounted for, and five remained in the reservoir. Four of the five that remained in the reservoir stayed in the upper end of the reservoir (Personal communication with Dani Schiff, Project supervisor, IDFG, 2000).

From April to October 2001, 131 bull trout were captured; and radio transmitters were surgically implanted in 83 fish. The IDFG documented that 25 percent of the fish remained in the reservoir, and speculated that 115 of the undetected fish may have been in the reservoir at depths that could not be detected. The remaining fish moved into seven tributaries. The IDFG also discovered 75 redds at this time.

Current objectives of flow augmentation to enhance downriver conditions in the lower Snake River reservoirs for threatened and endangered salmon migration result in drastic drawdowns (80 to 155 feet) and high levels of erosion to Dworshak shorelines. Flow releases also alter the natural flow regime, affect nutrient cycles and zooplankton productivity, affect water temperature, and cause repeated and prolonged changes to the normal high water mark. The reduced volume of water in reservoirs during droughts affects the overall productivity that may ultimately reduce or redistribute the food base of predators such as bull trout (USFWS, 2000b). Kokanee tend to become entrained into the deeper forebay, with some proportion being entrained into the North Fork of the Clearwater River below Dworshak Dam. Impacts to water quality resulting from the proposed project would be negligible in comparison.

2.4.2 Analysis of Effects

The number of bull trout using Dworshak Reservoir from April to May is limited, and is not dependent on food sources derived from the littoral zone. The three Dworshak Reservoir embayments recommended for further study as large boat marinas are associated with the deep-water forebay. Due to the annual drawdown operation of the reservoir, each of these sites require any structure to float over 100 to 150 feet (30.48 to 45.72 m) of depth. Light transmission through structures need to penetrate the upper strata of surface waters of Snake River reservoirs to keep the photo zone productive. In an oligotrophic lentic water body like Dworshak Reservoir, the photic zone may extend further down [to 30 or more feet (9.14 m)] during the summer months. The pelagic zone in each of the recommended forebay-associated locations would be the zone of potential impact for bull trout and their primary prey (kokanee). Both bull trout and kokanee use these deep-water forebay habitats only for seasonal foraging, with most foraging by bull trout at depths of more than 60 feet (18.29 m). Low-flow years resulting from a hotter regional climate would be substantially more important for bull trout and kokanee production, because both of these species would be transported down reservoir more readily with decreasing reservoir width and increasing water velocities with increasing outflow from the dam. All known and likely spawning areas for bull trout are associated with upper Dworshak Reservoir tributaries, mostly in the North Fork of the Clearwater River. All known and likely spawning and important production areas for kokanee are associated with Dworshak Reservoir feeder streams located in significant arms of the reservoir more than 5 miles (8.05 kilometers) above the recommended marina development sites. Land use classifications in those areas (*i.e.*, Breakfast Creek of the Little North Fork arm of the Clearwater River, Elk Creek, Meadow Creek, Reeds, Creek, Doe Creek, Buck Creek, and feeder streams connecting to the North Fork of the Clearwater River) are protected for fish and wildlife or for low-density recreation. Fish overwintering in the reservoir use habitat below the drawdown water level. They could be impacted by marina expansion, although it is not expected to be significant. Anticipated developments will take place between 1400 and 1200 msl. Further analysis is required to completely assess all possible impacts of a large boat marina development.

2.4.3 Management Action

Management actions will be determined when a final site and design are developed.

2.4.4 Conclusion

No determination of impact can be made at this time but, based on current biological and design/siting information, the Corps would propose a determination of *may effect, but not likely to adversely affect.*

2.5 Snake River Basin Steelhead ESU

2.5.1 Inventories and Surveys

The Snake River Basin Steelhead ESU, listed as Threatened under ESA, has included wild Clearwater River steelhead since 1999. Overlapping Clearwater River steelhead stocks are maintained through supplementation and augmentation practices at Dworshak National Fish Hatchery and Clearwater Fish Hatchery. Prior to 2004, there had been no threatened or endangered anadromous salmonid stocks or critical designated habitat in the geographical subbasin region of the North Fork Clearwater River that contains Dworshak Reservoir.

The most recent Draft FCRPS consultation for the Snake and Columbia River hydrosystem (NOAA Fisheries, 2004) now includes all North Fork Clearwater River steelhead in the ESA-protected ESU. All *Oncorhynchus mykiss*, whether true steelhead or rainbow rout, are the only ESA-listed anadromous salmonids in the action area proper.

2.5.2 Analysis of Effects

All potential project actions will take place in developed areas, with open water greater than 150 feet (45.72 m) deep. Upon thorough evaluation of the best available biological information forming the criteria addressed in earlier paragraphs, it is likely that any of the three recommended sites would have equally minor impacts to *O. mykiss* that occupy Dworshak Reservoir. Given that updated or new information will be collected by the time marina development begins, a Biological Assessment should be prepared as soon as the specific recommended site is chosen as the preferred location and specific construction and operational designs and plans are generated.

2.5.3 Management Action

Management actions will be determined when a final site and design are developed.

2.5.4 Conclusion

The proposed project is not expected to impact Snake River steelhead. No determination of impact can be made at this time but, based on the current biological and design/siting information, the Corps would propose a determination of *may effect, but not likely to adversely affect*.

2.6 Snake River Sockeye Salmon ESU

2.6.1 Inventories and Surveys

There are no Snake River origin wild sockeye salmon in Dworshak Reservoir or downstream of the dam. Dworshak Reservoir contains supplemented kokanee salmon, a type of sockeye salmon that is considered a local gamefish. These fish are not typically anadromous if derived from a true kokanee stock, but can express an anadromous life history if environmental conditions are suitable and individuals are safely entrained through the dam during high flow or augmentation flow evacuation of the reservoir. Anadromous sockeye salmon need lakes for spawning and rearing, so they (or their kokanee forms) were not historically found in the North Fork Clearwater River during the period prior to dam construction and reservoir inundation.

2.6.2 Analysis of Effects

All of the project actions will take place in developed areas of open water greater than 150 feet (45.72 m) deep. No impacts to Snake River origin wild sockeye salmon are anticipated because no Snake River origin sockeye salmon occupy Dworshak Reservoir. In addition, the action would not affect the augmented flow volumes or scheduled releases from Dworshak Reservoir through the lower Snake River.

2.6.3 Management Action

Management actions will be determined when a final site and design are developed.

2.6.4 Conclusion

The proposed project is not expected to impact Snake River sockeye salmon. No specific determination of impact can be made at this time but, based on current biological and design/siting information, the Corps would propose a determination of *no effect*.

2.7 Snake River Spring/Summer-Run Chinook Salmon ESU

2.7.1 Inventories and Surveys

As a consequence of historical extirpation, the indigenous spring Chinook salmon stock of Clearwater River wild origin are legally considered extinct. No Snake River spring/summer-run Chinook salmon occupy Dworshak Reservoir. Clearwater River spring Chinook salmon stocks are derived from hatchery origins, and are maintained through supplementation and augmentation practices at Dworshak National Fish Hatchery and Clearwater Fish Hatchery.

2.7.2 Analysis of Effects

All of the project actions will take place in developed areas of open water greater than 150 feet (45.72 m) deep. No impacts to Snake River spring/summer-run Chinook salmon are anticipated because no Snake River spring/summer-run Chinook salmon occupy Dworshak Reservoir. In addition, the action would not affect the augmented flow volumes or scheduled releases from Dworshak Reservoir through the lower Snake River.

2.7.3 Management Action

Management actions will be determined when a final site and design are developed.

2.7.4 Conclusion

The proposed project is not expected to impact Snake River spring/summer-run Chinook salmon. No specific determination of impact can be made at this time but, based on current biological and design/siting information, the Corps would propose a determination of *no effect*.

2.8 Snake River Fall-Run Chinook Salmon ESU

2.8.1 Inventories and Surveys

No Snake River fall-run Chinook salmon ESU occupy Dworshak Reservoir. As a consequence of historical destruction of Chinook salmon in the Clearwater River subbasin, the indigenous fall Chinook salmon stock of Clearwater River origin either never existed or are legally considered extinct. The current spawning segment of the population at Hog Island is believed to be a function of extended spawning of Snake River stock resulting from Dworshak Reservoir cold water releases. The more recent (last 20 years) presence of this spawning segment of the ESA-listed Snake River ESU population has resulted in a designation by NOAA Fisheries that the lowest reach of the Clearwater River is Critical Habitat, and requires augmented flows to maintain spawning conditions.

2.8.2 Analysis of Effects

All project actions will take place in developed areas of open water greater than 150 feet (45.72 m) deep. No impacts to Snake River fall-run Chinook salmon are anticipated because no Snake River fall-run Chinook salmon occupy Dworshak Reservoir. In addition, the action would not affect the augmented flow volumes or scheduled releases from Dworshak Reservoir through the lower Snake River.

2.8.3 Management Action

Management actions will be determined when a final site and design is developed.

2.8.4 Conclusion

The proposed project is not expected to impact Snake River fall-run Chinook salmon. No specific determination of impact can be made at this time but, based on current biological and design/siting information, the Corps would propose a determination of *no effect*.

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Appendix D

Economic Evaluation

1. Introduction

Clearwater County lies in northern Idaho, along the Montana border. Although it contains the 10th largest acreage of all counties within the State of Idaho, it is 26th in terms of population. Nearly 54 percent of the county is Federally-owned, while 27 square miles (69.93 square kilometers) are water. Forest and wood products have driven the area's economy throughout its recorded history. In the last 10 years, however, there has been a gradual shift from wood-related manufacturing jobs to tourism-related, service-oriented jobs.

Both Dworshak Reservoir and the Clearwater River provide excellent fishing opportunities, and the forested areas of the region are home to a large population of deer and elk. Enough snow falls during the winter for many activities, including snowmobiling and cross-country skiing. The reservoir also provides ample boating and swimming activities during the warmer months. Clearwater County is a beautiful natural area, and it is hoped that this natural beauty (see figure 1) can be parlayed into economic growth to replace the loss of wood-related manufacturing jobs.

Figure 1. A view of Dworshak Reservoir, clearly illustrating the area's natural beauty.

2. Population, Employment, and Personal Income

The population of Clearwater County declined by 5 percent between 1992 and 2002, although the population of the City of Orofino actually increased by 4 percent, as shown in table 1.

Table 1
Resident Population

Year	Clearwater County		City of Orofino	
	Population	Percent Change	Population	Percent Change
1970	10,871		3,883	
1980	10,390	-4.40%	3,711	-4.40%
1990	8,505	-18.10%	2,868	-22.70%
1992	8,666	1.90%	3,010	5.00%
2002	8,446	-5.40%	3,142	4.40%

A total of 153 jobs were lost to the region in the period from 1992 to 2000. The service industry gained 280 jobs during the same period, but the overall decline can be directly traced to the loss of wood-related manufacturing jobs (1009 vs. 794 = -25), in particular wood processing (see table 2).

Table 2
County Employment

Industry Type	1980	1984	1988	1992	2002
Farm	235	280	243	224	222
Agricultural Services, Forestry, Fish	144	177	149	169	206
Manufacturing	1,597	1,152	1,131	1,009	794
Mining	<10	<10	14	14	<10
Construction	147	117	145	178	274
Transportation and Public Utilities	191	172	144	156	163
Wholesale Trade	51	55	58	35	na
Retail Trade	610	595	594	665	597
Finance, Insurance	134	135	125	130	na
Services	444	482	534	640	920
Federal Government, Civilian	417	344	325	317	270
Federal Government, Military	68	52	60	53	36
State and Local Government	669	727	764	945	900
Total Employment	**4,712**	**4,293**	**4,286**	**4,535**	**4,382**

Personal income rose by 44 percent from 1980 to 1992, but declined as a percent of both national and state averages. In 1992, Clearwater County per capita personal income was 78.5 percent of the national average and 94.7 percent of the state average. By 2002, those numbers had fallen off considerably, to 69.6 percent and 86.4 percent of the national and state averages, respectively (see table 3). This clearly reflects the shift from high-paying manufacturing jobs to low-paying service and retail jobs.

Table 3 Per Capita Personal Income for Clearwater County			
Year	**Per Capita Personal Income**	**Percent National**	**Percent State**
1980	$8,896	89.50%	105.50%
1984	$9,401	70.50%	88.30%
1988	$12,112	72.90%	94.30%
1992	$15,774	78.50%	94.70%
2001	$21,163	69.60%	86.64%

Chart 1 and table 4 show the comparable economic health indices for Clearwater County, as well as a random sampling of other counties disbursed over a wide area of the Pacific Northwest. Clearwater County ranked 18th when compared to the other 21 areas considered in this random sampling. Table 4 illustrates comparable economic health by using per capital productivity, per capita income, business diversity, unemployment, and human attraction as the weighted factors.

Chart 1

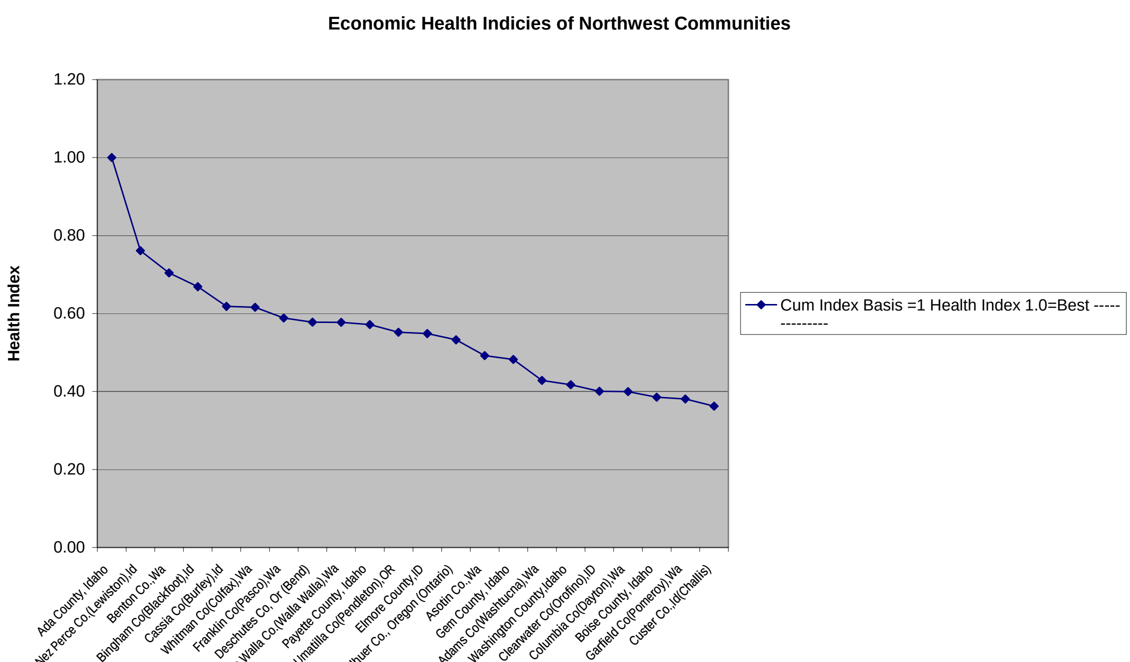


Table 4
Comparable Economic Health for Clearwater County

Applied Weight	Per Capita Productivity 45%	Per Capita Income 5%	Business Diversity 25%		Human Attraction 25%					
Population Growth Index (10 n 10000)	Productivity Ratio per Capita (annual sales/ assets) 10000=sales/ assets=1.0	Per Capita Income (1999)	Business Sections out of 541 100% divided by 54,100	Cumulative Index	Adjust for Population Growth	Cumulative Index After Population Adjustment	Unemployment Percentage (ID02,OR98, WA02)	Index Adjusted Unemployment Percentage	Cumulative Index After Unemployment Adjustment	Cumulative Index Basis=1 Health Index 1.0=Best
Ada County, Idaho										
1.462296197	11126.87	$31,420	26,000	13078.093	4781	17859	3.50%	1.29	22961.70	1.00
Nez Perce County (Lewiston), Idaho										
1.108313089	13266.16	$24,519	14,800	10895.720	3019	13915	3.90%	1.26	17482.56	0.76
Benton County, Washington										
1.265769367	11237.88	$25,004	18,500	10932.245	3459	14392	8.10%	1.12	16168.42	0.70
Bingham County (Blackfoot), Idaho										
1.110475481	12597.67	$17,621	13,300	9875.001	2741	12616	4.60%	1.22	15359.20	0.67
Cassia County (Burley), Idaho										
1.096457096	11995.79	$21,170	11,900	9431.606	2585	12017	5.50%	1.18	14201.84	0.62
Whitman County (Colfax), Washington										
1.050676983	7166.08	$19,082	12,100	7203.838	1892	9096	1.80%	1.56	14149.43	0.62
Franklin County (Pasco), Washington										
1.316868145	10728.76	$17,961	13,900	9200.991	3029	12230	9.50%	1.11	13517.49	0.59
Deschutes County (Bend), Oregon										
1.423463806	4388.07	$24,784	21800	8663.833	3083	11747	7.70%	1.13	13272.58	0.58
Walla Walla County (Walla Walla), Washington										
1.139577613	8891.64	$21,366	15,700	8994.536	2562	11557	6.80%	1.15	13256.59	0.58

Table 4
Comparable Economic Health for Clearwater County
(continued)

Applied Weight	Per Capita Productivity 45%	Per Capita Income 5%	Business Diversity 25%		Human Attraction 25%					
Population Growth Index (10 n 10000)	Productivity Ratio per Capita (annual sales/ assets) 10000=sales/ assets=1.0	Per Capita Income (1999)	Business Sections out of 541 100% divided by 54,100	Cumulative Index	Adjust for Population Growth	Cumulative Index After Population Adjustment	Unemployment Percentage (ID02,OR98, WA02)	Index Adjusted Unemployment Percentage	Cumulative Index After Unemployment Adjustment	Cumulative Index Basis=1 Health Index 1.0=Best
Payette County, Idaho										
1.252160156	11174.33	$18,128	12,000	8934.848	2797	11732	8.40%	1.12	13128.46	0.57
Umatilla County (Pendleton), Oregon										
1.190703641	7688.48	$21,018	16,000	8510.716	2533	11044	6.80%	1.15	12668.29	0.55
Elmore County, Idaho										
1.37373261	9211.81	$21,907	11,200	8040.665	2761	10802	6.00%	1.17	12602.44	0.55
Malheur County (Ontario), Oregon										
1.132959521	8830.85	$25,912	13,200	8569.482	2427	10997	8.90%	1.11	12232.29	0.53
Asotin County, Washington										
1.167338824	5951.11	$21,615	12,000	6758.748	1972	8731	3.40%	1.29	11299.18	0.49
Gem County, Idaho										
1.281746032	8584.97	$18,078	10,700	7442.136	2385	9827	7.90%	1.13	11070.78	0.48
Adams County (Washtucna), Washington										
0.989459736	8139.44	$20,941	9,900	7184.800	1777	8962	10.20%	1.10	9840.70	0.43
Washington County, Idaho										
1.166900585	7074.06	$16,079	10,700	6662.278	1944	8606	8.80%	1.11	9583.77	0.42

Table 4
Comparable Economic Health for Clearwater County
(continued)

Applied Weight	Per Capita Productivity 45%	Per Capita Income 5%	Business Diversity 25%		Human Attraction 25%					
Population Growth Index (10 n 10000)	Productivity Ratio per Capita (annual sales/ assets) 10000=sales/ assets=1.0	Per Capita Income (1999)	Business Sections out of 541 100% divided by 54,100	Cumulative Index	Adjust for Population Growth	Cumulative Index After Population Adjustment	Unemployment Percentage (ID02,OR98, WA02)	Index Adjusted Unemployment Percentage	Cumulative Index After Unemployment Adjustment	Cumulative Index Basis=1 Health Index 1.0=Best
Clearwater County (Orofino), Idaho										
0.993062904	7224.00	$21,163	10,200	6858.950	1703	8562	13.50%	1.07	9196.00	0.40
Columbia County (Dayton), Washington										
1.009940358	8279.36	$21,163	7,800	6733.861	1700	8434	11.30%	1.09	9180.44	0.40
Boise County, Idaho										
1.900826446	4226.86	$21,492	8,100	5001.685	2377	7379	5.00%	1.20	8854.22	0.39
Garfield County (Pomeroy), Washington										
1.066281139	5863.21	$18,237	7,400	5400.296	1440	6840	3.60%	1.28	8739.81	0.38
Custer County (Challis), Idaho										
1.050568594	5650.33	$23,087	8,700	5872.000	1542	7414	8.20%	1.12	8318.41	0.36

Table 5 illustrates that, at base year 1994, traditional logging manufacturing and harvesting-related manufacturing accounted for one-half of the total industrial output for Clearwater County. Since 1994, this trend has shifted from these traditional industries to service-related industries—especially those related to tourism. Statistics show, however, that six service-related jobs are needed to replace one wood-related manufacturing job (average value of a wood manufacturing job is $59,189, compared to $10,811 for a service-related job). This may be a difficult battle in future years but, if Clearwater County's natural beauty can be turned into an economic asset, perhaps an economic balance will be achieved.

Table 5
Clearwater County Business Sectors
Base Year 1994

Places of Employment	Dollar Output	Jobs	Value Added Over Costs	Percent of Value Added	Personal Income
Tourism-Related Industries					
Food Service	$4,334,000	165	$3,563,000	82%	$2,384,000
Eating and Drinking	$7,233,000	249	$2,842,000	39%	$2,172,000
Lodging Places	$1,544,000	55	$775,000	50%	$526,000
Amusement/Recreational	$1,174,000	49	$778,000	66%	$518,000
Total Tourism-Related	$14,285,000	518	$7,858,000	50%	$5,600,000
Average Value of One Job		**$10,811**			
Sales to Generate One Job		$27,577			
Percent of Total Output	4.00%				
Traditional Logging-Related Industry					
Logging Camps	$97,792,000	472	$37,633,000	38%	$24,727,000
Sawmills	$21,835,000	135	$8,812,000	40%	$6,470,000
Special Products-Sawmills	$7,585,000	87	$4,275,000	57%	$3,666,000
Veneers and Plywood Mills	$58,612,000	263	$28,292,000	50%	$21,781,000
Total Logging-Related	$183,804,000	957	$79,012,000	46%	$56,644,000
Percent of Total Output	51%				
Total Sales Output--1984 Base	$357,510,000				
Average Value of One Job		**$59,189**			
Sales to Generate One Job		$192,063			

3. Recreation

The major recreational activities at Dworshak Reservoir include boating, fishing, swimming, camping, sightseeing, and picnicking. Fishing occurs on a year-round basis. The kokanee season runs from March to August. The fishermen follow the adult year class of kokanee up the reservoir until late August when most leave the reservoir to spawn in the river system. Kokanee fishing occurs all winter long on the lower portion of the reservoir. Fishermen are on the lake year round for bass and trout, except where limited by ice or regulations above Grandad Bridge. Ninety percent of people fishing at the reservoir do so from boats, although bank fishing has become popular in certain areas.

Boating activities involving water-skiing, canoeing, and cruising. Sailing is limited by unpredictable winds and the narrow canyon. About 75 percent of all camping on the reservoir is boat related, as many of the mini-camps are accessible only by boat. Mini-camps become increasingly more difficult to access as the water level drops. Boat-in use effectively ceases when the water level is drawn down to 40 feet (12.19 meters). Most of the boat launches around the lake have already been extended, so it is not likely that launches could be extended much further during reservoir drawdown periods.

Swimming occurs in the summer months of June, July, and August. Beaches along the reservoir are useable only in the upper 10 feet (3.05 meters) of the reservoir pool. The recent addition of destination docks has provided an alternative to swimming at a beach.

Table 6 shows visitation statistics for Dworshak Dam and Reservoir. Statistics indicate that boat use accounts for 1/3 of the site's visitation. This may indicate that development of a large boat marina could be successful on the Dworshak pool.

Table 6
Dworshak Visitation, 1992 to 2003

Camping Visitors			
Year	**Overall Value**	**Camping Visitors**	**Percent of Camping Visitors**
1998	138,803	15,120	10.89
1999	227,558[1]	17,666	7.76
2000	147,155	21,117	14.35
2001	131,668	14,057	10.68
2002	117,128	19,627	16.76
2003	127,729	20,658	16.17
Totals	662,483	108,245	12.76833333[2]

Boating Use			
Year	**Overall Value**	**Boating Visitors**	**Percent of Boating Visitors**
1998	138,803	40,196	28.96
1999	227,558[1]	49,218	21.63
2000	147,155	51,537	35.02
2001	131,668	54,377	41.30
2002	117,128	42,300	36.11
2003	127,729	49,192	38.51
Totals	662,483	286,820	33.58833333[3]

1An anomaly, highway construction caused a detour across the dam, which exaggerated visitor counts.
2Average percent for camping
3Average percent for boating

Visitor surveys conducted at Dworshak Dam and Reservoir clearly show that the majority of visitors come from nearby areas. If development of a large boat marina is pursued, it would be advisable to aim marketing efforts at the two major population centers closest to Dworshak—Boise, Idaho, and Spokane, Washington—in order to encourage a larger percentage of visitors from those areas to visit Dworshak Dam and Reservoir.

4. Source Material

State of Idaho, Department of Commerce and Labor, 2004.
Website, *http://www.idoc.state.id.us/idcomm/profiles/index.html,* visited September 2004.

Minnesota IMPLAN Group, Inc., 2004.
Website, *http://www.mig-inc.com/index.php?page=index&BaseSession=807a2703358e12e70e9d2724f10c580e,* Impact Analysis for Planning (IMPLAN) Input-Output Model, visited September 2004.

US Army Corps of Engineers. 2004.
Website, *http://www.nww.usace.army.mil/dpn/*, Digital Project Notebook, visited September 2004, Base year 1994.

Appendix E

List of Potential Houseboat Rental/Resort Operators

The following list is not all-inclusive. An extensive distribution of the Request for Proposal is necessary in order to find as many interested and qualified potential operators as possible.

A few years ago, several large houseboat operators were informally contacted by Walla Walla District to determine what their requirements would be for a houseboat rental resort at a reservoir like Dworshak. In one case, the conversation was held with the individual in charge of the company's houseboat rental operation, who was extremely interested in such an idea.

The first three companies listed are large corporations with many houseboat rental resorts all over the United States. The remainder of companies on the list are smaller operators.

Forever Resorts
PO Box 52038
Phoenix, Arizona 85072
www.foreverhouseboats.com/
480-998-1981
Fax: 480-998-7399

Seven Crowns Resorts
PO Box 16247
Irvine, CA 92623-6247
www.sevencrown.com
949-588-7100
800-752-8669
Fax: 949-588-7400

Aramark Parks and Resorts
Joe Renfro, Vice President, Business Development Parks and Resorts
970 North Highland Avenue
Atlanta, GA 303036
www.aramarkparks.com
404-471-1707
404-875-6187

Antlers Resort and Marina
PO Box 140
Lakehead, California 96051
www.shastalakevacations.com
800-238-3924

Holiday Harbor Resort
PO Box 112
O'Brien, CA 96070
www.lakeshasta.com
800-776-2628

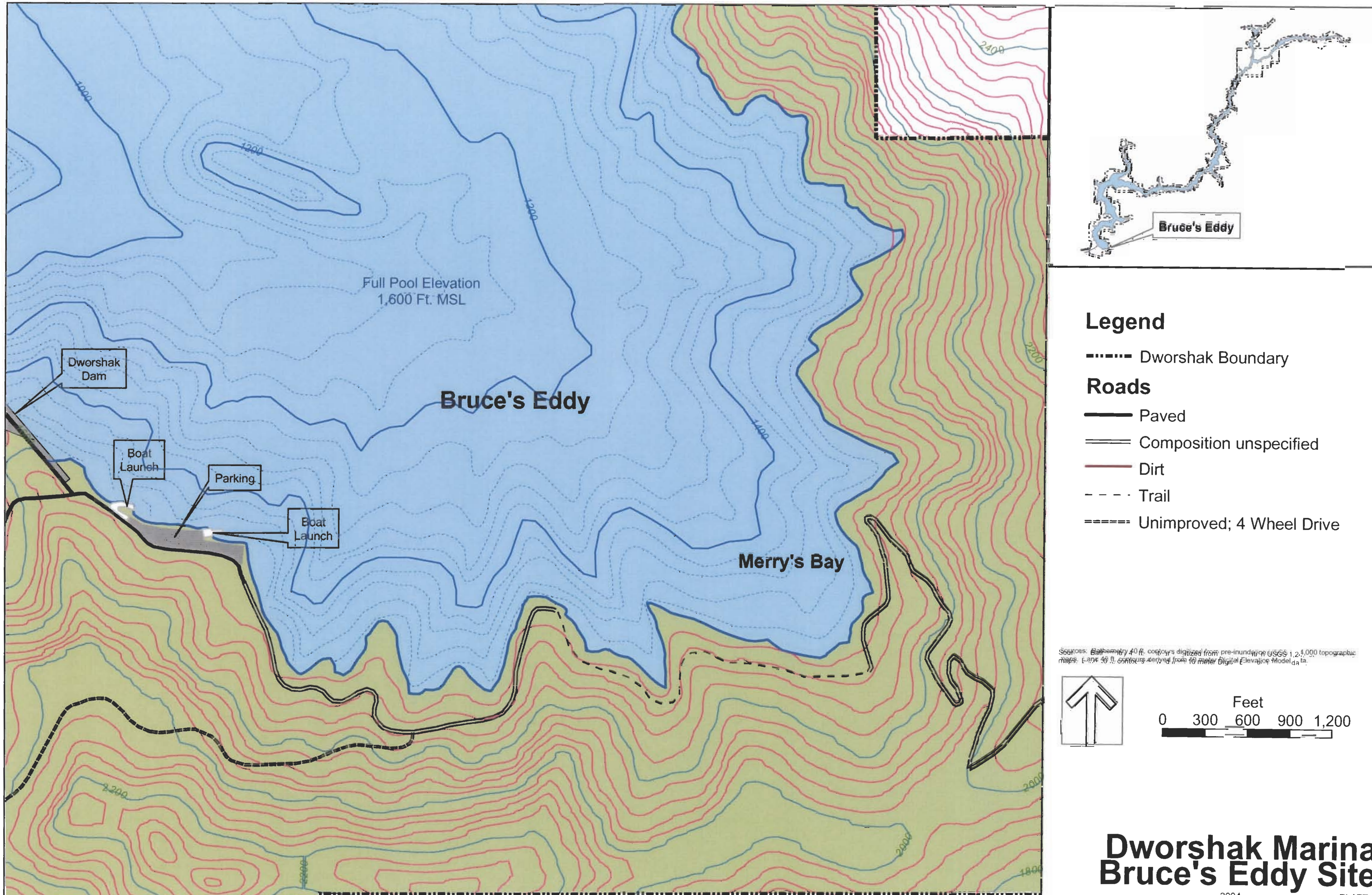
Jones Valley Resort
22300 Jones Valley Marina Drive
Redding, California 96003
www.houseboats.com/shasta/
800-223-7950

Roosevelt Recreational Enterprises
PO Box 5
Coulee Dam, Washington 99116
www.rrehouseboats.com
800-648-5253

Appendix F

Pre-Impoundment Topography

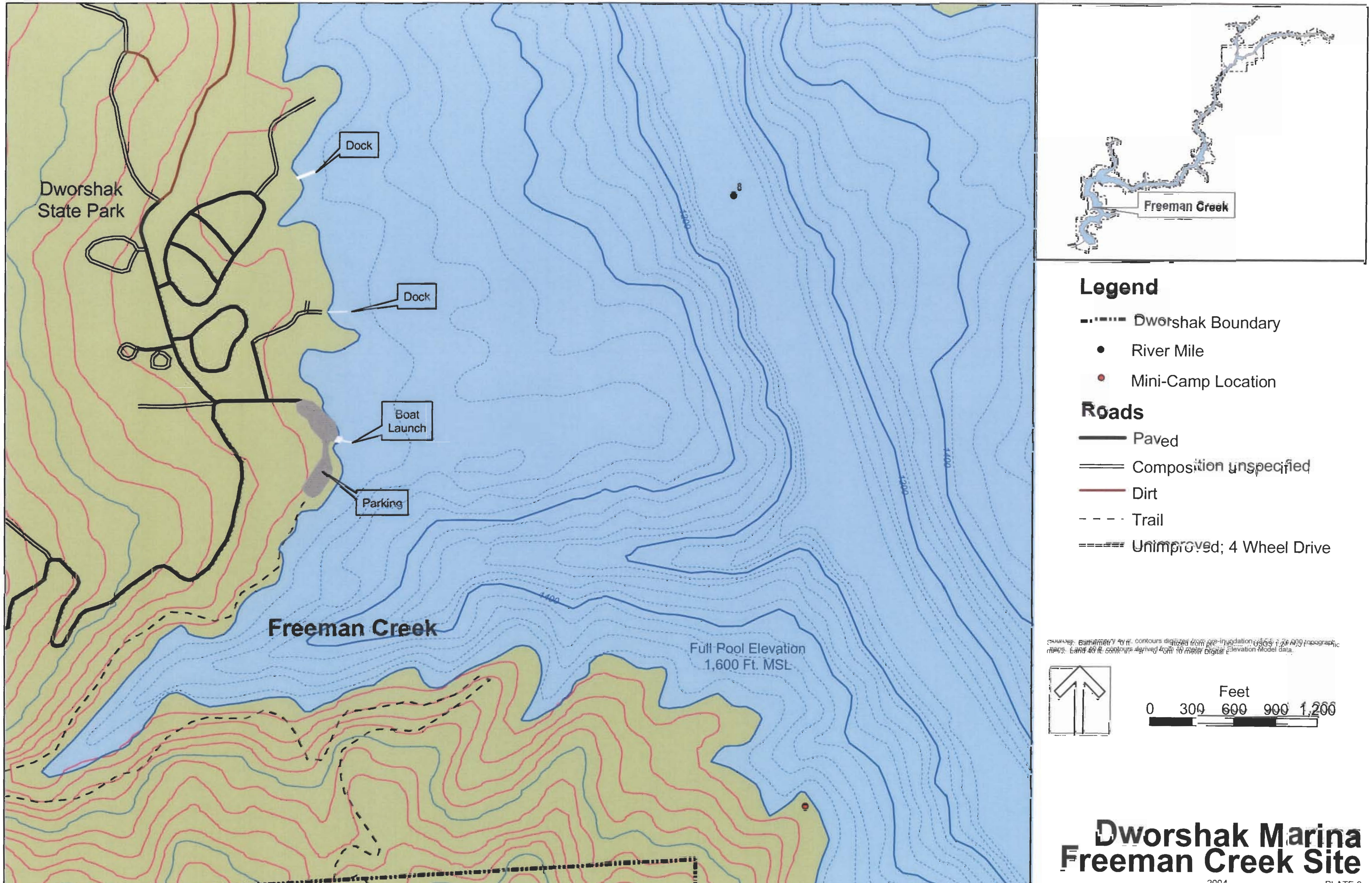
The underwater contour data provided in these maps was digitized by the U.S. Army Corps of Engineers, Walla Walla District, Applied Technology staff. The data originated from 7.5-minute US Geological Service quadrangle maps dated 1969, 1981, and 1990. The contours represented in the map show landforms as they looked prior to reservoir inundation. These maps do not document any slumping or sliding that may have occurred underwater since that time. They are intended to provide a close representation of underwater landform.



Dworshak Marina Bruce's Eddy Site

2004

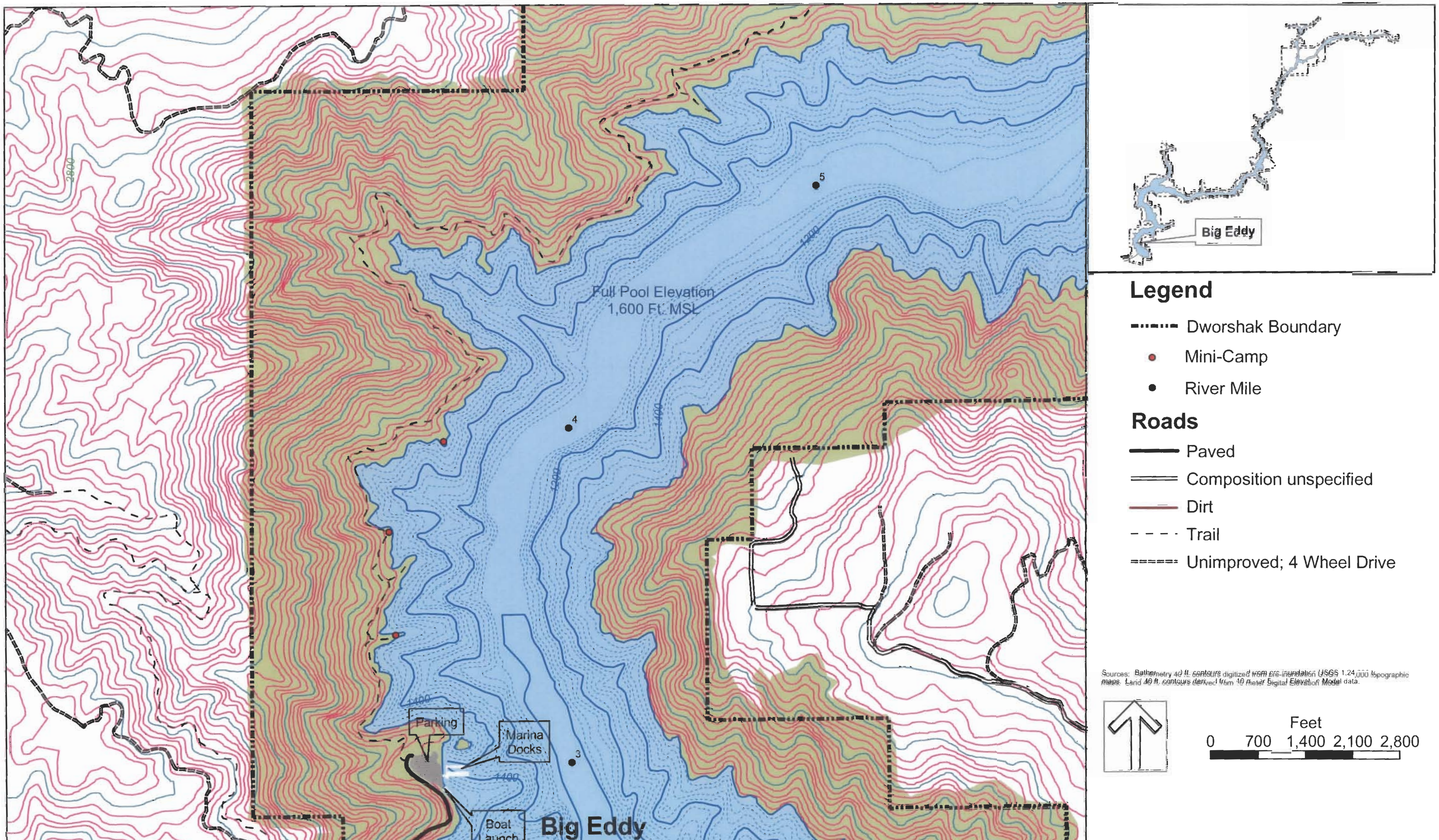
PLATE 1



Dworshak Marina Freeman Creek Site

2004

PLATE 2



Dworshak Marina Big Eddy Site

2004

PLATE 3

Appendix G

Product Delivery Team Members, US Army Corps of Engineers

Team Member	Field of Expertise	Responsibilities
Dave Dankel	Project Manager	• Coordinate funding and schedules • PDT involvement • Report
Cindy Boen	Landscape Architect	• GIS analysis • Land use analysis • Project oversight
Paul Pence	Dworshak Natural Resources Manager	• Field investigations coordination • Public communications coordination
Red Smith	NEPA Coordinator	• Environmental compliance coordination
Ray Tracy	Archaeologist	• Cultural evaluations
Phil Benge	Outdoor Recreation Planner	• Environmental document review • Policy and guidance input
Chris Pinney	Fish Biologist	• Biological input and review
Steve Juul	Limnologist	• Water/sediment quality and analysis
Jana Brinlee	Real Estate	• Tract research • Outgrant issues
George Hardin	GIS Specialist	• Land-based GIS analysis • Data input • Map production
Gary Ellis	Economics	• Economic evaluation
Jana Speer	Engineer	• Soils evaluation • Road evaluation • Engineering evaluation
Bill MacDonald	Wildlife Biologist	• Biological evaluation/review
Karen Kelly	Technical Writer	• Technical writing • Report coordination

Note: Chris Kuykendall from Clearwater County Economic Development participated in the Dworshak site tour on August 18 and provided the PDT with valuable information for the site evaluations.