IDAHO POWER
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Responses to FERC Additional Information Request OP-1(g) (Operational Scenarios)

Terrestrial Resources

Final Report

Idaho Power Company

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Hells Canyon Project
FERC No. P-1971-079

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SCHEDULE A: ADDITIONAL INFORMATION REQUEST OP-1(G) TERRESTRIAL RESOURCES OPERATIONAL SCENARIO

Time Required: 9 months

(g) Terrestrial resources

(i) Technical Report E.3.3-3 discusses the effects of two operational scenarios on riparian vegetation within the Hells Canyon corridor, based on extensive data collection, correlations with environmental variables (e.g., hydrology, slope, substrate) and HC_REM analysis. We need the same types of information to evaluate the effects of the 6 operational scenarios and sub-scenarios listed at the beginning of this AIR.

Please include the predicted increases or decreases in acreage of vegetation that would occur as a result of these scenarios for each of the six plant groups described in your original modeling efforts (FRA, FRP, HYD, ORA, ORP, and RA). Also, please describe predicted effects on the abundance and distribution of noxious weeds, non-native plants, and special status plant species.

Please evaluate the potential effects of more restrictive ramping rates on riparian vegetation along the Hells Canyon reach of the Snake River, relating predicted changes in vegetation to existing substrate type or to changes in erosion, deposition, or sediment transport that may also result from implementation of these scenarios.

(ii) Technical Report E.3.2-45 includes a summary table (table 2) showing the estimated acres affected by your current and proposed operations of the Hells Canyon Project. To ensure we have comparable information for all scenarios, please provide a similar table presenting estimates of acreage at Brownlee, Oxbow, and Hells Canyon reservoirs and the Hells Canyon reach of the Snake River that would be affected by implementation of each of the scenarios listed above.

1. INTRODUCTION

In the final *New License Application: Hells Canyon Hydroelectric Project (FERC Project No. 1971)* (IPC 2003), referred to as the final license application (FLA), Idaho Power Company (IPC) documented operational impacts to riparian and upland wildlife habitats (FLA section E.3.2.4) and proposed protection, mitigation, and enhancement measures (PM&Es) (FLA section E.3.2.3). Technical Report E.3.3-3 (Braatne et al. 2002) described the predicted effect of two operational scenarios (*Proposed Operations* and *Full Pool Run-of-River Operations*) on six plant functional groups. Technical Report E.3.2-40 (Blair et al. 2002) similarly predicted changes in 13 vegetation cover types, which were originally described in Technical Report E.3.3-1 (Holmstead 2001). Predicted impacts of IPC's *Proposed Operations* relative to *Full Pool Run-of-River Operations* on riparian vegetation and wildlife habitat were summarized in Technical Report E.3.2-45 (Edelmann et al. 2002).

On 4 May 2004, the Federal Energy Regulatory Commission (FERC) requested that IPC provide additional information about the Hells Canyon Complex (HCC). In Additional Information Request (AIR)

OP-1(g), FERC specifically directed IPC to discuss the potential effects of six operational scenarios and subscenarios (i.e., 11 total AIR scenarios) on the acreages of plant functional groups described in Technical Report E.3.3-3 (Braatne et al. 2002). Because this technical report did not predict acres of impact from HCC operations, IPC requested on 20 July 2004 that cover types be substituted for functional groups in the AIR OP-1(g) analysis. FERC approved the request in a letter dated 23 July 2004 (Appendix A). The resulting quantitative analysis, therefore, followed the general methodology in Technical Report E.3.2-40 (Blair et al. 2002) with qualitative discussions of scenario-induced effects to noxious weeds, nonnative plants, and special status plants. Effects on riparian habitat from changes in sediment transport downstream of Hells Canyon Dam are also qualitatively evaluated for each AIR scenario. Estimated acres of impacted habitat are summarized, similar to Table 2 in Edelmann et al. (2002), for each operational scenario.

For comparative purposes, we also present information on *Proposed Operations* and *Full Pool Run-of-River Operations* modeled in Parkinson (2002) and evaluated in Blair et al. (2002). Unless otherwise indicated, we referred to *Proposed Operations*, *Full Pool Run-of-River Operations*, and the 11 AIR scenarios as “scenarios.”

2. RESPONSES TO OP-1(G)—TERRESTRIAL RESOURCES OPERATIONAL SCENARIOS

2.1. Objectives

AIR OP-1(g) is composed of five main objectives:

1. Calculate predicted acreage changes in riparian and upland cover types and describe plant assemblages that could occur with implementation of each operational scenario. We interpreted that the AIR requests scenario-induced changes in the extent of cover types relative to existing conditions reported in Holmstead (2001) and Blair et al. (2002) rather than to *Full Pool Run-of-River Operations* as presented in the FLA and Edelmann et al. (2002).

2. Describe, qualitatively, the potential effects of each operational scenario on the distribution and abundance of rare plants in the shoreline zones of the HCC study area.

3. Describe, qualitatively, the potential effects of each operational scenario on the distribution, abundance, and spread of noxious weeds and selected invasive nonnative plants in the shoreline zones of the HCC study area.

4. Describe, qualitatively, how riparian vegetation is influenced by existing substrate and could be influenced by changes in erosion, deposition, or sediment transport that could result from implementation of each operational scenario for the Snake River below Hells Canyon. Information in AIR OP-1(d) provides the basis for the sediment transport evaluation.

5. Summarize estimated acres of impacted upland and riparian cover types for Brownlee, Oxbow, and Hells Canyon reservoirs and the Hells Canyon reach of the Snake River for each scenario. Comparable estimates of impacted acres of riparian and upland habitat for each scenario will be summarized similar to Table 2 in Edelmann et al. (2002).

2.2. Study Area

The HCC study area, its physiography, land features, geology, climate, vegetation, adjacent land uses, and reservoir operations are described in Blair et al. (2002). The HCC study area is composed of three reservoirs (Brownlee, Oxbow, and Hells Canyon) and the river reach from Hells Canyon Dam to the confluence of the Snake and Salmon rivers. Holmstead (2001) describes the current extent and distribution of vegetation cover types (i.e., wildlife habitat), plant assemblages, and other botanical characteristics of the study area. Krichbaum (2000) describes noxious weeds and rare plants in the study area.

For analyzing operational impacts of the HCC on riparian and upland habitat, we spatially stratified the study area into three operational zones: 1) reservoir fluctuation zone, 2) reservoir shoreline zone, and 3) river shoreline zone (i.e., below Hells Canyon Dam). We further stratified the fluctuation and shoreline zones by reservoir because each reservoir has unique operational constraints and habitat patterns. Thus, we estimated influences of the operational scenarios relative to the existing extent of vegetation cover types and component plant assemblages (i.e., current conditions) within three reservoir fluctuation zones, three reservoir shoreline zones, and two river shoreline zones (i.e., Idaho and Oregon shorelines). To provide complete and comparable estimates of impacted acres for each scenario similar to Table 2 in Edelmann et al. (2002), we also report impacts from erosion to the crucial winter range zone and the shoreline zone. Blair et al. (2002) and Edelmann et al. (2002) further describe the evaluation zones.

2.3. Methods

2.3.1. Analysis Assumptions

Our analyses were based on a series of assumptions and definitions stated in Blair et al. (2002). Key assumptions and definitions were as follows:

1. Observed historical operations (1958–1999, termed *Historical Operations* in this response) of the HCC determined the existing extent and characteristics of shoreline vegetation reported in Holmstead (2001). Existing conditions served as the comparison baseline for our analyses. Estimates of impacted acres in the shoreline zones from erosion and the crucial winter range zone reported in Edelmann et al. (2002) would remain constant with implementation of an AIR scenario.

2. Except for Scenario 5 (see section 2.3.2), suitable wildlife habitat would not establish in the reservoir fluctuation zones under the operational scenarios. The fluctuation zone is the maximum area of land that could be seasonally exposed during operational drafting. For Scenario 5, we predicted vegetation colonization in the fluctuation zone of Brownlee Reservoir because it would be dewatered for 30 years.

3. Suitable wildlife habitat would not establish in the scour zone of the Snake River below Hells Canyon Dam. Therefore, the lowest downslope extent of vegetation in the river shoreline zone would not change from existing conditions under any scenario.

4. Maximum daily headwater elevation (for the reservoirs) and flow (for the Snake River below Hells Canyon Dam) during the growing season are the parameters that best represent the interaction between operational scenarios and shoreline vegetation.

5. A characteristic headwater elevation (or flow below Hells Canyon Dam) would capture the range of potential runoff years. A characteristic headwater elevation (or flow) is defined as the weighted average of maximum daily headwater elevation (or flow) for three types of runoff years. Specific details are presented in section 2.3.4.

6. Predicted vegetation (i.e., cover types) changes would occur within 30 years; actual rates of change would vary depending on life form and environmental characteristics. This study was not designed to evaluate rates of change.

7. Changes in the extent of a cover type were assumed to occur proportionally throughout a study reach. This study was not designed to project actual locations or patch geometry of cover types into the future.

8. Disturbance factors, such as grazing, land development, or fire, were assumed to be constant and not considered in projections.

9. Shoreline geomorphology would remain constant and was not considered in quantitative projections.

10. Characteristics of the existing plant assemblages comprising a cover type would continue into the future.

2.3.2. Operational Scenarios and Hydrology

In the FLA, IPC estimated habitat impacts for *Proposed Operations* relative to *Full Pool Run-of-River Operations*. In this AIR, FERC directed IPC to evaluate the effects of 11 additional operational scenarios on vegetation cover types. Habitat impacts will be estimated for each AIR scenario relative to existing conditions. For comparison purposes, IPC also reports estimated habitat impacts of *Proposed Operations* and *Full Pool Run-of-River Operations* relative to existing conditions. Each scenario was modeled with CHEOPS as described in Parkinson (2002) and IPC's responses to AIR OP-1(a) and AIR OP-1(h), filed 4 February 2005.

The following description of the 11 operational scenarios was provided by FERC:

1. Using Hells Canyon Reservoir to re-regulate outflows, as follows:
    (a) instantaneous outflow from Hells Canyon Dam equals the average inflow to the Hells Canyon Reservoir during the previous 24 hours
    (b) maximum ramping rate of 2 inches per hour (year-round) as measured within 1.0 mile of Hells Canyon Dam
    (c) maximum ramping rate of 6 inches per hour (year-round) as measured within 1.0 mile of Hells Canyon Dam
    (d) maximum ramping rate of 2 inches per hour (1 March–31 May) as measured within 1.0 mile of Hells Canyon Dam
    (e) maximum ramping rate of 6 inches per hour (1 March–31 May) as measured within 1.0 mile of Hells Canyon Dam
    (f) maximum ramping rate of 2 inches per hour (1 March–31 May) and 6 inches per hour for the rest of the year, plus a maximum total daily fluctuation of 2.0 feet year-round as measured within 1.0 mile of Hells Canyon Dam
2. Using Brownlee Reservoir storage for flow augmentation and Hells Canyon Reservoir to re-regulate outflows. Maximum ramping rate of 2 inches per hour (1 March–31 May) as measured within 1.0 mile of Hells Canyon Dam, plus a 350,000-acre-foot draft of Brownlee Reservoir.

Identical to Scenario 1(d) except that up to 350,000 acre-feet of water would be drafted between 21 June and 31 July each year. The reservoir target elevation would be 2,049 mean sea level (msl), and no additional water could be stored (increased water-surface elevation) prior to 31 August, but the reservoir could be drafted further as needed to meet power needs.

3. Operating to achieve navigation flow targets consisting of (a) an instantaneous, year-round minimum flow of 8,500 cfs above the mouth of the Salmon River as measured at the Snake River at Hells Canyon Dam gage (no. 13290450), River Mile (RM) 247.0; and (b) an instantaneous minimum flow of 11,500 cfs below the mouth of the Salmon River as measured at the Snake River below China Gardens Rapids gage (no. 13317660), RM 175.5. When daily flows into Brownlee Reservoir drop below 8,500 cfs, the instantaneous minimum release required from Hells Canyon Dam for the current day would be equal to the previous 3-day moving average for Brownlee Reservoir inflow. At all times, the maximum variation in river stage would not exceed 1 foot per hour as measured at the Snake River at Johnson Bar gage (no. 13290460), RM 230.

4. Scenario 3 in combination with Scenario 1(f), wherein the Scenario 1(f) ramping rate and daily fluctuation limits would be overlain on the Scenario 3 navigation targets.

5. Operating Brownlee Reservoir at minimum operating pool year-round, with Oxbow and Hells Canyon reservoirs held at full pool (inflow equals outflow).

6. Increasing drawdown of Brownlee Reservoir during the fall and winter months to speed the cooling of outflows from the project and to reduce the incidence and severity of gas supersaturation associated with flood events. The timing and extent of reservoir drawdown to be evaluated in this scenario should be developed in consultation with the agencies and tribes that are identified at the end of this AIR.

2.3.3. Reservoir Fluctuation Zones

Blair et al. (2002) defined a reservoir fluctuation zone as the maximum area of land that could be seasonally exposed during operational drafting. Historically, maximum seasonal drafting was 101 vertical feet for Brownlee Reservoir and 10 vertical feet for Hells Canyon and Oxbow reservoirs. *Proposed Operations* would have the same maximum drafting depth of 101 ft for Brownlee Reservoir but only 5 ft for Oxbow and Hells Canyon reservoirs. Irrespective, IPC evaluated a 10-vertical-foot fluctuation zone in Hells Canyon and Oxbow reservoirs for estimating impacts to wildlife habitats in Blair et al. (2002) and for the FLA. For consistency with the FLA, IPC likewise evaluated fluctuation zones of 101 vertical feet for Brownlee Reservoir and 10 vertical feet for Hells Canyon and Oxbow reservoirs.

Seasonal and daily water-level changes inundated areas of each reservoir's fluctuation zone for various periods, which eliminated vegetation that historically provided riparian and upland wildlife habitats. Using a series of assumptions about the spatial characteristics of the reservoir fluctuation zones and botanical data from Holmstead (2001), Blair et al. (2002) reported the relative proportions of riparian and upland habitat that were theoretically precluded in the fluctuation zones during *Historical Operations*. No cover-type maps of the reservoir fluctuation zones are available. Consequently, assumptions were developed during consultation with the Terrestrial Resource Workgroup and are presented in *Hells Canyon Complex Draft Impact Statements: Terrestrial Resource Workgroup* and dated 1 February 2001. The document is part of the meeting notes for the Terrestrial Resources Workgroup meeting on 7 February 2001.

Blair et al. (2002) considered that the entire fluctuation zone of each reservoir would be impacted under *Proposed Operations* and recommended mitigation for the impacted acres (Edelmann et al. 2002). Proportions of cover types comprising the upland and riparian habitats were not predicted. Likewise, we assumed that additional operational scenarios with daily and seasonal water-surface fluctuations similar to *Proposed Operations* would preclude the establishment of perennial vegetation within the reservoir fluctuation zones. Therefore, habitat impacts reported by Blair et al. (2002) for the reservoir fluctuation zones under *Proposed Operations* would be incurred for the AIR scenarios, with the exception of Scenario 5.

In contrast to the other scenarios, Scenario 5 would require that the HCC be operated as run-of-river with Brownlee Reservoir kept at the minimum pool elevation of 1,976 ft msl yearlong for 30 years. Oxbow and Hells Canyon reservoirs would be kept at their full pool levels and the fluctuation zones would be neither dewatered nor colonized by vegetation. The minimum pool level of Brownlee Reservoir would entirely expose the 5,820-acre fluctuation zone and create an opportunity for perennial vegetation to colonize the initially bare substrates. A 101-ft drawdown would create a new reservoir pool beginning at about RM 317.0 and extend the unimpounded riverine channel 22.2 river miles from Cobb Rapid (RM 339.2), the existing upstream extent of Brownlee Reservoir, to the new reservoir pool. Upstream portions of the Powder River Arm would also be dewatered and form a riverine channel. The drawdown would expose barren riparian areas along the freshly established river, tributary, and pool shorelines that would be available for plant colonization. Likewise, a barren upland area would be exposed between the riparian areas and the former full-pool shoreline (i.e., 2,077 ft msl).

For this AIR response, we expanded upon the FLA estimate of 372 acres of riparian habitat and 5,448 acres of upland habitat in the fluctuation zone of Brownlee Reservoir and estimated the theoretical riparian and upland cover types that might establish after 30 years in these habitats. The fluctuation zone of Brownlee Reservoir extends approximately 54.7 river miles from Cobb Rapid (RM 339.2) to

Brownlee Dam (RM 284.5). Dimensions of the riparian and upland areas within the fluctuation zone were defined in *Hells Canyon Complex Draft Impact Statements: Terrestrial Resource Workgroup*. The amount of riparian habitat (372 acres) was based on the extent of existing riparian habitat along the shorelines of Oxbow and Hells Canyon reservoirs, which is about 6% of the area within a 20-m planimetric band upslope of each reservoir shoreline. It was assumed that at least an equal amount of habitat might develop after 30 years along the new low-pool shoreline of Brownlee Reservoir. To account for uncertainty, the estimate was increased to include 8% of the area within a 20-m shoreline corridor. For this AIR response, we used a geographic information system (GIS) and reservoir bathymetry (Butler 2002) to map the riparian area and subdivided it into the riverine, pool, and tributary sections to reflect the unique slopes, substrates, hydrology, and shoreline soil moisture conditions of these settings.

The riverine riparian section extended longitudinally from Cobb Rapid to the newly formed full-pool shoreline of 1,976 ft msl and laterally from the preinundation shoreline of the Snake River upslope 5 m planimetrically. The pool riparian section extended longitudinally from the upstream end of the 1,976-ft shoreline to Brownlee Dam and 10 ft vertically upslope between the 1,976-ft shoreline and 1,986-ft elevation contour. Each perennial tributary was mapped by linearly extending a 5-m-wide buffer along each side of the stream course from the point of intersection with the 2,077-ft full-pool shoreline downslope to the closer of the preinundation Snake River shoreline or the 1,976-ft pool shoreline. Islands were not considered in the analyses. Nonvegetated cover types, such as cliffs and talus slopes that occur in the fluctuation zone, were also not considered.

We assumed that *Forested Wetland*, *Scrub-Shrub Wetland*, *Emergent Herbaceous Wetland*, and *Shore and Bottomland Wetland* cover types would establish in the riparian area. We assigned cover types to the riparian area as the average proportions that, standardized to 100%, occur in the shoreline zones of the Weiser reach and Oxbow Reservoir (Blair et al. 2002).

We also mapped the upland area (5,448 acres) and subdivided it into the upper slope (3,025 acres) and lower slope (2,423 acres) sections. Occurring between the 2,077-ft full-pool shoreline and a 2,037-foot water-surface elevation, historical reservoir drafting often eroded soils from the upper slope section. Existing substrates in the upper slope section are typically coarse and offer limited rooting soil for plant colonization. Combining the limited soils and arid conditions, we assumed that only xeric-adapted forbs and grasses (i.e., *Desertic Herbland* cover type) would be suited for inhabiting the upper slope section. In contrast, soils below 2,037 ft were less often eroded by operational drafting and, furthermore, typically received soil sediments deposited during upslope erosion. Consequently, substrates in the lower slope section provide rooting soil for plant colonization. We assumed that invasive nonnative species and undesirable plant assemblages constituting *Forbland* and *Grassland* cover types would initially dominate the colonization. We conservatively estimated that, at the end of 30 years, the upper slope section would remain entirely *Desertic Herbland* and the lower slope would remain equally divided between *Forbland* and *Grassland*.

2.3.4. Reservoir Shoreline Zones

Potential effects to riparian vegetation from an operational scenario would occur within a defined area that is influenced by shoreline moisture. Therefore, a reservoir shoreline zone is the area of land above a reservoir's full pool that could support riparian vegetation. For the HCC, Blair et al. (2002) defined the shoreline zone to extend 50 m planimetrically upslope from the full-pool shoreline of each reservoir (Brownlee Reservoir = 2,077 ft msl, Oxbow Reservoir = 1,805 ft msl, Hells Canyon Reservoir = 1,688 ft msl). The evaluation area can be viewed as a 50-m-wide ring above the full-pool shoreline of each reservoir.

We used different analytical methods for Brownlee Reservoir than for to Oxbow and Hells Canyon reservoirs. Projections were conducted separately for the shoreline zone of each reservoir because of their specific operational constraints and unique assemblages of existing shoreline vegetation.

Brownlee Reservoir—Except for Scenario 5, all the AIR scenarios for Brownlee Reservoir would be operated similar to *Historical Operations,* which included large-scale seasonal drafting (Parkinson 2002, AIR OP-1[h]). Historically, drafting of Brownlee Reservoir early and late in the growing season limited riparian vegetation because soil moisture in the shoreline zone was insufficient. Although drafting of Brownlee Reservoir historically varied within and among years, relatively large seasonal fluctuations were common with fluctuations occasionally extending to 101 vertical feet below the full-pool elevation (2,077 ft). These rare events were necessary for flood-control during years with a large spring runoff. Because the operational scenarios, except Scenario 5 and *Full Pool Run-of-River Operations*, would draft Brownlee Reservoir similar to what occurred historically (see AIR OP-1[h]), IPC assumed that existing conditions would be maintained in the shoreline zone of Brownlee Reservoir, which is dominated by upland vegetation (Holmstead 2001). Figure 1 displays the expected headwater elevations for a year with moderate inflows (i.e., 1995) for each scenario relative to the observed *Historical Operations* for that year.

For analyses, Blair et al. (2002) subdivided Brownlee Reservoir into three reaches: headwaters, Powder River pool, and lower Brownlee reach. The lower Brownlee reach extends from Brownlee Dam (RM 284.5) upstream to RM 325.0 of the Snake River and to RM 5.6 of the Powder River. The Powder River pool reach extends upstream from RM 5.6 to the intersection of the Powder River with Brownlee Reservoir at the 2,077-ft full-pool shoreline. The headwaters reach extends from RM 325.0 of the Snake River upstream to Cobb Rapid (RM 339.2). IPC reports combined acres of cover types for the reaches of Brownlee Reservoir.

Scenario 5, however, differs markedly from *Historical Operations* and the other AIR scenarios. Scenario 5 would maintain Brownlee Reservoir year round at the minimum operating pool of 1,976 ft. This 101-ft decrease in water-surface elevation would create a new shoreline within the existing fluctuation zone and dewater the interface of the existing shoreline zone with the fluctuation zone. The removal of seasonally available shoreline soil moisture in the existing shoreline zone (i.e., 50 m above 2,077 ft) would convert riparian habitat to upland cover types. We predicted acres of upland cover types in the Brownlee shoreline zone for Scenario 5 based on existing proportions.

Oxbow and Hells Canyon Reservoirs—Oxbow and Hells Canyon reservoirs are re-regulating reservoirs that historically experienced relatively small but regular daily changes in water-surface elevations. Under *Historical Operations*, Oxbow Reservoir typically fluctuated daily within 5.6 ft of full pool (1,805 ft), and Hells Canyon Reservoir typically fluctuated within 3.8 ft of full pool (1,688 ft) (Parkinson 2002). The relatively stable water levels, which returned to near full pool each day during the growing season, enhanced the establishment of riparian habitat in the shoreline zones of Oxbow and Hells Canyon reservoirs (Holmstead 2001, Braatne et al. 2002). Where suitable substrate and topography occurred, a relatively wide band of riparian habitat was promoted by the regular daily water-surface fluctuations that "irrigated" riparian vegetation during the growing season (Blair et al. 2001, Braatne et al. 2002). This irrigation effect was defined in Blair et al. (2002) and discussed in Holmstead (2001) and Braatne et al. (2002).

For Oxbow and Hells Canyon reservoirs, headwater elevation at each dam was the parameter used to evaluate potential changes in the irrigation effect and shoreline vegetation. IPC used modeled data from CHEOPS for *Proposed Operations*, *Full Pool Run-of-River*, and the 11 AIR scenarios (Parkinson 2002, AIR OP-1[h]). This method differs from that used by Blair et al. (2002) to estimate riparian impacts for *Proposed Operations* and *Full Pool Run-of-River Operations* in the FLA. They qualitatively determined that vegetation in the shoreline zone of Oxbow and Hells Canyon reservoirs would not change for either *Proposed Operations* or *Full Pool Run-of-River Operations* because water-surface elevations would not differ significantly from *Historical Operations*. For comparison purposes, we reevaluated the effects of these two scenarios with the quantitative methods that we refined for the AIR scenarios. Note that for Oxbow and Hells Canyon reservoirs, *Full Pool Run-of-River Operations* and Scenario 5 are operationally equivalent because these reservoirs would be held at full pool yearlong.

In summary, CHEOPS takes observed inflow data from past years and shapes the flow through the dams to meet specified operating rules (see Parkinson 2002 for more detail). From the modeled 15-min headwater elevation data for each dam, we calculated average maximum daily headwater elevations for 1992, 1995, and 1997 (Tables 1 and 2). Year 1992 was a typical low runoff year, 1995 represented medium flows, and 1997 represented high flows (Parkinson 2002). We then calculated a weighted average, based on the proportions of the three types of runoff years (low = 58% of years <14 million acre-feet; medium = 31% of years 14–20 million acre-feet; high = 11% of years >20 million acre-feet) that occurred over the period of record (i.e., 1928–1999) (Tables 1 and 2). For each operational scenario, the weighted average maximum daily headwater elevation represents a characteristic headwater elevation that could be expected over the next 30 years. As discussed in Blair et al. (2002), weighting was required because 15-min data were not available for the entire period of record.

For each scenario, we determined whether there would be an effect on shoreline soil moisture and thus vegetation. Specifically, we evaluated whether the characteristic headwater elevation would return daily to full pool during the growing season (1 May–30 September). For each reservoir and scenario, we overlaid characteristic headwater elevations onto the bathymetry coverage in GIS (2-m accuracy) and calculated the surface area inundated. We projected acreage changes in the existing extent of cover types (Holmstead 2001) relative to differences in area inundated between full pool and the characteristic headwater elevation of an operational scenario. We assumed that the change in acreage inundated between full pool and the characteristic headwater elevation of a scenario would result in a proportional change in the reservoir influence on soil moisture in the shoreline zone. The corresponding change on the upslope extent of soil moisture (i.e., the irrigation effect) would have a proportional impact on the existing vegetation cover types within the shoreline zone. Existing conditions (i.e., acreages and proportions of each cover type), based on *Historical Operations*, were calculated in Blair et al. (2001) and reproduced here. The existing acreage of cover types was used as the comparison to estimate potential changes in shoreline zone vegetation for each scenario.

In response to a changing flow regime in the Snake River, Dixon and Johnson (1999) and Braatne et al. (2002) proposed that the upslope boundaries of established riparian vegetation would change where the shoreline moisture gradient responds to river stage. Soil moisture typically decreases with increasing distance from the river. Projections of cover-type changes, therefore, corresponded to the assumed shoreline moisture gradient. Conceptually, vegetation cover types along the Snake River shoreline are distributed in distinct elevational bands that correspond to the moisture gradient (Dixon and Johnson 1999).

The following analytical method was developed in Blair et al. (2002) to estimate cover-type changes downstream of Hells Canyon Dam in response to changes in shoreline moisture. We used a similar approach to predict cover-type changes on Oxbow and Hells Canyon reservoirs in response to characteristic headwater elevations of the scenarios. The following riparian cover types generally progressed upslope from the shoreline of the Snake River (Johnson et al. 1995, Dixon and Johnson 1999, Holmstead 2001, Braatne et al. 2002):

1. *Shore and Bottomland Wetland* (largely barren cobble shoreline that is seasonally inundated and scoured by the river)
2. *Emergent Herbaceous Wetland*
3. *Scrub-Shrub Wetland*
4. *Forested Wetland*
5. *Shrubland*
6. *Shrub-Savanna*
7. *Grassland*

Appendix B provides cover-type definitions. Cover-type changes were projected to respond to shoreline moisture changes in this progression. The primary exception was that Blair et al. (2002) assumed that existing *Forested Wetland* and *Scrub-Shrub Wetland* would both transition to upland *Shrubland* with long-term soil moisture decreases associated with lower headwater elevations in a scenario. The steep gradient of the HCC study area, coupled with the general absence of *Forested Wetlands* (except at the mouths of tributaries) suggested that a drying of the *Scrub-Shrub Wetland* vegetation under these conditions would in time result in conversion to *Shrubland*. We assumed that developed cover types, such as agricultural and residential areas, parks, and pastures, would not change in the future. Likewise, land features, such as cliffs and talus slopes, would not be affected by changes in shoreline moisture.

To estimate impacts to riparian habitat for each scenario, we subtracted the acres of predicted vegetated riparian cover types from the existing acres. Riparian cover types were *Forested Wetland, Scrub-Shrub Wetland,* and *Emergent Herbaceous Wetland*.

2.3.5. River Shoreline Zones

We applied the habitat descriptions of Holmstead (2001), vegetation modeling of Braatne et al. (2002), and subsequent habitat interpretation by Blair et al. (2002). Because of the relatively unique environment of the Snake River downstream of Hells Canyon Dam, the shoreline zone is defined differently than for the reservoirs. Braatne et al. (2002) defined the river shoreline zone to extend 11 m vertically above a constant flow of 20,695 cubic feet per second (cfs). They determined that the lowest extent of woody riparian vegetation was formed by a constant flow of 20,695 cfs. Corresponding, woody riparian vegetation extended an average of 11 m above the water-surface elevation formed by the 20,695-cfs flow. The evaluation area, therefore, was defined in Blair et al. (2002) to be a 3,435-acre polygon, which included the water surface and approximately followed an 11-m vertical contour above the 20,695-cfs water-surface elevation.

We followed methods in Blair et al. (2002) to estimate a characteristic flow from Hells Canyon Dam for each scenario. Specifically, from the CHEOPS-modeled 15-min flow data (i.e., turbine discharge plus spill) from Hells Canyon Dam, we calculated average maximum daily flows from 1 July to 31 August for 1992, 1995, and 1997 (Table 3). Maximum daily flow represents the maximum extent that operations interact with shoreline vegetation. The evaluation period of 1 July to 31 August was selected because this is the portion of the growing season that was most influenced by daily load-following operations. We also calculated a characteristic flow from actual historical data (i.e., *Historical Operations*) to serve as a basis from which to evaluate operational changes among the scenario-specific river flows.

The MIKE 11® one-dimensional hydrologic model was used to translate characteristic flows for *Historical Operations* and the scenarios into estimates of cross-sectional stage (i.e., water-surface elevations) for the Snake River from Hells Canyon Dam to the Salmon River confluence. As in Blair et al. (2002), we added average daily flow from the Imnaha and Salmon rivers for 1 July to 31 August to the resulting characteristic flows for each scenario (i.e., daily flows were used rather than maximum daily flows because flows vary little within a day on these unimpounded rivers). Resulting river stage for each scenario and *Historical Operations* was mapped with MIKE 11-GIS® and converted into inundation maps of the river channel within the evaluation area. For each inundation map, we calculated the water-surface acreage and compared the inundated acres of each scenario to the inundation acres under *Historical Operations*. We then used the same methods applied to Oxbow and Hells Canyon reservoirs to estimate potential changes in the extent of cover types and riparian impacts for each scenario.

2.3.6. Plant Assemblages

To qualitatively describe vegetation types potentially impacted by the operational scenarios, we summarized existing plant assemblages in Holmstead (2001). Holmstead (2001) collected extensive vegetation data in the HCC study area from 1994 to 1999. He used Two-Way Indicator Species Analysis (TWINSPAN; Cornell Labs, Ithaca, NY) to group riparian species and transects (the sample unit) into plant assemblages. We selected all transects within the reservoir and river shoreline zones and calculated the proportions of plant assemblages for each cover type and reach. Results are presented in Appendix C.

2.3.7. Noxious, Nonnative, and Special Status Plants

Prior field studies and extensive analyses of riparian and upland vegetation assessed 20 species of noxious weeds and nonnative plants and six species of special status plants within the HCC study area. See Holmstead 2001, Krichbaum 2000, and Braatne et al. 2002 for specific descriptions of study methodology and major findings. Specifically, Braatne et al. (2002) coupled life history strategies of these plants to the relatively wide range of environmental and hydrologic conditions (i.e., contrasting river flows and reservoir water-surface fluctuations) representative of *Proposed Operations* and *Full Pool Run-of-River Operations*. Edelmann et al. (2002) summarize effects of *Proposed Operations* and *Full Pool Run-of-River* for the next 30 years on the distribution and abundance of noxious weeds, nonnative plants, and special status plants.

Our focus is the possible impact of the AIR scenarios on the noxious, nonnative, and special status plants. With the exception of Brownlee Reservoir under Scenario 5 (Figure 1), the hydrologic patterns of the AIR scenarios largely fall within the range of conditions previously analyzed for *Proposed Operations* and *Full Pool Run-of-River Operations* (Figures 1 and 2b). Therefore, it is feasible to qualitatively apply the analyses and inferences of Braatne et al. (2002) to hydrologic patterns of the AIR scenarios.

2.3.8. Substrate and Sediments

To qualitatively assess the potential impacts of operational scenarios on sediment erosion, transport, and deposition regimes and consequent changes in vegetation substrate, we considered the prior assessments and interpretations by Blair et al. (2001) and Braatne et al. (2002), along with the sediment transport analysis of AIR OP-1(d).

2.4. Results and Discussion

2.4.1. Reservoir Fluctuation Zones

Cover-type Acreages and Plant Assemblages—Blair et al. (2002) reported that daily and seasonal fluctuations in water-surface elevations of *Proposed Operations* and *Full Pool Run-of-River Operations* would preclude the establishment of 5,820 acres (372 riparian, 5448 upland), 89 acres (7 riparian, 82 upland), and 240 acres (9 riparian, 231 upland) of habitat within the fluctuation zones of Brownlee, Oxbow, and Hells Canyon reservoirs, respectively. With the exception of Scenario 5, we concluded that the additional scenarios would likewise prevent the establishment of upland and riparian habitat, thus impacting the availability of habitat within the reservoir fluctuation zones.

For Scenario 5, however, we predicted that the fluctuation zone of Brownlee Reservoir would be colonized over 30 years by upland and riparian vegetation. Of the 372 acres in the riparian area, *Forested Wetland*, *Scrub-shrub Wetland*, *Emergent Herbaceous Wetland*, and *Shore and Bottomland Wetland* were estimated to occupy 74, 228, 47, and 23 acres, respectively. Of the 5,448 acres in the upland area, *Desertic Herbland*, *Herbland*, and *Grassland* were estimated to occupy 3,025, 1,211.5, and 1,211.5 acres, respectively.

These cover-type acres are imprecise estimates based on the proportion of existing cover types in the Oxbow and Weiser reaches applied as fixed-width bands and elevational contours to the bathymetry map of Brownlee Reservoir. Other than existing land cover estimates from elsewhere and bathymetric data, these cover-type estimates do not consider other empirically measured data (e.g., preinundation land cover, substrate availability and distribution, river hydrology, or channel geometry and geomorphology) that would influence the occurrence and distribution of upland and riparian cover types in the fluctuation zone.

Furthermore, the actual colonization and successional transition over 30 years of plant assemblages comprising riparian and upland cover types is unknown. The reported acreages of cover types in the fluctuation zone are merely imprecise estimates resulting from gross generalizations and assumptions about topography, hydrology, and soil substrates. However, the existing abundance of highly competitive exotic invaders upstream and upslope of the fluctuation zone (Krichbaum 2000, Braatne et al. 2002) suggests that desirable native plants would have a competitive disadvantage establishing and significantly expanding in the fluctuation zone. Thus, it is reasonable to predict that species colonizing the fluctuation zone would form plant assemblages dominated by undesirable exotic species. Overall, we believe that the riparian and upland areas of the fluctuation zone would be at least partially vegetated by the end of 30 years, but the preponderance of undesirable nonnative plants would largely render poor-quality wildlife habitat.

Qualitative Interpretation of Scenario 5—Only Scenario 5 would promote the establishment of perennial vegetation within a reservoir fluctuation zone, specifically Brownlee Reservoir. While the specific colonization and successional transitions over 30 years are not fully predictable, observations of the physical environment can provide some insight when combined with knowledge about vegetation along the headwaters reach of Brownlee Reservoir. Sample photographs of the fluctuation zone that would be permanently exposed with Scenario 5 are provided in Figures 3, 4, and 5. As shown, the fluctuation zone consists of a number of elevational bands (i.e., upland and riparian areas) that would support different plant communities. General characteristics of potential habitat that might establish within these elevational bands are described in Figures 3, 4, and 5, and in the following paragraphs.

The highest elevational band (i.e., wave-scour band) consists of coarse substrate because fine sediments have been removed due to wave action and other hill-slope and riverine processes (Figure 3a). This zone would be well above the newly established river and reservoir water surfaces and would not receive supplemental moisture from the river or 1,976-ft pool. The zone would likely be colonized by sparse cover of undesirable upland vegetation, mostly exotic species that exist in the area (e.g., cheatgrass and medusahead wildrye). Initially, we project that colonization would be dominated by invasive nonnative species and undesirable plant assemblages that constitute existing *Forbland* and *Grassland* cover types in the shoreline zone. We conservatively estimate that at the end of 30 years, the upper slope section (3,025 acres) would remain entirely *Desertic Herbland*.

Moving downslope, more gradual slopes characterize the next lower elevational band (Figure 3b). Having considerable cover of fine sediments, this area represents a transition between the dry and stony *Desertic Herbland* upland habitat and the riparian zone. The sediments originated from the upslope wave-scour band and from inflowing suspended sediments that settled upon entering the slow-flowing reservoir. This area would still be substantially above the river and 1,976-ft pool and thus would only periodically receive supplemental moisture (i.e., groundwater and surface water) from the river and reservoir pool. It would probably be colonized mostly by exotic upland species, potentially with some facultative riparian species (e.g., hackberry). Initially, we project that colonization of this area would be dominated by invasive nonnative species and undesirable plant assemblages that constitute existing *Forbland* and *Grassland* cover types occurring in the shoreline zone. We conservatively estimate that, at the end of 30 years, this lower slope zone (2,423 acres) would remain equally divided between *Forbland* and *Grassland* cover types.

The lowest elevational band, the riverine shoreline and the 1,976-ft pool shoreline, would represent the riparian area. The water table would extend horizontally into the shoreline substrate of the riparian area. Thus, shoreline plants would seasonally have access to reliable moisture. In addition to a shallow, perennial water table, fine sediments in the riparian area would provide capillarity to moisten substrates above the water table. This capillary fringe is visible in Figures 4a and 4b. Riparian vegetation would rapidly colonize this area. The combination of proximity to water and extensive fine mineral substrate provides an ideal environment for colonization by many native and exotic plants. Perennial riparian vegetation would most readily establish in relatively flat areas covered by fine sediments that were deposited during impoundment (Figure 4b). A shallow water table would especially benefit the establishment of phreatophytes (e.g., coyote willow [*Salix exigua*]). Within 30 years, this area would likely support relatively extensive vegetation, including both native and exotic woody plants.

Portions of the riparian area would be readily colonized by riparian plants where suitable substrates, slopes, and hydrology coexist. However, riparian areas are likely to be colonized extensively by invasive exotic species. The upstream end of Brownlee Reservoir is dominated by invasive exotics, especially salt cedar (*Tamarix* spp.) and false indigo (*Amorpha fruticosa*) (Braatne et al. 2002). Salt cedar is a prolific shrub or small tree that has expanded to dominate riparian zones throughout the American Southwest. With implementation of Scenario 5, the reestablished riverine and pool riparian areas would provide extensive areas where salt cedar would thrive. With its extensive occurrence in the headwaters reach of Brownlee Reservoir, abundant seeds and vegetative propagules would float downstream to colonize suitable sites.

Coyote willow was probably the predominant woody plant along the Snake River in Hells Canyon prior to the HCC (Blair et al. 2001). However, coyote willow is currently less abundant in the upstream Weiser reach, but some willows exist along tributary creeks that could provide seeds and clonal propagules. The re-exposed riparian area of Brownlee Reservoir would experience a more natural moisture regime, which might provide native willows with an advantage. However, it is reasonable to predict an overwhelming colonization by salt cedar and other invasive exotics that currently thrive in the headwaters reach and upstream (Braatne et al. 2002). Salt cedar, false indigo, and other exotic shrubs and trees do provide wildlife habitat but are considered less suitable than native shrubs and trees (Blair et al. 2002). The timing and pattern of reservoir drawdown would impact the nature of revegetation and deliberate scheduling might encourage native species.

The proliferation and downstream extension of invasive exotic plants is another prominent concern regarding colonization of the fluctuation zone (Krichbaum 2000, Holmstead 2001, Braatne et al. 2002). Providing a lethal environment for virtually all perennial plants, annual inundation of the fluctuation zone inhibits the downstream expansion of invasive exotics that are prolific in the headwaters reach (Braatne et al. 2002). In contrast to many rivers in the American West, the Snake River downstream of Hells Canyon Dam currently supports riparian vegetation communities that are largely composed of native species (Braatne et al. 2002). While Scenario 5 would permit the establishment of riparian vegetation in the current fluctuation zone of Brownlee Reservoir, much would probably be exotic. These exotic and invasive plants would progressively extend downstream toward Oxbow and Hells Canyon reservoirs and ultimately invade the Hells Canyon reach of the Snake River.

2.4.2. Reservoir Shoreline Zones

Brownlee Reservoir—Because all operational scenarios except Scenario 5 would be similar to historical operations (Figure 1), we would not expect shoreline vegetation to change into the future under these scenarios. Therefore, the existing amount of riparian vegetation (260.5 acres) is predicted to remain under *Proposed Operations* and AIR Scenarios 1 (a–f), 2, 3, 4, and 6 (Tables 4 and 5). The sparse amount of riparian vegetation in the shoreline zone of Brownlee Reservoir is typical for reservoirs with large water-level fluctuations (e.g., Nilsson and Keddy 1988). In contrast, Blair et al. (2002) predicted that riparian cover types along Brownlee Reservoir would increase 343 acres to 603 acres under *Full Pool Run-of-River Operations*.

Under Scenario 5, most of the 260.5 riparian acres would be converted to upland cover types, as the existing shoreline zone dries with the permanent drop to the minimum-operating pool level of 1,976 ft. Some riparian vegetation is likely to persist at tributary mouths where shoreline soil moisture is not entirely dependent on reservoir water-surface elevations (Rains et al. 2004), but we were unable to predict this. Thus, our estimate of riparian habitat conversion to upland habitat in the existing shoreline zone is likely liberal.

Based on existing vegetation, about 60% of the lost riparian acres would be *Scrub-Shrub Wetland*, 31% *Emergent Herbaceous Wetland*, and 9% *Forested Wetland* (Table 4). Most losses would be in the false indigo plant assemblage, followed by peachleaf willow (*Salix amygdaloides*)-coyote willow, and coyote willow (Appendix C). The most common emergent-herbaceous assemblages lost would be marsh grass (*Hymenachne* sp.), common cocklebur (*Xanthium* sp.), and purple loosestrife (*Lythrum salicaria*)-mixed herbaceous. Lost forested types would likely be Great Plains cottonwood (*Populus* sp.) and peachleaf willow.

Oxbow and Hells Canyon Reservoirs—For all scenarios, characteristic headwater elevations varied less than 1 ft from full pool on Oxbow Reservoir and less than 2 ft on Hells Canyon Reservoir (Tables 1 and 2). Therefore, shoreline riparian habitat adjacent to Oxbow and Hells Canyon reservoirs are expected to change very little in the future under any operational scenario (Tables 5, 6, and 7). All scenarios would return the water levels to or near full pool on a daily basis during the growing season. Compared with existing conditions, impacted riparian acres would range from a loss of 0.6 to 0.8 acres on Oxbow Reservoir (Table 6). On Hells Canyon Reservoir, impacted acres would range from 0.8 to 1.7 acres. Due to a constant water-surface elevation in Scenario 5, which mimics *Full Pool Run-of-River Operations* in Blair et al. (2002), there would be no change in riparian vegetation from existing conditions. Under any scenario, there would be a negligible effect to any plant assemblage (Table 7).

2.4.3. River Shoreline Zone

Cover-type Acreages and Plant Assemblages—*Proposed Operations*, *Full Pool Run-of-River Operations*, and 10 of the 11 AIR scenarios would have characteristic flows less than *Historical Operations* downstream of Hells Canyon Dam during the evaluation period (1 July–31 August) (Table 3). Because the scour zone would not change, lower flows would cause a decrease in the irrigation effect and a corresponding loss in shoreline riparian vegetation. The projected loss in riparian vegetation would range from approximately 1.8 acres in Scenario 2 to 34.8 acres in Scenario 5 (Tables 5 and 8). Because Scenario 6 would have higher flows during the growing season than occurred under *Historical Operations*, an increase in 16.5 acres of riparian vegetation is projected.

Currently, approximately 18.4% of the shoreline vegetation is riparian (Tables 5 and 8). The majority of riparian vegetation is *Scrub-Shrub Wetland* (86.5%). Impacted scrub-shrub vegetation would consist largely of hackberry-poison ivy (*Toxicodendron radicans*) and coyote willow (Appendix B). Decreases in the forested hackberry assemblage would be expected. The types of impacted *Emergent Herbaceous Wetlands* would be more variable; for example, water smartweed (*Polygonum amphibium)*, American licorice (*Glycyrrhiza lepidota*), common cocklebur, and hemp dogbane (*Apocynum cannabinum*) plant assemblages could decrease under most operational scenarios.

Correspondingly, total upland vegetation would increase in the shoreline zone due to the lower amount of available moisture. As the shoreline dries, some existing riparian vegetation would convert to *Shrubland* vegetation. The most abundant shrubland type below Hells Canyon Dam would continue to be netleaf hackberry (Appendix C). *Shrub Savanna*, the most common upland cover type, would actually experience a decrease in acreage; as this type dries, it would convert to *Tree Savanna*. Losses in *Shrub Savanna* would most likely be to the netleaf hackberry/bluebunch wheatgrass (*Pseudoroegneria [Agropyron] spicata*)-annual brome assemblage. Gains in *Tree Savanna* would be to the drier netleaf hackberry assemblage, with a more open canopy than the similar *Shrubland* assemblage. Netleaf hackberry, therefore, is the species most likely to be affected by changes in HCC operations. Under most scenarios, we predict that hackberry assemblages would decrease in coverage over time. For example, existing patches would thin, as some individuals die due to the drying effect of lower flows. In contrast, Scenario 6 would likely produce an increase in the wetter hackberry-poison ivy assemblage.

Qualitative Interpretation—Braatne et al. (2002) compared *Full Pool Run-of-River Operations* with *Proposed Operations* and largely concluded that differences in riparian vegetation and subsequent wildlife habitat would be relatively slight. This relative insensitivity reflects the physical nature of the Hells Canyon reach of the Snake River in which the river is confined within an extremely deep and steep v-shaped canyon with prominent basalt bedrock, very coarse colluvium, and virtually no floodplain zone. In the limited areas where the valley broadens, terraces often exist with materials deposited by the Bonneville floods, which dwarf contemporary flows. The terraces, which mostly support upland habitats, are largely unaffected by the current fluvial processes.

We graphically assessed scenario hydrographs for low (1992), medium (1995), and high (1997) flow years. Figure 2b displays hydrographs for the moderate flow year of 1995 as an example. Upon review, we concluded that flow patterns for the AIR scenarios are generally similar or intermediate to *Full Pool*

Run-of-River Operations and *Proposed Operations* (Figures 2a and 2b). As shown in Figures 2a and 2b, the scenarios commonly involve high flows in June, the natural timing of peaks for the Snake River and other Rocky Mountain rivers. Flows then decline relatively steadily through the summer, but the magnitude of flow augmentation (i.e., load following) through the summer varies somewhat among scenarios. Relative to riparian vegetation, the weekly pulsing would not impair riparian vegetation because the substrate would retain moisture over the weekends. The differing extent of summer flow augmentation among scenarios would provide a variable irrigation effect, with the supplemental water from daily peak flows promoting growth and survival of riparian plants through the hot and dry period of mid- to late summer.

The consequence of the irrigation effect is prominent in comparisons of photographs of the Hells Canyon reach of the Snake River taken before and after construction of the HCC and implementation of *Historical Operations* (see Blair et al. 2001). Particularly during *Historical Operations*, the foliar density of woody plants increased considerably within the band of hackberry-dominated riparian vegetation near the typical high-water mark. This response could be reversed with some scenarios, but in most other regards, the detailed modeling of *Proposed Operations* versus *Full Pool Run-of-River Operations* concluded that vegetation differences would be relatively slight. Since the AIR scenarios are generally within the range of these two comparative regimes, the same conclusion would be reached. Thus, we conclude that the extent and composition of riparian vegetation (i.e., riparian wildlife habitat) in the river shoreline zones would be relatively consistent among scenarios. Consistent with this general interpretation, estimated changes in the extent of riparian cover types seldom exceeded 10% (Table 5).

2.4.4. Noxious Weeds and Nonnative Plants

We focused on the 20 plant species assessed by Braatne et al. (2002) and addressed in the FLA. Sixteen species are regionally designated as noxious weeds, and four are potentially severely invasive in riparian zones (e.g., salt cedar, Russian olive (*Elaeagnus angustifolia*), reed canarygrass (*Phalaris arundinacea*), and false indigo) (Table 9). Potential impacts to the distribution and abundance of these 20 species are compared across *Proposed Operations*, *Full Pool Run-of-River Operations*, and the 11 AIR scenarios (Table 10). General predictions are described in the following paragraphs.

The relative abundance of each species across reaches within the HCC is provided in Table 9, as reported by Krichbaum (2000). These data represent a sample of the distribution and abundance of each species. A randomly selected 0.25-mile reach within each river mile was inventoried on both sides of the river and on islands from about 13 miles above the headwaters of Brownlee Reservoir at Weiser, Idaho (RM 351.2), downstream to the confluence of the Salmon River (RM 188.2) (163 miles) and for 9.6 miles along the Powder River Arm of Brownlee Reservoir. This robust sample adequately portrays the relative extent and distribution of noxious weeds in the study area.

2.4.4.1. Upland Plants

These upland weeds are broadly distributed along elevational transects but tend to be more common at upper elevations. Thus, upland noxious weeds were identified along the riparian zones during the study by Braatne et al. (2002), but they also typically extend upward into upland habitats as inventoried by Krichbaum (2000). Given their upland occurrence, this group of plants would typically be less affected by most operational scenarios than the other vegetation groups. However, dispersal can be substantially affected as some of these species display hydrochory, water-based dispersal of propagules.

Quackgrass— Quackgrass (*Agropyron repens*) is relatively rare in the study area, occurring mostly in the Brownlee Reservoir reach (Table 9). It occurred in only two quadrats of a single transect along the Powder River Arm of Brownlee Reservoir during sampling by Braatne et al. (2002). Krichbaum (2000) also reported a sparse but more widespread occurrence in the upland zones. With occurrence in upland as well as facultative riparian areas and with its distribution favored by various disturbances, the overall status of this noxious plant is unlikely to be substantially affected by *Proposed Operations*, *Full Pool Run-of-River Operations*, or 10 of the 11 AIR scenarios (Table 10). Under Scenario 5, this species may expand in the barren zone created following reservoir drawdown. This expansion would likely be initially slow due to low existing abundance, but it would accelerate over time.

Whitetop—Although listed as an upland species, whitetop (*Cardaria draba*) is an aggressive invader in some riparian areas. Whitetop, also known as hoary cress, occurred in low abundances in all reaches except along Brownlee Reservoir (Table 9). It occurred sparsely in riparian transects sampled by Braatne et al. (2002) along the Powder River Arm of Brownlee Reservoir and the main Brownlee Reservoir. It is sparse along the Snake River below Hells Canyon Dam, so future dispersal from upstream reaches should be especially considered. In this regard, all scenarios except Scenario 5 should continue to discourage downstream expansion of the upstream populations. Under Scenario 5, whitetop would likely expand significantly in the barren zone created by a permanent drawdown of Brownlee Reservoir and subsequently become more abundant downstream.

Canada thistle—Although listed as an upland species, Canada thistle (*Cirsium arvense*) can also be an aggressive invader of riparian areas. It was primarily restricted to the upstream reaches (Table 9) and only found in the Brownlee Reservoir and Weiser reaches during sampling by Braatne et al. (2002). Krichbaum (2000) concluded that this noxious weed was primarily associated with agricultural and other disturbances and generally situated in upland zones. This weed is thus mostly affected by factors other than river and reservoir management. Braatne et al. (2002) concluded that *Proposed Operations* and *Full*

Pool Run-of-River Operations would probably not differentially influence this species. They also concluded that the sparse presence of this species downstream of Brownlee Reservoir suggests that *Proposed Operations* might restrict the downstream expansion and that this impediment would continue with similar scenarios. In this regard, all scenarios except Scenario 5 should continue to discourage the downstream expansion of upstream populations. Under Scenario 5, Canada thistle would likely expand significantly in the barren upland and riparian zones created following reservoir drawdown, given its current abundance, and subsequently become more abundant in downstream areas.

Field bindweed—Field bindweed or morning glory (*Convolvulus arvensis*) occurred along much of the Hells Canyon corridor with considerable abundance at many sites (Table 9). As with most weeds, it was most abundant along the Weiser reach of the Snake River and the headwaters reach of Brownlee Reservoir, occurring at about one-quarter of transects along these two reaches (Braatne et al. 2002). It was then progressively less abundant along the lower Brownlee, Oxbow, and Hells Canyon reservoir reaches, occurring in 13%, 6%, and 4% of transects, respectively. It occurred in about 5% of the riparian transects along the Snake River downstream of Hells Canyon Dam. Krichbaum (2000) further concluded that field bindweed was associated with a number of disturbance factors such as trails and roads. With a broad distribution and extensive upland occurrence, it is unlikely to be substantially affected by *Proposed Operations*, *Full Pool Run-of-River Operations*, or 10 of the 11 AIR scenarios (Table 10). Given its current abundance, field bindweed would likely expand significantly in the barren zone of Brownlee Reservoir created after a permanent drawdown under Scenario 5.

Houndstongue—Krichbaum (2000) reported that houndstongue (*Cynoglossum officinale*) was the third most abundant noxious weed along the Hells Canyon corridor (Table 9). He concluded that it occurred in association with a range of disturbances, where dispersal of its burred seeds was facilitated by humans and animals. Because of its upland occurrence and animal-dispersal mechanism, this species would more likely be affected by factors other than water management. With a broad distribution and extensive upland occurrence, it is unlikely to be substantially affected by *Proposed Operations*, *Full Pool Run-of-River Operations*, or 10 of the 11 AIR scenarios (Table 10). Under Scenario 5, houndstongue would likely expand significantly in the barren zone created following reservoir drawdown, given its current abundance.

Leafy spurge—Leafy spurge (*Euphorbia esula*) is currently rare in the study area and was only located in the upstream reaches (Krichbaum 2000, Braatne et al. 2002) (Table 9). Although listed as an upland species, leafy spurge is a dominant riparian weed along many streams in cooler, semiarid regions such as Montana and southern Canada. It is extensively established along the Weiser River, which enters the Snake River about 13 miles upstream of Brownlee Reservoir. Along streams in these areas, leafy spurge has become a dominant plant, partly due to the production of stem sap alkaloids that discourage herbivory. Seeds and vegetative fragments are dispersed along waterways, and once established, the plant moves upslope from the riparian zone into transitional and upland habitats. Employing goat grazing, herbicides, reseeding, and biocontrols, Washington County, Idaho, is sponsoring a large cooperative effort to control the vast infestation along the Weiser River. This project is entering its third year and making good progress.

Although currently sparse and only in upstream reaches of Hells Canyon, leafy spurge is considered relatively new to the area and populations will likely expand downstream over time. Its dispersal has probably been impeded by historical drawdown patterns of Brownlee Reservoir. The continued annual filling and drawdown of Brownlee Reservoir, under all but *Full Pool Run-of-River Operations* and Scenario 5, would probably continue to discourage downstream dispersal. With a greater abundance in the upstream reaches, leafy spurge could rapidly invade downstream areas.

St. Johnswort—St. Johnswort (*Hypericum perforatum*) was the most abundant noxious weed in the riparian transects along the Snake River downstream of Hells Canyon Dam (Braatne et al. 2002). In contrast, this species was less abundant at riparian transects in reservoir reaches. Further extending this trend, this weed was absent in the headwaters reach of Brownlee Reservoir and in the Weiser reach (Braatne et al. 2002). Krichbaum (2000) reported similar distributional patterns in the Hells Canyon study area (Table 9). With this distribution, proliferation rather than dispersal would be the primary concern. As an upland plant, we would expect its proliferation at the upslope margin of the riparian zone to be similar to that of species within the facultative riparian perennial group. We predict minimal change in that group under all scenarios.

Dalmation toadflax—Although distributed along the three reservoirs and downstream of Hells Canyon Dam, Dalmation toadflax (*Linaria dalmatica*) is generally sparse throughout the study area. As a predominantly upland weed, its potential expansion would be more dependent on factors other than river and reservoir operations (Krichbaum 2000). With a relatively sparse distribution, although sometimes abundant at locations, it occurrence is unlikely to be substantially affected by *Proposed Operations*, *Full Pool Run-of-River Operations*, or 10 of the 11 AIR scenarios (Table 10). Under Scenario 5, Dalmation toadflax might expand in the barren zone created following a permanent drawdown of Brownlee Reservoir.

Scotch thistle—Scotch thistle (*Onopordium acanthium*) occurred occasionally along the riparian transects throughout the Hells Canyon corridor (Braatne et al. 2002). It was slightly more abundant along Brownlee Reservoir. In contrast to its relative scarcity along riparian zones, Krichbaum (2000) reported a much more extensive occurrence in the upland zones along all reaches of the study area. Promoted by many types of disturbances, it was the most abundant noxious weed inventoried. With an upland distribution, it presents another case in which river and reservoir operations would probably have little influence on its future distribution. With a broad distribution and extensive upland occurrence, it is unlikely to be substantially affected by *Proposed Operations*, *Full Pool Run-of-River Operations*, or 10 of the 11 AIR scenarios (Table 10). Under Scenario 5, however, Scotch thistle would likely expand significantly into barren areas exposed by a permanent drawdown of Brownlee Reservoir.

Medusahead wildrye—Medusahead wildrye (*Taeniatherum caput-medusae*) was common at riparian transects along the reservoirs but very scarce along the Snake River downstream of Hells Canyon Dam (Braatne et al. 2002). It presented an unusual distributional pattern, being abundant along the main portion of Brownlee and Oxbow reservoirs (53% and 47% of transects, respectively), sparse along the Hells Canyon Reservoir (16%), and absent in the headwaters reach of Brownlee Reservoir (0%). This pattern is somewhat consistent with that reported by Krichbaum (2000) (Table 9). Suited to upland landscapes, this noxious plant appears to be hindered by flow disturbance and is thus disfavored in riparian zones (Krichbaum 2000). As with most of the other upland weeds, it is unlikely that there would be substantial differences in the future distribution of medusahead wildrye under any operational scenario except Scenario 5. Given its current large abundance, it would likely expand extensively into barren areas created by a permanent drawdown of Brownlee Reservoir under Scenario 5 and would probably dominate or co-dominate with cheatgrass all upland habitats.

2.4.4.2. Facultative Riparian Perennials

These noxious and invasive plants are more dependent than upland species on the soil moisture provided in riparian zones. These plants occur in both upland and riparian areas and are often most abundant in transitional areas linking these two zones (Braatne et al. 2002). The overall proliferation of these species would be more dependent on river and reservoir operations than that of upland plants, but this conclusion may not necessarily apply to dispersal vectors.

Poison hemlock—Poison hemlock (*Conium maculatum*) was abundant along the riparian transects of the Weiser reach upstream of Brownlee Reservoir (Braatne et al. 2002). Krichbaum (2000) also reported a greater abundance in the upstream reaches (Table 9). This species would likely respond to reservoir management as other facultative riparian perennials would. For Brownlee Reservoir and possibly the other two reservoirs, modeling of *Proposed Operations* predicted slightly less favorable conditions for this species than under *Full Pool Run-of-River Operations*. However, little change was predicted along the Snake River downstream of Hells Canyon Dam (Braatne et al. 2002). Overall, these predicted effects were minor. Given its broad distribution and relatively extensive riparian occurrence, poison hemlock is unlikely to be substantially affected by *Proposed Operations*, *Full Pool Run-of-River Operations*, or any of the 11 AIR scenarios. However, the relatively stable reservoir water-surface elevations of *Full Pool*

Run-of-River Operations and Scenario 5 might provide enhanced conditions for this species to expand its distribution and abundance downstream of Brownlee Reservoir (Table 10).

Broadleaf pepperweed—Broadleaf or perennial pepperweed (*Lepidium latifolium*) was abundant along the Weiser reach of the Snake River and the HCC reservoirs (Krichbaum 2000, Braatne et al. 2002) (Table 9). Second to false indigo, broadleaf pepperweed was the next most extensive riparian weed sampled. Although minor, modeling predicted slightly less favorable conditions with *Proposed Operations* than with *Full Pool Run-of-River Operations* for Brownlee Reservoir and possibly the other two reservoirs. Little change was expected along the Snake River below Hells Canyon Dam (Braatne et al. 2002). Given its broad distribution and relatively extensive riparian occurrence, broadleaf pepperweed is unlikely to be substantially affected by *Proposed Operations*, *Full Pool Run-of-River Operations*, or any of the 11 AIR scenarios. However, *Full Pool Run-of-River Operations* and Scenario 5 may enhance conditions for the expansion of this species along the run-of-river shorelines and then downstream of Hells Canyon Dam (Table 10).

Russian olive—Russian olive (*Elaeagnus angustifolia*) is an exotic plant that is undesirable and seriously invasive but not locally designated as noxious. In contrast to many of the previously discussed noxious weeds, the life history of Russian olive is better understood relative to the influence of water regulation. Dispersal is an important attribute, as its large seeds are widely dispersed by birds and other animals. The common occurrence of saplings in bands along many streambanks throughout the West suggests that water-borne dispersal may also be important. Independent of this dispersal mechanism, their seeds require moist conditions for germination, establishment, and survival. Consequently, Russian olive is particularly invasive in riparian zones.

Russian olive was sparse along the Hells Canyon corridor. It was generally restricted to 1) the Weiser reach, 2) the full-pool shoreline of the headwaters reach, 3) and within 3 m of the high-water level of the Snake River. It is likely that the regular drawdown of Brownlee Reservoir has historically hindered the downstream expansion of this invasive tree. It is further predicted that the drawdown pattern associated with *Proposed Operations* and Scenarios 1, 2, 3, 4, and 6 would continue to discourage downstream expansion of this species (Table 10). However, dispersal from sources along Oxbow and Hells Canyon reservoirs would not be hindered by any of the operational scenarios. Relatively stable water levels of Scenario 5 and *Full Pool Run-of-River Operations* would likely promote the expansion of this species throughout riparian habitats in Hells Canyon.

2.4.4.3. Obligate Riparian Perennials

This vegetation group is critical relative to future riparian conditions along the Hells Canyon corridor. Having greater water requirement and lower elevational occurrences, obligate riparian species are more restricted to riparian areas than facultative riparian plants.

Yellow nut sedge—Yellow nut sedge, also known as chufa flatsedge (*Cyperus esculentus*), was observed in 40% of the riparian transects along the Weiser reach and 36% of the riparian transects along the headwaters reach of Brownlee Reservoir (Braatne et al. 2002). This sedge occurred in 3% of the riparian transects of the main portion of Brownlee Reservoir but not along transects farther downstream. This observed distribution contrasts somewhat with that of Krichbaum (2000), who reported this species to occur primarily along the Snake River downstream of Hells Canyon Dam. In both surveys, the plant was a minor weed, and it is not anticipated to pose as serious a problem as other noxious and invasive species. Braatne et al. (2002) predicted slight differences for yellow nut sedge between the two scenarios modeled. Given its relatively low occurrence and relatively nonaggressive life history, the abundance and distribution of this species is predicted to be minimal for all scenarios (Table 10).

False indigo—Generally occurring as a small shrub, false indigo (*Amorpha fruticosa*) was abundant along all of the HCC reservoirs. This exotic woody plant was not inventoried by Braatne et al. (2002) downstream of Hells Canyon Dam but was incidentally detected. Krichbaum (2000) reported its occurrence in 8% of the 0.5-mile segments inventoried downstream of Hells Canyon Dam.

In the riparian transects investigated by Braatne et al. (2002), false indigo was the most abundant undesirable species. It occurred extensively along the Weiser reach (27% of 15 transects), throughout the headwaters reach (36% of 11 transects), and partially along the main portion of Brownlee Reservoir (24% of 38 transects). After a gap in distribution along the lower portion of Brownlee Reservoir, false indigo was again very common along Oxbow and Hells Canyon reservoirs, where it occurred in about one-half of 46 transects. Its extensive abundance provided about 40% cover (Braatne et al. 2002). False indigo is abundant upstream of the HCC, including extensive occurrence along the Weiser River just upstream of Brownlee Reservoir. The limited elevational distribution, restricted to high-water elevations, probably reflects its water requirements for hydrochory, establishment, and survival. Once established, this species can apparently survive long periods of reservoir drawdown. The regular drawdown pattern of Brownlee Reservoir has not prevented downstream expansion of this species. Thus, downstream dispersal is not as critical an issue as it is for those noxious or invasive plants that are currently restricted to the Weiser and Brownlee headwaters reaches. Independent of the operational scenarios, this invasive shrub will likely continue to proliferate throughout much of the Hells Canyon corridor (Table 10).

Reed canarygrass—Reed canarygrass (*Phalaris arundinacea*) is the only native plant considered in this discussion of invasive species. It can flourish in disturbed riparian areas, causing other native plants to suffer. At this time, the causes of its proliferation are not fully understood. This species was abundant along the upstream reaches of the HCC and then sparse downstream (Table 9). Given its broad upstream distribution and relatively extensive riparian occurrence, reed canarygrass is unlikely to be substantially affected by *Proposed Operations*, *Full Pool Run-of-River Operations*, or 10 of the 11 AIR scenarios. Given the invasive nature of this species, it would likely become even more abundant in the exposed riparian habitats provided by low pool conditions under Scenario 5 and then invade areas downstream of the HCC (Table 10).

Salt cedar—Deliberately introduced into the American West as an ornamental and for streambank stabilization, salt cedar (*Tamarix* spp.) species have had devastating impacts to streams, particularly in the American Southwest. The invasion of this exotic plant is one of the most pronounced ecological impacts to western riparian ecosystems.

Following its extension from the Weiser reach of the Snake River, salt cedar is currently the most common riparian perennial along the headwaters reach of Brownlee Reservoir. However, it is absent from the main portion of Brownlee Reservoir, Oxbow and Hells Canyon reservoirs, and the Snake River below Hells Canyon Dam (Krichbaum 2000, Holmstead 2001, Braatne et al. 2002). An extensive discussion of the life history characteristics and predicted responses to water management is provided by Braatne et al. (2002).

The prevention of downstream expansion of salt cedar populations is a major priority for riparian habitat management. Control efforts for this species should target seedling recruitment, which is the most vulnerable life history phase of this species. The historical drawdowns of Brownlee Reservoir have probably provided a barrier to downstream dispersal. Reservoir drawdowns occurred during the late summer and early autumn period of seed release. During drawdowns, seeds probably germinated on soils below full pool, where seedlings were killed by either lethal drought stress or subsequent fatal inundation.

In the longer term, salt cedar will likely enter the Snake River reach below Hells Canyon Dam. However, the drawdown pattern predicted for *Proposed Operations* and Scenarios 1, 2, 3, 4, and 6 would continue to discourage downstream expansion of this species (Table 10). Given the many life history traits that make this species an aggressive invader, salt cedar would rapidly expand into all riparian habitats of Brownlee Reservoir under *Full Pool Run-of-River Operations* and Scenario 5. This invasion would then rapidly expand downstream. Of all of the probable impacts identified in this report, an invasion of salt cedar into native riparian habitats along the Snake River downstream of Hells Canyon Dam would have the most significant ecological consequences (see also Holmstead 2001, Braatne et al. 2002).

2.4.4.4. Hydrophytes

Purple loosestrife—Purple loosestrife (*Lythrum salicaria*) was abundant along the riparian transects in the upstream reaches. It occurred in two-thirds of the 15 transects in the Weiser reach and in almost one-half of the transects in the headwaters reach of the Brownlee Reservoir (Braatne et al. 2002). This distribution differed somewhat from Krichbaum (2000), who found this weed to be less abundant along the headwaters reach. Purple loosestrife was sparse but present along Oxbow and Hells Canyon reservoirs.

As a hydrophyte, this noxious weed is dependent on a wetter environment than other riparian species are. Braatne et al. (2002) predicted favorable conditions for hydrophytes with *Proposed Operations* due to a downward extension of these zones along Brownlee Reservoir and along the Snake River reach below Hells Canyon Dam. However, the current lack of purple loosestrife along the main Brownlee Reservoir suggests intolerance to reservoir drawdown. Thus, the *Proposed Operations* might continue to impede this noxious plant. Given the dependence for more stable hydrologic conditions, we predict that the *Full Pool Run-of-River Operations* and Scenario 5 would allow for the expansion of purple loosestrife along the relatively stable shorelines that would result. The *Proposed Operations* and Scenarios 1, 2, 3, 4, and 6 would restrict expansion of this species (Table 10).

2.4.4.5. Ruderal Annuals

Braatne et al. (2002) predicted that ruderal annuals along Brownlee Reservoir would be most affected by the operational scenarios. The model predicted two- to fivefold increases in the occurrence of this vegetation group due to the exposures of barren substrates along the reservoir drawdown zone. It is likely that some exotic ruderal annuals would increase in distribution and abundance along Brownlee Reservoir under *Proposed Operations* and Scenarios 1, 2, 3, 4, and 6. Their increased abundance along this upstream reservoir would also increase the propagule source that might result in expansion of ruderal annuals farther downstream.

Common ragweed—For transects analyzed by Braatne et al. (2002), common ragweed (*Ambrosia artemisifolia*) was most common along Oxbow and Hells Canyon reservoirs. The plant was sparse along Brownlee Reservoir but moderate in abundance along the Snake River below Hells Canyon Dam. Except for a slightly decreased abundance downstream of Hells Canyon Dam, Krichbaum (2000) reported generally consistent findings (Table 9).

It is currently a sparse noxious weed in Hells Canyon; the overall differences among operational scenarios would likely be minor. The minimal occurrence along Brownlee Reservoir and increased abundance along Oxbow and Hells Canyon reservoirs suggests that, although this plant is a ruderal annual, it benefits from the more stable water level. In contrast to the modeled prediction for ruderal annuals, it is likely that this noxious weed would increase along Brownlee Reservoir under *Full Pool Run-of-River Operations* and Scenario 5.

Puncturevine—Puncturevine (*Tribulus terrestris*) was abundant along Brownlee Reservoir with extensive occurrences along the headwaters reach (Braatne et al. 2002). This distribution is generally consistent with the distribution reported by Krichbaum (2000), although he also found it to be abundantly associated with road and recreational disturbance along Oxbow and Hells Canyon reservoirs. This weed was very sparse along the Snake River downstream of Hells Canyon Dam, occurring in only one of the 93 riparian transects.

The elevational distribution of puncturevine was consistent with modeled predictions for ruderal annuals (Braatne et al. 2002). It thus extends down through the fluctuation zone of Brownlee Reservoir, both in the headwaters reach and along the main reservoir. With this distribution, it would be favored by *Proposed Operations* and Scenarios 1, 2, 3, 4, 5, and 6. Puncturevine would likely increase dramatically under Scenario 5. After proliferating along Brownlee Reservoir, an increased source of propagules would likely be available for subsequent downstream expansion.

2.4.4.6. Major Findings

Noxious and nonnative invasive plant species (i.e., undesirable species) comprise a large fraction of the flora of the HCC study area (Krichbaum 2000, Holmstead 2001). Currently, undesirable riparian plants are most abundant in the Weiser reach of the Snake River and headwaters reach of Brownlee Reservoir (Krichbaum 2000, Holmstead 2001, Braatne et al. 2002). Conversely, most upland noxious weeds occur along Hells Canyon and Oxbow reservoirs and downstream of Hells Canyon Dam (Edelmann et al. 2002).

From an ecological perspective, the seasonal water-level fluctuations in Brownlee Reservoir limited the downstream expansion of undesirable species that occupy the Weiser and headwaters reaches (Holmstead 2001, Braatne et al. 2002). The barrier is formed by the sizeable drawdown of reservoir water levels during the growing season (~ 30 ft), rather than by the presence of Brownlee Dam itself. Regular drawdowns and the subsequent inundation create an environment that is largely lethal to seeds and vegetative propagules that are deposited in the reservoir fluctuation zone from upstream sources.

Undesirable invasive species of greatest environmental concern for downstream expansion include 1) salt cedar 2) false indigo, 3) leafy spurge, 4) broadleaf pepperweed, 5) reed canarygrass, 6) whitetop, and 7) purple loosestrife. Under Scenario 5, habitat for undesirable upland plants would also become significantly more available along Brownlee Reservoir. Braatne et al. (2002) provide detailed descriptions of the life history strategies and invasive properties of these species. Given their life history adaptations to a broad range of environmental conditions, operational scenarios should be sought to minimize their expansion.

Seasonal hydrology of the AIR scenarios is largely within the range of conditions (i.e., *Proposed Operations* and *Full Pool Run-of-River Operations*) analyzed by Blair et al. (2002) and Braatne et al. (2002) (Figures 2a and 2b). Most of the AIR scenarios and *Proposed Operations* would have significant seasonal drafting of Brownlee Reservoir (Figure 1). Consequently, we do not anticipate any significant differences in noxious weed and invasive nonnative plant populations among *Proposed Operations* and AIR Scenarios 1, 2, 3, 4, and 6.

In contrast, Scenario 5 and *Full Pool Run-of-River Operations* would eliminate the seasonal drafting of Brownlee Reservoir. The lack of seasonal drafting would likely aid the downstream expansion of undesirable riparian plants from the Weiser reach. Seasonally stable water levels at any shoreline elevation of Brownlee Reservoir would facilitate downstream colonization by undesirable plant species. However, Scenario 5 would have the increased detrimental effect of also providing large areas for the colonization of undesirable upland plants. Providing increasing amounts of reproductive propagules, undesirable plants would rapidly colonize downstream and eventually invade native plant communities that currently dominate downstream of Hells Canyon Dam (Braatne et al. 2002).

2.4.5. Special Status Plant Species

For this study, we focused on the six plant species reported by Edelmann et al. (2002) and addressed in the FLA (Table 11). Potential impacts to the distribution and abundance of these species were compared across *Proposed Operations*, *Full Pool Run-of-River Operations*, and the 11 AIR scenarios (Table 12). General predictions are described in the following paragraphs.

As reported by Krichbaum (2000), Table 11 reports the number of populations of each rare plant species for reaches within the HCC. These data represent a sample of the distribution and abundance of each species. A randomly selected 0.25-mile reach within each river mile was inventoried on both sides of the Snake River and on islands from about 13 miles above the headwaters of Brownlee Reservoir at Weiser, Idaho (RM 351.2), downstream to the confluence of the Salmon River (RM 188.2) (163 miles) and for 9.6 miles along the Powder River Arm of Brownlee Reservoir. This robust sample adequately portrays the relative extent and distribution of rare plants in the study area. The status of these species was reviewed by Krichbaum (2000).

No federally listed endangered or threatened plant species are known to occur in the 50-m survey areas along shorelines in the Hells Canyon corridor. However, three populations of the federally threatened MacFarlane’s four o’clock (*Mirabilis macfarlanei*) occur downstream of Hells Canyon Dam, upslope of the Snake River near Pittsburg Landing. No negative impacts to listed species are expected to occur from any of the scenarios.

Stalk-leaved monkeyflower—One population of stalk-leaved monkeyflower (*Mimulus patulus*), also known as Washington monkeyflower, was found along Oxbow Reservoir (Table 11). The population was found growing on gently sloping, damp, rocky ground in a road cut adjacent to State Route 71. The site is located well above the full-pool shoreline and approximately 20 m laterally from Oxbow Reservoir. Disturbance from the road corridor was recorded as extreme for this site (although a retaining wall does separate the population from the road). Disturbance from recreation, livestock, and alluvial erosion and deposition was recorded as slight. The site would not be affected by water-level fluctuations from any operational scenarios (Table 12).

Hazel’s prickly phlox—Six populations of Hazel’s prickly phlox (*Leptodactylon pungens* ssp. *hazeliae)*, also known as granite prickly phlox, were found: one downstream of Hells Canyon Dam and five along Hells Canyon Reservoir (Table 11). There are seven other known populations near the HCC. The six newly located populations were found growing on dry, steep to vertical cliffs above the reservoir’s full-pool shoreline and above the high-water level for the downstream population. None of the operational scenarios would negatively affect the populations as they are outside the influence of water-level fluctuations (Table 12). No other disturbance factors were noted.

Oregon bolandra—Eight populations of Oregon bolandra (*Bolandra oregana*) were found: four downstream of Hells Canyon Dam, one along Hells Canyon Reservoir, and three along Oxbow Reservoir. There are four other previously known populations of this species: two downstream of Hells Canyon Dam and two in Oregon just north of Brownlee Dam. These four populations were outside the 50-m survey area. All populations were found growing near seeps or streams in cliffs, surrounded mostly by bare rock. The four sites on Hells Canyon and Oxbow reservoirs were subject to a variety of disturbances including alluvial action, recreation, road corridor disturbance, livestock grazing, fire, and off-road vehicle use. No observable disturbance was recorded for the four new populations found downstream of Hells Canyon Dam. Because all populations occur outside the influence of water level fluctuations, no negative impacts are expected from any of the operational scenarios (Table 12).

Porcupine sedge—Ten populations of porcupine sedge (*Carex hystricina*) were found: three downstream of Hells Canyon Dam and seven on Oxbow Reservoir. There are two previously known occurrences of this species in the Hells Canyon vicinity: one along Hells Canyon Reservoir and one along Oxbow Reservoir. These two sites are located outside the 50-m survey corridor of the reservoir shorelines. Populations were found growing in either relatively bare shoreline areas or relatively lush riparian communities. Disturbance from many sources was evident at most of the sites. Hydrologic disturbance was heavy at one site and extreme at four sites.

In the reach below Hells Canyon Dam, the three populations might be negatively affected by lower flows experienced under most of the scenarios. *Proposed Operations*, *Full Pool Run-of-River Operations*, and 10 of the 11 AIR scenarios would have characteristic flows less than *Historical Operations* downstream of Hells Canyon Dam during the evaluation period (1 July–31 August) (Table 3). Because the scour zone would not change, lower flows would cause a decrease in the irrigation effect and a corresponding loss in shoreline riparian vegetation. The projected loss in riparian vegetation would range from approximately 1.8 acres under Scenario 2 to 34.8 acres under Scenario 5 (Tables 5 and 8). Because Scenario 6 would have higher flows during the growing season than occurred under *Historical Operations*, an increase in 16.5 acres of riparian vegetation is projected. Therefore, all scenarios except Scenario 6 would negatively affect some populations of porcupine sedge downstream of Hells Canyon Dam.

Characteristic headwater elevations varied less than 1 ft from full pool on Oxbow Reservoir and less than 2 ft on Hells Canyon Reservoir for all scenarios (Tables 1 and 2). Therefore, shoreline riparian habitats adjacent to Oxbow and Hells Canyon reservoirs are expected to change very little in the future under any operational scenario (Tables 5, 6, and 7). All scenarios would return the water levels to or near full pool on a daily basis during the growing season. Compared with existing conditions, impacted riparian acres would range from a loss of 0.6 to 0.8 acres on Oxbow Reservoir (Table 6). On Hells Canyon Reservoir, impacted acres would range from 0.8 to 1.7 acres. Due to a constant water-surface elevation in Scenario 5, which mimics *Full Pool Run-of-River Operations* in Blair et al. (2002), there would be no change in riparian vegetation from existing conditions. Under any scenario, there would be a negligible effect to the seven populations on Oxbow Reservoir (Table 12).

Schweinitz flatsedge—Twenty-one populations of Schweinitz flatsedge (*Cyperus schweinitzii*) were found downstream of Hells Canyon Dam (Table 11). All the populations were situated near the Snake River on dry, coarse, sandy loam soils of gentle to moderate slope. The majority of the sites (17 of 21, or 81%) did not extend downslope of the mean high-water mark. Recreation, fire, and livestock were the major disturbance types reported for the Schweinitz flatsedge populations.

More intensive study of six randomly selected populations of Schweinitz flatsedge identified additional conclusions. Braatne et al.(2002) found that the elevational distribution ranged from 2.57 to 6.6 m above the mean annual water level. These populations occurred well above mean annual peak flows (2.10 m above), yet they were subject to inundation during relatively infrequent historic peak-flow events. Their relative abundance was low to moderate, ranging from 1% to 27% cover per sample plot (mean = 9.8% cover). This pattern of distribution indicates that populations of Schweinitz flatsedge were located toward the upper end of the facultative riparian zone, an area only rarely inundated by scouring peak flows. Situated at these high elevations, these plants would probably be minimally influenced by differences in flow patterns across all scenarios, except possibly for Scenario 6.

During the growing season, the flow regimes below Hells Canyon Dam would be higher under Scenario 6 (Figure 2b) than under environmental conditions previously analyzed (Braatne et al. 2002). A higher river stage during the summer months might negatively impact those populations of Schweinitz flatsedge growing at lower riverbank elevations. However, since most populations of Schweinitz flatsedge are restricted to upland habitats in this study reach (4.5–7 m above historical mean annual water levels, Braatne et al. 2002), it is anticipated that this scenario would also have a minimal effect on populations of Schweinitz flatsedge.

American wood sedge—One population of American wood sedge (*Teucrium canadense* var. *occidentale*) was found. Two other populations were previously known to occur downstream of Hells Canyon Dam, outside the 50-m survey corridor. The population found during this survey was growing on gently sloping, moist, rocky ground along the shoreline of the Snake River. Plants spanned about 15 cm above to 75 cm below the mean high-water mark. Horizontal distance ranged from 10 cm above to 2 m below the mean high-water mark. Recreational activity was noted to slightly disturb the site.

This population might be negatively affected by lower flows experienced under most of the scenarios. *Proposed Operations*, *Full Pool Run-of-River Operations*, and 10 of the 11 AIR scenarios would have characteristic flows less than *Historical Operations* downstream of Hells Canyon Dam during the evaluation period (1 July–31 August) (Table 3). Because the scour zone would not change, lower flows would cause a decrease in the irrigation effect and a corresponding loss in shoreline riparian vegetation. The projected loss in riparian vegetation would range from approximately 1.8 acres in Scenario 2 to 34.8 acres in Scenario 5 (Tables 5 and 8). Because Scenario 6 would have higher flows during the growing season than occurred under *Historical Operations*, an increase in 16.5 acres of riparian vegetation is projected. Therefore, all scenarios except Scenario 6 might negatively affect this population of American wood sedge.

2.4.6. Substrate and Sediments

Within the Hells Canyon reach of the Snake River, localized deposits of sediments relevant to riparian vegetation (particularly sands) occur in two areas: sandbars along river banks and interstitial sand deposits in areas with coarse streambank sediments such as alluvial or colluvial cobbles and boulders. Conversely, the reach of the Snake River downstream of Hells Canyon Dam has historically been and still is supply limited. This situation results from three overlapping influences that were analyzed by Parkinson et al. (2003).

First, the Hells Canyon reach is characterized by a natural limitation in alluvial sediments dating to prehistoric times. The river downstream of Hells Canyon Dam has a steep gradient with high water velocities and turbulence. As a result, sediments suspended in inflowing waters would generally remain suspended through the Hells Canyon reach. This suspension is particularly the case for silts and other very fine sediments. Second, at the time that Brownlee Dam was constructed, 87% of the upstream watershed was already behind dams, and sediments trapped behind these projects were not available for physical processes in the Hells Canyon reach. The third influence involves the HCC. Brownlee, Oxbow and Hells Canyon reservoirs trap sediments that would otherwise be available for physical processes in the downstream Hells Canyon reach. Consequently, even very fine sediments settle out in the reservoirs, especially Brownlee Reservoir (Figure 4). [1]

Relative to these three major factors, the influences of the different operational scenarios would be predicted to produce a rather slight effect on the sediment regime. The analysis in IPC's response to AIR OP-1(d) is consistent with this prediction: there would be a difference in the order of plus or minus 1% in the ratio of area mobilized versus inundated for four prominent bars along the Hells Canyon reach of the Snake River. In IPC's response to AIR OP-1(d), Parkinson et al. report that the variability across years in a given scenario with respect to sandbar mobilization is an order of magnitude (or more) greater than the difference between *Proposed Operations* and any of the AIR scenarios.

The AIR OP-1(d) analysis was restricted to sandbar sediments, but relative to riparian vegetation, the interstitial sands are probably much more important in Hells Canyon since sandbars occupy only a very small fraction of the riparian landscape. Large sandbars are relatively barren of vegetation; sandbar sediments are very mobile (fluvial and aeolian) and regular sediment movement hinders the establishment and survival of vegetation. Thus, coyote willow, a prominent obligate riparian shrub, is generally restricted to the fringes of sandbars where larger sediments provide sufficient stability for survival. Along the Hells Canyon reach and more prolifically along the adjacent lower Salmon River, willows occur in zones with a combination of very coarse sediments and interstitial sands. The large sediments provide site stability, and interstitial sands provide rooting substrate and moisture retention.

It is very difficult to assess the depletion of interstitial sands along the Snake River in Hells Canyon, a process that is further complicated by the lack of information on the historical extent of interstitial sands.

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[1] For a discussion of sediment trapped in Brownlee Reservoir, see Technical Report E.1-1 (Parkinson et al. 2003).

Archival photographs are generally restricted to landscape views that are insufficient to assess interstitial sands (Blair et al. 2001). Aerial photographs have been used to quantify the depletion of sandbars along the Hells Canyon reach (Schmidt and Grams 1995, Grams and Schmidt 1999, Parkinson et al. 2003), but it is uncertain whether interstitial sands would have similar rates of depletion. While it is recognized that direct comparisons between the Snake and Salmon rivers are difficult and can be problematic (see FLA, Second Stage Consultation, Appendix 4), a broad comparison between the Hells Canyon reach of the Snake River and the lower Salmon River suggests that both sandbars and interstitial sands are considerably more abundant along the free-flowing Salmon River.

Despite the complexities and lack of direct data, it is probable that the conclusion regarding sandbar sediment erosion and transport is similarly applicable to interstitial sediments. The hydrologic differences across the various scenarios are relatively modest and largely relate to intermediate-level flows. Consequently, just as the AIR scenarios would have relatively minor influences on sandbars, we would predict very slight effects on interstitial sands. Accordingly, we would predict very slight effects on riparian vegetation through changes in substrate sediments for all the AIR scenarios.

2.5. Conclusions

2.5.1. OP-1(g)(i): Operational Scenarios

From our analyses, we have responded to the AIR relative to influences of the AIR scenarios on riparian vegetation, wildlife habitat, noxious weeds, selected nonnative plants, and special status plant species. Detailed assessments of each scenario have been provided, though we can summarize the general patterns with groupings into three reaches with similar impacts.

Brownlee Reservoir—AIR scenarios 1, 2, 3, and 4 would continue to provide two drawdown phases annually. Similar to *Historical Operations* and *Proposed Operations*, the drawdown would continue to produce a seasonal fluctuation zone that is almost barren of vegetation, except for colonization by ruderal annuals. Scenario 5 would provide a very different situation in which the reservoir would be permanently drawn down 101 ft, exposing areas that would be colonized by vegetation with a probable combination of some native plants and mostly exotic plants, including a preponderance of undesirable invasive nonnative species and noxious weeds. Upland cover types would likely be dominated by medusahead wildrye and cheatgrass, while saltcedar and false indigo would likely dominate riparian cover types along the new river and reservoir shorelines.

It is projected that both *Full Pool Run-of-River Operations* and, to a greater extent, Scenario 5 would result in an increased distribution and abundance of many listed noxious weeds and invasive nonnative plants in Brownlee Reservoir (Table 10). This invasion would likely progress rapidly downstream to Oxbow and Hells Canyon reservoirs and then to the Snake River below Hells Canyon Dam. Because no special status plant species are known to occur along Brownlee Reservoir, operational scenarios are not expected to affect special status species here.

Oxbow and Hells Canyon Reservoirs—Consistent with *Historical Operations* and *Proposed Operations*, all the AIR scenarios would involve relatively slight elevational fluctuations in the Oxbow and Hells Canyon reservoirs. Conditions would thus continue to support a relatively extensive band of woody vegetation above the full-pool shorelines, which would remain virtually unchanged from existing conditions. However, the existing vegetation would likely be invaded by undesirable nonnative species and noxious weeds that would disperse from the Weiser reach and Brownlee Reservoir if *Full Pool Run-of-River Operations* or Scenario 5 were implemented. None of the operational scenarios would significantly, if at all, impact the 20 known populations of the four special status plant species occurring along Oxbow and Hells Canyon reservoirs (Tables 11 and 12).

Hells Canyon Reach of the Snake River—This reach provides an exceptional and highly valued environmental, aesthetic, and recreational resource. Despite the extensive damming and diversion of the Snake River and its tributaries, the Hells Canyon reach still provides a wilderness setting with largely native vegetation. Under *Historical Operations*, density and cover have increased for hackberry and other shrubs that occupy the river shoreline upslope of the typical high-water mark. The riparian increases are attributed to the irrigation effect from load-following operations that elevate river flows daily and thereby enhance shoreline soil moisture during the late growing season.

The irrigation effect would continue with small variations among *Proposed Operations*, *Full Pool Run-of-River Operations*, and the AIR scenarios. The AIR scenarios are largely similar to or intermediate between the *Proposed Operations* and *Full Pool Run-of-River Operations* that were analyzed in detail in prior studies. Differences in late summer flows would cause slight scenario-induced differences in the extent of riparian vegetation. Consequently, we predict that the scenarios would directly produce responses similar to those under existing conditions, typically with reductions in riparian cover types of only 5% to 10% over a 30-year period. Slightly higher vegetation losses are predicted for Scenarios 1a, 1b, and 5, with slight reductions in most vegetation cover types. Indirectly, the existing vegetation would likely be invaded by undesirable species dispersing from the Weiser reach and Brownlee Reservoir if *Full Pool Run-of-River Operations* or Scenario 5 were implemented (Table 10). Undesirable invasive species of greatest environmental concern for downstream expansion include 1) saltcedar, 2) false indigo, 3) leafy spurge, 4) broadleaf pepperweed, 5) reed canarygrass, 6) whitetop, and 7) purple loosestrife.

Due to steep slopes, riparian vegetation is naturally very restricted within and below the HCC. Since the construction of the HCC, some types of riparian vegetation have been reduced because of the depletion of fine sediments that provide suitable riparian substrates. The AIR scenarios, however, would have minimal further influence on existing sediment regimes and vegetation substrates.

Downstream of Hells Canyon Dam, four populations of two special status plant species may be negatively affected by the lower flows experienced under all scenarios but Scenario 6. These include three populations of porcupine sedge and one population of American wood sedge. The scenarios would have minimal, if any, effects on the other known populations of special status plants in this reach (Tables 11 and 12).

2.5.2. OP-1(g)(ii): Summary Table of Impacted Acres

In OP-1(g), FERC requested that IPC produce a summary table of affected acres of upland and riparian habitats for each operational scenario similar to Table 2 in Technical Report E.3.2-45 (Edelmann et al. 2002). The summary table is to provide comparable information for all scenarios about estimated acres of impacted habitat. Table 2 in Edelmann et al. (2002) provided a tally of estimated impacts to riparian and upland habitats assuming implementation of *Proposed Operations*. *Proposed Operations* was estimated to impact 23,582 acres of habitat, for which IPC proposed mitigation through habitat acquisition and management (FLA section 3.2.3). IPC's response to AIR TR-1 proposes a strategy for implementing the habitat acquisition and management measure with a target of 23,582 acres.

This summary is presented in Table 13 with additional details provided in Appendix D. Appendix D follows a parallel format to Table 2 in Edelmann et al. (2002). For comparison purposes, we included estimates of impacted riparian and upland acres for *Proposed Operations* and *Full Pool Run-of-River Operations* reported in Blair et al. (2002), Edelmann et al. (2002) and the HCC FLA. Estimates of impacted acres and the resulting wildlife mitigation measures in the FLA were derived from a comparison between *Proposed Operations* and *Full Pool Run-of-River Operations*. However, estimates of impacted acres for the AIR scenarios resulted from comparisons with existing conditions. Therefore, we provide comparable estimates of impacted acres for *Proposed Operations* and *Full Pool Run-of-River Operations* relative to existing conditions (Table 13). Conceptually, the estimate of impacted acres would constitute the required amount of mitigation for habitat acquisition and management upon implementation of a scenario.

For Scenario 5, much uncertainty exists about habitat colonization rates and species composition of plant assemblages that might be expected in the fluctuation zone of Brownlee Reservoir. Moreover, methods for estimating cover-type acreages were highly imprecise and did not consider the existing environment of the fluctuation zone. Therefore, we added the theoretical acreages of riparian and upland habitats in the fluctuation zone to the estimate of total impacted acres that would require mitigation if Scenario 5 were implemented. Consequently, IPC assumes for mitigation purposes that reservoir fluctuation zones would be unsuitable wildlife habitat during the next license term under *Proposed Operations*, *Full Pool Run-of-River Operations*, and the additional AIR scenarios.

3. OP-1(G) CONSULTATION

FERC required that IPC prepare its response for OP-1(g) after consultation with agencies and Native American tribes. On December 22, 2004, IPC submitted the draft OP-1(g) response to the FERC-designated agencies and tribes for review and comment (Appendix E). Comments were due to IPC on January 24, 2004. Comments were received by the deadline from the following entities:

1) Bureau of Land Management

2) U.S. Forest Service

IPC delineated and numbered individual comments from each agency and then developed corresponding responses. The agency comments are in Appendix F and IPC's responses are in Table 14.

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5. ACKNOWLEDGMENTS

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Table 1. Average maximum daily headwater elevation (ft) for three runoff years and calculated weighted average (i.e., characteristic headwater elevation) of HCC *Proposed Operations* and 11 operational scenarios for Oxbow Reservoir, 1 May to 30 September.

Year	Type of Runoff Year	72-year Weighting	*Proposed Operations*[a]	Scenario 1a	Scenario 1b	Scenario 1c	Scenario 1d
1992	Low	0.5833	1,804.36	1,804.34	1,804.35	1,804.35	1,804.35
1995	Medium	0.3056	1,804.23	1,804.32	1,804.32	1,804.32	1,804.05
1997	High	0.1111	1,804.56	1,804.79	1,804.74	1,804.74	1,804.44
Weighted Average			1,804.34	1,804.38	1,804.38	1,804.38	1,804.27

Year	Scenario 1e	Scenario 1f	Scenario 2	Scenario 3	Scenario 4	Scenario 5[b]	Scenario 6
1992	1,804.35	1,804.35	1,804.38	1,804.30	1,804.30	1,805.00	1,803.95
1995	1,804.05	1,804.32	1,804.36	1,804.08	1,804.32	1,805.00	1,804.15
1997	1,804.44	1,804.74	1,804.49	1,804.36	1,804.74	1,805.00	1,804.94
Weighted Average	1,804.27	1,804.38	1,804.38	1,804.24	1,804.35	1,805.00	1,804.12

[a] Blair et al. (2002) assumed a maximum daily headwater elevation of 1,805 ft for *Proposed Operations* and predicted no change in the extent of vegetation cover types from existing conditions.

[b] Scenario 5 and *Full Pool Run-of-River Operations* have the same operating rules for Oxbow Reservoir.

Table 2. Average maximum daily headwater elevation (ft) for three runoff years and calculated weighted average (i.e., characteristic headwater elevation) of HCC *Proposed Operations* and 11 operational scenarios for Hells Canyon Reservoir, 1 May to 30 September.

Year	Type of Runoff Year	72-year Weighting	*Proposed Operations*[a]	Scenario 1a	Scenario 1b	Scenario 1c	Scenario 1d
1992	Low	0.5833	1,687.55	1,687.57	1,687.50	1,687.45	1,687.44
1995	Medium	0.3056	1,687.63	1,687.59	1,687.31	1,686.97	1,686.80
1997	High	0.1111	1,687.66	1,687.56	1,687.48	1,687.01	1,686.91
Weighted Average			1,687.59	1,687.58	1,687.44	1,687.25	1,687.19

Year	Scenario 1e	Scenario 1f	Scenario 2	Scenario 3	Scenario 4	Scenario 5[b]	Scenario 6
1992	1,687.43	1,687.46	1,687.45	1,687.49	1,687.44	1,688.00	1,687.57
1995	1,686.74	1,687.13	1,686.90	1,686.96	1,687.13	1,688.00	1,686.98
1997	1,686.92	1,687.24	1,686.93	1,687.01	1,687.24	1,688.00	1,686.98
Weighted Average	1,687.16	1,687.33	1,687.22	1,687.27	1,687.32	1,688.00	1,687.32

[a] Blair et al. (2002) assumed a maximum daily headwater elevation of 1,688 ft for *Proposed Operations* and predicted no change in the extent of vegetation cover types from existing conditions.

[b] Scenario 5 and *Full Pool Run-of-River Operations* have the same operating rules for Hells Canyon Reservoir.

Table 3. Average maximum daily flow (cfs) for three runoff years and calculated weighted average (i.e., characteristic flow) of HCC *Historical Operations*, *Proposed Operations*, and 11 operational scenarios for the Snake River downstream of Hells Canyon Dam, 1 July to 31 August.

Year	**Type of Runoff Year**	**42-year Weighting**[a]	***Historical Operations***	**72-year Weighting**[b]	***Proposed Operations***	**Scenario 1a**	**Scenario 1b**	**Scenario 1c**
1992	Low	0.5238	8,199	0.5833	6,626	6,344	6,460	6,550
1995	Medium	0.3095	21,239	0.3056	19,524	15,184	16,140	18,542
1997	High	0.1667	23,412	0.1111	23,007	20,019	20,266	23,645
Weighted Average			14,771		12,388	10,565	10,952	12,114

Year	**Scenario 1d**	**Scenario 1e**	**Scenario 1f**	**Scenario 2**	**Scenario 3**	**Scenario 4**	**Scenario 5**[c]	**Scenario 6**
1992	6,600	6,600	6,550	9,078	6,850	6,721	6,109	12,664
1995	20,106	20,106	17,095	21,376	20,024	17,095	14,393	24,473
1997	24,935	24,935	21,192	25,369	24,225	21,192	18,105	28,045
Weighted Average	12,764	12,764	11,399	14,646	12,806	11,499	9,973	17,982

[a] The characteristic flow for *Historical Operations* was assumed to cause existing vegetation conditions in the shoreline zone downstream of Hells Canyon Dam. Period of HCC operation (1958–1999) was used to calculate characteristic flow for *Historical Operations*.

[b] Entire period of record (1928–1999) was used to calculate characteristic flows for *Proposed Operations*, *Full Pool Run-of-River Operations*, and 11 AIR scenarios.

[c] Scenario 5 and *Full Pool Run-of-River Operations* have the same operating rules for the Snake River downstream of Hells Canyon Dam.

Table 4. Existing and predicted acres of cover types in the shoreline zone of Brownlee Reservoir for HCC *Proposed Operations*, *Full Pool Run-of-River Operations*, and the 11 AIR operational scenarios. Predicted cover-type changes are relative to existing conditions for all scenarios.

	Existing Conditions, *Proposed Operations*		***Full Pool Run-of-River Operations***		**Scenarios 1(a-f), 2, 3, 4, 6**		**Scenario 5**	
Vegetation Cover Type[a]	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**
Other Upland[b]	141.5	4.29	115.8	3.51	141.5	4.29	162.8	4.94
Grassland	614.6	18.65	554.9	16.84	614.6	18.65	706.9	21.45
Tree Savanna	0.2	0.01	0.2	0.01	0.2	0.01	0.0	0.00
Shrub Savanna	1,519.9	46.11	1,348.9	40.93	1,519.9	46.11	1,747.9	53.03
Shrubland	335.0	10.16	293.9	8.92	335.0	10.16	385.3	11.69
Forested Wetland	25.0	0.76	102.5	3.11	25.0	0.76	0.0	0.00
Scrub-Shrub Wetland	154.4	4.68	413.7	12.55	154.4	4.68	0.0	0.00
Emergent Herbaceous Wetland	81.1	2.46	87.0	2.64	81.1	2.46	0.0	0.00
Shore and Bottomland Wetland	131.1	3.98	101.6	3.08	131.1	3.98	0.0	0.00
Water[c]	2.8	0.08	2.8	0.08	2.8	0.08	2.8	0.08
Developed[d]	223.3	6.77	209.0	6.34	223.3	6.77	223.3	6.77
Land Feature[e]	67.1	2.04	65.5	1.99	67.1	2.04	67.1	2.04
Total	3,296.0	100.00	3,296.0	100.00	3,296.0	100.00	3,296.0	100.00
Projected Change in Riparian Vegetation[f] from Existing Conditions	0.0	0.0	+342.7	+231.50	0.0	0.00	–260.50	–100.00

[a] Cover types are defined in Appendix B.

[b] This category includes *Desertic Herbland*, *Desertic Shrubland*, *Forbland*, and *Forested Upland* cover types.

[c] Water in the reservoir shoreline zone includes *Lentic* and *Lotic* cover types.

[d] This category includes *Agriculture*, *Disturbed*, *Industrial*, *Parks/Recreation*, *Residential*, *Grazing Land/Pasture*, *Roads*, and *Forested/Orchard* cover types.

[e] This category includes *Barrenland*, *Cliff/Talus*, and *Unknown* cover types.

[f] Riparian vegetation includes *Emergent Herbaceous Wetland*, *Scrub-Shrub Wetland*, and *Forested Wetland. Shore and Bottomland Wetland*, better characterized as *Rock Bottom*, is not considered suitable wildlife habitat for most species.

Table 5. Summary of predicted changes to acres of riparian and upland cover types in shoreline zones from HCC existing conditions for *Proposed Operations*, *Full Pool Run-of-River Operations*, and the 11 AIR operational scenarios. Predicted cover-type changes are relative to existing conditions for all scenarios.

	Existing Conditions	***Proposed Operations***	***Full Pool Run-of-River Operations***[a]	**Scenario 1a**	**Scenario 1b**	**Scenario 1c**	**Scenario 1d**
Brownlee Reservoir							
Riparian[b]	260.50	260.50	603.20	260.50	260.50	260.50	260.50
Upland[c]	2611.20	2611.20	2,313.70	2,611.20	2,611.20	2,611.20	2,611.20
Change in Riparian from Existing Conditions	0.00	0.00[d]	+342.70	0.00	0.00	0.00	0.00
Oxbow Reservoir							
Riparian	59.60	58.99	59.60	59.02	59.02	59.02	58.94
Upland	377.90	378.51	377.70	378.48	378.48	378.48	378.56
Change in Riparian from Existing Conditions	0.00	–0.61	0.00	–0.58	–0.58	–0.58	–0.66
Hells Canyon Reservoir							
Riparian	112.00	111.18	112.00	111.16	110.88	110.49	110.37
Upland	722.70	723.52	722.70	723.54	723.82	724.21	724.33
Change in Riparian from Existing Conditions	0.00	–0.82	0.00	–0.84	–1.12	–1.51	–1.63
Downstream of HC Dam							
Riparian	261.90	246.85	245.60	232.06	235.15	243.85	248.38
Upland	709.08	724.13	725.40	738.93	735.83	727.13	722.60
Change in Riparian from Existing Conditions	0.00	–15.05[e]	–16.30	–29.84	–26.75	–18.05	–13.52

Table 5. (Continued)

	Scenario 1e	Scenario 1f	Scenario 2	Scenario 3	Scenario 4	Scenario 5[a]	Scenario 6
Brownlee Reservoir							
Riparian	260.50	260.50	260.50	260.50	260.50	0.00	260.50
Upland	2,611.20	2,611.20	2,611.20	2,611.20	2,611.20	2,871.70	2,611.20
Change in Riparian from Existing Conditions	0.00	0.00	0.00	0.00	0.00	–260.50	0.00
Oxbow Reservoir							
Riparian	58.94	59.02	59.02	58.91	59.00	59.60	58.82
Upland	378.56	378.48	378.48	378.59	378.50	377.90	378.68
Change in Riparian from Existing Conditions	–0.66	–0.58	–0.58	–0.69	–0.60	0.00	–0.78
Hells Canyon Reservoir							
Riparian	110.31	110.66	110.43	110.53	110.64	112.00	110.64
Upland	724.39	724.04	724.27	724.17	724.06	722.70	724.06
Change in Riparian from Existing Conditions	–1.69	–1.34	–1.57	–1.47	–1.36	0.00	–1.36
Downstream of HC Dam							
Riparian	248.38	238.56	260.08	248.69	239.40	227.06	278.35
Upland	722.60	732.42	710.90	722.29	731.58	743.92	692.63
Change in Riparian from Existing Conditions	–13.52	–23.34	–1.82	–13.21	–22.50	–34.84	+16.45

[a] Acreage estimates for *Full Pool Run-of-River Operations* are from Blair et al. (2002). Blair et al. (2002) reported no impacted acres downstream of Hells Canyon Dam because existing conditions did not form the basis of comparison. Although operations would be the same for *Full Pool Run-of-River Operations* and Scenario 5 downstream of Hells Canyon Dam, the change in riparian from existing conditions differs because of refined analytical procedures for the AIR scenarios.

[b] Riparian cover types include *Forested Wetland*, *Scrub-Shrub Wetland*, and *Emergent Herbaceous Wetland. Shore and Bottomland Wetland*, better characterized as *Rock Bottom*, is not considered suitable wildlife habitat for most species.

[c] Upland cover types include *Grassland*, *Tree Savanna*, *Shrub Savanna*, *Shrubland*, *Desertic Herbland*, *Desertic Shrubland*, *Forbland*, and *Forested Upland.* This category does not include developed (*Agriculture*, *Disturbed*, *Industrial*, *Parks/Recreation*, *Grazing Land/Pasture*, *Roads*, *Forested/Orchard*) or land feature (*Barrenland*, *Cliff/Talus*, *Unknown*) cover types, which were not projected to change in the future.

[d] For *Proposed Operations*, we predicted no change in riparian vegetation on Brownlee Reservoir compared with existing conditions. Blair et al. (2002) estimated 343 acres on Brownlee Reservoir would be impacted by *Proposed Operations* when compared with *Full Pool Run-of-River Operations.*

[e] For *Proposed Operations*, we predicted that 15.05 acres would be impacted downstream of Hells Canyon Dam compared with existing conditions. Blair et al. (2002) estimated that no riparian habitat would be impacted by *Proposed Operations* when compared with *Full Pool Run-of-River Operations.*

Table 6. Existing and predicted acres of cover types in the shoreline zone of Oxbow Reservoir for HCC *Proposed Operations*, *Full Pool Run-of-River Operations*, and the 11 AIR operational scenarios. Predicted cover-type changes are relative to existing conditions for all scenarios.

	Existing Conditions		***Proposed Operations*[b]**		***Full Pool Run-of-River Operations***		**Scenarios 1a, 1b, 1c, 1f, 2**		**Scenario 1d, 1e**	
Characteristic Headwater Elevation, ft	**1,805.00**		**1,804.34**		**1,805.00**		**1,804.38**		**1,804.27**	
Vegetation Cover Type[a]	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**
Other Upland[c]	2.70	0.54	3.61	0.72	2.70	0.54	3.56	0.71	3.68	0.74
Grassland	88.00	17.64	87.09	17.46	88.00	17.64	87.14	17.47	87.02	17.44
Tree Savanna	0.00	0.00	2.00	0.04	0.00	0.00	1.90	0.38	2.17	0.44
Shrub Savanna	194.70	39.03	193.65	38.82	194.70	39.03	193.70	38.83	193.56	38.80
Shrubland	92.50	18.54	92.16	18.47	92.50	18.54	92.18	18.48	92.13	18.47
Forested Wetland	8.90	1.78	8.81	1.77	8.90	1.78	8.81	1.77	8.80	1.76
Scrub-Shrub Wetland	50.70	10.16	50.18	10.06	50.70	10.16	50.20	10.06	50.13	10.05
Emergent Herbaceous Wetland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shore and Bottomland Wetland	2.00	0.40	2.00	0.40	2.00	0.40	2.00	0.40	2.00	0.40
Water[d]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Developed[e]	45.10	9.04	45.10	9.04	45.10	9.04	45.10	9.04	45.10	9.04
Land Feature[f]	14.30	2.87	14.30	2.87	14.30	2.87	14.30	2.87	14.30	2.87
Total	498.90	100.00	498.90	100.00	498.90	100.00	498.90	100.00	498.90	100.00
Projected Change in Riparian Vegetation[g] from Existing Conditions	0.00	0.00	–0.61	–1.02	0.00	0.00	–0.58	–0.97	–0.66	–1.11

Table 6. (Continued)

	Scenario 3		Scenario 4		Scenario 5		Scenario 6	
Characteristic Headwater Elevation, ft	**1,804.24**		**1,804.35**		**1,805.00**		**1,804.12**	
Vegetation Cover Type[a]	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**
Other Upland[c]	3.72	0.74	3.59	0.72	2.70	0.54	3.85	0.77
Grassland	86.98	17.44	87.11	17.46	88.00	17.64	86.85	17.41
Tree Savanna	2.25	0.45	1.98	0.40	0.00	0.00	2.54	0.51
Shrub Savanna	193.52	38.79	193.66	38.82	194.70	39.03	193.37	38.76
Shrubland	92.12	18.46	92.17	18.47	92.50	18.54	92.07	18.45
Forested Wetland	8.80	1.76	8.81	1.77	8.90	1.78	8.78	1.76
Scrub-Shrub Wetland	50.11	10.05	50.19	10.06	50.70	10.16	50.04	10.03
Emergent Herbaceous Wetland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shore and Bottomland Wetland	2.00	0.40	2.00	0.40	2.00	0.40	2.00	0.40
Water[d]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Developed[e]	45.10	9.04	45.10	9.04	45.10	9.04	45.10	9.04
Land Feature[f]	14.30	2.87	14.30	2.87	14.30	2.87	14.30	2.87
Total	498.90	100.00	498.90	100.00	498.90	100.00	498.90	100.00
Projected Change in Riparian Vegetation[g] from Existing Conditions	–0.69	–1.16	–0.60	–1.01	0.00	0.00	–0.78	–1.31

[a] Cover types are defined in Appendix B.

[b] Blair et al. (2002) predicted no changes from existing conditions for riparian upland habitats in the shoreline zone of Oxbow Reservoir for *Proposed Operations*. Although criteria for *Proposed Operations* have not changed from Blair et al. (2002), the estimated change in riparian from existing conditions differs here because of refined analytical procedures for the AIR scenarios.

[c] This category includes *Desertic Herbland*, *Desertic Shrubland*, *Forbland*, and *Forested Upland* cover types.

[d] Water in the reservoir shoreline includes *Lentic* and *Lotic* cover types.

[e] This category includes *Agriculture*, *Disturbed*, *Industrial*, *Parks/Recreation*, *Residential*, *Grazing Land/Pasture*, *Roads*, and *Forested/Orchard* cover types.

[f] This category includes *Barrenland*, *Cliff/Talus*, and *Unknown* cover types.

[g] Riparian vegetation includes *Emergent Herbaceous Wetland, Scrub-Shrub Wetland,* and *Forested Wetland. Shore and Bottomland Wetland*, better characterized as *Rock Bottom*, is not considered suitable wildlife habitat for most species.

Table 7. Existing and predicted acres of cover types in the shoreline zone of Hells Canyon Reservoir for *Proposed Operations*, *Full Pool Run-of-River Operations*, and the 11 AIR operational scenarios. Predicted cover-type changes are relative to existing conditions for all scenarios.

	Existing Conditions		***Proposed Operations*[b]**		***Full Pool Run-of-River Operations***		**Scenario 1a**		**Scenario 1b**	
Characteristic Headwater Elevation, ft	**1,688.00**		**1,687.59**		**1,688.00**		**1,687.58**		**1,687.44**	
Vegetation Cover Type[a]	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**
Other Upland[c]	64.40	6.01	65.21	6.09	64.40	6.01	65.23	6.09	65.51	6.12
Grassland	110.30	10.30	109.64	10.24	110.30	10.30	109.63	10.23	109.40	10.21
Tree Savanna	20.70	1.93	23.43	2.19	20.70	1.93	23.50	2.19	24.43	2.28
Shrub Savanna	392.60	36.65	390.71	36.48	392.60	36.65	390.66	36.47	390.01	36.41
Shrubland	134.70	12.58	134.53	12.56	134.70	12.58	134.53	12.56	134.47	12.55
Forested Wetland	33.40	3.12	33.15	3.10	33.40	3.12	33.15	3.09	33.06	3.09
Scrub-Shrub Wetland	78.60	7.34	78.02	7.28	78.60	7.34	78.01	7.28	77.81	7.26
Emergent Herbaceous Wetland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shore and Bottomland Wetland	2.70	0.25	2.70	0.25	2.70	0.25	2.70	0.25	2.70	0.25
Water[d]	1.80	0.17	1.80	0.17	1.80	0.17	1.80	0.17	1.79	0.17
Developed[e]	45.90	4.29	45.90	4.29	45.90	4.29	45.90	4.29	45.90	4.29
Land Feature[f]	186.00	17.37	186.00	17.37	186.00	17.37	186.00	17.37	186.00	17.37
Total	1,071.10	100.00	1,071.10	100.00	1,071.10	100.00	1,071.10	100.00	1,071.10	100.00
Projected Change in Riparian Vegetation[g] from Existing Conditions	0.00	0.00	–0.82	–0.73	0.00	0.00	–0.84	–0.75	–1.12	–1.00

Table 7. (Continued)

	Scenario 1c		Scenario 1d		Scenario 1e		Scenario 1f		Scenario 2	
Characteristic Headwater Elevation, ft	**1,687.25**		**1,687.19**		**1,687.16**		**1,687.33**		**1,687.22**	
Vegetation Cover Type[a]	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**
Other Upland[c]	65.88	6.15	66.00	6.16	66.06	6.17	65.72	6.14	65.94	6.16
Grassland	109.10	10.19	109.00	10.18	108.95	10.17	109.22	10.20	109.05	10.18
Tree Savanna	25.70	2.40	26.10	2.44	26.30	2.46	25.16	2.35	25.90	2.42
Shrub Savanna	389.13	36.33	388.86	36.30	388.72	36.29	389.50	36.36	388.99	36.32
Shrubland	134.39	12.55	134.37	12.55	134.36	12.54	134.43	12.55	134.38	12.55
Forested Wetland	32.95	3.08	32.92	3.07	32.90	3.07	33.00	3.08	32.93	3.07
Scrub-Shrub Wetland	77.54	7.24	77.46	7.23	77.42	7.23	77.66	7.25	77.50	7.24
Emergent Herbaceous Wetland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shore and Bottomland Wetland	2.70	0.25	2.70	0.25	2.70	0.25	2.70	0.25	2.70	0.25
Water[d]	1.79	0.17	1.79	0.17	1.79	0.17	1.79	0.17	1.79	0.17
Developed[e]	45.90	4.29	45.90	4.29	45.90	4.29	45.90	4.29	45.90	4.29
Land Feature[f]	186.00	17.37	186.00	17.37	186.00	17.37	186.00	17.37	186.00	17.37
Total	1,071.10	100.00	1,071.10	100.00	1,071.10	100.00	1,071.10	100.00	1,071.10	100.00
Projected Change in Riparian Vegetation[g] from Existing Conditions	–1.51	1.35	–1.63	–1.46	–1.69	–1.51	–1.34	–1.20	–1.57	–1.40

Table 7. (Continued)

	Scenario 3		Scenario 4		Scenario 5		Scenario 6	
Characteristic Headwater Elevation, ft	**1,687.27**		**1,687.32**		**1,688.00**		**1,687.32**	
Vegetation Cover Type[a]	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**
Other Upland[c]	65.84	6.15	65.74	6.14	64.40	6.01	65.74	6.14
Grassland	109.13	10.19	109.21	10.20	110.30	10.30	109.21	10.20
Tree Savanna	25.57	2.39	25.23	2.36	20.70	1.93	25.23	2.36
Shrub Savanna	389.23	36.34	389.46	36.36	392.60	36.65	389.46	36.36
Shrubland	134.40	12.55	134.42	12.55	134.70	12.58	134.42	12.55
Forested Wetland	32.96	3.08	32.99	3.08	33.40	3.12	32.99	3.08
Scrub-Shrub Wetland	77.57	7.24	77.64	7.25	78.60	7.34	77.64	7.25
Emergent Herbaceous Wetland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shore and Bottomland Wetland	2.70	0.25	2.70	0.25	2.70	0.25	2.70	0.25
Water[d]	1.79	0.17	1.79	0.17	1.80	0.17	1.79	0.17
Developed[e]	45.90	4.29	45.90	4.29	45.90	4.29	45.90	4.29
Land Feature[f]	186.00	17.37	186.00	17.37	186.00	17.37	186.00	17.37
Total	1,071.10	100.00	1,071.10	100.00	1,071.10	100.00	1,071.10	100.00
Projected Change in Riparian Vegetation[g] from Existing Conditions	–1.47	–1.31	–1.36	–1.21	0.00	0.00	–1.36	–1.21

[a] Cover types are defined in Appendix B.

[b] Blair et al. (2002) predicted no changes from existing conditions for riparian upland habitats in the shoreline zone of Hells Canyon Reservoir for *Proposed Operations*. Although criteria for *Proposed Operations* have not changed from Blair et al. (2002), the estimated change in riparian from existing conditions differs here because of refined analytical procedures for the AIR scenarios.

[c] This category includes *Desertic Herbland*, *Desertic Shrubland*, *Forbland*, and *Forested Upland* cover types.

[d] Water in the reservoir shoreline zone includes *Lentic* and *Lotic* types.

[e] This category includes *Agriculture*, *Disturbed*, *Industrial*, *Parks/Recreation*, *Residential*, *Grazing Land/Pasture*, *Roads*, and *Forested/Orchard* cover types.

[f] This category includes *Barrenland*, *Cliff/Talus*, and *Unknown* cover types.

[g] Riparian vegetation includes *Emergent Herbaceous Wetland*, *Scrub-Shrub Wetland*, and *Forested Wetland. Shore and Bottomland Wetland*, better characterized as *Rock Bottom*, is not considered suitable wildlife habitat for most species.

Table 8. Existing and predicted acres of cover types in the shoreline zone of the Snake River downstream of Hells Canyon Dam for *Proposed Operations*, *Full Pool Run-of-River Operations*, and the 11 AIR operational scenarios. Predicted cover-type changes are relative to existing conditions for all scenarios.

	Existing Conditions		***Proposed Operations*[b]**		***Full Pool Run-of-River Operations*[c]**		**Scenario 1a**		**Scenario 1b**	
Characteristic Flow, cfs	**14,771**		**12,388**		**9,972**		**10,565**		**10,952**	
Vegetation Cover Type[a]	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**
Other Upland[e]	30.5	0.89	41.8	1.22	42.8	1.3	53.0	1.54	50.7	1.48
Grassland	196.9	5.73	186.5	5.43	185.6	5.4	176.3	5.13	178.4	5.19
Tree Savanna	16.9	0.49	39.7	1.16	41.6	1.2	62.2	1.81	57.5	1.67
Shrub Savanna	412.0	11.99	391.2	11.39	389.5	11.3	370.8	10.79	375.1	10.92
Shrubland	52.9	1.54	64.9	1.89	65.9	1.9	76.6	2.23	74.2	2.16
Forested Wetland	33.6	0.98	31.6	0.92	31.5	0.9	29.7	0.87	30.1	0.88
Scrub-Shrub Wetland	226.6	6.60	213.6	6.22	212.5	6.2	200.8	5.85	203.5	5.92
Emergent Herbaceous Wetland	1.7	0.05	1.6	0.05	1.6	0.05	1.5	0.04	1.5	0.04
Shore and Bottomland Wetland	329.1	9.58	385.3	11.22	455.2	13.3	440.5	12.82	428.9	12.49
Water[f]	2,009.7	58.50	1,953.5	56.87	1,883.6	54.8	1,898.3	55.26	1,909.9	55.60
Developed[g]	20.4	0.60	20.4	0.60	20.5	0.6	20.4	0.60	20.4	0.60
Land Feature[h]	104.9	3.06	104.9	3.06	105.0	3.1	104.9	3.06	104.9	3.06
Total	3,435.20	100.00	3,435.2	100.00	3,435.2	100.0	3,435.2	100.00	3,435.2	100.00
Projected Change in Riparian Vegetation[i] from Existing Conditions	0.00	0.00	–15.1	–5.7	–16.3	–6.2	–29.8	–11.4	–26.8	–10.2

Table 8. (Continued)

	Scenario 1c		Scenario 1d		Scenario 1e		Scenario 1f		Scenario 2	
Characteristic Flow, cfs	**12,114**		**12,764[d]**		**12,764[d]**		**11,399**		**14,646**	
Vegetation Cover Type[a]	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**
Other Upland[e]	44.1	1.28	40.7	1.18	40.7	1.18	48.1	1.40	31.8	0.93
Grassland	184.4	5.37	187.6	5.46	187.6	5.46	180.8	5.26	195.7	5.70
Tree Savanna	44.3	1.29	37.4	1.09	37.4	1.09	52.3	1.52	19.6	0.57
Shrub Savanna	387.1	11.27	393.4	11.45	393.4	11.45	379.8	11.06	409.5	11.92
Shrubland	67.3	1.96	63.6	1.85	63.6	1.85	71.5	2.08	54.3	1.58
Forested Wetland	31.3	0.91	31.8	0.93	31.8	0.93	30.6	0.89	33.3	0.97
Scrub-Shrub Wetland	211.0	6.14	215.0	6.26	215.0	6.26	206.5	6.01	225.1	6.55
Emergent Herbaceous Wetland	1.6	0.05	1.6	0.05	1.6	0.05	1.5	0.04	1.7	0.05
Shore and Bottomland Wetland	396.5	11.54	379.6	11.05	379.6	11.05	416.2	12.12	335.9	9.78
Water[f]	1,942.3	56.54	1,959.3	57.03	1,959.3	57.03	1,922.6	55.97	2,002.9	58.31
Developed[g]	20.4	0.60	20.4	0.60	20.4	0.60	20.4	0.60	20.4	0.60
Land Feature[h]	104.9	3.06	104.9	3.06	104.9	3.06	104.9	3.06	104.9	3.06
Total	3,435.2	100.00	3,435.2	100.00	3,435.2	100.00	3,435.2	100.00	3,435.2	100.00
Projected Change in Riparian Vegetation[i] from Existing Conditions	–18.1	–6.9	–13.5	–5.2	–13.5	–5.2	–23.3	–8.9	–1.8	–0.7

Table 8. (Continued)

	Scenario 3		Scenario 4		Scenario 5		Scenario 6	
Characteristic Flow, cfs	**12,806**		**11,499**		**9,972**		**17,982**	
Vegetation Cover Type[a]	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**
Other Upland[e]	40.4	1.18	47.5	1.38	56.8	1.65	28.5	0.83
Grassland	187.8	5.47	181.3	5.28	172.8	5.03	186.4	5.43
Tree Savanna	36.9	1.07	51.0	1.49	69.8	2.03	28.2	0.82
Shrub Savanna	393.8	11.46	381.0	11.09	363.9	10.59	387.0	11.27
Shrubland	63.4	1.85	70.8	2.06	80.6	2.35	62.5	1.82
Forested Wetland	31.9	0.93	30.7	0.89	29.1	0.85	35.7	1.04
Scrub-Shrub Wetland	215.2	6.27	207.2	6.03	196.5	5.72	240.9	7.01
Emergent Herbaceous Wetland	1.6	0.05	1.5	0.04	1.4	0.04	1.7	0.05
Shore and Bottomland Wetland	378.4	11.02	413.1	12.02	459.1	13.37	267.7	7.79
Water[f]	1960.4	57.07	1925.7	56.06	1879.7	54.72	2071.1	60.29
Developed[g]	20.4	0.60	20.4	0.60	20.4	0.60	20.4	0.60
Land Feature[h]	104.9	3.06	104.9	3.06	104.9	3.06	104.9	3.06
Total	3,435.2	100.00	3,435.2	100.00	3,435.2	100.00	3,435.2	100.00
Projected Change in Riparian Vegetation[i] from Existing Conditions	–13.2	–5.0	–22.5	–8.6	–34.8	–13.3	+16.5	+6.3

[a] Cover types are defined in Appendix B.

[b] For *Proposed Operations*, we predicted that 15.1 acres would be impacted downstream of Hells Canyon Dam compared with existing conditions. Blair et al. (2002) estimated that no riparian habitat would be impacted by *Proposed Operations* when compared with *Full Pool Run-of-River Operations.*

[c] Acreage estimates for *Full Pool Run-of-River Operations* are from Blair et al. (2002). Blair et al. (2002) reported no impacted acres downstream of Hells Canyon Dam because existing conditions did not form the basis of comparison. Although operations would be the same for *Full Pool Run-of-River Operations* and Scenario 5 downstream of Hells Canyon Dam, the change in riparian from existing conditions differs because of refined analytical procedures for the AIR scenarios.

[d] Scenarios 1d and 1e have the same total flows for the evaluation period, 1 July to 31 August.

[e] This category includes *Desertic Herbland*, *Desertic Shrubland*, *Forbland*, and *Forested Upland* cover types.

[f] Water in the river shoreline zone includes the river water surface and other *Lentic* and *Lotic* cover types.

[g] This category includes *Agriculture*, *Disturbed*, *Industrial*, *Parks/Recreation*, *Residential*, *Grazing Land/Pasture*, *Roads*, and *Forested/Orchard* cover types.

[h] This category includes *Barrenland*, *Cliff/Talus*, and *Unknown* cover types.

[i] Riparian vegetation includes *Emergent Herbaceous Wetland, Scrub-Shrub Wetland,* and *Forested Wetland. Shore and Bottomland Wetland*, better characterized as *Rock Bottom*, is not considered suitable wildlife habitat for most species.

Table 9. Relative abundance of noxious weeds and selected nonnative invasive species found in each reach of the Hells Canyon corridor (Krichbaum 2000).

			Number of weed populations recorded					
Scientific Name	**Common Name**	**Noxious or Invasive**	**HC Downstream**	**HC Res.**	**Oxbow Res.**	**Brownlee Res.**	**Weiser**	**All reaches**
		Upland Species						
Agropyron repens	Quackgrass	Nox	1	1	1	4	0	7
Cardaria draba	Whitetop or hoary cress	Nox	4	0	3	39	9	55
Cirsium arvensis	Canada thistle	Nox	2	1	1	20	26	50
Convolvulus arvensis	Field bindweed or morning glory	Nox	22	18	13	72	3	128
Cynoglossum officinale	Common houndstongue	Nox	48	47	24	52	0	171
Euphorbia esula	Leafy spurge	Nox	0	0	0	1	2	3
Hypericum perforatum	St. Johnswort	Nox	112	25	12	2	0	151
Linaria dalmatica	Dalmatian toadflax	Nox	3	7	0	9	0	19
Onopordum acanthium	Scotch thistle	Nox	38	29	21	119	31	238
Taeniatherum caput-medusae	Medusahead wildrye	Nox	0	24	23	61	11	119
		Facultative Riparian Perennials						
Conium maculatum	Poison hemlock	Nox	1	6	11	42	32	92
Lepidium latifolium	Broadleaved pepperweed	Nox	0	33	21	64	31	149
Elaeagnus angustifolia	Russian olive	Inv	0	1	3	6	14	24
		Obligate Riparian Perennials						
Cyperus esculentus	Yellow nut sedge	Nox	6	0	0	1	0	7
Amorpha fruticosa	False indigo	Inv	11	47	23	124	14	219
Phalaris arundinacea	Reed canarygrass	Inv	3	20	1	62	27	113
Tamarix sp.	Saltcedar	Inv	0	0	0	31	14	45
Hydrophytes								
Lythrum salicaria	Purple loosestrife	Nox	0	1	3	5	4	13
Ruderal annuals								
Ambrosia artemisifolia	Common ragweed	Nox	1	15	16	1	0	33
Tribulus terrestris	Puncturevine	Nox	4	34	15	39	3	95

Table 10. Predicted impacts of noxious weeds and selected nonnative invasive species relative to existing conditions in Hells Canyon for all scenarios.

		Existing Conditions	**FLA Scenarios**[a]		**AIR Scenarios**[a]										
Scientific Name	**Noxious or Invasive**	**No. Occurrences**[b]	***Proposed Operations***	***Full-Pool Run-of-River***	**1a**	**1b**	**1c**	**1d**	**1e**	**1f**	**2**	**3**	**4**	**5**	**6**
Upland Species															
Agropyron repens	Nox	7	s	s	s	s	s	s	s	s	s	s	s	+	s
Cardaria draba	Nox	55	s	+	s	s	s	s	s	s	s	s	s	++	s
Cirsium arvensis	Nox	81	s	s	s	s	s	s	s	s	s	s	s	++	s
Convolvulus arvensis	Nox	128	s	s	s	s	s	s	s	s	s	s	s	++	s
Cynoglossum officinale	Nox	171	s	s	s	s	s	s	s	s	s	s	s	++	s
Euphorbia esula	Nox	3	s	+	s	s	s	s	s	s	s	s	s	+	s
Hypericum perforatum	Nox	151	s	s	s	s	s	s	s	s	s	s	s	s	s
Linaria dalmatica	Nox	19	s	s	s	s	s	s	s	s	s	s	s	+	s
Onopordum acanthium	Nox	238	s	s	s	s	s	s	s	s	s	s	s	++	s
Taeniatherum caput-medusae	Nox	119	s	s	s	s	s	s	s	s	s	s	s	++	s
Facultative Riparian Perennials															
Conium maculatum	Nox	92	s	+	s	s	s	s	s	s	s	s	s	+	s
Lepidium latifolium	Nox	149	s	+	s	s	s	s	s	s	s	s	s	+	s
Elaeagnus angustifolia	Inv	24	s	++	s	s	s	s	s	s	s	s	s	++	s
Obligate Riparian Perennials															
Cyperus esculentus	Nox	7	s	s	s	s	s	s	s	s	s	s	s	s	s
Amorpha fruticosa	Inv	219	s	s	s	s	s	s	s	s	s	s	s	s	s
Phalaris arundinacea	Inv	113	s	+	s	s	s	s	s	s	s	s	s	+	s
Tamarix sp.	Inv	45	s	+++	s	s	s	s	s	s	s	s	s	+++	s
Hydrophytes															
Lythrum salicaria	Nox	13	s	+	s	s	s	s	s	s	s	s	s	+	s
Ruderal Annuals															
Ambrosia artemisifolia	Nox	33	s	+	s	s	s	s	s	s	s	s	s	+	s
Tribulus terrestris	Nox	95	+	s	+	+	+	+	+	+	+	+	+	++	+

[a] The symbol "s" indicates similar/minimal difference, and "+" indicates increased occurrence and extent of noxious weeds. Multiple "+" signs indicate greater impacts.

[b] This represents a relative abundance over the entire study area based on sampling by Krichbaum (2000). See Table 10 for relative abundance by river reach.

Table 11. Populations of rare plant species found in each reach of the Hells Canyon corridor (Krichbaum 2000).

		Number of Populations Recorded					
Scientific Name	**Common Name**	**HC Downstream**	**HC Res.**	**Oxbow Res.**	**Brownlee Res.**	**Weiser**	**All reaches**
Mimulus patulus	Stalk-leaved monkeyflower	0	0	1	0	0	1
Leptodactylon pungens ssp. *hazeliae*	Hazel’s prickly phlox	1	5	0	0	0	6
Bolandra oregana	Oregon bolandra	4	1	3	0	0	8
Carex hystricina	Porcupine sedge	0	3	7	0	0	10
Cyperus schweinitzii	Schweinitz flatsedge	21	0	0	0	0	21
Teucrium canadense var. *occidentale*	American wood sage	1	0	0	0	0	1

Table 12. Predicted impacts of operational scenarios on rare plant populations relative to existing conditions in Hells Canyon for all scenarios.

	Existing Conditions	FLA Scenarios[a]		AIR Scenarios[a]										
Common Name	**No. Occurrences[b]**	**Proposed Operations**	**Full-Pool Run-of-River**	**1a**	**1b**	**1c**	**1d**	**1e**	**1f**	**2**	**3**	**4**	**5**	**6**
Stalk-leaved monkeyflower	1	s	s	s	s	s	s	s	s	s	s	s	s	s
Hazel's prickly phlox	6	s	s	s	s	s	s	s	s	s	s	s	s	s
Oregon bolandra	8	s	s	s	s	s	s	s	s	s	s	s	s	s
Porcupine sedge	3 downstream of Dam	–	–	–	–	–	–	–	–	–	–	–	–	s
Porcupine sedge[c]	7 on Oxbow Reservoir	s	s	s	s	s	s	s	s	s	s	s	s	s
Schweinitz flatsedge	21	s	s	s	s	s	s	s	s	s	s	s	s	s
American wood sage	1	–	–	–	–	–	–	–	–	–	–	–	–	s

[a] The symbol "s" indicates similar/minimal difference, and "–" indicates potential negative effects.

[b] This information is based on sampling by Krichbaum (2000). See Table 12 for populations by river reach.

[c] Impacts on porcupine sedge vary depending on location (reach).

Table 13. Summary of estimated acres of riparian and upland habitat impacted by HCC *Proposed Operations*, *Full Pool Run-of-River Operations*, and the 11 additional operational scenarios. Impacted acres were summed for the 1) fluctuation, 2) reservoir and 3) river shoreline, and 4) crucial winter range zones described in Edelmann et al. (2002). Appendix D provides additional details about acre estimates.

	Estimated Acres Impacted		
Operational Scenario	**Riparian**	**Upland**	**Total**
Proposed Operations[a]	821	22,761	23,582
Proposed Operations[b]	485	22,761	23,246
Proposed Operations[c]	494	22,761	23,255
Full Pool Run-of-River Operations[d]	151	22,761	22,912
Full Pool Run-of-River Operations[e]	170	22,761	22,931
Scenario 1a	509	22,761	23,270
Scenario 1b	507	22,761	23,268
Scenario 1c	498	22,761	23,259
Scenario 1d	494	22,761	23,255
Scenario 1e	494	22,761	23,255
Scenario 1f	503	22,761	23,264
Scenario 2	482	22,761	23,243
Scenario 3	493	22,761	23,254
Scenario 4	503	22,761	23,264
Scenario 5[f]	774	22,761	23,535
Scenario 6	464	22,761	23,255

[a] Acreages are reported in Blair et al. (2002) and Edelmann et al. (2002) and derived from comparison with a *Full Pool Run-of-River Operations* using analytical methods in Blair et al. (2002). These acreages were proposed for wildlife mitigation in the FLA and IPC's response to AIR TR-1.

[b] Acreages were derived from comparison with existing conditions and analytical methods reported in Blair et al. (2002).

[c] Acreages were derived from comparison with existing conditions reported in Blair et al. (2002) and analytical methods refined for the AIR scenarios.

[d] Acreages were derived from comparison with existing conditions and analytical methods reported in Blair et al. (2002) and with existing conditions.

[e] Acreages were derived from comparison with existing conditions reported in Blair et al. (2002) and analytical methods refined for the AIR scenarios.

[f] The riparian (373 acres) and upland (5,448 acres) areas of the fluctuation zone would be at least partially vegetated by the end of 30 years. However, the preponderance of undesirable nonnative plants would render largely poor-quality wildlife habitat. The theoretical acreages of riparian and upland habitats in the fluctuation zone were added to the estimate of total impacted acres, which would require mitigation if Scenario 5 were implemented.

Table 14. IPC responses to agency comments on the draft report for AIR OP-1(g). Agency comments are in Appendix F.

COMMENT NUMBER	IPC RESPONSE
USFS and BLM 01	IPC agrees with FERC's decision to use analysis methods of Blair et al. (2002). FERC requested that changes in the acreage of vegetation be estimated for each AIR scenario. HC_REM methods of Braatne et al. (2002) are incapable of estimating acreages of vegetation change. FERC also requested that acreage changes be presented in a summary table as "impacted acres" comparable to Table 2 in Edelmann et al. (2002). Edelmann et al. (2002) reported impacted acres by summing impacts to riparian and upland cover types as estimated in Blair et al. (2002). Thus, methods employed in OP-1(g) are appropriate and results parallel those reported in Edelmann et al. (2002). Methods of Blair et al. (2002) incorporate environmental and riverine factors most important for linking HCC operational scenarios to shoreline vegetation. Braatne et al. (2002) stated for the Snake River downstream of Hells Canyon Dam, "Plant distribution was strongly correlated with hydrologic variables, and weakly correlated with slope and substrate." Accordingly, factors quantified in Blair et al. (2002) are hydrology (i.e., river flow, stage, and channel geometry) and existing shoreline vegetation. Existing vegetation, as represented by a cover-type map and described as plant assemblages, provides a composite variable for environmental conditions (e.g., substrate and soil moisture) that support plant species. The Blair et al. (2002) method incorporates the dynamics of riverine processes by logically projecting cover-type changes from existing conditions relative to hydrologic changes represented by an AIR scenarios. The Blair et al. (2002) method does not eliminate the six plant groups defined in Braatne et al. (2002). Rather, species comprising the six plant groups are incorporated in the riparian cover types and then further detailed as plant assemblages. IPC also believes that the mean annual water level is the appropriate down-slope bound for modeling the establishment of perennial vegetation within the river channel downstream of Hells Canyon Dam. Braatne et al. (2002) state, "This zone located below the mean annual water level is presently barren of vegetation and this pattern would probably continue with either proposed or ROR scenarios." The Full Pool Run-of-River (ROR) operational scenario evaluated by Braatne et al. (2002) reflects a "natural" hydrograph that is free of HCC operational influence. The channel area down-slope of the mean annual water level (scour zone) is barren because high spring runoff flows, which exceed the capacity of the HCC, eliminate perennial vegetation through prolonged inundation and scour. Braatne et al. define the influences of inundation and scour on vegetation establishment and persistence. Figures 2a and 2b demonstrate that, even for a year with moderate runoff, river flows exceed the mean annual water level for all AIR Scenarios. Thus, it is reasonable in OP-1(g) to assume that the scour zone downstream of Hells Canyon Dam will be permanently barren of perennial vegetation under all of the AIR scenarios. Accordingly, the OP-1(g) response does not include colonization estimates for perennial vegetation within the scour zone. Contrary to this comment, methods of OP-1(g) do not assume that cover-type changes would occur proportionally throughout the study area. It is actually assumed that changes would occur proportionally within a relatively homogenous study reach. Projecting patch-level changes in the extent of vegetation was not requested by FERC and is beyond the scale of both the Braatne et al. (2002) and Blair et al. (2002) methods. As directed by FERC, the final OP-1(g) response reports acreage changes of cover types as estimated with methods of Blair et al. (2002).

Table 14. (Continued)

COMMENT NUMBER	IPC RESPONSE
USFS and BLM 02	IPC agrees that the HC_REM analysis of Braatne et al. (2002) is scientifically sound. However, this method does not estimate acreage of vegetation change because projections are transect-based and do not quantify the availability of vegetation types within an entire study reach. HC_REM is designed to address ecological questions requiring estimates of proportional changes in botanical composition at selected transects. In contrast, the Blair et al. (2002) approach predicts acreage changes because it is based on a vegetation cover-type map that entirely covers each study reach within the study area. Therefore, IPC believes that the Blair et al. (2002) approach is valid to evaluate the AIR scenarios and provide the FERC-requested information for OP-1(g). The mean annual water level is the appropriate down-slope bound for vegetation establishment in the river channel downstream of Hells Canyon Dam (see IPC response to USFS and BLM 01). As directed by FERC, the final OP-1(g) response report acreages changes of cover types using the Blair et al. (2002) methods.
USFS and BLM 03	As requested by FERC, IPC reports projected acreage changes from existing conditions for the AIR scenarios, not proportional changes.
USFS and BLM 04	IPC believes that erosion would occur within the fluctuation and shoreline zones of Brownlee Reservoir upon implementation of AIR Scenario 5. Figure 4a portrays an example of unstable slopes and likely erosion sites within the fluctuation zone. It is also likely that the expanses of barren slopes at the 2077 ft full-pool shoreline would continue to be susceptible to erosion for a prolonged period into the future. However, data are unavailable to reasonably predict slope stability and resulting acreages of soil slumping and erosion. The acres impacted by erosion documented in Edelmann et al. (2002) and assumed to be constant in the AIR scenarios are the best currently available information. IPC also concluded that the re-exposed slopes of the Brownlee fluctuation zone would not provide suitable winter range because the colonizing vegetation would not provide quality winter forage (e.g., bitterbrush and sagebrush) for deer. Thus, it can be reasonably assumed that suitable winter range would not be created within the fluctuation zone under Scenario 5. Estimating the quality of mule deer winter range with in the Brownlee fluctuation zone under various vegetation-management scenarios was not requested by FERC and is beyond the scope of OP-1(g). The final OP-1(g) response maintains the current assumptions and results about shoreline soil erosion and winter range.
USFS and BLM 05	Edelmann et al. (2002) reported only 6 acres of shoreline would be impacted by erosion downstream of Hells Canyon Dam. Holmstead (2001) stated, “The coarseness of shoreline substrates reduces the potential for shoreline erosion,” and “Most shoreline erosion sites were upslope of the average highwater levels.” Furthermore, Holmstead (2001) concluded, “Boat-generated waves apparently affect most shoreline erosion sites (58 of 60) (Table 3).” Characteristic flows for *Proposed Operations* and the AIR scenarios were calculated for only the growing season and are all well below the mean annual water level formed by a flow of 20,695 cfs. Therefore, characteristic flows of any scenario would not reach documented erosion sites. Furthermore, estimating impacts of boat-generated waves is beyond the scope of OP-1(g). Accordingly, it is reasonable to assume in OP-1(g) that a maximum of only 6 impact acres would be caused by an AIR scenario. Thus, the final OP-1(g) response does not include individual modeled estimates of shoreline erosion for each AIR scenario.

Table 14. (Continued)

COMMENT NUMBER	IPC RESPONSE
USFS and BLM 06	IPC disagrees that perennial riparian vegetation would establish down slope of the mean annual water level in the shoreline zone downstream of Hells Canyon Dam. See IPC's previous response to USFS and BLM comment 01.
USFS and BLM 07	The AIR scenarios were not developed to facilitate the establishment of willows. Both average minimum- and maximum-daily flows for all AIR scenarios are well below the mean annual water level formed by a flow of 20,695 cfs. Consequently, operational flows during the growing season are typically subject to load following that occurs within the barren scour zone. The scour zone remains barren because high spring runoff flows, which exceed the hydraulic capacity of the HCC, eliminate perennial vegetation through prolonged inundation and scour. See IPC's previous response to USFS and BLM comment 01. The scour zone would remain barren irrespective of AIR scenario or flow parameter used for modeling. However, modeling average minimum-daily flows would underestimate the influence of an operational scenario on the perennial vegetation existing upslope of the mean annual water level. IPC believes that the average maximum-daily flow (i.e., characteristic flow) best represents the interaction between AIR scenarios and shoreline vegetation. Therefore, the final OP-1(g) response presents estimates of impacts to riparian cover types downstream of Hells Canyon Dam with modeling of average maximum-daily river flows.
USFS and BLM 08	The USFS and BLM appear to have misinterpreted the assumption. IPC understands that riverine processes are dynamic. To evaluate the relative patterns and magnitudes of the AIR scenarios, IPC's ecological modeling required certain generalizations and assumptions because site-specific information was not available to make patch-level vegetation projections. Fortunately for this analysis, individual vegetation patches of a specific cover type are typically found in areas with similar environmental characteristics including substrate and soil-moisture gradients. Braatne et al. (2002) schematically documented this general pattern as reach-specific vertical zonation of vegetation types along the reservoir and river shorelines. A hydrologic regime would therefore generally influence like cover-type patches uniformly. Specifically, it was assumed that scenario-induced changes to shoreline soil moisture gradients would be more sensitive to differences among the AIR scenarios than to environmental variation of like cover-type patches within a study reach. Projecting acreage changes of individual vegetation patches was not requested by FERC and is beyond the scale of both the Braatne et al. (2002) and Blair et al. (2002) methods. Consequently, IPC generalized the estimates of cover-type change within a relatively homogonous study reach and then summed the estimates for each AIR scenario. As directed by FERC, the final OP-1(g) response reports acreage changes of cover types for each AIR scenario as estimated with the Blair et al. (2002) methods.
USFS and BLM 09	The HC_REM model was not constructed for the fluctuation zone down to the original river channel or 101 ft drafting. Furthermore, HC_REM does not estimate acreages of vegetation types as requested by FERC. Overall, the absence of empirical data for the Brownlee fluctuation zone limits the ability of any method to precisely project a 30-year colonization of vegetation. Furthermore, a model's accuracy is unknown for Scenario 5 because a rehabilitation effort similar to the Brownlee fluctuation zone has never been attempted. Unfortunately OP-1(g) provides low precision estimates for the Bownlee fluctuation zone derived from the best available information. Nevertheless, the final OP-1(g) response reports IPC's best estimates using available information.

Table 14. (Continued)

COMMENT NUMBER	IPC RESPONSE
USFS and BLM 10	IPC agrees that exposing the Brownlee fluctuation zone for 30 years would be bleak for wildlife habitat in Hells Canyon. Theoretically, the timing and pattern of reservoir draw down could influence colonization patterns within the fluctuation zone. However, it is uncertain and untested how well this approach might prevent extensive weed invasions for Brownlee Reservoir. As indicated by the USFS and BLM in Comment 23, invasions of noxious weeds throughout the HCC are inevitable regardless of operational scenario. IPC believes that this inevitability would likewise seriously hamper all efforts, operational or otherwise, to inhibit weed invasions in the Brownlee fluctuation zone upon implementation of Scenario 5. State and federal land management practices have been largely ineffective at eliminating noxious weeds on public lands in Hells Canyon. IPC contends that the permanent exposure of over 6,000 acres of barren lands in the Brownlee fluctuation zone would create ideal condition for invasive weed colonization despite all reasonable and practical restoration efforts. The fluctuation zone would then become a source of weed propagules that could accelerate the rate of weed colonization in other areas, including relatively healthy habitats downstream of Hells Canyon Dam.
USFS and BLM 11	Estimating the quality of riparian habitat and mule deer winter range within the Brownlee fluctuation zone under various vegetation-management scenarios is beyond the scope of OP-1(g). For Scenario 5, the final OP-1(g) response does not address active vegetation management scenarios, and will maintain the current analyses, results, and conclusions.
USFS and BLM 12	IPC appreciates the acknowledgement that the cover-type predictions for the reservoir shoreline zones are correct.
USFS and BLM 13	IPC agrees with FERC's decision to use analysis methods of Blair et al. (2002). See IPC's response to comment USFS and BLM 01. IPC agrees that historical HCC operations have largely influenced the extent of shoreline vegetation downstream of Hells Canyon Dam. Braatne et al. (2002) state, "Plant distribution was strongly correlated with hydrologic variables, and weakly correlated with slope and substrate." Similarly, Blair et al. (2002) state, "Soil moisture dynamics of shorelines is a primary determinant of riparian vegetation. Hence, factors affecting stage (e.g., hydrologic operations) could correspondingly affect shoreline soil moisture gradients and the associated riparian vegetation." The extent to which operational scenarios affect shoreline soil moisture is most significant for the upslope bounds of riparian vegetation in the shoreline zone. Specifically, load following associated with *Historical Operations* caused short-term elevations of average summer base flows, which likely influenced the extent of soil moisture up the shoreline slopes (Blair et al. 2002). Likewise, the influence of AIR scenarios on shoreline vegetation would also be most pronounced relative to their affects on shoreline soil moisture and the upslope bound of riparian vegetation. Blair et al. (2002) further states, "Nonetheless, periodically large scouring flows likely limit the lower extent of permanent vegetation on the shoreline slope (Holmstead 2001, Braatne et al. 2002)." The channel area down slope of the mean annual water level (scour zone) is barren because high spring runoff flows, which exceed the capacity of the HCC, eliminate perennial vegetation through prolonged inundation and scour. Consequently, IPC believes that the mean annual water

Table 14. (Continued)

COMMENT NUMBER	IPC RESPONSE
	level is the appropriate down-slope bound for modeling the establishment of perennial vegetation within the river channel downstream of Hells Canyon Dam. The mean annual water level was empirically determined by Braatne et al. (2002) and not assumed. Braatne et al. (2002) state, “This zone located below the mean annual water level is presently barren of vegetation and this pattern would probably continue with either proposed or ROR scenarios.” The Full Pool Run-of-River (ROR) operational scenario evaluated by Braatne et al. (2002) reflects a “natural” hydrograph that is free of HCC operational influence. Thus, it is reasonable in OP-1(g) to assume that the scour zone downstream of Hells Canyon Dam will be permanently barren under all of the AIR scenarios.
USFS and BLM 14	The USFS and BLM appear to misunderstand how the mean annual water level applies to vegetation projections. The mean annual water level established by a flow of 20,695 was not used to “…portray the flows during the riparian vegetation’s reproductive and growing season.” Rather, the mean annual water level established only the down-slope extent of permanent vegetation within the shoreline zone downstream of Hells Canyon Dam. Braatne et al. (2002) estimated that the river shoreline formed by a constant flow of 20,695 was related to the lowest extent of perennial woody riparian vegetation. The scour zone is barren because high spring runoff flows eliminate perennial vegetation through prolonged inundation and scour on this zone. See IPC’s previous response to USFS and BLM comment 13. Table 3 represents characteristic flows for the HCC operational scenarios not the mean annual water level. The characteristic flows were then used to project the upslope extent of riparian cover types within the shoreline zone under each AIR scenario. In fact, all of the characteristic flows would form water levels well below the mean annual water level. Consequently, each operational scenario would generally maintain water levels below the perennially vegetated shoreline during the modeled growing season (Figures 2a and 2b).
USFS and BLM 15	IPC disagrees that the modeled growing season downstream of Hells Canyon Dam should be expanded. The evaluation period of 1 July to 31 August was defined to encompass the portion of the growing season that was most influenced by daily load-following patterns, hence HCC operations. During May and June, Figures 2a and 2b demonstrate the river flows are most influenced by spring runoff, which exceeds the 30,000 cfs hydraulic capacity of Hells Canyon Dam, and not HCC load-following operations. Furthermore, the extent of riparian vegetation is more likely affected by the soil moisture gradient resulting from river hydrology (e.g., operational scenarios) during July and August, and the likely effects on riparian vegetation are thus accounted for by the analysis. IPC will retain the modeled growing season of 1 July to 31 August for the final OP-1(g) response. See IPC’s response to USFS and BLM comment 18 relative to flows for the Imnaha and Salmon Rivers.
USFS and BLM 16	The formation of the scour zone relative to the mean annual water level appears to be misunderstood by the USFS and BLM. Within the scour zone, the soil moisture gradient during the modeled growing season does not determine establishment of perennial riparian vegetation. Periodically large scouring flows limit the lower extent of permanent vegetation on the shoreline slope (Blair et al. 2002). Although characteristic river flows for all of the scenarios are less than 20,695, spring runoff flows typically far exceed the mean annual water level (Figure 2a and 2b). The scour zone is barren because high spring runoff flows eliminate perennial vegetation through prolonged inundation and scour. Braatne et al. (2002) state, “This zone located below the mean annual water level is presently barren of vegetation and this pattern would probably continue with either proposed or ROR scenarios.” The Full Pool Run-of-River (ROR) operational scenario evaluated by

Table 14. (Continued)

COMMENT NUMBER	IPC RESPONSE
	Braatne et al. (2002) reflects a “natural” hydrograph that is free of HCC operational influence. Thus, it is reasonable in OP-1(g) to assume that the scour zone downstream of Hells Canyon Dam will be permanently barren under all of the AIR scenarios. Consequently, IPC believes that the mean annual water level is the appropriate down-slope bound for modeling the establishment of perennial vegetation within the river channel downstream of Hells Canyon Dam.
USFS and BLM 17	Please see previous response to USFS and BLM comment 15.
USFS and BLM 18	Flows for the Imnaha and Salmon rivers were appropriately incorporated into the Mike 11 ® one-dimensional hydrologic model that was used to translate characteristic flows into estimates of cross-sectional stage (i.e., water-surface elevations) for the Snake River from Hells Canyon Dam to the Salmon River confluence. The USFS and BLM have misinterpreted that Imnaha and Salmon river flows were added to Snake River flows at Hells Canyon Dam. Lateral inflows for the Imnaha and Salmon river tributaries were added to the Snake River at their respective confluences. Although at the downstream boundary of the study reach, the Salmon River inflows can create a backwater effect that increases stage within the Snake River a short distance upstream of the confluence. Chapter 5 of Technical Report E.1-4 in the FLA describes parameterization of the Mike 11 ® model. Thus, OP-1(g) modeling results are not skewed as indicated in this comment.
USFS and BLM 19	Again, factors that form the scour zone relative to the mean annual water level is misunderstood. Please see IPC responses to USFS and BLM comments 16 and 20.
USFS and BLM 20	IPC agrees that riverine systems are dynamic and that regulated systems provide diverse ecosystems. For example, the riparian vegetation within the river shoreline zone downstream of Hells Canyon Dam provides highly productive and diverse habitats relative to the surrounding expanses of semiarid upland habitats. However, IPC believes that the factors maintaining a barren scour zone are misunderstood by the BLM and USFS. Braatne et al. (2002) describe river scour and inundation as mechanisms that prevent vegetation establishment within the scour zone. Perennial riparian vegetation cannot establish in the scour zone. The high runoff flows eliminate vegetation in the scour zone. Figures 2a and 2b demonstrate that high runoff flows would occur during spring irrespective of operational scenario. These figures further demonstrate that magnitude and timing of spring runoff for most of the AIR scenarios would not be altered significantly from observed *Historical Operations*. Lower flows induced by an AIR scenario would occur during the modeled growing season only, not yearlong. The daily and seasonal storage capabilities of the HCC can typically permit only short-term deviations between flows entering and exiting the HCC. Consequently, flows exceeding HCC storage and plant capacity (i.e., >30,000 cfs) must be passed as spill even during May and June. IPC agrees that flow timing, duration, magnitude, and recession will affect the physical location of riparian vegetation on the river shoreline. For the scenarios modeled, however, long-term physical shifts would only occur along the upslope extent of riparian vegetation as the lateral and vertical extent of the soil moisture gradient would be influenced by scenario-induced hydrology. High spring runoff flows prevent long-term physical shifts in the down-slope extent of perennial riparian vegetation.

Table 14. (Continued)

COMMENT NUMBER	IPC RESPONSE
USFS and BLM 21	The hydrology and geomorphology of the Snake River provide very limited opportunities for obligate riparian communities. Whereas, much greater opportunities exist for facultative riparian communities such as hackberry dominated plant assemblages. Hackberry does not require riparian areas and fluvial processes to establish and persist. Rather, hackberry is a facultative riparian species in the shoreline zone downstream of Hells Canyon Dam and can capitalize on water resources from the Snake River. Hackberry plants that access the water table, which is influenced by the Snake River, form riparian habitat within the shorelines zone and have increased robustness compared with hackberries in upland areas. This robustness is exhibited by increased foliar coverage and stem density (see Technical Report E.3.2-44 and Technical Report E.3.3-1). Relative to obligate riparian species such as willow, hackberry communities in the shoreline zone tend to occupy more upslope portions of the shoreline zone with relatively coarse substrates that are typically occupied by upland vegetation. Thus, an increase in hackberry in the shoreline zone tends to cause a decrease in upland communities not obligate riparian communities. Riparian communities dominated by hackberry are very diverse and provide many ecological benefits relative to the semiarid landscape of Hells Canyon. In fact, hackberry sites downstream of Hells Canyon Dam are more species rich than sites dominated by willow. A total of 49 species were found in the *Celtis reticulata–toxicodentron radicans* plant assemblage, the dominant hackberry community in this reach (total species in each life form: 2 trees, 25 shrubs, 9 grasses, and 14 forbs) (Holmstead 2001). This compares to 39 species in the *Salix exigua* assemblage (total species in each life form: 0 trees, 8 shrubs, 9 grasses, and 22 forbs) (Holmstead 2001). Furthermore, passerine bird densities in hackberry vegetation associations within *Scrub-Shrub Wetland* and *Forested Wetland* cover types ranged between 10 and 20 birds/ha. Bird densities in upland vegetation associations never exceeded 12 birds/ha (Technical Report E.3.2-1). Hence, hackberry-dominated riparian habitat in the shoreline zone is generally very beneficial to passerine birds relative to the expanses of upland habitats. This is important considering that hackberry-dominated riparian habitats mostly occupy areas that could not support obligate riparian communities. Although bird densities were higher in some riparian vegetation associations other than those dominated by hackberry, the other associations are typically confined to tributary streams and are not prevalent in the river shoreline zone of the Snake River downstream of Hells Canyon Dam. Although Figures 2a and 2b appear busy, the meaningful information portrayed is that hydrographs for the AIR scenarios largely overlap and adhere to a very similar seasonal pattern within the range of *Proposed Operations* and *Full Pool Run-of-River Operations* evaluated in the FLA. The figures are not intended to display the individual time series of cfs values for each scenario. Separating the hydrographs into many separate figures does not easily permit a visual and simultaneous comparison of hydrograph patterns. Consequently, figures 2a and 2b remain unaltered in the final OP-1(g) response.
USFS and BLM 22	The concept of “irrigation effect” is fundamental to riparian ecology as well as to agricultural and horticultural irrigation. An irrigation effect refers to the promotion of vegetation growth and vigor through supplemental water. Interestingly, land use practices commonly permitted on public lands are considered abusive in this comment. IPC acknowledges that the elimination of “abusive land use practices” allowed the recovery of riparian communities downstream of Hells Canyon Dam.

Table 14. (Continued)

COMMENT NUMBER	IPC RESPONSE
	However, the irrigation effect likely accelerated the recovery and enhanced the upslope extent of facultative riparian communities. Consequently, the irrigation effect should likewise be recognized as an important non-abusive factor contributing to the existing robustness of riparian habitats in the river shoreline zone of Hells Canyon.
USFS and BLM 23	IPC appreciates the acknowledgement that OP-1(g) conclusions about invasive weeds and Scenario 5 are correct. IPC also agrees that active management over the next license term should include measures to retard the expansion of undesirable weedy species. IPC believes that not implementing Scenario 5 in combination with other weed management actions would be a very appropriate measure to slow the expansion of undesirable weedy species in Hells Canyon.
USFS and BLM 24	IPC disagrees with the BLM and USFS interpretation of the scour zone and application of the irrigation effect. See previous responses to USFS and BLM comments 16 and 20. For the AIR scenarios evaluated, IPC believes that estimated impacts to special-status plants are reasonable, robust, and valid. Therefore, IPC does not alter conclusions about special-status plants in the final OP-1(g) response.
USFS and BLM 25	The BLM comment 25 is essentially a summary of USFS and BLM comments provided for AIR OP-1 (d). For convenience, the responses to these comments are provided below, but they are identical to responses to OP-1 (d). USFS and BLM OP-1(d) response to comments: This document provides IPC's responses to agency comments from consultation for the HCC AIR OP-1 (d). Comments were received for the USFS and BLM. Comments from the USFS and BLM are very similar. Responses to comments provided below follow the outline of the USFS document. Comments addressed are summarized and shown in underlined italics. Responses follow in regular text. **ATTACHMENT 1** **SITE DESCRIPTIONS** *No descriptions of the site boundaries is shown.* The boundaries are illustrated for each site on Figures B-1 to B-24 of AIR S-1. *Samples should have been taken from each site and analysis conducted for specific beach material. Or, at least use data from FLA E.1-2.* FERC requested that IPC conduct mobility analysis at the four sites for 1.0mm sands. The analyses were responsive to FERC's request and were conducted using 1.0mm sand.

Table 14. (Continued)

COMMENT NUMBER	IPC RESPONSE
	FLOW DURATION CURVES *Flow Duration Curves describe the frequency of flows of various magnitudes. The flow duration curves do not describe the frequency of wetting and drying for each scenario. This would assist in understanding how frequently sand is mobilized, and may assist in understanding other erosive mechanisms.* There appears to be some confusion about how the analysis was conducted, and text in OP-1(d) has been modified to clarify the analysis. Hydrographs of hourly discharges for each year of proposed operations and each scenario were used to develop the flow duration curves. The hydrographs of the same hourly data were also used to determine mobility for each hour of a year; flow duration curves were not directly used to determine mobility throughout the year. By using the hourly data rather than flow duration curves in determining mobility or stability, cycles of wetting and drying are in fact part of the analysis and results presented in OP-1(d). **INCIPIENT MOTION OF SAND** *Median sand size is much smaller than 1.0mm requested, ranging from <0.3 – 0.6mm. Consequently, flows calculated for incipient in this analysis will be much greater than those which will actually entrain sandbar sediment.* The comment implies that the agencies believe the bars are in actuality much more mobile than the modeling results indicate for a 1.0 mm particle size. If the bars are in fact much more mobile than predicted, bed load monitoring at the sandbars should demonstrate this. IPC conducted bed load sampling as requested in AIR S-1 (e) at the four bars at requested discharges. The sampling results generally indicate that in some cases there is no mobility in the sand areas that modeling predicts to be mobile for 1.0mm particle sizes and there are very few cases where positive samples were collected in areas predicted to be stable. This suggests that the mobility modeling (for 1.0mm sizes) is reasonable and may actually overestimate areas of mobility for any bed load (which is consistent with IPC's opinion that the modeling assumptions are in general conservative). While the agencies' hypothesis is understandable, the empirical information collected at the four bars don't support it. *The USFS states that since FERC left meaning of incipient motion unspecified, IPC defined incipient motion as a condition when 1% of an inundated area had applied shear stresses greater than the calculated critical shear stress for a 1.0 mm particle.* This is partially true, but apparently needs clarification. IPC defines incipient motion as a condition when the applied shear stress exceeds the critical shear stress, which is determined for each cell. A sand bar is considered to be mobile when more than 1% of the inundated area of sand at a bar has an applied shear stress that exceeds the critical shear stress (which IPC believes is a conservative threshold to determine bar mobility). Mobility of sand and the overall mobility of a bar is not the same thing.

Table 14. (Continued)

COMMENT NUMBER	IPC RESPONSE
	The critical and applied shear stress was determined for each cell using a two-dimensional model (MIKE 11).
	The two-dimensional results were determined with MIKE 21C, which is a 2-D curvilinear model. MIKE 11 is a 1-D model.
	These threshold flows are approximately shown on each of Figures 1-240, although they have been inexplicably rounded to the nearest 5,000 cfs.
	IPC did not "inexplicably" round off to the nearest 5,000 cfs. On the contrary, the information presented is responsive to FERC's request. FERC clearly requested analysis in 5,000 cfs increments and the estimates of sand mobility are based on these flows.
	More information needed to evaluate results
	Information on cell size, maps of sand bars with extent of sand area are in AIR S-1.
	ANALYSIS OF SAND MOBILIZATION
	IPC's analysis approach likely results in imprecise results that significantly underestimate sandbar sediment entrainment, especially for flow scenarios that have higher percentages of large flows.
	1. It is not clear how the areas of potential sediment transport for flows greater than 30,000 cfs were determined. Speculating, two likely possibilities are that (1) those periods where flow was greater than 30,000 cfs were not considered in the analysis, or (2) if they were, only the areas with critical shear stresses sufficient to mobilize 1 mm sand at the 30,000 cfs discharge were considered mobile no matter by how much the actual discharge exceeded 30,000 cfs.
	The modeling addressed the incipient motion or mobility in each cell. It did not assess the sediment transport in each cell.
	It is unnecessary for the agencies to speculate; we clearly state that each of the requested discharges represents flow from half way down to the lower flow or half way up to the next higher flow. Since 30,000 cfs is the highest increment, it is used from 27,500 and up.
	2. The step function with 5,000 cfs intervals likely minimizes differences in calculated sand entrainment areas between scenarios. It would have been relatively straightforward to use an empirical function to relate area mobilized to discharge. This approach reduces the resolution of the analysis.
	IPC does not have empirical data that would have lent to developing an empirical relationship of mobile areas between simulated discharges. IPC does agree that it would be possible to apply a continuous analytical expression between the discharges simulated. However, any assumed analytical function between the simulated discharges could be subject to criticism (just as the step function has been).

Table 14. (Continued)

COMMENT NUMBER	IPC RESPONSE
	It is not clear that assuming a functional relationship for conditions between simulated discharges would improve the resolution of the analysis. It would make the results appear continuous, but would not add resolution. It would, however, provide some variability that would be a function of the assumed relationship (not of the physical processes). Although we considered it in developing the analysis, it is doubtful that this would be any more beneficial to the analysis than the step function that was used, and it could give the impression that more information exists than actually does. *4. IPC's procedure to compare the extent of sand mobilization for proposed operations with the various specified scenarios cannot be fully assessed because there is insufficient information of the underlying assumptions, especially those justifying "balancing" or "offsetting" periods of greater mobile areas with periods of less mobile areas. The simplest and most straightforward approach to assessing the aerial "extent of sand mobilization" for each flow scenario is to combine the "mobile area function" for each sand bar with the particular flow distribution function to give a cumulative area (on an annual basis) subject to 1 mm sand entrainment.* There appears to be some confusion about how the analysis was conducted, and text in OP-1 (d) has been modified to clarify the analysis. Hydrographs of hourly discharges for each year of proposed operations and each scenario were used to develop the flow duration curves. The hydrographs of the same hourly data were also used to determine mobility for each hour of a year; flow duration curves were not directly used to determine mobility throughout the year. The area mobilized for proposed operations and each scenario was summed for every hour and then divided by the number of hours in a year (areas without mobility are not part of the summation), which gives the average annual mobilized area (m^2) that is in tables Xa of OP-1 (d). With the exception of the units of the resulting area mobilized (m^2 or m^2*hrs) and the format of the tables, IPC believes the results the USFS is looking for are in OP-1 (d). *This result would be in units of m^2*hrs similar to IPC's computation procedure but would not involve explicit "offsetting."* USFS appears to misunderstand the offsetting discussed. If USFS chooses to do the evaluation on a cumulative basis with different units, the annual average areas (m^2) can be easily multiplied by the number of hours in the year (365*24=8,760). The results won't change, the numbers will be larger, but the percent difference between the scenarios and proposed operations will remain the same. *However, from IPC's description (pg.5), areas during periods of calculated immobility are apparently subtracted from the cumulative total.* IPC never discusses subtracting immobile areas from a total. We simply note that by summing up the differences over a year, negative values (that is the mobile area under the alternative is more than under the proposed operation) will "offset" positive differences (where the mobile area under the proposed operation is larger than under the alternative). Immobile areas are not used in the calculation other than to represent total area. The USFS's proposed cumulating approach does exactly the same thing.

Table 14. (Continued)

COMMENT NUMBER	IPC RESPONSE
	This is completely invalid unless it is assumed that periods of immobility result in deposition that balances erosion on a time equivalent basis. This is stated on page 5 as “we assumed that any decrease in the area of mobilization was no impact and represented opportunities for deposition.” The methodology is valid and this sentence in OP-1 (d) has been modified in an attempt to make it less confusing. *This assumption is invalid because of the clear evidence of diminished supply of sediment feeding most sand bars and the highly nonlinear character of sediment entrainment.* This statement implies that the USFS is assuming that any condition of mobility correlates to transport of sands away from sandbars. The counts of sandbars presented in the FLA and AIR S-1 (g) show that the number of sandbars has increased during periods of higher flows (1973–1977 and 1982–1997). For the number of sandbars to increase during some periods, it is not possible for them to be in a continuous condition of sand being transported downstream. In fact, for the number of bars to ever increase, there must be deposition of sands under some conditions (likely from sources below HCD). This said, IPC agrees that there has been a diminished supply of sediment feeding most sandbars. In fact, in the FLA IPC presented that over 87% of the watershed that contributed sediment to the Hells Canyon reach was already blocked off (including the Boise and Payette that drain the Idaho Batholith) at the time the HCC was constructed. *Another aspect of this analysis mutes the effects of larger flows (those creating areas of sand mobility) on potential sand mobilization, thus understating the potential effects of scenarios with flow-duration curves skewed towards flows exceeding the transport thresholds. While Idaho Power perhaps meets the letter of the AIR request in determining “extent of sand mobilization,” it does not meet the spirit of the analysis by failing to make any attempt to consider differences in sediment volume entrained between the suite of scenarios. In a shear stress approach to calculating sediment transport, bedload transport rates are commonly related to the “excess shear” above critical transport conditions. This relation is nonlinear. For example, the commonly used Meyer-Peter and Müller (1948) equation for bedload transport reduces to* $q \propto \left(\tau_o - \tau_c\right)^{1.5}$. *where q is the bedload transport rate per unit width, τo is the applied shear stress, and τc is the critical shear stress for the particle size of interest (Julien, 1994, pg 161-162). Because transport is related to the difference between the applied and critical shear stress, bedload transport rates increase markedly once the critical shear stress value is exceeded for a specific area. Simply assessing the area affected by sediment transport for a particular scenario gives incomplete information of*

Table 14. (Continued)

COMMENT NUMBER	IPC RESPONSE
	the likely affects of that scenario on sediment mobilization. A more valid assessment, hence more valid comparisons between scenarios, would result from applying an excess shear calculation to the analysis so to estimate potential volumes entrained. While for a variety of reasons the resulting values may not be very accurate, such an analysis would provide the most complete information for comparison purposes and is clearly within the capabilities of the models and data available.
	IPC recognizes that sediment transport, as a function of bed shear is non-linear. The USFS states that due to this non-linearity, bed load transport rates will increase markedly once the critical shear stress has been exceeded. Thus, implying that transport rates increase non-linearly with river discharge.
	However, the Schoklitsch equation computes bed load per unit width as a function of excess discharge. The relationship between bed load and discharge is linear ($Q^{1.0}$). Simons and Senturk (1992) present excess shear transport equations in terms of excess discharge. This relationship shows bed load as a function of discharge raised to the 6/5 power ($Q^{6/5}$), which is close to unity.
	The USFS acknowledges that the information resulting from using transport equations may not be very accurate, and IPC agrees. Most sediment transport equations assume that supply is not a limiting factor (i.e. it is unlimited). This is not the case in many gravel bed rivers, and certainly not the case in Hells Canyon. Therefore, using them for this type of application is of dubious value.
	*5. The most valid and clear comparison would be a simple table (and a single corresponding chart) modeled after Table 2a that for each bar and for each scenario that presents the correctly calculated (see comments above) total annual mobilized area (in m^2*hours). There is no clear reason why these values should be normalized to bar area.*
	In IPC's opinion, it is much easier and much more clear to evaluate a number by saying, for example, the percentage of bar mobilized changes from 10% to 12% than to evaluate a number that says, for example, one alternative has 1,312,538 m^2*hrs of sand mobile and the other alternative has 1,575,046 m^2*hrs of sand mobile. If the USFS would rather evaluate larger and more complex numbers, the annual areas mobilized in tables Xa of OP-1 (d) can be multiplied by 8,760 hours/year. Regardless of the units, the results will be the same.
	The normalization adopted by IPC simply creates very small numbers without adding information,
	The intent wasn't to add information. The intent was to make the analysis easier to understand. It matters not what units are used, the difference between the scenarios and proposed operations will remain the same.
	hence supporting obtuse statements such as "In none of the scenarios or years does the ratio of area mobilized over all four bars differ by more than 1 percent with respect to Proposed Operations".

Table 14. (Continued)

COMMENT NUMBER	IPC RESPONSE
	Contrary to the USFS's opinion, there is nothing "obtuse" about a simple summary statement of fact. The results are not suggesting that there is no mobility at the bars. Rather, on an annual basis, the difference in area mobilized between the scenarios and proposed operations is relatively small. Again, this is a statement of fact based on the empirical evidence. *In reality, even with the flawed calculation procedures, the percent changes in absolute area are much greater, ranging up to 71% as shown in Table 2a.* The 71% change that the USFS notes is a change from an area of 0.90 m^2 to 0.26 m^2 ((0.9-0.26)/0.9). It is extremely doubtful, as the USFS seems to indicate, that a difference in mobilized area of 0.64 m^2 averaged over a year is significant. In fact, this is an excellent illustration of why IPC provided both percentage changes and area changes. If you look at the results on a cumulative basis, they would go from 7,884 m^2*hrs to 2,278 m^2*hrs. While this result yields larger numbers in different units that are less discernable, the percentage change remains the same as that represented in the response to this AIR. **SUMMARY** *It should also be noted that this approach—the critical tractive force approach—which was the logical analysis approach adopted by IPC given the request to determine incipient motion conditions—may not be relevant to other important erosional mechanisms affecting sandbars, such as sapping (owing to daily flow ramping cycles). The studies conducted so far as part of the relicensing effort have not shed sufficient light on the processes forming, maintaining, and eroding sandbars so that we can confidently and quantitatively predict their behavior on the basis of a single process model.* In general, IPC agrees with this comment. The question of mobility through the range of flows readily influenced by operations of the HCC is certainly relevant. And, applying critical tractive force to address the question is certainly appropriate. A number of studies have been conducted throughout the relicensing process, none of which have identified a single process as a primary mechanism that can fully explain sandbar processes in Hells Canyon. While IPC doubts there is a single process or factor that will explain everything, IPC agrees there are other processes that can be evaluated. The USFS and BLM both mention sapping of the bars, and the BLM suggest that wake erosion could be a factor. Either of these may be an important mechanism in sandbar processes.
USFS and BLM 26	Comments about shortcomings are addressed in BLM 25. The agencies should keep in mind that the analysis in OP-1 (d) compares sand areas mobilized between scenarios and proposed operations. The analysis does not assess sediment transport, erosion, or deposition. In IPC's opinion, the minor differences in sand areas mobilized between scenarios and proposed operations are reasonable.
USFS and BLM 27	For numerous reasons discussed in the FLA, IPC does not agree that the 1964 photographs are indicative of an equilibrium condition at that time. In IPC's opinion, the method that Grams and Schmidt used to count sandbars from aerial photographs is flawed. This is discussed in the FLA. IPC's sandbar count for the 1973 to

Table 14. (Continued)

COMMENT NUMBER	IPC RESPONSE
	1982 period shows a slight increase in the number of bars. Other periods since then show both increases and decreases, and there appears to be some correlation with wet periods and dry periods. This is discussed further with other information in AIR S-1 (g). Thus, IPC disagrees that 4% per year degradation is a reasonable value. And, in IPC's opinion, it is not reasonable to assume that sandbars will follow this rate of decline.
USFS and BLM 28	The objective of OP-1(g) was to evaluate the effects of the AIR scenarios on riparian vegetation by predicting acreage increases and decreases relative to existing conditions. FERC also requested a summary table of estimates of acres impacted for each AIR scenario comparable to estimates of *Proposed Operations* in Table 2 of Edelmann et al. (2002). The predicted effects were to also address the abundance and distribution of noxious weeds, non-native plants, and special status plants. HC_REM analyses of Braatne et al. (2002) are incapable of predicting acreage changes for plant functional groups. Consequently, IPC and FERC agreed to address the acreage increases of riparian cover types with methods of Blair et al. (2002). Blair et al. (2002) provided the estimates of impacted riparian acres in Table 2 of Edelmann et al. (2002). Consequently, it is reasonable to also use the Blair et al. (2002) methods to generate comparable estimates for OP-1(g). The USFS and BLM appear to misunderstand key hydrological elements for modeling riparian vegetation along a large and entrenched river system such as the Snake River in Hells Canyon. As characteristic of many large rivers in the West, the Snake River typically experiences periods of large spring runoff that are well above base flows during the water-limited summer growing season. Inflows to the HCC during spring runoff typically exceed storage and hydraulic capacity resulting in spill from Hells Canyon Dam. Figures 2a and 2b clearly demonstrate that, even for a moderate runoff year, peak spring flows are more than double the mean annual water level. When exposed during lower summer flows, the scour zone might temporally be colonized by ruderal annuals (Braatne et al. 2002). However, the down-slope extent of perennial riparian vegetation is largely determined by scour and inundation during significant spring runoff events. Considering the hydrology, channel geometry, shoreline geomorphology, and existing vegetation conditions in Hells Canyon, IPC used appropriate modeling assumptions to address the AIR scenarios and provide the information requested in OP-1(g). IPC believes that projections of relative acreage increases and decreases are reasonably precise for each AIR scenario. In fact, the USFS and BLM acknowledge in comment 12 that IPC's projections for the reservoir shoreline zone are "generally correct." They also acknowledge in comment 23 that IPC's conclusions regarding noxious weeds and non-native plants are correct. IPC disagrees that only a "relic riparian community" occurs in Hells Canyon. As indicated by the USFS and BLM in comment 22, riparian communities in Hells Canyon were greatly impacted by "abusive land use practices" prior to the HCC. They further indicated that the riparian communities have been restored during the period of *Historical Operations* of the HCC. It appears that the USFS and BLM arbitrarily and inconsistently characterize riparian habitat downstream of Hells Canyon Dam as "relic" when referencing the HCC but "restored" when referencing other discontinued land use practices. The USFS and BLM assume that more diverse and robust riparian habitats would be created by "natural conditions," presumably meaning a natural hydrograph (i.e., run-of-river operations). Regardless of analytical method, both HC_REM of Braatne et al. (2002) and Blair et al. (2002) demonstrate the value of the "irrigation effect" from operational load following for enhancing

Table 14. (Continued)

COMMENT NUMBER	IPC RESPONSE
	the vigor of facultative riparian habitats in the river shoreline zones. Therefore, modeled and observed conditions do not correspond to USFS and BLM assertions in this case.
USFS and BLM 29	OP-1(g) applies valid modeling and analytical methods to evaluate how scenario-specific hydrology (e.g., headwater elevations and river flows) would influence changes in the acreage and function of riparian vegetation. IPC's analysis methods and modeling assumptions are justified and valid. GIS was an important tool for analyzing the spatial extent of scenario-induced hydrology relative to existing vegetation cover types in the river and reservoir shorelines. The AIR scenarios do not influence the >86,000-acre crucial winter range zone, which exists upslope of the HCC reservoirs and shoreline zones. Theoretically, additional winter range might become available if the fluctuation zone of Brownlee Reservoir were permanently exposed under Scenario 5. However, it is reasonable to estimate that the fluctuation zone would be colonized by exotic invasive vegetation and provide poor quality winter range. As indicated by the USFS and BLM in Comment 23, invasions of noxious weeds throughout the HCC are inevitable regardless of operational scenario. IPC believes that this inevitability would likewise seriously hamper all efforts, operational or otherwise, to inhibit weed invasions in the Brownlee fluctuation zone upon implementation of Scenario 5. State and federal land management practices are largely ineffective at eliminating noxious weeds on public lands in Hells Canyon. It is reasonable to expect that weed control would be exponentially more difficult on lands that have been denuded of native vegetation by 50 years of repeated inundation. Applying information from technical reports in the FLA, IPC contends that the permanent exposure of over 6,000 acres of barren lands in the Brownlee fluctuation zone would create ideal conditions for invasive weed colonization despite all reasonable and practical restoration efforts. Consequently, IPC considers that the fluctuation zone would be unsuitable big game habitat and would not contribute measurable acres of winter range, even though exposed under Scenario 5. Therefore, the final OP-1(g) response has retained the estimates of impacted acres to crucial big game winter range. Edelmann et al. (2002) reported only 6 impact acres from shoreline erosion downstream of Hells Canyon Dam. Holmstead (2001) stated, "The coarseness of shoreline substrates reduces the potential for shoreline erosion," and "Most shoreline erosion sites were upslope of the average highwater levels." Furthermore, Holmstead (2001) concluded, "Boat-generated waves apparently affect most shoreline erosion sites (58 of 60) (Table 3)." Characteristic flows for *Proposed Operations* and the AIR scenarios were calculated for only the growing season and are all well below the mean annual water level formed by a flow of 20,695 cfs. Therefore, characteristic flows of any scenario would not contact documented erosion sites, and estimating impacts of boat-generated waves is beyond the scope of OP-1(g). Accordingly, it is reasonable to assume that a maximum of only 6 acres would be impacted by shoreline erosion under an AIR scenario. Thus, the final OP-1(g) response does not include individual estimates of shoreline erosion for each AIR scenario. Braatne et al. (2002) state, "This zone located below the mean annual water level is presently barren of vegetation and this pattern would probably continue with either proposed or ROR scenarios." The Full Pool Run-of-River (ROR) operational scenario evaluated by Braatne et al. (2002) reflects a "natural" hydrograph that is free of HCC operational influence. Blair et al. (2002) further states, "Nonetheless, periodically large scouring flows likely limit the lower extent of permanent vegetation on the shoreline slope (Holmstead 2001, Braatne et al. 2002)." The channel area down-slope of the mean annual water level (scour zone) is barren

Table 14. (Continued)

COMMENT NUMBER	IPC RESPONSE
	because high spring runoff flows, which exceed the hydraulic capacity of the HCC, eliminate perennial vegetation through prolonged inundation and scour. Consequently, IPC believes that the mean annual water level is the appropriate down-slope bound for modeling the establishment of perennial vegetation within the river channel downstream of Hells Canyon Dam. Thus, it is reasonable in OP-1(g) to assume that the scour zone downstream of Hells Canyon Dam will be permanently barren under all the AIR scenarios. The final OP-1(g) response retains the mean annual water level as the lowest down-slope extent for perennial riparian vegetation downstream of Hells Canyon Dam. To evaluate the relative patterns and magnitudes of the AIR scenarios, IPC's ecological modeling required certain generalizations and assumptions because site-specific information was not available to make patch-level vegetation projections throughout the study area. Individual vegetation patches of a specific cover type typically occur in areas with similar environmental characteristics including substrate and soil-moisture gradients. Braatne et al. (2002) schematically documented this general pattern as reach-specific vertical zonation of vegetation types along the reservoir and river shorelines. A hydrologic regime would therefore typically influence like cover-type patches uniformly. Specifically, it was assumed that scenario-induced changes to shoreline soil moisture gradients would be more sensitive to differences among the AIR scenarios than to environmental variation of like cover-type patches within a study reach. Projecting patch-level changes in the extent of vegetation was not requested by FERC and beyond the scale of both the Braatne et al. (2002) and Blair et al. (2002) methods. Consequently, IPC generalized the estimates of cover-type change within a relatively homogonous study reach and then summed the estimates for each AIR scenario. This assumption was applied uniformly when analyzing the AIR scenarios and this method provides reasonable estimates for comparing the relative affects among the scenarios. As directed by FERC, the final OP-1(g) response reports acreage changes of cover types for each AIR scenario using methods of Blair et al. (2002).

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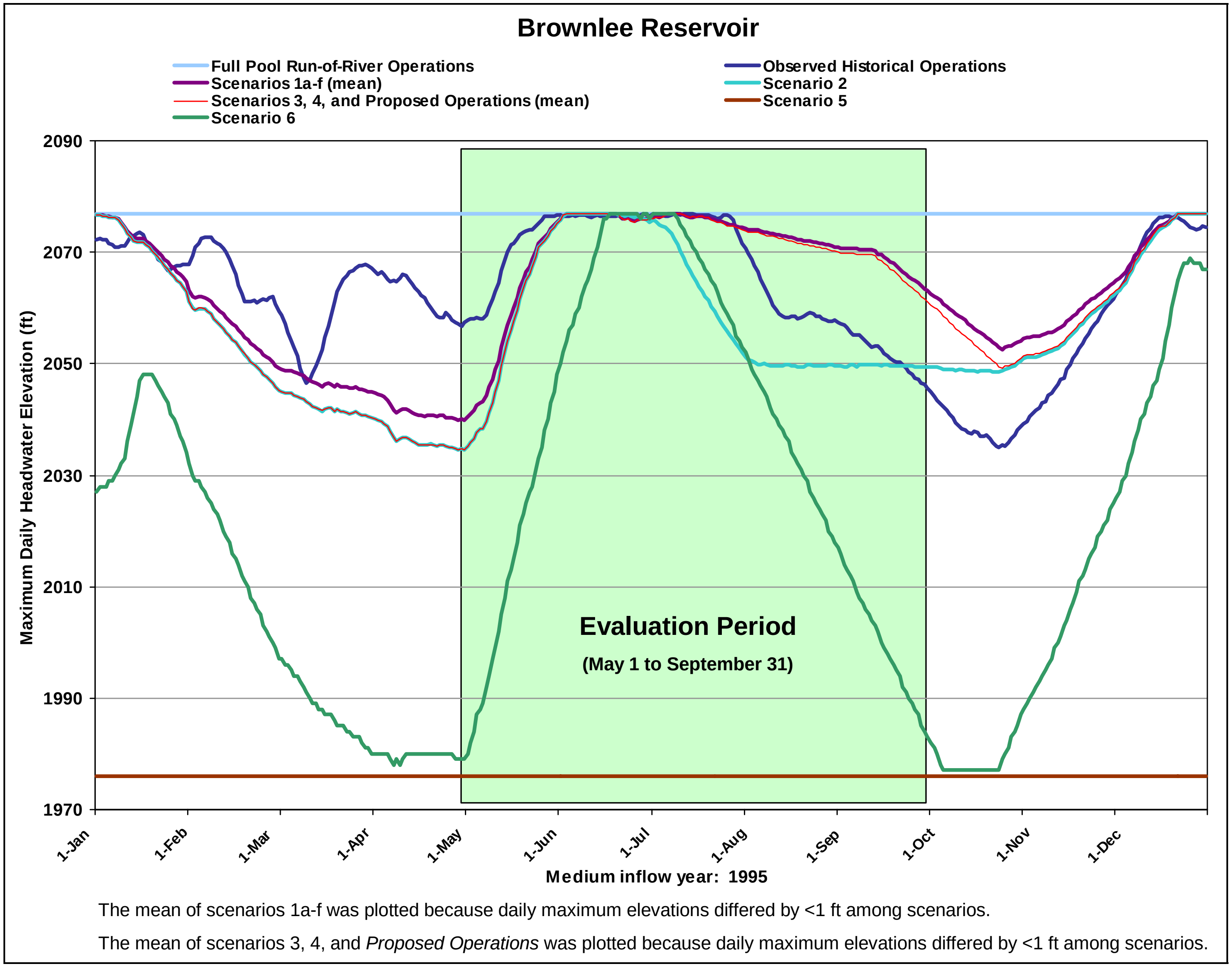

The mean of scenarios 1a-f was plotted because daily maximum elevations differed by <1 ft among scenarios.

The mean of scenarios 3, 4, and *Proposed Operations* was plotted because daily maximum elevations differed by <1 ft among scenarios.

Figure 1. Historically observed and modeled scenario-specific headwater elevations for Brownlee Reservoir during a moderate inflow year, 1995.

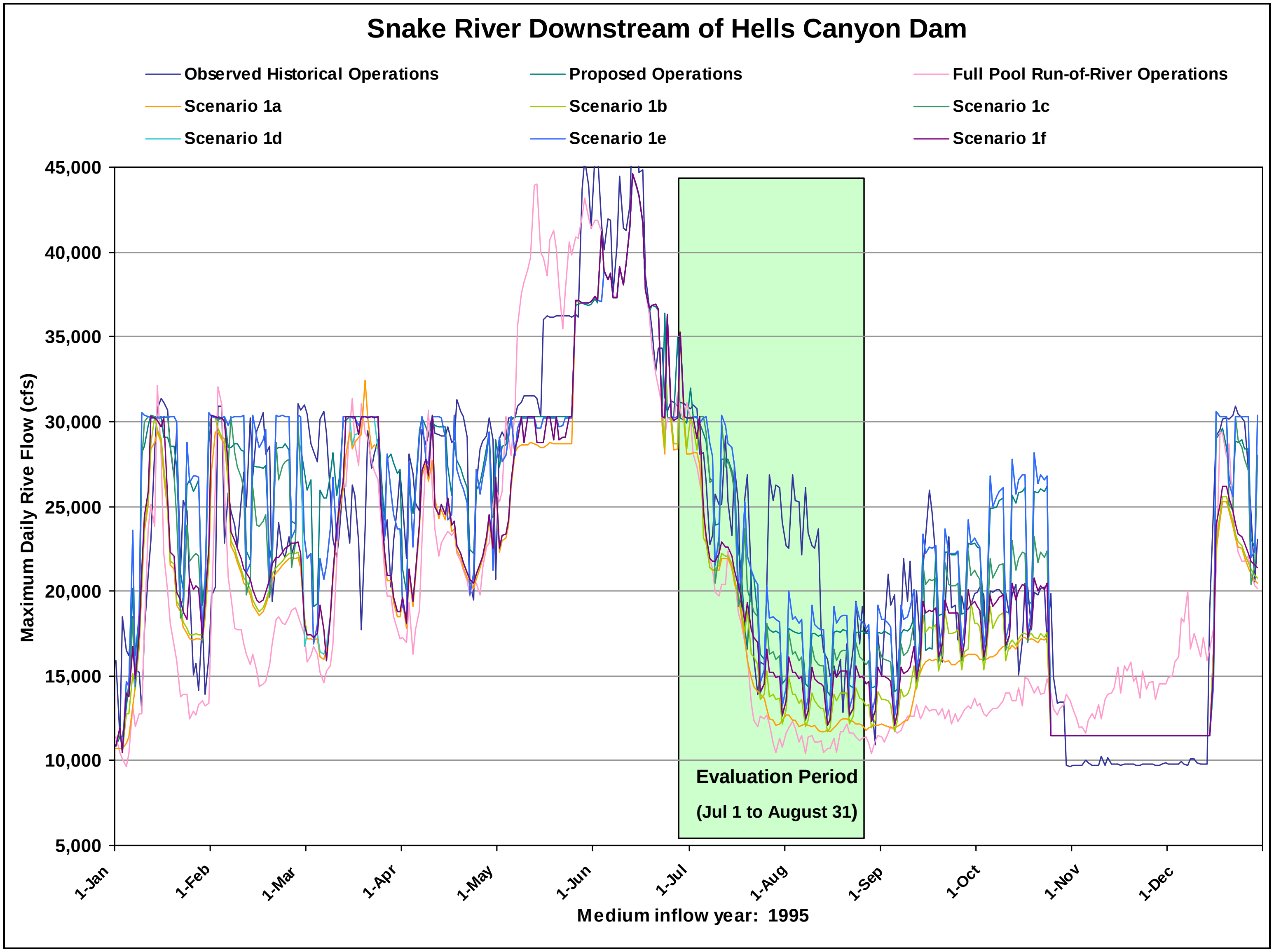

Figure 2a. Historically observed and modeled scenario-specific flows from Hells Canyon Dam during a moderate inflow year, 1995.

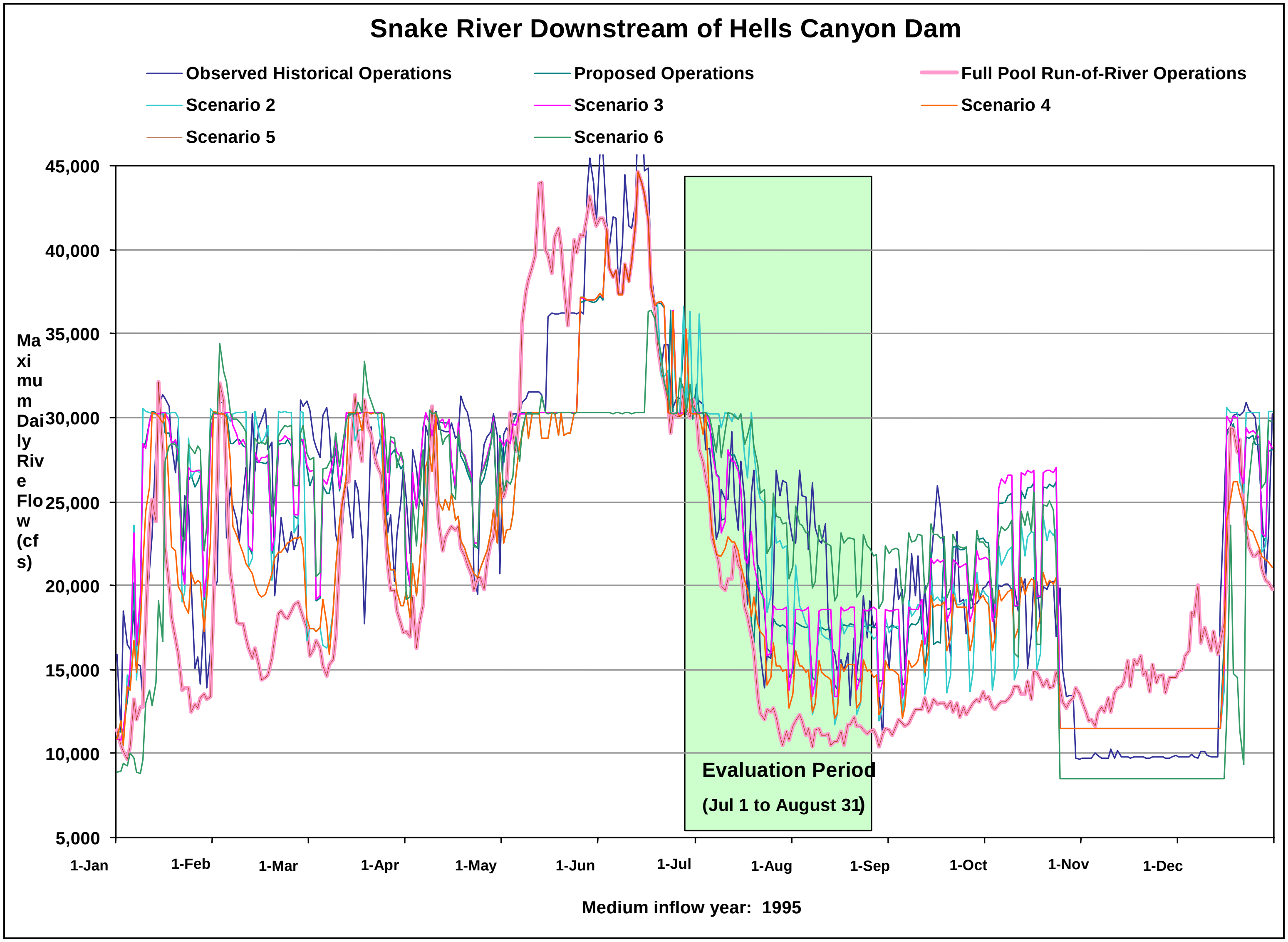

Figure 2b. Historically observed and modeled scenario-specific flows from Hells Canyon Dam during a moderate inflow year, 1995.

Figure 3a. View of the fluctuation zone of Brownlee Reservoir at RM 320, 7 May 1997. Inflows to Brownlee Reservoir are approximately 42,500 cfs, and the reservoir pool level is approximately 1,977.5 ft msl. The upper wave-scour band is visible, with exposed cobble where coarse sediments remain but finer sediments have been eroded. Below the coarsely textured band, the intermediate band has finer surface sediments due to deposition following reservoir impoundment. Much of the riparian area is probably inundated and not visible at this flow. The lowest riparian band would be most readily colonized as it is closest to the perennial water table and the associated capillary fringe.

Figure 3b. View of the fluctuation zone at RM 326, 7 May 1997. Inflows to Brownlee Reservoir are approximately 42,500 cfs, and the reservoir pool level is approximately 1,977.5 ft msl. Because this site is upstream of the other view, the fluctuation zone is less extensive in vertical and horizontal extent. Surface cracking is typical as silts and other fine sediments dry.

Figure 4a. View of Rock Creek and the fluctuation zone of Brownlee Reservoir at RM 320, 7 May 1997. Inflows to Brownlee Reservoir are approximately 42,500 cfs, and the reservoir pool level is approximately 1,977.5 ft msl. Tributary confluences might provide additional areas for the colonization of riparian vegetation. Existing riparian habitats in tributaries would provide propagules of native species for colonizing the fluctuation zone.

Figure 4b. View of the fluctuation zone of Brownlee Reservoir at RM 319, 7 May 1997. Inflows to Brownlee Reservoir are approximately 42,500 cfs, and the reservoir pool level is approximately 1,977.5 ft msl. Expansive flat surfaces are situated only slightly above the current river level with additional moist areas from capillarity. This combination of barren, fine mineral substrate and moisture would result in rapid colonization by native and exotic plants. At the depicted flows, the photograph might inflate the actual availability of moist substrates during the mid- to late growing season, when flows more typically range between 6,000 and 15,000 cfs. The upstream extent of the 1,976-ft pool would begin about one mile downstream of this location.

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Appendix A. Letter from FERC to IPC approving request to apply methods of Blair et al. (2002) to quantify scenario-induced effects on riparian vegetation with qualitative discussions of effects to noxious weeds, nonnative plants, and special status plants. Effects on riparian habitat from changes in sediment transport downstream of Hells Canyon Dam are also qualitatively evaluated.

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FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426
July 23, 2004

OFFICE OF ENERGY PROJECTS

Project No. 1971-079 B Idaho/Oregon
Hells Canyon Project
Idaho Power Company

Mr. Robert W. Stahman
Vice President, Secretary, and General Counsel
Idaho Power Company
P.O. Box 70
Boise, ID 83707

Reference: Summary of Teleconference and Modification of Terrestrial Additional Information Request

Dear Mr. Stahman:

On July 19, 2004, FERC staff conducted a teleconference[1] with Idaho Power Company (IPC) staff to clarify one of the additional information requests required by our letter of May 5, 2004. Specially, IPC requested clarification of request OP-1(g), which requires an analysis of the predicted effects of additional operational scenarios on botanical resources. A summary of the teleconference is enclosed (Enclosure 1).

Based on the discussions and review of the IPC's proposed modifications outlined in the July 20, 2004, e-mail from Craig Jones (see attachment to Enclosure 1), we believe the alternative approach would provide sufficient information for staff to analyze the potential effects of the different operational scenarios on botanical resources. Accordingly, we will modify OP-1(g) as outlined in the July 20, 2004, e-mail.

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[1] The teleconference was conducted under the provisions of the off-the-record communication exemption related to National Environmental Policy Act documentation and prior to the final environmental impact statement [18 CFR 385.2201(e)(1)(vi)]. This letter will serve as a record of the teleconference and the subsequent e-mail from IPC.

If you have any questions, please contact Alan Mitchnick at 202-502-6074, alan.mitchnick@ferc.gov.

Sincerely,

Timothy J. Welch
Chief
Hydro West Branch 2

Enclosure 1: Summary of July 19, 2004, teleconference (with July 20, 2004, e-mail attached)

cc: Public Files
Service List

ENCLOSURE 1

Hells Canyon Hydroelectric Project, FERC No. 1971-079
Teleconference Summary

Date of Teleconference: Monday, July 19, 2004
Notes prepared by: Ellen Hall, The Louis Berger Group, July 21, 2004

Participants:
Alan Mitchnick, FERC
Ellen Hall, The Louis Berger Group
Eileen McLanahan, Meridian Environmental
Craig Jones, Idaho Power Company (IPC)
Gary Holmstead, IPC
Frank Edelman, IPC
Alan Ansell, IPC
Nathan Gardiner, IPC

1. The conference call was held to discuss one of FERC's Additional Information Requests (AIRs) to IPC; specifically, AIR OP-1(g), *Operational Scenarios, Terrestrial Resources.* IPC had indicated to the FERC Team Lead, Alan Mitchnick, that IPC had a problem with the AIR as stated and that IPC proposed a different method for providing information that would be useful to FERC in evaluating impacts to terrestrial resources.

2. Craig Jones indicated that IPC's overarching concern is to provide helpful information to FERC, but to provide it in a different way than specified in the AIR.

3. Frank Edelman explained the problem from IPC's perspective. AIR OP-1(g) refers to the technical analysis described in Technical Report (TR) 3.3-3 and to HC_REM analysis, requesting the same type of information for the 11 cases described in OP-1. The AIR also requests that the information be provided as predicted increases and decreases in the acreage of vegetation in six plant groups. Frank explained that the analysis reported in TR 3.3-3 is very time consuming to do and reports proportional changes, not acreages. Further, IPC has not developed a method for converting the proportional changes to acreages.

4. Frank went on to explain that IPC can provide acreage information for cover types by using the methods described in TR 3.2-40 and summarized in Table 2 of TR 3.2-45. IPC noted that all of the protection, mitigation, and enhancement measures were based on the cover type acreage information. After some discussion, the group agreed that IPC would write up its proposal and email the proposal to Alan Mitchnick (see attached copy).

5. With respect to noxious weeds, non-native plants, and special status plant species, IPC described their proposal, which is to have these issues addressed qualitatively by the consultants who did the initial studies. The consultants will look at the model outputs from CHEOPS and interpret the likely effects, the same as they did for the alternatives addressed in the license application.

6. Eileen asked if IPC would be able to link changes in vegetation to changes they might find in sediment transport, such as increased sandbar erosion, as they develop their response to OP-1(d), *Sediment Transport*, if they were to use the approach now under consideration (i.e., modeling developed for TR E.3.2-40, instead of HC_REM). After some discussion, IPC indicated that they can generate the sediment transport results for OP-1(d), and then have their consultants interpret the results with respect to vegetation. Ellen noted that the scenarios of interest in this regard are those with changes in ramping rates.

7. Eileen expressed concern about whether IPC's proposed approach would provide information on changes in plant group functions that might occur along with changes in the extent of cover types. IPC indicated that descriptions of plant assemblages that occur in each cover type could be used to provide this additional detail. They described the relationship in their responses to comments on the draft license application, and could use a similar approach in this case. Agreement was reached that IPC will provide changes in acreage by cover type and will qualitatively address how species and functions might change by cover type under each scenario.

8. IPC indicated that the sequencing required to respond to several of the elements of OP-1 will likely take more time than FERC provided for AIR responses. Craig indicated that IPC would be requesting more time for their AIR responses. Alan Mitchnick asked if IPC had considered providing the responses incrementally, as each part of the studies is completed. Craig indicated that IPC had not considered that option, but would do so. The concept would be to provide study results to FERC incrementally to show progress toward completion, and would be considered as part of the review for any request for extension of time. Alan Mitchnick indicated that FERC could perhaps issue the Ready for Environmental Analysis (REA) notice before all AIR responses are received if the incrementally provided results provide enough information for the FERC staff to begin its analysis.

9. IPC agreed to summarize their proposal in an e-mail to Alan Mitchnick (see attached). Alan Mitchnick will see to getting this teleconference summary and IPC's proposal entered into the record and distributed as required.

Attachment to Enclosure 1

From: Jones, Craig [mailto:CJones@idahopower.com]
Sent: Tuesday, July 20, 2004 3:57 PM
To: Alan Mitchnick
Subject: Modification of OP-1 (g) Analysis

Dear Alan,

As we discussed during our conference call yesterday, I am forwarding for your consideration a modification to the methodology for providing the FERC with information it is requesting in OP-1 (g). While IPC is going forward with the analysis, IPC continues to maintain that there is not an appropriate nexus between HCC project impacts and the operational scenarios it is being asked to evaluate.

Thank you for your consideration of this modification. As discussed, we believe that the modification will provide the information the FERC is seeking and remain consistent with the analysis included in the FLA.

Please let me know if you have any questions.

Best regards,

Craig

IPC Alternative to provide OP-1 (g) Information

The FERC has requested additional information about the predicted effects of additional operational scenarios on botanical resources associated with the HCC. However, it is not possible to generate the acreages requested by the FERC using the methodology described in E.3.3-3. The modeling approach in Technical Report E.3.3-3 evaluated proportional changes in the relative cover of 6 plant functional groups and did not predict acreages. Moreover, HC_Rem (the modeling tool used to do the E.3.3-3 analysis) is not capable of predicting acreage changes or simulating substrate changes. Instead, IPC proposes to address the FERC request by conducting both qualitative and quantitative additional analyses as described in the following.

IPC requests that the 6 functional groups analyzed in E 3.3-3 be replaced with the 13 cover types (4 riparian and 9 upland) analyzed in E.3.2-40 and summarized in Table 2 of E.3.2-45. Acreage changes in each cover type would be predicted with methods used in E.3.2-40 and would be summarized by reach and operational scenario, similar to Tables 5, 6, 7, 8, and 14 in E.3.2-40. Acreage predictions would be those expected after 30 years of each operational scenario.

In addition, IPC would add detail to the function of cover type predictions by describing potential increases or decreases to various plant assemblages that comprise existing cover types in each project reach. Plant assemblages and cover types occurring in Hells Canyon are described in Technical Report E.3.3-1. IPC would also consult with discipline experts (Dr. J

Braatne and Dr. S. Rood) to qualitatively assess potential vegetation changes that may occur under the additional operational scenarios. The assessments will consider life history strategies of key species comprising plant assemblages and cover types, and potential changes in erosion, deposition, and sediment transport as identified in AIR OP-1 (d).

IPC also proposes to qualitatively assess, with Dr. J Braatne and Dr. S. Rood, the effects of the additional operational scenarios on noxious weeds, non-native plants, and special status plants. Methods of E.3.3-3 would be used to qualitatively predict and evaluate the abundance and distribution of the focal species for each of these plant groups.

As mentioned during the conference call, IPC estimates that the large number of operational scenarios, time required to generate the datasets, and subsequent dependencies/sequencing of data for analyses will require more than nine months currently provided to complete the AIR. Specifically, cover-type analyses will require extensive CHEOPS modeling, MIKE 11 modeling, GIS spatial analyses, and OP-1 (d) substrate integration. A final report must then be prepared, edited, and submitted for consultation review prior to filing it with the FERC.

Therefore, IPC will be requesting an extension of time to complete this AIR, along with several others that IPC had objected to completing, and reasons the extensions are necessary in a forthcoming letter to the FERC.

Appendix B. The following definitions are provided for the land use/land cover types used by Idaho Power Company. Wetland cover types generally follow the classification system described by Cowardin et al. (1979) and modified for Habitat Evaluation Procedures (HEP) (USFWS 1980). Upland cover types generally follow the classification system used for HEP cover types as outlined in USFWS (1980).

Emergent Herbaceous Wetland—is dominated by erect, rooted, herbaceous hydrophytes excluding mosses and lichens. This cover type is only found in the riparian zone and vegetation is present for most of the growing season in most years and is usually dominated by perennial plants. It has less than 30% cover of woody vegetation and a total vegetation cover of at least 30%. The lands in this cover type are usually saturated with or covered by water at least for part of the growing season. However, because of the difficulties in distinguishing between species and interpreting hydrologic indicators during remote sensing activities, some lands in this cover type may be dominated by upland species (FAC, FAC-, and UPL hydrologic indicator status) and in areas without the necessary hydrologic regime to be considered "jurisdictional wetlands" by the U.S. Army Corps of Engineers. Actual extent of "wetland" boundaries are not indicated on cover type maps and must be determined on the ground through formal wetland delineation techniques.

Shore and Bottomland Wetland—may consist of bare sand, gravel, or rocky areas along the riparian zone. If vegetation is present, its cover is less than 30%. Examples of this cover type include Rock Bottom, Unconsolidated Bottom, Streambed, Rocky Shore, and Unconsolidated Shore, as defined by Cowardin (1979). Actual extent of jurisdictional "wetland" boundaries are not indicated on cover type maps and must be determined on the ground through formal wetland delineation techniques.

Scrub-Shrub Wetland—is dominated by woody wetland vegetation less than 6 m (20 feet) tall in the riparian zone. It has a total vegetation cover of at least 30% and at least 30% cover of woody vegetation. Because of the difficulties in distinguishing between species and interpreting hydrologic indicators during remote sensing activities, some lands in this cover type are dominated by upland species (FAC, FAC-, and UPL hydrologic indicator status) and in areas without the necessary hydrologic regime to be considered "jurisdictional wetlands" by the U.S. Army Corps of Engineers. Actual extent of "wetland" boundaries are not indicated on cover type maps and must be determined on the ground through formal wetland delineation techniques.

Forested Wetland—is dominated by woody wetland vegetation that is 6 m (20 feet) tall or taller in the riparian zone. It has a total vegetation cover of at least 30%, at least 30% cover of woody vegetation, and at least 30% cover of trees (≥6 m tall). Because of the difficulties in distinguishing between species and interpreting hydrologic indicators during remote sensing activities, some lands in this cover type are dominated by upland species (FAC, FAC-, and UPL hydrologic indicator status) and in areas without the necessary hydrologic regime to be considered "jurisdictional wetlands" by the U.S. Army Corps of Engineers. Actual extent of "wetland" boundaries are not indicated on cover type maps and must be determined on the ground through formal wetland delineation techniques.

Lentic (Standing Water)—is non-moving open water habitat such as ponds and lakes.

Lotic (Moving Water)—is moving open water habitat such as rivers and streams.

Forested Upland—is dominated by trees (taller than 5 m) and has a tree canopy cover of at least 25%.

Shrubland—an upland vegetation community, dominated by shrubs (including small trees shorter than 5 m) and has a shrub canopy cover of at least 25%. Total vegetation cover is greater than 25%.

Tree Savanna—an upland community, with a canopy cover of trees (taller than 5 m) between 5% and 25%. Total vegetation cover is at least 25%. The area between trees is typically dominated by grasses or other herbaceous vegetation.

Shrub Savanna—an upland community, with a canopy cover of shrubs (including small trees shorter than 5 m) between 5% and 25%. This cover type has a total vegetation cover of at least 25%. The area between shrubs is typically dominated by grasses or other herbaceous vegetation.

Desertic Woodland—an upland community, with 1-25% total vegetation cover and trees (taller than 5 m) forming the dominant vegetation stratum. It includes sparsely vegetated types in non-desert areas.

Desertic Shrubland—an upland community, with 1-25% total vegetation cover and shrubs (and small trees shorter than 5 m) forming the dominant vegetation stratum. This cover type includes sparsely vegetated habitats in non-desert areas.

Desertic Herbland—an upland community with 1-25% total vegetation cover, and non-woody plants (including lichens and mosses) forming the dominant vegetation stratum. It includes sparsely vegetated types in non-desert areas.

Grassland—an upland community with a total vegetation cover of at least 25%, and dominated by non-woody plants (including lichens and mosses), of which grasses (native or introduced) are dominant. This cover type may include prairies, rangeland, and upland subalpine meadows.

Forbland—an upland community with a total vegetation cover of at least 25%, and dominated by non-woody plants (including lichens and mosses), of which forbs (native or introduced) are dominant. This cover type includes many weedy fields, old fields, and other types in early successional stages.

Barrenland (e.g. Sand Dunes)—is an undisturbed (by direct human influence) upland area that has a total vegetation cover of 5% or less.

Cliff/Talus Slope—consists of nearly vertical rock or bare soil faces, or slopes of unconsolidated rock material with a total vegetation cover of 5% or less.

Disturbed—is land with more than 50% of the area disturbed by human activities and has a total vegetation cover of less than 15%. This cover type may include off-road vehicle areas, rural trash dumps, and soil borrow pits.

Agriculture (Cultivated)—land that is principally used for the production of agricultural crops or products.

Grazing Land/Pasture—land that is principally used for pasture or grazing of domestic livestock.

Urban—land that is principally located in a city and pertaining to city life (i.e. small business buildings and facilities).

Residential—land that is principally associated with human housing. This cover type may include homes, garages, yards, gardens, sidewalks, driveways, and small livestock pens and pastures (1-2 acres).

Industrial—land that is principally used for larger businesses and corporations such as office complexes, manufacturing plants, and warehouses.

Parks/Recreation—cultivated landscape that is principally used for human recreation such as city and county parks, roadside rest areas and picnic areas.

Roads—consists of roadways for vehicle travel including major freeways and highways, local paved roads, improved gravel and dirt roads. This cover type may be mapped as a linear feature rather than a polygon.

Forested/Orchard—is artificially planted and cultivated trees for the production of fruit or nut crops, or timber.

Appendix C. Plant assemblages in the shoreline zone of each HCC reach (Holmstead 2001).

Appendix C1. Percentage of *Scrub-Shrub Wetland* plant assemblages within each reach and total number of vegetation plots sampled.

Scrub-Shrub Wetland	**Weiser Reach**	**Brownlee Headwaters**	**Lower Brownlee**	**Powder River**	**Oxbow Reservoir**	**Hells Canyon Reservoir**	**Below HC Dam**
Number of plots	56	55	57	7	16	43	41
Black cottonwood			1.8				
Common chokecherry			3.5		12.5	9.3	
Coyote willow	1.8	9.1	8.8	42.9	12.5		14.6
Coyote willow/hemp dogbane	12.5					2.3	2.4
Coyote willow-Wood’s rose	7.1	3.6					
Dog rose		1.8	1.8				
False indigo	1.8	14.6	36.8			11.6	
False indigo/hemp dogbane	7.1						
False indigo-coyote willow	1.8		14.0			2.3	
Hackberry		1.8	8.8				
Hackberry-poison ivy			1.8			18.6	75.6
Himalayan blackberry			1.8		12.5	23.3	
Peachleaf willow-coyote willow	32.1	29.1	1.8	28.6			
Peachleaf willow-Wood’s rose	3.6	1.8					
Poison ivy			12.3		37.5	11.6	7.3
Red osier dogwood					6.3		
Russian olive	3.6	1.8					
Siberian elm	1.8					2.3	
Syringa					18.8	11.6	
Saltcedar	5.4	12.7	1.8				
Saltcedar/common cocklebur	1.8	1.8	1.8				
Saltcedar/western goldenrod	12.5	7.3					
Saltcedar-coyote willow	5.4						
Virgins bower		1.8	1.8			2.3	
Wood’s rose		1.8		14.3			
Wood’s rose-golden currant	1.8	10.9	1.8	14.3		4.7	

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Appendix C2. Percentage of *Emergent Herbaceous Wetland* plant assemblages within each reach and total number of vegetation plots sampled.

Emergent Herbaceous Wetland	**Weiser Reach**	**Brownlee Headwaters**	**Lower Brownlee**	**Powder River**	**Oxbow Reservoir**	**Hells Canyon Reservoir**	**Below HC Dam**
Number of plots	110	77	23	21	13	11	29
Alkali saltgrass	11.8	6.5		4.8			
American licorice	0.9		4.4			9.1	20.7
Broadleaf pepperweed	23.6	7.8	47.8		46.2		
Broadleaf pepperweed-poison hemlock	9.1	5.2		4.8	15.4		
Common cattail			4.4			9.1	
Common cocklebur	5.5	26.0	8.7			36.4	17.2
Creeping spike-rush				14.3	7.7		
Hemp dogbane	15.5	3.9					13.8
Marsh grass	8.2	26.0		38.1			
Mixed herbaceous						18.2	3.5
Prairie cordgrass	0.9						6.9
Purple loosestrife-mixed herbaceous	12.7	18.2	4.4	14.3		9.1	6.9
Purslane	5.5	3.9	4.4			9.1	
Reed canarygrass	1.8	1.3	8.7	23.8			
Seacoast bulrush	0.9	1.3					
Smooth scouring rush	2.7		4.4			9.1	3.5
Teasel			13.0		7.7		
Water smartweed (*Polygonum amphibium*)							3.5
Water smartweed (*Polygonum coccineum*)							24.1
Yellow flag iris	0.9				23.1		

Appendix C3. Proportion of *Forested Wetland* plant assemblages within each reach and total number of vegetation plots sampled.

Forested Wetland	**Weiser Reach**	**Brownlee Headwaters**	**Lower Brownlee**	**Powder River**	**Oxbow Reservoir**	**Hells Canyon Reservoir**	**Below HC Dam**
Number of plots	51	13	3	4	10	16	3
Black cottonwood					10.0		
Black cottonwood/syringa						6.3	
Black locust			33.3				
Boxelder	9.8						
Coyote willow/Wood’s rose	9.8	7.7					
Great Plains cottonwood		15.4	33.3				
Hackberry	2.0	7.7			30.0	12.5	100.0
Hackberry/Himalayan blackberry						12.5	
Peachleaf willow	17.7	17.7		25.0			
Russian olive	11.8						
Siberian elm		7.7			10.0	43.8	
Silver maple	37.2						
Saltcedar		15.4					
White alder/hackberry			33.3		10.0	12.5	
White alder/poison ivy					20.0	12.5	
White alder/syringa					20.0		
White willow				75.0			
White willow/Wood’s rose	11.8						

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Appendix C4. Percentage of *Shore and Bottomland Wetland* plant assemblages within each reach and total number of vegetation plots sampled.

Shore and Bottomland Wetland	**Weiser Reach**	**Brownlee Headwaters**	**Lower Brownlee**	**Powder River**	**Oxbow Reservoir**	**Hells Canyon Reservoir**	**Below HC Dam**
Number of plots	3	8	11	7	0	3	23
Yellow nut sedge	66.7	12.5					
Common cocklebur			54.6				
Eaton’s aster						33.3	26.1
Hemp dogbane							4.4
Mixed herbaceous			9.1			33.3	
Netleaf hackberry						33.3	52.2
Purslane	33.3	75.0	27.3	100.0			4.4
Salix exigua		12.5					13.0
Showy milkweed			9.1				

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Appendix C5. Percentage of *Desertic Herbland* plant assemblages within each reach and total number of vegetation plots sampled.

Desertic Herbland	**Weiser Reach**	**Brownlee Headwaters**	**Lower Brownlee**	**Powder River**	**Oxbow Reservoir**	**Hells Canyon Reservoir**	**Below HC Dam**
Number of plots	0	9	8	0	1	2	2
Blue Mountain eriogonum/cheatgrass		22.2	12.5				
Desert alyssum/cheatgrass		33.3					
Gray's lomatium/cheatgrass		11.1	50.0		100.0		
Heart-leaved buckwheat/cheatgrass		33.3	12.5				
Mixed herbaceous			25.0			100.0	100.0

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Appendix C6. Percentage of *Desertic Shrubland* plant assemblages within each reach and total number of vegetation plots sampled.

Desertic Shrubland	**Weiser Reach**	**Brownlee Headwaters**	**Lower Brownlee**	**Powder River**	**Oxbow Reservoir**	**Hells Canyon Reservoir**	**Below HC Dam**
Number of plots	1	1	1	0	0	1	0
Big sagebrush/bulbous bluegrass	100.0						
Bitterbrush/cheatgrass		100.0	100.0			100.0	

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Appendix C7. Percentage of *Shrubland* plant assemblages within each reach and total number of vegetation plots sampled.

Shrubland	**Weiser Reach**	**Brownlee Headwaters**	**Lower Brownlee**	**Powder River**	**Oxbow Reservoir**	**Hells Canyon Reservoir**	**Below HC Dam**
Number of plots	2	7	28	0	5	23	11
Big sagebrush			57.1		40.0	4.4	9.1
Big sagebrush-gray rabbitbrush	100.0	57.1	25.0				
Bitterbrush			10.7		60.0	43.5	
Common snowberry-serviceberry						13.0	
Curl leaf mountain mahogany						4.4	
Greasewood		14.3					
Matrimony vine		14.3					
Netleaf hackberry		14.3	7.1			34.8	90.9

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Appendix C8. Percentage of *Shrub Savanna* plant assemblages within each reach and total number of vegetation plots sampled.

Shrub Savanna	**Weiser Reach**	**Brownlee Headwaters**	**Lower Brownlee**	**Powder River**	**Oxbow Reservoir**	**Hells Canyon Reservoir**	**Below HC Dam**
Number of plots	2	22	39	1	9	25	13
Big sagebrush/bulbous bluegrass-bluebunch wheatgrass			11.5				
Big sagebrush/annual brome		4.6	38.5				
Bitterbrush/arrowleaf balsamroot/bluebunch wheatgrass			5.1			8.0	
Bitterbrush/bluebunch wheatgrass			5.1			24.0	
Bitterbrush/cheatgrass		9.1	2.6		77.8	44.0	7.7
Gray rabbitbrush/cheatgrass	100.0	86.4	23.1	100.0			
Netleaf hackberry/bluebunch wheatgrass-annual brome			18.0		22.2	24.0	92.3
Stiff sagebrush/Sandberg bluegrass			5.1				

Appendix C9. Percentage of *Tree Savanna* plant assemblages within each reach and total number of vegetation plots sampled.

Tree Savanna	**Weiser Reach**	**Brownlee Headwaters**	**Lower Brownlee**	**Powder River**	**Oxbow Reservoir**	**Hells Canyon Reservoir**	**Below HC Dam**
Number of plots	0	0	0	0	0	2	5
Common snowberry-serviceberry						50.0	
Netleaf hackberry							60.0
Ponderosa pine						50.0	40.0

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Appendix C10. Percentage of *Forbland* plant assemblages within each reach and total number of vegetation plots sampled.

Forbland	**Weiser Reach**	**Brownlee Headwaters**	**Lower Brownlee**	**Powder River**	**Oxbow Reservoir**	**Hells Canyon Reservoir**	**Below HC Dam**
Number of plots	3	10	11	1	5	8	10
Arrowleaf balsomroot/bluegrass wheatgrass-cheatgrass	33.3	20.0			60.0	75.0	100.0
Green pigweed		30.0	9.1				
Green pigweed/purslane		10.0		100.0			
Madwort/bulbous bluegrass			27.3			12.5	
Mixed herbaceous/cheatgrass		30.0	27.3		40.0	12.5	
Puncturevine		10.0					
Russian knapweed-goosegrass	66.7						
White sweetclover/Japanese brome			18.2				

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Appendix C11. Percentage of *Forested Upland* plant assemblages within each reach and total number of vegetation plots sampled.

Forested Upland	**Weiser Reach**	**Brownlee Headwaters**	**Lower Brownlee**	**Powder River**	**Oxbow Reservoir**	**Hells Canyon Reservoir**	**Below HC Dam**
Number of plots	0	0	2	0	3	12	1
Black locust			50.0			8.3	
Douglas fir/common snowberry					33.3	50.0	
Grand fir/rocky mountain maple-globe huckleberry						8.3	
Ponderosa pine/common snowberry			50.0		66.7	25.0	100.0
White mulberry						8.3	

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Appendix C12. Percentage of *Grassland* plant assemblages within each reach and total number of vegetation plots sampled.

Grassland	**Weiser Reach**	**Brownlee Headwaters**	**Lower Brownlee**	**Powder River**	**Oxbow Reservoir**	**Hells Canyon Reservoir**	**Below HC Dam**
Number of plots	5	9	27	2	2	14	21
Bluebunch wheatgrass			37.0		50.0	64.3	9.5
Bulbous bluegrass-cheatgrass	20.0	22.2	14.8				
Cheatgrass	60.0	22.2	7.4			14.3	19.1
Cheatgrass-bluebunch wheatgrass		55.6				7.1	57.1
Idaho fescue-bluebunch wheatgrass			18.5			7.1	14.3
Meadow fescue-quackgrass	20.0			100.0			
Medusahead wildrye			22.2		50.0	7.1	

Appendix D. Summary of estimated acres impacted by proposed operations and 11 operational scenarios for the HCC. Table is reproduced from Edelmann et al. (2002) for Proposed Operations compared with Full Pool Run-of-River Operations.

Impact Zone	**Area of Impact Zone (Acres)**	**Proportion of Zone Impacted**	**Impact Acres**
***Proposed Operations* compared with *Full Pool Run-of-River Operations* with analytical methods from Blair et al. (2002)**			
Brownlee Reservoir Inundation Zone	4,072	0.0%	0
Reservoir Fluctuation Zones (Brownlee, Oxbow, and Hells Canyon)			
Riparian wildlife habitat	388	100.0%	388
Upland wildlife habitat	5,761	100.0%	5,761
Brownlee Reservoir low-elevation winter range (upland habitat)	5,820	10.0%	582
Reservoir Shoreline Zones			
Brownlee riparian habitat	3,296	10.4%	343
Oxbow and Hells Canyon riparian habitat	1,570	0.0%	0
Soil erosion	4,866	1.7%	84
Crucial Winter Range Zone	86,408	19.0%	16,418
River Shoreline Zones			
River riparian habitat	3,435	0.0%	0
Soil erosion	3,435	0.2%	6
Total			23,582
***Proposed Operations* compared with existing conditions with analytical methods from Blair et al. (2002)**			
Brownlee Reservoir Inundation Zone	4,072	0.0%	0
Reservoir Fluctuation Zones (Brownlee, Oxbow, and Hells Canyon)			
Riparian wildlife habitat	388	100.0%	388
Upland wildlife habitat	5,761	100.0%	5,761
Brownlee Reservoir low-elevation winter range (upland habitat)	5,820	10.0%	582
Reservoir Shoreline Zones			
Brownlee riparian habitat	3,296	0.0%	0
Oxbow and Hells Canyon riparian habitat	1,570	0.0%	0
Soil erosion	4,866	1.7%	84
Crucial Winter Range Zone	86,408	19.0%	16,418
River Shoreline Zones			
River riparian habitat	3,435	0.2%	7
Soil erosion	3,435	0.2%	6
Total			23,246

Impact Zone	Area of Impact Zone (Acres)	Proportion of Zone Impacted	Impact Acres
***Proposed Operations* compared with existing conditions with analytical methods refined for the AIR scenarios**			
Brownlee Reservoir Inundation Zone	4,072	0.0%	0
Reservoir Fluctuation Zones (Brownlee, Oxbow, and Hells Canyon)			
Riparian wildlife habitat	388	100.0%	388
Upland wildlife habitat	5,761	100.0%	5,761
Brownlee Reservoir low-elevation winter range (upland habitat)	5,820	10.0%	582
Reservoir Shoreline Zones			
Brownlee riparian habitat	3,296	0.0%	0
Oxbow and Hells Canyon riparian habitat	1,570	<0.1%	1
Soil erosion	4,866	1.7%	84
Crucial Winter Range Zone	86,408	19.0%	16,418
River Shoreline Zones			
River riparian habitat	3,435	0.4%	15
Soil erosion	3,435	0.2%	6
Total			23,255
***Full Pool Run-of-River Operations* compared with existing conditions with analytical methods from Blair et al. (2002)**			
Brownlee Reservoir Inundation Zone	4,072	0.0%	0
Reservoir Fluctuation Zones (Brownlee, Oxbow, and Hells Canyon)			
Riparian wildlife habitat	388	100.0%	388
Upland wildlife habitat	5,761	100.0%	5,761
Brownlee Reservoir low-elevation winter range (upland habitat)	5,820	10.0%	582
Reservoir Shoreline Zones			
Brownlee riparian habitat	3,296	10.4%	+343
Oxbow and Hells Canyon riparian habitat	1,570	0.0%	0
Soil erosion	4,866	1.7%	84
Crucial Winter Range Zone	86,408	19.0%	16,418
River Shoreline Zones			
River riparian habitat	3,435	0.5%	16
Soil erosion	3,435	0.2%	6
Total			22,912

Impact Zone	Area of Impact Zone (Acres)	Proportion of Zone Impacted	Impact Acres
***Full Pool Run-of-River Operations* compared with existing conditions with analytical methods refined for the AIR scenarios**			
Brownlee Reservoir Inundation Zone	4,072	0.0%	0
Reservoir Fluctuation Zones (Brownlee, Oxbow, and Hells Canyon)			
Riparian wildlife habitat	388	100.0%	388
Upland wildlife habitat	5,761	100.0%	5,761
Brownlee Reservoir low-elevation winter range (upland habitat)	5,820	10.0%	582
Reservoir Shoreline Zones			
Brownlee riparian habitat	3,296	10.4%	+343
Oxbow and Hells Canyon riparian habitat	1,570	0.0%	0
Soil erosion	4,866	1.7%	84
Crucial Winter Range Zone	86,408	19.0%	16,418
River Shoreline Zones			
River riparian habitat	3,435	1.0%	35
Soil erosion	3,435	0.2%	6
Total			22,931
Scenario 1a compared with existing conditions with analytical methods refined for the AIR scenarios			
Brownlee Reservoir Inundation Zone	4,072	0.0%	0
Reservoir Fluctuation Zones (Brownlee, Oxbow, and Hells Canyon)			
Riparian wildlife habitat	388	100.0%	388
Upland wildlife habitat	5,761	100.0%	5,761
Brownlee Reservoir low-elevation winter range (upland habitat)	5,820	10.0%	582
Reservoir Shoreline Zones			
Brownlee riparian habitat	3,296	0.0%	0
Oxbow and Hells Canyon riparian habitat	1,570	<0.1%	1
Soil erosion	4,866	1.7%	84
Crucial Winter Range Zone	86,408	19.0%	16,418
River Shoreline Zones			
River riparian habitat	3,435	0.9%	30
Soil erosion	3,435	0.2%	6
Total			23,270

Impact Zone	Area of Impact Zone (Acres)	Proportion of Zone Impacted	Impact Acres
Scenario 1b compared with existing conditions with analytical methods refined for the AIR scenarios			
Brownlee Reservoir Inundation Zone	4,072	0.0%	0
Reservoir Fluctuation Zones (Brownlee, Oxbow, and Hells Canyon)			
Riparian wildlife habitat	388	100.0%	388
Upland wildlife habitat	5,761	100.0%	5,761
Brownlee Reservoir low-elevation winter range (upland habitat)	5,820	10.0%	582
Reservoir Shoreline Zones			
Brownlee riparian habitat	3,296	0.0%	0
Oxbow and Hells Canyon riparian habitat	1,570	0.1%	2
Soil erosion	4,866	1.7%	84
Crucial Winter Range Zone	86,408	19.0%	16,418
River Shoreline Zones			
River riparian habitat	3,435	0.8%	27
Soil erosion	3,435	0.2%	6
Total			23,268
Scenario 1c compared with existing conditions with analytical methods refined for the AIR scenarios			
Brownlee Reservoir Inundation Zone	4,072	0.0%	0
Reservoir Fluctuation Zones (Brownlee, Oxbow, and Hells Canyon)			
Riparian wildlife habitat	388	100.0%	388
Upland wildlife habitat	5,761	100.0%	5,761
Brownlee Reservoir low-elevation winter range (upland habitat)	5,820	10.0%	582
Reservoir Shoreline Zones			
Brownlee riparian habitat	3,296	0.0%	0
Oxbow and Hells Canyon riparian habitat	1,570	0.1%	2
Soil erosion	4,866	1.7%	84
Crucial Winter Range Zone	86,408	19.0%	16,418
River Shoreline Zones			
River riparian habitat	3,435	0.5%	18
Soil erosion	3,435	0.2%	6
Total			23,259

Impact Zone	Area of Impact Zone (Acres)	Proportion of Zone Impacted	Impact Acres
Scenario 1d compared with existing conditions with analytical methods refined for the AIR scenarios			
Brownlee Reservoir Inundation Zone	4,072	0.0%	0
Reservoir Fluctuation Zones (Brownlee, Oxbow, and Hells Canyon)			
Riparian wildlife habitat	388	100.0%	388
Upland wildlife habitat	5,761	100.0%	5,761
Brownlee Reservoir low-elevation winter range (upland habitat)	5,820	10.0%	582
Reservoir Shoreline Zones			
Brownlee riparian habitat	3,296	0.0%	0
Oxbow and Hells Canyon riparian habitat	1,570	0.1%	2
Soil erosion	4,866	1.7%	84
Crucial Winter Range Zone	86,408	19.0%	16,418
River Shoreline Zones			
River riparian habitat	3,435	0.4%	14
Soil erosion	3,435	0.2%	6
Total			23,255
Scenario 1e compared with existing conditions with analytical methods refined for the AIR scenarios			
Brownlee Reservoir Inundation Zone	4,072	0.0%	0
Reservoir Fluctuation Zones (Brownlee, Oxbow, and Hells Canyon)			
Riparian wildlife habitat	388	100.0%	388
Upland wildlife habitat	5,761	100.0%	5,761
Brownlee Reservoir low-elevation winter range (upland habitat)	5,820	10.0%	582
Reservoir Shoreline Zones			
Brownlee riparian habitat	3,296	0.0%	0
Oxbow and Hells Canyon riparian habitat	1,570	0.1%	2
Soil erosion	4,866	1.7%	84
Crucial Winter Range Zone	86,408	19.0%	16,418
River Shoreline Zones			
River riparian habitat	3,435	0.4%	14
Soil erosion	3,435	0.2%	6
Total			23,255

Impact Zone	Area of Impact Zone (Acres)	Proportion of Zone Impacted	Impact Acres
Scenario 1f compared with existing conditions with analytical methods refined for the AIR scenarios			
Brownlee Reservoir Inundation Zone	4,072	0.0%	0
Reservoir Fluctuation Zones (Brownlee, Oxbow, and Hells Canyon)			
Riparian wildlife habitat	388	100.0%	388
Upland wildlife habitat	5,761	100.0%	5,761
Brownlee Reservoir low-elevation winter range (upland habitat)	5,820	10.0%	582
Reservoir Shoreline Zones			
Brownlee riparian habitat	3,296	0.0%	0
Oxbow and Hells Canyon riparian habitat	1,570	0.1%	2
Soil erosion	4,866	1.7%	84
Crucial Winter Range Zone	86,408	19.0%	16,418
River Shoreline Zones			
River riparian habitat	3,435	0.7%	23
Soil erosion	3,435	0.2%	6
Total			23,264
Scenario 2 compared with existing conditions with analytical methods refined for the AIR scenarios			
Brownlee Reservoir Inundation Zone	4,072	0.0%	0
Reservoir Fluctuation Zones (Brownlee, Oxbow, and Hells Canyon)			
Riparian wildlife habitat	388	100.0%	388
Upland wildlife habitat	5,761	100.0%	5,761
Brownlee Reservoir low-elevation winter range (upland habitat)	5,820	10.0%	582
Reservoir Shoreline Zones			
Brownlee riparian habitat	3,296	0.0%	0
Oxbow and Hells Canyon riparian habitat	1,570	0.1%	2
Soil erosion	4,866	1.7%	84
Crucial Winter Range Zone	86,408	19.0%	16,418
River Shoreline Zones			
River riparian habitat	3,435	<0.1%	2
Soil erosion	3,435	0.2%	6
Total			23,243

Impact Zone	Area of Impact Zone (Acres)	Proportion of Zone Impacted	Impact Acres
Scenario 3 compared with existing conditions with analytical methods refined for the AIR scenarios			
Brownlee Reservoir Inundation Zone	4,072	0.0%	0
Reservoir Fluctuation Zones (Brownlee, Oxbow, and Hells Canyon)			
Riparian wildlife habitat	388	100.0%	388
Upland wildlife habitat	5,761	100.0%	5,761
Brownlee Reservoir low-elevation winter range (upland habitat)	5,820	10.0%	582
Reservoir Shoreline Zones			
Brownlee riparian habitat	3,296	0.0%	0
Oxbow and Hells Canyon riparian habitat	1,570	0.1%	2
Soil erosion	4,866	1.7%	84
Crucial Winter Range Zone	86,408	19.0%	16,418
River Shoreline Zones			
River riparian habitat	3,435	0.4%	13
Soil erosion	3,435	0.2%	6
Total			23,254

Impact Zone	Acres of Impact Zone	Proportion of Zone Impacted	Impact Acres
Scenario 4 compared with existing conditions with analytical methods refined for the AIR scenarios			
Brownlee Reservoir Inundation Zone	4,072	0.0%	0
Reservoir Fluctuation Zones (Brownlee, Oxbow, and Hells Canyon)			
Riparian wildlife habitat	388	100.0%	388
Upland wildlife habitat	5,761	100.0%	5,761
Brownlee Reservoir low-elevation winter range (upland habitat)	5,820	10.0%	582
Reservoir Shoreline Zones			
Brownlee riparian habitat	3,296	0.0%	0
Oxbow and Hells Canyon riparian habitat	1,570	0.1%	2
Soil erosion	4,866	1.7%	84
Crucial Winter Range Zone	86,408	19.0%	16,418
River Shoreline Zones			
River riparian habitat	3,435	0.7%	23
Soil erosion	3,435	0.2%	6
Total			23,264

Impact Zone	Area of Impact Zone (Acres)	Proportion of Zone Impacted	Impact Acres
Scenario 5 compared with existing conditions with analytical methods refined for the AIR scenarios			
Reservoir Fluctuation Zones (Brownlee, Oxbow, and Hells Canyon)			
Riparian wildlife habitat	388	100.0%	388
Upland wildlife habitat	5,761	100.0%	5,761
Brownlee Reservoir low-elevation winter range (upland habitat)	5,820	10.0%	582
Reservoir Shoreline Zones			
Brownlee riparian habitat	3,296	8.0%	261
Oxbow and Hells Canyon riparian habitat	1,570	0.0%	0
Soil erosion	4,866	1.7%	84
Crucial Winter Range Zone	86,408	19.0%	16,418
River Shoreline Zones			
River riparian habitat	3,435	1.0%	35
Soil erosion	3,435	0.2%	6
Total			23,535
Scenario 6 compared with existing conditions With analytical methods refined for the AIR scenarios			
Reservoir Fluctuation Zones (Brownlee, Oxbow, and Hells Canyon)			
Riparian wildlife habitat	388	100.0%	388
Upland wildlife habitat	5,761	100.0%	5,761
Brownlee Reservoir low-elevation winter range (upland habitat)	5,820	10.0%	582
Reservoir Shoreline Zones			
Brownlee riparian habitat	3,296	8.0%	0
Oxbow and Hells Canyon riparian habitat	1,570	0.1%	2
Soil erosion	4,866	1.7%	84
Crucial Winter Range Zone	86,408	19.0%	16,418
River Shoreline Zones			
River riparian habitat	3,435	0.0%	+16
Soil erosion	3435	0.2%	6
Total			23,225

Appendix E. Example of letter dated December 22, 2004 formally requesting written comments from FERC-designated agencies and Native American tribes about HCC AIR OP-1(g).

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IDAHO POWER COMPANY
P.O. BOX 70
BOISE, IDAHO 83707

Craig A. Jones (208) 388-2934
Project Manager fax (208) 388-6902
Hydro Relicensing Department e-mail cjones@idahopower.com

December 22, 2004

David Henderson
Bureau of Land Management
100 Oregon Street
Vale, OR 97918

Re: Hells Canyon Additional Information Request OP-1(g) – Terrestrial Resources

Dear Mr. Henderson:

In a letter dated May 4, 2004, the Federal Energy Regulatory Commission (FERC) issued to Idaho Power Company (IPC) an additional information request (AIR) for the Hells Canyon New License Application.

In AIR OP-1(g), the FERC requested specific information related to operational scenarios and terrestrial resources and directed IPC to consult with various entities (see attached list) about its response to the AIR. Therefore, IPC is requesting your review and comments regarding the draft response to AIR OP-1(g).

The draft response is enclosed on a CD. The FERC has directed IPC to provide a 30-day review and comment period on the draft response. Because of the tight time constraints imposed by the FERC for this AIR, your comments must be delivered to me by no later than January 24, 2005 for inclusion in the final response that will be filed with the FERC. Comments received after this 30-day review period may not be included in the final response.

Please contact me if you have questions or need clarification.

Sincerely,

Craig A. Jones
Hells Canyon Relicensing Project Manager

CAJ/da
Enclosure
Cc: Jim Tucker, IPC
Nathan Gardiner, IPC
Jim Vasile, DWT

IDAHO POWER COMPANY
P.O. BOX 70
BOISE, IDAHO 83707

Craig A. Jones
Project Manager
Hydro Relicensing Department

(208) 388-2934
fax (208) 388-6902
e-mail cjones@idahopower.com

December 22, 2004

Dorothy Mason
Bureau of Land Management
3165 10th Street
Baker City, OR 97814

Re: Hells Canyon Additional Information Request OP-1(g) – Terrestrial Resources

Dear Ms. Mason:

In a letter dated May 4, 2004, the Federal Energy Regulatory Commission (FERC) issued to Idaho Power Company (IPC) an additional information request (AIR) for the Hells Canyon New License Application.

In AIR OP-1(g), the FERC requested specific information related to operational scenarios and terrestrial resources and directed IPC to consult with various entities (see attached list) about its response to the AIR. Therefore, IPC is requesting your review and comments regarding the draft response to AIR OP-1(g).

The draft response is enclosed on a CD. The FERC has directed IPC to provide a 30-day review and comment period on the draft response. Because of the tight time constraints imposed by the FERC for this AIR, your comments must be delivered to me by no later than January 24, 2005 for inclusion in the final response that will be filed with the FERC. Comments received after this 30-day review period may not be included in the final response.

Please contact me if you have questions or need clarification.

Sincerely,

Craig A. Jones
Hells Canyon Relicensing Project Manager

CAJ/da
Enclosure
Cc: Jim Tucker, IPC
Nathan Gardiner, IPC
Jim Vasile, DWT

IDAHO POWER COMPANY
P.O. BOX 70
BOISE, IDAHO 83707

Craig A. Jones
Project Manager
Hydro Relicensing Department

(208) 388-2934
fax (208) 388-6902
e-mail cjones@idahopower.com

December 22, 2004

Albert Teeman
Burns-Paiute Tribe
100 Pasigo Street
Burns, OR 97720

Re: Hells Canyon Additional Information Request OP-1(g) – Terrestrial Resources

Dear Mr. Teeman:

In a letter dated May 4, 2004, the Federal Energy Regulatory Commission (FERC) issued to Idaho Power Company (IPC) an additional information request (AIR) for the Hells Canyon New License Application.

In AIR OP-1(g), the FERC requested specific information related to operational scenarios and terrestrial resources and directed IPC to consult with various entities (see attached list) about its response to the AIR. Therefore, IPC is requesting your review and comments regarding the draft response to AIR OP-1(g).

The draft response is enclosed on a CD. The FERC has directed IPC to provide a 30-day review and comment period on the draft response. Because of the tight time constraints imposed by the FERC for this AIR, your comments must be delivered to me by no later than January 24, 2005 for inclusion in the final response that will be filed with the FERC. Comments received after this 30-day review period may not be included in the final response.

Please contact me if you have questions or need clarification.

Sincerely,

Craig A. Jones
Hells Canyon Relicensing Project Manager

CAJ/da
Enclosure
Cc: Jim Tucker, IPC
Nathan Gardiner, IPC
Jim Vasile, DWT

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December 22, 2004

Robert Lothrop
Columbia River Inter-Tribal Fish Commission
729 NE Oregon Street, Suite 200
Portland, OR 97232

Re: Hells Canyon Additional Information Request OP-1(g) – Terrestrial Resources

Dear Mr. Lothrop:

In a letter dated May 4, 2004, the Federal Energy Regulatory Commission (FERC) issued to Idaho Power Company (IPC) an additional information request (AIR) for the Hells Canyon New License Application.

In AIR OP-1(g), the FERC requested specific information related to operational scenarios and terrestrial resources and directed IPC to consult with various entities (see attached list) about its response to the AIR. Therefore, IPC is requesting your review and comments regarding the draft response to AIR OP-1(g).

The draft response is enclosed on a CD. The FERC has directed IPC to provide a 30-day review and comment period on the draft response. Because of the tight time constraints imposed by the FERC for this AIR, your comments must be delivered to me by no later than January 24, 2005 for inclusion in the final response that will be filed with the FERC. Comments received after this 30-day review period may not be included in the final response.

Please contact me if you have questions or need clarification.

Sincerely,

Craig A. Jones
Hells Canyon Relicensing Project Manager

CAJ/da
Enclosure
Cc: Jim Tucker, IPC
Nathan Gardiner, IPC
Jim Vasile, DWT

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BOISE, IDAHO 83707

Craig A. Jones
Project Manager
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December 22, 2004

Gary Burke
Confederated Tribes of the Umatilla Indian Reservation
PO Box 638
Pendleton, OR 97801

Re: Hells Canyon Additional Information Request OP-1(g) – Terrestrial Resources

Dear Mr. Burke:

In a letter dated May 4, 2004, the Federal Energy Regulatory Commission (FERC) issued to Idaho Power Company (IPC) an additional information request (AIR) for the Hells Canyon New License Application.

In AIR OP-1(g), the FERC requested specific information related to operational scenarios and terrestrial resources and directed IPC to consult with various entities (see attached list) about its response to the AIR. Therefore, IPC is requesting your review and comments regarding the draft response to AIR OP-1(g).

The draft response is enclosed on a CD. The FERC has directed IPC to provide a 30-day review and comment period on the draft response. Because of the tight time constraints imposed by the FERC for this AIR, your comments must be delivered to me by no later than January 24, 2005 for inclusion in the final response that will be filed with the FERC. Comments received after this 30-day review period may not be included in the final response.

Please contact me if you have questions or need clarification.

Sincerely,

Craig A. Jones
Hells Canyon Relicensing Project Manager

CAJ/da
Enclosure
Cc: Jim Tucker, IPC
Nathan Gardiner, IPC
Jim Vasile, DWT

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Craig A. Jones
Project Manager
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December 22, 2004

Don Sampson
Confederated Tribes of the Umatilla Indian Reservation
PO Box 638
Pendleton, OR 97801

Re: Hells Canyon Additional Information Request OP-1(g) – Terrestrial Resources

Dear Mr. Sampson:

In a letter dated May 4, 2004, the Federal Energy Regulatory Commission (FERC) issued to Idaho Power Company (IPC) an additional information request (AIR) for the Hells Canyon New License Application.

In AIR OP-1(g), the FERC requested specific information related to operational scenarios and terrestrial resources and directed IPC to consult with various entities (see attached list) about its response to the AIR. Therefore, IPC is requesting your review and comments regarding the draft response to AIR OP-1(g).

The draft response is enclosed on a CD. The FERC has directed IPC to provide a 30-day review and comment period on the draft response. Because of the tight time constraints imposed by the FERC for this AIR, your comments must be delivered to me by no later than January 24, 2005 for inclusion in the final response that will be filed with the FERC. Comments received after this 30-day review period may not be included in the final response.

Please contact me if you have questions or need clarification.

Sincerely,

Craig A. Jones
Hells Canyon Relicensing Project Manager

CAJ/da
Enclosure
Cc: Jim Tucker, IPC
Nathan Gardiner, IPC
Jim Vasile, DWT

IDAHO POWER

IDAHO POWER COMPANY
P.O. BOX 70
BOISE, IDAHO 83707

Craig A. Jones
Project Manager
Hydro Relicensing Department

(208) 388-2934
fax (208) 388-6902
e-mail cjones@idahopower.com

December 22, 2004

Tribal Chairman
Confederated Tribes of the Warm Springs
PO Box C
Warm Springs, OR 97761-0078

Re: Hells Canyon Additional Information Request OP-1(g) – Terrestrial Resources

Dear Mr. Chairman:

In a letter dated May 4, 2004, the Federal Energy Regulatory Commission (FERC) issued to Idaho Power Company (IPC) an additional information request (AIR) for the Hells Canyon New License Application.

In AIR OP-1(g), the FERC requested specific information related to operational scenarios and terrestrial resources and directed IPC to consult with various entities (see attached list) about its response to the AIR. Therefore, IPC is requesting your review and comments regarding the draft response to AIR OP-1(g).

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Please contact me if you have questions or need clarification.

Sincerely,

Craig A. Jones
Hells Canyon Relicensing Project Manager

CAJ/da
Enclosure
Cc: Jim Tucker, IPC
Nathan Gardiner, IPC
Jim Vasile, DWT

IDAHO POWER COMPANY
P.O. BOX 70
BOISE, IDAHO 83707

Craig A. Jones
Project Manager
Hydro Relicensing Department

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fax (208) 388-6902
e-mail cjones@idahopower.com

December 22, 2004

Kate Kelly
Idaho Department of Environmental Quality
DEQ- Boise Regional Office
1445 North Orchard
Boise, ID 83706-2239

Re: Hells Canyon Additional Information Request OP-1(g) – Terrestrial Resources

Dear Ms. Kelly:

In a letter dated May 4, 2004, the Federal Energy Regulatory Commission (FERC) issued to Idaho Power Company (IPC) an additional information request (AIR) for the Hells Canyon New License Application.

In AIR OP-1(g), the FERC requested specific information related to operational scenarios and terrestrial resources and directed IPC to consult with various entities (see attached list) about its response to the AIR. Therefore, IPC is requesting your review and comments regarding the draft response to AIR OP-1(g).

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Please contact me if you have questions or need clarification.

Sincerely,

Craig A. Jones
Hells Canyon Relicensing Project Manager

CAJ/da
Enclosure
Cc: Jim Tucker, IPC
Nathan Gardiner, IPC
Jim Vasile, DWT

IDAHO POWER COMPANY
P.O. BOX 70
BOISE, IDAHO 83707

Craig A. Jones (208) 388-2934
Project Manager fax (208) 388-6902
Hydro Relicensing Department e-mail cjones@idahopower.com

December 22, 2004

Tracey Trent
Idaho Department of Fish and Game
600 South Walnut
PO Box 25
Boise, ID 83702

Re: Hells Canyon Additional Information Request OP-1(g) – Terrestrial Resources

Dear Mr. Trent:

In a letter dated May 4, 2004, the Federal Energy Regulatory Commission (FERC) issued to Idaho Power Company (IPC) an additional information request (AIR) for the Hells Canyon New License Application.

In AIR OP-1(g), the FERC requested specific information related to operational scenarios and terrestrial resources and directed IPC to consult with various entities (see attached list) about its response to the AIR. Therefore, IPC is requesting your review and comments regarding the draft response to AIR OP-1(g).

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Please contact me if you have questions or need clarification.

Sincerely,

Craig A. Jones
Hells Canyon Relicensing Project Manager

CAJ/da
Enclosure
Cc: Jim Tucker, IPC
Nathan Gardiner, IPC
Jim Vasile, DWT

IDAHO POWER
IDAHO POWER COMPANY
P.O. BOX 70
BOISE, IDAHO 83707

Craig A. Jones
Project Manager
Hydro Relicensing Department
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fax (208) 388-6902
e-mail cjones@idahopower.com

December 22, 2004

Rick Eichstaedt
Nez Perce Tribe
PO Box 305
Lapwai, ID 83540

Re: Hells Canyon Additional Information Request OP-1(g) – Terrestrial Resources

Dear Mr. Eichstaedt:

In a letter dated May 4, 2004, the Federal Energy Regulatory Commission (FERC) issued to Idaho Power Company (IPC) an additional information request (AIR) for the Hells Canyon New License Application.

In AIR OP-1(g), the FERC requested specific information related to operational scenarios and terrestrial resources and directed IPC to consult with various entities (see attached list) about its response to the AIR. Therefore, IPC is requesting your review and comments regarding the draft response to AIR OP-1(g).

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Please contact me if you have questions or need clarification.

Sincerely,

Craig A. Jones
Hells Canyon Relicensing Project Manager

CAJ/da
Enclosure
Cc: Jim Tucker, IPC
Nathan Gardiner, IPC
Jim Vasile, DWT

IDAHO POWER
IDAHO POWER COMPANY
P.O. BOX 70
BOISE, IDAHO 83707

Craig A. Jones
Project Manager
Hydro Relicensing Department

(208) 388-2934
fax (208) 388-6902
e-mail cjones@idahopower.com

December 22, 2004

Ritchie Graves
NOAA Fisheries
Hydro Program
525 NE Oregon Street, Suite 500
Portland, OR 97232

Re: Hells Canyon Additional Information Request OP-1(g) – Terrestrial Resources

Dear Mr. Graves:

In a letter dated May 4, 2004, the Federal Energy Regulatory Commission (FERC) issued to Idaho Power Company (IPC) an additional information request (AIR) for the Hells Canyon New License Application.

In AIR OP-1(g), the FERC requested specific information related to operational scenarios and terrestrial resources and directed IPC to consult with various entities (see attached list) about its response to the AIR. Therefore, IPC is requesting your review and comments regarding the draft response to AIR OP-1(g).

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Please contact me if you have questions or need clarification.

Sincerely,

Craig A. Jones
Hells Canyon Relicensing Project Manager

CAJ/da
Enclosure
Cc: Jim Tucker, IPC
Nathan Gardiner, IPC
Jim Vasile, DWT

IDAHO POWER
IDAHO POWER COMPANY
P.O. BOX 70
BOISE, IDAHO 83707

Craig A. Jones
Project Manager
Hydro Relicensing Department

(208) 388-2934
fax (208) 388-6902
e-mail cjones@idahopower.com

December 22, 2004

Bob Lohn
NOAA Fisheries
525 NE Oregon Street, Suite 500
Portland, OR 97232-2737

Re: Hells Canyon Additional Information Request OP-1(g) – Terrestrial Resources

Dear Mr. Lohn:

In a letter dated May 4, 2004, the Federal Energy Regulatory Commission (FERC) issued to Idaho Power Company (IPC) an additional information request (AIR) for the Hells Canyon New License Application.

In AIR OP-1(g), the FERC requested specific information related to operational scenarios and terrestrial resources and directed IPC to consult with various entities (see attached list) about its response to the AIR. Therefore, IPC is requesting your review and comments regarding the draft response to AIR OP-1(g).

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Please contact me if you have questions or need clarification.

Sincerely,

Craig A. Jones
Hells Canyon Relicensing Project Manager

CAJ/da
Enclosure
Cc: Jim Tucker, IPC
Nathan Gardiner, IPC
Jim Vasile, DWT

IDAHO POWER COMPANY
P.O. BOX 70
BOISE, IDAHO 83707

Craig A. Jones
Project Manager
Hydro Relicensing Department

(208) 388-2934
fax (208) 388-6902
e-mail cjones@idahopower.com

December 22, 2004

Paul DeVito
Oregon Department of Environmental Quality
2146 NE Fourth Street, Suite 104
Bend, OR 97701

Re: Hells Canyon Additional Information Request OP-1(g) – Terrestrial Resources

Dear Mr DeVito:

In a letter dated May 4, 2004, the Federal Energy Regulatory Commission (FERC) issued to Idaho Power Company (IPC) an additional information request (AIR) for the Hells Canyon New License Application.

In AIR OP-1(g), the FERC requested specific information related to operational scenarios and terrestrial resources and directed IPC to consult with various entities (see attached list) about its response to the AIR. Therefore, IPC is requesting your review and comments regarding the draft response to AIR OP-1(g).

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Please contact me if you have questions or need clarification.

Sincerely,

Craig A. Jones
Hells Canyon Relicensing Project Manager

CAJ/da
Enclosure
Cc: Jim Tucker, IPC
Nathan Gardiner, IPC
Jim Vasile, DWT

IDAHO POWER
IDAHO POWER COMPANY
P.O. BOX 70
BOISE, IDAHO 83707

Craig A. Jones
Project Manager
Hydro Relicensing Department

(208) 388-2934
fax (208) 388-6902
e-mail cjones@idahopower.com

December 22, 2004

Colleen Fagan
Oregon Department of Fish and Wildlife
107 20th Street
La Grande, OR 97850

Re: Hells Canyon Additional Information Request OP-1(g) – Terrestrial Resources

Dear Ms. Fagan:

In a letter dated May 4, 2004, the Federal Energy Regulatory Commission (FERC) issued to Idaho Power Company (IPC) an additional information request (AIR) for the Hells Canyon New License Application.

In AIR OP-1(g), the FERC requested specific information related to operational scenarios and terrestrial resources and directed IPC to consult with various entities (see attached list) about its response to the AIR. Therefore, IPC is requesting your review and comments regarding the draft response to AIR OP-1(g).

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Please contact me if you have questions or need clarification.

Sincerely,

Craig A. Jones
Hells Canyon Relicensing Project Manager

CAJ/da
Enclosure
Cc: Jim Tucker, IPC
Nathan Gardiner, IPC
Jim Vasile, DWT

IDAHO POWER COMPANY
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BOISE, IDAHO 83707

Craig A. Jones
Project Manager
Hydro Relicensing Department

(208) 388-2934
fax (208) 388-6902
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December 22, 2004

Frederick Auck
Shoshone-Bannock Tribe
PO Box 306
Fort Hall, ID 83203

Re: Hells Canyon Additional Information Request OP-1(g) – Terrestrial Resources

Dear Mr. Auck:

In a letter dated May 4, 2004, the Federal Energy Regulatory Commission (FERC) issued to Idaho Power Company (IPC) an additional information request (AIR) for the Hells Canyon New License Application.

In AIR OP-1(g), the FERC requested specific information related to operational scenarios and terrestrial resources and directed IPC to consult with various entities (see attached list) about its response to the AIR. Therefore, IPC is requesting your review and comments regarding the draft response to AIR OP-1(g).

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Please contact me if you have questions or need clarification.

Sincerely,

Craig A. Jones
Hells Canyon Relicensing Project Manager

CAJ/da
Enclosure
Cc: Jim Tucker, IPC
Nathan Gardiner, IPC
Jim Vasile, DWT

IDAHO POWER
IDAHO POWER COMPANY
P.O. BOX 70
BOISE, IDAHO 83707

Craig A. Jones
Project Manager
Hydro Relicensing Department

(208) 388-2934
fax (208) 388-6902
e-mail cjones@idahopower.com

December 22, 2004

Donald Clary
Shoshone-Paiute Tribe
633 West Fifth Street
Twenty-First Floor
Los Angeles, CA 90071-2040

Re: Hells Canyon Additional Information Request OP-1(g) – Terrestrial Resources

Dear Mr. Clary:

In a letter dated May 4, 2004, the Federal Energy Regulatory Commission (FERC) issued to Idaho Power Company (IPC) an additional information request (AIR) for the Hells Canyon New License Application.

In AIR OP-1(g), the FERC requested specific information related to operational scenarios and terrestrial resources and directed IPC to consult with various entities (see attached list) about its response to the AIR. Therefore, IPC is requesting your review and comments regarding the draft response to AIR OP-1(g).

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Please contact me if you have questions or need clarification.

Sincerely,

Craig A. Jones
Hells Canyon Relicensing Project Manager

CAJ/da
Enclosure
Cc:	Jim Tucker, IPC
	Nathan Gardiner, IPC
	Jim Vasile, DWT

IDAHO POWER COMPANY
P.O. BOX 70
BOISE, IDAHO 83707

Craig A. Jones
Project Manager
Hydro Relicensing Department

(208) 388-2934
fax (208) 388-6902
e-mail cjones@idahopower.com

December 22, 2004

Jeffery Foss
U.S. Fish and Wildlife Service
1387 South Vinnell Way, Suite 368
Boise, ID 83709

Re: Hells Canyon Additional Information Request OP-1(g) – Terrestrial Resources

Dear Mr. Foss:

In a letter dated May 4, 2004, the Federal Energy Regulatory Commission (FERC) issued to Idaho Power Company (IPC) an additional information request (AIR) for the Hells Canyon New License Application.

In AIR OP-1(g), the FERC requested specific information related to operational scenarios and terrestrial resources and directed IPC to consult with various entities (see attached list) about its response to the AIR. Therefore, IPC is requesting your review and comments regarding the draft response to AIR OP-1(g).

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Please contact me if you have questions or need clarification.

Sincerely,

Craig A. Jones
Hells Canyon Relicensing Project Manager

CAJ/da
Enclosure
Cc: Jim Tucker, IPC
Nathan Gardiner, IPC
Jim Vasile, DWT

IDAHO POWER
IDAHO POWER COMPANY
P.O. BOX 70
BOISE, IDAHO 83707

Craig A. Jones
Project Manager
Hydro Relicensing Department

(208) 388-2934
fax (208) 388-6902
e-mail cjones@idahopower.com

December 22, 2004

Forest Supervisor
Wallowa-Whitman National Forest
1550 Dewey Avenue
PO Box 907
Baker City, OR 97814

Re: Hells Canyon Additional Information Request OP-1(g) – Terrestrial Resources

Dear Forest Supervisor:

In a letter dated May 4, 2004, the Federal Energy Regulatory Commission (FERC) issued to Idaho Power Company (IPC) an additional information request (AIR) for the Hells Canyon New License Application.

In AIR OP-1(g), the FERC requested specific information related to operational scenarios and terrestrial resources and directed IPC to consult with various entities (see attached list) about its response to the AIR. Therefore, IPC is requesting your review and comments regarding the draft response to AIR OP-1(g).

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Please contact me if you have questions or need clarification.

Sincerely,

Craig A. Jones
Hells Canyon Relicensing Project Manager

CAJ/da
Enclosure
Cc: Jim Tucker, IPC
Nathan Gardiner, IPC
Jim Vasile, DWT

Idaho Power Company
Hells Canyon Complex (FERC Project No. 1971)
Additional Information Request OP-1(g) - Consulting Entities List

David Henderson	Bureau of Land Management
Dorothy Mason	Bureau of Land Management
Albert Teeman	Burns-Paiute Tribe
Robert Lothrop	Columbia River Inter-Tribal Fish Commission
Gary Burke	Confederated Tribes of the Umatilla Indian Reservation
Don Sampson	Confederated Tribes of the Umatilla Indian Reservation
Tribal Chairman	Confederated Tribes of the Warm Springs
Kate Kelly	Idaho Department of Environmental Quality
Tracey Trent	Idaho Department of Fish and Game
Rick Eichstaedt	Nez Perce Tribe
Ritchie Graves	NOAA Fisheries
Bob Lohn	NOAA Fisheries
Paul DeVito	Oregon Department of Environmental Quality
Colleen Fagan	Oregon Department of Fish and Wildlife
Frederick Auck	Shoshone-Bannock Tribe
Donald Clary	Shoshone-Paiute Tribe
Jeffery Foss	U.S. Fish and Wildlife Service
Forest Supervisor	Wallowa-Whitman National Forest

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Appendix F. Written comments received from FERC-designated agencies and Native American tribes regarding HCC AIR OP-1(g) in response to IPC’s letter request of December 22, 2004.

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United States Department of the Interior
BUREAU OF LAND MANAGEMENT
VALE DISTRICT
100 Oregon Street
Vale, Oregon 97918
http://www.or.blm.gov/Vale/

IN REPLY REFER TO: 1780

January 24, 2005

Craig Jones
Idaho Power Company
PO Box 70
Boise ID 83707

Dear Mr. Jones;

Thank you for the opportunity to comment on your recently completed AIR, OP-1(g). BLM has an interest in the outcome of the Terrestrial and Operational Resource issues for the Hells Canyon Complex because of the large quantity of BLM managed lands affected by the project. We offer the attached comments to your draft AIR Response OP-1(g) for your use in finalizing this important document.

We look forward to continued cooperation in working with the aquatic and operational issues in the relicensing of the Hells Canyon Complex. For more information please contact me at 541-523-1308. My mailing address is: BLM, 3165 10th St. Baker City OR 97814.

Sincerely,

Dorothy Mason
OR/WA and ID BLM
Relicensing Team Lead

One Attachment

Cc: Alan Mitchnick, FERC
Hells Canyon Complex P-1971 Service List

Bureau of Land Management's Response to OP-1 (g)
Operational scenarios – Terrestrial Resources
January 21, 2005

The Additional Information Request (AIR) OP-1 Operational Scenarios (g) Terrestrial Resources for the Hells Canyon Hydroelectric Project by the Federal Energy Regulatory Commission (FERC) specifies certain analyses. These include: 1) modeling predicted increases or decreases in acreage of vegetation that would occur as a result of the 6 operational scenarios and sub-scenarios for the six riparian plant (FRA, FRP, HYD, ORA, ORP, and RA) groups using the HC_REM analysis described in Technical Report E.3.3-3 (Braatne et al. 2002); 2) describing predicted effects on the abundance and distribution of noxious weeds, non-native plants, and special status plant species; and 3) relating predicted changes in riparian vegetation groups to existing substrate type or to changes in erosion, deposition, or sediment transport that may also result from implementation of these scenarios.

Subsequent to FERC's May 2004 assignments of this AIR, IPC and FERC agreed to modify OP-1(g) analysis methodology (reference FERC's July 23, 2004 letter IPC). Specifically, IPC proposed to not use the HC_REM analysis, stating, "that the analysis reported in Technical Report E.3.3-3 is very time consuming to do and reports proportional changes, not acreages…is not capable of…simulating substrate changes." Rather, IPC stated they could provide acreage information for 13 cover types (4 riparian and 9 upland) by using the methods described in Technical Report E.3.2-40 (Blair et al. 2002) and summarized in Table 2 of Technical Report E.3.2-45 (Edelmann et al. 2002). IPC would add detail to the function of cover type predictions by describing potential increases or decreases to various plant assemblages that comprise existing cover types by consulting with discipline experts (Dr. Jeffery H. Braatne and Dr. Stewart Rood) to qualitatively assess potential vegetation changes that may occur under the additional operational scenarios. Further, IPC would qualitatively assess, with Dr. Jeffery H. Braatne and Dr. Stewart Rood, the effects of the additional operational scenarios on noxious weeds, non-native plants, and special status plants.

BLM 01 The BLM disagrees with FERC's and IPC's decision to modify the analysis method for OP-1(g) because the conceptual model employed by Blair does not account for the numerous environmental variables affecting riparian vegetation associated with a dynamic riverine system, reduces the number of riparian plant groups from 6 to 4, assumes the scour zone (below the MAWL) would not establish suitable wildlife habitat, and assumes changes in cover types would occur proportionally throughout the study area.

BLM 02 The HC_REM analysis (Technical Report E.3.3-3) provides a scientific methodology integrating model components of: germination & growth (including substrate), plant competition, inundation-induced mortality, desiccation-induced mortality, scour-induced mortality, time period, and time step. Additionally, there are specific parameters within the various subroutines (components) in HC_REM that simulate the establishment,

BLM 02 growth and removal of riparian vegetation. The model was run using the riverbank geometry, and substrate conditions at 92-vegetation transects and mean daily historic water-surface fluctuations as input variables. The authors compared the modeled vegetation pattern composed of the 6-life forms (FRA, FRP, HYD, ORA, ORP, and RA) with the observed vegetation pattern in the field collected at each of the 92-transects. This constituted the HC_REM calibration and verification process. Further detail of the calibration and verification process can be found in E.3.3-3. The BLM supports the use of the HC_REM analysis, although the agency questions the use of the mean annual water level (MAWL) as the flow to model riparian vegetative responses to the operational scenarios. The MAWL is 20,695 cfs.

BLM 03 Conversely, the method employed by Blair et al. 2002 used a conceptual model projecting hypothesized cover type changes associated with river stage changes during summer months (1-July to 31-August) then projected proportional changes of current cover types relative to differences in area inundated between historic operations and IPC's two operational scenarios described in the Final License Application (FLA). Blair's conceptual model forms the basis for analyzing FERC's 6 operational scenarios and sub-scenarios, except proportional changes in cover types are estimated for each AIR scenario relative to existing conditions. Refinements of Blair's assumptions are outlined in IPC's response to OP-1(g) at 2.1.3.1.

The BLM disagrees with several of these assumptions. Comments follow the numbering sequence in the IPC OP-1(g) document:

<u>2.1.3.1 - Analysis Assumptions</u>

BLM 04 1) Blair assumes the estimates of impacted acres in the shoreline zone from erosion and the crucial winter range zone would remain constant with implementation of each AIR scenario.

This is generally valid for the reservoir shorelines except for scenario 5. A new shoreline zone surrounding Brownlee reservoir would be formed as the reservoir level is held at the minimum operating pool year-round. Therefore, it could be assumed that the potential erosion impacts associated with a lower pool may be less.

It could also be assumed that with an increase in acreage from de-watering the fluctuation zone of Brownlee reservoir there would be an increase of available crucial winter range for mule deer. As detailed in Christensen 2001, the inundated areas of the Project reservoirs were crucial winter range for mule deer. However, IPC's discussion regarding vegetative composition of the fluctuation zone (section 2.1.4.1) does not consider active management to increase native vegetation species composition.

BLM 05 For the Snake River reach downstream from Hells Canyon dam, erosion in the shoreline zone will vary depending upon each AIR scenario and should be quantified accordingly. Reference IPC's Table 3 (page 43), the weighted average maximum-daily flows (cfs) for

BLM 05 FERC's operational scenarios may be lower than the MAWL. Lower flow velocities may reduce the river's overall erosive capability.

BLM 06 3) IPC assumes that suitable wildlife habitat will not establish in the scour zone of the Snake River below Hells Canyon, therefore, the lowest down slope extent of vegetation in the river shoreline zone would not change from existing conditions.

This assumption is based on use of the MAWL. Depending upon the AIR scenario, daily and weekly water levels increase available shoreline, below the MAWL, for riparian vegetation establishment. The available shoreline between the MAWL and an AIR scenario must be modeled to account for some riparian vegetation establishment. While at the same time, modeling will most likely account for a reduction of riparian vegetation on the upslope boundaries of the established riparian zone.

BLM 07 4) IPC's assumption that a maximum-daily flow (for the Snake River below Hells Canyon dam) during the growing season are the parameters that best represent the interaction between operational scenarios and shoreline vegetation.

This assumption may not provide an accurate portrayal of shoreline vegetation response for the AIR scenarios. For example, *Salix exigua* can establish either by clonal or seed germination in the seedling recruitment zone. If the assumption were to use a minimum-daily flow with specific parameters for timing and duration of flow releases and recession, seedling root growth in the recruitment zone would be able to keep pace with the gradual flow stage decline. This species, once established indicates a large tolerance to withstand periods of inundation (Amlin and Rood, 2001). As indicated by Braatne 1999, *Salix exigua* populations along the Snake River between Hells Canyon dam and the Salmon River mouth, appear to be largely relict populations. He did not observe zones of active seedling or clonal recruitment. It could be hypothesized that using a minimum-daily flow to represent the interaction between operational scenarios and riparian vegetation, and staging the flows during the seed dispersal and germination, and root establishment periods for key riparian species, modeling may indicate an increase in riparian vegetation for the AIR scenarios.

BLM 08 7) IPC's assertion that, changes in the extent of a cover type was assumed to occur proportionally throughout a study reach does not account for the dynamic structure of a riverine system.

Hydrologic and geologic conditions, and scour and deposition rates over the 30-year projection would most likely change the vegetative cover types disproportionately. Very few things are proportional in a dynamic riverine system. For example, Dixon 2002, suggested that the magnitude and timing of flows during the growing season influenced the species composition, elevation distribution, and density of each year's seedling recruitment.

2.1.3.3 and 2.1.4.1- Reservoir Fluctuation Zone

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BLM 24 As stated above, the BLM disagrees with IPC's conclusion "the scour zone would not change, lower flows would cause a decrease in the irrigation effect and a corresponding loss in shoreline riparian vegetation." It is hypothesized that the riparian communities

BLM 24 would shift physical location on the river shoreline based on lower flow operational scenarios, keeping pace with soil moisture. Management opportunities exist to change the magnitude, duration, frequency and timing of flow to pattern natural streamflows to promote a biological diverse riparian community. Based on this concept, porcupine sedge, Schweinitz flatsedge and American wood sedge may not be negatively affected by lower flow scenarios.

2.1.4.6 - Substrate and Sediments

BLM 25 As outlined in the BLM comments on OP-1(d), the agency describes several shortcomings with the assumptions, calculations, and presentation of the analysis. The approach of using a 2D model to (1) determine flow duration curves and (2) determine and define flows resulting in incipient motion at the four sandbars (for the specified 1 mm grain size) are probably appropriate and reasonable accurate. This modeling should be revised however, using the median sand size for each bar; and calculations should be revised as detailed in the agency's report. More complete documentation of sites and assumptions should be provided. The calculations of duration and extent of sand mobilization for the Proposed Operation and specified scenarios do not provide an adequate basis for interpreting differences between scenarios on sandbar mobility. A few changes in calculation procedures could provide much more robust determinations.

The calculations probably result in substantial underestimation of the potential erosion of median sand size as currently modeled and presented. It should also be noted that this approach - the critical tractive force approach—which was the logical analysis approach adopted by IPC given the request to determine incipient motion conditions—may not be relevant to other important erosional mechanisms affecting sandbars, such as sapping (owing to daily flow ramping cycles). The studies conducted so far as part of the relicensing effort have not shed sufficient light on the processes forming, maintaining, and eroding sandbars so that we can confidently and quantitatively predict their behavior on the basis of a single process model.

BLM 26 IPC in using OP-1(d) to assess and interpret changes in riparian vegetation due to sediment transport, such as increased sandbar erosion concludes relatively minor influences on sandbars. Given the BLM descriptions of several shortcomings with the assumptions, calculations, and presentation of the analysis, IPC conclusions of minor influences on sandbars and very slight effects on interstitial sands may not portray actual processes.

BLM 27 Grams and Schmidt 1999, noted in 1964, approximately 46 acres of sand deposits in approximately 200 locations between Hells Canyon dam and the Salmon River. By 1973 the area of deposits had diminished to around 24 acres, and by 1982 it had shrank 50% again to around 13 acres. Possible future diminishment might be predicted based on the depletion between 1973 and 1982. In that time period the sandbars were reduced in size by 4%/year. Applying that to the 1973-present time period yields 6 acres, which is

BLM 27 approximately what was assessed by IPC in their recreation survey. Applying it to the future 40 years shows that less than 1 acre of sand deposits would remain.
As IPC suggests, it is probable that a reduction in sand deposits is similarly applicable to interstitial sands. The reduction of interstitial sands may partially account for the lack of active *Salix exigua* seedling or clonal recruitment indicated by Braatne 1999.

2.1.5 - Conclusions

BLM 28 The purpose of FERC's AIR request is to describe riparian vegetative response to varying operational scenarios. By use of restrictive modeling assumptions, IPC has not provided an accurate description of riparian vegetative response. Although IPC's current flow regime may feature a sustainable relic riparian community, a more extensive riparian community, supported by natural conditions would be more diverse and robust, thereby providing more resiliency and greater value for associated wildlife.

Flow regime that include abrupt flow increases or decrease and flow pulsing effect riparian communities. The effects of these changes depend on their magnitude, duration, frequency and timing relative to the pattern of natural streamflows. The regular, daily pulsing of flows characteristically produced downstream by the Hells Canyon project can produce artifacts in channel geomorphology and the associated riparian communities.

BLM 29 IPC's conceptual model and its assumptions employed to calculate predicted acreage changes in riparian and upland cover types, appears to represent a GIS mapping exercise. The combined assumptions of no change in shoreline zone erosion and crucial winter range, no establishment of riparian vegetation below the scour zone (MAWL), maximum-daily flow, and proportional changes in cover types limit any credible scientific model to accurately project riparian vegetation responses to FERC's 6 operational scenarios and sub-scenarios. The sensitivity of seedling recruitment to flow pattern suggests that human management of flows may be used in a prescriptive fashion to intentionally manage or restore riparian systems (Rood and Mahoney 1990, Johnson 1994, Rood et al. 1998, Schmidt et al. 1998). An understanding of how vegetation recruitment is linked to headwater elevation (reservoirs) and flow (river) may be critical for restoring and managing structure and function in riparian ecosystems.

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United States Department of Agriculture **Forest Service** **Wallowa-Whitman National Forest**

1550 Dewey Ave.
P.O. Box 907
Baker City, OR 97814

File Code: 2770
Date: January 24, 2005

Mr. Craig Jones
Project Manager
Idaho Power Company
P.O. Box 70
Boise, ID 83707

RECEIVED
JAN 2 6 2005

Re: Additional Information Request (AIR) OP-1(g) Terrestrial Resources

Dear Mr. Jones:

The Federal Energy Regulatory commission (FERC) directed Idaho Power Company (IPC) to allow identified agencies and Native American Tribes a 30-day review and comment period of IPC's response to FERC's AIR OP-1(g) Terrestrial Resources report prior to final submission to FERC. The USDA Forest Service appreciates the opportunity to review and provide comments on IPC's AIR OP-1(g) report.

Upon completion of staff review of OP-1(g), USDA Forest Service has a number of concerns with the choice of analysis methodology, analysis assumptions, and stated conclusions. Our comments are provided in Attachment 1. USDA Forest Service believes the model that IPC employed does not account for numerous environmental variables that affect riparian vegetation associated with a dynamic riverine system and, therefore, does not fully disclose project impacts to FERC's AIR scenarios.

If you have any questions regarding this response, please contact Lynn Roehm, Wallowa-Whitman National Forest Hydropower Coordinator, at (541) 523-1316 or Mike Gerdes, Zone Terrestrial Resource Specialist, at (541) 416-6521.

Sincerely,

STEVEN A. ELLIS
Forest Supervisor

Enclosure

cc: FERC, BLM, USFWS, IDFG, ODFW, Nez Perce Tribe

Attachment I

The Additional Information Request (AIR) OP-1 Operational Scenarios (g) Terrestrial Resources for the Hells Canyon Hydroelectric Project by the Federal Energy Regulatory Commission (FERC) specifies certain analyses. These include: 1) modeling predicted increases or decreases in acreage of vegetation that would occur as a result of the 6 operational scenarios and sub-scenarios for the six riparian plant (FRA, FRP, HYD, ORA, ORP, and RA) groups using the HC_REM analysis described in Technical Report E.3.3-3 (Braatne et al. 2002); 2) describing predicted effects on the abundance and distribution of noxious weeds, non-native plants, and special status plant species; and 3) relating predicted changes in riparian vegetation groups to existing substrate type or to changes in erosion, deposition, or sediment transport that may also result from implementation of these scenarios.

Subsequent to FERC's AIR, IPC and FERC agreed to modify OP-1(g) analysis methodology (reference FERC's July 23, 2004 letter IPC). Specifically, IPC proposed to not use the HC_REM analysis, stating, "that the analysis reported in Technical Report E.3.3-3 is very time consuming to do and reports proportional changes, not acreages…is not capable of…simulating substrate changes." Rather, IPC stated they could provide acreage information for 13 cover types (4 riparian and 9 upland) by using the methods described in Technical Report E.3.2-40 (Blair et al. 2002) and summarized in Table 2 of Technical Report E.3.2-45 (Edelmann et al. 2002). IPC would add detail to the function of cover type predictions by describing potential increases or decreases to various plant assemblages that comprise existing cover types by consulting with discipline experts (Dr. Jeffery H. Braatne and Dr. Stewart Rood) to qualitatively assess potential vegetation changes that may occur under the additional operational scenarios. Further, IPC would qualitatively assess, with Dr. Jeffery H. Braatne and Dr. Stewart Rood, the effects of the additional operational scenarios on noxious weeds, non-native plants, and special status plants.

USFS 01

The USDA Forest Service disagrees with FERC's decision to modify the analysis method for OP-1(g) because the conceptual model employed by Blair does not account for the numerous environmental variables affecting riparian vegetation associated with a dynamic riverine system, reduces the number of riparian plant groups from 6 to 4, assumes the scour zone (below the MAWL) would not establish suitable wildlife habitat, and assumes changes in cover types would occur proportionally throughout the study area.

USFS 02

The HC_REM analysis (Technical Report E.3.3-3) provides a scientific methodology integrating model components of: germination & growth (including substrate), plant competition, inundation-induced mortality, desiccation-induced mortality, scour-induced mortality, time period, and time step. Additionally, there are specific parameters within the various subroutines (components) in HC_REM that simulate the establishment, growth and removal of riparian vegetation. The model was run using the riverbank geometry, and substrate conditions at 92-vegetation transects and mean daily historic

USFS 02 water-surface fluctuations as input variables. The authors compared the modeled vegetation pattern composed of the 6-life forms (FRA, FRP, HYD, ORA, ORP, and RA) with the observed vegetation pattern in the field collected at each of the 92-transects. This constituted the HC_REM calibration and verification process. Further detail of the calibration and verification process can be found in E.3.3-3. The USDA Forest Service supports the use of the HC_REM analysis, although the agency questions the use of the mean annual water level (MAWL) as the flow to model riparian vegetative responses to the operational scenarios. The MAWL is 20,695 cfs.

USFS 03 Conversely, the method employed by Blair et al. 2002 used a conceptual model projecting hypothesized cover type changes associated with river stage changes during summer months (1-July to 31-August) then projected proportional changes of current cover types relative to differences in area inundated between historic operations and IPC's two operational scenarios described in the Final License Application (FLA). Blair's conceptual model forms the basis for analyzing FERC's 6 operational scenarios and sub-scenarios, except proportional changes in cover types are estimated for each AIR scenario relative to existing conditions. Refinements of Blair's assumptions are outlined in IPC's response to OP-1(g) at 2.1.3.1.

The USDA Forest Service disagrees with several of these assumptions. Comments follow the numbering sequence in:

2.1.3.1 - Analysis Assumptions

USFS 04 1) Blair assumes the estimates of impacted acres in the shoreline zone from erosion and the crucial winter range zone would remain constant with implementation of each AIR scenario.

This is generally valid for the reservoir shorelines except for scenario 5. A new shoreline zone surrounding Brownlee reservoir would be formed as the reservoir level is held at the minimum operating pool year-round. Therefore, it could be assumed that the potential erosion impacts associated with a lower pool may be less.

It could also be assumed that with an increase in acreage from de-watering the fluctuation zone of Brownlee reservoir there would be an increase of available crucial winter range for mule deer. As detailed in Christensen 2001, the inundated areas of the Project reservoirs were crucial winter range for mule deer. However, IPC's discussion regarding vegetative composition of the fluctuation zone (section 2.1.4.1) does not consider active management to increase native vegetation species composition.

USFS 05 For the Snake River reach downstream from Hells Canyon dam, erosion in the shoreline zone will vary depending upon each AIR scenario and should be quantified accordingly. Reference IPC's Table 3 (page 43), the weighted average maximum-daily flows (cfs) for FERC's operational scenarios may be lower than the MAWL. Lower flow velocities may reduce the river's overall erosive capability.

USFS 06

3) IPC assumes that suitable wildlife habitat will not establish in the scour zone of the Snake River below Hells Canyon, therefore, the lowest down slope extent of vegetation in the river shoreline zone would not change from existing conditions.

This assumption is based on use of the MAWL. Depending upon the AIR scenario, daily and weekly water levels increase available shoreline, below the MAWL, for riparian vegetation establishment. The available shoreline between the MAWL and an AIR scenario must be modeled to account for some riparian vegetation establishment. While at the same time, modeling will most likely account for a reduction of facilitative riparian vegetation on the upslope boundaries of the established riparian zone.

USFS 07

4) IPC's assumption that a maximum-daily flow (for the Snake River below Hells Canyon dam) during the growing season are the parameters that best represent the interaction between operational scenarios and shoreline vegetation.

This assumption may not provide an accurate portrayal of shoreline vegetation response for the AIR scenarios. For example, *Salix exigua* can establish either by clonal or seed germination in the seedling recruitment zone. If the assumption were to use a minimum-daily flow with specific parameters for timing and duration of flow releases and recession, seedling root growth in the recruitment zone would be able to keep pace with the gradual flow stage decline. This species, once established indicates a large tolerance to withstand periods of inundation (Amlin and Rood, 2001). As indicated by Braatne 1999, *Salix exigua* populations along the Snake River between Hells Canyon dam and the Salmon River mouth, appear to be largely relict populations. He did not observe zones of active seedling or clonal recruitment. It could be hypothesized that using a minimum-daily flow to represent the interaction between operational scenarios and riparian vegetation, and staging the flows during the seed dispersal and germination, and root establishment periods for key riparian species, modeling may indicate an increase in riparian vegetation for the AIR scenarios.

USFS 08

7) IPC's assertion that, changes in the extent of a cover type was assumed to occur proportionally throughout a study reach does not account for the dynamic structure of a riverine system.

Hydrologic and geologic conditions, and scour and deposition rates over the 30-year projection would most likely change the vegetative cover types disproportionately. Very few things are proportional in a dynamic riverine system. For example, Dixon 2002, suggested that the magnitude and timing of flows during the growing season influenced the species composition, elevation distribution, and density of each year's seedling recruitment.

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USFS 23 IPC's conclusion regarding the expansion of salt cedar and several other undesirable riparian plants under full pool run-of-river operations and scenario # 5 is correct. All stakeholders involved with the Hells Canyon project acknowledge that regardless of operational scenario it's just a matter of time before noxious weeds and non-native plant populations expand throughout the project. However, there are active management opportunities that may be implemented over the next license term to retard salt cedar and other undesirable plant expansion.

2.1.4.5 - Special-Status Plant Species

USFS 24 As stated above, the USDA Forest Service disagrees with IPC's conclusion "the scour zone would not change, lower flows would cause a decrease in the irrigation effect and a corresponding loss in shoreline riparian vegetation." It is hypothesized that the riparian communities would shift physical location on the river shoreline based on lower flow operational scenarios, keeping pace with soil moisture. Management opportunities exist to change the magnitude, duration, frequency and timing of flow to pattern natural

USFS 24 streamflows to promote a biological diverse riparian community. Based on this concept, porcupine sedge, Schweinitz flatsedge and American wood sedge may not be negatively affected by lower flow scenarios.

2.1.4.6 - Substrate and Sediments

USFS 25 As outlined in the USDA Forest Service comments on OP-1(d), the agency describes several shortcomings with the assumptions, calculations, and presentation of the analysis. The approach of using a 2D model to (1) determine flow duration curves and (2) determine and define flows resulting in incipient motion at the four sandbars (for the specified 1 mm grain size) are probably appropriate and reasonably accurate. This modeling should be revised however, using the median sand size for each bar; and calculations should be revised as detailed in the agency's report. More complete documentation of sites and assumptions should be provided. The calculations of duration and extent of sand mobilization for the Proposed Operation and specified scenarios do not provide an adequate basis for interpreting differences between scenarios on sandbar mobility. A few changes in calculation procedures could provide much more robust determinations.

The calculations probably result in substantial underestimation of the potential erosion of median sand size as currently modeled and presented. It should also be noted that this approach - the critical tractive force approach—which was the logical analysis approach adopted by IPC given the request to determine incipient motion conditions—may not be relevant to other important erosional mechanisms affecting sandbars, such as sapping (owing to daily flow ramping cycles). The studies conducted so far as part of the relicensing effort have not provided sufficient information on the processes forming, maintaining, and eroding sandbars so that we can confidently and quantitatively predict their behavior on the basis of a single process model.

USFS 26 IPC in using OP-1(d) to assess and interpret changes in riparian vegetation due to sediment transport, such as increased sandbar erosion concludes relatively minor influences on sandbars. Given the USDA Forest Service descriptions of several shortcomings with the assumptions, calculations, and presentation of the analysis, IPC conclusions of minor influences on sandbars and very slight effects on interstitial sands may not portray actual processes.

USFS 27 Grams and Schmidt 1999, noted in 1964, approximately 46 acres of sand deposits in approximately 200 locations between Hells Canyon dam and the Salmon River. By 1973 the area of deposits had diminished to around 24 acres, and by 1982 it had shrank 50% again to around 13 acres. Possible future diminishment might be predicted based on the depletion between 1973 and 1982. In that time period the sandbars were reduced in size by 4%/year. Applying that to the 1973-present time period yields 6 acres, which is approximately what was assessed by IPC in their recreation survey. Applying it to the future 40 years shows that less than 1 acre of sand deposits would remain.

USFS 27 As IPC suggests, it is probable that a reduction in sand deposits is similarly applicable to interstitial sands. The reduction of interstitial sands may partially account for the lack of active *Salix exigua* seedling or clonal recruitment indicated by Braatne 1999.

2.1.5 - Conclusions

USFS 28 The purpose of FERC's AIR request is to describe riparian vegetative response to varying operational scenarios. By use of restrictive modeling assumptions, IPC has not provided an accurate description of riparian vegetative response. Although IPC's current flow regime may feature a sustainable relic riparian community, a more extensive riparian community, supported by natural conditions would be more diverse and robust, thereby providing more resiliency and greater value for associated wildlife.

Flow regimes that include abrupt flow increases or decreases, and flow pulsing effect riparian communities. The effects of these changes depend on their magnitude, duration, frequency and timing relative to the pattern of natural streamflows. The regular, daily pulsing of flows characteristically produced downstream by the Hells Canyon project can produce artifacts in channel geomorphology and the associated riparian communities.

USFS 29 IPC's conceptual model and its assumptions employed to calculate predicted acreage changes in riparian and upland cover types, appears to represent a GIS mapping exercise. The combined assumptions of no change in shoreline zone erosion and crucial winter range, no establishment of riparian vegetation below the scour zone (MAWL), maximum-daily flow, and proportional changes in cover types limit any scientific model to accurately project riparian vegetation responses to FERC's 6 operational scenarios and sub-scenarios. The sensitivity of seedling recruitment to flow pattern suggests that human management of flows may by used in a prescriptive fashion to intentionally manage or restore riparian systems (Rood and Mahoney 1990, Johnson 1994, Rood et al. 1998, Schmidt et al. 1998). An understanding of how vegetation recruitment is linked to headwater elevation (reservoirs) and flow (river) may be critical for restoring and managing structure and function in riparian ecosystems.

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