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March 11, 2005

E-FILING

Hon. Magalie Roman Salas
Secretary
Federal Energy Regulatory Commission
Room 1-A, East
888 First St., N.E.
Washington, DC 20426

**Re: Baker River Hydroelectric Project No. 2150; Comments on Report of Steward and Associates re: Environmental Effects of Additional Flood Control on the Baker River and Comments on Report of Pacific International Engineering (PIE) and Alexander Aaron, Inc. (Aaron), both submitted by Skagit County**

Dear Hon. Magalie Roman Salas:

On behalf of Puget Sound Energy, Inc. ("PSE"), enclosed for electronic filing, please find the following two documents commenting on reports submitted by Skagit County:

1. Comments on PIE Study, prepared by HDR for PSE, dated March 1, 2005, and

2. Comments on August 2004 report authored by Steward and Associates titled: "Environmental Effects of Additional Flood Control on the Baker River," prepared by R2 Resource Consultants, Inc. for PSE, dated March 11, 2005.

PSE provides these comments at this time for the following reasons;

a) The *Technical Memorandum – Analysis of Flood Control Storage at Baker River,* dated August 27, 2004 (PIE Study), was provided to PSE (just before PSE was required to file its Responses to FERC's Additional Information Requests 1-4 on August 30, 2004) and evaluated a 140,000 acre-feet flood storage option. The *Skagit*

*River – Flood Inundation Damage Reduction Upper and Lower Baker Dams,* dated June 2004, prepared by Alexander Aaron, Inc. (Aaron Memo) is referenced in the PIE Study. Since that time, the Baker River Hydroelectric Project Comprehensive Settlement Agreement ("Settlement") was completed, with Skagit County as a signatory. The maximum flood storage option identified in the Settlement would provide a total of 103,000 acre-feet of storage. However, because Skagit County has not since withdrawn the PIE Study and it may therefore be considered by the Commission, PSE provides these comments; and

b) The *Environmental Effects of Additional Flood Control on the Baker River*, dated August 2004 (Steward Report), was filed with the *Comments of Skagit County, Washington on the Baker River Project Relicensing Comprehensive Settlement Agreement on December 23, 2004.* The Steward Report evaluated a 150,000 acre-feet flood storage option, also in excess of the 103,000 acre-feet of flood storage in the Settlement. The Steward Report was not prepared according to the established protocols developed for the Commission approved alternative licensing process and therefore did not undergo technical review by the collaborative parties prior to its submission. As the level of storage evaluated in the Steward Report is not in the Settlement, PSE provides these comments.

Sincerely,

Pamela W. Krueger

Enclosures
cc: FERC Service List

# Comments on PIE Study

HDR

| | | | |
|---|---|---|---|
| **To:** | **Paul Wetherbee, Puget Sound Energy, Inc.** | **Date:** | **March 1, 2005** |
| **From:** | **David Williams, HDR**<br>**Steve Foster, HDR** | **Project:** | **Baker River Project** |
| **cc:** | | **Job No.:** | **22722** |
| **Subject:** | **Review of Technical Documents** | | |

## I. Introduction

The purpose of this memo is to present a review of two technical documents prepared separately by Pacific International Engineering (PIE) and Alexander Aaron, Inc. (Aaron). These two documents were submitted to the Federal Energy Regulatory Commission (FERC) in the relicensing proceedings of the Baker River Project. The documents are:

1. *Technical Memorandum – Analysis of Flood Control Storage at Baker River,* dated August 27, 2004 (PIE Memo)
2. *Skagit River – Flood Inundation Damage Reduction Upper and Lower Baker Dams,* dated June 2004, prepared by Alexander Aaron, Inc. (Aaron Memo)

Puget Sound Energy contracted with HDR Engineering, Inc. to review the documents listed above and evaluate the results of the flood control analysis presented in the documents based on the following:

- Appropriate use of assumptions to produce the results.
- Adequacy of the application of models as discussed in the two technical documents.
- Creditability of the findings.

The review was to concentrate on the PIE Memo due to the short time frame for this review.

Documents listed in the reference section of this memo were reviewed and used to support the review.

## II. Background

The Baker River Project (FERC No. 2150) consists of the Upper Baker and the Lower Baker Developments. Lake Shannon, formed by Lower Baker Dam, and Baker Lake, formed by Upper Baker Dam, are reservoirs managed for hydropower generation. Upper Baker Dam and reservoir are also managed at the direction of the Corps of Engineers for flood control. The Corps' authority for flood control regulation of the Baker River Project, provided by the project's FERC license, includes 16,000 acre feet (AF) for lost valley storage and 58,000 AF for federally authorized additional storage. A total of 74,000 AF of flood control storage between minimum flood control pool elevation 707.93 feet and normal full pool elevation 724 feet. Seasonal storage evacuation provides 16,000 AF of flood storage by November 1 and a total of 74,000 AF of flood storage by November 15. This

flood storage will be maintained as a minimum until March 1, except when storage is used for flood control. Authorized flood control regulation at Upper Baker must be initiated 8 hours before the natural (unregulated) discharge at Concrete reaches 90,000 cfs on a rising flood. A minimum discharge of 5,000 cfs is required during normal flood control operations.

The 50-year FERC license for the Project expires in 2006, and Puget Sound Energy (PSE) is presently involved in relicensing activities.

## A. Location

The Baker River Project is located in western Washington on the Baker River, a tributary of the Skagit River, approximately 28 miles east northeast of Mount Vernon, Washington.

## B. Physical Components

### Upper Baker Reservoir (Baker Lake)

- Normal full pool elevation: 724 feet
- Length: 10 miles
- Surface area: 4,985 acres
- Active storage: 184,256 AF (724 feet to 674.5 feet)
- Inactive storage: 50,000 AF

### Upper Baker Dam

- Concrete gravity structure 330 feet high with a roadway at the top, Elevation 732 feet, a spillway, penstocks, but no sluices.
- Spillway capacity is 50,000 cubic feet per second (cfs) at normal full pool elevation and 55,000 cfs at maximum surcharge storage pool.
- Spillway gates: 3 to 25 feet wide by 30 feet high tainter (radial) gates
- Other features include a two-unit powerhouse at the downstream right toe of the dam, two fish spawning bed structures, a fish collection barge moored in Baker Lake about 100 feet upstream of the dam, and two log booms providing drift control upstream of the project.

### Lower Baker Reservoir (Lake Shannon)

- Normal full pool elevation: 438.6 feet
- Length: 8.3 miles
- Surface area: 2,218 acres
- Active storage: 139,352 AF (438.6 feet to 370.0 feet)

### Lower Baker Dam

- Semi-gravity concrete arch structure 285 feet high with a center spillway section and left and right non-overflow sections at Elevation 439.87 feet.

- Spillway contains 23 gates, all 14.5 feet high. Two gates near the right bank are 10.2 and 10.4 feet wide, while all others are 9.4 feet wide. The total discharge capacity at normal full pool is 41,000 cfs.
- Other features include a powerhouse located on the left bank about 1,200 feet downstream from the dam. The powerhouse contains one vertical shaft Francis turbine served by a pressure conduit tunnel 22 feet in diameter, a surge camber, and a 16-foot diameter penstock. Fish passage is provided by a barrier dam and a fish trap on the left bank downstream from the dam for upstream migrants, and a fish collection barge similar to the one in Baker Lake for downstream migrants.

# III. Analyses of Basic Assumptions

## A. Reservoir Operation

Outflows from Baker Lake assumed in the PIE Memo will be reduced to the minimum flow of 0 cfs, instead of the 5,000 cfs currently released, when Skagit River flow at the Concrete gauge reaches 90,000 cfs, (PIE Aug. 27, 2004). This is consistent with the Settlement Agreement, (Settlement-2004), but not the current flood control operation, (USACE Water Control Manual. June 2000).

## B. Levee Failure Modes and Location

The PIE study assumed no levee failure or overtopping of levees. This was based upon a potential future condition that assumed the levees were properly constructed and/or upgraded to the highest flood levels simulated. Although PIE states that the County plans to modify or rehabilitate the levees, there is no discussion of when, how it would be funded, or definitive locations. The Corps used three scenarios for levee failure (worst case, average case, and best case) and each of these should have been analyzed by PIE. There is insufficient information to assess the proper location of the levees.

## C. Operational Delays and Failures

The agreement with PSE and the Corps says that outflows from Baker Lake must be maintained equal to the inflows until 8 hours before the Skagit River flow at the Concrete gauge is **forecasted** to reach 90,000 cfs, and then the outflow is to be dropped to a minimum of 5,000 cfs. We assume that the forecast would be made by the National Weather Service, Northwest River Forecast Center. This situation was modeled by PIE; however, the reservoir simulations did not consider any delays in responding to the 8-hour prediction. Operation of reservoirs, especially in tandem with short distances between reservoirs, is often not optimum due to delays in relaying information, maximum and minimum rates of gate opening and closing, implementation chains of command, human errors, and for numerous other reasons. Also, problems are often encountered such as gates and gauge levels getting stuck, instruments giving erroneous output, debris loadings at gates, etc. Because of operational delays and failures, uncertainty analyses should be conducted before any conclusions are made about the effectiveness of reservoir operations.

## D. Operational Assumptions

As a basis of its HEC-5 modeling, PIE used "provisional" synthetic hydrographs provided by the Corps in April 2004. These hydrographs are to be scrutinized through the Corps' Technical Review (ITR) process and any revisions may affect the modeling results.

Indications from Tetra Tech's review of the Corps' hydrology show that the revisions may be extensive.

### E. Institutional and Regulatory Constraints

The operation assumed by PIE would provide a minimum release of 100 cfs at Lower Baker during flood control operations and allow rate of change flows from both Baker Lake and Lake Shannon at 5,000 cfs per hour. Both provisions would not meet the institutional and regulatory constraints proposed in Article 107 as described in the Settlement Agreement, but would cause little change during a flood control operation.

### F. Physical Constraints

The PIE HEC-5 simulations included assumptions that the Lower Baker Dam would operate three new lower and larger spillway gates. The physical limitations (structural and timing of design and construction) were not discussed. For instance, the dimensions of the proposed gates may not be compatible with the structural integrity of the existing dam. Approval of modifications by FERC and resource agencies (e.g., approval of environmental documents), design, plans and specifications, and construction phasing at times of low reservoir levels could delay implementation of the gate modifications such that the flood damage reduction analysis could become obsolete.

### G. Risk and Reliability Analyses

As previously recommended, uncertainty analyses should be conducted in relation to operational delays and failures. In addition, uncertainty analyses should be made in relation to the hydrology, the hydraulics in terms of the flood routing, and the damage reduction assessment in accordance to the Corps' *Engineering Manual 1110-2-1619, Risk Based Analysis for Flood Damage Reduction Studies* (http://www.usace.army.mil / publications/eng-manuals/em1110-2-1619/toc.htm). *Some of this can be performed* using HEC-FDA; however, PIE included no discussions on the uncertainty parameters used in the hydrology, hydraulics, or damage prevention assessment. The closest analysis of this type was the use of 140,000 AF of additional storage for optimum storage (the range cited was between 130,000 and 140,000 AF), utilizing the upper part of the range to account for uncertainty.

## IV. Analyses of PIE Model Applications Used

### A. HEC-5

The reservoir operations were made using HEC-5. The Hydrologic Engineering Center (HEC) has issued HEC-ResSim (current Version 2.0, September 2003), which was designed to succeed HEC-5. Since HEC-ResSim has more capabilities than HEC-5, why were the HEC-5 models not converted to HEC-ResSim? New capabilities of HEC-ResSim are described at http://www.hec.usace.army.mil/publications/HEC_Newsletter_Summer2004.pdf. The PIE scenarios are within the capabilities of HEC-5; however, HEC-ResSim is computationally more robust and would not need some of the computational "crutches" that are often needed in HEC-5 (such as changes in time steps) and that could affect the results.

### B. UNET/HEC-RAS

It appears that HEC-RAS was used to route the floods and incorporate parts that were originally modeled by UNET. However, the Corps' report mentions the use of FLO-2D in

conjunction with HEC-RAS. It is uncertain how the models were used together and if there were continuity checks (flux rates and total volume) between the models. As previously mentioned, the levees were not allowed to fail or be overtopped. The routing also assumed that there were no debris buildups at bridges. These assumptions underestimate the flood storage, and could cause the flood routing to overestimate the peaks as well as affect the timing of the peaks. The overall result would be to overestimate the economic benefits of additional storage.

### C. PIE Initial Model Conditions

Initial conditions for the HEC-5 models appear to be reasonable.

### D. PIE Model Choice - Ability to Simulate Physical Conditions and Scenarios

The PIE applications of HEC-5 and HEC-RAS are within the capabilities of these models.

### E. Reasonableness of Model Results

For the inputs specified by PIE for HEC-5 and HEC-RAS, the model behaved as expected given the model input.

## V. Analyses of Conclusions of the Studies

### A. Analyses of Optimization Conclusion

#### Flood Damage Reduction

The PIE Memo develops flood reduction benefits by comparing the current flood control operation with various storage scenarios. Each scenario assumes that the flow in the river is contained within the levees and no failure or overtopping would occur. The result of this analysis is to overestimate the river stages produced in each scenario. When the increased river stages are used as input to the HEC FDA model, described in the Aaron Memo, the flood damage estimates and resultant benefit computations tend to be higher.

#### Selection of a Storage Alternative

The PIE Memo contains the statement: "The evaluation demonstrates that the combination of additional storage should total 140,000 AF to obtain benefits on an incrementally justified basis" without consideration of costs or net benefits. A complete economic analysis must consider the cost of providing the benefits, and selection of an alternative is normally done by maximizing net benefits. The memo does not describe the methodology used to select the flood control storage or demonstrate justification. Costs associated with providing the flood control storage options were ignored, but the selected alternative was referred to as justified. Costs related to:

- Upgrading of spillways;
- Gate modifications;
- Environmental mitigation;
- Power generation loss due to keeping reservoirs lower to reserve storage for flood control;

- Power generation loss during upgrades; and
- Operational costs related to providing flood storage from the two reservoirs in tandem;

must be considered to determine the incremental justification and optimization.

## B. Comparison of Conclusions from Similar Projects/Studies

The Tetra Tech, Inc. 2004 *Draft Memorandum* addressed a very similar objective: flood damage reduction provided by the Baker River Project. The following are differences between the PIE memo and the Tetra Tech, Inc. 2004 memo:

- The Tetra Tech evaluation incorporated a methodology to determine when levee failure and resultant overbank flow into the floodplain would occur. Levee failure has occurred historically at the modeled flows and has a significant impact on the predicted water surface elevations. PIE modeled the system without levee failure or overtopping.
- The Tetra Tech evaluation considered configurations of Lower Baker Dam with and without new gates in place. PIE considered only Lower Baker with new spillway gates positioned at a lower crest elevation to access more flood control storage. A full optimization analysis must consider the benefit and cost of both configurations before reaching a conclusion.

# VI. Summary and Conclusions

PIE's evaluation of the Baker River Project's potential contribution to flood control in the Skagit River Basin presents a narrowly focused assessment of added flood control storage. The proposed flood control operation used by PIE was defined for maximum flood control from storage with minor consideration of mandatory fish flows and drawdown restrictions contained in the Settlement Agreement.

Models were run with simplified assumptions such as no levee failure or overtopping and no debris buildup at bridges, which both exaggerates the estimate of flood damages for each scenario and tends to overstate benefits. The analysis was performed using a model that has been subsequently reviewed by an independent team of experts, who recommended several significant corrections.

The PIE memo presents an incremental analysis and maximization of alternatives leading to a selected alternative, without considering costs. The benefits presented form only a part of an optimization and selection process. The PIE analysis is incomplete and must address costs, sensitivity analysis, various levee failure modes, risk and uncertainty, operational constraints, and other first-added flood control measures to adequately identify the selected alternative. The data presented in the PIE memo may be useful as part of a full analysis, but is incomplete and narrow in its focus and should not be considered an adequate basis for a conclusion.

# References

Pacific International Engineering, PLLC. – 2003. *Assessment of Additional Flood Control Storage at Baker River Project – Draft Technical Memorandum.* April 9, 2003.

Pacific International Engineering, PLLC. – 2004. *Assessment of Additional Flood Control Storage at Skagit River Project – Technical Memorandum.* April 15, 2004.

Pacific International Engineering, PLLC. – 2004. *Baker River Dams Storage Evaluation – Numerical Modeling of Historic Flood Events – Draft Executive Summary.* January 15, 2004.

Settlement – 2004. *Baker River Hydroelectric Project, FERC No. 2150 – Baker River Hydroelectric Project Comprehensive Settlement Agreement.* Prepared for Puget Sound Energy. November 24, 2004.

Puget Sound Energy – 2002. *Baker River Project Relicense, FERC No. 2150 – Initial Consultation Document.* March 2002.

Skagit County Public Works Department – 2004. *Additional Flood Control Storage – Baker Project Reservoirs – Supporting Documents.* Submitted to the Baker Project Relicensing Policy Team. September 8, 2004.

Tetra Tech, Inc. – 2004. *Technical Review of the Hydrology and Hydraulics for the Skagit River Flood Damage Reduction Study – Memorandum.* Prepared for Puget Sound Energy. June 18, 2004.

U.S. Army Corps of Engineers (USACE) – Seattle District – 2000. *Baker River Project – Baker River, Washington – Water Control Manual.* June 2000.

U.S. Army Corps of Engineers (USACE) – Seattle District – 2001. *Baseline Economic Report – Skagit River – Mount Vernon, Washington.* August 2001.

U.S. Army Corps of Engineers (USACE) – Seattle District – 2002. *Skagit River Flood Damage Reduction Feasibility Study – Skagit County, Washington – Draft Baseline Economic Report.* December 2002.

U.S. Army Corps of Engineers (USACE) – 2004. *Skagit River Basin – Skagit River Flood Damage Reduction Feasibility Study – Draft Report.* May 2004.

U.S. Army Corps of Engineers (USACE) – 2004. *Skagit River Basin – Skagit River Flood Damage Reduction Feasibility Study – Draft Report.* August 2004.

# Appendix A

## Chronology of Events

| Report | Date | Improvements or Actions Considered/ Addressed | Recommendations / Status |
|---|---|---|---|
| House Document 95-149, 95th Congress 1st session | May 9, 1977 | Flood control storage at Upper Baker | Recommended operation of the Upper Baker Project to provide 74,000 AF of flood control storage. |
| Skagit River Washington, Flood Damage Reduction Study Reconnaissance Report | April 1993 | Basin flood control including the Samish River bypass channel and levee improvements | Recommended improved levees that would protect the towns of Burlington, Mount Vernon, and west Mount Vernon from a 100-year flood event, and construction of overflow levees in rural areas. |
| Initial Consultation Document, Baker River Project Relicense FERC No. 2150 Puget Sound Energy | March 2002 | Prerequisite to filing a new FERC license application | Initiate consultation with federal and state resource agencies and affected Indian tribes. |
| Baker River Hydroelectric Project, FERC No. 2150-33 Baker River Hydroelectric Project Comprehensive Settlement Agreement | Nov. 24, 2004 | PSE's filing with the Commission as PSE's Offer of Settlement. Requests that the Commission incorporate the Proposed License Articles without modification, in conformance with the Sponsoring Parties. | Article 107 "Flood Storage" contains: 74,000 AF flood control storage at Upper Baker. 29,000 AF flood control storage at Lower Baker provided acceptable by Corps of Engineers and licensee is compensated. Licensee report in 3 years on operational changes developed as a result of consultation. |

R2 Resource Consultants, Inc.

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March 11, 2005

To: Cary Feldmann, Puget Sound Energy, Inc.

From: Phil Hilgert and Sue Madsen, R2 Resource Consultants, Inc.

Subject: Comments on August 2004 report authored by Steward and Associates titled: "Environmental Effects of Additional Flood Control on the Baker River"

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This memorandum describes our review of the document: *Environmental Effects of Additional Flood Control on the Baker River* prepared by Steward and Associates for Skagit County Public Works. The Steward and Associates report was submitted to the Federal Energy Regulatory Commission in January 2005. The stated intent of the report was to assess the environmental effects of increasing annual flood storage at Puget Sound Energy's (PSE) Baker River Project (FERC No. 2150) to a total of 150,000 acre-feet by October 15. We find their conclusions to be speculative and unsubstantiated either by documentation or by use of the best available evidence.

Their evaluation of the environmental effects of additional flood storage failed in several major areas including:

1) Skagit River Basin Flood Control options and effects – Steward and Associates failed to consider other flood control options in the Skagit basin and the effects of those options. The Corps of Engineers are currently evaluating other flood control options in the Skagit River basin including setback levees, Mount Vernon floodwall, ring-dikes, additional flood storage at Seattle City Light's Skagit River Project, and non-structural measures (USACE 2004). The effects of other Skagit Basin flood control options must be considered to place in context the acceptability of adverse environmental impacts associated with increased flood storage at the Baker Project. These alternate options offer downstream flood protection and may have less adverse environmental impact than increased flood storage at the Baker Project. Steward and Associates' failure to consider other Skagit basin flood control options could lead to loss of salmon that would otherwise be avoided.

2) Baker River Basin Flood Control options and effects – Steward and Associates only considered one option for increased flood storage volume and timing at the Baker Project. For instance, evaluation of flood storage volumes should have included several increments of storage volume including the baseline condition of 74,000 acre-feet, and specifically the option of 103,000 acre-feet of total storage recommended for evaluation in the settlement agreement and outlined in proposed License Article 107:Flood Storage. Evaluating operational start dates other than October 15 would have identified

opportunities to provide flood protection while minimizing adverse environmental impacts.

3) Best Available Science – Steward and Associates failed to use best available science. The document did not use quantitative habitat modeling tools developed specifically to support Baker Relicensing instream flow and reservoir operations decisions. The aquatic habitat analysis tools were collaboratively developed by tribal, federal, state, and local resource agencies and non-governmental organizations. Details of the habitat models and working group agreement to critical modeling assumptions were documented in handouts and meeting records of the Baker Aquatic Resources Working Group. Skagit County participated in the near monthly meetings of the Aquatic Resources Working Group and participated in the instream flow technical meeting in June 2004 where tentative agreement was reached on a flow and reservoir operations scenario. Failure to use quantitative evaluation tools led to speculation regarding operational effects rather than technical analyses to support flood storage decisions.

   Steward and Associates also failed to use best available science by ignoring the effect of increased Baker flood storage on the complement of Protection, Mitigation and Enhancement measures (the Proposed License Articles) included in the Baker Settlement Agreement. Settlement Agreement measures were the result of years of study and discussion among the various working groups. Over 170 different operational scenarios were run through the HYDROPS operations model. This painstaking effort of research, review and discussion culminated in the Settlement Agreement designed to protect multiple resource interests in the Baker Basin and downstream Skagit River habitats. Steward and Associates did not identify which of the proposed License Articles can be achieved, and which measures are compromised by the 150,000 acre-feet of flood storage scenario. By not incorporating the proposed License Articles in their review of 150,000 acre-feet of flood storage, Steward and Associates did not provide information that could be used to support Corps of Engineers decisions on increased flood storage or FERC relicensing decisions.

R2 believes that options to avoid or minimize environmental impacts of increased flood storage must be explored, and where impacts are unavoidable, appropriate measures must be proposed to mitigate those impacts. Conclusions regarding the net environmental effect of alternative flood control measures must use best available science. Moreover, Steward and Associates admits that their assessment was "substantially qualitative" (pg 5). Consequently, the subject report does not meet minimum standards for analysis of effects for a proposal of this magnitude.

## 1.0 BACKGROUND

Since 2001, R2 Resource Consultants have provided technical support to the Baker Aquatic Resources Working Group and the Instream Flow Technical Subgroup during relicensing of Puget Sound Energy's Baker River Hydroelectric Project (FERC No. 2150). At the request of

the Aquatic Resources Working Group, R2 staff have been involved in developing and implementing over a dozen technical aquatic studies designed to assess the effects of Baker River Project operations on reservoir and downstream aquatic habitats. We have prepared biological assessments of the effects of Baker Project hydropower operations on aquatic species listed under the Endangered Species Act and have participated in formal and informal consultations with the FERC, NOAA Fisheries, USFWS and PSE regarding the environmental effects of Baker Project operations.

In support of Project relicensing R2 has conducted analyses including quantitative assessment of middle Skagit River salmonid spawning and incubation, ramping rates, varial zone, side-channel and off-channel connectivity, salmonid rearing and indices of hydrologic alteration. We also conducted technical studies designed to evaluate Project effects on the Upper Baker River delta, Lower Baker River alluvial fan, Baker River basin tributaries, distribution of bull trout, recruitment of large woody debris, basin hydrology, and fluvial geomorphology. We conducted these studies in collaboration with, and often accompanied by staff from tribal, federal, state, local agencies, non-governmental organizations and the utility. We presented the results of these studies during relicensing meetings and engaged in frequent discussions regarding the technical merit of various analyses and responded to suggestions for modifications as the studies proceeded. This close involvement has provided us with an appreciation of and expertise in the complexity and challenges surrounding successful integration of multiple resource values at the Baker Project.

As part of our review of the Steward and Associates report, we evaluated the quality and sufficiency of their efforts in the context of our experience and familiarity with basin aquatic resources, hydrology and Project operations. General evaluation weaknesses or data gaps are discussed in Section 1.1 below. Comments specific to the analysis of the Hydrologic and Physical Effects of Flood Control are provided in Section 2 following the same numbering system used in the Steward and Associates report. Comments specific to their Reservoir Impacts Analysis are provided in Section 3, and comments specific to their Downstream Effects Analysis are provided in Section 4.

## 1.1 General Comments

Since the start of working group meetings in early 2000 through reaching Settlement Agreement in November 2004, relicensing of the Baker River Project has been a very open and collaborative process (WDFW letter to the FERC dated December 22, 2004). However, the review of the environmental effects of increased flood storage at the Baker Project provided by Steward and Associates did not undergo the collaborative development nor the peer review received by every other study effort associated with the relicense. The almost monthly meetings of the Aquatic Resources Working Group provided ample opportunity for discussion and agreement on process and assumptions. Had the work been exposed to such scrutiny, many of the flaws in the methods and analyses could have been disclosed before the report was drafted. Steward and Associates

did not provide access to the work until the August 2004 working group meeting at which they presented a 35-page summary of their review.

At this time, the working group provided comments on obvious errors and data gaps during the meeting www.pse.com/hydro/baker/meetings/2004/aquatic20040812notes). Despite notification of these errors, Steward and Associates did not modify their report or respond to comments.

In addition to the comments noted in response to their August 2004 presentation, a more comprehensive review revealed significant data gaps and weaknesses which include:

- Steward and Associates failed to identify effects associated with the distribution of flood storage between Baker Lake and Lake Shannon. Based on their comment that Lake Shannon "would likely become an integral part of the flood-protection system" (page 5), it is apparent that they did not evaluate a clearly defined proposal for additional flood storage. The magnitude and type of adverse environmental effect of increased flood storage depends on the volume and timing of reservoir evacuation. Defining the proposed action (i.e., timing and volume of evacuation of each reservoir) is a basic requirement of environmental analysis.

- Steward and Associates did not properly evaluate the effects of proposed License Article 107:Flood Storage, which would provide a total of 103,000 acre-feet of flood storage by adding 29,000 acre-feet of flood storage at Lake Shannon.

- Steward and Associates failed to consider the 103,000 acre-feet flood storage proposal and therefore ignored potential opportunities to avoid or minimize adverse environmental effects associated with the 150,000 acre-feet storage proposal they analyzed.

- Steward and Associates failed to properly quantify downstream impacts. This would have required hourly hydrographs of Baker Project releases under flood storage operations; using the habitat modeling tools developed during Baker relicensing studies. These tools were available but not utilized.

- Steward and Associates failed to analyze the effects of increasing the volume and advancing early fall flood storage on other environmental protection measures collaboratively developed by the Baker Aquatic Resources Working Group (see Proposed License Articles 101 and 106). Ignoring these Settlement Agreement measures could cause loss of salmonid habitats that would need to be mitigated. Steward and Associates failed to identify or acknowledge measures such as:

    - No confirmation that the 150,000 acre-feet of flood storage can be evacuated by October 15 while meeting the generation, flow and reservoir rule curve constraints. The maximum generation flow and recreational pool levels were identified in the Settlement Agreement as necessary to balance multiple resource interests. Steward and Associates should have confirmed that those operational

constraints could be universally met before speculating that impacts of increased flood storage are "largely insignificant and discountable."

- The ability to meet minimum instream flow requirements during late October and early November droughts. Under proposed License Article 106, minimum flow releases from the Lower Baker Development would increase from 80 cfs to 1,000 cfs or greater depending on the month. Failure to maintain minimum flows during late fall droughts would compromise one of the primary salmon protection measures identified in the Baker relicensing Settlement Agreement.

- No evaluation of how the proposed 150,000 acre-feet of reservoir evacuation will reduce the expected increase in sockeye rearing requirements. Incremental increases in sockeye fry recruitment are proposed to take advantage of available reservoir productivity (see proposed Article 101). These expected benefits of the Settlement Agreement are threatened by the use of reservoir storage for flood control instead of sockeye production.

- Steward and Associates failed to address the impacts of their suggested "mitigation opportunities" on other aquatic resources. For example, they propose early spring reservoir refill as mitigation for loss of aquatic productivity associated with decreased reservoir volume, but their proposal did not address downstream impacts during an accelerated refill period, effects of rapid refill on amphibian reproductive success in the reservoirs, nor, potential loss of sockeye smolts due to increased risk of springtime spill during the sockeye outmigration season.

- Steward and Associates failed to properly assess the relative importance of flood control in the context of multiple and competing uses. Instead their analysis assumes that flood control is the primary purpose of the Baker Project and in so doing they effectively disregarded impacts to power production, fisheries, recreation, and other important interests.

- Steward and Associates did not address the effects of increased flood storage on increasing residential and commercial floodplain development. Increased flood storage may encourage floodplain development that in turn causes secondary impacts to aquatic resources[1].

[1] As background research into the potential effects of increased floodplain development associated with increased flood storage, at the Baker Project, R2 reviewed the September 1976 U.S. Army Corps of Engineers document titled: *Final Environmental Impact Statement for Additional Flood Control at Upper Baker Project.* That document provided the initial environmental review of the existing level of flood storage at the Baker Project. In their 1976 Environmental Impact Statement, the Corps of Engineers evaluated basin-wide flood control alternatives and incremental changes in the volume of additional flood storage at the Baker Project.

In their analysis, the Corps of Engineers (USACE 1976) considered several alternatives, including Alternative 2, Flood Plain Management Alone, which relied on nonstructural measures to lessen future potential loss of lives and property susceptible to flood damage. Under Alternative 2, flood proofing would be applied to all future development in the floodplain, and new construction would be severely restricted if not precluded in designated floodway areas. The main effectiveness of Alternative 2 in the 1976 EIS would have been to control future floodplain developments. Alternative 2, by itself, did not provide sufficient protection for developments already existing in 1976. Therefore, Alternative 2 was combined with a proposal for an additional 58,000 acre-feet of flood storage for a total of 74,000 acre-feet of flood storage at the Baker Project. As part of the agreement, Skagit County Commissioners committed to implementing the floodplain management portion of the recommended plan and prevent future unwise or undesirable development in flood hazard areas. "Flood proofing would be applied to all future development in the floodplain. In most cases, this would involve placement of fill and constructing the ground floor of structures above the 100-year flood level" (Section 6.1.2, Corps of Engineers FEIS). In response to a specific question regarding commitments to future land-use control, the Corps of Engineers noted in 1976 "Skagit County Commissioners have agreed to control development in flood hazard areas as a precondition to implementation of this proposal" [58,000 acre-feet of flood storage at Baker Project].

Twenty-eight years later, Skagit County has asserted that "the Skagit River floodplain has the highest risk for a major flood disaster than anywhere in the western United States." An analysis of increasing flood storage at the Baker Project must consider the effect of the perceived increase in floodplain security on pressure to build in flood-prone areas. Increasing flood storage at the Baker Project will likely lead to increased residential and commercial floodplain development. Similar to the requirement that the Federal Emergency Management Agency must consider indirect impacts of flood insurance on Puget Sound Chinook salmon, analysis of increased storage at the Baker Project must consider indirect impacts of increased flood storage on floodplain development. Steward and Associates failed to address the environmental impacts of floodplain development.

# 2.0 HYDROLOGIC AND PHYSICAL EFFECTS OF FLOOD CONTROL

## 2.1 Flood control effects on reservoirs

- [Page 1, paragraph 4] Steward and Associates noted that reservoir pool levels would generally be lower from September through November; however, they did not analyze specific pool levels resulting from the proposed increased flood storage volume. Information on specific reservoir pool levels under a range of hydrologic conditions is basic to an understanding of operational impacts and is needed to reach conclusions regarding environmental impacts.

- [Page 2, paragraph 1] The Aquatics Resource Working Group (the Collaboration participants) used hourly hydrology developed as output from the HYDROPS operations model for specific years as input to aquatic habitat models. Weighted average values of the habitat model results were used to make cross-scenario comparisons of environmental impacts. Once evaluation of the model results identified potentially acceptable scenarios, a 12-year continuous hourly record was analyzed to confirm expectations. Steward and Associates used weighted average annual hydrology rather than habitat model output to assess project effects. Use of weighted average hydrology masked adverse environmental impacts and led to erroneous conclusions.

- [Page 5, paragraph 1] Steward and Associates indicated that they should have conducted a quantitative assessment, but acknowledged that they did not. They note that their review was substantially qualitative. Quantitative models, such as salmon spawning, incubation, rearing, and off-channel habitats were used when evaluating instream flows and reservoir operations during the Baker relicensing process. A similar analysis could have, and should have, been conducted to evaluate effects of increased flood storage. Steward and Associates failed to use best available science and because they did not, their conclusions were at least premature and likely erroneous.

- [Page 5, paragraph 1] Steward and Associates noted that they needed, but did not use, an operational model to simulate Project releases under increased flood storage volume. R2 agrees that simulations of hourly hydrographs of the lower Baker River under increased flood storage should and could have been conducted. Habitat models used to evaluate operational alternatives during Baker relicensing were designed to use hourly hydrographs of the lower Baker River as input. Steward and Associates proceeded without this information thus their conclusions were unnecessarily speculative.

## 2.2 Flood control effects on downstream conditions

- [Page 5, paragraph 3] The report notes that beginning drawdown earlier and achieving lower target reservoir elevation means that fall flow releases will generally be higher than

for current conditions. However, a quantitative analysis of the sustainability of fall flow releases throughout the spawning season in years with fall droughts is absent. Therefore, conclusions presented in Chapter 4 are without support. The quantitative assessment should have taken into account increased minimum flow requirements, maximum generation flows and minimum reservoir pool levels. These conditions were formally identified in the November 2004 Settlement Agreement (but had been adopted by the collaborative parties months before in May 2004). They did not utilize these understandings for their report.

- [Page 6, paragraph 2] Steward and Associates failed to quantify the effect of post-flood reservoir evacuation on prolonging the duration of flood events. These effects increase the frequency and duration of smaller magnitude high flow events. A quantitative analysis of the effect of flood magnitude, duration and frequency, including the magnitude and frequency of spill at the Baker Project is required to properly conduct the environmental analyses presented in Sections 3 and 4.

- [Page 6 paragraph 5] Steward and Associates speculated that even with the proposed addition of two additional turbines at the Lower Baker Development, it would be difficult to achieve the proposed level of reservoir evacuation by October 15 without substantial spill. Without quantifying the size, timing and frequency of this "substantial" spill, they conclude that the adverse effects are "largely insignificant and discountable." Spill causes a variety of adverse environmental impacts and Steward and Associates' failure to address these impacts indicates they failed to comprehend the significance of this issue and the substantial effort the Baker Aquatic Resources Working Group exerted to avoid and minimize spill events (see proposed License Article 106:Flow Implementation).

- [Page 8, Table 2-4] It is unclear what the data source is for Table 2-4. If USGS recorded data were used (as the 1925-2002 period of record would suggest), the data set combines periods of different water control procedures at both the Baker River and Skagit River Projects. The data set would not reflect future conditions and would therefore, lead to erroneous conclusions.

- [Page 10, paragraph 1] Comparison of mean seasonal flow exceedance values understates the risk of environmental impacts, since it only takes a brief period (days) to reduce flows and impact incubating salmon eggs. The effects of these short-term events are lost when aggregated in exceedence statistics. Extreme low flow conditions during winter months are typically associated with short periods of cold weather and may not be correlated to wet or dry conditions defined by average 3-month runoff. Steward and Associates should have considered the adverse consequences of short-term low flows on incubating salmon eggs but did not.

- [Page 10, paragraphs 3 and 4] Steward and Associates notes that minimum instream flow and ramping rate constraints identified in the flow implementation plan (proposed License Article 106) will substantially affect the management of project reservoirs during

springtime refill. However, they did not model springtime refill conditions and thus, their conclusions are not supported.

## 3.0 RESERVOIR IMPACT ANALYSIS

### 3.1 Reduced juvenile fish passage success during refill

- [Page 12, paragraph 7] Steward and Associates suggest that their springtime "aggressive refill program" could be implemented to mitigate for adverse effects of increased flood storage. However, they did not simulate proposed instream flow and reservoir pool levels under springtime refill conditions and thus, their suggestion of net environmental benefit is hopefully speculative, but unsupported by technical analysis. They did not consider the flow management measures developed by the Baker Aquatic Resources Working Group to protect aquatic resources (see proposed License Article 106), and did not consider other impacts such as loss of power production during cold weather and loss of sockeye smolts through increased spill.

### 3.2 Reduction in fish habitat for rearing in the reservoir due to decreased volume, leading to lower fish numbers

- [Page 13, paragraph 2 and 3] Steward and Associates discuss the effects of reducing reservoir volume during the winter on sockeye productivity, but fail to assess the impacts of an early September drawdown to achieve increased flood storage by October 15. Zooplankton abundance and water temperatures above 7°C drive sockeye production (Koenings and Burkett 1987), and September and October are both important months for sockeye productivity in Baker Lake (Mazumder 2004). These highly productive months would be impacted by the early drawdown but this was not assessed.

- [Page 13, paragraph 4] Steward and Associates state that loss of reservoir volume is acceptable since Baker Lake could potentially support 2-3 times more sockeye fry. However, this fails to consider the future production initiatives adopted by the Settlement Agreement. The Baker Aquatic Resources Working Group identified the potential to increase sockeye production, and proposed License Article 101:Fish Propagation was developed to incrementally increase sockeye fry plants to make full use of the potential production of the reservoirs. Thus, the exchange of increased flood storage for future sockeye production is a clear adverse impact and should have been addressed as a mitigation need.

- [Page 13, paragraph 5] Quantitative data and evaluation of changes in reservoir pool levels and processing of hourly flows through downstream habitat models under an "aggressive refill" program should be provided before the measure is considered to provide net environmental benefits.

### 3.3 Reduction in fish food supply, due to reduction in euphotic zone volume

- [Page 14 paragraph 2] The Steward and Associates analysis should have considered the effect of changes in euphotic volume in light of proposed License Article 101:Fish Propagation, which was designed to increase the density of sockeye juveniles. Reductions in reservoir rearing habitat must either be shown to have no impact on proposed License Article 101, or an acceptable level of mitigation identified through collaborative study with affected stakeholders.

### 3.4 Spawning success for fish in the drawdown zone, both on lakeshore and tributaries

- [Page 17 paragraph 1] Steward and Associates assume that having the reservoir lower at start of sockeye spawning will reduce "drawdown effects." Flood control operations result in ongoing cycles of reservoir refill during floods and post-flood evacuation. To be meaningful, Steward and Associates should compare the maximum reservoir elevation during flood control season with and without 150,000 acre-feet of additional flood storage. Conclusions regarding effects of additional storage volume on sockeye spawning are unsupported. The analysis should have evaluated both potential impacts and potential benefits. Expanding the analysis to include other storage volumes may identify opportunities to avoid or minimize adverse effects.

- [Page 17, paragraph 3] Steward and Associates overstate the potential benefits of early reservoir drawdown on sockeye spawning and incubation. They state that 95% of sockeye spawning occurred on natural beaches; however, data on historic spawning are limited and often contradictory. For example, a memo on early Baker Lake fisheries suggested that up to 25 percent of the sockeye spawned upstream of Baker Lake (Buck, H.H. 1899).

- [Page 18, paragraph 1] Steward and Associates should also acknowledge and address the possibility that providing increased riverine habitat in the drawdown zone early in the season will provide an "attractive nuisance" to spawning fish. Redds constructed in the drawdown zone are exposed to increased scour during floods, sedimentation and adverse water quality during surcharges, and subsequent drawdown-related scour during post-flood evacuation to flood storage target elevations.

- [Page 18, paragraph 2] Given the dynamics of flood-related scour, installing instream structures and creation of meanders is unlikely to provide positive environmental benefits that could be used as mitigation. Delta landforms, which form within the lake at all tributary outlets regardless of size, represent areas of net sediment accumulation. Despite the fact that reservoir levels are reduced for flood control, deposition typically occurs above the flood storage pool elevation when the reservoir is surcharged to capture floodwaters at the same time that large quantities of sediment are delivered. During surcharges, sediment deposits within the channel, and would bury large wood or boulders

placed to stabilize the banks. Channels frequently migrate laterally across delta deposits in response to deposition within the channels.

### 3.5 Increased predation on fish in reservoirs due to reduced volume

- [Page 18, paragraph 4] Steward and Associates cite current belief that the reservoirs are not fully utilized by juvenile salmonids; however, the number of sockeye fry released to the reservoirs will increase substantially under proposed License Article 101:Fish Propagation. Their analysis of the effects of increased flood storage on predation impacts should assume that proposed License Article 101:Fish Propagation is implemented.
- [Page 19, paragraph 3] The report stated that adequate data are not available to evaluate changes in the amount of shallow habitats under the proposed increased flood storage scenario. If the analysis of shallow habitats was necessary, then Steward and Associates should have stated that their evaluation was incomplete and insufficient to draw conclusions.

  Reservoir bathymetry data in 5-foot contour intervals down to elevation 685 ft NAVD 88 have been available since early in the relicensing process. Area-elevation data reflecting these bathymetries were provided on hydrology disk 2 distributed on September 26, 2003; these data could have been used to conduct a coarse-scale assessment of shallow water habitats (i.e., depth < 5 feet) that would be available seasonally under proposed License Article 106:Flow Implementation. However, an analysis of shallow water habitats using reservoir bathymetry data requires information on reservoir pool levels under future operating conditions. It is the lack of information on reservoir pool levels under increased flood storage volumes that limits use of existing bathymetry data.

### 3.6 Increased predation on fish in tributaries in the drawdown zone

- [Page 19, paragraph 5] The report speculates that the increased availability of riverine habitat conditions in the drawdown zone is a benefit that outweighs the potential impacts of increased predation. As noted previously, the earlier and greater length of riverine habitat conditions in the drawdown zone under increased flood storage may attract spawning adult coho or native char. Not only is this considered a negative impact from the perspective of spawning success, it also represents a substantial increase in predation risk on adult spawners. Although there are localized large wood deposits that could provide cover in streams within the drawdown zone, such conditions are atypical, and are expected to be short-lived due to the nature of geomorphic processes. Shallow riffles represent the predominant habitat type observed in streams that cross the Baker Lake drawdown zone, and represent areas of predation risk to fish that must migrate through these areas. Foraging eagles and osprey, and evidence of fish killed by bears were all observed during sockeye spawning surveys conducted in September and October.

### 3.7 Increased turbidity, due to drawdown, with impacts on euphotic zone and fish production

- [Page 20, paragraph 4] A photo-based analysis completed by Bob Wright (Washington State Department of Ecology) concluded that re-suspended sediments represent a turbidity concern within Lake Shannon when pool levels drop below elevation 389 NAVD 88, and in Baker Lake at elevations below 685 feet NAVD 88. As a result of this analysis, minimum reservoir pool levels were incorporated into proposed License Article 401:Water Quality to protect water quality. Steward and Associates did not acknowledge or incorporate Ecology's analysis or the proposed License Article in the report.

### 3.8 Decrease in foraging success of avian species, due to increased turbidity

- [Page 21, paragraph 3] The report implies benefits from increased turbidity. While this benefit is speculative, it is doubtful that resource agencies would consider sediment a benefit. However, without peer review of this report the agencies opinions were not solicited. Moreover, the very low visibility (<2 ft) encountered by R2 Resource Consultants during spawning surveys and cited by Steward and Associates occurred immediately following the October 2003 flood and should not be presented as representative of typical conditions. R2 agrees that little site-specific information is available and any conclusions are speculative.

### 3.9 Amphibian impacts; decreases in reproduction success

- [Page 21, paragraph 7] Steward and Associates speculated on the potential effects of increased flood storage on amphibians. Unfortunately, the report failed to demonstrate an understanding of the mechanisms of amphibian survival in the basin. Availability of habitat during the early spring, can be offset by rapid reservoir refill. Consequently, Article 106 was crafted to address this conflict. These data were available describing the location of amphibian habitat within the reservoir drawdown zone, and timing of use by amphibian species (Hamer and R2 2003). These data could have been incorporated into a quantitative analysis provided that information on future reservoir pool levels were developed for increased flood storage alternatives. It is the lack of information on future pool levels under increased flood storage volumes that limits quantitative analyses.
- [Page 22 paragraph 1] The Steward and Associates summary refers to conflicting conditions without resolution. They suggest that in response to increased flood storage, spring reservoir refill could be delayed which they speculate would benefit amphibian species. However, they previously suggested that an aggressive early spring refill program would benefit sockeye reservoir production. This section highlights the need to identify consistent operational guidelines for each alternative and to quantify reservoir

pool levels and flow release hydrographs. Lack of quantitative information on future pool levels and downstream releases prevents quantitative analyses.

### 3.10 Section Summary

- [Page 22, paragraph 2] The summary discussion speculates that adverse effects are minor or that impacts can be ameliorated. As noted previously, many of the suggested measures may not be possible or advisable given the operational constraints identified in proposed License Article 106:Flow Implementation. This section fails to identify and address the environmental tradeoffs between competing operational strategies, which should be the focus of this section summary.

## 4.0 DOWNSTREAM IMPACTS

### 4.1 Higher fall flows may allow salmon to spawn higher along the channel margins

- [Page 23, paragraph 3] Steward and Associates did not acknowledge or incorporate the resource protection measures contained in the proposed License Articles. They also did not use the variety of quantitative habitat modeling tools developed to support relicensing discussions regarding instream flow and reservoir operations. The analysis tools were developed in collaboration with the Aquatic Resources Working Group, and details of the analyses and agreements to critical assumptions were documented in handouts and meeting records. Modeling runs were conducted under peer review to protect the integrity of the process.

  The various aquatic habitat models used to support Baker relicensing discussions were designed to use hourly hydrographs of the lower Baker River as input. The HYDROPS hydropower operations model was designed to predict hourly release flows and reservoir pool levels under alternate hydropower operational scenarios. The HYDROPS model was not designed, intended or promoted as a flood control operations model. Information on hourly flow releases under future flood control scenarios was needed in order to evaluate the effects of increased flood storage, but Steward and Associates did not provide such data. Instead of quantitative technical analyses, Steward and Associates relied on qualitative analyses, which leads to speculation. The lack of quantitative analysis led to unsupported conclusions and speculations used to justify flood control perspectives.

- [Page 23, paragraph 5] Steward and Associates acknowledged the significance of short-term dewatering events, yet they relied on 3-month averages instead of calculating more precise short-term indices as part of the hydrologic analysis. The analyses used to evaluate downstream habitats as part of Baker Project relicensing assumed a 48-hour maximum dewatering period for salmonid eggs and a 1-hour maximum dewatering period for alevins. These criteria, adopted by the reviewing agencies during relicense

studies, better reflect salmonid sensitivity to dewatering than 3-month averages. Steward and Associates use of 3-month averages instead of 48-hr or 1-hr hydrologic indices contributed to miscalculating the adverse consequences of the proposed 150,000 acre-feet of flood storage.

- [Page 24, paragraph 2] The speculation that redistribution of salmonid redds to margin areas in response to increased flow releases associated with reservoir evacuation is unsupported by quantitative analysis. This potential benefit is realized only if those areas remain wetted throughout the incubation period. The spawning/incubation model developed during the Baker Relicensing process is one method to quantify net benefit or impacts associated with increased fall releases. However, Steward and Associates did not use the habitat models and therefore could only speculate regarding potential effects.

## 4.2 Reducing flood peaks reduces egg mortality due to scour

- [Page 28, paragraph 3] The authors note that available data suggest salmonid survival is inversely correlated with flood magnitude. However, correlation does not represent cause and effect. Salmon evolved and thrived in Skagit River well before flood control was implemented. Moreover, the extent such benefits may be available to fish is at least in part dependent upon where in the river the fish are located. Additional flood storage may benefit salmon egg survival; however, the intent of an environmental analysis should be to weigh benefits against environmental costs to determine a net effect. Steward and Associates did not conduct the necessary quantitative analyses to compare benefits and adverse impacts to support flood control decisions. Use of Assumptions as surrogates for empirical data may be justifiable for short periods until appropriate studies can be completed.

- [Page 29 paragraph 6] The results of the spawning/incubation analyses presented at the Aquatic Resources Working Group meetings, and studies cited on page 28 of the Steward and Associates report clearly indicate that sediment particle motion (suspension) begins at moderate flood flows. An environmental analysis of increased flood storage should weigh the effects of reducing the magnitude of peak flood events against extending the frequency and duration of lower magnitude flood events to determine the net effect.

## 4.3 Low pool levels may retard ability to augment flows during very dry winters

- [Page 30, paragraph 2] Steward and Associates assert that the proposed 150,000 acre-feet of flood storage carries a "minor" increased risk that minimum instream flows could not be maintained. Analyses using hourly flow releases and reservoir pool levels under the proposed increase in flood storage would have quantified that risk and supported future flood control decisions. These analyses were not conducted. Consequently, the assertion is not supported with data.

- [Page 30, paragraph 2] Early reservoir evacuation in the fall may prove to be a greater limitation to meeting minimum flow releases than very dry winters. While fall rains in the Skagit Basin typically begin in late October, a delay in the onset of fall rains may cause the reservoirs to be rapidly drawn down in an attempt to maintain minimum flow releases. Failure to maintain minimum flows could impact Chinook salmon spawning in the middle Skagit River, which are a species listed as threatened under the Endangered Species Act. Proposed License Article 106:Flow Implementation (Aquatics Table 1) was the result of multiple parties balancing high minimum flows, low maximum generation flows and reservoir pool levels to meet their combined interests. An appropriate analyses of additional flood storage should have used a similar quantitative modeling effort within the peer review process such as was utilized by the collaboration for all of the other studies in the relicensing.

## 4.4 Reducing flood peaks may reduce the effectiveness and/or frequency of channel maintenance flows

- [Page 30, paragraph 4] Background material suggests that "channel shaping and maintaining flows" are flows of a magnitude that create and shape side channels, mobilize substrate, provide sediment to riparian areas, recruit large wood and a number of other critical functions. However, in paragraph 4 on page 31, the authors contend that bankfull flows are sufficient to accomplish these functions. The report is correct in that bankfull flows have been determined to be the most effective discharge for moving sediment and maintaining instream habitat conditions over the long-term. However, by definition bankfull flows are largely contained within the channel banks and thus they do not provide the overbank flows required to sustain riparian and floodplain habitats, and may not be sufficient to maintain off-channel habitats. Overbank flows may be important for maintaining aquatic habitat used by amphibians and other species in off-channel habitats located in the floodplain (e.g., oxbows) that do not directly transmit surface flows below flood stage.

- [Page 32, Figure 2] Figure 2 illustrates the frequency and duration of bankfull events that occurred between 1980 and 2002 under the current flood storage agreement. Comparable data on the frequency and duration of bankfull events under the proposed increased flood storage scenario should be added to Figure 2. To adequately evaluate the environmental effects of increased flood storage, the area of floodplain inundated by various flood levels and quantitative data on the changes in flood frequency that would result from increased flood storage should be provided to assess the effects on floodplain maintenance. This comment is not intended to suggest that protection of these habitats is more important than protection of homes and property; however, the information is important for identifying the appropriate level of mitigation if adverse environmental impacts are unavoidable. Existing floodplain mapping and data gathered by the USACE in support of their Revised Flood Insurance Study Report should be sufficient to initiate such an assessment.

## 4.5 Section Summary

- [Page 33, paragraph 2] Steward and Associates understates the effect of increased flood storage on redd dewatering by comparing it with the effects of flow fluctuations caused by power production operations. The comparison is incorrect for several reasons, first because it is not an exchange of two different risks but a compounding of risks. Second the effects of hydropower operations must be analyzed in the context of the substantial aquatic benefits resulting from the proposed License Articles, not on historic hydropower operations. Finally no results of quantitative analysis are presented to support this comparison.

  The risk to Chinook salmon and other aquatic resources posed by increased flood storage is not diminished nor is it offsetting to other operational impacts. On the contrary, the evaluation of potential changes to flood storage must carefully consider the effects such changes would have on the proposed operations to ensure that the anticipated benefits associated with the Settlement Agreement are not diminished. Where increased flood storage compromises proposed License Articles, appropriate mitigation must be provided.

  Supporting quantitative analyses are regrettably absent from Steward and Associates summary contentions in the Section Summary. Appropriate research, review and collaboration are needed to identify flood protection measures in the Skagit Basin. The Steward and Associates report was not quantitative or prepared in a collaborative context and does not provide information to support flood storage decisions.

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CERTIFICATE OF SERVICE

I hereby certify that I have this 11th day of March, 2005, served the foregoing documents upon each person designated on the official service list compiled by the Secretary in this proceeding.

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