BAKER RIVER PROJECT RELICENSE

Flood Control Feasibility Teamlet

July 28, 2003
9:00 to 2:00
Lower Baker Project Office
Concrete, WA

FINAL MEETING NOTES

Teamlet Leader: Lloyd Pernela, 425-462-3507, lloyd.pernela@pse.com

Attendees:

Name	Organization	Name	Organization
Bruce Sexauer	USACE	Lloyd Pernela	PSE
Steve Babcock	USACE	Paul Wetherbee	PSE
Ted Perkins	USACE	Joel Molander	PSE
Bill Fullerton	Tetra Tech	Don Dixon	Skagit County DPW
Jason Schmidt	PSE	John Moffat	Skagit County Pros. Attny
Bill Shaffer	Washington Group	Harry Hosey	PIE
Jay Smith	Tetra Tech	Jim Robertson	PIE
Bob Barnes	PSE	Albert Liou	PIE

Notes:

1) Lloyd Pernela handled introductions and outlined the agenda.

2) Agenda:
   a) Tetra Tech and Washington Group present their scopes of work
   b) Discuss schedule
   c) Comments on Tetra Tech and Washington Group scopes
   d) Data Requests
   e) Tour Facilities

3) *Flood Control Feasibility Scopes of Work:* Bill Fullerton and Bill Shaffer walked through the Tetra Tech and Washington Group scopes of work, respectively (Attached). Following the walk through, Joel Molander explained that the scopes of work are designed and intended to satisfy technical Corps regulatory requirements so that the work products could be adopted by the Corps in their flood control feasibility study. In response to Joel's explanation, John Moffat (Skagit County Prosecuting Attorney Office) said that the County expects their study to have as much weight as the Relicensing Flood Control Feasibility Teamlet's study. Bruce Sexauer explained that the Corps saw a need to complete two studies (the Corps Feasibility study and the Flood Control Feasibility Teamlet Study) because they focused on different aspects of flood control in the Skagit system. Bruce explained that the Corps/County study focused on broad issues comparing alternatives for flood damage reduction. The Baker Relicensing Flood Control Feasibility Teamlet study is addresses technical flood control issues just in the Baker system.

4) *Project Schedule:* Bill Fullerton walked through the proposed schedule, including draft schedules work items performed by Tetra Tech, the Washington Group, and the Corps. As presented, the scopes of work would be completed within 36 weeks from project initiation. This schedule depends in part on power loss computations performed by the Corps. Bruce Sexauer indicated that this analysis is likely to take longer than the two weeks presented in the draft schedule.

5) *Comments on Scope of Work:* Joel Molander explained that the Flood Control Feasibility Teamlet's scope of work is part of the collaborative relicensing process and asked for comments. Bruce Sexauer indicated that the scope of works looked acceptable and the Corps looked forward to reviewing the work products. John Moffat (Skagit County Prosecuting Attorney's Office) said that the County is directing its consultant effort into the study with the Corps. He said that the County will not comment on the Baker Relicensing Flood Control Feasibility Teamlet scope of work or get involved with the collaborative effort studies.

6) *Data Requests:* Lloyd Pernela walked through the data requests in the County letter dated May 16, 2003.
   a) Probably Maximum Flood Study and report using HMR-57: Bob Barnes explained that these studies had not been completed and the requested reports did not exist.
   b) Hourly dam discharge at Upper and Lower Baker for November 8 through 28, 1990, and November 26 through December 3, 1995. Paul Wetherbee explained that these data were available via microfiche and would likely be necessary to extract for the Flood Control Feasibility Teamlet study. He indicated that hourly data developed in electronic format for the Flood Control Feasibility Teamlet would be made available to the County. Joel Molander said that the data, in microfiche form, was currently available to the County and if the County was interested in more rapid extraction of the data to hourly form, PSE would like to discuss a cost-sharing arrangement.
   c) CADD files of Upper and Lower Baker Spillway designs. Lloyd Pernela reviewed the security issued involved with this data requests and indicated that electronic drawings did not exist. To provide access for the County to this data, Lloyd suggested that hard copy

drawing could be made available to the County's if non-disclosure agreements are signed.

The meeting adjourned to a tour of the Upper and Lower Baker facilities.

Attachment:
1) Tetra Tech scope of work
2) Washington Group scope of work

TETRA TECH SCOPE OF WORK
Skagit River, WA
Skagit River Flood Damage Reduction Feasibility Study
Baker River Dams Storage Evaluation
(June 27, 2003, revised June 30, 2003, July 7, July 17, and July 18, 2003)

General

Engineering services to be provided by Tetra Tech under this scope of work will be to participate in and provide hydraulic engineering and economic analysis expertise for an evaluation of the optimal flood storage that can be utilized for Lower and Upper Baker Dams to reduce flood damages for the Skagit River floodplain. A separate scope of work will be performed by Washington Infrastructure Group to determine the Probable Maximum Flood (PMF) and design hydraulic modifications, if necessary, to pass the floods per Corps of Engineers standards. PSE may decide to not have Tetra Tech and/or Washington Infrastructure Group perform some services if prior analyses indicate that there is no or little likelihood of significant flood damage benefits being realized.

A complete evaluation of flood control utilizing the Baker projects is identified in this scope. The scope is divided into four separate phases. Phase I represents tasks associated with determination of the flood damage benefits that can be provided by additional flood storage. Phase II of the project involves determination of the adequacy of Upper Baker to pass the PMF and required modifications if necessary. Additionally, Phase II involves the Lower Baker PMF determination and dam modifications to pass the PMF, if necessary, as well as provide flood storage at Lower Baker. Phase III consists of determination of the flood damage benefits associated with flood storage in Lower Baker. Phase IV is an assessment of the damage benefits for combined flood storage in Upper and Lower Baker. Phase V consists of developing reports for the five previous phases. The specific tasks to be performed in each phase are identified below.

Phase I – Determination of Upper Baker Dam Benefits

This effort will address three additional flood storage scenarios for Upper Baker reservoir consisting of three scenarios between the existing 74,000 acre-feet and a maximum potential storage approaching the live storage of 125,000 acre-feet. The scope assumes that the PMF study (Phase II) will be performed simultaneously with this analysis (Phase I). If necessary, the design of structural modifications to accommodate the PMF will be also performed simultaneously with Phase I. The Washington Infrastructure Group will perform the Phase II tasks and any design of modifications to hydraulic structures.

Task 1 – A kickoff meeting will be conducted to coordinate the effort with PSE, the Corps, Skagit County, Washington Infrastructure Group, Tetra Tech and other entities involved in the

project. The purpose of the meeting will be to transfer available information and discuss important aspect of the work execution.

Task 2 – A site visit will be conducted to view the Upper and Lower Baker projects and the downstream flood damage areas. It is anticipated that representatives from PSE, the Corps, Skagit County and Washington Infrastructure Group will join Tetra Tech on the site visit.

Task 3 - Determine maximum storage that provides noticeable downstream benefits by performing the following steps:

a. Review and become familiar with the existing HEC-5 model (model provided by the Corps),
b. Modify existing USACE HEC-5 model for 3 new rule curve conditions to include the maximum useful storage and two other conditions between the maximum and the existing condition (i.e., if 125,000 acre-feet is the maximum and existing is 74,000 acre-feet, then 85,000 acre-feet, 100,000 acre-feet, and 125,000 acre-feet could be chosen),
c. Route 10-, 25-, 50-, 75-, 100-, 250-, 500-year flows through the 3 new HEC-5 models to produce the peak flow hydrology at Concrete for the 3 new rule curve conditions,
d. Run the 5% and 95% chance of exceedance inflows for the 10-, 25-, 50-, 75-, 100-, 250-, 500-year events through the 3 new HEC-5 models to characterize the hydrologic uncertainty at Concrete (42 runs), and
e. Develop Exceedance Probability Function with Uncertainty data for the Skagit River at Concrete.

Task 4 – Add the segment of the Skagit River from the upstream end of the damage assessment area near Sedro-Woolley to Concrete to the HEC-FDA model by performing the following steps:

a. Site surveys to locate structures and provide estimates of first floor elevations, and other relevant structure attributes,
b. Development of database of structure inventory
c. Develop hydraulic information from the Corps UNET model to determine flooding stages/depths,
d. Develop damage curves, and
e. Update HEC-FDA model to include the additional damage area.

Task 5 – Execute the modified HEC-FDA analysis for the three storage scenarios to determine damages, residual damages and damages reduced downstream of Concrete (damages will be calculated for both the new study reaches upstream of Sedro-Woolley and the already modeled damage reaches downstream of Sedro Woolley).

Task 6 - If these damages reduced are determined to be significant, then Tetra Tech will provide information for performance of power loss computations by the Corps' Northwestern Division for the 4 new conditions. Based on the results of the power loss computations by the Corps, the cost of any PMF modifications and the flood damage analyses, the benefit cost ratios for the various flood storage scenarios at Upper Baker will be determined.

Task 7 – Develop and a technical memorandum summarizing the initial findings on the potential benefits of the three additional storage scenarios for Upper Baker and coordinate with PSE, the

Corps and Skagit County on whether the damages appear large enough to warrant continued efforts to further evaluate flood storage at Upper Baker.

Task 8 – If modifications are necessary to pass the PMF, the HEC-5 analysis will be revised to reflect the associated changes. This effort will consist of:

a. Modify HEC-5 models to reflect changes in the dam due to the PMF improvements and re-run the 3 new rule curve conditions and the existing condition,
b. Route 10-, 25-, 50-, 75-, 100-, 250-, 500-year flows through the 4 new HEC-5 models to produce the peak flow hydrology at Concrete for the 4 new reservoir conditions,
c. Run the 5% and 95% chance of exceedance inflows for the 10-, 25-, 50-, 75-, 100-, 250-, 500-year events through the 4 new HEC-5 models to characterize the hydrologic uncertainty at Concrete (56 runs), and
d. Develop Exceedance Probability Function with Uncertainty data for the Skagit River at Concrete.

Task 9 – If modifications are necessary to pass the PMF, Tetra Tech will re-run the modified (includes Sedro-Woolley to Concrete and Sedro-Woolley downstream models) HEC-FDA model to determine damages, residual damages and damages reduced downstream of Concrete. Tetra Tech will perform a cost benefits analysis of life-cycle project costs and benefits over a fifty year period of analysis.

Task 10 - If these damages reduced exceed any costs of improving the dam to PMF standards, then Tetra Tech will provide information for performance of power loss computations by the Corps' Northwestern Division for the 4 new conditions. Based on the results of the power loss computations by the Corps, the cost of any PMF modifications and the flood damage analyses, the benefit cost ratios for the various flood storage scenarios at Upper Baker will be determined.

Task 11 – Prepare and meet with PSE, the Corps and Skagit County to discuss a technical memorandum summarizing the findings of the Upper Baker incremental flood storage investigation including the benefits and costs associated with each flood storage option investigated.

Phase II – Upper and Lower Baker PMF Investigation

This portion of the effort will be performed by Washington Infrastructure and will consist of analyzing the passage of the PMF through the existing Upper and Lower Baker dams and any modifications necessary to pass the PMF per Corps standards (See Washington Infrastructure scope of work). Washington Infrastructure will coordinate investigation findings with Tetra Tech for inclusion in Phase I – Determination of Upper Baker Dam Benefits, as appropriate.

Phase III – Determination of Lower Baker Benefits

This effort will address determination of benefits for flood storage in Lower Baker. The existing conditions and three modified reservoir scenarios (with PMF spillway, with PMF spillway and full utilization of storage for flood control, and with PMF spillway and 50 percent use of storage for flood control) will be addressed.

Task 1 – If modifications to Lower Baker are necessary, Tetra Tech will revise the HEC-5 model (initial model to be developed by Washington Infrastructure Group and provided to Tetra Tech

for execution of this task) to incorporate the modification to dam structures designed by others. The following steps will be performed:

a. Modify Rule Curve (initial rule curve to be developed by Washington Infrastructure Group and provided to Tetra Tech for execution of this task) for flood control. Modifications will be consistent with the guidelines in Chapter 3 of EM 1110-2-3600 for an improved spillway (one in which the spillway gates are modified so they can be remotely operated),
b. Modify Spillway Regulation Schedule (initial spillway regulation schedule to be developed by Washington Infrastructure Group and provided to Tetra Tech for execution of this task) for flood control for an improved spillway that makes the current spillway gates operational. This schedule should be developed following Chapter 4 of EM 1110-2-3600, and
c. Modify the HEC-5 model to reflect steps a and b above.

Task 2 – Develop rule curves and spillway regulation schedules for two Lower Baker flood storage utilization scenarios. The following steps will be performed:

a. Develop Rule Curve from the guidelines in Chapter 3 of EM 1110-2-3600 for Lower Baker with new outlet works that allows full utilization of the reservoir for flood control,
b. Develop Spillway Regulation Schedule for improved dam with new, full utilization of storage outlet works. This schedule should be developed following Chapter 4 of EM 1110-2-3600,
c. Develop Rule Curve from the guidelines in Chapter 3 of EM 1110-2-3600 for Lower Baker with new outlet works that only uses half of the space between the bottom of the spillway gates and an empty pool, and
d. Develop Spillway Regulation Schedule for improved dam with new outlet works that only uses half of the space between the bottom of the spillway gates and an empty pool. This schedule should be developed following Chapter 4 of EM 1110-2-3600.

Task 3 – Perform HEC-5 modeling for Lower Baker for four scenarios to develop input for the HEC-FDA model. The following steps will be executed:

a. Develop HEC-5 model for the full utilization of the reservoir for flood storage,
b. Develop HEC-5 model for the 50 percent usage of reservoir for flood storage,
c. Route 10-, 25-, 50-, 75-, 100-, 250-, 500-year flows through the three new reservoir models to produce the peak flow hydrology at Concrete for the 4 conditions,
d. Run the 5% and 95% chance of exceedance inflows for the 10-, 25-, 50-, 75-, 100-, 250-, 500-year events through the 3 new reservoir models to characterize the hydrologic uncertainty at Concrete (42 runs),
e. Develop Exceedance Probability Function with Uncertainty data for the Skagit River at Concrete in the HEC-FDA format.

Task 4 - Execute the modified (includes area between Sedro-Woolley and Concrete) HEC-FDA analysis for the three storage scenarios to determine damages, residual damages and damages reduced downstream of Concrete. Conduct benefit cost analysis using life cycle costs and benefits over a 50-year period of analysis.

Task 5 - If these damages reduced exceed any costs of improving the dam to PMF standards and costs for providing outlet works, then Tetra Tech will provide information for performance of power loss computations by the Corps' Northwestern Division for the 4 new conditions. Based on the results of the power loss computations by the Corps, the cost of the PMF modifications, the cost of installing outlet works and the flood damage analyses, the benefit cost ratios for the various flood storage scenarios at Lower Baker will be determined.

Task 6 – Develop a technical memorandum summarizing the initial findings on the potential benefits and costs of the flood storage scenarios for Lower Baker and coordinate/meet with PSE, the Corps and Skagit County.

Phase IV – Determination of Benefits for Use of both Upper and Lower Baker Dams in Conjunction for Flood Control

This effort will address determination of benefits for utilization of combined flood storage in Upper and Lower Baker Dams. The effort will be conducted if the individual analyses for flood storage at Upper and at Lower Baker indicate each to be economically feasible. Three scenarios consisting of varied levels of storage will be evaluated.

Task 1 – Tetra Tech will coordinate with PSE, the Corps and Skagit County on execution of this phase of the effort.

Task 2 - Determine which of the Upper and Lower Baker scenarios provide the largest B/C ratio. Keep that dam (first added) scenario constant while changing the other dam (second added) to the three different conditions laid out in the above analyses.

Task 3 - Perform HEC-5 modeling for Upper and Lower Baker scenarios to develop input for the HEC-FDA model. The following steps will be executed:

a. Route 10-, 25-, 50-, 75-, 100-, 250-, 500-year flows for all 3 of these conditions. ,
b. Run the 5% and 95% chance of exceedance inflows for the 10-, 25-, 50-, 75-, 100-, 250-, 500-year events through the 3 reservoir models to characterize the hydrologic uncertainty at Concrete (42 runs), and
c. Develop Exceedance Probability Function with Uncertainty data for the Skagit River at Concrete in electronic HEC-FDA.

Task 4 - Execute the modified (includes area between Sedro-Woolley and Concrete) HEC-FDA analysis for the three storage scenarios to determine damages, residual damages and damages reduced downstream of Concrete. Conduct benefit cost analysis using life cycle costs and benefits over a 50-year period of analysis.

Task 5 - If these damages reduced exceed any costs of improving the dam to PMF standards and providing outlet works, then Tetra Tech will provide information for performance of power loss computations by the Corps' Northwestern Division for the 3 new conditions. Based on the results of the power loss computations by the Corps, the cost of any PMF modifications, the cost of installing outlet works and the flood damage analyses, the benefit cost ratios for the various flood storage scenarios for combined Upper and Lower Baker flood control will be determined.

Task 6 – Develop a technical memorandum summarizing the initial findings on the potential benefits and costs of the flood storage scenarios for Upper and Lower Baker combined flood control and coordinate/meet with PSE, the Corps and Skagit County.

Phase V – Report Documentation
This phase involves expanding the various technical memorandums into full reports documenting the results of the previous six project phases. The effort also includes response to review of the reports conducted by PSE, the Corps and Skagit County.

Task 1 - Prepare draft report documenting results of benefits analysis for Upper Baker Dam flood control.

Task 2 - Respond to comments and modify report from Task 1.

Task 3 - Prepare draft report documenting results of benefits analysis for Lower Baker Dam flood control.

Task 4 - Respond to comments and modify report from Task 3.

Task 5 - Prepare draft report documenting results of benefits analysis for combined Upper and Lower Baker Dam flood control.

Task 6 - Respond to comments and modify report from Task 5.

Note: Washington Infrastructure to provide report documentation, response to comments and report modifications as part of its work scope.

WASHINGTON GROUP SCOPE OF WORK
BAKER PROJECT – PROBABLE MAXIMUM FLOOD
AND STRUCTURAL / ALTERNATIVES STUDY

1.0 SCOPE OF WORK - PMF

The tasks envisioned to perform the study are as follows: 1) meetings and coordination with the Corps of Engineers (COE) and others; 2) obtain existing information from COE and Puget Sound Energy (PSE) regarding historical flood records, calibrated unit hydrographs, rating curves, or similar relevant data; 3) delineate subbasins to be used in analysis; 4) determine area-elevations for subbasins; 5) determine snowpacks, and obtain seasonal temperatures and winds for use in hydrograph development; 6) evaluate basin geology and cover; 7) develop 72-hour general storm PMP and thunderstorm PMP for basin; 8) develop HEC-1 model of basin; 9) determine base flows and initial reservoir elevations and conditions; 10) calibrate model to historical flood data; 11) run PMF simulations for basinwide general storm and thunderstorm, and 12) report preparation. Brief discussions of these tasks are provided in the following paragraphs.

1.1 Meetings and Coordination with Corps of Engineers and Others

Meet with COE to insure that the approach to PMF development is in accordance with COE needs and determine the differences, if any, between COE needs and FERC requirements. Coordinate with other consultants and provide routing results for incorporation into companion or related flood mitigation studies.

1.2 Obtain and Review Existing Information

Review available hydrologic related reports and data for use in study. Particular emphasis will be placed on confirmed and calibrated unit hydrographs that may be included in previous PMF reports or from the COE. Other desirable data includes hourly flow data and coincident climatic conditions for large historical floods.

1.3 Delineate Subbasins

Divide the overall drainage basin into subbasins as appropriate. These subbasins are typically well defined portions of the basin containing specific tributaries. Hydrologic runoff and routing parameters are then developed for the individual subbasins.

1.4 Develop Subbasin Area-Elevation Data

Measure area versus elevation bands within delineated subbasins. These area-elevation values are used within the HEC-1 model to compute snowmelt for the various elevation zones.

1.5 Determine Snowpacks and Climatic Data

Develop 100-year snowpacks for subbasins and determine wind speeds and solar radiation for use in HEC-1 snowmelt energy budget snowmelt computations.

1.6 Evaluate Basin Geology and Cover

Perform a review of available geologic mapping for the basin and develop estimated infiltration rates. Determine the basinwide type and extent of ground cover as needed for inclusion in the HEC-1 model.

1.7 PMP Development

Using HMR 57, develop 72-hour basinwide general storm probable maximum precipitation (PMP) and thunderstorm precipitation. Also, as part of the PMP development, evaluate and determine the calendar month of PMF occurrence. Based on preliminary discussions with the COE, the likely period for the PMF is in the November-December timeframe.

1.8 Develop HEC-1 Model

Develop HEC-1 simulation model incorporating the upper and lower Baker projects, their associated subbasins, and the subbasin hydrologic parameters.

1.9 Determine Base Flows and Initial Conditions

Evaluate likely base flow conditions for PMF season. Similarly, develop initial reservoir and project conditions likely to be experienced during the season or at the time of a PMF event. Evaluate likely powerhouse discharge capability during PMF.

1.10 Model Calibration and Basin Parameter Development

Using the HEC-1 model, calibrate basin parameters to one or two historic floods having adequate records, to the extent possible. For subbasins not able to be calibrated, develop Snyder runoff and routing parameters using topographic mapping, slopes, ground covers, etc.

1.11 PMF Simulations

Perform simulations for the general storm PMP for one or two months as needed, as well as for the thunderstorm event.

1.12 Report Preparation

The results of the study will be included in a final report. A draft report will be issued for review and comment prior to final report completion. Results of the study will also be included in the technical memoranda prepared for the Upper Baker and Lower Baker dams.

2.0 SCOPE OF WORK – STRUCTURAL AND ALTERNATIVES EVALUATION

2.1 Site Visit

Participate in a site inspection with representatives from PSE, Tetra Tech and others.

2.2 Upper Baker Dam Evaluation

Evaluate the Upper Baker Dam structures including the spillway, outlet works, etc. to determine if they meet USACE standards based on ER 1110-8-2 and Chapter 14 of EM 1110-2-1420. If the standards are not met, develop alternatives to achieve standards and develop reconnaissance level cost estimates. If necessary, rerun the basin simulation HEC-1 model with modified Upper Baker Dam parameters to verify standards are met.

2.3 Technical Memorandum for Upper Baker Dam

Prepare initial technical memorandum documenting results of the PMF determination and associated evaluation of the Upper Baker Dam.

2.4 Lower Baker Dam Evaluation

Evaluate the Lower Baker Dam structures including the spillway, outlet works, etc. to determine if they meet USACE standards based on ER 1110-8-2 and Chapter 14 of EM 1110-2-1420. If the standards are not met, develop alternatives to achieve standards and develop reconnaissance level cost estimates. If necessary, rerun the basin simulation HEC-1 model with modified Lower Baker Dam parameters to verify standards are met

2.5 Technical Memorandum for Lower Baker Dam

Prepare initial technical memorandum documenting results of the PMF determination and associated evaluation of the Lower Baker Dam.

2.6 Coordination of Efforts

As evaluations are completed, coordinate and pass on routing and alternative assessments to PSE, Tetra Tech, and others as needed.

2.7 Cost Estimates

Reconnaissance level cost estimates will be prepared for any alternatives developed in meeting the COE requirements for the Upper and Lower Baker dams.

2.8 Report Preparation

The results of the study will be included in a final report, largely by combining the information contained in the technical memoranda prepared for each of the dams. A draft report will be issued for review and comment prior to final report completion.

3.0 SCHEDULE

Our proposed schedule is to receive notice to proceed at your earliest convenience and to begin essentially immediately upon receipt. With this in mind, we expect to complete the PMF study and draft report approximately three months after initiation of the efforts and submit a final report approximately two weeks after PSE and the COE have reviewed and provided comments on the draft report. Based on this, it is estimated that the PMF results and draft report would be available in about the mid-October timeframe. Upon obtaining the PMF routing results for the projects, expected to be essentially simultaneous because of the proposed basinwide HEC-1 model, efforts will be initiated on the structural and alternatives evaluation in meeting COE criteria. Together with the coordination of results, it is expected that this work would be completed over approximately a two-month period. Based on these estimates, the overall evaluation, including technical memoranda and reports, will be completed in the mid to late December 2003 timeframe.

It is understood, however, that it is desirable for PSE to have results for the flood reduction investigations prior to the mid to late December timeframe due to deadlines associated with project licensing. Because of this, it is proposed that once routing results are developed for floods lesser than the PMF, that the technical evaluation for compliance with COE standards be initiated. Similarly, if it is determined that COE standards are not met, the structural and alternatives evaluation will be initiated. Routing results for the more frequent floods are anticipated well in advance of completion of the PMF study. With this in mind, the previously described schedule for the technical memoranda will be advanced by roughly the differential between the estimated mid-October PMF study completion and the time routing results for the lesser floods are developed.