FINAL FUNCTIONAL ANALYSIS

WETLANDS AND RELATED RESOURCES

BLUE LAKE PROJECT EXPANSION (FERC No. 2230)

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INTRODUCTION, PURPOSE, AND BACKGROUND

INTRODUCTION

The City and Borough of Sitka Electric Department ("City") is in the process of applying for an amendment to the existing FERC license for the Blue Lake hydroelectric project ("Project," FERC No. 2230) to address recent electric load growth in the face of increasing diesel fuel costs. The amendment will reflect two significant changes in Project design: 1) construction of a new powerhouse including three new turbine generators and decommissioning of the existing turbine generators; and 2) raising the Project dam as much as 83 feet from the existing spillway height of El (elevation in feet above mean sea level) 342 to El 425. Collectively, these and other associated changes are referred to as the "Blue Lake Project Expansion" or simply "Expansion."

Details of the proposed Expansion are described in the Final Amendment Application (CBS *2010*), available at the City's Project website:

(http://www.cityofsitka.com/government/departments/electric/BlueLakeExpansion.html)

Among resources potentially affected by the Expansion (specifically the proposed raise in water level and associated land inundation) are aquatic resources, some of which are noted as jurisdictional under Section 404 of the US Clean Water Act (CWA). Under this act, the US

Army Corps of Engineers (USACE) has jurisdiction over "Waters of the United States," which include:

- Navigable waters of the United States;
- Wetlands; and
- Tributaries to navigable waters of the United States, including adjacent wetlands and lakes and ponds.

Within the boundaries of Blue Lake and its inflow tributaries, jurisdictional areas under the CWA include: 1) Wetlands potentially inundated by the proposed dam raise; and 2) Blue Lake and its inflow tributaries as they may be affected by the dam raise, *3) The establishment of an afterbay at the new powerhouse site and the filling in of the existing afterbay and afterbay pond following commissioning of the new powerhouse. The area of the existing afterbay and pool is 0.10 acres. The area of the new afterbay is 0.11 acres*

In this analysis, we refer to these areas as "Wetland," "Blue Lake," and "Tributary" habitats, as described in detail in later sections.

This analysis describes a method used by the City to assess Expansion impacts on the potentially affected resources with the objective of determining the need and extent of compensatory mitigation. Draft results of the analysis are also included.

CONSULTATION and COMMENT

A draft of this plan was sent to a limited

PURPOSE

The purpose of this analysis is to describe an approach for assessing impacts on habitats, wetlands, lake, and river habitats, in areas potentially affected by inundation following the Expansion dam raise. This assessment method has been applied to evaluate existing conditions ("pre-Expansion") and those resulting from dam raise and establishment of new operating regime conditions ("with-Expansion"). The method may also be used in the future to quantify compensatory mitigation for Expansion-related effects on the subject resources.

BACKGROUND

Several actions have preceded development of this approach and completion of this analysis, as described in the following sections.

Wetlands Delineation

The City contracted with DOWL HKM Engineers of Anchorage, Alaska, to conduct a wetlands delineation of the potentially inundated area. Products of this delineation are maps documenting wetland boundaries defined as jurisdictional under the CWA. The final DOWL (2011) delineation report was completed in December, 2011.

In addition to the DOWL study, the City has also contracted with Hart Crowser/Pentec Environmental (Pentec) of Edmonds, Washington, to develop and complete a Functional Analysis to be applied to wetland, lake and river habitats for impact assessment and mitigation planning for the Expansion.

Preliminary Field Visit

As a first step in developing a functional assessment, a field visit and meeting were held on June 24–25, 2011. In attendance for the June 24 field visit were the following:

Dean Orbison, City Project Manager
Linda Speerstra, US Army Corps of Engineers (USACE)
Kacy Hillman and Jessica Christianson, DOWL
Jon Houghton and Celina Abercrombie, Pentec

These participants visited a portion of the area potentially affected by the increased water level in the valley of Blue Lake Creek, Blue Lake's primary inflow tributary.

Previous Studies

In addition to the wetlands surveys conducted in 2011, the City has, as part of the license amendment process, conducted extensive fisheries and wildlife studies suitable to define both existing conditions and estimated impacts for those species. Particularly in the Lake and River habitat categories described below, this assessment draws heavily on reports documenting those studies.

Previous Mitigation Planning

The City has conducted an ongoing mitigation planning process during the pre-filing period. Relevantly, the City and Stakeholders have discussed several mitigation measures for the project's projected land inundation effects. For certain resources, such as wildlife and botanical resources, these preliminary agreements are noted in the overall mitigation planning referenced in this document.

Mitigation for wildlife and botanical effects in areas that would be inundated, but that do not fall under the jurisdiction of the USACE under the Clean Water Act Sec. 404, may be addressed through a land acquisition agreement. Therefore, wildlife and botanical resources are not addressed in this functional analysis which focuses on habitats and resources that fall under Corps of Engineers jurisdiction, i.e., wetlands, the lake, and streams that are considered to be Waters of the United States.

First Technical Meeting

A meeting held in Sitka on June 25 was attended by the above representatives of USACE, the City, Pentec, and C. Mike Prewitt, City FERC consultant (by phone). Using insights gained during the field visit, the general approach described below was developed during that meeting. Draft minutes of the June 25 meeting were distributed among meeting attendees with a request for comment. After comments were received and incorporated, the Final Meeting Minutes were distributed on July 7, 2011 to a list of Stakeholders with technical and regulatory interest in the habitat analysis.

In the cover letter to the meeting minutes, the City committed to preparation of a Draft Functional Analysis Study Plan that was distributed to stakeholders on January 10, 2012 and included a preliminary functional analysis of the project using the acreages of wetlands from the DOWL wetland study and preliminary acreages of the several lake and stream wetland types.

Second Technical Meeting

A second stakeholder meeting was held in Sitka on January 27, 2012 to discuss the approach described in the January 10, 2012 memo and the use of the analysis in mitigation determinations. Attendees included representatives of USACE, ADF&G, US Forest Service, the Sitka Conservation Society, the City, Pentec, and C. Mike Prewitt (City FERC consultant). This analysis incorporates discussions of the preliminary approach and categorizations in the January 10 memo. This memo is intended to be a draft of the complete functional analysis and will be circulated to the stakeholders for review and comment before being finalized.

Development of Final Plan

After review of the meeting minutes and draft functional analysis documents, comments were recieved from US Forest Service dated April 6, 2012 and USACOE dated April 6, 2012. The US Forest Service comments were addressed as described in Attachment I. Where text changes were necessary, all changed or added words are italicized in this version.

HABITAT EQUIVALENCY ANALYSIS

GENERAL

Habitat Equivalency Analysis (HEA) is a method developed by National Oceanic and Atmospheric Administration (NOAA) (1997) which has been widely used to quantify compensatory mitigation for resources affected by land and water development. HEA has also been used by USACE to quantify impacts on resources such as wetlands and other Waters of the United States under USACE jurisdiction (Ray 2007). In Southeast Alaska, a modified HEA was used to assess impacts and define mitigation options for the expansion of the Sitka Airport runway safety area and parallel taxiway (Pentec 2009, 2010a, and 2010b).

STEPS in the HEA

This section describes the steps in the HEA assessment as modified for application to the Blue Lake Expansion project. Note that the HEA for the Blue Lake Expansion has two components, one for wetlands and the other for Blue Lake and Tributaries, i.e., Blue Lake and its primary inflow tributaries. As described below, the detailed methods for these two analyses differ somewhat, but the objective is to compare function-weighted surface areas, for pre- and with-Expansion conditions, for both habitat types.

Step 1. Identify and delineate the jurisdictional Primary Habitat Types (PHTs) in the analysis area.

The study and analysis area includes all lands within an area bounded by the predicted with-Expansion high water line at El 425. Based on discussions during the June field trip and subsequent meeting, two PHTs were observed in the study area: **1) Wetlands;** and **2) Blue Lake and Tributaries,** as described in the following.

Wetlands

DOWL (2011), under their wetlands delineation contract, identified and delineated wetlands in the analysis area and has submitted a final report documenting field work in 2011. One product of the DOWL work was a map showing the boundaries of jurisdictional wetlands in the inundation zone. From this map, it is possible to determine surface areas of each delineated wetland type analyzed in the functional analysis.

Blue Lake and Tributaries

In this PHT, we have included both Blue Lake and its potentially affected tributaries as Blue Lake and Tributaries. We have included their respective areas in the PHT because, with changes in water elevation, not only lake area but stream lengths and areas change, and in many cases, transform from one feature to the other. The analytic technique used accounts for these changes, allowing both lake and stream habitat types to be quantified in a single analysis.

As described above, extensive studies of fish populations and habitat were conducted by the City and its contractors. These studies have been used to define existing habitat functions provided by different habitat types, and, following the proposed raising of Blue Lake dam and the expected additional inundation, to document effects on Blue Lake and Tributaries.

Step 2. Divide each PHT into Secondary Habitat Types (SHTs) using the appropriate classification criteria.

Wetlands

The **Wetland PHT** was divided into the seven SHTs identified in the DOWL report within the pre-Expansion area. The jurisdictional wetlands categories in the DOWL report were based on the **Cowardin Classifications (Cowardin et al. 1979) as follows**:

1. **PFO4B 12% mosaic;**
2. **PFO4B 27% mosaic;**
3. **PFO4B 38% mosaic;**
4. **PFO4B/SS1B 38% mosaic;**
5. **PFO4B/SS1B 49% mosaic;**
6. **PFO4B/SS1B 72% mosaic; and**
7. **PSS1B/EM1B.**

Acreages of each of these wetland types that would be impacted by Expansion are provided in Table 1.

Table 1 – PHTs, SHTs, and their Respective Areas in the Blue Lake Study Area

Primary Habitat Type (PHT)	Secondary Habitat Type (SHT)	Acres, Pre-Expansion	Acres, With-Expansion
Wetlands	PFO4B 12% Mosaic	0.7	0
	PFO4B 27% Mosaic	1.1	0
	PFO4B 38% Mosaic	2.2	0
	PFO4B/SS1B 38% Mosaic	3.2	0
	PFO4B/SS1B 49% Mosaic	1.8	0
	PFO4B/SS1B 72% Mosaic	2.5	0
	PSS1B/EM1B	3.7	0
Blue Lake and Tributaries	Lake Pelagic	1026	1363
	Lake Littoral	260	283
	Interface	0.80	1.25
	Fluvial Spawning[1]	0.08	0.41
	Fluvial Rearing[1]	1.68	3.27
	Total Area	1303.8	1650.9

[1]Includes Blue Lake, Becky, Sheldon, and Brad Creeks.

Blue Lake and Tributaries

Background. Secondary Habitat Types (SHTs) within the Blue Lake and Tributaries PHT were assigned based on fish utilization of the various stream and lake areas by rainbow trout in Blue Lake and its primary inflow tributaries. During pre-application studies (CBS 2006a and Wolfe 2009), rainbow trout, *Oncorhychus gairdneri*, was found to be the only fish species in Blue Lake. To fully understand the Blue Lake and Tributaries Functional Analysis, and particularly assignment of SHTs, it is necessary to describe rainbow trout life history and habitat utilization in Blue Lake, Blue Lake Creek (the lake's major inflow tributary) and several other smaller inflow tributaries, all of which contribute habitat areas used for one purpose or another by rainbow trout.

Blue Lake rainbow trout populations are self-sustaining and depend on available habitats in which to spawn and incubate eggs, rear fry and juvenile fish, and support adult fish feeding. The extensive work done by City contractors to determine rainbow trout life history and habitat utilization (CBS 2006a and Wolfe 2009) revealed that Blue Lake rainbow trout spawning consistently occurs between early May and early July with a peak in early June. During this time period, Blue Lake is typically filling, with water levels rising from the yearly minimum, progressively inundating areas that were previously part of flowing water habitat within stream mouths. Much of the spawning in the system takes place in specific areas, called "interfaces," where streams enter the lake resulting in reduced water velocity and deposition of suitable spawning gravels over larger substrates, particularly old cobble bars. Thus, these interface areas are an important SHT addressed in this analysis.

Below is a table indicating the acreage of interface and fluvial spawning areas pre expansion and with expansion.

	Interface Pre	*Interface With*	*Fluvial Spawning pre*	*Fluvial Spawning with*	*Fluvial Rearing Pre*	*Fluvial Rearing with*
Blue Lake Creek	*0.29*	*1.18*	*0.04*	*0.35*	*1.68*	*3.27*
Becky Creek	*0.34*	*0.01*	*0.01*	*0.02*	*N/A*	*N/A*
Sheldon Creek	*0.15*	*0.01*	*0.01*	*0.01*	*N/A*	*N/A*
Brad Creek	*0.02*	*0.05*	*0.02*	*0.03*	*N/A*	*N/A*

Of note in the fish habitat analysis is the presence of a barrier to fish upstream migration located approximately 634 feet upstream of the lowest bedrock control feature of Blue Lake Creek. This feature is referred to as the "barrier falls." In the pre-Expansion condition, Blue Lake water

levels remain below the crest elevation of this feature during the entire spawning period, thereby blocking access to Blue Lake Creek. After spawning ends, in early July, water elevation continues to rise and the barrier falls crest elevation is normally reached by early August, allowing fish access to Blue Lake Creek. No significant spawning or fry rearing, however, has been documented in Blue Lake Creek above the barrier falls in the period of the pre-application studies. Blue Lake Creek above the barrier falls, however, does offer excellent habitat for adult rainbow trout, which appear to utilize the area during the late summer/early fall period in most years (CBS 2006a and Wolfe 2009).

Water levels predicted for the with-Expansion condition are expected to be higher than the level of the barrier falls throughout the spawning period, allowing access to both the stream and to potentially-extensive interface areas and to potential fluvial spawning areas higher in Blue Lake Creek valley. *Breaching the barrier fallsin the with –Expansion condition increases the interface spawning area by 0.89 acres and the fluvial spawning area by 0.31 acres in Blue Lake Creek.*

Fry and juvenile rearing habitats in Blue Lake and its inflow tributaries are less specifically defined than those for spawning, and occur both in interface areas and in areas comprising more of the overall Blue Lake and tributary surfaces. *The net gain in fluvial rearing with the expansion is 1.59 acres.*

Secondary Habitat Types (SHTs). In this draft study plan, we have assigned the following SHT's to account for areas believed to be important to rainbow trout during the spawning season and for the remainder of the year:

1. Lake Pelagic. This SHT includes the entire open water area in Blue Lake not otherwise categorized; for computation of areas, the lake area at low pool is used; because the pelagic area of the lake may be treated differently in mitigation negotiations, this SHT is identified as a separate line in the tables that are generated.
2. Lake Littoral. This SHT includes mostly shallow water shoreline habitats between the high and low pool elevations. This difference in both the pre- and with-Expansion condition is about 60 feet in depth; the top 60 feet in the lake has been shown in site baseline studies to support significant fish use.
3. Interface. As noted above, these are areas of stream mouth where spawning and egg incubation occurs as the lake is rising. In field studies, polygons were measured to include all areas where this interface spawning is expected to occur. To avoid double counting, the area of interfaces is deducted from other SHTs.
4. Fluvial Spawning. These are stream habitats where spawning was shown to occur during pre-Expansion and similar habitats where spawning is likely to occur with-Expansion.
5. Fluvial Non-Spawning. This includes all known fish-accessible stream habitats at mean reservoir pool levels.

The location and boundaries of these SHTs are depicted in Figures 1W & 1E (Pre-Expansion) and 2W & 2E (With-Expansion).

Step 3. Calculate the area (in acres) of each potentially affected SHT in the pre-Expansion condition.

For the Wetlands PHT, the areas in acres of the various SHTs (Table 1) were derived from results and analyses of the DOWL field studies.

For the Blue Lake and Tributaries PHT, pre-Expansion areas were determined from data, habitat descriptions, maps, and aerial photography compiled during the license amendment application as well as previous relicensing studies. With-Expansion areas were similarly determined using these sources, as well as predicted water levels. A brief description of the technique(s) used for determination of the areas of the five SHTs is outlined below.

1. Lake Pelagic. As stated above this SHT includes the entire open water habitat in Blue Lake not otherwise categorized. For calculation purposes, the pelagic surface area was measured at the low pool elevation.

2. Lake Littoral. As previously stated, this SHT includes lake shoreline area between high pool and low pool elevations, during an average water year. Pre-Expansion bathymetric maps are in 20-foot intervals therefore pre-Expansion low and high pool elevations of 276 and 342 feet were first rounded to 280 and 340 feet, respectively; thus, the lake littoral SHT would extend between 280 and 340 feet. Since 5-foot elevation contours are available for with-Expansion area, elevations of 368 and 425 feet were rounded (for depth range consistency) to 365 and 425 feet; the lake littoral area was then defined to include the area between 365 and 425 feet. Total acreage of the littoral zone was determined using computer mapping between these contour lines.

   Site studies conducted by the City provide the rationale for treating this 60-foot range of lake shore as a distinct habitat, with different fish-related functions than pelagic portions of the lake. Catch per unit effort (CPUE) data were organized by lake area, depth, and whether fish were considered juveniles (<180 mm) or adults (>180 mm) (CBS 2006b). In a plot of catch per unit effort vs. depth, there was steady decline in the number of juveniles with depth and an inflection in the curve for adult fish at about 60 feet.

3. Interface. During spawning studies (CBS 2006a and Wolfe 2009), boundaries of interface spawning areas (described above) were measured at a reservoir elevation of 281 feet, corresponding closely to a pre-Expansion average spawning elevation of 280 feet. These measurements were then closed into polygon shape files to provide pre-Expansion interface areas. Since it was determined that habitat characteristics in the pre- and with-Expansion areas would be similar (Dube 2010), a cobble bar corresponding to

average water elevations at with-Expansion peak spawning time was utilized to determine a similar polygon using similar mapping techniques. While interface areas were delineated on the basis of observed or predicted spawning activity, these areas also support other fish functions (Table 2).

4. Fluvial Spawning. As with Interface areas, during spawning surveys, location data were taken along with habitat descriptions and used to develop areas for pre-Expansion spawning in free flowing portions of streams above the extant pool levels (i.e., upstream of the interface areas). With-Expansion areas were developed by taking pre-Expansion data and applying them to detailed habitat maps, aerial (vertical and oblique) photography, and ground photography to develop probable spawning areas in the river reaches that will be accessible, following Expansion.

Table 2 – Relative Function of Habitat Types in the Blue Lake Inundation area

		Habitat Attribute or Function										RHF	
		Water Quality		Hydrology		Organic Matter	Vegetation		Fish Functions				
Primary Habitat Type	**Secondary Habitat Type**	Sediment/ Pollutant Removal	Nutrient/ Sediment Retention	Erosion Control/ Flow Reduction	Water Storage	Import/ Export	Strata/ Complexity	Species Diversity	Spawning	Juvenile Rearing	Adults	Total	Normalized score
Wetlands	**PFO4B 12% mosaic**	6	5	0	5	6	8	7	0	0	0	37	0.67
	PFO4B 27% mosaic	6	6	5	5	6	8	7	0	0	0	43	0.78
	PFO4B 38% mosaic	7	8	5	6	8	9	9	0	0	0	52	0.95
	PFO4B/SS1B 38% mosaic	9	8	0	8	10	10	10	0	0	0	55	1.00
	PFO4B/SS1B 49% mosaic	9	8	0	8	10	10	10	0	0	0	55	1.00
	PFO4B/SS1B 72% mosaic	9	8	0	8	10	9	9	0	0	0	53	0.96
	PSS1B/EM1B	8	7	0	7	8	8	7	0	0	0	45	0.82
Blue Lake and Tributaries	**Lake Pelagic**	6	7	10	10	1	0	0	0	2	5	41	0.75
	Lake Littoral	4	4	2	3	4	1	1	1	6	10	37	0.67
	Fluvial Spawning	2	2	1	4	1	0	1	8	8	8	35	0.64
	Fluvial Rearing	2	2	1	4	1	0	1	1	10	8	30	0.55
	Interface	4	8	1	1	1	0	1	10	9	4	36	0.71

* Notes: 1 Each habitat type is rated on a scale from 0 up to 10 for each habitat attribute/function.

2 Normalized score calculates the score for the row as a fraction of the highest score (as good as it gets).

5. Fluvial Non-Spawning. Fluvial rearing and adult feeding areas were developed for accessible stream area with the lake at mean pool elevation during an average year for both pre- and with-Expansion (El 309 and 395 feet, respectively). Fluvial rearing in the Blue Lake watershed occurs during periods of warmer summer water temperatures (>6° C). Rainbow trout utilize both fast and slower water habitats; therefore, the entire stream surface area was considered. In pre- and with-Expansion stream reaches where direct width measurements were unavailable, areas where calculated using computer mapping or aerial photographs to determine reach lengths and mean widths. Other with-Expansion areas were determined using TEIR 3 (USFS 2001) habitat width measurements along with reach lengths corresponding to the width measurements.

Methodologies used to determine and estimate areas were the subject of discussion during the January 27, 2012 meeting.

Step 4. Establish Habitat Functions (HFs) and Relative Habitat Functions (RHFs) for potentially affected SHTs.

A list of Habitat Functions (HFs) was selected to reflect ecologically important functions in the study area habitats (see list below). These HFs represent "the physical, chemical, and biological processes or attributes that contribute to the self-maintenance of ecosystems" (Brinson 1993) as well as aquatic habitat functions (e.g., for the health of fish populations) found to be important in the Blue Lake licensing studies.

Selected HFs for the two jurisdictional PHTs in this analysis included:

- Water quality (sediment removal and nutrient/toxicant removal);
- Hydrology (erosion control/shoreline stabilization, flood-flow alteration);
- Organic matter (import and export);
- Vegetation (strata/complexity and species diversity); and
- Fish (spawning, fry rearing, adult feeding).

The HFs for each SHT were then be scored for their perceived level of importance or performance on a scale of from 0 up to 10, where 0 indicated that the HF is not present or functioning in that SHT, and 10 indicated that the HF is of very high importance (Table 2).

Once all HF scores were assigned for each SHT and function, they were summed along each row in Table 2 and the sum expressed as a decimal fraction of the highest score among all HT sums.

In this analysis, two types of wetlands scored equally high and both were thus assigned a **Relative Habitat Function (RHF)** of 1.0. RHFs for each SHT can range between 0 (that function not provided in that SHT), and 1.0 ("as good as it gets").

Wetlands

Initial scoring for each of the HFs for each SHT in the Wetland PHT (Table 2) was done preliminarily in the June 25, 2011 meeting. This was done based on available scientific information and the best professional judgment of those participating in the meeting; these HFs and associated scores are preliminary and subject to further consultation with the Stakeholders. Because two of the wetland types were scored to be as good as it gets in a computation considering all SHTs, all of the calculations in Table 2 reflect scaling against that number.

Blue Lake and Tributaries

The set of HFs (Table 2) for Blue Lake and Tributaries was developed in consultation with Stakeholders having purview over and knowledge of fish resources in the system during the January 27, 2012 meeting. These values reflect the overall RHF in the broader context of the total project impact area and reflect the fact that the lake and streams provide some level of several of the functions more typically thought of as wetland functions, e.g., water storage.

Alternative Analyses

Examination of Table 2 will show that the several wetland types were all rated as providing no function for any of the fish-related functions, whereas, as noted above, the lake and streams were scored as providing some level of those more typically thought of as wetland functions, e.g., water storage.

To explore the two somewhat different classes of functions, those typical of wetlands and those related to fish, the stakeholders considered each class separately. For the wetlands PHT, this does not alter the fact evident in Table 2, that they score high for the typical wetland functions and do not directly support fish. When the lake and tributaries (aquatic) PHT scoring and normalization is separated by the two habitat classes (Table 3), it can be seen that the RHFs based on wetland functions alone (still scaled against the "as good as it gets" wetlands) are relatively low, with the pelagic habitat scoring the highest. However, when the RHFs are calculated based only on the scores for fish-related habitat functions (and normalized against the highest score, that for fluvial spawning areas; Table 3) the scores are mostly higher than when all functions are considered (as in Table 2). The big difference is the pelagic habitat which is sharply lower, reflecting the lack of spawning and generally lower functions for juvenile and adult rearing. These contrasts will be carried forward in the analysis into the following calculations of habitat functional area.

Table 3 – Alternative Calculations of Relative function of habitat types in the Blue Lake inundation area

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02/02/12

		Habitat Attribute or Function															
		Water Quality		Hydrology		Organic Matter	Vegetation			RHF	Fish Functions				RHF		
Primary Habitat Type	**Secondary Habitat Type**	Sediment/ Pollutant Removal	Nutrient/ Sediment Retention	Erosion Control/ Flow Reduction	Water Storage	Import/ Export	Strata/ Complexity	Species Diversity	Total	**Normal-ized score**	Spawning	Juvenile Rearing	Adults	Total	**Normal-ized score**		**Table 2 RHF**
Wetland	**PFO4B 12% mosaic**	6	5	0	5	6	8	7	37	**0.67**	0	0	0	0	**0.00**		**0.67**
	PFO4B 27% mosaic	6	6	5	5	6	8	7	43	**0.78**	0	0	0	0	**0.00**		**0.78**
	PFO4B 38% mosaic	7	8	5	6	8	9	9	52	**0.95**	0	0	0	0	**0.00**		**0.95**
	PFO4B/SS1B 38% mosaic	9	8	0	8	10	10	10	55	**1.00**	0	0	0	0	**0.00**		**1.00**
	PFO4B/SS1B 49% mosaic	9	8	0	8	10	10	10	55	**1.00**	0	0	0	0	**0.00**		**1.00**
	PFO4B/SS1B 72% mosaic	9	8	0	8	10	9	9	53	**0.96**	0	0	0	0	**0.00**		**0.96**
	PSS1B/EM1B	8	7	0	7	8	8	7	45	**0.82**	0	0	0	0	**0.00**		**0.82**
Lake and Streams	**Lake Pelagic**	6	7	10	10	1	0	0	34	**0.62**	0	2	5	7	**0.29**		**0.75**
	Lake Littoral	4	4	2	3	4	1	1	19	**0.35**	1	6	10	17	**0.71**		**0.65**
	Fluvial Spawning	2	2	1	4	1	0	1	11	**0.20**	8	8	8	24	**1.00**		**0.64**
	Fluvial Rearing	2	2	1	4	1	0	1	11	**0.20**	1	10	8	19	**0.79**		**0.55**
	Interface	4	8	1	1	1	0	1	16	**0.29**	10	9	4	23	**0.96**		**0.71**

* Notes:

1 Each habitat type is rated on a scale from 0 up to 10 for each habitat attribute/function.

2 Normalized score calculates the score for the row as a fraction of the highest score (as good as it gets).

Step 5. Determine Habitat Functional Area (HFA).

Overall analysis

Habitat functional area (HFA) for each SHT was first calculated by multiplying the RHF for each SHT by its associated area. Areas for each wetland SHT were determined in the DOWL study; areas for the several SHT within Blue Lake and Tributaries were derived from available site maps and design plans (Table 4).

HFAs for all SHTs based on the initial calculation in Table 2 were summed to produce the total HFA for the study area (Table 4) for the Functional Area in the pre-Expansion condition. A similar HFA was calculated for various with-Expansion conditions through prediction of the areas of the various SHTs after the dam is raised and a new operating regime is in place for a range of time periods (Figures 2W & 2E).

Note that this analysis includes the projected HFA from the expansion of the Blue Lake pelagic habitat by over 300 acres. This large increase in area of the pelagic habitat becomes the dominant factor in the calculation shown in Table 4, which indicates that, with the assumptions stated above, the loss of wetland HFA in the project area (13.85) would be more than offset by a gain of 268.1 HFA in the newly accessible and expanded aquatic habitats. If the gain for the pelagic area of the expanded Blue Lake is excluded from the calculation, as suggested by precedents set in other reservoir expansion projects, there would still be a net gain of 3.02 HFA for the project area (bottom line in Table 4).

Alternative Analysis

An alternative approach to this analysis uses the RHFs based on wetland functions alone to score the wetland SHTs, and on fish functions alone, to score the aquatic SHTs (Table 5). In this analysis inclusive of all habitat types, the net gain in HFA from pre- to with-Project is substantially less, because the large lake pelagic SHT has a lower RHF (0.29 vs. 0.75) when scored against only the other aquatic habitats (Table 3). When the lake pelagic habitat category is removed from the analysis (bottom line in Table 5), then net gain in HFA (4.46) is greater than when the similar calculation is made (Table 4) using RHFs normalized over all habitat types. However, it must be cautioned that one HFA based on this calculation is not equivalent to one HFA based on values in Table 2. For *equivalency*, all RHF must be normalized to the highest functioning habitat in either the project impact or mitigation areas as is done in Tables 2 and 4.

Table 4 – "Snapshot" of Habitat Functional Acres Pre-Project and in Year 1

Primary Habitat Type	Secondary Habitat Type	Relative Habitat Function	Estimated Area (acres)			Habitat Function Acres (HFA)		
			Existing	After Year 1 (then same)	Net Change in Area (acres)	Existing	After Year 1 (then same)	Net Change in Functional Area (acres)
Wetland	PFO4B 12% mosaic	0.67	0.70	0.0	-0.70	0.47	0.00	-0.47
	PFO4B 27% mosaic	0.78	1.10	0.0	-1.10	0.86	0.00	-0.86
	PFO4B 38% mosaic	0.95	2.20	0.0	-2.20	2.08	0.00	-2.08
	PFO4B/SS1B 38% mosaic	1.00	3.20	0.0	-3.20	3.20	0.00	-3.20
	PFO4B/SS1B 49% mosaic	1.00	1.80	0.0	-1.80	1.80	0.00	-1.80
	PFO4B/SS1B 72% mosaic	0.96	2.50	0.0	-2.50	2.41	0.00	-2.41
	PSS1B/EM1B	0.82	3.70	0.0	-3.70	3.03	0.00	-3.03
	Wetland Total		**15.20**	**0.00**	**-15.20**	**13.85**	**0.00**	**-13.85**
Blue Lake and Tributaries	**Lake Pelagic Total**	0.75	**1026.0**	**1363.0**	**337.0**	**764.84**	**1016.05**	**251.22**
	Lake Littoral	0.67	260.00	283.00	23.0	174.91	190.38	15.47
	Fluvial Spawning	0.64	0.08	0.41	0.3	0.05	0.26	0.21
	Fluvial Rearing	0.55	1.68	3.27	1.6	0.92	1.78	0.87
	Interface	0.71	0.80	1.25	0.5	0.57	0.89	0.32
	Other Aquatic Total		**262.6**	**287.9**	**24.4**	**176.5**	**193.4**	**16.9**

If the Wetland HFA is of equal value to the Other Aquatic HFA there is a net gain of 3.05 HFA

Table 5 – Alternative "Snapshot" of Habitat Functional Acres Pre-Project and in Year 1

Primary Habitat Type	Secondary Habitat Type	Relative Habitat Function	Estimated Area (acres)			Habitat Function Acres (HFA)		
			Existing	After Year 1 (then same)	Net Change in Area (acres)	Existing	After Year 1 (then same)	Net Change in Functional Area (acres)
Wetland	PFO4B 12% mosaic	0.67	0.7	0.0	-0.70	0.47	0.0	-0.5
	PFO4B 27% mosaic	0.78	1.1	0.0	-1.10	0.86	0.0	-0.9
	PFO4B 38% mosaic	0.95	2.2	0.0	-2.20	2.08	0.0	-2.1
	PFO4B/SS1B 38% mosaic	1.00	3.2	0.0	-3.20	3.20	0.0	-3.2
	PFO4B/SS1B 49% mosaic	1.00	1.8	0.0	-1.80	1.80	0.0	-1.8
	PFO4B/SS1B 72% mosaic	0.96	2.5	0.0	-2.50	2.41	0.0	-2.4
	PSS1B/EM1B	0.82	3.7	0.0	-3.70	3.03	0.0	-3.0
	Wetlands Totals		**15.2**	**0.0**	**-15.2**	**13.8**	0.0	**-13.8**
Blue Lake and Tributaries	**Lake Pelagic Total**	**0.29**	**1026.0**	**1363.0**	**337.00**	**299.25**	**397.5**	**98.3**
	Lake Littoral	0.71	260.00	283.00	23.00	184.17	200.5	16.3
	Fluvial Spawning	1.00	0.08	0.41	0.33	0.08	0.4	0.3
	Fluvial Rearing	0.79	1.68	3.27	1.59	1.33	2.6	1.3
	Interface	0.96	0.80	1.25	0.45	0.77	1.2	0.4
	Other Aquatic Total		**262.56**	**287.9**	**25.4**	**186.3**	**204.7**	**18.3**

If the Wetland HFA is of equal value to the Other Aquatic HFA there is a net gain of 4.5 HFA

Step 6. Determine Mitigation Needs.

This analysis has shown the HFA in the project area under pre-Expansion conditions (the baseline) and at an assigned period (1 year) following construction. Tables 4 and 5 present the results of these calculations under various scenarios. *These tables indicate that, based on this methodology, the project would have a net gain in HFA when the substantial functional gains resulting from lake expansion are included in the equation. The City believes this result would suggest that no additional mitigation is needed to maintain the ecological functions in the project area. The City believes if the functional gains resulting from lake expansion are left out of the equation,and the Aquatic HFA is of equal value to the Wetlands HFA there remains a small net gain of 3.05 HFA (Table 4).*

Stakeholders are expected to consider this result in formulating their mitigation package for the project.

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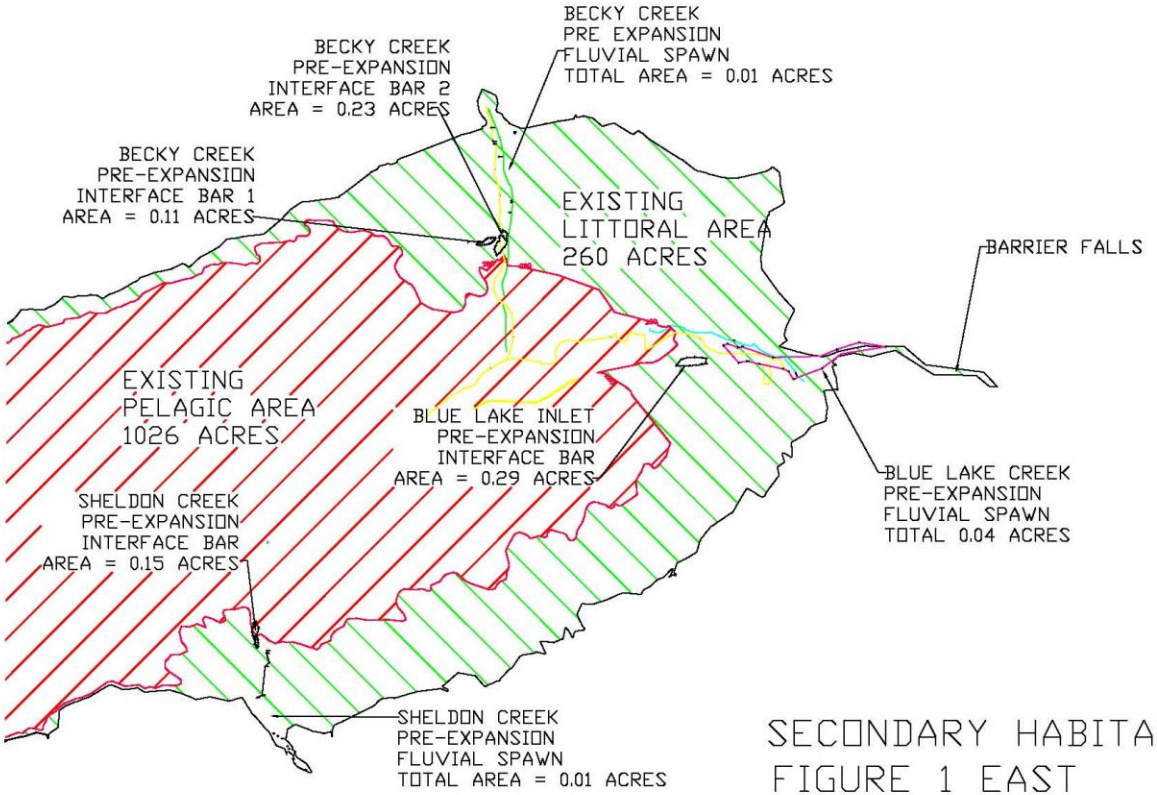
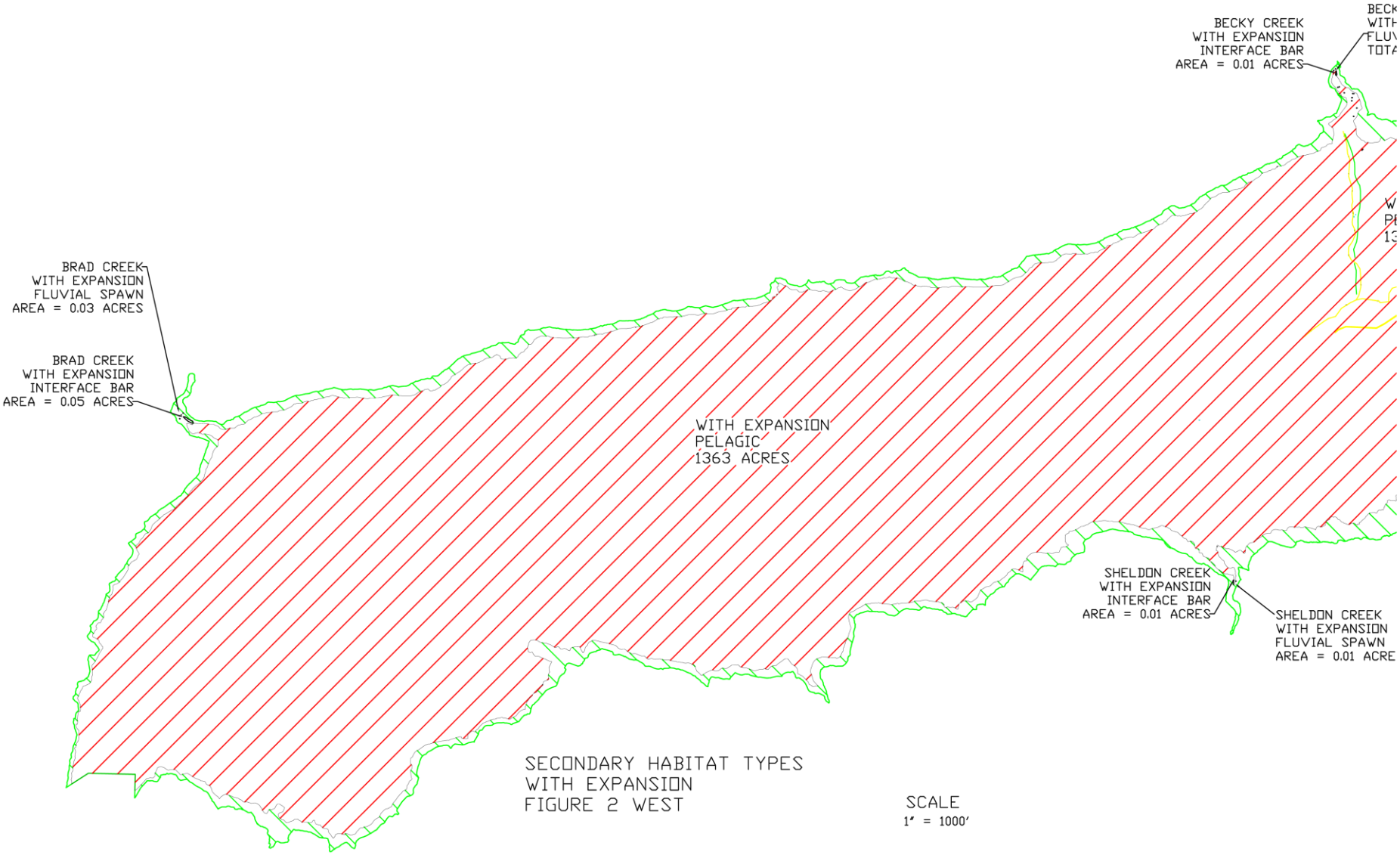
SECONDARY HABITAT TYPES (PRE-EXPANSION)
FIGURE 1 WEST

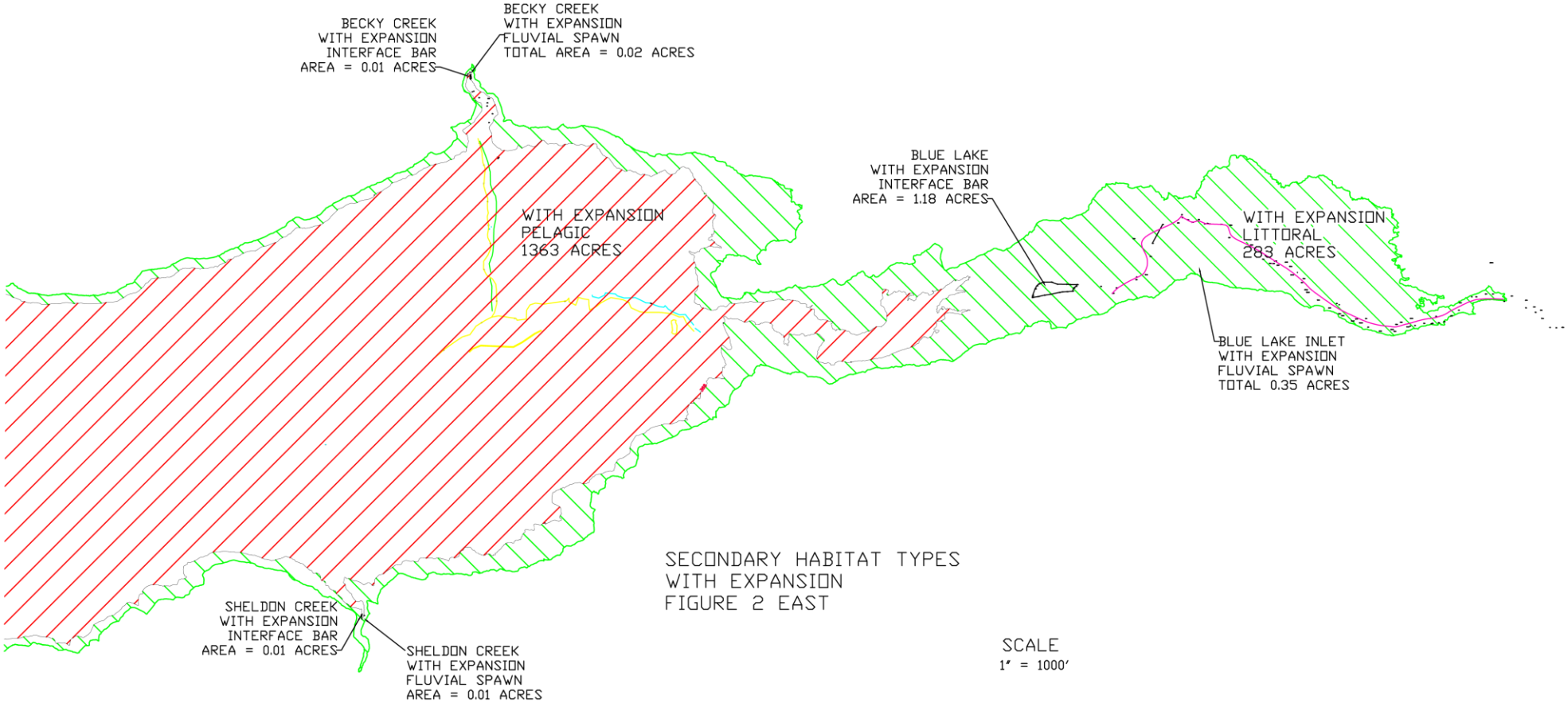
SCALE
1" = 1000'



SECONDARY HABITAT TYPES (PRE-EXPANSION)
FIGURE 1 EAST

SCALE
1" = 1000'


BECKY CREEK
WITH EXPANSION
INTERFACE BAR
AREA = 0.01 ACRES
BRAD CREEK
WITH EXPANSION
FLUVIAL SPAWN
AREA = 0.03 ACRES
BRAD CREEK
WITH EXPANSION
INTERFACE BAR
AREA = 0.05 ACRES
WITH EXPANSION
PELAGIC
1363 ACRES
SHELDON CREEK
WITH EXPANSION
INTERFACE BAR
AREA = 0.01 ACRES
SHELDON CREEK
WITH EXPANSION
FLUVIAL SPAWN
AREA = 0.01 ACRE
SECONDARY HABITAT TYPES
WITH EXPANSION
FIGURE 2 WEST
SCALE
1" = 1000'


BECKY CREEK
WITH EXPANSION
INTERFACE BAR
AREA = 0.01 ACRES
BECKY CREEK
WITH EXPANSION
FLUVIAL SPAWN
TOTAL AREA = 0.02 ACRES
WITH EXPANSION
PELAGIC
1363 ACRES
BLUE LAKE
WITH EXPANSION
INTERFACE BAR
AREA = 1.18 ACRES
WITH EXPANSION
LITTORAL
283 ACRES
BLUE LAKE INLET
WITH EXPANSION
FLUVIAL SPAWN
TOTAL 0.35 ACRES
SHELDON CREEK
WITH EXPANSION
INTERFACE BAR
AREA = 0.01 ACRES
SHELDON CREEK
WITH EXPANSION
FLUVIAL SPAWN
AREA = 0.01 ACRES
SECONDARY HABITAT TYPES
WITH EXPANSION
FIGURE 2 EAST
SCALE
1' = 1000'

ATTACHMENT I

Numbered Comments from USFS

USFS 1: On page 1, second paragraph: The Final Amendment Application was submitted in November 2010, rather than in 2009. The 2009 date is incorrect.

City Response: The year 2009 was replaced by 2010 both in Page 1, second paragraph and in the Literature Cited Section at the end of the Application.

USFS 2: On page 3, *Previous Mitigation Planning:* This section states that there are preliminary agreements in place for project mitigation, including a land acquisition agreement. This section is misleading. Potential mitigation measures have been discussed but there are no actual written agreements in place. There is no land acquisition agreement. One potential mitigation measure might result in the donation of City-owned land to the United States/Forest Service. This section should be rewritten to indicate that discussions are on-going and no agreements (preliminary or otherwise) are in place.

City Response: On Page 3, paragraphs 2 and 3 we have reworded the description of the mitigation planning process to date, noting that considerable progress has been made, but not referencing any preliminary agreements. We have retained language that mitigation for such resources as wildlife and botanical resources mitigation measures are being developed within their respective impact/mitigation processes using methods specific to those resources.

USFS 3a. Step 4, page 11: It is unclear how the list of habitat functions in Table 2 was derived (or how they were ranked).

City Response: Concerning the process through which habitat functions were derived and ranked, please see the response to Comment USFS 4c, below.

USFS 3b. Brinson 1993 is cited, however, Brinson developed a Hydrogeomorphic Classification system, and on page 2 he states that the system "is not intended to be a valuation procedure."

City Response: The Brinson citation is an example of how such hydrogeomorphic factors may be included in wetlands analyses. It is stated in our draft study plan, however, that the factors, analysis methods and other aspects of the Blue Lake Expansion analysis have been developed specifically for this project. As such, the Blue Lake Expansion functional analysis is designed to be used in an evaluation setting.

USFS 4a: Concerning the analysis: There are some wetland functions that would seem to be important but are not accounted for in the draft analysis. These include WL habitat, berry picking, carbon sequestration, amphibian habitat, subsistence use, and even song-bird habitat. Inclusion of these values would increase the value of the terrestrial habitat when compared to the open water or deep water habitat.

City Response: As noted above, impacts to wetlands functions such as wildlife habitat, berry picking, etc. have not been considered to be appropriate in a wetlands functional analysis. Functions in our plan relate to the unique set of aquatic and terrestrial resources which interact in and downstream of wetlands, e.g. water quality, fish habitat and certain wetlands-specific plants and animals. We believe that our list of functions adheres to this requirement to contribute to the benefits of a wetlands ecosystem.

Impacts to the factors suggested in Comment 4a, while important, do not relate directly to wetlands functions. They have, however, been accounted for in other resource-specific sections of the Environmental Assessment (EA), as described in detail below:

- **"WL habitat".** We assume this to mean Wildlife Habitat. Wildlife habitat, in terms of both individuals and their associated plant and topographic based habitats are extensively evaluated in the Wildlife and Botanical Resources sections of the EA. The primary wildlife impacts (disturbance during construction and increased hunting pressure from eased boat access) are addressed in the EA through specific measures, including

changes in the City's access policy and restrictions on blasting, etc. to be approved in upcoming plan reviews);

- **Berry Picking:** Berry picking is an activity addressed in both the recreation and subsistence sections of the EA. While there may be impacts to this resource, they are fully addressed under these two resource analyses and outside the wetlands area;

- **Carbon Sequestration:** This issue has not been raise at any point during the Scoping process and during successive reviews of the EA.

- **Amphibian Habitat:** In the over three years of terrestrial and aquatic studies conducted for the Amendment Application, no amphibians were noted, either in wetland or non-wetland habitats.

- **Subsistence Use:** As noted under "Berry Picking" above, subsistence uses are addressed in their own resource section in the EA. Our researchers have noted no subsistence use of the potentially -impacted wetlands areas around Blue Lake;

- **Song-bird habitat.** Song-bird habitat is fully addressed in the EA as part of the Wildlife resources section. Little impact was envisioned.

USFS 4b: Because the watershed is steep, many of the side slopes are Sitka alder-dominated brush fields. Gently sloping forested ground is not common in the watershed, yet this is some of the ground that will be inundated at the head of the lake.

City Response: The alder-dominated brush fields referenced in this comment are classified as "upland" habitats and are not jurisdictional in a USACOE wetlands analysis. They are therefore not appropriately evaluated using the functional analaysis in our study plan. Such areas are described in the Wildlife and Botanical Resources section of the EA, however, and their loss to inundation will be accounted for in mitigation planning for those resources.

USFS 4c. The indicators of wetland values and functions should have been agreed upon with all stake holders before the Blue Lake wetland functional analysis was undertaken.

City Response: As described in the study plan, habitat functions were derived and ranked during a meeting held on June 25, 2011, among the City and the principal USACOE representative. Habitat Functions from this meeting were selected and ranked, preliminarily, for later review by a larger group of Stakeholders.

On January 27, 2012, the City distributed the draft Functional Analysis Study plan to a much larger Stakeholder list with a request for review of all components and methods in the analysis. By the end of this review period, it was the City's belief that sufficient opportunity had been afforded for review of all aspects of the method, including selection and ranking of the Habitat Functions.