**BEAR, LITTLE BEAR, CUB, AND ASHER LAKES**
**HYDROLOGIC / NUTRIENT BUDGET AND WATER**
**QUALITY MANAGEMENT PLAN EVALUATION**

**EXHIBIT A: SCOPE OF SERVICES**

Prepared By
Environmental Research & Design, Inc.
Revised November 13, 2009

As requested by Seminole County (County), Environmental Research & Design, Inc. (ERD) has prepared the following Scope of Services to develop a nutrient/hydrologic budget and water quality management plan for Bear Lake (311 acres), Little Bear Lake (29 acres), Cub Lake (14 acres), and Asher Lake (5 acres) located in southwest Seminole County. Hydrologic and nutrient budgets will be developed for each lake to identify significant pollution sources and to provide a ranking of areas with respect to annual mass loadings and areal loadings. The hydrologic budgets will include estimated inputs from precipitation, groundwater seepage, and stormwater runoff. The nutrient budgets will include inputs from bulk precipitation, groundwater seepage, internal recycling, and stormwater runoff. A 12-month field monitoring program is proposed to collect data on groundwater seepage and significant inflows. This program will include both dry and wet season conditions and will be used to develop the hydrologic and nutrient budgets. A water quality management plan will be developed for each lake to identify specific projects and recommendations designed to maintain and improve water quality in Bear Lake. The recommendations will include both structural and non-structural activities. Specific work efforts to be performed to achieve these objectives are outlined below.

Environmental Research & Design, Inc. (ERD) shall, at a minimum, perform the following specific tasks for the Bear Lake, Little Bear Lake, Cub Lake, and Asher Lake project:

1. **Attend project kick-off meeting**: Representatives of ERD will attend a project start-up meeting with representatives of the County to review the overall project objectives, the scope of services, and the project schedule. Copies of all previous water quality investigations and data, engineering studies, bathymetry, hydrologic/hydraulic models, and other information related to Bear Lake, Little Bear Lake, Cub Lake, and Asher Lake and the surrounding watershed areas, will be provided to ERD by the County.

2. **Review available data**: All data provided to ERD at the project start-up meeting will be reviewed and summarized for potential use in developing hydrologic and nutrient budgets for the lake. All available water quality data will be entered into a statistical database, and trend analyses will be performed to identify significant water quality trends for typical trophic state indicators (total nitrogen, total phosphorus, chlorophyll-a and Secchi disk depth). Data related to vegetation surveys, vegetation control, and benthic populations will also be collected and reviewed.

3. **Perform field reconnaissance**: ERD will perform detailed field reconnaissance of the Bear Lake, Little Bear Lake, Cub Lake, and Asher Lake drainage basins and contributing stormsewer systems. This reconnaissance will be used to visually observe characteristics of the watershed areas and to identify potential locations for the inflow monitoring efforts discussed under Task 5. Watershed areas treated by existing stormwater management systems will be identified, and this information will be used in estimation of hydrologic and nutrient inputs from stormwater runoff.

4. **Surface water monitoring**: Routine surface water monitoring will be conducted by ERD on a monthly basis at a single location near the center of Bear Lake, Little Bear Lake, Cub Lake, and Asher Lake. During each monthly monitoring event, field measurements of pH, temperature, conductivity, dissolved oxygen, and turbidity will be conducted at 0.5-m intervals from the surface to the lake bottom. A measurement of Secchi disk depth will also be conducted during each monitoring event.

   Surface water samples will be collected in each lake at depths equivalent to 50% of the Secchi disk depth and 0.5 m from the lake bottom to assist in identifying ambient water quality characteristics within the lake. Each of the collected lake samples will be analyzed in the ERD Research Laboratory for the following parameters:

   a. Alkalinity
   b. Ammonia
   c. $NO_x$ (nitrite + nitrate)
   d. Particulate Nitrogen
   e. Total Nitrogen
   f. Orthophosphorus
   g. Particulate Phosphorus
   h. Total Phosphorus
   i. Total Suspended Solids (TSS)
   j. Turbidity
   k. Chlorophyll-a (surface sample only)

   The proposed surface water monitoring program will generate a total of 96 samples (12 events x 2 samples/event x 4 lakes)

5. **Inflow monitoring**: A supplemental monitoring program will be conducted by ERD to evaluate the hydrologic and chemical characteristics of significant inflows into the four lakes. Potential locations for the supplemental monitoring program will be selected jointly by ERD and the County. When inflows are observed, field measurements of discharge will be conducted using the velocity/cross-sectional area method as outlined by USGS. Surface water samples will be collected and analyzed in the ERD research laboratory for the following parameters:

   a. pH
   b. Specific Conductivity
   c. Alkalinity
   d. Ammonia
   e. $NO_x$ (nitrite + nitrate)
   f. Particulate Nitrogen
   g. Total Nitrogen
   h. Orthophosphorus
   i. Particulate Phosphorus
   j. Total Phosphorus
   k. Total Suspended Solids (TSS)
   l. Turbidity

   The proposed supplemental monitoring program will assist in establishing hydrologic and nutrient loadings from significant inflows into the four lakes. For budget purposes, a total of 40 supplemental inflow samples is proposed.

6. **Evaluate characteristics of seepage inflow**:

   a. **Installation of seepage meters**: A total of 14 groundwater seepage meters will be installed in Bear Lake with 12 groundwater seepage meters in Little Bear Lake, Cub Lake and Asher Lake combined (26 sites total) to determine the quality and quantity of shallow groundwater seepage entering each lake. The seepage meters will be installed in shallow and deep areas of each lake and will include a wide range of land use, waste disposal techniques, and topographic characteristics in upland areas adjacent to the seepage meters.

   b. **Routine monitoring of seepage meters**: Seepage monitoring will be conducted for a period of 12 months. A total of 8 separate collection events will be conducted during the 12-month monitoring program, with samples collected more frequently during wet season conditions and less frequently during dry season conditions. Seepage monitoring events will be conducted during the months of June, July, August, September, October, December, February, and April. During each collection event, the quantity of seepage collected in each seepage meter will be measured, and a sample of the collected seepage will be returned to the ERD laboratory for chemical analysis. Water samples collected from the seepage meters will be analyzed for the following parameters:

| | | | |
|---|---|---|---|
| (1) | pH | (4) | Total Nitrogen |
| (2) | Specific Conductivity | (5) | Total Phosphorus |
| (3) | Alkalinity | | |

   A maximum of 208 separate seepage samples (26 seepage meters x 8 events) will be collected as part of this task. For budget purposes, a sample collection rate of 80% is assumed (164 samples).

7. **Sediment survey**: A sediment depth contour map will be developed for Bear Lake, Little Bear Lake, Cub Lake, and Asher Lake to quantify the volume and depth of existing organic sediments. ERD will perform simultaneous measurements of water depth and organic sediment depth to hard bottom at a minimum of 250 locations in the four lakes. The location of each probe will be determined using a hand-held GPS system. The organic sediment depth information will be used to develop an organic sediment thickness map with 1-ft contours. The total organic sediment volume in each lake will be calculated from this contour map.

8. **Sediment collection / characterization**: Lake bottom sediment core sample will be collected at 35 separate sites in Bear Lake and 20 sites in Little Bear Lake, Cub Lake, and Asher Lake combined (55 samples total) using a 2-inch diameter stainless steel split-spoon core collector. Visual characteristics of each sediment core will be recorded, and the 0-10 cm layer of the sediment core will be sectioned off and collected. This layer is collected since prior research has indicated that water quality impacts from lake sediments are limited primarily to the top 10 cm. Each core sample will be placed into a separate sample container and returned to the ERD research laboratory for analysis of the following parameters:

a. Moisture Content
b. Organic Content
c. Sediment Density
d. Total Phosphorus
e. Total Nitrogen
f. pH

Each of the 55 core samples will also be tested using the Chang and Jackson phosphorus speciation technique. This technique divides sediment phosphorus associations into the following categories:

a. Saloid Phosphorus
b. Iron-Bound Phosphorus
c. Aluminum-Bound Phosphorus

9. **Internal recycling of phosphorus**: Direct measurements of internal recycling of phosphorus under oxic and anoxic conditions will be performed in Bear Lake by collection of large diameter (~10 cm) sediment core samples from various locations within the lake. A total of 5 separate core samples will be collected in Bear Lake from a variety of water depths and sediment characteristics. Two core samples will be collected in each of the remaining lakes (11 total). The core samples will be returned to the ERD Laboratory and incubated under both oxic and anoxic conditions. Sediment release of phosphorus will be measured in each column over time. Filtered water samples will be collected from each core chamber every other day for a period of 30 days under both oxic and anoxic conditions. The release rate information will be combined with current and historical dissolved oxygen measurements to evaluate phosphorus recycling on a seasonal basis based on the percentage of oxic and anoxic zones within the lake. A total of 260 samples will be collected (11 chambers x 12 samples/chamber x 2 conditions) and analyzed for total phosphorus during the testing program.

10. **Perform hydrologic modeling**: Estimates of annual runoff inputs to Bear Lake, Little Bear Lake, Cub Lake, and Asher Lake from each of the contributing watershed areas will be developed using computer modeling techniques. The modeling will be performed using site-specific hydrologic characteristics for each drainage sub-basin area, including basin size, percentage of impervious areas, soil characteristics, and conveyance system types. Estimates of annual runoff inputs to each lake will be generated for each contributing sub-basin area.

11. **Develop hydrologic budget**: Annual hydrologic budgets will be developed for Bear Lake, Little Bear Lake, Cub Lake, and Asher Lake based upon evaluated inputs from direct precipitation, stormwater runoff, and groundwater seepage. Inputs from direct precipitation will be calculated based upon the lake surface area and historical rainfall characteristics for the Central Florida area. Hydrologic inputs from stormwater runoff will be estimated based upon computer modeling of the drainage sub-basin areas. Inputs from groundwater seepage will be estimated based upon the field monitoring program. The results of the hydrologic budgets will be presented in both graphical and tabular formats.

12. **Develop nutrient budget**: Nutrient budgets will be developed for Bear Lake, Little Bear Lake, Cub Lake, and Asher Lake which include inputs from bulk precipitation, stormwater runoff, internal recycling, and groundwater seepage. Inputs from bulk precipitation will be calculated using typical bulk precipitation characteristics for the Central Florida area. Inputs from stormwater runoff will be estimated using typical literature-based values or actual stormwater monitoring data for the Bear Lake watershed, if available. Phosphorus loading as a result of internal recycling will be calculated based upon the field and laboratory monitoring proposed by ERD. Nutrient inputs from groundwater seepage will be estimated based upon the field monitoring program. The results of the nutrient budget will be presented in both graphical and tabular formats.

13. **Develop water quality model**: Nutrient limitation water quality models will be developed for Bear Lake, Little Bear Lake, Cub Lake, and Asher Lake based on the results of the hydrologic and nutrient budgets. The models will be calibrated on an average annual basis using the identified hydrologic and nutrient inputs. The models will be developed in a spreadsheet format which can be used to evaluate changes in water quality resulting from identified retrofit options.

14. **Develop management recommendations**: Based on the results of the hydrologic and nutrient budgets, ERD will develop lake management plans for Bear Lake, Little Bear Lake, Cub Lake, and Asher Lake. These plans will include both structural and non-structural techniques to maintain and/or improve water quality in the lake. Preliminary conceptual designs, including costs and pollutant removal benefits, will be developed for each evaluated management option. A minimum of two structural options will be developed for Bear Lake, with one option each for Little Bear Lake, Cub Lake, and Asher Lake. The anticipated water quality improvements achieved by the recommended options will be evaluated using the water quality models developed for each lake.

15. **Prepare Draft Final Report**: A Draft Final Report will be prepared which presents the results of the previous tasks. The Draft Final Report will be submitted to the County for review in digital format only (pdf).

16. **Attend review meeting**: Representatives from ERD will attend a review meeting with representatives from the County to discuss the Draft Final Report.

17. **Prepare/present presentation to HOA**: The ERD Project Director will prepare and present a presentation of the results of the hydrologic/nutrient budgets and water quality management plan for the lakes to the Bear Lake Home Owners Association.

18. **Prepare Final Report**: After receiving comments from the County, a Final Report will be prepared for the project. Five hard copies and one digital copy (pdf format) of the Final Report will be submitted to the County.

# BEAR, LITTLE BEAR, CUB, AND ASHER LAKES HYDROLOGIC / NUTRIENT BUDGET AND WATER QUALITY MANAGEMENT PLAN EVALUATION

## EXHIBIT B: MAN-HOURS / FEE SUMMARY

Prepared By
Environmental Research & Design, Inc.
Revised November 13, 2009

| TASK | DESCRIPTION | MAN-HOURS* | | | | | | | TASK AMOUNT ($) |
|---|---|---|---|---|---|---|---|---|---|
| | A. Labor | PD | SE | LM | FT | CH | D | CL | |
| 1. | Project kick-off meeting | 3 | - | 3 | - | - | - | - | $ 615.57 |
| 2. | Review available information | 4 | 20 | 24 | - | - | - | - | 3,817.36 |
| 3. | Perform field reconnaissance | 12 | - | 16 | 16 | - | - | - | 3,495.60 |
| 4. | Surface water monitoring | 8 | - | 24 | 48 | - | - | - | 4,971.76 |
| 5. | Inflow monitoring | 4 | - | 12 | 24 | - | - | - | 2,485.88 |
| 6. | Groundwater seepage | | | | | | | | |
| | a. Seepage meter preparation/installation | 12 | - | 16 | 40 | - | - | - | 4,700.16 |
| | b. Routine monitoring/sample collection | 8 | - | 16 | 160 | - | - | - | 10,132.48 |
| 7. | Sediment survey | 4 | - | 8 | 40 | - | 12 | - | 3,767.60 |
| 8. | Sediment collection/characterization | 4 | - | 24 | 24 | 60 | - | - | 6,361.52 |
| 9. | Internal recycling evaluation | 8 | 16 | 40 | 64 | - | - | - | 8,172.08 |
| 10. | Perform hydrologic modeling | 4 | 48 | - | - | - | - | - | 5,018.96 |
| 11. | Develop hydrologic budgets | 12 | 24 | - | - | - | 8 | - | 4,458.32 |
| 12. | Develop nutrient budgets | 12 | 16 | - | - | - | 8 | - | 3,720.24 |
| 13. | Develop water quality models | 20 | 4 | - | - | - | - | - | 3,321.44 |
| 14. | Develop management recommendations | 40 | 64 | 8 | - | - | 40 | - | 14,633.20 |
| 15. | Prepare Draft Final Report | 54 | 32 | 16 | - | - | 16 | 24 | 13,888.44 |
| 16. | Review meeting with County | 4 | - | - | - | - | - | - | 590.48 |
| 17. | Prepare/present presentation to HOA | 12 | 4 | 4 | - | - | 4 | 8 | 2,973.16 |
| 18. | Prepare Final Report | 12 | 8 | 8 | - | - | 4 | 12 | 3,755.52 |
| | TOTAL - LABOR: | 237 | 236 | 219 | 416 | 60 | 92 | 44 | $ 100,879.77 |

| | B. Laboratory Expenses | |
|---|---|---|
| 4 | Surface Water Samples | |
| | a. Surface water samples (48 samples @ $150/sample) | $ 7,200.00 |
| | b. Surface water samples (48 samples @ $130/sample) | 6,240.00 |
| 5 | Inflow Samples (40 samples @ $130/sample) | 5,200.00 |
| 6 | Groundwater Seepage (26 sites x 8 events/site x $50/sample x 80%) | 8,320.00 |
| 8 | Sediment Analyses (55 samples x $116/sample) | 6,380.00 |
| 9 | Internal Recycling Analyses (260 samples x $12/sample) | 3,120.00 |
| | TOTAL – LABORATORY EXPENSES: | $ 36,460.00 |

| | C. Reimbursable Expenses | |
|---|---|---|
| 15, 18 | B/W Copies (4000 copies @ $0.10/copy) | $ 400.00 |
| 15, 18 | Color Copies (800 copies @ $1.00/copy) | 800.00 |
| 6 | Seepage meter fabrication/preparation (26 seepage meters @ $110/meter) | 2,860.00 |
| 6 | Seepage monitoring supplies (26 sites x 8 events/site x $15/site-event x 80%) | 2,496.00 |
| 9 | Large Diameter Sediment Core Tubes (11 sites x $50/site) | 550.00 |
| -- | Mileage (1000 miles @ $0.35/mile) | 350.00 |
| 15, 18 | Misc. Report Expenses (binders, covers, tabs, etc. - at cost) | 100.00 |
| | TOTAL - REIMBURSABLE EXPENSES: | $ 7,556.00 |
| | **PROJECT TOTAL:** | $ 144,895.77 |

***LABOR CATEGORY:**

| | | | |
|---|---|---|---|
| PD: | Project Director ($147.62/hour) | CH: | Chemist ($53.08/hour) |
| SE: | Senior Engineer ($92.26/hour) | D: | Draftsman ($59.08/hour) |
| LM: | Limnologist ($57.57/hour) | CL: | Clerical ($45.76/hour) |
| FT: | Field Technician ($50.19/hour) | | |