

ENVIRONMENTAL ANALYSIS AND DECISION ON THE NEED FOR AN ENVIRONMENTAL IMPACT STATEMENT (EIS)

Form 1600-1 Rev. 6-2001  
#140250 v1 - EAGLE SPRING LAKE LEVEL ENVIRONMENTAL ANALYSIS  
300-1077  
11/14/08,01/21/09,02/03/09

Department of Natural Resources (DNR)

Region or Bureau  
South East Region

Type List Designation  
Type List Designation II

NOTE TO REVIEWERS: This document is a DNR environmental analysis that evaluates probable environmental effects and decides on the need for an EIS. The attached analysis includes a description of the proposal and the affected environment. The DNR has reviewed the Attachments and, upon certification, accepts responsibility for their scope and content to fulfill requirements in s. NR 150.22, Wis. Adm. Code. Your comments should address completeness, accuracy or the EIS decision. For your comments to be considered, they must be received by the contact person before 4:30 p.m., Insert Date.

Contact Person:

Title:

Address:

Telephone Number

Applicant: Eagle Spring Lake Management District

Address: P. O. Box 196  
Eagle, WI 53119-0196

Title of Proposal: REGULARIZATION OF WATER SURFACE LEVEL ELEVATIONS FOR EAGLE SPRING LAKE

Location: County: Waukesha City/Town/Village: Town of Eagle

Township Range Section(s): U.S. Public Land Survey Sections 25, 26, 35 and 36, Township 5 North, Range 17 East, Town of Eagle, Waukesha County

PROJECT SUMMARY

1. Brief overview of the proposal including the DNR action (include cost and funding source if public funds involved)

This Environmental Assessment (EA) addresses the potential impacts of modifying the surface water elevation of Eagle Spring Lake, created by the Wambold Dam, to reflect a 0.56 feet increase in the operating levels above that initially authorized by the Wisconsin Public Service Commission (PSC) in their 1954 ruling. This would result in the lake surface elevations of Eagle Spring Lake being maintained at between 820.53 feet and 820.83 feet above the National Geodetic Vertical Datum of 1929 (NGVD-29), or between 9.40 and 9.70 feet based upon the local datum.

2. Purpose and Need (include history and background as appropriate)

A discussion of water level management measures was included within the adopted lake management plan for Eagle Spring Lake at the request of the Eagle Spring Lake Management District Board of Commissioners (ESLMD) and Wisconsin Department of Natural Resources-South East Region staff (WDNR). This plan, Southeastern Wisconsin Regional Planning Commission (SEWRPC) Community Assistance Planning Report (CAPR) No. 226, *A Lake Management Plan for Eagle Spring Lake, Waukesha County, Wisconsin*, was published in October 1997. The plan noted that the minimum and maximum operating levels of between 817.3 feet and 817.6 feet NGVD-29—reported *in litt.* dated June 16, 1995 by Ms. Liesa Nesta of the Wisconsin Department of Natural Resources (WDNR) staff and referenced dam File #67.4—should be corrected by 2.65 feet as a result of a refinement in the elevation of the benchmark against which these levels were assessed. Based upon the data provided by Ms. Nesta, the actual equivalent operating levels, reported to have been established by the PSC in their 1954 ruling, should be 819.95 feet and 820.25 feet above NGVD-29. Subsequently, Ms. Michelle Schneider of the WDNR staff—*in litt.* dated February 18, 2008 and referenced Wambold Dam FF # 67.04—stated that the PSC ordered lake surface elevation was set based upon a local datum at between 8.84 and 9.14 feet. Consequently, any change in the operating levels of the Eagle Spring Lake would require that an Environmental Assessment (EA) be completed to “evaluate the impacts of maintaining the lake at higher levels than the approved range” relative to the local datum. This EA responds to that requirement.

3. Authorities and Approvals (list local, state and federal permits or approvals required)

This EA is prepared pursuant to the requirements of Chapter NR 150 of the *Wisconsin Administrative Code*, and addresses the establishment of operating levels of dams affecting navigable waters as set forth in Chapter 31 of the *Wisconsin Statutes*. The WDNR has authority to regulate and control the level and flow of water in all navigable waters pursuant to Section 31.02(1) of the *Wisconsin Statutes*: Section 31.13 of the *Wisconsin Statutes* specifically applies to the proposed action of raising or enlarging existing dams.

In order to achieve an increase in the ordered operational water level for Eagle Spring Lake, an environmental analysis and review is required pursuant to Paragraph 150.03(8)(f)8 a. of the *Wisconsin Administrative Code*. This environmental analysis is required for the establishment of new levels for large dams, as defined in terms of the height of structure (greater than six feet) and volume of impounded water (greater than 50 acre-feet) as set forth in Section 31.19(1)(b) of the *Wisconsin Statutes*, which criteria are met by the Wambold Dam impounding Eagle Spring Lake. The environmental analysis required is a Type II action, as such an increase in operating level has “the potential to cause significant environmental effects and may involve unresolved conflicts in the use of the available resources” (Section NR 150.03(2), *Wisconsin Administrative Code*). The first step in this process involves the preparation of an Environmental Assessment (EA) that includes a statement of the issue, as set forth in Section NR 150.21 of the *Wisconsin Administrative Code*, and an analysis consistent with Section NR 150.22.

The applicant is a duly constituted public inland lake protection and rehabilitation district created pursuant to Chapter 33 of the *Wisconsin Statutes*. Public inland lake protection and rehabilitation districts are a “local governmental unit” as defined in Section 30.79(1)(a) and a “municipality” for purposes of intergovernmental cooperation as defined in Section 66.0301(1)(a) of the *Wisconsin Statutes*. Public inland lake protection and rehabilitation districts, as a “municipal corporation,” are included within the definition of a “person” as set forth in Section 32.01(1) the *Wisconsin Statutes* and related to the exercise of eminent domain.

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PROPOSED PHYSICAL CHANGES (more fully describe the proposal)

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4. Manipulation of Terrestrial Resources (include relevant quantities - sq. ft., cu. yard, etc.)

This proposal affects approximately 12.6 acres of lands riparian to Eagle Spring Lake, Waterbody Identification Code 768600, located in the Town of Eagle, Waukesha County, Wisconsin. Such lands would be subject to inundation as a consequence of the proposed 0.56 feet increase in water surface elevation in Eagle Spring Lake. The affected lands include shoreland wetlands, especially along the western edge of the waterbody, and uplands, as shown on Attachment 1.

It should be noted that, as documented on the series of aerial photographs appended hereto as Attachments 2 through 10, the water surface elevation of Eagle Spring Lake has been maintained within the 820.53 feet and 820.83 feet above NGVD-29 range—or at a level that is approximately 0.56 feet above the permitted operating level established by the local datum—for a period extending back in time to at least 1941. The current (2005) shoreline of Eagle Spring Lake has been superimposed upon the series of aerial photographs referenced as Attachments 2 through 10 as documentary evidence of this fact. The stability over time of the shoreland wetland system that forms the western shoreline of Eagle Spring Lake is noteworthy.

5. Manipulation of Aquatic Resources (include relevant quantities - cfs, acre feet, MGD, etc.)

This proposal would effectively add approximately 156.35 acre-feet of water to the volume of water impounded by the Wambold Dam. This volume is estimated from the revised bathymetry and is not inconsistent with the estimate generated from the hypsographic curve published by the WDNR—then, the Wisconsin Conservation Department—in August 1967 (estimated to be about 152.5 acre-feet). Modification of the impounded volume of water and associated changes in lake surface area would have an impact on the biology and physical environment of Eagle Spring Lake, as elaborated below.

Initial estimates of an impact on lake water quality, based upon an evaluation of the nutrient load estimated using the Wisconsin Lake Model Spreadsheet (WiLMS, version 3.3) and the Organization for Economic Cooperation and Development (OECD) model for calculating in-lake phosphorus concentration, would suggest that no change would be anticipated in the in-lake phosphorus concentration, which would remain at about 20 micrograms per liter ( $\mu\text{g/l}$ ).

6. Buildings, Treatment Units, Roads and Other Structures (include size of facilities, road miles, etc.)

There are no buildings, roads, or other structures affected by the proposal. Subject to certification by a Wisconsin-licensed Professional Engineer, no structural changes to the Wambold Dam or its appurtenant structures are likely to be required with respect to the proposed change in operational water level evaluated herein. This proposal effectively regularizes the historic operating conditions associated with this impoundment.

7. Emissions and Discharges (include relevant characteristics and quantities)

The increase in lake surface elevation will not result in any long-term changes in discharges and will not generate any emissions. A short-term change (decrease) in stream discharge would be expected during the initial period of implementation, as a volume of water equivalent to the proposed increase in lake volume would be retained behind the Dam. This would be a temporary impact, the net effect of which could be managed through a small adjustment in rate of discharge from the impoundment to the downstream segment of the Mukwonago River. This would result in an incremental increase in volume of the impoundment with limited disruption of the downstream transmission of water from the Dam. No atmospheric discharges will occur.

8. Other Changes

The proposed increase in lake surface area impounded by the Wambold Dam is expected to affect Eagle Spring Lake and its riparian community and users in a variety of ways, including expanding the water volume and habitat heterogeneity available to fishes and other aquatic life, providing a larger surface area for water-based recreational activities, and modifying the area of shoreland available to wetland plants both within and adjacent to Eagle Spring Lake and within and adjacent to the upstream Lulu Lake whose water surface elevation also is controlled by the Wambold Dam (see Attachment 11).

9. Identify the maps, plans and other descriptive material attached

Attachment 1: Project Location and Stream Reach Designation: 2005

Attachment 2: Eagle Spring Lake: 1941

Attachment 3: Eagle Spring Lake: 1950

Attachment 4: Eagle Spring Lake: 1963

Attachment 5: Eagle Spring Lake: 1970

Attachment 6: Eagle Spring Lake: 1980

Attachment 7: Eagle Spring Lake: 1990

Attachment 8: Eagle Spring Lake: 1995

Attachment 9: Eagle Spring Lake: 2000

Attachment 10: Eagle Spring Lake: 2005

Attachment 11: Existing Surface Water Elevation Profile of Lulu and Eagle Spring Lakes: 2005

Attachment 12: Historic and Current Subwatershed Boundary Tributary to Eagle Spring Lake: 2008

Attachment 13: Bathymetric Map of Eagle Spring Lake: 2007

Attachment 14: Comparison of Historic, Current, and Proposed Drawdown Conditions of Hydrology and Morphometry of Eagle Spring and Lulu Lakes: 1969-2005

Attachment 15: Flow Rate Measurements in the Upper Reach of the Mukwonago River

Attachment 16: Water Level in Eagle Spring Lake: June 2001-June 2003

Attachment 17: Transect Locations Between Lulu and Eagle Spring Lakes: 2008

Attachment 18: Maximum Water Depth and Mean Sediment Depth Among Transects Between Eagle Spring and Lulu Lakes: 2008

Attachment 19: Transect Locations Upstream Lulu Lake: 2008

Attachment 20: Maximum Water Depth and Mean Sediment Depth Among Transects Upstream of Lulu Lake: 2008

Attachment 21: Water Width and Maximum Pool Depth Profiles Within the Mukwonago River Upstream of Lulu Lake: Summer 2008

Attachment 22: Average Annual Temperature and Total Annual Precipitation for the NOAA Waukesha Weather Recording Station Near the Eagle Spring Lake Watershed 1950-2005

Attachment 23: July Average Temperature and Precipitation Departures From Normal at the NOAA Waukesha Weather Recording Station: 1950-2005

Attachment 24: Weather Station and Water Temperature Logger Locations: 2007-2008

Attachment 25: Hourly Surface Water Temperature at Sites Upstream of Lulu Lake to Downstream of Eagle Spring Lake: May-September 2008

Attachment 26: Daily Maximum Water Temperature Among Surface and Deep Sites in Eagle Spring Lake: May-September 2008

Attachment 27: Hourly Surface Water Temperatures Between Sites on the Western Shore Versus the Eastern Shore in Eagle Spring Lake and Lulu Lake: May-September 2008

Attachment 28: Hourly Surface Water Temperatures at Sites in Lulu Lake and Eagle Spring Lakes: May-September 2008

Attachment 29: Aquatic Plant Species Present in Eagle Spring Lake and Their Positive Ecological Significance: 1994

Attachment 30: Aquatic Plant Species Present in Lulu Lake and Their Positive Ecological Significance: 1994

Attachment 31: Aquatic Plant Species Observed in Eagle Spring Lake: August 2008

Attachment 32: Aquatic Plant Community Distribution in Eagle Spring Lake: 2008

- Attachment 33: Aquatic Plant Species Observed in Lulu Lake: August 2008
- Attachment 34: Aquatic Plant Community Distribution in Lulu Lake: 2008
- Attachment 35: Annual Mean Summer (June 15-September 15) Chlorophyll-a Among Shallow Lakes in Southeast Wisconsin: 1970-2008
- Attachment 36: Annual Mean Summer (June 15-September 15) Secchi Depth Among Shallow Lakes in Southeast Wisconsin: 1970-2008
- Attachment 37: Annual Mean Summer (June 15-September 15) Total Phosphorus Among Shallow Lakes in Southeast Wisconsin: 1970-2008
- Attachment 38: Trophic State Index for Eagle Spring and Lulu Lakes: 1988-2008
- Attachment 39: Aquatic Plant Species Observed in Shallow Lakes Throughout Southeastern Wisconsin
- Attachment 40: Fish Species Composition By Physiological Tolerance in the Eagle Spring Subwatershed: 1958-2008
- Attachment 41: Fish Stocking Report for Eagle Spring Lake: 1992-2006
- Attachment 42: Catch Per Hour and Average Length of Largemouth Bass in Eagle Spring Lake: 1992-2008
- Attachment 43: Size Frequency Distribution of Largemouth Bass in Eagle Spring and Lulu Lakes: 1996-2008
- Attachment 44: Largemouth Bass and Bluegill Size-At-Age Within Eagle Spring Lake Compared to the Southeastern Wisconsin Lakes Average Growth Rates: 1996-2004
- Attachment 45: Catch Per Hour and Average Length of Bluegill in Eagle Spring Lake: 1992-2008
- Attachment 46: Size Frequency Distribution of Bluegill in Eagle Spring and Lulu Lakes: 1999-2008
- Attachment 47: Catch Per Hour and Average Length of Carp in Eagle Spring Lake: 1992-2008
- Attachment 48: Size Frequency Distribution of Carp in Eagle Spring and Lulu Lakes: 2002-2008
- Attachment 49: Eagle Spring Lake Wetland Complex Plant Community Summary
- Attachment 50: Existing Land Use Within the Eagle Spring Subwatershed: 2000

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AFFECTED ENVIRONMENT (describe existing features that may be affected by proposal)

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10. Information Based On (check all that apply):

Literature/correspondence (specify major sources)

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Personal Contacts (list in item 26)

Field Analysis By:  Author  Other (list in item 26)

Past Experience With Site By:  Other (list in item 26)

11. Physical Environment (topography, soils, water, air)

**Topography and Bathymetry**

Eagle Spring Lake is located in the Town of Eagle, southeast of the Village of Eagle and west of the Village of Mukwonago. The Lake is a flow-through lake with extensive shallow areas and a single deep basin, located on the Mukwonago River, a major tributary stream to the Illinois-Fox River. The lake level is augmented by an impoundment and is controlled by two outlet control structures located on the northeastern shore of the Lake, locally known as the Kroll Dam and the Wambold Dam. These control structures form part of a single impoundment, referenced in the WDNR file as Wambold Dam FF # 67.04

The maximum depth of Eagle Spring Lake was reported as 12 feet in the Wisconsin Conservation Department Report, *Surface Water Resources of Waukesha County*, published in 1963; as eight feet in the Wisconsin Department of Natural Resources Lake Use Report No. FX- 19, *Eagle Spring Lake, Waukesha County, Wisconsin*, published in 1969; and as eight feet in the Wisconsin Department of Natural Resources Publication No. PUBL-FH-800 2005, *Wisconsin Lakes*, published in 2005. During 1995-1996, the Eagle Spring Lake Management District undertook limited dredging of the northwestern embayment of the Lake which restored the maximum Lake depth to about 12 feet. Consequently, SEWRPC CAPR No. 226, *A Lake Management Plan for Eagle Spring Lake, Waukesha County, Wisconsin*, published in 1997, cited 12 feet as the maximum depth of the impoundment. Subsequent siltation and sediment movements within this dredged portion of the Eagle Spring Lake basin, however, has resulted in a current maximum depth of about eight feet.

The outlet structures currently have fixed discharge elevations which maintain the eight feet depth in the deepest portions of the Lake. The current Lake surface elevations of between 8.84 and 9.14 feet based upon the local datum were established by the PSC in 1954 pursuant to Order 2WP-997-54. These elevations relative to the local datum have been equated to 819.96 feet and 820.26 feet NGVD-29. However, it should be noted that, historically, the elevation of the gauge readings was incorrectly considered to be about 2.65 feet lower in relation to NGVD-29.

The subwatershed area and lake bathymetry have been refined based upon 2005 and 2007 survey information, respectively. The subwatershed area was evaluated by SEWRPC staff using two-foot interval elevation contours generated from the 2005 Waukesha County digital terrain model (DTM). This evaluation resulted in the identification of a number of internally drained areas and the refinement of the outer boundary of the area tributary to Eagle Spring Lake, which was originally developed on the basis of United States Geological Survey (USGS) 10-foot contour interval mapping. The revised subwatershed area is estimated to be 16,076 acres, which is 6,637 acres or 29 percent smaller than previously estimated. Of this total subwatershed a further 2,948 acres were determined to be internally drained and unlikely to contribute surface runoff to the Mukwonago River Basin (Attachment 12).

During 2007, SEWRPC staff refined the bathymetry of Eagle Spring Lake using data from the WDNR and The Nature Conservancy (TNC) in partnership with the Eagle Spring Lake Management District (Attachment 13). The revised hydrographic characteristics of Eagle Spring Lake and the characteristics reported by the then Wisconsin Conservation Department—now the WDNR—during 1969 are set forth in Attachment 14. In addition, the use of high resolution orthophotography resulted in a refinement of the Lake surface areas for Eagle Spring Lake and Lulu Lake. Based upon these data the surface area of Eagle Spring Lake is approximately 280 acres and that of Lulu Lake is about 95 acres. These new data were used in this EA.

The original basin of Eagle Spring Lake was formed as the Michigan and Green Bay Lobes of the continental glacier retreated from Southeastern Wisconsin during the late Wisconsin stage of glaciation. The Lake, like many others in the Southeastern Wisconsin Region, lies in a depressed area of this interlobate, or "kettle moraine," area that is characterized by unconsolidated glacial sediments consisting predominantly of silty-clay till and sandy outwash deposits. These glacial sediments, ranging in thickness from 100 to 200 feet are underlain by Silurian dolomite and are overlain by organic deposits formed after glaciation. The Lake bottom sediment types were surveyed in 1990, 2002, and 2003 (Hey and Associates 2005). About 80 percent of the surveyed bottom was covered by "muck (combination of flocculent silt, clay, marl, and organics that pass through a #200 µm sieve screen)," although limited portions of the near shore area along the developed shoreline contained sand or gravel bottom. This is due, in part, to the placement of imported sand along the shoreline to develop a more useable beach area. The depths of the soft sediments ranged from less than one foot to more than 10 feet in the western embayment. Based upon the observed results of 19 transects by SEWRPC staff in the summer 2008 survey, the bed of Eagle Spring Lake is comprised of approximately 30 percent silt/sand, 29 percent marl, 23 percent silt, 8 percent sand, 6 percent silt/sand, and 4 percent sand/gravel substrates. This is

consistent with the aforementioned previous surveys on Eagle Spring.

### **Soils**

The then U.S. Soil Conservation Service—now the U.S. Natural Resources Conservation Service (NRCS)—under contract to SEWRPC completed a detailed soil survey of the entire seven-county Region. This survey was published as SEWRPC Planning Report No. 8, *The Soils of Southeastern Wisconsin*, during June 1966. This soil survey included interpretations for planning and engineering applications and for suitability for various types of urban land uses, as well as for agricultural applications.

Soils within the area tributary to Eagle Spring Lake were categorized into four main hydrologic soil groups, as well as an "other" category. About 91 percent of the tributary area is covered by the moderately well drained soils. This results in high to very high permeability with concomitant high to very high recharge potential, as documented in SEWRPC Technical Report No. 47, *Groundwater Recharge in Southeastern Wisconsin Estimated by a GIS-Based Water-Balance Model*, July 2008.

### **Water Resources**

The Mukwonago River constitutes the major inflow into Eagle Spring Lake, entering the Lake from the south where it discharges from Lulu Lake. Lulu Lake is situated immediately upstream of Eagle Spring Lake and is accessible from Eagle Spring Lake by a navigable channel. Hilary Erin Gittings in her Master of Science Thesis, entitled "Hydrogeologic Controls on Springs in the Mukwonago River Watershed, SE Wisconsin," submitted to the University of Wisconsin-Madison in 2005, quantified the average base flow at the TNC bridge upstream of Lulu Lake as 3.5 cubic feet per second (cfs) based upon measurements obtained from September 2002 through September 2004 (see Attachment 15). During low flow periods, the spring complex above Nature Road contributed about 70 percent of the total volume of water flow into Lulu Lake. In a parallel investigation, Karin Marie Hollister, in her Master of Science Thesis entitled, "Hydrologic Modeling of the Upper Mukwonago River: An Investigation of the Effects of Urban Development and an Evaluation of Mitigation Schemes, Southeastern Wisconsin," submitted to the University of Wisconsin-Madison in May 2006, documented water level fluctuations from June 2001 through June 2003. The standard deviation of the range in elevation was documented to be plus or minus one inch around a mean stage of 820.69 feet NGVD-29 (Attachment 16).

The Eagle Spring Lake outflow is controlled by two outlet structures—a dam with a manually operated control gate (Wambold Dam) and a former mill race (locally known as the Kroll Dam)—both located at the east side of Eagle Spring Lake just west of CTH E. The confluence of Jericho Creek and the Mukwonago River is located about 350 feet downstream of the Wambold Dam structure. The southernmost lake outlet from the former mill race joins the Mukwonago River about 500 feet downstream of the dam structure. The Mukwonago River continues easterly and passes through Lower Phantom Lake and ultimately discharges into the Fox River in Waukesha County, about 8.5 miles downstream from Eagle Spring Lake. The stretch of the Mukwonago River, downstream of Eagle Spring Lake and extending to "Upper Phantom Lake" (the WDNR staff have suggested that the *Wisconsin Administrative Code* incorrectly identifies Lower Phantom Lake as Upper Phantom Lake), has been designated as an Exceptional Resource Water of the State, while the upstream Lulu Lake has been designated as an Outstanding Resource Water of the State, both pursuant to Chapter NR 102 of the *Wisconsin Administrative Code*.

Todd Shoemaker in his Master of Science Thesis entitled, "Evaluation of the Hydrology and Hydraulics of Eagle Spring Lake, Eagle Wisconsin," submitted to the Department of Civil and Environmental Engineering at the University of Wisconsin-Madison, May 2002, demonstrated that the discharge from the Kroll Dam was fairly constant at about 3.5 cfs during 2001, over a range of precipitation events. This represents only a small fraction of the Wambold Dam flow. He also determined the long-term average baseflow in the Mukwonago River entering Eagle Spring Lake to be 14.3 cfs, with 9.6 cfs (about 70 percent) arising from groundwater sources. In addition, he showed that, at the time of his study, Eagle Spring Lake and Lulu Lake essentially operated as one hydrological unit with water levels at elevations of 820.60 and 820.68 feet above NGVD-29, respectively. The difference in elevation between the lakes decreases with increasing discharges at the Wambold Dam, indicating that the Wambold Dam influences water levels in both Lakes. This is consistent with the surface water elevation profile developed by SEWRPC staff from the 2005 Waukesha County DTM data (Attachment 11). Shoemaker's findings are also consistent with observations by SEWRPC staff obtained during 2008 that showed fairly constant water depths of about 3.5 feet along the channel linking Eagle Spring Lake with Lulu Lake outlet (see Attachments 17 and 18).

The surface water elevation profile shown in Attachment 11 indicates that the Wambold Dam at the Eagle Spring Lake outlet affects surface water elevations of Lulu Lake and extends approximately 1,650 feet upstream of Lulu Lake to The Nature Conservancy bridge (Attachment 19). Therefore, any changes of the operation level of the Wambold Dam will affect both Lulu Lake and this section of the Mukwonago River. The Nature Conservancy bridge is located on a historic railroad bed upon which significant amounts of gravel and rock have been placed to create a stable foundation for the railroad. Therefore, the streambed adjacent to and underneath the TNC bridge contains a significant amount of gravel and cobble substrates of the same sizes and types as observed within the fill in the railroad berms at this location. This historical fill material has established a unique riffle habitat comprised of a mixture of gravel and cobble substrates, which is the only riffle habitat found within the 7,000 linear feet of channel surveyed by SEWRPC staff in the summer 2008. This riffle was the only location where muck sediments were not

observed and it is the shallowest of all the cross sections surveyed as shown in Attachment 20. Based upon the 27 transects surveyed at the locations shown on Attachment 19, 96 percent were comprised of muck substrates, 85 percent contained peat substrates, and sand was found in 18 percent. The TNC bridge riffle is a high point on the streambed that causes a backwater effect up to the Nature Road culvert approximately 2,900 linear feet upstream. The Nature Road culvert is also causing an upstream backwater effect. These control points are likely to be the main cause for the observed decreasing stream width from upstream to downstream, which is opposite of what is expected to occur (Attachment 21). The sediment depth distribution also indicates the significant backwater effect of Lulu Lake, with the deepest sediments being located closer to Lulu Lake (Attachment 20). This backwater effect also is reflected in maximum pool depth within this portion of the Mukwonago River as shown in Attachment 21. Maximum pool depths are less than three feet upstream of Nature Road, range from three feet to four feet between Nature Road and the TNC bridge, and range from three feet to nearly six feet downstream of the TNC bridge.

The shoreline of Eagle Spring Lake, except for the western portion, is almost entirely developed for residential uses. The western shoreline is comprised of about 1.6 miles of wetland and accounts for about 28 percent of the total Eagle Spring Lake shoreline (not including islands). That wetland area is contiguous with a major wetland complex associated with Lulu Lake and the Mukwonago River inlet upstream. Eagle Spring Lake has a shoreline length of 7.4 miles, including the shoreline lengths of the islands. The Lake shoreline is fairly irregular and about twice as long as a circular lake of the same area. A survey of the Eagle Spring Lake shoreline, conducted during the summer of 1993 by Waukesha County Department of Parks and Land Use, Land Conservation Division staff, identified existing shoreline protection conditions around this lake. Most of the developed shoreline of Eagle Spring Lake in 1993 had some form of shoreline protection of which most were in good condition. Only the undeveloped western shore was unprotected except for extensive growths of aquatic vegetation. This situation was observed to be largely unchanged during a subsequent reconnaissance in 2008.

### **Climate**

Long-term average annual air temperature and precipitation values for the Eagle Spring Lake subwatershed are set forth in Attachment 22. These averages were taken from official National Oceanic and Atmospheric Administration (NOAA) records for the weather recording station at Waukesha, Wisconsin. The records of this station may be considered typical of the entire subwatershed. The mean annual precipitation at Waukesha is about 32.8 inches, and the mean annual temperature is 47.1 degrees Fahrenheit. Attachment 22 also shows that both mean temperature and mean precipitation have been increasing over this period of record; however, variability in each parameter remains unpredictably high from year to year. This is consistent with historical weather changes as well as other indicators of warmer conditions such as decreasing ice-cover duration on lakes throughout the State of Wisconsin (Magnuson and others 2003). It is important to note that only the increasing mean annual temperature trend was shown to be statistically significant ( $p \leq 0.009$ ; multiple  $R^2 = 0.122$ ). More than half the normal yearly precipitation falls during the growing season, from May to September. During this time period, runoff volumes are moderated because evapotranspiration rates are high, vegetative cover is good, and the soils are not frozen, so infiltration can occur. However, the occurrence of intense thunderstorms during this period can result in high rates of runoff and associated flooding. Normally, about 20 percent of the summer precipitation is expressed as surface runoff. Approximately 45 percent of the annual precipitation occurs during the winter or early spring when the ground may be frozen, and may result in high surface runoff rates and/or volumes when air temperatures are high enough for the precipitation to fall as rain or as a result of rapid snowmelt or rainfall with snowmelt.

Higher air temperatures can lead to higher water temperatures, which have a major influence on fish and other ectothermic organisms in terms of their physiology, growth, and development, including reproduction (Tonn 1990). High air temperatures which warm water and land surfaces, when combined with periods of decreased precipitation during the summer, can also negatively affect surface water dissolved oxygen concentrations. Hence, low dissolved oxygen concentrations are a major concern during the summer months, because even short periods of time where concentrations fall below 5.0 milligrams per liter (mg/l) can cause significant decreases in the abundance and diversity of the aquatic organisms in lakes and streams. Attachment 23 shows that the average temperature and precipitation for the month of July to be 72.0 degrees Fahrenheit and 3.8 inches, respectively, over the 55-year period from 1950 through 2005. Similar to the annual trends described above, variability in both July average temperature and precipitation remains unpredictably high from year to year. The deviation from normal air temperature can range from two to almost six degrees Fahrenheit and the deviation from normal precipitation can range from two to nearly eight inches. Fortunately, Eagle Spring Lake's discharge is supplemented by a high proportion of cold, well-oxygenated groundwater flow, which helps to mitigate temperature in critical summer periods that are warmer and/or dryer than normal. Attachment 23 also shows the monthly average July temperature to be increasing slightly over this 56-year period of record, which emphasizes the importance of protecting the quality and quantity of groundwater as future development occurs in this subwatershed. The neighboring Beulah Lake outlet, which is tributary to the Mukwonago River, has been reported by riparian residents to go "dry" periodically during the summer months. Commission staff interpret this statement as suggesting a lack of flow over the dam and no perceptible flow in the outlet. Such conditions are most likely to be due to a combination of low precipitation, pumping of the shallow groundwater aquifers to serve urban development, and high evapotranspiration rates. This loss of discharge from Beulah Lake has negative consequences for the aquatic organisms living within this tributary to the Mukwonago River system.

During 2007, there was a weather station established on the eastern shoreline of Eagle Spring Lake, as shown on Attachment 24. The Commission staff analyzed precipitation data from this station and found that they were statistically correlated with the precipitation data reported from the Mukwonago River gauge station, confirming agreement between the two gauges, and suggesting that these data sources can be used in a complimentary manner.

### **Groundwater**

Hilary Erin Gittings, in her aforereferenced Master of Science Thesis, showed that flow in the Mukwonago River system is dependent upon groundwater discharges from multiple aquifers, including the surficial sand and gravel aquifer and deep bedrock aquifer. Of the groundwater contributed to the spring complex upstream of Lulu Lake, about 15 to 100 percent was discharged through “boils” from a bedrock source, entering the springs through preferential flow paths within the fractured bedrock; the sand and gravel aquifer was estimated to contribute from 0 to 20 percent to this flow, between the spring complex and the TNC foot bridge—total inputs during any given year could equal up to 100 percent of the inflow to Lulu Lake, with the ratio of deep aquifer to surficial aquifer flows varying as a function of rainfall, runoff, and degree of aquifer recharge experienced during a specific year. A similar relationship was reported for the Lake Beulah area which also received a small contribution of groundwater from the deep aquifer. Gittings further reported high levels of chloride in water samples obtained from the open water and shallow groundwater sites upstream of Lulu Lake. This is consistent with findings reported by the Eagle Spring Lake Management District’s August 2008 report entitled “Mukwonago River-Watershed Nutrient Study: August 2004-October 2008.”

Groundwater inflows within the Eagle Spring Lake and Lulu Lake basins have a direct affect on the thermal structure of the Lakes and can be clearly seen in the temperature records obtained from the 18 temperature dataloggers placed in the nearshore areas of the two lakes by SEWRPC staff between May and September 2008 (Attachment 24). These datalogger records document a longitudinal thermal gradient along the Mukwonago River system from upstream Lulu Lake to downstream of Eagle Spring Lake. Significant warming occurs at the outlet of Lulu Lake, which seems to indicate that surface waters from Lulu Lake are discharging into the outlet. Temperatures generally remain relatively constant beyond this point (Attachment 25), although the influence of groundwater inflows within Eagle Spring Lake significantly decreased water temperatures in the northwestern portions of that Lake (Attachment 26). Additionally, the temperature data show that the eastern portions of each lake are warmer than the western portions (Attachment 27); however, the southern portions of Eagle Spring Lake exhibited the highest maximum temperatures than any station on Eagle Spring Lake. This indicates that the southern bays are likely to be less well mixed and more susceptible to heating than all other areas within Eagle Spring Lake.

Within Eagle Spring Lake there were three sites where both surface and bottom temperatures were recorded. These data, shown in Attachment 26, demonstrate the significant cooling effects of groundwater at the northwestern station, which is located above an area of groundwater discharge. This station exhibited the coldest deep and surface water temperatures compared to the other stations. Conversely, the eastern station located near the Kroll Dam exhibited the warmest temperatures compared to the two other stations. In addition, the differences between the surface and bottom temperature records at the eastern station were minimal in comparison to the other stations, indicative of a portion of the Lake that would tend to be more well-mixed than the northern and western portions of the basin. This is consistent with the effect of the prevailing westerly winds. This same phenomenon was observed on Lulu Lake, which showed that the eastern surface water station was consistently about two to four degrees warmer than the western station from May through August. Further comparison between Eagle Spring Lake and Lulu Lake indicates that the surface water at the eastern station on Eagle Spring Lake is consistently warmer than that at the eastern station on Lulu Lake (Attachment 28). However, the southern portion of Eagle Spring Lake is consistently the warmest area compared to all stations throughout the Eagle Spring Lake and Lulu Lake system. As mentioned above, this indicates that the southern bays are likely less well mixed and more susceptible to heating than other areas within the Eagle Spring and Lulu Lakes system. These temperature differences are significant in terms of fish spawning and/or degree-day egg development as well as potential for growth differences within and among fish species or temperature tolerances, among others (Becker 1983).

12. Biological Environment (dominant aquatic and terrestrial plant and animal species and habitats including threatened/endangered resources; wetland amounts, types and hydraulic value)

### **Aquatic Plants**

During July 1994, 20 species of plants were identified in Eagle Spring Lake, many of which were common to abundant (see Attachment 29). Plant growth occurred throughout the Lake. Species that interfere with the recreational and aesthetic use of the Lake, such as *Myriophyllum spicatum*, *Ceratophyllum demersum*, and *Potamogeton crispus*, were found to be present in the Lake. All but the latter were found to be common. Muskgrass (*Chara* spp.) and wild celery (*Vallisneria americana*) were the dominant species in many areas of the main basin, and were especially abundant in the southern portion of the main lake basin at depths of up to six feet. *C. demersum* and *Potamogeton pectinatus* were common in the northern portion of the main lake basin at depths of four to six feet. *M. spicatum* was largely confined to the southeastern embayment.

Due to the navigable connection between Eagle Spring Lake and Lulu Lake, a survey of aquatic plant communities in Lulu Lake also was conducted by SEWRPC staff during July 1994. This survey identified some 21 species of plants, many of which were

found to be common to abundant (see Attachment 30). Species that interfere with the recreational and aesthetic use of that Lake, such as *M. spicatum*, *C. demersum*, and *P. crispus*, also were found to be present in Lulu Lake. All were found to be scarce. Plant growth occurred primarily along the periphery of Lulu Lake at water depths of up to 15 feet. Muskgrass (*Chara* spp.), bushy pondweed (*Najas flexilis*), and spiny naiad (*Najas marina*) were the dominant species in many areas of the main basin, at depths of up to 15 feet. *C. demersum* occurred in the vicinity of the Mukwonago River inlet to the Lake. *M. spicatum* was largely confined to the northern shores adjacent to the Mukwonago River outlet from Lulu Lake to Eagle Spring Lake, appearing to have been introduced to Lulu Lake from Eagle Spring Lake by the boat traffic that routinely traverses the short section of river between the two Lakes.

During 2008, the Commission staff conducted a further aquatic plant survey of the Lakes utilizing the same transects as in the 1994 survey. This survey indicated that there continued to be a high abundance and diversity of aquatic plants within both Lakes. During the 2008 survey, 21 species of plants were identified in Eagle Spring Lake, many of which were considered to be common to abundant (Attachments 31 and 32). A total of 18 species of submerged aquatic plants were observed in the upstream Lulu Lake (Attachments 33 and 34). The aquatic plant communities of both Lakes were similar, although a greater range in diversity of aquatic plant community types was present within Eagle Spring Lake. In Eagle Spring Lake, northern water milfoil (*Myriophyllum* sp.) was the dominant submersed aquatic plant, with bushy pondweed (*N. flexilis*), muskgrass (*Chara* spp.), and wild celery (*V. americana*) comprising the other commonly occurring aquatic plant species. The major aquatic plant species present in Lulu Lake included Eurasian water milfoil (*M. spicatum*) and muskgrass (*Chara* spp.). Bushy pondweed (*N. flexilis*) and coontail (*C. demersum*) were also common.

Compared to George and Wind Lakes, other shallow lakes within the Southeastern Wisconsin Region, algal populations in Eagle Spring Lake, as reflected by the observed chlorophyll-*a* concentrations, have remained at relatively low levels over the 10 year period of record (Attachment 35). Algal blooms have occurred on Eagle Spring Lake, as indicated by chlorophyll-*a* concentrations in excess of 20 micrograms per liter, but have not been perceived as a major problem to date. Likewise, turbidity, as reflected by Secchi disk transparency values, is notably consistent with other shallow lakes within the Region as shown in Attachment 36. Both chlorophyll-*a* concentrations and Secchi disk transparency values are similar to the median values for the Region reported by WDNR in Technical Bulletin No. 138, *Limnological Characteristics of Wisconsin Lakes*, 1983. The relatively low chlorophyll-*a* concentrations are consistent with the observed total phosphorus concentrations of typically less than 20 microgram per liter (Attachment 37). In addition, the Wisconsin Trophic State Index (WTSI) values calculated for Eagle Spring Lake are not dissimilar to those calculated for Lulu Lake, which is a deep water system (Attachment 38).

The high diversity and abundance of aquatic macrophytes within Eagle Spring Lake is largely an artifact of being a shallow lake with an extensive littoral zone. In addition to the submerged aquatic macrophytes, Eagle Spring Lake also contains significant amounts of floating and emergent macrophytes particularly within the western and southwestern portion of the lake. The physical structure established by aquatic macrophytes provides fisheries habitat within the littoral zones of lakes for foraging, spawning, shade, and protective cover (Weaver and others 1997, Dibble and others 1996). Recent research by the Wisconsin Cooperative Fisheries Research Unit (Carden 2002) has shown that the characteristics and composition of macrophyte beds significantly influences fish community structure in littoral zones of north temperate lakes. This and other research has shown that macrophytes are important to fish abundance and diversity; however, relations between specific macrophyte characteristics and fish communities are not consistent, which indicates that lake-specific differences are more important than applying across-lake strategies for managing macrophyte communities in lakes (Carden 2002).

Based upon the information above, Eagle Spring Lake can be considered to be a macrophyte dominated, clear-water, shallow lake system as opposed to a turbid water ecosystem with few submerged plants, which is based upon the theoretical alternative stable states classification system of Scheffer and others (1993), Scheffer (1998), and Scheffer and van Nes (2006). Research has shown that, in general, both clear-water and turbid states can be stabilized by a number of mechanisms such as nutrient loading, water level changes, biotic manipulations, and severe weather (Moss 1998, Jeppesen 1998, Jeppesen and others 1998, and Scheffer 1998). The theoretical model that leads to the alternative states is based upon a “critical turbidity” level and three assumptions: 1) vegetation disappears when a critical turbidity is exceeded, 2) vegetation reduces turbidity, and 3) turbidity increases with the nutrient level due to increased phytoplankton growth (Scheffer and others 1993; Scheffer and van Nes 2007). Therefore, this model shows that over an intermediate range of nutrient levels two alternatives exist: a highly turbid one without vegetation and a clear water state dominated by submerged macrophytes.

It is important to note that there are many factors that can affect critical nutrient levels and the consequent equilibrium state such as lake depth, lake size, and climate (Scheffer and van Nes 2007). Higher water levels can lead to loss of submerged aquatic plants causing a shift to the turbid equilibrium state (Wallsten and Forsgren 1989; Engel and Nichols 1994); however, Eagle Spring Lake has remained in a clear water macrophyte dominated state despite being maintained at 0.56 feet above its permitted level (Attachments 2 through 10 and Attachments 35 to 37). Alternatively, low water levels may have more complicated effects on a lake system. For example, low water levels can lead to freezing of lake bottom sediments and in some cases cause enough damage to the submerged vegetation to move the lake from a clear water to a turbid state (Blindow and others 1993). Low water

levels may also increase the risk of fish kills due to anoxic conditions in summer and/or winter (Van Geest and others 2003). Lake size has been shown to be an important factor in determining whether a lake is clear versus turbid (Van Geest and others 2003; Sondergaard and others 2005). Eagle Spring Lake is a relatively large lake; therefore, based upon lake size, this means that it is more likely to contain abundant fish, which increases the likelihood of the unvegetated turbid-water state. Finally, moderate warming caused by climate change, which has been well documented to be occurring in Wisconsin by Magnuson and others (2003), might promote the turbid state, although it also could promote the growth of submerged aquatic vegetation and a clear water state (Scheffer and van Nes 2007). In conclusion, research has shown that there is no single critical nutrient level for maintaining a clear state, as factors such as lake size, depth and climate can significantly affect the threshold (Scheffer and van Nes 2007). “In principle, the list of factors that may influence the probability that a lake turns to the turbid state is almost endless.” (Scheffer and van Nes 2007: p 459).

As suggested by the constancy of the wetland fringe shown in Attachments 2 through 10, and documented by the chlorophyll-a and total phosphorus concentrations and Secchi disc transparency values—and associated Trophic State Index values—shown Attachments 35 to 38, Eagle Spring Lake appears to have maintained a macrophyte-dominated clear water state for nearly 70 years, which is probably due to the relatively low nutrient loading, high flushing rate, high rate of groundwater inflow, and significant areas of wetlands adjacent to this waterbody. Not only has Eagle Spring Lake consistently remained macrophyte-dominated, but it has a macrophyte flora that is similar to, but more diverse than, other major lakes in the Southeastern Wisconsin Region (Attachment 39). The abundant submerged plants greatly reduce turbidity through several mechanisms (e.g., nutrient uptake, shading, physical filtration) resulting in control of excessive phytoplankton development and reduction of wave resuspension of sediments. However, episodic turbidity has been a problem within this Lake, which has been primarily caused by high speed boating activities at weekends. Wind resuspension of sediments along with the presence of bottom-feeding fishes (i.e., carp) that facilitate this process by reducing the erosion resistance of the sediment may also be contributing to the periodic turbidity problem within Eagle Spring Lake (Scheffer and others 2003).

### **Fish**

In Wisconsin, high-quality warmwater streams are characterized by many native species including cyprinids, darters, suckers, sunfish, and percids that typically dominate the fish assemblage. Intolerant species (species that are particularly sensitive to water pollution and habitat degradation) are common in high-quality warmwater systems. Tolerant fish species (species that are capable of persisting under a wide range of degraded conditions) also are typically present within high-quality warmwater streams, but they do not dominate. Insectivores (fish that feed primarily on small invertebrates) and top carnivores (fish that feed on other fish, vertebrates, or large invertebrates) are generally common. Omnivores (fish that feed on both plant and animal material) are generally common, but do not dominate. Simple lithophilous spawners (species that lay their eggs directly on large substrate, such as clean gravel or cobble, without building a nest or providing parental care for the eggs) also are generally common.

Review of the fishery data collected upstream of the Wambold Dam inclusive of Eagle Spring Lake, Lulu Lake, and the Mukwonago River between 1958-1989 and 1990-2005 indicates that the historic and recent fishery are similar and contain nearly 30 species as shown in Attachment 40. Two species, the least darter and banded killifish, which are species of special concern in the State of Wisconsin, have not been observed in this watershed since 1989. However, the lake chubsucker, which also is a species of special concern in the State of Wisconsin, continues to be present in the Lakes.

Eagle Spring Lake contains a moderately diverse fishery community, is known for its fishing, and is the site of numerous fishing-related community events, such as the community “carp out” that was conducted annually between 1990 and 2001. There have been no known fish kills reported by WDNR for Eagle Spring. However, this Lake has suffered from an unbalanced fishery community in terms of a disproportionately high proportion of bass with low average size, an abundance of small predatory fishes, and low numbers of large predatory fishes; namely, largemouth bass and northern pike. Northern pike fingerlings were annually stocked in Eagle Spring Lake from 1992 to 2006 in an effort to establish a larger population of this gamefish species (Attachment 41). However, the northern pike fishery continues to remain limited in this system. For example, only 8 total northern pike were collected during the most recent 2008 survey. In addition, mandatory slot size regulations excluding 14- to 18-inch largemouth bass from the harvest have recently been established by WDNR to protect and enhance this species. There are no minimum size limits for largemouth bass of less than 14 inches and a bag limit of one of largemouth bass greater than 18 inches, with a maximum of three largemouth bass in total. These management measures are geared toward reversing the unbalanced fishery that has existed within Eagle Spring Lake and recent data suggest that this has begun to occur.

Based upon surveys conducted by WDNR staff, as shown in Attachment 42, overall abundances of largemouth bass have decreased and average lengths have slowly increased between 1992 and the present. Since the largemouth bass populations in 1992 contained numerous small-sized fishes, the trend toward a lower abundance and larger average fish length is a sign that this predatory species is developing a more balanced proportion of larger, higher quality fishes. This trend is supported by the most recent 2008 size frequency distribution, shown in Attachment 43, which contained the highest proportions of largemouth bass greater than 14 inches recorded in recent years. In addition, the 2008 survey of Lulu Lake showed that this basin also contained a similar size structure to that reported from Eagle Spring Lake. WDNR population estimates in the 2008 mark-recapture survey

indicated a mean population size of approximately 3,450 total largemouth bass in Eagle Spring Lake and 1,691 total largemouth bass in Lulu Lake. The 2008 survey indicated that the recent slot length size management measures seem to be having the desired effect on the population size structure in Eagle Spring Lake. However, the size-at-age data for largemouth bass reported between 1996 and 2004 indicate that the largemouth bass population grows more slowly and achieves smaller than average sizes per age class compared to regional average largemouth bass growth rates for lakes in the Southeastern Wisconsin (Attachment 44). It is possible that the size-at-age data for 2008 may show better growth rates than previously recorded years, but those data have not yet been compiled.

Although the bluegill population abundance has been much more variable than the largemouth bass abundance, since 1999 the bluegill abundances have continued to decrease with a concomitant increase in average size (Attachment 45). This is likely to be a result of the catch limits of 10 panfish that recently have been instituted to protect these species from overharvesting. Like largemouth bass, the trend of increasing abundance and larger average size is a sign that bluegill are developing a more balanced population. In 2008, bluegill achieved the largest average size compared to the previous 16 years of surveys. The size frequency analysis also showed a dominant 7-inch size class in 2008 (Attachment 46). Like Eagle Spring Lake, the 2008 size frequency distribution of bluegill in Lulu Lake indicated a significant proportion of bluegill greater than seven inches in length, which has not been recorded previously. It is important to note that the 2008 fish survey results may be biased due to differences in gear compared to previous surveys; fyke nets were used in combination with electrofishing during the 2008 survey. Fyke nets are very effective at collecting bluegill, and a large proportion of the bluegill catch were collected in the fyke nets. Nevertheless, the 2004 growth rates, as shown in Attachment 44, indicate that bluegill are achieving a larger size-at-age class than the regional average bluegill growth rates, which is a good sign of a recovering fishery.

Carp have been a part of the fishery within Eagle Spring Lake for a long time; however, this species has not been a dominant component of the fishery historically. Carp are a tolerant fish species that can significantly degrade water quality and habitat conditions for other fish species when they become dominant; hence, they are considered an injurious species in lakes. The catch per unit effort for carp has generally remained below 10 per hour of electrofishing between 1992 and 2008, indicating that their abundance has remained consistently low (Attachment 47). In general, average carp length has remained high during this period, indicating that the population has been dominated by large adults with limited recruitment. This latter fact is likely to be the reason why the population has not become a dominant component of the fishery. The size frequency distribution of carp in Eagle Spring Lake in 2002 and 2008 indicates a similar pattern among size classes; however, the 2008 survey indicates that there were significantly more fishes overall, as shown in Attachment 48. There also seems to be a greater proportion of smaller fishes, which is a troubling sign, indicating that recruitment may be more successful and carp may become a more dominant part of the fishery. Recent population estimates based upon the 2008 survey show that there are 4,264 carp in Eagle Spring Lake, suggesting that they are a significant component of the fishery within the Lake.

Carp can be extremely disruptive to the aquatic vegetation that provides habitat and shelter for more desirable species of fishes (Becker 1983), as well as increase lake turbidity levels through resuspension of sediments when carp densities get high enough (Breukelaar and others 1994). Carp are benthivorous fish and ingest sediment to obtain food particles by filtering material through their gill rakers (Lammens and Hoogenboezem 1991). Carp can process up to five times their body weight per day and the fine particles that are not retained by the fish become suspended in the water. Recent studies have shown that the small pits on the sediment surface that are left over from feeding fishes greatly reduce the erosion resistance, which makes the sediment more susceptible to resuspension through wind and/or motor boat activity (Scheffer and others 2003). Since shallow lakes are naturally much more susceptible to increased turbidity levels from wind and motor boat activity than deep lakes, carp potentially have a much greater synergistic impact on water quality within the shallow Eagle Spring Lake.

Loss of habitat is a primary concern of a fisheries management program, and it has become well understood that littoral zone habitat and fishery degradation is highly associated with lake shore residential development (Jennings and others 1999, 2003; Schindler and others 2000). Eagle Spring Lake's shoreline is largely developed, which puts significant pressure on protecting the remaining highest quality natural shoreline in the western portion of the Lake. Since the types and quality of habitat for bluegill, largemouth, and northern pike have not been quantified within Eagle Spring Lake, it is not known if a particular habitat type is limiting one or more of these species or one or more parts of their life history (i.e. spawning, egg development, fry, juvenile, adults) within the Lake. To complicate matters, it is also not known how much the fishery within Eagle Spring Lake depends upon Lulu Lake. It has been well documented in the mark-recapture surveys that limited numbers of marked largemouth bass and carp in Eagle Spring Lake were also found in Lulu Lake and vice versa. The distances within, and between, these lakes are well within the documented normal movement ranges of bluegill (Paukert and others 2004), largemouth bass (Hanson and others 2007), and northern pike (Kobler and others 2008, Vehanen and others 2006). In addition, size frequency distributions of bluegill and largemouth bass as noted above were very similar between Eagle Spring and Lulu Lakes, which seems to support the idea that these species may be readily immigrating and emigrating between these lakes.

Based upon known habitat requirements for bluegill, largemouth bass, and northern pike, each of which is an important recreational species, Eagle Spring Lake seems to qualitatively contain an adequate amount of vegetative cover, depth, and

substrate habitat for fishes. However, recruitment and/or population sizes are limited in Eagle Spring Lake for bluegill, largemouth bass, and northern pike species compared to other lakes in the Region and the reasons for this are not known. Overharvest or exploitation from anglers is likely to be a major factor affecting these species; however, there has not been a creel survey to quantify this impact. Based upon sediment observations taken during the aquatic plant survey on Eagle Spring Lake in 2008, it seems that gravel substrates may be limiting the amount of available spawning substrates for largemouth bass (Annett and others 1996). Based upon the observed results, the substrates of Eagle Spring Lake are comprised of approximately 30 percent silt/sand, 29 percent marl, 23 percent silt, 8 percent sand, 6 percent silt/sand, and 4 percent sand/gravel substrates. Gravel or sand/gravel combination substrates were only identified within four of the 19 total transects taken on Eagle Spring Lake, and no gravel substrates were found among 10 transects taken on Lulu Lake. Gravel or sand/gravel substrates were only recorded at the nearest-shore lake depth of 1.5 feet within each of the Transects 4, 6, 14, and 18, with one exception of sand/gravel at the 3.0 feet depth in Transect 4. Qualitative observations on May 6, 2008, indicated that nesting largemouth bass were only located on the shoreline waters edge in less than 1.5 feet of water depth overlying gravel substrates near transect locations 14 and 18. Bluegills generally spawn in sand or gravel in water depths of 1 foot to 2.5 feet. Eagle Spring Lake seems to contain adequate amounts of sand substrates, and bluegills have been observed to spawn adjacent to a large proportion of shoreline within the Lake (pers. com., Commissioner Tom Day, ESLMD). In contrast, northern pike have never been observed to spawn within Eagle Spring Lake. Northern pike require emergent shoreline vegetation and sufficient depth and time of flooding inundation for successful spawning (Casselman and Lewis 1996). There appears to be plenty of emergent vegetation for northern pike spawning on the western and southwestern shoreline; however, this vegetation might not be inundated for long enough periods of time to promote successful northern pike spawning and egg development within Eagle Spring Lake, given the current static water level management (i.e., generally plus or minus one inch around a mean stage of 820.69 feet NGVD) that occurs within this Lake (Attachment 16).

### **Terrestrial Wildlife**

Although a quantitative field inventory of amphibians, reptiles, birds, and mammals was not conducted as a part of the Eagle Spring Lake study, a field reconnaissance was undertaken by the WDNR during July 1992. The technique used in compiling the wildlife data involved obtaining lists of those amphibians, reptiles, birds, and mammals known to exist, or known to have existed in the Eagle Spring Lake area; associating these lists with the historic Lake area as inventoried; and projecting the appropriate amphibian, reptile, bird, and mammal species into the Eagle Spring Lake area. The net result of the application of this technique is a listing of those species which were probably once present in the subwatershed; those species which may be expected to still be present under currently prevailing conditions; and those species which may be expected to be lost or gained as a result of urbanization within the area.

Given the rural nature of all but the immediate shoreline area of Eagle Spring Lake, many animals and numbers of waterfowl commonly inhabit areas of the subwatershed, especially in the still undeveloped areas southwest of the Lake and upstream of the Lake. A variety of mammals, ranging in size from large animals like the white-tailed deer to small animals like the pygmy shrew, are found in the Eagle Spring Lake area. Some 37 mammals have ranges that are known to extend into the area. Mink, muskrat, beaver, white-tailed deer, red and grey fox, grey and fox squirrel, and cottontail rabbits are mammals reported to frequent the area.

A large number of birds, numbering about 190 species ranging in size from large game birds to small songbirds, are found in the Eagle Spring Lake area. The Eagle Spring Lake subwatershed supports a significant population of waterfowl, with mallards, wood duck, and blue-winged teal being the most numerous waterfowl known to nest in the area. Larger numbers of birds move through the subwatershed during migrations when most of the regional species may also be present. Because of the mixture of lowland and upland woodlots, wetlands, and agricultural lands still present in the area, along with the favorable summer climate, the area supports many other species of birds. Many game birds, songbirds, waders, and raptors also reside or visit the Lake and its environs. Hawks and owls function as major rodent predators within the ecosystem. Swallows, whippoorwills, woodpeckers, nuthatches, and flycatchers, as well as several other species, serve as the major insect predators. In addition to their ecological roles, birds such as robins, red-winged blackbirds, orioles, cardinals, kingfishers, and mourning doves serve as subjects for bird watchers and photographers. Sandhill cranes and loons are notable migratory visitors, and a small population of sandhill cranes have been reported to be resident on the Lake year-round. Bald eagles, osprey, black terns, Forster's terns, loggerhead shrikes, peregrine falcons, barn owls, and Cooper's hawks-all threatened or endangered species-have been reported to have been seen in the vicinity of Eagle Spring and Lulu Lakes.

Amphibians and reptiles are vital components of the ecosystem in an environmental unit like the Eagle Spring Lake subwatershed. Examples of amphibians native to the area include frogs, toads, and salamanders. Turtles and snakes are examples of reptiles common to the Eagle Spring Lake area. Blanding's turtle, a threatened species, is resident in Lulu and Eagle Spring Lakes. A total of 15 amphibian and 17 reptile species are normally expected to be present in the Eagle Spring Lake area. Most amphibians and reptiles have definite habitat requirements which are adversely affected by advancing urban development as well as by certain agricultural land management practices. The major detrimental factors affecting the maintenance of amphibians in a changing environment is the destruction of breeding ponds, urban development occurring in migration routes, and changes in food sources brought about by urbanization.

### **Threatened, Endangered and Special Concern Species**

Eagle Spring Lake and its environs contain a number of State-listed special concern, threatened, and endangered species of plants and animals. Most of these species are listed as species of special concern, including two mammal species, 14 species of birds, five species of reptiles and amphibians, three fishes, one mussel, and 22 plants, including both terrestrial and wetland aquatic species (source: WDNR Bureau of Endangered Resources). An additional four species of birds, one reptile, one mussel, and six plants are considered to be threatened. Of the State-listed endangered species, one bird—Foster’s Tern, two reptiles and amphibians—Blanchard’s Cricket Frog and the Western Ribbon Snake, and one mussel—the Rainbow Shell, have been noted as being present in the study area. No endangered fishes or plants were reported. The combined presence of this number of State-listed special concern, threatened and endangered species is consistent with the Outstanding and Exceptional Resource Waters classifications applied to Lulu Lake and the portion of the Mukwonago River downstream of Eagle Spring Lake and the Wambold Dam.

### **Wetlands**

Wetlands in Southeastern Wisconsin are classified predominantly as deep marsh, shallow marsh, southern sedge meadow, fresh (wet) meadow, shrub carr, alder thicket, low prairie, calcareous fen, bog, southern wet- and wet-mesic hardwood forest, and conifer swamp based upon their plant covers. Wetlands form an important part of the landscape in and adjacent to Eagle Spring Lake in that they perform natural functions that make them ecologically and environmentally invaluable resources. Wetlands affect the quality of water by acting as a filter or a buffer zone by utilizing some of the nutrients as well as allowing silt and sediments to settle out. They also influence the quantity of water by providing water during periods of drought and storing it during periods of flood and peak runoff. When located along shorelines of lakes and streams, wetlands help protect those shorelines from erosion. Wetlands also may serve as groundwater discharge and recharge areas, and they are important resources for overall ecological health and diversity that provide essential breeding and feeding grounds, shelter, and escape cover for many forms of fish and wildlife.

Wetlands are poorly suited to urban use. This is due to the high soil compressibility and instability, high water table, low load-bearing capacity, and high shrink-swell potential of wetland soils, and, in some cases, to the potential for flooding. In addition, metal conduits placed in some types of wetland soils may be subject to rapid corrosion. These constraints, if ignored, may result in flooding, wet basements and excessive operation of sump pumps, unstable foundations, failing pavements, broken sewer and water lines, and excessive infiltration of clear water into sanitary sewerage systems. In addition, there are significant onsite preparation and maintenance costs associated with the development of wetlands, particularly as they relate to roads, foundations, and public utilities.

SEWRPC maintains an inventory of wetlands within the Region which is updated periodically. In 2000, wetlands covered about 1,425 acres, or 9 percent, of the area tributary to Eagle Spring Lake. The amount and distribution of wetlands in the area should remain relatively constant if the recommendations contained in the adopted regional land use plan are followed. About 28 percent of the Eagle Spring Lake is wetland (not including the islands), which increases the Lake’s ability to cope with nutrient loading and probably has contributed to the maintenance of the clear-water macrophyte dominated ecosystem state (Janse and others 2001). In addition, contiguous shoreline wetland acreages upstream of Eagle Spring Lake continue on for miles and represent a significant component of the overall land use adjacent to this portion of the Mukwonago River system.

Based upon a recent survey of the riparian wetland areas around Eagle Spring Lake by Hey and Associates, Inc. entitled “Wetland Vegetation Survey at Eagle Spring Lake,” dated January 2004, 19 wetland communities were identified ranging from moderate to high quality (Attachment 49). These wetlands were located along the western shoreline of Eagle Spring Lake. While the majority of species reported were native plants, a number of non-native species including narrow-leaf cattail, purple loosestrife, phragmites, and buckthorn were reported. SEWRPC staff also observed all of these species adjacent to the upstream Lulu Lake during the 2008 field season.

### **Woodlands**

Woodlands are defined by the Regional Planning Commission as those areas containing a minimum of 17 trees per acre with a diameter of at least four inches at breast height (4.5 feet above the ground). The woodlands are classified as dry, dry-mesic, mesic, wet-mesic, wet hardwood, and conifer swamp forests; the last three are also considered wetlands. SEWRPC maintains an inventory of woodlands within the Region which is updated periodically. Approximately 2,984 acres of woodland were inventoried during 2000 within the area tributary to Eagle Spring Lake. These woodlands covered about 19 percent of the tributary area. The major tree species include the black willow (*Salix nigra*), cottonwood (*Populus deltoides*), green ash (*Fraxinus pennsylvanica*), silver maple (*Acer saccharinum*), American elm (*Ulmus americana*), basswood (*Tilia americana*), northern red oak (*Quercus borealis*), and shagbark hickory (*Carya ovata*). Some isolated stands of tamarack (*Larix laricina*) also exist in the tributary area, together with such other upland species as the white oak (*Quercus alba*), burr oak (*Quercus macrocarpa*), black cherry (*Prunus serotina*), American beech (*Fagus grandifolia*), and paper birch (*Betula papyrifera*).

The amount and distribution of woodlands in the area should also remain relatively stable if the recommendations contained in the regional land use plan are followed. If, however, urban development is allowed to continue within the subwatershed much of the remaining woodland cover may be expected to be lost.

### **Environmental Corridor Lands**

Primary environmental corridors were first identified within the Region in 1963 as part of the original regional land use planning effort of SEWRPC and were subsequently refined under the Commission watershed studies and regional park and open space planning programs. The primary environmental corridors in Southeastern Wisconsin generally lie along major stream valleys and around major Lakes and contain almost all the remaining high-value woodlands, wetlands, and wildlife habitat areas, and all the major bodies of surface water and related undeveloped floodlands and shorelands. As reported in SEWRPC CAPR No. 226, primary environmental corridors in the Eagle Spring Lake tributary area, which has since been revised as described previously, comprise about 4,221 acres, or 25 percent, of the historical tributary area. Portions of this area are also included within the Lulu Lake State Natural Area boundary which currently encompasses about 1,660 acres. It is anticipated that this area will be increased to 2,310 acres based on proposed purchases by the WDNR and TNC. An additional 114 acres, or 0.7 percent of the historical tributary area, were classed as secondary environmental corridor, while 303 acres, or 2 percent of the historical tributary area, were identified as isolated natural features.

## 13. Cultural Environment

### a. Land use (dominant features and uses including zoning if applicable)

About 2,612 acres, or about 17 percent of the area tributary to Eagle Spring Lake, were devoted to urban land uses in 2000 (Attachment 50). The dominant urban land use was residential, encompassing 1,624 acres, or about 62 percent of the area in urban use. About 12,515 acres, or about 83 percent of the Eagle Spring Lake drainage area, were still devoted to rural land uses. About 6,370 acres, or about 50 percent of the rural area, were in agricultural land uses. Woodlands, wetlands, and surface water, including the surface area of Eagle Spring Lake, accounted for approximately 4,852 acres, or about 39 percent of the area in rural uses. Under year 2035 conditions, no significant changes in land use conditions within the Eagle Spring Lake subwatershed are envisioned in the regional land use plan, although some infilling of existing platted lots and some backlot development may be expected to occur. In addition, the redevelopment of properties and the reconstruction of existing single-family homes may be expected on lakeshore properties. Under the full build-out condition envisioned under the Waukesha County development plan, published as SEWRPC Community Assistance Planning Report No. 209, *A Development Plan for Waukesha County, Wisconsin*, completed in 1996, most of the undeveloped lands outside the environmental corridors and other environmentally sensitive areas could potentially be developed for low-density urban uses. This development could occur in the form of residential clusters on smaller lots, and thereby preserving portions of the remaining open space and, thus, reducing the impacts on the Lake.

The Waukesha County Wetland and Shoreland Zoning Ordinance provisions apply to the Town of Eagle, while the Towns of LaGrange and Troy are under the jurisdiction of the Walworth County General Zoning Ordinance. The Village of Eagle administers its own zoning ordinance. The existing zoning in the Waukesha County portion of the subwatershed would permit far more urban development than is envisioned in the adopted regional plan. In addition to the comprehensive zoning ordinances administered in the Eagle Spring Lake subwatershed, both the Waukesha County and Walworth County Boards of Supervisors exercise special-purpose shoreland and floodland zoning. These special-purpose zoning ordinances, prepared pursuant to the requirements of the Wisconsin Water Resources Act of 1965 (Chapter 30, *Wisconsin Statutes*), impose special land use regulations on unincorporated lands in the shoreland zone, which is defined as all lands located within 1,000 feet of the of any navigable lake, pond, or flowage, and within 300 feet of the ordinary high water mark of any navigable river or stream, or to the landward side of the floodplain, whichever is greater. The shoreland and floodland protection zoning ordinances are similar in content to the Waukesha and Walworth County Zoning Ordinances, but include additional regulations intended to protect waterways and the attendant shorelines.

Other pertinent land use and management regulations include wetland and shoreland protection ordinances. Chapters 23 and 330 of the *Wisconsin Statutes* require that counties regulate the use of all wetlands five acres or larger in shoreland zones of unincorporated areas. Wetland maps for Waukesha and Walworth Counties that were originally prepared for the WDNR by SEWRPC in 1981 and 1982 were recently updated. In accordance with Chapter NR 115 of the *Wisconsin Administrative Code*, Waukesha and Walworth Counties have updated their shoreland zoning regulations and attendant maps to preclude further loss of wetlands in the shoreland areas.

The existing zoning ordinances have proven to be relatively effective in protecting the wetlands and water resources of the Walworth County portion of Eagle Spring Lake subwatershed, but not in the Waukesha County portion. If continued, current trends will result in the loss of a considerable amount of the open space in the area tributary to Eagle Spring Lake. Concern has been expressed by residents of the area over the widespread development of urban and suburban development on former agricultural lands in the vicinity of the Lake in Waukesha County. In addition, infilling and replacement of existing housing

with larger structures, especially within the shoreland surrounding Eagle Spring Lake has, to a limited extent, taken place. Such redevelopment of the subwatershed and lakefront may be undesirable from the point of view of water quality protection as it generally results in a greater area of impervious surface, increased runoff, and increased pollutant loading. This may be accompanied by the year-round use of formerly seasonal lakefront properties potentially resulting in an over-loading of onsite sewage disposal systems. Control of shoreland redevelopment, and the related intensification of use, is not specifically addressed in the existing zoning codes, although new construction must meet specific compliance and inspection requirements for onsite sewage disposal systems. All onsite sewage disposal systems serving the Eagle Spring Lake community are inspected on a rotating two-year cycle by Waukesha County staff operating under contract to the ESLMD, pursuant to the District's septic inspection ordinance.

b. Social/Economic (including ethnic and cultural groups)

The area tributary to Eagle Spring Lake includes portions of the Village of Eagle and the Town of Eagle in Waukesha County and the Towns of LaGrange and Troy in Walworth County. The resident population of the area tributary to Eagle Spring Lake has increased steadily since 1960. The 1990 resident population of the subwatershed, estimated at about 3,470 persons, was almost twice the estimated 1960 population. Population forecasts prepared by SEWRPC, as a basis for the preparation of the regional land use plan, indicate that the resident population of the area tributary to Eagle Spring Lake will increase to between 3,500 and 5,800 persons. Under the County development plan, a considerably higher resident population could be anticipated in the area tributary to Eagle Spring Lake. The number of resident households in the area tributary to Eagle Spring Lake has also increased steadily since 1960. Based upon forecasts developed for the regional land use plan, the number of resident households in the area would increase from about 1,120 in 1990 to between about 1,230 and 1,900 in the year 2010. Under the County development plan, a higher number of households would be anticipated under buildout conditions in the area tributary to Eagle Spring Lake. In addition to the year-round resident population and households, there were, as of 1990, about 265 seasonal residents and 100 seasonal housing units within the area tributary to Eagle Spring Lake.

Eagle Spring Lake provides an ideal setting for the provision of parks and open space sites and facilities. There is a publicly-owned open space site—the northern portion of the Lulu Lake State Natural Area—and a publicly-owned lake access site along the Eagle Spring Lake shoreline. In addition, three privately owned recreational sites, comprising a golf course, a park, and one private boat launching site, exist around the lakeshore. The public recreational boating lake-access site is on the eastern shore of Eagle Spring Lake near the outflow to the Mukwonago River, and is considered to be adequate public access pursuant to Chapter NR 1 of the *Wisconsin Administrative Code*. This public recreational boating access site recently was upgraded by the WDNR. Other existing recreational facilities in the vicinity of Eagle Spring Lake, situated off the lakeshore, include the Kettle Moraine State Forest, State Historical Society Old World Wisconsin site, McMiller Sports Center, and Eagle Spring Golf Course.

Water-based outdoor recreational activities on Eagle Spring Lake include boating, fishing, swimming, and other active and passive recreational pursuits. Because of its size, Eagle Spring Lake receives some powerboat use. However, because of its limited depth and aquatic plant growth, the predominant use is fishing and pleasure boating. Boat surveys conducted on June 25 and June 27, 1996, indicated that 14 and 13 watercraft of various types, respectively, were in use on the Lake at one time on those days. In addition, about 260 boats were moored on the Lake or stored on shore. Most of the watercraft not in use were powerboats, pontoon boats, and fishing boats, with lesser numbers of canoes, paddle boats, sailboats, and personal watercraft. A recreational watercraft count conducted on August 6, 2008, indicated that about 450 boats were moored on the Lake or stored on shore, which indicates that there was an increase of approximately 73 percent in the number of boats on the Lake since 1996. This increase in the number of boats is consistent with changes in lake recreational use throughout the Southeastern Wisconsin Region.

Seasonal community and private events and activities take advantage of the aesthetic qualities of the Lake, including an annual Carp-Out Fisheree conducted between 1990 and 2001 that had an average attendance of 70 persons per event. Ice fishing is a popular winter pastime on Eagle Spring Lake.

c. Archaeological/Historical

The movement of European settlers into the Southeastern Wisconsin Region began about 1830. Completion, within Southeastern Wisconsin, of the U.S. Public Land Survey in 1836, and the subsequent sale of public lands in Wisconsin, brought a rapid influx of settlers into the area. Urban development began to occur within the area tributary to Eagle Spring Lake shortly after the completion of the U.S. Public Land Survey, with the earliest development occurring within the current Village of Eagle area. Development began to occur around Eagle Spring Lake in the early 1900s. The most rapid increase in urban land use development in the tributary area occurred between 1975 and 1990, when 1,280 acres of the area were converted from rural to urban land uses. Urban development surrounding Eagle Spring Lake occurred largely between 1900 and 1940.

14. Other Special Resources (e.g., State Natural Areas, prime agricultural lands)

The Lulu Lake State Natural Area, adjoining the southwestern shoreline of Eagle Spring Lake, is a portion of a 1,660 acre reserve comprised of oak openings, a leatherleaf bog, calcareous fen and sedge meadow wetland. It is proposed that this natural area be expanded to a total area of 2,310 acres through the purchase of additional lands by the WDNR and TNC.

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ENVIRONMENTAL CONSEQUENCES (probable adverse and beneficial impacts including indirect and secondary impacts)

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15. Physical (include visual if applicable)

The immediate impact of the increase in water levels within the waterbody created by the Wambold Dam would be the inundation of approximately 12.6 acres of additional riparian lands surrounding Eagle Spring Lake, with the majority of inundation occurring on the western shore of the lake. In contrast, the result of any action to conform the impoundment to the current regulatory levels would be the exposure of this acreage of substrate that is currently flooded by the waters of Eagle Spring Lake. The proposed increase in water level would harmonize the legally permitted (*de jure*) operating level of Eagle Spring Lake with the actual (*de facto*) operating level of the Lake. Both of these actions have potential physical consequences for the lake ecosystem of Eagle Spring Lake and for the riparian community and users of the Lake.

It should be noted that the physical dimensions of Eagle Spring Lake, determined by the Wisconsin Conservation Department and reported in the Wisconsin Department of Natural Resources Lake Use Report No. FX-19, *Eagle Spring Lake, Waukesha County, Wisconsin*, published during 1969, and reported in subsequent editions of WDNR Publication No. PUB-FH-800, *Wisconsin Lakes*, last published in 2005, represent the *de facto* conditions within Eagle Spring Lake, as documented in Attachments 2 through 10—the aerial photographs or orthophotographs of the Lake obtained between 1941 and 2005.

Increasing the *de jure* operational water level within Eagle Spring Lake, impounded by the Wambold Dam, would potentially flood additional areas of the shorelands riparian to the Lake. Such inundation of terrestrial lands would have immediate biological consequences, as enumerated in Section 16, below. The increased lake surface area also would potentially affect: (1) the regulatory regimes governing public recreational boating access, pursuant to Chapter NR 1 of the *Wisconsin Administrative Code* which established maximum and minimum standards for public recreational boating access based upon boatable lake surface area; (2) the ability of the riparian owners to access the beneficial uses of the waterbody, including aesthetic enjoyment, participation in angling, boating and related water-based recreational opportunities; and, (3) the integrity of the land and water interface, potentially exposing newly inundated lands to the erosive effects of wind and wave action and ice damage, as well as physical occupation of former shoreland areas by public waters of the State. Depending upon the individual property boundary descriptions, an increased lake level would potentially (i) store public water on private property and (ii) require the dam owners to acquire easements for this purpose from riparian owners or court action to convey prescriptive rights of ownership to the owner of the dam. Prescriptive rights are public rights of access over private lands that are acquired through continued use for a specific or prescriptive period. Such a right essentially is an easement over real property that comes into being without the explicit consent of the owner. In Wisconsin, prescriptive rights are governed by Chapter 893 of the *Wisconsin Statutes*, and require continuous “adverse” use of the rights in real estate of another party for at least 20 years. Action by the circuit court is required under Chapter 841 of the *Wisconsin Statutes* to establish title to the property.

Increasing the *de jure* operational water level within Eagle Spring Lake could increase the potential for flooding of basements of those few homes located downstream of the dam. Mr. John Mann, a resident of the ESLMD, has reported that one house south of the public recreational boating access site has a frequently running sump pump, but that this condition would be unlikely to change with a 0.56 feet lower lake level; the Board of Commissioners of the ESLMD also note that similar conditions apply to other homes near the public recreational boating access site and surrounding the embayment locally known as Jacks Bay. No other flooding or lake level related effects have been reported within the Eagle Spring Lake community.

Decreasing the *de facto* operational water level within Eagle Spring Lake by itself would not be likely to affect the overall abundance and diversity of submerged aquatic plants within Eagle Spring Lake. However, reduced water levels combined with motorboat traffic may lead to a decrease in the abundance and diversity of this plant community and possibly shift this ecosystem to a turbid water state (Scheffer and Carpenter 2003). Decreasing the *de facto* operational water level could also lead to negative impacts to the extensive lily pad population that exists within the southwestern portion of Eagle Spring Lake, where it is estimated that the majority of mudflats would be exposed. This impact may be temporary or permanent, but these species are sensitive to freezing due to drawdown. The lily pads may or may not respond by extending their distribution further out into the lake. These lily pads offer a variety of habitat for food and cover for much wildlife (Borman and others 1997), but it is not known how the potential impacts to this species will affect the overall quality of the Lake ecosystem. Additionally, decreasing the *de facto* operational water level within Eagle Spring Lake would be likely to promote the growth of emergent macrophytes such as native Bullrush species along the exposed mudflats and nearshore shallow lake areas. Given the extent of the native species along the majority of shoreline, these nearshore areas likely contain a significant seedbank of native species. However, these areas would also be at greater risk of exotic invasive species invasions, which would lead to a degradation of the wetland and nearshore

community.

A further possible consequence of a reduced elevation of the water surface within the Eagle Spring-Lulu Lake would likely be a decrease in surface water levels within the connection between Eagle Spring and Lulu Lakes, within Lulu Lake itself, and within the reach of the Mukwonago River upstream Lulu Lake to the TNC bridge. The reach of the River upstream of Lulu Lake is a designated Outstanding Resource Water of the State pursuant to Section NR 102.10(1m) of the *Wisconsin Administrative Code*. Based upon observed water depths that are generally greater than three feet within both reaches (Attachments 18 and 20), a decrease of 0.56 feet in depth would not significantly affect the overall depth. This observation combined with the limited water surface slope in both reaches, due to the backwater effect of the dam, indicates that, if the Lake level were set at the *de jure* elevation, there would be minimal streambed erosion of sediments beyond what is already occurring. Since the streambanks in both reaches are comprised of peat, there is an elevated probability that streambank erosion would increase in response to a drawdown primarily due to an increased streambank height that will be more susceptible to drying out and more exposed to freeze/thaw cycles. In addition, the streambanks within the reach between Eagle Spring and Lulu Lakes would also be more susceptible to wave action from passing motorboats, whose movement will not be restricted or limited with the 0.56 feet of drawdown. It has been suggested that a drawdown could benefit the reach upstream of Lulu Lake by exposing gravel substrates and thereby increasing habitat heterogeneity and quality; however, the streambed in this reach is comprised almost entirely of muck sediment overlying peat, so this improvement is not physically possible.

Implementation of the *de facto* water level management regime has resulted in a complex physical limnology within Eagle Spring Lake, which has maintained the macrophyte-dominated clear-water state for nearly 70 years. Temperature stratification is much more pronounced in the northern portions of the Lake compared to the middle portion of the lake, which indicates mixing is much more pronounced in the middle. Surface water temperatures are warmer in the eastern portion of the Lake, which also indicates that more mixing is occurring in the eastern versus the western portion of the Lake and is likely to be driven by westerly winds. Surface water temperatures are warmest in the southern portion of the Lake, which indicates that this area is more isolated and less well mixed than other areas of the Lake. Furthermore, this water level management regime has also resulted in a highly diverse and abundant aquatic plant community that provides habitat and food for a variety of aquatic organisms, reduces shoreline erosion, and contributes to the maintenance of the good water quality within the basin. The high water levels also provide good connectivity among the various bays to the central part of the lake as well as a variety of substrates among various water depths.

The drawdown associated with the *de jure* condition may not change the physical limnology of Eagle Spring Lake as summarized above. However, based upon current information, the drawdown associated with the *de jure* condition would be likely to increase the chances of shifting the Lake or a portion of the Lake to a turbid water state. This turbid water shift would likely be attributed to several factors associated with changes in the physical limnology of this impoundment that include, but are not limited to, the following:

- Decreased stratification leading to increased mixing and resuspension of wind- and motorboat-induced sediments due to overall shallower water conditions; and
- Increased isolation and reduced mixing within the southern portion of Lake, which increases the likelihood of water quality degradation (see biological section below); consolidation of carp within less water volumes and shallower littoral zones reducing erosion resistance, which makes the sediment more susceptible to resuspension through wind and/or motor boat activity throughout the Lake.

The northern portion of the Lake is likely to be much less susceptible to a reversal to a turbid state due to its significant groundwater input, but that influence is limited to the north and most of the rest of the impoundment would be more susceptible to a reversal as summarized above (Scheffer and van Nes 2007).

Decreasing water levels may result in a short-term increase in head pressure, allowing groundwater discharges to increase into Eagle Spring Lake and Lulu Lake. This would potentially provide cooler temperatures to help mitigate possible thermal increases as described above, which would be a benefit to the fishery and other aquatic organisms. It is also possible that, over the long-term, groundwater discharges may not change, in response to a drawdown. A change in discharge would be of particular concern for the sustainability of groundwater supplied wetland systems such as the fens located adjacent to Lulu Lake. As groundwater flows change, there are potential consequences for the wetland vegetation that characterizes these rare ecosystems, altering the wetland fringe, encouraging the growths of plants such as the narrow leaf cattail that are tolerant of changing water levels, and potentially disadvantaging native wetland species such as tamaracks, sedges, and rushes. Such species provide a variety of good habitats not only for aquatic and amphibious organisms but also for some terrestrial animals and birds known to inhabit the areas surrounding Eagle Spring and Lulu Lakes.

A change in lake surface area of about 12.6 acres is less than five percent of the existing water surface area of Eagle Spring Lake and an increase in lake depth of about 0.56 feet would not be expected to have any measurable impact of Lake water quality, based upon forecasts generated using WiLMS and the OECD model suite. It is important to note that this is a unit area loading

model and does not take into account any physical limnology (i.e., mixing), biological interactions (i.e., fisheries), or boating activity among others that may significantly affect water quality (see above).

16. Biological (including impacts to threatened/endangered resources)

As noted above, significant biological consequences are likely to arise as a result of changes in the operational water levels within Eagle Spring Lake. Also as noted above, the proposed action would result in either an increase in permitted operational lake level, increasing lake surface area, or a drawdown. The biological impacts of these actions are dealt with as enumerated below.

Increasing the water surface elevation would increase available aquatic habitat within the Lake. Increasing Lake depth by about 0.56 foot would create an additional volume of approximately 156.35 acre-feet of water in the Lake. Lake depth is a major determinant of fish community structure and this additional volume provides an increased volume of water and habitat heterogeneity within which aquatic organisms can live, feed, and reproduce (Rahel 1984, Rodriguez and Lewis 1997, Robinson and Tonn 1989, Tonn and Magnuson 1982, Tonn and others 1983, Morrow and Fischenich 2000).

Reduced water levels within Eagle Spring Lake could affect some fish species more than others in terms of spawning, rearing, and/or foraging habitat. Prior to addressing possible fishery community outcomes from reducing the water levels within Eagle Spring Lake, it is important to reiterate the major conclusions from the fisheries section (Section 12) above:

- The types, quality, and use of habitat for bluegill, largemouth, and northern pike have not been quantified within Eagle Spring Lake; therefore, it is not known if a particular habitat type is limiting one or more of these species or one or more parts of their life history (i.e., spawning, egg development, fry, juvenile, adults) within this impoundment.
- Recruitment and/or population sizes are limited in Eagle Spring Lake for bluegill, largemouth bass, and northern pike species compared to other lakes in the region and the reasons for this are not known.
- Overharvest or exploitation from anglers is likely to be a major factor affecting these species; however, there has not been a creel survey to quantify this impact. New regulations have been established and northern pike continue to be stocked within the lake to address this issue.
- It is also not known how much the fishery within Eagle Spring Lake depends upon or influences the fishery within Lulu Lake and vice versa.

Assuming that Eagle Spring Lake, or a portion of the Lake, does not revert to a turbid water state, it is probable that the fishery (most notably bluegill, largemouth bass, and northern pike) will not be negatively affected by the drawdown. Based upon the ability of bluegill to use a variety of habitats (Becker 1983), this species is the most likely to not be affected by the drawdown. If largemouth bass spawning habitat (e.g., shallow water and gravel substrates) is limited in Eagle Spring Lake, it is likely that the drawdown would reduce the amount of this habitat for spawning and negatively affect this species. If spawning habitat is limited for northern pike, which utilize submergent and emergent macrophyte vegetation in nearshore shallow areas to suspend their eggs above sediments for development, the drawdown may provide increased area of emergent vegetation and positively affect this species recovery.

Water level drawdowns are typically implemented to improve water quality and stimulate a shift or reversal from the turbid-water state to a clear-water macrophyte dominated state (Scheffer 1989, Scheffer and others 2001, Scheffer and Carpenter 2003, Wallsten and Frosgren 1989, Bengtsson and Hellstrom 1992, WDNR EA Koshkonong 2004). The SEWRPC staff was unable to find a study documenting a draw down of lake that was within a clear-water macrophyte-dominated state for the purpose of improving water quality and/or a lake fishery or macrophyte community. As noted above, the clear-water dominated state has been maintained for 70 years, and has continued to be maintained. Therefore, a drawdown is not likely to improve water conditions beyond what already exists, since water quality is very good and aquatic plant abundance and diversity are higher than any other lake in the Southeastern Wisconsin Region. Therefore, since water quality and plant abundance and diversity will not likely change, it is important to focus on the potential effects of a drawdown on fisheries habitat, which can have significant negative effects on quality, quantity, and/or composition of littoral zone fisheries habitat (Irwin and Noble 1996, Beauchamp and others 1994). In particular, drawdowns within shallow impoundments can lead to a significant reduction in littoral zone habitat and a corresponding increase in fragmentation of remaining habitat patches (Irwin 1994, Irwin and Noble 1996). In the case of Eagle Spring Lake, shallow water depths with gravel substrate habitat may be significantly reduced and much patchier in distribution for areas that remain. Since the southern bays within Eagle Spring Lake were found to be warmer and less well mixed than other parts of the lake, a drawdown may significantly increase the likelihood of a fish kill occurring in the summer or winter within these areas. The chances of this occurring also are increased due to the continued evidence that lakes throughout the State of Wisconsin are getting warmer (Magnuson and others 2003) and that urban development continues to increase both of which will contribute to increased surface water temperatures in the future.

Changing one static water level state for another static water level state will be unlikely to benefit the fishery. Ploskey (1986) summarizes over 350 papers, noting that, in order to be successful in complementing fisheries management in lakes and reservoirs, changes in water level must be on a seasonal or annual time scale to yield significant fisheries benefits. This observation that hydrologic variation is key to fishery quality has been shown to be key to restoration or maintenance of high quality littoral vegetation, wildlife, and associated wetlands (Johnson and others 2007, Duncan and Kubecka 1995, Van der Valk 1981, Harris and Marshall 1963). Although there have been changes in water surface elevations to restore or improve fishery potentials in Wisconsin (WDNR EA-Koshkonong 2004), there is no indication that one time permanent drawdowns or increases in water level have succeeded in modifying the fishery.

Because of the relatively shallow nature of Eagle Spring Lake, the additional surface area provided by an increase in operational level of about 0.56 feet would proportionately increase available benthic habitat within the epilimnion of the lake, adding to the available littoral zone habitat utilized by amphibians, mollusks, and other organisms dwelling within or near the land-water ecotone. This additional benthic habitat also would increase the area potentially available to rooted aquatic plants for growth. In such cases, the nonnative Eurasian water milfoil (*Myriophyllum spicatum*) frequently is reported to be a colonizing species—such colonization was reported in the case of Pine Lake following actions to deepen boating channels in the southern and southwestern portions of that Lake, as reported in SEWRPC Memorandum Report No. 124, *An Aquatic Plant Inventory for Pine Lake, Waukesha County, Wisconsin*, published in December 1998. Consequently, additional management measures may be required to control any additional area of infestation by Eurasian water milfoil. Notwithstanding, the presence of extensive lily pad stands within much of the area along the southwestern shoreline of the Lake currently limits the success of Eurasian water milfoil in these areas, which, because of the limited depth of overlying water, are likely to be most affected by any water level change (in comparison with the more steeply sloping portions of the Lake).

Conversely, decreasing the water surface elevation would provide approximately 12.6 acres of additional land surface within the area of the land-water interface available for colonization by littoral plants and animals. These areas may be colonized by native plants; however, there is a much greater potential for this newly exposed land surface to be colonized by nonnative invasive species such as purple loosestrife (*Lythrum salicaria*), narrow-leaf cattail (*Typha angustifolia*), buckthorn (*Rhamnus* spp.), phragmites (*Phragmites australis*), and reed canary grass (*Phalaris arundinacea*), which frequently outcompete native plant species in the absence of concerted and ongoing land management measures. These invasive species have little or no habitat value and frequently replace those native species which contribute to the biological integrity of the Region. In this regard, the presence of many of these species in proximity to Eagle Spring Lake and within the wetland flora of the riparian wetlands adjacent to Eagle Spring Lake would encourage the invasion of such species within the newly exposed lakebed sediments, as the plants noted above are aggressive colonizing species that respond quickly to changing water level conditions. Colonization by these less desirable emergent plants was observed by SEWRPC staff in the exposed shoreland areas of Big Muskego Lake following the drawdown of that impoundment.

## 17. Cultural

### a. Land Use (including indirect and secondary impacts)

Landscape-level changes that may occur as a result of any change in water surface elevation in Eagle Spring Lake are likely to be limited to the aquatic ecosystem and shoreland area. The increase in permitted operational lake level, increasing lake surface area, would maintain the current shoreland conditions currently occurring within the lake basins of Eagle Spring Lake and Lulu Lake. In contrast, the drawdown associated with the *de jure* condition would reduce the surface areas of the Lakes, alter the aesthetic character of the landscape in the vicinity of the Lakes, and modify the ecological value of the shoreland wetlands and other high value ecological lands within the SEWRPC-delineated environmental corridors surrounding the Lakes and River.

### b. Social/Economic (including ethnic and cultural groups, and zoning if applicable)

Human impacts of the increase in permitted operational lake level would be associated with the increased lake surface area, including greater accessibility and better recreational boating access to the main Lake basin by riparian residents and recreational users accessing the Lake through the public recreational boating access site. This increased lake surface area, however, would be gained at the expense of some loss of shoreland area and a possible increase in risk to property downstream in the event of a dam failure. Under the increased water level scenario, public waters would be stored on private lands, inundating approximately 12.6 acres of shoreland and potentially requiring the conduct of legal proceedings to establish easements to this effect—although, as noted above, such easements may be subject to Statutory provisions governing adverse possession, given the current and historic water levels in Eagle Spring Lake (as documented in the aerial photographs attached hereto as Attachments 2 through 10). The addition of approximately 12.6 acres to the Lake surface will not affect the public recreational boating standards applicable to Eagle Spring Lake—the maxima are established in 15-acre boatable area increments and the minima are set in 30-acre increments.

Given that the *de facto* lake surface elevation would remain unchanged if the operating permit for the Wambold Dam is

amended to reflect the current situation, riparian landowners and residents would have continued access to the Lakes, with adequate water depth at most locations around the Lakes to support the existing range of water-based recreational and ecological uses.

Reducing the lake surface elevation to conform to the permitted operating conditions established by the 1954 PSC order would necessitate determination of ownership of the exposed lake bed. While it may be assumed in many cases that the lands revert to the adjacent riparian property owners, such ownership would be subject to the precise wording of the boundary descriptions applicable to each property. This may entail the need for public records searches to establish ownership. Where riparian ownership does not extend to the edge of the water, additional research may be required to establish the owners of the exposed lands. In addition, imposition of the *de jure* water levels would impact the ability of riparian owners to access the water. This could require the extension or modification of piers, shoreline protection structures, and shoreland access points, including the public recreational boating access site. These modifications would entail costs to property owners, including, but not limited to, title searches, changes [which may increase the amount of taxable land] in taxation affecting real property, construction costs, and costs of acquisition and installation of additional infrastructure such as pier sections, shoreline protection materials, and landscaping. In a few cases, the additional distance to the edge of the water may benefit property owners whose nonconforming structures may subsequently meet the shoreland set back requirements, for example. Such determinations, however, would entail some expense to the homeowners with respect to land surveying and deed registration costs, for example. Some of these costs can be considered to be “one-off” costs associated with one time payments, while other costs, such as taxation increases, may be of longer or continuing duration.

c. Archaeological/Historical

There are no known impacts that would affect archaeological or historical sites within the vicinities of the affected Lakes.

18. Other Special Resources (e.g., State Natural Areas, prime agricultural lands)

The environmental consequences of the increase in permitted operational lake level would result in the continued integrity of the current ecological condition of the State Natural Area adjacent to Lulu Lake, and associated lands owned by the TNC that complement the State Natural Area lands in this area. These lands and their associated flora and fauna include high value natural areas and critical species habitat areas, as defined in the *Regional Natural Areas and Critical Species Habitat Protection and Management Plan*, published in September 1997 as SEWRPC Planning Report No. 42. These lands are encompassed within the primary environmental corridor lands that form a key element of the adopted regional land use plan for Southeastern Wisconsin, the most recent iteration thereof being published as SEWRPC Planning Report No. 48, *A Regional Land Use Plan for Southeastern Wisconsin: 2035*, which was published in June of 2006. A return to the permitted water level, should the operating permit not be amended to reflect the current surface elevation of the Lake, may encourage the intrusion of nonnative species into the vacated shoreland areas, as discussed above. Management measures would be required to limit the negative impacts of such intrusions; such measures would include, but not be limited to, plantings of native species; burning, pulling or herbiciding of invasive species; and, related time- and staff-intensive management operations beyond those currently being carried out on and around Eagle Spring Lake. While the impact of any changes in water surface elevation on the landward boundary of the terrestrial-wetland ecotone cannot be forecast with certainty (given the groundwater system, for example, that may sustain the *status quo*), it is possible that the shoreland ecotone could shift lakeward—in the event that the permitted lake levels are implemented—exposing the landward extreme of the existing shoreland wetland to the intrusion of terrestrial species that may include nonnative pioneer species, such as buckthorn.

19. Summary of Adverse Impacts That Cannot Be Avoided (more fully discussed in 15 through 18)

The regularization of the *de facto* lake surface elevation of Eagle Spring Lake would maintain and sustain the current high quality ecosystems that comprise the Eagle Spring Lake and Lulu Lake area. This would maintain approximately 12.6 acres of lake surface to a depth of about 0.56 feet.

A drawdown to the *de jure* lake surface elevation established for Eagle Spring Lake, on the other hand, could result in concomitant reductions in surface water elevation with the upstream Lulu Lake, leading to changes in the stream channel immediate upstream of Lulu Lake associated with channel erosion as the stream bed responds to the drawdown. Eroded sediments would be mobilized and, most likely, deposited in the nearshore areas of Lulu Lake adjacent to the point of entry of the stream into the Lake. Both Lakes would sustain modification of their littoral and riparian zones, with the adjustment in Eagle Spring Lake resulting in the exposure of about 12.6 acres of current lake bed that would be susceptible to colonization by a number of nonnative invasive species known to occur in the area, including purple loosestrife, reed canary grass, phragmites, and buckthorn. These impacts could be avoided should current lake levels in Eagle Spring Lake be maintained.

20. Environmental Effects and Their Significance

- a. Discuss which of the primary and secondary environmental effects listed in the environmental consequences section are long-term or short-term.

Short-term changes in the fisheries and aquatic communities would be anticipated in response to a drawdown to the *de jure* lake surface elevation established for Eagle Spring Lake. The concentration of fishes in a slightly smaller volume of water could potentially increase predation and result in some modification of the fisheries community that would outlast these short term impacts. Longer term impacts would be experienced by the riparian plant communities, which would be subjected to modification as a result of the further encroachment onto exposed former lakebed by nonnative invasive species such as purple loosestrife, reed canary grass, phragmites, and buckthorn, and the stability of the stream channel both upstream of Lulu Lake and downstream of Eagle Spring Lake, which would “adjust” to the “new” conditions created by the drawdown should the application to maintain current water surface elevations be denied.

- b. Discuss which of the primary and secondary environmental effects listed in the environmental consequences section are effects on geographically scarce resources (e.g. historic or cultural resources, scenic and recreational resources, prime agricultural lands, threatened or endangered resources or ecologically sensitive areas).

Lulu Lake is a designated Outstanding Resource Water of the State. This waterbody, which has a surface water elevation that is linked to that of Eagle Spring Lake—and hence to the surface water elevation of that waterbody which is impounded by the Wambold Dam, would potentially be subjected to the introduction of additional sediments arising from the process of channel erosion of the upstream Mukwonago River as that River adjusts to the modified water levels in the two Lakes. While such adjustments are unlikely to significantly affect groundwater flows into Eagle Spring Lake, a change in water surface elevation of about 0.56 feet could influence the ecological integrity of the fen located on the southern shores of Lulu Lake. In addition, the channel connection between Eagle Spring and Lulu Lakes would also be subject to greater erosion, due to turbulence caused by boat traffic, from the 0.56 feet of additional exposure of unvegetated banks.

- c. Discuss the extent to which the primary and secondary environmental effects listed in the environmental consequences section are reversible.

A lake surface elevation based on the *de jure* water surface elevation (about 0.56 feet below the current elevation) is more likely to have longer term consequences than maintenance of the *de facto* condition. Establishment of the *de jure* condition would result in the exposure of former lake bed sediments to colonization by nonnative invasive species. Boers and Zedler (2006, 2008) note the potential for cattails (*Typha x glauca*) to rapidly expand into exposed shoreland areas and dominate associated wetland systems. Such a consequence, amongst others—such as the expansion of the phragmites and purple loosestrife populations, would significantly degrade the overall ecological integrity of the Lake area (including the upstream Lulu Lake area and its associated natural areas) and provide a larger reservoir of source materials that will ultimately result in degraded downstream ecosystems. These latter changes are more likely to be difficult or impossible to reverse, even with sustained management and control programs, than those associated with the regularization of water levels at their current (and historical) levels, as proposed. Such changes have the potential to be replicated throughout the Mukwonago River Basin as seeds, root stock, and other reproductive structures fuel the transport mechanism that is the Mukwonago River.

21. Significance of Cumulative Effects

Discuss the significance of reasonably anticipated cumulative effects on the environment (and energy usage, if applicable). Consider cumulative effects from repeated projects of the same type. Would the cumulative effects be more severe or substantially change the quality of the environment? Include other activities planned or proposed in the area that would compound effects on the environment.

The proposed regularization of the current surface water elevations as part of the permitted operations of the Wambold Dam will ensure the continuity of the *status quo*, i.e., no significant changes in the Lakes, River, and associated terrestrial and aquatic ecosystems would be anticipated. Eagle Spring Lake would continue to be operated at its *de facto* elevation which serves to support and sustain the associated terrestrial and aquatic systems as well as the human community living in and around the resource. Modification of the operating level in accordance with the *de jure* requirements of the PSC permit would result in a period of adjustment by the ecosystems that would affect not only the immediate area surrounding Eagle Spring Lake but also the lands adjacent to Lulu Lake and the portions of the Mukwonago River downstream of Eagle Spring Lake. These areas include the State designated Outstanding and Exceptional Resources Waters of Lulu Lake and the Mukwonago River between Eagle Spring Lake and Upper Phantom Lake.

## 22. Significance of Risk

- a. Explain the significance of any unknowns that create substantial uncertainty in predicting effects on the quality of the environment. What additional studies or analysis would eliminate or reduce these unknowns?

While the specific behavior of any given ecosystem is subject to natural variations, there is little uncertainty in the forecasts made in this environmental analysis. A positive response to the proposed regularization of water levels within the Eagle Spring Lake would not result in any significant changes to the lake and stream system, either upstream affecting Lulu Lake and the Mukwonago River, or downstream affecting the Mukwonago River and ultimately Lower Phantom Lake and the Fox River. SEWRPC, in partnership with the WDNR, Eagle Spring Lake Management District, Phantom Lakes Management District, Lake Beulah Management District, TNC, local colleges and universities, and other civic groups such as the Friends of the Mukwonago, have initiated a planning program leading to the preparation of a river protection plan for the Mukwonago River basin. This planning program is designed to compile and synthesize the current state of knowledge on this river system, including its lakes. The availability of this data for use in the EA provides a significant and substantial knowledge base from which to extrapolate potential impacts and consequences. Additionally, the Eagle Spring Lake Management District has developed and approved a lake management plan for that Lake which addresses many of the concerns highlighted in this EA, providing knowledge and a basis for mitigation of the worst anticipated impacts. Consequently, the information set forth in this EA represents a solid basis for evaluating the two proposed alternatives; namely, regularization of the *de facto* lake levels of Eagle Spring Lake or the drawdown to the *de jure* lake levels.

- b. Explain the environmental significance of reasonably anticipated operating problems such as malfunctions, spills, fires or other hazards (particularly those relating to health or safety). Consider reasonable detection and emergency response, and discuss the potential for these hazards.

This EA is predicated upon the protection and continuation of the current environmental and ecological conditions applicable to Eagle Spring Lake and the upper portions of the Mukwonago River system, including Lulu Lake, and their attendant drainage basin. Regularization of the current (and historical) operating levels of the Wambold Dam, therefore, represents a known outcome.

## 23. Significance of Precedent

Would a decision on this proposal influence future decisions or foreclose options that may additionally affect the quality of the environment? Describe any conflicts the proposal has with plans or policy of local, state or federal agencies. Explain the significance of each.

Regularization of the surface water elevation of Eagle Spring Lake and the Wambold Dam reflects the continuation of the historic condition. Regularization of these levels relative to a known datum (the National Vertical Geodetic Datum of 1929) would eliminate uncertainties associated with a local datum. The establishment of lake level elevations within regulated river systems in accordance with an established datum would be a useful precedent, eliminating future such conflicts associated with local datums. Conversion of relative PSC and WDNR benchmarks to benchmarks tied into NGVD-29 would benefit not only the affected communities riparian to a dammed waterbody but would minimize the work load on State employees tasked with managing such impoundments.

## 24. Significance of Controversy over Environmental Effects

Discuss the effects on the quality of the environment, including socio-economic effects, that are (or are likely to be) highly controversial, and summarize the controversy.

There is significant sentiment within the Eagle Spring Lake community in favor of maintaining the current water levels which would continue to sustain not only the conduct of recreational activities within and around the Lake basin but also maintain the integrity of the Lake and associated stream ecosystem, including the upstream lake and stream system of Lulu Lake and the Mukwonago River. There is widespread support for the maintenance of the *status quo*, which, in effect, represents the regularization of the *de facto* operating levels of the Wambold Dam. This action would require the amendment of the current operating permit.

The actual impact of the proposed change in water surface elevation within Eagle Spring Lake of about 0.56 feet is likely to have immediate consequences in the littoral areas of the Lake. While no changes are anticipated should the *de facto* levels be maintained, implementation of the *de jure* water surface elevations could affect the ecological integrity of the shoreland wetlands. While the precise form of this impact can only be known with certainty in the event of a drawdown, the basic nature of this impact can be forecast with a high degree of certainty, with all of the likely consequences being viewed as negative by the community, including both the human community and the associated (terrestrial and aquatic) ecological communities.

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## ALTERNATIVES

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25. Briefly describe the impacts of no action and of alternatives that would decrease or eliminate adverse environmental effects. (Refer to any appropriate alternatives from the applicant or anyone else.)

The no action alternative would continue the *de facto* conditions within Eagle Spring and Lulu Lakes and the associated stream system. There would be no environmental impacts associated with the no action alternative. Enforcing the *de jure* water surface elevations could have significant negative consequences that extend both upstream and downstream of the Wambold Dam. These are summarized above in sections 15 through 18 and include loss or modification of desirable species of plants and animals throughout this river and lake system. Aside from the complete abandonment and removal of the Wambold Dam or increasing the operating levels of the Lake—neither of which are proposed or considered herein, there are no other alternatives other than the two alternatives discussed; namely, the continued operation of the Wambold Dam so as to maintain the *de facto* water levels that have existed in this Lake system since at least 1941, or the implementation of the *de jure* water operating levels that would result in a partial drawdown of the impoundment.

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## SUMMARY OF ISSUE IDENTIFICATION ACTIVITIES

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26. List agencies, citizen groups and individuals contacted regarding the project (include DNR personnel and title) and summarize public contacts, completed or proposed).

<u>Date</u>	<u>Contact</u>	<u>Comment Summary</u>
10/06/08- 1/31/09	TNC – Pat Morton, Director: Mukwonago River Watershed Project	Representing a major riparian landowner in the Mukwonago River Basin upstream of Eagle Spring Lake; provided review of the draft document
4/21/08- 10/21/08	TNC – Nick Miller	Provided biological data on the TNC properties within the study area
3/25/08- 3/28/08	TNC – John Wagner	Provided bathymetric data for Eagle Spring and Lulu Lakes
10/06/08 -1/31/09	ESLMD – Thomas A. Day, Commissioner Chairperson	Provided project oversight, coordination and liaison, and provided review of the draft document
10/06/08 -1/31/09	ESLMD – Nick Wambach, Commissioner	Provided review of the draft document
1/31/09	ESLMD – Nate Cobb, Commissioner	Provided review of the draft document
10/06/08 -1/31/09	ESLMD – John Mann, Resident	Provided citizen comment and historical perspective on the management and water levels of Eagle Spring Lake
1/31/09	ESLMD – Bill Koepek, Resident	Provided citizen comment and historical perspective on the management and water levels of Eagle Spring Lake
10/06/08 -1/31/09	SEWRPC – Dr. Thomas M. Slawski, Principal Planner	Principal author; fisheries biologist and stream ecologist
10/06/08 -1/31/09	SEWRPC– Dr. Jeffrey A. Thornton PH,CLM Principal Planner	Principal author; limnologist and lake management specialist
10/06/08 -1/31/09	SEWRPC – Michael G. Hahn PE, PH Chief Environmental Engineer	Provided expertise on hydrology and hydraulics, and regional climate data

<u>Date</u>	<u>Contact</u>	<u>Comment Summary</u>
10/06/08- 1/31/09	SEWRPC – Dr. Donald M. Reed, Chief Biologist	Provided expertise on the wetlands of the Lulu Lake-Eagle Spring Lake system and its environs
10/06/08- 1/31/09	SEWRPC – Sara W. Teske, Research Analyst	Provided data analysis, cartographic support, and drafting of EA
10/06/08- 1/31/09	WDNR – Benjamin Heussner, Fisheries Biologist	Provided information and data on the fisheries of Eagle Spring Lake, and provided review of the fisheries content of the EA
10/06/08- 1/31/09	WDNR – Susan Beyler, Fisheries Team Supervisor	Provided information and data on the fisheries of Eagle Spring Lake, and provided review of the fisheries content of the EA
10/06/08- 1/31/09	WDNR – James D’Antuono, Basin Supervisor	Coordinated WDNR staff response, provided overall guidance relating to the drafting and review of the EA
10/06/08- 1/31/09	WDNR – Michelle Schneider PE, Water Regulations and Zoning Engineer	Initiated the EA process, provided review and comment relating to WDNR permitting and regulatory requirements, and dam safety regulations pursuant to the <i>Wisconsin Administrative Code</i> and <i>Wisconsin Statutes</i>
10/06/08- 1/31/09	WDNR – Heidi Bunk, Water Resources Management Specialist	Provided information and data on the aquatic ecology of Eagle Spring and Lulu Lakes, and provided review of the limnological content of the EA
1/31/09	WDNR – Maureen Millmann, Environmental Analysis and Review Specialist	EA reviewer, provided information on the review process relating to WDNR permitting and regulatory requirements, pursuant to the <i>Wisconsin Administrative Code</i> and <i>Wisconsin Statutes</i>
1/31/09	WDNR – Jennifer Jerich, Water Regulations and Zoning Specialist	EA editor, provided information on the drafting process relating to WDNR Procedures and requirements, pursuant to the <i>Wisconsin Administrative Code</i> and <i>Wisconsin Statutes</i>
9/26/08- 10/20/08	WDNR – Lisie Kitchel, Environmental Reviewer	Provided information and data on the riverine mussels of the Mukwonago River
9/4/08	WDNR – Dr. John Lyons, Research Scientist	Provided information and data on the fishes of the Mukwonago River
11/20/08	University of Liverpool – Dr. Brain Moss, Professor of Biological Sciences	Provided comment relating to the definition of a shallow lake ecosystem

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DECISION (This decision is not final until certified by the appropriate authority)

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In accordance with s. 1.11, Stats., and Ch. NR 150, Adm. Code, the Department is authorized and required to determine whether it has complied with s.1.11, Stats., and Ch. NR 150, Wis. Adm. Code.

Complete either A or B below:

A. EIS Process Not Required

The attached analysis of the expected impacts of this proposal is of sufficient scope and detail to conclude that this is not a major action which would significantly affect the quality of the human environment. In my opinion, therefore, an environmental impact statement is not required prior to final action by the Department.

B. Major Action Requiring the Full EIS Process

The proposal is of such magnitude and complexity with such considerable and important impacts on the quality of the human environment that it constitutes a major action significantly affecting the quality of the human environment.

Signature of Evaluator	Date Signed
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Number of responses to news release or other notice:

Certified to be in compliance with WEPA	
Environmental Analysis and Liaison Program Staff	Date Signed

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NOTICE OF APPEAL RIGHTS

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If you believe that you have a right to challenge this decision, you should know that Wisconsin statutes and administrative rules establish time periods within which requests to review Department decisions must be filed.

For judicial review of a decision pursuant to sections 227.52 and 227.53, Stats., you have 30 days after the decision is mailed, or otherwise served by the Department, to file your petition with the appropriate circuit court and serve the petition on the Department. Such a petition for judicial review shall name the Department of Natural Resources as the respondent.

To request a contested case hearing pursuant to section 227.42, Stats., you have 30 days after the decision is mailed, or otherwise served by the Department, to serve a petition for hearing on the Secretary of the Department of Natural Resources. The filing of a request for a contested case hearing is not a prerequisite for judicial review and does not extend the 30-day period for filing a petition for judicial review.

Note: Not all Department decisions respecting environmental impact, such as those involving solid waste or hazardous waste facilities under sections 144.43 to 144.47 and 144.60 to 144.74, Stats., are subject to the contested case hearing provisions of section 227.42, Stats.

This notice is provided pursuant to section 227.48(2), Stats.