SURFACE WATER STORAGE INVESTIGATION
WEST BRANCH LITTLE SPOKANE RIVER
WETLAND RESTORATION & RECHARGE OPPORTUNITIES
WRIA 55 & 57

Spokane County, Washington

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April 2009

Project No. 100004720.08

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1.0 INTRODUCTION

This document presents the results of an evaluation of surface water storage options for the West Branch Little Spokane River (WBLSR) portion of Water Resource Inventory Area (WRIA) 55 in support of watershed planning activities. The area covered by the WBLSR portion of WRIA 55 is shown on **Figure 1-1**. PBS&J completed this evaluation under contract with the Spokane County Division of Utilities (Spokane County Utilities), and it is one component of a larger study of wetland restoration and recharge opportunities in WRIA 55 and WRIA 57. The studies are designed to identify actions that could improve summer flow conditions in the Little Spokane and Spokane Rivers. The other components of the larger study include:

- An assessment of wetland restoration opportunities in both WRIA 55 and 57; and
- An investigation of surface water storage options and groundwater recharge opportunities for WRIA 57.

In 1998 the Washington State legislature passed the Watershed Planning Act (Chapter 90.82 RCW) to set a framework for developing local solutions to watershed issues on a watershed basis. The law is administered by the Washington Department of Ecology (Ecology) in the form of grants. The current watershed planning effort for WRIA 55/57 was initiated in late 1998. Spokane County is the Lead Agency and one of the initiating governments in completing these watershed planning efforts for the Middle Spokane and Little Spokane watersheds. The WRIA 55/57 Planning Unit and Watershed Implementation Team (WIT) committee oversee watershed planning development within WRIA 55/57.

1.1 Purpose and Scope

The purpose of this evaluation was to identify non-wetland surface water storage options in the West Branch Little Spokane River portion of WRIA 55. The surface water storage options would be used to store water during periods of excess capacity for use during periods of limited capacity to mitigate current or future impacts to streamflows, provide new water supply, and to potentially improve habitat. The evaluation included an assessment of the potential for new surface water storage and expansion of existing surface storage. The primary goal of this effort was to determine if feasible surface water storage projects exist or if future efforts should emphasize wetland options.

The identification of surface water storage opportunities was accomplished through a combination of existing information review, site visits, consultation with the Watershed Implementation Team (WIT), and meetings with the West Branch Little Spokane River Committee. As potential sites were identified each site was ranked using the various criteria noted above into sites with a high, medium and low potential for surface water storage and in-stream flow increases.

This document includes the following:

- A review of previous investigations;
- Identification of potential surface water storage options for WBLSR;
- Feasibility screening of the identified surface water storage options; and
- Recommendations regarding further detailed evaluation.

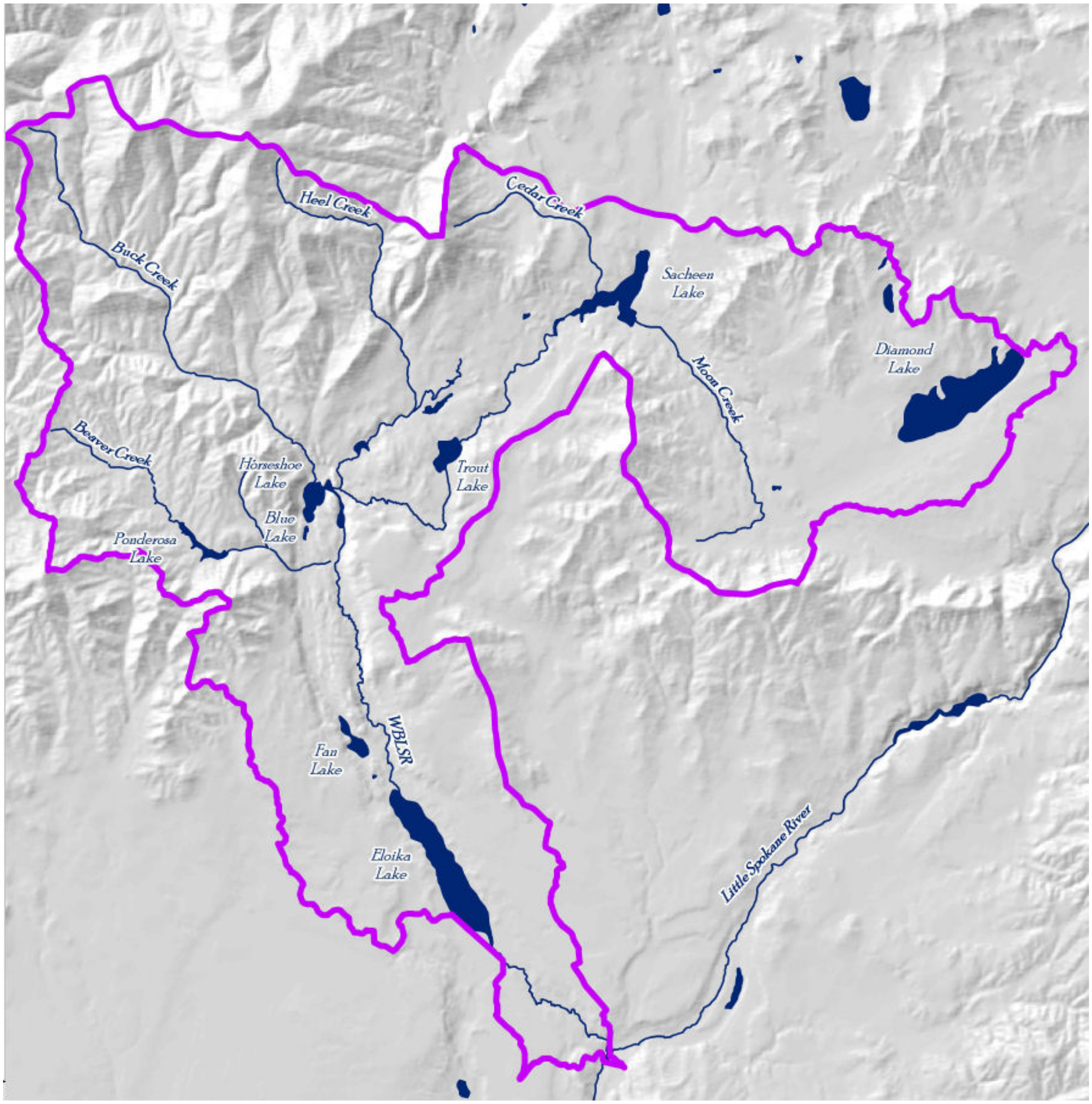

Figure 1-1. WBLSR Area of WRIA 55

A list of objectives for storage assessment was previously developed (Golder, 2004b) based on results of Watershed Planning work completed in WRIA 55 and conversations with Spokane County Utilities staff. These objectives were incorporated into the evaluation for this study and include:

- Offset potential impacts on streamflow from future water supply development under existing water rights;
- Offset potential impacts on streamflow from future water allocations (new water rights);
- Potential use of reclaimed water;
- Improve aquatic habitat through increased flows (examples include flows to facilitate aquatic organism passage and improve redd coverage) where flow is a potentially limiting factor; and
- Improve flow-related surface water quality problems.

1.3 Previous Investigations and Documents

Significant previous investigations and documents relevant to the evaluation of surface water storage options in WRIA 57 include:

- Water Storage Task Force Report (Washington Department of Ecology, 2001): This document addressed potential water storage alternatives and is intended to provide support to development of a watershed plan. Additional SEPA compliance (checklist or EIS) may be needed for implementation of specific projects. Alternatives specified included:
    - Alternative WP19: Construct and operate new on-channel storage facilities. Under this alternative, a water storage facility would be created by impounding a river or stream. On-channel storage facilities could include large reservoirs on the mainstem of major rivers as well as small reservoirs on tributary streams. Construction could involve creation of an earthen dam or a concrete dam.
    - Alternative WP 20: Raise and operate existing on-channel storage facilities. Under this alternative the capacity of an existing on-channel reservoir would be increased by raising or enlarging the impoundment structure.
    - Alternative WP 21: Construct and operate new off-channel storage facilities. Under this alternative, an impoundment structure, either earthen or concrete, would be created in an upland location. Water would be diverted or pumped from a river to an off-channel location for storage.
    - Alternative WP 22: Raise and operate existing off-channel storage facilities. Under this alternative the capacity of an existing off-channel reservoir would be increased by raising or enlarging the impoundment structure.
    - Alternative WP 23: Use existing storage facilities for additional beneficial uses. Operation of a storage facility constructed to provide water for one beneficial use or group of uses could be modified to provide water for additional beneficial uses. For example, use of a storage facility originally constructed for municipal water supply could be expanded to supply water for irrigation or to provide additional flows for fish during critical life stages.

- WRIA 55/57 Watershed Planning, Phase II – Level 1 Assessment (Golder, 2003). This document presents a preliminary assessment of existing information for WRIA 55 and 57. The information was used to describe the major characteristics of the watersheds and to identify data gaps. The Level 1 work was a precursor to the development of a hydrologic model under Level 2.

- Little Spokane River Basin (WRIA 55) Instream Flow Needs Assessment (Golder, 2003b). This study presents an evaluation of flow data and model flows designed to characterize flow conditions in the basin and provide recommendations for instream flow requirements.

- Final Storage Assessment, Little and Middle Spokane Watersheds (Golder, 2004b). This study included an appendix summarizing a preliminary evaluation of surface water storage options for both WRIA 55 and WRIA 57. The only surface water storage option reviewed in any detail for WRIA 57 was raising the dam at Newman Lake, which was ultimately eliminated in favor of wetland restoration at that location. This current evaluation follows a similar approach to that used by Golder in examining potential surface water storage options and contains some of the information presented by Golder for the Newman Lake option.

- Ground-Water Flow Model for the Spokane Valley-Rathdrum Prairie Aquifer (Hsieh et al, 2007). This investigation represents a culmination of several previous investigations of the Spokane Valley Rathdrum Prairie (SVRP) aquifer. The USGS, working with Washington and Idaho representatives, developed a groundwater flow model of the SVRP aquifer.

- Watershed Management Plan for WRIA 55/57 (Spokane County, 2006). This document was prepared by the Little Spokane River and Middle Spokane River Planning Unit under the lead of Spokane County. Two of the key recommendations relevant to this evaluation were to “Continue site identification and feasibility analysis for use of surface runoff storage in existing lakes as means of augmenting base flow in the Little Spokane Watershed (VI.A.02.a.)” and “Continue site identification and feasibility analysis for use of surface runoff storage in new artificial lakes or ponds as means of augmenting base flow in the Little Spokane Watershed. (VI.A.02.b).”

- Detailed Implementation Plan for WRIA 55/57 (WIT, 2008). This document provides specific actions and implementation details to address a variety of issues including strategies for river baseflow, reclamation and reuse, instream flow needs, and water rights and claims. Relative to this evaluation, the document specifies that “Spokane County will hire consultants to do two feasibility analyses of the use of surface runoff storage in 1) existing lakes (medium-high benefit to the watershed according to WIT) and 2) new reservoirs, manmade ponds, or wetlands as a means of augmenting base flow in the Middle Spokane Watershed (medium benefit to the watershed). The feasibility analyses will include an engineering analysis of the feasibility of surface water flow augmentation at one or more sites, a wetlands delineation and assessment, and an explanation of the legal issues, including water rights, and identification of all needed permits.”

2.0 POTENTIAL SURFACE WATER STORAGE OPPORTUNITIES

Potential surface water storage alternatives include on-channel and off-channel reservoirs, small impoundments, and wetlands. An evaluation of wetland options is currently in progress under a separate effort and is not included in this document.

On-channel reservoirs are situated on the main stem of a river or stream and are filled by the flow from an upstream watershed. Off-channel reservoirs are located completely off of stream channels and are filled by overland flow or pumped from a nearby source. Small impoundments in natural depressions, oxbows, or small surface ponds would need to be implemented on a basin-wide basis in order to provide the greatest benefit.

In the initial screening approach to evaluating potential surface water storage options Golder (2004b) eliminated a number of potential storage options. Subsequently they assessed the remainder using several criteria including topography, potential size, location of roads and railroads, geology, and potential continuity with the local aquifer. In addition Golder did not consider storage options that would provide less than 1,000 acre-feet (AF) of storage based on an evaluation of required storage. The total number of potential surface water storage options considered by Golder (2004b) for the WBLSR during preliminary screening is not clear. However, the only options evaluated in any detail were new dams at Buck Creek and Beaver Creek.

Potential surface water storage opportunities in the WBLSR are presented in this section. The opportunities discussed include a summary of information and conclusions from earlier investigations, along with additional information and input from various interested parties including the WIT and WBLSR Committee. Potential storage options are divided into the following categories:

- Existing Dams;
- Natural Lakes;
- New Dams; and
- Infiltration Using Existing Lakes or Depressions.

Other surface water storage alternatives that involve wetland or stream restoration are addressed in a separate document and are not provided here.

Water data presented below are in units of acre-feet (AF) or cubic feet per second (cfs). To put these units in perspective, 1,000 AF/yr of water equates to an annual flow of about 1.4 cfs, or 8.4 cfs for a 60 day period.

2.1 General Site Conditions

Key physical characteristics of WRIA 55 and 57 are described in previous investigations (Golder 2003a & b, Golder 2004a & b, Kahle and Bartolino 2007, and Hseih et al 2007) and many of the details presented in these studies are not repeated here. Some of the factors critical to understanding the feasibility of various surface water options evaluated below include geology, hydrology, and land use.

The West Branch of the Little Spokane River originates at the outlet of Sacheen Lake flowing through multiple wetlands into Trout Lake and Horseshoe Lake before it enters Eloika Lake. The WBLSR then exits the south end of Eloika Lake and converges 3.9 miles downstream with the Little Spokane River.

The geology of the study area is important in that it controls how effective surface water storage can be. A highly permeable subsurface will allow water to rapidly infiltrate and recharge the groundwater, while less permeable material will slow groundwater recharge and allow for a more controlled release of stored water, increasing the chances for improving summer flows. A general geologic map of the area is shown on **Figure 2-1.** The geologic map and cross-section show that southern portions of the area are mostly underlain by alluvium and coarse flood deposits, while northern portions of the area are marked by less permeable crystalline basement rock. The latter setting is more conducive to surface water storage efforts because leakage into the subsurface at these locations would be slower.

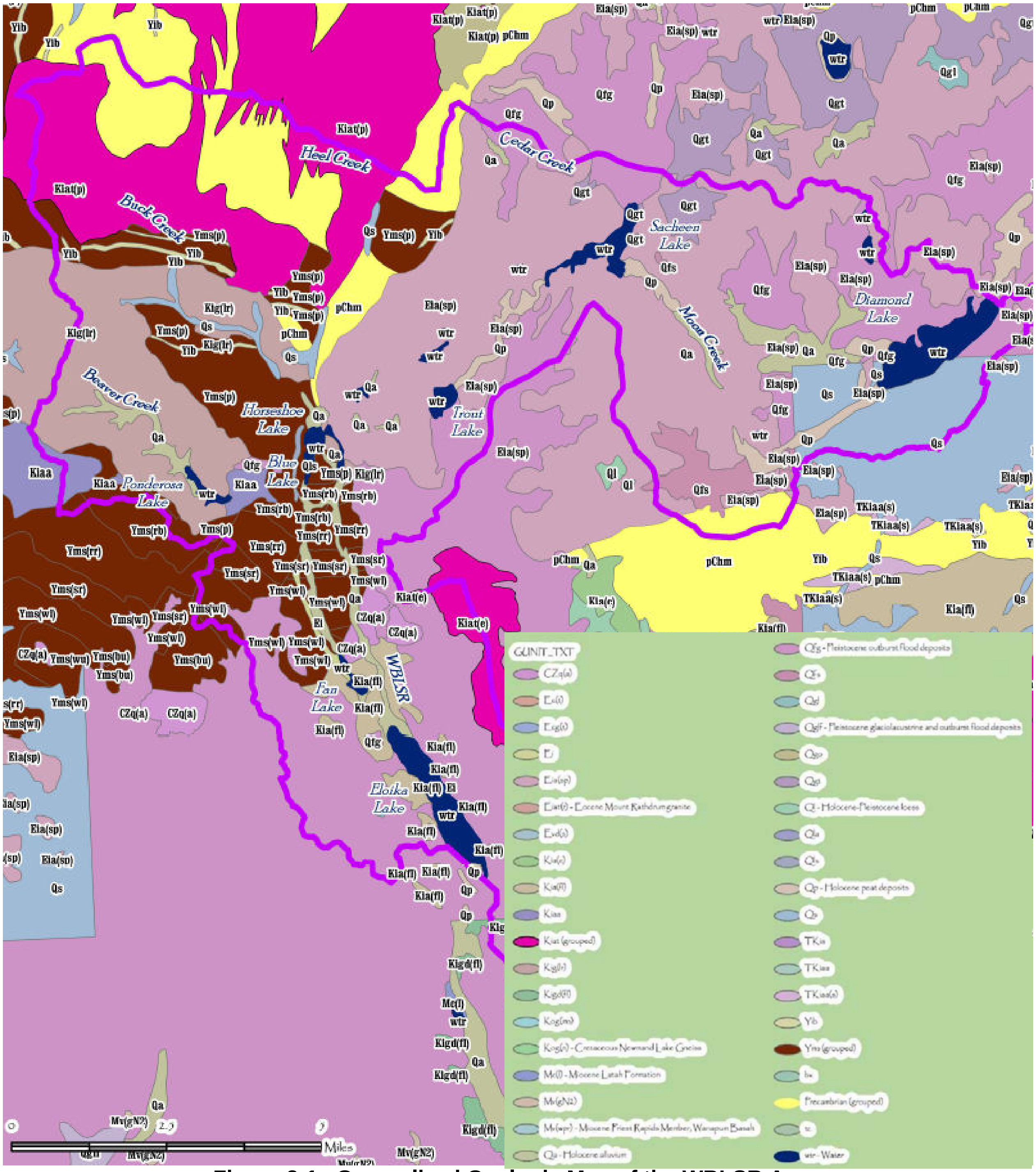

Figure 2-1. Generalized Geologic Map of the WBLSR Area

A large amount of flow data exists for the Little Spokane River, with the key gaging station of interest for this study located at Chattaroy Road, below the confluence of the Little Spokane River and the West Branch Little Spokane River (**Figure 2-2**). Minimum instream flows at Chattaroy are specified at 57-165 cfs. It has been estimated that an additional 1,721-4,751 AF of water is needed for the Little Spokane River to offset future uses (Golder, 2004a). An instream flow study of minimum instream flow excursions at the Chattaroy station and three others on the Little Spokane River (Golder 2003b) found that the average excursion ranges from 12-22 days. Additional findings for the Chattaroy station data include:

- This station has the highest percent of below minimum instream flow levels with more than 42% of dry season flows below these levels; and
- The Chattaroy station also had the longest excursion length which lasted 262 days.

Flow data for other streams in the WBLSR area is limited with no continuous gaging stations or data available. Periodic measurements are available for Beaver and Buck Creeks for the period 1986-1990. These measurements were used to develop simulated hydrographs (Golder, 2003a) near potential dam sites on the two creeks, which are reproduced on **Figure 2-3**. The predicted mean annual flow of Beaver Creek is 2,200 AF/yr, and of Buck Creek is 10,806 AF/yr.

Measured flows are also available from Ecology for the WBLSR near the mouth of Beaver Creek for late spring and summer months for the period 1986-1990. These flows were discussed in relation to Beaver Creek flows (Golder 2004b) and it was determined that Beaver Creek flows were 2-12% of the WBLSR flows with an average of 5%.

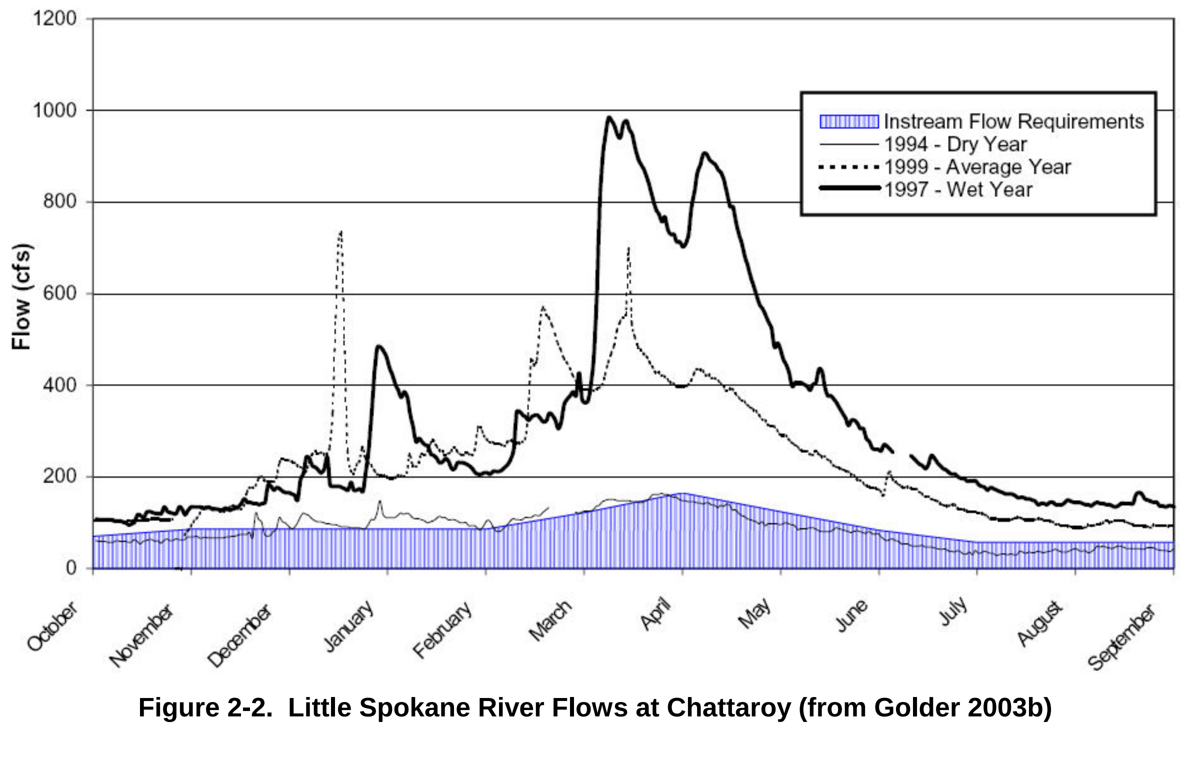

Figure 2-2. Little Spokane River Flows at Chattaroy (from Golder 2003b)

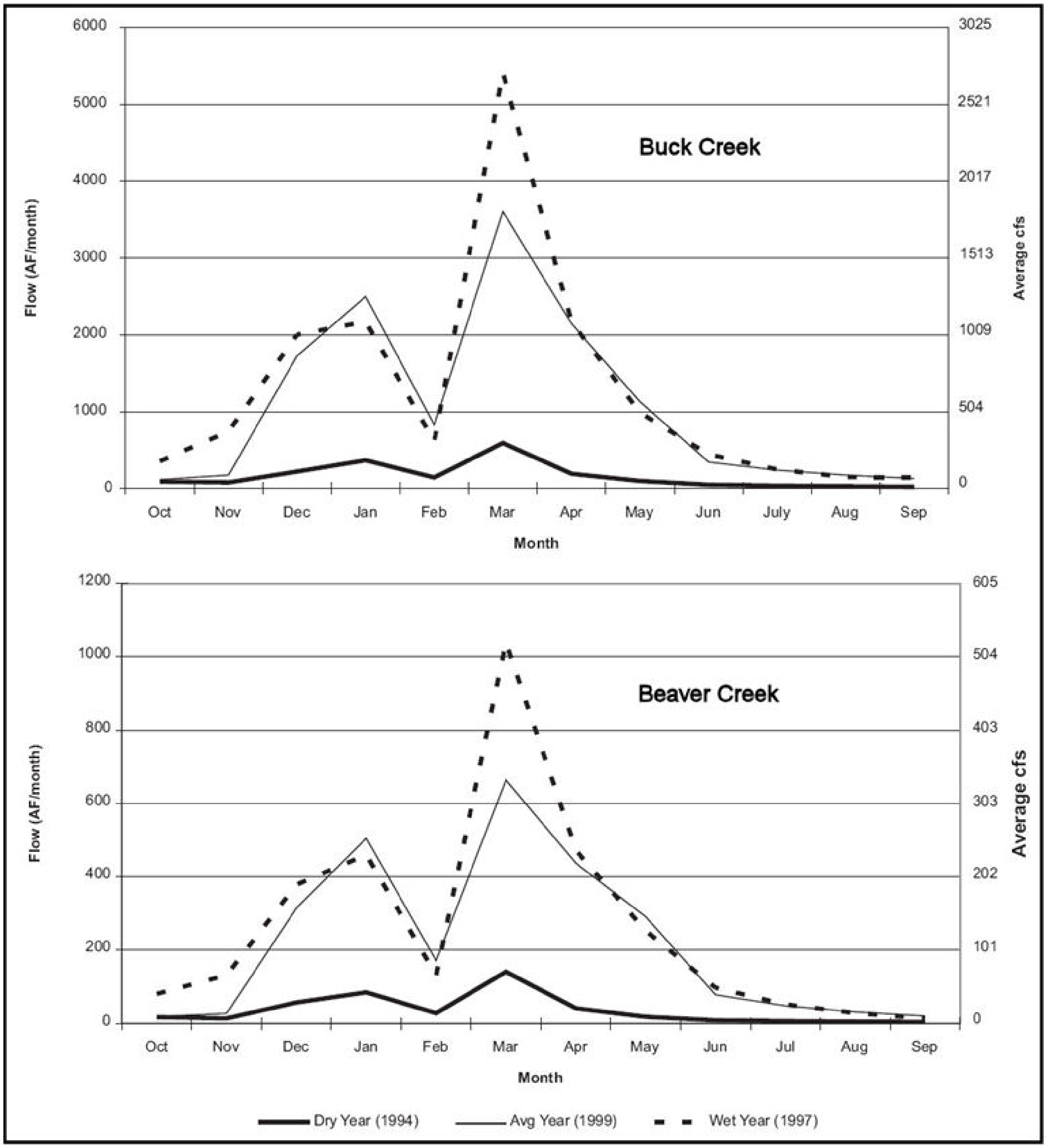

Figure 2-3. Buck Creek and Beaver Creek Simulated Flows 1994-1999 (from Golder 2003b)

In the last few years the Spokane County Conservation District (SCCD) reportedly reestablished gages in the WBLSR previously operated by Washington State University (WBLSR, 2007). These gages are located on Moon Creek, Fan Lake, above Eloika Lake and below Eloika Lake. In addition, the SCCD planned to install new gages at the Sacheen Lake outlet and gages to measure lake level at Sacheen Lake and Eloika Lake. These data were not gathered for this study.

Land use in the study area is illustrated on **Figure 2-4**. The dominant land use in the WBLSR is classified as forest land and much of the area is undeveloped. Agricultural areas increase to the south and around many of the lakes. The minimal amount of development in the area is favorable to the creation of surface water storage opportunities. However the lack of overall development may be misleading because surface water storage opportunities will concentrate along existing drainages and those are the areas where population and land use issues can complicate efforts to store water in the watershed.

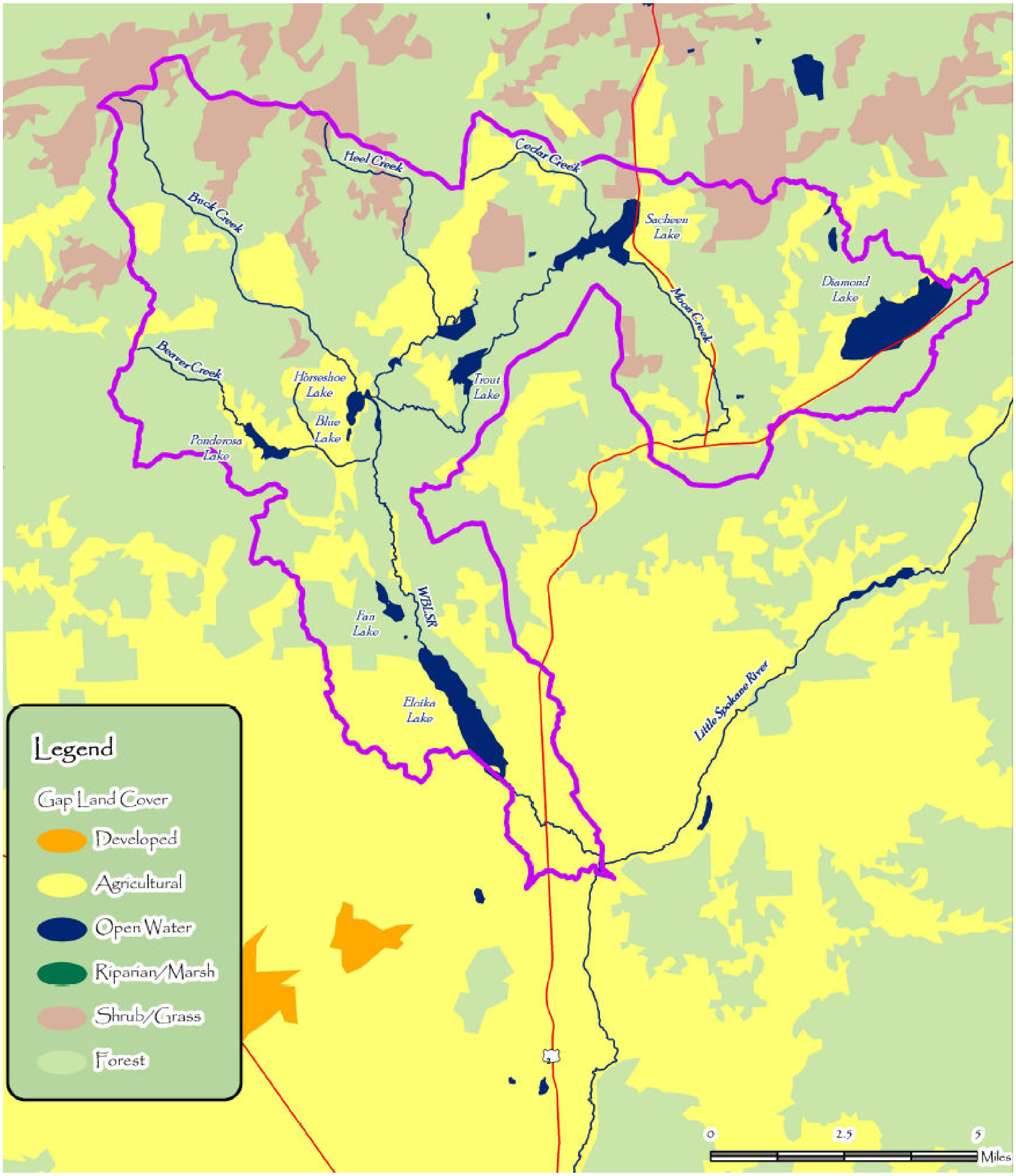

Figure 2-4. Land Use Map of the WBLSR Area

2.2 Existing Dams

There are eight existing dams in the WBLSR area that were identified by Golder (2004b). A summary of the information available for the dams is presented in **Table 2-1** and the locations are shown on **Figure 2-5**. Seven of the existing dams were removed from consideration for further evaluation of storage expansion for the following reasons:

- Three of the dams were being used for water quality treatment (Diamond Lake Aeration Lagoon No.1, Diamond Lake Aeration Lagoon No.2, and Ponderay Newsprint Mill Settling Lagoon);
- Two of the dams had less than 1,000 AF of potential storage (Homestead Lake Dam, Koenig Dam); and
- Two of the dams could not be located on a topographic map (Kettwig Wildlife Dam, Little Spokane River Dam).

An attempt was not made to locate the two dams Golder could not find. Based on a map because based on the existing information it is likely they would not have the potential to store greater than 1,000 AF of water.

The Ponderosa Lake dam was retained for further study by Golder. An evaluation suggested that it could be feasible to increase storage by 2,090-6,630 AF by raising the dam height. However, as the study progressed the owner indicated that he was not willing to raise the dam or allow the lake level to fluctuate more than 3 feet which equates to approximately 200 AF of storage (Golder, 2004b). He did indicate he would be willing to allow construction of a dam upstream on Beaver Creek and this option is discussed further below in **Section 2.4**.

This information was presented to the WIT and WBLSR Committee and discussed. These groups did not feel that looking any further into the potential of using existing dams to increase surface water storage was warranted.

Table 2-1. Summary of Dam Information

Name	Fed ID	Stream	Owner Name	Owner Type	Dam Type	Purpose	Date Built	Length (ft)	Height (ft)	Storage (AF) Max	Storage (AF) Normal	Drainage Area (mi2)	Reason removed
Diamond Lake Aeration Lagoon No. 1	WA01632	Tr LSR-offstream	Diamond Lake Sewer District	Private	Earth	Water Quality	1988	500	12	12	10	0	Wastewater treatment
Diamond Lake Aeration Lagoon No. 2	WA00568	Tr LSR-offstream	Diamond Lake Sewer District	Private	Earth	Water Quality	1987	800	16	61	51	0	Wastewater treatment
Homestead Lake Dam	WA00035	Tr Moon Creek	NA	Private	Earth	Recreation	1971	420	18	52	30	0	no room for expansion, <1000 AF
Kettwig Wildlife Dam	WA00385	Spring Heel Creek	Kettwig, D.R.	Private	Earth	Recreation	1979	550	13	180	100	2	unable to locate on USGS topo map
Koenig Dam	WA01014	Tr-Otter Creek	NA	Private	Earth	Recreation	1968	80	12	35	15	0	<1000 AF of new storage
Little Spokane River Dam	WA01293	WBLSR	WA Dept of Wildlife	State	Earth	Recreation	1960	290	8	35	20	0	unable to locate on USGS topo map
Ponderay Newsprint Mill Settling Lagoon	WA00598	Pend Orielle River-offstream	Ponderay Newsprint	Private	Earth	Water Quality	1989	2250	24	105	82	0	Wastewater treatment
Ponderosa Lake Dam	WA00041	Beaver Creek	Baker, Kedric	Private	Earth	Recreation	1969	412	55	710	357	8	Owner refuses permission

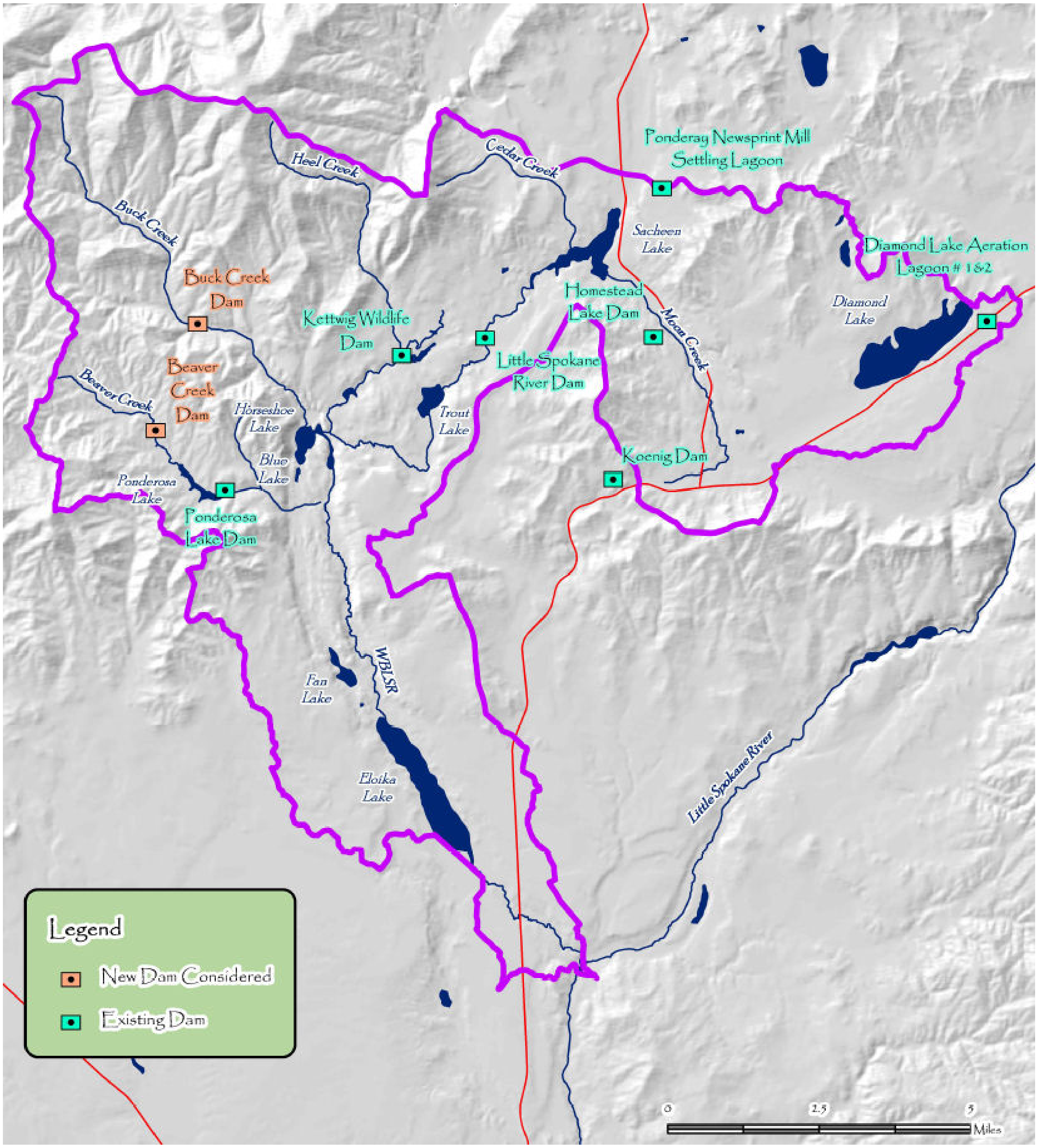

Figure 2-5. Existing Dams in WBLSR Area of WRIA 55

2.3 Natural Lakes

The potential expansion of natural lakes in the WBLSR is discussed below. The majority of these options were briefly considered previously (Golder, 2004b). The previous conclusions were reevaluated based on new information that could be gathered and on information and input from the WIT and WBLSR Committee.

2.3.1 Diamond Lake

Diamond Lake is located in the northeast edge of the WBLSR area (**Figure 1-1** and **Figure 2-6**). The previous investigation into surface water storage opportunities (Golder, 2004b) eliminated Diamond Lake from further consideration in large part due to extensive development around the lake.

Based upon presentations and input from the WIT and WBLSR Committee it was decided further evaluation of the potential to increase surface water storage in Diamond Lake was not warranted. In addition to the development issue, the watershed feeding into the lake is relatively small and may not be capable of supporting increased storage strategies.

However, there are a number of areas around Diamond Lake, shown on **Figure 2-6**, that have potential to increase storage in the WBLSR through wetland restoration. This potential is being evaluated under a separate study.

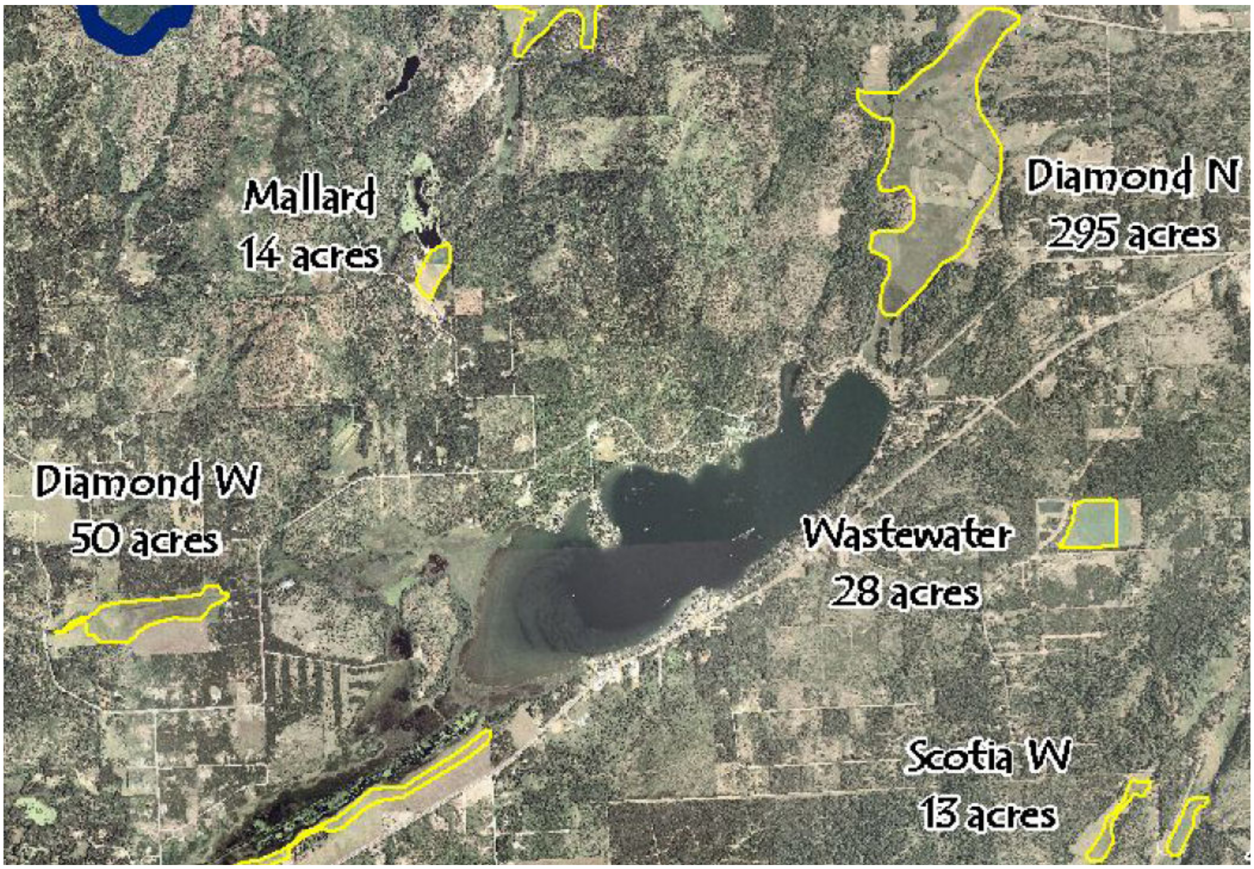

Figure 2-6. Diamond Lake

2.3.2 Sacheen Lake

Sacheen Lake is located in the northern portion of the WBLSR (**Figure 1-1** and **Figure 2-7**). This lake was eliminated from consideration for surface water storage increase during the Golder evaluation (2004b) because of existing development around the lake.

Residents in the Sacheen Lake area have experienced frequent flooding problems associated with beaver dams near the lake outlet. These dams provide a glimpse of what higher lake levels resulting from surface water storage increase strategies would look like. Current efforts in the area entail maintaining the beaver dams to keep the lake level low, so raising it to increase storage does not appear to be desirable.

Like the situation at Diamond Lake, however, there may be some potential ways to increase storage in the area through wetland restoration. Some of the potential wetland sites are shown on **Figure 2-7**.

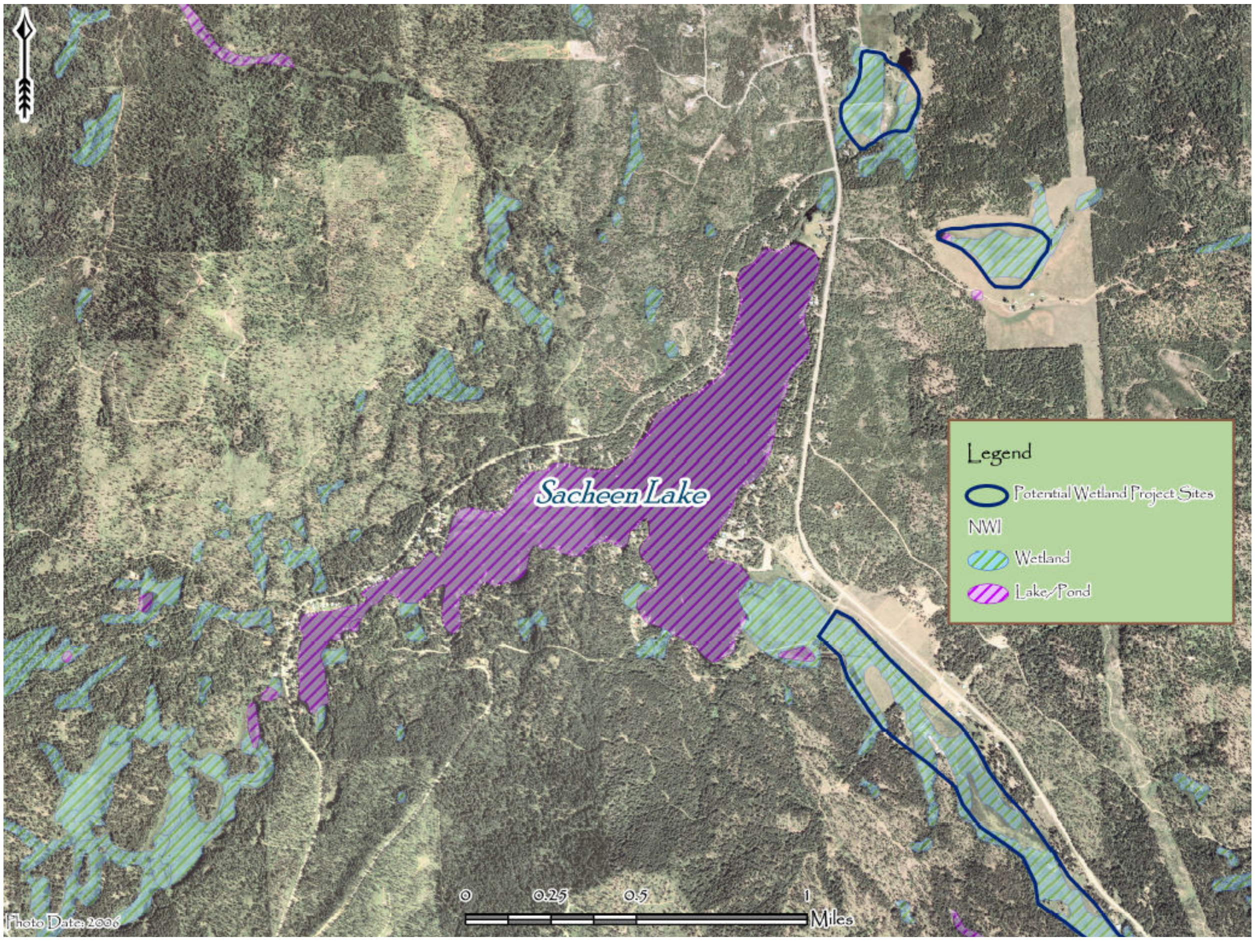

Figure 2-7. Sacheen Lake

2.3.3 Trout Lake

Downstream from Sacheen Lake is Trout Lake (**Figure 1-1** and **Figure 2-8**) which occupies and area of roughly 100 acres. Previous analyses (Golder, 2004b) indicated this location provides a potential additional storage of 3,831-12,489 AF, but the evaluation of the topography suggested that raising the lake level would back water up into Spring Heel Creek towards Sacheen Lake. Ultimately this option was also removed from consideration in the previous investigation because of reported existing development and negative public response.

Trout Lake is surrounded by a single land owner. A discussion with the land owner indicated he might be open to looking at storage options at the lake. One thought was to excavate areas around the lake, which would increase lake storage, but any additional storage that is below the elevation of the outlet would be unavailable for downstream benefit.

An alternative option for the lake may be to install an outlet control structure, or convert existing culverts to that purpose. The control structure could be designed to either increase the current maximum lake level or to manage the seasonal fluctuations such that spring high levels are maintained longer in the season in order to release more water in summer. Current lake levels fluctuate a couple of feet and the owner could be amenable to having a lake level a couple feet higher than the natural maximum, so the maximum water volume for downstream flow purposes would only amount to about 400 AF. Additional discussions with the owner would be necessary if this option were to be pursued, but it appears that this type of control may be more effective downstream at Eloika Lake as discussed below.

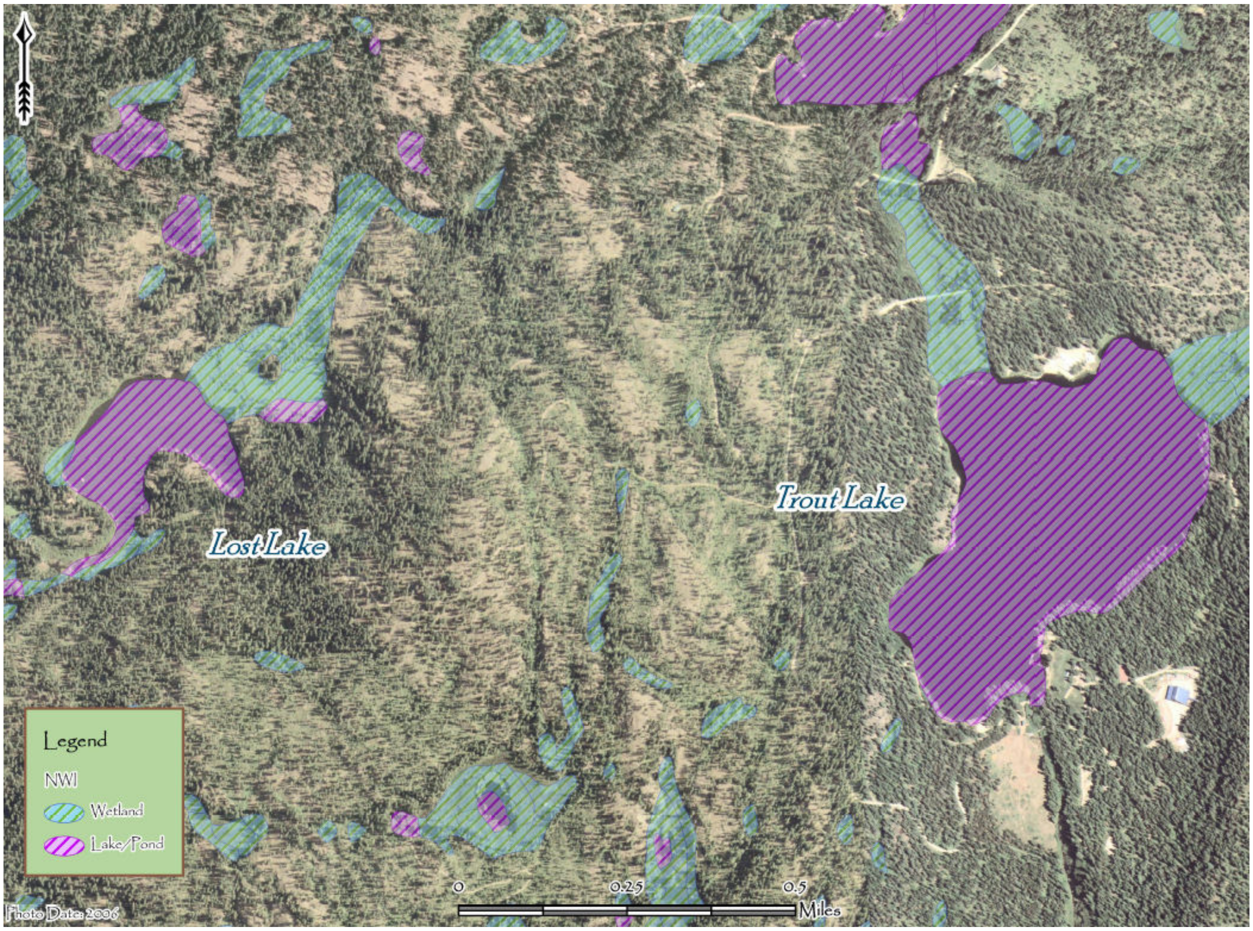

Figure 2-8. Trout Lake

2.3.4 Horseshoe Lake and Blue Lake

Horseshoe Lake lies at the confluence of Buck Creek, Spring Heel Creek, and the WBLSR (**Figure 1-1** and **Figure 2-9**). As its name implies the lake is a downward horseshoe shaped lake with the eastern end being the primary channel and the western end being a marshy channel. To the south of Horseshoe Lake lies Blue Lake which sits higher in elevation. The potential for increasing water storage had been previously considered for Horseshoe Lake but not for Blue Lake.

An evaluation of storage options for Horseshoe Lake indicated a potential additional storage of 14,660-45,880 AF was possible (Golder 2004b). Flow in the WBLSR was considered to be great enough to support a large storage volume. However, drawbacks ultimately led to this option being discarded. Some of the drawbacks were that a diversion conveyance would likely be needed, the marshy ground surface might not support a structure or increase leakage, and most critically, negative public response to additional storage on the WBLSR was cited. In addition to these considerations, increasing storage at Horseshoe Lake would also flood areas currently mapped as wetland (**Figure 2-9**).

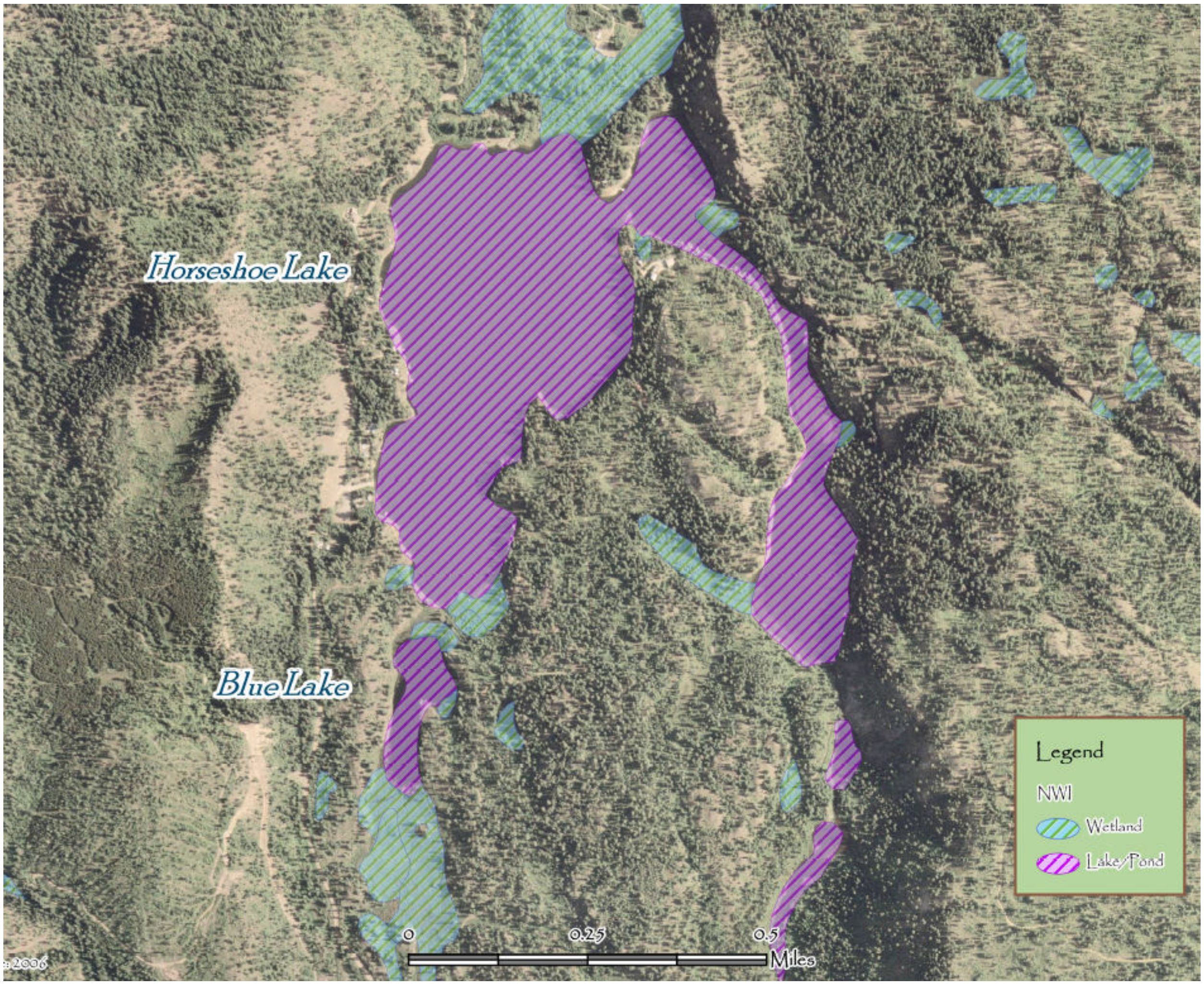

Figure 2-9. Horseshoe Lake and Blue Lake

The option for increasing storage at Horseshoe Lake was discussed in meetings with the WIT and WBLSR Committee and it was not considered to be worth pursuing. The potential for increasing storage at Blue Lake was discussed at these meetings and was considered a possibility due to little development in the area and the fact that surrounding land is mostly state owned. However, upon further review this option was discarded because the amount of additional storage would be small. Other complications are that an outlet control structure would be needed, the access road for owners would need to be rerouted, and as the lake size increased to the south existing wetlands would be flooded and southward discharge could develop as lake elevations rose.

2.3.5 Fan Lake and Eloika Lake

Fan Lake and Eloika Lake lie in the southern portion of the WBLSR area (**Figure 1-1** and **Figure 2-10**), downstream of the other lakes. Potential wetland restoration sites are also shown on **Figure 2-10** and are addressed in a separate study. Fan Lake was eliminated from consideration during the previous water storage investigation (Golder, 2004b) because the proximity of Eloika Lake limits the amount of expansion of the lake. This conclusion remains valid so no further evaluations were completed for Fan Lake. Eloika Lake was also dismissed because of extensive development around the lake. However, based on interest from WBLSR members, a reevaluation of the potential for increasing surface water storage at Eloika Lake was conducted.

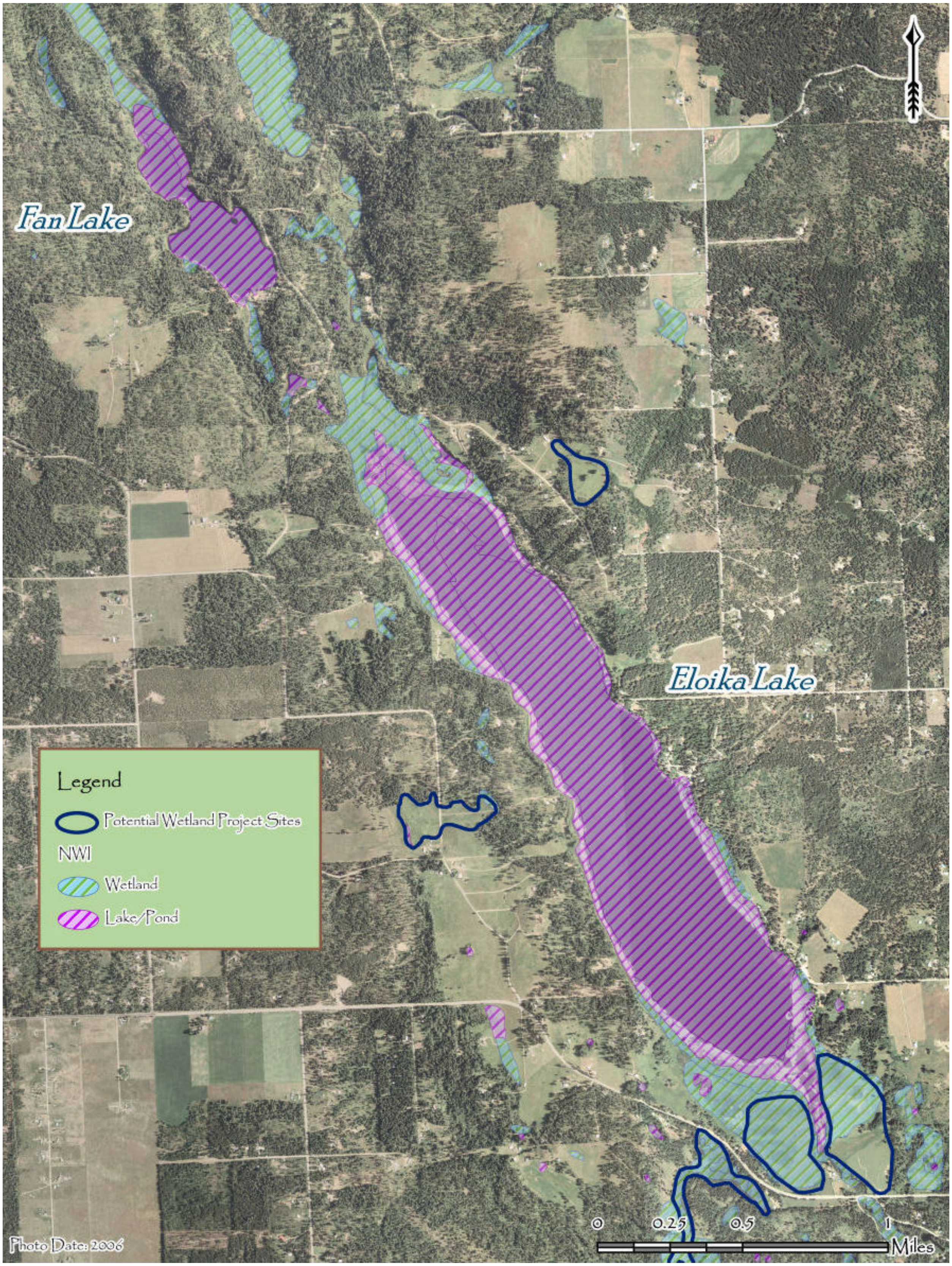

Figure 2-10. Fan Lake and Eloika Lake

In 1952 the lake level was lowered by landowners by deepening the outlet. This event was later ruled to be illegal and an order was issued to restore the lake to its original level. One attempt was made by landowners to address this but the dam was poorly constructed and washed out after the first year. No attempts have been made since that time to restore the lake level.

In the 1990's a number of investigations were completed that addressed Eloika Lake issues. The main concern was a deterioration of water quality in the lake. The investigations culminated in the design of an outlet control structure (USDA, 1997) that would be used to maintain the springtime high lake level later in the year. This control structure was never constructed, apparently largely due to a lack of funding.

The control structure as designed would not raise the lake level, but instead keep it at the current high levels of 1907 ft MSL that occur in the spring for a longer period of time. This equates to a volume of roughly 2,000-4,000 AF of water that would be available for downstream flows. For illustration, 1,000 AF would provide 8.4 cfs for a period of 60 days.

The Eloika Lake Association (ELA), a local homeowner's organization, is currently collecting information on the impact of various lake levels on surrounding property, with the goal of determining an optimal maximum level. Members of the ELA are very supportive of an outlet control structure strategy.

In addition to local support and the information from the previous investigations a control structure in this location appears to be ideal. Because this is the last of a series of lakes, controlling discharge here makes the most sense, and previous studies have concluded that maintaining lake levels later in the year would likely improve water quality issues.

Based on our evaluation and input from the WIT, WBLSR Committee, and Eloika Lake Association (ELA) we conclude that an in-depth evaluation of Eloika Lake is warranted. This recommendation has been accepted by the WBLSR Committee.

2.4 New Dams

Two potential new dam sites were previously evaluated in detail by Golder (2004b). The site include one on Buck Creek in the northwest portion of the basin and one on Beaver Creek upstream of the Ponderosa Lake dam (**Figure 2-5** and **Figure 2-11**). The previous detailed evaluation concluded that the Buck Creek dam could provide up to 4,750 AF of storage, and the Beaver Creek Dam would provide 1,175-1,932 AF of storage. A number of potential impediments to constructing these dams was also presented in that study, most notable of which were the high cost, potential permitting and dam safety issues (due to downstream population), and property issues due to flooding of existing landowners.

To our knowledge, no further evaluation of these potential dams has been done since the 2004 study. These options were discussed during meetings with the WIT and WBLSR Committee and there clearly is no interest at this time to look into these any further so no additional evaluations were completed for this study.

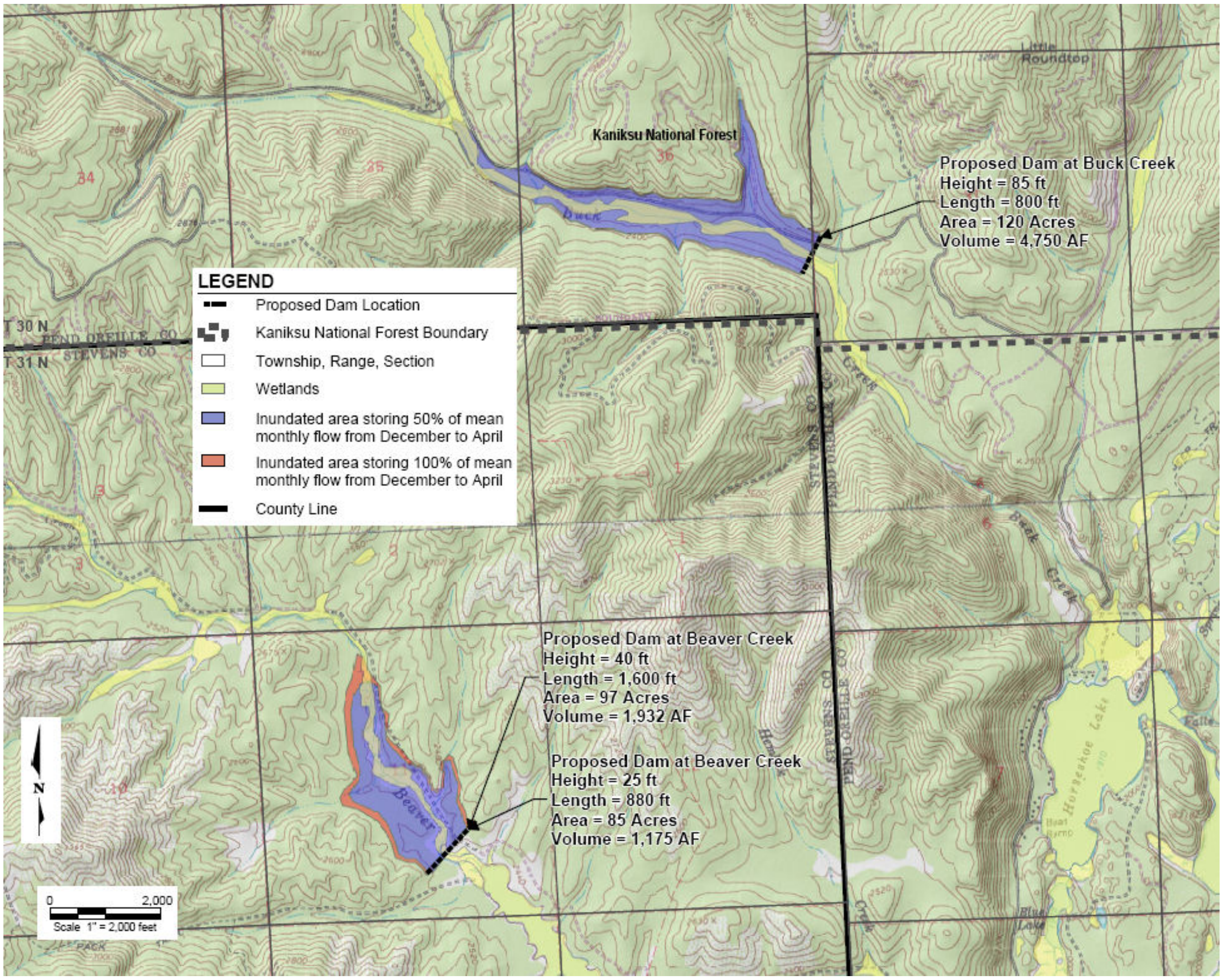

Figure 2-11. Potential Dam Sites on Beaver and Buck Creeks (from Golder, 2004b)

2.5 Infiltration Using Existing Lakes or Depressions

Potential storage options included in this category would generally involve transferring water from an existing location, such as a lake into a created reservoir or existing depression to allow infiltration into the groundwater. In areas underlain by coarse material the infiltration would be relatively rapid and unless the areas of recharge were placed some distance from surface water there would be little delay between the timing of infiltration and recharge to surface water. In the northern portion of the basin where finer grain basement rock underlies the surface, infiltration would be slower and this could be a viable area for delayed infiltration.

The major downside to this approach is that in order to create significant storage either a number of small locations would be needed or large reservoirs would need to be constructed. An illustration of this comes from the previous investigation by Golder (2004b) that considered the potential of using inactive gravel pits for infiltration sites.

The location of existing gravel pits in the WBLSR area identified by Golder (2004b) is shown on **Figure 2-12**. The inactive gravel pits identified include the following:

- Pend Oreille Public Works Pit: This pit commonly known as Fertile Valley 3003 (Permit No. 10119) is located in T30N R43E Section 3 in Pend Oreille County just north of Trout Lake. The area of the pit is listed as 4.21 acres;

- Eloika Lake Dept of Transportation: This pit (#12188) also known as PS-C-52 is the only inactive pit of the six shown for the Eloika lake area. Pit area is listed as 13 acres; and
- Deer Park Gravel Pit: This pit commonly known as Boggs Pit (Permit No. 12213) is located in T30N R42E Section 36 in Stevens County to the northwest of Eloika Lake. The area of the pit is listed as 30 acres.

Clearly the number of pits are too few and the size too small to make this a viable infiltration option. In addition, the coarse grained nature of gravel pits indicates that infiltration would need to be slowed, potentially by lining. With input from the WIT and WBLSR Committee, no further evaluation of potential infiltration options in the WBLSR was conducted.

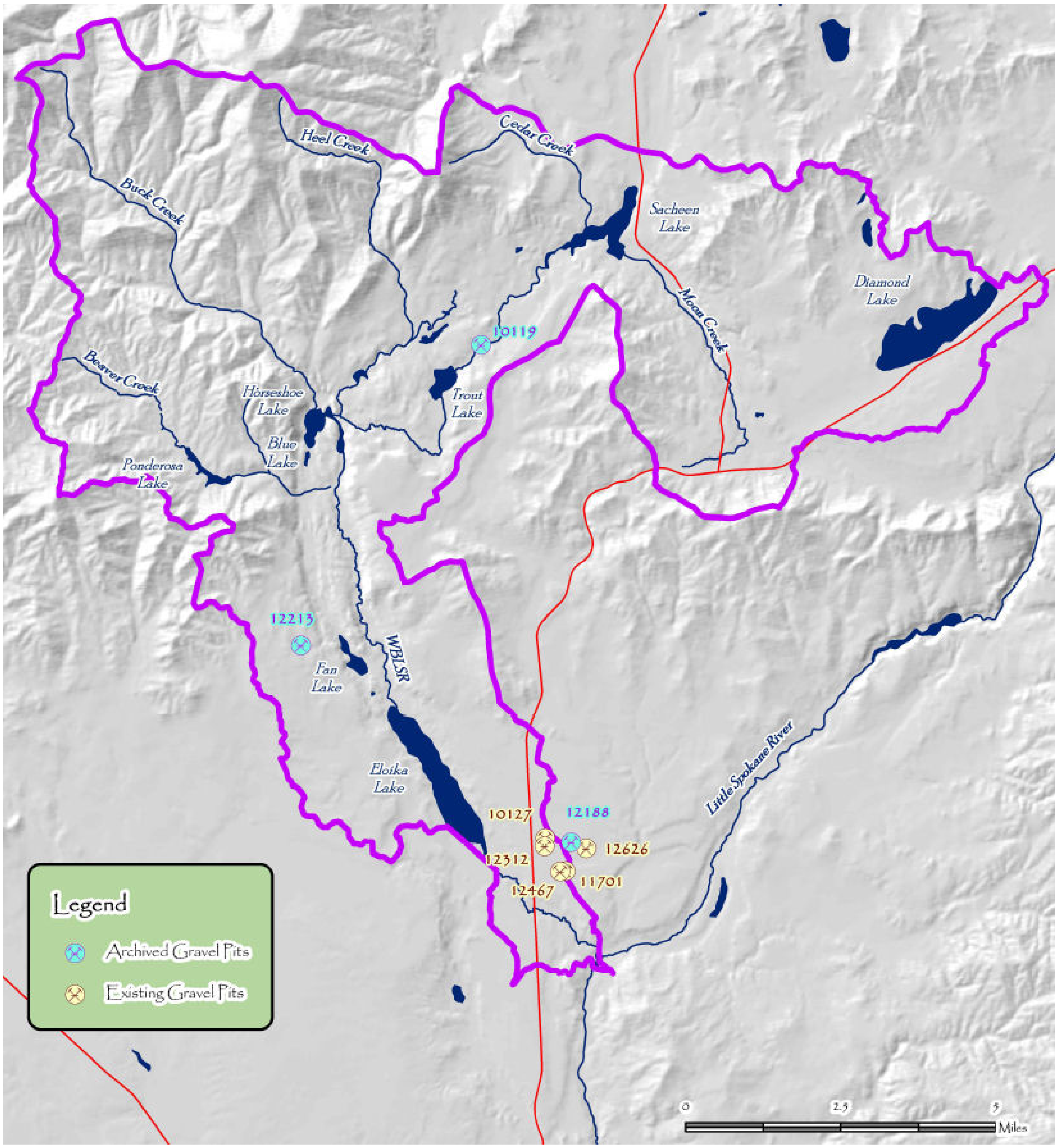

Figure 2-12. Gravel Pit Locations

3.0 CONCLUSIONS AND RECOMMENDATIONS

A number of potential options have been evaluated for increasing surface water storage in the West Branch Little Spokane River (WBLSR) area. The goal of the storage opportunities is to improve streamflow and streamflow related water quality and habitat conditions.

Potential storage options that were evaluated fall into four groups:

- Existing Dams;
- Natural Lakes;
- New Dams; and
- Infiltration Using Existing Lakes or Depressions.

Revising existing dams to increase storage in the WBLSR is not feasible as the existing dams are either used for water quality treatment or are too small and would not appreciably increase water storage. New dams were not evaluated in great detail but two sites that were previously evaluated were discussed with interested parties and it was concluded the current attitude is that these are not options of interest at this time. Infiltration using existing lakes or depressions would require multiple sites to be effective due to the small size of any one option, which makes this an inefficient and unattractive option.

Despite the number of lakes in the WBLSR, increasing storage in natural lakes is limited by the fact that most lakes have various degrees of development along the shore. This creates a problem for the landowners if lake levels rise. Existing development are the main reasons that Diamond Lake and Sacheen Lake are not considered viable opportunities for increased storage. Horseshoe Lake is not considered viable in part because marshy ground warns of potential complications with any control structure, and Blue Lake and fan Lake are too small. Trout Lake may have some potential for increased storage but Eloika Lake to the south presents the best opportunity of all.

Eloika Lake lies at the downstream end of the string of lakes in the WBLSR. The lake was historically higher and there is a legal basis for restoring the lake to its original level. Extensive studies have been completed, including an actual design for an outlet control structure which would not increase the maximum lake level but instead provide a mechanism to hold water in the lake later in the year for release during low flow summer months. This potential project has the support of key interested parties including the WIT, WBLSR Committee, and Eloika Lake Association.

In addition to the surface water storage opportunities summarized above, there are a number of potential wetland restoration possibilities in the WBLSR that would also serve to increase surface water storage. Some of these have been noted in this document, but are being evaluated in greater detail under a separate study.

Our recommendation for the WBLSR surface water storage investigation is as follows:

- Conduct an In-Depth evaluation of the opportunity at Eloika Lake. This in-depth study would consider the viability of the existing outlet structure design, alternative approaches and desirable maximum and minimum lake levels, potential impediments including landowner and long-term maintenance issues, and potential funding sources. These would be summarized and steps necessary to reach implementation would be outlined; and

- Conduct in-depth evaluations of selected wetland opportunities in the WBLSR. Details and recommendations regarding these specific wetland projects are included in a companion report to this document.

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