Guiding Growth – Healthy Watersheds: Black Lake Basin Water Resource Protection Study

thurston regional planning council

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Guiding Growth – Healthy Watersheds

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1. Introduction

Overview: Guiding Growth – Healthy Watersheds

Black Lake and the land that drains into it was one of three Thurston County basins identified for a focused study as part of the *Guiding Growth – Healthy Watersheds* program. Thurston County is located at the southern end of Puget Sound, and boasts a wealth of natural resources, including large forested areas and many streams and water bodies. In part, we owe our relatively good water quality to the fact that the county is less developed than other urbanized areas in the Puget Sound region. Thurston County is also home to the state capitol and the metropolitan area surrounding the cities of Olympia, Lacey, and Tumwater. It is one of the fastest growing counties in Washington State. According to the 2013 population forecast developed by Thurston Regional Planning Council (TRPC), we can expect an additional 110,000 people to move into our region over the next 20 years.

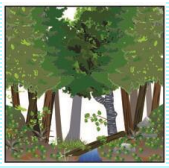
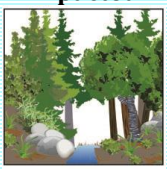
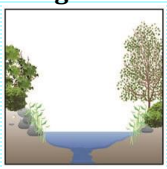
This growth will bring many benefits to the economy and residents of Thurston County, yet there are downsides to such a rapid increase in population and the demand for new homes, roads, and services that it entails. Development in sensitive areas can damage or disrupt important ecosystem services provided by our watersheds, including the filtering and purification of water, regulation of water flows, protection from floods, and creation of habitat for plants and animals. Careless development in these areas could lead to lakes, streams, and beaches that are unhealthy and unusable for both people and wildlife. One response is to plan for this growth by identifying ecologically important areas at a landscape scale, and considering how development can occur in a way that preserves the ecosystem services that are important within specific watersheds.

Project Background

Thurston County teamed with TRPC and the cities of Olympia, Tumwater, and Lacey to integrate watershed science into local policies. The aim of the study was to investigate ways to accommodate projected population growth while preserving water resources in areas impacted by that growth. This collaborative effort is funded by a grant from the U.S. Environmental Protection Agency, as part of that agency's efforts to protect and restore water quality in Puget Sound. The project initially focused on areas within the Totten, Eld, Budd/Deschutes, Henderson, and Nisqually Reach watersheds (Map 1). The watershed planning process began in 2010 and includes the following stages, several of which are detailed in accompanying documents:

Evaluating Current Basin Conditions

In Phase One of this project, stream basins within the Totten, Eld, Budd/Deschutes, Henderson, and Nisqually Reach watersheds were categorized by their current conditions:

Intact 	*Intact basins have little to no impervious surfaces (<2% basin-wide), a nearly complete forest canopy (>80% basin-wide), and vegetated riparian corridors (>90%). Water bodies are in excellent condition, with no water quality violations and a high B-IBI score (>41).*
Sensitive 	*Sensitive basins have minimal impervious area (2-10% basin-wide), considerable forest cover (65-80% basin-wide), and riparian corridors with few breaks in protective buffers (75-90% vegetated). Water bodies are in good condition, meeting most water quality standards, and have a high B-IBI score (36-41).*
Impacted 	*Impacted basins are moderately urbanized (10-25% total impervious area), with some remaining forest cover (45-65%). Riparian corridors are cleared in many places (only 60-75% vegetated) and water quality is fair, with some impairments and lower B-IBI scores (28-35).*
Degraded 	*Degraded basins are urbanized (25-40% total impervious area) with limited remaining forest canopy (30-45%) or vegetated riparian areas (30-60%). Water quality is poor, with multiple impairments and very low B-IBI scores (28-35).*
Highly Degraded 	*Highly degraded stream basins generally have poor water quality and support a low diversity of aquatic species. Impervious cover is generally over 40% and forest cover is generally less than 30%. No Thurston County stream basins fall into this category.*

Project Stages

1. Evaluate basins based on current conditions and impacts from future growth. The results of this evaluation are detailed in a separate report, *Basin Evaluation and Management Strategies for Thurston County* (TRPC 2013). This report reviews recent research about the impacts of urbanization on water quality and watershed health and provides an assessment of the current condition of 69 basins within Thurston County that drain to Puget Sound, classifying each as intact, sensitive, impacted, or degraded (see sidebar). This assessment was based on monitoring and land cover data as well as a characterization of watershed processes. It also details the potential impacts of future growth on each of those basins, using projections of impervious surfaces and loss of forest lands.
2. Select three at-risk basins for detailed study. Based on the results of the basin evaluation and the availability of sufficient data for hydrologic modeling, the project team recommended three key basins for further attention: McLane Creek basin, Black Lake basin, and Woodard Creek basin. Section 2 of this report includes a narrative depiction of the current conditions, threats, and management goals for Black Lake basin.
3. Analyze future land-use scenarios. Section 3 of this report includes a description of the scenarios developed and a summary of the results of the hydrologic modeling. A more detailed account of the modeling methodology and results is included in a separate report, *Hydrologic Modeling in Support of Watershed Based Land Use Planning in Thurston County* (NHC 2014).
4. Develop recommended changes to management policies. Section 4 of this report

includes a set of recommended policy changes for the Black Lake basin, based on the results of the modeling work and land use analysis.

5. Adopt and implement changes to land use practices. Although this report recommends a preferred management approach and Section 5 includes suggested next steps for making the identified policy changes, each local jurisdiction will determine how best to apply the results in their communities using their own public process. The long-term success of this effort depends on continued regional coordination as well as public outreach and support.
6. Monitoring/Adaptive management. The effectiveness of the policies developed and implemented through this project will be evaluated in future phases of this study.

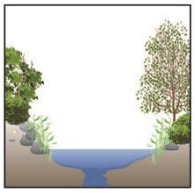
Project Goals

The *Guiding Growth – Healthy Watersheds* project was begun with the understanding that preventing damage to our watersheds is less expensive and often more effective than paying to restore natural forest cover and stream flow conditions after they have been extensively altered. Rather than focus on restoring the most degraded areas, the focus of this project is to prevent basins that are categorized as "intact" or "sensitive" from becoming "impacted," and to prevent basins that are categorized as "impacted" from becoming "degraded." The approach taken by the project team has been to look at landscape patterns from a basin-scale and determine the goals and policies that make sense based on the current conditions and future potential of that basin (Table 1).

The strategies identified for achieving these goals include:

- Focusing new development in existing urban areas
- Guiding growth away from identified sensitive or critical habitats
- Reducing the impacts of growth through low impact development and stormwater regulations

TABLE 1: SUMMARY OF MANAGEMENT GOALS BASED ON EXISTING BASIN CONDITIONS.

	Basin and In-Stream Current Conditions		
	Sensitive	**Impacted**	**Degraded**
Management Goals:			
Basin-wide Conditions to support properly functioning Water Flow and Water Quality			
Protect basin-wide conditions[1]	Yes	Functions already impacted	Functions already degraded
Restore basin-wide conditions	Yes	Possibly	Probably not achievable
Maintain existing basin-wide conditions	Yes	Yes	Yes
Critical Habitats Functions (Shorelines, Wetlands, Riparian Corridors)			
Protect critical habitats:	Yes	Yes	Yes
Restore critical habitats:	Yes	Possibly	Less likely although it is dependent on the size / uniformity of basin conditions[2]
Water Quality			
Minimize downstream pollutants from new growth:	Yes	Yes	Yes
Improve water quality – lower existing pollutant levels:	Yes	Yes	Yes
Water Flow (Flooding)			
Minimize increase in peak flows	Yes	Yes	Yes
Improve water flow conditions where degraded	Yes	Yes	Yes

[1] Basin conditions – mainly related to land use and land cover characteristics such as urbanization and impervious area, forest cover, and other land uses that effect in-stream conditions.

[2] Some basins may have large patches of intact or sensitive areas where restoration will be successful. Each basin must be evaluated for local conditions.

Planning Process

This basin study was conducted by a project team that included staff from Thurston County's Planning and Water Resources departments, Thurston Regional Planning Council (TRPC), U.S. Environmental Protection Agency, and Northwest Hydraulic Consultants. The basin scenarios and management recommendations were developed with the input and assistance of planning and public works staff from the cities of Olympia, Tumwater, and Lacey, and the Squaxin Island Tribe, as well as members of the Municipal Stormwater Technical Advisory Committee for Thurston County (StormTAC), and the WRIA 13 Salmon Habitat Workgroup.

A Scientific Advisory Team (SAT) was convened to review technical decisions and products at key points during the project, including the data used for the project, the basins selected, and the modeling results. The SAT included technical experts from Cambria Science and Communication, Washington State Department of Ecology, King County, and the Squaxin Island Tribe.

Public Engagement

Thurston County solicited input from basin residents and other interested parties throughout the course of the project. In August and September of 2013, Thurston County and TRPC distributed a survey to property owners and residents in the three basins to assess the community's awareness and interest in water resource issues, and their preferences in developing management policies that affect the future of the basins. The results of the survey for Black Lake basin are detailed below, in Section 2.

On April 9, 2014, the County hosted a Water Resource Community Workshop for residents of the Black Lake basin at the Black Lake Grange Hall. Those who attended were given a presentation with background on water resource issues in the McLane Creek and Black Lake basins and the watershed planning work. Participants provided feedback on what management goals should be prioritized for the basin, and on specific places that they considered worthy of attention.

On October 30, 2014, the County hosted a second workshop for residents and interested parties at Kenneydell Park Lodge. The workshop included a presentation describing the alternative future scenarios developed for the project, an overview of the preliminary modeling results, and a discussion about the draft management options discussed in Section 3 of this report.

Additional opportunities for public feedback on the project and recommendations were provided in the spring and summer of 2015 as this report was reviewed by the Thurston County Planning Commission and Board of County Commissioners.

Relationship to Regional Goals

While the results included in this basin study apply specifically to the Black Lake basin, this watershed planning project also supports the goals and strategies outlined in several ongoing regional efforts, as detailed below:

Puget Sound Partnership Indicators and Targets

The Puget Sound Partnership is the state agency charged with coordinating the recovery of Puget Sound. The agency has identified a set of 21 key ecosystem indicators to track progress toward their recovery goals, and the Partnership's Leadership Council has adopted specific targets for many of these indicators. This basin study and the management policies recommended support several of these indicators and targets.

Indicator: Freshwater Quality

- By 2020, at least 50% of all monitoring stations with suitable data have Freshwater Water Quality Index scores of 80 or higher.
- By 2020, achieve a decrease in the number of impaired waters (303(d) list) in Puget Sound freshwaters.
- By 2020, 100% of Puget Sound lowland stream drainage areas monitored with baseline B-IBI scores of 42-46 or better retain these "excellent" scores and mean B-IBI scores of 30 Puget Sound lowland drainage areas improve from "fair" to "good."

What are Urban Growth Areas?

Local cities and counties in Washington State plan under the Growth Management Act (GMA). In Thurston County, jurisdictions have worked together to designate urban growth areas (UGAs). These are the areas that already have, or are planned to receive, urban services such as sewer, in the future.

Thurston County's first urban growth boundary agreement was established in 1983 for the north county areas, and later revised in 1988. In the early 1990s growth boundaries were established county-wide. Since that time the urban growth boundaries have been adjusted slightly. Overall, the area designated for urban growth has been reduced by over 1,000 acres, or around 1.7% in the last 20 years.

Thurston County's urban growth areas include the incorporated areas (cities and towns), the unincorporated urban growth areas within and around the cities and towns, and the unincorporated Grand Mound area.

Indicator: Land Cover & Land Development

- By 2020, average annual loss of forested land cover to developed land cover in non-federal lands does not exceed 1,000 acres per year and 268 miles of riparian vegetation are restored or restoration projects are underway.
- By 2020, the proportion of basin-wide growth occurring within urban growth areas is at least 86.5% (equivalent to all counties exceeding goal by 3%) and all counties show an increase over their 2000-2010 percentage.
- Basin-wide, by 2020, loss of vegetation cover on indicator land base over a 5-year period does not exceed 0.15% of the 2011 baseline land area.

Sustainable Thurston

Thurston Regional Planning Council's Sustainable Thurston plan, *CREATING PLACES—PRESERVING SPACES: A SUSTAINABLE DEVELOPMENT PLAN FOR THE THURSTON REGION*, adapts the Puget Sound Partnership's 2020 freshwater quality target and sets the following target for the Thurston County region in 2035:

- Protect small stream basins that are currently ranked as "intact" or "sensitive," and improve and restore as many as possible "impacted" stream basins.

The Sustainable Thurston plan also sets two land-use priority targets, which with will help the region protect water quality, as well as reduce vehicle miles traveled and related greenhouse gas emissions:

- By 2035, 72% of all (new and existing) households in our cities, towns, and unincorporated growth areas will be within a half-mile (comparable to a 20-minute walk) of an urban center, corridor, or neighborhood center with access to goods and services to meet some of their daily needs.

- Between 2010 and 2035, no more than 5% of new housing will locate in the rural areas, and 95% will be within cities, towns, unincorporated growth areas, and tribal reservations. Rural areas include land outside of the cities, towns, unincorporated urban growth areas and tribal reservations.
    - Supporting target: No net loss of farmlands, forest lands, prairie habitats (in addition to environmentally critical areas that are currently protected) while providing for a range of densities within rural Thurston County.

2. Basin Description

Overview

The Black Lake basin (Figure 1; Map 2) includes around 5,000 acres that drain to one of the largest lakes in Thurston County. The basin is located in northwestern Thurston County, east of the Black Hills and McLane Creek basin, and contains a western portion of the city of Tumwater.

Historically, Black Lake was the headwaters of the Black River system, which flows southwest into the Chehalis River, and drains to Grays Harbor on the Pacific coast; however, since the excavation of the Black Lake Ditch in 1922, the lake has been hydrologically linked to Percival Creek and drains to Budd Inlet and Puget Sound. The lake is large - roughly 570 acres - but relatively shallow, with a mean depth of 19 feet. The historic lake outlet is now mostly obstructed by beaver dams and vegetation.

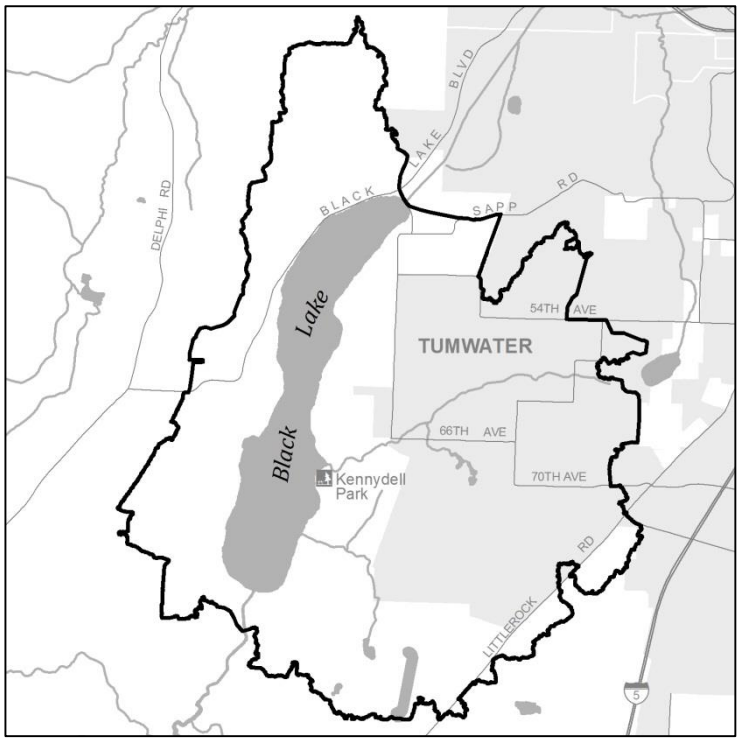


FIGURE 1: BLACK LAKE BASIN

The hydrology of the basin is complicated – there is shallow groundwater in much of the area, and Black Lake is bordered by extensive wetlands, particularly at its northern and southern ends. Several small creeks flow into the lake – the largest of these is Fish Pond Creek, which flows through the city of Tumwater and drains into Black Lake at Kenneydell Park. There is an additional, unnamed tributary on the east side of the lake, one larger tributary on the west side that drains to the lake at the county-owned Guerin Park property, as well as several intermittent streams. At certain times of year, a portion of the flow from Dempsey Creek flows into the lake via the large wetland complex at its southern end rather than south into the Black River. Black Lake basin likely also receives some groundwater inputs from the Salmon Creek basin (NHC 2014) (Map 3).

In 2010, almost 5,500 people lived within the Black Lake basin boundaries. The population of the area is expected to grow by 12,300 people by 2035, an increase of 123%, with most of the growth forecast for the urban areas (city and urban growth area).

Jurisdiction

Black Lake basin is divided between Thurston County (42%) and Tumwater (36%) – the remaining 22% of the basin is in the Tumwater urban growth area (UGA), which is managed under Joint Planning agreements between the County and City (Map 3). Under current plans, land within the UGA eventually will be annexed into the city of Tumwater; in preparation for this, zoning and development regulations

within the UGA match those of the city of Tumwater. Emergency services in the UGA are provided by the County.

Soils

The basin is underlain by a mix of outwash and till soils, with almost a quarter identified as saturated soils (NHC 2014)[3]. Outwash soils include glacial deposits of permeable sands and gravels; these include large areas on the east side of the lake within the city of Tumwater. Till soils include areas where glacial activity left a compacted and relatively impermeable layer of clay, silt, loam, and/or gravels; they generally allow limited drainage and have higher surface runoff. Within Black Lake basin, till soils are located mostly on the west side of the lake, and within the Tumwater UGA. Kitsap soils include those formed by lacustrine sediment, and generally have greater moisture storage and drainage than till soils, but less than outwash – only a very small area on the northwest side of Black Lake has Kitsap soils. Saturated soils are poorly drained and include wetland areas – these occur with wetland areas on the northern and southern ends of the lake, and surrounding the tributaries to the lake, as well as wetland areas associated with those streams, particularly within the city of Tumwater.

Thurston County sets some standards for development and stormwater management according to hydrologic soil group classifications. Hydrologic soil groups are defined by the Natural Resource Conservation Service and are based on estimates of surface water runoff potential determined by how fast water can be expected to infiltrate – these groups are related but do not correspond exactly to the soil classes described above. Group A soils have the highest infiltration rates (low runoff potential) even when thoroughly wetted (greater than 0.30 in/hr); Group B soils have more moderate infiltration rates (0.15-0.3 in/hr); Group C soils have slow infiltration rates (0.05-0.15 in/hr) and include fine textured soils and those with a layer that impedes downward draining of water; Group D soils have very low infiltration rates (0-0.05 in/hr) and include clay soils as well as areas with high groundwater that nears the surface (Thurston County DDEM 2009). In Black Lake basin, most of the soils have moderately high to high runoff potential (Groups C and D), with some areas with more moderate infiltration within the city of Tumwater and in the area around Fish Pond Creek (see Table 2; Map 4).

TABLE 2: SOIL TYPES IN BLACK LAKE BASIN

USGS Soil Class	Outwash	Till	Kitsap	Saturated
	36%	37%	1%	26%
Hydrologic Soil Group (NRCS)	**Group A**	**Group B**	**Group C**	**Group D**
	15%	27%	29%	29%

Species and Habitat

[3] These four soil classifications were defined using NRCS soils inventory data by the US Geological Survey and were used in the HSPF modeling study for this project.

The Black Lake basin supports a variety of wildlife, including several endangered and threatened species. The lake is a popular fishing destination with resident populations of Coastal Cutthroat Trout, Largemouth and Smallmouth Bass, Yellow Perch, Black Crappie, and Brown Bullhead, and is stocked annually with Rainbow Trout by the Washington Department of Fish and Wildlife (WDFW). Black Lake Drainage Ditch at the north end of the lake is mapped as habitat for coho salmon, as well as cutthroat. The wetlands at the southern end of the lake support large concentrations of ducks and other waterfowl, including mallards, wigeons, pintail, shoveler, goldeneye, greenwing and cinnamon teal, and green heron. Though much of the area is wet, the southeastern portion of the basin has soils conducive to prairie habitat.

The Black Lake basin includes habitat for several species protected under the federal Endangered Species Act. The Mazama pocket gopher was listed as a threatened species in April 2014. Soils associated with gopher activity are found east of Black Lake, particularly within the city of Tumwater and UGA along Littlerock Road.[4] These soils are used as a screening tool for identifying gopher habitat during land use proposals. The Oregon spotted frog was listed as a threatened species in September 2014; potential habitat for the frog includes areas around the lake shoreline, tributaries to the lake, and wetland areas. Within Thurston County and the UGA, these and other prairie species will be managed under a Habitat Conservation Plan that is under development.[5]

WDFW maintains a list of Priority Habitats and Species (PHS) that identify state priorities for conservation and management. Priority species include state listings of Endangered, Threatened, Sensitive, or Candidate species, as well as wildlife that are vulnerable to habitat alteration and disturbance, or that are of economic or tribal importance. The PHS catalog and map data identify the following important species and habitats within the Black Lake basin:

TABLE 3: PRIORITY HABITATS AND SPECIES IN BLACK LAKE BASIN

	Common Name	**Black Lake Basin Location**
Species		
	Cutthroat trout	Black Lake
	Olympic mudminnow	Unnamed tributary on west side of lake connecting wetland to McLane basin
	Wood duck	Breeding areas south of Black Lake and in wetlands east of the lake

[4] Based on historic data and recent field work, U.S. Fish and Wildlife Service has indicated that they do not expect to find gophers west of the Black River. If there is no existing evidence to suggest a given parcel west of the Black River has gopher occupancy, the County does not presently screen in these areas. This includes all areas west or northwest of the Black River, Black Lake, Black Lake Drainage Ditch, and Percival Creek. Prairie habitat does exist west of the Black River.

[5] http://www.co.thurston.wa.us/planning/hcp/hcp-home.htm

	Oregon spotted frog	Breeding areas noted near Belmore, Fish Pond Creek
	Big brown bat, Townsend's big-eared bat, Little brown myotis, Yuma myotis	Throughout basin
	Oregon vesper sparrow	Southern Tumwater, near the Olympia airport
	Bald eagle	Nesting areas west of Black Lake Boulevard
	Mazama (Western) pocket gopher	East of Littlerock Road and near 70th Avenue in Tumwater
Habitats		
	Palustrine wetlands	Extensive wetlands throughout basin, especially associated with Fish Pond Creek and other tributaries, as well as Black Lake
	Lacustrine littoral	Associated with Black Lake

Critical Areas

Thurston County's Critical Areas Ordinance (TCC 24) was updated in 2012; it includes protective policies for five types of critical areas: important fish and wildlife habitat areas (including prairie and riparian corridors), wetlands, critical aquifer recharge areas, frequently flooded areas, and geologically hazardous areas (including steep slopes and bluffs). A variety of critical areas are located within Black Lake basin.

Habitat Areas

Fish Pond Creek is listed as Type-F, or fish-bearing, streams under the Washington Department of Natural Resources (DNR) classification system, as is an unnamed tributary that drains to the west side of the lake near 60th Lane SW. Other tributaries are listed as Type-N or unknown. Thurston County's Critical Areas Ordinance assigns Type-F streams a riparian habitat area ranging from 150 to 250 feet, depending on the width of the stream. Other streams would have a standard riparian habitat area of 100 feet.

Prairie habitat is protected by the Critical Areas Ordinance. Soil types are the screening tool used to detect the presence of prairie, and the soil groups that support Mazama pocket gophers and prairies have a lot of overlap. Prairie habitat does exist in some areas of the basin west of Black Lake, while gopher habitat is limited to east of Black Lake and Black River.

Wetlands

There are extensive wetlands in the basin, including those associated with the various tributaries to Black Lake, and at the north and south ends of the lake itself. These areas qualify

for protections under the Critical Areas Ordinance, with wetland buffers ranging from 50 to 300 feet, depending on the condition of the habitat.

Critical Aquifer Recharge Areas

Critical Aquifer Recharge Areas (CARAs) are locations that overlie significant groundwater resources and, based on geology and soils, are particularly susceptible to groundwater contamination. Category I CARAs are considered extremely sensitive, and include Wellhead Protection Areas, or the distance around a well through which contaminants are likely to travel within one, five, or ten years. There are 16 wellhead protection areas within or overlapping the Black Lake basin, including those surrounding the water systems for Black Lake Bible Camp and Conference Center, Evergreen Shores, Timberland Mobile Estates, Lakeside, Lakeland Manor Black Lake Estates, Black Lake Acres, Laurel Park Community, Israel Place San Angelo Park, Lazy Acres, Holiday Acres, Andersen, Summerhill, Ski View Estates neighborhoods. There are Category I CARAs mapped within most of the basin. Activities that use hazardous materials or that could pose a risk to groundwater are restricted and regulated within these areas.

Frequently Flooded Areas

The large number of wetland and high groundwater areas within Black Lake basin contributed to flooding concerns in the basin. High groundwater areas are most concentrated within the city of Tumwater. FEMA has designated one-hundred-year floodplain along parts of Fish Pond Creek and the unnamed tributary to the southeast end of the lake. Development must be set back and above the base flood elevation of these areas. New onsite septic systems must be located outside of the one-hundred-year floodplain, floodway, and high groundwater hazard areas.

Geologically Hazardous Areas

The northeast corner of Black Lake basin includes slopes that are greater than 40% and that may pose a risk if cleared. Removal of vegetation is restricted within these hazard areas, and tree harvesting is subject to review in addition to that required under Forest Practice Permits.

Land Use

Most of the lake shoreline is developed for residential use at moderate densities, and there are two mobile home parks on the east shore, along with several recreational resorts and a bible camp. The County owns one developed park property on the east shore, Kenneydell Park, and one undeveloped property on the west, Guerin Park. In the southern part of the basin is an artificially created waterski pond and residential development.

Zoning

Most of the County portion of the basin is zoned Rural Residential Resource 1/5 (35% of basin), with some smaller areas zoned as Limited Areas of More Intensive Rural Development (LAMIRD) 1/1, 1/2, 2/1, Rural 1/20, or Public Parks Trails and Preserves (1%). The major zoning designations in the Tumwater areas of the basin are Single Family Low Density Residential (19% of basin), Residential Sensitive Resource (5%), Single Family Medium Density (4%), and Light Industrial (2%). The Tumwater

urban growth area is mostly zoned Single Family Low Density (16%), with smaller areas in Single Family Medium Density (2%), Open Space (1%), or other (Map 5).

Rural Residential Resource 1/5. The purpose of this zone is to balance human uses with the natural environment, maintain rural character, and buffer environmentally sensitive areas and resource management areas from incompatible activities. Primary land uses permitted in this zone include agriculture, forestry, open space, and low-density residential. The zone allows one dwelling unit for every five acres of land. Land in this zone may have critical areas or limited groundwater, and should not require the provision of urban services. This zone is not permitted to be upland to an aquaculture management district or a "natural" shoreline designated in the Shoreline Master Program.

Within this zone, maximum impervious surface coverage is 60%, except lots that are primarily on soils with minimal infiltration capacity (hydrologic soil groups C and D) are limited to 10% impervious coverage. Maximum building coverage on a lot is 6,000 square feet for parcels between five to ten acres, and 20,000 square feet for parcels over ten acres. Within Black Lake basin, there are no vegetation retention requirements for this zone.

Residential LAMIRD 1/1, 1/2, 2/1. These zones recognize residential development in rural areas that was developed at a higher density prior to July 1990. Within the Black Lake basin, this zoning includes the Cougar Ridge (1988) and Camelot (1970) subdivisions off Delphi Road, and the Alpine Hills neighborhood (1971). New development in these areas is limited to infill and to a density that is consistent with existing development (one unit per acre, one unit per two acres, or two units per acre, respectively). The maximum impervious coverage limit within these zones is 60%, and there are no vegetation retention requirements.

Rural 1/20. The purpose of this zone is to protect public health and safety by minimizing development in environmentally sensitive and hazardous areas, and to protect critical areas and create open space corridors. Within this zone, maximum impervious surface coverage is 60%, except lots that are primarily on soils with minimal infiltration capacity (hydrologic soil groups C and D) are limited to 10% impervious coverage.

Shorelines

The shoreline of Black Lake has been highly modified and much of it armored with hard structures. Thurston County's Shoreline Master Program regulates land use and development along marine shorelines, rivers with flows greater than 20 cubic feet per second, lakes larger than 20 acres, associated floodplains and wetlands, as well as areas within 200 feet of these shorelines. Most of the lake shoreline is designated as Rural; the east side of the lake south of 66th Avenue (including Kenneydell Park) is designated Conservancy, as is a short reach on the west side of the lake beside Lakeside Street. The lakeshore and wetlands at the southern end of the lake are designated Natural. The County is currently working on an update to the Shoreline Master Program.

Rural Designation. The Rural Environment designation applies to areas along the shoreline with low-intensity land uses, including residential development less than two dwelling units per acre. Permitted uses include agriculture, aquaculture, forest management, and low- to medium-intensity recreational access. Boat ramps, docks, buoys, and piers are allowed within this designation, subject to general regulations, as are shoreline protective measures, such as bulkheads, dikes, riprap, and berms. Mining is allowed with a conditional use permit, and industrial uses are prohibited.

Within the Rural Environment designation, total impervious surface coverage is limited to 30% coverage of a lot. Commercial and residential structures must be set back 50 feet from the ordinary high water mark, and a minimum 20-foot buffer of existing ground cover must be maintained.

Conservancy Designation. The Conservancy Environment designation applies to areas along the shoreline with low-intensity land uses, and is intended to protect and manage existing natural resources, as well as valuable historic and cultural areas, to ensure sustainable utilization of renewable forest and aquatic resources as well as limited recreational use. Permitted uses include agriculture, aquaculture, and low-intensity recreational access. Residential development of up to one unit per acre is allowed, as is clustering of development – for non-clustered developments, 100 feet is the minimum lot width. Forest Management is permitted with regulations to provide additional protections for wildlife habitat. Boat ramps, docks, buoys, and piers are allowed within this designation, subject to general regulations, as are shoreline protective measures, such as bulkheads, dikes, riprap, and berms. Mining is allowed with a conditional use permit, and industrial uses are prohibited. Utility distribution and transmission lines are permitted, but facilities such as sewage treatment plants and substations are prohibited.

Within the Conservancy Environment designation, total impervious surface coverage is limited to 30% coverage of a lot. Commercial recreation and residential structures must be set back 100 feet from the ordinary high water mark. A minimum 20-foot buffer of existing ground cover must be maintained, but there are no additional regulations related to the removal of trees and vegetation for views or other reasons.

Aquatic Habitat Conditions

Black Lake basin is a moderately impacted basin, but still has many areas with good habitat conditions. The lake shoreline and hydrology have been extensively modified, and many historic wetland areas have been filled or altered, but many good quality wetland areas remain. The basin has just above 8% total impervious surfaces and 37% tree canopy, and streams within the basin remain vegetated along their shores in most places, although vegetation has been cleared along much of the lakeshore.

TABLE 4: CURRENT AQUATIC HABITAT CONDITIONS FOR BLACK LAKE BASIN

Level of Urbanization	Hydrology	Riparian Corridor	In-stream and Wetland Physical Conditions

• Total Impervious Area Estimate 1991: 5.1% 2006: 8% 2011:8%	• Effective Impervious Area Estimate, 2006: 5.9% • Forest Cover, 2011: 37% • Unmodified Wetlands: 20.6% • Miles of Streams: 9.2 • Areas of high groundwater flooding: 1.2% of basin	• Coniferous forest cover in 250 foot stream riparian corridor, 2006: 9.6% • Forest, scrub/shrub vegetation and wetlands in stream riparian corridor: 150 ft: 88.4% 250 ft: 79.9% 1,000 ft: 57.1% • Number of road crossings per mile of creek: 1.9	• Black Lake Ditch lowered lake level, establishing a barrier to historic runs of Black River Chinook, coho, and chum salmon • Many wetland areas have been filled or modified • Beaver activity in lake outlet results in high lake levels and flooding

SOURCE: TRPC 2013

Overall water quality for Black Lake is ranked *Fair* by Thurston County Environmental Health. The lake has moderate-to-high nutrient concentrations which result in nuisance blue-green algae growth in late summer and fall. The lake is thermally stratified in the summer, and the lower layer of cooler water can be very low in oxygen. This results in a slow release of phosphorus from the sediments into the water near the lake bottom. When the lake mixes in early fall, the phosphorus released from the sediments stimulates algae growth in the lake (TCEH 2012).

Residential Development Potential

The eastern portion of the Black Lake basin is within Tumwater's city limits and urban growth area, and is largely undeveloped and designated for urban growth. There are several planned residential projects in the area, and one master-planned community. The rural portions of the basin are largely developed at rural densities, although there are some subdividable rural lots (Map 6).

Threats and Concerns

- The Basin Evaluation report (TRPC, 2013) identified Black Lake basin as at high risk from development pressure. Impervious area in the basin is projected to increase by 6.5% between 2010 and buildout under current plans.
- Algal blooms have been a recurring and increasing problem in the lake, particularly blooms of blue-green algae in the fall, which can close the lake to recreational uses: 1992, 1994, 2000, 2004, 2006, 2007, 2010, 2011, and 2012 were all bad years for algae blooms.
- Black Lake is listed on the 303(d) list for Phosphorus, since 1996, and for PCBs in rainbow trout tissue samples since 2008.
- Adjacent wetlands, shallow groundwater, and the many septic systems along the lake shore likely influence water quality in Black Lake. Residential homes along the lake are not hooked up to sewer.
- The Black Lake Grocery property on the northwest shore of Black Lake has groundwater and soil contaminated with petroleum hydrocarbons from leaking underground storage tanks. Cleanup efforts in 1995 and 2004 removed the tanks and installed a treatment wall of sphagnum peat

moss to remediate the contaminated groundwater that flows into the lake, but cleanup is not considered complete.

- Fish Pond (Fishtrap) Creek has consistently failed to meet either part of the fecal coliform bacteria standard. This creek flows through Tumwater and the urban growth area before discharging into the lake near the swimming area at Kenneydell County Park.
- Beaver activity in the Black Lake Ditch can cause the lake level to rise and lead to flooding of yards and docks.
- Black Lake Ditch, which drains the lake at its northern end, violates fecal coliform standards and dissolved oxygen standards, and may violate temperature standard in the summer.
- Eurasian milfoil was discovered in the lake in 2004, and has been actively managed by Thurston County. Yellow iris, fragrant water lily, and native submersed water nymph are all nuisance species in Black Lake.

Threats and concerns in the Black Lake basin include (clockwise) pollution from stormwater runoff, agriculture, and residential septic systems.

FIGURE 2: BLACK LAKE BASIN – THREATS AND CONCERNS.

Public Views

In response to a survey[6] sent in August 2013, residents and property owners indicated that the things they value most about living in the Black Lake basin are its natural environment and scenery, the opportunities it provides for a rural lifestyle while being close to stores and businesses, and its wildlife. Clean drinking water, swimmable lakes and streams, Puget Sound water quality are all issues that are very important to the majority of respondents. More than half of those who responded (69%) indicated that they are somewhat or very concerned about water quality in the basin. The greatest risks to water quality they see are urban development, as well as pollution from stormwater runoff and septic systems. When it comes to planning for the future of the basin, residents felt that the most important issues to address were:

- Protecting water quality (58%),
- Protecting wildlife and fish habitat (44%),
- Preserving farmland and agriculture (28%),
- Improving water quality (27%), and
- Low-impact development (27%).

When asked how they would like to describe Black Lake basin in the future, many residents expressed hope that water quality will be much improved, and that they and their children or grandchildren would be able to safely swim and fish in the lake. Several residents expressed a desire that there be greater monitoring and oversight of septic tanks. There is a desire to maintain the semi-rural, quiet aspect of the area while enhancing recreational opportunities around Black Lake.

These views were emphasized at a community workshop held on April 9, 2014, at the Black Lake Grange. Participants expressed curiosity about the potential impacts of planning and growth on the watershed, as well as concerns about water quality in Black Lake, the use of chemicals used for lawn care, flooding issues, and how zoning might impact wells and overall quality of life. Map 7 shows a summary of comments noted on an aerial map of the basin. Participants were asked to identify areas they thought should be identified for protection, or that were of special concern to them. These notes included references to several areas that folks would like to see maintained at lower zoning, as open space or developed for recreation, areas that currently have issues with beavers and flooding, as well as areas that historically or currently support wildlife species, such as salmon or Oregon spotted frog.

Management Goals for Black Lake Basin

Black Lake basin was categorized as “impacted” in the Basin Evaluation report. The report identifies the following management goals for “impacted” basins:

- Maintain, and where possible restore, basin-wide conditions
- Protect, and where possible restore, critical habitats
- Minimize downstream pollutants from new growth
- Improve water quality by lowering existing pollutant levels
- Minimize increase in peak flows

[6] The survey was sent to 2,293 homes and had a response rate of 15 %.

- Improve water flow conditions where degraded

Watershed Characterization

The project team considered the results of the Washington Department of Ecology's Puget Sound Watershed Characterization Project (Stanley et al., 2010) in the course of this study. Watershed characterizations are landscape-scale analyses that integrate data sources to describe and relate ecological processes at a basin and watershed scale, rather than at a site scale. These analyses can provide an early filter to help identify priority areas for protection, restoration, and development.

The Puget Sound Characterization includes assessments for water flow processes (delivery, surface storage, recharge, and discharge), water quality (sediment, nutrients, pathogens, metals), and fish and wildlife habitat (terrestrial, freshwater, marine shorelines). In its regional analysis, the project assessed the Black Lake basin as part of the greater Deschutes watershed (WRIA 13), although Black Lake has traditionally been included in the Upper Chehalis watershed (WRIA 23). The basin was not included in the habitat assessment. The west side of Black Lake basin was identified as a priority area for a mix of conservation and restoration, particularly for protection of surface storage and delivery of water. The east side of Black Lake basin, which includes areas within the city of Tumwater was identified as a high priority area for restoration of surface storage as well as important areas for recharge of groundwater, due to the loss of historic wetlands and increase in impervious surfaces. In its water quality evaluation, Black Lake basin was identified as having high potential for exporting phosphorus, sediment, and pathogens into surface water if source areas in the upland is disturbed. Suggested management actions include:

- Restore storage in urban areas by retrofitting development to increase retention and infiltration of surface waters
- Restore depressional wetland areas and increase storage on agricultural lands and open space
- Cluster new development, minimize impervious cover, and increase forest cover, especially along riparian corridors
- Prevent activities that remove vegetation
- Restore natural cover and control existing sources of phosphorus
- Limit new sources of pathogens (west side of lake)

The project team worked with Ecology to further refine its water flow analysis within the Black Lake basin; that analysis identified the following priorities:

- ***Northwest of Black Lake:*** the sub-area west of the lake and north of 62nd Avenue SW is identified as a priority area for protection, particularly for delivery of water to lake. This includes the steep, forested area in the northwest corner of the basin.
- ***East of Black Lake:*** this sub-area is identified as a priority for restoration, particularly the lands within the City of Tumwater that drain to Fish Pond Creek and the unnamed tributary to the south end of the lake. Many historic wetlands in this area have been drained, ditched, or

otherwise modified, which has affected surface storage and the recharge of groundwater sources.

3. Analysis of Basin Alternatives

How Scenarios Were Developed

Black Lake basin was classified as "impacted" in the Basin Evaluation report (TRPC, 2013), although total impervious area was below 10%, which placed it on the better-functioning range of the "impacted" basins. A large portion of the study area is within Tumwater's city limits and unincorporated urban growth area, but is fairly undeveloped. For this reason it was felt that both protection and restoration management strategies would be effective in this basin.

What are Impervious Surfaces?

Impervious surfaces are materials that prevent the infiltration of water into the soil. The most common impervious surfaces in the built environment are roads, rooftops, sidewalks, and patios. While these structures are almost 100% impervious; other features such as gravel roads, compacted soils, and even lawns are impervious to varying degrees, as they allow for less infiltration than natural ground cover such as forests.

Scenarios of historic, current, and future alternatives were developed to better understand stream water quantity and quality dynamics under a variety of conditions. All scenarios were developed for a hydrologic model that gave outputs on various stream flow and water quality factors.

The basic premise is that as land cover (forest, grass, impervious areas, etc.) and hydrology (stream network and infrastructure that modifies water flow such as ditches, pipes, and stormwater ponds) change it will have an impact on both the stream water quantity and quality. In general, as urbanization increases, so does the amount of impervious surfaces. This means less rainwater can infiltrate into the ground, and there is a greater amount of stormwater runoff (Figure 3). The runoff can scour stream beds and carry pollutants to the water. Stormwater infrastructure, such as ponds that capture runoff and release it slowly, can help mitigate some of the effects of runoff.

Using a hydrologic model, land cover and hydrologic conditions can be tied to stream flow and water quality where stream monitoring data are available. For this reason, the scenarios start with a Current Condition scenario to help ensure that the model is working (calibrated) correctly. The Historic Condition scenario gives an idea of how the stream flowed and functioned before the land cover and hydrology was altered. The three future scenarios were developed to evaluate potential management strategies. All future scenarios were designed to be realistic and achievable.

Scenarios were conceptualized and developed by a project team of land use, storm water, and hydrology specialists with experience in Thurston County. The scenarios were designed to answer some specific questions such as:

- Will stream health degrade with additional development under current zoning regulations, and would changing the zoning density make a difference?
- Will it make a significant difference in stream health if some areas are removed from the urban growth areas, where growth was likely to occur on sewer systems, and rezoned to rural densities, where less growth is likely to occur, but it would be on septic systems?

- Will stream health degrade under current stormwater regulations, and will updating stormwater regulations to include low impact development techniques make a difference?
- Will stream corridor or wetland restoration lead to an improvement in stream health?
- Will retrofits of stormwater infrastructure in areas of existing development lead to an improvement in stream health?

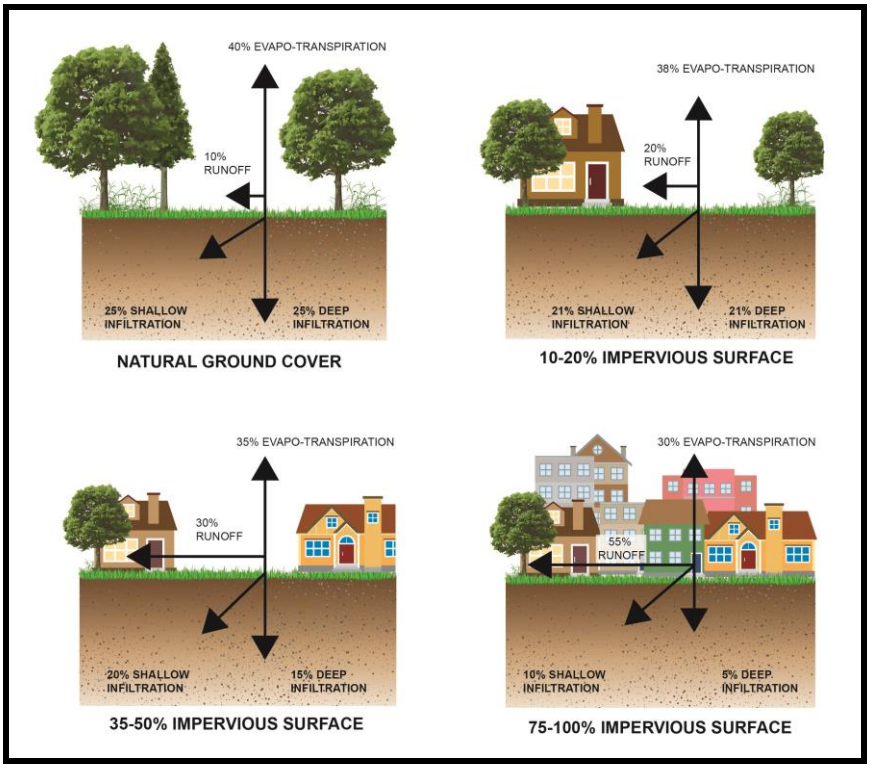


FIGURE 3: WATER CYCLE CHANGES ASSOCIATED WITH URBANIZATION.
SOURCE: GUIDANCE SPECIFYING MANAGEMENT MEASURES FOR SOURCES OF NONPOINT SOURCE POLLUTION IN COASTAL WATERS, 1993; AS SHOWN IN (ARNOLD, 1996).

Current Condition

The Current Condition scenario was developed to approximate 2010-12 conditions for land cover and land use, hydrology, and stormwater treatment facilities. Sources included existing land cover and land use data, basin reports, infrastructure mapping, and air photo mapping. Each land cover was assigned a value for water infiltration and runoff, as well as the amount of pollutants it was likely to generate. The current condition data layers were used to calibrate the hydrologic model to stream flow and water quality data.

Historic Condition

The Historic Condition scenario was developed by assuming land cover was a combination of forest, wetlands and prairie throughout the basin. A variety of sources were used to develop the land cover data, including maps of historic wetlands and prairies.

Planned Trend

The Planned Trend scenario was developed to approximate future development under adopted zoning and development regulations. Planned trend was consistent with the assumptions developed for the region's population and employment forecast and buildable lands analysis (www.trpc.org). Assumptions for future impervious area were made depending on the type or density of expected development. (see *TRPC 2013A and TRPC 2015).*

Specific assumptions for the Planned Trend scenario included:

- Current zoning and development regulations would remain in place
- Current stormwater regulations would remain in place
- Future development occurs in similar style / density as recent trends
- As development occurs, land cover would convert from existing cover to a mixture of impervious surfaces (homes, driveways, roads) and other urban land cover (lawns and cleared areas)

Alternative Future A

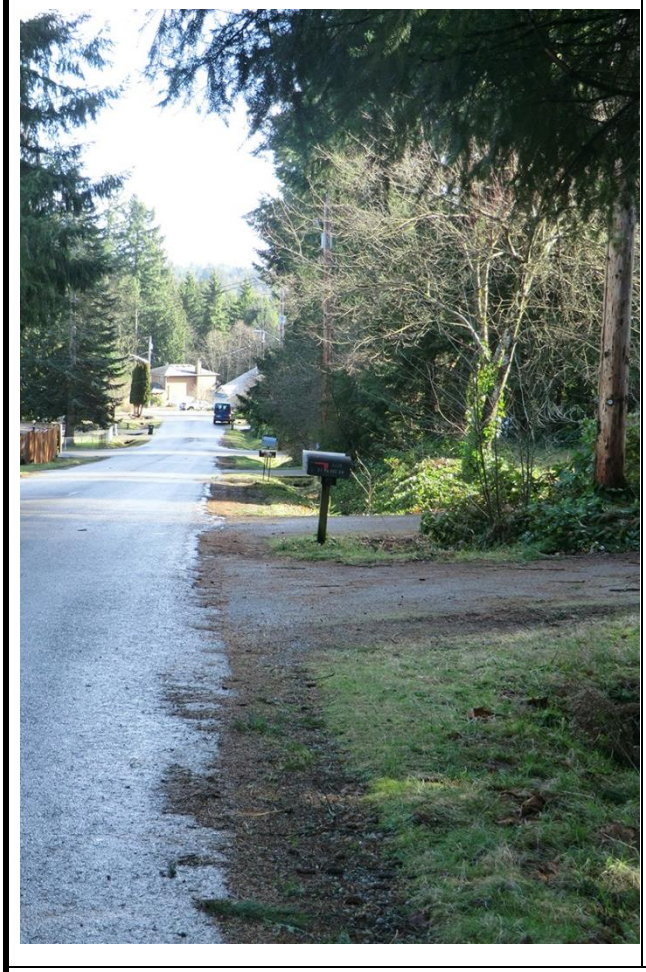
The Future A scenario examined changes to regulations as a way to protect stream health from the effects of development. The following changes were evaluated:

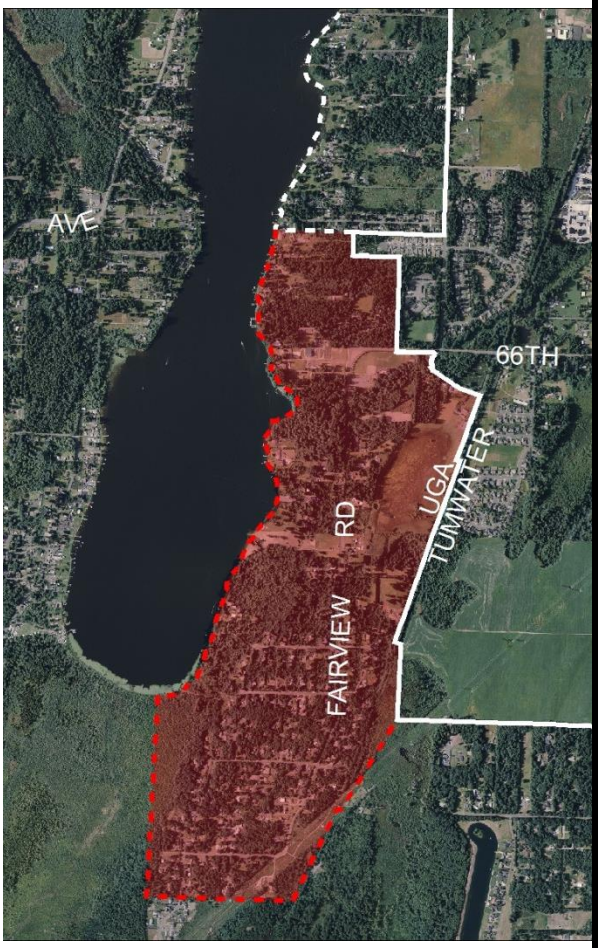
- Remove the portion of the unincorporated growth area surrounding the lake edge where water and sewer infrastructure is not yet available and rezone to rural densities (Figure 4). The area north of Kenneydell Park already has sewer infrastructure (Map 8) along Black Lake Belmore Road to 60th Avenue SW, and was retaining inside the urban growth area for all scenarios.
- Assume that new development in both the city and rural area would meet low impact development requirements for stormwater control, if feasible (Figure 5)
- Implement mandatory clustering in large undeveloped parcels within the city to minimize new impervious area
- Rezone portions of the rural area around the lake periphery to lower densities (up to 10-acre lots) (Map 9)
- Place large undeveloped and forested parcels in long term forestry zoning designation (in area adjacent to McLane Creek Basin) and make adjustment to urban growth area
- Set tree cover and impervious surface limits for new rural development

What are the New Low Impact Development (LID) Requirements for Stormwater Control?

The current stormwater flow control standard only requires controlled release for infrequent, large storms (50% of 2-year peak flow = 1.4 inches in 24-hrs at Olympia Airport) and is intended to only protect against stream bank erosion and control downstream flooding impacts. Smaller storm events are routed through stormwater facilities with little to no restrictions. This flow control standard can be met by detention ponds only, with little or no infiltration.

The new LID flow control standard (required by 2016 in parts of Thurston County) will provide control for much smaller storms (8% of 2-year peak flow = 0.22 inches in 24-hrs at Olympia Airport). It is intended reduce the volume of stormwater runoff and limit low flows to pre-development (forested) conditions. Based on recent research, changes to these low flows can have impacts to stream quality and the increased volume of runoff increases pollutant loadings. In general to meet this standard requires extensive infiltration of stormwater into the ground through bioretention, porous pavement, infiltration ponds/trenches, etc. A detention pond in the majority of cases cannot be the only stormwater control method, mainly because they would be prohibitively large to meet the standard.





Future A includes an evaluation of whether removing a portion of Tumwater's urban growth area (area in red on the right) and rezoning it to rural densities would protect water quality.

There are approximately 190 homes in that area today, all on septic systems.

A single-family home with a properly functioning septic system generates eight to twenty times the nitrate pollution as a home on a sewer system. (TRPC Sustainable Thurston Water Infrastructure Panel, 2013).

If the area (red) stays within the urban growth area (or the area the city has designated for future growth), as new development occurs sewer infrastructure will be extended. This ensures that new development will occur on sewer, and makes it more likely that the existing development will be able to hook into sewer if their septic systems fail. If the area were to remain in the growth area, the buildout capacity is around 520 homes total, or 310 new homes.

If the area were to be removed from the growth area and rezoned to rural densities, the buildout capacity would decrease to around 210 homes total, or 20 additional homes, however all new growth would occur on septic systems.

FIGURE 4: FUTURE A SCENARIO URBAN GROWTH AREA ADJUSTMENT.

What is Low Impact Development?

Low impact development (LID) is an approach to land development that works with nature to manage stormwater as close to its source as possible.

Some of the principles of low impact development are:

- Preserving and re-creating natural landscape features,
- Minimizing impervious areas and create functional and appealing site drainage that treat stormwater as a resource rather than a waste product.

By implementing low impact principles and practices, stormwater can be managed in a way that promotes the natural movement of water within an ecosystem.

At the site-level, low impact development techniques include:

- Reducing impervious area by requiring narrower streets than conventional development, Requiring smaller lots and clustering development to reduce miles of street,
- Using porous materials such as pervious sidewalks rather than impervious materials
- Maintaining native vegetation
- Using bioswales and bioretention areas to infiltrate runoff, rather than trying to capture the runoff and move it off of the site as quickly as possible

FIGURE 5: CONVENTIONAL DEVELOPMENT (LEFT) VERSUS LOW IMPACT DEVELOPMENT (RIGHT).
SOURCE: AHBL, 2012.

Compact Growth as a Form of Low Impact Development

Compact growth is also a form of low impact development. Given the same amount of homes, directing growth to city centers and urban residential neighborhoods as compared to rural areas can significantly reduce the amount of impervious area within a basin. In the example below, at rural densities (A) 1,000 homes would cover the entire rural area – or 5,000 acres – resulting in 200 acres of impervious surfaces. At typical urban residential neighborhood densities, the same amount of homes would require around 125 acres (B) and result in around 55 acres of impervious surfaces. At city center densities, 1,000 apartments or condominiums would require around 10 acres (C) and result in around 6 acres of impervious surfaces. Of course actual growth will be accommodated in all three areas, but guiding growth to urban areas has less impact overall on a basin.

Type of Area	Density	Units of New Growth	Percent Impervious Area	Total Acres	Impervious Acres
City Center	100 dwellings per acre	1,000	55%	10	6
Urban Residential Neighborhood	8 dwellings per acre	1,000	44%	125	55
Rural 5 acre lots	1 dwelling per five acres	1,000	4%	5,000	200

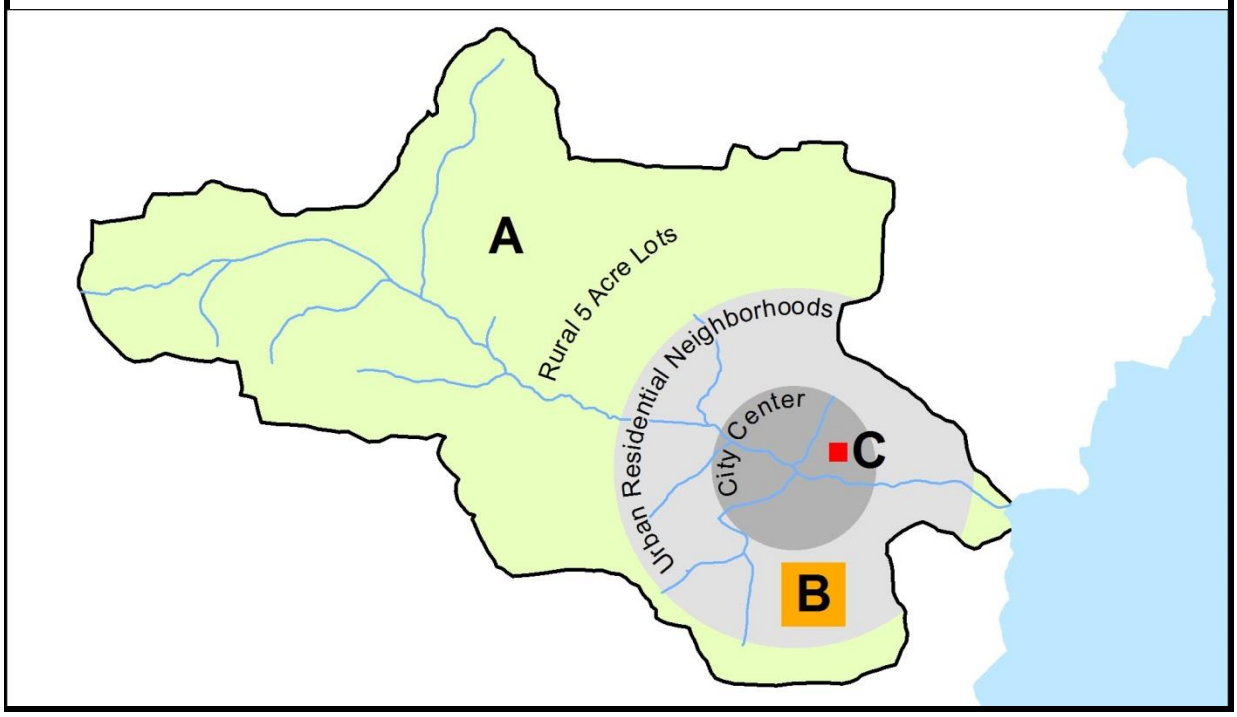


FIGURE 6: COMPACT GROWTH AS A FORM OF LOW IMPACT DEVELOPMENT.

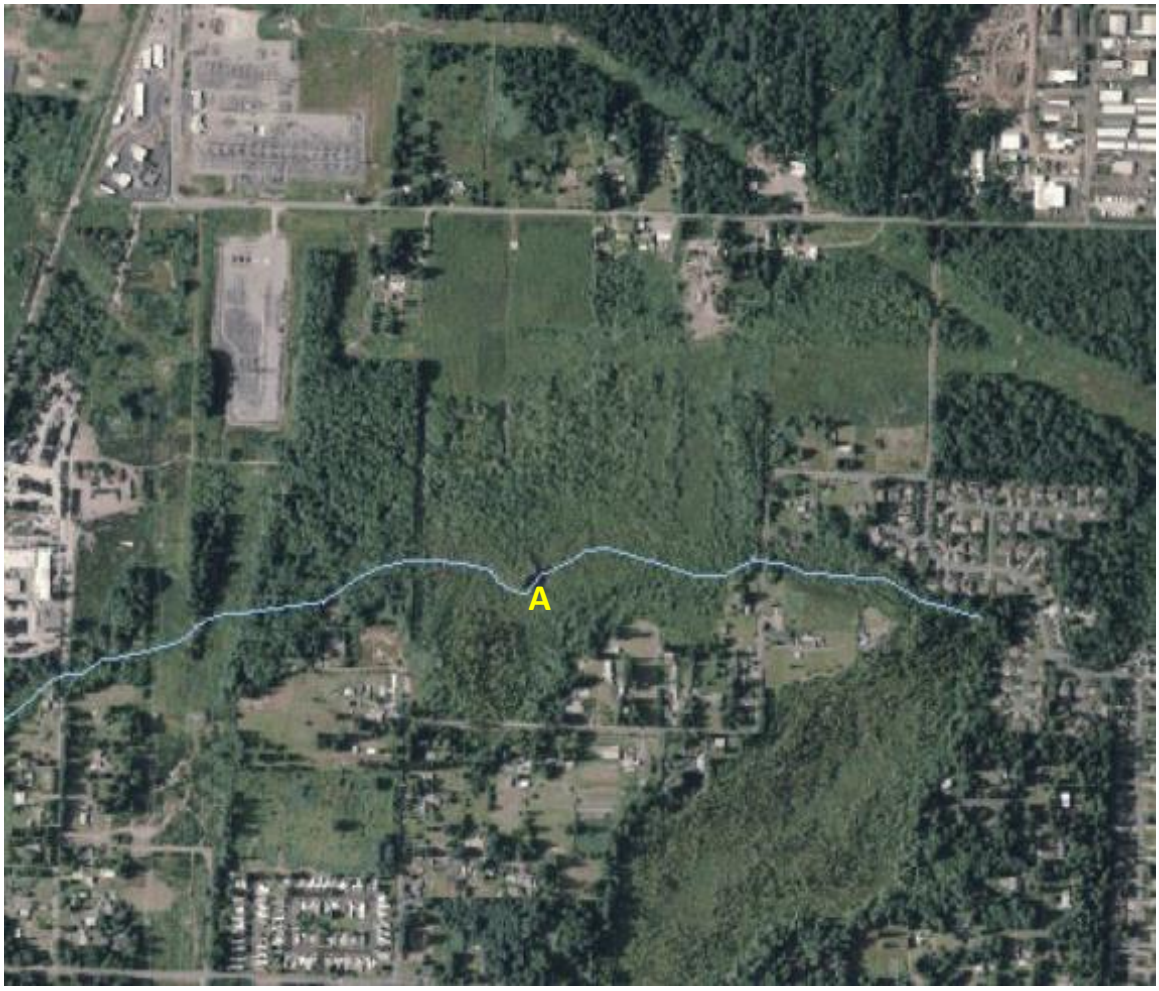
Alternative Future B

The Future B scenario built on the Future A scenario and added the following (Map 10):

- Restore forest cover (where altered) along the major stream corridor that drains into Black Lake near Kenneydell Park and the stream near Black Lake Grocery (Figure 7)
- Restore wetland hydrology (where degraded) along the major stream corridor that drains into Black Lake near Kenneydell Park (Figure 8).
- Implement stormwater retrofit projects for older residential rural subdivisions (Figure 9)

The stream corridor (A) along the creek that drains into Black Lake is an example where planting trees in the riparian area could help shade the stream and filter contaminants from stormwater. Restoration sites for Future B were identified by examining stream corridors around major creeks through aerial photography. Many restoration opportunities are on private property, and will require working with the landowner.	

FIGURE 7: EXAMPLE OF A POTENTIAL RESTORATION SITE.



Much of the eastern portion of Black Lake basin was an extensive wetlands complex prior to development. Restoring wetlands could help alleviate flooding, such as that shown on Kirsop Road (A) on various photos.

FIGURE 8: EXAMPLE OF A POTENTIAL WETLAND RESTORATION AREA.

Stormwater retrofit is a term used when stormwater treatment is added to areas of existing development. Under current regulations, all new developments must be built with stormwater treatment facilities, but there are many existing development where stormwater can flow untreated into natural water bodies. These are areas where retrofits would be beneficial to water quality.

The project team asked public works and water resources professionals to identify areas where stormwater retrofits may be beneficial for the purposes of developing the Future B scenario.

FIGURE 9: EXAMPLE OF A STORMWATER RETROFIT PROJECT.

Comparison of Results

Land Use and Dwelling Units

Black Lake basin is a moderately developed area and has around 2,330 homes in it under current conditions. Under the Planned Trend, at buildout it would have around 5,970 homes, or an increase of 171%. Under the Future A and B Alternatives, buildout within the city would remain the same, but the unincorporated areas (rural and unincorporated growth areas combined) would see a significant reduction in potential buildout. This would be a result of rezoning a portion of the unincorporated growth area to rural densities (and removing it from the growth area), and rezoning rural areas along the stream corridor to lower densities.

What is Buildout?

Buildout is a theoretical maximum number of homes that can be built in a specific area based on current land use, ownership, and zoning. It is unlikely that all of the possible homes that could be built will be built, as many land owners will choose to keep their properties undeveloped. Properties that are designated for parks, open space, and long term forestry are not considered to be buildable.

TABLE 5: NUMBER OF DWELLING UNITS FOR CURRENT AND FUTURE SCENARIOS.

Dwelling Units (homes)	Current Condition 2010	Planned Trend Buildout	Future A & B Buildout
City	1,100	4,030	4,030
Unincorporated	1,230	2,280	1,940
Total	2,330	6,310	5,970
Percent Increase from Current Condition			
City		266%	266%
Unincorporated		85%	58%
Total		171%	156%

SOURCE: THURSTON REGIONAL PLANNING COUNCIL.
NOTE: DOES NOT INCLUDE REDEVELOPMENT, FAMILY MEMBER UNITS OR ACCESSORY DWELLING UNITS.

Land Cover

Compared with historic conditions, Black Lake basin has lost a considerable amount of forest cover, as well as some wetlands, but has only moderate coverage of impervious surfaces. Under the Planned Trend scenario, more forested and open areas would be converted to hard surfaces (roofs, roads, driveways) and other uses, and total impervious surfaces in the basin could increase to 10%. Land use changes in Alternative A would mitigate this result somewhat, but do not restore tree cover or ecological processes such as storage of water. By restoring vegetation, particularly along streams, Future Alternative B leads to the recovery of some forest cover, as well as a total reduction in polluting surfaces (Map 11, Map 12).

TABLE 6: COMPARISON OF HISTORIC, CURRENT, AND FUTURE LAND COVERS.

	Historic Condition	Current Condition 2010	Planned Trend Buildout	Future A	Future B
Forest	72%	56%	55%	55%	56%
Pasture/Prairie	6%	14%	11%	12%	11%
Grass	0%	6%	9%	8%	8%
Wetland	17%	16%	15%	15%	15%
Water	5%	5%	5%	5%	5%
High-polluting Total Impervious Area	0%	3%	4%	4%	3%
Low-polluting Total Impervious Area	0%	3%	6%	5%	5%

SOURCE: NHC 2014[7]

Water Flow & Water Quality

The hydrologic model tested the effects of each of the five scenarios on surface water flow in the basin to the lake (hydrology), both for the basin as a whole and for the area draining into Fish Pond Creek and entering Black Lake at Kenneydell Park. This allowed the study to partially isolate the impacts associated with the area that is likely to become the most developed in the future. The study focused on surface water flows to the lake, and did not consider processes within the lake itself, nor did it consider effects associated with groundwater.

Overall, when compared with historic conditions, minimum water flow into the lake has not changed substantially; however, streams on the east side of the lake are flashier, with sharply higher flows after storms and lower low flows in dry weather. These streams have a greater number of high pulse events when the amount of water in the stream doubles from its average flow. These high pulse events also last longer than they would have historically, and both these factors affect the ecological communities of macroinvertebrates that are sentinels for stream health, and that are vulnerable to changes in flow brought by urbanization. Looking at the basin as a whole, the flashiness of inflows to the lake is dampened by the lake's storage capacity, and flows are smoothed out for the outflow to Black Lake Ditch. None of the future scenarios led to significant degradation from existing conditions, and none made changes sufficient to restore flow patterns into the lake to historic conditions.

The model also considered several water quality parameters, including temperature, bacteria (fecal coliform), and nitrates. Water quality has degraded, with substantial increases in the number of days that stream temperatures are too warm, as well as increased nutrient and bacteria loads. Under existing

[7] Percentages in this table look at the Black Lake basin, plus the additional contributing area around the Dempsey and Fish Trap Creek tributaries to the Black River, which contribute a portion of their runoff to Black Lake – a total area of 19.2 square miles. Much of this additional area is forested and in a natural condition, which the more developed areas are within the core Black Lake basin, including within the city of Tumwater.

conditions, phosphorus loading for the basin is estimated to have approximately doubled relative to historic conditions. The differences between the Planned Trend and Alternative Future scenarios were much smaller when compared with the changes from Historic to Current conditions. In general, the Planned Trend scenario did not lead to additional degradation in the basin; however, fecal coliform concentrations in Fish Pond Creek at Kenneydell Park will increase slightly, though they decrease slightly for the basin as a whole. This outcome was seen in the modeling despite the assumption that all units on septic systems within the city and UGA boundaries will be converted to sewer.

With the land use changes proposed in Future Scenario A, water quality would improve in some local stretches of streams, including in Fish Pond Creek. Nitrate loads would be reduced in this tributary thanks to increased water quality treatment for sites developed to a low-impact standard. The greatest improvements were seen in Alternative Future Scenario B, which includes restoration of riparian and wetland areas, retrofits of older development to provide improved stormwater flow control and treatment in addition to land use changes. Under Future Scenario B, temperature in tributaries to the lake would be restored to closely resemble conditions prior to any development in the region and nutrient levels would be substantially reduced. This scenario would provide the greatest benefit to aquatic health for the basin, although it would not address nutrient issues associated with internal lake processes.

A summary that compares the results from the alternative futures modeling is shown in Table 7. For a complete discussion of the model results, see NHC 2014.

TABLE 7: BLACK LAKE BASIN MODELING RESULTS SUMMARY

	Planned Trend	Future Alternative A	Future Alternative B
Hydrology	No change	No change	No change
Temperature	No change (frequent violations)	No change (frequent violations)	Large improvement
Fecal Coliform (Bacteria)	Small local increase; small reduction basin-wide	Small reduction	Small reduction
Nitrate	No significant change	Moderate reduction	Moderate reduction
Overall Benefit to Aquatic Health	Mixed	Moderate	Moderate

SOURCE: NHC 2014

Septic Systems & Water Quality

One question raised at the start of the modeling was whether the Planned Trend scenario would result in less nutrient pollution than in the alternative future scenarios. Because traditional septic systems do not remove nutrients, a single home using a septic system can contribute between 8 to 20 times as much nitrate to groundwater and shallow sub-surface flows as one that is hooked up to a sewer system, which will treat waste at a central facility. When many homes are concentrated in a sensitive area, this can cause a substantial impact to water quality. Alternative Future A and B scenarios include an adjustment to the growth area boundary (Figure 4). This will affect how many homes are likely to have access to sewer infrastructure versus septic systems. Under the Growth Management Act, sewer

infrastructure should only be extended to development within the urban growth area (UGA) and city limits, so homes that remain outside that boundary are likely to be permanently on septic systems[8].

One hypothesis was that the Planned Trend scenario would result in less nitrate and bacteria pollution than current conditions and Future A and B, because although the Planned Trend would result in more new homes overall, there would be fewer homes on septic systems. In practice, this assumption was complicated by the fact that some homes on septic systems pose a higher risk to water quality because of factors such as their proximity to water or the soil type used for drainage. The project team identified areas that would be considered higher risk for contributing pollution loads, and noted those septic systems as being higher contributors in the model (see Table 8). Many of these higher-risk areas are along the lake shore, and a portion of them are in the area that would be removed from the Tumwater UGA in Alternative Future scenarios A and B. As discussed above, the Planned Trend showed mixed results, with a small decrease in bacteria loading for the basin, but a local increase for some of the area slated to be removed from the UGA, no significant change in nitrate loading and a moderate reduction in phosphorus loading. The land use changes and low impact development of Alternative Future A seem to offset the benefit of sewering additional homes in Planned Trend, resulting in greater reductions of bacteria and nutrient loads, while the restoration actions of Alternative Future B bring the greatest benefit of all the scenarios.

TABLE 8: ESTIMATES OF NITRATE POLLUTION UNDER CURRENT CONDITIONS, PLANNED TREND, AND FUTURE A & B.

	Current Condition 2010	Planned Trend Buildout	Future A & B Buildout
Number of homes in area that is designated in Future A & B Scenarios for removal from UGA	190	520	210
Type of wastewater treatment	septic	sewer	septic
Number of homes on septic systems in a high-risk zone for fecal coliform, total basin[9]	668	355	458
Number of homes on septic systems in a high-risk zone for nitrates, total basin[7]	1,177	561	755

Interpretation and Limits of Results

In summary, the model results indicate that:

[8] Under RCW 36.70A.110(4), exceptions to extending urban services, such as a sewer line, into rural areas may only be justified, "in those limited circumstances shown to be necessary to protect basic public health and safety and the environment and when such services are financially supportable at rural densities and do not permit urban development."

[9] Source: NHC 2014.

- Existing land uses in the basin have impacted both water flow patterns and water quality, when compared to conditions that would have prevailed prior to Euro-American settlement in the 1850s. The tributaries draining areas that have developed, such as land within the city of Tumwater, are flashier with higher flows after storm events, due to the higher percentage of impervious area in upland areas that channel runoff into streams instead of into the ground. Bacteria and nutrient loads to the lake are much higher than they would have been prior to development.

- Although the analysis shows that there has been significant degradation of water quality when compared with historic conditions, this trajectory seems to have slowed, and conditions are not seen to get dramatically worse under the Planned Trend scenario. This result indicates that current regulations – including zoning and critical area protections – when properly implemented, can be effective at minimizing the impact of new development.

- Lowering the dwelling unit densities through downzoning, as presented in Alternative Future A, by itself is unlikely to have a substantial impact on water flow or water quality basin-wide, although there may be localized improvements in some smaller areas.

- Removing the proposed area from the Tumwater UGA, as proposed in Alternatives A and B, would not degrade water quality in Black Lake, and may lead to potential water quality improvements when compared to development that could occur under the Planned Trend. The potential water quality improvements of converting homes in this area from on-site septic systems to sewer under the Planned Trend scenario could be offset by other actions included in the Alternative Future scenarios, such as having all new homes in the basin built to a low impact development standard.

- The policies identified for Future Alternative B, which pairs land use changes with a substantial restoration effort, will have the greatest benefit to water quality in Black Lake basin. In particular, revegetating shorelines where they have been cleared will help to shade and cool streams. Such restored riparian areas will also reduce the amount of fecal coliform bacteria and nitrogen loading into streams. Restoration of degraded wetland areas would provide additional storage and treatment in some areas.

- Retrofitting older stormwater infrastructure to provide more flow control and water quality treatment can bring substantial improvements to stream conditions.

- No scenarios approach the simulated Historic condition. This is in part due to a lack of forest restoration in any scenarios – all non-pervious land covers will contribute nutrients and bacteria through runoff at more than twice the rate of a forested area. To restore water quality to be closer to historic, pre-development condition, existing pasture areas would need to be treated for nutrient removal, or returned to a non-agricultural, forested use.

A number of assumptions were made in the development and application of the model that should be considered when interpreting these results. The future scenarios assumed that new development would only clear and cover a minimal amount of each parcel with impervious surfaces, rather than the total amount allowed under current regulations (for example, up to 60% in areas zoned RRR 1/5). More extensive clearing and conversion could lead to additional impacts in the watershed. The model also assumed that all pasture areas have some livestock or agricultural use, and that this use would contribute a certain amount of bacteria and nutrient loads – these contributions could be lessened or mitigated through a variety of best practices. The model analysis assumed that existing regulations would effectively protect critical areas, and that stormwater facilities, including those required under the new low impact development standard, would be mostly effective at reducing and treating stormwater to mimic a pre-developed, forested condition. This assumption underlines the need for tools to ensure these facilities are properly built and maintained over time.

The model results provide a window into the potential effects of different policies, but they are limited to considering only impacts to water flow and water quality – they do not take into account many other important environmental factors that should be considered as part of the planning effort. For example, the model does not account for the many habitat benefits that would come from preserving tree cover in the basin. For this reason, the recommendations listed in Section 4 of this study are based on the full spectrum of information included in this report, rather than solely on the model results.

Public Views on Future Scenarios

On October 30, 2014, Thurston County and Thurston Regional Planning Council (TRPC) hosted a second community workshop for residents of Black Lake basin and other interested parties. Attendees had the opportunity to view maps that showed the different future scenarios and outlined different outcomes associated with each, including the results of the modeling work. They were provided with colored dots that they could place to indicate items they liked (green dot) or disliked (red dot) about a certain scenario, and could also write comments on notes attached to the maps.

Overall, participants showed support for policies that go beyond maintaining current conditions in the basin to actions that restore ecological functions and improve water quality. Of the three future scenarios, participants generally disliked the Planned Trend scenario, which had the greatest increase in projected number of new dwelling units and showed the most area to be annexed into the city of Tumwater. Some residents in the area identified for potentially being removed from the Tumwater UGA in the Alternative Future A scenario indicated they preferred the area remain rural. Participants liked the restoration actions of Future Alternative B, but were concerned about the cost associated with such activities. Some participants suggested that their preference was for a combination of actions in Alternative Future scenarios A and B – actions that would simultaneously limit growth in existing rural area, concentrate that growth in the urban areas of Tumwater, take a low impact development approach, and restore degraded areas.

4. Management Recommendations

This watershed study provided an opportunity to consider current conditions in the Black Lake basin, how future growth and development may impact those conditions, and how alternative management approaches might affect that future. The following recommendations for management actions in the Black Lake basin are based on the basin alternatives analysis outlined above in Section 3, as well as public input and other information described in this report. This section outlines four overarching ***goals*** for the basin – these are high-level statements that outline the desired aim of any actions taken. The basin goals are grounded in the watershed-scale assessments completed in the Baseline Conditions report and Puget Sound Watershed Characterization project, which both emphasized the need for protection and restoration of ecological functions in this basin, as well as in the feedback received during public outreach. Associated with each goal are a mix of ***strategies*** intended to set the guiding direction for achieving that goal, as well as specific ***actions*** that address each strategy. Some actions have priority areas for implementation, as identified in the analyses or other planning efforts. These actions can be taken on by Thurston County, as well as other local jurisdictions, state and federal agencies, or community organizations.

GOAL B.1 Maintain and restore basin-wide ecological functions, particularly surface storage of water and recharge to groundwater

Black Lake basin was identified as a priority area for protection and restoration of water flow processes. The basin historically has a high percentage of wetlands, and while some of these remain, many wetlands were drained or modified, resulting in a loss of storage capacity. Development in the basin has resulted in an overall loss of forest cover, as well as more areas covered with impervious surfaces or converted to lawns. As a result, less precipitation is stored on site or allowed to infiltrate to groundwater, and more is directed as runoff into tributaries to Black Lake. This disruption of hydrology, combined with high groundwater in some areas, also has likely contributed to flooding issues in the basin. The basin is likely to see a significant amount of growth in the future, and while the modeling results show that existing regulations do a good job of reducing some impacts, it is important that new development not exacerbate these issues. Construction should be designed to minimize discharge and retain existing tree cover and vegetation, and mitigate any impacts to remaining wetlands.

Strategies

- Minimize the installation of new impervious surfaces
  Thurston County areas
  - Require clustering of new development (See Memo, Appendix A)
  - Consider ways to minimize new impervious surfaces from detached family member units (see Memo, Appendix B)
  - Establish impervious surface limits through zoning for this basin (See Memo, Appendix C)
  - Consider implementing an impervious surface trading program that would shift the placement of new surfaces out of sensitive areas

Tumwater areas

- Allow grouped units such as duplexes, townhouses, fourplexes as part of new development. (see Memo, Appendix E)
- Require narrower streets as part of development near wetlands and in high groundwater areas. (see Memo, Appendix E)

- Maintain existing tree cover and native vegetation, particularly along riparian corridors

  Thurston County areas

  - Establish tree retention standards for the rural portions of the basin to ensure canopy cover remains at current levels or better
  - Review open space standards, and consider increasing incentives to landowners who set aside and maintain open space

  Tumwater areas

  - Base the number of permitted units on density rather than minimum lot size (see Memo, Appendix E)
  - Make the storm system and natural areas a key part of the development's open space and an extension of people's yards (see Memo, Appendix E)
  - Designate sensitive area tracts as areas separate from individual lots (see Memo, Appendix E)

- Implement low impact development approaches for areas that develop
  - *County and Tumwater*: Update stormwater regulations to encourage low impact development, where feasible, in accordance with state guidelines

- Encourage and support the restoration and enhancement of degraded wetland and riparian areas

  County

  - Identify potential mitigation sites for use in the pilot in lieu fee mitigation program
  - Develop guidance and improved outreach for landowners interested in conducting voluntary restoration on their own properties
  - Provide priority ranking for funding of projects in this basin, including through Conservation Futures
    - Priority areas: Fish Pond Creek, Goldsby Creek (next to Black Lake Grocery), unnamed creek near Guerin Park property
  - Work with Bonneville Power Administration to consider options for appropriate vegetation and wetland restoration under power lines

  Tumwater

  - Fund and construct retrofit projects in Black Lake basin already identified in Capital Facilities Plan
    - *Priority areas*: undersized culverts and drainage ditches that contribute to flooding along Kirsop Road

- Monitor key indicators – such as impervious surfaces, water quality, and acres of forested land – to assess long-term condition of basin
  - Continue annual monitoring through TRPC's benchmark program

- Consider how climate change may affect ecological functions
  - Develop a watershed-based climate resilience plan

GOAL B.2 Protect and improve water quality in sources to Black Lake

Past development and current activities have substantially degraded water quality in tributaries to Black Lake, resulting in higher levels of bacteria and nutrients when compared with historic conditions. These current conditions are likely contributing to water quality concerns in Black Lake, including the frequency of harmful algal blooms that result in lake closures. Residents in the basin are very concerned about water quality in the lake and would like more actions taken to improve current conditions to ensure the lake is in better condition in the future. The modeling study found that land use changes could help hold the line against further degradation and improve some parameters, while actions that address existing impairments could result in a substantial improvement to water quality. More information is needed to understand how ecological processes within the lake itself contribute to an ongoing cycle of excess nutrients and low oxygen conditions, and how these processes compare with potential contributions from sources to the lake.

Strategies

- Limit dense development in sensitive areas

  County

  - Consider removing area from the Tumwater UGA along the shore of Black Lake and rezone to a lower density, such as Residential 1/10
    - *Priority area*: Area within the UGA south of 66th Street and between Black Lake-Belmore and the lake shore. Boundary to be refined after additional analysis to consider factors such as neighborhoods with higher septic densities
  - Consider lowering zoning densities in sensitive areas
  - Support protective shoreline regulations through update of Thurston County Shoreline Management Program
  - Consider expanding the county's Transfer of Development Rights Program to include priority forested lands within Black Lake basin as applicable sending areas (See Memo, Appendix D)

  Tumwater

  - Base the number of permitted units on density rather than minimum lot size (see Memo, Appendix E)
  - Make the storm system and natural areas a key part of the development's open space and an extension of people's yards (see Memo, Appendix E)

- Minimize and reduce pollution from septic systems

  County

  - Expand septic risk assessment to identify high-risk areas for septics in the rural areas of the County
  - Institute focused operation and maintenance program for Black Lake basin, similar to existing program for Henderson Inlet

- *County and Tumwater:* Implement a focused program to convert high- and moderate-risk septic systems in the urban portion of basin to sewer systems
  - *Priority Areas*: Neighborhoods identified in 2015 Urban Septic Risk Assessment

- Minimize and reduce pollution from stormwater runoff
  - *County and Tumwater*: Update stormwater regulations to encourage low impact development, where feasible, in accordance with state guidelines
  - *County*: Investigate and prioritize additional stormwater retrofit opportunities within this basin in Thurston County's Capital Facilities Plan
  - *Tumwater*: Fund and construct retrofit projects in Black Lake basin already identified in Capital Facilities Plan
    - *Priority areas*: undersized culverts and drainage ditches, wetland mitigation and water quality treatment along Kirsop Road adjacent to Fish Pond Creek and wetland areas

- Minimize and reduce nutrient pollution from agricultural and residential use
  - Work with landowners to educate and encourage best management practices for agriculture
  - Develop homeowner education and outreach program to discourage use of fertilizer near lake and tributaries and encourage natural shoreline enhancement

GOAL B.3 Protect open space and critical habitat for wildlife and fish

Black Lake basin includes habitat for a number of priority species, including the Oregon Spotted Frog, which is a federally listed threatened species. Residents value opportunities they have to view wildlife in the area, and the more open feel of the northern reaches of the basin. The County should work to ensure that current regulations continue to protect critical habitat, and look for innovative ways to encourage preservation of open space areas.

Strategies

- Provide options for preserving habitat through land use regulations
  - Ensure development occurs in compliance with the Critical Areas Ordinance (TCC 24)
  - Encourage clustered development that preserves more open space and habitat (See Memo, Appendix A)
  - Consider expanding the county's Transfer of Development Rights Program to include priority wetlands and riparian areas within Black Lake basin as applicable sending areas, and developable areas within the city of Tumwater and its UGA as applicable receiving areas (see Memo, Appendix D)
  - Develop a regional approach to track and plan for open space
- Protect and enhance habitat for endangered and threatened species
  - Provide guidance for enhancement of Oregon Spotted Frog habitat in residential and agricultural areas
  - Develop guidance for maintenance of Oregon Spotted Frog habitat in county public right-of-way areas and stormwater facilities

GOAL B.4 Support and increase recreational opportunities

Residents in Black Lake basin value access to recreational opportunities in the basin, including existing boat ramps and Kenneydell County Park. Some additional areas within the basin were identified as places used informally by residents and visitors for low-impact recreation. In its planning efforts, the County and other entities should consider ways to expand existing recreational opportunities to provide additional low-impact recreation in this basin.

Strategies

- Ensure land use regulations support recreation use in appropriate areas
    - Adjust zoning around Kenneydell Park to Public Parks, Trails & Preserves to better reflect use in this area
- Develop recreational facilities
    - Consider areas for purchase and development of low-impact recreation facilities, including hiking trails, and interpretive displays
        - Priority areas: Black Hills area in northwest portion of basin; southern wetlands complex

5. Implementation and Next Steps

This study identified a number of recommended strategies and actions to protect and improve water quality and aquatic resources in the Black Lake basin. Accomplishing the goals set out in the previous section will require leadership and continued support from project partners as well as funding for many of the individual actions. Because this study was directed by Thurston County, most of the actions noted are ones that should be led by one or another county department, except where noted otherwise. Additional actions could be taken up by other organizations interested in supporting these strategies.

The actions identified in this study can be grouped into a number of different categories; some may potentially be addressed by work that is currently underway.

Land use. These actions concern changes to zoning, development regulations, or plans that guide land use in the County, such as the Shoreline Master Program (SMP) or Comprehensive Plan (CP). Actions in this category would likely be led by Thurston County's Long-Range Planning Division.

- *Code review:* The County is currently reviewing many of its development codes for as required under its NPDES stormwater permit to make low impact development the preferred option for development. This code review is being led by an interdepartmental LID Work Group and is covering topics like tree and vegetation retention, cluster and open space standards, and impervious surface limits.

Programs. These actions would involve the modification of current programs run by the county, or the development of entirely new programs.

- *Outreach and education*: This study identified a need for additional outreach to landowners in a number of categories, and a way to provide centralized information and support for those who may be interested in either preserving large open areas or doing restoration in degraded areas.

Table 9 lays out an implementation plan that identifies the potential lead and timeline for each action.

TABLE 9: IMPLEMENTATION OF BASIN-SPECIFIC ACTIONS

Goals, *Strategies*, Actions			Category	Lead	Partners
B.1 Maintain and restore basin-wide ecological functions, particularly surface storage of water and recharge to groundwater					
	Minimize the installation of new impervious surfaces				
		Require clustering of new development	Land use; code review	County, Tumwater	LID Work Group
		Consider ways to minimize new impervious surfaces from detached family member units	Land use; code review	County	LID Work Group
		Establish impervious surface limits through zoning for this basin	Land use; code review	County	LID Work Group

Goals, *Strategies*, Actions			Category	Lead	Partners
		Consider implementing an impervious surface trading program that would shift the placement of new surfaces out of sensitive areas	Programs	County	
		Allow grouped units such as duplexes, townhouses, fourplexes as part of new development.	Land use; code review	Tumwater	
		Require narrower streets as part of development near wetlands and in high groundwater areas.	Code review	Tumwater	
	Maintain existing tree cover and native vegetation, particularly along riparian corridors				
		Establish tree retention standards for the rural portions of the basin to ensure canopy cover remains at current levels or better	Land use; code review	County	LID Work Group
		Review open space standards, and consider increasing incentives to landowners who set aside and maintain open space	Land use; code review	County	LID Work Group
		Base the number of permitted units on density rather than minimum lot size	Land use; code review	Tumwater	
		Make the storm system and natural areas a key part of the development's open space and an extension of people's yards	Code review	Tumwater	
		Designate sensitive area tracts as areas separate from individual lots	Land use; code review	Tumwater	
	Implement low impact development approaches for areas that develop				
		Update stormwater regulations to encourage low impact development, where feasible, in accordance with state guidelines	Land use; code review	County, Tumwater	LID Work Group
	Encourage and support the restoration and enhancement of degraded wetland and riparian areas				
		Identify opportunities for use in the pilot in lieu fee mitigation program	Programs	County	
		Develop guidance and improved outreach for landowners interested in conducting restoration on their own properties	Programs; outreach	County	
		Provide priority ranking for funding of projects in this basin	Programs	County	
		Work with Bonneville Power Administration to consider options for appropriate vegetation and wetland restoration under power lines	Programs; research		
		Fund and construct retrofit projects in Black Lake basin already identified in Capital Facilities Plan	Programs; CFP	County, Tumwater	
	Monitor key indicators to assess long-term condition of basin				

Goals, *Strategies*, Actions			Category	Lead	Partners
		Continue annual monitoring through benchmark program	Programs	TRPC	
	Consider how climate change may affect ecological functions				
		Develop a watershed-based climate resilience plan	Land use	TRPC	County
B.2 Protect and improve water quality in sources to Black Lake					
	Limit dense development in sensitive areas				
		Consider removing area from the Tumwater UGA along the shore of Black Lake and rezone to a lower density, such as Residential 1/10	Land use	County	Tumwater
		Consider lowering zoning densities in sensitive areas	Land use	County	
		Support protective shoreline regulations through update of Thurston County Shoreline Management Program	Land use	County	
		Consider expanding the county's Transfer of Development Rights Program to include priority forested lands within Black Lake basin as applicable sending areas	Programs	County	
		Base the number of permitted units on density rather than minimum lot size	Land use; code review	Tumwater	
		Make the storm system and natural areas a key part of the development's open space and an extension of people's yards	Code review	Tumwater	
	Minimize and reduce pollution from septic systems				
		Expand septic risk assessment to identify high-risk areas for septics in the rural areas of the County	Research	County	
		Institute focused operation and maintenance program for Black Lake basin, similar to existing program for Henderson Inlet	Programs	County	
		Implement a focused program to convert high- and moderate-risk septic systems in the urban portion of basin to sewer systems	Programs	County; Tumwater	
	Minimize and reduce pollution from stormwater runoff				
		Update stormwater regulations to encourage low impact development, where feasible, in accordance with state guidelines	Code review	County; Tumwater	
		Investigate and prioritize additional stormwater retrofit opportunities within this basin in Thurston County's Capital Facilities Plan	Programs	County	
		Fund and construct retrofit projects in Black Lake basin already identified in Capital Facilities Plan	Programs	Tumwater	
	Minimize and reduce nutrient pollution from agricultural and residential use				

Goals, *Strategies*, Actions			Category	Lead	Partners
		Work with landowners to educate and encourage best management practices for agriculture	Programs	County	
		Develop homeowner education and outreach program to discourage use of fertilizer near lake and tributaries and encourage natural shoreline enhancement	Programs	County	
B.3 Protect open space and critical habitat for wildlife and fish					
	Provide options for preserving habitat through land use regulations				
		Ensure development occurs in compliance with the Critical Areas Ordinance	Land use; ongoing	County	
		Encourage clustered development that preserves more open space and habitat	Land use; code review	County	LID Work Group
		Consider expanding the county's Transfer of Development Rights Program	Programs	County	
		Develop a regional open space plan	Land use	TRPC	County
	Protect and enhance habitat for endangered and threatened species				
		Provide guidance for enhancement of Oregon Spotted Frog habitat in residential and agricultural areas	Research		USFWS
		Develop guidance for maintenance of Oregon Spotted Frog habitat in county public right-of-way areas and stormwater facilities	Research		USFWS
B.4 Support and increase recreational opportunities					
	Ensure land use regulations support recreation use in appropriate areas				
		Adjust zoning around Kenneydell Park to Public Parks, Trails & Preserves to better reflect use in this area	Land use	County	
	Develop recreational facilities				
		Consider areas for purchase and development of low-impact recreation facilities	Programs	County	

This study did not include an analysis of the costs associated with the different scenarios, but an initial next step could include a prioritization of actions that includes such an analysis. Collaboration among the different groups and partners with interest in the watershed will be essential to carrying out these recommendations, as will continued monitoring to track the condition of the basin over the long term.

References

ABHL, 2012. Integrating LID into Local Codes: A Guidebook for Local Governments. Prepared by AHBL for the Puget Sound Partnership. July 2012.

Arnold, C. L., Jr., and Gibbons, C.J. (1996). Impervious Surface Coverage - The Emergence of a Key Environmental Indicator. *Journal of the American Planning Association, 62*(2), 243-258.

Northwest Hydraulic Consultants (NHC) (2014). *Thurston County Hydrologic Modeling for Watershed Based Land Use Planning.*

Stanley, S. 2010. *Puget Sound Watershed Characterization. Introduction to the Water Flow Assessment for Puget Sound: A Guide for Local Planners.* Publication No. 10-06-014.

Stanley, S., S. Grigsby, D. Booth, D. Hartley, R. Horner, T. Hruby, J. Thomas, P. Bissonnette, R. Fuerstenberg, J. Lee, P. Olson, and G. Wilhere. 2012. *Puget Sound Characterization – Volume 1: The Water Resource Assessments (Water Flow and Water Quality).* Washington State Department of Ecology. Publication No. 11-06-016. Olympia, WA

Stanley, S., G. Wilhere, C. Hume, S. Grigsby, E. McManus, M. Clancy, and the Watershed Characterization Technical Assistance Team. 2013. *Users Guide for the Puget Sound Watershed Characterization. Version 1. Draft – June 10th, 2013*. Ecology Publication No. 13-06-008.

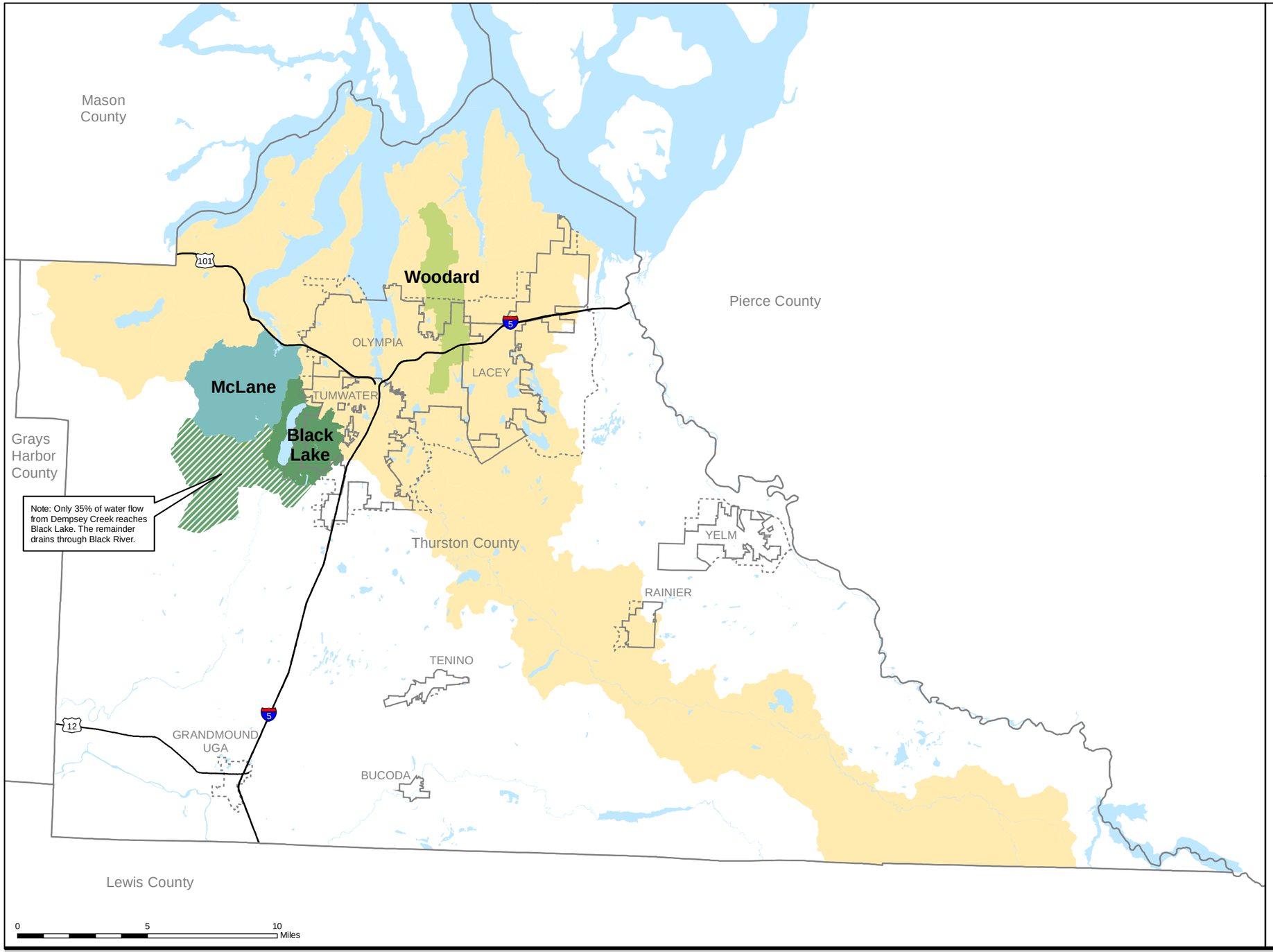
Thurston County Public Health and Social Services Department, Environmental Health Division and Thurston County Resource Stewardship Department, Water Resources Division (TCEH) (2012), *Thurston County Water Resources Monitoring Report: 2009-2010 Water Year and 2010-2011 Water Year*.

Thurston Regional Planning Council and Thurston County (2013), *Estimates of Current and Future Impervious Area for Watershed Based Land Use Planning*, Thurston County.

Thurston Regional Planning Council and Thurston County (2013), *Basin Evaluation and Management Strategies for Thurston County WRIAs 13 and 14*.

Thurston Regional Planning Council Sustainable Thurston Water Infrastructure Panel (2013), *Water Infrastructure Panel White Paper,* Sustainable Thurston.

List of Maps



Black Lake Basin
Map 1: Project Area

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Science to Local Policy Project Area

Modeled Basins
- Black Lake
- McLane Creek
- Woodard Creek

Jurisdiction
- City Limits
- Urban Growth Area (UGA)

THURSTON COUNTY
WASHINGTON
SINCE 1852

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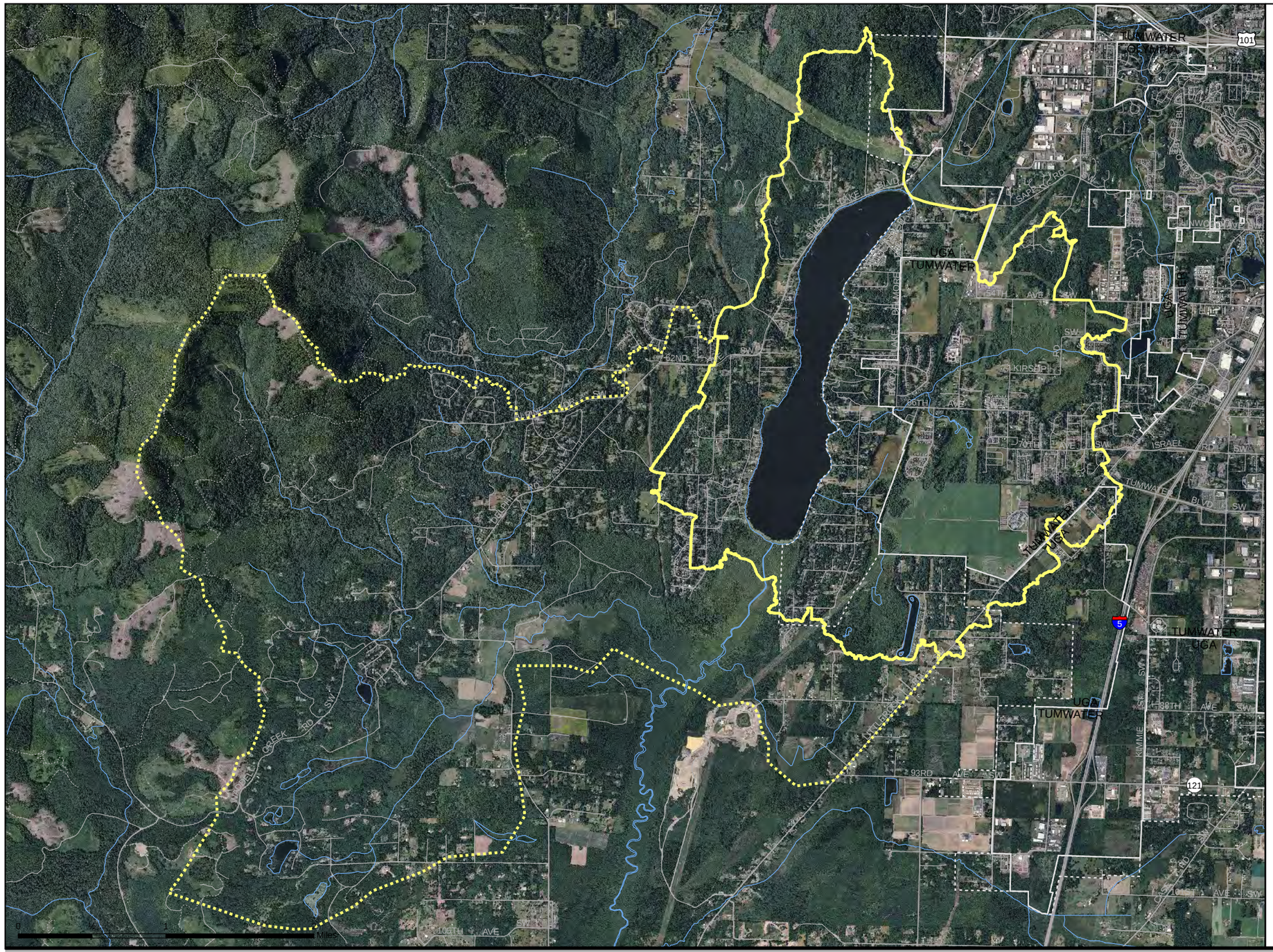

Black Lake Basin
Map 2: 2012 Aerial Overview

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- Basin Boundary
- City Limits
- Urban Growth Area

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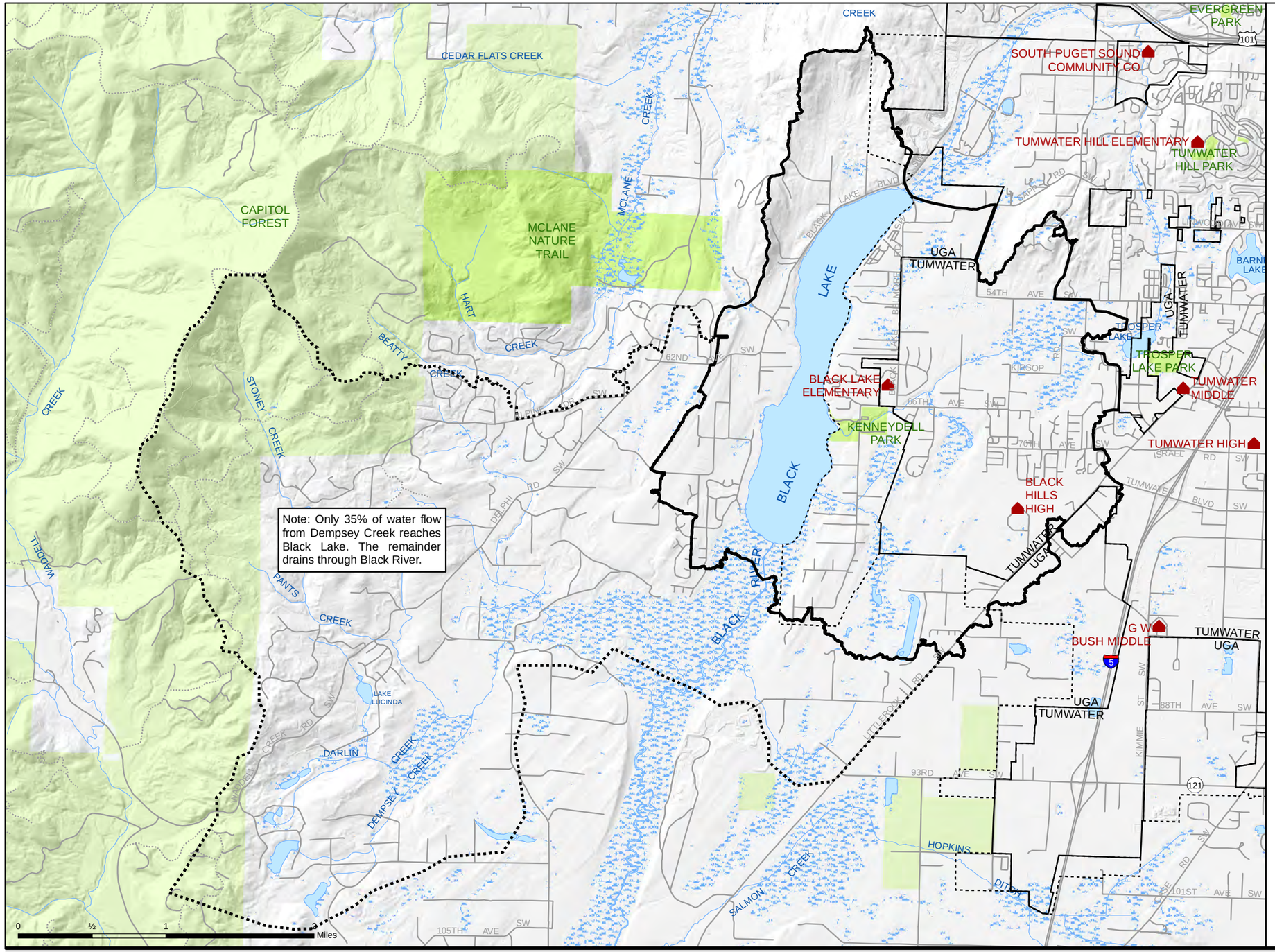

Black Lake Basin
Map 3: Basin Overview

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- Basin Boundary
- City Limits
- Urban Growth Area (UGA)
- Wetland Indicators
- Parks & Preserves
- Capitol Forest
- Schools

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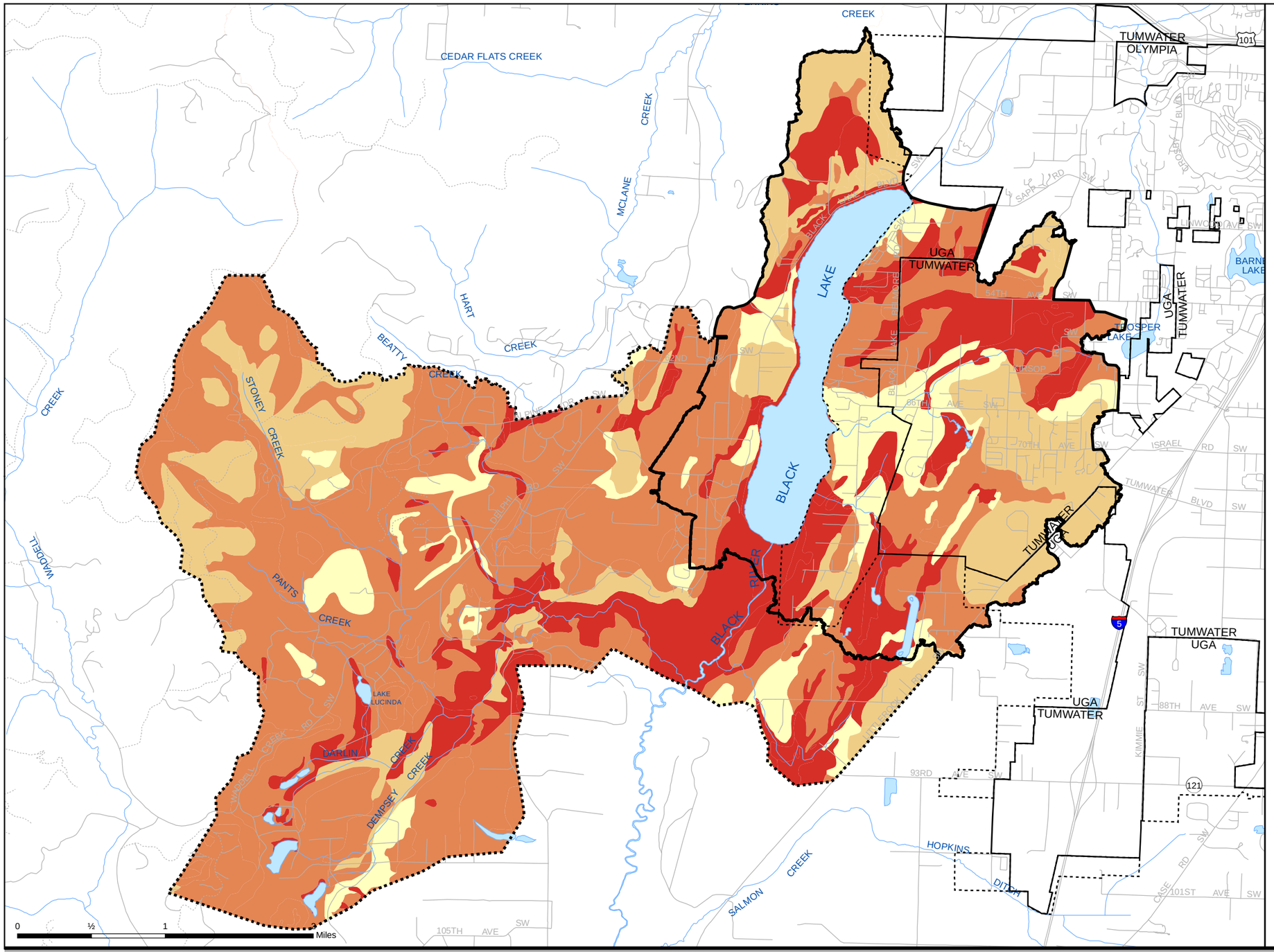
Black Lake Basin
Map 4: Soils



- Basin Boundary
- City Limits
- Urban Growth Area (UGA)
- **Group A Soils** Low runoff potential and high infiltration rates
- **Group B Soils** Moderate infiltration rates and moderately well to well drained soils.
- **Group C Soils** Low infiltration rates
- **Group D Soils** High runoff potential and very low infiltration rates. Includes soils with a high water table.

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Black Lake Basin
Map 5: Current Zoning (2014)

N W E S

Basin Boundary
City Limits
Urban Growth Area (UGA)

Zoning Category
- RURAL RESIDENTIAL (R 1/20, R 1/10)
- RURAL RESIDENTIAL RESOURCE 1/5
- RESIDENTIAL LAMIRD (RL 2/1, RL 1/1, RL1/2)
- RESIDENTIAL SENSITIVE RESOURCE (R/SR)
- SINGLE FAMILY RESIDENTIAL (SFL, SFM)
- MULTIFAMILY RESIDENTIAL (MFM, MFH)
- MANUFACTURED HOME PARK
- MIXED USE
- COMMERCIAL (CD, GC, NC)
- INDUSTRIAL (HI, LI)
- OPEN SPACE & PARKS (OS, GB, PP)
- LONG TERM FORESTRY

Shoreline Master Plan Designation
- Natural
- Conservancy
- Rural
- Other

0 ½ 1 2 Miles

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Black Lake Basin
Map 6: Residential Development Potential

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- Basin Boundary
- City Limits
- Urban Growth Area

2010 Residential Development Potential

- Recently Permitted
- Subdivision Lots
- Planned Projects
- Master Planned Communities
- Vacant Single Lots
- Vacant Subdividable Lots
- Partially-Used Subdividable
- Environmental Constraints

0 ½ 1 2 Miles

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Some refer to this area as "Sub Black Hills" - Want to make this area a nature preserve with recreational uses (bikes, hiking, horses). Ideal mountain biking & views

Keep undeveloped. Green

Maintain as green space (recreational area)

Chemicals used to control algae & milfoil damage native shore plants & wildlife not to mention people

Maintain existing zoning standards so as to meet current property owners expectations about future development potential

algae weed growth

Keep the blueberry farm here!! Save the Frogs! OSF [Oregon Spotted Frog]

Salmon (1970s) at culvert on Black Lk Blvd

Save Farmlands

Possible Development?

Lower zoning in this area. Fairview. Remove from UGA

Slow Boats Down Here

Amazing Bog

Mow ROW. Minimize herbicide

Keep this green

Maintain ROW See PHS info. OSF [Oregon Spotted Frog]

algae weeds boaters

Park Potential

Old Beaver Dam & Ponds

Salmon in small stream

wet wet wet down here ~ This farm is covered with high groundwater - springs and ponds in winter

I believe a mining company owns the grounds in this neighborhood. If they mine this (not sure how likely) can the county put in some regs?

Keep this safe green protected

Low zoning for future development on this property - Doelman Farm. Safe water use practiced on agr land

Lower zoning

Proposed school site. Water drains south

Black Lake Basin

Map 7: Public Comments from April 2014 Workshop

At the McLane Creek and Black Lake Community Workshop (4/9/2014), participants were asked two questions:

What special areas need protection?

What special concerns do you have?

This map shows the comments that were received.

- Basin Boundary
- City Limits
- Urban Growth Area

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Black Lake Basin
Map 8: Water, Sewer and Stormwater Infrastructure

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- Basin Boundary
- City Limits
- Urban Growth Area (UGA)

Infrastructure

- Water
- Sewer
- Stormwater
- Future Service Area

0 ½ 1 2 Miles

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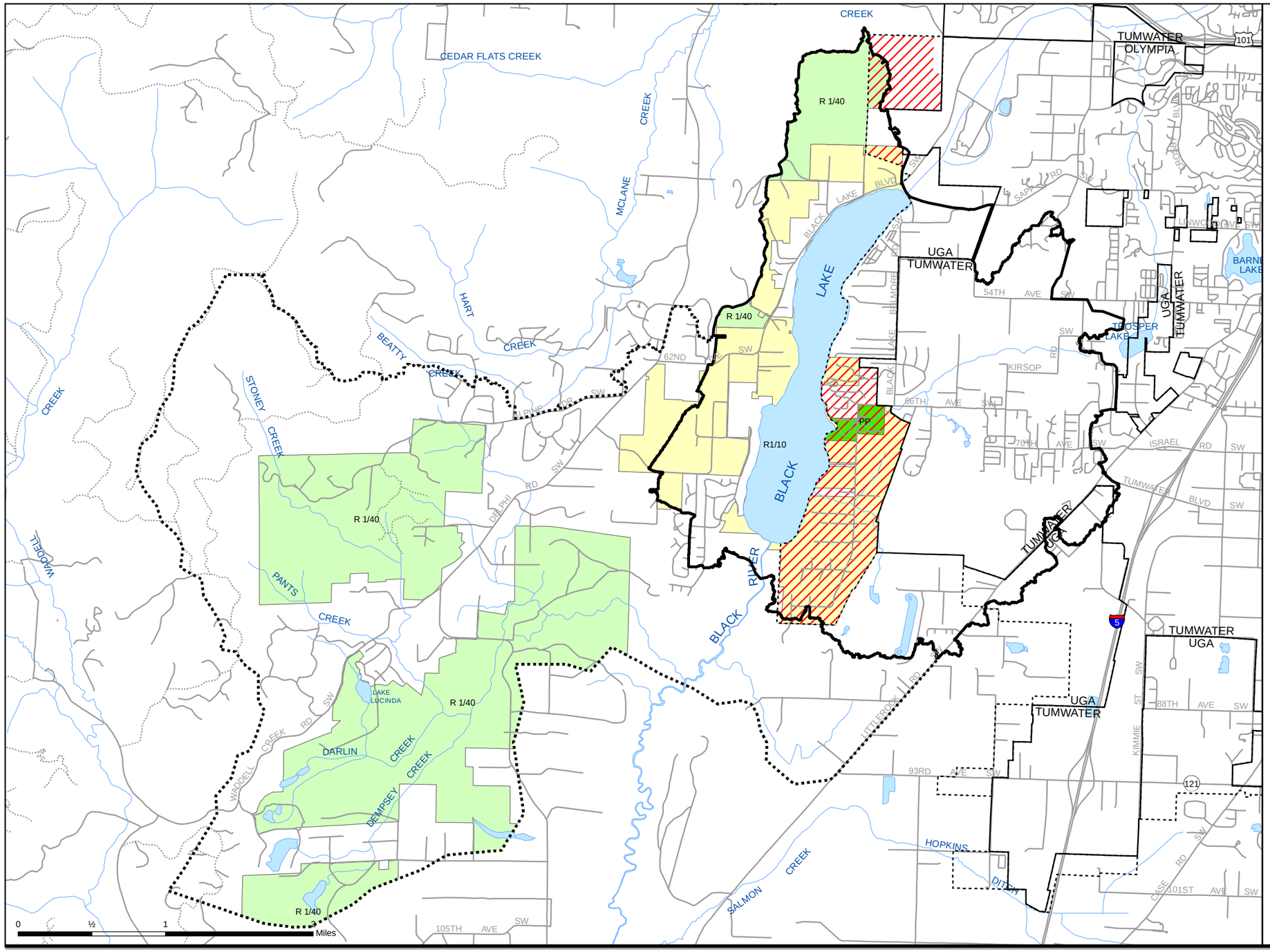

Black Lake Basin
Map 9: Future A Scenario

- Basin Boundary
- City Limits
- Urban Growth Area (UGA)
- Remove from UGA

Zoning Change

- RURAL RESIDENTIAL (1/40)
- RURAL RESIDENTIAL (R 1/20, R 1/10)
- OPEN SPACE & PARKS (OS, GB, PP)

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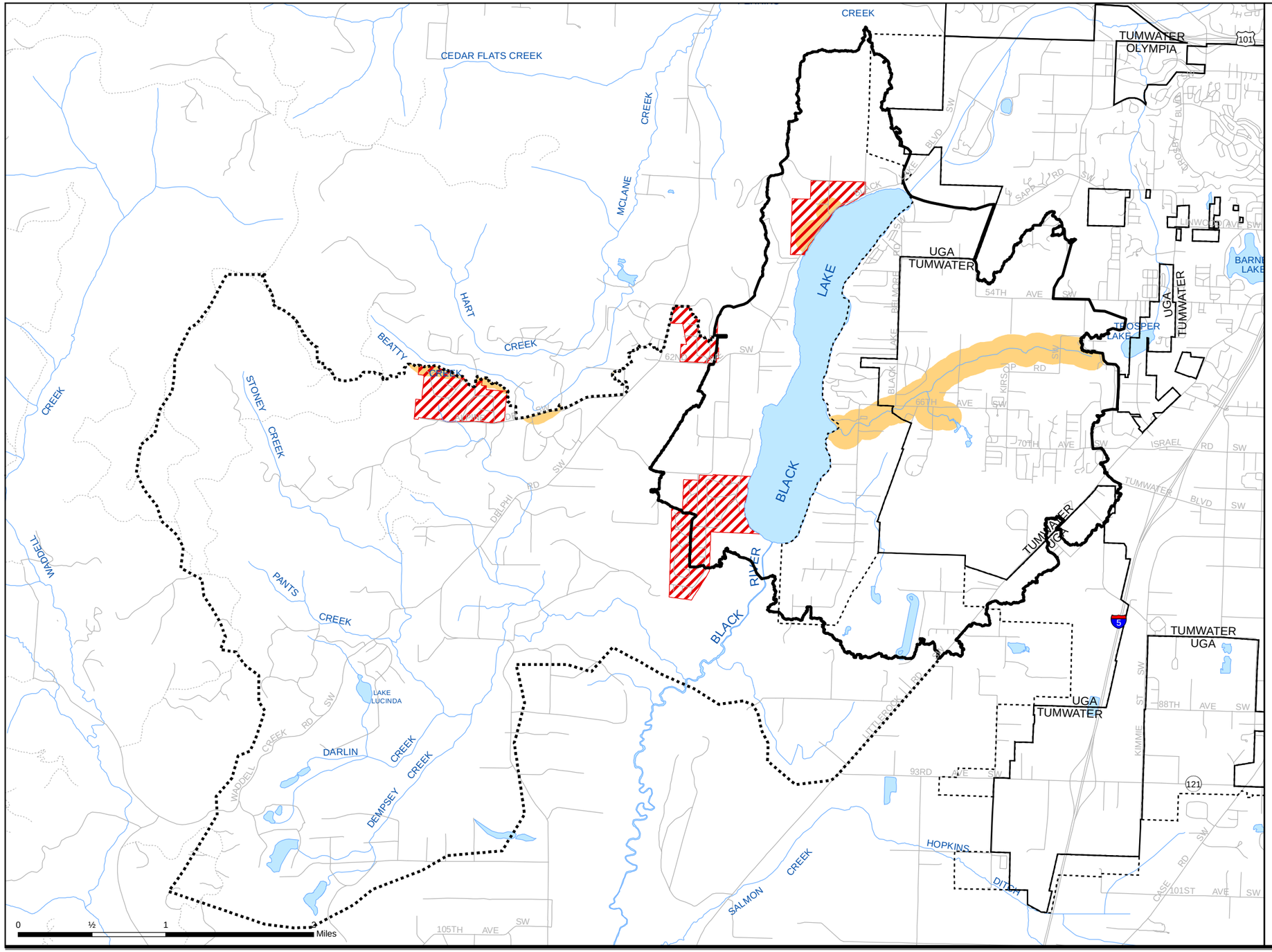

Black Lake Basin
Map 10: Future B Scenario

N W E S

- Basin Boundary
- City Limits
- Urban Growth Area
- Restoration
- Stormwater Retrofit Sites

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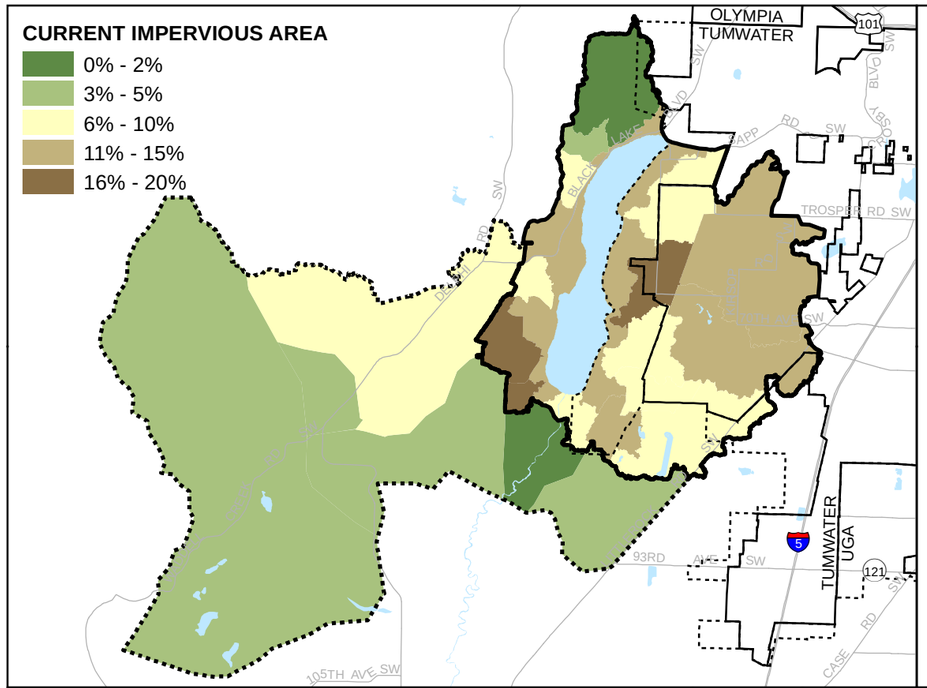

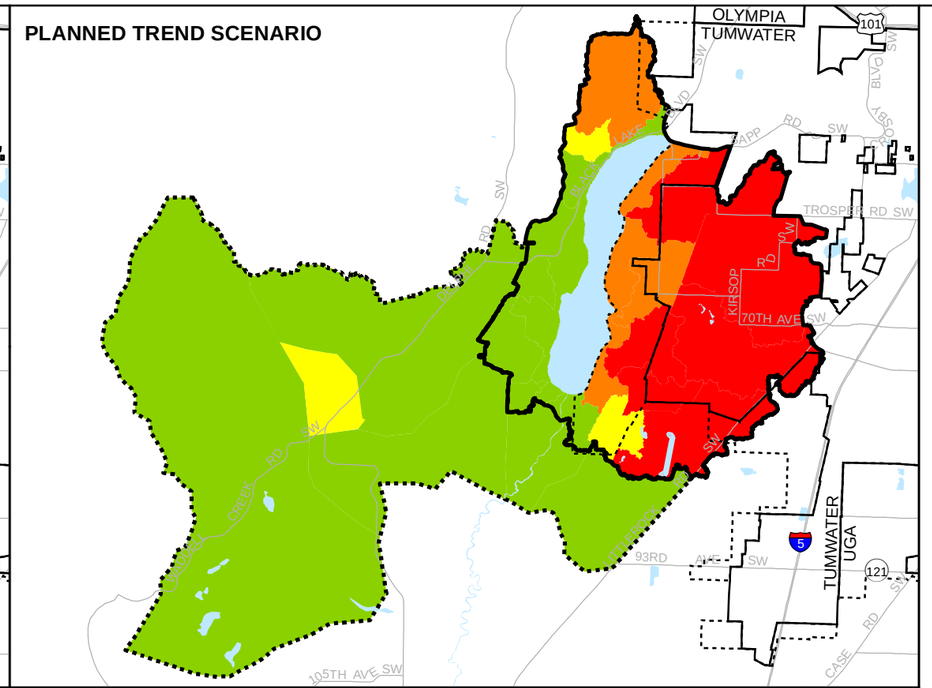

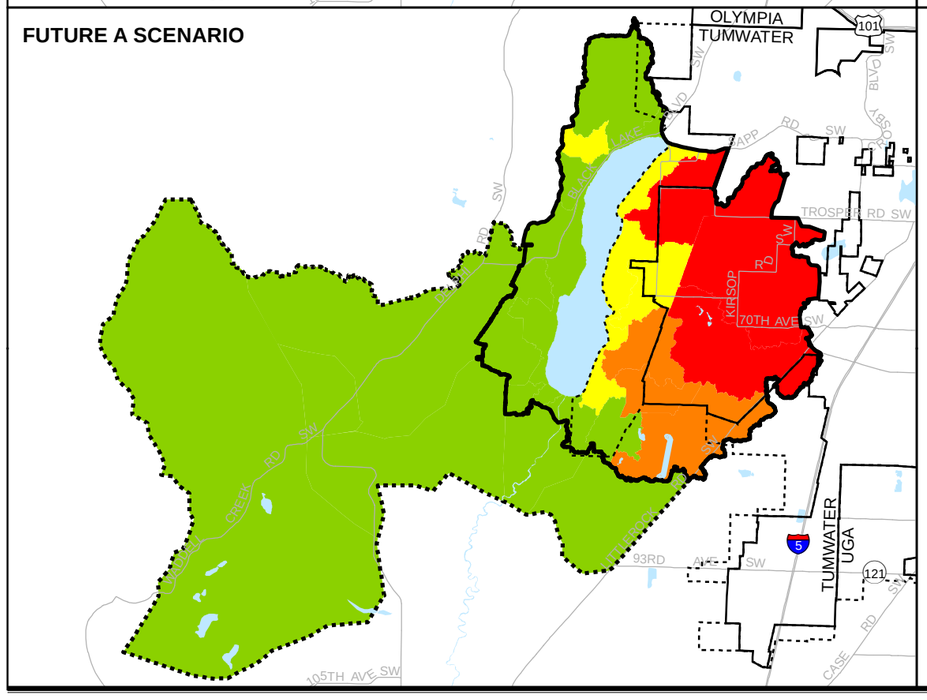

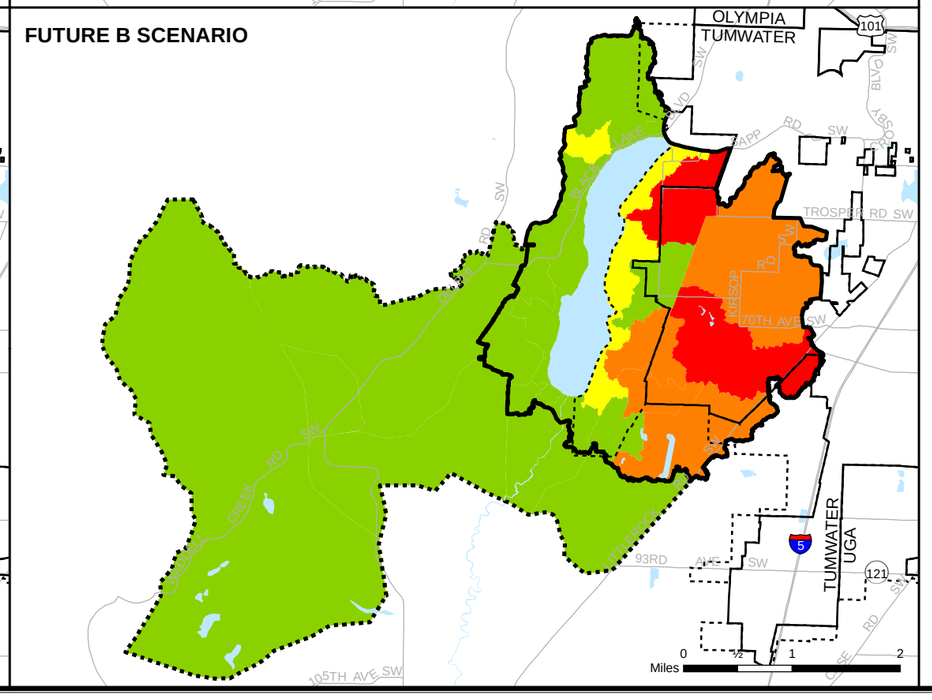

Black Lake Basin
Map 11: Impervious Area

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Basin Boundary
City Limits
Urban Growth Area (UGA)

Change in Impervious Area
- Decrease in Impervious Area
- Less than 2.0% Increase
- 2.1% - 5.0%
- 5.1% - 10.0%
- 10% Increase or Greater

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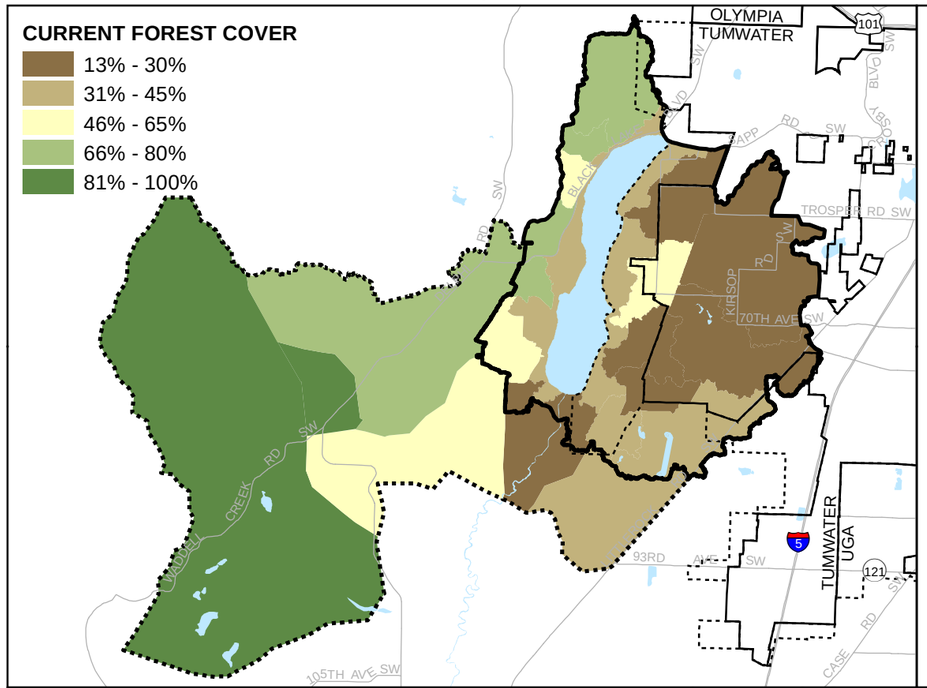

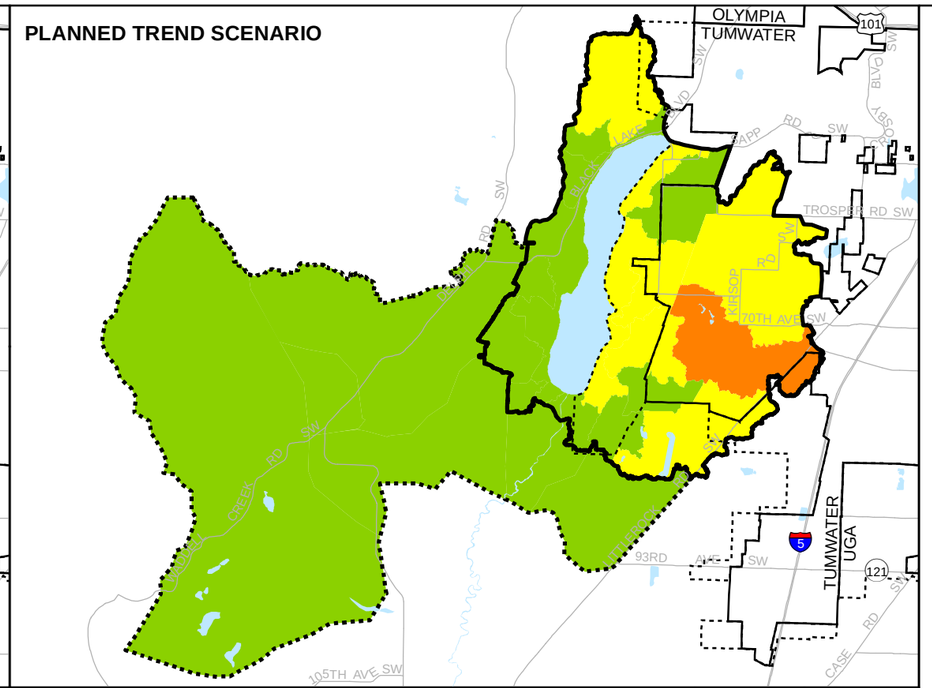

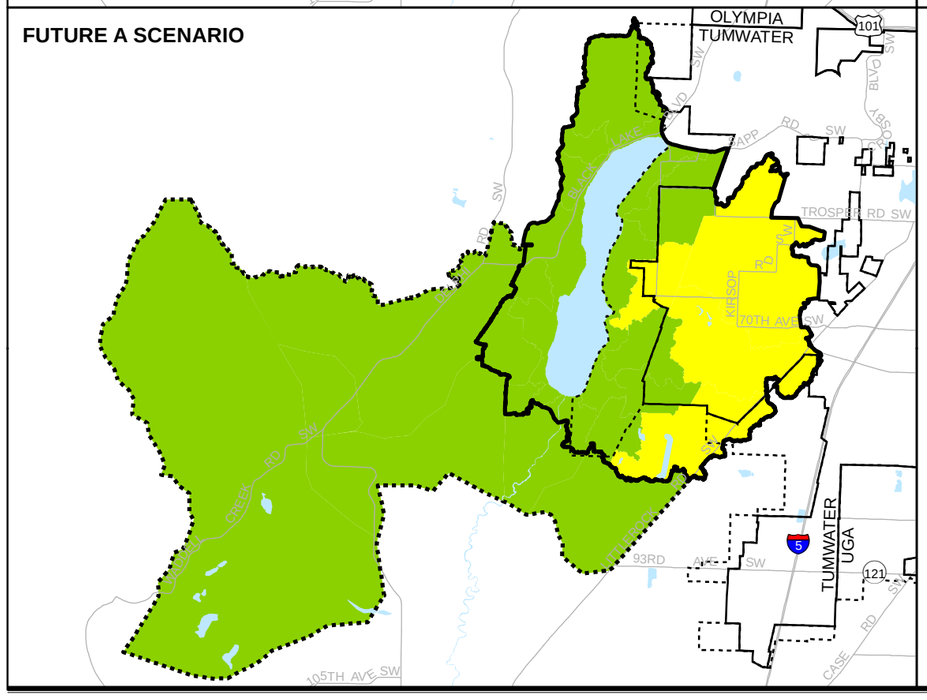

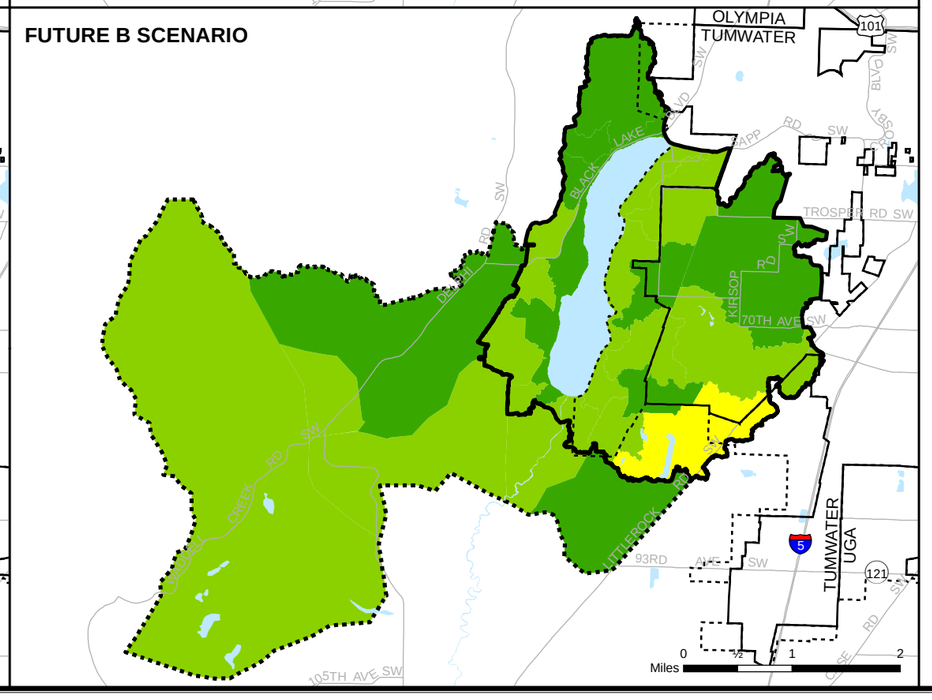

Black Lake Basin
Map 12: Forest Cover

Basin Boundary
City Limits
Urban Growth Area (UGA)

Change in Forest Cover
- Increase in Forest Cover
- Less than 2% Loss
- 2.0 - 4.9%
- 5.0 - 9.9%
- More than 10% Loss

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Appendixes

Appendix A. Thurston County Cluster Developments

Appendix B. Family Member Units in Rural Thurston County

Appendix C. Impervious Surface Limits

Appendix D. Transfer of Development Rights and Purchase of Development Rights

Appendix E. Tumwater Subdivision Recommendations