Guiding Growth – Healthy Watersheds: Woodard Creek 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

Woodard Creek and the land surrounding it and its tributaries 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 120,000 people to move into our region between 2010 and 2035.

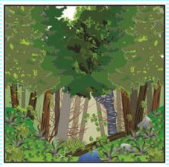
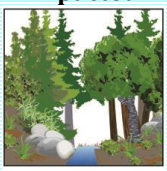
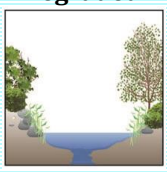
This growth will bring many benefits to the economy and residents of Thurston County, yet there are downsides to such a rapid increase in population and the demand for new homes, roads, and services that it entails. Development in sensitive areas can damage or disrupt important ecosystem services provided 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 risk from future growth. The results of this evaluation are detailed in a separate report, *BASIN EVALUATION AND MANAGEMENT STRATEGIES FOR THURSTON COUNTY* (TRPC). 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 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, Black Lake, and Woodard Creek Basins. Section 2 of this report includes a narrative depiction of the current conditions, threats, and management goals for Woodard Creek 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 Woodard Creek 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.

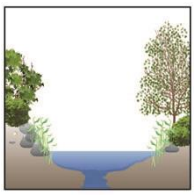
Project Goals

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, 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 Woodard Creek basin are detailed below, in Section 2.

On March 12, 2014, the County hosted a Water Resource Community Workshop for residents of the Woodard Creek basin at South Bay Elementary School. Those who attended were given a presentation with background on water resource issues in the Woodard Creek basin 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 22, 2014, the County hosted a second workshop for residents and interested parties at the Thurston County Public Health Building on Lilly Road. 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 Woodard Creek 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 help 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.

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: 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."

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

Woodard Creek basin (Figure 1; **Map 2**) is located in central Thurston County; it includes a mix of urban and rural areas and is crossed by Interstate-5, a major transportation corridor in the region. The basin surrounds Woodard Creek, the second-largest stream flowing into Henderson Inlet.

The hydrology of the area has been extensively modified by development in the upstream (southern) portion of the basin. The creek originates in a constructed wetland surrounded by commercial and industrial development, including the South Sound Center shopping complex. Stormwater from residential neighborhoods south of 18th Avenue would originally have drained toward Budd Inlet, but have been redirected into the basin, and major thoroughfares including I-5, Martin Way, and Pacific Avenue also disrupt the historic water flow patterns. The creek travels north along the Dickerson peninsula until it empties into Woodard Bay, an intact saltmarsh owned by the state Department of Natural Resources and protected as part of a Natural Area Preserve (the preserve itself is outside the study basin area).

The basin encompasses just over 5,000 acres, and is home to approximately 10,500 people. The population is anticipated to grow by around 42% by 2035, or to almost 15,000. Most of the growth will be accommodated in the urban growth area (UGA).

Jurisdiction

Woodard Creek basin is divided between Thurston County (52%), Olympia (33%), and the Olympia urban growth area (UGA), which is managed under Joint Planning agreements between the County and City (13%). A small portion of the basin is within the city of Lacey (2%) and the Lacey UGA (<1%) (**Map 3**). Under current plans, land within a UGA eventually will be annexed into their respective cities – in preparation for this, zoning and development regulations within the UGA match those of the city. Emergency services in the UGA are provided by the County.

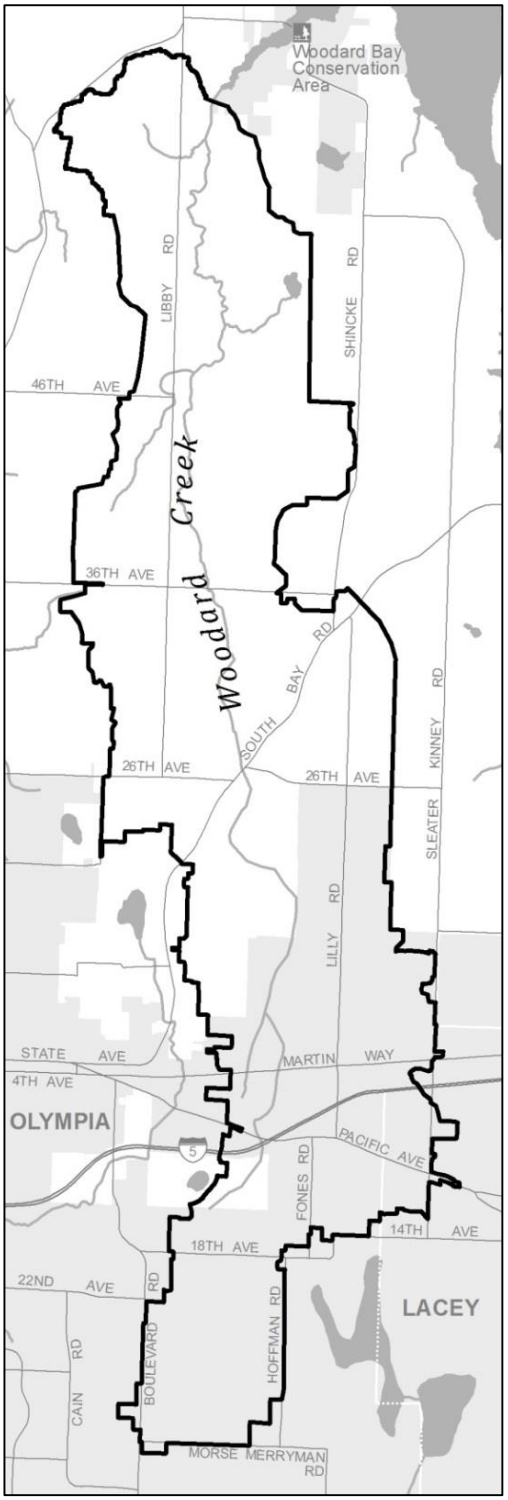


FIGURE 1: WOODARD CREEK BASIN.

Soils

Much of the basin is underlain by outwash soils, with significant areas of Kitsap, till, and saturated soils (NHC 2014)[3]. Outwash soils include glacial deposits of permeable sands and gravels; these are present in most of the southern half of the basin. 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 Woodard Creek basin, till soils are located along the northwestern and southeastern edges of the basin. Kitsap soils include those formed by lacustrine sediment, and generally have greater moisture storage and drainage than till soils, but less than outwash – much of the northern, rural half of the basin is underlain with Kitsap soils. Saturated soils are poorly drained – these occur along the creek and in several wetland areas.

Thurston County sets some standards for development and stormwater management according to hydrologic soil group classifications. Hydrologic soil groups are defined by the Natural Resources Conservation Service (NRCS) 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 209). In Woodard Creek basin, most of the soils have moderately high to high runoff potential (Groups C and D), particularly in the northern end of the basin, with some areas with more moderate infiltration within the city of Olympia and urban growth area (see Table 2; **Map 4**).

TABLE 2: SOIL TYPES IN WOODARD CREEK BASIN

USGS Soil Class	Outwash	Till	Kitsap	Saturated
	43%	20%	18%	19%
Hydrologic Soil Group (NRCS)	**Group A**	**Group B**	**Group C**	**Group D**
	12%	4%	52%	32%

Species and Habitat

Although portions of the area have been highly urbanized, Woodard Creek basin supports a variety of wildlife. Many species of fish utilize the creek, including coho, chum, steelhead, and cutthroat trout, and Olympic mudminnow have been noted in the creek near the I-5 interchange, though high winter flows

[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.

and low summer flows in the river have reduced the usability of this habitat. There are a number of bald eagle nesting sites within the basin, as well as a purple martin breeding area. There are several large wetland areas in the basin, including along Ensign and South Bay Roads.

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 riparian corridors), wetlands, critical aquifer recharge areas (including wellhead protection areas), frequently flooded areas, and geologically hazardous areas (including steep slopes and bluffs). Olympia's Critical Areas Ordinance was updated in 2006, and contains similar provisions. A variety of critical areas are located within Woodard Creek basin.

Habitat Areas

Woodard Creek, and some of its small tributaries, is listed as Type-F, or fish-bearing, stream under the Washington Department of Natural Resources (DNR) classification system. 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.

Wetlands

There are many wetlands in the basin, including where the creek winds through property of Providence St. Peter Hospital and near the headwaters of several small tributaries. These areas qualify for protections under Critical Areas Ordinances, 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 two wellhead protection areas within or overlapping the Woodard Creek basin, including those surrounding the water systems for Woodard Place and Red Cedar Estates. There are additional Category I CARAs within the basin, including near the Olympia city border. Activities that use hazardous materials or that could pose a risk to groundwater are restricted and regulated within these areas.

Frequently Flooded Areas

Flooding concerns are minimal within the basin, and the FEMA designated one-hundred-year floodplain along Woodard Creek is relatively narrow. There are a few identified high groundwater areas in the basin, including between South Bay and Lilly Road and near Lemon Road. 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

There are minimal areas within the basin where slopes are greater than 40%, mostly associated with ravines that include the stream channel in the northern, rural end of the basin. Removal of vegetation is restricted within these hazard areas, and tree harvesting is subject to review in addition to review required under Forest Practice Permits.

Land Use

The southern half of the basin is characterized by urban development, particularly along the Interstate-5 corridor and along Martin and Pacific Way. The northern half of the basin is largely low-density residential with some agricultural use. The Chehalis-Western Trail cuts through part of the basin.

Zoning

Most of the County portion of the basin is zoned Rural Residential Resource 1/5 (48% of basin), with some smaller areas in Limited Areas of More Intensive Rural Development (LAMIRD) 1/2 (3%), Rural Commercial, and Urban Reserve. Zoning within the city of Olympia is mostly Residential 4-8 units/acre (14% of basin), with a section of High Density Corridor (5% of basin) along Martin Way and a section zoned Medical Service (5%) surrounding Providence St. Peter Hospital. Smaller areas in the basin are zoned Residential Multifamily 18 (13%), General Commercial (2%), Light Industrial (2%), and Two Family Residential (2%) (**Map 5**).

Aquatic Habitat Condition

Woodard Creek basin is divided in its current level of modification – the southern headwaters of the basin have been heavily impacted and degraded, while the northern half of the basin is in relatively good condition. Overall, according to the Basin Evaluation Report (TRPC 2013) the basin has 14.5% total impervious surfaces and has retained just 35% of its tree canopy. The riparian area along the length of the creek has been impaired by removal of vegetation, direct animal access to stream, and a lack of large conifers remaining in riparian buffers – the downstream portions of the riparian corridor are in better condition than the upstream areas, which have been heavily impaired by clearing. There are a number of barriers to fish passage within the stream and an overall lack of large woody debris. Urban development in the basin has increased winter flood flows, causing erosion, sedimentation and scour, and decreased summer flows.

Overall water quality is ranked *Fair* by Thurston County Environmental Health, which has monitored the stream since 1983 (TCEH 2012). Woodard Creek is listed on Washington State's 303(d) list of impaired waterbodies for fecal coliform, dissolved oxygen, and pH violations. The stream has a history of failing the bacteria standard: in water year 2010/2011 it failed both parts of the fecal coliform standard. There have been occasional low dissolved oxygen measurements, though none in recent years. A TMDL study was completed for Henderson Inlet in 2006. It found that Woodard Creek contributed 11% of bacteria loads to Henderson Inlet during the wet season, and 18% during the dry season.

Water quality in the stream has improved since the formation of the Henderson Shellfish Protection District in 2001, but stormwater runoff and agricultural practices in the basin continue to be a concern.

The Benthic Index of Biologic Integrity (B-IBI) is a method for evaluating and comparing the biological condition of streams by evaluating the presence and diversity of different macroinvertebrates. For Woodard Creek, the average B-IBI score for 2002-2011 ranks in good condition at 40.8.

TABLE 3: CURRENT AQUATIC HABITAT CONDITIONS FOR WOODARD CREEK BASIN

Level of Urbanization	Hydrology	Riparian Corridor	In-stream and Wetland Physical Conditions
• Total Impervious Area Estimate 1991: 9.1% 2006: 14.2% 2011: 14.5%	• Effective Impervious Area Estimate, 2006: 11.2% • Forest Cover, 2011: 35.2% • Unmodified Wetlands: 13.8% • Miles of Streams: 14.8 • Areas of high groundwater flooding: 3.4% of basin	• Coniferous forest cover in 250 foot stream riparian corridor, 2006: 10% • Forest, scrub/shrub vegetation and wetlands in stream riparian corridor: 150 ft: 73.3% 250 ft: 69.8% 1,000 ft: 55.7% • Number of road crossings per mile of creek: 2.8	• Good amount of LWD, poor key piece LWD • Pools: fair for both surface area and frequency • Canopy closure not sufficient to maintain water temperatures • Fair amount of fine sediment • Estuary at mouth in good condition • Unmodified wetlands: 4.1%

SOURCE: TRPC 2013

Residential Development Potential

Most of the residential development potential in the basin lies within the city and UGA, including some master-planned community and other proposed subdivisions. The rural portion of the basin is largely developed at rural densities, though there are some areas that could see further development (**Map 5Map 6**).

Threats and Concerns

- The Basin Evaluation report (TRPC 2013) identified Woodard Creek basin as at moderate risk from development because of the projected increase in number of dwelling units and total impervious surfaces. Though the estimated increase in impervious surfaces was moderate (1.2%), the total amount of impervious cover in the basin would tip to over 15%.
- Water quality in the basin is impacted by urban stormwater runoff, particularly in the headwater wetlands complex, and nonpoint pollution from agricultural activities and septic systems in the more rural areas of the basin. Woodard Creek consistently fails part 2 of the fecal coliform standard and has repeatedly failed the turbidity standard. Nitrite is elevated in the creek and phosphorus levels are linked to low dissolved oxygen.

- Dissolved oxygen levels are low near the headwater, but improve downstream before discharging to Henderson Inlet.
- Woodard Creek has historically supported native runs of coho, chum, cutthroat, and winter steelhead. Limiting factors identified for the creek include alteration of the natural flow regime from increased impervious surfaces, lack of large woody debris (LWD), and barriers to fish passage.
- The riparian corridor has been impaired by the removal of vegetation in some areas, a lack of conifers in the remaining vegetation, and direct animal access to the stream. Fine sediment may also be a naturally occurring barrier.

Woodard Creek basin (clockwise) originates in a wetland behind some large commercial districts of Olympia and Lacey (A). It travels under several large arterials, including Pacific Way, Interstate 5 and Martin Way (B). The wetland complex is well-marked and accessible from Ensign Road, near Providence St. Peter Hospital (C). Outside of the city, the character of the basin is rural and agricultural (D). The creek empties into Woodard Bay, an intact saltmarsh owned by the Department of Natural Resources and protected as part of a Natural Area Preserve (E).

FIGURE 2: WOODARD CREEK BASIN – OVERVIEW.

Threats and concerns in the Woodard Creek basin include (clockwise) pollution from urban stormwater runoff (oil sheen during storm event [A], and pollution and debris in culvert draining wetland [B]), agricultural activities (farm adjacent to a wetland) (C), and septic systems (rural residential development) (D).

FIGURE 3: WOODARD CREEK BASIN – THREATS AND CONCERNS.

Public Views

In response to a survey[4] sent in August 2013, residents and property owners indicated that some of the things they value most about living in the Woodard Creek basin are its natural environment and scenery; access to parks, trails, and other recreational facilities; and opportunities for a rural lifestyle. Clean drinking water, Puget Sound water quality, and healthy salmon runs are all issues that are very important to the majority of respondents. More than half of those who responded (65%) 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, pollution from stormwater runoff and septic systems, and loss of forest cover. When it comes to planning for the future of the basin, residents felt that the most important issues to address were:

- Protecting water quality (55%),
- Protecting wildlife and fish habitat (54%),
- Preserving undeveloped land (37%)
- Preserving farmland and agriculture (29%), and
- Low-impact development (22%).

When asked how they would like to describe Woodard Creek basin in the future, many residents expressed hope that the area would remain much as it is today, with natural and rural areas maintained and protected, and with improved water quality. Development that does occur should be concentrated in the more urban areas, and designed to be low impact. Residents in this basin emphasized a desire to preserve natural areas while maintaining a high quality of life.

These views were underscored at a community workshop held on March 12, 2014 at the South Bay Elementary School gymnasium. Participants were knowledgeable about water quality issues in the basin, interested in watershed conservation and stormwater issues, and were curious about how development might affect the area in the future. **Map 7** shows a summary of comments from that workshop 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. They noted a number of places where natural drainage has been modified in the basin, either through the digging of ditches to drain land (potentially for agricultural use) or through the installation of roads and culverts that may prevent fish passage. Many participants at the workshop noted a high level of interest in being involved with water quality improvements in the area.

Management Goals for Woodard Creek Basin

Woodard Creek 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

[4] The survey was sent to 3,374 homes and had a response rate of 12%.

- Minimize downstream pollutants from new growth
- Improve water quality by lowering existing pollutant levels
- Minimize increase in peak flows
- Improve water flow conditions where degraded

The TMDL process for Henderson Inlet set a target dissolved oxygen level of 9.0 mg/L, to be met at river mile 2.9. Stormwater bacterial reduction targets included a 98% reduction in fecal coliform in discharge to the Taylor wetland, a 76% reduction at river mile 6.9, and a 90% reduction at the river mouth. It also recommended that sources of phosphorus be controlled.

The Salmon Habitat Preservation and Restoration Plan (2005) for WRIA 13 includes the following recommended actions for Woodard Creek:

- Restore riparian corridors, primarily in the lower basin, for increased shade and large woody debris (LWD) recruitment
- Increase LWD key piece abundance to encourage pool formation
- Provide adequate management to reduce/eliminate current stormwater impacts
- Identify and correct where livestock have direct access to Woodard Creek
- Educate landowners located in Woodard basin to increase compliance and voluntary implementation of BMPs
- Protect and restore stream associated and headwater wetlands

The Woodard Creek basin lies within the Henderson Inlet Shellfish Protection District, which was established in 2001 to reduce bacterial pollution in runoff that lead to the closure of shellfish beds in Henderson Inlet. The Henderson Inlet Shellfish Protection District Implementation work plan lists the following actions to improve water quality in the area:

- Encourage use of low impact development (LID)
- Protective rezoning where appropriate
- More protective development standards
- Purchase land and build stormwater facilities to new standards
- Use purchase of development rights, conservation easements to protect intact habitat

Watershed Characterizations

The project team considered two recently completed landscape-scale ecological analyses in the course of this study. Watershed characterizations 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 Washington Department of Ecology's Puget Sound Watershed Characterization Project (2010) 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 Woodard Creek basin as part of the greater Deschutes watershed (WRIA 13), and identified it as a high priority area for restoration because of its high level of importance for recharge of water sources and surface storage and high level of degradation in the urban headwaters. In its assessment of freshwater habitats, the Woodard Creek basin is identified as relatively high value for a variety of freshwater species.

The project team worked with Ecology staff to further refine its water flow analysis within the Woodard Creek basin; that analysis identified the following priority areas:

- ***North Basin***: The northern parts of the basin located approximately north of 36th Avenue were identified as the highest priority areas for protection. These areas have been the least degraded by past development and are important for surface storage and discharge of water.
- ***Central Basin***: The central part of the basin, north of Interstate-5 is the highest priority area for restoration of surface storage, including wetland areas that have been modified or drained. One high priority area includes the sub-area along Ensign Road; a second key sub-area is the region around 26th Avenue NE north to 36th Avenue between Libby Road NE and Friendly Grove Road.
- ***South Basin***: South of Interstate-5, the basin has been heavily degraded and was identified as best suited for redevelopment. The area around the wetlands at the headwaters of Woodard Creek – south of I-5 and north of 18th Avenue SE in the city of Olympia – is a higher priority area for restoration of recharge and surface storage.

Thurston County's Water Resources Division conducted a separate landscape analysis of the basin as part of the Henderson Watershed Characterization Report (2007). The primary purpose of this analysis was to support stormwater management planning, by assessing functional processes and identifying wetland, riparian, and floodplain areas that could provide ecological benefit if restored.

This assessment identified a number of priority riparian restoration areas along the main stream corridor, as well as potential larger wetland restoration areas at several locations within the basin. These areas were incorporated into the restoration alternative future scenario discussed below in Section 3.

3. Analysis of Basin Alternatives

How Scenarios Were Developed

Woodard Creek basin was classified as "impacted" in the Basin Evaluation report (TRPC 2013). While the headwaters are in an urbanized area, the downstream portions of the basin are fairly intact, and the stream still supports a diversity of species. For this reason it was felt that both protection and restoration management strategies would be effective in this basin.

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[5] that gave outputs on various stream flow and water quality factors.

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 percent 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.

The premise behind considering alternative scenarios 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 4). 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, stormwater, 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

[5] For a detailed description of the hydrologic modeling study, see NHC 2014.

densities, where less growth is likely to occur, but the new development that does occur 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?

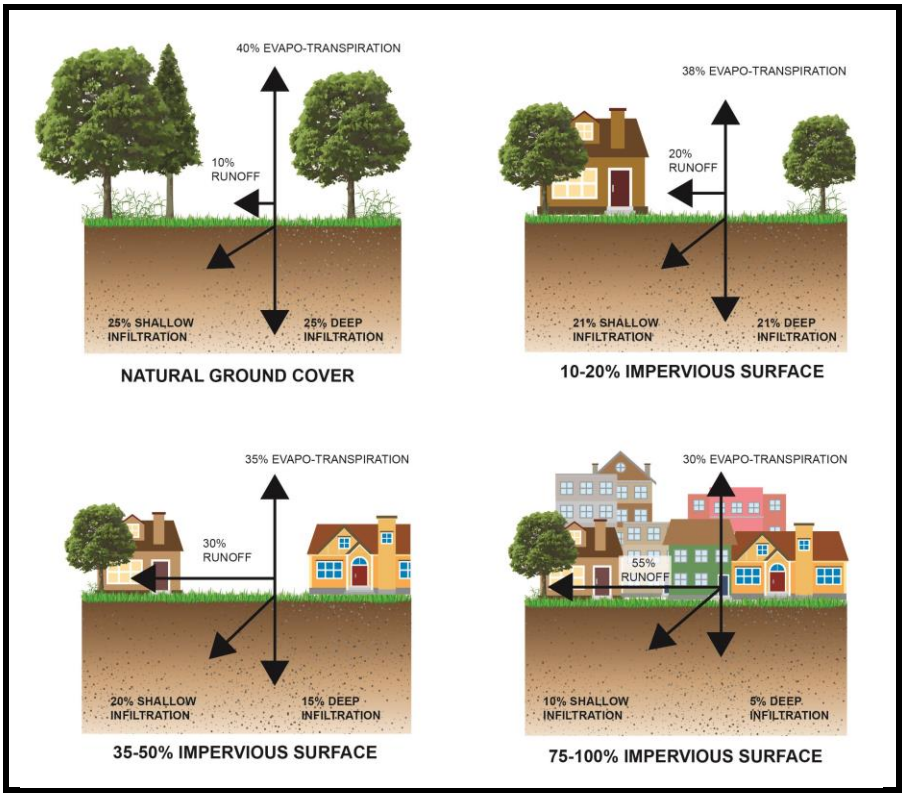


FIGURE 4: WATER CYCLE CHANGES ASSOCIATED WITH URBANIZATION.
SOURCE: GUIDANCE SPECIFYING MANAGEMENT MEASURES FOR SOURCES OF NONPOINT SOURCE POLLUTION IN COASTAL WATERS, 1993, AS SHOWN IN (ARNOLD, 1996).

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, prior to Euro-American settlement. 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 (TRPC 2013A, 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 Alternative Future A scenario (**Map 9**) 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 urban growth area surrounding the stream corridor and rezone to rural densities. The portion of the urban growth area that is already serviced by water and sewer infrastructure would remain in the growth area (**Map 8**; Figure 5)
- Rezone the area around the stream corridor and mouth of the stream to lower density (20 acre lots) rural zoning.
- Set tree cover and impervious surface limits for new rural development
- Assume that new development in both the city and rural area would meet low impact development requirements for stormwater control, if feasible (Figure 6)

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 = 1.4" 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 = 0.22" in 24-hrs at Oly 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 or not removing a portion of Olympia's urban growth area (area in red on the right) and rezoning it to rural densities would protect water quality.

There are approximately 200 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 580 homes total, or 380 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 250 homes total, or 40 additional homes, however all new growth would occur on septic systems.

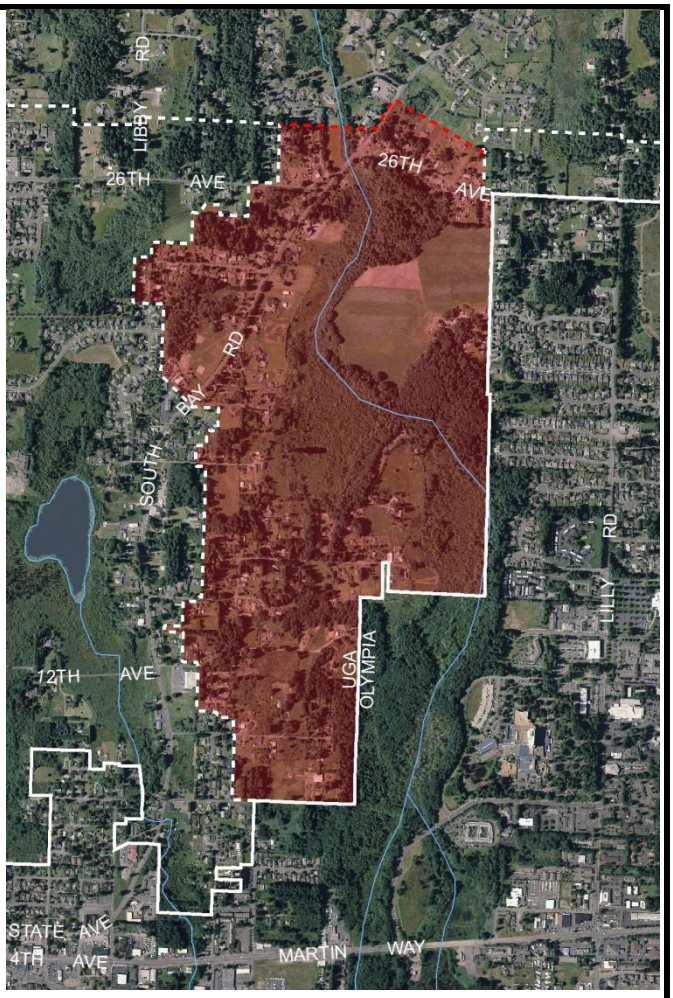


FIGURE 5: FUTURE A SCENARIO URBAN GROWTH AREA ADJUSTMENT.

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 6: 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 instead of 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

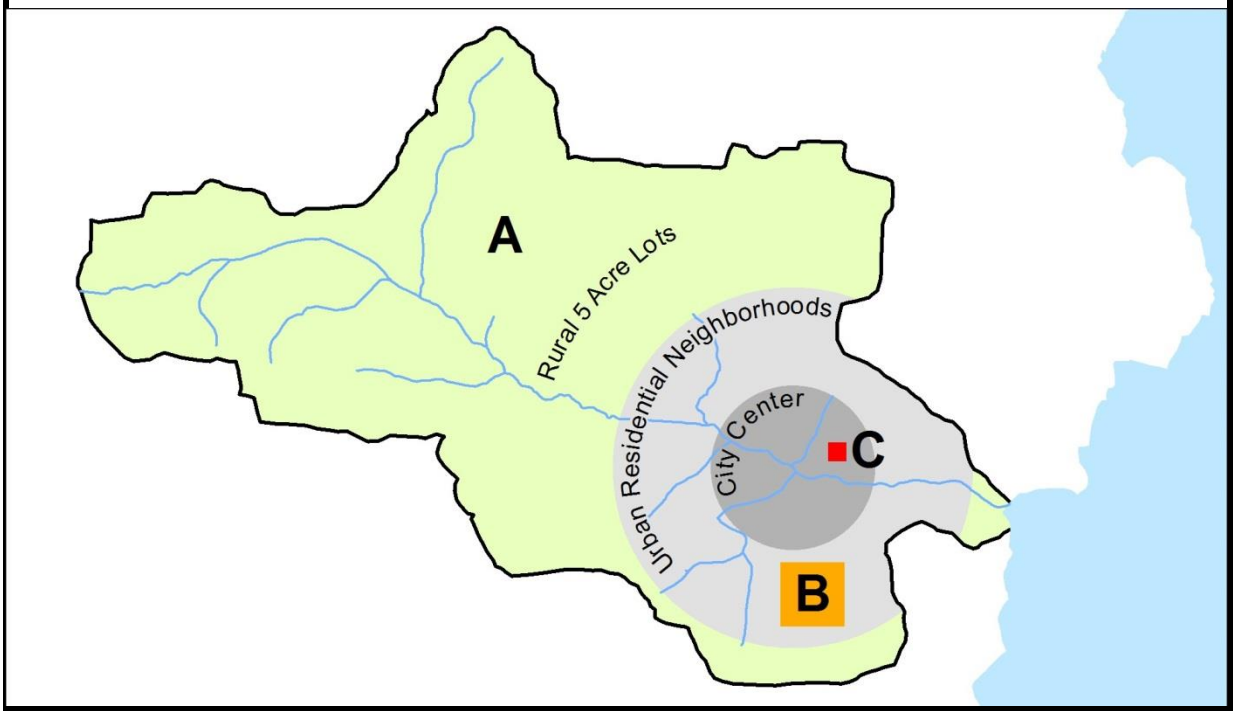


FIGURE 7: COMPACT GROWTH AS A FORM OF LOW IMPACT DEVELOPMENT.

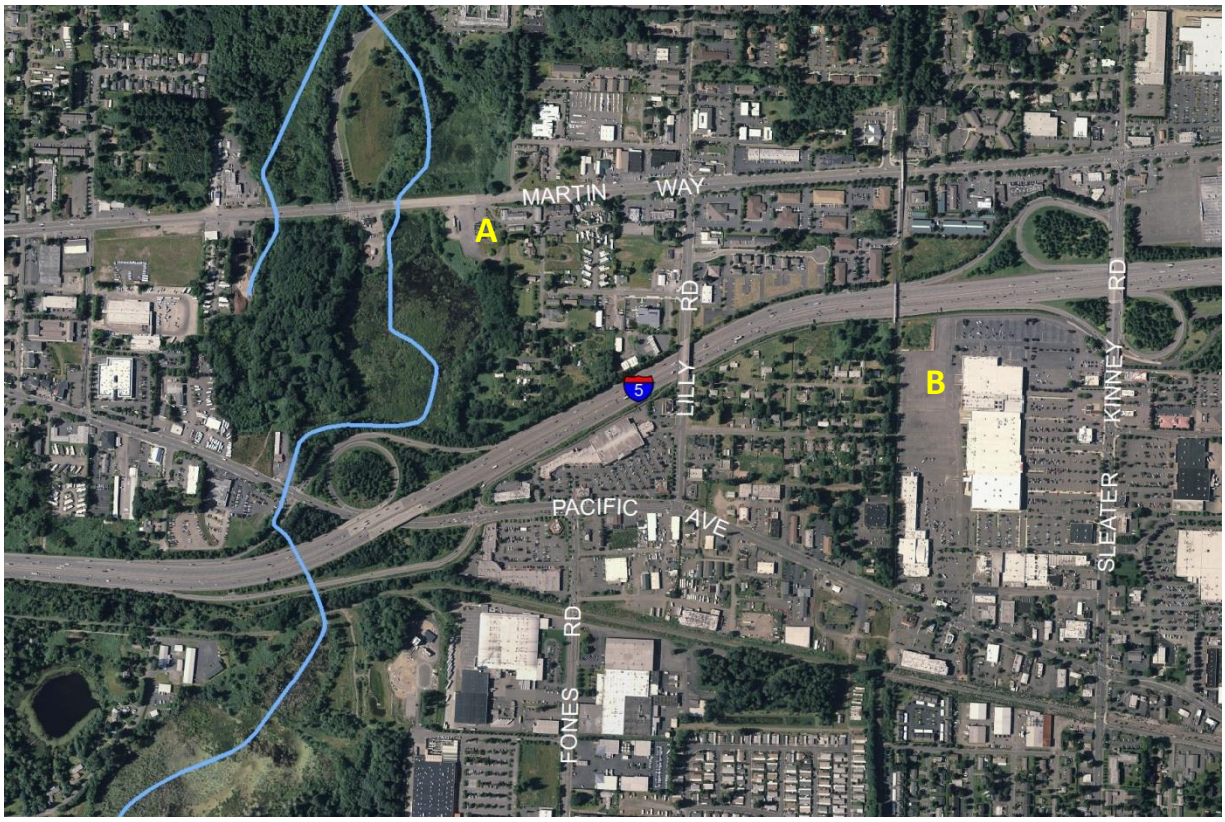
Alternative Future B

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

- Restore wetland hydrology (where degraded)
- Restore forest cover along major stream corridors (where altered) (Figure 8)
- Implement stormwater retrofit projects for older residential subdivisions (Figure 9 and Figure 10)
- Encourage redevelopment and stormwater improvements along the Martin Way and Pacific corridors and Woodland District (Figure 9)

The stream corridor (A) along Woodland Creek 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 using a combination of data from the Thurston County Watershed Characterizations and examining stream corridors around major creeks. Many restoration opportunities are on private property, and will require working with the landowner.

FIGURE 8: EXAMPLE OF A POTENTIAL RESTORATION SITE.



Large, vacant (A) or underutilized (B) properties present opportunities for redevelopment in the urban areas of the Woodard Basin. As redevelopment occurs, additional stormwater infrastructure (retrofits) can be added to encourage infiltration of stormwater as well as flow control.

FIGURE 9: EXAMPLES OF POTENTIAL REDEVELOPMENT AND STORMWATER RETROFIT AREAS.

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 10: EXAMPLE OF STORMWATER RETROFIT.

Comparison of Results

Land Use and Dwelling Units

Woodard Creek basin has around 4,880 homes in it today. Under the Planned Trend, at buildout it would have around 7,660 homes, or an increase of 57%. Under the Future A and B Alternatives, buildout within the city would remain the same, but the unincorporated areas (rural and urban growth area 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 4: NUMBER OF DWELLING UNITS FOR CURRENT AND FUTURE SCENARIOS.

Dwelling Units (homes)	Current Condition 2010	Planned Trend Buildout	Future A & B Buildout
City	3,890	6,160	6,160
Unincorporated	990	1,500	1,170
Total	4,880	7,660	7,330
% Increase from Current Condition			
City		58%	58%
Unincorporated		52%	18%
Total		57%	50%

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

Land Cover

Development in the Woodard Creek basin has led to an estimated loss of 44% loss of forest cover when compared to conditions that likely existed in the region prior to the 1800s. Much of that area has been converted to grazing pastures[6], roads, homes with yards, commercial spaces, parking lots or other uses. That development also contributed to some loss of historic wetland areas. The total amount of impervious surfaces in the basin has grown to around 18% – most of this is concentrated in the southern, urbanized area of the basin (see Table 5).

Under current regulations, in the Planned Trend scenario, impervious surfaces will increase to 22% in the future, with small additional loss of remaining forest cover. More open pasture areas will also likely be converted into residential development.

The zoning and land use changes proposed in the Future A scenario would result in slightly fewer new impervious surfaces when compared to the Planned Trend scenario, and retain slightly more forest

[6] The model assumes that all pasture areas have some livestock or agricultural use.

cover – but the difference would be very small. Adding the restoration activities in the Future B scenario would result in even less total impervious area and would restore some tree cover when compared with Planned Trend and even Current Conditions, but it does not restore to near historic conditions (**Map 11**; **Map 12**).

TABLE 5: COMPARISON OF HISTORIC, CURRENT, AND FUTURE LAND COVERS.

	Historic Condition	Current Condition 2010	Planned Trend Buildout	Future A	Future B
Forest	80%	36%	34%	35%	38%
Pasture/Prairie	1%	21%	19%	20%	17%
Grass	0%	14%	16%	15%	14%
Wetland	19%	17%	17%	17%	17%
High-polluting Total Impervious Area	0%	10%	11%	11%	10%
Low-polluting Total Impervious Area	0%	8%	11%	10%	10%

SOURCE: THURSTON REGIONAL PLANNING COUNCIL

Water Flow & Water Quality

The hydrologic model tested the effects of each of the five scenarios on water flow (hydrology) for both the basin as a whole and at the boundary between Olympia's Urban Growth Area and the more rural parts of Thurston County. This allowed the study to isolate the impacts associated with the most developed and urbanized parts of the basin, from the rest of the watershed. Overall, when compared with historic conditions, minimum flows in the Woodard Creek have dropped by almost 10% and flows have become 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. This has had an impact on the ecological communities of macroinvertebrates that are sentinels for stream health, and that are vulnerable to changes in flow brought by urbanization.

Looking ahead in the Planned Trend scenario, water flow is not projected to degrade substantially under existing plans and regulations and little difference was seen for flow projections between the Planned Trend and Alternative Future A scenarios, which considered the impact of lowering zoning and removing some area from the Olympia UGA. Alternative Future B, which involved extensive restoration of wetlands and shoreline vegetation as well as stormwater retrofits, would improve high pulse counts. This was most pronounced at the UGA boundary, where retrofits in the upper portion of the watershed provided about half the ecological lift to return the stream to its pre-development, historic condition.

The model also considered several water quality parameters, including temperature, bacteria (fecal coliform), and nitrates. Although the stream is slightly warmer than indicated in the Historic scenario, under current conditions, Woodard Creek as a whole does not experience temperature violations, in

which the water gets warmer than 16° Celsius, although there are occasional violations at the UGA boundary. This healthy condition is likely because the stream corridor remains vegetated along much of its length, particularly in the rural area, which keeps the stream shaded. In other factors, water quality has degraded, with substantial increases in nutrient and bacteria loads. Conditions do not significantly improve or worsen under the Planned Trend scenario, despite the assumption that all units on septic systems within the city and UGA boundaries will be converted to sewer.

The Alternative Future A and B scenarios do show some benefits to water quality, although they do not return to historic conditions. For the basin as a whole, there is a small reduction in fecal coliform concentrations between the Planned Trend and Alternative Future A (land use) scenarios with a larger reduction (10%) focusing just at the UGA boundary. Greater improvements to fecal coliform loads were seen in the Alternative Future B (restoration) scenario, as much as a 14% reduction in bacteria concentration for the basin as a whole, with as high as a 22% reduction at the UGA boundary.

All three future scenarios, including Planned Trend, showed a reduction in nitrate loads to Woodard Creek when compared to Current Conditions. The most pronounced reductions were noted at the UGA boundary, which reflects the replacement of septic systems by sewers in the urban areas. The reduction was roughly similar for both the Planned Trend and Future Alternative Future A, which indicates that the reductions associated with having more homes converted to sewer under the Planned Trend scenario was offset by the lower density of homes and low impact development standard in Alternative A (see next section below for more discussion). Even greater reductions in nitrates (24% reduction from Current Conditions) were seen in Alternative Future B due to increased stormwater treatment associated with redevelopment and retrofit projects, as well as the restoration of some pasture and grass areas to forest. The model also indicated that Alternative Future B would result in a reduction of phosphorus loads to the stream.

A summary that compares the results from the alternative futures modeling is shown in Table 6**Error! Reference source not found.**. For a complete discussion of the model results, see NHC 2014.

TABLE 6: WOODARD CREEK BASIN MODELING RESULTS SUMMARY (SOURCE: NHC 2014)

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

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

One hypothesis was that the Planned Trend scenario would result in less nitrate and bacteria pollution than current conditions and Future A & 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 7). Many of these higher-risk areas are within the city of Olympia, and would be converted to sewer systems in any of the future scenarios – this was one assumption of the model. As discussed above, the two Alternative Future A and B scenarios show greater reductions in bacteria and nutrients when compared with the Planned Trend. The land use changes and low impact development of Alternative Future A seem to offset the benefit of sewering additional homes in Planned Trend, while the restoration actions of Alternative Future B bring the greatest benefit of all the scenarios.

TABLE 7: ESTIMATES OF NITRATE POLLUTION UNDER CURRENT CONDITION, 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	200	580	250
Type of wastewater treatment	septic	sewer	septic
Number of homes on septic systems in a high-risk zone for fecal coliform, total basin[7]	523	328	347
Number of homes on septic systems in a high-risk zone for nitrates, total basin[7]	1094	495	604

[7] Source: NHC 2014.

Interpretation and Limits of Results

In summary, the model results indicate that:

- Existing land uses in the basin have impacted both water flow and water quality, when compared to conditions that would have prevailed prior to euro-American settlement in the 1850s. Woodard Creek is flashier with higher flows after storm events, due to the high percentage of impervious area around its headwaters, and lower summer flows. Bacteria and nutrient loads in the stream 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. Such an outcome is likely due in part to the fact that much of the basin is already built to the density of its underlying zoning, so downzoning the northern areas of the basin would not result in a substantial reduction in the number of units.

- 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, although there may be localized improvements in some smaller areas.

- Removing the proposed area from the Olympia UGA is not likely to either improve or degrade water quality in Woodard Creek. The potential improvements that would come by converting homes in this area from on-site septic systems to sewer could be offset by other actions, such as having all new homes in the basin built to a low impact development standard.

- Stream temperatures remain below the threshold that is safe for aquatic resources, in part because the Woodard Creek riparian corridor is largely intact and provides shade to the stream. Targeted restoration of stream corridors in areas that have a lack of vegetation could further reduce temperatures, particularly for areas in the city and UGA. Stewardship of existing corridors will be important to maintaining this good condition.

- 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 Woodard Creek basin. In particular, revegetating shorelines where they have been cleared will help to shade and cool streams, making temperatures more hospitable to fish. 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 can bring substantial improvements to stream conditions. Alternative Future B included the development of a regional stormwater facility to provide additional flow control and treatment for the heavily urbanized area around the headwaters of Woodard Creek. Redevelopment along Martin Way that meets higher stormwater standards also could benefit the watershed.

- 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 22, 2014, Thurston County and Thurston Regional Planning Council (TRPC) hosted a second community workshop for residents of Woodard Creek 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 important wildlife habitat. Of the three future scenarios, participants generally disliked the Planned Trend scenario, which had the greatest increase in projected number of new dwelling units – they noted a concern for the quality of drinking water and were concerned that it underestimated the full impact of development, such as traffic impacts. For the Alternative Future A scenario, participants recognized that it did not lead to a great difference in water flow or quality, but some indicated that they thought it would have greater value for wildlife habitat and quality of life and would help preserve rural areas. Participants liked and were highly engaged by the restoration actions of Future Alternative B – a number of landowners indicated their interest and willingness to undertake restoration activities on their own land. Multiple 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 the rural area, preserve undeveloped land, and restore degraded areas.

4. Management Goals and Recommendations

This watershed study provided an opportunity to consider current conditions in the Woodard Creek 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 Woodard Creek 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 W.1 Maintain and restore basin-wide ecological functions, including surface storage and recharge to groundwater

Woodard Creek basin was identified as a priority area for protection and restoration of water flow processes, especially surface storage and recharge of water sources. Extensive development in the upper watershed has resulted in a loss of forest cover and nearly a fifth of the basin is covered in impervious surfaces that cut off the infiltration of water into the ground. Historically, the area had a number of depressional wetlands that would have provided significant storage capacity – while some of these wetlands remain, many others have been modified, filled, or redirected. As a result, overall stream flow is flashier with increased peak flows and reduced base flows, and, particularly in the lower watershed, the stream is more channelized. Although the basin is not anticipated to see extensive additional growth under the future scenarios, to maintain current conditions it will be important to ensure that new development is built in a way that minimizes discharge and retains existing tree cover and wetlands. The riparian corridor is currently in relatively good condition along the lower watershed, and should be protected.

Strategies

- Minimize the installation of new impervious surfaces
  Thurston County
  - Encourage 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 in 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

- Maintain existing tree cover and riparian vegetation
  Thurston County
  - 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

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

- Encourage redevelopment of older infrastructure in ways that can improve stormwater flow control
  - *County, Olympia, Lacey*: Collaborate to consider the feasibility of a regional stormwater facility to provide additional treatment and control for runoff from the urbanized area
    - *Priority Area*: The area identified in Alternative Scenarios B was bounded by 14th Avenue on the north, the Chehalis-Western Trail on the east and Lilly Road on the west.
  - *County, Olympia*: Fund and implement stormwater retrofit projects identified in the Woodard Creek Stormwater Retrofit study
    - *Priority Areas*: The top five sites identified by AHBL in memo from August 2014

- Encourage and support the restoration and enhancement of degraded wetland areas
  - *County*: Identify opportunities for use in the pilot in lieu fee mitigation program
    - *Priority areas:* Along Ensign Rd, along South Bay Rd, area west of Libby Rd between 36th and 46th
  - *County*: Develop guidance and improved outreach for landowners interested in conducting restoration on their own properties

- Encourage and support restoration of vegetation within riparian corridors, where degraded
  - Continue restoration work through Stream Team, Shellfish Protection District projects
  - *County*: Consider how to conduct restoration within County-owned areas of riparian corridor
  - *County*: Develop guidance and improved outreach for landowners interested in conducting restoration on their own properties

- 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 W.2 Protect and improve water quality

Past development and current activities have substantially degraded water quality in Woodard Creek, resulting in higher levels of bacteria and nutrients when compared with historic conditions. Considering the level of development in the basin, however, water quality in Woodard Creek is better than might be expected. This is likely due to the focused work over the past decade related to the Henderson Inlet Shellfish Protection District, which has led to more oversight and public engagement about how activities in the upland can impact water quality downstream. The modeling study found that actions that address existing impairments could improve water quality.

Strategies

- Continue focused work of Henderson Inlet Watershed protection area to address water quality
- Minimize and reduce pollution from septic systems
  - *County*: Continue focused operation and maintenance program for Henderson Inlet
  - *County:* Expand septic risk assessment to identify high risk areas for septics in the rural areas of the County
  - *County and Olympia:* Implement a focused program to convert septic systems of the southern, urban portion of basin to sewer systems
    - *Priority Areas*: Neighborhoods identified in 2015 Urban Septic Risk Assessment
- Encourage redevelopment and retrofit of older infrastructure to improve stormwater treatment
  - *County, Olympia, Lacey*: Collaborate to consider the feasibility of a regional stormwater facility to provide additional treatment and control for runoff from the urbanized area
    - *Priority Area*: The area identified in Alternative Scenarios B was bounded by 14th Avenue on the north, the Chehalis-Western Trail on the east and Lilly Road on the west.
  - *County, Olympia*: Fund and implement stormwater retrofit projects identified in the Woodard Creek Stormwater Retrofit study
    - *Priority Areas*: The top five sites identified by AHBL in memo from August 26, 2014
  - *Olympia*: Fund and implement stormwater retrofit projects along Martin Way, included in Capital Facilities Plan
    - *Priority Areas*: 2020 Martin Way water quality retrofit planned at Indian Creek ($750,000 and a grant); 2028 Martin Way water quality retrofit planned at Ensign and Mary Elder ($750,000 and a grant)

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

With Woodard Bay Natural Resources Conservation Area at its mouth, Woodard Creek basin provides an important corridor for wildlife traveling along Southern Puget Sound, and the basin contains important habitat for a number of 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)
  - Develop a regional approach to track and plan for open space
- Consider long-term protection options for remaining large parcels in private ownership
  - Provide priority ranking for projects in Woodard Creek basin through the county's Conservation Futures program, including purchase of development rights or fee simple land acquisition
  - Consider expanding the county's Transfer of Development Rights Program to include priority open space within Woodard Creek basin as applicable sending areas, and urban areas within the city of Olympia as applicable receiving areas (See Memo, Appendix D)
- *County*: Investigate and devise management plan for county-owned right-of-way along stream

GOAL W.4 Encourage sustainable development and redevelopment within urban corridors

An infrastructure assessment for the Martin Way District considered the development of a mixed-use district with improved pedestrian and transportation options along a corridor that connects downtown Olympia to Lacey and crosses through the Woodard Creek basin at an area that contains extensive wetlands. Such redevelopment would also result in enhanced stormwater control and treatment, and these were incorporated into Future Alternative B, which showed improved water quality benefits and was preferred by attendees who viewed it at a public workshop. A market study revealed a number of economic barriers to redevelopment in this area, but if incentives could be provided to encourage it, it would benefit the greater watershed. In addition, the Woodland District Plan, which was adopted by the Lacey City Council in 2013, recommends a regional stormwater management plan for the District. If the District redevelops over time as planned, it would support the case for stormwater upgrades identified by Olympia staff in the neighborhood to the west of the Chehalis-Western Trail and south of I-5.

Strategies

- *Olympia, Lacey*: Create incentives for redevelopment along central urban corridor areas
  - Utilize incentive to improve financial viability for infill and redevelopment projects. This includes: Special Valuation multifamily tax program, reducing or eliminating impact fees, waiving stormwater fees for a number of years, providing frontage and utility improvements, eliminating connection charges
    - Priority areas: Martin Way corridor, Pacific Avenue/Fones Road, Woodland District
  - Explore ways to meet regional stormwater goals yet allow infill and redevelopment flexibility amid urban corridor and center areas.

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 Woodard Creek 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.

The following table includes an implementation plan that identifies the potential lead and timeline for each action.

TABLE 8: IMPLEMENTATION OF BASIN-SPECIFIC ACTIONS.

Goals, *Strategies*, Actions			Category	Lead	Partners	Timeline
W.1 Maintain and restore basin-wide ecological functions, including surface storage and recharge to groundwater						
	Minimize the installation of new impervious surfaces					
		Encourage clustering of new development	Land use; code review	County	LID Work group	Underway
		Consider ways to minimize new impervious surfaces from detached family member units	Land use; code review	County		Short

Goals, *Strategies*, Actions			Category	Lead	Partners	Timeline
		Establish impervious surface limits through zoning in this basin	Land use; code review	County	LID Work group	Medium
		Consider implementing an impervious surface trading program that would shift the placement of new surfaces out of sensitive areas	Programs	County		Long
	Maintain existing tree cover and riparian vegetation					
		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	Underway
		Review open space standards, and consider increasing incentives to landowners	Land use; code review	County	LID Work group	Underway
	Implement low impact development approaches for areas that develop					
		Update stormwater regulations to encourage low impact development	Land use; code review	County, Olympia	LID Work group	Underway
	Encourage redevelopment of older infrastructure in ways that can improve stormwater flow control					
		Collaborate to consider the feasibility of a regional stormwater facility to provide additional treatment and control for runoff from the urbanized area	Programs		Olympia, Lacey, County,	Long
		Fund and implement stormwater retrofit projects identified in the Woodard Creek Stormwater Retrofit study	Programs	County		Medium
	Encourage and support the restoration and enhancement of degraded wetland areas					
		Identify opportunities for use in the pilot in lieu fee mitigation program	Programs	County		Medium
		Develop guidance and improved outreach for landowners interested in conducting restoration on their own properties	Programs	County		Medium
	Encourage and support restoration of vegetation within riparian corridors, where degraded					
		Continue restoration work through Stream Team, Shellfish Protection District projects	Programs; ongoing	County		Ongoing
		Consider how to conduct restoration within County-owned areas of riparian corridor	Programs; research	County		Long
		Develop guidance and improved outreach for landowners interested in conducting restoration on their own properties	Programs; outreach	County		Medium
	Monitor key indicators to assess long-term condition of basin					
		Continue annual monitoring through TRPC's benchmark program	Programs	TRPC	County	Ongoing
	Consider how climate change may affect ecological functions					

Goals, *Strategies*, Actions			Category	Lead	Partners	Timeline
		Develop a watershed-based climate resilience plan	Land use	TRPC	County	
W.2 Protect and improve water quality						
	Continue focused work of Henderson Inlet Watershed protection area to address water quality		Programs; ongoing	County	Olympia, Lacey, SPD Citizens Advisory Group	Ongoing
	Minimize and reduce pollution from septic systems					
		Continue focused operation and maintenance program for Henderson Inlet	Programs; ongoing	County		Ongoing
		Expand septic risk assessment to identify high risk areas for septics in the rural areas of the County	Programs; research	County		Medium
		Implement a focused program to convert septic systems of the southern, urban portion of basin to sewer systems	Programs	County		Long
	Encourage redevelopment and retrofit of older infrastructure to improve stormwater treatment					
		Collaborate to consider the feasibility of a regional stormwater facility to provide additional treatment and control for runoff from the urbanized area	Programs	Olympia, Lacey, County		Long
		Fund and implement stormwater retrofit projects identified in the Woodard Creek Stormwater Retrofit study	Programs	County		Medium
		Fund and implement stormwater retrofit projects along Martin Way, included in Capital Facilities Plan	Programs	Olympia		Medium
W.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 CAO	Programs; ongoing	County, Olympia		Ongoing
		Encourage clustered development that preserves more open space and habitat	Land use; code review	County		Medium
		Develop a regional open space plan	Land use	TRPC	County	Medium to long
	Consider long-term protection options for remaining large parcels in private ownership					
		Provide priority ranking for projects in Woodard Creek basin through the county's Conservation Futures program	Programs	County		Short

Goals, *Strategies*, Actions			Category	Lead	Partners	Timeline
		Consider expanding the county's Transfer of Development Rights Program	Programs	County		Medium
		Investigate County ownership of area along stream corridor	Programs; research	County		Medium
W.4 Encourage sustainable development and redevelopment within urban corridors						
	Create incentives for redevelopment along central urban areas		Programs; research	Olympia		Medium

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.

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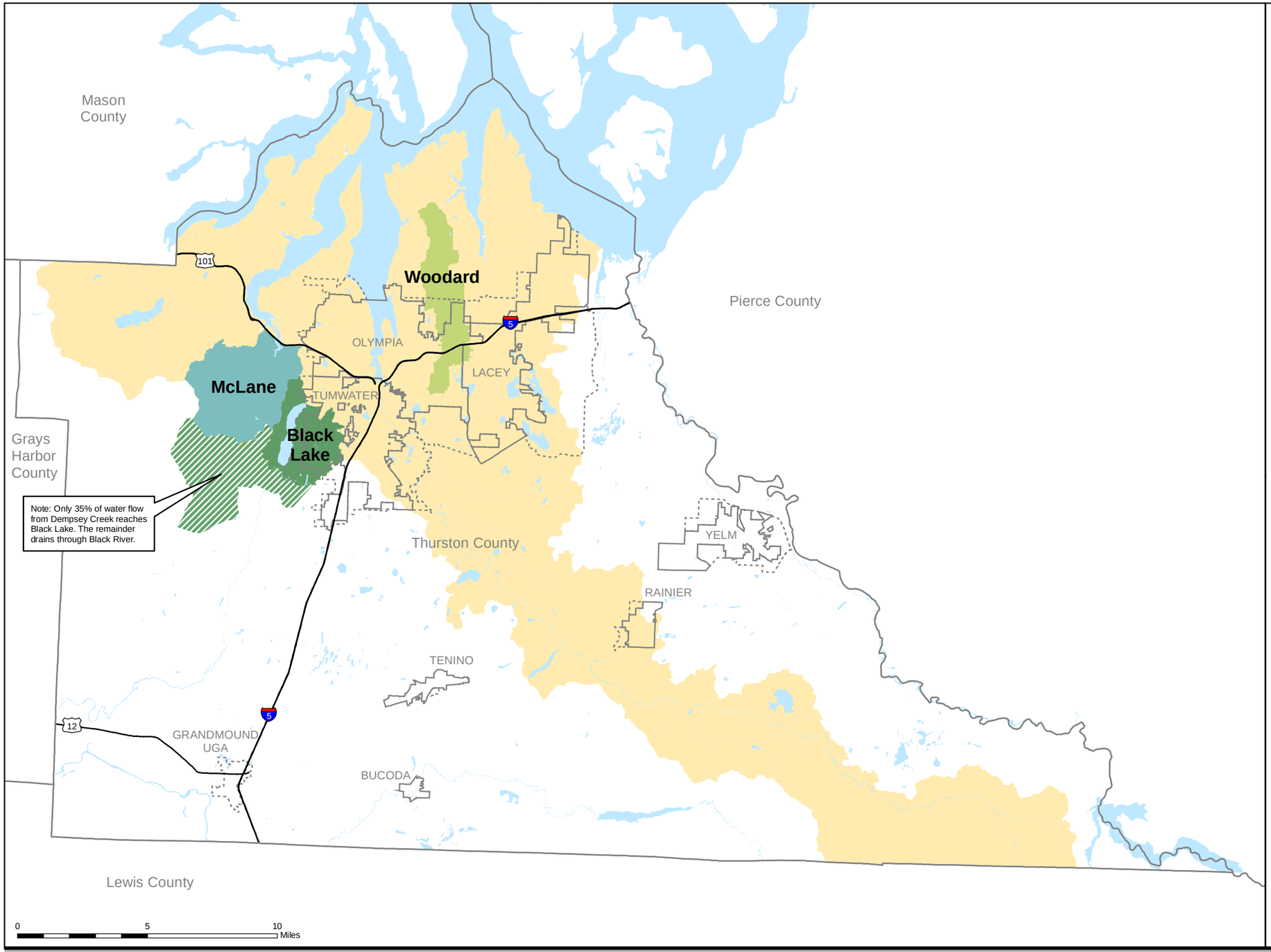
Maps



Woodard Creek 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)

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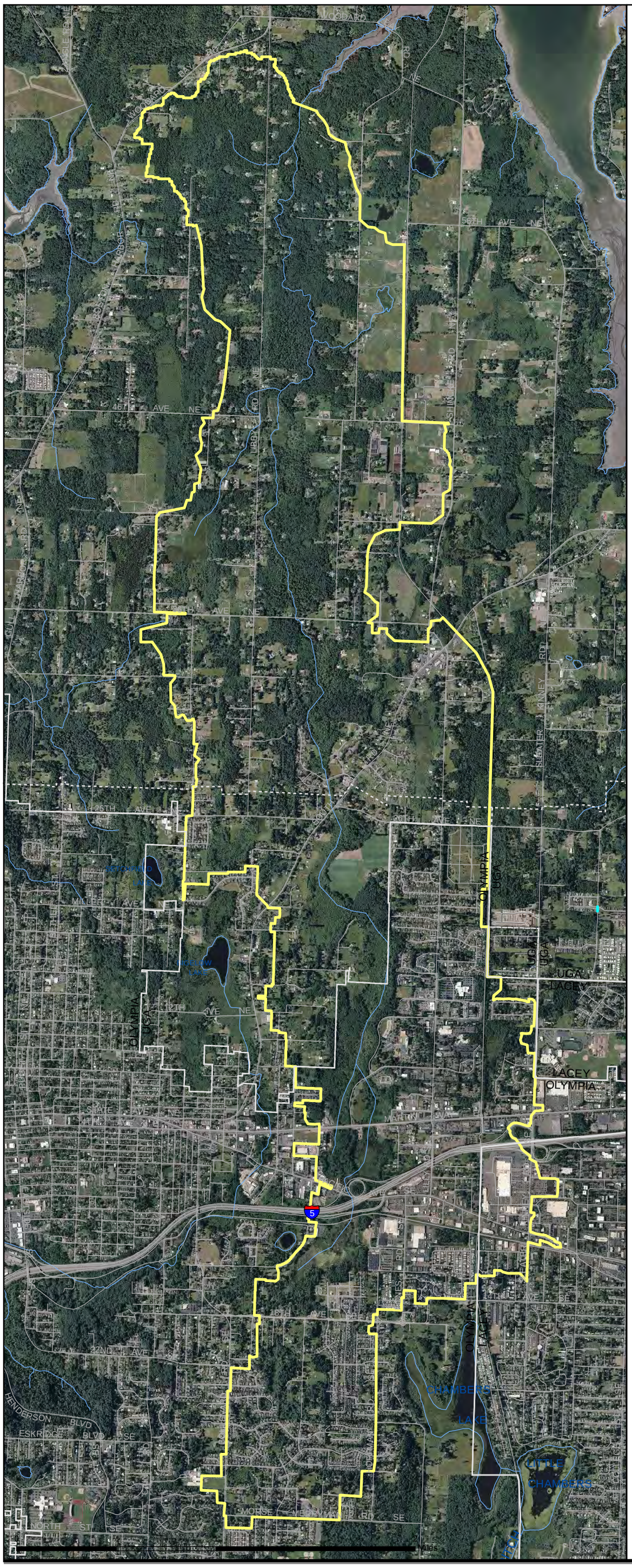

Woodard Creek Basin

Map 2: 2012 Aerial Overview

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Basin Boundary

City Limits

Urban Growth Area (UGA)

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Woodard Creek Basin
Map 3: Basin Overview

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- Basin Boundary
- City Limits
- Urban Growth Area (UGA)
- wetlands_trpc
- Parks & Preserves
- Capitol Forest
- school_sites

WOODARD BAY RD NE
ZANGLE RD NE
WOODARD BAY RD NE
BOSTON HARBOR RD NE
56TH AVE NE
SHINCKE RD NE
LIBBY RD NE
46TH AVE NE
GULL HARBOR RD NE
36TH AVE NE
SOUTH BAY RD NE
KINNEY RD NE
BLEATER RD NE
26TH AVE NE
SETCHFIELD LAKE
MILLER AVE NE
BETHEL ST NE
BIGELOW LAKE
12TH AVE NE
LILLY RD NE
PUGET ST SE
STATE AVE NE
4TH AVE E
MARTIN WAY E
PACIFIC AVE SE
EASTSIDE ST SE
LILLY RD SE
KINNEY RD SE
BLEATER RD SE
14TH AVE SE
18TH AVE SE
22ND AVE SE
HENDERSON BLVD SE
ESKRIDGE BLVD SE
BOULEVARD RD SE
CAIN RD SE
HOFFMAN RD SE
JONES RD SE
MORSE MERRYMAN RD SE
COLLEGE ST SE
NORTH ST SE
HENDRICKS CUTOFF RD SE

O.R.L.A.
FRIENDLY GROVE PARK
SOUTH BAY ELEMENTARY
PLEASANT GLADE ELEMENTARY
ROOSEVELT ELEMENTARY
SOUTH SOUND CHINOOK MIDDLE
NORTH THURSTON HIGH
DISTRICT OFFICE
MADISON ANTI HIGH SCHOOL
MADISON ELEMENTARY
WATERSHED PARK
MARGARET MCKENNEY PARK
WASHINGTON MIDDLE
PIONEER ELEMENTARY
MCKENNY ELEMENTARY
OLYMPIA HIGH
CHAMBERS LAKE
LITTLE CHAMBERS

OLYMPIA UGA
LACEY UGA
UGA LACEY
OLYMPIA LACEY

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Woodard Creek Basin
Map 4: Soils

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- 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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Woodard Creek Basin
Map 5: Current Zoning (2014)

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

Zoning Category

- RURAL RESIDENTIAL (RRR 1/5, UR 1/5)
- RESIDENTIAL LAMIRD (RL1/2)
- RESIDENTIAL (R-4, R-4-8)
- HIGH DENSITY RESIDENTIAL (HD, RM-18, RM-24, R-6-12)
- NEIGHBORHOOD VILLAGE
- MANUFACTURE HOUSING PARK (MHP)
- URBAN CENTER (CBD4, CBD5, UC, WD)
- HIGH DENSITY CORRIDOR (HDC-4)
- COMMERCIAL (GC, RCC)
- LIGHT INDUSTRIAL (LI, LI-C)
- PROFESSIONAL SERIVICE (MS, PO/RM)
- OPEN SPACE (OS-I, OSI-S)

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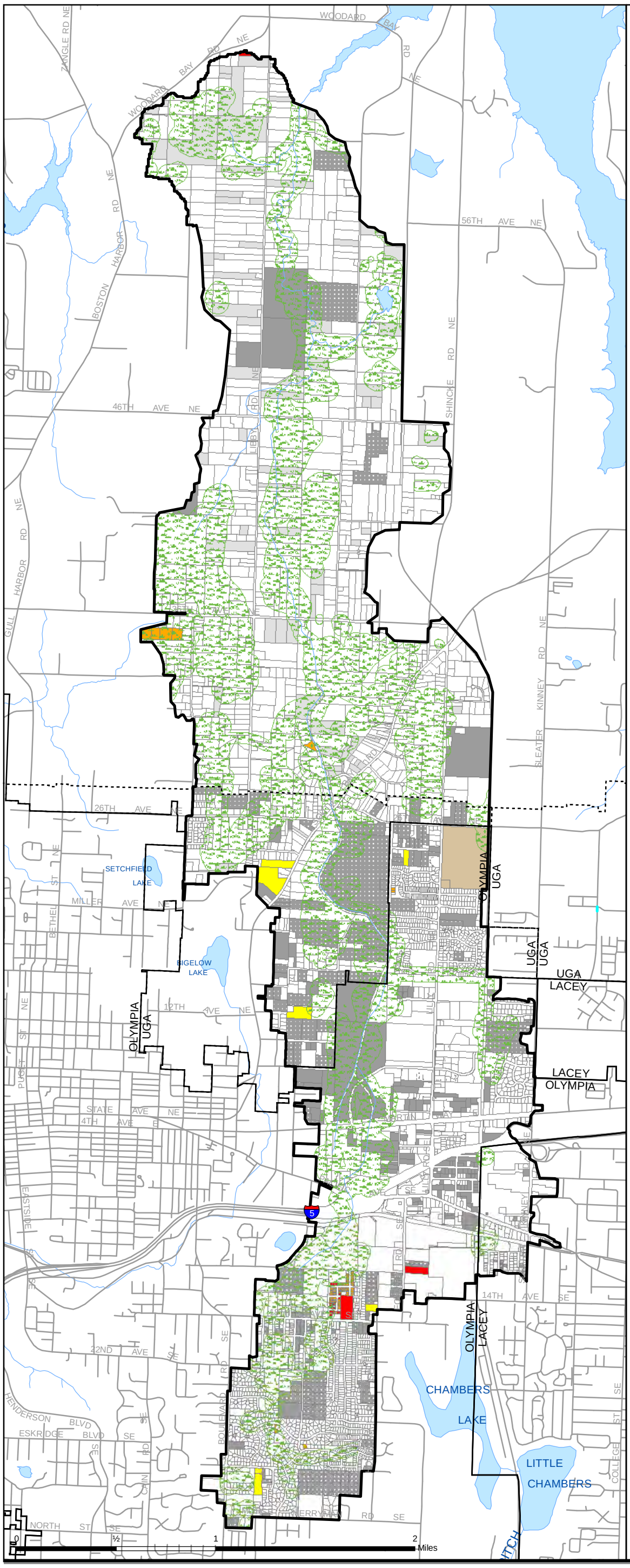

Woodard Creek Basin
Map 6: Residential Development Potential

N W E S

- 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

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Woodard Creek 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 (UGA)

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Woodard Creek 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

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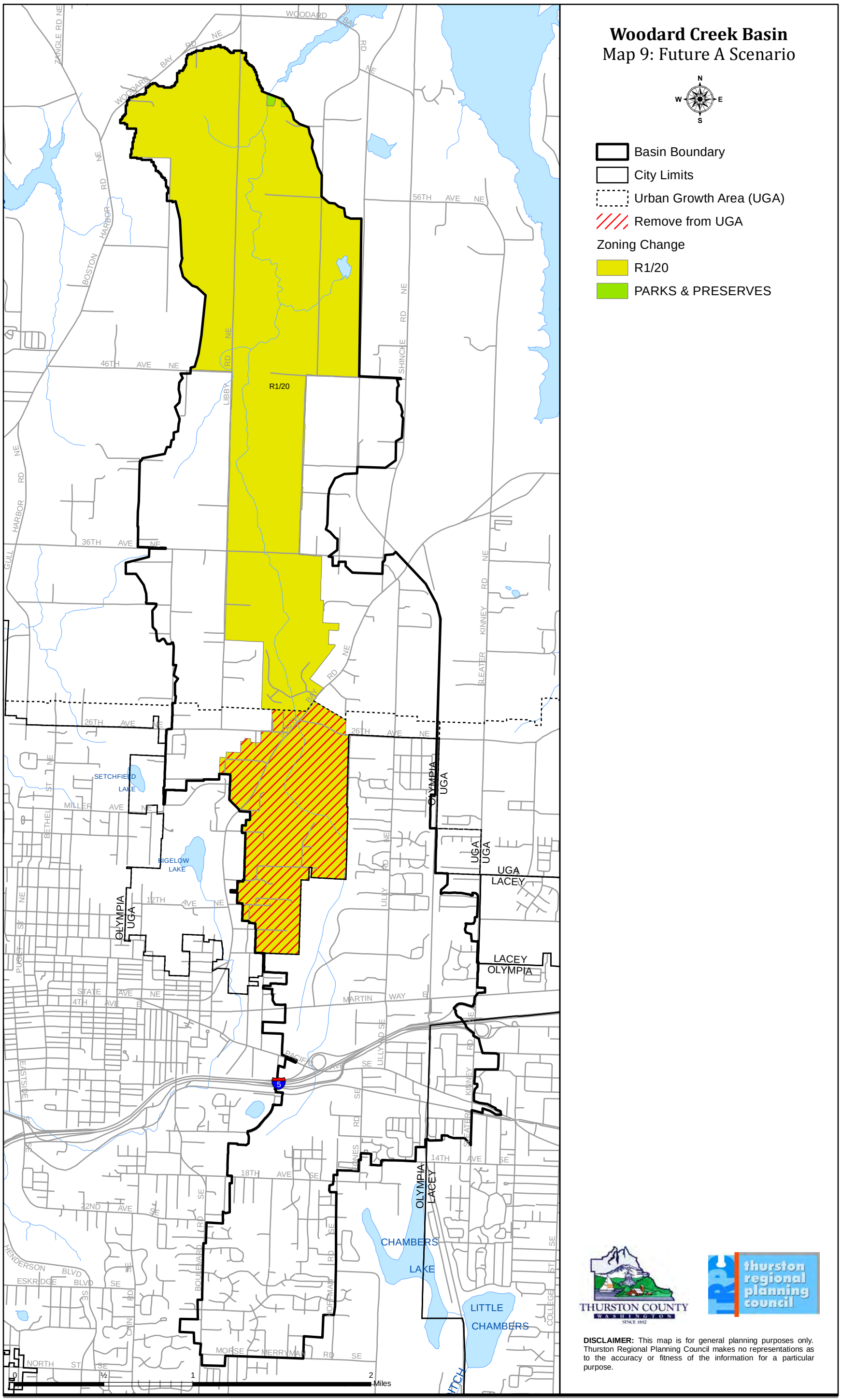
Woodard Creek Basin
Map 9: Future A Scenario
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Basin Boundary
City Limits
Urban Growth Area (UGA)
Remove from UGA
Zoning Change
R1/20
PARKS & PRESERVES
R1/20
WOODARD BAY RD NE
ZANGLE RD NE
HARBOR RD NE
BOSTON HARBOR RD NE
56TH AVE NE
46TH AVE NE
LIBBY RD NE
SHINCKE RD NE
36TH AVE NE
GULL HARBOR RD NE
KINNEY RD NE
BLEATER RD NE
26TH AVE NE
SETCHFIELD LAKE
MILLER AVE NE
BETHEL ST NE
BIGELOW LAKE
12TH AVE NE
PUGET ST SE
STATE AVE NE
4TH AVE E
MARTIN WAY E
EASTSIDE ST SE
PACIFIC AVE SE
LILLY RD SE
18TH AVE SE
22ND AVE SE
HENDERSON BLVD
ESKRIDGE BLVD SE
CHAMBERS LAKE
LITTLE CHAMBERS
14TH AVE SE
MORSE MERRYMAN RD SE
NORTH ST SE
OLYMPIA UGA
LACEY UGA
OLYMPIA
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SINCE 1852
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DISCLAIMER: This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to the accuracy or fitness of the information for a particular purpose.

Woodard Creek Basin
Map 10: Future B Scenario

N
W E
S

- Basin Boundary
- City Limits
- Urban Growth Area (UGA)
- Restoration Areas
- Stormwater Retrofit Sites

0 ½ 1 2 Miles

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CURRENT IMPERVIOUS AREA

4% - 5%
6% - 10%
11% - 20%
21% - 50%
51% - 100%

PLANNED TREND SCENARIO

FUTURE A SCENARIO

FUTURE B SCENARIO

Woodard Creek Basin
Map 11: Impervious Area

N
W E
S

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

0 ½ 1 2
Miles

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CURRENT FOREST COVER

0% - 30%
31% - 45%
46% - 65%
66% - 80%
81% - 100%

PLANNED TREND SCENARIO

FUTURE A SCENARIO

FUTURE B SCENARIO

Woodard Creek Basin
Map 12: Forest Cover

N
W E
S

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

Miles 0 ½ 1 2

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Appendices

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