Chambers Basin Moratorium

EVALUATION REPORT

March 2008

CITY OF OLYMPIA

Public Works Department

Community Planning and Development Department

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This plan was produced by City of Olympia

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1. SUMMARY

This report summarizes the technical and policy evaluation of the interrelated groundwater and stormwater problems in a portion of Chambers Basin and their implications for future land use development. The evaluation was conducted during a moratorium on development begun in April 2006 due to concerns associated with proposed residential development in the drainage basin south of Chambers Lake and north of 40th Avenue in southeast Olympia. Particular concerns were the difficulty of designing adequate drainage systems in this valley area due to shallow groundwater and minimal grades, and the likelihood of flooding, property damage, and other environmental impacts. Also, development of the uplands west of Wiggins Road would result in stormwater runoff exceeding the capacity of the current drainage system in the valley floor.

Both valley and upland areas are zoned for urban development at densities of 5 to 13 units per acre. Lack of wastewater service and environmental constraints have so far limited development. However, developer interest is increasing, and staff analysis of several subdivision proposals in early 2006 raised concerns about the impacts of flooding and drainage.

City Council approved a six-month moratorium on development in April 2006, later extended in October 2006 and April 2007 to allow time for analysis and development of sound policy and technical recommendations.

Major conclusions of the analysis are:

- The valley area is not developable at current zoned densities because of the high groundwater and flat topography. Conventional stormwater ponds would take up much of the developable area. Individual homes could be at risk of flooding.
- Absent major regional stormwater conveyance improvements, upland development at current zoned densities will cause additional flooding of the valley and downstream areas.
- Providing urban services such as street improvements, wastewater, and drinking water to this area under lower densities will be costly to homeowners and potentially the City.
- Downstream flooding impacts have resulted over time. Managing these impacts will require coordinated multi-jurisdictional efforts.

Based on this analysis, staff recommends the following:

- Reduce allowed development density and apply new low-density road standards in the valley.
- Construct a stormwater pipe along Wiggins Road to control stormwater flows from the uplands.
- Pursue additional stormwater management measures in the basin in cooperation with other responsible agencies.

This report is organized into several major sections:

- Background information describing the nature of the problem, City actions to date, and next steps in the decision process.
- Environmental and land use conditions in the study area, including soil and groundwater, and topography and drainage; and current land use, zoning, and actual development potential.
- Stormwater management challenges, including the limitations of conventional management in high groundwater areas.
- Stormwater management and land use options evaluated for this report.
- Details of the recommended low-density zoning for the valley area, regional stormwater pipe along Wiggins Road, and other actions.

The recommendations of this report, summarized in **Table 1.1**, will be shared with residents of the study area and other interested parties this summer. A City Council Public Hearing on proposed interim zoning and capital facilities plan amendments will be scheduled in September. Permanent zoning changes would be considered in 2008 during the annual Comprehensive Plan amendment process.

Table 1.1. Summary of Recommendations

Chambers Valley	
1	Apply full stormwater dispersion design criteria in high groundwater areas, including a maximum impervious coverage of 10 percent.
2	Create an interim zoning district for high groundwater areas, consistent with full dispersion stormwater design guidance. Zoning would be a modification of the existing Residential 4 Units per Acre (R-4) District.
3	Apply a new low-density street standard to proposed local access roads in the new zoning district.
Upland Contributing Area	
1	Construct a pipe along Wiggins Road to convey stormwater from the upland area, to be funded and installed by development within the upland contributing area west of Wiggins Road.
2	Leave existing zoning and development criteria unchanged.
Downstream Area	
1	Encourage application of stormwater management consistent with 2005 Washington State Department of Ecology (Ecology) guidelines.
2	Retrofit existing impervious surface discharging to the Chambers Ditch, especially in the Wilderness subdivision, a key source of unmanaged runoff. Correct deficient stormwater systems in subdivisions east of the Chambers area.
3	Work with regulatory agencies to explore options for agricultural property flooding near 60th Loop.
4	Flatten the side slopes of the Chambers Ditch in order to reduce erosion and bank sloughing. Work with Chambers Drainage Ditch District to obtain easements for the wider ditch section.
5	Support long-term efforts to meter surface water releases from Chambers Lake.
6	Offer to maintain the 40th Avenue driveway culvert along the Chambers Ditch.
7	Increase flow duration and water quality treatment standards if warranted by water quality studies (TMDL) being completed by Ecology.
8	Require sanitary sewer for new development in Olympia and its Urban Growth Area (UGA). Correct failing onsite sewage systems.
9	Manage stormwater flows from Wiggins Road and 37th Avenue in concert with future street improvements.

2. BACKGROUND

This report evaluated a 530-acre area in the southeast portion of the Chambers Lake drainage basin. The area drains into the Chambers Ditch, which flows from its outlet at the south end of Chambers Lake southerly to Chambers Creek and thence to the Deschutes River. This area, including the valley floor and uplands west of Wiggins Road, is sparsely developed with about 60 dwelling units, mostly along Wiggins Road, and remains relatively rural in character.

In 1994, the City of Olympia and Thurston County adopted a new Comprehensive Plan that provided for urban densities of future development in the vicinity of Chambers Lake and its drainages. Based on current zoning, this area could theoretically accommodate an additional 2,000 dwelling units or more.

The challenges associated with developing these low-lying areas were to some extent evaluated in the 1995 Chambers/Ward/Hewitt Comprehensive Drainage Basin Plan, jointly developed by Thurston County and the Cities of Olympia and Lacey. The Plan evaluated and proposed engineered solutions for potential surface water flooding immediately adjacent to the ditches. Typical solutions included culvert replacements and regional stormwater storage ponds. However, the Plan did not investigate groundwater and stormwater conditions that could impact the development of individual sites. Plan recommendations, however limited, were incorporated initially in capital facilities plans, but deleted in the early 2000s as ditch-associated flooding did not become an appreciable neighborhood problem.

In the summer and fall of 2005, the City received development proposals for three subdivisions in the area. Preliminary staff reviews of these proposals raised concerns that development under existing stormwater and drainage regulations could cause flooding. Residents of the area expressed concerns associated with development in general and stormwater flooding, water quality, and traffic in particular. Residents and staff have reported many occurrences of shallow flooding already occurring every few years, including flooding of the public roadways.

Because of these concerns, City Council placed a moratorium on development to allow time for technical and policy analysis of potential solutions.

PROBLEM STATEMENT

Two areas of concern, shown in **Figure 2.1** (located at the end of this chapter) were identified for this evaluation:

- Chambers Valley: A 350-acre section of the valley floor, characterized by flat topography and a high groundwater table. The analysis in this area focused on identifying the appropriate land use consistent with environmental limitations.
- Contributing Upland Area: A 180-acre upland area west of Wiggins Road. The analysis of this area focused on controlling stormwater runoff from future urban development safely downstream.

The valley area is characterized by high groundwater during much of the year, resulting in little infiltration capacity, minimal gradients that make conveyance and discharge of stormwater difficult, ditch systems that fill with existing flows, and limited options for new systems.

The poor drainage and flooding in this area results from a combination of:

- High groundwater due to minimal infiltration in native soils.
- A minimal surface gradient, limiting the rate of drainage from the area.
- Lack of capacity in the existing stormwater conveyance system.

Flooding in the valley could be exacerbated by development of the uplands draining into the Wiggins Road Ditch. The Ditch is presently at capacity and overflows into the valley. Development would increase the risk of flooding the roadway and downstream properties.

This combination of circumstances puts existing and future development in the valley at risk of flooding. The relatively small parcel ownership pattern makes it difficult for any one development to solve the problem, and increases the risk that a solution for one development may increase the risk of flooding of other property.

Although highly unusual in Olympia, this situation occurs elsewhere in the South Sound region. Groundwater flooding recently led Thurston County to impose special "high groundwater" regulations as part of the County's critical areas ordinance. Tumwater is reevaluating its plans and regulations to address very similar conditions detailed in the recently adopted Salmon Creek basin plan. Like the Chambers valley, the Salmon Creek area has minimal gradient, shallow groundwater, and an independent Ditch District with substantial responsibility for maintaining a key feature of the drainage system.

ACTIONS TO DATE

This section explains short-term actions by the City to date, including a moratorium on development, technical, and policy evaluation and public process.

Moratorium and Preliminary Evaluation

On April 16, 2006, City Council responded to the concern about potential flooding with urban density development with a moratorium barring new subdivision applications in the valley for six months. Following a public hearing on May 23, the moratorium area was expanded to include the upland area west of Wiggins Road; another 100 acres extending south to Smith Lake was added upon annexation of that area in August 2006.

In the spring and summer of 2006, staff considered a wide range of possible approaches to the problem; these were narrowed to three options and presented to the public for response. These three options were:

- No action – continue development with current regulations.
- Design and construct a regional drainage system to lower the water table and mitigate wetland impacts.
- Change the zoning to a lower residential density.

None of these approaches would result in significant changes to the upland areas west of Wiggins Road that contribute stormwater flows to the valley. Staff concluded that these flows could be accommodated by stormwater system improvements along the Wiggins Road right-of-way. Major options analyzed to address this need were:

- Conveyance along Wiggins Road.
- A regional stormwater pond.

Moratorium Extensions and Continued Evaluation

The moratorium on development was extended twice, following public hearings in October 2006 and March 2007, and is currently due to expire in October 2007. The City Council approved the continued moratorium to allow more time for technical and policy analysis. The technical analysis included:

- Groundwater monitoring between February and April 2007 to establish more precisely the seasonal depth to groundwater and direction of groundwater flow.
- Hydraulic flow modeling of the Chambers Drainage Ditch.
- Stormwater modeling of the Wiggins Road Conveyance System and its contributing area.
- Evaluation of potential regional stormwater ponds for mitigating flow from Olympia.

- Field survey of the Wiggins Road drainage ditch.
- Field inspection of Chambers Drainage Ditch from Chambers Lake to the junction with the south fork of Chambers Creek.
- Communication with Thurston County and City of Lacey water resources staff, Washington State Department of Fish and Wildlife (Fish and Wildlife) staff and the Chambers Drainage Ditch representatives.
- Field meetings with individual property owners and neighborhood representatives to see their properties and understand their concerns.
- Continued communication and coordination with private consultants seeking to define and propose an alternative stormwater management approach.
- Evaluation of possible adverse impacts on the downstream resources.
- Evaluation by legal counsel of mechanisms to ensure that the proposed Wiggins Road stormwater line will be installed prior to or concurrent with development west of Wiggins Road.

The policy analysis included:

- Analysis of the relationship between the level of residential development and the costs of construction of other new infrastructure, including streets and sewage systems.
- Formulation of a potential low-density land use zone, based on a 10 percent impervious coverage limit and criteria for boundaries of the zone including the possibility of extending it into the UGA.
- Evaluation of the need to amend other facility plans, such as streets, wastewater and drinking water.
- Review of citywide urban growth capacity implications.
- Communication with Thurston County and the City of Lacey on potential joint solutions to regional concerns.

Issues incorporated into the work plan in April 2007 focused on those secondary to the primary issue of managing the flooding potential of the area:

- Relationship between the potential downzone and the need for transportation upgrades. Roadway improvements are needed regardless of the scale of development in the basin because considerable traffic from outside the immediate area uses the streets. Typically, urban scale developments are instrumental in funding and constructing roadway improvements.
- Relationship between the potential downzone and extension of City wastewater and water services. Urban scale developments more cost-effectively bring utilities to an

unserved area such as Chambers valley. Low-density development is less cost-effective.

- Relationship between the need for an improved stormwater pipe system adjacent to Wiggins Road and the potential for increased downstream flooding and water quality problems. The pipe would convey managed stormwater from new urban scale development in the area west of the Chambers Basin valley.
- Status and responsibilities of the Chambers Ditch District relative to the increasingly urbanized nature of the basin.

These issues address tradeoffs between the potential benefits of urban scale development (street upgrades, sidewalks, sanitary sewers) and the cost of development (increased stormwater flows, water quality impacts). The potential benefits and costs affect residents of the immediate area, downstream residents, and the broader community. City services and budgets can be greatly affected by the presence or absence of privately funded improvements.

Public Process

During the summer of 2006, public notice of the moratorium and optional approaches was given to interested parties affected by the decision. City staff hosted two public meetings on September 6. Participants included about 100 property owners, developers, consultants, agency representatives, and residents.

On December 21, 2006, City staff presented to property owners and other interested parties the staff proposal for alleviating drainage problems west of Wiggins Road. The proposed project was a stormwater line along the western edge of Wiggins Road to convey stormwater south from the Morse-Merryman Road intersection to the Chambers Ditch. Costing over $1 million, this improvement would address an existing deficiency and provide capacity for development west of Wiggins Road as anticipated in the Comprehensive Plan. At the public meeting, staff identified the necessity of that line and the lack of funding for it, and requested that funding proposals be submitted. None have been received.

On February 5, 2007, in lieu of a comparable meeting with property owners in the valley east of Wiggins Road, staff issued a request for "information and analysis" regarding drainage conditions in that area. Some information was provided by private engineers and others and was evaluated by staff.

On March 7, the City's SEPA official issued a determination that neither the proposed Wiggins Road stormwater conveyance nor the contemplated change in valley zoning would have a significant adverse impact on the environment. Due to concerns about the lack of a refined zoning proposal, this determination was withdrawn and a new SEPA threshold determination will be issued in due course.

NEXT STEPS

The recommendations of this report will be shared with residents of the study area and other interested parties this summer. Interested parties to be notified include: 1) parties of record; 2) all property owners within the moratorium area and within 300 feet of the moratorium area; 3) downstream property owners adjacent to Chambers Ditch; 4) recognized neighborhood associations within 1,000 feet of the moratorium area; 5) representatives of subdivision applicants and prospective applicants (pre-submitters) within the moratorium area; 6) tribes; and, 7) other agencies including the Chambers Ditch District, City of Lacey, Thurston County, and Fish and Wildlife.

A City Council Public Hearing on proposed interim zoning and capital facilities plan amendments will be scheduled for September. If approved, permanent zoning changes will be considered in 2008 during the annual Comprehensive Plan amendment process.

The SEPA determination and public hearing in September will give the public an opportunity to comment on the proposed interim zoning and capital facilities plan amendments. Permanent land use plan amendments and associated measures will be evaluated by the Olympia Planning Commission and others as part of the 2008 Comprehensive Plan amendment process.

3. ENVIRONMENT AND LAND USE

For the areas of concern – the Chambers Basin valley and the upland contributing area west of Wiggins Road – this section summarizes the conditions of topography, soils, groundwater, and surface drainage; and the existing land use, zoning and actual development potential given this combination of physical constraints. **Table 3.1** below summarizes environmental conditions and land use challenges.

Table 3.1. Basin Traits and Land Use Challenges

Basin Trait	Upland Contributing Area West of Wiggins Road	Chambers Valley East of Wiggins Road
Topography	Inclined with average slope of 3 feet per 100 feet.	Flat with average slope of 3 inches per 100 feet.
Soil	Till soil. Moderately well drained.	Till soil. Very deep with poor drainage.
Groundwater	Recharges regional groundwater or emerges as springs feeding into wetlands.	Rises to surface and slowly flows towards Chambers Drainage Ditch.
Surface Drainage	Overland and wetland system flowing to Wiggins Road Ditch and then to Chambers Drainage Ditch.	Network of shallow surface drains to Chambers Drainage Ditch.
Wetlands	Narrow, but extensive system parallels Wiggins Road.	Scattered wetlands.
Stormwater Challenges	Limited capacity in Wiggins Road ditch.	High groundwater elevations and low gradients.

PHYSICAL CONDITIONS

This section describes topography and soils, groundwater conditions, and surface water drainage in the Chambers valley and contributing area.

Topography and Soils

There are two distinctly different topography areas within the moratorium boundary. The dividing feature between the two areas is Wiggins Road.

Chambers Valley (East of Wiggins Road)

The defining feature of the topography east of Wiggins Road is the slope or lack of slope to the land. This flat grade is seen in the slope of the drainage ditch and the roadways ditches through the valley area. The valley floor is naturally sloped from Wiggins Road to the Chambers Drainage Ditch with an average slope of 3 inches over 100 feet. The 37th Avenue roadway ditch has an 800-foot section with a slope of ¾ inch over 100 feet. These grades are extremely flat for a natural area and are rare in Olympia.

The soils east of Wiggins Road are described as Norma silt loam. These are very deep, poorly drained soils that form in depressions in till plains with typical slopes of less than 3 percent. The till underlying the surface has been shown to be about 100 feet thick in the valley area.

The valley floor is covered with an extensive network of shallow, 2- to 3-foot deep surface drainage ditches. These ditches provide drainage for surface water, and all eventually flow into the Chambers Drainage Ditch. The system of surface drainage ditches allowed the valley to be used for agricultural purposes and most likely drained the natural wetlands. Some remnant wetlands remain. Given the topography of the valley more wetlands would be expected if the surface drainage network was not present.

Upland Contributing Area (West of Wiggins Road)

Wiggins Road provides an artificial divide between an area that has some slope and an area that is predominately flat. The land west of Wiggins Road drains either to the Wiggins Road ditch or to a wetland complex just west of Wiggins Road. The roadway ditch system and the wetland complex both drain to the south and into Chambers Drainage Ditch.

The soils west of Wiggins Road are described as Alderwood till. These soils are formed on glacial till plains and are moderately well drained. Soil borings at the top of the watershed divide showed that the till soils are about 30 feet thick and transition into very dense advanced outwash material composed of sand with silt and gravel.

The Thurston County wetland inventory indicates a series of wetlands just west of Wiggins Road, extending from Morse-Merryman Road to 40th Avenue, SE.

The defining difference between the topography west and east of Wiggins Road is the slope of the land. The average slope of the land west of Wiggins Road is 3 feet per 100 feet compared to the average slope of 3 inches per 100 feet east of Wiggins Road.

The presence of the sloped ground surface results in the lateral movement of surface and infiltrated water from the upland area. A perched groundwater condition is observed on to the top of impermeable layers west of Wiggins Road. This perched groundwater condition does not saturate the surface soils, because the slope allows the infiltrated water to drain away.

The topography west of Wiggins Road is typical of Olympia. Soils have limited infiltration capacity and drain to a system of natural wetlands or streams that has been modified by past activities. In the area west of Wiggins Road, the natural drainage patterns were altered when the road was built. Before the road was built, the upland area drained into the flat valley floor area. Since the road was built, upland flow has been

conveyed directly to the Chambers Drainage Ditch. The Chambers Drainage Ditch is also an artificial feature of the drainage area.

Groundwater Conditions

The general groundwater flow pattern in the moratorium area is from west and east upland areas to the valley. Considerable groundwater in the upland contributing area drains downhill in an easterly direction, to the wetlands adjacent to Wiggins Road. The soils west of Wiggins Road often have layers of perched water tables above silt lens with the soil profile. These perched water tables slow the recharge of the regional aquifers and result in springs or seeps at the base of slopes.

Groundwater from the contributing area west of Wiggins Road generally recharges regional aquifers. It reaches the surface as springs that feed the wetland systems at the bottom of the slope or fill the available water storage capacity of the valley soils. Except for the wetlands, high groundwater conditions do not occur in the area west of Wiggins Road.

Groundwater in the Chambers valley is a complex interaction between the water level in the lake, the amount of rainfall, and soil infiltration rates. In most of the valley there is no separation between groundwater and surface water during above-average rainfall years; groundwater rises to the surface and can stay there for long periods. In below-average rainfall years, the groundwater does not rise to the surface and the valley floor can infiltrate stormwater.

This complex action of the groundwater was documented in the Chambers/Ward/Hewitt Comprehensive Drainage Plan and is seen in the groundwater monitoring data conducted in the winter of 2004 and 2007 for the proposed Poets Cove Development in the southeastern portion of the valley. In this area, groundwater levels in 2007 were 3 to 5 feet higher than in 2004.

City of Olympia staff measured depths to groundwater at two locations in the valley every 10 minutes from February 27 to April 17, 2007. These measurements show a dramatic rise in groundwater levels when it is raining, with groundwater levels starting to drop within hours after the rain stops. See **Figure 3.1.** In one five-day period without rain, the groundwater level dropped 2 feet. Similarly, three days with cumulative rainfall of 1.5 inches resulted in a 2-foot rise in groundwater levels. Data indicates that the groundwater does not stay elevated for extended periods of time (i.e., weeks or months), but rises and falls daily with changes in rainfall.

In March 2007, the dominant groundwater flow direction observed in the valley floor was from the edges towards the Chambers Drainage Ditch. The upland areas on either side of the valley and direct rainfall are the main contributors to groundwater flow in the valley.

Groundwater elevations in the valley were above the water levels in the lake, indicating that the lake is not the primary source of groundwater flow into the valley.

The 2007 measurements showed a strong draw down of groundwater levels along the ditch at Wiggins Road. At Wiggins Road, the groundwater was 3 to 4 feet below the surface while groundwater was less than 1 foot deep in the rest of the valley.

For data results, see **Figure 3.1 -** Water Level Fluctuations with Rainfall, **Figure 3.2 -** Measured Depths to Groundwater, and **Figure 3.3 -** Groundwater Flow Directions at the end of this chapter. For details on the groundwater monitoring results, see Appendix A.

Surface Water Drainage System

A system of ditches provides the primary drainage for the valley and upland contributing area. The major ditches – Chambers Drainage Ditch, 37th Avenue Ditch, and Wiggins Road Ditch – drain into Chambers Creek and eventually into the Deschutes River.

Upland Contributing Area (West of Wiggins Road) – Wiggins Road Ditch

The Wiggins Road ditch system drains an area of approximately 265 acres, mostly on the moderately sloped west side of Wiggins Road. A small area on the east side of Wiggins Road also drains to the road ditch system. Wiggins Road prevents surface flows from the contributing basin on the west from flowing freely into the flat area east of Wiggins Road. The roadway ditches capture some of the sub-surface flow and all of the surface flow coming from the contributing area to the west and convey it to the Chambers Drainage Ditch.

The Wiggins Road Ditch system extends from the high point of Wiggins Road just north of Morse-Merryman Road, south to the junction of Chambers Drainage Ditch and Wiggins Road. This ditch system drops 14 feet in the 4,900 feet from the highest to lowest point, an average of 3 inches per 100 feet. The flattest section of the ditch has 1,000 feet of zero grade. The primary ditch is on the west side of Wiggins Road, with 14 culverts ranging from 12 to 36 inches in diameter. A small ditch system on the east side of Wiggins is connected to the west side via culverts.

The existing Wiggins Road Ditch has limited capacity to convey runoff and is difficult to keep clean and fully operational. The flat ditch grades combined with culverts of different sizes results in a conveyance system with limited capacity for high flows. Clogging problems are caused by the combination of plants and grasses growing in the ditch, leaves and other debris from adjacent forested areas, and roadway litter.

Roadway flooding problems are associated with the Wiggins Road Ditch. The roadway has a history of minor flooding events due to the amount of water received by the ditch and clogging of the culverts and ditches. When the ditch system reaches capacity, runoff from the uplands west of Wiggins Road crosses the roadway and floods the flat area east

of the road. There are often long periods of standing water within the ditch system due to the flat grade of the ditch system.

Chambers Valley (East of Wiggins Road) – Chambers/37th Avenue Ditches

The Chambers Basin valley area, about 350 acres, drains into the Chambers and 37th Avenue ditches. The surface flows in the valley are collected in a network of shallow 2- to 3-foot deep ditches and conveyed to either the 37th Avenue or the Chambers Drainage Ditch.

As described above, the surface drainage is influenced during much of the year by the very high groundwater. The ground surface is nearly flat, sloping gently toward the Chambers Ditch.

The Chambers Drainage Ditch receives flows from Chambers Lake (drainage area of 925 acres), directly from the City of Lacey (260 acres contributing) and directly from the City of Olympia (470 acres contributing). After the Drainage Ditch leaves Olympia it flows through the Olympia Urban Growth Area in Thurston County with an additional 630 acres contributing flow to the ditch/stream before it joins with the south fork of Chambers Creek. The total contributing area of the Chamber Drainage Ditch and the north fork of the Chambers Creek is 2,285 acres.

Hydraulic modeling of the Chambers Ditch shows that the culverts upstream of Wiggins Road back up water during the 100-year design flow event. Water does not back up behind the culverts in the simulated 10-year flows. The most restrictive culverts are at 40th and 37th Avenues. The Fuller Lane culvert also results in some backwatering. The Wiggins Road culvert does not back up water in the 100-year design flow event.

The Chambers Basin storm and surface water plan documented areas of inundation surrounding the Chambers Ditch during the 100-year design event. See Appendix B for inundation areas upstream of existing culverts. There are no built structures within these areas. Ditches and streams are expected to exceed their banks in large storm events. There is no clear definition of what constitutes flooding in relation to the ditch capacity and when inundation of adjacent land represents a lack of ditch capacity.

The upper portion of the Chambers Drainage Ditch tends to have fairly deep flows when water is present. The flow depths are a consequence of the very flat slope of the Ditch, rather than culvert capacities limitations. The filling of the Ditch to close to its banks during storm events results in lower water flow velocities thereby helping to keep the earthen side slopes stable. Once the water makes it to the Chambers Ditch there is sufficient capacity to convey it downstream.

For more information, see **Figure 3.4** – Water Related Problems in Chambers Basin Moratorium Area and **Figure 3.5** – Chambers Basin Moratorium Topography Zones at the end of this chapter.

Additionally, water level data for Chambers and Smith Lake have been recorded for the last 15 years. These records are collected by Thurston County and are presented in Appendix B.

EXISTING LAND USE AND ZONING

This section describes existing land use and zoning for the Chambers valley and upland contributing area, compared to the actual development potential given groundwater and drainage conditions of the valley. See **Figure 3.6** – Study Area Current Zoning at the end of this chapter for more information.

Chambers Valley

The valley area, approximately 350 acres south of Chambers Lake, extends south to the City limits at 40th Avenue SE, west to Wiggins Road and east to Lacey city limits. It includes 100 acres to the south that were annexed in September 2006.

The valley floor is sparsely developed in large lots with single-family houses. The houses are spread along the major roadways and the private driveways that extend east from Wiggins Road. The existing lots with houses on them average about 2 acres in size. The vast majority of the valley floor area is undeveloped with the land cover being pasture established during the time of extensive agricultural land uses. The valley is zoned for both single-family and mixed residential development, with permitted densities varying from five to 13 units per acre. The City of Olympia recently purchased a 48-acre parcel between 37th Avenue, SE and Chambers Lake for a future park.

Upland Contributing Area

The contributing area is 185 acres in size, extending from Wiggins Road to the ridge west of the valley. The majority of the contributing area is forested; the remainder includes several large undeveloped parcels and 40 single-family dwellings. The area is mostly zoned single-family residential, with some mixed residential and neighborhood village designations.

DEVELOPMENT POTENTIAL

Street and utility system improvements, including extension of Log Cabin Road from Boulevard Road to 37th Avenue at Wiggins Road, are planned to accommodate potential development in the moratorium area. However, environmental constraints and stormwater concerns suggest that this level of development may not be appropriate in the

valley area. Changes to plans and regulations for stormwater management and/or reductions in density may be needed.

Chambers Valley

Development potential of the valley is constrained by the high water table and flat topography, as well as scattered wetlands and other natural features. High groundwater results in little infiltration capacity, and the minimal gradient makes stormwater discharge from building sites difficult. Currently there is a minimum network of constructed stormwater systems in place, and due to the flatness of the land and high groundwater, few options for new systems. It would be difficult to effectively manage stormwater from urban development using conventional methods of onsite detention and conveyance to existing ditches.

In addition, despite shallow flooding, little of the area is classified as a flood hazard area by regulatory agencies. Because the area is not defined as a flood zone on the FEMA Flood Insurance Rate Maps, regulated finished floor elevations and flood protection for new and existing residences, public improvements, and structures are not required. An area adjacent to Chambers Lake is identified on FEMA maps as a flood zone.

Given the surface and groundwater constraints in the valley floor, development potential may be considerably less than zoning suggests. Application of current stormwater regulations, including sizable onsite stormwater ponds, could reduce the actual development potential in the valley from a theoretical 900 lots to about 150 to 500 lots.

Upland Contributing Area

The upland area is typical of undeveloped forested land in Olympia. While the soils have limited infiltration capacity, stormwater management requirements can provide adequate engineered solutions. Stormwater can be treated, stored on site, infiltrated as feasible, and ultimately released. Environmental conditions are adequately suited to current zoning.

Summary of Development Potential

Table 3.2 compares the current number of development units with the zoned and actual potential in Chambers valley and upland contributing area.

Table 3.2. Land Use and Development Potential (Dwelling Units)

	Current	Zoned	Actual Potential
Chambers Valley	20	900	150 to 500*
Upland Contributing Area	40	1,100	1,100

* Depends on the depth to groundwater on individual lots. The less separation from groundwater, the fewer dwellings can be accommodated.

4. STORM AND SURFACE WATER MANAGEMENT CHALLENGES

Major stormwater challenges within the moratorium area include the high groundwater levels east of Wiggins Road and roadway flooding associated with Wiggins Road. This section describes the stormwater management challenges of urban development in general, as well as challenges specific to the moratorium area. Additionally, the unique role of the Chambers Drainage Ditch District is explained.

Urban development of land alters the natural hydrology of a site. Replacing natural vegetation with impervious surfaces and landscaping increases runoff. Without adequate management, this increase in runoff results in:

- Increased rate of peak runoff from a site.
- Increased volume of runoff from a site.
- Increased quantity of pollutants in the runoff.
- Less rainwater recharged to groundwater supplies.

In a high groundwater area such as the Chambers valley, these problems are exacerbated, potentially making traditional approaches to stormwater management ineffective.

STORMWATER REQUIREMENTS

To mitigate the negative impacts of urban development on the natural hydrologic system, State and local governments have adopted stormwater manuals that give design guidance for new and redevelopment. The manuals prescribe criteria and engineering methods to control stormwater quantity and quality so that stormwater generated by developments will comply with water quality standards and sustain beneficial uses of receiving water.

The applicable manuals for Olympia are the Washington State Department of Ecology (Ecology) 2005 Stormwater Management Manual for Western Washington and the City of Olympia Stormwater Manual, 2005. These manuals address the water quality standards in the Washington Administrative Code (WAC) Chapter 173-200, Water Quality Standards for Ground Waters of the State of Washington; Chapter 173-201A, Water Quality Standards for Surface Waters of the State of Washington; and Chapter 173-204, Sediment Management Standards. The requirements of the stormwater manuals are satisfied by the application of reasonable technology and Best Management Practices (BMPs) that are effective at reducing the adverse impacts of urban stormwater runoff.

The current stormwater regulations require four main types of permanent stormwater BMPs:

- Source control – to prevent pollutants from entering runoff by modifying how people work with the land.
- Onsite stormwater management – to infiltrate as much clean stormwater onsite as possible.
- Runoff treatment facilities –to remove pollutants from stormwater.
- Flow control – to modify the rate, frequency, and flow duration of runoff leaving a site.

The 2005 Ecology and City of Olympia stormwater manuals require that the duration of stormwater flow after development match predevelopment flows for certain storm events, specifically for half of the 2-year event to the 50-year event. This means that the runoff from most larger storm events is managed to a level that mimics the runoff prior to development.

Rationale for Current Stormwater Standards

The now outdated 1992 Ecology stormwater manual focused primarily on controlling the peak flow release rates for recurrence intervals of concern; the 2-, 10- and 100-year events. This approach for controlling peak flows did not adequately address the increased duration of high flows. Developed lands generate significantly greater volumes and durations of stormwater flows compared to the undeveloped lands.

In order to protect stream channels from increased erosion, it is necessary to control the duration over which a stream channel experiences higher flows. The hydraulic energy of high flows should not increase significantly following development. Erosive flows are those that are capable of moving sediments. With this in mind, the newer 2005 stormwater manuals seek to match pre- and post-runoff flow duration. Stormwater pond sizes increase, while stream channels are protected from erosion.

Even with the application of all four permanent stormwater controls, urbanization commonly results in more stormwater leaving a site and more pollutants in the runoff. With the application of the flow duration standards, the peak discharge and length of time of the peak discharge can be expected to be the same after development as before development. There will be an increase in the duration of flows that are less than half of the 2-year peak flow rate, because extra runoff is generated from impervious surfaces and cannot be infiltrated. The additional runoff is discharged slowly after the storm event, resulting in an increase in base flow.

Basin Plan Findings and Recommendations

The 1995 Chambers/Ward/Hewitt Comprehensive Drainage Basin Plan determined that approximately 1,600 feet of Wiggins Road would experience some level of flooding under 1995 conditions with a 100-year event. Flooding was predicted to increase with development and reach 3,200 feet of flooding under future build out development conditions and a 100-year storm event. The basin plan stated that replacing the ditch system with a piped system would eliminate flooding. These flooding evaluations utilized the stormwater management requirements in place at the time (Olympia Stormwater Manual, 1994).

The basin plan suggested storing water in two stormwater ponds west of Wiggins Road in order to reduce the peak flow in the Wiggins Road Ditch system. The basin plan did not further study this option in detail and concluded that the effectiveness of the proposed storage would depend on the ability to modify the existing wetlands into stormwater control facilities.

Other actions recommended in the basin plan were:

- Expansion of the Chambers Drainage Ditch District to provide funding for maintenance of the Ditch.
- Homeowner flood prevention education.
- Larger culverts along Wiggins Road.
- Enlargement or reconstruction of stormwater facilities discharging to the Ditch.
- Construction of a stormwater detention pond at Ferndale Court in the Wilderness subdivision.
- Construction of a Herman Road/Chambers stormwater treatment facility.
- More frequent stormwater system maintenance.

Staff now believes implementation of these measures would not be enough to ensure protection of existing and future homes and roads.

LIMITATIONS OF CONVENTIONAL STORMWATER MITIGATION

Stormwater impacts are usually mitigated by installing conveyance pipes, water quality technology, and storage and/or infiltration ponds. Stormwater ponds are designed for rainfall events, to store the runoff from impervious surfaces, treat and infiltrate as feasible, and meter the release into the downstream system over time. To be effective, stormwater ponds must not fill up with groundwater. The bottom of the pond must be built above the highest level of the groundwater so that when the design rainfall event occurs all of the pond volume is available for storage of the runoff.

The analysis conducted for this report shows that the valley area of the Chambers Basin is not developable with conventional stormwater mitigation, because there is not enough separation from the land surface to the highest groundwater level. If feasible at all, stormwater ponds would need to be shallow and therefore cover large areas in order to provide storage of the necessary volume of stormwater. These ponds would likely encompass 75 percent or more of development sites. In addition:

- Roads and houses are not typically built 0 to 2 feet above groundwater. Foundations would have to be designed and constructed for saturated sub-grade conditions.
- Roadways can act as dams or conduits for groundwater flow. Ground and surface water flow patterns in the valley could change with various construction methods, with potentially negative impacts on existing homes and onsite sewage systems. These impacts could be subtle and difficult to analyze.
- Keeping the current and new drainage system operational would be difficult. Pipes and ditches placed on flat grades are very sensitive to any obstruction, with little water head/pressure to allow self-cleaning of the system. Increased maintenance would be required to provide a level of service similar to other areas of the City. Localized flooding and/or standing water would be expected.
- Drainage problems for properties adjacent to new developments could be exacerbated. The land is so flat that any disturbance on one parcel could change surface or groundwater flow patterns on adjacent parcels. The impact of a new development on surrounding areas would be difficult to quantify.

Staff has concluded that if development continues without special standards, impacts would include substantial flooding damage to private and public property and excessive costs to maintain public stormwater systems.

REGULATING STORMWATER DISCHARGE TO CHAMBERS DRAINAGE DITCH

Stormwater runoff from new development must meet State and City storm and surface water requirements for increased base flow discharge volume, control of peak flows, and water quality. Olympia's stormwater standards are currently more restrictive than Thurston County's. However, due to downstream flooding and/or water quality concerns, Thurston County could, in the future, adopt a basin plan that sets more restrictive standards. In that case, discharges from Olympia would be required to meet Thurston County's requirements.

Flooding: Changes in peak discharges to existing drainage systems that are at capacity or are experiencing flooding problems is not permitted. The Chambers Drainage Ditch is currently at capacity with respect to peak discharges. However, no structural flooding

problems occur along the Ditch. Further downstream, low gradients, high flows, and potential obstructions in the Ditch near 60th Loop in Thurston County have increasingly inundated agricultural property. For new development that would discharge to these existing problem areas, downstream mitigation of existing system deficiencies or increased flow control standards is required.

Water Quality. Downstream water quality problems have also been identified. The Deschutes River has been listed for impaired water quality by fecal coliform bacteria, temperature and fine sediment. Stormwater can be a significant source of fine sediment, particularly runoff from construction sites. However, stormwater is not a primary source of fecal coliform in the watershed, and temperature is best addressed by shading and vegetation management. If Ecology sets Total Maximum Daily Load (TMDL) limits for the Deschutes watershed, Thurston County may adopt a basin plan that sets more restrictive water quality requirements.

COORDINATION BETWEEN THE CITY AND CHAMBERS DRAINAGE DITCH DISTRICT

Since its creation in 1919, the Chambers Drainage Ditch District has been responsible for maintaining the drainage system between the lake outlet and the Yelm Highway. This section describes the District's history, authority, regulatory challenges, and relationship to other agencies responsible for stormwater management in the valley. See Appendix C for further details, including a historical timeline, area map, ditch and crossing map, typical ditch cross-section and regular maintenance activities.

History and Regulatory Authority

The Chambers valley has an extensive history of storm and surface water management, which continues to define management approaches and jurisdictional relationships. According to available documents, there is no record of an artificial drainage course in the Chambers Valley area before 1902. In 1907, a survey of the basin area refers to a natural creek in the lower reaches and an artificial ditch at the lake outlet. In 1919, several residents petitioned the Thurston County Commissioners to establish the ditch district. Shortly thereafter 1.5 miles of ditch was enlarged. Federal Government Civilian Conservation Corps crews may have enlarged the ditch in the 1930s. See Appendix C for a timeline summarizing this history.

Fish and Wildlife has regulatory authority over the Chambers Ditch, which is technically a freshwater stream. Discharge to the ditch must comply with Olympia or Thurston County stormwater regulations. The Ditch District has the authority to review proposed developments and comment on whether they meet the current stormwater regulations.

Operation and Maintenance Responsibilities

The Ditch District is responsible for the operation and maintenance of the drainage ditch from the outlet of Chambers Lake to Yelm Highway. Culverts crossing the ditch are maintained by the City of Olympia, Thurston County, or private residents who own the roads above the culverts.

There are no formal easements or right-of-ways in place for the drainage ditch. All access is over private property. The lack of formal access rights, as well as limited funding, restricts the District's ability to make improvements to the drainage ditch. Because the District does not have any easements or right-of-ways, all operations are performed with a presumptive easement based on its many years of maintaining the ditch with consent of adjacent property owners.

Ditch maintenance consists mainly of cutting the grass and managing other vegetation. Some minor repair projects have been completed over the years. The most recent work completed by the District was to replace an eroding section of the Ditch with a 48-inch culvert.

The Ditch District has an operations manual, maintenance standards, and has completed a Chambers Ditch Evaluation Study.

National Pollutant Discharge Elimination System Permit Requirements

The Chambers Drainage Ditch District is a secondary permittee under the recent State National Pollutant Discharge Elimination System (NPDES) Phase II permit, a stormwater regulatory tool linked to the federal Clean Water Act. As a secondary permittee, the District is required to ensure that permit requirements are met in its jurisdiction.

On April 20, 2007, District commissioners and engineers met with staff from Ecology, Thurston County, and the Cities of Lacey and Olympia to discuss the District's responsibility for NPDES compliance. They concluded that since the County and Cities must comply with all other requirements of the NPDES permit, the District needs only to comply with regulations applicable to its maintenance activities. This would include keeping maintenance records, using best management practices, and reporting maintenance activities. In order to formalize this arrangement and allow the District to apply for its permit, an interlocal agreement between each of the jurisdictions and the Ditch district would be needed.

Potential Dissolution of the District

The Ditch District has also considered dissolving rather than fulfilling the requirements of the NPDES permit. In order to dissolve, the District must petition the Thurston County Commissioners. Before dissolution, the District would need to obtain consent from some other body, mostly likely Thurston County and/or the City of Olympia, to

assume responsibility for maintaining the Ditch. City of Olympia does not anticipate performing Ditch district responsibilities in the future. However, staff will continue to support the work of the District and lend assistance as appropriate.

Maintenance of the Chambers Drainage Ditch would be a new type of maintenance activity for the City. Olympia's Storm and Surface Water Utility currently performs similar vegetation and sediment maintenance activities on roadside ditches, which typically have very good access and are not classified as streams. However, the City does not maintain other streams as the District now does with the Ditch.

Chambers Drainage Ditch receives flows from the cities of Olympia and Lacey and Thurston County. The headwaters of the ditch is Chambers Lake which spans the boundaries between Olympia and Lacey. **Figure 4.1** – Chambers Drainage Ditch District Jurisdiction, at the end of the chapter, shows the drainage area from each jurisdiction and the areas of concern identified on the Chambers Ditch.

5. MANAGEMENT OPTIONS

This chapter describes the management options considered for the Chambers valley, upland contributing area, and downstream areas.

OPTIONS CONSIDERED FOR THE CHAMBERS VALLEY

For the valley area, an initial list of ten options was narrowed to three approaches that were then analyzed in more detail. The results are described in this section.

Initial Ten Options

Ten management approaches, shown in **Table 5.1** were developed to address the high groundwater conditions in the Chambers Basin valley. Potential economic, environmental, and social impacts of each approach were evaluated, and any option that would have a large negative impact in any of these areas was eliminated from further consideration.

Table 5.1. Initial Management Approaches for the Chambers Valley

Approach	Description	Evaluation
Traditional Development (Do nothing.)	Continue with current zoning and development regulations.	Fails to address the concerns.
Modify Construction Practices	Use special construction practices such as elevating houses, flood-proofing utilities, and elevating roads to avoid the water concerns.	Approach may work but considered too costly. May impact existing homes.
Fill the Valley	Import material to raise the valley floor well above the groundwater levels.	Incremental filling would result in increased flooding of non-filled properties. Would work if the entire valley is filled but requires flood-proofing of existing structures. Not realistic to expect of existing property owners.
Apply Low Impact Development Techniques	Adopt low impact development (LID) standards for all new construction within the area of concern.	LID practices increase onsite stormwater infiltration to reduce the stormwater impacts of the development downstream. Valley soils are ineffective at infiltration. LID will not solve the problem, although LID techniques may be effective if used in conjunction with other management tools.
Lower the Groundwater	Drain the valley. Place the water in a pipe and convey it downstream.	Approach is feasible. Draining of the valley floor would modify the hydrology of the remaining wetlands. Permitting agencies will not allow loss of wetland function.
Lower the Groundwater and Mitigate Wetlands Impacts	Drain the valley and construct new wetlands to mitigate the impacts.	Approach is feasible. Mitigation of impacted wetlands will be costly and has some regulatory uncertainty.
Restore the Whole Area as Wetland	Create a wetland bank out of the valley floor. Sell the credits from the bank to pay for the land acquisition and wetland creation.	The cost to create wetlands in the valley is high and the site is too small for economic return given the investment costs.
Rezone the Area to Open Space	Apply open space zoning in the valley floor to prevent future development.	Potential City liability. Complete open space zoning unnecessary as valley can support some development.
Lower Density to Minimal Impact	Lower the zoning density so as to not create any new stormwater impacts.	Approach is feasible provided density allows for full dispersion of stormwater within each parcel. LID techniques could help.
Apply Restrictive Groundwater Regulations	Regulate allowable impacts to the current groundwater conditions and require all new development to prove that they are complying with regulations.	Creates confrontational regulations that are difficult to enforce. Would create de-facto moratorium.

The development community has expressed interest in reducing high groundwater impacts by raising land elevations in the entire valley or specific areas of the valley. Ideally, filling would separate the surface from groundwater enough to facilitate the

construction of stormwater ponds capable of storing runoff. Theoretically, the filling would not alter the existing surface or groundwater flow patterns of adjacent parcels.

Filling of the entire valley is not considered to be a feasible approach. It would require a coordinated effort to fill the valley at one time or start the filling on the edges of the valley and progress down gradient towards the Ditch. Existing homes would need to be raised. Because it is unrealistic to expect such a high level of coordination and commitment on the part of existing homeowners, this approach was not considered further.

While filling of the entire valley was discarded as unrealistic, some filling may be possible on the edges of the valley area to increase the developable land adjacent to the high groundwater area.

Approaches Selected for Detailed Analysis

Three of the initial 10 approaches listed above were considered in detail:

- Traditional development (do nothing).
- Lower the groundwater and mitigate wetland impacts (change the valley to suit the zoning).
- Lower density to minimal impact (change the zoning to suit the valley).

Table 5.2 summarizes the advantages and disadvantages of these three management approaches. Highlights of this analysis are described below.

Option 1: Traditional Development (Do Nothing)

The "do nothing" approach was evaluated as the base line condition. This approach assumes that the current regulations are sufficient to allow the valley area to develop with the current zoning and existing topography and groundwater conditions. Current regulations require that stormwater ponds be placed above the current groundwater elevation. With this management approach, a large area of the valley floor would be utilized for shallow stormwater ponds. Conveyance systems would be shallow and flat, and would often contain standing water. Structures would be built on higher ground around the network of stormwater ponds.

Option 2: Lower the Groundwater and Mitigate Wetland Impacts

This management approach would lower the groundwater level in the valley by installing a network of drainage ditches and pipes. The network would extend out from the Chambers Drainage Ditch and slope towards the Ditch. The spacing between the drain lines would be designed to draw the groundwater down to 3 feet below the surface. Given the shallow depth of the receiving ditch, the drain lines would be spaced fairly closely together, 100 feet or less. Traditional development and stormwater mitigation

would be employed in the valley and the network of drainage lines would operate to remove infiltrated water from the soils.

Lowering the groundwater would affect wetlands within the valley area. Most likely the wetlands would lose all function and impacts would have to be mitigated. The drainage network would include a large amount of infrastructure that would have to be highly maintained, because perforated pipes are prone to root intrusion and clogging. Continued operation of the drainage network would have to be ensured indefinitely to prevent flooding in the valley.

Option 3: Reduce Development Density

Within the valley high groundwater area there are approximately 20 developed lots, typically about 2 acres in size. Residents report periods of standing water in the winter months, and some have installed sump pumps to deal with crawl space flooding. Generally residents are able create surface drainage away from their structures to prevent flooding, and roof runoff is dispersed onto their lots.

The reduced development density approach would seek to replicate the stormwater dispersion practiced by the existing valley residents. Dispersion of stormwater relies on the ability to spread the runoff from a small amount of impervious area over a large area of undisturbed native soils. If the impervious area is less than 10 percent of the total valley area the dispersion would meet current stormwater regulations. Dwellings within the valley would be constructed to withstand the highest expected groundwater conditions.

Table 5.2. Management Approaches for Chambers Valley

Management Approaches	What It Looks Like	Pros	Cons	Number of Houses and Density	Cost Comparison to "Normal Development"		
					Lower	Typical	Higher
Traditional development (Do nothing)	Develop with current regulations. Groundwater is 0 to 1 feet below the ground surface. Stormwater ponds can only be used where there is more than 6 inches of separation from groundwater. The majority of the valley floor cannot be developed using stormwater ponds. Subdivision sites that have 6 to 12 inches of separation from groundwater could end up being 75% ponds. Homes would be constructed using flood-proof techniques. A pipe network would be installed to control surface water within and around each development. Stormwater conveyance systems would be in all roads.	Easy to implement. Meets City and UGA zoning expectations.	High potential for flooding due to: • Very flat grades. • Limited ditch capacity. • Flat pipes that would be prone to clogging. • Large number of dwellings with nuisance flooding. • Incremental development causing increased flooding for existing residents. • Very low tolerance for development, design, and construction errors. • Limited and costly opportunities to retrofit a more effective solution after lands are developed.	150 dwellings Gross density 0.5 units per acre		Roads Utility service	On-site stormwater Fewer dwellings to share cost of infrastructure
Lower the groundwater and mitigate wetland impacts. (Change the valley to suit the zoning.)	The Drainage Ditch and culverts would be lowered about 2 feet with a network of drains installed to allow ground and surface water to flow from the valley area with adequate slope. As a result, groundwater would be 2 to 3 feet below ground and stormwater ponds 1 to 2 feet deep. Stormwater ponds could consume 30% of the valley area. The valley would be about 50% developable land. Houses would be constructed with standard procedures. A large portion of land adjacent to the Chambers Ditch would be established as wetland mitigation sites. Stormwater conveyance systems would be in all roads.	Meets City and UGA zoning expectations. Groundwater at 2 to 3 feet below grade. Provides some grade for stormwater conveyance systems. Able to resolve flooding issues for current and future residents. Very little or no nuisance flooding.	Integrated regional, ditch, and wetland mitigation construction needed up front. Large upfront infrastructure cost ($9 million to $17 million). Long-term commitment to protection of mitigation sites. Large amount of stormwater infrastructure to maintain.	1000 dwellings Gross density 3 units per acre		Roads Utility services On-site stormwater	Regional pipe system Offsite wetland mitigation

Management Approaches	What It Looks Like	Pros	Cons	Number of Houses and Density	Cost Comparison to "Normal Development"		
					Lower	Typical	Higher
Lower density to minimal impact (Change the zoning to suit the valley)	Development density would be lowered to allow for full stormwater dispersion within each building lot. Grouping of houses would be required to utilize all favorable topography. Impervious area limits would be placed on each development along with building setbacks from property line restrictions. Groundwater would be 0 to 1 feet below the surface with no stormwater ponds on the lots. Houses would be constructed with flood-proof techniques. Local roads would drain to adjacent infiltration areas.	Able to disperse water from houses into the majority of the area on the lot. Lowest stormwater impact to current residents. Fewer residents in area of water concerns. Standing water would be a nuisance but not damaging to property. Most predictable outcome.	Changes zoning and UGA density expectations. High potential for standing water in areas: Very flat grades difficult to make the water flow Groundwater at 1 to 2 feet below ground Limited Ditch capacity Effects the implementation of other services. Fewer dwellings to share the cost. High utility service costs per lot.	150 dwellings Gross density 0.5 units per acre	On-site stormwater	Roads Utility service	Fewer dwellings to share cost of infrastructure

OPTIONS CONSIDERED FOR CONTRIBUTING AREAS

Given the potential flooding problems associated with development of the upland contributing area west of Wiggins Road, an initial list of five specific approaches for managing storm and surface water was narrowed to three options that were evaluated in more detail. The evaluation is summarized in **Table 5.3**.

Table 5.3. Initial Development Options for Upland Contributing Area

Approach	Description	Evaluation
Accept the valley flooding. (Do nothing.)	Continue with current zoning and development regulations.	Fails to address the concerns.
Reduce the allowed development density of the contributing area.	Reduce the amount of impervious surface to be built in the contributing area thereby reducing the quantity of runoff reaching the valley.	Wiggins Road is currently experiencing some level of flooding. Stopping or restricting development would not solve the existing problems.
Increase stormwater storage requirements for new developments.	Build larger ponds in the contributing area to reduce the discharge to the valley.	Reducing discharges to the area would solve the flooding problem. Given the topography and soils of the contributing area, applying more restrictive stormwater regulations would be expensive for affected properties.
Require low impact development techniques.	Adopt low impact development standards for all new construction within the area of concern.	LID practices increase onsite stormwater infiltration to reduce the stormwater impacts of the development downstream. The contributing area soils have poor infiltration. LID will not solve the problem, though LID techniques may be effective if used in conjunction with other management tools.
Increase the conveyance capacity along Wiggins Road.	Increase the size of the roadway drainage ditch or install a pipe in the ditch location.	Approach is feasible and consistent with resolution applied to other stormwater flooding problems in the City.

Approaches Selected for Detailed Analysis

After evaluation of these options in light of current stormwater regulations, three of the initial five approaches listed above were selected for further consideration:

- Accept the flooding.
- Increase the stormwater storage for new developments.
- Increase the conveyance capacity along Wiggins Road.

Each of these options is discussed below.

Option 1: Accept Valley Flooding

The do nothing option assumes the current stormwater conditions would continue. Intermittent, short-duration flooding of Wiggins Road could be allowed with the occasional road closure expected due to water over the road. Olympia does not typically accept a lower level of service on roadways due to flooding.

Discharges to existing drainage systems, such as the Chambers Ditch, that are at capacity or are experiencing flooding problems is not permitted by current State and City stormwater regulations. This requirement would continue to be applied through the SEPA process to identity and mitigate downstream impacts.

Option 2: Increase Stormwater Storage for New Developments

Current Olympia stormwater regulations require that releases of stormwater from new development match the rate and duration typical of forested land cover. More restrictive release rates could be adopted in the contributing area. Such restrictions would lower the peak rates reaching the Wiggins Road ditch system. The goal would be to limit the release rate from the contributing area to the capacity of the current roadway ditch and culvert system.

Given that the soils in the contributing area have moderate to poor infiltration capacity, it is unlikely that all of the additional water generated from new development could be mitigated within the upland areas. Some water would have to be released. To significantly reduce the release rate a large increase in storage volume would be required.

Option 3: Increase Wiggins Road Ditch Capacity

Ditch capacity could be increased by widening and deepening the existing roadway ditch or replacing it with a stormwater conveyance pipe.

If the ditch size were increased, existing roadway culverts would have to be replaced with larger culverts. When the roadway is improved in the long-term, the ditch would have to be moved or replaced by a pipe to allow for the ultimate use of the right of way by vehicles, bicycles and pedestrians. The interim use of a wider, deeper roadway ditch could create safety concerns.

Replacing the roadway ditch with a stormwater pipe would increase the conveyance capacity and prepare the right of way for future roadway improvements. Pipes have the added advantage that they tend not to clog as easily as culverts.

OPTIONS CONSIDERED FOR DOWNSTREAM AREAS

Residents adjacent to the Chambers Drainage Ditch and in downstream areas of Thurston County have raised issues and concerns about the current condition of the ditch and the potential for negative impacts on downstream properties if a conveyance pipe is installed along Wiggins Road to replace the existing roadside ditch.

These residents have been experiencing greater than normal volumes of water, increased peak flows and erosion problems in the Ditch. This is primarily due to the impervious surfaces built without stormwater storage facilities in the basin.

The Chambers Drainage Ditch receives flow from several sources:

- Chambers Lake – natural flow control.
- City of Lacey from 37th Avenue – piped flow from new developments.
- Chambers Basin valley – overland and ditch flows for dispersed development and roads surface.
- Upland contributing area – overland, ditch and subsurface flows from dispersed development and roads.
- Wilderness Subdivision contributing area – piped flows from the subdivision and roads with little stormwater storage in place.

Because of this, responsibility for Chambers Drainage Ditch is shared among Thurston County, the Cities of Lacey and Olympia, and the Chambers Ditch District (see **Chapter 4**, Storm and Surface Water Management Challenges).

Table 5.4 summarizes downstream issues, possible actions, and responsible parties.

Table 5.4. Chambers Drainage Ditch - Downstream Issues and Options

Concern/Issue	Severity	Cause	Possible Actions	Party Able to Implement Action
Structure flooding at town homes immediately downstream of Yelm Highway.	Occurred at least once due to debris blockage in the ditch.	Obstruction of flows during a major storm event.	Increase inspection frequency and maintain if required. Clarify the cause of structure flooding.	Thurston County.
Flooding of property near 60th Loop.	Loss of agricultural use of land. Saturated soils into the summer months.	Discharge of under-managed or unmanaged stormwater flows to Chambers Drainage Ditch. Debris and beaver dams reducing downstream capacity.	Better manage new flows through duration flow control in watershed. Retrofit current unmanaged areas with stormwater controls (i.e., Wilderness subdivision). Work with property owner and government agencies to investigate the capacity and maintenance of the stream downstream of Yelm Highway.	City of Lacey and Thurston County. Thurston County. City of Olympia and Thurston County.
Ditch side slope stability problems throughout Wilderness subdivision	Occasional small slides and soil loss.	Lack of vegetation on side slopes of the ditch. Increase in peak flows in Chambers Ditch.	Work with the Ditch District and residents to construct flatter side slopes to the ditch and establish vegetation. Implement duration control in watershed.	Chambers Ditch District, Thurston County, City of Olympia. City of Lacey and Thurston County.
Increased stormwater discharges from the Wiggins Road area into the Chambers Ditch.	Estimate 20 to 75% more water occurring as non-storm related base flow.	Increase in volume of water due to urbanization of upstream areas.	Implement flow controls for new development that mitigate maintain or reduce peak flows. Typical base flows would increase.	City of Olympia
Chambers Ditch at capacity.	Occurs often. Does not flood structures or break banks.	Ditch is very flat and velocities are slow. Water depth will always be high.	Do nothing. High water levels do not cause structural or other property damage.	N/A
Lack of culvert capacity along the Chambers Ditch.	Culverts control Ditch capacity during high flows.	Culverts reach capacity near 10-year storm event peak flows.	Consider culvert upgrades with roadway improvements projects.	City of Olympia and Thurston County.

Concern/Issue	Severity	Cause	Possible Actions	Party Able to Implement Action
Culverts need cleaning.	Culverts sometimes clog with debris and sediment.	A 40th Avenue driveway culvert is the smallest culvert. Low velocity and little gradient.	Increase inspection. City of Olympia should maintain private culvert at 40th Ave driveway.	City of Olympia or Thurston County.
Increased flows in Chambers Ditch due to poor performance of some stormwater systems in Lacey.	Documented flooding at Schilter Farm. Unquantified concerns about other developments.	Incorrect design assumptions or systems not built according to design.	Monitor systems for performance and compare with original design and standards. Retrofit if needed.	City of Lacey.
Deschutes River is water quality impaired for fecal coliform, temperature and fine sediment. New development could exacerbate the problem.	Pollutants have exceeded allowable levels several times a year over the last 10 years.	Failing onsite sewage systems and urbanization with no or older stormwater controls.	Implement the latest stormwater BMPs within the watershed. Complete Ecology's watershed TMDL study and set additional requirements if needed. Repair failing onsite sewage systems.	Department of Ecology, Thurston County, City of Lacey, City of Olympia. Thurston County.

Potential Regional Stormwater Pond

The Chambers/Ward/Hewitt Basin Plan recommended construction of a regional stormwater pond to mitigate downstream flooding impacts from existing development. The contemplated pond would be constructed in the Wiggins Road area. This option was analyzed in the course of the current study.

The current analysis indicates that the regional pond would not appreciably reduce downstream flows. A reduction of downstream flows could best be accomplished by addressing the major sources of unmanaged surface and stormwater, Chambers Lake, and the Wilderness subdivision. The facility would only manage minor stormwater flow from the relatively low-density development and minimal road system in the valley. Conversely, stormwater from proposed higher density development in the upland contributing area west of Wiggins Road will be adequately managed by localized, onsite facilities. While conceptually a stormwater facility would improve the stability of the Drainage Ditch from the adverse effects of existing development within the basin, benefits would be immeasurable. The stormwater pond would not solve Ditch problems due to unmanaged flows.

Mitigating Impacts from Road Runoff

Several Olympia roads that generate stormwater and discharge to the Chambers Ditch do not have stormwater controls (see **Figure 5.1** at the end of the chapter). Stormwater mitigation will be required for extensions and improvements to 37th Avenue and Wiggins Road. New roads incorporate stormwater management controls.

As roadways in the Chambers valley develop, they will be retrofitted with stormwater management controls. Eventually the contributions from uncontrolled sources in Olympia will decrease and be eliminated. Uncontrolled flows from the lake and the Wilderness subdivision are not likely to improve without a specific stormwater management retrofit project.

Table 5.5 lists pond specifications for existing and future roads. Currently 0.5 to 1.8 acres of privately owned land is suitable for pond construction. Its availability is unknown.

Table 5.5. Roadway Stormwater Ponds – Possible Sizes

Option	Needed Volume (Acre-feet)	Surface Area (Acre)	Cost (Millions)
Existing Olympia roads	2.2	1.0	$1.4
Existing Olympia and UGA roads	3.6	1.6	$2.0
Future Wiggins Road in Olympia with 1/2 street improvements	1.5	0.7	$1.1
Future Wiggins Road in Olympia and UGA with 1/2 street improvements	2.1	1.0	$1.3
Future 37th Avenue and Wiggins Road to City limit (1)	2.0	1.0	$1.3

[1] This project would require using the Chambers Ditch for conveyance of unmanaged stormwater to the pond. Such use of the Ditch, a regulated stream, may be inappropriate.

As indicated in Table 5.5, mitigation of the impacts of existing Olympia roads draining to the Ditch would require a 1.0-acre regional stormwater facility with an estimated cost of $1.4 million. To mitigate existing roads as well as provide capacity for future roadway projects, a 1.7-acre facility would be needed, with an estimated cost of $2.5 million. Such a facility would mostly like have to be funded by the City's Storm and Surface Water Utility using its bonding capacity. Utility rate increases could be expected. In the long-term, costs could be partially recaptured from City road widening projects.

6. PRELIMINARY RECOMMENDATIONS

This section presents the preliminary recommendations resulting from this study for Chambers valley, the upland contributing area, and downstream areas. For Chambers valley, a recommended change in stormwater standards is presented first, since it forms the basis for the recommended change to a lower density zoning. For the upland contributing area, a major stormwater conveyance pipe is recommended, with no change in existing land use regulations. For the downstream area, a number of interrelated basin-wide management measures are recommended.

RECOMMENDATIONS FOR CHAMBERS VALLEY

This study recommends lowering the zoned density of the Chambers Basin valley to a level consistent with the Ecology and Olympia stormwater management guidance for managing stormwater using full dispersion techniques.

Preliminary recommendations for the valley are:

- Apply full stormwater dispersion design criteria in high groundwater areas, including a maximum impervious coverage of 10 percent.
- Create an interim zoning district for high groundwater areas, consistent with full dispersion stormwater design guidance. Zoning would be a modification of the existing Residential 4 Units per Acre (R-4) District.
- Apply a new low-density street standard to local access roads in the new zoning district.

Following a description of the recommendations, this section discusses implications of low-density development for the City's responsibilities under the Growth Management Act and for costs of development.

Storm and Surface Water Management

Managing stormwater by full dispersion techniques involves spreading runoff over a wide area and allowing it to gradually infiltrate into surface soils. This method takes advantage of the soil moisture capacity of any soil remaining above the groundwater level. Full dispersion attempts to maximize groundwater recharge, while decreasing or eliminating runoff, and greatly reducing the concentration of runoff at any one location.

This report recommends applying these guidelines in high groundwater areas of the Chambers valley, which implies a lower development density than current zoning allows.

Full Dispersion Criteria

The City of Olympia's 2005 Stormwater Manual provides design standards for meeting full stormwater dispersion. Similarly, Ecology has produced a guidance document for implementing Low Impact Development (LID) stormwater techniques, which gives complete information about achieving full dispersion of stormwater. **Table 6.1** summarizes Ecology's guidance. For additional information, see the Olympia Stormwater Manual, Volume V, Chapter 5, BMP T.30 Full Dispersion, and Volume III, Appendix C, Section 7.2. Copies of these standards are provided in Appendix D of this report.

The full dispersion guidance states that developments subject to the standards must preserve at least 65 percent of a site in a forested or native condition. Runoff can be dispersed from the developed portion of the site into the native vegetation area as long as the impervious surfaces in developed areas draining to the native vegetation does not exceed 10 percent of the entire site. Runoff must be dispersed into the native area in accordance with BMP T5.30 Dispersion.

Table 6.1. Full Dispersion Criteria for Meeting Stormwater LID Requirements.

Percent Natural Vegetation Preserved (minimum allowed)	Percent Effective Impervious (maximum allowed)	Percent Lawn/Landscape (maximum allowed)
65	10	35
60	9	40
55	8.5	45
50	8	50*
45	7	55*
40	6	60*
35	5.5	65*

Source: Washington Department of Ecology, Low Impact Development Design and Flow Modeling Guidance. DOE Stormwater Manual, Volume III, Appendix C.
*Where these lawn/landscape areas are established on till soils, and exceed 50 percent of the total site, they should be developed using approved soil quality and depth specifications.

Effective impervious surfaces as referenced in Table 6.1 are those hard surfaces (e.g., driveways, sidewalks) that generate runoff that must be managed. Conversely, ineffective impervious surface are those hard surfaces that generate runoff that is expediently infiltrated in the soil. Runoff from ineffective surfaces does not need to be managed. Given soil, groundwater, and slope conditions in the Chambers valley, all impervious surfaces are considered potentially effective and must be managed.

Impervious Surface Coverage and Density

Based on local analysis, achieving an impervious surface coverage of 10 percent is consistent with a developed density of one dwelling per two acres. This analysis by the Thurston Regional Planning Council is presented in **Table 6.2.**

Table 6.2. Impervious Area Coverage of Residential Zoning Districts

GENERALIZED ZONING DISTRICT (RESIDENTIAL AND RESIDENTIAL COMPONENT OF MIXED USE)	Residential Lots Only		Division of Land in Subdivisions			Adjusted for Rights-of-Way and Open Space	
	% TIA[1]	% EIA[2]	Residential Lots	Open Space	Right-of-Way	% TIA	% EIA
1 – Very High Multifamily	78.0%	63.0%	100%	0%	0%	78.0%	63.0%
2 – High Multifamily	60.9%	48.9%	61%	22%	17%	47.9%	38.1%
3 – Moderate Multifamily	55.2%	42.4%	57%	21%	23%	45.0%	34.6%
4 – Mixed Residential	50.2%	37.7%	61%	16%	23%	43.9%	33.2%
5 – Medium (Cities)	45.1%	33.5%	56%	27%	17%	36.6%	27.5%
5 – Medium (UGAs)	38.2%	28.3	60%	25%	16%	33.2%	24.9%
6 – Medium – Low	31.9%	23.5%	77%	15%	8%	30.2%	22.4%
7 – Low Sensitive	23.0%	17.2%	53%	32%	15%	22.7%	17.2%
8 – Low	26.5%	19.5%	77%	19%	4%	24.2%	18.0%
9 – Very Low	19.9%	14.6%	94%	0%	6%	21.8%	16.1%
10 – Rural – 1 du/acre	14.1%	10.1%	82%	11%	7%	16.0%	11.7%
11 – Rural – 1 du/2 acres	10.2%	7.2%	71%	22%	6%	12.5%	9.2%
12 – Rural – 1 du/5 acres	5.3%	3.7%	64%	30%	6%	9.2%	6.9%
14 – Rural – 1 du/20 acres	3.7%	2.6%	100%	0%	0%	3.7%	2.6%

[1] TIA = total impervious area
[2] EIA = effective impervious area

Source: Thurston Regional Planning Council, *Estimates of Future Impervious Area Conditions Thurston County*, January 2007.

Land Use

This study recommends creating an interim zoning district in the Chambers Basin valley at a density consistent with the stormwater management guidance for high groundwater areas described above. The interim zoning would be further evaluated in 2008 during the Comprehensive Plan amendment process. At that time, it could be modified based on analysis and public comment.

Proposed Interim Zoning District Boundaries

The proposed interim zoning would be applied in the area of the Chambers Basin valley floor that is subject to high groundwater, has flat topographic slopes, and where filling or other engineering solutions are not feasible. **Figure 6.1** at the end of the chapter shows the proposed boundary of the interim zoning district excluding areas of potential fill.

The areas of high groundwater are determined from the 2007 monitoring data (see **Chapter 3**) and defined as having less than 2-foot of separation from the groundwater to the surface. Areas of flat topography are those with a land slope of less than 1 percent slope (1-foot rise over a 100-foot length).

Interim Zoning Regulations

In the proposed interim zone, open space set asides would encompass 65 percent of the overall development site. The remaining developable area could accommodate four units per acre. Homes would be more or less centered on lots with appreciable set backs for parcel

boundaries to allow stormwater to disperse on the lot. Houses would be constructed with flood proof techniques. Stormwater ponds would be minimal or nonexistent, because the large open spaces would allow adequate stormwater management.

The proposed interim zoning would be a modification of the existing Residential 4 Units per Acre (R-4) District. The purpose of the R-4 district as described in the development code is: "To accommodate residential development in areas sensitive to stormwater runoff in a manner and at a density (up to four (4) units per acre) that avoids stormwater related problems (e.g., flooding and degradation of environmentally critical areas)." OMC 18.04.020(B)(3). This zone is already applied to areas of poor drainage, such as above Ken Lake and surrounding Bigelow Lake. Staff proposes a variation of the standard R-4 zone for application in the areas south of Chambers Lake shown in **Figure 6.1**.

Due to drainage limitations of this area, the proposed Chambers R-4 zone would differ from the standard R-4 zone by the following regulations:

- The minimum lot size would be 12,000 square feet for most new subdivisions. One acre would be required if an open space tract is not created. A minimum lot width of 100 feet, 50-foot rear yards, and total side yard widths of 60 feet would be required to ensure an area to disperse run-off.
- A minimum of 65 percent of the lot or development must be preserved as natural vegetation in a dedicated tract.
- Total impervious surface coverage would be limited to 6 percent of outside of public right-of-way.
- Flow from impervious areas must be dispersed into the natural vegetation tract. A maximum of 700 square feet of roof area can be discharged from each downspout. Improvements cannot impound or change flows from adjacent parcels. All yards, landscaping, and disturbed pervious surfaces shall receive compost-amended soil in accordance with BMP T5.13 of Olympia's stormwater manual (2005).
- To provide density opportunities, three-story structures would be permitted, with a maximum height of 40 feet.
- Apartment buildings and condominiums with up to four units per lot would be permitted, but townhouses (shared wall structures on separate lots) would not.
- Roadways must use the proposed new local access street standard with full dispersion.
- Blocks with a 5,300-foot perimeter would be permitted to minimize new streets. However, bicycle and pedestrian connectivity must meet a 2,700-foot perimeter. Connectivity can be made with a utilizing a 10-foot wide hard surfaced path. Each development must also provide motor vehicle connectivity to adjoining parcels.

Lot impervious areas include impermeable driveways and structures. Permeable pavements are not included in the impervious area calculations. The vegetated flow path is measured

from the downspout or dispersion system discharge point to the downstream property line, stream, wetland or other impervious surface.

Figures 6.2 and **6.3** at the end of this chapter illustrate how the requirements for natural vegetation, impervious surface and lawn/landscaping could be met. **Figure 6.2A** shows a 39-acre parcel with dispersed lots and natural vegetative tracts on each lot. **Figure 6.2B** shows a 39-acre parcel with clustering and setbacks to allow maximum dispersion to large natural vegetation tracts. **Figure 6.3** shows a typical 2-acre parcel.

Local Access Street Standard

For this type of development to occur in the Chambers Basin, stormwater must be dispersed into natural vegetation from all new impervious surfaces, including publicly owned streets. Construction of the local access and internal roadway network typically occurs with each development. The present City of Olympia local access street standard is designed for more traffic than a lower density area would generate.

To minimize impervious area and allow dispersion of stormwater from local access roadways, a new low-density street standard is recommended for the interim zoning district. **Figure 6.4** at the end of this chapter shows a cross-section of the low-density street. It would have two travel lanes and a curb and sidewalk on one side. The street would be sloped so runoff would sheet flow toward the curbless roadway edge and over a 11-foot strip of compost-amended soils and into the adjacent natural vegetation tracts.

The low-density street standard would also require provisions to allow adjacent groundwater to flow under the roadway section. This could be achieved by using permeable base materials or by using collection trenches, pipes under the roadway, or redistribution trenches. Applying a low-density local access street standard would reduce the overall cost of roadways in the zoning district.

The proposed increase in block perimeter size will also reduce the amount of roadway impervious surface. Separate bicycle and pedestrian block spacing is intended to enable pedestrian mobility even with the larger block sizes. With the proposed vehicle and pedestrian block perimeters, the transportation network will create an impervious coverage of 3.8 percent of the valley floor. This combined with the impervious coverage on the lots must be within the stormwater criteria of 10 percent total impervious coverage.

Implications of Low-density Zoning

Applying low-density zoning in Chambers Basin valley has implications for Olympia's responsibilities under the Growth Management Act, as well as the cost of development in the valley.

Growth Management Requirements

Washington's Growth Management Act (GMA) requires that the UGAs of Thurston County and its cities accommodate the urban growth projected to occur in the county within the next 20 years. The GMA also requires protection of wetlands, provision of open space and greenbelts, and promotion of a variety of housing densities.

In 1994 it was estimated that the County's UGAs might be large enough to accommodate up to 40 years of growth. The size of Olympia's growth area was challenged as being too large, but the Growth Hearings Board held that it was consistent with the mandates of GMA. A review of such accommodation is required every ten years. After the last review in 2005, Thurston County's Plan was appealed to the Growth Hearings Board, which concluded that collectively the UGAs may be larger than is appropriate. That decision is on appeal to the Washington State Supreme Court.

Coincidentally, GMA requires that Thurston County issue a monitoring report every five years. The first such "Buildable Lands Report" was issued in 2002. Information from the County's in-progress 2007 study has been being incorporated into the Chambers Basin study.

The 350 acres of the Chambers basin east of Wiggins Road in Olympia is about 2 percent of the total UGA of Olympia. The City's land use plan designates much of this area for "mixed residential" development and most of this area would be deemed to be currently "vacant" or "partially used" as those terms are defined for buildable lands reports. Absent constraints, such areas commonly achieve a gross density of seven units per acre. As a result of wetland protection standards and other factors, City staff estimates that conceptual current zoning in the area would accommodate about 900 residential units. However, groundwater constraints further reduce the development potential. Approximately 150 to 500 units are feasible and likely under current zoning.

Preliminary estimates of the on-going buildable lands study indicate that Olympia's growth area exceeds the minimum required size by about 2,500 units. If these estimates are accurate, the proposed change in zoning would not be contrary to GMA mandates, but would remove some of the existing extra. (Note: GMA allows consideration of something similar, termed a "land market supply factor," in sizing growth areas.)

Development Cost Implications

Providing urban infrastructure for roads, wastewater, and drinking water services is typically a large part of the cost of new developments. When many houses are built in a small area, these costs can be shared among many residents. Low-density development would increase the typical development cost per dwelling.

At densities typical of conventional Olympia subdivisions (five to eight dwellings/acre), a typical lot has 50 feet of road frontage. Corner lots are associated with considerably more frontage. Since lots are located on both sides of the road thereby sharing the frontage, we

estimate a per lot frontage of 35 feet. The relative cost of infrastructure improvements for each lot is based on this evaluation.

In the low-density zone, the estimated average street frontage per dwelling would be approximately 140 feet. The cost of street infrastructure would be slightly lower than for typical urban densities, because pipes would be smaller and the proposed street standard only has one sidewalk. With these factors in mind, low-density street and utility improvements are expected to cost 90 percent of the traditional development cost per foot of improvements.

Even though the per foot cost of the improvements in the low-density is expected to be less than conventional development, more street frontage and improvements are needed per house. The increased cost of supplying utility service and street access in the low density zone would be about four times greater than installing these same improvements at traditional urban densities.

At densities of five to eight dwellings per acre, infrastructure costs per dwelling are typically $15,000 for roads, $5,000 for wastewater, and $3,000 for water service. The expected average cost for improvements in the low-density zone is $60,000 for roads, $20,000 for wastewater and $12,000 for water service.

Ultimately, whether development is economically feasible within the valley area will depend on the market value of the dwellings that can be built. If there is enough value added to having a large lot dwelling with city services in an urban area, then development is likely to occur.

Planned City Infrastructure for Chambers Valley

The City would implement current plans for urban infrastructure in the valley area regardless of development density. New development in the valley would be expected to pay its share of these regional streets and wastewater and drinking water utility improvements as described above.

Streets

Improvement of both Herman Avenue/37th Avenue and Wiggins Road is required regardless of the amount of development in the Chambers valley. Both major collectors are intended to eventually provide transportation network service for an area much larger than the valley. Herman Avenue (37th Avenue in Lacey) will connect with the Log Cabin Extension Road to the west; Wiggins Road is expected to expand with turn lanes at intersections. A roundabout is planned for the intersection of the two main roads. Stormwater mitigation for improvement of these major collector roadways within the high groundwater area will be expensive and difficult.

The City's transportation comprehensive plan calls for a new major collector extending from 45th Avenue SE in Lacey to Wiggins Road. This major collector must cross the Chehalis

Western recreational trail and a section of the identified high groundwater zone. The collector is needed regardless of the planned density in the valley area. Projects that occur on parcels adjacent to the major collector roadways would be expected to build their frontage improvement portions of the new roads as is typical of developments in other areas of the city. City and grant funds will be needed to complete the major collector roadway construction when traffic service levels indicate the improvements are required. Herman/37th Avenue is considered a higher priority for improvement than Wiggins Road or the new major collector at 45th Avenue.

With the adoption of a reduced density zone in the Chambers Basin valley area, some revisions to the City's transportation comprehensive plan would be needed. The current plan shows a future neighborhood collector running north and south through the valley area. This future roadway should utilize the full dispersion street standard proposed for the entire valley area. The current comprehensive plan states that 37th Avenue from Wiggins to the City limits will be a major collector boulevard. Given the high groundwater conditions that exist in this location and the difficulty of mitigating the stormwater from the roadway improvements, it would be prudent to revise the roadway classification in this section to reduce environmental impacts and construction costs.

Developments are expected to improve the frontage of existing roadways adjacent to their property. With the adoption of a reduced density zone the ability of the City to require frontage improvements on the existing major collectors within the reduced density zone becomes less certain. A consequence of the reduced density zoning may be more City funding of the major roadway improvements.

Wastewater

The City's Wastewater Management Plan (2006) recommends a gravity sewer in Wiggins Road and 37th Avenue draining to a pump station at the junction of Wiggins Road and Chambers Drainage Ditch. A wastewater force main would extend from the pump station to Hoffman Road for discharge in gravity sewers to the LOTT treatment plant. The pump station and wastewater lines in Wiggins Road would service a large area to the west of Wiggins Road. The high groundwater present in the valley does not change the need for this infrastructure.

Olympia does not allow installation of onsite sewage systems or STEP systems to provide wastewater service. The most efficient way to provide wastewater service in a low-density area would be to install a regional gravity sewer network with grinder pumps to connect individual houses to the network. Such a system would require 60 to 80 percent of the cost of a traditional system.

Drinking Water

The City already has a water line in Wiggins Road. Future water system needs call for a water line from Wiggins Road to Lacey along 37th Avenue. This water line would be used for

a possible water service interconnect with Lacey. All other water system needs in the valley floor area are driven by the need to service residents within the valley area. Reducing the density of developments in the valley does not change the regional need for water lines or affect the need for the water main in 37th Avenue.

Water service lines are sized for fire flows thus reducing the number of served residencies does not reduce their size. Looped water lines are preferred, but dead end lines can be installed if they are slightly larger.

The water service infrastructure for a low-density area would be similar in extent as conventional development. The number of water lines is determined by the roadway network and access to dwellings. The current water system and fire code standards currently in place within the City are appropriate for a low-density zone.

RECOMMENDATIONS FOR UPLAND CONTRIBUTING AREA

Recommendations for the upland contributing area are:

- Construct a pipe along Wiggins Road to convey stormwater from the upland area, to be funded and installed by development within the upland contributing area west of Wiggins Road.
- Leave existing zoning and development criteria unchanged.

This section describes the recommended conveyance pipe, including a description of its route, and impacts on peak and base flow.

Storm and Surface Water Management

This report recommends construction of a Wiggins Road stormwater conveyance pipe from Morse-Merryman Road to the Chambers Drainage Ditch. The conveyance system would be sized to provide 100-year flow capacity, with pipe size varying from 18 to 36 inches in diameter. The pipeline would approximately follow the existing roadside ditch alignment. Ultimately, with future roadway reconstruction, it would be located under the curb or outside vehicle travel lane of a widened Wiggins Road. The pipe would be installed under the existing roadside ditch to allow collection of local runoff in the ditch and provide flood protection until the roadway develops. Flows into the ditch would be routed to the pipe and conveyed downstream.

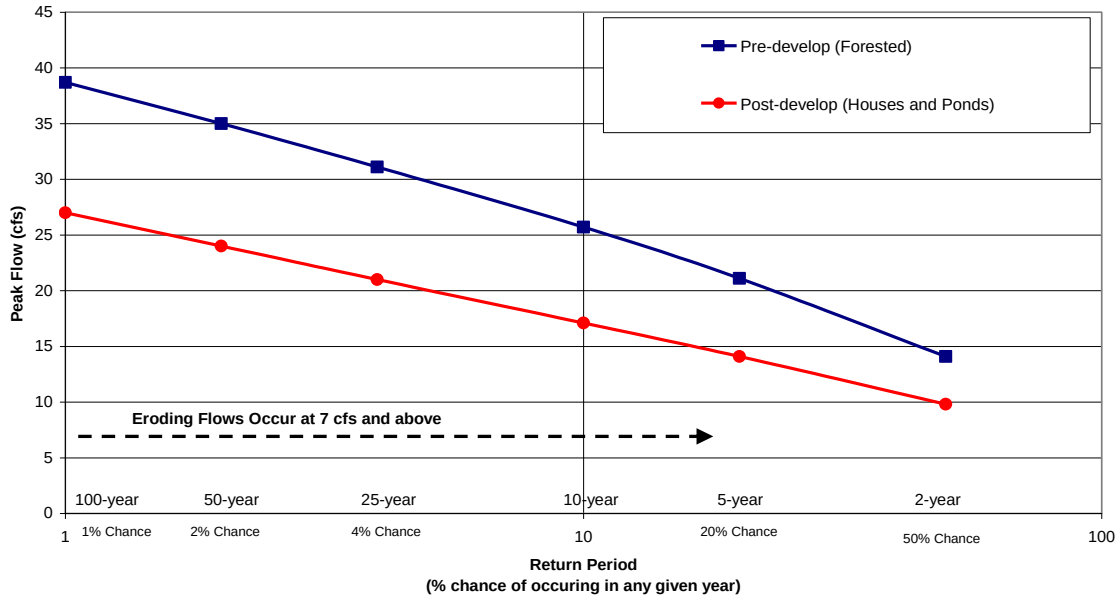
All future developments discharging to the proposed pipe would be required to meet standard City of Olympia stormwater manual requirements. These requirements include onsite stormwater management, water quality treatment, and flow control. Existing runoff would remain in its current flow condition until it reaches the west roadside ditch where it would enter the Wiggins Road stormwater pipe.

The location and size of the proposed conveyance system is shown in **Figure 6.5** at the end of this chapter. The preliminary design of the conveyance system is presented in Appendix E. The stormwater conveyance is expected to cost $1.1 million (2006 dollars). The conveyance system would be funded and installed by development locating west of Wiggins Road and within the basin contributing flow to the valley floor.

Impacts of the Wiggins Pipe on Peak Flow

A Western Washington Hydrology Model (WWHM) of the contributing basin shows that with full development and implementation of Olympia flow control regulations, the peak flows and their duration in the system would be less than under pre-developed forested conditions. Flooding is typically associated with high peak flows that exceed the capacity of conveyance systems. Given the modeling results, flooding is not expected. **Figure 6.6** shows the difference in peak flow characteristics before and after development. The watershed model for the basin is provided in Appendix E.

Figure 6.6. Modeled Pre and Post-Development Peak Flows



Impact of Wiggins Pipe on Base Flow

Base flow is defined as the sustained flow that occurs between storm events. Base flow includes groundwater discharge to surface water and runoff from stormwater ponds that have a metered release. Base flows typically do not generate downstream flooding. The Chambers Ditch provides adequate capacity for expected increases in base flow.

The range of increase in base volume in the proposed pipe is dependent upon the level of onsite infiltration that can be accomplished in new developments. The model shows that base flow would increase about 20 percent if all of roof runoff is infiltrated onsite. The base flow would increase 70 percent if half of roof runoff is infiltrated on site.

In all cases, the modeled base flow generated water velocities of less than 7 cubic feet per second (cfs), which is the largest feasible flow without causing erosion of the ditch. The increase in stormwater volume does not consider infiltration in the development ponds or any spring flows of groundwater that reappears as surface water. **Table 6.3** summarizes the water budget for different land conditions.

Table 6.3. Water Budget for Land Conditions West of Wiggins Road

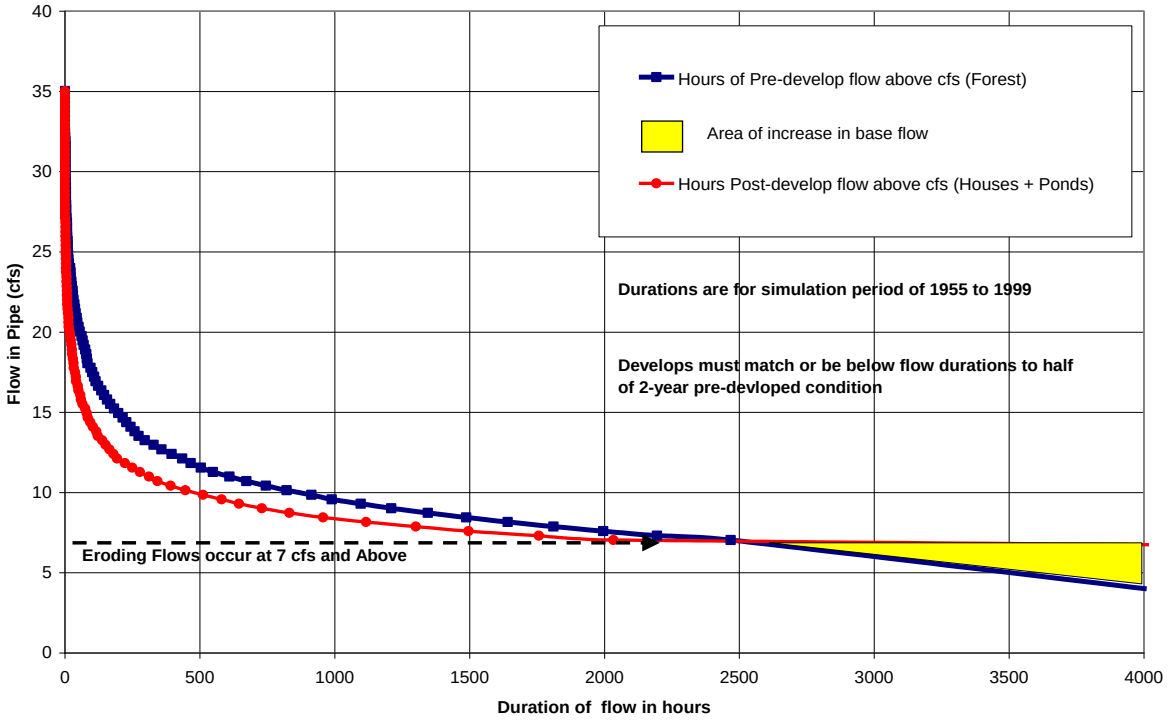
Land Condition	Total Rainfall	Portion of Rainfall to Runoff		Portion of Rainfall to Groundwater and Evaporation	
	Inches	Inches	% Rainfall	Inches	% Rainfall
Forested	56	18	32	38	68
Developed – no infiltration of roof runoff	56	47	84	9	16
Developed – 50% of roof runoff infiltrated	56	31	55	25	45
Developed - 100% roof runoff infiltrated	56	22	39	34	61

As **Table 6.3** shows development of the land from forest to urban use increases surface runoff and decreases groundwater recharge. The impact of this change on hydrology depends on implementation of effective onsite stormwater management, namely the infiltration of roof runoff within the lots, a deep, high quality soil profile using compost amended soils on all pervious surfaces, and correctly-sized stormwater ponds.

These hydrologic changes due to urbanization are not unique to the Wiggins Road area. Every urbanizing stream and natural waterway is affected by similar changing water budgets. The current stormwater regulations define the acceptable limits of change.

The proposed Wiggins Road pipe would discharge existing flows and new flows that meet the current stormwater manual requirements. **Figure 6.7** shows the difference in base flow characteristics before and after development.

Figure 6.7. Proposed Wiggins Road Pipe Base Flows



Land Use

This report recommends continuing existing land use and development regulations in the upland contributing area west of Wiggins Road. This area has the same topography and groundwater conditions as other parts of Olympia, and the City's current development regulations provide for the appropriate development of this area. Application of current regulations will protect existing wetlands, mitigate stormwater impacts, and result in houses free from nuisance flooding.

Development does change the distribution and water quality of surface and groundwater, but by meeting current development regulations, the environmental impacts of development in this area will be the same as in any other part of the City.

RECOMMENDATIONS FOR DOWNSTREAM AREA BY PARTNERS AND OLYMPIA

Eight key recommendations to address stormwater concerns downstream of the Chambers valley are being made based on issues and concerns raised during this study.

These recommendations, listed in **Table 6.4,** form an interrelated package addressing overall basin stormwater concerns. The recommendations are intended to be implemented by

different governing bodies or parties within the basin area. Olympia can propose and encourage implementation of some of these recommendations; ultimately other parties must take the lead and responsibility for implementing recommendations outside of Olympia. Some recommendations such as modifying side slopes to the Chambers ditch and changing Chambers Lake release rates are complex, long-term efforts requiring applicable analysis and coordination.

Table 6.4. Summary of Stormwater Management Recommendations for Downstream Area

Recommendation	Responsible Party
1. Encourage application of stormwater management consistent with 2005 Washington State Department of Ecology (Ecology) guidelines.	City of Lacey and Thurston County
2. Retrofit existing impervious surface discharging to the Chambers Ditch, especially in the Wilderness subdivision, a key source of unmanaged runoff. Correct deficient stormwater systems in subdivisions east of the Chambers area.	Thurston County City of Lacey.
3. Work with regulatory agencies to explore options for agricultural property flooding near 60th Loop.	Thurston County, Fish and Wildlife, and City of Olympia.
4. Flatten the side slopes of the Chambers Ditch in order to reduce erosion and bank sloughing. Work with Chambers Drainage Ditch District to obtain easements for the wider ditch section.	Chambers Drainage Ditch District, City of Olympia, Thurston County and residents adjacent to Chambers Ditch.
5. Support long-term efforts to meter surface water releases from Chambers Lake.	Fish and Wildlife, Cities of Olympia and Lacey and residents adjacent to Chambers Lake.
6. Offer to maintain the 40th Avenue driveway culvert along the Chambers Ditch.	City of Olympia
7. Increase flow duration and water quality treatment standards if warranted by water quality studies (TMDL) being completed by Ecology.	Thurston County, City of Olympia, City of Lacey.
8. Require sanitary sewer for new development in Olympia and its Urban Growth Area (UGA). Correct failing onsite sewage systems.	City of Olympia and Thurston County.
9. Manage stormwater flows from Wiggins Road and 37th Avenue in concert with future street improvements.	City of Olympia.

APPENDICES

Appendix A. Chambers Basin Seasonal Groundwater Monitoring Project Summary

Appendix B. Chambers Ditch Inundation areas and Lake Water Level Data

Appendix C. Chambers Drainage Ditch District Extracts of Documents

Appendix D. Stormwater Requirements for Full Dispersion

Appendix E. Wiggins Road Stormwater Pipe preliminary design.