# CHAPTER 5: ANALYSIS OF NONCONVEYANCE ALTERNATIVES

## 5.1 OVERVIEW

A wide range of potential alternatives were considered by the County and Stakeholders Committee (See section 1.4). Based on financial, technical, and regulatory considerations, the following four nonconveyance alternatives were evaluated for alleviating flooding impacts in the sub-basins where the most flood damage occurred in 1999: (Details on the model's development are in Appendix A.)

- Alternative 1 - Sanitary sewer collection system in lieu of septic systems
- Alternative 2 - Preserving/increasing forest canopy
- Alternative 3 - Buyouts or floodproofing of properties
- Alternative 4 - Raising road surfaces above the anticipated flood stage

The term "nonconveyance" is used here to describe measures that are not constructed drainage projects to lower flood elevations. Approximate or "planning level" costs for implementing the various alternatives are also presented.

Whether or not modeling was done for the existing or future build-out conditions (or both) depended on the question that each alternative was seeking to answer. For instance, Alternative 1 seeks to find out if connecting future residences to a sewer system would significantly reduce flooding. In this case, both existing and future conditions were modeled. Alternative 3, on the other hand, evaluates the possible cost of buying out existing properties, and therefore does not address the issue of future development.

### Modeling Limitations

Mapping with a 2-foot contour interval is accurate for most applications. However, for this analysis, 2-foot contours provide insufficient information to predict whether Alternatives 1 and 2 could lower groundwater flood elevations enough to prevent flood hazards. The basin slope is virtually flat, and any change in elevation within a two-foot contour could mean that property either floods or does not. This mapping further limits the model from conclusively predicting which properties would need to be flood-proofed or bought-out for Alternative 3 or which road segments would have to be raised for Alternative 4. However, Thurston County Roads and Transportation Services staff provided additional data based on field observations that allowed road raising analysis to be more specific than modeled results.

## 5.2 METHODOLOGY

### 5.2.1 Determining Flooded Areas

Topographic maps, infrared photos from the spring 1999 flood, and field observations were used to determine which areas were flooded in the spring of 1999 in many portions of the basin. Of the fifteen Salmon Creek sub-basins, these four were found to experience the most extensive flooding in terms of total area, with one or more locations having significantly large flooded areas: SC 9, SC10, SC11, and SC13. For this reason, only sub-basins SC9, SC10, SC11, and SC13 were included in the damage/cost analyses for non-conveyance alternatives.

### 5.2.2 Determining Future Land Cover

In order to determine future land cover (one of the variables used in modeling), existing parcels coded as "undeveloped" were selected. Assuming full-build-out conditions, the zoning codes for those selected parcels were used to determine future land use. Once future land cover was determined, a "% future effective impervious area" was calculated, based on whether the land would be commercial, residential, or rural, and these percents were used in the model for predicting results from each alternative. Effective impervious area (EIA) is the proportion of the total impervious area that generates runoff directly into the drainage network. Literature-based EIA values from previous studies conducted in or near Thurston County were used to represent the average condition. (See details of analysis and tables in Appendix B.)

## 5.3 ALTERNATIVE 1 - SANITARY SEWER SYSTEM IN LIEU OF SEPTIC SYSTEM

Model simulations were run for the existing and future (full build-out) residential parcels to assess what contributions residential septic systems make to groundwater elevations. The number of potential future residential households was estimated by multiplying the undeveloped parcel acreage by the maximum allowable dwelling unit per acre. Since future commercial and industrial development is zoned to occur primarily in the City of Tumwater's Urban Growth Area, it was assumed that this type of development will be required to connect to sanitary sewer, and there would be no additional contribution to groundwater from these sources.

Contributions to the septic systems were estimated using an average 150 gallons per day, per household (based on estimates from the American Water Resources Association). If the basin were sewered, this would result in a reduction of 150 gallons per residential unit per day.

As shown on Table 5-1, future development will slightly increase the flood stages in sub-basins SC9, SC11, and SC13. Connecting the residential households with sanitary sewer systems would not discernibly reduce the flood stages, suggesting that sewering will not alleviate the flooding if a future event is similar to the spring 1999 event. The volume of septic input is small compared to the large volume of water in precipitation, soil, and groundwater that led to the spring 1999 flooding.

**Table 5-1 Simulated Water Depths for Alternative 1 (Spring 1999 Rainfall Conditions)**

| Monitoring location (See maps in Appendix E) | Sub-Basin Name[1] | Existing Watershed Condition | Fully Developed Watershed, current zoning | |
|---|---|---|---|---|
| | | w / Septic | w / Septic | w / Sanitary Sewer |
| A | SC9 | 175.4 | 176.7 | 176.7 |
| B | SC10 | 186.0 | 186.0 | 186.0 |
| C | SC11 | 186.9 | 187.5 | 187.5 |
| D | SC13 | 192.3 | 192.7 | 192.7 |

[1]There were no measurable changes for sub-basins SC1-8, SC12, 14, SCR
Source: URS Tech Memo, 2002a

## 5.4 ALTERNATIVE 2 - PRESERVING AND INCREASING FOREST CANOPY

Recent studies have indicated that retention of forest cover can help avoid or reduce the adverse hydrologic impacts of new development. Alternative 2 examines whether maintaining either a 35% or a 65% forest canopy could help alleviate flooding. The modeling of this alternative was completed by varying the assumed basin tree canopy and determining whether increased tree canopy requirements would ultimately result in a reduced percentage of impervious surfaces.

The adjustments of the HSPF model involved converting some of the pervious lawn/grass acreage to forest as needed to attain 35 percent and 65 percent canopy coverage. When insufficient pervious area was available to reach the target canopy levels, some of the impervious surface was converted to tree canopy. [This analysis shows that the percentage of tree canopy could be increased to 65 percent in all but three sub-basins (SC4, SC12, and SC14) without a corresponding conversion of impervious area in the full build-out condition.] The percentage of various land covers modeled in each sub-basin is summarized in Appendix B for both existing and build-out conditions.

The HSPF modeling was done for an exceptionally wet period (1997-1999). Model results (Table 5-2) indicate that increasing the tree cover to 65 percent of the basin area would not decrease groundwater flood elevations for floods produced by exceptionally wet periods, such as the 2 years preceding the spring 1999 flooding event. The lack of significant reduction in flood elevation suggests that even with 65 percent tree cover, the volume of water moved by trees through canopy interception, and evapotranspiration would be small compared to the large volume of precipitation that fell during 1997-1999.

**Table 5-2 Simulated Water Depths for Alternative 2 (Spring 1999 Rainfall Conditions)**

| Monitoring location (See maps in Appendix E) | Subbasin Name | Existing Watershed Condition, preserved forest canopy | | Fully Developed Watershed, preserved forest canopy | |
|---|---|---|---|---|---|
| | | 35% Tree Canopy (ft elev) | 65% Tree Canopy (ft elev) | 35% Tree Canopy (ft elev) | 65% Tree Canopy (ft elev) |
| A | SC9 | 175.4 | 175.4 | 176.7 | 176.7 |
| B | SC10 | 186.0 | 186.0 | 186.0 | 186.0 |
| C | SC11 | 186.9 | 186.9 | 187.5 | 187.5 |
| D | SC13 | 192.3 | 192.2 | 192.7 | 192.7 |

Source: URS Tech Memo, 2002a

## 5.5 ALTERNATIVES 3 AND 4 – PURCHASING PROPERTIES AND RAISING ROADS

Knowing that periodic flooding will likely continue in the basin, the Stakeholders directed staff and the URS Corporation to analyze what it would take to end flooding hardships for existing property owners by buying out their properties and/or raising roads. Note that this approach is fundamentally different from building pipes and ditches to drain water. Conveyance options seek to lower flood levels; in contrast, buyouts and road elevating seek to "remove" structures from flood waters. In essence, the conveyance approach seeks to alter nature while buyouts and road elevations seek to remove structures from harm's way.

### 5.5.1 Alternative 3 – Buying Out Property

Thurston County staff used 2002 tax assessor records to estimate the cost of buying the following properties:

- Properties that were known to have flooded based on the Hazard Mitigation Grant process (described after Table 5-3).
- Properties that likely had water at or near the ground surface, based on the High Groundwater Flood Hazard Areas Resource Map (described in Chapter 3).

It is possible that some of the properties that experienced flooding could be flood-proofed at less cost, instead of being purchased. Hence, the following calculations provide a worst-case scenario of the cost of buying properties in the four sub-basins that experienced the worst flooding in 1999, as shown on Table 5-3.

It should also be noted that the costs in Table 5-3 do not include the tax revenue Thurston County (and local levies) would lose if the properties were purchased and therefore removed from the tax base.

**Table 5-3 Estimated Costs to Buy Out Properties**

| Sub-basin[1] | West Salmon Creek Basin (west of I-5) | | East Salmon Creek Basin (east of I-5) |
|---|---|---|---|
| | | | |
| SC 9 | $2.3 million | | |
| SC 10 | $2.07 million | | |
| SC 11 | $0.96 million | | |
| SC 13 | | | $1.7 million |
| | | | |
| Total estimated cost to buy out all structures with known/assumed structural flooding during 1999 | In 2002 = $5.3 million<br>In 2022 (assuming a 5% growth in assessed value) = $14.1 million | | In 2002 = $1.7 million<br>In 2022 (assuming a 5% growth in assessed value) = $4.5 million |

[1] Properties identified by Thurston County. Source: Thurston County Geodata Center Tax Assessor Records, URS Tech Memo, 2002a, and Hazard Mitigation Grant research.

In 2002, Thurston County had a rare opportunity to compete for grant funding from the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program to flood-proof and purchase homes. FEMA found that none of the proposed flood-proofing or buy-out projects for the Salmon Creek Drainage Basin met the agency's required 1:1 cost/benefit ratio. This does not negate the fact that these properties were damaged and their owners experienced financial and emotional hardship. All properties in Salmon Creek Basin are eligible for flood insurance, and this remains a viable option for property owners.

The Hazard Mitigation Grant process, however, provided valuable information about flood damages in the Salmon Creek Basin. For details about the FEMA Hazard Mitigation Grant Applications, see Appendix C.

**Related recommendations**

- Thurston County should seek grants, loans, and other financial assistance to flood-proof, elevate, or in the most severe cases, acquire those homes in high groundwater hazard areas.
- Thurston County should work with FEMA to have high groundwater areas recognized as "Special Flood Hazard Areas" under the FEMA Flood Insurance Rate Map program.
- Thurston County should collect, record, and process flood damage data in high groundwater hazard areas.

See Chapter 7 for details.

*Conclusion:* An estimated total of $7 million would be needed to buy-out all the existing homes that could potentially be damaged during the next flood event similar to that of 1999. While past efforts to secure federal assistance for flood-proofing were not successful, future funding opportunities could be explored and criteria established for determining which properties would qualify for flood-proofing or buy-out should funding become available. In addition, the Flood Insurance Rate Map (FIRM) should be updated to show all of the flooding areas in the basin as "Special Flood Hazard Areas." (Currently, the areas that experienced flooding in 1999 are mapped on the FIRM as Zone C, "Areas of Minimal Flooding." This could hinder the ability of Thurston County and citizens to qualify for federal assistance for flood-related activities because Zone C is not a high priority designation for receiving mitigation funding.)

### 5.5.2 Alternative 4 - Raising Roads above Predicted Flood Stages

Flooding of roads was a significant problem during the spring 1999 event, causing access and traffic safety problems.

Raising roads in Salmon Creek Basin would be one way to lessen the impact of flooding on residents, provided each road segment is evaluated to determine the proper elevation and placement of culverts. While raising roads would not reduce flood levels, this action would help ensure that residents and emergency vehicles have access to properties.

The existing topographic mapping is not accurate enough to identify the exact level of flooding on particular roads in either existing or full buildout conditions. This is because the topographic

map has a +1 or –1 foot margin of error (2 feet), which is significant in very flat areas such as Salmon Creek Basin.
Given these 2-foot variations, the URS Corporation averaged predicted flood stages for existing and fully-developed conditions, found the contour lines where flood elevations reached these levels, and estimated how many lineal feet of roads would likely be inundated.

For example, in SC9, the predicted flood stage ranges from a low of 175.4 feet for the existing condition to a high of 176.7 feet for the built-out condition. Using an average groundwater flood elevation of 176 feet (the closest contour line), approximately 1,740 feet of major roads and 240 feet of minor roads could be flooded in SC9 alone.

Thurston County provided cost estimates for raising major and minor roads, assuming an average increase in road elevation of two feet, and compliance with Thurston County design standards. Estimated values for road upgrades are $110 per linear foot for major roads, and $60 per linear foot for minor roads based on a 2002 engineering estimate.

**Table 5-4 Estimated costs to raise roads**

| | **West Salmon Creek Basin (west of I-5)** | | |
|---|---|---|---|
| **Sub-basin** | Linear feet of major road affected | Linear feet of minor road affected | Estimated cost to raise (in 2002 dollars) |
| SC9 at 176 feet | 1,740 | 240 | $205,800 |
| SC10 at 186 feet | 0 | 2,250 | $135,000 |
| SC11 at 188 feet | 300 | 5,100 | $339,000 |
| | | | |
| Total estimated cost to eliminate predicted road flooding in West Basin. | | | $679,800 |
| | **East Salmon Creek Basin (east of I-5)** | | |
| **Sub-basin** | Linear feet of major road affected | Linear feet of minor road affected | Estimated cost to raise (in 2002 dollars) |
| SC13 at 192 feet | 0 | 800 | $48,000 |
| SC 13 at 194 feet | 860 | 1,500 | $184,600 |
| | | | |
| Total estimated cost to eliminate predicted road flooding in East basin. | | | $232,600 |

While the modeling provided lineal feet for the purpose of estimating costs, it did not identify, or prioritize, specific road projects. This task was accomplished by the Thurston County Roads and Transportation Department, which made onsite observations of road flooding. Staff prioritized roads based on traffic counts, emergency vehicle usage, and availability of alternative routes (Figure 5-1, Appendix E). The County identified the following critical roads (those with high traffic counts, critical to emergency services and having no practical alternative route):

- Littlerock Road and 88th Avenue;
- 93rd Avenue west of Jones Road and east of Littlerock Road;
- 93rd Avenue west of I-5 and east of Blomberg Street;
- Tilly Road over Hopkins Ditch extension; and
- Case Road between 86th Avenue and 93rd Avenue.

Case Road is scheduled to be realigned and elevated as part of the Port of Olympia's expansion plans. The intersection of Tilley (SR 121) over the Hopkins Ditch extension is within the jurisdiction of the Washington State Department of Transportation and is therefore not a local funding decision.

In addition to the abovementioned recommendations by the Thurston County Roads and Transportation Department, the Stakeholders Committee felt the following area should be added to the critical roads list:

- The vicinity around Rhondo Street and its intersections with 83rd Avenue and 85th Avenue.

**Related recommendation**

Thurston County should elevate critical roads that have historically flooded. Outside funding should be solicited to help fund these public safety-oriented projects. Thurston County should also coordinate with the Washington State Department of Transportation to elevate SR 121 over the Hopkins Ditch extension.

As a secondary priority, Thurston County and the City of Tumwater should pursue elevating the remaining roads that historically flood.

See Chapter 7 for details.

Other roads within the basin flood, but due to lower traffic counts, alternative routes, or private ownership, are not considered critical roads. However, flooding of non-critical roads greatly affects people's lives, especially when access to homes is limited for weeks at a time. These "less critical" flooded roads include:

- Prine Drive southeast near I-5;
- Blomberg Street just south of Emerald Lane and just south of 93rd Avenue;
- Kimmie Street and the southeast freeway frontage road near 80th and 83rd, and an area between 91st Avenue and 93rd Avenue;
- Walter Court;
- Hart Street, north of 100th;
- Armstrong Street, south of 89th
- Case Road at the intersection of 101st; and
- 101st Avenue at the corner of Nunn Road.

Costs calculated by URS Corp. provide a very general estimate for elevating roads predicted to flood according to computer modeling. More precise estimates for elevating the critical and secondary roads identified by Thurston County Roads and Transportation Department would be calculated on a per-road basis as part of the design process.

*Conclusion:*

Roughly $920,000 would be needed to elevate roads within Salmon Creek Drainage Basin that are predicted to flood during another 1999-level event. Some of these roads, however, are more critical than others because they offer crucial access to the basin for emergency vehicles and residents. These roads are:

- Littlerock Road and 88th Avenue;
- 93rd Avenue west of Jones Road and east of Littlerock Road;
- 93rd Avenue west of I-5 and east of Blomberg Street;
- Tilly Road over Hopkins Ditch extension; and
- The vicinity around Rhondo Street and its intersections with 83rd Avenue and 85th Avenue.
- Case Road between 86th Avenue and 93rd Avenue

The cost of elevating each of these roads would be estimated as part of the design and bid process.

## 5.6 SUMMARY

This chapter examined four nonconveyance alternatives to alleviate flooding impacts that could occur from rainfall similar to spring 1999 conditions.

Flooding conditions will remain essentially unchanged for most properties, with or without the nonconveyance alternatives. The most certain means of alleviating flooding impacts on existing developed properties is to either elevate or acquire those properties.

- Alternative 1 – Sanitary Sewer System in Lieu of Septic Systems

  Connecting existing and future households to sanitary sewers would not discernibly reduce flood stages during large events such as the spring 1999 event. This is because the volume of water entering the ground from septic drain fields is small compared to the large volume of precipitation.

- Alternative 2 –Preserving and Increasing Forest Canopy

  Preserving/increasing forest canopy would not alleviate flooding during large events similar to the spring 1999 event. This is because the volume of water moved by trees through canopy interception and evapotranspiration is small compared to the large volume of precipitation that fell during 1997-1999.

- Alternative 3 – Buyouts and Flood-proofing of Property

  Buyouts would eliminate structural flooding for homeowners that experienced flooding in 1999. In most cases where property flooding was reported, damage was not significant enough to justify current federal or state funding for assistance. However, funding options should continue to be explored and ranking criteria established. A total of $7.0 million would be needed to buy-out all the existing homes that could potentially be damaged during the next flood event similar to that of 1999.

- Alternative 4 – Raising Road Surfaces above Anticipated Flood Stages

  Elevating roads will not materially affect water surface levels, provided culverts are installed where appropriate, but would allow access during flood periods. An estimated $920,000 would be needed to elevate roads that could potentially be damaged during the next flood event similar to that of 1999. Some roads, however, are more important to elevate than others. Critical roads (main routes with high traffic counts) should be elevated as funds become available. Less-critical roads should be elevated as a second priority.

## 5.7 CONCLUSION

None of the four non-conveyance alternatives would significantly *lower* flood levels in Salmon Creek Basin. However, two alternatives would ease the hardships residents experience as a result of flooding. Buying out properties would eliminate the risk of structural flooding for residents whose property experienced flooding in 1999 (estimated cost is $7 million). Elevating roads would ensure that emergency services have unrestricted access to homes during flood events and make it easier for people to access their neighborhoods (estimated cost is $920,000).
These approaches are fundamentally different from the conveyance options (discussed in the next chapter) because they do not seek to "engineer" floodwaters, but rather to protect structures (homes, roads) from flood damage.