

## **9.0 DEVELOPMENT OF BASIN PLAN ALTERNATIVES**

### **9.1 Introduction**

Three kinds of improvements are necessary to correct current and potential future flooding and environmental problems in the Gig Harbor Basin: capital improvements, regulatory improvements and programmatic improvements. Capital improvements are improvements that require the investment of capital by public agencies or private parties. Regulatory improvements are improvements to the laws and regulations that govern practices that have the potential to increase flood hazard or injure water quality and wildlife habitat. Programmatic improvements are improvements to the programs operated by the County related to public involvement in watershed improvement related efforts. Alternatives for capital, regulatory and programmatic improvements are discussed separately below.

### **9.2 Capital Improvements**

As discussed in Chapters 6, 7 and 8, some flooding, water quality, and fish and wildlife habitat problems can be solved or lessened by capital improvements or investments. The types of flooding problems and drainage deficiencies encountered in the Gig Harbor Basin can be corrected by culvert replacement projects. Fish passage problems can also be corrected by culvert replacement projects or by culvert modification. Water quality problems in already developed areas can be eliminated or reduced by construction of water quality improvement facilities. High quality aquatic and riparian fish and wildlife habitat can be acquired for the public and protected from development. Degraded aquatic habitat and riparian corridors can be acquired for the public and restored.

The most serious problems identified in the Gig Harbor Basin are flooding and fish passage problems, both of which are amenable to solution by capital improvements. Only one water quality problem was identified as both serious and amenable to solution by a publicly funded capital improvement project - the rapid silting up of Sylvia Lake. The development and evaluation of capital projects that are designed to eliminate these problems are described below.

Existing high quality fish and wildlife habitat can be protected from development by acquisition on behalf of the public, or by imposing regulations that prevent its destruction by private parties. The development and evaluation of capital projects that are designed to protect fish and wildlife habitat by acquisition are described below. The relative merits of acquisition and regulation are discussed in Chapter 10.

Degraded fish and wildlife habitat can be improved by acquisition and restoration on behalf of the public, or by promoting habitat restoration by private parties. The development and evaluation of capital projects that are designed to improve degraded fish and wildlife habitat by acquisition are described below. The relative merits of acquisition for the public or encouragement of restoration by private parties are discussed in Chapter 10.

## Development of Alternative Flooding and Fish Passage Capital Projects

Capital projects were developed for each of the identified flooding and fish passage problems. Six culverts were identified as sufficiently undersized to cause road flooding during the 100-year storm event. Another 25 culverts were identified as having sufficient capacity to prevent road flooding but as out-of-compliance with Pierce County's drainage standards. Thirty-nine culverts were identified as the cause of serious fish passage problems. Each problematic culvert was examined and a conceptual solution developed.

In cases where a culvert is expected to cause flooding, or is out of compliance with drainage standards, the preferred solution is replacement with a new culvert that both meets the drainage standards and provides unrestricted fish passage. Typically, this involves the installation of a culvert with an even larger cross-sectional area than that needed for flood flow conveyance alone. The Washington Department of Fish and Wildlife has published guidelines for "fish-friendly" culverts that limit the velocity of flow in culverts during the 2-year return-frequency flow event (1). The velocity requirement usually dictates the size of the culvert.

In the case of culverts that cause serious fish passage problems, the preferred solution is replacement with new culverts that both meet the drainage standards and provide unrestricted fish passage. Some culverts that cause serious fish passage problems may be able to be modified to provide fish passage, rather than entirely replaced. For example, a culvert with an impassable drop at the downstream end could be modified by the installation of a fish ladder, and a steeply sloping culvert could have baffles installed to slow and deepen flow. Generally, modifications of this sort are less effective than culvert replacement, but they may be justified when culvert replacement would be very costly or may not take place for some time. For analytical purposes, it was first assumed that any culverts that cause a serious fish passage problem should be replaced with "fish friendly" culverts. Later in the analysis, culvert replacement projects designed to correct fish passage problems that exhibit low benefit-to-cost ratios were reexamined to determine whether a culvert modification project could produce a better benefit to cost ratio.

For the purposes of estimating the cost of culvert replacements, a replacement culvert size was chosen for each culvert replacement project. The replacement culvert size chosen was generally one to three standard culvert sizes larger than the existing culvert (e.g. a 54" diameter culvert would replace a 36" diameter culvert), with larger increases in culvert diameter applied when existing culverts were severely undersized. It is important to note that prior to construction each culvert replacement project should undergo a site-specific engineering design process to ensure appropriate sizing, slope, and positioning to accommodate future flows and allow safe fish passage.

Capital improvements were developed to correct potential flooding problems caused by publicly owned culverts but not for privately owned culverts. Most privately owned culverts carry streams under driveways that lead to homes or businesses. While many private culverts may have insufficient capacity to convey flood flows, the consequences of their failure are not expected to be as severe as the failure of public culverts during flood flows. Undersized driveway culverts may cause occasional inconvenience, but they are unlikely to cause damaging flooding affecting many property owners or create hazards to public safety. Furthermore, Pierce County is not responsible for maintaining privately owned culverts.

Capital improvements were developed to correct all identified barriers to fish passage that are created by culverts regardless of whether they are owned by public agencies or private parties. Although private parties are responsible for privately owned barriers to fish passage, removal of fish barriers owned by public agencies without also removing privately owned barriers will not provide fish with full access to available habitat. The only exception to this was that capital improvements for the 12 culverts upstream of Reach MC03 on McCormick Creek that likely form fish passage barriers were not developed because the existing design and configuration of these culverts beneath State Route 16 and other roads was not known. These culverts will require more detailed study at some point in the future if Pierce County and the Washington State Department of Transportation wish to improve fish passage beyond Reach MC03.

#### Development of Alternative Water Quality Improvement Capital Projects

The County has developed three potential solutions for reducing the siltation of Sylvia Lake. These include:

- MDSL(a): build a settling/detention pond and swale system on upstream tributaries to the lake.
- MDSL(b): install 3 sediment removal devices and nutrient removal compost filtration system vaults on tributaries to the lake.
- MDSL(c): construct only swales on tributaries to the lake.

#### Development of Alternative Land Acquisition Capital Projects

Lands that could be obtained by the County for protection or enhancement of important fish and wildlife habitat were identified. Land acquisition projects were developed for protection of existing reaches with good quality fish habitat and good riparian corridor. Projects were also developed for currently degraded reaches with potential for restoration. Data gathered in the characterization phase of the Gig Harbor Planning Program indicated that of the total approximately 100,000 feet of stream corridor surveyed, 44 percent of in-stream fish habitat in the basin is in good condition, 46 percent is in fair condition, and 10 percent is in poor condition. Seventy-two percent of the riparian corridor is in good condition, 21 percent is in fair condition, and 7 percent is in poor condition.

Much of the streamside land in the Gig Harbor Basin is already developed. Parcels adjacent to streams are attractive for residential development, golf courses, and agriculture. In order to develop land acquisition alternatives, existing vacant land data was obtained from the Pierce County Assessor-Treasurer's Office. Purchasing vacant land for protection and enhancement is generally the most cost-effective and publicly accepted alternative, although in some cases the County may purchase previously developed parcels with high protection or enhancement potential if the opportunity arises. In this development of alternative land acquisition projects, only existing vacant land was considered for acquisition.

Approximately 25% (6,800 acres) of Pierce County land in the Gig Harbor Basin was vacant as of April 2002. Many vacant parcels are not located near streams, and are not suitable for acquisition by the County for aquatic and riparian fish and wildlife habitat protection and enhancement. Those parcels that are suited for County acquisition may or may not be for sale,

and the asking prices for properties that are for sale may or may not be appropriate for public purchase. Parcels for sale that include streamside land may contain more land than necessary for the purpose of protecting and enhancing aquatic and riparian conditions. These unknown factors are likely to limit the County's ability to acquire land for aquatic habitat and riparian corridor protection and enhancement.

Vacant parcels are shown on the individual stream maps in Figures 4-8 through 4-21. Using these maps, good quality fish habitat and riparian corridor reaches with streamside vacant land parcels were identified for potential land acquisition for protection purposes. Poor and fair quality fish habitat and riparian corridor reaches with high potential for successful and beneficial enhancement were also identified. Those reaches with streamside vacant land parcels were identified for potential land acquisition for enhancement and protection purposes. Thirty-three reaches were identified on the 12 major streams in the Gig Harbor Basin that have streamside vacant land parcels and have high potential for advantageous protection or enhancement.

### Development of Stream Enhancement Alternatives

Stream enhancement projects were developed for the County to improve degraded reaches of fish habitat and riparian corridor. Data gathered in the characterization phase of the Gig Harbor Planning Program indicated that of the approximately 100,000 feet of stream corridor surveyed, 44 percent of in-stream fish habitat in the basin is in good condition, 46 percent is in fair condition, and ten percent is in poor condition. Seventy-two percent of the riparian corridor is in good condition, 21 percent is in fair condition, and seven percent is in poor condition.

Stream enhancement alternatives were developed by identifying reaches with poor quality fish habitat or riparian corridor. In many cases, reaches are classified as poor for both riparian corridor and fish habitat because fish habitat often suffers when the riparian corridor is degraded. In these reaches, stream enhancement activities targeted toward both improving fish habitat and the riparian corridor are appropriate to implement. However, there are a variety of causes for fish habitat degradation, and reaches also exist where fish habitat is in poor condition but the riparian corridor is in fair condition. In these reaches, it may be more cost effective to target stream enhancement activities solely toward improving fish habitat. There are also several reaches where the riparian corridor has degraded to poor condition, but fish habitat has only degraded to fair condition. In these reaches, it may be more cost effective to target stream enhancement activities solely toward improving the riparian corridor, which over time will also likely improve fish habitat.

Twenty-one stream reaches totaling 14,750 feet were identified as potential sites for stream enhancement that would substantially benefit fish and wildlife. Of these stream reaches, 11 reaches have some adjacent vacant land that the County could acquire and restore. The other ten reaches are located entirely adjacent to or within privately owned and developed land.

The cooperation of private landowners in reaches targeted for stream enhancement projects will be necessary for successful project implementation. Lack of cooperation from private landowners could limit the County's ability to perform stream enhancement projects, particularly improvements to the riparian corridor. Limited in-stream work to improve fish habitat can be

performed without affecting streamside property owners, but generally most fish habitat enhancement projects will require the cooperation of streamside property owners as well. For this reason, although an entire reach may be identified as a candidate for stream enhancement, in actuality the County may only be successful in enhancing a portion of the reach or the reach may not be available for enhancement.

### Evaluation of Capital Improvement Projects

Capital improvement projects were evaluated using a modified form of the procedure outlined in *Pierce County's Guidelines for Basin Planning*. The procedure was designed to provide a means for calculating the benefits and costs of capital projects, so that projects could be prioritized objectively and consistently across basins. The cost of capital projects can be readily estimated but the benefits are more difficult to calculate because they cannot be expressed in monetary terms. Therefore, the potential capital improvement projects were evaluated for their net natural resource management benefit.

In evaluating net benefit, each project was scored using a score sheet that assigned points for the project's potential for various aspects natural resource management benefit. The scoring schedule included in *Pierce County's Guidelines for Basin Planning* was preliminary. URS made some minor modifications to the scoring schedule to better adapt it to the types of capital projects encountered in the basin planning process. The modified scoring schedule is shown in Table 9-1. After approval by the County the modified scoring schedule was used to evaluate capital projects. Points were assigned based on benefits related to flood reduction (approximately 35% of total), water quality protection or improvement (approximately 30% of total), natural resource protection or improvement (approximately 30% of total), and other factors such as multiple use, education, and recreation (approximately 5% of total). Each project was reviewed and scored using approximately 40 specific criteria.

The total number of benefit points awarded to a capital project are then divided by the estimated project cost to provide a benefit to cost ratio. Project costs were estimated using Pierce County's cost estimating guidelines, which are contained in Appendix G.

The results of the evaluation are shown in Tables 9-2, 9-3, 9-4, and 9-5. Table 9-2 was developed assuming that fish passage problems created by culverts would be permanently corrected by replacing the existing culverts with "fish-friendly" culverts. Some of the fish passage problems could be temporarily solved by measures such as culvert cleaning, installation of baffles or installation of fish ladders. An evaluation of these alternative solutions is shown in Table 9-3. Capital projects are listed in descending order of score in Tables 9-2, 9-3, 9-4, and 9-5. A summary of the evaluation of each potential capital improvement project, detailed project score forms and cost estimates are contained in Appendix G.

## **9.3 Programmatic Improvements**

As discussed in Chapters 6, 7 and 8, some potential flooding, water quality, and fish and wildlife habitat problems can be prevented by programmatic improvements. The gradual increase in flood hazard typically associated with progressive urban development in a watershed can be

lessened by development standards that limit development-associated hydrologic change. The increase in pollutants loads that are also associated with progressive urban development can be reduced by regulations requiring the installation of water quality improvement facilities in all new development and the prohibition of development on or near stream banks. Fish and wildlife habitat values can be partially protected from the adverse effects of urban development by requiring the retention or creation of vegetated buffers along stream banks.

In the last decade, Pierce County has enacted regulations to reduce the adverse effects of human activities on surface streams. Many of the regulations were designed to help Pierce County meet the requirements of the Clean Water Act and the Endangered Species Act. In 1987, the Clean Water Act was amended to require better control of pollutants in urban runoff. In response, Pierce County prepared and began implementing a countywide storm water management plan designed to protect water quality in surface streams (2). Some of the provisions of the plan were incorporated into the county's development standards. In addition, Pierce County, together with King and Snohomish counties, has been working to develop measures that will enable the county to maintain surface streams in a "properly functioning condition", as required by the Endangered Species Act. These measures rely heavily on preservation of wide vegetated buffer zones along streams and have been or will shortly be incorporated into Pierce County's development standards.

Before determining whether new regulatory or programmatic measures are needed to protect streams it was first necessary to review the existing regulations and evaluate their effectiveness.

### Review and Evaluation of Existing Regulations

#### *Vegetated buffer zones*

To control potential impacts on stream health from new development within riparian corridors of the Gig Harbor Basin, buffer width ordinances and regulations have been developed at the regional and local level. The *Tri-County Salmon Recovery Plan* management zone (June 2000), *Pierce County Development Regulations* draft critical area buffer widths (April 2001), *Gig Harbor Peninsula Community Plan* natural buffer areas (March 2002), and *City of Gig Harbor Municipal Codes* critical fish and buffer areas (August 2001) all address protection of critical areas such as streams, lakes, and wetlands. Table 9-6 provides a summary of the plans and codes that affect Gig Harbor Basin and the corresponding range in buffer widths required. The buffer requirements are described in detail below.

#### *Tri-County Salmon Recovery Plan*

The *Tri-County Salmon Recovery Plan* provides a conservation framework for protection of salmon habitat in Pierce, King and Snohomish Counties, incorporating regulation of near-shore and aquatic development through the application of management zones. The management zone widths are buffer widths that provide interim measures of protection until local governments develop basin-specific widths. The *Pierce County Development Regulations for Critical Areas* (April 2001, Section 18E.60.060) are under revision to incorporate buffer requirements for critical areas very similar to those described in the Tri-County Plan (3).

### *Pierce County Development Regulations*

Pierce County complies with the Washington State Growth Management Act and the Endangered Species Act by requiring protection of critical areas such as streams and wetlands. Pierce County's proposed maximum buffer width is 150 feet or the greater of 150 feet or 25 feet from top of the bank, and minimum buffer width is 65 feet. The maximum width is significantly greater than the existing ordinance, which requires a buffer width of 35 feet. Pierce County's buffer requirements, like the Tri-County Plan, rely on the new Washington Department of Natural Resources water typing scheme to determine the appropriate buffer for each critical fish and wildlife habitat area. This water typing system is described below in the section entitled "Application of the County Buffer Requirements".

### *Gig Harbor Peninsula Community Plan*

The *Gig Harbor Peninsula Community Plan* provides development standards that establish natural buffer area widths in the Rural-Sensitive Resource Designation, Objective 10, Principle 4, Standard 10.4.1 (4). The *Gig Harbor Peninsula Community Plan's* proposed standards protect streams by establishing undisturbed natural buffers of 75 to 150 feet by water type (75 feet for non-fish bearing streams, 150 feet for fish bearing streams and shorelines). Unlike Pierce County's proposed buffer ordinance, the Community Plan also establishes a 250-foot management zone for all streams. Though specific development standards within this management zone are undefined, it is expected that activity would be restricted in some way to minimize impacts to streams. Potential activity restrictions could be applied through implementation of Low Impact Development standards in management zones.

### *Gig Harbor Municipal Code*

The Gig Harbor Municipal Code provides a section (18.12.090.D) on buffer requirements for critical fish and wildlife habitat areas, which, unlike the other planning documents, does not refer to water types. The code section states that “the width of the buffer shall be based upon a recommendation of at least one of the appropriate review agencies but, in no case, shall exceed 150 feet, nor be less than 25 feet” (5). The Pierce County ordinances or Gig Harbor Community Plan will provide more guidance on designating the buffer width.

### *Application of the County Buffer Requirements*

To assess the effectiveness of current development regulations in stream corridors this analysis assumes that the draft buffer widths in the *Pierce County Development Regulations* for critical areas will be approved. An evaluation of what buffer width would be specified for each major stream in the Gig Harbor Basin was conducted. The Washington State Department of Natural Resources (DNR) Stream Typing Classification System, as amended by the Fish and Forest Report and adopted by the Washington State Legislature in March 2000, was used to classify streams as water types correspond to buffer requirements in the County's regulations on determining buffer widths. The DNR method of classification is “habitat-driven” and replaces

Type 1 through 5 water designations with geomorphic parameters, which help to classify water bodies as S, F or N. These new water classifications are defined as follows:

- Type S: shorelines of the state
- Type F: segments of natural waters other than Type S that contain fish or fish habitat
- Type N: segments of natural waters other than Type S that do not contain fish or fish habitat.

It is important to note that waters without fish due to fish passage barriers, but with fish supporting conditions, are considered Type F. The detailed definitions for these water types and the subcategories of each type are provided in WAC 222-16-030 (6). There may be wetlands within ponds or lakes that may have a required buffer greater than those listed. Pierce County has adopted the DNR water types, which are provided in the draft table in the revised buffer requirements in the *Pierce County Development Regulations*, Section 18E.60.060.

The water typing system is meant to rely on fish habitat water typing maps developed based on a multi-parameter, field-verified geographic information system (GIS) logistic regression model, and these maps will be updated every five years. The multi-parameter model is designed to identify fish habitat by using geomorphic parameters such as basin size, gradient, elevation, and other indicators. The modeling process is designed to achieve a level of statistical accuracy of 95% in separating fish habitat streams and nonfish habitat streams (3).

Because the geomorphic model is still under development, stream typing for Gig Harbor Basin was based on field inventory data, and this method, therefore, is not entirely consistent with the new water typing system. The geomorphic model is likely to rely on readily available GIS data to estimate slope, soil type, basin size, etc. Stream typing based on actual field observations should be more accurate than a totally GIS-based system. However, the new stream typing system will likely depend upon both GIS-based and field observation-based information.

Field surveys in Gig Harbor Basin determined that there is a significant difference in stream condition between those streams with adequate area between the water body and development and those streams that have been encroached upon by agricultural and residential development, especially for streams with steep slopes. Any new development or significant redevelopment should be subject to a stream buffer ordinance that protects the condition of the riparian corridor and water body. In Table 9-7 the information used to describe the water type and associated buffer widths for each of the major streams in Gig Harbor Basin is summarized.

#### *Potential Barriers to Effective Implementation of Buffer Requirements*

To determine whether the existing (and proposed) buffer requirements would adequately protect the areas of good habitat and riparian corridors identified in Gig Harbor Basin, the extent to which these requirements would be applied was examined. Because the buffer requirements would be applied largely to new development, the effectiveness of the buffer requirements is dependent on the amount of vacant land that would be subject to development restrictions in critical areas. All new development would be subject to the current critical areas and resource lands regulations (including the increased buffer widths), unless a property is vested, meaning

the date used to determine which development regulations apply to the property is prior to the date that the current regulations became effective.

The county has a section in the general provisions section of the development regulations on vesting which is intended to "provide property owners, permit applicants, and the general public assurance that regulations for project development will remain consistent during the lifetime of the application" (3). This section is applicable to use permits, preliminary plats, final plats, short plats, large subdivisions, binding site planes, shoreline development permits and any other land use permit application that is determined by the Washington State Legislature to be subject to the Vested Rights Doctrine. While this section of the development regulations provides protection for applicants and incorporates time limitations so as to avoid rendering new development regulations completely ineffective, this clause does create a barrier to effectively protecting riparian corridors with an increased buffer width ordinance. Therefore, it is important to determine the number of parcels of vacant land that are already platted or have the potential to subdivide under existing regulations that have vested rights requiring only a 35-foot buffer, so as to identify where the new buffer ordinances are rendered ineffective. This type of analysis was not undertaken as part of the Gig Harbor Basin Plan, but it is recommended and would be feasible using existing data and information as described below.

The County has conducted two studies that would aid in the assessment of the effectiveness of the buffer ordinances. In preparation for the Community Plan, the total number of pending preliminary plat applications and the potential number of building sites that could be approved by the Pierce County Hearing Examiner within the Community Plan Area were described in the Subdivision Vesting Report. In addition, the potential buildable lands in the Gig Harbor Peninsula were determined as part of a Buildable Lands Study incorporating analyses of wetlands, land slide hazard areas, flood plains, etc. Using these studies in conjunction with GIS mapping tools, it would be possible to identify the total acreage that would be affected by the buffer width ordinances relative to the acreage exempt from the ordinances. The maximum 150-foot buffer around the major streams could be overlaid on County zoning maps and the vacant space within these buffers delineated. The assessor's platting information could then be overlaid to identify the total number of parcels that would be affected. The number of parcels with plats or other applications that would vest these properties with the current 35-foot buffer could be identified based on the results of the County's vesting study in relationship to the buildable land information. The total area with the potential for protection by the 150-foot buffer could then be calculated and used to qualitatively describe the effectiveness of these ordinances.

In conclusion, it is difficult to predict the effectiveness of the buffer regulations in the Gig Harbor Basin. If the studies described above were completed they would help predict effectiveness, but considerable uncertainties would remain. A better approach would be to monitor the effectiveness of the buffer regulations for a minimum of five years. If good habitat continues to be lost then clearly the existing regulations would have failed and would need to be modified.

### Low impact development

The *Gig Harbor Peninsula Community Plan* incorporates low impact development standards for protection of the natural environment, specifically shorelines, lakes, streams, and fish and wildlife habitat (Natural Environment Policies). Some of the standards included would:

- generally prohibit new construction or any expansion of existing structures over the water along the shoreline (Objective 15, Principle 2, Standard 15.2.5.4)
- require nonconforming use permits for any proposed expansion of a nonconforming use on parcels that are located within designated fish and wildlife habitat areas (Objective 20, Principle 5, Standard 20.5.1)
- require that requests for riparian buffer width reductions be accompanied by a riparian buffer enhancement plan prepared by a professional aquatic resource ecologist or biologist that provides evidence that the system will not be negatively impacted by such a request (Objective 20, Principle 6, Standard 20.6.8)
- protect natural drainage courses and watercourses post-development through an appropriate mechanism, such as developer agreements, maintenance agreements, homeowner's covenants, and/or conservation easements (Objective 16, Principle 2, Standard 16.2.2)
- require a conceptual stormwater drainage plan for certain projects when subject to review by the Peninsula Advisory Commission including all development projects on sites that are three acres in size or greater (Objective 16, Principle 3, Standard 16.3.1)
- condition preliminary plat approvals to reduce transport of commonly used household hazardous chemicals, fertilizers, pesticides, and pet wastes into adjacent lakes, streams, and wetlands (Objective 18, Principle 1, Standard 18.1.6)

Low impact development guidance will be provided in the Pierce County Stormwater Management Manual. This manual is currently in revision to incorporate site design with on-site best management practices to meet stormwater management requirements. In addition, low impact development standards including site design, density requirements, and impervious surface mitigation have been incorporated into the *Gig Harbor Peninsula Community Plan* as part of the Urban Sensitive Resource Overlay zone and Natural Environment Policies. The Urban Sensitive Resource Overlay designates open space corridors within the Urban Growth Area of the Gig Harbor Peninsula and identifies allowable uses, development density, and level of project intensity that are appropriate in the open space areas. Fifteen to 50 percent of each site that is proposed for development in the overlay zone shall be retained in a natural, undisturbed condition. Referred to as the open space tract, this part of the site shall be located on each site plan in such a manner that the potential for wildlife movement is maintained through corridors (Objective 5, Principle 1, Standard 5.1.1).

In the Community Plan, low impact development standards will be required in the Urban Sensitive Resource Overlay area to avoid fragmentation of the remaining open space corridors that create habitat for wildlife species native to the Gig Harbor Peninsula. Site and architectural design will be a necessary component of many new projects in order to comply with the standard of retaining 15 to 50 percent of each site that is proposed for development in a natural, undisturbed condition. Incentives such as bonus densities, reduced setbacks, and a reduction in

minimum lot size could be offered for development that reduces impervious surfaces, protects open space, preserves trees, etc.

In the Pierce County Stormwater Management Manual, there will be guidance on how to incorporate low impact development techniques to enhance stormwater management on a site-by-site basis. This manual is currently in revision to incorporate low impact development site design standards into the stormwater retention and treatment requirements and best management practices to more comprehensively address water quality protection.

The effectiveness of low impact development techniques increases when the concepts are applied at both the individual site scale and at the community and regional scale, especially where transportation infrastructure is considered. In the Gig Harbor Basin most of the low impact development requirements will be implemented at the individual site scale because much of the community and regional scale development in the basin has already occurred. Since the 80 percent build out condition presents little opportunity for community scale solutions it will be important for the County to consider how to incorporate low impact development standards for new development, significant redevelopment, and infrastructure expansion and maintenance to achieve maximum effectiveness. The County should also consider the use of incentives to promote implementation of low impact development as comprehensively as possible.

#### Other environmental protection policies

The Community Plan also includes natural environment policies, which are intended to protect and conserve elements of the natural environment including fish and wildlife habitat, native vegetation, aquifer recharge areas, lakes, streams, wetlands, marine shorelines, and steep slopes by limiting developing in these areas. Standards under these policies include:

- discouraging use of fertilizers and pesticides in shoreline areas and requiring that public and private golf courses maintain their facilities in an environmentally sensitive manner
- encouraging the replanting and maintenance of appropriate native vegetation in stream buffer areas
- establishing volunteer groups for lake and stream water quality monitoring
- requiring permanent markers designating riparian area buffers as "native growth protection area" be placed on site and including this designation on the face of the plat and as a deed restriction on the property
- requiring that requests for riparian buffer width reductions need to be accompanied by a riparian buffer enhancement plan prepared by a professional aquatic resource ecologist or biologist that provides evidence that the system will not be negatively impacted by such a request.

A number of education, outreach, and technical assistance programs designed to reduce nonpoint source water pollution are recommended in the *Key Peninsula-Gig Harbor-Islands Watershed Characterization and Action Plan* (7). Many of these programs would improve Gig Harbor residents' understanding of human impacts on creeks and provide residents with tools to act as better watershed stewards. Some of the action items proposed in this plan are:

- encourage riparian buffering by offering landowners technical and financial assistance (AF 7)
- create and distribute generalized best management practice (BMP) guidebooks for farm and forestry activities (AF 20)
- develop an education program on slope stability, shoreline armoring, and vegetation management for shoreline landowners (SH 3)
- provide technical assistance to landowners concerning shoreline stewardship/management options and offer an incentives program guidebook to encourage shoreline property owners to improve habitat and maintain a naturally functioning shoreline (SH 4 and SH 12) [It is also recommended as a part of this Basin Plan that this action item be expanded to include streamside property owners]
- develop showcase shoreline habitat restoration projects (SH 10)
- support volunteer shoreline stewardship programs (SH 13)
- provide assistance to property owners on reducing stormwater flows and implementing BMP's (SW 7)
- assess streams and develop habitat improvement projects (SW 13)
- initiate a public outreach program that targets illegal dumping of solid waste (OT 6)
- implement a voucher system for disposal of "problem items" such as furniture, tires, used batteries and appliances (OT 7)
- expand the master gardener programs to include public presentations on integrated pest management and other environmentally-friendly gardening practices (OT 9)
- develop an education program for golf course grounds keepers on water quality, integrated pest management, and habitat enhancement on golf courses (OT 14)
- pursue alternatives to roadside spraying of herbicides (OT 15)
- establish a pet waste education program (GN 1)
- create a buffer improvement program (GN 7)
- support water conservation projects and encourage water recycling (GN 10 and 11)
- establish a native plant salvage program and encourage use of native plants in public installations (GN 23 and GN 25)

Cost estimates, potential funding sources, and methods of implementation were developed for each of the action items in the *Key Peninsula-Gig Harbor-Islands Watershed Characterization and Action Plan*. Pierce County, Kitsap County, and the City of Gig Harbor are the regulatory organizations identified in the plan that will implement the action items in the plan. The KGI Watershed Council and Steering Committee will pursue implementation of the action plan with these organizations. The KGI Watershed Council is responsible for coordination of plan implementation, monitoring, and public involvement.

### Storm water management

Pierce County's storm water management plan and development standards include a number of provisions designed to reduce the adverse effects of urban storm water runoff on streams. They include the implementation of various best management practices that limit the discharge of pollutants in storm water to surface waters from both existing and new development and limit the hydrologic change associated with new development.

Because urban runoff control technology is in its infancy it is not yet known how effective the best management practices will be. Best management practices for storm water management have been in effect for less than ten years at the most urban areas, including Pierce County, and few attempts have been made to measure their effects on water quality and stream health. However, a recent study conducted in Maryland compared the quality of instream habitat in two neighboring watersheds, one with and one without application of best management practices and found few differences (8).

### Possible regulatory and programmatic improvements

Based upon review of the existing Pierce County regulations designed to reduce development-related adverse effects on streams, it is clear that positive changes have been made in the regulatory structure in the last ten years regarding stream buffers, development regulations, and other environmental protection policies. The changes have resulted from a better understanding of the connection between development patterns and stream health and the placement of a greater emphasis on protecting water quality and fish and wildlife habitat.

The buffer regulations, low impact development regulations, education programs, and water quality regulations implemented as a part of the local planning and regulatory efforts described above are expected to reduce degradation of water quality and habitat loss as a result of streamside development. The land use designations and natural environment policies proposed in the *Gig Harbor Community Plan* in particular could reduce the impacts of new development within stream corridors if implemented properly. As is apparent from the foregoing, many new regulations that affect stream health and water quality have been enacted in the last several years. Many new regulations and programs, for example those recommended in the *Gig Harbor Community Plan* and the *Key Peninsula-Gig Harbor-Islands Watershed Characterization and Action Plan*, are likely to be enacted soon. It is too early to tell how effective the regulations will be in protecting the streams of the Gig Harbor Basin. Because of this it would be prudent to monitor the effectiveness of existing regulations before making any substantial changes.

If monitoring shows that the current regulations and programs are not effectively protecting streams, it may be beneficial to revise or propose new programmatic and regulatory changes aimed a protection of critical areas. In addition, existing proposed actions (such as those in the *Key Peninsula-Gig Harbor-Islands Watershed Characterization and Action Plan*) could be funded and implemented. Additional programmatic and regulatory changes that could be made in the future to further protect stream health from the impacts of new development include:

- promotion of incentive-based, voluntary landowner development practices that will protect streams adjacent to properties vested under less stringent stream protection regulations
- implementation of the education and outreach programs proposed in the *Key Peninsula-Gig Harbor-Islands Watershed Characterization and Action Plan* in an effort to help to reduce negative impacts to streams from future development in the basin
- incorporation of low impact development standards for new development and significant redevelopment, infrastructure expansion and maintenance

- use of incentives to promote low impact development standards implementation as comprehensively as possible

Most of the recent development standards apply primarily to new development. The Gig Harbor Basin is approximately 80% built out and so most of the recent standards will only apply to the 20% of the basin that will be developed in the future. A substantial proportion of streamside areas in the Gig Harbor basin have already been developed and are consequently unaffected by new development standards. To protect water quality and stream health it would be desirable to restore and enhance already developed areas to the extent practicable. Programmatic and regulatory measures that could be considered to protect stream health in already developed areas include the following:

- special tree ordinance for stream corridors
- limitations on pesticide and fertilizer use in stream corridors
- limitations on domestic animal access to streams
- basin-specific stream protection measures
- implementation of the education and outreach programs proposed in the Key Peninsula-Gig Harbor-Islands Watershed Characterization and Action Plan in an effort to help to reduce negative impacts to streams from existing development in the basin.

Each sub-basin in the Gig Harbor Basin has particular land uses that pose specific problems for stream health. For example, golf courses in the headwater area of the Goodnough Creek subbasin and in the middle reaches of Artondale Creek use pesticides, herbicides, and fertilizers for maintenance. Limiting quantities and types of chemicals used in these areas could control the water quality degradation occurring in these subbasins. Restrictions such as these would likely be politically unpopular and difficult to enforce. Tree ordinances to protect streamside trees from removal and limitations on domestic animal access to streams may be more feasible politically, although enforcement of these regulations would still be difficult. Implementation of education and outreach programs is likely to be moderately successful and better received by the public.

**Notes:**

- (1) Fish friendly culvert guideline, Washington Department of Fish and Wildlife
- (2) *Pierce County Stormwater Management Plan*, 1998, Pierce County.
- (3) *Pierce County Development Regulations – Critical Areas, Title 18E, Fish and Wildlife Habitat Areas, Chapter 18E.60, Version 4-23-01*,  
<http://www.co.pierce.wa.us/abtus/ourorg/council/code/18e.pdf>, accessed October 12, 2001.
- (4) *Gig Harbor Peninsula Community Plan Update, “Draft Community Plan and Draft Supplemental Environmental Impact Statement”*  
<http://www.co.pierce.wa.us/services/home/property/pals/disclaim/landuse/ghplan.htm>  
accessed August 24, 2001.
- (5) *Gig Harbor Municipal Code, Environment, Title 18, Critical Areas, Chapter 18.12, Critical Fish and Wildlife Habitat Areas, Section 18.12.090*, <http://www.ci.gig-harbor.wa.us/>,  
accessed October 15, 2001.
- (6) *Washington Administrative Code, WAC 222-16-030, Water Typing System*,  
<http://search.leg.wa.gov/wslwac/WAC%20222%20.../WAC%20222%20-%2016%20-030.htm>, accessed October 16, 2001.
- (7) *Key Peninsula–Gig Harbor–Islands Watershed Characterization and Action Plan*, July 1999, Pierce County Water Programs.
- (8) Loftin and Coffman, 2002, “Relating stormwater management practices to instream biological and physical conditions.” Paper presented at Watershed 2002 Conference, Fort Lauderdale, Florida.

**Table 9-1: Pierce County Capital Improvement Project Prioritization  
EVALUATION OF PROJECT BENEFITS**

<b>Name:</b>	<b>SAMPLE</b>		
<b>Location:</b>			
<b>Subbasin:</b>			
<b>Project:</b>			
		<b>Score</b>	
<b>1. FLOOD REDUCTION (Maximum Score 185)</b>		<b>Maximum</b>	<b>Assigned</b>
a	<i>Level of Flooding (score all that apply)</i>		
	Prevents inconvenience flooding	5	
	Prevents hazard to public safety	25	
	Prevents risk to critical facilities (hospitals, etc.)	20	
	Prevents severe property damage (> \$100,000/year)	15	
	Prevents minor property damage (< \$100,000/year)	10	
b	<i>Frequency of Flooding (score one)</i>		
	Prevents annual flooding	20	
	Prevents flooding every 1 to 5 years	15	
	Prevents flooding every 5 to 25 years	10	
	Prevents flooding less than one in 25 years	5	
c	Required due to flooding liability	20	
d	Increases capacity of flood plain	20	
e	Corrects non-compliance with County design standard (H/D ratio < 1.5)	20	
f	<i>Future Flooding: level of increase in peak discharge that is expected due to landuse changes within the project area (score one)</i>		
	High	15	
	Medium	10	
	Low	5	
g	<i>Estimated benefit to doing the project now (in feasibility and cost benefit) versus waiting and doing project later (score one)</i>		
	High	15	
	Medium	10	
	Low	5	
<b>*</b>	<b>Total Flooding Score</b>	<b>185</b>	
<b>2. WATER QUALITY IMPROVEMENT (Maximum Score 160)</b>			
a	Reduces sources of or impacts from emission of fine sediments	20	
b	Reduces sources of or impacts from emission of heavy metals	20	
c	Reduces sources of or impacts from emission of excess nutrients	20	
d	Reduces sources of or impacts from excess oxygen demanding conditions.	20	
e	Reduces sources of or impacts from emission of oil and grease	20	
f	Reduces sources of emission of pathogens such as fecal coliform	30	
g	Lowers water temperature, provides more shade	30	
<b>*</b>	<b>Total Water Quality Score</b>	<b>160</b>	
<b>3. NATURAL RESOURCE IMPROVEMENT &amp; PROTECTION (Maximum Score 160)</b>			
a	Improves and/or protects habitat for aquatic species	30	
b	Improves and/or protects habitat for terrestrial species	20	
d	Increases proportion of native plant species	10	
f	Improves flow regime and/or natural hydrology	10	
g	Increases channel stability/reduces erosion	5	
h	<i>Increases extent of salmonid spawning habitat (score one - score weighted based on quality "Q"*)</i>		
	Opens passage to long reach of habitat (>4000 ft)	80*Q	
	Opens passage to medium reach of habitat (1000 - 4000 ft)	65*Q	
	Opens passage to short reach of habitat (<1000 ft)	50*Q	
i	Salmonids other than cutthroat trout present	5	
** Q = [Good (ft) + Fair (ft)] / [Total (ft)]			
<b>*</b>	<b>Total Natural Resource Improvement Score</b>	<b>160</b>	
<b>4. OTHER FACTORS (Maximum Score 40)</b>			
a	Provides recreational or multiple use opportunities	10	
b	Enhances visual aesthetic of area	10	
c	Provides public education opportunities	10	
d	Is a highly visible project or has been on the CIP needs list multiple years.	10	
<b>*</b>	<b>Total Other Factors Score</b>	<b>40</b>	
<b>***</b>	<b>Total Project Score</b>	<b>545</b>	

**Table 9-2: Evaluation of CIPs**

Subbasin	CIP name	Location	Problem Addressed				Ownership	Down stream fish passage barriers	Estimated Cost (\$)	Score	Score /Cost (points per \$10,000 cost)	
			Future flood hazard	Fish passage barrier	Potential fish passage barrier (Level B)	Not in compliance with County Design Standard						
Donkey	DK05	Harborview Dr. & N. Harborview Dr.	X	X		X	public	X	\$121,478	205	16.9	
Artondale	AD02	Artondale Dr	X	X		X	public	X	\$21,742	170	78.2	
Mark Dickson	MDSL (a)	Sylvia Lake tributaries	water quality in Sylvia Lake					public		\$512,000	200	2.6
Warren	WR01 (a)	Warren Dr and 92nd Ave		X		X	public		\$87,685	160	18.2	
Goodnough	GN02	141st Court NW & 52nd Ave.	X	X		X	public	X	\$13,651	150	109.9	
Nelyaly	NL01	82nd Street		X		X	public		\$23,345	148	63.4	
Sullivan Gulch	SL02 (a)	Sullivan Drive			X	X	public		\$32,403	135	41.7	
Sullivan Gulch	SL01 (a)	East Bay Dr		X		X	public	X	\$45,381	130	28.6	
Artondale	AD01	Hunt St	X	X		X	public	X	\$16,879	125	74.1	
Goodnough	GN05 (a)	54th Ave.			X	X	public	X	\$116,076	120	10.3	
Wollochet	WC05 (a)	57th Street		X		X	public	X	\$24,825	120	48.3	
Crescent	CR07	136th St (private)			X		private		\$6,983	105	150.4	
Donkey	DK03 (a)	Harborview/Burnham Dr		X			public	X	\$120,211	105	8.7	
Donkey	DK04 (a)	Harborview Dr.			X	X	public		\$224,481	100	4.5	
McCormick	MC01	Sehmel Dr/ Burnham Dr	X			X	public	X	\$61,704	100	16.2	
Wollochet	WC01 (a)	East Bay Dr		X			public		\$14,967	100	66.8	
Goodnough	GN06 (a)	State Route 16		X		X	public (state)	X	\$199,456	95	4.8	
Goodnough	GN08 (a)	Good-nough Drive		X		X	public	X	\$107,402	95	8.8	
Goodnough	GN09 (a)	State Route 302		X		X	public (state)		\$219,827	95	4.3	
Rosedale	RD01 (a)	Rosedale Street		X			public		\$21,412	95	44.4	
Wollochet	WC06 (a)	Hunt St		X			public	X	\$58,312	95	16.3	
Artondale	AD04 (a)	Wollochet Dr			X		public		\$116,653	77	6.6	
Mark Dickson	MD02 (a)	Private driveway off Ray Nash Dr.		X			private		\$5,666	65	114.7	
Mark Dickson	MD03 (a)	Private driveway off Ray Nash Dr.			X		private	X	\$4,732	65	137.4	
Doc Weathers	DW01	County Park		X			public		\$202,058	61	3.0	
McCormick	MC03 (a)	Woodhill Dr		X		X	public		\$27,687	45	16.3	
Goodnough	GN01	144th St. and 51st Ave. Ct.			X	X	public	X	\$18,117	30	16.6	
Murphy	MY01	East Bay Dr		X			public		\$75,077	30	4.0	

**Table 9-2: Evaluation of CIPs**

Subbasin	CIP name	Location	Problem Addressed				Ownership	Down stream fish passage barriers	Estimated Cost (\$)	Score	Score /Cost (points per \$10,000 cost)
			Future flood hazard	Fish passage barrier	Potential fish passage barrier (Level B)	Not in compliance with County Design Standard					
Muri	MU01	Ford Dr			X		public	\$6,974	25	35.8	
Donkey	DK06	Harborview Dr.		X		X	public	\$24,800	20	8.1	
Sullivan Gulch	SL03 (a)	25th Street		X			public	\$10,971	20	18.2	

**Note:**

Table 9-2 was developed assuming that fish passage problems created by culverts would be permanently corrected by replacing the existing culverts with “fish-friendly” culverts. Some of the fish passage problems could be temporarily solved by measures such as culvert cleaning, installation of baffles or installation of fish ladders. An evaluation of these alternative solutions is shown in Table 9-3, along with two alternative water quality improvement measures for Sylvia Lake. Capital projects are listed in descending order of benefit score. The benefit to cost ratio of each project is also shown. A summary of the evaluation of each potential capital improvement project and detailed evaluation forms and cost estimates are contained in Appendix G.

**Table 9-3  
Evaluation of Alternative CIPs**

Subbasin	CIP name	Location	Problem Addressed				Owner-ship	Down stream fish passage barriers	Estimated Cost (\$)	Score	Score /Cost (points per \$10,000 cost)
			Future flood hazard	Fish passage barrier	Potential fish passage barrier (Level B)	Not in compliance with County Design Standard					
Mark Dickson	MDSL (b)	Sylvia Lake tributaries	water quality in Sylvia Lake				public		\$1,103,000	265	4.2
Warren	WR01 (b)	Warren Dr and 92nd Ave		X			public		\$59,582	145	24.3
Donkey	DK03 (b)	Harborview/Burnham Dr		X			public	X	\$17,050	115	67.4
Mark Dickson	MDSL (c)	Sylvia Lake tributaries	water quality in Sylvia Lake				public		\$291,000	155	5.3
Sullivan Gulch	SL02 (b)	Sullivan Drive			X		public		\$25,595	115	44.9
Goodnough	GN05 (b)	54th Ave.			X		public	X	\$51,903	110	21.2
Sullivan Gulch	SL01 (b)	East Bay Dr		X			public	X	\$38,750	110	28.4
Wollochet	WC01 (b)	East Bay Dr		X			public		\$8,060	110	136.5
Wollochet	WC05 (b)	57th Street		X			public	X	\$16,327	110	67.4
Rosedale	RD01 (b)	Rosedale Street		X			public		\$15,305	105	68.6
Wollochet	WC06 (b)	Hunt St		X			public	X	\$55,015	95	17.3
Artondale	AD04 (b)	Wollochet Dr			X		public		\$17,050	87	51.0
Donkey	DK04 (b)	Harborview Dr.			X		public		\$93,000	85	9.1
Goodnough	GN06 (b)	State Route 16		X			public	X	\$65,100	85	13.1
Goodnough	GN08 (b)	Good-nough Drive		X			public	X	\$45,117	85	18.8
Goodnough	GN09 (b)	State Route 302		X			public (state)		\$24,800	75	30.2
Mark Dickson	MD02 (b)	Nash Dr.		X			private		\$4,272	75	175.6
Mark Dickson	MD03 (b)	Nash Dr.			X		private	X	\$4,650	75	161.3
McCormick	MC03 (b)	Woodhill Dr		X			public		\$15,500	35	22.6
Sullivan Gulch	SL03 (b)	25th Street		X			public	X	\$9,300	30	32.3

**Note:**

Table 9-3 was developed to illustrate alternative Capital Improvement Projects. Alternative CIPs could temporarily solve fish passage problems at a lower cost than permanently correcting the fish passage problems by replacing the existing culverts with "fish-friendly" culverts, or are alternatives proposed to improve water quality. Alternative fish passage improvement measures evaluated in Table 9-3 include culvert cleaning, installation of baffles or installation of fish ladders. Alternative water quality improvement measures evaluated in Table 9-3 include constructing filtration system vaults and swales. Table 9-2 provides the evaluation of Capital Improvement Projects that would permanently correct fish passage problems by replacing the existing culverts with "fish-friendly" culverts. Table 9-2 also presents the water quality improvement measure of constructing a settling pond and swales. Capital projects are listed in descending order of benefit score. The benefit to cost ratio of each project is also shown. A summary of the evaluation of each potential capital improvement project and detailed evaluation forms and cost estimates are contained in Appendix G.

**Table 9-4  
Property Acquisition Capital Improvement Program Projects**

	Stream	CIP Name	Fish Habitat	Riparian Corridor	Length of Reach (ft)	Acquire Land to Improve Reach	Acquire Land to Protect Reach	Priority	Zoning <sup>1</sup>	Est. % of Reach Bordered by Vacant Land <sup>2</sup>	Cost / acre <sup>3</sup>	Estimated acreage to acquire <sup>4</sup>	Estimated acq. Cost	Score <sup>5</sup>	Score/ Cost (points/ \$10,000)
1	Sullivan Gulch	LA-SL02	fair	good	600		X	Med	Res	90%	\$ 80,000	3.10	\$ 247,934	290	11.7
2	Wollochet	LA-WC02	good	good	600		X	High	Res	80%	\$ 80,000	2.75	\$ 220,386	290	13.2
3	Sullivan Gulch	LA-SL03	good	good	3,500		X	Med	Res	10%	\$ 80,000	2.01	\$ 160,698	289	18.0
4	Donkey	LA-DK02	fair	good	2,500		X	Med	Res	90%	\$ 80,000	12.91	\$ 1,033,058	285	2.8
5	McCormick	LA-MC02	good	good	3,500		X	High	Res	30%	\$ 80,000	6.03	\$ 482,094	285	5.9
6	Wollochet	LA-WC03	good	good	2,000		X	High	Res	70%	\$ 80,000	8.03	\$ 642,792	285	4.4
7	Warren	LA-WR04	good	good	3,000		X	Med	Res	20%	\$ 80,000	3.44	\$ 275,482	281	10.2
8	Wollochet	LA-WC08	good	good	1,800		X	High	Res	20%	\$ 80,000	2.07	\$ 165,289	279	16.9
9	Wollochet	LA-WC04	good	good	750		X	High	Res	30%	\$ 80,000	1.29	\$ 103,306	278	26.9
10	Artondale	LA-AD06	fair	good	2,500		X	Med	Res	70%	\$ 80,000	10.04	\$ 803,489	275	3.4
11	Goodnough	LA-GN03	fair	good	3,600		X	Low	Res	20%	\$ 80,000	4.13	\$ 330,579	275	8.3
12	Wollochet	LA-WC11	good	good	1,800		X	Med	Res	90%	\$ 80,000	9.30	\$ 743,802	275	3.7
13	Crescent	LA-CR11	good	good	1,700		X	High	Res	40%	\$ 80,000	3.90	\$ 312,213	273	8.7
14	Goodnough	LA-GN05	fair	good	1,700		X	Low	Res	20%	\$ 80,000	1.95	\$ 156,107	273	17.5
15	Wollochet	LA-WC12	fair	good	1,500		X	Med	Res	50%	\$ 80,000	4.30	\$ 344,353	273	7.9
16	Artondale	LA-AD02	poor	poor	100	X		High	Res	50%	\$ 80,000	0.29	\$ 22,957	272	118.5
17	Wollochet	LA-WC10	fair	good	400		X	Med	Res	50%	\$ 80,000	1.15	\$ 91,827	272	29.6
18	Donkey	LA-DK04	good	good	1,300		X	Med	Res	40%	\$ 80,000	2.98	\$ 238,751	271	11.4
19	Artondale	LA-AD07	fair	good	600		X	Med	Res	70%	\$ 80,000	2.41	\$ 192,837	270	14.0
20	Doc Weathers	LA-DW02	good	good	2,000		X	Low	Res	90%	\$ 80,000	10.33	\$ 826,446	270	3.3
21	Nelyaly	LA-NL03	good	good	800		X	High	Res	40%	\$ 80,000	1.84	\$ 146,924	269	18.3
22	Nelyaly	LA-NL01	fair	good	750		X	High	Res	20%	\$ 80,000	0.86	\$ 68,871	267	38.8
23	Artondale	LA-AD08	good	good	3,800		X	Med	Res	20%	\$ 80,000	4.36	\$ 348,944	266	7.6
24	Crescent	LA-CR05	fair	poor	200	X		High	Res	90%	\$ 80,000	1.03	\$ 82,645	263	31.8
25	Crescent	LA-CR07	poor	poor	800	X		Med	Res	30%	\$ 80,000	1.38	\$ 110,193	258	23.4
26	Crescent	LA-CR15	poor	poor	1,700	X		Med	Res	10%	\$ 80,000	0.98	\$ 78,053	258	33.1
27	Crescent	LA-CR12	poor	poor	900	X		Med	Res	10%	\$ 80,000	0.52	\$ 41,322	257	62.2
28	Nelyaly	LA-NL07	poor	poor	700	X		Med	Res	10%	\$ 80,000	0.40	\$ 32,140	257	80.0
29	Rosedale	LA-RD01	poor	poor	100	X		High	Res	40%	\$ 80,000	0.23	\$ 18,365	257	139.9
30	Wollochet	LA-WC01	fair	fair	250	X		Med	Res	80%	\$ 80,000	1.15	\$ 91,827	173	18.8
31	Mark Dickson	LA-MD01	poor	fair	800	X		High	Res	50%	\$ 80,000	2.30	\$ 183,655	164	8.9
32	Sullivan Gulch	LA-SL01	fair	fair	600	X		High	Res	30%	\$ 80,000	1.03	\$ 82,645	162	19.6

33	Mark Dickson	LA-MD02	fair	fair	200	X		Med	Res	50%	\$ 80,000	0.57	\$ 45,914	152	33.1
	TOTAL											109	\$ 8,725,895		

**NOTES:**

- <sup>1</sup> "Residential" zoning (Res) includes High Density Residential, Moderate Density Single Family, Master Planned Community, Rural Separator, Rural and Reserve residential designations
- <sup>2</sup> "Estimated % of Reach Bordered by Vacant Land" determined from Figures 4-8 through 4-21 (Individual Basin Maps)
- <sup>3</sup> Cost/acre based on Pierce County Cost Estimating Guidance (high value residential land = \$80,000/acre)
- <sup>4</sup> Estimated acquisition area based on the following assumptions: average width of land acquisition from streambank outward would be 250 ft, length of land acquisition would be "estimated % of reach bordered by vacant land" multiplied by "length of reach".
- <sup>5</sup> Stream restoration project benefits were evaluated using the Capital Improvement Project benefit score sheets, shown in Appendix G.

**Table 9-5  
Stream Restoration Capital Improvement Program Projects**

	Stream	CIP Name	Fish Habitat	Riparian Corridor	Improve Aquatic Habitat	Improve Riparian Corridor	Potential to Acquire Land in Reach	Length (ft)	Cost/ft. <sup>1</sup>	Sub-total	35% contingency	Total	Score <sup>2</sup>	Score/Cost (points/\$10,000)
1	Artondale	SR-AD02	poor	poor	X	X	X	100	\$ 400	\$ 40,000	\$ 14,000	\$ 54,000	275	50.9
2	McCormick	SR-MC03	poor	poor	X	X		650	\$ 400	\$ 260,000	\$ 91,000	\$ 351,000	275	7.8
3	Goodnough	SR-GN01	poor	poor	X	X		250	\$ 400	\$ 100,000	\$ 35,000	\$ 135,000	270	20.0
4	Goodnough	SR-GN02	poor	poor	X	X		200	\$ 400	\$ 80,000	\$ 28,000	\$ 108,000	270	25.0
5	Crescent	SR-CR07	poor	poor	X	X	X	800	\$ 400	\$ 320,000	\$ 112,000	\$ 432,000	265	6.1
6	Rosedale	SR-RD01	poor	poor	X	X	X	100	\$ 400	\$ 40,000	\$ 14,000	\$ 54,000	265	49.1
7	Artondale	SR-AD05	poor	poor	X	X		1,000	\$ 400	\$ 400,000	\$ 140,000	\$ 540,000	260	4.8
8	Crescent	SR-CR05	fair	poor		X	X	200	\$ 200	\$ 40,000	\$ 14,000	\$ 54,000	260	48.1
9	Crescent	SR-CR12	poor	poor	X	X	X	900	\$ 400	\$ 360,000	\$ 126,000	\$ 486,000	260	5.3
10	Crescent	SR-CR15	poor	poor	X	X	X	1,700	\$ 400	\$ 680,000	\$ 238,000	\$ 918,000	260	2.8
11	Nelyaly	SR-NL07	poor	poor	X	X	X	700	\$ 400	\$ 280,000	\$ 98,000	\$ 378,000	260	6.9
12	Crescent	SR-CR08	fair	poor		X		600	\$ 200	\$ 120,000	\$ 42,000	\$ 162,000	255	15.7
13	Artondale	SR-AD04	fair	poor		X		800	\$ 200	\$ 160,000	\$ 56,000	\$ 216,000	250	11.6
14	Sullivan Gulch	SR-SL01	fair	fair	X			600	\$ 200	\$ 120,000	\$ 42,000	\$ 162,000	180	11.1
15	Wollochet	SR-WC01	fair	fair	X		X	250	\$ 200	\$ 50,000	\$ 17,500	\$ 67,500	180	26.7
16	Warren	SR-WR02	fair	good	X			500	\$ 200	\$ 100,000	\$ 35,000	\$ 135,000	175	13.0
17	Wollochet	SR-WC05	fair	fair	X			800	\$ 200	\$ 160,000	\$ 56,000	\$ 216,000	175	8.1
18	Mark Dickson	SR-MD01	poor	fair	X		X	800	\$ 200	\$ 160,000	\$ 56,000	\$ 216,000	160	7.4
19	Mark Dickson	SR-MD06	poor	fair	X			500	\$ 200	\$ 100,000	\$ 35,000	\$ 135,000	160	11.9
20	Nelyaly	SR-NL04	poor	fair	X			2,500	\$ 200	\$ 500,000	\$ 175,000	\$ 675,000	160	2.4
21	Doc Weathers	SR-DW01	poor	fair	X			800	\$ 400	\$ 320,000	\$ 112,000	\$ 432,000	150	3.5
	Total							14,750		\$ 4,390,000	\$ 1,536,500	\$ 5,926,500		

**NOTES:**

<sup>1</sup> Stream restoration costs can vary significantly depending on the level of work necessary at a given site. These cost estimates are based on lineal feet of stream. Cost estimates are \$200/ft for riparian corridor improvements (streambank stabilization,

<sup>2</sup> Stream restoration project benefits were evaluated using the Capital Improvement Project benefit score sheets, shown in Appendix G.

**Table 9-6**

**Planning Documents and the Range in Buffer Widths  
Specified for Protection of Critical Areas**

<b>REGIONAL AND LOCAL PLANNING DOCUMENTS</b>	
Tri-County Salmon Recovery Plan	Buffers from 65 to 200 feet
Pierce County Development Regulations	Buffers from 65 to 150 feet
Gig Harbor Peninsula Community Plan	Buffers from 75 to 250 feet
City of Gig Harbor Municipal Codes	Buffers from 25 to 150 feet

Table 9-7  
SUMMARY OF GIG HARBOR SUBBASIN WATER TYPES AND BUFFER WIDTHS

Gig Harbor Subbasin	Gig Harbor Plan Area	Water Characteristics	Pierce County Water Type	County Buffer Width	Fish Passage Barriers?	Flood Problems?	Water Quality Limited?	Predominant Land Use	Current Impermeable Surface
Goodnough	UGA - Purdy	Drainage area - 2 square miles; Gradient - moderate to steep; Discharge - to Henderson Bay; Contains Fish - supports coho and chum, cutthroat are present.	F1	150 feet	Yes	Yes	Yes - DO, Fecal coliform, nutrients	35% in low-density residential	17%
Crescent	Rural - Crescent Valley	Drainage area - 5 square miles; Gradient - moderate to shallow; Discharge - to bay at Gig Harbor; Contains Fish - supports coho and chum salmon and steelhead.	F1	150 feet	Yes - although less than on other streams	No	Yes - Fecal coliform	36% in low-density residential	18%
McCormick	UGA - Swede Hill	Drainage area - 2.5 square miles; Gradient - moderate to steep; Discharge - to Henderson Bay; Contains Fish - supports coho and chum salmon, steelhead and cutthroat trout.	F1	150 feet	Yes	Unknown	Yes - DO, Fecal coliform	37% in vacant space	16%
Donkey3	UGA - Donkey Creek Corridor	Drainage area - 1.9 square miles; Gradient - steep in upper reaches, moderate elsewhere, Discharge - to bay at Gig Harbor; Contains Fish - volunteers raise and release one million chum annually	F1	150 feet	Yes	Unknown	No	26% in vacant space; 20% in low-density residential	19%
Nelyaly	UGA - West Gig Harbor	Drainage area - 1.5 square miles; Gradient - moderate; Discharge - to Lay inlet; Contains Fish - planted coho and chum w/ reported high rates of hatching and returns.	F1	150 feet	Yes	Yes	Yes -DO, Fecal coliform	48% in low-density residential	6%
Rosedale	Rural - Rosedale	Drainage area - 0.6 square miles; Gradient - moderate; Discharge - to tidal inlet near Rosedale; Contains Fish - coho and chum, possibly Chinook.	F1	150 feet	Partial	No	Yes - Fecal coliform	59% in low-density residential	8%
Mark Dickerson	Rural - Ray Nash Valley	Drainage area - 2.2 square miles + Sylvia Lake; Gradient shallow to moderate; Discharge - to tidal inlet south of Raft Island; Contains Fish - supports coho, chum and possibly cutthroat.	F1	150 feet	Yes	Unknown	No	54% in low-density residential	7%
Artondale Creek	Rural - Artondale	Drainage area - 3.2 square miles; Gradient - lower reaches are moderate to shallow, upper reaches are moderate to steep; Discharge - to Wollochet Bay; Contains Fish - Coho, chum and cutthroat present.	F1	150 feet	Yes	Yes	Yes - Fecal coliform	41% in low-density residential	7%
Wollochet Creek	UGA to Rural	Drainage area - 2.6 square miles; Gradient - mainstem is moderate, branches range from low to moderate; Discharge - to Wollochet Bay; Contains Fish - supports coho and chum salmon and cutthroat trout.	F1	150 feet	Yes	No	No	40% in low-density residential	12%
Murphy		Drainage area - unknown, a 100-foot long reach was surveyed; Gradient - moderate to steep; Discharge - to Wollochet Bay; Contains Fish - unknown.	F1	150 feet	Yes	Unknown	Unknown	38% in low-density residential	23%
Sullivan Gulch	Rural - Point Fosdick?	Drainage area - 2 square miles; Gradient - moderate; Discharge - to Wollochet Bay; Contains Fish - supports coho and chum, cutthroat are present.	F1	150 feet	Yes	No	Yes - Fecal coliform	27% in low-density residential; 20% in commercial and industrial	28%
Point Evans - Doc Weathers	Rural - Point Fosdick?	Drainage area - small; Gradient - moderate to steep; Discharge - to Tacoma Narrows; Does Not Support Salmonids.	N1	115 feet	Yes	Unknown	Unknown		10%
Sunny Bay - Muri Creek	Rural - Cromwell and Warren	Drainage area - small; Gradient - moderate to steep; Discharge - to Hale Passage; Contains Fish - cutthroat trout present in lower reaches.	F2	Greater of 150 feet or 25 feet from top of bank	Yes	Unknown	Unknown	58% in low-density residential	12%
Warren Creek	Rural - Cromwell and Warren	Drainage area - 0.9 square miles; Gradient - moderate; Discharge - to Hale Passage; Contains Fish - coho salmon and cutthroat trout present.	F1	150 feet	Yes	No	Unknown	59% in low-density residential	9%