# *Achieving an Ecosystem Based Approach to Planning in the Puget Sound*

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## Introduction

To effectively protect aquatic and terrestrial ecosystems, government must focus on protecting or restoring key watershed processes affecting the interaction of water, sediment, plants and animals (Hidding and Teunissen 2002, Dale et al. 2000, Gove et al. 2001). The framework described herein presents an approach for identifying areas contributing to those processes that may be in need of protection or restoration as well as areas most suitable for future development. There are few examples within Washington of local planning that have effectively incorporated process-based watershed information and goals into land use designations, development standards and regulations. This is critical since local jurisdictions are the principal entities responsible for issuing development permits that can result in the types and patterns of land development that can adversely affect the Puget Sound's watershed processes and ecological functions.

Multiple reasons for past ineffective application of watershed information are likely, including:

- Incoherent, inconsistent or simply inadequate state and federal laws regulating planning;
- Local regulations that don't identify, address or adequately recognize watershed based, ecological and biological goals and objectives at the local scale;
- Inadequate interpretation and application of watershed data and information (note: whereas, historically a lack of data or poor understanding of ecology could have been a reason for this problem, extensive data is now available for most planning areas and thus we discount lack of data as an excuse for poor planning).

State and federal laws provide for the protection of land and water resources in the state of Washington. The State's Shoreline Planning Act has recently incorporated advances in watershed science into state requirements for the preparation of Shoreline Master Programs. However, since the enacting legislation applies to a narrow segment of coastal ecosystems (typically 200 feet wide), land use provisions that protect and maintain shoreline processes operating outside of the regulated shoreline cannot be required in most cases. This is particularly true, say, for a city jurisdiction located on a shoreline but surrounded by watersheds within county jurisdiction. Though encouraged, there is no explicit and absolute requirement that adjoining jurisdictions, as described, coordinate their planning and permitting activities within a watershed context.

Under the Growth Management Act, local governments have systematically enacted regulations required to protect the functions of critical areas at the site scale. However, these critical area regulations are not explicitly required to consider watershed processes or plans even though such process based analysis would qualify as Best Available Science under the Growth Management Act. As a result, mitigation required at the site scale is often ineffective or even counter-productive since it is either of the wrong type or in the wrong location or both.

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Finally, there is no set method or approach for interpreting and incorporating watershed data and information into land use planning.

This paper will present an approach to using watershed data and information in a manner that should result in more effective watershed policies, regulations and projects in Puget Sound. Additionally, we describe an example and potential model of successful inter-jurisdictional planning within a watershed context for Lake Washington Basin, King County.

## Approach to Watershed Planning in Puget Sound

### Role of Ecosystem Processes: Process, Structure and Function

Habitat "is the biological, physical and chemical conditions of an area that support a particular species or species assemblage" (Ruckelshaus and McClure 2007). Examples of Puget Sound habitats include high-elevation glaciers, alpine meadows, mid-elevation mixed forests of fir, hemlock, alder and maple, river floodplains, freshwater wetlands, riparian forests, estuarine and tidal marshes, mudflats, eelgrass beds, and sand and gravel beaches (Kruckeberg 1991; Williams et al. 2001; Ruckelshaus and McClure 2007). These habitats are not formed *de novo* and are not static in their condition, area or availability. Instead, they are part of a complex web of habitats formed and maintained over time by the interaction of physical, chemical and biological processes occurring throughout their watersheds (Spence et al. 1996; Dale et al. 2000; NRC 2001; Roni et al. 2002; Stanley 2005; Simenstad et al. 2006).

Ecosystem processes deliver, move, and transform water, sediment, wood, nutrients, pathogens, and organic matter. These processes are responsible for creating and maintaining the habitats that we see and for the functions that habitats provide (Naiman and Bilby 1998; Beechie & Bolton 1999, Hobbie 2000; Benda 2004; Simenstad et al. 2006; King County 2007). These processes exist in a dynamic state and constantly respond to controlling factors such as precipitation or to episodic disturbance events like landslides, fires, and flooding (NRC 1996).

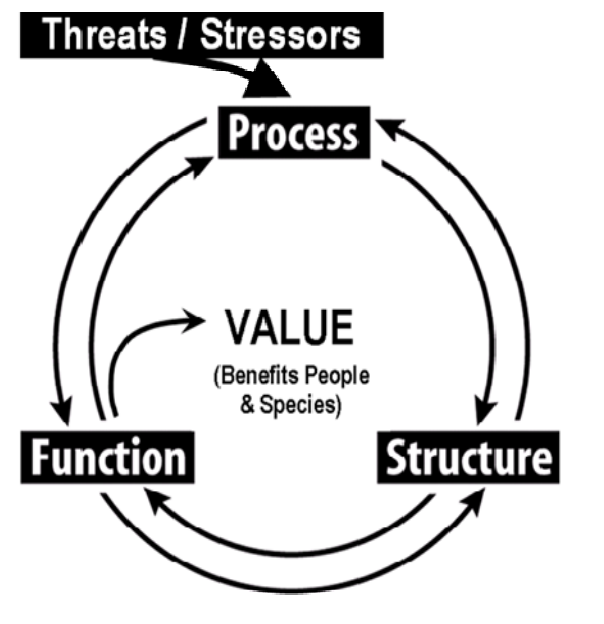


Figure 1. Ecosystem processes are responsible for creating/maintaining habitat structures and the resulting functions. Threats alter components of ecosystem processes, which in turn, affect structure and function and ultimately the values people and species may desire (Fuerstenberg 1998; King County 2007).

These processes operate at multiple scales (e.g., regional/large-scale local/landscape-scale, or finite/small-scale) and time scales (e.g., daily versus once a century) and at varying magnitudes (e.g., baseflow or bankfull river flows versus 100-year storm event). Despite adverse short-term impacts to survival, native species are adapted to and ultimately benefit over time from the frequency and magnitude of disturbances in their habitats (Reice et al. 1990).

In order to evaluate “threats” to habitats from land use practices we must understand how threats impair ecosystem processes. This also provides an understanding of the level of impairment to water quality, water quantity, and habitat functions.

## Major Threats to Ecosystem Processes and Habitats

Human activities often alter factors such as land cover, topography and soils that control processes and, in turn, the structure, function and value of a given habitat (Figure 1). Major impairments or “threats” [1] to ecosystem processes include: forest clearing, impervious surfaces, draining/diking and filling of wetlands and floodplains, roads and associated storm drainage systems, shoreline armoring, overwater structures, removal of riparian vegetation, and excessive loading of nutrients, sediment, pathogens and toxic materials.

## Watershed Planning Framework

Figure 2 presents a proposed framework for watershed planning (Granger et al. 2005) that incorporates ecosystem processes and function and their impairments. The framework is designed to use existing data and information and consists of five basic steps:

1. Inventory resources and characterize the condition of watershed processes and functions;
2. Identify problems in watershed - where, why and to what extent have watershed processes and functions been impaired;
3. Identify regulatory, programmatic and capital measures necessary to protect and restore processes and functions;
4. Take action through implementation (non-regulatory and regulatory approaches); and
5. Monitor results and modify plans and regulations accordingly.

To assist planners in organizing and evaluating the watershed data and information, an analysis template, for the reach scale, is presented in Table 1.

For step 1, planners should use existing watershed information and data such as existing watershed or basin plans (e.g., WRIA 8 Salmon Recovery Plan, King County Issaquah Basin Plan) and online data sources (NOAA’s Coastal Change Analysis Program) to characterize ecosystem processes and functions. This information can be entered into an analysis template that allows planners to establish the relationship between processes and functions and various spatial scales. Planners can then identify the type and level of process impairment at the watershed, sub-watershed or reach scales (Table 1, column 2) and use this information to develop preliminary solutions (Table 1, column 3) including spatially explicit alternative scenarios for development or management.

[1] In this paper “threats” are human activities that can alter habitat processes, and ultimately the structure and function and value of habitat. It is synonymous with “stressors”, a term that is often used in scientific literature.

Examples include:

- Selecting the appropriate types and intensity of development for different locations;
- Changing zoning at key locations to better protect the ecological services provided by the environment at that scale;
- Identifying the best locations for mitigation;
- Identifying the types of mitigation needed in different areas;
- Identifying the best areas for cost-effective restoration; or
- Identifying the best areas for protection and development.

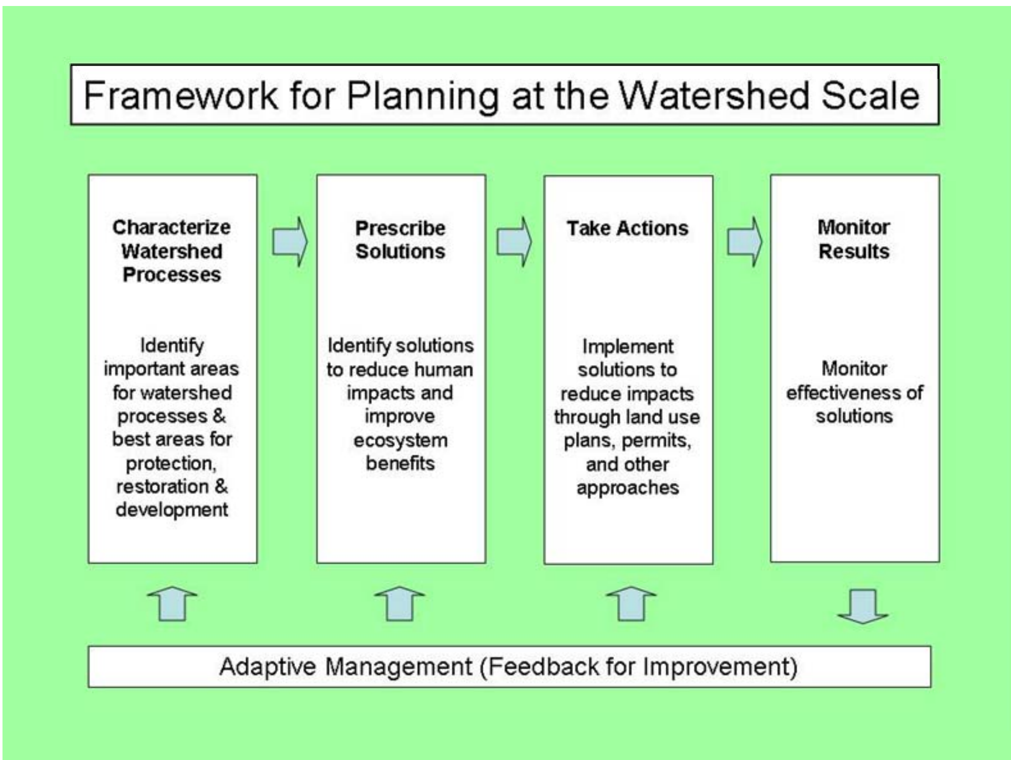


**Figure 2. A general framework for planning at the landscape scale.** This represents a suggested framework that local governments could use in protecting and managing aquatic ecosystems through land use planning.

When scenarios for future development and management are analyzed, locally reviewed, and accepted the solutions can be implemented in the "Take Actions" step of Figure 2. Actions could include adopting updates for comprehensive plans or Shoreline Master Programs with specific provisions based on the analyses.

The final, and most important step in the framework, is monitoring the results of the adopted plan. This determines if the provisions of the plan are effectively protecting and/or restoring aquatic ecosystems. Feedback from this monitoring effort can be used to modify or "adapt" the plan to correct those aspects that are not meeting the objectives of protection and restoration. Using this framework, a planning example for the Issaquah Creek Basin is presented below.

## Watershed or Basin Planning for Lake Washington

The City of Issaquah and Issaquah Creek Basin are located within the Lake Washington, Cedar, and Sammamish Watershed (WRIA 8). The Issaquah Creek Basin encompasses sixty-one square miles (about 10%) of the 692 square miles of the Washington/Cedar/Sammamish Watershed (Figure 3). The basin boundaries follow the ridge and mountain tops of Grand Ridge/Mitchell Hill, Tiger, Taylor, Squak and Cougar Mountains. These mountains are informally known as the "Issaquah Alps." The "Issaquah Alps" surround and form the scenic backdrop to the City of Issaquah. Lake Sammamish is located at the "base" or northern end of the basin.

Issaquah Creek Basin is further divided into eight sub-basins: Upper Issaquah, Fifteenmile, Middle Issaquah, McDonald, East Fork, North Fork, Lower Issaquah and Tibbetts Creeks. Within the Upper Issaquah sub-basin, two major tributaries, Holder and Carey Creeks, form Issaquah Creek at their confluence.

## Step 1 – Characterize the Watershed

### *History of Basin Planning in King County*

Today, most planners have much more information available than ever to conduct landscape characterization analysis and establish a context for planning. Throughout the Puget Sound region, a wide array of local, state and federal analyses have been conducted along both marine and fresh waters for a variety for purposes, including shoreline master plans, Puget Sound and endangered salmon recovery, timber harvest, and comprehensive land use plans. In the Issaquah Creek Basin, we have an example of how basin planning, led by King County, has been useful in local salmon recovery plans as well as dealing with the City of Issaquah's flooding and Shoreline Master Plan needs.

King County's Basin Planning Program was initiated in the late 1980s to identify and create holistic solutions to surface water management problems and prevent or minimize the creation of new ones. The program's precursor was a relatively brief (1985 - 1987) Basin Reconnaissance Program, the success and findings of which led to formation of the Basin Planning Program. Both programs evolved over time out of a growing awareness that earlier approaches to surface water problems tended to address symptoms rather than causes. For example, bank erosion, flooding and other surface water problems were typically "fixed" using bank armoring and flood control structures. Underlying causes such as altered watershed hydrology, hydraulics and sediment supply and routing resulting from the conversion of forest and natural soils to impervious surfaces were not being addressed. Further, the "fixes" were highly artificial stormwater contrivances (pipes and ponds) that were very expensive, prone to failure and caused collateral damage to aquatic habitat.

The Basin Plan Program goals centered on the prevention and, where feasible, restoration of desired or non-problematic flooding, water quality and aquatic habitat conditions. To provide solutions for both people and aquatic biota, the BPP approach recognized the need to understand the spatial and historic interrelationships among water, sediment and vegetation (note: the plans were mostly funded by Surface Water Management utility fees and thus did not explicitly address terrestrial species and habitat needs).

The basin plans used a two step process. First, a Current and Future Conditions (CFC) Report was drafted to assess hydrology, geology, water quality, and stream and wetland habitat conditions and to identify specific erosion, flooding, water quality and aquatic habitat problems. The assessment of current conditions considered historic changes while the future conditions projected potential land use scenarios using hydrologic models to identify where existing problems may worsen or new ones arise. In the second step, a "Plan" was developed. The plan identified capital projects and programmatic, regulatory and stewardship activities to meet plan goals and resolve problems in a basin or reach context using CFC information and input from local, state, tribal and federal governments and citizens.

### *Characterization for Issaquah Creek Basin*

As a first step in conducting a characterization, it is important that its purpose be clearly identified. This tells you the correct scale to conduct the characterization and what data and information to collect. For the Issaquah Creek Basin, the purpose was to address surface water problems (i.e. flooding) at multiple scales (broad, mid and fine) and identify pragmatic solutions to address those problems. This required collection of data on land cover type, surficial geology and soil characteristics and channel geometry and condition. The Current and Future Conditions analysis used hydrologic modeling to assess the effect of impairments, such as forest clearing and impervious surfaces, on surface water flow processes in the Issaquah Creek Basin. From the results of the modeling it was concluded that:

- Widespread flooding in lower Issaquah Creek and through the City of Issaquah would worsen with future basin development;
- Existing water quality, considered to be generally good, would deteriorate markedly as the upper basin developed; and
- Habitat deterioration had resulted in loss of fish and wildlife and further declines in both habitat and biota would occur with continued basin development.

In developing the basin plan, the County involved both the planning and public works departments at the City of Issaquah. This helped established an understanding of the science behind the plan and established local government support of the plan.

## Step 2 – Identify Solutions

To avoid or minimize and mitigate for the ongoing and potential future impacts of development, the Basin Plan recommendations included:

- Protect the upper watershed by reducing the amount of forest clearing and impervious conditions;
- Reduce flood hazards by removing homes from the stream corridor, acquire easements on undeveloped property, and restore channel and floodplain capacity;
- Regulate the location and characteristics of new development to reduce impacts on stormwater runoff, water quality, and fish and wildlife; and
- Solve drainage, habitat and non-point water quality problems through a combination of capital improvement projects, public programs, monitoring, enforcement and education.

## Step 3 – Take Action

Based on recommendations in the Basin Plan, the County enacted a County ordinance to limit the clearing of forest on individual parcels to 35% and impervious surfaces to 10%. These thresholds were based on research conducted by Booth (2004) and others and have helped maintain processes that support aquatic systems throughout the watershed. In tandem with its shoreline and critical areas ordinances to protect riparian and aquatic resources, the City of Issaquah has implemented an active creek-side property acquisition program, known as the Issaquah Creek WaterWays Program, to preserve aquatic and riparian resources.

Over the past fifteen years, the City has acquired 117 acres of creek, wetland and riparian resources using a combination of grant funds and Transfer of Development Rights. This has included sites identified in the "Issaquah Creek Final Basin and Nonpoint Action Plan," (1996). The City also formed the Squak, Tiger and Cougar Interagency Committee to assist in purchasing properties in the watershed outside city limits. The agencies that formed the Committee were the City of Issaquah, King County, State Parks and state Dept. of Natural Resources. By partnering with other non-profit groups, such as the Mountains to Sound Greenway and Issaquah Alps Club, the City has purchased and protected over 10,000 acres in the upper watershed (i.e. for a total of 26,555 protected acres).

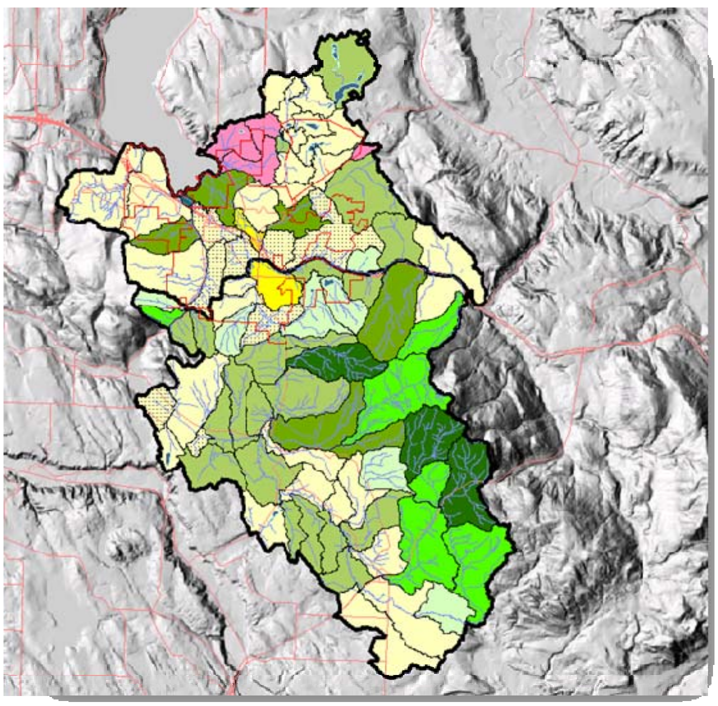

Figure 3. Issaquah Creek Basin. Areas for protection (green), restoration (yellow) and development (pink). Darker colors have higher priority. Based on updated characterization for Shoreline Master Program (2008). City of Issaquah is located in northern end of basin and is outlined by the red boundary. City and County have successfully protected the upper watershed (dark and bright greens) and purchased, restored riparian habitat in dark yellow areas (see Table 1).

As the knowledge base for aquatic science expanded, the City continued to improve the existing solutions to watershed problems (Figure 2, adaptive management feedback). This included the watershed "Stream and Riparian Areas Restoration Plan," (November 2006) and the watershed characterization and analysis as part of the Shoreline Master Program update.

The 2008 Shoreline Master Program update identified the best areas for protection, restoration and development in the City based on application of an updated characterization methodology.

This overlay (Figure 3) is being used to further prioritize the restoration and protection actions proposed in the plans above. For example, many of the areas within the core portion of the City were identified as a high priority for restoration given the presence of important areas for groundwater discharge, recharge and surface water.

To ensure a watershed approach, the City of Issaquah has partnered with King County's Issaquah Creek Basin Steward and the Dept. of Ecology. The agencies also worked with local basin residents through the Issaquah Basin Action Team ("IBAT"). Using existing basin plans, as described earlier, IBAT has identified critical property acquisitions and restoration projects throughout the basin. The Basin Steward has been a crucial element to the success of preserving and protecting resources within the basin. The Basin Steward is critical in looking at the resources found within the entire basin and working on the various planning efforts to ensure its continued protection.

## Step 4 – Monitoring

The City and County are continuing to monitor hydrologic, physical and biological conditions in Issaquah Creek to detect any positive or negative trends in overall ecological health of creek habitat. This monitoring is providing important feedback for planners and policy makers as to the success of regulatory and management measures in the watershed. So far, the monitoring indicates that the creek ecosystem is not deteriorating and shows improvement in functions at a number of the restored riparian sites.

## Why this Worked

There are three key reasons why this watershed planning process has been successful, including:

- Planning of the right elements at the right time, particularly that:
  - a) Problems had compatible solutions (flooding and habitat need), and
  - b) Solutions had value for both people and aquatic resources
- High level of cooperation within the basin between County, City, and Non-Profit Groups
- Long term involvement by key individuals from agencies and non-profit groups

Supporting this success was a systematic approach to collecting and analyzing watershed based information to establish local conditions, goals and objectives. Additionally, the City of Issaquah recognized early on that it must work with the other agencies and organizations to ensure protection of the entire Issaquah Creek Basin. This on-going partnership requires long term staff and political will in order to achieve the continued protection of the natural resources of the Issaquah Creek Basin.

| **Table 1. Example of Watershed Analysis Template (Reach Scale Application)<br>East Fork Issaquah Creek and Mainstem, Reaches X & D:** | | |
|---|---|---|
| **Unimpaired Conditions Assessment of watershed processes & functions** | **Level of impairment to processes & functions and associated issues** | **Solutions and Actions:<br>Recommended protection & restoration measures and environment designations** |
| **Ecosystem processes:**<br><br>*What areas are important in the watershed for maintaining processes at this reach?*<br><br>Forested areas of watershed in areas of higher precipitation, including rain-on-snow and snow dominated areas. Areas of higher permeability.<br><br>**Shoreline functions:**<br><br>*What functions are present at the site (un-impaired conditions)?*<br><br>Floodplain storage, removal of sediment, nutrients and toxins, aquatic and riparian habitat. | **Ecosystem processes:**<br><br>*How have the processes been impaired?*<br><br>Watershed Processes. Forested areas in upper watershed have low degree of clearing and development. Water flow processes are therefore functioning properly for the broad scale.<br><br>Reach Scale Processes. Overbank flooding is impaired by streambank armoring. This increases overall flooding potential for the City of Issaquah, which is a significant issue. Sediment processes highly impacted: High percentage of substrate impacted by fine sediment. Large woody debris (LWD) is limited and existing material is either unstable or ineffective.<br><br>**Shoreline functions**:<br><br>*How have the functions been impaired?*<br><br>Floodplain storage function has been significantly impaired by armoring and dikes. Water quality functions are not significantly impaired in the East Fork. Fecal coliform, low DO and suspended sediment problems in mainstem for Reach D.<br>Riparian functions: 68% of riparian habitat dominated by urban uses in Reach X. Sizable portion of riparian corridor intact for Reach D.<br>Fish Habitat: Only 5% of riffles are available for spawning in Reach X. Lack of side channel habitat in Reach D. 7 to 8% of time spawning temperatures exceeded for Reach D. Pool frequency low and spawning gravels embedded for Reach D. | **Ecosystem processes and functions:**<br><br>*What are the solutions and actions based on analysis of processes and functions (columns 1 and 2)?*<br><br>Analysis: Water flow processes are intact and protected for broader watershed. This will help support natural flow regimes and restoration of structure and function in downstream habitats. Sediment and LWD processes appear to be impaired at the reach scale.<br><br>Solution and Actions: Restore overbank flooding in reach X and D by removing armoring and dikes. Restore riparian forest - replant buffer with species contributing to LWD recruitment. Provide for better control of sediment sources from roads and construction. Start stormwater retrofit program to reduce direct discharge to creek and capture sediment through bioswales and restoration of natural features.<br><br>**Recommended Designation, Development Standards and Regulations:**<br><br>A Public Recreation and Riparian Restoration Management zone or designation is recommended for these reaches. Several of the properties are in city ownership and slated for park development (Emily Darst and Cybil Madeline Parks). Restoration actions should be linked by regulations to projects 17,18,19,20 and 48 in Stream and Riparian Restoration Plan (2006). Setbacks for park development should be adequate to allow establish of riparian buffer (minimum 150 feet). |

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