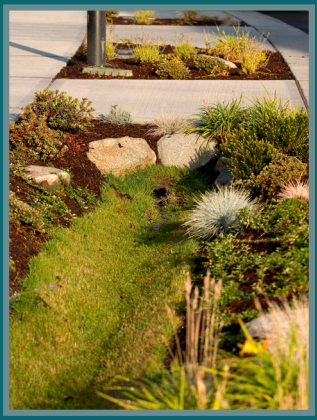
SUNSET AREA SURFACE WATER MASTER PLAN

APRIL 2011



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City of Renton

Community and Economic Development Department
Public Works - Surface Water Utility Department

CITY COUNCIL REVIEW DRAFT

Sunset Area Surface Water Master Plan

Prepared for
City of Renton

Prepared by
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April 2011

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1 Introduction

Purpose

This Surface Water Master Plan was written to guide the City of Renton's surface water management program within the Sunset Planned Action Study Area. It also identifies surface water projects and priority needs and develop long-term solutions that meet regulatory requirements, reflect the community's priorities, and can be funded by the City or through future developments. A study was conducted in support of this master plan to evaluate surface water infrastructure improvements necessary to support the redevelopment of the Sunset Terrace public housing community and associated neighborhood growth and revitalization, including other public service and infrastructure improvements (e.g., transportation improvements). This Surface Water Master Plan is prepared in conjunction with a Sunset Terrace Planned Action Environmental Impact Statement.

Planned Action Study Area

The study area for the Surface Water Master Plan is generally bounded by NE 21st Street on the north, Monroe Avenue NE on the east, NE 7th Street on the south, and Edmonds Avenue NE on the west. The development of the study area started in the mid 1940's. The City utilities, includes storm drains, serving the area were installed as the area developed. The age of some of the existing storm drains infrastructure is estimated to be more than fifty years old. The study area land uses include mixed-use, mixed-income residential, commercial, and retail properties. The businesses are primarily located along Sunset Boulevard and NE 12th Street.

The Sunset Area Community Investment Strategy developed by the City of Renton in 2009 identified several residential streets in the neighborhood, designated as "Green Connections," that would be transformed to improve pedestrian and bicyclist mobility, improve stormwater quality, mitigate the quantity of stormwater runoff, and create an inviting corridor to enhance the neighborhood.

Community Input

In 2009, a Sunset Community Investment Strategy (CIS) was initiated to create a blueprint for the public investment that can be coordinated and phased in over the coming years. Some of the projects listed below were based on the result of the CIS. Elements of the Surface Water Master Plan were also included in the Planned Action environmental impact statement process, which includes scoping meetings and comment periods, the Draft Environmental Impact Statement (EIS) and comments, and responses to comments in the Final EIS.

Priority Levels

Priority levels were assigned to projects identified in this plan. These priority levels are intended to inform decisions on the timing of the projects and the expenditure of limited resources, and are defined as follows:

Priority Level 1: Projects with priority level 1 are deemed critical because they address an immediate system deficiency or coincide with redevelopment of Sunset Terrace or other public infrastructure improvements to support the potential redevelopment. For example, the Harrington Avenue Green Connections projects, which improve pedestrian mobility and safety between important public spaces and schools within the Sunset Area, are priority level 1.

Priority Level 2: Priority level 2 projects are not immediately necessary and could be implemented to support redevelopment or to reduce costs by constructing them concurrently with other public infrastructure improvements, e.g. lower priority Green Connections.

2 Study Area Characteristics

Drainage Basins and Land Cover

The Planned Action Study Area is currently developed for residential and commercial land uses. In general, the stormwater runoff from this area drains to roadside ditches, catch basins, and storm drains. The runoff is collected and conveyed into larger storm drains within the major streets and discharges into local creeks and drainage tributaries. No stream, water body, or water-related critical area is located in or immediately adjacent to the Planned Action Study Area, and no local flooding has been reported in the area. The Study Area is not within a special flood hazard area mapped by the Federal Emergency Management Agency (FEMA).

The Planned Action Study Area comprises approximately 269 acres of urban developed area. The area drains to three tributary creeks: Honey Creek, May Creek (Lower May Creek), and Johns Creek. All three creeks are part of the Greater Lake Washington Watershed (Water Resources Inventory Area [WRIA] 8 in King County). Lake Washington, the receiving water body from May Creek and Johns Creek, is the second largest natural lake in Washington. Most of the immediate watershed is highly developed and urban, with 63 percent fully developed.

Approximately three (3) acres at the northeast corner of the study area drain to Honey Creek, which is a tributary to May Creek. The northwest corner of the study area, which includes 23 acres of primarily single-family residential land use, drains to May Creek. The balance of the study area, approximately 243 acres of mixed single-family residential, multifamily residential, and commercial uses, drains to Johns Creek (Figure 1). The existing and preferred alternatives land cover summary are shown in Table A-2 in Appendix A.

Soil

The soils influencing the design and function of the study area generally consist of urban soils (largely fill) and glacially derived outwash and till deposits. Figure 2 shows the surface soil as mapped by the Natural Resources Conservation Service. The northern and southern area consists of outwash soil, which is generally very permeable and has a good infiltration rate. The central and western portion of the study area generally consists of till soil, which is a dense, unsorted mixture of gravel, sand, silt, and clay. Till soil is less permeable than outwash soil and has limited infiltration capacity. Much of the central portion of the study area is designated as urban soils, which are difficult to classify due to the variable nature of the soil; however, for the purposes of this study, urban soils are assumed to exhibit similar infiltration characteristics as till soil. Figure 2 shows the soil conditions of the study area. Figure 3 shows the area of steep slopes where an infiltration facility is not allowed per City of Renton code.

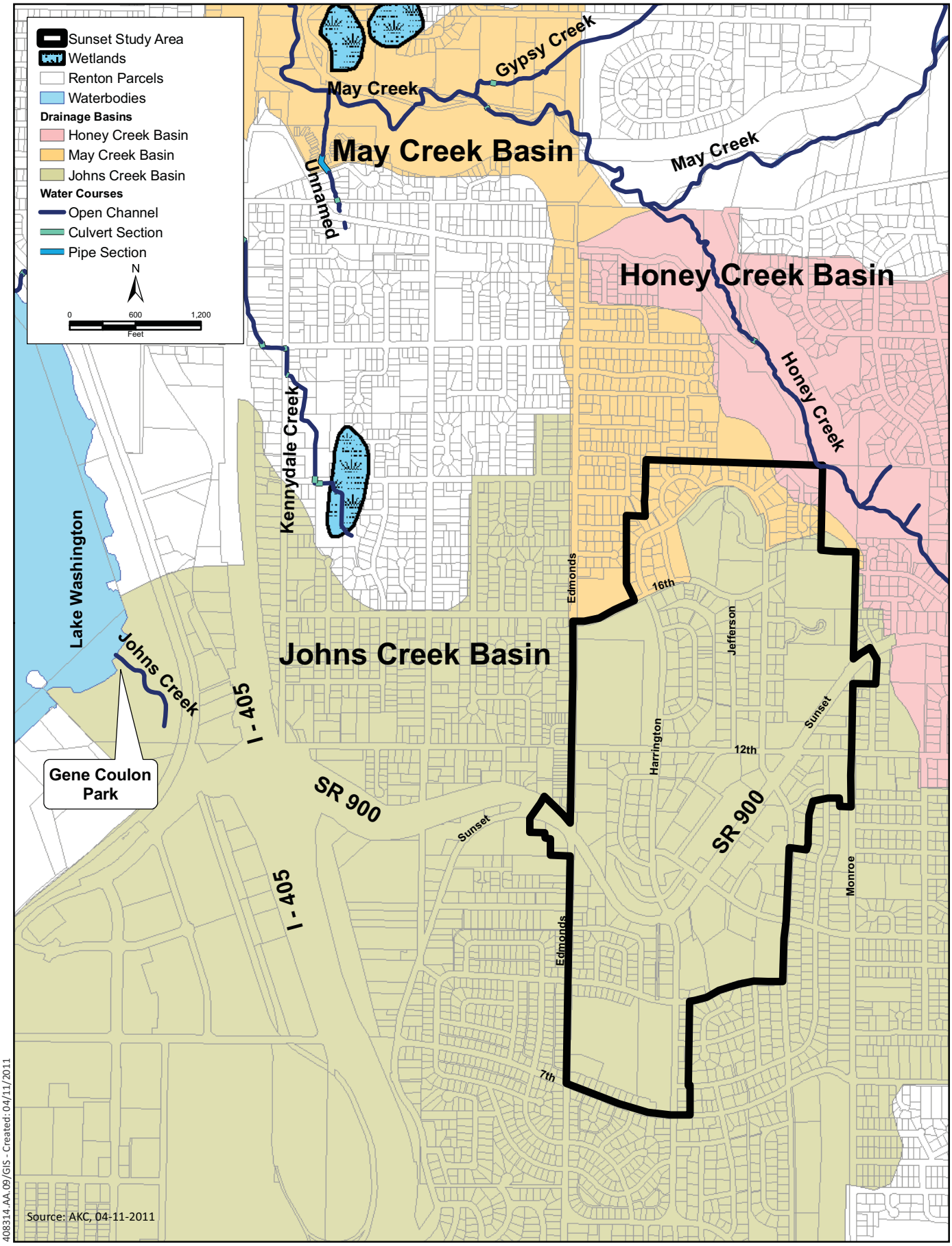

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Figure 1
DRAINAGE BASINS
City of Renton Sunset Area Master Drainage Plan

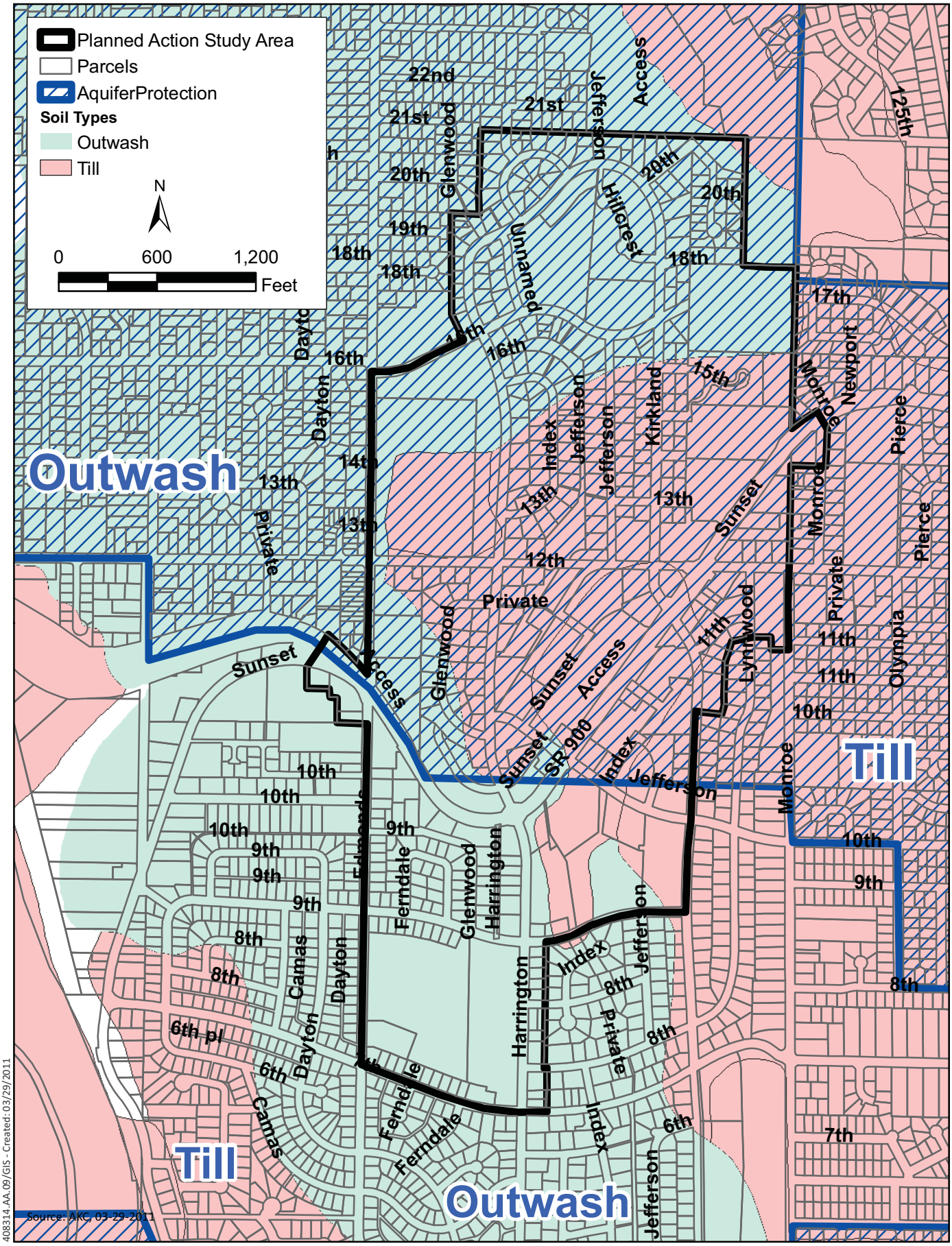

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Figure 2
Soil Types & Aquifer Protection Zone
City of Renton Sunset Area Master Drainage Plan

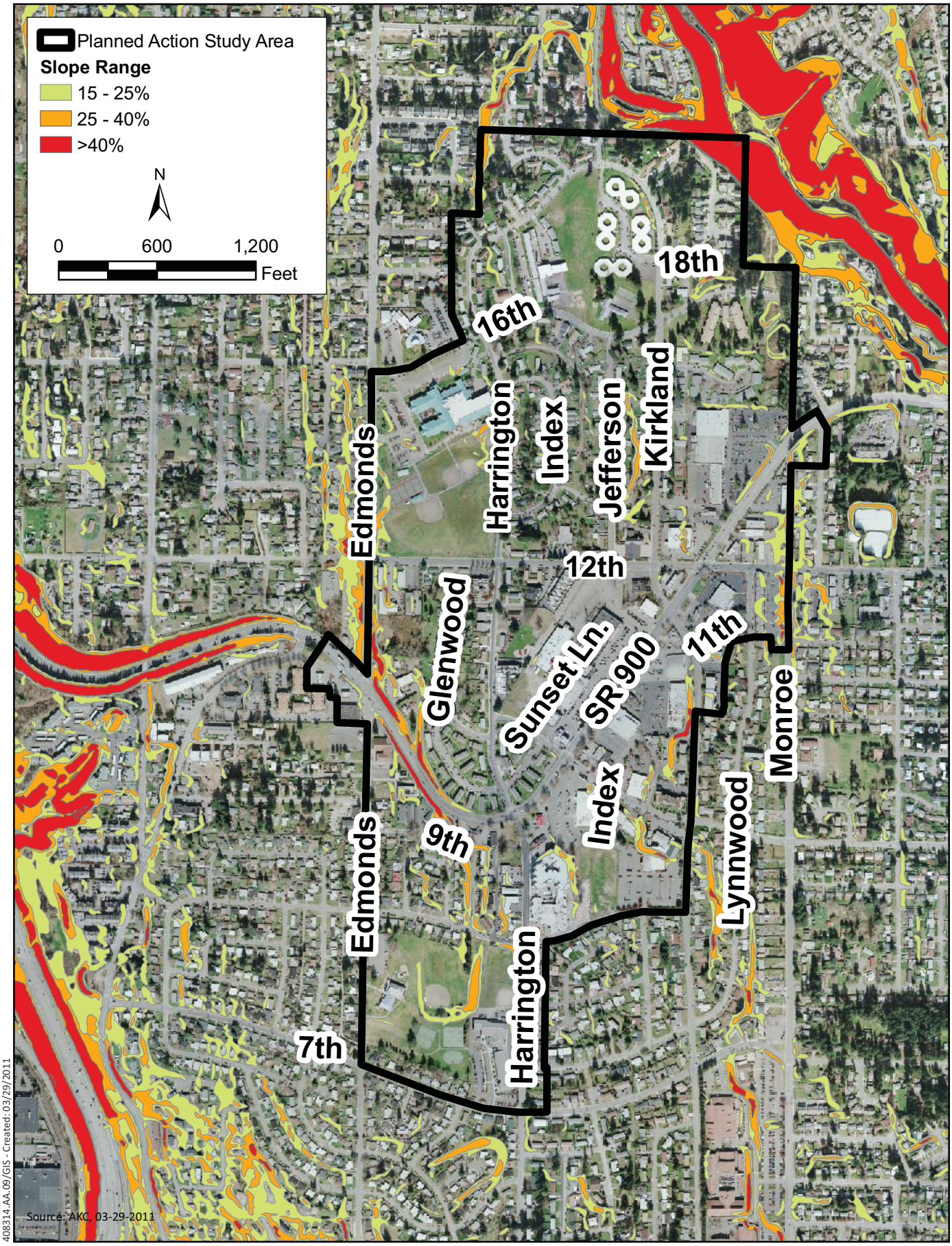

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Figure 3
Steep Slope Hazard Areas
City of Renton Sunset Area Master Drainage Plan

Groundwater

The Planned Action Study Area is within the City's Aquifer Protection Zone 2. The protection areas are the portions of an aquifer within the zone of capture, and the recharge area for wells owned or operated by the City. Zone 2 is the land area situated between the 365-day groundwater travel time contour and the boundary of the zone of potential capture wells. This aquifer is the sole drinking water source for the City of Renton. The Planned Action Study Area south of Sunset Boulevard lies within the source area of Cedar Valley Sole Source Aquifer, designated by the U.S. Environmental Protection Agency, which is also part of the City's Aquifer Protection Zone 2. The limits of the Aquifer Protection Zone and infiltration potential within the study area are presented in Figure 2.

Drainage System

May Creek Basin

Approximately 26 acres within the northern portion of the study area drain to the May Creek Basin. This area is largely developed under single-family residential land use. There is one storm drain system in the study area in May Creek Basin. This system extends along NE 16th Street beginning west of Index Avenue NE and drains westward and then north on Edmonds Avenue NE. This system eventually drains to May Creek.

May Creek is 7 miles long and originates in the steep forested slopes of Cougar and Squak mountains and in the highlands of the Renton Plateau. The entire basin encompasses an area of fourteen (14) square miles that drains to the southeast portion of Lake Washington (City of Renton and King County 2001). The May Creek Basin also includes other tributaries: Honey Creek, Boren Creek, and the north, east, and south forks of May Creek. May Creek and its tributaries are designated by Washington Department of Ecology (Ecology) as "Class AA" (superior) because May Creek is a feeder stream to Lake Washington. Class AA waters can be used for water supply (domestic, industrial, and agricultural), stock watering, fish spawning, wildlife habitat, and recreation (Foster Wheeler Environmental 1995).

Johns Creek Basin

Most of the study area is within the John's Creek Basin. The land use in this basin is mainly single-family residential, schools, and commercial/industrial development. A small portion is used for multi-family or high-density housing. The upper basin is dominated by residential and commercial land use, and the lower basin is dominated by industrial and commercial uses.

Johns Creek discharges to Lake Washington at Gene Coulon Park in Renton. Johns Creek extends upstream in a southeasterly direction for less than 1 mile. Because of its proximity to Lake Washington, the stream water elevation is controlled by Lake Washington, and therefore it is considered to be a major receiving water body per the City amendment to the *King County Surface Water Design Manual* (City of Renton 2010a). The Johns Creek Basin covers approximately 1,236 acres and is located east of the Cedar River, in the northeastern portion of Renton. The drainage system serving the overall basin consists primarily of

roadside ditches and storm drain pipes. There are three primary storm drainage systems in this basin: Sunset Boulevard, NE 9th Street, and NE 7th Street.

Sunset Boulevard Storm Drainage System

Record drawings indicate the Sunset Boulevard (SR 900) storm drainage system was constructed in the 1970s. The system consists of 30-inch-diameter pipe downstream of the study area, west of Edmonds Avenue NE. The main trunk of the storm drainage system extends along Sunset Boulevard. This storm drain directly collects runoff from Sunset Boulevard and adjacent properties. This trunk also receives flows from drainage systems on adjacent streets and a 12-inch diameter storm drain on Harrington Avenue NE (south of NE 10th Street) was constructed in the 1950s.

This system also conveys runoff from Edmonds Avenue NE between Sunset Boulevard and south of NE 16th Street, Harrington Avenue NE, and NE 10th Street immediately north of Sunset Boulevard. The Edmonds Avenue NE system conveys runoff from the NE 12th Street system, Harrington Avenue NE system, Jefferson Avenue NE, and Kirkland Avenue NE. The NE 12th Street system was upgraded in the early 1980s into 36-inch-diameter pipe from Kirkland Avenue NE to Edmonds Avenue NE. The system remains as 12-inch-diameter pipe east of Kirkland Avenue NE. The Kirkland Avenue NE system is a 12-inch-diameter pipe that starts at NE 16th Avenue. It was built pre-1950. Currently, the stormwater runoff from Harrington Avenue NE and Jefferson Avenue flows on the street surface and is intercepted by the storm drain on NE 12th Street.

NE 9th Street Storm Drainage System

The NE 9th Street system drains the area south of Sunset Boulevard to NE 9th Street. It starts west of Monroe Avenue NE and drains west. It intercepts a storm drain at Harrington Avenue NE. The combined system continues to flow west, then turns north at Ferndale Circle NE, then turns west and becomes an 18-inch-diameter pipe. This system turns west again, crossing under Edmonds Avenue NE toward NE 9th[h] Place.

NE 7th Street Storm Drainage System

The NE 7th Street system starts east of the study area from Monroe Avenue NE. This system drains west and intercepts two storm drains at Harrington Avenue NE. Only a small portion of the study area drains into this storm drain.

3 Applicable Regulations

This chapter summarizes the federal, state, and local stormwater regulations that all developments should comply with. Also, the Sunset Terrance Area specific flow control strategy is discussed.

Federal

Federal stormwater regulations in the Clean Water Act (33 U.S.C. §1251 et seq.) are typically promulgated through local stormwater requirements (see below). Projects proposed as part of the Sunset Area Surface Water Master Plan will need to meet the requirements of Section 7 of the Endangered Species Act (16 U.S.C. §1531 et seq.), which is regulated by the U.S. Department of the Interior, National Marine Fisheries Service, and U.S. Fish and Wildlife Service.

State

For projects with an area of disturbance exceeding one (1) acre, the City is required to file a Notice of Intent with Ecology for coverage under the National Pollutant Discharge Elimination System (NDPES) program's General Permit for Stormwater Discharges Associated with Construction Activities. These filings typically require projects to provide erosion-control measures consistent with Ecology's *Stormwater Management Manual for Western Washington* (Ecology 2005).

The City of Renton is required to administer a stormwater management program developed in accordance with the Western Washington Municipal Stormwater NDPES phase II Permit. Among the specific obligations set forth in this NDPEs permit, the City is required to adopt by ordinance a stormwater design manual that is equivalent to the 2005 Ecology manual. Therefore, the City has adopted the 2009 King County Surface Water Design Manual with City amendments (City of Renton 2010a) for the design, construction, and maintenance of stormwater management systems and facilities that are approved through the development permit process. Permanent stormwater features must meet the manual's design standards or be equivalent.

Local

RMC 4-3-050, Critical Areas Regulations, addresses the requirements for development within or adjacent to the aquifer protection areas or any other critical area (i.e., flood hazard areas, erosion hazard areas, wetland, streams, etc).

Renton Municipal Code (RMC) 4-6-030 and Ordinance No. 5526 address storm drain utilities. Technical requirements for the design of stormwater facilities are contained in the *King County Surface Water Design Manual* (King County 2009) and the City amendments to the manual (City of Renton 2010).

The City's drainage (surface water) management standards are focused on reducing potential impacts from new impervious surfaces, replaced impervious surface, new pervious surface, and land disturbing activity (2009 KCSWDM and City Amendment). Redevelopment and new development exceeding the thresholds specified in the 2009 KCSWDM (as amended by the City) are required to comply with the requirements set forth in the manual, including stormwater treatment and flow control BMPs. The majority of the Planned Action Study Area was developed prior to the advent of modern stormwater requirements (e.g., implementation of the 1990 *King County Surface Water Design Manual*) or under less stringent requirements.

The drainage (surface water) standards also require the use of flow-control best management practices (BMPs), where feasible. Flow-control BMPs include many low-impact development techniques such as infiltration, dispersion, rain gardens, permeable pavements, vegetative roofs, rainfall harvesting, reduction of impervious area, and retention of native vegetation. Projects should implement full dispersion or full infiltration of roof runoff where feasible. Where runoff from impervious surfaces cannot feasibly be dispersed or infiltrated, the code requires that a minimum portion of the site or impervious area be managed through these practices. Small lots of less than 22,000 square feet are required to provide either full infiltration/dispersion of stormwater, where feasible, or, where not feasible, provide flow-control BMPs for an impervious area equal to 10 percent of the site area (for lots smaller than 11,000 square feet) or 20 percent of the site area (for lots between 11,000 square feet and 22,000 square feet). For lots larger than 22,000 square feet, the total allowable impervious area exceeds 65 percent for all zoning classifications; therefore, all potential new or redevelopment projects within the study area are required to comply with the flow-control requirements for Large Lot High Impervious BMP requirements that require flow-control BMPs to manage 10 percent of the site or 20 percent of the target impervious surface, whichever is less. The flow control BMP requirement shall be applied to the project site regardless to whether a flow control facility is required. Additional flow controls may be required within the Johns Creek Basin to match peak flows under existing conditions. Areas within May Creek and Honey Creek basins are required to comply with the more stringent Flow Control Duration Standard, which the stormwater runoff release from the site requires matching forested predevelopment conditions.

Sunset Area Revised Flow Control Strategy

Redevelopment in the study area will comply with all the stormwater regulations and requirements (federal, state and City of Renton). Proposed development and redevelopment projects will provide flow control BMPs (AKA low-impact development practices) onsite as feasible, and water quality treatment onsite. The sub-regional facility and Green Connections will provide flow control mitigation for approximately 5.7 acres of effective impervious area. After flow control BMPs (as feasible and applicable) are implemented on a proposed development site within the Johns Creek Basin, any additional required flow control mitigation maybe fulfilled off-site by the City's sub-regional facility and Green Connections. To do so, project applicants will need to demonstrate that the net effective impervious area for the development or redevelopment site, constructed public infrastructure improvements and post-2011 projects for the entire Sunset area is less than or

equal to the current (2011) existing conditions. Flow control mitigation for all targeted surfaces will be required to be met on-site under the following conditions:

- Proposed projects precede construction of the public infrastructure improvements
- Connection to the downstream drainage system is not available.
- Net new effective impervious area of the proposed project plus projects constructed in the Study area after 2011 (after implementing Flow Control BMPs) exceeds 5.7 acres (or the total area mitigated by the constructed public infrastructure projects)
- Or a combination of the three conditions above.

No public infrastructure projects are proposed within the May Creek Basin and therefore individual development or redevelopment projects will be required to comply with the appropriate flow control requirements on-site.

4 Proposed Projects

As part of the Planned Action Draft EIS (City of Renton 2010b) and the Sunset Community Investment Strategy (City of Renton 2009), several stormwater projects were identified, including a sub-regional flow control facility, Green Connections using low-impact development facilities (LID), a new conveyance system, and upsizing of the existing system. These projects will provide flow control, water quality improvements, or conveyance capacity for future redevelopment.

Green Connections

Green Connections involves street improvements meeting the City of Renton Complete Street requirements. Complete Streets include features that enhance the pedestrian experience such as wider sidewalks, narrower travel lanes for vehicles, and landscaping in the form of rain garden/planters. Harrington Avenue NE, Jefferson Avenue NE, Edmonds Avenue NE, 12th Street, and two alleys were identified as potential locations for Green Connection improvements. Ten segments of Green Connections improvements were identified for potential implementation. Three segments are located on Harrington Avenue NE. Another three segments are located on NE 12th Street and Edmonds Avenue NE. One segment is on Jefferson Avenue NE. Two segments are on alleys: one is west of Jefferson Avenue NE, and the other one is west of Harrington Avenue NE. A last segment is on the sidewalk between NE 16th Street and Index Avenue. Figure 4 shows the location of the Green Connection projects.

The primary storm drainage features of the Green Connections projects consist of roadside rain gardens and permeable sidewalks. Roadside rain gardens receive stormwater runoff from the roadway and, in limited instances, from adjacent properties. The runoff is treated by flowing through the bioretention soil mix (consisting of sandy loam soils and compost) and vegetation, and then infiltrated into the native ground during smaller storms. During larger or higher-intensity storms, the stormwater runoff will continue to infiltrate as allowed by the native soil, with excess runoff stored temporarily in the soil and the active storage within the rain garden. Once the storage and infiltration capacity of the rain garden is exceeded, runoff would then overflow into the street. Where native soil infiltration capacity is limited, the rain gardens would be installed with subsurface underdrains to collect the treated water that filters through the bioretention soils. A storm drain system will be needed to convey the overflow runoff from the rain garden and to meet the City's storm drain design standard. Only the cost of the Low Impact Development improvements (e.g. rain gardens, porous sidewalks, etc.) associated with the green connections are shown in Table 2. The storm drain conveyance systems needed for street improvements are includes as part of the street improvements cost estimates included in the capital facilities plan.

Residential Access Streets

Harrington Avenue, Jefferson Avenue, NE 16th Street, and NE 9th Street are classified as Residential Access Streets in the City of Renton Compete Street Ordinance (5517). Per this

Ordinance residential access streets requires a right-of-way width of 53 feet for a two-lane road. This breaks down into 20 feet of paved roadway, 6 feet of parking on one side of the street, a 6-foot-wide sidewalk, and an 8-foot planter strip on both sides of the street.

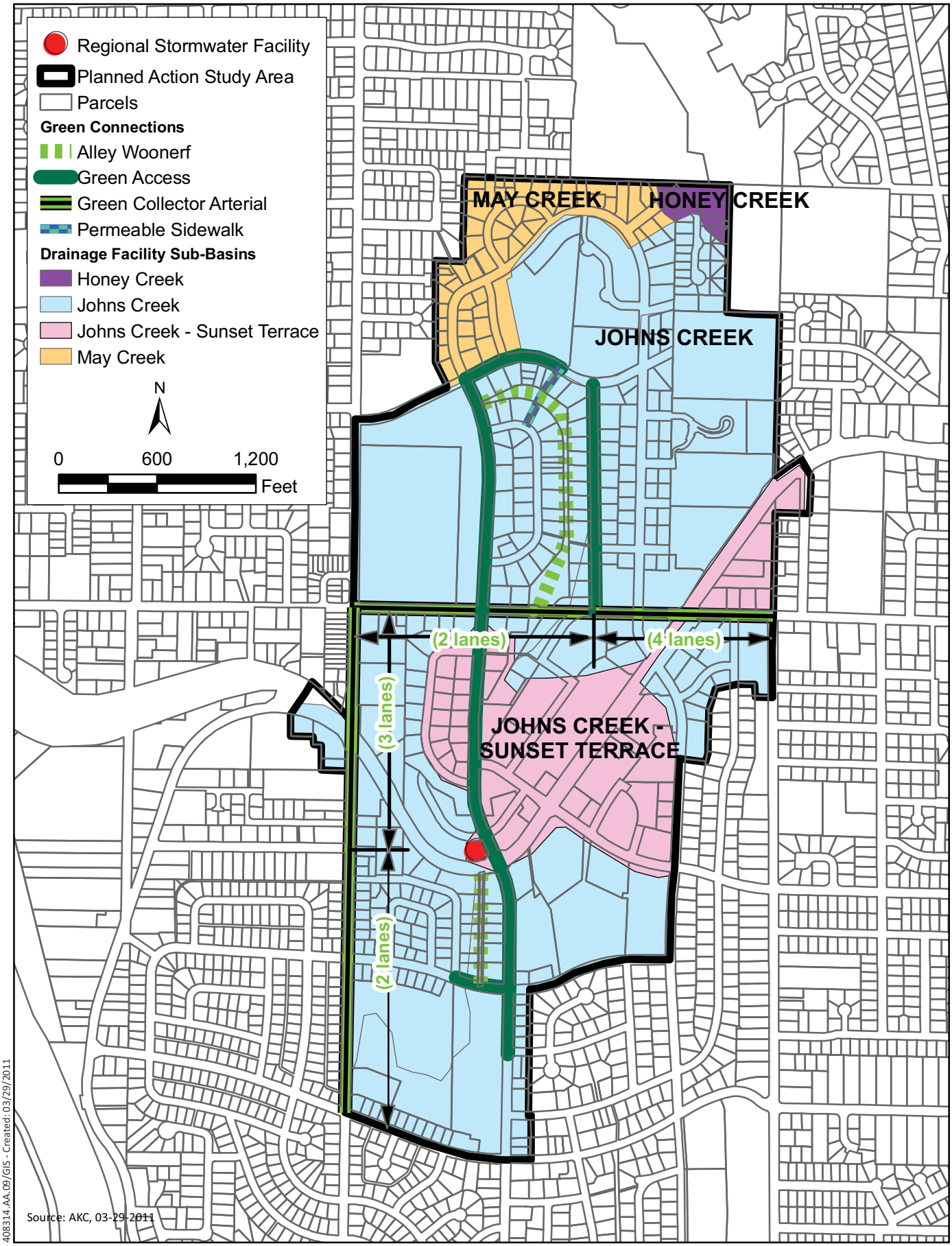

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Figure 4
Green Connections
City of Renton Sunset Area Master Drainage Plan

The existing right-of-way on these streets is 60 feet; thus there is an additional 7 feet of space that can be used for low-impact development features. The proposed Green Connection typical street section would include 20 feet of paved roadway with 6 feet of parking on one side of the street, an 8-foot sidewalk on one side of the street and a 5-foot sidewalk on the other side of the street, and a 6-foot planter and a 12-foot rain garden on one side of the street. It requires a total of 58 feet of street width. Figure 5 shows the proposed roadway section.

Harrington Avenue NE

Three segments of Green Connections are proposed in Harrington Avenue Ne. The northern segment on Harrington Avenue NE is between NE 16th Street and NE 12th Street. This Green Connection corridor would be enhanced by narrowing the through-traffic lanes to calm traffic, creating wide planter areas and wider sidewalks as shown in the City's complete street section. The 2 10 feet of vehicle travel lanes will be centered on the street right-of-way. A rain garden (12 feet wide) and the 6-foot parking with 6-foot-wide planter will be generally alternating on either side of the street. An 8-foot-wide sidewalk will be on the west side of Harrington adjacent to the McKnight Middle School and a 5-foot sidewalk on the east. At the end of the block, rain gardens will be on both sides of the street. Depending on the need for street parking, parking may be available on both sides of the street at selected locations.

The middle segment is between NE 12th Street and Sunset Boulevard. A portion of Harrington Avenue NE will be vacated, becoming an open space for Sunset Terrace, and there will be no Green Connection in this portion. The last segment is the south segment, between Sunset Boulevard and NE 8th Place, and on NE 9th Street between Harrington Avenue NE and Index Avenue NE. The street improvements for the middle and south segments would be similar to the north segment.

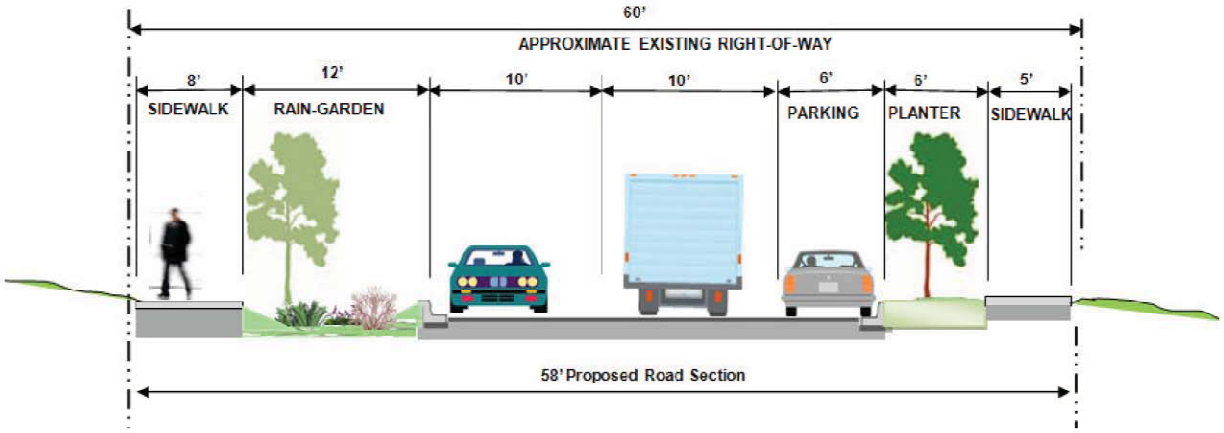
Jefferson Avenue

Jefferson Avenue NE is a residential access street, like Harrington Avenue NE. The typical 2-lane street section used on Harrington Avenue NE will be used on Jefferson Avenue NE as well. It will have two 10-foot travel lanes in the center, with the rain gardens either on alternating sides or both sides of the street.

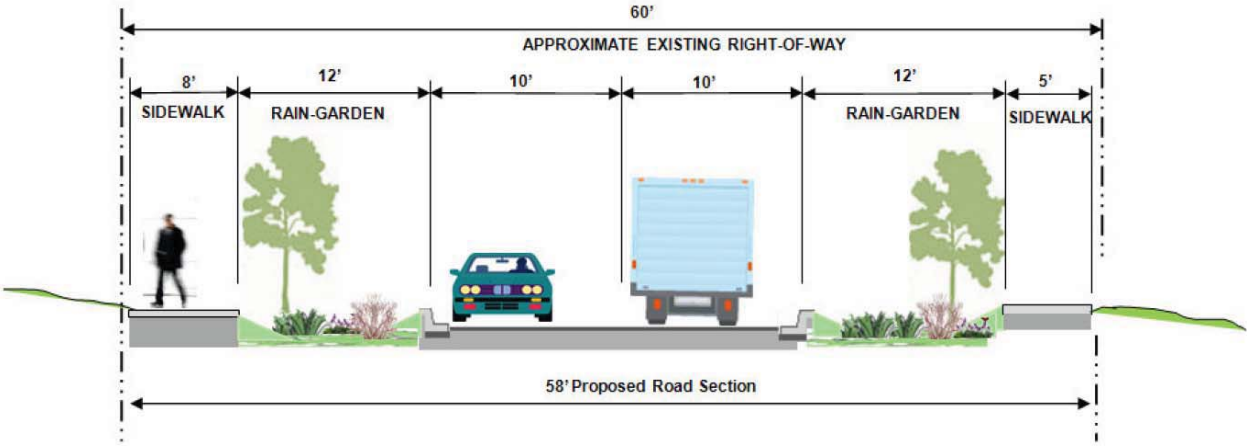
Collector Arterials

NE 12th Street and Edmonds Avenue NE is classified as collector arterial in the City of Renton Complete Street Ordinance. The required width for a collector arterial includes a 83-foot right-of-way for a two-lane road and 94foot right-of-way for a three-lane road. The street section generally requires 30 feet of paved roadway for vehicle and bicycle lanes, 8 feet of parking, and 8-foot sidewalks and 8-foot planter strips on both sides of the street. The proposed typical street section for this Green Connection would include a minimum of 30 feet for paved roadway, 8 feet of parking, an 8-foot planter strip on one side of the street, a 16-foot rain garden on the other side of the street, and 8-foot-wide sidewalks on both sides of the street. Figure 6 shows the proposed two-lane, three-lane, and four-lane roadway sections.

Section 1: Rain Garden on West Side of Street



Section 2: Rain Garden on Both Sides



Section 3: Parking on Both Sides

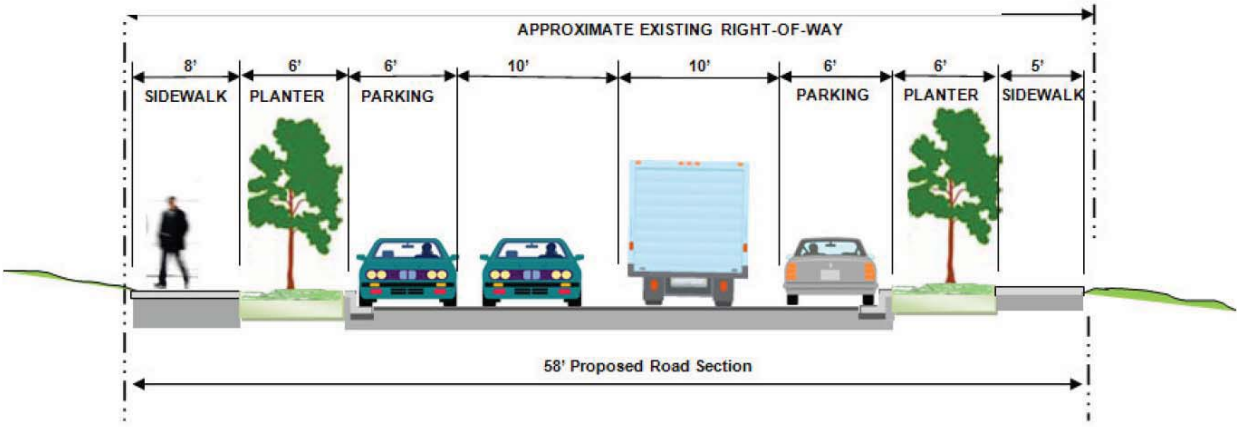
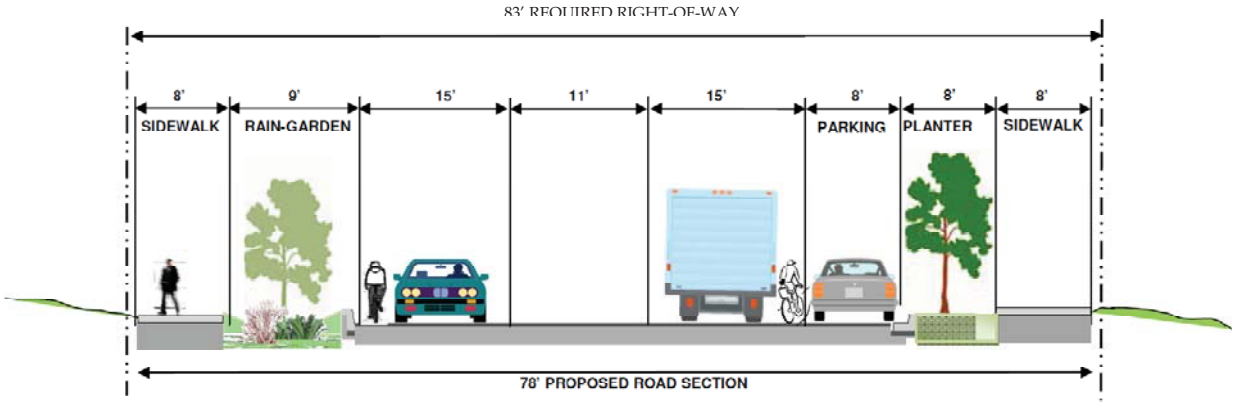
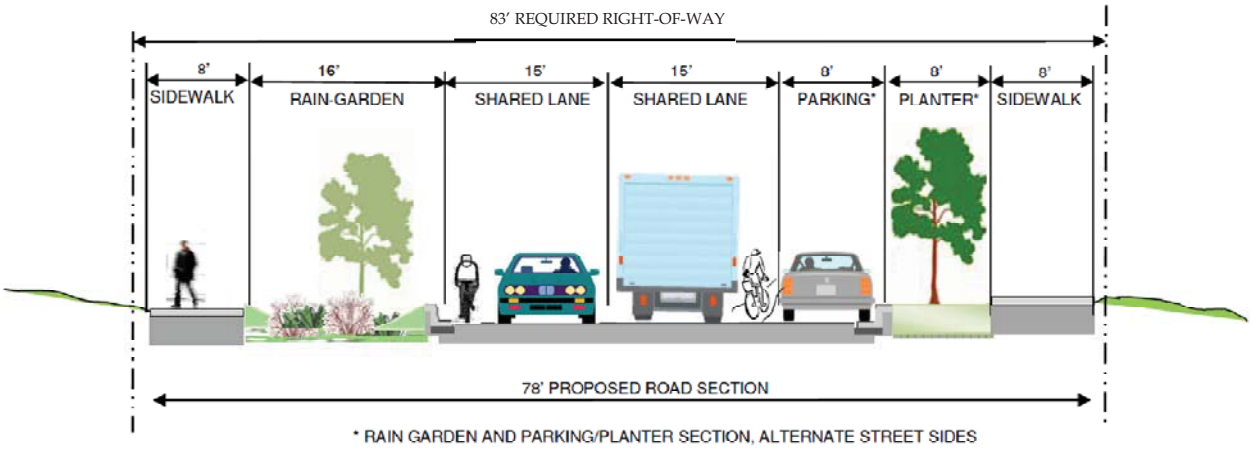


Figure 5
Harrington and Jefferson Avenue Sections

Section 1: Collector Arterial with Left Turn Lane (Edmonds Ave.)



Section 2: Collector Arterial, 2-Lane with Shared Roadway (12th St & Edmonds Ave.)



Section 3: 4-Lane Collector Arterial, No Parking (12th Street)

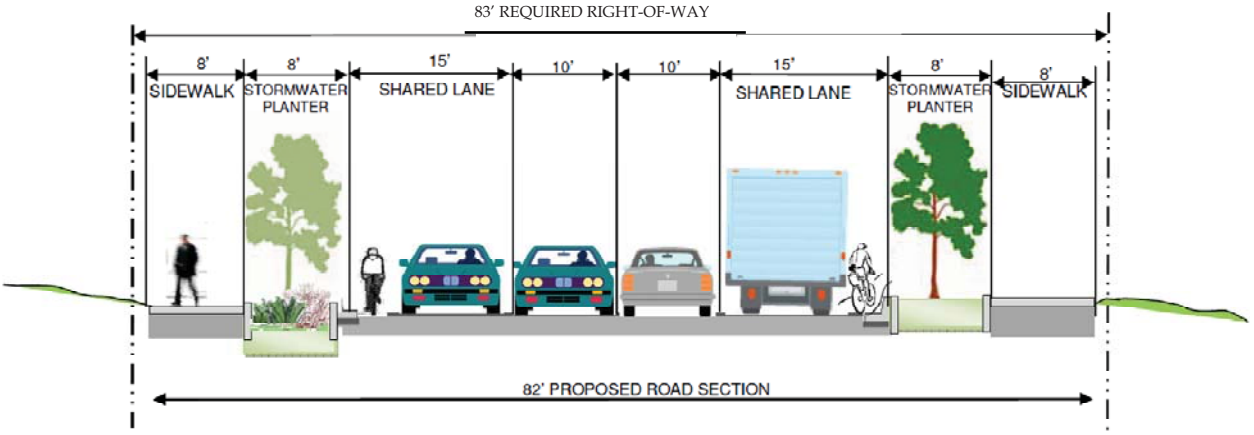


Figure 6
Edmonds and 12th Street Sections

The Green Connection on collector arterial includes Edmonds Avenue from 7th Avenue to NE 12th Street, then continues eastward on NE 12th Street to Monroe Avenue NE. Three typical sections are proposed for these two collector arterials. These sections are shown in Figure 6.

Other Green Connection Improvements

Green alleys are proposed in two locations. One is on the parcel between Jefferson Avenue and Index Avenue, north of NE 12th Street, and the other is in the alley between Harrington Avenue and Glennwood Avenue, south of Sunset Boulevard. Green alleys consist of a narrow conventional asphalt driving aisle with adjacent permeable pavement shoulders for delineating areas for pedestrians and infiltrating stormwater.

Pervious sidewalk is proposed between Index Avenue and NE 16th Street, connecting the Index Avenue neighborhood to the Hillcrest neighborhood.

Sunset Terrace Sub-Regional Facility

Sunset Terrace is located between Sunset Boulevard (SR 900), Edmonds Ave, and NE 12th Street. It is currently a multi-family and retail commercial use area. Under the Preferred Alternative in the Planned Action Final Environmental Impact Statement, the Sunset Terrace public housing community would be redeveloped into a mixed-use, mixed-income residential and commercial space with public amenities. An open space/park would be centered in this redevelopment, which has been identified as a potential location for a sub-regional stormwater facility. To maximize the open space area, most of this sub-regional facility will be underground. It is proposed to be located at the northwest corner of the open space, which allows public usage of most of the park space and allows maintenance access from NE 10th Street.

The Sunset Community Investment Strategy identified three additional potential locations for sub-regional stormwater facilities in the John's Creek Basin: at Hillcrest Terrace, on a vacant lot north of Sunset Park, and in Highland Park. Through analysis of the potential land use changes and redevelopment under the Preferred Alternative of the Planned Action Final EIS, it was determined that up to 2.6 acres of the 5.7 acres of additional effective impervious surface area could be created at full build-out conditions. It was determined that a single facility could meet the flow control needs of this new impervious area. The construction of the sub-regional facility can be part of the redevelopment and optimize the construction cost. This facility can provide flow control protection and water quality treatment in the basin in advance of the rest of the redevelopment.

A sub-regional facility will provide stormwater infiltration as practical to control the runoff volume and reduce potential pollutants. Pre-treatment will be provided prior to infiltration via rain gardens. Stormwater runoff volume that cannot be infiltrated will be detained in an underground vault and will be released matching existing flow conditions.

Soil

The soil at the proposed sub-regional facility site is at the boundary of glacial till and advance outwash soil. Further soil exploration is needed for the final design of the facility to

determine the soil properties onsite. The sub-regional facility will be sized using low infiltration rates typical of till soil conditions.

Tributary and Land Cover

The tributary area draining to this facility could be from Sunset Terrace, Sunset Boulevard from 10th Street to Monroe Avenue, Glennwood Avenue, and Sunset Lane or some private parcels along Sunset Lane. To maximize the water quality treatment benefit of pretreatment and infiltration, it is preferable to convey stormwater runoff from public roadways (e.g., Sunset Boulevard), which has the highest pollutant loading. The actual contributing area will be determined based on the redevelopment of NE 10th Street and Sunset Boulevard in the future.

Facility Design

The facility is preliminarily sized to provide flow control for the expected 2.6 acres of increase in impervious surface area related to the redevelopment. Table 1 summarizes the targeted design level for flow control for the subregional facility and Green Connections projects. The stormwater runoff from Sunset Boulevard will drain to NE 10th Street, then flow to a series of rain gardens with a total bottom area of 3,100 square feet on the north side of the proposed Sunset Terrace Park. The rain gardens would provide pretreatment for the water flowing through the bioretention soil and vegetation. Perforated drains pipes beneath the rain garden would collect treated runoff and distribute the water to an infiltration gallery south of the rain garden. It would have a bottom area of 12,500 square feet to increase the available area for infiltration into the native soil. Flows that exceed the infiltration capacity of the rain garden and infiltration gallery would overflow into a conventional storm drain system, and into an underground detention vault west of the infiltration gallery. The detention vault is preliminarily sized to have an active storage volume of 0.38 acre-feet. The vault would control the release rate of the water, matching the peak flow rate for the existing conditions. Figure 7 shows the conceptual layout of the sub-regional facility and Appendix A shows the summary of analysis of the expected new effective impervious area. Appendix D1 summarizes the preliminary sizing calculations using the Western Washington Hydrology Model (WWHM v. 3.0).

Upon further investigation of the native soil infiltration capacity, design modifications could include either increasing the size of the detention vault and eliminating the infiltration gallery (if infiltration is largely infeasible) or decreasing the size of the detention vault (if the infiltration rate is greater than the preliminary sizing assumption of 0.25 inch/hour).

The intent of the subsurface infiltration gallery is to preserve open space for active space and recreation. The rain garden is proposed to be located in the northwest corner of the open space to provide a landscaped buffer between the open space and the street. Figure 7 shows the conceptual layout of the facility. The stormwater runoff could be conveyed from storm drains on Sunset Lane or S 10th Street. The discharge from the detention vault will connect to an existing storm drain on Sunset Boulevard at Harrington Avenue S by a new storm drain under the vacated Harrington Avenue.

TABLE 1
Targeted Level of Flow Control Mitigation by Public Infrastructure Projects

	Title	Targeted Flow Reduction of Flow Control BMPs or Facility	Net Effective Impervious Area Reduction (ac)
1	Sunset Terrace Regional Facility	100%	2.6
2	Harrington Avenue NE Green Connection	30%	0.6
3	Jefferson Avenue NE Green Connection	30%	0.5
4	Alley Green Connections (Harrington, Jefferson Alleys)	50%	0.5
5	Collector Arterial Green Connection (Edmonds Avenue NE and NE 12th Street)	20%	1.5
	Total		**5.7**

Note: Net effective impervious area reduction includes new/reduced impervious area to construct proposed section (e.g., new sidewalks) and effective performance of flow control BMPs within the Green Connection project.

Conveyance Improvements

The future development is expected to increase effective impervious surface area. A schematic storm drain network model was developed to estimate the design peak flow for planning purposes. This model uses Santa Barbara Unit Hydrograph methodology with Type 1A storm rainfall distribution using StormShed2G computing software. Seven conveyance system improvements are proposed. The conveyance improvements are shown in Figure 8 and are classified based on the condition of the existing storm drain system and the concurrence with other transportation improvements below. The peak flow rate summary of the sub-tributary area is included in Appendix B. Conveyance capacity calculations using SBUH methodology in the StormShed™ hydraulic model are provided in Appendix D2.

New Storm Drains with Green Connections

Harrington Avenue NE and Jefferson Avenue NE currently do not have a storm drain system. With the street improvements for the proposed Green Connections, a new storm drain will be required. The conveyance system improvements in Harrington Avenue NE are separated to match the same segments for the Green Connection street improvements. It is assumed that the storm drain conveyance improvements needed with the street improvements would occur concurrently with the proposed Green Connections improvements to decrease costs.

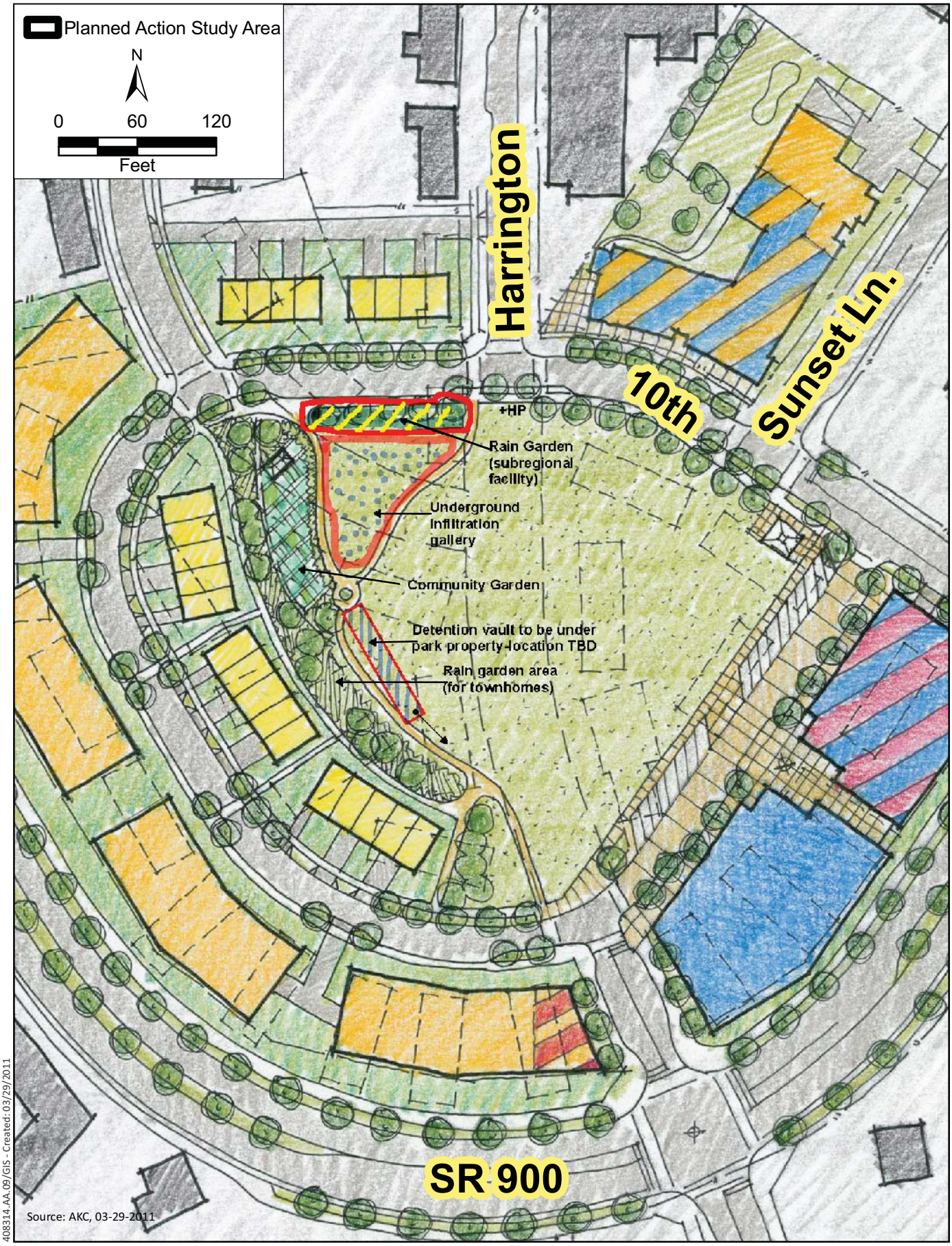


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Figure 7
Sub-Regional Flow Control Facility
City of Renton Sunset Area Master Drainage Plan

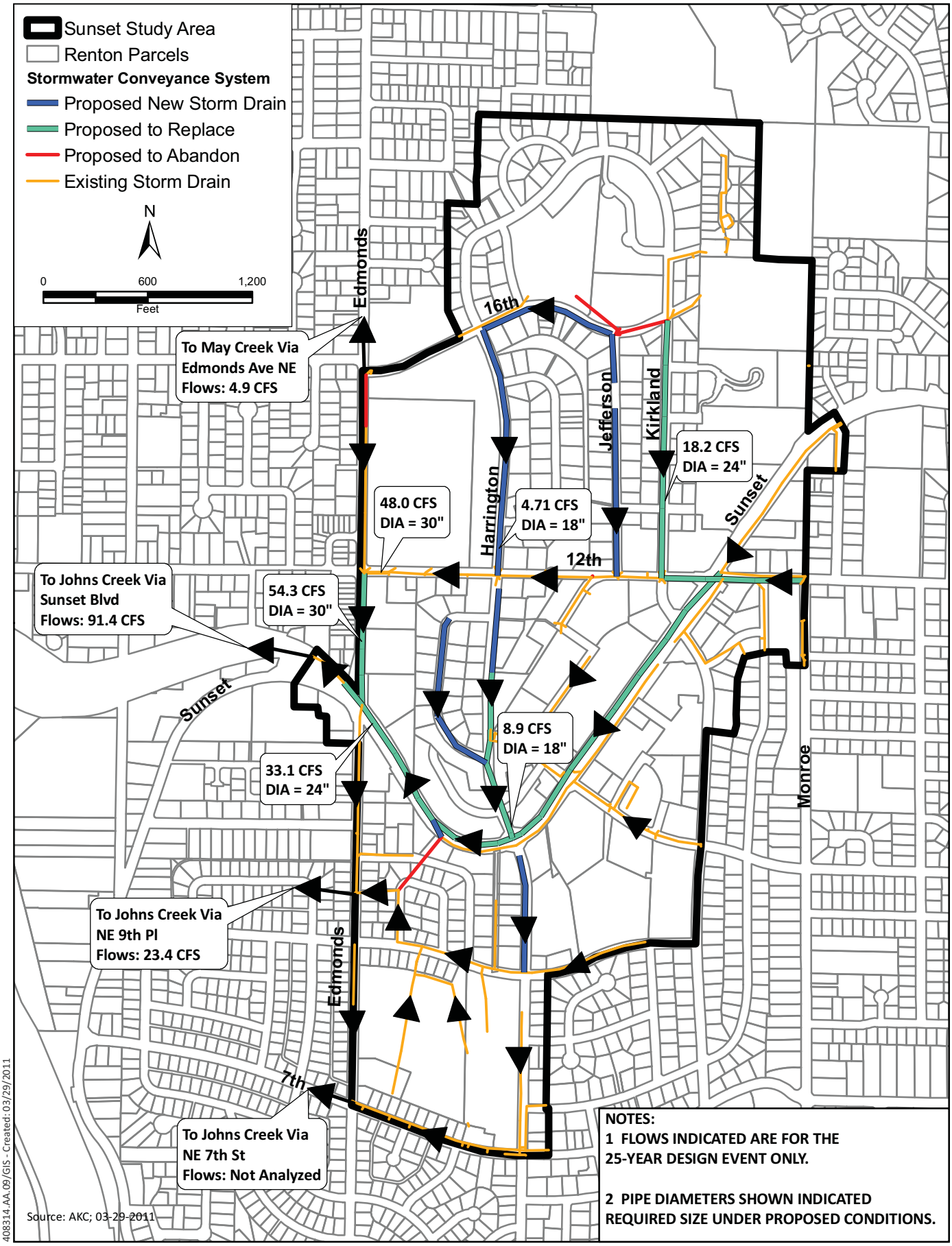

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Figure 8
STORMWATER DRAINAGE CONVEYANCE SYSTEM
City of Renton Sunset Area Master Drainage Plan

Replace Storm Drains with Green Connections

The Edmonds Avenue NE and NE 12th Street storm drain systems are undersized for both existing and future redevelopment conditions. The proposed conveyance system improvements are separated to match the segments for Green Connections. It is assumed that these storm drain conveyance improvements needed for the street improvements would occur concurrently with the proposed the Green Connections improvements to decrease costs.

Replace Existing Storm Drain without Street Improvement

The existing storm drain system of Kirkland Avenue NE is undersized for existing and future development conditions. No Green Connections or street improvements are proposed for Kirkland Avenue NE, and therefore these improvements are assumed to occur independently.

New Storm Drain without Street Improvement

Glennwood Avenue NE currently has no conveyance system and will require a new storm drain system to serve as a connection for future redeveloped properties. No Green Connections or street improvements are proposed for Glenwood Avenue NE, and therefore these improvements are assumed to occur independently.

Replace Existing Storm Drain with Street Improvement

Sunset Boulevard is a major east-west arterial connecting the Sunset Terrace neighborhood, the Renton Highland area, and Interstate I-405. As part of redevelopment plan for Sunset Terrace, improvements on Sunset Boulevard are proposed to provide the Complete Street section requirements, including bicycle lanes, planter strips, and sidewalks.

The current GIS map shows that a portion of the eastbound Sunset Boulevard storm drain system will leave the street right-of-way and go underneath several private properties near NE 9th Street and Ferndale Circle NE. Then this system will continue west under NE 9th Place down to the valley. With the improvements on Sunset Boulevard, it is preferable to reroute these conveyance system back and remain along the Sunset Boulevard. A field investigation is needed to confirm the location and routing of this storm drain. Further analysis is needed to verify the capacity of the storm drain downstream of the study area.

City of Renton staff has indicated that the storm drain system at NE 9th Place may have capacity issues further downstream. Further engineering analysis is needed to determine whether to continue to route the stormwater runoff from Sunset Boulevard to this storm drain system.

5 Project Implementation

Consistent with existing and proposed goals and policies, two priority levels for surface water improvements have been identified in order to prioritize projects presented in this plan. Conceptual project solutions were developed for other problems based on the Sunset Community Investment Strategy (City of Renton 2009) and other information provided by the City. The development of a conceptual project solution began with a review of the study area to determine if property is available for a detention facility and the need to upsize the existing pipe systems or the need to add a new pipe system where there is no existing system. Pipe capacity was analyzed with a schematic hydrological and hydraulic model using Santa Barber Unit Hydrograph method and hydraulic grade line analysis.

Project implementation requires future engineering analysis, soil exploration, and engineering design to confirm all assumptions and design information. For the conveyance system, the design will provide protection at the level of a 25-year storm. The flow control facilities will maximize infiltration where feasible and control release rates to match the 2-, 10-, and 100-year runoff rates for existing pre-development conditions.

Table 2 and Table 3 show the projects that are categorized for priority level 1 and level 2. The implementation of each project depends on the availability of City funding, the possible developer contribution, and the pace and scale of redevelopment happening in this area in the future.

TABLE 2
Priority Level 1 Projects and Costs

	Title	Description	Opinion of Cost
1	Sunset Terrace Regional Facility	Sunset Terrace Regional Facilities including bioretention swale, infiltration gallery, and detention vault	$722,700.00
2a[a]	Harrington Avenue NE Green Connection - Segment 1	Segment 1 from16th Street to 12th Street. Construct rain gardens on the sides of the street.	$602,250.00
2b[a]	Harrington Avenue NE Green Connection - Segment 2	Segment 2 from NE 12th Street to NE 10th Street. Construct rain gardens on the sides of the street.	$328,500.00
2c[a]	Harrington Avenue NE Green Connection - Segment 3	Segment 3 from Sunset Blvd. to NE 9th Street. Construct rain garden on the sides of the street.	$459,900.00
Total			**$2,113,350.00**

Note: The cost represents the construction cost in March 2011dollars.
[a] Cost only includes the low impact development features; the storm drain conveyance cost is part of the street improvements.

TABLE 3
Priority Level 2 Projects and Costs

	Title	Description	Opinion of Cost
3	Glennwood Avenue NE Storm Drainage Conveyance Improvements	Construct new storm drainage pipes.	$328,500.00
4[a]	NE 12th Street Green Connection	From Jefferson Avenue NE to Edmunds Avenue NE. Construct rain garden on the sides of the street.	$646,050.00
5a[a]	Edmunds Avenue NE Green Connection	From NE 12th Street to NE 10th Place. Construct rain garden on the sides of the Street.	$372,300.00
5b[a]	Edmunds Avenue NE Green Connection	From NE 10th Place to NE 6th Place. Construct rain garden on the sides of the Street.	$755,550.00
6	Kirkland Avenue NE Storm Drainage Conveyance Improvements	Upsize existing storm drainage pipes	$602,250.00
7	Jefferson Avenue NE Green Connection	From NE 16th Street to NE 12th Street. Construct rain garden on the sides of the Street.	$328,250.00
Total			**$3,032,900.00**

Note: The cost represents the construction cost in March 2011dollars.
[a] Cost only include the low impact development features; the storm drain conveyance cost is part of the street improvements.

Project Planning Cost Estimate

A conceptual estimate of construction cost has been prepared for these new projects. These costs are shown in Table 1 for Priority Level 1and Table 2 for Priority Level 2. The cost tables in this chapter present the construction cost estimates in March 2011 dollars. The cost for the Green Connection is only included the LID features. The cost for the conveyance system is part of the roadway improvement cost, when one is proposed. However, if street improvements are not proposed, the new or replaced conveyance cost would be included in the estimates. The cost estimates do not include design engineering and construction plans development, the purchase of right-of-way or construction easement, City administration, and construction management. The breakdown of the summary of cost is included in Appendix C.

These improvements would be needed within the 2011-2030 time frame. The project costs and funding sources for these projects are identified in the Sunset Area Community Capital Facilities Plan found within the City's Capital Facilities Element.Funding for the surface water master plan improvements will come through a variety of sources and means. Public funding will be sought through grant programs, dedication of funds through City Council or partial funding through available utility fees. Where public funding cannot be secured, the remaining funding will be provided by future development through a combination of

frontage improvements and fee assessments under various structures depending on applicable city codes, implementation schedule and rate of redevelopment such as collection of impact fees, fee in lieu of mitigation and special assessment districts.

6 References

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Appendix A – Summary of Expected New Effective Impervious Surface Area

Table A-1. Existing Land Cover Summary

	Total Area (acres)	Total Impervious Area (acres)	Total Pervious Area (acres)	Total PGIS[a] (acres)	Total Untreated PGIS[a] (acres)	Effective Impervious
Planned Action Study Area	255.82	161.17	94.65	92.86	88.10	161.17
Potential Sunset Terrace Redevelopment Subarea[b]	12.64	4.73	7.91	1.83	1.83	4.73
Total	268.46	165.90	102.56	94.69	89.93	165.90

[a]PGIS = pollution-generating impervious area

[b]The Sunset Terrace Redevelopment Subarea is slightly smaller than the subarea in the DEIS due to the adjusted boundary at Sunset Boulevard and Harrington Ave.

Table A-2. Land Cover Summary—Preferred Alternative

	Total Area (acres)	Total Impervious Area (acres)	Total Pervious Area (acres)	Total PGIS (acres)	Total Untreated PGIS (acres)	Effective Impervious (acres)
Planned Action Study Area	255.82	174.40	81.42	76.44	46.26	165.41
Potential Sunset Terrace Redevelopment Subarea[a]	12.64	6.1	6.54	1.7	0	3.66
Total	268.46	180.50	87.96	78.14	46.26	169.07

Table A-3. Change in Land Cover Summary—Preferred Alternative

Project Area	Net Change in Impervious Area (acres)	Net Change in PGIS Area (acres)	Net Change in Untreated PGIS (acres)	Net Change in Effective Impervious Area (acres)[a]
Planned Action Study Area	13.23 (8.2%)	-16.41 (-17.7%)	-41.84 (-47.5%)	4.24 (2.6%)[b]
Potential Sunset Terrace Redevelopment Subarea	1.37 (29.0%)	-0.13 (-7.1%)	-1.83 (-100%)	-1.07 (-22.6%)[b]
Total	14.60 (16.2%)	-16.54 (-18.4%)	-43.67 (-48.6%)	3.17 (1.9%)

Note: All areas are expressed relative to existing conditions. See Section 3.3 of the Draft Environmental Impact Statement (Table 3.3-1) for a summary of existing conditions.

[a] Impervious area not directly connected to a stream or drainage system.

[b] The net change in effective impervious area within the Johns Creek Basin, excluding mitigation through regional detention, is equal to 2.63 acres. Within the May Creek Basin, the net change is equal to 0.54 acre.

Appendix B – Summary of Peak Flow Rates for the Study Area

Table B-1. The Existing Conditions Area Breakdown for the Sub-Tributary Area

Sub-Basin Area	Existing Condition							
	Impervious				Pervious Lawn			
	Road (ac)	Roof[a] (outwash) (ac)	Roof (till) (ac)	Total Impervious (ac)	Outwash (ac)	Till (ac)	Forest (ac)	Total Area (ac)
1	6.4	7.31	16.95	**30.66**	6.63	6.39	0.80	**44.48**
2	5.5	2.46	-	**7.96**	1.96	-	-	**9.92**
3	1.91	0.34	0.65	**2.90**	6.51	12.31	-	**21.72**
4	4.92	2.12	4.25	**11.29**	2.88	4.25	-	**18.42**
5	0.92	0	1.71	**2.63**	5.41	1.25	-	**9.29**
6	3.77	0	11.67	**15.44**	-	4.46	-	**19.90**
7	2.47	0	9.22	**11.69**	-	5.21	-	**16.90**
9	8.79	0	17.88	**26.67**	0.02	6.03	-	**32.72**
10	1.39	14.58	14.04	**30.01**	19.77	2.91	-	**52.69**
11	5.58	4.78	0.92	**11.28**	1.37	0.55	-	**13.20**
12	2.15	10.83	0.39	**13.37**	4.66	-	-	**18.03**
13	12.30	-	4.3	**16.60**				**16.60**
Total	**56.10**	**42.42**	**81.98**	**180.50**	**49.21**	**43.34**	**0.80**	**273.85**

a. The roof runoff is modeled as hydrological soil group B grass to estimate potential low range under existing conditions reflecting potential rooftop disconnection.

Table B-2. The Proposed Conditions Area Breakdown for the Sub-Tributary Area

Sub-Basin Area	Preferred Proposed Condition							
	Impervious				Pervious Lawn			
	Road	Roof (outwash)	Roof (till)	Total Impervious	HSGB	HSGC	Forest	Total Area
	(ac)	(ac)	(ac)	(ac)	(ac)	(ac)	(ac)	(ac)
1	6.40	7.85	17.36	**31.61**	6.09	5.98	0.80	**44.48**
2	5.50	2.74	-	**8.24**	1.67	-	-	**9.91**
3	1.91	0.34	0.65	**2.90**	6.51	12.305	-	**21.72**
4	4.92	2.86	5.1	**12.88**	2.14	3.4	-	**18.42**
5	0.92	3.55	2.37	**6.84**	1.86	0.59	-	**9.29**
6	3.77	0.00	13.9	**17.67**	-	2.23	-	**19.90**
7	2.47	0.00	9.45	**11.92**	-	4.98	-	**16.90**
9	8.79	0.00	18.24	**27.03**	0.02	5.67	-	**32.72**
10.0	1.39	15.4	13.7	**30.4**	18.99	3.26	-	**52.69**
11	5.58	5.52	1.31	**12.41**	0.63	0.16	-	**13.20**
12	2.14	13.17	0.37	**15.68**	2.32	0.03	-	**18.03**
13	12.30	-	4.3	**16.60**				**16.60**
Total	**56.09**	**51.39**	**86.74**	**194.22**	**40.23**	**38.60**	**0.80**	**273.85**

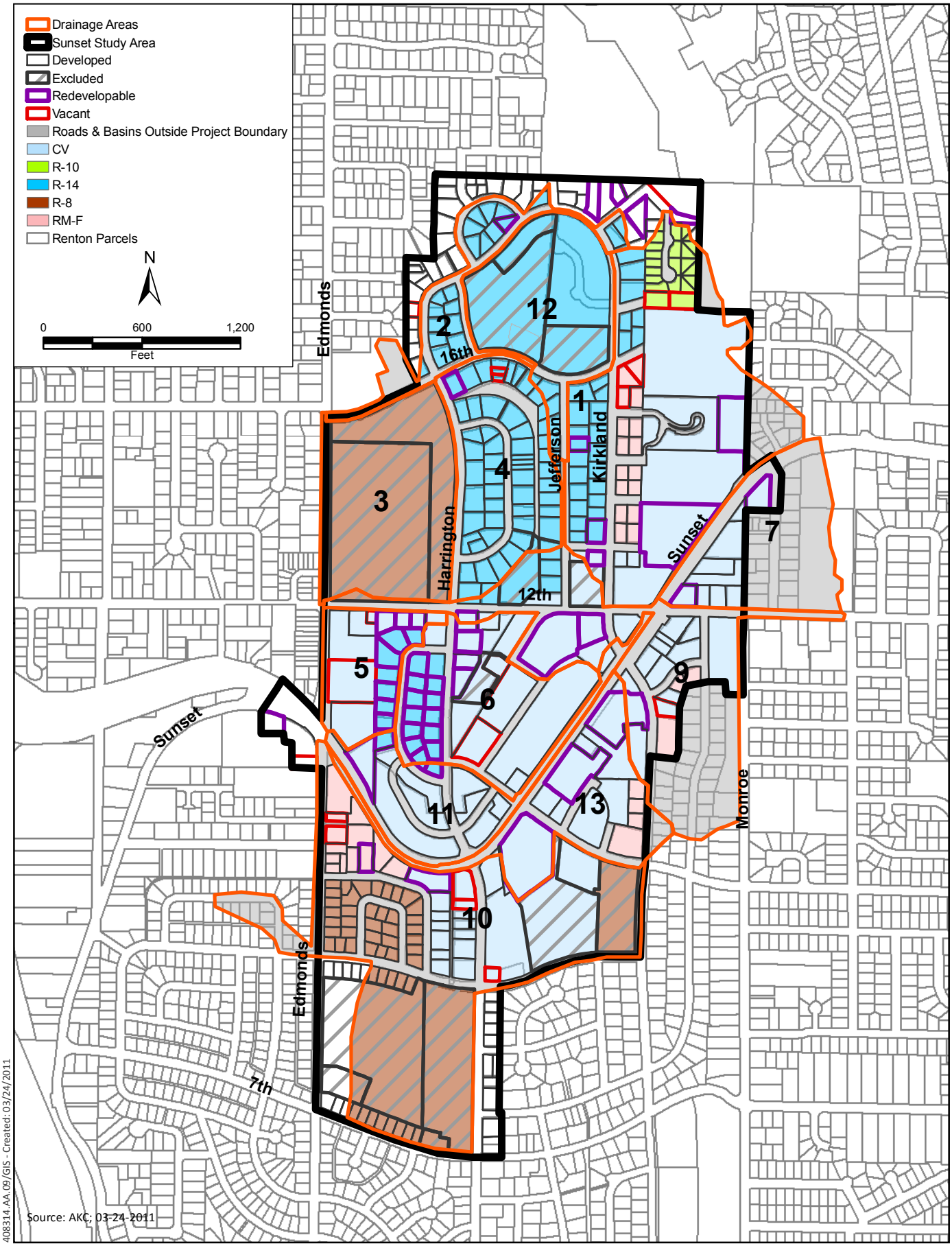

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Figure 01
STORMWATER DRAINAGE BASINS
City of Renton Sunset Area Master Drainage Plan

The stormwater runoff peak flow rate is calculated using Santa Barbara Unit Hydrograph (SBUH) (TR55) methodology and it was computed by the Stormshed2G program.

Table B-3. Existing Conditions Stormwater Runoff Peak Flow Rate

Sub-Basin Area	Stormwater Runoff Peak Flow Rate Design Event (SBUH)			
	2-year	10-year	25-year	100-year
1	8.4	14.7	18.1	21.5
2	2.3	4.0	4.9	5.9
3	2.2	4.9	6.4	7.9
4	3.1	5.5	6.8	8.1
5	1.5	3.1	3.9	4.8
6	4.4	7.1	8.5	9.9
7	4.2	6.9	8.3	9.7
9	9.5	15.2	18.1	21.0
10	14.0	24.2	29.6	35.1
11	2.4	4.3	5.3	6.4
12	4.1	6.7	8.1	9.4
13	6.0	9.3	10.9	12.5

Table B-4. Proposed Conditions Stormwater Runoff Peak Flow Rate

Sub-Basin Area	Stormwater Runoff Peak Flow Rate Design Event (SBUH)			
	2-year	10-year	25-year	100-year
1	10.4	17.2	20.7	24.2
2	3.2	5.1	6.0	7.0
3	2.3	5.0	6.5	8.0
4	3.8	6.4	7.7	9.0
5	2.8	4.6	5.6	6.5
6	4.8	7.5	8.9	10.3
7	4.2	6.9	8.3	9.7
9	9.6	15.3	18.2	21.1
10	14.2	24.4	29.9	35.4
11	3.9	6.1	7.2	8.3
12	4.7	7.4	8.8	10.2
13	6.0	9.3	10.9	12.5

Appendix C – Opinion of Cost

RENTON SUNSET PLAN ACTION EIS PROJECT **DATE: 3/9/2011**
REGIONAL FACILITIES **PROJECT NO.: 408314**
ORDER OF MAGNITUDE ESTIMATE

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
Bioretention Swale (vegetated)				
Excavation & Waste	1,421	CY	$20.00	$28,420
Compost	350	CY	$30.00	$10,500
Seeding	654	SY	$3.76	$2,458
Misc. Detail Allowance	1	LS	$4,137.80	$4,138
Bioretention Swale Subtotal				**$45,516**
Infiltration Gallery				
Excavation	3,100	CY	$10.00	$31,000
Waste	694	CY	$10.00	$6,940
Native Backfill	2,406	CY	$15.00	$36,090
Drain Rock	694	CY	$30.00	$20,820
Seeding	1,390	SY	$3.76	$5,221
Geotextile (wrap around drain rock x2)	2,780	SY	$2.00	$5,560
6" Perforated Pipe, 4' O.C. (32 ea at 100')	3,200	LF	$3.00	$9,600
Cleanout (32 ea, per 6" pipe)	32	EA	$200.00	$6,400
Birdcage Overflow Structure (CB Type 2)	1	EA	$1,000.00	$1,000
Misc. Detail Allowance	1	LS	$12,263.07	$12,263
Infiltration Vault Subtotal				**$134,894**
Detention Vault				
Detention Vault (135'x20'x7.5')	1	EA	$180,000.00	$180,000
Excavation	1,775	CY	$10.00	$17,750
Waste (Vault Size, 135'x20'x7.5')	750	CY	$10.00	$7,500
Native Backfill	1,025	CY	$15.00	$15,375
Seeding	690	CY	$3.76	$2,592
CSBC (6" layer)	74	CY	$35.00	$2,590
Detention Vault ManHole Access	3	EA	$1,000.00	$3,000
Flow Control Structure, at south end of Det. Vault	1	EA	$3,000.00	$3,000
12" CPEP Storm Drain	420	LF	$49.69	$20,868
Manhole	1	EA	$2,000.00	$2,000
Manhole (Tie into Existing SD)	1	EA	$2,500.00	$2,500
Misc. Detail Allowance	1	LS	$25,717.45	$25,717
Detention Vault Subtotal				**$282,892**
SUBTOTAL				**$463,302**
MOBILIZATION, BONDS, INSURANCE, TEMP. FACILITIES, DEMOB, ETC	**10.0%**			**$46,330**
SUBTOTAL				**$509,632**
CONTINGENCY	**30.0%**			**$152,890**
CONSTRUCTION TOTAL (ROUNDED)				**$660,000**
SALES TAX	**9.5%**			**$62,700**
CONSTRUCTION TOTAL (ROUNDED)				**$722,700**
Low range	**-30.0%**			**$510,000**
High Range	**50.0%**			**$1,080,000**

NOTE: The above cost opinion is in March 2011 dollars and does not include future escalation, financial or O&M costs.
The cost opinion shown has been prepared for guidance in project evaluation from the information available at the time of preparation. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final schedule and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

project scope, final schedule and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

RENTON SUNSET PLAN ACTION EIS PROJECT **DATE: 3/9/2011**
HARRINGTON AVE GREEN CONNECTION **PROJECT NO.: 408314**
ORDER OF MAGNITUDE ESTIMATE

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
HARRINGTON GREEN CONNECTION TOTAL LENGTH	**1,791**	**LF**		
From 16th Street to 12th Street				
Section 1: Rain Garden on West Side of Harrington	**1,279**	**LF**		
12-ft Rain Garden Strip	15,348	SF	$18.86	$289,446
Section 1 Subtotal				**$289,446**
Section 2: Rain Garden Both Sides	**205**	**LF**		
12-ft Rain Garden Strip (x2)	4,920	SF	$18.86	$92,786
Section 2 Subtotal				**$92,786**
SUBTOTAL				**$382,231**
MOBILIZATION, BONDS, INSURANCE, TEMP. FACILITIES, DEMOB, ETC	**10.0%**			**$38,223**
SUBTOTAL				**$420,454**
CONTINGENCY	**30.0%**			**$126,136**
CONSTRUCTION TOTAL (ROUNDED)				**$550,000**
SALES TAX	**9.5%**			**$52,250**
CONSTRUCTION TOTAL (ROUNDED)				**$602,250**
Low range	**-30.0%**			**$420,000**
High Range	**50.0%**			**$900,000**

NOTE: The above cost opinion is in March 2011 dollars and does not include future escalation, financial or O&M costs.
The cost opinion shown has been prepared for guidance in project evaluation from the information available at the time of preparation. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final schedule and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

RENTON SUNSET PLAN ACTION EIS PROJECT **DATE: 3/9/2011**
HARRINGTON AVE GREEN CONNECTION **PROJECT NO.: 408314**
ORDER OF MAGNITUDE ESTIMATE

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
HARRINGTON GREEN CONNECTION TOTAL LENGTH	**980**	**LF**		
From 12th Street to10th Street				
Section 1: Rain Garden on West Side of Harrington	**700**	**LF**		
12-ft Rain Garden Strip	8,400	SF	$18.86	$158,414
Section 1 Subtotal				**$158,414**
Section 2: Rain Garden Both Sides	**112**	**LF**		
12-ft Rain Garden Strip (x2)	2,688	SF	$18.86	$50,696
Section 2 Subtotal				**$50,696**
Section 3 Subtotal				**$0**
SUBTOTAL				**$209,110**
MOBILIZATION, BONDS, INSURANCE, TEMP. FACILITIES, DEMOB, ETC	**10.0%**			**$20,911**
SUBTOTAL				**$230,021**
CONTINGENCY	**30.0%**			**$69,006**
CONSTRUCTION TOTAL (ROUNDED)				**$300,000**
SALES TAX	**9.5%**			**$28,500**
CONSTRUCTION TOTAL (ROUNDED)				**$328,500**
Low range	**-30.0%**			**$230,000**
High Range	**50.0%**			**$490,000**

NOTE: The above cost opinion is in March 2011 dollars and does not include future escalation, financial or O&M costs.
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RENTON SUNSET PLAN ACTION EIS PROJECT **DATE: 3/9/2011**
HARRINGTON AVE GREEN CONNECTION **PROJECT NO.: 408314**
ORDER OF MAGNITUDE ESTIMATE

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
HARRINGTON GREEN CONNECTION TOTAL LENGTH	**1,371**	**LF**		
From Sunset Blvd to 9th Street				
Section 1: Rain Garden on West Side of Harrington	**979**	**LF**		
12-ft Rain Garden Strip	11,748	SF	$18.86	$221,554
Section 1 Subtotal				**$221,554**
Section 2: Rain Garden Both Sides	**157**	**LF**		
12-ft Rain Garden Strip (x2)	3,768	SF	$18.86	$71,060
Section 2 Subtotal				**$71,060**
SUBTOTAL				**$292,614**
MOBILIZATION, BONDS, INSURANCE, TEMP. FACILITIES, DEMOB, ETC	**10.0%**			**$29,261**
SUBTOTAL				**$321,875**
CONTINGENCY	**30.0%**			**$96,563**
CONSTRUCTION TOTAL (ROUNDED)				**$420,000**
SALES TAX	**9.5%**			**$39,900**
CONSTRUCTION TOTAL (ROUNDED)				**$459,900**
Low range	**-30.0%**			**$320,000**
High Range	**50.0%**			**$690,000**

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RENTON SUNSET PLAN ACTION EIS PROJECT
GLENNWOOD AVE STORM DRAIN
ORDER OF MAGNITUDE ESTIMATE

DATE: 3/9/2011
PROJECT NO.: 408314
ESTIMATE BY: D Hedglin
REVIEW BY:

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
GLENNWOOD AVENUE 16TH ST TO 12TH ST	**1,000**	**LF**		
Remove Curb, Gutter & Sidewalk	1,000	LF	$15.00	$15,000
Replace Curb, Gutter & Sidewalk	1,000	LF	$40.00	$40,000
2-in ACP Overlay	3,333	SY	$9.95	$33,167
12-in CPEP Storm Drain (1 total)	1,000	LF	$81.07	$81,074
12-in CPEP Storm Drain Lateral	150	LF	$81.07	$12,161
Catch Basins (at 200-ft intervals both sides)	10	EA	$800.00	$8,000
Misc. Detail Allowance	1	LS	$18,940.23	$18,940
Subtotal 1				**$208,343**
SUBTOTAL				**$208,343**
MOBILIZATION, BONDS, INSURANCE, TEMP. FACILITIES, DEMOB, ETC	**10.0%**			**$20,834**
SUBTOTAL				**$229,177**
CONTINGENCY	**30.0%**			**$68,753**
CONSTRUCTION TOTAL (ROUNDED)				**$300,000**
SALES TAX	**9.5%**			**$28,500**
CONSTRUCTION TOTAL (ROUNDED)				**$328,500**
Low range	**-30.0%**			**$230,000**
High Range	**50.0%**			**$490,000**

NOTE: The above cost opinion is in March 2011 dollars and does not include future escalation, financial or O&M costs.
The cost opinion shown has been prepared for guidance in project evaluation from the information available at the time of preparation. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final schedule and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

RENTON SUNSET PLAN ACTION EIS PROJECT **DATE: 3/9/2011**
12TH STREET GREEN CONNECTION **PROJECT NO.: 408314**
ORDER OF MAGNITUDE ESTIMATE

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
12TH STREET SEG. 2 TOTAL LENGTH	**1,370**	**LF**		
2 Lanes Section, Jefferson - Harrington	**620**	**LF**		
16-ft Rain Garden Strip	9,920	SF	$18.86	$187,080
Subtotal 1				**$187,080**
2 Lanes Section, Harrington - Edmonds	**750**	**LF**		
16-ft Rain Garden Strip	12,000	SF	$18.86	$226,306
Subtotal 2				**$226,306**
SUBTOTAL				**$413,386**
MOBILIZATION, BONDS, INSURANCE, TEMP. FACILITIES, DEMOB, ETC	**10.0%**			**$41,339**
SUBTOTAL				**$454,725**
CONTINGENCY	**30.0%**			**$136,417**
CONSTRUCTION TOTAL (ROUNDED)				**$590,000**
SALES TAX	**9.5%**			**$56,050**
CONSTRUCTION TOTAL (ROUNDED)				**$646,050**
Low range	**-30.0%**			**$450,000**
High Range	**50.0%**			**$970,000**

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RENTON SUNSET PLAN ACTION EIS PROJECT **DATE: 3/9/2011**
EDMONDS AVE GREEN CONNECTION **PROJECT NO.: 408314**
ORDER OF MAGNITUDE ESTIMATE

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
EDMONDS SEG. 3 TOTAL LENGTH	**1,400**	**LF**		
3 Lanes Section, 12th - Sunset Blvd	**850**	**LF**		
9-ft Rain Garden Strip	7,650	SF	$18.86	$144,270
Subtotal 1				**$144,270**
3 Lanes Section, Sunset Blvd - 10th pl	**550**	**LF**		
9-ft Rain Garden Strip	4,950	SF	$18.86	$93,351
Subtotal 2				**$93,351**
SUBTOTAL				**$237,622**
MOBILIZATION, BONDS, INSURANCE, TEMP. FACILITIES, DEMOB, ETC	**10.0%**			**$23,762**
SUBTOTAL				**$261,384**
CONTINGENCY	**30.0%**			**$78,415**
CONSTRUCTION TOTAL (ROUNDED)				**$340,000**
SALES TAX	**9.5%**			**$32,300**
CONSTRUCTION TOTAL (ROUNDED)				**$372,300**
Low range	**-30.0%**			**$260,000**
High Range	**50.0%**			**$560,000**

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RENTON SUNSET PLAN ACTION EIS PROJECT **DATE: 3/9/2011**
EDMONDS AVE GREEN CONNECTION **PROJECT NO.: 408314**
ORDER OF MAGNITUDE ESTIMATE

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
EDMONDS SEG. 4 TOTAL LENGTH	1,600	LF		
2 Lanes Section, 10th pl - 6th Street	1,600	LF		
Subtotal 1				$482,787
SUBTOTAL				$482,787
MOBILIZATION, BONDS, INSURANCE, TEMP. FACILITIES, DEMOB, ETC	10.0%			$48,279
SUBTOTAL				$531,065
CONTINGENCY	30.0%			$159,320
CONSTRUCTION TOTAL (ROUNDED)				$690,000
SALES TAX	9.5%			$65,550
CONSTRUCTION TOTAL (ROUNDED)				$755,550
Low range	-30.0%			$530,000
High Range	50.0%			$1,130,000

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RENTON SUNSET PLAN ACTION EIS PROJECT
KIRKLAND AVE STORM DRAIN
ORDER OF MAGNITUDE ESTIMATE

DATE: 3/9/2011
PROJECT NO.: 408314
ESTIMATE BY: D Hedglin
REVIEW BY:

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
KIRKLAND AVENUE 16TH ST TO 12TH ST	**1,450**	**LF**		
Remove Curb, Gutter & Sidewalk	1,450	LF	$15.00	$21,750
Replace Curb, Gutter & Sidewalk	1,450	LF	$40.00	$58,000
2-in ACP Overlay	4,833	SY	$9.95	$48,092
24-in CPEP Storm Drain (1 total)	1,450	LF	$133.04	$192,906
12-in CPEP Storm Drain Lateral	218	LF	$81.07	$17,634
Catch Basins (at 200-ft intervals both sides)	15	EA	$800.00	$11,680
Misc. Detail Allowance	1	LS	$35,006.14	$35,006
Subtotal 1				**$385,068**
SUBTOTAL				**$385,068**
MOBILIZATION, BONDS, INSURANCE, TEMP. FACILITIES, DEMOB, ETC	**10.0%**			**$38,507**
SUBTOTAL				**$423,574**
CONTINGENCY	**30.0%**			**$127,072**
CONSTRUCTION TOTAL (ROUNDED)				**$550,000**
SALES TAX	**9.5%**			**$52,250**
CONSTRUCTION TOTAL (ROUNDED)				**$602,250**
Low range	**-30.0%**			**$420,000**
High Range	**50.0%**			**$900,000**

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RENTON SUNSET PLAN ACTION EIS PROJECT **DATE: 3/9/2011**
JEFFERSON GREEN CONNECTION **PROJECT NO.: 408314**
ORDER OF MAGNITUDE ESTIMATE

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST
JEFFERSON GREEN CONNECTION TOTAL LENGTH	**1,300**	**LF**		
Section 1: Rain Garden on one side of Steet	**850**	**LF**		
12-ft Rain Garden Strip	10,200	SF	$18.86	$192,360
Section 1 Subtotal				**$192,360**
Section 2: Rain Garden both Sides of Street	**150**	**LF**		
12-ft Rain Garden Strip (x2)	3,600	SF	$14.26	$51,336
Section 2 Subtotal				**$51,336**
SUBTOTAL				**$243,696**
MOBILIZATION, BONDS, INSURANCE, TEMP. FACILITIES, DEMOB, ETC	**10.0%**			**$24,370**
SUBTOTAL				**$268,066**
CONTINGENCY	**30.0%**			**$80,420**
CONSTRUCTION TOTAL (ROUNDED)				**$350,000**
SALES TAX	**9.5%**			**$33,250**
CONSTRUCTION TOTAL (ROUNDED)				**$383,250**
Low range	**-30.0%**			**$270,000**
High Range	**50.0%**			**$570,000**

NOTE: The above cost opinion is in March 2011 dollars and does not include future escalation, financial or O&M costs.
The cost opinion shown has been prepared for guidance in project evaluation from the information available at the time of preparation. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final schedule and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

Appendix D
Hydrologic and Hydraulic Model Output

Appendix D1 – Sub-Regional Flow Control Facility

Run Description Sheet

MODELER: Raymond Chung/SEA

REVIEWER: Dustin Atchison/SEA

PROJECT: Renton Sunset Terrace

CLIENT: City of Renton

PROJECT NUBER: 408314

DATE: April 14 2011.

RUN NO:	RF_1	**MODEL USED:**	WWHM (ver3)
DRIVE AND PATH:	\\simba\proj\RentonWACityOf\408314\9_Stormwater\Analysis\RegionalDetention		
PURPOSE OF RUN:	Preliminary determine the size of a regional detention size needed to control the peak flow rate for the additional 2.6 ac of impervious per FEIS Preferred Alternative. WQ design flow go to infiltration to native soil (0.25″/hr) while the high flow go to a detention vault.		

Input Description

FILE NAMES: RF_1

COMMENTS: Scale Factor = 1.0 using SeaTac gage.

The new impervious area estimated to be detained is 2.6 ac. Adding 10% safety factor, the detention facility to be sized fro 2.9 ac.

The water will flow thru rain garden for treatment with 1.5″/hr of infiltration rate.

Rain garden 6″ was ponding, and 18″ of compost soil with 30% void. A total of 0.95 feet of storage and 1.45 feet deep with freeboard.

Infiltration gallery assumes 18″ of gravel with 30% void and underdrain pipe.

Output Description

FILE NAMES: RF_Sunset.doc

COMMENTS: See output summary. The release rate from the detention vault meets the Peak flow rate matching standard. All the water quality flow is infiltrated into native ground.

	Rain Garden	Vault	Infiltration Gallery
Pond Dimensions			
Bottom Length x Width (feet)	155 x 20	135x20	125x100
Depth (feet)	1.45	6.5	3
Side slopes (H:V)	4	Vert	Vert
Discharge Structure			
Riser Height (feet)	0.95	6	2.9
Riser Diameter (in)	18	18	
Orifice 1 Diameter (in)	0	1.75	
Orifice 1 Height (feet)	0	0	
Orifice 2 Diameter (in)	0	2.2	
Orifice 2 Height (feet)	0	3.5	
Orifice 3 Diameter (in)	0	1.5	
Orifice 3 Height (feet)	0	5	
Modeled Infiltration Rate (inches/hour)	1.5	0	0.25
Side infiltration	Off	Off	Off
Evaporation	On	Off	Off
Precipitation on Facility	On	Off	Off

Western Washington Hydrology Model
PROJECT REPORT

Project Name: RF_1
Site Address:
City : Renton
Report Date : 4/15/2011
Gage : Seatac
Data Start : 1948/10/01
Data End : 1998/09/30
Precip Scale: 1.00
WWHM3 Version:

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Lawn, Flat	2.9

Impervious Land Use	Acres

Element Flows To:

Surface	Interflow	Groundwater

Name : 10000SF
Bypass: No

GroundWater: No

Pervious Land Use	Acres

Impervious Land Use	Acres
ROADS FLAT	2.9

Element Flows To:

Surface	Interflow	Groundwater
etention Rain Garden,	etention Rain Garden,	

Name : etention Rain Garden
Bottom Length: 155ft.
Bottom Width: 20ft.

Depth : 1.45ft.
Volume at riser head : 0.0826ft.
Infiltration On
Infiltration rate : 1.5
Infiltration saftey factor : 1
Side slope 1: 4 To 1
Side slope 2: 4 To 1
Side slope 3: 4 To 1
Side slope 4: 4 To 1
Discharge Structure
Riser Height: 0.95 ft.
Riser Diameter: 18 in.

Element Flows To:
Outlet 1 **Outlet 2**
Detention Vault 1, Infiltration Bed,

Pond Hydraulic Table

Stage(ft)	Area(acr)	Volume(acr-ft)	Dschrg(cfs)	Infilt(cfs)
0.000	0.071	0.000	0.000	0.000
0.016	0.072	0.001	0.000	0.108
0.032	0.072	0.002	0.000	0.108
0.048	0.073	0.003	0.000	0.108
0.064	0.073	0.005	0.000	0.108
0.081	0.074	0.006	0.000	0.108
0.097	0.074	0.007	0.000	0.108
0.113	0.075	0.008	0.000	0.108
0.129	0.075	0.009	0.000	0.108
0.145	0.076	0.011	0.000	0.108
0.161	0.076	0.012	0.000	0.108
0.177	0.077	0.013	0.000	0.108
0.193	0.077	0.014	0.000	0.108
0.209	0.078	0.016	0.000	0.108
0.226	0.078	0.017	0.000	0.108
0.242	0.079	0.018	0.000	0.108
0.258	0.080	0.019	0.000	0.108
0.274	0.080	0.021	0.000	0.108
0.290	0.081	0.022	0.000	0.108
0.306	0.081	0.023	0.000	0.108
0.322	0.082	0.025	0.000	0.108
0.338	0.082	0.026	0.000	0.108
0.354	0.083	0.027	0.000	0.108
0.371	0.083	0.029	0.000	0.108
0.387	0.084	0.030	0.000	0.108
0.403	0.084	0.031	0.000	0.108
0.419	0.085	0.033	0.000	0.108
0.435	0.085	0.034	0.000	0.108
0.451	0.086	0.035	0.000	0.108
0.467	0.087	0.037	0.000	0.108
0.483	0.087	0.038	0.000	0.108
0.499	0.088	0.040	0.000	0.108
0.516	0.088	0.041	0.000	0.108
0.532	0.089	0.042	0.000	0.108
0.548	0.089	0.044	0.000	0.108

0.564	0.090	0.045	0.000	0.108
0.580	0.090	0.047	0.000	0.108
0.596	0.091	0.048	0.000	0.108
0.612	0.091	0.050	0.000	0.108
0.628	0.092	0.051	0.000	0.108
0.644	0.092	0.053	0.000	0.108
0.661	0.093	0.054	0.000	0.108
0.677	0.094	0.056	0.000	0.108
0.693	0.094	0.057	0.000	0.108
0.709	0.095	0.059	0.000	0.108
0.725	0.095	0.060	0.000	0.108
0.741	0.096	0.062	0.000	0.108
0.757	0.096	0.063	0.000	0.108
0.773	0.097	0.065	0.000	0.108
0.789	0.097	0.066	0.000	0.108
0.806	0.098	0.068	0.000	0.108
0.822	0.099	0.070	0.000	0.108
0.838	0.099	0.071	0.000	0.108
0.854	0.100	0.073	0.000	0.108
0.870	0.100	0.074	0.000	0.108
0.886	0.101	0.076	0.000	0.108
0.902	0.101	0.078	0.000	0.108
0.918	0.102	0.079	0.000	0.108
0.934	0.102	0.081	0.000	0.108
0.951	0.103	0.083	0.000	0.108
0.967	0.104	0.084	0.031	0.108
0.983	0.104	0.086	0.087	0.108
0.999	0.105	0.088	0.158	0.108
1.015	0.105	0.089	0.242	0.108
1.031	0.106	0.091	0.337	0.108
1.047	0.106	0.093	0.443	0.108
1.063	0.107	0.094	0.557	0.108
1.079	0.108	0.096	0.680	0.108
1.096	0.108	0.098	0.811	0.108
1.112	0.109	0.100	0.950	0.108
1.128	0.109	0.101	1.095	0.108
1.144	0.110	0.103	1.247	0.108
1.160	0.110	0.105	1.406	0.108
1.176	0.111	0.107	1.571	0.108
1.192	0.112	0.109	1.742	0.108
1.208	0.112	0.110	1.918	0.108
1.224	0.113	0.112	2.100	0.108
1.241	0.113	0.114	2.288	0.108
1.257	0.114	0.116	2.481	0.108
1.273	0.114	0.118	2.679	0.108
1.289	0.115	0.119	2.882	0.108
1.305	0.116	0.121	3.090	0.108
1.321	0.116	0.123	3.303	0.108
1.337	0.117	0.125	3.520	0.108
1.353	0.117	0.127	3.742	0.108
1.369	0.118	0.129	3.968	0.108
1.386	0.119	0.131	4.199	0.108
1.402	0.119	0.133	4.434	0.108
1.418	0.120	0.135	4.674	0.108
1.434	0.120	0.137	4.917	0.108
1.450	0.121	0.138	5.165	0.108

Name : Infiltration Bed
Bottom Length: 125ft.
Bottom Width : 100ft.
Trench bottom slope 1: 0.005 To 1
Trench Left side slope 0: 0.1 To 1
Trench right side slope 2: 0.1 To 1
Material thickness of first layer : 3
Pour Space of material for first layer : 0.33
Material thickness of second layer : 0
Pour Space of material for second layer : 0
Material thickness of third layer : 0
Pour Space of material for third layer : 0
Infiltration On
Infiltration rate : 0.25
Infiltration saftey factor : 1
Discharge Structure
Riser Height: 2.9 ft.
Riser Diameter: 18 in.

Element Flows To:
Outlet 1 **Outlet 2**

Gravel Trench Bed Hydraulic Table

Stage(ft)	Area(acr)	Volume(acr-ft)	Dschrg(cfs)	Infilt(cfs)
0.000	0.287	0.000	0.000	0.000
0.033	0.287	0.003	0.000	0.072
0.067	0.287	0.006	0.000	0.072
0.100	0.287	0.009	0.000	0.072
0.133	0.287	0.013	0.000	0.072
0.167	0.287	0.016	0.000	0.072
0.200	0.287	0.019	0.000	0.072
0.233	0.287	0.022	0.000	0.072
0.267	0.287	0.025	0.000	0.072
0.300	0.287	0.028	0.000	0.072
0.333	0.287	0.032	0.000	0.072
0.367	0.287	0.035	0.000	0.072
0.400	0.287	0.038	0.000	0.072
0.433	0.287	0.041	0.000	0.072
0.467	0.287	0.044	0.000	0.072
0.500	0.287	0.047	0.000	0.072
0.533	0.287	0.051	0.000	0.072
0.567	0.287	0.054	0.000	0.072
0.600	0.287	0.057	0.000	0.072
0.633	0.287	0.060	0.000	0.072
0.667	0.287	0.063	0.000	0.072
0.700	0.287	0.066	0.000	0.072
0.733	0.287	0.069	0.000	0.072
0.767	0.287	0.073	0.000	0.072
0.800	0.287	0.076	0.000	0.072
0.833	0.287	0.079	0.000	0.072
0.867	0.287	0.082	0.000	0.072
0.900	0.287	0.085	0.000	0.072
0.933	0.288	0.088	0.000	0.072

0.967	0.288	0.092	0.000	0.072
1.000	0.288	0.095	0.000	0.072
1.033	0.288	0.098	0.000	0.072
1.067	0.288	0.101	0.000	0.072
1.100	0.288	0.104	0.000	0.072
1.133	0.288	0.107	0.000	0.072
1.167	0.288	0.111	0.000	0.072
1.200	0.288	0.114	0.000	0.072
1.233	0.288	0.117	0.000	0.072
1.267	0.288	0.120	0.000	0.072
1.300	0.288	0.123	0.000	0.072
1.333	0.288	0.126	0.000	0.072
1.367	0.288	0.130	0.000	0.072
1.400	0.288	0.133	0.000	0.072
1.433	0.288	0.136	0.000	0.072
1.467	0.288	0.139	0.000	0.072
1.500	0.288	0.142	0.000	0.072
1.533	0.288	0.145	0.000	0.072
1.567	0.288	0.149	0.000	0.072
1.600	0.288	0.152	0.000	0.072
1.633	0.288	0.155	0.000	0.072
1.667	0.288	0.158	0.000	0.072
1.700	0.288	0.161	0.000	0.072
1.733	0.288	0.164	0.000	0.072
1.767	0.288	0.168	0.000	0.072
1.800	0.288	0.171	0.000	0.072
1.833	0.288	0.174	0.000	0.072
1.867	0.288	0.177	0.000	0.072
1.900	0.288	0.180	0.000	0.072
1.933	0.288	0.183	0.000	0.072
1.967	0.288	0.187	0.000	0.072
2.000	0.288	0.190	0.000	0.072
2.033	0.288	0.193	0.000	0.072
2.067	0.288	0.196	0.000	0.072
2.100	0.288	0.199	0.000	0.072
2.133	0.288	0.202	0.000	0.072
2.167	0.288	0.206	0.000	0.072
2.200	0.288	0.209	0.000	0.072
2.233	0.288	0.212	0.000	0.072
2.267	0.288	0.215	0.000	0.072
2.300	0.288	0.218	0.000	0.072
2.333	0.288	0.221	0.000	0.072
2.367	0.288	0.225	0.000	0.072
2.400	0.288	0.228	0.000	0.072
2.433	0.288	0.231	0.000	0.072
2.467	0.288	0.234	0.000	0.072
2.500	0.288	0.237	0.000	0.072
2.533	0.288	0.241	0.000	0.072
2.567	0.288	0.244	0.000	0.072
2.600	0.289	0.247	0.000	0.072
2.633	0.289	0.250	0.000	0.072
2.667	0.289	0.253	0.000	0.072
2.700	0.289	0.256	0.000	0.072
2.733	0.289	0.260	0.000	0.072
2.767	0.289	0.263	0.000	0.072
2.800	0.289	0.266	0.000	0.072
2.833	0.289	0.269	0.000	0.072

2.867	0.289	0.272	0.000	0.072
2.900	0.289	0.275	0.000	0.072
2.933	0.289	0.279	0.089	0.072
2.967	0.289	0.282	0.251	0.072
3.000	0.289	0.285	0.462	0.072

Name : Detention Vault 1
Width : 20 ft.
Length : 135 ft.
Depth: 6.5ft.
Discharge Structure
Riser Height: 6 ft.
Riser Diameter: 18 in.
Orifice 1 Diameter: 1.75 in. **Elevation:** 0 ft.
Orifice 1 Diameter: 2.2 in. **Elevation:** 3.5 ft.
Orifice 1 Diameter: 1.5 in. **Elevation:** 5 ft.

Element Flows To:
Outlet 1 **Outlet 2**

Vault Hydraulic Table

Stage(ft)	Area(acr)	Volume(acr-ft)	Dschrg(cfs)	Infilt(cfs)
0.000	0.062	0.000	0.000	0.000
0.072	0.062	0.004	0.022	0.000
0.144	0.062	0.009	0.031	0.000
0.217	0.062	0.013	0.037	0.000
0.289	0.062	0.018	0.043	0.000
0.361	0.062	0.022	0.048	0.000
0.433	0.062	0.027	0.053	0.000
0.506	0.062	0.031	0.057	0.000
0.578	0.062	0.036	0.061	0.000
0.650	0.062	0.040	0.065	0.000
0.722	0.062	0.045	0.068	0.000
0.794	0.062	0.049	0.072	0.000
0.867	0.062	0.054	0.075	0.000
0.939	0.062	0.058	0.078	0.000
1.011	0.062	0.063	0.081	0.000
1.083	0.062	0.067	0.084	0.000
1.156	0.062	0.072	0.086	0.000
1.228	0.062	0.076	0.089	0.000
1.300	0.062	0.081	0.092	0.000
1.372	0.062	0.085	0.094	0.000
1.444	0.062	0.090	0.097	0.000
1.517	0.062	0.094	0.099	0.000
1.589	0.062	0.098	0.101	0.000
1.661	0.062	0.103	0.104	0.000
1.733	0.062	0.107	0.106	0.000
1.806	0.062	0.112	0.108	0.000
1.878	0.062	0.116	0.110	0.000
1.950	0.062	0.121	0.112	0.000
2.022	0.062	0.125	0.114	0.000
2.094	0.062	0.130	0.116	0.000
2.167	0.062	0.134	0.118	0.000

2.239	0.062	0.139	0.120	0.000
2.311	0.062	0.143	0.122	0.000
2.383	0.062	0.148	0.124	0.000
2.456	0.062	0.152	0.126	0.000
2.528	0.062	0.157	0.128	0.000
2.600	0.062	0.161	0.130	0.000
2.672	0.062	0.166	0.131	0.000
2.744	0.062	0.170	0.133	0.000
2.817	0.062	0.175	0.135	0.000
2.889	0.062	0.179	0.137	0.000
2.961	0.062	0.184	0.138	0.000
3.033	0.062	0.188	0.140	0.000
3.106	0.062	0.192	0.142	0.000
3.178	0.062	0.197	0.143	0.000
3.250	0.062	0.201	0.145	0.000
3.322	0.062	0.206	0.147	0.000
3.394	0.062	0.210	0.148	0.000
3.467	0.062	0.215	0.150	0.000
3.539	0.062	0.219	0.176	0.000
3.611	0.062	0.224	0.195	0.000
3.683	0.062	0.228	0.209	0.000
3.756	0.062	0.233	0.220	0.000
3.828	0.062	0.237	0.230	0.000
3.900	0.062	0.242	0.239	0.000
3.972	0.062	0.246	0.248	0.000
4.044	0.062	0.251	0.256	0.000
4.117	0.062	0.255	0.263	0.000
4.189	0.062	0.260	0.270	0.000
4.261	0.062	0.264	0.277	0.000
4.333	0.062	0.269	0.283	0.000
4.406	0.062	0.273	0.290	0.000
4.478	0.062	0.278	0.296	0.000
4.550	0.062	0.282	0.302	0.000
4.622	0.062	0.287	0.308	0.000
4.694	0.062	0.291	0.313	0.000
4.767	0.062	0.295	0.319	0.000
4.839	0.062	0.300	0.324	0.000
4.911	0.062	0.304	0.329	0.000
4.983	0.062	0.309	0.334	0.000
5.056	0.062	0.313	0.353	0.000
5.128	0.062	0.318	0.365	0.000
5.200	0.062	0.322	0.376	0.000
5.272	0.062	0.327	0.385	0.000
5.344	0.062	0.331	0.393	0.000
5.417	0.062	0.336	0.401	0.000
5.489	0.062	0.340	0.409	0.000
5.561	0.062	0.345	0.416	0.000
5.633	0.062	0.349	0.424	0.000
5.706	0.062	0.354	0.431	0.000
5.778	0.062	0.358	0.437	0.000
5.850	0.062	0.363	0.444	0.000
5.922	0.062	0.367	0.450	0.000
5.994	0.062	0.372	0.457	0.000
6.067	0.062	0.376	0.714	0.000
6.139	0.062	0.381	1.225	0.000
6.211	0.062	0.385	1.892	0.000
6.283	0.062	0.389	2.684	0.000

6.356	0.062	0.394	3.584	0.000
6.428	0.062	0.398	4.579	0.000
6.500	0.062	0.403	5.662	0.000
6.572	0.062	0.407	6.827	0.000
6.644	0.000	0.000	8.066	0.000

MITIGATED LAND USE

ANALYSIS RESULTS

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.146865
5 year	0.231604
10 year	0.295364
25 year	0.384285
50 year	0.456469
100 year	0.533678

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.127516
5 year	0.208151
10 year	0.270392
25 year	0.358881
50 year	0.43189
100 year	0.510955

Yearly Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1950	0.180	0.115
1951	0.475	0.125
1952	0.244	0.285
1953	0.110	0.096
1954	0.078	0.103
1955	0.137	0.078
1956	0.187	0.230
1957	0.185	0.138
1958	0.201	0.134
1959	0.127	0.121
1960	0.097	0.122
1961	0.218	0.280
1962	0.122	0.115
1963	0.072	0.074
1964	0.127	0.101
1965	0.143	0.090
1966	0.104	0.124
1967	0.119	0.081
1968	0.222	0.147
1969	0.158	0.090
1970	0.122	0.121
1971	0.128	0.109
1972	0.137	0.104

1973	0.298	0.177
1974	0.105	0.094
1975	0.140	0.069
1976	0.246	0.207
1977	0.137	0.106
1978	0.052	0.086
1979	0.149	0.125
1980	0.064	0.074
1981	0.192	0.199
1982	0.164	0.106
1983	0.347	0.364
1984	0.137	0.120
1985	0.129	0.096
1986	0.072	0.119
1987	0.251	0.312
1988	0.228	0.331
1989	0.088	0.095
1990	0.062	0.031
1991	0.498	0.398
1992	0.410	0.387
1993	0.124	0.099
1994	0.097	0.108
1995	0.047	0.028
1996	0.129	0.119
1997	0.309	0.276
1998	0.228	0.380
1999	0.151	0.105

Ranked Yearly Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.4985	0.3980
2	0.4752	0.3866
3	0.4102	0.3802
4	0.3466	0.3637
5	0.3086	0.3312
6	0.2979	0.3120
7	0.2509	0.2849
8	0.2456	0.2796
9	0.2435	0.2759
10	0.2280	0.2299
11	0.2279	0.2072
12	0.2218	0.1993
13	0.2176	0.1769
14	0.2015	0.1474
15	0.1919	0.1379
16	0.1872	0.1337
17	0.1849	0.1254
18	0.1805	0.1253
19	0.1637	0.1240
20	0.1575	0.1224
21	0.1508	0.1214
22	0.1491	0.1211
23	0.1435	0.1198
24	0.1404	0.1194
25	0.1374	0.1187
26	0.1372	0.1154

27	0.1369	0.1147
28	0.1366	0.1094
29	0.1289	0.1082
30	0.1288	0.1063
31	0.1279	0.1060
32	0.1274	0.1046
33	0.1271	0.1037
34	0.1238	0.1030
35	0.1224	0.1013
36	0.1222	0.0989
37	0.1192	0.0965
38	0.1095	0.0960
39	0.1049	0.0952
40	0.1043	0.0939
41	0.0974	0.0901
42	0.0972	0.0897
43	0.0878	0.0860
44	0.0784	0.0808
45	0.0724	0.0776
46	0.0717	0.0740
47	0.0645	0.0738
48	0.0621	0.0687
49	0.0520	0.0308
50	0.0466	0.0282

POC #1

Facility FAILED duration standard for 1+ flows.

Flow(CFS)	Predev	Dev	Percentage	Pass/Fail
0.0734	2357	1986	84	Pass
0.0773	2032	1802	88	Pass
0.0812	1754	1634	93	Pass
0.0850	1555	1475	94	Pass
0.0889	1420	1350	95	Pass
0.0928	1238	1195	96	Pass
0.0966	1094	1056	96	Pass
0.1005	974	926	95	Pass
0.1044	861	816	94	Pass
0.1083	770	702	91	Pass
0.1121	687	608	88	Pass
0.1160	627	540	86	Pass
0.1199	556	464	83	Pass
0.1237	485	396	81	Pass
0.1276	442	353	79	Pass
0.1315	396	319	80	Pass
0.1353	356	274	76	Pass
0.1392	317	242	76	Pass
0.1431	283	214	75	Pass
0.1469	270	194	71	Pass
0.1508	247	178	72	Pass
0.1547	224	173	77	Pass
0.1586	206	170	82	Pass
0.1624	183	166	90	Pass
0.1663	159	163	102	Pass
0.1702	141	160	113	Fail

0.1740	125	155	124	Fail
0.1779	115	154	133	Fail
0.1818	97	149	153	Fail
0.1856	87	144	165	Fail
0.1895	74	139	187	Fail
0.1934	66	133	201	Fail
0.1972	60	131	218	Fail
0.2011	58	128	220	Fail
0.2050	52	124	238	Fail
0.2088	47	123	261	Fail
0.2127	44	120	272	Fail
0.2166	43	119	276	Fail
0.2205	39	116	297	Fail
0.2243	34	113	332	Fail
0.2282	31	102	329	Fail
0.2321	28	96	342	Fail
0.2359	27	90	333	Fail
0.2398	25	88	352	Fail
0.2437	21	80	380	Fail
0.2475	18	78	433	Fail
0.2514	17	77	452	Fail
0.2553	17	75	441	Fail
0.2591	16	70	437	Fail
0.2630	15	67	446	Fail
0.2669	15	65	433	Fail
0.2708	14	60	428	Fail
0.2746	13	56	430	Fail
0.2785	12	50	416	Fail
0.2824	12	47	391	Fail
0.2862	10	39	390	Fail
0.2901	10	36	360	Fail
0.2940	10	35	350	Fail
0.2978	10	34	340	Fail
0.3017	9	30	333	Fail
0.3056	9	30	333	Fail
0.3094	8	28	350	Fail
0.3133	8	27	337	Fail
0.3172	8	25	312	Fail
0.3211	8	21	262	Fail
0.3249	8	20	250	Fail
0.3288	8	19	237	Fail
0.3327	8	16	200	Fail
0.3365	8	16	200	Fail
0.3404	7	16	228	Fail
0.3443	7	16	228	Fail
0.3481	6	16	266	Fail
0.3520	6	16	266	Fail
0.3559	6	14	233	Fail
0.3597	6	12	200	Fail
0.3636	6	10	166	Fail
0.3675	6	8	133	Fail
0.3713	6	8	133	Fail
0.3752	6	8	133	Fail
0.3791	6	6	100	Pass
0.3830	6	5	83	Pass
0.3868	6	5	83	Pass
0.3907	6	4	66	Pass

0.3946	5	4	80	Pass
0.3984	5	3	60	Pass
0.4023	5	2	40	Pass
0.4062	5	1	20	Pass
0.4100	5	1	20	Pass
0.4139	4	1	25	Pass
0.4178	4	0	0	Pass
0.4216	4	0	0	Pass
0.4255	4	0	0	Pass
0.4294	4	0	0	Pass
0.4333	4	0	0	Pass
0.4371	3	0	0	Pass
0.4410	3	0	0	Pass
0.4449	3	0	0	Pass
0.4487	3	0	0	Pass
0.4526	3	0	0	Pass
0.4565	2	0	0	Pass

The development has an increase in flow durations from 1/2 predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.

Water Quality BMP Flow and Volume for POC 1.
On-line facility volume: 0 acre-feet
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

Perlnd and Implnd Changes

No changes have been made.

Figure 1. Screen Capture of the Rain Garden Input and Infiltration Output

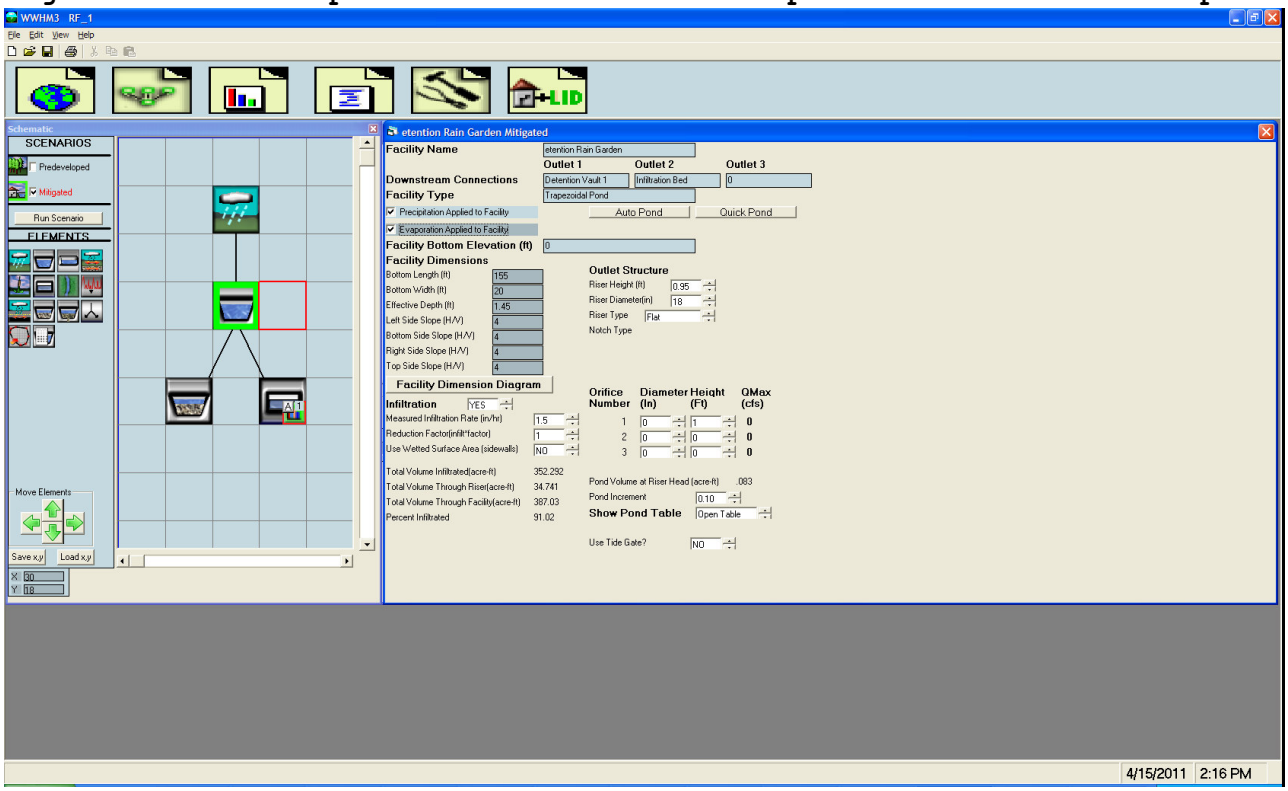
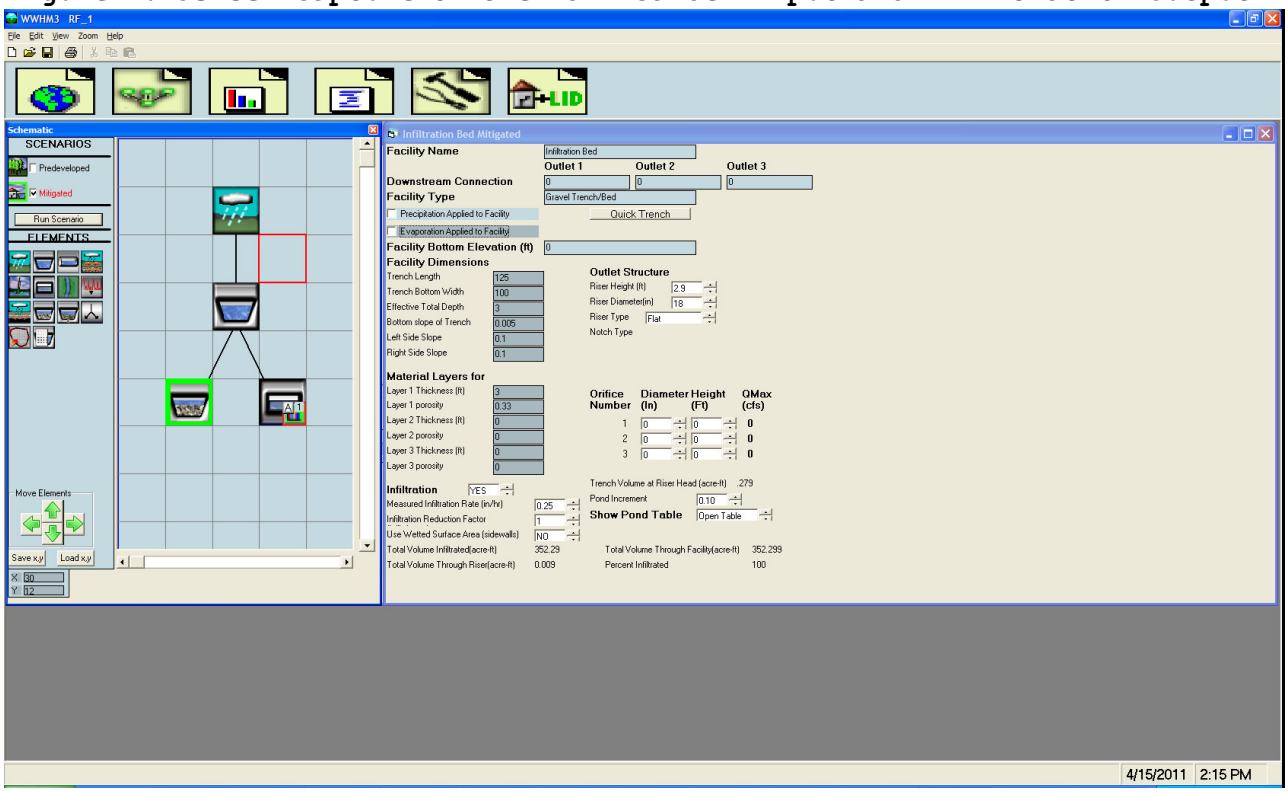
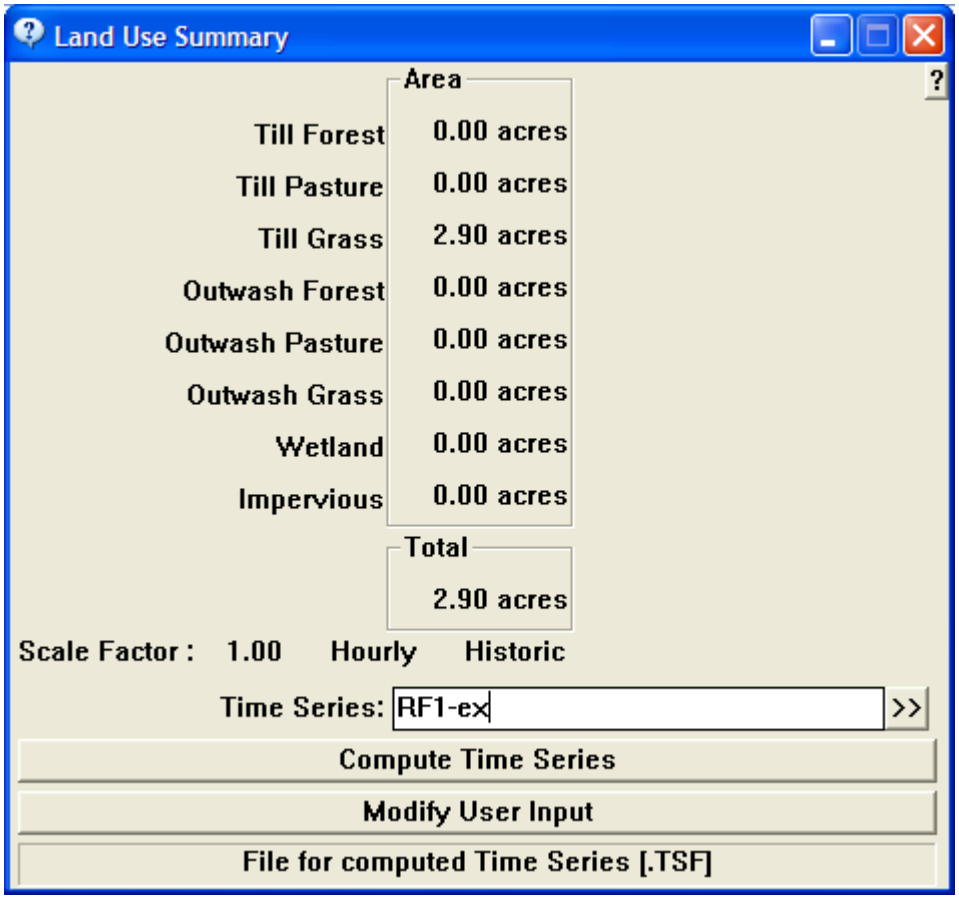


Figure 2. Screen Capture of the Rain Garden Input and Infiltration Output



Sunset Terrace Study Area

Existing Conditions - KCRTS Output



Flow Frequency Analysis LogPearson III Coefficients
Time Series File:rf1-ex.tsf Mean= -0.795 StdDev= 0.226
Project Location:Sea-Tac Skew= 0.298

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
0.196	15	2/16/49 21:00	0.533	1	80.57	0.988
0.533	1	3/03/50 16:00	0.522	2	28.92	0.965
0.259	8	2/09/51 2:00	0.431	3	17.63	0.943
0.119	34	1/30/52 8:00	0.363	4	12.67	0.921
0.090	39	3/24/53 15:00	0.329	5	9.89	0.899
0.155	21	12/19/53 19:00	0.270	6	8.12	0.877
0.195	16	2/07/55 17:00	0.266	7	6.88	0.855
0.201	14	12/20/55 17:00	0.259	8	5.97	0.832
0.220	12	12/09/56 14:00	0.238	9	5.27	0.810
0.143	27	12/25/57 16:00	0.232	10	4.72	0.788

0.108	37	1/26/59 20:00	0.220	11	4.27 0.766
0.220	11	11/20/59 21:00	0.220	12	3.90 0.744
0.139	29	2/14/61 21:00	0.215	13	3.59 0.722
0.081	41	11/22/61 2:00	0.201	14	3.33 0.699
0.146	25	12/15/62 2:00	0.196	15	3.10 0.677
0.151	22	12/31/63 23:00	0.195	16	2.90 0.655
0.112	35	12/21/64 4:00	0.177	17	2.72 0.633
0.132	32	1/05/66 16:00	0.172	18	2.57 0.611
0.232	10	1/19/67 14:00	0.165	19	2.43 0.589
0.172	18	8/24/68 16:00	0.158	20	2.31 0.566
0.132	33	12/03/68 16:00	0.155	21	2.19 0.544
0.133	30	1/13/70 22:00	0.151	22	2.09 0.522
0.148	24	12/06/70 8:00	0.150	23	2.00 0.500
0.329	5	2/27/72 7:00	0.148	24	1.92 0.478
0.111	36	1/13/73 2:00	0.146	25	1.84 0.456
0.165	19	11/28/73 9:00	0.144	26	1.77 0.434
0.270	6	12/26/74 23:00	0.143	27	1.70 0.411
0.144	26	12/02/75 20:00	0.143	28	1.64 0.389
0.054	45	8/26/77 2:00	0.139	29	1.58 0.367
0.158	20	9/22/78 19:00	0.133	30	1.53 0.345
0.067	44	11/19/78 0:00	0.133	31	1.48 0.323
0.215	13	12/14/79 21:00	0.132	32	1.43 0.301
0.177	17	11/21/80 11:00	0.132	33	1.39 0.278
0.363	4	10/06/81 15:00	0.119	34	1.34 0.256
0.143	28	1/05/83 8:00	0.112	35	1.31 0.234
0.150	23	3/15/84 20:00	0.111	36	1.27 0.212
0.073	42	6/06/85 23:00	0.108	37	1.23 0.190
0.266	7	1/18/86 16:00	0.101	38	1.20 0.168
0.238	9	11/24/86 3:00	0.090	39	1.17 0.145
0.090	40	1/14/88 12:00	0.090	40	1.14 0.123
0.068	43	11/05/88 14:00	0.081	41	1.11 0.101
0.522	2	1/09/90 6:00	0.073	42	1.09 0.079
0.431	3	11/24/90 8:00	0.068	43	1.06 0.057
0.133	31	1/27/92 15:00	0.067	44	1.04 0.035
0.101	38	3/22/93 22:00	0.054	45	1.01 0.012

Computed Peaks	0.601	100.00	0.990
Computed Peaks	0.506	50.00	0.980
Computed Peaks	0.419	25.00	0.960
Computed Peaks	0.317	10.00	0.900
Computed Peaks	0.297	8.00	0.875
Computed Peaks	0.246	5.00	0.800
Computed Peaks	0.156	2.00	0.500
Computed Peaks	0.107	1.30	0.231

Appendix D2 – Proposed Conveyance System

Figure 1. Node ID and Pipe ID

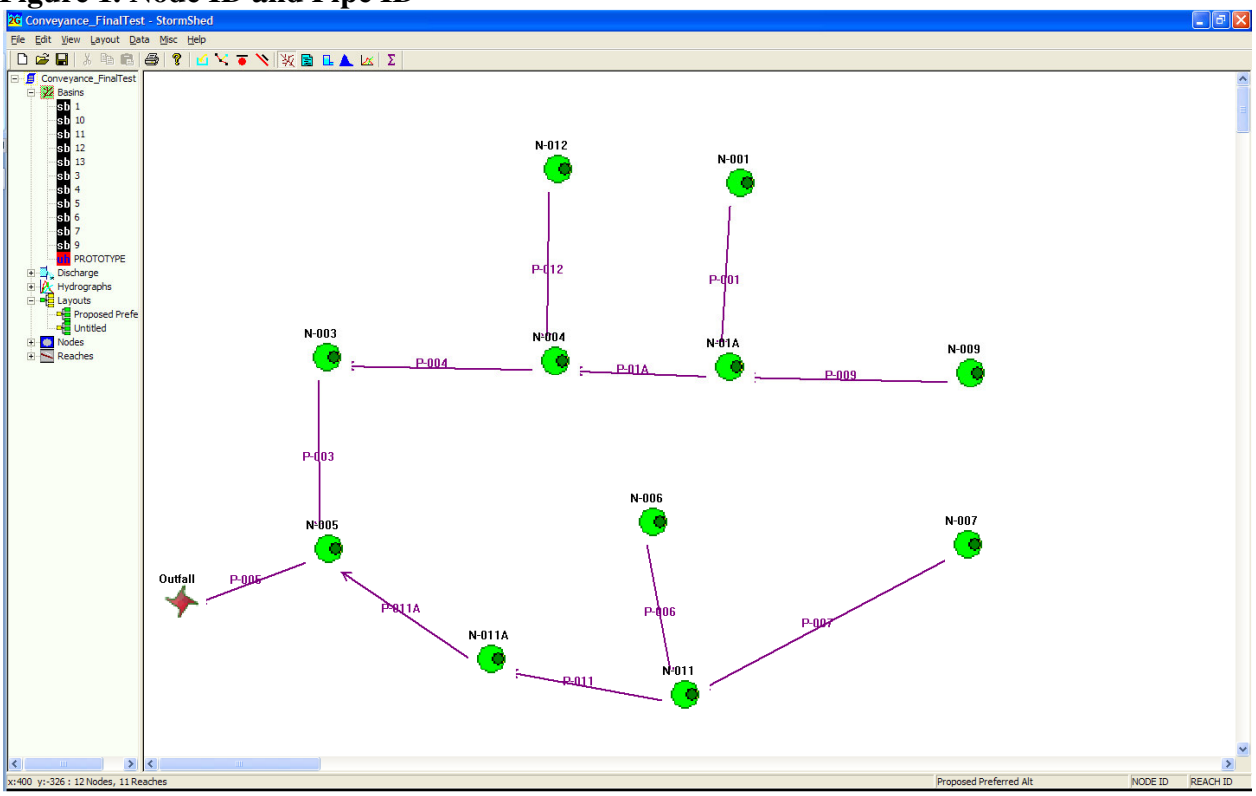


Figure 2. CB Rim Elevations and Pipe Sizes

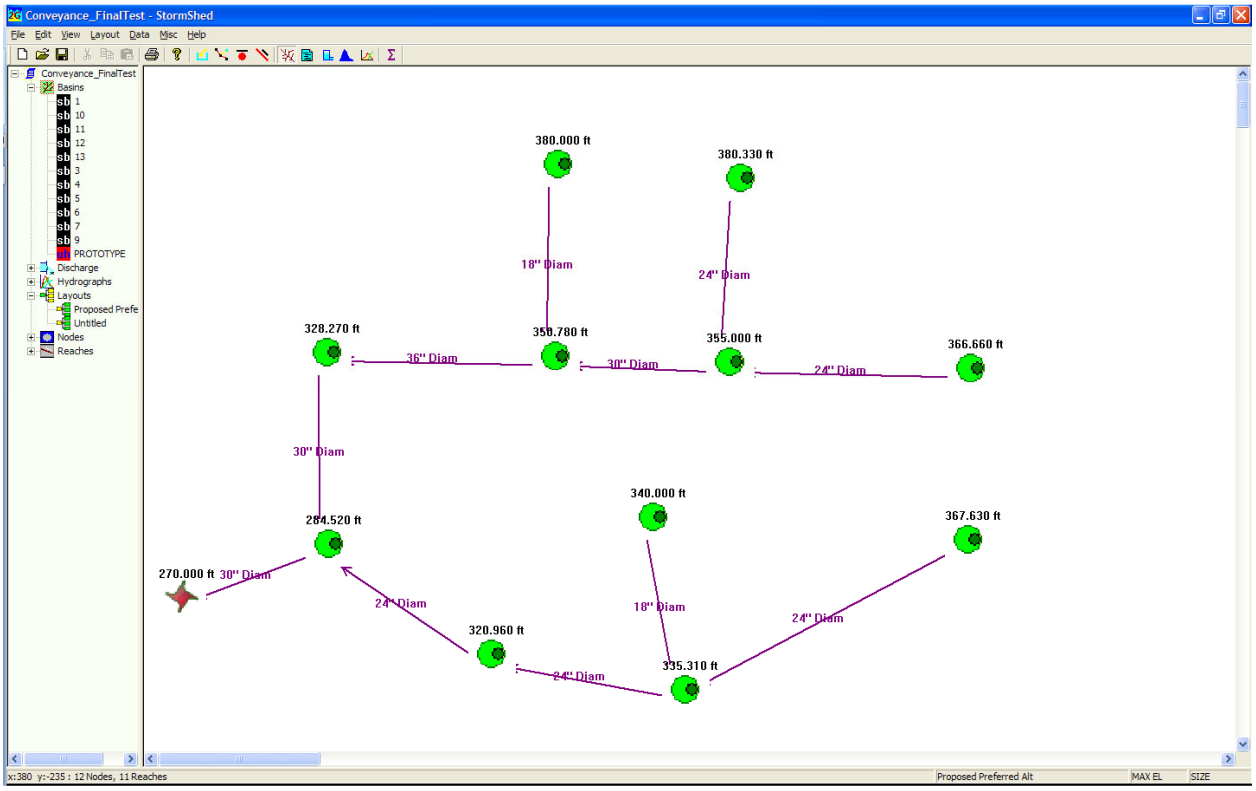
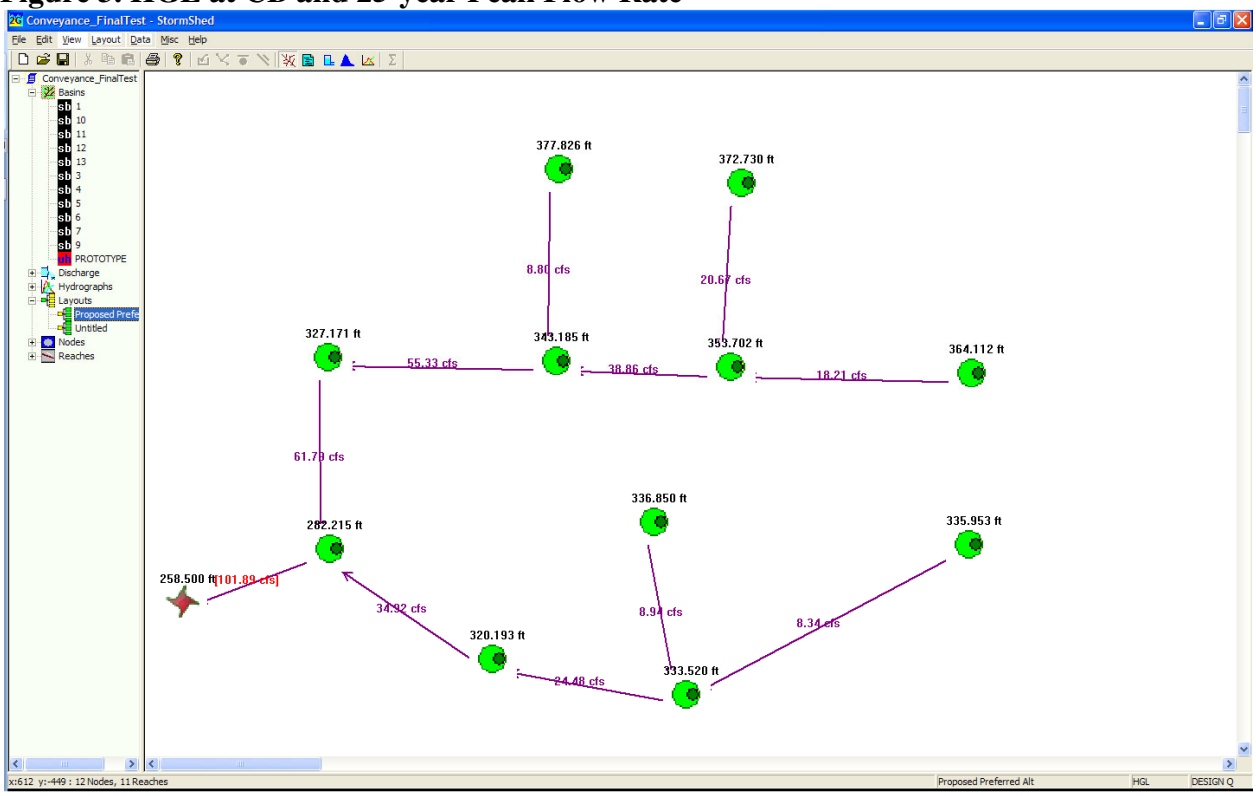


Figure 3. HGL at CB and 25-year Peak Flow Rate



History Cleared: 13:26:05 Friday, April 15, 2011

ROUTEHYD [] THRU [Proposed Preferred Alt] USING TYPE1A AND [25 year] NOTZERO RELATIVE SCS/SBUH

Reach ID	Area (ac)	Flow (cfs)	Full Q (cfs)	Full ratio	nDepth (ft)	Size	nVel (ft/s)	fVel (ft/s)	CBasin / Hyd
P-006	19.9000	8.9390	10.8248	0.83	1.0389	18" Diam	6.8445	6.1256	6
P-007	16.9000	8.3385	12.5181	0.67	1.1929	24" Diam	4.2671	3.9846	7
P-011	50.0000	24.4783	50.9399	0.48	0.9771	24" Diam	16.0524	16.2147	11
P-011A	66.6000	34.9215	51.0254	0.68	1.2144	24" Diam	17.4940	16.2419	13
P-012	18.0300	8.7961	11.5595	0.76	0.9789	18" Diam	7.2011	6.5413	12
P-001	44.4800	20.6655	28.6632	0.72	1.2573	24" Diam	9.9367	9.1238	1
P-009	32.7200	18.2062	22.6394	0.80	1.3579	24" Diam	8.0167	7.2064	9
P-01A	77.2000	38.8614	44.5548	0.87	1.8069	30" Diam	10.2289	9.0766	
P-004	113.6500	55.3268	88.7341	0.62	1.7157	36" Diam	13.2388	12.5533	4
P-003	135.3700	61.7918	110.07	0.56	1.3400	30" Diam	23.0632	22.4225	3
P-005	211.2600	101.89	99.6277	1.02	-----	30" Diam	20.7577	20.2960	5

From Node	To Node	Rch Loss (ft)	App (ft)	Bend (ft)	Junct Loss (ft)	HW Loss Elev (ft)	Max El (ft)
							258.5000
No approach losses at node N-003 because inverts and/or crowns are offset.							
N-005	Outfall	282.2148	------	------	------	282.2148	284.5200
N-011A	N-005	321.0049	0.9427	0.1312	------	320.1934	320.9600
No approach losses at node N-006 because inverts and/or crowns are offset.							
N-011	N-011A	333.5197	------	------	------	333.5197	335.3100
N-006	N-011	336.8504	------	------	------	336.8504	340.0000
N-007	N-011	335.9533	------	------	------	335.9533	367.6300
No approach losses at node N-004 because inverts and/or crowns are offset.							
N-003	N-005	327.1708	------	------	------	327.1708	328.2700
N-004	N-003	343.9864	0.9732	0.0055	0.1666	343.1853	350.7800
N-012	N-004	377.8257	------	------	------	377.8257	380.0000
N-01A	N-004	353.1676	0.6719	0.8655	0.3412	353.7023	355.0000
N-001	N-01A	372.7299	------	------	------	372.7299	380.3300
N-009	N-01A	364.1122	------	------	------	364.1122	366.6600

Layout Report: Proposed Preferred Alt

Event	Precip (in)
2 year	2.0000
10 year	3.0000
25 year	3.5000
100 year	4.0000

Reach Records

Record Id: P-001

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0120
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	N-01A	UpNode	N-001
Material	Conc-Spun	Size	24" Diam
Ent Losses	Groove End w/Headwall		
Length	1470.0000 ft	Slope	1.36%
Up Invert	370.0000 ft	Dn Invert	350.0000 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	2.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	350.0000 ft	Dn Invert	370.0000 ft
Match inverts.			

Record Id: P-003

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0120
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	N-005	UpNode	N-003
Material	Conc-Spun	Size	30" Diam
Ent Losses	Groove End w/Headwall		
Length	750.0000 ft	Slope	6.10%
Up Invert	320.7700 ft	Dn Invert	275.0000 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	2.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	275.0000 ft	Dn Invert	320.7700 ft
Match inverts.			

Record Id: P-004

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0120
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	N-003	UpNode	N-004
Material	Conc-Spun	Size	36" Diam
Ent Losses	Groove End w/Headwall		
Length	770.0000 ft	Slope	1.50%
Up Invert	340.0000 ft	Dn Invert	328.4500 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	2.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	328.4500 ft	Dn Invert	340.0000 ft
Match inverts.			

Record Id: P-005

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0120
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	Outfall	UpNode	N-005
Material	Conc-Spun	Size	30" Diam
Ent Losses	Groove End w/Headwall		
Length	300.0000 ft	Slope	5.00%
Up Invert	271.0000 ft	Dn Invert	256.0000 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	2.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	256.0000 ft	Dn Invert	271.0000 ft
Match inverts.			

Record Id: P-006

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0120
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	N-011	UpNode	N-006
Material	Conc-Spun	Size	18" Diam
Ent Losses	Groove End w/Headwall		
Length	450.0000 ft	Slope	0.90%
Up Invert	335.0000 ft	Dn Invert	330.9500 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	2.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	330.9500 ft	Dn Invert	335.0000 ft
Match inverts.			

Record Id: P-007

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0120
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	N-011	UpNode	N-007
Material	Conc-Spun	Size	24" Diam
Ent Losses	Groove End w/Headwall		
Length	2000.0000 ft	Slope	0.26%
Up Invert	332.6300 ft	Dn Invert	327.4400 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	2.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	327.4400 ft	Dn Invert	332.6300 ft
Match inverts.			

Record Id: P-009

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0120
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	N-01A	UpNode	N-009
Material	Conc-Spun	Size	24" Diam
Ent Losses	Groove End w/Headwall		
Length	820.0000 ft	Slope	0.85%
Up Invert	361.6600 ft	Dn Invert	354.7000 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	2.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	354.7000 ft	Dn Invert	361.6600 ft
Match inverts.			

Record Id: P-011

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0120
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	N-011A	UpNode	N-011
Material	Conc-Spun	Size	24" Diam
Ent Losses	Groove End w/Headwall		
Length	350.0000 ft	Slope	4.30%
Up Invert	330.3100 ft	Dn Invert	315.2700 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	2.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	315.2700 ft	Dn Invert	330.3100 ft
Match inverts.			

Record Id: P-011A

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0120
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	N-005	UpNode	N-011A
Material	Conc-Spun	Size	24" Diam
Ent Losses	Groove End w/Headwall		
Length	950.0000 ft	Slope	4.31%
Up Invert	315.9600 ft	Dn Invert	275.0000 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	2.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	275.0000 ft	Dn Invert	315.9600 ft
Match inverts.			

Record Id: P-012

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0120
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	N-004	UpNode	N-012
Material	Conc-Spun	Size	18" Diam
Ent Losses	Groove End w/Headwall		
Length	1900.0000 ft	Slope	1.03%
Up Invert	376.0000 ft	Dn Invert	356.5000 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	2.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	356.5000 ft	Dn Invert	376.0000 ft
Match inverts.			

Record Id: P-01A

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0120
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	N-004	UpNode	N-01A
Material	Conc-Spun	Size	30" Diam
Ent Losses	Groove End w/Headwall		
Length	950.0000 ft	Slope	1.00%
Up Invert	349.5000 ft	Dn Invert	340.0000 ft

Conduit Constraints

Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	2.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	340.0000 ft	Dn Invert	349.5000 ft
Match inverts.			

Node Records

Record Id: N-001

Descrip:	Node	Increment	0.10 ft
Start El.	370.0000 ft	Max El.	380.3300 ft
Classification	Manhole	Structure Type	CB-TYPE 1-48
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	1.5000 ft	Bottom Area	19.6350 sf
Condition	Existing		

Record Id: N-003

Descrip:	Node	Increment	0.10 ft
Start El.	320.7700 ft	Max El.	328.2700 ft
Classification	Manhole	Structure Type	CB-TYPE 1-48
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	1.5000 ft	Bottom Area	19.6350 sf
Condition	Existing		

Record Id: N-004

Descrip:	Node	Increment	0.10 ft
Start El.	340.0000 ft	Max El.	350.7800 ft
Classification	Manhole	Structure Type	CB-TYPE 1-48
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	1.5000 ft	Bottom Area	19.6350 sf
Condition	Existing		

Record Id: N-005

Descrip:	Node	Increment	0.10 ft
Start El.	271.0000 ft	Max El.	284.5200 ft
Classification	Manhole	Structure Type	CB-TYPE 1-48
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	1.5000 ft	Bottom Area	19.6350 sf
Condition	Existing		

Record Id: N-006

Descrip:	Node	Increment	0.10 ft
Start El.	335.0000 ft	Max El.	340.0000 ft
Classification	Manhole	Structure Type	CB-TYPE 1-48
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	1.5000 ft	Bottom Area	19.6350 sf
Condition	Existing		

Record Id: N-007

Descrip:	Node	Increment	0.10 ft
Start El.	332.6300 ft	Max El.	367.6300 ft
Classification	Manhole	Structure Type	CB-TYPE 1-48
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	1.5000 ft	Bottom Area	19.6350 sf
Condition	Existing		

Record Id: N-009

Descrip:	Node	Increment	0.10 ft
Start El.	361.6600 ft	Max El.	366.6600 ft
Classification	Manhole	Structure Type	CB-TYPE 1-48
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	1.5000 ft	Bottom Area	19.6350 sf
Condition	Existing		

Record Id: N-011

Descrip:	Node	Increment	0.10 ft
Start El.	330.3100 ft	Max El.	335.3100 ft
Classification	Manhole	Structure Type	CB-TYPE 1-48
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	1.5000 ft	Bottom Area	19.6350 sf
Condition	Existing		

Record Id: N-011A

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	315.9600 ft	Max El.	320.9600 ft
Classification	Manhole	Structure Type	CB-TYPE 1-48
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	1.5000 ft	Bottom Area	19.6350 sf
Condition	Existing		

Record Id: N-012

Descrip:	Node	Increment	0.10 ft
Start El.	376.0000 ft	Max El.	380.0000 ft
Classification	Manhole	Structure Type	CB-TYPE 1-48
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	1.5000 ft	Bottom Area	19.6350 sf
Condition	Existing		

Record Id: N-01A

Descrip:	Node	Increment	0.10 ft
Start El.	349.5000 ft	Max El.	355.0000 ft
Classification	Manhole	Structure Type	CB-TYPE 1-48
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	1.5000 ft	Bottom Area	19.6350 sf
Condition	Existing		

Record Id: Outfall

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	258.0000 ft	Max El.	270.0000 ft
Dummy Type Node			

1 Event Summary

Event	Peak Q (cfs)	Peak T (hrs)	Hyd Vol (acft)	Area (ac)	Method	Raintype
2 year	10.4257	8.17	5.3837	44.4800	SBUH	TYPE1A
10 year	17.1903	8.17	8.7917	44.4800	SBUH	TYPE1A
25 year	20.6655	8.17	10.5397	44.4800	SBUH	TYPE1A
100 year	24.1797	8.17	12.3061	44.4800	SBUH	TYPE1A

Record Id: 1

Design Method	SBUH	**Rainfall type**	TYPE1A
Hyd Intv	10.00 min	**Peaking Factor**	484.00
		Abstraction Coeff	0.20
Pervious Area (AMC 2)	12.87 ac	**DCIA**	31.61 ac
Pervious CN	82.29	**DC CN**	98.00
Pervious TC	34.79 min	**DC TC**	34.79 min

Pervious CN Calc		
Description	**SubArea**	**Sub cn**
Open spaces, lawns,parks (>75% grass)	6.09 ac	80.00
Open spaces, lawns,parks (>75% grass)	5.98 ac	86.00
Wood/forest land (young 2nd growth/brush)	0.80 ac	72.00
Pervious Composited CN (AMC 2)		82.29

Pervious TC Calc						
Type	**Description**	**Length**	**Slope**	**Coeff**	**Misc**	**TT**
Sheet	Short prairie grass and lawns.: 0.15	250.00 ft	1.60%	0.1500	2.00 in	28.20 min
Shallow	Short grass, pasture and lawns (n=0.030)	280.00 ft	4.30%	0.0300		2.10 min
Channel (interm)	Concrete pipe (n=0.012)	1350.00 ft	1.40%	0.0120		4.48 min
Pervious TC						34.79 min

Directly Connected CN Calc		
Description	**SubArea**	**Sub cn**
Impervious surfaces (pavements, roofs, etc)	6.40 ac	98.00
Impervious surfaces (pavements, roofs, etc)	17.36 ac	98.00
Impervious surfaces (pavements, roofs, etc)	7.85 ac	98.00
DC Composited CN (AMC 2)		98.00

Directly Connected TC Calc						
Type	**Description**	**Length**	**Slope**	**Coeff**	**Misc**	**TT**
Sheet	Short prairie grass and lawns.: 0.15	250.00 ft	1.60%	0.1500	2.00 in	28.20 min
Shallow	Short grass, pasture and lawns (n=0.030)	280.00 ft	4.30%	0.0300		2.10 min
Channel (interm)	Concrete pipe (n=0.012)	1350.00 ft	1.40%	0.0120		4.48 min
Directly Connected TC						34.79min

2 Event Summary

Event	Peak Q (cfs)	Peak T (hrs)	Hyd Vol (acft)	Area (ac)	Method	Raintype
2 year	3.1630	8.00	1.2966	9.9100	SBUH	TYPE1A
10 year	5.0572	8.00	2.0748	9.9100	SBUH	TYPE1A
25 year	6.0178	8.00	2.4707	9.9100	SBUH	TYPE1A
100 year	6.9847	8.00	2.8694	9.9100	SBUH	TYPE1A

Record Id: 2

Design Method	SBUH	**Rainfall type**	TYPE1A
Hyd Intv	10.00 min	**Peaking Factor**	484.00
		Abstraction Coeff	0.20
Pervious Area (AMC 2)	1.67 ac	**DCIA**	8.24 ac
Pervious CN	80.00	**DC CN**	98.00
Pervious TC	17.32 min	**DC TC**	17.32 min

Pervious CN Calc

Description	SubArea	Sub cn
Open spaces, lawns,parks (>75% grass)	1.67 ac	80.00
Pervious Composited CN (AMC 2)		80.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Short prairie grass and lawns.: 0.15	130.00 ft	5.00%	0.1500	2.00 in	10.60 min
Shallow	Paved	1100.00 ft	1.80%	0.0100		6.72 min
Pervious TC						17.32 min

Directly Connected CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	5.50 ac	98.00
Impervious surfaces (pavements, roofs, etc)	2.74 ac	98.00
DC Composited CN (AMC 2)		98.00

Directly Connected TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Short prairie grass and lawns.: 0.15	130.00 ft	5.00%	0.1500	2.00 in	10.60 min
Shallow	Paved	1100.00 ft	1.80%	0.0100		6.72 min
Directly Connected TC						17.32min

3 Event Summary

Event	Peak Q (cfs)	Peak T (hrs)	Hyd Vol (acft)	Area (ac)	Method	Raintype
2 year	2.2713	8.17	1.5895	21.7200	SBUH	TYPE1A
10 year	4.9741	8.17	3.0386	21.7200	SBUH	TYPE1A
25 year	6.4650	8.17	3.8171	21.7200	SBUH	TYPE1A
100 year	8.0129	8.17	4.6183	21.7200	SBUH	TYPE1A

Record Id: 3

Design Method	SBUH	**Rainfall type**	TYPE1A
Hyd Intv	10.00 min	**Peaking Factor**	484.00
		Abstraction Coeff	0.20
Pervious Area (AMC 2)	18.82 ac	**DCIA**	2.90 ac
Pervious CN	83.92	**DC CN**	98.00
Pervious TC	43.73 min	**DC TC**	43.73 min

Pervious CN Calc

Description	SubArea	Sub cn
Open spaces, lawns,parks (>75% grass)	6.51 ac	80.00
Open spaces, lawns,parks (>75% grass)	12.31 ac	86.00
Pervious Composited CN (AMC 2)		83.92

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Short prairie grass and lawns.: 0.15	200.00 ft	0.50%	0.1500	2.00 in	37.57 min
Shallow	Short grass, pasture and lawns (n=0.030)	600.00 ft	2.30%	0.0300		6.16 min
Pervious TC						43.73 min

Directly Connected CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	0.65 ac	98.00
Impervious surfaces (pavements, roofs, etc)	1.91 ac	98.00
Impervious surfaces (pavements, roofs, etc)	0.34 ac	98.00
DC Composited CN (AMC 2)		98.00

Directly Connected TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Short prairie grass and lawns.: 0.15	200.00 ft	0.50%	0.1500	2.00 in	37.57 min
Shallow	Short grass, pasture and lawns (n=0.030)	600.00 ft	2.30%	0.0300		6.16 min
Directly Connected TC						43.73min

4 Event Summary

Event	Peak Q (cfs)	Peak T (hrs)	Hyd Vol (acft)	Area (ac)	Method	Raintype
2 year	3.8254	8.17	2.2405	18.4200	SBUH	TYPE1A
10 year	6.3643	8.17	3.6609	18.4200	SBUH	TYPE1A
25 year	7.6693	8.17	4.3885	18.4200	SBUH	TYPE1A
100 year	8.9888	8.17	5.1233	18.4200	SBUH	TYPE1A

Record Id: 4

Design Method	SBUH	**Rainfall type**	TYPE1A
Hyd Intv	10.00 min	**Peaking Factor**	484.00
		Abstraction Coeff	0.20
Pervious Area (AMC 2)	5.54 ac	**DCIA**	12.88 ac
Pervious CN	83.68	**DC CN**	98.00
Pervious TC	40.31 min	**DC TC**	50.70 min

Pervious CN Calc

Description	SubArea	Sub cn
Open spaces, lawns,parks (>75% grass)	3.40 ac	86.00
Open spaces, lawns,parks (>75% grass)	2.14 ac	80.00
Pervious Composited CN (AMC 2)		83.68

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Short prairie grass and lawns.: 0.15	280.00 ft	1.40%	0.1500	2.00 in	32.57 min
Shallow	Paved	1300.00 ft	1.90%	0.0100		7.73 min
Pervious TC						40.31 min

Directly Connected CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	5.10 ac	98.00
Impervious surfaces (pavements, roofs, etc)	4.92 ac	98.00
Impervious surfaces (pavements, roofs, etc)	2.86 ac	98.00
DC Composited CN (AMC 2)		98.00

Directly Connected TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Cultivated Soil w/ residue cover (s>20%)..: 0.17	280.00 ft	1.40%	0.1700	2.00 in	36.01 min
Shallow	Short grass, pasture and lawns (n=0.030)	1300.00 ft	1.90%	0.0300		14.69 min
Directly Connected TC						50.70min

5 Event Summary

Event	Peak Q (cfs)	Peak T (hrs)	Hyd Vol (acft)	Area (ac)	Method	Raintype
2 year	2.8289	8.00	1.1387	9.2900	SBUH	TYPE1A
10 year	4.6317	8.00	1.8519	9.2900	SBUH	TYPE1A
25 year	5.5558	8.00	2.2174	9.2900	SBUH	TYPE1A
100 year	6.4899	8.00	2.5865	9.2900	SBUH	TYPE1A

Record Id: 5

Design Method	SBUH	**Rainfall type**	TYPE1A
Hyd Intv	10.00 min	**Peaking Factor**	484.00
		Abstraction Coeff	0.20
Pervious Area (AMC 2)	2.45 ac	**DCIA**	6.84 ac
Pervious CN	81.44	**DC CN**	98.00
Pervious TC	15.25 min	**DC TC**	15.25 min

Pervious CN Calc

Description	SubArea	Sub cn
Open spaces, lawns,parks (>75% grass)	0.59 ac	86.00
Open spaces, lawns,parks (>75% grass)	1.86 ac	80.00
Pervious Composited CN (AMC 2)		81.44

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Short prairie grass and lawns.: 0.15	200.00 ft	5.50%	0.1500	2.00 in	14.40 min
Shallow	Short grass, pasture and lawns (n=0.030)	250.00 ft	20.80%	0.0300		0.85 min
Pervious TC						15.25 min

Directly Connected CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	2.37 ac	98.00
Impervious surfaces (pavements, roofs, etc)	0.92 ac	98.00
Impervious surfaces (pavements, roofs, etc)	3.55 ac	98.00
DC Composited CN (AMC 2)		98.00

Directly Connected TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Short prairie grass and lawns.: 0.15	200.00 ft	5.50%	0.1500	2.00 in	14.40 min
Shallow	Short grass, pasture and lawns (n=0.030)	250.00 ft	20.80%	0.0300		0.85 min
Directly Connected TC						15.25min

6 Event Summary

Event	Peak Q (cfs)	Peak T (hrs)	Hyd Vol (acft)	Area (ac)	Method	Raintype
2 year	4.7747	8.17	2.7704	19.9000	SBUH	TYPE1A
10 year	7.5487	8.17	4.3851	19.9000	SBUH	TYPE1A
25 year	8.9390	8.17	5.1998	19.9000	SBUH	TYPE1A
100 year	10.3301	8.17	6.0172	19.9000	SBUH	TYPE1A

Record Id: 6

Design Method	SBUH	**Rainfall type**	TYPE1A
Hyd Intv	10.00 min	**Peaking Factor**	484.00
		Abstraction Coeff	0.20
Pervious Area (AMC 2)	2.23 ac	**DCIA**	17.67 ac
Pervious CN	86.00	**DC CN**	98.00
Pervious TC	52.81 min	**DC TC**	52.81 min

Pervious CN Calc

Description	SubArea	Sub cn
Open spaces, lawns,parks (>75% grass)	2.23 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Short prairie grass and lawns.: 0.15	300.00 ft	0.70%	0.1500	2.00 in	45.42 min
Shallow	Short grass, pasture and lawns (n=0.030)	450.00 ft	0.90%	0.0300		7.39 min
Pervious TC						52.81 min

Directly Connected CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	13.90 ac	98.00
Impervious surfaces (pavements, roofs, etc)	3.77 ac	98.00
DC Composited CN (AMC 2)		98.00

Directly Connected TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Short prairie grass and lawns.: 0.15	300.00 ft	0.70%	0.1500	2.00 in	45.42 min
Shallow	Short grass, pasture and lawns (n=0.030)	450.00 ft	0.90%	0.0300		7.39 min
Directly Connected TC						52.81min

7 Event Summary

Event	Peak Q (cfs)	Peak T (hrs)	Hyd Vol (acft)	Area (ac)	Method	Raintype
2 year	4.2411	8.17	2.1148	16.9000	SBUH	TYPE1A
10 year	6.9561	8.17	3.4397	16.9000	SBUH	TYPE1A
25 year	8.3385	8.17	4.1155	16.9000	SBUH	TYPE1A
100 year	9.7299	8.17	4.7966	16.9000	SBUH	TYPE1A

Record Id: 7

Design Method	SBUH	**Rainfall type**	TYPE1A
Hyd Intv	10.00 min	**Peaking Factor**	484.00
		Abstraction Coeff	0.20
Pervious Area (AMC 2)	4.98 ac	**DCIA**	11.92 ac
Pervious CN	86.00	**DC CN**	98.00
Pervious TC	32.36 min	**DC TC**	32.36 min

Pervious CN Calc

Description	SubArea	Sub cn
Open spaces, lawns,parks (>75% grass)	4.98 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Short prairie grass and lawns.: 0.15	250.00 ft	1.60%	0.1500	2.00 in	28.20 min
Shallow	Short grass, pasture and lawns (n=0.030)	520.00 ft	3.80%	0.0300		4.15 min
Pervious TC						32.36 min

Directly Connected CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	9.45 ac	98.00
Impervious surfaces (pavements, roofs, etc)	2.47 ac	98.00
DC Composited CN (AMC 2)		98.00

Directly Connected TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Short prairie grass and lawns.: 0.15	250.00 ft	1.60%	0.1500	2.00 in	28.20 min
Shallow	Short grass, pasture and lawns (n=0.030)	520.00 ft	3.80%	0.0300		4.15 min
Directly Connected TC						32.36min

9 Event Summary

Event	Peak Q (cfs)	Peak T (hrs)	Hyd Vol (acft)	Area (ac)	Method	Raintype
2 year	9.6179	8.17	4.3985	32.7200	SBUH	TYPE1A
10 year	15.3232	8.17	7.0229	32.7200	SBUH	TYPE1A
25 year	18.2062	8.00	8.3518	32.7200	SBUH	TYPE1A
100 year	21.1026	8.00	9.6872	32.7200	SBUH	TYPE1A

Record Id: 9

Design Method	SBUH	**Rainfall type**	TYPE1A
Hyd Intv	10.00 min	**Peaking Factor**	484.00
		Abstraction Coeff	0.20
Pervious Area (AMC 2)	5.69 ac	**DCIA**	27.03 ac
Pervious CN	85.98	**DC CN**	98.00
Pervious TC	25.17 min	**DC TC**	25.17 min

Pervious CN Calc

Description	SubArea	Sub cn
Open spaces, lawns,parks (>75% grass)	5.67 ac	86.00
Open spaces, lawns,parks (>75% grass)	0.02 ac	80.00
Pervious Composited CN (AMC 2)		85.98

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Short prairie grass and lawns.: 0.15	200.00 ft	2.50%	0.1500	2.00 in	19.74 min
Shallow	Short grass, pasture and lawns (n=0.030)	130.00 ft	2.30%	0.0300		1.34 min
Shallow	Paved	600.00 ft	2.70%	0.0100		2.99 min
Channel (interm)	Concrete pipe (n=0.012)	400.00 ft	2.00%	0.0120		1.11 min
Pervious TC						25.17 min

Directly Connected CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	18.24 ac	98.00
Impervious surfaces (pavements, roofs, etc)	8.79 ac	98.00
DC Composited CN (AMC 2)		98.00

Directly Connected TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Short prairie grass and lawns.: 0.15	200.00 ft	2.50%	0.1500	2.00 in	19.74 min
Shallow	Short grass, pasture and lawns (n=0.030)	130.00 ft	2.30%	0.0300		1.34 min
Shallow	Paved	600.00 ft	2.70%	0.0100		2.99 min
Channel (interm)	Concrete pipe (n=0.012)	400.00 ft	2.00%	0.0120		1.11 min
Directly Connected TC						25.17min

10 Event Summary

Event	Peak Q (cfs)	Peak T (hrs)	Hyd Vol (acft)	Area (ac)	Method	Raintype
2 year	14.2083	8.00	5.6225	52.7900	SBUH	TYPE1A
10 year	24.4884	8.00	9.4609	52.7900	SBUH	TYPE1A
25 year	29.8801	8.00	11.4593	52.7900	SBUH	TYPE1A
100 year	35.3817	8.00	13.4918	52.7900	SBUH	TYPE1A

Record Id: 10

Design Method	SBUH	**Rainfall type**	TYPE1A
Hyd Intv	10.00 min	**Peaking Factor**	484.00
		Abstraction Coeff	0.20
Pervious Area (AMC 2)	22.30 ac	**DCIA**	30.49 ac
Pervious CN	80.89	**DC CN**	98.00
Pervious TC	11.96 min	**DC TC**	11.96 min

Pervious CN Calc

Description	SubArea	Sub cn
Open spaces, lawns,parks (>75% grass)	19.00 ac	80.00
Open spaces, lawns,parks (>75% grass)	3.30 ac	86.00
Pervious Composited CN (AMC 2)		80.89

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Shallow	Paved	250.00 ft	2.00%	0.0100		1.45 min
Channel (interm)	Concrete pipe (n=0.012)	1550.00 ft	5.30%	0.0120		2.64 min
Channel (interm)	Concrete pipe (n=0.012)	550.00 ft	1.50%	0.0120		1.76 min
Channel (interm)	Concrete pipe (n=0.012)	1100.00 ft	0.50%	0.0120		6.11 min
Pervious TC						11.96 min

Directly Connected CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	1.39 ac	98.00
Impervious surfaces (pavements, roofs, etc)	15.40 ac	98.00
Impervious surfaces (pavements, roofs, etc)	13.70 ac	98.00
DC Composited CN (AMC 2)		98.00

Directly Connected TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Shallow	Paved	250.00 ft	2.00%	0.0100		1.45 min
Channel (interm)	Concrete pipe (n=0.012)	1550.00 ft	5.30%	0.0120		2.64 min
Channel (interm)	Concrete pipe (n=0.012)	1100.00 ft	0.50%	0.0120		6.11 min
Channel (interm)	Concrete pipe (n=0.012)	550.00 ft	1.50%	0.0120		1.76 min
Directly Connected TC						11.96min

11 Event Summary

Event	Peak Q (cfs)	Peak T (hrs)	Hyd Vol (acft)	Area (ac)	Method	Raintype
2 year	3.9121	8.17	1.8753	13.2000	SBUH	TYPE1A
10 year	6.1050	8.17	2.9502	13.2000	SBUH	TYPE1A
25 year	7.2008	8.17	3.4916	13.2000	SBUH	TYPE1A
100 year	8.2963	8.17	4.0345	13.2000	SBUH	TYPE1A

Record Id: 11

Design Method	SBUH	**Rainfall type**	TYPE1A
Hyd Intv	10.00 min	**Peaking Factor**	484.00
		Abstraction Coeff	0.20
Pervious Area (AMC 2)	0.79 ac	**DCIA**	12.41 ac
Pervious CN	81.22	**DC CN**	98.00
Pervious TC	31.21 min	**DC TC**	31.21 min

Pervious CN Calc		
Description	**SubArea**	**Sub cn**
Open spaces, lawns,parks (>75% grass)	0.16 ac	86.00
Open spaces, lawns,parks (>75% grass)	0.63 ac	80.00
Pervious Composited CN (AMC 2)		81.22

Pervious TC Calc						
Type	**Description**	**Length**	**Slope**	**Coeff**	**Misc**	**TT**
Sheet	Short prairie grass and lawns.: 0.15	200.00 ft	1.00%	0.1500	2.00 in	28.47 min
Shallow	Paved	350.00 ft	1.10%	0.0100		2.74 min
Pervious TC						31.21 min

Directly Connected CN Calc		
Description	**SubArea**	**Sub cn**
Impervious surfaces (pavements, roofs, etc)	1.31 ac	98.00
Impervious surfaces (pavements, roofs, etc)	5.58 ac	98.00
Impervious surfaces (pavements, roofs, etc)	5.52 ac	98.00
DC Composited CN (AMC 2)		98.00

Directly Connected TC Calc						
Type	**Description**	**Length**	**Slope**	**Coeff**	**Misc**	**TT**
Sheet	Short prairie grass and lawns.: 0.15	200.00 ft	1.00%	0.1500	2.00 in	28.47 min
Shallow	Paved	350.00 ft	1.10%	0.0100		2.74 min
Directly Connected TC						31.21min

12 Event Summary

Event	Peak Q (cfs)	Peak T (hrs)	Hyd Vol (acft)	Area (ac)	Method	Raintype
2 year	4.6749	8.17	2.4291	18.0300	SBUH	TYPE1A
10 year	7.4137	8.17	3.8629	18.0300	SBUH	TYPE1A
25 year	8.7961	8.17	4.5897	18.0300	SBUH	TYPE1A
100 year	10.1844	8.17	5.3207	18.0300	SBUH	TYPE1A

Record Id: 12

Design Method	SBUH	**Rainfall type**	TYPE1A
Hyd Intv	10.00 min	**Peaking Factor**	484.00
		Abstraction Coeff	0.20
Pervious Area (AMC 2)	2.35 ac	**DCIA**	15.68 ac
Pervious CN	80.08	**DC CN**	98.00
Pervious TC	38.55 min	**DC TC**	38.55 min

Pervious CN Calc

Description	SubArea	Sub cn
Open spaces, lawns,parks (>75% grass)	2.32 ac	80.00
Open spaces, lawns,parks (>75% grass)	0.03 ac	86.00
Pervious Composited CN (AMC 2)		80.08

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Short prairie grass and lawns.: 0.15	300.00 ft	2.00%	0.1500	2.00 in	29.85 min
Shallow	Short grass, pasture and lawns (n=0.030)	500.00 ft	0.80%	0.0300		8.71 min
Pervious TC						38.55 min

Directly Connected CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	0.37 ac	98.00
Impervious surfaces (pavements, roofs, etc)	2.14 ac	98.00
Impervious surfaces (pavements, roofs, etc)	13.17 ac	98.00
DC Composited CN (AMC 2)		98.00

Directly Connected TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Short prairie grass and lawns.: 0.15	300.00 ft	2.00%	0.1500	2.00 in	29.85 min
Shallow	Short grass, pasture and lawns (n=0.030)	500.00 ft	0.80%	0.0300		8.71 min
Directly Connected TC						38.55min

13 Event Summary

Event	Peak Q (cfs)	Peak T (hrs)	Hyd Vol (acft)	Area (ac)	Method	Raintype
2 year	6.0184	8.00	2.4544	16.6000	SBUH	TYPE1A
10 year	9.2869	8.00	3.8293	16.6000	SBUH	TYPE1A
25 year	10.9081	8.00	4.5186	16.6000	SBUH	TYPE1A
100 year	12.5236	8.00	5.2082	16.6000	SBUH	TYPE1A

Record Id: 13

Design Method	SBUH	**Rainfall type**	TYPE1A
Hyd Intv	10.00 min	**Peaking Factor**	484.00
		Abstraction Coeff	0.20
Pervious Area (AMC 2)	0.00 ac	**DCIA**	16.60 ac
Pervious CN	0.00	**DC CN**	98.00
Pervious TC	18.84 min	**DC TC**	18.84 min

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Short prairie grass and lawns.: 0.15	128.40 ft	3.12%	0.1500	2.00 in	12.67 min
Shallow	Paved	165.80 ft	2.41%	0.0100		0.88 min
Channel (interm)	Concrete pipe (n=0.012)	847.00 ft	5.87%	0.0120		1.37 min
Channel (interm)	Concrete pipe (n=0.012)	1770.00 ft	3.14%	0.0120		3.92 min
Pervious TC						18.84 min

Directly Connected CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	16.60 ac	98.00
DC Composited CN (AMC 2)		98.00

Directly Connected TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Short prairie grass and lawns.: 0.15	128.40 ft	3.12%	0.1500	2.00 in	12.67 min
Shallow	Paved	165.80 ft	2.41%	0.0100		0.88 min
Channel (interm)	Concrete pipe (n=0.012)	847.00 ft	5.87%	0.0120		1.37 min
Channel (interm)	Concrete pipe (n=0.012)	1770.00 ft	3.14%	0.0120		3.92 min
Directly Connected TC						18.84min