EXECUTIVE SUMMARY

King County has developed proposals to control combined sewer overflows (CSOs) at two locations in West Seattle—the Barton and Murray CSO basins. One project is the construction of a new 1.0-million-gallon storage tank on the east side of Beach Drive SW near Lowman Beach Park to control CSOs in the Murray CSO basin. The other is the installation of rain gardens in the right-of-way along 32 to 64 half-blocks in the Sunrise Heights and Westwood neighborhoods east of 35th Avenue SW to control overflows in the Barton CSO basin.

The *Barton and Murray Combined Sewer Overflow Control Facilities Plan* describes the reasons for these projects, the processes used to develop and evaluate alternatives, and the selection of proposed alternatives to advance for further environmental review.

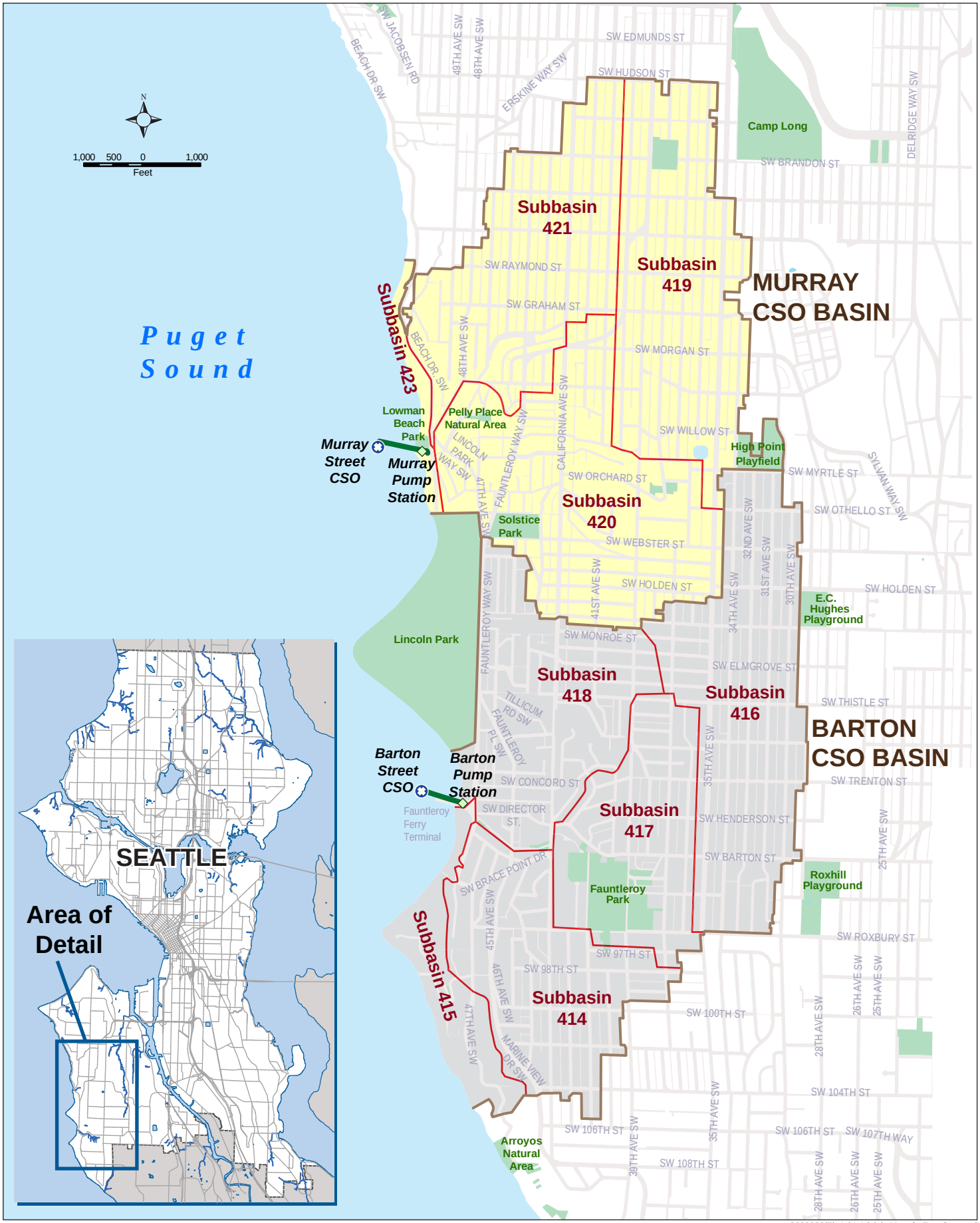
1.1 BACKGROUND

The Barton and Murray CSO basins cover 1,111 acres and 1,006 acres, respectively, along Puget Sound in West Seattle (see Figure 1.1). The basins drain to the Barton Pump Station near the Fauntleroy Ferry Terminal and the Murray Pump Station at Lowman Beach Park, respectively. The Barton Pump Station pumps flows to the Murray Pump Station. In the Barton CSO basin, the peak wet-weather flow is approximately 93 million gallons per day (mgd) and the pump station's capacity is 26 mgd (with plans in place for increasing the capacity to 33 mgd). In the Murray CSO basin, the peak wet-weather flow is approximately 105 mgd and the pump station's capacity is 31.5 mgd.

When flows from the basins exceed the capacity of the pump stations, the excess is discharged untreated through CSO outfalls to Puget Sound. Between the years of 2000 and 2007, the Barton CSO basin experienced an average of four untreated overflows per year. During this same time period, the Murray CSO basin experienced an average of five untreated overflows per year.

In Washington State, the control of CSOs is governed by the following codes:

- **Revised Code of Washington (RCW) 90.48.480:** This law requires "the greatest reasonable reduction" of combined sewer overflows.
- **Washington Administrative Code (WAC) 173-245-020 (22):** This law defines "the greatest reasonable reduction" as "control of each CSO in such a way that an average of one untreated discharge may occur per year."



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BARTON AND MURRAY COMBINED SEWER OVERFLOW CONTROL FACILITIES PLAN

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Figure 1.1.
BARTON AND MURRAY CSO BASINS VICINITY

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Under these requirements, CSOs must be controlled to an average of no more than one untreated discharge per year per outfall, based on a long-term average. This Facility Plan outlines improvements to the sewer systems serving the Barton and Murray CSO basins that are necessary to control CSOs in compliance with the RCW and WAC. The following general CSO control approaches were evaluated:

- Storage.
- Convey-and-Treat.
- End-of-Pipe Treatment.
- Peak-Flow Reduction.
- A combination of these approaches.

1.2 BASIS OF PLANNING

The Barton and Murray CSO basins flows were generated using a basin model that was calibrated against historical flow monitoring data. The calibrated models were used to determine peak wet-weather flows and volumes, which were derived from a 30-year long-term simulation for the period from January 1, 1978 to June 13, 2008. Based on the modeled flows, the required storage volume and peak flow rate were determined for the two basins. Table 1.1 summarizes the resulting basis-of-planning requirements.

Table 1.1 Basis of Planning Criteria for Barton and Murray CSO Basins

	Barton	Murray
Required Capacity at Peak Flow	45 mgd(4)	60 mgd(4)
Existing Capacity	33 mgd(1)	31.5 mgd
	Required Volume or Capacity[4]	
Storage Control Approach at Bottom of Basin	0.11 MG(4)	1.0 MG(4)
Storage Control Approach at Mid-Basin	0.22 MG(4)	N/A
Convey and Treat Control Approach	12 mgd(2)	28.5 mgd(2)
End of Pipe Treatment Control Approach	12 mgd(2)	28.5 mgd(2)
Peak Flow Reduction Control Approach – Impervious Disconnection	20%(3)	>75%(3)
Peak Flow Reduction Control Approach – Green Stormwater Infrastructure	Peak flow reduction of 14.6 mgd(4)	N/A

1. Assumes upgrade to Barton Pump Station and that the Barton Pump Station discharges to the Murray Pump Station.
2. Required capacity is the difference between "required capacity at peak flow" and "existing capacity."
3. Represents the percentage of impervious surface currently connected to the combined sewer system in the basin that must be disconnected to eliminate the need for storage.
4. Providing the required storage volume or flow capacity will meet the state criteria of one overflow per year.

1.3 PRELIMINARY ALTERNATIVE DEVELOPMENT

Identification of preliminary alternatives included evaluation of suitable sites for facilities based on technical criteria. The initial screening resulted in identification of several parcels and right-of-way locations meeting the project requirements. Using these potential sites, preliminary alternatives were developed based on the defined control approaches and basis-of-planning requirements. Nine preliminary alternatives were developed for each basin as summarized in Tables 1.2 and 1.3.

1.4 SCREENING OF PRELIMINARY ALTERNATIVES

The preliminary alternatives were refined and evaluated between August 2009 and February 2010, based upon the following criteria:

- Technical feasibility
- Environmental impacts
- Community impacts
- Land use and permitting impacts
- Property acquisition
- Cost
- Operations and maintenance.

The preliminary alternative development and evaluation process resulted in a shortlist of alternatives recommended for further evaluation: Alternatives 1E, 1F and 4A in the Barton CSO basin and Alternatives 1A, 1C and 1F in the Murray CSO basin.

1.5 REFINEMENT OF SHORT-LISTED ALTERNATIVES

After the preliminary alternatives were short-listed to three alternatives per basin, the County held public meetings to present the short-listed alternatives and to receive comments and feedback. The Barton CSO basin public meeting was conducted on March 18, 2010 and the Murray CSO basin public meeting was conducted on March 29, 2010. The County also presented the short-listed alternatives at a regular meeting of the Morgan Junction Community Association on April 21, 2010.

1.5.1 Murray CSO Basin

The County received feedback from the Murray community strongly indicating that the short-listed alternatives were not acceptable. The key concerns involved the following:

- Impacts on Lowman Beach Park
- Impacts on private property
- Concerns that the Murray community was bearing an undue burden because storage facilities were sized to handle flows coming from the Barton Pump Station.

Table 1.2 Barton CSO Basin Preliminary Alternatives

Approach	Alternative	Description
Centralized storage	1A	One 0.11-MG rectangular tank; construction footprint = 65’ x 55’ x 15’
	1B	One 0.11-MG circular tank, 52’ diameter, 14’ deep
	1C	One 0.11-MG storage pipe, 12’ diameter, 150’ long
	1D	One 0.11-MG storage pipe, 12’ diameter, 150’ long
	1E(1)	One 0.11-MG storage pipe, 12’ diameter, 150 long
	1F(1)	One 0.11-MG rectangular tank; construction footprint = 65’ x 55’ x 15’
	1G(1)	One 0.11-MG rectangular tank; construction footprint = 65’ x 55’ x 15’
End-of-Pipe Treatment	3A	12-mgd Actiflo treatment plant; construction footprint = 120’ x 60’ x 15
Peak Flow Reduction	4A	26 acres of impervious roof and street right-of-way area disconnected from combined sewers

1. Alternatives 1E, 1F and 1G are at locations in the mid or upper basin and require more storage than the bottom-of-basin alternatives; however, the mid/upper-basin storage requirement was not calculated prior to development of the preliminary alternatives, so sizing for the preliminary alternatives assumed storage volume equal to that of the bottom-of-basin alternatives

Table 1.3 Murray CSO Basin Preliminary Alternatives

Approach	Alternative	Description
Centralized storage	1A	One 1-MG rectangular tank; construction footprint = 175’ x 90’ x 17’
	1B	One 1-MG circular tank, 110’ diameter, 20’ deep
	1D	One 1-MG storage pipe, 12’ diameter, 1,250’ long
	1E	One 28.5-mgd pump station and one 1-MG rectangular tank; tank construction footprint = 175’ x 90’ x 17’
Distributed Storage	1C	One 0.28-MG storage pipe, 12’ diameter, 350’ long; One 0.72-MG storage pipe, 12’ diameter, 900’ long
	1F	One rectangular tank (0.6 to 1.0 MG) and one storage pipe (0 to 0.4 MG)
Convey & Treat	2A	One 28.5-mgd pump station and 13,350’ of new 42” force main
End-of-Pipe Treatment	3A	28.5-mgd Actiflo treatment plant; construction footprint = 160’ x 80’ x 20
Combination	5A	10 acres of impervious roof and street right-of-way area disconnected from combined sewers; one storage pipe, 12’ diameter, 1,075’ long (0.86 MG)

King County agreed to form a community advisory group (CAG) to help develop alternatives that would meet the County's CSO control needs, address the community's desire to reduce impacts at the bottom of the Murray basin, and provide a solution that meets the needs of both the Barton and Murray basins. The CAG met from June through September 2010 and identified nine new control alternatives. The project team developed technical details to better define these alternatives. These efforts resulted in a group of five CAG alternatives and two project-team alternatives that were evaluated by the CAG in September 2010.

1.5.2 Barton CSO Basin

Between January 2010 and October 2010, the three short-listed alternatives for Barton were further developed by the project team. This included the development of control flows and volumes for mid-basin storage alternatives. The Alternative 4A impervious area disconnection option was refined and developed into a green stormwater infrastructure (GSI) alternative which uses a bioretention (rain garden) system to detain and infiltrate stormwater from the street right-of-way. This work occurred concurrently with the CAG process, although final evaluation of the Barton alternatives was not conducted until the CAG process was complete.

1.6 FINAL EVALUATION AND SELECTION PROCESS

The project team convened several focus group meetings between May 2010 and October 2010. The team reviewed updated and new information about the alternatives. The team refined the criteria questions and evaluation ratings using the results of these meetings. The team then compiled evaluation results from the focus group meetings and convened two project implementation risk assessment workshops in November 2010. Results of the risk assessment were as follows:

- For the Barton CSO basin, Alternatives 1E and 1F had a number of potential high-impact and high-probability risks, as shown in Table 1.4. Barton Alternative 4A had no identified high-probability/high-impact risks.
- For the Murray CSO basin, Alternatives 1A, 1F, and CAG 2-a all had a number of potential high-impact and high-probability risks, as shown in Table 1.5. These risks result in higher cost and schedule risk for these alternatives.

Based on these results, the project team forwarded five alternatives, along with briefings and summary key evaluation considerations, to King County management for a final decision to move forward for further environmental review:

- For the Barton CSO basin:
  - Alternative 1F—Storage at Fauntleroy School
  - Alternative 4A—Green Stormwater Infrastructure (GSI)
- For the Murray CSO basin:
  - Alternative 1A—Storage in Lowman Beach Park
  - Alternative 1F—Beach Drive Area Underground Storage
  - Alternative CAG 2-a—Storage in Lincoln Park Lower Parking Lot

Table 1.4 Barton Short Listed Alternatives Evaluation Summary Data

	Alternative 1E: Pipe Storage in Upper Fauntleroy Way	**Alternative 1F: Tank Storage at Fauntleroy School**	**Alternative 4A: GSI in Sub-basin 416**
Overall Evaluation Ratings	This alternative had the fewest low-impact scores and had some high impact ratings.	This alternative had the most mid-impact ratings and scored in the middle for low-impact ratings.	This alternative had the most low-impact ratings.
Technical Considerations	Mid-basin alternative that requires careful management of flows to ensure CSO control. Storage pipe and infrastructure similar to other county facilities. Shoring, groundwater, and physical space concerns for constructability. Street access required. Increased staffing and maintenance requirements for facilities in the right-of-way and cleaning of pipe configuration.	Mid-basin alternative that requires careful management of flows to ensure CSO control. Buried rectangular storage tank similar to other county facilities. Street access required for maintenance of drop structure and diversion structure. Concern about staff safety and street closure requirements.	Technically the simplest alternative—no wastewater equipment. Flow meter and telemetry optional dependent on desire to install flow meter for long term monitoring. This alternative has opportunity to expand for additional removal of impervious area flows. No significant construction issues or risks beyond typical landscape construction in right-of-way. Routine landscape maintenance and inspection required.
Preliminary Cost Estimates			
Construction	$4,092,000	$4,500,000	$6,900,000 - $8,900,000
Land/Easement	$0	$740,000	$0
Street Use Fee	$1,200,000	$185,000	$1,200,000
Additional Costs	$3,728,000	$4,100,000	$5,100,000 - $5,900,000
Total	**$9,020,000**	**$9,525,000**	**$13,200,000 - $16,000,000**
Community Input	Strong opposition to this alternative.	Support for this alternative from Fauntleroy Community Association, some concerns about temporary parking impacts from tenants.	Although some community members have expressed support for this alternative, some have also raised concerns about increased risk of water intrusion into basements.

Table 1.4 Barton Short Listed Alternatives Evaluation Summary Data

	Alternative 1E: Pipe Storage in Upper Fauntleroy Way	**Alternative 1F: Tank Storage at Fauntleroy School**	**Alternative 4A: GSI in Sub-basin 416**
Real Estate	Concerns about loss of trees and impacts on view from Upper Fauntleroy Way. May need private acquisition if additional space required to accommodate project.	Property owner amenable to providing an easement for siting the tank in the parking lot.	Concerns about loss of parking. Curb bulbs would be at end of blocks where parking is already prohibited.
Land Use, Permits (in addition to typical construction permits)	SDOT street use permit. Local construction permits. Exceptional tree permit.	Council Conditional Use Permit – review process would probably be straightforward. There is community support for this alternative.	SDOT street use (street improvement permit).
Environmental Considerations	Significant archaeological concerns.	Based on site characteristics, site has medium potential to contain archaeological resources.	No known environmental, issues of concern.
Risk Analysis High Impact and High Probability Risks	Archaeological resources found during construction, delaying project. Community protests removal of treasured roses and exceptional trees to County and City Council, delaying project.	Tenant at Fauntleroy School objected to use of site because of fear of loss of business, delaying project.	No 'high-high' risks were identified during the risk analysis.

Table 1.5 Murray Short Listed Alternatives Evaluation Summary Data

	Alternative 1A: Rectangular Storage in Lowman Beach Park	**Alternative 1F: Beach Drive Area Underground Storage**	**CAG Alt. 2-a: Storage in Lincoln Park Lower Parking Lot**
Overall Evaluation Ratings	This alternative had the most high-impact ratings.	This alternative had a mixture of mostly mid-impact and low-impact ratings.	This alternative had a mixture of mostly high-impact and mid-impact ratings.
Technical Considerations	Bottom-of-the-basin alternative that is the most reliable for capturing peak flows and ensuring CSO control. Buried rectangular storage tank similar to other county facilities. Shoring, groundwater, and physical space concerns for construction in park.	Bottom-of-the-basin alternative that is the most reliable for capturing peak flows and ensuring CSO control. Buried rectangular storage tank similar to other county facilities. Shoring, groundwater, and physical space concerns for construction on a small site without spare space for lay-down and staging.	Technically the most complicated alternative—Storage at two locations relying on telemetry and predictive control algorithms to divert flow to storage. Air management would be a challenge at the Lincoln Park parking lot storage tank. Emergency overflow to local sewer required. Fewer groundwater and excavation issues than at the bottom of the basin locations.
Preliminary Cost Estimates			
Construction	$15,800,000	$17,700,000	$23,500,000
Land/Easement	$9,000,000	$6,400,000	$1,800,000
Street Use Fee	$1,800,000	$1,700,000	$140,000
Additional Costs	$14,000,000	$15,200,000	$19,300,000
Total	**$40,600,000**	**$41,000,000**	**$44,740,000**
Community Input	Strong opposition to this alternative. Seattle Ordinance 118477 requires council approval for construction in the park. Council decision is appealable.	Strong opposition by some community members.	Strong opposition to this alternative. Seattle Ordinance 118477 requires council approval for construction in the park. Council decision is appealable.
Real Estate	Concerns about loss of trees and impacts on view from Lowman Beach Park. Use of park.	Some property owners may not be willing to sell, which would require condemnation under eminent domain. Relocation of tenants.	Concerns about loss of parking and park use/access.

Table 1.5 Murray Short Listed Alternatives Evaluation Summary Data

	Alternative 1A: Rectangular Storage in Lowman Beach Park	**Alternative 1F: Beach Drive Area Underground Storage**	**CAG Alt. 2-a: Storage in Lincoln Park Lower Parking Lot**
Land Use, Permits (in addition to typical construction permits)	Exceptional tree permit. Shoreline Permit Council Conditional Use Permit with DOE approval—The storage tank would be located in a city park designated "Conservancy Recreation" (CR) in Seattle's Shoreline Master Program. Storage is considered a "Utility Service Use." Utility Service Uses are prohibited.	Storage tank in Low-rise Multi-family zoning is allowed if construction can meet same standards identified for Institutions. Utility pipelines and associated underground diversion structure within the park would require a Shoreline Permit.	Council Conditional Use Permit. The storage tank would be located in a city park. The zoning is single-family residential and the overlying Shoreline designation is Conservancy Recreation (CR) and Conservancy Preservation (CP). Storage is considered a utility service use, which is allowed through City Council Conditional Use approval. Storage tanks are prohibited within the CR and CP Shoreline designation but utility pipelines are allowed as a special use.
Environmental Considerations	High probability for site to contain archaeological resources. No anticipated impacts on Pelly Creek.	Site has medium probability of containing archaeological resources. Construction would take place next to steep slopes.	No known archaeological sites but high probability of encountering resources in the proposed locations. Some construction within Shoreline but no construction in beach.
Risk Analysis High Impact and High Probability Risks	Permit appeal successful, delaying project. Rezoning required, delaying project. Park trees need to be removed, delaying project. Community successfully protests project, causing delays.	Differing site conditions encountered during excavation. Replacement of property substantially more expensive than planned.	Permit appeal successful, delaying project. Limited haul routes require substantial restoration and limitations on work hours, delay project completion and high expense. Loss of hydraulic capacity of Barton Pump Station because of flow transition to new storage facility, increase tank size and cost. Community successfully protests project, causing delays.

1.7 PROPOSED ALTERNATIVE

King County management selected the proposed alternatives for further environmental review as described below.

1.7.1 Barton CSO Basin

Barton Alternative 4A Green Stormwater Infrastructure (GSI) was selected for the following reasons:

- Least complex approach for reducing CSOs.
- Reduces the total volume of stormwater that needs to be conveyed and treated in the regional system.
- Responds to interest from some community members in green infrastructure.
- Minimal permitting/zoning issues.
- Property acquisition not required if all work is within right-of-way.

Barton Alternative 4A (GSI) would establish a system of bioretention/bioinfiltration facilities between the sidewalks and streets in the Sunrise Heights and Westwood neighborhoods (Sub-Basin 416). This basin was selected because the area had these following favorable characteristics for implementing GSI:

- Slopes less than 5 percent.
- Good soil conditions for infiltrating water.
- Good local drainage patterns.
- Adequate space within existing planting strips.
- Location on residential streets.

In this facilities plan, the term “rain garden” is used to describe these facilities. These small-scale vegetation-filled depressions use special soil and vegetation to attenuate storm flows and treat stormwater. The rain gardens will be constructed in City of Seattle public right of way and will reduce CSO overflows by capturing and infiltrating rainwater that would otherwise enter the combined sewer system. The project offers these benefits:

- Bioretention soil and vegetation allow stormwater runoff to infiltrate into the ground to reduce the volume of stormwater entering the combined sewer system.
- By maximizing the use of natural processes, the project supports the region's commitment to energy conservation and sustainability.
- King County will work with the neighborhoods to enhance the street’s landscape aesthetics, minimize parking impacts, and respond to applicable neighborhood preferences for the project.

- The project will not require major operating facilities however it may be desirable to install flow metering to monitor effectiveness during storm events.
- This approach reduces the risk of combined sewer overflows at Barton and reduces flows to the Murray CSO basin.

Figure 1.2 shows the key elements of the GSI alternative. Tables 1.6 and 1.7 summarize the project and operation and maintenance (O&M) cost estimates. Table 1.8 outlines the approximate project schedule.

1.7.2 Murray CSO Basin

Murray Alternative 1F was selected for the following reasons:

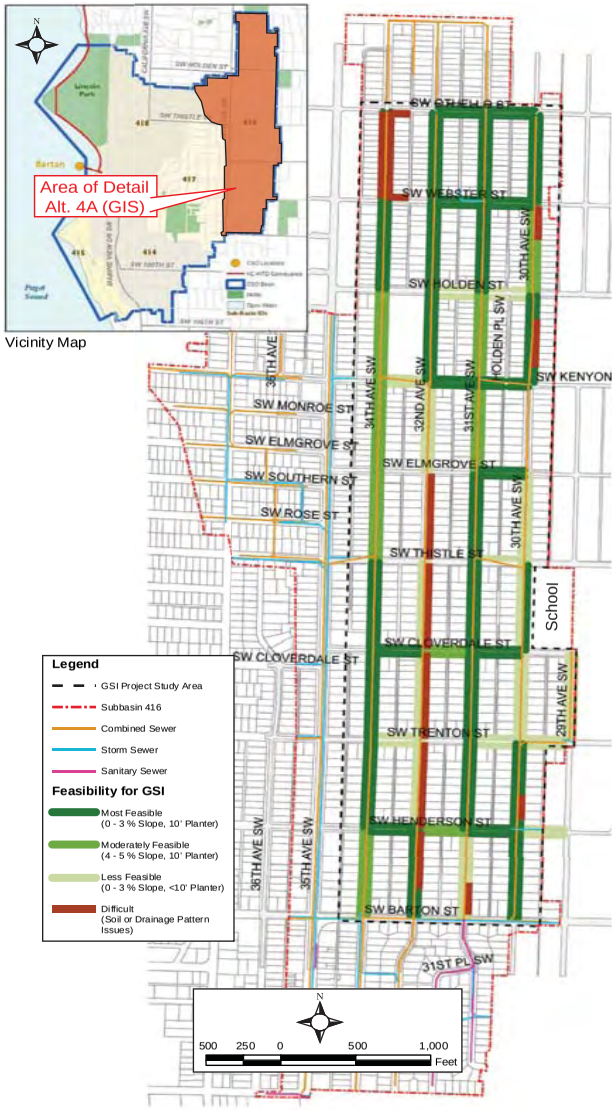
- Simple, reliable system in which gravity diversion of flow fills the storage tank.
- Does not involve tank construction on park property.
- Minimal permitting/zoning issues.
- Lowest schedule and cost risk.

Murray Alternative 1F includes a 1-MG underground storage tank on property that is currently in private ownership across Beach Drive SW from the existing Murray Pump Station. Ancillary facilities would be located on the same site. This alternative offers these advantages:

- There may be opportunities to enhance the surface of the site following construction in a way that benefits the neighborhood (for example, additional green space).
- Surface components of the project and related improvements will be constructed outside of Lowman Beach Park.
- The alternative provides for a single, reliable, facility near the existing pump station.
- The County has been planning upgrades to the Murray Pump Station's electrical and odor control facilities for several years. The proximity of the proposed site to the Murray Pump Station provides an opportunity to serve both the CSO tank and the pump station from a single odor control facility and electrical standby generator at the storage tank site. Combining service functions would reduce the impact on Lowman Beach Park.

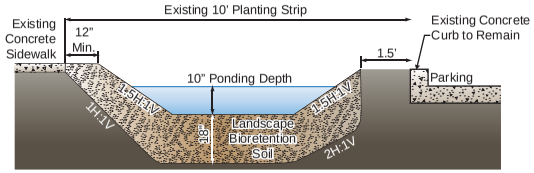
Figure 1.3 shows the key elements of the GSI alternative. Tables 1.9 and 1.10 summarize the project and operation and maintenance (O&M) cost estimates. Table 1.11 outlines the approximate project schedule.

Location Feasibility Diagram



Layout of Rain Garden Cells on a Typical Block

Typical Cross-Sections



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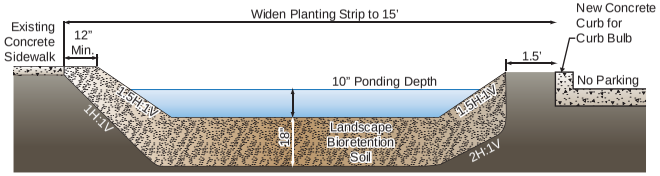

Section 3

Typical Planting Strip

Before Rain Garden Installation

After

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BARTON AND MURRAY COMBINED SEWER OVERFLOW CONTROL FACILITIES PLAN

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Figure 1.2.
BARTON CSO BASIN PROPOSED ALTERNATIVE 4A (GSI): GSI IN SUB-BASIN 416

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Wastewater Treatment Division

Table 1.6 Project Cost Summary for Proposed Barton CSO Basin Project

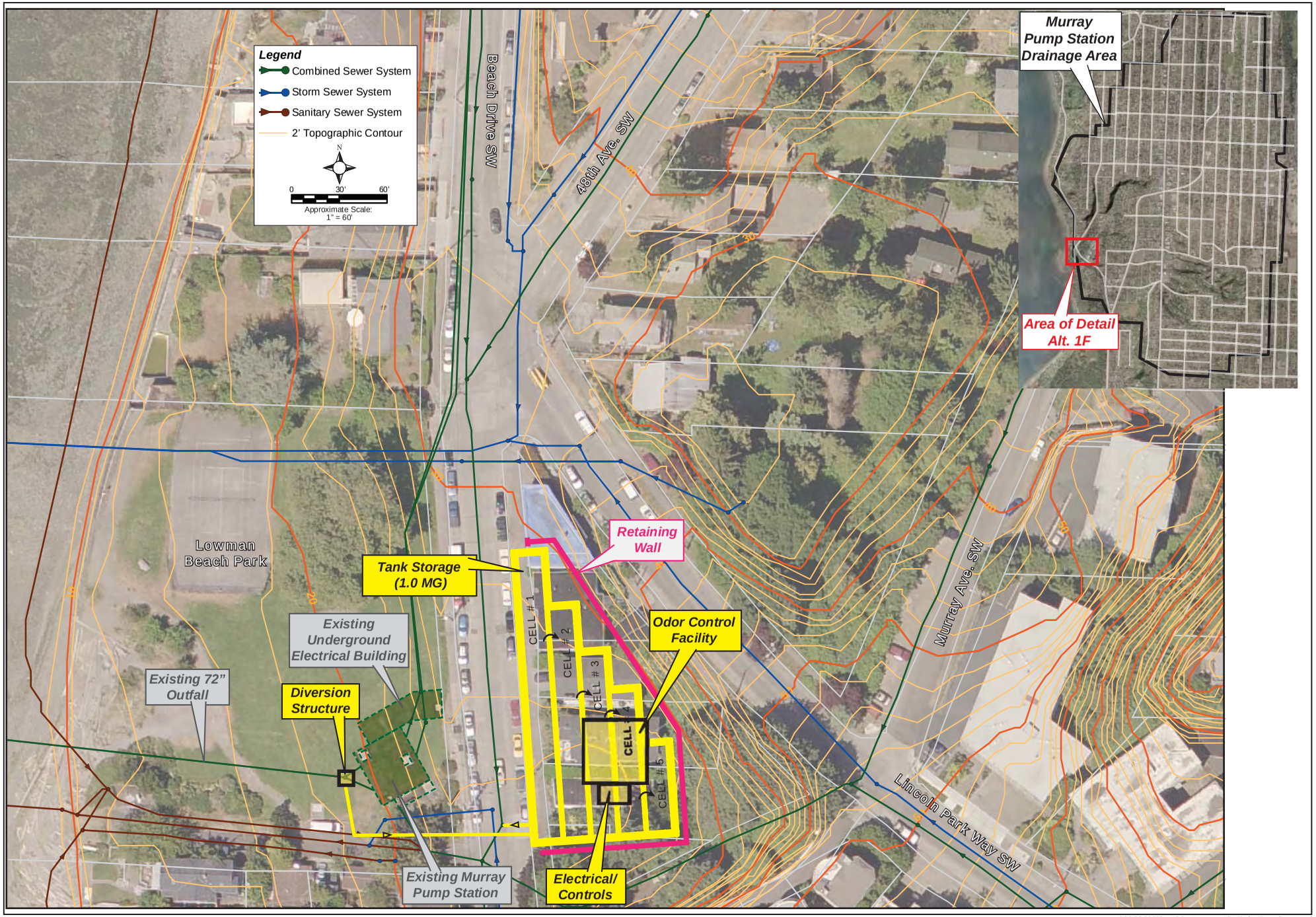
Item	Estimated Cost
Construction	$6.9 M - $8.9 M
Land/Easement (Land, temporary construction easements and construction staging)	$0
Street Use Fee	$1.2 M
Additional Costs (Tax, allied costs, permit fees, and project contingency)	$5.1 M - $5.9 M
Total	**$13.2 M - $16.0 M**

Table 1.7 O&M Cost Summary for Proposed Barton CSO Basin Project

Item	Annual Cost 2014 ($/year)
Operations and Maintenance Labor (Landscape maintenance, tank, diversion structure, ancillary facilities)	$37,300
Flow Monitoring	$7,000
Electricity (ventilation, power)	$0
Chemicals (activated carbon replacement once per two years)	$0
Standby Generator (fuel)	$0
Total	**$44,300**

Table 1.8 Preliminary Project Schedule for Proposed Barton CSO Basin Project

Activity	Anticipated Dates
Facility Plan Development	November 2010 – December 2010
State Environmental Policy Act Threshold Determination	April 2011
Facility Plan Approval	June 2011
Permitting	June 2011 – September 2012
Final Design Consultant Selection	January 2011 – August 2011
Final Design	September 2011 – October 2012
Construction	October 2013 – September 2015
Commissioning	November 2015 – January 2017 (2 wet seasons)



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BARTON AND MURRAY COMBINED SEWER OVERFLOW CONTROL FACILITIES PLAN

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Figure 1.3.
MURRAY CSO BASIN PROPOSED ALTERNATIVE 1F:
BEACH DRIVE AREA UNDERGROUND STORAGE

King County
Department of Natural Resources and Parks
Wastewater Treatment Division

Table 1.9 Project Cost Summary for Proposed Murray CSO Basin Project

Item	Estimated Cost
Construction	$17.7 M
Land/Easement (Land, temporary construction easements and construction staging)	$6.4 M
Street Use Fee	$1.7 M
Additional Costs (Tax, allied costs, permit fees, and project contingency)	$15.2 M
Total	**$41.0 M**

Table 1.10 O&M Cost Summary for Proposed Murray CSO Basin Project

Item	Annual Cost 2014 ($/year)
Operations and Maintenance Labor (Landscape maintenance, tank, diversion structure, ancillary facilities)	$29,300
Electricity (ventilation, power)	$500
Chemicals (activated carbon replacement once per two years)	$21,000
Standby Generator (fuel)	$1,200
Total	**$52,000**

Table 1.11 Preliminary Project Schedule for Proposed Murray CSO Basin Project

Activity	Anticipated Dates
Facility Plan Development	November 2010 – December 2010
State Environmental Policy Act Threshold Determination	April 2011
Facility Plan Report Approval	June 2011
Property Acquisition	June 2011 – September 2012
Permitting	June 2011 – September 2012
Final Design Consultant Selection	January 2011 – September 2011
Final Design	September 2011 – December 2012
Construction	March 2013 – August 2015
Commissioning	October 2015 – May 2016 (2 wet seasons)