

*King County Puget Sound Beach CSO Control Projects
Alternative Screening Workshop for Murray Basin*

Alternative Screening Workshop for Murray Basin

Dec. 9, 2009; Dec. 16, 2009; and Jan. 27, 2010

King Street Center

Summary of Discussion

Attendance

<i>King County</i>		<i>Consultant</i>	<i>SPU</i>
Betsy Cooper	John Phillips	Ellen Blair	Sahba Mohandessi
Hien Dung	Kevin Schock	Jennifer Corrigan	
Pam Erstad	Linda Sullivan	Kevin Dour	
Ron Kohler	Bob Swarner	Jeff Lykken	
Tiffany McClaskey	Martha Tuttle	Brian Matson	
Sue Meyer	Jim Weber	Allen de Steiguer	
Shahrazad Namini	Mary Wohleb	Lloyd Skinner	
Chris Okuda	Monica Van der Vieren	Bob Wheeler	

Purpose of this Summary:

This document provides a summary of the workshop process and captures the discussion themes that supported recommendations for CSO control project alternatives to be forwarded for review by internal management and further development by the project team.

Workshop Process

Team members used a collaborative approach to screen alternative means for CSO control using a range of factors. The work was accomplished through a series of meetings on Dec. 9, 2009; Dec. 16, 2009 and Jan. 27, 2010 and is part of the team evaluation process to identify three CSO control alternatives for further evaluation. Documenting the workshop process is a critical piece of the project.

Workshop Goals and Objectives:

1. Recommend three alternative means for CSO control for the Murray Basin to present the public for input and to develop in more detail, with the remaining alternatives to be tabled at this time.
2. Where possible, recommend a set of alternative means that represents the range of complexity and constraints in the basin.
3. Discuss and document the reasons and rationale for recommendations.

December 9, 2009 Workshop – “Straw Poll”

Materials Available for Workshop

1. Final revised Murray Basin Alternatives summary sheets (1 for each alternative)

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2. Final revised table of selection factors ratings and descriptions of Low, Moderate, and High impact
3. Final revised Alternative Rating Sheets for Murray Basin (summary & expanded to include description of ratings)
4. Summary of major changes to Barton, Murray, and South Magnolia Basin Alternatives and overall selection factors
5. Inventory of Available Property and Property Profiles

Workshop Approach/Agenda

A "Straw Poll" was conducted to generate discussion and help inform the team's recommendations.

An enlarged chart of the screening factors and draft ratings for all alternatives for the Murray basin was posted on the wall. King County staff used dot stickers to indicate the alternatives they thought should be recommended for further evaluation and those they thought should not be recommended. Most importantly, staff also wrote their thoughts on the wall charts as to why certain alternatives should or should not be recommended as well as any questions they might have.

Workshop Outcome

The straw poll provided staff with an initial, visual survey of how their colleagues viewed the alternatives, and provided valuable insight into the reasons for their views. This initial survey and the written thoughts were used to start an in-depth discussion of the alternatives at the Dec. 16, 2009 workshop.

December 16, 2010 – *Initial Murray Alternatives Narrowing*

Materials Available for Workshop

1. Preliminary planning level cost information for comparison purposes for Murray Basin
2. Initial Straw Poll Results

Workshop Approach/Agenda

1. *Review of Initial Straw Poll Results for Murray* (Jeff Lykken, Tetra Tech)
2. *Initial Murray Alternatives Narrowing - Discussion* (facilitated by Bob Wheeler, Triangle Associates)
 - Identify alternatives that clearly do not merit further consideration at this time
 - Identify alternatives that clearly merit further consideration at this time
 - Discussion of remaining alternatives to reduce the recommended number to three
 - Discussion of basis for recommendations on all alternatives
3. *Presentation of Preliminary Planning Level Cost Information for Comparison Purposes* (Kevin Dour, Tetra Tech)
 - Methodology for determining costs
 - Review of methodology for creating comparative cost ratings

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- Discussion of whether cost information changes any of the three alternatives currently identified for further evaluation

4. Team Agreement on 3 Alternative means for CSO control for Further Development
(facilitated by Bob Wheeler, Triangle Associates)

- Survey of team for confidence in recommended alternatives
- Final thoughts on recommendations

Workshop Outcome

King County staff recommended the following alternative means for CSO control to be considered for further development:

- Rectangular Storage, Bottom of Basin (Alternative 1A)
- Distributed Storage Beach Drive & Murray Ave (Alternative 1C)
- Bottom of Basin - Combined Pipe/Rectangular Storage (Alternative 1F)
- Peak Flow Reduction Combined w/Storage (Alternative 5A).

Staff requested additional evaluation of Alternative 5A to determine whether peak flow reduction could be accomplished by roof drain disconnection from the sewer system rather than a combination of residential disconnection and redirection of street flows. Eliminating street flows avoids the potential need for stormwater treatment infrastructure to address water quality requirements. Staff proposed that Alternative 5A be evaluated in parallel if peak flow reduction from rooftops could be used to eliminate the pipe storage in Murray Ave that is part of Alternative 1C.

The engineering basin leads, Jeff Lykken and Kevin Dour, for the Murray Basin supported these choices.

January 27, 2010 - Follow up Meeting

Meeting Approach/Agenda

Alternative 5A was subjected to additional investigation and the results were presented at the January 27, 2010 project team meeting. The project team had considered impervious area disconnection (installation of storm sewers) and green stormwater infrastructure (rain gardens; bioswales) in the Murray basin. Hydraulic modeling indicated that there is not enough connected impervious area available throughout the entire basin to eliminate the need for “gray” infrastructure (storage or treatment). Analysis showed that the required storage volume could be reduced by 15-20% if large areas of connected street runoff and roof runoff were disconnected from the CSO system.

Meeting Outcome

King County staff recommended that Alternative 5A not be further developed at this time since it involves considerably higher costs and does not substantially reduce the challenges of constructing the remaining necessary storage at the bottom of the basin.

Staff recommended that the following alternative means for CSO control be considered for further development:

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- Rectangular Storage, Bottom of Basin (Alternative 1A)
- Distributed Storage Beach Drive & Murray Ave (Alternative 1C)
- Bottom of Basin - Combined Pipe/Rectangular Storage (Alternative 1F)

Summary of Workshop Process Discussion for Murray Basin

Considerations for all CSO Project Basins

- Several issues related to Operations/Maintenance activities were raised:
 - The costs and availability of water to flush storage facilities should be considered during the next phase as alternatives are refined.
 - Using a weir to passively capture flow is simpler than using telemetry and other controls to capture flows, but weirs still require careful design to insure that height is correct for projected flows. Also, Operations staff has to monitor for sedimentation and may need to manage issues.
 - A CSO treatment facility is much more complex operationally than storage.
 - Life cycle costs have not been calculated yet, but O&M costs will be small compared to capital costs for the alternatives.

Considerations for Murray Basin

- An emergency generator and odor control upgrade project is planned for the Murray Pump Station. Further work on this project was deferred until the CSO alternatives in the Murray basin were narrowed to see if there would be opportunities to combine the projects; thereby reducing neighborhood impacts. Combining the upgrade and CSO control projects may reduce community impacts, permitting requirements, and costs. As the CSO control alternatives are narrowed and refined, WTD management will determine if the emergency generator and odor control upgrade project can be combined with the CSO control project.
- The King County Puget Sound Beach CSO Control Projects project manager will review past discussions with Seattle City Light regarding power line extension to provide electricity to facilities.

Considerations for Murray Basin CSO Control Alternatives

Alternative 1A: Rectangular Storage, Bottom of Basin (Recommended for further development)

Design Engineering

- All of the peak flow is captured using passive technology. This is the least technically complex method for CSO control.
- This alternative can be combined with the required emergency generator and odor control project at Murray pump station.
- Some amount of storage or pumping capacity will need to be added at the Murray pump station because of increased flows from the upgraded Barton pump station. This alternative features a single facility that can control CSOs and manage the additional flows from Barton without adding additional pumping capacity at Murray.

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Cost

- Low planning level cost relative to other Murray CSO control alternatives.
- Off-street construction limits avoids permitting costs associated with street right-of-way construction.

Land Use/Permitting

- Sufficient space to accommodate staging and construction.
- May require property acquisition.
- Construction might be required in Lowman Beach Park. The Seattle Dept. of Parks and Recreation has a policy that opposes the use of parks for certain types of utilities. This could impact the project schedule.
- Work is located within shoreline zone. A Plan Shoreline Permit from the City of Seattle may be needed, in which case a formal alternatives analysis would be required. This could extend the project schedule.

Environmental

No discussion. Environmental comments were captured in the evaluation document for the Murray basin CSO control alternatives.

Community Impact

- Off-street construction limits traffic impacts in residential area with limited access.
- Construction would cause temporary reduction in recreational use of Lowman Beach Park.
- Small above-ground facilities may cause limited but permanent reduction in accessible park area.
- Some community members have expressed strong opposition to additional utility work in Lowman Beach Park.
- May require property acquisition.

O&M

- O&M access already exists in the park.

Alternative 1B: Circular Storage, Murray Ave & Lincoln Park Way (Not recommended for further development)

Design Engineering

- About half of basin peak flow is captured using passive technology (with peak flow pump station, 100% of peak would be captured and directed to circular storage tank). Moderate level of technical complexity and operational management compared to other CSO control approaches.
- Soft ground associated with stream flows may be difficult to construct on.

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Cost

- Off-street construction avoids permitting costs associated with street right-of-way construction.

Land Use/Permitting

- Could potentially use City of Seattle-owned property.
- If greenbelt is not used, requires purchase of residential properties.

Environmental

- Potential facility location is designated a critical area (environmental) and permitting could extend the project schedule or make the project infeasible.
- The site has steep slopes which might make it difficult to permit the project.

Community Impact

- Requires peak flow pump station at bottom of basin in addition to the storage facility to pump additional flows from Barton.
- Potential facility location is identified as a greenbelt in a neighborhood plan. Community members may oppose any construction there.
- Off-street construction limits traffic impacts in residential area with limited access.

O&M

- Circular storage requires more frequent maintenance and more staff time than rectangular or pipe storage.

Alternative 1C: Distributed Storage Beach Drive & Murray Ave (Recommended for further development)

Design Engineering

- All of the peak flow is captured using passive technology.
- Two storage facilities are considered technically more complex than a single, bottom of the basin storage facility.
- This alternative can be combined with the planned emergency generator and odor control project at Murray pump station.
- Some amount of storage or pumping capacity will be required at the Murray pump station to accommodate increased flows from the upgraded Barton pump station. This alternative can control peak flows within the Murray basin while accommodating increased flows from Barton without adding additional pumping capacity at Murray.

Cost

- Potential for relocation of utilities in ROW could result in additional construction costs.

Land Use/Permitting

- Project is mostly located within right-of-way. Would not require use of Lowman Beach Park or purchase of residential properties.

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Environmental

- Minimal environmental impacts.

Community Impact

- Project is mostly located within right-of-way. Would not require use of Lowman Beach Park or purchase of residential properties.
- Relocation of sanitary sewer, water and other underground utilities will be required along Beach Drive and Murray Ave SW. This may result in utility disruptions during construction.
- Construction would be very disruptive to street right-of-way for Beach Drive and Murray Ave. However, construction impacts are not static in a single area because of open cut & cover construction.

O&M

- Telemetry and instrumentation will be necessary to predict and capture projected flows. Flow management by telemetry for multiple facilities is more complex compared to passively capturing all of basin flow at one location at the bottom of the basin.
- Access for O&M staff poses traffic control and safety issues. Accessibility would be limited and require traffic control if entry were within the paved road. Site access structures off the roadway could increase project complexity.

Alternative 1D: Bottom of Basin – Tunneling (Not recommended for further development)

Design Engineering

- All of the peak flow is captured using passive technology. This is the least technically complex means to meet the CSO control requirement.
- No on-the-ground geotechnical investigations have been done to confirm that the material is suitable for tunneling. Investigation may show that tunneling is not feasible in this location.
- Tunneling is a more complex construction method than cut-and-cover.
- This alternative can be combined with the planned emergency generator and odor control project at Murray pump station.

Cost

No discussion. Comments related to cost were captured in evaluation document.

Land Use/Permitting

- Any easement requirements for boring under private property were not considered in the selection factors.

Environmental

No discussion. Environmental comments were captured in evaluation document.

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Community Impact

- Tunneling portals would require large areas in a compact, residential neighborhood.
- Construction would completely block Beach Drive near Lowman Beach Park, which is the only access route to residences south of the park.
- Avoids construction in most of Lowman Beach Park. Construction would likely occur in a portion of the park, in the vicinity of the existing Murray pump station.
- Relocation of sanitary sewer, water and other underground utilities would be required along Beach Drive. This may result in utility disruptions.

O&M

No discussion. Comments related to O&M were captured in the evaluation document.

<i>Alternative 1E: Upper Basin Storage (Not recommended for further development)</i>
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Design Engineering

- This alternative can be combined with the planned emergency generator and odor control project at Murray pump station.

Cost

- High cost compared to other Murray CSO control alternatives.

Land Use/Permitting

- Construction might be required in Lowman Beach Park. The Seattle Dept. of Parks and Recreation has a policy that opposes the use of parks for certain types of utilities. This could impact the project schedule.
- Work is located within shoreline zone. A Plan Shoreline Permit from the City of Seattle may be needed, in which case a formal alternatives analysis would be required. This could extend the project schedule.

Environmental

No discussion. Environmental comments were captured in evaluation document.

Community Impact

- 32 mgd pump station would be needed at the bottom of basin.
- Temporary and permanent impacts to multiple areas in the Murray basin. Construction impacts and a permanent facility at the bottom of the basin, construction impacts and a permanent facility in the upper basin, and construction impacts to 2550 lineal feet of street right-of-way.
- Community has historically opposed additional utility location in Lowman Beach Park.
- Relocation of sanitary sewer, water and other underground utilities may be required along Beach Drive. This may result in utility disruptions.

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O&M

- Telemetry and instrumentation will be necessary to monitor and control storage volume in upper basin. Flows would be diverted passively by gravity to peak flow pump station at bottom of basin.

Alternative 1F: Bottom of Basin - Combined Pipe/Rectangular Storage (Recommended for further development)

Design Engineering

- All of the peak flow is captured using passive technology.
- Although this alternative involves multiple facilities, they are located proximal to each other and management is less complicated than distributed storage.
- This alternative can be combined with the planned emergency generator and odor control project at Murray pump station.

Cost

- Low cost relative to other Murray CSO control alternatives.

Land Use/Permitting

- Avoids construction in Lowman Beach Park and in the shoreline zone.
- Requires purchase of residential properties.

Environmental

No discussion. Comments related to environmental issues were captured in the evaluation document.

Community Impact

- Construction would be located in Beach Drive right-of-way resulting in traffic disruptions over a long period of time.
- Relocation of sanitary sewer, water and other underground utilities may be required along Beach Drive. This may result in utility disruptions.
- Requires purchase of residential properties.

O&M

- Multiple facilities will require more maintenance and are not as easy to manage as a single facility.

Alternative 2A: Convey & Treat at Alki (Not recommended for further development)

Design Engineering

- The capacity of the Alki CSO treatment facility and outfall would need to be evaluated and likely upgraded for discharging additional flows to Puget Sound.

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- Would require upgrades to the existing 63rd Street pump station and the Alki treatment facility to handle the additional flows.
- This alternative can be combined with the planned emergency generator and odor control project at Murray pump station.

Cost

- High cost compared to other Murray CSO control alternatives.

Land Use/Permitting

- Work is located within shoreline zone. A Plan Shoreline Permit from the City of Seattle may be needed, in which case a formal alternatives analysis would be required. This could extend the project schedule.
- Construction might be required in Lowman Beach Park. The Seattle Dept. of Parks and Recreation has a policy that opposes the use of parks for certain types of utilities. This could impact the project schedule.

Environmental

- The capacity of the Alki CSO treatment facility and outfall would need to be evaluated and likely upgraded for discharging additional flows to Puget Sound.
- Permitting effluent discharge to Puget Sound could delay the project schedule.

Community Impact

- Construction would be disruptive for residents, park users, and commuters:
 - Construction of 13,500 lineal feet of force main in Beach Drive.
 - Would require upgrades to the existing 63rd Street pump station and the Alki treatment facility to handle the additional flows.
 - Would require construction of a 28.5 mgd peak flow pump station at the bottom of the basin, possibly in Lowman Beach Park.
- If Lowman Beach Park is not used, it would be necessary to purchase residential properties to site the peak flow pump station.
- Community has historically opposed additional utility location in Lowman Beach Park

O&M

No discussion. Comments related to O&M were captured in the evaluation document.

Alternative 3A - End of Pipe Treatment, Bottom of Basin (Not recommended for further development)

Design Engineering

- Technically complex.
- This alternative can be combined with the planned emergency generator and odor control project at Murray pump station.
- This alternative can control CSOs and manage the additional flows from Barton Pump Station without adding additional pumping capacity at Murray.

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Cost

- High cost relative to all other Murray CSO control alternatives.

Land Use/Permitting

- Treatment facility in shoreline is currently prohibited by code.
- Construction might be required in Lowman Beach Park. The Seattle Dept. of Parks and Recreation has a policy that opposes the use of parks for certain types of utilities. This could impact the project schedule.
- If Lowman Beach Park is not used, it would be necessary to purchase residential properties to site the storage facility.

Environmental

- Permitting effluent discharge to Puget Sound could delay the project schedule.

Community Impact

- Community members may object to treatment facility in residential neighborhood.
- Community has historically opposed additional utility location in Lowman Beach Park
- If Lowman Beach Park is not used, it would be necessary to purchase residential properties to site the storage facility.

O&M

- O&M more complicated and time-consuming for staff than storage.

Alternative 5A: Peak Flow Reduction Combined w/Storage (Not recommended for further development)

Design Engineering

- Storage volume required for CSO control will be reduced with effective rooftop disconnection. Flows to West Point Treatment Plant will also be reduced.
- Although more stormwater flows to the Combined Sewer System from streets than from roof drains, there may be enough acreage of connected roof drains to considerably reduce the amount of storage required in the basin.
- While it may take some time to achieve enough roof drain disconnects, the disconnect efforts can begin as soon as the Facility Plan is complete.
- May be challenging to identify sufficient stormwater sources that can be disconnected from the system to reliably reduce the storage volume to meet CSO control requirements.
- Some amount of storage or pumping capacity will need to be added at the Murray pump station because of increased flows from the upgraded Barton pump station. The Beach Drive storage facility can control CSOs and manage the additional flows from Barton Pump Station without adding additional pumping capacity at Murray.
- The Beach Drive storage facility can be combined with the planned emergency generator and odor control project at Murray pump station.

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Cost

- If only areas with existing stormwater systems are targeted to meet the project goal, permitting and construction costs might be lower than initially anticipated because no new stormwater pipes will be needed.

Land Use/Permitting

- The King County CSO Program is interested in roof drain disconnects as a way to control CSOs. Other agencies have had success with roof drain disconnects. The City of Seattle has an operational roof drain disconnect program and they have offered to partner and cost-share with King County to encourage people to redirect their roof drains to the stormwater system in partially separated basins.
- Department of Ecology and EPA have indicated interest in “source control” as a way to control CSOs.
- The storage facility would not require use of Lowman Beach Park or acquisition of residential properties.

Environmental

- If only roof drain disconnection is needed to meet the project goal, and not street disconnection, Department of Ecology does not require additional treatment of stormwater.

Community Impact

- Many community members have expressed interest in an option other than a traditional “gray” facility.
- Project schedule could be considerably delayed because of need to coordinate with City of Seattle and work required on hundreds of private properties.
- Construction of storage facility would be very disruptive to street right-of-way for Beach Drive.
- Relocation of sanitary sewer, water and other underground utilities would be required along Beach Drive. This may result in utility disruptions.

O&M

- Access for O&M staff poses traffic control and safety issues. Accessibility would be limited and require traffic control if entry were within the paved road. Site access structures off the roadway could increase project complexity.

Alternative Narrowing Process

11/23/09

The Purposes of December King County CSO Narrowing Workshops

1. Describe and respond to King County staff clarifying questions related to the narrowing process.
2. Provide an opportunity for King County staff to ask questions and for clarifications of the criteria and ratings and then confirm the criteria and ratings.
3. Conduct an initial straw poll with King County staff of their Alternative preferences
4. Primarily to narrow the 9 alternatives for each Basin to three alternatives that will be further evaluated and considered.
5. Important though is to provide the reasons and justification on why alternatives were and were not selected for public, agency, and participants' understanding.

What Information Will We Have?

1. Final revised Barton, Murray, and South Magnolia Basin Alternatives summary sheets (1 for each alternative).
2. Final revised table of criteria ratings and descriptions of Low, Moderate, and High impact.
3. Final revised Alternative Rating Sheets for Barton, Murray, and South Magnolia Basins (summary & expanded to include description of ratings).
4. Comment logs relating to Barton, Murray, and South Magnolia Basin Alternatives.
5. Summary of major changes to Barton, Murray, and South Magnolia Basin Alternatives and overall evaluation criteria.
6. Cost information for Barton, Murray, and South Magnolia Basins.
7. Community input from public meetings
8. Initial Straw Poll Results (Available after December 9th Workshop)

What process Will We Use?

1. King County staff will ask questions and for clarifications of the criteria and ratings.
2. King County staff will confirm the criteria and the ratings for use in the narrowing of the 9 Alternatives to 3 Alternatives
3. King County staff will participate in an initial Straw Poll of Alternative preferences
4. Directions for Straw Poll Preference Process
 - o For each Basin there will be an enlarged wall chart of the criteria and ratings for all Alternatives for that Basin
 - o For all King County staff, 3 Green Dots and unlimited Red Dots
 - o King County staff place Green Dots on Alternatives that they believe should move forward for further evaluation and consideration, if any
 - o King County staff place Red Dots on Alternatives that should not move forward, if any
 - o King County staff write on wall charts their justifications and rationales for why any Alternative should be considered further or why it should not be considered further

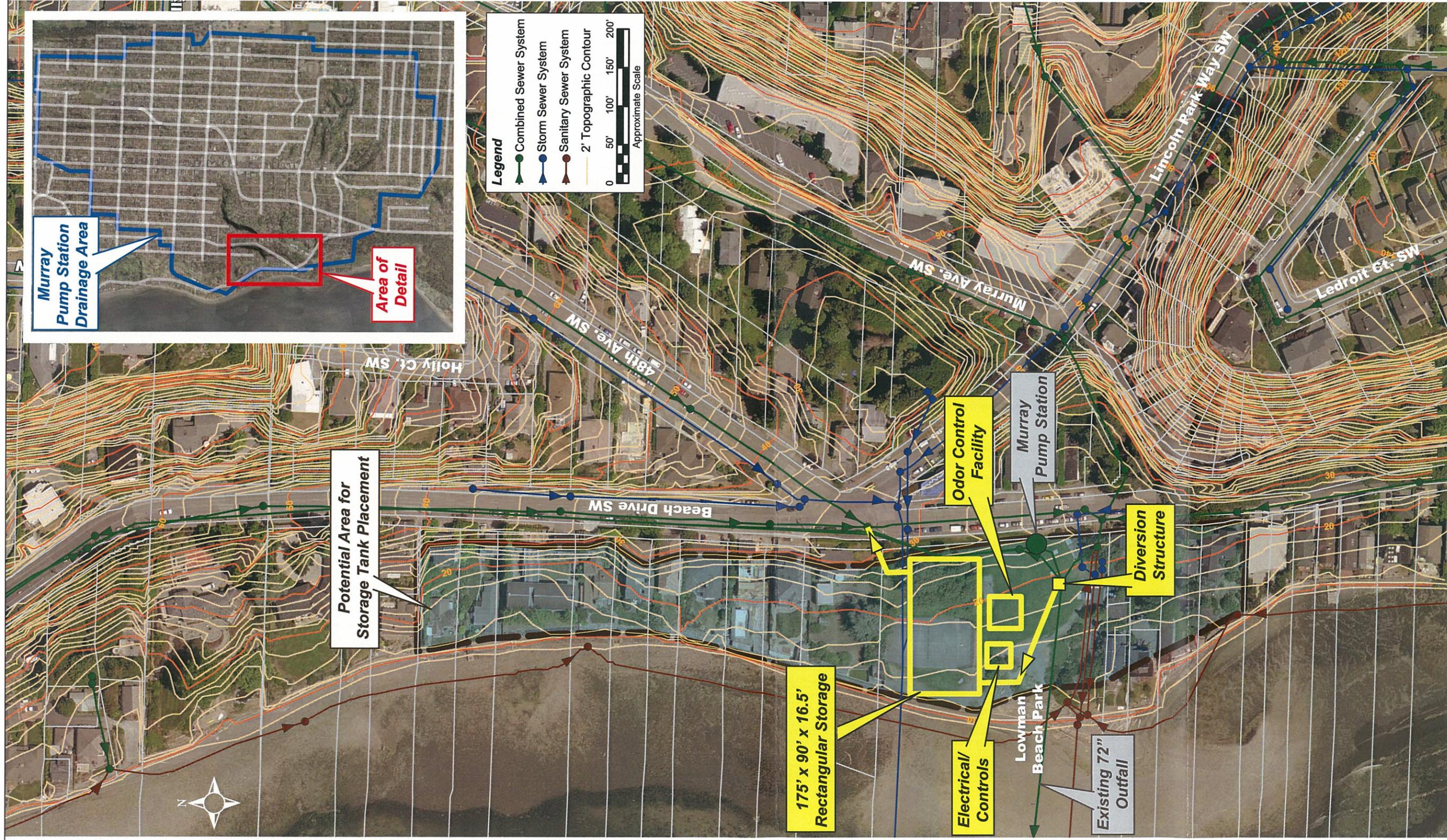
MURRAY BASIN ALTERNATIVES
 PRELIMINARY DRAFT DISCUSSION PURPOSES ONLY

CATEGORY / CRITERIA	1A	1B	1C	1D	1E	1F	2A	3A	5A
LAND USE AND PERMITTING									
1. Land Use Compatibility	1	2	2	2	1	2	1	1	2
2. City of Seattle Planning Policies (Comp Plan)	2	2	3	3	2	2	2	1	3
3. Municipal Code and Shoreline Management Program	1	3	3	3	1	2	1	1	3
4. Permitting Complexity	2	2	2	2	2	2	1	1	2
5. Property Acquisition Complexity	1	2	2	2	1	2	1	1	2
ENVIRONMENT									
1. Cultural Resources	2	2	2	2	2	2	2	2	2
2. Fish and Wildlife	3	2	3	3	3	2	3	3	2
3. Wetlands and Streams	2	1	2	2	3	2	3	2	2
4. Soils and Sediments	3	1	3	3	2	2	3	3	2
5. Water Quality	3	3	3	3	3	3	3	3	1
TECHNICAL									
1. Technical Complexity	3	2	2	3	2	2	2	1	3
2. Compatibility with Existing WW system	2	2	2	2	2	2	1	3	3
3. Flexibility/Adaptive Management	2	2	2	2	3	3	2	2	2
4. Constructability/Implementation Schedule	2	2	2	1	2	3	2	2	2
OM&M									
1. Staffing	3	2	3	3	2	3	2	1	3
2. Training	3	3	3	3	3	3	3	1	3
3. Reliability	3	2	2	3	2	3	2	2	3
4. Maintenance	3	2	2	2	2	3	2	1	3
5. Safety	3	3	1	1	3	1	3	3	2
COST EFFECTIVENESS									
1. Project Capital Costs	3	3	2	2	1	3	1	1	2
2. Life Cycle Costs									
3. Cost Variability/Risk	3	3	3	3	3	3	2	3	2
COMMUNITY IMPACT									
1. Location	2	2	2	3	3	2	2	1	3
2. Long Term Risk, New Facilities	2	2	2	3	3	2	2	1	2
3. Construction Impacts	1	1	1	1	1	2	1	1	2

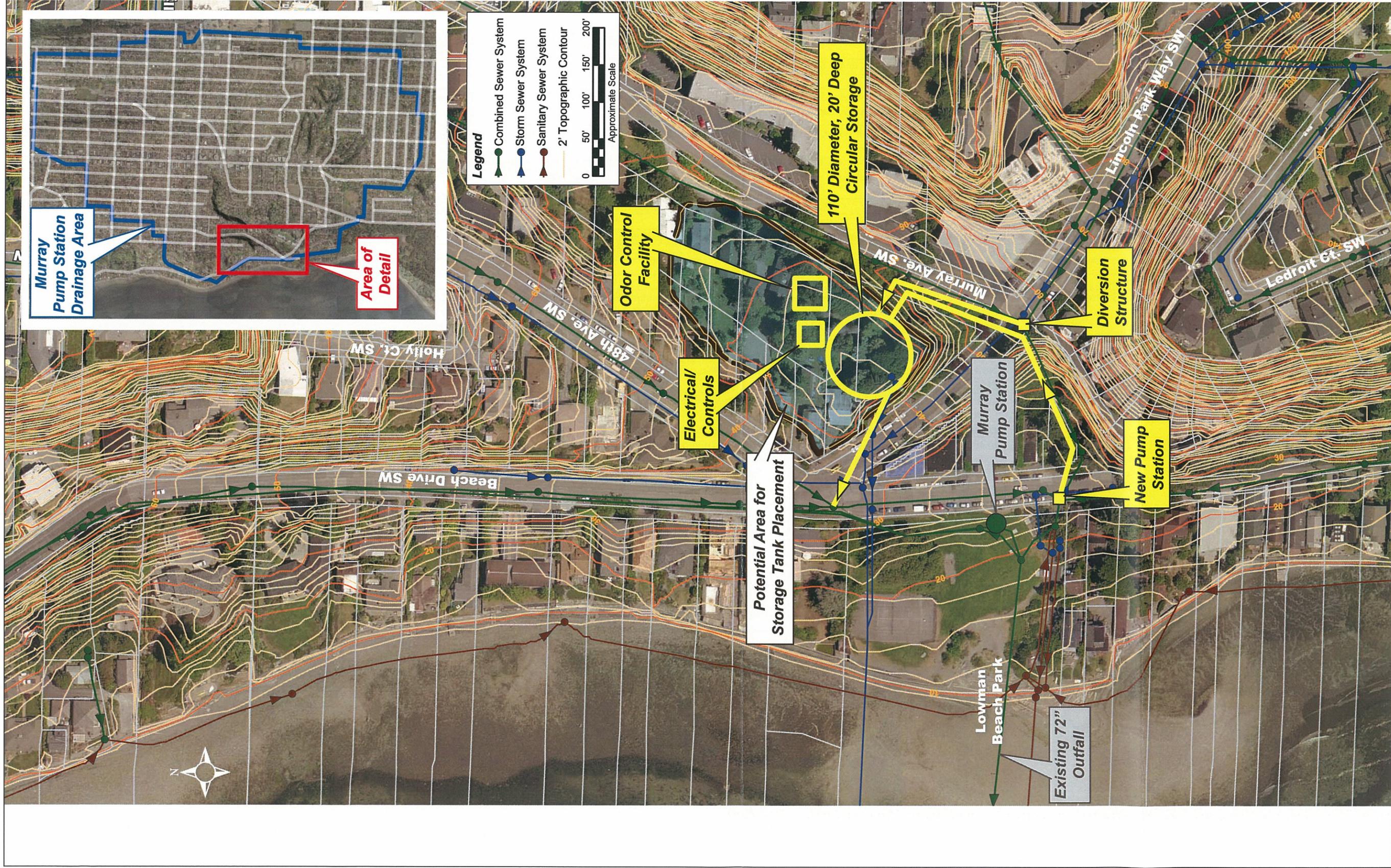
ALTERNATIVE DEVELOPMENT PHASE				
			Barton Basin	Murray Basin
CSO Control Approach	Configuration	Minimum Requirements for Potential Sites	Design Requirements: <ul style="list-style-type: none"> 110,000 gallon storage or 26 acres effective disconnection 	Design Requirements: <ul style="list-style-type: none"> 1.0 mg storage or 28.5 mgd conveyance or Up to 10 acres effective disconnection to reduce 300,000 gallons of storage
1. Convey & Treat	Peak flow pump station, pipeline to existing treatment facility	<ul style="list-style-type: none"> Flat (< 5%) open space near existing CSO Outside public Right-of-Way Sized for peak flow pump station 	Cannot increase conveyance capacity out to Murray Basin	Alternative 2-K Convey and Treat
2. Centralized/Distributed Storage				
A. Bottom of Basin	Rectangular/Circular Tank	<ul style="list-style-type: none"> Flat (< 5%) open space near existing CSO Outside public Right-of-Way Size dependent on storage volume 	Alternative 1-A Rectangular Storage Alternative 1-A Circular Storage Alternative 1-C Circular Storage	Alternative 1-G Rectangular Storage
	Linear (in-line) Pipe	<ul style="list-style-type: none"> Linear, flat (< 5%) open space near existing CSO Inside or outside public Right-of-Way Minimum 12-foot wide Length dependent on storage volume 	Alternative 1-A Pipe Storage Alternative 1-D Pipe Storage Alternative 1-E Pipe Storage	
	Deep Tunnel	<ul style="list-style-type: none"> Flat (< 5%) open space near existing CSO Flat (<5%) open space at access shaft (location dependent on storage volume) Both sites outside public Right-of-Way 		Alternative 1-J Pipe Storage
B. "Up-Basin"	Rectangular/Circular Tank	<ul style="list-style-type: none"> Flat (< 5%) open space Outside public Right-of-Way Size dependent on storage volume 	Alternative 1-B Rectangular Storage	Alternative 1-H Circular Storage
	Linear (in-line) Pipe	<ul style="list-style-type: none"> Linear, flat (< 5%) open space Inside or outside public Right-of-Way Minimum 12-foot wide Length dependent on storage volume 		
3. End of Pipe Treatment				
A. Bottom of Basin	New high rate treatment facility	<ul style="list-style-type: none"> Flat (< 5%) open space near existing CSO Outside public Right-of-Way Sized for treatment plant facilities and access 	Alternative 3-A – End of Pipe Treatment	Alternative 3-G – End of Pipe Treatment
B. "Up-Basin"	Peak flow pump station, pipeline to new high rate treatment facility	<ul style="list-style-type: none"> Flat (< 5%) open space near existing CSO, sized for peak flow pump station Flat (<5%) open space at treatment plant location, sized for treatment plant facilities and access Both sites outside public Right-of-Way 		
4. Peak Flow Reduction				
A. Stormwater Disconnection	Disconnection of impervious areas (roof drains and catch basins) with stormwater re-routed to new or existing MS4.	<ul style="list-style-type: none"> Available impervious area for disconnection Inside or outside public Right-of-Way 	Alternative 4-F – Stormwater Disconnection	Cannot achieve CSO control through disconnection alone in available CSO subbasins.
B. Green Stormwater Infrastructure (GSI)	Implementation of GSI techniques to limit stormwater response to rainfall	<ul style="list-style-type: none"> See GSI analysis for constraints 	TBD	TBD
5. Combined Approach				
A. Storage and Stormwater Disconnection	Disconnection of impervious areas to achieve reduction in required storage volume.	<ul style="list-style-type: none"> See Approach 2 and Approach 4 above. 	Can eliminate need for storage through disconnection in CSO sub-basin.	Alternative 5-J/L Combined Storage with Disconnection
NOTES:				

**MURRAY BASIN
INITIAL ALTERNATIVES MATRIX**

Control Approach	Location	Alternatives								
		1A	1B	1C	1D	1E	1F	1G	3A	5A
		Rectangular Storage at Bottom of Basin	Circular Storage in Vicinity of Murray Avenue and Lincoln Park Way	Distributed Storage Along Beach Drive and Murray Avenue SW	Pipe Storage at Bottom of Basin by Tunneling	Upper Basin Storage	Combined Pipe/Rectangular Storage at Bottom of Basin	Convey and Treat at Alki	End of Pipe Treatment at Bottom of Basin	Peak Flow Reduction Combined with Storage
	Location	Bottom of Basin	Mid-Basin	Mid-Basin/ROW	Bottom of Basin/ROW	Upper Basin	Bottom of Basin/ROW	Bottom of Basin	Bottom of Basin	
1. Peak Flow Storage										
"Rectangular Storage"		X				X	X			
"Circular Storage"			X							
"Pipe Storage"				X	X		X			
2. Convey and Treat								X		
3. End of Pipe Treatment									X	
4. Stormwater Flow Reduction										
5. Combined Approach										X



ALTERNATIVE TITLE		1- A - RECTANGULAR STORAGE AT BOTTOM OF BASIN
TECHNICAL SUMMARY		
LOCATION	BOTTOM OF BASIN	
CSO BASIN	MURRAY	
DESCRIPTION	1.0 MG, 175 x 90 x 16.5 feet, buried, rectangular, multi-channel, self cleaning, cast-in-place concrete tank. Flushing chamber with automated flushing gates and drain chambers with submersible pumps. New diversion structure.	
ANCILLARY FACILITIES	40' x 40' carbon scrubber type Odor Control Facility, 30' x30' Electrical/Controls Structure with electrical equipment and controls. Access hatches and above grade structures.	
OPERATIONAL FEATURES	Gravity flow over weir in Diversion Structure into tank, pumped flow out of tank.	
SELECTION CRITERIA NOTES		
LAND USE	Zoning	Commercial and Residential. Conditional use permit required.
	Ownership/acquisition	Easement required. May require private property acquisitions.
	Critical Areas	Yes, near shore line. Requires shoreline permit and possibly park permit.
ENVIRONMENT	Shorelines Zone	Yes
	Endangered Species	TBD
TECHNICAL	Complexity and Startup	Routing of flows using overflow weirs, automatic gates, and drain pumps. Facility would be located near to the Murray Pump Station. The weir would be used for flow measurement and drain pump would be single speed "on/off". All controls and infrastructure would be located within the site.
	Compatibility w/WW system	A new diversion structure would be needed near the existing CSO outfall to divert flow to the new storage tank. Flow would be pumped from storage tank back to an existing sanitary sewer manhole upstream of Murray Pump Station.
	Flexibility	Minimal opportunity to expand. Residential properties are developed within possible tank location. The County has planned a 96.5' x23.5' future generator upgrade project in park.
	Constructability	Geotechnical and construction constraints due to close proximity of shore line. Special shoring and dewatering measures would likely be required. Contractor Staging Issues likely because of space constraints, off site staging would be required. Special construction and permanent measures would be required to stabilize the site such as slurry walls, tiebacks, etc.
O&M	Staffing	Facility can be automatically started and remotely monitored/operated. Drain pump start and shut down would be through county telemetry and control system. Periodic access would be required for equipment exercising and cleaning. The facility requires operator attention during design conditions (e.g. monitoring, sampling, chemical control, etc.). An operator may need to be present periodically for sampling, carbon delivery or other discrete tasks. Peak staff times require 1-2 operators. The facility can be shut down with minimal staff time. Cleanup work is generally automated; however, 1-2 personnel may be required. Some procedures of shutdown may need to be conducted immediately; however, most work can be scheduled to be integrated with other staff duties.
	Training	Routine training would be required in accordance with County's standards.
	Access	Inside the park or on private property near the storage tank.
	Process Effects	None anticipated.
COST	Project Cost Factors	Mitigation for local traffic disruption during construction.
	Operation Cost Factors	Carbon for odor control.
	O&M	Carbon replacement, site checks, electricity, equipment and pump replacements and regular maintenance and cleaning.
	External Agency	Seattle Parks
	External Costs	Easement acquisition, site mitigation. Replacement of existing improvements required.
COMMUNITY	Location	Bottom of the basin near residential and park properties.
	Long Term Risk	Minimal impacts to residents from ongoing O & M: staff would be present infrequently (intermittent or only during/after storms).
	Construction	Reduction of usable park space due to proposed structures. Construction would be located near residences and it will be difficult to mitigate impacts such as noise, after hours work, light, vibration, and access.
		Traffic disruption from construction Requires disruption of park space or condemning of residential properties for storage tank placement.

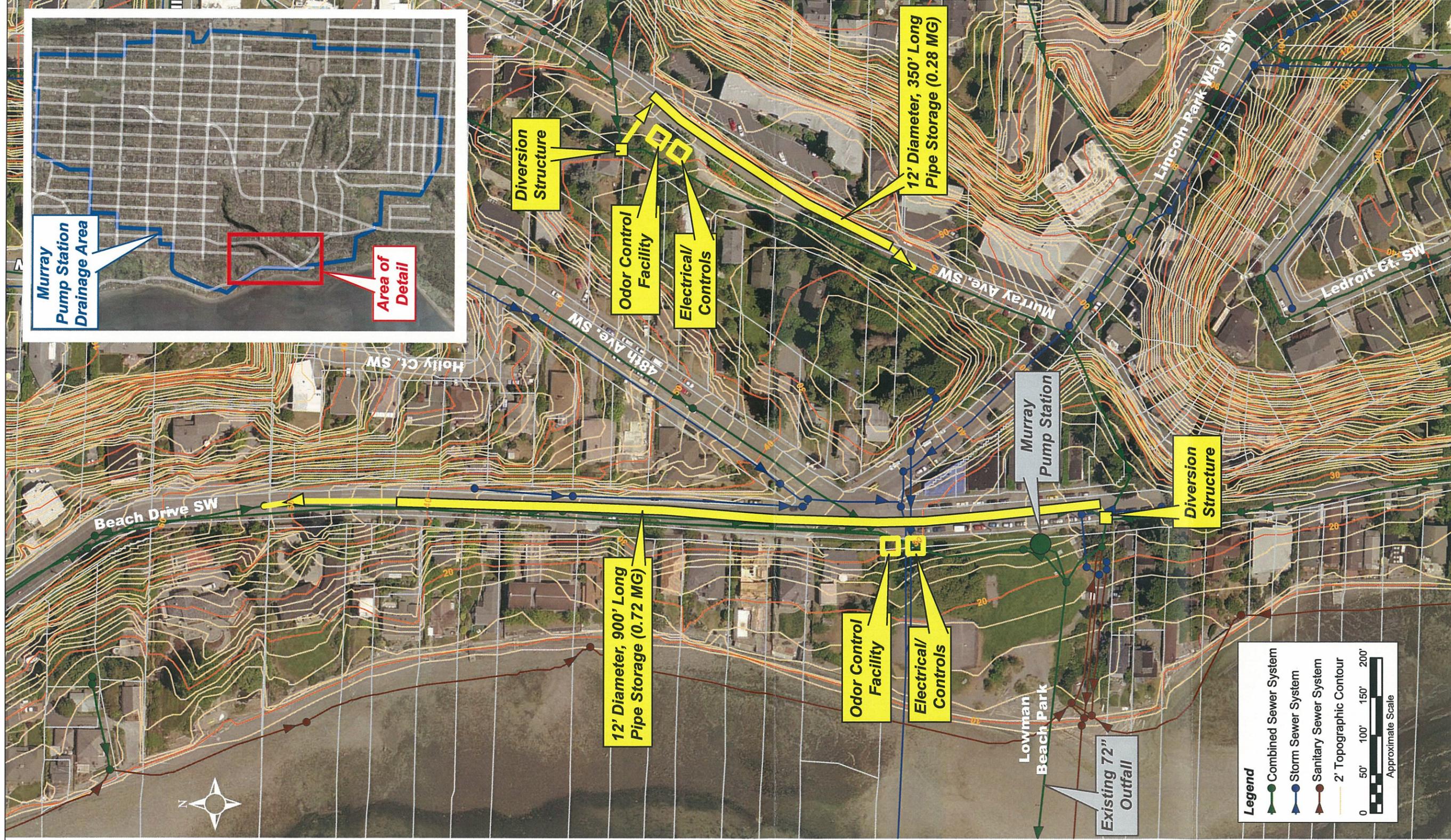


Legend

- Combined Sewer System
- Storm Sewer System
- Sanitary Sewer System
- 2' Topographic Contour

0 50' 100' 150' 200'
Approximate Scale

ALTERNATIVE TITLE		1 - B - CIRCULAR STORAGE AT INTERSECTION OF MURRAY AVE SW AND LINCLON PARKWAY SW
TECHNICAL SUMMARY		
LOCATION	INTERSECTION OF MURRAY AVE SW AND LINCLON PARKWAY SW	
CSO BASIN	MURRAY	
DESCRIPTION	1.0 MG, 110' diameter, 20 feet deep, circular caisson storage tank. A new diversion structure at the intersection of Murray Ave SW and Lincoln Parkway SW to divert flows to the new storage tank. New ancillary pump station at Beach Drive SW to pump the excess peak flow from the Barton Pump Station to the new storage facility.	
ANCILLARY FACILITIES	When Barton Pump Station would be pumping 33 MGD during peak flows, Murray Pump Station can only pump 31.5 MGD. Therefore, a new 1.5 mgd pump station would be required near Murray Pump Station to pump excess flows to the new storage tank during peak flow events. 40' x 40' carbon scrubber type Odor Control Facility, 30' x 30' Electrical/Controls Structure with electrical equipment and controls. Access roads, fencing around surface structures.	
OPERATIONAL FEATURES	Gravity flow and pumped flow into storage tank, pumped flow out of tank.	
SELECTION CRITERIA NOTES		
LAND USE	Zoning	Vacant and residential
	Ownership/acquisition	Vacant land City of Seattle and/or may need to acquire land from residential property owners.
	Critical Areas	The site has steep slopes.
ENVIRONMENT	Shorelines Zone	TBD-Possible creek crossing.
	Endangered Species	TBD
TECHNICAL	Complexity and Startup	Routing of flows using overflow weirs, automatic gates, and drain pumps. Facility would be within a single site located approximately 300 ft upstream of the Murray Pump Station. The weir in the diversion structure and a flow meter in the ancillary pump station would be used for flow measurement. Drain pumps would be single speed "on/off". Ancillary pump station may be variable speed. Controls and infrastructure would be located at storage facility and in the ancillary pump station. Part of the site has steep slopes. Special construction and permanent measures are needed to stabilize the site using caissons, slurry walls, tiebacks, etc.
	Compatibility w/WW system	A new diversion structure at the intersection of Murray Ave SW and Lincoln Parkway SW to divert flows by gravity to the new storage tank. New 1.5 mgd ancillary pump station near Murray Pump Station to pump excess flows to the new storage tank.
	Flexibility	Minimum opportunity for expansion.
	Constructability	Geotechnical and construction constraints due to steep slopes in the proposed area. Special measures required. Contractor Staging Issues. Possible creek crossing in the proposed area may require relocation.
O&M	Staffing	Facility can be automatically started and remotely monitored/operated. Drain pump start and shut down would be through county telemetry and control system. Periodic access would be required for equipment exercising and cleaning. The facility requires operator attention during design conditions (e.g. monitoring, sampling, chemical control, etc.). An operator may need to be present periodically for sampling, carbon delivery or other discrete tasks. Peak staff times require 1-2 operators. The facility can be shut down with minimal staff time. Cleanup work is generally automated; however, 1-2 personnel may be required. Some procedures of shutdown may need to be conducted immediately; however, most work can be scheduled to be integrated with other staff duties.
	Training	Routine training would be required in accordance with County's standards.
	Access	Within the site.
	Process Effects	TBD
COST	Project Cost Factors	Mitigation for local traffic disruption during construction.
	Operation Cost Factors	Carbon for odor control.
	O&M	Carbon replacement, site checks, electricity, equipment and pump replacements and regular maintenance and cleaning.
	External Agency	TBD
COMMUNITY	External Costs	Land acquisition, mitigation.
	Location	Site located in residential neighborhood.
	Long Term Risk	Minimal impacts to community from ongoing O & M: staff would be present infrequently (intermittent or only during/after storms).
	Construction	Construction would be located near residences and it would be difficult to mitigate impacts such as noise, after hours work, light, vibration, and access. Traffic disruption from construction

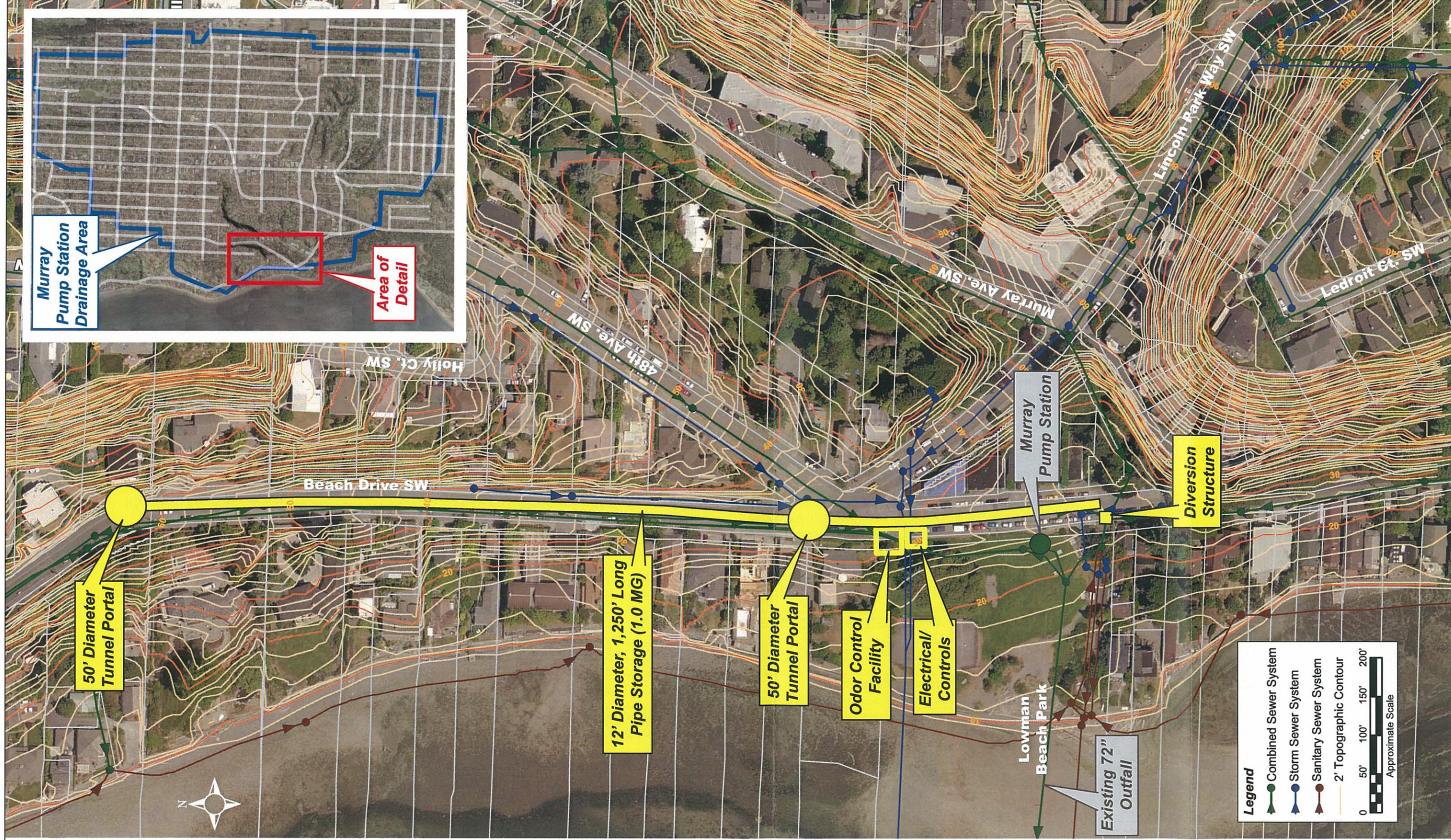


Legend

- Combined Sewer System
- Storm Sewer System
- Sanitary Sewer System
- 2' Topographic Contour

0 50' 100' 150' 200'
Approximate Scale

ALTERNATIVE TITLE		1 - C - DISTRIBUTED STORAGE ALONG BEACH DRIVE AND MURRAY AVENUE SW
TECHNICAL SUMMARY		
LOCATION	BEACH DRVIE AND MURRAY AVE SW	
CSO BASIN	MURRAY	
DESCRIPTION	Requires approximately 900 LF of 144" (12-foot) diameter reinforced concrete pipe on Beach Drive SW Road and 350 LF of 12-foot diameter pipe on the Murray Ave SW for storing the 1.0 MG. The storage pipe on Murray Ave SW would be tributary to 75% of the peak flow coming to the basin. About 0.28 MG will be stored on the Murray Ave SW road and the remaining 0.72 MG will be stored at the bottom of the basin. Major components include: Diversion structures, flushing chamber with flushing gates and drain chamber with submersible pumps. Flow control sensors and instrumentation.	
ANCILLARY FACILITIES	Surface access structures or manholes on the Beach Drive and Murray Ave SW along the length of the pipe line for regular operation and maintenance. Drain pumps. 30' x 30' carbon odor control facility, 30' x 30' electrical/control structure at the Beach Drive SW Road and 20' x 20' carbon odor control facility, 20' x 20' electrical/control structure at the Murray Avenue SW Road	
OPERATIONAL FEATURES	Diversion through weirs and automatic gates. Controlled by telemetry.	
SELECTION CRITERIA NOTES		
LAND USE	Zoning	Street right-of-way.
	Ownership/acquisition	Easement required.
	Critical Areas	Located on road right-of-way.
ENVIRONMENT	Shorelines Zone	No
	Endangered Species	TBD
TECHNICAL	Complexity and Startup	Similar to other County storage tanks.
	Compatibility w/WW system	A new diversion structure near Murray Pump station and one on Murray Ave SW would be required to divert peak flow to the new storage pipes. The alternative may also require modifications to the operational methods for existing infrastructure.
	Flexibility	Minimum opportunity for expansion.
	Constructability	The north end of the pipe on the Beach Drive road would be approximately 40' deep due to existing ground elevation. Special measures would be required for tunneling. Geotechnical and construction constraints due to location of the pipe on the Right-of-Way. Site is constrained, requiring careful construction sequencing, with several move-in, move-out stages to accommodate specialty contractors as well as conventional construction. Might require deep excavation for a portion of pipe. Contractor would require provide offsite staging and operations. Relocation of sanitary sewer, water and other underground utilities may be required along Beach Drive and Murray Ave SW.
O&M	Staffing	Facility can be automatically started and remotely monitored/operated. Drain pump start and shut down would be through county telemetry and control system. Periodic access would be required for equipment exercising and cleaning. The facility requires operator attention during design conditions (e.g. monitoring and control, etc.). An operator may need to be present periodically for sampling, carbon delivery or other discrete tasks. Peak staff times require 1-2 operators. The facility can be shut down with minimal staff time. Cleanup work is generally automated; however, 1-2 personnel may be required. Some procedures of shutdown may need to be conducted immediately; however, most work can be scheduled to be integrated with other staff duties.
	Training	Routine training would be required in accordance with County's standards.
	Access	Surface access, or from structure located outside of travelled roadway.
	Process Effects	None anticipated.
COST	Project Cost Factors	Mitigation for local traffic disruption and temporary access during construction.
	Operation Cost Factors	Carbon for odor control.
	O&M	Carbon replacement, site checks, electricity, equipment and pump replacements and regular maintenance and cleaning.
	External Agency	SDOT, SPU
	External Costs	Land/ Easement Acquisition, mitigation.
COMMUNITY	Location	Site located on Beach Drive SW right-of-way and Murray Ave SW. Visible to surrounding residences.
	Long Term Risk	Minimal impacts to community from ongoing O & M: staff would be present infrequently (intermittent or only during/after storms).
	Construction	Construction would be located on Beach Drive and Murray Ave SW right-of-way. Temporary access would be needed for residents along Beach Drive Road. It would be difficult to mitigate impacts such as noise, after hours work, light, vibration, and access.
		Traffic disruption from construction

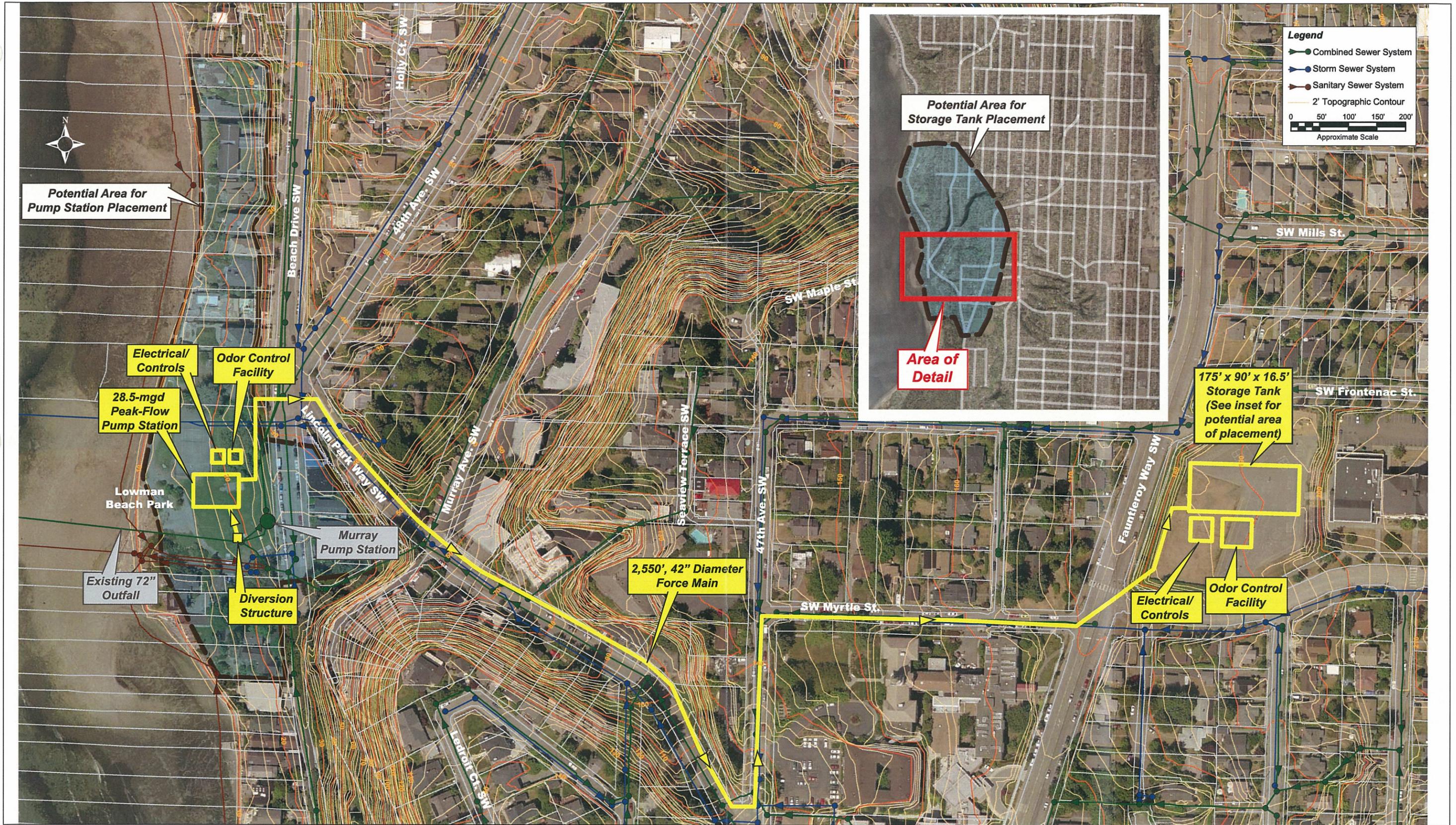


Legend

- Combined Sewer System
- Storm Sewer System
- Sanitary Sewer System
- 2' Topographic Contour

0 50' 100' 150' 200'
Approximate Scale

ALTERNATIVE TITLE		1- D - PIPE STORAGE AT BOTTOM OF BASIN BY TUNNELING
TECHNICAL SUMMARY		
LOCATION	BEACH DRIVE ROAD SW	
CSO BASIN	MURRAY	
DESCRIPTION	Requires approximately 1,250 LF of 144" (12-foot) diameter reinforced concrete pipe for storage of 1.0 MG. Major components include: a flushing chamber with flushing gates and drain chamber with submersible pumps. Flow control sensors and instrumentation. A new diversion structure with control gates near the existing CSO outfall to divert flow to the new storage pipe.	
ANCILLARY FACILITIES	40' x 40' carbon scrubber type Odor Control Facility, 30' x30' Electrical/Controls Structure with electrical equipment and controls. Surface access structures or manholes on the Beach Drive along the length of the pipe line for regular operation and maintenance. Drain pumps.	
OPERATIONAL FEATURES	Gravity flow into tank, pumped flow out of tank.	
SELECTION CRITERIA NOTES		
LAND USE	Zoning	Street right-of-way. Requires conditional use permit and permit from Seattle DOT.
	Ownership/acquisition	Easement required.
	Critical Areas	Located on road right-of-way.
ENVIRONMENT	Shorelines Zone	No
	Endangered Species	TBD
TECHNICAL	Complexity and Startup	Similar to other County storage tanks.
	Compatibility w/WW system	A new diversion structure to divert peak flow to the new storage pipe. The alternative may also require modifications to the operational methods for existing infrastructure.
	Flexibility	Minimum opportunity for expansion.
	Constructability	The north end of the pipe would be approximately 60' deep due to existing elevation. Special measures would be required for tunneling. Geotechnical and construction constraints due to location of the pipe on the right-of-way. Tunneling portals would block street requiring temporary access and detour measures for local residents along Beach Drive. Site is constrained, requiring careful construction sequencing, with several move-in, move-out stages to accommodate specialty contractors as well as conventional construction. Contractor would require provide offsite staging and operations. Relocation of sanitary sewer, water and other underground utilities may be required along Beach Drive.
O&M	Staffing	Facility can be automatically started and remotely monitored/operated. Drain pump start and shut down would be through county telemetry and control system. Periodic access would be required for equipment exercising and cleaning. The facility requires operator attention during design conditions (e.g. monitoring and control, etc.). An operator may need to be present periodically for sampling, carbon delivery or other discrete tasks. Peak staff times require 1-2 operators. The facility can be shut down with minimal staff time. Cleanup work is generally automated; however, 1-2 personnel may be required. Some procedures of shutdown may need to be conducted immediately; however, most work can be scheduled to be integrated with other staff duties.
	Training	Routine training would be required in accordance with County's standards.
	Access	Surface access, or from structure located outside of travelled roadway.
	Process Effects	None anticipated.
COST	Project Cost Factors	Mitigation for local traffic disruption and temporary access during construction.
	Operation Cost Factors	Carbon for odor control.
	O&M	Carbon replacement, site checks, electricity, equipment and pump replacements and regular maintenance and cleaning.
	External Agency	SDOT, SPU
	External Costs	Land / Easement Acquisition, mitigation.
COMMUNITY	Location	Site located on Beach Drive right-of-way. Visible to surrounding residences.
	Long Term Risk	Minimal impacts to community from ongoing O & M: staff would be present infrequently (intermittent or only during/after storms).
	Construction	Construction would be located on Beach Drive right-of-way. Access along the pipe alignment would be blocked by tunnel portals. Temporary access would need to be developed for those residents along Beach Drive located between the portals. It would be difficult to mitigate impacts such as noise, after hours work, light, vibration, and access. Traffic disruption from construction

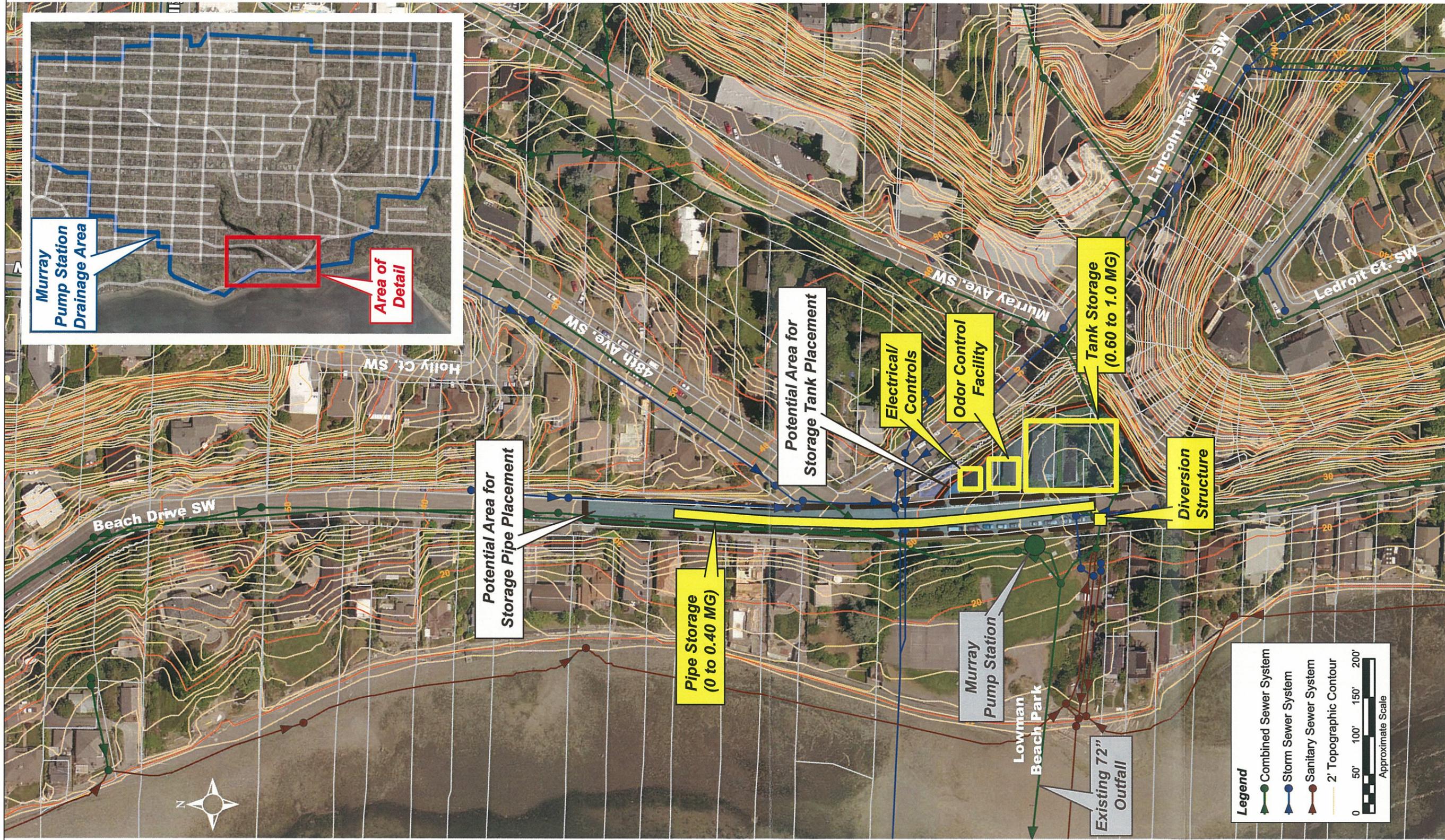


ALTERNATIVE TITLE | I - B - UPPER BASIN STORAGE | **TECHNICAL SUMMARY**

LOCATION	UPPER MURRAY BASIN
CSO BASIN	MURRAY
DESCRIPTION	Peak flows from the Murray basin would be conveyed to a rectangular storage tank located up-basin. The figure shows a rectangular storage tank in the parking lot of Gate wood Elementary School for example purposes. This would require a 60 x 75 feet, 28.5 MGD peak flow pump station near existing Murray pump station in Lowman Beach Park. In the example shown in the figure, approximately 2,550 LF of 42" diameter forcemain would be required to pump the flows from Lowman Beach Park to the storage tank site.
ANCILLARY FACILITIES	20' x 20' carbon scrubber type Odor Control Facility and 20' x 20' Electrical/Controls Structure (30' x 30') and carbon scrubber (40' x 40'). the pipe line alignment for operation and maintenance. Electrical/Controls Structure (30' x 30') and carbon scrubber (40' x 40').
OPERATIONAL FEATURES	Peak flow diversion structure, peak flow wet weather pump station to convey flows to the rectangular storage facility.

SELECTION CRITERIA NOTES

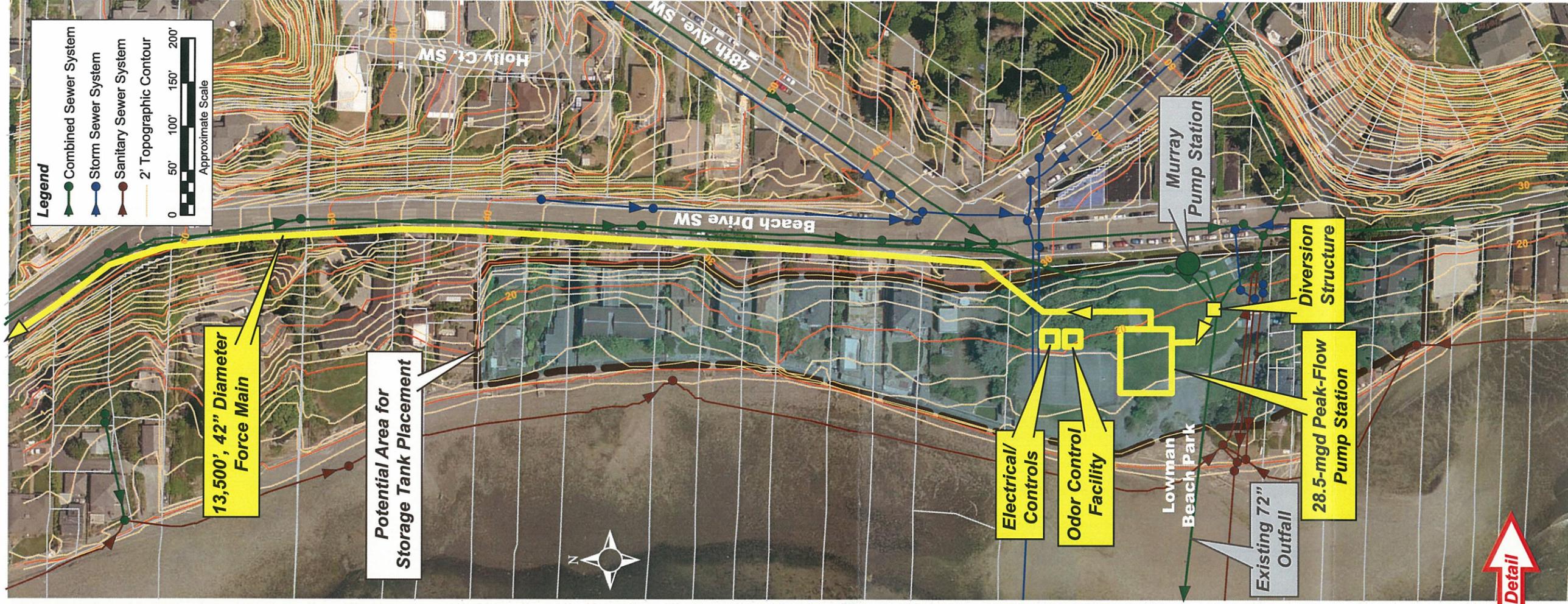
LAND USE	Zoning Park - Commercial use where the pump station would be located and road right-of-way for force main. Property for rectangular storage is zoned commercial. Requires conditional use permit and permit from Seattle DOT. Easement for new pump station at Lowman Park and easement for new rectangular storage tank at the school.
ENVIRONMENT	Ownership/acquisition TBD Critical Areas Yes Shorelines Zone Yes Endangered Species TBD
TECHNICAL	Complexity and Startup Similar to other County pump stations, forcemains, and storage facilities. Compatibility w/WW system A new diversion structure shall be constructed near the existing CSO outfall to divert flow to the new wet weather pump station. Flexibility Minimum opportunity to expand (limited space in the park) In example shown, approximately 0.5 miles of forcemain construction would be required along Lincoln Park Way and SW Myrtle Street. Disruption to Lowman Beach Park due to peak flow pump station construction.
O&M	Staffing Remotely monitored. Pump station automatically started, and shut down. Storage facility remotely monitored and controlled using county telemetry and control system. Training Routine training would be required in accordance with County's standards. Access Inside the Park (pump station), along the road (forcemain), and school parking lot (storage facility in this example). Process Effects None
COST	Project Cost Factors Mitigation for park restoration, local traffic disruption during construction. Operation Cost Factors New pump station/forcemain O & M. Carbon replacement, site checks, electricity, equipment and pump replacement, storage facility cleaning. O&M Electricity, pump station checks and forcemain maintenance. External Agency Seattle Parks, SDOT. External Costs Easement acquisition from Seattle Parks, SDOT, school property and mitigation
COMMUNITY	Location Pump Station visible to surrounding residences, storage facility would have above grade facilities at reservoir site. Long Term Risk O & M Risk: Accessing park site for regular pump station checks and maintenance. Construction Foremain construction would be on street right-of-way and it would be difficult to mitigate impacts such as noise, after hours work, light, vibration, and access. Traffic disruption from construction. Disruption from park use. Reduction of usable area of park due to proposed above grade structures.



ALTERNATIVE TITLE		1-F- COMBINED PIPE / RECTANGULAR STORAGE TANK AT BOTTOM OF BASIN
TECHNICAL SUMMARY		
LOCATION	BOTTOM OF BASIN	
CSO BASIN	MURRAY	
DESCRIPTION	This is a combined storage alternative with a rectangular tank and pipe storage at the bottom of the basin. Depending upon the layout of the storage tank, approximately 0.6 – 1.0 million gallons can be stored in the storage tank location and the remaining 0.0-0.4 million gallons could be stored in a 12-foot diameter RCP pipe on the Beach Drive SW Road.	
ANCILLARY FACILITIES	Diversion Structure, 30' x 30' Electrical/Controls Structure and 40' x 40' Carbon Odor Control Facility. Surface access structures or manholes along the length of the pipe line alignment for operation and maintenance.	
OPERATIONAL FEATURES	Gravity flow into tank, pumped flow out of tank.	
SELECTION CRITERIA NOTES		
LAND USE	Zoning	Rectangular Storage: Residential (SFR), Pipe Storage: Road right-of-way. Conditional use and right-of-way permit required.
	Ownership/acquisition	Easement required.
	Critical Areas	TBD
ENVIRONMENT	Shorelines Zone	No
	Endangered Species	TBD
TECHNICAL	Complexity and Startup	Similar to other storage facilities.
	Compatibility w/WW system	A new diversion structure shall be constructed on the Beach Drive road to divert flow to the new storage facilities.
	Flexibility	Minimum opportunity to expand.
	Constructability	Sites are constrained, requiring careful construction sequencing, with several move-in, move-out stages to accommodate specialty contractors as well as conventional construction. Contractor would require offsite staging and operations. Relocation of sanitary sewer, water and other underground utilities may be required along Beach Drive.
O&M	Staffing	Facility can be automatically started and remotely monitored/operated. Drain pump start and shut down would be through county telemetry and control system. Periodic access would be required for equipment exercising and cleaning. The facility requires operator attention during design conditions (e.g. monitoring and control, etc.). An operator may need to be present periodically for sampling, carbon delivery or other discrete tasks. Peak staff times require 1-2 operators. The facility can be shut down with minimal staff time. Cleanup work is generally automated; however, 1-2 personnel may be required. Some procedures of shutdown may need to be conducted immediately; however, most work can be scheduled to be integrated with other staff duties.
	Training	Routine training would be required in accordance with County's standards.
	Access	Surface access from structure located outside of travelled roadway.
	Process Effects	None anticipated.
COST	Project Cost Factors	Mitigation for local traffic disruption and temporary access during construction.
	Operation Cost Factors	Carbon for odor control.
	O&M	Carbon replacement, site checks, electricity, equipment and pump replacements and regular maintenance and cleaning.
	External Agency	SDOT, SPU
	External Costs	Land / Easement Acquisition, mitigation.
COMMUNITY	Location	Sites located on residential lots and Beach Drive right-of-way. Highly visible to surrounding residences.
	Long Term Risk	Minimal impacts to community from ongoing O & M: staff would be present infrequently (intermittent or only during/after storms).
	Construction	Construction would be located on Beach Drive right-of-way. It would be difficult to mitigate impacts such as noise, after hours work, light, vibration, and access.
		Traffic disruption from construction

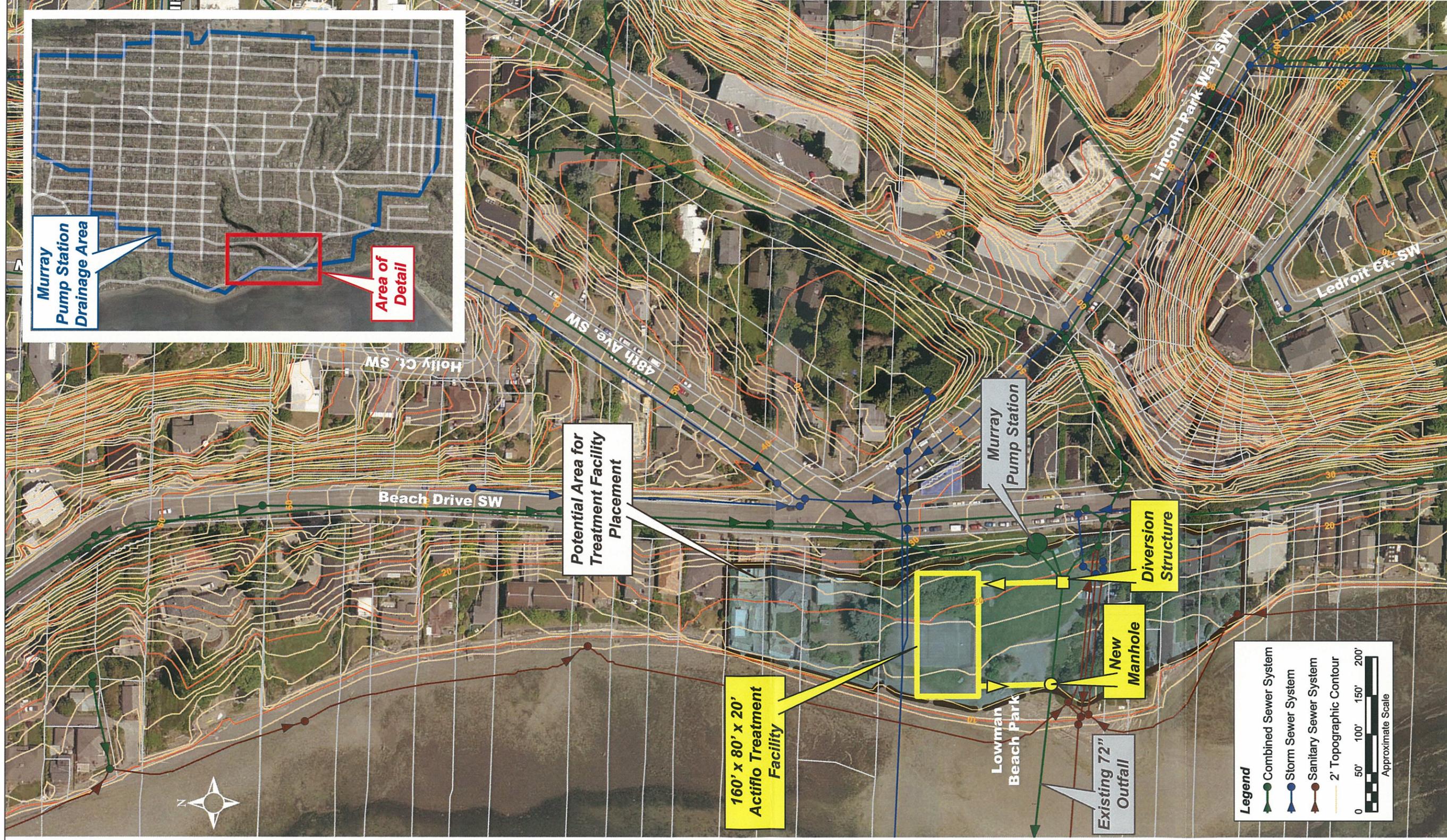


Detail

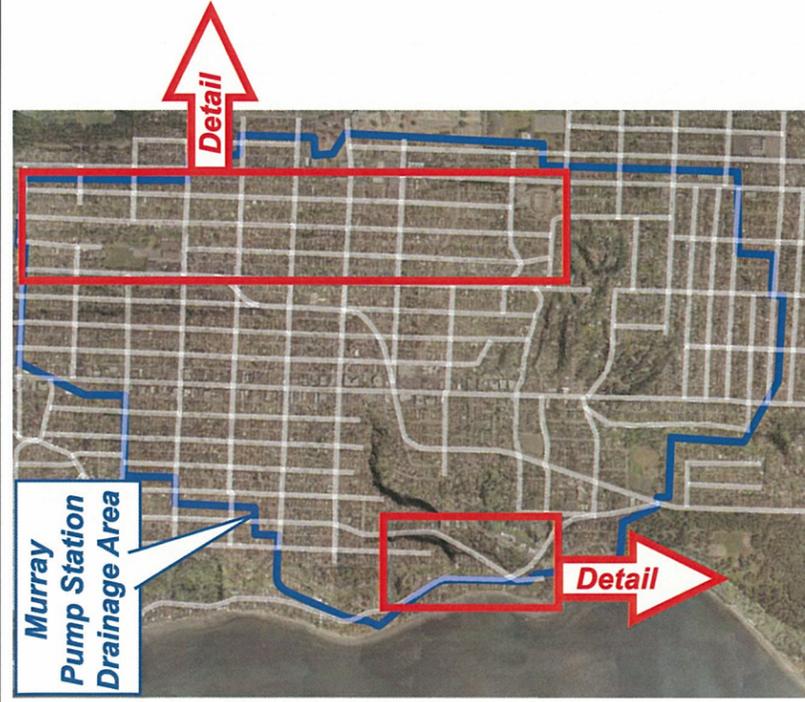


ALTERNATIVE TITLE		2- A - CONVEY AND TREAT TO ALKI
TECHNICAL SUMMARY		
LOCATION	BEACH DRIVE ROAD SW	
CSO BASIN	MURRAY	
DESCRIPTION	Peak flows from the Murray basin would be conveyed to the 63 rd Street pump station where they would continue to flow downstream and be treated at the Alki CSO Treatment Facility. This would require a 60 x 75 feet, 28.5 MGD peak flow pump station near the existing Murray pump station on Lowman Beach Park. Approximately 13,350 LF of 42" diameter forcemain along the Beach Drive road would be needed to convey the flows to the existing 63 rd street pump station. This would also require upgrades to the existing 63 rd Street pump station and the Alki treatment facility to handle the additional flows. Also, capacity of the Alki CSO outfall needs to be evaluated for discharging additional flows to Puget Sound.	
ANCILLARY FACILITIES	20' x 20' carbon scrubber type Odor Control Facility, 20' x20' Electrical/Controls Structure with electrical equipment and controls, Surface access structures or air release manholes on the Beach Drive along the length of the pipe line alignment for operation and maintenance. Upgrades to existing Alki CSO Treatment Facility.	
OPERATIONAL FEATURES	Peak flow diversion structure, peak flow wet weather pump station to convey flows to the Alki CSO Facility.	
SELECTION CRITERIA NOTES		
LAND USE	Zoning	Commercial and residential use where the pump station would be located, road right-of-way for force main. Requires conditional use permit.
	Ownership/acquisition	Easement required. May need to acquire land from property owners.
	Critical Areas	Located on road right-of-way
ENVIRONMENT	Shorelines Zone	Yes
	Endangered Species	TBD
TECHNICAL	Complexity and Startup	Similar to other County Pump Stations.
	Compatibility w/WW system	A new diversion structure shall be constructed near the existing CSO outfall to divert flow by gravity to the new wet weather pump station.
	Flexibility	Minimum opportunity to expand (limited space in the park)
	Constructability	Approximately 2.5 miles of forcemain construction along Beach Drive. Traffic disruptions during construction, existing utility relocations due to new forcemain alignment. Disruption of Lowman Beach Park during construction of pump station.
O&M	Staffing	Remotely monitored, started, and shut down using county telemetry and control system. Periodic access for equipment exercising and cleaning.
	Training	Routine training would be required in accordance with County's standards.
	Access	Inside the Park (pump station), Along the road (forcemain)
	Process Effects	Treatment plant/outfall capacity will need to be increased at the Alki CSO facility.
COST	Project Cost Factors	Mitigation for local traffic disruption during construction.
	Operation Cost Factors	Additional O & M at Alki. New pump station /forcemain O & M.
	O&M	Electricity, pump station checks and forcemain maintenance.
	External Agency	Seattle Parks, SDOT, SPU
COMMUNITY	External Costs	Easement acquisition, mitigation
	Location	Visible to surrounding residences.
	Long Term Risk	O & M Risk: Accessing park site for regular pump station checks and maintenance.
	Construction	Construction would be located on Beach Drive right-of-way and it would be difficult to mitigate impacts such as noise, after hours work, light, vibration, and access.
		Traffic disruption from construction
		Disruption of park use
	Possible reduction of usable area of park due to proposed above grade structures	

PROPOSED
 MURRAY DRAFT



ALTERNATIVE TITLE		3-A - END OF PIPE TREATMENT AT BOTTOM OF BASIN
TECHNICAL SUMMARY		
LOCATION	BOTTOM OF BASIN	
CSO BASIN	MURRAY	
DESCRIPTION	28.5 MGD capacity, 160 x 80 x 20 feet, buried, rectangular Actiflo High Rate Clarification (HRC) system in cast-in-place concrete tank. HRC facilities include an Actiflo HRC unit, 10mm prescreening, odor control, electrical and chemical buildings and UV treatment.	
ANCILLARY FACILITIES	Surface access structures such as hatches for regular operation and maintenance. Access roads and fencing around surface structures.	
OPERATIONAL FEATURES	Gravity flow through diversion structure into to treatment unit. May require pumping of treated effluent to existing CSO outfall depending upon hydraulic profile of treatment units.	
SELECTION CRITERIA NOTES		
LAND USE	Zoning	Commercial and residential. Conditional use permit required.
	Ownership/acquisition	May need to acquire land from residential property owners.
	Critical Areas	Yes, near to shore line. Requires shoreline permit and park permit.
ENVIRONMENT	Shorelines Zone	Yes
	Endangered Species	TBD
TECHNICAL	Complexity and Startup	More complex than typical county facilities.
	Compatibility w/WW system	A new diversion structure would be required near the existing CSO outfall to divert flows by gravity to the new Treatment Facility.
	Flexibility	Minimum. The County has a 96.5' x23.5' future generator upgrade project near the site.
	Constructability	Geotechnical and construction constraints due to close proximity of shore line. Special measures required. Contractor staging issues. Site has low to medium slopes and requires dewatering if disturbed because excavation would be near to the shore line. Special construction and permanent measures would be required to stabilize the site such as slurry walls, tiebacks, etc.
O&M	Staffing	Remotely monitored, started, and shut down using county telemetry and control system. May require staff monitoring during operation. Periodic access for equipment exercising, solids removal and cleaning.
	Training	Training would be required for operation and maintenance of facility.
	Access	On site
	Process Effects	TBD
COST	Project Cost Factors	Mitigation for local traffic disruption during construction.
	Operation Cost Factors	Carbon for odor control, polymer for high rate clarification and operational cost associated with disinfection.
	O&M	Carbon replacement, site checks, electricity, equipment and pump replacements and regular maintenance and cleaning.
	External Agency	TBD
	External Costs	Easement acquisition, site mitigation.
COMMUNITY	Location	Visible to surrounding residences.
	Long Term Risk	O & M impacts on surrounding community: moderate maintenance would be needed by staff and staff would be onsite to check during large storms.
	Construction	Construction would be located near residences and it would be difficult to mitigate impacts such as noise, after hours work, light, vibration, and access.
		Traffic disruption from construction
		Disruption of park use.
	Possible reduction of usable park area due to proposed structures, residential neighbors to the South.	



TETRA TECH



King County
Department of Natural Resources and Parks
Wastewater Treatment Division

PRELIMINARY
DRAFT

Murray CSO Basin Alternative 5A:
Peak Flow Reduction by Roof Drain Disconnection,
Combined with Storage

1420 Fifth Avenue, Suite 600
Seattle, Washington 98101
Tel: 206.883.9300 Fax: 206.883.9301

ALTERNATIVE TITLE		5- A - PEAK FLOW REDUCTION COMBINED WITH STORAGE
TECHNICAL SUMMARY		
LOCATION	SOUTHEAST AREA OF SUBBASIN M_7 (SUBBASIN 419 FROM GIS REPORT) AND PIPE STORAGE ON BEACH DRIVE SW	
CSO BASIN	MURRAY	
DESCRIPTION	Disconnect approximately 10 acres of roof and street storm water connections from combined sewer system (CSS). This would reduce the control volume by 140,000 MG. The remaining 860,000 MG can be controlled by using a 1,075 LF, 144 inch diameter RCP pipe on Beach Drive SW. Compared to Alternative-1-D, by disconnecting impervious area in sub basin 419, approximately 175 LF of pipe storage could be reduced.	
ANCILLARY FACILITIES	Construction of approximately 6,800 LF of 12-inch diameter storm sewer pipe along 34 th , 35 th and 36 th AVE SW streets (refer to map for storm sewer location) 40' x 40' carbon scrubber type Odor Control Facility, 30' x30' Electrical/Controls Building with electrical equipment and controls. Surface access structures or manholes on the beach drive along the length of the pipe for regular operation and maintenance.	
OPERATIONAL FEATURES	Impervious area disconnections and diversion of flows from roof drains and catch basins into new storm sewers. The existing CSS will be used as the sanitary sewer system. For storage, operational features will be similar to pipe storage Alternative 1D.	
SELECTION CRITERIA NOTES FOR DEMAND MANAGEMENT		
LAND USE	Zoning	Residential (SFR). Conditional use permit required.
ENVIRONMENT	Shorelines Zone	No
	Endangered Species	TBD
CAPACITY	Storm System:	
	Pipeline Diameter	12-inch diameter and greater (estimate only, TBD)
	Tie-in MS4 Diameter	Varies
	Capacity	TBD
Sanitary System:		(Reuse existing CSS)
	Pipeline Diameter	Varies
	Downstream SS	18 inches
	Capacity	TBD
CONTROL VOLUME REDUCTION	Total Effective Impervious Area Disconnected	10.0 acres
	Total Control Volume Reduction	140,000 gallons
CONSTRUCTION IMPACTS	Lineal feet of pipe, ft	6,800 LF
O&M	Staffing	Not required.
	Training	Not required.
	Access	N/A
	Process Effects	TBD
COST	Project Cost Factors	Mitigation for local traffic disruption during construction. Concrete pavement panel replacement, side walk repairs, storm lateral connections.
	Operation Cost Factors	Minimum
	O&M	Minimum
	External Agency	SPU
	External Costs	TBD
COMMUNITY	Location	Highly visible to residences.
	Long Term Risk	Minimum
	Construction	Traffic disruption on streets during construction.
SELECTION CRITERIA NOTES FOR STORAGE		
Similar to Alternative 1-D for pipe storage.		

Barton, Murray, Magnolia and North Beach CSO Projects
Alternatives Analysis

MURRAY BASIN ALTERNATIVES

CATEGORY / CRITERIA	1A: RECTANGULAR STORAGE, BOTTOM OF BASIN		ALTERNATIVE 1B: CIRCULAR STORAGE, MURRAY AVE & LINCOLN PARK		ALTERNATIVE 1C: DIST. STORAGE BEACH DRIVE & MURRAY AVE	
	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION
ENVIRONMENT						
1. Cultural Resources	2	No archaeological or historic resources identified in the project area. Based on site characteristics, the project area has a high probability of containing archaeological resources.	2	No archaeological or historic resources identified in the project area. Based on site characteristics, the project area has a high probability of containing archaeological resources.	2	No archaeological or historic resources identified in the project area. Based on site characteristics, the pipe storage area in Beach Drive SW has a high probability of containing archaeological resources. The pipe storage area in Murray Ave. SW has a low probability for containing archaeological resources.
2. Fish and Wildlife	3	It is assumed that Pelly Creek is not a fish-bearing stream. Construction and operation of this alternative would not affect fish and wildlife, or their habitat. If marine access was required, rating would change from 3 to 1.	2	It is assumed Pelly Creek is not a fish-bearing stream. Construction would require clearing of forested area, which may affect fish and wildlife. If marine access was required, rating would change from 2 to 1.	3	Construction and operation of this alternative would not affect fish and wildlife or their habitat.
3. Wetlands, Streams, and Shoreline	2	It is assumed that Pelly Creek, which is piped through the project area along the northern edge of Lowman Beach Park, would likely have to be moved to construct this alternative. It is assumed that marine access would not be required. If marine access was required, construction would impact Puget Sound shoreline and rating would change from 2 to 1. No wetlands in the project area.	1	Pelly Creek flows through the project area and would be impacted by construction activities. The project area may contain wetlands that would be impacted by construction activities. This alternative would not impact shoreline areas.	2	It is assumed that Pelly Creek, which is piped through the project area, would likely have to be moved to construct this alternative. This alternative would not impact wetlands or shoreline areas.
4. Soils and Sediments	3	No known contaminated sites. Project area is within liquefaction zone. No steep slopes and/or potential or known landslide areas.	1	No known contaminated sites. Eastern part of project area has steep slopes and is identified as a potential landslide area. Project area is not within liquefaction zone and contains no known landslide areas.	3	No known contaminated sites. Project area is not within liquefaction zone and contains no steep slopes and/or potential or known landslide areas. Murray Avenue SW is adjacent to steep slopes.
5. Water Quality	3	No new untreated discharges to surface waters.	3	No new untreated discharges to surface waters.	3	No new untreated discharges to surface waters.

Barton, Murray, Magnolia and North Beach CSO Projects
 Alternatives Analysis

MURRAY BASIN ALTERNATIVES

CATEGORY / CRITERIA	1A: RECTANGULAR STORAGE, BOTTOM OF BASIN		ALTERNATIVE 1B: CIRCULAR STORAGE, MURRAY AVE & LINCOLN PARK		ALTERNATIVE 1C: DIST. STORAGE BEACH DRIVE & MURRAY AVE	
	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION
TECHNICAL						
1. Technical Complexity	3	At bottom of basin and will capture peak flow using a weir in a diversion structure. Most reliable and will not require telemetry to divert flows.	2	Mid-Basin Alternative but close to bottom of the basin. Will require some telemetry and possibly predictive algorithms. Considered more reliable since close to the bottom of the basin.	2	Mid-Basin Alternative/Distributed Storage but close to bottom of the basin. Will require some telemetry and possibly predictive algorithms. Considered more reliable since close to the bottom of the basin.
2. Compatibility with Existing WW system	2	May prolong peak event to existing system because stored flows will be fed back into the system after peak event passes. More pounds of BOD, TSS will be routed through treatment facilities.	2	May prolong peak event to existing system because stored flows will be fed back into the system after peak event passes. More pounds of BOD, TSS will be routed through treatment facilities.	2	May prolong peak event to existing system because stored flows will be fed back into the system after peak event passes. More pounds of BOD, TSS will be routed through treatment facilities.
3. Flexibility/Adaptive Management	2	Limited space available for expansion or construction of auxillary tank. Property is limited at the bottom of the basin and ability to expand in the future could be problematic.	2	Limited space available for expansion or construction of auxillary tank. Property is limited at the bottom of the basin and ability to expand in the future could be problematic.	2	Ability to expand in the R/W is limited because of space and ground surface restrictions. Ability to lengthen pipe limited because of steep excavation depths north and south of the placement area.
4. Constructability/Implementation Schedule	2	There may be construction difficulties with groundwater and excavation. Limited construction access and issues associated with ferry traffic.	2	There may be construction difficulties with groundwater and excavation. Limited construction access and issues associated with ferry traffic.	2	There may be construction difficulties with groundwater and excavation. Limited construction access and issues associated with ferry traffic.

Barton, Murray, Magnolia and North Beach CSO Projects
Alternatives Analysis

MURRAY BASIN ALTERNATIVES

CATEGORY / CRITERIA	1A: RECTANGULAR STORAGE, BOTTOM OF BASIN		ALTERNATIVE 1B: CIRCULAR STORAGE, MURRAY AVE & LINCOLN PARK		ALTERNATIVE 1C: DIST. STORAGE BEACH DRIVE & MURRAY AVE	
	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION
O&M						
1. Staffing	3	Facility can be automatically started (gravity overflow) and run autonomously under design conditions. Minimal staffing required for operation and shut down. Some staffing/supervision may be needed for cleaning. Facility should not impact downstream facilities.	2	Facility can be automatically started (gravity overflow) and run autonomously under design conditions. Minimal staffing required for operation and shut down. Some staffing/supervision may be needed for cleaning. Facility should not impact downstream facilities.	3	Facility can be automatically started (gravity overflow) and run autonomously under design conditions. Minimal staffing required for operation and shut down. Some staffing/supervision may be needed for cleaning. Facility should not impact downstream facilities.
2. Training	3	Staff familiar with storage facilities and technology - North Creek. Similar control approaches to other facilities within the system can be specified for consistency.	3	Staff familiar with storage facilities within the system. There are no other circular storage tanks in the KC system.	3	Staff familiar with storage facilities and technology - Henderson & Mercer Street Tunnel. Similar control approaches to other facilities within the system can be specified for consistency.
3. Reliability	3	System is not complex. Gravity diversion over a weir. Power not critical for ability to store peak flows. Storage is a proven technology for controlling peak flow events.	2	System is not complex. Gravity diversion over a weir to storage facility. Power not critical for ability to store peak flows. Storage is a proven technology for controlling peak flow events. Reliance on peak flow pump station send excess Barton flows to storage reduces overall reliability.	2	Access to pipe storage on Beach drive is not complex. Gravity diversion over a weir. Power not critical for ability to store peak flows. Storage is a proven technology for controlling peak flow events. Diversion to storage on Murray Avenue will be by telemetry and gates which may be more complex and less reliable
4. Maintenance	3	Alternative requires less maintenance than other alternatives. Automatic flushing gates should provide most, if not all, the cleaning needed. Minimal telemetry/controls to maintain (typical level sensing and pump system controls). Assumes no entry.	2	Alternative requires less maintenance than other alternatives. Automatic flushing gates should provide most, if not all, the cleaning needed. Minimal telemetry/controls to maintain (typical level sensing and pump system controls). Assumes no entry.	2	Alternative requires less maintenance than other alternatives. Automatic flushing gates should provide most, if not all, the cleaning needed. Minimal telemetry/controls to maintain (typical level sensing and pump system controls). Assumes no entry.
5. Safety	3	No street access required. No traffic control procedures required. No street use/closure permit required.	3	No street access required. No traffic control procedures required. No street use/closure permit required.	1	Street access required. Traffic control procedures required. Street use/closure permit required. Heavily travelled roadway. Rating would change from from 1 to 2 if maintenance access can be moved outside of the travelled right-of-way.

Barton, Murray, Magnolia and North Beach CSO Projects
Alternatives Analysis

MURRAY BASIN ALTERNATIVES

CATEGORY / CRITERIA	1A: RECTANGULAR STORAGE, BOTTOM OF BASIN		ALTERNATIVE 1B: CIRCULAR STORAGE, MURRAY AVE & LINCOLN PARK		ALTERNATIVE 1C: DIST. STORAGE BEACH DRIVE & MURRAY AVE	
	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION
COST EFFECTIVENESS						
1. Project Capital Costs	3	Relative cost = 1.0	3	Relative cost = 1.2	2	Relative cost = 1.7
2. Life Cycle Costs						
3. Cost Variability/Risk	3	Variability Ratio = 1.4	3	Variability Ratio = 1.1	3	Variability Ratio = 1.1
Note: Project Capital Costs for Murray Alternatives range from a low \$13M to a high of \$70M						
COMMUNITY IMPACT						
1. Location	2	Small, above ground facilities and vents may cause limited reduction in land use. Design must consider surrounding land use. If the facility is built across the street from the park, it should be rated a 2. If it is built in Lowman Park it should be rated a 1.	2	Small, above ground facilities and vents may cause limited reduction in land use. Design must consider surrounding land use.	3	Facility does not impede land use.
2. Potential Community Impacts	3	Similar nearby facilities and design can help small aboveground facilities fit into community vision that is consistent with current surrounding uses. If built across the street from the park it should be rated a 3, if built in the park, a 2.	2	Design can help small aboveground facilities fit into community vision that is consistent with current surrounding uses.	3	Does not change community vision of itself as facilities in street.
3. Construction Impacts	2	Park users will be affected by construction traffic and noise. Some aspects of construction can be reduced through design and construction controls. If constructed in across from the park, it should be rated a 2. If built in Lowman park, it should be a 1.	2	Construction traffic and hauling will use residential arterials. Wooded area provides visual buffer from nearby residences. Some aspects of construction can be reduced through design and construction controls.	1	Construction duration, access limitations, and traffic disruption as well as utilities relocations will adversely impact up to 40 residences, commuter traffic, emergency vehicle access. Construction controls used to reduce impacts will be difficult to implement.

Barton, Murray, Magnolia and North Beach CSO Projects
Alternatives Analysis

MURRAY BASIN ALTERNATIVES

CATEGORY / CRITERIA	ALTERNATIVE 1D: BOTTOM OF BASIN - TUNNELING		1E: UPPER BASIN STORAGE		1F: BOTTOM OF BASIN - COMBINED PIPE/RECTANGULAR STORAGE	
	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION
LAND USE AND PERMITTING						
1. City of Seattle Comprehensive Plan	2	Section 6.5 of the Seattle Comprehensive Plan (Utilities Element of the Planning Policies, U16) states that the City should work cooperatively with King County to identify and expeditiously address combined sewer overflows. Elsewhere in the Comp Plan (Land Use Element, Section 2.1, LU 61 & 62), uses in Single Family Residential neighborhoods should affirm and encourage residential use by one household as the principal use or should only encourage uses that are permitted outright. Storage is compatible with existing land use within ROW, but may not be fully consistent with Seattle Parks policies for ancillary structures if located in Lowman Beach Park.	1	Section 6.5 of the Seattle Comprehensive Plan (Utilities Element of the Planning Policies, U16) states that the City should work cooperatively with King County to identify and expeditiously address combined sewer overflows. Elsewhere in the Comp Plan (Land Use Element, Section 2.1, LU 61 & 62), uses in Single Family Residential neighborhoods should affirm and encourage residential use by one household as the principal use or should only encourage uses that are permitted outright. Location may require review for consistency with City parks policies. If the storage facility is not located in the park, the rating would be improved.	2	Section 6.5 of the Seattle Comprehensive Plan (Utilities Element of the Planning Policies, U16) states that the City should work cooperatively with King County to identify and expeditiously address combined sewer overflows. Elsewhere in the Comp Plan (Land Use Element, Section 2.1, LU 61 & 62), uses in Single Family Residential neighborhoods should affirm and encourage residential use by one household as the principal use or should only encourage uses that are permitted outright. Storage is compatible with existing land use within ROW, but may not be fully consistent with Seattle Parks policies for ancillary structures if located in Lowman Beach Park.
2. Seattle Municipal Code (SMC/Zoning Code)	3	Utilities would be buried underground in the ROW which would only temporarily disrupt public access. Zoning: N/A (Located in ROW).	2	Zoning is Single Family Residential. Lowman Beach Park in potential placement area will require review for consistency with Parks policies. Dependent upon final location of pump station.	2	In Shoreline zone. Storage tank in Single Family Residential zone; storage pipe in RW.
3. Shoreline Master Program Compatibility	3	Utilities would be buried underground in the ROW which would only temporarily disrupt public access. Parts of alternative may be in the Shoreline Zone.	1	Storage is compatible with existing land use within ROW, but may not be consistent with Seattle Parks policies for ancillary structures if located in Lowman Beach Park. Pump stations is a "Utility Service Use" within the Shoreline District are only allowed outright only if it is considered a shoreline dependent use. Because this option involves acquisition of Single Family Residential properties, it is uncertain if this option will be considered compatible with existing land uses in the area.	2	Storage is most likely considered a "Utility Service Use". A Utility Service Use is allowed outright within the Shoreline District only if it can be demonstrated that it requires a shoreline location, although water-related uses (pump stations will likely be considered a water-related use) are preferred next in line to water-dependent uses within the Shoreline District.
4. Permitting Complexity	2	This alternative may require a Shoreline Permit for portions of the alternative within 200-ft of the shoreline. Only local permits required from SDOT (no federal or state permits required). Traffic impacts for local residents. Provisions for temporary and emergency access required. SDOT Street Use permit fees could be extremely high because of size of facilities (pipe storage) and number of structures located within ROW (Costs accounted for in Cost Effectiveness Category).	2	This alternative will require a Shoreline Permit. Potential for marine access will add federal and state permits in addition to local permits. This could add up to a year or more to the schedule. Affected roadways have moderate traffic volumes in residential neighborhood with restricted access to residences south of Lowman Beach Park. Will require careful traffic planning to maintain access. Work hours likely to be restricted. Permit review likely to be complex.	2	This alternative may require a Shoreline Permit for portions of the alternative within 200-ft of the shoreline. Only local permits required from SDOT (no federal or state permits required). Traffic impacts for local residents. Provisions for temporary and emergency access required. SDOT Street Use permit fees could be extremely high because of size of facilities (pipe storage) and number of structures located within ROW (Costs accounted for in Cost Effectiveness Category).
5. Property Acquisition Complexity	2	SDOT residential street, may require additional property for tunnel portal and ancillary facilities (odor control, electrical, generator, etc.). Acquisition is possible.	1	Property acquisition difficult if tank located on Seattle Public School Property and pump station located in park. Rating would change from 1 to 2 if tank and pump station are located on private property.	2	Single family residential properties must be acquired for rectangular tank. For pipe storage, SDOT (Residential Street), may require additional property for ancillary facilities (odor control, electrical, generator, etc.)

Barton, Murray, Magnolia and North Beach CSO Projects
Alternatives Analysis

MURRAY BASIN ALTERNATIVES

CATEGORY / CRITERIA	ALTERNATIVE 1D: BOTTOM OF BASIN - TUNNELING		1E: UPPER BASIN STORAGE		1F: BOTTOM OF BASIN - COMBINED PIPE/RECTANGULAR STORAGE	
	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION
ENVIRONMENT						
1. Cultural Resources	2	No archaeological or historic resources identified in the project area. Based on site characteristics, the project area has a high probability of containing archaeological resources.	2	No archaeological resources identified in the project area. Based on site characteristics, the project area in which the pump station would be located has a high potential for containing archaeological resources. The majority of the rest of the basin has a low probability of containing archaeological resources. Historic properties in the upper basin include the Gatewood School (4320 SW Myrtle St.) and the Kenney Presbyterian Home for the Retired (7125 Fauntleroy Way).	2	No archaeological or historic resources identified in the project area. Based on site characteristics, the project area has a high probability of containing archaeological resources.
2. Fish and Wildlife	3	Construction and operation of this alternative would not affect fish and wildlife or their habitat.	3	Construction and operation of this alternative would not affect fish and wildlife or their habitat (assuming no clearing of forested areas was required). If marine access was required, rating would change from 3 to 1.	2	Construction would require clearing of forested area, which may affect fish and wildlife.
3. Wetlands, Streams, and Shoreline	2	It is assumed that Pelly Creek, which is piped through the project area, would likely have to be moved to construct this alternative. This alternative would not impact wetlands or shoreline areas.	3	Pelly Creek is piped through the project area along the northern edge of Lowman Beach Park. This rating assumes that construction would not impact the creek or any wetlands or shoreline area within the basin.	2	It is assumed that Pelly Creek, which is piped through the project area, would likely have to be moved to construct this alternative. This alternative would not impact wetlands or shoreline areas.
4. Soils and Sediments	3	No known contaminated sites. Project area is not within liquefaction zone and contains no steep slopes and/or potential or known landslide areas.	2	No known contaminated sites. Project area on west side of Beach Dr. SW is within liquefaction zone. No steep slopes and/or potential or known landslide areas on west side of Beach Dr. SW. Project area on the east side of Beach Dr. SW is not in liquefaction zone, but is adjacent to steep slopes and potential landslide area. Impacts on soils and sediments for storage in upper basin depends on location.	2	No known contaminated sites. Project area on west side of Beach Dr. SW is within liquefaction zone. No steep slopes and/or potential or known landslide areas on west side of Beach Dr. SW. Project area on the east side of Beach Dr. SW is not in liquefaction zone, but is adjacent to steep slopes and potential landslide area.
5. Water Quality	3	No new untreated discharges to surface waters.	3	No new untreated discharges to surface waters.	3	No new untreated discharges to surface waters.

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Alternatives Analysis

MURRAY BASIN ALTERNATIVES

CATEGORY / CRITERIA	ALTERNATIVE 1D: BOTTOM OF BASIN - TUNNELING		1E: UPPER BASIN STORAGE		1F: BOTTOM OF BASIN - COMBINED PIPE/RECTANGULAR STORAGE	
	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION
TECHNICAL						
1. Technical Complexity	3	At bottom of basin and will capture peak flow using a weir in a diversion structure. Most reliable and will not require telemetry to divert flows.	2	Peak Pump Station Bottom of Basin, peak flows diverted by weir. But will require some telemetry to manage flow and volumes at storage facility. Considered more reliable since diversion is at bottom of the basin.	2	Bottom of Basin alternative, peak flows diverted by weir. But will require some telemetry to manage flow and volumes between two storage facilities. Considered more reliable since diversion is at bottom of the basin.
2. Compatibility with Existing WW system	2	May prolong peak event to existing system because stored flows will be fed back into the system after peak event passes. More pounds of BOD, TSS will be routed through treatment facilities.	2	May prolong peak event to existing system because stored flows will be fed back into the system after peak event passes. More pounds of BOD, TSS will be routed through treatment facilities.	2	May prolong peak event to existing system because stored flows will be fed back into the system after peak event passes. More pounds of BOD, TSS will be routed through treatment facilities.
3. Flexibility/Adaptive Management	2	Ability to expand in the R/W is limited because of space and ground surface restrictions. Ability to lengthen pipe limited because of steep excavation depths north and south of the placement area.	3	Area available within the parking of the Gatewood School.	3	Area available within parking lot of Fautleroy School to expand tank or construct auxillary tank.
4. Constructability/Implementation Schedule	1	There may be construction difficulties with groundwater and excavation. Difficult construction conditions within street R/W; issues associated with ferry traffic.	2	There may be construction difficulties with groundwater, archaeological conditions, and excavation. Difficult construction conditions within street R/W; issues associated residential access during construction.	3	No significant construction issues or risks beyond typical structure excavation and construction. Few, if any, traffic or access issues identified.

Barton, Murray, Magnolia and North Beach CSO Projects
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MURRAY BASIN ALTERNATIVES

CATEGORY / CRITERIA	ALTERNATIVE 1D: BOTTOM OF BASIN - TUNNELING		1E: UPPER BASIN STORAGE		1F: BOTTOM OF BASIN - COMBINED PIPE/RECTANGULAR STORAGE	
	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION
O&M						
1. Staffing	3	Facility can be automatically started (gravity overflow) and run autonomously under design conditions. Minimal staffing required for operation and shut down. Some staffing/supervision may be needed for cleaning. Facility should not impact downstream facilities.	2	Facility can be automatically started and run autonomously under design conditions. However, facility will be started using monitoring and telemetry. This may require operator response to ensure proper startup and operation of the facility. Some staffing/supervision may be needed for cleaning. Facility should not impact downstream facilities.	3	Facility can be automatically started and run autonomously under design conditions. However, facility will be started using monitoring and telemetry. This may require operator response to ensure proper startup and operation of the facility. Some staffing/supervision may be needed for cleaning. Facility should not impact downstream facilities.
2. Training	3	Staff familiar with storage facilities and technology - Henderson & Mercer Street Tunnel. Similar control approaches to other facilities within the system can be specified for consistency.	3	Staff familiar with storage & pumping facilities and technology - Henderson & Mercer Street Tunnel. Similar control approaches to other facilities within the system can be specified for consistency.	3	Staff familiar with storage facilities and technology - North Creek & Henderson. Similar control approaches to other facilities within the system can be specified for consistency.
3. Reliability	3	System is not complex. Gravity diversion over a weir. Power not critical for ability to store peak flows. Storage is a proven technology for controlling peak flow events.	2	System requires telemetry/controls to effectively operate pump station and manage the storage of peak flows. Power is critical for operation of pump station, telemetry & monitoring equipment and ability to store peak flows. Storage is a proven technology for controlling peak flow events.	3	System is not complex. Gravity diversion over a weir. Power not critical for ability to store peak flows. Storage is a proven technology for controlling peak flow events. Telemetry and controls may be required to effectively manage storage volumes between rectangular tank and storage pipe.
4. Maintenance	2	Alternative requires less maintenance than other alternatives. Automatic flushing gates should provide most, if not all, the cleaning needed. Minimal telemetry/controls to maintain (typical level sensing and pump system controls). Assumes no entry.	2	Automatic flushing gates should provide most, if not all, the cleaning needed. More complex telemetry/controls than bottom of the basin alternatives (pump station monitors, possible flow meters, level sensing and pump system controls). Assumes no entry.	3	Alternative requires less maintenance than other alternatives. Automatic flushing gates should provide most, if not all, the cleaning needed. Minimal telemetry/controls to maintain (typical level sensing and pump system controls). Assumes no entry.
5. Safety	1	Street access required. Traffic control procedures required. Street use/closure permit required. Heavily travelled roadway. Rating would change from 1 to 2 if maintenance access can be moved outside of the travelled right-of-way.	3	No street access required. No traffic control procedures required. No street use/closure permit required.	1	Street access required. Traffic control procedures required. Street use/closure permit required. Heavily travelled roadway.

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MURRAY BASIN ALTERNATIVES

CATEGORY / CRITERIA	ALTERNATIVE 1D: BOTTOM OF BASIN - TUNNELING		1E: UPPER BASIN STORAGE		1F: BOTTOM OF BASIN - COMBINED PIPE/RECTANGULAR STORAGE	
	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION
COST EFFECTIVENESS						
1. Project Capital Costs	2	Relative cost = 1.7	1	Relative cost = 3.5	3	Relative cost = 1.2
2. Life Cycle Costs						
3. Cost Variability/Risk	3	Variability Ratio = 1.1	3	Variability Ratio = 1.2	3	Variability Ratio = 1.1
Note: Project Capital Costs for Murray Alternatives range from a low \$13M to a high of \$70M						
COMMUNITY IMPACT						
1. Location	1	Location of abovegrade structures will likely require residential property acquisition that may not be residential uses in future. Rating may depend on future uses of property.	1	Aboveground structure for large pump station in park, two pump stations in same location will impede land use in park. Below grade tank does not impose similar limitations on land use.	2	Below grade facility with limited abovegrade structures provides potential for future public access.
2. Potential Community Impacts	3	Infrequent, planned access by O&M staff reduces periodic impacts. Design considerations for abovegrade structures can reduce adverse impacts on community vision.	1	Pump station and tanks on separate sites will require additional maintenance attention. Design can reduce visual impacts. This would be a permanent change in how the land is used in this area and should be rated a 1.	3	Limited O&M frequency. Site use not likely to change community vision.
3. Construction Impacts	1	Large portal construction on Beach Dr. will require property acquisition and have impacts on traffic and emergency vehicle access. Long duration, high volume hauling would use narrow residential street adjacent to park.	1	Due to construction duration, multiple sites, temporary closure of park, and pipeline alignment along residential arterials for extended period, impacts will be significant.	2	Off street area available for construction staging. Construction can be sequenced to reduce impacts on traffic and neighborhood.

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MURRAY BASIN ALTERNATIVES

CATEGORY / CRITERIA	ALTERNATIVE 2A: CONVEY & TREAT AT ALKI		ALTERNATIVE 3A - END OF PIPE TREATMENT, BOTTOM OF BASIN		ALTERNATIVE 5A: PEAK FLOW REDUCTION COMBINED W/STORAGE	
	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION
LAND USE AND PERMITTING						
1. City of Seattle Comprehensive Plan	1	Section 6.5 of the Seattle Comprehensive Plan (Utilities Element of the Planning Policies, U16) states that the City should work cooperatively with King County to identify and expeditiously address combined sewer overflows. Elsewhere in the Comp Plan (Land Use Element, Section 2.1, LU 61 & 62), uses in Single Family Residential neighborhoods should affirm and encourage residential use by one household as the principal use or should only encourage uses that are permitted outright. Alternative may not be fully consistent with Seattle Parks policies if peaking pump station is located in Lowman Beach Park. If the storage facility is not located in the park, the rating would be improved.	1	The large size of facility located within the Park and proximity to shoreline would most likely be contrary to Land Use policies LU 58, 61, & 62.	2	Section 6.5 of the Seattle Comprehensive Plan (Utilities Element of the Planning Policies, U16) states that the City should work cooperatively with King County to identify and expeditiously address combined sewer overflows. According to the Comp Plan (Land Use Element), uses in Single Family Residential neighborhoods should affirm and encourage residential use by one household as the principal use or should only encourage uses that are permitted outright. Storage is compatible with existing land use within ROW, but may not be fully consistent with Seattle Parks policies for ancillary structures if located in Lowman Beach Park.
2. Seattle Municipal Code (SMC/Zoning Code)	2	Zoning is Single Family Residential. Lowman Beach Park in potential placement area will require review for consistency with Parks policies. Dependent upon final location of pump station.	1	Zoning is Single Family Residential. New sewage treatment plants or expansion of existing are prohibited in SFR areas.	3	Utilities would be buried underground in the ROW which would only temporarily disrupt public access. Zoning: N/A (Located in ROW).
3. Shoreline Master Program Compatibility	1	Pump station is a "Utility Service Use". A Utility Service Use is allowed outright within the Shoreline District if it can be demonstrated that it requires a shoreline location. Because this option involves acquisition of Single Family Residential properties, it is uncertain if this option will be considered compatible with existing land uses in the area.	1	New treatment plants are not allowed in Shoreline District	3	Utilities would be buried underground in the ROW which would only temporarily disrupt public access. Parts of alternative may be in the Shoreline Zone.
4. Permitting Complexity	1	This alternative will require a Shoreline Permit. Potential for marine access will add federal and state permits in addition to local permits. This could add up to a year or more to the schedule. Affected roadways have high traffic volumes on a residential arterial with restricted access to residences. Will require careful traffic planning to maintain access. Work hours likely to be restricted. Permit review likely to be complex.	1	This alternative will require a Shoreline Permit. Potential for marine access will add federal and state permits in addition to local permits. This could add up to a year or more to the schedule. Affected roadways have low traffic volume in residential land uses. Will require careful traffic planning to maintain access. Work hours likely to be restricted. Permit review likely to be most complex. Treatment plant is an inconsistent use for single-family residential zone.	2	ROW permits required. Water quality treatment issues may increase permitting complexity. Affected roadways have moderate traffic volume in residential land uses. Will require careful traffic planning to maintain access. Work hours may be restricted. Permit review likely to be complex.
5. Property Acquisition Complexity	1	Location on park property for Murray pump station would be difficult. Rating would change from 1 to 2 if pump station located on private property.	1	Assumes location on park property. If located on private property rating would change to from 1 to 2. Neighborhood has expressed concerns, waterfront real estate. Acquisition possible for private property.	2	Street use permits, may require rights of entry for property disconnection. May require property acquisition for electrical, odor control, and/or stormwater treatment facilities.

Barton, Murray, Magnolia and North Beach CSO Projects
Alternatives Analysis

MURRAY BASIN ALTERNATIVES

CATEGORY / CRITERIA	ALTERNATIVE 2A: CONVEY & TREAT AT ALKI		ALTERNATIVE 3A - END OF PIPE TREATMENT, BOTTOM OF BASIN		ALTERNATIVE 5A: PEAK FLOW REDUCTION COMBINED W/STORAGE	
	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION
ENVIRONMENT						
1. Cultural Resources	2	No archaeological or historic resources identified in the project area. Based on site characteristics, the project area in which the pump station would be located has a high probability of containing archaeological resources.	2	No archaeological or historic resources identified in the project area. Based on site characteristics, the project area has a high probability of containing archaeological resources.	2	No archaeological or historic resources identified in the pipe storage part of the project area. Based on site characteristics, this part of the project area has a high probability of containing archaeological resources. Disconnections in upper basin not expected to impact archaeological or historic resources.
2. Fish and Wildlife	3	Construction and operation of this alternative would not affect fish and wildlife, or their habitat. If marine access was required, rating would change from 3 to 1.	3	It is assumed that Pelly Creek is not a fish-bearing stream. Construction and operation of this alternative would not affect fish and wildlife, or their habitat. If marine access was required, rating would change from 3 to 1.	2	Construction of this alternative would not affect fish and wildlife, or their habitat. Operation could have adverse effects on fish and wildlife if treatment was not required for stormwater discharges.
3. Wetlands, Streams, and Shoreline	3	Pelly Creek is piped through the project area along the northern edge of Lowman Beach Park. This rating assumes that construction would not impact the creek or any wetlands or shoreline area within the basin.	2	It is assumed that Pelly Creek, which is piped through the project area along the northern edge of Lowman Beach Park, would likely have to be moved, and would be impacted by construction of this alternative. It is assumed that marine access would not be required. If marine access was required, construction would impact Puget Sound shoreline and rating would change from 2 to 1. No wetlands in the project area.	2	Pelly Creek, which is piped through the project area along the northern edge of Lowman Beach Park, would be impacted by construction of this alternative. This alternative would not impact wetlands.
4. Soils and Sediments	3	No known contaminated sites. Project area is within liquefaction zone. No steep slopes and/or potential or known landslide areas.	3	No known contaminated sites. Project area is within liquefaction zone. No steep slopes and/or potential or known landslide areas.	2	No known contaminated sites in the Beach Drive SW project area. This project area is not within liquefaction zone and contains no steep slopes and/or potential or known landslide areas. Soil and sediment impacts in upper basin depend on location of disconnections and stormwater system construction. Operation could impact sediment quality if treatment was not required for stormwater discharges.
5. Water Quality	3	No new untreated discharges to surface waters.	3	No new untreated discharges to surface waters.	1	It is assumed that stormwater treatment would not be required. If stormwater treatment was required, rating would change from 1 to 3.

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TECHNICAL						
1. Technical Complexity	2	Bottom of Basin alternative, peak flows diverted by weir to peak flow pump station. But will require some telemetry and management of an intermittently used pump station. Considered more reliable since diversion is at bottom of the basin.	1	Complex wastewater equipment and instrumentation	3	No wastewater equipment or telemetry.
2. Compatibility with Existing WW system	1	Will send the peak flow to existing downstream system as event occurs. May cause capacity issues at treatment plant. More pounds of BOD, TSS will be routed through treatment facilities.	3	Will not affect the operation of the existing treatment system.	3	Will not affect the operation of the existing treatment system.
3. Flexibility/Adaptive Management	2	Limited space available for expansion of peak flow pump station. Property is limited at the bottom of the basin and ability to expand in the future could be problematic.	2	Limited space available for expansion of HRC treatment facility. Property is limited at the bottom of the basin and ability to expand in the future could be problematic.	2	Additional separation could be undertaken if initial efforts do not provide control. However, identified cross-connected CSO sub-basin are not concentrated and limited within the Murray Basin.
4. Constructability/Implementation Schedule	2	No significant construction issues or risks beyond typical structure excavation and construction. Possible traffic and access issues regarding temporary construction conditions associated with Roxhill Playground.	2	There may be construction difficulties with groundwater and excavation. Limited construction access and issues associated with ferry traffic.	2	There may be construction difficulties with groundwater and excavation. Difficult construction conditions within street R/W; issues associated residential access during construction.

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	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION	IMPACT RATING	DESCRIPTION
O&M						
1. Staffing	2	Facility can be automatically started and run autonomously under design conditions. However, facility will be started using monitoring and telemetry. This may require operator response to ensure proper startup and operation of the facility. Some staffing/supervision may be needed for cleaning. Facility should not impact downstream facilities.	1	Facility can be automatically started but will require operator response to ensure proper startup and operation. Staffing/supervision may be needed for cleaning. Facility should not impact downstream facilities.	3	Routine staffing for stormwater system/treatment system maintenance.
2. Training	3	Staff familiar with pumping systems and technology. Similar operation and control approaches to other facilities within the system can be specified for consistency.	1	There are no other high-rate clarification treatment systems in the KC system. Staff unfamiliar with Actiflo or packaged HRC system.	3	There are numerous stormwater conveyance and treatment facilities throughout the area.
3. Reliability	2	Requires operation of a pump station to convey peak flows. System will have standard reliability and redundancy measures incorporated into the design. Requires power, telemetry, and maintenance for reliable operation and function of the system.	2	System requires telemetry/controls to effectively store peak flows. Power is critical for operation of treatment facility, telemetry & monitoring equipment. Treatment technology is proven.	3	System is not complex. Gravity stormwater and treatment system. Peak flow reduction, when effectively implemented, is a proven technology for controlling peak flow events.
4. Maintenance	2	Alternative requires less maintenance than most other alternatives. More complex telemetry/controls than bottom of the basin alternatives (pump station monitors, possible flow meters, level sensing and pump system controls).	1	System will require the most maintenance of all alternatives. The treatment plant will have numerous systems (chemical, pumping, controls, disinfection, etc.) to maintain.	3	Minimal maintenance compared to other alternatives. Typical stormwater piping and treatment system maintenance.
5. Safety	3	No street access required. No traffic control procedures required. No street use/closure permit required.	3	No street access required. No traffic control procedures required. No street use/closure permit required.	2	Maintenance of storm sewers will require manhole access in streets.

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COST EFFECTIVENESS						
1. Project Capital Costs	1	Relative cost = 3.9	1	Relative cost = 5.3	2	Relative cost = 1.6
2. Life Cycle Costs						
3. Cost Variability/Risk	2	Variability Ratio = 1.8	3	Variability Ratio = 1.1	2	Variability Ratio = 2.0
Note: Project Capital Costs for Murray Alternatives range from a low \$13M to a high of \$70M						
COMMUNITY IMPACT						
1. Location	1	Large pump station in park will reduce size of park.	1	Changes land use.	3	No above grade facilities anticipated.
2. Potential Community Impacts	1	Long term duration of construction on Beach Dr. will impede traffic, access, and emergency vehicle access.	1	Significant O&M activities and storage of chemicals. Incompatible with land use.	2	Project will not increase the risk of flooding or slope instability. Traffic will be impacted due to access of facilities from roadway for maintenance.
3. Construction Impacts	1	Construction duration, access limitations, and traffic disruption as well as utilities relocations will adversely impact up to 400 residences, commuter traffic, emergency vehicle access. Construction controls used to reduce impacts will be difficult to implement.	2	Duration of construction, moderate hauling required with periodic deliveries of large equipment during construction. Temporary closure of park for construction staging.	1	Construction duration, access limitations, and traffic disruption as well as utilities relocations will adversely impact up to 30 residences along Beach Dr, commuter traffic, emergency vehicle access. Construction controls used to reduce impacts will be difficult to implement. Storm sewer construction will temporarily affect access for approximately 200 residences, however small diameter pipe only affects one side of right of way.