Technical Memorandum 1100

King County 2012 CSO Control Program Review

Project Sequence

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Wastewater Treatment Division

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Contents

1.0. Introduction 3
1.1 Background and Purpose 3
1.2 CSO Sites and Recommended Preferred Alternatives 3
1.3 Green Stormwater Infrastructure Projects 5
2.0. Schedule Drivers and Project Building BLocks 6
2.1 Schedule Drivers 6
2.2 Project Building Blocks 7
2.2.1 CSO Storage Tanks 7
2.2.2 Wet-Weather Treatment Facilities 7
2.2.3 GSI Projects 8
3.0. Evaluation of Alternatives 9
3.1 Initial Alternatives 9
3.1.1 Duwamish-First Alternative 9
3.1.2 GSI-First Alternative 11
3.1.3 Meet-SPU-Schedule Alternative 13
3.1.4 Joint-Tunnel Alternative 15
3.2 Evaluation Process 17
3.2.1 Schedule Driver Analysis 17
3.2.2 Rate Analysis 17
3.2.3 Workshops 17
3.2.4 Development of Hybrid Alternatives 18
4.0. Recommended Project Sequence 19

Tables

Table 1-1. Uncontrolled CSO Sites and Facilities in King County 4
Table 1-2. CSO Sites Controlled by Each Recommended Preferred Alternatives 5
Table 3-1. Ability of Project Sequence Alternatives to Meet Schedule Drivers 17

Figures

Figure 2-1. Assumed Timelines for Project Building Blocks 7
Figure 3-1. Duwamish-First Project Sequence Alternative 10
Figure 3-2. GSI-First Project Sequence Alternative 12
Figure 3-3. Meet-SPU-Schedule Project Sequence Alternative 14
Figure 3-4. Joint-Tunnel Project Sequence Alternative 16
Figure 4-1. Recommended Project Sequence 20

Acronyms

CSO	Combined sewer overflow
DSN	Discharge serial number
EBI	Elliott Bay Interceptor
GSI	Green stormwater infrastructure
MG	Million-gallon
NPDES	National Pollutant Discharge Elimination System
SPU	Seattle Public Utilities
WWTF	Wet-weather treatment facility

1.0. INTRODUCTION

1.1 Background and Purpose

King County's 1999 *Combined Sewer Overflow (CSO) Control Plan* outlines measures for controlling CSO discharges to surface waters. The Washington Department of Ecology requires that CSO sites average no more than one untreated discharge per year (Washington Administrative Code 173-245-020). CSO sites that meet this requirement are classified as "controlled." Those that do not are called "uncontrolled" CSO sites. King County's combined sewer system includes 38 CSO sites, of which 15 are currently uncontrolled, with no project underway to achieve control. According to King County's West Point Treatment Plant National Pollutant Discharge Elimination System (NPDES) permit, all remaining uncontrolled CSO sites must be controlled by 2030.

The CSO Control Plan will be updated in conjunction with the 2013 renewal of the West Point NPDES permit. To prepare for the update, the County's CSO Control Program has undergone a review—the *2012 CSO Control Program Review*—to identify currently appropriate measures to achieve required CSO control by 2030. The Program Review has identified recommended preferred CSO control alternatives for the uncontrolled CSO sites and is summarized in the "CSO Control Program Summary of Technical Memorandum". This technical memorandum documents the analyses performed to select a suitable project sequence for implementing the recommended preferred CSO control alternatives as well as public input on scheduling preferences.

1.2 CSO Sites and Recommended Preferred Alternatives

Each of the 14 uncontrolled CSO sites for which no control projects are currently underway has an associated CSO outfall (numbered by "Discharge Serial Number" or DSN) and a structure where overflows are diverted to the outfall from the combined sewer system. Table 1-1 lists the uncontrolled CSO sites, the DSN for each CSO site, and the name of the associated overflow diversion facility.

In the development of recommended preferred alternatives, some CSO control projects were identified that would provide control for multiple CSO sites. A total of seven projects are proposed to control the 14 sites. The projects are as follows:

- 11th Ave NW Conveyance—Approximately 3,200 feet of 84-inch-diameter conveyance pipe to increase the conveyance capacity from the 11th Ave NW Overflow Structure to the Ballard Regulator Station to control King County CSOs
- Ship Canal CSO Basin Projects—Two alternatives are still being considered for the CSO basins near the Lake Washington Ship Canal (University, 3rd Ave W, and Montlake):
  - University, 3rd Ave W, Montlake Joint Tunnel with Seattle Public Utilities (SPU)—A 21.4-MG storage tunnel along the Ship Canal
  - Individual storage for each basin, jointly with SPU—A 7.23-million-gallon (MG) facility on the north side of the Ship Canal for 3rd Ave W; a 5.23-MG facility

upstream of the University Regulator Station for University; and a 7.87-MG facility near the Montlake Regulator Station for Montlake

- Hanford #2, Lander, Kingdome, and King Street Wet-Weather Treatment Facility (HLKK WWTF #2)—A 151-million-gallon-per-day wet-weather treatment facility with a 1.7-MG equalization basin near the Hanford St Regulator Station and modifications to the Elliott Bay Interceptor (EBI) to divert flows to the new wet-weather treatment facility
- Hanford @ Rainier Storage/Conveyance—A 0.34-MG storage facility near the Bayview North Overflow Structure and conveyance improvements to use available capacity in the Bayview Tunnel
- Brandon/S Michigan Wet-Weather Treatment Facility (WWTF #1)—A 66-million-gallon-per-day wet-weather treatment facility with a 1.7-MG equalization basin near the S Michigan St Regulator Station and new conveyance from the Brandon St Regulator Station to the new wet-weather treatment facility
- W Michigan St/Terminal 115 Storage—A 0.32-MG storage facility near the Terminal 115 Overflow Structure
- Chelan Ave Storage—A 3.85-MG storage facility near the Chelan Ave Regulator Station and modifications to the Alki Trunk

Table 1-1. Uncontrolled CSO Sites and Facilities in King County

Uncontrolled CSO Site	DSN	Overflow Diversion Facility
Ship Canal		
11th Ave NW	004	11th Ave NW Overflow Structure
3rd Ave W	008	3rd Ave W Overflow Structure
University	015	University Regulator Station
Montlake	014	Montlake Regulator Station
Elliott Bay Interceptor Area		
Hanford #2	032	Hanford St Regulator Station
Lander St	030	Lander St Regulator Station
Kingdome	029	Kingdome Regulator Station
King St	028	King St Regulator Station
Hanford #1	031	Hanford@Rainier Overflow Structure, Bayview North Overflow Structure
Duwamish Area		
S Michigan St	039	S Michigan St Regulator Station
Brandon St	041	Brandon St Regulator Station
W Michigan St	042	W Michigan St Regulator Station
Terminal 115	038	Terminal 115 Overflow Structure
Chelan Ave	036	Chelan Ave Regulator Station

Table 1-2 identifies which CSO sites are controlled by each recommended preferred alternative.

Table 1-2. CSO Sites Controlled by Each Recommended Preferred Alternatives

Uncontrolled CSO Site	Recommended Preferred Alternative
11th Ave NW	11th Ave NW Conveyance
3rd Ave W, University, Montlake	University, 3rd Ave W, Montlake Joint Tunnel with SPU ***or*** individual storage projects for each basin
Hanford #2, Lander St, Kingdome, King St	HLKK WWTF #2
Hanford #1	Hanford @ Rainier Storage/Conveyance
S Michigan St, Brandon St	Brandon/S Michigan WWTF #1
W Michigan St, Terminal 115	W Michigan St/Terminal 115 Storage
Chelan Ave	Chelan Ave Storage

1.3 Green Stormwater Infrastructure Projects

In addition to the recommended preferred alternatives listed in Table 1-2, opportunities have been identified for helping to control CSOs using green stormwater infrastructure (GSI) techniques. GSI refers to a range of small-scale measures to reduce runoff throughout a neighborhood or area. Typical GSI techniques are low-impact measures such as bioretention swales, rain gardens, roof drain disconnects, cisterns, green roof retrofits, and permeable paving.

GSI techniques generally are not enough to eliminate CSOs by themselves, but by reducing the volume of runoff close to the sources, they can help reduce the size of more expensive control measures downstream.

The Program Review evaluated the GSI approach separately from the evaluation of alternatives developed from other CSO control approaches. While it is assumed that most alternatives have opportunities for a GSI component that could reduce the size of the CSO control facility, more detailed monitoring and modeling will be required to verify the resulting flow reduction; to be conservative, the facility sizes are not reduced in the alternatives developed for this Program Review. Future evaluations will consider benefit of GSI techniques in corresponding CSO basins. For the development of project sequence, GSI projects were identified as most promising for the following uncontrolled CSO sites:

- Montlake
- University
- 11th Ave NW
- W Michigan Street/Terminal 115 (Duwamish).

2.0. SCHEDULE DRIVERS AND PROJECT BUILDING BLOCKS

2.1 Schedule Drivers

A first step toward developing an appropriate sequence for implementing the recommended preferred CSO control alternatives was to define scheduling constraints, or "drivers." Many conversations were held with area stakeholders to discuss their preferences and concerns. Based on minimizing community impact (both financial and construction-related), collaborating with community stakeholders priorities, and meeting regulatory compliance schedules, the following schedule drivers were identified:

- **GSI Project Monitoring**—GSI projects would be implemented early enough to allow time for flow monitoring and modeling to determine the flow reduction achieved by the completed project and the consequent reduction in sizing for other control projects in the same CSO basin. GSI projects will provide early CSO reduction, with final control following.
- **Duwamish Area Projects**—Projects in the Duwamish area would be scheduled to coordinate with the large regional effort to clean up and restore the Duwamish area.
- **Rate Impact**— Sewer rates will need to be increased by King County to implement the CSO control projects. The projects should be spread out to flatten the rate increase. This mainly relates to spreading out the construction spending for each project – the highest cost for project implementation.
- **Workload Impact—**The impact on county project management, construction and operation and maintenance staff needs to be considered during the implementation of these projects. Wet-weather treatment facilities will likely require additional operation and maintenance staff.
- **King County 2030 Compliance**—Projects would be implemented by the target of 2030 established in King County's Regional Wastewater Services Plan.
- **SPU 2025 CSO Control Schedule**—Projects implemented jointly with SPU (in the Ship Canal area) must be implemented in time to comply with SPU's Ecology Order requirement to control CSOs by 2025. Ultimate control of Seattle's Genesee, CSO 107 and South Waterfront CSOs will occur with construction of the County's Hanford-Lander-King-Kingdome CSO treatment facility.
- **Opportunities and Conflicts with Other Agencies' Projects—**Coordination with other agency and community projects may result in cost savings for both, or may be necessary to avoid expensive conflicts during construction, and streamline permitting. Either may minimize impacts on the community. As part of the Program Review, the County contacted other agencies for information on future habitat and projects to evaluate potential impacts on the proposed CSO project schedules.

2.2 Project Building Blocks

Determination of an appropriate project sequence also requires an understanding of the broad components of work to be done for each type of project to be incorporated into the sequence. These "building blocks" and the duration assumed for each are described below and illustrated in Figure 2-1.

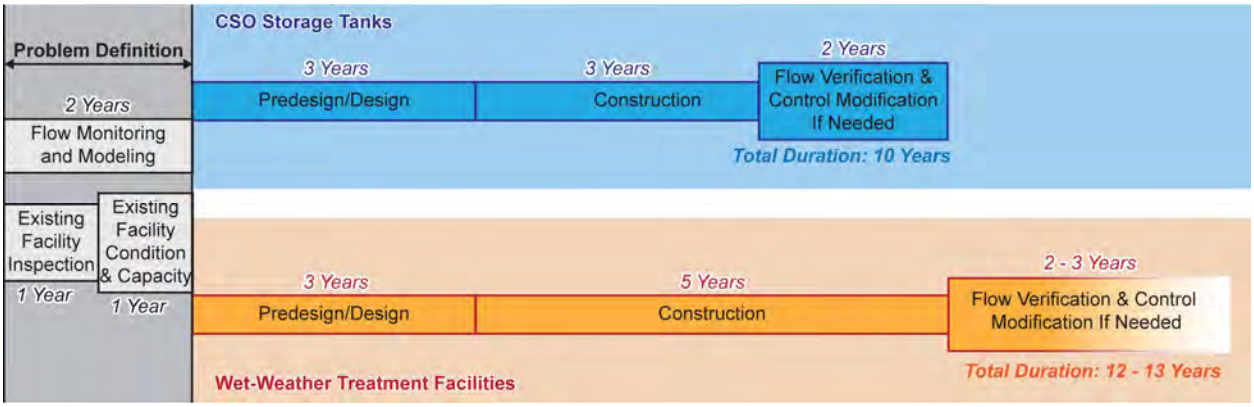

Figure 2-1. Assumed Timelines for Project Building Blocks

2.2.1 CSO Storage Tanks

For the evaluation of project sequencing for storage tank projects, it was assumed that the key components of storage tank projects and their durations would be as follows:

- Problem definition (2 years total):
  - Flow monitoring and modeling to refine project sizing (2 years)
  - Existing facility inspection (1 year)
  - Existing facility condition and capacity verification (1 year)
- Predesign and design (3 years)
- Construction (3 years)
- Flow verification and control adjustments if needed (2 years)

2.2.2 Wet-Weather Treatment Facilities

For the evaluation of project sequencing for wet-weather treatment facilities, it was assumed that the key components of wet-weather treatment facility projects and their durations would be as follows:

- Problem definition (2 years total):
  - Flow monitoring and modeling to refine project sizing (2 years)
  - Existing facility inspection (1 year)
  - Existing facility condition and capacity verification (1 year)
- Predesign and design (3 years)
- Construction (5 years)

- Flow verification and control adjustments as needed (2-3 years)

2.2.3 GSI Projects

In CSO basins with medium to high potential for GSI opportunities, GSI projects are considered before the design progresses on more traditional CSO control projects in the same basin. The effectiveness of GSI projects will be monitored after they are constructed to more accurately determine how much CSO reduction they achieve in the sizing of other CSO control projects. For this evaluation, it was assumed that the following components and durations would be included in the project sequence to incorporate GSI projects:

- Problem definition—
  - The flow monitoring and modeling data collected in Year 1and 2 of problem definition for traditional CSO control projects will determine the GSI sizing.
  - GSI design will begin in the second year of the problem definition.
- GSI construction (2 years)
- Verification of flow reduction will be accomplished by flow monitoring for two wet seasons (2 years).

GSI projects will generally begin before the affected traditional CSO control projects, in order to affirm or adjust the sizing of the traditional projects during the design process. The time between GSI construction and the beginning of design for the traditional CSO control project will be driven by the goal to meet the 2030 King County compliance date. This will require flexibility in coordinating the GSI and traditional projects.

3.0. EVALUATION OF ALTERNATIVES

3.1 Initial Alternatives

Considering the schedule drivers and building blocks established for this analysis, four initial project sequence alternatives were evaluated, as described below. A fifth project sequence was developed that scheduled the two wet-weather treatment facilities concurrently, but that option was eliminated because of the high impact it would have on utility rates and county staff workload. These sequence options were discussed with many stakeholder groups.

3.1.1 Duwamish-First Alternative

The Duwamish-First Alternative (see Figure 3-1) emphasizes the early completion of projects in the Duwamish area to coordinate with regional efforts to clean up and restore the river. Key features of this alternative are as follows.

- The first WWTF to be completed is the Brandon/S Michigan WWTF in the Lower Duwamish Area.
- The W Michigan/Terminal 115 storage project in the Duwamish area is completed before the University, Montlake, and 3rd Ave W storage projects in the Ship Canal area.
- Separate storage projects are implemented for University, 3rd Ave W and Montlake.
- The Montlake project could be completed earlier and the Chelan project later if coordination is required with Seattle Parks or Washington Department of Transportation.
- GSI precedes and informs traditional CSO control projects
- Early ultimate control is provided to Seattle CSO projects that will transfer captured CSO to the County for CSO treatment.

The Feasibility Study for the Lower Duwamish Waterway is out for public review and no decisions have been made about the order of the actions. Stakeholders provided some suggestions to consider in developing the sequence.

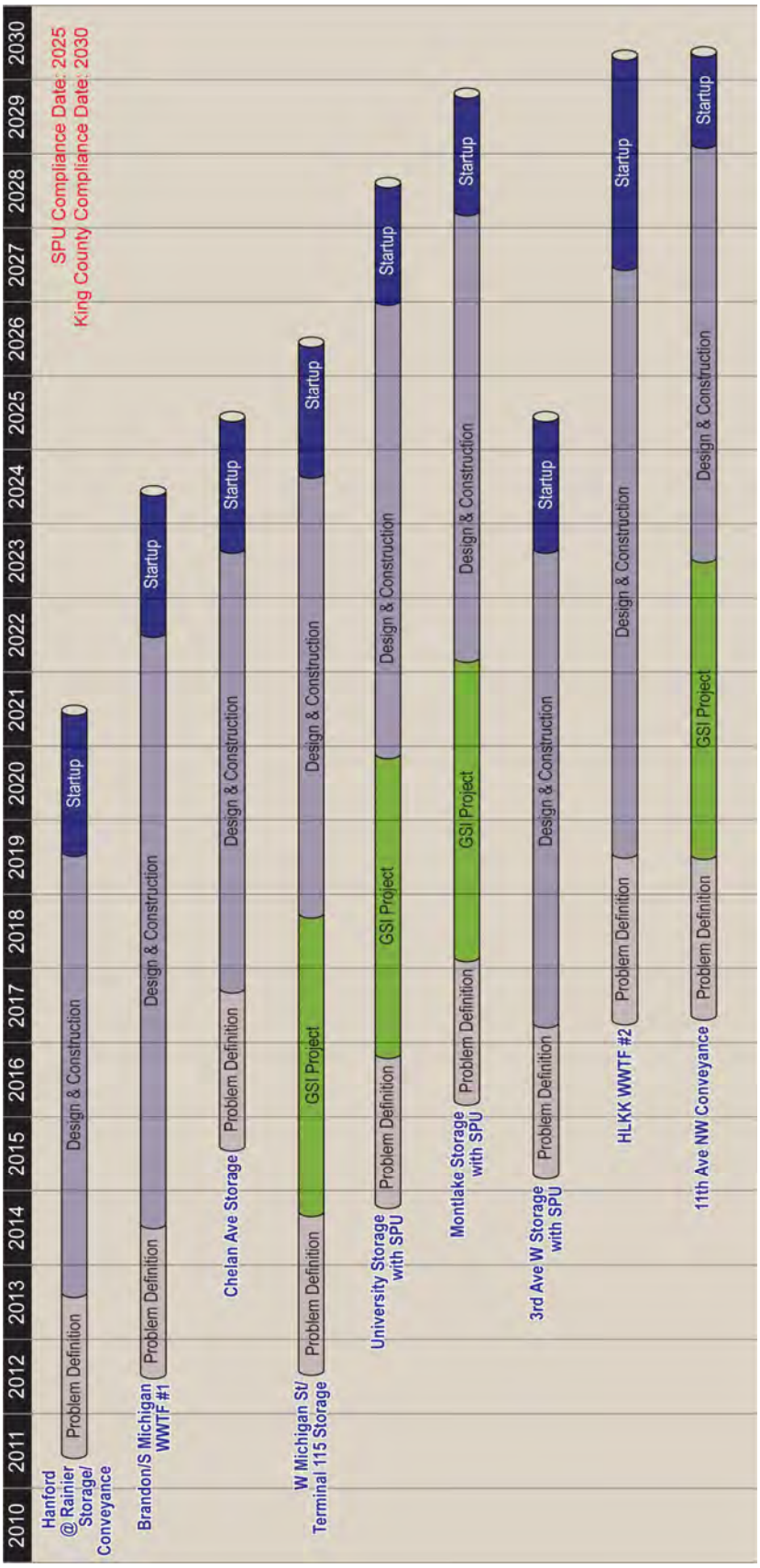

Figure 3-1. Duwamish-First Project Sequence Alternative

3.1.2 GSI-First Alternative

The GSI-First Alternative (see Figure 3-2) emphasizes the early completion of GSI projects, so that their effectiveness can be measured and used in the design of storage and treatment projects. Key features of this alternative are as follows.

- GSI is early in the program, with the goal of reducing the size of the traditional control methods.
- GSI projects for the Duwamish area (W Michigan St and Terminal 115) are combined into a single project.
- GSI for WWTF #1 affects the operation, but not the size of the plant.
- Separate storage projects are implemented for University, 3rd Ave W and Montlake.
- This sequence meets the SPU compliance date of 2025 for joint projects, but a variation that does not could be evaluated.
- GSI evaluations overlap the design of storage or treatment projects, so the SPU compliance date is met, but the sizing of affected storage or treatment projects is less certain.
- This sequence spreads WWTF construction over a longer time for reduced rate impacts.
- The start dates for design of storage and treatment projects are staggered to reduce impacts on rates and resources.
- The start date for the Montlake project is delayed to allow time for coordination with the Washington Department of Transportation on State Route (SR) 520 in the Montlake Basin.
- This sequence addresses Lower Duwamish River contamination concerns with the Brandon/S Michigan WWTF treatment project first.

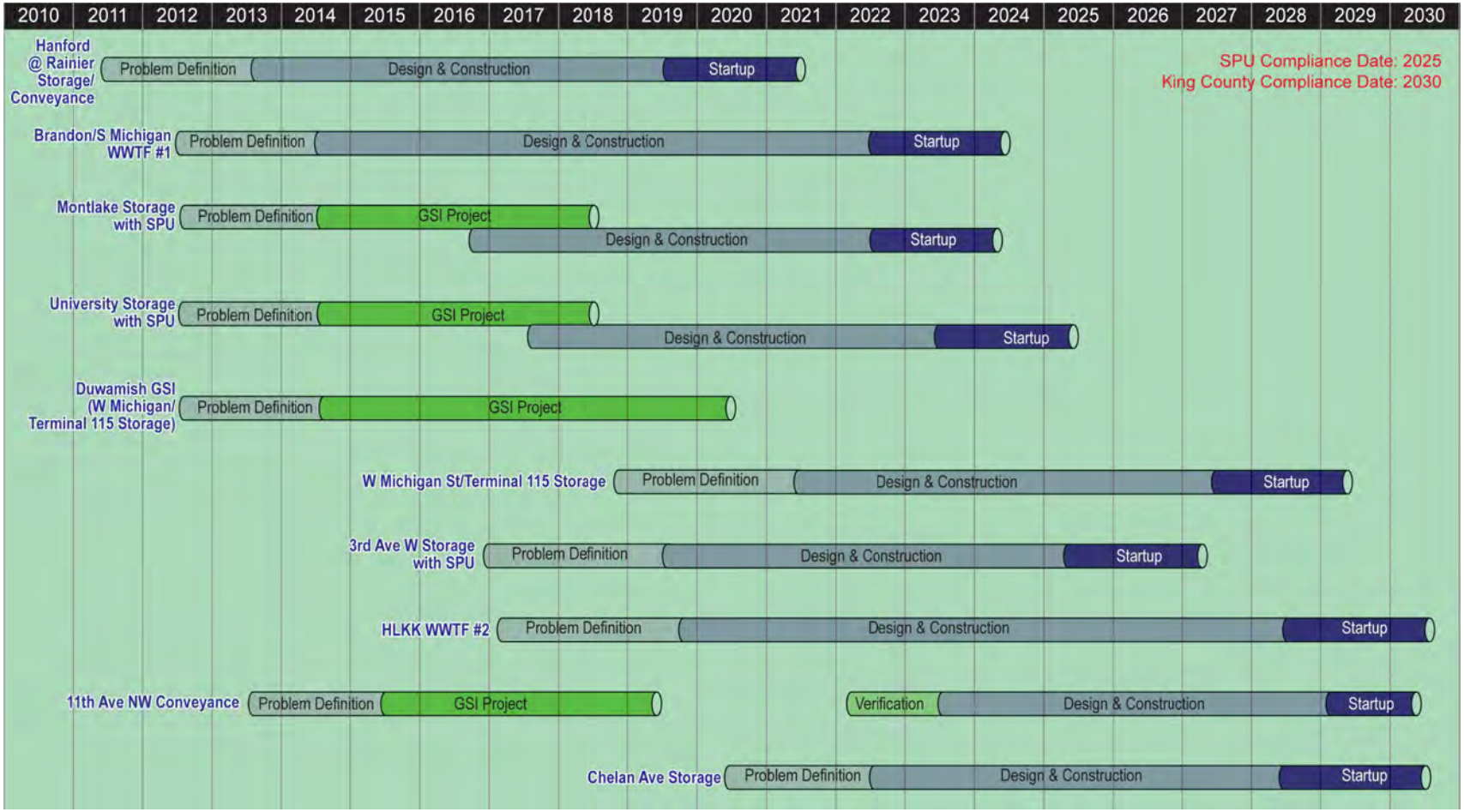

Figure 3-2. GSI-First Project Sequence Alternative

3.1.3 Meet-SPU-Schedule Alternative

The Meet-SPU-Schedule Alternative (see Figure 3-3) is similar to the GSI-First Alternative; the primary differences are that it includes GSI design/build projects to be performed by SPU, and it delays the start date of the 11th Ave NW GSI project. Key features of this alternative are as follows.

- This sequence meets the SPU compliance date of 2025 for joint projects.
- Separate storage projects are implemented for University, 3rd Ave W and Montlake.
- GSI evaluations overlap the design of storage or treatment projects, so the SPU compliance date is met, but the sizing of affected storage or treatment projects is less certain.
- This sequence spreads WWTF construction over a longer time for reduced rate impacts.
- The start dates for storage and treatment projects are staggered to reduce impacts on rates and resources.
- The start date for the Montlake project is delayed to allow time for coordination with the Washington Department of Transportation on State Route (SR) 520 in the Montlake Basin.
- This sequence addresses public health concerns at University/Ship Canal early.
- This sequence addresses Lower Duwamish River contamination concerns with the Brandon/S Michigan and W Michigan/Terminal 115 projects early.

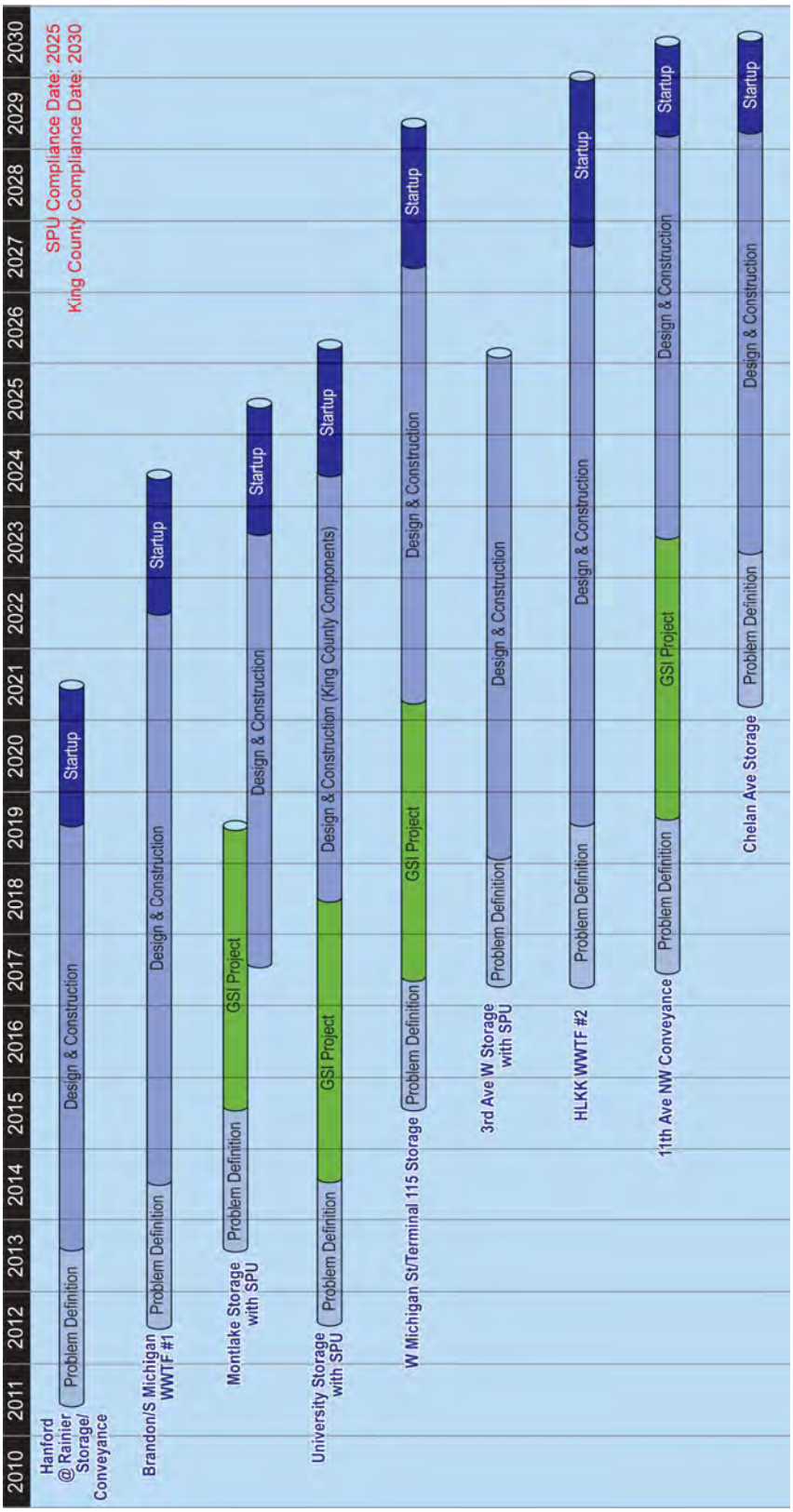

Figure 3-3. Meet-SPU-Schedule Project Sequence Alternative

3.1.4 Joint-Tunnel Alternative

The Joint-Tunnel Alternative (see Figure 3-4) provides CSO control in the basins near the ship canal (University, 3rd Ave W, and Montlake) using the tunnel with SPU rather than the individual storage projects for each basin. Key features of this alternative are as follows.

- This sequence meets SPU compliance date of 2025 for joint projects.
- A single tunnel project is implemented for University, 3rd Ave W and Montlake.
- This sequence spreads WWTF construction over a longer time for reduced rate impacts.
- GSI precedes and informs traditional CSO control projects on those projects where GSI is feasible
- The start dates for storage and treatment projects are staggered to reduce impacts on rates and resources.
- A three-year geotechnical feasibility study on the joint tunnel would overlap with the first year of predesign of the tunnel

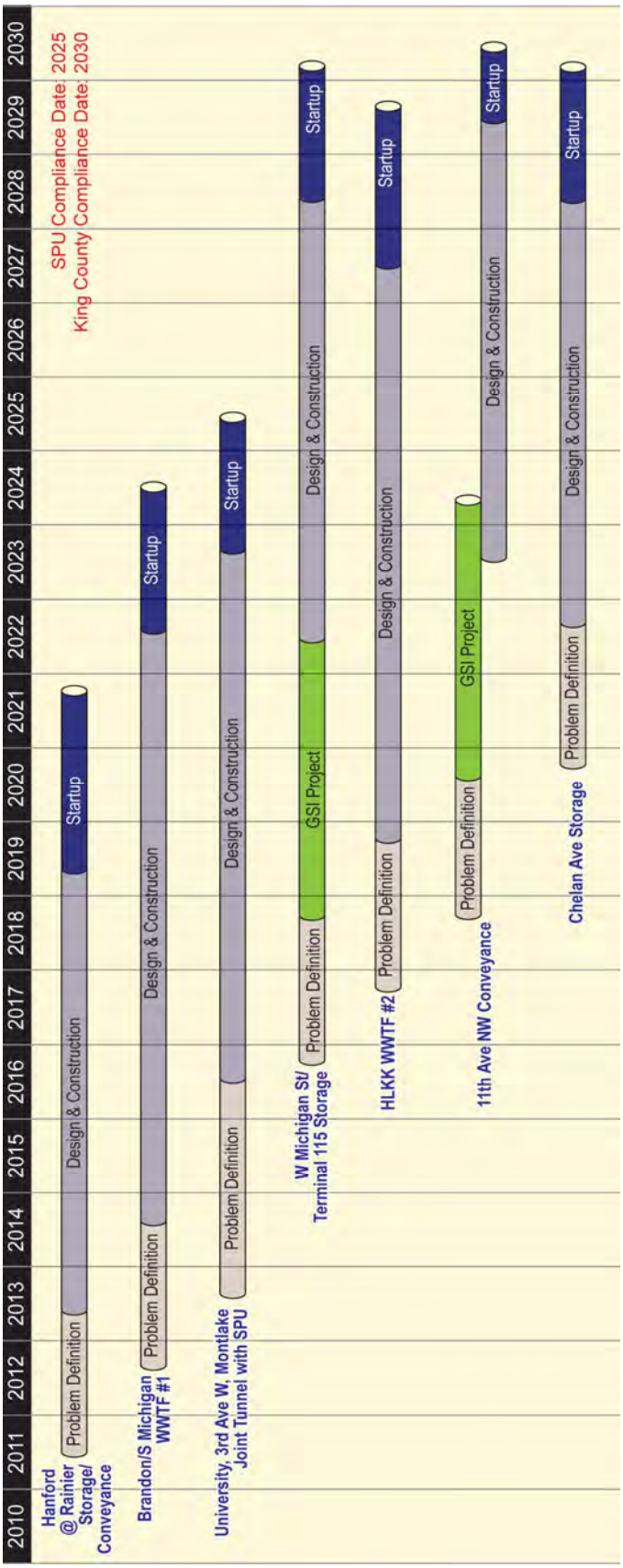

Figure 3-4. Joint-Tunnel Project Sequence Alternative

3.2 Evaluation Process

3.2.1 Schedule Driver Analysis

The four project sequence alternatives were evaluated against the schedule drivers. Table 3-1 summarizes the results.

Table 3-1. Ability of Project Sequence Alternatives to Meet Schedule Drivers

Schedule Drivers	Duwamish-First Alternative	GSI-First Alternative	Meet-SPU-Schedule Alternative	Joint-Tunnel Alternative
GSI Project Monitoring	X	X		
Duwamish Area Projects	X			
Rate Impact	X	X	X	X
Workload Impact	X	X	X	X
King County 2030 Completion	X	X	X	X
SPU 2025 Completion		X	X	X
Conflicts with Other Agencies' Projects	X	X	X	X

3.2.2 Rate Analysis

A rate analysis performed for each project sequence indicated that the sewer rate is not a differentiator among project sequence alternatives. The County considered project sequences with end dates beyond 2030 to evaluate potential reductions in rate impacts by extending the schedule. This evaluation will be described in a separate technical memorandum.

3.2.3 Workshops

The following workshops were held to present the four project sequence alternatives and solicit input:

- King County Construction Management—Input was solicited from construction management personnel to confirm the design/construction schedule proposed for the storage and treatment projects.
- SPU (May 2011)—The alternatives were presented to SPU.
- Duwamish Stakeholder Meetings—Three meetings were held with the Duwamish stakeholders to solicit their thoughts on the project sequence. The Duwamish-First sequence was developed to address their ideas.
- King County Management—The project sequence alternatives and project drivers were presented to management to solicit input and select a final project schedule for inclusion in the CSO Control Program Review.

The following input received at the workshops was used in identifying a preferred project sequence:

- Delay the University and Montlake projects to avoid construction conflicts with Washington Department of Transportation improvements planned for SR 520.
- Develop a project sequence that emphasizes both the Duwamish and GSI project drivers.
- Increase the GSI verification process to 3 years to obtain data from 2 wet seasons and validate the CSO reduction effectiveness.
- Eliminate startup time as a unique phase from the project schedules.

3.2.4 Development of Hybrid Alternatives

As a result of the evaluations and workshops, a hybrid project sequence was developed that prioritizes the Duwamish and GSI schedule drivers.

This hybrid prioritizes the Duwamish projects to better coordinate with regional clean up and restoration efforts along the Lower Duwamish by implementing the Brandon/Michigan WWTF project early in the schedule. King County and SPU will continue to discuss ways to address schedule needs.

4.0. RECOMMENDED PROJECT SEQUENCE

Figure 4-1 shows the recommended project sequence. The key changes from the initial alternatives are as follows:

- Startup time is not called out as a unique phase.
- The duration of GSI projects (excluding Problem Definition) was extended from 4 years to 5 years: 2 years of design/build and then 3 years for verification (instead of 2).

The key features of this alternative are as follows:

- Brandon/S Michigan is the first wet-weather treatment facility to be designed and constructed.
- The W Michigan/Terminal 115 project is implemented before the Ship Canal projects.
- GSI monitoring time to gather data for project sizing is maximized by extending to 3 years.
- The Chelan storage project could be moved earlier and the Montlake project moved later to prioritize the Duwamish.

The recommended project sequence relies on the following assumptions:

- Chelan GSI will be done by SPU and timed to inform King County's sizing for the Chelan storage facility.
- GSI design/build is 2 years.
- GSI verification is 3 years.
- King County and SPU will continue to discuss ways to address schedule needs.

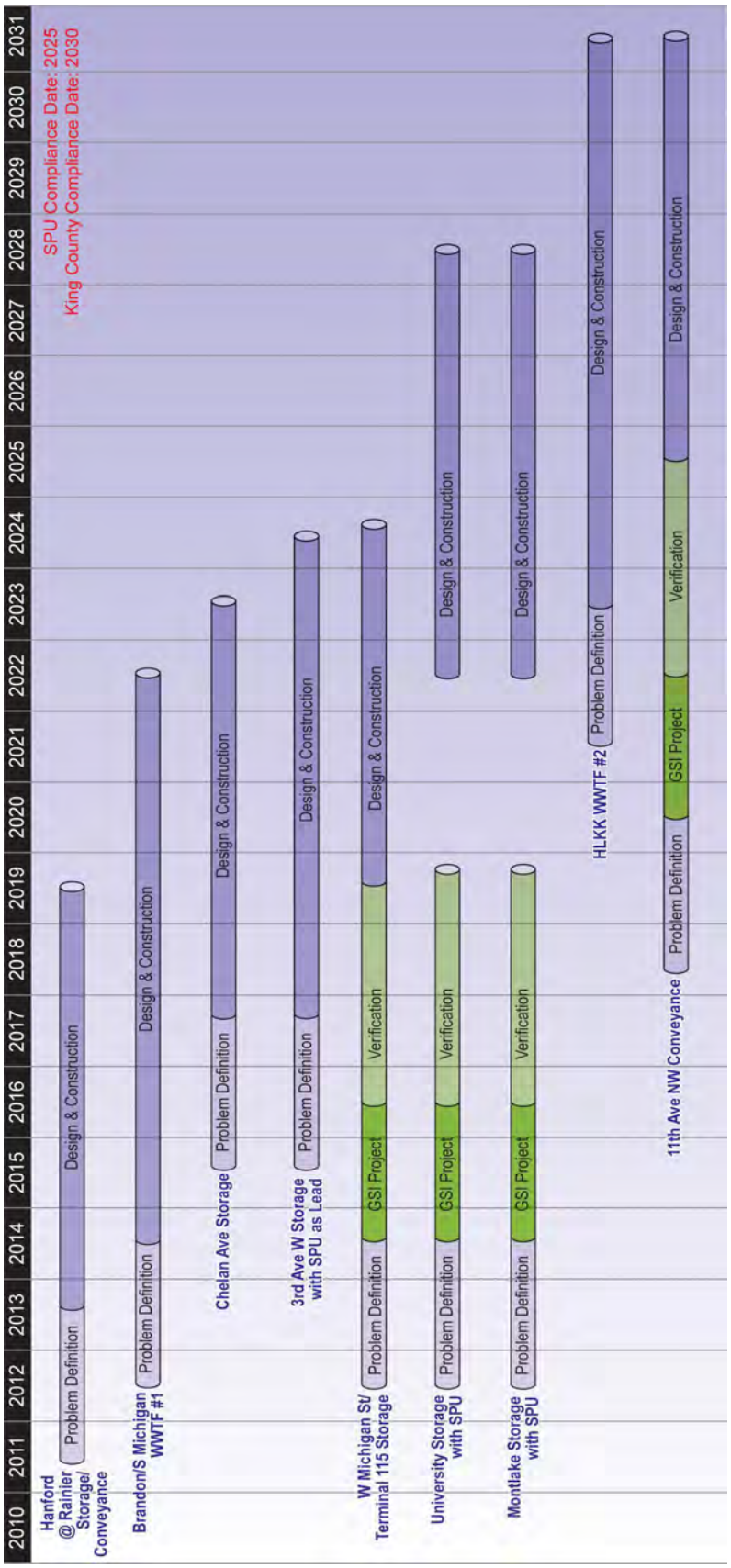

Figure 4-1. Recommended Project Sequence