Appendix F
Supporting Technical Reports

F.10 Preliminary Stormwater Management Plan

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Subject:	Preliminary Stormwater Management Plan

1.0 Introduction

1.1 Project Location

The METRO Blue Line LRT Extension (BLRT) project will extend light rail passenger service from the Target Field Station in Minneapolis to Oak Grove Parkway/101st Avenue N in Brooklyn Park. The project corridor is approximately 13 miles and runs through the cities of Minneapolis, Golden Valley, Robbinsdale, Crystal, and Brooklyn Park. The project has been divided into six segments corresponding with municipal boundaries where possible, which have been labeled according to city. The portion within Brooklyn Park has been further divided into two segments: Brooklyn Park 1, which is the northernmost segment, and Brooklyn Park 2.

Roughly eight miles of the proposed project will be constructed within the existing BNSF Railway corridor. This includes portions of the Golden Valley, Robbinsdale, Crystal and Brooklyn Park segments. Most of the Minneapolis segment is located within the median of TH 55 (Olson Memorial Highway), and portions of the two Brooklyn Park segments are within the median of CSAH 103 (West Broadway Avenue). The proposed project also includes the construction and/or reconstruction of affected roadways, construction of station platforms, several park-and-ride facilities, and an Operations and Maintenance Facility (OMF).

Hennepin County is in the preliminary design phase of a portion of CSAH 103 (West Broadway Avenue) that coincides with a portion of the Brooklyn Park 1 segment. A separate environmental assessment worksheet (EAW) and preliminary stormwater design have been completed for the Hennepin County project, which incorporates the floodplain and wetland impacts and stormwater treatment best management practices (BMPs) required to treat runoff from the BLRT Extension project. These have been documented in the EAW and in supporting technical memoranda.

1.2 Purpose

This *Stormwater Technical Memorandum* has been prepared in support of the Final Environmental Impact Statement (Final EIS) for the BLRT Extension project. The objective of this memorandum is to evaluate the project's potential stormwater impacts within the study area and to identify potential mitigation measures. This includes the following:

- Identify regulatory requirements that will set forth mitigation standards that are specific to stormwater management
- Determine how the proposed improvements would affect existing drainage patterns and nearby water resources
- Identify stormwater BMPs that would be used to satisfy current regulatory requirements for the project corridor

- Determine approximate sizes and locations for BMPs along the corridor

This report contains qualitative and quantitative design recommendations for the BLRT Extension project corridor that will be used by the consultant team preparing the Final EIS and will provide information about how the project would meet various regulatory requirements. Potential impacts to existing stormwater infrastructure (e.g., storm sewer and culverts) will be investigated during the next stages of design.

A separate technical memorandum has been prepared to discuss floodplains in the corridor. The analysis of wetlands adjacent to the project limits and the potential impacts to those is being performed by others.

1.3 Data Collection

The storm sewer and hydrology data employed for this study was obtained from a variety of sources. The following is a brief summary of the data used.

1.3.1 Regulatory Criteria

Meetings and discussions took place with staff from the various cities and watershed management organizations (WMOs) to obtain a better understanding of existing systems and their respective criteria for evaluating and designing new drainage systems and BMPs.

1.3.2 Hydrology

Hydrologic information came from a variety of sources, including:

- Contour data was developed from a flight of the corridor and the 2012 Hennepin County LiDAR data
- Existing drainage boundaries were based on those shown in the local water management plans of the cities and watersheds and those from recent reconstruction projects along the corridor. These were then adjusted as needed to reflect the existing contour data
- For the portion of the project within Brooklyn Park:
    - The 1995 Brooklyn Park Comprehensive Stormwater Management Plan listed discharge limits for subwatersheds and peak outflows from ponds along the corridor. After discussion with staff from the City of Brooklyn Park, it was determined that areas where drainage boundaries had not changed significantly were held to these discharge rates and that they were still applicable. Areas that experienced significant changes in land use as determined by comparing aerial images and recent construction site plans would also be held to the 1995 discharge limits.
    - In addition, ponds that discharged to creeks and channels within the Setzler Pond/Century Channel subwatershed were designed to limit discharge to 0.1 cubic-feet per second per acre of tributary drainage area.

1.3.3 Existing Stormwater Infrastructure

Record drawings were collected for the BLRT Extension project, and additional record drawings were collected by Hennepin County for the CSAH 103 (West Broadway Avenue) project, which coincides with a portion of the project corridor. This information was supplemented with storm sewer maps from the various local water management plans and used to determine the connectivity of the existing storm sewer system to ponds, wetlands, and other water features.

2.0 Regulatory Environment

Regulatory and permitting authority for stormwater management falls to the cities, the Minnesota Pollution Control Agency (MPCA), and the WMOs. Each watershed organization is governed by a Joint Powers Agreement that is

held between the watershed organization and the member communities that are located within the boundaries of the WMO. Regulations change from time to time, and the project will be subject to regulations in effect when the design is submitted for approval by the permitting authorities. The stormwater management system for the project corridor was designed to meet the most stringent requirements for that particular segment according to the WMO and municipality boundaries. In all cases except for the OMF and park-and-ride structures, the WMO rules were the most stringent requirements. The rate and volume control requirements of the B3 Guidelines are more stringent and will be applied to those sites. The agencies listed below play a role in stormwater management within the project area; Appendix B contains a matrix listing the specific requirements of each agency.

- Minnesota Pollution Control Agency (MPCA)
- Mississippi Watershed Management Organization (MWMO)
- Bassett Creek Water Management Commission (BCWMC)
- Shingle Creek and West Mississippi Watershed Management Commission (SCWMC and WMWMC, or SCWM WMC when referred to in reference to their joint watershed management plan)
- City of Minneapolis
- City of Golden Valley
- City of Robbinsdale
- City of Crystal
- City of Brooklyn Park

2.1 Minnesota Pollution Control Agency

2.1.1 NPDES Construction Stormwater Permit

The MPCA administers the National Pollutant Discharge Elimination System (NPDES) Construction Stormwater Permit program in the State of Minnesota (MN 115; MN Rule 7050). The NPDES permit program requires creation of a site-specific Storm Water Pollution Prevention Plan (SWPPP). The SWPPP must detail temporary and permanent erosion prevention and sediment control BMPs that would be utilized during construction. The NPDES permit also requires permanent treatment of stormwater runoff on sites where construction activity results in a net increase of more than one acre of impervious surface area. The NPDES permit requires treatment for the water quality volume, which is equivalent to one-inch of runoff from the new impervious surface created by the project. The primary treatment mechanism preferred by the NPDES permit is infiltration, but other BMPs are allowed when site conditions are not conducive for infiltration.

2.1.2 Impaired Waters and TMDLs

Section 303(d) of the Clean Water Act (CWA) requires states to assess all waters to determine if they meet water quality standards and to conduct total maximum daily load (TMDL) studies in order to set pollutant reduction goals. Project areas that outlet within one mile of MPCA-designated impaired or special waters must incorporate additional BMPs, including stricter stormwater treatment requirements. There are 10 impaired waters identified within one-mile of the project area, of which five would receive runoff from the project area. Impaired receiving waters within one mile of the project area are shown on **Figures 1 through 12** in Appendix A and include, from south to north:

Impaired Receiving Water	Impairments	TMDL Status
Mississippi River	Mercury In Fish Tissue; Fecal Coliform; PCB In Fish Tissue	Upper Mississippi River Bacteria TMDL and Protection Plan (2014)
Bassett Creek	Chloride; Fecal Coliform; Fishes Bioassessments	Included in the above TMDL plan
Crystal Lake	Nutrient/Eutrophication Biological Indicators	Crystal Lake Nutrient TMDL Implementation Plan (2009)
Twin Lakes: Lower, Middle, and Upper	Mercury in Fish Tissue; Nutrient/ Eutrophication Biological Indicators; PCB in Fish Tissue; PFOS in Fish Tissue	Twin and Ryan Lakes Nutrient TMDL (2007); Plans are required for mercury, PCB and PFOS
Shingle Creek	Aquatic Macroinvertebrate Bioassessments; Chloride; Oxygen, Dissolved	Shingle and Bass Creeks Biota and Dissolved Oxygen TMDL Implementation Plan (2012) Shingle Creek Chloride TMDL Implementation Plan (2007)

The TMDL plans identify BMPs appropriate to addressing the impairments. BMPs for nutrient impairments may include increasing infiltration and filtration through the use of rain gardens, native plantings, and reforestation, and retrofitting existing detention ponds as ways to implement the TMDL plan. BMPs for dissolved oxygen impairments may include improving aeration and reducing nutrients. The chloride TMDL calls for a reduction in the use of sodium chloride for ice control in the watershed.

2.2 Watershed Agencies

2.2.1 Mississippi Watershed Management Organization

The MWMO manages waters within its boundaries through its Watershed Management Plan that was amended in 2011. This plan complies with the water resource protection requirements under Minnesota Statutes 103A through 103G in conformance with Minnesota Rules Chapters 8410 and 8420. The communities within the boundaries include parts of Lauderdale, Minneapolis, St. Anthony, and St. Paul, as well as property owned by the Minneapolis Park and Recreation Board (MPRB).

The MWMO does not issue permits or provide approval letters for construction projects, but works with the member communities to ensure the implementation of its standards. The MWMO requires its member cities to develop stormwater management ordinances that reduce runoff and promote increased stormwater management for construction and redevelopment projects. The following provides a summary of the design requirements for rate control, water quality, and water quantity.

2.2.1.1 Rate Control Requirements

Runoff rates for the proposed activity shall match pre-development rates for the 2-year, 10-year, and 100-year storm events. Discharge rates may be restricted to less than pre-development rates when the capacity of the downstream conveyance system is limited.

2.2.1.2 Water Quality Requirements

Projects shall achieve a removal of 90% total suspended solids (TSS) from the 95th percentile daily rainfall total (1.17 inches over 24 hours) over the entire project area. The MWMO has an alternative compliance process for

sites that are not able to meet the MWMO's water quality standard for TSS. This is described in more detail in the MWMO Standards document.

2.2.1.3 Volume Control Requirements

The MWMO does not currently have a volume control standard. The MWMO has indicated a desire to add such a standard in the future. The stormwater management standards should be reviewed during final design.

2.2.2 Bassett Creek Watershed Management Commission

The BCWMC manages waters within its boundaries through its 2015 – 2025 Watershed Management Plan. This Plan complies with the water resource protection requirements under Minnesota Statutes 103A through 103G in conformance with Minnesota Rules Chapters 8410 and 8420. The BCWMC is governed by a Joint Powers Agreement that is held between the watershed organization and the member communities that are located within the boundaries of the WMO. The member municipalities include Crystal, Golden Valley, Medicine Lake, Minneapolis, Minnetonka, New Hope, Plymouth, Robbinsdale, and St. Louis Park.

The BCWMC reviews development and redevelopment project proposals once the project receives preliminary review by the municipality indicating general compliance with the existing local water management plan. All submittals involving floodplains, Bassett Creek trunk systems, water appropriations, variances, underground wet vaults or other alternative BMPs are presented at the BCWMC meetings. The BCWMC will review projects and developments to evaluate compliance with the MPCA's Minimal Impact Design Standards (MIDS) performance goals (which are adopted by the Commission as BCWMC water quality management standards) if the projects are located in member cities that have not adopted the MIDS performance goals, triggers, and flexible treatment options, or at the request of the member city. The BCWMC requires public agencies to comply with water quality management standards and policies presented in this Plan in order to maintain or improve water quality of stormwater runoff.

2.2.2.1 Rate Control Requirements

For projects containing more than one acre of new or redeveloped impervious area, stormwater runoff must be managed such that peak flow rates leaving the site are equal to or less than the existing rate leaving the site for the 2-, 10-, and 100-year events based on Atlas 14 precipitation amounts and using a nested 24-hour rainfall distribution. Documentation of existing and proposed discharge rates for the 2-, 10-, and 100-year events must be provided for BCWMC review.

2.2.2.2 Water Quality Requirements

The BCWMC requires all stormwater to be treated in accordance with MIDS performance goal for new development, redevelopment, and linear projects. If the MIDS performance goal is not feasible and/or is not allowed for a proposed project, then the project proposer must implement the MIDS flexible treatment options, as shown in the MIDS Design Sequence Flow Chart.

For linear projects, the MIDS performance goal is retention of whichever is greater:

- 0.55 inches from new or fully reconstructed impervious areas
- 1.1 inches from the net increase in impervious areas

2.2.2.3 Volume Control Requirements

The BCWMC's volume control requirement is the same as the water quality requirements, which is summarized in the preceding paragraph.

2.2.3 Shingle Creek and West Mississippi Watershed Management Commissions

The SCWMC and WMWMC are two separate WMOs; however, they plan and conduct business jointly, managing waters within its boundaries. Each is governed by a Joint Powers Agreement that is held between the watershed organization and the communities/members that are located within the boundaries of the WMOs. The communities within the boundaries include parts of Brooklyn Center, Brooklyn Park, Crystal, Maple Grove, Minneapolis, New Hope, Osseo, Plymouth, Robbinsdale, and Champlin.

The SCWM WMC manages waters through its Third Generation Watershed Management Plan, which was adopted in 2013. This Plan complies with the water resource protection requirements under Minnesota Statutes 103A through 103G in conformance with Minnesota Rules Chapters 8410 and 8420.

The SCWM WMC requires project reviews for non-single family detached projects that are 0.5 acres in size or larger and linear projects that create one or more acres of new impervious surface, as well as other types of projects described in the rules. The rules and standards of the SCWM WMC must be met for the *net new impervious surface*.

The SCWM WMC requires a project's Stormwater Management Plan to be consistent with all applicable management rules and standards. Specific BMPs that are identified include detention and infiltration systems. Each new or revised crossing of Shingle Creek is required to retain adequate hydraulic capacity with no adverse impact to conveyance of the 100-year flow. The following provides a summary of the design requirements for rate control, water quality, and water quantity.

2.2.3.1 Rate Control Requirements

Runoff rates for the proposed activity shall not exceed existing runoff rates for the 2-year, 10-year, and 100-year critical storm events for the project location as set forth in the NOAA Atlas 14 Volume 8, published in June 2013, or its successor, using the online NOAA Precipitation Frequency Data Server or a similar source. The applicant must document the location and event depths used. If an approved local water management plan requires more restrictive rate control, then the more restrictive rate shall govern. Runoff rates may be restricted to less than the existing rates when necessary for the public health and general welfare of the watershed. Member cities and project review applicants shall not exceed discharge rates at City boundaries as determined in the Commission's hydrologic model. Regional detention basins shall be utilized to manage peak discharge rates and meet water quality objectives when feasible.

2.2.3.2 Water Quality Requirements

Stormwater must be treated prior to discharge to remove 60 percent of phosphorus and 85 percent of TSS. Treatment may be provided by one or more permanent sedimentation and water quality ponds, infiltration practices, or a combination of BMPs that together will meet removal requirements.

If permanent sedimentation and water quality ponds are used they shall be designed to the Wet Pond Design Standards set forth in Appendix A of the SCWM WMC Rules and provide:

- Water quality features consistent with NURP criteria and best management practices.
- A permanent wet pool with dead storage of at least the runoff from a 2.5-inch storm event.

Runoff may be directed to a downstream facility within the same hydrologic subwatershed that has sufficient capacity to provide the required treatment. This means that no treatment may be required for an individual development provided there is a regional facility designed and constructed to accommodate the flow from this property.

The applicant may meet both the treatment requirement and the volume requirement by infiltrating all site runoff from a 1.3 inch rain event (see Water Quantity Requirements in the following sub-section).

2.2.3.3 Volume Control Requirements

Volume control BMPs must be incorporated into the site design to minimize the creation of new impervious surface and reduce existing impervious surfaces, minimize the amount of directly connected impervious surface, preserve the infiltration capacity of the soil, and limit increases in runoff volume exiting the site to the extent feasible considering site-specific conditions. Stormwater runoff volume abstraction shall be provided onsite in the amount equivalent to one inch of runoff generated from new impervious surfaces for linear projects.

2.3 City of Minneapolis

The City of Minneapolis' Stormwater Management Ordinance (Chapter 54) establishes stormwater management requirements for land disturbing activities on sites greater than one acre including phased or connected actions, and for existing stormwater constructed devices.

2.3.1 Rate Control

The City of Minneapolis requires that development should be planned in a manner that does not increase peak flows from the existing flow rates.

2.3.2 Water Quality

Water quality BMPs must be designed to remove 70 percent TSS prior to stormwater discharge from the site.

2.3.3 Volume Control

The City of Minneapolis's ordinance includes a requirement to maximize infiltration. The requirement is to the greatest possible degree (except in the case of stormwater hotspots), natural drainage ways and vegetated soil surfaces should be used to convey store, filter, and retain stormwater before discharging runoff into public waters or the public storm drain system. Opportunities for maximizing infiltration include minimizing the extent of impervious surfaces and directing runoff from impervious surfaces and roof gutter systems onto lawns or other pervious surfaces.

2.4 City of Golden Valley

The City of Golden Valley's Stormwater Ordinance (Section 4.31) establishes regulatory requirements for land development and land disturbing activities aimed at minimizing the threats to public health, safety, public and private property and natural resources within the community resulting from construction site erosion and post-construction stormwater runoff. The portion of the BLRT Extension project that is located in Golden Valley is located within the BCWMC. Projects located within the City are required to comply with the WMO's stormwater management requirements for rate control, water quality, and volume control. Please see the BCWMC section for more detailed information on these requirements.

2.5 City of Robbinsdale

The City of Robbinsdale is located within the BCWMC and SCWMC. Projects located within the City are required to comply with the WMOs' stormwater management requirements for rate control, water quality, and volume control. Please see the BCWMC and SCWMC sections for more detailed information on these requirements.

2.6 City of Crystal

The City of Crystal's Planning and Land Use Regulations (Chapter V of Crystal City Code) include stormwater management criteria for permanent facilities.

2.6.1 Rate Control

The City of Crystal requires that the existing 2-year, 10-year, and 100-year storm peak discharge rates shall not be increased with the proposed development, and that accelerated channel erosion will not occur as a result of the proposed land disturbing or development activity.

2.6.2 Water Quality

The City of Crystal requires that detention facilities should have a permanent pond surface area equal to two percent of the impervious area draining to the pond, or one percent of the entire area draining to the pond, whichever is greater. An alternative requirement is that the volume of the permanent pool shall be equal to or greater than the runoff from a 2.0-inch rainfall over the fully developed site. The sequencing of preferred treatment options is natural infiltration of precipitation on-site; flow attenuation by use of open vegetated swales and natural depressions; stormwater retention facilities; and stormwater detention facilities.

2.6.3 Volume Control

The City of Crystal does not currently have a volume control standard. The City's Local Surface Water Management Plan indicates that the City may update the City's ordinances to include a volume control standard in the future. The stormwater management standards should be reviewed during final design.

2.7 City of Brooklyn Park

With the exception of drainage to the Setzler Pond/Century Channel system, the City of Brooklyn Park has adopted the SCWM WMC requirements for stormwater management. Development of previously open space areas draining to the Setzler Pond/Century Channel system are required by the City to control their discharge rates to 0.1 cubic-foot per second for every acres of area. The City works with the SCWM WMC on the permit reviews to ensure the stormwater management requirements are met.

2.8 Minnesota B3 Guidelines

Beginning in January 2004, all new buildings that receive funding from the bond proceeds fund are required to meet sustainable building design guidelines. The BLRT Extension project will be required to meet Version 2.2 of the B3 Guidelines for park-and-ride buildings and the OMF. The guidelines include a variety of criteria ranging from energy use, indoor air quality, and stormwater management to lifecycle costs. The intent of the stormwater management guideline is to minimize the negative impacts of the project, both on and off site, by maintaining a more natural hydrologic cycle through infiltration, evapotranspiration, and reuse. The particular performance criteria are listed below, but the project must meet the rules and regulations of the local governmental units if those rules are more stringent.

2.8.1 Runoff Rate and Volume Requirements

The rate of runoff from the post-development site must be controlled to match the runoff rates for the native soil and vegetation conditions for the 2-year and 10-year, 24-hour design storms. The stormwater management plan must be designed to prohibit discharge from the site for 1.1 inches of runoff from all new or redeveloped impervious (non-vegetated) areas.

2.8.2 Water Quality Requirements

The stormwater management plan must be designed to remove 80% of the post-development TSS and 60% of the post-development total phosphorus (TP).

2.8.3 Operations and Maintenance Requirements

The B3 Guidelines also requires that an operations and maintenance manual be created for all BMPs specifying the maintenance requirements and schedules for completion. Operations and maintenance manuals shall be recorded with the County Registrar.

3.0 Affected Environment

3.1 Existing Conditions

3.1.1 Segment M – Minneapolis

The Minneapolis segment extends from Target Field Station along 6th Avenue N and TH 55 (Olson Memorial Highway) west to the bridge over the existing BNSF Railway corridor, where the project corridor turns north. Approximately 25 percent of the segment drains to East Channel Bassett Creek, 60 percent drains to the old Bassett Creek tunnel crossing at TH 55 (Olson Memorial Highway), and 15 percent drains to the old Bassett Creek tunnel north of the project corridor. The majority of this segment of the project has an urban drainage system with curb and gutter containing runoff and conveying it to catch basins and storm sewer, but the portion within the BNSF Railway corridor has ditches and culverts to convey stormwater.

The predominant water resource in this segment is Bassett Creek, which crosses TH 55 (Olson Memorial Highway) today approximately 750 feet west of the BNSF Railway corridor. (Prior to construction of TH 55 (Olson Memorial Highway) in the 1940s, the crossing was approximately ¼ mile to the east, referred to in this report as the East Channel Bassett Creek.) A second open channel crossing of what is now TH 55 (Olson Memorial Highway) was located near Dupont Avenue N until the early 1900s, when the channel was replaced by a tunnel system. This tunnel is now known as the old Bassett Creek tunnel. The channel and the tunnel frequently flooded. As part of a flood abatement project in the 1980s and 1990s, Bassett Creek was rerouted into a new tunnel system, called the new Bassett Creek tunnel. The new tunnel is farther south and does not cross the BLRT corridor. Although Bassett Creek no longer flows into the old Bassett Creek tunnel, the old tunnel remains active, carrying stormwater runoff from local drainage systems and overflow from the new Bassett Creek tunnel. Both the old and new Bassett Creek tunnels drain to the Mississippi River.

Local areas draining to the old and new Bassett Creek tunnels are within the Mississippi Watershed Management Organization. The portion of the project which drains to East Channel Bassett Creek is within the Bassett Creek Watershed Management Commission. The jurisdictional watershed divide in the TH 55 (Olson Memorial Highway) corridor is at Russell Avenue N.

The soils in the Minneapolis segment have been highly disturbed over the past century of development. They consist of variable urban fill, frequently overlying clay loams or organic, clayey muck that was deposited when Bassett Creek flowed through the area. Therefore, Hydrologic Soil Group (HSG) C soils, which have slow infiltration rates, were assumed for the purposes of this level of analysis based upon recent soil borings and information received from the Heritage Park reconstruction. Groundwater elevations are not known for most of the corridor but are expected to be relatively close to the ground surface near the old Bassett Creek tunnel and very close to the ground surface where wetlands are adjacent to the BNSF Railway embankment.

These areas are described in detail in the following sections. See Appendix A, **Figures 1 and 2** for a representation of the flow patterns and receiving waters.

3.1.1.1 Drainage to Bassett Creek Tunnels, East of I-94 (Stations 2010+75 to 2021+80)

In this portion of the segment, runoff from 6th Avenue N and the BLRT Corridor between high points at 7th Street and the I-94 bridge is captured in storm sewer and leaves the corridor, flowing north in the East Lyndale Avenue right-of-way. The storm sewer drains to a tunnel owned by MnDOT near 3rd Street N and 12th Avenue N. The MnDOT tunnel crosses the old Bassett Creek tunnel and connects to the new Bassett Creek tunnel roughly 0.5 mile to the east.

Runoff east of 7th Street N enters another existing storm sewer system that runs north through the Heyward Garage parcel. This storm sewer eventually discharges to the old Bassett Creek tunnel.

This area is industrial with some existing grassed boulevard areas, and a small amount of offsite runoff enters the storm sewer system in Olson Memorial Highway. There are no existing stormwater BMPs in this area, other than those recently constructed as part of the Target Field Station stormwater management plan.

3.1.1.2 Drainage to Old Bassett Creek Tunnel, West of I-94 (Stations 2021+80 to 2075+60)

Runoff from the project corridor reaches the tunnel from two storm sewer systems in this portion of the segment. Just to the west of I-94, runoff enters a small storm sewer system that connects to the old Bassett Creek tunnel under TH 55 (Olson Memorial Highway) between Bryant Avenue N and Dupont Avenue N. Some offsite runoff from the south is collected in this storm sewer system. This area consists of both industrial businesses and multi-family homes. The median boulevard is paved for half of this area and is covered by turf grass for the rest.

A large storm sewer system starting at CSAH 2 (Penn Avenue N) runs east along TH 55 (Olson Memorial Highway) and also connects to the old Bassett Creek tunnel under TH 55 (Olson Memorial Highway) near Dupont Avenue N. This storm sewer trunk line serves a large residential area to the north of TH 55 (Olson Memorial Highway) from CSAH 2 (Penn Avenue N) to approximately James Avenue N. The trunk storm sewer also collects runoff from small offsite areas to the south of TH 55 (Olson Memorial Highway) between James Avenue N and Dupont Avenue N. This portion of the segment also features a grassed boulevard and a wide, grassed median with incrementally placed trees. Roadway runoff is not treated before entering the old Bassett Creek tunnel and eventually discharging to the Mississippi River.

3.1.1.3 Drainage to Old Bassett Creek Tunnel, Heritage Park South Treatment System (Stations 2075+60 to 2081+95)

Storm sewer on TH 55 (Olson Memorial Highway) from Russell Avenue N to Queen Avenue N collects runoff from the residential area north of TH 55 (Olson Memorial Highway) and roadway runoff at this location. The system drains south and then east, collecting runoff from residential neighborhoods south of TH 55 (Olson Memorial Highway). It eventually reaches the south treatment system in Heritage Park, a series of water quality BMPs constructed with the Heritage Park redevelopment project, located south of TH 55 (Olson Memorial Highway) along Van White Memorial Boulevard. Runoff is first routed through a sediment forebay and then through a filtration basin, before entering a large wet detention pond. The pond outlet drains to the old Bassett Creek tunnel, which eventually discharges into the Mississippi River.

3.1.1.4 Drainage to East Channel Bassett Creek, Russell Avenue N to TH 55 (Olson Memorial Highway) /BNSF Crossing

This portion of the segment has a storm sewer system that collects roadway runoff which discharges directly into East Channel Bassett Creek, south of TH 55 (Olson Memorial Highway). East Channel Bassett Creek diverts from the main channel just west of the existing BNSF Railway corridor and north of TH 55 (Olson Memorial Highway). The east channel crosses under the BNSF Railway corridor through three existing culverts located north of TH 55 (Olson Memorial Highway). Two large urban residential storm sewer systems discharge to the creek at this location before

the channel crosses the highway via a culvert. There is currently no treatment for this runoff prior to discharging into the East Channel Bassett Creek. East Channel Bassett Creek flows south and then east, making its way to the new Bassett Creek tunnel, which discharges into the Mississippi River.

The City of Minneapolis has discussed drainage concerns with the portion of the East Channel Bassett Creek between the BNSF Railway corridor and the TH 55 (Olson Memorial Highway) crossing. They indicated that the culvert under the highway may not have adequate capacity, may be undersized, or may be partially plugged with sediment.

3.1.1.5 Drainage to East Channel Bassett Creek and Bassett Creek, TH 55 (Olson Memorial Highway) to Oak Park Avenue (Stations 2095+00 to 2109+25)

See the Segment GV section for a general overview of the BLRT Corridor in Theodore Wirth Regional Park (TWRP). See the Floodplain and Wetland Technical Memoranda for additional information on this area.

West of Vincent Avenue, the project turns north along the BNSF Railway and Canadian Pacific Railway corridors. Segment M ends at Oak Park Avenue. Runoff from the corridor and residential areas to the east is picked up by ditches along the railroads, but it does not always appear to drain to the creek due to flat grades, poor soils, high groundwater, and buried or missing culverts. Generally, the ditches flow south and discharge to East Channel Bassett Creek except for the northernmost portion which discharges to Bassett Creek.

3.1.2 Segment GV – Golden Valley

The Golden Valley segment extends along the existing BNSF Railway corridor from Oak Park Avenue north to 26th Avenue N. The entire segment ultimately drains to Bassett Creek, but a portion drains first to the wetlands north of Golden Valley Road or to smaller wetlands adjacent to the creek. The entire segment is within the BCWMC boundaries.

The BNSF Railway corridor has a typical railroad section, with an embankment constructed of ballast rock and ditches or water bodies on either side. Outside of the BNSF Railway right-of-way, the corridor is surrounded by residential areas to the east and two parks, TWRP and Mary Hills Nature Area, to the west. Drainage from eastern residential areas drains into the ditches in the BNSF Railway corridor right-of-way and through culverts into the parks.

There are a number of areas along the BNSF Railway corridor where depressions in the ditches are not fully drained due to flat grades, poor soils, high groundwater, and buried or missing culverts. These areas have been delineated as wetlands. There are additional areas where ditches are very small or nonexistent and water appears to drain over the railroad embankment or through the ballast rock.

Like much of the Bassett Creek watershed, the soils in the Golden Valley segment are typically in HSG C or D, and groundwater is high in many places along the corridor where wetlands are present. The portion of the BLRT Corridor between Plymouth Avenue and 26th Avenue is in a Drinking Water Supply Management Area (DWSMA) with high vulnerability.

The segment is described in more detail in the following sections. See Appendix A, **Figures 2 and 3** for a representation of the flow patterns and receiving waters.

3.1.2.1 Drainage to Bassett Creek, Oak Park Avenue to Plymouth Avenue (Stations 2109+25 to 2122+55)

Drainage from residential areas to the east of the corridor collects in the eastern BNSF Railway corridor ditch and discharges to wetlands in TWRP and to Bassett Creek. The existing ditch provides a small amount of water quality treatment by slowing down runoff and allowing for some settlement of larger sediments and some degree of rate

attenuation due to the storage volume in the ditch. There is no ditch on the west side of the tracks, and runoff from the BNSF Railway corridor that drains directly to the west is untreated before it flows to Bassett Creek in the park.

Bassett Creek has undergone a recent streambank stabilization and habitat restoration project from Golden Valley Road to Irving Avenue, which extends south beyond the BLRT Extension project limits.

3.1.2.2 Drainage to Bassett Creek, Plymouth Avenue to Theodore Wirth Parkway (Stations 2122+55 to 2154+00)

Upstream of Plymouth Avenue and just south of 14th Avenue N, a large storm sewer system discharges to Bassett Creek. Approximately 680 acres of Minneapolis storm sewer drains through two large hydrodynamic separators located southwest of the intersection of Xerxes Avenue and 14th Avenue N. See Drainage Design Approach below for a description of BMPs such as these. The storm sewer passes under the BNSF Railway corridor and directly into Bassett Creek.

Additional residential areas east of the BNSF Railway corridor drain to the eastern railroad ditch before discharging through culverts to wetlands in TWRP and to Bassett Creek. North of 14th Avenue N, runoff discharges to a wide channelized wetland before entering Bassett Creek. The existing ditch provides a small amount of water quality treatment by slowing down runoff and allowing for some settlement of larger sediments and some degree of rate attenuation due to the storage volume in the ditch. There is no ditch on the west side between the tracks and the wetland, and runoff from the BNSF Railway corridor that drains west is untreated before it enters the wetland.

The City of Golden Valley and the BCWMC propose to construct a stormwater treatment BMP between the project corridor and Theodore Wirth Parkway at approximate northbound station 2142+00. The project will treat 115 acres of residential drainage. Both entities have included the project in their capital improvement plans for construction in 2018 to 2019. The exact location, size, and type of the BMP are not known at this time.

3.1.2.3 Drainage to Bassett Creek, Golden Valley Road Wetlands (Stations 2154+00 to 2165+50)

The wetlands just north of Golden Valley Road on either side of the BNSF Railway corridor cover an area that was historically one wetland that was divided into two when the BNSF Railway corridor was built. An east-west bisection was created in the 1930s, when a 48-inch watermain was installed, and a berm constructed over it. This berm has partially collapsed between the southeast and the northeast basins, allowing the eastern basins to function as one pond. The western basins are equalized through a submerged culvert under that portion of the berm.

The eastern basin drains to the western through a culvert under the BNSF Railway. The western basins drain to Bassett Creek via a surface overflow and small channel through Mary Hills Nature Area. According to field survey data, the basins on either side of the railroad embankment act independently, and the normal water level of the eastern basin is roughly two feet higher than that of the western basins. Initial modeling shows that the eastern wetland overtops the BNSF Railway in the 50-year storm event and that the 100-year high water level of the eastern basin is approximately five higher than that of the western basins. City of Golden Valley staff has expressed concern that any changes in the storage available in these basins could affect the 100-year flow rates and floodplain elevations of Bassett Creek. There are several homes adjacent to the creek in this area that have little to no freeboard above the 100-year flood elevation and that could be impacted by even small changes in the function of the basins.

Rainfall landing on the railroad embankment drains directly into the wetlands on either side. In addition to drainage to the ponds from the railroad corridor, approximately 100 acres of residential area to the east drain to the ponds through storm sewer.

3.1.2.4 Drainage to Bassett Creek, Station 2166+00 to 2185+00 at 26th Avenue N

Existing storm sewer carries residential drainage from Byrd Ave N and Kewanee Way to storm sewer that discharges to an undrained depression on the east side of the existing BNSF Railway corridor. It is not clear how water moves from the east depression to the west side of the railroad. There are two additional depressions on the west side of the railroad that also appear to be landlocked. Water that overtops the western depressions flows though the Mary Hills Nature Area, over an existing trail, through a wetland, and into Bassett Creek. It is possible that the east and west depressions were once connected by a culvert under the railroad, but there was no evidence of a culvert during field surveys for the BLRT project.

3.1.3 Segment R – Robbinsdale

The Robbinsdale segment extends from 26th Avenue N to 47th Avenue N along the existing BNSF Railway corridor. The area surrounding the corridor primarily consists of residential neighborhoods, with the southernmost portion of the segment running through Sochacki Park. Additionally, the corridor passes just to the east of two smaller parks, Lee Park and Triangle park, and just to the west of downtown Robbinsdale. The northernmost portion of the segment corridor, after crossing over TH 100, runs parallel to CSAH 8 (West Broadway Avenue), before making its way into Crystal.

Much of the existing offsite drainage flowing towards the BNSF Railway corridor is either collected in storm sewer systems before reaching the corridor or flows into the many wetlands along the corridor. However, in some cases, there are existing culverts and short runs of storm sewer that discharge into the ditches along the railroad. The corridor itself generally drains to ditches and flat grassed areas along the track or to the existing wetlands. This segment falls within the BCWMC south of 36th Avenue N and within the SCWMC north of 36th Avenue N. Stormwater runoff in BCWMC drains to Grimes, North Rice, and South Rice Ponds upstream of Bassett Creek. The stormwater in SCWMC primarily drains to Crystal Lake and Middle and Lower Twin Lakes which are nutrient-impaired lakes and have TMDL implementation plans. Approximately 34 percent of the corridor drainage ultimately flows to Bassett Creek (via Grimes, North Rice, and South Rice Ponds), 51 percent to Crystal Lake, and 15 percent to Twin Lakes.

Like much of the Bassett Creek watershed, the soils in the portion of the segment south of 36th Avenue N are typically HSG C or D, with slow to very slow infiltration rates. Between 36th Avenue N and TH 100, the soils consist of HSG B soils, with moderate infiltration rates, while the soils north of TH 100 are typically HSG A soils having high infiltration rates. The groundwater table is high in many places within the trench portion of the corridor, as indicated by the presence of many wetlands adjacent to the BNSF Railway embankment. Groundwater elevations elsewhere in the segment are not known.

The segment is described in more detail in the following sections. See Appendix A, **Figures 4 through 6** for a representation of the flow patterns and receiving waters.

3.1.3.1 Drainage to South Rice Pond, Existing Stormwater Pond in Sochacki Park (Stations 2185+00 to 2196+80)

South of 27th Avenue N, the corridor drains to adjacent wetlands that drain under the corridor and eventually to South Rice Pond via culverts. The City of Robbinsdale recently constructed a wet detention pond in Sochacki Park that receives stormwater from a storm sewer system draining the residential area east of the project corridor. The existing pond receives runoff from the project corridor in the existing condition. The pond ultimately discharges to South Rice Pond.

3.1.3.2 Drainage to Grimes and North Rice Ponds (Stations 2196+80 to 2252+35)

While the jurisdictional watershed divide between BCWMC and SCWMC is at 36th Avenue N and neighboring residential drainage is split here, the portion of the corridor starting at Lee Park drains south under the bridge at 36th Avenue N. Lee Park and an adjacent retirement home drain to a low lying area in Lee Park that eventually discharges to the corridor. This portion of the corridor is very flat and contains primarily HSG B soils, so it is likely that much of the corridor water infiltrates. The portion of stormwater runoff that does not infiltrate eventually discharges to Grimes and North Rice Ponds.

South of 36th Avenue N there are wetlands running along both the east and west sides of the corridor. These receive both corridor water and discharge from several storm sewer systems and only appear to have natural overflows that eventually discharge to Grimes and North Rice Ponds.

From 33rd Avenue N to just north of 27th Avenue N, the corridor drains to Grimes Pond on the east and North Rice Pond on the west through various wetlands. There is also residential runoff draining to both of these ponds, which are separated by the existing BNSF Railway embankment and connected by a 48"culvert on the south end of the ponds. Grimes and North Rice ponds discharge to South Rice Pond, which ultimately discharges to Bassett Creek.

3.1.3.3 Drainage to Crystal Lake (Stations 2251+00 to 2298+00)

The northern portion of Robbinsdale is in the SCWMC and drains to Crystal Lake and Middle and Lower Twin Lakes. In this portion of the corridor, instead of wetlands and ditches, the BNSF Railway corridor is adjacent to residential and commercial properties. The area south of TH 100 is characterized by HSG B soils. From north of Lee Park to 42nd Avenue N, corridor water that does not infiltrate and residential area runoff is picked up by storm sewer and drains to Crystal Lake. There are two storm sewer systems in this area that outlet directly to the lake.

3.1.3.4 Drainage to Middle Twin Lake (Station 2298+00 to 2329+00)

North of 42nd Avenue N, the adjacent storm sewer systems would likely only receive corridor runoff in large events. North of TH 100 the HSG A soils and the flat grassed edges of the corridor also likely infiltrate some runoff from the ballast. These storm sewer systems drain to a series of ponds near TH 100 before discharging to Lower and Middle Twin Lakes, which eventually drain to Shingle Creek. Middle Twin Lake receives the corridor and offsite water from north of TH 100 while Lower Twin Lake receives primarily residential water from between TH 100 and 42nd Avenue N.

3.1.4 Segment C – Crystal

The Crystal segment extends from 47th Avenue N to 62nd Avenue N. The proposed project continues in the BNSF Railway corridor, which is along the west side of CSAH 8 (West Broadway Avenue) in the south and transitions to run along the west side of CSAH 81 (Bottineau Boulevard) in the north. The area around the project limits is fully developed with a mixture of ¼-acre residential lots, townhomes, commercial, and industrial uses. There are several parks in the area adjacent to the project. The Crystal Airport is also near the project corridor in the north portion of the segment. Approximately 66 percent of the project area drains to the Upper and Middle Twin Lakes and 34 percent drains to the Crystal Airport infiltration area.

Web soil survey information for this segment categorizes the existing soils as predominantly "urban land". Soil borings for the area show fine-grained sand, occasionally with a layer of loamy sand and/or sandy loam above it. These would be typical of HSG A and B soils, with high to moderate infiltration capacity. The project falls within a wellhead protection area south of the Canadian Pacific Railway corridor but is not within an emergency response area. Groundwater elevations for this segment are not known at this time.

Figures 6 and 7 in Appendix A show the existing flow patterns and receiving waters. The sections below provide more detail regarding the drainage within this segment.

3.1.4.1 Drainage to Twin Lakes, BNSF Railway Corridor South of CSAH 10 (Bass Lake Road) (Station 2520+80 to 2380+90)

In the southern portion of the Crystal segment, the BNSF Railway corridor transitions from running along the west side of CSAH 8 (West Broadway Avenue) to the west side of CSAH 81 (Bottineau Boulevard). During this transition, the corridor runs through a commercial and industrial area and is not adjacent to a roadway. Due to the presence of sandy soil, most of the runoff infiltrates along the railroad corridor and there appears to be no catch basins or culverts to collect or direct runoff. Any runoff that does not infiltrate may flow into adjacent parking lots and enter catch basins, which ultimately discharge into Upper or Middle Twin Lake.

There are storm trunk lines which pass under the railroad corridor where it crosses Corvallis Avenue and to the west of the intersection of Wilshire Boulevard and CSAH 81 (Bottineau Boulevard). There is also a pair of culverts running underneath the track from the wetland southeast of the Canadian Pacific Railway crossing that connects to storm sewer lines that flow to an existing pond in the southwest quadrant of the intersection of CSAH 8 (West Broadway Avenue) with the Canadian Pacific Railway corridor.

3.1.4.2 Drainage to Twin Lakes, Bass Lake Road Park-and-Ride (Station 2371+25 and 2379+30)

The area proposed for a future park-and-ride between the BNSF Railway corridor and CSAH 81 (Bottineau Boulevard), immediately south of CSAH 10 (Bass Lake Road), is a petroleum brownfield with a high risk of groundwater contamination. The area is mostly open, grassy space, but other land uses include a small commercial property with a surface parking lot, walking path, and a cul-de-sac for vehicle access to a cellular tower. There is a catch basin located in the area that connects to the CSAH 10 (Bass Lake Road) trunk line which discharges into Upper Twin Lake without further treatment.

Another concern in the area is that, as noted in the Water Resources Preliminary Design Report (July 2004) prepared for the CSAH 81 reconstruction project, the existing CSAH 10 (Bass Lake Road) trunk storm sewer is known to have capacity issues and has an emergency relief system in place.

3.1.4.3 Drainage to Crystal Airport Infiltration Area (Station 2380+90 to 2418+75)

North of the intersection with CSAH 10 (Bass Lake Road), the BNSF Railway corridor continues along the west side of CSAH 81 (Bottineau Boulevard) throughout the remainder of the segment. Runoff in this section collects in ditches on either side of the track. Any runoff that does not infiltrate flows to a low point on the west side of CSAH 81 (Bottineau Boulevard) across from the Crystal Airport. At the low point, two culverts drain water from the west side of the tracks, and another culvert passes underneath CSAH 81 (Bottineau Boulevard) to drain the ditches, along with stormwater from a section of CSAH 81 (Bottineau Boulevard), into an infiltration area located on the Crystal Airport property. The outfall from the infiltration area is a series of ditches and culverts within the airport property to a large wetland complex and ultimately to Twin Creek and Upper Twin Lake.

The Metropolitan Airport Commission will not allow an increase in rate or volume being discharged to the existing infiltration area without permission, and the FAA will not allow surface ponds close to airports as they may attract birds which can interfere with airplane safety.

3.1.5 Segment BP2 – Brooklyn Park 2

The BP2 segment is in the portion of the project located in southern Brooklyn Park and extends from 62nd Avenue N to just south of Candlewood Drive N. The project corridor consists of the BNSF Railway corridor immediately adjacent to CSAH 81 (Bottineau Boulevard) from 62nd Avenue N to 73rd Avenue N, where the BLRT Extension

project will leave the BNSF Railway corridor, and the CSAH 103 (West Broadway Avenue) corridor from 73rd Avenue N to the northerly segment boundary. The reconstruction of CSAH 103 (West Broadway Avenue), including the addition of turn lanes, trails, and boulevards, and a portion of CSAH 152 (Brooklyn Boulevard) is included in this segment. The main receiving waters in this segment are Twin Creek, which flows into Upper Twin Lake and collects runoff from the portion of the segment south of I-94; and Shingle Creek, which collects runoff from the remainder of the segment. Approximately 22 percent of the project area drains to Twin Creek and 78 percent drains to Shingle Creek.

The soils in this segment of the BLRT Project corridor have been categorized as predominantly HSG B soils south of 75th Avenue N and predominantly HSG A soils north of 75th Avenue N. These soils have moderate to high infiltration capacity. Much of this segment falls within a wellhead protection area but is outside the emergency response area. Groundwater elevations are unknown at this time, except immediately adjacent to wetlands that are an expression of the surficial groundwater table.

Figures 7 through 9 in Appendix A show the existing flow patterns and receiving waters. The sections below provide more detail regarding the drainage within this segment.

3.1.5.1 Drainage to Twin Creek, 62nd Avenue Wetland (Stations 2418+75 to 2436+30)

The existing BNSF Railway corridor runs adjacent to a stormwater wetland located in the northwest quadrant of 62nd Avenue N and CSAH 81 (Bottineau Boulevard). Runoff that collects in ditches on the west side of the railroad corridor between 62nd Avenue N and 63rd Avenue N, and does not infiltrate, flows into the wetland. The ditch on the east side of the railroad corridor has a different drainage pattern which is explained below. The wetland currently receives runoff from a watershed of approximately 625 acres. Roughly 250 acres of that, consisting largely of ¼-acre residential lots located west of CSAH 81 (Bottineau Boulevard) and south of I-94, is routed directly to the wetland. The pond outlet is in the southeast corner. From there, the outlet pipe crosses under CSAH 81 (Bottineau Boulevard), runs along the property line directly east, and discharges to a wetland in Southbrook Park east of industrial properties. It eventually discharges to Twin Creek, where it crosses 63rd Avenue N.

In 2003, the City of Brooklyn Park re-graded the wetland and improved the outlet structures to reduce flooding in the City of Crystal and provide additional water quality benefits. The wetland system allows suspended sediments to settle out and also provides filtering through a buffer of wetland vegetation. According to hydraulic modeling performed by the City of Brooklyn Park, the high water level of the wetland is roughly 8.2 feet higher than the normal water elevation.

3.1.5.2 Drainage to Twin Creek, CSAH 81 (Bottineau Boulevard) (Stations 2436+30 to 2468+00)

As mentioned above, the BLRT project runs along the existing BNSF Railway corridor adjacent to CSAH 81 (Bottineau Boulevard) until the crossing at 73rd Avenue N. South of Dutton Avenue N, CSAH 81 (Bottineau Boulevard) has an urban drainage section with a trunk storm sewer that routes roadway runoff away from the ditch between the BNSF Railway corridor and CSAH 81 (Bottineau Boulevard). North of Dutton Avenue N, CSAH 81 (Bottineau Boulevard) currently has a rural drainage section.

The ditch on the east side of the existing BNSF Railway embankment collects runoff from about 700 feet south of the Brooklyn Park/Crystal border to 63rd Avenue N. The ditch flows to a low point across from the 62nd Avenue N wetland where a culvert drains into the CSAH 81 (Bottineau Boulevard) storm sewer. The east ditch between 63rd Avenue N and the I-94 interchange, which receives runoff from northbound CSAH 81 (Bottineau Boulevard) in the rural section north of Dutton Avenue N, also drains into the CSAH 81 (Bottineau Boulevard) storm sewer system through an inlet north of 63rd Avenue N. Both of these systems discharge to Twin Creek east of CSAH 81 (Bottineau Boulevard), near the intersection of 63rd Avenue N and Florida Avenue.

Runoff from southbound CSAH 81 (Bottineau Boulevard) flows into the ditch on the east side of the BNSF Railway corridor, where most of it infiltrates due to the presence of sandy soils. Any runoff not infiltrated flows to Twin Creek for the portion of the corridor south of I-94. In addition to the volume reduction from infiltration, the ditches also provide a degree of water quality treatment (due to vegetative filtering and plant uptake) and rate attenuation (due to the storage volume available). Hennepin County plans to reconstruct CSAH 81 (Bottineau Boulevard) in the near future. It is likely that the new roadway will utilize the same fully urban drainage section as for the portions of CSAH 81 (Bottineau Boulevard) reconstructed in Robbinsdale and Crystal. Further coordination with Hennepin County will be needed to understand the future drainage conditions.

3.1.5.3 Drainage to Shingle Creek, Stations 2468+00 to 2540+50 at CSAH 152 (Brooklyn Boulevard)

The project corridor continues along the west side of CSAH 81 until 73rd Avenue N, where it transitions to the CSAH 103 (West Broadway Avenue) corridor. South of station 2481+00, the characteristic of project corridor is consistent with the BNSF Railway corridor to the south. The portion of this segment between stations 2468+00 and 2481+00 drains into the ditches on either side of the BNSF Railway corridor. The ditches drain through the I-94 corridor and ultimately discharge to Shingle Creek to the east of the BLRT Corridor. Between station 2481+00 and the crossover to CSAH 103 (West Broadway Avenue), runoff from the project corridor drains to Shingle Creek to the west of the BLRT Corridor.

As the BLRT Corridor transitions to the CSAH 103 (West Broadway Avenue) alignment, it passes through commercial areas with a high percentage of impervious cover. There is minimal existing storm sewer in the area between CSAH 81 (Bottineau Boulevard) and CSAH 103 (West Broadway Avenue). Runoff flows to the surrounding vegetated areas and is infiltrated, collected by storm sewer in Jolly Lane, or flows into the roadside ditches along Lakeland Avenue. The storm sewer and ditches drain to a narrow pond on the east side of the BNSF Railway track adjacent to DNR Wetland #563W to the west of the project corridor, which ultimately drains to Shingle Creek.

CSAH 103 (West Broadway Avenue) has curb and gutter to channel stormwater into catch basins and storm sewer. There is a trunk storm sewer running to the north along CSAH 103 (West Broadway Avenue) from 73rd Avenue N to CSAH 152 (Brooklyn Boulevard). This trunk line connects to a larger trunk line running to the east along CSAH 152 (Brooklyn Boulevard) that discharges without treatment into Shingle Creek approximately 0.75 miles from the project corridor. In addition to the roadway runoff, the CSAH 103 (West Broadway Avenue) trunk storm sewer collects the outflow from stormwater BMPs in the Cub Foods/Target parking lot to the west.

3.1.5.4 Drainage to Shingle Creek, North of CSAH 152 (Brooklyn Boulevard) (Stations 2540+50 to 2552+65)

North of CSAH 152 (Brooklyn Boulevard), CSAH 103 (West Broadway Avenue) has curb and gutter with catch basins to collect the stormwater. A trunk storm sewer runs from just north of CSAH 152 (Brooklyn Boulevard) to just north of 78th Avenue N where it turns east and collects stormwater from the residential area north of CSAH 152 (Brooklyn Boulevard) and west of Idaho Avenue N. This area discharges into Shingle Creek where it intersects with Candlewood Drive. In addition, the trunk storm sewer collects runoff from a portion of the residential area around the 78th Court N cul-de-sac and the shopping area, including outflow from stormwater BMPs, to the northeast of the CSAH 103 (West Broadway Avenue) and CSAH 152 (Brooklyn Boulevard) intersection.

3.1.6 Segment BP1 – Brooklyn Park 1

This segment extends from the Shingle Creek Crossing at CSAH 152 (West Broadway Avenue) just south of Candlewood Drive north to Oak Grove Parkway/101st Avenue N, where the OMF will be located approximately one-half mile northwest of the Target North Campus. Drainage from the Shingle Creek crossing north to CSAH 109 (85th Avenue N) is within the SCWMC jurisdiction and drains to Shingle Creek. Drainage north of CSAH 109 (85th Avenue N) is within the WMWMC jurisdiction and is tributary to the Mississippi River via Century Channel and other

drainageways. These areas are described in more detail in the following sections. Approximately 20 percent of the project drains to Shingle Creek, 35 percent to Century Channel, and 45 percent to the Mississippi River.

The soils in this segment of the BLRT Project corridor has been categorized as HSG A and B soils, with high to moderate infiltration capacity. Much of this segment falls within a wellhead protection area, but only the portion between CSAH 109 (85th Avenue N) and Maplebrook Parkway N is within or near the emergency response area, which would be considered a highly vulnerable portion of the Brooklyn Park Central DWSMA.

See **Figures 9 through 12** in Appendix A for a representation of the existing flow patterns and receiving waters for this segment.

3.1.6.1 Drainage to Shingle Creek, Shingle Creek Crossing to Maplebrook Parkway N (Station 2552+65 to 2604+20)

The portion of CSAH 103 (West Broadway Avenue from Shingle Creek to roughly Maplebrook Parkway N consists of both rural and urban drainage systems. Inlets in the roadside ditches and catch basins in the street route the runoff into an existing trunk storm sewer under CSAH 103 (West Broadway Avenue). In addition to the road runoff, the trunk storm sewer serves large offsite areas consisting of single- and multi-family homes, the North Hennepin Community College (NHCC), and parks before discharging to Shingle Creek downstream of the crossing at CSAH 103 (West Broadway Avenue). Runoff from the rural roadway section receives some amount of water quality treatment through vegetative filtering and rate attenuation when flowing through ditches. However, much of the roadway runoff receives no treatment.

3.1.6.2 Drainage to Century Channel, Setzler Pond and the DNR Wetlands (#559W) (Station 2604+20 to 2644+15)

Setzler Pond is located in the northwest quadrant of the intersection of 89th Avenue N and CSAH 103 (West Broadway Avenue). Runoff from a portion of CSAH 103 (West Broadway Avenue) between 89th Avenue N and Setzler Parkway is conveyed to the pond via ditches. Setzler Pond was created as a regional rate control pond in the location of a public watercourse. Much of the stormwater that flows into Setzler Pond is runoff from the commercial and industrial land surrounding the pond from the north and west, as well as large contributing areas in the cities of Maple Grove and Osseo. Setzler Pond discharges through an existing culvert that crosses CSAH 103 (West Broadway Avenue), reconnecting into Century Channel. Century Channel is also known as Edinbrook Channel and Mattson Brook at various points along its course, with Mattson Brook at the most downstream end. Mattson Brook ultimately discharges into the Mississippi River.

DNR Wetland #559W is located between Setzler Parkway and 92nd Avenue N. The wetland was bisected with the original construction of CSAH 103 (West Broadway Avenue). DNR #559W receives stormwater runoff from CSAH 103 (West Broadway Avenue) between Setzler Parkway and CSAH 30 (93rd Avenue N), which has a rural drainage system. Roadway runoff receives some amount of water quality treatment through vegetative filtering prior to reaching the wetland. Although it was not designed as a treatment basin, the wetland provides additional water quality treatment via sedimentation and plant uptake, as well as rate attenuation. DNR #559W discharges through an existing culvert in the southwest corner of the west wetland. This culvert travels west until connecting into the trunk line traveling beneath Wyoming Avenue N. This trunk line discharges into Setzler Pond, which ultimately discharges to Century Channel.

The jurisdictional divide between the SCWMC and WMWMC falls at CSAH 109 (85th Avenue N). However, the hydrologic divide occurs at approximately Maplebrook Circle N.

3.1.6.3 Drainage to Century Channel, TH 610 Ponding System (Station 2644+15 to 2684+00)

CSAH 103 (West Broadway Avenue) between CSAH 30 (93rd Avenue N) and TH 610 has an urban drainage system with a trunk storm sewer running down the east gutter line. A small portion immediately north of CSAH 30 (93rd Avenue N) drains into an existing infiltration basin on the east side of CSAH 103 (West Broadway Avenue). This basin's outlet connects into the existing trunk line. The remainder of CSAH 103 (West Broadway Avenue) north to TH 610 drains directly into the trunk line, which discharges into existing stormwater treatment basins located inside the infield area in the southeast quadrant of the TH 610 interchange. CSAH 103 (West Broadway Avenue) runoff from approximately 800 feet north of the TH 610 bridge is conveyed via storm sewer running down the east gutter line and discharges into existing stormwater treatment basin located inside the infield area in the northeast quadrant of the TH 610 interchange. The TH 610 ponds ultimately discharge to Century Channel.

CSAH 103 (West Broadway Avenue) drainage from 800 feet north of TH 610 to 101st Avenue N is conveyed via storm sewer and roadside ditches to the existing stormwater pond located in the southeast quadrant of the intersection of CSAH 103 (West Broadway Avenue) and Oak Grove Parkway. Between Oak Grove Parkway and Winnetka Avenue N, CSAH 103 (West Broadway Avenue) transitions from an urban drainage section to rural section. Where the urban section ends, roadside culverts pick up ditch drainage, providing conveyance to the existing stormwater pond, which overflows south to the TH 610 system. The area bordered by TH 610, CSAH 103 (West Broadway Avenue), and Winnetka Avenue N flows south to an existing 42-inch culvert beneath CSAH 103 (West Broadway Avenue), and discharges to the north loop infield area of the TH 610 interchange, which ultimately drains to Century Channel.

3.1.6.4 Target North Campus Drainage

According to the 2012 AUAR Update – Stormwater Management for Target North Campus, the Target North Campus stormwater is treated with onsite BMPs that are routed to the existing stormwater pond southeast of Oak Grove Parkway and CSAH 103 (West Broadway Avenue) intersection, which then discharges to the TH 610 system. This appears to have been intended as a temporary drainage connection, and the City of Brooklyn Park 1995 Comprehensive Stormwater Management Plan (CSMP) and the 2013 Shingle Creek and West Mississippi Watershed Management Commissions Third Generation Watershed Management Plan indicate that the Target North Campus drainage is intended to flow northeast into a series of wetlands and drainageways that ultimately reach the Mississippi River. Further coordination is needed with the City of Brooklyn Park, WMWMC, Target North Campus, and other stakeholders to determine exactly how the Target North Campus drainage functions in the existing condition and whether the current drainage patterns will be maintained.

3.1.6.5 Drainage to Mississippi River, North of TH 610 (Station 2684+00 to OMF)

North of TH 610, the project includes additional site development outside of the corridor (i.e. park-and-ride, OMF, and the Oak Grove Parkway realignment), which extends approximately 1,500 feet to the west of Winnetka Avenue N. See **Figures 11 and 12** in Appendix A for Oak Grove Parkway N realignment concept design.

Per the 2013 Shingle Creek Third Generation Plan, the area west of Winnetka Avenue N is within the 'Northwest/Riverside' West Mississippi Subwatershed, which is within the Anoka sand plain and is relatively flat with little relief. Per the 2009 City of Brooklyn Park Draft Local Water Management Plan Update, runoff generated in this area that is not infiltrated within the numerous low areas eventually drains easterly into a series of wetlands, open channels, and a trunk storm sewer system. At the eastern end of 101st Avenue N, this system discharges into a large wetland complex, ultimately reaching the Mississippi River.

4.0 Drainage Design Approach

4.1 Proposed Project

The proposed project includes the following basic components:

- Construction of a northbound and a southbound BLRT guideway. The majority of the guideways will be ballasted track, except within at-grade intersections. In some areas, the guideways will replace existing vegetated surfaces. Where the guideway will be ballasted, six-inch perforated pipe track drains will be located below the subballast.
- Reconstruction of TH 55 (Olson Memorial Highway), the majority of CSAH 103 (West Broadway Avenue), and Oak Grove Parkway within the project limits
- Construction of new roadways as needed to support the OMF and park-and-ride in the BP1 segment
- Relocation of the BNSF tracks and construction of an access road to be used by BNSF for access to their facility
- Construction of LRT stations and platforms
- Construction of park-and-ride facilities

As noted above, the project has been divided into six segments: Minneapolis, Golden Valley, Robbinsdale, Crystal, Brooklyn Park 2, and Brooklyn Park 1. The following sections will describe the overall drainage design approach and the types of BMPs being considered. They will also provide more detail of the proposed changes in each segment and the specific stormwater strategies recommended.

4.2 Methodology

In general, a proposed stormwater plan needs to analyze three items, which are discussed in more detail in the sub-sections below:

1. Existing drainage patterns and the regulatory environment (the latter was summarized in the Section above).
2. Changes to hydrology due to an increase in impervious surface
3. Changes to hydraulics due to a conversion from one conveyance system to another (surface flow in ditches versus pipe flow) and due to reduction in the storage available

Following this, the stormwater management plan needs to include the design of BMPs in accordance with the regulatory agencies' rules and ordinances to manage changes to these three items. The sequencing approach to locating BMPs was as follows:

1. Locate BMPs within the available right-of-way to the greatest extent practicable
2. Locate BMPs within other public right-of-way or remnants of parcels that are anticipated to be acquired due to other project requirements
3. Locate BMPs within currently undeveloped land outside of the right-of-way

4.2.1 Drainage Patterns

The intent of the proposed drainage system for the BLRT Extension project is to mimic the existing drainage patterns to the greatest extent possible while also meeting the requirements of the regulatory agencies. There are some instances where small diversions in drainage patterns are proposed in order to route project runoff to a BMP. These diversions are limited to below the subwatershed level, such that stormwater will not be diverted between jurisdictional watershed agencies and typically will not be diverted between different water bodies within a

watershed. When diversions are proposed for treatment purposes, the BMPs will need to be designed to ensure that there is no increase in discharge rates to existing storm sewer facilities or to the receiving water.

4.2.2 Changes to Hydrology

For the purposes of this preliminary design, the portions of the project that will be constructed on ballast rock have been considered to be impervious surface due to the compacted class 5 aggregate underneath the ballast. However, the calculations have assumed the ballast to have a lower runoff coefficient (a curve number of 85) than other impervious surfaces, such as concrete and asphalt (with a curve number of 98), due to the higher percentage of surface area of the ballast rock to abstract more rainfall than pavement and due to the higher percentage of void spaces that allow for some storage of rainfall. Impervious surfaces translate to higher runoff volumes and higher discharge rates due to the decrease in pervious areas capable of infiltrating the rainfall. They also tend to correlate to a faster time of travel for the rainfall runoff due to the lower resistance of paved surfaces, which also results in higher discharge rates.

Changes from pervious to impervious land uses are also typically associated with increased pollutant loads in the runoff. This is especially true of impervious surfaces associated with automobiles, such as roadways and parking lots. Therefore, BMPs will be proposed that can provide rate attenuation, water quality treatment, and, where conditions permit, reduction in runoff volumes.

4.2.3 Changes to Hydraulics

The proposed conveyance system for the majority of the Minneapolis, Golden Valley, Robbinsdale, and Crystal segments will match that of the existing condition. However, due to widening of the roadway in the Brooklyn Park segments, the existing roadside ditches will be partially or completely eliminated, and the drainage will be captured in storm sewer systems instead. In general, changing the conveyance system from ditch flow to storm sewer flow increases the velocity of the stormwater. It tends to eliminate the attenuation of flow that happens in open channel systems. There is also an increase in the volume of stormwater due to the elimination of evapotranspiration. Therefore, changing to a storm sewer system from a ditch system can also result in an increase peak discharge rates and volumes.

The project corridor is bounded by natural and constructed stormwater detention basins along much of its length, in particular in the Golden Valley, Robbinsdale, and Brooklyn Park segments. Because the proposed BLRT and BNSF facilities will be wider than the existing BNSF facility, the area available to store stormwater in some of these basins will be reduced. Reduction in storage volumes can lead to an increase in high water levels (HWLs) and/or an increase in discharge rates. The proposed stormwater management plan includes various storage BMPs to mitigate increases in discharge rates and HWLs in an effort to match existing conditions.

It should be noted that several wetlands and regulated floodplains exist along the corridor. Many of these will also be partially filled by the project. A separate technical memorandum has been prepared to discuss floodplain impacts and mitigation. The analysis of wetlands adjacent to the project limits and the potential impacts to those is being performed by others.

4.3 Proposed BMPs

The proposed stormwater management plan includes a variety of BMPs that can provide water quality treatment, rate control, and volume reduction. The Proposed Conditions section below will discuss the BMPs that appear to be best suited for the particular segment and may suggest preferred options. However, specific BMP types and locations will need to be confirmed as the design progresses and as more is known about the existing soil conditions. Further coordination with city and watershed organization staff may also affect the ultimate stormwater management plan. The following includes a brief description of the BMPs being considered.

4.3.1 Bioretention Basins

Bioretention basins are shallow, dry depressions that rely on a combination of plants, microbes, and soil to provide water quality treatment. Stormwater runoff is captured in the basin where it then infiltrates through a soil medium. The soil medium may be the native soil where conducive to infiltration or may be an engineered soil mix where the native soils are too clayey, which is not conducive to infiltration. Plants and microbes within the basin take up nutrients and other pollutants in the runoff. The plants also create macropores in the soil that aid in the infiltration of runoff. Bioretention basins remove pollutants by a number of mechanisms, including filtration, adsorption, cation exchange, volatilization, plant uptake, and decomposition. It is important that the basins drain within 48 hours of a rainfall event so that the plants do not drown.

Basins are typically designed with 12 inches to 18 inches of depth. Therefore, while they will provide rate attenuation for smaller storms, they may not be sufficient to provide rate attenuation for the 100-year rainfall event on their own. Modeling will be completed during the next phase of design to ensure adequate storage has been incorporated.

Depending on site conditions, bioretention basins can be designed as infiltration or filtration basins. The former are sometimes referred to as bioinfiltration basins while the latter are referred to as biofiltration basins. Typically, bioretention basins are designed to promote infiltration, thereby attaining volume reduction through evapotranspiration and infiltration in addition to water quality treatment and some degree of rate attenuation. The NPDES permit provides guidance on the site conditions that preclude the use of bioinfiltration and infiltration practices (such as insufficient depth to the groundwater table, contaminated soil and groundwater, and “tight” soils). Where infiltration practices are not encouraged, biofiltration basins can be designed with perforated piping to minimize infiltration and ensure the basin drains within the specified 48 hours. In addition, a liner could be utilized to prevent infiltration.

Pretreatment is required before discharging runoff into bioretention basins. This can take the form of proprietary hydrodynamic oil and grit separators, wet sediment forebays, or filter strips.

4.3.2 Ditch Treatment and Bioswales

The ditches that will be constructed between the BLRT guideway and BNSF tracks and/or the outside ditches will be utilized to provide water quality treatment, rate attenuation, and volume reduction (where conditions permit). In general, these are long ditches with very flat longitudinal slopes that will convey stormwater as a traditional ditch does. These are expected to take one of two general forms:

1. It is expected that the center corridor protection ditch (CPD) and any ditch to the outside of the BNSF Railway will be rock lined, either with free-draining ballast rock or riprap. The flat longitudinal slope will slow the velocity of water flowing in the ditches, which will encourage sedimentation and infiltration. Where conditions allow infiltration, a sand section would be included if needed to increase the available storage volume prior to infiltration. Where soil or groundwater conditions do not allow infiltration, either a sand section with perforated piping would be included below the ditch bottom to allow for filtration of runoff, or rock weepers would be included to provide horizontal filtering. Furthermore, the elevations of culverts would be set above the bottom of the channel to encourage infiltration/filtration.
2. Vegetated ditches may be possible to the east of the BLRT guideways. Where conditions allow infiltration, a sand section would be included if needed to increase the available storage volume prior to infiltration. Where conditions do not allow infiltration, either a sand section with perforated piping would be included for filtration or rock weepers would be included to provide horizontal filtering. The vegetated ditches would act similarly to bioswales.

Bioswales are vegetated swales that use the same soil as a bioretention basin. They convey stormwater to low areas similarly to a traditional swale, but ditch checks, rock weepers, and other devices are used to encourage

infiltration or filtration. The vegetation, microbes, and soil in the bioswale allow this BMP to provide the same treatment functions as bioretention basins.

Treatment ditches and bioswales can be designed to provide rate attenuation in addition to the water quality treatment and volume reduction benefits. However, because bioswales are vegetated and therefore need to drain within 48 hours of a rain event, they may not be able to attenuate the 100-year rainfall event. Modeling will be completed during the next phase of design to ensure adequate storage has been incorporated.

4.3.3 Hydrodynamic Separators

Hydrodynamic oil and grit separators are underground structures that remove larger particles and the pollutants that may be attached to them, as well as floating debris and oils. They are not capable of providing the level of treatment required but are used to pretreat runoff routed to bioretention and other infiltration BMPs, thereby prolonging their lifespans. They can be used as the sole treatment measure if no other options are practicable, but they do not provide any rate attenuation or volume reduction.

4.3.4 Wet Detention Pond

Also called NURP (for National Urban Runoff Program) ponds, these ponds are usually constructed at the end of storm sewer pipes or near ditch low points. Their function is to remove a large majority of the sediment and associated pollutants contained in the stormwater runoff prior to being discharged downstream. Furthermore, most pond designs incorporate skimmer structures that cause floating debris and oils to be trapped in the pond. Because of their relatively large surface area, they also can be used to attenuate peak discharge rates. In general, wet detention ponds do not provide volume reduction, but they can be used to pretreat runoff upstream of bioretention or infiltration practices.

4.3.5 Tree Trenches

Tree trenches are typically used in the boulevard areas adjacent to roadways. They consist of a prepared soil mix, an underdrain system, and a tree. If the tree trench is located in a boulevard with turf grass, the soil mix is similar to that used in bioretention basins. If the tree trench is located in a more urbanized setting with a paved surface, a structural soil or other structural technique is used that provides adequate void space for tree roots to develop but also support for the paving above.

Tree trenches provide water quality treatment by filtering runoff through the prepared soil mix and through uptake of some pollutants by the trees and microbes. Tree trenches also reduce the volume of runoff through infiltration into the underlying soils and through evapotranspiration. However, the amount of rate attenuation provided, especially for the larger storm events, varies by the type and design of system used.

4.3.6 Underground Detention and Infiltration

Underground detention systems can be used solely to store stormwater runoff temporarily or they can include an infiltration component. These systems typically consist of multiple parallel pipes that can be solid wall, perforated, or have an open bottom. When infiltration is not possible due to site conditions, solid wall pipes or liners are used. Their primary function in this case is rate control. When infiltration is possible, perforated or open-bottom pipes are set on top of and within a free-draining aggregate layer that allows for water quality treatment through filtering, volume reduction, and rate attenuation.

4.4 Proposed Conditions

4.4.1 Segment M – Minneapolis

In the Minneapolis segment, the proposed BLRT alignment will run down the center of TH 55 (Olson Memorial Highway), replacing the existing grassed median. The track will be in track panels at intersections and in ballast with ballast curb for the remainder of the roadway section. Track drains will collect runoff from the BLRT guideway that will be connected to the roadway storm sewer. A variety of stormwater BMPs are being considered for this portion of the project in order to meet regulatory requirements to the greatest extent possible. See **Figures 1 and 2** in Appendix A for the potential locations of the stormwater BMPs. **Tables 1 and 2** below provide a summary of the changes in impervious surfaces and the sizes of potential BMPs.

In addition to the proposed pedestrian sidewalk, a 10-foot wide cycle track is currently proposed to run on the north side of TH 55 (Olson Memorial Highway) from Van White Memorial Boulevard west to the TH 55 (Olson Memorial Highway) bridge over the BNSF Railway corridor. The cycle track will tie in with existing cycle trails in TWRP on the west side of the BNSF Railway corridor. The design accommodates the future cycle track.

4.4.1.1 Drainage to Bassett Creek Tunnels, East of I-94 (Stations 2010+75 to 2021+80)

Right-of-way constraints and a high number of underground utilities limit the type and size of BMPs that can be used in this area. Runoff from this portion of the project is proposed to be treated using tree trenches placed in the boulevard between the roadway and sidewalk on the north side, and between the sidewalk and frontage road on the south side. Because of poor soils in this area of the project, the proposed tree trenches would use a perforated pipe underdrain to both distribute water through the trench, but also to prevent extended periods of full saturation of the soil that could damage the trees. This portion of the corridor is owned by MnDOT, but the TH 55 (Olson Memorial Highway) corridor was designated to follow Lyndale Avenue south of the I-94 crossing several years ago. Therefore, the roadway in this area is operated and maintained by the City of Minneapolis.

4.4.1.2 Drainage to Old Bassett Creek Tunnel, West of I-94 (Stations 2021+80 to 2076+20)

Design of the BLRT guideway in this portion of the corridor is complicated by the shallowness of the old Bassett Creek tunnel near Dupont Avenue N. Further complications for the project include the number of underground utilities, including major sanitary sewer lines owned by the City of Minneapolis and by Metropolitan Council.

This portion of the project is proposed to have two storm sewer trunk lines, one to the north and one to the south of the proposed BLRT alignment, in order to minimize the number of storm sewer crossings under the proposed guideway. These storm sewer trunk lines will start at approximately CSAH 2 (Penn Avenue N) and discharge into the old Bassett Creek tunnel where it crosses TH 55 (Olson Memorial Highway) near Dupont Avenue N. Storm sewer will also collect runoff from TH 55 (Olson Memorial Highway) between the I-94 bridge and approximately Dupont Avenue N that will connect to the old Bassett Creek tunnel at the same location. As part of the MnDOT trunk highway system, the BMPs within their right-of-way need to be limited to those acceptable to MnDOT. Therefore, further coordination with staff from MnDOT and the City of Minneapolis will be required to finalize BMP types and locations.

Because right-of-way and open space is very constrained between the old Bassett Creek tunnel and I-94, no stormwater BMPs are being proposed in this area. BMPs west of the old Bassett Creek tunnel would be designed to treat otherwise untreated off-site runoff to compensate for lack of treatment east of the tunnel. The BMPs west of the old Bassett Creek tunnel may also need to be designed to provide enough rate attenuation such that there is no increase in peak discharge rates to the tunnel at the connections near Dupont Avenue. Coordination with the the City of Minneapolis will be required to confirm this approach.

Several BMP options are being considered to treat roadway runoff in this segment of the project, including bioretention basins, hydrodynamic separators, underground detention, and a NURP pond. Bioretention basins could be implemented in the south boulevard within the current TH 55 (Olson Memorial Highway) right-of-way. However, MnDOT has committed to conveying surplus right-of-way along the south side of TH 55 (Olson Memorial Highway) between Russell Avenue and Knox Avenue to the City of Minneapolis once the BLRT project and roadway improvements are completed. City staff has indicated a desire to have redevelopment occur in these spaces. Therefore, the locations of any basins would balance stormwater treatment needs and minimizing the impacts to land that the City of Minneapolis is considering for future redevelopment. The basins will function as retention and filtration with perforated pipe underdrains to ensure the basins drain within the allowed 48-hour drawdown time. Hydrodynamic separators or similar pretreatment BMPs will be used where viable to pretreat runoff before entering a bioretention basin. The existing three-cell treatment system in the Heritage Park south park area described above may have capacity to provide water quality treatment and rate control for the project area and future redevelopment. Further coordination with the City of Minneapolis will be necessary to understand the constraints and opportunities in the south park area. East of Knox Avenue N, right-of-way is very constrained, leaving little to no room for traditional above-ground BMPs. For this reason, underground detention BMPs are being considered for locations under low-volume frontage roads, aiming to avoid potential utility conflicts. This type of BMP provides rate control only, and hydrodynamic separators would be used to provide some level of water quality treatment. These could be used in conjunction with bioretention basins as needed to manage the total project discharge rate to the old Bassett Creek tunnel in this portion west of I-94.

A wet detention pond or other regional BMP could be implemented as part of future redevelopment of the parcel currently owned by the Minneapolis Public Housing Authority south of TH 55 (Olson Memorial Highway) and west of Van White Memorial Boulevard. This may provide an opportunity to cooperate on construction of the BMP to accommodate runoff from the BLRT Extension project and obtain both rate control and water quality treatment.

4.4.1.3 Drainage to Old Bassett Creek Tunnel, Heritage Park South Treatment System (Stations 2075+60 to 2081+95)

Although this portion of the segment drains to a series of existing water quality and rate control BMPs, the increase in discharge rates will need to be mitigated before connecting to the existing storm sewer systems immediately downstream of the project corridor. Furthermore, the existing treatment facilities would need to be investigated to determine if there is excess capacity to provide the treatment for the additional runoff. Options being investigated include a bioretention basin, which would treat offsite and project runoff in the boulevard at Russell Avenue, and that would connect to the existing storm sewer, thereby maintaining existing flow patterns.

However, because the City of Minneapolis desires to use the existing grassed boulevard for future redevelopment, a similar bioretention basin or other above-ground BMP is not possible at Queen Avenue N, and runoff would therefore enter the existing system untreated. Alternatively, offsite runoff could continue south to the existing storm sewer by crossing under the BLRT and roadway, while project runoff is routed to other proposed BMPs to the east and west. The proposed high point is located approximately half way between Russell Avenue N and Queen Avenue N, so approximately half of project runoff in this area would be routed to the old Bassett Creek tunnel, and half to East Channel Bassett Creek. Further coordination with the City, MnDOT, and BCWMC will be required to resolve this location.

4.4.1.4 Drainage to East Channel Bassett Creek, Russell Avenue N to TH 55 (Olson Memorial Highway)/BNSF Crossing

Runoff from this portion of the roadway is currently proposed to be treated in bioretention basins and an underground detention BMP. To limit the need for storm sewer crossings under the BLRT guideway, BMPs are being considered on both sides of the road. Due to the limited right-of-way on the north side of TH 55 (Olson Memorial Highway), an underground detention BMP is being considered under the north frontage road, between Thomas

Avenue N and Sheridan Avenue N. Before entering the underground storage BMP, water would be routed through a hydrodynamic separator for pretreatment. Bioretention basins are being considered on the south side of TH 55 (Olson Memorial Highway), where there is sufficient right-of-way, and would be designed with extra storage to provide rate control. Because of limited right-of-way to the west of the BNSF corridor, BMPs east of the bridge would be designed to compensate for the project runoff that is unable to be treated west of the bridge.

Westbound TH 55 (Olson Memorial Highway) will be realigned to the north to accommodate the BLRT guideway. A retaining wall is proposed to limit the amount of fill placed into the area near the upstream end of the East Channel Bassett Creek culvert crossing the highway. As a result of this, the culvert will need to be lengthened. More analysis will be done during the next stages of design to verify the culvert has the necessary hydraulic capacity. It may also be necessary to coordinate with the City of Minneapolis and the MPRB to better understand the drainage issues and opportunities in this area.

4.4.1.5 Drainage to East Channel Bassett Creek and Bassett Creek, TH 55 (Olson Memorial Highway) to Oak Park Avenue (Stations 2095+00 to 2109+25)

See the Segment GV section for general discussion of the BLRT Extension project corridor in TWRP. See the floodplain and wetland technical memoranda for additional information on this area.

Some water quality treatment and rate control will be achieved in the CDP between station 2098+00 and station 2109+30, which will discharge to East Channel Bassett Creek. Limited right-of-way and flat grades restrict the options for BMPs in this area. Ditch treatment, both on the east side of the BLRT tracks and in CPD, will be maximized during final design to the extent practicable.

Table 1. Change in Impervious Cover

Receiving Water	Total Area (acres)	Existing Impervious (acres)	Existing Percent Impervious	Total Proposed Impervious(1) (acres)	Change in Impervious (acres)	Proposed Percent Impervious	Percent Impervious Increase
Bassett Creek Tunnels at 7th St (East of I-94)	6	5	83%	5	0	83%	0%
Old Bassett Creek Tunnel at TH 55 (West of I-94)	23	17	74%	20	3	87%	18%
Heritage Park South Pond	2	2	100%	2	0	100%	0%
East Channel Bassett Creek	8	4	50%	6	2	75%	50%
Bassett Creek	5	2	40%	3	1	60%	50%

(1) This reflects only the impervious surface that will be in place following construction of the proposed project, which includes the access road adjacent to the relocated BNSF track. It does not include the additional impervious area from possible expansion of operational capacity in the BNSF Railway corridor. See the Golden Valley segment below for more discussion.

Table 2. Potential BMP Strategies

Receiving Water/Location	Water Quality Volume Required (acre-feet)	BMP Options Considered	BMP Surface Area (square feet)	BMP Volume Provided (acre-feet)
Bassett Creek Tunnels at 7th St (East of I-94)	0.24	Tree Trenches	16,850	0.31
Old Bassett Creek Tunnel at TH 55 (West of I-94)	0.90	Bioretention Wet Pond Underground Detention Hydrodynamic Separator	30,500 37,120 N/A N/A	0.91 0.80 1.0(3) N/A
Heritage Park South Pond	0.09	Bioretention	4,050	0.10
East Channel Bassett Creek	0.28	Bioretention Underground Storage Hydrodynamic Separator	13,350 N/A N/A	0.27 0.17(3) N/A
East Channel Bassett Creek(1)	0.12	CPD	N/A(2)	0.05

(1) The Water Quality Volume Required calculation includes the approximate impervious area that would be added by an expansion in operational capacity by BNSF. Total area of future freight impervious in segment M is approximately 0.4 acres.
(2) The treatment BMP is incorporated into the ditches that are part of the typical section for the proposed project, and therefore, the surface area is not provided as a separate number.
(3) This BMP is designed for rate control only.

4.4.2 Segment GV – Golden Valley

In the Golden Valley segment, the BLRT Corridor is located within the easterly 50 feet of the BNSF right-of-way along the eastern edge of TWRP. To make room for the BLRT guideway, the existing BNSF tracks will be relocated to the western 50 feet of the right-of-way. An access road will be constructed on the west side of the proposed BNSF Railway from TH 55 (Olson Memorial Highway) to Theodore Wirth Parkway. Due to poor soils and wetlands, the access road has been eliminated from Theodore Wirth Parkway to the northern end of the segment. The preliminary stormwater management strategy has been to include mitigation for the access road, which is generally where potential expansion of the BNSF Railway would occur, to the extent practicable.

The BLRT Extension project corridor in this section is a ballasted section with retained embankment and retaining walls used as needed. Either ditches or walls are expected to be used throughout the segment for corridor protection. For the most part, the profile of the BNSF track is lower than the BLRT. The corridor does not have any at-grade crossings, but does pass under bridges at Plymouth Avenue, Theodore Wirth Parkway, and Golden Valley Road.

Limited right-of-way, the potential for expansion of BNSF operational capacity, and the effort to minimize park impacts has reduced the possibilities of placing BMPs, including ditch treatment, on the west side of the corridor. Infiltration will not be considered in the Golden Valley segment because of the prevalence of HSG C and D soils, high groundwater levels, and the DWSMA with high vulnerability. In part because the BNSF profile is lower than the BLRT profiles, much of the BNSF track drainage will be difficult to pick up and treat. It sheet flows into TWRP in the same way as in the existing condition. In final design as much runoff from the BNSF Railway will be collected and treated as is practicable.

Several stormwater BMPs are being considered for this portion of the project in order to meet regulatory requirements to the greatest extent possible. As much water quality treatment as possible will be achieved through biofiltration basins and in the CPDs. Ditch treatment, both on the east side of the BLRT and in the CPD, will be maximized in the final design to the extent practicable. Because of poorly drained soils, ditch treatment will be through filtration and detention via rock weepers. When other treatment options are unavailable, pretreatment via hydrodynamic separators will be used as feasible.

Figures 2 and 3 in Appendix A provide a representation of the potential locations of the stormwater BMPs. **Tables 3 and 4** below provide a summary of the changes in impervious surfaces and the sizes of potential BMPs. See the floodplain and wetland technical memoranda for additional information on other water resources impacts and mitigations of the project in this area.

4.4.2.1 Drainage to Bassett Creek, Oak Park Avenue to Plymouth Avenue (Stations 2109+25 to 2122+55)

Some water quality treatment and rate control will be achieved in the CPD from station 2109+30 to station 2114+50, which will discharge to the west into Bassett Creek.

A large biofiltration basin is currently proposed on the east side of the BLRT Corridor between Oak Park Avenue and Plymouth Avenue in the excess Canadian Pacific Railway right-of-way in this area. The biofiltration basin will treat as much corridor drainage as possible between station 2107+00 and 2135+00 as well as from residential areas to the east, and will discharge to Bassett Creek downstream of Plymouth Avenue. The basin is larger than what is required to treat the project water quality volume that can drain to it. The additional water quality volume provided will to be used to compensate for other areas within the segment where treatment is less feasible. Access for maintenance will be investigated more fully during final design, and if determined not to be feasible, this basin may be modified. The project will continue to coordinate with MPRB for any construction that affects parkland.

The alignment of the creek will be shifted to the east to accommodate the BLRT project. Effort will be made to minimize the impacts to the recent streambank restoration project.

4.4.2.2 Drainage to Bassett Creek, Plymouth Avenue to Theodore Wirth Parkway (Stations 2122+55 to 2154+00)

As described in the Existing Conditions section, the City of Golden Valley and the BCWMC are proposing to construct a stormwater BMP in the area to the west of the BNSF Railway corridor, north of Plymouth Avenue and east of Theodore Wirth Parkway. If the BMP is built, some corridor runoff would drain to it. If the city's project goes forward, it is possible that the BLRT Extension project could coordinate with the city and BCWMC to expand or deepen the BMP as needed to also provide treatment for corridor runoff. This will occur during the next phases of design.

A biofiltration basin/trench is proposed on the east side of the BLRT Corridor, north of 16th Avenue N. The biofiltration basin will treat as much corridor drainage as possible between station 2135+00 and 2147+00 as well as from residential areas to the east, and will drain to the wetland west of the corridor. Access for maintenance will be investigated more fully during final design, and if determined not to be feasible, this basin may be modified.

4.4.2.3 Drainage to Bassett Creek, Golden Valley Road Wetlands (Stations 2154+00 to 2165+50)

Drainage in this section discharges to the wetlands north of Golden Valley Road. The current BLRT Extension project design through the Golden Valley Road wetlands includes building bridges for the BLRT guideways while maintaining the existing BNSF embankment. The guideway bridges would minimize fill impacts to the wetlands. Any mitigation necessary to maintain existing water surface elevations and flow rates would be addressed in final design but could include excavation at the edges of the wetlands and lowering the normal water level of the basins to provide additional active storage.

Discharge to the Golden Valley Road wetlands from the project will be difficult to treat before it reaches the basins. Other corridor runoff would be treated as much as practicable through ditch treatment before being discharged to the ponds.

A park-and-ride between Theodore Wirth Parkway, Golden Valley Road, and the BNSF Railway corridor has been proposed but is not currently part of the project. If it is included in the final design, it is expected that water quality treatment will be provided to meet BCWMC requirements on the site via tree trenches, biofiltration, or other options that are determined to be feasible during the final design.

4.4.2.4 Drainage to Bassett Creek, Station 2166+00 to 2185+00 at 26th Avenue N

This section drains through Sochacki Park to Bassett Creek. The minimal space between the BLRT Extension project corridor and Kewanee Way limits the possibility of ditch treatment on the east side of the tracks in this area. The potential expansion of BNSF operational capacity and park land on the west side limit opportunities for ditch treatment on the west side. The CPD from station 2166+75 to station 2176+75 will provide some water quality treatment and rate attenuation to corridor runoff.

Two existing storm sewer systems from residential areas to the east discharge into the existing ditch. These will be extended and routed west, under the BLRT guideway and BNSF Railway, picking up drainage from the CPD and the west ditch. Because of elevation constraints, the pipe will outlet further west, to one of the existing channels at station 2169+00 or station 2176+00. From the pipe, the stormwater will flow through Mary Hills Nature Area before eventually reaching Bassett Creek.

Table 3. Change in Impervious Cover

Receiving Water	Total Area (acres)	Existing Impervious (acres)	Existing Percent Impervious	Total Proposed Impervious[2] (acres)	Change in Impervious (acres)	Proposed Percent Impervious	Percent Impervio Increase
Bassett Creek[1]	21	6	29%	16	10	76%	166%

(1) This includes 5.1 acres that drain to the Golden Valley Road wetlands before draining to Bassett Creek.
(2) This reflects only the impervious surface that will be in place following construction of the proposed project, which includes the access road adjacent to the relocated BNSF track. It does not include the additional impervious area from possible expansion of operational capacity in the BNSF Railway corridor.

Table 4. Potential BMP Strategies

Receiving Water/Location	Water Quality Volume Required[1] (acre-feet)	BMP Options Considered	BMP Surface Area (square feet)	BMP Volume Provided (acre-feet)
Bassett Creek/ South of Golden Valley Road	0.61	CPD Biofiltration Basin (Sta 2112 to Sta 2122) Biofiltration Basin (Sta 2136 to 2139)	2,100 18,000 3,600	0.02 1.10 0.29
Golden Valley Roads Wetlands	0.22	Additional treatment volume will be provided in other portions of the segment		
Bassett Creek/ North of Manor Drive[3]	0.25	CPD	N/A[2]	0.05

(1) The Water Quality Volume Required calculation includes the approximate impervious area that would be added by an expansion in operational capacity by BNSF. Total area of future freight impervious in segment GV is approximately 2 acres.
(2) The treatment BMP is incorporated into the ditches that are part of the typical section for the proposed project, and therefore, the surface area is not provided as a separate number.
(3) Some of this area drains to the Robbinsdale segment.

4.4.3 Segment R – Robbinsdale

In the Robbinsdale segment, the BLRT Corridor is located within the easterly 50 feet of the BNSF right-of-way. To make room for the BLRT guideway, the existing BNSF tracks will be relocated to the western 50 feet of the right-of-way. An access road will be constructed on the west side of the proposed BNSF Railway from the north end of Grimes and North Rice Ponds to the northerly end of the segment. (Due to poor soils and wetlands, the access road has been eliminated from the southerly end of the segment through Grimes and North Rice Ponds.) The preliminary stormwater management strategy has been to include mitigation for the access road, which is generally where potential expansion of the BNSF Railway would occur, to the extent practicable.

The primary method of achieving water quality treatment in Robbinsdale is through treatment ditches, either by infiltrating where soils are suitable (HSG A and B) or via filtration through rock check dams. All ditches within the jurisdictional boundary of the BCWMC will function as filtration ditches with ditch blocks due to the presence of HSG C soils. It has been assumed that these ditches will be covered with ballast rock but will have uncompacted native soils beneath the ballast rock. Overall drainage patterns will be maintained as much as is feasible and corridor water will be treated to the extent practicable. Ditch volumes have been checked to ensure that they can accommodate both the BLRT Extension project site runoff and the BNSF access road, which is generally where potential expansion of the BNSF Railway would occur. Although there are currently ditch sections proposed along the western edge of the corridor, these ditches were not included in water quality computations because parts of them would be eliminated if there is a future expansion in BNSF operational capacity. In final design, freight and access road runoff will be collected and treated with runoff from the BLRT Corridor where feasible. The alignment may also shift east, impacting the amount of treatment volume available, so ponding offsite is also being considered, although not preferred.

Figures 4 through 6 in Appendix A provide a representation of the potential locations of the stormwater BMPs in the Robbinsdale segment. **Tables 5 and 6** below provide a summary of the changes in impervious surfaces and the sizes of potential BMPs. See the floodplain and wetland technical memoranda for additional information on other water resources impacts and proposed mitigation in this area.

4.4.3.1 Drainage to South Rice Pond, Existing Stormwater Pond in Sochaki Park (Stations 2185+00 to 2196+80)

There will be an eastern ditch from station 2184+00 to 2190+00 that will treat water before discharging to the existing stormwater pond in Sochacki Park that was recently constructed by the City of Robbinsdale. This ditch has enough capacity to treat water from the portion of the corridor within Robbinsdale south of Grimes and North Rice Ponds. Runoff from the Golden Valley segment also drains to this area and may require the existing pond be expanded or deepened if it does not have enough capacity to accommodate the project runoff. The expanded pond will also likely be needed for rate control as City of Golden Valley staff has expressed concern about increasing discharge rates to Bassett Creek due to the proximity of several homes to the creek's flood elevation.

4.4.3.2 Drainage to Grimes and North Rice Ponds (Stations 2196+80 to 2252+35)

In the BCWMC portion of Robbinsdale, the BLRT guideway will run along the eastern side of the corridor. The current design puts the BLRT on bridges over the ponds while the BNSF freight track will remain on its existing embankment. The fill at the BLRT bridge abutments will be compensated for by excavation at the edges of Grimes and North Rice Ponds in order to maintain the existing 100-year HWL and peak discharge rates of the ponds. The relocated BNSF track will run along the western side with an access road starting at the north end of Grimes and North Rice Ponds and extending to the northern end of the watershed.

Stormwater runoff from the project will be treated in CPDs where they have been incorporated into the corridor and in eastern ditches from station 2219+00 to 2230+00 and station 2210+00 to 2211+00. The outflow from these BMPs drains to Grimes and North Rice Ponds. Infiltration will occur in eastern ditches from station 2240+00

to station 2245+00. This is the area adjacent to Lee Park that currently infiltrates and drains over the watershed divide. This infiltration ditch would continue to discharge to the south through the eastern ditches and eventually to Grimes Pond in large events.

4.4.3.3 Drainage to Crystal Lake (Stations 2251+00 to 2298+00)

There will be infiltration in ditches from approximately station 2253+00 to station 2290+00 and underground detention at the proposed park-and-ride and station at 42nd Avenue N. The overflow would drain to existing storm sewer running down Hubbard Ave N, eventually discharging to Crystal Lake. Runoff would be routed through a pretreatment BMP, such as a hydrodynamic separator, before entering the underground detention system.

4.4.3.4 Drainage to Middle Twin Lake (Station 2298+00 to 2329+00)

A portion of the Crystal segment flows into the Robbinsdale segment to a low point near 45-1/2 Avenue N. Infiltration will occur in the CPD between approximately station 2313+00 to station 2325+00 and the east side ditch from station 2308+00 to station 2312+00 before discharging to Graeser Pond, an existing wet detention pond in MnDOT right-of-way that may need to be enlarged to accommodate the additional runoff from the project corridor. As design progresses, the intent will be to treat project runoff within the treatment ditches to the greatest extent practicable and thereby limit any changes needed to Graeser Pond. Outflow from Graeser Pond is routed to another existing pond east of CSAH 81 before the stormwater discharges to Middle Twin Lake.

Table 5. Change in Impervious Cover

Receiving Water	Total Area (acres)	Existing Impervious (acres)	Existing Percent Impervious	Total Proposed Impervious(1) (acres)	Change in Impervious (acres)	Proposed Percent Impervious	Percent Impervious Increase
Bassett Creek	5	2	40%	3	1	60%	50%
Grimes and Rice Ponds	7	2	29%	6	4	86%	200%
Crystal Lake	18	11	61%	15	4	83%	36%
Middle Twin Lake	6	3	50%	4	1	67%	33%

(1) This reflects only the impervious surface that will be in place following construction of the proposed project, which includes the access road adjacent to the relocated BNSF track. It does not include the additional impervious area from possible expansion of operational capacity in the BNSF Railway corridor.

Table 6. Potential BMP Strategies

Receiving Water/Location	Water Quality Volume Required(1) (acre-feet)	BMP Options Considered	BMP Surface Area (square feet)	BMP Volume Provided (acre-feet)
Bassett Creek	0.22	Treatment Ditch	1,660	0.22
Grimes and Rice Ponds	0.38	Treatment Ditch	3,620	0.48
		CPD	N/A(2)	0.31
Crystal Lake	0.76	Treatment Ditch	12,320	1.32
		Underground Detention	5,530	0.41
Middle Twin Lake	0.15	CPD	N/A(2)	0.48
		Treatment Ditch	1,210	0.13

(1) The Water Quality Volume Required calculation includes the approximate impervious area that would be added by an expansion in operational capacity by BNSF. Total area of impervious associated with the future BNSF track in segment R is approximately 3 acres.

(2) The treatment BMP is incorporated into the ditches that are part of the typical section for the proposed project, and therefore, the surface area is not provided as a separate number.

4.4.4 Segment C – Crystal

In the Crystal segment, the BLRT Corridor is located within the easterly 50 feet of the BNSF right-of-way as it runs along CSAH 8 (West Broadway Avenue) in the south portion of the segment and transitions to along CSAH 81 (Bottineau Boulevard) in the north portion. To make room for the BLRT guideway, the existing BNSF tracks will be relocated to the western 50 feet of the right-of-way. An access road will be constructed on the west side of the proposed BNSF track. The preliminary stormwater management strategy has been to include mitigation for the access road, which is generally where potential expansion of the BNSF Railway would occur, to the extent practicable.

There are at-grade crossings at CSAH 8 (West Broadway Avenue), Corvallis Avenue, and CSAH 10 (Bass Lake Road). Where the BNSF track crosses the Canadian Pacific Railway north of Corvallis Avenue, a bridge will be constructed for the BLRT while the freight track will cross at-grade. One station and park-and-ride surface lot is proposed for this segment at CSAH 10 (Bass Lake Road).

Tables 7 and 8 provide a summary of the anticipated increases in impervious area from this project and the sizes of potential BMPs. **Figures 6 and 7** in Appendix A show the potential locations of BMPs. The floodplain and wetland technical memoranda contain more information about the impacts to those resources.

4.4.4.1 Drainage to Twin Lakes, BNSF Railway Corridor South of CSAH 10 (Bass Lake Road) (Station 2520+80 to 2380+90)

Along the stretch of the BNSF Railway corridor south of CSAH 10 (Bass Lake Road), the freight railroad and the BLRT run between CSAH 8 (West Broadway Avenue) and CSAH 81 (Bottineau Boulevard). This section of track has ditches on either side of the proposed ballasted sections and a wall or retained embankment between the BNSF track and the BLRT for corridor protection. This section can be split into two drainage boundaries at proposed high points as explained below.

The first drainage area extends from just north of the end of the segment to just north of Corvallis Avenue. The remainder of the segment to the south will go to a BMP located in the Robbinsdale segment. A bioretention basin is proposed to provide volume control and water quality treatment through infiltration and plant uptake and will likely be located on the parcel of land currently occupied by Steve O's Bar and Grill, which will likely be acquired by the project. Pretreatment will be used before the BLRT track drains discharge to the bioretention practice. An overflow structure will direct overflow into existing storm sewer along CSAH 8 (West Broadway Avenue) which discharges to Middle Twin Lake.

The second drainage area extends just north of Corvallis Avenue to CSAH 10 (Bass Lake Road). This area contains the BLRT bridge over the Canadian Pacific Railway. Options for stormwater BMPs in this portion of the segment are limited due to lack of open space and right-of-way constraints. The track drains in this segment will discharge to another bioretention basin or to an underground detention BMP. The bioretention basin will likely be located in open space to the west of station 2366+00 or a currently vacant lot west of station 2359+00. If these are determined to not be feasible during final design, BMPs located elsewhere in the corridor that take offsite stormwater would be oversized to provide the necessary treatment volume. A hydrodynamic separator or other pretreatment method will be used prior to discharge into the basin or underground detention. An overflow structure will direct overflow into existing storm sewer near the BMP which discharges to Upper Twin Lake.

4.4.4.2 Drainage to Twin Lakes, Bass Lake Road Park-and-Ride (Station 2371+25 and 2379+30)

There is a surface parking lot proposed on the site between the BNSF Railway corridor and CSAH 81 (Bottineau Boulevard) south of CSAH 10 (Bass Lake Road). Due to the high likelihood of existing contamination on the site, infiltration practices are not allowed. To provide water quality treatment, an underground filtration BMP or other

underground practice will be used as there is a lack of available space for surface treatment. There are two potential outlets for the site: the trunk storm sewer in CSAH 10 (Bass Lake Road), which drains to Upper Twin Lake, and the storm sewer system in CSAH 81 (Bottineau Boulevard), which drains south through Wilshire Pond and Xenia Pond before discharging to Upper Twin Lake. The design of the storage for the underground BMP and the outlet will need to balance the capacity concerns of the trunk storm sewer in CSAH 10 (Bass Lake Road) and maintaining drainage flow patterns if the CSAH 81 (Bottineau Boulevard) ponds do not have capacity to take the site runoff.

4.4.4.3 Drainage to Crystal Airport Infiltration Area (Station 2380+90 to 2418+75)

North of CSAH 10 (Bass Lake Road) the BLRT Corridor follows the BNSF Railway corridor along the west side of CSAH 81 (Bottineau Boulevard). The existing ditch between CSAH 81 (Bottineau Boulevard) and the BNSF Railway corridor will be filled as part of the BLRT project. Further investigation will be needed during final design to ensure that adequate conveyance systems are provided for systems that drained into the ditch.

The Metropolitan Airports Commission prohibits the construction of new open water features within a specified distance of airport runways due to the potential for conflicts between waterfowl and planes taking off and landing. All stormwater BMPs within that zone will need to meet their criteria for maximum duration of ponded water.

There is a CPD proposed between the realigned BNSF track and the BLRT guideway. This CPD can serve as an infiltration trench as the in situ soils in this area appear to be sandy and have a high infiltration rate. Additional treatment is planned for the ditches on the outside of the tracks, which will also provide opportunities to infiltrate the runoff. The existing culverts under the freight track and CSAH 81 (Bottineau Boulevard) will be maintained or replaced. Careful design will be necessary to ensure there is no increase in the rate or volume discharging to the infiltration area at the Crystal Airport. Some of the overflow from both the inside and outside ditches may need to be routed to another BMP.

Table 7. Change in Impervious Cover

Receiving Water	Total Area (acres)	Existing Impervious (1) (acres)	Existing Percent Impervious	Total Proposed Impervious (acres)	Change in Impervious (acres)	Proposed Percent Impervious	Percent Impervious Increase
Twin Lakes	19	6	32%	14	8	74%	133%
Crystal Airport infiltration area	10	2	20%	7	5	70%	250%(2)

(1) This reflects only the impervious surface that will be in place following construction of the proposed project, which includes the access road adjacent to the relocated BNSF track. It does not include the additional impervious area from possible expansion of operational capacity in the BNSF Railway corridor.

(2) The feasibility of infiltration in the treatment ditches will need to be verified during final design to ensure there is no increase in discharges to the Crystal Airport.

Table 8. Potential BMP Strategies

Receiving Water/Location	Water Quality Volume Required (1) (acre-feet)	BMP Options Considered	BMP Surface Area (square feet)	BMP Volume Provided (acre-feet)
Twin Lakes/Steve O's Bar and Grill	0.32(3)	Bioretention	8,520	0.30
Twin Lakes/Sta 2366+00 LT or Sta 2359+00 LT	0.43	Bioretention	15,730	0.54
Twin Creek/Bass Lake Rd Park-and-Ride	0.33	Underground Detention (Filtration)	13,125	0.36
Shingle Creek/North of Bass Lake Road	0.60(4)	Treatment Ditch	N/A(2)	0.88

(1) The Water Quality Volume Required calculation includes the approximate impervious area that would be added by an expansion in operational capacity by BNSF. Total area of future freight impervious in segment C is approximately 1.6 acres.

(2) The treatment BMP is incorporated into the ditches that are part of the typical section for the proposed project, and therefore, the surface area is not provided as a separate number.

(3) Some of this area drains to the Robbinsdale segment.

(4) Some of this area drains to segment BP2.

4.4.5 Segment BP2 – Brooklyn Park 2

In the BP2 segment, the BLRT Corridor is located in the easterly 50 feet of the BNSF right-of-way along CSAH 81 (Bottineau Boulevard) south of 73rd Avenue N. To make room for the BLRT guideway, the existing BNSF tracks will be relocated to the westerly 50 feet of the right-of-way. An access road will be constructed on the west side of the proposed BNSF track. The preliminary stormwater management strategy has been to include mitigation for the access road, which is generally where potential expansion of the BNSF Railway would occur, to the extent practicable.

At 73rd Avenue N, the BLRT Extension will cross CSAH 81 (Bottineau Boulevard) on a bridge structure and then transition to the center median of CSAH 103 (West Broadway Avenue). CSAH 103 (West Broadway Avenue) will be reconstructed to accommodate the BLRT and will include the addition of turn lanes, trails, and sidewalk.

Tables 9 and 10 below provide a summary of the anticipated increases in impervious area from this project and the sizes of potential BMPs. **Figures 7 through 9** in Appendix A show the potential locations of BMPs. The floodplain and wetland technical memoranda contain more information about the impacts to those resources.

4.4.5.1 Drainage to Twin Creek, 62nd Avenue Wetland (Stations 2418+75 to 2436+30)

To accommodate the repositioned BNSF Railway and access road, there will be fill placed along the east edge of the 62nd Avenue wetland. As noted above, the basin has a high 100-year high water level elevation associated with it that is based on city modeling. The existing storage volume needed to attenuate larger rain events and maintain the 100-year HWL will be partially filled by the project. Although the wetland is not a regulated floodplain, mitigation for both the wetland and storage impacts is proposed along the northwest edge and the southeast corner As currently conceived, neither the fill nor the grading will affect the above-mentioned buffer section in the center. The outlet for the wetland may need to be reconstructed depending on the final grading limits. No changes to drainage into or out of this basin are anticipated with this project at this time.

The existing ditch between CSAH 81 (Bottineau Boulevard) and the BNSF Railway corridor will be filled as part of the BLRT project. Further investigation will be needed during final design to ensure that adequate conveyance systems are provided for systems that drained into the ditch.

There has been discussion about reconstructing the surface parking lot at the existing park-and-ride at 63rd Avenue to the west of the project corridor. At the time of this memorandum, the proposed BLRT Extension project does not include this work. If the park-and-ride is reconstructed in the future, a stormwater management plan will be developed that will include any changes to the existing stormwater BMPs and any new BMPs that are needed to meet the effective regulatory environment at that time.

4.4.5.2 Drainage to Twin Creek, CSAH 81 (Bottineau Boulevard) (Stations 2436+30 to 2468+00)

The proposed BLRT will run along the BNSF Railway corridor adjacent to CSAH 81 (Bottineau Boulevard) until the crossing at 73rd Avenue N. The addition of the two BLRT tracks and an access road create an increase in the impervious area of approximately 12.6 acres along this portion of the corridor. The existing ditch between the railroad corridor and CSAH 81 (Bottineau Boulevard) south of 63rd Avenue N will be filled in to accommodate the BLRT Corridor.

The proposed CPDs between the BNSF track and BLRT, which run along most of CSAH 81 (Bottineau Boulevard), will likely be used as infiltration trenches. Because of the sandy soils present in this area, the infiltration rate of the in situ soil is high. Infiltration will be encouraged due to the flat longitudinal grade of the ditches and through the use of check dams or by setting culvert elevations above the bottom of the ditches. The storage in the ditches and

the rock will also provide rate attenuation. Additional water quality volume could be similarly treated and infiltrated in ditches to the outside of the tracks as well.

In the 63rd Avenue station area where there is no ditch, runoff will be routed to the ditches to the north and south via track drains. Overflow structures will be used to make sure stormwater does not overtop the tracks and will direct the overflow into existing storm sewer.

Hennepin County is proposing to reconstruct CSAH 81 (Bottineau Boulevard) from Dutton Avenue to 71st Avenue. It may be possible that the Hennepin County project could provide stormwater BMPs that would include runoff from the BLRT Extension project north of Dutton Avenue if the CPDs are not able to. Further coordination with Hennepin County during final design will determine whether this is feasible.

4.4.5.3 Drainage to Shingle Creek, Stations 2468+00 to 2540+50 at CSAH 152 (Brooklyn Boulevard)

To accommodate the BLRT track's transition from the BNSF Railway corridor along CSAH 81 (Bottineau Boulevard) to the center median of the CSAH 103 (West Broadway Avenue) corridor, property will be acquired by the project. The intersection of Jolly Lane and CSAH 103 (West Broadway Avenue) will be removed with Jolly Lane ending in a cul-de-sac just north of the proposed BLRT Corridor. BMPs being considered include a bioretention basin in the remnants of the parcel(s) being acquired, an underground storage/infiltration practice, and a hydrodynamic separator or similar pretreatment. The BMP(s) will drain to the proposed trunk along CSAH 103 (West Broadway Avenue), which will connect to the trunk line on CSAH 152 (Brooklyn Boulevard) and ultimately discharges to Shingle Creek.

After crossing from the BNSF corridor, the BLRT will run down the center median of CSAH 103 (West Broadway Avenue). CSAH 103 (West Broadway Avenue) will be reconstructed to make room for the BLRT and will also include the construction of trails and grass boulevards on either side of the road. A station will be constructed just south of the intersection with CSAH 152 (Brooklyn Boulevard). In order to minimize the number of crossings under the BLRT guideways needed for a single trunk line, two trunk storm sewer lines are proposed, one for each outside gutter, to collect roadway drainage. These will then connect into the trunk along CSAH 152 (Brooklyn Boulevard) as in the existing condition. This system ultimately drains to Shingle Creek.

There is very limited right-of-way available in this area for stormwater BMPs other than in the boulevards. Due to a potential redevelopment project within the Target/Cub Foods complex, it will not be possible to expand the existing ponds within the parking lot. Therefore, tree trenches in the boulevards between 75th Avenue N and CSAH 152 (Brooklyn Boulevard) are the primary BMP being investigated. Underdrains will connect to the CSAH 103 (West Broadway Avenue) trunk, which will connect to the CSAH 152 (Brooklyn Boulevard) system that ultimately discharges to Shingle Creek.. If the tree trenches are not possible, additional treatment capacity will need to be added to other proposed BMPs to compensate for the area.

4.4.5.4 Drainage to Shingle Creek, North of CSAH 152 (Brooklyn Boulevard) (Stations 2540+50 to 2552+65)

North of Brooklyn Boulevard, the BLRT continues down the center of CSAH 103 (West Broadway Avenue). Similar to above, two trunk lines on either side of CSAH 103 (West Broadway Avenue) are proposed which will connect with a system to be constructed by Hennepin County to carry stormwater down CSAH 103 (West Broadway Avenue) to a wet detention pond, also constructed by Hennepin County, just south of Shingle Creek and will drain into Shingle Creek. The pond will provide rate control with an outlet control structure as well as water quality treatment through sedimentation. The residential area around the 78th Court N cul-de-sac will continue to discharge to the trunk line as in the existing condition. The portion of existing storm sewer from where the existing trunk turns east north of 78th Avenue N will be separated from the CSAH 103 (West Broadway Avenue) roadway drainage.

Table 9. Change in Impervious Cover

Receiving Water	Total Area (acres)	Existing Impervious (acres)	Existing Percent Impervious	Total Proposed Impervious[1] (acres)	Change in Impervious (acres)	Proposed Percent Impervious	Percent Impervious Increase
Twin Creek	12	3	25%	8	5	67%	167%
Single Creek	33	17	52%	25	8	76%	47%

(1) This reflects only the impervious surface that will be in place following construction of the proposed project, which includes the access road adjacent to the relocated BNSF track. It does not include the additional impervious area from possible expansion of operational capacity in the BNSF Railway corridor.

Table 10. Potential BMP Strategies

Receiving Water/Location	Water Quality Volume Required[1] (acre-feet)	BMP Options Considered	BMP Surface Area (square feet)	BMP Volume Provided (acre-feet)
Twin Creek/South of I-94	0.56	Treatment Ditch	N/A[2]	0.61
Shingle Creek/North of I-94	0.38	Treatment Ditch	N/A[2]	0.59
Shingle Creek/Crossover Section	0.26	Bioretention	1,800	0.05
Shingle Creek/West Broadway Ave: 75th Ave N to Brooklyn Blvd	0.50	Tree Trenches	Maximize available boulevard space	0.76
Shingle Creek/North of Brooklyn Blvd	0.56	See **Table 12**	See **Table 12**	See **Table 12**

(1) The Water Quality Volume Required calculation includes the approximate impervious area that would be added by an expansion in operational capacity by BNSF. Total area of future freight impervious in segment BP2 is approximately 1.4 acres

(2) The treatment BMP is incorporated into the ditches that are part of the typical section for the proposed project, and therefore, the surface area is not provided as a separate number

4.4.6 Segment BP1 – Brooklyn Park 1

In the BP1 segment, the BLRT Corridor alignment follows the center median of CSAH 103 (West Broadway Avenue), which will be incorporated into Hennepin County's reconstruction of CSAH 103 (West Broadway Avenue) from just south of Candlewood Drive to approximate northbound station 2651+15. North of this, the BLRT guideway alignment will shift west of CSAH 103 (West Broadway Avenue) and run northerly parallel to CSAH 103 (West Broadway Avenue) across a new TH 610 bridge. The BLRT alignment will continue north of the bridge for approximately 2,250 feet, where it will turn 90 degrees and head west for another 2,250 feet to the new OMF.

This segment includes construction of the BLRT guideway, reconstruction of CSAH 103 (West Broadway Avenue) north of the Hennepin County project, reconstruction of Oak Grove Parkway and 101st Avenue N, construction of new roads as necessary to serve project facilities, and construction of park-and-ride and OMF facilities. The guideway will be ballasted throughout this section except through at-grade intersections, and track drains will route runoff to the same BMPs as described by drainage segment in the CSAH 103 (West Broadway Avenue) EAW. The CSAH 103 (West Broadway Avenue) project has committed to constructing BMPs that will provide stormwater treatment for the portion of the BLRT footprint located within the CSAH 103 (West Broadway Avenue) project limits, as is summarized in the following paragraphs.

Tables 11 and 12 below provide a summary of the anticipated increases in impervious area from this project and the sizes of potential BMPs. **Figures 9 through 12** in Appendix A show the potential locations of BMPs. The floodplain and wetland technical memoranda contain more information about the impacts to those resources.

4.4.6.1 Drainage to Shingle Creek, Shingle Creek Crossing to Maplebrook Parkway N (Station 2552+65 to 2604+20)

This portion of the segment consists solely of the BLRT guideway, which will be in the center median of CSAH 103 (West Broadway Avenue). Hennepin County is currently working on the design of the reconstruction of CSAH 103 (West Broadway Avenue) as noted above. As part of Hennepin County's project, stormwater BMPs are planned that will accommodate runoff from the BLRT project. Although not part of the BLRT project, the BMPs that are currently being proposed by the County are summarized here.

Underground BMPs (either for detention or infiltration/filtration) are proposed at College Park Drive and/or North Hennepin Community College (NHCC) to treat stormwater draining from just north of 85th Avenue N to College Park Drive before ultimately discharging to Shingle Creek. Runoff from the area between College Park and Shingle Creek will be treated in a sedimentation basin on the west side of CSAH 103 (West Broadway Avenue) and with a hydrodynamic separator on the east side of CSAH 103 (West Broadway Avenue) before ultimately discharging to Shingle Creek. For more detail on this design, see the *West Broadway (CSAH 103) Reconstruction Final Stormwater Technical Memorandum*.

CSAH 103 (West Broadway Avenue) will be widened at the Shingle Creek crossing to accommodate the BLRT and trail crossings. The proposed changes will result in floodplain fill. Refer to *West Broadway (CSAH 103) Reconstruction Final Floodplain Technical Memorandum* for additional details on proposed impacts and mitigation options under consideration.

4.4.6.2 Drainage to Century Channel, Setzler Pond and the DNR Wetlands (#559W) (Station 2604+20 to 2644+15)

As noted above, this portion of the project falls within the area of CSAH 103 (West Broadway Avenue) that will be reconstructed by Hennepin County. The BMPs proposed with that project are summarized here. Setzler Pond will

continue to receive corridor drainage and offsite drainage. Because of the added impervious area that will be directed to this pond, additional volume will be created and a new outlet control structure will be added in order to provide water quality and rate control before discharging to Century Channel. A flow splitter and hydrodynamic separator are proposed upstream of DNR Wetland #559W to maintain hydrology to this wetland and send additional runoff generated by new impervious directly to Setzler Pond for treatment. There is also the possibility of expanding sediment forebays already present at this wetland, such that a flow splitter may not be needed. Setzler Pond will continue to receive corridor drainage and offsite drainage. Because of the added impervious area that will be directed to this pond, additional volume will be created and a new outlet control structure will be added in order to provide water quality and rate control before discharging to Century Channel.

The expansion of CSAH 103 (West Broadway Avenue) will result in floodplain fill impacts to Setzler Pond and DNR #559W. Refer to *West Broadway (CSAH 103) Reconstruction Final Floodplain Technical Memorandum* for additional details on proposed impacts and mitigation options under consideration.

4.4.6.3 Drainage to Century Channel, TH 610 Ponding System (Station 2644+15 to 2684+00)

The southernmost part of this area falls within the Hennepin County CSAH 103 (West Broadway Avenue) project limits, between CSAH 30 (93rd Avenue N) and northbound station 2651+15. North of that, the BLRT Extension project will reconstruct CSAH 103 (West Broadway Avenue) in addition to construction of the BLRT guideway. The existing culvert just north of CSAH 30 (93rd Avenue N), which drains a small portion of CSAH 103 (West Broadway Avenue) runoff to a basin at the TH 610 Commerce Center, will be lengthened and the flow to the basin will be maintained. The remainder of West Broadway/BLRT guideway drainage will be re-routed to a new wet pond on the property southwest of the TH 610 and CSAH 103 (West Broadway Avenue) intersection, in what is known as the Baxter Property. An existing wet pond at the southeast corner of this property will be partially filled in to accommodate the shift of the BLRT alignment west of CSAH 103 (West Broadway Avenue) in this location. This pond will be relocated to the west of its existing location and the existing trunk storm sewer currently routing runoff from this segment to the TH 610 ponds will be removed and a new trunk storm sewer will be installed to convey CSAH 103 (West Broadway Avenue) runoff to the new pond. The pond will be increased in size to accommodate all existing tributary areas and the new impervious surface created by the BLRT project. The pond overflow will likely be directed north to discharge into the existing stormwater treatment basin located inside of the infield area in the south loop of the TH 610 interchange, which discharges to Century Channel.

CSAH 103 (West Broadway Avenue) will be realigned north of the intersection with Oak Grove Parkway. This intersection will shift north approximately 800 feet, and north of the intersection, CSAH 103 (West Broadway Avenue) will shift west to tie into Winnetka Avenue approximately 1,000 feet north of 101st Avenue N. The proposed CSAH 103 (West Broadway Avenue) section will widen 650 feet north of TH 610 to accommodate a series of bioretention basins to be located within the 100-foot wide median between the northbound and southbound CSAH 103 (West Broadway Avenue) lanes. The widened section will end just past the new intersection of Oak Grove Parkway and CSAH 103 (West Broadway Avenue). The BLRT alignment will turn west at the new Oak Grove Parkway and CSAH 103 (West Broadway Avenue) intersection and will follow along the north side of the proposed Oak Grove Parkway extension that will tie into 101st Avenue N just past the proposed OMF location. See **Figure 11 and 12** in Appendix A for illustrations of the concept plan for this area.

Construction of Oak Grove Parkway will occur in multiple phases. At the opening of the METRO Blue Line Light Rail Extension, Oak Grove Parkway west of CSAH 103 (West Broadway Avenue) will be an undivided two-lane roadway. Similarly, CSAH 103 (West Broadway Avenue) transitions to an undivided two-lane roadway north of the Oak Grove Parkway. Future plans could include adding a second set of lanes for a four-lane divided parkway.

The proposed bioretention basins will provide storage and treatment for parts of the reconstructed portions of Oak Grove Parkway, CSAH 103 (West Broadway Avenue), Main Street, as well as the Oak Grove Park-and-Ride and Station. Pretreatment such as hydrodynamic separators will be provided prior to stormwater discharge to the bioretention basins. It appears that these basins would overflow to the TH 610 system unless coordination with adjacent landowners allows for conveyance of this drainage to the drainageway system consistent with the City of Brooklyn Park CSMP and Shingle Creek Third Generation Plan.

A potential regional treatment pond has been discussed on the property northwest of the intersection of TH 610 and CSAH 103 (West Broadway Avenue). This regional pond could provide storage and treatment for some of the surrounding area, and could be discharged into the TH 610/MnDOT drainage system. Another regional treatment pond has been discussed for a location near the intersection of CSAH 103 (West Broadway Avenue) and Oak Grove Parkway. Given that the drainage for the larger subwatershed flows in the general direction of the latter pond, it is likely that it could provide treatment for much of the rest of the surrounding area. Further coordination will be required between the City of Brooklyn Park, MnDOT, the WMWMC and other stakeholders during final design.

4.4.6.4 Target North Campus Drainage

The proposed CSAH 103 (West Broadway Avenue) section will have a wider footprint than the existing section, which will require filling in the existing stormwater pond located southeast of the intersection of Oak Grove Parkway and CSAH 103 (West Broadway Avenue). The existing ditch system and associated infrastructure along CSAH 103 (West Broadway Avenue) that currently conveys runoff from the pond, which appears to include Target North Campus drainage, will be maintained and/or replaced as needed, unless a potential regional treatment pond northwest of the Target North Campus is implemented. This pond could provide storage and treatment of much of the surrounding area before discharging northeast to the existing drainageway, consistent with the flow pattern shown in the 2013 Shingle Creek Third Generation Plan.

4.4.6.5 Drainage to Mississippi River, North of TH 610 (Station 2684+00 to OMF)

Treatment of runoff from the proposed OMF is currently proposed to occur in two new BMPs located in the southern portions of the property and just south of the property. The BMPs would provide treatment of runoff from the ballast and pavement runoff north of the building, runoff from the roof, ballast south of the building, parking lot, and the adjacent roadways. These ponds would drain to the adjacent roadway trunk storm sewer systems, which will flow to the series of wetlands and open channels that eventually discharge to the Mississippi River.

In **Table 12** below, the 'BMP Volume Provided' includes only project runoff, but could be revised to accommodate future development runoff and expansion of Oak Grove Parkway. Further coordination to determine feasibility will be required with the City of Brooklyn Park, the WMWMC, Hennepin County and other stakeholders during final design.

Table 11. Change in Impervious Cover

Receiving Water	Total Area[1] (acres)	Existing Impervious (acres)	Existing Percent Impervious	Total Proposed Impervious (acres)	Change in Impervious (acres)	Proposed Percent Impervious	Percent Impervious Increase
Shingle Creek	4[2]	4[2]	100%	4[2]	0	100%	0%
Century Channel	3[2]	3[2]	100%	3[2]	0	100%	0%
TH 610	21	10	48%	15	6	71%	60%
Oxbow Creek	42	4	10%	33	29	79%	725%

(1) Total area within LOD, does not include "Future Construction"
(2) Only accounts for impervious areas due to the Blue Line Light Rail Transit Extension project, see the EAW for the Hennepin County CSAH 103 project for changes due to that project.

Table 12. Potential BMP Strategies

Receiving Water/Location	Water Quality Volume Required (acre-feet)	BMP Options Considered	BMP Surface Area	BMP Volume Provided (acre-feet)
Shingle Creek	(1)	(1)	(1)	(1)
Century Channel	(1)	(1)	(1)	(1)
TH 610/West Broadway Sta 2676+00 to Sta 2685+00	1.13	Bioretention	38,335	1.31
Oxbow Creek/West Broadway north of Sta 2685+00	1.48	Bioretention	49,660	1.72
TH 610/Baxter Property, SW of TH 610	2.68	Wet Pond	32,121	2.68
Oxbow Creek/Reconstructed Oak Grove Parkway west of Sta 2702+00	1.16	Wet Pond	16,012	1.16
Oxbow Creek/Southern OMF Property	1.11	Wet Pond	15,444	1.11
Oxbow Creek/Northern OMF Property	0.33	Wet Pond	6,167	0.33

(1) Stormwater runoff from the project corridor will drain to the BMPs being constructed by the Hennepin County CSAH 103 project. See the EAW for that project for more information.

5.0 Conclusion

Construction of the proposed BLRT Extension project will affect water resources in a variety of ways. The increased impervious surfaces and the decrease in ditch capacity will have the effect of increasing runoff quantity and pollutant loading without mitigation. The preliminary stormwater management plan proposes several mitigation measures, including the use of existing regional facilities, expansion of existing facilities, and construction of new BMPs at key locations throughout the corridor near storm sewer outfalls.

Further coordination with the cities is needed regarding DWSMA and wellhead protection requirements, groundwater elevations, and soil types in order to finalize the selected BMP strategies. Additional soil borings and piezometers may be needed to better understand the feasibility of implementing BMPs as shown. Further coordination is also needed regarding the BMP options for the portions of the corridor within MnDOT and Hennepin County right-of-way to clarify ownership and maintenance responsibilities of the BMPs. Although not covered in the sections above, the final plans will include temporary and permanent erosion and sediment control measures to protect water resources and stormwater infrastructure during and after construction in compliance with the NPDES permit. Finally, coordination with the cities is needed to better understand the condition and capacity of existing storm sewer systems that are to remain in place and to provide maintenance access to existing or proposed storm sewer systems.

The stormwater management plan will need to be approved by the BCWMC, SCWM WMC, the cities, and the MPCA, and therefore, to the extent practicable, adverse impacts due to the project will be mitigated.

APPENDIX A. STORMWATER FIGURES

LEGEND

- PROP LRT ℄
- DRAINAGE DIVIDES
- WATERSHED BOUNDARY
- WETLAND DELINEATION
- CITY LIMITS
- EXISTING STORM SEWER OR CULVERT
- FLOODPLAIN
- RECEIVING WATERS
- SURFACE FLOW DIRECTION
- POTENTIAL BMP LOCATION
- PROPOSED BMP LOCATION (BY OTHERS)

GENERAL NOTE:
FLOODPLAIN AND FLOODWAY BOUNDARIES SHOWN ON FIGURE ARE FROM GIS SHAPEFILES DOWNLOADED FROM MnDNR.

OLD BASSETT CREEK TUNNEL

OLD BASSETT CREEK TUNNEL

HERITAGE PARK SOUTH TREATMENT SYSTEM

NEW BASSETT CREEK TUNNEL (APPROXIMATE LOCATION)

TARGET FIELD STATION

TARGET FIELD

8TH AVE N
9TH AVE N
10TH AVE N
7TH AVE N
6TH AVE N
5TH AVE N
4TH AVE N
IRVING AVE
HUMBOLDT AVE
EMERSON AVE
VAN WHITE MEMORIAL BLVD
BRYANT AVE N
ALDRICH AVE N
WEST LYNDALE AVE
EAST LYNDALE AVE
OAK LAKE AVE
5TH ST N
7TH ST N
8TH AVE N
7TH AVE N
6TH AVE N
5TH AVE N
3RD ST N
4TH ST N
TH 55/OLSON MEMORIAL HWY
BRYANT AVE
I-94
BORDER AVE
ROYALSTON AVE N
ALDRICH AVE
DUPONT AVE N
GIRARD TER
2050+00
2045+00
2040+00
2035+00
2030+00
2025+00
2020+00
2015+00
2010+00
2005+00
2000+00

DRAFT-WORK IN PROCESS

BLUE LINE LRT EXTENSION

WATER RESOURCES PRELIMINARY OVERVIEW
FIGURE 1 OF 12

10/7/2015

NORTH
0 50 200 400
SCALE

METROPOLITAN COUNCIL

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GENERAL NOTE:
FLOODPLAIN AND FLOODWAY BOUNDARIES SHOWN ON FIGURE ARE FROM GIS SHAPEFILES DOWNLOADED FROM MnDNR.

LEGEND
- PROP LRT ℄
- DRAINAGE DIVIDES
- WATERSHED BOUNDARY
- WETLAND DELINEATION
- CITY LIMITS
- EXISTING STORM SEWER OR CULVERT
- FLOODPLAIN
- RECEIVING WATERS
- SURFACE FLOW DIRECTION
- POTENTIAL BMP LOCATION
- PROPOSED BMP LOCATION (BY OTHERS)

SEGMENT GV
SEGMENT M
THEODORE WIRTH REGIONAL PARK
BASSETT CREEK
BASSETT CREEK FLOOD CONTROL STRUCTURE
EAST CHANNEL BASSETT CREEK
WIRTH LAKE
THEODORE WIRTH REGIONAL PARK
BASSETT CREEK
EAST CHANNEL BASSETT CREEK
CITY OF GOLDEN VALLEY
CITY OF MINNEAPOLIS
BASSETT CREEK WMC
MISSISSIPPI WMO
XERXES AVE
FARWELL AVE
WASHBURN AVE
VINCENT AVE
UPTON AVE
THOMAS AVE
SHERIDAN AVE
RUSSELL AVE
QUEEN AVE
PENN AVE
OLIVER AVE
NEWTON AVE
MORGAN AVE
LOGAN AVE
THOMAS PL
JAMES AVE
KNOX AVE
HEANER TER
OAK PARK AVE
8TH AVE N
5TH AVE N
4TH AVE N
GLENWOOD AVE
TH 55
TH 55/61 SON MEMORIAL HWY
2115+00
2100+00
2090+00
2075+00
2060+00
2045+00

DRAFT-WORK IN PROCESS

BLUE LINE LRT EXTENSION

WATER RESOURCES PRELIMINARY OVERVIEW
FIGURE 2 OF 12

10/7/2015

NORTH
0 100 200 400
SCALE

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LEGEND

- PROP LRT ℄
- DRAINAGE DIVIDES
- WATERSHED BOUNDARY
- WETLAND DELINEATION
- CITY LIMITS
- EXISTING STORM SEWER OR CULVERT
- FLOODPLAIN
- RECEIVING WATERS
- SURFACE FLOW DIRECTION
- POTENTIAL BMP LOCATION
- PROPOSED BMP LOCATION (BY OTHERS)

GENERAL NOTE:
FLOODPLAIN AND FLOODWAY BOUNDARIES SHOWN ON FIGURE ARE FROM GIS SHAPEFILES DOWNLOADED FROM MnDNR.

BASSETT CREEK
SWEENEY LAKE
BRANCH

THEODORE WIRTH
REGIONAL PARK

BASSETT CREEK

BASSETT CREEK DR
MARY HILLS DR
DRESDEN LA
KEWANEE WAY
BYRD AVE N
BONNIE LANE
MARY HILLS NATURE AREA
CRESTVIEW AVE
McNAIR DR
MANOR DR
PARKVIEW BLVD
GOLDEN VALLEY RD

2180+00
2175+00
2170+00
2165+00
2160+00
2155+00
2150+00
2145+00
2140+00
2135+00
2130+00
2125+00
2120+00
2115+00

GOLDEN VALLEY
ROAD WETLANDS

GOLDEN VALLEY
PARK-AND-RIDE

THEODORE WIRTH PKWY
PLYMOUTH AVE
YORK AVE
ZEPHYR PL
XERXES AVE
WASHBURN AVE
FARMELL AVE
12TH AVE N
14TH AVE N
16TH AVE N
17TH AVE N
18TH AVE N

CITY OF GOLDEN VALLEY
CITY OF MINNEAPOLIS

THEODORE WIRTH PARKWAY

DRAFT-WORK IN PROCESS

BLUE LINE LRT EXTENSION

WATER RESOURCES PRELIMINARY OVERVIEW
FIGURE 3 OF 12

10/7/2015

NORTH
0 100 200 400
SCALE

METROPOLITAN COUNCIL

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LEGEND

- PROP LRT ℄
- DRAINAGE DIVIDES
- WATERSHED BOUNDARY
- WETLAND DELINEATION
- CITY LIMITS
- EXISTING STORM SEWER OR CULVERT
- FLOODPLAIN
- RECEIVING WATERS
- SURFACE FLOW DIRECTION
- POTENTIAL BMP LOCATION
- PROPOSED BMP LOCATION (BY OTHERS)

GENERAL NOTE:
FLOODPLAIN AND FLOODWAY BOUNDARIES SHOWN ON FIGURE ARE FROM GIS SHAPEFILES DOWNLOADED FROM MnDNR.

S. RICE POND

N. RICE POND

GRIMES POND

SOCHACKI PARK

APPROX LOCATION OF EXISTING CITY POND

SEGMENT R

SEGMENT GV

CITY OF GOLDEN VALLEY

CITY OF ROBBINSDALE

CITY OF CRYSTAL

LEE SQUARE COOPERATIVE

LEE PARK

BASSETT CREEK WMC

SHINGLE CREEK WMC

CRYSTAL LAKE

LEE AVE

KYLE AVE

ELMDALE RD

ADELL AVE

CULVER RD

34TH AVE N

NOBLE AVE

MAJOR AVE

37TH AVE

36TH AVE

JUNE AVE

INDIANA AVE

LOWRY AVE

33RD AVE N

34TH AVE

35TH AVE

HALIFAX AVE

HUBBARD AVE

31 1/2 AVE N

GRIMES AVE

FRANCE AVE

27TH AVE N

28TH AVE N

26 1/2 AVE N

EWING AVE

McNAIR DR

DREW AVE N

PARKVIEW BLVD

CR 81

2190+00

2195+00

2200+00

2205+00

2210+00

2215+00

2220+00

2225+00

2230+00

2235+00

2240+00

2245+00

2250+00

DRAFT-WORK IN PROCESS

BLUE LINE LRT EXTENSION

WATER RESOURCES PRELIMINARY OVERVIEW
FIGURE 4 OF 12

10/7/2015

NORTH
0 100 200 400
SCALE

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LEGEND

- PROP LRT ℄
- DRAINAGE DIVIDES
- WATERSHED BOUNDARY
- WETLAND DELINEATION
- CITY LIMITS
- EXISTING STORM SEWER OR CULVERT
- FLOODPLAIN
- RECEIVING WATERS
- SURFACE FLOW DIRECTION
- POTENTIAL BMP LOCATION
- PROPOSED BMP LOCATION (BY OTHERS)

GENERAL NOTE:
FLOODPLAIN AND FLOODWAY BOUNDARIES SHOWN ON FIGURE ARE FROM GIS SHAPEFILES DOWNLOADED FROM MnDNR.

GRAESER POND

LOWER TWIN LAKE

MIDDLE TWIN LAKE

TRIANGLE PARK

42ND AVE PARK-AND-RIDE

CITY OF ROBBINSDALE

CITY OF CRYSTAL

CITY OF BROOKLYN CENTER

TH 100

REGENT AVE N

QUAIL AVE N

PERRY AVE N

ORCHARD AVE N

NOBLE AVE N

MAJOR AVE N

LEE AVE

HALIFAX AVE

HUBBARD AVE

RAILROAD AVE

LAKELAND AVE N

BOTTINEAU BLVD (CSAH 81)

WEST BROADWAY AVE (CSAH 8)

42ND AVE (CSAH 9)

43RD AVE

42 1/2 AVE

41 1/2 AVE

41ST AVE

40 1/2 AVE

40TH AVE

39TH AVE

38TH AVE

39 1/2 AVE N

38 1/2 AVE N

35 1/2 AVE

SCOTT AVE N

44 1/2 AVE N

45TH AVE N

2310+00

2305+00

2300+00

2295+00

2290+00

2285+00

2280+00

2275+00

2270+00

2265+00

2260+00

2255+00

DRAFT-WORK IN PROCESS

BLUE LINE LRT EXTENSION

WATER RESOURCES PRELIMINARY OVERVIEW
FIGURE 5 OF 12

10/7/2015

NORTH

0 100 200 400
SCALE

METROPOLITAN COUNCIL

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LEGEND

- PROP LRT ℄
- DRAINAGE DIVIDES
- WATERSHED BOUNDARY
- WETLAND DELINEATION
- CITY LIMITS
- EXISTING STORM SEWER OR CULVERT
- FLOODPLAIN
- RECEIVING WATERS
- SURFACE FLOW DIRECTION
- POTENTIAL BMP LOCATION
- PROPOSED BMP LOCATION (BY OTHERS)

GENERAL NOTE:
FLOODPLAIN AND FLOODWAY BOUNDARIES SHOWN ON FIGURE ARE FROM GIS SHAPEFILES DOWNLOADED FROM MnDNR.

BASS LAKE ROAD PARK-AND-RIDE

WILSHIRE POND (EXISTING)

XENIA POND (EXISTING)

CITY OF CRYSTAL

CITY OF ROBBINSDALE

SEGMENT C

SEGMENT R

WEST BROADWAY (CSAH 8)

BOTTINEAU BLVD (CSAH 81)

LAKELAND AVE

LAKELAND AVE N

CANADIAN PACIFIC RAILROAD

HANSON CT

WILSHIRE BLVD

ZANE AVE

YATES AVE

FAIRVIEW AVE

XENIA AVE

47TH AVE

48TH AVE

WELCOME AVE

WELCOME AVE N

CORVALLIS AVE

VERA CRUZ AVE

46TH AVE

45TH AVE

44TH AVE

50TH AVE

49TH AVE

51ST AVE

LAKESIDE AVE

BYRON AVE

UNITY AVE N

TOLEDO AVE N

SCOTT AVE N

45TH AVE N

44TH AVE N

2300+00

2305+00

2310+00

2315+00

2320+00

2325+00

2330+00

2335+00

2340+00

2345+00

2350+00

2355+00

2360+00

2365+00

2370+00

DRAFT-WORK IN PROCESS

BLUE LINE LRT EXTENSION

WATER RESOURCES PRELIMINARY OVERVIEW
FIGURE 6 OF 12

10/7/2015

NORTH

0 100 200 400

SCALE

METROPOLITAN COUNCIL

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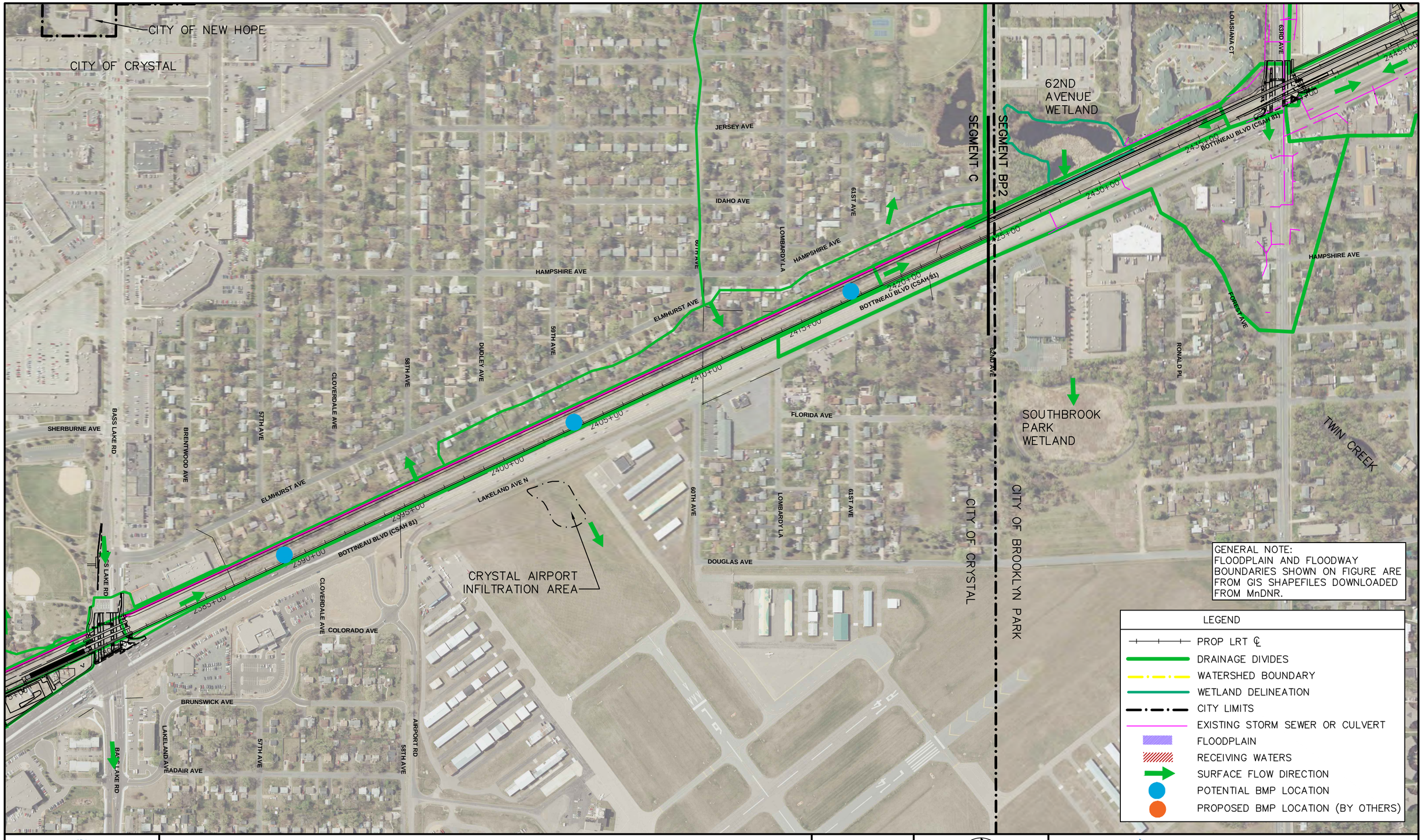

GENERAL NOTE:
FLOODPLAIN AND FLOODWAY BOUNDARIES SHOWN ON FIGURE ARE FROM GIS SHAPEFILES DOWNLOADED FROM MnDNR.

LEGEND

- PROP LRT ℄
- DRAINAGE DIVIDES
- WATERSHED BOUNDARY
- WETLAND DELINEATION
- CITY LIMITS
- EXISTING STORM SEWER OR CULVERT
- FLOODPLAIN
- RECEIVING WATERS
- SURFACE FLOW DIRECTION
- POTENTIAL BMP LOCATION
- PROPOSED BMP LOCATION (BY OTHERS)

BLUE LINE LRT EXTENSION

WATER RESOURCES PRELIMINARY OVERVIEW
FIGURE 7 OF 12

10/7/2015

NORTH
0 100 200 400
SCALE

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LEGEND

- PROP LRT ℄
- DRAINAGE DIVIDES
- WATERSHED BOUNDARY
- WETLAND DELINEATION
- CITY LIMITS
- EXISTING STORM SEWER OR CULVERT
- FLOODPLAIN
- RECEIVING WATERS
- SURFACE FLOW DIRECTION
- POTENTIAL BMP LOCATION
- PROPOSED BMP LOCATION (BY OTHERS)

GENERAL NOTE:
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DRAFT-WORK IN PROCESS

BLUE LINE LRT EXTENSION

WATER RESOURCES PRELIMINARY OVERVIEW
FIGURE 8 OF 12

10/7/2015

NORTH
0 100 200 400
SCALE

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DNR #563W

BOTTINEAU BLVD (CSAH 81)

LAKELAND AVE

JOLLY LANE

BROOKLYN BLVD

TARGET/CUB FOODS PARKING LOT

WEST BROADWAY (CSAH 103)

SEGMENT BP1

SEGMENT BP2

CSAH 103 PROJECT

HENNEPIN COUNTY

BEGIN

SUMTER AVE N

QUEBEC CT

82ND AVE

COLLEGE PARK DR

78TH CT N

78TH AVE N

79TH AVE N

OREGON AVE N

CANDLEWOOD DR

SHINGLE CREEK

KENTUCKY CIR N

KENTUCKY AVE N

LOUISIANA AVE N

74TH AVE N

74TH WAY N

75TH AVE N

75TH CIR N

76TH AVE N

GENERAL NOTE:
FLOODPLAIN AND FLOODWAY BOUNDARIES SHOWN ON FIGURE ARE FROM GIS SHAPEFILES DOWNLOADED FROM MnDNR.

LEGEND

- PROP LRT ℄
- DRAINAGE DIVIDES
- WATERSHED BOUNDARY
- WETLAND DELINEATION
- CITY LIMITS
- EXISTING STORM SEWER OR CULVERT
- FLOODPLAIN
- RECEIVING WATERS
- SURFACE FLOW DIRECTION
- POTENTIAL BMP LOCATION
- PROPOSED BMP LOCATION (BY OTHERS)

NOTES:

① SEE CSAH 103 EAW FOR INFORMATION ON BMPs PROPOSED SOUTH OF 94TH AVENUE FOR THAT PROJECT.

② SRF CONSULTING GROUP, INC. MODIFIED GIS FLOODPLAIN SHAPEFILE TO INCLUDE AREA AS SHOWN ON FLOOD INSURANCE RATE MAP

DRAFT-WORK IN PROCESS

BLUE LINE LRT EXTENSION

WATER RESOURCES PRELIMINARY OVERVIEW
FIGURE 9 OF 12

10/7/2015

NORTH
0 100 200 400
SCALE

METROPOLITAN COUNCIL

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SRF Consulting Group, Inc.

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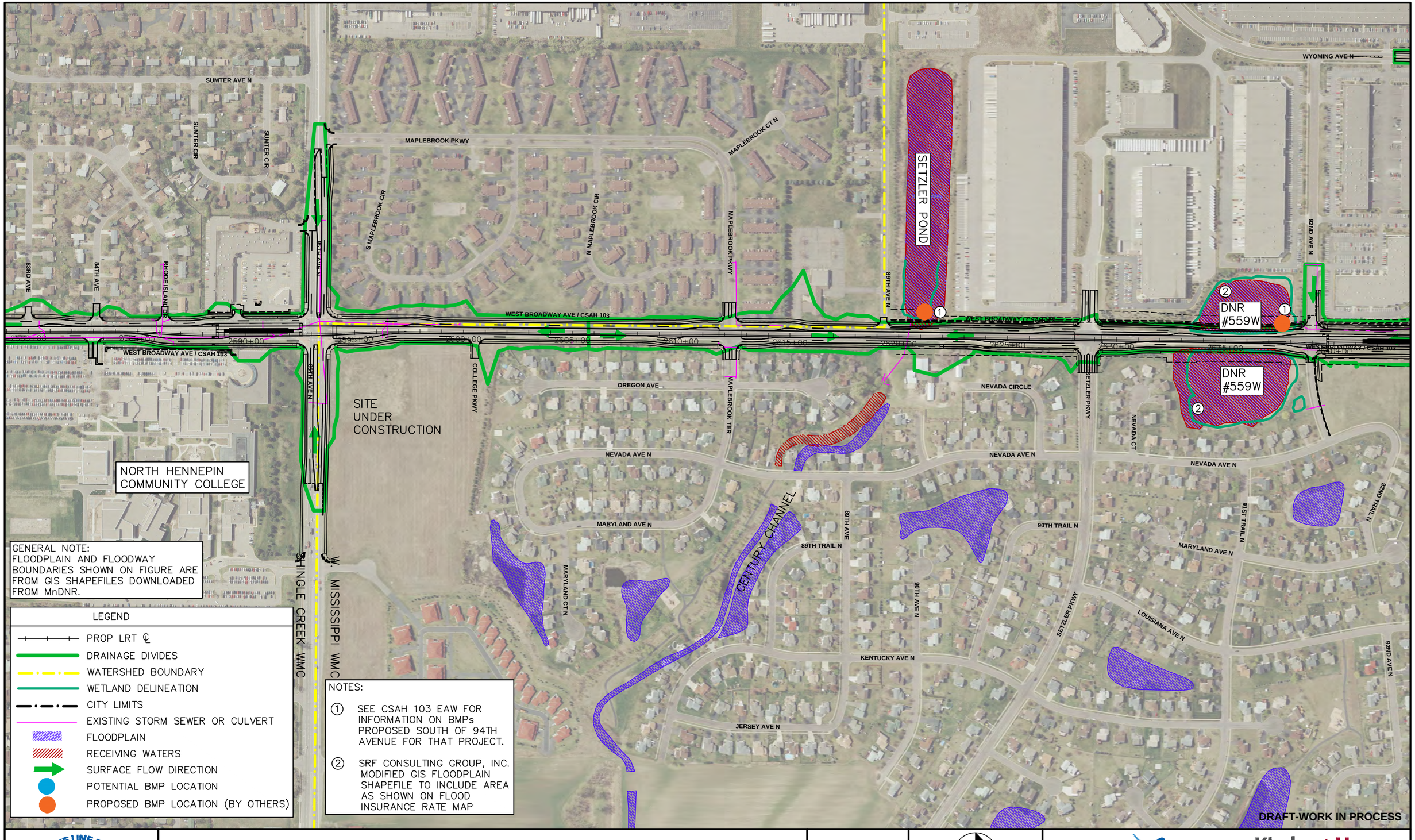

GENERAL NOTE:
FLOODPLAIN AND FLOODWAY BOUNDARIES SHOWN ON FIGURE ARE FROM GIS SHAPEFILES DOWNLOADED FROM MnDNR.

LEGEND

- PROP LRT ℄
- DRAINAGE DIVIDES
- WATERSHED BOUNDARY
- WETLAND DELINEATION
- CITY LIMITS
- EXISTING STORM SEWER OR CULVERT
- FLOODPLAIN
- RECEIVING WATERS
- SURFACE FLOW DIRECTION
- POTENTIAL BMP LOCATION
- PROPOSED BMP LOCATION (BY OTHERS)

NOTES:

① SEE CSAH 103 EAW FOR INFORMATION ON BMPs PROPOSED SOUTH OF 94TH AVENUE FOR THAT PROJECT.

② SRF CONSULTING GROUP, INC. MODIFIED GIS FLOODPLAIN SHAPEFILE TO INCLUDE AREA AS SHOWN ON FLOOD INSURANCE RATE MAP

DRAFT-WORK IN PROCESS

BLUE LINE LRT EXTENSION

WATER RESOURCES PRELIMINARY OVERVIEW
FIGURE 10 OF 12

10/7/2015

NORTH
0 100 200 400
SCALE

METROPOLITAN COUNCIL

Kimley»Horn

SRF Consulting Group, Inc.

WINNETKA AVE N

WINNETKA AVE N

WINNETKA AVE N

BAXTER
PROPERTY

94TH AVE

TH 610

WEST BROADWAY AVE

WEST BROADWAY AVE

OAK GROVE
PARK-AND-RIDE

2655+00
2660+00
2665+00
2670+00
2675+00
2680+00
2685+00
2690+00
2695+00
2700+00
2705+00
2710+00

OAK GROVE PARKWAY

OAK GROVE PARKWAY

TH 610
POND

CSAH 103 PROJECT

END HENNEPIN COUNTY

SITE UNDER
CONSTRUCTION

CENTURY
CHANNEL
TRIBUTARY

TARGET
NORTH
CAMPUS

GENERAL NOTE:
FLOODPLAIN AND FLOODWAY BOUNDARIES SHOWN ON FIGURE ARE FROM GIS SHAPEFILES DOWNLOADED FROM MnDNR.

LEGEND

- PROP LRT ℄
- DRAINAGE DIVIDES
- WATERSHED BOUNDARY
- WETLAND DELINEATION
- CITY LIMITS
- EXISTING STORM SEWER OR CULVERT
- FLOODPLAIN
- RECEIVING WATERS
- SURFACE FLOW DIRECTION
- POTENTIAL BMP LOCATION
- PROPOSED BMP LOCATION (BY OTHERS)

DRAFT-WORK IN PROCESS

BLUE LINE LRT EXTENSION

WATER RESOURCES PRELIMINARY OVERVIEW
FIGURE 11 OF 12

10/7/2015

NORTH
0 100 200 400
SCALE

METROPOLITAN COUNCIL

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SRF Consulting Group, Inc.

N:\ANY ONE

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AY / CSAH 10

OMF

TH 169

101ST AVE

WINNETKA AVE N

2715+00

2710+00

2705+00

2700+00

2695+00

2690+00

2685+00

OAK GROVE PARK-AND-RIDE

OAK GROVE PARKWAY

SITE UNDER CONSTRUCTION

TARGET NORTH CAMPUS

WEST BROADWAY / CSAH 103

GENERAL NOTE:
FLOODPLAIN AND FLOODWAY BOUNDARIES SHOWN ON FIGURE ARE FROM GIS SHAPEFILES DOWNLOADED FROM MnDNR.

LEGEND

- PROP LRT ℄
- DRAINAGE DIVIDES
- WATERSHED BOUNDARY
- WETLAND DELINEATION
- CITY LIMITS
- EXISTING STORM SEWER OR CULVERT
- FLOODPLAIN
- RECEIVING WATERS
- SURFACE FLOW DIRECTION
- POTENTIAL BMP LOCATION
- PROPOSED BMP LOCATION (BY OTHERS)

DRAFT-WORK IN PROCESS

BLUE LINE LRT EXTENSION

WATER RESOURCES PRELIMINARY OVERVIEW
FIGURE 12 OF 12

10/7/2015

NORTH
0 100 200 400
SCALE

METROPOLITAN COUNCIL

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SRF Consulting Group, Inc.

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APPENDIX B. SUMMARY OF REGULATORY CRITERIA

Blue Line LRT Extension
Water Resources - Regulatory Matrix - DRAFT
2/5/2015
Revised 10/5/2015

RFPE = Regulatory Flood Protection Elevation [2]

Requirements Summary								
Organization	**Applies to**	**Rainfall Data**	**Rate Control**	**Water Quality (1)**	**Volume Control**	**Floodplain/Flood Control Requirements**	**Plan Review Process**	**Comments**
MWMO MWMO Watershed Management Plan 2011-2021, dated May 10, 2011	Segment M	TP-40 or "subsequent revisions"	Match pre-development rates for 2-, 10-, and 100-year; may be restricted to less than pre-development rates when the capacity of the downstream conveyance system is limited	Remove 90% TSS from 95th percentile daily rainfall total (1.17 in. over 24 hrs) over entire project area, or Alternate Compliance which involves payments and/or credits and is summarized in MWMO standards document	Includes statement: placeholder for future volume standard by ~ 2013	Public Roadway Condition - roadway shall not flood when adjacent to stormwater storage basin or subsurface stormwater managmeent BMP designed to store the 100-year event. Freeboard requirement set by road authority. Alternative - minimum freeboard requirement above the 100-year HWL may be calculated as the height determined by adding depth of volume of runoff received by BMP from two-year event over the BMP.	The MWMO works with the member communities to ensure the implementation of its standards. The MWMO recommends members adopt its ordinance-ready MWMO Standards language into their local ordinances.	Note in the Standards Section that the MWMO will be working with agencies and its member organizations over the next 2.5 years to review or determine new water quality and volume standards.
BCWMC BCWMC 2015-2025 Watershed Management Plan, dated September 2015	Segment GV and Segment R	Atlas 14	Match existing rates for 2-, 10-, and 100-year events	Meet MIDS performance goals FOR LINEAR PROJECTS: Retention of whichever is greater: - 0.55 in from new or fully reconstructed areas or -1.1 in from the net increase in impervious areas If the MIDS performance goal is not feasible and/or is not allowed for a proposed project, then the project must implement the MIDS flexible treatment options, as shown in the MIDS Design Sequence Flow Chart	Meet MIDS performance goals FOR LINEAR PROJECTS: Retention of whichever is greater: - 0.55 in from new or fully reconstructed areas or -1.1 in from the net increase in impervious areas If the MIDS performance goal is not feasible and/or is not allowed for a proposed project, then the project must implement the MIDS flexible treatment options, as shown in the MIDS Design Sequence Flow Chart	Prohibits new structures or improvements in the floodplain, which would be subject to damage by the 100-year flood, including basements, public utilities, and streets. Where streets, utilities, and structures currently exist below the 100-year floodplain, BCWMC encourages member cities to remove these features as development/redevelopment allows. Projects within the floodplain must maintain no net loss to floodplain storage and no increase in flood level at any point along the trunk system. Prohibits expansion of existing non-conforming land uses within floodplain unless fully flood-proofed. OLD REQUIREMENTS DOC: Filling will generally not be allowed within the floodplain. Proposals to fill within the established floodplain must obtain BCWMC approval and must provide compensating storage and/or channel improvement so that the flood level shall not be increased at any point along the trunk system due to the fill	BCWMC reviews development/redevelopment proposals after project receives preliminary review by municipality indicating general compliance with existing local water management plan. Complex projects may require additional review time. All submittals involving floodplains, Bassett Creek trunk system, appropriations, variances, underground wet vaults or other alternative BMPs are presented at the BCWMC meetings.	Requirements for Improvements and Development Proposals' document has not been updated to match the revised standards in the 2015 Draft plan.

Requirements Summary								
Organization	**Applies to**	**Rainfall Data**	**Rate Control**	**Water Quality (1)**	**Volume Control**	**Floodplain/Flood Control Requirements**	**Plan Review Process**	**Comments**
SCWMC SCWMC Rules and Standards, dated April 2013	Segment C, Segment BP2, and Segment BP1	Atlas 14	Match existing rates for 2-, 10-, and 100-year events	Remove 60% of P and 85% of TSS Use NURP ponds or infiltrate all site runoff from 1.3-inch event NURP pond dead storage requirement is runoff from 2.5-inch storm event over the contributing drainage area Linear projects that create one acre or more of new impervious surface must meet all Commission requirements for the **net new impervious surface.**	1-inch of runoff from impervious surfaces. Linear projects that create one acre or more of new impervious surface must meet all Commission requirements for the **net new impervious surface.**	Floodplain alteration/filling shall not cause a net decrease in flood storage capacity below the 100-year critical flood elevation unless it is shown that the proposed alteration or filling, together with the alteration or filling of all other land on the affected reach to the same degree of encroachment will not cause high water or aggravate flooding on other land and will not unduly restrict flood flows.	The Commission reviews proposed land development and redevelopment projects affecting water resources. Projects are reviewed in accordance with the management standards and policies of the SCWMC and recommendations are made to the member City in which the project is located. It is the City's responsibility to enforce the Commission's recommendations. Linear projects that create one acre or more of new impervious surface must meet all Commission requirements for the **net new impervious surface**. Projects impacting wetlands where Commission is LGU must be reviewed regardless of size. Plans for developemtn within the 100-year floodplain as defined by the FIS must be reviewed.	
MPCA (via NPDES permit issued 8/1/2013) As of 2/5/2015, the impaired and special waters within 1 mile of corridor include: Shingle Creek Upper Twin Lake Middle Twin Lake Lower Twin Lake Crystal Lake Bassett Creek Mississippi River	All segments	N/A	N/A	Water quality volume of 1-inch of runoff from new impervious surfaces must be retained on site. If infiltration is prohibited,must use other methods of volume reduction and the water quality volume (or remainder if some volume reduction is achieved) must be treated by a wet sedimentation basin, filtration system, regional ponding or equivalent methods prior to discharge of stormwater to surface waters. If use wet sedimentation pond to provide treatment, dead storage requirement is 1800 cubic feet per acre of surface area drained.	Retain on site 1-inch of runoff from new impervious surfaces. If infiltration is prohibited, must use other methods of volume reduction and the water quality volume (or remainder if some volume reduction is achieved) must be treated by a wet sedimentation basin, filtration system, regional ponding or equivalent methods prior to discharge of stormwater to surface waters. NOTE: infiltration BMPs are prohibited when soil infiltration rates are > 8.3 in/hr unless the soil is amended to slow it down. See permit for other conditions that prohibit infiltration.	N/A	SWPPP must be submitted to MPCA for review if the project size is 50 acres or more and will discharge to special or impaired waters. Application and SWPPP must be submitted at least 30 days before the start of the construction activity.	The General Permit used to develop this matrix expires on 8/1/2018. It will be necessary to verify how any proposed changes in the permit would apply to this project.
Minnesota B3 Guidelines	OMF and park-and-ride buildings in all segments		Match runoff rates for the native soil and vegetation conditions for 2- and 10-year, 24 hr design storms	Remove 80% of post development TSS Remove 60% of post development TP	Retain 1.1 inches from all new or redeveloped impervious	N/A	N/A	Minimize the negative impacts of the project, both on and off site, by maintaining a more natural hydrologic cycle through infiltration, evapotranspiration, and reuse.

Requirements Summary								
Organization	**Applies to**	**Rainfall Data**	**Rate Control**	**Water Quality (1)**	**Volume Control**	**Floodplain/Flood Control Requirements**	**Plan Review Process**	**Comments**
City of Minneapolis Email from Jeremy Strehlo, dated 1/23/15 Minneapolis Floodplain Overlay District Ordinance (Chapter 551.540) Minneapolis Erosion and Sediment Control and Drainage Ordinance (Chapter 52) Minneapolis Stormwater Ordinance (Chapter 54)	Segment M		Maintain discharge rates at or below the existing rates. May be restricted to less than existing rates when the capacity of the downstream conveyance system is limited	Remove 70% TSS	N/A	Linear projects within the floodplain shall be designed to minimize increases in flood elevations and shall be compatible with local comprehensive floodplain development plans. Protection to the RFPE shall be provided where failure or interruption of public facilities would result in danger to public health or safety where facilities are essential to orderly functioning of the area. Conditional uses in Floodway District allowed provided such uses shall have a low flood damage potential, shall not cause an increase in the stage of the regional flood or cause an increase in flood damages in the reach(es) affected.	Must submit application and obtain approval for Storm Water Management Plan from the city engineer. Requirements are included in Chapter 54.70 of City Code.	
City of Golden Valley	Segment GV		Must meet BCWMC standards.	Must meet BCWMC standards.	Must meet BCWMC standards.	Linear projects may be located in the floodplain provided they are designed to minimize increases in flood elevation and are compatible with the BCWMC Management Plan. These uses can cause no increase in stage to the 100-year flood within the floodway and cannot increase the floodplain elevation by more than 1/2 foot in a designated Zone A or AE where a floodway has not been designated. Protection to the RFPE shall be provided where failure or interruption of these public facilities would endanger the public health or safety or where such facilities are essential to the orderly functioning of the area.	See BCWMC plan review process for information on stormwater management review. Floodplain alteration permit will be submitted to the City, which will then submit the information to the DNR Commisssioner and BCWMC for review.	

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City of Robbinsdale Robbinsdale 2030 Comprehensive Plan - Appendix IIIA Storm Water Management Plan	Segment R		Must meet SCWMC and BCWMC standards.	Must meet SCWMC and BCWMC standards.	Must meet SCWMC and BCWMC standards.	No structure, fill (including for roads and levees),..., or other uses may be allowed as a conditional use in the **floodway** that will cause any increase in the stage of the 100-year regional flood or cause an increase in flood damages in the reach(es) affected. Floodplain developments shall not adversely affect the hydraulic capacity of the channel and adjoining floodplain of any tributary watercourse or drainage system where a floodway or other encroachment limit has not been specified on the Official Zoning Map.	See SCWMC and BCWMC plan review process for stormwater management. Floodplain Alteration - must submit application for review to the City's Zoning Administrator and obtain all necessary State and Federal permits.	
City of Crystal 2009 Local Surface Water Management Plan and Land Use and Planning Ordinance	Segment C		Existing rates for 2-, 10-, and 100-year events; accelerated channel erosion will not occur as a result of the proposed land disturbing or development activity.	Detention facilities should have permanent pond surface area = to 2% of impervious area draining to pond, or 1% of entire area draining to pond, whichever is greater; Or as an alternative, the volume of permanent pool shall be equal to or greater than the runoff from a 2.0-inch rainfall for the fully developed site. Sequencing of preferred treatment options: infiltration, flow attenuation by using open space, stormwater retention, stormwater detention	LSWMP includes text that the City's ordinances need to be revised to include volume control standard that is in line with most restrictive between SCWMC and MPCA as it relates to discharge to impaired waters.	No structure, fill (including for roads and levees),..., or other uses may be allowed as a conditional use in the **floodway** that will cause any increase in the stage of the 100-year regional flood or cause an increase in flood damages in the reach(es) affected. Floodplain developments shall not adversely affect the hydraulic capacity of the channel and adjoining floodplain of any tributary watercourse or drainage system where a floodway or other encroachment limit has not been specified on the Official Zoning Map.	SCWMC and BCWMC review projects that fall within the watershed review authority. Crystal forwards development plans to the applicable watershed when received at the City.	
City of Brooklyn Park Email from Kevin Larson (City), dated 2/4/14 Flood Hazard Area Overlay Ordinance (152.510)	Segment BP1 and Segment BP2		Must meet SCWMC standards.	Must meet SCWMC standards.	Must meet SCWMC standards.	Railroad tracks, roads, and bridges must be elevated above the regulatory flood protection elevation where failure of facilities would result in danger to public healthy/safety or where facilities are essential to orderly function of area. None of these uses shall increase flood elevations. No fill, excavation, or storage of materials or equipment that obstruct flows or increase flood elevations will be permitted.	Must submit application to City Manager. SCWMC will review projects that fall within watershed review authority.	

(1) Wet stormwater pond design should follow the guidelines in the MPCA Stormwater Manual for dead storage depth, side slopes, and benches.
(2) Refers to an elevation 1 foot (minimum) above the 100-year flood plus any stage increase due to the designation of flood fringe areas. In Minnesota, the floodplain management ordinances (local regulations) require that the elevation of the surface of the lowest floor of a dwelling be at or above the regulatory flood protection elevation. Local regulations will also require the top of the access road elevations to be within 2 feet of the flood protection elevation.
All regulatory entities will have requirements for erosion and sediment control and at a minimum will refer back to the NPDES requirements.