5.0 Physical and Environmental Analysis

Chapter 5 presents results from the analysis of impacts on the physical and environmental system components. Results are presented for the No-Build alternative for the purpose of establishing a base from which to identify impacts of the other alternatives. Operating phase (long-term) and construction impacts are identified for the Enhanced Bus/Transportation System Management (TSM) alternative and the four Build alternatives. The alternatives are described and illustrated in Chapter 2 Alternatives.

This Draft EIS evaluates a number of different physical and environmental resources for impacts: utilities; floodplains; wetlands; geology, soils and topography; hazardous materials; noise; vibration; biological environment; water quality and stormwater; air quality; and energy.

The study area represents a geographic area used to identify resources, and varies based on the resource being evaluated. The basis for each study area begins with the potential area of disturbance, which has been defined as the estimated area where construction would occur for the proposed project at this stage of design. In some cases the study area extends beyond the potential area of disturbance to understand the potential extent of impacts on adjacent resources (for example, a wetland or waterway may extend beyond the potential area of disturbance). The study area considered for each area of analysis in this chapter is summarized in Table 5.0-1. Greater detail is provided in each section of this chapter. For reference, conceptual engineering plans are located in Appendix E.

Table 5.0-1. Summary of Defined Study Areas – Physical and Environmental Analysis

Resource Evaluated	Study Area Definition	Basis for Study Area
Utilities	Within or directly adjacent to the potential area of disturbance	Captures utilities within the potential area of disturbance, as well as adjacent utilities that may also be impacted
Floodplains	Within ¼ mile of potential area of disturbance	Captures floodplain impacts to upstream and downstream waters for a distance outside of the potential area of disturbance
Wetlands	Within ¼ mile of potential area of disturbance	The distance captures the wetlands that are within and directly adjacent to the Bottineau Transitway Project. Physical impacts to wetlands are not expected to extend beyond this distance.
Geology/Soils/ Topography	Within and adjacent to potential area of disturbance	Estimated area where construction would occur for the proposed project at this stage of design
Biological Environment	Within ¼ mile of the potential area of disturbance	The distance captures the habitat that is directly adjacent to the Bottineau Transitway Project and the wildlife that could potentially be affected by it.
Hazardous Materials Contamination	One mile on either side of alignments	ASTM standards (E1527-05 and 40 CFR Sec. 312)
Noise and Vibration	Based on the screening distances provided in Chapters 4 and 9 of the FTA guidance manual *Transit Noise and Vibration Impact Assessment* (May 2006)	Based on the screening distances provided in Chapters 4 and 9 of the FTA guidance manual *Transit Noise and Vibration Impact Assessment* (May 2006)

Resource Evaluated	Study Area Definition	Basis for Study Area
Water Quality/ Stormwater	One mile on either side of the alignments (impaired waters); within potential area of disturbance for stormwater	Per National Pollutant Discharge Elimination System (NPDES) requirements for identifying impaired waters within or sensitive resources within 1-mile of the project
Air Quality	Roadways and intersections along the alignments currently proposed to be evaluated in the DEIS and potentially affected by proposed transit service; intersections expected to operate at poor level of service[1] (LOS E or F) in the traffic evaluation will be selected for detailed air quality analysis	Established in cooperation with MPCA
Energy	Anticipated changes in travel patterns and bus operations within the various alternatives proposed for study in the Draft EIS	Total energy consumption of Build alternatives measured in British thermal units (BTUs) (industry standard)

[1] Level of service (LOS) is a measure based on the amount of congestion experienced by motorists. Congestion is rated from A to F, with LOS A representing free flow with no congestion and LOS F representing high levels of congestion with very long delays and slow speeds.

5.1 Utilities

A utility-free zone, based on project design criteria, will be established during design. This will be an area under and adjacent to the LRT track in which no utilities would be allowed, minimizing damage to existing utilities, conflicts during construction, and disruption of LRT service during revenue operations. The design of the transitway corridor will include an evaluation of potential utility conflicts and will review whether affected utilities within the utility-free zone would require relocation. The complete relocation of a conflicting utility line beyond the limits of construction will prevent conflicts with the LRT construction and future service disruptions during maintenance of the underground utilities.

General information on existing public and private utilities and the potential effects that may result from the proposed project are included in this section. Only major utility owners that service the study area were contacted for utility information. This section is not intended to identify every utility that provides service in the study area but to address those that may be affected by the proposed project.

5.1.1 Regulatory Context and Methodology

5.1.1.1 Legal and Regulatory Context

The following is a representative summary of the laws, regulations, and guidelines that are associated with utility relocation and accommodation.

Federal

- U.S. Code, Title 23, Sections 123 and 109(I)(1)

- U.S. Code, Title 23, Code of Federal Regulations 645, Chapter I, Subchapter G, Part 645, Subparts A and B (Federal Highway Administration (FHWA) 2003)
- Federal Transit Administration's (FTA) Project and Construction – Management Guidelines (2003), Appendix C – Utility Agreements

Railroad

- Burlington Northern Santa Fe (BNSF) Railway Utility Accommodation Policy

State

Minnesota Department of Transportation (MnDOT)

- MnDOT's Procedures for Accommodation of Utilities on Highway Right-of-Way
- MnDOT's Wireline Accommodation Policy

Minnesota State Constitution

- Article 1, section 13, addresses just compensation associated with private property that is taken, destroyed, or damaged for public use.

Minnesota Statutes

- Section 161.20, subdivision 1, addresses the general powers of the commissioner to carry out the provisions of Article 14, section 2, of the Minnesota State Constitution regarding the public highway system. Subdivision 2 addresses the commissioner's power regarding acquisition of property.
- Section 161.45 addresses utilities within highway rights-of-way that require relocation. This section describes rulemaking authority and utility owner interests when real property is conveyed.
- Section 161.46 addresses reimbursement of utility owners for the relocation of facilities. The section includes definitions, reimbursement requirements, and describes provisions associated with a lump sum settlement, acquisition of relocated facility for utility, and relocation work by the state.
- Section 222.37, subdivision 2, addresses pipeline relocations.
- Section 216D.04, addresses the Department of Public Safety's notice, plan, and locating requirements for excavation projects involving underground facilities.
- Section 216B, Public Utilities addresses utilities that are located within right-of-way that is owned by cities. These utilities may be subject to an individual franchise agreement, which provides the terms for which the utility companies may operate in the public right-of-way.

Minnesota Rules

Parts 8810.3100 through 8810.3600 address the utility permit process, standards for work conducted under permit, aerial lines, and underground lines.

Chapter 4720.5100 – 4720.5590 sets standards for wellhead protection planning, which is administered by the Minnesota Department of Health's Well Management Program.

5.1.1.2 Methodology

Existing utilities were inventoried within the study area using existing information that was provided by the utility owners identified below and field investigations.

The Cities of Maple Grove, Brooklyn Park, Crystal, Robbinsdale, Golden Valley, and Minneapolis; Hennepin County; Metropolitan Council; MnDOT; and BNSF Railway provided public utility information for sanitary sewer, storm sewer, and water main, in the form of GIS database files and engineering drawings. This information was compared to the alignment alternatives to identify conflicts.

Private utility information was obtained directly from Xcel Energy, Great River Energy, Sprint Nextel, and CenterPoint Energy for facilities that were located within the study area. This information was compared to the alignment alternatives to identify conflicts.

Wells in the project vicinity were identified from the Minnesota County Well Index database.

5.1.2 Study Area

The study area is defined as those utilities within, or directly adjacent to, the potential area of disturbance. The potential area of disturbance can be defined as the estimated area where construction would occur for the proposed project at this stage of design.

5.1.3 Affected Environment

Existing Water Service

Existing water service within the study area is provided, maintained, and owned by the following entities:

- City of Maple Grove Public Works (Alignment A)
- City of Brooklyn Park (Alignments A, B)
- City of Crystal Public Works (Alignment C)
- City of Robbinsdale Public Works (Alignment C)
- City of Golden Valley Public Works (Alignments D1, D2)
- City of Minneapolis Water Works (Alignments D1, D2, D Common Section)

Water mains within the study area typically range in size from six to 16 inches in diameter. However, there are a few instances where an 18- to 48-inch water main crosses or runs parallel to the study area (Table 5.1-1).

Six private wells[1] are located within the project limits. These wells are shown in Figure 5.1-1 and Table 5.1-2. Portions of the project are also located within Drinking Water Supply Management Areas, as well as Wellhead Protection Areas, as shown in Figure 5.1-2.[2] The location of wells that supply public water systems cannot be mapped per the Homeland Security Act of 2002.

[1] Private wells are those that do not supply the public water system.
[2] Drinking Water Supply Management Area is the Minnesota Department of Health approved surface and subsurface area surrounding a public water supply well that completely contains the scientifically calculated wellhead protection area and is managed by the entity identified in a wellhead protection plan. The boundaries of Drinking Water Supply Management Areas are delineated by identifiable physical features, landmarks, or political and administrative boundaries. A Wellhead Protection Area is the recharge area to a public well and is the area managed by the public water supplier, as identified in the wellhead protection plan, to prevent contaminants from entering public wells.

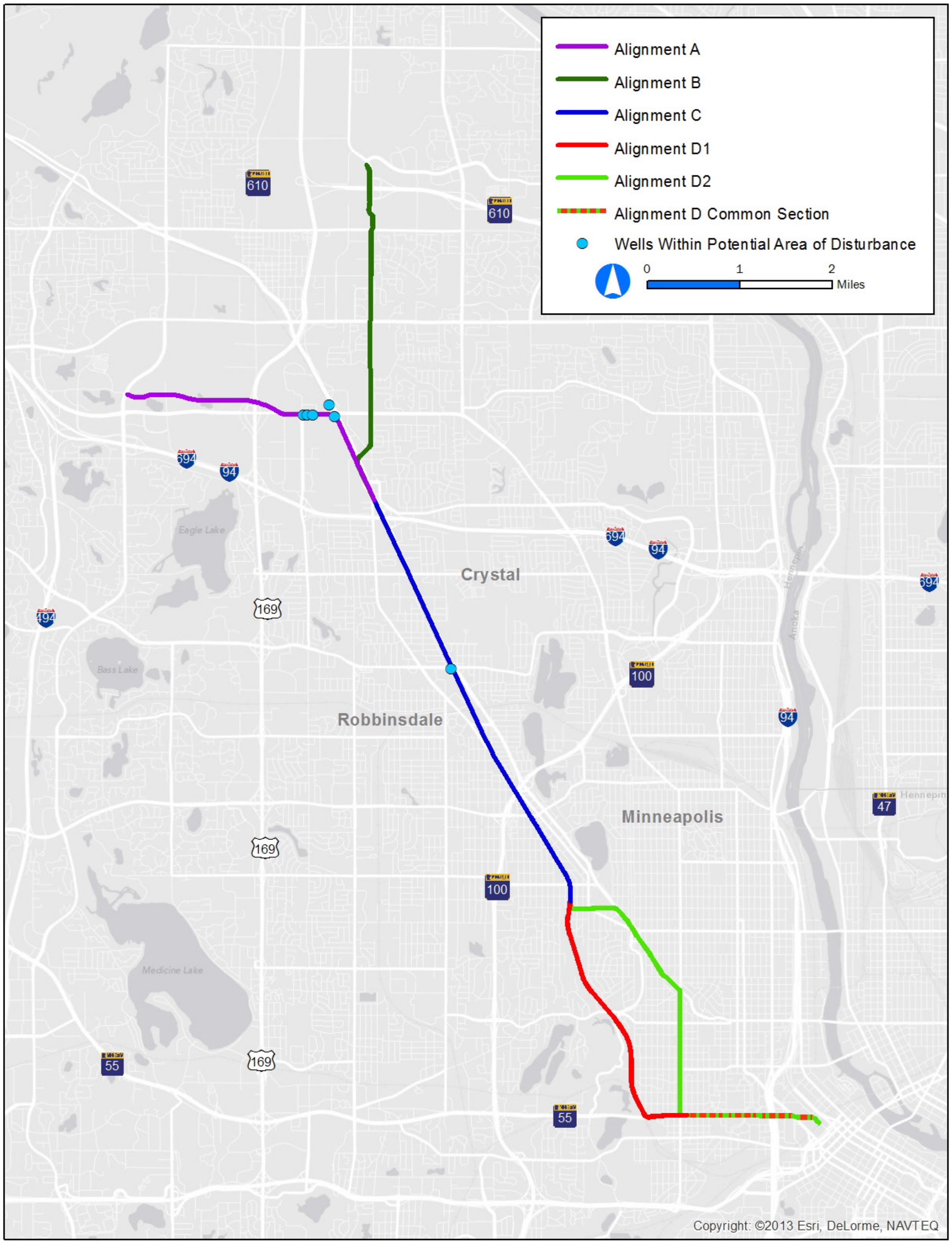
Table 5.1-1. Water Mains (Greater than 18") within the Study Area

Alignment	Utility Location
A	No water mains that are greater than 18" are located in Alignment A.
B (part of the Preferred Alternative)	24" water main at two locations: ■ On West Broadway at 89th Avenue and Maplebrook Parkway ■ On West Broadway south of 85th Avenue, parallel to the roadway
C (part of the Preferred Alternative)	No water mains that are greater than 18" are located in Alignment C.
D1 (part of the Preferred Alternative)	48" steel pipe water main located north of Golden Valley Road, crossing under the existing BNSF railroad corridor
D2	24" water main at two locations: ■ Crossing West Broadway at 29th Avenue ■ Crossing TH 55 at Penn Avenue

Table 5.1-2. Known Private Wells within the Study Area

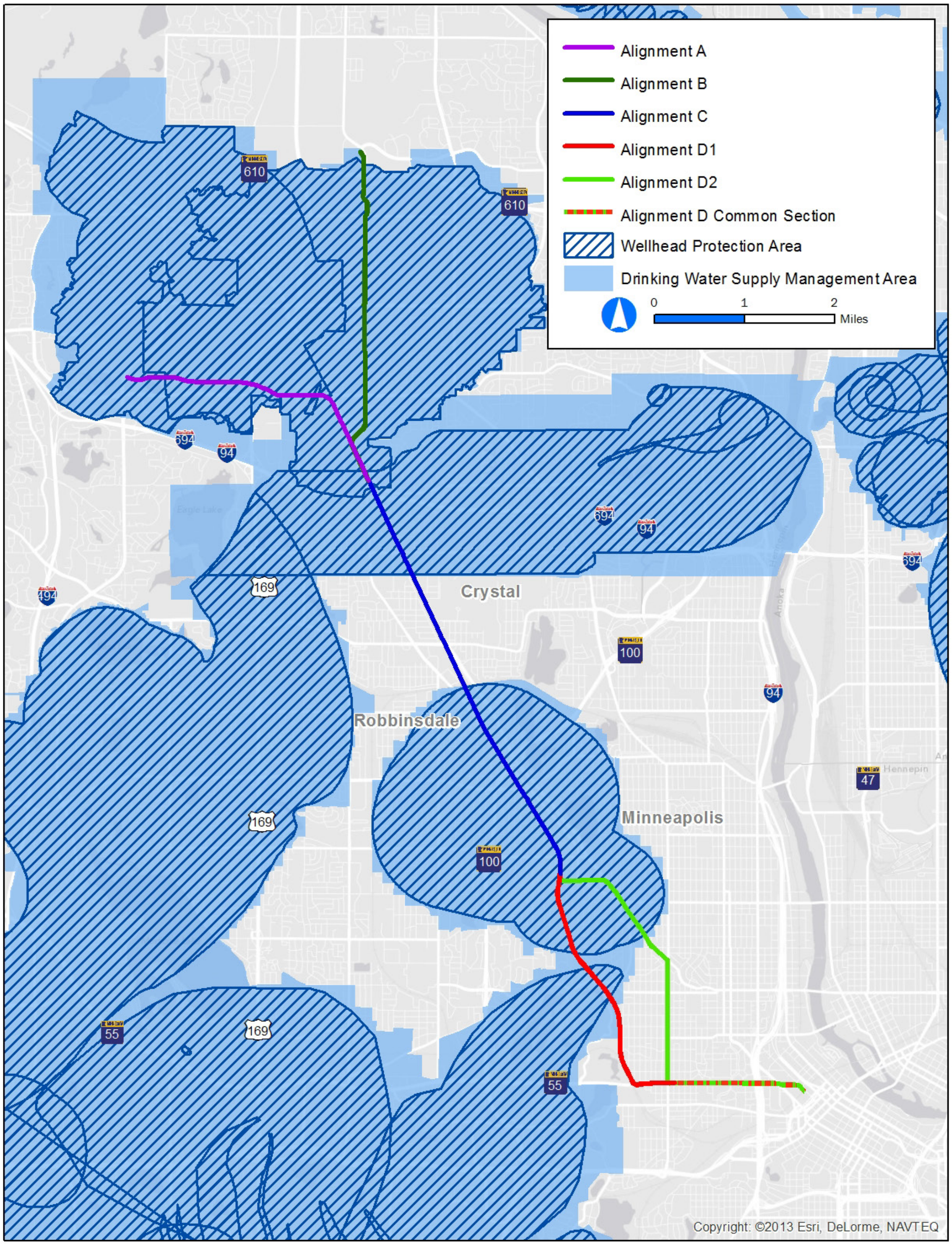
Minnesota Unique Well Number	Address	Alignment
137710	7746 Lakeland Avenue Brooklyn Park, MN 55445	A
183196	8601 77th Avenue N Brooklyn Park, MN 55445	A
203273	8100 77th Avenue N Brooklyn Park, MN 55428	A
203284	8509 77th Avenue N Brooklyn Park, MN 55428	A
203285	77th Avenue N Brooklyn Park, MN 55428	A
203500	6221 56th Avenue N Crystal, MN 55429	C (part of the Preferred Alternative)

Figure 5.1-1. Known Private Wells within the Potential Area of Disturbance[3]



[3] Source: Minnesota Geological Survey, County Wells Index, 2011

Figure 5.1-2. Drinking Water Supply Management Areas & Wellhead Protection Areas[4]



[4] Source: Minnesota Department of Health, 2012

Existing Sanitary and Storm Sewer Service

Sanitary and storm sewer services are owned and maintained by the public works divisions of the cities in which they are located, including:

- City of Maple Grove, Brooklyn Park, Crystal, Robbinsdale, Golden Valley, and Minneapolis Public Works
- Hennepin County

Storm sewer services that are located within a county roadway, such as County State Aid Highway (CSAH) 103 (West Broadway Avenue) and CSAH 81, are owned and maintained by Hennepin County.

Several publicly owned sanitary and storm sewer services run parallel and intersect the proposed project alignment. The sanitary sewers range in size from eight to 86 inches in diameter, and storm sewers range in size from nine to 144 inches in diameter, all varying in depth. A Metropolitan Council Environmental Services (MCES) interceptor sewer is also located within the study area. See Table 5.1-3 for a summary of sanitary sewer and MCES interceptor sewers that are located within the study area. Existing storm sewers that are located within the study area are described in detail within the Stormwater Technical Report (Kimley-Horn and Associates, 2012).

Existing Electric and Gas Lines

Both Xcel Energy and Great River Energy provide electrical service within the study area through overhead power lines. Xcel Energy provided drawings, identifying the location of electric transmission and distribution lines that intersect and run parallel to the proposed project. An Xcel Energy transmission line is located near the north end of Alignment B and within Alignments C and D1. Great River Energy also provided drawings identifying an electric transmission line that is located on the north side of TH 610 and crosses over the West Broadway/TH 610 interchange in Alignment B. See Table 5.1-4 for a summary of the overhead power lines that are located within or adjacent to the potential area of disturbance.

CenterPoint Energy owns several underground gas line utilities within the study area. These lines were reviewed using utility maps that were provided by CenterPoint Energy. Gas lines that are located within the corridor range in size from one to 24 inches in diameter, running parallel to and intersecting with the alignments. The highest concentration of conflicts exists within Alignments A and B. The majority of these gas lines are less than 12 inches in size. Table 5.1-5 identifies gas lines that are located within or adjacent to the potential area of disturbance that are equal to or exceed 12 inches in diameter. CenterPoint Energy is currently undergoing a Minnesota Belt Line Rehabilitation project which will include pipeline replacement and in some cases refurbishment of the existing pipeline system. The Belt Line supplies natural gas to distribution lines and includes 80-miles of 20-inch and 24-inch steel pipe, serving hundreds of thousands of customers in the Twin Cities Metropolitan Area. The Belt Line crosses the existing BNSF railroad corridor near Golden Valley Road.

Table 5.1-3. Sanitary/MCES Interceptor Sewers

Alignment	Utility Type	Utility Location
A	Sanitary Sewer	No sanitary sewer infrastructure is located within the Alignment A potential area of disturbance.
	MCES Interceptor Sewer	■ 46-inch MCES interceptor sewer located within Brooklyn Boulevard east of Shingle Creek, running parallel to the roadway; the sewer continues east on Brooklyn Boulevard towards Alignment B ■ 40-inch MCES interceptor sewer crosses Brooklyn Boulevard, west of Shingle Creek
B (part of the Preferred Alternative)	Sanitary Sewer	Sanitary sewer lines are located on the east side of West Broadway, south of 83rd Avenue, parallel to the roadway.
	MCES Interceptor Sewer	■ 54-inch MCES interceptor sewer located on the south side of 101st Avenue, running parallel to the roadway ■ 46-inch MCES interceptor sewer crosses West Broadway at Brooklyn Boulevard
C (part of the Preferred Alternative)	Sanitary Sewer	A sanitary sewer line is located on the east BNSF right-of-way line between 48th Avenue and Byron Avenue, parallel to the freight rail tracks. Alignment C includes some sanitary sewer lines that cross under the LRT and freight rail track.
	MCES Interceptor Sewer	None
D1 (part of the Preferred Alternative)	Sanitary Sewer	Sanitary sewer lines are located parallel to and cross the freight rail corridor at multiple locations with Alignment D1, specifically near Kewanee Way, Manor Drive, and 16th Avenue.
	MCES Interceptor Sewer	A 36-inch MCES interceptor sewer is located west of the freight rail corridor near the Theodore Wirth Regional Park, adjacent to the study area. South of 14th Avenue, continuing past TH 55, the interceptor runs north-south on the west side of the BNSF railroad corridor.
D2	Sanitary Sewer	Several sanitary sewer lines are located within 34th Avenue, West Broadway, and Penn Avenue, running parallel to and crossing the roadway.
	MCES Interceptor Sewer	A 30-inch to 42-inch MCES interceptor sewer parallels TH 55. The interceptor is located on the north side of TH 55 until just west of the existing BNSF freight rail track, where it crosses TH 55 and runs on the south side of TH 55.
D Common Section (part of the Preferred Alternative)	Sanitary Sewer	A sanitary sewer line is located on the south side of TH 55/6th Avenue.
	MCES Interceptor Sewer	A 30- to 42-inch MCES interceptor is located on the south side of TH 55. At Dupont Avenue, the interceptor line combines with two other interceptor lines and crosses TH 55 towards 8th Avenue. A 72-inch diameter pipe and an 8 foot-6 inch x 6 foot box culvert are utilized for this crossing.

Table 5.1-4. Overhead Power Lines within the Study Area

Alignment	Owner	Type	Location
A	Xcel Energy	Distribution	North side of Brooklyn Boulevard between Bottineau Boulevard and TH 169
B (part of the Preferred Alternative)	Xcel Energy	Distribution	South of 95th Avenue, west side of West Broadway
	Xcel Energy	Transmission	West side of West Broadway, north of 89th Avenue
	Great River Energy	Transmission	North side of TH 610, running parallel to TH 610 and crosses over the West Broadway/TH 610 interchange
C (part of the Preferred Alternative)	Xcel Energy	Distribution	East side of BNSF railroad corridor, north of Bass Lake Road
	Xcel Energy	Transmission	West side of BNSF railroad corridor south of TH 100
D1 (part of the Preferred Alternative)	Xcel Energy	Transmission	West side of BNSF railroad corridor to Lowry Avenue, east side of freight rail corridor south of Lowry Avenue Transmission towers change from a single pole to a four-side truss tower at Lowry Avenue A substation for the transmission line is located near 34th Avenue and the BNSF railroad corridor.

Table 5.1-5. Gas Lines within the Study Area

Alignment	Location
A	No gas lines greater than 12 inches are located within Alignment A.
B (part of the Preferred Alternative)	A 12 inch gas line runs beneath Jolly Lane to the east of CSAH 81, and another 12 inch gas line runs east to west beneath 73rd Avenue, as it crosses the BNSF railroad corridor.
C (part of the Preferred Alternative)	A gas line crosses under CSAH 81, north of I-94.
D1 (part of the Preferred Alternative)	A 20 inch gas line, which is part of the Belt Line, is located south of Golden Valley Road. A 24 inch gas line runs parallel to Queen Avenue, crossing under TH 55.
D2	A 16 inch gas line runs parallel along the north side of TH 55 from Queen Avenue to Logan Avenue.
D Common Section (part of the Preferred Alternative)	A 16 inch gas line runs north to south and crosses TH 55 just west of I-94.

Existing Long Distance Communication Service

Sprint Nextel Corporation (Sprint) has a fiber optic line that runs parallel to the BNSF railroad corridor through most of Alignment C and Alignment D1. At the Robbinsdale Station, the fiber optic line transitions from the east to the west side of the BNSF railroad corridor. At Plymouth Avenue (Alignment D1), the fiber optic line transitions back to the east side of the freight rail corridor.

5.1.4 Environmental Consequences

5.1.4.1 Operating Phase (Long-Term) Impacts

Coordination with local and state agencies may be required to relocate specific utilities outside the project corridor. Utilities that are located within right-of-way that is owned by cities may be subject to an individual franchise agreement as authorized by Minnesota Statue 216B, Public Utilities, which provides the terms for which the utility companies may operate in the public right-of-way. Public and private utilities must conform to MnDOT's Procedures for Accommodation of Utilities on Highway Right of Way, which require owners to obtain a permit in order to place utility facilities on trunk highway right of way. Utility installations, on, over, or under BNSF property will require review and approval by the railroad, shall conform to requirements contained within the BNSF Utility Accommodation Policy, and will require a Utility License Agreement issued by BNSF Railway.

No-Build Alternative

No utility impacts would be associated with the No-Build alternative.

Enhanced Bus/TSM Alternative

A proposed transit center and park-and-ride facility in Brooklyn Park along West Broadway Avenue near TH 610 would be constructed as part of the Enhanced Bus/TSM alternative. No major utility impacts would be associated with the Enhanced Bus/TSM alternative.

Build Alternatives

Private and public utilities that run parallel or cross within the transitway corridor would be located during design to determine if they are in conflict with the transitway corridor and would require relocation to avoid conflict with LRT operations.

Overhead Utilities

Adjustments to the horizontal and vertical location of overhead electric and communication lines would be made to provide adequate vertical and horizontal clearance for LRT vehicles and the overhead catenary system. Overhead utilities may be relocated to a different type of pole or could be buried underground. However, transmission lines are not recommended to be buried underground due to increased construction costs associated with burying the transmission line and operational issues associated with potential overheating of the system because underground lines cannot dissipate heat as well as overhead lines.

Impacts are anticipated for existing electrical transmission towers located within Alignments B, C, and D1 due to the relocation of the freight rail track and construction of the LRT track. Due to the proximity between the proposed transitway corridor and existing transmission towers, several transmission towers would need to be relocated, in coordination with Xcel Energy. These towers would be relocated to the outside edge of the proposed right-of-way to provide sufficient horizontal clearance between the tower and the transitway corridor. In some locations, the towers may be located outside of the transitway corridor right-of-way in order to maintain the required horizontal clearances. These towers would need to be relocated in order to accommodate the transitway corridor.

Underground Utilities

Impacts are anticipated for underground utilities in each alignment. Underground utilities, both private and public, will be evaluated on a case-by-case basis to determine their condition, potential reaction to loading from the LRT and freight rail, and to verify that the utility meets the vertical clearance requirements for the utility owner, MnDOT, and BNSF. Utility conflicts would be resolved by lowering the existing utility, encasing the utility for additional protection, or relocation. Manholes and vaults that are in conflict with the transitway corridor and limit access to the underground utilities would require relocation to provide adequate access.

Potential corrosion of existing metal utilities due to stray-current from the electrification systems would be evaluated. Corrosion could result in a utility line failure, so measures would be taken to reduce the amount of corrosion.

5.1.4.2 Construction Phase Impacts

No-Build Alternative

No utility impacts are anticipated.

Enhanced Bus/TSM Alternative

No utility impacts are anticipated.

Build Alternatives

Construction phase impacts to utilities are most likely to occur during excavation and grading activities, placement of structural foundations, and work that requires large-scale equipment, which could impact overhead utilities. Utility service disruptions would occur throughout construction to facilitate utility relocations. It is anticipated that these disruptions would be minimal, with temporary connections provided to customers prior to permanent relocation activities. Utility owners would ultimately decide when and if disruptions to service would be allowed.

Utility locations that are uncertain or misidentified can be unintentionally damaged during construction. The large number of utilities present within the study area increases the likelihood of encountering previously unidentified utilities.

5.1.5 Avoidance, Minimization, and/or Mitigation Measures

Utility location excavations and preconstruction surveys would be performed in general accordance with the MnDOT policy of Subsurface Utility Engineering, helping minimize unintended utility service disruptions.

The Metropolitan Council will require the utility contractor to notify affected businesses and residences of any planned disruption of service due to construction activities. Should utilities be discovered during construction that had not been identified in the contract documents, work would be discontinued and appropriate utility companies and agencies would be contacted to identify the line(s). The discovered line(s) would not be disturbed until businesses and residences are notified and the utility owner approves the proposed alteration.

Wells within the proposed permanent right-of-way would be abandoned and sealed per state and local regulations. Wells outside, but near, the proposed project right-of-way would be avoided. Any well discovered during construction within the right-of-way would be sealed according to state and local regulatory requirements.

Minnesota Department of Health guidance will be utilized to evaluate feasibility of stormwater infiltration practices located within vulnerable wellhead protection areas.

Temporary dewatering during construction may require Minnesota Department of Natural Resources (DNR) groundwater appropriation permits.

5.2 Floodplains

Information included within this section is based on the information provided in the Water Resources Technical Report (Kimley-Horn and Associates, 2012). The analysis completed for this section was conducted in coordination with the DNR and local watershed organizations (Bassett Creek Water Management Commission, Shingle Creek and West Mississippi Water Management Organization, and Mississippi Watershed Management Organization) as described in the technical report. Wetlands are addressed separately in Section 5.3.

5.2.1 Regulatory Context and Methodology

Floodplains[5] are protected by local, state, and federal legislation because of their ecological value and functionality. The federal laws protecting floodplains are the Clean Water Act (CWA) Section 404, the Rivers and Harbors Act (RHA), and Executive Order 11988. State and local protection is enforced through DNR public waters work permits, Watershed District, Water Management Organization/Commission, or City permits. Impacts to floodplains require permitting from various agencies and regulatory bodies. The required permits vary depending on the feature, size of impact, location of impact, and other factors. A floodplain impact can be defined as a disturbance or fill within a 100-year Federal Emergency Management Agency (FEMA) floodplain boundaries resulting in a floodplain storage loss. Floodplain impacts were estimated based on a conceptual (five percent) design of the alternatives (summer 2012). The estimated magnitude of impacts is expected to decrease as the project design is further developed.

FEMA 100-year floodplains[6] and FEMA floodways[7] were reviewed as part of the Bottineau Transitway evaluation. The floodplains and floodways were identified and evaluated based on current digital data (GIS shapefiles and aerial survey mapping data (contours)).[8]

Flood Insurance Rate Maps (FIRMS) and FEMA Flood Insurance Study (No. 27053CV002A) were used to identify floodplains and floodways within the study area. FEMA 100-year floodplain and floodway GIS shapefiles were downloaded from the DNR floodplain/floodway website and used to determine the impacts for each alternative. The floodplains within the study area are associated with either Shingle Creek in the north or Bassett Creek in the southern alignments.

5.2.2 Study Area

The study area for 100-year floodplain and floodway impacts was defined as the area approximately ¼ mile around each of the alignments and associated facilities (operations and maintenance facility (OMF) and park-and-rides). This distance captures floodplains and streams within a ¼ mile of the Bottineau Transitway Project that could potentially be affected by the project. Potential impacts were identified as floodplains and streams within the potential area of disturbance for the proposed alignments.

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[5] Floodplains are defined by Executive Order 11988 as “the lowland and relatively flat areas adjoining inland and coastal waters including floodprone areas of offshore islands, including at a minimum, that area subject to a one percent or greater chance of flooding in any given year."

[6] According to 44 CFR §9.4, 100-year floodplain (also known as base floodplain) means the floodplain “for the flood which has a one percent chance of being equaled or exceeded in any given year.”

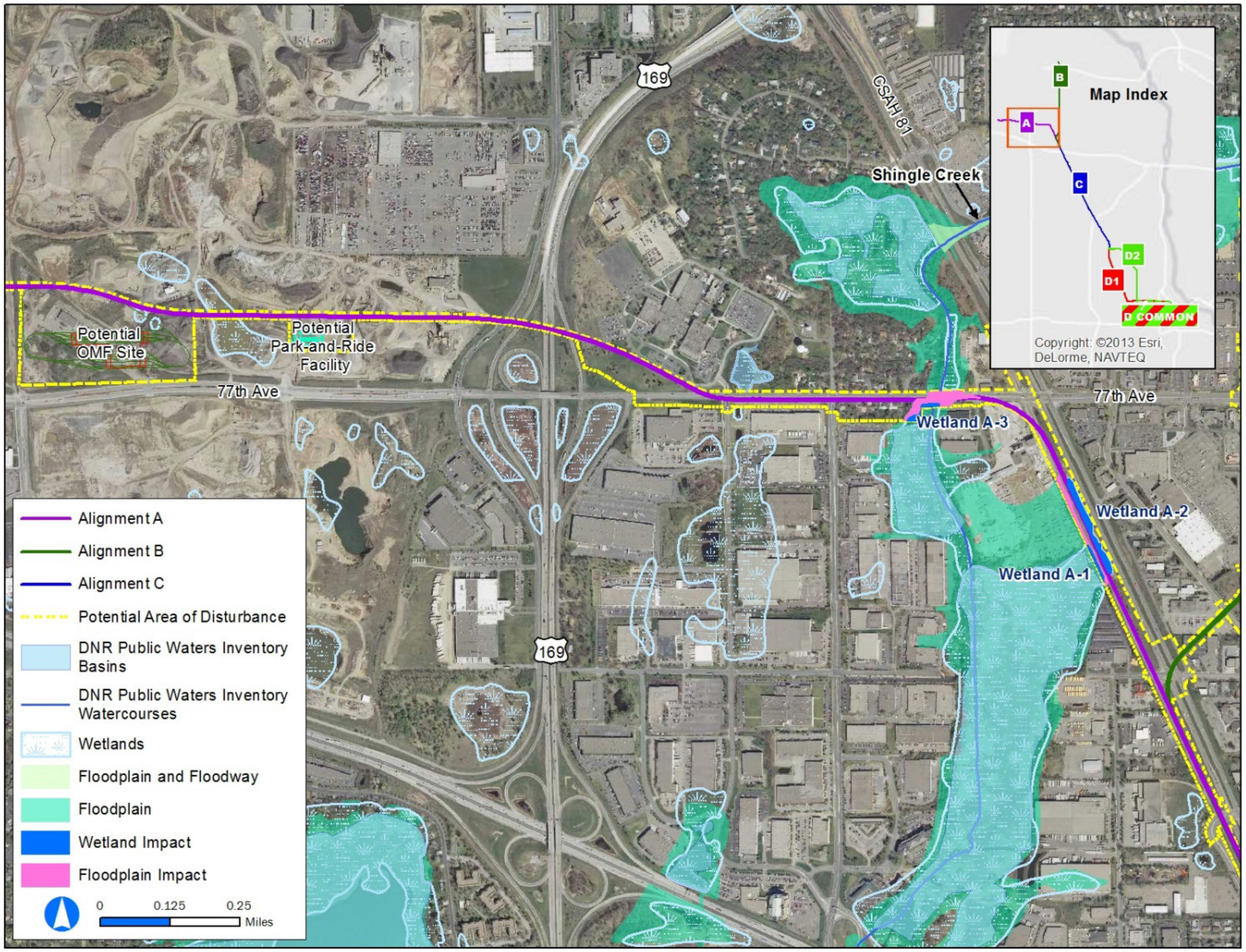
[7] According to 44 CFR §9.4, “floodway means that portion of the floodplain which is effective in carrying flow, within which this carrying capacity must be preserved and where the flood hazard is generally highest, i.e., where water depths and velocities are the greatest. It is that area which provides for the discharge of the base flood so the cumulative increase in water surface elevation is no more than one foot.”

[8] Sources: Aerial: Minnesota Geospatial Information Office, 2010; Wetland: National Wetlands Inventory modified by Kimley-Horn, June 2012; Floodplain: Federal Emergency Management Agency GIS

5.2.3 Affected Environment

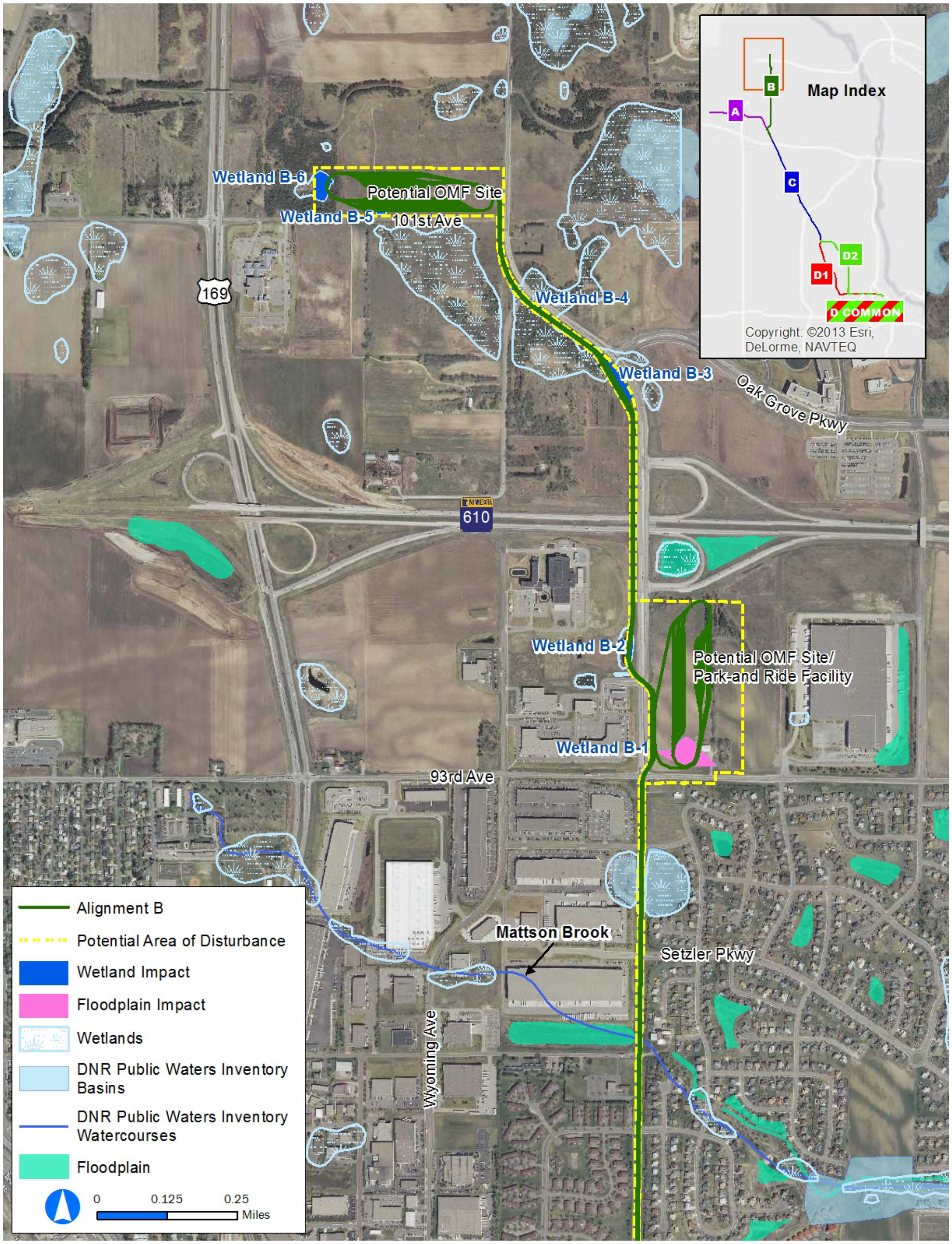
The adjacent land use within the study area is characterized by commercial, industrial, and residential development. Although not abundant, floodplains and floodways exist within the Bottineau Transitway study area. Floodways and 100-year floodplain boundaries within the study area and impacts within the potential area of disturbance are shown on Figure 5.2-1 through Figure 5.2-5. Segments of the corridors without floodplain or floodway impacts may not be shown in Figure 5.2-1 through Figure 5.2-5.

Figure 5.2-1. Alignment A Floodplain and Wetland Resources and Impacts[9]



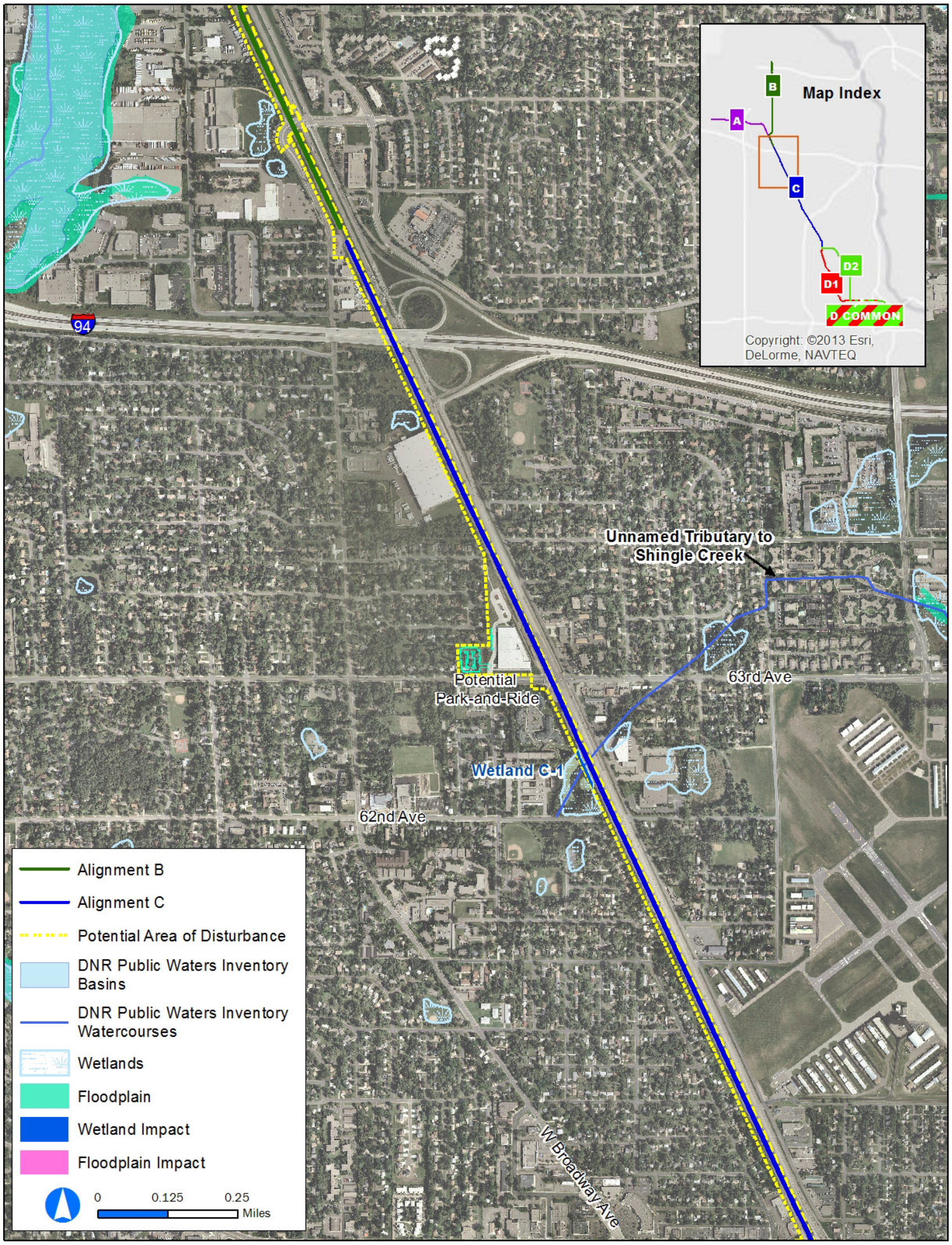
[9] Sources: Aerial: Minnesota Geospatial Information Office, 2010; Wetland: National Wetlands Inventory modified by Kimley-Horn, June 2012; Floodplain: Federal Emergency Management Agency GIS, 2010; DNR Public Waters Inventory: DNR 2008

Figure 5.2-2. Alignment B Floodplain and Wetland Resources and Impacts[10]



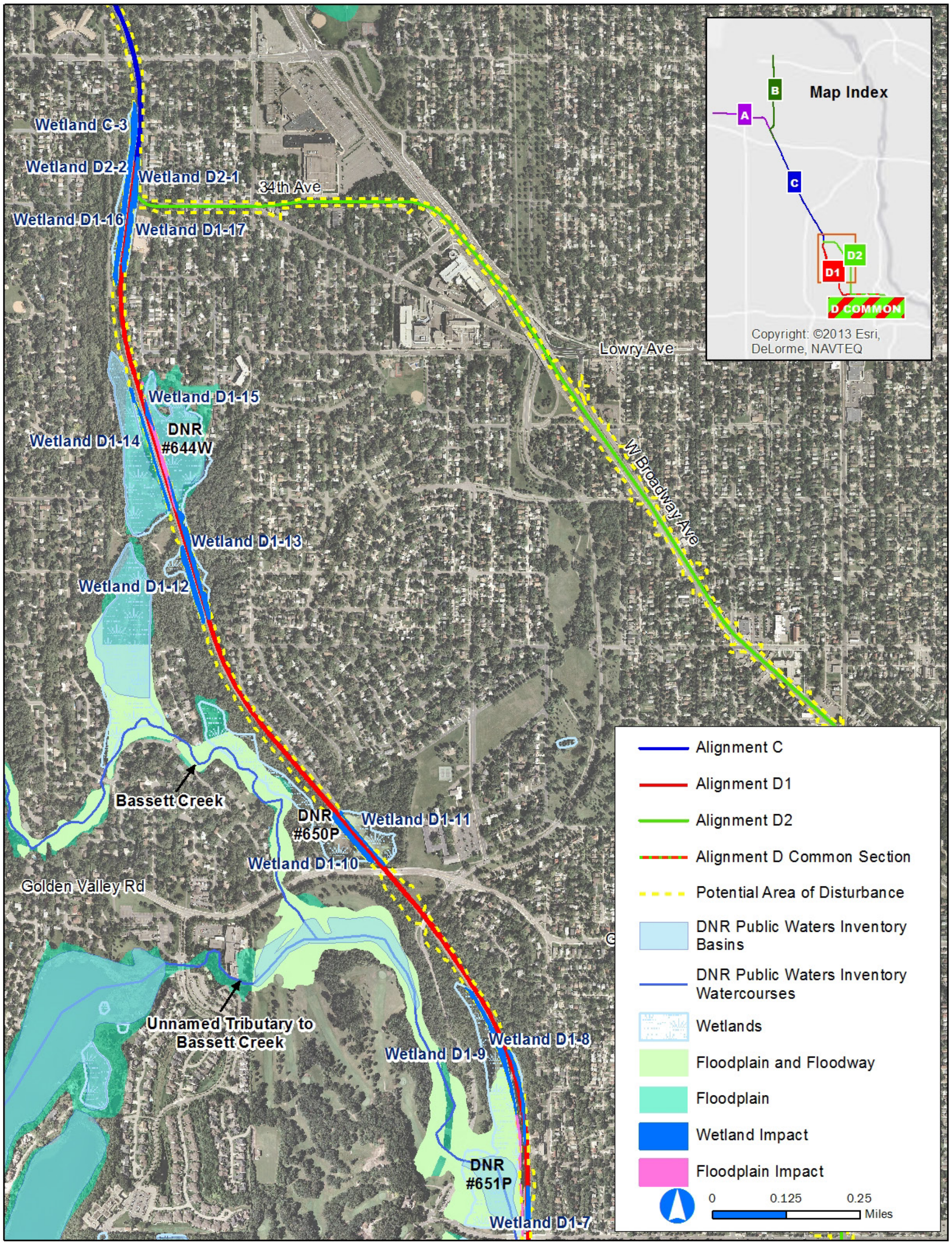
[10] Sources: Aerial: Minnesota Geospatial Information Office, 2010; Wetland: National Wetlands Inventory modified by Kimley-Horn, June 2012; Floodplain: Federal Emergency Management Agency GIS, 2010; DNR Public Waters Inventory: DNR 2008

Figure 5.2-3. Alignment C Floodplain and Wetland Resources and Impacts[11]



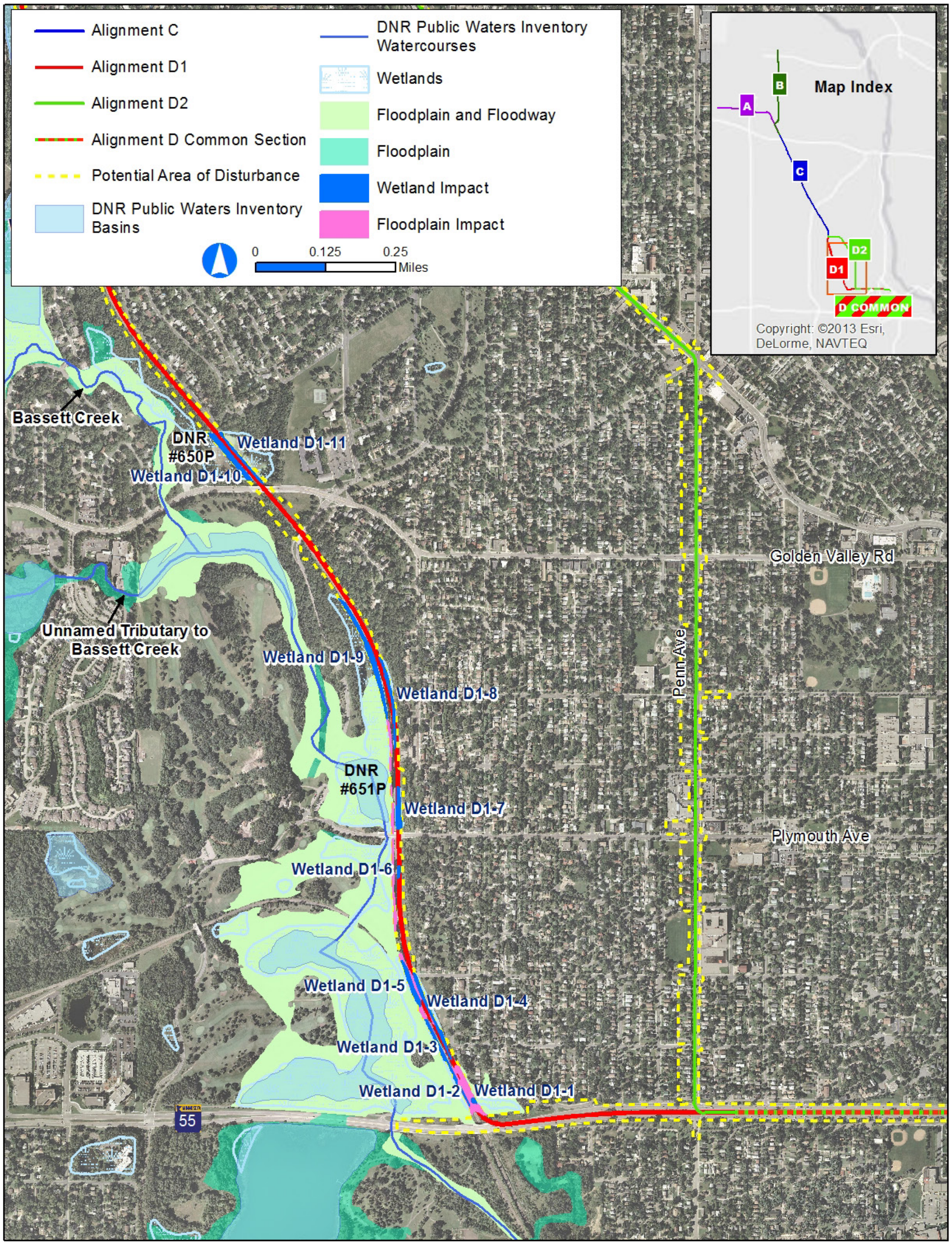
[11] Sources: Aerial: Minnesota Geospatial Information Office, 2010; Wetland: National Wetlands Inventory modified by Kimley-Horn, June 2012; Floodplain: Federal Emergency Management Agency GIS, 2010; DNR Public Waters Inventory: DNR 2008

Figure 5.2-4. Alignments D1 and D2 Floodplain and Wetland Resources and Impacts (north end)[12]



[12] Sources: Aerial: Minnesota Geospatial Information Office, 2010; Wetland: National Wetlands Inventory modified by Kimley-Horn, June 2012; Floodplain: Federal Emergency Management Agency GIS, 2010; DNR Public Waters Inventory: DNR 2008

Figure 5.2-5. Alignments D1 and D2 Floodplain and Wetland Resources and Impacts (south end)[13]



[13] Sources: Aerial: Minnesota Geospatial Information Office, 2010; Wetland: National Wetlands Inventory modified by Kimley-Horn, June 2012; Floodplain: Federal Emergency Management Agency GIS, 2010; DNR Public Waters Inventory: DNR 2008

5.2.4 Environmental Consequences

5.2.4.1 Operating Phase (Long-Term) Impacts

No-Build Alternative

There would be no impacts to floodplains and floodways as a result of the No-Build alternative.

Enhanced Bus/TSM Alternative

There would be no impacts to floodplains and floodways as a result of the Enhanced Bus/TSM alternative.

Build Alternatives

There are four Build alternatives composed of a combination of alignments. Potential impacts were calculated using the proposed alignment, available elevation data (contours), and floodplain elevations within the potential area of disturbance to determine the volume of impact in cubic yards (CY). The potential impacts to floodplains and floodways are listed by alignment, with a summary of impacts per alternative shown in Table 5.2-1. Impact areas are illustrated in Figure 5.2-1 through Figure 5.2-5. Segments of the corridor without impacts may not be included in these figures. Floodplain impacts are determined by the potential loss or gain in flood storage volume.

Table 5.2-1. Summary of 100-Year Floodplain and Floodway Storage Loss by Alternative

Alternative	100-year Floodplain Impacts (cubic yards)			
	Alignment/ Station Impact	Park-and-Ride Impact	OMF Impact	Total Impact
No-Build	0	0	0	**0**
Enhanced Bus/TSM	0	0	0	**0**
A-C-D1	17,250	0	0	**17,250**
A-C-D2	6,250	0	0	**6,250**
B-C-D1 (Preferred Alternative)	11,000	7,700	93rd Avenue option: 0[1]	**18,700**
			101st Avenue option: 0	**18,700**
B-C-D2	0	7,700	93rd Avenue option: 0[1]	**7,700**
			101st Avenue option: 0	**0**

[1] Floodplain impacts are included under the 93rd Avenue park-and-ride.

Alignment A

Two areas around Shingle Creek within the study area for Alignment A were identified as 100-year floodplains. The impact to the floodplain within the study area of Alignment A has been estimated to be a 6,250 cubic yards (CY) loss of flood storage, as shown in Figure 5.2-1. There will be no floodplain impacts as a result of the OMF and proposed park-and-ride locations along Alignment A.

Alignment B (part of the Preferred Alternative)

A 100-year floodplain associated with Shingle Creek was identified within Alignment B, as shown in Figure 5.2-2. The impact to the floodplain has been estimated at 7,700 CY due to the location of the proposed park-and-ride at the 93rd Avenue station. The location of the OMF will not increase the total floodplain and/or floodway impacts since no impacts are anticipated for either the 101st Avenue or the 93rd Avenue OMF location options.

Alignment C (part of the Preferred Alternative)

No floodplain or floodways were identified within the potential area of disturbance for Alignment C.

Alignment D1 (part of the Preferred Alternative)

The floodplain and the floodway for Alignment D1 are overlapping, resulting in approximately the same amount of impact. The 100-year floodplain and floodway along Alignment D1 are associated with Bassett Creek. The total proposed floodplain/floodway fill for Alignment D1 is approximately 11,000 CY as shown in Figure 5.2-5.

Alignment D2

No floodplain or floodways were identified within the potential area of disturbance for Alignment D2.

Alignment D Common Section (part of the Preferred Alternative)

No floodplain or floodways were identified within the potential area of disturbance for Alignment D Common Section.

TPSS

First priority would be to place TPSS sites outside of floodplain areas where possible, to avoid floodplain fill impacts due to required access and placement of the TPSS above floodplain elevation. If TPSS location in a floodplain area is the only option, retaining walls would be installed to minimize impacts. Any pavement surfaces would also be constructed with materials that are more conducive to infiltration (i.e. gravel vs. paved surfaces).

5.2.4.2 Construction Phase Impacts

Construction phase impacts are those activities that would be above and beyond the impacts described in the previous section and would occur for a short period of time coincident with the installation/construction of the project.

No-Build Alternative

No short-term construction impacts would result from the No-Build alternative.

Enhanced Bus/TSM Alternative

No short-term construction impacts would result from the Enhanced Bus/TSM alternative.

Build Alternatives

There would be no permanent or temporary construction phase impacts to floodways or floodplains for the Build alternatives.

TPSS

No temporary construction phase impacts to floodplains or floodways are anticipated from TPSS sites.

5.2.5 Avoidance, Minimization, and/or Mitigation Measures

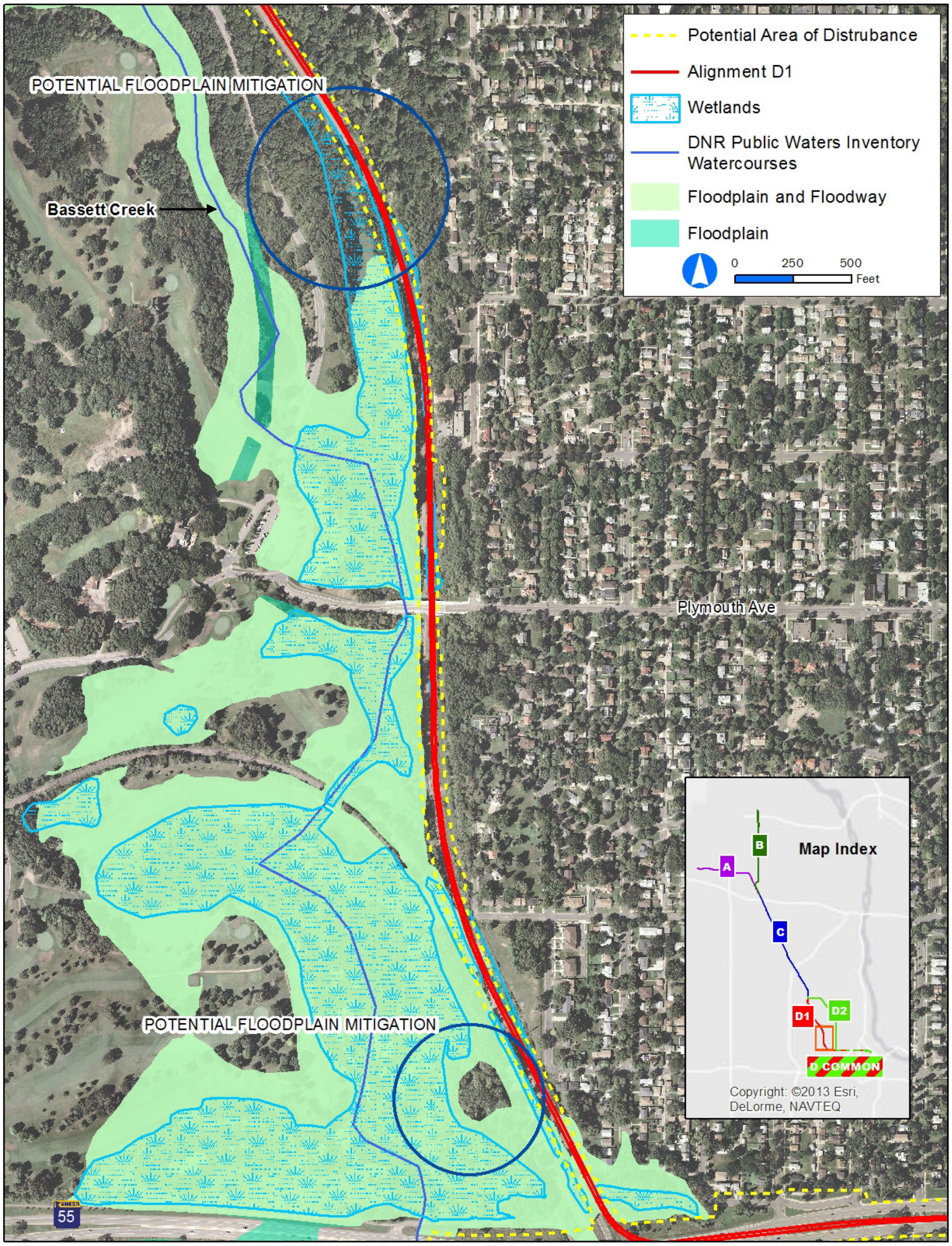
Potential on-site or project specific floodplain storage mitigation has been preliminarily evaluated for the project, which included low areas adjacent to existing floodplain that are not wetland. The Bassett Creek Watershed Management Commission (BCWMC) has identified that floodplain storage mitigation is required to be located within the same drainage channel (culvert to culvert) as the impact. Adjacent to Alignment D1, there are two areas within Theodore Wirth Regional Park that could meet the storage volume replacement requirement. Based on existing floodplain and wetland sources, both are located outside existing wetland and floodplain. One of these parcels is owned by the Canadian Pacific (CP) Railroad (located within the park), as shown in Figure 5.2-6. The details of how these areas would be designed to meet replacement requirements would need to be coordinated with the Minneapolis Park & Recreation Board (park manager), the landowner (if different), and the approving agencies (city, DNR, Watershed Management Organization (WMO)). Review of the scope and location of flood storage mitigation in Theodore Wirth Regional Park would be conducted by the Metropolitan Council to determine consistency with the Council's Regional Parks Policy Plan and other relevant park planning documents.

Construction best management practices (BMPs), as discussed in the Stormwater Technical Report (Kimley-Horn and Associates, 2012), would serve to minimize impacts to floodplains and floodways during the construction period.

The BCWMC will be performing a study to update the existing floodplain and floodway elevations, which could modify the floodplain and floodway boundaries adjacent to Bassett Creek. Continued coordination with the City of Golden Valley and the BCWMC will be required to confirm the floodplain impacts based on the outcome of this study. A hydraulic analysis would need to be completed to determine actual floodplain and floodway impacts due to the proposed construction; this cannot be completed until design is further refined and final construction limits are established.

Floodplain mitigation adjacent to Alignment D1 will require approval from the City of Golden Valley, who will issue a permit to the project for the proposed work. As part of that permitting process both the City of Golden Valley and the BCWMC would be provided the opportunity to review and provide comments on the proposed floodplain mitigation to verify that all of the pertinent requirements have been met prior to issuing the permit. Further details regarding the agencies involved in floodplain review can be found in the Water Resources Technical Report (Kimley-Horn and Associates, 2012).

Figure 5.2-6. Alignment D1 Potential Floodplain Storage Mitigation Sites[14]



[14] Sources: Aerial: Minnesota Geospatial Information Office, 2010; Wetland: National Wetlands Inventory modified by Kimley-Horn, June 2012; Floodplain: Federal Emergency Management Agency GIS, 2010; DNR Public Waters Inventory: DNR 2008

5.3 Wetlands

Information included within this section is based on the information provided in the Water Resources Technical Report (Kimley-Horn and Associates, 2012). The analysis completed for this section was conducted in coordination with the US Army Corps of Engineers (USACE) as part of the 404 Merger Process, as discussed in Section 5.3.1 and Chapter 9 Consultation and Coordination. Floodplains are addressed separately in Section 5.2.

Wetlands, as defined by the USACE and United States Environmental Protection Agency (EPA), are "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

Wetlands are areas that are covered by water or have waterlogged soils for long periods during the growing season. Plants growing in wetlands are capable of living in saturated soil conditions for at least part of the growing season. Wetlands such as swamps and marshes are often obvious, but some wetlands are not easily recognized, as they are dry during part of the year.

For purposes of this analysis, wetlands and wetland boundaries have been identified through the use of existing mapping and field observation, as noted below, providing a reasonable estimate of wetland boundaries for potential impact analysis. A detailed delineation of wetland boundaries will be completed for the Preferred Alternative to provide the required detail necessary for the permit review process. All wetlands identified for this analysis were considered Waters of the US and under jurisdiction of the USACE and Local Government Units. As discussed with the USACE, a Jurisdictional Determination will be requested after a formal delineation is completed.

5.3.1 Regulatory Context and Methodology

Wetlands are protected by local, state, and federal legislation because of their ecological and functional value. The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into the waters of the United States and for regulating quality standards for surface waters. The EPA oversees state implementation of the CWA, reviews and comments on individual permit applications, and has the ability to elevate specific permitting cases. Section 404 of the CWA, which establishes a program to regulate the discharge of dredged or fill material into waters of the United States, excluding those wetlands that are hydrologically isolated on the landscape (Rapanos v. United States, 547 U.S. 715 (2006)). Section 404 of the CWA is under the purview of the USACE St. Paul District and requires a permit to be issued by the USACE prior to the placement of any dredged or fill material into any Waters of the United States, including wetlands. The USACE is responsible for administering the Section 404 permitting program (including individual and general permit decisions), conducting Final or Preliminary Jurisdictional Determinations, developing policy and guidance, and enforcing all other Section 404 provisions. Transportation projects with less than a half-acre of wetland impact are covered by a general permit, whereas impacts over a half acre require a Letter of Permission, and impacts more than three acres require an Individual Permit and public comment period. When an EIS is conducted for a project with wetland impacts, the USACE typically participates in what is called the 404 Merger Process, where the USACE gets involved in the review of the project purpose and need, alternatives evaluated and selection of the Least Environmentally Damaging Practicable Alternative (LEDPA). This coordinated review process has been initiated with the USACE for this project. The USACE has concurred with the project purpose and need and range of alternatives, and has selected the LEDPA with respect to Section 404 b(1) guidelines, concluding the first three concurrence points of the 404 Merger Process (see also Chapter 9).

Lakes, rivers, streams, and wetlands are regulated by the DNR if they have been identified by the state as public waters or public waters wetlands. Public waters and public waters wetlands are all water basins and water courses that meet the criteria set forth in Minn. Stat., Section 103G.005, subd. 15, and that are identified on Public Water Inventory (PWI) maps (Minn. Stat., Section 103G.201). Proposed impacts involving a change in the course, current, or cross-section of public waters (including streams) and public waters wetlands would require a permit from the DNR.

The Minnesota Wetland Conservation Act (WCA) of 1991, under the purview of the Minnesota Board of Water and Soil Resources (BWSR) and local government units (LGU), establishes the goal of no net loss of wetlands (Minnesota Rule 8420). The WCA requires that anyone proposing to drain or fill a wetland must try to avoid disturbing the wetland. If avoidance cannot be achieved, the WCA requires that impacts be minimized to the extent possible, and any impacted areas be replaced in kind (comparable function and value).

Impacts to wetlands require permitting from various agencies and regulatory bodies. The required permits vary depending on the feature, size of wetland, location of wetland, and other factors. Other permits relating to stormwater management, erosion control, stream crossings, etc., may also be necessary.

Wetland impacts are defined as a disturbance or placement of fill within the wetland boundary resulting in the loss of the function of the wetlands. All wetland areas within the potential area of disturbance were considered an impact. The area of disturbance was estimated based on a conceptual (five percent) design of the alternatives (summer 2012). The estimated magnitude of impacts is expected to decrease as the project design is further developed.

Wetland boundaries and types were identified based on current digital data (GIS shapefiles, aerial survey mapping data (contours)) and a variety of other sources including U.S. Geological Survey Quadrangle maps, the U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI), the Department of Natural Resources Public Water Inventory maps (USDOI, 2010; USFWS, 1974-1988; DNR, 1983), and a field review(of wetland areas, which consisted of general observation of the extent of the wetland boundary, dominant vegetation and relative quality based on plant dominance. The USFWS NWI shapefiles were modified based on 2010 aerial photography interpretation, the Hennepin County Soils Survey hydric soils layer (National Resource Conservation Survey (NRCS) Web Soil Survey), and contour data received from the City of Golden Valley. A formal delineation and jurisdictional determination will be completed for the Preferred Alternative.

5.3.2 Study Area

The study area for wetlands is defined as the area approximately ¼ mile around each of the alignments and associated facilities (OMF and park-and-rides). This distance captures wetlands near the Bottineau Transitway that could potentially be affected by the project.

5.3.3 Affected Environment

The study area is characterized by commercial, industrial, and residential development. Although not abundant, wetlands exist within the Bottineau Transitway study area. Wetland boundaries within the study area are shown on Figure 5.2-1 through Figure 5.2-5. For purposed of this analysis, all wetlands identified are assumed to be under the jurisdiction of the USACE per Section 404 of the CWA and the Local Government Units per the Minnesota WCA. Public Waters Wetlands under DNR jurisdiction are denoted in Table 5.3-1 through Table 5.3-5.

5.3.4 Environmental Consequences

5.3.4.1 Operating Phase (Long-Term) Impacts

No-Build Alternative

There would be no impacts to wetlands as a result of the No-Build alternative.

Enhanced Bus/TSM Alternative

There would be no impacts to wetlands as a result of the Enhanced Bus/TSM alternative.

Build Alternatives

The four Build alternatives are made up of a combination of alignments. The wetlands inventoried and evaluated along with potential impacts are listed by alignment in Table 5.3-1 to Table 5.3-5, with total wetland impacts for each alternative shown in Table 5.3-6, broken out by alignment/station impact, park-and-ride impact, and OMF impact. Impact areas are shown in Figure 5.2-1 through Figure 5.2-5. No wetlands were identified within the potential area of disturbance for Alignment D Common Section.

Stream impacts would be limited to culvert extensions at existing stream crossings. There are no existing crossings in Alignment D2 or the D Common Section. The known crossings are located:

- Alignment A: crosses Shingle Creek between Boone Avenue and CSAH 81
- Alignment B (part of the Preferred Alternative): crosses Mattson Brook north of 89th Avenue N and crosses Shingle Creek north of Candlewood Drive
- Alignment C (part of the Preferred Alternative): crosses an unnamed creek/drainage ditch between 62nd Avenue N and 63rd Avenue N
- Alignment D1 (part of the Preferred Alternative): crosses backwater channel of Bassett Creek just north of TH 55

Standard erosion control BMPs would be used for work within the streams to extend existing culverts where necessary, minimizing impacts to the streams and aquatic wildlife.

TPSS

First priority would be to place TPSS sites within the existing railroad right-of-way or on public owned lands where possible, to avoid impacts to wetlands. If impacts to wetland areas are unavoidable, they would be minimized using features such as retaining walls and steep fill slopes, consistent with USACE minimization guidance.

5.3.4.2 Construction Phase Impacts

Construction phase impacts are generally those that would be above and beyond the impacts described in the previous section and would occur for a short period of time coincident with the installation/construction of the project.

No-Build Alternative

No short-term wetland impacts would result from the No-Build alternative.

Enhanced Bus/TSM Alternative

No short-term wetland impacts would result from the Enhanced Bus/TSM alternative.

Build Alternatives

Wetland impacts during construction would be temporary and occur in locations where retaining walls are needed to minimize permanent wetland fill. The extent of temporary wetland disturbance will be defined through the project design phase, but is not expected to extend beyond what is needed to get equipment in to construct the proposed retaining walls. These temporary impacts would be restored to pre-construction wetland conditions after the retaining walls are completed.

Grading and soil disturbance during construction may cause temporary erosion and sedimentation of disturbed areas. These temporary construction phase impacts would be minimized to the extent possible by using BMPs for erosion control. All disturbed areas would be graded and reseeded to stabilize the soil. Measures such as silt fences, erosion control blankets, and other soil stabilization measures would be implemented to maintain water quality.

TPSS

There would be no temporary construction phase impacts to wetlands resulting from TPSS sites.

Table 5.3-1. Wetland Disturbance or Fill for Alignment A by Plant Community

Wetland Inventory No. (DNR#)	Plant Community[1]	Wetland Impact (acres)
A-1 (562W)	Deep Marsh	0.2
A-2	Fresh (Wet) Meadow	1.2
A-3 (563W)	Shallow Marsh	0.4
	Total	**1.8**

[1] Plant Communities based on "Wetland Plants and Plant Communities of Minnesota and Wisconsin" by Eggers and Reed (USACOE – St. Paul District). Please see Appendix A of the Water Resources Technical Report (Kimley-Horn and Associates, 2012) for Plant Communities descriptions.

Table 5.3-2. Wetland Disturbance or Fill for Alignment B (part of the Preferred Alternative) by Plant Community[1]

Wetland Inventory No. (DNR#)	Plant Community[2]	Wetland Impact (acres)
B-1	Seasonally Flooded Basin	0.1
B-2, B-3, B-4	Shallow Marsh	2.3
B-5	Fresh (Wet) Meadow	0.1
	Total	**2.5**

[1] Does not include park-and-ride or OMF options. Depending on option, adds 0.1 acre or 0.8 acre. See Table 5.3-6.
[2] Plant Communities based on "Wetland Plants and Plant Communities of Minnesota and Wisconsin" by Eggers and Reed (USACOE – St. Paul District). Please see Appendix A of the Water Resources Technical Report (Kimley-Horn and Associates, 2012) for Plant Communities descriptions.

Table 5.3-3. Wetland Disturbance or Fill for Alignment C (part of the Preferred Alternative) by Plant Community

Wetland Inventory No. (DNR#)	Plant Community[1]	Wetland Impact (acres)
C-1, C-2, C-3	Shallow Marsh	0.7
	Total	**0.7**

[1] Plant Communities based on "Wetland Plants and Plant Communities of Minnesota and Wisconsin" by Eggers and Reed (USACOE – St. Paul District). Please see Appendix A of the Water Resources Technical Report (Kimley-Horn and Associates, 2012) for Plant Communities descriptions.

Table 5.3-4. Wetland Disturbance or Fill for Alignment D1 (part of the Preferred Alternative) by Plant Community

Wetland Inventory No. (DNR#)	Plant Community[1]	Wetland Impact (acres)
D1-1, D1-7	Floodplain Forest	0.4
D1-2, D1-4, D1-5, D1-8, D1-9, D1-16	Fresh (Wet) Meadow	2.4
D1-3, D1-6	Seasonally Flooded Basin	0.3
D1-10 (650P), D1-11 (650P), D1-12, D1-13, D1-14, D1-17	Shallow Marsh	2.9
D1-15 (644W)	Deep Marsh	0.1
	Total	**6.1**

[1] Plant Communities based on "Wetland Plants and Plant Communities of Minnesota and Wisconsin" by Eggers and Reed (USACOE – St. Paul District). Please see Appendix A of the Water Resources Technical Report (Kimley-Horn and Associates, 2012) for Plant Communities descriptions.

Table 5.3-5. Wetland Disturbance or Fill for Alignment D2 by Plant Community

Wetland Inventory No. (DNR#)	Plant Community[1]	Wetland Impact (acres)
D2-1 , D2-2	Shallow Marsh	0.7
	Total	**0.7**

[1] Plant Communities based on "Wetland Plants and Plant Communities of Minnesota and Wisconsin" by Eggers and Reed (USACOE – St. Paul District). Please see Appendix A of the Water Resources Technical Report (Kimley-Horn and Associates, 2012) for Plant Communities descriptions.

Summary of Impacts

Table 5.3-6. Summary of Wetland Disturbance or Fill by Alternative

Alternative	Wetland Impacts (acres)			
	Alignment/Station Impact	Park-and-Ride Impact	OMF Impact	Total Impact[1]
No-Build	0	0	0	0
Enhanced Bus/TSM	0	0	0	0
A-C-D1	8.6[2]	0	0	8.6
A-C-D2	3.2	0	0	3.2
B-C-D1 (Preferred Alternative)	9.3[2]	0.1	93rd Avenue option: 0.0[3]	9.4
			101st Avenue option: 0.8[4]	10.2
B-C-D2	3.9	0.1	93rd Avenue option: 0.0[3]	4.0
			101st Avenue option: 0.8	4.8

[1] The current replacement ratio for wetland credits in this portion of Minnesota is 2.5 to 1 for WCA, although under certain conditions it may be reduced to 2 to 1. The USACE requires a 2 to 1 ratio for wetland replacement.
[2] This total includes wetland impacts at the Plymouth Avenue/Theodore Wirth Regional Park station option. There would be no wetland impacts at the Golden Valley Road station option.
[3] Wetland impacts are included under the 93rd Avenue park-and-ride. .
[4]This acreage is based on supplemental assessment report completed by Hennepin County Conservation District (HCD, July 2013)

5.3.5 Avoidance, Minimization, and/or Mitigation Measures

Wetland permits from the USACE (Section 404), Minnesota Pollution Control Agency (MPCA) (Section 401 certification), and DNR (Public Waters) would be required as a part of this project. Additionally, the designated local government unit (LGU) would need to make a Wetland Conservation Act wetland replacement plan determination for the project. Because this is a linear project, Build alternatives cross through several cities and four watershed management organization boundaries – Shingle Creek Watershed - Management Commission (WMC), West Mississippi WMC, Bassett Creek WMC, and Mississippi Watershed Management Organization (WMO). The LGU that experiences the most wetland impact within its jurisdiction would be considered the lead agency and make the WCA wetland replacement plan determination for this project. The LGU would be determined as the project advances into further stages of project development.

Wetland impacts have been avoided and minimized to the extent practical. Wetland impacts will be further studied and a wetland delineation will be completed as part of the 404 permitting process.

The construction timeline for this project has not been established, therefore, the approach to mitigating wetland impacts was to assume purchasing wetland credits from the state-managed wetland bank rather than on-site or project specific replacement. The current replacement ratio for wetland credits in this portion of Minnesota is 2.5 to 1, although under certain conditions it may be reduced to 2 to 1. The final amount, type, and location of wetland replacement or bank credits would be determined by the respective permit agencies during final design and the permit review process.

Areas for construction of on-site or project specific wetland replacement will be investigated as the project advances into further stages of project development. Areas to be considered include public land adjacent to the Preferred Alternative and/or lands acquired for the project.

5.4 Geology, Soils, and Topography

5.4.1 Regulatory Context and Methodology

In Minnesota, geologic resources are rarely regulated, aside from groundwater dewatering. A permit is required to dewater in excess of 1.0 million gallons per year or 10,000 gallons a day. The DNR issues dewatering permits.

The discharge from dewatering is regulated under the National Pollutant Discharge Elimination System (NPDES) permit that is required for construction activities. If the water is contaminated, an individual NPDES permit must be obtained from the MPCA or the groundwater can be discharged to the sanitary sewer system if approved by Metropolitan Council Environmental Services.

The geologic resources listed in this section are not isolated and can affect or be affected by other water resources discussed in Sections 5.2 and 5.3.

The Geologic Atlas of Hennepin County (Minnesota Geological Survey 1989) was consulted for information regarding surface geology, bedrock geology, and groundwater resources.

5.4.2 Study Area

The study area for geology/soils/topography is defined as the area within and adjacent to the potential area of disturbance.

5.4.3 Affected Environment

5.4.3.1 Geology

The surface sediments of Hennepin County were deposited primarily by glacial ice and meltwater during the last glaciation (Wisconsinan Stage). Sediments along the major portion of the study area can be attributed to the advancement and retreat of the Superior lobe and Grantsburg sublobe of the Des Moines lobe and meltwater from these lobes. The St. Paul Sand Flats, a broad sandy outwash plain, dominates this region. As the outwash plain was being deposited, the Glacial River Warren was deepening, and sediments ranging from gravel to sand to some silt and clay were deposited along the terraces of the river. No karst features were identified within the study area (a karst landscape is an irregular limestone region in which erosion has produced sinkholes, underground streams, and caverns).[15]

5.4.3.2 Soils

The proposed project lies within 36 different soil types. Soil data was obtained from digital soil surveys of Hennepin County distributed by the Twin Cities Metropolitan Council. Digital soil data and descriptions for Hennepin County were gathered from the April 1974 Soil Survey of Hennepin County, Soil Conservation Service (now NRCS) soil maps produced for eastern Hennepin County in 1983, and NRCS Mylar Maps of the Hennepin County Soil Survey.

The description of soils within each alignment is provided below.

Alignment A

The majority of Alignment A is within an existing active gravel mine. The soils within this area are highly disturbed; however, the major soil types within the potential area of disturbance for Alignment A are as follows:

- Gravel pits
- Muskego, Blue Earth, and Houghton soils
- Urban – Udorthents soils

These soils range from poorly drained soils to well drained soils. The poorly drained soils are associated with the wetlands and floodplains areas within the study area.

Alignment B (part of the Preferred Alternative)

The majority of Alignment B is previously developed land. The soils within this area are highly disturbed; however, the major soil types within the potential area of disturbance for Alignment B are as follows:

- Forada sandy loam
- Anoka and Zimmerman soils
- Duelm loamy sand
- Isan sandy loam
- Soderville loamy fine sand

Sandy loams and loamy sands make up the majority of the soil types within Alignment B. These soils range from poorly drained soils to well drained soils. The poorly drained soils are associated with the wetlands and floodplains areas within the study area.

Alignment C (part of the Preferred Alternative)

The majority of Alignment C is previously developed land within the BNSF railroad corridor. The soils within this area are highly disturbed; however, the major soil types within the potential area of disturbance for Alignment C are as follows:

[15] DNR, Karst Feature Inventory Points shapefile, 2003

- Urban land – Hubbard Complex
- Urban land – Udipsamments

These soils within Alignment C are generally well-drained and excessively drained soils.

Alignment D1 (part of the Preferred Alternative)

The majority of Alignment D1 is previously developed land within the BNSF railroad corridor. The major soil types within the potential area of disturbance for Alignment D1 are as follows:

- Udorthents, wet substratum
- Urban land – Lester complex
- Urban land – Dundas complex

These soils within Alignment D1 are generally classified as well drained and somewhat poorly drained soils.

Alignment D2

The majority of Alignment D2 is previously developed land. The major soil types within the potential area of disturbance for Alignment D2 are as follows:

- Udorthents, wet substratum
- Urban land – Lester complex
- Urban land – Dundas complex

These soils within Alignment D2 are generally classified as well drained and somewhat poorly drained soils.

5.4.3.3 Topography

The general topography of the area consists of gently rolling hills. Land surface elevation ranges from 810 feet to 925 feet throughout the study area based on contour data received from Hennepin County (Summer 2012). The average elevation in the vicinity of Alignment A is approximately 885 feet. Alignment B is at approximately 875 feet. Through Alignment C the elevation stays about the same, ranging from 875-885 feet. Alignment D1 ranges from 810 to 865 feet. Some of the elevation changes in this alignment are due to the need for the alignment to go up and over the roadway. Alignment D2 varies from 825 to 925 feet, again from having to go up and over some of the roadways.

5.4.4 Environmental Consequences

5.4.4.1 Operating Phase (Long-Term) Impacts

Impacts to geology and soils will occur solely during construction; therefore, no operating phase (long-term) impacts are anticipated as a result of the Bottineau Transitway Project.

5.4.4.2 Construction Phase Impacts

No geologic features or hazards (karst formations) were identified in the project area and therefore will not be impacted. There were no highly erodible soils or steep slopes found within the potential area of disturbance, however, there are several areas of poorly drained soils (Udorthents) throughout the study area, which generally coincide with the wetland and floodplains described in previous sections. Poorly drained soils within the potential area of disturbance may require soil correction (remove and replace with stabile soils or treat in-place) for construction of track, pavement or other structures. These excavated soils would need to be removed from the project site or reused in areas that do not require consolidated soils.

Since the majority of the project will follow adjacent to existing track and/or roadways at similar elevations, there will not be substantial grading needed to work around steep slopes or other topographic constraints.

5.4.5 Avoidance, Minimization, and/or Mitigation Measures

All project-related construction activity would adhere to appropriate standards and applicable permitting requirements of MPCA, MnDOT, and Hennepin County for grading and erosion control.

5.5 Hazardous Materials Contamination

Information included within this section is based on the information provided in the Hazardous Materials Technical Report (Kimley-Horn and Associates, 2012).

5.5.1 Regulatory Context and Methodology

The MPCA oversees regulations pertaining to contaminated soil, groundwater, and waste cleanup plan approvals; petroleum underground storage tank registration and removal; and NPDES permitting. Additionally, the Minnesota Department of Health regulates asbestos abatement. Activities that encounter contaminated materials must follow state requirements for safe handling and disposal under the purview of the MPCA.

There is no single comprehensive source of information available which identifies known or potential sources of environmental contamination. Therefore, to identify and evaluate sites potentially containing hazardous or regulated materials (such as petroleum products) or other sources of potential contamination, a governmental database search was conducted. This screening tool identifies locations of sites with known or potential environmental liabilities based on information contained in various federal and state government databases (available via MPCA), including the following:

- Superfund Site Information Listing (SHWS) – Database including all sites that the state Superfund Program is dealing with or has dealt with.
- Voluntary Investigation and Cleanup Program (VIC) – Database containing records for sites enrolled in the VIC
- Brownfields – Database containing property information for petroleum impacted sites
- Leaking Underground Storage Tanks (LUST) – Database containing records of reported leaking underground storage tanks and other subsurface tank storage incidents
- Leaking Aboveground Storage Tanks (LAST) – Database containing records of reported leaking aboveground storage tanks and other surface tank storage incidents
- SPILLS – Database containing records for spills reported to the MPCA
- Department of Agriculture Spills (AG SPILLS) – Database containing records for pesticide and fertilizer incidents reported to the MPCA
- Underground Storage Tanks (UST) – Database listing registered underground storage tanks
- Aboveground Storage Tanks (AST) – Database listing registered aboveground storage tanks

The impact analysis attempts to evaluate the potential risk of contaminants being found during construction based on known records. It does not measure the severity of the hazardous materials found onsite. Each of the sites identified through the database search was assigned a degree of risk for potential soil and or groundwater impacts. When multiple databases referred to a site, the highest applicable risk was used for classification.

- Low Risk – These are sites where hazardous material or petroleum products may have been stored or used; however, based on subsequent file review and field reconnaissance, no known contamination is associated with the property. Low risk sites include closed LUST and LAST sites that are more than 1/8 mile away from an alignment, inactive UST and AST sites, and closed SPILLS and AG SPILLS sites.
- Medium Risk – These sites are known to have or have had soil and/or groundwater contamination, but current information indicates that contamination is being remediated, does not require remediation, or requires continued monitoring. Medium risk sites include all Brownfields, open LUST and LAST sites that were more than 1/8 mile away from an alignment, open SPILLS and AG SPILLS sites.
- High Risk – These sites have a high potential for contamination to be found on-site. In some cases, contaminated groundwater may have migrated outside the boundaries of the site. Field investigation of soil and groundwater within planned construction limits may be needed to identify any contributing contamination from these sites and to identify a response action plan to be implemented during construction. High risk sites include all SHWS sites, VIC sites, and open LAST and LUST sites within 1/8 mile of Build alternative alignments.

A full listing of the contaminated sites potentially affecting the Bottineau Transitway alignments obtained during the records search can be found in the Hazardous Materials Technical Report (Kimley-Horn and Associates, 2012).

5.5.2 Study Area

The study area includes potentially contaminated properties or regulated material facilities within the appropriate ASTM (American Society of Testing and Materials) search radius for available governmental databases identified in the ASTM standards (E1527-05 and 40 CFR Sec. 312). These standard search distances vary and can extend up to one mile around the transitway project depending on the data source, as shown in Figure 5.5-1.

5.5.3 Affected Environment

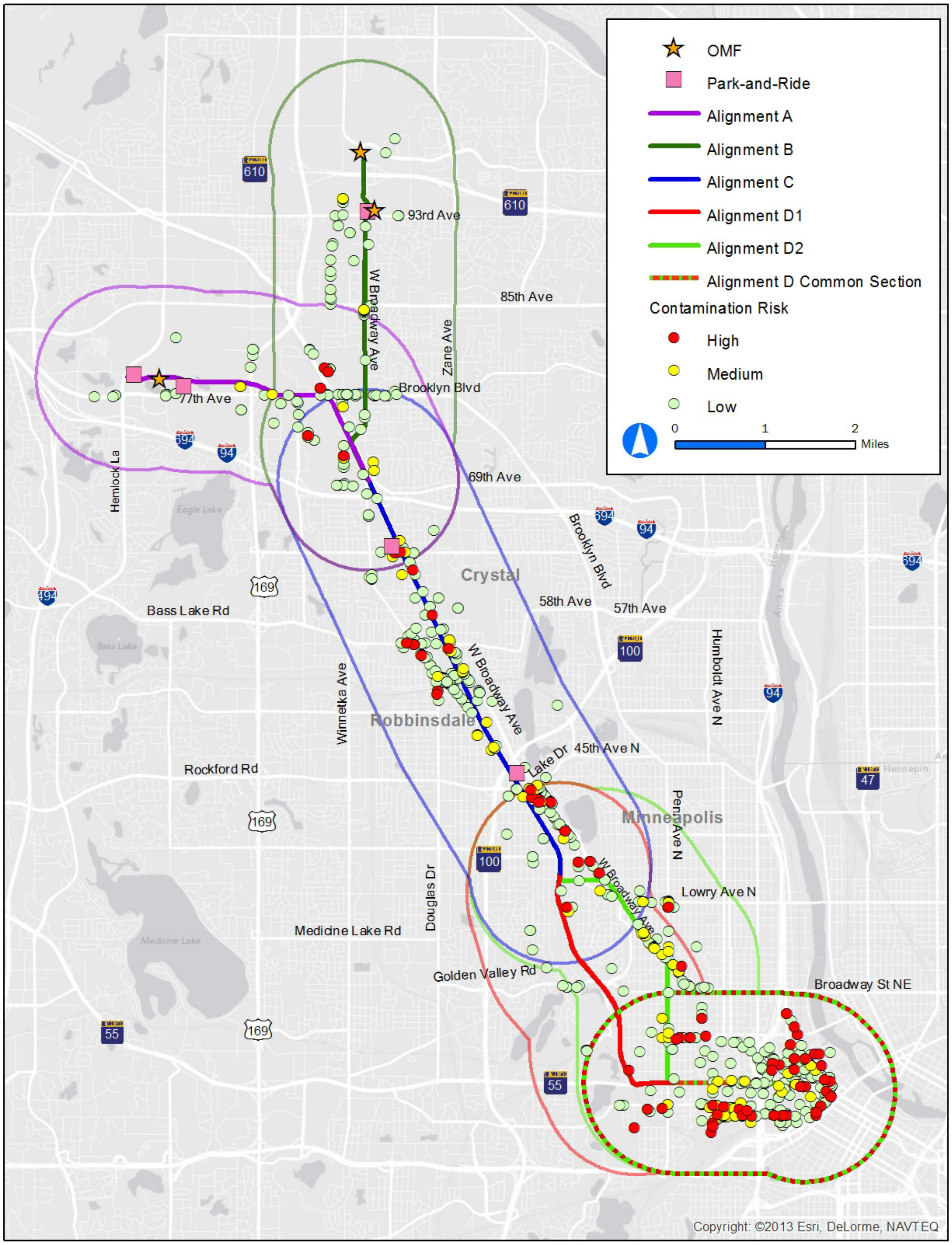
Potentially contaminated properties are often found in previously developed industrial and commercial areas. These types of land uses are common throughout the Bottineau Transitway study area. All of the proposed alternatives have some potential to encounter contaminated soils, groundwater, and materials based on prior use and development along the corridor. Table 5.5-1 provides a summary of the known hazardous/regulated materials sites identified within the study area based on a review of several databases that track known contamination sites. The identified sites are shown on Figure 5.5-1.

Table 5.5-1. Number of Recorded Sites with Potential Contaminants by Alternative

Alternative	Total Number of Recorded Sites[1]
No-Build	-
Enhanced Bus/TSM	-
A-C-D1	820
A-C-D2	907
B-C-D1 (Preferred Alternative)	790
B-C-D2	883

[1]Totals reflect all sites within the applicable ASTM standard search distances for each governmental database extending up to one mile of the alternative. Sites that exist in the study area for multiple alignments (A, B, C, D1, and D2) were counted as one site within the study area for an alternative.

Figure 5.5-1. Bottineau Transitway Hazardous and Contaminated Sites[16]



16 Source: Environmental Data Resources, April 2012, classified by Kimley-Horn and Associates, 2012

5.5.4 Environmental Consequences

5.5.4.1 Operating Phase (Long-Term) Impacts

No-Build Alternative

There is no likelihood of encountering contamination from hazardous or regulated materials as a result of the No-Build alternative.

Enhanced Bus/TSM Alternative

There is no likelihood of encountering contamination from hazardous or regulated materials as a result of the Enhanced Bus/TSM alternative.

Build Alternatives

There would be no hazardous or regulated materials produced by the project during operation of the Bottineau Transitway. No permanent storage tanks would be installed for this project. The collection and disposal of oils, grease, and other waste materials generated during vehicle maintenance and repair activities would be accomplished in accordance with recognized industry BMPs for rail transit maintenance facilities.

Acquiring land that is contaminated or contains hazardous or regulated material creates risk in the form of costs and potential liability to the project and project sponsors. The extent of that risk would be based on the type and extent of the contamination. Therefore, acquiring land with known contamination which cannot be easily remediated or contained would be avoided to the extent possible based on a more detailed investigation (Phase I and/or II Environmental Site Assessment [ESA]) of potential for contamination as the project advances into further stages of project development. The long term risk to the project will be determined once remediation is completed in areas of known and encountered contamination during construction.

TPSS

There would be no hazardous or regulated materials used or generated by the TPSS sites during operation of the Bottineau Transitway.

5.5.4.2 Construction Phase Impacts

No-Build Alternative

There is no likelihood of encountering contaminated or regulated materials as a result of the No-Build alternative. Therefore, no positive or negative impacts are expected.

Enhanced Bus/TSM Alternative

There is no likelihood of encountering contaminated or regulated materials as a result of the Enhanced Bus/TSM alternative. Therefore, no positive or negative impacts are expected.

Build Alternatives

The number of potentially contaminated sites in each alignment is summarized in Table 5.5-2. Since there is overlap in the study area for each alignment, some sites are listed under more than one alignment. Figure 5.5-1 illustrates these overlaps and the known sites. There are no impact differences for the OMF site options under Alignment B, as there are no known potentially contaminated sites near either location. There are also no differences in impacts for either of the proposed stations under Alignment D1, as there are no known potentially contaminated sites near either station location.

TPSS

Known hazardous sites would be avoided to the extent possible in the siting of TPSS to minimize the risk of encountering contaminated materials during construction.

5.5.4.3 Summary of Impacts by Alternative

As shown in Table 5.5-2, only one alignment has a high risk site within the potential area of disturbance (Alignment C), which is included in each of the Build alternatives. There are zero to ten medium risk sites within the potential area of disturbance, depending on the alignment. Table 5.5-3 shows the combined totals of sites by alternative and estimated risk. Alternative B-C-D1 has the lowest number of high/medium risks sites with just one site, whereas the alternatives with alignment D2 have the greatest amount of high/medium risk sites (17 to 18 sites).

High and medium risk sites, if within or near the area of disturbance, would be further assessed to determine the presence, type, and magnitude of contaminated soil and/or groundwater. A high risk area (such as SHWS sites, VIC sites, and open LAST and LUST sites within 1/8-mile of an alignment) or medium risk area (such as Brownfields, open LUST and LAST sites more than 1/8-mile from an alignment, and open SPILLS and AG SPILLS sites) has a greater known risk potential based on contamination type (databases listed in the Regulatory Context and Methodology section). Potential construction phase impacts include the time and expense of identifying, testing, and removing the contaminated materials found within the potential area of disturbance. A Phase I Environmental Site Assessment (ESA) (ASTM standards) will be completed for all disturbance areas under the Preferred Alternative to identify the type of contaminated materials. The results of the investigation would be used to determine if contaminated materials could be minimized or avoided or if additional investigation is needed to define the extent of contamination (Phase II ESA).

A Construction Contingency Plan would be developed as part of a Response Action Plan (RAP) for properly handling, treating, storing, and disposing of solid wastes, hazardous materials, petroleum products, and other regulated materials/wastes that are used or generated during construction and in the event that previously unknown hazardous materials are discovered during construction. Prior to construction activities, the project would be enrolled in the MPCA VIC program and the RAP would be developed and approved by MPCA. In the event that previously unknown hazardous materials are discovered during construction, the Contractor would notify the Project Engineer and follow the prescribed management protocol contained in the Construction Contingency Plan. The RAP will be developed through Engineering and approved prior to the release of the Final EIS.

Table 5.5-2. Contamination Risk by Alignment based on Classification and Location

Alignment	High Risk Sites		Medium Risk Sites		Low Risk Sites	
	Within Study Area	Within Estimated Disturbance Area[1]	Within Study Area	Within Estimated Disturbance Area[1]	Within Study Area	Within Estimated Disturbance Area[1]
A	8	0	7	2	144	7
B (part of the Preferred Alternative)	5	0	9	1	114	13
C (part of the Preferred Alternative)	27	1	32	2	254	8
D1 (part of the Preferred Alternative)	31	0	45	0	354	0
D2	31	0	62	10	379	21

Alignment	High Risk Sites		Medium Risk Sites		Low Risk Sites	
	Within Study Area	Within Estimated Disturbance Area[1]	Within Study Area	Within Estimated Disturbance Area[1]	Within Study Area	Within Estimated Disturbance Area[1]
D Common Section (part of the Preferred Alternative)	48	0	44	3	203	12

[1] Sites within the estimated area of disturbance are highlighted in Appendix B of the Hazardous and Regulated Materials Technical Report (Kimley-Horn and Associates, 2012).

Table 5.5-3. Contamination Risk by Alternative

Alternative	Risk Classification for Sites[1] within the Study Area		
	Low Risk	Medium Risk	High Risk
No-Build	0	0	0
Enhanced Bus/TSM	0	0	0
A-C-D1	27	7	1
A-C-D2	53	17	1
B-C-D1 (Preferred Alternative)	33	0	1
B-C-D2	59	16	1

[1] Totals reflect all sites within the applicable ASTM standard search distances for each governmental database ranging from adjacent to the project area to sites within one mile of the alternative. Sites that exist in the study area for multiple alignments (A, B, C, D1, and D2) were counted as one site within the study area for an alternative.

5.5.5 Avoidance, Minimization, and/or Mitigation Measures

Hennepin County and the Metropolitan Council would enroll in the MPCA VIC Program to obtain assurances that contaminated site cleanup work and/or contaminated site acquisition would not associate the agencies with long-term environmental liability for the contamination, and to obtain approvals for managing contaminated and hazardous materials encountered during construction.

A Phase I ESA (ASTM 1527-05) would be completed for all disturbance areas under the Preferred Alternative. The results of the investigation would be used to determine if contact with contaminated materials could be minimized or avoided and the extent of additional investigation needed (Phase II ESA). Based on the results of Phase II drilling investigations, the RAP will include proper handling and treating of contaminated soil and/or groundwater that could not be avoided during construction. A Construction Contingency Plan would be developed as part of the RAP for properly handling, treating, storing, and disposing of solid wastes, hazardous materials, petroleum products, and other regulated materials/wastes that are used or generated during construction and in the event that previously unknown hazardous materials are discovered during construction. The plan would also establish protocols to minimize impacts to soils and groundwater in the event a release of hazardous substances occurs during construction. If a release were to occur, the Minnesota Duty Officer would be contacted immediately to make the required agency contacts.

Prior to the demolition of any structures, assessments for asbestos-containing materials, lead-based paint, and other regulated materials/wastes would be performed. A demolition and disposal plan would be prepared for any identified contaminants that may be encountered during construction.

5.6 Noise

Information included within this section is based on the information provided in the Noise and Vibration Technical Report (HMMH, Inc., 2012).

5.6.1 Regulatory Context and Methodology

5.6.1.1 Regulatory Context

Noise has been assessed in accordance with guidelines specified in the FTA *Transit Noise and Vibration Impact Assessment* guidance manual (FTA Report FTA-VA-90-1003-06, May, 2006). This section describes the methodology for assessing potential impact from proposed transit projects such as the Bottineau Transitway.

Local ordinances will regulate construction-generated noise. The applicable ordinances are described in Section 5.6.4.2.

5.6.1.2 Methodology

The methodology for assessing potential long-term noise impact from transit operations includes:

- Identification of noise-sensitive land uses within the area of potential effect of the proposed project
- Measurement and characterization of existing noise conditions at these sensitive receptors
- Projections of future noise levels from transit operations for future Build alternatives
- Assessment of potential long-term noise impact
- Recommendations for noise mitigation

The guidance manual also includes the methodology for predicting and assessing potential short-term noise impact from construction activities. The approach to assessing potential impact from construction activities is more general than for transit operations since specific construction equipment and methods depend on the contractor's approach and are not typically defined at this stage of project development.

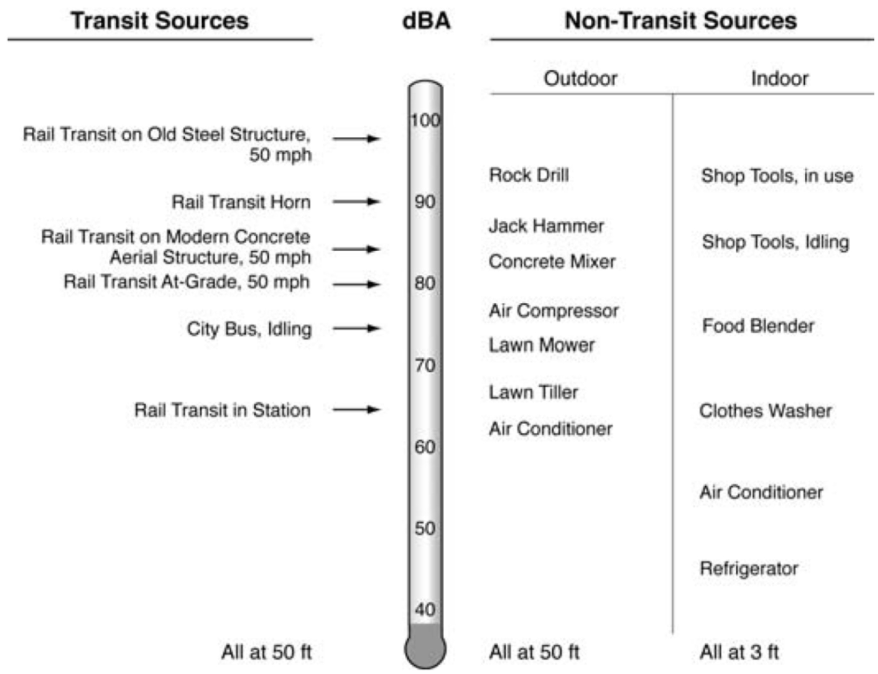
Noise Fundamentals and Descriptors

Two important aspects of sound that determine its potential impacts are loudness and frequency. The unit used to measure the loudness of noise is a decibel (dB). An adjusted dB scale, referred to as the A-weighted decibel scale, accounts for humans' ability to hear only a limited range of frequencies. Decibels in the A-weighted scale are designated as dBA. This analysis uses the dBA unit of measurement.

Noise levels at a given location tend to vary with time. To account for the variance in loudness over time, a common noise measurement is the equivalent sound pressure level (L_{eq}). It is measured in dBA for a specific time period (e.g., one minute). This analysis uses L_{eq} to describe traffic and transit noise at schools, libraries, and other sensitive institutions. This analysis also gave more weight to noise that occurs at night (10:00 p.m. to 7:00 a.m.), consistent with federal regulations. Calculations that use this method produce the Day-Night Equivalent Sound level, which is abbreviated as L_{dn}.

The following chart provides a comparison of the noise levels of some common noise sources.

Figure 5.6-1. Examples of Typical A-Weighted Sound Levels [17]



Noise Impact Criteria

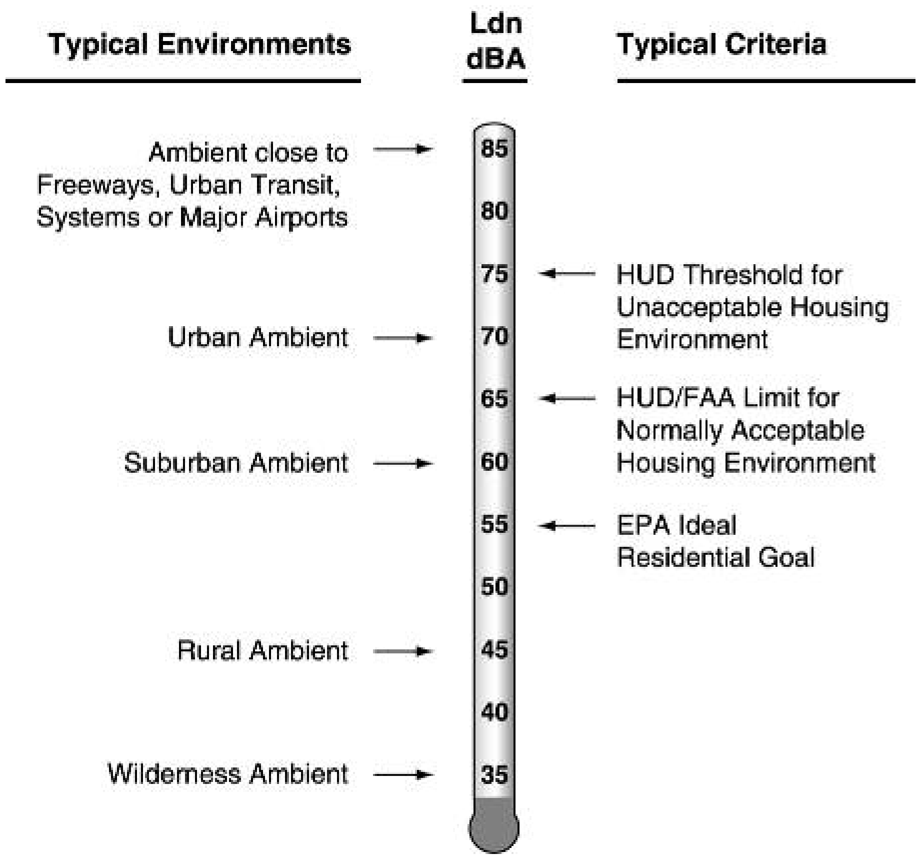
Noise Sensitive Land Use Categories

The FTA classifies noise-sensitive land uses into the following three categories:

- Category 1: Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use. Also included are recording studios and concert halls.
- Category 2: Residences and buildings where people normally sleep. This category includes homes, hospitals, and hotels where a nighttime sensitivity is assumed to be of utmost importance.
- Category 3: Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, theaters, and churches where it is important to avoid interference with such activities as speech, meditation, and concentration on reading material. Places for meditation or study associated with cemeteries, monuments, museums, campgrounds, and recreational facilities can also be considered to be in this category. Certain historical sites and parks are also included, such as parks used for passive recreation like reading, conversation, meditation, etc. However, most parks used primarily for active recreation would not be considered noise sensitive.

[17] Source: FTA Transit Noise and Vibration Impact Assessment, May 2006

Figure 5.6-2. Examples of Typical Outdoor L_{dn} Noise Exposure[18]



Impact Criteria

The FTA airborne noise impact criteria are based on the future change in noise exposure using a sliding scale. At locations with higher levels of existing noise, smaller increases in total noise exposure will cause impact. The L_{dn} is used to characterize noise exposure for locations with nighttime sensitivity, or Category 2 uses. For institutional land uses with primarily daytime use, such as parks and school buildings (Categories 1 and 3), the one-hour L_{eq} during the facility's operating period is used.

There are two levels of impact used in the FTA criteria, as summarized below:

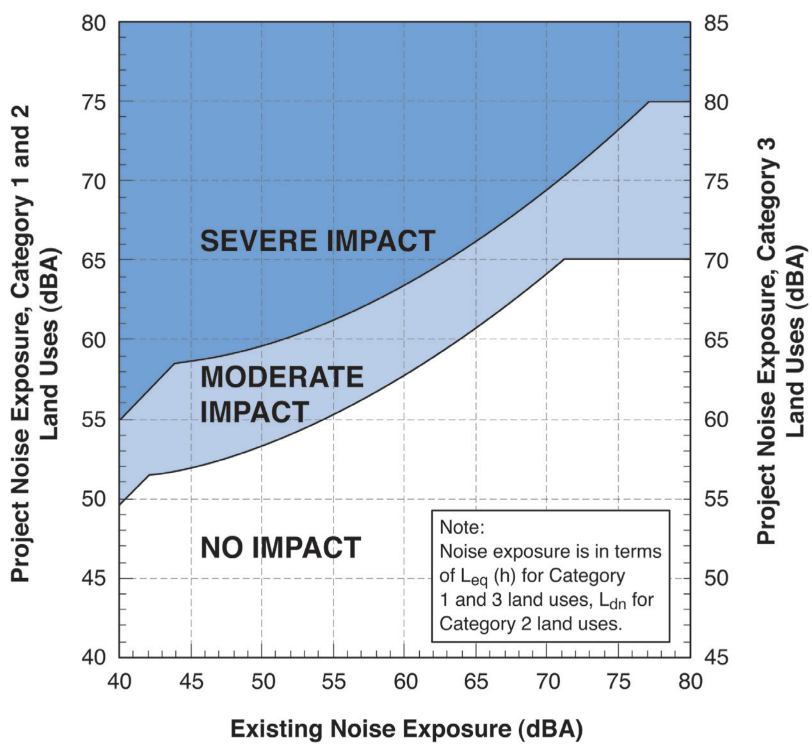
- **Severe Impact:** Project-generated noise in the severe impact range can be expected to cause a significant percentage of people to be highly annoyed by the new noise and represents the most compelling need for mitigation. Noise mitigation would normally be specified for severe impact areas unless there are truly extenuating circumstances that prevent it.
- **Moderate Impact:** In this range of noise impact, the change in the cumulative noise level is noticeable to most people but may not be sufficient to cause strong, adverse reactions from the community. In this transitional area, other project-specific factors must be considered to determine the magnitude of the impact and the need for mitigation. These factors include the existing noise level, the predicted level of increase over existing noise levels, the types and numbers of noise-sensitive land uses affected, the noise sensitivity of the properties, the effectiveness of the mitigation measures, community views, and the cost of mitigating noise to more acceptable levels.

[18] Source: HMMH Inc., 2012

The noise impact criteria are summarized in graphical form in Figure 5.6-3. The figure shows existing noise exposure along the horizontal axis, noise from a new project source (alone) along the vertical axis, and the resulting moderate and severe impact thresholds. In some instances, a proposed project may affect existing noise sources such as in the cases of relocation of streets or existing railroad tracks. In such cases, where existing noise sources would change as a direct result of the project, potential impact must be assessed based on the increase in overall noise exposure from existing to future conditions. While the two methods of assessing potential impact are equivalent, only the method based on the future increase in noise can be used to take into account changes to existing noise sources. Figure 5.6-4 expresses the same criteria in terms of the increase in total or cumulative noise that causes potential impact.

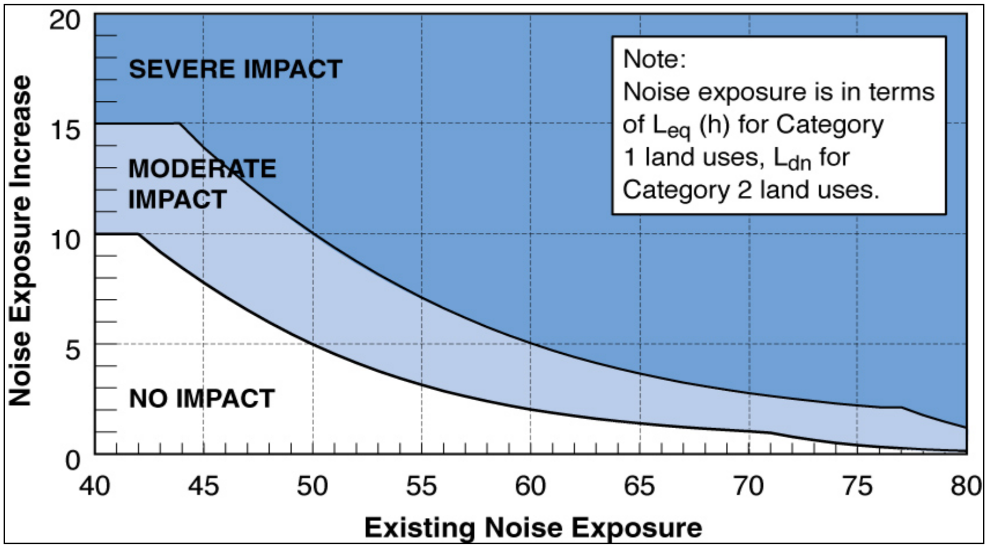
Because this project involves shifting of freight railroad tracks at some locations, this assessment uses the criteria in the form shown graphically in Figure 5.6-4. Along the horizontal axis of the graph is the range of existing noise exposure and the vertical axis shows the noise exposure increase due to the project that would cause either moderate or severe impact. The noise exposure increase is the difference between the existing noise level and the total future noise level, where the future level includes a combination of noise from existing and/or modified existing sources and from future project sources. Therefore, the future noise exposure increase would account for modifications to the existing environment such as shifting the freight railroad tracks.

Figure 5.6-3. FTA Noise Impact Criteria Comparing Existing Noise to Project Noise[19]



[19] Source: FTA, 2006

Figure 5.6-4. FTA Noise Impact Criteria Comparing Existing Noise to Increase in Future Noise[20]



Construction Noise Impact Criteria

Construction noise criteria are based on the guidelines provided in the FTA guidance manual. These criteria, summarized in Table 5.6-1 below, are based on land use and time of day and are given in terms of noise exposure over an eight-hour work shift or 30-day period.

Table 5.6-1. FTA Construction Noise Assessment Criteria

Land Use	8-hour L_{eq} (dBA)		Noise Exposure (dBA)
	Day	Night	30-day Average
Residential	80	70	75[1]
Commercial	85	85	80[2]
Industrial	90	90	85[2]

[1] In urban areas with very high ambient noise levels (L_{dn} > 65 dB), L_{dn} from construction operations should not exceed existing ambient + 10 dB.
[2] Twenty-four-hour L_{eq}, not L_{dn}.
Source: FTA, 2006

Noise Impact Assessment Methodology

The noise and vibration projections were carried out using the following methodological assumptions:

- All modeling projections are consistent with the methodology in the detailed assessment chapters of FTA's *Transit Noise and Vibration Impact Assessment* guidance manual (May 2006).
- Noise-sensitive land use in the corridor was determined based on parcel data, aerial imagery, and windshield surveys in the field. Specific noise-sensitive uses include: Residential homes (single-family, multi-family, retirement community), churches, children's center parks, a library, schools, retail establishments (shopping, restaurants, etc.), a radio station, and other places of business.

[20] Source: FTA, 2006

- LRT speeds were provided by the project team at 100-foot increments along the corridor. Speeds range from 20 mph to 55 mph along the corridor, and the same speed profile was used for both directions of travel.
- LRT operations were assumed to use three-car trains.
- The operating hours and service frequencies for LRT were assumed to be consistent with Metro Transit's Blue Line (Hiawatha). The service frequency assumed is as follows:
    - Early morning (4:00 to 6:00 a.m.): 20-30 minutes
    - Peak periods (6:00 to 9:00 a.m., 3:00 to 6:30 p.m.): 7.5 minutes
    - Midday (9:00 a.m. to 3:00 p.m.): 10 minutes
    - Evening (6:30 to 10:00 p.m.): 10 minutes
    - Late evening (10:00 p.m. to 2:00 a.m.): 30 minutes
- Existing noise levels were assigned to noise-sensitive receptors based on noise measurements conducted throughout the corridor and discussed in the next section of this report.
- The hours between 10:00 p.m. and 7:00 a.m. define nighttime events.
- Locations of aerial structures, crossovers, and embedded track were identified based on conceptual engineering plans available at the time of the assessment.
    - Noise level increases of up to six dB are assumed for receptors near crossover locations.
    - Noise level increases of four dB are assumed for receptors near aerial structures due to structure-radiated noise and reduced sound absorption for non-ballasted track.
    - Embedded track is assumed to be one dB quieter than ballast and tie track based on measured levels of the Blue Line as reported in the Central Corridor LRT Final EIS.
    - Elevations of structures were based on profile information provided.
- Noise from audible warning devices was projected based on the following assumptions:
    - Trains will sound the bells when entering and exiting station platforms.
    - Train horns will begin to be sounded 20 seconds, but not more than ¼ mile, in advance of higher-speed grade crossings.
    - Wayside bells will be sounded before and after the passage of each train for a total duration of 30 seconds, based on field measurements of the Blue Line.
    - Due to anticipated travel speeds in excess of 45 mph the train high horn will be sounded at the following intersections:
        - 73rd Avenue (Alignment A Only)
        - 71st Avenue (Alignment B Only)
        - Corvallis Avenue
        - Broadway Avenue
        - 45 ½ Avenue
        - 42nd Avenue
        - 39 ½-40th Avenue

- Reference Levels:
  - The source reference levels for the light rail vehicle (LRV) and wayside bells were based on the default values from the FTA guidance manual. The FTA manual assumes that a single rail car on ballast and tie track with continuous welded rail (CWR) generates a sound exposure level (SEL) of 82 dBA at a distance of 50 feet from the track centerline, and that the wayside bells generate a maximum sound level (Lmax) of 73 dBA at a distance of 50 feet.
  - The source reference level for wayside bells at pedestrian crossings was determined based on field measurements of the Blue Line. The pedestrian wayside crossing bells were found to generate a sound level of 68 dBA at a distance of 50 feet.
  - Reference levels for the vehicle horn and bell were provided by Metropolitan Council. It is assumed that LRV audible warning devices would generate sound levels of 95 dBA at 100 feet for the high horn and 79 dBA at 50 feet for the bell. Use of the high horn is assumed at all grade crossings where the speed exceeds 45 mph, and use of the bell is assumed at all other grade crossings. No low-horn usage was assumed.
  - Where LRVs operate on tight-radius curves (approximately 400-foot radius curves or less), there is the potential for increased noise due to wheel squeal. However, because wheel squeal is highly variable and difficult to predict, it has not been included in this assessment. It is assumed that mitigation for wheal squeal on curves, such as track lubrication devices, will be included in final design if curve squeal occurs on the Bottineau Transitway.
  - Assumed property acquisitions were not counted as potential noise impacts.

Because the construction of the Bottineau Transitway in Alignments C and D1 would require the existing BNSF rail line to be shifted to the west, the effect of moving freight operations relative to noise-sensitive receivers was included in the noise impact analysis. Freight train noise levels, including contributions from locomotives, rail cars, and horns, were predicted using Federal Railroad Administration (FRA) methodology. Because freight trains tended not to contribute significantly to the measured existing noise levels, and to provide a consistent comparison of existing and future noise levels, the noise from current freight operations was first estimated and then combined with the background ambient noise levels described above to determine the total existing noise levels in Alignments C and D1. The prediction of existing freight train noise was based on the following assumptions:

- Baseline freight train operations include one daily round trip during the daytime hours.
- All freight trains include two locomotives and 20 cars and operate at a speed of 20 mph.
- All freight trains sound their horn 20 seconds, but not more than ¼ mile in advance of grade crossings in conformance with current FRA regulations.
- Locomotive horns are center mounted, generating a sound level of 104 dBA at a distance of 100 feet.
- The shifted BNSF railroad track will be updated from jointed rail to CWR.
- Wheel impacts at track joints cause noise level increases of five dB for rail cars.

The update of the BNSF rail line to CWR will result in a five dB decrease in noise level from the wheel rail interaction for rail cars, but no change to the noise level from locomotive engines. Properties west of the rail line will be closer to the relocated track and may experience an increase in noise level. The increase in noise level due to the shift of the BNSF rail line varies for these properties because their distance to the existing and future rail line varies. Noise levels may increase by up to four dB for properties within 50 feet of the shifted future freight line. Properties that are at least 100 feet or farther from the future freight line will experience little to no increase in noise level from freight operations.

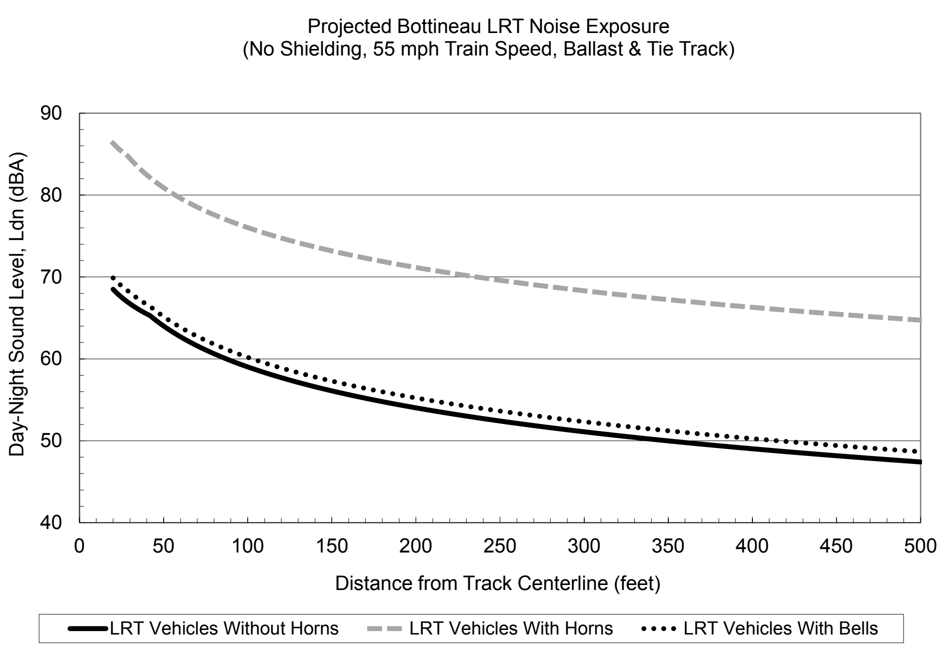
Future freight train noise levels were estimated based on the information above, except that all operations were assumed to be on the relocated and upgraded track (from jointed rail to CWR). The future noise levels from the freight operations were then combined with both the existing baseline ambient noise levels and the predicted LRT noise levels to determine the total future noise exposure. Finally, noise impact was assessed based on the projected noise increase at each sensitive receptor area, according to the FTA criteria.

Additional noise from OMF and station park-and-ride activities has also been taken into account in the assessment. The prediction of noise from these facilities was based on the following assumptions:

- There will be 29 LRT train movements for OMF locations on Alignment B.
- For the park-and-ride facility, the parking lot will fill to capacity in the morning (5:00 to 7:00 a.m. during nighttime hours) and empty completely in evening (5:00 to 7:00 p.m. during daytime hours)

Examples of the projected noise exposure from LRT operations at the maximum operating speed of 55 mph with and without vehicle horns and bells are shown in Figure 5.6-5 as a function of distance. The projections are based on the assumptions described above and are for community locations with an unobstructed view of the tracks. These results show that the highest noise levels occur when LRT train horns are sounded.

Figure 5.6-5. Projected 24-Hour Noise Exposure from LRT Operations[21]



Noise Measurement Locations and Procedures

Existing ambient noise levels in the project area were characterized through direct measurements at selected sites along the study corridor. Sites were selected along each corridor alignment at locations that are representative of an area of similar ambient sources and noise levels, with similar traffic, and

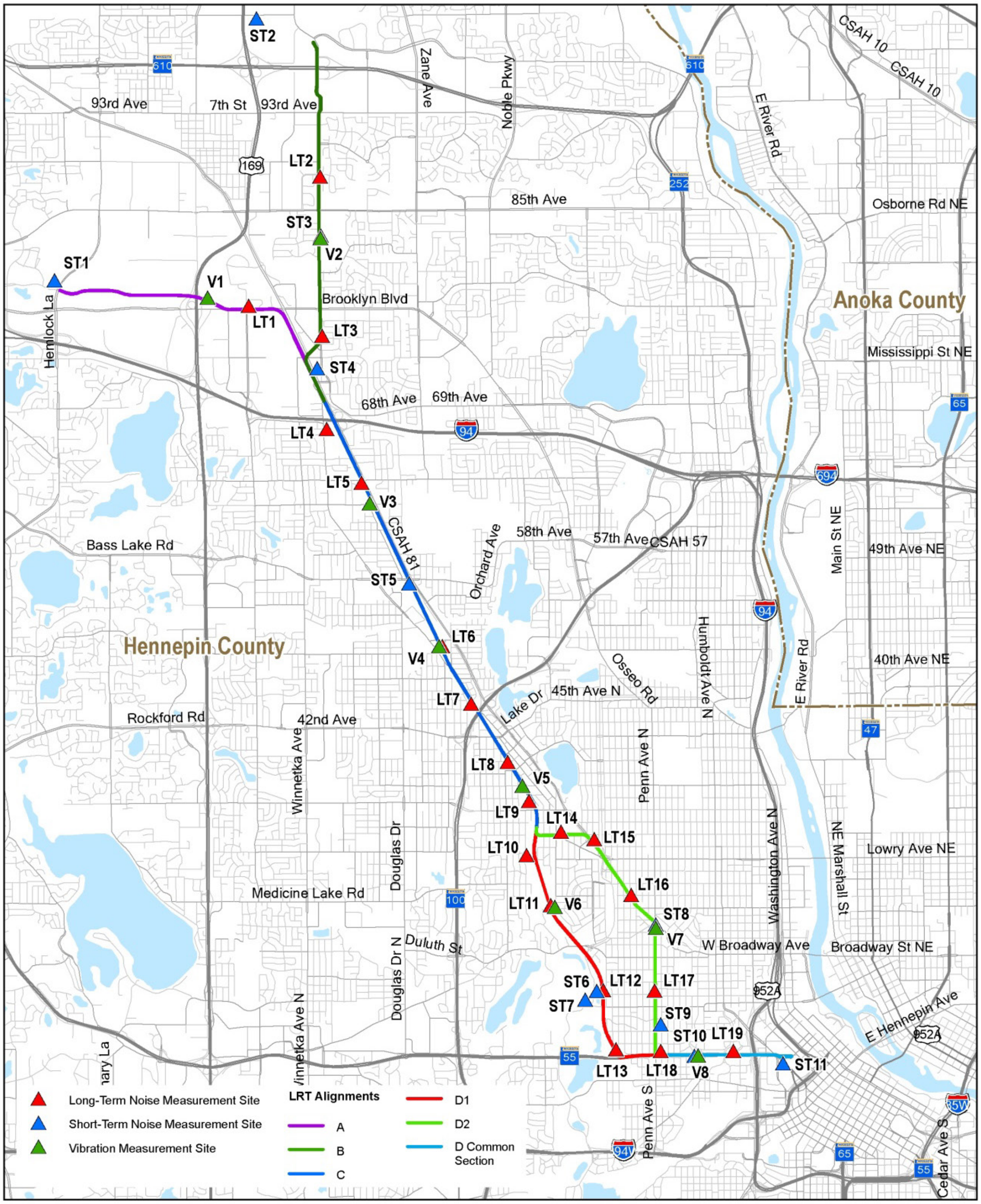
[21] Source: HMMH Inc., 2012

community noise activities. Generally these measurement locations represent an area of several blocks. Measurements were then used for numerous modeling sites in the area, and represent ambient noise levels for every type of land use in the vicinity.

The testing was performed during two time periods, first from July 13 through July 15, 2011 and subsequently from May 14 through May 18, 2012. The measurements consisted of long-term (24-hour) and short-term (one-hour) monitoring of the A-weighted sound level at representative noise-sensitive locations. Seven long-term and two short-term noise measurements were conducted in July 2011, and 12 long-term and nine short-term noise measurements were conducted in May 2012. The measurement locations, shown in Figure 5.6-6, were selected to reflect locations most likely to be affected by transit noise (i.e., sensitive receptors as described previously under Noise Impact Criteria) due to proximity of the proposed LRT alignment and/or future crossing locations. Additionally, measurement locations were selected such that each measurement represents similar existing noise characteristics for a general area. For instance, one measurement site would represent many homes that are parallel to a roadway with consistent traffic volume and speed, or a measurement might represent an area of homes all parallel to an existing freight line. These locations are illustrated in a series of figures in the Noise and Vibration Technical Report (HMMH, Inc., 2012). At each site, the measurement microphone was positioned to characterize the exposure of the site to the dominant noise sources in the area.

Bruel & Kjaer model 2250 noise monitors, conforming to ANSI Standard S1.4 for precision (Type 1) sound level meters, were used for gathering noise data. Calibrations, traceable to the US National Institute of Standards and Technology (NIST) were carried out in the field using acoustic calibrators. Thunderstorms in the Minneapolis area on July 15, 2011 caused a measureable increase in ambient noise from approximately 11:00 a.m. to 1:00 p.m. To more accurately determine existing noise levels from noise monitoring conducted during the thunderstorms, noise levels from data in the hours prior to and following the affected hours were used to estimate the noise levels during the affected time period.

Figure 5.6-6. Noise and Vibration Measurement Locations



5.6.2 Study Area

The study area for noise is based on the screening distances provided in Chapters 4 and 9 of the FTA guidance manual *Transit Noise and Vibration Impact Assessment* (May 2006). Screening distances provided in the FTA manual are based on typical project conditions and were adjusted based on the specific conditions of the Bottineau Transitway Project. All noise-sensitive land uses within the relevant screening distances were reviewed to identify locations where impacts may possibly occur. Typical screening distances provided by the FTA for LRT projects are given in Table 5.6-2. The “unobstructed” screening distances apply to noise-sensitive receivers where no large buildings or rows of homes are located in the sound path between the receiver and the noise source to provide shielding from noise. The “intervening buildings” screening distances apply to noise-sensitive receivers where large buildings or rows of homes do exist in the sound path and provide shielding between the receiver and the noise source.

Table 5.6-2. FTA Screening Distances for Noise Assessments

Type of Project	Screening Distances[1] (ft)	
	Unobstructed	Intervening Buildings
Light Rail Transit	350	175
Commuter Rail-Highway Crossing with Horns and Bells	1,600	1,200
Yards and Shops	1,000	650
Parking Facilities	125	75
Power Substations	250	125

[1] Measured from the centerline of guideway for mobile sources; from center of noise-generating activity for stationary sources.
Source: FTA, 2006

5.6.3 Affected Environment

The Bottineau Transitway Project Build alternative alignments are located in suburban and urban areas in the greater Minneapolis metropolitan area. The existing noise environments and sensitive land uses vary among the alignments and are described below.

Alignment A

This alignment is located along CSAH 130 (Brooklyn Boulevard), and the predominant noise sources are CSAH 130 traffic, local roadway traffic, and commercial activity. Noise-sensitive land use includes Arbor Lakes Senior Living, Hennepin Technical College, and several single- and multi-family residences near Boone Avenue North.

Alignment B (part of the Preferred Alternative)

This alignment is located along CSAH 103 and CSAH 130, and the predominant noise sources are traffic on CSAH 103, CSAH 130, and local roadways. Activity from residential neighborhoods, schools, and commercial land uses also contribute to the existing noise environment. Noise-sensitive land use includes North Hennepin Community College, Step by Step Montessori School, and several single- and multi-family residences north and south of CSAH 109 (85th Avenue).

Alignment C (part of the Preferred Alternative)

This alignment is located within the BNSF railroad corridor from 73rd Avenue North in Brooklyn Park to 36th Avenue North in Robbinsdale. The alignment is located along CSAH 81 starting from the north, and then shifts to run along West Broadway Avenue after crossing the CP railroad tracks. This alignment also passes by Crystal Airport. The predominant noise sources affecting the existing noise environment are traffic on CSAH 81 and West Broadway Avenue, BNSF train traffic, and airport activity. Noise-sensitive land use includes single- and multi-family residences, schools, churches, several hotels, parks identified for passive use, and Glen Haven Memorial Garden Cemetery, located about 450 feet west of the proposed alignment.

Alignment D1 (part of the Preferred Alternative)

This alignment is located within the BNSF railroad corridor and is adjacent to several park areas, including Theodore Wirth Regional Park. The alignment turns east along TH 55 until it reaches downtown Minneapolis. The predominant noise sources affecting the existing noise environment are train traffic on the BNSF railroad, local roadway traffic, and community activity. Noise-sensitive land use includes single- and multi-family residences, schools, churches, hotels, Sumner Library, and parks identified for passive use.

Alignment D2

This alignment exits the rail corridor at 34th Avenue and proceeds east to CSAH 81, runs along CSAH 81 and Penn Avenue, and then turns east along TH 55 until it reaches downtown Minneapolis. The predominant noise sources affecting the existing noise environment are traffic on those roads, local roadway traffic, and community activity. North Memorial Medical Center, NorthPoint Health and Wellness Center, and KMOJ Radio Station are noise-sensitive land uses that are adjacent to this alignment. Other noise-sensitive land use includes single- and multi-family residences, schools, churches, hotels, Sumner Library, and parks identified for passive use.

5.6.3.1 Noise Measurement Results

The results of the existing ambient noise measurements are summarized in Table 5.6-3. For each site, the table lists the adjacent alignment(s), site location, measurement details, and the measured noise levels. The results at each site are further described below. Photographs of the noise measurement sites and detailed noise measurement results are included in the appendices of the Noise and Vibration Technical Report (HMMH, Inc., 2012).

The noise measurement results indicate that most areas along the Bottineau Transitway within the study area have an existing noise environment typical of urban and suburban ambient levels, while some areas have ambient levels typical of quiet suburban environments. Noise monitoring sites in more densely populated areas such as downtown Robbinsdale, Penn Avenue, and TH 55 have ambient noise levels ranging from 62 to 68 dBA. This is because most of these sites are near major roadways and heavier commercial activity. Noise levels in Brooklyn Park range from 60 to 66 dBA due to the presence of major roadways and higher roadway speeds. Noise levels are lower for sites in the corridor where there is less roadway traffic and community and commercial activity. This includes sites near Theodore Wirth Regional Park on Alignment D1, with ambient noise levels ranging from 50 to 56 dBA. Some areas along Alignment C that are further from major roadways and commercial activity also experience quieter suburban ambient noise levels. Due to the nature of the FTA noise criteria, areas with lower ambient noise levels are more likely to be affected by noise from the project, and therefore are more likely to have locations with noise impact.

Table 5.6-1. Summary of Existing Ambient Noise Measurement Results

Site No.	Alignment	Measurement Location	Measurement Location Description	Start of Measurement		Measurement Duration (hrs)	Noise Exposure (dBA)		Contributing Noise Sources
				Date	Time		L_{dn}[1]	L_{eq}[2]	
LT-1	A	7700 Boone Avenue North, Brooklyn Park	Back yard of single-family residence	5-14-12	11:00	24	63	59	Traffic on Brooklyn Boulevard and other local roads
LT-2	B (part of the Preferred Alternative)	8745 Oregon Avenue North, Brooklyn Park	Back yard of single-family residence	7-14-11	10:00	24	66	62	Traffic on CSAH 103 and local roads, commercial and community activity
LT-3	B (part of the Preferred Alternative)	7428 75th Circle North, Brooklyn Park	Back yard of duplex residence	5-14-12	13:00	24	60	55	Traffic on CSAH 103 and local roads, commercial and community activity
LT-4	C (part of the Preferred Alternative)	6648 West Broadway Avenue, Brooklyn Park	Back yard of single-family residence	5-15-12	13:00	24	61	61	Traffic on CSAH 8, CSAH 81, and other local roads
LT-5	C (part of the Preferred Alternative)	6288 Louisiana Court North, Brooklyn Park (Waterford Manor)	Back yard of multi-family retirement community	5-14-12	12:00	24	63	57	Freight traffic on the BNSF railroad, traffic on CSAH 81 and other local roads
LT-6	C (part of the Preferred Alternative)	5001 Welcome Avenue North, Crystal	Back yard of single-family residence	7-14-11	15:00	24	54	48	Freight traffic on the BNSF railroad and other nearby rail lines, traffic on local roads, residential community activity
LT-7	C (part of the Preferred Alternative)	4416 Toledo Avenue North, Robbinsdale	Back yard of single-family residence	5-14-12	14:00	24	57	49	Freight traffic on the BNSF railroad, traffic on CSAH 8 and other local roads
LT-8	C (part of the Preferred Alternative)	3954 Noble Avenue North, Robbinsdale	Back yard of single-family residence	7-14-11	14:00	24	66	49	Freight traffic on the BNSF railroad, traffic on local roads, commercial and community activity
LT-9	C (part of the Preferred Alternative)	4400 36th Avenue North, Robbinsdale (Lee Square Co-Op)	Back yard of multi-family retirement community	5-15-12	15:00	24	54	48	Freight traffic on the BNSF railroad, pedestrian and bicycle path traffic, traffic on 36th Avenue North and other local roads
LT-10	D1 (part of the Preferred Alternative)	3230 Kyle Avenue North, Golden Valley	Back yard of single-family residence	5-15-12	14:00	24	51	45	Freight traffic on the BNSF railroad, local roadway traffic, residential community activity
LT-11	D1 (part of the Preferred Alternative)	3912 26th Avenue North, Robbinsdale	Back yard of single-family residence	7-13-11	16:00	24	50	45	Freight traffic on the BNSF railroad, residential community activity
LT-12	D1 (part of the Preferred Alternative)	The Family Partnership – 1501 Xerxes Avenue North, Golden Valley	Back yard of The Family Partnership	7-14-11	17:00	24	55	50	Freight traffic on the BNSF railroad, traffic on local roads, residential and school activity
LT-13	D1 (part of the Preferred Alternative)	623 North Vincent Avenue, Minneapolis	Back yard of duplex residence	5-16-12	17:00	24	56	50	Freight traffic on the BNSF railroad and other nearby rail lines, traffic on local roads
LT-14	D2	3807 Van Demark Avenue, Robbinsdale	Side yard of single-family residence	5-16-12	16:00	24	53	44	Traffic on CSAH 81 and local roads, hospital activity at North Memorial Medical Center
LT-15	D2	3334 Lakeland Avenue North, Robbinsdale	Side yard of single-family residence	7-13-11	14:00	24	62	57	Traffic on CSAH 81 and local roads, hospital activity at North Memorial Medical Center
LT-16	D2	2519 North 27th Avenue, Minneapolis	Side yard of single-family residence	5-16-12	18:00	24	65	61	Traffic on West Broadway Avenue and local roads, community activity
LT-17	D2	1411 Penn Avenue North, Minneapolis	Back yard of duplex residence	7-13-11	15:00	24	68	62	Traffic on Penn Avenue and other local roads, hospital activity at NorthPoint Health and Wellness Center
LT-18	D Common Section (part of the Preferred Alternative)	611 North Oliver Avenue, Minneapolis	Back yard of single-family residence	5-17-12	12:00	24	62	59	Traffic on TH 55 and other local roads
LT-19	D Common Section (part of the Preferred Alternative)	1000 TH 55, Minneapolis (Heritage Park)	Back yard of duplex residence	5-15-12	18:00	24	65	61	Traffic on TH 55 and other local roads
ST-1	A	Arbor Lakes Retirement Community, Maple Grove	Retirement community	5-15-12	7:58	1	50	52	Traffic on Hemlock Lane and Arbor Lakes Parkway

Site No.	Alignment	Measurement Location	Measurement Location Description	Start of Measurement		Measurement Duration (hrs)	Noise Exposure (dBA)		Contributing Noise Sources
				Date	Time		L_{dn}[1]	L_{eq}[2]	
ST-2	B (part of the Preferred Alternative)	Grace Fellowship Church, Brooklyn Park	Church	5-14-12	17:00	1	54	56	Traffic on US 169 and other nearby roads
ST-3	B (part of the Preferred Alternative)	North Hennepin Community College, Brooklyn Park	Parking lot of school	5-14-12	15:33	1	58	60	Traffic on Broadway Avenue
ST-4	C (part of the Preferred Alternative)	Prince of Peace Church, Brooklyn Park	Church	5-16-12	13:11	1	57	59	Traffic on Broadway Avenue and CSAH 81
ST-5	C (part of the Preferred Alternative)	Becker Park, Crystal	Park	5-17-12	13:51	1	54	56	Traffic on CSAH 81 and Bass Lake Road, community activity
ST-6	D1 (part of the Preferred Alternative)	Theodore Wirth Regional Park, Golden Valley	Park	5-18-12	10:01	1	47	49	Traffic on Theodore Wirth Parkway
ST-7	D1 (part of the Preferred Alternative)	The Chalet at Theodore Wirth Regional Park, Golden Valley	Park	5-18-12	11:20	1	53	55	Traffic on Theodore Wirth Parkway
ST-8	D2	KMOJ Radio Station – Penn Avenue and Broadway Avenue, Minneapolis	Sidewalk next to radio station	7-15-11	13:27	1	68	70	Traffic on Broadway Avenue, Penn Avenue, and McNair Avenue, commercial and community activity
ST-9	D2	Lincoln Junior High – Oliver Street, Minneapolis	Parking lot of school	7-13-11	16:21	1	50	52	Traffic on Oliver Street, community activity
ST-10	D Common Section (part of the Preferred Alternative)	Harrison Education Center, Minneapolis	Park	5-15-12	16:07	1	60	62	Traffic on TH 55 and other local roads
ST-11	D Common Section (part of the Preferred Alternative)	Mary My Hope Children's Center, Minneapolis	Sidewalk next to Children's Center	5-17-12	16:09	1	65	67	Traffic on 7th Avenue, community activity

[1] For sites ST-1 through ST-11, the L_{eq} measurements were used to estimate the L_{dn} using FTA methodology for estimating noise exposure. This approach tends to be conservative and underestimate the existing noise levels, which can result in higher levels of noise impact for a project.
[2] For sites LT-1 through LT-19, the L_{eq} was taken from the quietest hour of the typical peak traffic hours: 6:00 a.m. to 9:00 a.m. and 4:00 p.m. to 7:00 p.m. The lowest peak traffic hour noise level is used to provide a conservative estimate of the noise.
Source: HMMH Inc., 2012

5.6.4 Environmental Consequences

5.6.4.1 Operating Phase (Long-Term) Impacts

No-Build Alternative

While there would be some changes in bus traffic on existing roadways due to future No-Build transit improvements, these would not significantly affect the existing noise levels. Thus, no noise impacts are anticipated within the Bottineau Transitway study area for the No-Build alternative.

Enhanced Bus/TSM Alternative

Similar to the No-Build alternative, no significant noise impacts would occur within the Bottineau Transitway study area for the Enhanced Bus/TSM alternative.

Build Alternatives

Table 5.6-4 below summarizes the results of the noise impact assessment by alignment. Comparisons of the existing and future noise levels are presented in Table 5.6-4, which includes ranges of results for FTA Category 2 (residential) receptors with both daytime and nighttime sensitivity to noise and Category 3 receptors, consisting of institutional and recreational land uses with primarily daytime and evening use. In addition to the distances to the track and proposed train speeds, Table 5.6-4 includes the existing noise levels, the projected noise levels from rail operations, the future total noise levels, and the predicted noise increases due to the project within each segment along the corridor. The predicted noise level increase equals the future total noise level minus the existing noise level. Based on a comparison of the predicted noise level increase with the impact criteria, the table also includes an inventory of the number of moderate and severe noise impacts for each alignment option. The impacts for each alignment option are discussed below, and Figures 12 through 40 in Appendix G show the locations of projected unmitigated noise impacts. This represents all of the potential impacts along the corridor if no mitigation measures were implemented. The application of mitigation measures would reduce the number of impacted locations and the severity of impacts. The noise impact figures show the entire Bottineau Transitway even though impacts are not projected to occur at all locations along the corridor.

It should be noted that impacts to historic properties as a result of project-related noise are discussed in Section 4.4 and Chapter 8 Section 4(f) Analysis.

Table 5.6-4. Summary of Unmitigated Noise Impacts by Alignment

Alignment	Receptor Type	Dist. to Track (ft)[1]	Train Speed (mph)	Existing Noise Level[1] (dBA)[3]	Project Noise Level[1] (dBA)[4]	Total Noise Level[1] (dBA)[5]	Noise Level Increase[2] (dB)			Number of Receptors Impacted	
							Predicted[6]	Impact Criteria			
								Mod.	Sev.	Mod.	Sev.
A	Cat. 2	90 to 890	20 to 55	56 to 63	57 to 61	59 to 65	1.7 to 5.3	1.6 to 2.8	4.1 to 6.4	75	0
	Cat. 3	0		0	0	0	0	0	0	0	0
B (part of the Preferred Alternative	Cat. 2	65 to 890	20 to 50	56 to 66	57 to 74	59 to 75	1.5 to 11.4	1.3 to 3	3.5 to 6.9	150	8
	Cat. 3	450		56	63	64	7.4	5.8	10.7	1	0
C[7] (part of the Preferred Alternative)	Cat. 2	30 to 770	20 to 55	54 to 68	55 to 83	58 to 83	1.7 to 26.5	1.1 to 3.6	3 to 7.8	689 to 708	481 to 484
	Cat. 3	90 to 610		48 to 49	59 to 75	59 to 75	10.1 to 26	9.4 to 10.2	15.3 to 16.3	4	2
D1[8] (part of the Preferred Alternative)	Cat. 2	30 to 260	20 to 55	51 to 58	54 to 69	56 to 69	2.9 to 11.9	2.4 to 4.6	5.8 to 9.4	49 to 56	40
	Cat. 3	40 to 115		45 to 50	57 to 64	58 to 64	12.4 to 14.2	9.1 to 12.1	14.9 to 18.6	2	0
D2	Cat. 2	30 to 410	20 to 45	53 to 67	50 to 67	57 to 69	1.5 to 14.4	1.2 to 3.9	3.2 to 8.4	320	40
	Cat. 3	15 to 80		44 to 62	62 to 67	62 to 68	6.5 to 17.9	4.1 to 13	8.2 to 19.7	2	0
D Common Section (part of the Preferred Alternative)	Cat. 2	100	20 to 35	64	61	66	1.8	1.5	4	18	0

[1] Distance to track is based on current alignment location data and has been rounded to the nearest five feet for this summary.
[2] Noise levels for land use category 2 are based on L_{dn} and noise levels for land use category 3 are based on one-hour L_{eq}; both are measured in dBA.
[3] Existing noise levels are the results of the ambient noise measurements conducted for the project.
[4] Project noise levels are exclusive of ambient noise levels, and includes project noise elements only.
[5] Total noise levels are the cumulative noise levels including both ambient and project noise elements.
[6] Predicted levels include LRV horn and bell noise and wayside crossing bells, where applicable.
[7] Impacts on Alignment C vary due to the use of horn at the 71st Avenue grade crossing with Alignment B and the bell with Alignment A. This assumption is based on speed.
[8] Impacts on Alignment D1 vary depending on use of the Golden Valley Road or Plymouth Avenue/Theodore Wirth Regional Park station options due to differences in speeds and noise sources at different locations on the corridor.
Source: HMMH Inc., 2012

Alignment A

For Alignment A, no severe noise impact is predicted to occur and moderate noise impact is predicted to occur at 75 residences. There are generally a low number of impacts for this alignment option compared to other alignments due to a low number of noise-sensitive properties, although the presence of multi-family properties results in more residences affected. The impacts in this section are largely due to the use of the LRV high-horn audible warning device. Impacts are also caused by receiver proximity to both the track and to the wayside crossing signals.

Alignment B (part of the Preferred Alternative)

For Alignment B, severe noise impact is predicted to occur at eight residences and moderate noise impact at 150 residences. Moderate noise impact is also predicted to occur at Prince of Peace Lutheran Church. The impacts in this section are largely due to receiver proximity to the track and wayside crossing signals, as well as proximity to crossovers.

Alignment C (part of the Preferred Alternative)

For Alignment C, the total number of impacts differs depending on the north alignment option selected (Alignment A or B) as the assumed LRT speed at the 71st Avenue grade crossing is lower with Alignment A due to the proximity to the 71st Avenue station. The noise analysis assumes a bell will be sounded at the 71st Avenue grade crossing with Alignment A and a horn will be sounded with Alignment B. Severe noise impact is predicted to occur at up to 481 residences, and also at Robin Hotel, Doug Stanton Ministries, and Triangle Park. Moderate noise impact is predicted to occur at up to 689 residences, and also at Washburn McReavy Funeral Home, Sacred Heart Church and School, Welcome Park, and Lee Park. The impacts in this section are largely due to the use of the LRV high-horn audible warning device. Impacts are also caused by receiver proximity to the LRT track, the relocated BNSF rail line, and crossovers.

Alignment D1 (part of the Preferred Alternative)

For Alignment D1, the total number of impacts differs depending on which LRT station option is selected -- the Golden Valley Road station option or the Plymouth Avenue/Theodore Wirth Regional Park station option. This variation is due to changes in LRT speed depending on station location. Severe noise impact is predicted to occur at 40 residences and moderate noise impact is predicted to occur at up to 56 residences, South Halifax Park, and The Family Partnership School. The impacts in this section are largely due to receiver proximity to the track and crossovers. The residential noise impacts occur east of the alignment because the properties to the east are closer to the track and there are fewer residences to the west as the corridor is positioned along Walter Sochacki Park and Theodore Wirth Regional Park.

Alignment D2

For Alignment D2, severe noise impact is predicted to occur at 40 residences and moderate noise impact is predicted at 320 residences, North Memorial Medical Center and Outpatient Center, and NorthPoint Health and Wellness Center. The impacts in this section are largely due to receiver proximity to the track, crossovers, and track on aerial structure. No impact is predicted at KMOJ Radio Station. A greater number of moderate noise impacts is predicted on the west side of Penn Avenue (this includes homes that front on the east side of Queen Avenue with backyards adjacent to the transitway) than on the east due to the increase in future noise level predicted to result from the shift of Penn Avenue approximately 40 feet to the west. Impacts are due to both the removal of a row of homes facing Penn Avenue and the shift of Penn Avenue to the west.

Alignment D Common Section (part of the Preferred Alternative)

For the Alignment D Common Section moderate noise impact is predicted to occur at 18 residences. The predicted impacts in this section are due to proximity to the track and crossovers. There are few impacts in this section due to higher existing noise levels in this area as the corridor nears downtown Minneapolis and the placement of the alignment in the median of TH 55, which is a six-lane roadway along most of the alignment. There is also no predicted use of the high-horn in this section.

Summary of Impacts by Alternative

Table 5.6-5 below summarizes the predicted noise impact assessment results by Build alternative.

Table 5.6-5. Summary of Unmitigated Noise Impacts by Alternative

Alternative	Total Number of Receptors with Moderate Noise Impact	Total Number of Receptors with Severe Noise Impact
No-Build	No noise impacts currently anticipated	
Enhanced Bus/TSM	No noise impacts currently anticipated	
A-C-D1	844[1] 837[2]	523
A-C-D2	1,108	523
B-C-D1 (Preferred Alternative)	939[1] 932[2]	534
B-C-D2	1,203	534

[1] With Golden Valley Road station option
[2] With Plymouth Avenue/Theodore Wirth Regional Park station option
Source: HMMH Inc., 2012

Roadway Changes

There would be modifications to existing roadways due to the proposed Bottineau Transitway, which may affect future noise conditions. In particular, Penn Avenue on Alignment D2 would be shifted approximately 40 feet west, and the westbound lanes of TH 55 on Alignment D1 would be shifted approximately 60 feet north over a section approximately 800 feet in length. A noise analysis was conducted to determine the change in future noise levels for nearby sensitive receptors due to the roadway modifications. The noise analysis was based on measured noise levels from these roadways and future roadway alignments. The results indicate that roadway modifications would be expected to cause noise level increases of less than one dB, which would not substantially affect future noise conditions.

Stations

Noise projections near stations include speed adjustments and consideration of horn and bell noise at these locations. Additional noise from park-and-ride locations has also been included in the noise projections. However, the additional noise from park-and-ride activity does not significantly contribute to the total project noise level at any receptor.

OMF

The OMF option at the northernmost end of Alignment B at 101st Avenue is not predicted to cause noise impact at any noise-sensitive receptors. The closest receptor to this OMF option is Grace Fellowship church at approximately 1,300 feet from the center of OMF yard activity. The predicted L_{eq} from yard noise is approximately 45 dBA at this receptor, which results in no increase above the measured existing L_{eq} of 56 dBA at this location. For the OMF option on Alignment B at 93rd Avenue, the noise levels from yard activity is predicted to contribute to project noise levels at nearby receptors but is not predicted to cause impact.

TPSS

TPSS have the potential to cause noise impact when they are located proximate to noise-sensitive receptors. The primary noise sources associated with substations are magnetostriction of the transformer core, which causes low-frequency tonal noise (hum), and cooling fans, which typically generate broadband noise. At most, the potential for noise impacts from substations would be limited to noise-sensitive receptors located within 250 feet, which is the FTA noise impact screening distance for this source. The potential for noise impact from substations will be evaluated in a later phase of the project when sufficient details relating to their design and specific locations become available. Noise impact can be avoided by selecting TPSS sites that are not near noise-sensitive receptors or, if necessary, by including noise limits in the procurement documents.

The Chalet at Theodore Wirth Regional Park

The Chalet at Theodore Wirth Regional Park is an active-use recreational building. Much of the use in Theodore Wirth Regional Park is active recreational activity, aside from an area of picnic tables that has been included in the noise assessment and is predicted to experience no noise impact under the Build alternatives A-C-D1 and B-C-D1. Minneapolis Parks and Recreation Board, the agency with jurisdiction over Theodore Wirth Region Park, has concurred that the park is meant for active-use and therefore should not be considered for noise sensitive impacts. However, the change in noise level that would be experienced at The Chalet at Theodore Wirth Regional Park due to the project has been considered. The existing noise level measured over a one-hour period at The Chalet near the 10th Hole Tee was 55.4 dBA. According to FTA criteria, a noise level increase due to the project of 6.2 dBA would be the threshold for moderate impact at this location. The future noise level due to the project at this location would be 55.5 dBA with either the Golden Valley Road station option or the Plymouth Avenue/Theodore Wirth Regional Park station option. In either case, virtually no increase in noise level would be experienced at The Chalet under Build alternatives A-C-D1 and B-C-D1.

5.6.4.2 Construction Phase Impacts

Project-generated construction noise is subject to requirements of local noise ordinances in the following cities in the Bottineau Transitway corridor:

- Minneapolis - Construction/demolition noise is allowed 7:00 a.m. to 6:00 p.m., Monday through Friday. An After-Hours Work Permit is required for work anytime on Saturday or Sunday.
- Golden Valley – Construction noise is limited to the hours of 7:00 a.m. to 10:00 p.m.
- Robbinsdale – No specific ordinance relative to construction noise
- Crystal - Operating power equipment or machinery is allowed from 7:00 a.m. to 10:00 p.m. on weekdays and 9:00 a.m. to 9:00 p.m. on weekends and holidays.
- Brooklyn Park – Construction noise is limited to the house of 7:00 a.m. to 10:00 p.m.
- Maple Grove - Within 500 feet of any residentially zoned property, construction activities involving the use of manual tools, movement of equipment or power equipment are not allowed at any time other than between the hours of 7:00 a.m. and 9:00 p.m. on weekdays, and 8:00 a.m. and 9:00 p.m. on public holidays, Saturdays, and Sundays.

No-Build Alternative

No construction-related noise impacts of the Bottineau Transitway are anticipated to result from the No-Build alternative.

Enhanced Bus/TSM Alternative

No construction-related noise impacts of the Bottineau Transitway are anticipated to result from the Enhanced Bus/TSM alternative.

Build Alternatives

Temporary noise impacts could result from activities associated with the construction of new tracks and stations, utility relocation, grading, excavation, track work, demolition, and installation of systems components. Such impacts may occur in residential areas and at other noise-sensitive land uses located within several hundred feet of the alignment. The potential for noise impact would be greatest at locations near pile-driving operations for bridges and other structures, pavement breaking, and at locations close to any nighttime construction work.

Construction noise varies greatly depending on the construction process, type and condition of equipment used, and layout of the construction site. Many of these factors are traditionally left to the contractor's discretion. Overall, construction noise levels are governed primarily by the noisiest pieces of equipment. For most construction equipment, the engine, which is usually diesel, is the dominant noise source. This is particularly true of engines without sufficient muffling. For activities such as impact pile driving and pavement breaking, the predominant noise is that generated by the actual process.

Table 5.6-6 summarizes some available data on noise emissions of construction equipment from the FTA guidance manual, in terms of averages of the Lmax values at a distance of 50 feet. Although the noise levels in the table represent typical values, there can be wide fluctuations in the noise emissions of similar equipment. Construction noise exposure at a given noise-sensitive location depends on the magnitude of noise during each construction phase, the duration of the noise, and the distance from the construction activities.

Table 5.6-6. Construction Equipment Noise Emission Levels

Equipment Type	Typical Sound Level at 50 ft. (dBA)
Backhoe	80
Bulldozer	85
Compactor	82
Compressor	81
Concrete Mixer	85
Concrete Pump	82
Crane, Derrick	88
Crane, Mobile	83
Loader	85
Pavement Breaker	88
Paver	89
Pile Driver, Impact	101
Pump	76
Roller	74
Truck	88

Source: Federal Transit Administration, 2006

Projecting construction noise exposure requires an understanding of the equipment likely to be used, the duration of its use, and the way it may be used by an operator (e.g., the percentage of time during operating hours that the equipment operates under full power during each phase). Using typical sound emission characteristics, as given in Table 5.6-6, it is possible to estimate L_{eq} or Ldn at various distances from the construction site.

The noise impact assessment for a construction site is based on:

- An estimate of the type of equipment that would be used during each phase of the construction and the average daily duty cycle for each category of equipment

- Typical noise emission levels for each category of equipment such as those in Table 5.6-6
- Estimates of noise attenuation as a function of distance from the construction site

Table 5.6-7 is an example of the noise projections for equipment that is often used during tie-and-ballast track construction. For the calculations, it is assumed that all the equipment is located at the geometric center of the construction work site. Based on this scenario, an eight-hour L_{eq} of 88 dBA would be expected at a distance of 50 feet from the geometric center of the work site. This calculation in Table 5.6-7 does not assume any noise mitigation measures or any limits on the contractor about how much noise can be made. With at-grade track construction, the duration of the activities at a specific location along the alignment would be relatively limited, usually a matter of several weeks. As a result, even when there may be noise impacts, the limited duration of the construction can mean that mitigation is not cost effective.

Table 5.6-7. Typical Equipment List, At-Grade Track Construction

Equipment Item	Typical Maximum Sound Level at 50 ft. (dBA)	Equipment Utilization Factor (%)	L_{eq} (dBA)
Air Compressor	83	50%	80
Backhoe	80	40%	76
Crane, Derrick	82	10%	72
Dozer	85	40%	81
Generator	81	80%	80
Loader	85	40%	81
Pavement Breaker	84	4%	70
Shovel	80	40%	76
Dump Truck	88	16%	80
Total Workday L_{eq} at 50 feet (8-hour workday)			88

Source: HMMH Inc., 2012

Based on the criteria in Section 3.1.3 of the Noise and Vibration Technical Report (HMMH, Inc., 2012) and the noise projections in Table 5.6-7, and assuming that construction noise is reduced by six decibels for each doubling of distance from the center of the site, screening distances for potential track construction noise impact can be estimated. These estimates suggest that the potential for track construction noise impact would be minimal for commercial and industrial land use, with impact screening distances of 70 feet and 40 feet, respectively. Even for residential land use, the potential for temporary track construction noise impact would be limited to locations within about 125 feet of the corridor. However, the potential for noise impact from nighttime track construction could extend to residences as far as 400 feet.

5.6.5 Avoidance, Minimization and/or Mitigation Measures

To mitigate noise impact from train operations, noise control can be considered at the source, along the sound path, or at the receiver. Potential mitigation measures for reducing noise impacts from the proposed project operations in terms of source, path, and receiver are described in Table 5.6-8.

Noise mitigation is considered depending on the need, feasibility, reasonableness, and effectiveness of potential options. The FTA states that in considering potential noise impact, severe impacts should be mitigated if at all practical and effective. At the moderate impact level, more discretion should be used, and other project-specific factors should be included in considering the need for mitigation. These factors include the existing noise level, predicted increase over the existing noise levels, the types and number of noise-sensitive land uses affected, the noise sensitivity of the properties, the acoustic effectiveness of mitigation options, and the cost-effectiveness of mitigating the noise.

Table 5.6-8. Potential Noise Mitigation Measures for Operational Impacts

Mitigation Location	Mitigation Option	Description
Source	Establishment of Quiet Zones	An effective option for mitigating noise impacts along the alignment would be to establish "quiet zones" near at-grade crossings. Quiet zones would need to be established in accordance with FRA regulations. In quiet zones, because of safety improvements at the at-grade crossings, train operators would sound horns only in emergency situations rather than as a standard operating procedure. Establishing quiet zones would require cooperative action among the municipalities along the corridor, Minnesota DOT, FRA, BNSF, and the transit agency. The municipalities are key participants in the process, as they must initiate the request to establish quiet zones through application to the FRA. To meet safety criteria, the municipalities may also be required to provide improvements at grade crossings such as modifications to the streets, raised medians, warning lights, and other devices. The FRA regulation also authorizes the use of automated wayside horns at crossings along with flashing lights and gates as a substitute for the train horn. While activated by the approach of trains, these devices are pole-mounted at the grade crossing, thereby limiting the horn noise exposure area to the immediate vicinity of the crossing.
	Modified Use of Audible Warning Devices	An approach for mitigating noise impacts due to LRV and wayside audible warning devices (e.g., horns and bells) would be to modify the design, settings, or use of these devices.
	Special Trackwork	Turnouts are a major source of noise impact when they are located in sensitive areas. If turnouts cannot be relocated away from sensitive areas, other methods can be used to reduce noise impacts such as the use of spring-rail, flange-bearing, or moveable-point frogs in place of standard rigid frogs at turnouts. These devices allow the flangeway gap to remain closed in the main traffic direction for revenue service trains.
	Wheel/Rail Lubrication	There are several options to mitigate potential wheel squeal from small-radius curves, including on-board solid-stick rail lubrication and wayside rail lubrication. Automated wayside top-of-rail friction modifier systems put a small amount of lubricant onto the top of the rail, which maintains a constant coefficient of friction. This type of lubricant has been shown to reduce or eliminate the potential for wheel squeal.
Path	Noise Barriers	This is a common approach to reducing noise impacts from surface transportation sources. The primary requirements for an effective noise barrier are that the barrier must be high enough and long enough to break the line-of-sight between the sound source and the receiver, be of an impervious material with a minimum surface density of four lb/sq. ft., and not have any gaps or holes between the panels or at the bottom. Because numerous materials meet these requirements, the selection of materials for noise barriers is usually dictated by aesthetics, durability, cost, and maintenance considerations. Noise barriers for transit projects typically range in height from eight feet to twelve feet.

Mitigation Location	Mitigation Option	Description
Receiver	Building Sound Insulation	Sound insulation of residences and institutional buildings to improve the outdoor-to-indoor noise reduction has been widely applied around airports and in some situations for transit projects. Although this approach has no effect on noise in exterior areas, it may be the best choice for sites where noise barriers are not feasible or desirable and for buildings where indoor sensitivity is of most concern. Substantial improvements in building sound insulation (of 5 to 10 dBA) can often be achieved by adding an extra layer of glazing to the windows, by sealing any holes in exterior surfaces that act as sound leaks, and by providing forced ventilation and air-conditioning so that windows do not need to be opened.

Source: HMMH Inc., 2012

More specific potential noise mitigation measures associated with each alignment are summarized in Table 5.6-9. The table includes the number of impacted receptors that could be benefitted with the implementation of the primary potential mitigation measures listed, as well as the number of noise impacts that would remain. The potential mitigation strategies will be further evaluated in subsequent engineering to determine their feasibility and reasonableness, considering factors such as safety impacts, cost effectiveness, and acceptability to the community.

Table 5.6-9. Potential Noise Mitigation Measures by Alignment

Alignment	Primary Potential Mitigation Measure[1]	Receptors Benefitted with Primary Potential Mitigation Measure	Remaining Noise Impacts		Discussion
			Moderate	Severe	
A	Quiet Zones	65 to 70	5 to 10	0	Potential mitigation could include the implementation of quiet zones from 73rd Avenue to 40th Avenue, sound insulation, and modification to the design, settings, or use of audible warning devices.
B (part of the Preferred Alternative)	Quiet Zones	90 to 95	55 to 60	5 to 10	Potential mitigation could include the implementation of quiet zones from 73rd Avenue to 40th Avenue, sound insulation, and modification to the design, settings, or use of audible warning devices.

Alignment	Primary Potential Mitigation Measure[1]	Receptors Benefitted with Primary Potential Mitigation Measure	Remaining Noise Impacts		Discussion
			Moderate	Severe	
C[2] (part of the Preferred Alternative)	Quiet Zones, Noise Barriers, Crossover Mitigation	800 to 830	350 to 355	15 to 20	Potential mitigation could include the implementation of quiet zones from 73rd Avenue to 40th Avenue, modifying or relocating crossovers located between 39th Avenue North and 37th Avenue North, and the potential installation of two noise barriers on the east side of the alignment between Corvallis Avenue North and West Broadway Avenue and between 40th Avenue North and 34th Avenue North. Further potential mitigation includes modifications to the design, settings, and use of audible warning devices at grade crossings, additional noise barriers, or sound insulation.
D1[3] (part of the Preferred Alternative)	Noise Barriers	70 to 75	25 to 35	0 to 5	Potential mitigation could include three noise barriers on the east side of the alignment between 34th Avenue North and 31 ½ Avenue North, 27th Avenue North and Golden Valley Road, and North Oak Park Avenue and TH 55. Further potential mitigation includes additional noise barriers, sound insulation or modifications to the design, settings or use of audible warning devices.
D2	Noise Barriers, Crossover Mitigation	45 to 50	305 to 310	5 to 10	Potential mitigation could include the installation of a noise barrier on the south side of the alignment between France Avenue North and Abbott Avenue North, as well as modification or relocation of crossovers between 30th Avenue North and 29th Avenue North. Further potential mitigation includes additional noise barriers, sound insulation or modifications to the design, settings or use of audible warning devices.
D Common Section (part of the Preferred Alternative)	–	0	15 to 20	0	Potential mitigation could include sound insulation or relocating or modifying crossovers.

[1] Potential mitigation strategies will be further evaluated during subsequent phases of engineering to determine their feasibility and reasonableness, considering factors such as safety impacts, cost effectiveness, and acceptability to the community.
[2] Properties on C vary depending on the north alignment selected (A or B).
[3] Properties on D1 vary depending on use of the Golden Valley Road or Plymouth Avenue/Wirth Park station options due to differences in speeds and noise sources at different locations on the corridor.
Source: HMMH Inc., 2012

Construction activities would be carried out in compliance with all applicable local noise regulations. A variety of best management practices for noise mitigation will be included in construction contract specification in order to reduce noise effects during construction. These may include:

- Avoiding nighttime (10 p.m. to 7 a.m.) construction in residential neighborhoods
- Using specially quieted equipment with enclosed engines and/or high-performance mufflers
- Requiring all equipment to comply with pertinent EPA equipment noise standards
- Locating stationary construction equipment as far as possible from noise-sensitive sites
- Constructing noise barriers, such as temporary walls or piles of excavated material, between noisy activities and noise-sensitive receivers
- Re-routing construction-related truck traffic along roadways that would cause the least disturbance to residents
- Notifying nearby residents and community stakeholders whenever extremely noisy construction work would occur
- Avoiding impact pile driving near noise-sensitive areas, where possible. Drilled piles or the use of a sonic or vibratory pile driver are quieter alternatives where the geological conditions permit their use. If impact pile drivers must be used, their use would be limited to the periods between 8:00 a.m. and 5:00 p.m. on weekdays.
- Conducting noise monitoring during construction to verify compliance with the limits

5.7 Vibration

Information included within this section is based on the information provided in the Noise and Vibration Technical Report (HMMH, Inc., 2012).

5.7.1 Regulatory Context and Methodology

5.7.1.1 Regulatory Context

Vibration impact has been assessed according to guidelines specified in FTA's *Transit Noise and Vibration Impact Assessment* guidance manual (FTA Report FTA-VA-90-1003-06, May 2006). This section describes the methodology for assessing potential impact from proposed transit projects such as the Bottineau Transitway Project.

5.7.1.2 Methodology

The methodology for assessing potential long-term vibration impact from transit operations includes:

- Identification of vibration-sensitive land uses within the area of potential effect of the proposed project
- Measurement and characterization of existing vibration conditions at these receptors
- Projections of future vibration levels from transit operations for future Build alternatives
- Assessment of potential long-term vibration impact
- Recommendations for vibration mitigation

The guidance manual also includes the methodology for predicting and assessing potential short-term vibration impact from construction activities. The approach to assessing potential impact from construction activities is more general than for transit operations since specific construction equipment and methods depend on the contractor's approach and are not typically defined at this stage of the project.

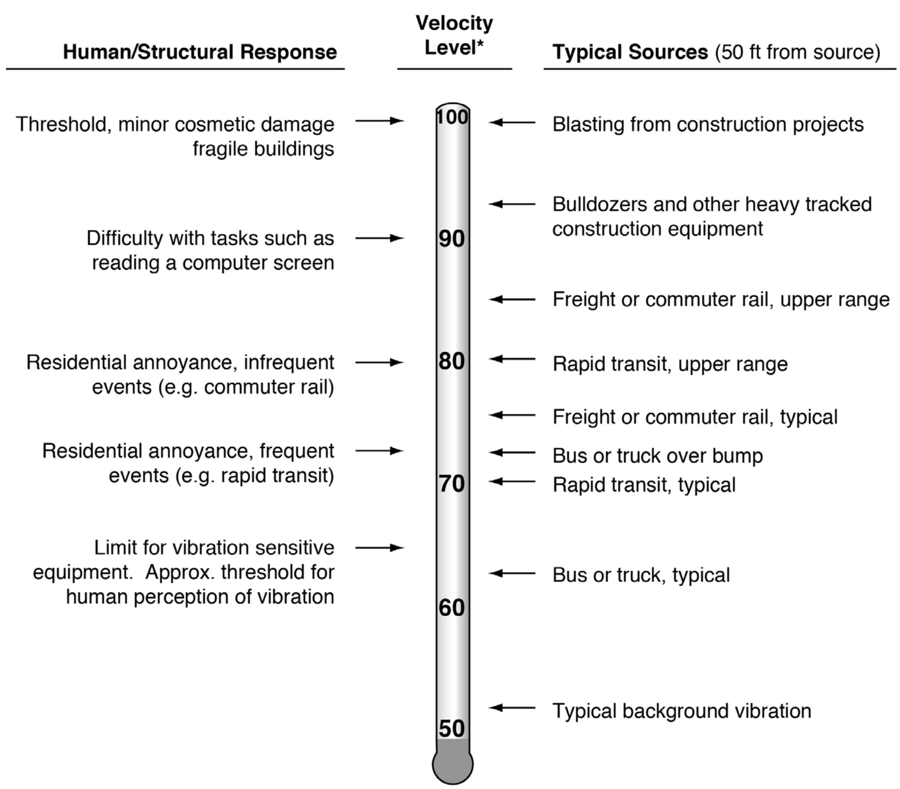
Ground-Borne Noise and Vibration Fundamentals and Descriptors

Vibration consists of oscillatory waves that generate from the source through the ground to adjacent buildings, and is typically called ground-borne vibration (GBV). Two types of vibration were analyzed for the Bottineau Transitway – vibrations from the operation of the Build alternatives, and vibration that would occur during project construction.

Vibration velocity is usually given in terms of either inches per second or decibels. This analysis utilizes the abbreviation VdB for vibration decibels to minimize confusion with sound decibels.

Figure 5.7-1 illustrates human and building response to different levels of vibration in VdB. Existing background building vibration is usually in the range of 40 to 50 VdB, which is well below the range of human perception.

Figure 5.7-1. Typical Ground-Borne Vibration Levels[22]



** RMS Vibration Velocity Level in VdB relative to 10^{-6} inches/second*

Ground-borne noise (GBN) is perceived as a low frequency rumble and is produced when GBV propagates into a room and radiates noise from the motion of the surfaces. Airborne noise often masks GBN for at-grade and elevated rail systems. Ground-borne noise criteria were applied only to buildings with sensitive interior spaces that are well insulated from exterior noise for the above-ground Bottineau Transitway.

[22] Source: FTA, 2006

Vibration Impact Criteria

Vibration-Sensitive Land Use Categories

The FTA manual classifies vibration-sensitive land uses into the same three categories as noise. However, since vibration is only assessed inside buildings, outdoor land uses are not considered to be sensitive. In addition to the potential for human annoyance from vibration, vibration impact is also assessed to evaluate potential interference with the use of certain sensitive equipment and interior spaces and to evaluate the potential for damage to building structures.

- Vibration Category 1: High Sensitivity: Included in this category are buildings where vibration would interfere with operations. Vibration levels may be well below those associated with human annoyance. These buildings include vibration-sensitive research and manufacturing facilities, hospitals with sensitive equipment, and university research operations. The sensitivity to vibration is dependent on the specific equipment present. Some examples of sensitive equipment include electron-scanning microscopes, magnetic resonance imaging scanners, and lithographic equipment.
- Vibration Category 2: Residential: Residences and buildings where people normally sleep. This category includes homes, hospitals, and hotels.
- Vibration Category 3: Institutional: This category includes buildings with primarily daytime and evening use. This category includes schools, libraries, and churches.

There are some buildings, such as concert halls, recording studios, and theaters, that can be very sensitive to noise and/or vibration but do not fit into any of the three categories. Due to the sensitivity of these buildings, they usually warrant special attention during the environmental assessment of a transit project.

Vibration Impact Criteria

The FTA vibration and GBN impact criteria are based on land use and train frequency, as shown in Table 5.7-1. Table 5.7-2 gives criteria for acceptable levels of GBV and GBN for various types of special buildings.

Table 5.7-1. Ground-Borne Noise and Vibration Impact Criteria

Land Use Category	Ground-Borne Vibration Impact Criteria (VdB re: 1 micro-inch per second)			Ground-Borne Noise Impact Criteria (dBA re: 20 micro-Pascal)		
	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]
Category 1: Buildings where low ambient vibration is essential for interior operations	65 VdB[4]	65 VdB[4]	65 VdB[4]	N/A[5]	N/A[5]	N/A[5]
Category 2: Residences and buildings where people normally sleep	72 VdB	75 VdB	80 VdB	35 dBA	38 dBA	43 dBA
Category 3: Institutional land uses with primarily daytime use	75 VdB	78 VdB	83 VdB	40 dBA	43 dBA	48 dBA

[1] "Frequent Events" is defined as more than 70 vibration events per day. Most rapid transit projects fall into this category.
[2] "Occasional Events" is defined as 30-70 vibration events of the same kind per day; typical of most commuter rail trunk lines.
[3] "Infrequent Events" is defined as fewer than 30 vibration events of the same kind per day; this includes most commuter rail branch lines.
[4] This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration sensitive manufacturing or research would require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.
[5] Vibration-sensitive equipment is generally not sensitive to ground-borne noise.
Source: FTA, 2006

Table 5.7-2. Ground-Borne Noise and Vibration Impact Criteria for Special Buildings

Type of Building or Room	Ground-Borne Vibration Impact Criteria (VdB re: 1 micro-inch per second)		Ground-Borne Noise Impact Criteria (dBA re: 20 micro-Pascals)	
	Frequent Events	Occasional or Infrequent Events	Frequent Events	Occasional or Infrequent Events
Concert Halls	65 VdB	65 VdB	25 dBA	25 dBA
TV Studios	65 VdB	65 VdB	25 dBA	25 dBA
Recording Studios	65 VdB	65 VdB	25 dBA	25 dBA
Auditoriums	72 VdB	80 VdB	30 dBA	38 dBA
Theatres	72 VdB	80 VdB	35 dBA	43 dBA

Source: Federal Transit Administration, 2006.

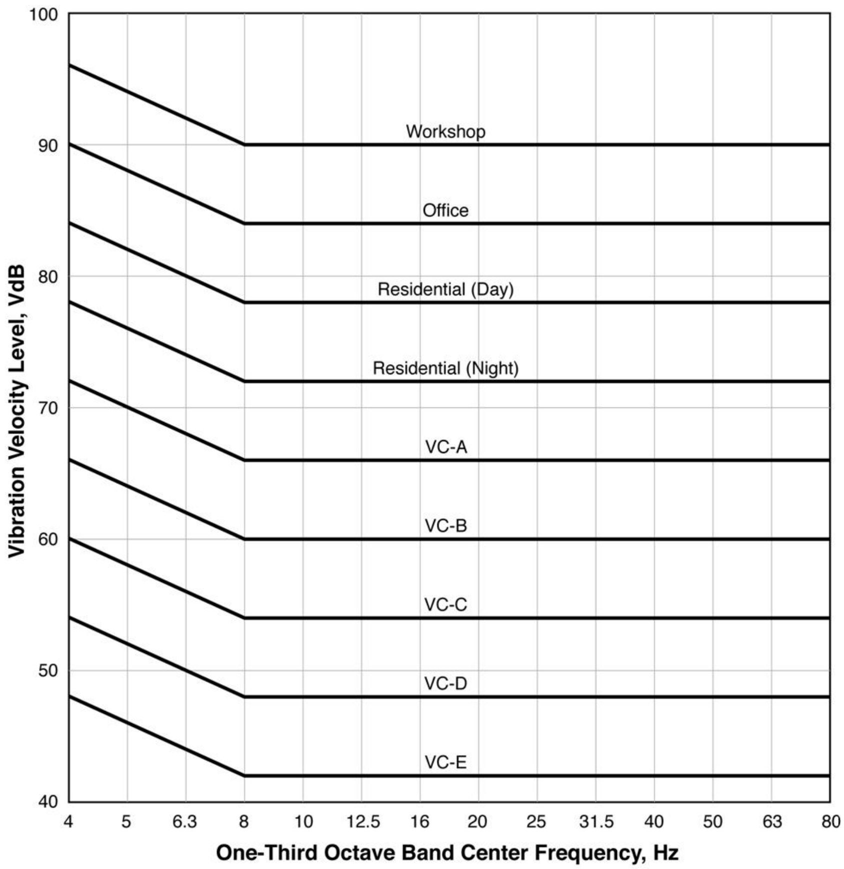
In addition to the criteria provided in Table 5.7-1 and Table 5.7-2 for general assessment purposes, FTA has established more specific criteria for use in detailed analyses. Table 5.7-3 and Figure 5.7-2 show the more detailed vibration criteria and the description of their use.

Table 5.7-3. FTA Criteria for Detailed Vibration Analysis

Criterion Curve	Maximum Vibration Level (VdB re: 1 micro-inch per second)	Description of Use
Workshop	90	Distinctly feelable vibration; appropriate to workshops and non-sensitive areas
Office	84	Feelable vibration; appropriate to offices and non-sensitive areas
Residential Day	78	Barely feelable vibration; adequate for computer equipment and low-power optical microscopes (up to 20X)
Residential Night, Operating Rooms	72	Vibration not feelable but ground-borne noise may be audible inside quiet rooms; suitable for medium-power optical microscopes (100X) and other equipment of low sensitivity
VC-A	66	Adequate for medium- to high-power optical microscopes (400X), microbalances, optical balances, and similar specialized equipment
VC-B	60	Adequate for high-power optical microscopes (1000X), inspection and lithography equipment to three micron line widths
VC-C	54	Appropriate for most lithography and inspection equipment to one micron detail size
VC-D	48	Suitable in most instances for the most demanding equipment, including electron microscopes operating to the limits of their capability
VC-E	42	The most demanding criterion for extremely vibration-sensitive equipment

Source: FTA, 2006

Figure 5.7-2. FTA Criteria for Detailed Vibration Analysis[23]



In accordance with FTA guidance, the existing vibration conditions in the corridor have been used to determine the assessment approach for sensitive receptors within an existing freight rail corridor. Because the BNSF railroad corridor in the study area is infrequently-used (fewer than five trains per day), the same approach is used to assess vibration impact for LRT operations as would be used for an alignment not within an existing rail corridor, and the FTA criteria for a detailed vibration analysis are applied. However, potential vibration impact due to the future shift of the BNSF railroad freight operations is assessed separately. For this scenario, the FTA criteria for a general vibration assessment are applied to both the existing and predicted future vibration levels from the freight activity and impact is identified based on the following guidelines:

- If the existing freight vibration levels exceed the general assessment criteria, impact is only identified if the future freight vibration levels are more than three VdB greater than the existing levels.
- If the existing freight vibration levels do not exceed the general criteria, impact is identified if the future freight vibration levels exceed the general assessment criteria.

Construction Vibration Impact Criteria

In addition to GBV criteria for humans in residential, institutional, and special buildings and for vibration-sensitive equipment, there are GBV criteria for potential damage to structures. The limits of vibration that structures can withstand are substantially higher than those that affect humans and sensitive equipment.

[23] Source: FTA, 2006

Table 5.7-4 presents the FTA criteria for assessing the potential for vibration damage to structures based on the type of building construction.

Table 5.7-4. FTA Vibration Criteria for Potential Structural Damage

Building Category	PPV (in/sec)	Approximate L_V[1]
I. Reinforced-concrete, steel or timber (no plaster)	0.5	102
II. Engineered concrete and masonry (no plaster)	0.3	98
III. Non-engineered timber and masonry buildings	0.2	94
IV. Buildings extremely susceptible to vibration damage	0.12	90

[1] RMS velocity in VdB re: 1 micro-inch/second
Source: FTA, 2006

Vibration Impact Assessment Methodology

The assessment of vibration impact resulting from the Bottineau Transitway Project was based on the following assumptions:

- All modeling projections are consistent with the methodology in the detailed assessment chapters of FTA's *Transit Noise and Vibration Impact Assessment* guidance manual (May 2006).
- Vibration-sensitive land use in the corridor was determined based on parcel data, aerial imagery, and windshield surveys in the field.
- LRT speeds were provided by the project team at 100-foot increments along the corridor. Speeds range from 20 mph to 55 mph along the corridor, and the same speed profile was used for both directions of travel.
- LRT operations were assumed to use three-car trains.
- The operating hours and service frequencies for LRT mode were assumed to be consistent with Metro Transit's Blue Line. For the vibration impact assessment, this assumed schedule corresponds to the criteria for "Frequent Events."
- Locations of aerial structures, crossovers, and embedded track were identified based on conceptual engineering plans available at the time of the assessment.
  - Vibration level increases of up to 10 VdB are assumed for receptors near crossover locations.
  - A vibration level reduction of 10 VdB are assumed for receptors near aerial structures.
  - Structure elevations were based on profile information provided.
- Reference Levels:
  - Vehicle vibration force density levels measured on the Blue Line and reported in *Vibration Measurements and Predictions for Central Corridor LRT Project* (ATS Consulting, 2008) were used in this assessment.
  - A safety factor of three vibration decibels (VdB) was included in the projected vibration levels.
- Assumed property acquisitions were not counted as potential vibration impacts.

- Vibration levels from BNSF freight trains were modeled using the FTA General Vibration Assessment methodology. Maximum vibration levels from diesel locomotive-hauled trains were assumed to follow the Locomotive Powered Passenger or Freight curve in Figure 10-1 of the FTA guidance manual.

Because construction of the Bottineau Transitway in Alignments C and D1 would require the existing BNSF rail line to be shifted to the west, the effect of moving freight operations relative to vibration-sensitive receivers was included in the vibration impact analysis. The prediction of freight train vibration was based on the following assumptions:

- Baseline freight train operations include one daily round trip during the daytime hours.
- All freight trains include two locomotives and 20 cars and operate at a speed of 20 mph.
- The shifted BNSF railroad track will be updated from jointed rail to CWR.
- Wheel impacts at track joints cause vibration level increases of five VdB.

Vibration Measurement Locations and Procedures

Vibration propagation measurements were conducted in the project area from May 14 through May 18, 2012.

Vibration propagation testing was performed at eight locations, as shown on Figure 5.7-3. Measurement sites were selected to be representative of the different areas with vibration-sensitive receptors proximate to the proposed project.

5.7.2 Study Area

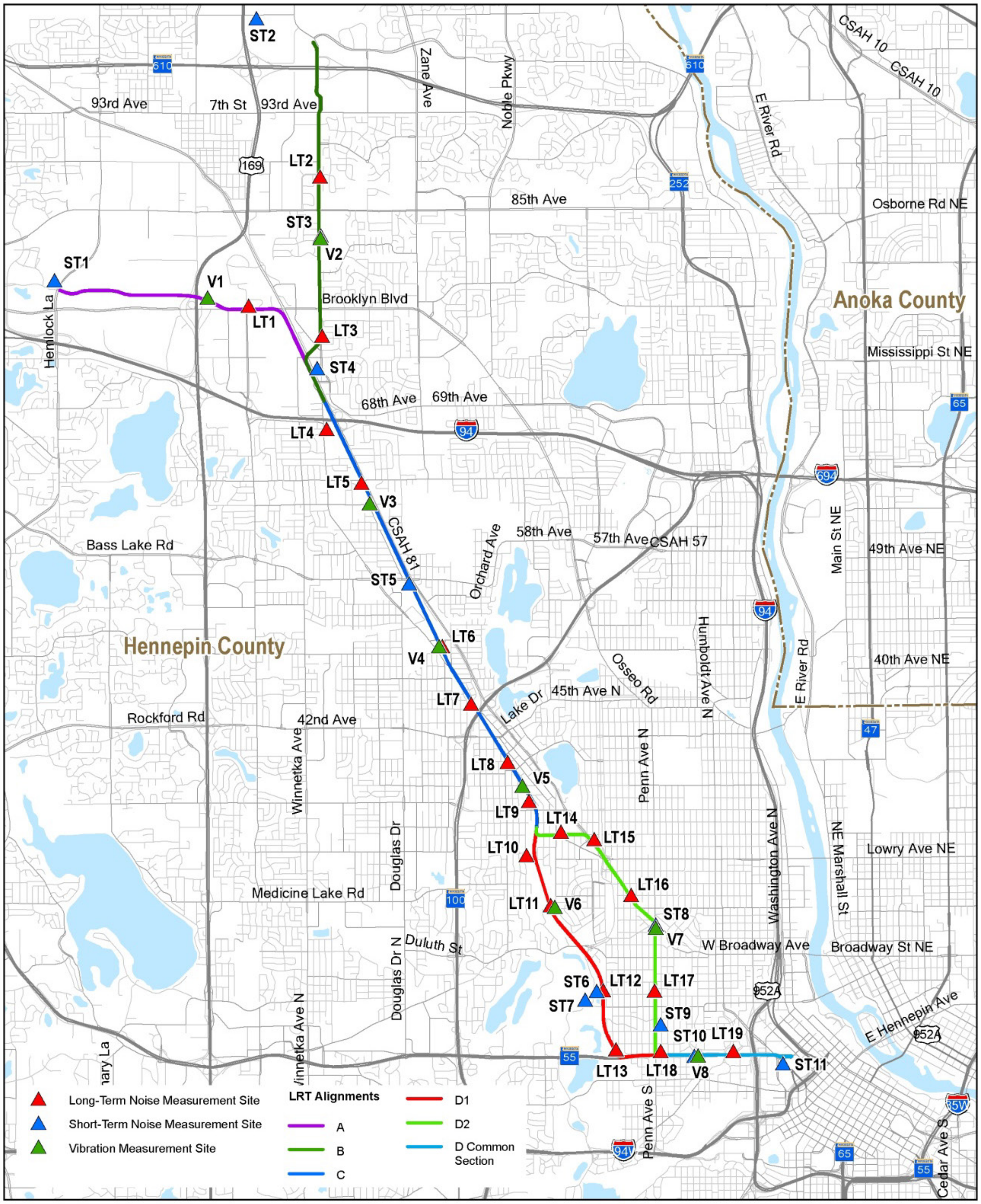
The study area for vibration is based on the screening distances provided in Chapters 4 and 9 of the FTA guidance manual *Transit Noise and Vibration Impact Assessment* (May 2006). Screening distances provided in the FTA manual are based on typical project conditions and were adjusted based on the specific conditions of the Bottineau Transitway Project. All vibration-sensitive land uses within the relevant screening distances were reviewed to identify locations where impacts may possibly occur. Typical screening distances provided by the FTA for light rail transit projects are given in Table 5.7-5.

Table 5.7-5. FTA Screening Distances for Vibration Assessments

Type of Project	Critical Distance for Land Use Categories[1] Distance from Right-of-Way or Property Line (ft)		
	Category 1	Category 2	Category 3
Light Rail Transit	450	150	100

[1] The land-use categories are defined in Section 5.6.1.2. Other vibration-sensitive land uses are included in Table 5.6-5. For the screening procedure, vibration sensitive land uses such as TV and radio studios are evaluated as Category 1 receptors.
Source: FTA, 2006

Figure 5.7-3. Noise and Vibration Measurement Locations



The measurement site locations are shown in Figure 5.6-6. Table 5.7-6 describes the locations of the vibration propagation test sites.

Table 5.7-2. Ground-Borne Vibration Propagation Measurement Locations

Measurement Site No.	Alignment	Measurement Location Description
V-1	A	Hennepin Technical College Parking Lot, Brooklyn Park: represents the soil vibration propagation characteristics of the Maple Grove and Brooklyn Park area on Alignment A
V-2	B (part of the Preferred Alternative)	North Hennepin Community College Parking Lot, Brooklyn Park: represents characteristics of the Brooklyn Park area on Alignment B
V-3	C (part of the Preferred Alternative)	6801 62nd Avenue North Adjacent Roadway, Crystal: represents characteristics on Alignment C in Crystal between Interstate 94/694 and 56th Avenue North
V-4	C (part of the Preferred Alternative)	Doyle's Lanes Parking Lot, Crystal: represents the characteristics on Alignment C in Crystal between 56th Avenue North and TH 100 North
V-5	C (part of the Preferred Alternative)	Lee Park, Robbinsdale: represents the characteristics on Alignment C in Robbinsdale between TH 100 North and 34th Avenue North
V-6	D1 (part of the Preferred Alternative)	26th Avenue North and Kewanee Way on Roadway, Golden Valley: represents characteristics on Alignment D1 in Golden Valley between 34th Avenue North and TH 55
V-7	D2	KMOJ Radio Station Parking Lot, Minneapolis: represents characteristics on Alignment D2 in Minneapolis between 34th Avenue North and TH 55
V-8	D Common Section (part of the Preferred Alternative)	Harrison Park Adjacent Roadway, Minneapolis: represents characteristics on the Alignment D Common Section in Minneapolis along TH 55

Source: HMMH Inc., 2012

5.7.3 Affected Environment

The Bottineau Transitway Build alternative alignments are located in suburban and urban areas in the greater Minneapolis metropolitan area. The existing vibration environment and sensitive land uses vary among the alignments and are described below by alignment option.

Alignment A

This alignment is located along CSAH 130. Existing sources of vibration are limited to vehicular traffic on local roadways. Vibration-sensitive land use includes Arbor Lakes Senior Living, Hennepin Technical College, and several single- and multi-family residences near Boone Avenue North.

Alignment B (part of the Preferred Alternative)

This alignment is located along CSAH 103 and CSAH 130. Existing sources of vibration are limited to vehicular traffic on local roadways. Vibration-sensitive land use includes North Hennepin Community College, Step by Step Montessori School, and several single- and multi-family residences north and south of CSAH 109. Vibration-sensitive equipment exists at two commercial properties on this alignment, Northwest EMC and Genmab.

Alignment C (part of the Preferred Alternative)

This alignment is located within the BNSF railroad corridor from 73rd Avenue North in Brooklyn Park to 36th Avenue North in Robbinsdale. The alignment is located along CSAH 81 starting from the north, and then shifts to run along West Broadway Avenue after crossing the CP railroad tracks. This alignment also passes by Crystal Airport. Existing sources of vibration are limited to vehicular traffic on local roadways and freight train operations on the BNSF railroad. Vibration-sensitive land use includes single-and multi-family residences, schools, churches, and several hotels.

Alignment D1 (part of the Preferred Alternative)

This alignment is located within the BNSF railroad corridor. The alignment turns east along TH 55 until it reaches downtown Minneapolis. Existing sources of vibration are limited to vehicular traffic on local roadways and freight train operations on the BNSF railroad. Vibration-sensitive land use includes single- and multi-family residences, schools, churches, hotels, and Sumner Library.

Alignment D2

This alignment runs along CSAH 81 and Penn Avenue and then turns east along TH 55 until it reaches downtown Minneapolis. Existing sources of vibration are limited to vehicular traffic on local roadways. North Memorial Medical Center, NorthPoint Health and Wellness Center, and KMOJ Radio Station are vibration-sensitive land uses that are adjacent to this alignment. Other vibration-sensitive land use includes single- and multi-family residences, schools, churches, hotels, and Sumner Library.

5.7.4 Environmental Consequences

5.7.4.1 Operating Phase (Long-Term) Impacts

No-Build Alternative

While there would be some changes in bus traffic on existing roadways due to other future No-Build transit improvements, these would not significantly affect the existing vibration levels. Thus, no vibration impacts are anticipated within the Bottineau Transitway study area for the No-Build alternative.

Enhanced Bus/TSM Alternative

Similar to the No-Build alternative, no significant vibration impacts would occur within the Bottineau Transitway study area for the Enhanced Bus/TSM alternative.

Build Alternatives

Maximum ground-borne vibration levels were projected at each of the eight test sites for LRT trains operating at 55 mph (the maximum speed along the corridor) on ballast and tie track, without special trackwork and without any adjustment for vibration coupling between the ground and building foundations. The results show that, beyond approximately 100 feet from the track, the projected maximum vibration levels for light rail trains at the maximum operating speed are all below the FTA residential impact criterion of 72 VdB. Detailed vibration projections at each measurement site are included in Appendix E of the Noise and Vibration Technical Report (HMMH, Inc., 2012).

Table 5.7-7 below summarizes the results of the GBV impact assessment by alignment option for FTA Category 2 (residential) receptors. No Category 3 receptors are impacted by GBV. The table also lists the distance to the near track, and the projected LRT speed at each location. In addition, the predicted project GBV level and the impact criterion level are indicated along with the number of impacts projected for each receptor or receptor group.

Table 5.7-3. Summary of Ground-Borne Vibration Impacts by Alignment

Alignment	Receptor Type	Distance to Track (ft)[1]	Train Speed (mph)	Maximum Vibration Velocity Level (VdB) in any 1/3-Octave Band from 4 Hz to 200 Hz[2]		Number of Receptors with GBV Impact
				Projected Vibration Velocity Level	Vibration Impact Criterion	
A[3]	Cat. 2	90	20 to 55	52	72	0
B[3] (part of the Preferred Alternative)	Cat. 2	80	20 to 50	69	72	0
C (part of the Preferred Alternative)	Cat. 2	30 to 80	20 to 55	72 to 90	72	51
D1[3] (part of the Preferred Alternative)	Cat. 2	60	20 to 55	68	72	0
D2[3]	Cat. 2	50	20 to 45	71	72	0
D Common Section[3] (part of the Preferred Alternative)	Cat. 2	100	20 to 35	59	72	0

[1] Distance to track is based on current alignment location data and has been rounded to the nearest five feet for this summary.
[2] GBV levels are measured in VdB referenced to 1 μ-in/sec.
[3] Data are for the closest non-impacted residential receptor. There are no vibration impacts in this section.
Source: HMMH Inc., 2012

The GBV impacts for each alignment are discussed below. Figures 12 through 40 in Appendix G show the locations of projected vibration impacts. The vibration impact figures only show locations of the Bottineau Transitway where impact is projected to occur.

Alignment A

Vibration-sensitive receptors adjacent to this alignment are generally no closer than about 85 feet from the near track centerline. No GBV impacts are predicted to occur with this alignment. The maximum vibration velocity level predicted from an LRV passing by the closest receptor (LRT passby) is 52 VdB.

Alignment B (part of the Preferred Alternative)

Vibration-sensitive receptors adjacent to this alignment are generally no closer than about 65 feet from the near track centerline. No GBV impacts are predicted to occur with this alignment. The maximum vibration velocity level predicted from LRV passbys at the closest receptor is 69 VdB. In addition, GBV and GBN levels were assessed at Northwest EMC, Genmab, and the Science Building of North Hennepin Community College based on the FTA criteria. No GBV or GBN impact is predicted at any of these receptors.

Alignment C (part of the Preferred Alternative)

Vibration-sensitive receptors adjacent to this alignment are generally no closer than about 30 feet from the near track centerline. GBV impacts are predicted to occur at 51 residences with this alignment option. Predicted GBV levels from LRV passbys range from 72 to 90 VdB at impacted receptors.

No vibration impact would occur from the shift of the BNSF freight operations. The shifted freight tracks would not result in an increase of more than three VdB at any sensitive receptors.

Alignment D1 (part of the Preferred Alternative)

Vibration-sensitive receptors adjacent to this alignment are generally no closer than about 45 feet from the near track centerline. No GBV impacts are predicted to occur with this alignment option. The maximum vibration velocity level predicted from LRV passbys at the closest receptor is 68 VdB.

No vibration impact would occur from the shift of the BNSF freight operations. The shifted freight tracks would not result in an increase of more than three VdB at any sensitive receptors.

Alignment D2

Vibration-sensitive receptors adjacent to this alignment are generally no closer than about 30 feet from the near track centerline. No GBV impacts are predicted to occur with this alignment option. The maximum vibration velocity level predicted from LRV passbys at the closest receptor is 71 VdB. In addition, GBV and GBN levels were assessed at KMOJ Radio Station based on the FTA criteria, and the results indicate that no GBV or GBN impact is predicted at this location.

Alignment D Common Section (part of the Preferred Alternative)

Vibration-sensitive receptors adjacent to this alignment are generally no closer than about 95 feet from the near track centerline. No GBV impacts are predicted to occur in for this alignment option. The maximum vibration velocity level predicted from LRV passbys at the closest receptor is 59 VdB.

Summary of Impacts by Alternative

Table 5.7-8 below summarizes the predicted vibration impact assessment results by alternative.

Table 5.7-8. Summary of Vibration Impacts By Alternative

Alternative	Total GBV Impacted Receptors
No-Build	No vibration impacts currently anticipated
Enhanced Bu/TSM	No vibration impacts currently anticipated
A-C-D1	51
A-C-D2	51
B-C-D1 (Preferred Alternative)	51
B-C-D2	51

Source: HMMH Inc., 2012

5.7.4.2 Construction Phase Impacts

Vibration from construction is caused by equipment operations, and is usually highest during pile driving, soil compacting, jack-hammering, and construction related demolition activities. Although it is conceivable for ground-borne vibration from construction to cause building damage, vibration from construction is almost never of sufficient amplitude to cause even cosmetic damage to buildings. The primary concern is that the vibration can be intrusive and annoying to building occupants.

Construction activities can result in vibration effects to surrounding receivers. Major vibration-producing activities would occur primarily during demolition and preparation for new light rail tracks. Activities that have the potential to produce high levels of vibration include pile driving, vibratory shoring, soil compacting, and some hauling and demolition activities. Vibration effects from pile driving or vibratory sheet installations could occur within several hundred feet of sensitive receivers.

No-Build Alternative

No construction vibration impacts currently anticipated within the Bottineau Transitway study area for the No-Build alternative.

Enhanced Bus/TSM Alternative

No construction vibration impacts are anticipated within the Bottineau Transitway study area for the Enhanced Bus/TSM alternative.

Build Alternatives

Temporary vibration impacts could result from activities associated with the construction of new tracks and stations, utility relocation, grading, excavation, track work, demolition, and installation of systems components. Such impacts may occur in residential areas and at other vibration-sensitive land uses located within several hundred feet of the alignment. The potential for vibration impact would be greatest at locations near pile-driving for bridges and other structures, pavement breaking, and at locations close to vibratory compactor operations.

5.7.5 Avoidance, Minimization, and Mitigation

The vibration assessment assumes that the vehicle wheels and track are maintained in good condition with regular wheel truing and rail grinding. Beyond this, there are several approaches to mitigate predicted vibration impact from LRT operation, as described below in Table 5.7-9.

Potential vibration mitigation measures associated with each alignment are summarized in Table 5.7-10. The table includes the number of receptors that could be benefitted with the implementation of the potential mitigation measure listed. These potential mitigation strategies will be further evaluated during subsequent engineering to determine their feasibility and reasonableness, considering factors such as safety impacts, cost effectiveness, and acceptability to the community.

Construction activities would be carried out in compliance with all applicable local regulations. A variety of best management practices for vibration mitigation will be included in construction contract specifications in order to reduce vibration effects during construction. These may include:

- Re-routing construction-related truck traffic along roadways that would cause the least disturbance to residents.
- Avoiding impact pile driving near vibration-sensitive areas, where possible. Drilled piles or the use of a sonic or vibratory pile driver are alternatives where the geological conditions permit their use.
- Conducting vibration monitoring during construction to verify compliance with the limits.
- Implementing a complaint resolution procedure to rapidly address any problems that may develop during construction.

With the incorporation of appropriate mitigation measures, impacts from construction-generated vibration would be minimized.

Table 5.7-9. Potential Vibration Mitigation Measures

Mitigation Option	Description
Ballast Mats	A ballast mat consists of a pad made of rubber or rubber-like material placed on an asphalt or concrete base with the normal ballast, ties, and rail on top. The reduction in GBV provided by a ballast mat is strongly dependent on the vibration frequency content and the design and support of the mat.
Tire Derived Aggregate (TDA)	Also known as shredded tires, a typical TDA installation consists of an underlayment of 12 inches of nominally 3-inch size tire shreds or chips wrapped with filter fabric, covered with 12 inches of sub-ballast and 12 inches of ballast above that to the base of the ties. Tests suggest that the vibration attenuation properties of this treatment are midway between that of ballast mats and floating slab track. This low-cost option has been installed on two US light rail transit systems (San Jose and Denver) for a number of years, and test results have shown this treatment to be very effective at frequencies above about 25 Hz.
Floating Slabs	Floating slabs consist of thick concrete slabs supported by resilient pads on a concrete foundation; the tracks are mounted on top of the floating slab. Most successful floating slab installations are in subways, and their use for at-grade track is less common. Although floating slabs are designed to provide vibration reduction at lower frequencies than ballast mats, they are extremely expensive.
Resiliently Supported Concrete Ties (Under-Tie Pads)	This treatment involves a special soft rubber pad embedded in the base of a concrete tie. The pad serves two purposes: (1) provides a pliable surface to help anchor the ties on ballast and (2) provides vibration isolation between the tie and the ballast. This relatively simple treatment has been used extensively in Europe. Test results have shown this treatment to be very effective at frequencies above about 25 Hz, and its cost is about 1.2 times the cost of a standard concrete tie.
Resilient Rail Fasteners	Resilient fasteners can be used to provide vibration isolation between rails and ties, as well as on concrete slabs for direct fixation track on aerial structures or in tunnels. These fasteners include a soft, resilient element to provide greater vibration isolation than standard rail fasteners in the vertical direction. There are resilient fasteners available that can be used on high axle load transit systems such as locomotive hauled passenger trains. Resilient rail fasteners are effective at frequencies above about 40 Hz.
Special Trackwork	Because the impacts of vehicle wheels over rail gaps at track turnout locations increases GBV by about 10 VdB close to the track, turnouts are a major source of vibration impact when they are located in sensitive areas. If turnouts cannot be relocated away from sensitive areas, another approach is to use spring-rail, flange-bearing or moveable-point frogs in place of standard rigid frogs at turnouts. These devices allow the flangeway gap to remain closed in the main traffic direction for revenue service trains.

Source: HMMH Inc., 2012

Table 5.7-10. Potential Vibration Mitigation Measures by Alignment

Alignment Option	Potential Mitigation Measure[1]	Receptors Benefitted with Potential Mitigation Measure	Discussion
A	No Mitigation Required		No GBV impacts are predicted to occur; therefore, no vibration mitigation is required.
B (part of the Preferred Alternative)	No Mitigation Required		No GBV impacts are predicted to occur; therefore, no vibration mitigation is required.
C (part of the Preferred Alternative)	Crossover Mitigation/ Track Vibration Isolation Treatment	51	Potential mitigation could include modification or relocation of crossovers between Corvallis Avenue North and West Broadway Avenue and 40th Avenue and 36th Avenue North, as well as installation of track vibration isolation treatment.
D1 (part of the Preferred Alternative)	No Mitigation Required		No GBV impacts are predicted to occur; therefore, no vibration mitigation is required.
D2	No Mitigation Required		No GBV impacts are predicted to occur; therefore, no vibration mitigation is required.
D Common Section (part of the Preferred Alternative)	No Mitigation Required		No GBV impacts are predicted to occur; therefore, no vibration mitigation is required.

[1] Potential mitigation strategies will be further evaluated during preliminary engineering to determine their feasibility and reasonableness, considering factors such as safety impacts, cost effectiveness, and acceptability to the community.
Source: HMMH Inc., 2012

5.8 Biological Environment (Wildlife Habitat and Endangered Species)

Information included within this section is based on the information provided in the Biological Environment Technical Report (Kimley-Horn and Associates, 2012). The analysis completed for this section was conducted in coordination with the USFWS and DNR regarding the presence of, and potential impacts to, threatened or endangered species and other biological resources in the study area. The Minneapolis Park and Recreation Board was also contacted. See Section 5.8.4 for discussion on the findings. Correspondence letters are included in Appendix D.

This section is subdivided into four parts; endangered species, wildlife habitat, migratory birds and noxious weeds.

5.8.1 Regulatory Context and Methodology

Endangered Species

Section 7 of the Endangered Species Act (ESA) of 1973 (16 USC 1531-1544) requires that all federal agencies consider and avoid, if possible, adverse impacts to federally listed threatened or endangered species or their critical habitats, which may result from their direct, regulatory, or funding actions. The United States Fish and Wildlife Service (USFWS) is responsible for compiling and maintaining the federal list of threatened and endangered species. Section 7 of the ESA also prohibits the taking of any federally listed species by any person without prior authorization. The term “taking” is broadly defined at the federal level and explicitly extends to any habitat modification that may significantly impair the ability of that species to feed, reproduce, or otherwise survive.

Minnesota’s endangered species law (MN Statute 84.0895) and associated rules (MN Rules 6212.1800-.2300) regulates the taking, importation, transportation, and sale of state endangered or threatened species. The DNR administers the state law and manages the listing of state rare, threatened, and endangered species.

The USFWS Endangered Species Program website (http://www.fws.gov/endangered/) was reviewed to determine if there any federally listed threatened or endangered species that have critical habitat within Hennepin County or within any of the proposed alignments. No critical habitats are located within the study area or potential area of disturbance.

The DNR Natural Heritage Information System (NHIS) Database was used to identify potential federal and state listed species within the study area. The NHIS database comprises locational records of rare plants, rare animals, and other rare sensitive natural resources features including native plant communities, geologic features, and animal aggregations (such as nesting colonies). Per stipulations of the NHIS program, known locations of state species cannot be mapped.

Each proposed alignment was evaluated for preferred habitats of the identified rare species in coordination with state and local agencies, and in accordance with Minnesota's endangered species law (MN Statute 84.0895).

Wildlife Habitat

The proposed Bottineau Transitway is to be constructed largely in areas that have been previously disturbed or developed with impervious surfaces and buildings. Some proposed Build Alternatives, however, run near natural areas or open spaces with vegetation cover that may provide foraging, migrating, or nesting habitat for wildlife. The size and quality of these natural areas or open spaces determines the likelihood of supporting terrestrial and aquatic wildlife.

There are no comprehensive lists or data sources that quantify or list wildlife species present in any given location, and the number potential plants and animals in even urban areas are to numerous and the inventory processes too complex to conduct a project specific inventory. The accepted method for wildlife impact assessment is via wildlife habitat association. Given the largely developed/disturbed nature of the study area, wildlife habitat was generally classified into two categories, terrestrial and aquatic habitat. Aquatic habitat includes plant communities that are dominated by water such as wetlands, lakes, streams, and creeks and support water dependent species such as fish, frogs, turtles, etc. Terrestrial habitat includes all other plant communities, excluding frequently disturbed areas such as mowed/landscaped areas, right of way, and farmland and support species such as white-tailed deer, squirrels, rabbits, and birds. Aquatic habitat is protected by wetland/public waters regulations, as described Section 5.3. There are no specific regulations that provide protection to terrestrial habitats.

Methodology for identifying these habitat types was conducted through review of aerial photography (Minnesota Geospatial Information Office, 2010) and noting undeveloped areas with potentially natural native cover (excluding landscaped areas, farm fields, and right of way. A field review was conducted (April 25, 2012) to refine the aquatic habitats (see Section 5.3) and eliminate disturbed or developed areas not reflected in the aerial photography or NWI maps. Using the defined aquatic and terrestrial habitat types, common habitat/wildlife associations were developed based on references from the DNR and local resources. Because Theodore Wirth Regional Park is a large habitat resource along the D1 alignment, the Minneapolis Park & Recreation Board staff was also contacted in 2012 to determine if any wildlife inventories for the park were available; however, none have been completed recently.

In addition, the Minnesota Land Cover Classification System data for Hennepin County (DNR, 2008) was reviewed to determine the quality of habitat located within the project alignments. The MLCCS provides a general assessment of the quality of native habitat present within each identified natural community (Table 5.8-1).

As described in the MLCCS Manual (DNR, 2004) The MLCCS quality of native habitat is determined using the following letter grade (A-D). This letter grade is only given to native habitats. Non-native, altered, or disturbed communities were given a non-native ranking (NN or NA).

- A = Highest quality natural community, no disturbances and natural processes intact.
- B = Good quality natural community. Has its natural processes intact, but shows sign of past human impacts. Low levels of exotics.
- C = Moderate condition natural community with obvious past disturbance but is still clearly recognizable as a native community. Not dominated by weedy species in any layer.
- D = Poor condition of natural community. Includes some natives, but is dominated by non-natives and/or is widely disturbed and altered.
- NA = Natives species present in an altered/non-native plant community.
- NN = Altered/non-native plant community. These semi natural communities do not qualify for natural quality ranking.

Migratory Bird Act

The Migratory Bird Treaty Act of 1918 (16 USC 703-712) governs the taking, killing, possession, transportation, and importation of migratory birds including eggs, parts, and nests. Such actions are prohibited unless authorized under a valid permit. This law applies to migratory birds native to the United States and its territories. It does not apply to non-native migratory birds or resident species that do not migrate on a seasonal basis.

The bald eagle is a native migratory bird and is also protected by the Bald Eagle and Golden Eagle Protection Act of 1940 (16 USC 668-668d, 54 Stat. 250) and prohibits the taking, possession, or commerce of these species.

The Minnesota Ornithologist Union's (MOU) Hennepin County checklist was reviewed to determine the number of species within the county. The MOU checklist contains accepted records of every species observed within that particular county. This list does not single out the number of migratory species observed within Hennepin County; therefore, some species on the list are resident bird species.

Noxious Weeds

Invasive species are regulated by federal and state laws. The Federal Noxious Weed Act, Title 7, Chapter 61, Section 2803, regulates federally listed noxious weeks through the U.S. Department of Agriculture (USDA). Under this rule, the sale, purchase, exchange, or receipt of federal noxious weeds is illegal.

The Minnesota Noxious Weed Law (MN Statutes 18.75-18.91) defines a noxious weed as an annual, biennial, or perennial plant that the Commissioner of Agriculture designates to be injurious to public health, the environment, public roads, crops, livestock, or other property. Prohibited noxious weeds must be controlled or eradicated as required in Minnesota Statutes, section 18.78.

The Minnesota Noxious Weed location map was reviewed to identify known noxious weed concentrations within the study area.

5.8.2 Study Area

The study area specifically for rare, threatened, and endangered species included a record search area of a one mile radius from the potential area of disturbance.

The study area for wildlife habitat, migratory birds, and noxious weeds is defined as an area approximately ¼ mile around each of the alignments and associated facilities (OMF and park-and-rides). This distance captures the terrestrial and aquatic habitat, invasive species, and migratory birds that are directly adjacent to the Bottineau Transitway Project and the wildlife that could potentially be affected by it.

5.8.3 Affected Environment

Endangered Species

A review of the USFWS Endangered Species Program website identified one species, the Higgins eye pearlymussel (*Lampsilis higginsii*), within Hennepin County. The critical habitat for the Higgins eye pearlymussel can be found within the Mississippi River; however, the recovery plan dated May 2004 identified the critical habitat south of Mississippi River Lock and Dam No. 2 (Hastings, MN). The Bottineau Transitway Project will not impact the Mississippi River; therefore, no impacts are anticipated to any federally listed threatened or endangered species as a result of this project. The USFWS concurred that there is no threatened or endangered species within the study area (Appendix D).

A review of the DNR NHIS database, which provides information on Minnesota's rare plants, animals, native plant communities, and other sensitive rare natural resources features by county, was conducted. In Hennepin County, there are records for 13 endangered species, 18 threatened species, and 30 special concern species. The species from this list that may be found within the habitats identified in the study area are shown in Table 5.8-1.

Table 5.8-1. State- and Federal-Listed Species in the Study Area

Scientific Name	Common Name	State Status	Federal Status	Last Observation Date/Nearest Alignment	Preferred Habitat
Erythronium propullans	Dwarf Trout Lily	E[1]	E[2]	2005 D1, D2, D Common Section	Wooded, north-facing slope above or near a streambed within Maple-Basswood Forests
Ligumia recta	Black Sandshell	SC	-	2007 D Common Section	Medium to large rivers in riffles or raceways in gravel or firm sand
Setophanga citrina	Hooded Warbler	SC	-	1979 D1, D2, D Common Section	Large mature deciduous forest with a dense, shrubby understory and shrub layer
Haliaeetus leucocephalus	Bald Eagle	SC	-	2001/A 2005/C	Lakes and rivers with large trees for nesting
Etheostoma microperca	Least Darter	SC	-	1931 C, D1, D2	Natural lakes and deep marshes with permanent water levels with aquatic vegetation
Emydoidea blandingii	Blanding's Turtle	T	-	2000 D1, D2, D Common Section	Shallow water with sandy uplands
Falco peregrinus	Peregrine Falcon	SC	-	3 locations: 2008, 2011/D Common Section	Cliff ledges along rivers or lakes or tall building ledges

E – Endangered, SC – Special Concern, T – Threatened
[1] State-Listed Endangered Species, but there are no known native populations in Hennepin County, MN
[2] Federally-Listed Endangered Species, but there are no known native populations in Hennepin County, MN
Source: Minnesota DNR: National Heritage Database, 19 August 2012

Dwarf Trout Lily

There is one record of Dwarf Trout Lily within the study area located south of TH 55, in Theodore Wirth Regional Park approximately a half mile away from the nearest alignment. The populations in Hennepin County were introduced prior to listing as an endangered species. It is not known to be present north of TH 55 based on the understanding that it was introduced to the park south of TH 55, and the forested areas of the park north of TH 55 are relatively fragmented and have a number of invasive species present.

Black Sandshell

There are two records of Black Sandshell within the banks of the Mississippi River. The recorded locations are over ¾ mile from the nearest alignment. The Bottineau Transitway Project does not cross or directly impact the Mississippi River. All stormwater runoff will be managed according to an erosion and sediment control plan. Therefore, the project is not expected to result in any indirect water quality impacts to the river or this species.

Hooded Warbler

There is one record of Hooded Warbler within the project study area, but it is over 30 years old, and there is no recent evidence known to support a current breeding population. The record was south of TH 55, in Theodore Wirth Regional Park, approximately 0.6 mile from the nearest alignment. This species is not expected to nest in areas that are impacted by the Bottineau Transitway Project. Absence is likely due to a lack of large tracts of mature deciduous forest and adequate nesting habitat.

Bald Eagle

There are two records of bald eagles within the study area. The record from 2005 occurred near Twin Lakes, approximately 0.9 mile from Alignment C. The record from 2001 is near Eagle Lake, approximately 0.9 mile from Alignment A. No evidence of old nests was observed within the potential area of disturbance or nearby tree cover.

Least Darter

One record of a Least Darter was identified in Crystal Lake. The record is located approximately 0.6 mile from the nearest project alignment and is over 70 years old. This species is no longer believed to be present in the area because it has not been observed for over 70 years. This species was most likely affected by deteriorating water quality as the area was developed over the last 70 years.

Blanding's Turtle

There is one record of Blanding's Turtle within the study area. The record is south of TH 55, in Theodore Wirth Regional Park, approximately a half mile away from the nearest alignment. It is possible for these turtles to be present along Bassett Creek and associated wetlands. They are known to travel up to one mile for suitable nesting sites (sand).

Peregrine Falcon

There are three records of the Peregrine Falcon within the study area. These records are within downtown Minneapolis nesting on tall buildings, between 0.4 and 0.7 mile from the project alignment. There are no known nesting locations of this falcon species along any of the project alignments.

The DNR has reviewed and concurred that there is no potential for impact to these species or their preferred habitat except for the Blanding's turtle (ERDB #20120176-003; November 2, 2012).

Wildlife Habitat

Wildlife habitat is present within the study area. The wildlife habitat found within the study area can be categorized into two types, aquatic and terrestrial. The table below describes the different communities that make up each type of habitat (terrestrial and aquatic) within the proposed alignments.

MLCCS data did not identify any natural habitat within the study area of greater than a D letter grade. The majority of the habitat quality was given a grade of NN or NA as the habitat is considered non-native, altered, or disturbed.

Table 5.8-2. Habitat Types by Alignment

Alignment	Habitat Type	Community	Wildlife Association	Acres	Total Acres
A	Terrestrial	Unmanicured grassland (non-native), deciduous trees, forested areas	Grey squirrel, raccoon, rabbit, field mice, vole, mole, common songbirds, Canada geese, hawks, owls, white-tailed deer, red fox	22	132
	Aquatic	Wetlands, Shingle Creek	Bald eagles, common reptile and amphibian species, non-game fish species, white-tailed deer, songbirds	110	
B (part of the Preferred Alternative)	Terrestrial	Unmanicured grassland (non-native), deciduous trees, forested areas	Grey squirrel, raccoon, rabbit, field mice, vole, mole, common songbirds, Canada geese, hawks, owls, white-tailed deer, red fox	203.5	267
	Aquatic	Wetlands, Shingle Creek, Mattison Creek, unnamed tributary to Shingle Creek	Bald eagles, common reptile and amphibian species, non-game fish species, white-tailed deer, songbirds	63.5	
C (part of the Preferred Alternative)	Terrestrial	Unmanicured grassland (non-native), deciduous trees, forested areas	Grey squirrel, raccoon, rabbit, field mice, vole, mole, common songbirds, Canada geese, hawks, owls, white-tailed deer, red fox	4	22
	Aquatic	Wetlands	Bald eagles, common reptile and amphibian species, non-game fish species, white-tailed deer, songbirds	18	
D1 (part of the Preferred Alternative)	Terrestrial	Unmanicured grassland (non-native), deciduous trees, forested areas	Grey squirrel, raccoon, rabbit, field mice, vole, mole, common songbirds, Canada geese, hawks, owls, white-tailed deer, red fox	304	405
	Aquatic	Wetlands, unnamed tributary to Bassett Creek, Bassett Creek	Bald eagles, common reptile and amphibian species, non-game fish species, white-tailed deer, songbirds	101	
D2	Terrestrial		N/A	0	2
	Aquatic	Wetlands	Bald eagles, common reptile and amphibian species, non-game fish species, white-tailed deer, songbirds	2	

Alternative A-C-D1

- **Terrestrial**

Much of the potential area of disturbance for Alternative A-C-D1 lies within or adjacent to a right-of-way for freight or vehicular traffic. As a result, much of the area surrounding the proposed alternative has been developed, manicured, and maintained.

A portion of this alternative is within the BNSF railroad corridor. Along the D-1 alignment, the area adjacent to the railroad right-of-way is vegetated, open space, or wooded property.

- **Aquatic**

Some aquatic habitats are located within the potential area of disturbance of this alternative. There are many wetland areas identified (all identified in Section 5.3). No lakes or rivers are located within the study area of this alternative. Shingle Creek and Bassett Creek are also located within the study area; however, through this portion of the study area, the creek is currently channelized.

Alternative A-C-D2

- **Terrestrial**

The majority of the area of impact for the A-C-D2 alternative lies within or adjacent to a right-of-way for freight or vehicular traffic with surrounding areas of manicured, and maintained lawns grass and some fallow fields and unmanicured areas adjacent to the freight rail.

- **Aquatic**

Some aquatic habitats are located within the potential area of disturbance of this alternative. There are many wetland areas identified (all identified in Section 5.3). No lakes or rivers are located within the study area of this alternative. Shingle Creek is also located within the study area; however, through this portion of the study area, the creek is channelized.

Alternative B-C-D1 (Preferred Alternative)

- **Terrestrial**

Most of the study area for the B-C-D1 alternative lies within or adjacent to a right-of-way for freight or vehicular traffic with surrounding areas of manicured and maintained lawns.

A portion of this alternative is within the BNSF railroad corridor. Along the D-1 alignment, the area adjacent to the railroad right-of-way is vegetated, open space, or wooded property.

- **Aquatic**

There are many wetland areas identified (all identified in Section 5.3), and a few stormwater detention ponds along with Shingle Creek, Mattison Creek, Bassett Creek, and an unnamed tributary to Shingle Creek. The creeks through this part of the study area are channelized.

Alternative B-C-D2

- **Terrestrial**

The majority of the study areas for the B-C-D2 alternative lies within or adjacent to a right-of-way for freight or vehicular traffic with surrounding areas of manicured and maintained lawns.

- **Aquatic**

Some aquatic habitats are located within the study area. There are many wetland areas identified (all identified in Section 5.3). No lakes or rivers are located within the study area; however, they are located in the project vicinity (within one mile of the study area). Shingle Creek, an unnamed tributary to Shingle

Creek, and Mattson Creek are also located within the study area; however, the creeks have been modified through this portion of the study area.

Migratory Birds

The MOU Hennepin County checklist identifies 353 bird species within the county. Of the 353 species, 131 species are known to nest in Hennepin County. Not all of the species identified on the checklist are migratory birds. Some on the list are resident species such as hawks, sparrows, cardinals, and other songbird species.

Migratory bird habitat in urban areas is typically defined nesting structure such as trees, shrubs and tall grasses in aquatic and terrestrial habitats. Generally, if construction occurs outside of the nesting season, no impacts to migratory birds are expected.

There are no known eagle, falcon, or swallow nesting sites within the potential area of disturbance, therefore no impacts are anticipated. Swallows are known to use structures such as bridges and large culverts as nesting structure and possibly could be found within the project study area, but could be prevented from nesting during construction if found. Bald eagles are known to nest within Hennepin County; however, the closest nest site to the study area is over a half mile from the proposed transitway. Peregrine falcons are also known to be within the project vicinity (within one mile of transitway); however, they are known to use nesting boxes on tall buildings as suitable habitat to nest. The closest suitable nesting location is outside of the study area.

Noxious Weeds

Invasive species are generally defined as those species that have been introduced, or moved to an area where they have not historically occurred. These species are of concern because they are prone to quickly colonize and dominate disturbance areas, often crowding out native species. Once established, invasive species tend to persist and effective eradication may not be feasible. Given the urban landscape of the study area, invasive species are common. Generally, invasive plant species concentrate within open/undeveloped areas. Given the highly disturbed nature of the project study area, invasive species are prevalent.

The Minnesota and Federal Noxious Weed List (DNR Invasive Species Program, updated March 2013) and known locations of those species were reviewed to determine the prevalence of noxious weeds within the study area. Multiple records of three aquatic noxious weed species were identified within the project study area. Purple Loosestrife (*Lythrum salicaria, L. virgatum*), Eurasian watermilfiol (*Myriophyllum spicatum*), and curly-leaf pondweed (*Potamogeton crispus*) were identified within the study area, but outside of the potential area of disturbance. No terrestrial noxious species were identified within the study area.

5.8.4 Environmental Consequences

5.8.4.1 Operating Phase (Long-Term) Impacts

No-Build Alternative

No adverse impacts to wildlife habitat, including threatened and endangered species, are anticipated to result from the No-Build alternative.

Enhanced Bus/TSM Alternative

No adverse impacts to wildlife habitat, including threatened and endangered species, are anticipated to result from the Enhanced Bus/TSM alternative.

Build Alternatives

The Build Alternatives would not result in the construction of any physical barriers that would further restrict the crossing of the corridor by wildlife than existing transportation infrastructure (roads/freight rail tracks) does today, with the potential exception of the proposed station locations. The proposed stations, which would generally be less than 600 feet long, may include some barriers to restrict human crossing of the tracks for limited distances. The spacing of stations would allow wildlife to continue to cross as they do today between the stations.

Potential impacts to migratory birds will be minimal and limited to the potential loss of habitat within the potential area of disturbance of all alternatives.

Three species of noxious weed are known to exist within a number of aquatic habitat locations within the study area; however, no locations of these species were identified within the potential area of disturbance.

Anticipated impacts by alternative are summarized below and illustrated in Figure 5.8-1 through Figure 5.8-4.

Alternative A-C-D1

- **Endangered Species**

Blanding's turtles may be found in Bassett Creek and adjacent open water wetland areas in Theodore Wirth Regional Park. The project is anticipated to result in some wetland impacts. Therefore, some potential impact to turtle habitat would be anticipated within Alignment D1.

- **Wildlife Habitat**

The A-C-D1 alternative results in a 10.7-acre loss of wildlife habitat.

Due to the urban setting of this alternative, the wildlife that inhabit these areas are generalist species adapted to urbanized conditions. These species are generally more tolerant of human presence and activities, including traffic (pedestrian, rail, and vehicular), and have demonstrated by their presence that they adapt readily to the human environment.

Alternative A-C-D2

- **Endangered Species**

No endangered species were identified within the study area for this alternative; therefore, no impact to endangered species is anticipated.

- **Wildlife Habitat**

The A-C-D2 alternative results in a three-acre loss of wildlife habitat.

Due to the urban setting of this alternative, the wildlife that inhabit these areas are generalist species adapted to urbanized conditions. These species are generally more tolerant of human presence and activities, including traffic (pedestrian, rail, and vehicular), and have demonstrated by their presence that they adapt readily to the human environment.

Alternative B-C-D1 (Preferred Alternative)

- **Endangered Species**

Blanding's turtles may be found in Bassett Creek and adjacent open water wetland areas in Theodore Wirth Regional Park. The project is anticipated to result in some wetland impacts, and therefore there would be some potential impact to turtle habitat anticipated for the Alignment D1 section of this alternative.

- **Wildlife Habitat**

The B-C-D1 alternative results in a 30.9-acre loss of wildlife habitat if the OMF is located at 101st Avenue or 13.9 acres of lost wildlife habitat if the OMF is located at 93rd Avenue. It should be noted that Alignment D1 runs adjacent to the west side of Theodore Wirth Regional Park, which provides a relatively large area of natural and manicured maintained open space as well as wetland areas (Figure 5.8-4).

Due to the urban setting of this alternative, the wildlife that inhabit these areas are generalist species adapted to urbanized conditions. These species are generally more tolerant of human presence and activities, including traffic (pedestrian, rail, and vehicular), and have demonstrated by their presence that they adapt readily to the human environment.

Alternative B-C-D2

- **Endangered Species**

No endangered species were identified within the study area for this alternative; therefore, no impacts are anticipated

- **Wildlife Habitat**

The B-C-D2 alternative results in a 23.2 acre loss of wildlife habitat if the OMF is located at 101st Avenue or 6.2 acres of lost natural/open habitat if the OMF is located at 93rd Avenue.

Due to the urban setting of this alternative, the wildlife are considered generalist species adapted to urbanized conditions. These species are generally more tolerant of human presence and activities, including traffic (pedestrian, rail, and vehicular), and have demonstrated by their presence that they adapt readily to the human environment.

Summary of Impacts

Wildlife habitat impacts are anticipated to result from all Build Alternatives. However, due to the urban setting of the Bottineau Transitway Project, and the low quality of the existing habitat, the wildlife that inhabit these areas are generalist species adapted to urbanized conditions. These species are generally more tolerant of human presence and activities, including traffic (pedestrian, rail, and vehicular), and have demonstrated by their presence that they adapt readily to the human environment.

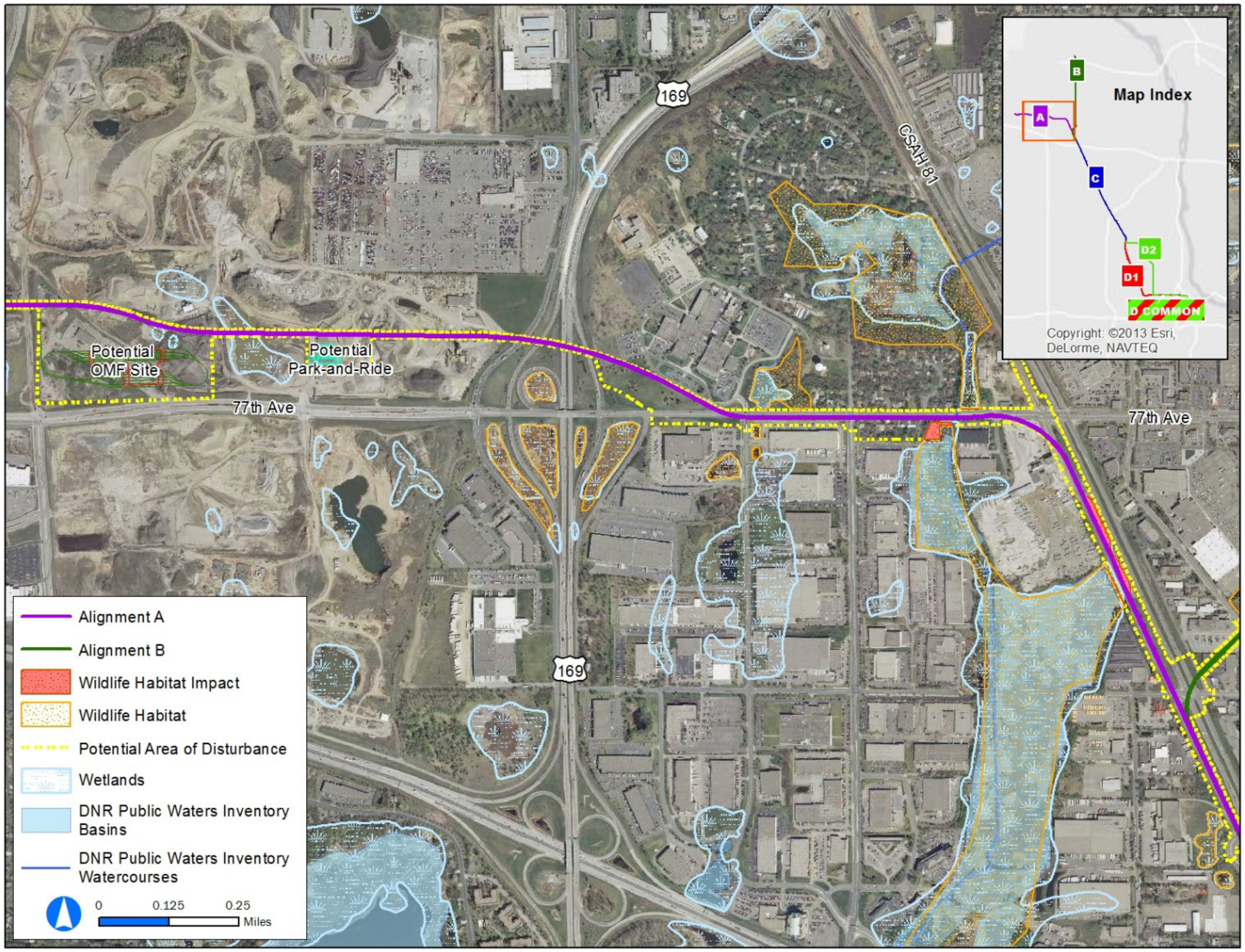
Generally, the amount of wildlife habitat that would be impacted by any Build Alternative is less than two percent of the available habitat in the study area, resulting in a negligible impact on terrestrial and aquatic wildlife overall. The two largest areas of aquatic habitat that may be impacted would be at the OMF site option at 101st and along Alignment D1 (potential for Blanding's turtles). See summary of impacts in Table 5.8-3 and Table 5.8-4.

TPSS

TPSS sites would be placed within the existing railroad right-of-way or on publicly-owned lands where possible. Additionally, impacts to wooded, wetland, and fallow land would also be minimized and/or avoided to the extent possible.

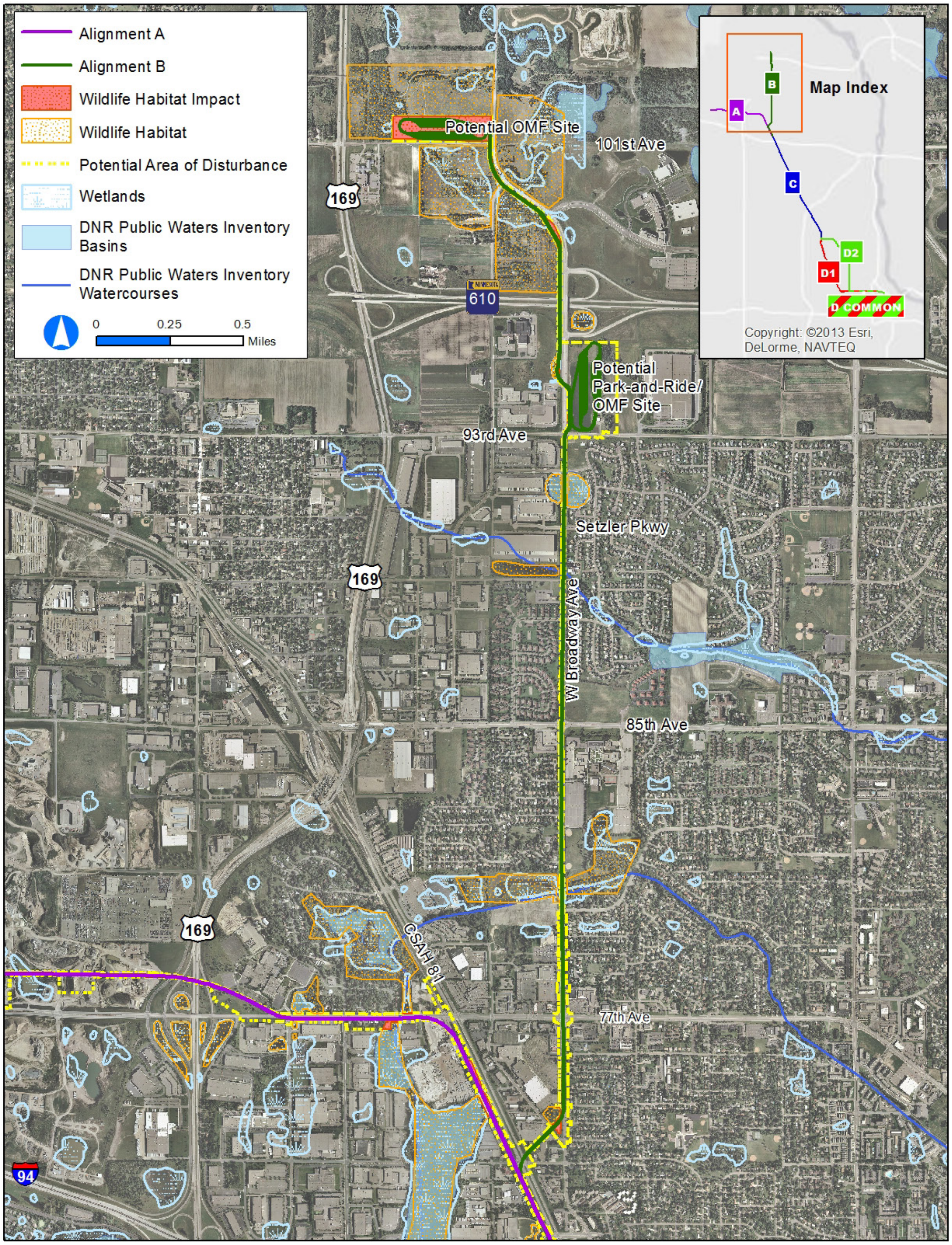
There are no known threatened, endangered, or special concern species within the 500-ft radius study areas for the proposed TPSS sites along all alignments; therefore, negligible impacts to habitat and wildlife would be associated with TPSS placement (see Appendix D).

Figure 5.8-1. Alignment A Wildlife Habitat Impact[24]



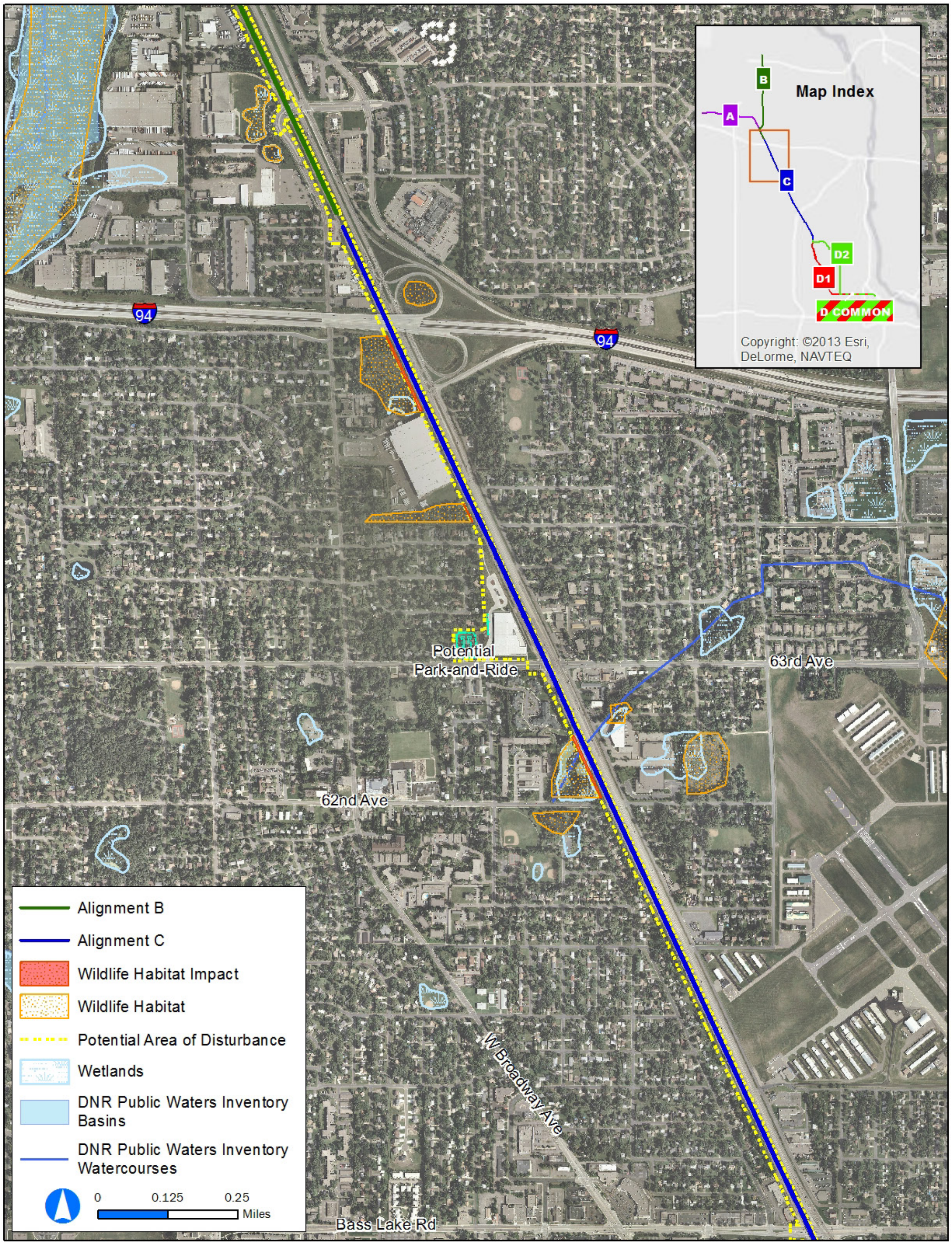
[24] Sources: Aerial: Minnesota Geospatial Information Office, 2010; Wildlife Habitat: Kimley-Horn and Associates, 2012

Figure 5.8-2. Alignment B Wildlife Habitat Impact[25]



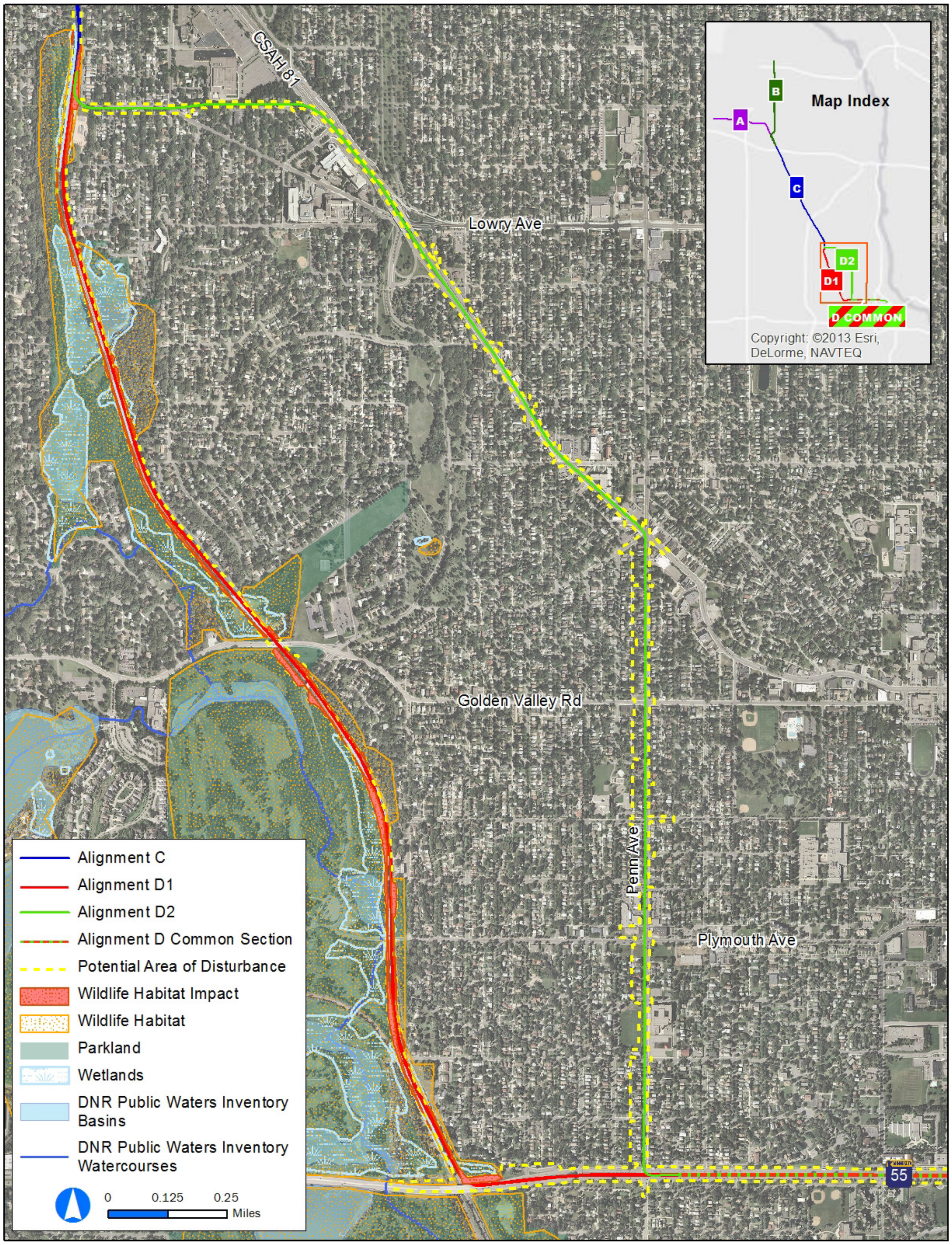
[25] Sources: Aerial: Minnesota Geospatial Information Office, 2010; Wildlife Habitat: Kimley-Horn and Associates, 2012

Figure 5.8-3. Alignment C Wildlife Habitat Impact[26]



[26] Sources: Aerial: Minnesota Geospatial Information Office, 2010; Wildlife Habitat: Kimley-Horn and Associates, 2012

Figure 5.8-4. Alignments D1, D2, and D Common Section Wildlife Habitat Impacts[27]



[27] Sources: Aerial: Minnesota Geospatial Information Office, 2010; Wildlife Habitat: Kimley-Horn and Associates, 2012

Habitat

Table 5.8-3. Wildlife Habitat Impacts by Alignment

Alignment	Alignment/Station Impact (acres)	Park-and-Ride Impact	OMF Impact	Total Habitat Impact Area (acres)
A	1.8	0	0	**1.8**
B (part of the Preferred Alternative)	4.8	0.1	93rd Avenue option: 0[1]	**4.9**
			101st Avenue option: 17.0	**21.9**
C (part of the Preferred Alternative)	0.8	0	N/A	**0.8**
D1 (part of the Preferred Alternative)	8.2[2]	N/A	N/A	**8.2**
D2	0.5	N/A	N/A	**0.5**
D Common Section (part of the Preferred Alternative)	0	N/A	N/A	**0**

[1] Wildlife habitat impacts are included under the 93rd Avenue park-and-ride.
[2] There was no discernible difference in impact between the Golden Valley Road and Plymouth Avenue/Theodore Wirth Regional Park station options.

Table 5.8-4. Wildlife Habitat Impacts by Alternative

Alternative	Wildlife Habitat within 1/4 mile of Alternative	Alignment/ Station Impact (acres)	Park-and-Ride Impact	OMF Impact	Total Habitat Impact Area (acres)
No-Build	N/A	0	0	0	**0**
Enhanced Bus/TSM	N/A	0	0	0	**0**
A-C-D1	559	10.7[1] (2%)	0	0	**10.7**
A-C-D2	156	3.2(2%)	0	0	**3.2**
B-C-D1 (Preferred Alternative)	694	13.8[1] (2%)	0.1	93rd Avenue option: 0[2]	**13.9[2]**
				101st Avenue option: 17.0	**30.9**
B-C-D2	291	6.1 (2%)	0.1	93rd Avenue option: 0[1,2]	**6.2**
				101st Avenue option: 17.0	**23.2**

[1] There was no discernible difference in impact between the Golden Valley Road and Plymouth Avenue/Wirth Park station options.
[2] Wildlife habitat impacts are included under the 93rd Avenue park-and-ride.

Endangered Species

Of the species identified as rare in the database search, only two of the species (bald eagle and Blanding's turtle) were determined to have the potential to be present in the study area. The bald eagle has known nesting sites within approximately one mile of Alignments A and C. The distance of these nest sites from project activities (greater than the nest impact zone of 660 feet) would result in no impact on eagle nesting, based on eagle management guidelines (National Bald Eagle Management Guidelines, US Fish and Wildlife Service, 2007).

Blanding's turtles are found in urban wetland areas more commonly today than when initially listed as rare species. As a result, the DNR has provided best management practices for avoiding impacts to turtles during construction, resulting in no measureable impact to turtles (DNR, 2008). These measures would be implemented where there are activities within or near shallow water wetlands (Appendix D).

No impacts to known rare features would result from any of the Build alternatives.

5.8.4.2 Construction Phase Impacts

Construction phase impacts are generally those that would be above and beyond the impacts described in the previous section and would occur for a short period of time coincident with the installation/construction of the project.

No-Build Alternative

No short-term construction impacts would result from the No-Build alternative.

Enhanced Bus/TSM Alternative

No short-term construction impacts would result from the Enhanced Bus/TSM alternative.

Build Alternatives

Short-term construction impacts to wildlife would result from the Build Alternatives due to construction activities, including use of heavy equipment and silt fence/construction barriers. These impacts may cause temporary disruption to wildlife; however, they would be temporary and limited to active construction areas. The number of active construction areas must be the minimum number needed to construct the project as required by construction permits, and inactive disturbed areas must be stabilized with seeding and other forms of erosion control BMPs.

5.8.5 Avoidance, Minimization, and Mitigation

There were no impacts identified to state or federal listed threatened, endangered, and special concern species as a result of the Build Alternatives (alignments, stations, OMF, park-and-rides, or TPSS sites). Therefore, no long-term mitigation measures are warranted.

During or prior to construction, there are a number of measures that can be taken to avoid or minimize impacts to bald eagle or turtle habitat. Construction BMPs, as discussed in the Stormwater Technical Report (Kimley-Horn and Associates, 2012,) would serve to minimize impacts to both terrestrial and aquatic habitats. As discussed in the Biological Environmental Technical Report (Kimley-Horn and Associates, 2012), standard guidelines for avoiding impacts to bald eagle nesting sites include keeping limiting construction activity at least within 330 feet away from of the nesting habitat and limiting clearing of vegetation within 660 -feet of the nest site during the nesting season (February – July). Eagle nest surveys would be conducted during final design to determine if any nests are present at that time, and, if so, the standard guidelines would be followed.

Similarly, in areas with potential for Blanding's turtle habitat, the DNR has established standard BMPs for construction, which would be implemented as needed. These BMPs consist of measures such as using overlapping silt fence that allows turtles to bypass the fencing while still capturing the sediment; providing identification information to the contractor to facilitate avoidance of turtles if observed in the construction zone; and removing silt fence after stabilization of the site to remove barriers to turtle movements. Additionally, BMP and permanent stormwater controls will reduce sedimentation to a level that is acceptable for an NPDES permit and therefore would have no adverse impact on aquatic habitat and associated aquatic wildlife.

During the early stages of final design, bridge structures, and forested areas within the construction limits would be field checked in compliance with the Migratory Bird Treaty Act to determine whether swallow or other species nests are present. If active nests are documented, appropriate mitigation measures would be implemented during construction, such as seasonal work windows or nest and tree removal during the non-nesting season. The measures selected for construction mitigation would be made in consultation with the appropriate agencies.

Prior to construction, measures to reduce the spread of noxious weed species and seeds (cleaning equipment prior to bringing equipment onsite or leaving the site) would be done in accordance with standards in Minnesota Rule 6126.0250 to minimize the spread of noxious weeds within the potential area of disturbance.

5.9 Water Quality and Stormwater

Water quality and stormwater information included within this section is based on the information provided in the Stormwater Technical Report (Kimley-Horn and Associates, 2012). The analysis completed for this section was conducted in coordination with the Bassett Creek Watershed Management Commission, the Mississippi Watershed Management Organization, and the Shingle Creek and West Mississippi Water Management Organization.

5.9.1 Regulatory Context and Methodology

Potential stormwater impacts are studied by quantifying the potential changes to impervious surfaces as a result of project implementation. Impervious surfaces are typically roadway and parking lot pavements, sidewalks, rooftops, or other hard surfaces that are impenetrable to water, eliminating rainwater infiltration and natural groundwater and surface water recharge. Seasonal water (rain/snowmelt) instead runs off and can pick up pollutants before entering a nearby waterbody.

For the purposes of this analysis, LRT guideway segments that include ballasted track are assumed to be impervious in order to account for the worst-case scenario in calculating impacts. Track ballast is material (often crushed stone) used to support the track and facilitate drainage. Coordination with the regulating Watershed Management Organizations (WMOs) and cities would be required to determine whether ballasted track is considered an impervious or pervious surface for regulatory purposes.

Five agencies play a role in stormwater management within the study area:

- Bassett Creek Watershed Management Commission (BCWMC)
- Mississippi Watershed Management Organization (MWMO)
- Shingle Creek and West Mississippi Watershed Management Organization (SCWMO/WMWMO)
- MPCA
- Cities of Minneapolis, Golden Valley, Robbinsdale, Crystal, Brooklyn Park, and Maple Grove

Physical infrastructure (storm sewer) associated with stormwater management is discussed in Section 5.1.

Regulatory and permitting authority for stormwater management falls to the cities, the MPCA, and in most cases also the WMOs. In the case of stormwater management facilities constructed on Minneapolis Park & Recreation Board (MPRB) property in either Minneapolis or Golden Valley, permits will be needed from the MPRB and applicable regulations will be those of the city in which the property is located. Each watershed organization is governed by the Joint Powers Agreement that is held between the watershed organization and the communities/ members that are located within the boundaries of the WMO. See Figure 5.9-1 for WMO and Watershed Management Commission (WMC) boundaries. 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, which will occur when the project is in final design, to capture the most accurate anticipated impacts.

Wellhead protection is a way to prevent drinking water from becoming polluted by managing potential sources of contamination in the area which supplies water to a public well. Wellhead protection areas are areas identified as having additional regulatory requirements to protect a well. Additional guidance will be required from the Minnesota Department of Health to evaluate proposed stormwater infiltration projects that are located within vulnerable wellhead protection areas.

Impaired waters are waters that do not meet quality standards for one or more water quality parameters. The EPA maintains a list of impaired waters based on input from each state.

5.9.2 Study Area

The study area for stormwater is defined as the potential area of disturbance for each alternative and the receiving waters within and immediately adjacent to the project. The study area for impaired waters includes impaired waters that are located within one mile on either side of the alignment and which would receive stormwater discharge from the project as per state regulation and shown in Figure 5.9-2.

5.9.3 Affected Environment

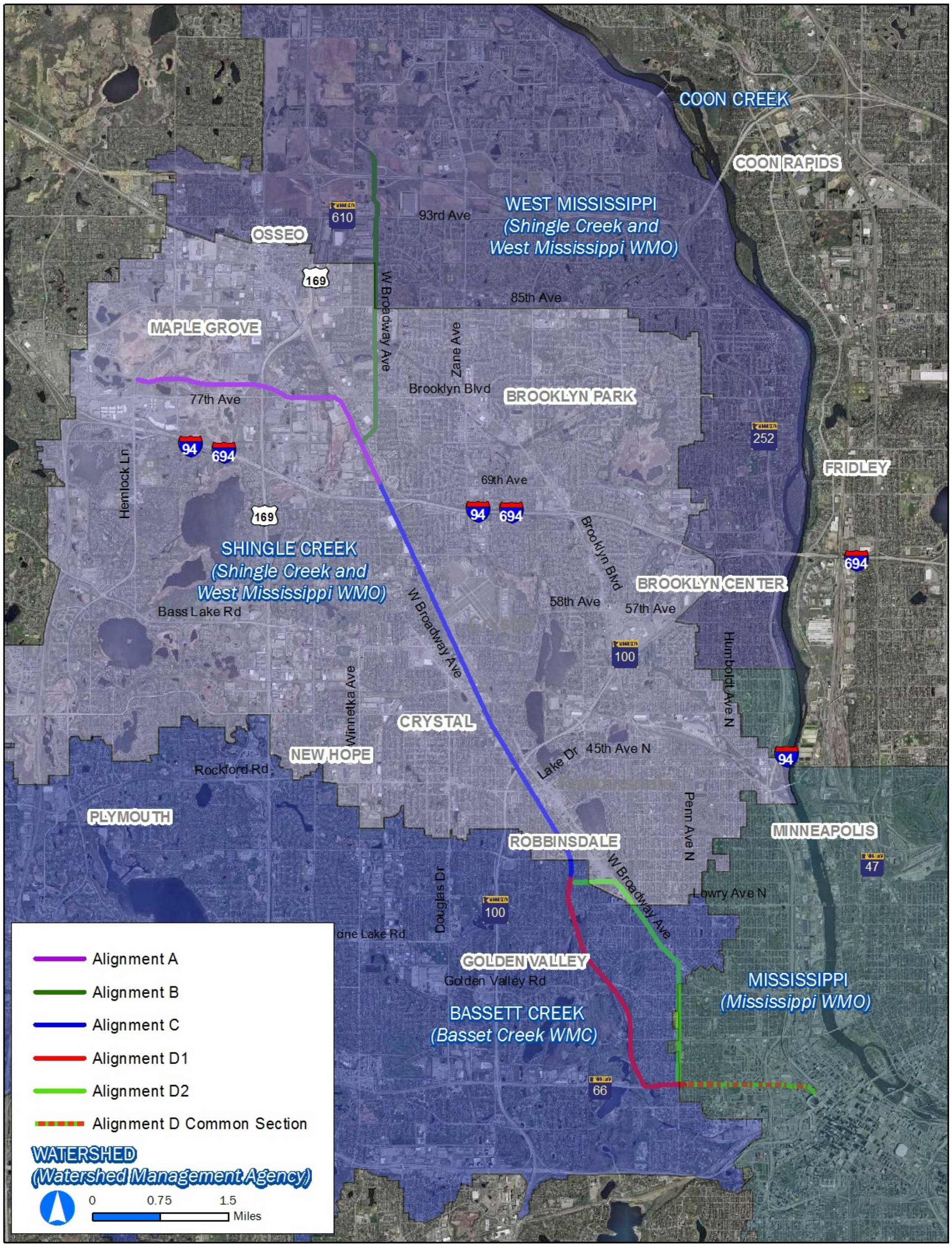
The study area is generally urbanized, highly altered as compared to natural conditions, and characterized by commercial, industrial, or residential development. The intensity of development ranges from suburban to urban and also includes a large gravel mining area in Maple Grove and existing farmland located in the northern part of Alignment B. Figure 5.9.2 identifies the receiving waters, including impaired waters, located within the study area including Bass Creek, Bassett Creek, the Mississippi River, Sweeney Creek, Cedar Island Lane, Crystal Lake, Eagle Lake, Lower Twin Lake and Wirth Lake. Table 5.9-1 provides specific information on the impairment and Total Maximum Daily Load (TMDL) status.

Table 5.9-1. Downstream Impaired Waters within One Mile of Proposed Alignment

Name	Impairment	TMDL Status
Wirth Lake[1,2]	Nutrients, Mercury (Hg)	No action
Bassett Creek (Medicine Lake to Mississippi River)[1]	Chloride, Fecal Coliform, Fish Bioassessments	No action
Mississippi River (Coon Creek to Upper St. Anthony Falls)[1,2]	Fecal Coliform, Polychlorinated biphenyl (PCB), Hg	No action
Crystal Lake[1,2]	Nutrients	EPA approved TMDL plan for Nutrients
Shingle Creek[1]	Aquatic Macroinvertebrate Bioassessment, Chloride, Dissolved Oxygen (DO)	EPA approved TMDL plan for biotic integrity/ dissolved oxygen

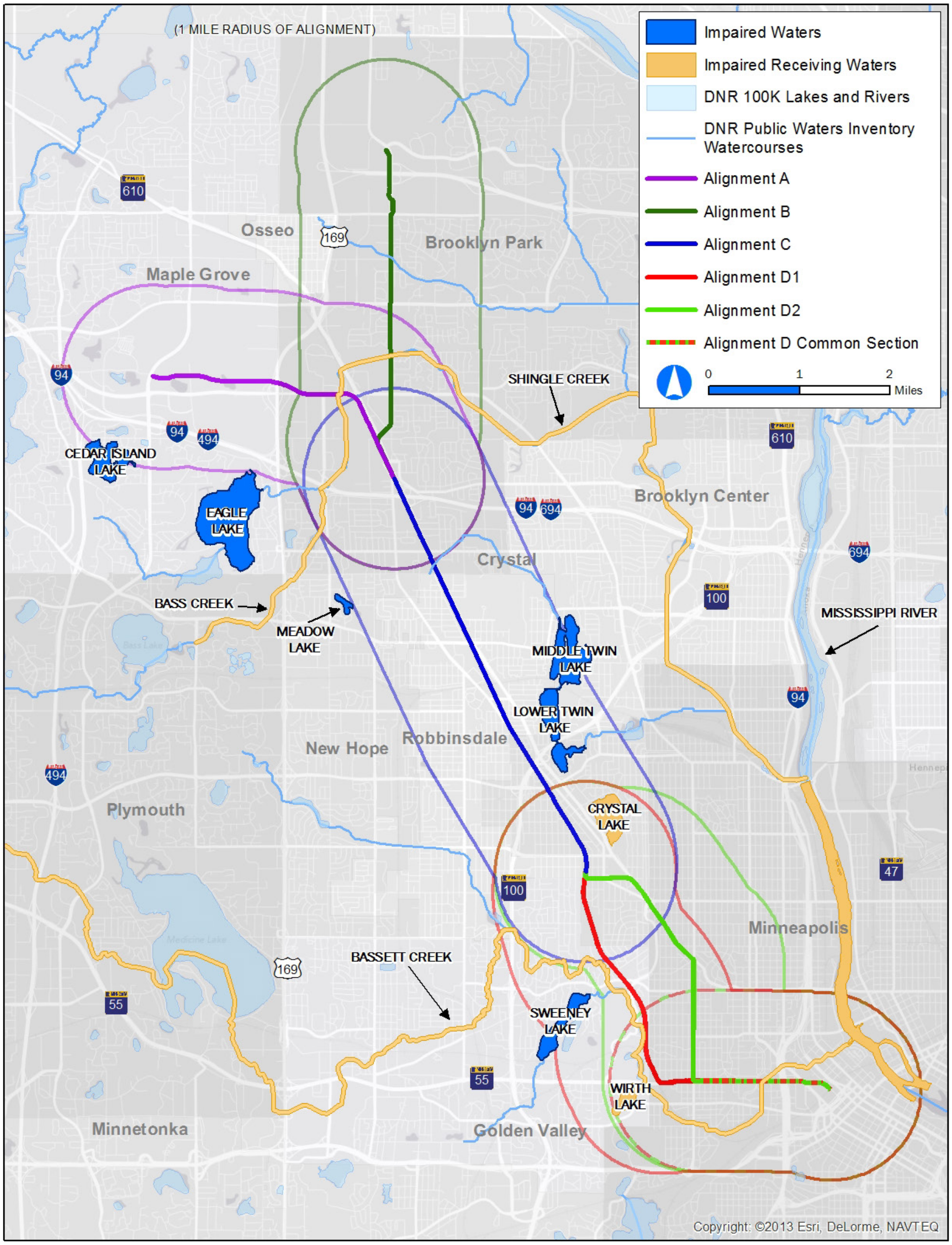
[1] Impaired waters located within drainage areas affected by the Bottineau Transitway Project
[2] Impaired waters receiving indirect discharge from existing drainage areas

Figure 5.9-1. Bottineau Transitway: Watershed Management Areas[28]



[28] Sources: Aerial: Minnesota Geospatial Information Office, 2010; Watershed: DNR Data Deli, 2003

Figure 5.9-2. Impaired Waters Within the Study Area[29]



[29] Sources: Impaired Waters: Minnesota Pollution Control Agency, 2012

Currently much of the study area for Alignments A, C, D1, and portions of the D Common Section have no formal stormwater treatment to meet current water quality regulatory requirements. Stormwater typically flows directly into surrounding vegetated ditches, which provide water quality benefits such as sediment stabilization and filtering out waterborne sediments, and existing wetlands (see Section 5.3), conveying the water into adjacent watercourses, some of which are impaired (Figure 5.9-2). Less commonly in Alignments B, D2, and portions of the D Common Section, runoff is piped directly to watercourses through existing curb and gutter. Table 5.9-2 includes a summary of the WMC, WMO, and city regulatory requirements; detailed descriptions of the regulatory requirements of the various agencies can be found in the Stormwater Technical Report (Kimley-Horn and Associates, 2012).

Table 5.9-2. WMC, WMO, and City Stormwater Management Requirements Summary

WMC/ WMO	Detention Requirements				Infiltration BMP Requirements	
	Permanent Pool Volume	Permanent Pool Depth	Flood Pool Volume	Slopes	Volume	Drawdown Time
BCWMC	Runoff from 2.5-inch, 24-hour storm over the contributing drainage area 100-year storm discharge < existing conditions	4-10 feet 3-10 feet for small ponds (less than 3 acre-feet)	5-year and 100-year storm peak discharge rate < existing conditions	1:3 above the NWL and below the safety bench 10-foot wide safety bench at slope 1:10 below the NWL	0.5 inch of runoff from tributary impervious surfaces	48 hours, up to 72 hours if justified
SCWMO/ WMWMO	Runoff from 2.5-inch storm event over the contributing drainage area	Use Minnesota Stormwater Manual	Two-year, 10-year, and 100-year critical storm events < existing conditions	1:3 above the NWL and below the safety bench 10-foot wide safety bench at slope 1:10 below the NWL	0.5 inch of runoff from the tributary impervious surfaces (likely changing to 1 inch)	48 hours
MPCA (Cities)	1800 cubic feet per acre of surface area drained	3-10 feet	5.66 cubic feet per second, per acre of surface area	1:3 above the NWL and below benches 10-foot wide bench at slope 1:10 above and below the NWL	0.5 inch of runoff from the new impervious surfaces	48 hours

5.9.4 Environmental Consequences

5.9.4.1 Operating Phase (Long-Term) Impacts

No-Build Alternative

No stormwater operating phase (long-term) impacts would be associated with the No-Build alternative.

Enhanced Bus/TSM Alternative

A proposed transit center and park-and-ride facility in Brooklyn Park along West Broadway Avenue near TH 610 would be constructed as part of the Enhanced Bus/TSM alternative. The proposed park-and-ride site is located on an existing pervious site and approximate estimates indicate that the impervious surface could increase by up to 60 percent with the addition of a paved park-and-ride site. The addition of the impervious area within the park-and-ride site, along with a drainage system (i.e. curbs, gutters, and storm drain pipes) will increase the volume of stormwater runoff from the site.

Build Alternatives

The Bottineau Transitway Project will result in an increase in the impervious area located within the limits of construction, with the percent of impervious surface increasing between 23 and 60 percent, depending on the alternative (Table 5.9-3). Impervious surfaces within each Build alternative include construction of ballasted track, platforms, park-and-ride facilities, an OMF, aerial structures for the LRT guideway, roadway, and sidewalk improvements. These additional impervious surfaces and drainage systems (i.e., curbs, gutters, and storm drain pipes) will increase the volume of stormwater runoff from sites located within each Build alternative.

Table 5.9-3. Impervious Surface Increase by Alternative[1]

Alternative	Percent Impervious Increase			
	Alignment/Station Impact	Park-and-Ride Impact	OMF Impact	Total Impact
No-Build	0%	0%	0%	0%
Enhanced Bus/TSM	0%	60%[2]	0%	60%
A-C-D1	39%[3]	48%	25%	38%
A-C-D2	31%	48%	25%	29%
B-C-D1 (Preferred Alternative)	30%[3]	53%	25%[4]	31%
B-C-D2	20%	53%	25%[4]	23%

[1] Percent over existing; impacts represent the total area that is located within the potential area of disturbance of the project.
[2] Percent impervious increase value to be confirmed with design development of Enhanced Bus/TSM park-and-ride facility.
[3] There was no discernible difference in impact between the Golden Valley Road and Plymouth Avenue/Theodore Wirth Regional Park station options.
[4] 25% represents the impervious amount for either the 93rd Avenue or 101st Avenue OMF options..

There will also be several culvert extensions necessary to accommodate the project. These extensions will be coordinated with the BCWMC. Other culvert extensions related to stream crossings are discussed in Section 5.3.

TPSS

There are 27 potential TPSS locations along the proposed alignments. The majority of the TPSS would be located on the east side of the proposed LRT tracks, with some associated with the LRT platforms and stations. Individually, TPSS sites would generally not need to meet the various watershed requirements due to the small size of the sites (less than 10,000 square feet). TPSS are included as part of the overall

Bottineau Transitway Project when considering various WMO and/or city requirements for addressing stormwater.

5.9.4.2 Construction Phase Impacts

No-Build Alternative

No stormwater impacts are anticipated.

Enhanced Bus/TSM Alternative

Construction activities would disturb soils and cause runoff that could potentially erode slopes and drainage ways, form gullies, and deposit sediment in adjacent water bodies at the proposed transit center and park-and-ride facility in Brooklyn Park along West Broadway Avenue near TH 610. Stormwater and transported sediments may contain pollutants. Stormwater runoff and erosion could destabilize slopes and affect water quality.

Build Alternatives

Construction activities associated with constructing utilities, ballasted track platforms, park-and-ride facilities, an OMF, aerial structures for the LRT guideway, roadway, and sidewalk improvements within each Build alternative would disturb soils and cause runoff that could potentially erode slopes and drainage ways, form gullies, and deposit sediment in adjacent water bodies. This could destabilize slopes and affect water quality if temporary BMPs, required through the permitting process, are not in place prior to a storm event.

For those sections in the project area served by piped stormwater conveyance, construction activities could disturb soils and affect water quality by carrying sediment in runoff discharging to storm drains if temporary BMPs, required through the permitting process, are not in place prior to a storm event.

5.9.5 Avoidance, Minimization, and/or Mitigation Measures

An NPDES Construction Stormwater Permit from the MPCA would be required because the project will disturb one acre or more of land. Other Minnesota agencies requiring permits might include watershed districts, municipalities, and soil and water conservation districts. The NPDES permit requires that a Stormwater Pollution Prevention Plan (SWPPP) be developed and implemented during construction.

Short-term mitigation measures would include the development of erosion and sediment control plans to control runoff and reduce erosion and sedimentation during construction, limiting the amount of sediment carried into lakes, streams, and rivers by stormwater runoff. These plans, in combination with the SWPPP, would identify how to control runoff, stabilize slopes and exposed soils, and limit the movement of soils into drainage systems and natural areas. Construction activities would be phased in so as to disturb as minimal an amount of area as possible at any one time.

Long-term mitigation measures would include the design and construction of permanent BMPs, such as detention and infiltration facilities, which would control and treat stormwater runoff caused by an increase in impervious surfaces as a result of the project. Due to the linear nature of the project, BMPs that are compatible with linear corridors would be used to the extent possible without the need to purchase additional right-of-way. A list of BMPs, including ponds and infiltration areas, are summarized below:

Stormwater treatment ponds provide rate control and water quality treatment. General pond locations for each alignment are discussed below and in Table 5.9-4. Ponds should be sited near low points or adjacent to outfalls that are located within the proposed right-of-way. Opportunities to collaborate with corridor cities on combined stormwater management may also be considered as the selected alternative is developed and specific mitigation needs are refined.

Infiltration or filtration BMPs are used to provide volume control and water quality treatment. Certain areas may be suitable for infiltration BMPs based on soil types at the sites. Based on the "National Cooperative Soil Survey" from the US Department of Agriculture Natural Resources Conservation Service, a large portion of the corridor contains soils appropriate for this type of BMP. Infiltration basins and infiltration trenches that are integrated into the guideway and sidewalk areas in urban areas would be considered in preliminary and final design. In areas where infiltration is not feasible (contaminated soils or low soil porosity), filtration BMPs would be considered instead of infiltration.

Filtration BMPs can be utilized in locations where poorly draining soils or proximity to groundwater precludes the use of infiltration BMPs. They can also be used at treatment pond locations, by using the 10-foot bench above the normal water level as a filtration bench. This would allow a certain volume of water in the pond to filtrate through engineered soil and be collected in a drain tile that would flow to the pond outfall. Soil borings would be taken during preliminary and final design to determine where infiltration or filtration BMPs are appropriate.

Outside ditches along the proposed railway corridor can be used for infiltration/filtration of stormwater. Ditch blocks would be installed along the east side of the railway corridor to provide storage capacity.

Table 5.9-4 includes a summary of the BMPs that could be utilized to meet the stormwater requirements for each alignment, as defined by the WMC or WMO in which the alignment is located. To the extent feasible, additional BMPs would be considered during preliminary engineering and final design. See Figure 5.9-3 for potential pond locations at park-and-ride facilities.

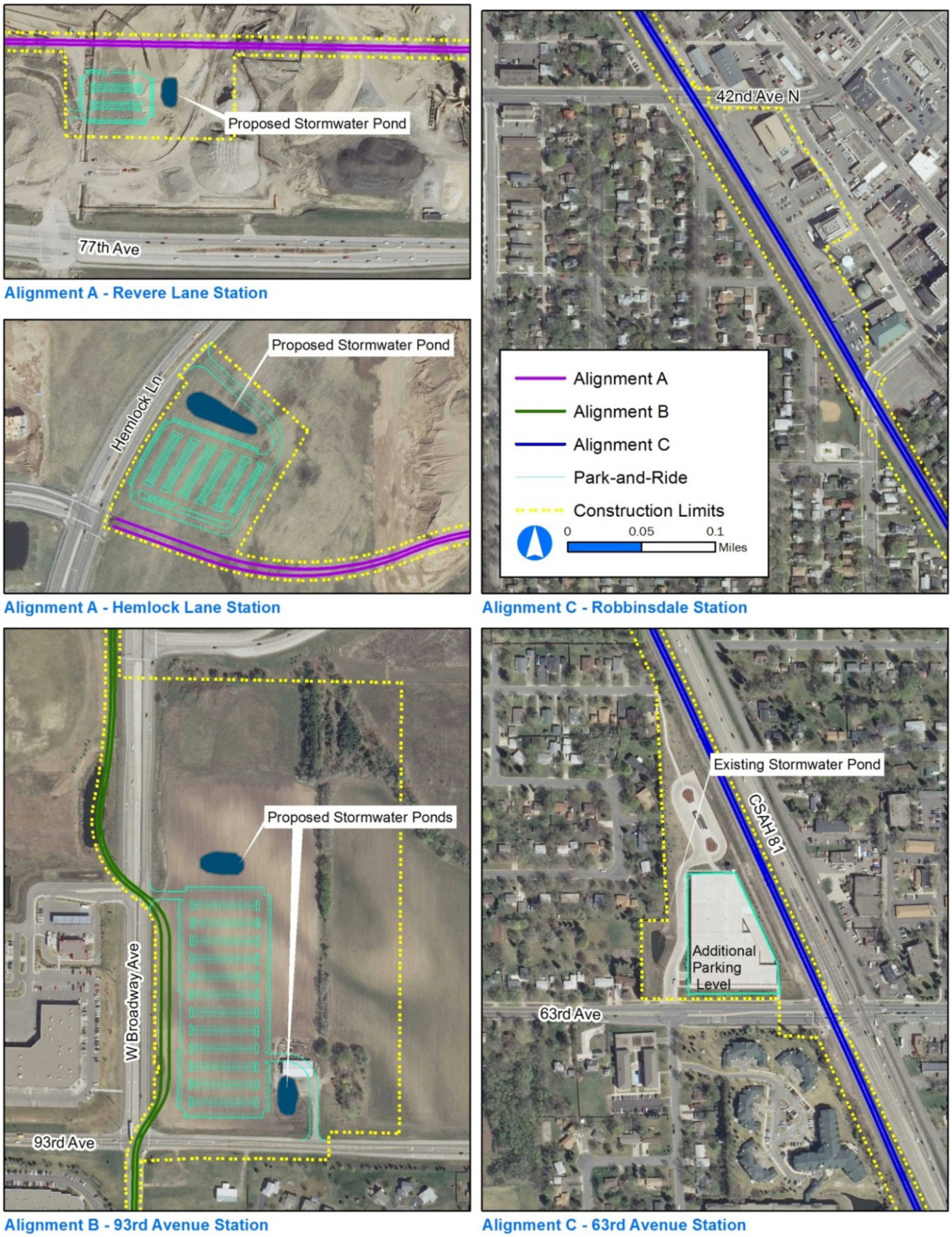
Table 5.9-4. Proposed BMPs

Alignment	Section	Proposed BMPs
Enhanced Bus / TSM Alternative	West Broadway / TH 610 Transit Center / Park-and-Ride Facility	Construct on-site pond and infiltration BMPs to meet rate control, volume control, and water quality requirements
A	Roadway Section West of US 169	BMPs for the roadway and LRT guideway would be constructed as part of the roadway project.
	Hemlock Lane Park-and-Ride	Construct on-site pond and infiltration BMPs to meet rate control, volume control, and water quality requirements
	Revere Lane Park-and-Ride	Construct on-site pond and infiltration BMPs to meet rate control, volume control, and water quality requirements
	OMF Facility	Construct on-site pond and infiltration BMPs to meet rate control, volume control, and water quality requirements
	Brooklyn Blvd	■ Utilize existing Brooklyn Boulevard BMPs to the extent feasible and construct additional BMPs to meet rate control, volume control, and water quality requirements ■ Proposed improvements have a discharge point within one mile of, and flows to, Shingle Creek and may require additional BMPs as required by the NPDES permit
	Freight Rail Corridor	■ Construct infiltration areas within adjacent ditches ■ Proposed improvements have a discharge point within one mile of, and flows to, Shingle Creek and may require additional BMPs as required by the NPDES permit

Alignment	Section	Proposed BMPs
B (part of the Preferred Alternative)	93rd / 101st Avenue OMF Facility	Construct on-site pond and infiltration BMPs to meet rate control, volume control, and water quality requirements
	93rd Avenue Park-and-Ride	Construct on-site pond and infiltration BMPs to meet rate control, volume control, and water quality requirements
	Roadway Section between 93rd Avenue and Candlewood Drive	BMPs for the roadway and LRT guideway would be constructed as part of the roadway project.
	Roadway Section south of Candlewood Drive	■ Utilize existing West Broadway BMPs to the extent feasible and construct additional BMPs to meet rate control, volume control, and water quality requirements ■ Proposed improvements have a discharge point within one mile of, and flows to, Shingle Creek and may require additional BMPs as required by the NPDES permit
	BNSF Railroad Corridor	Construct infiltration areas within adjacent ditches; Proposed improvements have a discharge point within one mile of, and flows to, Shingle Creek and may require additional BMPs as required by the NPDES permit
C (part of the Preferred Alternative)	63rd Avenue Park-and-Ride	No additional BMPs anticipated
	Robbinsdale Park-and-Ride	Construct on-site pond and infiltration BMPs to meet rate control, volume control, and water quality requirements
	BNSF Railroad Corridor	Construct infiltration areas within adjacent ditches; avoid existing well areas near the Robbinsdale station
D1[1] (part of the Preferred Alternative)	BNSF Railroad Corridor	■ Construct infiltration areas within adjacent ditches ■ Proposed improvements have a discharge point within one mile of, and flows to, Bassett Creek, Sweeney Lake and Wirth Lake and may require additional BMPs as required by the NPDES permit
D2[2]	34th Avenue	■ Construct pond and infiltration BMPs to meet rate control, volume control, and water quality requirements, consistent with the Crystal Lake TMDL plan ■ Proposed improvements have a discharge point within one mile of, and flows to, Crystal Lake and may require additional BMPs as required by the NPDES permit
	West Broadway	No additional BMPs anticipated for this portion of the corridor
	Penn Avenue	Construct pond and infiltration BMPs to meet rate control, volume control, and water quality requirements
D Common Section[2] (part of the Preferred Alternative)	TH 55	■ Construct pond and infiltration BMPs to meet rate control, volume control, and water quality requirements ■ Proposed improvements have a discharge point within one mile of, and flows to, the Mississippi River and may require additional BMPs as required by the NPDES permit

[1] Regarding station sites, there would be no discernible difference in stormwater impact between the Golden Valley Road and Plymouth Avenue/Theodore Wirth Regional Park station options.
[2] Due to the right-of-way constraints, infiltration trenches within the LRT guideway and adjacent sidewalk areas would be considered to provide additional infiltration capacity.
[3] Erosion control and sedimentation control BMPs will be required at all locations to meet the requirements of the cities and MPCA NPDES permits.

Figure 5.9-3. Proposed Stormwater Ponds at Park-and-Ride Locations



5.10 Air Quality

Information included within this section is based on the information provided in the Air Quality Technical Report (SRF Consulting Group, 2012). Coordination with MPCA occurred as described below.

Motorized vehicles affect air quality by emitting airborne pollutants. Changes in traffic volumes, travel patterns, and roadway locations affect air quality by changing the number of vehicles and the congestion levels in a given area. The air quality impacts from the Bottineau Transitway Project are analyzed by addressing criteria pollutants, a group of common air pollutants regulated by the EPA on the basis of information on health and/or environmental effects of pollution. A qualitative evaluation of Mobile Source Air Toxics (MSATs) has also been performed for this project. The scope and methods of these analyses were developed in collaboration with MPCA, Hennepin County, the Metropolitan Council, MnDOT, and FHWA.

5.10.1 Regulatory Context and Methodology

Air quality is evaluated as part of the National Environmental Policy Act (NEPA) review process for large projects receiving federal funding or approvals. This is done in accordance with the Federal Clean Air Act (CAA) of 1970 and the Clean Air Act Amendments (CAAA) of 1977 and 1990. The EPA regulates air quality and delegates this authority to the State of Minnesota, where it is monitored and enforced by the MPCA.

Air quality impacts are defined as an exceedance of established regulatory thresholds for certain pollutants. The criteria pollutants identified by the EPA are ozone, particulate matter, carbon monoxide, nitrogen dioxide, lead, and sulfur dioxide. Potential impacts resulting from these pollutants are assessed by comparing projected concentrations for the Build alternatives to National Ambient Air Quality Standards (NAAQS).

The EPA designates geographic areas based on measurements of criteria pollutant concentrations compared to NAAQS. An attainment designation indicates that concentrations are below NAAQS, nonattainment designation denotes concentrations exceeding NAAQS, and maintenance areas are those recently re-designated as attainment from non-attainment. No areas in Minnesota are designated as nonattainment for criteria pollutants. Hennepin County, where the proposed project is located, is designated as a maintenance area for carbon monoxide (CO). As a result, the Transportation Conformity Rule (40 CFR 93) requires this project to demonstrate compliance with the State Implementation Plan (SIP) to eliminate or reduce NAAQS violations. Therefore, an evaluation of carbon monoxide impacts has been performed.

In addition to the criteria air pollutants, the EPA also regulates air toxics. There are seven compounds with significant contributions from mobile sources identified by the EPA as Mobile Source Air Toxics (MSATs): acrolein, benzene, 1,3-butadiene, diesel particulate matter plus diesel exhaust organic gases (diesel PM), formaldehyde, naphthalene, and polycyclic organic matter. The FTA accepts the FHWA guidance for the assessment of MSAT effects for transportation projects in the NEPA process.

5.10.2 Study Area

A study area for evaluation of air quality effects was established for this project in cooperation with MPCA. The analysis performed includes consideration of carbon monoxide and MSATs. The evaluation of these pollutants is typically considered in the immediate project area where traffic volumes, travel patterns, and roadway locations affect air quality. Therefore, all roadway segments adjacent to and crossing the transitway alignments currently under consideration were included in the evaluation of air quality impacts.

5.10.3 Affected Environment

Air quality is evaluated based on impacts to humans in the impacted environment. Humans experience air quality impacts by breathing unsafe concentrations of airborne pollutants. Exposure to carbon monoxide and MSATs emitted from motor vehicles, the pollutants evaluated for this project, can occur in homes, businesses, and recreation facilities located adjacent to affected roadway segments or on pedestrian facilities along project-area roadways. Other pollutants, such as ozone, are regional pollutants and are not attributable to a single transportation facility or project.

5.10.4 Environmental Consequences

5.10.4.1 Operating Phase (Long-Term) Impacts

National Ambient Air Quality Standards

Potential impacts resulting from criteria pollutants were assessed by comparing projected concentrations to National Ambient Air Quality Standards (NAAQS). Results of the analyses for each criteria pollutant are described in the Air Quality Technical Report (SRF Consulting Group, 2012), including descriptions of each pollutant.

Carbon Monoxide (CO)

Carbon monoxide (CO) is a traffic-related pollutant that has been of concern in the Twin Cities Metropolitan Area. In 1999, the EPA re-designated all of Hennepin, Ramsey, Anoka, and portions of Carver, Scott, Dakota, Washington, and Wright Counties as a maintenance area for CO. This means the area was previously classified as a nonattainment area but was found to be in attainment and is now classified as a maintenance area. Maintenance areas are required to undertake actions to demonstrate continuing compliance with CO standards. Since the Bottineau Transitway Project is located in Hennepin County, evaluation of CO for assessment of air quality impacts is required for environmental approval in NEPA documents.

Air Quality Conformity

The 1990 Clean Air Act Amendments (CAAA) require that SIPs must demonstrate how states with nonattainment and maintenance areas will meet federal air quality standards.

The EPA issued final rules on transportation conformity (40 CFR 93, Subpart A) which describe the methods required to demonstrate SIP compliance for transportation projects. It requires that transportation projects must be part of a conforming Long Range Transportation Plan (LRTP) and four-year Transportation Improvement Program (TIP). The Bottineau Transitway is part of the 2030 Transitway System shown in Metropolitan Council's *2030 Transportation Policy Plan* (*TPP*) (Figure 7-43, November 10, 2010). The proposed project is not included in the 2012-2015 Transportation Improvement Program (September 28, 2011) because it is not scheduled to be constructed until after year 2015. The TPP was found to be in conformity by FHWA on February 23, 2011. (FHWA acts as the executive agent for the FTA for purposes of determining conformity of metropolitan transportation plans.)

The *2030 TPP* supports expansion of transit services as a means of improving regional air quality. Chapter 7: Transit of the *2030 TPP* references changing federal policies that lead to coordinated investments in housing and transit service that can improve air quality through fewer vehicle miles traveled in private cars. Appendix F: Clean Air Act Conformance of the *2030 TPP* includes "Public Transit Strategies" in the list of "Timely Implementation of Transportation Control Measures." In sum, the proposed transitway improvements are consistent with the Metropolitan Council's goal of improving regional air quality.

On November 8, 2010, the EPA approved a request for a limited maintenance plan for the Twin Cities maintenance area. Under a limited maintenance plan, the EPA has determined that there is no requirement to estimate projected emissions over the maintenance period and that "emissions budgets in limited maintenance plan areas may be treated as essentially not constraining for the length of the initial maintenance period because it is unreasonable to expect that such an area will experience so much growth in that period that a violation of the CO NAAQS would result" (EPA Limited Maintenance Plan

Option for Nonclassifiable CO Nonattainment Areas, October 6, 1995). Therefore, no regional modeling analysis for the LRTP and TIP is required; however, federally funded and state funded projects are still subject to isolated intersection-level, or "hot spot" analysis, requirements. The limited maintenance plan adopted in 2010 determines that the level of CO emissions and resulting ambient concentrations will continue to demonstrate attainment of the CO NAAQS. Therefore, no regional emissions modeling was completed as part of the evaluation of the current project; however, hot spot analysis has been completed, as required, and is summarized below.

Conformity Analysis

The effects of the proposed project on air quality were examined through analysis of the predicted impacts on CO concentrations. The following section discusses the CO analysis modeling methods and results.

To assess CO concentration changes, background concentrations were measured and adjusted for future background traffic growth and changes in vehicle emissions. Potential CO impacts on air quality were analyzed with respect to intersection conditions for the proposed Bottineau Transitway Project. Forecast year 2030 traffic was used to model future CO concentrations as the worst-case conditions. The analysis methods and procedures and the scope of this analysis were developed in collaboration with MPCA.

Air quality modeling was performed using current versions of EPA CO emission (MOBILE 6.2) and dispersion modeling (CAL3QHC) software. All methods and procedures used in the air quality analyses are generally approved as industry-standard analytical methods by the EPA and MPCA.

Intersection Carbon Monoxide Analysis

Carbon monoxide concentrations were calculated for five intersections in the study area, one representing the worst-case condition along each of the alignments under consideration. These locations were identified from the Traffic Technical Report (Kimley-Horn and Associates, 2012) as the intersections with the highest traffic volumes and poorest levels of service and are expected to result in the worst-case CO concentrations. The rationale for this approach is to evaluate whether any of the proposed alignments might be expected to result in carbon monoxide concentrations exceeding NAAQS allowable limits. This methodology was developed based on input from MPCA and Hennepin County. The intersections selected for evaluation were:

- Alignment A: CSAH 81 & CSAH 130
- Alignment B: CSAH 103 & CSAH 130 (part of the Preferred Alternative)
- Alignment C: CSAH 81 & CSAH 10 (Bass Lake Road) (part of the Preferred Alternative)
- Alignment D1: TH 55 & Penn Ave (part of the Preferred Alternative)
- Alignment D2: CSAH 81 & Penn Ave

Background CO concentrations are needed for air quality analysis purposes to represent conditions without the influence of nearby vehicles. By definition, the background CO concentration in any particular area is that concentration which exists independently of direct contributions from nearby traffic.

The background concentrations are added to intersection-scale modeled results to yield predicted CO levels. To represent worst-case conditions, no background reduction factor to account for future emissions-control improvements was used, which likely results in overestimations of ambient background CO concentrations. Results of background CO monitoring and the adjustment calculations are presented in Table 5.10-1.

Table 5.10-1. Background Carbon Monoxide Concentrations

Grove Academy, St. Louis Park, MN	1-Hour	8-Hour
March 2011 maximum concentrations[1]	0.56	0.49
Holzworth Correction Factor (Spring)	1.53	1.53
2011 background CO concentration (ppm)	0.86	0.75
Background traffic growth – 2011 to 2030	1.3	1.3
Adjusted background CO concentration (ppm) - 2030	1.12	0.98

Source: MnDOT Background Carbon Monoxide Monitoring Report, February 17 through March 4, 2011

Evaluation Results

The intersection CO modeling results are shown in Table 5.10-2. These results are the worst-case results from the CAL3QHC dispersion model, showing the location of the highest expected concentration, the value of the highest one-hour and eight-hour concentrations, and the wind angle that produced these concentrations. The CO results provided represent background CO concentrations plus modeled intersection CO concentrations. The worst-case was identified at the intersection of CSAH 81 and CSAH 130.

Table 5.10-2. Carbon Monoxide Modeling Results (Listed in parts-per-million (ppm))

Alignment	Highest CO Receptor Location	1-Hour Average Concentration	8-Hour Average Concentration	Wind Direction
A: CSAH 81 & CSAH 130	SE Quadrant	2.52	1.96	310°
B: CSAH 103 & CSAH 130 (part of the Preferred Alternative)	SW Quadrant	2.12	1.68	300°
C: CSAH 81 & CSAH 10 (part of the Preferred Alternative)	NW Quadrant	2.22	1.75	110°
D1: TH 55 & Penn Ave (part of the Preferred Alternative)	SW Quadrant	2.42	1.89	70°
D2: CSAH 81 & Penn Ave	NW Quadrant	1.52	1.26	170°

Discussion and Conclusions

Intersection-level CO modeling was performed for the worst operating intersection under worst-case conditions. The highest predicted concentrations are expected to occur near the intersection of CSAH 81 and CSAH 130, with one-hour and eight-hour concentrations of 2.52 and 1.96 ppm, respectively. Based on these results, concentrations of CO in the study area would not exceed the federal one-hour standard of 35 ppm, the Minnesota one-hour standard of 30 ppm, and the federal eight-hour standard of nine ppm.

These CO modeling results show that the Bottineau Transitway Project is not expected to cause CO concentrations that exceed state or federal standards. Based on the qualitative assessment presented at the beginning of this section, the project would not cause exceedances of the other criteria pollutants.

Mobile Source Air Toxics

Controlling air toxic emissions became a national priority with the passage of the Clean Air Act Amendments (CAAA) of 1990, whereby Congress mandated that the EPA regulate 188 air toxics, also known as hazardous air pollutants. The EPA has assessed this list in their latest rule on the Control of Hazardous Air Pollutants from Mobile Sources (Federal Register, Vol. 72, No. 37, page 8430, February 26, 2007) and identified a group of 93 compounds emitted from mobile sources that are listed in their Integrated Risk Information System (IRIS) (http://www.epa.gov/ncea/iris/index.html).

In addition, EPA identified seven compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers from their 1999 National Air Toxics Assessment (NATA) (http://www.epa.gov/ttn/atw/nata1999). These are acrolein, benzene, 1,3-butadiene, diesel particulate matter plus diesel exhaust organic gases (diesel PM), formaldehyde, naphthalene, and polycyclic organic matter.

FHWA provides guidance on evaluation of MSATs for highway projects as part of the NEPA process. This guidance specifies a tiered approach for MSAT evaluation:

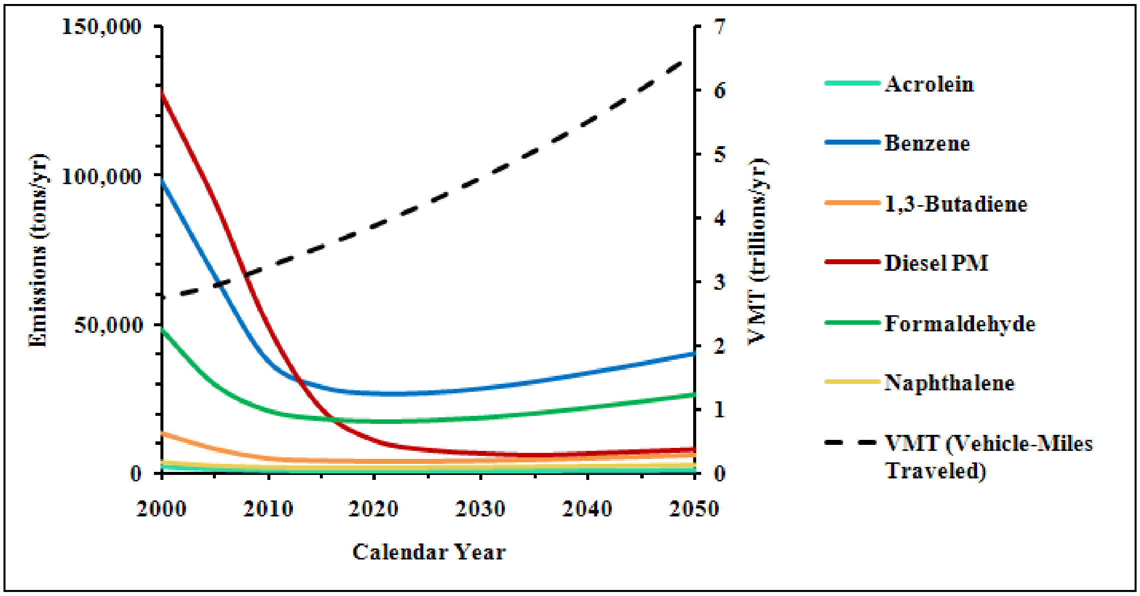
- No analysis is required for projects with no meaningful MSAT effects. These are projects qualifying as a categorical exclusion under 23 CFR 771.117(c), that are exempt under the CAA conformity rule, or have no meaningful impacts on traffic volumes or vehicle mix.
- Qualitative analysis is prescribed for projects with low potential MSAT effects. Most projects fall into this category if they do not meet the criteria for the other two categories.
- Quantitative analysis is required for major highway capacity projects on facilities with more than 140,000 to 150,000 vehicles per day or impact freight terminals with high levels of diesel particulate matter.

According to the FHWA guidance, a qualitative evaluation of MSAT impacts has been completed for the Bottineau Transitway Project. This is appropriate based on the scope of improvements contemplated as part of this project, particularly modifications to roadways and intersections through the project area. FHWA guidance states that the qualitative assessment should compare, in narrative form, the expected effect of the project on traffic volumes, vehicle mix, or routing of traffic and the associated changes in MSATs for the project alternatives, including No-Build, based on traffic volumes, vehicle mix, and speed. It should also discuss national trend data projecting substantial overall reductions in emissions due to stricter engine and fuel regulations issued by EPA.

Summary of MSAT Information

The 2007 EPA rule further requires controls that would dramatically decrease MSATs emissions through cleaner fuels and cleaner engines. According to an FHWA analysis using EPA's MOBILE6.2 model, even if vehicle activity (vehicle-miles traveled (VMT)) increases by 145 percent as assumed, a combined reduction of 72 percent in the total annual emission rate for the priority MSATs is projected from 1999 to 2050, as shown in Figure 5.10-1.

Figure 5.10-1. National MSAT Emission Trends 1999 - 2050 for Vehicles Operating On Roadways Using EPA's MOBILE 6.2 Model



[1] Annual emissions of polycyclic organic matter are projected to be 561 tons/yr for 1999, decreasing to 373 tons/yr for 2050.
[2] Trends for specific locations may be different, depending on locally derived information on vehicle-miles travelled, vehicle speeds, vehicle mix, fuels, emission control programs, meteorology, and other factors.
Source: U.S. Environmental Protection Agency. MOBILE6.2 model run 20 August 2009.

Air toxics analysis is a continuing area of research. While much work has been done to assess the overall health risk of air toxics, many questions remain unanswered. In particular, the tools and techniques for assessing project-specific health outcomes as a result of lifetime MSATs exposure remain limited. These limitations impede the ability to evaluate how the potential health risks posed by MSATs exposure should be factored into project-level decision-making within the context of NEPA.

Information is incomplete or unavailable to credibly predict project-specific health impacts due to changes in MSATs emissions associated with a proposed set of transportation alternatives. The FHWA, EPA, Health Effects Institute, and others have funded and conducted research studies to try to more clearly define potential risks from MSATs emissions associated with transportation projects. However, available technical tools do not enable us to predict the project-specific health impacts of MSATs emissions. In compliance with 40 CFR 1502.22(b), FHWA has provided a discussion demonstrating that scientific techniques, tools, and data are not sufficient to accurately estimate human health impacts that could result from a transportation project in a way that would be useful to decision-makers.

Qualitative MSATs Analysis

For each alternative considered, the amount of MSATs emitted would be proportional to the average daily traffic (ADT), assuming that other variables, such as fleet mix, are the same for each alternative. All of the Build alternatives are expected to serve approximately 26,000 transit trips by year 2030. Current air quality levels are considered acceptable and are expected to remain at acceptable levels under the Build alternatives. Changes in ADT between alternatives differ among the various alignments. Each alignment is evaluated individually and discussed below.

Alignment A

The proposed operations of the Bottineau Transitway along Alignment A are not expected to have a significant impact on vehicular traffic. The transitway would be largely separated from the adjacent roadways of CSAH 81 and CSAH 130. As a result, the ADT estimated for the A-C-D1 and A-C-D2 Build alternatives does not differ from that for the No-Build alternative. Since ADT does not differ, no changes in MSATs emissions for the Build alternatives along the corridor are expected.

The realigned travel lanes contemplated as part of Alignment A would have the effect of moving some traffic closer to nearby homes, schools, and businesses; therefore, under the Build alternatives there may be localized areas where ambient concentrations of MSATs could be higher under the Build alternatives than the No-Build alternative. The localized increases in MSATs concentrations would likely be most pronounced along the expanded roadway sections that would be built along CSAH 130 (Elm Creek Boulevard) between Northland Drive and CSAH 81. However, the magnitude and the duration of these potential increases compared to the No-Build alternative cannot be reliably quantified due to incomplete or unavailable information in forecasting project-specific MSATs health impacts.

Alignment B (part of the Preferred Alternative)

The ADT estimated for the B-C-D1 and B-C-D2 Build alternatives along Alignment B is not expected to change compared to the No-Build alternative. It is possible that the presence of the transitway along CSAH 103 (Broadway Avenue) would be expected to impact the efficiency of the roadway and result in longer queues at intersections and more idling vehicles. This would lead to higher MSATs emissions for the Build alternatives along Alignment B because lower speeds are associated with higher MSATs emission rates; according to EPA's MOBILE6.2 model, emissions of all of the priority MSATs except for diesel particulate matter increase as speed decreases. The extent of these speed-related emissions increases cannot be reliably projected due to the inherent deficiencies of technical models.

The realigned travel lanes contemplated as part of Alignment B would have the effect of moving some traffic closer to nearby homes, schools, and businesses; therefore, under the Build alternatives containing Alignment B there may be localized areas where ambient concentrations of MSATs could be higher under the Build alternatives than the No-Build alternative. The localized increases in MSATs concentrations would likely be most pronounced along the expanded roadway sections that would be built along CSAH 103 (Broadway Avenue) between Oak Grove Parkway and 75th Avenue. However, the magnitude and the duration of these potential increases compared to the No-Build alternative cannot be reliably quantified due to incomplete or unavailable information in forecasting project-specific MSATs health impacts.

Alignment C (part of the Preferred Alternative)

The ADT estimated along Alignment C (all Build alternatives) is not expected to change compared to the No-Build alternative. It is possible that the presence of the transitway along CSAH 81 would be expected to impact the efficiency of the roadway and result in longer queues at intersections and more idling vehicles. This would lead to higher MSATs emissions for the Build alternatives along Alignment C because lower speeds are associated with higher MSATs emission rates; according to EPA's MOBILE6.2 model, emissions of all of the priority MSATs except for diesel particulate matter increase as speed decreases. The extent of these speed-related emissions increases cannot be reliably projected due to the inherent deficiencies of technical models.

Alignment D1 (part of the Preferred Alternative)

Changes in ADT are not a relevant measure for the segments of Alignment D1 passing near Theodore Wirth Park. This is because the Bottineau Transitway would operate on exclusive right-of-way with little or no impact to vehicular traffic. As a result, no changes in MSATs emissions would be expected for the Build alternatives incorporating the D1 alignment (A-C-D1 or B-C-D1) compared to the No-Build alternative.

Alignment D2

The ADT estimated for the Build alternatives along Alignment D2 is not expected to change compared to the No-Build alternative. It is possible that the presence of the transitway along 34th Avenue, CSAH 81, and CSAH 2 (Penn Ave) would be expected to impact the efficiency of the roadway and result in longer queues at intersections and more idling vehicles. This would lead to higher MSATs emissions for the Build alternatives along Alignment D2 because lower speeds are associated with higher MSATs emission rates; according to EPA's MOBILE6.2 model, emissions of all of the priority MSATs except for diesel particulate matter increase as speed decreases. The extent of these speed-related emissions increases cannot be reliably projected due to the inherent deficiencies of technical models.

The realigned travel lanes contemplated as part of the Build alternatives would have the effect of moving some traffic closer to nearby homes, schools, and businesses; therefore, under the Build alternatives utilizing Alignment D2 there may be localized areas where ambient concentrations of MSATs could be higher than the No-Build alternative. The localized increases in MSATs concentrations would likely be most pronounced along the expanded roadway sections that would be built along 34th Avenue, CSAH 81, and CSAH 2 (Penn Ave) between the 34th Avenue railroad crossing and TH 55 (Olson Memorial Highway). However, the magnitude and the duration of these potential increases compared to the No-Build alternative cannot be reliably quantified due to incomplete or unavailable information in forecasting project-specific MSATs health impacts. Also, MSATs would be lower in other locations when traffic shifts away from them.

Alignment D Common Section (part of the Preferred Alternative)

The ADT estimated for the Build alternatives along the Alignment D Common Section is not expected to change compared to the No-Build alternative. It is possible that the presence of the transitway along TH 55 would be expected to impact the efficiency of the roadway and result in longer queues at intersections and more idling vehicles. This would lead to higher MSATs emissions for the Build alternatives along the Alignment D Common Section because lower speeds are associated with higher MSATs emission rates; according to EPA's MOBILE6.2 model, emissions of all of the priority MSATs except for diesel particulate matter increase as speed decreases. The extent of these speed-related emissions increases cannot be reliably projected due to the inherent deficiencies of technical models.

All Alternatives

Under each of the proposed alternatives (No-Build, Enhanced Bus/TSM, and Build alternatives) emissions would likely be lower than present levels in the design year as a result of EPA's national control programs that are projected to reduce annual MSATs emissions by 72 percent between 1999 and 2050. On a regional basis, EPA's vehicle and fuel regulations, coupled with fleet turnover, will over time cause substantial reductions that, in almost all cases, will cause region-wide MSATs levels to be significantly lower than today. The magnitude of the EPA-projected reductions is so great (even after accounting for traffic growth) that MSATs emissions in the study area are likely to be lower under a wide variety of future conditions.

5.10.4.2 Construction Phase Impacts

No-Build Alternative

No air quality impacts are associated with construction under the No-Build alternative.

Enhanced Bus/TSM Alternative

Construction activities under the Enhanced Bus/TSM alternative are limited to the development of a proposed transit center at Oak Grove Parkway. Construction activities under the Enhanced Bus/TSM alternative could result in higher concentrations of air pollutants. Construction equipment powered by fossil fuels emits the same air pollutants as do highway vehicles. Exposed earthen materials can also produce increased particulate matter when they are moved or disturbed by wind. BMPs described in Section 5.10.5 will ensure that concentrations of air pollutants are kept at the lowest possible levels during the construction phase.

Build Alternatives

The construction of each of the alignments under consideration would affect traffic volumes and operations along roadways in and around the study area. During construction, some intersections may need to temporarily operate with reduced capacities or be temporarily closed. Under these conditions, traffic would be expected to detour to parallel roadway facilities near the project area. This increased traffic may result in increased emissions and higher concentrations of air pollutants near homes and businesses.

In addition to traffic-related emissions increases, construction activities can also result in higher concentrations of air pollutants. Construction equipment powered by fossil fuels emits the same air pollutants as highway vehicles. Exposed earthen materials can also produce increased particulate matter when they are moved or disturbed by wind. BMPs described in Section 5.10.5 will ensure that concentrations of air pollutants are kept at the lowest possible levels during the construction phase.

5.10.5 Avoidance, Minimization, and/or Mitigation Measures

5.10.5.1 Operating Phase (Long-Term) Impacts

The analysis presented in this document demonstrates there will be no anticipated exceedances of air pollutant concentrations during the operating phase (long-term) of the proposed project; therefore, no mitigation measures are necessary. The State of Minnesota does not require permits related to air quality for projects of this type.

5.10.5.2 Construction Phase Impacts

This analysis also demonstrates that there will be no anticipated exceedances during the construction phase. However, a series of BMPs would be implemented during construction to control dust. This may include the following preventive and mitigative measures:

- Minimization of land disturbance during site preparation
- Use of watering trucks to minimize dust
- Covering of trucks while hauling soil/debris off-site or transferring materials
- Stabilization of dirt piles if they are not removed immediately
- Use of dust suppressants on unpaved areas
- Minimization of unnecessary vehicle and machinery idling
- Revegetation of any disturbed land post-construction

Traffic control measures would be developed in subsequent stages of the project to address detours and flow of traffic.

5.10.5.3 Summary of Impacts and Mitigation Measures

Table 5.10-3 summarizes the general air quality impacts of the Build alternatives proposed for the Bottineau Transitway Project. This table is meant to give a snapshot of the types of impacts that may be anticipated. It is not anticipated that adverse air quality impacts would result from the No-Build or Enhanced Bus/TSM alternatives.

Table 5.10-3. Summary of Air Quality Impacts and Mitigation Measures

Impact Category	Impacts of Build Alternatives	Avoidance, Minimization, and/or Mitigation Measures
Operating Phase (Long-Term) Air Quality – CO Hot Spot Analysis	None of the alternatives under consideration would be expected to result in CO concentrations exceeding state or federal standards.	None required
Operating Phase (Long-Term)Air Quality – MSATs Analysis	While there may be localized areas where MSATs emissions would increase, EPA vehicle and fuel regulations, coupled with fleet turnover, would result in substantial reductions that, over time, would result in significantly lower region-wide MSATs than those found today.	None required
Construction Impacts of Build Alternatives on Air Quality	Construction of the proposed Bottineau Transitway may also cause increased concentrations of dust and air pollutants. When roads are closed or operating with reduced capacity, detoured traffic would result in increased traffic on parallel roadways near the project area. Increased emissions would also be produced by construction equipment, and particulate matter can enter the air from exposed earthen materials. However, it is expected that ambient concentrations of increased air pollutants would remain below state and federal standards.	BMPs would be implemented during construction to control dust and manage equipment. Traffic control measures would be developed in subsequent stages of the project to address detours and flow of traffic.

5.11 Energy

5.11.1 Regulatory Context and Methodology

This section reports the estimated changes in regional energy consumption resulting from the Bottineau Transitway Project. The analysis results are reported in British Thermal Units (BTUs) per mile as calculated from the vehicle miles traveled (VMT) reported for each alternative by the Twin Cities Regional Travel Demand Model. A BTU is a commonly used unit of energy and represents the amount of heat energy needed to raise the temperature of one pint of water by one degree Fahrenheit. Energy consumption factors will be based on estimates of average energy consumption rates.

The energy impacts of the Build alternatives were determined by comparing total energy consumption of each Build alternative with the No-Build and Enhanced Bus/TSM alternatives. The amount of energy used per mile by each mode of transportation is presented in Table 5.11-1. By multiplying these energy-use factors by the total miles traveled, annual energy use can be estimated.

Table 5.11-1. Energy Consumption Factors

Mode	Factor (BTU/Vehicle Mile)
Light Rail Transit	61,645
Heavy Duty Vehicles	21,463
Bus	35,958
Passenger Vehicles	5,692

Source: Transportation Energy Data Book: Edition 31 (July 2012) USDOE Oak Ridge National Laboratory

5.11.2 Study Area

The study area for energy includes anticipated changes in travel patterns and bus operations within the various alternatives proposed for study in this Draft EIS. The focus is on direct energy use. That is, the energy consumed in the operation of vehicles including autos, buses, and trucks.

5.11.3 Affected Environment

The study area is primarily urban with small amounts of agricultural land at the northern end of one of the project alignments. Development along the proposed Bottineau Transitway includes residential, business, industrial, institutional, agricultural, park, and transportation uses. Existing land uses along the proposed alignment options are identified and described in Section 4.1 of this Draft EIS.

5.11.4 Environmental Consequences

5.11.4.1 Operating Phase (Long-Term) Impacts

Long-term operational effects are presented in Table 5.11-2 and are discussed below.

No-Build Alternative

The annual regional direct energy consumption for the No-Build alternative would be approximately 224.214 trillion BTUs annually, based on output from the Twin Cities Regional Travel Demand Model, as modified for the Bottineau Transitway Project.

Enhanced Bus/TSM Alternative

The estimated annual regional direct energy consumption for the Enhanced Bus/TSM alternative would be 224.163 trillion BTUs annually.

Build Alternatives

All of the Build alternatives have slightly lower energy consumption as compared to the No-Build alternative. Energy consumption is similar across all Build alternatives, with Alternative A-C-D1 having the lowest annual regional direct energy consumption. Estimated annual energy consumption for each of the Build alternatives is listed below.

- A-C-D1: 224.092 trillion BTUs
- A-C-D2: 224.096 trillion BTUs
- B-C-D1 (Preferred Alternative): 224.112 trillion BTUs
- B-C-D2: 224.116 trillion BTUs

Table 5.11-2. Estimated Energy Use of Alternatives by 2030

Vehicle Type	No-Build	Enhanced Bus/TSM	A-C-D1	A-C-D2	B-C-D1 (Preferred Alternative)	B-C-D2
2030 Annual VMT (in thousands) [1, 2]						
Light Rail	3,383	3,383	5,446	5,464	5,552	5,570
Heavy Duty Vehicle	1,552,081	1,551,515	1,550,707	1,550,720	1,550,811	1,550,827
Bus	46,200	48,017	47,129	47,129	46,904	46,904
Passenger Car	33,210,046	33,191,741	33,165,612	33,166,037	33,168,976	33,169,507
Total	34,811,710	34,794,656	34,768,893	34,769,349	34,772,243	34,772,808
2030 Annual Energy Consumption (billion BTUs)						
Light Rail	209	209	336	337	342	343
Heavy Duty Vehicle	33,312	33,300	33,283	33,283	33,285	33,285
Bus	1,661	1,727	1,695	1,695	1,687	1,687
Passenger Car	189,032	188,927	188,779	188,781	188,798	188,801
Total	224,214	224,163	224,092	224,096	224,112	224,116
Difference from No-Build	--	(51)	(122)	(118)	(102)	(98)

[1] Source: Annual VMT for No-Build (auto and truck) is estimated and calibrated based on MnDOT 2010 VMT figures for the 7-County Twin Cities Metropolitan Area.
[2] Source: SRF Consulting Group, Inc. (2011)

5.11.4.2 Construction Phase Impacts

No-Build Alternative

There would be no project-related construction energy use for the No-Build alternative.

Enhanced Bus/TSM Alternative

Limited short-term energy use would likely be required for implementation of the Enhanced Bus/TSM alternative through the construction of a proposed transit center and park-and-ride facility near Oak Grove Parkway and West Broadway Avenue, north of TH 610. However, such energy use would be much less than for the Build alternatives.

Build Alternatives

Energy would be required for construction of the Build alternatives, for the production of the raw materials used in construction, and for the operation of construction equipment. Energy use would be localized and temporary. Compared to the energy consumption of the entire Twin Cities Metropolitan Area, the construction of the Build alternatives would not have a substantial impact on regional energy consumption.

5.11.5 Avoidance, Minimization, and Mitigation Measures

Implementation of any of the Build alternatives would result in a decrease in total energy used annually by a small amount compared to the No-Build alternative. No mitigation has been identified or recommended.

Although the analysis indicates that the project would not increase energy consumption, there are additional opportunities to decrease energy consumption. Potential opportunities include construction of energy efficient structures such as stations and the operation and maintenance facility. Further evaluation of these opportunities would occur during project design and development.