SOUTHWEST transitway

green means go.

Southwest LRT
Technical Memorandum No. 9

ENVIRONMENTAL EVALUATION

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PRELIMINARY
FOR REVIEW ONLY

September 9, 2009

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1.0 INTRODUCTION

This technical memorandum provides an inventory and assessment of the possible impacts on the following potentially critical resource areas:

- potential historic resources;
- natural resources (including endangered and threatened species and riparian areas/habitat);
- water resources (including floodplains and wetlands);
- contaminated properties and hazardous materials;
- parklands or other Section 4(f) resources;
- geologic conditions;
- noise; and
- vibration.

This evaluation assesses each LRT alternative (see Figure 1-1) with respect to the presence of, and where information is available, impacts to the resources listed above. A summary of the evaluation is presented at the end of this technical memorandum. The matrix provides a qualitative comparison of the environmental conditions, and where sufficient information is available, the potential impacts of the proposed project.

The information in this memorandum will be incorporated into the Locally Preferred Alternative (LPA) report. In the LPA Report, the LRT alternatives will be ranked to determine which one best meets the Purpose and Need for the Project. The alternative identified through this process to best meet the Purpose and Need will be recommended as the LPA. Impacts, benefits and recommended mitigations to reduce unavoidable adverse impacts of the LPA to acceptable levels will be documented in the Draft Environmental Impact Statement (DEIS).

Section 3.3 in Technical Memorandum 3 provides additional information about the eight resource areas which have been identified as “critical.” These resource areas are “critical” because the potential for impacts to resources could substantially alter the ability of the project sponsor to implement the project in a timely manner and within the financial resources available.

2.0 SUMMARY OF ALTERNATIVES

The proposed Southwest LRT project includes four build alternatives which were identified through the Alternatives Analysis and National Environmental Policy Act (NEPA) Scoping processes. These alternatives include LRT 1A, LRT 3A, LRT 3C-1 (Nicollet Mall) and LRT 3C-2 (11th/12th Street).

For analysis purposes, the alternatives were divided into logical segments, including segments 1, 3, 4, A, C-1 (Nicollet Mall), C-2 (11th/12th Street), C-2A (Blaisdell Avenue), and C-2B (1st Avenue). Table 1 presents the segments for each Alternative; Figures 2-1 through 2-4 present the alternatives.

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Table 1. Segments Associated with Alternatives

Alternative	Segments
LRT 1A	1, 4, A
LRT 3A	3, 4, A
LRT 3C-1 (Nicollet Mall)	3, 4, C-1 (Nicollet Mall)
LRT 3C-2 (11th/12th Street)	3, 4, C-2 (11th/12th Street), C-2A (Blaisdell Avenue), C-2B (1st Avenue)

2.1 Segment Descriptions

The following sections provide descriptions of the key components of the planning segments for the Southwest LRT alternatives. See also Figures 2-1 through 2-4.

2.1.1 Segment 1

Segment 1 originates at TH 5 and follows the HCRRA property through Eden Prairie and Minnetonka in a northeast direction which generally parallels Eden Prairie Road approximately ½ to one mile to the south. Traveling northeast from TH 5 the alignment crosses Venture Lane, a small local street that parallels TH 5. Continuing in a northeast direction, Segment 1 crosses over Valley View Road which is a major east/west collector through Eden Prairie between Eden Prairie Road and I-494. Traveling northeast, the route intersects Edenvale Boulevard at grade before crossing at grade with West 62nd Street and underneath TH 62 which run parallel to one another in an east-west direction. TH 62 is a minor east/west expander for the region and its bridge crosses over the alignment. After crossing under TH 62 the alignment travels under the Twin Cities and Western Railroad (TC&W) tracks. Segment 1 intersects Baker Road at grade and travels under I-494 before crossing Rowland Road at grade. Baker Road is a minor reliever and I-494 is the largest principal arterial in the western metro region traveling in a north/south until it reaches Eden Prairie where its alignment turns to travel eastward. Before reaching Shady Oak Road at the end of the segment, the alignment crosses the local street Dominick Drive at grade near Shady Oak Lake. Shady Oak Road travels north-south and is a major collector street between I-494 and U.S. Highway 169. Segment 1 travels under Shady Oak Road before approaching the station.

2.1.2 Segment 3

Segment 3 begins near the intersection of TH 5 and Mitchell Road in Eden Prairie. From that point the route crosses Mitchell Road at-grade, and enters an exclusive (LRT) guideway in new right-of-way along the south side of TH 5 behind several office buildings, crossing the eastbound TH 5 to Prairie Center Drive bus exit ramp and the Technology Drive to eastbound TH 5 bus entrance ramp at-grade, and under Prairie Center Drive. The Southwest Station would be located near the interchange of TH 5 and Prairie Center Drive. This station location is currently a hub location for SouthWest Transit, a limited stop and express bus service connecting southwest metro communities with downtown Minneapolis, and is equipped with large parking garages used regularly by commuters. The alignment continues in new right-of-way along the south side of Technology Drive to enter the Eden Prairie Town Center Station. Immediately to the east of this station, the alignment shifts north to cross at-grade with Technology Drive. The route continues west along the north side of Technology Drive until

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turning northeast to cross over I-494, Flying Cloud Drive, and Viking Drive. The alignment continues along the east side of the Flying Cloud Drive right-of-way to cross Valley View Road at-grade.

The route then swings east and north along new right-of-way through the Golden Triangle area. This alignment crosses at-grade with a different segment of Flying Cloud Drive, and a proposed future extension of West 70th Street. The route then crosses under Flying Cloud Drive and Shady Oak Road to continue north along the east side of TH 212. Following this, the alignment crosses over TH 212 traveling northwest for a short distance through undeveloped lands to the City West Station. Segment 3 crosses over TH 62, which is a minor east/west expander for the region. The route follows new right-of-way through the Opus area, crossing over Yellow Circle Drive, then crossing Bren Road East and Bren Road West at-grade. The Opus area of Minnetonka is one of the metropolitan region's major employment centers, dominated by high and mid-rise office towers. The route crosses at-grade with Feltl Road and Smetana Road before continuing north over a floodplain area which parallels the Minnetonka-Hopkins city limits. The Segment 3 alignment crosses over the CPR and crosses at-grade with K-Tel Drive before reaching the HCRRA's property near Shady Oak Road Station.

2.1.3 Segment 4

Segment 4 follows the HCRRA's property from the Hopkins/Minnetonka border, and continues northeast through Hopkins, St. Louis Park and Minneapolis. The alignment crosses four local streets; the proposed extension of 16th Avenue South, 11th Avenue South, the proposed extension of 8th Avenue South and 5th Avenue South at-grade in the City of Hopkins before crossing under TH 169. The alignment then crosses over Excelsior Boulevard. Excelsior Boulevard is a minor reliever traveling generally east/west between the study area cities. From this area to the end of the segment the alignment parallels State Highway 7 approximately ¾ to ¼ mile to the south. Segment 4 intersects Blake Road which is a major north/south collector and continues traveling in a northeast direction crossing over Louisiana Avenue. The alignment crosses Wooddale Avenue (a local collector) at-grade, before crossing over TH 100, a principal north/south arterial. LRT 1A would intersect with the Canadian Pacific Railroad (CPR), approximately .75 miles west of State Highway 100. The proposed alignment would travel under the existing CPR corridor. The last roadway Segment 4 crosses before it ends underneath West Lake Street is Belt Line Boulevard, a local collector.

2.1.4 Segment A

Segment A follows the HCRRA's property from the Hopkins/Minnetonka border, and continues northeast through Hopkins, St. Louis Park and Minneapolis. The alignment crosses four local streets; the proposed extension of 16th Avenue South, 11th Avenue South, the proposed extension of 8th Avenue South and 5th Avenue South at-grade in the City of Hopkins before crossing under TH 169. The alignment then crosses over Excelsior Boulevard. Excelsior Boulevard is a minor reliever traveling generally east/west between the study area cities. From this area to the end of the segment the alignment parallels State Highway 7 approximately ¾ to ¼ mile to the south. Segment 4 intersects Blake Road which is a major north/south collector and continues traveling in a northeast direction crossing over Louisiana Avenue. The alignment crosses Wooddale Avenue (a local collector) at-grade, before crossing over TH 100, a principal north/south arterial. LRT 1A would intersect with the Canadian Pacific Railroad (CPR), approximately .75 miles west of State Highway 100. The proposed alignment would travel under

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the existing CPR corridor. The last roadway Segment 4 crosses before it ends underneath West Lake Street is Belt Line Boulevard, a local collector.

2.1.5 Segments 3C-1 (Nicollet Mall) and 3C-2 (11th/12th Street)

Segment C-1 (Nicollet Mall) begins at West Lake Station; the alignment turns east and enters the Midtown Corridor, a former rail corridor passing through Minneapolis' Uptown and Whittier neighborhoods. The Midtown Corridor is a popular amenity to this corridor is an off-street bicycle and pedestrian trail that allows users to travel from east to west across much of Minneapolis in a grade separated gorge passing under street bridges or on a levy above the street grade with traffic passing underneath. The trail is paved, with access ramps connecting to city streets crossing above or below the trail, and is heavily used throughout the year.

The right-of-way through this corridor is currently owned by the HCRRA. The alignment would pass between two lakes, Lake Calhoun and Lake of the Isles, and continue down the Midtown Corridor to Nicollet Avenue. Two stations, the Uptown and Lyndale stations would be located at cross streets above the alignment. The Uptown Station would be collocated with the Uptown Transit Station on Hennepin Avenue and the Lyndale Station beneath Lyndale Avenue

At Nicollet Avenue, the alignment would turn north, entering a shallow cut-and-cover tunnel extending from the Midtown Corridor to Franklin Avenue and would not impact roadways. The train would emerge immediately north of Franklin Avenue. The alignment would travel at grade across over I-94, which travels in an east/west alignment at that juncture around the south side of the city's central business district. The alignment would continue at street grade through Nicollet Avenue mall and downtown Minneapolis. The alignment would interface with existing traffic and operations through this urban corridor. Stations are proposed at 12th Street, 8th Street and 4th Street. In Segment C the alignment would intersect the Hiawatha LRT tracks on Nicollet Mall at 5th Street in downtown Minneapolis.

Segment C-2 (11th/12th Street) follows the same route as Segment C-1 (Nicollet Mall) until it reaches the intersection of Nicollet Avenue and 11th and 12th Streets. Roadways in proximity to the midtown and downtown Minneapolis segments are mostly city streets and avenues, with alleyways providing vehicular access to residential and commercial buildings. From Nicollet Avenue, the alignment would turn northwest on 11th Street and in the southbound direction back onto Nicollet Avenue from 12th Street. The northbound and southbound segments would cross I-394 on 11th and 12th Streets and could impact traffic operations on the exit ramp of I-394. North of I-394 the alignment becomes a two-way track and crosses over Glenwood Avenue where it becomes Royalston Avenue and follows the same alignment as Segment A to the downtown Minneapolis Intermodal Station. At Glenwood Avenue before the Royalston Avenue the proposed alignment would cross over the BNSF Railroad corridor. The segment interlines with the Hiawatha LRT tracks on 5th Street. The LRT would operate in mixed traffic north of Franklin Avenue on Nicollet or 1st Avenues, 11th and 12th Streets, and Royalston Avenue, and require the removal of some on-street parking facilities along with the construction and reconstruction of LRT bridge decks above I-394.

Segments C-2A (Blaisdell Avenue) and C2-B (1st Avenue) for Segment C-2 (11th/12th Street) include the following:

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Segment C-2A (Blaisdell Avenue) is an option for Segment C-2 (11th/12th Street) to travel in a tunnel under Blaisdell Avenue from the Midtown Corridor up to Franklin Avenue and would not impact roadways in that corridor. Because of existing roadway geometrics and impacts to traffic operations, the Blaisdell Avenue segment would emerge from the tunnel immediately north of Franklin Avenue, a minor reliever road that travels east/west. The alignment would turn east for one block across a surface parking lot to connect with Nicollet Avenue. Turning north to run at grade on Nicollet Avenue over I-94, the train would reach 11th Street and turn northwest to follow C-2 (11th/12th Street) as described above.

C-2B (1st Avenue) is an option for Segment C-2 (11th/12th Street) to travel in a tunnel under 1St Avenue from the Midtown Corridor to Franklin Avenue and would not impact roadways in that corridor. At Franklin Avenue the alignment would emerge from the tunnel and trains would run at-grade with traffic on the 1st Avenue Bridge over I-94. Following the crossing of I-94, the alignment would turn west on 15th Street for one block, passing diagonally through a surface parking lot area, and eventually turn north on Nicollet Avenue to 11th Street to follow C-2 (11th/12th Street) as described above.

3.0 RESOURCE ANALYSIS

3.1 Cultural Resources

This section describes and evaluates existing conditions of cultural resources in the recommended Area of Potential Effect (APE) for the Southwest LRT and discusses potential impacts to these resources that would result from implementation of the project.

This section summarizes historic properties within the vicinity of the proposed LRT alternatives and the potential impacts that LRT implementation would have on these historic properties. The information is presented both by segment and by full LRT alternative. Generally, the Southwest LRT project will have few direct effects because the alternatives, with a few notable exceptions, follows existing streets, former railroad corridors, and is proposed to be constructed in a manner that avoids existing buildings and structures. In addition, the project will not include substantive street widening or the demolition of numerous buildings. Some visual effects are anticipated, which include overhead catenary systems (poles and wires) and the location of stations along the route.

3.1.1 Legal and Regulatory Context

Section 106 of the National Historic Preservation Act (NHPA) of 1966, as implemented by 36 CFR 800 Protection of Historic Properties, requires federal agencies or designees to consider the effects of their actions on historic properties before undertaking a project. The Southwest LRT project is applying to receive FTA funding and therefore must comply with Section 106 of the NHPA of 1966 as amended, and with other applicable federal and state mandates, including the Minnesota Field Archaeology Act, the Minnesota Historic Sites Act, and the Minnesota Private Cemeteries Act.

A historic property is defined as any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places (National Register). The Section 106 process consists of a number of steps that must be carried out by the Responsible Federal Agency. These steps include: 1) defining the undertaking, 2) defining the APE, 3) identifying and evaluating historic properties within the APE; 4) assessing the

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effects of the undertaking on the historic properties within the APE; and 5) consultation with a variety of parties on appropriate methods to avoid, minimize, or mitigate for adverse effects to historic properties within the APE.

3.1.2 Methodology

This section discusses cultural resources and their potential to be adversely effected by the Southwest LRT project. It is based on existing information provided by the Minnesota State Historic Preservation Officer (MN SHPO) and preliminary surveys of areas with high concentrations of land containing vintage (i.e., 40 years or older) buildings and structures.

The Section 106 process is currently being formally initiated between the FTA (the Responsible Federal Agency) and the MN SHPO. The FTA has designated the Minnesota Department of Transportation (MnDOT) as their local representative for the Section 106 process. For purposes of this technical memorandum and the LPA selection process, readily available existing information has been collected and is presented below. It should be noted that the information contained in this chapter is subject to revision or expansion once the Section 106 process is formally initiated and the consultation process with the MN SHPO begins. This is required as part of the DEIS process.

The initial step in the Section 106 process is to determine if the proposed project is an undertaking. An undertaking is defined at 36 CFR 800.16(y) as “a project, activity or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or on behalf of a Federal agency; those carried out with Federal financial assistance; and those requiring a Federal permit, license or approval.” The Southwest LRT Project is clearly an undertaking according to this definition because it will require substantial Federal financial assistance for engineering, design and construction.

The next step in the Section 106 process is to identify an APE for the undertaking. After the APE is identified the next steps are to identify cultural resources within the APE and assess effects on those cultural resources..

The following draft APEs are recommended for the various alternative segments. These recommendations are subject to review and modification as part of the formal Section 106 process which is required under the DEIS. The APE for each alternative segment is designed to address the potential for the following types of impacts to historic property, if present:

- Right of Way (ROW) acquisitions
- Changes in access to properties
- Noticeable traffic volume increases or alterations in traffic patterns
- Perceptible increases in noise
- Visual effects from changes in grade
- Increases in vibrations
- Changes in air quality
- Impacts to land use and a property’s setting

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3.1.2.1 Recommended Area of Potential Effect

Segment A

The recommended APE for Segment A includes existing or new right-of-way and the properties fronting the segment with the exception of the proposed station stops at Royalston and Van White. The recommended APE for the station stops extends for a quarter-mile radius around the proposed stations, which is similar to the station APE selected for the Central Corridor LRT project between Minneapolis and St. Paul.

The portions of Segment A south of I-394 are close to already developed properties, therefore the suggested APE includes the existing right-of-way and two tiers of property fronting it with the exception of the proposed station stops at Van White, Penn, 21st Street, and West Lake. The recommended station stop APEs extend in a one quarter-mile radius around the proposed stations, which is consistent with the station APEs selected for the Central Corridor LRT project between Minneapolis and St. Paul. It should also be noted that Segment A crosses Cedar Lake Parkway, which is a component of the proposed Grand Rounds Historic District.

Segments C-1, C-2, C-2A, and C-2B

The APE for the portion of Segment C-1 through downtown Minneapolis is suggested to include the footprint of Nicollet Mall and the properties fronting it. In many cases, the properties in this densely built-up area extend all the way through the block, either east to Marquette Avenue or west to Hennepin Avenue, north of 8th Street, or west to LaSalle, south of 8th Street. Because the existing buildings extend through the blocks to Marquette on the east and Hennepin or LaSalle on the west and are unlikely to be replaced, density, the APE around the proposed stations is recommended to not be extended beyond the adjacent properties.

The recommended APE for the portion of Segments C-1 (Nicollet Mall) and C-2 (11th/12th Street) through downtown Minneapolis includes the street beds and the properties fronting both sides of both streets. Because the existing buildings extend through the blocks in many cases and are unlikely to be replaced, density, the APE around the proposed stations is recommended to not be extended beyond the adjacent properties.

For the portions of Segments C-1, C-2A, and C-2B that include the Nicollet, Blaisdell, and 1st Avenue options, the suggested APE is quite broad. It would include all the streets and the properties fronting the streets. Because the blocks are fairly narrow, the east edge would be the midblock alley between Stevens Avenue and 1st Avenue South and the west edge would be the midblock alley between Blaisdell Avenue and Pillsbury Avenue, except for the entire block south of 29th Street between Blaisdell and Pillsbury. This allows for the curve in the track from the Midtown Corridor to the north-south corridor.

The APE proposed for the Midtown Corridor from the east end (where the tunnel would connect to the trench) to the proposed West Lake Station portion of Segments C-1, C-2A, and C-2B would include all properties within the boundary of the Chicago Milwaukee & St. Paul Railroad Grade Separation (CM&StP) Historic District, including the area of the below-grade trench and the properties adjacent to the trench, including the area on the north side that would be affected by the curved connection to the northbound segment. West of Hennepin Avenue, where the route is at-grade or follows an elevated embankment, the APE would include the corridor footprint and the properties fronting it. These include several components of the proposed National Register-eligible Grand Rounds Historic District, including the Mall, Lake of the Isles

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Parkway and Park, and Dean Parkway. Additional areas north and south of the corridor may be included in National Register-eligible historic districts, subject to further review.

Segment 1

The suggested APE for Segment 1 includes the existing right-of-way and the properties fronting it, with the exception of the proposed station stops at Shady Oak, Rowland, Highway 62, and Highway 5. The local municipalities are undertaking station-area planning studies within a half-mile radius of the proposed stations, which are recommended to be included as the APE for these stations.

Segment 3

The APE for Segment 3 is proposed to include the new right-of-way and properties fronting it, with the exception of the proposed station stops at Shady Oak, Opus, City West, Golden Triangle, Eden Prairie Town Center, Southwest Station, and Mitchell/TH5. The local municipalities are undertaking station-area planning studies within a half-mile radius of the proposed stations, which are recommended to be included as the APE for these stations.

Segment 4

The APE for Segment 4 is suggested to include the existing right-of-way and properties fronting it, with the exception of the proposed station stops at West Lake, Beltline, Wooddale, Louisiana, Blake, Hopkins, and Shady Oak. The local municipalities are undertaking station-area planning studies within a half-mile radius of the proposed stations, which are recommended to be included as the APE for these stations.

3.1.3 Existing Conditions

Existing information on historic properties, either listed or previously determined eligible for listing, was obtained from the MN SHPO for each segment of the recommended APE. These previously determined historic properties are included for each segment of the recommended project APE. Information was also gathered from the Office of the State Archaeologist and the Minnesota State Historic Preservation Office on previously recorded archaeological properties within each segment of the recommended APE.

It should be noted that some segments appear to contain very few historic properties, whether buildings, structures, or archaeological sites. This may simply be due to the fact that some of the segments have not been completely surveyed at present. However, based on available information on site location in general, some portions of these segments have a very high potential for archaeological sites based on the presence of uplands that overlook lake and stream basins along Minnehaha Creek, Purgatory Creek and Nine Mile Creek drainages. In general, such locations have often been found to contain archaeological sites when surveyed because locations near water that are high enough not to routinely flood make good settlement locations. These conditions are particularly prevalent along Segment 3, which would be placed on all new right-of-way that skirts wetlands and other bodies of water. These conditions may also be a factor in Segment 1 to the extent that new construction would expand beyond the existing railway embankments.

3.1.3.1 Segment A

Table 2 lists information provided by the MN SHPO regarding the existing historic properties, either listed in the National Register or determined eligible for listing in the National Register by

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MN SHPO in conjunction with previous 106 undertakings, located within the recommended APE of Segment A. A formal survey of the built environment within Segment A is required under the Section 106 process in order to determine the status of previously unsurveyed property or property that has been previously surveyed by the Minneapolis Heritage Preservation Commission (HPC) within the recommended APE. No archaeological sites are known to exist within Segment A.

Preliminary analysis and preliminary survey work along Segment A indicate that the bridge that carries the freight rail and Kenilworth Trail over the channel from Cedar Lake to the Kenilworth Lagoon requires evaluation to determine its National Register potential. Recommendations contained in previous Minneapolis HPC surveys will be reviewed during the Section 106 process.

Table 2: Existing Historic Property within the Recommended APE of Segment A

Inventory	Property Name	Property Address	Status
HE-MPC-0441	Minneapolis Warehouse Historic District	1st Avenue N., 1st Street N., 10th Avenue N., 6th Street N.	Listed
HE-MPC-8125	Northwestern Knitting Company Factory	718 Glenwood Avenue	Listed
N/A	Cedar Lake Parkway, Cedar Lake Park, channel, and Kenilworth Lagoon leading to Lake of the Isles	Part of the proposed Grand Rounds Historic District	Eligible
HE-MPC-6068	Frieda and Henry Neils House	2801 Burnham Blvd.	Listed
HE-MPC-9295	Northside Garage Barge Dock	N/A	Eligible

3.1.3.2 Segments C-1 (Nicollet Mall) and C-2 (11th/12th Street)

Table 3 lists information provided by the MN SHPO regarding the existing historic properties, either listed in the National Register or determined eligible for listing in the National Register by MN SHPO in conjunction with previous 106 undertakings, located within the recommended APE of Segments C-1 and C-2. A survey of the built environment within Segments C-1 and C-2 is required under the Section 106 process in order to determine the status of previously unsurveyed property or property that has been previously surveyed by the Minneapolis Heritage Preservation Commission (HPC) within the recommended APE. No archaeological sites are known to exist within Segments C-1 and C-2.

Four archaeological sites were identified in this segment as part of a 1999 survey of Lake of the Isles and assessed for National Register eligibility in 2000. MN SHPO found that three of the sites were National Register eligible; a fourth site, 21 HE 0315, Maples Island East, was found to be too disturbed to meet eligibility criteria. Of the three eligible sites, two are far enough away from the proposed project that they will not be impacted by the project. Site 21 HE 0314, Maples Island West, might be impacted by construction.

Segment C-1 contains numerous vintage buildings or other unevaluated property that may be historic property. The length of Nicollet Mall between 4th Street and 13th Street, including the width, surface, and configuration of the street, has potential for National Register eligibility. All of the buildings on the east side of Nicollet Mall between 9th Street and 12th Street, as well as Peavey Plaza between 11th and 12th Streets, require analysis to determine their National Register potential. On the west side of Nicollet Mall, the NSP Building between 4th and 5th

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Streets, the Andrus Building south of 5th Street, Macy's (former Dayton's) between 7th and 8th Streets, and the blockfront between 11th and 12th Streets, require analysis to determine their potential for National Register eligibility. Preliminary analysis also indicated the following areas contain buildings that require evaluation: Nicollet Avenue between Grant Street and Franklin Avenue, including the Music Box Theater south of 14th Street, the Plymouth Congregation Church between Groveland and Franklin Streets. Also, the area of Nicollet Avenue between Franklin Avenue and 27th Street contains clusters of early twentieth-century apartment buildings and early twentieth-century commercial buildings that require evaluation to determine their potential for National Register eligibility. Recommendations contained in previous Minneapolis HPC surveys will be reviewed during the Section 106 process.

Preliminary evaluation and windshield survey of Segment C-2 indicates that there are major concentrations of residential buildings on both sides of Blaisdell Avenue between Franklin Avenue and 28th Street that require evaluation to determine their potential for National Register eligibility. Much of 1st Avenue is already incorporated into the Washburn-Fair Oaks Historic District. There are major concentrations of residential buildings south of the district boundaries that require evaluation to determine their potential for National Register eligibility. Recommendations contained in previous Minneapolis HPC surveys will be reviewed during the Section 106 process.

Finally, Segment C-2 (11th/12th Street) also has the potential to contain unevaluated historic property. These unevaluated properties front Nicollet Mall and are bounded by 11th and 12th Streets (see C-1). Other properties within Segment C-1 and C-2 that exhibit National Register eligibility potential are First Baptist Church, 10th Street, Harmon Place, and 11th Street, and portions of the locally designated Harmon Place Historic District, between Hennepin Avenue and Harmon Place, 11th and 12th Streets, and the south side of 12th Street between Hennepin Avenue and Yale Place. Recommendations contained in previous Minneapolis HPC surveys will be reviewed during the Section 106 process.

Table 3: Existing Historic Property within the Recommended APE of Segments C-1 and C-2

Inventory	Property Name	Property Address	Status
HE-MPC-0479	Northwestern National Life Insurance, now ING	20 Washington Avenue South	Eligible
N/A	Lumber Exchange	425 Hennepin Avenue South	Listed
HE-MPC-0345	Soo Line/First National Bank	105 South 5th Street	Listed
HE-MPC-0514	Shubert Theater	Hennepin and Fifth	Listed
HE-MPC-0436	Masonic Temple	530 Hennepin	Listed
HE-MPC-0444	Marquette National Bank	517 Marquette Avenue South	Eligible
HE-MPC-0354	Farmers and Mechanics Savings Bank	520 Marquette & 90 South 6th Street	Listed
HE-MPC-0445	Rand Tower	527 Marquette	Listed
HE-MPC-0367	IDS Center	710 Marquette Avenue	Eligible
HE-MPC-9026	Pence Building	800 Hennepin Avenue South	Listed
HE-MPC-0438	State Theater	805 Hennepin Avenue South	Eligible
HE-MPC-0439	Hennepin Theater	910 Hennepin Avenue South	Listed
HE-MPC-0446	Foshay Tower	821 Marquette Avenue	Listed
HE-MPC-0374	YMCA	36 South 9th Street	Listed
HE-MPC-0382	Handicraft Guild	89 – 95 South 10th Street	Eligible

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Inventory	Property Name	Property Address	Status
HE-MPC-0394	Ogden Apartment Hotel	66-68 South 12th Street	Listed
HE-MPC-0395	Westminster Presbyterian Church	83 South 12 Street	Listed
HE-MPC-0624	Architects and Engineers Building	1200 2nd Avenue South	Listed
HE-MPC-0406	Wesley Methodist Church	101 Grant Street East	Listed
HE-MPC-0540	Basilica of St. Mary	88 17th Avenue North	Listed
HE-MPC-0516	H. Alden Smith House	1403 Harmon Place	Listed
HE-MPC-0461	Zinman Bronzin Apartments	125 Oak Grove Street	Eligible
HE-MPC-0549	Eugene J. Carpenter House	300 Clifton Avenue South	Listed
HE-MPC-0549	Elbert J. Carpenter House	314 Clifton Avenue South	Eligible
HE-MPC-0553	Bovey House	400 Clifton Avenue South	Eligible
HE-MPC-6432	George R. Newell House	1818 LaSalle Avenue South	Listed
HE-MPC-6434	George W. Van Dusen House	1900 LaSalle Avenue South	Listed
HE-MPC-4965	Stevens Square Historic District	East 17th Street, 1st Avenue South, Franklin Avenue, 3rd Avenue South	Listed
HE-MPC-0421	Warner Brothers Picture Distribution Corporation Building	1000 Currie Avenue North	Eligible
HE-MPC-0520	Swinford Town Houses and Apartments	1213-1221 Hawthorne Avenue South	Listed
HE-MPC-0521	Swinford Apartments	1225 Hawthorne Avenue South	Listed
HE-MPC-4800	Edwin H. Hewitt House	126 East Franklin Avenue	Listed
	Frank and Ann Semple House	100-104 West Franklin Avenue	Listed
HE-MPC-4900	Washburn-Fair Oaks Mansion Historic District	1st Avenue South, Stevens Avenue South, East 22nd Street	Listed
HE-MPC-4839	Despatch Laundry Building	2611 1st Avenue South	Eligible
HE-MPC-9965	Chicago, Milwaukee & St. Paul Grade Separation Historic District	Cedar Avenue to Humboldt Avenue between 28th and 29th Streets	Listed
	Bridge L5728 (9649)	Rail corridor over Knox Avenue South	Eligible
	Bridge 93909 (9957)	Rail corridor over channel between Lake of the Isles and Lake Calhoun	Eligible
HE-MPC-5341	Bridge 90661 (9650)	Rail corridor over Dean Boulevard	Eligible
	Lake of the Isles Park and Lake of the Isles Parkway	Part of proposed Grand Rounds Historic District	Eligible
	Lake Calhoun Park and Lake Calhoun Parkway	Part of proposed Grand Rounds Historic District	Eligible
	Dean Parkway	Part of proposed Grand Rounds Historic District	Eligible
HE-MPC-6126	Calhoun Beach Club	2730 West Lake Street	Listed
	The Mall	Part of proposed Grand Rounds Historic District	Eligible
HE-MPC-6284	Walker Library	2901 Hennepin Avenue South	Listed
HE-MPC-6896	Lake St. Bridge (90449)	Lake Street over Lake Calhoun channel	Eligible
HE-MPC-6900	Park Board Bridge No. 3 (L5722)	West 28th Street over Isles-Calhoun Channel	Eligible
HE-MPC-6901	Park Board Bridge No. 4 (L5729)	Lake of Isles Parkway over Lake of the Isles Channel	Eligible
HE-MPC-9003	Bridge 90448	Pedestrian bridge over Excelsior Blvd.	Eligible
21 HE 0312	Mike's Island	Archaeological site	Eligible
21 HE 0313	Raspberry Island	Archaeological site	Eligible
21 HE 0314	Maples Island West	Archaeological site	Eligible

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3.1.3.3 Segment 1

The MN SHPO has no information regarding listed or eligible buildings or structures within this segment of the recommended APE. A survey of the built environment within the Segment 1 recommended APE is required in order to determine the status of previously unsurveyed property.

Four archaeological sites, all located within Birch Island Park (City of Eden Prairie), were identified in this segment during a city-wide survey in 1992. Of these, one site, 21 HE 0334, Red Rock Site, is reported to be associated with ceremonial historic Dakota Indian use according to oral history accounts and may be eligible for listing. A second site, 21 HE 0216, Birch Island Park No. 2 was found to be disturbed but oral tradition of use as a Native American burial site would need further assessment. The other two sites, 21 HE 0215, Birch Island Park No. 1, and 21 HE 0217, Birch Island Park No. 3, were found to be disturbed and unlikely to meet eligibility criteria. These sites appear to be far enough away from existing right-of-way to not be impacted by construction.

Preliminary analysis and a windshield survey indicate that the former railroad bridge that carries the Southwest LRT Trail over Valley View Road requires evaluation of its potential to exhibit National Register eligibility.

3.1.3.4 Segment 3

The MN SHPO has no information regarding listed or eligible buildings or structures within this segment of the APE. A survey of the built environment within the Segment 3 recommended APE is required in order to determine the status of previously unsurveyed buildings and structures.

Four archaeological sites were identified in this segment in 1988 during a survey of the proposed TH 212 corridor. Of these, one site, 21 HE 208, Purgatory Creek NE, was found to be eligible for listing. Two sites, 21 HE 0206 and 21 HE 0207, were found to not meet eligibility criteria. The fourth site, 21 HE 0289, Startled Fox (west of Purgatory Creek), has not yet been evaluated for its ability to meet the eligibility criteria (Table 4).

Preliminary analysis and a windshield survey have not found any obvious above-ground properties with National Register potential in Segment 3.

Table 4: Previously Known Archaeological Property within the Recommended APE of Segment 3

Inventory	Property Name	Property Address	Status
21 HE 208	Purgatory Creek NE	Archaeological site	Eligible

3.1.3.5 Segment 4

Table 5 lists information provided by the MN SHPO regarding the existing historic property, either listed or eligible for listing, located within the recommended APE of Segment 4. A survey of the built environment within Segment 4 is required in order to determine the status of previously unsurveyed property within the APE. No archaeological sites are known to exist within Segment 4.

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Preliminary analysis and a windshield survey indicate that the following railroad structures need further evaluation to determine National Register potential:

- Two parallel deck-girder railroad bridges (Bridge Nos. 5308 and 5309) that cross Highway 100.
- The double concrete railroad bridge that crosses over Louisiana Avenue.
- The two bridges carrying the tracks and Southwest LRT Trail that cross Minnehaha Creek near Brookview Drive.
- Former Minneapolis and St. Louis Railway Depot (now Depot Coffee House), 9451 Excelsior Boulevard.
- Hopkins Milwaukee Depot, south of tracks, between Highway 169 and 5th Avenue South.

Non-railroad related buildings within Segment 4 that need evaluation to determine National Register potential include:

- Hopkins Tech Center (former NAPCO factory complex) at 11101 – 11199 Excelsior Boulevard, Hopkins
- Factory complex at 11303 Excelsior Boulevard, Minnetonka

Table 5: Existing Historic Property within the Recommended APE of Segment 4

Inventory	Property Name	Property Address	Status
HE-SLC-009	Peavey-Haglin Experimental Concrete Grain Elevator	Minn. Highways 7 and 100, St. Louis Park	Listed
HE-SLC-008	Chicago, Milwaukee, St. Paul and Pacific Depot	37th Street and Brunswick, St. Louis Park	Listed
HE-SLC-017	Lilac Park (formerly St. Louis Park Roadside Parking Area)	SE corner of TH 100 and TH 7 intersection	Eligible

3.1.3.6 Summary of Known Historic Property by Alternative

Table 6 presents a summary of the known historic property by alternative. It is important to note that this is only a representation of the known resources adjacent to the alternatives; it does not address properties that have not been surveyed, and does not necessarily indicate that the project would have an adverse effect on any properties.

Table 6. Known Historic Properties by Alternative

Criteria	Alternative			
	LRT 1A	LRT 3A	LRT 3C-1 (Nicollet Mall)	LRT 3C-2 (11th/12th Street)
Listed or Eligible Properties within Recommended APE	8	9	52	53+

3.1.4 Long-Term Effects

Insufficient information is available at the present time to precisely identify all the long-term effects to historic property within the recommended project APE. It is important; however, to

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note that potential impacts do not equate to adverse effects. Determination of adverse effects to the resources, as noted, has not yet been made. Consultation with MnDOT-CRU, MN SHPO, the FTA, the Advisory Council on Historic Preservation (ACHP), other relevant resource agencies, and identified consulting parties will be conducted once the Section 106 process is formally initiated. It is anticipated that adverse effects to historic property will be addressed through the development and execution of a Programmatic Agreement (PA).

Preliminary information on long-term effects is presented in Section 3.1.4.2 by segment.

3.1.4.1 No-Build Alternative

There are no anticipated effects to the identified cultural resources if the Southwest LRT is not implemented.

3.1.4.2 Build Alternatives

The following historic properties have the most potential to be impacted by LRT construction because they are adjacent to and face the segment alternatives.

Segment A

Cedar Lake Parkway, Cedar Lake Park, channel, and Kenilworth Lagoon leading to the Lake of the Isles. These properties are all part of the proposed Grand Rounds Historic District. This segment will pass through these properties, and construction may have adverse effects.

Northside Garage Barge Dock, HE-MPC-9295. This industrial structure is located adjacent to the existing right-of-way, south of the proposed Van White station. Construction may impact the structure.

Segments C-1 (Nicollet Mall), C-2A (Blaisdell Avenue), and C-2B(1st Avenue)

Chicago, Milwaukee & St. Paul (CM&StP) Grade Separation Historic District. This district is formed by a depressed railroad trench that was constructed in 1912-1916 to lower the railroad tracks below street grade, eliminate grade crossings, and enhance civic planning. A series of bridges of reinforced concrete with architectural details in the Classical Revival style cross the rail trench as part of the street grid.

The proposed project would widen the bottom of the trench from the existing 35 to 60 feet to 55 to 100 feet; alter approximately 50 percent of the grade embankments, alter the abutments on one or both sides of 14 of the 16 bridges in the project area crossing the trench, relocate portions of the existing pedestrian and bike trail, and install double track light rail transit guideway with two stations, stairs and elevators between the stations and streets, ballasted track, overhead electric system, and one or two signal communication and power substation buildings. Modifications to the width of the trench, the slopes, the walls, or the bridges would have both construction effects and long-terms effects on character-defining features of the historic district.

Washburn-Fair Oaks Historic District. The district contains a significant number of residences built at the turn of the twentieth century by prominent Minneapolis developers and residents. In addition to elegant homes, single- and two-family houses and apartment buildings were constructed in the area through the 1930s. Consistently throughout the district, the buildings are fronted by small lawns, sidewalks, and boulevard strips planted with street trees.

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The west side of First Avenue South between Franklin Avenue and East 26th Street forms the western edge of the Washburn-Fair Oaks Historic District, except at 24th Street where the district extends west to Nicollet Avenue to include the former Church of Christ, Scientist. One version of Segment C-2 proposes the construction of two LRT tracks in a tunnel below the surface of the street that would rise to grade level at Franklin Avenue. The construction of the tunnel would impact the buildings and site features adjacent to First Avenue.

Segment C-1 proposes the construction of two LRT tracks in a tunnel below the surface of Nicollet Avenue that would rise to grade level at Franklin Avenue. The construction of the tunnel would impact the former Church of Christ, Scientist at 24th Street and its site features.

Bridge L5728 (9649), Bridge 93909 (9957), Bridge 90661 (9650). These three bridges form part of the Midtown rail corridor. Construction has the potential to impact these three bridges.

Lake of the Isles Park and Lake of the Isles Parkway; Lake Calhoun Park and Lake Calhoun Parkway; The Mall; and Dean Parkway. These properties are all part of the proposed Grand Rounds Historic District. This segment will pass through these properties, and construction may have adverse effects.

Segment C-1 (Nicollet Mall)

IDS Center, HE-MPC-0367, 710 Marquette. The building is located on the east side of Nicollet Mall, on the block bounded by 7th Street South, Marquette Avenue South, 8th Street South, and Nicollet Mall. A skyway leads from the interior Crystal Court at the second-story level across Nicollet Mall to connect to Macy's (former Dayton's) Department Store on the west side of the street. The proposed 8th Street station would be located at the south end of the block. Construction would have potential impacts on the building and site. The installation of catenaries and station platforms would have potential visual impacts on the building.

Westminster Presbyterian Church, HE-MPC-0395, 83 South 12th Street. The church complex is located on the east side of Nicollet Mall; on the north half block bounded by 12th Street South, Marquette Avenue South, 13th Avenue South, and Nicollet Mall. The church is set back from the street and fronted by landscaped lawns on the 12th Street and Nicollet Mall sides. The proposed 12th Street station would be located near the church. Construction would have potential impacts on the building and site. The installation of catenaries and station platforms would have potential visual impacts on the building.

Segment C-2 (11th/12th Street)

Stevens Square Historic District. The district is mainly comprised of apartment buildings constructed in the 1910s and 1920s. The apartment buildings are unified by the consistent three-story height, brick facades, and architectural details such as cornices and building entries. The buildings are fronted by small lawns, sidewalks, and boulevard strips planted with street trees.

First Avenue South between East 17th Street and Franklin Avenue extends along the western edge of the Stevens Square Historic District. One version of Segment C-2 proposes the construction of two LRT tracks along First Avenue. If First Avenue remains at its present width, the impacts on the historic district would be largely visual, although it is likely that existing curbs, boulevard strips, and street trees would be affected.

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Ogden Apartment Hotel, HE-MPC-0394, 66-68 South 12th Street. This early twentieth-century apartment building is located at the northeast corner of 12th Street South and LaSalle Avenue South. It is located close to the property line with minimal setbacks. Segment C-2 would pass directly in front of the building entrance. The proposed 12th Street station would be located near the building. Construction has the potential to have impacts on the building and site. The installation of catenaries and station platforms would have potential visual impacts on the building.

George R. Newell House, HE-MPC-6432, 1818 LaSalle Avenue South, and George W. Van Dusen House, HE-MPC-6434, 1900 LaSalle Avenue South. These two large houses with related outbuildings are located on the west side of LaSalle Avenue between 18th Street South and 19th Street South. Designed in the Richardsonian Romanesque Revival style, the houses were built in 1888 and 1893 respectively. Both are located on expansive sites and set back from the street. One version of Segment C-2 would pass directly in front of the buildings. Construction would have potential impacts on the buildings and sites. The installation of catenaries would have potential visual impacts on the buildings.

Frank and Ann Semple House, 100-104 West Franklin Avenue. The Renaissance Revival house and carriage house, built in 1899-1901, is located at the northwest corner of Franklin Avenue and LaSalle Avenue. One version of Segment C-2 would pass directly in front of the building. The Franklin Avenue station will be located in the vicinity of the building. Construction would have potential impacts on the building and site. The installation of catenaries and station platforms would have potential visual impacts on the buildings.

Despatch Laundry Building, HE-MPC-4839, 2611 First Avenue South. The building is located on the east side of First Avenue between East 26th Street and East 27th Street. One version of Segment C-2 would pass directly in front of the building in a depressed tunnel. Construction would have potential impacts on the building and site.

Segment 1

No impacts can be identified to date because historic property surveys have not yet been conducted in this segment and no known historic properties are located in the project area.

Segment 3

No impacts can be identified to date because historic property surveys have not yet been conducted in this segment and no known historic properties are located in the project area.

Segment 4

Peavey-Haglin Experimental Concrete Grain Elevator, HE-SLC-009, Minnesota Highways 7 and 100, St. Louis Park. This industrial structure is located immediately adjacent to the tracks on the north side. Unless construction expands beyond the existing right-of-way, it is unlikely to impact the structure.

Lilac Park (formerly St. Louis Park Roadside Parking Area), HE-SLC-017, southeast corner of the intersection of Minnesota Highway 7 and Highway 100 in St. Louis Park. This landscaped and restored rest area appears to be far enough away from the existing right-of-way that construction is unlikely to impact it.

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3.1.5 Short-Term Construction Effects

3.1.5.1 No-Build Alternative

If the project does not occur, then there would be no construction effects to cultural resources.

3.1.5.2 Build Alternatives

Noise, vibration, visual, and traffic impacts would be experienced during construction through all segments. These impacts would be short term and temporary. Additional work to identify and evaluate the effects of noise and vibration on historic buildings and resources along the alignment is anticipated to be required. Noise and vibration impacts and mitigation measures would be discussed in the DEIS, as would short-term visual impacts and mitigation, and traffic impacts and mitigation. Potential adverse impacts due to this traffic diversion will be addressed in a PA that is anticipated to be developed during the Section 106 process.

Noise and vibration mitigation for construction impacts would be implemented as in all other areas of the project. Additional or specific mitigation measures for construction impacts will be implemented through consultation as specified in the PA that is anticipated to be developed during the Section 106 process.

3.1.6 Mitigation

The Section 106 process is a consultation process used to identify acceptable methods to avoid, minimize, or mitigate adverse effects to historic properties within the APE. Adverse effects occur when the project results in changes to the property, its setting, or its use that affect the National Register characteristics of the property in a manner that diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling or association. One goal of the Section 106 process for this project will be to avoid adverse effects to historic properties where possible. Where avoidance cannot be accomplished, measures to compensate or otherwise mitigate for unavoidable adverse effects will be identified.

Specific mitigation measures are anticipated to be developed during the Section 106 process, which is currently being initiated. Methods for avoidance, minimization, or mitigation of impacts to historic property (any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in the National Register) will be developed and coordinated as the Section 106 process proceeds. The results of the Section 106 process will be reported in the DEIS.

3.2 Natural Resources

This section discusses the existing biota and habitat, including vegetation, wildlife, and aquatic habitat.

The Southwest LRT Study Area encompasses a number of natural areas. Former native ecosystems that supported substantial vegetation and wildlife habitat have been replaced with mostly impervious surfaces and buildings. The ability of the Southwest LRT Study Area to support native species varies greatly, from areas within the Study Area that provide habitat for native species and for species adapted to aquatic environments to areas that provide habitat for species adapted to an urban, highly developed environment. Based on this analysis and the

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effects anticipated to result from the proposed project, long-term impacts vary based on the alignment location.

3.2.1 Legal and Regulatory Context

Ecosystems are protected by federal, state, and local laws because of their ecological and social functions and values. The primary federal regulations or statutes that apply to wetlands, fish, streams, and wildlife in the project area are the Clean Water Act (CWA) Sections 401 and 404, the Endangered Species Act (ESA), the Migratory Bird Treaty Act, and the Rivers and Harbors Act. State and local regulations that apply to these resources include State and local sensitive/critical area ordinances. A general goal of these regulations is to protect water quality, shorelines, streams, wetlands, and riparian areas and associated terrestrial habitats, as well as the species that depend on these areas.

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

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) compiles and maintains 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 State of Minnesota's endangered species law (Minn. Statute 84.0895) and associated rules (Minn. Rules 6212.1800-.2300) regulate the taking, importation, transportation and sale of state endangered or threatened species. The DNR administers the state listed rare, threatened and endangered (RT&E) species.

In general, aquatic habitat is protected by the DNR through the public waters permit (Minn. Rules 6115.0150 – 1280). The DNR Protected Water Permit and Crossing License ensures that bridge construction or reconstruction is not detrimental to significant fish and wildlife habitat (including, but not limited to, obstructing the movement of game fish or disrupting fish spawning) or protected vegetation. Any anticipated adverse effects require implementation of feasible and practical measures to mitigate effects.

3.2.2 Methodology

The purpose of this inventory is to provide information about the Southwest LRT alternatives regarding riparian habitat and threatened and endangered species impacts.

Sensitive natural areas that may be affected (other than wetlands) along the corridor alignments are listed if they possess characteristics that deem them important for a local community (e.g. preservation areas, parks, trails) or are part of an ongoing known restoration project (e.g. native prairie restoration).

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3.2.2.1 Riparian habitat areas, unique or sensitive areas

The DNR Minnesota Land Cover Classification System (MLCCS) for Hennepin County (2008) was used to locate and map the riparian habitat within and adjacent to the alignments. All wetlands, streams, and lakes were identified within 1,000 feet of the proposed corridors. These natural features have riparian habitats associated with them consisting of the transitional area between the wetlands, lakes, and streams and the adjacent uplands areas. These types of ecosystems provide habitat for multiple plant and animal species and are sensitive to disturbance.

3.2.2.2 Threatened and Endangered Species

The DNR Natural Heritage Information System (NHIS, December 2008) was utilized to identify all known locations of rare plant, animal, or native plant community features within one mile of the LRT alternatives, where applicable. The DNR Minnesota Land Cover Classification System (MLCCS) dataset (2008) was used in conjunction with the NHIS database to identify areas that may provide habitat for the rare features.

All spatial analyses and mapping were completed using the ArcView license of ESRI® ArcMap™ 9.3.

3.2.3 Existing Conditions

3.2.3.1 Riparian habitat areas, unique or sensitive areas.

LRT 1A

LRT 1A is close to 115 areas that are wetlands, streams, or lakes. These are predominantly cattail-dominated wetlands and degraded forested wetlands, which are common in the region. The alignment passes directly through ten wetlands and associated riparian habitats. Several features include a tamarack swamp (sphagnum subtype), an open sphagnum bog, a rich fen (floating-mat subtype), and two lowland hardwood forests are uncommon in the region. LRT 1A passes over Minnehaha Creek and its associated wetland complex, and is in proximity to Cedar Lake and Lake of the Isles. These features are all sensitive to disturbance.

LRT 3A

LRT 3A is close to 132 areas that are wetlands, streams, or lakes. These are predominantly cattail-dominated emergent wetlands and degraded forested wetlands. The alignment passes directly through 12 wetlands and associated riparian habitats. These features include four forested wetlands, two shrublands, three emergent wetlands, and three open water wetlands. LRT 3A also passes over Minnehaha Creek and its associated wetland complex, and is in proximity to Cedar Lake and Lake of the Isles. These features are all sensitive to disturbance.

Idlewild Lake (DNR Public Water Inventory 74P) is located just south of Technology Drive and would be near the alignment.

LRT 3C-1 (Nicollet Mall) and LRT 3C-2 (11th/12th Street)

LRT 3C-1 (Nicollet Mall) is close to 125 areas that are wetlands, streams, or lakes. These are predominantly cattail-dominated emergent wetlands and degraded forested wetlands. The alignment passes directly through 12 wetlands and associated riparian habitats. These features include four forested wetlands, two shrublands, three emergent wetlands, and three open water

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wetlands. LRT 3C-1 also passes over Minnehaha Creek and its associated wetland complex, and is in proximity to Lake of the Isles and Lake Calhoun. These features are all sensitive to disturbance. The portion of LRT 3C-2 (11th/12th Street) that is distinct from LRT 3C-1 is not located near wetlands or riparian habitats.

Idlewild Lake (DNR Public Water Inventory 74P) is located just south of Technology Drive and would be near the alignment.

3.2.3.2 Threatened and Endangered Species

LRT 1A

Review of DNR Natural Heritage Information System database indicates 11 occurrences of State Listed threatened, endangered, or special concern plant or animal species and one Federally Listed endangered plant species within one mile of the LRT 1A (Table 7). These occurrences account for eight distinct species, which are comprised of five animal species and three plant species. Three of these records are historical, documenting observations from the late 19th century and mid 20th century and the presence of these rare features is not certain. It is probable that these features are no longer present due to significant land-use changes since the observation date.

LRT 1A is close to four DNR Regionally Significant Ecological Areas. These include a tamarack swamp (location of one of the rare natural features listed above), an open sphagnum bog, and grassland areas containing native prairie vegetation. Additionally, LRT 1A passes within one mile of a State Listed Native Plant Community - Tamarack Swamp (Southern) Type. These natural environmental features are potential habitats for a variety of threatened and endangered species.

Table 7. State or Federally Listed Species or Native Plant Communities within 1 Mile of Alignment 1A

Scientific Name	Common Name	State Status	Federal Status	Last Observation Date
Ligumia recta (2 occurrences)	Black Sandshell	Special Concern		2007
Valeriana edulis ssp. *ciliata*	Valerian	Threatened		1891
Arethusa bulbosa	Dragon's-mouth	Tracked, no legal status		1931
Notropis anogenus	Pugnose Shiner	Special Concern		1941
Wilsonia citrina	Hooded Warbler	Special Concern		1979
Falco peregrinus (3 occurrences)	Peregrine Falcon	Threatened		2006
Etheostoma microperca	Least Darter	Special Concern		2006
Erythronium propullans	Dwarf Trout Lily	Endangered	Endangered	2005
Tamarack Swamp (Southern) Type	Tamarack Swamp (Southern)	Native Plant Community		1998

LRT 3A

Review of DNR Natural Heritage Information System database indicates 12 occurrences of State Listed threatened, endangered, or special concern plant or animal species within one mile of LRT 3A and one Federally Listed endangered plant species (Table 8). These occurrences account for nine distinct species, which are comprised of six animal species and three plant

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species. Two of these records are historical, documenting observations from the late 19th century and mid 20th century and the presence of these rare features is not certain. It is probable that these features are no longer present due to significant land-use changes since the observation date.

LRT 3A is close to three DNR Regionally Significant Ecological Areas. Additionally, LRT 3A passes within one mile of a State Listed Native Plant Community -Tamarack Swamp (Southern) Type. These natural environmental features are potential habitats for a variety of threatened and endangered species.

Table 8. State or Federally Listed Species or Native Plant Communities within 1 Mile of Alignment 3A

Scientific Name	Common Name	State Status	Federal Status	Last Observation Date
Ligumia recta (2 occurrences)	Black Sandshell	Special Concern		2007
Valeriana edulis ssp. *ciliata*	Valerian	Threatened		1891
Gallinula chloropus	Common Moorhen	Special Concern		1986
Notropis anogenus	Pugnose Shiner	Special Concern		1941
Wilsonia citrina	Hooded Warbler	Special Concern		1979
Falco peregrinus (3 occurrences)	Peregrine Falcon	Threatened		2006
Besseya bullii	Kitten-tails	Threatened		1996
Etheostoma microperca	Least Darter	Special Concern		2006
Erythronium propullans	Dwarf Trout Lily	Endangered	Endangered	2005
Tamarack Swamp (Southern) Type	Tamarack Swamp (Southern)	Native Plant Community		1998

LRT 3C-1 (Nicollet Mall) and LRT 3C-2 (11th/12th Street)

Review of DNR Natural Heritage Information System database indicates 11 occurrences of State Listed threatened, endangered, or special concern plant or animal species within one mile of the LRT 3C-1 and LRT 3C-2 alignments, and no Federally Listed endangered species (Table 9). These occurrences account for eight distinct species, which are comprised of six animal species and two plant species. Two of these records are historical, documenting observations from the late 19th century and mid 20th century and the presence of these rare features is not certain. It is probable that these features are no longer present due to significant land-use changes since the observation date.

Additionally, LRT 3C-1 (Nicollet Mall) and LRT 3C-2 (11th/12th Street) passes within one mile of a State Listed bat colony.

LRT 3C-1 and LRT 3C-2 are close to two DNR Regionally Significant Ecological Areas. These are comprised of grassland areas containing native prairie vegetation and are potential habitats for threatened and endangered species.

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Table 9. State or Federally Listed Species or Native Plant Communities within 1 Mile of Alignment 3C-1 and 3C-2

Scientific Name	Common Name	State Status	Federal Status	Last Observation Date
Ligumia recta (2 Occurrences)	Black Sandshell	Special Concern		2007
Valeriana edulis ssp. *ciliata*	Valerian	Threatened		1891
Gallinula chloropus	Common Moorhen	Special Concern		1986
Notropis anogenus	Pugnose Shiner	Special Concern		1941
Pipistrellus subflavus	Eastern Pipistrelle	Special Concern		2000
Falco peregrinus (3 Occurrences)	Peregrine Falcon	Threatened		2006
Besseya bullii	Kitten-tails	Threatened		1996
Etheostoma microperca	Least Darter	Special Concern		2006
Bat Colony	Bat Concentration	N/A		2000

3.2.4 Long-Term Effects

Vegetation and wildlife bordering and within the project area are associated with lakes, wetlands, woodlands, right-of-way grassland, and urban landscaping. Based on the inventory of biological resources within and adjacent to the Southwest LRT alternatives, there are potential impacts to wetlands, floodplains, and other features. Comparatively, the suburban setting is generally considered low quality for wildlife habitat, but does provide habitat for wildlife that have adapted to this type of environment, such as song birds and small mammals. The urban setting is generally comprised of scattered trees, mowed bluegrass, and non-native vegetation (weeds). Wildlife in these areas includes species adapted to an urban environment. Most of the affected wetlands are smaller, lower-quality wetlands of types relatively common in the area. Construction of LRT 1A , in particular segment 1, would affect ecosystem conditions and functions because of the number of higher quality wetlands adjacent to the route; such as Minnetoga and Shady Oak Lakes. Segment 3 contains a higher number of wetlands. Some of the effects would be beneficial, some, such as filling or shading wetlands, would be negative.

A summary list of potential impacts along each segment has been provided Section 3.3.4.

The small fragments of habitat are relatively rare in the urban environment that is characteristic of the project vicinity. Effects of project development on wildlife in these areas would vary according to existing habitat quality. Much of the affected area currently consist of low-quality, small, fragmented patches dominated by non-native shrubs and grasses, while some areas are contiguous, with patches of native, mature trees and native shrubs. Though all of the patches are, for the most part, isolated from forming a continuous corridor and thus are of lesser quality or benefit to plant or wildlife species. These impacts can be addressed through the appropriate permitting processes and do not pose major obstacles to the Southwest LRT project.

3.2.5 Short-Term Construction Effects

Grading of the existing land within the project area will be required for construction of the LRT. Within the right-of-way, existing topography and vegetation will be disturbed. Grading design is directed by standardized guidelines, and should result in landforms that appear natural and

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reflect the existing topography. Removal of grasses, shrubs and trees will be necessary, causing impacts during and after construction. Disturbed areas will be revegetated.

Much of the construction related impact would occur on low quality grasslands and existing development within the existing right-of-way, resulting in overall minor impacts to vegetation and wildlife. Construction of any of the alternatives would permanently remove some existing habitat, which will be identified as the study narrows in focus. Any construction near waterbodies would need extra precautions to protect existing fishery resources, as they exist.

3.2.6 Mitigation

All negative effects on ecosystems or listed species would be fully mitigated to comply with applicable local, state, and federal regulations.

The Endangered Species Act (ESA) requires that projects with federal funding or federal permits consult with the appropriate federal resource agencies to determine whether the project could harm ESA-listed species or their habitat. The federal agencies with jurisdiction over endangered species in our project area are the U.S. Fish and Wildlife Service. Coordination with the U.S. Fish and Wildlife Service will be ongoing. The Minnesota Department of Natural Resources will also review potential impacts to state listed species. Coordination with the MN DNR and U.S. Army Corps of Engineers is ongoing.

After the LPA is selected, an assessment will be prepared that evaluates effects on listed species in detail. The assessment will incorporate more specific design information that will be developed on the preferred alternative, along with descriptions of the potential effects of proposed construction techniques. After reviewing the assessment, the appropriate agencies will provide a determination of effects and required mitigation, as appropriate. The results of the consultation process will be documented in the Final EIS.

3.3 Water Resources

This section discusses the existing conditions and potential impacts to water resources, including wetlands, streams, rivers, and floodplains.

3.3.1 Legal and Regulatory Context

Ecosystems are protected by federal, state, and local laws because of their ecological and social functions and values. The primary federal regulations or statutes that apply to wetlands, streams, and public waters in the project area are the Clean Water Act (CWA) Section 404, the ESA, and the Rivers and Harbors Act. State and local regulations that apply to these resources include the public waters work permits, and local sensitive/critical area ordinances. A general goal of these regulations is to protect water quality, shorelines, streams, wetlands, and riparian areas and associated terrestrial habitats, as well as the species that depend on these areas.

The results of the analysis revealed multiple areas along each segment may affect wetlands, floodplains, and other natural or important features. Impacts to wetlands, floodplains, and other waterbodies 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. Other permits relating to stormwater management, erosion control, stream crossings, floodplain

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impacts, etc., may also be necessary. The permitting agencies and corresponding regulatory responsibilities for the Southwest LRT include:

- United States Army Corps of Engineers (COE)
  - Section 404 of the Clean Water Act
  - Section 10 of the Rivers and Harbors Act of 1899
- Federal Emergency Management Agency (FEMA)
  - National Flood Insurance Act
- Minnesota Department of Natural Resources (DNR)
  - Public Waters Work Permits
  - License to cross permits
- Minnesota Pollution Control Agency (PCA)
  - National Pollutant Discharge Elimination System Permits (NPDES)
- Local Government Unit (LGU) (the Cities of Eden Prairie, Minneapolis, Minnetonka.)
  - Wetland Conservation Act (WCA)
- Minnehaha Creek Watershed District (MCWD)
  - WCA (for the Cities of Hopkins and St. Louis Park)
  - Local Watershed Permits
- Bassett Creek Watershed Management Commission (BCWMC)
  - Local Watershed Permits
- Mississippi Watershed Management Organization (MWMO)
  - Regulatory authority lies with local municipalities or LGUs.
- Nine Mile Creek Watershed District (NMCWD)
  - Local Watershed Permits
- Riley/Purgatory/Bluff Creek Watershed District
  - Regulatory authority transferred to local municipalities or LGUs in 2008.

3.3.1.1 United States Army Corps of Engineers

Navigable waters are regulated under Section 10 of the Rivers and Harbors Act (RHA) of 1899 (33 USC 403) and Section 404 of the Clean Water Act (CWA) (33 USC 1344). The RHA regulates work involving a change in the course, current, or cross-section of navigable waters, including wetlands.

Impacts to wetlands are regulated by two agencies under the CWA if they are connected or adjacent to "navigable waters" of the United States. Section 404 of the CWA requires a permit to be issued by the USACE (or a delegated state agency) prior to the placement of any dredged or fill material into any waters of the United States, including wetlands. Section 401 of the CWA requires the affected state to issue a water quality certification, or a waiver, for each Section 404 permit.

3.3.1.2 Federal Emergency Management Agency

Floodplains are regulated under Executive Order (EO) 11988, signed on May 24, 1977, by President Jimmy Carter. This EO requires all federal agencies to evaluate and, to the extent possible, avoid adverse impacts to the floodplain areas which may result from actions they administer, regulate or fund. This EO specifically requires floodplain impacts to be considered in the preparation of an EIS for major federal actions. FEMA, under the National Flood Insurance Program (NFIP) as authorized according to the National Flood Insurance Act of 1968 (as amended), has the authority to regulate floodplains and floodways. The cities administer these

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regulations, including activities such as construction, excavation, or deposition of materials in, over, or under waters which any affect flood stage, floodplain, or floodway boundaries.

The 100-year flood is used by the NFIP as the standard for floodplain management and to determine the need for flood insurance. The boundary of this floodplain is defined by the flood elevation that has a one-percent chance of being equaled or exceeded each year.

Rivers or streams where FEMA has prepared detailed engineering studies may have designated floodways. For most waterways, the floodway is defined as the area where floodwaters are likely to run deepest and fastest (FEMA 2007). It is the area of the floodplain that should be reserved (free from obstruction) to allow floodwaters to move downstream. Placing fill or buildings in a floodway may block the flow of water and increase flood elevations. Such activities in the floodway are generally restricted and require mitigation in the form of compensatory volume to offset lost floodway storage.

Floodplains and Riparian Areas

The 100-year floodplain includes areas that are subject to a one percent or greater chance of flooding in any given year. These are defined by the Federal Emergency Management Agency (FEMA) on Flood Insurance Rate Maps (FIRM). Furthermore, the 100-year floodplain is divided into Special Flood Hazard Areas (SFHA) as follows:

- Zone A: no base flood elevations determined
- Zone AE: areas have been studied in detail where base flood elevations are determined
- Zone AH: areas where ponding usually occurs and flood depths are between one and three feet
- Zone AO: areas where flood depths are between one and three feet, usually sheet flow on sloping terrain
- Other zones identify the areas within the 500-year floodplain, areas determined to be outside the 500-year floodplain, areas where no flood hazards have been determined, and areas with a 0.2 percent annual chance of flooding.

3.3.1.3 Minnesota Pollution Control Agency

The MPCA establishes water quality standards and conducts periodic water quality (surface water, groundwater and wastewater) and biological monitoring. Water quality standards are implemented primarily through National Pollution Discharge Elimination System (NPDES) permits issued to dischargers by the member states (MN Statute 115; MN Rule 7050). The MPCA will review draft NPDES permits.

The MPCA reviews USACE permits and is responsible for issuing Section 401 water quality certification.

3.3.1.4 Minnesota Department of Natural Resources

Wetlands are regulated by the DNR if they are identified as public waters or public waters wetlands. Public waters are all water basins and watercourses that meet the criteria set forth in Minn. Stat., Section 103G.005, subd. 15, and that are identified on Public Water Inventory (PWI) maps and lists authorized by Minn. Stat., Section 103G.201. Proposed impacts to these types of wetlands would require a permit from the DNR.

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The DNR also requires cities to adopt zoning regulations to protect the environmental quality of surface waters and the natural and economic value of shoreline areas, and to provide for wise use of such waters.

3.3.1.5 Minnesota Wetland Conservation Act

To maintain and protect wetlands the Minnesota Legislature approved and Governor Arne Carlson signed the Wetland Conservation Act (WCA) in 1991 (as amended). Local Government Units (LGUs) which include cities, counties, watershed management organizations, soil and water conservation districts and townships, implement the act locally. The Minnesota Board of Water and Soil Resources administers the act statewide and the DNR enforces it.

3.3.1.6 Cities and general permits

Minneapolis regulates water quality through its building plan reviews, Erosion and Sediment Control Ordinance, and Stormwater Management Ordinance. An Erosion and Sediment Control Plan is required for projects that disturb in excess of either five thousand square feet or five hundred cubic yards of earth moved. A Stormwater Management Plan is required for project sites that exceed one acre. The Stormwater Pollution Prevention Plan (SWPPP) prepared for the MPCA for the NPDES General Construction Permit, in some cases, provides the information applicable to both of the Minneapolis plans described in this section. The cities, however, may have additional requirements.

3.3.1.7 Mississippi Watershed Management Organization

The Mississippi Watershed Management Organization (MWMO) boundaries extend from Downtown Minneapolis to Highway 280 in St. Paul. (See Figure 3-1 for the WMO locations.) The MWMO is responsible for construction permitting as it pertains to stormwater runoff and ensuring that new construction projects meet the goals and requirements established by the watersheds. For example, this agency will ensure that BMPs, as outlined in the NPDES permit, are used to limit sediment and particulate runoff during construction activities.

3.3.1.8 Minnehaha Creek Watershed Management District (MCWD)

The Minnehaha Creek Watershed District (MCWD) is the regional governmental unit responsible for managing and protecting the water resources of the Minnehaha Creek Watershed. The District covers 181 square miles that ultimately drain into the Minnehaha Creek. The district includes all or part of 27 cities and two townships in Hennepin and Carver Counties. The cities of Hopkins, St. Louis Park, Minnetonka and Minneapolis are within the district. MCWD is responsible for construction permitting as it pertains to Projects that effect erosion, floodplains, wetlands, dredging, shoreline or streambank improvements, stream and lake crossings, stormwater management and ensuring that new construction projects meet the goals and requirements established by the watersheds. The agency will ensure that BMPs, as outlined in the NPDES Permit, are used to limit sediment and particulate runoff during construction activities.

3.3.1.9 Bassett Creek Watershed Management Commission (BCWMC)

The Bassett Creek Watershed Management Commission (BCWMC) manages surface water within the boundaries of the BCWMC which exceeds 40 square miles and is divided into four major subwatersheds. The cities of Minnetonka, St. Louis Park and Minneapolis are represented by the BCWMC to facilitate the management of the watershed's water resources.

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The BCWMC is responsible for regulating flooding and to maintain and enhance the quality of the surface and ground water resources in the watershed. In 1989, a permit program was required for appropriations from small watercourses under MS 103B.211, Subd. 4. The BCWMC developed a policy establishing standards and criteria defining when water could be appropriated from public water courses and wetlands and included a draft permit application form. Permit applications are evaluated by the cities and permits are issued by the cities. The BCWMC also reviews applications to the DNR for public waters work permits.

3.3.1.10 Nine Mile Creek Watershed District (NMCWD)

The Nine Mile Creek Watershed District (NMCWD) is a special purpose unit of government established in accordance with Minnesota State Statute 103D. The responsibility of the Nine Mile Creek Watershed District is to protect and manage the water resources within the District's legal boundaries. The Nine Mile Creek Watershed District is approximately 50 square miles in surface area and encompasses the land area tributary to Nine Mile Creek. The District is located in Hennepin County. Portions of the cities of Eden Prairie, Edina, Hopkins, and Minnetonka are located within the Nine Mile Creek watershed. The Nine Mile Creek Watershed District NMCWD has had a regulatory and permit program since 1963. The NMCWD established a permitting program to protect the natural resources of the NMCWD by establishing minimum requirements for the grading, water quality, water quantity, floodplain protection, and wetlands.

3.3.1.11 Riley/Purgatory/Bluff Creek Watershed District (NMCWD)

The Riley/Purgatory/Bluff Creek Watershed District (RPBCWD) works with other government bodies to regulate stormwater runoff, improve water quality, and provide recreation. The District also works with developers on any project that proposes to alter floodplains, wetlands or streams. The RPBCWD requires permits for such projects to ensure that land use changes do not negatively impact water quality and flood protection. District review of permits provides an opportunity for citizen input on water related issues. With the newly approved Water Management Plan, the District now may pursue projects that improve water quality. These projects, like past flood control projects, will be conducted in full cooperation with municipalities. A five member Board of Managers governs the RPBCWD. Regulatory authority of the RPBCWD was transferred to LGUs in 2008.

3.3.2 Methodology

Wetland impacts were defined as those areas where the extent of impact of the alignments overlap an existing wetland feature, and hence would cause a change in the boundary of the wetland. Floodplain impacts were determined using the same method as the wetland impacts. It is important to note that no wetland delineations have been completed as part of this analysis and all wetland boundaries are approximate. Any impact to wetlands requires an approved delineated wetland boundary which will occur prior to permit application.

The analyses were performed on each of the Southwest LRT segments of the Alternative Alignments given below:

- Segment 1
- Segment 3
- Segment 4

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- Segment A
- Segments 3C-1 and 3C-2

The DNR Minnesota Land Cover Classification System (MLCCS) results for Hennepin County (2008) were used to locate and map all wetlands, streams, and lakes within 100 feet of the proposed alignments. Wetlands were classified based on the Fish and Wildlife Service Circular 39 wetland type classification system.

The Computer Aided Design (CAD) drawings provided by HDR (March 25, 2009) were used for visually identifying where impacts were likely to occur along each Major Segment. Each potential impact was given a numerical designation and is labeled on the attached figures. See Section 3.3.4.

To quantify potential impacts, the cut and fill limit line features of the CAD drawings were used as proxies for the extent of impact of the alignment corridors. These were then used to calculate wetland-related impacts using Geographic Information System (GIS) analyses.

All spatial analyses and mapping were completed using the ArcView license of ESRI® ArcMap™ 9.3.

3.3.2.1 100-year Floodplain

Floodplain data used for this investigation was obtained from the Minnesota DNR Data Deli website (http://deli.dnr.state.mn.us). The information is based on the Q3 Flood Data derived from the Flood Insurance Rate Maps (FIRMs) published by the Federal Emergency Management Agency (FEMA). This data represents 100-year floodplain boundaries rather than floodway boundaries.[1]

Only paper copies of floodway limits were used in the time available to complete this inventory.

3.3.2.2 Wetlands, Streams, and Lakes

As mentioned above The DNR Minnesota Land Cover Classification System (MLCCS) results for Hennepin County (2008) were used to locate and map all wetlands, streams, and lakes.

3.3.2.3 Bassett Creek Tunnel

Record drawings were obtained from the Bassett Creek WMO's engineer, Barr Engineering. Drawing M34.3-P-10/17 shows the alignment of the tunnel's centerline (Figure 3-1). This alignment was then compared to the various alignments of the Southwest LRT to identify potential conflicts within 100 feet of the corridor centerline.

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[1] *Further information regarding floodplain impacts can be found in WSB's previously submitted Water Resources Inventory Technical Memorandum dated February 13, 2009. WSB's Bassett Creek Tunnel Technical Memorandum, dated March 3, 2009, provides further information pertaining to the potential impacts to the Bassett Creek Tunnel in Minneapolis.*

3.3.2.4 Watershed Management Areas

The watershed information used for this investigation was obtained from the Minnesota DNR Data Deli website. The data set was published by the Board of Soil and Water Resources (BWSR) and depicts watershed district and watershed management organization boundaries throughout the state of Minnesota.

3.3.2.5 Identify Major Drainage and Watershed Management Issues

The Public Waters Inventory (PWI) shapefiles were obtained from the Minnesota DNR Data Deli website. These shape files are provisional representations of PWI Basin delineations found on the current paper regulatory maps and lists.

3.3.3 Existing Conditions

The Study Area is mostly urbanized and highly altered compared to pre-settlement conditions. The land is characterized by commercial, industrial, or residential development with some parkland and other open space (golf courses, for example) adjacent to the corridor. A number of wetlands or public waters are located within the Southwest LRT Study Area, so impacts to these resources may occur.

Due to the developed nature portions of the Study Area, limited surface water resources exist in Segments A, C, and 4. Historic wetlands have been modified or eliminated and natural stream courses have been rerouted into a network of channels, culverts, and storm sewers. In Segments 1 and 3 there are wetlands and open space areas remaining.

3.3.3.1 Floodplains

LRT 1A

Based on the Q3 Flood Data, there are six areas within 100 feet of LRT 1A (Figure 3-1). Two of these areas are located within Eden Prairie on Purgatory Creek and an unnamed tributary of Nine Mile Creek. The areas in Minnetonka and Hopkins involve the south fork and north fork, respectively, of Nine Mile Creek. Of the two areas located within St. Louis Park on Minnehaha Creek, one of them is included in this discussion only because it is still shown on the Q3 Flood Data. The easterly-most floodplain area has actually been revised through a Letter of Map Revision (LOMR) issued September 28, 2007, and the edge is now outside the 100-foot corridor.

LRT 3A

Based on the Q3 Flood Data, there are six areas within 100 feet of LRT 3A. Two of these areas are located within Eden Prairie on Purgatory Creek and the south fork of Nine Mile Creek. The areas in Minnetonka and Hopkins involve an unnamed water body and the north fork of Nine Mile Creek, respectively. Of the two areas located within St. Louis Park on Minnehaha Creek, one of them is included in this discussion only because it is still shown on the Q3 Flood Data. The easterly-most floodplain area has actually been revised through a Letter of Map Revision (LOMR) issued September 28, 2007, and the edge is now outside the 100-foot corridor.

LRT 3C-1 (Nicollet Mall) and LRT 3C-2 (11th/12th Street)

Based on the Q3 Flood Data, there are six areas within 100 feet of LRT 3C-1. Two of these areas are located within Eden Prairie on Purgatory Creek and the south fork of Nine Mile Creek.

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The areas in Minnetonka and Hopkins involve an unnamed water body and the north fork of Nine Mile Creek, respectively. Of the two areas located within St. Louis Park on Minnehaha Creek, one of them is included in this discussion only because it is still shown on the Q3 Flood Data. The easterly-most floodplain area has actually been revised through a Letter of Map Revision (LOMR) issued September 28, 2007, and the edge is now outside the 100-foot corridor. There are no floodplain impacts associated with the three alternative alignments for LRT 3C-2; Segments C-2A (Blaisdell Avenue) and C-2B (1st Avenue), and the 11th/12th Street couplet.

3.3.3.2 Wetlands, Public Waters, and Floodplains

Wetland impacts are based on existing wetland information (primarily from the National Wetland Inventory) and conceptual construction limits. Tables 10 and 11 summarize the results of the wetland and floodplain impact analysis. For each segment the permitting agency, cumulative wetland impacts, cumulative floodplain impacts, type of wetland impacted, and comments are provided. Wetland impacts are based on existing wetland information (primarily from the National Wetland Inventory) and conceptual construction limits.

Table 10. Impact by Segment

Segment	Permitting Agency	Wetland Impact		Floodplain Impact		Impacted Wetland Type (Circular 39)	Comments
		ft^2	acre	ft^2	acre		
1	LGU DNR COE NMCWD PCA Local Municipality	Approx. 24,000	Approx. 0.6	Approx. 24,000	Approx. 0.6	1, 2, 3, 4, 5	Impacts to multiple wetland types. Floodplain impacts are associated with Purgatory Creek and tributaries of Nine Mile Creek.
3	LGU DNR COE NMCWD PCA Local Municipality	Approx. 147,000	Approx. 3.5	Approx. 40,000	Approx. 1.0	1, 2, 3, 5, 6	Significant impacts to multiple wetland types. Floodplain impacts are associated with Purgatory Creek, tributaries of Nine Mile Creek, and an unnamed waterbody.
4	LGU DNR COE NMCWD MCWD PCA Local Municipality	Approx. 3,000	Approx. 0.1	Approx. 40,000	Approx. 1.0	1, 4	Impact to various wetlands and potential for impacting Minnehaha Creek. Floodplain impacts are associated with Nine Mile Creek and Minnehaha Creek.
A	LGU DNR	Approx. 7,000	Approx. 0.2	0	0	5	Impacts are associated with

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Segment	Permitting Agency	Wetland Impact		Floodplain Impact		Impacted Wetland Type (Circular 39)	Comments
		ft²	acre	ft²	acre		
	COE						crossing the channel between Lake of the Isles and Cedar Lake. Utilizing bridge may eliminate impact.
	BCWMC						
	MCWD						
	PCA						
	Local Municipality						
3C-1 (Nicollet Mall) and 3C-2 (11th/12th Street)	LGU	Approx. 1,500	Less than 0.1	0	0	5	Impacts are associated with crossing the channel between Lake of the Isles and Lake Calhoun. Utilizing bridge may eliminate impact.
	DNR						
	COE						
	MCWD						
	PCA						
	Local Municipality						

Table 11. Impact by Alternative

Alternative	Permitting Agency	Wetland Impact		Floodplain Impact		Impacted Wetland Type (Circular 39)	Comments
		ft²	acre	ft²	acre		
1A	LGU	Approx. 34,000	Approx. 0.8	Approx. 62,000	Approx. 1.5	1, 2, 3, 4, 5	Impacts to multiple wetland types. Floodplain impacts are associated with Purgatory Creek and tributaries of Nine Mile Creek. Impacts also with crossing the channel between Lake of the Isles and Cedar Lake. Utilizing bridge may eliminate impact.
	DNR						
	COE						
	NMCWD						
	PCA						
	Local Municipality						
3A	LGU	Approx. 157,000	Approx. 3.5	Approx. 77,000	Approx. 1.8	1, 2, 3, 5, 6	Significant impacts to multiple wetland types. Floodplain impacts are associated with Purgatory Creek, tributaries of Nine Mile Creek, and an unnamed waterbody. Impacts also with crossing the channel between Lake of the Isles and Cedar Lake. Utilizing bridge may eliminate impact.
	DNR						
	COE						
	NMCWD						
	PCA						
	Local Municipality						
3C-1 (Nicollet Mall) and 3C-2 (11th/12th Street)	LGU	Approx. 152,000	Approx. 3.5	Approx. 77,000	Approx. 1.8	1, 2, 3, 4, 5, 6	Impact to various wetlands and potential for impacting Minnehaha Creek. Floodplain impacts are associated with Nine Mile Creek and Minnehaha Creek. Impacts are associated with crossing the channel between Lake of the Isles and Lake Calhoun. Utilizing bridge may eliminate impact.
	DNR						
	COE						
	NMCWD						
	MCWD						
	PCA						
	Local Municipality						

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3.3.3.3 Watershed Management Areas

The following list summarizes the watershed management organizations which oversee and permit various develop activities which are proposed and take place within their boundaries.

LRT 1A

The boundaries of the watershed management areas are shown on Figure 3-1. The agencies involved for LRT 1A include:

- Mississippi River Watershed Management Organization
- Bassett Creek Watershed Management Organization
- Minnehaha Creek Watershed District
- Nine Mile Creek Watershed District
- Riley/Purgatory/Bluff Creek Watershed District

LRT 3A

The boundaries of the watershed management areas are shown on Figure 3-1. The agencies involved for LRT 3A include:

- Mississippi River Watershed Management Organization
- Bassett Creek Watershed Management Organization
- Minnehaha Creek Watershed District
- Nine Mile Creek Watershed District
- Riley/Purgatory/Bluff Creek Watershed District

LRT 3C-1 (Nicollet Mall) and LRT 3C-2 (11th/12th Street)

The boundaries of the watershed management areas are shown on Figure 3-1. The agencies involved for LRT 3C-1 and LRT 3C-2 include:

- Mississippi River Watershed Management Organization
- Bassett Creek Watershed Management Organization
- Minnehaha Creek Watershed District
- Nine Mile Creek Watershed District
- Riley/Purgatory/Bluff Creek Watershed District

3.3.3.4 Bassett Creek Tunnel

The Bassett Creek storm water tunnel, in the vicinity of the HCRRA's right-of-way, was constructed in 1992. Prior to this construction, the runoff from the creek was conveyed to the Mississippi River through a different tunnel north of this alignment. The 1992 project created a new diversion structure near the west edge of the property line for the school bus facility at 1001 2nd Avenue N. The diversion re-directs runoff to the new tunnel through the downtown area (see Figure 3-1.) that ultimately discharges to the Mississippi River near the St. Anthony Falls lock and dam.

The old conduit tunnel is still maintained and handles local storm sewer drainage as well as occasional overflow from the creek near the new tunnel entrance.

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LRT 1A

The Bassett Creek storm water tunnel crosses LRT 1A at approximately a right angle, in the vicinity of Sta. 1123+50. The tunnel at this location consists of twin 11'x11' reinforced concrete box culverts (RCBC.) Based on the record drawings, there is 11 to 12 feet of vertical separation between the top of the RCBC and the ground elevation at this crossing.

The alignment of the storm tunnel is generally south of the Cedar Lake Trail; however, east of the I-94 Bridge, the alignment of the storm tunnel is within 100 feet of the proposed LRT alignment. The depth in this area also appears to be 11 to 12 feet.

LRT 3A

The LRT 3A alignment is the same as LRT 1A in the vicinity of the Bassett Creek storm water tunnel, so the discussion above applies to this alignment as well.

LRT 3C-1 (Nicollet Mall) and LRT 3C-2 (11th/12th Street)

LRT 3C-1 and LRT 3C-2 pose no conflict with the Bassett Creek storm water tunnel.

3.3.4 Long-Term Effects

Based on the analysis of the Southwest LRT alternatives, there are multiple potential impacts to wetlands, floodplains, and other features. However, these impacts can be addressed through the appropriate permitting processes and do not pose major obstacles to the Southwest LRT project.

The number of each item on the lists below corresponds to the impact or area of interest number on the eleven figures provided. (Figures 3-2 to 3-11)

3.3.4.1 Segment 1 (Figures 3-2 and 3-3)

1. Wetland impact
2. Wetland impact, Purgatory Creek, 100 yr floodplain impact
3. Wetland impact, possible stormwater pond
4. Possible stormwater pond impact
5. Wetland impact, 100 yr floodplain impact
6. Proximity to wetland. Rare species occurrence
7. Proximity to wetland
8. Proximity to wetland
9. Wetland impact, 100 yr floodplain impact
10. Wetland impact
11. Wetland impact
12. Proximity to stormwater pond

3.3.4.2 Segment 3 (Figures 3-4, 3-5, and 3-6)

13. Proximity to wetland
14. Proximity to potential wetland (roadside drainage)
15. Wetland impact, 100 yr floodplain impact
16. Proximity to stormwater pond, 100 yr floodplain impact
17. Proximity to Idlewild Lake (MnDNR Public Water Inventory #74P)

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18. Proximity to wetland; location is associated with the South Fork of Nine Mile Creek.
19. Wetland impact, 100 yr floodplain impact
20. Wetland impact
21. Potential wetland impact: roadside drainage
22. Large undeveloped property owned by United Healthcare. The property contains a large woodland, several wetlands, and open grasslands with scattered trees.
23. Wetland impact
24. City of Minnetonka: Oak woodland preservation area
25. Wetland impact
26. Wetland impact, possible stormwater pond impact
27. Wetland impact, possible stormwater pond impact
28. Wetland impact
29. Wetland impact, 100 yr floodplain impact
30. Stormwater pond impact

3.3.4.3 Segment 4 (Figures 3-7 and 3-8)

31. Potential stormwater pond impact
32. Wetland impact
33. Wetland impact, 100 yr floodplain impact: location is associated with Minnehaha Creek.
34. Proximity to wetland, 100 yr floodplain impact
35. Proximity to stormwater pond

3.3.4.4 Segment A (Figures 3-9)

36. Potential impact to channel between Cedar Lake and Lake of the Isles
37. Prairie restoration projects along existing railroad and pedestrian paths

3.3.4.5 Segment C-1/C-2 (Figures 3-10 and 3-11)

38. Potential wetland impacts and impacts to channel between Lake of the Isles and Lake Calhoun
39. Multiple Peregrine Falcon (*Falco peregrinus*, MN threatened species) nesting sites within city center.

A summary list of potential major drainage impacts and watershed management issues that could influence the alternative alignments along each segment is given below.

3.3.4.6 LRT 1A

Potential areas of concern for LRT 1A are shown on Figure 3-12. They include:

- Crossing of Purgatory Creek
- Crossing of Nine Mile Creek (two locations)
- Proximity to Shady Oak Lake
- Proximity to Minnehaha Creek (future green way corridor)
- Crossing of unnamed channel between Cedar Lake and Lake of the Isles

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3.3.4.7 LRT 3A

Potential areas of concern for Alignment 3A are shown on Figure 3-13. They include:

- Crossing of Purgatory Creek
- Crossing of Nine Mile Creek (two locations)
- Proximity to Minnehaha Creek (future green way corridor)
- Crossing of unnamed channel between Cedar Lake and Lake of the Isles

3.3.4.8 LRT 3C-1 (Nicollet Mall) and LRT 3C-2 (11th/12th Street)

Potential areas of concern for these alternatives are shown on Figure 3-14. They include:

- Crossing of Purgatory Creek
- Crossing of Nine Mile Creek (two locations)
- Proximity to Minnehaha Creek (future green way corridor)
- Crossing of unnamed channel between Lake of the Isles and Lake Calhoun

There are no potential impacts associated with major drainage or watershed management issues for the Blaisdell or 1st Avenue segments for LRT 3C-2 (11th/12th Street).

3.3.5 Short-Term Construction Effects

Construction activities will expose soils and may result in the generation of sediment laden stormwater within the construction area. This sediment laden stormwater runoff, if drained into a conduit leading to adjacent water resources, has the potential to affect water quality. Construction best management practices (BMPs) will be used to minimize water quality impacts.

Short-term impacts related to construction activities may generate sediment laden stormwater within the construction area. BMPs will be used to minimize potential impacts.

The Southwest LRT will involve reconstruction of impervious surface, with current engineering designs that result in a net decrease in such surfaces. Additionally, the project will include construction of permanent BMPs that will reduce pollutant loads as compared to existing conditions. The cities may require upgrades to the existing storm sewer system to provide additional treatment for storm water runoff within the proposed construction limits. Likewise, the watershed districts and WMOs rules require practices that reduce runoff.

3.3.6 Mitigation

Impacts to wetlands as a result of the construction of the Southwest LRT will require mitigation, either through replacement of wetland or purchasing of wetland bank credits. Impacts to stormwater ponds that result in an insufficient stormwater treatment volume will require construction of additional treatment areas to compensate for the loss in treatment volume. Generally, floodplain impacts are mitigated by compensatory storage. To minimize impacts to the prairie restoration projects, we recommend planting native prairie vegetation along the corridor.

The best opportunities to improve conditions of these water bodies are by incorporating water quality management practices as part of development and redevelopment activities.

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The project will require coordination and permitting from local, state, and federal water resource agencies. Development of permit applications will be completed during the final design phase of the project. The proposed project will comply with applicable state, federal, and local regulations, and will install BMPs to control and minimize erosion and potential impacts to surface water resources.

Construction BMPs may include:

- Inlet protection of catch basins – filters, bio-bags, and catch basin drop filters
- Excavation silt control – silt fence and bio-bags as appropriate
- Temporary seeding of open excavations and stockpiles – as appropriate for surface soil areas that remain exposed for several weeks or longer
- Swales with check dams – surface waterways with periodic check dams for silt removal
- Temporary paving of area to receive traffic prior to final restoration
- Infiltration of storm water runoff after removal of heavy sediments
- Temporary re-routing of storm water away from exposed slopes and stockpiles
- Vehicle tracking pads to reduce the amount of mud transported offsite

When applicable, these practices would be installed prior to earthwork and grading activities, and would be kept in good working order for the duration of the project. The project will be monitored under grading permits issued by the watershed districts, WMOs, as well as the cities in the corridor.

As discussed, the Southwest LRT will be constructed partly on land that is currently developed and has significant impervious surface cover, the southern alignments, however, have numerous resources which would be affected. Although this project is not anticipated to have any adverse long term impacts to water resources or to significantly increase the quantity of surface runoff, sustainable and context sensitive best management practices to improve surface water management will be included as part of this project. Runoff volume control techniques such as those listed below will be considered during final, detailed design of this project to help decrease the management of rate and volume, and increase the quality of surface runoff in the surrounding area:

- Green swales
- Infiltration strips
- Rainwater gardens
- Subsurface storage
- Grit chambers
- Sump manholes

The above mentioned techniques and other pertinent methods will be used when practical to help improve the receiving water resources from this project

3.4 Contaminated Properties and Hazardous Materials

The purpose of this section is to evaluate the potential for soil and/or groundwater contamination within or immediately adjacent to the Southwest LRT Study Area. This impact analysis does not attempt to measure the hazardous material impacts at the contaminated sites themselves. It does attempt to make a preliminary evaluation of the impact of site contaminants

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that could be encountered during construction activities, or that have the potential to migrate through the soil or groundwater from nearby sites to the project alignment.

This is a preliminary assessment of the presence of known contaminated sites. As the environmental review process progresses, a preferred alignment is selected, and the project moves forward into preliminary engineering. At this point, a Phase I Environmental Site Assessment (ESA) for the preferred alignment should be conducted. Follow-up Phase II ESAs to identify the extent and magnitude of contamination within proposed right of way and/or construction limits should be conducted based on the results of the Phase I ESA.

3.4.1 Preliminary Site Identification

A limited evaluation of the project was conducted by a national regulatory information vendor. This evaluation consisted of a review of databases for sites within 1,000 feet of the Southwest LRT alignment alternatives. The governmental database search included a review of federal, state, local, and tribal records, performed in general accordance with the All Appropriate Inquiries (AAI) standard (40 CFR 312). The locations of the sites identified by this file evaluation are shown on Figures 3-15 through 3-19.

The AAI standard indentifies many sites where hazardous materials may be present but where the potential for significant contamination of the property is low. There are three on-line databases available in Minnesota that provide more focused identification of potentially contaminated properties, These databases are found on the “What’s In My Neighborhood” Internet sites maintained by the Minnesota Pollution Control Agency (MPCA) and the Minnesota Department of Agriculture (MDA).The “What’s In My Neighborhood” data sets are the MPCA Master Entity System (MES) database, the MPCA database inventory of leaking underground storage tank (LUST) sites and the MDA agricultural chemical (AgChem) databases of spill and investigation sites. The MES database includes locations of Superfund sites (CERCLIS, NPL and PLP sites), voluntary investigation and cleanup (VIC) sites, RCRA facilities, unpermitted dump sites and NFRAP (no further remedial action planned) sites. The LUST sites include locations of on-going and closed investigations of petroleum releases. The AgChem includes historic sites, spill sites and the locations of site investigations of pesticides and herbicides.

It should be noted that environmental site investigations and remediation are designed to address significant risks to human health and the environment, and that these sites are often conditionally closed with some residual, low-risk contamination remaining. If encountered during construction, these materials are removed and disposed of appropriately. As a result, the potential costs to a construction project are often not significantly changed by the active/closed status of the remediation site.

3.4.2 Impact Assessment Methodology

This assessment developed a system to allow objective comparison of the expected range of costs to address the environmental remediation that may be required along each alignment alternative during construction. This evaluation consisted of two major parts: identification of contaminated sites and development of a cost estimation model.

For the purposes of this assessment, the databases were used to identify contaminated sites within 500 feet of the construction alignment. Table 12 summarizes the number of sites

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identified by this data search by segment; Table 13 summarizes known contaminated sites by alternative.

Table 12. Numbers of Contaminated Sites by Segment

Site Type	Segment					
	1	3	4	A	C-1	C-2
LUST	6	5	27	22	53	71
CERCLA	0	0	2	0	0	0
VIC	2	3	15	12	26	40
AgChem	1	2	4	2	2	2
Dump	1	0	3	0	2	1
Other	1	0	0	1	0	1

Table 13. Numbers of Contaminated Sites by Alternative

Site Type	Alternatives			
	LRT 1A	LRT 3A	LRT 3C-1 (Nicollet Mall)	LRT 3C-2 (11th/12th Street)
LUST	55	54	85	103
CERCLA	2	2	2	2
VIC	29	30	44	58
AgChem	7	8	8	8
Dump	4	3	5	4
Other	2	1	0	1

A probabilistic cost model was developed to estimate the costs of remediation. Costs were estimated by the following equation:

$$C = A + Ch + V\,(E + O + D),$$

where *C* is the cost per site, *A* is the administrative cost per site, *Ch* is the cost to characterize the site, *V* is the volume of contaminated soil, *E* is the unit cost (per cubic yard) to excavate and transport the contaminated materials, *O* is the unit cost for environmental oversight and *D* is the disposal cost. The administrative cost was an assumed flat rate of $5,000 per site, determined by assuming a total of 50 hours from a team of environmental professionals with an average billing rate of $100 per hour. For all the remaining variables, a range of unit costs were estimated with an associated probability. Soil volumes and unit rates for excavation, oversight, and disposal were based on review of cleanup costs during the construction of TH 212 in southern Hennepin and Carver Counties ending in 2007. Characterization rates were estimated based on general ranges of cost for labor and chemical analyses in our experience in coordinating disposal of contaminated materials.

A list of scenarios was developed by permuting all combinations of the inputs to Equation 1. Costs per site and probabilities for each scenario were calculated. A probability density function was calculated by sorting costs and calculating the cumulative probability.

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The total estimated cost for each alignment was determined by multiplying the estimated number of sites along each alignment by the probabilistic cost per site. The actual number of sites that must be addressed along each alignment will be somewhat less than the total number of contaminated sites. This is due to the variability in factors such as distance, position relative to the alignment, and degree of contamination. To account for this, the total number of sites was reduced by 50 percent for LUST, VIC, Superfund, NFRAP, and unpermitted dump sites, and by 80 percent for AgChem sites (AgChem spills are assumed to be small and less likely to be encountered) and other types of sites.

3.4.3 Long-Term Effects

The long-term effects of hazardous materials and contaminated properties primarily consist of the potential to shift all or a portion of environmental liability to the project. These effects can be minimized or eliminated under the following conditions:

- Where possible, avoid the acquisition or properties that are significantly contaminated
- Obtain assurances (e.g., letters of no association or no further actions letters) from the state for any contaminated properties that are acquired
- Avoid contractual obligations to operate or maintain remedial actions on acquired properties

3.4.4 Short-Term Construction Effects

Construction effects include the time and expense of identifying, testing, removing, transporting, and disposing of contaminated materials to properly licensed facilities. Project construction could also be affected through contact with contaminated soil and/or groundwater during excavation or drilling activities.

In addition to impacts to construction, people present within and adjacent to the project construction area could be exposed to potentially hazardous materials. Site workers may be exposed through physical contact with, or ingestion or inhalation of, contaminants uncovered in excavations. Exposures to passersby would likely be limited to inhalation of contaminant vapors emanating from freshly uncovered contaminants. Public exposure through physical contact with a contaminated material or contaminant ingestion would be prevented through the use of site access barriers.

Table 14 summarizes the environmental remediation costs for each segment estimated using the probabilistic method described in Section 3.4.2. Table 15 and Chart 1 show cleanup costs by alignment based on the same method. It should be emphasized that the objective of this evaluation was to develop a means of assessing the relative costs of environmental remediation for each proposed alignment. This analysis is a good faith effort to accurately project the cost by using realistic ranges and actual numbers of known contaminated sites, but it should not be taken as a projection of the actual remediation costs.

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Table 14. Estimated Costs for Environmental Remediation by Segment

No. of Sites:		Segment					
		1	3	4	A	C-1	C-2
		5	4	24	18	41	57
Probability (%)	Per Site Cost						
10	13,000	65,000	52,000	312,000	234,000	533,000	741,000
20	14,300	71,500	57,200	343,200	257,400	586,300	815,100
30	15,500	77,500	62,000	372,000	279,000	635,500	883,500
40	17,500	87,500	70,000	420,000	315,000	717,500	997,500
50	19,000	95,000	76,000	456,000	342,000	779,000	1,083,000
60	23,000	115,000	92,000	552,000	414,000	943,000	1,311,000
70	40,750	203,750	163,000	978,000	733,500	1,670,750	2,322,750
80	51,750	258,750	207,000	1,242,000	931,500	2,121,750	2,949,750
90	67,500	337,500	270,000	1,620,000	1,215,000	2,767,500	3,847,500

Note: Estimated costs are expressed as a probability of cost not to exceed, that is, the probability that the actual costs will be less than or equal to the amount indicated in the table

Table 15. Estimated Costs for Environmental Remediation by Alignment Alternative

Probability (%)	Alignment			
	LRT 1A	LRT 3A	LRT 3C-1 (Nicollet Mall)	LRT 3C-2 (11th/12th Street)
10	611,000	598,000	897,000	1,105,000
20	672,100	657,800	986,700	1,215,500
30	728,500	713,000	1,069,500	1,317,500
40	822,500	805,000	1,207,500	1,487,500
50	893,000	874,000	1,311,000	1,615,000
60	1,081,000	1,058,000	1,587,000	1,955,000
70	1,915,250	1,874,500	2,811,750	3,463,750
80	2,432,250	2,380,500	3,570,750	4,398,750
90	3,172,500	3,105,000	4,657,500	5,737,500

Note: Estimated costs are expressed as a probability of cost not to exceed, that is, the probability that the actual costs will be less than or equal to the amount indicated in the table

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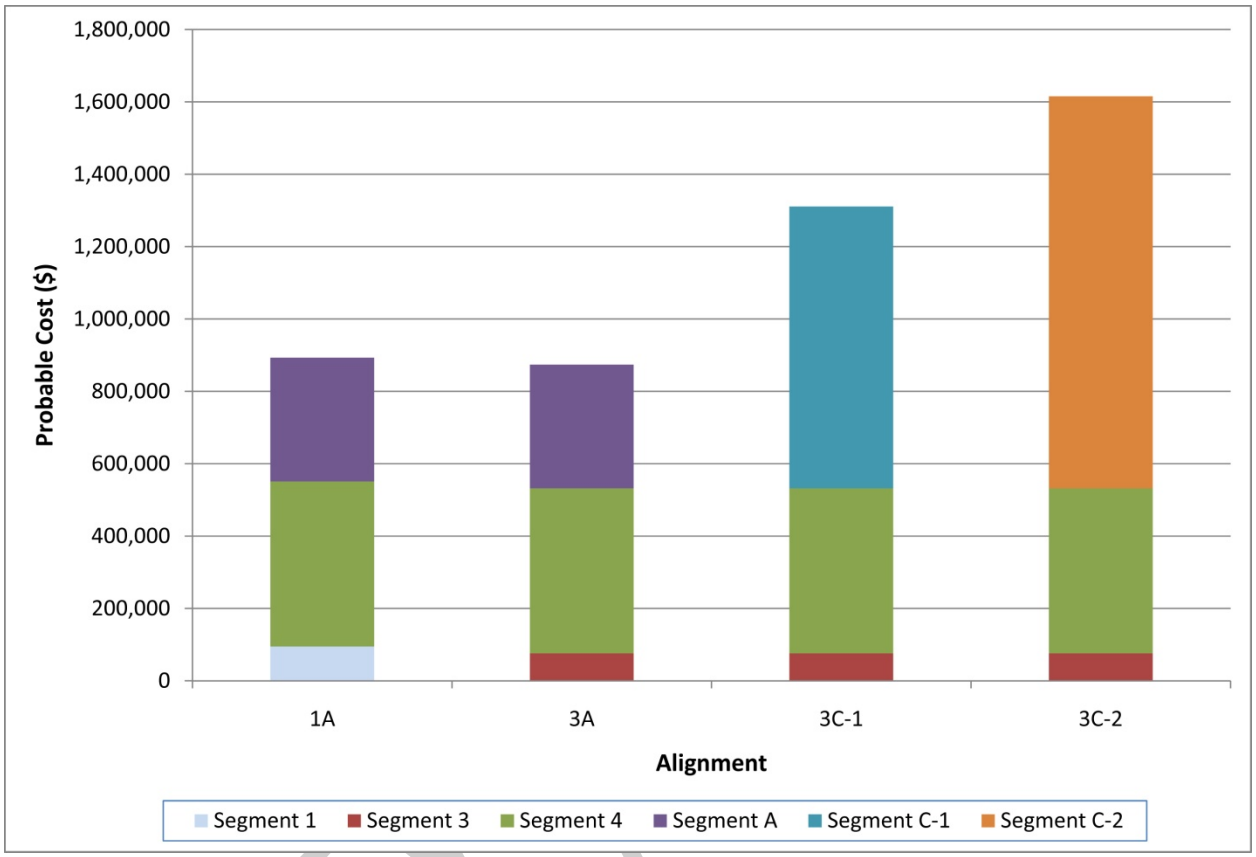
Chart 1. *Comparative Environmental Remediation Costs*



3.4.5 Mitigation

A Phase I ESA and subsequent regulatory file review and field research would be conducted to identify potential contaminated sites that may be encountered by the project. Phase II ESAs would be conducted for specific areas along the alignment that have the potential for impact from contaminated sites. Depending on the level of environmental liability exposure, an application may be made to enroll the project in the MPCA Voluntary Investigation and Clean-up (VIC) and/or Voluntary Petroleum Investigation and Clean-up (VPIC) programs upon initiation of Phase II studies. The Phase II ESAs would include preparation of investigative work plans, field investigations, contaminant sampling and testing, and recommendations to mitigate detected contamination.

Upon approval of the mitigation plans, cleanup of identified contamination would begin prior to, or in concert with, project excavation and or drilling activities. All clean-up activity would be conducted with prior MPCA approval and in accordance with the approved Site Safety and Health Plan and would be continuously monitored by qualified inspectors. A final report would be prepared to document all removal and disposal activity.

It is reasonable to expect that previously undocumented soil or groundwater contamination may be encountered during construction. A Construction Contingency Plan would be prepared prior to the start of construction to account for the discovery of unknown sites. This plan would outline

procedures for initial contaminant screening, soil and groundwater sampling, laboratory testing, and removal, transport, and disposal at licensed facilities. Contamination removal and disposal would be in accordance with this plan, monitored by qualified inspectors, and documented in final reports for submittal to MPCA.

Where appropriate, MPCA approvals of environmental investigations and remedial actions would include assurance letters relieving long-term liability for the contamination. In addition to contaminated soil and groundwater, the potential exists for structures on acquired lands to contain asbestos, lead paint, or other hazardous materials. Any existing structures would be surveyed for the presence of hazardous/regulated materials such as asbestos-containing materials, lead-based paint, chemical storage, etc., prior to their demolition or modification. Potentially hazardous materials would be handled and managed to comply with standard best practices and would be disposed of in accordance with an approved remediation plan.

3.5 Section 4(f) Evaluation

3.5.1 Background Information and Regulatory Requirements

This chapter presents the existing conditions and potential effects to parklands and historic properties as they relate to the provisions of Section 4(f) of the U.S. Department of Transportation Act of 1966. Section 4(f) of the Department of Transportation Act of 1966 is a federal law intended to prevent the conversion of specific categories of property to transportation use, unless the U.S. Department of Transportation (USDOT) determines there is no feasible and prudent alternative to such conversion and all possible planning has been done to minimize harm.

This law, codified at 49 USC 303 and 23 USC 138, is commonly referred to as Section 4(f) and is implemented by regulations found at 23 CFR 774. The specific categories of properties protected by Section 4(f) include publicly owned parks, publicly-owned recreation areas, publicly-owned wildlife and waterfowl refuges, and historic properties regardless of ownership. Section 4(f) applies to all USDOT agencies; including the Federal Highway Administration (FHWA), the Federal Transit Administration (FTA), the Federal Aviation Administration (FAA), and the Federal Railroad Administration (FRA).

Section 4(f) permits the Secretary of Transportation to approve a project that requires the use of any publicly-owned land from a park, recreation area, wildlife refuge, or historic property only where it is shown that:

- There is no feasible or prudent alternative to the use of the land; and
- The action includes all possible planning to minimize harm to the property resulting from such use.

Use of a Section 4(f) property is defined by 23 CFR 774.17 as occurring:

- When land is permanently incorporated into a transportation facility;
- When there is a temporary occupancy of land that is adverse in terms of the statute's preservation purpose as determined by the criteria in §774.13(d); or
- When there is a constructive use of a Section 4(f) property as determined by the criteria in §774.15.

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Permanent incorporation of land into a transportation facility can by done by fee simple purchase of the land or through permanent right-of-way acquisition.

Temporary impacts to Section 4(f) properties may occur during construction and might include noise and/or vibration impacts, impacts to air and/or water quality, and visual or access limitations. Such impacts are typically minor and end before a project is completed. For a temporary occupancy of Section 4(f) land to be considered not adverse and a Section 4(f) use, it must meet the following conditions:

- The duration of the occupancy must be less than the time needed for the construction of the project and there must not be a change in ownership;
- Both the nature and magnitude of the changes to the Section 4(f) properties are minimal;
- There are no anticipated permanent adverse physical changes nor interference with activities or purposes of the resource on a temporary or permanent basis;
- The land is restored to the same or better condition; and,
- There is documented agreement of the appropriate federal, state, or local officials having jurisdiction over the resource regarding the above conditions.

A constructive use of land occurs when the project does not require permanent or temporary use of land, but has an impact on a Section 4(f) property that substantially impairs the activities, features, or attributes of the resource. Such uses are defined in 24 CFR 774.15 and include:

- The projected noise level increase attributable to a proposed project substantially interferes with the use and enjoyment of a resource protected by Section 4(f), such as hearing a performance at an outdoor amphitheater, enjoyment of a historic site where a quiet setting is a generally recognized feature of the site, or enjoyment of an urban park where serenity and quiet are significant attributes.
- The proximity of a proposed project substantially impairs aesthetic features or attributes of a resource protected by Section 4(f), where such features or attributes are considered important contributing elements to the value of the resource. An example of substantial impairment to visual or aesthetic qualities would be the location of a proposed transportation facility in such proximity that it obstructs or eliminates the primary views of an architecturally significant historical building, or detracts from the setting of a park or historic site which derives its value in substantial part from its setting.
- A proposed project results in a restriction of access to the Section 4(f) property, which substantially diminishes or eliminates the utility of the resource.
- The vibration impact from operation of a proposed project would substantially impair the use of a Section 4(f) property, such as a projected vibration level that is great enough to affect the structural integrity of a historic building or substantially diminish the utility of a historic building.
- The ecological intrusion of a proposed project substantially diminishes the value of wildlife habitat in a wildlife or waterfowl refuge adjacent to a proposed project or substantially interferes with the access to a wildlife or waterfowl refuge when such access is necessary for established wildlife migration or critical life cycle processes.

The determination of “feasible and prudent” alternatives must include supporting information that demonstrates unique problems or unusual factors involved in the use of alternatives which would avoid the use of Section 4(f) properties; or that the cost, social, economic, and

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environmental impacts or community disruption resulting from such alternatives reach extraordinary magnitudes. An alternative may be rejected as not being feasible and prudent if it:

- Does not meet the purpose and need of the project;
- Has excessive cost of construction of extraordinary magnitude; or,
- Results in severe operational or safety problems, unacceptable adverse social, economic or environmental impacts, serious community disruption, or, accumulation of the aforementioned impacts that combined, reach an unacceptable level.

When a proposed project would need to use a minor amount of Section 4(f) protected property, the FTA can make a de minimis impact determination. Such findings must include sufficient supporting documentation to demonstrate that the impacts, after avoidance, minimization, mitigation, or enhancement measures are taken into account, are de minimis as defined in regulation, and that the required coordination has been completed. Because of their nature as minor impacts, de minimis impact determinations require minimal review and documentation when compared to traditional Section 4(f) determinations.

23 CFR part 774.17 defines two specific types of de minimis impacts.

- For historic sites, de minimis impact means that the FTA has determined, in accordance with 36 CFR part 800 that no historic property is affected by the project or that the project will have “no adverse effect” on the historic property in question.
- For parks, recreation areas, and wildlife and waterfowl refuges, a de minimis impact is one that will not adversely affect the features, attributes, or activities qualifying the property for protection under Section 4(f).

The Section 4(f) properties identified within the Southwest LRT Study Area include both publicly owned parklands that meet the specific criteria defined in 23 CFR 774 and historic properties regardless of ownership. Section 4(f) applies to all historic properties (i.e., on or eligible for inclusion in the National Register of Historic Places (NHRP)), except for archaeological resources unless the archaeological resources merit preservation in place).

In addition to the protection provided by Section 4(f), Section 6(f) of the Land and Water Conservation Fund Act of 1965 (LAWCON) stipulates that any land or facility planned, developed, or improved with LAWCON funds cannot be converted to uses other than parks, recreation, or open space unless land of at least equal fair market value and reasonably equivalent usefulness is provided. Anytime a transportation project would cause such a conversion, regardless of funding sources, such replacement land must be provided. At this time, no Section 6(f) protected property has been identified within the corridor. Therefore, it is unknown if permanent conversion of Section 6(f) park property is proposed and if Section 6(f) review is required.

3.5.2 Methodology

The methodology used to identify the use of Section 4(f) protected properties includes the following steps:

- Development of detailed base maps depicting property ownership overlaid on current aerial photographs.

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- Incorporate information by reference from Section 3.1, Cultural Resources. As discussed previously, the Section 106 process has not yet been initiated for this project. Until the Section 106 process is initiated, the area of potential effect can not be determined in consultation with the MN SHPO and identification of previously unknown property can not be conducted. At present, the investigation of historic property within the project corridor is limited to the use of existing information from readily available sources about historic property in the project vicinity. It is unknown when the Section 106 consultation process will be initiated for this project.
- Identify and document parks and public land within 0.25 mile of the corridor that are documented in Section 3.5. Those parks and public lands that qualify as 4(f) properties and are found within 500 feet of the project corridor were evaluated in greater detail for their potential to be used by the proposed project.
- Project the construction limits onto the base map to determine if any of the 4(f) properties would be used by the proposed action.
- Where there appeared to be a project-related use of 4(f) properties, additional analysis will be conducted to determine the type and magnitude of the use.
- Where there appeared to be a project related use of a 4(f) property, additional engineering analysis will be conducted to determine if such use could be avoided or minimized during the planning and design process.

The results of this analysis will lead to a series of coordination meetings with the parties that control these properties and the regulatory agencies responsible for these resources.

3.5.3 Properties Protected by Section 4(f)

The Section 4(f) properties found in the project vicinity include publicly owned parks and recreation areas, conservation areas, and historic properties. A list of the publicly owned parks, open spaces, and recreation areas located in the vicinity of the Southwest LRT is found in Tables 16-22. Note that the locations listed as parks may not actually qualify as a Section 4(f) property based on the criteria set forth in the rules and discussion with the regulatory agencies. There will be a consultation process with the FTA during the DEIS analysis, and they will make a final determination. Conservation areas are found within the project vicinity that qualify as Section 4(f) properties. However, no formally designated wildlife or waterfowl refuges are found in the project vicinity. A list of previously identified historic properties within the project vicinity is found in Section 3.1.

The following sections describe the Section 4(f) properties identified in the project vicinity. The properties have been categorized based on whether a use will occur from the project. The findings presented below have been developed by FTA through coordination with MN SHPO and agencies with jurisdiction over the properties. However, these determinations cannot be finalized until FTA receives written concurrence from the agency with jurisdiction over that property.

For historic properties, concurrence from MN SHPO on Section 106 findings of effect is needed for those properties that are also protected under Section 4(f). The Section 106 findings of effect assist in the determination of whether or not there is a Section 4(f) use and the nature of that use. For *de minimis* findings for historic properties, FTA is required to notify MN SHPO of the intent to conclude the use of specific historic properties is *de minimis* and MN SHPO concurrence in writing with the Section 106 determination is required. For *de minimis* findings

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for parks and recreation areas, FTA is required to provide written notification to the agency with jurisdiction over the specific park or recreation area and their written concurrence with this finding is required.

3.5.3.1 Section 4(f) Properties Within 500 Feet of Project

Segment A

The Section 4(f) properties within 500 feet of Segment A are listed on Table 16 and shown on Figure 3-20.

Table 16. ***Section 4(f) Properties within 500 Feet of Segment A***

Property Name	Property Description	Direct 4(f) Use
Minneapolis Warehouse Historic District	Historic district primarily consisting of warehouses from historic manufacturing and transportation period	Possible use, a portion of the district is adjacent to project corridor
Bryn Mawr Park	50.84 acre park; 2 baseball fields, biking path, 2 broomball rinks, cricket field, ice rink, 10-table picnic area, restroom facilities, soccer field, 11 softball fields, sports facility, tennis court, tot lot/playground, wading pool, & walking path	Possible use, property is adjacent to project corridor
Kenwood Parkway	Parkway	Use unlikely due to distance from project corridor
Cedar Lake & Cedar Lake Parkway	Three supervised beaches, biking path, cross country skiing, fishing dock, picnic area, walking path, and parkway	Possible use, property is adjacent to project corridor and project must cross Cedar Lake Parkway
Lake of the Isles Parkway	Parkway	Possible use, property is adjacent to project corridor
Park Siding	Park-owned property, not described on the MPRB website	Use unlikely due to distance from project corridor
Alcott	Park-owned property, not described on the MPRB website	Use unlikely due to distance from project corridor

Segments C-1, C-2, C-2A, and C-2B

The Section 4(f) properties within 500 feet of Segments C-1, C-2, C-2A, and C-2B are listed on Table 17 and shown on Figure 3-20.

Table 17. ***Section 4(f) Properties within 500 Feet of Segment*** *C-1, C-2, C-2A, and C-2B*

Property Name	Property Description	Direct 4(f) Use
Stevens Square	2.51 acre park with playground, seating & performance area and walking paths	Use unlikely due to distance from project corridor
Stevens Square Historic District	Listed residential historic district	Possible use, a portion of the district is adjacent to project corridor
Washburn Fair Oaks	Park with green space and scenic vistas of downtown Minneapolis	Use unlikely due to distance from project corridor
Grade Separation Historic District	Historic railroad district consisting of railroad tracks, embankment, crossing structures, and retaining walls	Direct use likely to be required

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Property Name	Property Description	Direct 4(f) Use
The Mall	Park owned property, not described on the MPRB website	Possible use, property is adjacent to project corridor
Lake of the Isles Parkway	Parkway	Possible use, property is adjacent to project corridor
Lake of the Isles	Lake with 2.86 miles of shoreline, bike path, display fountain, fishing dock, hockey rink, ice rink, parkway, soccer field, walking path, wells, off-leash recreation area	Possible use, property is adjacent to project corridor
Dean Parkway	Parkway with 17.5 acres of parkland, 0.6 miles of bicycle and walking paths	Possible use, property is adjacent to project corridor
Park Siding	Park owned property, not described on the MPRB website	Use unlikely due to distance from project corridor
Alcott	Park owned property, not described on the MPRB website	Use unlikely due to distance from project corridor
Lake Calhoun	3.2 mile bike/skate path, 3.1 mile walking path, three supervised beaches, archery, boat dock, eatery/concessions, fishing dock, parkway, picnic area, restroom facilities, soccer field, softball field, volleyball court, wells	Use unlikely due to distance from project corridor
Lake Calhoun Parkway	Scenic parkway that circles Lake Calhoun	Use unlikely due to distance from project corridor

Table 18 lists the Section 4(f) property within 500 feet of Segment C-1 that is not also within 500 feet of Segment C-1.

Table 18. Section 4(f) Property within 500 Feet of Segment C-1

Property Name	Property Description	Direct 4(f) Use
Gateway Park	Display fountain, sculpture	Use unlikely due to distance from project corridor

Table 19 lists the Section 4(f) property within 500 feet of Segment C-2 that is not also within 500 feet of Segment C-1.

*Table 19. **Section 4(f) Property within 500 Feet of Segment C-2***

Property Name	Property Description	Direct 4(f) Use
Minneapolis Warehouse Historic District	Historic district primarily consisting of warehouses from historic manufacturing and transportation period	Possible use, a portion of the district is adjacent to project corridor

Segment 1

The Section 4(f) properties within 500 feet of Segment 1 are listed on Table 20 and shown on Figure 3-22.

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Table 20. ***Section 4(f) Properties within 500 Feet of Segment 1***

Property Name	Property Description	Direct 4(f) Use
Camp Edenwood	20 acres of woodlands and wetlands on Birch Island Lake. Dining & welcome lodge, two modern cabins, rustic dormitory, indoor and outdoor recreation areas, outdoor camping and picnic sites, health services center and laundry facilities. Challenge courses, sledding, broomball, canoeing, fishing, volleyball, basketball, and nature walks.	Use unlikely due to distance from project corridor
Birch Island Woods Conservation Area	A 36-acre sanctuary of trees and wetlands. Amenities include lakes, wetlands, woods, wildlife and bird habitats, Glen Lake Golf Center, Picha Heritage Farm, archeological and historic sites, bike, nature and ski trails, Eden Wood's camp for special needs children, and a conference center	Use unlikely due to distance from project corridor
Edenvale Park	Ball field, play structure with swings, hockey rink with warming house and skating area, picnic shelter and picnic area. Edenvale conservation area is adjacent to the park.	Use unlikely due to distance from project corridor
Edenvale Conservation Area	181 acre conservation area, walking trails, parking	Possible use, property is adjacent to project corridor
Westgate Conservation Area	24 acre conservation area	Use unlikely due to distance from project corridor

Segment 3

The Section 4(f) properties within 500 feet of Segment 3 are listed on Table 21 and shown on Figure 3-22.

Table 21. ***Section 4(f) Properties within 500 Feet of Segment 3***

Property Name	Property Description	Direct 4(f) Use
Eden Prairie Off Leash Area	Public off-leash dog park located on Flying Cloud Drive	Possible use, property is adjacent to project corridor
Nine Mile Creek Conservation Area	89.7 acre conservation area on Nine Mile Creek	Possible use, property is adjacent to project corridor
Purgatory Creek Park	Purgatory Creek Park. Covered band stand/pavilion, parking, rest rooms, public art, lawn	Use unlikely due to distance from project corridor.

Segment 4

The Section 4(f) properties within 500 feet of Segment 4 are listed on Table 22 and shown on Figure 3-21.

Table 22. ***Section 4(f) Properties within 500 Feet of Segment 4***

Property Name	Property Description	Direct 4(f) Use
Jorvig Park	Relocated historic depot building, horseshoes, play structure, rest shelter	Possible use, property is adjacent to project corridor
Meadowbrook Manor Park	Open space	Use unlikely due to distance from project corridor
Edgebrook Park	Playground, basketball, skating	Possible use, property is adjacent to project corridor

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Property Name	Property Description	Direct 4(f) Use
Isaac Walton League/Creekside	Canoe landing	Use unlikely due to distance from project corridor
Overpass Skate Park	Located under the Highway 169 bypass, 18,000-square-foot skate park. Provides piano banks, fun boxes, kinked rails and staircases, and equipment (protective helmets and pads).	Possible use, property is adjacent to project corridor

3.5.3.2 Properties Used

Table 23 summarizes the potential for the proposed project to use Section 4(f) properties. These properties are shown on Figure 3-20.

*Table 23: **Use of Section 4(f) Property***

Property Name	Property Description	Direct 4(f) Use
Cedar Lake Parkway	Public parkland and parkway	Some form of direct use likely required due to the need for Alternative A to cross this linear park resource
CM&StP Grade Separation Historic District	National Register-eligible historic railroad district consisting of railroad tracks, railroad embankment, railroad crossing structures, road bridges, and retaining walls	Direct use likely to be required. Historic retaining walls and bridges that contribute to the historic district would need to be demolished or substantially modified in order to widen the corridor to accommodate LRT C-1 and C-2.

Note: The Section 106 process has not yet been initiated; therefore, such a determination may be premature.

3.5.4 Summary by Alternative

Table 24 summarizes the number of Section 4(f) properties that have the potential to be used by each alternative. This table includes public parks and recreation areas and historic districts. Individual historic property is not included at the present time because the Section 106 process has not yet been initiated for this project. Finally, this summary is very preliminary in nature because design is not sufficiently advanced to determine actual use for the majority of these properties. Therefore, no efforts can be made at this time to avoid or minimize the use of any of these 4(f) properties.

Table 24. Summary of 4(f) Properties by Alternative

Alternative	Number of Section 4(f) Properties within 500 feet
LRT 1A	17
LRT 3A	15
LRT 3C-1 (Nicollet Mall)	21
LRT 3C-2 (11th/12th Street)	21

3.5.5 Avoidance Alternatives

This section evaluates the potential of various alternatives to avoid the properties protected by Section 4(f).

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3.5.5.1 No-Build Alternative

The No-Build Alternative would result in a continuation of the transportation system that is currently in place. Transit system improvements under the No-Build Alternative include minor modifications to the existing bus services and transit facilities as specified in the appropriate agency Transportation Improvement Programs (TIP) of the metro area counties and the Metropolitan Council's 2030 Transportation Policy Plan (TPP) for which funding has been committed. According to current plans, the existing transit facilities and services would mostly be retained under the No-Build Alternative, with some routes consolidating services or modifying existing route alignments. The No-Build Alternative does not meet the project Purpose and Need; therefore, it is not a feasible and prudent alternative for avoiding properties protected by Section 4(f).

3.5.5.2 Build Alternatives Considered

Section 2.0 summarizes the build alternatives considered for this project.

3.5.5.3 Potential for Avoiding Properties Protected by Section 4(f)

In addition to evaluating the overall project alternatives for the potential to avoid Section 4(f) properties, avoidance alternatives will be evaluated during the Section 4(f) process for the immediate vicinity around those Section 4(f) properties when a use has been identified.

3.5.6 Measures to Minimize Harm

Avoidance of properties protected by Section 4(f) will be pursued as a first course of action when the use of Section 4(f) property is identified. When avoidance of Section 4(f) property is not possible, a variety of minimization measures will be employed to minimize the use of each Section 4(f) protected property. For those properties that cannot be avoided and for which uses exist even after minimization measures have been employed, a variety of compensatory mitigation measures will be developed to further minimize harm.

3.5.7 Coordination

Extensive coordination with all interested parties will occur during the Section 4(f) process and the associated NEPA and Section 106 processes. The MN SHPO has been invited to participate in the NEPA process for this proposed project. The MN SHPO will be invited to participate in the Section 106 process as well. Because of the complexity of issues and the number of historic properties present in the project area and its surroundings, extensive agency consultation and numerous public meetings will need to be held to complete the Section 106, NEPA, and Section 4(f) processes in a coordinated manner. The U.S. Department of Interior (DOI) will be included in the review of the draft Section 4(f) evaluation when it is available.

3.6 Geologic Resources

The section describes the geology in the vicinity of the Southwest LRT alignments. In addition, a number of issues related to the geologic and geotechnical conditions are evaluated. These issues are:

- Soil or bedrock conditions that would propagate ground-borne vibrations (GBV) (see Section 3.8.3)
- Near-surface bedrock that would require removal during construction

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- Shallow groundwater that would require dewatering during construction
- Shallow groundwater near proposed deep excavations (cuts) or tunnels that would require permanent dewatering
- The suitability of soils in tunnel areas for cut-and-cover construction methods, including estimated side slopes
- Soil conditions that may require extra shoring
- Soil conditions that may create differential settlement, requiring over-excavation filling and recompaction during construction

Of these issues, GBV and permanent dewatering potentially have long-term implications. The remaining factors would only affect construction activities and are therefore considered short-term effects.

3.6.1 Methodology

Documentation of the geologic conditions in the vicinity of the Southwest LRT is based on information provided in the Hennepin County Geologic Atlas (MGS, 1989[2]).

3.6.1.1 Near-Surface Bedrock

Near-surface bedrock was evaluated by screening well logs from the Minnesota Geological Survey County Well Index (CWI) for the occurrence of bedrock within 10 feet of the surface. As in the case of shallow bedrock propagating GBV, areas where clusters of wells existed were identified as having the potential for concern.

3.6.1.2 Shallow Groundwater Requiring Construction Dewatering

Construction dewatering could be necessary at numerous locations along the alignment, from soil cuts to the excavations for structural footings. Soil cuts are evaluated separately in this document. Thus, for the purposes of this evaluation, the focus was on identifying areas where it is likely that groundwater exists within 10 feet of the surface. Three data sets were used in making this evaluation. The CWI was queried for wells completed in shallow aquifers where water levels have been measured within 10 feet of the surface. Because the resultant number of wells is relatively small and the spatial distribution is uneven, the water level measurement data were supplemented by identifying areas where the alignments cross or are adjacent to surface water, and terrestrial areas along the alignment where the topographic separation from nearby surface water is narrow.

3.6.1.3 Cuts

This section considers significant excavations along the alignments. There are a total of seven cuts at the approximate locations shown in Figures 3-23 through 3-26. Data for evaluating the cuts insofar as they affect groundwater and soil stability have been compiled from the CWI, the Hennepin County Geologic Atlas, the Hennepin County Soil Survey, and topographic maps for the area. Table 25 summarizes the data used to make the evaluation.

[2] *Minnesota Geological Survey, 1989. Geologic Atlas of Hennepin County. County Atlas C-4*

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Table 25. Excavation Effects on Soil Stability and Groundwater

Cut Number	Alternative Segment	Alignment Stationing	Cut Name	Surface Elevation (feet)	Proposed Elevation (feet)	Cut Depth (feet)	Geology			Water Elevation (feet)
							Deposition	Material Description	Unified Classification	
1	1	312+00	TC&W Rail Crossing	916	895	21	Outwash (Des Moines Lobe)	Clay with stone	SC, w/ SM & CL	905
2	3	205+00	Prairie Center Dr / TH 5	849	823	26	Till (Des Moines Lobe), with adjacent Peat	Clay overlying sand	CL-ML w/ CL, Pt	820 1
3	3	376+00	Flying Cloud Dr/ Shady Oak Rd	894	868	26	Outwash and granular ice contact deposits (Des Moines Lobe)	Sand with some clay and silt	SC	880
4	3	349+00	Nine Mile Creek	880	861	19	Till (Des Moines lobe) with adjacent Peat	Sand with silt, Peat	SM, Pt	845
5	A	1146+00	Glenwood Avenue	842	823	19	Fluvial	Sand overlying lean clay	Urban 4	810
6	A	1162+00	Royalston Ave / N 7th St.	832	808	24	Fluvial	Sand overlying clayey sand	Urban 4	810
7	C	1096+00	Tunnel North	896	870	26	Outwash (Des Moines Lobe)	Sand with some clay and silt	Urban 4	Not determined
		1085+00	Tunnel Mid	884	857	27	Outwash (Des Moines Lobe)	Sand overlying sandy clay	Urban 4	Not determined
		1069+00	Tunnel South	872	848	24	Outwash (Des Moines Lobe)	Sand	Urban 4	Not determined

Notes: *1 Potential for perched groundwater at 845-850 (adjacent pond, buried artesian aquifer)*
2 Nearby pond with topo-posted elevation of 852'
3 8' layer of "peat & gravel" in clay/gravel sandwiching
4 Soils filled or disturbed
5 High apparent water table and nearby peat

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3.6.1.4 Potential for Differential Settlement

The primary cause for differential settlement will be the presence of organic soils, e.g., peat or fat clay. Three data sources were considered to address this question: identifying peat soils in the Hennepin County Soil Survey, identifying fat clay soils (Unified Soil Classification code 'CH' in the Hennepin County Soil Survey), and the documentation of peaty or mucky soils encountered in the logs of wells in the CWI. The search for fat clay soils in the Hennepin County Soil Survey did not return any results in the area of interest. Therefore, our methodology was limited to the other two data sources.

3.6.2 Existing Conditions

3.6.2.1 Surficial Geology

The proposed alignments are underlain by sediments deposited primarily by glacial ice and meltwater during the last glaciation (Wisconsinan Stage), and by post-glaciation deposits. Wisconsinan-age sediments can be attributed to the advance and retreat of two ice lobes from different origins, and their meltwater deposits. The (older) Superior lobe originated from the Labradorean ice sheet in Canada to the northeast, and the (younger) Des Moines lobe and Grantsburg sublobe, originated from the Keewatin ice sheet to the northwest. Deposits from the Des Moines lobe and Grantsburg sublobe (Twin Cities Formation) overly and are intermixed with deposits from the Superior lobe, and dominate the area of the proposed alignments. The topographic surface was shaped by movement of glacial ice, by deposition, by erosion from flowing meltwater, and by melting of buried ice blocks. After the retreat of Des Moines-Grantsburg ice, meltwater from Glacial River Mississippi cut a series of terraces forming what is now the Mississippi River valley in Minneapolis.

Along the proposed alignments, the sediments of the Twin Cities Formation consist of outwash, ice-contact stratified deposits, loamy till, sandy till, and mixed till. A map of the surficial geologic materials is shown in Figure 3-27[3]. Post-glacial sediments consist of middle and upper terrace deposits, organic deposits, and lacustrine deposits. The following list summarizes the composition of each deposit type, in general order of appearance from northeast to southwest along the proposed alignments:

- **Middle and Upper Terrace Deposits:** Consist of sand, gravelly sand, and loamy sand overlain by thin deposits of silt, loam, or organic sediment
- **Lacustrine Deposits:** Consist of thick clay overlain by areas of thick artificial fill over peat
- **Ice-Contact Stratified Deposits:** Consist of sand, loamy sand, and gravel; cobbles and boulders are common
- **Outwash:** Consists of sand, loamy sand, and gravel, overlain by less than 4 feet of loess.
- **Organic Deposits:** Consist of peat and organic-rich sediment, in some places removed and backfilled
- **Mixed Till:** Consists of complexly intermixed yellowish-brown to gray and reddish-brown to reddish-gray loam to sandy loam.

[3] *Meyer, G.N. and H.C. Hobbs, 1989.Surficial Geology. Geologic Atlas of Hennepin County, Plate 3. County Atlas C-4, Minnesota Geological Survey.*

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- **Loamy Till:** Consists of unsorted sediment ranging from clay to boulders (till), although chiefly made up of loam
- **Sandy Till:** Consists of till chiefly made up of loam to sandy loam.

Surficial geologic materials range in thickness from 50 to 400 feet, although the majority of the proposed alignments overly sediments less than 250 feet thick. The thickest sediments (250-400 feet) are found in relatively narrow buried bedrock valleys near the Minneapolis Chain of Lakes and also near the intersection of LRT 1A and Interstate 494 in Minnetonka.

3.6.2.2 Bedrock Geology

The uppermost bedrock along the proposed alignments consists of (from youngest to oldest) Platteville (limestone) and Glenwood (shale) Formations, St. Peter Sandstone (sandstone), and Prairie du Chien Group (dolostone). A map of the uppermost bedrock units is shown on Figure 3-28[4].

The following list summarizes the composition of each formation:

- **The Platteville and Glenwood Formations:** Consist of limestone of the Platteville Formation (30 feet thick) underlain by thin, green, sandy shale of the Glenwood Formation (5 feet thick).
- **St. Peter Sandstone:** Consists of fine- to medium-grained quartz sandstone, underlain by multicolored beds of mudstone, siltstone, and shale with interbedded very coarse sandstone; approximately 160 feet thick where present.
- **The Prairie du Chien Group:** Consists of karsted dolostone which varies in thickness but averages 120 feet. In the eastern portion of Hennepin County the Prairie du Chien Group is more sandy and the upper third to half contains minor amounts of shale. The lower portion is less sandy except at the base where it forms a transition zone with the Jordan Sandstone.

The Platteville, Glenwood, and St. Peter Sandstone share the majority of the uppermost bedrock coverage. The Prairie du Chien Group is the least likely to be encountered first in the area of the proposed alignments.

3.6.3 Long-Term Effects

3.6.3.1 Permanent Dewatering

Evaluations of permanent dewatering are summarized in Table 26. There is probable need for permanent dewatering at one cut on Segment 1 and a possible need for permanent dewatering at five cuts along Segment 3.

3.6.4 Short-Term Construction Effects

3.6.4.1 Near-Surface Bedrock

One small area where the bedrock surface lies within 10 feet of the surface was identified northwest of the terminus of Alignment C, but this area is unlikely to affect construction.

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[4] *Olsen, B.M., and B. A. Bloomgren, 1989. Bedrock Geology. Geologic Atlas of Hennepin County, Plate 2. County Atlas C-4, Minnesota Geological Survey*

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3.6.4.2 Shallow Groundwater Requiring Construction Dewatering

On Segment 1, there are five shallow groundwater areas identified, all due to adjacent surface water features (Figure 3-29). These are the crossings of Purgatory Creek and the South Branch of Nine Mile Creek (the main branch and a tributary), and wetland areas associated with Glen Lake and Shady Oak Lake.

There are three areas of concern for shallow groundwater on Segment 3 (Figure 3-30). First is the crossing of Purgatory Creek and associated wetland areas between the Mitchell and Southwest stations. Second is the crossing of the South Branch of Nine Mile Creek and neighboring wetlands just southwest of the Golden Triangle station. The final area of concern is between the Opus and Shady Oak stations, where nearly all of the alignment abuts wetland areas or low-lying uplands near the Shady Oak station.

There are three general areas of concern for shallow groundwater along Segment 4 (Figure 3-31). At the west end of the segment, between the Shady Oak Station to about 1,000 feet east of the Hopkins station is an area of suspected shallow groundwater. There is one well with a confirming measurement in this area, and the area includes the crossing of the South Branch of Nine Mile Creek. The second area of concern is generally centered on the crossing of Minnehaha Creek. This area extends from about 1,000 feet west of the Blake Station to about 1,000 feet east of the Louisiana Station. There are at least eight wells in this area with documented water levels at depths less than 10 feet. The final area in Segment 4 extends approximately from Highway 100 to the end of the segment. This is an area of low relief topography with some nearby wetlands.

Much of the area along Segment A has the potential for shallow groundwater. As seen on Figure 3-32, this concern exists for the areas near Lake Calhoun. In addition, the topographically low areas beginning near the 21st Street Station and extending through the areas near the Penn and Van White stations to I-94 potentially have shallow groundwater present.

Finally, on Segments C-1 and C-2 (Figure 3-33), the areas from the West Lake Station through the isthmus between Lake of the Isles and Lake Calhoun have the potential for shallow groundwater.

3.6.4.3 Cuts

Table 26 summarizes the results of the evaluations in terms of the need for dewatering, predicted side slopes, and the need for additional engineering controls.

Table 26. Cut Details

Cut Number	Segment	Cut Name	Dewatering		Excavation Side Slopes	Need for Benching or Shoring
			Construction	Permanent		
1	1	TC&W Rail Crossing	Probable	Probable	1:1	Shoring
2	3	Prairie Center Dr / TH 5	Probable	Possible	1:1	Benching
3	3	Flying Cloud Dr/ Shady Oak Rd	Probable	Probable	1.5:1	Shoring
4	3	Nine Mile Creek	Possible	Unlikely	1.5:1	No

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Cut Number	Segment	Cut Name	Dewatering		Excavation Side Slopes	Need for Benching or Shoring
			Construction	Permanent		
5	A	Glenwood Avenue	Unlikely	Unlikely	1.5:1	No
6	A	Royalston Ave / N 7th St.	Possible	Unlikely	1.5:1	Shoring
7	C	Tunnel North	Unlikely	Unlikely	1.5:1	Shoring

Notes: Site-specific excavation engineering, including benching or shoring, is required for excavations greater than 20 feet deep. Shored excavations have been assumed necessary for underpasses and where there is apparent limitation to the width of right of way.

Cut No. 1, located on Segment 1 just north of the crossing of County Road 62, is for an underpass beneath the TC&W rail tracks (Figure 3-23). The proposed cut will have a base elevation of approximately 895 feet above mean sea level (ft amsl). Soils at this location are described in the Hennepin County Atlas as glacial outwash, although review of well logs in the area indicate that the presence of interfingered clay and silt, which is more indicative of glacial till. The excavation will likely require 1:1 side slopes but, since the total depth of the cut is greater than 20 feet, OSHA guidance indicates that a site-specific excavation plan, likely including benching or shoring, is warranted. The elevation of groundwater from well logs and the topographic maps is expected at about 905 ft amsl. Dewatering of the excavation will likely be necessary.

Cut No. 2 is located on Segment 3 between the Southwest and Eden Prairie Towne Centre stations (Figure 3-24). The purpose of these cuts is to level the grade of the alignment by removing the tops of hills. The geologic materials in the area consist of clay overlying sand at depth. Peat soils are present nearby and could be encountered, as well. The regional water table appears to be present at about 820 ft amsl. Cut No. 2, is proposed to be terminated just above this elevation. However, groundwater could be present in this excavation due to seasonal variations. In addition, a pond located northeast of the Eden Prairie Towne Centre Station has an elevation of 852 ft amsl, suggesting that perched groundwater may be a potential issue in this area. The excavation side slopes are recommended to be 1:1. Two of the three cuts The cut exceeds 20 feet in depth, triggering the need for a site-specific excavation plan.

Cut No. 3 is located near the intersection of Flying Cloud Drive and Shady Oak Road (Figure 3-24). Its purpose is for the construction of a tunnel beneath Shady Oak Road. The water table in the area is expected at about an elevation of 840 ft amsl, well above the elevation of the base of the cut at 868 ft amsl. As a result, dewatering is expected to be necessary and, since the tunnel structure will be built, a permanent dewatering system will likely be necessary. Soils in the area consist of glacial outwash and alluvial terrace deposits, suggesting that the materials are sandy, potentially with small amounts of silt and/or clay. As a result, the side slopes of the excavation are recommended to be 1.5:1. Since the depth of the cut exceeds 20 feet, a site-specific excavation plan will be necessary.

Cut No. 4 occurs in the vicinity of the crossing of Nine Mile Creek-South Fork and will consist of cutting into a hillside to lower the grade (Figure 3-24). It will also be necessary in this area to replace culverts. The soils in this area consist of glacial till in the uplands and peat at the lower elevations near the creek. The till is characterized as silty sand. As a result, excavation side slopes of 1.5:1 are recommended. The depth of the cut is proposed to be 19 feet, so a site-specific excavation plan is not strictly required. The elevation of groundwater in the area will occur at or near the creek elevation, so construction dewatering will be necessary for work performed at the lowest elevations. Permanent dewatering is not deemed necessary.

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Cuts Nos. 5 and 6 lie north of Glenwood Avenue on Segment A (Figure 3-25). Cut No. 5 is for the purposes of grade leveling, where Cut No. 6 will be for the underpass where the rail line crosses N. Seventh Street. The mode of deposition for the geologic materials in this area is fluvial. The geologic materials consist of a significant thickness of sand overlying clay. The regional water table is expected near elevation 810 ft amsl. It is expected that Cut No. 5 will terminate above the water table but Cut No. 6 may encounter groundwater near its base, potentially requiring limited dewatering. Due to the granular soils present, both cuts will require 1.5:1 side slopes, although Cut No. 6 will require site-specific soil stability engineering due to its depth.

Cut No. 7 is the proposed tunnel along Nicollet Avenue on Segment C (Figure 3-26). The geologic materials in this area are glacial outwash consisting of sand overlying clay at depth. Due to the presence of the granular soils, 1.5:1 side slopes for the excavation are warranted. Due to the depth of cut, site-specific soil stability engineering will be required. Based on the apparent available width, shoring will likely be necessary over the entire length. The Hennepin County Atlas indicates the elevation of the water table is approximately 825 ft amsl, well below the estimated base elevation of the cut. Given the granular soil types, the potential for perched water is low. Dewatering is not expected to be necessary.

A summary of the potential geologic impact is shown in Table 27.

Table 27. Potential Geologic Impact Summary by Alternative

Geologic Impact	Alternative			
	1A	3A	3C-1 (Nicollet Mall)	3C-2 (11th/12th Street)
Number of Cuts	3	5	4	4
Temporary Dewatering Locations (possible and probable)	2	6	5	5
Permanent Dewatering Locations (possible and probable)	1	5	5	5

3.6.4.4 Potential for Differential Settlement

The areas with potential for differential settlement (compressible soils) are shown in Figure 3-34 through 3-38. These results are summarized below.

Along Segment 1 (Figure 3-34), wells containing peat or muck were found near each end of the segment. In addition, peat soils are present at the crossing of Purgatory Creek, at both crossings of the main and tributary stems of South Branch of Nine Mile Creek, and in the vicinity of Glen Lake.

Segment 3 (Figure 3-35) has three general areas where compressible peat soils might be encountered: near the Purgatory Creek Crossing and west of Eden Prairie Towne Centre Station, near the crossing of South Branch of Nine Mile Creek, and near the wetlands between Opus and Shady Oak stations. Wells completed in these areas appear to confirm the presence of peat soils.

The soils mapping in the area of Segment 4 does not document extensive areas of peat, although small extents are mapped near both ends of the segment (Figure 3-36). However, peat

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is noted in several wells in the area of Louisiana Avenue, just east of the Minnehaha Creek crossing.

Along Segment A (Figure 3-37), peat is documented only along the shoreline in the northeast corner of Cedar Lake. Similarly, peat is documented only near the southwest corner of Lake of the Isles on Segment C-1 (Figure 3-38).

3.6.4.5 Effects of the Segments C-1, C-2, C-2A, and C-2B

The geological or geotechnical considerations discussed above are not affected by the selection of any of these segments, with the sole exception of the area of high bedrock near the northern terminus of LRT C-1 (Nicollet Mall) identified as an issue for GBV would no longer be a concern if the LRT 3C-2 (11^{th}/12^{th} Street) was selected.

3.6.5 Mitigation

Mitigation for impacts to geologic resources varies by the type and severity of impact. Two key areas that will require detailed analysis during the EIS process and preliminary engineering are ground borne vibrations, and temporary and permanent dewatering. Vibration mitigation options are briefly discussed in Section 3.8.7, and will be expanded upon as necessary during the development of the DEIS and FEIS. Dewatering impacts will be evaluated for effects on adjacent wells and surface water features; if such effects are significant, LRT design and construction engineering options will be considered to minimize impacts.

3.7 Noise

3.7.1 Human Perception Levels

Sound travels through the air as waves of tiny air pressure fluctuations caused by vibration. In general, sound waves travel away from a noise source as an expanding sphere. Loudness decreases at greater distances from the sound source. Unwanted or undesirable sound is typically defined as noise.

The intensity or loudness of a sound is expressed in units of decibels (dB). The range of normally encountered sound can be expressed by values between 0 and about 140 dB.

Sound-level meters measure the pressure fluctuations caused by sound waves and record separate measurements for different frequency ranges. Most sounds consist of a broad range of sound frequencies, from low to high. The average human ear does not perceive all frequencies equally. To compensate for this the A-weighting scale (dBA) was developed to approximate the way the human ear responds to sound levels; it mathematically applies less “weight” to frequencies we don’t hear well, and applies more “weight” to frequencies we do hear well. Typical A-weighted noise levels for various types of sound sources are summarized in Chart 2.

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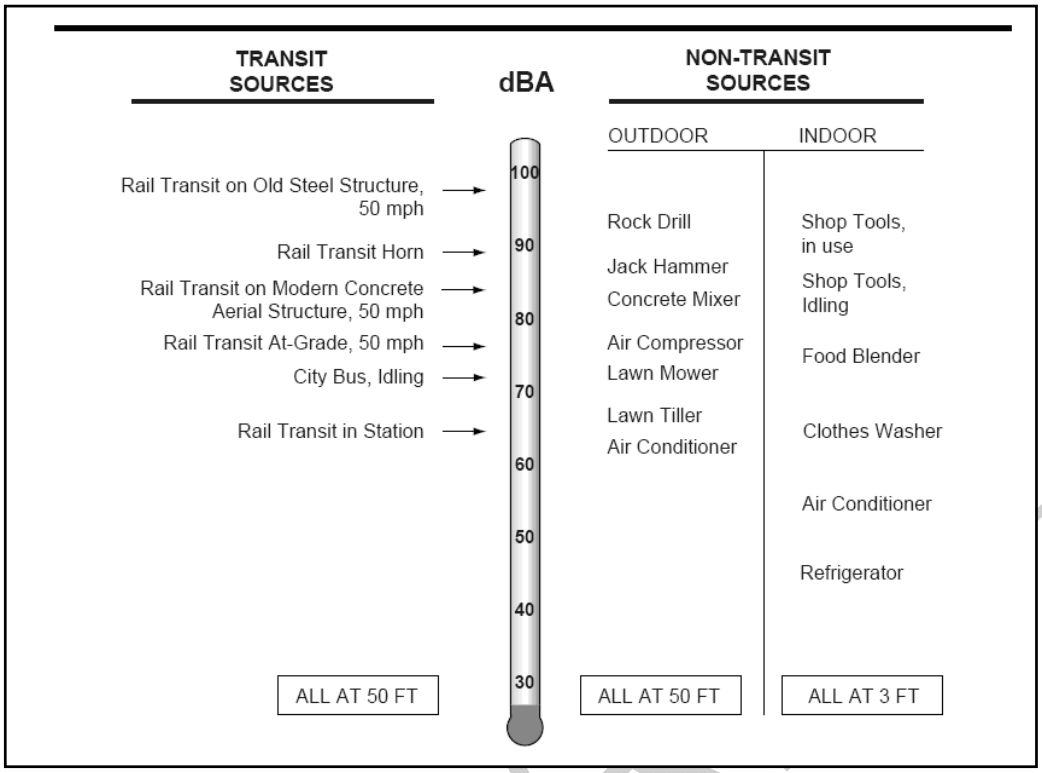
Chart 2. Typical A-Weighted Sound Levels



Source: FTA, "Transit Noise and Vibration Impact Assessment" (May 2006)

The equivalent sound level (Leq) is often used to describe sound levels that vary over time, usually a one-hour period. The Leq is considered an energy-based average noise level. Using twenty-four consecutive 1-hour Leq values it is possible to calculate daily cumulative noise exposure. The descriptor used to express daily cumulative noise exposure is the Day-Night Sound Level (Ldn). The Ldn includes a 10-dBA penalty imposed on noise that occurs during the nighttime hours (between 10 PM and 7 AM) where sleep interference might be an issue. The 10-dBA penalty makes the Ldn useful when assessing noise in communities. The Sound Exposure Level (SEL) combines the equivalent sound level with the duration of an event to determine the total amount of noise exposure.

Individual dB levels for different noise sources cannot be added directly to give the noise level for the combined noise source. For example, two noise sources that produce equal dB levels at a given location will produce a combined noise level that is 3 dBA greater than either sound alone. When two noise sources differ by 10 dBA, the combined noise level will be 0.4 dBA greater than the louder source alone.

People generally perceive a 10-dBA increase in a noise level as a doubling of loudness. For example, a 70-dBA sound will be perceived by an average person as twice as loud as a 60-dBA sound. People generally cannot detect differences of 1 dBA to 2 dBA. Differences of 3 dBA can be detected by most people with average hearing abilities. A 5-dBA change would likely be perceived by most people under normal listening conditions.

When distance is the only factor considered, sound levels from isolated point sources of noise (for example, a jackhammer) typically decrease by about 6 dBA for every doubling of distance from the noise source. When the noise source is a continuous line (for example, vehicle traffic on a highway), noise levels decrease by about 3 dBA for every doubling of distance away from the source.

Noise levels at different distances can also be affected by topographic features and structural barriers that absorb, reflect, or scatter sound waves. Atmospheric conditions (wind speed and direction, humidity levels, and temperatures) can also affect the degree to which sound is attenuated over distance.

Reflections off topographical features or buildings can sometimes result in higher noise levels (lower sound attenuation rates) than would normally be expected. Temperature inversions and wind conditions can also diffract and focus a sound wave to a location at considerable distance from the noise source. As a result of these factors, the existing noise environment can be highly variable depending on local conditions.

3.7.2 Evaluation Criteria

The FTA has an established screening procedure for identifying locations where a project may cause a noise impact. The methodology is outlined in Chapter 4 of the FTA's *Transit Noise and Vibration Impact Assessmen*t (May 2006). Screening distances are intended to be conservative and large enough to include all potentially affected noise-sensitive receptors in the vicinity of the project. . The noise screening procedure takes into account the type of project, anticipated project related noise levels, and noise-sensitive land uses within the vicinity of the project.

3.7.3 Methodology

Airborne noise effects associated with the Project were evaluated using the FTA's Screening Procedure ("Transit Noise and Vibration Impact Assessment," May 2006). The methodology included calculating project-related noise levels and identifying noise-sensitive land uses. For screening purposes all noise-sensitive land uses are considered to be a single category. Noise-sensitive land uses were identified using digital aerial photographs, land use-related GIS files, and maps.

The screening distances are based on certain assumptions described in Table 4-2 of the FTA Manual, which prescribes adjustments to the screening distances to suite the particular project. The Southwest LRT has several parameters which depart from the FTA's assumptions. Notably, the speeds are substantially higher in several segments of the corridor, and the expected traffic volume is greater. Traffic volume assumptions used in the noise screening analysis are based on current traffic volumes on the operating Hiawatha LRT, the anticipated similar traffic volume on the future Central Corridor LRT, and Metropolitan Council's anticipated increase from two to three articulating vehicles on both LRT systems.

Sound exposure levels (SEL) for Southwest LRT were determined using field measurements of current operating conditions on the Hiawatha LRT and are shown in Table 28.

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Table 28. Sound Exposure Levels used in the Screening Analysis

Noise Source	Sound Exposure Level (SEL)
Railcar Pass-by	84 dBA
Audible Warning Signal (bells)	88 dBA
Horn Blasts	99 dBA

Based on standard operating conditions on the Hiawatha LRT it is reasonable to anticipate that bells, horns, or both may be used at grade crossings, crosswalks, and passenger stations. However, there will be portions of the Project areas where bell or horn use is not likely to occur. To insure all potentially affected noise-sensitive land uses are included, this screening procedure uses the distances for vehicle pass-by with horn and bell noise along each alternative's entire alignment.

Given the magnitude of the screening distances for vehicle pass-bys with horns and bells, the screening contours included areas with intervening buildings throughout the majority of the corridor. Therefore, the screening procedure used the distances for intervening buildings shown in Table 29.

Table 29. Noise Screening Distances

Noise Source	Speed (mph)	Screening Distance (ft)	
		Unobstructed	Intervening Buildings
Vehicle Pass-by	20	250	150
	25	350	200
	30	450	250
	40	650	350
	45	750	400
	50	850	450
Vehicle Pass-by with Horns and Bells	20	1850	950
	25	1650	850
	30	1500	800
	40	1450	750
	45	1450	750
	50	1450	750

LRT 3C-1 (Nicollet Mall) and 3C-2 (11th/12th Street) includes operating in a tunnel between 29th Street and Franklin Avenue along Blaisdell, Nicollet, or 1st Avenues. Noise screening distances were assumed to be minimal during tunnel operation.

3.7.4 Existing Conditions

Existing noise conditions are not evaluated as part of the noise screening level analysis. Existing noise conditions will be further evaluated in the DEIS.

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3.7.5 Long-Term Effects

Potentially affected receptors were estimated along each alignment using the screening level methodology described in Section 3.6.3. Table 30 presents the number of potentially affected noise-sensitive receptors along each project alignment.

Table 30. Noise Screening Receptors

	Alignments			
	1A	**3A**	**3C-1 (Nicollet Mall)**	**3C-2 (11th/12th Street)**
Potentially Affected Receptors	3510	3301	7133	6939

3.7.6 Short-Term Construction Effects

Short-term construction noise effects are not evaluated as part of the screening level analysis. A detailed assessment of construction related noise impacts will be presented in the DEIS.

Construction noise varies greatly depending on the type of activity, equipment used, staging of the construction process, and layout of the construction site. For most construction equipment, diesel engines are the dominant noise source. For special activities such as impact pile driving and pavement breaking, noise generated by the actual process dominates.

Temporary noise during construction of the rail line and the stations has the potential of being intrusive to residents near the construction sites. Most of the construction would consist of site preparation and laying new tracks or roadways.

3.7.7 Mitigation

Mitigation is not evaluated as part of the noise screening level analysis. If necessary, a noise mitigation plan will be developed as part of the DEIS.

The noise screening presented in Section 3.7.3 identifies all possibly affected receptors within the project area. Noise screening does not identify impacted noise-sensitive areas nor does the screening analysis specify the severity of the noise impact.

A detailed noise assessment will be performed to determine the number of noise impacts during the DEIS process. Possible mitigation options that could be evaluated at that time include source-based treatments, path-based treatment, and receiver-based mitigation.

3.8 Vibration

3.8.1 Human Perception Levels

Vibration consists of rapidly fluctuating motions. For convenience, vibration decibels (VdB) are used to describe vibration. Ground-borne vibration (GBV) can be a serious concern for residents or at facilities that are vibration-sensitive, such as laboratories or recording studios. The effects of GBV include perceptible movement of building floors, interference with vibration sensitive instruments, rattling of windows, shaking of items on shelves or hanging on walls, and rumbling sounds.

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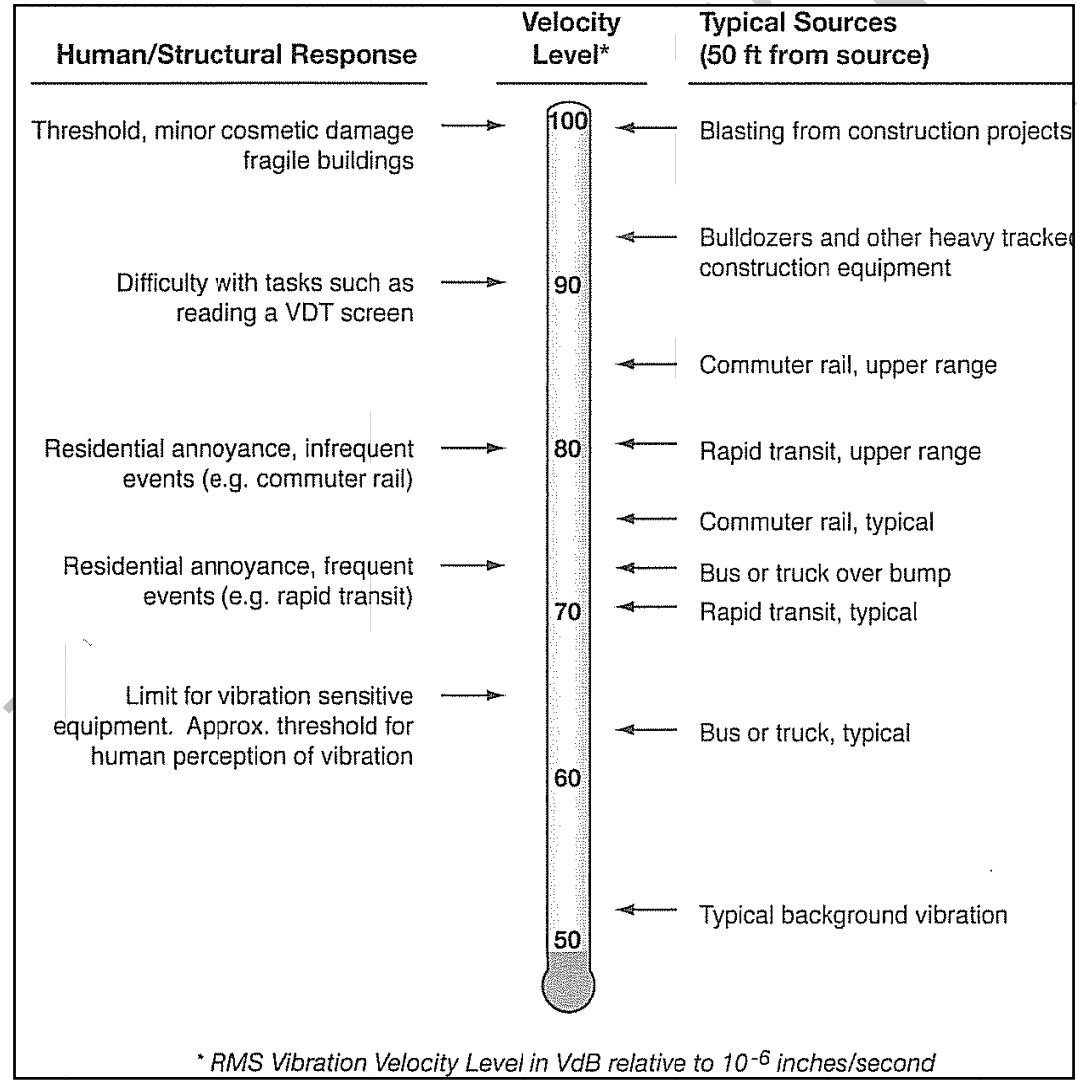
In contrast to airborne noise, GBV is not an everyday experience for most people. The background vibration level in residential areas is usually 50 VdB or lower—well below the threshold of perception for humans, which is around 65 VdB. Levels at which vibration interferes with sensitive instrumentation, such as nuclear magnetic resonance (NMR) equipment and other optical instrumentation, can be much lower than the threshold of human perception. Most perceptible indoor vibration is caused by sources within a building such as the operation of mechanical equipment, movement of people, or slamming of doors. Typical outdoor sources of perceptible ground-borne vibration are construction equipment, steel-wheeled trains, and traffic on rough roads.

Chart 3 illustrates common vibration sources and the human and structural response to GBV.

Chart 3. Common Vibration Sources



Vibration related to railway movements is generally caused by uneven interactions between the wheels of the train and the railway surfaces. Examples of this include wheels rolling over rail

joints, or flat spots on wheels that are not true. These uneven interactions result in vibration that travels through the adjacent ground. This vibration can range from barely perceptible to very disruptive. The following section provides a description of how vibration affects human activity.

3.8.2 Vibration Criteria

The FTA recognizes three land use categories for assessing general vibration impacts.

- **Land Use Category 1 – High Vibration Sensitivity:** This category includes buildings where low ambient vibration is essential for operations within the building that may be well below levels associated with human annoyance. Typical Category 1 land uses include vibration-sensitive research and manufacturing facilities, hospitals with vibration-sensitive equipment, and university research operations.

Category 1 also includes special land uses, such as concert halls, television and recording studios, and theaters, which can be very sensitive to vibration and ground-borne noise. The FTA has developed special vibration levels for these land uses.

- **Land Use Category 2 – Residential:** This category includes all residential land uses and any building where people sleep, such as hotels and hospitals. No differentiation is made between different types of residential areas because ground-borne vibration and noise are experienced indoors, and building occupants have very few means of reducing their exposure to vibration. Even in a noisy urban area, the bedrooms often will be quiet in buildings that have effective noise insulation and tightly closed windows. Consequently, an occupant of a bedroom in a noisy urban area is just as likely to be sensitive to ground-borne noise and vibration as someone in a quiet suburban area.
- **Land Use Category 3 – Institutional:** This category includes schools, churches, other institutions, and quiet offices that do not have vibration-sensitive equipment, but still have the potential for activity interference. Although it is appropriate to include office buildings in this category, it is not appropriate to include all buildings that have office space.

The criteria for ground-borne vibration (general assessment) are shown in Table 31.

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Table 31. Ground-Borne Vibration Impact Criteria for General Assessment

Land Use Category	Ground-Borne Vibration Impact Levels (VdB re 1 micro inch/sec)		
	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]
Category 1: Buildings where vibration would interfere with interior operations.	65 VdB[4]	65 VdB[4]	65 VdB[4]
Category 2: Residences and buildings where people normally sleep.	72 VdB	75 VdB	80 VdB
Category 3: Institutional land uses with primarily daytime use.	75 VdB	78 VdB	83 VdB

Source: FTA, "Transit Noise and Vibration Impact Assessment" (May 2006) (FTA-VA-90-1103-06), page 8-3.

Notes:

[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 between 30 and 70 vibration events of the same source per day. Most commuter trunk lines have this many operations.

[3] "Infrequent Events" is defined as fewer than 30 vibration events per day. This category 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.

The criteria for vibration and noise for Category 1 special buildings are shown in Table 32.

Table 32. Ground-Borne Vibration and Noise Impact Criteria for Special Buildings

Type of Building or Room	Ground-Borne Vibration Impact Levels (VdB re 1 micro-inch/sec)	
	Frequent Events[1]	Occasional or Infrequent Events[2]
Concert Halls	65 VdB	65 VdB
TV Studios	65 VdB	65 VdB
Recording Studios	65 VdB	65 VdB
Auditoriums	72 VdB	80 VdB
Theaters	72 VdB	80 VdB

Source: FTA, "Transit Noise and Vibration Impact Assessment" (May 2006) (FTA-VA-90-1103-06), page 8-4.

Notes:

[1] "Frequent Events" is defined as more than 70 vibration events per day. Most transit projects fall into this category.

[2] "Occasional or Infrequent Events" is defined as fewer than 70 vibration events per day. This category includes most commuter rail systems.

[3] If the building will rarely be occupied when the trains are operating, there is no need to consider impact. As an example, consider locating a commuter rail line next to a concert hall. If no commuter trains will operate after 7 p.m., the trains should rarely interfere with the use of the hall.

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3.8.3 Methodology

The FTA vibration screening procedure was performed for the project. The vibration screening distances are presented in Table 9-2 of the FTA Manual.

How vibration moves through the ground is defined as propagation. When considering at-grade vibration sources, the selection is between normal and efficient vibration propagation. Screening distances are multiplied by 1.5 where the vibration propagation characteristic is determined efficient. The normal propagation screening distances include a 5-dB factor of safety. The screening distances for Light Rail Transit are shown in Table 33 below.

Analysis determined GBV propagation potential along each alternative alignment. The analysis shows evidence that there could be efficient propagation, and this efficient propagation characteristic tends to dominate the project area. There are no large, homogenous ground zones with normal propagation characteristics. Therefore, this screening procedure used distances for ground with efficient propagation characteristics throughout the alternative corridors. For those smaller lengths of the corridor which do have normal propagation characteristics, the screening distance will be conservatively high.

Table 33. Ground-Borne Vibration Screening Distances

Vibration Propagation Characteristic	Screening Distance (ft) for Land Use Categories		
	Cat. 1	Cat. 2	Cat. 3
Normal Propagation	450	150	100
Efficient Propagation	675	225	150

3.8.3.1 Ground-borne Vibration Conditions

Soil and subsurface conditions are known to have a strong influence on the levels of GBV. Vibration levels are generally higher in stiff, clay-type soils than in loose, sandy soils (Table 34). Vibration levels are usually high near at-grade track when the depth to bedrock is 30 feet or less. Soil layering and the depth to the water table can also affect GBV, but the effects are not always predictable and are not well established (Hanson, et. al, 2006[5]).

The potential for GBV was assessed by:

- Logs of water wells contained in the Minnesota County Well Index (CWI) were screened for the occurrence of bedrock within 30 feet of the surface and located within one-quarter mile of the alignment alternatives. The CWI database has certain limitations, including the technical accuracy of individual records, so the data from a single borehole must be viewed in the context of the surrounding boreholes. In addition, there is potential variability in the depth to bedrock data. To overcome these issues, areas where clusters of wells with apparent shallow bedrock were identified as having a high potential to propagate GBV.

[5] *Hanson, C.E., D. A. Towers and L.D. Meister, 2006. Transit Noise and Vibration Impact Assessment. U.S. Department of Transportation, Federal Transit Administration, Office of Planning and Environment. FTA-VA-90-1003-06.*

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- Soils geomorphology from the Hennepin County Soil Survey (USDA, 2005[6]) were categorized with high, medium or low potential based on interpretation of the likelihood for containing dense clay soils.

Table 34. Ground-borne Vibration Potential

Geomorphological Description	Assigned GBV Potential
Beach	Low
Escarpment	Moderate
Flood Plain	Moderate
Hill	Moderate
Lake Plain	High
Moraine	High
Outwash Plain	Low
Stream Terrace	Low

3.8.4 Existing Conditions

Existing vibration conditions are not evaluated as part of the Vibration Screening Level Analysis, but will be explored in the DEIS. In most cases, the existing environment does not include a significant number of perceptible GBV or noise events. The most common example of the need to account for pre-existing vibration is when a project is located in an existing rail corridor. When the project will cause vibration more than 5 VdB greater than the existing source, the existing source can be ignored and the standard vibration criteria applied.

3.8.5 Long-Term Effects

Vibration impacts were estimated along each alignment using the screening level methodology described in Section 3.8.3. Table 35 provides a conservative estimate of vibration impacts predicted for the project.

Table 35. Screening-Level Impacts for Vibration Assessment

	Alignments											
	1A			3A			3C-1 (Nicollet Mall)			3C-2 (11th/12th Street)		
	Cat. 1	Cat. 2	Cat. 3	Cat. 1	Cat. 2	Cat. 3	Cat. 1	Cat. 2	Cat. 3	Cat. 1	Cat. 2	Cat. 3
Potentially Affected Receptors	2	1,122	6	1	1,042	6	19	2,362	20	23	3,454	31

A map showing the potential for propagation of GBV is included in Figures 3-39 through 3-43. Following is an overview of these results.

[6] *USDA, 2005. Soil Survey Geographic (SSURGO) for Hennepin County, Minnesota. U.S. Department of Agriculture, Natural Resource s Conservation Service*

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There are two areas of concern for GBV on Segment 1 (Figure 3-39): from the southern terminus of the alignment to approximately 0.5 miles northeast of the crossing of Purgatory Creek; and the majority of the land between Glen Lake and Shady Oak Lake. Both of these areas are dominated by moraine terrains, although there is a band of floodplain deposits adjacent to the Purgatory Creek crossing.

With two significant exceptions, the alignment for Segment 3 lies on materials with a moderate or high potential for propagating GBV (Figure 3-40). The exceptions are an area extending approximately 800-1,000 feet on either side of the Shady Oak Road crossing and the area extending approximately 2,000 feet south from the Shady Oak station. As in the case of Segment 1, moraine soils predominate along this alignment.

Areas of elevated concern for GBV along Segment 4 are the area extending west approximately 1.0 mile from the Minnehaha Creek crossing and an area approximately 0.5 miles long just west of the West Lake station (Figure 3-41).

On Segment A (Figure 3-42), the primary concern for GBV is the area of morainic soils between Cedar Lake and Lake of the Isles. In this area as well, materials classified as having moderate GBV potential are hills that likely originated as glacial moraines.

The area between Lake of the Isles and Lake Calhoun on Segment C is of high potential for propagating GBV (Figure 3-43). The area between these lakes and Lyndale Avenue is classified as moderate potential, as are the hills that may be morainic in origin. In addition, the sole known area of shallow bedrock occurs near the northern terminus of Segments C-1 and C-2.

3.8.6 Short-Term Construction Effects

Short-term construction effects of vibration are not evaluated as part of the Vibration Screening Level Analysis. As part of the DEIS, vibration from construction activities will be assessed apart from general vibration to determine what limits may need to be placed on construction activity and what affects vibration may have during construction.

Most limits on construction vibration are based on minimizing the potential for damage to nearby structures. The construction activity that is most commonly associated with building damage is blasting during mining operations or excavation. Other construction procedures that generate relatively high vibration levels include pile-driving, use of hoe rams and jackhammers for demolition, vibratory compaction, and tracked vehicles such as bulldozers.

3.8.7 Mitigation

Mitigation is not evaluated as part of the Vibration Screening Level Analysis. If necessary, potential vibration mitigation measures will be explored as part of the DEIS. These potential mitigation measures may include maintenance, planning and design of special trackwork, vehicle specifications, and special track support systems such as resilient fasteners, ballast mats, resiliently supported ties, and floating slabs.

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4.0 EVALUATION MATRIX

This section summarizes the environmental evaluation of the LRT alternatives based on the information presented in the preceding sections (see Table 36). This evaluation is based on information currently available, and impacts will likely change as the environmental review process proceeds. However, the information provides a useful tool for informed decision-making within the LPA selection process.

In general, LRT 1A and LRT 3A pose less environmental risk than LRT 3C-1 and LRT 3C-2 due to an overall lower density of environmental resources. At this point, it cannot be stated whether or not the environmental issues identified in the project area would make any of the alternatives infeasible or not. However, the greater number of resources along the LRT 3C-1 and LRT 3C-2 alternatives make it more likely that environmental issues would arise during the environmental review process, preliminary engineering, and construction, and would make it more likely that these two alternatives would require greater environmental review, coordination, and mitigation.

Table 36. Environmental Issues Summary

Criteria	Measure(s)	LRT 1A	LRT 3A	LRT 3C-1 (Nicollet Mall)	LRT 3C-2 (11th/12th Street)
Historic properties[a]	Number of known listed or eligible properties	8	9	52	53+
Parklands or other Section 4(f) resources, excluding historic	Inventory of likely 4(f) properties	17	15	21	21
Natural resources (riparian habitat – wetlands, streams, lakes within 1000')[b]	Critical habitat for threatened or endangered species Wetlands or bodies of water that provide habitat for flora and fauna of interest	See water resources below	See water resources below	See water resources below	See water resources below
Endangered and threatened species (within 1 mile)[1]	Presence of state or federally listed threatened or endangered species, or native plant communities, within one mile of the alternative	9	10	9	9
Water resources / wetlands (within 100')[c] Floodplains and riparian areas (within 100')[d]	Designated Waters of the US subject to US Corp of Engineers 404 permitting requirements Wetlands Riparian areas Floodplains Watershed management resources	Approx. 0.8 wetland acres; approx. 1.5 floodplain acres	Approx. 3.5 wetland acres; approx. 1.8 floodplain acres	Approx. 3.5 wetland acres; approx. 1.8 floodplain acres	Approx. 3.5 wetland acres; approx. 1.8 floodplain acres
Contamination sites (hazardous materials)	inventory number of contaminated or hazardous materials or sites in proximity Probabilistic estimation of remediation costs	99	98	144	176

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Criteria	Measure(s)	LRT 1A	LRT 3A	LRT 3C-1 (Nicollet Mall)	LRT 3C-2 (11th/12th Street)
Geological evaluation	Number of significant cuts Dewatering locations	3 cuts; 1 dewatering location	5 cuts; 5 dewatering locations	4 cuts; 5 dewatering locations	4 cuts; 5 dewatering locations
Noise	Number of potential noise sensitive receptors	3,510	3,301	7,133	6,939
Vibration	Number of potential vibration sensitive receptors	1,130	1,049	2,401	3,508

Notes:

[a] *In addition to the listed and eligible properties, a higher density of "vintage" properties were observed along LRT 3C-1 and LRT 3C-2.*

[b] *February 13, 2009, WSB Tech Memo "Riparian Habitat and Threatened and Endangered Species Inventory"*

[c] *March 27, 2009, WSB Tech Memo "Potential Impacts to Water and Natural Resources"*

[d] *February 13, 2009, WSB Tech Memo "Water Resources Inventory"*

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