Technical Addendum
Update to the Regional Bicycle Barriers Study

METROPOLITAN COUNCIL

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Background

A Regional Bicycle Barriers Study (RBBS) was completed by Met Council in 2018 to identify the region's major physical barriers to bicycle transportation[1]. This effort analyzed the existing spacing between available bicycle crossings of the barriers to determine where there were infrequent crossings and how these "gaps" in available crossing opportunities impacted the overall connectivity of local and regional bicycle networks. The RBBS considered major physical regional barriers to bicycle travel including:

- Freeways and expressways
- Railroad corridors
- Secondary rivers and streams

It is noteworthy that the major river crossings (i.e., the existing or planned highway or bicycle-pedestrian bridges over the Mississippi, Minnesota & Saint Croix Rivers) were not analyzed in the RBBS due to differences in the scale and approach of the analysis that would be required compared to all other barriers; however, all major river crossings in the Twin Cities region were designated as "*Major River Bicycle Barrier Crossings*" in the Council's 2018 Update of its 2040 Transportation Policy Plan.

The RBBS study area was the Regional Bicycle Transportation Network[2] (RBTN) coverage area defined as the area within a two-mile buffer of all RBTN alignments and corridor centerlines. This area was chosen because it represents the developed and developing areas of the seven-county region most likely to have ongoing bicycle planning processes in place and with the greatest current and potential demand for bicycle travel. The RBBS and this Technical Addendum includes bicycle barrier crossing locations already identified in local plans, points within or on RBTN corridors or alignments, existing and planned regional trails within the study area, and additional points based on the spacing criteria referenced in Table 1. Points on local networks and regional facilities were considered equally in the analysis.

The map shown in Figure 1 depicts all freeways and expressways, railroad corridors, and secondary rivers and streams identified as regional bicycle barriers in the RBBS.

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[1] https://metrocouncil.org/Transportation/Planning-2/Transit-Plans,-Studies-Reports/Bike-Pedestrian-Planning/Regional-Bikeway-Barriers-Study.aspx
[2] https://metrocouncil.org/Transportation/Planning-2/Transit-Plans,-Studies-Reports/Bike-Pedestrian-Planning/Regional-Bikeways.aspx

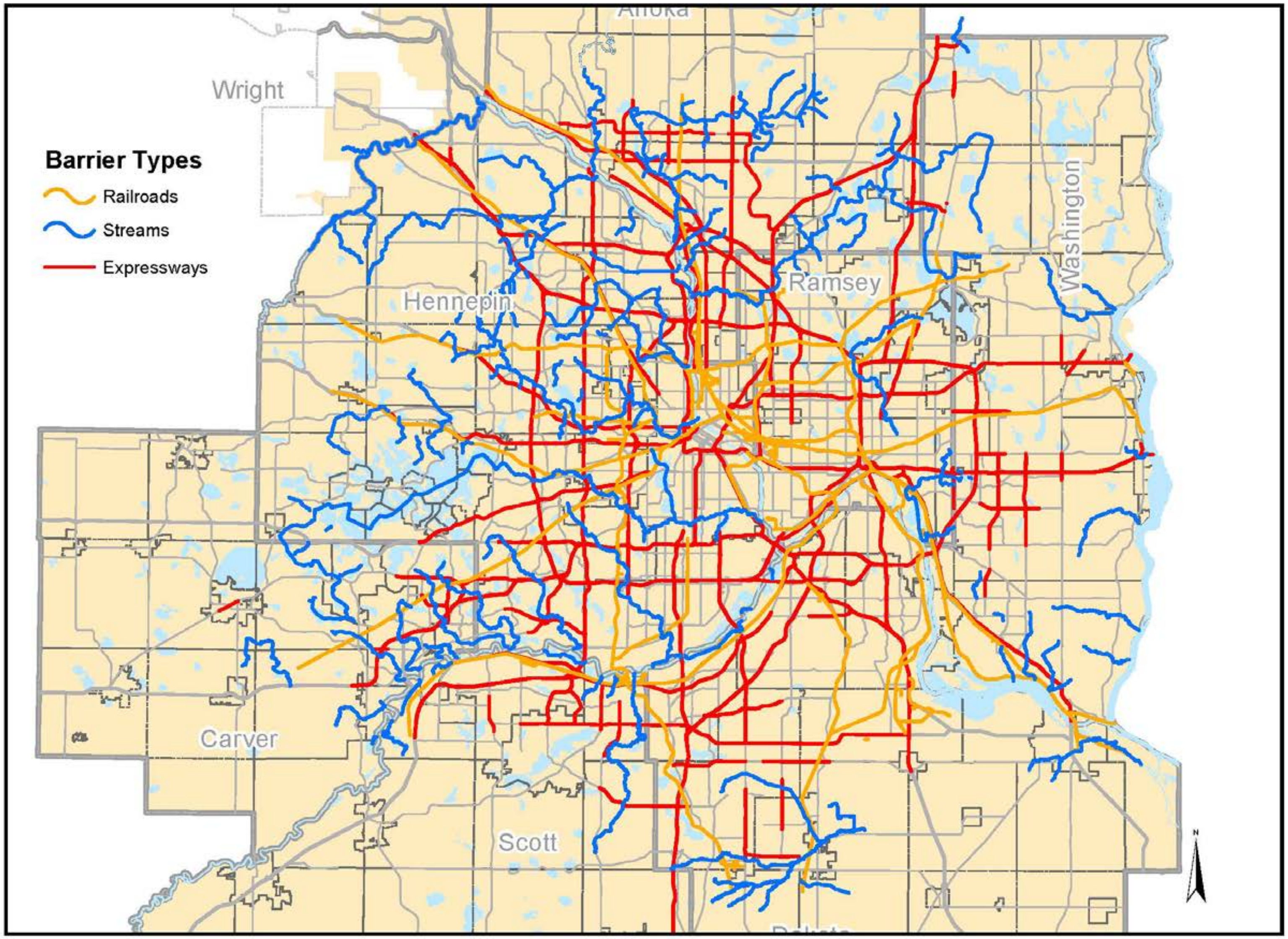

Figure 1. Regional Rail, Stream, and Expressway Bicycle Barriers as defined in the RBBS

Data Review Process

REVIEW AND REFINEMENT OF BARRIER CROSSING POINTS DATA SET

Relatively late in the process of finalizing the RBBS, some "over clustering" of points in the maps of prioritized barrier crossings was discovered that was due to an idiosyncrasy of the GIS analysis. This unexpected clustering occurred along several rail corridor barriers which had corresponding long range "planned bikeways" running linearly along the rail line. This resulted in the display of too many "planned" barrier "crossing points" with no influence of set spacing criteria. Most of these "planned crossings" were not actual crossings of barriers and have been removed from this updated data set. Additionally, a reassessment of general spacing along the regional barriers was warranted due to the modified concept of mapping "bicycle barrier crossing improvement *areas*" in lieu of "crossing *points*" in the TPP. The spacing of barrier crossing analysis points was reassessed on a barrier-by-barrier basis to reflect this mapping change. The previously established preferred spacings between available bicycle barrier crossings that vary based on community planning areas established in the Council's Thrive MSP 2040 Plan (Table 1) were reapplied (see also technical memo[3] and TPP Update[4]). These spacing criteria were determined by the RBBS technical work group and ranged from a ½-mile between available bicycle crossings in urban core cities to two miles between available crossings in the region's rural areas.

Through this barrier crossing spacing reassessment, changes to original point locations were made that included:

- Consolidating points in close proximity that would be included in the updated "barrier crossing improvement area;"
- Adding points where spacing gaps were found (i.e., outside the preferred spacing distance for the specific community designation group);
- Moving points to balance spacing along a specific barrier segment based on actual spacing along the barrier.

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[3] https://metrocouncil.org/Transportation/Planning-2/Transit-Plans,-Studies-Reports/Bike-Pedestrian-Planning/Regional-Bikeway-Barriers-Study/TechMemo1.aspx

[4] https://metrocouncil.org/Transportation/Planning-2/Key-Transportation-Planning-Documents/Transportation-Policy-Plan/tpp-update/2018-Transportation-Policy-Plan-Update/Chapter-7-Bicycle-and-Pedestrian-Invetment-Directi.aspx

Table 1. Preferred Maximum Distances between Available Bicycle Barrier Crossings

Thrive Planning Area	Preferred Maximum Spacing	Example Cities
Urban Center	½-mile	Minneapolis, St Paul, Richfield, Hopkins, South St Paul
Urban	¾-mile	Golden Valley, Roseville, Maplewood, Crystal, Edina
Suburban, Suburban Edge, Emerging Suburban Edge	1 mile	Blaine, Woodbury, Maple Grove, Eagan, Lakeville
Diversified Rural, Rural Residential, Agricultural	2 miles	Grant, Afton, Ham Lake, Lake Elmo, Independence

In addition, any new or previously unidentified "planned" crossings (i.e., locally planned crossings that were not included in regional datasets) were added to the dataset. These crossings were added at collectors or minor arterials not already covered within the spacing buffer areas of adjacent points. Points within one-tenth of a mile of another point on an adjacent parallel barrier were combined and denoted as "dual barrier crossing locations."

After making these refinements to the barrier crossings data set, Met Council staff held individual meetings with members of the Technical Advisory Work Group (a group of local bike transportation professionals who helped guide the RBBS) and/or their local agency colleagues to review the revised set of bicycle barrier crossing points. These discussions and numerous follow-up communications led to further crossing point additions or refinements. This technical addendum to the RBBS describes the data refinement results and the subsequent re-prioritization of barrier crossing points through a reapplication of the bicycle barrier crossing analysis model.

REVIEW OF EXPRESSWAY BARRIERS

The intent of the RBBS was to define "regional bicycle expressway barriers" to include the highway functional classifications of non-freeway principal arterials and minor arterials for those segments exhibiting all of the following attributes:

- At least four, continuous through lanes
- Divided by a highway median or barrier
- Posted speeds of at least 45 miles per hour

Initially an attempt was made to include traffic signal spacing of at least ½-mile as a qualifying attribute, but the criterion was dropped due to complexities in data availability and GIS application. While the first two attribute criteria were relatively simple to assess, due to the lack of consistent data for posted speeds, some expressway-like highways were omitted from the original analysis. As a result, some new expressway barriers, plus a few extensions of previously defined expressways, were included in this updated analysis process. Figure 2 shows the final expressway barriers map for the study area. See Table A-1 in the Appendix for the full list of regional bicycle expressway barrier additions and adjustments for this technical addendum update to the RBBS.

Analysis Factors and Measures

FACTORS

The original factor types, weights, and components were retained from the RBBS. The factors and their scoring weights (as determined by the TAWG) are presented in Table 2.

Table 2. Analysis Factors and Weights

Factor	Weight
Network Connectivity	48.25%
Bicycle Trip Demand	24.25%
Safety/Existing Conditions	15.25%
Social Equity	12.25%

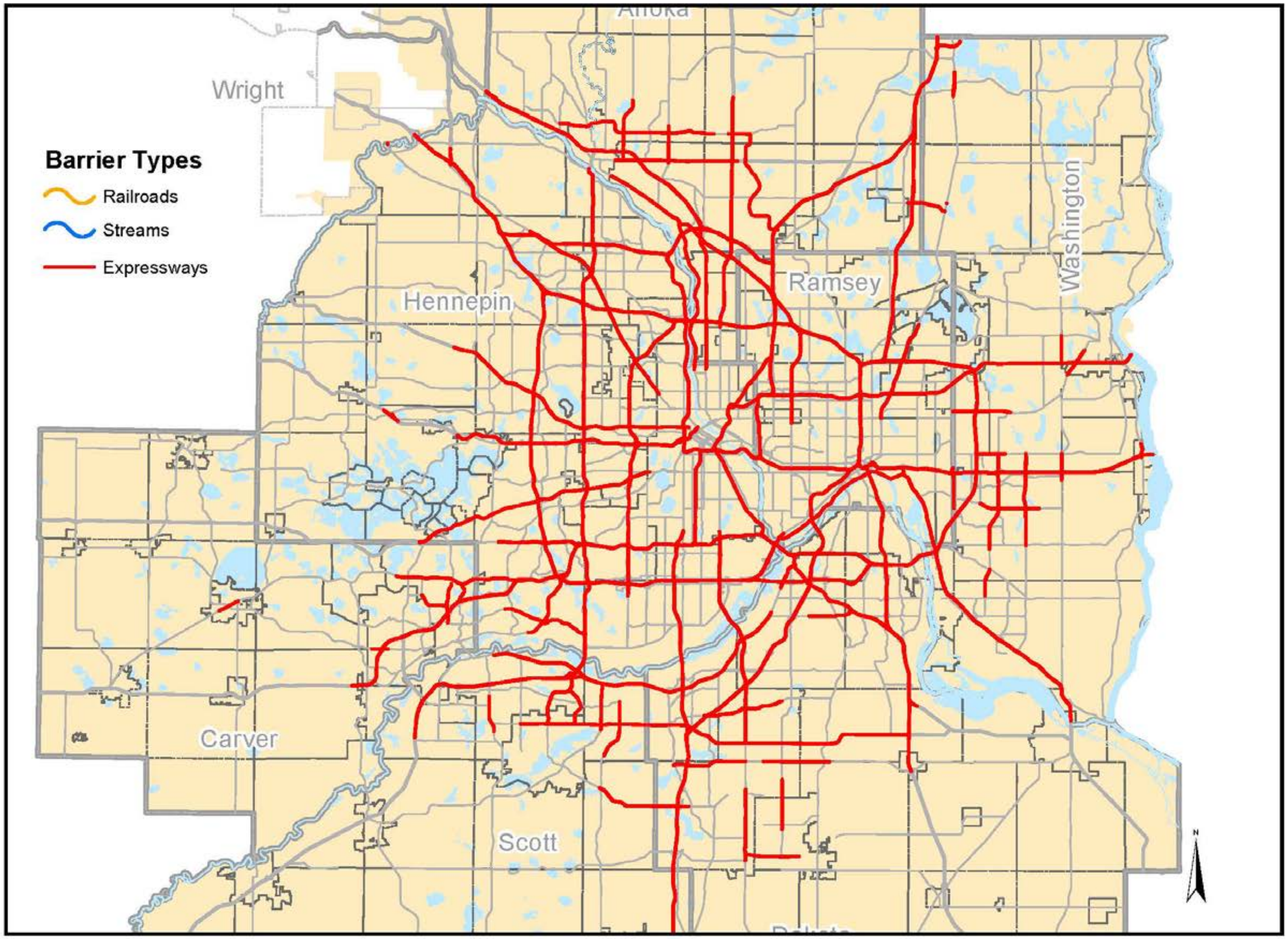

Figure 2. Regional Expressway Bicycle Barriers as adjusted in this RBBS update

FACTOR MEASURES

Multiple measures were chosen for each evaluation factor. The outputs of these measures, or variables, were averaged to determine a composite factor score which was then weighted according to Table 2. Except where otherwise noted, the analysis methods used in the RBBS were replicated exactly in this update. The variables comprising each factor score are briefly described in the next sections; additional documentation is available from the RBBS[5].

Network Connectivity

The network connectivity factor score characterizes the barrier crossing opportunity's potential to unite the network of local and regional bicycle facilities and improve connectivity for bicyclists. Component measures reflect the crossing opportunity's proximity to existing and planned facilities from the Regional Bicycle System Inventory (RBSI), the RBTN, and distance to the nearest existing crossing. Table 3 lists the component variables of this factor score, including how they are measured and their data sources.

This update includes two adjustments to the Distance to Nearest Existing Barrier Crossing measure. First, it includes corrections based on limitations of the RBBS' methodology. The original database of existing crossing opportunities was generated using a network approximation technique. This method generated some points that were erroneously counted as "existing crossings". These erroneous points were systematically removed using a spatial overlay on the updated database of potential crossings, as well as manual spot-checking and edits.

Second, the existing crossing opportunity database only covered barriers from the RBBS, leaving new analysis points without relevant existing crossings from which to measure the distance. Forty-seven out of the 758 potential crossing points occur along new barriers. For these points, the regional average distance to nearest existing crossing of 918 meters was used, as the actual distance to nearest crossing could not be measured.

[5] https://metrocouncil.org/Transportation/Planning-2/Transit-Plans,-Studies-Reports/Bike-Pedestrian-Planning/Regional-Bikeway-Barriers-Study.aspx

Table 3. Network Connectivity Factor Components

Measure Name	Units of measure	Data Source
Proximity to Existing Local Bikeways	Sum of length in miles of existing local bikeways within ¼ mile	RBSI, 2016
Proximity to Planned Local Bikeways	Sum of length in miles of planned local bikeways within ¼ mile	RBSI, 2016
Proximity to Regional Bicycle Transportation Network (RBTN)	Sum of length in miles of RBTN centerline or alignment within ½ mile	Metropolitan Council RBTN
Proximity to Existing or Planned Regional Trail	Sum of length in miles of existing or planned regional trail within ½ mile	2040 Regional Parks Policy Plan
Distance to Nearest Existing Barrier Crossing *(updated)*	Euclidean distance (i.e., "as the crow flies") in meters to the nearest existing barrier crossing, defined as existing bikeway or local road crossing	RBSI; Local road network

Bicycling Demand

The bicycling demand factor score measures several dimensions of potential bicycling demand generators around each potential barrier crossing over the next several decades. Forecasted population and employment densities and transit ridership describe the intensity of land use. Proximity to popular bicycling destinations like schools, colleges, and parks was also measured. Maximum points were allocated to potential barrier crossings that are already captured in local or regional plans. Points with a high number of requests for a new crossing nearby received via the on-line Wikimap survey also received additional points. Table 4 describes each measure's units and data sources. The methods for measuring these variables remained unchanged from the RBBS.

Table 4. Bicycling Demand Factor Components

Measure Name	Units of measure	Data Source
Point-Type Score	Points allocated if potential crossing is a planned barrier crossing (10 points), a point added by the TAWG or Metropolitan Council (6 points), or generated based on spacing criteria (4 points)	Planned crossings derived from planned bikeways identified in a local or regional plan, RBSI 2016
Projected Population Density, 2040	Persons per square mile within ½ mile	Minnesota Geospatial Commons (MnGeo)
Projected Employment Density, 2040	Employees per square mile within ½ mile	Minnesota Geospatial Commons (MnGeo)
Transit Ridership	Sum of boardings and alightings within ½ mile from 2013 to 2014	Minnesota Geospatial Commons (MnGeo)
Proximity to Schools	Number of K-12 schools within ½ mile	Minnesota Geospatial Commons (MnGeo)
Proximity to Universities and Colleges	Number of colleges and universities within ½ mile	Minnesota Geospatial Commons (MnGeo)
Proximity to Regional Parks	Number of existing regional parks within ½ mile	Minnesota Geospatial Commons (MnGeo)
Public-generated new crossings	Sum of "suggested new crossing" responses within ¼ mile	WikiMap survey from RBBS

Safety and Existing Conditions

The Safety and Existing Conditions factor score measured current intensity of bicycling as well as safety issues nearby that might be addressed through the addition of a new barrier crossing. Safety was measured as the number of pedestrian and bicycle crashes near the potential crossing point as well as Wikimap survey responses indicating problem areas where improvements are needed. Existing conditions and use are expressed as current population and employment densities (in contrast with 2040 forecasted densities included in the demand factor score) and existing bicycle mode shares.

Table 5 documents the variables included in the Safety and Existing Conditions factor score. The methods for measuring these variables remains unchanged from the RBBS.

Table 5. Safety and Existing Conditions Factor Components

Measure Name	Units of measure	Data Source
Bicyclist and Pedestrian Crashes	# crashes within 500 ft over 5 years	MnDOT non-motorized collisions data, 2010 - 2015
Bicyclist and Pedestrian Mode Shares	Percent walk and bike commute share within ½ mile	US Census Bureau American Community Survey, 2015 5-Year Estimates
Existing Population Density, 2014	Persons per square mile within ½ mile	Minnesota Geospatial Commons (MnGeo)
Existing Employment Density, 2014	Employees per square mile within ½ mile	Minnesota Geospatial Commons (MnGeo)
Public identified problem location	Sum of "improvement needed" responses within ¼ mile	WikiMap survey

Social Equity

The Metropolitan Council has adopted equity as one of the outcomes of Thrive MSP 2040.

All variables that contribute to the overall priority score for equity relate to the Metropolitan Council's regional equity goals and are described in this section. These variables are documented in Table 6. Their method of calculation remains consistent with the RBBS.

Table 6. Social Equity Factor Components

Measure Name	Units of measure	Data Source
Areas of Concentrated Poverty (ACP)	10 points if the barrier crossing opportunity is in an Area of Concentrated Poverty (ACP)	Minnesota Geospatial Commons (MnGeo)
Areas of Concentrated Poverty with More than 50% People of Color (ACP50)	10 points if the barrier crossing opportunity is in an ACP with at least 50% people of color	Minnesota Geospatial Commons (MnGeo)
Population Under 15 Years Old	Percent of population under age 15 within ½ mile	US Census Bureau American Community Survey, 2015, 5-year estimates
Population 65 Years and Older	Percent of population age 65 and older within ½ mile	US Census Bureau American Community Survey, 2015, 5-year estimates
Zero-Car Households	Percent of households with zero autos within ½ mile	US Census Bureau American Community Survey, 2015, 5-year estimates
People of Color	Percent of population that is non-white (including Hispanic and Latino) within ½ mile	US Census Bureau American Community Survey, 2015, 5-year estimates
Public Input from Female Respondents	Number of comments from WikiMap survey participants self-identifying as women within ¼ mile	WikiMap survey
Public Input from People of Color	Number of comments from WikiMap survey participants self-identifying as people of color within ¼ mile	WikiMap survey

Prioritization Analysis Results

Figure 3 on the next page depicts all 758 regional bicycle barrier crossing analysis points, grouped into three priority tiers based on each point's priority score. The final barrier crossing point priority scores represent the sum of each weighted factor score, adjusted to a 100-point scale. About two thirds (67 percent) of potential crossing points fall within the 25- to 50-point range of priority scores. Only about 6 percent of points have scores greater than 60.

Barrier crossing point priority score averages and ranges by barrier type are presented in Table 7. Crossing points along dual barriers (i.e., where two different barrier types align in proximity) scored higher than points on other barrier types, on average. In addition to having high priority scores, dual barrier points have the potential added advantage of a single roadway or bridge project addressing multiple barriers simultaneously.

Potential crossing points along rail barriers had a higher average priority score than freeway/expressway barrier points, whereas the latter group had a higher maximum value (i.e., the top-scoring expressway crossing point had a higher score than the top-scoring railroad crossing point). Among the top ten potential crossing points, three are along dual barriers, five are along freeways/expressways, and two are along rail barriers. The highest scoring stream barrier is ranked 55.

Priority tiers, indicating "high priority", "medium priority", and "low priority", were assigned based on whether each point's score ranked in the top, middle, or bottom third of the dataset. Following this equal distribution into three tiers, the tier threshold lines were adjusted downward by looking for naturally occurring breaks in the data so the cutoffs would be less arbitrary. For example, the threshold between tier 1 and tier 2 would have been between points ranked 252 and 253 under the equal distribution scenario, but the actual priority score for these two points are fairly close in value (38.92 and 38.78 respectively, a difference of 0.14 points). In contrast, by shifting the threshold down to between ranks 267 and 268, the difference in priority scores between tier 1 and tier 2 is larger (0.25). This method also elevated some potential crossings in the suburban counties up to tiers 1 or 2. Ultimately, tier 1 included points ranked 1 through 267; tier 2 contained points ranked 268 through 519; and tier 3 contained points ranked 520 and above.

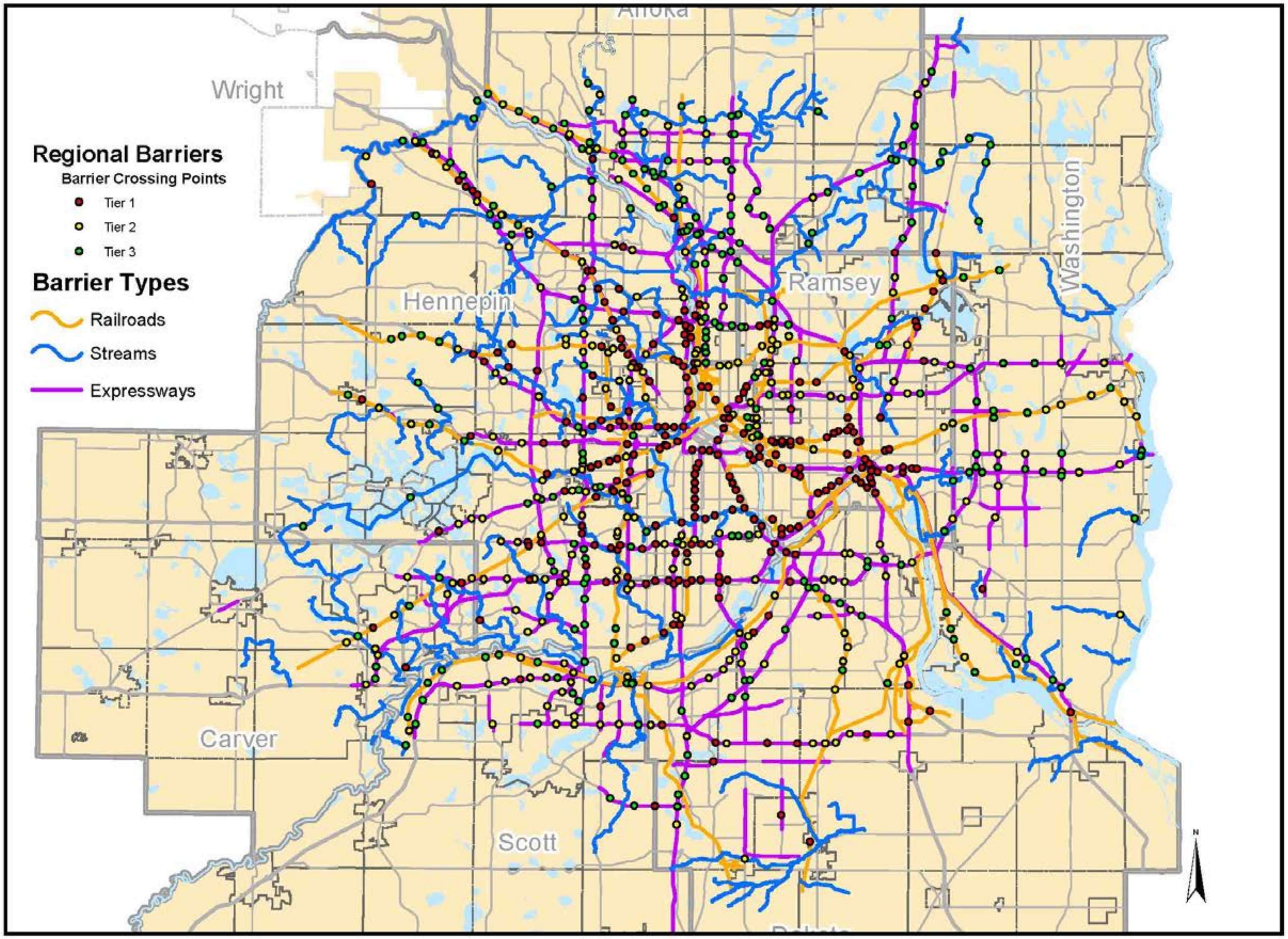

Figure 3. Barrier crossing prioritization results grouped in tiers

Table 7. Average barrier crossing point priority scores by barrier type

Barrier Type	Number of Points	Average Priority Score	Lowest Score	Highest Score
Dual Barriers	33	41.2	13.6	100.0
Railroads	197	38.7	11.8	92.0
Freeways/ Expressways	467	34.7	12.0	99.7
Streams	61	27.3	10.6	58.1
All Types	**758**	**35.4**	**10.6**	**100.0**

Ultimately, this update to the RBBS provided a series of ***bicycle barrier crossing improvement areas*** along the identified regional bicycle barriers (see Figure 4 and Figure 5 for Freeway/Expressway and Rail/Stream barrier crossing areas, respectively). The ranked barrier crossing points shown previously in Figure 3 are the center points for these barrier crossing improvement area circles. These improvement area circles have diameters (or buffers) that vary by their Thrive 2040 community designation group and correspond to the preferred barrier crossing spacing distances previously described in Table 1. These area circles delineate the specific barrier segments across which bicycle improvements may be desired. As described earlier, these barrier segments were grouped into three priority tiers which are indicated by the colored circles in the map figures that follow.

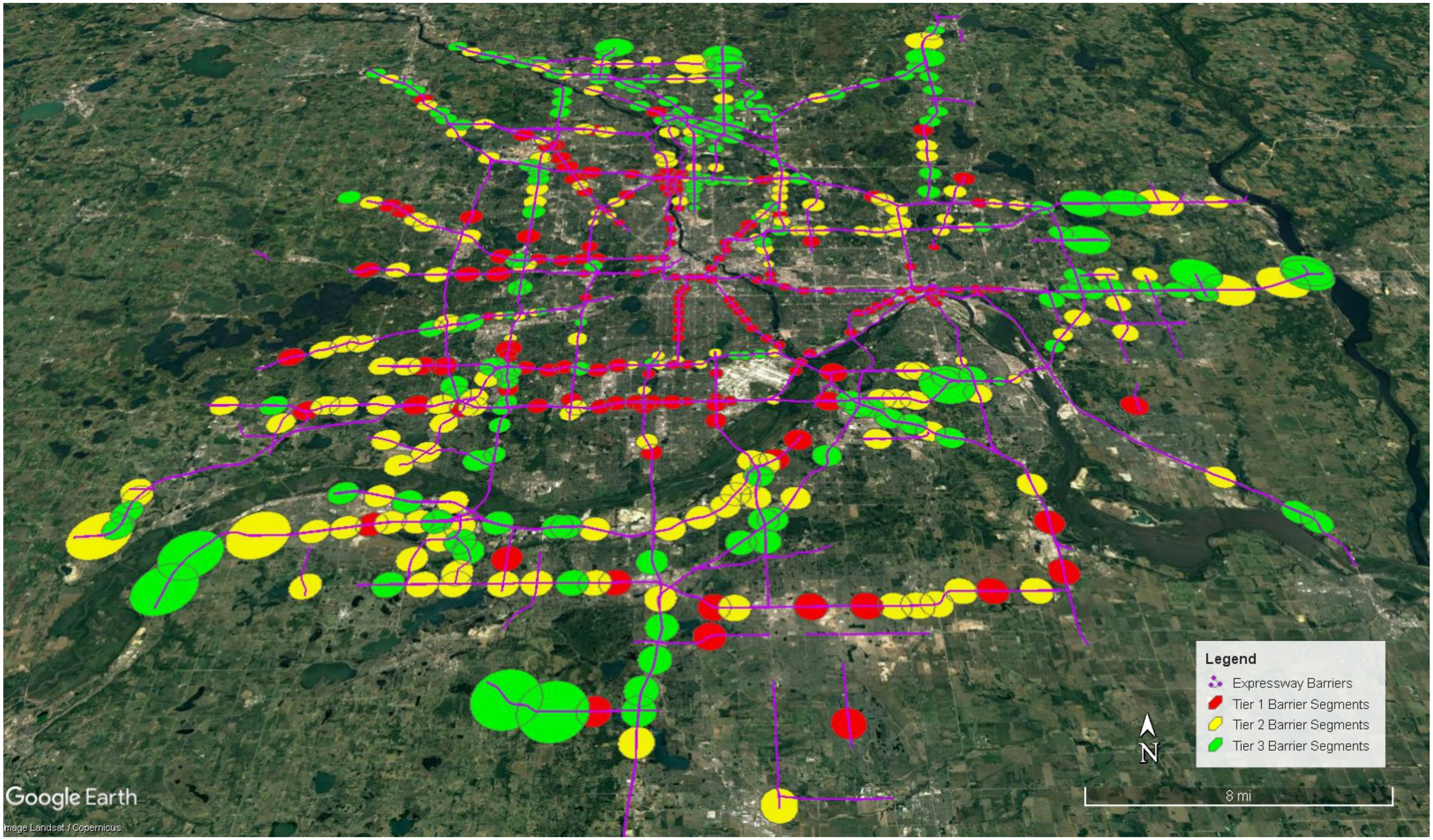

Figure 4. Regional bicycle barrier crossing improvement areas: Freeways and Expressways.
Circle size reflects improvement area size based on Thrive 2040 community designation.

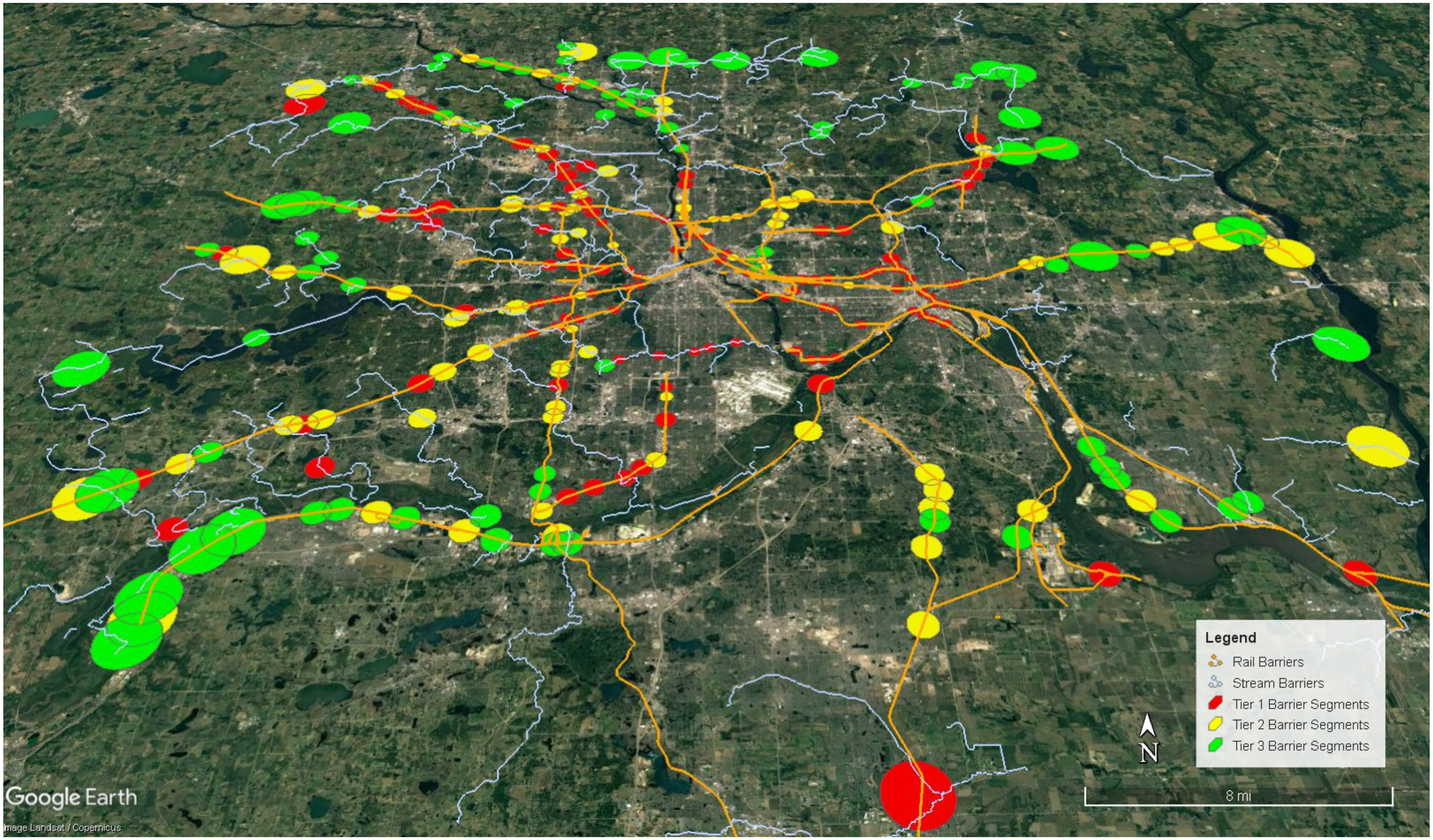

Figure 5. Regional bicycle barrier crossing improvement areas: Railroads and Streams.
Circle size reflects improvement area size based on Thrive 2040 community designation.

Relevance to Metropolitan Council Plans and Processes

The original Regional Bicycle Barriers Study and this update to the barrier crossings analysis have resulted in the series of potential bicycle barrier crossing improvement areas shown previously in Figure 4 and Figure 5. This prioritized set of barrier crossings represents potential improvement opportunity locations but should not be interpreted to represent a "plan" through which projects are eventually implemented at every location. The intended purpose of the RBBS was to identify the most regionally significant physical barriers to bicycle travel and, through a data driven analysis, to highlight the relative priority levels for new or improved barrier crossing segments based on the factors of network connectivity, social equity, bicycle trip demand, and safety/existing conditions.

This regional analysis can assist local and state agency planners involved in planning bikeway networks and in developing or funding bicycle improvement projects by prioritizing the locations for bikeway crossing improvements. At a glance, planners and project managers should be able to visualize where the greatest benefit and potential use of a new barrier crossing improvement exists within their communities. This should supplement other local considerations and the more detailed technical studies typically conducted in the engineering and design phase of projects.

These updates to regional bicycle barriers and the corresponding barrier crossing improvement areas provided in this Technical Addendum are proposed to be incorporated into future Regional Solicitations for distributing federal transportation dollars through the Met Council's Transportation Advisory Board (TAB). Decisions on how these results may be incorporated into Regional Solicitation project selection criteria will be made by the TAB. It is likely the updated regional bicycle barriers and crossing improvement areas will be proposed for inclusion in the next TPP update in 2023, or potentially sooner (though less likely) through the opportunity of a TPP amendment that would incorporate a major change to the regional plan.

Appendix

Table A-1. Regional Bicycle Expressway Barrier Adjustments

County	Barrier Change	Barrier Name	From	In	To	In
Anoka	Extension	CR 1 (E. River Rd/Coon Rapids Blvd.)	I-694 (extend northward)	Fridley	Dakotah St NW	Anoka
Anoka	New	CR 116 (Bunker Lake Blvd)	CR 57 (Sunfish Lake Blvd)	Ramsey	Jefferson St NE	Ham Lake
Anoka	New	CR 116 (Bunker Lake Blvd)	Lincoln St NE	Ham Lake	CSAH 52	Ham Lake
Anoka	New	CR 9 (Round Lake Blvd)	CSAH 14 (E Main Street)	Coon Rapids	152nd Lane NW	Andover
Anoka	New	CSAH 52 (Radisson Rd)	CR 116 (Bunker Lake Blvd)	Ham Lake	I-35W interchange East Ramp	Circle Pines
Anoka	New	CR 78 (Hanson Blvd)	124th Ave NW	Coon Rapids	Jay Street NW	Andover
Anoka	Extension	CSAH 14 (Main Street)	Wedgewood Drive	Anoka	U.S. 10	Coon Rapids
Anoka	New	CR 10 N/of TH 610	TH 610	Coon Rapids	CR 1 (West River Rd.)	Coon Rapids
Carver	New	CR 17 (Powers Blvd)	RR Bridge	Chanhassen	CR 14 (Pioneer Trail)	Chanhassen

County	Barrier Change	Barrier Name	From	In	To	In
Carver	New	CR 18 (Lyman Blvd)	CR 17 (Powers Blvd)	Chanhassen	CR 117 (Galpin Blvd)	Chaska
Carver	New	CSAH 10 (Engler Blvd.)	Prescott Lane	Chaska	Chaska Creek	Chaska
Carver	New	TH 101	U.S. 212 N Ramp/	Carver	New	TH 101
Carver	New	TH 5	TH 284	Waconia	Oak Avenue	Waconia
Hennepin	Extension	TH 62/CR 62 (W 62nd St/Townline Rd)	CR 60 (Baker Road)	Eden Prairie	Duck Lake Rd	Minnetonka
Hennepin	Extension	CSAH 61 (Flying Cloud Dr.)	Singletree Lane	Eden Prairie	South to Charlson Rd	Eden Prairie
Hennepin	New	CR 1 (Pioneer Trail)	U.S. 169 interchange east ramp	Bloomington	W/of Shetland Rd.	Eden Prairie
Hennepin	New	TH 610	I-94	Maple Grove	CSAH 81 (Bottineau Blvd)	Maple Grove
Ramsey	Extension	TH 51 (Snelling Ave)	Lydia Ave	Roseville	South to Hoyt Ave	Falcon Heights
Ramsey	Truncate	U.S. 61	End at Larpenteur Ave W	St Paul	South to Wheelock Pkwy	St Paul

County	Barrier Change	Barrier Name	From	In	To	In
Scott	New	CSAH 17 (Marschall Rd)	N/of Marcia Ln S thru CSAH 42 interchange	Shakopee	Valley View Road	Shakopee
Scott	Extension	TH 13	TH 13/TH 13 interchange	Savage	McColl Drive	Savage
Washington	New	CR 16 (Valley Creek Rd)	Bielenberg Drive	Woodbury	Woodcrest Drive	Woodbury
Washington	New	CSAH 13 (Radio/Inwood Dr.)	CSAH 10 (10th St N)	Oakdale	Hargis Parkway	Woodbury
Washington	New	TH 95/CSAH 15 (Manning Ave)	S/of Hudson Rd S	Woodbury	CSAH 10 (10th St N)	Lake Elmo
Washington	New	CSAH 19 (Woodbury Dr./ Keats Ave)	CSAH 10 (10th St N)	Lake Elmo	S/of CSAH 18 (Bailey Rd)	Woodbury
Washington	Extension	TH 36	E/of Osgood Ave N	Oak Park Heights	Saint Croix River	Oak Park Heights
Washington	New	CSAH 120/TH 120(Century Ave)	N/of Linwood Ave E	Maplewood	Innovation Blvd	Maplewood
Washington	New	CSAH 13 (Radio Dr./ Hinton Ave S)	Military Rd	Cottage Grove	Pine Arbor Blvd.	Cottage Grove
Washington	Remove	U.S. 61	120th St N	Hugo	S/of TH 97 & N/of 11th Ave S	Forest Lake

County	Barrier Change	Barrier Name	From	In	To	In
Washington	New	CSAH 10 (10th St N)	I-694	Oakdale	Island Trail	Lake Elmo
Washington	New	CSAH 15 (Manning Ave)	TH 36	Stillwater	CSAH 12 (75th St N)	Stillwater
Washington	New	CSAH 5 (Stillwater Blvd)	N/of 53rd St N	Oak Park Heights	Cottage Drive	Stillwater
Washington /Ramsey	New	CSAH 8/14 (Main St./ Frenchman Rd)	21st Ave N	Centerville	U.S. 61	Hugo
Washington	New	U.S. 8	I-35	Forest Lake	Goodview Circle N	Forest Lake

Table A-2, *Regional Bicycle Barrier Crossing Area Rank Scores,* is available separately.