Report

Green Infrastructure Identification and Prioritization in the Menomonee River Watershed

MMSD Contract No. M03064P08

Wisconsin Coastal Management Program Grant

Agreement No. AD149883-015.06

Prepared for:

MMSD

PARTNERS FOR A CLEANER ENVIRONMENT

WISCONSIN COASTAL MANAGEMENT PROGRAM

sweet water

SOUTHEASTERN WISCONSIN WATERSHEDS TRUST, INC.

August 2015

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NOAA

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

U.S. DEPARTMENT OF COMMERCE

Executive Summary

This project has been a collaboration on green infrastructure (GI) planning around street and parking lot capital improvement projects among the Milwaukee Metropolitan Sewerage District (MMSD), the Southeastern Wisconsin Watersheds Trust, Inc. (Sweet Water), Sweet Water's partners (Clean Wisconsin, American Rivers, and Milwaukee Riverkeeper), the 11 Menomonee River Watershed Permit municipalities, the Southeastern Wisconsin Regional Planning Commission (SEWRPC), and the Wisconsin Department of Natural Resources (WDNR).

Residential setting bioretention with curb bump outs.

The project builds upon the City of Milwaukee Green Streets Plan (CH2M HILL 2013a) and the MMSD Regional GI Plan (CH2M HILL 2013b) to work with local municipalities within the Menomonee River Watershed using available street reconstruction capital improvement plans (CIP) to identify near-term GI opportunities. This evaluation identified the top two GI opportunities within each municipality (Table ES-1), enabling the municipalities to plan for GI implementation and to have the project information needed for funding applications from a wide range of potential funding partners. The table is color coded by municipality.

The project vision focused upon raising GI opportunity awareness with road and parking lot reconstruction projects. Through feedback from one-on-one meetings and results from the project survey, 8 out of 11 respondents indicated the project raised GI opportunity awareness.

The project goals included:

1. Develop a list of municipal staff-endorsed projects.
2. Prepare planning-level budgets and benefits to support funding requests.
3. At the end of the project, have support to expand the process to other municipalities in the MMSD service area.

Table ES-1 includes the list of recommended GI projects, including planning-level budgets for preparing budget requests that realized project goals 1 and 2. Feedback through the project survey indicated that 9 out of 11 survey respondents believed the project should be expanded to more municipalities. Based upon the project feedback, MMSD has included a draft budget request to expand the evaluation to the remaining 18 municipalities in the MMSD service area.

Other survey results (see Appendix B) indicated all respondents thought that Sweet Water provided a valuable service to the municipalities by envisioning this project. The survey also provided significant insight into barriers to widespread GI implementation, including the importance of funding as well as understanding maintenance cost impacts to municipal budgets and available training/equipment.

In their responses to the survey, municipalities emphasized the importance of operation and maintenance costs to inform GI implementation decisions. Including operation and maintenance costs in addition to capital costs in future analyses will allow municipalities to consider the overall life-cycle costs of GI projects.

The project identified improvements for the GI prioritization process used in this project that could be implemented in the future. For example, the information available for calculating scores for depth to

groundwater and depth to bedrock was limited and could be improved upon. Developing more depth categories (i.e. 4, 5, 6, 7, 8, etc.) would expand the scoring values available and provide more differentiation in the numerical scoring results as to what projects would have more constraints to implementation.

The project created a map for each GI opportunity that passed an initial screening analysis to understand site-specific GI implementation constraints, including: topography, utility conflicts, median and/or terrace widths, tree conflicts, and other features. An example map created for each project is included in Figure ES-1.

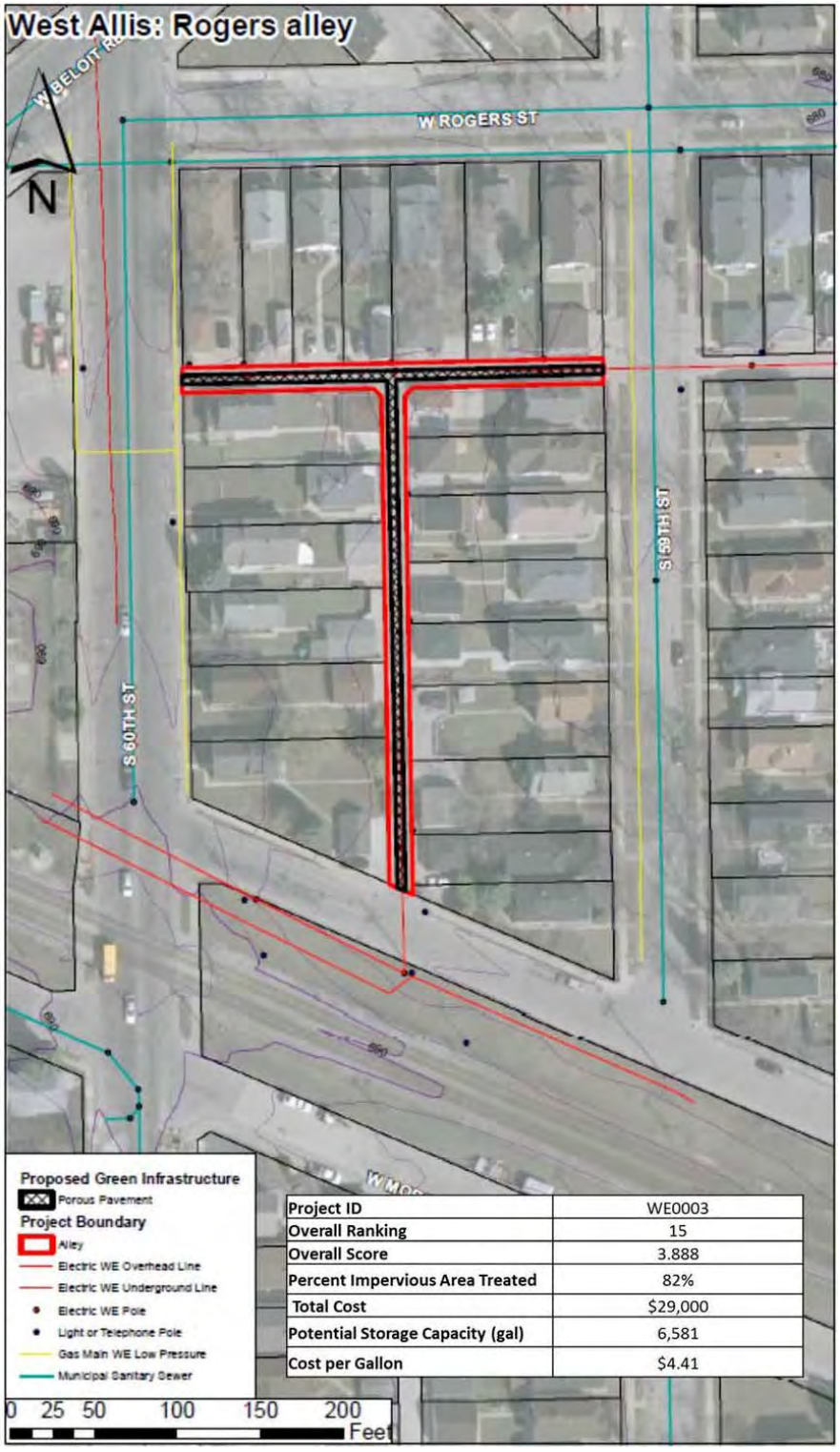
As a result of this project, the 11 municipalities have two or more GI opportunities they can implement with cost estimates and maps to support funding requests.

TABLE ES-1
GI Project Recommendations

Project ID	Project Name	Municipality	Total Cost
BR0001	North Ave East	Brookfield	$ 1,972,000
BR0002	North Ave West	Brookfield	$ 783,000
BU0004	Frontier Park (south lot)	Butler	$ 12,000
BU0003	N 127th St	Butler	$ 27,000
EG0001	Village Hall	Elm Grove	$ 105,000
EG0002	North Ave East	Elm Grove	$ 1,972,000
GE0001	River Crest Drive	Germantown	$ 41,000
GE0002	Concord Rd	Germantown	$ 333,000
GF0004	35th Frontage Rd	Greenfield	$ 59,000
GF0002	60th St	Greenfield	$ 87,000
MF0005	St. Francis Drive	Menomonee Falls	$ 36,000
MF0003	Cheyenne Drive	Menomonee Falls	$ 63,000
MI0002	W Lisbon Ave	Milwaukee	$ 590,000
MI0001	N 91st St	Milwaukee	$ 367,000
MC0004C	BHD Parking Lot North	Milwaukee County	$ 38,000
MC0001	West Oklahoma	Milwaukee County	$ 111,000
MC0004A	BHD Parking Lot South	Milwaukee County	$ 48,000
MC0004B	BHD Parking Lot Central	Milwaukee County	$ 181,000
WA0005	Gridley Alley	Wauwatosa	$ 22,000
WA0008	State Street	Wauwatosa	$ 206,000
WE0005	89th Street	West Allis	$ 37,000
WE0003	Rogers Alley	West Allis	$ 29,000
WM0001	Greenfield Ave	West Milwaukee	$ 91,000
WM0002	Miller Park Way	West Milwaukee	$ 515,000

FIGURE ES-1

Project-Specific GI Opportunity Map



Contents

1 Introduction

This report documents the collaboration on green infrastructure (GI) planning around street and parking lot capital improvement projects between the Milwaukee Metropolitan Sewerage District (MMSD), the Southeastern Wisconsin Watersheds Trust Inc., (Sweet Water), Sweet Water's partners (Clean Wisconsin, American Rivers, and Milwaukee Riverkeeper), and the 11 Menomonee River Watershed Permit municipalities. Besides the 11 municipalities, the Southeastern Wisconsin Regional Planning Commission (SEWRPC) and the Wisconsin Department of Natural Resources (WDNR) also actively participated.

The project builds from the City of Milwaukee Green Streets Plan (CH2M HILL 2013a) and the MMSD Regional GI Plan (CH2M HILL 2013b) to work with local municipalities within the Menomonee River Watershed using available street reconstruction capital improvement plans (CIP) to identify near-term GI opportunities. This evaluation identified the top two GI opportunities within each municipality, enabling the municipalities to plan for GI implementation and to have the project information needed for funding applications from a wide range of potential funding partners.

The Wisconsin Coastal Management Program Grant program provided funding for the project under Agreement No. AD149883-015.06.

1.1 Project Vision

The project team developed a project vision to guide the project. The project vision is: *Increase awareness of GI opportunities within municipal street reconstruction projects so municipalities can cost-effectively implement GI as part of their normal capital improvement plan (CIP) process.*

The project vision focused on communication with municipal stakeholders during workshops and with the project team. Feedback from municipal partners on raising awareness of GI projects was obtained through the project survey, which found 8 out of 11 respondents indicated the project raised awareness of GI opportunities. The survey and results are described in greater detail in the project survey section.

1.2 Project Goals

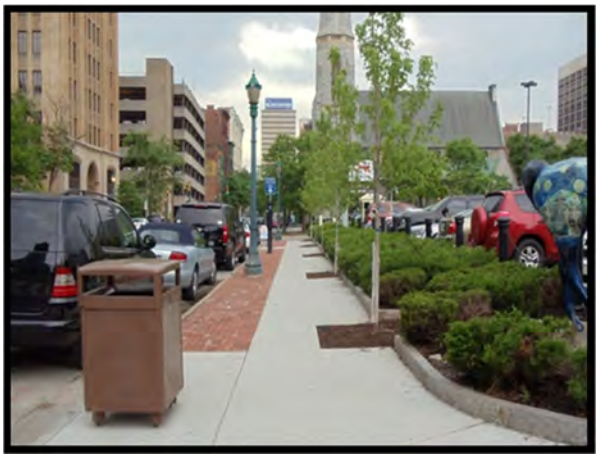
The project team identified three key goals to accomplish during the project. The three project goals are:

1. Develop a list of municipal-staff-endorsed projects.
2. Prepare planning-level budgets and benefits to support funding requests.
3. At the end of the project, have support to expand the process to the other municipalities in the MMSD service area.

As the project evaluation progressed, the project goals guided communications with the municipalities to ensure projects would be endorsed by staff. The project technical team developed the budget estimates for future budget requests. The report includes the information for the first two goals and the third goal is on track to be achieved based upon municipality recommendations and requested MMSD funding.

Bioretention garden.

Porous paver parking lane with bioretention garden.



Tree trenches in downtown setting.

During the project survey (described more below), 9 out of 11 survey respondents indicated the project should be expanded to the rest of the municipalities in the MMSD service area. Based upon the success of the project, MMSD has included a draft budget request to expand the evaluation to the remaining 18 municipalities in the MMSD service area. Final MMSD budgets are subject to MMSD Commission endorsement and approval.

Curb bump outs in residential neighborhood create bioretention garden.

2 Workshops

To communicate the project vision, goals, and roles for the municipal partners, the team held two project workshops. The workshops were held as part of regularly scheduled Menomonee Watershed Permit Group meetings in the City of Brookfield. All 11 municipalities (which includes Milwaukee County) participated in each workshop along with WDNR and SEWRPC representatives. Approximately 25 people participated in each workshop.

Workshop 1: Workshop 1 provided the municipal partners with an overview of the project, discussed roles and responsibilities, and requested information from the municipalities on street CIPs. Information on parking lot construction improvements was also requested and included in the analysis, especially when municipalities had limited street reconstruction plans and with Milwaukee County, which has many parking lots that are soon to be reconstructed.

Workshop 2: Workshop 2 previewed the project findings by communicating the analysis process, explaining the scoring criteria, and providing the basis for estimating project costs. The participants were informed of the remaining projects tasks including: upcoming one-on-one meetings to review individual municipality results, project survey, and report review. Municipalities were made aware of the opportunity to quantify the water quality benefits of the projects if they choose to conduct water quality modeling using Source Loading and Management Model (SLAMM) software.

Workshop Feedback: Feedback at both workshops from the municipalities stressed the importance of knowing GI operation and maintenance costs. Based upon this feedback, if this type of analysis is expanded to other municipalities, life cycle costs should be included in an analysis that combines one-time capital costs with annual operation and maintenance costs.

Workshop participants listen to GI funding opportunities available from MMSD.

Workshops provided opportunity for dialogue on GI questions.

3 Data Gathering

The project team requested road and parking lot CIP information for the next 5 years from each of the municipalities. Road and parking lot reconstruction projects were evaluated for GI implementation potential. The information provided varied in format and content depending upon the municipality. Some municipalities had limited information because the current CIP had limited funding, allowing only a few projects for the next several years.

The number of road or parking lot reconstruction projects planned varied according to the size of the municipalities, the age of the infrastructure, and their budgeting processes. Older municipalities tended to have a long list of projects because more roads and alleys had reached the end of their expected life and needed to be replaced.

The project team initially thought smaller municipalities might have a limited number of projects. However, not all small municipalities have limited street CIP plans. For example, Butler, one of the smaller municipalities, is developing a plan to have significant reconstruction on practically all of the roads in the municipality over the next 10 years. Such investments represent a once-in-a-lifetime opportunity to integrate GI into publicly-owned projects and would present a significant funding hurdle based upon current GI funding models, as described in the One-on-One Meetings Section, which rely heavily upon MMSD grants.

3.1 Types of Data

Data varied in form from geographic information system (GIS) shapefiles, maps, and also simple one-page village board funding resolutions (Figure 1). While CIP data was provided in differing formats, the information needed for the GI evaluation was readily available from each municipality by reviewing the CIP project description or through clarifying conversations with municipal staff.

The project team reviewed and screened the CIP list to select the projects for GI potential evaluation. The project team followed up with questions to public works staff to clarify the types of projects and which ones were most likely to occur within the next several years. Projects planned for 2015 were generally avoided to allow time for engineering design and opportunity to apply for grant funding. Exceptions were made where the municipality only had a few projects and good opportunities for GI existed in 2015 projects.

FIGURE 1
Example CIP Formats

3.2 Focus on Reconstruction Projects

The project team focused on road or parking lot reconstruction projects because reconstruction involves the most grading and earth moving, and therefore GI can typically be integrated more efficiently in road reconstruction projects than repaving projects. The Water Environment Federation (WEF) has documented the benefits of integrating GI into planned construction projects (WEF 2014) and the U.S. Environmental Protection Agency (USEPA) has recognized the cost savings available through integrating GI into municipal constructions projects (EPA 2015). Being able to mobilize construction equipment and labor coincident with other projects allows GI the opportunity to realize cost savings and economies of scale because the equipment and labor needed for GI is often already mobilized onsite for construction.

It is possible to cost-effectively implement GI with road resurfacing projects as well. However, there are implementation uncertainties with repaving projects without allowing for more investigation to check that road slopes will allow for runoff capture. Additional costs are likely compared to reconstruction projects.

Each project footprint was entered into GIS, once there was agreement on which projects to include in the evaluation. The project footprint enabled review of the amount of imperviousness, ground slope, depth to groundwater, depth to bedrock, and other GIS information that has been previously developed through the MMSD Regional GI Plan and subsequent efforts.

Of the 66 reconstruction projects initially received, the team narrowed down the number of projects with discussions with municipal representatives to 46 for evaluation. These projects were selected because they represented projects that are most likely to have GI opportunities readily available. More GI implementation opportunities exist, but these 46 projects provide sufficient opportunity to identify at least two GI implementation projects within each municipality. The list of projects by municipality is included in Table 1. The table is color coded by municipality.

TABLE 1
Projects Evaluated by Municipality

Project ID	Project Name	Municipality	Construction Year	Project Type
BR0001	North Ave East	Brookfield	2018	Road
BR0002	North Ave West	Brookfield	2019	Road
BU0001	Frontier Park	Butler	TBD	Parking
BU0002	Silver Spring	Butler	TBD	Road
BU0003	N 127th St	Butler	TBD	Road
BU0004	Frontier Park (south lot)	Butler	TBD	Parking
EG0001	Village Hall	Elm Grove	TBD	Parking
EG0002	North Ave East	Elm Grove	2018	Road
GE0001	River Crest Drive	Germantown	2015	Road
GE0002	Concord Rd	Germantown	2016	Road
GF0001	Crawford Ave	Greenfield	2019	Road
GF0002	60th St	Greenfield	2017	Road
GF0003	43rd St	Greenfield	2016	Road
GF0004	35th Frontage Rd	Greenfield	2017	Road
MC0001	West Oklahoma	Milwaukee County	2018	Road
MC0002	Currie Park Service Yard	Milwaukee County	2015	Parking

TABLE 1
Projects Evaluated by Municipality

Project ID	Project Name	Municipality	Construction Year	Project Type
MC0003	Currie Park Clubhouse	Milwaukee County	2015	Parking
MC0004A	BHD Parking Lot South	Milwaukee County	2016	Parking
MC0004B	BHD Parking Lot Central	Milwaukee County	2016	Parking
MC0004C	BHD Parking Lot North	Milwaukee County	2016	Parking
MC0005	Dretzka Chalet	Milwaukee County	2017	Parking
MC0006	Dretzka Golf Course	Milwaukee County	2018	Parking
MF0001	Arthur Ave	Menomonee Falls	2016	Road
MF0002	Cherokee Drive	Menomonee Falls	2017	Road
MF0003	Cheyenne Drive	Menomonee Falls	2018	Road
MF0004	May Ave	Menomonee Falls	2016	Road
MF0005	St. Francis Drive	Menomonee Falls	2018	Road
MI0001	N 91st St	Milwaukee	2018	Road
MI0002	W Lisbon Ave	Milwaukee	2019	Road
WA0001	N 113th Street	Wauwatosa	2016	Road
WA0002	Harding Blvd South	Wauwatosa	2016	Road
WA0003	Harding Blvd North	Wauwatosa	2016	Road
WA0004	WatertownPlk Alley	Wauwatosa	2017	Alley
WA0005	Gridley Alley	Wauwatosa	2016	Alley
WA0006	Center_74th to 75th Alley	Wauwatosa	2017	Alley
WA0007	Center_75th to 76th Alley	Wauwatosa	2017	Alley
WA0008	State Street	Wauwatosa	2016	Road
WA0009	N 92nd St	Wauwatosa	2018	Road
WE0001	Grant Alley	West Allis	2015	Alley
WE0002	Lapham Alley	West Allis	2015	Alley
WE0003	Rogers Alley	West Allis	2015	Alley
WE0004	85th Street	West Allis	2016	Road
WE0005	89th Street	West Allis	2016	Road
WE0006	124th Street	West Allis	2018	Road
WM0001	Greenfield Ave	West Milwaukee	2016	Road
WM0002	Miller Park Way	West Milwaukee	2016	Road

4 Project Scoring

Each of the 46 projects was reviewed and scored in two stages to generate three sub-scores: initial score, cost score, and efficiency score. The three sub-scores were averaged to calculate the overall score for potential GI implementation at a project site. The following subsections describe each of the sub-scores.

4.1 Initial Scoring

The 46 initial projects were first scored to understand site-specific constraints or benefits of GI implementation. The scoring considered the nine criteria listed in Table 2. The criteria were established based on the available GIS information in the region. Each criteria was scored 1 through 5, with the higher scores indicating a higher potential for GI implementation. Criteria-specific scores were averaged to generate the initial project-specific score. Each scoring criteria is described in more detail in the subsequent paragraphs and figures.

TABLE 2
Scoring Criteria

Criteria	Score Description
Ground Slope	Ground slope influences the potential for GI implementation. Mild slopes allow for easily capturing stormwater runoff allowing for GI implementation, while stormwater capture and storage on steep slopes becomes more difficult and costly. The team calculated the score by using the percent of the project area with mild, medium, and steep slopes multiplied by the scores listed below: 5: Mild Slope (less than 5 percent) 3: Medium Slope (5-10 percent) 1: Steep Slope (greater than 10 percent)
Depth to Groundwater	GI implementation generally requires separation between the groundwater and the GI strategy. A depth to groundwater of less than 6 feet may limit the type/depth of GI that can be employed. The team calculated the score by using the following approach: 5: groundwater depth greater than or equal to 6 feet throughout the entire project area 3: groundwater depth greater than or equal to 6 feet for a portion of the project area 1: groundwater depth less than 6 feet throughout the entire project area
Depth to Bedrock	GI implementation generally requires separation between bedrock and the GI strategy. A depth to bedrock of less than 6 feet makes GI implementation less likely to be practical. The team calculated the score by using the following approach: 5: depth to bedrock greater than or equal to 6 feet throughout the entire project area 3: depth to bedrock greater than or equal to 6 feet for a portion of the project area 1: depth to bedrock less than 6 feet throughout the entire project area
Existing Tree Canopy	Trees are part of the MMSD Regional GI Plan strategy. Where few trees exist, there is an opportunity to plant more and space available for bioretention or other GI strategies. Where many trees already exist, there are potential conflicts of needing to cut down or work around trees to install bioretention. Because the MMSD Regional GI Plan promotes trees for stormwater management, cutting down trees is avoided where possible. The team calculated the score by using the following approach: 5: less than 20 percent of project area 3: 20-40 percent of project area 1: greater than 40 percent project area

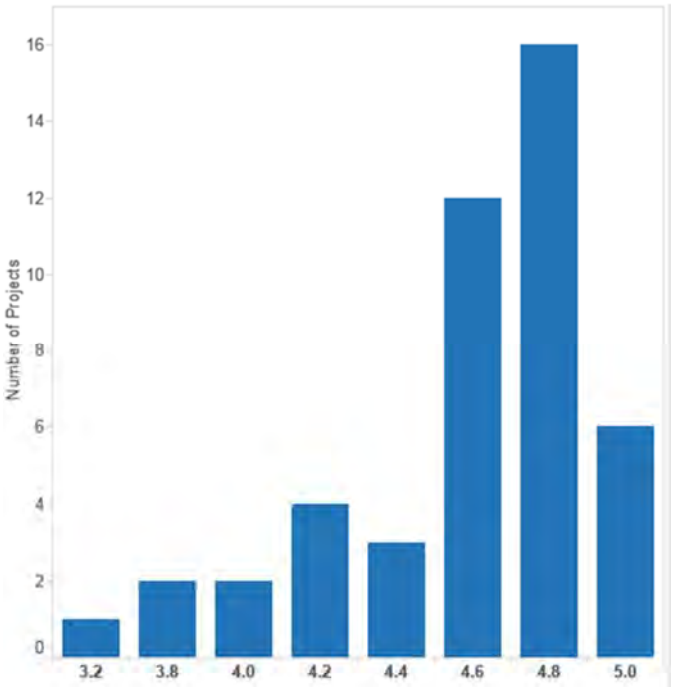
TABLE 2
Scoring Criteria

Criteria	Score Description
Opportunity	The MMSD Regional GI Plan developed watershed sub-basin-specific scores to describe GI implementation opportunities such as open space and other factors. The Plan developed a rank for each sub-basin. The percentile ranking of the opportunity score from the MMSD Regional GI Plan was divided into five categories and scores from 1 to 5.
Benefit	The MMSD Regional GI Plan developed watershed sub-basin-specific scores to describe GI implementation benefits such as water quality improvement and other factors. The Plan developed a rank for each sub-basin. The percentile ranking of the benefit score from the MMSD Regional GI Plan was divided into five categories and scores from 1 to 5.
Parking Lanes	The presence of parking lanes more easily enables implementation of the porous pavement GI strategy within the street right-of-way by using the parking lane. Parking lanes can also be conducive for bioretention in curb extensions. The team allocated scores as follows: 5: 2 or more parking lanes or a parking lot 3: 1 parking lane 1: 0 parking lanes
Project Impervious Area Size	A larger impervious area requires more GI to effectively treat the area, but also offers opportunity to achieve reduced costs through the economies of scale provided by larger projects. The team allocated scores by calculating the impervious area for each project and dividing them into 5 equal categories with scores of 1 to 5.
Best Professional Judgment	Some projects offered benefits that were not easily captured by the other scoring features. Benefits such as high visibility and interest expressed by the municipality were considered and a best professional judgment score was provided. The best professional judgment score considered if one of the other scoring factors may have unnecessarily provided a low score where field conditions have not been verified, such as low depth to groundwater or low depth to bedrock, and which would have taken the project out of consideration. Scores were assigned using values of 5, 3, or 1.

4.2 Criteria-Specific Scoring Results

Ground slope, depth to groundwater, depth to bedrock, and existing tree canopy are factors that influence the feasibility of GI and the ease of constructability at a project site. The slope of the ground constrains the area that can be constructed into GI. For example, project areas with steep slopes require additional excavation and additional expense or they might be unable to effectively capture the runoff if it flows too quickly. The greater Milwaukee area is generally flat with few hills, and parking lots are also mildly sloped if at all. Consequently, scores were generally high, reflecting few ground slope constraints. Figure 2 illustrates the ground slope score distribution.

FIGURE 2
Ground Slope Score Histogram



Figures 3 and 4 illustrate the percentage of projects based on their depth to groundwater and depth to bedrock scoring. For both criteria, a depth of 6 feet was used as the threshold due to the data readily available from the MMSD Regional GI Plan. While a review of the maps in the MMSD GI Plan indicates some areas of the region do have shallow constraint conditions, the vast majority of projects have a depth to groundwater and bedrock greater than or equal to 6 feet. As a result, the criteria did not provide significant differentiation in scoring among the projects. While the 6-foot delineation is beneficial for regional planning, a potential improvement for future analysis could provide more gradation in the depth to groundwater or depth to bedrock at project sites. Having information on the actual groundwater and bedrock depths (rather than just whether it is less than or greater than 6 feet) could provide refinement in the scoring approach and additional insight into the potential constraint.

FIGURE 3
Depth to Groundwater Score Distribution
Scores of 1 to 5 with 5 being the highest (best) score, see Table 2 for details

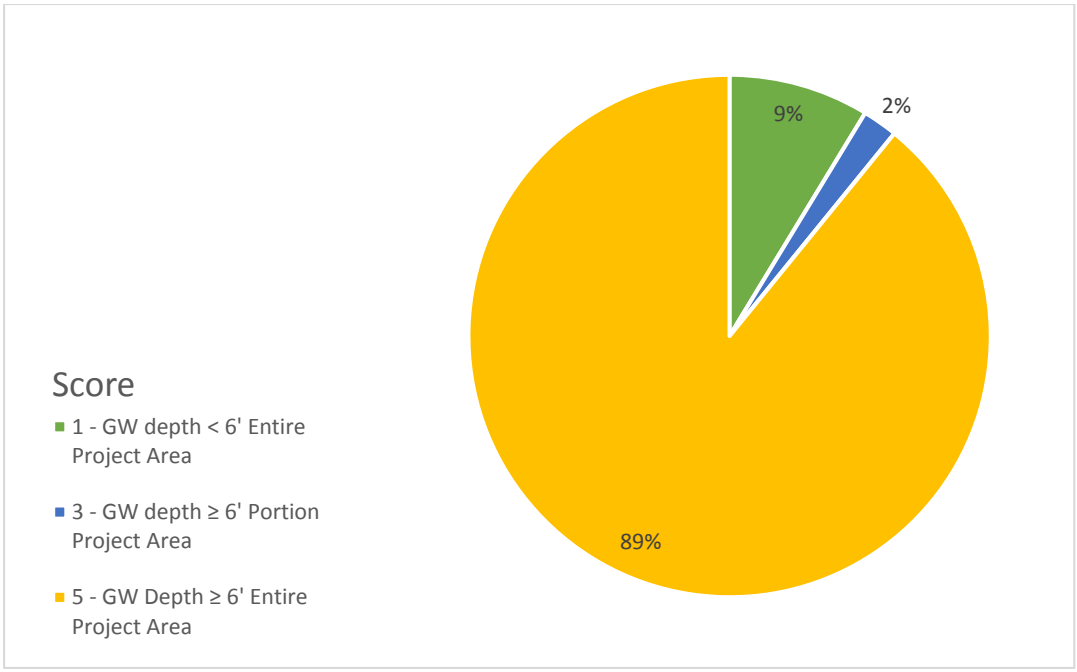


FIGURE 4
Depth to Bedrock Score Distribution
Scores of 1 to 5 with 5 being the highest (best) score, see Table 2 for details

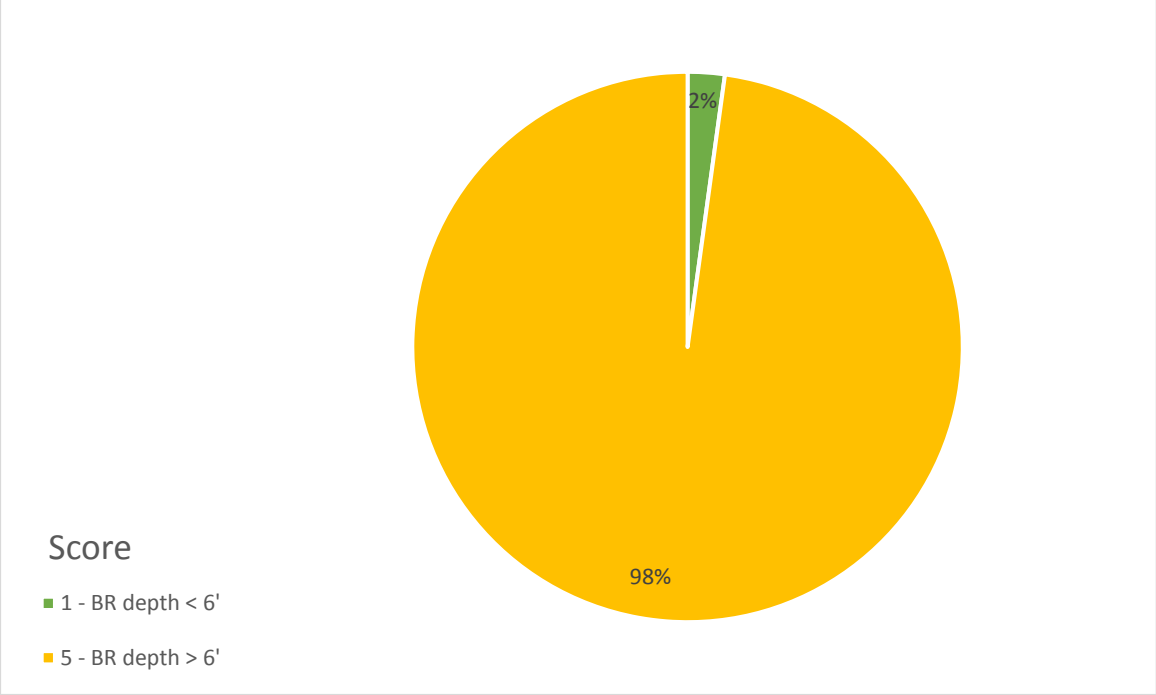
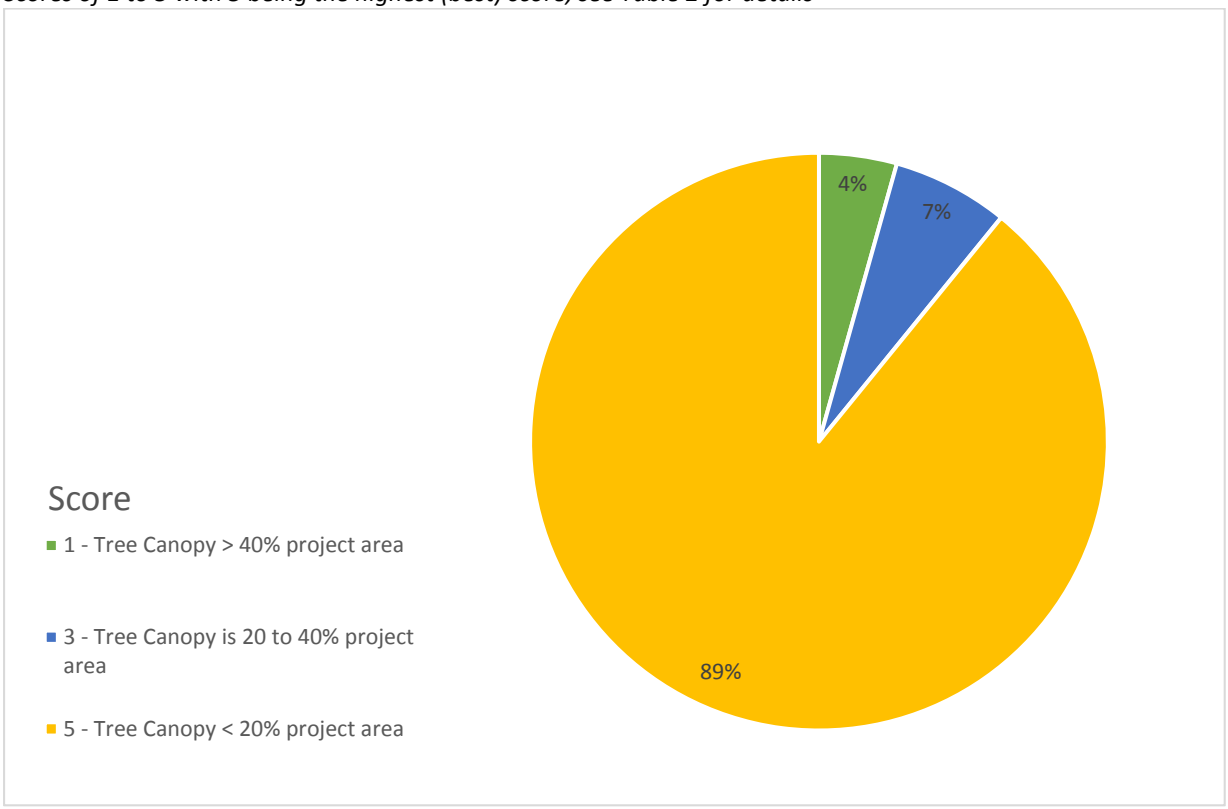


Figure 5 illustrates the project scoring distribution based on the existing tree canopy score. Projects with more trees were scored lower due to the desire to preserve existing trees within each municipality. Almost 90 percent of the projects have lower than 20 percent tree canopy and were thus scored a 5. Many of the CIP projects reviewed were alleys or two-lane streets, indicating that few streets have tree canopy that spans much of the impervious area. This indicates that many projects should have opportunities for bioretention installation and additional tree plantings. The stormwater and other benefits available from trees, as documented in the MMSD Regional GI Plan, and the low tree canopy percentage in the projects reviewed indicates there is a significant opportunity to increase tree canopy in the region.

FIGURE 5
Existing Tree Canopy Score Distribution
Scores of 1 to 5 with 5 being the highest (best) score, see Table 2 for details



The opportunity and benefit criteria capture the rankings calculated in the MMSD Regional GI Plan. The MMSD Regional GI Plan ranked 707 distinct sub-watershed areas based on their benefit and opportunity score. The scores factored in aspects such as: parks, redevelopment, existing neighborhood GI, vacant land, future watercourse projects, and other factors. Refer to the MMSD GI Plan for more information on how the scores were generated. Figures 6 and 7 display the score distribution for the project sites.

FIGURE 6
Opportunity Score Histogram

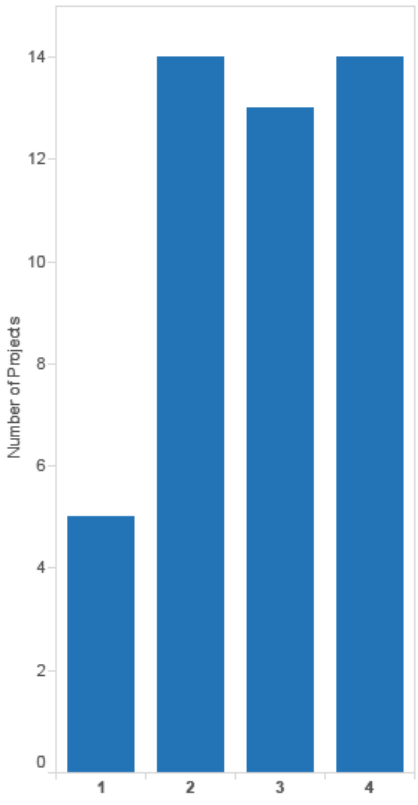
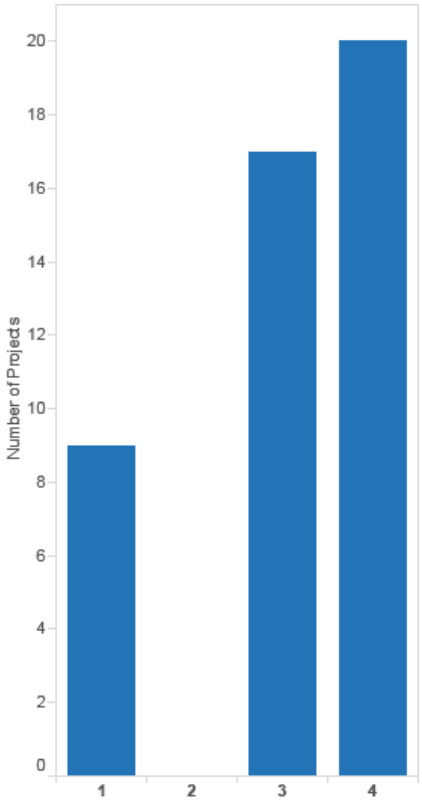
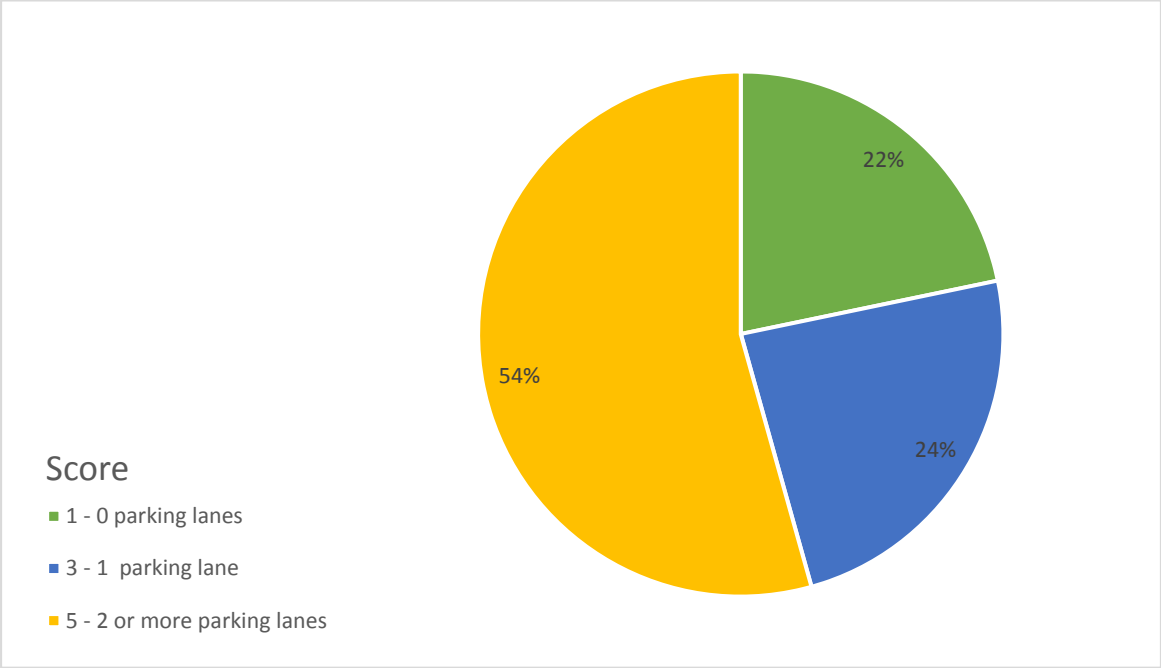


FIGURE 7
Benefit Score Histogram



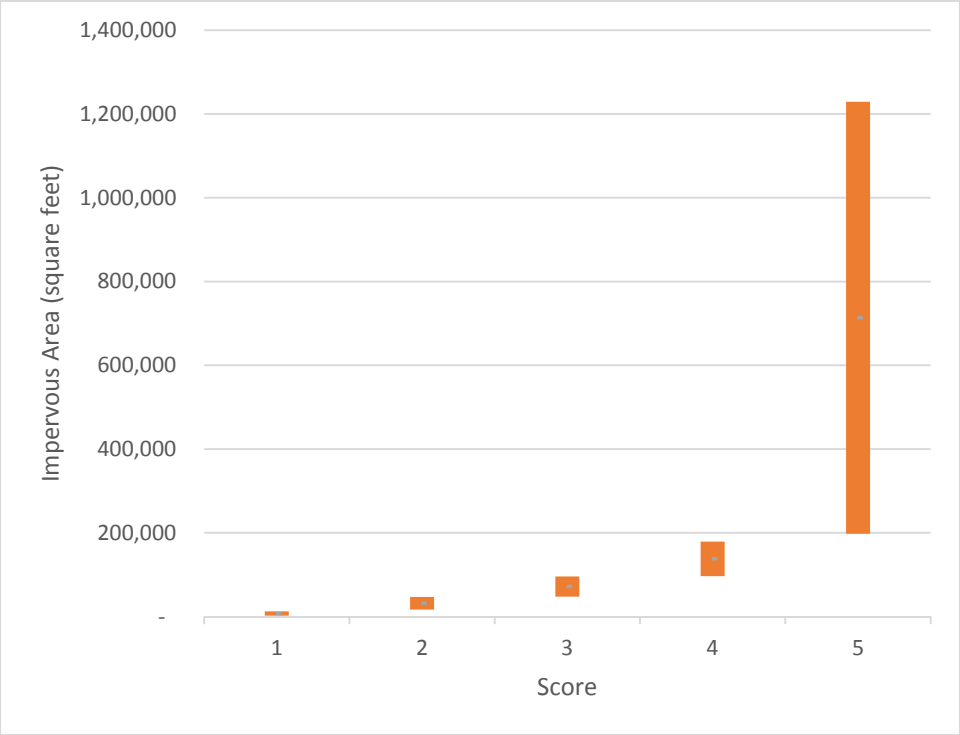
Projects with parking lanes nearby were scored higher due to the potential implementation of permeable pavement. Figure 8 illustrates the number of parking lanes for the projects. Parking lots were scored the same as roads, with two parking lanes representing a higher potential for permeable pavement.

FIGURE 8
Parking Lane Score Distribution
Scores of 1 to 5 with 5 being the highest (best) score, see Table 2 for details



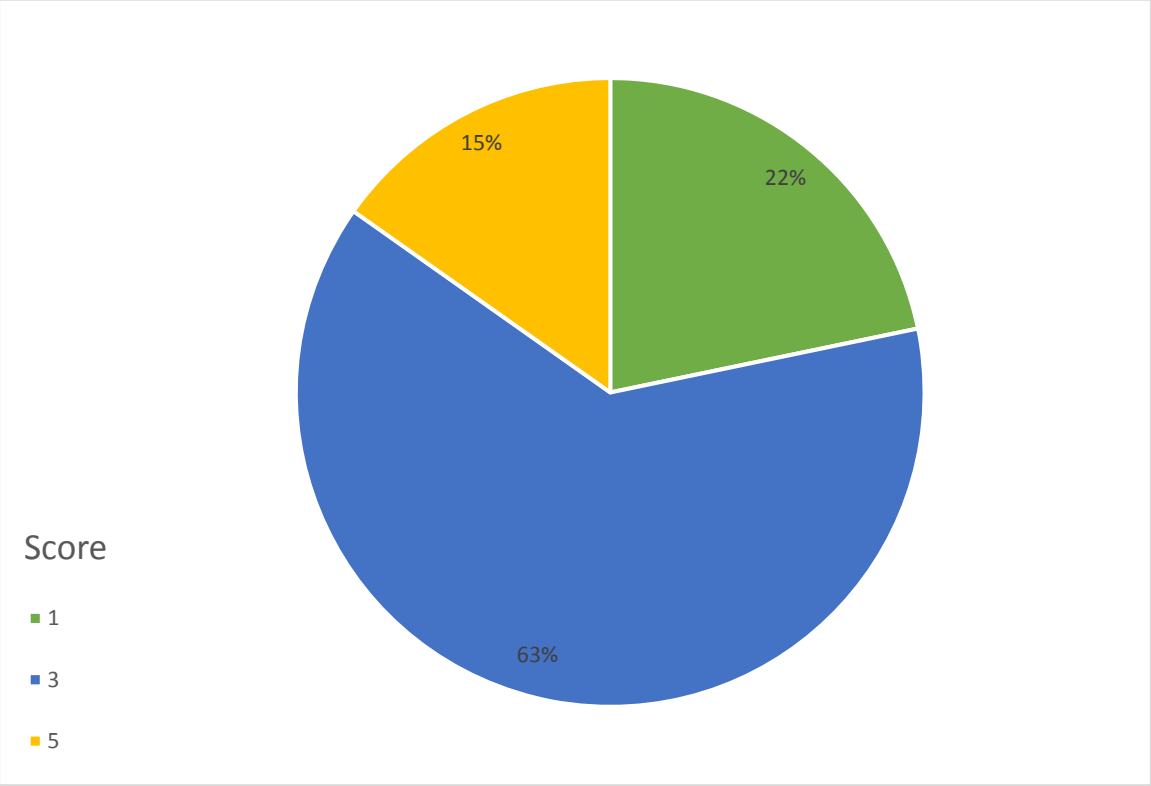
The project impervious area score is based on the total impervious area within the project right-of-way. Projects were divided into five equal categories, with projects scoring a 5 having the largest impervious area. Since impervious area is directly proportional to stormwater runoff, this criteria quantifies the need for stormwater best management practices (BMPs) and the potential for projects that could remove more pollutants with GI. Figure 9 shows the impervious area range for each scoring category. The range of impervious area increases with the score with two exceptionally large projects in the City of Brookfield. The Brookfield projects represent the largest impervious area and are several miles of road reconstruction and expansion.

FIGURE 9
Project Impervious Area Score Relationship to Impervious Area



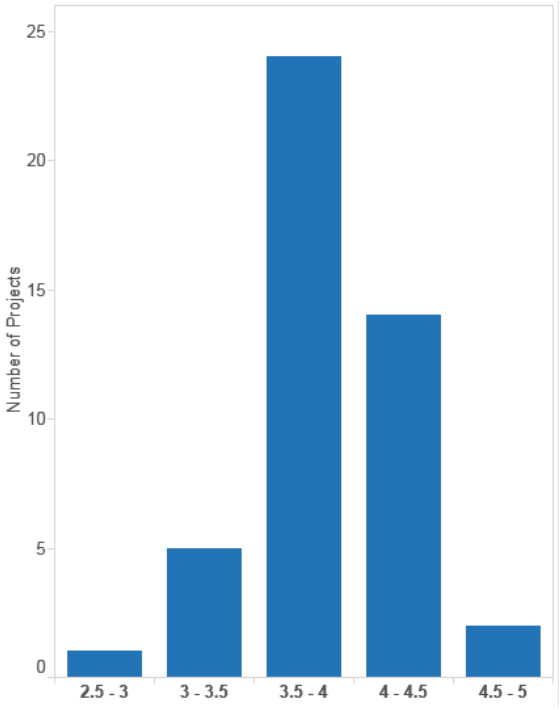
The best professional judgment score serves the purpose of any miscellaneous factors that need to be considered. The score was determined based on a detailed review of each project using a geographic information system (GIS). Projects were scored a 3 if there was no additional factor to consider for the project, while projects scored a 5 if there was a positive factor, such as wide terraces or open space, increasing the ease of GI constructability. Projects were scored as a 1 if there were negative factors, such as municipality GI strategy preferences or features not represented in other scores that could limit implementation. Figure 10 includes the best professional judgement scoring summary.

FIGURE 10
Best Professional Judgement Score
Scores of 1 to 5 with 5 being the highest (best) score, see Table 2 for details



Each criteria score was averaged to generate the initial score for each project. Figure 11 illustrates the initial score distribution. Twelve projects with lower initial scores within individual municipalities (scores varied from 3.4 to 4.2 depending upon the municipality) were eliminated from any further analysis. Some projects from some municipalities were eliminated were ranked higher than projects in other municipalities that were kept, this illustrates some municipalities have a lot of good projects and other municipalities have a limited number of projects. . An example of this is Milwaukee County which has many road and parking lot reconstruction projects slated for construction as illustrated in Table 4 at the end of this chapter.

FIGURE 11
Initial Project Score Histogram



Residential setting rain garden.

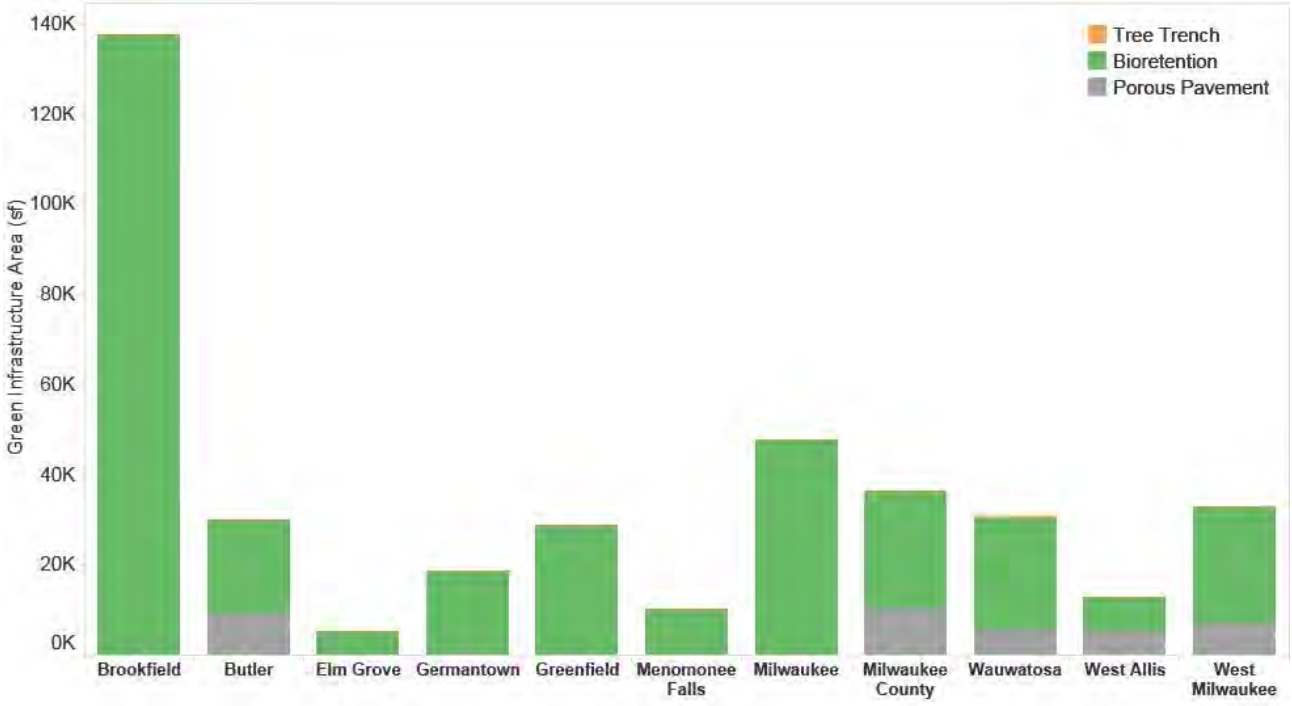
4.3 Cost Score

The initial score did not include any cost information. Municipalities expressed feedback during the one-on-one meetings that including an element of how cost-effective projects are would be helpful. Consequently, for the projects that were evaluated in detail after the initial screening, a cost score and efficiency score were added. For the cost score, the available area for bioretention or porous pavement was delineated based on site restrictions and potential utility conflicts (See Figure 12 for the total areas covered by the evaluated projects by municipality). Total cost was calculated using assumptions listed in Table 3. Cost information was obtained from the City of Milwaukee's recent projects (2014) and rounded up slightly to $20 per square foot to have a reasonably conservative funding request consistent with this high level GI screening. Tree trench costs were assumed the same as bioretention. Porous pavement costs considered a credit for pavement that would otherwise have to be installed. These costs are slightly higher than those assumed in the MMSD Regional GI Plan, however they are estimates based upon recent smaller projects. Additional efficiencies will likely result when broader GI installation occurs in the region.

TABLE 3
Assumed Values

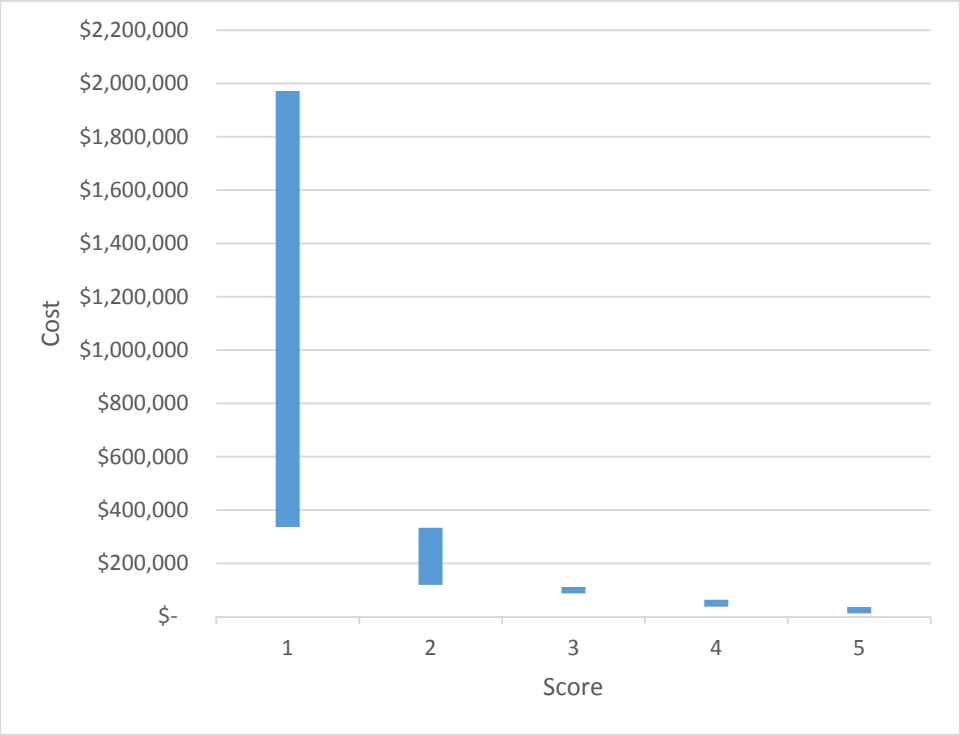
GI Type	Unit Cost ($/sf)	Loading Ratio (impervious area/GI area)	Potential Storage Capacity (gal/sf)
Bioretention/tree trenches	20	10	7.5
Porous Pavement	13	3 (roads/alleys); 5 (parking)	3

FIGURE 12
Potential Project GI Area by Municipality



For scoring, projects were divided into five equal categories based on their total cost, with projects with the highest cost given a score of 1 and projects with the lowest cost given a score of 5. Figure 13 illustrates the cost score distribution.

FIGURE 13
Cost Score Distribution



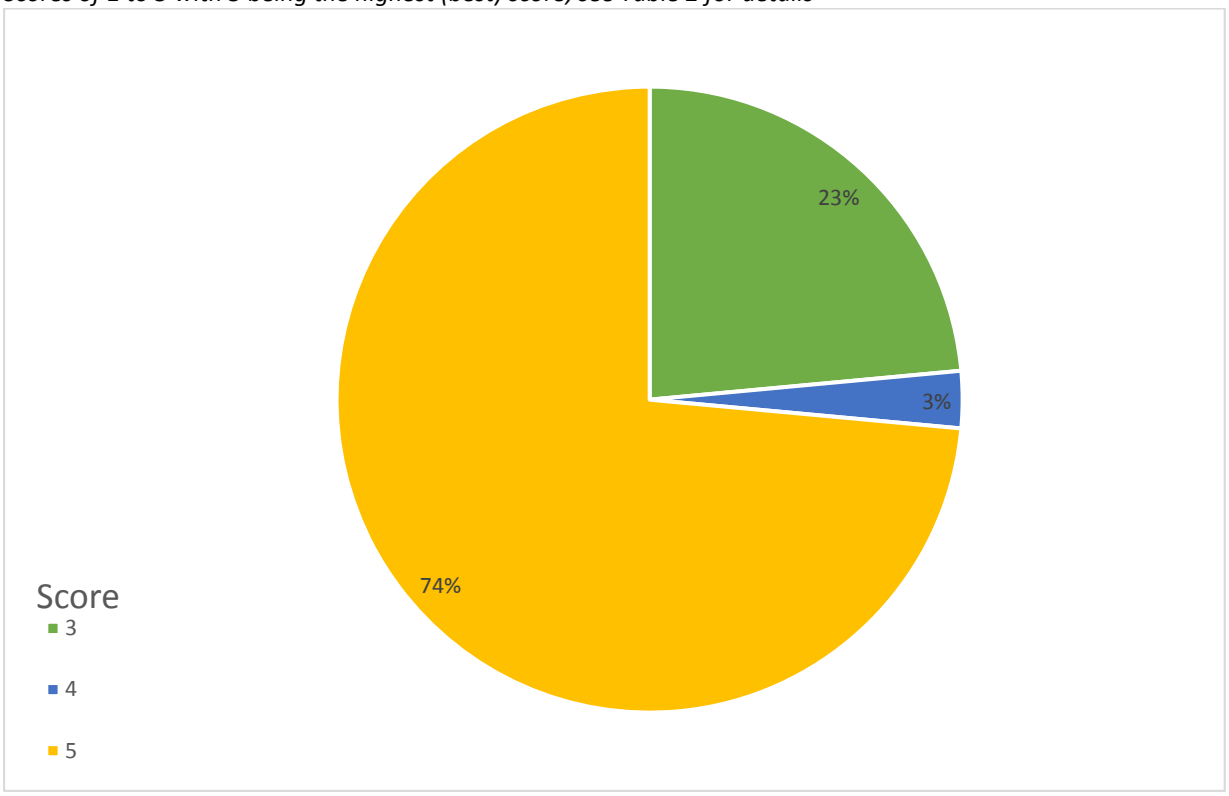
4.4 Efficiency Score

The efficiency score was used to prioritize GI projects that provided the most storage for the least cost. The efficiency score is based on the project's total cost per gallon of storage capacity. Projects were scored as follows:

- 3 when cost per gallon was greater than $4
- 4 when cost per gallon was between $3 and $4
- 5 when cost per gallon was less than $3

Figure 14 illustrates the number of projects for each score. Projects that implement bioretention have a higher score due to bioretention's ability to treat a larger impervious area per square foot of bioretention and potential storage capacity.

FIGURE 14
Efficiency Score Distribution
Scores of 1 to 5 with 5 being the highest (best) score, see Table 2 for details



4.5 Final Score

The initial feasibility score, cost score, and efficiency score was averaged to calculate the overall score. Figure 15 illustrates the overall score distribution. Projects that were eliminated after the initial scoring have the lowest scores in that municipality. Projects with scores less than 3 were not evaluated in detail.

FIGURE 15
Final Score Histogram

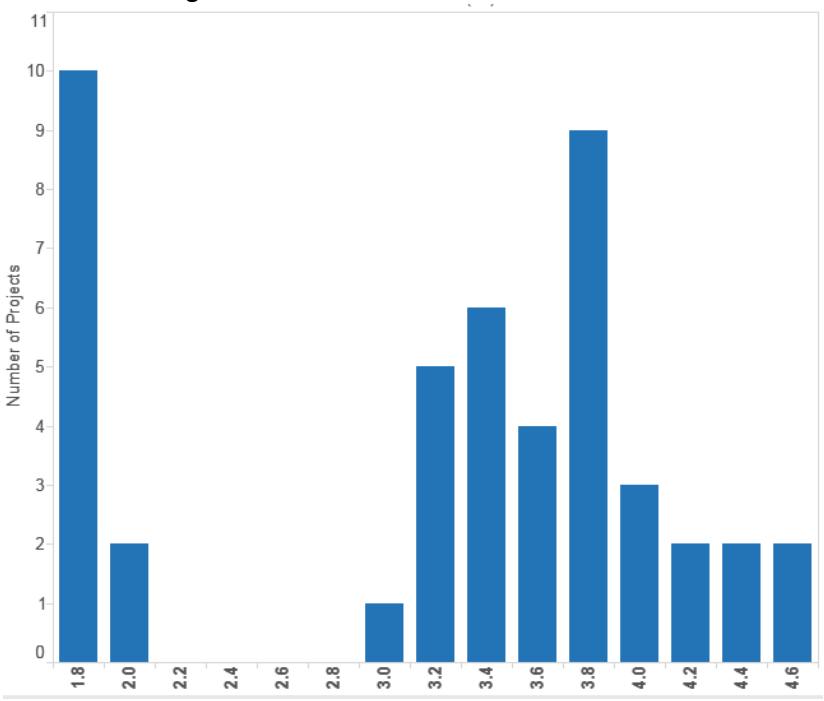


Figure 16 provides summary information by municipality. Brookfield had two very large state highway projects evaluated, which accounts for the highest cost associated with Brookfield and the largest impervious area. The project goal of evaluating two or more projects for each municipality was achieved, when accounting the second project in Elm Grove also included one of the large Brookfield projects.

FIGURE 16
Totals by Municipality

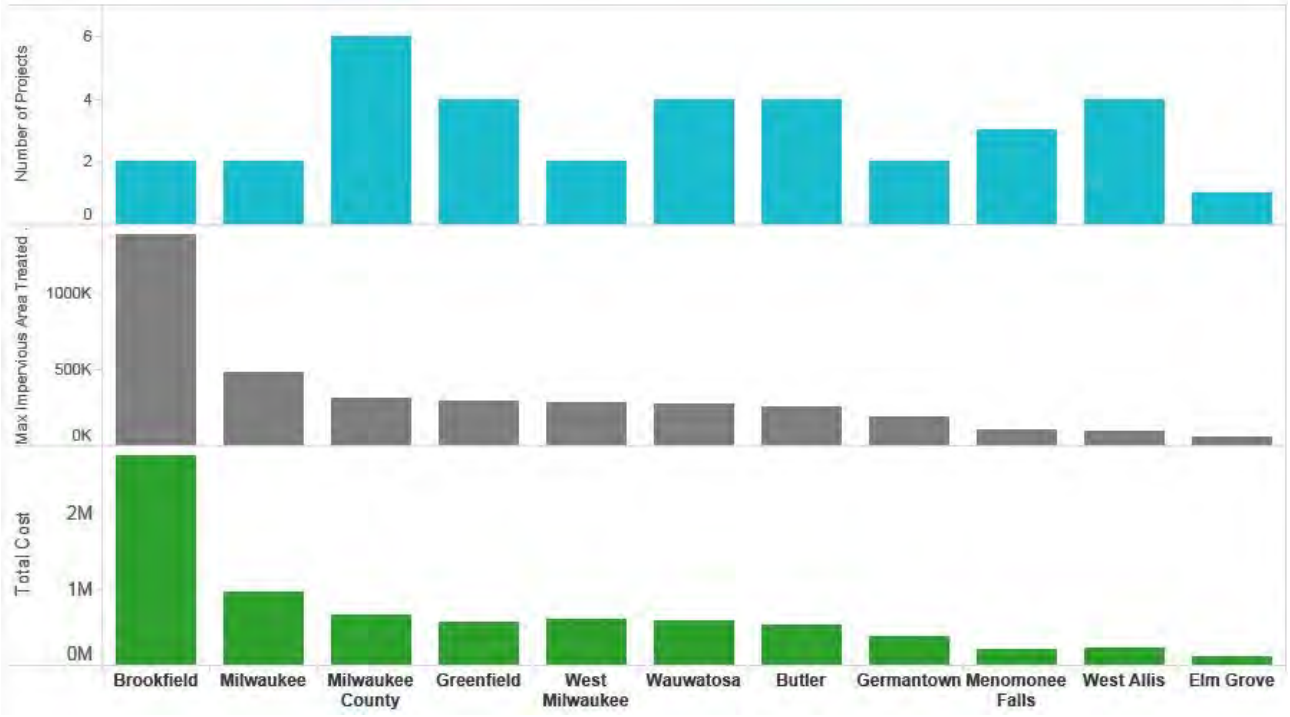


Table 4 has the final recommended projects in order of their overall score. Projects are color coded by municipality. An overall score for projects not at least within the top two projects by municipality is not provided.

Ready for implementation within the next several years, the analysis identified capital costs of over $7 million in potential GI projects that could provide nearly 3 million gallons of GI storage. Of potential interest to funders, the median project cost was just under $100,000. The median project cost was able to capture runoff from 75 percent of the impervious area within the road reconstruction project footprint, indicating runoff from all imperviousness cannot be readily captured without implementing additional technologies, such as porous pavement in conjunction with bioretention.

Additional analysis detail on all of the scoring categories for each project is included in Appendix C.

5 Technical Considerations

The initial prioritization considered 46 projects. The project team took the initial prioritization and selected the top two to four projects by municipality to do a further screening for GI potential. This team considered such elements as: topography, hydrologic soil group, the presence of utilities, GI siting, the space that is available for bioretention or porous pavement, the area that would be needed for GI to fully treat all of the imperviousness within the project footprint, and other factors. The process involved reviewing each project in GIS and “heads up” digitizing potential locations for GI. Preference was given to bioretention because it is the most cost-effective strategy evaluated for the project with the assumptions used.

In addition, several municipalities mentioned porous pavement maintenance as a concern due to the lack of equipment to maintain it, such as vacuum sweepers.

The GIS analysis of the projects resulted in draft GI recommendations for each project. This allowed the creation of project-specific maps with GI opportunity (see example in Figure 17). The maps were then reviewed with each municipality through one-on-one meetings.

TABLE 4
Project Scoring and Cost Results

Overall Rank	Project ID	Project Name	Municipality	CIP Year	Type	Overall Score	Total Cost	Potential Storage Capacity (gal)	Cost per Gallon
1	MF0005	St. Francis Drive	Menomonee Falls	2018	Road	4.65	$ 36,000	13,665	$ 2.63
2	BU0004	Frontier Park (south lot)	Butler	TBD	Parking	4.62	$ 12,000	4,522	$ 2.65
3	MC0004C	BHD Parking Lot North	Milwaukee County	2016	Parking	4.48	$ 38,000	14,202	$ 2.68
4	WE0005	89th Street	West Allis	2016	Road	4.45	$ 37,000	13,787	$ 2.68
5	MF0003	Cheyenne Drive	Menomonee Falls	2018	Road	4.31	$ 63,000	23,635	$ 2.67
6	GF0004	35th Frontage Rd	Greenfield	2017	Road	4.29	$ 59,000	22,076	$ 2.67
7	MC0001	West Oklahoma	Milwaukee County	2018	Road	4.16	$ 111,000	41,763	$ 2.66
8	GF0002	60th St	Greenfield	2017	Road	4.15	$ 87,000	32,727	$ 2.66
9	EG0001	Village Hall	Elm Grove	TBD	Parking	4.05	$ 105,000	39,318	$ 2.67
10	MF0002	Cherokee Drive	Menomonee Falls	2017	Road	3.99	$ 103,000	38,526	$ 2.67
11	WA0005	Gridley Alley	Wauwatosa	2016	Alley	3.98	$ 22,000	5,075	$ 4.34
12	MC0002	Currie Park Service Yard	Milwaukee County	2015	Parking	3.97	$ 94,000	35,098	$ 2.68
13	GE0001	River Crest Drive	Germantown	2015	Road	3.97	$ 41,000	15,545	$ 2.64
14	WA0006	Center_74th to 75th Alley	Wauwatosa	2017	Alley	3.96	$ 14,000	3,124	$ 4.48
15	WE0003	Rogers Alley	West Allis	2015	Alley	3.89	$ 29,000	6,581	$ 4.41
16	BU0003	N 127th St	Butler	TBD	Road	3.88	$ 27,000	6,118	$ 4.41
17	MC0004A	BHD Parking Lot South	Milwaukee County	2016	Parking	3.81	$ 48,000	11,129	$ 4.31
18	MC0003	Currie Park Clubhouse	Milwaukee County	2015	Parking	3.81	$ 183,000	68,643	$ 2.67
19	GF0001	Crawford Ave	Greenfield	2019	Road	3.67	$ 142,000	53,326	$ 2.66
20	WA0008	State Street	Wauwatosa	2016	Road	3.66	$ 206,000	72,127	$ 2.86
21	WE0001	Grant Alley	West Allis	2015	Alley	3.64	$ 38,000	8,796	$ 4.32
22	GF0003	43rd St	Greenfield	2016	Road	3.61	$ 288,000	108,046	$ 2.67

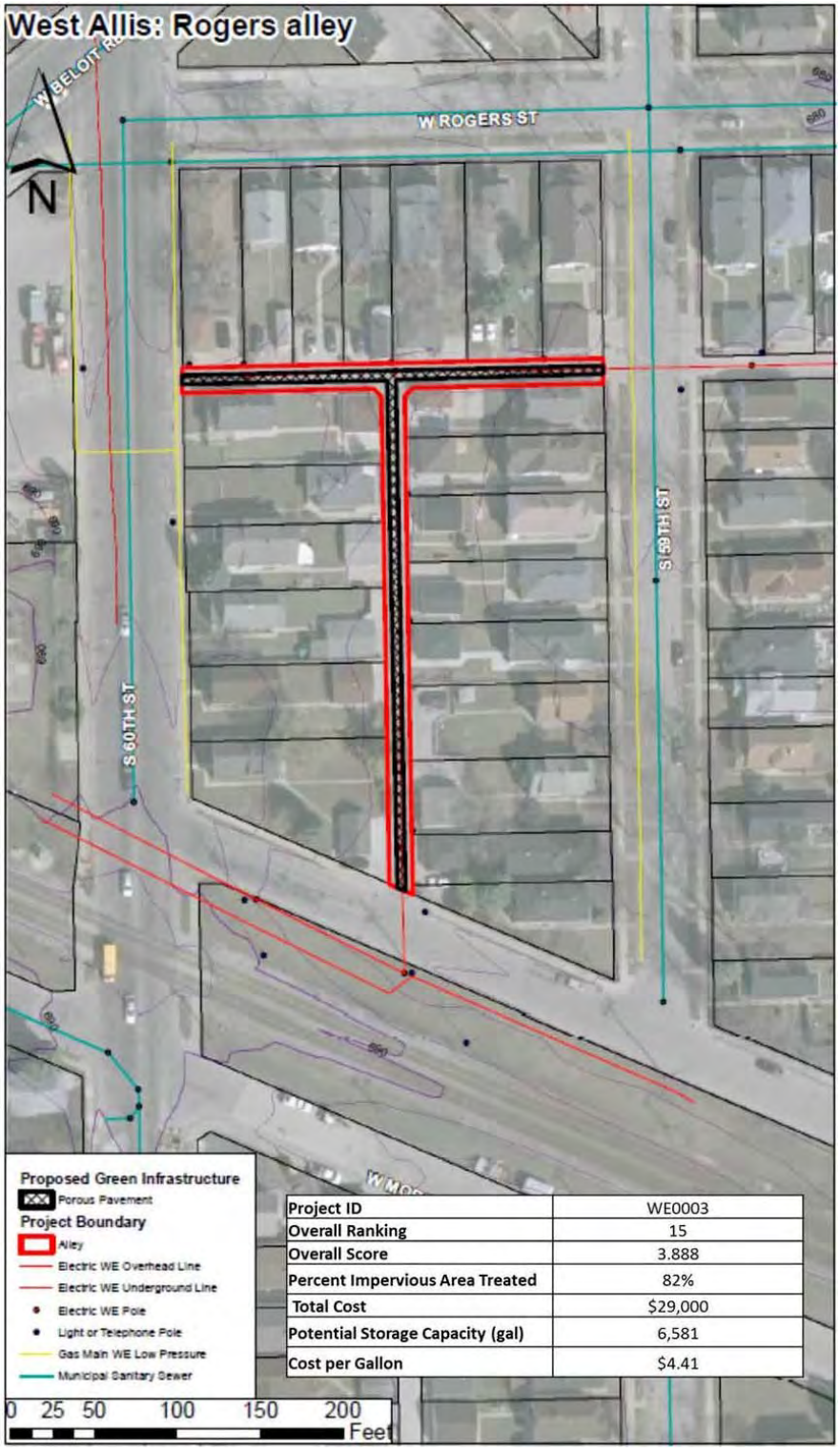
TABLE 4
Project Scoring and Cost Results

Overall Rank	Project ID	Project Name	Municipality	CIP Year	Type	Overall Score	Total Cost	Potential Storage Capacity (gal)	Cost per Gallon
23	WE0006	124th Street	West Allis	2018	Road	3.56	$ 119,000	44,730	$ 2.66
24	MC0004B	BHD Parking Lot Central	Milwaukee County	2016	Parking	3.55	$ 181,000	55,566	$ 3.26
25	MI0002	W Lisbon Ave	Milwaukee	2019	Road	3.52	$ 590,000	221,246	$ 2.67
26	GE0002	Concord Rd	Germantown	2016	Road	3.48	$ 333,000	125,031	$ 2.66
27	WA0009	N 92nd St	Wauwatosa	2018	Road	3.47	$ 336,000	125,941	$ 2.67
28	WM0001	Greenfield Ave	West Milwaukee	2016	Road	3.43	$ 91,000	21,080	$ 4.32
29	MI0001	N 91st St	Milwaukee	2018	Road	3.39	$ 367,000	137,541	$ 2.67
30	WM0002	Miller Park Way	West Milwaukee	2016	Road	3.37	$ 515,000	192,967	$ 2.67
31	BR0001	North Ave East	Brookfield	2018	Road	3.31	$ 1,972,000	739,521	$ 2.67
32	BR0002	North Ave West	Brookfield	2019	Road	3.28	$ 783,000	293,629	$ 2.67
33	BU0002	Silver Spring	Butler	TBD	Road	3.27	$ 402,000	150,700	$ 2.67
34	BU0001	Frontier Park	Butler	TBD	Parking	3.15	$ 95,000	22,008	$ 4.32
35	MC0005	Dretzka Chalet	Milwaukee County	2017	Parking	2.07	-	-	-
36	MC0006	Dretzka Golf Course	Milwaukee County	2018	Parking	2.03	-	-	-
37	EG0002	North Ave East	Elm Grove	2018	Road	1.97	-	-	-
38	WE0004	85th Street	West Allis	2016	Road	1.93	-	-	-
39	WA0003	Harding Blvd North	Wauwatosa	2016	Road	1.90	-	-	-
40	MF0004	May Ave	Menomonee Falls	2016	Road	1.90	-	-	-
41	WA0004	WatertownPlk Alley	Wauwatosa	2017	Alley	1.89	-	-	-
42	WA0007	Center_75th to 76th Alley	Wauwatosa	2017	Alley	1.88	-	-	-
43	WA0002	Harding Blvd South	Wauwatosa	2016	Road	1.85	-	-	-
44	WA0001	N 113th Street	Wauwatosa	2016	Road	1.82	-	-	-

TABLE 4
Project Scoring and Cost Results

Overall Rank	Project ID	Project Name	Municipality	CIP Year	Type	Overall Score	Total Cost	Potential Storage Capacity (gal)	Cost per Gallon
45	MF0001	Arthur Ave	Menomonee Falls	2016	Road	1.82	-	-	-
46	WE0002	Lapham Alley	West Allis	2015	Alley	1.81	-	-	-
					Total	-	$ 7,567,000	2,767,791	-
					Maximum	4.653	$ 1,972,000	739,520	$ 4.48
					Median	3.558	$ 99,000	36,812	$ 2.67
					Average	3.318	$ 222,558	81,405	$ 3.09
					Minimum	1.810	$ 12,000	3,124	$ 2.63

FIGURE 17
Project-Specific GI Opportunity Map



Disclaimer

"No warranties, expressed or implied, are provided for this data/map, its use, or its interpretation. The Milwaukee Metropolitan Sewerage District (MMSD) provides data/maps "as is." The MMSD does not guarantee the quality, content, or accuracy of the information and is not responsible for any misuse or misrepresentation of this information or its derivatives. It is recommended that you carefully consider the accuracy and content of any electronic data, and that you contact the MMSD Facilities Information Department with any questions regarding appropriate use."

MMSD developed the map in Figure 17 as well as the other maps contained in Appendix A. The maps are intended to be a draft representation of GI locations that could be implemented once sufficient design is completed taking into account more detailed site-specific information. While care is taken in creating the maps, the disclaimer on this page accompanies Figure 17 and the maps in Appendix A.

The technical considerations for GI implementation followed much of the flow chart processes developed for the City of Milwaukee Green Streets Plan (CH2M HILL 2013a). An example of the evaluation process is shown in Figure 18. Key considerations include the amount of green space available in a street median or terrace area, the presence and width of street parking lanes, and other technical considerations, such as the depth of bedrock and depth to groundwater. These features drove the project evaluation.

GI strategies focused on bioretention and porous pavement. Other opportunities, such as tree trenches, could be applicable, especially in areas that have limited area for bioretention and would benefit from additional tree plantings.

Residential rain gardens with porous sidewalk.

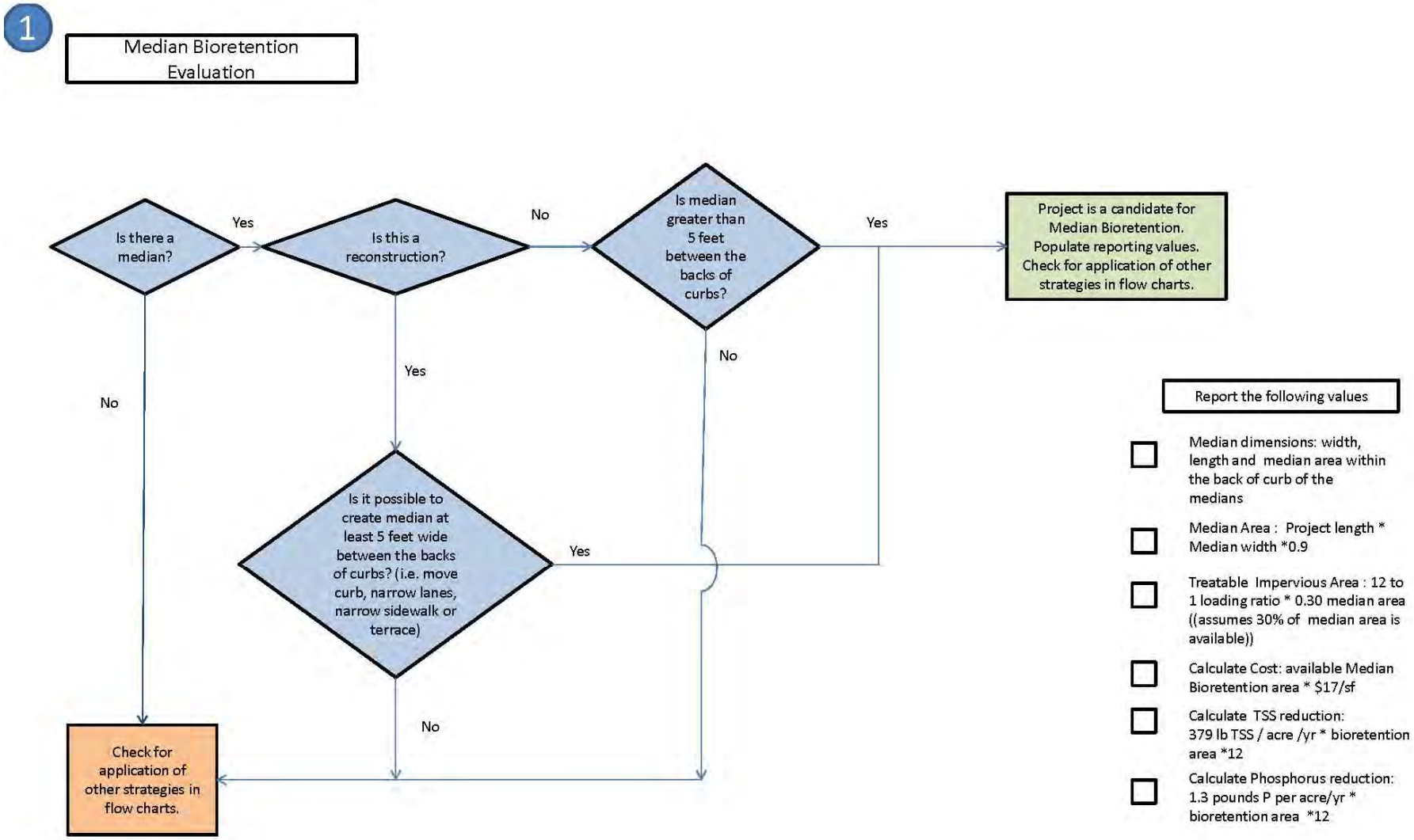
6 One-on-One Meetings

The one-on-one meetings provided valuable insight into municipal perspectives on GI implementation that could add value to similar analysis in the future. Meetings were scheduled with all 11 municipalities, with 9 out of the 11 meetings occurring at either the City of Wauwatosa or at MMSD headquarters over the course of one week. The meeting format included review of the overall scoring process and draft maps, with feedback on the specific projects, but also allowed for discussion of questions or concerns about GI in general. Municipal feedback during the meetings included the following:

- Caution that sanitary sewer alignments are often placed along the roadway centerline. When placing bioretention in road medians, care should be taken not to exacerbate inflow and infiltration challenges into the sanitary sewer system. Bioretention in road medians is an example of an easier to implement GI opportunity. The team reviewed available sanitary sewer alignment information in response to this comment and made adjustments on bioretention recommendation locations.
- Feedback on how municipalities would fund GI. Most municipalities indicated that they would use the available MMSD funding for GI implementation. Several municipalities indicated that, if city councils directed municipal staff to implement more GI, stormwater utility funding could be accessed to implement GI projects; currently however, additional funds are not available. A review of the available MMSD funding compared to municipal funding needs (see Table 4), indicates available funding is much less than the potential projects that exist. Table 4 only represents a small fraction of the overall number of projects. One smaller municipality said that many of their roads will be reconstructed within the next 10 years. Significant funding beyond what is available through the MMSD GI programs would be needed for the region to implement GI more broadly. As prior projects have found and as indicated in the survey results for this project, funding GI remains one of the biggest challenges to broader GI implementation.

FIGURE 18

Example GI Strategy Flow Chart Decision Process from Milwaukee Green Streets Plan



- Feedback on funding also extended to GI operation and maintenance. Several municipalities indicated they would have to inform their councils or boards about the cost of GI operation and maintenance before broader GI implementation could occur. However, additional costs may not apply in areas the municipality already maintains. For example, mowing may be replaced by maintaining bioretention plants, which may have the same maintenance costs. Municipalities often use general funds to pay for ongoing public works maintenance. As a result, if additional funds are not made available for GI maintenance, municipalities would be in competition internally between funding GI maintenance and providing other general fund services. Direct competition between GI maintenance and other city services could put GI function at risk over time. Consequently, adding information on GI operation and maintenance would be very beneficial if similar analysis are provided in the future.

Residential setting rain garden with tree plantings.

- Several municipalities expressed an interest in knowing how GI strategies compare when considering life-cycle costs (both capital as well as operation and maintenance costs). Generating present worth cost information for GI strategy options would allow comparing strategies, and would also allow comparison to other practices used to address water quality (detention ponds, street sweeping, etc.). Adding life cycle costs into the evaluation would be useful for future analysis.

- Milwaukee County expressed that they are not eligible for the MMSD Green Solutions funding program for municipalities. Yet, they have many projects that ranked highly from the analysis. Milwaukee County is eligible for other MMSD GI funding programs including the Green Infrastructure Partnership Program and Signature Series. Like other municipalities, Milwaukee County would rely upon grants for GI implementation. Many County projects were observed to have high visibility, with locations in parks and other heavy-use parking areas. Without a specific funding stream for GI, project opportunities will likely be passed over, making identification of funding sources that could apply to Milwaukee County beneficial for realizing broader GI implementation in the Menomonee River Watershed.

Several municipalities expressed a preference for bioretention over porous pavement because they did not have the equipment necessary to maintain porous pavement. As more GI implementation occurs, this concern may be reduced over time if appropriate equipment becomes readily available. However, in the meantime, GI implementation recommendations should consider municipal capabilities for maintenance. Collaboration opportunities with other entities that have maintenance equipment could potentially reduce this concern.

Many municipalities expressed interest in implementing more GI. A concern raised, especially for municipalities that would be implementing GI in new settings, is having pictures to share with residents on what a project would look like. Two municipalities expressed an interest in having GI photos for residential settings. Example photos have been added to this report in response to this request.

While not specifically mentioned in direct feedback, the project team would have preferred to have met with the municipalities at their offices. With meetings successfully scheduled with all 11 municipalities, the approach of conducting the one-on-one meetings at two locations worked well. However, it could provide additional value to municipalities if sufficient budget and time allowed for meetings at individual municipal offices.

7 Water Quality Benefits through Source Loading and Management Model Analysis

Parking lot with bioretention.

The project team provided an opportunity for the municipalities to model the water quality benefits using SLAMM. The SLAMM model provides pollutant reduction information for total suspended solids (TSS) and phosphorus (P) for stormwater runoff through BMPs, including GI practices. During the workshops, one-on-one meetings, and other interactions, municipal representatives said that knowing the water quality benefit GI provides would be useful. Municipalities indicated knowing the water quality benefit GI provides will be especially important when the municipalities find out what their TSS and P load allocations will be under a total maximum daily load (TMDL) analysis in progress.

While municipalities said they valued the water quality benefit information, not all municipalities have the in-house capability to use SLAMM and only two municipalities indicated a willingness to do the modeling. The municipalities were given the GI-recommended project information needed to run SLAMM. However, due to workload and other priorities, the SLAMM modeling was not completed during the project timeframe. This impacted the project's in-kind matching contributions.

Parking lot with porous pavement and bioretention.

Water quality benefits reported by the City of Milwaukee for projects they have modeled in SLAMM predicted a TSS pollutant reduction of 80 percent can occur with bioretention in street medians. P reduction varies with the amount of runoff reduction, but bioretention modeling has shown reductions of 60 percent. This reported modeling from other projects illustrates GI water quality benefits can be substantial.

With roads and parking lots known to contribute a significant amount of pollution, combining GI with planned road and parking lot CIP projects could provide significant water quality benefits to the region.

If this project methodology is repeated in additional municipalities, is the team recommends that a water quality benefits analysis be included for the projects because knowing the water quality benefits would clearly be valued by the municipalities.

SLAMM analysis conducted by municipalities as part of this project obtained the following results:

Porous alley SLAMM analysis for a project in Wauwatosa showed a total suspended solids (TSS) reduction of approximately 50 percent. This is consistent with the other Wauwatosa porous pavement project and WDNR modeling guidance and illustrates substantial TSS improvements can be achieved through GI.

8 Project Survey

Following the one-on-one meetings with the watershed municipalities, the project team administered an online survey to gather project feedback from the 11 municipalities. The goal of the survey was to gain feedback on how useful the project was for participants and how likely they will implement the recommendations. The survey also served to gain a greater understanding of municipal perspectives on general barriers to municipally-led GI projects and possible inducements that could foster more such projects.

The survey received 11 responses from representatives of 10 total municipalities, including Milwaukee County. The full set of questions and summarized responses can be found in Appendix B. Some of the most interesting and instructive findings from the survey are highlighted below.

One key objective of this project for Sweet Water, MMSD, and the entire project team was to raise awareness of key municipal staff on GI opportunities they could be considering as part of their routine capital projects. The second survey question asked “Has this project raised your awareness that there are GI opportunities with street and parking lot reconstruction projects [in your municipality]?” Six of eleven respondents (nearly 73%) chose “Definitely yes” or “Somewhat yes” as their response to this question, an indication that the project indeed was able to raise awareness of GI opportunities. One comment in this section of the survey read: “From a staff standpoint, it has allowed dialog regarding green infrastructure as projects arise.” Fostering that kind of dialog in the early stages of municipal capital project planning was precisely the aim of this project and the City of Milwaukee Green Streets Plan after which this project was modeled. Without awareness of the GI potential with street reconstruction projects, there will be missed implementation opportunities that won’t come around again until decades into the future when roads are once again reconstructed.

When asked (in the fourth survey question) how likely they thought it was that their municipality would implement the two GI opportunities provided to them through this project, five of the ten municipalities represented in the survey indicated it was as least somewhat likely. Some insights into why that number was not higher came through the responses to the survey’s fifth and sixth questions, covering perceived barriers to GI implementation. Nine of eleven respondents replied that there are barriers to implementing the two projects recommended for their municipalities. The top three specific barriers identified were funding, political support, and maintenance concerns. These results are not surprising or new, but they are quite useful in validating and building understanding region-wide (if not nationwide) of where attention and effort must be placed if the goal is to increase reliance on GI approaches for stormwater management.

Another positive feedback on the value of the project came in the form of responses to the survey’s ninth and tenth questions, which asked whether participants would recommend this approach to other municipalities in the region and why. Nine of eleven responded “yes,” citing the increased awareness a process like this brings and the heightened enthusiasm it can generate.

Some additional positive results of the survey came in the form of responses to question 14, which asked whether collaborative efforts like this one, spearheaded by Sweet Water, added value for participants. All eleven respondents replied that the project added value to their municipalities. One commenter noted “I

think projects like this will begin to lead us toward more affordable and successful green infrastructure projects."

One other important highlight from the survey comes from responses to question 11 regarding suggested improvements to the process followed in this project. In addition to noting that elected officials ought to be another key target audience for this kind of work, many respondents emphasized the importance of operation and maintenance costs as part of the information they will need to inform their GI implementation decisions. Future analysis that can include operation and maintenance costs and that would expand the analysis to include a total life-cycle cost analysis (capital as well as operation and maintenance costs) would allow GI implementation decisions to consider overall life-cycle costs to a municipality and to compare those for GI against those for more traditional infrastructure investments in an apples-to-apples way. One survey respondent said it well when they said "I think everyone would like to use green infrastructure more. It is a matter of funding… I think as these projects become more common, the costs may start to come down and we may determine where certain methods [practices] work best."

Finally, when asked what factors would drive them or their municipalities to consider implementing more GI, respondents made it clear that regulatory drivers, be it at the state or regional level, would be most likely to influence their decisions. Increased political and public support for GI would also play a role. Survey respondents indicated that they are motivated to pursue GI by the knowledge that GI improves water quality and by the ancillary benefits provided, including aesthetic improvement and improved drainage. Some pointed out that assistance with GI maintenance—including possible help with logistics, necessary equipment, and the costs—would factor into their decision-making.

The survey provided very useful information to the project team, and MMSD and Sweet Water in particular, who will use these findings to help guide future investments in encouraging the more widespread GI implementation across the region. The hope is that the survey results are also of use to the project's participants themselves as well as to municipal leaders and others from other geographies who may read this report.

9 Improvements for Future Analysis

Feedback from municipalities and observations of the project scoring process identified several potential improvements to the process. Some potential improvements could include the following:

- The information available for depth to groundwater and depth to bedrock was limited to less than or greater than 6 feet. This created little differentiation between projects because most projects had a depth of greater than 6 feet. However, even when the depth was less than 6 feet, it was uncertain if GI implementation was constrained or not since site-specific data might show GI is still practical. Developing more depth categories (i.e. 4, 5, 6, 7, 8, etc.) would expand the scoring values available, provide a range of potential implementation constraints, and bring more differentiation to the numerical scoring.
- Municipalities emphasized the importance of operation and maintenance costs to inform GI implementation decisions. Future analysis that can include operation and maintenance costs would provide additional value to municipalities.
- Related to operation and maintenance costs, expanding the analysis to include a total life-cycle cost analysis (capital as well as operation and maintenance costs) would allow GI implementation decisions to consider overall life-cycle costs to a municipality.
- Using ARC-GIS On-line to share and edit GIS data among the consultant, MMSD, and the municipalities could save time and share important GI implementation information valuable to all project participants.
- Municipalities consistently expressed interest in having water quality benefits quantified for GI projects. However, few municipalities committed to evaluating water quality benefits due to other priorities,

available in-house expertise, and uncertainty about how the outcome of the pending TMDL studies would impact their municipality. Completing a SLAMM water quality analysis as part of the project budget in the future would provide the benefit of communicating the water quality benefits of the GI project implementation.

- Several municipalities expressed appreciation of having the one-on-one meetings to learn more about GI and as an opportunity to educate other municipal staff. Several expressed that it would be valuable to share similar information to city councils and village boards, because clearly communicating the benefits of GI will be needed for public works officials when more significant levels of GI implementation occur.
- Meeting with other entities involved in road reconstruction would be beneficial. For example, some of the significant projects forthcoming in the City of Brookfield will be implemented by Waukesha County. Waukesha County is not a specific member of MMSD, but County road projects will impact the MMSD service area and provide water quality improvement opportunities. Including Waukesha, Ozaukee, and Washington counties in future discussions on GI within the MMSD service area would be beneficial.

10 Available Funding

All survey respondents listed GI funding as the most significant barrier to implementing GI. While the goal of this project is not to solve the funding question, some information on the level of funding needed has been identified through the project. For example, the median price for a GI project identified through this project is just under $100,000 (Table 4) and the project identified over $7 million in potential projects in the next several years without even considering all of the road reconstruction projects available in the Menomonee River Watershed.

Funding for 2015 from MMSD through the Green Solutions program totals $1.5 million and ranges from just over $500,000 for the City of Milwaukee, representing the largest recipient of funds, to $103,000 for Wauwatosa, the next largest recipient of funds, to $4,000 for Butler, as the recipient of the lowest amount of funding in the Menomonee River Watershed.

Other potential funding sources in 2015 include:

- MMSD GI Signature Series
- Fund for Lake Michigan
- WDNR and Coastal Zone Management Grants
- Municipal funding

While the level of funding would optionally to increase for broad-based GI implementation, implementing GI in concert with planned road and parking lot CIP projects allows for stretching available dollars through cost-effective implementation. The City of Milwaukee has indicated cost savings of 50 percent or greater by implementing GI in association with planned road reconstruction projects (Thur, 2015).

11 Conclusions

While the project successfully achieved the project vision of raising GI awareness, municipalities indicated funding is the biggest barrier to GI implementation. The project cost estimates provided insight into the available funding compared to funding needs for a typical project. Most municipalities can implement one or two of the recommended projects with the funding that is available over time.

A typical project costs just under $100,000 (Table 4), and the project identified over $7 million in ready available projects, with more potential projects to be considered. MMSD's 2015 Green Solutions funding level is $1.5 million, with funding levels by municipality varying from over $500,000 to under $5,000. Milwaukee County had a significant number of highly ranked potential projects, but has no specific funding as part of the MMSD's Green Solutions program. However, Milwaukee County does qualify for other GI funding sources. To significantly increase GI implementation, the region will need to consider how to realize increased local and regional funding not only for construction, but also for ongoing maintenance.

Improvements to the project evaluation process were documented, especially for evaluating the depth to groundwater and depth to bedrock implementation constraints. Recommended changes to evaluating the constraints could provide a broader differentiation in the project scores.

Through one-on-one meetings, the municipalities said that SLAMM water quality analysis would be beneficial but, due to either the lack of in-house capabilities or other constraints, the municipalities participated in a limited way for the water quality analysis. This impacted the project's overall in-kind matching contributions. Future analysis would benefit from municipalities including SLAMM water quality evaluation as part of the project scope.

Feedback from one-on-one meetings and the project survey proved that municipalities valued the project. The survey results indicated 8 out of 11 respondents found the project raised awareness of GI opportunities and 9 out of 11 survey respondents believe the project should be expanded to more municipalities. Based upon the project feedback, MMSD has included a draft budget request to expand the evaluation to the remaining 18 municipalities in the MMSD service area.

Other survey results indicated all respondents thought that Sweet Water provided a valuable service to the municipalities by envisioning this project. The survey also provided significant insight into barriers to widespread GI implementation, including the importance of funding, as well as understanding maintenance cost impacts to municipal budgets.

The project survey had good participation, with 10 out of 11 municipalities represented in the final survey results. This project had strong participation, making the findings representative of the municipalities in the Menomonee River Watershed.

12 References

CH2M HILL. 2013a. *Green Streets Stormwater Management Plan*.

CH2M HILL. 2013b. *Milwaukee Metropolitan Sewerage District Regional Green Infrastructure Plan*.

Thur, Tim. 2015. Personnel communication.

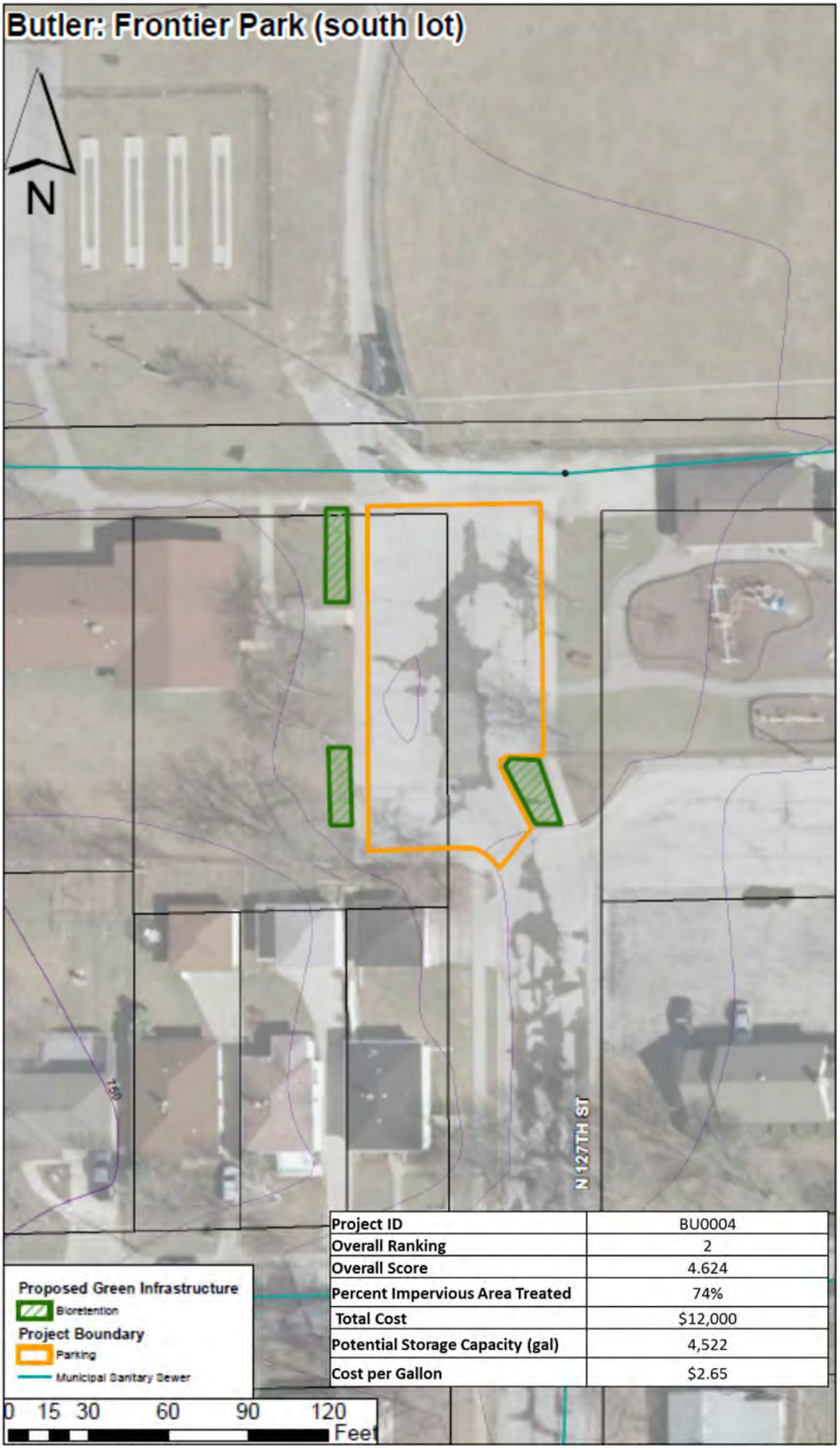
U.S. Environmental Protection Agency (EPA). 2015. *Green Infrastructure Opportunities that Arise During Municipal Operations*.

Water Environment Federation (WEF). 2014. *GI Implementation Manual*.

Appendix A
Maps

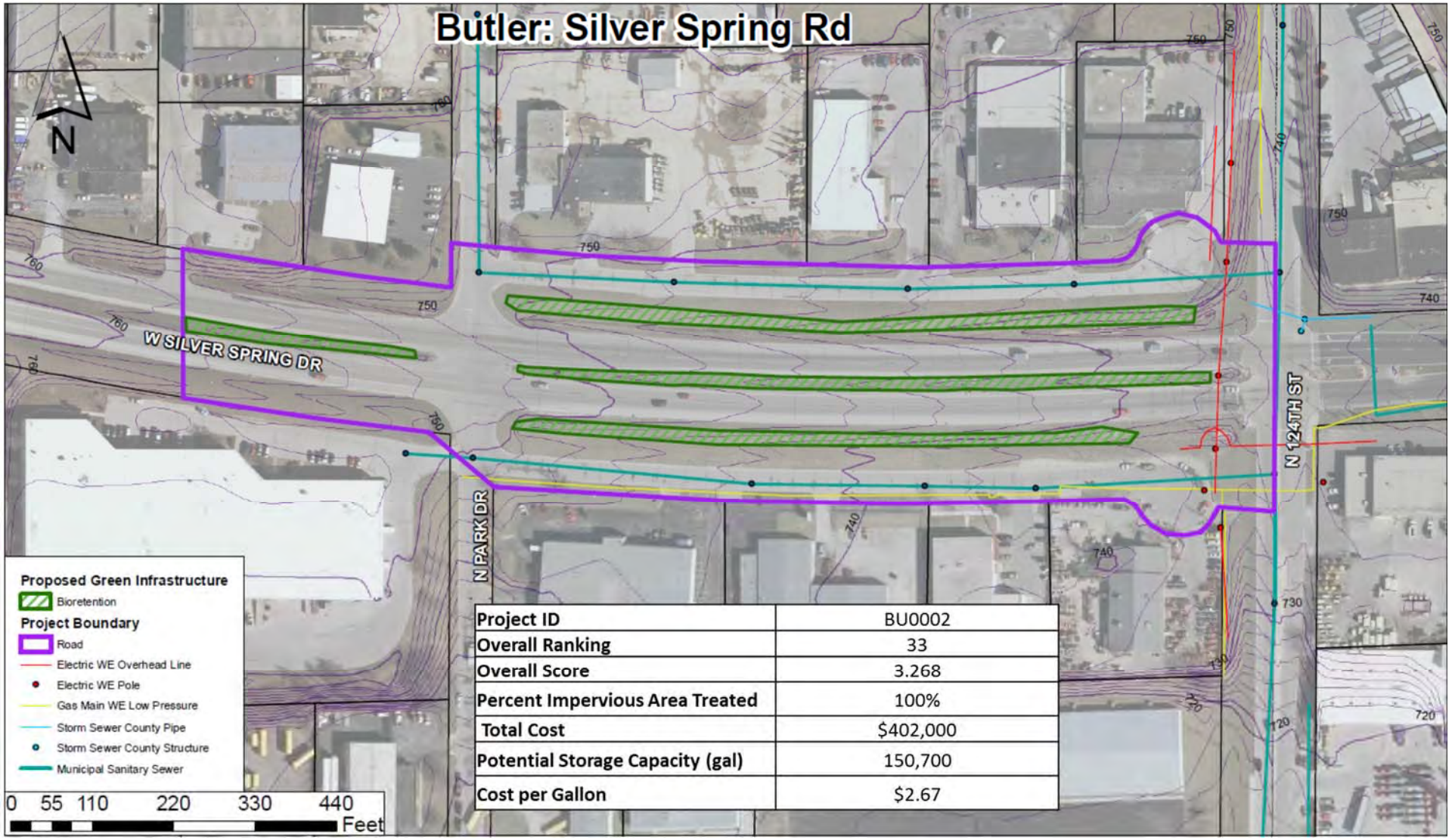
"No warranties, expressed or implied, are provided for this data/map, its use, or its interpretation. The Milwaukee Metropolitan Sewerage District (MMSD) provides data/maps "as is." The MMSD does not guarantee the quality, content, or accuracy of the information and is not responsible for any misuse or misrepresentation of this information or its derivatives. It is recommended that you carefully consider the accuracy and content of any electronic data, and that you contact the MMSD Facilities Information Department with any questions regarding appropriate use."

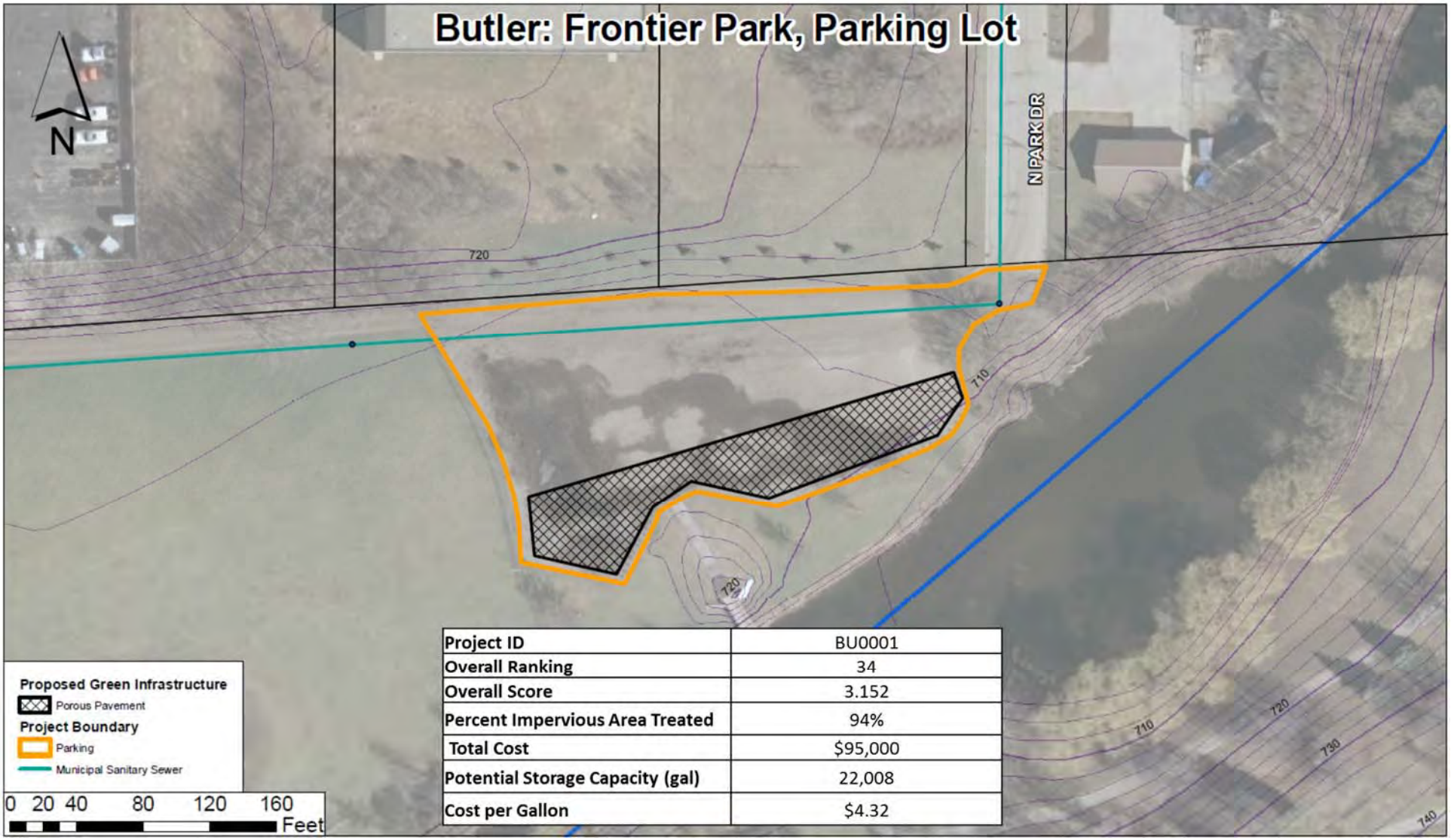
Butler: Frontier Park (south lot)



Project ID	BU0004
Overall Ranking	2
Overall Score	4.624
Percent Impervious Area Treated	74%
Total Cost	$12,000
Potential Storage Capacity (gal)	4,522
Cost per Gallon	$2.65

Project ID	BU0003
Overall Ranking	16
Overall Score	3.881
Percent Impervious Area Treated	48%
Total Cost	$27,000
Potential Storage Capacity (gal)	6,118
Cost per Gallon	$4.41

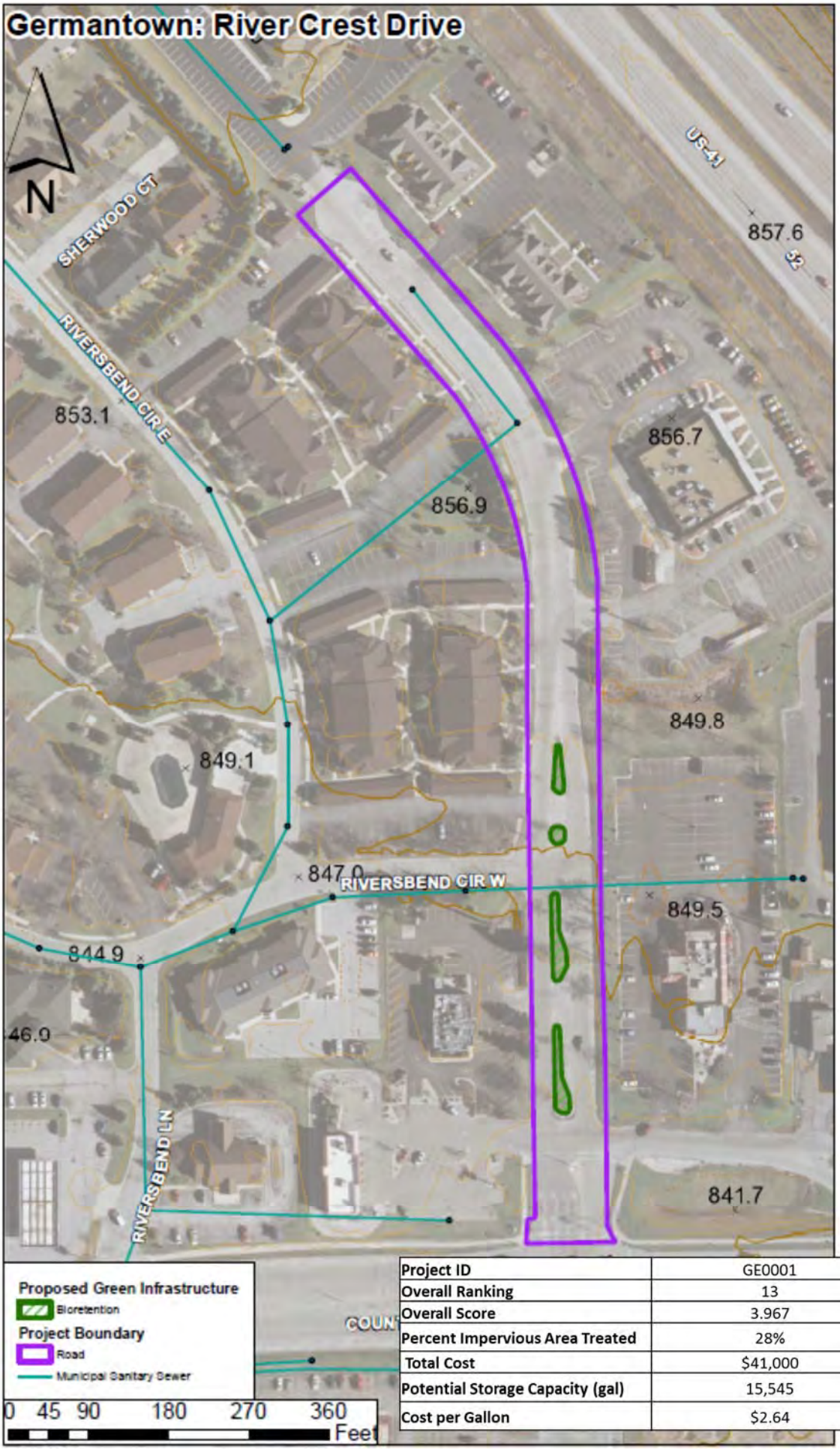

Butler: Silver Spring Rd
N
W SILVER SPRING DR
N PARK DR
N 124TH ST
Proposed Green Infrastructure
Bioretention
Project Boundary
Road
Electric WE Overhead Line
Electric WE Pole
Gas Main WE Low Pressure
Storm Sewer County Pipe
Storm Sewer County Structure
Municipal Sanitary Sewer
0 55 110 220 330 440
Feet
Project ID | BU0002
Overall Ranking | 33
Overall Score | 3.268
Percent Impervious Area Treated | 100%
Total Cost | $402,000
Potential Storage Capacity (gal) | 150,700
Cost per Gallon | $2.67



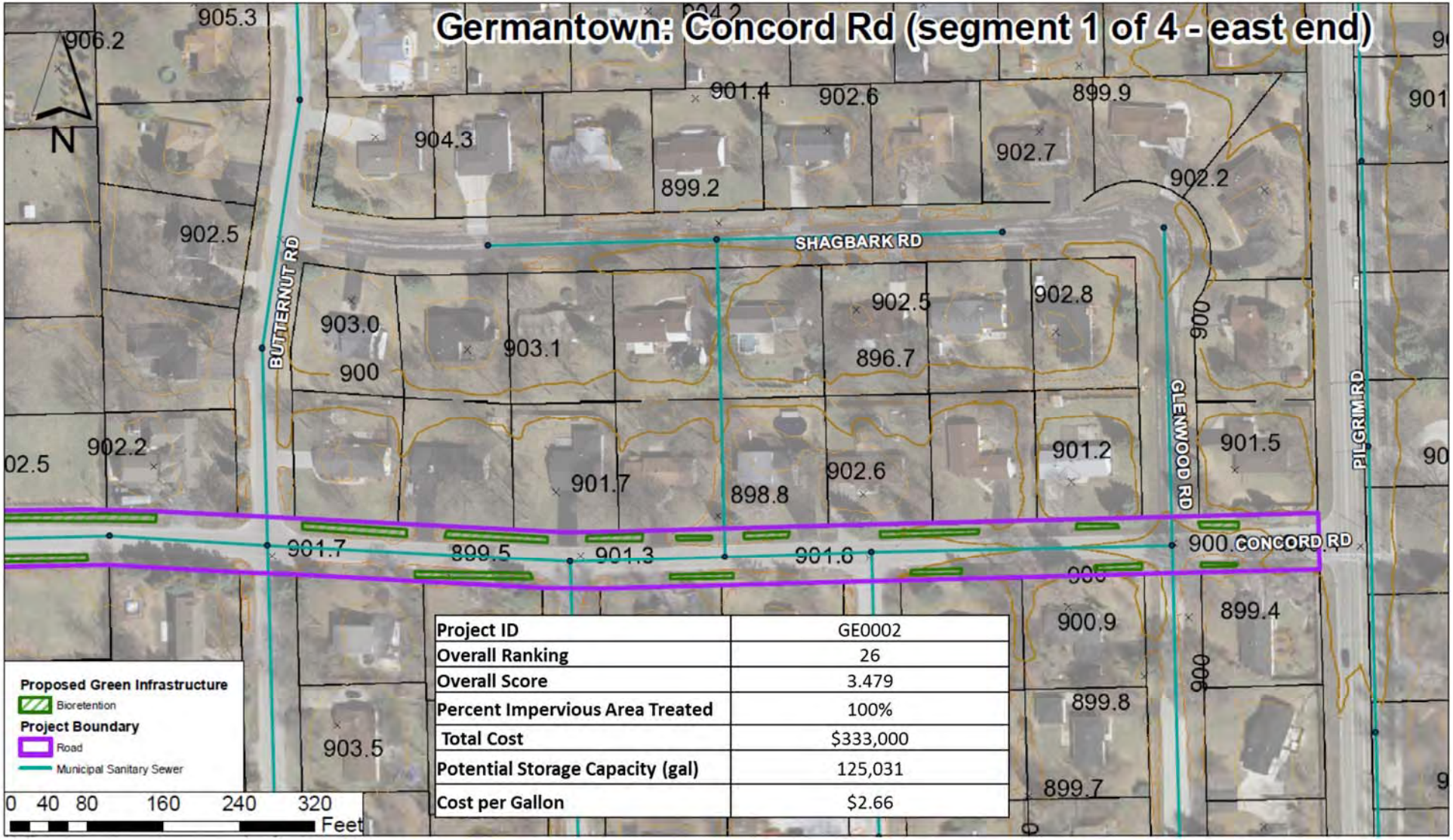
Project ID	BU0001
Overall Ranking	34
Overall Score	3.152
Percent Impervious Area Treated	94%
Total Cost	$95,000
Potential Storage Capacity (gal)	22,008
Cost per Gallon	$4.32

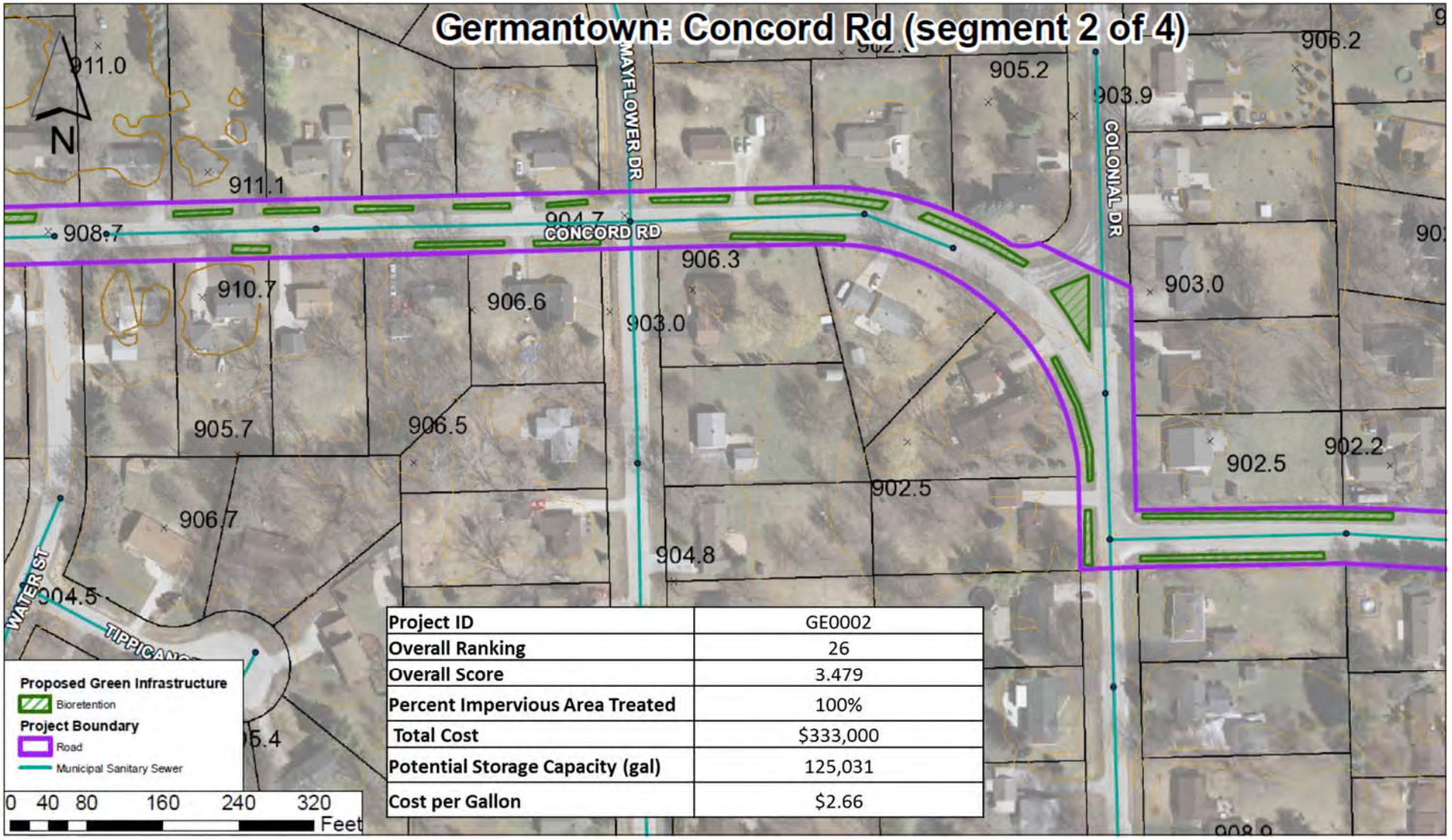

Elm Grove: Village Hall, Parking Lot
N
NICOLET AVE
JUNEAU BLVD
Underwood C
760
740
Proposed Green Infrastructure
Bioretention
Project Boundary
Parking
Municipal Sanitary Sewer
0 40 80 160 240 320
Feet
Project ID EG0001
Overall Ranking 9
Overall Score 4.05
Percent Impervious Area Treated 100%
Total Cost $105,000
Potential Storage Capacity (gal) 39,318
Cost per Gallon $2.67

Germantown: River Crest Drive



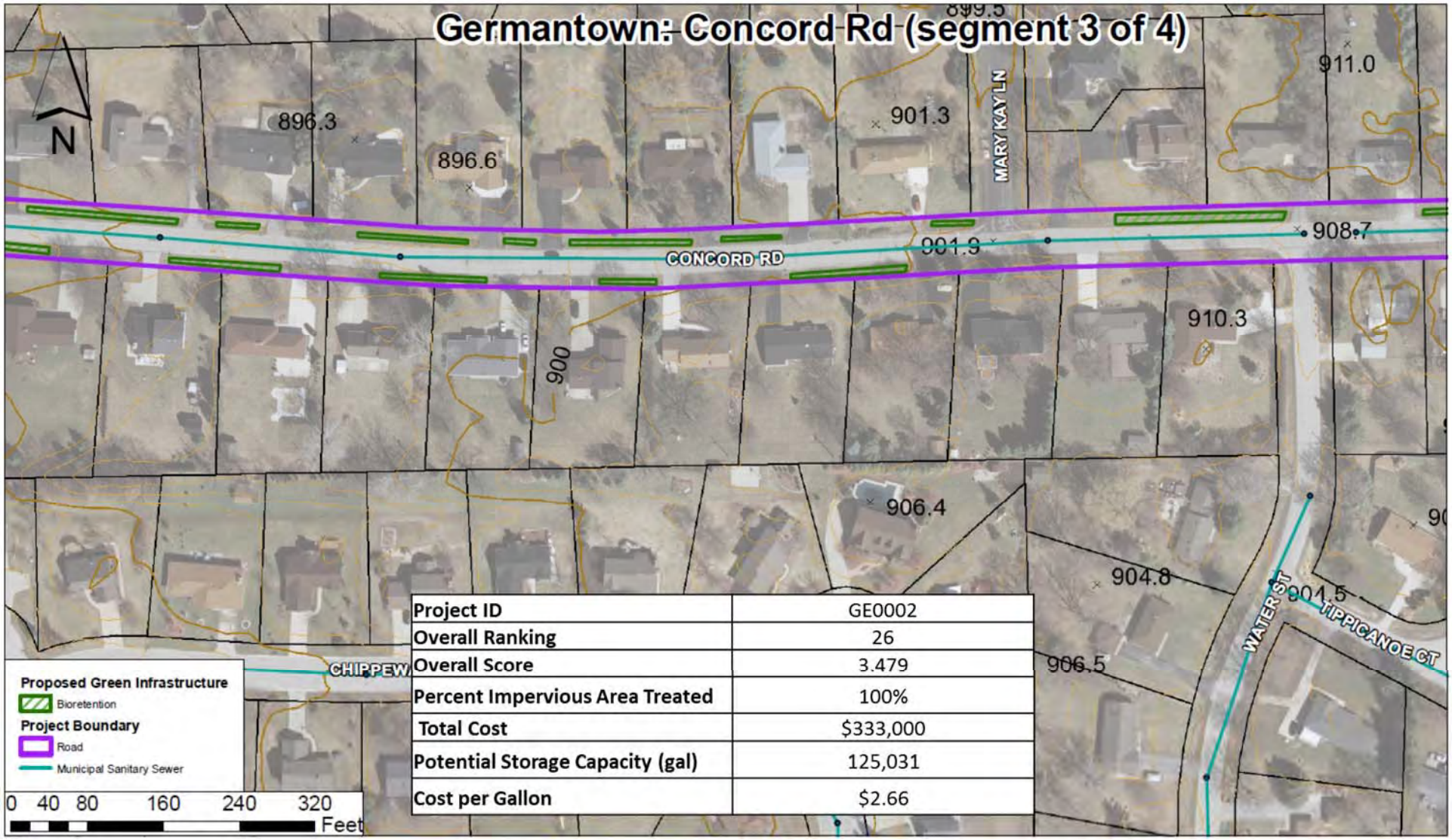
Project ID	GE0001
Overall Ranking	13
Overall Score	3.967
Percent Impervious Area Treated	28%
Total Cost	$41,000
Potential Storage Capacity (gal)	15,545
Cost per Gallon	$2.64


Germantown: Concord Rd (segment 1 of 4 - east end)
N
SHAGBARK RD
BUTTERNUT RD
GLENWOOD RD
PILGRIM RD
CONCORD RD
Proposed Green Infrastructure
Bioretention
Project Boundary
Road
Municipal Sanitary Sewer
0 40 80 160 240 320
Feet
Project ID | GE0002
Overall Ranking | 26
Overall Score | 3.479
Percent Impervious Area Treated | 100%
Total Cost | $333,000
Potential Storage Capacity (gal) | 125,031
Cost per Gallon | $2.66

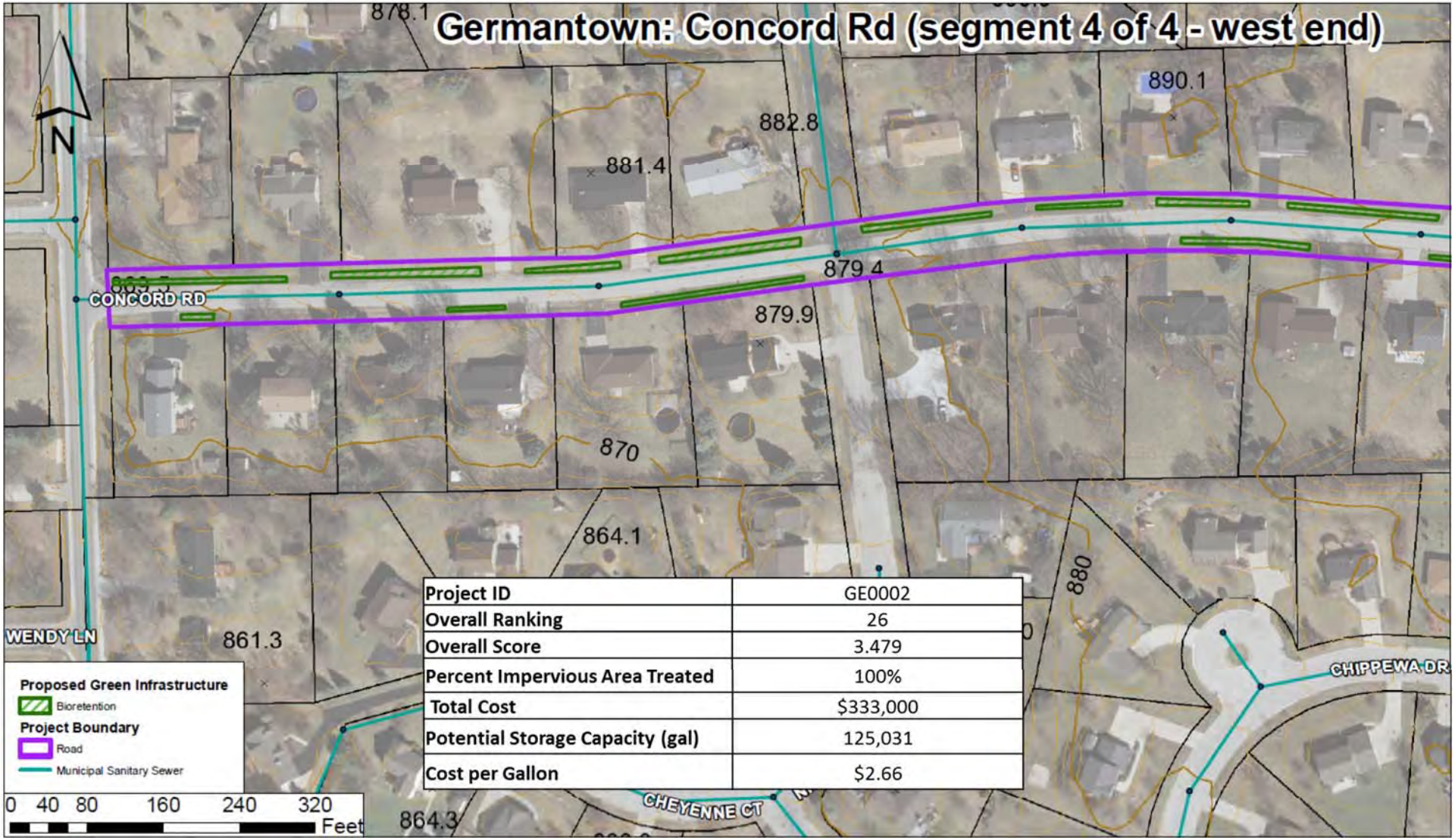


Project ID	GE0002
Overall Ranking	26
Overall Score	3.479
Percent Impervious Area Treated	100%
Total Cost	$333,000
Potential Storage Capacity (gal)	125,031
Cost per Gallon	$2.66

Germantown: Concord Rd (segment 3 of 4)

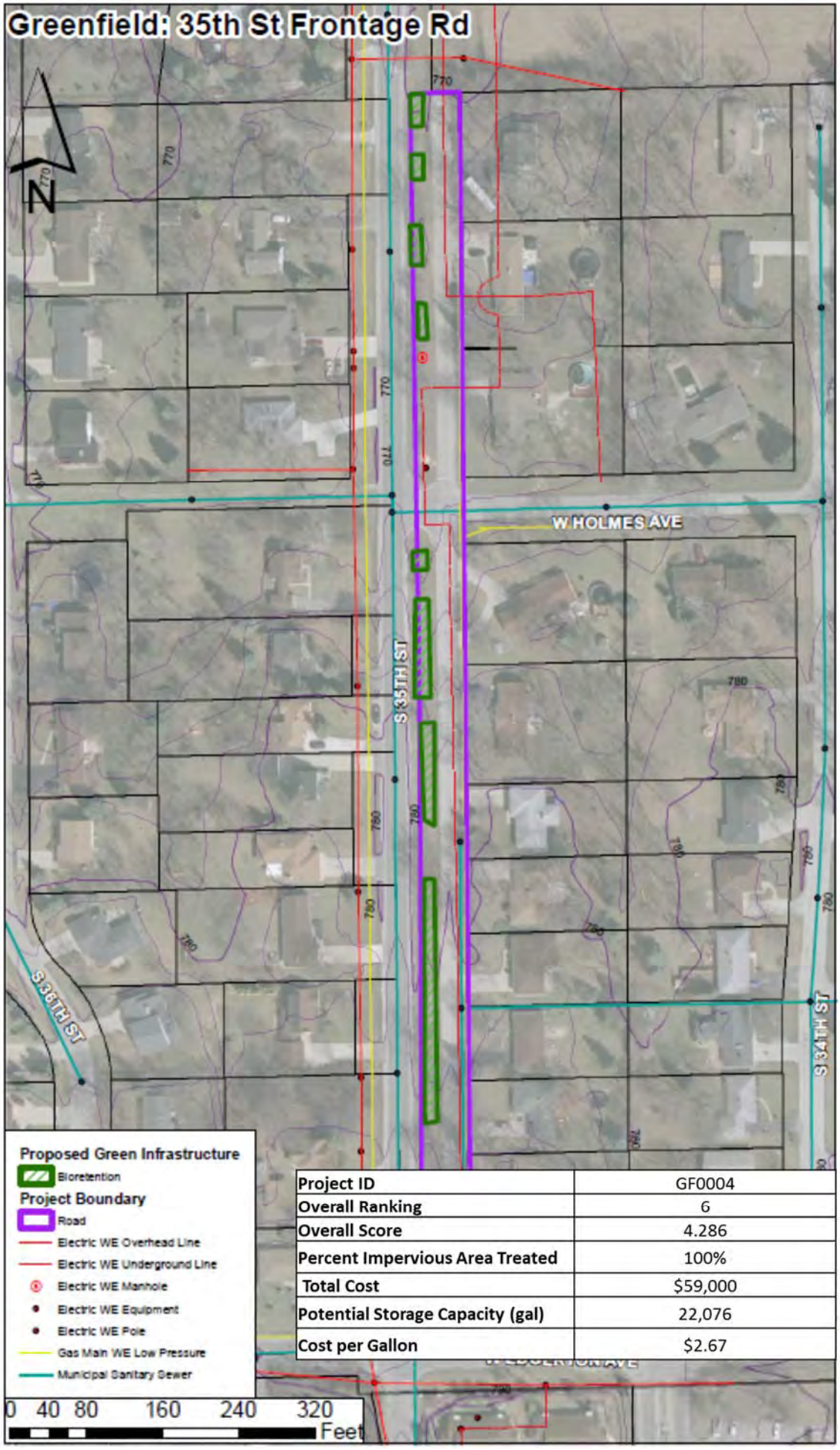


Project ID	GE0002
Overall Ranking	26
Overall Score	3.479
Percent Impervious Area Treated	100%
Total Cost	$333,000
Potential Storage Capacity (gal)	125,031
Cost per Gallon	$2.66

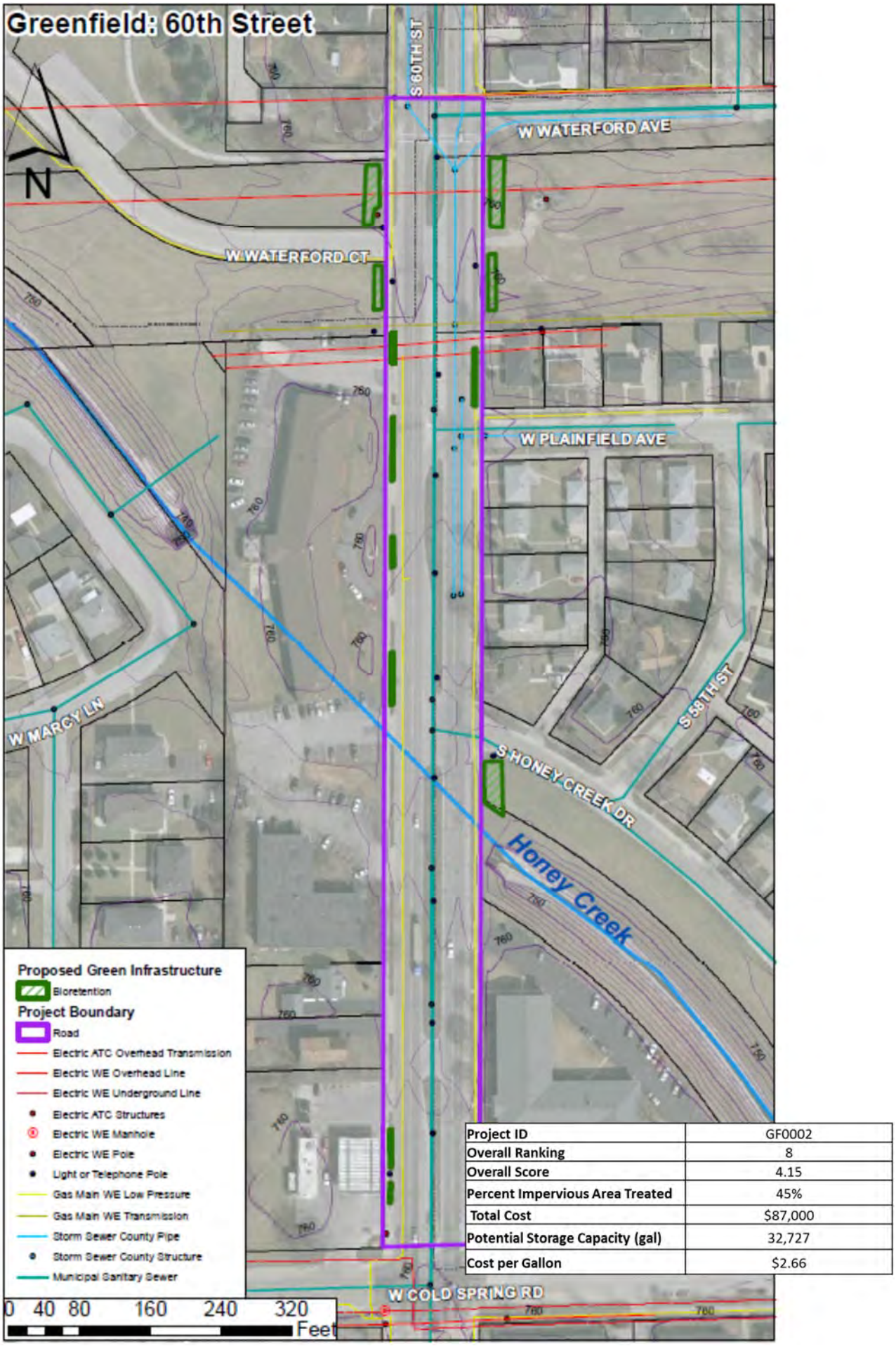


Project ID	GE0002
Overall Ranking	26
Overall Score	3.479
Percent Impervious Area Treated	100%
Total Cost	$333,000
Potential Storage Capacity (gal)	125,031
Cost per Gallon	$2.66

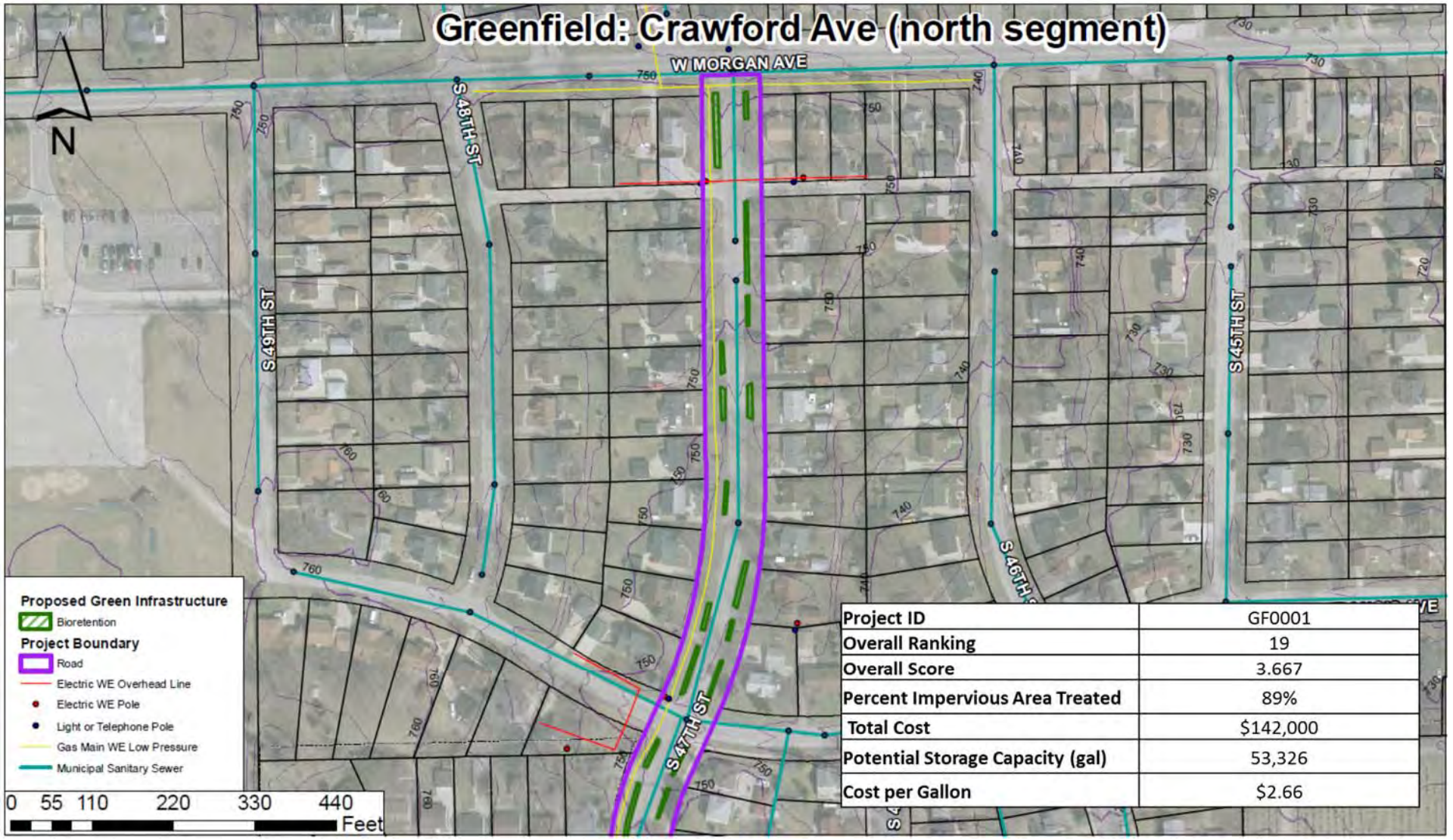
Greenfield: 35th St Frontage Rd



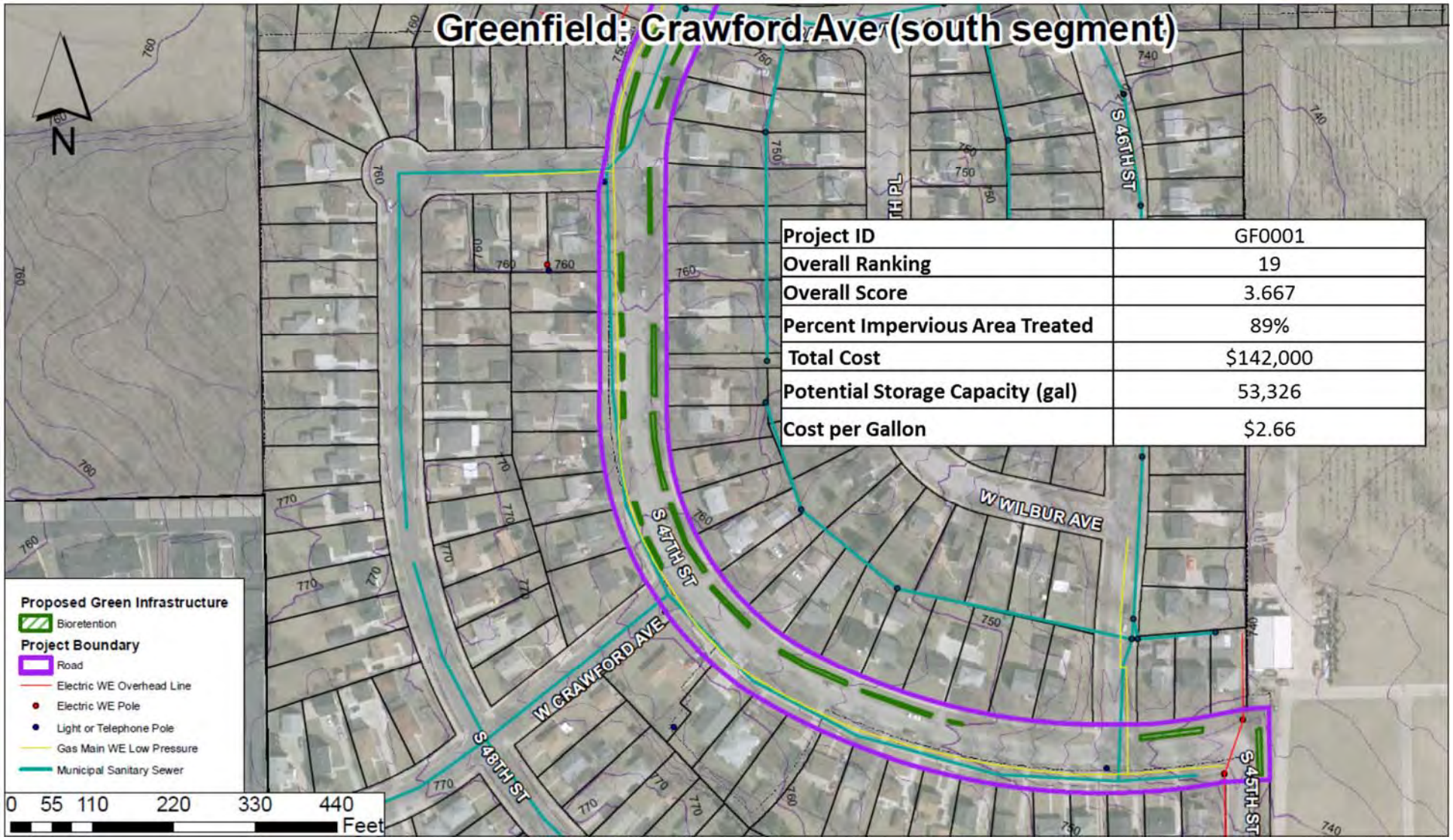
Project ID	GF0004
Overall Ranking	6
Overall Score	4.286
Percent Impervious Area Treated	100%
Total Cost	$59,000
Potential Storage Capacity (gal)	22,076
Cost per Gallon	$2.67



Project ID	GF0002
Overall Ranking	8
Overall Score	4.15
Percent Impervious Area Treated	45%
Total Cost	$87,000
Potential Storage Capacity (gal)	32,727
Cost per Gallon	$2.66

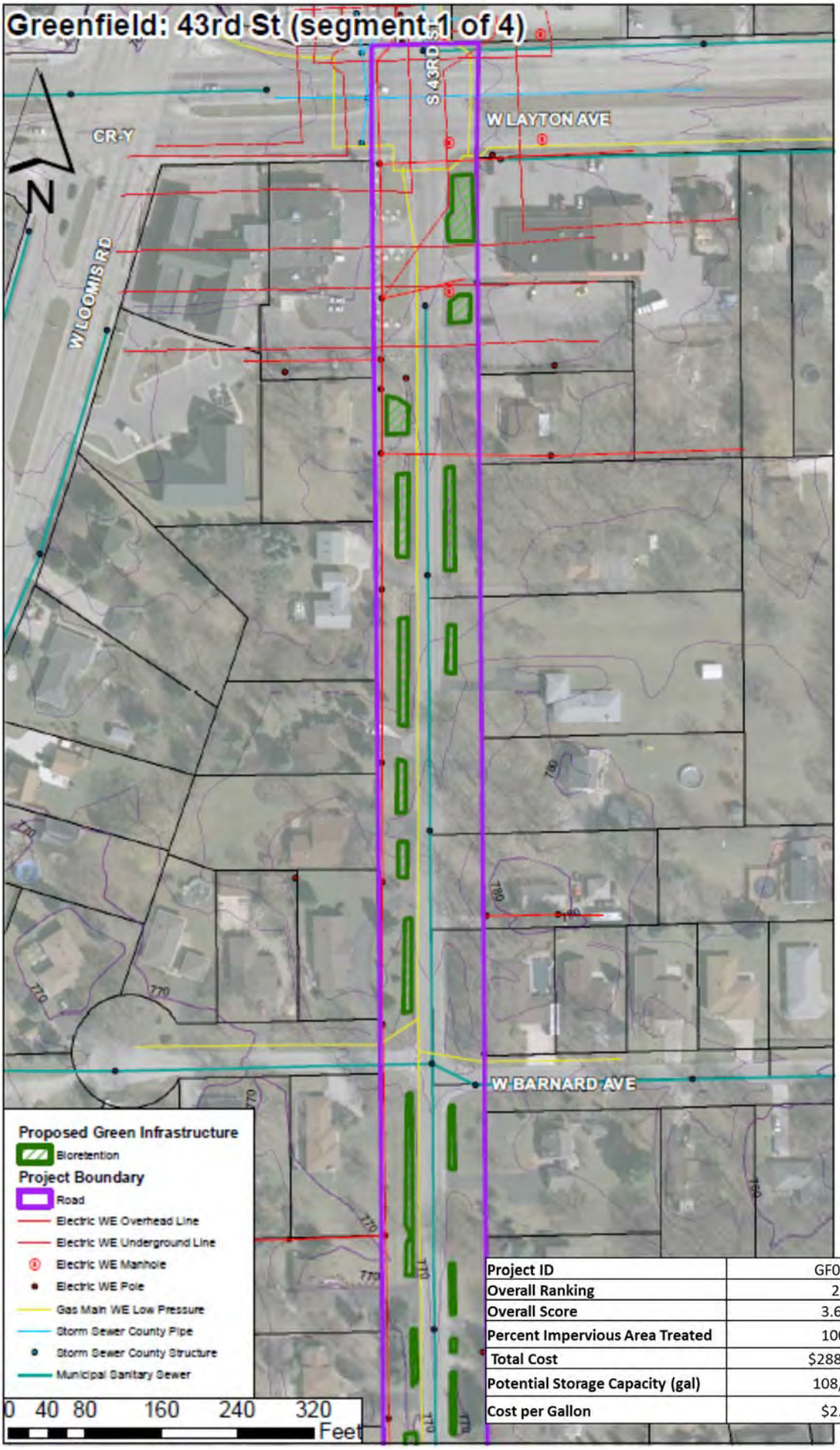

Greenfield: Crawford Ave (north segment)
W MORGAN AVE
S 48TH ST
S 49TH ST
S 45TH ST
S 46TH ST
S 47TH ST
N
Proposed Green Infrastructure
Bioretention
Project Boundary
Road
Electric WE Overhead Line
Electric WE Pole
Light or Telephone Pole
Gas Main WE Low Pressure
Municipal Sanitary Sewer
0 55 110 220 330 440
Feet
Project ID GF0001
Overall Ranking 19
Overall Score 3.667
Percent Impervious Area Treated 89%
Total Cost $142,000
Potential Storage Capacity (gal) 53,326
Cost per Gallon $2.66

Greenfield: Crawford Ave (south segment)



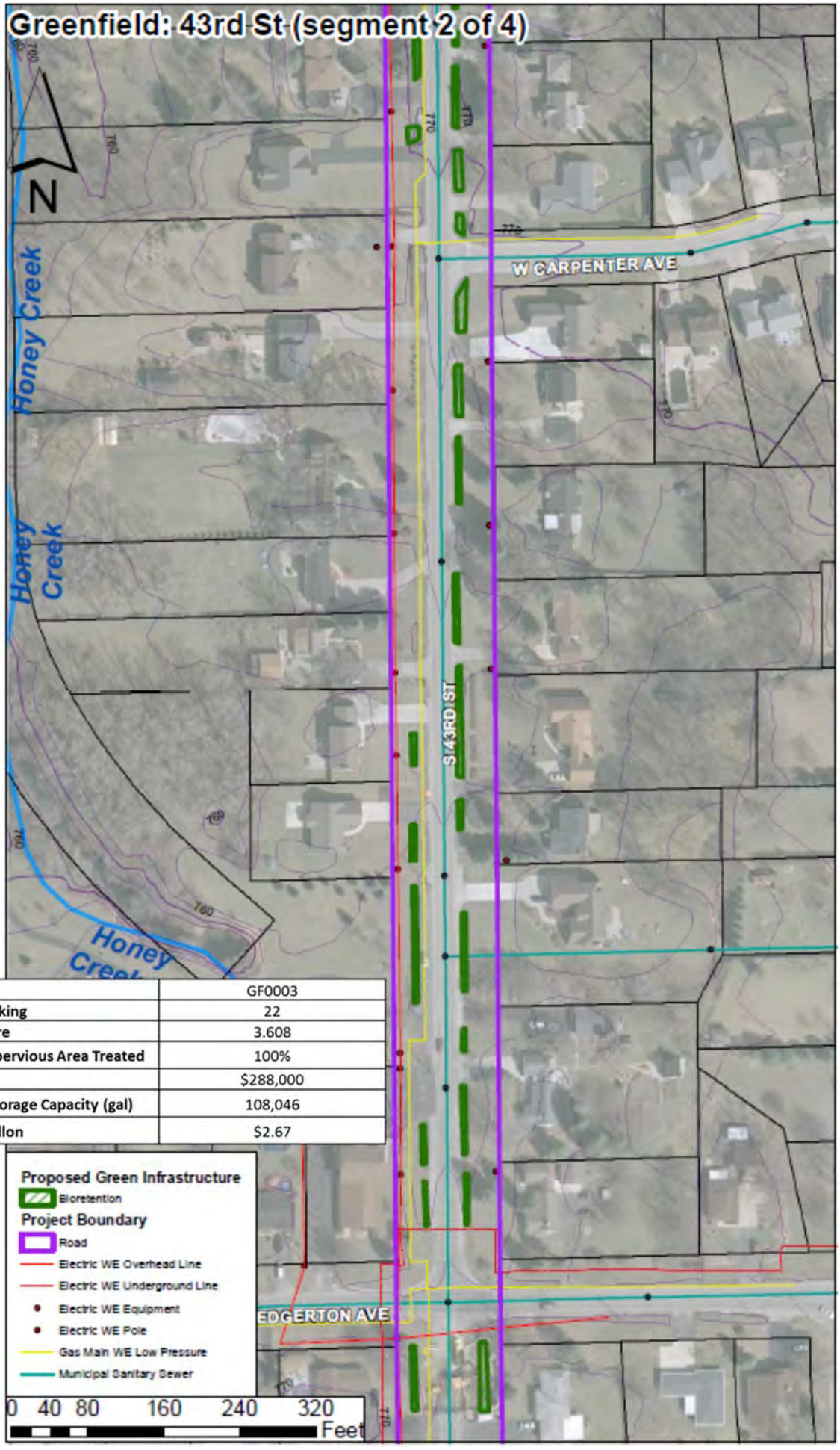
Project ID	GF0001
Overall Ranking	19
Overall Score	3.667
Percent Impervious Area Treated	89%
Total Cost	$142,000
Potential Storage Capacity (gal)	53,326
Cost per Gallon	$2.66

Greenfield: 43rd St (segment 1 of 4)



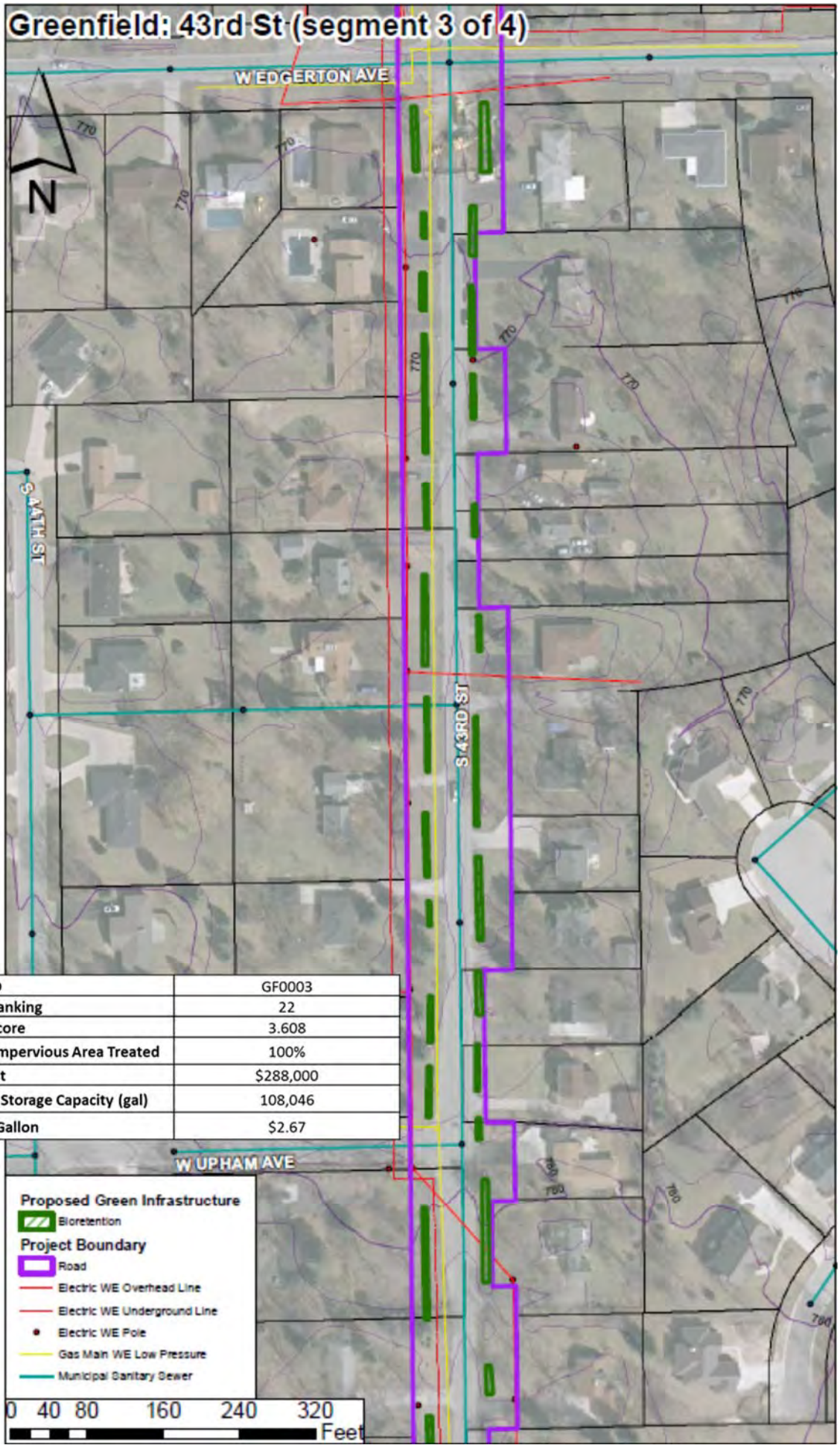
Project ID	GF0003
Overall Ranking	22
Overall Score	3.608
Percent Impervious Area Treated	100%
Total Cost	$288,000
Potential Storage Capacity (gal)	108,046
Cost per Gallon	$2.67

Greenfield: 43rd St (segment 2 of 4)



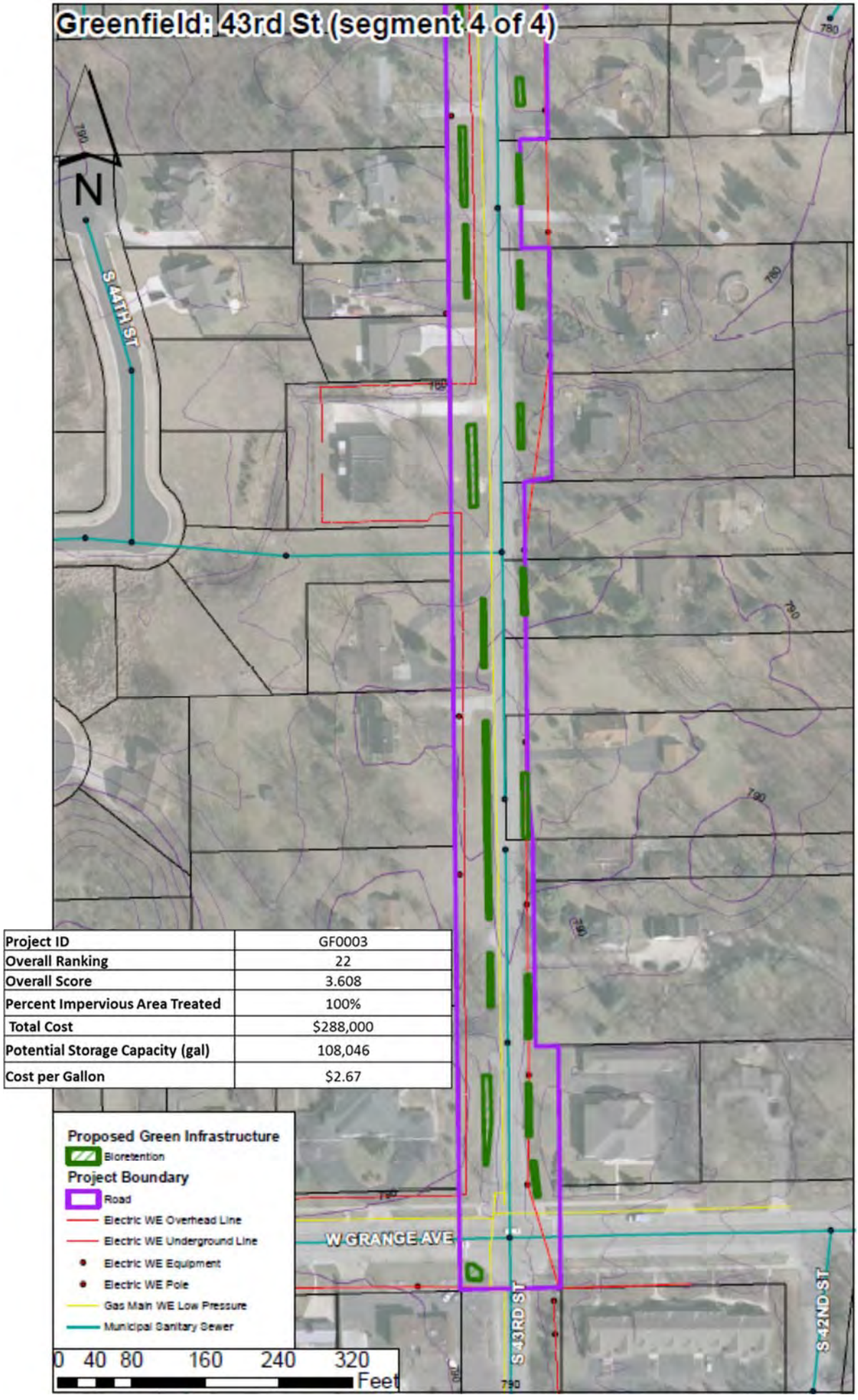
Project ID	GF0003
Overall Ranking	22
Overall Score	3.608
Percent Impervious Area Treated	100%
Total Cost	$288,000
Potential Storage Capacity (gal)	108,046
Cost per Gallon	$2.67

Greenfield: 43rd St (segment 3 of 4)



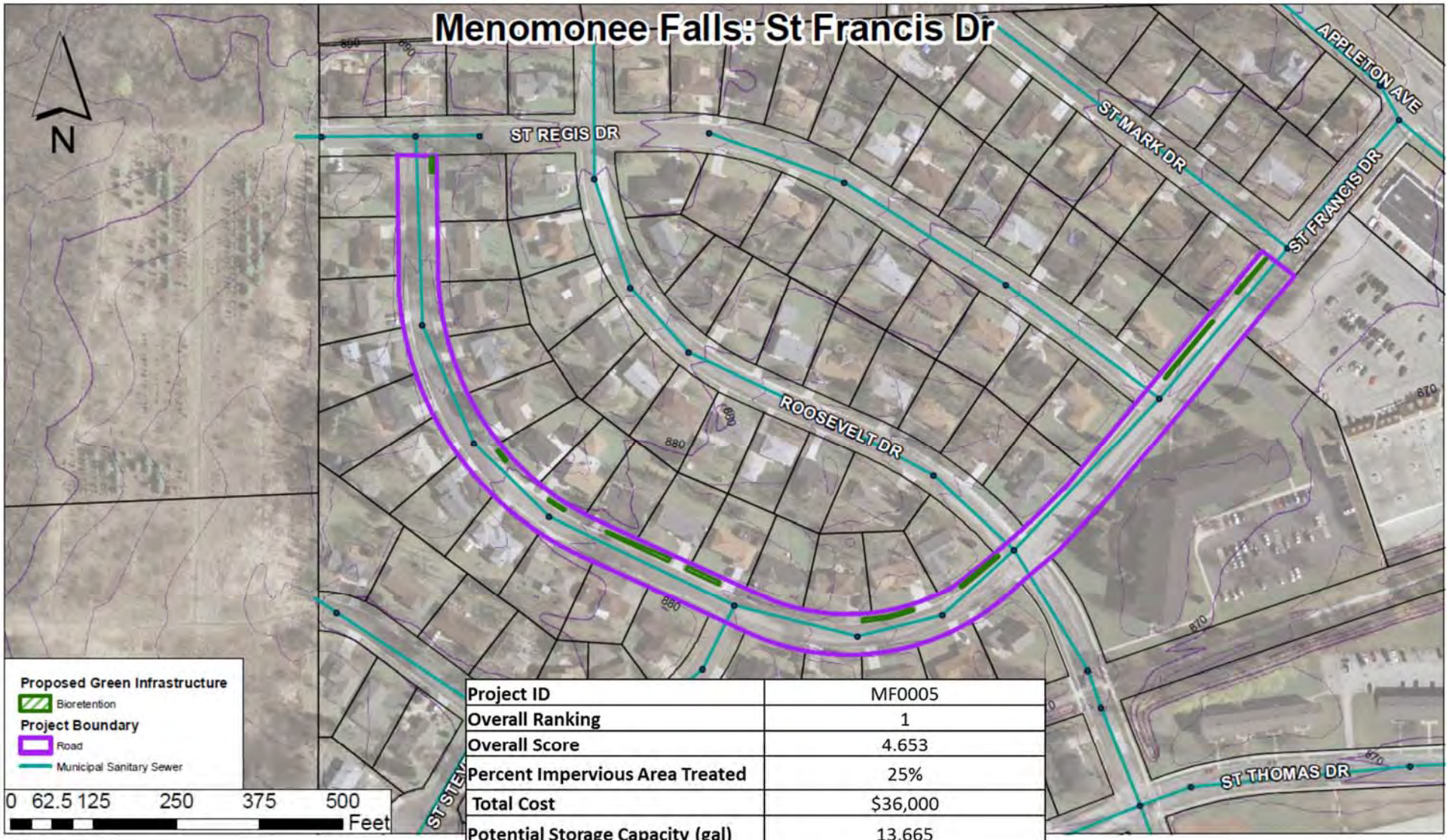
Project ID	GF0003
Overall Ranking	22
Overall Score	3.608
Percent Impervious Area Treated	100%
Total Cost	$288,000
Potential Storage Capacity (gal)	108,046
Cost per Gallon	$2.67

Greenfield: 43rd St (segment 4 of 4)

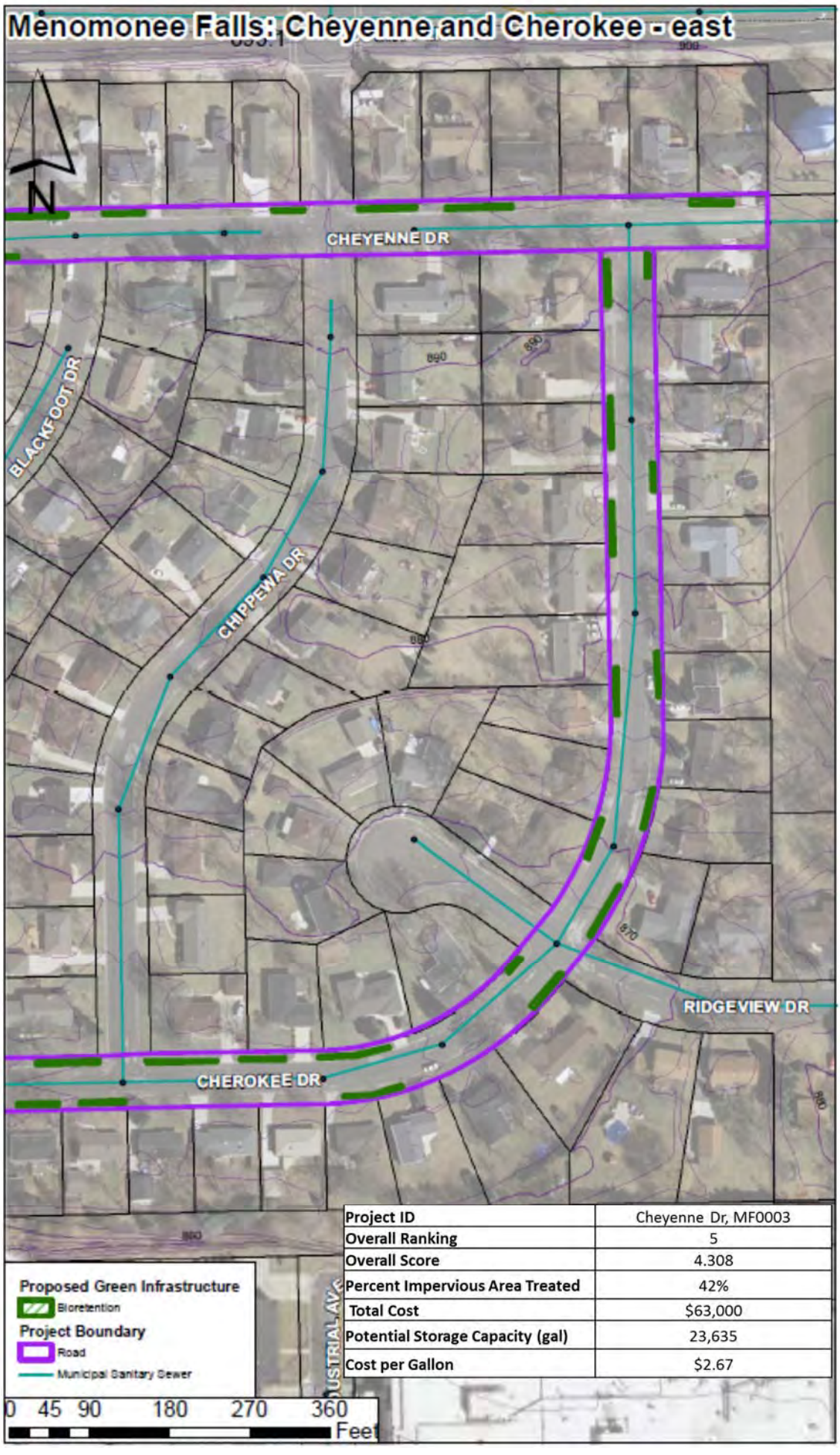


Project ID	GF0003
Overall Ranking	22
Overall Score	3.608
Percent Impervious Area Treated	100%
Total Cost	$288,000
Potential Storage Capacity (gal)	108,046
Cost per Gallon	$2.67

Menomonee Falls: St Francis Dr

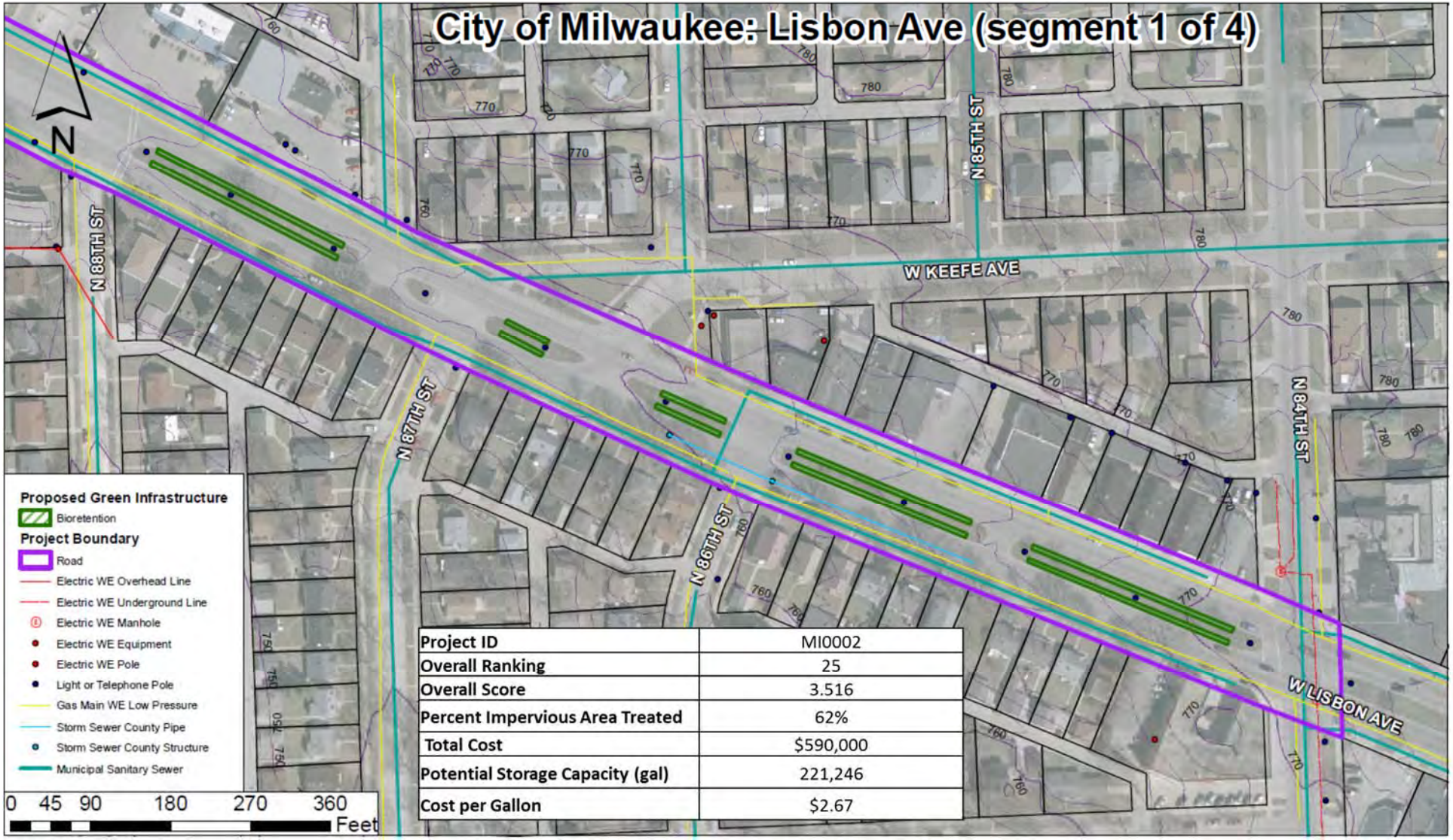


Project ID	MF0005
Overall Ranking	1
Overall Score	4.653
Percent Impervious Area Treated	25%
Total Cost	$36,000
Potential Storage Capacity (gal)	13,665
Cost per Gallon	$2.63

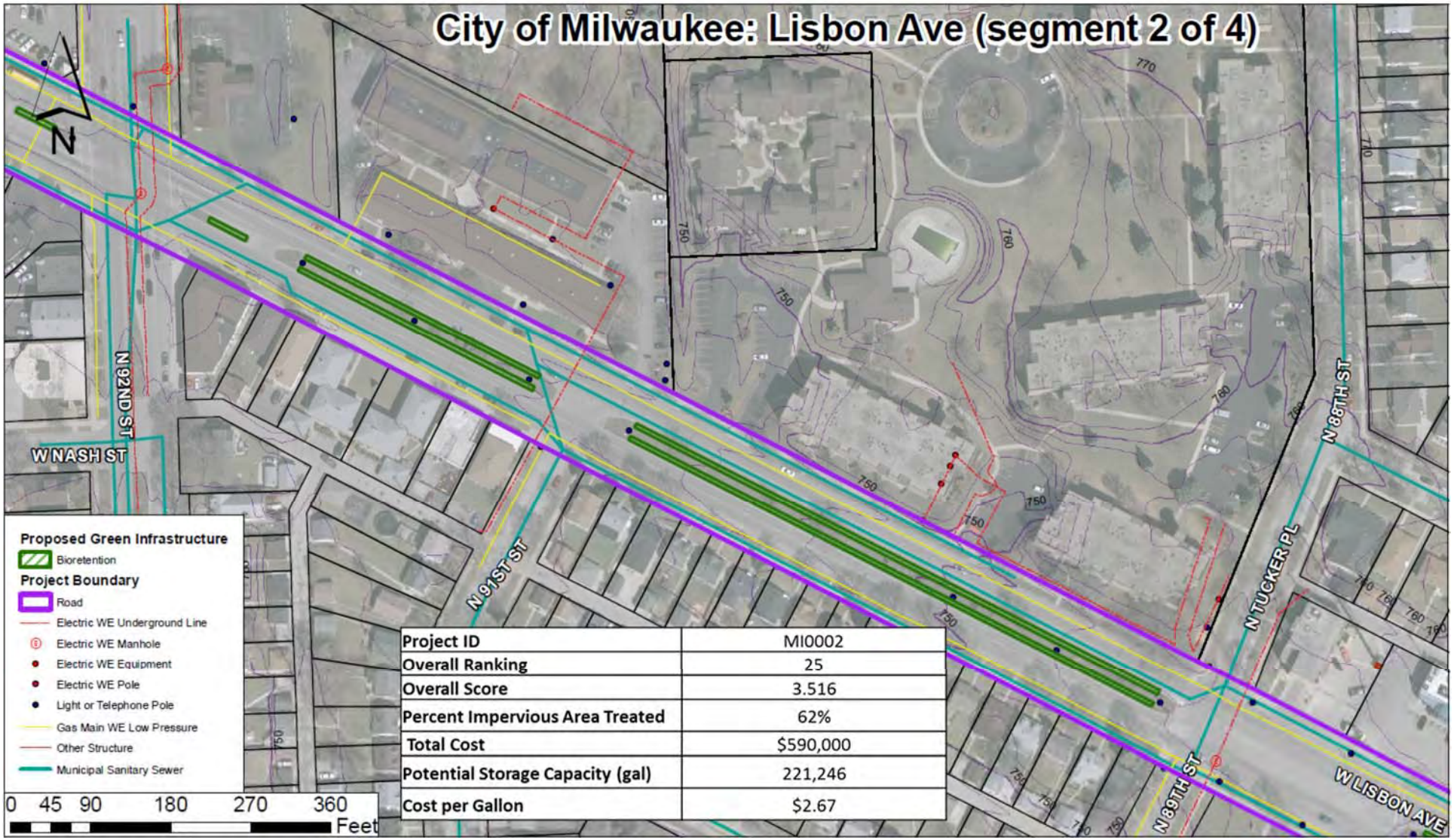


Project ID	Cheyenne Dr, MF0003
Overall Ranking	5
Overall Score	4.308
Percent Impervious Area Treated	42%
Total Cost	$63,000
Potential Storage Capacity (gal)	23,635
Cost per Gallon	$2.67

Project ID	Cherokee Dr, MF0002
Overall Ranking	10
Overall Score	3.986
Percent Impervious Area Treated	64%
Total Cost	$103,000
Potential Storage Capacity (gal)	38,526
Cost per Gallon	$2.67

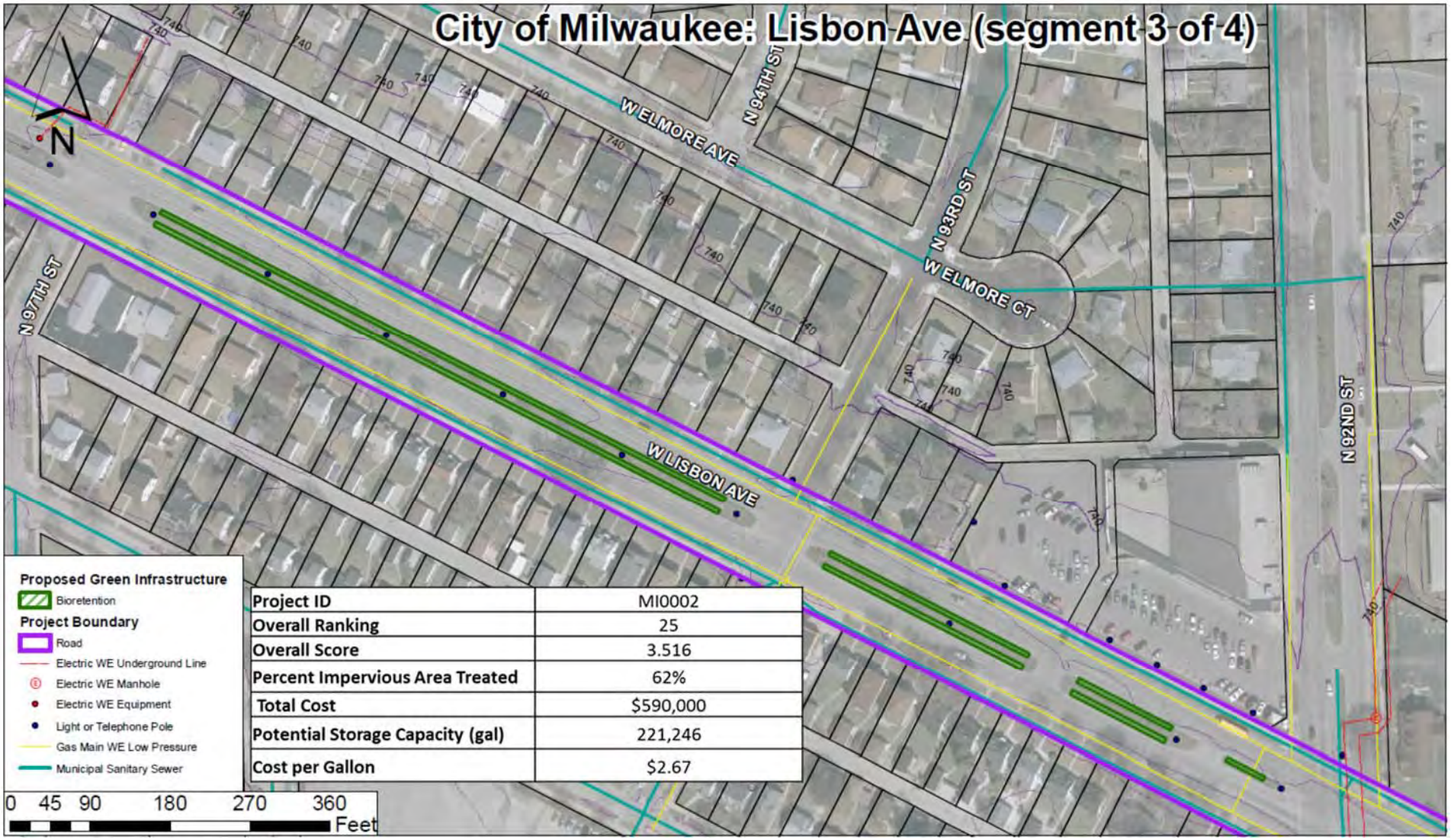


Project ID	MI0002
Overall Ranking	25
Overall Score	3.516
Percent Impervious Area Treated	62%
Total Cost	$590,000
Potential Storage Capacity (gal)	221,246
Cost per Gallon	$2.67

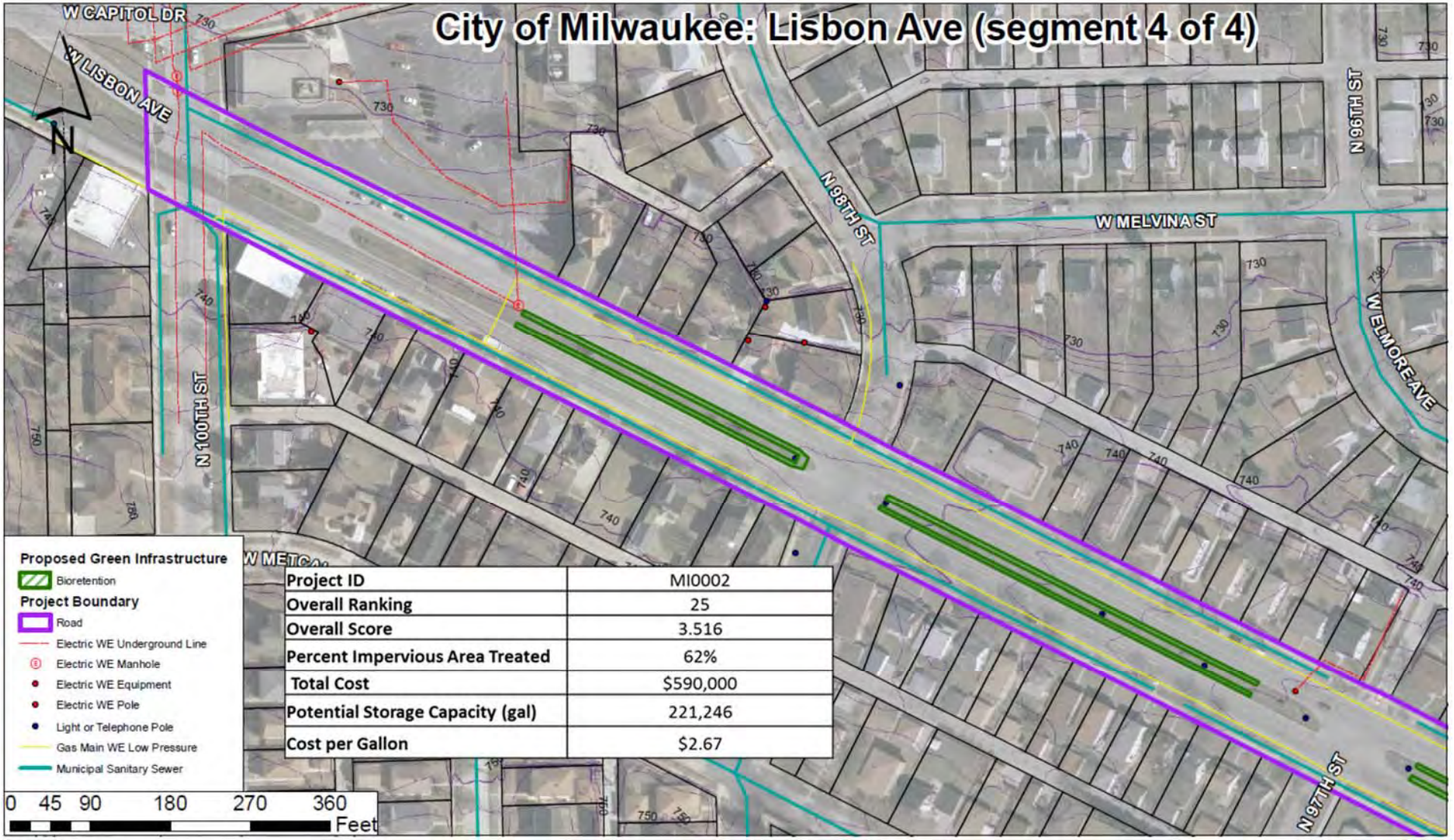


Project ID	MI0002
Overall Ranking	25
Overall Score	3.516
Percent Impervious Area Treated	62%
Total Cost	$590,000
Potential Storage Capacity (gal)	221,246
Cost per Gallon	$2.67

City of Milwaukee: Lisbon Ave (segment 3 of 4)

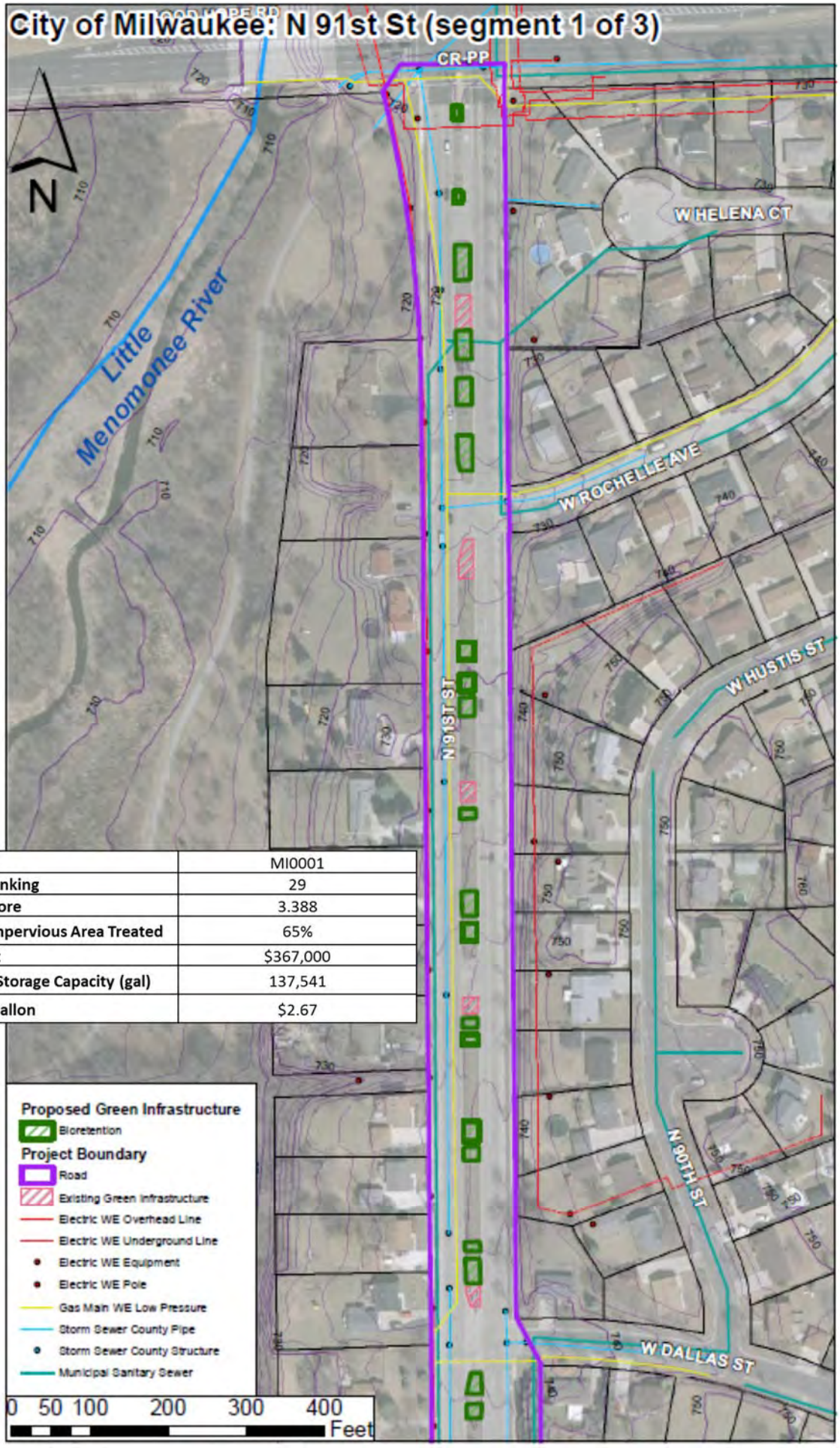


Project ID	MI0002
Overall Ranking	25
Overall Score	3.516
Percent Impervious Area Treated	62%
Total Cost	$590,000
Potential Storage Capacity (gal)	221,246
Cost per Gallon	$2.67



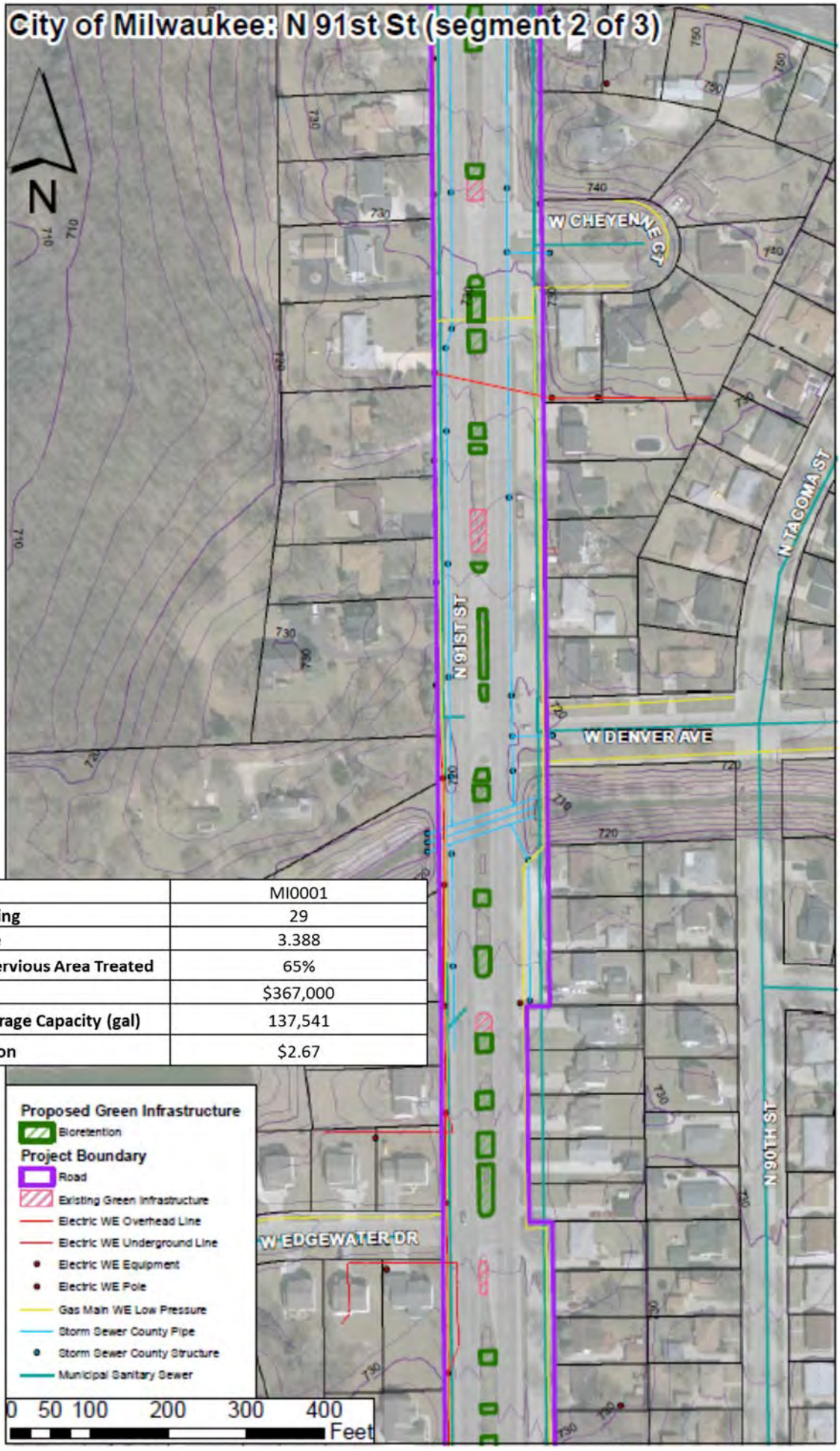
Project ID	MI0002
Overall Ranking	25
Overall Score	3.516
Percent Impervious Area Treated	62%
Total Cost	$590,000
Potential Storage Capacity (gal)	221,246
Cost per Gallon	$2.67

City of Milwaukee: N 91st St (segment 1 of 3)



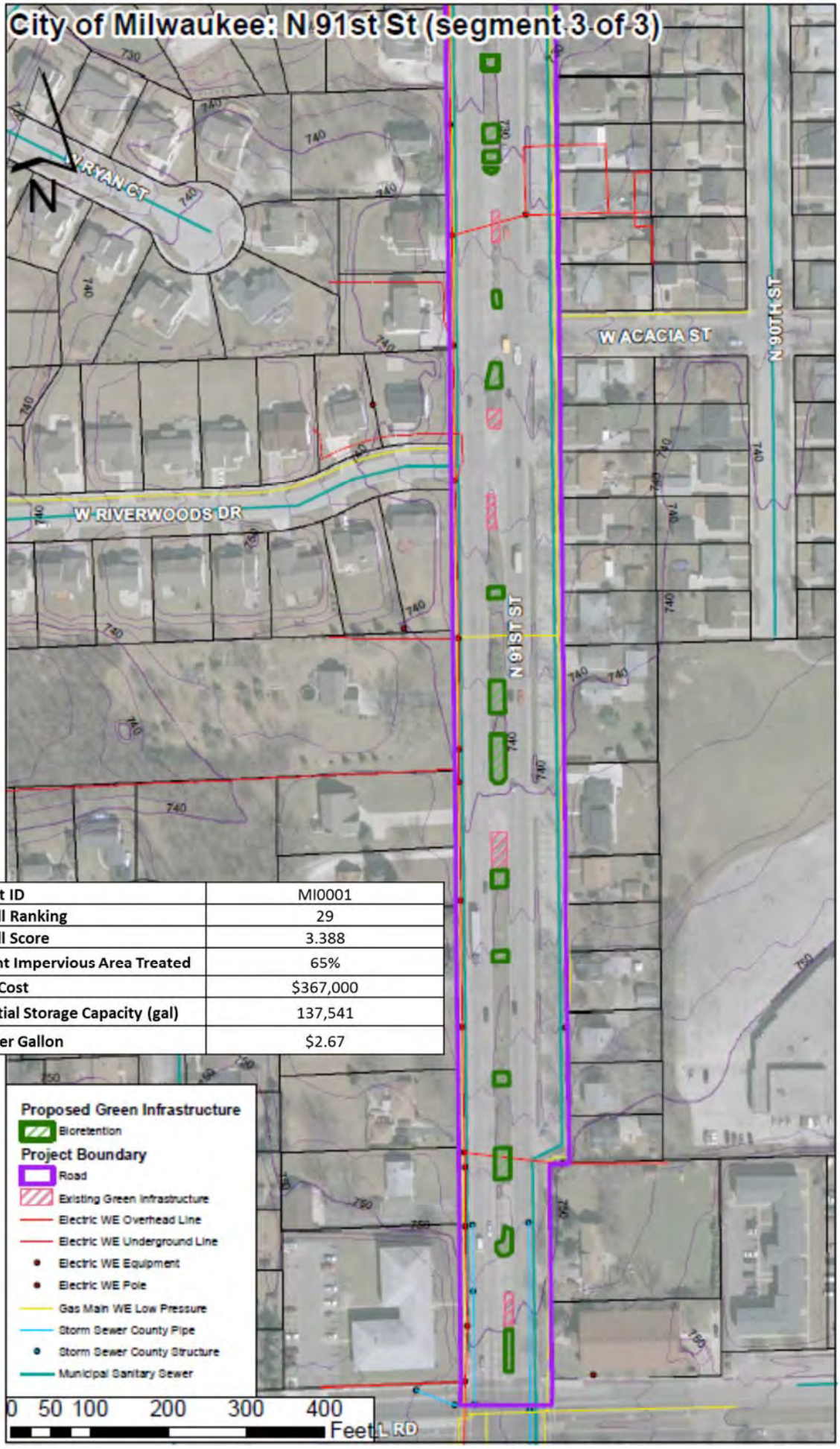
Project ID	MI0001
Overall Ranking	29
Overall Score	3.388
Percent Impervious Area Treated	65%
Total Cost	$367,000
Potential Storage Capacity (gal)	137,541
Cost per Gallon	$2.67

City of Milwaukee: N 91st St (segment 2 of 3)



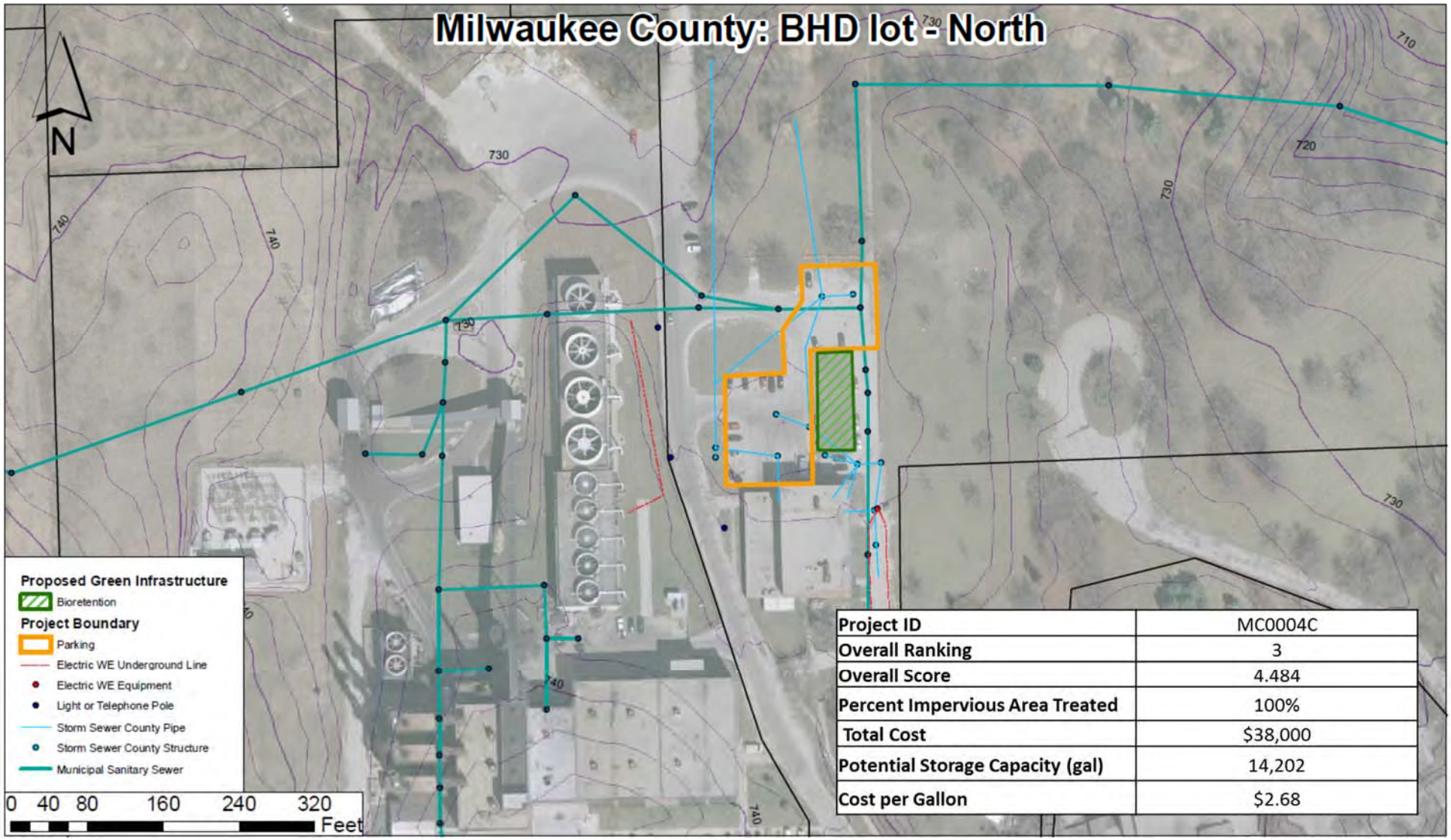
Project ID	MI0001
Overall Ranking	29
Overall Score	3.388
Percent Impervious Area Treated	65%
Total Cost	$367,000
Potential Storage Capacity (gal)	137,541
Cost per Gallon	$2.67

City of Milwaukee: N 91st St (segment 3 of 3)



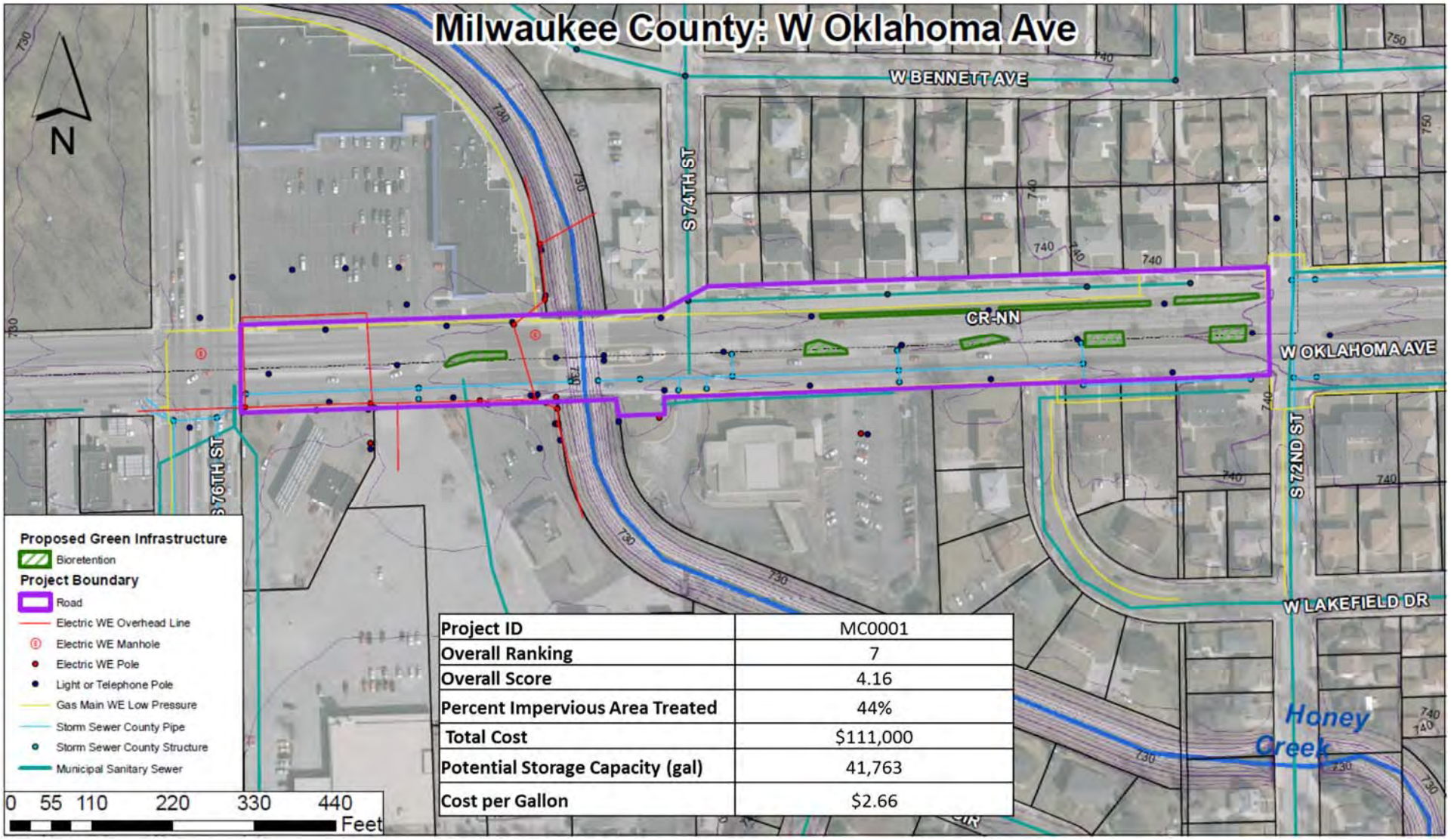
Project ID	MI0001
Overall Ranking	29
Overall Score	3.388
Percent Impervious Area Treated	65%
Total Cost	$367,000
Potential Storage Capacity (gal)	137,541
Cost per Gallon	$2.67

Milwaukee County: BHD lot - North

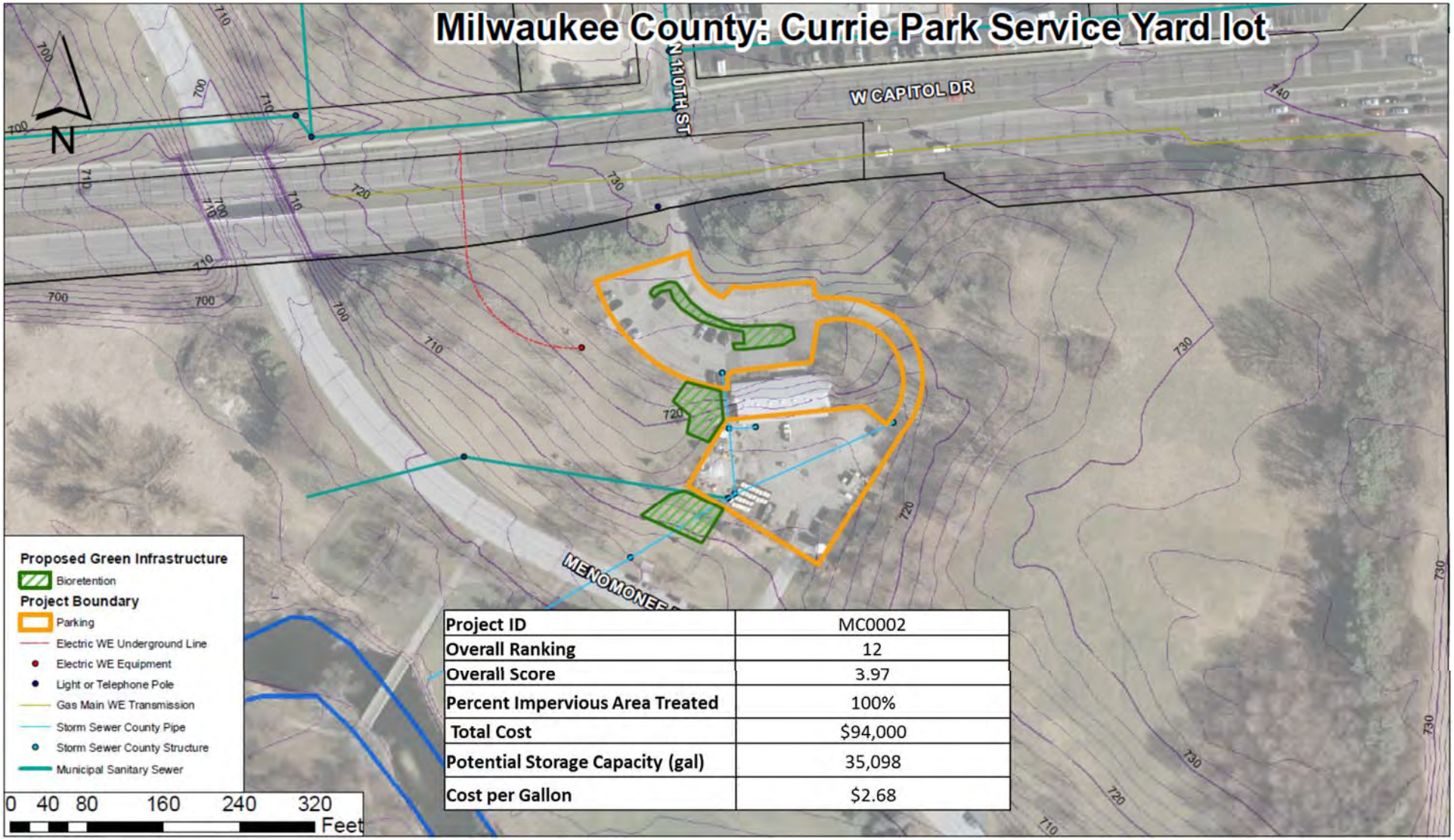


Project ID	MC0004C
Overall Ranking	3
Overall Score	4.484
Percent Impervious Area Treated	100%
Total Cost	$38,000
Potential Storage Capacity (gal)	14,202
Cost per Gallon	$2.68

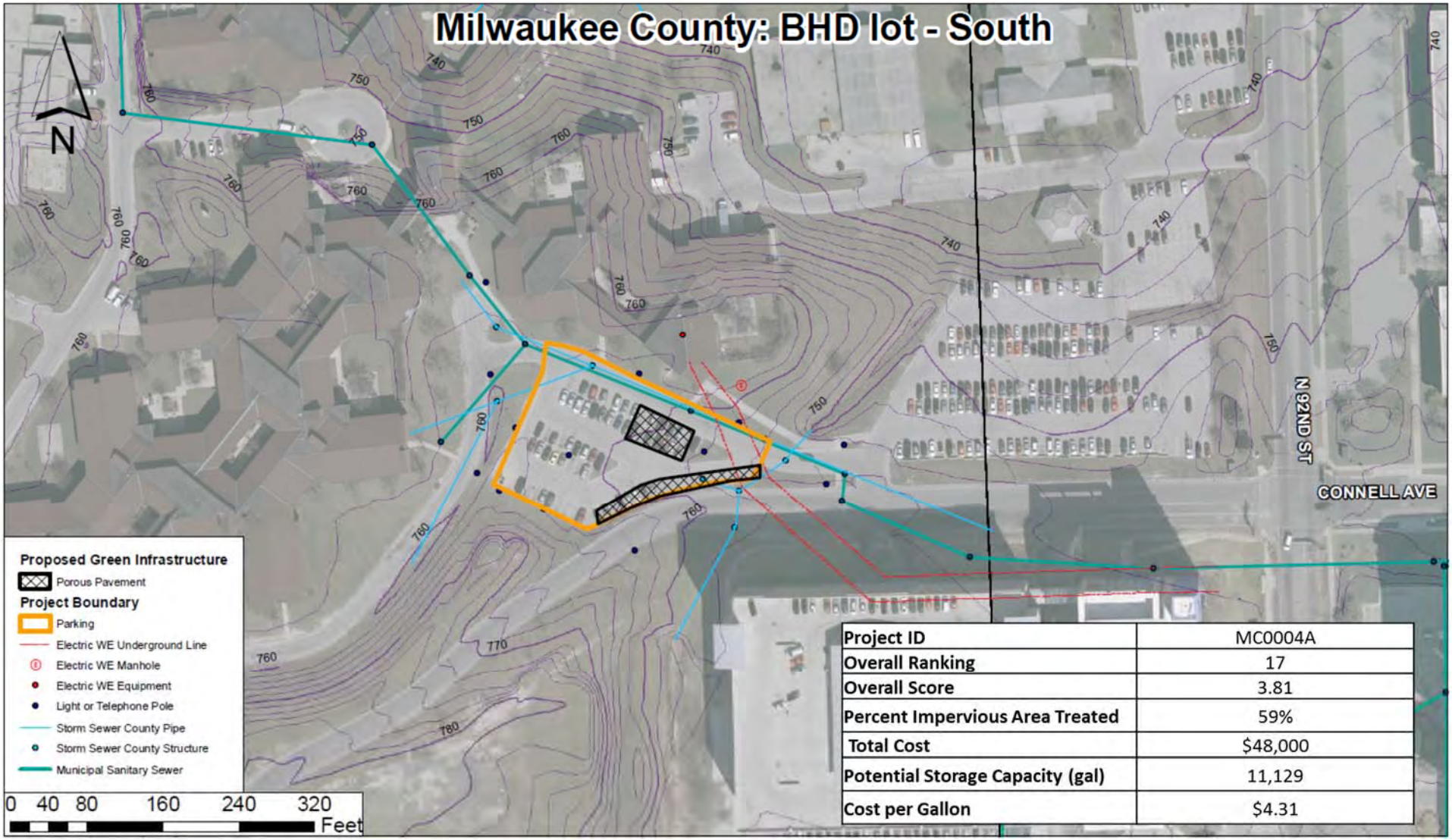
Milwaukee County: W Oklahoma Ave



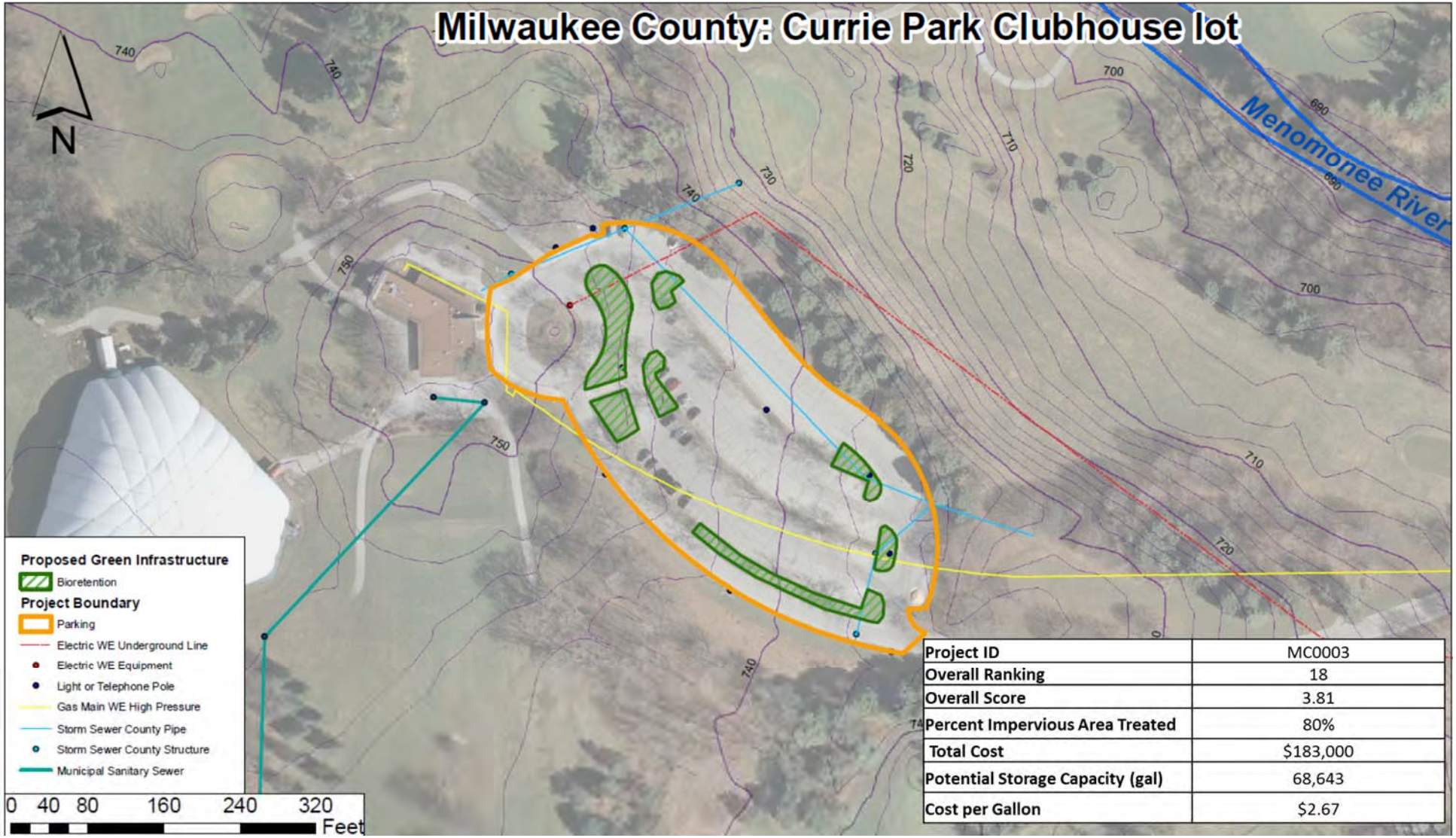
Project ID	MC0001
Overall Ranking	7
Overall Score	4.16
Percent Impervious Area Treated	44%
Total Cost	$111,000
Potential Storage Capacity (gal)	41,763
Cost per Gallon	$2.66



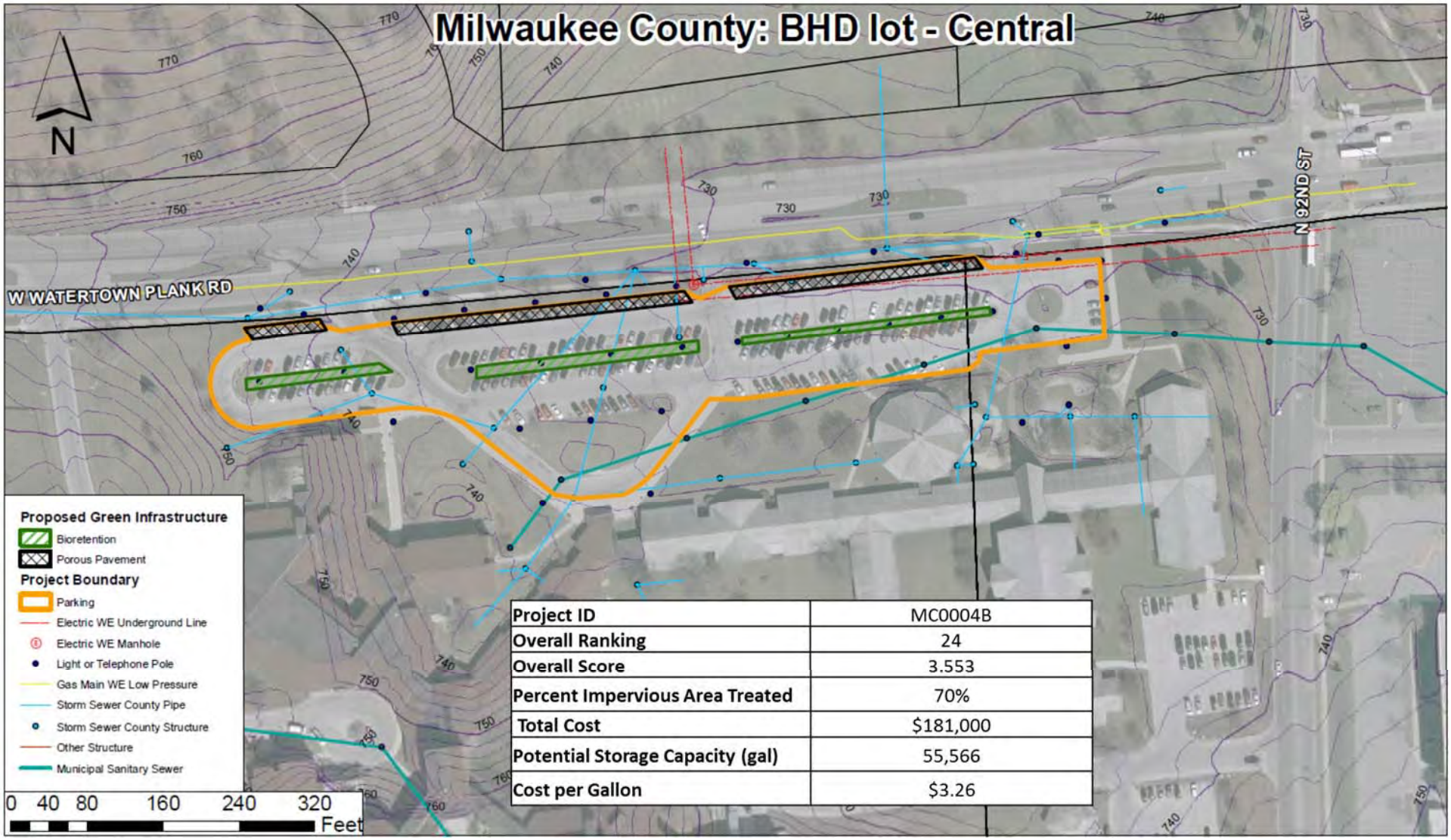
Project ID	MC0002
Overall Ranking	12
Overall Score	3.97
Percent Impervious Area Treated	100%
Total Cost	$94,000
Potential Storage Capacity (gal)	35,098
Cost per Gallon	$2.68



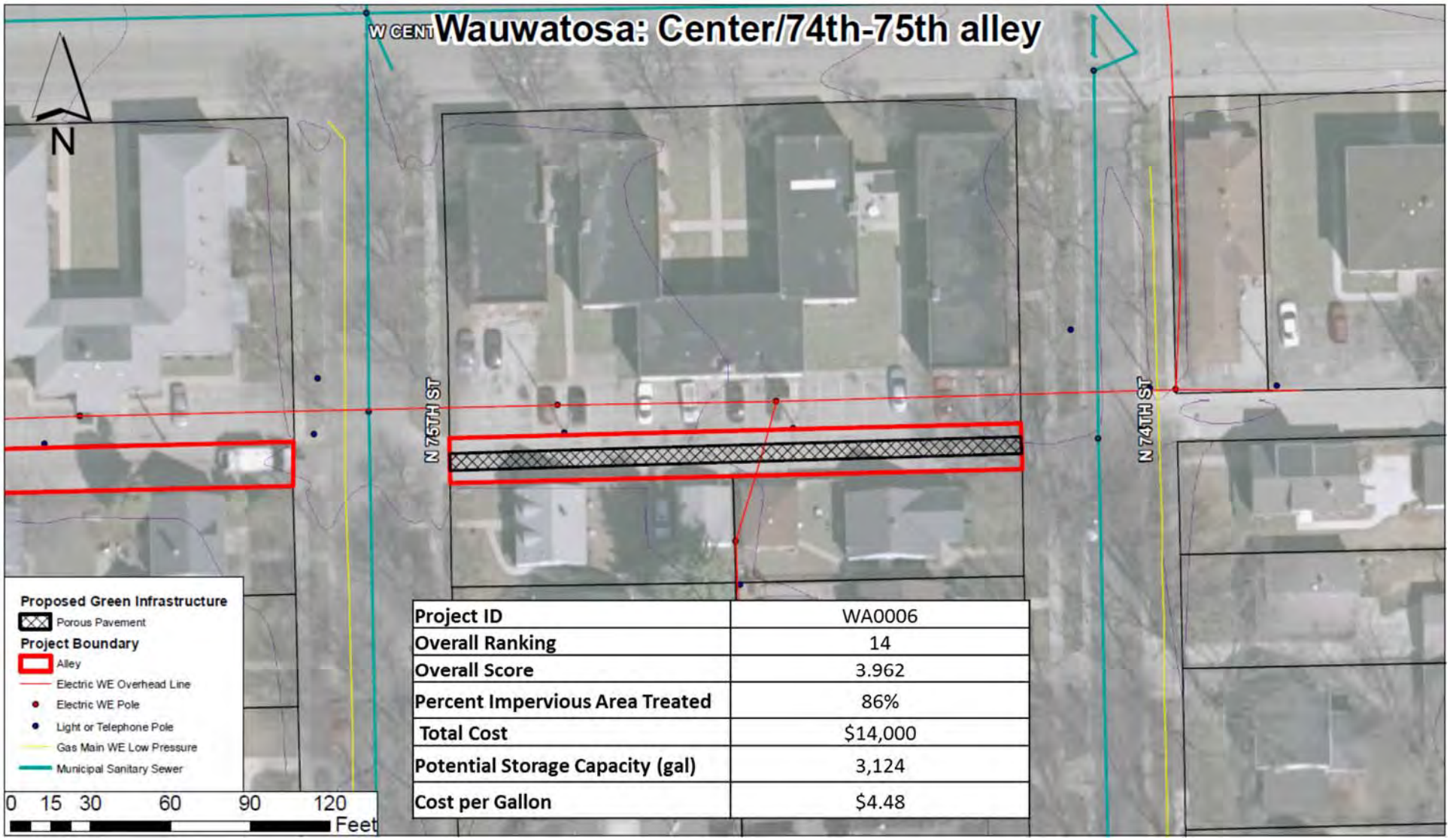
Project ID	MC0004A
Overall Ranking	17
Overall Score	3.81
Percent Impervious Area Treated	59%
Total Cost	$48,000
Potential Storage Capacity (gal)	11,129
Cost per Gallon	$4.31


Milwaukee County: Currie Park Clubhouse lot
N
Menomonee River
740
750
730
720
710
700
690
Proposed Green Infrastructure
Bioretention
Project Boundary
Parking
Electric WE Underground Line
Electric WE Equipment
Light or Telephone Pole
Gas Main WE High Pressure
Storm Sewer County Pipe
Storm Sewer County Structure
Municipal Sanitary Sewer
0 40 80 160 240 320
Feet
Project ID MC0003
Overall Ranking 18
Overall Score 3.81
Percent Impervious Area Treated 80%
Total Cost $183,000
Potential Storage Capacity (gal) 68,643
Cost per Gallon $2.67

Milwaukee County: BHD lot - Central

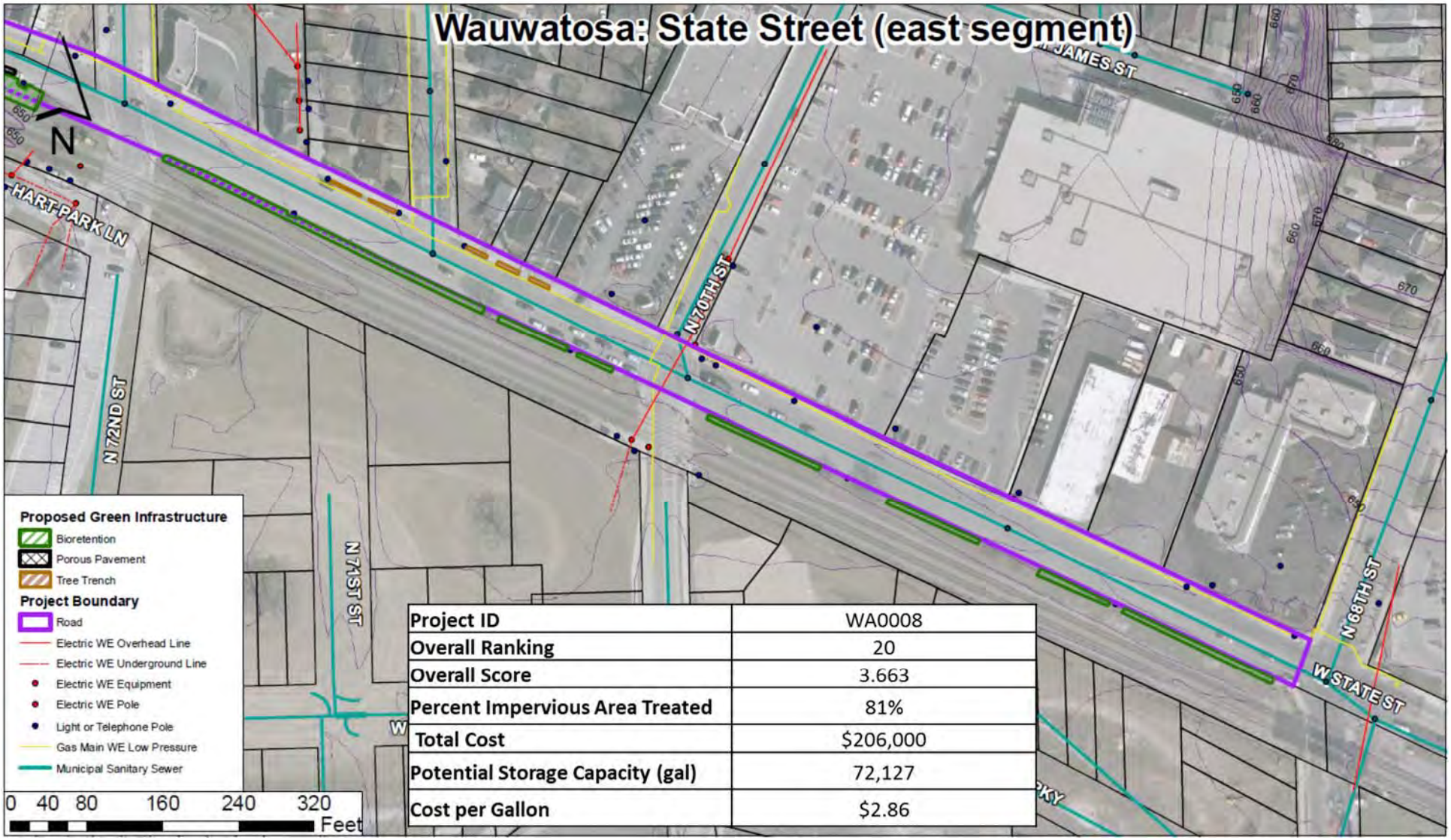


Project ID	MC0004B
Overall Ranking	24
Overall Score	3.553
Percent Impervious Area Treated	70%
Total Cost	$181,000
Potential Storage Capacity (gal)	55,566
Cost per Gallon	$3.26

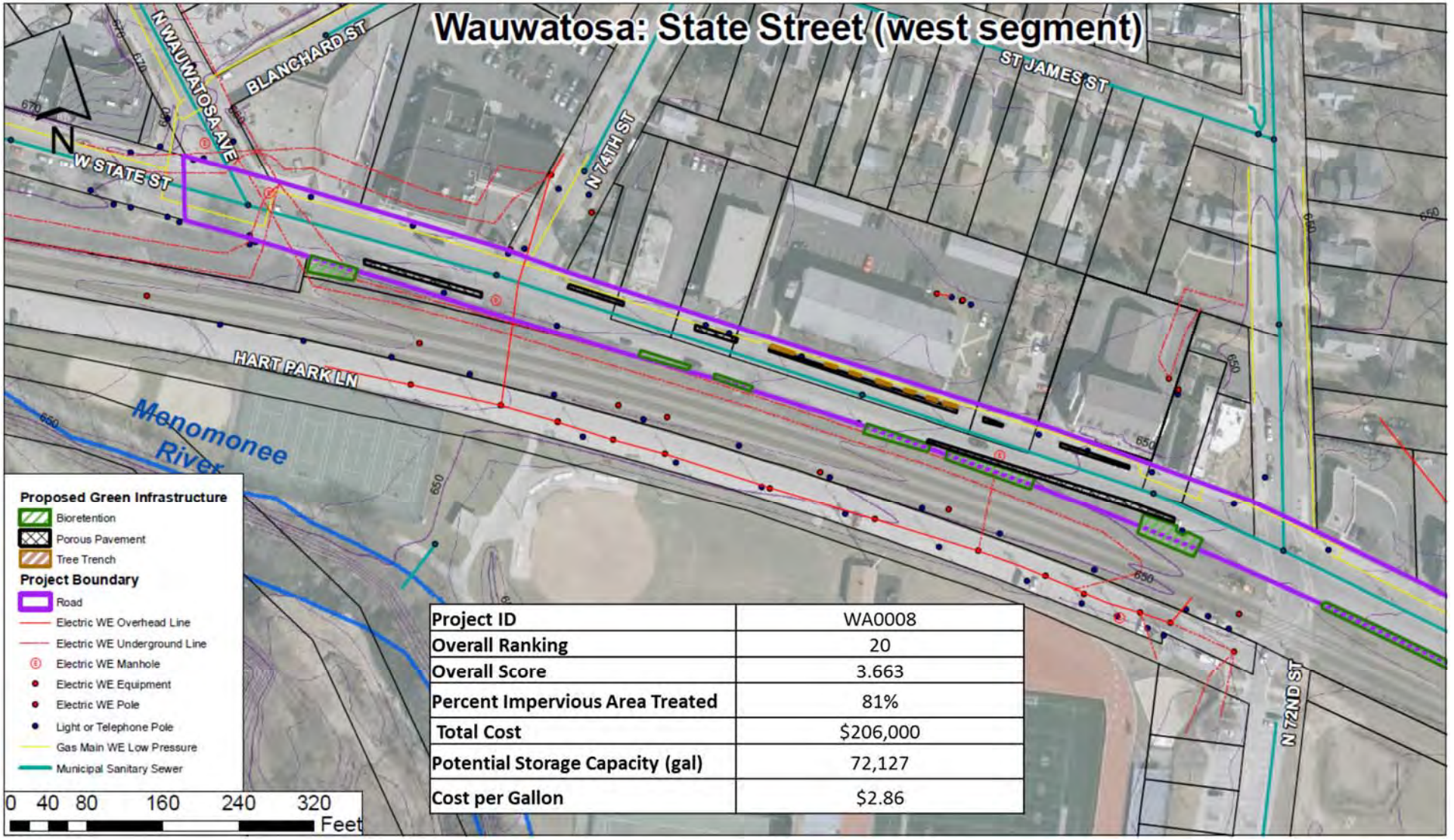


Project ID	WA0006
Overall Ranking	14
Overall Score	3.962
Percent Impervious Area Treated	86%
Total Cost	$14,000
Potential Storage Capacity (gal)	3,124
Cost per Gallon	$4.48

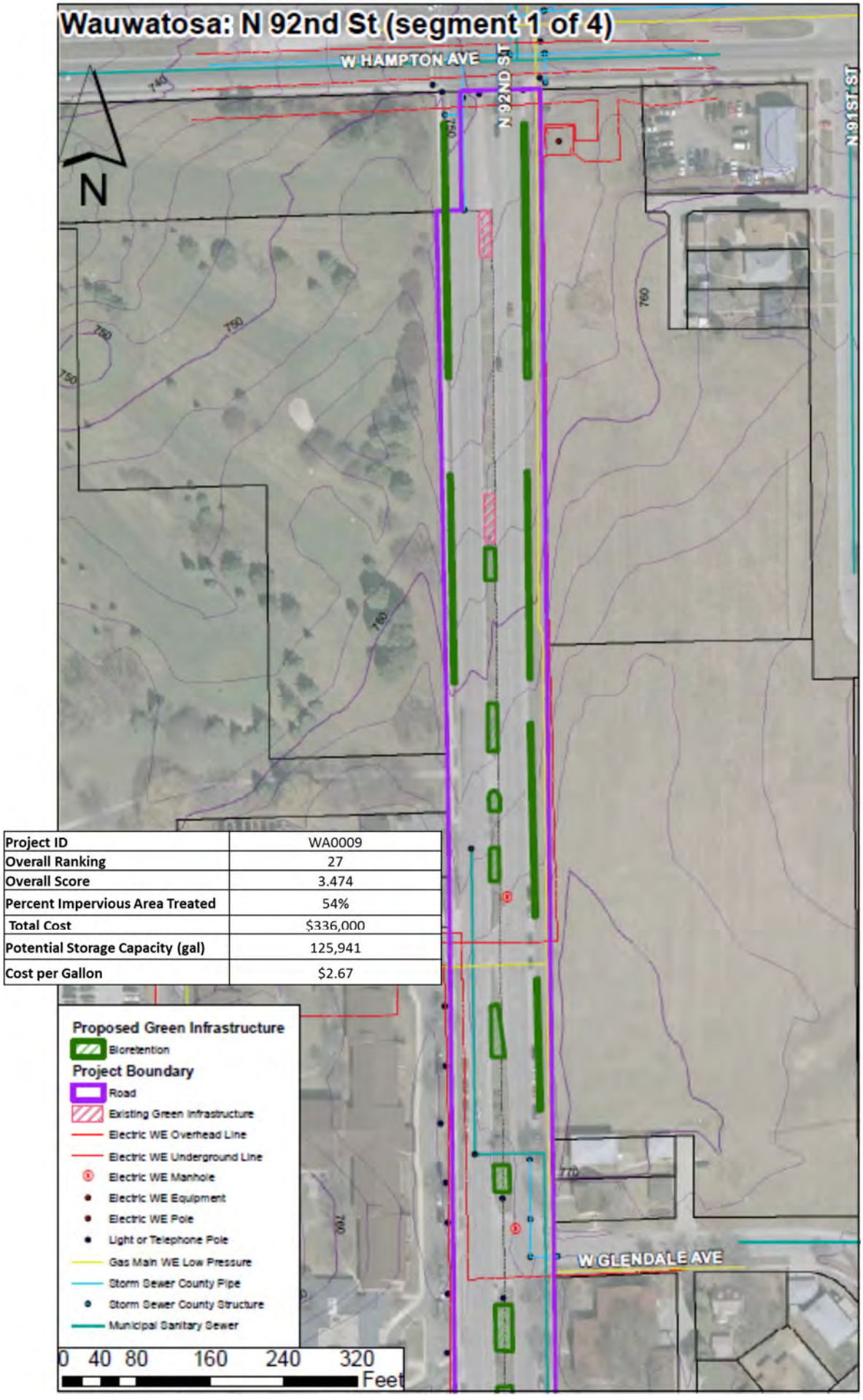
Wauwatosa: State Street (east segment)



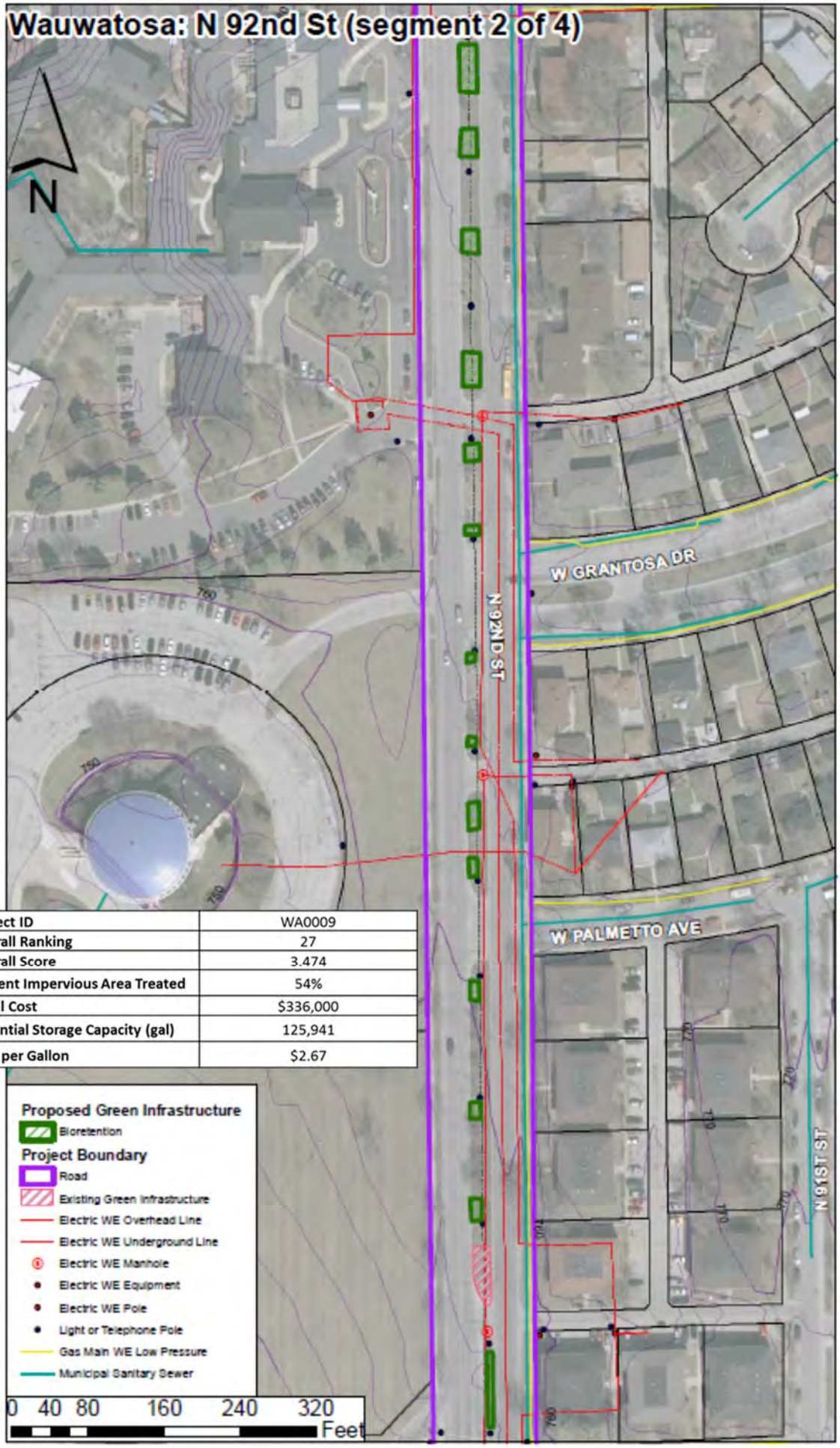
Project ID	WA0008
Overall Ranking	20
Overall Score	3.663
Percent Impervious Area Treated	81%
Total Cost	$206,000
Potential Storage Capacity (gal)	72,127
Cost per Gallon	$2.86



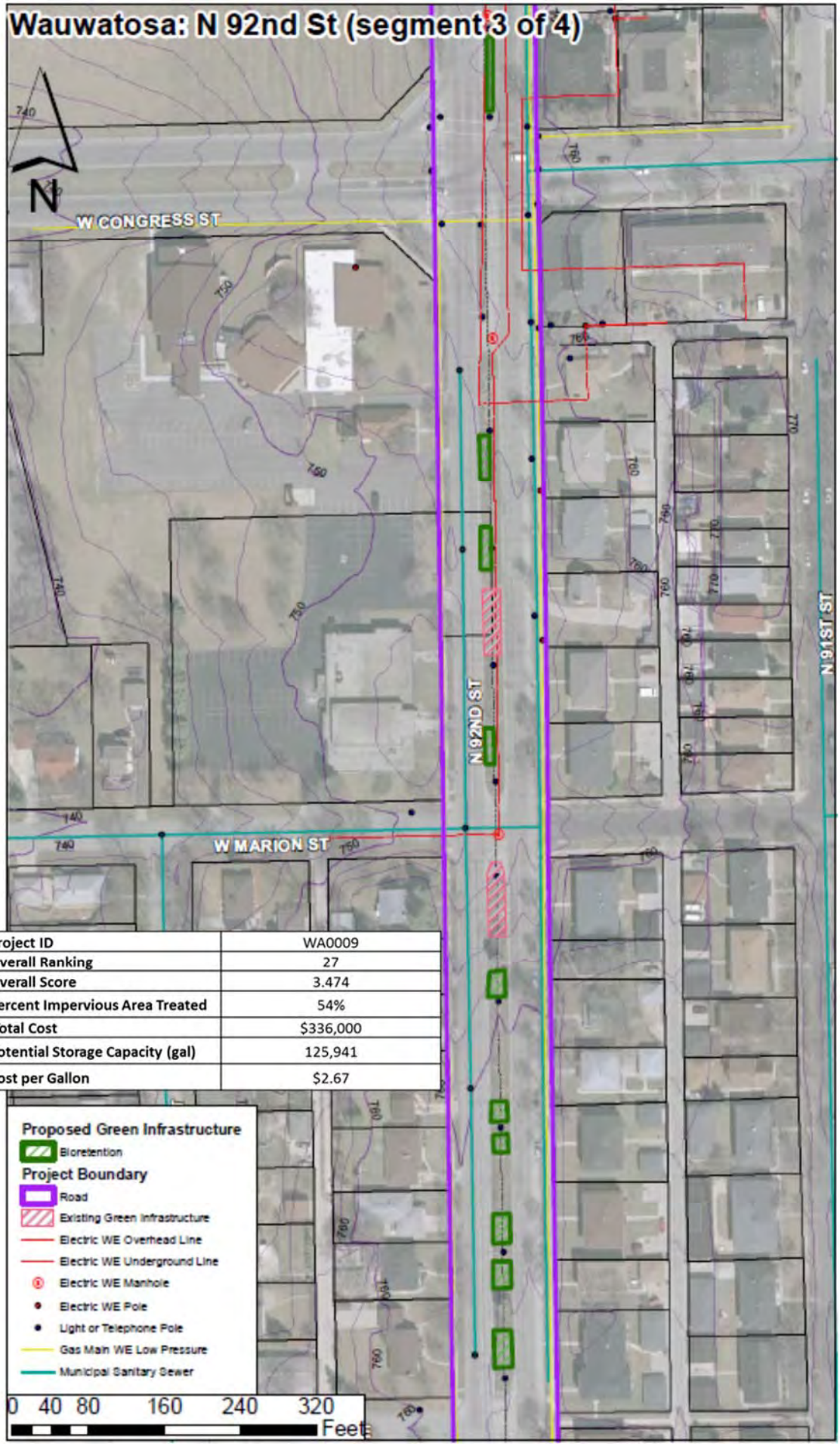
Project ID	WA0008
Overall Ranking	20
Overall Score	3.663
Percent Impervious Area Treated	81%
Total Cost	$206,000
Potential Storage Capacity (gal)	72,127
Cost per Gallon	$2.86


Wauwatosa: N 92nd St (segment 1 of 4)
W HAMPTON AVE
N 92ND ST
N 91ST ST
W GLENDALE AVE
N
740
750
760
770
Project ID | WA0009
Overall Ranking | 27
Overall Score | 3.474
Percent Impervious Area Treated | 54%
Total Cost | $336,000
Potential Storage Capacity (gal) | 125,941
Cost per Gallon | $2.67
Proposed Green Infrastructure
Bioretention
Project Boundary
Road
Existing Green Infrastructure
Electric WE Overhead Line
Electric WE Underground Line
Electric WE Manhole
Electric WE Equipment
Electric WE Pole
Light or Telephone Pole
Gas Main WE Low Pressure
Storm Sewer County Pipe
Storm Sewer County Structure
Municipal Sanitary Sewer
0 40 80 160 240 320
Feet

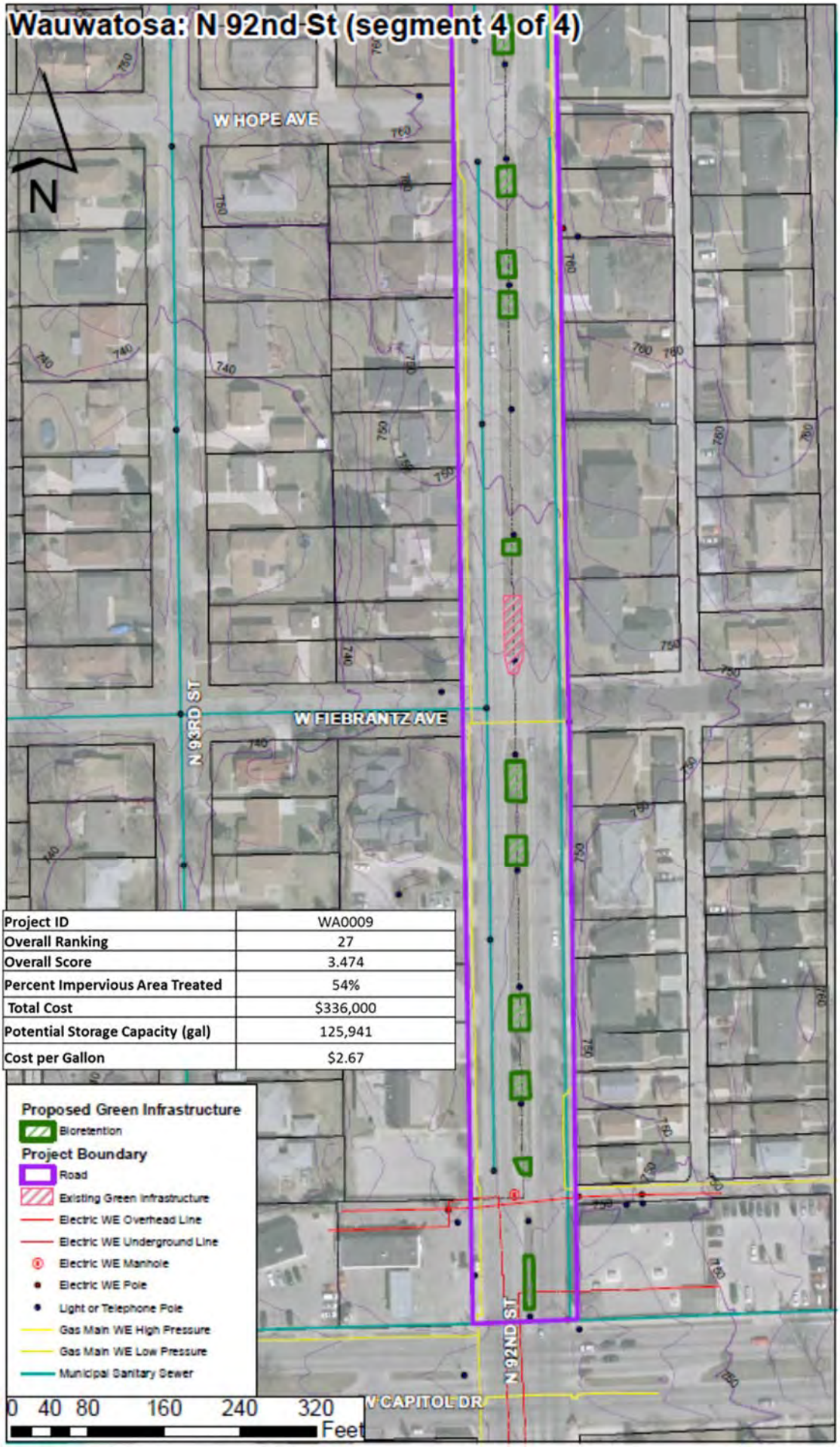
Wauwatosa: N 92nd St (segment 2 of 4)



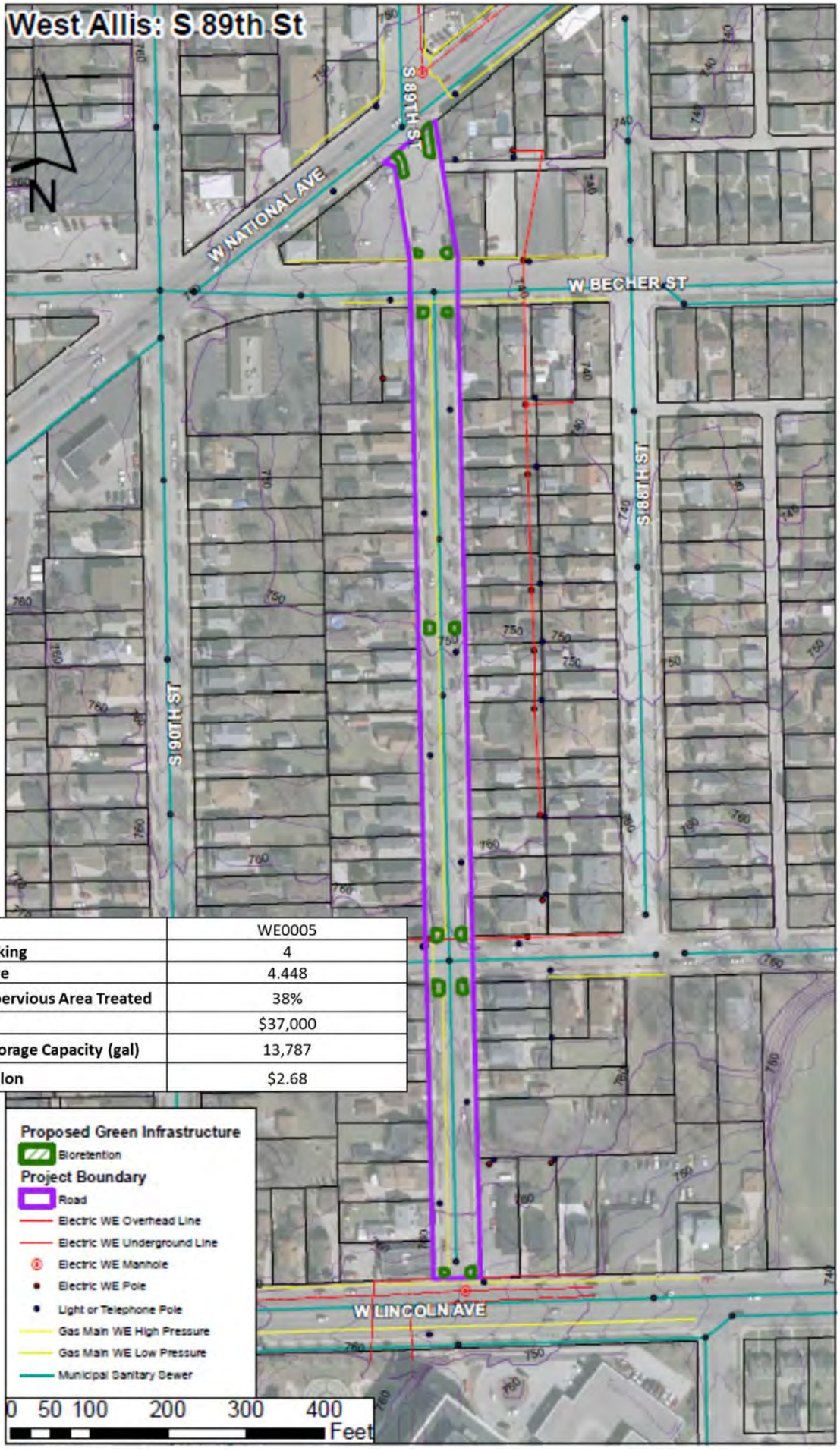
Project ID	WA0009
Overall Ranking	27
Overall Score	3.474
Percent Impervious Area Treated	54%
Total Cost	$336,000
Potential Storage Capacity (gal)	125,941
Cost per Gallon	$2.67


Wauwatosa: N 92nd St (segment 3 of 4)
N
W CONGRESS ST
W MARION ST
N 92ND ST
N 91ST ST
740
750
760
770
780
790
Project ID
WA0009
Overall Ranking
27
Overall Score
3.474
Percent Impervious Area Treated
54%
Total Cost
$336,000
Potential Storage Capacity (gal)
125,941
Cost per Gallon
$2.67
Proposed Green Infrastructure
Bioretention
Project Boundary
Road
Existing Green Infrastructure
Electric WE Overhead Line
Electric WE Underground Line
Electric WE Manhole
Electric WE Pole
Light or Telephone Pole
Gas Main WE Low Pressure
Municipal Sanitary Sewer
0 40 80 160 240 320
Feet

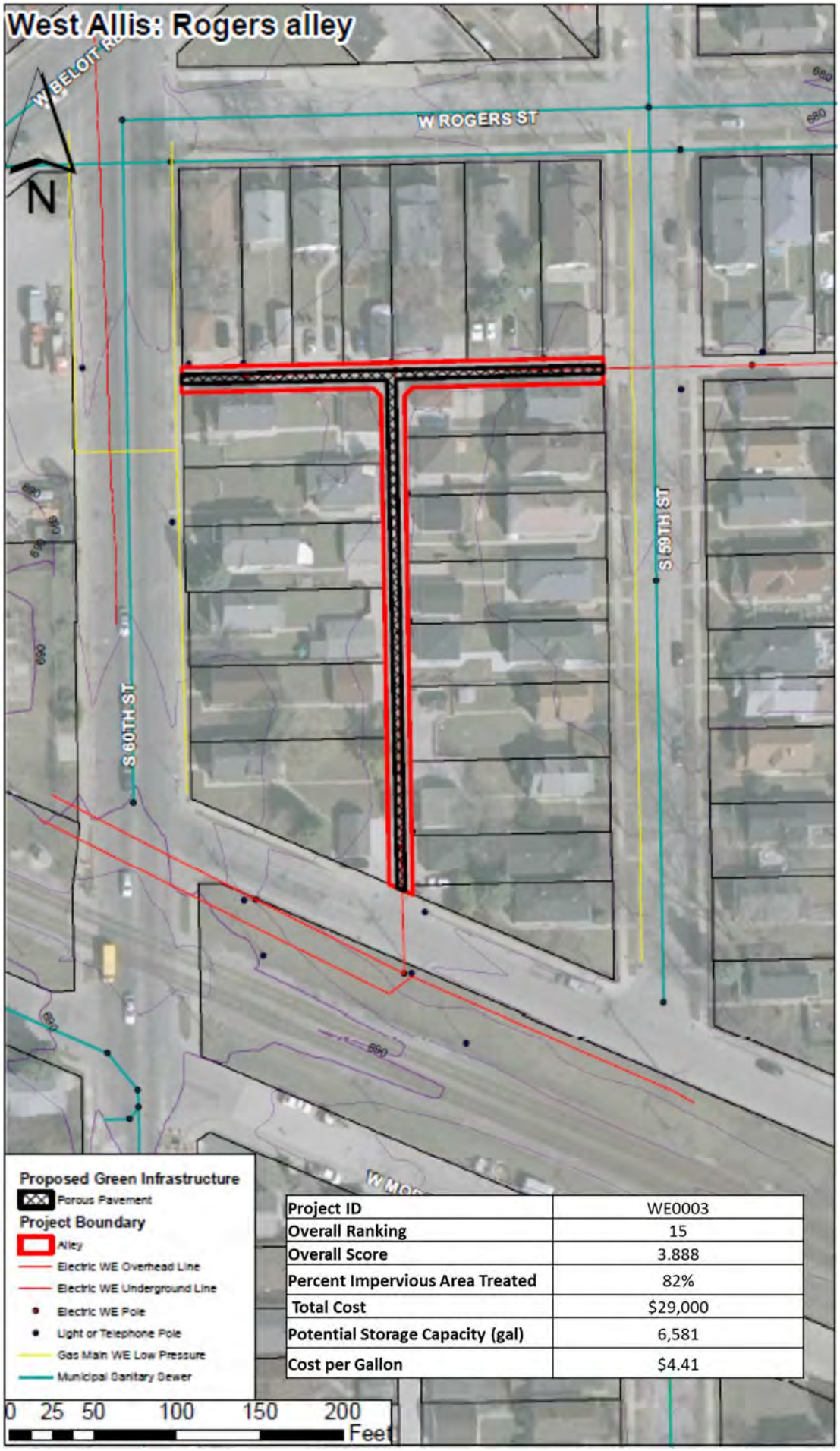
Wauwatosa: N 92nd St (segment 4 of 4)



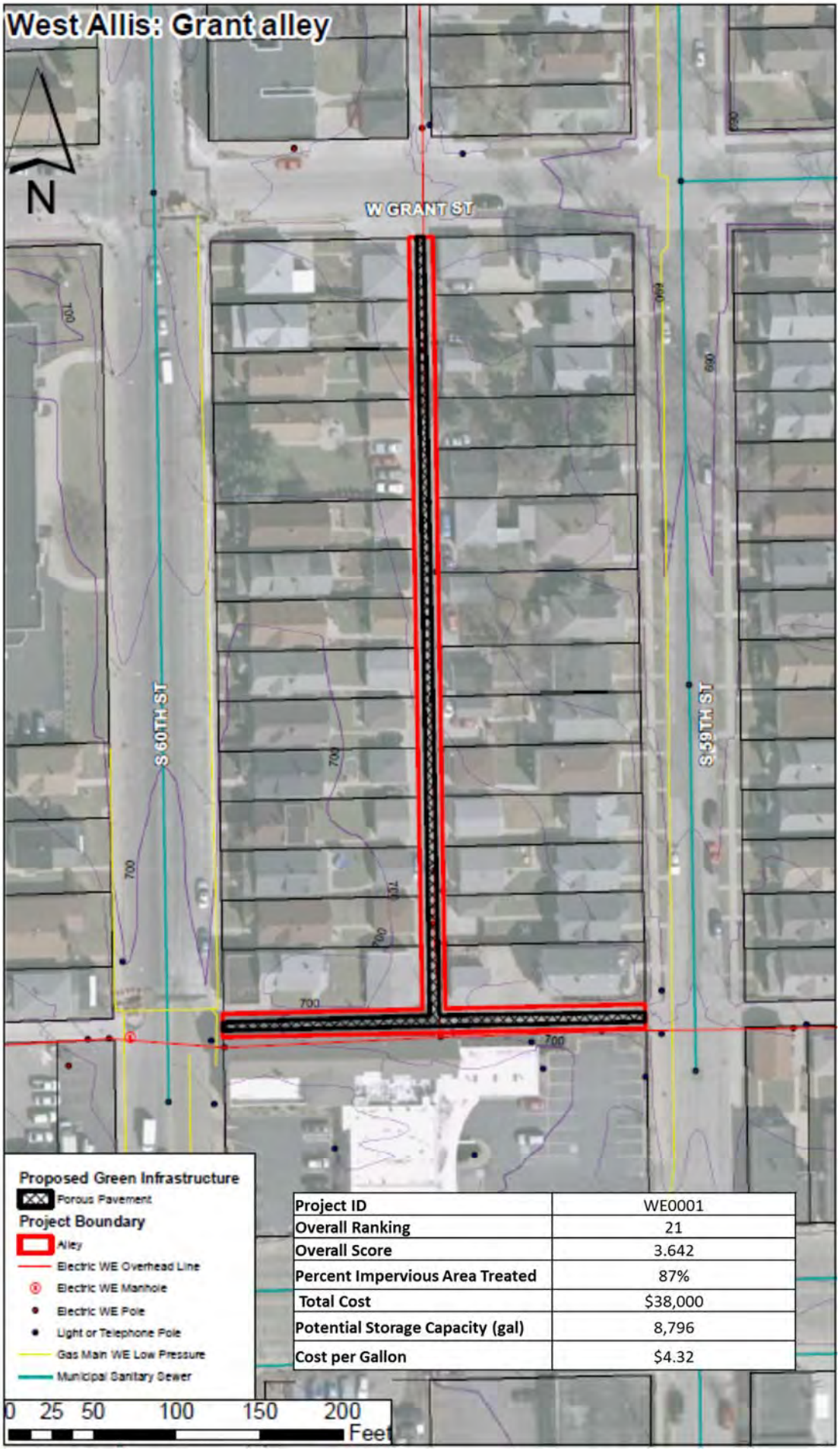
Project ID	WA0009
Overall Ranking	27
Overall Score	3.474
Percent Impervious Area Treated	54%
Total Cost	$336,000
Potential Storage Capacity (gal)	125,941
Cost per Gallon	$2.67



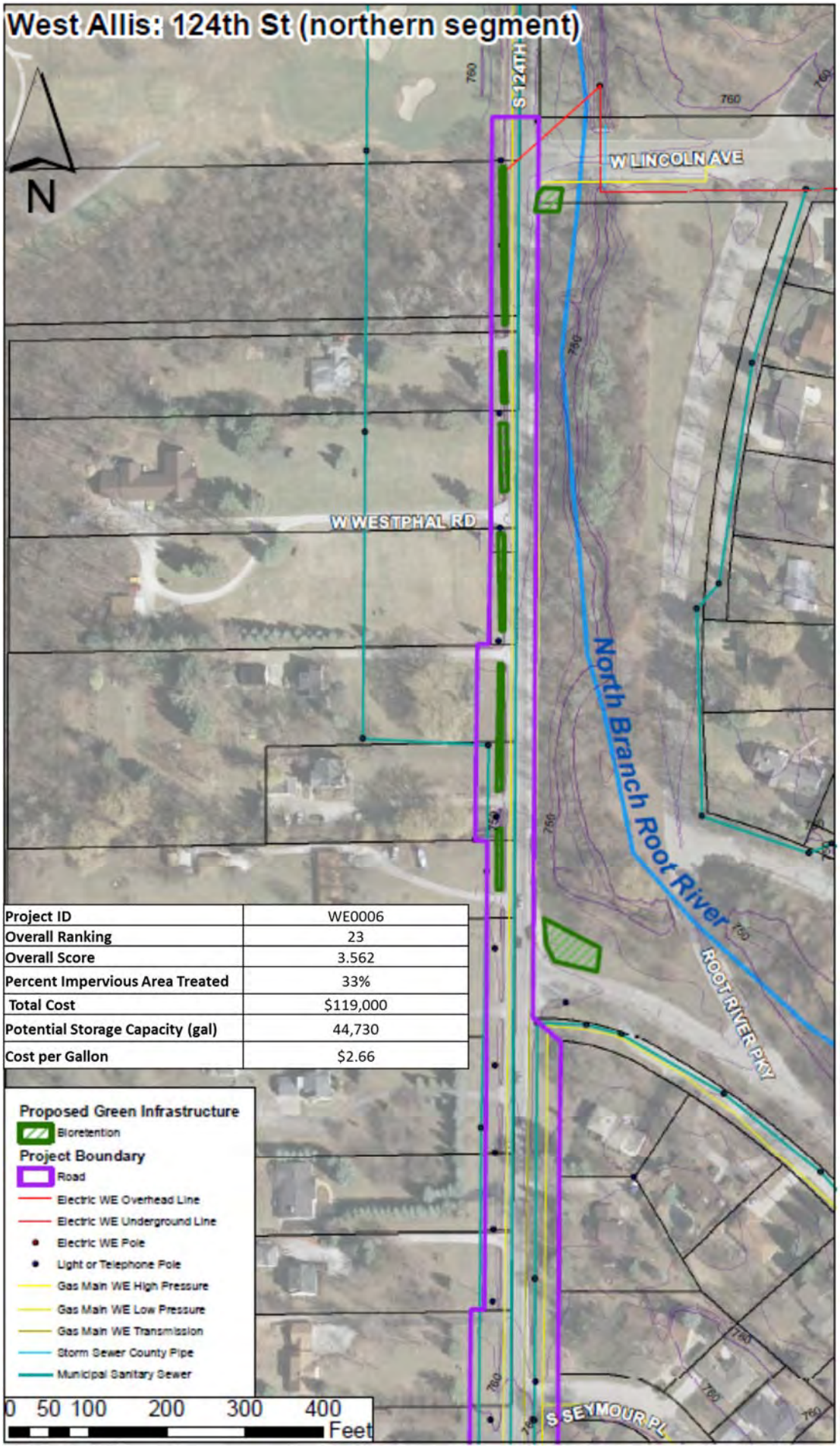
Project ID	WE0005
Overall Ranking	4
Overall Score	4.448
Percent Impervious Area Treated	38%
Total Cost	$37,000
Potential Storage Capacity (gal)	13,787
Cost per Gallon	$2.68

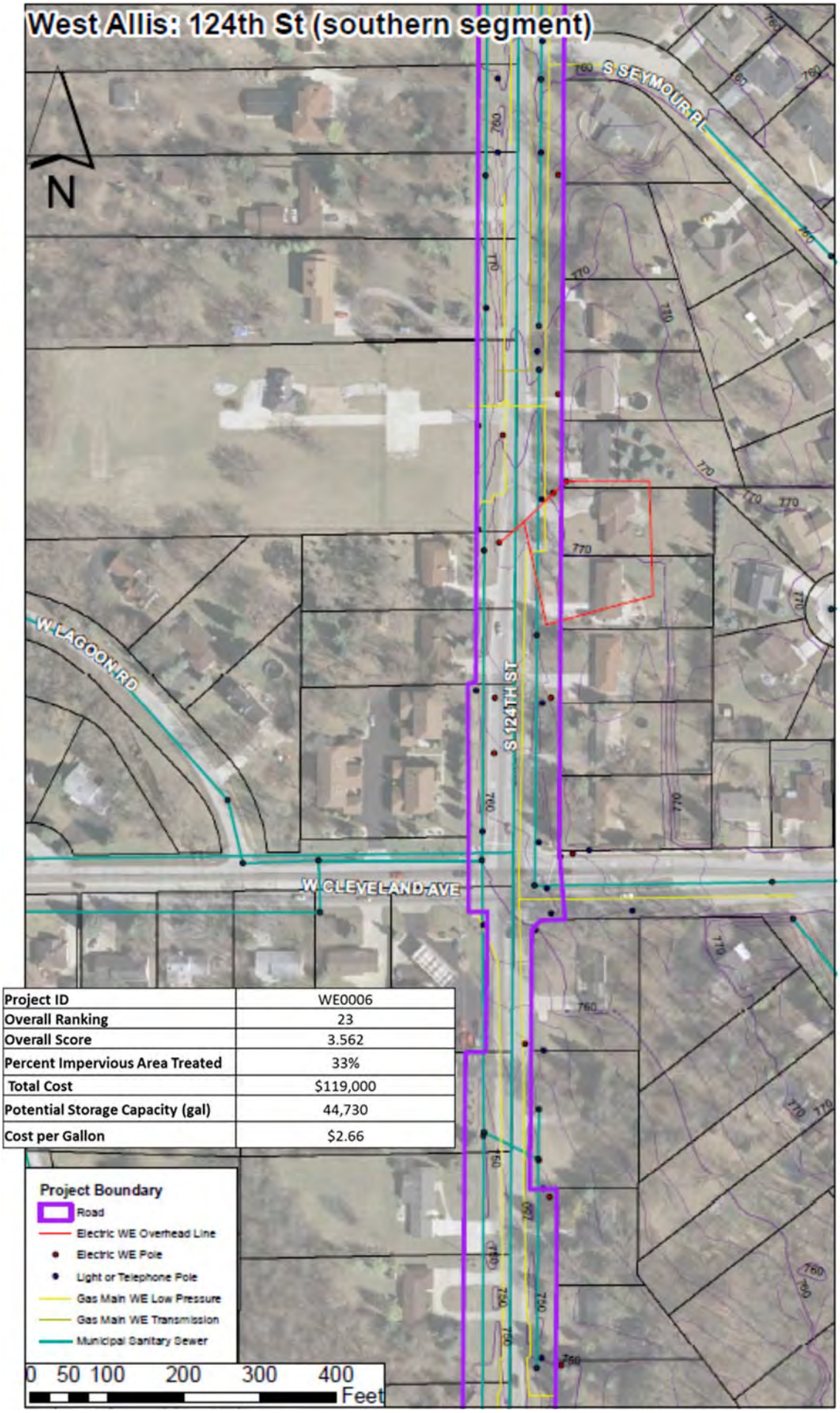


Project ID	WE0003
Overall Ranking	15
Overall Score	3.888
Percent Impervious Area Treated	82%
Total Cost	$29,000
Potential Storage Capacity (gal)	6,581
Cost per Gallon	$4.41

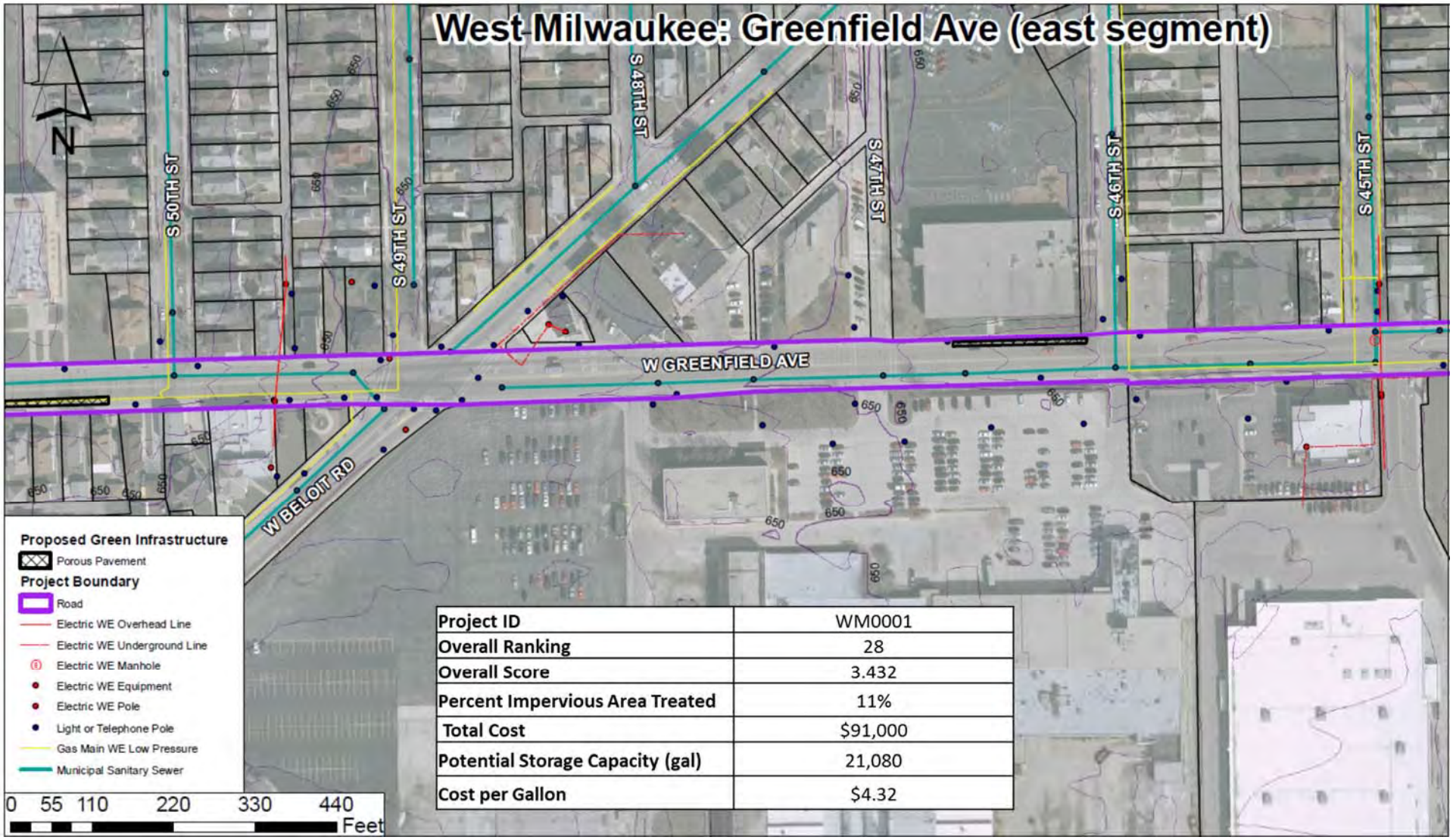


Project ID	WE0001
Overall Ranking	21
Overall Score	3.642
Percent Impervious Area Treated	87%
Total Cost	$38,000
Potential Storage Capacity (gal)	8,796
Cost per Gallon	$4.32


West Allis: 124th St (northern segment)
N
S 124TH
W LINCOLN AVE
W WESTPHAL RD
North Branch Root River
ROOT RIVER PKY
S SEYMOUR PL
760
Project ID | WE0006
Overall Ranking | 23
Overall Score | 3.562
Percent Impervious Area Treated | 33%
Total Cost | $119,000
Potential Storage Capacity (gal) | 44,730
Cost per Gallon | $2.66
Proposed Green Infrastructure
Bioretention
Project Boundary
Road
Electric WE Overhead Line
Electric WE Underground Line
Electric WE Pole
Light or Telephone Pole
Gas Main WE High Pressure
Gas Main WE Low Pressure
Gas Main WE Transmission
Storm Sewer County Pipe
Municipal Sanitary Sewer
0 50 100 200 300 400
Feet

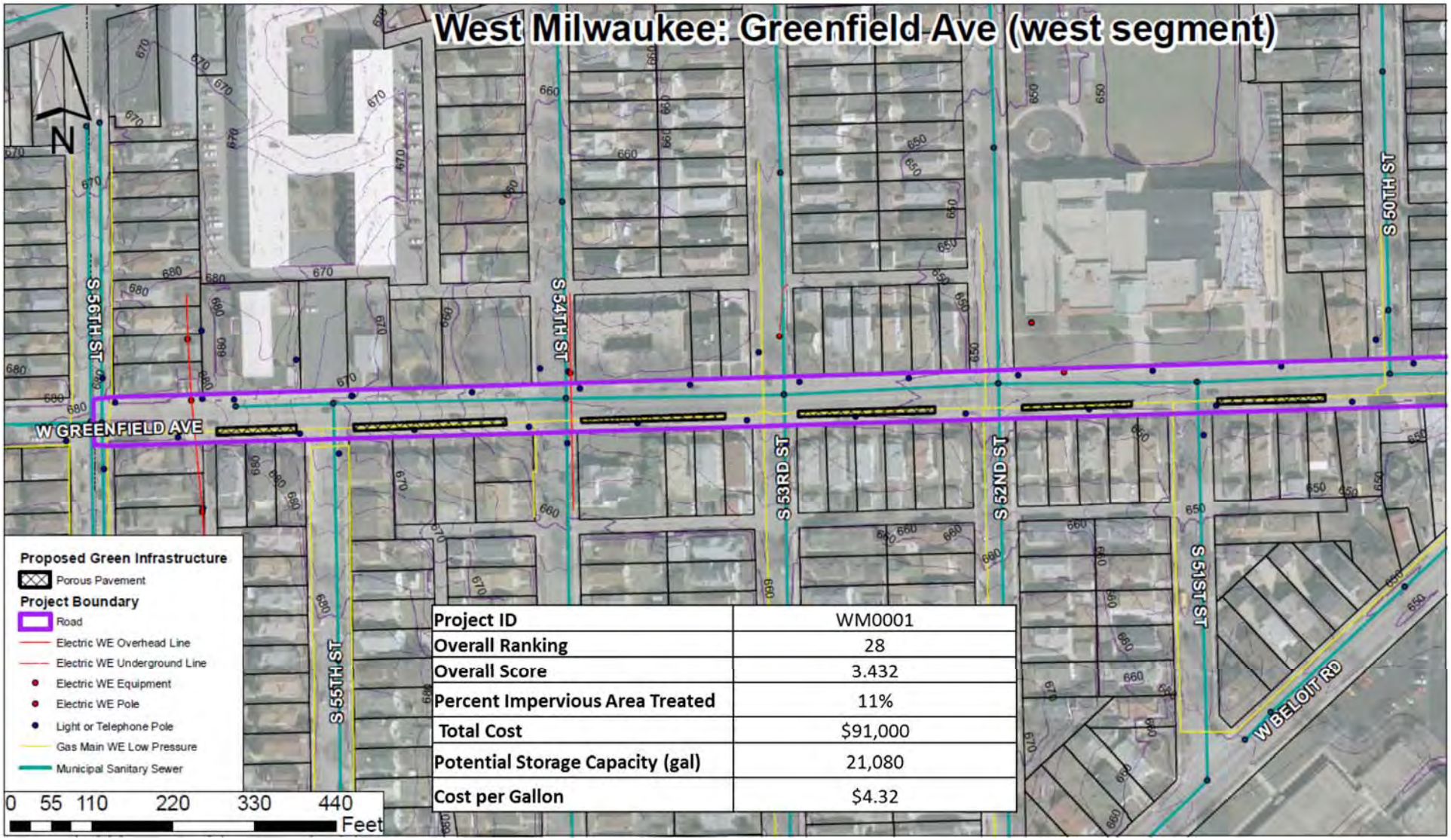

West Allis: 124th St (southern segment)
N
S SEYMOUR PL
W LAGOON RD
S 124TH ST
W CLEVELAND AVE
Project ID | WE0006
Overall Ranking | 23
Overall Score | 3.562
Percent Impervious Area Treated | 33%
Total Cost | $119,000
Potential Storage Capacity (gal) | 44,730
Cost per Gallon | $2.66
Project Boundary
Road
Electric WE Overhead Line
Electric WE Pole
Light or Telephone Pole
Gas Main WE Low Pressure
Gas Main WE Transmission
Municipal Sanitary Sewer
0 50 100 200 300 400
Feet

West Milwaukee: Greenfield Ave (east segment)



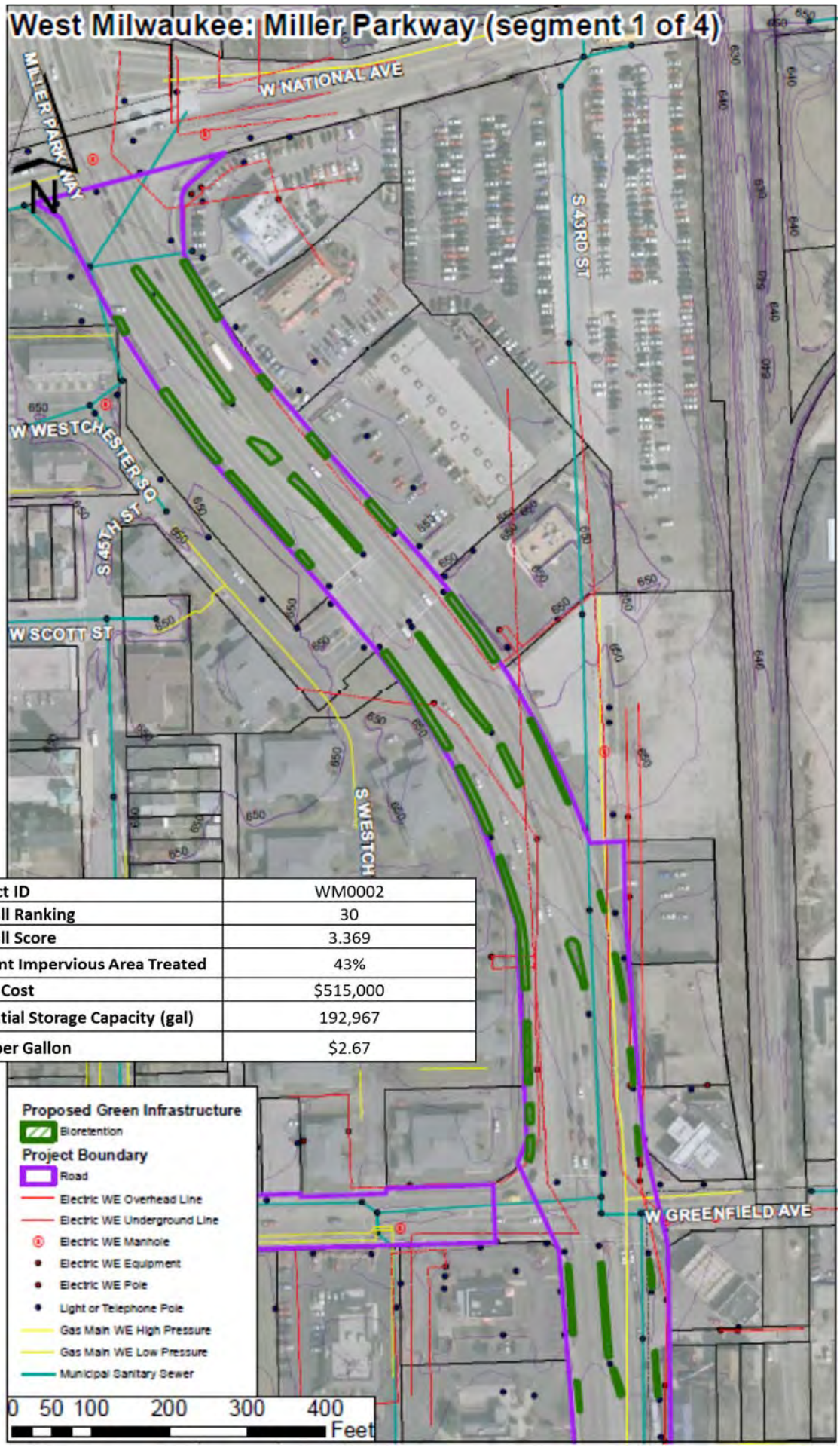
Project ID	WM0001
Overall Ranking	28
Overall Score	3.432
Percent Impervious Area Treated	11%
Total Cost	$91,000
Potential Storage Capacity (gal)	21,080
Cost per Gallon	$4.32

West Milwaukee: Greenfield Ave (west segment)



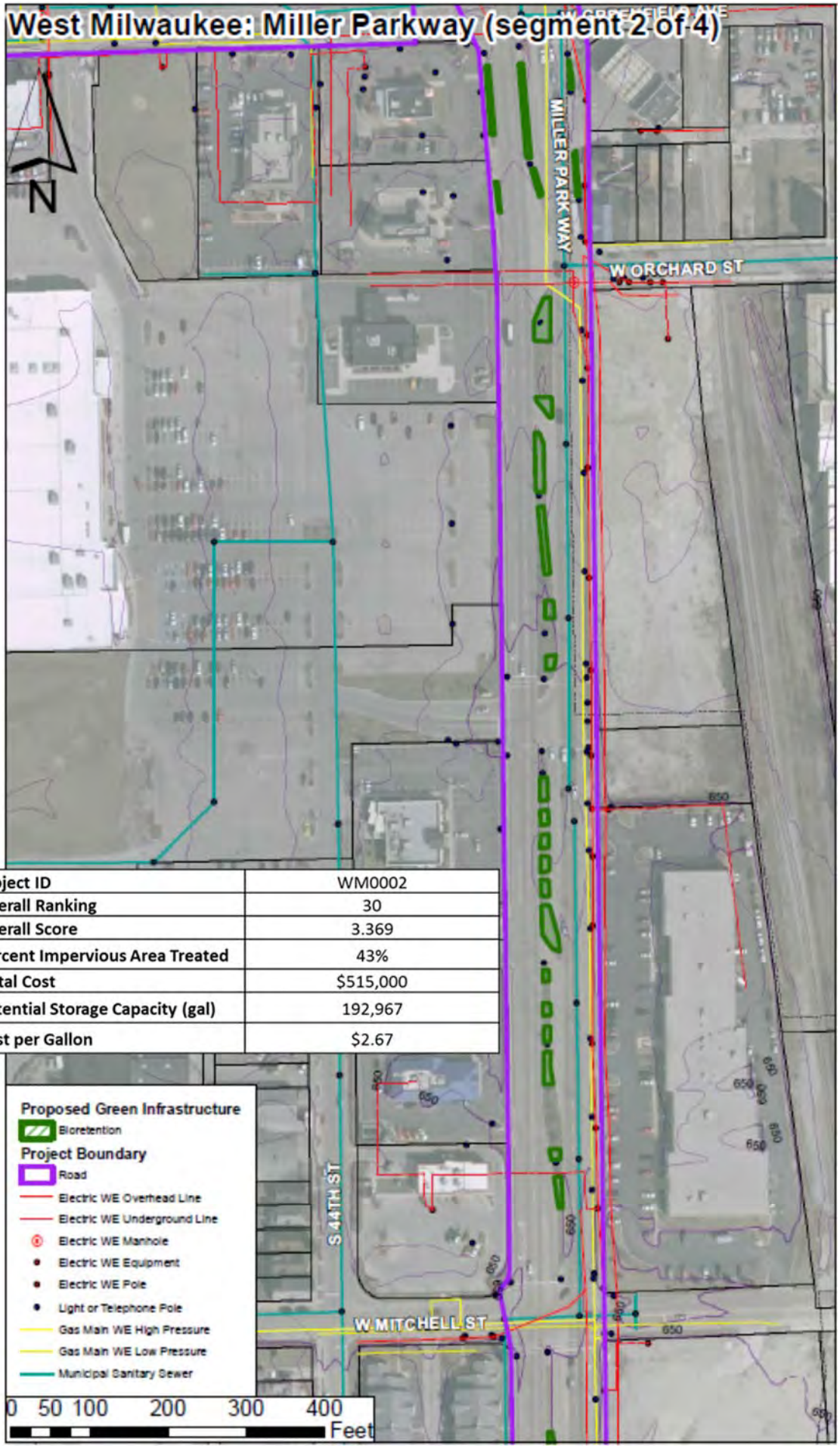
Project ID	WM0001
Overall Ranking	28
Overall Score	3.432
Percent Impervious Area Treated	11%
Total Cost	$91,000
Potential Storage Capacity (gal)	21,080
Cost per Gallon	$4.32

West Milwaukee: Miller Parkway (segment 1 of 4)



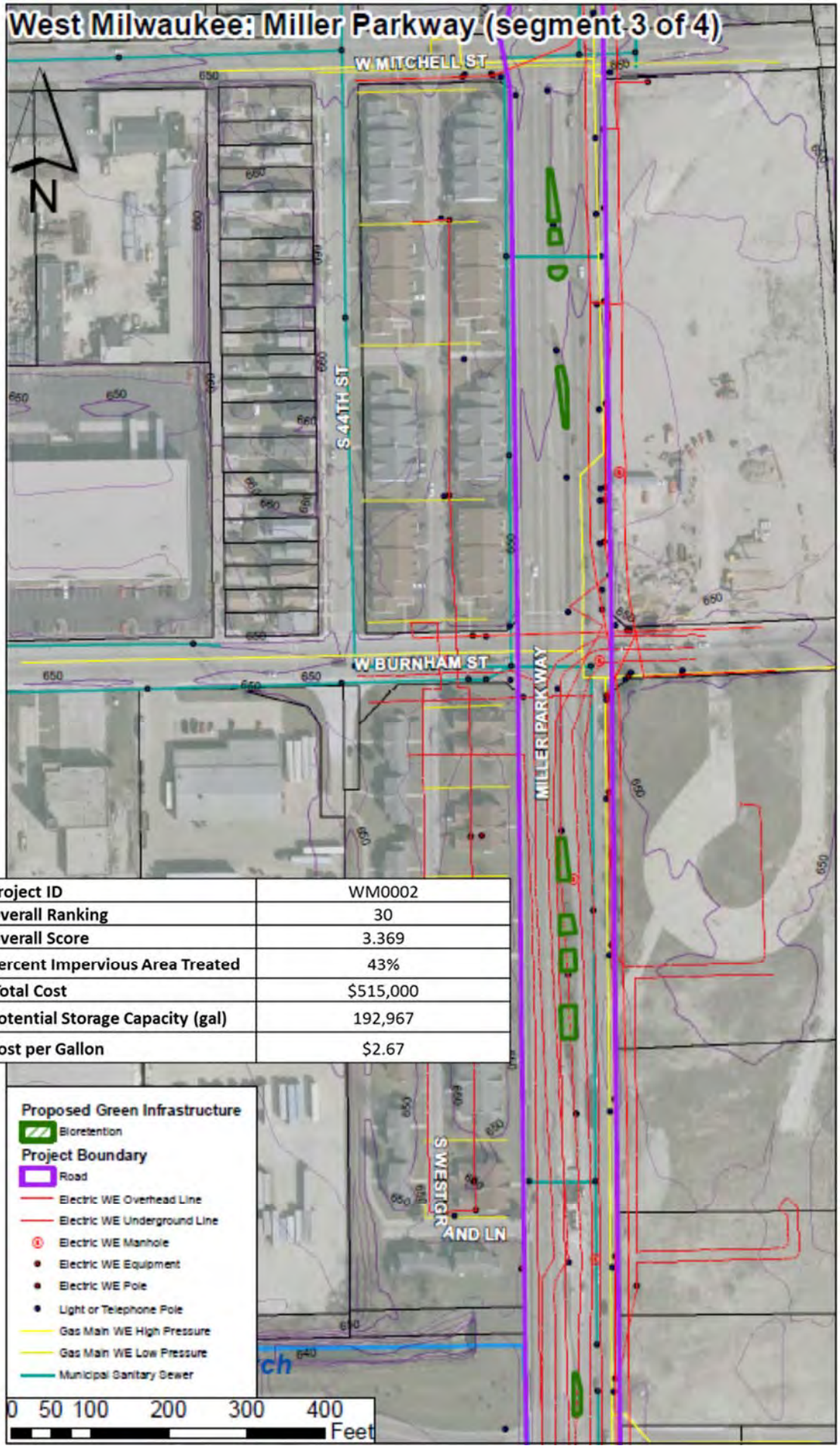
Project ID	WM0002
Overall Ranking	30
Overall Score	3.369
Percent Impervious Area Treated	43%
Total Cost	$515,000
Potential Storage Capacity (gal)	192,967
Cost per Gallon	$2.67

West Milwaukee: Miller Parkway (segment 2 of 4)

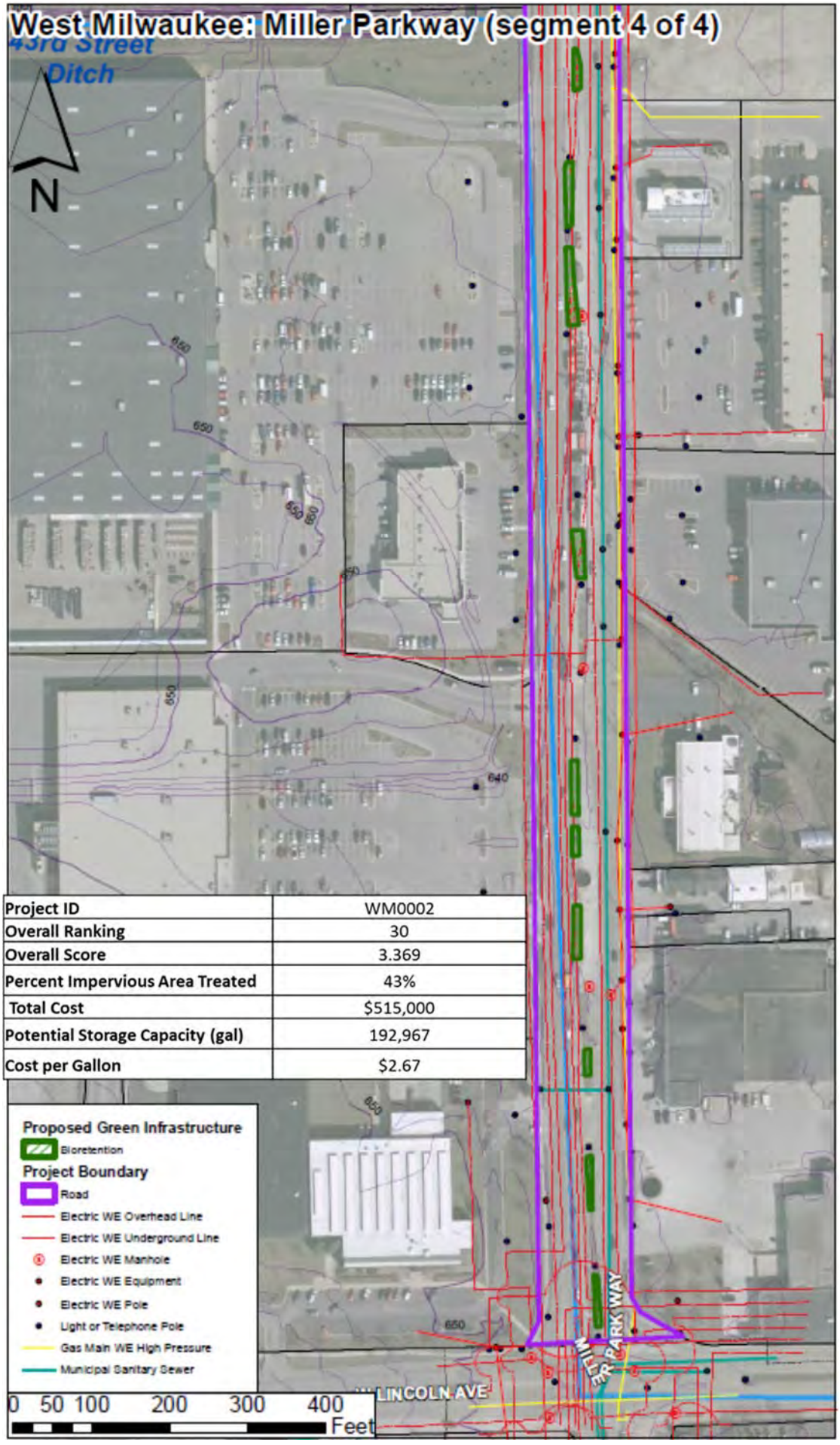


Project ID	WM0002
Overall Ranking	30
Overall Score	3.369
Percent Impervious Area Treated	43%
Total Cost	$515,000
Potential Storage Capacity (gal)	192,967
Cost per Gallon	$2.67

West Milwaukee: Miller Parkway (segment 3 of 4)



Project ID	WM0002
Overall Ranking	30
Overall Score	3.369
Percent Impervious Area Treated	43%
Total Cost	$515,000
Potential Storage Capacity (gal)	192,967
Cost per Gallon	$2.67



Project ID	WM0002
Overall Ranking	30
Overall Score	3.369
Percent Impervious Area Treated	43%
Total Cost	$515,000
Potential Storage Capacity (gal)	192,967
Cost per Gallon	$2.67

Appendix B
Survey Questions and Responses

11 responses

View all responses Publish analytics

Summary

Name and organization

RIchard Paul Village of Elm Grove

Jeff Nettesheim, Menomonee Falls Utilities

Maggie Anderson, City of Wauwatosa

Tim Barbeau, Village of Butler

Tim Thur - City of Milwaukee DPW

Joe Burtch, City of West Allis

Stevan Keith, Milwaukee County

Theresa Caven, City of Brookfield

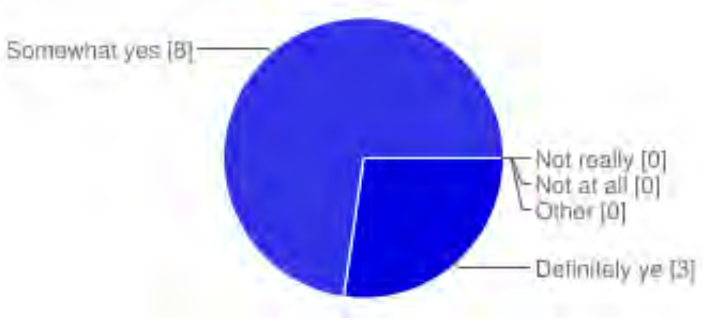
Tom Grisa, City of Brookfield

Eric Bartlein - Village of Germantown

Greenfield

EVALUATING THIS PROJECT

1. Did you find this project useful?



Definitely yes	**3**	27.3%
Somewhat yes	**8**	72.7%
Not really	**0**	0%
Not at all	**0**	0%

Other	**0**	0%

Comment (1):

It was good to have a third party involved in the identification and suggestions related to potential GI solutions.

The project did a nice job of identifying potential opportunities for GI. If the objective was to raise awareness vs develop a project, then I think it was successful

The project was not directly useful for West Allis, but it provided a connection to what is going on with the other Municipalities. The real benefit will be when we can share experiences with different types of projects done by other communities.

I appreciated the tips on how to prioritize green infrastructure projects. A few of the recommendations gave us confirmation on green infrastructure we had already included in our CIP.

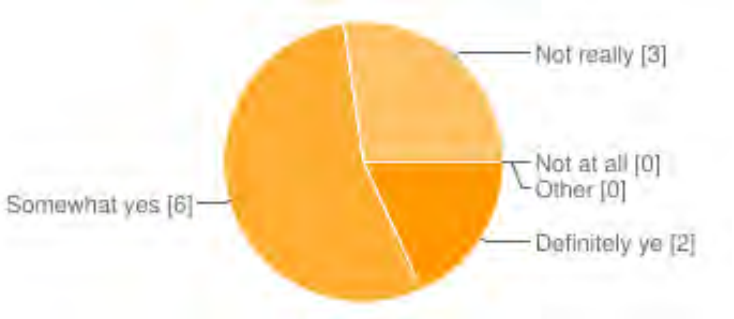
City of Milwaukee has previously developed a methodology to look at including green infrastructure as part of its capital paving program.

Great insight into planning future projects that could may a more effective impact on the bigger picture.

It gave us awareness of how these GI practices can be fit into the streetscape.

I don't think anything new or innovative was provided for the projects. Basically it was just a listing of the types of green infrastructure that could be included on certain projects with approximate costs identified. This can be helpful as municipalities proceed with the work, but costs were very high for what you get in water quality improvements.

2. Has this project raised your awareness that there are green infrastructure opportunities with street and parking lot reconstruction projects?



Definitely yes	**2**	18.2%
Somewhat yes	**6**	54.5%
Not really	**3**	27.3%
Not at all	**0**	0%
Other	**0**	0%

Comment (2):

We do look at opportunities when possible, but the fact that there was a focus was evidently more advantageous.

I believe the only problem with green infrastructure projects is that they are not financially sustainable at this time. I think as Municipalities experience the successes and failures of projects, it will provide better methods and bang for you buck on future projects.

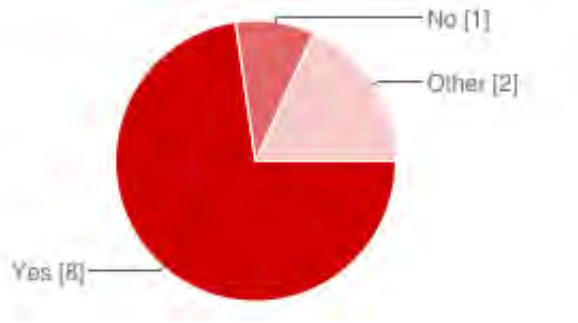
City of Milwaukee has previously developed a methodology to look at including green infrastructure as part of its capital paving program.

From a staff standpoint it has allowed dialogue regarding GI as projects arise. Not the same reaction for the local elected officials. It can be a hard sell to the elected officials if they do not see the immediate benefit and if the up front costs make the GI solution cost prohibitive.

I was aware of the types of GI available and nothing new or innovative was presented.

We are a large and somewhat silo'd operation. As a result, not all of the property owners could attend the presentation, so I'm unsure if all of the people who needed to become more aware have read & understand the information

3. Has this project provided your community with at least two potential green infrastructure projects that could be implemented?



Yes	**8**	72.7%
No	**1**	9.1%
Other	**2**	18.2%

Comment (3):

Certainly there is potential to construct something akin to the concepts at these sites

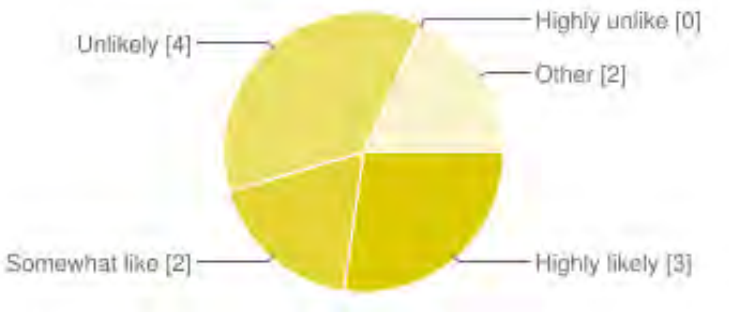
Absolutely an option on one, but the only other project that is in our community is under jurisdiction of the county.

City of Milwaukee has previously developed a methodology to look at including green infrastructure as part of its capital paving program.

The recommendations for alleys are included in our CIP.

I can show a plan sheet to make others aware of the potential to add this.

4. How likely is it that your community will implement the two green infrastructure opportunities?



Highly likely	**3**	27.3%
Somewhat likely	**2**	18.2%
Unlikely	**4**	36.4%
Highly unlikely	**0**	0%
Other	**2**	18.2%

Comment (4):

Likely we will implement the one project that pertains directly to the Village's grounds.

County may choose to use GI or other technologies. I was surprised to hear a team representative bash retention ponds as if they were not GI or somehow a terrible water quality feature. Ponds are quite cost-effective, very effective in improving water quality and can be an amenity that is quite attractive.

Property owners could weigh the added costs of GI vs using the funds to build/repair something else. There is no over-arching directive from the higher levels of admin to spend more than is necessary to comply with state, regional (MMSD) or local rules. Also, for highways projects, they rely largely on state funds and they may not feel compelled to add GI if WisDOT is not promoting/funding that type of work

The projects indicated in the study were limited to the Menomonee River watershed. West Allis drains to Root River and the KK River as well and we see opportunities in those watersheds. The information on the possible projects was good and will be used, but it may be in different locations.

City of Milwaukee has an annual program for the installation of green infrastructure.

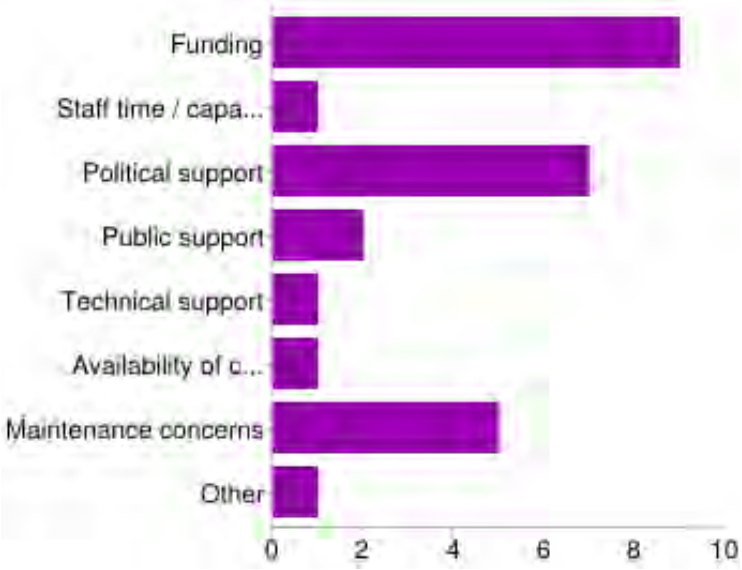
I am gradually getting the Engineering Dept. and others to see that this will need to be done and can be done.

Due to limited physical space in the road rights of way for GI solutions and the fact that there may be no political will to implement a GI solution, makes it unlikely that something will be implemented. However, the discussions will continue as part of educating the staff and elected officials as success stories form other communities become more apparent.

5. Are there barriers to implementing the two projects recommended for your community?

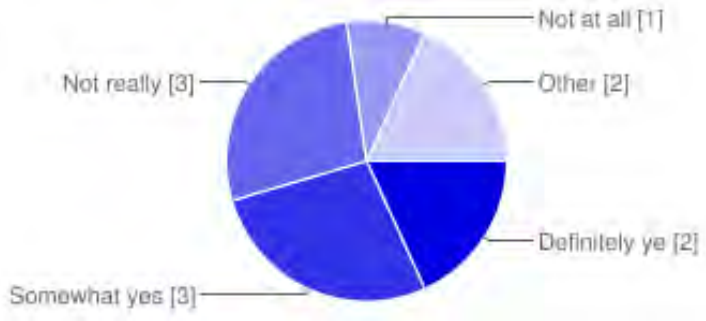
Yes	**9**	81.8%
No	**2**	18.2%
Other	**0**	0%

6. If you said "yes" regarding barriers in #5, please select the top 3 barriers for your community.



Funding	**9**	100%
Staff time / capacity	**1**	11.1%
Political support	**7**	77.8%
Public support	**2**	22.2%
Technical support	**1**	11.1%
Availability of construction standard details	**1**	11.1%
Maintenance concerns	**5**	55.6%
Other	**1**	11.1%

7. If resources were available, would you want more street and parking lot projects evaluated for green infrastructure opportunities in your community?



Definitely yes	**2**	18.2%
Somewhat yes	**3**	27.3%
Not really	**3**	27.3%
Not at all	**1**	9.1%
Other	**2**	18.2%

Comment (7):

unsure. Owners are expressing concerns about the O&M aspects. Even if matching funds were available for construction, owners may balk on any GI that is over&above min required due to O&M concerns

This would be matter for the administrator to provide direction on whether additional opportunities should be evaluated. The implementation and success of a project in a surrounding community could lead to further investigation.

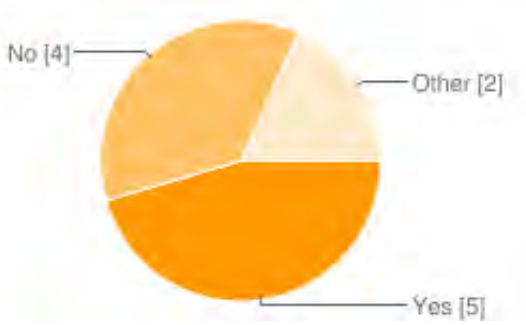
We know there is a lot of opportunities where green infrastructure could be constructed. The funding for this is not there. The green infrastructure adds a significant amount to the cost of a project.

City of Milwaukee has previously developed a methodology to look at including green infrastructure as part of its capital paving program.

As long as it does not pertain to porous pavement, since we are not equipped with the proper equipment to maintain that type of GI.

It gives us alternatives that our staff probably isn't cognizant of yet. It would help to create the culture that this is required and is to be part of the thought process.

8.Would you like to see your municipality include green infrastructure screening, like the process used in this project, as a standard step in the street / parking lot capital improvement planning process?



Yes	**5**	45.5%
No	**4**	36.4%
Other	**2**	18.2%

Comment (8):

It doesn't hurt.

We do look at the possibility of adding green infrastructure on all of our projects. The only funding we have available is our allocation from MMSD. This is only enough to provide a very small scale project.

We already use a screening tool in our capital planning process. Not nearly as sophisticated, but it's broader in scope to address more areas of sustainability - to consider energy, recycling, etc. However, unless the land owner department expresses desire in having GI added to their projects, the persons who prepare the capital estimates may not be inclined to include it. So there are several key levels that affect how GI can be incorporated

We need to include this in our thinking as we have with municipal utilities, pedestrian and bike traffic etc.

9. Would you recommend the green infrastructure opportunities evaluation process for streets and parking lots be expanded to other communities in the region?

Yes	**9**	81.8%
No	**0**	0%
Other	**2**	18.2%

Comment (9):

I think it brings awareness to communities regarding green infrastructure.

Sure

This process could be used by all communities to find opportunities to include green infrastructure as part of their capital paving work.

10. What are the strengths of the process used in this project?

It was a good way to heighten awareness and to share experiences of past projects.

gathering information as a group allows input from various size communities with varied political support. If one community can successfully complete a project, that community has a close audience to convince others to participate.

In general, a good approach to look at the 5-year CIP for opportunities, and to develop some conceptual plans with conceptual-level costs

Individuals had focus on this initiative which allowed for more comprehensive options.

Process builds enthusiasm.

The data analysis and use of GIS.

11. What suggestions do you have for improving the process used in this project?

Can't think of any at this time,.

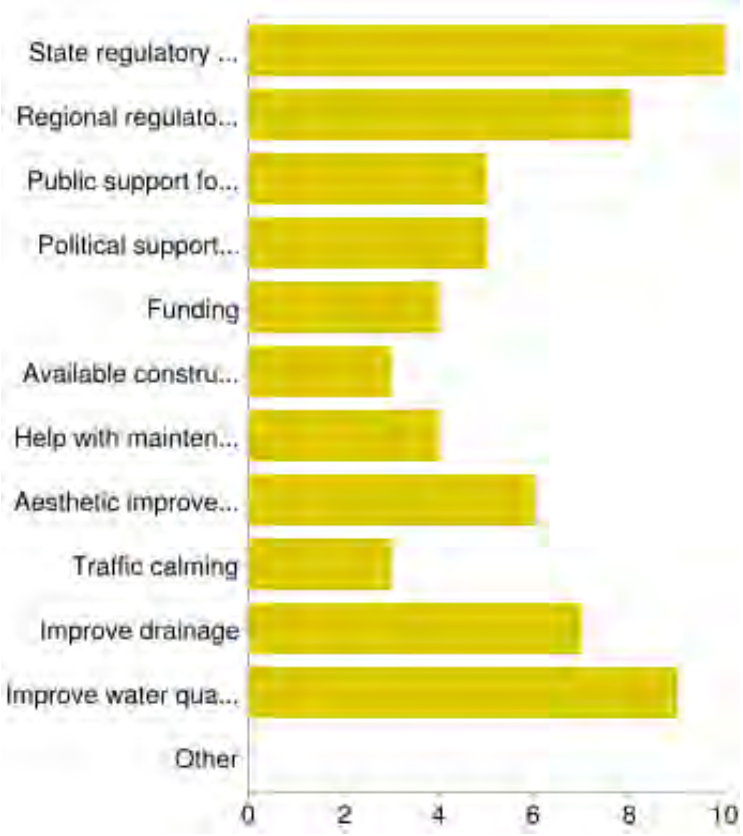
Closer collaboration with local officials.

Consider O&M costs Evaluate the decision-making process how GI gets incorporated into capital projects

It would be nice to have a "menu" of BMPs to choose from that would show the benefit, cost, maintenance, etc. of each BMP. For instance, if you install this BMP, it will cost $30,000 and will reduce TSS 40% for 0.25 acres and maintenance will be annual cleaning. Information like that would help in planning a project.

GREEN INFRASTRUCTURE ACROSS THE REGION

12. Why would you consider implementing more green infrastructure on public property in your community?



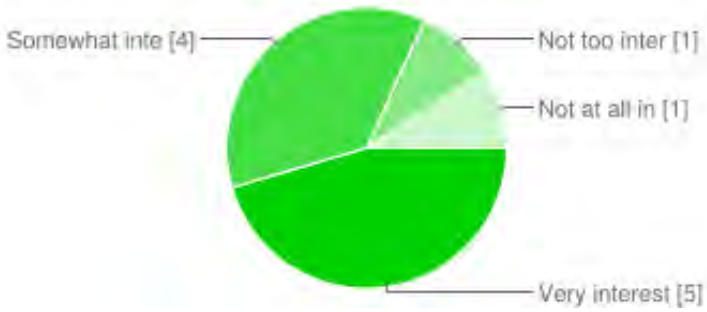
State regulatory requirements (TMDLs, NR 151, etc.)	**10**	90.9%
Regional regulatory requirements (MMSD Chapter 13, etc.)	**8**	72.7%
Public support for green infrastructure	**5**	45.5%
Political support for green infrastructure	**5**	45.5%
Funding	**4**	36.4%
Available construction standard details	**3**	27.3%
Help with maintenance (logistics, equipment, costs, etc.)	**4**	36.4%
Aesthetic improvement	**6**	54.5%
Traffic calming	**3**	27.3%
Improve drainage	**7**	63.6%
Improve water quality	**9**	81.8%
Other	**0**	0%

Comment (12):

I think everyone would like to use green infrastructure more. It is a matter of funding such a costly project. I think as these projects become more common, the costs may start to come down and we may determine where certain methods work best.

The Village has long been a leader in storm water detention/retention basin requirements, we just need to educate and have a few successful pilot projects.

13. What is your level of interest in learning more about green infrastructure operation and maintenance for public works departments (including how other communities are addressing these issues)?



Very interested	**5**	45.5%
Somewhat interested	**4**	36.4%
Not too interested	**1**	9.1%
Not at all interested	**1**	9.1%

Comment (13):

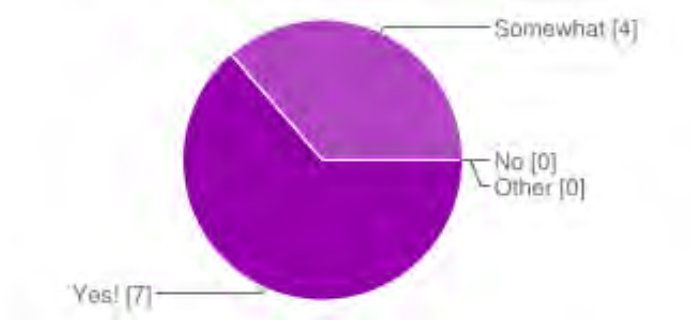
I feel I am already up on the latest GI.

With more green infrastructure getting installed, it will change the way DPWs have to provide maintenance.

We need to convene a group of local govt folks to discuss O&M

I need to have answers for questions that others have as to the level of effort these practices require for O&M.

14. Sweet Water (Southeastern Wisconsin Watersheds Trust, Inc.) was instumental in obtaining the grant that funded this project, with the goal of providing practical, useful outputs that can lead to implementable green infrastructure projects benefitting the Menomonee River Watershed. Does this kind of effort led / coordinated by Sweet Water add value to your community?



Yes!	**7**	63.6%
Somewhat	**4**	36.4%
No	**0**	0%
Other	**0**	0%

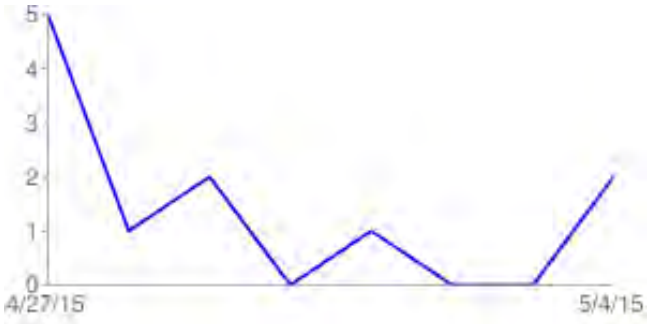
Comment (14):

SWWT offers value already, this is nice that this type of project can be brought to us

from those who can obtain grants.

I think projects like this will begin to lead us toward more affordable and successful green infrastructure projects.

Number of daily responses



Appendix C
GI Criteria Analysis Table

TABLE C-1

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ObjectID	Municipality	Project ID	Location	Municipality	Ground Slope (percent)	Depth to Groundwater (feet)	Depth to Bedrock (feet)	Benefit Rankings (percentile)	Opportunity Rankings (percentile)	Parking Lanes (2) on Road	Project Impervious Area Size	Existing Tree Canopy (percent)	Best Professional Judgement Review	Average GIS Score	Cost	Cost Rank	Cost Score	Cost Per Gallon	Efficiency Score	Overall Score	Overall Rank	By Municipality
1	BR	BR0001	North Ave_124th to Pilgrim Rd	Brookfield	4.40	5	5	3.932107	2.91372	1	5	5	3	3.92	$ 1,972,000.00	1	1	$ 2.67	5	3.31	31	1
3	BR	BR0002	North Ave_Pilgrim Rd to Calhoun Rd	Brookfield	4.48	5	5	3.352192	2.694484	1	5	5	3	3.84	$ 783,000.00	2	1	$ 2.67	5	3.28	32	2
30	BU	BU0001	Parking Lot N of Meno River at FrontierPrk	Butler	4.26	1	5	1.739745	4.094767	5	2	5	3	3.45	$ 95,000.00	18	3	$ 4.32	3	3.15	34	4
58	BU	BU0002	Silver Spring Drive in Butler	Butler	4.40	5	5	1.739745	4.094767	1	5	5	3	3.80	$ 402,000.00	5	1	$ 2.67	5	3.27	33	3
64	BU	BU0003	N 127th - Lancaster to Colfax	Butler	4.96	5	5	1.739745	4.094767	5	1	3	3	3.64	$ 27,000.00	31	5	$ 4.41	3	3.88	16	2
63	BU	BU0004	Parking Lot S of river at 127th St	Butler	5.00	5	5	1.739745	4.094767	5	1	5	3	3.87	$ 12,000.00	34	5	$ 2.65	5	4.62	2	1
60	EG	EG0001	13600 Juneau Blvd, Elm Grove	Elm Grove	4.86	5	5	3.54314	2.934936	5	3	5	3	4.15	$ 105,000.00	16	3	$ 2.67	5	4.05	9	1
7	EG	EG0002	North Ave_124th to Pilgrim Rd	Elm Grove	4.40	5	5	3.932107	2.91372	1	5	5	3	3.92	$ -	35	1	-	1	1.97	37	2
31	GE	GE0001	Rivercrest Drive_N of County Line Rd	Germantown	5.00	1	1	1.633663	1.463932	5	3	5	3	2.90	$ 41,000.00	25	4	$ 2.64	5	3.97	13	1
32	GE	GE0002	Concord Rd from Division Rd to Pilgrim Rd	Germantown	4.84	5	5	1.633663	1.463932	1	4	5	3	3.44	$ 333,000.00	8	2	$ 2.66	5	3.48	26	2
33	GF	GF0001	Crawford Ave btwn 45th and Morgan Ave	Greenfield	4.54	5	5	3.528996	1.944837	3	3	5	5	4.00	$ 142,000.00	13	2	$ 2.66	5	3.67	19	3
34	GF	GF0002	60th St from Cold Spring to Waterford Ave	Greenfield	4.98	5	5	3.373409	4.70297	5	4	5	3	4.45	$ 87,000.00	21	3	$ 2.66	5	4.15	8	2
36	GF	GF0003	43rd St from W Grange Ave to Layton Ave	Greenfield	4.96	5	5	3.783593	2.673267	1	4	5	3	3.82	$ 288,000.00	9	2	$ 2.67	5	3.61	22	4
38	GF	GF0004	35th Frontage from Edgerton to N of Holmes	Greenfield	4.94	5	5	3.87553	2.899576	1	2	5	5	3.86	$ 59,000.00	23	4	$ 2.67	5	4.29	6	1
53	MC	MC0001	West Oklahoma Ave from 72nd to 76th Street	Milwaukee County	4.88	5	5	4.137199	4.314003	5	4	5	3	4.48	$ 111,000.00	15	3	$ 2.66	5	4.16	7	2
14	MC	MC0002	Capitol Dr and 110th St	Milwaukee County	4.04	5	5	3.514851	4.632249	5	2	5	1	3.91	$ 94,000.00	19	3	$ 2.68	5	3.97	12	3
17	MC	MC0003	3535 N Mayfair Rd	Milwaukee County	4.72	5	5	3.514851	4.632249	5	4	5	3	4.43	$ 183,000.00	11	2	$ 2.67	5	3.81	18	5
55	MC	MC0004A	Watertown Plank Road and 92nd Street	Milwaukee County	4.74	5	5	4.745403	3.394625	5	2	5	5	4.43	$ 48,000.00	24	4	$ 4.31	3	3.81	17	4
54	MC	MC0004B	Watertown Plank Road and 92nd Street	Milwaukee County	4.80	5	5	4.745403	3.394625	5	4	5	5	4.66	$ 181,000.00	12	2	$ 3.26	4	3.55	24	6

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ObjectID	Municipality	Project ID	Location	Municipality	Ground Slope (percent)	Depth to Groundwater (feet)	Depth to Bedrock (feet)	Benefit Rankings (percentile)	Opportunity Rankings (percentile)	Parking Lanes (2) on Road	Project Impervious Area Size	Existing Tree Canopy (percent)	Best Professional Judgement Review	Average GIS Score	Cost	Cost Rank	Cost Score	Cost Per Gallon	Efficiency Score	Overall Score	Overall Rank	By Municipality
56	MC	MC0004C	Watertown Plank Road and 92nd Street	Milwaukee County	4.94	5	5	4.745403	3.394625	5	2	5	5	4.45	$ 38,000.00	26	4	$ 2.68	5	4.48	3	1
18	MC	MC0005	12020 W Bradley Rd	Milwaukee County	5.00	5	5	3.656294	4.158416	5	4	5	1	4.20	$ -	35	1	-	1	2.07	35	7
19	MC	MC0006	12020 W Bradley Rd	Milwaukee County	4.92	5	5	3.656294	4.158416	5	3	5	1	4.08	$ -	35	1	-	1	2.03	36	8
8	MF	MF0001	Arthur Ave_MenomAve to Appleton Ave	Menomonee Falls	3.82	3	5	3.055163	3.302687	5	2	5	1	3.46	$ -	35	1	-	1	1.82	45	5
9	MF	MF0002	CherokeeDr_CheyenneDr to Water St	Menomonee Falls	4.94	5	5	1.69024	2.998586	5	3	5	3	3.96	$ 103,000.00	17	3	$ 2.67	5	3.99	10	3
11	MF	MF0003	CheyenneDr_Village StandPipe to Cherokee Dr	Menomonee Falls	4.64	5	5	1.69024	2.998586	5	3	5	3	3.93	$ 63,000.00	22	4	$ 2.67	5	4.31	5	2
12	MF	MF0004	MayAve_ArthurAve to Fleet Ave	Menomonee Falls	3.82	1	5	3.055163	3.302687	5	2	5	5	3.69	$ -	35	1	-	1	1.90	40	4
13	MF	MF0005	St.FrancisDr_St Mark Dr to W St. Regis Dr	Menomonee Falls	4.94	5	5	1.69024	2.998586	5	3	5	3	3.96	$ 36,000.00	29	5	$ 2.63	5	4.65	1	1
61	MI	MI0001	N 91st btwn Mill Rd and Good Hope Rd	Milwaukee	4.52	5	5	3.981612	4.978784	1	5	5	3	4.16	$ 367,000.00	6	1	$ 2.67	5	3.39	29	2
62	MI	MI0002	W Lisbon btwn 84th and 100th	Milwaukee	4.98	5	5	4.893918	3.069307	5	5	5	3	4.55	$ 590,000.00	3	1	$ 2.67	5	3.52	25	1
48	WA	WA0001	N 113th St btwn North Ave and 75'S of Clark St	Wauwatosa	4.06	5	5	3.437058	1.711457	3	3	3	3	3.47	$ -	35	1	-	1	1.82	44	9
49	WA	WA0002	Harding Blvd btwn 96th and 97th	Wauwatosa	4.68	5	5	4.462518	3.769448	5	2	1	1	3.55	$ -	35	1	-	1	1.85	43	8
50	WA	WA0003	Harding Blvd btwn 97th and City Limits	Wauwatosa	4.98	5	5	4.462518	3.769448	5	3	1	1	3.69	$ -	35	1	-	1	1.90	39	5
23	WA	WA0004	Alley btwn Elm Lawn St and 85th_N of Watrtwn Plk	Wauwatosa	4.78	5	5	4.745403	3.394625	3	1	5	1	3.66	$ -	35	1	-	1	1.89	41	6
51	WA	WA0005	Allewy between W. of Robertson_N of Gridley Ave	Wauwatosa	5.00	5	5	4.632249	3.74116	3	1	5	3	3.93	$ 22,000.00	32	5	$ 4.34	3	3.98	11	1
25	WA	WA0006	Alley btwn 74thAnd75th_S of Center	Wauwatosa	5.00	5	5	4.992928	2.970297	3	1	5	3	3.88	$ 14,000.00	33	5	$ 4.48	3	3.96	14	2
26	WA	WA0007	Alley btwn 75thAnd76th_S of Center	Wauwatosa	4.74	5	5	4.992928	2.970297	3	1	5	1	3.63	$ -	35	1	-	1	1.88	42	7
20	WA	WA0008	State St_68th to Wauwatosa Ave	Wauwatosa	4.94	1	5	4.922207	3.041018	3	4	5	5	3.99	$ 206,000.00	10	2	$ 2.86	5	3.66	20	3

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52	WA	WA0009	N 92nd btwn Capitol Dr and Hampton Ave	Wauwatosa	4.72	5	5	4.561528	2.51768	5	5	5	3	4.42	$ 336,000.00	7	1	$ 2.67	5	3.47	27	4
39	WE	WE0001	Alley between 59th and 60th_S of Grant St	West Allis	4.86	5	5	4.398868	4.07355	3	1	5	3	3.93	$ 38,000.00	26	4	$ 4.32	3	3.64	21	3
40	WE	WE0002	Alley between 65th and 66th_S of Lapham St	West Allis	3.20	5	5	4.830269	2.835926	3	1	5	1	3.43	$ -	35	1	-	1	1.81	46	6
42	WE	WE0003	Alley between 59th and 60th_S of Rogers St	West Allis	5.00	5	5	4.533239	1.442716	3	1	5	3	3.66	$ 29,000.00	30	5	$ 4.41	3	3.89	15	2
43	WE	WE0004	85th St btwn Washington and Greenfield Ave	West Allis	4.68	5	5	4.420085	4.024045	5	2	3	1	3.79	$ -	35	1	-	1	1.93	38	5
44	WE	WE0005	89th St btwn National Ave and Lincoln Ave	West Allis	4.66	5	5	4.420085	4.024045	5	3	5	3	4.34	$ 37,000.00	28	4	$ 2.68	5	4.45	4	1
45	WE	WE0006	124th St btwn Lincoln Ave and Oklahoma Ave	West Allis	4.70	5	5	3.097595	2.38331	1	4	5	3	3.69	$ 119,000.00	14	2	$ 2.66	5	3.56	23	4
46	WM	WM0001	Greenfield Ave btwn Miller Park way and 56th	West Milwaukee	4.66	5	5	4.653465	3.338048	3	5	5	3	4.29	$ 91,000.00	20	3	$ 4.32	3	3.43	28	1
47	WM	WM0002	Miller Park Way from National to W Lincoln Ave	West Milwaukee	4.96	5	5	4.653465	3.338048	1	5	5	3	4.11	$ 515,000.00	4	1	$ 2.67	5	3.37	30	2