Office of the City Manager

CONSENT CALENDAR
September 10, 2019

To: Honorable Mayor and Members of the City Council

From: Dee Williams-Ridley, City Manager

Submitted by: Phillip L. Harrington, Director, Department of Public Works

Subject: Green Infrastructure Plan Adoption

## RECOMMENDATION

Adopt a Resolution adopting the City of Berkeley Green Infrastructure Plan, July 2019, submit the Plan to the SF Bay Regional Water Quality Control Board, and authorize the City Manager to amend the Green Infrastructure Plan as needed to adjust for changes in technologies, or changes in City priorities.

## SUMMARY

The City of Berkeley Green Infrastructure Plan, July 2019 is a requirement under the Stormwater Municipal Regional National Pollutant Discharge Elimination System Permit 2 (MRP2)[1]. The Green Infrastructure Plan was developed in coordination with the SF Bay Regional Water Quality Control Board (Water Board) to meet regulatory requirements and provide guidance for prioritizing Green Infrastructure projects in the City. Applying Geographic Information System (GIS) based analysis techniques, the Green Infrastructure Plan identified 11 priority sites for Green Infrastructure facilities for the City. In addition, the Green Infrastructure Plan predicts the City will need to treat runoff from an additional 17 acres of the City to meet regionwide PCB (polychlorinated biphenyl) and mercury reduction goals by 2030, and 19 additional acres of the City to meet regionwide PCB and mercury reduction goals by 2040. The information on the 11 priority sites and the additional areas to be treated by 2030 and 2040 is used on a regionwide basis to allow MRP2 permittees and the Water Board to assess how well the stormwater agencies are reducing pollution to the San Francisco Bay. MRP2 requires the Green Infrastructure Plan be submitted to Water Board by September 30, 2019.

## FISCAL IMPACTS OF RECOMMENDATION

The cost for constructing the eleven Green Infrastructure projects identified in the Green Infrastructure Plan is estimated to be $1.7 million (2018 dollars). Ongoing maintenance of these 11 facilities will cost approximately $100,000 per year (2018 dollars).

[1] https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/stormwater/Municipal/R2-2015-0049.pdf

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The City's goal is to treat an additional 17 acres between 2020 and 2030. The estimated cost for installing GI to treat 17 acres is $8.9 million (2018 dollars) spread over the ten year period from 2020 to 2030. The corresponding ongoing annual maintenance cost would increase by approximately $550,000 per year (2018 dollars).

The City's goal from 2030 to 2040 in the Green Infrastructure Plan is to treat an additional 19 acres. The estimated cost for installing Green Infrastructure to treat 19 acres is $10.0 million (2018 dollars) spread over ten year period from 2030 to 2040. The corresponding ongoing annual maintenance cost would increase by approximately $620,000 per year (2018 dollars).

A funding option that is available to the City includes the Clean Stormwater Fee funds. These funds can be used as matching or local fund contributions to obtain grant funding. However, to implement all the goals of the Green Infrastructure Plan additional funding sources will need to be identified.

## CURRENT SITUATION AND ITS EFFECTS

The Green Infrastructure Plan (see Proposed Resolution Exhibit A) was prepared according to the framework adopted by Resolution 68,041—N.S. (see Attachment 2) on June 13, 2017. The Green Infrastructure Plan is a planning document required under MRP2, to guide selection and development of Green Infrastructure projects beginning in 2020, and assure reductions of polychlorinated biphenyls (PCB), mercury and other pollutants in urban runoff. Adopting the Green Infrastructure Plan supports the City's Strategic Plan Priority Goal of being a global leader in addressing climate change, advancing environmental justice, and protecting the environment.

Staff made a Green Infrastructure Plan presentation to the Public Works Commission (PWC) on February 7, 2019. The PWC submitted an off agenda memo dated April 10, 2019 summarizing its recommendations following the presentation from staff. The PWC's recommendations and staff responses are summarized as follows:

1. PWC recommended staff develop metrics that educate readers about the economic benefits of the plan in reducing flooding and increasing water supply by infiltrating runoff.

   Staff response: The purpose of the Green Infrastructure Plan is to improve urban runoff quality and includes outreach and education for the general public and developers on the requirements for implementing GI in projects, and the purpose is not to reduce flooding and increase water supply.

2. PWC recommended staff meet with Regional Board staff to be sure that the plan will be acceptable.

   Staff response: The Green Infrastructure Plan was developed in consultation with Water Board staff to understand their expectations, and to meet the requirements set forth in MRP2.

3. PWC recommended City work with Caltrans to develop a comprehensive Green Infrastructure approach for San Pablo Avenue, in a manner similar to the approach for the Adeline Corridor.

   Staff response: The Green Infrastructure Plan requires urban runoff water quality and Green Infrastructure be incorporated into the City's planning processes.

PWC requested the Green Infrastructure Plan model be applied to additional options such as the center median of Sacramento and other historic streetcar lines. The assessment of the Sacramento median showed that it does not rank as high in priority as other sites at this time. Other historic streetcar lines can be reassessed in the future and compared as project development changes.

Following the presentation to the PWC, the Green Infrastructure Plan was presented to the public on February 27, 2019; to the Council's Facilities, Infrastructure, Transportation, Environment, and Sustainability (FITES) Committee on May 2, 2019; and to the full Council at the Work Session on June 18, 2019.

<u>BACKGROUND</u>
Implementing Green Infrastructure or Low Impact Development (LID) in Berkeley has been happening in various forms for many years. Tracking Green Infrastructure improvements began under Municipal Regional Stormwater National Pollutant Discharge Elimination System Permit 1 (MRP1, October 2009 to November 2015) and has continued into the current MRP2 with over 50 such installations completed to date. These installations include permeable pavement applications (Allston Way), bio-swale retrofits into existing conditions (Presentation Park at California Street/Allston Way), complete street applications of bio-swales (Hearst Avenue/Oxford Street), flow-through planters (BART Plaza), and green roofs (Dona Spring Animal Shelter). These past Green Infrastructure projects have been incorporated into the Green Infrastructure Plan.

The Green Infrastructure Plan performs several functions including prioritizing areas for Green Infrastructure projects, tracking Green Infrastructure projects, tracking compliance with regionwide reductions in pollutants including PCB and mercury, identifying other City planning documents to incorporate GI considerations, and exploring funding options for GI projects.

<u>Prioritizing and Identifying Green Infrastructure Projects.</u> A major tool in reducing pollutant loading in urban runoff is addressing impacts created by impervious surfaces. The Green Infrastructure Plan uses an UrbanSim based model to forecast future potential development areas and the corresponding impervious area where Green Infrastructure will be implemented to treat urban runoff. These predictions are combined with the City's planned projects and projections to develop target amounts of impervious surface treatment for the milestone years of 2020, 2030, and 2040. Two GIS based tools are used to prioritize projects for the Green Infrastructure Plan. The first tool (Multi-Benefit Prioritization Tool) ranks based on characteristics that include ground slope, soil

permeability, potential for pollutant reduction and augmenting groundwater, flood control benefit, potential to restore habitat, trash capture, and public involvement. The second tool (Micro-Watershed Tool) uses specific drainage area or Micro-Watershed to refine how urban runoff is collected and delineates specific drainage areas for placing Green Infrastructure facilities. These two tools were applied and the priority sites that were identified include:

- Page Street between Fourth Street and the RR Tracks (Gilman Watershed)
- Jones Street between Fourth Street and RR Tracks (Gilman Watershed)
- Channing Way at the RR Tracks (Potter Watershed)
- Heinz Avenue near RR Tracks (Potter Watershed)
- Dwight Way between Fourth Street and the RR Tracks (Aquatic Park Watershed)
- Grayson Street near the RR Tracks (Aquatic Park Watershed)
- Tenth Street at Codornices Creek (Codornices Watershed)
- Ninth Street at Codornices Creek (Codornices Watershed)
- Piedmont Avenue Median between Durant Avenue and Channing Way (Potter Watershed)
- Piedmont Avenue Traffic Circle (Potter Watershed)
- San Pablo Park at Ward Street (Potter Watershed)

<u>Tracking and Regionwide Compliance.</u> These values are shared regionally to determine how well targeted pollutants such as mercury and PCBs are reduced through treating urban runoff by Green Infrastructure facilities. The Alameda Countywide Clean Water Program (ACCWP) and Contra Costa Countywide Clean Water Program combined efforts to develop a tracking and load reduction accounting tool. This ArcGIS Online web application (AGOL Tool) is an online GIS application to track GI projects and will be open for public viewing when fully implemented.

<u>Planning Documents.</u> The Green Infrastructure Plan provides the most current information on methods and locations for optimal pollutant load reductions in urban runoff. This information must be incorporated into the City's planning documents. This will require inter-departmental cooperation and communications. The planning documents identified include:

- City of Berkeley General Plan
- Downtown Berkeley Design Guidelines
- Downtown Streets and Open Space Improvement Plan

- Downtown Area Plan
- Berkeley Strategic Transportation Plan (BeST Plan)
- Watershed Management Plan
- Adeline Corridor Plan (in progress)
- Pedestrian Master Plan (update in progress)
- Southside Complete Streets (in progress)

ENVIRONMENTAL SUSTAINABILITY

The Green Infrastructure Plan is designed to work in conjunction with existing City planning documents and programs with the goal of coordinating and ensuring Green Infrastructure opportunities are identified and implemented.

RATIONALE FOR RECOMMENDATION

The City is required to adopt the Green Infrastructure Plan and submit the plan to the Water Board by September 30, 2019 to satisfy regulatory requirements in MRP2. The City of Berkeley Green Infrastructure Plan July 2019 has been developed in consultation with Water Board staff; was presented to the Public, PWC, Council's FITES Committee, and the full Council; and comments have been addressed.

ALTERNATIVE ACTIONS CONSIDERED

There are no current alternatives to adopting and submitting the Green Infrastructure Plan to the Water Board. The Green Infrastructure Plan is a requirement of MRP2.

CONTACT PERSON

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Attachments:
1: Resolution
    Exhibit A: City of Berkeley Green Infrastructure Plan, July 2019
2: Resolution 68,401—N.S.

RESOLUTION NO. ##,###-N.S.

GREEN INFRASTRUCTURE PLAN ADOPTION

WHEREAS, the San Francisco Bay Regional Water Quality Control Board (Water Board) adopted the second Municipal Regional Stormwater National Pollutant Discharge Elimination System Permit (MRP2) on November 19, 2015 as Order No. R2-2015-0049 to the City of Berkeley; and

WHEREAS, MRP2 Provision C.3.j requires the City to adopt a Green Infrastructure Plan framework for the Green Infrastructure Plan by June 30, 2017; and

WHEREAS, the City adopted the framework for the Green Infrastructure Plan by passing Resolution 68,401—N.S. on June 13, 2017; and

WHEREAS, MRP2 Provision C.3.j further requires the City adopt and submit the Green Infrastructure Plan (see Exhibit A) to the Water Board by September 30, 2019; and

WHEREAS, the Green Infrastructure Plan was developed in consultation with Water Board staff; and

WHEREAS, the draft Green Infrastructure Plan has been presented to the Public Works Commission, to the Public, to the City's Facilities, Infrastructure, Transportation, Environment, and Sustainability Committee, and to the full Council; and

WHEREAS, the Green Infrastructure Plan presents a plan for reducing urban runoff pollutant loads to the Bay in particular PCBs and mercury; and

WHEREAS, adopting the Green Infrastructure Plan supports the City's Strategic Plan Priority Goal of being a global leader in addressing climate change, advancing environmental justice, and protecting the environment.

NOW THEREFORE, BE IT RESOLVED by the Council of the City of Berkeley that the City adopts the City of Berkeley Green Infrastructure Plan, July 2019 (Exhibit A) for submittal to the SF Bay Regional Water Quality Control Board by September 30, 2019.

BE IT FURTHER RESOLVED that the City Manager is authorized to amend the Green Infrastructure Plan as needed to adjust for changes in technologies, or changes in City priorities.

Exhibits
A: City of Berkeley Green Infrastructure Plan July 2019

# Green Infrastructure Plan
# City of Berkeley

July 2019

# Table of Contents

# List of Appendices



# List of Acronyms

| Acronym | Definition |
|---|---|
| ACCWP | Alameda Countywide Clean Water Program |
| AGOL | ArcGIS Online |
| BAHM | Bay Area Hydrology Model |
| BASMAA | Bay Area Stormwater Management Agencies Association |
| DMA | Drainage management area |
| GI | Green infrastructure |
| LID | Low impact development |
| MRP | Municipal Regional Stormwater Permit |
| HM | Hydromodification management |
| RWQCB | Regional Water Quality Control Board, San Francisco Bay |
| PCBs | Polychlorinated biphenyls |
| TMDL | Total maximum daily load |

# 1. Introduction

## 1.1 Statement of Purpose

The purpose of this Green Infrastructure Plan (GI Plan) is to guide the identification, implementation, tracking, and reporting of green infrastructure projects within the City of Berkeley in accordance with the Municipal Regional Stormwater Permit (MRP), Order No. R2-2015-0049, adopted by the San Francisco Bay Regional Water Quality Control Board on November 15, 2015. "Green infrastructure" refers to a sustainable system that slows runoff by dispersing it to vegetated areas, harvests and uses runoff, promotes infiltration and evapotranspiration, and/or uses bioretention and other low impact development practices to improve the water quality of stormwater runoff.

## 1.2 Physical Setting[1]

The City of Berkeley, approximately 10.5 sq miles, is located in northern Alameda County on the eastern shoreline of the San Francisco Bay and extends east to the ridgelines of the East Bay Hills. In general, the physiography of the Berkeley watersheds reflects their general position or alignment in relation to the primary geologic structures in the East Bay. The watersheds in Berkeley typically drain to the west out of the steeper headwaters (Berkeley Hills, with a maximum elevation of approximately 1,770' at Chaparral Peak), across a transitional alluvial fan zone, and then across the more gently sloping Bay plain before discharging into the San Francisco Bay (approximately at sea-level). One exception is the Wildcat watershed which runs along the eastern side of the ridgelines of the Berkeley Hills and drains to Wildcat Creek. There are 10 watersheds wholly or partially within the City of Berkeley (not including the Marina). Moving from north to south, these are: Wildcat, Cerrito, Marin, Codornices, Gilman, Schoolhouse, Strawberry, Aquatic Park, Potter, and Temescal (Figure 1). Several watersheds extend past Berkeley's municipal boundaries into the Cities of Emeryville and Oakland to the south, and the Cities of Albany and El Cerrito to the north. The City of Berkeley is predominately urban; however drainage from approximately 2 sq. mi. of non-urban area outside the City boundary flows into the City from Strawberry Canyon and Claremont Canyon east of the City. Detailed characteristics of Berkeley's watersheds are provided in Appendix A.

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[1] Excerpt from City of Berkeley, 2011. *Watershed Management Plan, Public Works Engineering, Version 1.0,* October.

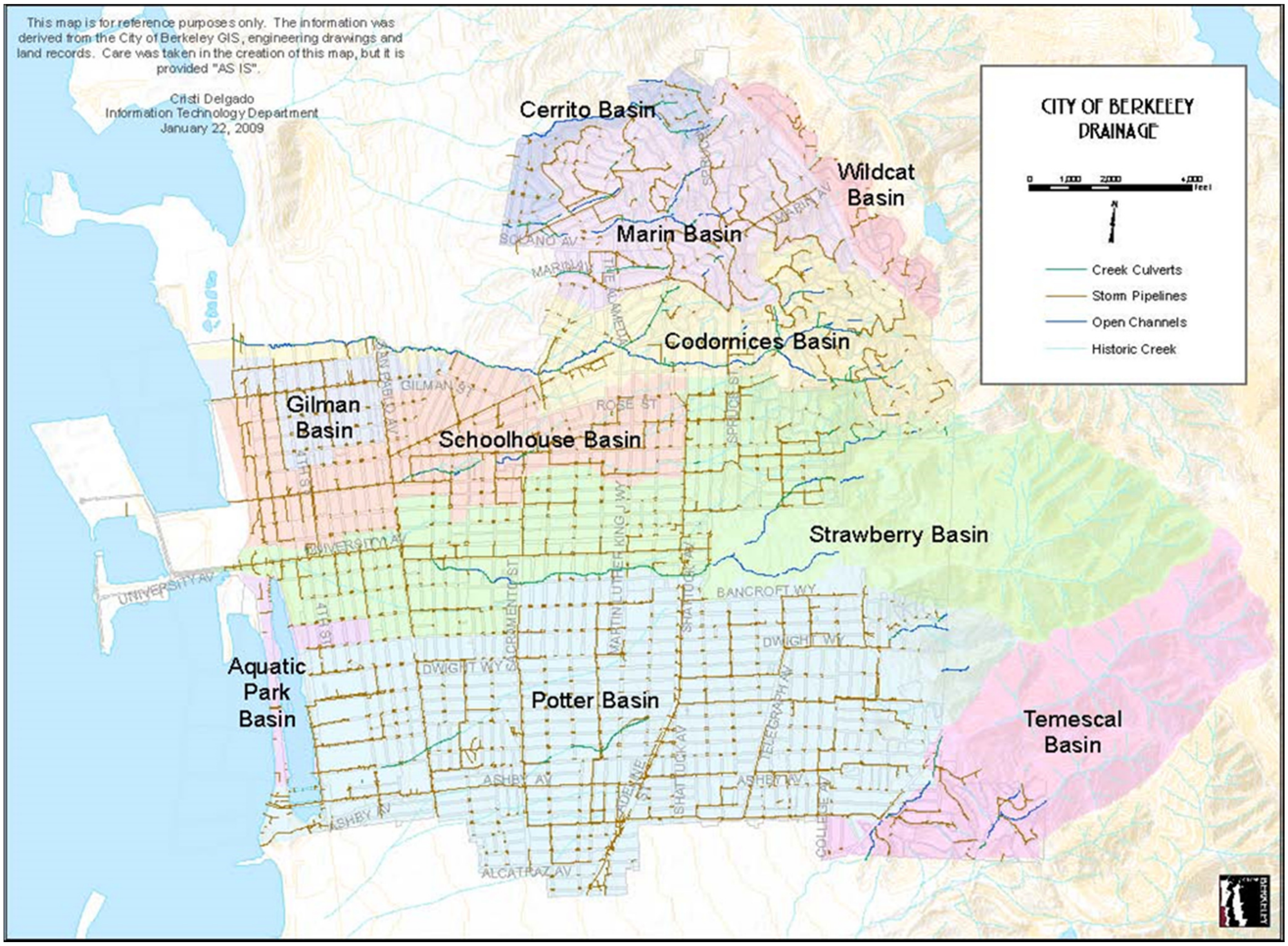


**Figure 1 – Map of Watersheds in the City of Berkeley, California**

## 1.3 Existing Green Infrastructure in Berkeley

Since the early 2000s, green infrastructure facilities have been installed in Berkeley at a rapid pace. As of 2019, over 50 public and private green infrastructure facilities have been installed in Berkeley. These facilities have been installed as parts of City "Green Streets" initiatives and as a result of Low-Impact Development (LID) requirements for private development projects. Additionally, some private landowners have voluntarily installed green infrastructure facilities on their properties. Figure 2 shows the locations of existing Green Infrastructure/Low-Impact Development (GI/LID) facilities in Berkeley. Figures 3 through 8 provide examples of existing GI/LID facilities. In 2012, the City adopted its Watershed Management Plan (WMP, Appendix A). Chapter 3 of the WMP provides detailed explanations and compares the benefits of different types of GI/LID facilities.

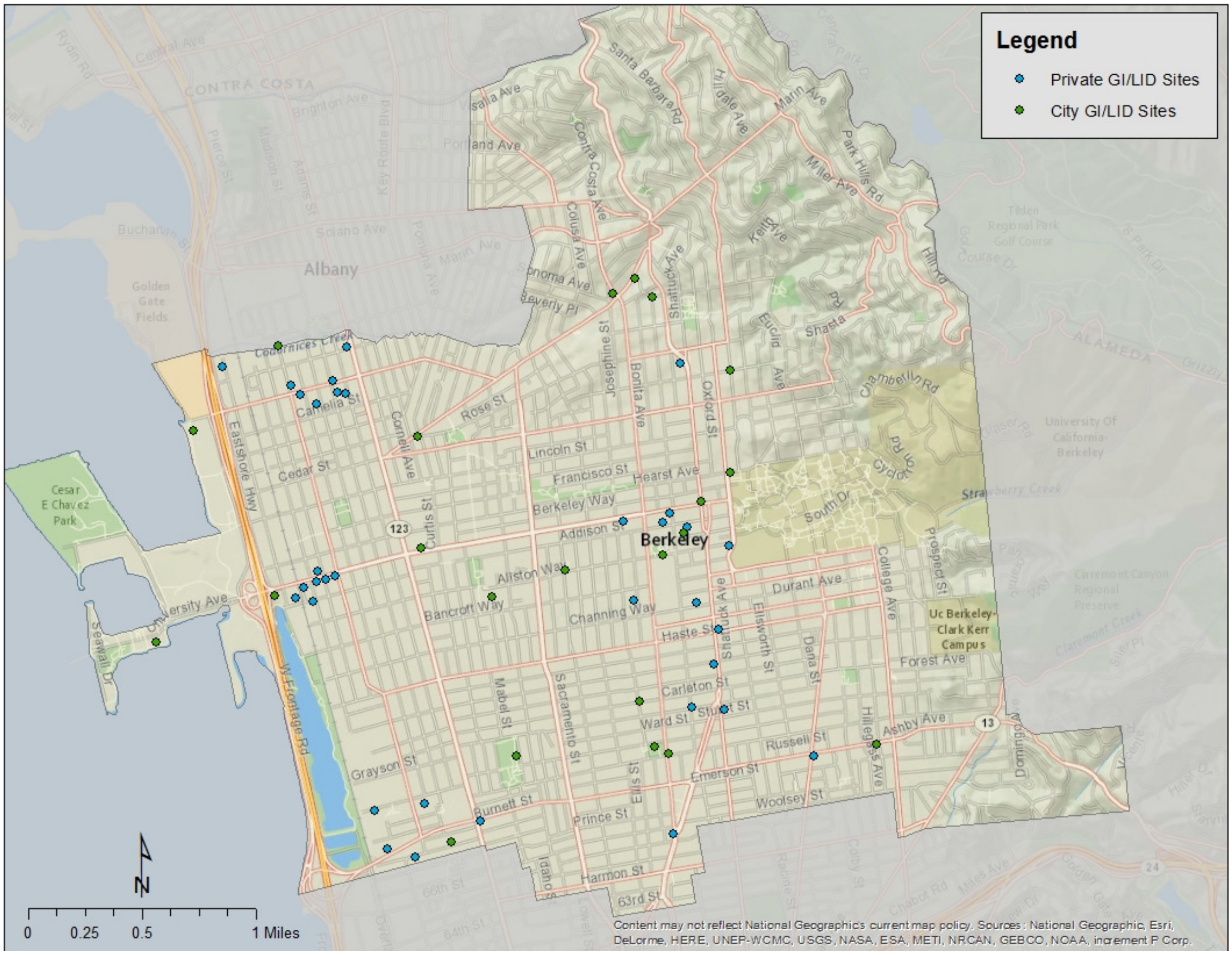


**Figure 2 – Existing Green Infrastructure/Low-Impact Development (GI/LID) Sites as of 2019 in the City of Berkeley, California**

**Figure 3 – The entire block of Allston Way between Milvia Street and Martin Luther King Jr. Way is paved with permeable pavers.**

**Figure 4 – Permeable pavers combined with underground flow detention at Milvia and Hopkins Streets.**

**Figure 5 – A large concrete traffic island/median was reconstructed with a bioretention facility at Rose and Hopkins Streets.**

**Figure 6 – A bioretention facility was installed along with pedestrian and cyclist safety improvements as part of the Hearst Complete Streets Project.**


**Figure 7 – Connected bioretention features in a traffic circle and corner bulb-out at Spruce and Vine Streets.**

**Figure 8 – The green roof at the City of Berkeley's Dona Spring Animal Shelter.**

## 1.4 MRP Requirements

This Green Infrastructure Plan has been developed to comply with Green Infrastructure Plan requirements in Provision C.3.j of the MRP, which states in part:

> *The Plan is intended to serve as an implementation guide and reporting tool during this and subsequent Permit terms to provide reasonable assurance that urban runoff TMDL wasteload allocations (e.g., for the San Francisco Bay mercury and polychorinated biphenyls [PCBs] Total Maximum Daily Loads [TMDLs]) will be met, and to set goals for reducing, over the long term, the adverse water quality impacts of urbanization and urban runoff on receiving waters. For this Permit term, the Plan is being required, in part, as an alternative to expanding the definition of Regulated Projects prescribed in Provision C.3.b to include all new and redevelopment projects that create or replace 5,000 square feet or more of impervious surface areas and road projects that just replace existing imperious surface area. It also provides a mechanism to establish and implement alternative or in-lieu compliance options for Regulated Projects and to account for and justify Special Projects in accordance with Provision C.3.e.*
>
> *Over the long term, the Plan is intended to describe how the Permittees will shift their impervious surfaces and storm drain infrastructure from gray, or traditional storm drain infrastructure where runoff flows directly into the storm drain and then the receiving water, to green—that is, to a more-resilient, sustainable system that slows runoff by dispersing it to vegetated areas, harvests and uses runoff, promotes infiltration and evapotranspiration, and uses bioretention and other green infrastructure practices to clean stormwater runoff.*
>
> *The Plan shall also identify means and methods to prioritize particular areas and projects within each Permittee's jurisdiction, at appropriate geographic and time scales, for implementation of green infrastructure projects. Further, it shall include means and methods to track the area within each Permittee's jurisdiction that is treated by green infrastructure controls and the amount of directly connected impervious area. As appropriate, it shall incorporate plans required elsewhere within this Permit, and specifically plans required for the monitoring of and to ensure appropriate reductions in trash, PCBs, mercury, and other pollutants.*

Table 1-1 below links each section of this plan to the applicable MRP provision.

**Table 1-1: Green Infrastructure Plan Sections and Applicable MRP Provisions**

| Section of Green Infrastructure Plan | Applicable MRP Provision |
|---|---|
| 1. Introduction | C.3.j |
| 2. Impervious Surface Retrofit Targets | C.3.j.i.(2)(c) |
| 3. Prioritizing and Mapping Planned and Potential Projects | C.3.j.i.(2)(a),(b),(j) |
| 3.1 Approach for Prioritizing and Mapping Projects | C.3.j.i.(2)(a) |
| 3.2 High Priority Projects | C.3.j.i.(2)(b) |
| 3.3 Early Implementation Projects | C.3.j.i.(2)(j) |
| 4. Tracking and Mapping Completed Projects | C.3.j.i.(2)(d) & C.3.d.iv.(1) |
| 5. Summary of General Guidelines for GI Projects | C.3.j.i.(2)(e), C.3.j.i.(2)(f), C.3.j.i.(2)(g) |
| 6. Integration of GI Requirements in Other City Planning Documents | C.3.j.i.(2)(h) & (i) |
| 7. Evaluation of Funding Options | C.3.j.i.(2)(k) |

# 2. Impervious Surface Retrofit Targets

The City of Berkeley has identified targets for the amount of impervious surface, from public and private projects within its jurisdiction (including redevelopment projects regulated under Provision C.3.b of the MRP), to be retrofitted by 2020, 2030, and 2040. The targets are presented in Table 2-1. The time schedules shown in this table are consistent with the timeframes for assessing load reductions for mercury and PCBs specified in Provisions C.11 and C.12 of the MRP. The City is currently participating in a regional effort to perform a Reasonable Assurance Analysis that demonstrates how green infrastructure will be implemented to achieve PCB and mercury load reductions.

Target amounts of impervious surface to be retrofitted by Private Development are based on the UrbanSim Model used by the San Francisco Bay Area Metropolitan Transportation Commission. Target amounts of impervious surface to be retrofitted by Public Development, City Green Streets, and Regional GI Projects are based on local knowledge of planned future development, anticipated availability of funding, High Priority Projects discussed in Section 3.2, and Early Implementation Projects discussed in Section 3.3. Due to uncertainties related to the funding of public green infrastructure projects and the reliability of projections for private development projects, The City of Berkeley will track the progress toward achieving the targets presented in Table 2-1, identify any challenges that arise in achieving these targets, and propose solutions, in coordination with other MRP Permittees.

**Table 2-1**

**Impervious Surface Retrofit Targets through 2040**

**City of Berkeley 2019 Green Infrastructure Plan**

| Future Year | Project Category | Total Area Treated by GI (acres) | Estimated Impervious Surface Retrofitted (acres) |
|---|---|---|---|
| **2020** | Private Development* | 21 | 21 |
| | Public Development | 9 | 9 |
| | City Green Streets and Regional GI Projects | 15 | 11 |
| | **Total Targets:** | **45** | **41** |
| | | | |
| **2030** | Private Development* | 38 | 38 |
| | Public Development | 16 | 16 |
| | City Green Streets and Regional GI Projects | 25 | 19 |
| | **Total Targets:** | **79** | **73** |
| | | | |
| **2040** | Private Development* | 59 | 59 |
| | Public Development | 25 | 25 |
| | City Green Streets and Regional GI Projects | 35 | 26 |
| | **Total Targets:** | **119** | **110** |

*: Based on UrbanSim development projections provided by the San Francisco Bay Area Metropolitan Transportation Commission

# 3. Prioritizing and Mapping Planned and Potential Projects

Section 3 describes the use of a mechanism for prioritizing and mapping green infrastructure projects as required in Provision C.3.j.i.(2)(a), provides descriptions of planned and potential green infrastructure projects and other outputs of the mechanism per Provision C.3.j.i.(2)(b), and discusses early implementation projects.

## 3.1 Approach for Prioritizing and Mapping Projects (GI Mechanism)

This section describes the Green Infrastructure Mechanism ("GI Mechanism") used to prioritize and map areas for planned and potential green infrastructure projects in the City of Berkeley. The mechanism consists of the Alameda Countywide Multi-Benefit Metrics Prioritization Protocol ("Multi-Benefit Prioritization Tool"), the City of Berkeley Land-Use-Based Micro-Watershed Pollutant Load Estimation Tool ("Micro-Watershed Tool"), and the Alameda County/Contra Costa Project Tracking and Load Reduction Accounting Tool ArcGIS Online web application ("AGOL tool").

As described below, the mechanism includes criteria for prioritization, such as specific logistical constraints, water quality drivers (load reductions of mercury and PCBs consistent with TMDLs), and opportunities to treat runoff from private parcels in street right-of-way (ROW). It also produces outputs, including maps and project lists, which can be incorporated into the City of Berkeley's long-term planning and capital improvement processes.

### *Multi-Benefit Prioritization Tool*

The Multi-Benefit Prioritization Tool is a stepwise GIS analysis documented in the Alameda Countywide Stormwater Resource Plan Screening and Prioritization using Multi-Benefit Metrics Technical Memorandum[2] and summarized below.

**Step 1. Identify planned projects** – Planned future green infrastructure projects within Alameda County were identified and entered into a GIS layer, based on project information provided by local agencies within the county.

**Step 2. Identify opportunity sites** – Additional potential project locations were identified and catalogued by the Alameda Countywide Clean Water Program consultant Geosyntec using a GIS-based opportunity analysis. The project opportunity analysis followed the steps listed below:

a. Identify publicly-owned parcels.
b. Screen identified public parcels to include only those that are at least 0.1 acre in size and with an average slope of less than 10 percent. Parcels that met these criteria were screened for physical feasibility.

[2] Geosyntec. 2017. *Alameda Countywide Stormwater Resource Plan Screening and Prioritization using Multi-Benefit Metrics Technical Memorandum*. December 13.

c. Identify non-interstate highway public right-of-way (ROW) within urban areas. Roadways considered included state and county highways and connecting roads and local, neighborhood, and rural roads.
d. Identify land uses or adjacent land uses of the sites resulting from steps b and c.
e. Screen sites identified in steps b and c to remove sites with the following physical constraints:
   i. Regional facilities were not considered for sites that were greater than 500 feet from a storm drain due to limited feasibility in treating runoff from a larger drainage area;
   ii. Parcel-based facilities were not considered for sites that were more than 50% undeveloped due to the limited potential for pollutant reduction of concern load reduction;
   iii. Sites with more than 50% of their drainage area outside of the urbanized area, as these sites would not provide opportunity for significant pollutant of concern load reduction;
   iv. Sites with more than 50% overlying landslide hazard zones to avoid the potential for increasing landslide risk.

**Step 3. Classify planned projects and opportunity sites in preparation for metrics-based evaluation** – A GIS analysis was performed to classify the planned projects identified in step 1 and the opportunity sites identified in step 2 according to four parameters listed below:

a. Green infrastructure project type – Each project received one of the following classifications: parcel-based, regional, or ROW/green street project.
b. Infiltration feasibility - Each project location received one of the following classifications for infiltration: infeasible, partially feasible, or feasible.
c. Facility type – Each project received one of the following classifications: green infrastructure[3], non-green infrastructure treatment control facility, water supply augmentation, flood control facility, hydromodification control, public use area or public education area, programmatic stormwater management opportunity.
d. Drainage area information – A drainage area was identified for each project.

**Step 4. Score projects using an automated metrics-based evaluation** – A quantitative metrics-based multiple benefit evaluation was performed using an automated process. Projects or opportunity sites received a score of 0, 1, or 2 for each of the metrics listed below. The automated scores were used to preliminarily rank the projects by watershed, jurisdiction, project type, and/or project stakeholder(s). Geosyntec provided a jurisdiction-specific list of planned projects and opportunity sites located in the City of Berkeley including an automated score for each project.

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[3] All opportunity sites identified in step 2 were classified as GI projects. Based on information provided by local agencies in step 1, other classifications were assigned, where appropriate, to planned projects. Projects that were not classified as GI have co-benefits that may include GI.

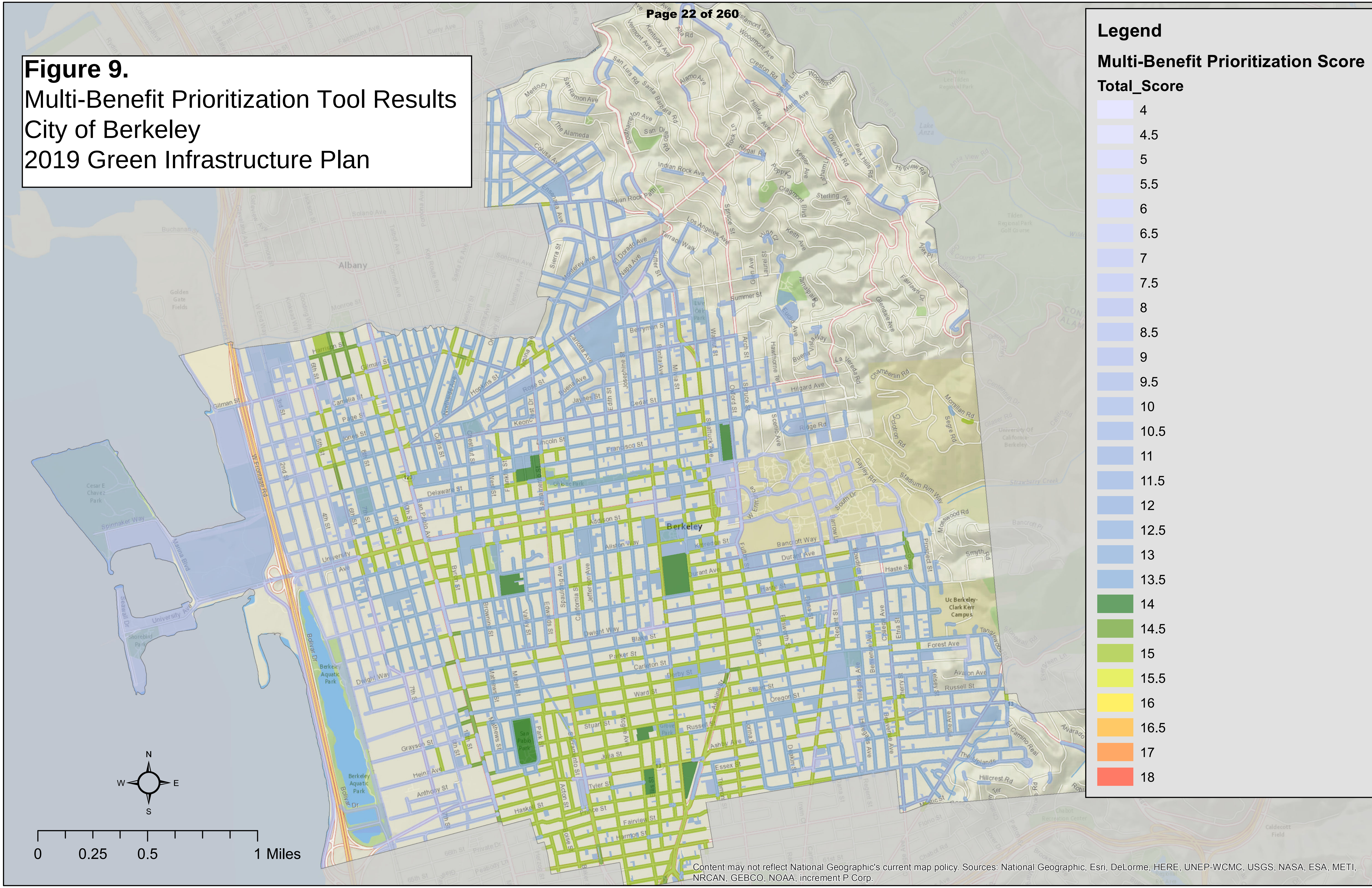
Spatial data for the projects included in the list were provided in both GIS shape file and Google Earth KMZ file formats.

a. Parcel area (for regional and parcel-based projects only)
b. Location slope
c. Infiltration feasibility
d. PCBs/mercury yield classification in project drainage area
e. Regional facility
f. Removes pollutant loads from stormwater
g. Augments water supply
h. Provides flood control benefits
i. Re-establishes natural water drainage systems
j. Develops, restores, or enhances habitat and open space
k. Provides enhanced or created recreational and public use areas with potential opportunities for community involvement and education
l. Trash capture co-benefit

The results of the multiple benefit evaluation were compiled into a countywide Master List of Prioritized Planned and Potential Projects which is included in the Alameda Countywide Clean Water Program's Storm Water Resource Plan[4]. The City of Berkeley maintains a GIS database of the results of the multiple benefit evaluation within the City's boundaries. This database includes a GIS layer depicting the prioritization score for each section of right-of-way and applicable publicly owned parcel that can be displayed along with other City GIS layers to inform current and future planning decisions. A citywide evaluation performed using the Multi-Benefit Prioritization Tool is depicted in Figure 9.

[4] Alameda Countywide Clean Water Program. 2019. *Storm Water Resource Plan*. January.

**Figure 9.**
Multi-Benefit Prioritization Tool Results
City of Berkeley
2019 Green Infrastructure Plan



### *Micro-Watershed Tool*

The City of Berkeley developed the Land-Use-Based Micro-Watershed Pollutant Load Estimation Tool ("Micro-Watershed Tool") as a complimentary tool to the Multi-Benefit Prioritization Tool. The purpose of the Micro-Watershed Tool is to evaluate small drainage areas in Berkeley for pollutant load reduction potential based on the historical land-use classifications contained within them. The MRP requires permittees to plan and implement green infrastructure projects to achieve load reductions of PCBs and mercury. The Micro-Watershed Tool is designed to assist with siting green infrastructure installations in locations that maximize PCBs and mercury load reductions. The Micro-Watershed Tool is based on the Bay Area Stormwater Management Agencies Association's Interim Accounting Methodology for TMDL Loads Reduced (Interim Accounting Methodology)[5], which states:

> *A land-use-based yield is an estimate of the mass of a contaminant contributed by an area of a particular land use per unit time. Essentially, different types of land uses yield different amounts of pollutants because land use types differ in their degree of contamination resulting from differing intensities of historic or ongoing use of pollutants. The land use categories used to land use-based yields were identified from studies conducted to identify potential Pollutant of Concern (POC) sources and source areas.*
>
> *A number of preliminary GIS data layers were developed using existing and historical information on land use and facility types that were located in the Bay Area during the early to mid-20th century. GIS data layers developed included a revised "Old Industrial" land use layer that attempted to depict industrial areas that were present in the year 1968 and an "Old Urban" land use layer that depicts urbanized areas developed by 1974, other than Old Industrial areas. The year 1974 was used as this was the closest year to 1968 for which data were available. The other categories include "New Urban", which depicts areas urbanized after 1974; "Open Space", which represents undeveloped land; and "Other", which consists of airport and military areas. "Source Property" areas are located in historically industrial or other areas where PCBs were used, released, and/or disposed of and/or where sediment concentrations are significantly elevated above urban background levels.*

Assumed average PCBs and Mercury yields (in milligrams per acre per year) were developed for each of the six Historical Land Use categories listed above.

For the Micro-Watershed Tool, the City of Berkeley's drainage maps were digitized using GIS software. The result is a GIS Shapefile with roughly 1,000 polygons representing drainage areas as small as that contributing to a single catch basin/inlet. The drainage areas layer was overlain with the Historical Land Use Layers described in the Interim Accounting Methodology and calculations were run to determine the amount of each category of historical land use contained within each drainage area. A second round of calculations were then run to determine the assumed land-use-based PCBs yield for each drainage area based on the

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[5] BASMAA. 2017. *Interim Accounting Methodology for TMDL Loads Reduced*. Prepared by Geosyntec Consultants and EOA, Inc. March 23.

formulas provided in the Interim Accounting Methodology. Finally, the assumed land-use-based PCBs yields were multiplied by the Efficiency Factor for green infrastructure treatment (0.7), then divided by the total area of each drainage area to produce a PCB reduction potential per acre treated value for each Micro-Watershed in the City. The City maintains the Micro-Watershed Tool in the form of a GIS database which includes a GIS layer depicting the PCBs reduction potential for each Micro-Watershed in Berkeley that can be displayed along with the other City GIS layers to inform current and future planning decisions. Figure 10 depicts the land-use-based PCBs reduction potential for each Micro-Watershed in Berkeley.

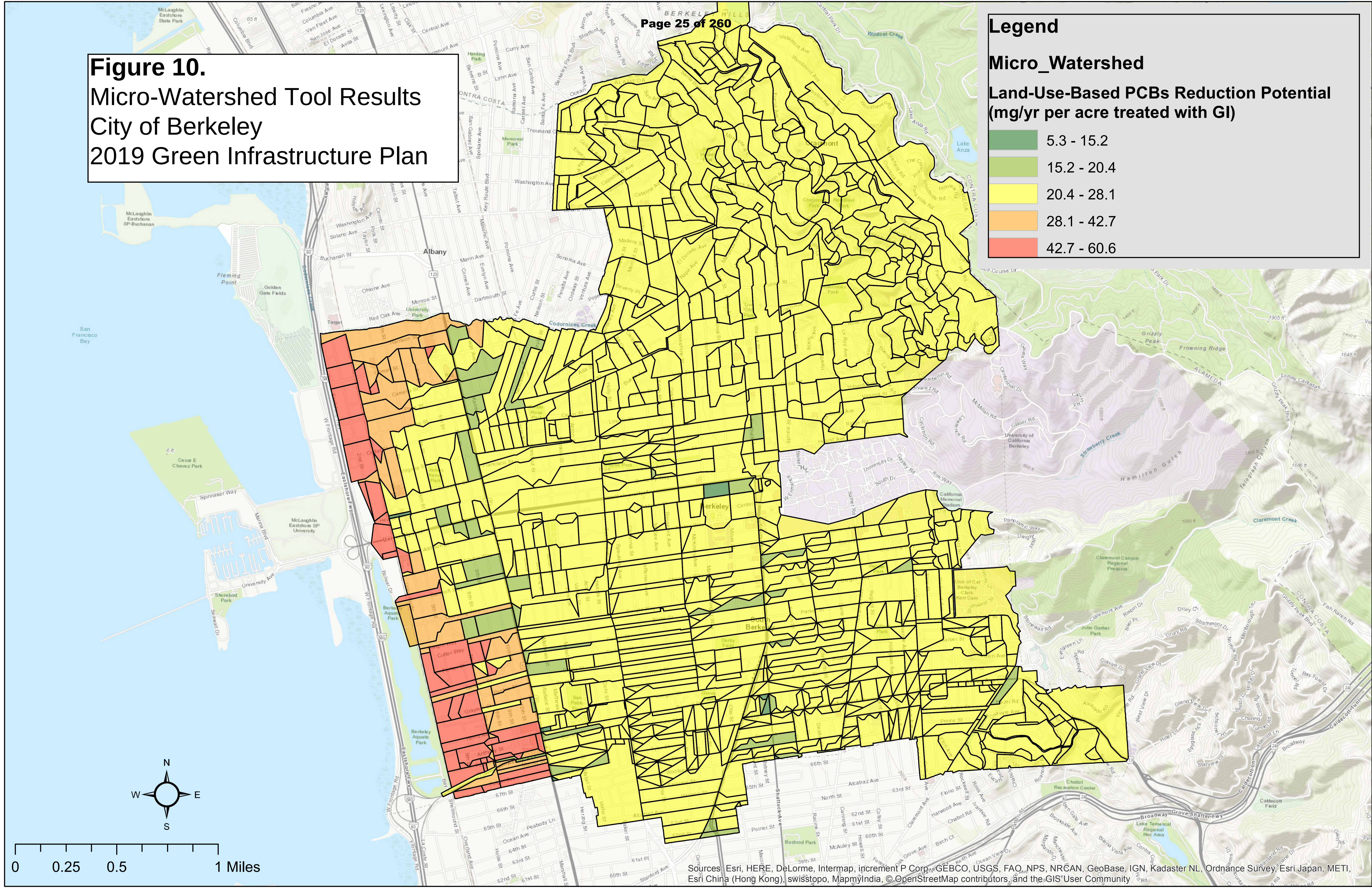



**Figure 10.**
Micro-Watershed Tool Results
City of Berkeley
2019 Green Infrastructure Plan

## 3.2 High Priority Projects

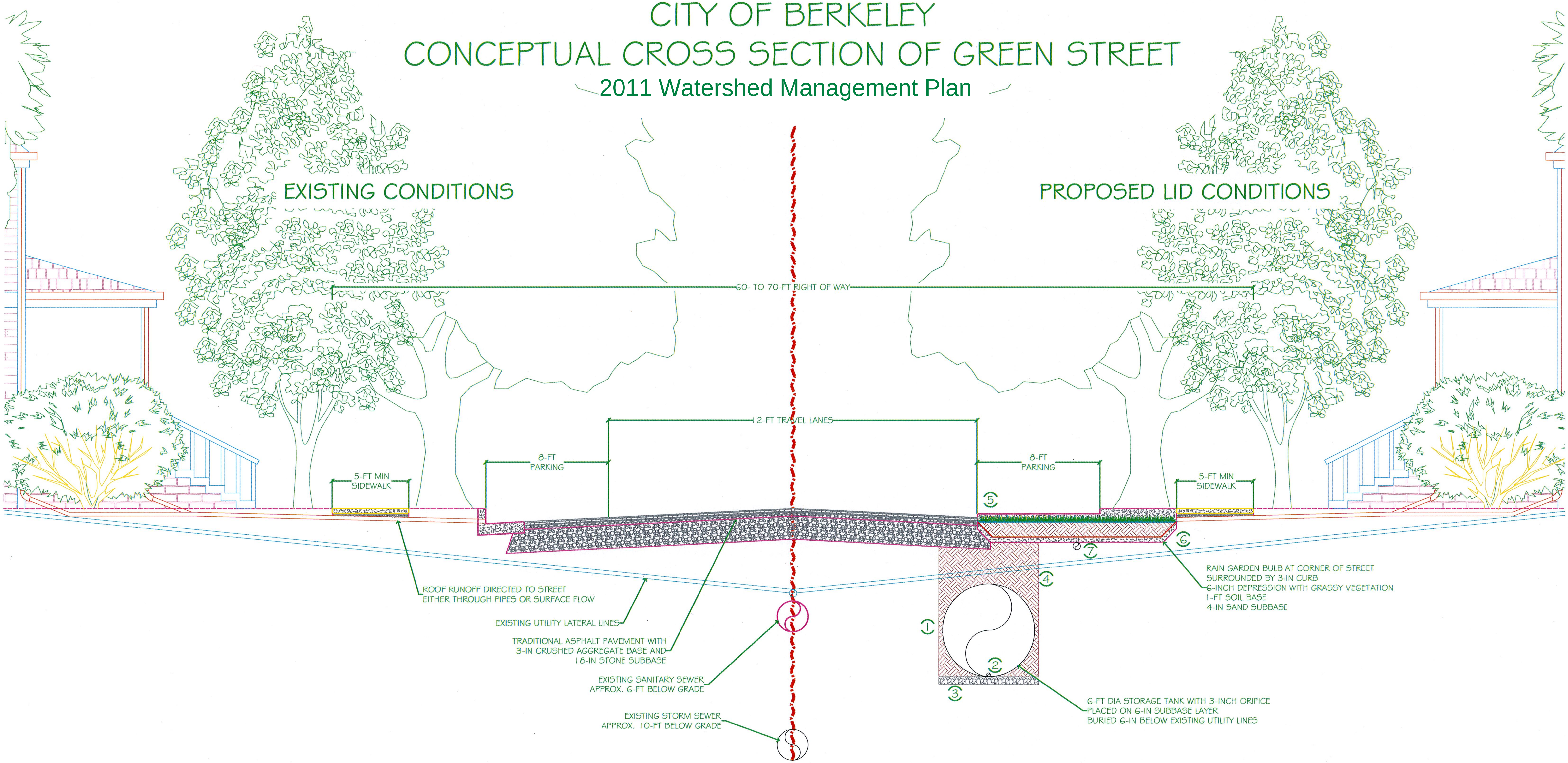
Using the tools of the GI Mechanism described above, the City of Berkeley has identified the high priority potential green infrastructure projects described in this section that may be used to help meet the impervious surface retrofit targets presented in Section 2. This is only a current list of projects. It is envisioned that as future capital projects and City plans are developed, the tools of the GI Mechanism will be used to identify additional high priority green infrastructure projects that can be constructed as parts of broader City efforts.

### *Watershed Management Plan Projects*

As part of the Watershed Management Plan (WMP), hydraulic models were developed for the Potter and Codornices Watersheds in Berkeley. The results of modelling in the Potter Watershed suggested that installation of surface-level bioretention combined with underground storage facilities (that would divert peak flows, then slowly meter flows back to the storm drain) in the upper watershed would result in incremental flood reductions throughout the watershed. The WMP identifies twenty five locations for GI/storage units in the upper Potter Watershed. As part of the current green infrastructure planning effort, the City reexamined these locations using the GI Mechanism to determine which locations are most likely to provide multiple benefits in addition to flood control. Figure 11 shows a conceptual cross section of a green infrastructure/storage unit as proposed in the WMP. Figure 12 shows the WMP-proposed GI/storage unit locations overlain with the Multi-Benefit Prioritization Tool GIS layer. Table 3-1 shows the Multi-Benefit Prioritization Scores for each location.

# Figure 11

## CITY OF BERKELEY
## CONCEPTUAL CROSS SECTION OF GREEN STREET
### 2011 Watershed Management Plan




## PROPOSED STORAGE DETAILS:

1. 6-FT DIA UNDERGROUND CIRCULAR STORAGE TANK (300-FT LONG)
2. 3-IN DIA CIRCULAR ORIFICE WITH FLAP GATE (CONNECTS TO STORM SEWER DOWNSTREAM)
3. 6-IN ROCK SUBBASE AS FOUNDATION FOR STORAGE PIPE
4. LIMIT OF EXCAVATION 1.5-FT FROM EDGE OF GUTTER
5. RAIN GARDEN BULB EXTENDS 8-FT INTO STREET AT BLOCK CORNER
6. 1-FT LAYER OF SANDY LOAM FILL AND 4-IN LAYER OF CLEAN SAND
7. 4-IN PERFORATED PIPE DRAINS TO CROWN OF STORAGE TANK

Balance Hydrologics, Inc.
800 Bancroft Way · Suite 101
Berkeley, CA 94710-2227
tel (510) 704-1000 · fax (510) 704-1001
www.balancehydro.com

**Table 3-1**
**Watershed Management Plan Proposed GI Sites - Potter Watershed**
**Multi-Benefit Prioritization Scores**
**2019 City of Berkeley Green Infrastructure Plan**

| Project Description | Multi-Benefit Prioritization Score* |
|---|---|
| 2 GI/Storage Units - Piedmont (Forest to Derby) | 15 |
| 2 GI/Storage Units - College (Parker to Derby) | 15 |
| 2 GI/Storage Units - Ashby (Benvenue) | 15 |
| 2 GI/Storage Units - Bowditch (Channing to Haste) | 15 |
| 2 GI/Storage Units - Shattuck (Bancroft to Kittredge) | 15 |
| 2 GI/Storage Units - Ellsworth (Channing) | 15 |
| 2 GI/Storage Units - Shattuck (Channing) | 15 |
| 2 GI/Storage Units - Adeline (Ashby) | 15 |
| 2 GI/Storage Units - Adeline (Oregon) | 15 |
| 2 GI/Storage Units - Shattuck (Blake) | 15 |
| 2 GI/Storage Units - Ellsworth (Dwight) | 15 |
| 2 GI/Storage Units - Ashby (Telegraph) | 15 |
| 1 GI/Storage Unit - Woolsey (Tremont) | 15 |
| 2 GI/Storage Units - Piedmont (Durant to Channing) | 14.5 |
| 2 GI/Storage Units - College (Channing to Dwight) | 13.5 |
| 2 GI/Storage Units - Derby (Telegraph to Regent) | 13.5 |
| 2 GI/Storage Units - Webster (College) | 13.5 |
| 2 GI/Storage Units - Wheeler (Prince to Woolsey) | 13.5 |
| 3 GI/Storage Units - Derby (Warring) | 13.5 |
| 2 GI/Storage Units - Telegraph (Stuart) | 13.5 |
| 2 GI/Storage Units - Woolsey (Eton) | 12.5 |
| 2 GI/Storage Units - Bancroft (Bowditch) | 12.5 |
| 2 GI/Storage Units - Dwight (Prospect) | 12.5 |
| 2 GI/Storage Units - Stuart (College to Cherry) | 12.5 |
| 2 GI/Storage Units - Woolsey (Dana) | 12 |

*: Maximum Multi-Benefit Prioritization Score for Berkeley = 15.

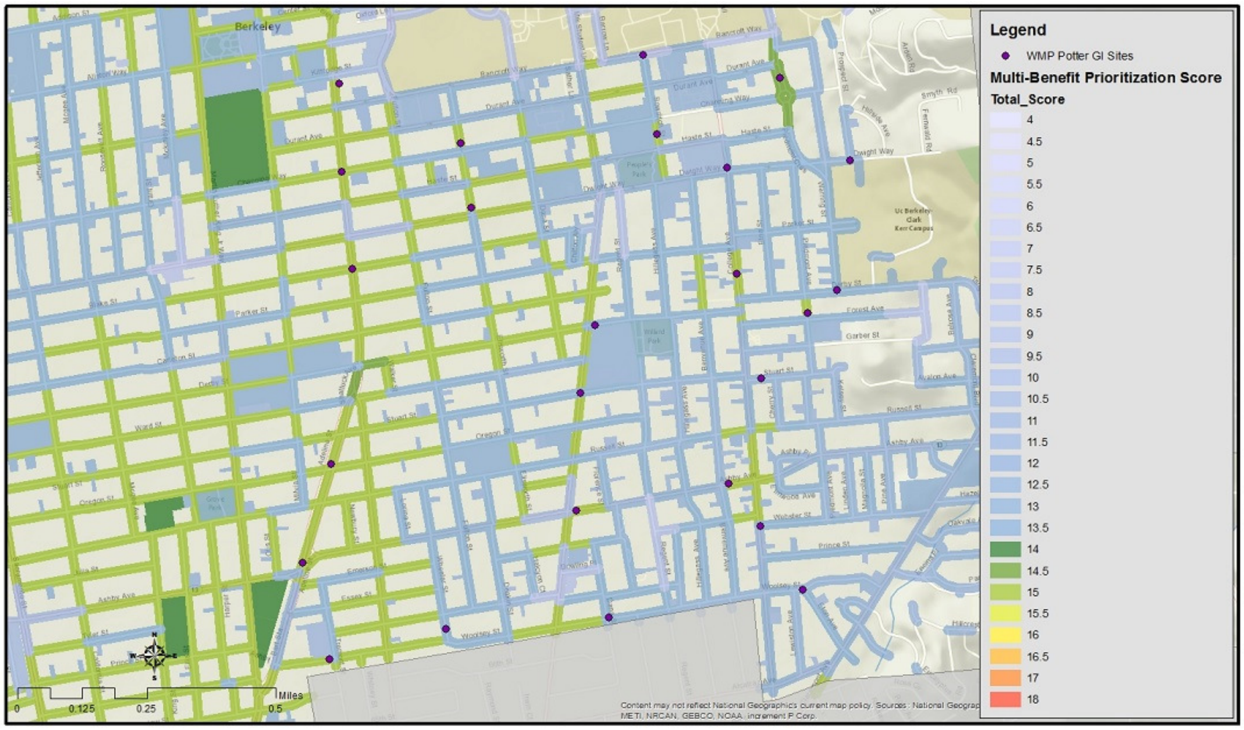



**Figure 12 – WMP-Proposed GI/Storage Unit Locations in the Upper Potter Watershed Plotted Against Multi-Benefit Prioritization Scores**

### *Woolsey Street Bioretention and Underground Flow Detention Facility*

City staff has selected Woolsey Street at Tremont Street as the first WMP-proposed GI/storage unit to be constructed in the Potter Watershed. This location was selected for the following reasons:

- Synergy with the City's Paving Program;
- High level of constructability relative to other proposed locations;
- Relatively few space constraints;
- Multi-Benefit Prioritization Score of 15 (maximum);
- High visibility location adjacent to the Ed Roberts Campus and the Ashby Bart Station.

The Woolsey Street project is fully designed and the City is currently in the process of retaining a contractor for construction.

### *Piedmont Avenue Traffic Circle and Medians*

The City of Berkeley and the University of California, Berkeley (UC Berkeley) have identified the large traffic circle and medians on Piedmont Avenue between Durant Avenue and Haste Street (Figure 13) as a potential site for a joint green infrastructure project. This is the location of a WMP-proposed GI/storage unit with a high Multi-Benefit Prioritization Score of 14.5. As Piedmont

Avenue is one of the main roads leading into the UC Berkeley campus, this is a very high visibility location to students and visitors alike. The large size of the traffic circle, ability to team with UC Berkeley, existing storm drain infrastructure, and location in the upper Potter Watershed make this an attractive project.

**Figure 13 – The large grassy traffic circle at Piedmont Avenue and Channing Way could be retrofitted into a bioretention feature to treat runoff from the street.**

## *Codornices Watershed Projects*

The WMP identifies a number of potential sites for green infrastructure installations in the Codornices Watershed. Two proposed locations that received relatively high scores from the Multi-Benefit Prioritization Tool and have relatively high PCBs Reduction potential are Ninth Street at Codornices Creek and Tenth Street at Codornices Creek (Figures 14 and 15).

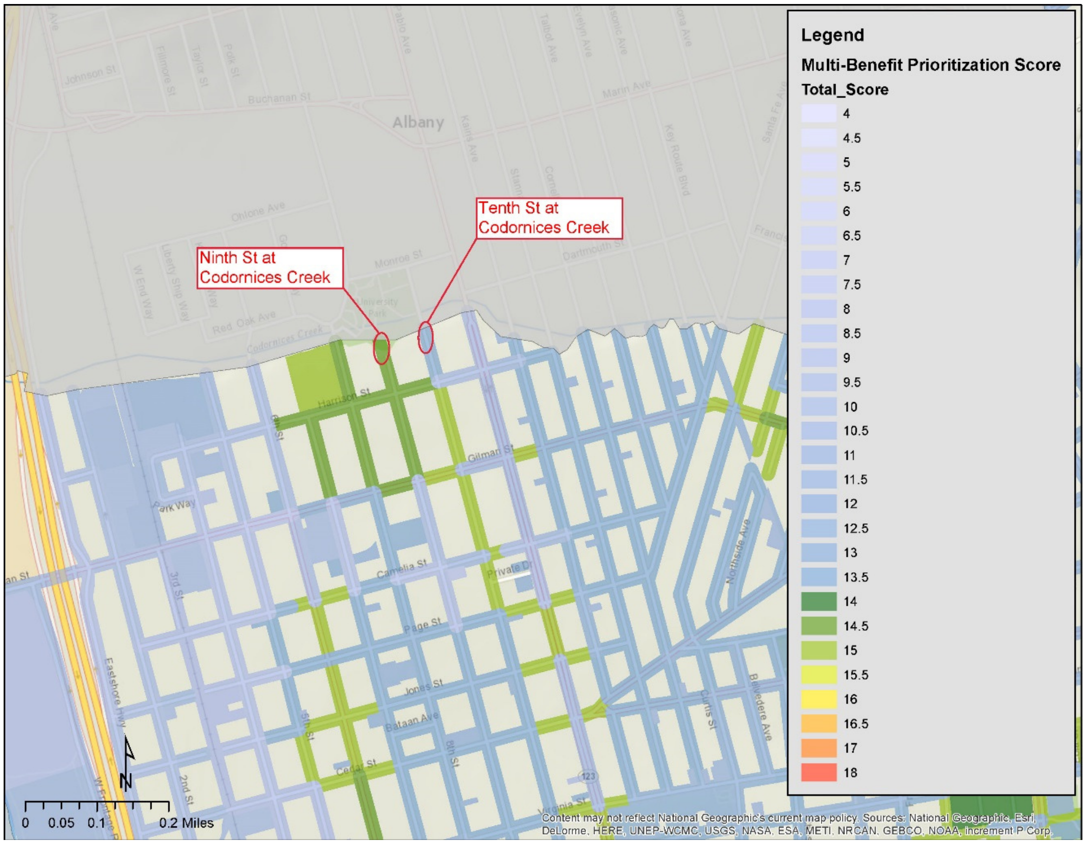



**Figure 14 – Lower Codornices Watershed Potential GI Sites, Multi-Benefit Prioritization Scores**

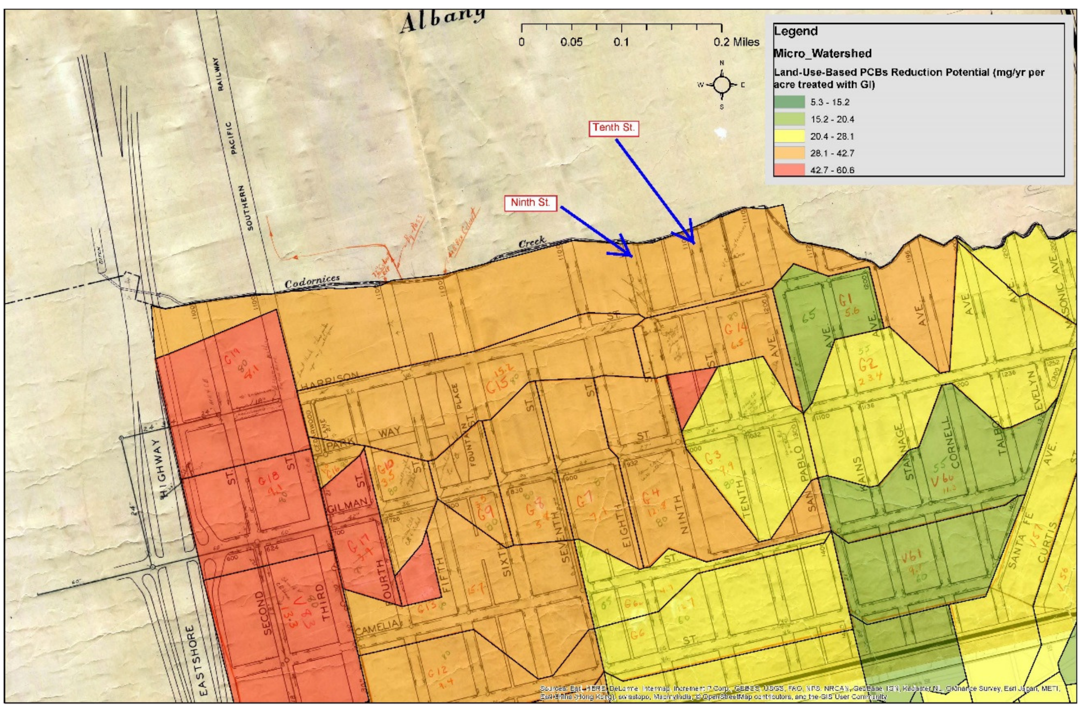



**Figure 15 – Lower Codornices Watershed Potential GI Sites, PCBs Reduction Potential**

As shown in Figure 16, a large raised concrete surface currently occupies the dead-end of Ninth Street at Codornices Creek. A portion of this concrete island could be converted into a bioretention unit to treat runoff from the street before it enters the creek. This retrofit could be completed concurrent with other improvements to the right-of-way and stabilization and restoration of the creek. In order for the City to complete this project, cooperation from upstream and downstream land owners on both sides of the creek would be necessary.

**Figure 16 – A portion of the raised concrete surface on Ninth Street at Codornices Creek could be converted into a bioretention feature.**

As shown in Figure 17, the parking lanes on both sides of Tenth Street at Codornices Creek are potential locations for bioretention features to treat runoff from the street prior to entering the creek. A similar project was previously completed on Sixth Street at Codornices Creek (Figure 18).

**Figure 17 – Bioretention features could be installed in the parking lanes on Tenth Street at Codornices Creek.**

**Figure 18 – Existing bioretention features on Sixth Street that treat runoff from the street prior to running into the creek show how similar treatment at Tenth Street could be implemented.**

## *Parks Projects*

As the City of Berkeley is relatively built out, space constraints often limit opportunities for green infrastructure in the public right-of-way. Alternative opportunities may exist to install green infrastructure on City property such as parks. In some cases, green infrastructure can be installed along the perimeter of a park to treat runoff from the adjacent roadway. A bioswale in Presentation Park at the intersection of Allston Way and California Street (Figure 19) is an existing example of this type of project in Berkeley. City staff have identified San Pablo Park in southwest Berkeley as a potential site for a bioswale. As shown in Figure 20, the park itself has a relatively high Multi-Benefit Prioritization Score of 14. Many of the residential streets in the vicinity of the park have even higher Multi-Benefit Prioritization Scores (up to 15). Potential sites for a bioswale on the north end of the park (along Ward Street) or the east side of the park (along Park Street) could be used treat runoff from the surrounding neighborhood.

**Figure 19 – An existing bioswale at Presentation Park detains, treats, and infiltrates runoff from Allston Way.**

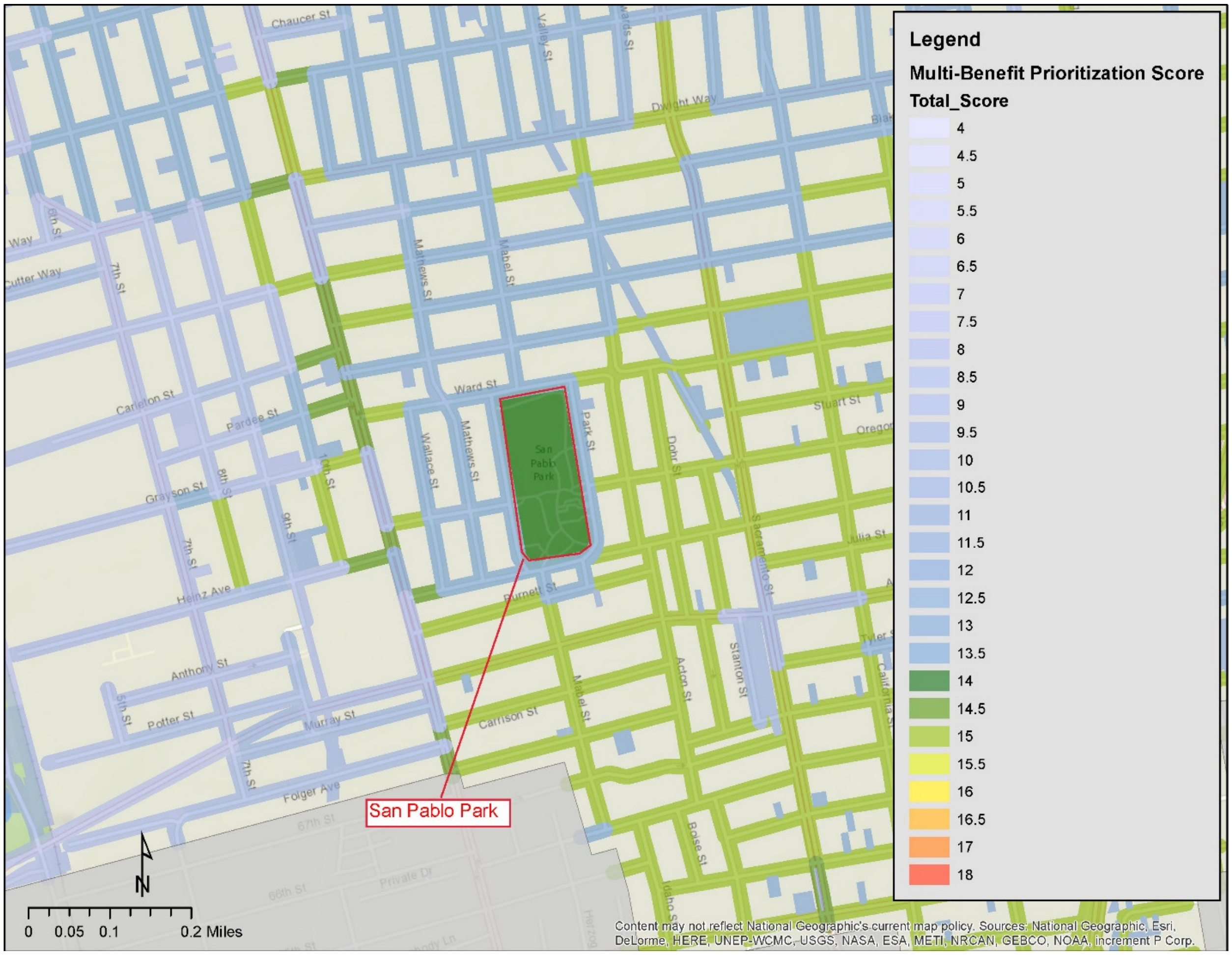



**Figure 20 – Results from the Multi-Benefit Prioritization Tool for San Pablo Park and Surrounding Areas**

## *West Berkeley Projects*

As illustrated in Figure 10, the greatest opportunities in Berkeley to reduce PCBs (and Mercury) from stormwater runoff exist in Micro-Watersheds to the west of San Pablo Avenue. Utilizing outputs from the GI Mechanism, City staff conducted field and remote reconnaissance to determine where green infrastructure installations might be feasible in west Berkeley. Considering factors such as slope, space constraints, and existing storm drain infrastructure, seven west Berkeley Micro-Watersheds (or combinations of adjacent Micro-Watersheds) were identified for potential green infrastructure projects (Figure 21). Potential projects in the northernmost highlighted Micro-Watershed (adjacent to Codornices Creek) are discussed earlier in this section. Potential projects from the remaining highlighted Micro-Watersheds are discussed below.

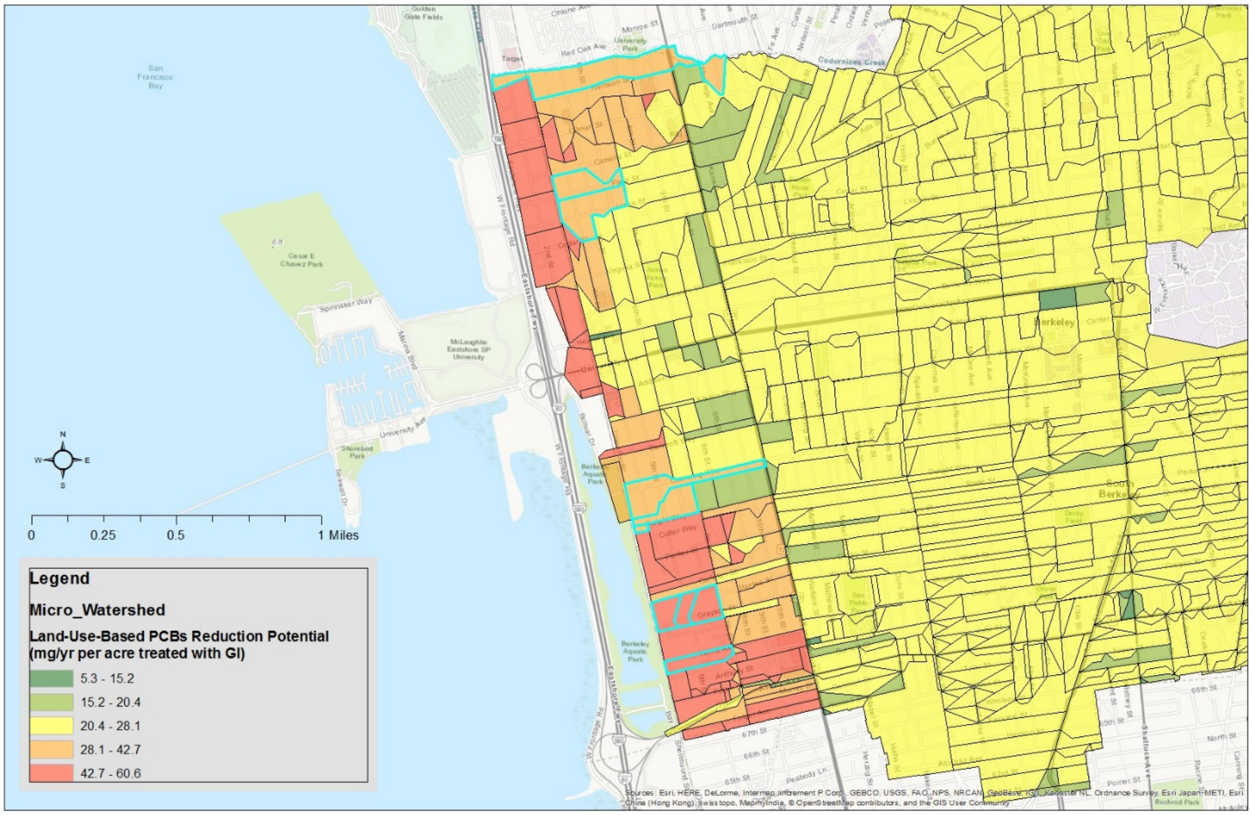



**Figure 21 – Micro-Watersheds in West Berkeley with Identified Potential Green Infrastructure Opportunities (Outlined in Cyan)**

Several east-west running streets in west Berkeley dead-end at the Union Pacific Railroad (UPRR) Right-of-Way (Third Street). At the locations discussed below, existing storm drain inlets are present near the UPRR dead-end, which could be retrofitted into surface-level bioretention features. These locations present a unique opportunity to treat runoff from Old Industrial parcels in west Berkeley. As the streets are closed to through traffic, space limitations for surface-level green infrastructure are minimized. As groundwater may be relatively shallow at these locations and groundwater contamination plumes may be present, additional feasibility studies will be required to properly assess subsurface conditions. Potential bioretention features at these locations may need to be lined to prevent interaction with groundwater.

### *Page Street at Railroad Right-of-Way*

As illustrated on Figures 22 and 23, the dead end of Page Street at the UPRR Right-of-Way is a promising potential location for a bioretention feature. A 9.6-acre Micro-Watershed (including 3.9 acres of Old Industrial and 4.3 acres of Old Urban Historical Land Uses) drains to this location. Existing storm drain inlets on the north and south sides of Page Street should allow for a relatively straightforward retrofit. This Micro-Watershed has an average Land-Use-Based PCBs Reduction Potential of 34.3 milligrams per year per acre treated (mg/yr/ac) and is located in the Gilman Watershed.

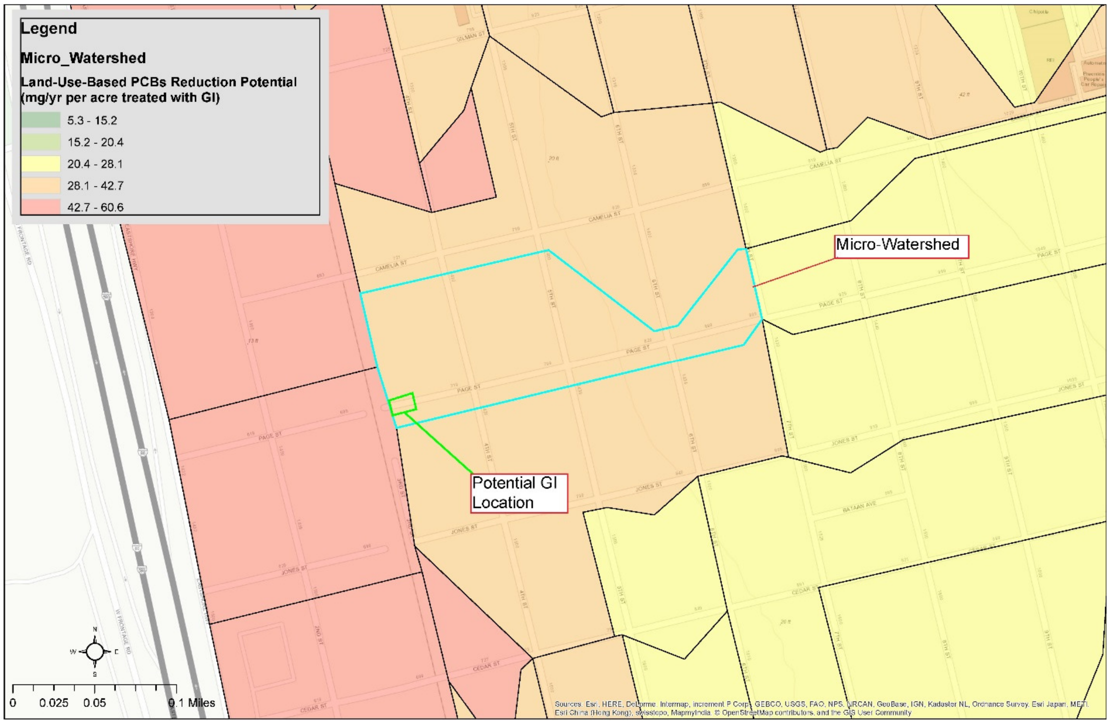



**Figure 22 – Potential Location for a Bioretention Feature on Page Street at the UPRR ROW and Tributary Micro-Watershed**

**Figure 23 – Potential Location for a Bioretention Feature on Page Street at the UPRR ROW**

### *Jones Street at Railroad Right-of-Way*

Similar to Page Street, the dead end of Jones Street at the UPRR Right-of-Way is another potential location for one or more bioretention features (Figures 24 and 25). A 15.4-acre Micro-Watershed (including 5.2 acres of Old Industrial and 7.9 acres of Old Urban Historical Land Uses) drains to this location. An existing storm drain inlet on the south side of Jones Street at the UPRR Right-of-Way could be converted into a green infrastructure facility. Under current conditions, stormwater ponds at the southwest corner of Jones Street at Fourth Street. Installation of one or more bioretention features along the south side of Jones Street between Fourth Street and the UPRR Right-of-Way could be combined with drainage improvements to alleviate localized flooding. This Micro-Watershed has an average Land-Use-Based PCBs Reduction Potential of 31.8 mg/yr/ac and is located in the Gilman Watershed.

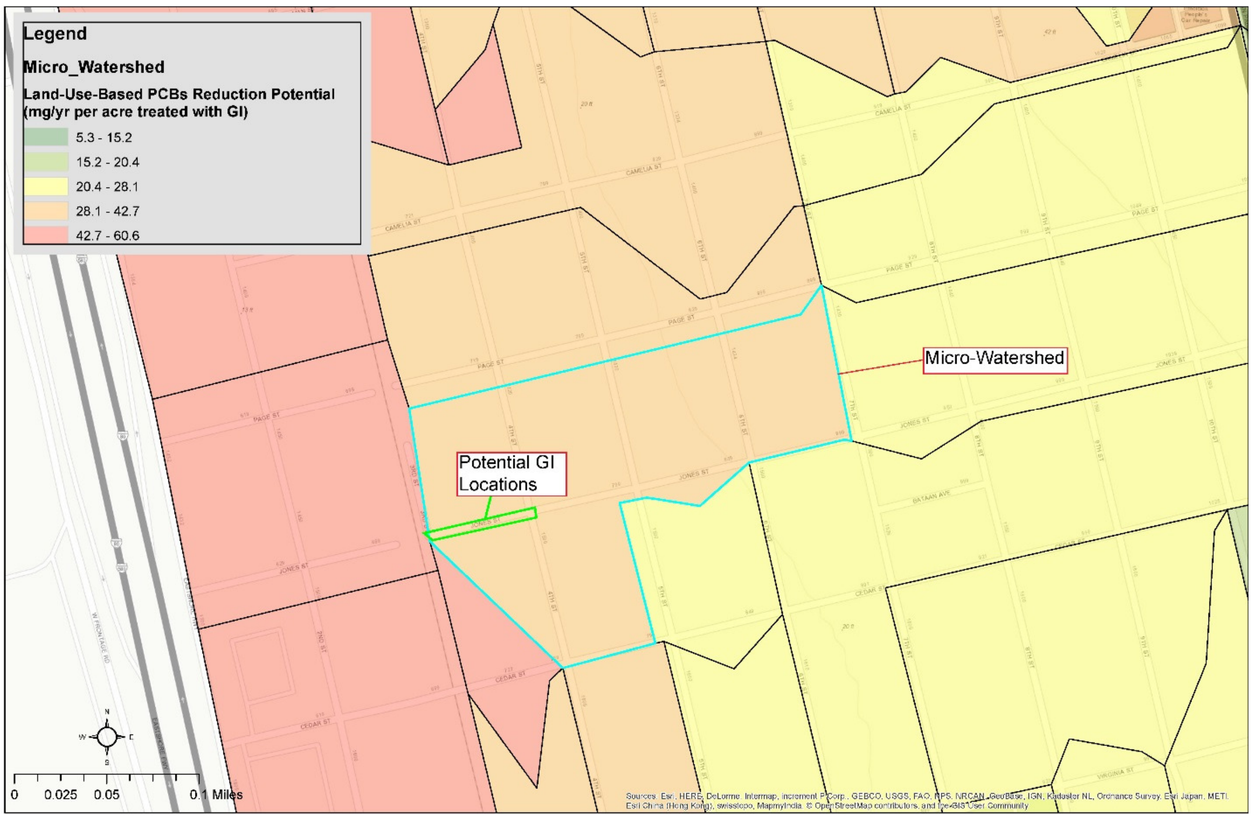



**Figure 24 – Potential Location for a Bioretention Feature on Jones Street at the UPRR ROW and Tributary Micro-Watershed**


**Figure 25 – Potential Location for a Bioretention Feature on Jones Street at the UPRR ROW**

## *Channing Way at Railroad Right-of-Way*

As illustrated on Figures 26 and 27, the dead end of Channing Way at the UPRR Right-of-Way is a potential location for a bioretention feature. A 15.8-acre Micro-Watershed (including 5.1 acres of Old Industrial and 9.6 acres of Old Urban Historical Land Uses) drains to this location. Existing storm drain inlets on the north and south sides of Channing Way should allow for a relatively straightforward retrofit. This Micro-Watershed has an average Land-Use-Based PCBs Reduction Potential of 32.7 mg/yr/ac and is located in the Potter Watershed.

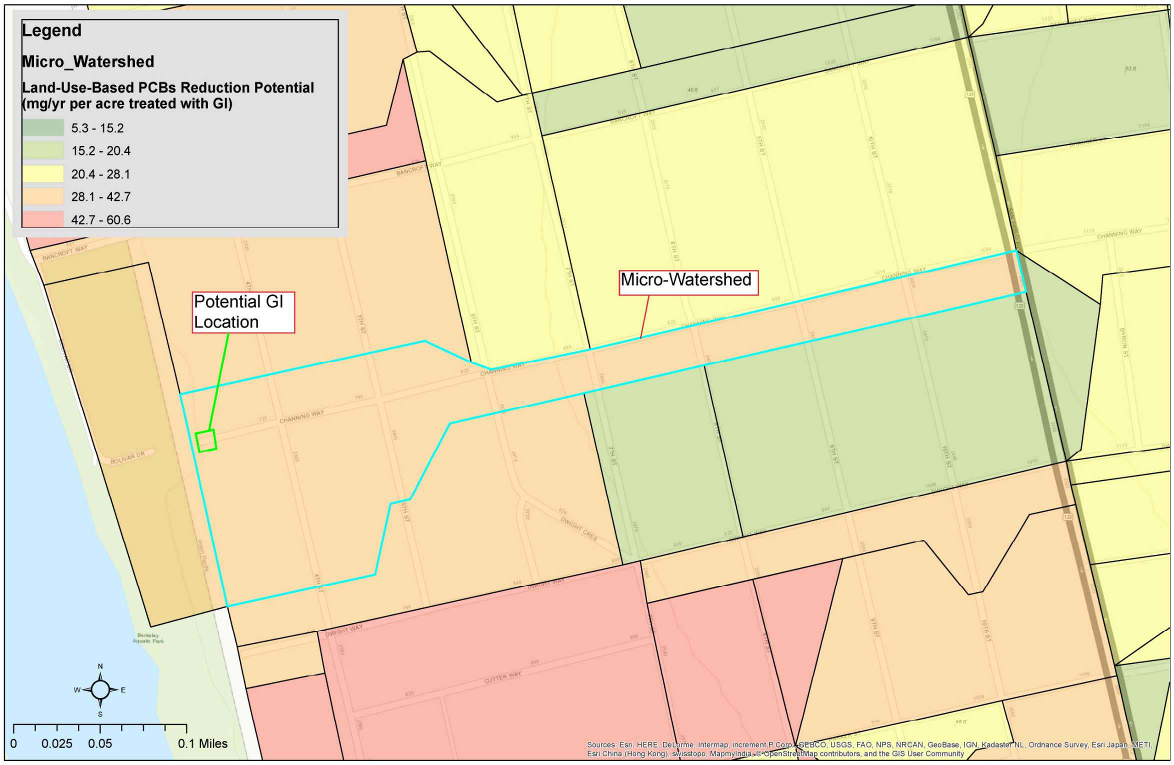



**Figure 26 – Potential Location for a Bioretention Feature on Channing Way at the UPRR ROW and Tributary Micro-Watershed**

**Figure 27 – Potential Location for a Bioretention Feature on Channing Way at the UPRR ROW**

### *Heinz Avenue at Railroad Right-of-Way*

As illustrated on Figures 28 and 29, the dead end of Heinz Avenue at the UPRR Right-of-Way is a potential location for a bioretention feature. A 6.5-acre Micro-Watershed drains to this location. An existing storm drain inlet on the west end of the Heinz Avenue turn-around could be converted into a bioretention feature. This Micro-Watershed has an average Land-Use-Based PCBs Reduction Potential of 48.4 mg/yr/ac and is located in the Potter Watershed.

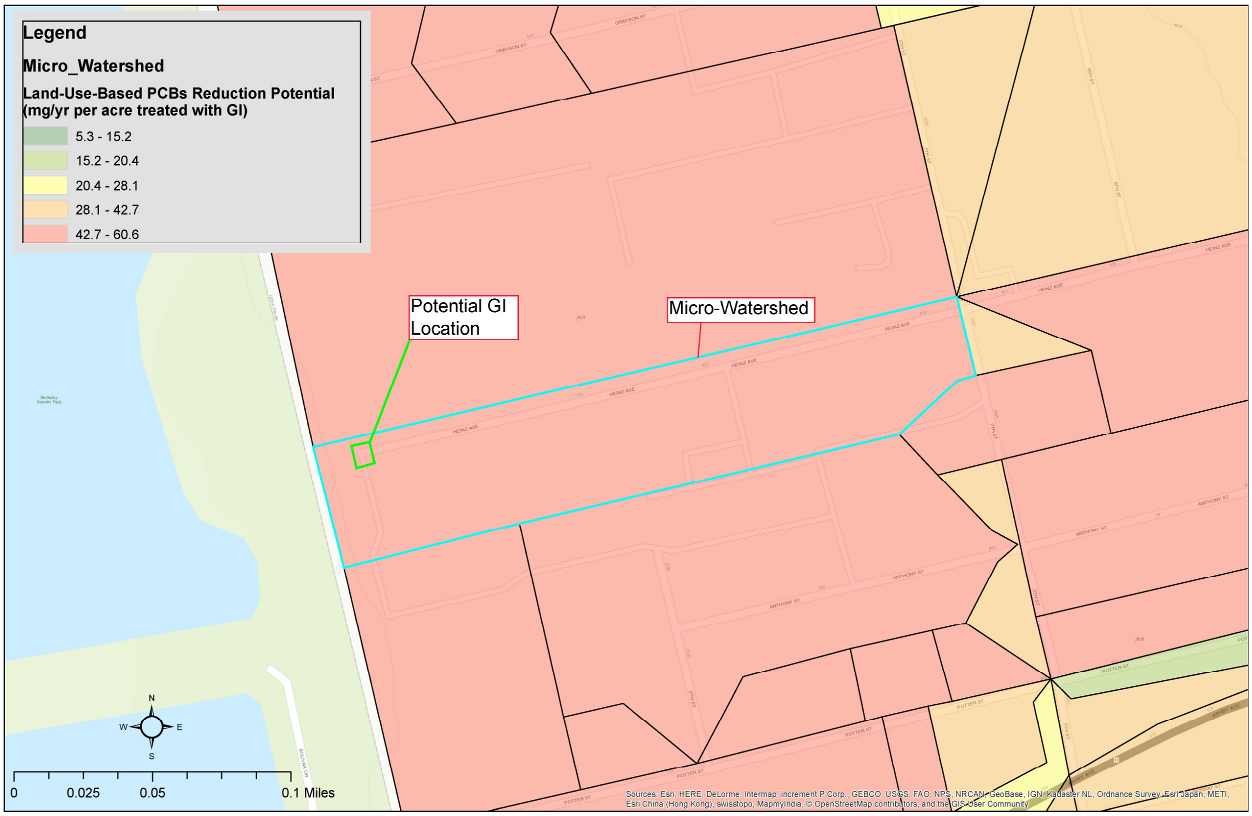



**Figure 28 – Potential Location for a Bioretention Feature on Heinz Avenue at the UPRR ROW and Tributary Micro-Watershed**