Green Infrastructure Capacity Building Project: San Pablo Avenue Spine and Hacienda Avenue Monitoring Plan

Green Infrastructure is a stormwater best management practice that increases capacity for stormwater contaminant removal and detention, at the watershed scale, via biological and physical processes. Municipalities are required to reduce storm water pollutants loading to San Francisco Bay and Green Infrastructure is being evaluated as one approach in this reduction. A major component of the Regional Green Infrastructure Capacity Building Project, managed by the San Francisco Estuary Partnership, is to evaluate the pollutant removal efficacy and hydrologic impacts of the project's constructed green stormwater treatment facilities along San Pablo Avenue in Eastern San Francisco Bay (San Pablo Avenue Spine) and Hacienda Avenue in Campbell, California.

San Francisco Estuary Institute will provide scientific support and perform pollutant and flow monitoring to determine and further refine success in terms of the desired outcomes of stormwater treatment by green infrastructure implementation.This document outlines the project monitoring plan and metrics used to evaluate the project performance.

Note that the Napa Rainwater Harvesting Project is no longer part of the Round One Implementation Grant and will not be covered in this monitoring plan.

Baseline Conditions

In order to understand the effectiveness of green infrastructure features, baseline conditions must be assessed. In the San Pablo Avenue Spineproject, baseline conditions will be assessed using land-use characteristics in the drainage areas, which will be delineated for each monitored site. Baseline contaminant conditions will be measured via feature inlet monitoring. Inlet monitoring will provide an estimate of contaminant concentrations in stormwater prior to treatment, and adds to the body of knowledge on how land-use and contaminant concentrations are related. The Hacienda Avenue project will include hydrologic monitoring in order to assess stormwater infiltration via green infrastructure. There is no baseline condition, per se, in this project. Rather, there will be an assessment of meeting the green infrastructure design specifications (discussed later in this document).

Monitoring Locations

Seven cities are participating in the San Pablo Avenue Spine green infrastructure project. Figure 1 (following page) illustrates the San Pablo Avenue Spine corridor in the East San Francisco Bay Area.Out of seven planned green infrastructure projects along this corridor, the project team will

work together to identify the three most appropriate monitoring locations.Among other considerations, this decision will be based upon monitoring feasibility with respect to site logistics (e.g. safety, an inlet and outlet that allows for high quality water sampling), land use characteristics, and green infrastructure type.

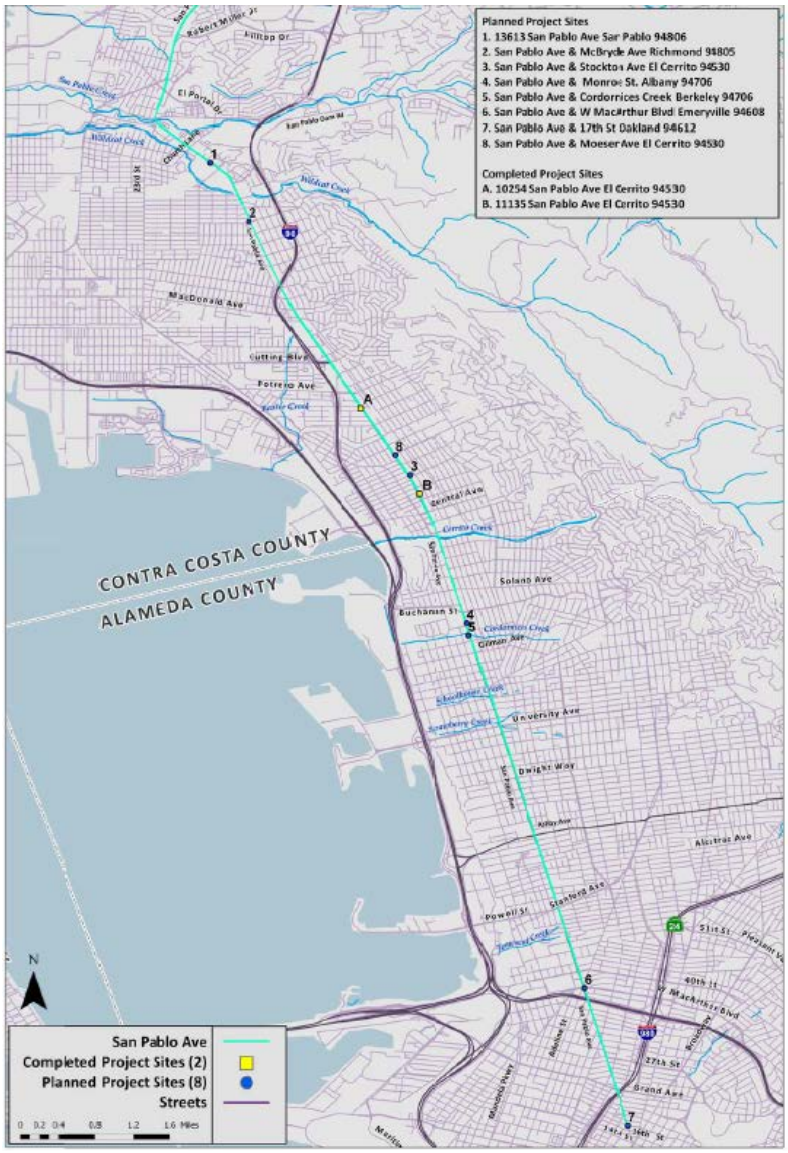

Figure 1.*Regional location map of the San Pablo Avenue Spine corridor (highlighted in blue) and the approximate locations of the participating cities. Exact project locations and monitoring locations to be determined.*

The Hacienda Avenue project is a 1 mile section of road that will be redeveloped to include linear sections of bio infiltration features (Figure 2). Bio infiltration features will range from 5 feet to 25 feet in width along Hacienda Avenue. Each section will be designed to infiltrate 80%

of stormwater runoff from the individual drainage areas. Monitoring equipment will be installed in certain elements of the 1 mile section, depending on feasibility.

At the Hacienda Avenue location, a rain gauge, piezometer, and pressure transducer will be installed in order to estimate the water budget of the feature. Similar to the Spine project, stormwater flow into the feature will be estimated using empirical rainfall and a modeling platform (e.g. SWMM). Stormwater bypass will also be measured which will allow calculation of the infiltration capacity of the green infrastructure feature.

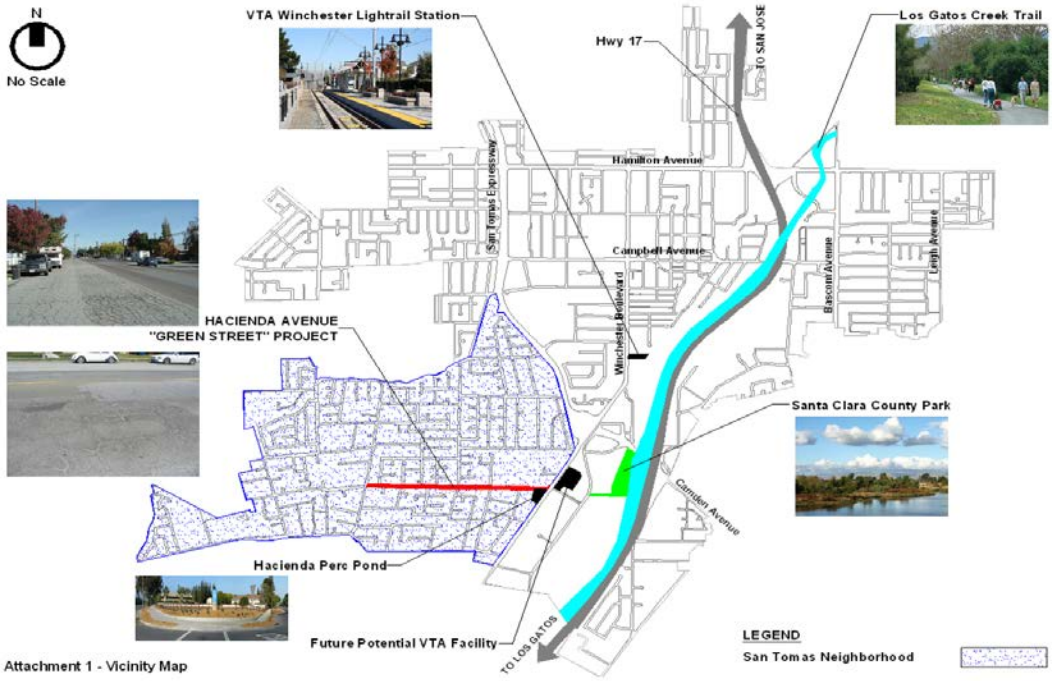

Figure 2.*Proposed Hacienda Ave., Campbell Green Street location (red line)*

Monitoring Methodology and Frequency

Empirical measurements for calculating loads reduction will be the priority metric and will be incorporated where feasible. Following green infrastructure installation, stormwater influent and effluent samples will be collected at the three chosen sampling locations along San Pablo Avenue during three storm events. At each of the 3 project locations, a green infrastructure feature will be chosen that receives water from the landscape that has not been treated and therefore sampling at the inlet to this feature will represent baseline conditions. This same feature will also be sampled at its outlet, after the stormwater has been filtered or otherwise treated by the green infrastructure element. The collected inlet/outlet samples will be compared to infer treatment by the green infrastructure feature. As budget and design feasibility allow, at one location, effluent water flow will be measured during storm events to quantify the water and pollutant budget as an additional assessment performance measure. In such an analysis, the influent water volume would be estimated through simulation based on rainfall (empirically

measured) and land use (using a broadly accepted modeling platform such as US EPA's Storm Water Management Model).

The analyte list for each location will be developed by the project team in consideration of the most likely pollutant sources within each project's watershed area, and within the limits of the project budget. The preliminary analyte list for consideration includespolychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), mercury (total and dissolved), copper (total and dissolved), nutrients, and SSC; however the final analyte list may vary based on site conditions and costs. In addition, the project will explore the use of proxy measurements (in this case SSC for heavy metals) alongside contaminant measurements. This analyte list is similar to those which have been measured in green infrastructure monitoring projects elsewhere in the Bay Area.

For the Hacienda Avenue project, green infrastructure features will be gauged with equipment to estimate the water budget at that location. Rainfall, stormwater bypass, and within feature water level will be measured. These measures will allow for calculation of stormwater infiltration and stormwater bypass to determine if the features are functioning as designed.

Monitoring Systems to be Utilized

The San Pablo Avenue Spine project will include stormwater monitoring at both the inlet and outlet of the green infrastructure features. Reducing contaminants loading to San Francisco Bay is one of the primary management questions facing the region. Accordingly, the monitoring plan will focus on estimating inlet and outlet contaminant levels and assessing green infrastructure contaminant removal efficiency. Stormwater will be collected either as individual grab samples or as storm composite samples. Outlet flow, where feasible, will also be measured.

At each of the three Spine monitoring locations, field staff will use auto and manual samplers, such as peristaltic pumps, to collect stormwater runoff at the inlet and outlet of the monitored green infrastructure feature. Ultra trace clean sampling protocols will be followed, including the use of sampler tubing trace cleaned by the analyzing laboratories. All samples will be stored on ice and then refrigerated at 4°C. All samples will be delivered to the laboratory within holding times required by the analytical method.

The Hacienda Avenue project will include developing a water budget for monitored sites. Stormwater outlet flow, bypass, and feature water level will be measured at the project site. A rain gauge will also be installed at the site. The estimated water budget will provide information on the infiltration capacity of the green infrastructure features.

Metrics Used to Evaluate Project Performance

The primary metric used to evaluate the Spine project performance will be pollutant reduction, as inferred by the difference between inlet and outlet contaminants at each monitored site (Appendix A). If budget and design feasibility allow for quantification of effluent volumes, pollutant loads may be estimated.It is expected that for most pollutants, concentration reductions

will be greater than or equal to 40%. However, the project performance based on this metric will largely depend on a combination of influent concentration characteristics (i.e. magnitude, fraction) and green infrastructure design (sizing, type of green infrastructure feature, materials, etc.).

For Hacienda Avenue, stormwater infiltration will be the primary metric for measuring performance. The features will be designed to infiltrate 80% of typical design stormwater runoff event.

Project Deliverables

The output deliverables for the Spine Project will be QAQC reviewed data in the SWAMP database and a short technical report describing the outcomes of the assessment. The report will also include a brief summary of LID monitoring in the region to highlight knowledge evolution and remaining knowledge gaps. For the Hacienda Avenue project, the final deliverable will be hydrologic groundwater data which will be submitted to DWR's Water Data Library (WDL), with a narrative description of data submittal activities included in project reports. There will also be a technical report reviewing the project findings in relation to project performance measures.

Appendix A

SF Bay Area Regional Priority Projects and Programs
Attachment 6 – Monitoring, Assessments and Performance Measures

(Note: Napa Rain Barrel Harvesting Project was not funded, thus associated references are listed in red, strike-out font)

Project Performance Measures Table: Bay Area Regional Green Infrastructure Capacity Building Program

Project Goals	Desired Outcomes	Output Indicators	Outcome Indicators	Measurement Tools and Methods	Targets
Increase adoption of LID/Green Infrastructure projects in the region	Reduced barriers to adoption of green infrastructure BMPs	Completed projects/Final project report	Completed project	Track total number of completed LID/green infrastructure projects around region through input from cities, counties, and the Regional Board, including those complete for this program	Complete the San Pablo Spine, Hacienda Ave ~~and Napa Valley rain barrels and rain gardens~~
~~Analyze each project to determine actual benefits of water supply benefits~~	~~Documented and quantified water supply benefits of green infrastructure~~	~~1. Report of monitoring results~~ ~~2. SFEP website with project outcomes~~	~~1. Amount of rainwater captured.~~ ~~2. Reduction in potable water demand for irrigation/indoor non-potable uses~~	~~1. Track the number of rain barrels installed~~ ~~2. Monitor potable water meter readings~~	~~Achieve 0.25 AF of reduced potable consumption (or provide no. of rain barrels installed)~~
Analyze each project to determine actual benefits of water quality benefits	Documented and quantified water quality benefits of green infrastructure	1. Report of monitoring results 2. SFEP website with project outcomes	Demonstrated % Reduction of heavy metals, hydrocarbons, and possibly pesticides, nutrients, and sediment loads	Conduct hydrologic and contaminant monitoring	1. Treat 39 acre feet/year (SWS: 7 acres treatment per city * 2 feet of rain / year = 14 acre/ft per year. ~~Napa: 1 acre * 2 feet of rain/ year = 2 acre/feet/year.~~ Campbell = 11.5 acres * 2 acre/ft/year = 23 acre/ft/year.) 2. Capture 80-90% of polluted Stormwater in treatment units on San Pablo Avenue & Hacienda Avenue

Project Performance Measures Table: Bay Area Regional Green Infrastructure Capacity Building Program

Project Goals	Desired Outcomes	Output Indicators	Outcome Indicators	Measurement Tools and Methods	Targets
Increase pervious cover	More natural hydrology and increased infiltration which will reduce pollutant levels in runoff	Completed projects/Final project report	Number of acres of impervious hardscape converted to planted areas	Calculate planted area during from final design plans and perform verification measurements after project construction	Convert 1.8 acres of impervious hardscape to planted area
Disseminate the lessons learned from implementing these projects for applicability by other cities, counties and water management entities to benefit their future water management practices	Increased public awareness	1. Signage explaining projects to the public 2. SFEP website with project outcomes 3. Presentations to jurisdictions 4. Report to the IRWMP governance group on project results	1. Completed demonstration projects	List of jurisdictions who've heard about program, list of signage locations	All cities and counties in Bay Area have heard a presentation about the benefits of green infrastructure
~~Determine the cost/benefit of small cisterns for rainwater harvesting benefits~~	~~Understanding of the quantitative benefits of projects based on monitoring results~~	~~Completed projects/Final project report~~	~~Completed project costs and quantified benefits~~	~~Cost: Bid estimates, actual construction cost, quantification of indirect costs.~~ ~~Benefit: Public surveys, quantification of water supply benefit, indirect benefits.~~	~~Benefit-Cost ratio greater than 1 to 1~~