BAY AREA GREEN INFRASTRUCTURE

SPOTLIGHT ON: HACIENDA AVENUE BIO-INFILTRATION BASINS CAMPBELL, CA

WHAT IS GREEN INFRASTRUCTURE AND HOW CAN IT HELP SAN FRANCISCO BAY?

Green infrastructure (GI) is a cost-effective, resilient approach to managing stormwater at its source while also delivering environmental, social, and economic benefits. GI uses vegetation, soils, and other elements to restore more natural watershed processes that mimic nature to soak up stormwater, provide habitat, clean the air, and filter out chemicals from the stormwater. GI can reduce peak flows and stream erosion; recharge groundwater; and improve water quality in urban stormwater that drains to San Francisco Bay.

WHY IS IT IMPORTANT TO STUDY GREEN INFRASTRUCTURE?

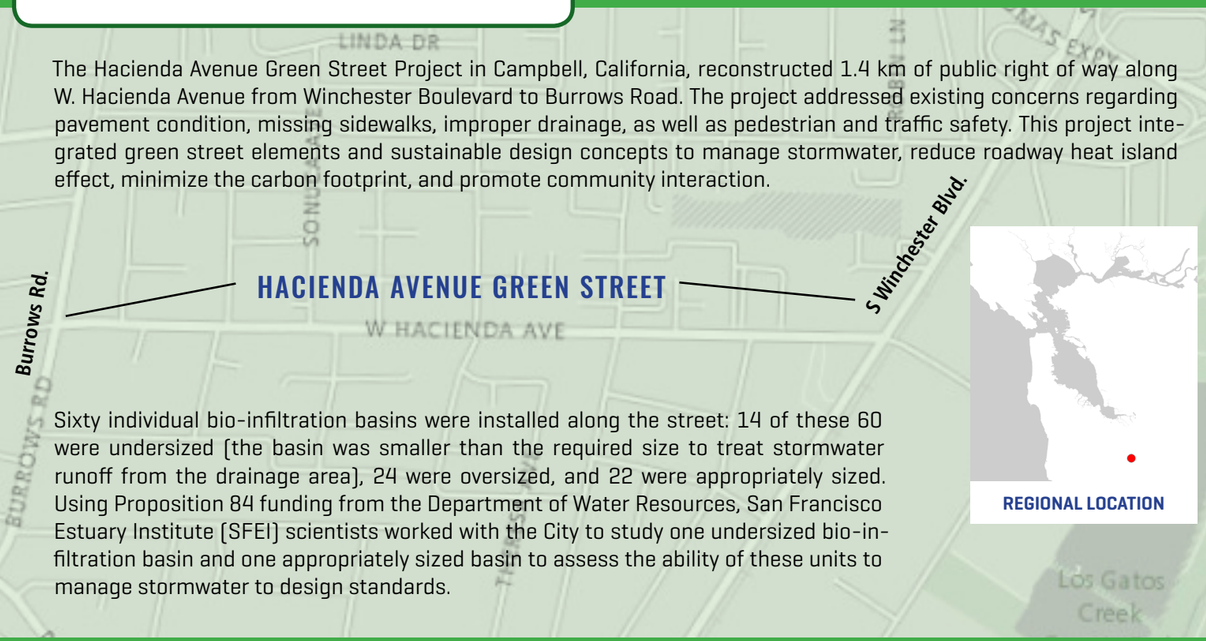
As we add GI into our city landscapes, we need to develop and implement projects that result in the most cost-effective benefits. To do this, we need to understand how GI works in our climate, what designs work best, the best places for implementation, and the maintenance needs to keep these systems performing properly. This is particularly important given a future when GI will begin to comprise major parts of city landscapes.

Read on to learn about the award winning Hacienda Avenue bio-infiltration basins and what the monitoring tells us about how they are working....

HACIENDA AVENUE BIO-INFILTRATION BASINS PERFORM BETTER THAN EXPECTED

WHY HACIENDA AVENUE?

The Hacienda Avenue Green Street Project in Campbell, California, reconstructed 1.4 km of public right of way along W. Hacienda Avenue from Winchester Boulevard to Burrows Road. The project addressed existing concerns regarding pavement condition, missing sidewalks, improper drainage, as well as pedestrian and traffic safety. This project integrated green street elements and sustainable design concepts to manage stormwater, reduce roadway heat island effect, minimize the carbon footprint, and promote community interaction.



Sixty individual bio-infiltration basins were installed along the street: 14 of these 60 were undersized (the basin was smaller than the required size to treat stormwater runoff from the drainage area), 24 were oversized, and 22 were appropriately sized. Using Proposition 84 funding from the Department of Water Resources, San Francisco Estuary Institute (SFEI) scientists worked with the City to study one undersized bio-infiltration basin and one appropriately sized basin to assess the ability of these units to manage stormwater to design standards.

HOW DO BIO-INFILTRATION BASINS WORK?

It's simple! Rain runs off the roads, footpaths and roof tops into the bio-infiltration basins, where the water then sinks into the engineered biosoil and native soils. If the runoff entering the basin exceeds the infiltration rate, the water will pond in the unit until it reaches the elevation of the overflow inlets that lead directly to storm drain pipes under the street.

Green Infrastructure Sizing

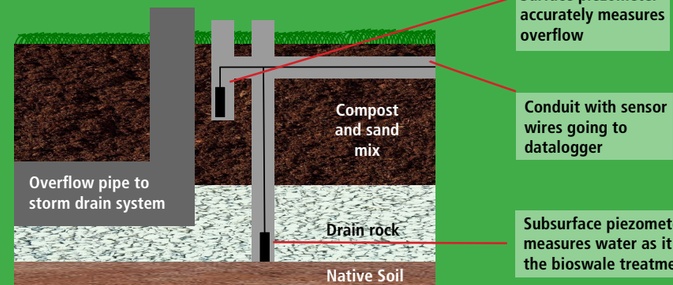
GI units are typically sized to manage a minimum of 0.2 inches of rainfall per hour falling onto the drainage management area (the area that drains into the basin). The primary features that affect the amount of stormwater a GI unit can treat include:

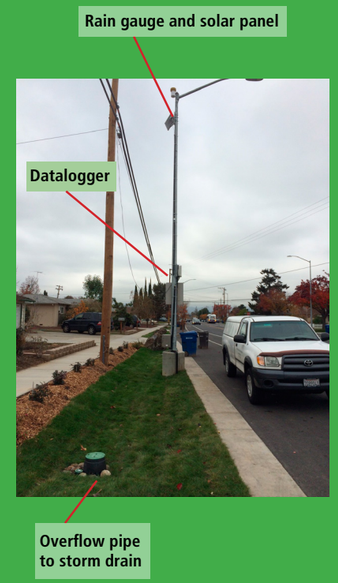
- Size and imperviousness of the area draining into the unit
- GI unit surface area
- Infiltration rate of the GI biosoils and the underlying native soils

A common design formula is a sizing ratio of 1:25 (the impervious cover surface area of the drainage area should be no more than 25 times the surface area of the GI unit), given a GI biosoil infiltration rate of 5 inches per hour.

HOW WERE THE BASINS MONITORED?

In collaboration with the City of Campbell, scientists from SFEI installed monitoring equipment in two adjacent basins. The primary instruments - piezometers - were positioned to measure water levels in the treatment soils, water ponding on the surface of the basin, and water overflow to the storm drain system at times when the bio-infiltration basin's capacity to absorb stormwater was exceeded. A rain gauge, data logger, and solar panel were also installed to measure site specific precipitation, record data between biweekly downloads, and power all the equipment. These instruments measured how the basins treated and infiltrated runoff over the rainy season. The information was gathered to verify performance and help City managers design GI for future installations in other parts of the city.



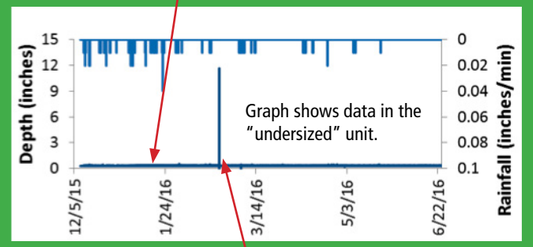


WHAT HAVE WE LEARNED?

100% INFILTRATION OF STORMWATER!

All stormwater flowing into the bio-infiltration basins from December 2015 to July 2016 infiltrated into the underlying soils and none overflowed into the stormdrain system.

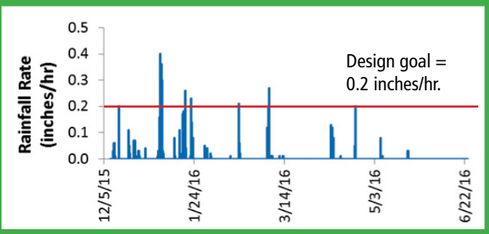
Instruments in the bio-infiltration basins recorded minimal water levels in the soils despite rainfall throughout most of the season.



Quality Assurance Check: SFEI scientists poured approximately 60 gallons of water directly into the piezometer tube to ensure it was working correctly. Water infiltrated into the soils very quickly, but the piezometer accurately recorded the maximum depth of the water during the experiment.

Did we collect enough data?

There were 7 storm events with rainfall rates of 0.2 inches/hr or greater (max = 0.4 inches/hr). Based on the data, the basins we studied surpassed design goals. However, the storm events occurring this rainy season were relatively small. We cannot know how the units will perform during larger, more intense rain events. Continued observations by City staff or the community will help to answer this question.



BROADER IMPLICATIONS FROM STUDYING THE HACIENDA AVENUE BIO-INFILTRATION BASINS

The Hacienda Avenue bio-infiltration basins performed better than expected, likely because the underlying soils are highly infiltrative and absorb water at a fast rate. It is likely that the other bio-infiltration basins on the block, including the undersized units, are also performing beyond design specifications. In locations where GI implementation is being considered but available space is below the 1:25 sizing criterion, it may still be possible to see high performance if the underlying soils are highly infiltrative and the GI units are designed to maximize infiltration by having the overflow occur from the surface of the unit rather than via a perforated underdrain.

AWARD WINNING PROJECT

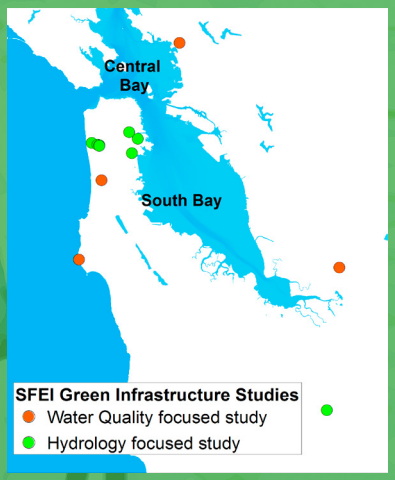
- First project in the State of California that has received a silver certification from GREENROADS
- Bay Friendly Rated
- Recognition from the American Public Works Association
- Recognition from the California Stormwater Quality Association
- Recognition from the Santa Clara Valley Urban Runoff Pollution Prevention Program

GREENPLAN-IT: A TOOL FOR MUNICIPALITIES

As we add GI into our city landscapes, we must develop and implement plans that result in the most cost-effective benefits. Tool sets like GreenPlan-IT [http://greenplanit.sfei.org/] are an example of a freely available resource to support the cost-effective selection and placement of GI in urban watersheds around the Bay Area, and to track where GI is in our communities and what we are getting from all the effort to green our landscape. Tools like this one are being used all over the country by municipalities to develop watershed master plans, to guide future GI implementation, to address water quality and quantity targets, and to demonstrate with "reasonable assurance" that the retrofit plans that are proposed will meet expected load reductions along the timelines that environmental regulators are seeking. Our locally developed tool set has already been trialed by the cities of San Mateo and San Jose.

GREEN INFRASTRUCTURE STUDIES AROUND THE BAY AREA

SFEI is studying GI projects around the Bay Area to develop and provide quality scientific information to the stormwater management community. Studies are answering questions about improvements in stormwater runoff characteristics like total volume and timing, and also about water quality improvements like removal of PCBs, mercury, pesticides, and sediments.



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