Veggielution Farms Bioswale Demonstration Project

Biochar Performance Summary

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Executive Summary

Earth Foundries, with support from the U.S. Forest Service, CAL FIRE, and Valley Water, implemented and evaluated a redesigned bioswale at Veggielution Farms in San José. The project addressed a long-standing drainage failure that caused routine winter flooding, loss of crops and required repeated pumping by farm staff.

The new bioswale was intentionally constructed as a side-by-side demonstration, with one half built to standard specifications (control) and the other constructed identically but amended with biochar. This configuration allowed direct comparison of performance under the same storm conditions.

Following construction, the bioswale successfully eliminated on-site flooding during significant rain events that previously caused operational disruptions at the farm. Visual observations and photographic documentation during and after storm events showed measurably faster water infiltration and draining on the biochar-amended side compared to the control.

Soil and water testing was conducted over a two-year period to evaluate whether biochar influenced filtration, water quality, or soil conditions. Results indicate that the bioswale is functioning as intended as a stormwater treatment system, while the biochar-amended section demonstrated improved water retention within the soil profile and faster surface drawdown after storm events. The soil and water testing did not, however, identify a clear or consistent improvement in measured water or soil quality performance attributable specifically to the biochar amendment when compared to the control. Additional monitoring over a longer time horizon could help evaluate whether performance differences emerge as the system matures and undergoes repeated seasonal storm cycles.

In addition to technical outcomes, the project included hands-on community education and workforce training. Community members participated in bioswale design education and construction activities, expanding local capacity to implement nature-based stormwater infrastructure.

Project Background and Objectives

Veggielution Farms experienced chronic flooding due to an undersized and poorly performing bioswale. During winter storm events, water pooled and persisted for extended periods, requiring farm personnel to deploy pumps to remove standing water. This disrupted farm operations and damaged growing areas, and contaminated crops so that they had to be removed.

The project objectives were to (1) correct the drainage failure and eliminate flooding, (2) demonstrate whether biochar can improve bioswale performance, and (3) document outcomes in a way that could inform future stormwater and green infrastructure projects.

Bioswale Design and Demonstration Approach

The bioswale was rebuilt and divided lengthwise using a temporary barrier during construction. Both sides used the same geometry, soil profile, and vegetation. One side served as the control, while the other included a biochar amendment mixed into the soil media. This side-by-side configuration allowed stormwater to enter both systems simultaneously under identical conditions.

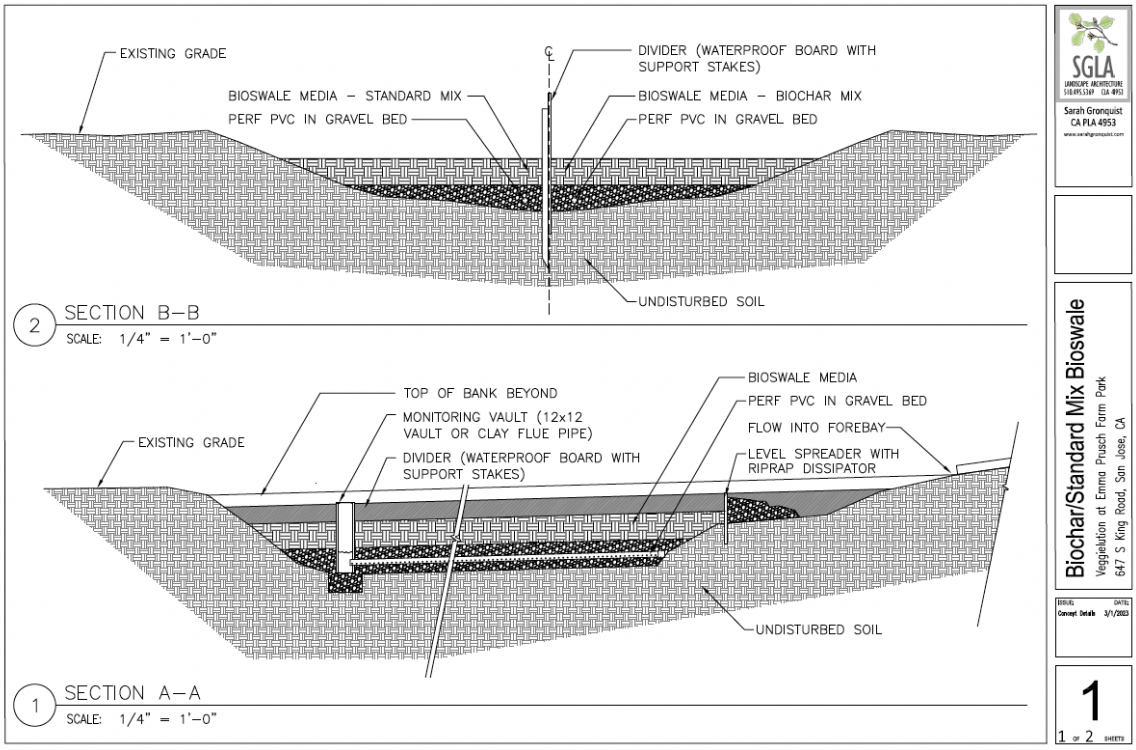

Figure 1. Bioswale Design

Stormwater Infiltration Performance

Visual monitoring and photographic documentation were conducted during multiple storm events. Photos taken on the same day, after morning flooding and later the same afternoon, show clear differences in drainage behavior. The biochar-amended side consistently showed less standing water and faster infiltration than the control side.

These observations demonstrate that adding biochar potentially improved the soil's ability to absorb and hold water below the surface while reducing surface ponding duration.

Figure 2. Bioswale at 9:00AM (Left Picture) and 2:30PM Same Day (Right Picture). Left side of bioswale is the control, and the right side of the bioswale is the biochar-amended. The biochar-amended side shows greater water infiltration over time.

Flood Mitigation Outcomes

Since installation, the bioswale has successfully prevented flooding during rain events that previously caused water to overtop and spread into active farm areas. Farm staff have not needed to deploy pumps to remove standing water, confirming that the redesigned bioswale resolved the underlying drainage problem.

Water Quality Testing Summary

Water entering and exiting the bioswale was tested by a certified laboratory for nutrients, metals, suspended solids, and other common stormwater indicators. Results show that the bioswale functions effectively as a treatment system, reducing sediment and nutrients carried in storm runoff.

Measured concentrations were consistent with expected urban stormwater values, and no unsafe conditions were identified. Water quality differences between the control and biochar sides were modest during single storm events, which is expected given short contact times. Water testing did not identify any significant differences in performance between the control and biochar-amended sides, and the biochar amendment did not have a discernible effect on measured water quality

parameters under the conditions evaluated. Overall performance supports bioswales as a practical stormwater management tool.

Soil Testing and Biochar Effects

Soil samples were collected from multiple locations within both the biochar-amended and non-biochar sections and analyzed by an independent soil biology laboratory. Results show that both sides supported microbial communities typical of stormwater infrastructure soils, which are designed to tolerate periodic saturation and drying.

While overall microbial populations were similar across treatments, biochar particles were visibly present in amended soils, and those soils tended to retain more moisture between storm events. This moisture retention aligns with observed improvements in infiltration and may support longer-term plant establishment and system resilience, although none were observed over the duration of the study.

Community Education and Workforce Training

The project included hands-on bioswale training for community members, farmers, and volunteers. Participants learned about stormwater management, bioswale design principles, and how biochar can be incorporated into green infrastructure.

Community participants assisted with bioswale construction, receiving practical experience that can be applied to similar projects elsewhere. This educational component expanded the project's impact beyond the site itself by building local knowledge and capacity.

Figure 3. Bioswale Community Training

Figure 4: Bioswale Community Installation

Conclusion

The Veggielution bioswale demonstration project successfully resolved a chronic flooding problem while providing clear, visual evidence that biochar can enhance bioswale infiltration performance. Over the course of the two year study, there were no discernable improvements in soil quality or water filtering capability. More study over a longer time horizon may be required to quantify potential effects. The project combined infrastructure improvement, applied research, and community training, making it a replicable model for future stormwater and climate-resilience investments.