EA Project Summaries and Findings Report Project
Project 4 – Proposal for Stormwater Retrofit and Research Project
Project Summary

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Funding Amount
$351,474

1 Summary

This study evaluated the performance of a treatment train system composed of three Best Management Practices (BMPs) constructed in series. The goal was to identify the feasibility and benefits of retrofitting low impact development (LID) features to improve stormwater management at existing residential areas within the Edwards Aquifer Recharge Zone (EARZ). This provides an example for existing residential developments seeking to implement LID BMPs to manage stormwater and improve water quality.

The project included the retrofit of an existing swale and a forested basin that drain to Lorence Creek.

Stated objectives of the study - *This project will retrofit a residential stormwater drainage easement to include a vegetated swale and a bioretention facility and will conduct pre- and post- construction stormwater runoff water quality monitoring.*

Justification for the study – *The project will improve water quality in the Edwards Aquifer Recharge Zone, generate critical data to characterize pollutant loadings from San Antonio neighborhoods, and promote infiltration into the Recharge Zone.*

The area is residential and the area draining to the site is approximately 33 acres. The resulting treatment train consisted of three major components:

1. Sediment Forebay
2. Bioinfiltration Basin
3. Enhanced Natural Bioretention Area

These are shown in Figure 1. The sediment forebay collects runoff, trash, and debris before runoff enters the bioswale. A portion of runoff in the swale is diverted into the bioinfiltration basin via two small culverts. Stormwater is detained in the basin and treated by the system that includes an engineered soil mix and plants, before the treated stormwater is discharged into the swale

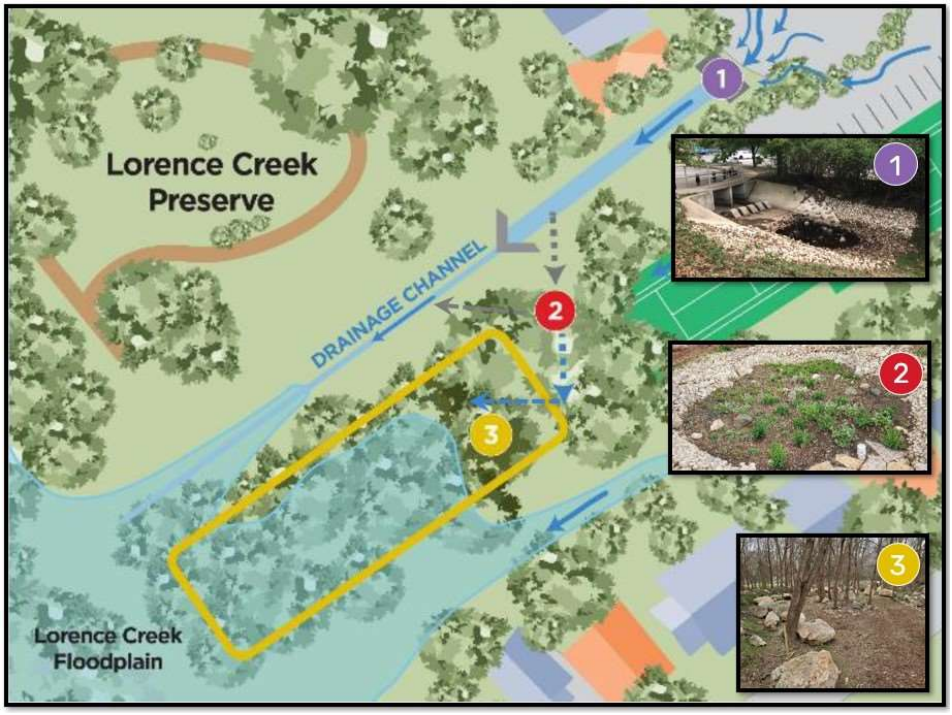

Figure 1 – Project Site and Treatment Train

through an underdrain. During larger rain events, the basin overflows and stormwater enters the bioretention area where pollutants can also settle out and stormwater can infiltrate.

1.1 Methods

The project team collected soil and stormwater samples before construction to estimate pollutant levels from the residential drainage area. To assess the performance of the treatment train, they also collected paired stormwater samples at two locations during five runoff events after retrofitting, one upstream (at the sediment forebay) and one downstream (at the bioinfiltration basin outlet).

Samples were analyzed for 25 common water quality parameters, including nutrients, hydrocarbons, and metals. Sample collection began after the site was stabilized and samples were only collected when there was at least 0.1" of rain after a 72-hour dry period. The results were evaluated statistically to determine if the pollutant concentrations were significantly different before and after treatment by the BMP.

1.2 Findings

The analysis of pre- and post- retrofit stormwater sampling included estimation of the effectiveness of the treatment train's ability to remove pollutants in stormwater runoff. The samples were collected upstream of the sediment forebay and at the outlet of the bioinfiltration basin's underdrain. The water quality impacts of the bioretention area were not included in the pollutant removal analysis. The difference between pre- and post- results for seven of the measured pollutants was determined to be statistically significant. The percent removal was calculated for these seven pollutants. Results show that concentrations decreased for five parameters and increased for two parameters, as listed in *Figure 2*.

The decrease in concentrations for five of the parameters suggests that the treatment train is improving water quality from upstream to downstream through the LID features. For the two parameters that increased, hardness and total nitrogen, the authors propose that the composition of the engineered soil mix might have increased concentrations. Further study would be required to confirm this.

Parameter	Percent Removal (%)
Hardness (mh/L)	-277%
Total Nitrogen (mg/L)	-35%
E. coli (MPN/100 ml)	27%
Total Organic Carbon (mg/L)	63%
Total Coliform (mpn/100 ml)	24%
Total Suspended Solids (mg/L)	77%
Terphyenl-d14 (% Recovery)	13%

Figure 2 – Pollutant Removal Efficiencies

The project team also suggested that the amount of sediment accumulating in the forebay exceeded their expectations for an older, residential development assumed to be fully stabilized with established landscaping. The amount of accumulated sediment was measured and characterized after five additional rain events. The results were variable and depended on several factors, including the intensity of the rain event and activities within the watershed, with an average of 67 liters of sediment accumulation during each event. The sediment removed from the forebay was a composition of larger particles and debris, such as grass clippings and crushed rock from composition shingles. This may be different from the smaller particles, such as limestone dust and clay particles, that remain suspended in flowing water measured as Total Suspended Solids (TSS). The results suggest that the system is preventing a larger amount of sediment and associated pollutants from entering Lorence Creek than the TSS concentration results show.

1.3 Challenges and Limitations

Finding adequate space to construct stormwater BMPs within an existing suburban development can be difficult. The available space may not be large enough to meet treatment goals, or it may not be in a location capable of receiving runoff from a significant drainage area. This study was able to retrofit a system that provides water quality benefits in more frequent, low intensity rain events; however, the capacity of the system is unable to fully treat larger rain events. However, this study confirms that some significant reduction of pollutant loading can be achieved with smaller systems. Stormwater only discharges into the enhanced natural bioretention area when the bioinfiltration basin overflows, reducing the potential additional treatment benefits. The study did not measure the additional treatment benefits of the natural bioretention area, and, therefore, the water quality benefits of the entire system, likely exceed the results shown in this study.

In addition to estimating the changes in pollutant concentration, evaluating the changes in flow and pollutant loads through the treatment train would provide beneficial insights for future LID and treatment train projects. These data enable a better understanding of the beneficial impacts to receiving waters. These also help watershed managers understand the magnitude of watershed pollutants and potential impacts of pollutant mitigation measures that could be implemented in the catchment area.

2 Benefits

This project provides water quality benefits, additional data, analysis, and public education / outreach for water quality treatment efforts in the Edwards Aquifer Recharge Zone. In addition, the study provides information for entities interested in retrofitting an area with a water quality BMP. The effort also provided data about discharge from a residential area and additional data on amounts of sediment discharge.

The benefits of the study are as follows:

- The study provides insight into pollutants of concern and potential treatment design opportunities in residential developments within the EARZ. For example, sediment loads exceeded expectations for an older residential neighborhood with established, well-maintained landscaping. This result suggests the importance of considering retrofit stormwater treatment BMPs for established neighborhoods in addition to new developments. In addition, this highlights the importance of including forebays as a sedimentation pretreatment measure in systems incorporating infiltration-based features, such as bioinfiltration and bioretention. Without promoting sediment settling upstream of an infiltration system, maintenance will be required at increased frequencies due to clogging of the pore space.
- This study serves as a local example to generate interest with other similar developments in the region. This could result in an increase in local adoption, due to the recreational and aesthetic benefits of the bioretention area adjacent to the Lorence Creek Linear Park.
- The retrofit system improved water quality in the neighborhood. If adopted by other developments in the area, it could have a compounding positive impact on local surface water and the Edwards Aquifer.
- The researchers expanded the local dataset of pollutant removal effectiveness for bioinfiltration based BMPs.

Project Deliverables:

Glavy, N., Reid, D. (2023). Lorence creek HOA retrofit project and water quality assessment. Greater Edwards Aquifer Authority.

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Project 4 – Proposal for Stormwater Retrofit and Research Project
Fact Sheet

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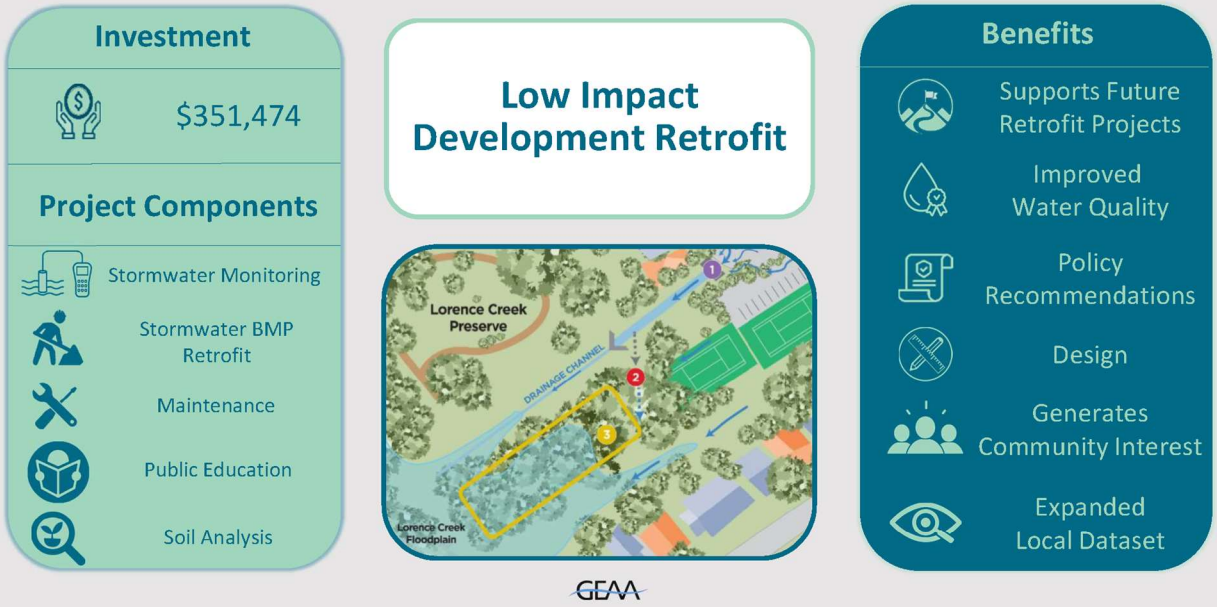

GEAA

Benefits

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Project Graphic

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Stormwater retrofit to evaluate feasibility and benefits of improving stormwater management