Ohio's Balanced Growth
Best Local Land Use Practices
Technical Assistance, Fall 2014

INFORMATION ABOUT BIOSWALES AND BIORETENTION IN THE RIGHT-OF-WAY
KD 11-6-14 revised 5-27-15

Built projects:

1. **Maywood Avenue, Toledo,** between Stickney Ave and Mulberry Street.

Informant: Dan Christian, Tetra Tech, 517-316-3940.
Dan.Christian@tetratech.com

Overall. This was a pilot project installed in 2009 with American Recovery and Reinvestment Act (ARRA) funding. Maywood is a residential street with asphalt pavement and concrete curb, gutter, sidewalk and driveway aprons. As part of street reconstruction, the bioswale was installed in the 8-foot-wide planting strip (AKA tree lawn, parkway) between the curb and sidewalk on both sides of the street. Resident engagement was done door-to-door, and residents were given a choice of treatment: native plants, lawn, or trees/planting bed.

Image: K. Date

image: K. Date

image: K. Date

Construction. The underlying soil is hard clay. Approximately 60% of the 1200-foot overall street length was provided with bioswales; the remaining 40% represented driveways, sidewalks, and other obstructions. Curb cut inlet structures are provided at each segment of the planting strip to provide flow into the bioswale area. The overall section was approximately 4 feet deep, with an engineered soil "planting mix" keyed into the aggregate base of the street section. The surface was swaled at a 3:1 slope, approximately 1 foot deep, between the paved areas. (sidewalks, curb and driveways). Two sections were provided, 12-foot and 14-foot (including sidewalk) based on right-of-way width available. A four-foot-wide pervious concrete sidewalk was provided, and driveway aprons were also pervious. An underdrain runs the length of the street just below the planting mix in the aggregate base, and is valved at the low point in the street catch basin before connection to the main storm sewer.

The main utilities for the road are under the road, and home laterals pass through the bioswale in trenches with coarse sand fill. This appears to be the practical approach in many similar projects.

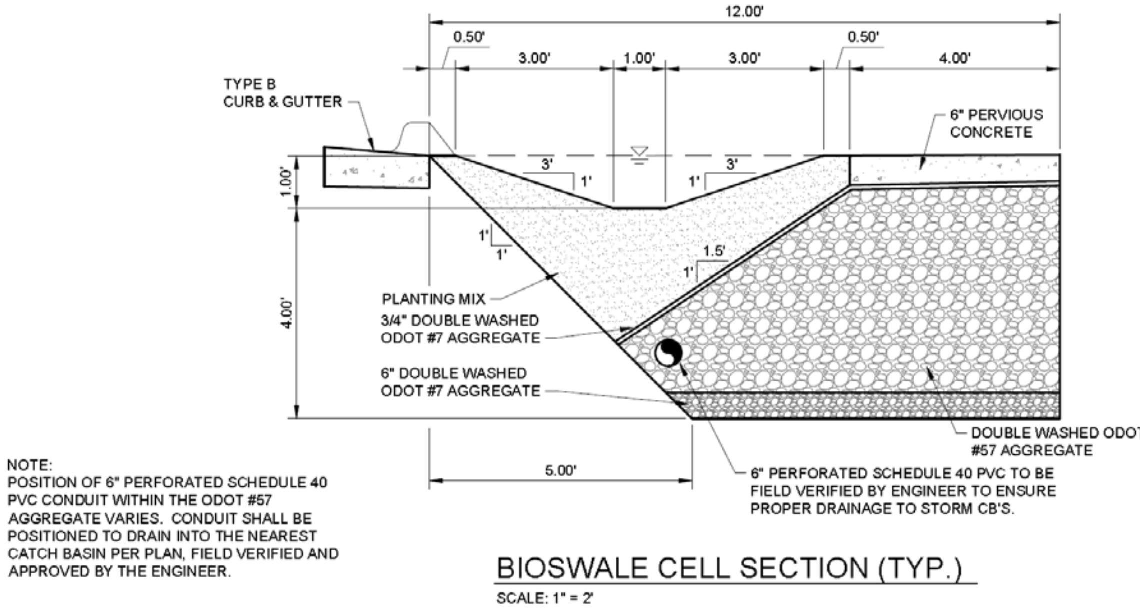


image: Tetra Tech

Maintenance. Maintenance is provided by the property owner, and should include weeding, mowing (if applicable) trash removal, and ensuring that inlets remain clear. Maintenance along the street appears to be good. Some property owners have chosen to replace the native plants with more traditional horticultural plants; others appear to be mowing installed lawn or possibly having let their mulch beds return to lawn. It is not clear whether the installed buffalo grass is still in place, or whether more traditional turfgrass or other weed plants have taken over.

According to the City, to date, no vacuuming or other maintenance has been done on the pervious pavement areas.

Sediment pretreatment was not part of the Maywood project. It is not clear whether grass and soil will obstruct the inlets at some point. The system has been in place now for 5 years and it's functioning very well. It is possible that it could be 20 years until work is needed.

Effectiveness. Monitoring was provided for water quantity at the low point of the street in the catch basin. The project was installed to address street ponding and flooded basements on the street. At first, the valve on the system was open, and there was little change in outflow from pre-project conditions. However, once the valve was closed, the outflow was reduced by 65%; furthermore, even through several major storm events, street ponding has been eliminated, and flooded basements have not occurred.

Research indicates that there is likely no difference in effectiveness between different types of planting.

Cost. Bioretention systems typically cost between $20 and $40 per square foot (excluding curb, gutter, sidewalk, driveway aprons, inlets in curbs). Smaller systems on residential lots can go as low as $10 per square foot. Larger systems in central business districts (lots of concrete and existing conditions to work around) can range $80 to $140/square foot.

The Maywood project total cost was $347/linear foot, both sides, including all structures and pavements, and street reconstruction.

2. Conrad Avenue, Toledo, between Nebraska Avenue, Hartwell Avenue, and dead end.

Informant: Scott Sibley, City of Toledo engineer's office, 419-936-2275, scott.sibley@toledo.oh.gov

Overall. Conrad Avenue is an unimproved residential street, without curb and gutter. The purpose of the project was to clear up nuisance ponding. This was a pilot project done in 2011 (verify) with funding from the Ohio EPA Stormwater Innovation Fund (SWIF). Bioswales were provided in the planting strip between the road pavement and the sidewalk. Similar to Maywood, door-to-door resident engagement was done. Residents were given a choice of lawn, native plants, or gravel parking areas (without bioswale, draining into adjacent planter areas) to replace existing parking areas. The project did not have hydraulic design or monitoring; it was just an attempt to do what was possible in the space provided, and see if it could help with the street ponding problem. This was successfully accomplished.

Image: K. Date

Image: TMACOG

Construction. The design goal was to introduce drainage where there was none (unimproved street), at minimum cost. Construction section was simplified compared to Maywood Avenue. Individual rain gardens were provided where they would fit (see section and plan below) with engineered soil and swaled surface between pavement areas. An underdrain was provided down the length of one side of the street in a separate drainage trench filled with aggregate; raingarden areas on the opposite side were tied in individually with underdrains crossing the street. Inflow is sheet flow; inlets are not needed as there was no curb/gutter. Driveway aprons were provided to match existing; most were gravel, a few were concrete.

Costs. Costs range from $50/linear foot of frontage without underdrain, to $85/linear foot with underdrain, assuming turf cover. With native plants, add $15/linear foot.

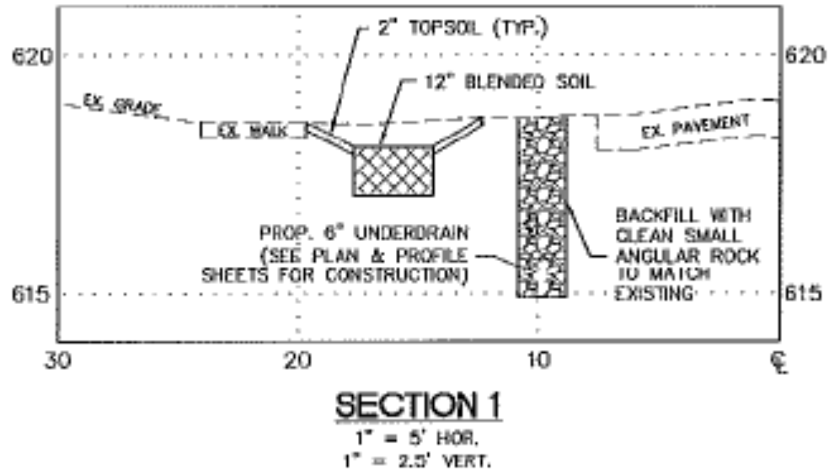


Image: City of Toledo

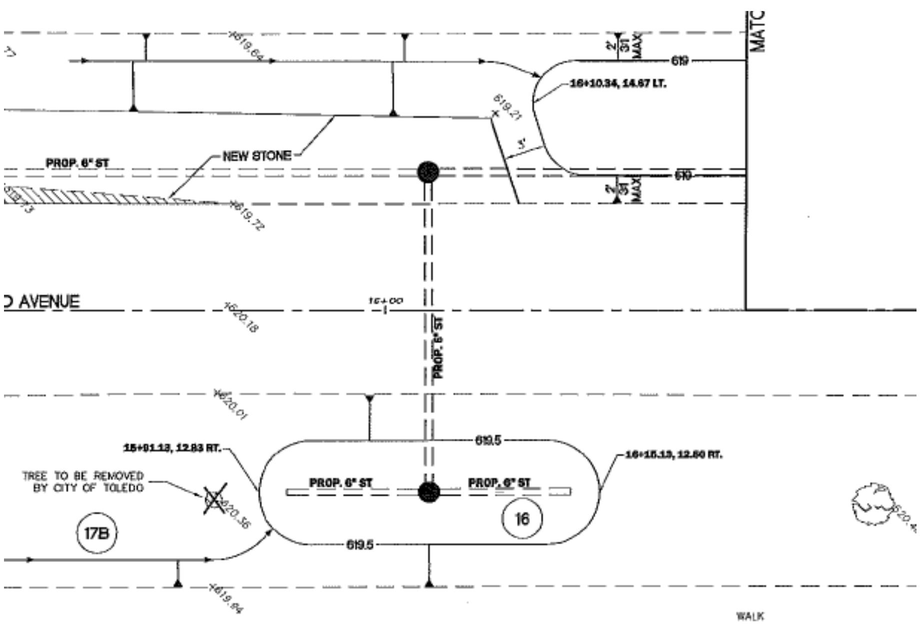


Image: City of Toledo

Maintenance. Similar to Maywood, maintenance is the responsibility of the property owner. To date, there has been no need for City involvement in maintenance.

Effectiveness. Street ponding has been significantly reduced. Of interest, the block between Hartwell and the dead end was not originally provided with an underdrain, but was not effective, so an underdrain was installed at a later date. The system is now working effectively.

3. South Reynolds Rd, Toledo, between Airport Hwy and Glendale Avenue.

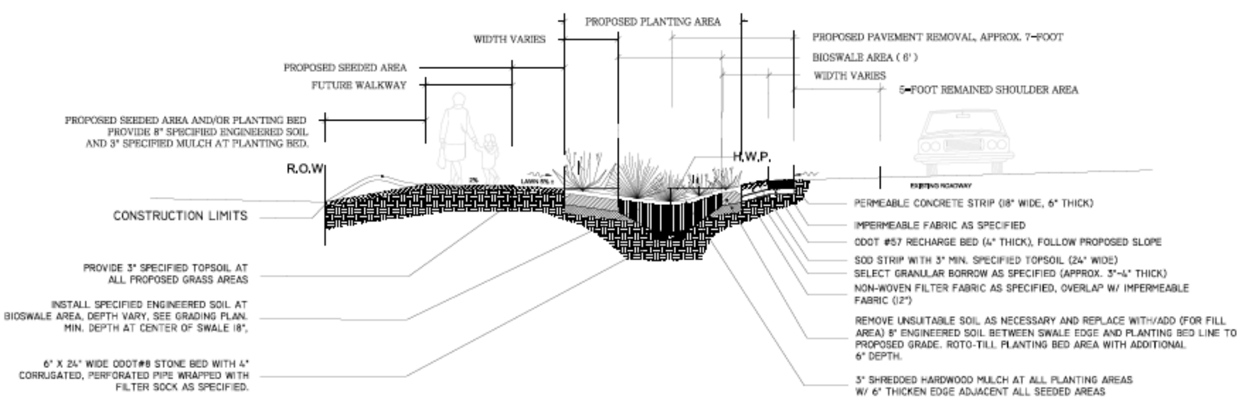
Informant: Steve Day, landscape architect, City of Toledo Engineer's office.
419-936-2275

Overview. Reynolds Road is a commercial arterial, originally six lanes wide plus a central median/turning lane. As part of road reconstruction including reduction of road width one lane on each side, bioswales were introduced on both sides of the street. The project was completed in 2010-2014. Funding was provided by transportation enhancement grants, plus direct earmarks on federal transportation funding.

Image: K. Date

Image: K. Date

Construction. The construction section is similar to the section for Angola Rd. Bioswales were installed with 18” sandy loam engineered soil and an underdrain connecting to existing catch basins, which were elevated in order to act as an emergency overflow. In some places, extra wide curb cuts were used as inlets; in others, a narrower curb inlet was used. In some areas a pervious pavement strip was installed along the curb. Surface grade in planting areas was sloped to drain to the catch basins, which were fitted with domed inlet grates to catch debris. Native plantings were installed and mulched. The systems function as a filtered storm water drainage system for most storm conditions.



TYPICAL SECTION OF BIOSWALE AND ADJACENT IMPROVEMENTS (EAST - WEST)
NOT TO SCALE

Maintenance. After the initial 2-year contractor establishment period, maintenance is the responsibility of the property owner and involves trash pickup and weeding. Property owners were educated about proper maintenance of plant material, and were reminded that they would be mowing lawn in these areas anyway. They were encouraged to start weeding early each season in order to reduce the effort later. It is recognized by the City that property owner education is an ongoing project to improve communication and encourage better maintenance and "ownership" of the landscape by property owners. Review of the areas showed that maintenance was generally fair to good. There has been no known maintenance on catch basins or pervious pavement gutter strips.

Effectiveness. The area is not monitored and it is difficult to tell the effectiveness of the plantings. No problems seem to have arisen regarding drainage.

4. Angola Rd, Toledo, between Reynolds Road and 200 feet west of Airport Highway.

Informant: Scott Sibley, City of Toledo Engineer's office (see above).

Overview. This portion of Angola Road is an arterial that runs through residential and commercial/office areas. The road is two lanes with additional turning lanes at major intersections. It has a wide shoulder but no curb and gutter. Bioswales were provided in selected locations on both sides of the road in the planting strip behind the shoulder. They were complemented by matching (same plant material, but mounded) landscaped plantings interspersed along the road. The project was completed in 2012; it has just finished the two-year contractor establishment period. The project was funded through general transportation funds, with an NRDC grant providing $200,000 toward the total cost.

Image: K. Date

Construction. The drawings illustrate the cross-section and longitudinal section of each bioswale area. 18" engineered soil was provided with a perforated drain pipe set in drain rock, connected to standard catch basins. The surface was sloped 10 to 15% in both directions toward the catch basin. Bermed areas were provided with 9 inches engineered soil.

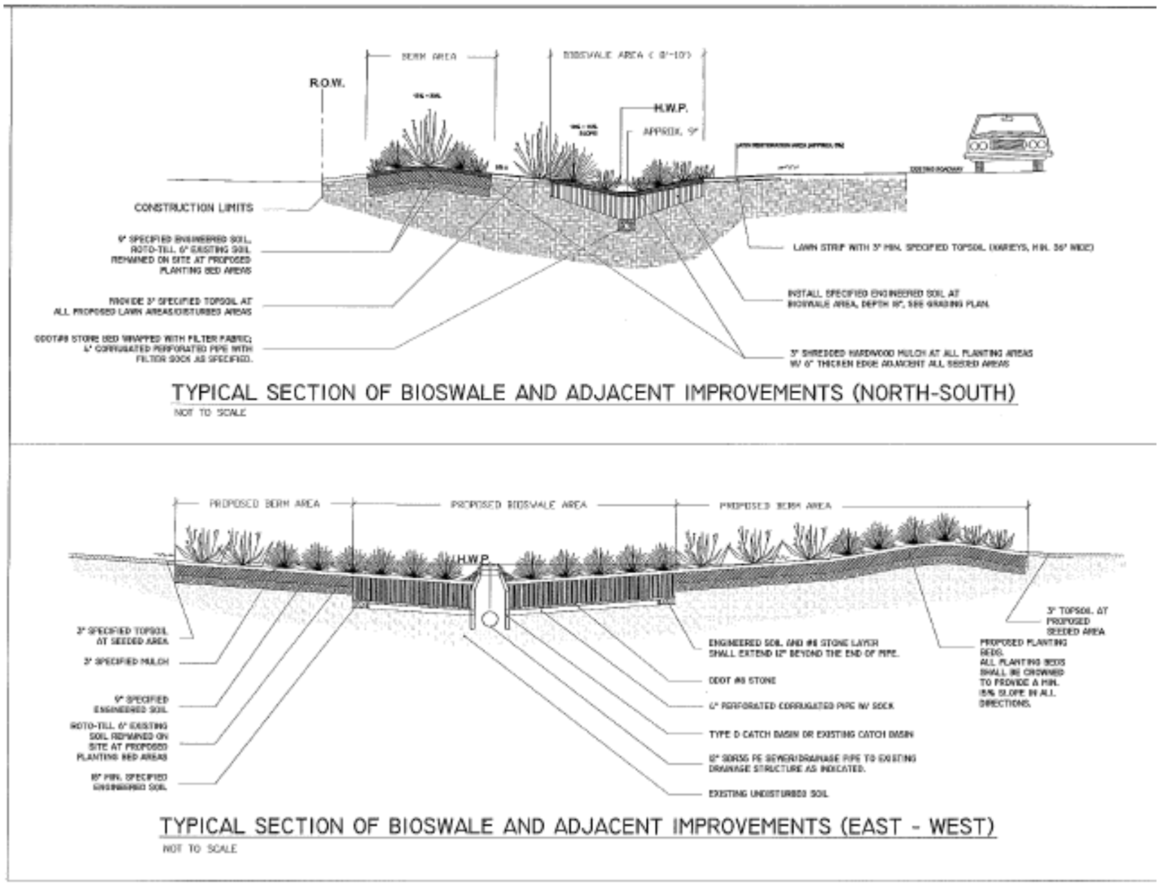


Image: City of Toledo

Cost. Total cost was $67/linear foot for 3,340 feet of bioswale, or $223,640.

Maintenance. The two-year contractor establishment period has just been completed. Maintenance will now be the responsibility of the property owners. The City has done education sessions with property owners. Maintenance will involve weeding and trash removal. They are not yet sure how clogged drains, dead plants, etc will be handled.

Effectiveness. The project is not monitored and effectiveness is not measured at this time. No problems have arisen related to drainage.

5. Main Street Bioretention Planters, Main Street between S. Riverside Drive and S. Fifth Street, Batavia.

Informants: Dennis Nichols, Village Administrator, 513-732-2020; Don Bezold, engineer, Burgess and Niple, 513-579-0042 x 4115, dbezold@burnip.com.

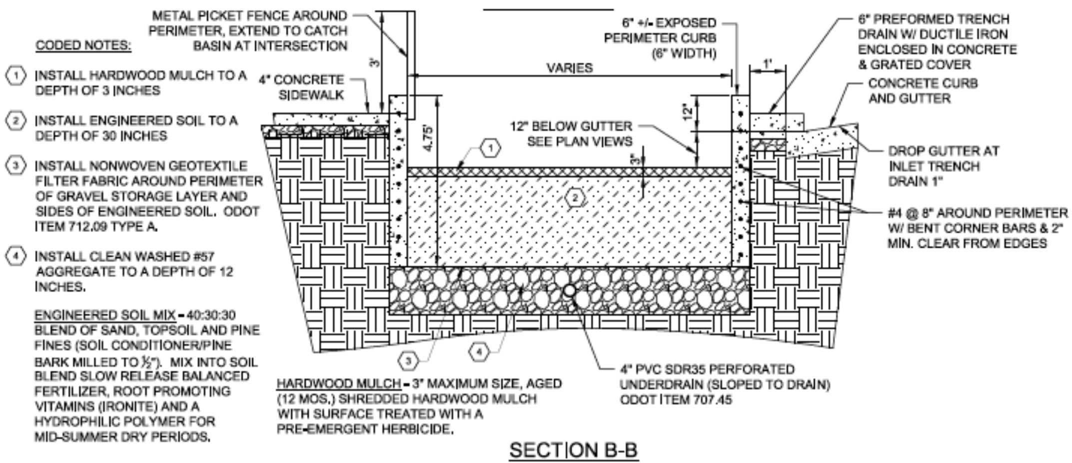
Overview. The "bioswale retention planters" were installed to provide storm water treatment, as a condition of receiving an Ohio Public Works Commission grant of $2 million toward the $5 million reconstruction of Main Street. 40 bioretention planter boxes were installed along East Main Street. The purpose of the system was to retain and treat first flush storm flows from street runoff, and allow it to percolate through bioretention plants and soil mix. Because the project was in the center of Batavia Village, attention was paid to design.

Image: John McManus, Clermont County SWCD

Construction. See detail. The boxes were approximately 4 feet wide by 8 feet long by 4 feet deep. They were provided with 12" gravel bed with underdrain pipe, overlain by geotextile filter fabric or 3" pea gravel and 3" sand, overlain by 30 inches of engineered soil mix of sand, topsoil and pine fines, topped with 3" of mulch. A filter fabric layer was originally provided between the sand and sand/topsoil layers;

this has turned out to be a clog problem, and has been removed in boxes where needed. The soil surface is about 12 inches below grade to provide storm water treatment volume, and planted with Zelkova and Lacy Bark Elm trees, and smaller water tolerant plant materials.

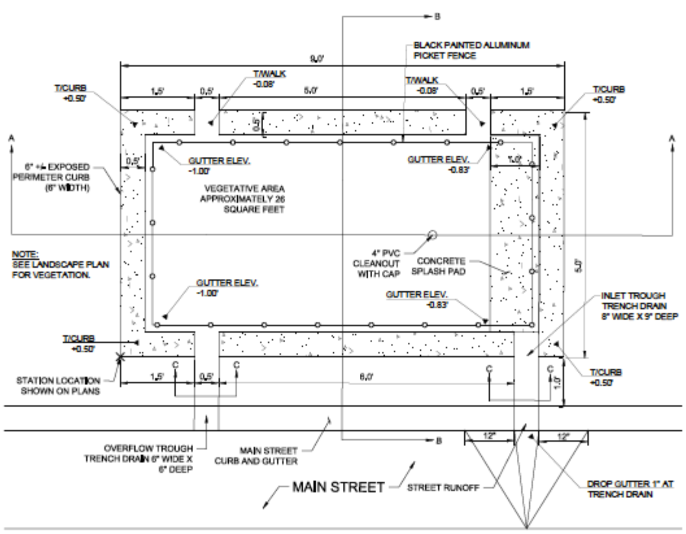
Within each block there is an underdrain of 4" perforated PVC pipe laid within a gravel trench; the underdrain connects all the boxes in one block. Inlets in each bioretention planter are via the gutter; there is an overflow in the curb at the low end of each bioretention planter. The boxes were sized to accommodate the first flush capacity; the boxes could have been shallower if they were made larger to accommodate the same amount of water. Each box is surrounded by decorative fencing.



SECTION B-B

BIORETENTION PLANTER TYPICAL - CROSS SECTIONS

NOT TO SCALE



BIORETENTION PLANTER ALONG MAIN STREET - TYPE A

NOT TO SCALE

Images: Burgess and Niple, Inc.

Effectiveness. While no monitoring is provided, the Engineer feels that the runoff reduction is obvious and the system is meeting its purpose as intended.

6. Overall Maintenance and longevity considerations:

Informant: Dan Christian, Tetra Tech (see contact info above).

There are 3 potential sources of bioswale system failure: silt sealing the surface, sediment buildup and other pollutants.

Silt. The concern is that silt washed into the system will seal the surface from infiltration. The plants are the key to avoiding this. A healthy vegetated system will easily handle small silt/sediment loads by growing up and over it. The natural growth and die off of the roots keeps the soil open for infiltration. This is the big advantage of deep rooted plants over turf grass. As long as there is a healthy vegetation cover, silt sealing the system is much less of a concern. From experience, systems that fail due to silt have been where (1) vegetation wasn't established, (2) excessive soil washed in from a construction site, or (3) systems built in the floodplain where a thick silt layer deposited from a flood smothered the vegetation. The vegetation does tend to grow up and over small silt/sediment depositions so one concern is over time vegetation may obstruct the inlets.

Sediment. Sediment deposition is a real problem in some areas. For this reason, it is best to evaluate the tributary watershed and assess the sediment load potential. A sediment pretreatment system should be installed as appropriate.

Other pollutants. Some people feel that since these systems are filtering out pollutants (heavy metals, excessive nutrients, etc.) that the system will need to be replaced periodically. They conclude that life expectancy is in the 10 to 20 year range, although there is little scientific evidence to date to support this. Human impact is likely a bigger issue. Some bioretention systems have been destroyed by people spraying herbicides to remove the "weedy-looking" native plants. The vegetation is important to keep the system functioning properly. Or people dump in some other significant pollutant like car oil (small quantities are fine; large quantities are not) and again kill the biology.

From experience, a well designed, constructed and maintained system should last indefinitely. Maintenance includes cleaning out the inlets. Most road maintenance programs plan on repair every 20 to 25 years, most of the concrete curbs and sidewalks are good for 50 years, and the underground sewers and water mains are good for 50 to 100-years. At some point, when rebuilding the road corridor and utilities, repairing/rebuilding the bioretention systems should be included as part of routine maintenance.