Downer Place Bioinfiltration Project
Final Report
Narrative
July 2013
Agreement No. IGIG1114
Prepared by:
City of Aurora Engineering Division

Pre Project Conditions

The water quality improvements were constructed on Stolp Island in the heart of Aurora's downtown area. Stolp Island is approximately 16 acres and is covered almost entirely by impervious surfaces. The majority of the stormwater runoff from the Island discharges into the Fox via storm sewer outfalls. A very small amount of the runoff enters the river by overland flow paths. Prior to the completion of the subject improvements, all of the stormwater that ran off of the Island was discharged into the Fox with no treatment.

Post Project Conditions

Location and practice type:

The constructed water quality improvements consist of bioinfiltration basins. The bioinfiltration basins are located on the south side of Downer Place between the east Downer Place bridge and Stolp Avenue. The Bioinfiltration basins consist of shallow depressions that receive stormwater runoff from surrounding impervious roadway pavement, sidewalk, and buildings. The Bioinfiltration basins are covered with a 12" thick layer of engineered soil and planted with vegetation. The stormwater that enters the basins will be treated by the plants, engineered soil, as well as the porous existing soils that underlie the area.

Design:

Most of the stormwater enters the bioinfiltration basins through inverted siphons. The inverted siphons consist of two catch basins connected by a 12" diameter pipe. The upstream catch basin is located within the curb line and the second catch basin is located in the bottom of the bioinfiltration basin. The rim of the catch basin grates within the bioinfiltration basin are approximately 1.5 feet lower than the rim of the catch basin grates within the curb line. When stormwater runoff enters the curb and gutter along the edge of the roadway, the water is directed into the upstream catch basins. Once the water surface elevation within the upper catch basins gets higher than the rim of the lower catch basin grates within the infiltration basin, stormwater bubbles out of the lower catch basins and begins to fill the infiltration basins.

The catch basins are constructed without bottoms and are partially filled with CA-16 gravel in order to provide additional opportunity for stormwater to infiltrate into the ground. The inverted siphon configuration pre-treats the stormwater prior to entering the bioinfiltration basins by screening out larger objects and gives some opportunity for sediment to settle out of the influent. Also, by filling the bioinfiltration basins from the bottom up, there is virtually no erosion caused by the stormwater as it enters the bioinfiltration basins.

The bioinfiltration basins were constructed with overflow structures that will allow stormwater to discharge into an existing storm sewer during rainfall events that exceed the capacity of the basins. The overflow elevations were set just below the elevation of the adjacent roadway gutter in order to avoid water ponding within the street during larger storm events.

The performance of the bioinfiltration basins was modeled using HydroCad software. The basins were designed to infiltrate 100% of the runoff from a 1 year 1 hour storm event. Based on statistical rainfall data published in Bulletin 70/71 by the Illinois State Water Survey, the 1 year, 1 hour storm event for the City of Aurora is 1.19”. The 1.19” 1 hour storm was chosen since roughly 90% of the rain fall events will be equal to or less than the design storm. Consequently, the proposed improvements are designed to infiltrate 100% of the runoff that occurs for about 90% of all of the rainfall events on an annual average.

The basis for the hydraulic design of the Bioinfiltration basins is as follows:

1. Infiltrate 100% of the runoff from the 1 year, 1 hour storm event (1.19” rainfall over 1 hour).

   HydroCAD 10.0 was utilized to model the Bioinfiltration basins. Exfiltration was modeled as the primary outlet device for the basins. The following assumptions were applied to the modeling exercise:

   - 2” per hour exfiltration rate
   - SCS Type III rainfall distribution
   - 30% void ratio for the proposed CA-16 washed gravel backfill
   - 0% void ratio for the engineered top soil and existing native soils
   - Zero storage within the proposed catch basins and underdrain
   - 0% evapotranspiration due to native plantings
   - Cn = 0.98

   Based on the modeling, the raingardens infiltrate 100% of the runoff generated by the 1 year, 1 hour storm event.

2. Limit ponding within the basins to a maximum of 12 hours after a rain event in order to minimize complaints and avoid damaging the vegetation.
   The draw down time (Dt) for the basins was estimated as follows:
   Dt = maximum depth/infiltration rate
   Dt = 18”/2”per hour
   Dt = 9 hours

3. Retain (or infiltrate) the runoff volume from the directly connected impervious area generated by a 0.75” rainfall for a minimum of 72 hours per the requirements of the Kane County Stormwater Ordinance for new development a redevelopment.
   Retainage volume required = tributary impervious area x rainfall depth
   Retainage volume required = 21,800 s.f. X 0.75”/12 = 1,362.5 cubic feet
   Retainage volume provided = 1,686 cubic feet.

Project Tasks

The different tasks required to construct this project can be separated into three categories: the first phase involved overall project planning; the second phase consisted of design and development of contract documents; and the third phase was the construction of the improvements.

Planning:

The planning phase for the project relied heavily on a workshop that was conducted by the City of Aurora’s Downtown Business Association in September of 2010. The removal and replacement of the Downer Place bridges that span the Fox on either side of Stolp Island took place in 2012. The workshop was organized in order to develop recommendations for improvements to Downer Place that could be implemented concurrently with the bridge reconstruction. The outcome of the workshop included recommendations for realigning the existing curb and sidewalk to create an atmosphere that would be more inviting to potential consumers. Furthermore the workshop attendees recommended curb bump outs to reduce the length of the existing cross walks, and discourage excessive vehicle speeds.

Design:

Developing the construction plans and specifications included the following steps:

- Perform Hydrologic calculations to determine the amount of stormwater runoff that is tributary to the project site.

- Estimate an approximate area/volume for the bioinfiltration basins needed to infiltrate the stormwater runoff.
- Develop the geometric lay out for the proposed roadway alignment.
- Determine areas within the proposed improvements that could include infiltration basins.
- Evaluate the potential for creating seepage issues for nearby structures.
- Develop a preliminary plan, and model the stormwater improvements to determine if the proposed improvements will have the capacity to treat the design storm.
- Present the preliminary plans to interested stake holders and make revisions based on comments received where appropriate.
- Proceed with final engineering plans and specifications that include detailed grading information, geometric layout, utility improvements, surface restoration, and landscape designs.

Construction:

The tasks associated with constructing the water quality improvements were very similar to a typical roadway and underground utility reconstruction project. One notable requirement unique to this project was that the contractor could not position excavation equipment within the infiltration basins. The purpose for this requirement was to avoid over compacting the existing and proposed soils. The sequence of tasks was as follows:

- Installation of sediment controls.
- Exploratory excavations to determine exact locations of some critical existing improvements.
- Adjustments to the proposed improvements based on information obtained during the exploratory excavations.
- Removal of pavement, curb and gutter, and sidewalk.
- Installation of underground utilities and porous granular embankment.
- Excavation for bioinfiltration basins.
- Placement of curb and gutter, sidewalk, and pavement.
- Final excavation for bioinfiltration basins and placement of engineered top soil.
- Placement of river rock and limestone retaining walls.
- Installation of plants and hardwood mulch.

Performance:

Based on observations made during rainfall events, the bioinfiltration basins appear to be infiltrating water at a much greater rate than the hydrologic and hydraulic calculations predict. Since the basins were constructed last fall, water ponding within the basins has not been observed. The largest rain fall that has been treated by the basins occurred on April 18, 2013. The storm consisted of approximately 5" of rain over a 24 hour time frame. There were no reports of water ponding within the basins as a result of the April 18th storm. Furthermore the plants and wood mulch were not installed until May and June of 2013.

Cost:

Final Costs for the installed improvements are $151,575. Evaluating the cost effectiveness of the project is hampered by the fact that lack of space and the presence of existing underground infrastructure makes the installation of comparable types of volume control BMP's very impractical to construct.

Maintenance:

Regular inspection and maintenance of the Bioinfiltration basins will be an integral component of the projects long term success. In accordance with the Financial Assistance Agreement, inspection and maintenance shall be performed for a period of at least ten (10) years after the project is completed. A detailed Operation and Maintenance Field Guide has been submitted to the IEPA by April 1, 2013 per the Financial Assistance Agreement.

Based on our past experience with these types of BMP's, the Bioinfiltration basins will need to be maintained at least twice monthly during the growing season, and as needed during the cold weather months. The primary maintenance activities will consist of weed control, trash removal, and sediment removal from the catch basins.