Green Infrastructure & Stormwater Management
CASE STUDY

Applebee's Support Center - Treatment Train

Location: Lenexa, KS
Client: Applebee's
Design Firm(s): BNIM
Landscape architect/Project contact: Jim Schuessler, ASLA
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ASLA Chapter: Prairie Gateway

Project Specifications

Project Description: The Applebee's Restaurant Support Center was designed to house more than 500 associates that provide assistance to approximately 2,000 Applebee's Restaurants worldwide. The Center's design responds directly to the needs of Applebee's Services, Inc. with a focus on associate satisfaction, productivity, food innovation, and development of the land and facility in ways that minimize negative environmental impact. The project received a LEED Silver Certification by the USGBC in 2008.

The two-story building is nestled into the sloped terrain and organized along a curved circulation system – with public entries above on a prairie level and private access below at lake level. Four open-office wings extend out from the circulation spine like "fingers," and are separated by three atria and exterior landscaped courtyards that connect down to the lake and trail system. The courtyards each have a unique design and extend the uses in each atrium. To showcase the company's focus, the Culinary Center is located on center stage directly off of the main entry in the first grand atrium. The building enclosure is energy efficient with increased thermal insulation and reflective roofing materials.

The restorative site design incorporates native landscape with water-efficient and low-maintenance prairie grasses, wildflowers, and storm water BMPs. Stormwater management is an integral part of the site design. All on-site stormwater, as well as a percentage of off-site water, is either absorbed or routed and cleaned within a treatment train of BMPs that include

native vegetated swales, rain gardens, rock sediment forebay, a sand filter, and a wetland prior to reaching the existing neighboring lakes. Each of the courtyards includes a series of rain gardens that treat roof runoff.

Project Type:
Other (please specify)
Part of a new development

Design features: The design of the system includes a series of native plantings in sheet flow drainage areas, bioswales, rain gardens, bioretention areas, sediment forbays, a sand filter, and a wetland. These BMPs in linear configurations maximize pollutant removal for the parking areas and most of the site driveways.

In was anticipated that the quality of runoff after processing through the BMP Treatment Train would be substantially cleaner than the runoff from the adjacent public street (or traditional street/parking lot design). Compare the LEED documents submitted for the LEED Silver Certification application to the actual finding observed and prove the appropriate complete stormwater credits were met.

This project was designed to meet the following specific requirements or mandates:
County ordinance, local ordinance

Impervious area managed:
greater than 5 acres

Amount of existing green space/open space conserved or preserved for managing stormwater on site: greater than 5 acres. LEED Submission: This project received SScr 6.2 Stormwater Design: Quality Control credit using LEED-NC 2.2. The credit requires 80% of the total suspended solids (TSS) to be removed. The following information was provided by the LEED submission.

- Non-structural BMP practices included vegetated swales, rain gardens and native vegetation (17+ acres).
- Structural BMP practices included sediment forebay, sand filter and constructed wetland. The wetland was sized for 15 acres of impervious area.
- The credit was achieved by sending 93% of the site runoff through at least one of the listed non-structural or structual controls.

The regulatory environment and regulator was supportive of the project.

Did the client request that other factors be considered, such as energy savings, usable green space, or property value enhancements? Yes. The client worked with the designer to implement the following sustainable features:

- Restored native site that provides a rich and bio-diverse landscape, including water efficient, low maintenance prairie grasses, wild flowers, and vegetated swales and wetlands.
- A natural storm water management approach with rain gardens and filtering basins that naturally clean and manage surface water; not only from the parking areas and remaining site but also capturing and cleansing the first flush flows from Renner Boulevard.
- The building's exterior wall enclosure is of long life materials including wood plank cladding that is harvested from certified managed forests and recyclable, low maintenance zinc metal.
- Energy use reduction to achieve a score of 68% better than the average energy consumption for similar buildings in the same region. This is also a 19.3% reduction from the increased ASHRAE 90.1 2004 standards which are 30% more stringent than the previous 1999 standards.
- Highly energy efficient building enclosure with external sun shading, advanced thermal resistance and Energy Star, reflective roofing.
- A low configuration of the workplace area increasing the ability for groups to work together, interact, and be more flexible for change.
- Over 50% total water use reduction attributed to low flow fixtures, waterless urinals, kitchens, sinks and showers.
- Maximizing material resources by using materials with high recycled content from local and regional resources, and by diverting over 50% of construction waste from the landfill.
- Increased thermal comfort by using an under floor displacement air supply system with individual controls and enhanced commissioning of building systems to optimize performance.
- Increased outdoor air ventilation rates to provide fresh, filtered air for improved indoor air quality.
- Selection of building materials, finishes, paints, coatings, sealants, adhesives, furniture and fabrics with zero or low levels of off-gassing volatile organic compounds (VOC's) to minimize undesirable pollutants for a healthy indoor environment.
- Designed to provide increased daylight and views that enliven internal spaces, while increasing user satisfaction and improving performance.

Cost & Jobs Analysis

Estimated Cost of Stormwater Project: $50,000-$100,000 (Public funding: None)

Was a green vs. grey cost analysis performed? No

Cost impact of conserving green/open space to the overall costs of the site design/development project: Restoring green space did not effect the overall cost for the project.

Cost impact of conserving green/open space for stormwater management over traditional site design/site development approaches (grey infrastructure)? Slightly increased. Costs of the treatment train where slightly higher than a traditional detention basin, however the City of Lenexa requires Best Management Practices be incorporated into new developments.

Number of jobs created: 500

Job hours devoted to project:

Planning and Design: 33,100
Construction: Not available
Annual Maintenance: Not available

Performance Measures

Stormwater reduction performance analysis:

Water quantity: In general, the flow data collected is not consistent. Therefore, it is difficult to gauge if less water per acre flows off the treatment train or off Renner Road. Sediment Forbays - The quantity of water on the north forebay and lack of elevation of the berm allowed the berm to be compromised during large rain events. Sand Filter - The sand filter experiences surface erosion in larger storm events. Overflow from the sand filter caused erosion on the banks and spillway at that feature Wetland - The wetland may be undersized for the size of the combined on-site and off-site drainage areas leading to it. The combined site drainage areas are 18.2 acres. The wetland is 0.5 acres, making it 2.8% of the drainage area. The erosion problems at the sediment forebay and sand filter highlight the benefits of locating BMPs near the source of runoff rather than at the “end of pipe.”

Water quality: Comparison to Renner - Water quality off Renner Road appears a little better than that coming off the parking/site. This is likely due to the site being under construction during the summer of 2010, which caused upstream erosion and more sediment buildup than normal in the treatment train. Other than the sand filter, the treatment train did not improve water quality. In fact, a number of water quality parameters worsened by the end of the system.

Without a good explanation, there were elevated sulfate and chloride levels discharging from the sand filter. Major causes of water quality issues are likely site erosion, lack of dense vegetation, and the attraction of geese to the wetland. Sediment Forebay/Sand Filter - As expected, the sand filter removes sediment and associated particulate pollutants such as metals and phosphorous. As expected, the sand filter has not shown to affect dissolved constituents. Wetland - The geese and duck populations were problematic for a first-year wetland establishment. Until the vegetation is established, water quality will be polluted by water fowl. The water quality issues highlight the importance of stabilizing the site prior to BMP start-up.

Soil and infiltration: Inspection of site soils indicates heavily disturbed areas due to construction activities. Topsoil was removed, and remaining soils consist of a mix of disturbed and compacted subsoil, rock, and fill material. This contributed to erosion, sediment runoff, and slow establishment of vegetation. Minimal infiltration can be expected within the sediment forebays/sand filter and was not monitored.

Vegetation: The lack of established vegetation along the berm between the west forebay and wetland contributed to erosion and sediment runoff into the wetland. The substantial landscaping project near the main entry to the building in June of 2010 contributed to erosion and sediment runoff into the eastern sediment forebay. The wetland experienced its first growing season in 2010. Substantial growth occurred within the first year, however additional time is required for emergent plants to establish.

Community & economic benefits that have resulted from the project: The property was responsible for cleaning a majority of it's runoff with a series of BMP that provides clean runoff into the adjacent development lake and downstream neighbors.

Project Recognition

2008 AIA Kansas - Merit Award | Excellence in Architecture, 2008 Kansas City Business Journal - Capstone Award | Green Design Category, 2008 Kansas City Business Journal - Capstone Award | Office Category, 2008 America's SmartCorridor - The Kansas K-10 Cities, Development Award |2008 Kansas City Construction Specification Institute, Excellence in Construction Award

Additional Information

Links to images: http://www.bnim.com/work/applebees-restaurant-support-center

Lessons learned:

- The larger, more complex nature of this site required more care and time for BMP establishment.
- The larger the area of the site that is disturbed, the more effort it takes to restore vegetation and control erosion. Site development significantly disturbs site soils. Greater effort needs to be placed on restoring soil structure and organic matter before sites are vegetated, in order to help establish healthy, dense vegetation, limit weeds and erosion, and reduce the need for herbicide applications.
- Erosion at the site, both upstream of the BMPs, and around the BMPs, was a significant problem in performance of the system. Ideally, the BMPs at the site would have been installed and established from upstream to downstream, with the wetland established last after the rest of the site was fully stabilized and vegetated. It could have been used as a temporary sediment pond during that time.
- "End of Pipe" treatment systems can make it difficult to manage larger storm events. The BMPs are generally designed to treat the first flush of stormwater runoff from the site, yet flows from large storms must be safely conveyed through or bypassed around the BMPs. Managing erosion from larger storms appears to be a challenge at the sediment forebay and sand filter.
- The wetland seems to be undersized for the site. Large flows will pass through it with minimal residence times, reducing treatment efficiency. Capacity has been further reduced by sedimentation. Correction of upstream erosion problems and dredging the wetland would help improve its performance.
- Geese can be controlled by landscaping practices. Geese prefer open lines of sight to be able to observe potential predators. Tall, dense vegetation around the edges of ponds and wetlands and narrow widths of open water tends to discourage them. Additional plantings of tall emergent vegetation around the edge of the wetland and additional plantings on the shoreline would help reduce geese at the wetland.

Design recommendations:

Sediment Forebay

- Size berms and conveyance features of sediment forebays appropriately to hold and convey large rain events without deterioration. The southern forebay berm height of 24-

inches taller than the top of the overflow channel was successful. The northern sediment forebay berm height of 12-inches higher than the overflow channel was undersized.

- Evaluate the size of rock at the sediment forebay inlet to reduce erosion potential. Even though the sediment forebay was 3' deep of 6-12 inch diameter rock, larger rock should have been installed at the outlet from the 30" storm sewer pipe.

Sand Filter

- Dissipate runoff and ensure slow runoff velocities into sand filters. Vegetated spillways still allow a substantial velocity of runoff. The entry points to sand filters should be reinforced to dissipate runoff velocities. A different level spreader configuration with a vegetated surface over the sand filter could resist displacement due to flow velocities.

Wetland

- Discourage water fowl from entering an establishing wetland. If land is available, consider a 10' wide vegetated low water buffer (of approximately 12" deep water) to discourage water fowl from occupying an establishing wetland.
- Dissipate runoff flow at entry points to wetland to control erosion at inlet points.