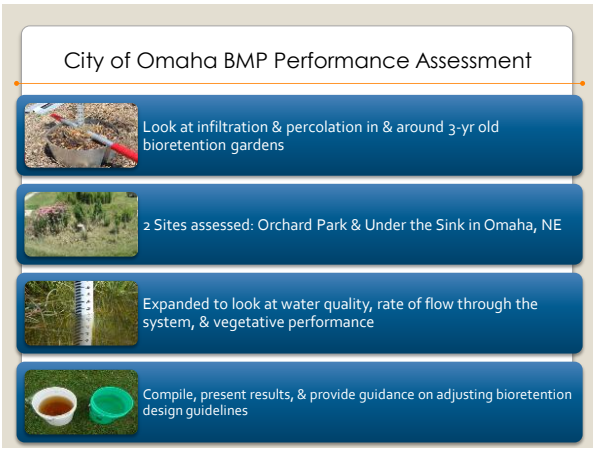
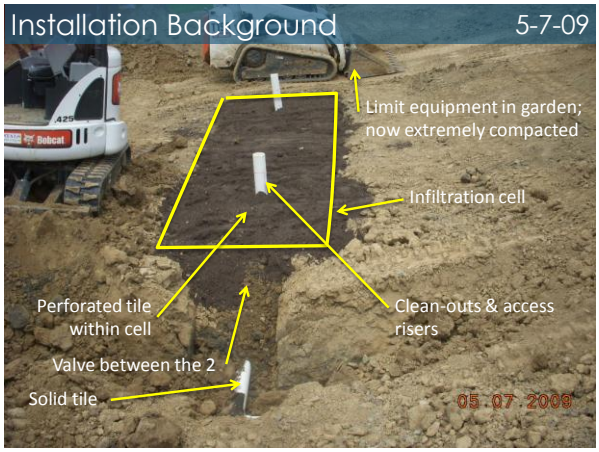

Infiltration Study 2011, City of Omaha
Ted Hartsig, Soil Scientist, Olsson & Associates
Andy Szatko, Graduate TA UNL, City of Omaha

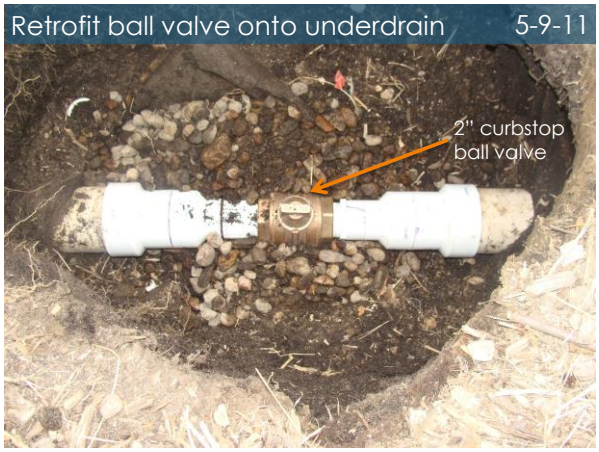

City of Omaha BMP Performance Assessment
Look at infiltration & percolation in & around 3-yr old bioretention gardens
2 Sites assessed: Orchard Park & Under the Sink in Omaha, NE
Expanded to look at water quality, rate of flow through the system, & vegetative performance
Compile, present results, & provide guidance on adjusting bioretention design guidelines


4-10-10
Stream Restoration
Orchard Park: The Site


UNDER THE SINK


Installation Background
Entire excavation to 2'
Underdrain encircles garden
4" Ball valve
Drops into solid line connecting to storm sewer


Installation Background
5-7-09
Limit equipment in garden; now extremely compacted
Infiltration cell
Perforated tile within cell
Clean-outs & access risers
Valve between the 2
Solid tile
05.07.2009

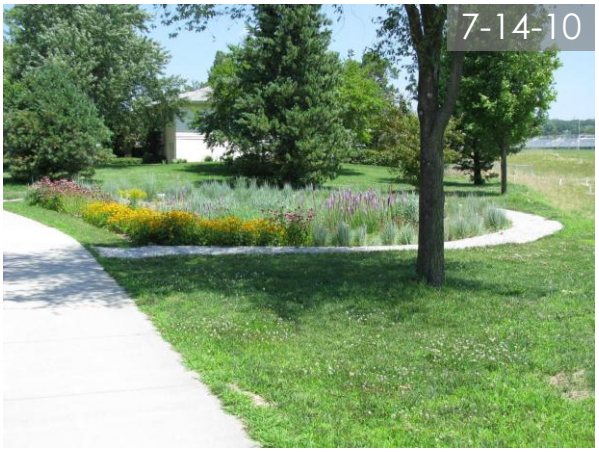

Retrofit ball valve onto underdrain
5-9-11
2" curbstop ball valve

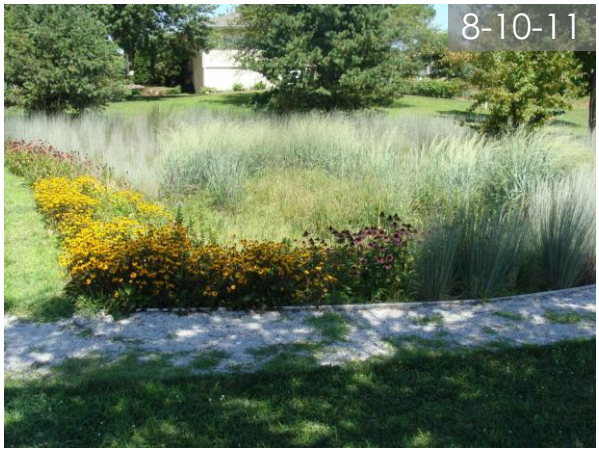

5-7-09
Infiltration cell
05.07.2009

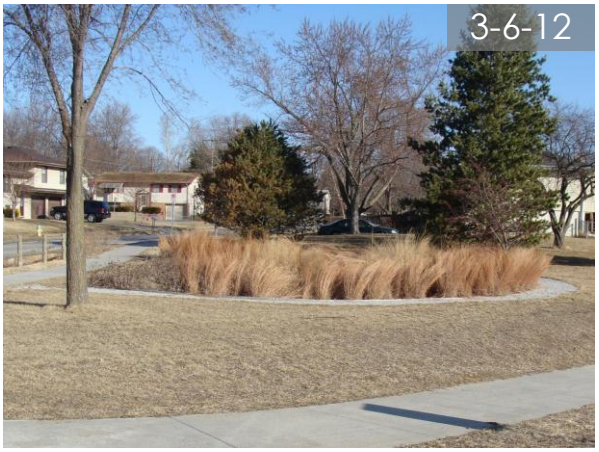

5-7-09
Valves
installed
May of 2011
05 07 2009


5-20-09


5-29-09


7-14-10


8-10-11


3-6-12


Close valves & flood


0 min

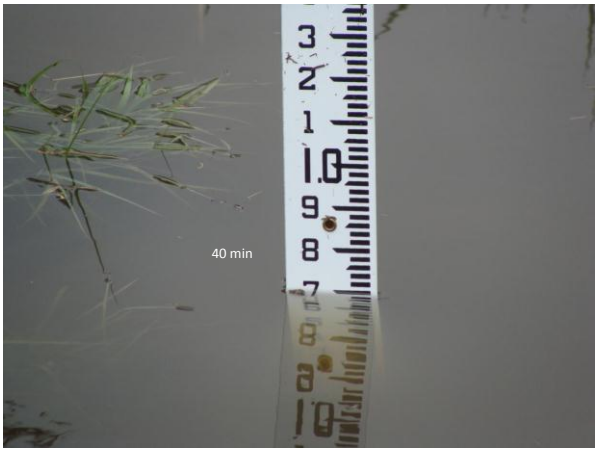

5 min


15 min


20 min


25 min


30 min


40 min


45 min


50 min


55 min


60 min


70 min


74 min

Rooting Performance

Plant Performance

Infiltration Results

Table 4-2: Orchard Park Bioretention Garden Flooding Infiltration Results June and August 2011

	Water Elevation 0 hr (ft)	Water Elevation 24 hr (ft)	Drop (ft)	Drop (inches)	Infiltration Rate (in/hr)
June 30, 2011					
24 hr infiltration (ft):	1.7	1.47	0.23	2.76	0.12
August 17, 2011					
24 hr infiltration (ft):	1.465	1.22	0.245	2.94	0.12

- Simulations @ Orchard Park show very little infiltration into native soils
- 1.3' of ponded water drained out in 74 minutes @ Orchard Park
- Mini-infiltrometer & double-ring readings within amended soil area of gardens is rapid, commonly >40 in/hr
- 1.5"-2" thick silt covered gardens at UtS showed rates ranging from 2.3 – 6.9 in/hr

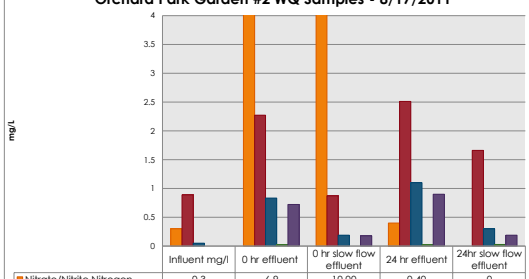
Water Quality Results

- Show releases of N & P concentrations
- Similar to other findings in the U.S. BMP Database
- Only garden #2 sampled
- Limited data points
- Distinct color of effluent between rates of discharge

Table 4-3: Water Quality Analytical Results Orchard Park – June 2011

	Nitrate/Nitrite Nitrogen	Total Kjeldahl Nitrogen	Total Phosphorous	Nitrite	Total Dis. Phosphorous
Influent (mg/l)	0.03	2.39	0.44	0	0
0-hr effluent (mg/l)	0.52	2.54	0.71	0	0.62
24-hr effluent (mg/l)	0.90	2.00	0.76	0.02	0.63
U.S. median influent (mg/l)[a]	0.59	01.80	0.25	NA	0.09
U.S. median effluent (mg/l)[a]	0.60	1.51	0.34	NA	.044

a. Median of 57 infiltration BMPs nationwide. Source: USEPA National BMP Database, May 2011



Summary

1. Fine sand & compost mix is very permeable, typically >40 in/hr
2. Native soils, in most locations, are slowly permeable & prone to compaction
3. Infiltration in native soils is enhanced in very close proximity to plants & their roots
4. During simulations, water quality showed releases of Phosphorus & Nitrogen w/uncontrolled flow through the garden. Reductions in N, TKN, & TP were observed between the 0 hour and 24 hour samples
5. Vegetative performance overall is good in spite of compacted native soils. Root growth also is good: 12" deep in amended soil & 8" in native (lack of spread however)
6. Time of inundation plays significant role in plant performance: highlighted by performance after valve installation. Properly sited plants critical to success
7. The results observed here highlight the importance of the fine details of bioretention to its overall performance & success

Recomendations

1. Limit the extent of sand/compost mix, 3 strategies include:
   1. Install amended mix directly above underdrain system (trench)
   2. Install a valve after perforated tile to regulate rate of flow
   3. Install a reducer after perforated tile to restrict flow
2. Water quality benefits are likely greater with longer residence time, which can be controlled by a valve. Valve also gives greater flexibility to draining garden in times of repair/modifications & adjusting for increased infiltration due to plant growth
3. Coordinate & limit access to prevent compaction of native soils. If compaction occurs, till soils to a depth of 8-12 inches (min.) to break any compaction & amend with compost at a rate approx. 1 cy per 100 sf to a depth of 6 inches (min.)
4. If compaction occurs after construction, dig or auger holes in area to 12 inches (min.) & amend w/compost at a 1:1 rate
5. Maximize plant density: plants & roots are the single most important factor. Consider seeding around potted plants to achieve
6. Monitor regularly to imporve infiltration performance & benefits


Thank you!
Questions?
Ted Hartsig: thartsig@oaconsulting.com
Andy Szatko: aszatko9@huskers.unl.edu