Stormwater Impacts on Groundwater Quality: A Review of Available Information

Presented by:
Aspect Consulting, LLC
J. Scott Kindred, PE
Photos from: www.WestSeattleBlog.com
Phase 1: Initial Estimate of Toxic Chemical Loadings to Puget Sound, Hart Crowser, et. al., 2007, and Phase 2: Improved Estimates of Toxic Chemical Loadings to Puget Sound from Surface Runoff and Roadways, EnviroVision et al., 2008
The Role of Infiltration in Solving these Problems

- **Benefits**
  - Reduce peak flows (CSO’s, erosion, etc.)
  - Reduce toxic loading to surface water
  - Increase groundwater levels and summer stream flows

- We need to be smart about our LID designs and make sure they are designed to achieve our objectives at the lowest cost
Stand-Alone Drilled Drain Completion Detail

- Typically 2-3 ft in diameter
- Backfilled with Pea Gravel
- Type 2 Structure
- Piezometer
- May include surface casing
Infiltration often Feasible Beneath Till

SCHEMATIC CROSS SECTION OF THE SOUTH TACOMA CHANNEL
[View looking northeast; vertical exaggeration X20]

Water Table (est.)
Rain Garden Connected to Deep Drain
SW Infiltration: Potential Impacts on Groundwater Quality

- Widespread historic use of stormwater infiltration:
  - ~9,000 drywells in Portland
  - ~10,000 dry wells in Spokane county
  - ~5,000 dry wells in Yakima county
  - ~40,000 dry wells in Arizona
  - 100’s? of infiltration facilities in western Washington

- Many qualitative/theoretical discussions, sparse real world data

- Known examples of contaminated wells from stormwater infiltration difficult (impossible?) to find
EPA, 1983. Results of the Nationwide Urban Runoff Program

- Looked at GW impacts associated with infiltration basins in Long Island, NY and Fresno, CA
- Studies limited to sites with GW deeper than 20 feet
- Heavy metals, most organics, most pesticides, and coliform bacteria are sorbed to soil and do not reach GW
- Contaminants retained within several meters of surface
A Quest for Credible Real World Data

- Phoenix, AZ 1985 study
- Fresno, CA 1995 study
- Los Angeles, CA 2005 study
- Portland UIC data (Barbara Adkins)
- Spokane data (Rob Lindsay)
Schmidt, K.D., 1985, Results of Dry Well Monitoring Project for a Commercial Site in the Phoenix Urban Area, Maricopa Association of Governments.

- GW sampling upgradient and downgradient of retail development with 2 dry wells completed 30 feet beneath water table
- No treatment other than settling chambers
- Monitoring wells installed within 20 feet of dry wells
- Tested for major inorganic constituents, metals, VOCs and pesticides
- No stormwater pollutants found in groundwater
Arizona DEQ Requires an Aquifer Protection Permit for Certain Facilities (Petroleum and Haz. Substances)

- Safeguards may include:
  - Raised inlet lips
  - Pretreatment sumps, interceptors, settling chambers
  - Oil-water separators; passive skimmers; inlet filters; and absorbents
  - Settling chamber sampling,
  - Operation, maintenance, and inspection requirements
  - Recordkeeping, spill response, closure and decommissioning

- Essentially a SPCC plan…
The aggregate net recharge to alluvial aquifers from drywells is significant.

The overall impact on groundwater is believed to be low.

State now requires 10 ft of GW separation.

Arizona DEQ Requires an Aquifer Protection Permit for Certain Facilities (Petroleum and Haz. Substances).

Modern drywell technology, combined with adequate water-table separation and proper operational practices, may actually improve overall groundwater quality.

- Basin has a catchment of 280 acres
- 53% impervious, 66% industrial land use
- 1.25 acre infiltration basin underlain by fine to coarse sand
- Basin usually flooded due to sediment clogging (no pre-treatment)
- Last dredged 4 years before study
- 25 feet to GW
Fresno Site

Ref: Schroeder, 1995
Fresno Results

- 8-16 cm of accumulated sediment in basin
- Significant sorption of contaminants (metals, pesticides, oil and grease, PAHs, etc.) in upper 5-20 cm of basin sediments
- No elevated stormwater contaminants in GW
Concentrations in Sediment with depth

Ref: Schroeder, 1995
Los Angeles Basin Water Augmentation Study

- Long term research study to explore potential for promoting stormwater infiltration without impacting groundwater quality
- Involved a number of agencies:
  - LA and San Gabriel Rivers Watershed Council
  - LA Regional Water Quality Control Board
  - CA Dept. of Water Resources
  - US Bureau of Reclamation
  - Others…
Facilities Studied

- Broadous School
- Sun Valley recycling transfer facility
- IMAX office building
- Hall house residence
- Scrap metal yard
- Veterans Park

Ref: LA Basin Water Augmentation Study, Phase II Final Report, 2005
Monitoring Sites

School

Recycling Facility

City Park

Metal Recycler

Ref: LA Basin Water Augmentation Study, Phase II Final Report, 2005
General Conditions and Approach

- Depth to GW ranged from 20 to 350 feet
- Relatively low tech treatment: settlement tanks/basins, vegetated swales, oil/water separator, etc.
- Infiltration swales, large scale infiltration fields, drywells
- Samples collected from vadose zone lysimeters and groundwater wells
- Analyzed for general WQ parameters, metals, oil and grease, perchlorate, pesticides, VOCs, SVOCs, surfactants, and bacteria
- 4 years of monitoring
LA Study Results

- Excellent removal of fecal coliform and E. coli
- No evidence of increasing metals concentrations in GW, except elevated copper in one mid-depth lysimeter at recycling facility
- At city park, GW conc. of nitrate, chloride, TDS and salts decreased due to SW infiltration
- General conclusion: no negative impacts on GW
More Information

J. Scott Kindred, PE
Associate Water Resources Engineer
skindred@aspectconsulting.com
206.838.6589

Bainbridge Island – Mount Vernon – Seattle - Wenatchee