

Title: Monitoring Contaminant Transport from a Stormwater Infiltration Facility to Ground Water

Project I.D.: DNR Project #168

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Period of Contract: July 2001 through June 2003

Background/Need: The State of Wisconsin has recently finalized administrative code NR 151 which will, in part, define performance standards for infiltration of stormwater from new developments. The stormwater infiltration standards are intended to preserve ground-water recharge and stream baseflow. However, depending on the landuse characteristics of a drainage area, stormwater may contain significant amounts of contaminants including hydrocarbons, metals, and chloride. In such cases, enforcement of infiltration performance standards has the potential to adversely affect ground-water quality.

Objectives: Monitoring contaminant transport to ground water resulting from infiltration at a site with specific physical characteristics (land use, contaminants, soil type, vadose zone characteristics) has been carried out in only a few settings around the country. This study was undertaken to quantify the relation between the quality of stormwater from the Stonefield neighborhood in Middleton, Wisconsin, and the transport of contaminants to the ground-water system.

Methods: The hydrology of the Stonefield infiltration site was characterized by defining the contributing watershed, coring and describing the sediments from ground surface in the basin to the ground-water table, monitoring pond stage during stormwater runoff events, monitoring water-table elevation, and monitoring flow into the injection well. Water was sampled for chemical analysis from ponded stormwater, from the water table, and from the vadose zone above the water table. Water-quality sampling was done on a routine schedule as well as in response to events. The period of study began July 2001, with data collection for different study aspects beginning at different times. Data continue to be collected beyond the June 2003 end of project, using additional WDNR and USGS funds.

Results and Discussion: Hydrology – Data collected during this investigation suggest that infiltration of ponded stormwater through the basin bottom does occur, but at fairly modest rates (between 0.1 and 1 inch per hour). It is most likely that stormwater recharges ground water by introduction to the unsaturated zone through the injection well in the basin. Data demonstrate that when ponded stormwater overtops the injection well, water flows into the well infiltrating into permeable sediments below a shallow clayey interval and has a measurable effect on the water-table elevation. Conversely, there is no strong signal of infiltration through the basin bottom on water-table elevation data collected to date. Changes made to the infiltration basin and surrounding area by the City of Middleton midway in the study introduced a measurable change on the relation between precipitation and the stage of ponded stormwater. Currently, precipitation in excess of 0.5 inch (daily average) is necessary for ponded stormwater to overtop the injection well. Hydrologic data

continue to be collected, and quantifying the complex inflows to, and outflows from, the infiltration basin is a focus of the ongoing work.

Water chemistry - The chemistry of stormwater at the Stonefield site is consistent with reported stormwater chemistry for Wisconsin and Michigan, and reflects the chemistry of precipitation with addition of metals and polynuclear aromatic hydrocarbon (PAH) constituents from residential land use within the Stonefield watershed. Major ion chemistry of ground water at the Stonefield site is consistent with that of the sand and gravel aquifer of Wisconsin, though generally at the higher end of the concentration ranges. In addition, ground water and vadose-zone water have appreciably higher solids concentrations and generally higher metals concentrations than the stormwater. These data for ground water and vadose-zone water are believed to be representative because they have been confirmed by samples collected from the monitoring well using a low-flow method and through the porous cup of suction lysimeters. PAHs are present in the stormwater at the Stonefield site, but are not found in vadose or ground water. Some interesting trends in water quality are becoming apparent, however, with less than a year of sampling complete, further analysis of current and pending water quality data will be needed to quantify transport of contaminants from stormwater to ground water at the Stonefield Infiltration Site.

**Conclusions/
Implications/
Recommendations:**

The Stonefield basin appears to be working as an infiltration site largely because the injection well routes ponded stormwater to porous, unsaturated sediments below. Infiltration is generally slow through the basin bottom, but could probably be improved with conditioning of the shallow soils, establishment of appropriate vegetation, and strict control of sediment and debris in the watershed. Water-quality analyses to date suggest that the concentration of many constituents is lower in the site stormwater than in vadose or ground water; this is particularly true of the concentration of solids and most metals. While much work is yet to be done in interpreting these data, it appears that for such constituents, infiltration of stormwater from this watershed will benefit rather than degrade ground-water quality. Hydrologic and water-quality data collected during stormwater events may yet reveal some interesting relations between stormwater quality and transport of contaminants at the Stonefield site. Data continue to be collected and interpretation is ongoing.

Related

Publications: A USGS report is expected to be released following the third year of project activities (likely in 2005)

Key Words: Infiltration, stormwater, water quality, ground water, injection well

Funding: Wisconsin Department of Natural Resources and US Geological Survey

Final Report: A final report containing more detailed information on this project is available for loan at the Water Resources Institute Library, University of Wisconsin - Madison, 1975 Willow Drive, Madison, Wisconsin 53706 (608) 262-3069.