Stormwater-A Beneficial Resource or A Source of Contamination: Infiltrate with Caution

Authors:

Mary Musick, PG
Senior Water Policy Advisor
Ground Water Protection Council
mmusick@gwpc.org

Chuck Job, MEn, MAE, LEED BC&D
Regulatory Affairs Manager
National Ground Water Association
cjob@ngwa.org

Stormwater is a valuable resource that, with proper infiltration, can provide new groundwater resources or supplement groundwater quantity. Thus, it can be a significant water source for many managed aquifer recharge facilities.[1] The US Environmental Protection Agency (EPA) is encouraging subsurface infiltration of stormwater (including the disposal of contaminated stormwater) to protect surface water quality.[2] This infiltration can have an additional benefit of recharging groundwater aquifers[3]. We think stormwater Best Management Practices (BMPs) (including ongoing maintenance and monitoring) should be encouraged and designed to conserve and protect both surface water and groundwater resources. However, we recognize that more research is needed regarding groundwater quality impacts of stormwater infiltration, identifying appropriate BMPs for different hydrogeologic settings and climate conditions, and aquifer-protective infiltration designs.[4,5]

EPA's current approach of infiltration of contaminated stormwater to protect surface water is a siloed approach that needs to be broadened to a more holistic water resource approach (which includes impacts on groundwater). The Clean Water Act (CWA) National Pollutant Discharge Elimination System (NPDES) municipal separate storm sewer system (MS4) permit focuses on keeping stormwater pollutants out of surface water without consideration of groundwater quality impacts. The NPDES program emphasis is on managing the quantity of stormwater, rather than the quality effects on the subsurface disposal zone and possible later water discharged to surface water.[6]

Stormwater infiltration could also be considered stormwater "harvesting" (the collection, storage, treatment, distribution, and use of stormwater runoff for beneficial purposes). However, to be truly effective, benefit to groundwater resources should also be achieved. BMPs that do not transfer pollution from surface water to groundwater resources should be used, and steps should be taken to protect the quality of groundwater during stormwater harvesting. In a study on Managed Underground Storage of Recoverable Water (2007), the National Academy of Sciences cautioned that "Urban stormwater....is highly variable in quality; for this reason, caution is needed in determining whether stormwater is of acceptable quality for recharge."[7]

Quality of stormwater is variable from one watershed to another and between different storm events. Different land uses (such as industrial and commercial watersheds, high traffic paved roads, residential and urban watersheds, and agricultural watersheds) will have different potential contaminants that may require different BMPs.[7] Stormwater runoff can contain chemicals, pesticides, sewage overflow, road salt, oil and grease, animal waste, disease-causing bacteria and viruses, used motor oil, fertilizers, paint, construction debris,

industrial waste, PAHs (Polycyclic aromatic hydrocarbons) and PFAS (perfluoroalkyl and polyfluoroalkyl substances).[7,8]

A holistic (rather than siloed) approach would be a "one-water" approach[9] that considers all waters in an aquifer-watershed space and evaluates the appropriate quantity and quality steps to manage the water (surface and ground) in that space, valuing all water sources. Contamination of groundwater by untreated stormwater infiltration could impact the over 1500 MS4 permit holders that are located coincident with groundwater-supplied communities[10] and potentially adjacent groundwater-reliant communities and private well owners. If the contamination exceeds groundwater/drinking water standards, those affected may incur water treatment costs that should have been addressed at the point of infiltration.

Some stormwater infiltration structures fall under the Safe Drinking Water Act (SDWA) Underground Injection Control (UIC) program, which would require the protection of underground sources of drinking water (USDWs) from injection activities that would cause contamination. EPA has set minimum standards to address the threats posed by all injection wells, including stormwater drainage wells. Under the UIC program, stormwater injection is a concern because (as discussed previously) stormwater may contain contaminants.

Climate extremes (flooding, drought, decreased snowpack and early melting, to mention a few) and hydrogeologic vulnerability (which affect the stormwater infiltration rate) must also be considered when evaluating potential impacts to groundwater. In areas receiving more rainfall, stormwater and floods will potentially be more greatly affected by quality issues.[11] Research on the longer-term effects of infiltration of untreated stormwater to surface- and groundwater-sheds over a range of geologic settings is extremely limited.[12], [7] Forty-eight groundwater settings have been identified in the United States.[13] Fifteen percent of the continental United States has karst topography – 40 percent east of the Mississippi River[14] – that is very vulnerable to infiltration of potential stormwater contaminants[15]. Pretreatment, prior to infiltration, in some hydrogeologic settings may be needed be protect the quality of groundwater and ultimately base flow to surface water derived from groundwater.[16]

Research on impacts to groundwater quality from the infiltration of untreated stormwater is limited[7, 17] and inconclusive.[18] For example, EPA has been conducting investigations at two sites over a three-year period; however, no guidance has resulted from the evaluation of management practices nor on the design of representative long-term monitoring on an area-wide basis. The general lack of research in multiple hydrogeologic settings[13] and lack of evaluation on time of travel and degradation of contaminants in groundwater is needed. Results from this type of research (or collating existing research results) is needed and should be used as the basis for design guidance for the hundreds of sites expected to receive CWA/NPDES stormwater permits.

A total "one-water" management approach that promotes the protection of valuable water resources (surface water and groundwater) should be encouraged and based on sound research that looks at stormwater enhancement of both water quality and water resource factors, rather than an approach that focuses on narrow stove-piped permitting efforts. Stormwater and its potential to enhance groundwater resources should be viewed as a resource of broad utility to communities rather than a nuisance and a waste to be quickly disposed.

[1] International Groundwater Resource Assessment Center. 2020. Managed Aquifer Recharge Portal. https://www.un-igrac.org/special-project/mar-portal

[2] U.S. Environmental Protection Agency. 2020. MEMORANDUM, SUBJECT: Implementation of Integrated Planning in Accordance with the 2019 Water Infrastructure Improvement Act (WIIA), FROM: Sally Gutierrez, Acting Director, Water Permits Division, TO: Water Division Directors, Regions 1-10, Dated December 3, 2020. Implementation of Integrated Planning in Accordance with the 2019 Water Infrastructure Improvement Act | National Pollutant Discharge Elimination System (NPDES) | US EPA

[3] U.S. Environmental Protection Agency. Undated. Measurable Goals Guidance for Phase II Small MS4s. https://www.epa.gov/sites/production/files/2015-11/documents/measurablegoals_0.pdf

[4] U.S. Environmental Protection Agency. 2020. The Influence of Stormwater Management Practices and Wastewater Infiltration on Groundwater Quality: Case Studies. EPA/600/R-20/143. https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=350152&Lab=CESER

[5] U.S. Environmental Protection Agency. 2018. The Influence of Green Infrastructure Practices on Groundwater Quality: The State of the Science. EPA/600/R-18/227, https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=NRMRL&dirEntryId=342610; and National Academies of Science. 2019. Improving the EPA Multi-Sector General Permit for Industrial Stormwater Discharges. https://www.nap.edu/catalog/25355/improving-the-epa-multi-sector-general-permit-for-industrial-stormwater-discharges

[6] U. S. Supreme Court. 2020. County of Maui v. Hawaii Wildlife Fund, 140 S. Ct. 1462. https://www.supremecourt.gov/opinions/19pdf/18-260_jifl.pdf : and EPA–HQ–OW–2020–0673, FRL–10018–43–OW, Applying the Supreme Court's County of Maui v. Hawaii Wildlife Fund Decision in the Clean Water Act Section 402 National Pollutant Discharge Elimination System Permit Program, Notice of availability of draft guidance and request for comment. Federal Register :: Applying the Supreme Court's County of Maui v. Hawaii Wildlife Fund Decision in the Clean Water Act Section 402 National Pollutant Discharge Elimination System Permit Program

[7] Ground Water Protection Council, 2017, Section 6: Stormwater and Section 11: Alternative Water Resources in Ground Water Report to the Nation, Ground Water Report to the Nation - Ground Water Protection Council (gwpc.org)

[8] U.S. Environmental Protection Agency. 2020. Featured Story: Stormwater Runoff Prevent Chemicals, Garbage and Other Debris from Winding Up on the Local Beach. Featured Story: Stormwater Runoff, NPDES - Water | Pacific Southwest | US EPA; Deeb, Rula; Jennifer Arblaster; Adam Questad; and Brandon Steets. 2020. PFAS in Surface Water; The state of the practice. Published online in Stormwater. PFAS in Stormwater: The State of the Practice | Stormwater Online (stormh2o.com); and U.S. Environmental Protection Agency. 2020. New Interim Strategy Will Address PFAS Through Certain EPA-Issued Wastewater Permits; Press Release of Nov 30, 2020. https://www.epa.gov/newsreleases/new-interim-strategy-will-address-pfas-through-certain-epa-issued-wastewater-permits

[9] U.S. Water Alliance. 2021. One Water Hub. http://uswateralliance.org/one-water

[10] U.S. Environmental Protection Agency, Stormwater Branch, communication of August 26, 2020. Nationwide inventory of MS4 permittees in 2009. The inventory of permittees does not include any small Phase II communities that were brought into the program as part of the 2010 census; U.S. Environmental Protection Agency. 2020. Government Performance Results Act Drinking Water Tool. GPRA [Drinking Water] Inventory Report.

[11] Job, Charles. 2020. Flooding Impacts to Groundwater. Presented to the National Ground Water Association 2020 Groundwater Summit (online).

[12] U.S. Environmental Protection Agency. 2018. The Influence of Green Infrastructure Practices on Groundwater Quality: The State of the Science. EPA/600/R-18/227, https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=NRMRL&dirEntryId=342610; and Ground Water Protection Council, 2017, Section 11 Alternative Water Resources in Ground Water Report to the Nation, 26 p., Ground Water Report to the Nation - Ground Water Protection Council (gwpc.org)

[13] U.S. Environmental Protection Agency. 1987. DRASTIC: A Standardized System for Evaluating Ground Water Pollution Potential Using Hydrogeologic Settings. Kerr Research Laboratory, Ada, Oklahoma. EPA/600/2-87/035.

[14] U.S. Geological Survey. 2017. Karst Hydrology Initiative & Fractured-Rock Aquifer Studies. https://water.usgs.gov/ogw/gwrp/activities/karst_hydro.html#:~:text=Karst%20topography%20occurs%20over%20nearly%2015%20percent%20of,land%20area%20located%20east%20of%20the%20Mississippi%20River

[15] Herman, J. S., D. J. Vesper, and E. K. Herman. 2016. Groundwater contamination in karst regions affects human health. Eos, 97, https://doi.org/10.1029/2016EO056011.

[16] Minnesota Pollution Control Agency. 2020. Minnesota Stormwater Manual; Overview and methods of pretreatment. https://stormwater.pca.state.mn.us/index.php/Overview_and_methods_of_pretreatment

[17] U.S. Environmental Protection Agency. 2018. The Influence of Green Infrastructure Practices on Groundwater Quality: The State of the Science. EPA/600/R-18/227, https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=NRMRL&dirEntryId=342610; and National Academies of Science. 2019. Improving the EPA Multi-Sector General Permit for Industrial Stormwater Discharges. https://www.nap.edu/catalog/25355/improving-the-epa-multi-sector-general-permit-for-industrial-stormwater-discharges.

[18] U.S. Environmental Protection Agency. 2020. The Influence of Stormwater Management Practices and Wastewater Infiltration on Groundwater Quality: Case Studies. EPA/600/R-20/143. https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=350152&Lab=CESER