

Summary of the Results of the Investigation Regarding Gas Well Site Surface Water Impacts

In 2005, the Environmental Protection Agency awarded a grant to the City of Denton, Texas, to monitor and assess the impact of gas well drilling on stormwater runoff, and to provide, if necessary, regulatory and management strategies for these activities. This unique study focused on three nearby gas well sites where pad construction and drilling were occurring. Runoff, primarily from the sites' well pad areas, was monitored and analyzed, as were the contents of on-site drilling mud pits.

There is presently no regulatory oversight of oil and gas-related construction or operations under the National Pollutant Discharge Elimination System (NPDES) permit program, except in very limited circumstances. While NPDES stormwater regulations cover a large amount of the construction and industrial activity in the US, Congress mandated that oil and gas construction is specifically exempt from stormwater regulations in the Energy Policy Act of 2005 (the act encourages oil and gas operators to voluntarily implement best management practices to minimize erosion and control sediment). To help local governments decide whether drilling activities do, in fact, have impacts on their water resources, and how to minimize those impacts, the Agency awarded this research grant.

Findings

Gas well sites have the potential to produce sediment loads comparable to traditional construction sites.

- Total suspended solids (TSS) and turbidity event mean concentrations (EMC = pollutant mass / runoff volume) at gas sites were significantly greater than at reference sites (the median TSS EMC at gas sites was 136 times greater than reference sites).
- Compared to the median EMCs of storms sampled by Denton near one of their outfalls, the gas well site median EMC was 36 times greater.
- Gas site TSS EMCs ranged from 394 to 9898 mg/l and annual sediment loadings ranged from 21.4 to 40.0 tonnes/hectare/year (tonne = 1000 Kg; hectare = 10,000 square meters), and were comparable to previous studies of construction site sedimentation.

Other pollutants in gas well runoff were found in high concentrations.

- EMCs of total dissolved solids, conductivity, calcium, chlorides, hardness, alkalinity and pH were higher at gas well sites compared to reference sites, and differences were statistically significant for all parameters except conductivity.
- Generally, the presence of metals was higher at gas well sites compared to reference sites and EMCs were statistically significantly greater for Fe, Mn and Ni.
- Overall, the concentrations of metals tend to be higher at gas well sites compared to both nearby reference sites and as measured in runoff from local mixed-use watersheds (EMCs were statistically significantly greater for Fe, Mn and Ni).
- Total petroleum hydrocarbons (TPH) were not detected in any of the samples collected at gas well sites or reference sites.

Conclusions based on runoff sampling results.

- Gas well sites have the potential to negatively impact surface waters due to increased sedimentation rates and an increase in the presence of metals in stormwater runoff.
- Pad sites also have the potential to produce other contaminants associated with equipment and general site operations.
- Gas wells do not appear to result in high concentrations of petroleum hydrocarbons in runoff, but accidental spills and leaks are still a potential source of impact.

Runoff monitoring from gas well sites can be difficult.

- Requires complex equipment to do the volume-based sampling needed.
- Municipal inspections by trained individuals are important.
- In most cases, sediment impacts are visually apparent.

States or local governments should consider regulating sediment and associated pollutants in stormwater runoff.

- Recommended approach: develop regulations similar to current NDPES requirements for construction sites.
- Requirement options: stormwater pollution prevention plans, erosion and sediment control BMPs, provisions for containing spills and leaks, procedures for site inspections and enforcement of control measures, sanctions to ensure compliance.
- Require installation of berms around the down slope portion of gas well pad sites (regular compost can be used but newer, better technologies such as compost “socks” offer more stability, durability and ease of installation).

Models and other predictive tools can help with gas site management decisions.

- The Water Erosion Prediction Project (WEPP) and the Revised Universal Soil Loss Equation (RUSLE 2.0) can be used to model runoff and sediment yields from gas well sites, and to evaluate sediment impacts and control options
- Modeling indicated that using both erosion and sediment controls at sites tended to give the best combination of protection and cost, but the optimum combination is dependent on soil type and slope.
- Modeling showed that using BMPs reduced sediment from 52% to 93%.
- Generally, mulching and erosion control blankets produced the best results; however, in most cases, silt fences or filter strips were shown to be less expensive and still effective.
- The approach used can be applied to complex or simple slopes, can evaluate a wide variety of BMPs, and can be easily customized for specific site characteristics or geographical regions.

Regulating gas well drilling and production operations is needed, but can be complex.

- In addition to erosion and sediment control requirements, institute regulations for site locations and tree preservation.
- Requirements are needed for proper site management, equipment maintenance, and hazardous materials management and containment.
- Subchapter 22 of the Denton Development Code (www.cityofdenton.com) has information municipalities can use to establish gas well regulations.
- Regular monitoring of receiving waters using specific conductance (conductivity) can, under the right circumstances, offer a relatively inexpensive and rapid method for detecting contaminant discharges and tracing these discharges back to the well site source.

Regulating site activities (i.e., site management).

- Place drip pans or oil absorbing materials underneath all tanks, containers and other equipment with a potential to leak.
- Store chemical materials on pallets or other devices to raise containers off the ground, and shelter the materials from stormwater and wind.
- Depending on the type and quantity of materials, use secondary containment and other similar strategies.
- Institute a hazardous materials management plan, including adequate labeling and containment, and having material safety data sheets on hand.
- Remediate as quickly and safely as possible any accidental spills, leaks or discharges of materials.

Regulating well drilling locations.

- Typically, consists of site “setback” requirements from residential structures and places of assemblage (e.g., schools, churches).
- The proximity to surface water conveyances is an important consideration for minimizing water impacts, i.e., flat, heavily vegetated areas distant from surface waters are usually less of a concern than those areas close to waters that have highly erodible soils, steeper slopes and little vegetation.
- In floodplains or other environmentally sensitive areas, Denton requires a Watershed Protection Permit (WPP), which contains extra environmental regulations plus a fee to cover site assessments, additional regulatory oversight, and water quality testing.
- Denton’s WPP requirements highlights:
 - Must take a tree survey of the site and effect a 1:1 replacement for trees removed from the site.
 - Storage tanks and separation facilities allowed only if they are at least 18 in above the established base flood elevation, plus an extra depth for encroachment to the limits of the floodway

- Must show via an engineering study that the proposed activity will have no adverse impact on the carrying capacity of the adjacent waterway, and will not cause any increase in the elevations established for the floodplain.

Regulating tree preservation (Denton's program).

- All construction activities associated with gas wells, roads, pipelines, etc., must be considered.
- In non-WDD areas, must mitigate at a rate of 25% for all trees removed from the property in the form of payments to Denton's tree fund (not on-site planting).
- Removal of trees in WDD areas may cause a loss of critical habitat and harm waters, thus the 1:1 replanting requirement (or a very high payment into tree fund).

Well drilling mud pits merit attention and management.

- Mud pits exceeded the regulatory standard for total petroleum hydrocarbons (TPH) of 15 mg/L in approximately 46% of samples (there were also a few instances of very high concentrations, with a max of 25,590 mg/l).
- Based on the diesel and hydraulic equipment used at gas well sites, and the type of hydrocarbons found, contamination was likely due at least in part to such things as maintenance activities, fuel / hydraulic fluid leaks and spills, or similar sources.
- To a lesser extent, this also applies to fracture water pits.
- Municipalities may want to consider sampling and setting standards for pits, but mud pit contents are complex and appeared not amenable to analyses via rapid field-based methods or rapid laboratory methods.
- Although a regular monitoring program coupled with associated regulatory standards may be the best way to minimize the pollution potential for these pits, municipalities may not have the staff, resources or expertise to implement such a program.

Regulating mud pits.

- Enforceable standards for pit contents are not generally viable; instead, consider pit design standards that minimize the chances of releases.
- Restrict pits to areas with relatively flat slopes and design them to not capture much stormwater so the pits do not overflow.
- Use pit liners.
- Use freshwater-based muds only.
- Maintain a minimum freeboard distance between the elevation of the pit contents and the elevation of the top of the mud pit dam.
- Remove mud pits as soon as possible after drilling.
- Eliminate open mud pits altogether (e.g., use closed loop drilling).

Placement of drip pans or oil absorbing materials underneath all tanks, containers and other equipment with a potential to leak.

Safely store chemical materials on pallets or other devices to raise containers off the ground and, and sheltering them from stormwater and weather elements.

Depending on the type and quantity of materials, secondary containment and other similar strategies may be appropriate.

Institute a hazardous materials management plan including adequate labeling and containment, and have material safety data sheets available.

Remediate as quickly and safely as possible any accidental spills, leaks or discharges of materials.