UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, WA 98101

NOV 5 2004

Reply To
Attn Of: OCE-082

MEMORANDUM

SUBJECT: Final Work Product from the National UIC Technical Workgroup: Does a Fixed Radius Area of Review meet the statutory mandate and regulatory requirements of being protective of USDWs under 40 CFR §144.12?

FROM: Thor Cutler, Workgroup Chair
Kurt Hildebrandt, Workgroup Co-Chair

Thru: Ms. Joan Harrigan-Farrelly, Chief
Drinking Water Prevention Branch (4606M)

TO: Mr. Steven F. Heare, Director
Drinking Water Protection Division (4606M)

The national UIC technical workgroup (NTW) is pleased to submit the attached work product entitled:

Does a Fixed Radius Area of Review meet the statutory mandate and regulatory requirements of being protective of USDWs under 40 CFR §144.12?

This work product completes an assignment made to the NTW on April 15, 2002, from the Director of the Drinking Water Protection Division and examines concerns that have been raised surrounding the use of a ¼ mile fixed radius Area of Review (AOR) rather than a calculated Zone of Endangering Influence (ZEI) to determine the area where corrective action must occur to prevent contamination of underground sources of drinking water by an injection well.

This work product is the second NTW product that has been developed with participation of state representatives who had been added to the NTW just prior to this assignment. Additionally, while the NTW as a whole reviewed and contributed to the documents development, a considerable amount to time was put in by both the regional and state leads to present a product that meets the goals and objectives of the NTW and the charge of program management.

If you have any questions about this work product, please feel free to contact: Mike Frazier in Region 6 at (214) 665-7236; Steve Platt in Region 3 at (215) 814-5464; or Paul Osborne in Region 8 at (303) 312-6125. You may also contact NTW chairs: Thor Cutler in Region 10 at (206) 553-1673 or Kurt Hildebrandt in Region 7 at (913) 551-7413 if should you have any questions about the NTW.

Attachment

cc: Bruce Kobelski (4606M)
Robert E. Smith (4104M)

UIC NATIONAL TECHNICAL WORKGROUP
PRODUCT COVER SHEET

ISSUE # 8

1. Title:

"Does a Fixed Radius Area of Review meet the statutory mandate and regulatory requirements of being protective of USDWs under 40 CFR §144.12?

2. Date of Finalization:

October 1, 2004

3. Background/Brief Reason for its Need:

Summarize available information about the use of a ¼ mile fixed radius Area of Review (AOR) rather than a calculated Zone of Endangering Influence (ZEI) to determine the area where corrective action must occur to prevent contamination of underground sources of drinking water by an injection well, and provide specific suggestions to EPA HQ concerning the need for national consistency on the issue.

4. Author(s):

Mike Frazier, USEPA Region 6
Steve Platt in Region 3
Paul Osborne in Region 8

5. Background Information Location (where the supporting documents are):

Supporting documentation rests in EPA Region 6. Contact Mike Frazier at (214) 665-7236

Does a Fixed Radius Area of Review meet the statutory mandate (Section 1421 of the SDWA) and regulatory requirements of being protective of USDWs under 40 CFR §144.12?

BACKGROUND: During development of the federal UIC regulations regarding Area of Review (AOR), the Agency chose to give the program director the discretion to use a fixed ¼ mile radius or a calculated Zone of Endangering Influence (ZEI) when determining the need for any corrective action in the permitting process to assure protection of underground sources of drinking water (USDWs). The final AOR regulation at 40 CFR §146.6 was adopted even though much existing evidence showed that the actual pressure influence of any authorized underground injection operation is not limited to any pre-determined fixed radius around any proposed or existing injection well, but is a function of specific physical parameters (including initial pore pressures in both the injection zone and in the lowermost USDW and actual injection rate). It is important to note, that when UIC primacy was awarded to States under the Section 1425 amendments, some State programs specifically selected to use only the fixed radius AOR methodology. Therefore, some EPA and State UIC programs allow only for a fixed radius AOR without any ZEI evaluation even though the Safe Drinking Water Act (SDWA) and corresponding preambles to the federal UIC regulations are clear on the protection standard and the operator's non-endangerment demonstration to the UIC program director. However, the federal UIC program regulations appear to require corrective action within the zone of endangering influence of an injection well, whether permitted or authorized by rule, to prevent contamination through any artificial penetration within the pressure influence of the injection operation (40 CFR §144.12 and §144.55). Since injection rate (volume over time) is directly proportional in its effect on formation pressures in the injection zone, the duration of injection also affects any calculated ZEI.

By rule, Class I permits are limited to 10 year terms while most Class II injection wells enjoy authorization for the life of the project or well, except for Class II wells authorized by rule [see 40 CFR §144.21(c)(9)]. In addition, 40 CFR §144.36 requires EPA administered programs to review Class II and III permits "at least once every 5 years to determine whether it should be modified, revoked and reissued, terminated, or a minor revision made as provided in §§ 144.39, 144.40, and 144.41." This federal requirement assures that Class II wells with lifetime authorization are periodically evaluated to assure protection of USDWs. To address the potential of pressure buildup from authorized long-term injection, such evaluation should consider any formation pressure changes related to historical injection practices.

The SDWA requires any State UIC programs authorized under SDWA §1422 to adopt and implement regulations at least as stringent as the federal UIC regulations in 40 CFR §§ 124, 144, and 146. The SDWA and corresponding federal regulations prohibit authorization of injection activities that endanger USDWs and specifically burdens the well operator with demonstrating non-endangerment. Any EPA-approved State UIC permitting process includes a technical AOR evaluation to determine if a proposed injection activity may endanger USDWs by upward fluid migration through artificial penetrations (or other pathways) within the pressure influence of an injection activity. If

the AOR analysis determines the injection zone is over-pressured (either naturally or as a result of injection) so that fluids may migrate upward through any pathway (artificial or natural), the Director must require corrective action to protect USDWs. In contrast to programs authorized under §1422, State Class II programs authorized under SDWA §1425 must be effective in protecting USDWs by providing "an equivalent degree of protection for drinking water resources" as provided in EPA administered programs [see 1980 House Report No. 96-1348]. Some EPA-approved UIC programs apparently authorize Class II injection without adequately reviewing the pressure influence of authorized long-term injection. Some State UIC programs do not specifically require operators to submit injection formation information, i.e., initial formation pressures, porosity, and permeability of injection zone. In some cases, the information on the construction of wells within the fixed area of review may be insufficient to evaluate the potential for fluid movement. Without such information, authorization of injection into apparent over-pressured zones has the potential to result in upward fluid migration through inadequately plugged artificial penetrations.

CONCERN: Since initial State UIC primacy in the early 1980s, EPA has approved a broad range of AOR processes for State programs approved under SDWA §1425, ranging from the minimum ¼ mile radius adopted in the federal UIC regulations to requiring corrective action within a calculated ZEI. In many cases, a review of artificial penetrations within a fixed ¼–mile AOR may be inadequate, especially in areas where static pressures in the injection zone are great enough to impact pre-existing improperly plugged wells, i.e., those not plugged or plugged only with drilling mud (no cement), well beyond any implied fixed radius. Numerous flowing wells outside of the 1/4 mile area of review were noted by Jerry Thornhill's 1975 study (See *December 18, 1975, Memorandum, SUBJECT: Proposed Injection Well Regulations for Brine Produced with Oil or Gas. FROM: Jerry T. Thornhill, Regional Representative Office of Program Integration. TO: Ed Hockman, Chairman, Working Group for Development of Underground Injection Regulations, EPA, Washington, DC*). Additionally, a recent example was located on the Texas / Louisiana border. A commercial disposal well located in Texas within about 300 yards of the border caused two orphan wells located across the State boundary to begin to flow and affected a public water supply (surface water intakes). The orphan wells were more than a mile away.

SUGGESTED ACTION: In order to assist both EPA and State UIC programs meeting the SDWA non-endangerment protection standard, EPA Headquarters should develop and adopt additional AOR technical guidance that clarifies the applicability of the protection standard of §144.12 to AOR procedures and requirements of both EPA and State UIC Programs approved under SDWA §1422 or §1425.

Subsequently, every UIC program (whether implemented by EPA or State Primacy program) should develop a long-term plan to re-evaluate the area of review of all authorized injection activities to assure compliance with the SDWA protection standard. For Class II enhanced recovery operations, a thorough evaluation of historical and existing formation pressures may be adequate to assure the UIC Primacy program director that such authorized activities adequately protect USDWs from upward migration. However, plans for pressure evaluations proposed by each State or EPA UIC program director must

also be realistic based upon potential threats to USDWs. Program directors should consider all aspects of each injection operation in determining necessary corrective action. As part of this review, there should be an effort to collect reservoir data in varying environments in several States to evaluate the potential ZEI results in those areas. The calculations should be performed assuming worst case and best case conditions, similar to those carried out by the State of Texas in 1979 (See *Investigation of artificial penetrations in the vicinity of subsurface disposal wells, by Orville Johnston, P.E. and Charles J. Greene, Geologist Texas Department of Water Resources, May, 1979.*) This data collection could be done by the individual States with EPA contractor support.

Pressure influence calculations may be more appropriate for disposal operations and less appropriate for enhanced oil recovery (EOR) operations where pressures can be reduced proportionately by production activity. A director could accept a demonstration that EOR areas need no corrective action because formation pressures of injection zones will not result in upward fluid migration within the project area of EOR activity. Each plan should also include adequate evaluation of required annual monitoring reports and determination of maximum authorized surface injection pressures (MASIP) in conjunction with an adequate AOR determination. Whether authorized by permit or rule, no injection activity is "exempt" from meeting the non-endangerment protection standard. If improperly closed artificial penetrations exist within the pressure influence of an authorized injection activity, the State program must require appropriate corrective action to properly close potential pathways through artificial penetrations or reduce the pressure influence by reducing authorized injection parameters (even for wells authorized by rule). The majority of EPA UIC National Technical Workgroup members understands the magnitude of this suggested action and consider this proposal as a long-term solution to a long-standing inadequate permitting practice.

RATIONALE: The broad area of review concept incorporates potential corrective action within the calculated area impacted by the pressure influence of any injection activity. Historically, a fixed radius AOR is based on operational assumptions made in the early 1980s and does not technically consider the pressure buildup of long-term authorized injection activities. Without evaluating the potential buildup of authorized injection pressure on improperly plugged wells, any UIC permitting process could effectively authorize injection activities that endanger USDWs. Thus, in order to provide adequate protection to USDWs, any UIC authorization process must include the identification and review of any artificial penetration that may provide a pathway for fluids to move upward from the injection zone into a USDW. In UIC regulatory preamble language at 44 FR 23740, April 20, 1979, the Agency states,

> **"The test in these reproposed regulations is whether injection operations will cause the migration of injected or formation fluids into an underground source of drinking water. If the injection well can cause such migration, the owner/operator must take appropriate action to eliminate the fluid migration. . . Under this scheme, case by case decisions regarding well injection will rely more on physical data than**

on subjective judgment. Shifting the basis of decision-making in this way should make the regulatory scheme more easily understood and should remove a considerable degree of uncertainty."

Subsequently at 45 FR 42472, 42490, June 18, 1980, the Agency states,

> **"Radii less than ¼ mile were not considered because actual computations by EPA of <u>the zone of endangering influence indicate that, in most cases, the appropriate distance is less than ¼ mile</u>. Setting the radius at ¼ mile thereby ensures that all wells within the zone of endangering influence will be examined." [Emphasis added.]**

Following the UIC mid-course evaluation, a July 5, 1989, GAO report entitled: *DRINKING WATER–Safeguards Are Not Preventing Contamination From Oil and Gas Wastes* (GAO/RCED-89-97) concludes the fixed ¼ mile AOR inadequate and made specific recommendations that remain unaddressed. A majority of UIC National Technical Workgroup members believe that enough evidence exists to challenge the assumption that a fixed radius AOR is sufficient to assure adequate protection of USDWs from upward fluid migration through artificial penetrations within the pressure influence of authorized injection operations.

PITFALLS: Since previously proposed regulatory fixes in the early 1990s failed to bring operators of over-pressured, authorized-by-rule injection wells into compliance with the SDWA protection standard, State UIC programs and the oil and gas industry may view any newly proposed AOR guidance or regulation as unwarranted and costly. Many major State UIC Class II programs also view over-pressurization as a non-issue because they report no flows to surface outside of a ¼-mile radius. The UIC statute (Part C, SDWA) protects USDWs from the threat of contamination by underground injection activities, not contamination threats to surface waters. State UIC programs also argue that Congress did not intend EPA requirements to "interfere with or impede" oil and gas production operations and provided protection in SDWA language to that effect. However, the SDWA also contains the specific caveat: "unless such requirements are essential to assure that underground sources of drinking water will not be endangered by such injection." State UIC Class II programs may also argue the lack of resources necessary to re-evaluate AORs for authorized injection operations, even though states must demonstrate the financial and human resources needed to effectively implement approved State UIC primacy programs. Based on threat evidence that existed at the time of initial UIC regulatory development and subsequent EPA UIC oversight evaluations of State UIC programs, the Agency could be petitioned to withdraw UIC primacy from some State UIC programs through SDWA or APA provisions unless EPA develops and implements clear guidance and regulatory interpretation of this issue.