EXHIBIT 5

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
1595 Wynkoop Street
DENVER, CO 80202-1129
Phone 800-227-8917
http://www.epa.gov/region08

STATEMENT OF BASIS
FOR
UNDERGROUND INJECTION CONTROL
CLASS V PERMIT
PERMT NUMBER: CO51237-08412

Powertech (USA) Incorporated
5575 DTC Parkway, Suite 140
Greenwood Village, Colorado 80111

CONTACT: Valois Shea
U. S. Environmental Protection Agency
Region 8, 8P-W-GW
1595 Wynkoop Street
Denver, Colorado 80202-1129

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I. INTRODUCTION

On April 30, 2009, the Environmental Protection Agency (EPA) Region 8 received an application for a Class V Underground Injection Control (UIC) permit submitted by Powertech (USA) Incorporated (Powertech). Powertech proposes to reinject groundwater pumped from the upper portion of the Fox Hills Formation during an aquifer pump test back into the same aquifer; using the pumping well that pumped the groundwater to the surface. EPA is issuing a Final Permit to authorize the injection of groundwater back into the aquifer from which it was pumped. The pump test and injection site is located in NE quarter of Section 33 in Township 10 North and Range 67 West, as shown in Figure 1. This location is 17 miles northeast of Fort Collins, 29 miles northwest of Greeley, 8 miles northwest of Nunn, and 8 miles northeast of Wellington.

Powertech will be conducting the aquifer pumping test to meet the following objectives:

- Site specific and regional characterization of geology and groundwater.
- Assessment of hydrological characteristics and their lateral continuity within the A2 sandstone, the formation within the Fox Hills Formation containing uranium mineralization.
- Evaluation of hydrologic communication within the A2 sandstone between the pumping well and surrounding observation wells.
- Assessment of the presence of hydrologic boundaries, if any, within the A2 sandstone.
- Evaluation of integrity of the confinement zones above and below the A2 sandstone to determine the degree of hydrologic communication, if any, between the A2 sandstone and the overlying and underlying aquifers in the test area.

II. PUBLIC REVIEW PROCESS

On June 15, 2009, the EPA issued a Class V UIC Draft Permit and published notice of this Draft Permit in the Greeley Tribune. The public notice also announced a public comment period and a public hearing for the Draft Permit. The EPA held the public hearing on July 20, 2009, in Greeley, Colorado. The public comment period for the Draft Permit began on June 19 and ended on July 24, 2009. The EPA received comments from the public on the draft permit during the public comment period and the public hearing. One of the comments received identified that multiple permit numbers were incorrectly used in the Draft Permit, and indicated that the use of multiple numbers was potentially confusing to the public. In response to this comment, the EPA issued a second Class V UIC Draft Permit with the corrected permit number. Public notice of the second Draft Permit was published in the Greeley Tribune on Friday, November 20. The public notice also announced a second public comment period and public hearing for the second Draft Permit. The EPA held the second public hearing on Monday, December 21, 2009 at the Nunn Community Center in Nunn, Colorado. The public comment period for the second Draft Permit began on November 20 and ended on December 24, 2009.

EPA received public comments during both public comment periods and both public hearings. There were nine (9) main topics of comments related directly to this permitting action. EPA's responses to those comments are included in the document entitled "Responsiveness

Summary for the Underground Injection Control Class V Final Permit Decision for Powertech (USA) Inc. Centennial Site."

III. DESCRIPTION OF HYDROGEOLOGY

The proposed injection well is completed in the A2 sandstone of the Upper Fox Hills Formation and will penetrate the overlying Laramie Formation shown in Figure 2. The Upper Fox Hills includes the "A" Sands and the "WE" Sand aquifers. The "A" Sands are divided into as many as four (4) individual sandstone units throughout the Centennial Site. In some areas the four individual units are separated from each other; in some areas two or more of the sandstone units join, as demonstrated by the A ¾ sandstone unit shown in Figure 2. The injection well will be screened in only the A2 sandstone unit of the "A" Sands, and will, therefore, be pumping water from, and injecting water into, the A2 sandstone unit. Groundwater in the Upper Fox Hills Formation aquifers is separated from groundwater in the overlying Laramie Formation by a confinement zone, which is composed of impermeable shale, mudstone, and lignite. The impermeable confinement zone prevents mixing between groundwater in the Upper Fox Hills Formation aquifers and the groundwater in the overlying Laramie Formation. One of the purposes of the aquifer pump test is to verify that the confinement zone between the Fox Hills Formation aquifers and the overlying Laramie Formation aquifers, Upper Fox Hills "WE" Sand and the underlying "B" Sand, and possibly the unlabelled mudstone between the "A" Sands and the "WE" Sands within the Upper Fox Hills, are confining units impermeable to groundwater movement across them.

The injection well site is located within the Cheyenne Basin, located north of Denver-Julesburg Basin as shown in Figure 3. The Cheyenne Basin is separated from the Denver-Julesburg Basin by the Greeley Arch. The injection well location is on the western flank of the Cheyenne Basin where regional dip of the geologic strata is toward the east. However, locally, within Section 33, the site of the aquifer-pump test, the dip of the A2 sandstone is toward the south.

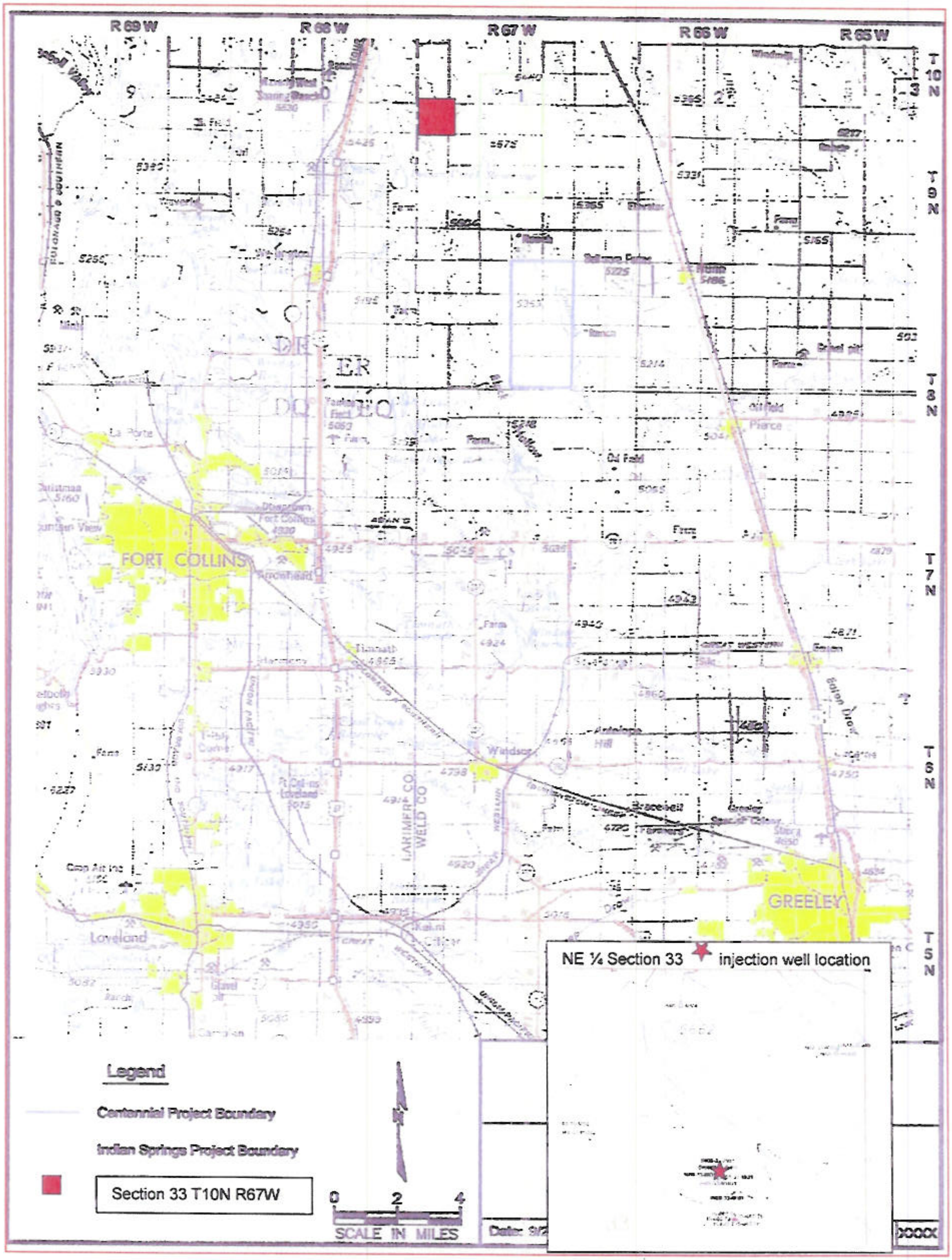

Figure 1. Location of Pump Test/Injection Well, IN08-33-PW1

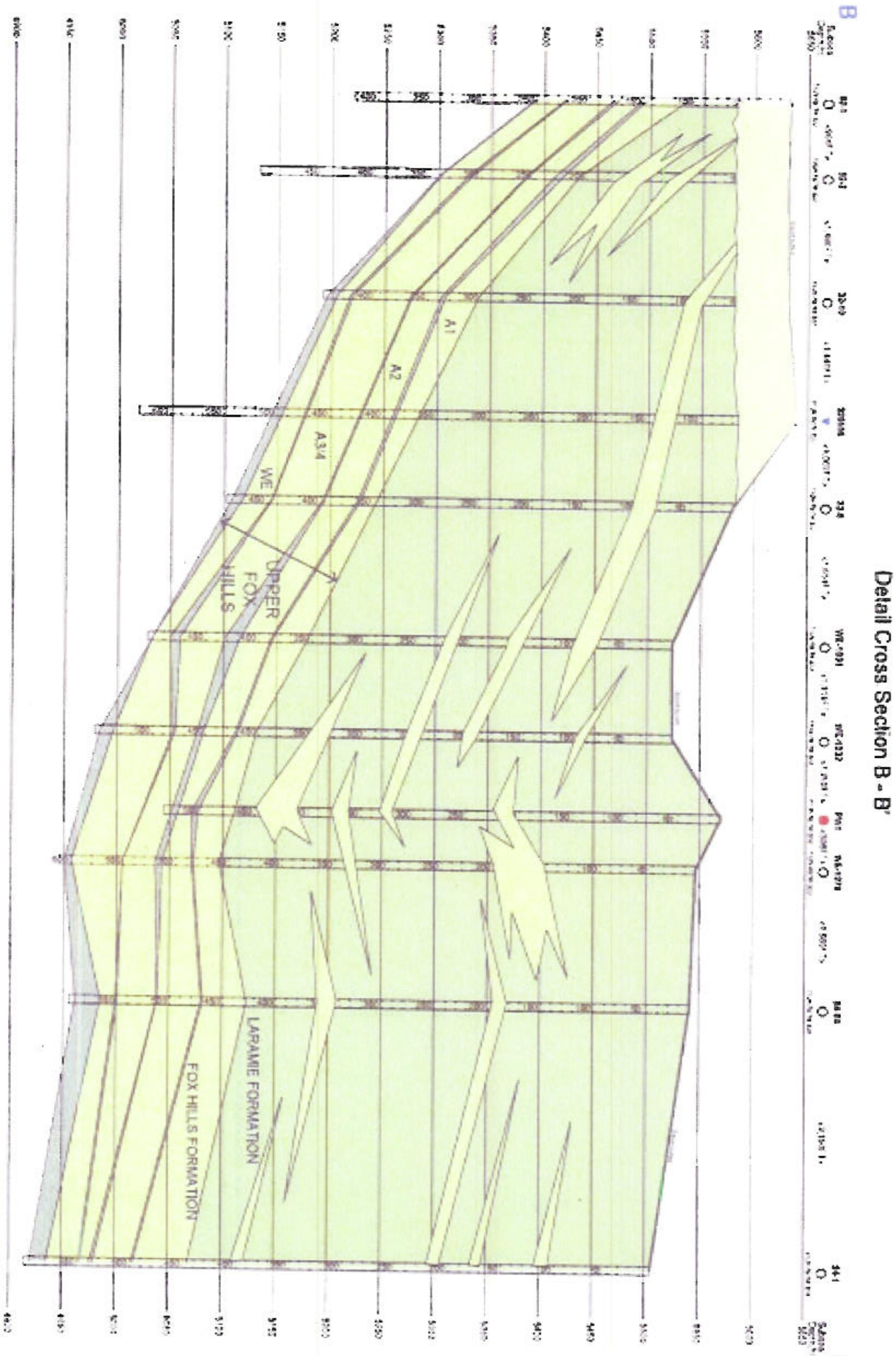

Figure 2. Stratigraphic Cross Section Showing the Laramie and Fox Hills Formations

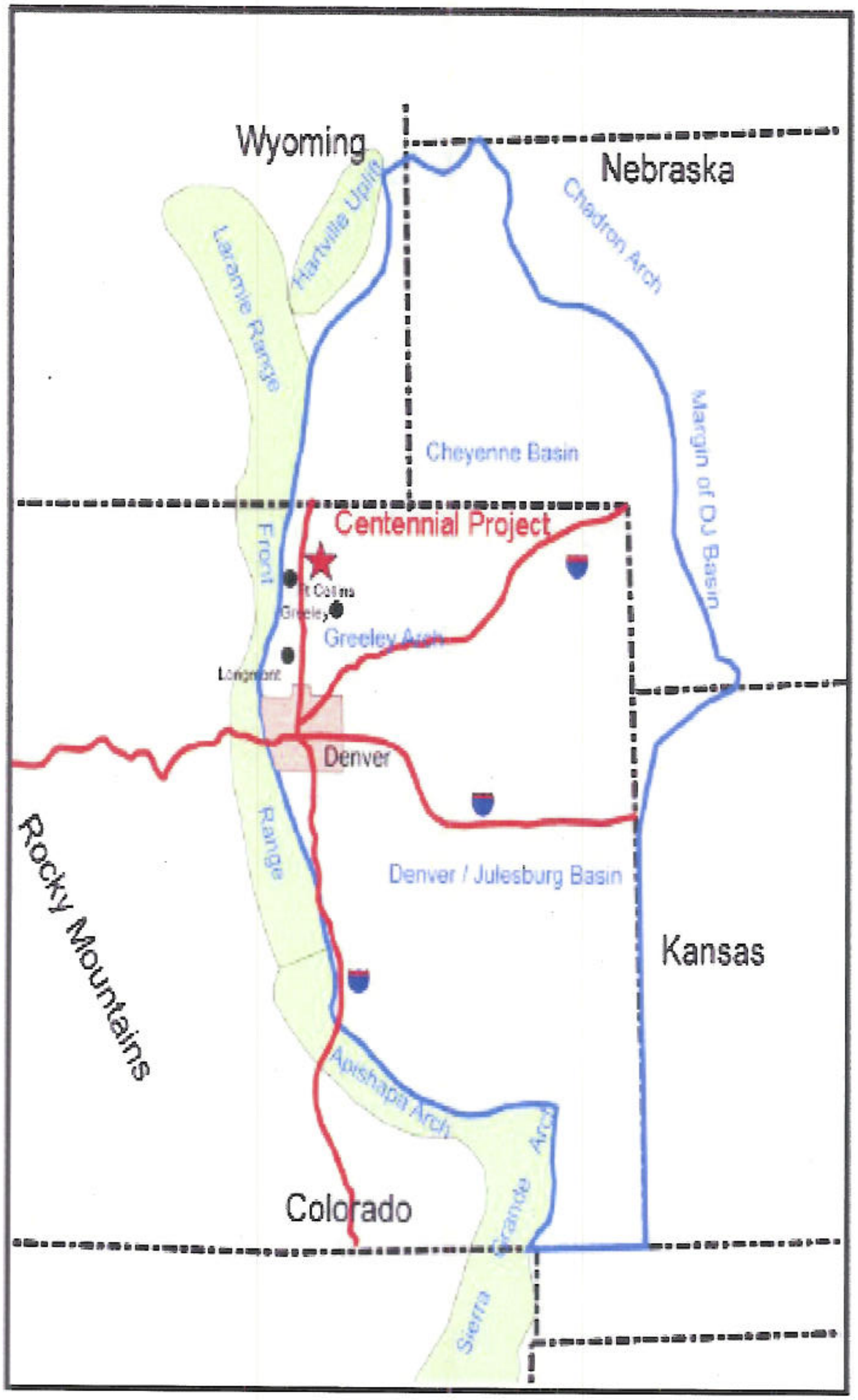

Figure 3. Structural Geology Features near the Injection Area (Figure 7 from Voss, 2007).

IV. TYPE AND QUANTITY OF INJECTED FLUIDS

The fluid to be injected will consist of groundwater pumped from the A2 sandstone unit of the Upper Fox Hills Formation "A" Sands. Approximately 43,200 gallons of groundwater will be produced during the pump test. The water will be stored in enclosed steel tanks. The groundwater produced from the A2 sandstone unit contains concentrations of uranium and radium above the primary drinking water standards, also called the Maximum Contaminant Limits or MCLs. The A2 sandstone groundwater also contains concentrations of iron above the Region 8 permit limit. The Laramie Formation groundwater does not contain uranium and radium above the MCLs and iron above the Region 8 permit limit. Water quality information for groundwater sampled in both formations is presented in Table 1.

Table 1: Permit Limits and Approved Analytical Methods for Total Metals

Parameter Name	Concentration in Laramie (μg/L)	Concentration in Fox Hills (μg/L)	Regulatory Limit (μg/L)	Standard Type*
Antimony	1	66	6	MCL
Arsenic	3	ND	10	MCL
Barium	ND	ND	2,000	MCL
Beryllium	ND	ND	4	MCL
Boron	200	100	1,400	HA-Lifetime
Cadmium	ND	ND	5	MCL
Chromium(total)	ND	ND	100	MCL
Copper	10	20	1,300	MCL-TT
Iron	250	13,000	5,000	Region 8 Permit Limit
Lead	ND	ND	15	MCL-TT
Manganese	150	220	800	Region 8 Permit Limit
Mercury (inorganic)	ND	ND	2	MCL
Molybdenum	ND	ND	40	HA-Lifetime
Nickel	ND	ND	100	HA-Lifetime
Selenium	ND	2	50	MCL
Silver	ND	ND	100	HA-Lifetime
Strontium	2,900	1,500	4,000	HA-Lifetime
Thallium	ND	ND	2	MCL
Uranium	11.2	250	30	MCL
Zinc	80	30	2,000	HA-Lifetime

= concentrations above permit limits

* Explanation of Standard Type

HA: Health Advisory. An estimate of acceptable drinking water levels for a chemical substance based on health effects information; a Health Advisory is not a legally enforceable Federal standard, but serves as technical guidance to assist federal,

state, and local officials.	
HA-Lifetime: The concentration of a chemical in drinking water that is not expected to cause any adverse, noncarcinogenic effects for a lifetime of exposure. The Lifetime HA is based on exposure of a 70-kg adult consuming 2-liters of water per day. The Lifetime HA for Group C carcinogens includes an adjustment for possible carcinogenicity.	
MCL: Maximum Contaminant Level. The highest level of a contaminant allowed in drinking water. MCLs are set as close to the MCLG as feasible using the best available analytical and treatment technologies and taking cost into consideration. MCLs are enforceable standards.	
MCL-TT: Treatment Technique. A required process intended to reduce the level of a contaminant in drinking water.	
Region 8 Permit Limit: Permit limit calculated by Region 8 Drinking Water Toxicologist based on human-health criteria.	

V. REASON FOR THE PERMIT

The UIC Program, created under the authority of the Safe Drinking Water Act (SDWA), is a preventive program tasked with protecting existing and future underground sources of drinking water (USDWs). The UIC regulates the discharge of fluids into the subsurface through injection wells. A Class V injection well discharges fluids into or above a USDW. Class V wells containing constituents with Primary Drinking Water Standard or Health Advisories may have the potential to contaminate or degrade groundwater, and are usually required to operate under a permit. The groundwater being pumped from, and reinjected into, the A2 sandstone has higher concentrations of some contaminants regulated under the SDWA than the Laramie Formation. Because the injection well will penetrate the Laramie Formation, EPA is issuing a permit for this injection activity to establish well construction standards and mechanical integrity testing as permit requirements for the protection of groundwater in the Laramie Formation from contamination resulting from the proposed injection activities.

EPA has determined that the injection activity will not endanger groundwater in the injection zone, because it is the same water that was pumped from the injection zone. The water quality of the groundwater is not expected to change before reinjection. The Final Permit requires the permittee to collect samples of A2 sandstone groundwater from the storage tanks before reinjection to verify that the storage tanks have not contaminated the groundwater during storage. The samples will be analyzed for Total Metals for arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver; Volatile Organic Compounds; Semi-volatile Organic Compounds; and Total Petroleum Hydrocarbons. A composite sample of the stored groundwater will also be analyzed for Total Coliforms to verify that the groundwater has not been exposed to microbial contamination. The permit also requires Powertech to provide a summary report of the aquifer pump testing results to EPA for review before the reinjection of the A2 sandstone groundwater is authorized.

VI. INJECTION WELL CONSTRUCTION DESIGN

The permit requires that well construction design prevents movement of injectate into the overlying Laramie Formation. EPA has evaluated the construction design of the injection well, and has determined that the design is protective of the Laramie Formation groundwater. The injection well has been constructed according to the specifications shown in Figure 4. The cement between the well casing and the borehole wall will prevent the movement of fluids along

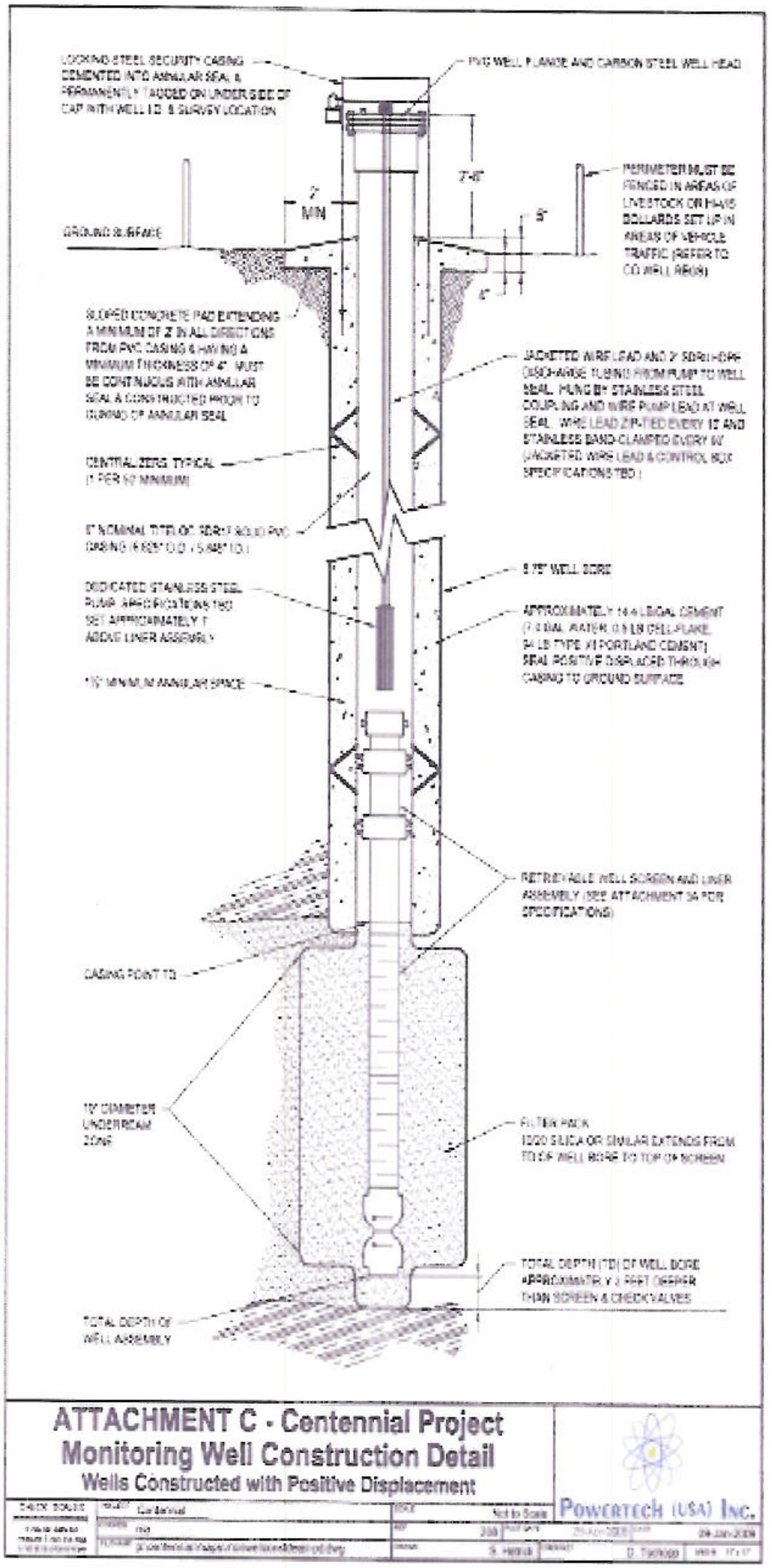

Figure 4. Injection Well Construction Design

the injection well and will isolate the injection zone to the A2 sandstone of the Upper Fox Hills Formation. Powertech has conducted mechanical integrity tests on the proposed injection well to demonstrate that the well will not serve as a conduit for the migration of fluids across the confinement zones. The aquifer pump test will also evaluate the integrity of the injection well and the confining zones.

VII. AQUIFER PUMP TEST AND RESULTS

The aquifer-pump test will include the measurement of water levels in observation wells completed in the same aquifer as the aquifer-pump test well, in this case the A2 sandstone. The test will also include the measurement of water levels in observation wells completed in aquifers above and below the aquifer being pumped. As groundwater is withdrawn from the test well being pumped, there will be a decrease in the water level of the A2 sandstone in the area surrounding this well. As pumping continues, eventually the water level in each of the observation wells will begin to show a decrease in elevation, called "drawdown." The amount of drawdown measured in each well is plotted on a graph, with amount of drawdown shown along the vertical axis and time shown along the horizontal axis. When both the axes for drawdown and time have a logarithmic scale, this curve has a characteristic shape, if the aquifer being pumped is fully confined. Any breaches in the confinement zones will manifest themselves in one or both of two ways:

1) as a deviation in the drawdown curve based on measured water levels in observation wells completed in the pumped aquifer and located at some distance from the pumping well, and/or
2) as a change in water level in observation wells completed in aquifers above or below the aquifer being pumped.

If the aquifer is fully confined, the drawdown curves in the observations wells completed in the aquifer being pumped plot as a curve of the characteristic shape of the Theis curve shown in Figure 5a[1] . Figure 5b[2] is an example of how the plot of the drawdown curve should look for a fully confined aquifer.

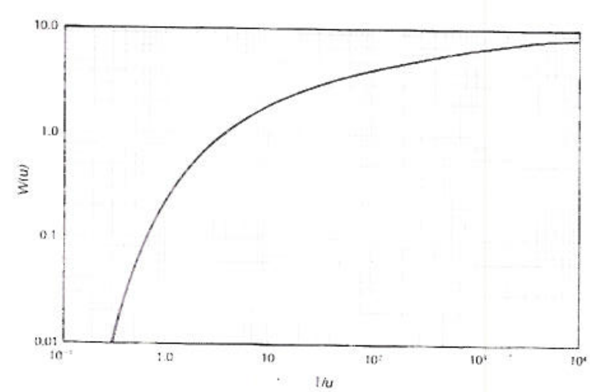

Figure 5a. Theis curve for fully confined aquifers.

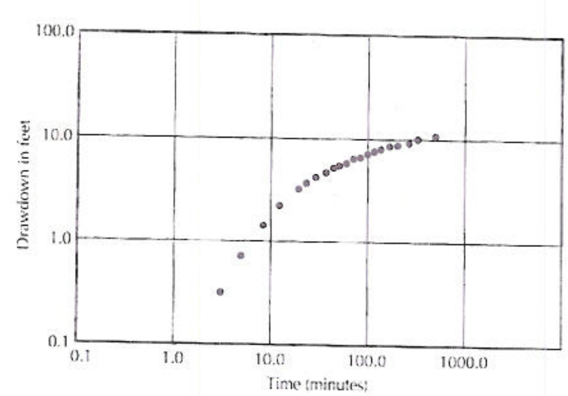

Figure 5b. Field data from observation well during an aquifer pump test.

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[1] From Fetter, C.W. 1994. *Applied Hydrology*. Upper Saddle River, New Jersey: Prentice-Hall, p. 220.
[2] *Ibid.*, p. 221.

If groundwater were to be pulled across a confinement zone into the pumped aquifer from an aquifer above or below the pumped aquifer through a breach in a confinement zone, the drawdown curve will deviate from the expected shape. Figure 6[3] shows a series of drawdown curves from aquifers with "leaky" confining zones.

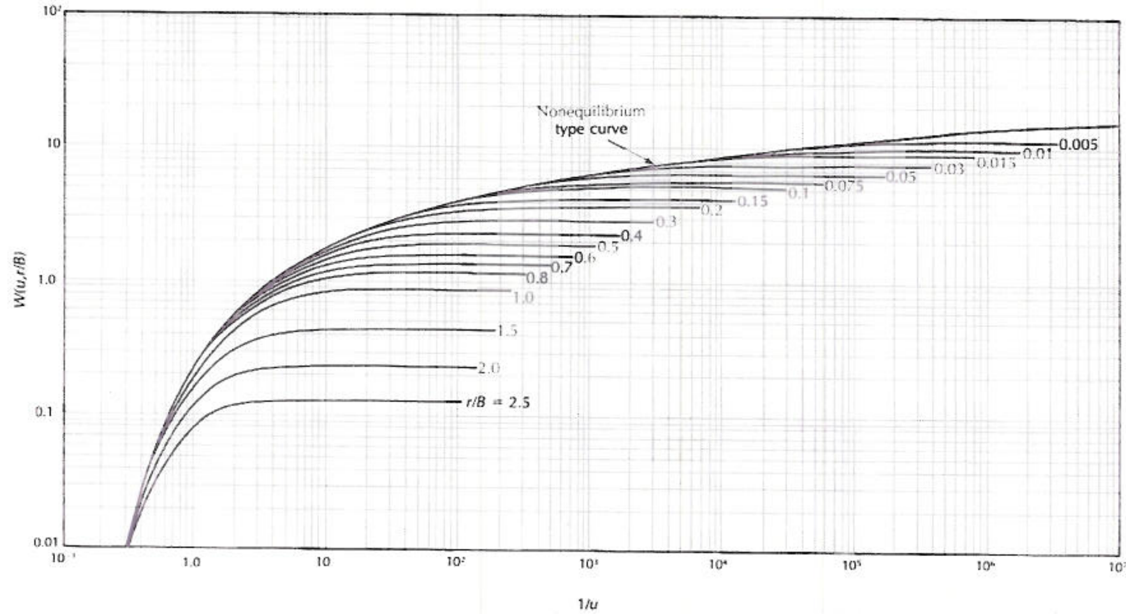

Figure 6. Type curves for aquifers with leaky confining zones.

The r/B is the ratio between r, the distance from the pumping well to the observation well, and B, the leakage factor.

The water level in observation wells completed in aquifers above and below the pumped aquifer should not show any change in water level during the aquifer-pump test if the confinement zones are impermeable. If the water level in one of these observation wells should decrease, then that would be an indication that water is being pulled from the aquifer, through a breach in the confinement zone, into the aquifer being pumped.

The Petrotek report that is included in the administrative record for the second Draft Permit demonstrates that the injectate will travel less than 50 feet from the injection well (see page 5 of the report). Within 50 feet of the pumping/injection well, there is a monitoring well completed in an overlying Laramie Formation sandstone. The greatest amount of pressure exerted on the confinement zone is in the area closest to the pumping well. If there is a breach in the confinement zone between the Laramie and Fox Hills Formations, it will be observable in the water level of the well completed in the Laramie Formation sandstone. Similarly, there is an observation well completed in the WE sandstone beneath the A2 sandstone in the Upper Fox Hills Formation within 75 feet of the pumping well. If there is a breach in the confinement zone

[3] From Walton, W.C. 1962, *Selected Analytical Methods for Well and Aquifer Evaluation.* Illinois State Water Survey Bulletin 49, p.81

between the A2 and the WE sandstone within 50 feet of the pumping well, it will be observable in the water level of the observation well completed in the WE sandstone.

Injection activity under the Class V permit will be of short duration; the injectate is not expected to travel more than 50 feet from the injection well; and the groundwater will not be injected under pressure. Given these considerations, EPA has determined that the aquifer-pump test results will provide information adequate for evaluating the integrity of the confinement zones surrounding the proposed injection well. EPA will review the aquifer-pump test results to determine that the integrity of the confinement zones is adequately characterized and to evaluate the potential for migration of Fox Hill Formation fluids into the overlying Laramie Formation during reinjection of the A2 sandstone groundwater.

VIII. THE EXTENT OF THE A2 SANDSTONE THAT WILL BE AFFECTED BY INJECTION

The porosity of sandstone is a measure of void space volume between sand grains that make up the sandstone formation. The effective porosity consists of the void spaces that are connected to each other and not filled with or separated by the cementing matrix that holds the sandstone together. The effective porosity is the space within the sandstone available for groundwater flow within the sandstone aquifer. There may be additional porosity within the sandstone, but these pores are isolated by the cementing matrix and are not available for groundwater to flow through them. The effective porosity of a sandstone aquifer typically varies between 10 and 25% of the total sandstone volume. Based on this estimate and the thickness of the sandstone, a volume can be calculated around the injection well that will be filled by the 43,200 gallons of groundwater reinjected into the sandstone.

Petrotek performed this calculation over a range of effective porosity values and a range of sandstone thickness. Based on this volume, Petrotek estimated that the distance from the injection well that will be affected by the volume of groundwater being reinjected will be less that 50 feet. Using the lowest effective porosity (10%) and a 10 foot thickness for the A2 sandstone, the injectate would travel 42.9 feet away from the injection well. The A2 sandstone ranges in thickness between 23.5 and 30 feet as observed in the monitoring wells in Section 33; the actual distance away from the injection well that will be affected by reinjection is more likely to be less than 30 feet. In this case, the term "affected by injection" means the area where the reinjected water will flow within the aquifer away from the injection well.

A much larger portion of the aquifer will respond to the volume of water being reinjected into the injection well by showing a change in water level in the observation wells monitored during the aquifer-pump test. The drawdown of water level within the aquifer causes a cone of depression that radiates away from the pumping well. As pumping continues, the cone of depression moves farther and farther away from the pumping well until it reaches the observations wells and results in a drawdown of water level at the observation well. Conversely, returning the volume of water into the aquifer through the reinjection well will cause a mounding of groundwater at the injection well. This mound will eventually result in a rise in the water level at the observation wells. This rise in water level at the observations wells does not mean that the injectate itself is reaching the observation wells. The rise in water level at the observation wells occurs as a result of the pressure effect migrating outward from the groundwater mound at the reinjection well as the mound returns to the equilibrium groundwater level.

IX. GROUNDWATER USE WITHIN ONE-HALF MILE OF INJECTION WELL

The current use of groundwater within a one-half mile radius of the injection well consists of livestock watering. There are two (2) livestock-watering wells located approximately one-quarter mile away from the injection wells. These wells are completed within the proposed injection zone, and are located either up-gradient or cross-gradient of the injection well, relative to groundwater flow within the Upper Fox Hill Formation.

The nearest domestic well completed in the Fox Hills Formation is located approximately 1 mile west of (up-gradient from) the injection well. Figure 7a shows the location of the domestic well, labeled by its permit number, 229556, in Figure 7a and the proposed injection wells, labeled PW1. The green line labeled B-B' in Figure 7a is the trend of the geologic cross section shown in Figure 2. Figure 7b is an enlarged portion of the Figure 2 geologic cross section. The driller's log for the domestic well has been superimposed on the cross section shown in Figure 7b. Based on the driller's log, domestic well appears to be completed in the A3/4 sandstone and the B sandstone of the Fox Hills Formation. These two aquifers are located deeper than the A2 sandstone injection zone as shown in Figure 7b.

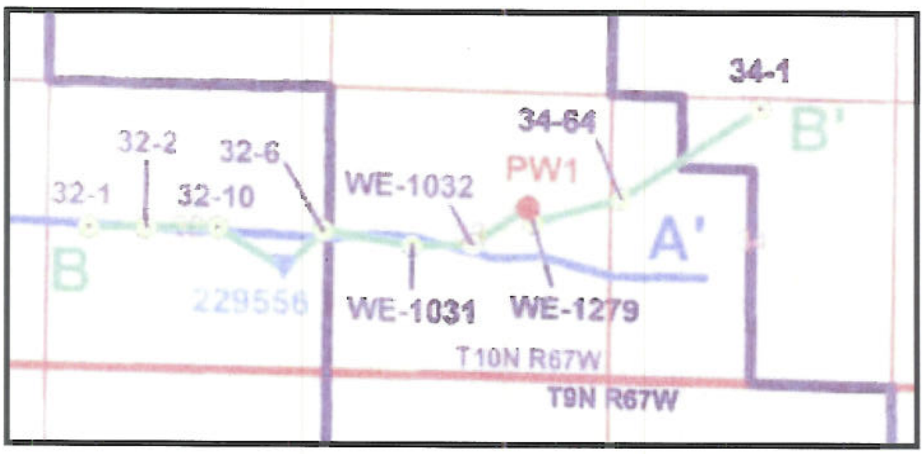

Figure 7a. Trend of cross-section shown in Figure 5a across Sections 32 and 33, Township 10 North, Range 67 West.

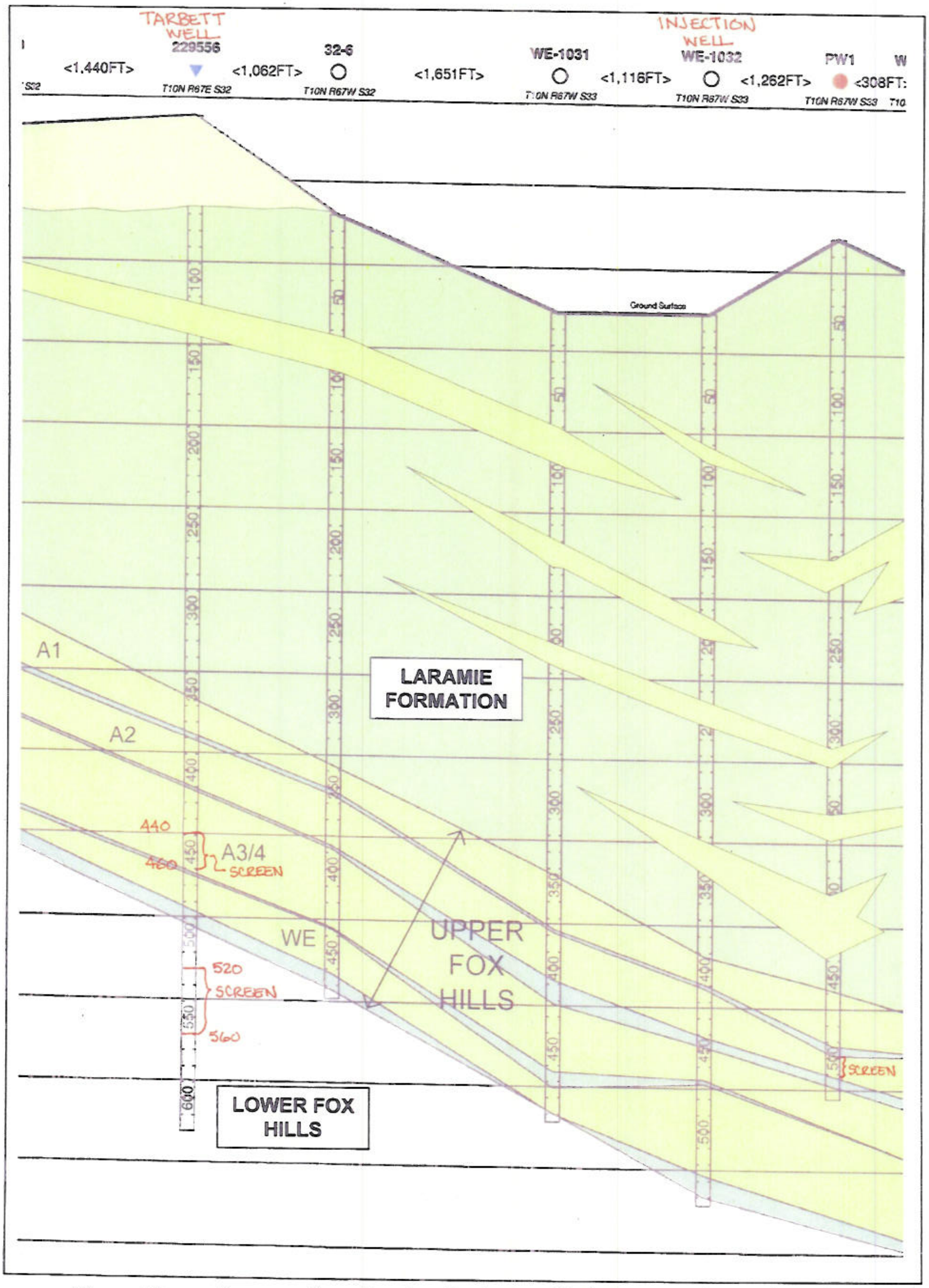

Figure 7b. **Cross section showing Tarbett well, the nearest domestic well to the proposed injection well.**

X. PROCEDURES TO APPEAL FINAL PERMIT

The procedures to appeal a UIC final permit decision are found under Title 40 Code of Federal Regulations 125.19. A copy of this regulation is attached to the end of this document. For additional information, contact Valois Shea at 1-800-227- 8917, extension 312-6276, or 303-312-6276.

XI. REFERENCES

Bonner, J., 2009, Updated Technical Report on the Centennial Uranium Project Weld County, Colorado, 41 pages.

Voss, W. C. and Gorski, D. E., 2007, Report on the Centennial Project Weld County, Colorado, 41 pages.

(3) Any written materials submitted at such a hearing;

(4) The response to comments required by § 124.17 and any new material placed in the record under that section;

(5) For NPDES new source permits only, final environmental impact statement and any supplement to the final EIS;

(6) Other documents contained in the supporting file for the permit; and

(7) The final permit.

(c) The additional documents required under paragraph (b) of this section should be added to the record as soon as possible after their receipt or publication by the Agency. The record shall be complete on the date the final permit is issued.

(d) This section applies to all final RCRA, UIC, PSD, and NPDES permits when the draft permit was subject to the administrative record requirements of § 124.9 and to all NPDES permits when the draft permit was included in a public notice after October 12, 1979.

(e) Material readily available at the issuing Regional Office, or published materials which are generally available and which are included in the administrative record under the standards of this section or of § 124.17 ("Response to comments"), need not be physically included in the same file as the rest of the record as long as it is specifically referred to in the statement of basis or fact sheet or in the response to comments.

§ 124.19 Appeal of RCRA, UIC, NPDES, and PSD Permits.

(a) Within 30 days after a RCRA, UIC, NPDES, or PSD final permit decision (or a decision under 270.29 of this chapter to deny a permit for the active life of a RCRA hazardous waste management facility or unit) has been issued under § 124.15 of this part, any person who filed comments on that draft permit or participated in the public hearing may petition the Environmental Appeals Board to review any condition of the permit decision. Persons affected by an NPDES general permit may not file a petition under this section or otherwise challenge the conditions of the general permit in further Agency proceedings. They may, instead, either challenge the general permit in court, or apply for an individual NPDES permit under § 122.21 as authorized in § 122.28 and then petition the Board for review as provided by this section. As provided in § 122.28(b)(3), any interested person may also petition the Director to require an individual NPDES permit for any discharger eligible for authorization to discharge under an NPDES general permit. Any person who failed to file comments or failed to participate in the public hearing on the draft permit may petition for administrative review only to the extent of the changes from the draft to the final permit decision. The 30-day period within which a person may request review under this section begins with the service of notice of the Regional Administrator's action unless a later date is specified in that notice. The petition shall include a statement of the reasons supporting that review, including a demonstration that any issues being raised were raised during the public comment period (including any public hearing) to the extent required by these regulations and when appropriate, a showing that the condition in question is based on:

(1) A finding of fact or conclusion of law which is clearly erroneous, or

(2) An exercise of discretion or an important policy consideration which the Environmental Appeals Board should, in its discretion, review.

(b) The Environmental Appeals Board may also decide on its own initiative to review any condition of any RCRA, UIC, NPDES, or PSD permit decision issued under this part for which review is available under paragraph (a) of this section. The Environmental Appeals Board must act under this paragraph within 30 days of the service date of notice of the Regional Administrator's action.

(c) Within a reasonable time following the filing of the petition for review, the Environmental Appeals Board shall issue an order granting or denying the petition for review. To the extent review is denied, the conditions of the final permit decision become final agency action. Public notice of any grant of review by the Environmental Appeals Board under paragraph (a) or (b) of this section shall be given as provided in § 124.10. Public notice shall set forth a briefing schedule for the appeal and shall state that any interested person may file an amicus brief. Notice of denial of review shall be sent only to the person(s) requesting review.

(d) The Regional Administrator, at any time prior to the rendering of a decision under paragraph (c) of this section to grant or deny review of a permit decision, may, upon notification to the Board and any interested parties, withdraw the permit and prepare a new draft permit under § 124.6 addressing the portions so withdrawn. The new draft permit shall proceed through the same process of public comment and opportunity for a public hearing as would apply to any other draft permit subject to this part. Any portions of the permit which are not withdrawn and which are not stayed under § 124.16(a) continue to apply.

(e) A petition to the Environmental Appeals Board under paragraph (a) of this section is, under 5 U.S.C. 704, a prerequisite to the seeking of judicial review of the final agency action.

(f)(1) For purposes of judicial review under the appropriate Act, final agency action occurs when a final RCRA, UIC, NPDES, or PSD permit decision is issued by EPA and agency review procedures under this section are exhausted. A final permit decision shall be issued by the Regional Administrator:

(i) When the Environmental Appeals Board issues notice to the parties that review has been denied;

(ii) When the Environmental Appeals Board issues a decision on the merits of the appeal and the decision does not include a remand of the proceedings; or

(iii) Upon the completion of remand proceedings if the proceedings are remanded, unless the Environmental Appeals Board's remand order specifically provides that appeal of the remand decision will be required to exhaust administrative remedies.

(2) Notice of any final agency action regarding a PSD permit shall promptly be published in the FEDERAL REGISTER.

(g) Motions to reconsider a final order shall be filed within ten (10) days after service of the final order. Every such motion must set forth the matters claimed to have been erroneously decided and the nature of the alleged errors. Motions for reconsideration under this provision shall be directed to, and decided by, the Environmental Appeals Board. Motions for reconsideration directed to the administrator, rather than to the Environmental Appeals Board, will not be considered, except in cases that the Environmental Appeals Board has referred to the Administrator pursuant to § 124.2 and in which the Administrator has issued the final order. A motion for reconsideration shall not stay the effective date of the final order unless specifically so ordered by the Environmental Appeals Board.

[48 FR 14264, Apr. 1, 1983, as amended at 54 FR 9607, Mar. 7, 1989; 57 FR 5335, Feb. 13, 1992; 65 FR 30911, May 15, 2000]

§ 124.20 Computation of time.

(a) Any time period scheduled to begin on the occurrence of an act or event shall begin on the day after the act or event.

(b) Any time period scheduled to begin before the occurrence of an act or event shall be computed so that the period ends on the day before the act or event.

(c) If the final day of any time period falls on a weekend or legal holiday, the time period shall be extended to the next working day.

(d) Whenever a party or interested person has the right or is required to act within a prescribed period after the service of notice or other paper upon him or her by mail, 3 days shall be added to the prescribed time.

§ 124.21 Effective date of part 124.

(a) Part 124 of this chapter became effective for all permits except for RCRA permits on July 18, 1980. Part 124 of this chapter became effective for RCRA permits on November 19, 1980.

(b) EPA eliminated the previous requirement for NPDES permits to undergo an evidentiary hearing after permit issuance, and modified the procedures for termination of NPDES and RCRA permits, on June 14, 2000.

(c)(1) For any NPDES permit decision for which a request for evidentiary hearing was granted on or prior to

EXHIBIT 6

Petrotek

CENTENNIAL PROJECT
WELD COUNTY, COLORADO
Notice of Intent Modification MD-03
File No. P-2008-043

RESPONSE TO DIVISION OF RECLAMATION, MINING, AND SAFETY SEPTEMBER 25, 2009, LETTER

Items 6, 11, 12, 13, 14, and 16c.

POWERTECH (USA) INC.

5575 DTC Parkway, Suite 140
Greenwood Village, Colorado 80111 USA

October 27, 2009

Prepared by
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Littleton, Colorado 80127-4239
Phone: 303-290-9414
Fax: 303-290-9580

RESPONSE TO DRMS SEPTEMBER 25, 2009 LETTER

In its letter dated September 25, 2009, the Division of Reclamation, Mining and Safety (DRMS) requested clarification of a number of items related to Powertech (USA) Inc.'s proposed modification MD-03 to Notice of Intent to Conduct Prospecting P-2008-043. The specific items identified in DRMS's September 25, 2009, letter and addressed in this response are shown below in italics.

6. The Section 33 Pumping Test Plan included with MD-03 states on Page 5 that the monitoring wells will be located spatially in order to define the regional potentiometric gradients in the Laramie Formation, A_2 Sand, and B Sand. Initial measurements for this purpose must be collected and the data provided to the DRMS prior to commencement of the proposed pumping test. These initial measurements, which may be single hand tagged measurements, if not already done should be taken as soon as possible, and are in addition to the baseline groundwater level data to be collected over a 72- to 96-hour period prior to initiation of pump testing as described on page 6 of the Pumping Test Plan.

Response:

The locations of the pumping well (IN08-33-PW-1[PW-1]) and monitoring wells for the Section 33 Pumping Test are shown on Figure 6-1. PW-1 is completed within the A_2 Sand horizon, which is the primary mineralized zone. In aggregate, six monitoring wells in Section 33 are also completed within the A_2 Sand, four monitoring wells are completed in the overlying Laramie Formation, two monitoring wells are completed in the underlying WE Sand, and three monitoring wells are completed within the underlying B Sand.

The static water-level elevations for the pumping and monitoring wells are summarized in Table 6.1. Within the overlying Laramie Formation, groundwater occurs as a series of discontinuous perched lenses, as indicated by the wide variations in observed static water-level elevations. Within the A_2 and B Sand horizons, the regional potentiometric gradients are generally toward the south and southeast. In Section 33, the potentiometric surface elevations within the B Sand are generally 26 to 30 feet higher than those within the A_2 Sand and on the order of 20 feet higher than those within the WE Sand.

Potentiometric levels measured on September 28, 2009, for the Section 33 Laramie monitoring wells are shown on Figure 6.2. Potentiometric contour maps for the A_2 and B Sands are shown on Figures 6.3, and 6.4, respectively.

The Section 33 monitoring wells will be instrumented with pressure transducers (LevelTrolls®) and static water levels monitored prior to and during the pumping test and during reinjection of the produced fluids.

Table 6.1

Powertech (USA) Inc., - Centennial Project

Section 33 Pumping Test - Pre-Test Static Water-Level Elevations

Completion Zone	Location ID	Elevation - Top of Casing (ft amsl)	Elevation - Ground Surface (ft amsl)	8/29/2009	9/17/2009	9/28/2009	10/22/2009
Laramie Fm.	IN08-33-MO1	5569.97	5569.97	5378.65	5378.77	5378.78	5378.95
	IN08-33-MO2	5574.36	5573.30	5397.21	5397.78	5397.93	5398.18
	IN08-33-MO3	5535.89	5534.30	5435.09	5435.26	5428.48	5428.60
	IS-003Ta	5542.36	NM	NM	NM	5419.55	5419.67
A_2 Sand	IN08-33-PW1	5573.34	5572.40	5270.50	5268.79	5268.79	5268.92
	IN08-33-MM1	5554.86	5553.30	5268.07	5268.26	5268.26	5268.47
	IN08-33-MM2	5574.40	5573.20	5266.55	5266.65	5266.72	5266.90
	IN08-33-MM3	5533.90	5532.60	5266.98	5267.28	5267.31	5267.45
	IN08-33-MM4	5613.96	5512.90	5268.84	5269.11	5269.13	5269.32
	IN08-33-MM5	5517.14	5515.50	5265.89	5266.11	5266.20	5266.33
	IS-003T	5541.94	NM	NM	NM	5267.91	5268.10
WE Sand	IN08-33-MU1	5566.11	5565.00	5273.88	5274.04	5274.05	5274.26
	IS-003Tb	5541.24	NM	NM	NM	5272.53	5272.73
B Sand	IN08-33-MUU1	5563.76	5562.60	5296.26	5297.43	5297.43	5297.63
	IN08-33-MUU2	5573.97	5572.60	5302.74	5303.55	5303.64	5304.63
	IN08-33-MUU3	5537.34	5536.00	5297.09	5297.81	5297.90	5298.15

Legend

NM - Not Measured

11. Discussion on page 8 of the Section 33 Pumping Test Plan under the heading "Produced Water Disposal" raises the following issues:

a. The Pumping Test Plan states that Powertech will demonstrate through Mechanical Integrity Testing that there is no potential for injectate to flow from the well into the Laramie Formation where the well passes through that formation. MD-03 lacks discussion of how it will be assured and demonstrated that injectate will not flow into strata above or below the injection well screened strata after it is discharged to that strata, via either natural or manmade (e.g., other wells) pathways.

b. The Pumping Test Plan states that the injection well is not expected to be operated under pressure but allows that the injection might be pressurized as needed. If the injection is pressurized, the potential for injectate to flow into other water bearing strata above or below the screened interval is increased. If the injection proceeds under atmospheric pressure only, it is unlikely that flow paths other than those occurring under natural conditions in the A_2 Sand will develop, but the development of such new paths even under atmospheric pressure alone cannot be ruled-out.

In order to address issues 11.a and b, Powertech may choose to commit to storing the pump test water in Baker Tanks until the pump test data are analyzed and a demonstration can be made that the A_2 Sand is sufficiently contained to allow pressurized injection without migration of injectate into overlying or underlying strata. However, it is possible hydraulic connection between the A_2 Sand and other strata via open or ineffectively plugged wells will not be detected during the pump test. This is particularly true if injectate were to flow along a leaky well and into a lenticular water bearing strata in the Laramie Formation in which none of the pump test monitoring wells have been screened. See item no. 12 below for further discussion of this issue. Another option would be for Powertech to combine existing available information with a commitment to inject at or slightly above ambient A_2 Sand pressure to demonstrate that injectate will not migrate into overlying and underlying strata, at least not any more than A_2 water would migrate under natural conditions. Alternatively, DRMS will review any other proposals Powertech may offer to address these issues.

Response:

Based on previous pumping tests conducted by Powertech in Section 33 and the observed aquifer response during development of pumping well PW-1, it is estimated that PW-1 can be produced at a sustainable rate of 8 to 10 gallons per minute for the planned test duration of 3 to 5 days. Based on the preliminary estimates of transmissivity and storativity for the A_2 Sand, the drawdown in the pumping well at the end of 72 hours of pumping at 10 gallons per minute is estimated to be substantially less than 100 feet.

Given that the potentiometric surface for the A_2 Sand horizon, depending on location, ranges from 250 to more than 300 feet below ground surface, Powertech is proposing to reinject the produced fluid under a vacuum into the same zone from which it was produced.

As noted in the response to Item 6, the Section 33 monitoring well network will be instrumented with pressure transducers (LevelTrolls®) and potentiometric levels in the Laramie and A_2, WE, and B Sands monitored during the pumping test and reinjection of the produced fluids. Observed aquifer responses in each completion zone will be evaluated in order to confirm the preliminary hydrogeological characterization prior to reinjection of the produced fluids.

12. *It is necessary to determine if there are any wells or bore holes within the potential zone of flow for the injectate and the status condition of those wells or bore holes. Powertech must provide a report that includes the following:*

a. *A technical analysis delineating the potential zone of flow for injectate.*

b. *A map illustrating all wells and boreholes within the potential zone of flow, a discussion of the sources of information for the wells and bore holes, and a description of the efforts put forth to assure that all wells and bore holes within the zone have been identified.*

c. *A description of the status condition of each well and bore hole including the sources of information for and investigations conducted to determine the status conditions.*

d. *For any wells or bore holes that are identified as being potential flow pathways for injectate or that cannot be ruled out as potential flow pathways, provide a plan to prevent injectate from traveling along these pathways and entering strata other than the A_2 Sand.*

Response:

As noted, Powertech is proposing to reinject the produced fluids from the Section 33 pumping test under vacuum into the same well from which it was produced.

a. Regarding the potential zone of flow for injectate, based on the best estimate of aquifer properties for the A2 Sand, it is proposed that during the planned pumping test, PW-1 will be pumped at a constant rate of approximately 10 gallons per minute for 72 hours, producing in aggregate 43,200 gals. Assuming "piston-like" displacement, the radius of fluid displacement around the injection well for different effective porosities and for assumed aquifer thicknesses (b) of 10 and 20 feet is summarized in the following table. As shown, in the most conservative (worst) case, the radius of fluid displacement would be less than 50 feet. The closest residential well is located more than 3,800 feet from the pumping/injection well PW-1.

		Radius of Fluid Displacement	
Effective Porosity	Aquifer Volume (cubic feet)	b = 10 feet	B = 20 feet
10 %	57,750	42.9	30.3
15 %	38,500	35.0	24.8
20 %	28,875	30.3	21.3
25 %	23,100	27.1	19.2

The actual thickness of the A_2 Sand in the A_2 monitoring wells ranges from 23.5 to 30 feet.

b. The records of the State Engineer's Office (SEO) indicate that there is only one registered well located in Section 33 T10N, R67W, other than the monitoring wells installed by Powertech. According to SEO's records, this well is shallow, 259 feet deep, and therefore, believed to be completed within the Laramie Formation. This well is used for livestock watering. According to the property owner, Mr. Howard Diehl, there are no domestic or other agricultural wells in Section 33.

The locations of the Section 33 monitoring wells are shown on Figure 6.1. In addition, numerous exploration holes dating back to the 1970s and 1980s have been drilled in Section 33 and in adjacent sections. A map showing known exploration holes in Section 33 is presented as Figure 12.1. Also shown on Figure 12.1 are the shallow Laramie well used for watering livestock and the Section 33 monitoring well network.

c. The pumping well PW-1 and the monitoring wells installed as part of the 2009 drilling program were completed by drilling to the top of the proposed screen interval, setting casing, and grouting from total depth to the ground surface. The screen intervals were installed by under-reaming discrete sand intervals based on geology identified from the e-logs. As such, there is a high degree of confidence that these wells will not provide a potential conduit for vertical migration of injectate.

The condition of the exploration boreholes and monitoring wells installed by others is unknown but will be evaluated through ongoing monitoring during the pumping test and reinjection of the produced fluid.

The detailed review of available potentiometric-level data for Section 33 monitoring wells shows the data to be consistent and does not indicate any apparent anomalies, which may be caused by vertical leakage through artificial penetrations.

d. At this time there are no known wells or bore holes that have been identified as being potential flow pathways for injectate. As described, Powertech is proposing to re-inject the produced fluid under vacuum into the same zone from which it was derived, using the pumping well. As noted, the established monitoring well network in Section 33 will be instrumented and monitored during pumping and re-injection of the produced fluids.

13. Item 11 above discusses the DRMS's current position that injectate be contained within the A_2 Sand or be managed such that migration into overlying and underlying strata be no greater than would occur under natural conditions. DRMS will consider modifying this position if Powertech can demonstrate that water quality impacts to the other A Sands and the WE Sand can be minimized even with the introduction of injectate into those strata. Such a determination would be largely dependent on water quality in these other sands compared to the water quality in the A_2 Sand.

Response:

As described in the responses to Items 11 and 12 above, Powertech is proposing to reinject the produced fluid from the Section 33 pumping test under vacuum into the same zone from which it was derived, using the pumping well PW-1.

14. Powertech stated in since withdrawn modification MD-02 to prospecting notice P-2008-043 that it has done preliminary hydrogeologic modeling and water production calculations for the strata to be investigated by the proposed pump test. DMRS has further discussed with Powertech that data collected during development of recently drilled wells in Section 33 has allowed for refinement of the modeling and calculations. This information will be useful in determination of whether or not pump test water can be injected into the A_2 Sand with assurance that impacts to other water bearing strata are sufficiently minimized, and must be provided.

Response:

Powertech has not performed groundwater modeling for the A_2 Sand, but has carried out a series of Theis simulations of the pressure response to pumping to estimate pumping rates and duration for the proposed test. These simulations were performed to match the observed drawdowns during development of the recently completed A_2 wells and the results from the previous Section 33 pumping tests.

The results from the Theis simulations for the well development scenario and from the previous pumping tests are consistent and indicate the order of magnitude of hydraulic conductivity and storativity. The results for the best fit analysis are shown below.

Powertech (USA), Inc. - Centennial Section 33 Pumping Test (Theis Simulations)

Trial #11b

K =	2.05	ft/day
S =	4.18E-05	
Q =	10.0	gpm
H =	31	ft

Observation Well Distance (feet)

Pump Time (hours)	Pump Time (days)	0.5 Drawdown (ft)	100 Drawdown (ft)	250 Drawdown (ft)	500 Drawdown (ft)	1800 Drawdown (ft)	3600 Drawdown (ft)
1.0	0.0	31.90	6.49	2.54	0.54	--	--
1.5	0.1	32.88	7.43	3.34	0.98	--	--
2.0	0.1	33.57	8.11	3.94	1.37	--	--
6	0.3	36.22	10.72	6.39	3.34	0.10	--
12	0.5	37.89	12.38	8.01	4.82	0.47	--
24	1.0	39.56	14.05	9.66	6.39	1.26	0.10
48	2.0	41.22	15.71	11.31	8.01	2.40	0.47
72	3.0	42.20	16.69	12.28	8.97	3.18	0.88

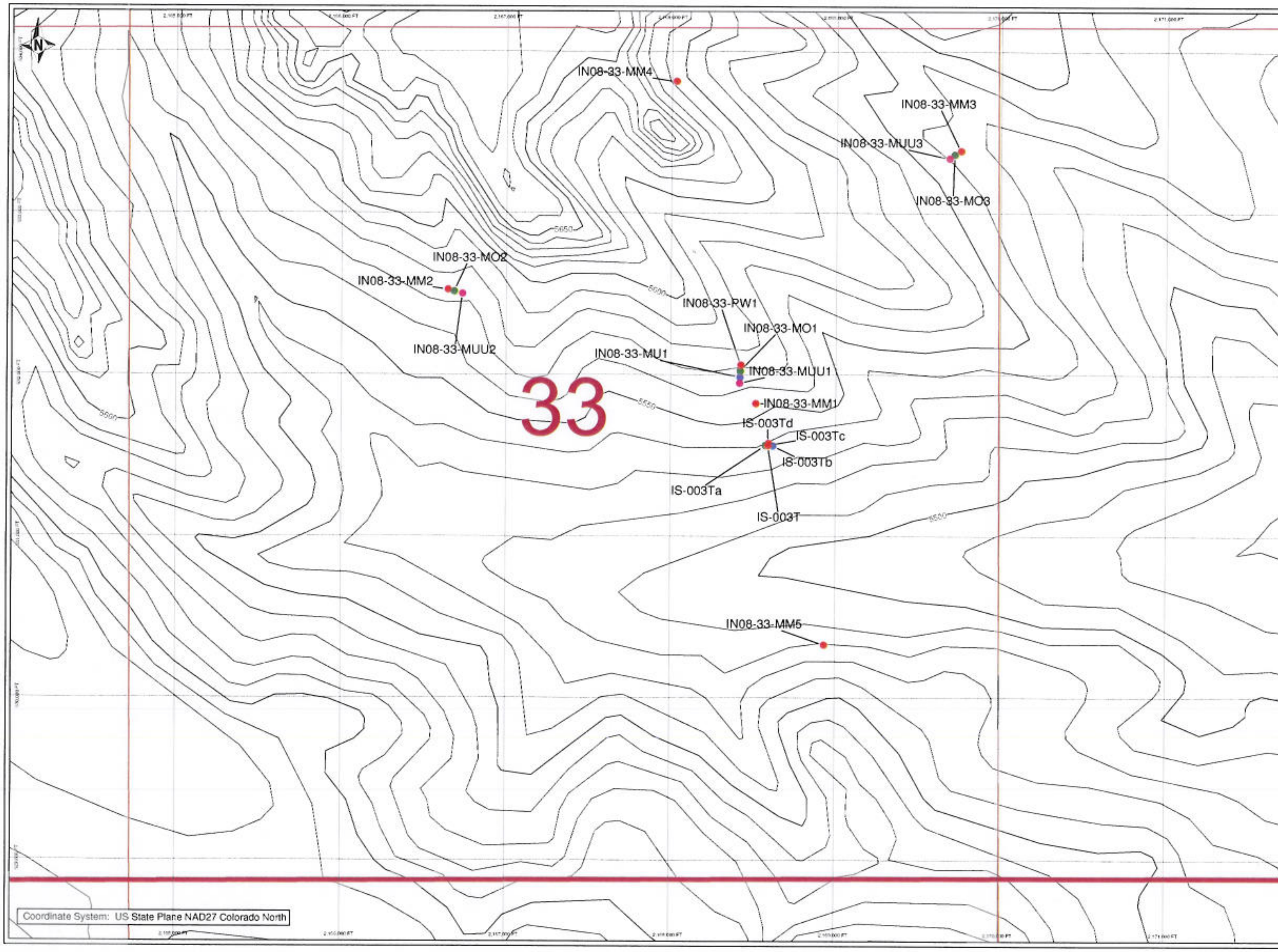
16c. *If Powertech provides an acceptable demonstration that injection at ambient pressure will minimize adverse water quality impacts, as discussed in item 11 above, DRMS can require sufficient bond for this type of injection. For this bonding option, Powertech must provide a technical evaluation of how long it would take to complete injection under ambient pressure.*

Response:

In theory, the rate at which an aquifer can be produced by pumping and the rate of injection at the same head differential are the same but opposite in sign (i.e., positive or negative). In the case of the Section 33 pumping test, if the production well PW-1 is pumped at 10 gallons per minute for 72 hours, under the same head differential, one should be able to reinject the produced water back into the same well at the same rate over the same period, i.e., 72 hours.

In practice, however, there may be other factors such as skin effects that may limit either production from the aquifer or the rate of injection into the aquifer. These factors may act either way, i.e., the rate of injection into the aquifer may be either greater than or less than the rate of production due to pumping. In most situations, the rate of injection is less than the rate of pumping.

At the Centennial pumping test location, there is more available head for reinjection under a vacuum than there is available drawdown above the A_2 Sand during pumping. As noted in the responses to Items 11 and 14, based on the preliminary estimates of transmissivity and storativity for the A_2 Sand, the projected drawdown in the pumping well at the end of 72 hours of pumping at 10 gallons per minute is less than 100 feet.



POWERTECH (USA) INC.

Centennial Project

Figure 6-1

Monitor Well Location Map

Section 33 Pump Test

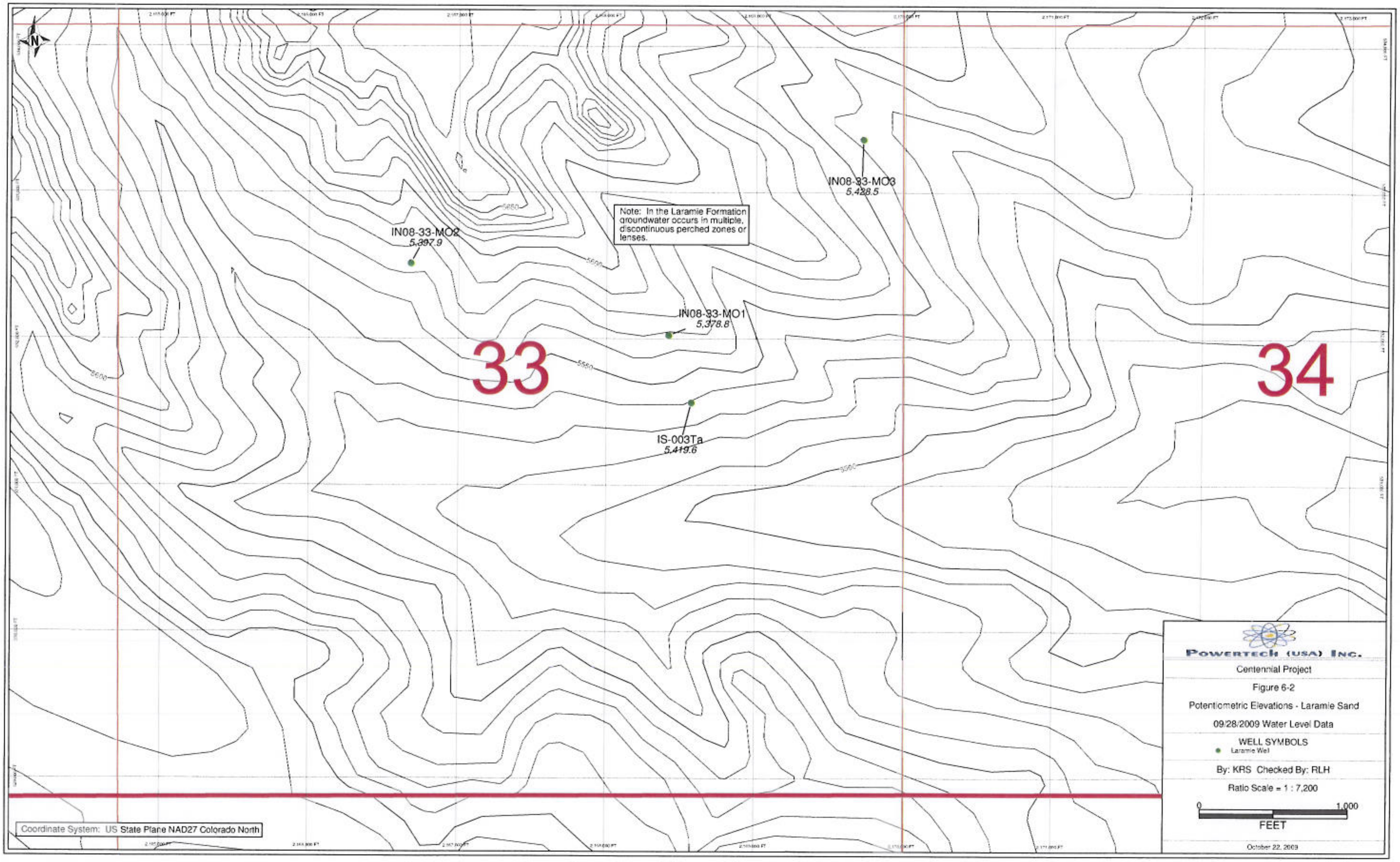
WELL SYMBOLS
- A2 Sand Well
- WE Sand Well
- Laramie Well
- B Sand Well

By: KRS Checked By: RLH

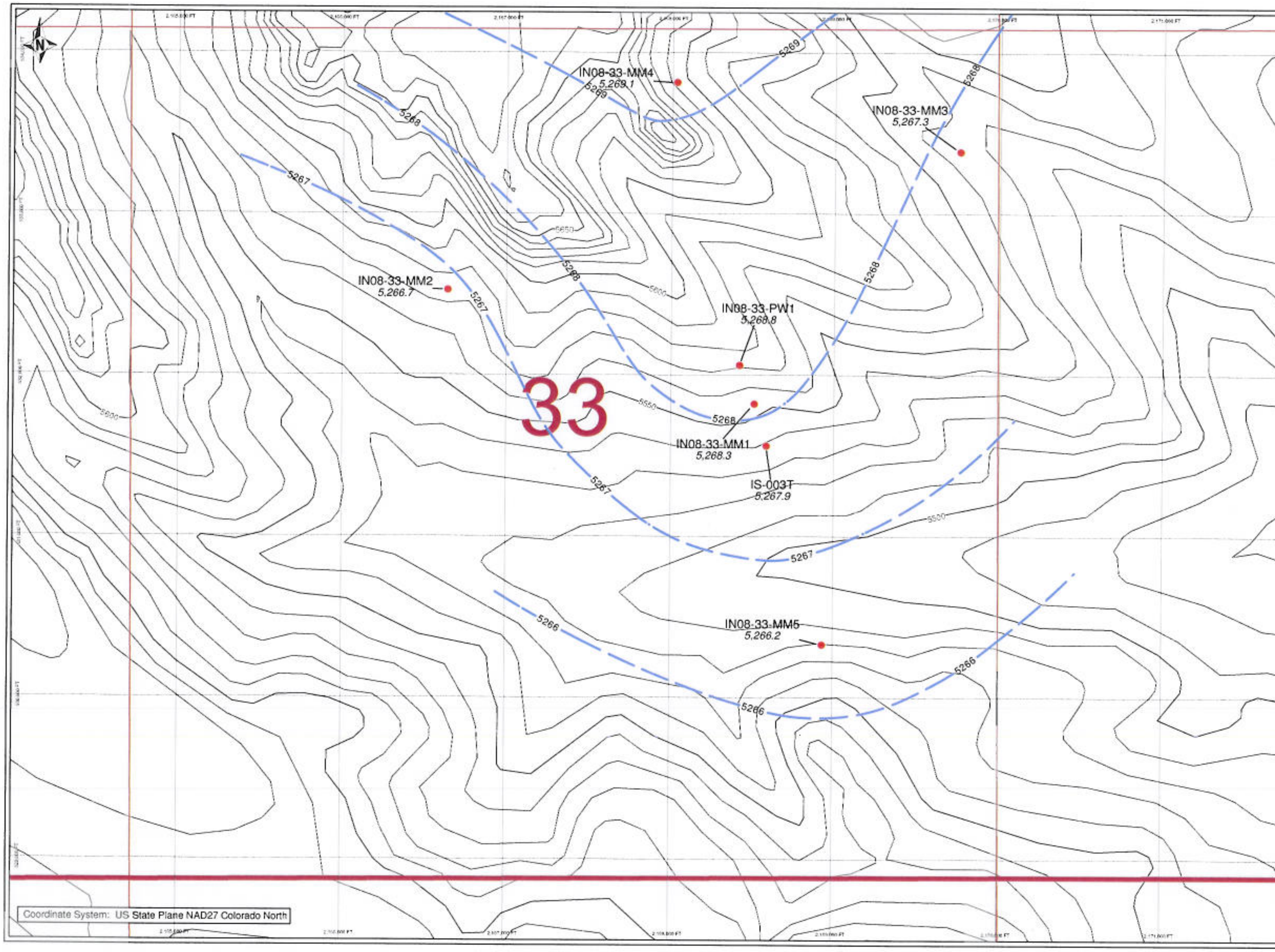
Ratio Scale = 1 : 7,200

0 — 1,000 FEET

October 22, 2009



N
IN08-33-MO3
5,428.5
Note: In the Laramie Formation groundwater occurs in multiple, discontinuous perched zones or lenses.
IN08-33-MO2
5,397.9
IN08-33-MO1
5,378.8
33
34
IS-003Ta
5,419.6
5650
5600
5550
5500
Coordinate System: US State Plane NAD27 Colorado North
Powertech (USA) Inc.
Centennial Project
Figure 6-2
Potentiometric Elevations - Laramie Sand
09/28/2009 Water Level Data
WELL SYMBOLS
Laramie Well
By: KRS Checked By: RLH
Ratio Scale = 1 : 7,200
0
1,000
FEET
October 22, 2009



Powertech (USA) Inc.

Centennial Project

Figure 6-3

Potentiometric Surface - A2 Sand

09/28/2009 Water Level Data

WELL SYMBOLS

● A2 Sand Well

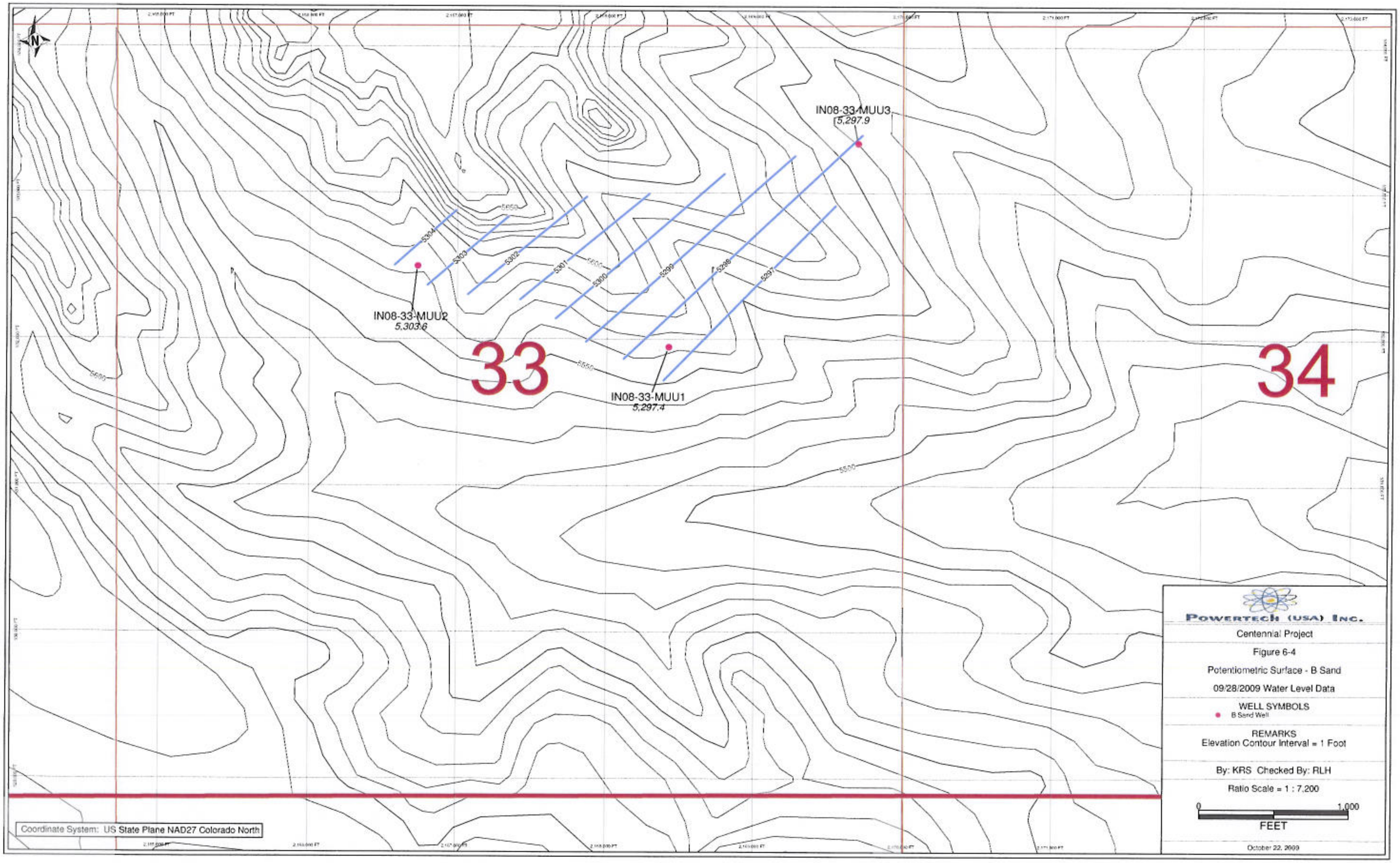
REMARKS

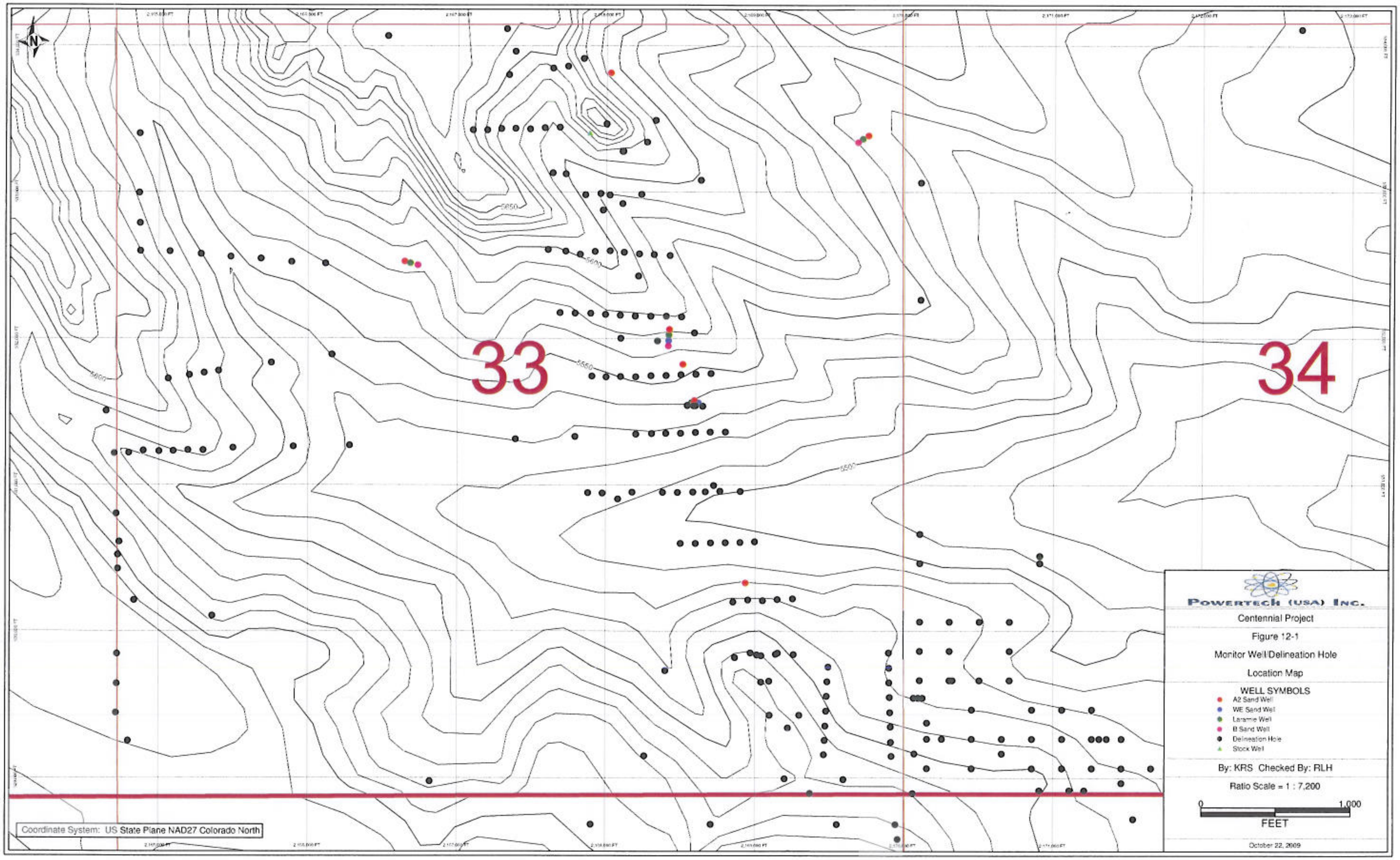
Elevation Contour Interval = 1 Foot

By: KRS Checked By: RLH

Ratio Scale = 1 : 7,200

0 — 1,000 FEET


IN08-33-MUU3
5,297.9
IN08-33-MUU2
5,303.6
IN08-33-MUU1
5,297.4
33
34
5304
5303
5302
5301
5300
5299
5298
5297
5650
5600
5550
5500
N
Coordinate System: US State Plane NAD27 Colorado North
POWERTECH (USA) INC.
Centennial Project
Figure 6-4
Potentiometric Surface - B Sand
09/28/2009 Water Level Data
WELL SYMBOLS
B Sand Well
REMARKS
Elevation Contour Interval = 1 Foot
By: KRS Checked By: RLH
Ratio Scale = 1 : 7,200
0
1,000
FEET
October 22, 2009



N
33
34
5650
5600
5550
5500
Powertech (USA) Inc.
Centennial Project
Figure 12-1
Monitor Well/Delineation Hole
Location Map
WELL SYMBOLS
A2 Sand Well
WE Sand Well
Laramie Well
B Sand Well
Delineation Hole
Stock Well
By: KRS Checked By: RLH
Ratio Scale = 1 : 7,200
0
1,000
FEET
October 22, 2009
Coordinate System: US State Plane NAD27 Colorado North

EXHIBIT 7

STATEMENT OF BASIS AND PURPOSE

UNDERGROUND INJECTION CONTROL REGULATIONS

OFFICE OF DRINKING WATER
ENVIRONMENTAL PROTECTION AGENCY

May, 1980

NATIONAL UIC PROGRAM DOCKET CONTROL NUMBER D 01079

STATEMENT OF BASIS AND PURPOSE

INTRODUCTION

This document is intended to summarize the basis and purpose underlying the underground injection control regulations promulgated in 40 CFR Part 146. It sets forth generally the reasoning behind the Agency's regulatory choices and references data upon which EPA relied.

This statement first discusses the categorization of wells. It then surveys the major pathways which contaminants can take to enter underground sources of drinking water and the requirements which these regulations impose to assure that movement of fluids resulting from well injection does not contaminate underground sources of drinking water. Programmatic requirements of Part 146, such as monitoring and reporting, are covered in the concluding section.

In general, the requirements of the regulation differ from those of the initial proposal of this regulation (**41 FR 36730**, August 31, 1976) and the reproposal of this regulation (**44 FR 36730**) in that they furnish a greater degree of flexibility to State Directors in regulating well injection. EPA has modified its earlier proposal in this way as it became more fully aware of various well injection practices, the characteristics of substrata into which fluids are injected, and the range of methods by which well injection is accomplished.

CATEGORIZATION OF WELLS

The regulations separate wells into distinct categories. This categorization is necessary to assure that wells with common design and operating techniques will be required to meet appropriate performance criteria.

In categorizing wells, EPA first looked to available literature regarding the injection practices. It considered information on existing and abandoned injection well practices, well construction technology, and on the variety of fluids injected into wells. It discussed with regulatory agency personnel from many States their experience with then-existing well injection regulatory practices and reviewed existing regulations in a number of States.[1] After such review and discussions, it commissioned a reputable consulting organization to provide assessments and a report on types of wells and their typical operation.[2] EPA then studied this information to arrive at a consistent and comprehensive well classification scheme. As a result, EPA decided to classify wells into the following five groups:

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[1] Interviews with State officials from Texas, Florida, Kansas, California and Michigan.

[2] Preliminary Injection Well Practices, Geraghty and Miller, Inc., Tampa, Florida; 1977.

Class I: Wells used by generators of hazardous wastes or owners or operators of hazardous waste management facilities to inject hazardous waste, other than Class IV wells. other industrial and municipal disposal wells which inject fluids beneath the lowermost formation containing, within one quarter mile of the well bore, an underground source of drinking water.

Class II: Wells which inject fluids (1) which are brought to the surface in connection with conventional oil or natural gas production (2) which are used for enhanced recovery of oil or natural gas and (3) which are used for storage of hydrocarbons which are liquid at standard temperature and pressure.

Class III: Wells which inject for e.xtraction of minerals or energy, including: mining of sulfur by the Frasch process; solution mining of minerals; in-situ combustion of fossil fuel, and recovery of geothermal energy.

Class IV: Wells used by generators of hazardous wastes or of radioactive wastes, by owners or operators of hazardous wasce management facilities or by owners or operators of radioactive wastes disposal sites to dispose of hazardous wastes into or above a formation which within one quarter mile of the well contains an underground source of drinking water.

Class V: Injection wells not included in Classes I, II, III, or IV.

In formulating these classifications, EPA gave substantial weight to a number of considerations. First the Agency concluded that wells which inject into strata nearest thd land surface should, as a general matter, be classified separately from those which inject into strata at greater depth. The method of injection which wells use is frequently dependent upon the injection horizon into which they deposit fluids. Wells which inject into strata near the land surface often inject by use of simple gravity. often crudely constructed, they can simply be holes dug or bored into the ground, the sides of which may be stabilized by brick, stone, timber, or other materials in the well. They can function as convenient dumping sites for wastes, or, in other instances, can serve beneficial purposes, such as recharging groundwater supplies or creating a subsurface barrier to saltwater intrusion.[3]

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[3] See Generally The Report to Congress, Waste Disposal Practices and Their Effects on Ground Water, U.S. Environmental Protection Agency (January, 1977), Sections V, VIII, XIII ("Report to Congress"); A Manual of Laws, Regulations, and Institutions-for Control of Groundwater Pollution, U.S. Environmental Protection Agency, (June, 1976), Chapter I ("Manual"). Underground Injection Control Regulations, Subpart F, Injection Well Practices, Draft Final Report, Geraghty and Miller, Inc. and Temple, Barker and Sloane, Inc. March, 1978 ("Subpart F"). Preliminary Evaluation of- Well Injection Practices, Geraghty and Miller, ("Preliminary Evaluation").

Wells which inject into lower strata are usually constructed and operated differently from wells which inject into strata near the land surface. Such wells are drilled rather than dug or bored, and emplace fluids into the subsurface by use of more sophisticated technology, materials, and equipment. Wells of this sort require the use of casing and cementing.[4] Escape of injected fluids into sources of drinking water is prevented by such casing, and by tubing and packer or other methods. Injection is accomplished by either the force.of gravity or the application of additional mechanical pressure to overcome the natural friction and hydrostatic,resistance of the receiving formation.[5]

In addition, aquifers nearest the land surface most often supply water for domestic use.[6] Consequently, wells which inject into or above these aquifers increase the risk of human exposure to the injected contaminants.

These considerations influenced the categorization of wells in Classes I and II separately from those in Classes IV and V. Classes I and II encompass wells which normally inject into strata below underground sources of drinking water. Class I wells are further limited to those which inject beneath formations which contain an USDW within 1/4 mile of the well site; other wells are included in Class V. The agency chose this approach since individual formations may be identifiable for hundreds of miles and a formation which is suitable in one area as a source of drinking water may not be in other sections. This limitation prevents a well from being subjected to Class I requirements simply because it injects under an aquifer which, miles away, contains drinking water. Class IV wells (which by definition inject into or above strata containing underground sources of drinking water) will generally inject into or above the aquifers nearest the land surface. Class V for the most part comprises wells which inject non-hazardous materials into those same aquifers.[7]

Also influencing this proposed well class-ification was the nature of injected fluids. Wells which handle hazardous materials war-rant close regulatory scrutiny. This consideration influenced EPA to create a separate category (Class I) for wells which dispose of industrial and municipal wastes. Such wastes commonly contain chemicals or other substances which can be fairly characterized as noxious and, as appropriate, require separate performance criteria. Nuclear waste practices are currently being reviewed by the Administration and therefore EPA is

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[4] §§ 146.12(b); 146.22(b); 146.32(a)

[5] See Generally Report to Congress, Section XI, XIII; Manual, Chapter IC: Preliminary Evaluation; Ground Water Pollution From Subsurface Excavations, U.S. Environmental Protection Agency, 1973, Part 2, Section II, Ground Water Pollution."

[6] Report to Congress, Sections III, IV; Manual, Chapter I, pp. I-10 -- 1-50.

[7] Report to Congress, Section VIII, IX, XIII: Manual, Chapter I; Subpart F; Preliminary Evaluation..

not including wells which inject nuclear waste a USDW into a Class I at this time.[8] Until a final policy is developed, such wells are included in Class V.

Similarly, among those wells which inject into aquifers nearest the land surface,.Class IV wells were separated from Class V because of the heightened risk which Class IV wells create. Class IV wells may be the most harmful class of wells because of the hazardous nature of fluids injected into them and the proximity of their injection zone to underground sources of drinking water. Within wells categorized as Class IV, two general subcategories may be defined: those which inject hazardous waste directly into underground sources of drinking water, and those which inject hazardous waste above underground sources of drinking water. It was felt that this difference was sufficient to warrant-distinct treatment. Accordingly, Class IV wells which inject into an underground source of drinking water are being banned under an "interim final" rule within 6 months after a State UIC program becomes effective. A decision regarding Class IV wells which inject above an underground source of drinking water is being reserved-at this time pending further Agency consideration and public comment. The rational for this approach is presented in more detail in a later discussion. Management of radioactive waste which is injected into or above USDWs will follow this same regulatory scheme, i.e., such waste injected into a underground source of drinking water will be banned within 6 months after a State UIC program becomes effective, and decisions regarding such waste injected above USDWs are being reserved. This applies to radioactive waste as defined by both RCRA and the Atomic Energy Act of 1954.

An additional factor which influenced this reproposed classification of wells was the Safe Drinking Water Act ("SDWA") itself. Sections 1421(b),(2) and 1422(c) of the SDWA state that regulations for State underground-injection control programs may not prescribe requirements which interfere with or impede underground injection in connection with oil and natural gas production or the secondary or tertiary recovery of oil and gas production unless such requirements are essential to assure that underground sources of drinking water will not be endangered by such injection. House Report No. 93-1185 accompanying the Act takes care to clarify this directive. At page 31, the Report characterizes the term "interferes with or impedes" as referring to only those requirements which could "stop or substantially delay" oil or natural gas production. Thus, the "test" of essentiality would only be relevant upon a demonstration that a requirement would stop or substantially delay such production.

EPA has observed this statutory admonition by including all injection wells relating to oil and natural gas production and hydrocarbon storage into a single category (Class II) with the exception of gas storage wells. Gas storage wells have been included in Class V wells. Such a grouping makes it possible to modify specific requirements and allow additional flexibility where possible without endangering human health. It was felt that the economic incentive for preventing leakage, and the relatively innocuous character (natural gas is not highly soluble)

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[8] Comprehensive Radioactive Waste Management Program Message from the President Received during Recess, Congressional Record - Senate, February 18, 1980

associated with gas storage wells warranted that these wells be studied further before subjecting them to regulation equivalent to other Class II wells.

Class III, which includes special process wells (including those used for solution mining) are classified separately from other wells because of their atypical injection practices. Special process wells serve a variety of purposes, including the extraction of minerals or other materials from the earth. Individual domestic injection wells used to generate heat and/or electricity, although special process wells, have been included in Class V. The Agency chose to consider these systems under Class V due to the limited impact on underground sources of drinking water anticipated from these wells. It should be noted that domestic syst ems utilizing a closed loop in conjunction with heat exchangers are not injection wells and consequently, are not covered under these regulations.

In the course of public review, a number of commenters urged that Class III wells be subcategorized. In response, the Agency commissioned a study to provide information on this issue.[9] Based on this study it does not appear that either current operating and construction practice for existing State regulations governing such wells differentiate sufficiently to warrant subcategorizing Class III wells. Consequently, the final regulations do not establish subcategories for Class III wells.

As stated earlier, Class IV wells injecting into a USDW are banned; decisions concerning Class IV wells injecting above an USDW are being reserved. In order to afford some level of protection before the final promulgation of regultions for Class IV wells and implementation of State UIC programs, all injectors of hazardous waste must obtain "interim Status" under the RCRA hazardous waste management program. The Agency decided to reserve final decisions concerning Class IV wells which inject above USDW's for several reasons. Commenters pointed out that injection wells which overlie deep or remote drinking water supplies would have little or no potential for contaminating the aquifer and thereby endangering health. Moreover, portions of some aquifers may be so deep or so remote that they may never serve as drinking water sources, or may not be subject to contamination from injection practices.

A further reason for the proposed approach is that regulations under RCRA and SDWA overlap at several points. Facilities under Class I and Class IV overlap the class of facilities designated under RCRA as hazardous waste management facilities. It is, therefore, appropriate that technical standards under RCRA and UIC be consistent, to the extent allowable under the governing statutes, for facilities capable of causing a similar degree of risk.

EPA anticipates issuance of permitting standards for HWM facilities until fall 1980. Adoption of UIC standards now for class IV wells could prove misleading to the States and the public, because EPA might decide this fall to revise the standards to reflect policy decisions

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[9] Development of Procedures for Subclassification of Class III Injection Wells, Geraghty and Miller, April 30, 1980.

made in connection with RCRA standards. Accordingly, EPA has determined that the best course is to defer the "technical standards for Class IV wells which inject above USDWs until fall 1980.

Finally, Class V wells include all wells not covered by the preceding categories, and those wells for which EPA currently lacks comprehensive information. With the exception of wells injecting radioactive waste, which are covered under Class IV and V, the Agency has reason to believe that Class V wells pose a significantly lesser environmental danger than do other categories of wells. Some Class V wells can cause risks to public health, of course, but many of them can be actually beneficial to groundwater. Due to incomplete data, EPA has classified these remaining wells together and is proposing no immediate performance criteria for them at this time. Instead, these wells are to be assessed and, based on that assessment, EPA will formulate a regulatory program suitable.for them at a later time. In the meantime, if remedial action appears necessary, an individual permit may be required (§122.37) or the Director may require remedial action or closure by order (§122.37(c)).

PERFORMANCE CRITERIA

The regulations propose the use of a variety of measures to assure that injection wells will not jeopardize underground sources of drinking water. This section addresses, the major technical requirements by discussing each in conjunction with the particular problem it is designed to prevent or remedy. The "problems" are basically six in number, and are described here as "pathways of contamination" - ways in which fluids can escape the well or injection horizon and enter underground sources of drinking water. These "pathways" are the following:

1. movement of fluids through a faulty injection well casing;
2. movement of fluids through the annulus located between the casing and well bore;
3. movement of fluids from'an injection zone through the confining strata;
4. vertical movement of fluids through improperly abandoned and improperly completed wells;
5. lateral movement of fluids from within an injection zone into a protected portion of that stratum; and
6. direct injection of fluids into or above an underground source of drinking water.

PATHWAY 1 - MIGRATION OF FLUIDS THROUGH A FAULTY INJECTION WELL CASING

The casing of a well can serve a variety of purposes. It supports the well bore to prevent collapse of the hole and consequent loss of the well, serves as the conductor of injected fluids from the land surface to the intended injection zone, and supports other components of the well. If a well casing is defective, injected fluids may leak through it. Such migration can contaminate an underground source of drinking water.[10]

To prevent migration of fluids in this manner, the promulgated regulations require that wells in Class I use casing sufficient to prevent the movement of fluids into any underground source of drinking water. Casing requirements for Class II and III wells are different and are discussed in more detail below.[11] The impact of this standard should va.ry on a well-by-well basis. In some instances, injection wells would only need a minimal surface casing to prevent migration of fluids into underground sources of drinking water. In other cases, multiple strings of casing might be necessary. EPA is proposing this flexible, goal-related standard, rather than a fixed requirement, in order to allow State Directors the discretion to vary the requirement, as appropriate, in each instance. Allowing this discretion should lessen the cost of the requirement while still accomplishing its preventive objective.[12]

The regulations also require wells to comply with certain operational requirements which can serve to minimize migration of fluids through casing. Foremost among these are the requirements to demonstrate mechanical integrity.[13] A mechanical integrity test is used to verify, as its name indicates, the "integrity" of a well, i.e., whether there is an absence of significant leaks.[14]

The determination of what constitutes a significant leak is left to the Director. This acknowledges the site-specific nature of the question and allows a case-by-case review of important local phenomena that must be considered in establishing-"significance". The regulations require operators of all new Class I-III wells (wells coming into operation after an

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[10] Report to Congress, Section XI, XIII; An Introduction to the Technology of Subsurface Wastewater Injection, U.S. Environmental Protection Agency (December, 1977), Chapter 7 ("Subsurface Wastewater Injection").

[11] §146.12(b). For a full discussion of the requirements for Class II, and III wells, see pages 11-12 below.

[12] Subsurface Wastewater Injection, Chapter 7.

[13] §146.08.

[14] See generally, Mechanical Integrity Testing of Injection Wells, Geraghty and Miller, Inc., April 30, 1980.

applicable UIC program becomes effective in the State) to conduct mechanical inte§rity tests and provide the results to the Director. If a test indicated that a well did not have mechanical integrity, i.e., it leaked injected fluids, the well would not be authorized for injection. For existing-wells, the regulations require that mechanical integrity be demonstrated before continued operation.of the well can be authorized.

The selection of a mechanical integrity test as a requirement of these regulations is uniquely appropriate because normally wells cannot be inspected directly. Well integrity can be demonstrated by the absence of a significant leak in the casing, tubing or packer and the absence of significant fluid movement into an underground source of drinking water. The regulations specify a choice of two tests to detect leaks, and two others to detect fluid movement.[15] The regulations specify monitoring of annulus pressure or pressure tests'with a liquid or gas for detecting leaks, and use of noise or temperature logs for detecting fluid movement. Existing Class II wells may use well records as proof of adequate cement to prevent fluid movement. These tests are commonplace in the well injection, industry, and are considered reliable indicators of mechanical integrity.[16]

The regulations also would allow the-use of mechanical text.[17] To integrity tests not specifically listed in the t use any of these tests, a Director would have to demonstrate its suitability for the intended. purpose and secure EPA approval prior to its use. Once approved by EPA, the test would be eligible for use by all persons unless specifically restricted. EPA allows this flexibility because it recognizes that there may be mechanical integrity tests which, although unspecified in the regulations, are fully adequate to detect well defects. Moreover, tests which might be acceptable may be developed in the future.

The regulations further require that operators of wells which have been authorized for injection under this program perform, additional,mechanical integrity testing at least once every five years of operation for most wells.[18] However, additional mechanical integrity tests for Class III wells will only be required for those wells which are used for relatively long periods, such-as salt solution and geothermal wells. Other Class III wells, which have a shorter life span, will not be required to perform periodic mechanical integrity tests. In addition, Class II wells may use well records to demonstrate the presence of adequate cement to prevent significant fluid movement. As part of an evaluation, a statistically valid random sample of wells will be tested with either noise or temperature logs to assess the adequacy of well records as a measurement of mechanical integrity.

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[15] §146.08(b),(c).

[16] see generally, Mechanical Integrity Testing of Injection Wells.

[17] §146.08(d).

[18] §§146.13(b),(3), 146.23(b),(3), 146.33(b),(3).

The Agency decided on the five year frequency period after long consideration and consultation with state officials. EPA staff determined that the requirement for a mechanical integrity test at least every five years during operation of the well would provide satisfactory assurance of continued well soundness and in addition would be reasonable from a cost perspective. Moreover, the five-year review schedule facilitates Agency efforts to combine the several permit programs under its charge.

A second protective feature of these regulations is the requirement for a tubing and packer, fluid seal, or an alternative approved by the director for Class I wells. The Agency applied this requirement to Class I wells due to the potentially corrosive nature associated with Class I wastes. This requirement does not apply to municipal. wells injecting non-corrosive fluids. The reproposal specified only tubing and packer or alternative. As a result of public comment, the Agency included the use of a fluid seal in the final regulations. Fluid seals are used extensively and have proved effective. Tubing and packer can best be described as a removable liner device within a well which isolates the casing of the well from injected fluids. By preventing this contact between casing and injected fluids, the possibility of movement of contaminants through leaks in the casing is greatly diminished. For the same reason, tubing and packer or equivalent also lessens the chances of corrosion of the casing. Tubing and packer offers two further advantages. It isolates the annulus (between the tubing and casing) from the injection zone, facilitating detection of any leaks in the tubing. It also allows for visual inspection for deterioration of the tubing during routine maintenance.[19]

The regulations make the use of tubing and packer or an acceptable substitute mandatory for Class I well S,[20] except for municipal wells injecting only non-corrosive wastes. EPA expects that Class I wells will be injecting highly corrosive material more frequently than Class II or III wells,[21] hence, routine use of tubing and packer or an acceptable substitute becomes appropriate (For Class II and III wells, the requirement to use tubing and packer is discretionary with the Director because the inflexible use of the requirement for Class II and III wells would likely interfere with production from many of these wells without any significant benefit to protecting USDW).[22] Even though a tubing and packer requirement is not mandatory for wells in Classes II and III, Directors should require its use when appropriate to prevent fluid migration into underground sources of drinking water.)

When the use of a packer in Class I wells is inappropriate, the regulations allow for use of alternative means to accomplish the'saime objective provided that the Director approves such

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19 Subsurface Wastewater Injection, Chapter 7.

20 §146.12(c).

21 Report to Congress, Section XIII; Ground-Water Pollution, Part 2, Section II.

22 Subsurface Wastewater Injection, Chapter 7.

methods.[23] In fact, based upon the type of well involved, it is possible that an alternative to tubing and packer or fluid seal might actually provide a greater degree of protection.[24] When other effective methods are proposed, EPA.does not oppose their use. Prior to use, however, EPA reserves the right of review and approval.

The final provision by which the regulations propose to eliminate contamination through this first pathway is to require that Class I and Class III wells-which in ect corrosive fluids be constructed of corrosion'-resistant materials. [25] This standard is intended to prolong the operating life and continued viability of wells.

PATHWAY 2 - MIGRATION OF FLUIDS THROUGH THE ANNULUS LOCATED BETWEEN THE CASING AND THE WELL BORE

A second way by which contaminants can reach underground sources of drinking water is by migrating upward through the annulus located between the drilled hole and the casing. Under usual injection conditions, injected fluids, upon leaving the well in the injection zone, enter a stratum which to some degree resists the entry of the fluids. Resistance results from friction created by extremely small openings in the materials which comprise the injection zone. Because fluids tend to take the path of least resistance unless properly contained, they may travel upward through this annulus. If sufficient injection pressure exists, the fluids could migrate into an overlying source of drinking water.

The measures taken in the regulations to prevent contamination by this pathway are parallel to those already mentioned concerning Pathway 1. In this case, well injectors must demonstrate to the satisfaction of the Director that there is no significant fluid movement into underground sources of drinking water through this annulus. Mechanical integrity tests can be conducted to provide information on contamination by this route.[26] As with Pathway 1, and for the same reasons, mechanical integrity must be demonstrated at least every five years.

For Class I and III wells, the annulus between the hole and casing must also be filled with cement adequate to prevent the flow of fluids into an overlying drinking water source.[27] Depending upon the complexity of the well, this cementing can be accomplished in different

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[23] §146.12(c)(1).

[24] Subsurface Wastewater Injection, Chapter 7; See also Cook, T.D. Underground Waste Management and Environmental Implications. American Association of Petroleum Geologists (Tulsa, Okla., 1972).

[25] §146.12(c).

[26] §146.08

[27] §§146.12(b); 146.32(a).

ways. A well with a single casing, for example, may need cementing at only one interval (e.g., through the confining stratum which separates the injection zone from the source of drinking water). Other wells, which penetrate to greater depths or which involve more than one casing, may need a more elaborate cementing procedure. Because of this range, EPA is proposing the cementing requirement in general terms and intends to leave decision making to Directors' discretion. Directors are instructed in the regulations to take a variety-of factors into account when determining specific cementing requirements for individual wells.[28]

All new Class II wells will be subject to requirements outlined above. Existing and converted Class II wells need nut meet these requirements if they were subject to regulatory controls at the time they were drilled and they are in compliance with those controls, and injection will not result in the migration of fluids into an underground source of drinking water so as to create a significant risk to the health of persons using the source as drinking water. Similarly, new (newly drilled) wells in existing fields must meet casing and cementing requirements applicable to the field, and cannot allow movement of fluids into an underground source of drinking water if such movement will create a significant risk to health of persons.[29]

For Class III wells, all new wells must comply with the requirements discussed above. Existing wells which have long lives, such as salt solution and geothermal wells, must demonstrate mechanical integrity; however, they are not required to meet other casing and cementing requirements. Various considerations underlie this modified approach.

As mentioned in the preamble to these regulations, costs played a role: EPA data indicates that compliance for Class II wells equivalent to casing and cementing requirements for Class I wells could generate cos ts to the oil industry of more than $20 billion over 5 years.[30],[31] Imposing regulatory requirements of this financial magnitude in EPA's view, would interfere with injection of brines or other fluids which are brought to the surface in connection with Oil and natural gas production and with injection for secondary or tertiary recovery of oil or natural gas without being essential to assure that underground sources of drinking water will not be endangered by such injection. Moreover, the imposition of this casing and cementing requirement could be an unnecessary disruption of state UIC programs currently in effect and being enforced in a substantial number of states.

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[28] §§ 146.12(b),(l)-(7); 146.22(b),(l)-(7); 146.32(a),(l)-(7).

[29] §146.22(b).

[30] Estimated after discussions with consultants. See generally Cost of Compliance Proposed Underground Injection Control Programs, Oil and Gas Wells, Arthur D. Little, Inc. (June, 1979) ("Oil and Gas Wells").

[31] See generally Underground Injection Control Program Class II Well Incremental Compliance Cost Refinements. Booz, Allen and Hamilton Inc., and Geraghty and Miller, Inc., April 30, 1980.

In addition, the imposition of the "full" casing and cementing requirement on Class II wells in existing injection fields would not yield significant environmental benefit. If past injection was performed in an unsafe way, nearby water resources will likely be too contaminated for consumption as drinking water. Imposing casing and cementing in this instance would not be helpful to the environment. On the other hand, if the injection has been performed historically in a way which is protective of underground drinking water, it is reasonable to believe that the injection method will continue to protect underground sources of drinking water. These facts are particularly applicable to Class II wells because they are relatively older than wells in other categories[32] and are normally found in groups the members of which are similarly constructed.[33] Older wells, with longer histories of operation; are more likely to have contaminated drinking water, if at all, by this time, than are newer wells. Moreover, the similar construction of wells in specific fields increases the chances that, if contamination has occurred, it is already extensive.

Lastly, the need for the "full" casing and cementing of Class II wells is generally less because-brine and other fluids associated with oil and natural gas production pose less threat to human health than fluids which Class I and some Class III wells often inject.

PATHWAY 3 - MIGRATION OF FLUIDS FROM AN INJECTION ZONE THROUGH THE CONFINING STRATA

The third way by which fluids can enter an underground source of drinking water is from an injection zone through the confining strata. Upon entry into an injection zone, fluids injected under pressure will normally travel away from the well laterally and through the receiving formation. In most cases, this expected occurrence gives rise to no concern, but, if the confining stratum which separates the injection zone from an overlying or underlying underground source of drinking water is either fractured or permeable, the fluids can migrate out of the receiving formation and into the protected region.

For obvious reasons, there are no well construction standards which can address this problem of migration of fluids through this pathway. Consequently, the regulations propose two provisions to assure that fluids do not travel this pathway into underground drinking water. First, the regulations require that, prior to the issuance of a permit, the geologic characteristics of the injection zone and confining strata be reviewed.[34] Data already available to states can assist Directors in making these reviews. A permit should only be issued upon the Director's finding that the underground formations are sufficiently sound to contain fluids in the injection zone.

Second, the regulations require that well injection pressure be controlled to prevent opening fractures in the confining strata or otherwise causing the rise of fluids into an overlying

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32 Report to Congress, Section XI.

33 Id.

34 §§146.14(a)(l); 146.24(a)(l); 146.34(a)(l).

protected zone.[35] Using this mechanism, injection pressures can be restricted to provide conservative protection even in the face of less than ideal geologic characteristics. For example, if a confining stratus is known to be fractured or permeable, injection might be permissible if done at predetermined pressure levels which under no circumstances could cause a rise of fluid to the height at which it would enter a drinking water source.

PATHWAY 4 VERTICAL MIGRATION OF FLUIDS THROUGH IMPROPERLY ABANDONED AND IMPROPERLAY COMPLETED WELLS

One of the common ways by which fluids can enter an underground source of drinking water is by migration through improperly abandoned and improperly completed wells. This would occur if fluids moving laterally within an injection zone encountered an improperly abandoned or completed well, and, following the path of least resistance, flowed upward within the well until entering an overlying underground source of drinking water or overflowing onto the land surface. Because of the large number of wells drilled in the past, and because well operation and abandonment have not always benefitted from close regulatory scrutiny, contamination by this route can present a significant risk to public health. It is estimated that there are about 17,000 improperly abandoned or improperly completed wells which could cause this problem.[36]

To prevent this contamination, the regulations require Directors to determine an "area of review" for injection wells. This is the area around the injection well through which the incremental pressure of injection can cause vertical migration. Operators of Class I, III, and new Class II wells (operators of existing and converted Class II wells are treated differently; see below) must locate other wells within the "area of review" and correct any problems related to improperly abandoned or improperly completed wells before beginning injection.[37] Under this approach, well injectors would have the affirmative responsibility to demonstrate that the proposed injection operation would not cause contamination by this route.

Directors could choose either of two methods to determine the area of review. the first method would be to require use of mathematical formulae to determine, on a case by case basis, the lateral impact which an injection operation could cause. The formula would indicate the distance outward from the well which this particular injection would or could affect. The Regulations provide one formula which can be used for this purpose. It takes into account a range of factors, including hydraulic conductivity, thickness of the injection zone, time of injection, storage coefficient, injection rate, hydrostatic head and specific gravity. EPA is proposing this particular formula because it is based on an equation which has been in common use for years and, in that time has demonstrated satisfactory results; however, other suitable

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[35] § 146.06

[36] Oil and Gas Wells; Chapter VIII-D.

[37] §122.44(a).

formulae are acceptable.[38]

If a suitable formula indicates that no problem exists, injection could commence without any obligation to repair faulty wells found within the area of review. If it did indicate a problem, however, the well operator would be expected to correct it. Correcting the problem could mean that the well operator would have to plug a faulty well at his/her expense. In other cases, the operator might simply have to modify injection pressure to assure that the rise of fluids caused would not cause fluids to enter an underground source of drinking water.

The use of a formula to determine the area of review may not always be feasible. In some instances, necessary information may be lacking. Such formulae also do not have universal applicability: Mathematical formulae, because they are based on ideal conditions (that aquifers are homogeneous, isotropic, and infinite in extent, for example), may not always reflect actual subsurface conditions. Moreover, they assume radial flow in all directions and, in some cases, will not yield a finite distance measurement for well review purposes.

Because of these possibilities, the regulations offer a second method for determining the area of review. Directors may use (in lieu of a case by case formula) a fixed radius of one-quarter mile or greater. The Agency selected this minimum radius after consideration of current state practices and after applying it to a randomly selected population of well fields representing various geologic conditions. EPA had considered use of more extensive review requirements, particularly the use of one-half mile radius for area of review computation, but decided-against them because the less rigorous requirement is more cost-effective, and the one-fourth mile radius proved satisfactory in actual applications.[39] In many cases, use of a larger fixed radius would result in duplicative review of the same wells.

Moreover, the quarter-mile radius is compatible with coverage practiced in most states. Generally, states impose review requirements on we'll operators in a range of 1000 feet from the injection site up to two miles. EPA's selection of the quarter-mile distance represents its assessment of the effectiveness of these varying requirements in the state programs.[40]

EPA has modified the area of review requirement for Class II wells.[41] Unlike the proposal for wells in Classes I and III, the regulations require that only new Class II wells observe area of review requirements. Class II is characterized by large numbers of wells clustered in oil fields. Because new injection wells are interspersed with existing Class II wells, imposing the area of review requirements on new Class II wells should still result in discovery

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[38] §146.06(a).

[39] See generally Oil and Gas wells, Chapter VIII.

[40] Preliminary Evaluation of Well Injection Practices.

[41] §146.24(a),(2).

and correction of all faulty wells within the existing well fields, although over a more extended time frame.[42] The Agency opted for this approach because it deemed it to be effective, both.from an environmental and cost perspective, and because it considers placing expenses on new, rather than existing, well operators to be a preferable regulatory approach.[43]

With respect to corrective action itself, the regulations impose a flexible standard. Corrective action required for each well will be fashioned by the Director on a case by case basis after considering a variety of site specific criteria.[44] EPA prefers this approach because of the variety of problems or conditions which can trigger the need for corrective action. In one instance, the only corrective action which may be needed to prevent the migration of fluids into an underground source of drinking water through a faulty well might be a reduction of the pressure at which fluids are injected. In other instances, monitoring of nearby wells coupled with a contingency plan to remedy any problems which result from the injection operation might be feasible. In still other cases, it might be necessary to correct the wells. This range of possibilities, as well as the significant costs which corrective action can generate; have encouraged the Agency to adopt the more flexible approach.

PATHWAY 5 - LATERAL MIGRATION OF FLUIDS FROM WITHIN AN INJECTION ZONE INTO A PROTECTED PORTION OF THAT STRATUM

In the most cases, the injection zone of a particular well will be physically segregated from underground sources of drinking water by impermeable materials. In some instances, however, well injectors,may inject into an unprotected portion of an aquifer which in another area will be designated for drinking water purposes. In this event, there may be no impermeable layer or other-barrier to prevent migration of fluids into underground drinking water.

Injection into unprotected portions of aquifers which contain drinking water in other areas must be done with great care. The regulations control this potentially dangerous activity by according the Director a range of construction and operating controls which can be imposed at his/her discretion.[45] Notwithstanding the discretionary controls afforded the Director, specific information must be considered by him prior to allowing injection into such an aquifer. The Director must consider such factors as the injection pressure, the nature of the fluid injected, specific geologic and hydrogeologic conditions, ground water use patterns and other factors. Usually, Directors can allow injections of this type if the predominant flow of the aquifer is such that injected fluids will tend to move away from, rather than toward, the protected part of the aquifer. Even if that is not the case, however, Directors could still allow the injection if any of a

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[42] See generally Oil and Gas Wells, Chapter VIII.

[43] Id.

[44] §§146.07, 146.14.

[45] §146.12; 146.22; 146.32.

variety of operational conditions were satisfied. For example, the Director might allow an injection upon a determination that the rate of flow or the volume or pressure of injection was sufficiently small to assure that fluids would not enter.the prote-cted region.

PATHWAY 6 - DIRECT INJECTION OF FLUIDS INTO OR ABOVE AN UNDERGROUND SOURCE OF DRINKING WATER

The last pathway of contamination of groundwater is potentially the most worrisome. The injection of fluids into or above underground sources of drinking water can present the most immediate risk to public health because it can directly degrade groundwater especially if the injected fluids do not benefit from any natural attenuation from contact with soil, as they might during movement through an aquifer or separating stratum.

The regulations prohibit injection of contaminants directly into an underground source of drinking water for wells in Classes I to III;[46] Class IV wells, which inject directly into underground drinking water are to be banned as soon as possible but in no event later than six months after a State underground injection control program becomes effective. Class IV wells which inject above an underground drinking water source are to be studied further. Accordingly, EPA has decided to defer issuance of permitting and technical standards for Class IV wells until this fall. Class V wells, of which little is known, will be assessed before regulations for their operation are proposed[47] (for a fuller discussion of the regulatory approach proposed for Class IV and V wells, see the preamble to the regulations).

OTHER REQUIREMENTS

ABANDONMENT - the regulations also require that well injectors abandon their injection wells in a way which will prevent the contamination of underground sources of drinking water.[48],[49] As indicated earlier, abandoned wells can act as conduits for contaminants to enter protected aquifers. To assure that currently used and future wells do not create problems of this type, the regulations require plugging of wells after termination of operation. Again, the exact means of accomplishing an effective abandonment are left to the judgment of the Director to be exercised on a case by case basis. In addition, §146.10(d) requires the operator of a Class III well to subinit a plan of abandonment which must demonstrate that no movement from the mining zone into underground sources of drinking water will occur after abandonment.

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[46] §122.34(a)(1).

[47] §146.52(b)(l).

[48] §146.10.

[49] See Generally, Development of Procedures and Costs for Proper Abandonment and Plugging of Injection Wells, Booz Allen and Hamilton Inc., and Geraghty and Miller, April 30, 1980.

§146.10(b) specifies that the dump bailer method, the balance method, or.the two plug method be used to plug a well. These practices represent existing methods employed that have proved effective in a wide range of application.[50]

With respect to Class IV wells, traditional methods of abandonment, such as plugging, may be inappropriate due to the crude construction of the well. In such a case, the only abandonment requirements might simply be closure of the well.

MONITORING FREQUENCIES

The regulations also require various kinds of monitoring.[51] Monitoring can provide an early warning of potential serious degradation of underground sources of drinking water.

Wells in Classes I, II, and III share common monitoring requirements. Injection fluids must be tested with sufficient frequency to field data representative of fluid characteristics. Information of this sort is essential for the Director to understand the operation of a particular well. Such information serves the important function of providing basic knowledge of enabling Directors to analyze reasons for well failures, to establish appropriate remedies to correct them and to assess any endangerment the failures might cause.

The regulations also require monitoring of operating characteristics of wells in Classes I, II, and III. Class I and III wells must have continuous recording devices to monitor injection pressure, flow rate, and volume of injection fluids.[52] Continuous monitoring is appropriate because fluids injected by Class I and III wells are usually more corrosive and hazardous than are fluids injected by others. These fluid properties increase the risk of serious well leaks or failures. Continuous monitoring, furthermore, is a common practice for these wells, in part because they often inject fluids in uninterrupted streams.

Class I wells must comply with the additional requirement of continuously monitoring the pressure in the annulus of the well between the tubing and the long string. The "long string" is the casing which extends from the ground surface to the injection zone. Wells in Class III which may require the use of the annulus for injection, need not meet this requirement since, when the annulus is employed for injection, pressure measurements reflect injection pressure.

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[50] Development of Procedures and Costs for Proper Abandonment and Plugging of Injection Wells.

[51] §§146.13; 146.23; and 146.33.

[52] §§146.13(b)(2); and 146.33(b)(2).

Class II injection well monitoring provisions aze less stringent than those for Classes I and III.[53] Continuous monitoring is not required for Class II; rather, depending on the actual injection operation, monitoring frequency varies from daily to monthly. A stricter approach is not essential for Class II wells because of the lesser toxicity and corrosivity of fluids which Class II wells handle and because the total cost of imposing continuous monitoring on Class II wells would have been inordinately burdensome in EPA's view.[54]

Class III wells are also required to monitor, on a quarterly basis, water supply wells adjacent to the injection site to detect any excursions from the injection site.[55] This monitoring is commonly practiced by operators of Class III wells.[56] EPA is promulgating this requirement for Class III wells (and not for Class I wells) because Class III wells are often designed to inject into shallower strata, thereby increasing the possibility of contamination of aquifers nearest the land surface.

This added risk has prompted the Agency to require monitoring wells at each project site, located to maximize the probability of detecting any horizontal or vertical fluid excursion from the injection zone. Weekly monitoring of the fluid levels in these monitoring wells and of parameters appropriate to determine if any excursions of injected fluids are entering underground sources of drinking water, is also required. This requirement, although involving additional expense, was considered necessary to assure that any migration of these potentially harmful injected fluids into underground sources of drinking water, which are often located quite close to the injection zones, would be discovered and rectified promptly. Class III wells may be monitored on a field or project basis rather than an individual well basis by manifold monitoring e.g. using a common header with individual well points. This approach may be used with facilities that consist of more than one injection well if the owner or operator can demonstrate that manifold monitoring is comparable to individual well monitoring.[57]

No monitoring requirements are proposed for Class V wells. These wells will be assessed under the proposed regulatory scheme. The assessment should produce a substantial amount of data upon which an entire regulatory approach, including monitoring, can be used.

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[53] §146.23(b).

[54] Oil and Gas Wells, Chapter V-B, C.

[55] §146.33(b)(5).

[56] Comments of Freeport Sulfur Co., Jan. 14, 1977; Statement by Texas Gulf Co., Oct. 13, 1976.

[57] §146.33(b)(6).

REPORTING

The regulations also impose reporting requirement on well injectors.[58] Owners and operators of wells regulated under Classes I and III must report the results of monitoring and any other significant operational information at least quarterly, while Class II well owners and operators need only report to the director annually. The reasons underlying these proposals parallel those for the monitoring requirements. Owners and operators of wells which inject fluids of greater potential hazard must report more often than those which do not. Class V wells need not submit monitoring or reporting data because the assessment planned for this category will supply EPA with a substantial amount of data in its own right.

[58] §§ 146.13; 146.23; and 146.33.