

Recent Changes to WDEQ In Situ Rules

LQD & WQD Rules

WQD - Chapter 8, Section 4 - In Situ Restoration

LQD - Chapters 7 and 11- Noncoal In Situ Mining

Power Resources, Inc. (PRI) - Highlands,
Erosion Fabric in F-Wellfield Drainage,
6/98, Quarterly Inspection.



Recent Changes to WDEQ In Situ Rules

Regulatory Framework - Overview

Purposes of the LQD & WQD Rule Packages

Hot Topics in the Rule Packages

PRI - Smith Ranch,
Wellfield 4 Pilot Holes,
12/98, Quarterly Inspection.



Regulatory Framework - Overview

Federal

EPA - Safe Drinking Water Act

- ◆ Underground Injection Control Program
- ◆ Code of Federal Regulations
- ◆ EPA Delegation of Primacy to WDEQ

NRC - Atomic Energy Act

- ◆ NRC Draft Memorandum of Understanding (MOU) with WDEQ

State

WDEQ

- ◆ ‘As stringent as’ federal requirements
- ◆ Wyoming Environmental Quality Act (WEQA)
- ◆ WQD Memorandum of Understanding with LQD
- ◆ Policies

Regulatory Framework - Overview

EPA - Safe Drinking Water Act (SDWA, 1974)

- ◆ 1974 - Underground Injection Control (UIC) Program established as part of SDWA.
- ◆ 1980 - 1st UIC Regulations
Class III wells - wells associated with solution mining.
- ◆ 1983 - EPA Delegation of Primacy to WDEQ.

Regulatory Framework - Overview

NRC - Atomic Energy Act (1954)


- ◆ NRC has a process similar to EPA ‘primacy’, through which a State is deemed an ‘Agreement State’. However, Wyoming has never sought Agreement State status for a variety of technical, regulatory, and monetary reasons.
- ◆ Prior to 2000, the NRC exercised jurisdiction over surface activities only (e.g., ore processing through ion exchange). However, in 2000, the NRC decided that NRC jurisdiction extends to the subsurface activities in the wellfields. (SECY-99-0013).
- ◆ In 2003, to help reduce or avoid dual regulation as a result of this decision, the NRC approved work on MOUs with the non-Agreement States - Wyoming, Nebraska, & New Mexico (SECY-03-0186).

Regulatory Framework - Overview

Wyoming Environmental Quality Act

- ◆ Created in 1973, specific in situ mining provisions (similar to current provisions) added in 1979.
- ◆ Associated WDEQ rules promulgated in 1980. Few changes until 2005.
- ◆ LQD Guideline 4 also developed in 1980. Periodically updated.

WQD/LQD Memorandum of Agreement

- ◆ Developed in 1996 to identify the “respective responsibilities of the divisions regarding the permitting and enforcement actions relation to mining operations.”
 - ◆ LQD responsible for in situ mining permits.
 - ◆ Groundwater classification responsibilities remain with WQD for consistency among all users.
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Regulatory Framework - Overview

WDEQ Policies

Three policies which impact in situ mining have been developed in the last few years:

- ◆ Wellfield Averaging (WDEQ 1996)
- ◆ Treatability Criteria (WDEQ 2000)
- ◆ Monitored Natural Attenuation
(EPA 1980s-1990s /WDEQ 2000)



PRI - Highlands, Well Installation in Wellfield H, 3/00, Quarterly Inspection.

Regulatory Framework - Overview

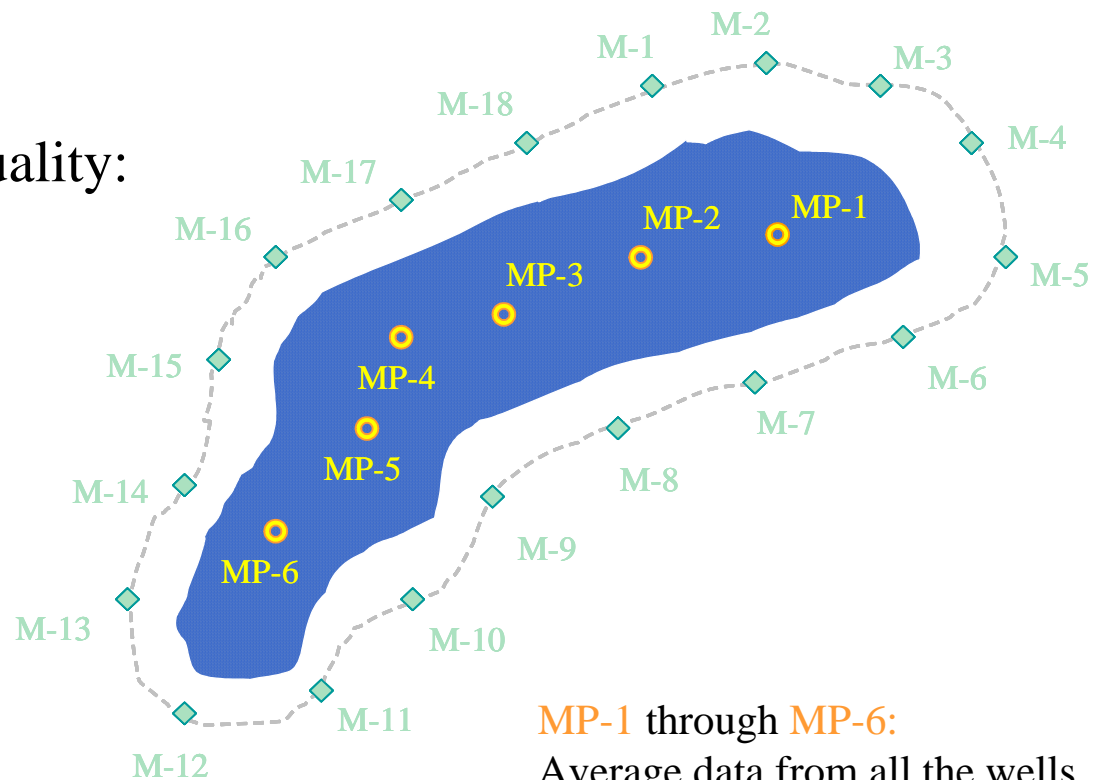
Wellfield Averaging

To characterize baseline water quality:

- ◆ Water quality data from inside the ore zone is averaged.
- ◆ Water quality data at the monitor well ring is on an individual well basis.

Primary reason:

- ◆ Extent of mixing in ore zone during mining.



MP-1 through MP-6:
Average data from all the wells.

M-1 through M-18:
Use individual well data.

Regulatory Framework - Overview

Radium Treatability Criteria

- ◆ Chapter 8, Section 5(a) provides WQD authority to set "treatability limits" for Class I (Domestic) groundwater which "shall be classified by ambient water quality and the technical practicability and economic reasonableness of treating ambient water quality to meet use suitability standards."
- ◆ The Class I standard for radium is 5 picoCuries per liter (pCi/l), and the treatability limit was 100 pCi/l.
- ◆ In 2000, at a joint meeting of LQD's and WQD's respective Advisory Boards, the decision was made to rescind the radium treatability limit.
- ◆ Primary reason: Concern was that, despite the ready treatability of radium (e.g., the Hanna water supply), an individual treatment unit could result in a radioactive source.

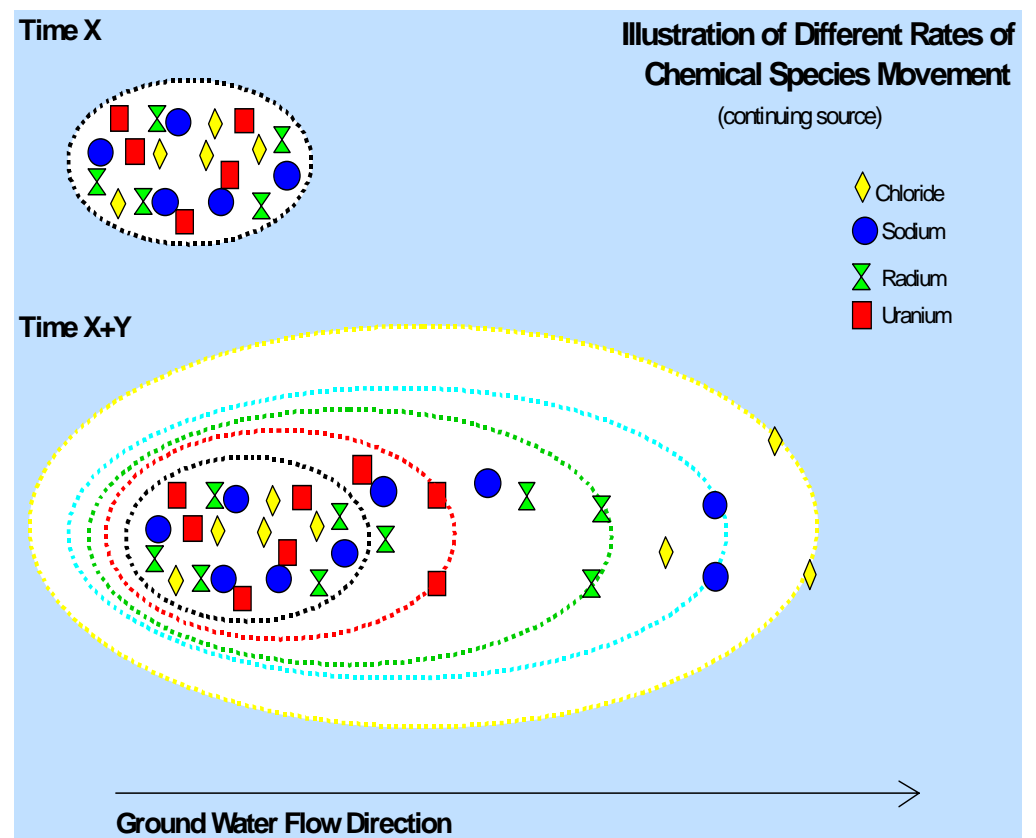
Regulatory Framework - Overview

Monitored Natural Attenuation

- ◆ To ensure water is still suitable for the uses for which it was suitable prior to mining.

Primary reasons:

- ◆ Uncertainty about effectiveness of MNA for in-situ, particularly given change in oxidation-reduction conditions.
- ◆ Potential impacts if not effective.



Changes to WDEQ In Situ Rules

✓ Regulatory Framework

→ Purposes of the LQD & WQD Rule Packages

Hot Topics in the Rule Packages

PRI - Smith Ranch,
Drilling activity in Wellfield 3,
12/98, Quarterly Inspection.



Changes to WDEQ In Situ Rules

Purposes of the LQD & WQD Rule Packages

- ◆ *Wyoming Program ‘Maintenance’;*
- ◆ *‘Harmonize’ Federal & State requirements;*
- ◆ *Clarify & coordinate language; and*
- ◆ *Address technical issues/improvements.*

*Some of
these are
also hot
topics.*

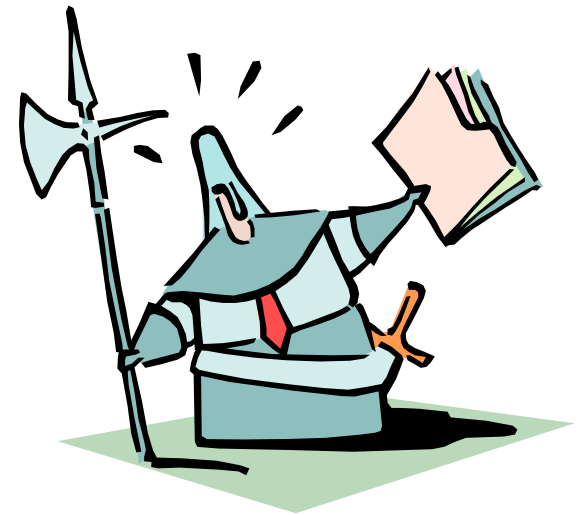
PRI - Highlands, F-Wellfield,
2nd year in operation. 7/98,
Quarterly Inspection.



Purposes of the LQD & WQD Rule Packages

Wyoming Program ‘Maintenance’

- ◆ Some of the decisions made by WDEQ and EPA when primacy was granted are not clear because documentation may not have been maintained and personnel involved in the decisions are no longer with the agencies.
- ◆ Need to update for EPA revisions since primacy was granted.

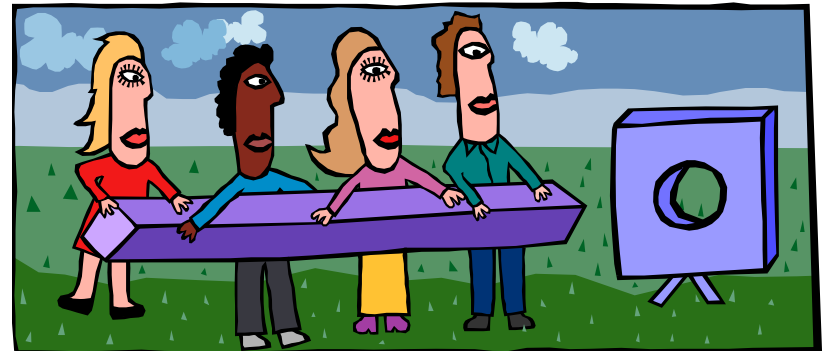


Purposes of the LQD & WQD Rule Packages

‘Harmonize’ Federal and State Requirements

2 Examples

- ◆ Permitting Process; and
- ◆ Applicability.



‘Harmonize’ Federal and State Requirements

The Permitting Process

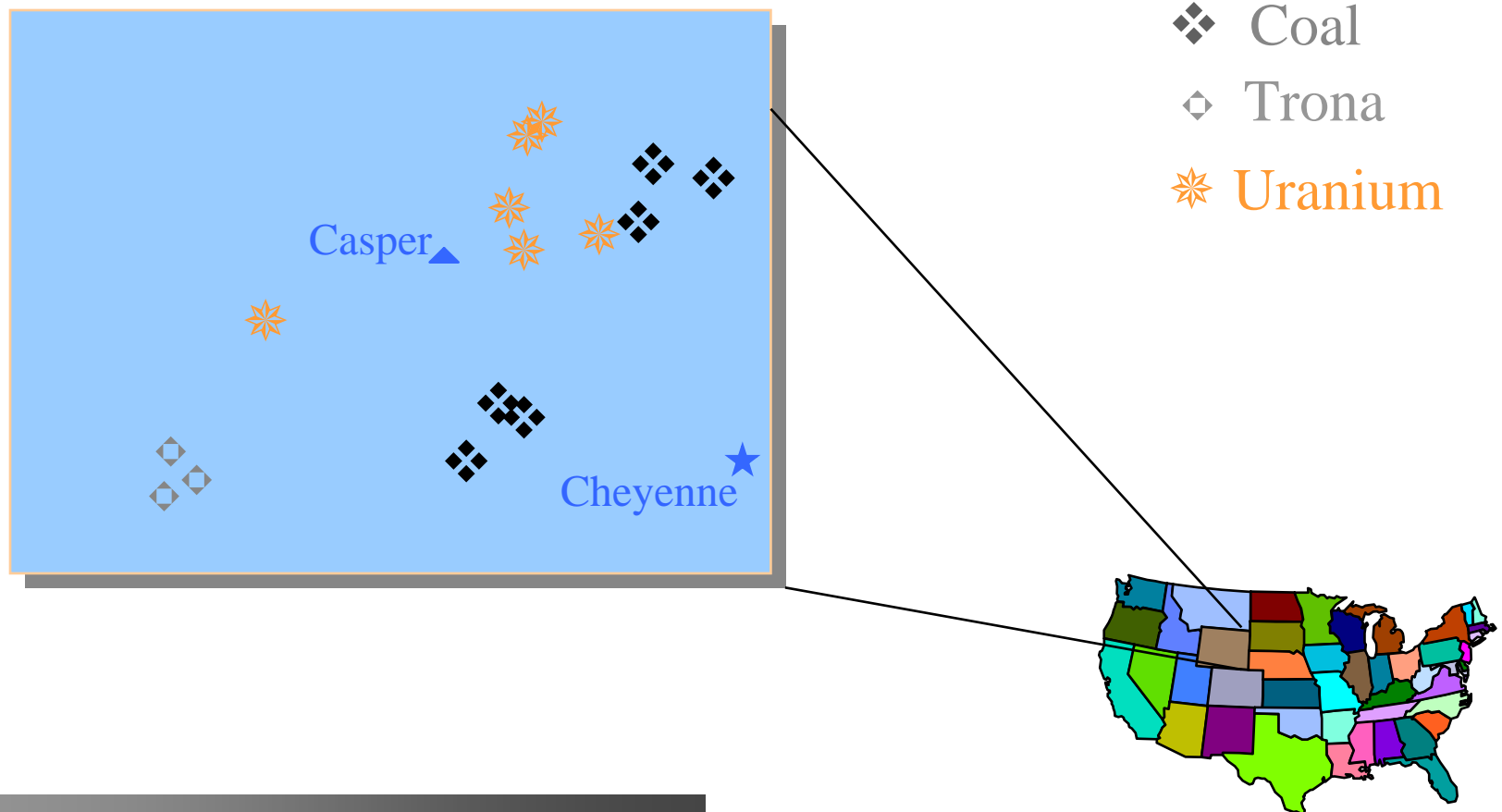
- ◆ EPA process designed for a small operation (e.g., only a few wells) with minimal changes.
- ◆ Wyoming process designed for a multiple well operation with wellfields coming on line and being taken off line.

Proposed rules retain the ***existing*** Wyoming permitting process with minimal changes, and differences from the EPA process are documented.



‘Harmonize’ Federal and State Requirements

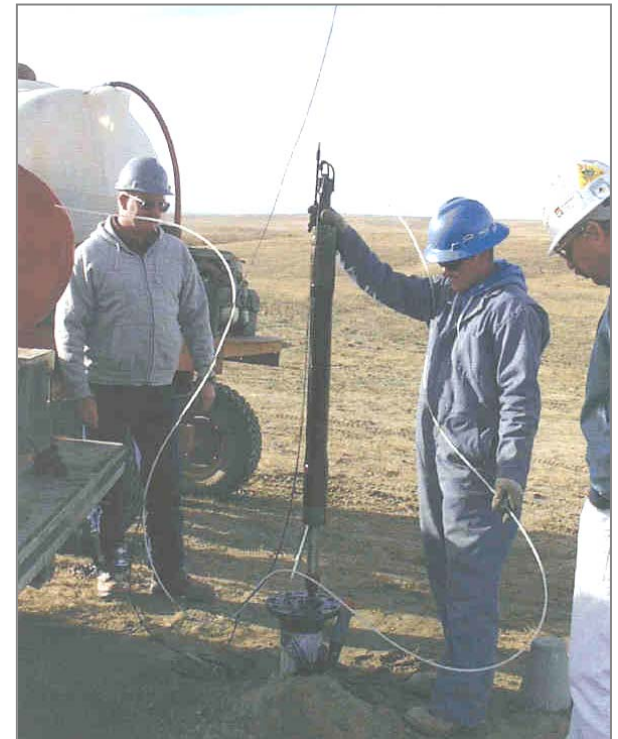
Applicability - Minerals other than uranium.



Changes to WDEQ In Situ Rules

- ✓ *Regulatory Framework*
- ✓ *Purposes of the LQD & WQD Rule Packages*
- *Hot Topics in the Rule Packages*

PRI - Highlands,
Mechanical Integrity Testing,
11/99, Quarterly Inspection.



Changes to WDEQ In Situ Rules

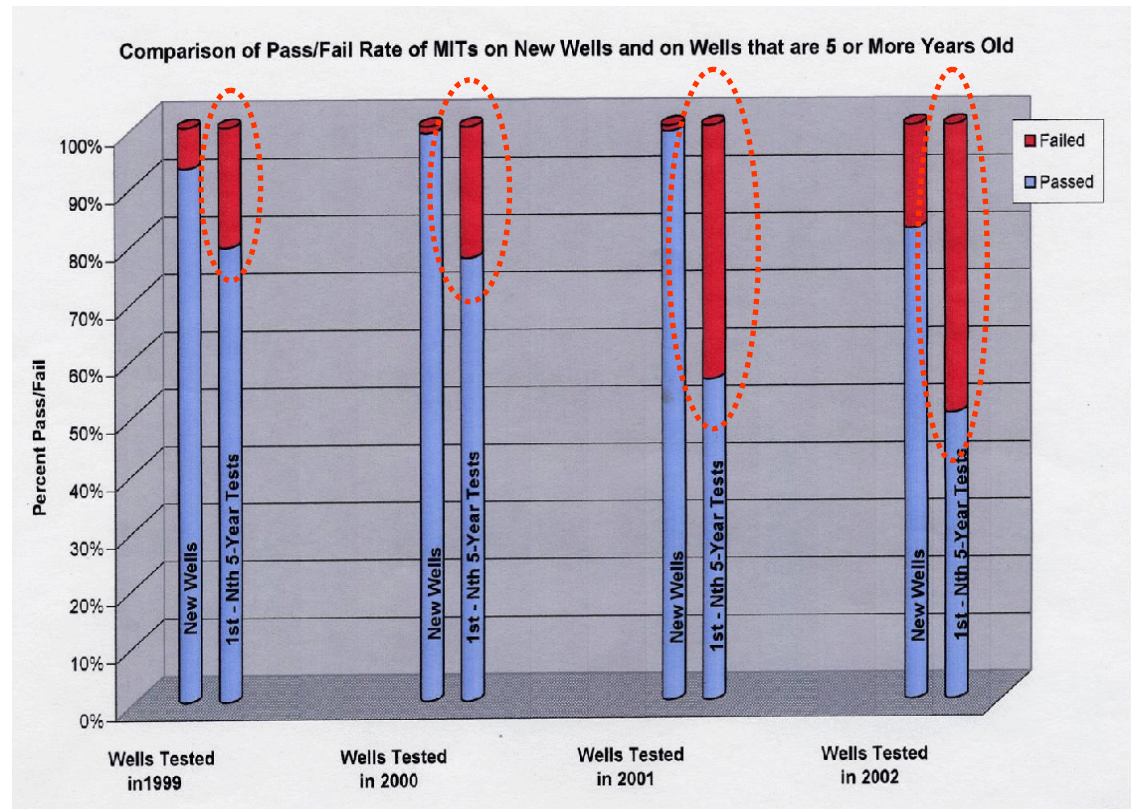
‘Hot Topics’ in the Rule Packages

- ◆ *Well Construction & MIT Testing Frequency*
- ◆ *Reporting Requirements*
- ◆ *EPA Aquifer Exemption/WQD Ground Water Classification*
- ◆ *Restoration Requirements*
- ◆ *Uranium Classification Standard*

Well Construction & MIT Testing Frequency

Underlying Technical Issue

Number of Wells (7,000+) &
Increasing MIT Failure Rate

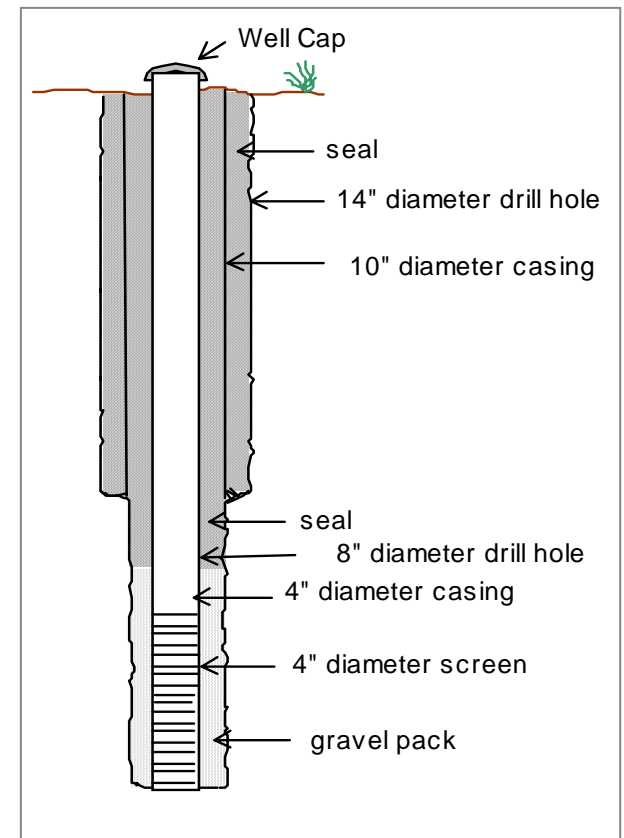


Well Construction & MIT Testing Frequency

Changes to Specific Sections in Chapter 11 (examples)

Section 6(c)(i) - The drill hole shall be of sufficient diameter for adequate sealing and, at any given depth, at least **three inches** greater in nominal diameter than the diameter of the outer casing at that depth. [Note: *Proposed State Engineer rules require 4 inches.*]

Section 7(a)(iii) - Maintenance of the mechanical integrity of each Class III well, which has not been plugged or converted as required by Section 8 of this Chapter, shall be demonstrated at least **once every five years, or on a schedule determined by the Administrator.**




Reporting Requirements

Underlying Regulatory Issue

As noted earlier, overall intent was to change the overall permitting process as little as possible, but a few changes had to be made to ensure consistency with federal language. For example, federal rule is specific that the notification from the Administrator to an operator that reinjection into a repaired well can resume must be provided on a well-by-well basis. However, operators requested an alternative that the notification could be provided on a wellfield basis.

Change to Specific Sections in Chapter 11 (Example)

Chapter 11, Section 7(a)(v) If the Administrator determines that **a** Class III well lacks mechanical integrity, he or she shall give written notice of this determination to the operator of the well....The operator may resume injection upon **written notification** from the Administrator that the operator has demonstrated mechanical integrity.



EPA Aquifer Exemptions/WQD Ground Water Classification

Underlying Regulatory & Technical Issues

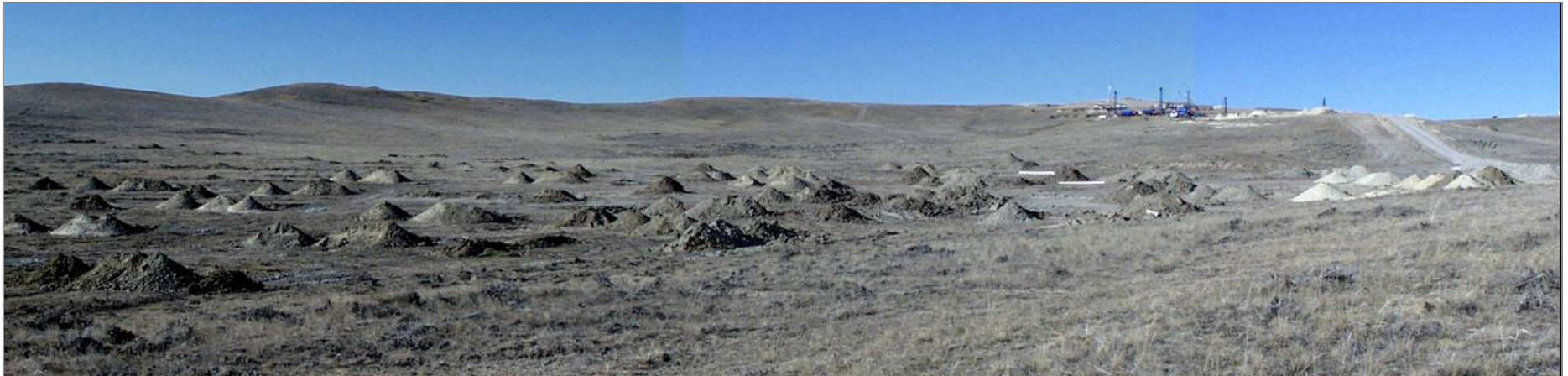
Differences in EPA & WQD Approaches

Ore Distribution

Water Quality Distribution

Water Testing Requirements

Selection of Exemption Boundaries



PRI - Smith Ranch, Pilot Hole drilling in Wellfield 4, 12/98, Quarterly Inspection.

EPA Aquifer Exemptions/WQD Ground Water Classification



Underlying Regulatory Issue -

Differences in EPA & WQD Approaches

The Safe Drinking Water Act *prohibits* injection into an aquifer that could serve as an “Underground Source of Drinking Water” *unless* one of the following aquifer exemption criteria is applicable...



PRI - Gas Hills, Cameron Spring & Associated Reservoir, 7/98, Pre-Operation Inspection.

EPA Aquifer Exemptions/WQD Ground Water Classification

...An aquifer (or portion of an aquifer) may be determined to be 'exempt' if:

- (a) It ***does not currently serve as a source of drinking water***; and
- (b) It cannot and will not be a source of drinking water because:
 - (1) It is ***mineral, hydrocarbon or geothermal energy producing***, or can be demonstrated to be commercially producible;
 - (2) It is situated at a ***depth or location*** which makes recovery of water for drinking water purposes economically or technologically impractical;
 - (3) It is ***so contaminated*** that it would be economically or technologically impractical to render that water fit for human consumption; *or*
 - (4) It is located over a Class III well mining area subject to ***subsidence or catastrophic collapse***; or
- (c) Total Dissolved Solids (TDS) are ***more than 3,000 and less than 10,000*** milligrams per liter (mg/l). (40 CFR 146.4)

EPA Aquifer Exemptions/WQD Ground Water Classification

In EPA's Aquifer Exemption process:

- ◆ The EPA can identify an aquifer as an exempted aquifer when the State Program is approved; or
- ◆ After the State Program is approved, the State can submit the request for an exemption to the EPA, and if the EPA approves the exemption, then the exemption becomes a program revision.

In discussing application of the aquifer exemption process in Wyoming, four items to keep in mind...



EPA Aquifer Exemptions/WQD Ground Water Classification

Wyoming-Specific Considerations (cont'd)

- ◆ The area to be exempted must meet one of EPA's exemption criteria. The exemptions EPA has granted in Wyoming have been based on '**commercially producible**' e.g., the wellfield boundary (with an allowance to the monitor well ring), due to overall good quality of the water (generally ≤ 500 mg/l TDS).
- ◆ When Wyoming was granted primacy for the UIC program by EPA, the State did not directly adopt the EPA aquifer exemption process, at least in part because of concerns about creating 'sacrifice areas.' Instead, **WQD retained their ground water classification process**, which includes Class V (Hydrocarbon Commercial, Mineral Commercial, or Geothermal). Therefore, none of the other EPA exemption criteria have direct counterparts in the WQD rules.

EPA Aquifer Exemptions/WQD Ground Water Classification

Wyoming-Specific Considerations (cont'd)

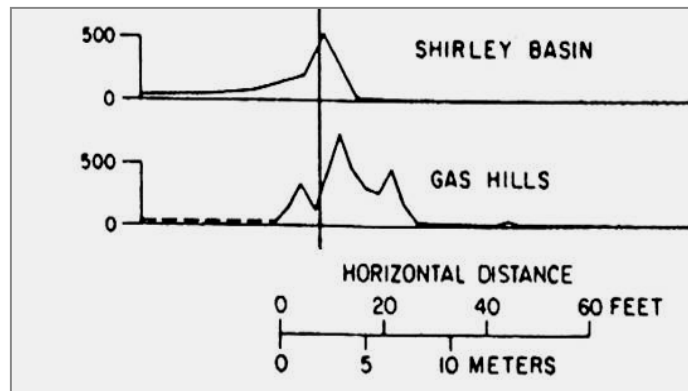
- ◆ Once WDEQ determines that an area can be reclassified as Class V, then WDEQ submits a request to EPA for an aquifer exemption. If EPA grants the aquifer exemption, then WDEQ reclassifies the ground water as Class V (public notice is required & generally occurs through the LQD permitting process).
- ◆ Although EPA exemption is permanent, ***the WQD classification is not considered permanent.*** W.S. § 35-11-103(f) includes ***restoration requirements*** specifically for in situ mining, and WQD rules (Chapter 8, Section 3(c)) require ***protection of ground waters for all uses for which the water is suitable.***

EPA Aquifer Exemptions/WQD Ground Water Classification

Underlying Technical Issue - Ore Distribution

In Wyoming, the distribution of uranium and associated minerals (e.g., selenium) is due to oxidation and reduction conditions in the subsurface formations when the minerals were deposited. At most sites, the concentration gradient from 'inside' to 'outside' the ore zone is quite steep.

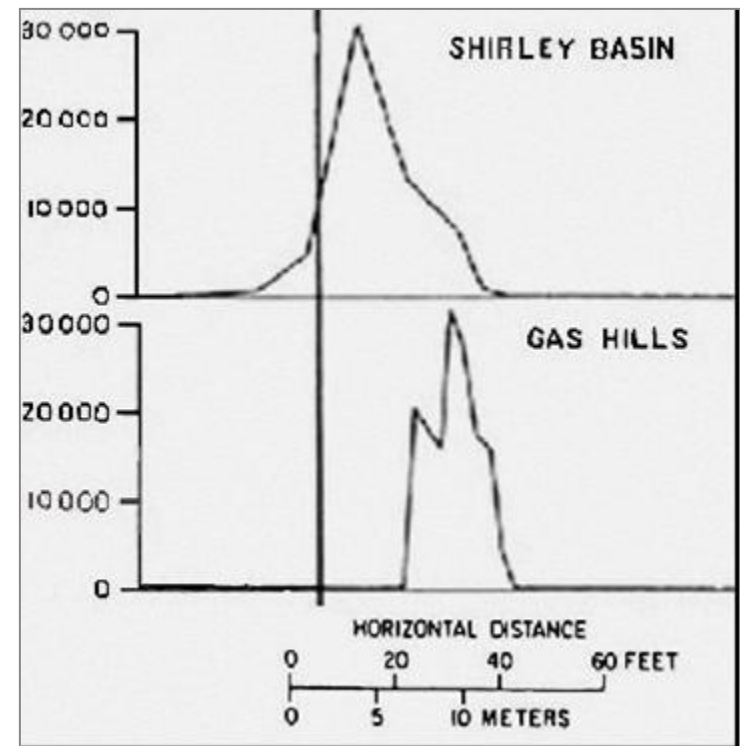
Selenium in Sandstone (ppm)



Adapted from E.N. Harshman, 1974,

Distribution of elements in some roll-type uranium deposits, in Formation of Uranium Ore Deposits, IAEA, pp.169-183.

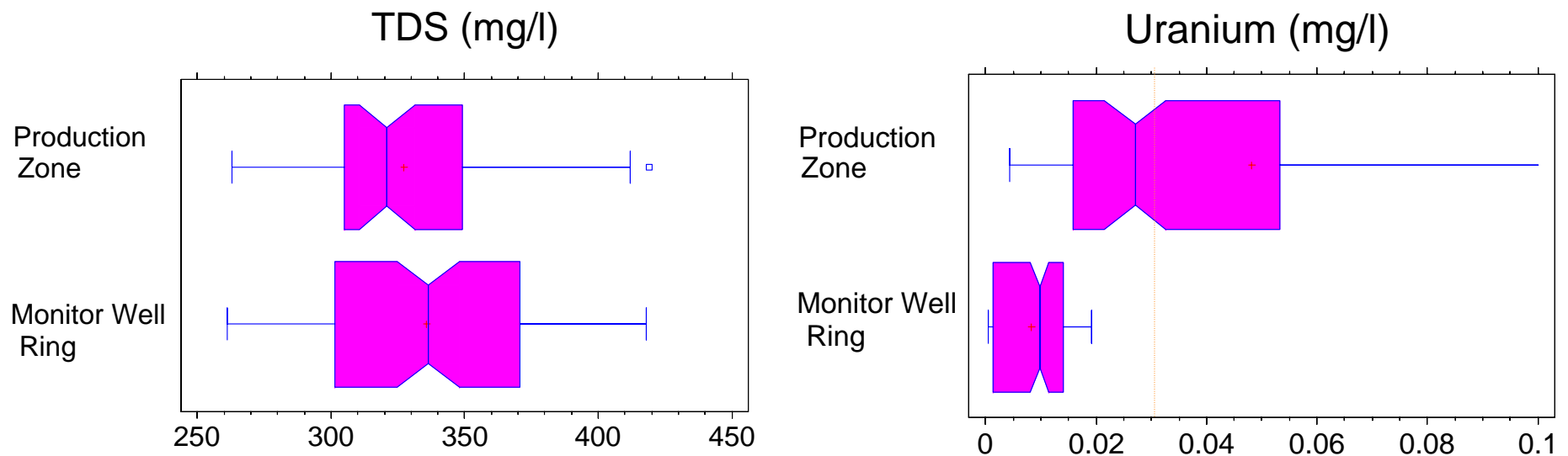
Uranium in Sandstone (ppm)



EPA Aquifer Exemptions/WQD Ground Water Classification

Underlying Technical Issue - Water Quality Distribution

In addition, significant water quality differences inside and outside most ore zones are generally limited to a very specific set of parameters - radionuclides...



Baseline data from PRI Smith Ranch Wellfield 4. Note that the scale on the uranium 'box & whisker' plot does not show highest uranium concentrations. Vertical line on uranium plot illustrates EPA standard.

EPA Aquifer Exemptions/WQD Ground Water Classification

Underlying Regulatory Issue - Water Testing Requirements

The parameters which distinguish the ore zone water quality are not parameters for which wells are commonly tested. In fact, there is no requirement that owners of 'individual' wells, who may use wells for domestic and/or stock purposes, test their wells for any parameters. There may often be a suggested list of parameters, but it may or may not include parameters of interest to uranium mine operators (e.g., uranium, radium, and radon).

These 'individual' wells provide essential water sources on many of the more than 9,000 farms and ranches (not to mention ranchettes) in Wyoming, including those in the areas where uranium mines are located. Plus new water users (e.g., CBM) are arriving.



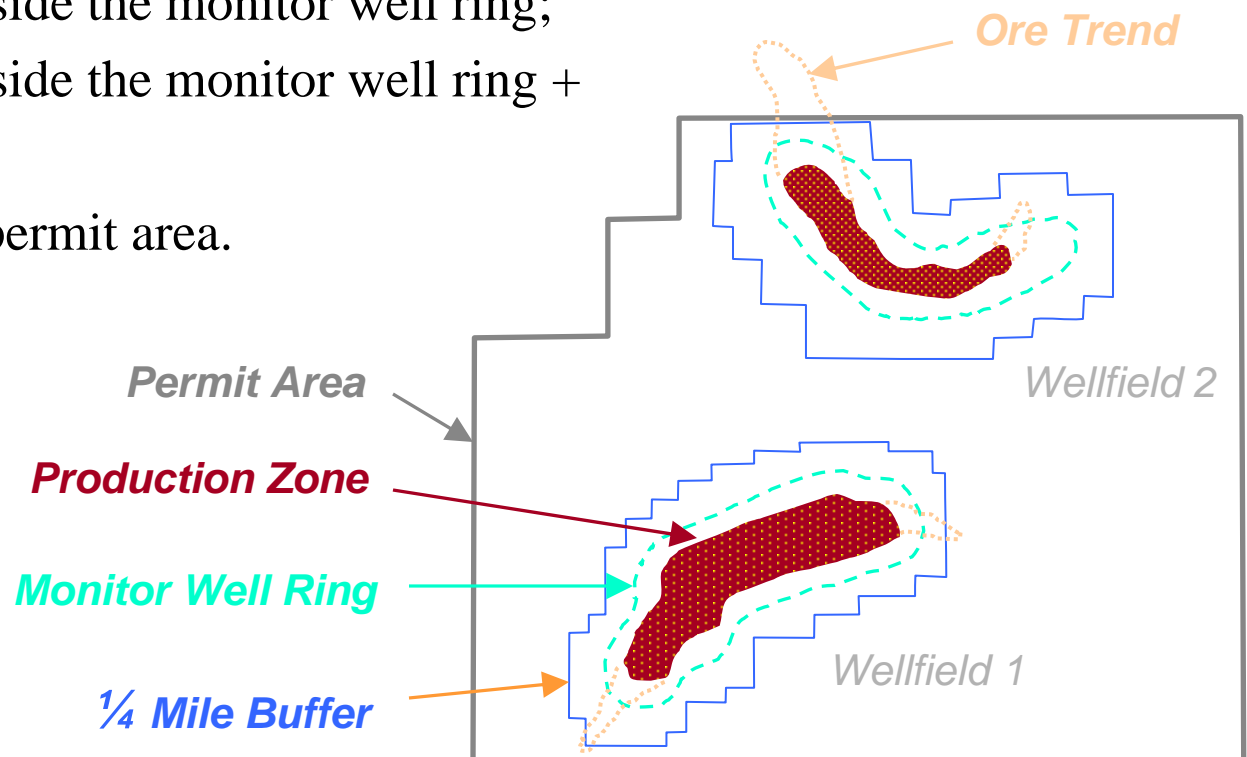
PRI - Highlands (south of Satellite No.2), Windmill used for livestock supply, 2/99, Quarterly Inspection.

EPA Aquifer Exemptions/WQD Ground Water Classification

Underlying Regulatory Issue - Selection of Exemption Boundaries

If exemption boundaries for in situ uranium mining in Wyoming, Nebraska, and Texas are compared, three approaches have been used:

- ◆ Exemption of the area inside the monitor well ring;
- ◆ Exemption of the area inside the monitor well ring + $\frac{1}{4}$ mile 'buffer';
- ◆ Exemption of the entire permit area.



EPA Aquifer Exemptions/WQD Ground Water Classification

Underlying Regulatory Issue - Selection of Exemption Boundaries

The differences are apparently due to three factors:

Water Quality - In an area where the TDS concentrations exceed 8,000 mg/l both inside and outside the production zone, the overall water quality limits the uses for which the water would be suitable. Conversely in an area where the TDS concentrations inside and outside the production zone are less than 5,000 mg/l, more uses are possible;

Best Professional Judgment - What is considered a limiting factor in one area may not be so considered in other areas; and

Lack of Historical Records - Resulting in unintended changes from previous boundary selection approaches.



EPA Aquifer Exemptions/WQD Ground Water Classification

Changes to Chapter 11

Added Section 10 (*paraphrased below*)

- (a) Injection restricted to production zones that:
 - (i) & (ii) Have been classified by WDEQ as Class V and exempted by EPA;
 - (iii) In a hydrologic setting in which ***fluid movement into unauthorized zones can be prevented***.
- (b) An aquifer, or a portion thereof may be exempted if:
 - (i) It meets criteria similar to ***EPA criteria***;
 - (ii) As demonstrated by information in application, including:
 - (A) Map and general description;
 - (B) Information that exemption area is ***commercially producible***, including:
 - (I) The permit boundary;
 - (II) The ***right to mine***; but ***no more than*** the area w/i the ***monitor well ring plus a distance to the next quarter quarter ($\frac{1}{4}$ $\frac{1}{4}$) section boundary that is at least one quarter ($\frac{1}{4}$) mile from the monitor well ring***;
 - (III) & (IV) Information on mineralogy, geochemistry and mining technology; and
 - (C) Amenability of production zone to proposed mining method; and a mining schedule.
- (c) Process for obtaining an exemption (i.e., the EPA Program Amendment).

EPA Aquifer Exemptions/WQD Ground Water Classification

Other Efforts

- ◆ Continue to work with EPA to develop a consistent aquifer exemption process.
- ◆ Continue compilation of available baseline water quality data to help ensure the exemption area is representative of ore distribution and protective of ground water resources.

PRI Gas Hills, 7/98,
Pre-permitting Inspection in
area of previous exploration.



Restoration Requirements

NRC

- ◆ Restoration language in the NRC Guidance Document 1569 mirrors what is now the old LQD rule language.
- ◆ Per letter of 11/2/2004 from NMA to NRC, NRC restoration requirements may be of concern to NMA.

(Note: Per the information in the previous slides, WDEQ does not consider the letter to be an accurate reflection of aquifer exemption and restoration requirements and concerns in Wyoming.)

Restoration Requirements

EPA

While EPA can require restoration of exempted area if it is deemed “necessary and feasible to insure adequate protection of USDWs” (40 CFR 146.11), and does require restoration of exempted areas on Indian Lands, more stringent restoration requirements within the exempted area are generally left up to the individual states. However, ...



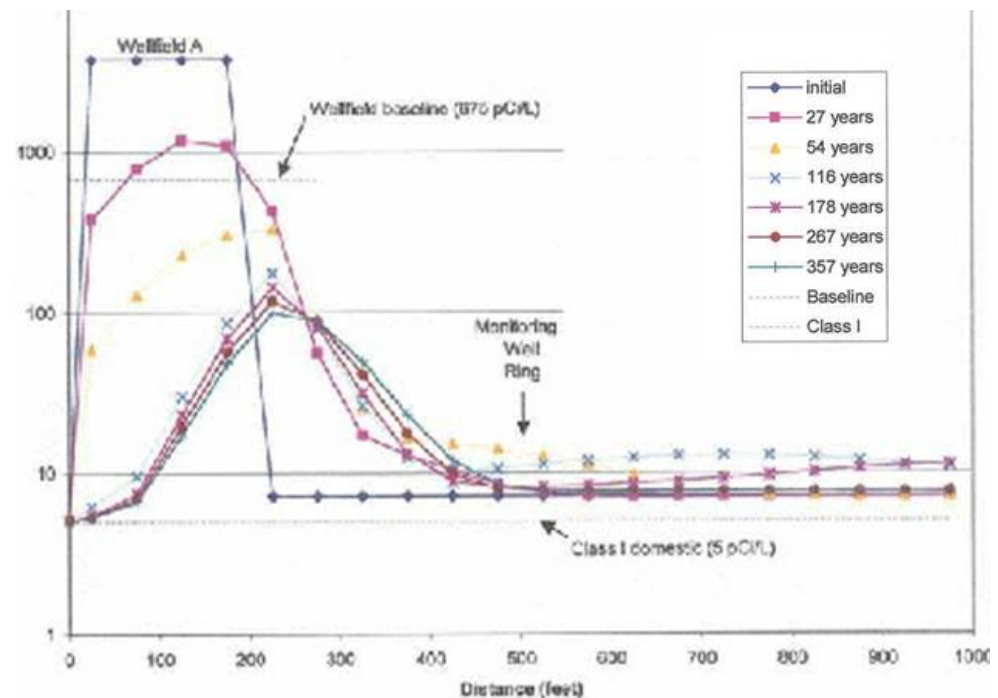
PRI - Highlands, Reverse Osmosis Units,
11/00, Quarterly Inspection.

Restoration Requirements

EPA (cont'd)

...EPA does require that USDWs next to the exempted portion of the aquifer not be adversely impacted by residual water quality in the exempted portion.

If natural attenuation processes (e.g., adsorption, precipitation, and dilution), are relied on to reduce concentrations migrating out of the wellfield, then monitoring to confirm the effectiveness of the attenuation may be necessary.
(EPA & WDEQ Policies)



PRI - Highlands, 2004, Evaluation of Natural Attenuation of Radium.

Restoration Requirements

Wyoming

W.S. § 35-11-103(f):

(iii) "Groundwater restoration" means the condition achieved when the quality of all groundwater affected by the injection of recovery fluids is returned to a ***quality of use equal to or better than, and consistent with the uses for which the water was suitable prior to the operation*** by employing the best practicable technology; (emphasis added)

where “best practicable technology” is defined as:

(i) ... [A] technology based process justifiable in terms of existing performance and achievability in relation to health and safety which minimizes, to the extent safe and practicable, disturbances and adverse impacts of the operation on human or animal life, fish, wildlife, plant life and related environmental values.

Restoration Requirements

Wyoming (cont'd)

- ◆ LQD relies on WQD's Class of Use in Chapter 8 to determine "quality of use", and classification responsibilities remain with WQD for consistency among all Wyoming water users.
- ◆ The rule changes are intended to: bring language more in line with the statute; better define the factors that go into an evaluation of whether BPT has been applied; and serve as a reminder of the statutory provision for changing restoration requirements (Director referral to the EQC).

Restoration Requirements

Wyoming (cont'd)

Old Rule

Chapter 11, Section 3(d)(i)

The information necessary to demonstrate that the operation will return all affected groundwater, including affected groundwater within the production zone, receiving strata, and any other areas, to a condition such that its quality of use is equal to or better than, and consistent with, the uses for which the water was suitable prior to the operation by employing the best practicable technology. Such a demonstration shall be made by showing that, through the employment of the best practicable technology, as defined in W.S. § 35-11-103(f)(i):

- (A) To background or better, or;
- (B) Quality of use equal to and consistent with uses for which the water was suitable prior to the commencement of the operation.

New Rule

Chapter 11, Section 5(a)(ii) (*paraphrased*)

The information necessary to demonstrate that the operation will achieve the standard of returning all affected groundwater to the pre-mining class of use or better using Best Practicable Technology, in accordance with the following provisions:

- (A) List of BPT factors;
- (B) Use wellfield averaging;
- (C) Parameter by parameter basis; and
- (D) Protection of adjacent aquifers
- (E) If unable to achieve the pre-mining class of use:
 - (I) Request Director recommend to EQC to modify restoration criteria (W.S. 35-11-429(iii));
 - (II) Provided Section 5(a)(ii)(D) can still be met.

Uranium Classification Standard

Groundwaters of the state are classified by:

Use

Groundwater that is a known source of supply and appropriated for uses identified in W.S. § 35-11-102 and 103(c)(i) is classified by use: domestic water (Class I); water for fish and aquatic life (Special A); water for agriculture (Class II); water for livestock (Class III); and water for industry (Class IVA&B); **or by**

Ambient Water Quality

Table 1 of Chapter 8 (first promulgated in 1980) establishes the type of use that groundwater is suitable for, based upon the concentrations of minerals in the water. Recognizing that the natural, or ambient, quality of groundwater varies and is dependent upon the concentrations of specific constituents that naturally exist in groundwater, Chapter 8 established a system to classify groundwater according to its suitability for various purposes.

Uranium Classification Standard

The concentration values (mg/L) in Table I are also used by WDEQ to:

- ◆ Establish the permissible limits to which a regulated discharge to groundwater can legally impair groundwater quality beyond ambient conditions (but with no change in the use suitability of the water); &
- ◆ Establish the limits to which impacted groundwater must be restored in the event a discharge or release results in an exceedance of that limit.

The values in Table I are ***not*** drinking water standards.



Uranium Classification Standard

- ◆ The concentration values in Table I had not been updated in several years, and WQD considered it necessary to update the table based on more recent information about safety and aesthetic considerations for some of the parameters, one of which was uranium.
- ◆ The change made by EPA to uranium drinking water standard was for new safety (health) considerations, and the change was to create a uranium standard of 0.03 mg/l for drinking water supplies.

‘Negley’ Subdivision near area of
LQD Permit 522, 1980s.



Uranium Classification Standard

- ◆ However, because Table I is for classification only, WQD decided not to adopt the new standard, because it could result in much of the water in the state not being eligible for Class I protections, even though the water quality was good in all other respects. WQD also did not want to leave the old standard in Table I because of concerns that it could lead to false sense of security if Table I were misapplied, i.e., if values in the table were thought to be drinking water standards. In addition, a concentration of 5 mg/l is high, even in the baseline data from wells in production zones in the Wyoming in situ uranium mines.

Range in Wellfield Concentrations: <0.003 to 18.600 mg/l

Range in Wellfield Means: 0.013 to 1.067 mg/l

Range in Wellfield Medians: 0.008 to 0.073 mg/l

(Note: *Reported ranges should be considered draft.*)