

SUPPLEMENTAL INFORMATION

**Uranium One Americas, Inc. Irigaray Ranch Disposal Well Field
Johnson County, Wyoming
UIC Permit No. 14-237
June 2014**

General Information

Uranium One Americas, Inc operates the Irigaray in situ uranium mine in Johnson County, Wyoming. Two wells are currently permitted for this facility, neither of which has been built: DW-1 and DW-2. The facility currently disposes of its waste at its sister facility: the Christensen Ranch Mine.

An aquifer exemption (AE) for the Irigaray disposal well field was granted by EPA in a letter dated August 26, 1991. The AE was granted for the area of review (AOR) designated in permit 91-247 which was described as a circular area of radius 6,729 feet which was centered on well DW-1.

The two Irigaray disposal wells were originally permitted in 1992 (Permit 91-247) for the life of the facility (letter dated May 27, 1992, to Total Minerals, Inc., from WDEQ). There is no reference to a permit term in the final permit. However, page 10 of the final permit states that the permit will be reviewed every five years and that it may be modified by the WDEQ at any time. Page 10 also states that Public Notice of the permit review and request for public comment will be made every ten years by the administrator. Prior to this review, the permit has not been reviewed nor has it been public noticed, probably because neither well has been built.

WDEQ Action

WDEQ has reviewed permit 91-247 had has prepared a draft permit (14-237) with the intention of updating the permit requirements so that they are consistent with current permitting practices. The primary updates to the Irigaray disposal well field permit include:

- Recalculating the AOR,
- Reassessing penetrations of the confining zone within the updated AOR,
- Recalculating the extent of the area of emplaced waste (AEW),
- Recalculating the limiting surface injection pressure, and
- Updating the financial assurance information.

AOR v. Extent of Class VI

The AOR is to be based on the largest of the following three areas: the cone of influence (COI), the AEW, or a circle of radius of 1,320 feet (¼-mile) (WWQRR CH. 13, Section 5(b)(iv)). The AOR is the area which should be examined for potential conduits through which fluid from the receiving aquifer may reach the lowermost underground source of drinking water (USDW). Thus, a larger AOR results in a more conservative analysis of potential conduits.

The area within the cone of influence (COI) represents the area in which heads in the injection zone exceed those in the lowermost underground source of drinking water (USDW). The COI is calculated using the Theis based equation from WWQRR Chapter 13, Section 5(iv)(A). For normally pressured receivers which have a hydraulic head similar to or greater than that of the lowermost USDW, the radius of the COI will be very large or infinite. The COI can be a very good indication of the area where it may be possible to move fluid from the receiver to overlying USDWs, but it does not reflect the fate of the injected fluid.

In the past it has been assumed that the AOR also represents the extent of the class VI groundwater classification and the portion of the aquifer exempted by EPA. In some cases, this may have resulted in class VI classifications and thus, aquifer exemptions (AE), which are larger than is strictly necessary. There is nothing in WWQRRs or in the Federal regulations that requires the AOR and the Class VI classification (or AE) to be coincident. Noting the increased scrutiny of aquifer exemptions in recent years, WDEQ has revised its policy governing the extent of the Class VI groundwater classification. The current policy recognizes that the Class VI groundwater designation is better represented by the area which will be occupied by the injected waste, i.e., the area of emplaced waste (AEW).

The AEW is based on the cylinder of emplaced waste (CEW) which is based on a cylindrical volumetric fill up calculation for each well for the life of the facility. The CEW is then adjusted for dispersion and for the effects of well stimulation. The addend accounting for dispersion is obtained by multiplying the radius of the CEW by a longitudinal dispersivity factor. A typical longitudinal dispersivity factor for sandstone is 0.1 (derived from "A Practical Guide to Groundwater and Solute Transport Modeling, Spitz and Moreno, 1996). The addend accounting for well stimulation is obtained from the length of fractures generated during well stimulation. Typical fracture lengths associated with stimulation of injection wells is estimated to be 200 feet, based on previous permit applications and personal correspondence with engineers at Gene George and Associates. These three addends (CEW, dispersion, and fracture length) are summed to obtain the individual AEW for each well.

If the areal traces of the individual AEWs overlap (assuming more than one injection well), well interference is assumed. In this case, the combined AEW is the area of the circle-tangent

perimeter outline of the individual AEWs for each well. The shape is created by using tangential lines to connect the outsides of the each of the individual AEW circles.

The minimum AOR is based on the area of a circle of radius of 1,320 ft. If these circles overlap, well interference is assumed and the minimum AOR is the area of the circle-tangent perimeter outline of the individual circles of radius 1,320 ft.

Irigaray AOR and AEW Calculations

AOR and AEW calculations for the Irigaray deep disposal wells are updated using the WDEQ UIC Program's current methods and an assumed combined injection rate of 6,180 bbl/d for 20 years (the life of the facility) into a 290-foot thick sandstone which has an intrinsic permeability of 0.009 darcies and a porosity of 12%.

The COI was modeled as a single well located half way between the two proposed wells. Once the COI radius was calculated, a distance of 666 feet (equal to $\frac{1}{2}$ the distance between the two wells) was added to that radius to account for the offset of the modeled well from the proposed wells. The radius of the final COI plus offset is 8,038 feet. At this distance from the proposed wells, distortion of the COI due to well interference is negligible. The area of the COI (a circle of radius 8,038 ft) is 4,688 acres. Please refer to Table 1 and Figure 1.

The AEW for each well was calculated as described above. The radius CEW is 1,519 ft. The addend accounting for dispersion (assuming a longitudinal dispersivity factor of 0.1) is 152 ft. The addend accounting for well stimulation is 200 ft. The radius of the individual AEW is 1,871 feet for each well.

These circles overlap, therefore the combined AEW is described as a circle-tangent perimeter outline of both individual AEWs. The ovoid shape is created by using tangential lines to connect the outsides of the 1,871-foot radius circles centered on each well. The area of the combined AEW is 368 acres. Please refer to Table 1 and Figure 2.

The minimum fixed radius of the AOR is 1,320 ft. The combined minimum AOR is described as a circle-tangent perimeter outline of both circles of 1,320-ft radius. The area of this minimum AOR is 207 acres. Please refer to Table 1 and Figure 3.

Table 1. Summary of Area of Review Calculations

Well Name	Combined AEW (acres)	Combined COI Area (acres)	Combined Minimum AOR (acres)
DW – 1 (proposed)	368	4,668	207
DW – 2 (proposed)			

In the case of the Irigaray disposal well field, the AOR is described by the combined COI area, or the circle of radius 8,038 feet centered on the point half way between the two proposed wells (Figure 1).

Aquifer Exemption

By current WDEQ UIC Program policy, the extent of the Class VI groundwater designation would be represented by the combined AEW. For the Irigaray disposal well field, this area would be best represented by the circle tangent perimeter of the two circles of radius 1,871 feet centered on each of the proposed wells. However, in the previous permit, the class VI classification and AE was based on a COI radius of 6,729 ft. Discussions with Wendy Cheung (EPA, Denver) and Don Fischer (WDEQ, Sheridan) resulted in the agreement that WDEQ would maintain the original extent of the class VI classification. No change to the AE is being requested. The AE extent is shown on Figure 4.

Wells Penetrating the Confining Zone

There are four wells which penetrate the confining zone (see Section 1 (d) of the draft permit). Three of these are permanently abandoned under the oversight of the (Wyoming Oil and Gas Conservation Commission (WOGCC). One is an active injection well injecting into the Shannon Sandstone below the TTP. The operator shall demonstrate, prior to injecting, that these wells are not potential conduits which might allow the movement of fluid from the TTP permitted injection zone into USDWs (Section 4(b)(vi) of the draft permit). These wells are shown on Figure 1.

Figure 1. Irigaray Cone of Influence

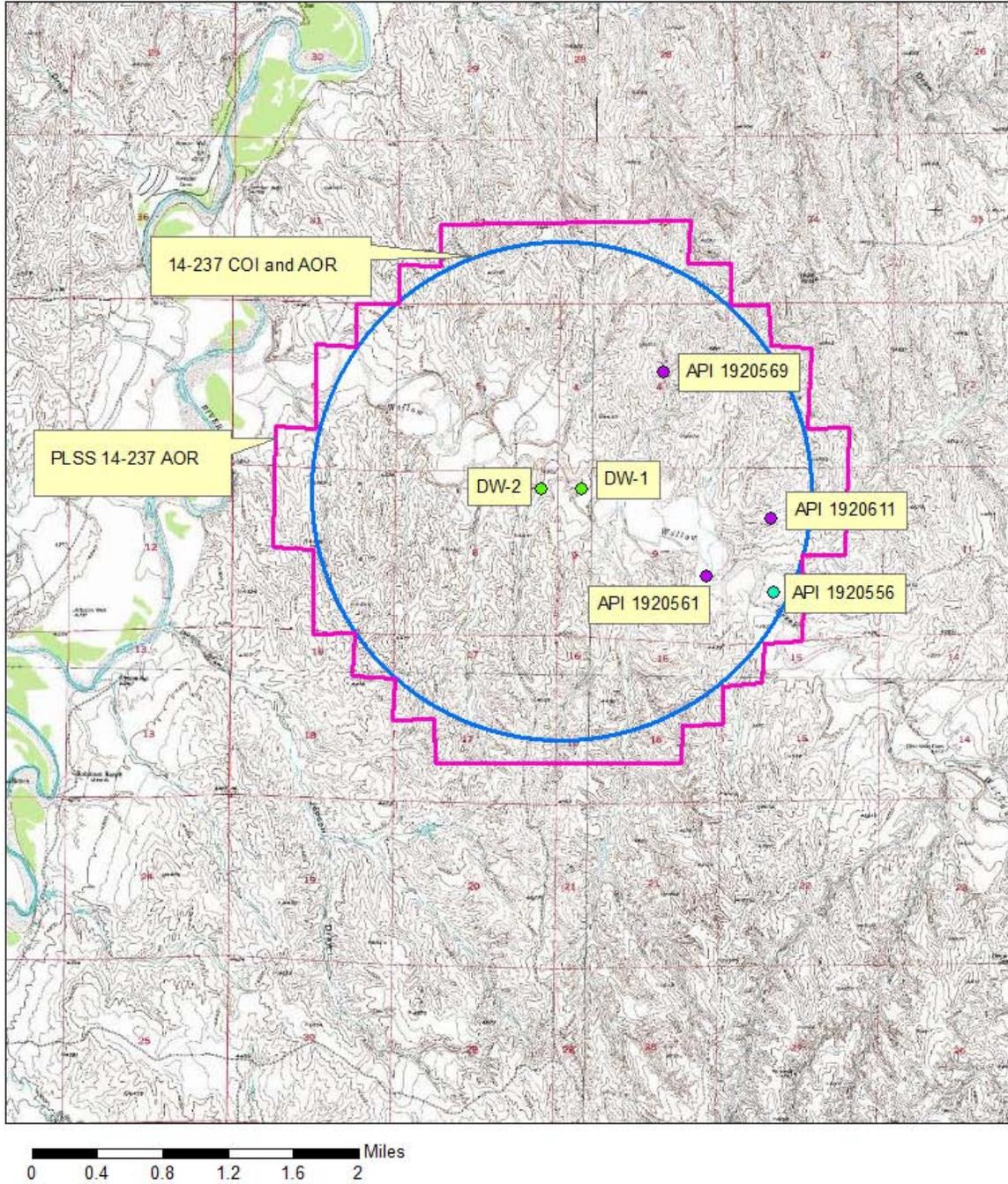


Figure 2. Irigaray Area of Emplaced Waste

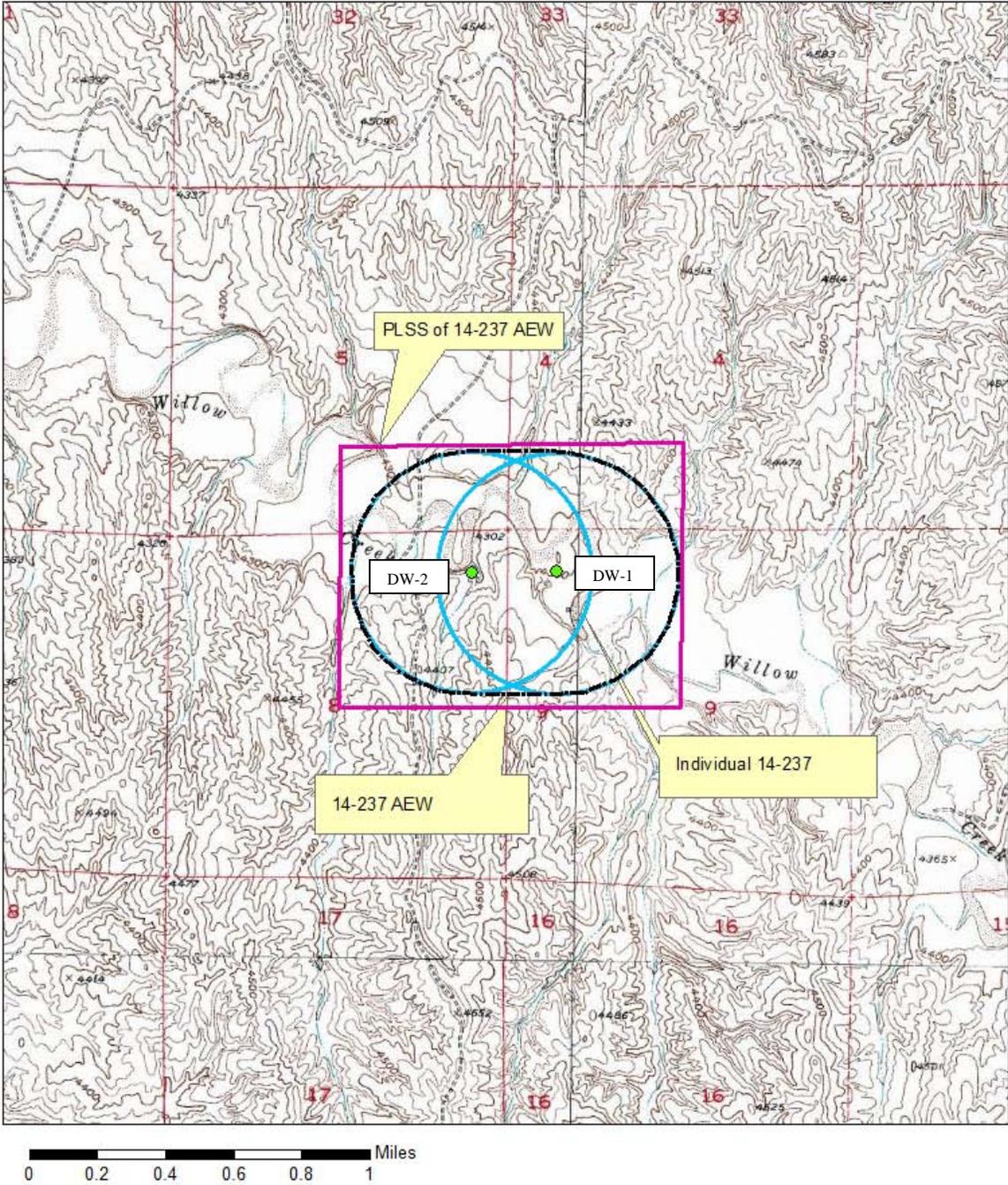


Figure 3. Irigaray Minimum Area of Review

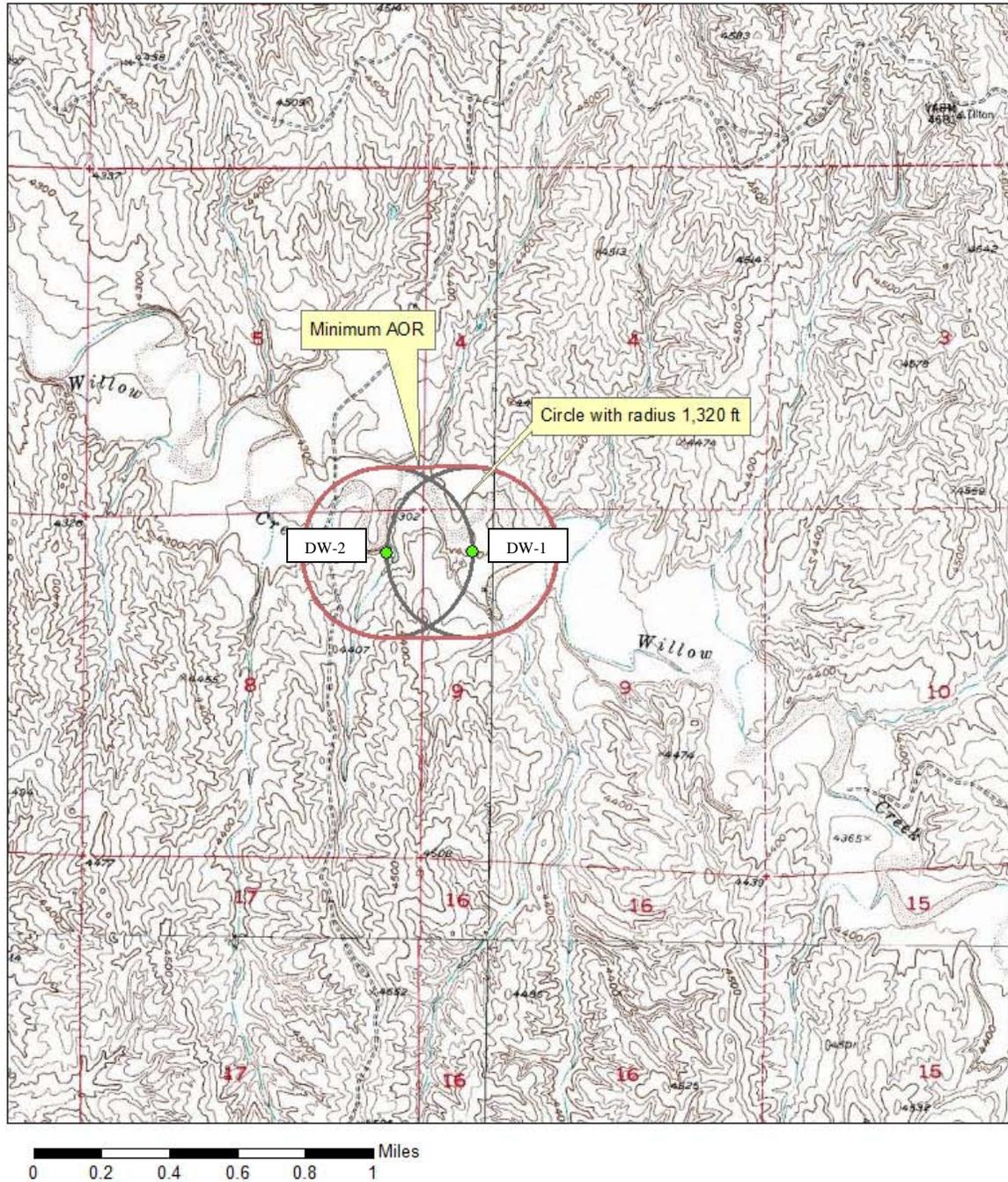


Figure 4. Irigaray Aquifer Exemption

