SUA-1341 License Renewal Application
Directions for Document Changes
Revisions Dated July, 2009
Relating to the RAI Dated February 19, 2009
& the Environmental RAI Dated March 24, 2009

Page(s) Removed	Page(s) Inserted
i	i followed by ia
iii	iii followed by iiia
vii	vii
2-3	2-3
2-4	2-4 followed by 2-4a through 2-4e
2-11	2-11 followed by 2-11a through 2-11c
2-12	2-12
2-18	2-18
3-3 through 3-5	3-3 through 3-5
3-30	3-30
3-37 & 3-38	3-37 & 3-38
3-44	3-44
4-7	4-7 followed by 4-7a
5-86	5-86 & 5-87
6-3	6-3
6-8	6-8 followed by 6-8a
7-5	7-5 followed by 7-5a

Directions for APPENDIX B:

Page(s) Removed	Page(s) Inserted
B-i	B-i & B-ii
B-1	B-1 followed by B-1a through B-1c
None	Insert Figures B.1.A through B.1.G (in plastic covers) directly behind Figure B.1

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

use of the land for the immediate future includes in-situ uranium mining on a commercial scale (see Appendix D1 of the Irigaray and Christensen Ranch permit applications) and coal bed methane development. Presently, COGEMA holds leases and Federal lode claims for 1,847 acres at Irigaray and 7,894 acres at Christensen Ranch. Surface owner consent to develop commercial scale mines within the permitted areas has been obtained from the private landowners. Of the acres controlled by COGEMA, some 454 acres have been disturbed to date by project development at Christensen Ranch (COGEMA annual report to WDEQ/LQD, August, 2007). Projected additional (future) disturbance at Christensen Ranch is estimated to total 520 acres. No further disturbance is projected at Irigaray unless additional wellfields are developed late in the life of the project. Existing disturbance at Irigaray is 133 acres. Subsequent to mining activities the land will be returned to the pre-mining use of cattle grazing. The reclamation plan to be used to return the land to cattle grazing use after mining is included in Section 6 of this application. Names and addresses of the surface and mineral owners of record within the Irigaray and Christensen Ranch areas are given in each project's permit to mine applications in the Adjudication File, Appendix A. Names and addresses of the surface owners and mineral owners of record within one-half mile (.8 km) adjacent to the areas are also given in the Adjudication File, Appendix B. These appendices also list owners of record with valid legal estate in the permit areas and on adjacent lands. Appendix C of the Adjudication Files lists all lands included within permit areas by section, township and range and gives an acreage tabulation. The Christensen Ranch permit area contains approximately 14,000 acres, and the Irigaray permit area includes approximately 1,000 acres.

2.2.2 AGRICULTURE ACTIVITY

Livestock grazing is the main source of food production and agriculture activity in the area. Due to the short growing season the forage provided by natural vegetation, although nutritious, is very sparse. According to personnel from the U.S.D.A. Soil Conservation Service Office in Gillette, the stocking rate in the vicinity of the projects averages .28 (AUM), or animal units per acre per month, on range that is in good condition. Some of the better lands along Willow Creek in the northwestern portion of the Christensen Ranch project area are cut for native hay production. There is also a small hay field in the southeast corner of the Christensen Ranch project area where alfalfa and intermediate wheat grasses have been seeded for hay production. These areas average about 1 ton per acre and the hay is used for winter livestock feed. There are no known commercial row or grain crops within or adjacent to the projects.

2.2.3 RECREATION

The Irigaray and Christensen Ranch areas are not well suited for many recreational activities such as camping, fishing, picnicking, hiking, skiing and snowmobiling, which are most often done in the national forest areas of the Bighorn Mountains over 50 miles (80 km) to the west of the sites. The area does, however, get some use by antelope and deer hunters during fall hunting seasons.

2.2.4 WATER RIGHTS

Water rights of record were obtained from the Wyoming State Engineer's Office for the project areas and adjacent areas within three miles for the initial permitting in 1977 (Irigaray) and 1988 (Christensen Ranch). Groundwater rights of record are listed, mapped and discussed for each project in Appendix D6 of the individual mine permit application documents. They include established groundwater rights for several domestic wells, livestock wells, several miscellaneous wells and industrial wells in and adjacent to the project areas. Current lists of groundwater rights within the permit area and within three miles of the permit area are presented in Appendix A of this document.

Surface water rights of record are listed, mapped and discussed in Appendix D6 of each project's mine permit application. Surface water rights in the area are generally livestock related. They include several surface water reservoirs ranging in capacities from 8.4 to 402 acre feet. Most of these reservoirs are adjacent to the project areas. Current lists of surface water rights within the permit area and within three miles of the permit area are presented in Appendix A of this document.

2.2.5 CUMULATIVE IMPACTS OF URANIUM AND OTHER MINERAL RESOURCE DEVELOPMENT

Other mineral resources within the project area have not been affected by the ISR mining operations. Other uranium facilities in the vicinity are shown on Figure 2.2. Oil and gas production within and adjacent to the Christensen Ranch area include the Heldt draw unit of the Table Mountain oil field. There are 24 oil wells within the Christensen Ranch area; of these, 17 are currently producing and seven have been abandoned. There are no oil wells within the Irigaray project area. There are five coal bed methane (CBM) wells adjacent to Christensen Ranch MU 5 which were drilled in 2005. No production has occurred to date from these wells. There are three companies that plan on commencing CBM drilling in or adjacent to the permit area (both Christensen Ranch and Irigaray) later in 2008. COGEMA continues to work with owners of other mineral interests to obtain a mutually agreeable solution to any conflicts which arise. It is unlikely that any subsurface problems will be encountered with oil or gas wells because those in the area are much deeper than the uranium deposits. Potential hazards do exist with uranium well field installations around the oil field equipment, especially where oil and gas lines have been buried. In turn, future CBM development within or adjacent to existing COGEMA well fields presents potential hazards relative to buried pipelines and utilities. Appropriate considerations which include surveys of the buried equipment locations and well field engineering and planning in cooperation with the oil/gas field operators will be conducted so as to avoid potential hazards and conflicts in advance of well field installations or CBM drilling. Appendix B to this submittal consists of a discussion of potential CBM impacts on Christensen Ranch operations prepared by Hydro-Engineering, Casper, Wyoming.

The existing and projected land surface disturbance due to COGEMA's Christensen Ranch ISR activities is presented in Table 3.1 as updated in this submittal. As indicated in the response to RAI1 above, there are 454 acres of existing disturbance due to COGEMA's activities at Christensen Ranch with a projected additional 520 acres of future disturbance. Figure B.1 from Appendix B of the renewal application illustrates the existing and future COGEMA disturbance. Figure B.1 also illustrates the projected (estimated) locations of CBM well locations on and within one mile of the Christensen Ranch permit area. There are an estimated 400+ CBM wells that will exist once CBM development is completed in the area (within the Christensen Ranch mine permit area and the one mile wide band adjacent to the permit boundary). At this point little of the CBM development has actually occurred. CBM operators have built some new primary access roads in the area, and they have drilled some wells (none of which are currently in production). No transmission pipelines have been built, but the local electrical cooperative has completed the installation of primary power lines into the area. Using Figure B.1 CBM well locations, an estimate of the total disturbance due to CBM road building and drill site development was derived. Some of the road placement was speculative since CBM planning by all lessees in the area has not been refined nor is that planning accessible to COGEMA. Our estimate of CBM future disturbance within the COGEMA mine permit area and the adjacent one mile wide band totals 700 acres due to roads, actual well drilling sites (at approximately 0.5 acres per well site), and ancillary facilities such as pipelines, electrical power corridors, etc. There will be some roads (primarily the major area access routes) which are common to both the ISR and CBM developments. In contrast to the future ISR development which will be concentrated in certain areas (the wellfields and attendant access corridors), CBM development will be dispersed over the entire project area since the typical lease in the area requires the installation of one well per eighty acres, and the targeted coal bed(s) are very extensive, underlying much of the Powder River Basin. The collective ISR and CBM surface disturbance (current plus future) within the COGEMA Christensen Ranch permit area and a one mile wide adjacent band is approximately 1,700 acres or about five percent of the overall land area.

Vehicular traffic and the associated impacts on fugitive dust emissions, wildlife, and personnel safety will increase in a combined ISR and CBM development scenario. Section 7.2.1 of the renewal application discusses fugitive dust emissions attributable to COGEMA's activities in the Christensen Ranch area. It was projected that the ISR-related fugitive dust at Christensen Ranch would be something less than 32 g/m^3, including 20 g/m^3 background. It is estimated that fugitive dust from CBM-related disturbance and vehicular traffic in the Christensen Ranch project area will be roughly equivalent. In the cases of both ISR and CBM development, the initial activities, involving facilities construction and wells installation will generate more fugitive dust per unit time than the ongoing maintenance/monitoring-related activities.

The cumulative increase in vehicular traffic will affect wildlife to varying degrees, primarily during the initial development phases. However, these impacts will be short-lived and minimal. Traffic-related fatalities for wildlife in the vicinity of Christensen Ranch and Irigaray have always been low. The imposition of speed limits, dictated by safety considerations and the inherent nature of roads in the area (numerous curves and hills) slows traffic, allowing big game animals and other wildlife to safely clear the roadway.

Considering the range of potential impacts to wildlife in the area from ISR and CBM development, the big game animals in the past have appeared to be fairly tolerant of human activity. Past and recent wildlife surveys by COGEMA do not point to a consistent trend toward declining big game populations that can be correlated with development activity. For instance, the winter mule deer population density was higher from 1995 through 1999, a period of ongoing ISR operations, but lower in 2007-2008 when very little activity occurred. The winter pronghorn population density in 1996, the year of peak ISR uranium production, was over twice the population density in 2008, a year of very limited activity. There have been periods of changing population (increasing or decreasing), but those periods appear to be more closely associated with impacts due to weather or disease.

The Christensen Ranch and Irigaray sites are not located in an area that represents critical winter habitat. In light of this fact, it can be speculated that even with combined ISR and CBM activities in the area, the overall impact to big game populations will be limited.

Sage-grouse is a species that currently generates concern throughout the western United States. Populations of sage-grouse have declined over a wide area in recent years, but definitive evidence explaining the decline is still being sought by researchers. Sage-grouse surveys over the past decade in the Irigaray/Christensen Ranch permit area (see Figure 3 of the wildlife survey report in Appendix C) appear to support the conclusion that the sage-grouse population has been increasing. Year 2002 which appears to be contrary to this trend has been explained as a reflection of very limited field observations during that year.

CBM activity is regulated on Federal land to minimize impacts on sage-grouse during the critical mating period; the BLM does not allow CBM drilling activity during this period. While ISR activity in the past has not been limited in a similar manner, the current source material license as amended in September, 2008, specifies consultation with the BLM or U.S. Fish and Wildlife Service in cases where ISR activity may impact sage-grouse activity on leks.

Impacts of COGEMA's activities on raptors in the Christensen Ranch area have been documented for many years. See Appendix C of this application. Briefly, raptors have maintained their presence in the area despite ongoing ISR activities. The Appendix C wildlife report indicates an overall tolerance of activity by the various raptor species. Fluctuations in nesting success appear to relate more to swings in prey populations than to variations in human activity. Generally, the sustained site presence by COGEMA has not discouraged raptor activity in the area. Raptor pairs have returned to nest despite ongoing human activity. In fact, constant activity during which raptor pairs return to nest is indicative of tolerance. In contrast, initiating activities in the immediate area after a raptor pair has started nesting has the potential to cause the birds to abandon the nest. In contrast to typical ISR activity, CBM wells installation is somewhat episodic, being of short duration, followed by a sustained, low level site presence in the form of routine monitoring and maintenance of producing wells. The BLM places significant constraints on CBM drilling activity to preclude disturbance to already occupied raptor nests; drilling activity proximate to an active nest is not allowed until after the young birds have fledged.

Noise as an impact due to collective ISR and CBM activity in the Christensen Ranch area should not be significant. Impacts of the collective activity, including those due to noise, on wildlife are discussed above. Noise impacts on adjacent human residents will be negligible; the site is very remote with few nearby residents. The nearest resident to the Christensen Ranch ISR site is three miles away.

Historical and cultural impacts due to the collective ISR and CBM activities in the Christensen Ranch area would primarily involve direct disturbance of archeological sites. As noted in Section 2.4 of this renewal application, all Federal lands within the mine permit area have been surveyed by COGEMA for archeologically significant sites in the past, and appropriate mitigation/avoidance has been accomplished. Potential impacts on private land (which is subject to the concurrence of the land owner to conduct archeological surveys) are still controlled by constraints in the Source Material License mandating mitigation in the event of archeological site discovery during ISR activities (see Condition 9.9 of the current license). CBM impacts on archeological sites are also fully regulated, requiring surveys and appropriate mitigation prior to any disturbance, including drill sites, road construction, and pipeline installation.

Visual and scenic impacts due to ISR/CBM activities in the Christensen Ranch area will be limited to the view from the adjacent Pumpkin Buttes which have limited access. The BLM requires the use of muted color on facilities buildings on Federal land to allow them to visually blend with the surroundings. The Christensen Ranch area does not represent unique or valuable vistas, and there are no parks visually proximate to the site.

Collective ISR and CBM activities on the surface of the area will impact soil resources. However, the impact will be mitigated by mandated soil preservation techniques. COGEMA is required by WDEQ to salvage and stockpile topsoil from any significant construction, such as buildings, roads, and pipelines (topsoil is segregated temporarily during pipeline excavation). Topsoil salvage is not required in entire wellfields; during wellfield development topsoil is segregated while digging drilling mud pits for replacement when the mud pits are backfilled. The typical two track roads into wellfields are not stripped of topsoil. The wellfields are managed in this manner because leaving most of the topsoil undisturbed in wellfields results is less impact on the soil resource.

CBM operators are also regulated to avoid the wasting and subsequent loss of the topsoil resource during their various construction activities. Another impact that CBM development in the area may have on the soil resource relates to the discharge of pumped water by CBM operators (although one of the major CBM operators in the general area pumps its production water by pipeline to a conventional oil field near the town of Midwest for deep injection). Some operators either utilize sizeable holding ponds for produced water, or rely upon permitted discharge to nearby drainages. CBM production water may contain higher concentrations of ions such as sodium. Over time this higher TDS water can negatively impact the soils immediately under and adjacent to the conveying drainage by creating saline conditions in the soil. In the Christensen Ranch area surface storage or discharge of CBM production water likely will be very limited (see the discussion of the subject in the revised Appendix B).

While COGEMA has a discharge permit for its Christensen Ranch operation, the discharge standards as applied by the NRC (Table 2 of Appendix B of 10 CFR 20) would mandate a very clean water prior to discharge. Presently, it is prohibitively expensive to treat water to the extent necessary prior to discharge. As a result, COGEMA has not discharged any water for a number of years.

Geological impacts from cumulative ISR and CBM activities are negligible beyond the obvious extraction of uranium and natural gas. Since the two activities target geological formations that are separated by approximately 900 vertical feet, there should be no conflicting geological impacts from the two extractive processes (see Appendix B).

Public health impacts due to the ISR and CBM activities in the immediate area have been and should continue to be minimal. The location is very remote with few residences in the area (see Table 2.1). COGEMA has routinely calculated doses to the nearest residents. Doses to the public are very low; the total effective dose equivalent (TEDE) for nearest residents ranged from 0.2 to 1.1 mrem/yr in the evaluation summarized in Subsection 7.3.3.4 of this renewal application (page 7-16). Historically, non-radiological public health impacts have been minimal to non-detectable due to COGEMA's activities. Chemical releases or spills have had no demonstrated impact on the public, and past/present standard operating procedures to address activities such as hydrogen sulfide injection during wellfields restoration have been consistently in place to mitigate potential accidents. With the expansion of CBM activity in future years there will be a modest increase in public health impacts, but the remoteness of the location from populations acts to mitigate what risk there is.

The cumulative increase in traffic relating to ISR and CBM activities will result in a theoretical increase in traffic accident risk for the public utilizing roads in the general area. However, the only non-worker traffic would be local ranchers or the occasional recreational user. The limited nature of the public presence in the area limits the potential for a traffic accident involving a member of the general public.

The occupational health implications due to a collective ISR and CBM presence in the Christensen Ranch area will involve only a limited increment of impact. CBM workers will only be in the proximity of operating ISR wellfields. Efforts on the part of COGEMA are ongoing and have been successful to date to work with CBM operators in the area during their planning phase to modify CBM well locations, utility corridors, and roads unique to CBM operations to avoid COGEMA's current and future wellfields. Because of the uniformity of the targeted coal beds, CBM companies are able to make adjustments in drilling locations without compromising production. The net result is a favorable resolution of potential operational conflicts between ISR and CBM. As noted in Section 5.6.2, the occasional presence of CBM workers in proximity to wellfields should not pose any radiological concerns. CBM workers will not have access to posted restricted areas, and their presence adjacent to COGEMA's operations will be of such short duration that compliance with Subpart D of 10 CFR 20 will not be an issue. There are no plans (or need) to track CBM worker time when present proximate to COGEMA's operations. Other occupational hazards are readily avoidable through the noted cooperative approach. COGEMA employees will not frequent CBM drill sites or have any need to be present at various CBM operations. As noted above there is a limited additional hazard relating to the potential for a higher incidence of traffic accidents relating to more work-related vehicular traffic in the area.

Socioeconomic impacts of the collective ISR and CBM activities in the immediate area will involve a positive influence by creating jobs. The two sectors will undoubtedly compete for some employees, but it is generally felt that the labor market can support both activities. The area towns such as Buffalo and Casper will realize an economic benefit from increased demand for goods, services, and housing. If such demands exceed the near term resources of a community there may be negative impacts such as inflation in the cost of local goods and housing. The two activities will directly compete for the services of drilling companies. If there is a shortage of available drillers, this can have an inflationary impact on drilling costs. The local land owners generally benefit from the increased income that derives from royalties or access leases. However, they may trade a portion of that supplemental income for less available land for stock grazing. The ISR and CBM extractive activities will result in additional tax revenues for Federal, state, and local governments, but in the case of state and local governments, they will likely have to provide additional services as a result of the increased workforce in the area.

development. After BLM approval of the mitigation plan (letter to WDEQ/LQD dated December 14, 1995) and SHPO concurrence, a revision to the DEQ permit condition regarding these two sites was requested by COGEMA in a letter to LQD dated March 4, 1996. LQD responded in a letter dated March 13, 1996, that the permit condition concerning mitigation of the sites had been fulfilled. Site 48CA533 remains isolated from any potential disturbance by an exclusionary fence. COGEMA will continue to avoid any disturbance of Site 48CA533.

The 7,082 acres surveyed at Christensen Ranch constitute approximately 52 percent of the permit area. The remaining 48 percent of the surface of the permit area is located on private land that was not surveyed during the 1986 inventory at the landowner's request. If previously unrecorded cultural materials are encountered during construction or operations of the facility, COGEMA will report the findings to appropriate regulatory authorities and take action to prevent adverse impacts to the resources whether they are located on previously surveyed lands or un-inventoried lands. A compromise will be worked out at that time between the landowner, COGEMA and the regulatory authorities to evaluate the significance of the materials and make recommendations for its disposition.

There are no known architectural resources in the area. The Pumpkin Buttes are themselves natural landmarks of scenic and cultural value which will be undisturbed by the proposed in-situ mining operation.

2.5 CLIMATOLOGY AND METEOROLOGY

2.5.1 GENERAL AREA CHARACTERISTICS

The Irigaray and Christensen Ranch areas are classified as a semi-arid continental climate. Meteorological data collection sites operated by the National Oceanic and Atmospheric Administration (NOAA) in the vicinity of the area include: Midwest - 30 miles SW, Kaycee - 31 miles W, Gillette - 43 miles NE, Buffalo - 51 miles NW, and Casper - 68 miles SW. Records from these locations provide general long term weather data for areas surrounding the sites.

Meteorological monitoring was conducted at Irigaray for one full year, December 1980 through December 1981. These data provide insight to local conditions and have served as the primary source of meteorological information for the Irigaray and Christensen Ranch projects. Copies of the two semi-annual meteorological reports for the Irigaray Mine are provided for review in Appendix D4 of the Christensen Ranch permit application. No onsite meteorological data collection was required or done since the early 1980s. The historical meteorological data for the area was summarized in the "Permit to Mine No. 478, A-2 Update and U.S. NRC License Renewal Application: Source Material License SUA-

1341, January 5, 1996." That summary found in Sections 2.5.2 through 2.5.5 of the January, 1996 renewal document (pages 2-16 to 2-25, 2-26, and 2-27) will not be repeated here, but is incorporated by reference.

To evaluate the possibility of changing weather trends since the previous application/renewal as well as the current applicability of meteorological data from general area weather stations to the mine site, available data from these stations were examined. Data were compiled from weather stations located at Buffalo, Gillette, Kaycee, Midwest, and Billy Creek, Wyoming. Billy Creek is located approximately 18 miles south of Buffalo. Changes at these monitored locations would infer similar changes at Irigaray and Christensen Ranch. Conversely, a lack of changes at the other sites would likely indicate no changes at the mine site. Average monthly and average annual temperature and precipitation were calculated for each site for a uniform period of record (1962 through 1989) and for the period 1990 through 2005. Years in which three or more months of data were missing from the record for a given station were deleted from the annual average calculation. The data are summarized in Table 2.3. The earlier data set for each station was compared to the later data set to see if there were noticeable differences.

The monthly average and annual average temperatures for the two different time periods for each of the five stations are presented in Table 2.3. Four of the five stations had virtually the same annual average temperature for both time periods; the biggest difference was an increase of 0.53° F for Buffalo with an average difference between the two periods for the four stations equaling 0.25° F. The Midwest data would seem to indicate a substantial and anomalous average annual temperature decline exceeding two degrees F, but the data have some significant gaps that may be influencing the average results. Overall, the data support the conclusion that the annual average temperature in the region surrounding Irigaray and Christensen Ranch has not changed significantly from the 1962-1989 period to the 1990-2005 period.

Despite the limited site specific temperature data for Irigaray/Christensen Ranch, it was worthwhile to compare the 1981 temperature data available for Irigaray with the comparable data from the regional weather stations. See Table 2.3 for this comparison. The 1981 data support the conclusion that the regional temperature data is reflective of temperatures at Irigaray. Since there are no substantial elevation differences between all of these locations, comparability of temperature data would be expected.

The monthly average and annual average precipitation for the two different time periods for each of the five stations are also presented in Table 2.3. Four of the five stations exhibited similar annual precipitation averages when comparing the two different time periods. Midwest was the only station that exhibited a significant difference in precipitation when comparing the annual averages for the two different time periods. Midwest experienced a decline of 2.9 inches average annual precipitation from the earlier period to the later period. However, there were a number of years that lacked sufficient data for Midwest.

This lack of data may have influenced the outcome of the evaluation. Discounting the incomplete record for Midwest, one can conclude there has not been a dramatic change in precipitation patterns from the period 1962-1989 to the period 1990-2005.

Evaluating changes in wind direction and speed for different periods is more difficult because of the limited regional data that are available. Only two of the stations (Buffalo and Gillette) utilized to evaluate regional temperature and precipitation changes have wind data available. See www.wrcc.dri.edu for historical summaries of wind direction and speed for reporting stations in Wyoming. Because of differences in local terrain and relative location, wind direction and speed data for Buffalo and Gillette are only marginally applicable to Irigaray and Christensen Ranch. Buffalo exhibits a strong north-northwest component to wind direction which is present in the 1981 Irigaray data for March through July. During the balance of the year the 1981 Irigaray data reflect a more southerly component to wind direction, more reflective of Gillette and Casper. Considering wind speed in general for eastern Wyoming, there is a relatively uniform pattern: December through May is the windiest period in terms of velocity with a peak in December-January. During the warm weather months there is some moderation of wind velocity.

The overall patterns of wind speed and direction for eastern Wyoming have not changed significantly since previous re-licensing actions for Irigaray/Christensen Ranch. Wind was and remains a dominant component of Wyoming's weather. No dramatic shifts in wind direction or wind speed have occurred at the site, based on casual observation by site personnel. The Wyoming Climate Atlas (available at www.wrds.uwyo.edu/sco/climateatlas) includes some graphical presentations of wind speed and wind direction frequency distributions for select weather stations covering diverse locations throughout Wyoming. Despite some year to year variation, the significant aspect demonstrated by the graphs is the consistency of wind speed and direction over an extended time period (1961-1990). This supports the conclusion that wind characteristics have not changed appreciably at Irigaray/Christensen Ranch in the past ten or so years.

2.6 GEOLOGY AND SEISMOLOGY

2.6.1 REGIONAL GEOLOGY

The regional geology associated with the Irigaray and Christensen Ranch project areas was thoroughly discussed in "Permit to Mine No. 478, A-2 Update and U.S. NRC License Renewal Application: Source Material License SUA-1341, January 5, 1996." The reader is referred to Section 2.6.1 of that document (pages 2-25 and 2-28 to 2-29 for a discussion of the regional geology.

TABLE 2.3

AVERAGE MONTHLY TEMPERATURE (°F)

temperature in °F

	Years	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Billy Creek	1962-'89	21.80	27.00	33.51	42.77	51.83	61.27	68.88	66.99	56.60	46.27	32.97	24.77	**44.76**
	1990-'05	24.87	27.64	34.12	42.34	51.38	60.22	68.47	67.33	57.37	44.68	32.27	25.52	**44.64**
Buffalo	1956-'89	21.90	26.82	33.76	43.65	53.36	62.95	70.23	68.43	57.50	46.96	32.77	25.31	**45.48**
	1990-'05	25.69	27.93	35.17	43.72	52.81	61.94	70.31	69.35	59.44	46.47	33.71	26.41	**46.01**
Gillette	1925-'89	21.15	25.67	32.27	43.08	52.90	61.93	71.24	69.52	58.64	47.55	33.12	24.99	**44.94**
	1990-'05	23.65	27.42	34.27	43.07	52.54	62.17	70.10	69.27	58.92	45.37	32.34	25.05	**45.25**
Kaycee	1948-'89	21.36	27.16	33.69	43.29	52.93	62.35	69.78	67.97	57.37	46.55	32.74	24.65	**45.16**
	1990-'05	24.46	26.95	34.86	43.27	53.36	63.15	71.54	69.71	59.09	45.79	32.14	24.96	**45.44**
Midwest	1948-'89	23.30	28.62	35.31	45.16	55.12	64.96	72.36	70.66	59.98	49.33	34.44	26.56	**46.78**
	1990-'05	25.94	27.83	36.14	44.34	53.51	63.40	71.06	68.99	58.89	47.22	32.76	24.73	**44.55**

AVERAGE MONTHLY TOTAL PRECIPITATION (inches)

Station	Years	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Billy Creek	1962-'89	0.29	0.30	0.57	1.40	2.28	2.35	1.29	1.15	1.13	0.88	0.40	0.35	**12.38**
	1990-'05	0.32	0.37	0.61	1.52	2.27	2.34	1.77	0.79	1.19	1.02	0.49	0.21	**12.99**
Buffalo	1962-'89	0.58	0.49	0.78	1.56	2.41	2.36	1.25	0.90	1.42	0.84	0.58	0.51	**13.51**
	1990-'05	0.42	0.41	0.64	1.50	2.22	2.46	1.59	0.80	1.19	1.25	0.47	0.36	**13.46**
Gillette	1962-'89	0.56	0.52	0.85	1.85	3.12	3.24	1.65	1.22	1.46	1.22	0.69	0.64	**17.00**
	1990-'05	0.58	0.71	1.10	2.29	2.63	2.38	1.60	1.29	1.36	1.66	0.68	0.63	**17.10**
Kaycee	1962-'89	0.48	0.37	0.76	1.65	2.53	2.29	1.09	0.85	1.07	0.92	0.52	0.46	**12.85**
	1990-'05	0.32	0.37	0.69	1.40	2.14	2.06	1.33	0.98	1.23	1.55	0.52	0.27	**12.70**
Midwest	1962-'89	0.74	0.69	0.89	1.73	2.64	2.06	1.29	0.67	1.07	0.97	0.65	0.80	**13.82**
	1990-'05	0.22	0.53	0.81	1.43	2.42	1.63	1.12	0.62	0.69	1.05	0.57	0.46	**10.92**

temperature in °F

	Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Irigaray	1981	32	28	37	48	52	63	73	70	63	46	41	28	48
Billy Creek	1981	32.29	27.86	38.29	47.38	50.24	59.3	70.19	68.35	61.67	44.23	40.18	27.48	47.29
Buffalo	1981	29.53	24.55	36.05	47.08	50.71	61	71.1	67.58	60.78	41.58	37.57	24.47	46
Gillette	1981	33.21	28.73	38.5	49.32	52.65	61.79	71.63	68.27	62.3	45.12	39.48	26.5	48.13
Kaycee	1981	32.31	29.7	38.55	49	52.92	63.58	73.23	69.52	61.78	45.92	39.7	26.94	48.59
Midwest	1981	33.32	31.04	39.66	50.88	53.95	66	73.58	70.18	63.75	46.97	40.57	28.97	49.91

2.6.2 SITE GEOLOGY

The site geology associated with the Irigaray and Christensen Ranch projects was thoroughly discussed in "Permit to Mine No. 478, A-2 Update and U.S. NRC License Renewal Application: Source Material License SUA-1341, January 5, 1996", as revised September 3, 1997. The reader is referred to Section 2.6.2 of that document (pages 2-29 to 2-33 for a discussion of the site geology.

2.6.3 SEISMOLOGY

The seismology associated with the Irigaray and Christensen Ranch projects was discussed in "Permit to Mine No. 478, A-2 Update and U.S. NRC License Renewal Application: Source Material License SUA-1341, January 5, 1996", as revised September 3, 1997. The reader is referred to Section 2.6.3 of that document (page 2-33 for a discussion of the site seismology.

2.7 HYDROLOGY

2.7.1 GROUNDWATER

Extensive investigation of the groundwater systems at the Irigaray and Christensen Ranch project areas were conducted to assess the impact of the proposed in-situ mining activities during initial permitting. The studies included a review of the hydrogeology of the area, extensive aquifer testing and field sampling to determine water quality. At Christensen Ranch, initial investigations included the "L" sandstone (underlying aquifer), lower confining layer, the "K" sandstone (mineralized zone), upper confining layer and the "J" sandstone (overlying aquifer). Potentiometric surfaces were developed for each aquifer and recharge and discharge areas were researched. There were nine aquifer - aquitard investigations performed at six test sites within the Christensen Ranch permit area to define aquifer characteristics. There were 10 horizontal permeability tests performed within the "K" sandstone at different deletion of that requirement. The 2007annual wildlife survey report is included with this submittal as Appendix C. In future years big game surveys will not be done.

Preparatory to the resumption of mining, COGEMA also commissioned an update report in early 2008 on the occurrence of threatened or endangered species of plants and animals in the vicinity of the mine permit area. No threatened or endangered species were identified in the recent re-evaluation. The report is included here also in Appendix C.

2.8.2 AQUATIC ECOLOGY

There is very little potential for aquatic life on the Irigaray and Christensen Ranch areas due to the intermittent and ephemeral nature of the drainage and relatively little surface water in the form of lakes or ponds. Two species of minnows, the plains minnow, Hybognathus placitus, and flathead minnow, Pimephales promelas, were trapped from the Willow Creek drainage in the northwest portion of the Christensen Ranch permit area. There are no known species of game fish in the immediate vicinity. Other aquatic life either observed or which could potentially occur on the area are listed in Appendix D9 of the Christensen Ranch permit application.

2.9 BACKGROUND RADIOLOGICAL CHARACTERISTICS

The reader is referred to Section 2.9 (pages 2-38 to 2-47) of "Permit to Mine No. 478, A-2 Update and U.S. NRC License Renewal Application: Source Material License SUA-1341, January 5, 1996", and to Section 2.4 of the "Decommissioning Plan for Irigaray and Christensen Ranch Projects", December, 2000, revised June, 2001, for a discussion of background radiological characteristics of the Christensen Ranch permit area. The latter reference is particularly relevant since it provides the rational basis for the background radiological values in that approved decommissioning plan.

2.10 BACKGROUND NON-RADIOLOGICAL CHARACTERISTICS

Background non-radiological characteristics of the site are discussed in depth in the applicable sections of Appendix D in both Irigaray and Christensen Ranch permit applications. Potentially toxic substances such as heavy metals in the surface and groundwater are presented in Appendix D6, Hydrology. Baseline water quality values for both surface and groundwater are also provided. Because of the relatively small surface disturbance necessary to construct the ISL facilities, very little atmospheric pollution in the form of dust and air particulates is produced. A significant change to the existing air quality in the vicinity is not anticipated.

3.1.2 CHRISTENSEN RANCH SITE

The Christensen Ranch permitted area is an irregular shaped but contiguous land unit which encompasses 14,035.19 acres in Townships 44 and 45 North, Ranges 76 and 77 West in Johnson and Campbell Counties, Wyoming. Originally, the permit area was divided into four phases for the purposes of mine planning, with a satellite operation planned in each phase. This is no longer the case, as all well field development areas can be reached from the current satellite plant through trunkline connections. Existing facilities at Christensen include the satellite ion exchange plant and restoration facility, four lined brine evaporation ponds, one unlined permeate storage pond, two deep injection disposal wells and well fields consisting of Mine Units 2, 3, 4, 5, and 6, an office building, and warehouse. A second permeate storage pond is licensed, but not currently scheduled for construction. A number of wells had been installed in planned Mine Unit 7 in the mid 1990's.

Figure 3.1 shows the location of the Christensen Ranch permit area, in relation to the Irigaray site. The well field development areas shown in Figure 3.1 consist of the North Prong geographical area (Mine Unit 6 and future Mine Unit 7), the Heldt Draw area (future Mine Units 8 and 9) and the Table Mountain area (future Mine Units 10, 11 and 12). Existing Mine Units 2, 3, 4 and 5 are located in the Willow Creek geographical area. The development sequences for these areas are described in more detail in Section 3.7 of this chapter.

Figure 3.3 (in pocket) shows a detailed location map of all existing facilities at Christensen. The total estimate of acreage disturbed by existing operations is 454 acres. This acreage consists of approximately 19 acres for the plant and pond facilities, 274 acres of well field, pipeline corridors and staging areas, 36 acres of access roads, 10 acres of soil stockpiles (topsoil and subsoil), and 115 acres relating to future mine units delineation drilling and other miscellaneous facilities. Table 3.1 summarizes the potential disturbances for the remainder of the Christensen Ranch development areas.

In summary, the new estimate of lands to be disturbed during all mining operations within the Christensen Ranch area totals approximately 974 acres. The total disturbance is only 7% of the 14,035.19 acres within the entire permit area. The size and configuration of the permitted area is necessary to encompass access roads, monitoring locations and mining claims for potential development areas.

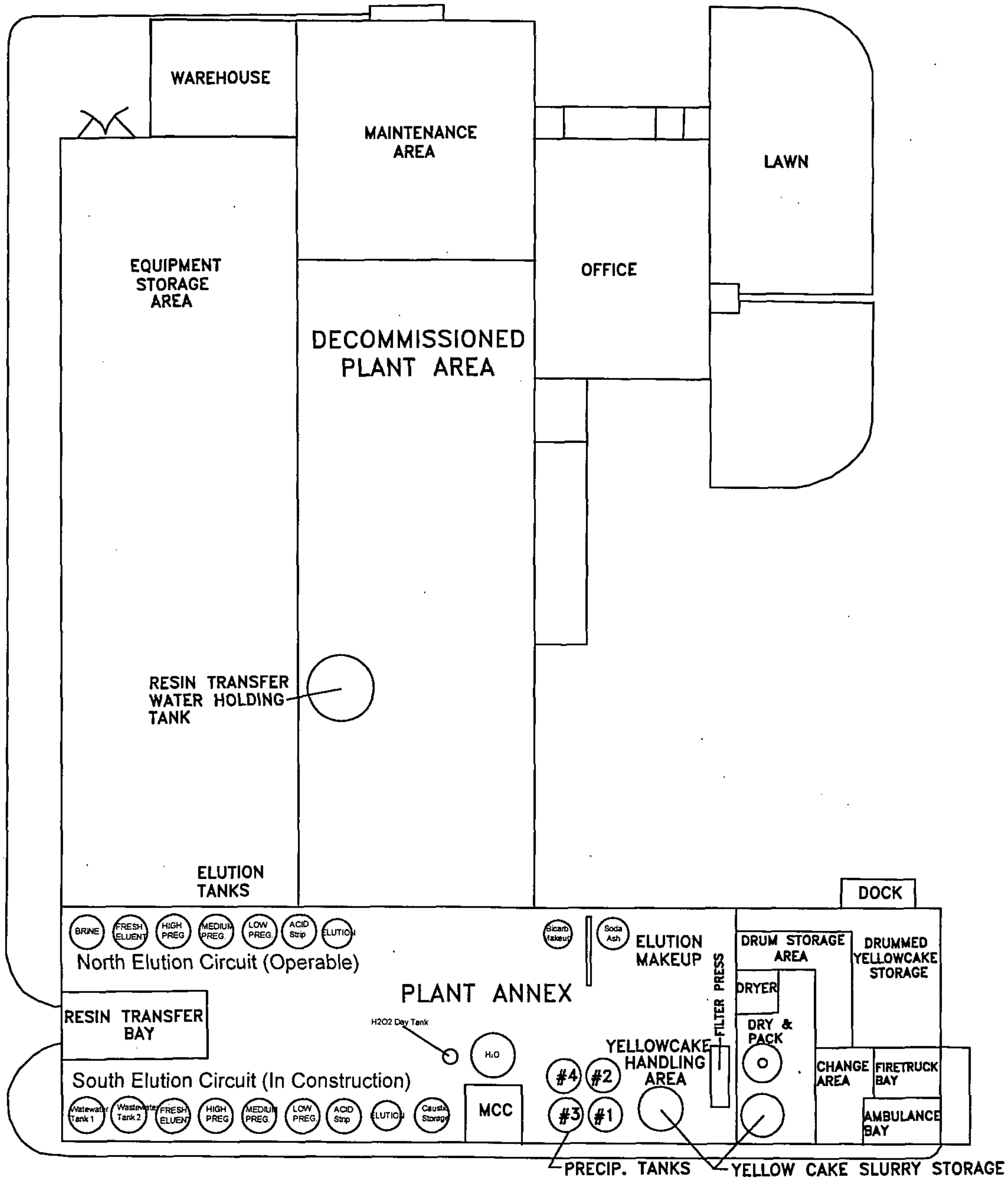
TABLE 3.1
EXISTING AND FUTURE ESTIMATED DISTURBANCE BY DEVELOPMENT AREA
CHRISTENSEN RANCH

DEVELOPMENT AREA	LOCATION	DISTURBED AREA TYPE	EXISTING (ACRES)	FUTURE* (ACRES)	TOTAL (ACRES)
Willow Creek (M.U. 2 - 5)	T44N, R76W, Secs. 5:W½; 6,7,8, W½; 17, 18, 19, & 20	Plant & Pond Facilities	19	0	19
		Wellfield Mine Units 2-5	84	0	84
		Peripheral Disturbance	137	0	137
		Access Roads	31	0	31
		Soil Stockpiles	7	0	7
		Total for Willow Creek	278	0	278
North Prong	T44N, R76W, Secs. 3, W½W½;4; 5, E½; 8, E½; 9; 10, W½W½; 16 & 21	Trunkline Access to Plant	10	0	10
		Wellfield Mine Units 6 & 7**	71	29	100
		Peripheral Disturbance	3	137	140
		Access Roads	5	25	30
		Total for North Prong	89	191	280
Heldt Draw	T45N, R76W, Secs. 19, S½S½; 30, 31; 32, SW¼ T45N, R77W, Secs. 24, S½S½; 25,N½ N½ SW¼, SE¼	Trunkline Access to Plant	0	10	10
		Wellfield Mine Units 8** & 9**	57	8	65
		Peripheral Disturbance	30	61	91
		Access Roads	0	30	30
		Total for Heldt Draw	87	109	196
Table Mountain	T44N, R77W, Secs. 1, 2, 3, 10, N½; 11, N½; 12, N½ T45N, R77W, Secs. 34, S½N½, S½; 35, S½ N½, S½	Trunkline Access to Plant	0	10	10
		Wellfield Mine Units 10, 11, & 12	0	75	75
		Peripheral Disturbance	0	105	105
		Access Roads	0	30	30
		Total for Table Mountain	0	220	220
		Grand Total	**454**	**520**	**974**

*Future acres of disturbance are estimates.

**Represents disturbance due to exploratory and delineation drilling and related activities.

THIS PAGE IS INTENTIONALLY LEFT BLANK.



AREVA

COGEMA Mining, Inc.
Christensen Project

Figure 3.10
Irigaray Facility
General Arrangement Diagram

0 30' 60'

Geology: Enviro: Drafting: Date: July 2009 Revision:	State: Wyoming County: Johnson: Scale: 1"=60' Drawing ID: Fig IR Plant.dwg

TABLE 3.3

IRIGARAY PLANT EQUIPMENT LIST

Plant Area	Type	Detail	Number	Units
Main Plant				
	Tanks			
		Resin Transfer Water Tank 25' dia x 15'	1.0	EA
	Misc			
		Compressor		
		Compressor 4'x6'x8'	1	EA
		Controls 6'x6'x6'	1	EA
		Gas Heater 2'x2'x2'	1	EA
		Waste Water Pump 3'x3'x6'	2	EA
		Compressor Tank	1	EA
	Main Plant Foundations and Floor			
		3.66CF/LF Footer 218'x80'	596	LF
		218' x 80' x 6" Floor	17,440	SF
	Main Plant Building			
		178' x 80' x 24' Steel Building	14,240	SF
		40' x 80' x 40' Steel Building	3,200	SF
Expansion Building				
	Tanks			
		Brine 12'dia x 20'	1	EA
		Wastewater 12' dia x 15'	2	EA
		Fresh Eluant 15' dia x 12'	2	EA
		Process Eluant Tanks 12'dia x 15'	6	EA
		Acid Strip 12'dia x 10'	2	EA
		Elution Tanks 6'dia x 12'	2	EA
		Fresh Water Tank 12' dia x 15'	1	EA
		Hydrogen Peroxide 6'dia x 8'	1	EA
		Caustic Storage 15' dia x 12'	1	EA
		Sulfuric Acid 10'dia x 12' (Outside)	1	EA
		Bicarb Makeup 12'dia x 15'	1	EA
		Soda Ash Silo 12'dia x 30' (Steel)	1	EA

TABLE 3.3

IRIGARAY PLANT EQUIPMENT LIST

Plant Area	Type	Detail	Number	Units
Expansion Building				
	Tanks			
		Precipitation Tanks 12'dia x 15'	4	EA
		Yellowcake Slurry Silo 17'dia x 26' (Steel)	2	EA
		Flocculants Feed Tank 4' dia x 4' (Steel)	1	EA
		Scrubber Feed Tank 4' dia x 4' (Steel)	2	EA
		Water Tank 3' dia x 3'	1	EA
		Scrubber Water Tank	1	EA
	Misc			
		Hot Water Heater 200gal 3'dia x 5'	1	EA
		Hanging Space Heaters 3' x 3' x 3'	4	EA
		Blower 3' x 3' x 4'	1	EA
	Process Equipment			
		Filter Press 20' x 6' x15'	1	EA
		Dryer/Calciner 8' Dia x 15'	1	EA
		Compressor 3' x 4' x 8'	1	EA
	Pumps			
		Assorted Pumps 3' x 4' x 6'	3	EA
		RO Pumps	3	EA
	Foundations & Floors			
		230' x 80' Foundation @3.66CF/LF Footer	620	LF
		230' x 80' x 6" Concrete Floor	18,400	SF
		6" Below Concrete Dirt Removal	18,400	SF
	Building			
		228' x 80' x 24' Steel Building	18,240	SF
		70' x 80' x 35' Steel Building	5,600	SF
		Masonry Walls 593 LF x 12' High x 8"	7,116	SF

3.4.2.4 Wastewater Management

Two liquid waste streams are produced during the mining operations. The first stream is the 1% bleed taken in the plant for lixiviant control in the well field. The 40 gpm stream consists of the brine from the RO unit discussed above in the ion exchange/lixiviant makeup circuit section. The 40 gpm of brine (less than two percent of the total injection flow) will be sent to a lined evaporation pond or disposed via deep well injection. The permeate not used for lixiviant makup or process stream recycle, is currently stored in a compacted clay-bottomed pond adjacent to the plant site (a second pond is licensed, but not yet installed). Synthetic liners and leak detection systems are not necessary for the permeate storage ponds due to the good quality of the water; uranium and radium will meet NPDES surface discharge criteria for uranium mines after treatment through the IX systems, reverse osmosis unit and, if necessary, radium removal resin in the plant. Additionally, because the water source is process water, NRC standards in 10 CFR 20, Appendix B, Table 2 values for uranium and radium will be met for discharge into the pond. Anticipated water quality concentration ranges of the permeate storage pond solutions are:

	(All data in mg/l)
Bicarbonate	35 - 100
Chloride	15 - 45
Sulfate	1.5 - 10
Sodium	25 - 75
TDS	60 - 200
pH	6.0 - 8.0
Uranium	<0.10 - 2.0
Radium-226 (pCi/l)	<1.0 - 3.0

Design criteria for the permeate storage ponds are provided in Section 4.2.

The second stream produced during mining operations consists of sand filter backwash solutions, resin wash water, plant washdown waters and, on occasion, brine from the RO unit. This wastestream ranges from approximately 5 gpm up to 62.5 gpm (very short term basis) and is diverted to the lined brine ponds for evaporation. There are four lined brine evaporation ponds at the Christensen Ranch site. Two deep disposal wells are also available. Anticipated waste/brine concentration ranges are:

	(All data in mg/l)
Bicarbonate	1500 - 7500
Chloride	150 - 1200
Sulfate	450 - 12000
Sodium	800 - 7500
TDS	2000 - 25000
pH	6.0 - 9.8

.4.2 LIQUIDS AND SOLIDS

4.2.1 CHRISTENSEN RANCH SITE

Liquid effluents from the operation are generated from both the mining and aquifer restoration processes. The restoration process and potential liquid effluents are discussed in Section 6 of this application.

Two liquid effluent streams are produced during the mining operations. The first stream is the typical 1% bleed (up to 40 gpm) taken from the plant process to control lixiviant migration in the wellfield. Disposition of the wellfield bleed during all phases of production and restoration is predominantly by injection into the deep disposal wells and in very minor amounts, by evaporative loss in the process water ponds. An expanded discussion of waste water management is provided below.

Production Only Phase

1. Direct injection from the plant process flow into the deep disposal wells (up to 40gpm) without other processing steps (which would occur if no RO permeate water is needed for lixiviant makeup or the RO system was temporarily unavailable).

2. Processing 160gpm of the plant process flow through a reverse osmosis unit when RO permeate water is needed for lixiviant makeup, the normal production-only scenario. Assuming a split of 75% permeate and 25% brine, 120gpm of high quality permeate would return to the wellfield via the lixiviant makeup system for reinjection; and 40gpm of brine would be sent directly to the deep disposal wells, or to the evaporation ponds. Sending all or a portion of the brine to the evaporation ponds prior to deep well disposal may be done to provide a temporary hold on the waste water as part of the optimization program for management of the deep disposal wells.

Joint Production / Restoration Phase

1. Up to 40gpm of bleed flow as outlined in the Production Only Phase above injected into the deep disposal wells.

2. Up to 110gpm flow to the deep disposal wells from a combination of:

    a. Groundwater sweep – total flow to the deep well.

    b. Reverse Osmosis – 25% of the flow (brine) to the deep well.

3. All or a portion of the flow above may go initially to the lined evaporation ponds which are used as holding ponds prior to deep disposal well injection.

Restoration Only Phase

1. Up to 150gpm flow to the deep disposal wells from a combination of:

    a. Groundwater sweep – total flow to the deep well.

    b. Reverse Osmosis – 25% of the flow (brine) to the deep well.

2. All or a portion of the flow above may go initially to the lined evaporation ponds which are used as holding ponds prior to deep disposal well injection.

The second liquid effluent stream from the process consists of the sand filter backwash solutions, resin transfer wash water, and plant washdown waters. These solutions comprise approximately 5 gpm, on a periodic basis, and are diverted to a lined solar evaporation pond or the deep disposal well after usage.

Sanitary wastes from the office facility are disposed of by a state approved septic tank/leach field system. Details of liquid effluent retention devices are provided in the following sections.

4.2.1.1 Lined Evaporation Pond Design

The lined solar evaporation ponds were initially designed to provide a surface area and capacity capable of evaporating a 5 gpm process effluent stream. The four pond system was based on two major design considerations. First, the pond system is capable of evaporating the process effluent over a ten year period. Secondly, the pond system is configured to have the capability for totally emptying the contents of one pond into the remaining pond(s).

The four lined solar evaporation ponds were designed to meet the requirements of the U.S.

5.10.2 NON-ROUTINE REPORTS

In the event that a report of a non-routine incident becomes necessary, COGEMA will follow specific reporting procedures for that incident as identified by the particular regulatory agency. In most cases, both the WDEQ and NRC are notified by telephone or e-mail within 24 to 48 hours of verified monitor well excursions, pond leakage, significant spills, tank ruptures, or any other incidents that would trigger the reporting requirements provided in 10 CFR 20, Subpart M. Written reports will follow such telephone reports within the timeframes discussed in this application, or by other requirements imposed by the regulatory agency.

5.11 RECORDS MAINTENANCE AND RETENTION POLICY

5.11.1 GENERAL RECORDS COMPLIANCE

Records maintenance and retention shall comply with Subpart L of 10 CFR 20.

5.11.2 RETENTION OF SPECIFIC TYPES OF RECORDS

a. On-site Radioactive Waste Disposal. The only relevant records concern the deep disposal wells. There is no land application or burial of such materials practiced on site. All byproduct material waste is shipped for disposal at a licensed site for the receipt of such material (currently, Pathfinder Mines Corporation's Shirley Basin tailings site). Records of shipments of these materials are maintained on site. No hazardous materials regulated by other agencies are subject to disposal on site. The deep disposal wells records include continuous monitoring records while operating of injection rate, annulus pressure, and injection pressure. Records of cumulative injection volume are maintained. There are also records of injectate quality (monitored on a quarterly frequency), biannual static bottom-hole pressure survey test reports, and quarterly summary monitoring reports sent to the Wyoming Department of Environmental Quality. All of these records are maintained on site until license termination.

b. Effluent Release Measurements and Calculations. These records are maintained on site until license termination.

c. Records Specified in Criterion 8 of Appendix A of 10 CFR 40. These records consist of the yellowcake dryer operation monitoring data (differential pressure recordings and documented manual reading checks, and dryer stack scrubber water flow rate recordings and documented manual reading checks). These records are maintained on site a minimum of three years after the records are made. Criterion 8a of Appendix A requires the maintenance of daily documented inspections of tailings or waste retention systems for a minimum of three years. By license condition the waste retention systems (evaporation ponds) at Irigaray and Christensen Ranch only require inspection on a weekly basis. These documented inspection records are maintained on site for a minimum of three years after the records are made.

d. Decommissioning and Reclamation Records. These records, including analytical data, supporting survey results, documentation of activities, and related monitoring records, are all maintained on site. These records are maintained until license termination.

e. Records Relating to the Evaluation and Demonstration of Compliance for Dose, Intake, and Releases to the Environment as Specified in 10 CFR 20. All of these records are maintained on site. These records are maintained until license termination.

f. Other Survey Records and Calibration Records. These records are maintained on site for a minimum of three years after the records are made.

6.1.2.1 Groundwater Sweep

The first step in the restoration process is to recall the mining solution from the periphery of the wellfields which has been affected by horizontal flaring. This process is termed groundwater sweep because the voids created within the ore zone aquifer during the removal of mining solutions are swept and filled with native groundwater. The goal of the groundwater sweep phase is to achieve an approximate 25% reduction in the conductivity (total dissolved solids indicator) of the composite wellfield groundwater, and return all mining solutions back to the wellfield.

Groundwater sweep is accomplished by pumping the recovery and injection wells within the wellfield with no re-injection of solutions (total water withdrawal). Wells used for the recovery may be varied during the pumping to achieve maximum flow distribution throughout the wellfield. Flow rates during groundwater sweep are dependent upon the sustainable yield of the ore zone aquifer, and will fluctuate as the program progresses. At Christensen Ranch all solutions recovered from the wellfield during the groundwater sweep phase are treated, temporarily stored in the evaporation ponds, and then injected down a deep disposal well. An alternative is to sufficiently treat the water in order to surface discharge in compliance with 10 CFR 20 Appendix B, Table 2 limits for radionuclides and under the WYPDES permit The solutions would be treated for uranium, radium-226, and total suspended solids removal prior to discharge. Further explanation follows:

A typical groundwater sweep treatment process is shown in Figure 6.1 (Christensen Ranch Restoration Process Flow Diagram for Units 2 through 6). The process involves routing the recovered groundwater sweep solutions from the wellfields to a holding pond(s), where barium chloride will be added. Treatment with barium chloride will remove approximately 95% of the total radium-226 content by a reaction forming a barium sulfate/radium-226 co-precipitate. The barium treatment also assists with other metals reduction. Solutions in the holding pond will then be routed to the main processing plant for further treatment.

Within the process plant, the groundwater solutions from the pond will be filtered (total suspended solids removal) and then sent through the ion exchange columns for recovery of uranium. After the primary uranium removal, the solutions are sent to the treated water holding tanks, or to two optional circuits which are available to further reduce uranium and radium-226 concentrations as necessary to meet the requirements of 10 CFR 20, Appendix B, Table 2, and the WYPDES permit. These optional circuits include additional barium chloride treatment and filtration through a filter press, and additional ion exchange treatment. Solutions stored in the treated water holding tanks are then released by pipeline to surface discharge.

Flow rates during groundwater sweep will vary, depending upon the aquifer properties. Flow rates typically begin around 200 to 300 gpm, then will decrease during the program due to the 100% consumptive removal.

The pore volume displacements (PVD) presented are derived from the average volumes experienced at Christensen Ranch during the restoration of Mine Units 2 through 6:

Treatment:	Groundwater Sweep
Flowrate:	Up to 300 gpm
Volume:	1 PVD
	Bleed to treatment, surface discharge, deep injection well, ponds, or other wastewater management practices approved in the future. Sweep solutions may be treated, stored and reinjected into other mine units undergoing restoration to minimize overall groundwater consumption and wastewater disposal volumes.

Treatment:	RO/permeate injection
Flowrate:	Up to 500 gpm
Volume:	10 PVD
	Brine to deep well injection, lined ponds, treatment and surface discharge or reinjection into another unit undergoing restoration, or other wastewater management practices approved in the future.

Treatment:	Recirculation
Flowrate:	Up to 500 gpm
Volume:	1 PVD

Treatment:	Stabilization Monitoring
Flowrate:	None
Time Period:	Minimum of 9 months

Groundwater volumes produced during restoration will depend upon the size of the mine unit and corresponding pore volume.

6.1.3.1 Restoration Schedule

It is anticipated that mining in a particular unit will be completed in a three year period. Restoration of a mine unit will follow the completion of mining consistent with the requirements of 10 CFR Part 40, §40.42(d) as may be modified by NRC agreement to a request under §40.42(f) (if such a request is submitted by COGEMA). If the mine unit is located adjacent to an active mining area or shares a trunkline with an active mining area, restoration may be delayed until the mining is accomplished in the adjacent unit or the trunkline is available for restoration. At that time, the mine unit in which production was just completed may serve as a buffer zone between the unit ready for restoration and another mine unit in a production mode. Restoration of each mine unit is designed to be accomplished within a two to three year period to keep up with the mining schedules. Mining and reclamation timetables for the Christensen Ranch area were previously discussed in Section 3.6. Additional discussion of restoration timeliness follows.

COGEMA has committed to groundwater restoration to commence in each wellfield as soon as possible following completion of mining operations. To accomplish this, a number of technical constraints for the Christensen Ranch facilities determine an appropriate schedule:

a. Production flow is limited to a maximum of 4,000gpm (but typically averaging 3,600 gpm).

b. Restoration flow is limited to 1,000gpm during restoration phase only operations or 500gpm during combined operations of production/restoration. The restoration capacity is in part limited by the wastewater disposal capacity.

c. Wastewater disposal capacity is 150gpm, based on the combined capacity of the two deep disposal wells. This is the most critical constraint on schedule.

d. Groundwater sweep flow is 150gpm/wellfield with a maximum of two wellfields in GWS.

e. Transition time is required between different phases (production, restoration GWS, restoration RO, recirculation), to re-plumb wellfield connections.

f. Avoiding groundwater sweep in a wellfield immediately adjacent to a producing wellfield is normally inadvisable because of the dramatic drawdown effect of a 150gpm consumptive flow. This groundwater sweep drawdown would tend to promote excursions from the adjacent producing wellfield.

g. The availability of process pipe trunklines between wellfields and the plant.

For Christensen Ranch, using the above assumptions and limitations, production in MU7 would begin in month zero and end in month 32. Restoration operations in MU7 would initiate in month 34, and restoration would continue unabated through the sequence of mine units until the completion of restoration for MU12 in month 200. In other words, the restoration process would continue uninterrupted for the project from month 34 onward. COGEMA Mining feels that adherence to such a schedule fulfills the overall requirement of timely renewal for the facilities. The schedule represents a good faith effort toward decommissioning while working within the constraints outlined above. However, if each wellfield is defined as a "separate outdoor area" under 10 CFR 40.42(d), COGEMA Mining would probably have to apply for a delay of restoration commencement in some wellfields under 10 CFR 40.42(f). One of the key constraints that would likely trigger a request for restoration delay is the very finite waste water disposal capacity of the Christensen Ranch facility. In the context of a 150 gpm disposal rate, COGEMA Mining is limited in terms of how much restoration can be done at one time, particularly when production is ongoing from another active wellfield, and depending on the restoration duration for individual wellfields. Regarding the latter factor, it is also likely that COGEMA Mining would request extensions for the completion of the restoration of individual wellfields under 10 CFR 40.42(h)(2)(i). This is based upon the historical time span to complete wellfield groundwater restoration at Christensen Ranch: an average of 48 months per wellfield.

Ranch sites have demonstrated that this type of monitoring system is effective and that excursions can be controlled. Excursions within the ore zone are typically identified and controlled within a several week (and sometimes days) period.
At Christensen Ranch, several excursions to the ore zone have occurred and have all been controlled.

Waste Disposal Ponds

Liquid and solid wastes are temporarily stored in lined solar evaporation ponds. A leak detection system installed under the ponds ensures that any failure in the lining will be detected before solutions migrate significant distances from the pond area. At both the Irigaray and Christensen Ranch areas, the impact of pond leakage, should it occur, is expected to be small because of the dry strata beneath the ponds and the large vertical distances to groundwater. At Irigaray five ponds were decommissioned prior to the decision to restart production. If any of these ponds are rebuilt, new liners and leak detection systems will be installed.

Since the last license renewal there have been three incidents of pond leakage , involving brine Pond 3 or 4 at Christensen Ranch. On April 28, 2004, leakage was detected in Ponds 3 and 4. The liner failures were traced to ice damage as blocks of ice broke off and impacted the liner during the spring or when moving a pump with ice attached to it. This appears to have been a unique set of circumstances that resulted in ice damage to the liners. Subsequent inspections during the spring have involved looking for similar circumstances warranting concern for potential ice damage. Those circumstances have not occurred since the incident. On November 15, 2004, a number of holes were found in the Pond 4 liner. The holes were repaired. The damage was traced to the placement of pond solids from the decommissioning of the Irigaray Ranch ponds in Pond 4. Some of the material impacted the liner during placement, causing damage. The transfer process was modified to avoid such material impact on the liner. The other problem with Pond 4 was discovered on March 16, 2005. There was a separation of a liner seam at a pond corner. That seam separation was repaired. The separation was caused by the weight of accumulated sediments in the pond that placed excessive strain on the liner at the corner. The buildup of sediments subsequently has been monitored to avoid significant differential buildup of sediments such that undue stress is placed on the liner.

Accidental Leaks or Spills

Accidental leaks or spills of process chemicals could potentially infiltrate shallow aquifers and locally reduce groundwater quality. Any leaks or spills would probably not be of a sufficient volume to significantly degrade near surface groundwater quality. The potential for these chemicals to migrate into deeper strata is also considered very low due to the large vertical distance between the near surface aquifers and the lower aquifers.

Spills within the well field areas do occur on occasion. The spills are typically a result of an injection line separation inside or adjacent to the mine unit module buildings, as these lines are pressurized and have connections to other piping or valves at the surface. Spills of injection solution are barren of uranium, but do contain radium-226. Spill locations are mapped and soil samples collected when a spill occurs. Soil analyses from past spills indicate that radium-226 does not tend to adsorb in the soil, and the soils have otherwise been unaffected.

Restoration

Should groundwater restoration be incomplete, groundwater quality could be locally degraded.

Previous restoration conducted at both Irigaray and Christensen Ranch has shown that the return of groundwater quality to near baseline conditions is feasible. The restoration of the Irigaray wellfields has been approved by both WDEQ and the NRC. The reader is referred to the restoration reports for Irigaray (COGEMA, 2004) and Christensen Ranch (2008) for complete discussions of wellfield restoration success.

7.2.3.3 Construction and Operations Impacts to Surface Water

The activities that could potentially impact surface water in the Irigaray/Christensen Ranch area

APPENDIX B: COAL BED METHANE WATER PRODUCTION

TABLE OF CONTENTS

FIGURES

APPENDIX B: COAL BED METHANE WATER PRODUCTION

TABLES

APPENDIX B: COAL BED METHANE WATER PRODUCTION

B.1 Coal Bed Production Effects

This appendix presents the potential effects of the coal bed water production on the Christensen Ranch ISR project ore sands. Coal bed methane (CBM) production has been underway for more than 10 years in the Powder River Basin. The CBM production in this uranium in-situ recovery (ISR) project area is presently in the process of being developed. The CBM wells typically produce a few tens of gallons per minute (gpm) and then production rates significantly decrease with time. This water production has typically resulted in several hundred feet of drawdown in the coal aquifer. The potential effect of the drawdowns on the ISR operation is discussed in this appendix. Figure B.1 presents the location of the Christensen Ranch ISR project. This map shows the known ore bodies and the approximate boundary of the monitoring rings around these ore bodies. The permit area for Christensen Ranch project is also shown on this map.

B.1.1 CBM Well Locations

The location of the CBM Wells that are in the Christensen Ranch license area or within one half mile of the perimeter can be seen on Figure B.1.A. Three companies have CBM Wells in this area of concern; Anadarko, Yates and Windsor. The majority of Anadarko CBM wells are in the center of the area and extend to the northwest. Yates wells are along most of the half mile perimeter line around the Christensen Ranch licensed boundary. All of the Windsor wells are located on the west side, with only a few that fall inside the concern area. The locations of the wells were found using the Oil and Gas Commission Database and COGEMA maps.

B.1.2 CBM NPDES and Reservoir Locations

The locations of the National Pollutant Discharge Elimination System Outfall points and Reservoirs can also be found on Figure B.1.A. There is only one WYPDES permit that contains outfall points within the area of concern. This permit is WY0044059 and its outfall points are located in Sections 5, 8, 9, 10, 15, 16 and 17 of Township 44N, Range 77W (see Figure B.1.A). Three reservoirs are permitted to be built inside the half mile surrounding the licensed area. These reservoirs names and locations are *Grover*: Sec.9 T44N R77W *Christensen*: Sec.9 T44N R76W and *P24-1:* Sec. 24 T45N R77W. The location of these reservoirs where found on the State Engineer's Database.

B.1.3 Potential Effects on Surface Water

None of the CBM Wells in and within the half mile perimeter around the Christensen Ranch licensed boundary have been discharging water, so that no known water volumes or qualities have been observed. Wyoming Pollutant Discharge Elimination System permit WY0044059, possessed by Windsor Energy Group, is the only permit that allows a discharge from a reservoir within the area of concern. In this permit there are only three outfall points that are located inside the half mile perimeter. The three outfall points are 10, 11 and 13, and are located in Sections 9 and 10 of T44N, R77W. The total effluent limits and volume of the discharged water from all outfall points in permit WY0044059 are shown below in Table B.0.

Table B.0 Effluent Limits of WYPDES Permit WY0044059

Effluent Characteristics	Daily Maximum Outfall
Chlorides, mg/l	46
Dissolved Manganese, µg/l	650
pH, standard units	6.5-9.0
Specific Conductance, micromhos/cm	7500
Sulfates, mg/l	3000
Total Arsenic, µg/l	7
Total Barium, µg/l	1800
TDS, mg/l	5000
Total Flow, MGD	4.1
Total Recoverable Aluminum, µg/l	750
Dissolved Iron, µg/l	1000
Total Radium 226, pCi/l	5

The adverse effects of discharging the CBM-product water to the surface would be minimal. This is due to the fact that the majority of the CBM wells that are inside the half mile perimeter are permitted with Anadarko, which plans to convey its discharge water by pipeline away from the area. Also, some water that is being discharged inside the half mile perimeter is going to reservoirs or storage/treatment tanks to be retained or treated and discharged. The only permitted discharge is under permit WY0044059. The discharged effluent also has to meet regulated limits defined by the State of Wyoming through the discharge permit.

The three outfall points under WY0044059 are permitted to discharge into corresponding reservoirs. The reservoirs are designed to receive the CBM-produced water and retain it so that it does not reach any major surface water. The major surface water of concern in this WYPDES permit is the Powder River. This permit states that water may be discharged from the reservoirs as long as none of the discharge reaches any major surface water. If the retention system is allowing CBM water to reach the Powder River, the water management plan must be altered. The COGEMA surface water sampling locations would not be affected by this discharge, because the outfall points do not flow to Willow Creek.

B.1.4 Potential Effects on Overlying Aquifer

The potential effects of CBM surface discharge will be very minimal to the overlying J Sandstone which is the uppermost aquifer at Christensen Ranch. As noted previously, the majority of the CBM wells in the Christensen Ranch area will be discharged to a pipeline system which transports the CBM water a long distance away from the site where the water is re-injected into a deep aquifer. Some CBM water will be discharged to reservoirs at three locations within ½ mile of the Christensen ranch permit. The CBM discharge water at these three locations has a very limited potential to affect the water quality in the J aquifer.

APPENDIX B: COAL BED METHANE WATER PRODUCTION

A reservoir is permitted to accept CBM water in Section 5 of Township 44N, Range 76W. This reservoir is located west of the Mine Unit 7 area. Figure B.1.B shows the location of cross-sections that have been developed in the Mine Unit 7 area. Figures B.1.C through B.1.G presents the Cross-sections A-A', A'-A", B-B', C-C' and D-D' respectively. Each of these figures suggests that the uppermost aquifer in this area is the J3 Sandstone except for a portion of Cross-section B-B' which contains a short section of J2 Sandstone. A massive aquitard the generally is greater then 100 feet think exists between the J Sandstone and the land surface. Water that is discharged into the reservoir in this area would have to migrate through roughly 100 feet of aquitard to reach the J Sandstone. Water quality in the J Sandstone should not be affected by the CBM discharge in this area.

The second area which will contain a CBM reservoir and potential discharge from the reservoir is in the northeast quarter of Section 9, Township 44N, Range 77W. This is the Grover reservoir. The cross-section in Figure B.2 shows a drilhole in the area of this reservoir and also shows that the J Sandstone is the uppermost aquifer in this area. The J Sandstone is overlain by a very thick aquitard in this area also. Therefore, the CBM discharge of water in Grover reservoir is not expected to affect the water quality in the J Sandstone.

The third proposed reservoir location is in the northwest quarter of Section 24, Township 45N, Range 77W. Reservoir P24-1 is located approximately ½ mile from the Christensen Ranch permit boundary. Drillhole JC1465 on Cross-section A-A' in Figure B.2 is fairly close to this area and shows a similar geologic setting of the J Sandstone as the uppermost aquifer in this area. The J Sandstone is overlain by roughly 100 feet of aquitard and therefore the CBM discharge to this reservoir is not expected to affect the water quality in the J Sandstone in this area.

B.2 Coal Bed Geologic Conditions

Figure B.2 shows a west to east cross section through the Christensen Ranch project. This cross section was taken from the Christensen Ranch mine permit. The location of cross section A-A' is shown on Figure B.1. This cross section includes three drillholes that penetrate the major coal seam in this area and three additional drillholes that only penetrate the ore sand. The ore sand at this location is the K Sandstone, which is divided into different K units at particular locations. The overlying aquifer at Christensen Ranch is the J Sandstone while the underlying aquifer is the L Sandstone. A thin coal seam that exists below the L Sandstone has typically been interpreted as the division between the Wasatch and Fort Union formations. This coal seam has been named the Badger Coal. This cross section shows that there are 800 to more than 1000 feet between the Badger Coal and the first major coal seam. The CBM is being produced from the first major coal seam, which is designated as the Wyodak seam in some locations and the Big George coal seam in other locations. This cross section shows that the lithology is primarily shale between the Badger Coal and the first major coal seam, but sandstones do exist in some areas near the top of the major coal seam.

The fluvial deposition of the sandstones creates areas where a sandstone has direct connection with other sandstones. The thickest layer of sandstone that has been observed from the logs in the Powder River Basin is approximately 150 feet. Therefore, the large zone between the Badger

Coal and the first major coal seam should always contain some layers of shale where drawdowns from the coal should be greatly attenuated and unlikely to reach the sandstones above the Badger Coal.

B.3 Potential Artificial Connections

Artificial connections through the shales above the first major CBM coal seam could be developed through deep exploration drillholes or deep wells which penetrate the coal seam.

B.3.1 Deep Exploration Drillholes

Typically, drillholes in the Christensen Ranch area are drilled only down into the L Sandstone. Some deeper exploration drillholes were drilled and penetrated the coal seam. Table B.1

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:

"Figure B.1.A. Locations of Christensen Ranch ISR Project, CBM Wells, NPDES Discharge, And Reservoirs"

WITHIN THIS PACKAGE...OR BY SEARCHING USING THE DOCUMENT/REPORT NO.

D-01

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED: "FIGURE B.1.B. Unit 7 Geologic Cross-Section Index Map"

WITHIN THIS PACKAGE...OR BY SEARCHING USING THE DOCUMENT/REPORT NO.

D-02

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED: "FIGURE B.1.C. Unit 7 Geologic Cross-Section A-A' (Looking South)"

WITHIN THIS PACKAGE...OR BY SEARCHING USING THE DOCUMENT/REPORT NO.

D-03

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:

"FIGURE B.1.D, Unit 7 Geologic Cross-Section A'-A" (Looking South)"

WITHIN THIS PACKAGE...OR BY SEARCHING USING THE DOCUMENT/REPORT NO.

D-04

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED: "FIGURE B.1.E Unit 7 Geologic Cross-Section B-B' (Looking North)"

WITHIN THIS PACKAGE...OR BY SEARCHING USING THE DOCUMENT/REPORT NO.

D-05

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:
"FIGURE B.1.F
Unit 7 Geologic Cross-Section
C-C'
(Looking North)"

WITHIN THIS PACKAGE...OR BY SEARCHING USING THE DOCUMENT/REPORT NO.

D-06

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:
"FIGURE B.1.G
Unit 7 Geologic Cross-Section
D-D'
(Looking South)"

WITH IN THIS PACKAGE...OR BY SEARCHING USING THE DOCUMENT/REPORT NO.

D-07X