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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

JUN 0 2 1981

WMUR:DMS
Docket No. 40-8768
SUA-1387

Kerr-McGee Nuclear Corporation
ATTN: W. J. Shelley, Director
Regulation and Control
Kerr-McGee Center
Oklahoma City, Oklahoma 73125

Gentlemen:

Enclosed is Source Material License No. SUA-1387. This license is being issued subsequent to our completion of an Environmental Impact Appraisal on your proposed in situ uranium solution mining operations at the Bill Smith Mine Site.

This Environmental Impact Appraisal and a Safety Evaluation Report prepared by the NRC staff in support of our licensing action are also enclosed.

At least six (6) weeks prior to the anticipated start-up of operations, you are required by License Condition No. 12 to notify the NRC of such in writing in order that the Commission's staff can conduct an onsite inspection to review the development and implementation of administrative and operating procedures and monitoring programs.

Please note that this license is subject to revision upon full implementation of the "Uranium Mill Licensing Regulations" published in the Federal Register (Vol. 45, No. 198) on October 3, 1980.

Please note that the majority of the license conditions contained herein were discussed in conversations among Messrs. W. Shelley and M. Freeman of Kerr-McGee and H. Pettengill and J. Linehan of my staff.

FOR THE NUCLEAR REGULATORY COMMISSION

Ross A. Scarano, Chief
Uranium Recovery Licensing Branch
Division of Waste Management

Enclosures:
As stated

cc: W. Ackerman, WDEQ

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UNITED STATES NUCLEAR REGULATORY COMMISSION

DOCKET NO. 40-3703

KERR-MCGEE NUCLEAR CORPORATION

NEGATIVE DECLARATION REGARDING ISSUANCE OF SOURCE AND BYPRODUCT LICENSE FOR OPERATION OF R&D IN SITU LEACH PROJECT IN CONVERSE COUNTY, WYOMING

The U.S. Nuclear Regulatory Commission (the Commission) is issuing a Source Material and Byproduct Material License to Kerr-McGee Nuclear Corporation authorizing R&D-scale uranium solution mining operations at their South Powder River Basin "Q" Sand Project Site in Converse County, Wyoming.

The Commission's Division of Waste Management has prepared an environmental impact appraisal for the proposed action. On the basis of this appraisal, the Commission has concluded that an environmental impact statement for this particular action is not warranted for there will be no significant environmental impact attributable to the action. The environmental impact appraisal is available for public inspection and copying at the Commission's Public Document Room at 1717 H Street, N.W., Washington, D.C.

Dated at Silver Spring, Maryland, this 2nd day of June, 1981.

FOR THE NUCLEAR REGULATORY COMMISSION

Ross A. Scarano, Chief
Uranium Recovery Licensing Branch
Division of Waste Management

U. S. NUCLEAR REGULATORY COMMISSION
MATERIALS LICENSE

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Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter 1, Parts 30, 31, 32, 33, 34, 35, 36, 40 and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s); and to import such byproduct and source material. This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

Licensee	
1. Kerr-McGee Nuclear Corporation	3. License number SUA-1387
2. Kerr-McGee Center P. O. Box 25861 Oklahoma City, Oklahoma 73125	4. Expiration date June 30, 1986
	5. Docket or Reference No. 40-8768

6. Byproduct, source, and/or special nuclear material	7. Chemical and/or physical form	8. Maximum amount that licensee may possess at any one time under this license
a. Natural Uranium b. Byproduct Materials	a. Aqueous Solution and Slurry b. Unspecified	a. That amount produced under licensed activities b. That amount produced under licensed activities

9. Authorized Place of Use: Section 36, T36N, R74W, Converse County, Wyoming, approximately 17 air miles northeast of Glenrock and 23 air miles northwest of Douglas.

10. Authorized Use: For uranium recovery from pregnant lixiviant in accordance with statements, representations and conditions contained in (1) the licensee's Environmental Report Sections 6.2, 6.3 and 6.4, enclosed with cover letter dated March 25, 1980; (2) Figure 3-2 of submittal dated September 11, 1980; (3) Attachment 4 of submittal dated, December 5, 1980; (4) Sections 1 and 3 of the licensee's March 25, 1980 Environmental Report and in supplements dated September 11, and December 5, 1980, and January 19, and April 27, 1981. Notwithstanding the above, the following conditions shall override any conflicting

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statements contained in the licensee's application and supplements. Wherever the word "will" is used in the licensee's submittals, it shall denote a requirement.

11. All sampling and monitoring data, calibration records, reports on audits, inspections, and other analyses, training records, and safety meeting minutes, as well as any subsequent reviews, investigations, and corrective actions, shall be documented. Unless otherwise specified in the U.S. Nuclear Regulatory Commission regulations, all such documentation shall be maintained for a period of at least five (5) years.

12. The licensee shall notify the U.S. Nuclear Regulatory Commission, Region IV, Office of Inspection and Enforcement, 611 Ryan Plaza Drive, Suite 1000, Arlington, Texas 76011, and U. S. Nuclear Regulatory Commission, Uranium Recovery Licensing Branch, Washington, D.C. 20555, at least six (6) weeks prior to commencing mining operations, in writing, so that an NRC inspection may be conducted to review the licensee's development and implementation of administrative and operating procedures and monitoring programs.

13. The licensee shall have a Radiation Safety Technician (RST) assigned full time to the site. The RST shall report directly to the Project Manager on matters dealing with radiological safety.

14. The licensee shall have a documented commitment to ALARA which provides for the following:

    1. Dissemination and posting of information and policy statements on radiation safety for employees, contractors, and visitors.

    2. Semiannual ALARA audit of the radiation safety program. The audit shall be performed by the Radiation Safety Officer (RSO) for Kerr-McGee Nuclear Corporation or other expert with equivalent qualifications.

    3. Annual management review of the health physics program, its staff, and the allocation of adequate space and money.

15. The Radiation Safety Officer (RSO) shall have the following responsibilities:

    1. Authority to enforce regulations and corporate policies that affect any aspect of the facility radiation safety program.

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2. Responsibility to plan and administer the ALARA audit and radiation safety training programs.

3. Authority to review and concur in writing on plans for new equipment, process changes, or changes in operating procedures prior to implementation and to concur that the changes do not adversely impact the radiation safety program or the ALARA objective.

16. The Radiation Safety Technician (RST) shall have the following responsibilities:

1. Supervise, evaluate, and assure that all in-plant and environmental surveys are properly documented and that such records are maintained.

2. Assure that worker exposures are measured or calculated, documented, and that such records are maintained.

3. Perform inspections of the facility to assure compliance with the regulations and the radiation safety program.

4. Daily review of the facility maintenance work order logs to assure that prescribed radiation safety procedures were followed.

5. Annually review all facility operational and monitoring procedures to assure they are still appropriate and not in conflict with newly established radiation safety policies or regulatory requirements.

17. The Radiation Safety Technician (RST) shall have the following minimum qualifications:

1. Education: An associate degree in the physical sciences, engineering, or a health-related field. Alternatively, a high school diploma plus four years of relevant work experience in applied radiation protection are acceptable.

2. General Experience: One year of previous work experience in a uranium recovery facility or related industry involving radiation protection.

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3. Health Physics Experience: One year of work experience using radiation detection equipment and analytical laboratory procedures that involve health physics, industrial hygiene, or industrial safety measures to be applied in uranium recovery operations.

4. Specialized Training: At least 4 weeks of formalized training in radiation health protection applicable to radiation hazards normally experienced at uranium recovery facilities.

5. Specialized Knowledge: A working knowledge of the proper operation of health physics instruments to be used in the recovery facility for surveying and sampling techniques, and personnel dosimetry requirements.

If the individual selected for the RST position does not meet the educational requirements specified above, however he or she possesses prior work experience in radiation safety, then the licensee may consider two years of applied radiation safety work experience as a substitute for each year of the college level educational requirement. In cases where the PST possesses a college degree, with major emphasis in the area of the physical sciences and some specialized courses in radiation safety, the requirement for additional specialized training may be waived.

18. The Radiation Safety Officer (RSO) shall have the following minimum qualifications:

1. Education: A bachelor's degree in the physical sciences or engineering from an accredited college or university.

2. General Experience: One year of supervisory experience and one year of experience in a uranium recovery facility or related industry.

3. Health Physics Experience: One year of work experience in applied health physics, radiation protection, industrial hygiene, or similar work. This experience shall involve actually working with radiation detection and measurement equipment rather than only administrative or "desk" work.

4. Specialized Training: A formalized intensive course in health physics of at least four (4) weeks duration. At least 1 week of the course shall be specifically applicable to health physics problems associated with uranium recovery facilities.

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In addition, every two (2) years, the RSO shall attend a refresher course on health physics.

5. Specialized Knowledge: A thorough knowledge of the proper application and use of all health physics equipment used in the uranium recovery facility, the chemical and analytical procedures used for radiological sampling and monitoring, and the methods used to calculate personnel exposure to uranium and its daughters.

If the individual selected for the RSO position does not meet the educational requirements specified above, however, he or she possesses prior work experience in radiation safety, the licensee may consider two (2) years of applied radiation safety work experience as a substitute for each year of the college level educational requirement. In cases where the RSO possesses a graduate degree, with major emphasis in radiological and environmental sciences, the requirement for specialized training may be waived.

19. Standard written operating procedures shall be established for all operational activities involving radioactive materials that are handled, processed, stored, or transported. Written procedures shall also be established for nonoperational activities, to include in-plant and environmental monitoring, sampling, analysis, and instrument calibration. An up-to-date copy of each written procedure shall be kept in each area where it is used.

All written procedures for both operational and nonoperational activities shall be reviewed and approved in writing by the RSO or other expert with equivalent qualifications before being implemented and whenever a change in a procedure is proposed to ensure that proper radiation protection principles are applied. The RST shall review all existing facility procedures on an annual basis. For work or nonroutine maintenance work where the potential for exposure to radioactive material exists and for which no standard written procedure already exists, a radiation work permit (RWP) shall be required. Such permits shall describe the following:

1. The scope of the work to be performed.

2. Any precautions necessary to reduce exposure to uranium and its daughters to as low as is reasonably achievable.

3. Any supplemental radiological monitoring and sampling required during and following completion of the work. Nonroutine maintenance involving exposure of workers to airborne particulates

of uranium and its daughters shall require the use of continuous breathing zone monitoring.

The RST shall indicate by signature the review of each RWP prior to the initiation of the work, and the work shall be carried out in strict adherence to the conditions of the RWP. When the RST is not available, a supervisory member of the facility staff who has received specialized radiation protection training may review and sign RWPs.

20. The licensee shall have a training program as described below.

An initial training program shall be conducted by the RSO or other expert with equivalent qualifications. This training program shall include: the basic principles of radiation safety; the health hazards of exposure to uranium and its daughters; the personal hygiene practices for a uranium recovery facility; the facility radiation safety procedures; and the appropriate response to emergencies and accidents involving exposure to radioactive materials.

Upon completion of the initial training program, each individual shall be given a written examination. Each worker must achieve a predetermined passing score on the examination. The instructor shall review the incorrect answers with the worker until the instructor determines the worker has a passing knowledge of the instructional information. The examinations shall be maintained on file. Annually, each permanent facility worker shall be given a refresher training course. Retraining shall include: a discussion of relevant information that has become available during the past year; a review of safety problems during the past year; a discussion of changes in regulations and license conditions; an explanation of exposure trends; and a discussion of any other pertinent topics. Also, six (6) times a year, all permanent site workers shall attend a general facility safety meeting at which radiation safety problems shall be offered for discussion. Safety meeting minutes, attendance records, and training program records shall be maintained on file.

All permanent site workers shall be given specialized instruction on the radiation health and safety aspects of the specific jobs they will perform. This instruction shall be in the form of individualized on-the-job training performed by supervisors with the assistance of the RST.

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21. The licensee shall perform monthly surveys for natural uranium in all enclosed process structures with the exception that they shall be increased to weekly for any enclosed area meeting the requirements of an "airborne radioactivity area" as defined in 10 CFR Part 20.203(d) and an investigation of the cause of the high levels shall be made. The licensee shall also perform monthly surveys for radon or radon progeny in all enclosed process structures inhabited by workers with the exception that radon or radon progeny surveys shall be increased to weekly if the radon or radon progeny concentrations are found to exceed 8 pCi/l or 0.08 WL (Working Levels), respectively. Such weekly sampling shall be maintained until four (4) consecutive weekly samples exhibit less than 8 pCi/l or 0.08 WL. Prior to commencing operations and within sixty (60) days of the issuance of this license, the licensee shall submit to the Uranium Recovery Licensing Branch, for NRC review and approval in the form of a license amendment, the designated locations for surveys of airborne natural uranium and radon or radon progeny.

The calculation of internal exposure to radon, radon progeny, or natural uranium shall be based on a TWE (Time Weighted Exposure) calculation incorporating a consideration of both occupancy times and average airborne working levels or activity concentrations. If occupancy times are established as an average for each category of worker, the licensee shall also, by means of a semiannual time study, determine the basis upon which average occupancy periods are established.

If any worker reaches or exceeds 25 percent of the maximum permissible exposure limits as specified in 10 CFR Part 20 based upon a calculated TWE for the week or the calendar quarter, dependent on the solubility of the material, the RST shall initiate an investigation of the employee's work record and exposure history to identify the source of the exposure. Necessary corrective measures shall be taken to ensure reduction of future exposures to as low as is reasonably achievable. Records shall be maintained of these investigations.

22. The licensee shall perform quarterly gamma radiation surveys in enclosed areas. Prior to commencing operations and within sixty (60) days of issuance of this license, the licensee shall submit to the Uranium Recovery Licensing Branch, for NRC review and approval in the form of a license amendment, the locations for the gamma radiation survey.

23. The licensee shall perform alpha contamination surveys of the facility laboratory and offices monthly, and of the eating and

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change areas, weekly. If the licensee performs the analyses of urine bioassay samples at a facility laboratory, the licensee shall also survey all surfaces used for urine sample preparation preceding the analyses.

If the alpha contamination levels exceed those listed in the attached "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct Source or Special Nuclear Material", dated November 1976, the area shall be decontaminated. The source of the contamination shall be determined, control measures shall be initiated, and the results shall be documented.

24. Any changes in the process circuit, illustrated and described in Figure 3-4 of the license application dated March 25, 1980, shall require the approval of the RSO and shall be submitted to the U.S. Nuclear Regulatory Commission, Uranium Recovery Licensing Branch, for prior approval in the form of a license amendment.

25. The licensee shall use external personnel dosimeters, either TLD or film type dosimeters, that are designed to measure exposure to penetrating radiation (e.g., gamma radiation and beta particles with a range greater than 7 mg/cm^2).

26. The licensee shall implement a urinalysis program as outlined in Regulatory Guide 8.22, "Bioassay at Uranium Mills", with the following exceptions:

    1. The licensee shall perform a baseline urinalysis for all permanent employees prior to their initial assignment at the facility.

    2. The frequency of urine sample collection shall be monthly.

    3. Anytime an action level of 15 ug U/l urine is reached or exceeded for any worker, the licensee shall provide documentation to the U.S. Nuclear Regulatory Commission indicating what corrective actions have been performed to satisfy the requirements of Regulatory Guide 8.22. This information shall be included as part of the ALARA audit report required by License Condition No. 27.

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Anytime an action level of 30 μg U/l for four (4) consecutive urine specimens or 130 μg U/l for any one specimen is reached or exceeded, the licensee shall provide documentation within thirty (30) days to the U.S. Nuclear Regulatory Commission, Uranium Recovery Licensing Branch, Washington, D.C. 20555, and Office of Inspection and Enforcement, Region IV, 611 Ryan Plaza Drive, Suite 1000, Arlington, Texas 76011, indicating what corrective actions have been performed to satisfy the requirements of Regulatory Guide 8.22.

27. The licensee shall perform a semiannual ALARA audit of the radiation safety program which shall be conducted by the RSO or other expert with equivalent qualifications who shall submit a detailed, written report to the Project Manager and the U. S. Nuclear Regulatory Commission, Uranium Recovery Licensing Branch, Washington, D.C. 20555, and the Office of Inspection and Enforcement, Region IV, 611 Ryan Plaza Drive, Suite 1000, Arlington, Texas 76011. In order to evaluate the ALARA objective, the licensee shall review the following records as part of the semiannual audit:

    1. Bioassay results including any actions taken when the results exceeded action levels in Table 1 of Regulatory Guide 8.22.

    2. Exposure records of external and internal time-weighted calculations.

    3. Safety meeting minutes, attendance records, and training program records.

    4. Daily inspection log entries and summary reports of the monthly reviews.

    5. In-plant radiological survey and monitoring data as well as environmental radiological effluent and monitoring data.

    6. Surveys required by radiation work permits.

    7. Reports on overexposure submitted to NRC, MSHA, or the State.

    8. Reviews of operating and monitoring procedures completed during this period.

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The written seminannual audit report shall be specific in addressing any noticeable trends in personnel exposures for identifiable categories of workers and types of activities, any trends in radiological effluent data, and the performance of exposure and effluent control equipment and whether it is being properly used, maintained, and inspected. Any recommendations to further reduce personnel exposures or environmental releases of uranium or radon and radon progeny shall be included in the report.

28. The licensee shall modify the facility layout design submitted as Attachment 4 to letter dated December 5, 1980, to provide for better traffic patterns from process areas to nonprocess areas. Access to the process area should be provided through the change room rather than through office areas. Within thirty (30) days of the issuance of this license, the revised floor plan and a description of the changes made shall be submitted to the Uranium Recovery Licensing Branch for review and approval in the form of a license amendment prior to initiation of operations at the facility.

29. The licensee shall provide a separate ventilation system for process and nonprocess areas, or a single system which shall be designed so that air shall flow from the nonprocess areas into the process areas.

    Additionally, all storage and/or process tanks within the building shall be vented to the outside atmosphere to prevent radon accumulation within the tank or an enclosed structure. Within thirty (30) days of issuance of this license, the licensee shall submit to the Uranium Recovery Licensing Branch, for NRC review and approval in the form of a license amendment, a more detailed description of the ventilation systems to include equipment specifications, airflow paths, estimated air turnover rates, and projected airborne radioactivity concentrations resulting from routine operations for all enclosed areas normally occupied by workers.

30. The licensee shall provide and require that all process and maintenance workers who work in yellowcake areas or work on equipment contaminated with yellowcake, wear protective clothing including coveralls and boots or shoe covers. Workers who package yellowcake slurry for transport shall also be provided gloves. Before leaving the change area, all process workers involved in the precipitation, through packaging for transport of yellowcake slurry shall either shower and/or monitor their face and hands using a calibrated alpha survey

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instrument. Where alpha monitoring is used exclusive of showering, the monitoring results shall be documented and maintained on file. In addition, the licensee shall perform spot surveys for alpha contamination at least quarterly on all workers leaving the facility proper. Alpha contamination greater than 1000 dpm/100 cm² on skin or clothes shall be cause for decontamination and resurveying, and for an investigation by the radiation safety staff. Records shall be maintained of these investigations.

31. Release of equipment, materials, or packages from the restricted area shall be in accordance with the enclosed "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," dated November 1976.

32. All radiation monitoring, sampling and detection equipment shall be recalibrated after each repair and as recommended by the manufacturer or at least semiannually, whichever is more frequent. In addition, all radiation survey instruments shall be operationally checked with a radiation source before each use.

33. The licensee is hereby exempted from the requirements of Section 20.203(e)(2) of 10 CFR 20 for posting areas within the facility, provided that all entrances to the facility are conspicuously posted in accordance with Section 20.203(e)(2) and with the words, "CAUTION - ANY AREA OR ROOM WITHIN THIS FACILITY MAY CONTAIN RADIOACTIVE MATERIAL."

34. The licensee shall develop a quality assurance program for all sampling and analyses performed as part of the in-plant radiation safety and environmental monitoring programs that includes all of the recommended elements of a quality assurance program specified in Regulatory Guide 4.15, "Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Stream and the Environment." In addition, prior to commencing operations and within ninety (90) days of issuance of this license, the licensee shall submit to the U.S. Nuclear Regulatory Commission, Uranium Recovery Licensing Branch, for approval in the form of a license amendment, complete specifications for this quality assurance program.

35. The inspection program shall be conducted by the RST with responsibility, along with those specified in License Condition 16, shall be to perform a daily "walk through" inspection of the operating area to ensure that all personnel maintain a safe working environment.

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Any items of noncompliance or violations of procedures, policies, regulations or license conditions shall be documented in a log and maintained on file. All problems requiring remedial action shall be brought to the attention of the Project Manager and proper action taken. The inspection program shall include a monthly written summary review of all documented radiological surveys, radiation work permits, operating program logs, all personnel exposure data, and environmental monitoring data. The monthly inspection summary shall be submitted to the Project Manager and shall include recommended remedial actions as necessary.

36. Within ninety (90) days of issuance of this license and prior to commencing operations, the licensee shall develop and submit to the Uranium Recovery Licensing Branch, for NRC review and approval in the form of a license amendment, a detailed emergency action plan establishing authorities and procedures to be followed for a variety of potential accidents likely to occur.

37. Degraded resin shall be transferred to an NRC licensed uranium recovery facility for disposal in their tailings impoundment or the resin shall be shipped to a licensed radioactive waste disposal site.

38. Eating shall only be allowed in administrative offices, enclosed lunch areas, and control rooms that are separated from the process areas.

39. The uranium in-situ solution mining operations shall be performed on a maximum well field area of 1.0 acre within the area shown in Figure 3-1 of the March 25, 1980 Environmental Report submitted by Kerr-McGee to the NRC.

40. Variation from the sodium carbonate-bicarbonate leach solution with hydrogen peroxide, oxygen, or peroxide added, as presented in Section 3, Pages 3-1 and 3-2 of the March 25, 1980 Environmental Report, shall require prior NRC approval through amendment of this license. The licensee shall discuss why he proposes the variation and how it will affect groundwater quality, the evaporation pond water characteristics, the quality of surface discharges, restoration methods and criteria, and monitoring requirements.

41. The eleven (11) wells (8 perimeter ore zone monitor wells and 2 shallow and 1 deep monitor well) shown on figure 2.2.07 of the Environmental Impact Appraisal (EIA) shall be used to monitor and

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establish the premining groundwater quality values of the test area. All the monitor wells shall be sampled prior to injection of leach solution and analyzed for all the parameters listed in Table 5.1.1.01 of the EIA.

42. At least ninety (90) days prior to termination of mining activities, when injection of lixiviant ceases, the licensee shall file, with the NRC, a specific plan for groundwater quality restoration at the test site, to include a description of restoration steps, projected schedule of activity and plans for post restoration and restoration phase monitoring. Restoration of the production aquifer groundwater and any other groundwaters affected by mining operations shall be initiated no later than sixty (60) days after solution mining operations have been terminated. Restoration method(s) must be approved by the NRC in the form of a license amendment. The licensee shall also provide written notification to the NRC, Division of Waste Management, when restoration activities have been initiated.

Proposed restoration criteria shall be submitted to the NRC for review and approval and must be approved in the form of a license amendment by the NRC prior to injection of lixiviant.

43. During solution mining operations, the monitor wells identified in License Condition No. 41 above shall be sampled for chloride and TDS every two (2) weeks and analyzed at least for chloride, alkalinity, carbonate, bicarbonate, selenium, sodium, uranium, sulfate and TDS, once every month. Water level elevations in these wells shall also be measured once every two (2) weeks, at least during the first quarter of operations, prior to sampling. Once per quarter, a set of samples from all of the monitor wells shall be analyzed for the full suite of water quality parameters listed in Table 5.1.1.01 of the EIA. Results shall be reported graphically and in tabular form in the quarterly report required in License Condition No. 58 below.

44. Upper control limit (UCL) criteria to be applied to monitor wells to determine when action must be taken to control excursions during mining shall be determined following the pre-mining water quality data collection outlined in License Condition No. 41 above. The UCLs shall be determined by the applicant, submitted to the NRC for review, and approved in the form of a license amendment prior to injection of lixiviant.

If two UCL values are exceeded in a well, or if one UCL value is exceeded by 20%, the licensee shall take another water sample within forty-eight (48) hours and analyze it for at least the nine

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constituents listed in License Condition No. 43 above. An excursion is confirmed if two or more UCL values are exceeded or if one UCL value is exceeded by 20% or more. Corrective action to mitigate the situation shall be initiated by the licensee when an excursion is detected and the NRC shall be notified within forty-eight (48) hours by telephone and within seven (7) days in writing. In addition to corrective actions, monitoring of all wells on excursion shall be intensified; water level elevation measurements and sampling and analysis for the nine constituents listed in License Condition No. 43 above, shall be conducted at least once every seven (7) days, for as long as those wells are on excursion status. A written report shall be provided to the NRC, Division of Waste Management, within thirty (30) days of confirming an excursion, describing the condition, the corrective action taken, and the results obtained. If wells are still on excursion at the time the report is filed, written progress reports concerning the excursion shall be sent to the NRC monthly until the monitor wells are no longer on excursion status.

If corrective actions have not been effective within ninety (90) days of the excursion verification, the injection of lixiviant, unless otherwise determined by the NRC in writing, shall be terminated until Kerr-McGee receives written approval to start up, from the NRC, in the form of a license amendment.

45. A formal report of events describing the corrective actions taken and detailed graphs and tables of all sample analyses shall be maintained during excursions as described in License Condition No. 44 above to document actions and the ensuing results. This report along with pre-excursion and post-excursion data obtained from the analysis of at least two separate samples taken before and after an excursion, shall be submitted to the NRC within thirty (30) days after an excursion is terminated.

46. Baseline water level elevations for each well shall be defined and submitted to the NRC for review and approval prior to injection of lixiviant. The potentiometric level of a given monitor well shall be monitored once daily for the first two (2) weeks of continuous operation of the well field. After the initial two weeks, water level monitoring can be decreased to once every two weeks, for at least the first quarter, with water levels taken just prior to sampling the wells. If the data are shown to be useful monitor criteria in the early detection of excursions, should any occur, water level measurements shall be required after the first quarter.

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Water level data in graphical and tabular form shall be kept for reporting to the NRC as prescribed in License Condition No. 47 below. Net flow rates for the well field shall be recorded whenever monitor well water levels are measured, and the barometric pressure at the site or vicinity and its effect on water levels shall also be recorded.

47. The results of the water quality and water level monitoring program shall be submitted in a separate section of each quarterly report, as described in License Condition No. 58 below. Monitoring data along with barometric pressure measurements and net flow from the well field shall be reported. In the first quarterly report, the licensee shall provide a discussion that presents, summarizes, and evaluates the water level and water quality data with respect to the degree of confinement of the ore zone. The licensee shall continue to measure water levels after the first quarter, until the NRC has made a written determination, based on the existing data, of whether or not continued water level monitoring is necessary.

48. Should the potentiometric level in any of the perimeter ore-zone monitor wells fluctuate significantly, particularly if levels rise, the NRC shall be notified within one (1) work day. The licensee shall take steps to determine the cause of the potentiometric changes and to correct potentiometric levels in the monitor wells by well field adjustment. Within thirty (30) days after first notifying the NRC of a potentiometric level problem, the licensee shall submit a report to the NRC, Division of Waste Management, describing the situation from the time the NRC was initially notified until the time of report submittal. The corrective actions taken and the results of those actions shall also be a part of the report.

49. The volume of discharges to the evaporation ponds shall be recorded. In addition, quarterly samples of solution shall be analyzed for calcium, chloride, alkalinity, sodium, gross alpha and gross beta, uranium, radium-226, selenium, arsenic, sulfate and TDS.

50. The two evaporation ponds shall be checked for leaks on a daily basis. Any fluid detected in the standpipes of the pond leak detection system shall be analyzed initially for chloride and TDS, and if these concentrations exceed Wyoming DEQ drinking water standards, the waters shall also be analyzed for calcium, alkalinity, sodium, uranium, gross alpha, gross beta, radium-226, selenium, arsenic, and sulfate. Water quality samples taken at the standpipe

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shall be sampled for all twelve (12) parameters at least every seven (7) days during the leak period and for at least two weeks following repair, if any residual liquid remains in the stand pipes. The results of all standpipe analysis shall be reported to the NRC in the quarterly report as per License Condition No. 53 below.

The NRC shall be notified within forty-eight (48) hours if the chemical quality of the fluid found in the standpipe exceeds Wyoming drinking water standards for any of the parameters tested. The licensee must take immediate steps to repair the leak and not only rely on a leak "pump-back" system to intercept leakage. A report shall be filed with the NRC describing the actions taken by Kerr-McGee to repair the pond. The results of these actions shall be submitted to the NRC within thirty (30) days after initially notifying NRC. If the leakage problem is not corrected at the time the report is filed, monthly reports shall be submitted until the leak is repaired. If an evaporation pond leak is significant and conditions warrant (i.e., large losses of very poor quality waste water to the subsurface), the NRC may, at that time, require the construction, pumping, and sampling of wells.

51. Kerr-McGee shall comply with the following requirements regarding the evaporation ponds:

a. The site of the ponds shall be that site recommended by Chen and Associates, as discussed in the December 5, 1980 submittal from Kerr-McGee to NRC.

b. Kerr-McGee shall submit to the NRC for review and approval prior to pond construction the quality assurance program for installation and testing of the 30 mil reinforced hypalon liners for the evaporation ponds, including the liner field seams. Kerr-McGee shall also provide data documenting that the liner is compatible with the waste products and atmospheric and temperature conditions that will be encountered at the site.

The liners shall be anchored in a one-foot deep trench near the crest of the impoundments, underlain throughout with bedding sand which has no more than 12 percent passing the number 200 sieve, which is at least three orders of magnitude more permeable than the subgrade, and which extends up the embankment slopes to enable detection of any leakage through

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the sides of the liner. Prior to placing the sand bedding layer, any sand seams and pockets that are visible should be covered by compacted clay soils and the compacted silty clay subgrade and embankment material shall be graded to a surface tolerance of less than or equal to 1 inch.

c. Kerr-McGee shall submit a QA program for installation and testing of the subgrade, underdrain, and pond slopes, with regards to excavation, fill placement, grading, compaction, and moisture control.

d. The perimeter embankments and dividing embankment shall have maximum height of 8 feet, exterior and interior slopes of 2.5H:1V, and a crest width of 10 feet. Embankment fill shall consist of sandy silty clays excavated from the site and compacted to 95 percent of the maximum dry density and placed within ±2 percent of the optimum moisture content as per ASTM D-698. Kerr-McGee shall submit a QA program outlining the embankment construction procedures and test methods for NRC approval in the form of a license amendment, prior to start of construction.

e. Kerr-McGee shall maintain at least two (2) feet of freeboard between the embankment crest and the pond level.

f. The leak detection system for each pond shall consist of a 2-inch diameter PVC pipe laid in a depressed trench at the lowest point (center line) of the ponds' bottoms which slope toward the centers at 3 degrees. A 6-inch sand bedding layer will be placed below each pond floor liner, and in the trenches for securing the liner at the surface. Collector pipes will lead to sumps, one for each pond, thereby providing two independent leak detection systems. Prior to liner placement, the leak detection system shall be tested to assure it functions properly.

g. A fence that prevents the intrusion of game animals (i.e., mule deer and antelope) into the evaporation pond area shall be maintained.

h. Kerr-McGee shall maintain sufficient freeboard to allow for pumping the contents of one pond into the other in the event of a major leak.

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52. Final disposition of any radioactive solid process or evaporation pond residues (byproduct material) shall be at a licensed NRC tailings disposal site.

53. The licensee shall submit to the NRC copies of any correspondence with the Wyoming Department of Environmental Quality regarding well field operations and/or monitoring.

54. The uranium recovery plant shall be operated at a maximum average flow rate of one-hundred (100) gpm. Pressures at the well heads of injection wells in the Q ore zone shall not exceed 100 psi.

55. Flow rates on each injection and production well and injection pressures on injection wells shall be measured at least once per day and recorded graphically on a daily operating log.

56. The licensee shall perform the radiological environmental monitoring program as outlined in Tables 5.2.1.01 and 5.2.1.01(a) of the EIA. Preoperational data from this program shall be provided to the NRC in the first quarterly report discussed in License Condition No. 58 below.

57. Exploration boreholes, post-test boreholes, and all wells within the well field area not used in production or monitoring and not properly cased or sealed within a specific unit shall be plugged prior to injecting lixiviant to comply with Wyoming Department of Environmental Quality (DEQ) requirements. All wells shall be plugged prior to decommissioning the site for unrestricted use.

58. A quarterly report shall be submitted to the NRC Waste Management Division that summarizes the status of the test program, with supporting analytical data and evaluations regarding important environmental aspects of the operation, including lixiviant migration control measures, waste generation volumes, and volumes of injected lixiviant and pregnant solution produced. The quarterly report shall include all environmental monitoring and groundwater data, as well as, all monitoring data and reports required under NPDES Permit No. WY-0022411. The initial quarterly report shall include all accumulated baseline and pre-operational data. All data shall be presented in tabular and graphical form, with a written summary evaluating the data.

59. During well field operations, injection pressures shall be monitored daily. Well head pressures shall not exceed 100 psi to assure that fracture pressure in the ore zone and adjacent confining layers, are not exceeded.

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60. Notwithstanding any conflicting statements in Kerr-McGee's application or supplements, all liquid discharges from the above-ground processing facility, with the exception of the bleed stream and restoration stream which must both first be processed through the IX unit and then be treated for radium removal and discharged in accordance with NPDES Permit No. WY-0022411, shall be to the hypalon lined evaporation ponds.

61. Kerr-McGee shall reclaim and decommission the well field and process facility sites as discussed in Section 3.7.2 of the EIA.

62. Kerr-McGee shall maintain a surety instrument to cover all groundwater restoration and all reclamation and decommissioning, including the cost of offsite disposal of radioactive solid process or evaporation pond residues. Kerr-McGee shall provide a copy of the surety instrument along with a cost breakdown to the NRC and receive NRC approval of the surety instrument in the form of a license amendment prior to injection of lixiviant.

63. This license shall not be terminated until the U.S. Nuclear Regulatory Commission has determined that all site reclamation including any necessary cleanup of the drainage way to Sage Creek, decommissioning, and well field restoration has met all applicable standards and regulations.

64. The licensee shall remove all sediments from any of the treatment or settling ponds, associated with pretreatment of surface discharges from solution mining operations under the NPDES permit, to a licensed tailings disposal site.

65. Upon cessation of solution mining activities, the licensee shall clean up the area of the treatment and settling ponds as well as the drainage to which discharges are directed under the NPDES permit, to essentially pre-operational levels. For radium-226 this shall require that the average radium-226 levels in soils and sediments resulting from discharges authorized under this license, are no more than 5 picocuries per gram of soil. Pre-operational background for these areas shall be determined by the sampling required in Table 5.2.1.01 of the EIA.

66. The licensee shall sample soils/sediments in the drainage to which surface discharges are directed as specified in Table 5.2.1.01(a). If at any time radium-226 levels are greater than 5 pCi/gram above the pre-operational background levels, the licensee shall notify the NRC within seven (7) days in writing and shall initiate corrective

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actions to lower the radium-226 levels in discharges and clean up the drainage so that radium-226 concentrations in soils/sediment from licensed discharges are no greater than 5 pCi/gram. If the corrective actions do not achieve these objectives within sixty (60) days, all discharges from the recovery plant shall be directed to the lined evaporation ponds.

67. The licensee shall perform daily visual inspections of all evaporation pond embankments. Such inspections shall be performed by a qualified engineer or scientist and shall be documented. Records of all inspections shall be kept on site.

68. The licensee shall immediately notify the U.S. Nuclear Regulatory Commission, Region IV, Office of Inspection and Enforcement, 611 Ryan Plaza Drive, Suite 1000, Arlington, Texas 76011, and the U.S. Nuclear Regulatory Commission, Uranium Recovery Licensing Branch, Washington, D.C. 20555, by telephone and telegraph, of any failure of any evaporation pond, any break or rupture of any pipeline, or any similar failure of any other fluid or material conduit or storage facility which results in an uncontrolled release of radioactive materials, or of any unusual conditions which if not corrected could lead to such a failure. Such notification shall be followed, within seven (7) days, by submittal of a written report detailing the conditions leading to the failure or potential failure, corrective actions taken, and results achieved. This requirement is in addition to the requirements of 10 CFR Part 20.

69. Prior to mixture with any other sources, the licensee shall monitor, at least monthly, any surface discharges from the recovery plant for chloride, alkalinity, carbonate, bicarbonate, selenium, sodium, uranium, sulfate, and TDS.

DMS 6/2/81
RTW 6/2/81
WJF 6/2/81
DDJ 6/2/81
[illegible] 6/2/81

Date JUN 2 1981

For the U. S. Nuclear Regulatory Commission

by _____

Division of [illegible]
Material Safety
Washington D.C. 20555

GUIDELINES FOR DECONTAMINATION OF FACILITIES AND EQUIPMENT PRIOR TO RELEASE FOR UNRESTRICTED USE OR TERMINATION OF LICENSES FOR BYPRODUCT, SOURCE, OR SPECIAL NUCLEAR MATERIAL

U. S. Nuclear Regulatory Commission
Division of Fuel Cycle and
Material Safety
Washington, D.C. 20555

NOVEMBER 1976

The instructions in this guide in conjunction with Table I specify the radioactivity and radiation exposure rate limits which should be used in accomplishing the decontamination and survey of surfaces or premises and equipment prior to abandonment or release for unrestricted use. The limits in Table I do not apply to premises, equipment, or scrap containing induced radioactivity for which the radiological considerations pertinent to their use may be different. The release of such facilities or items from regulatory control will be considered on a case-by-case basis.

1. The licensee shall make a reasonable effort to eliminate residual contamination.

2. Radioactivity on equipment or surfaces shall not be covered by paint, plating, or other covering material unless contamination levels, as determined by a survey and documented, are below the limits specified in Table I prior to applying the covering. A reasonable effort must be made to minimize the contamination prior to use of any covering.

3. The radioactivity on the interior surfaces of pipes, drain lines, or ductwork shall be determined by making measurements at all traps, and other appropriate access points, provided that contamination at these locations is likely to be representative of contamination on the interior of the pipes, drain lines, or ductwork. Surfaces of premises, equipment, or scrap which are likely to be contaminated but are of such size, construction, or location as to make the surface inaccessible for purposes of measurement shall be presumed to be contaminated in excess of the limits.

4. Upon request, the Commission may authorize a licensee to relinquish possession or control of premises, equipment, or scrap having surfaces contaminated with materials in excess of the limits specified. This may include, but would not be limited to, special circumstances such as razing of buildings, transfer of premises to another organization continuing work with radioactive materials, or conversion of facilities to a long-term storage or standby status. Such requests must:

   a. Provide detailed, specific information describing the premises, equipment or scrap, radioactive contaminants, and the nature, extent, and degree of residual surface contamination.

   b. Provide a detailed health and safety analysis which reflects that the residual amounts of materials on surface areas, together with other considerations such as prospective use of the premises, equipment or scrap, are unlikely to result in an unreasonable risk to the health and safety of the public.

5. Prior to release of premises for unrestricted use, the licensee shall make a comprehensive radiation survey which establishes that contamination is within the limits specified in Table I. A copy of the survey report shall be filed with the Division of Fuel Cycle and Material Safety, USNRC, Washington, D.C. 20555, and also the Director of the Regional Office of the Office of Inspection and Enforcement, USNRC, having jurisdiction. The report should be filed at least 30 days prior to the planned date of abandonment. The survey report shall:

   a. Identify the premises.

   b. Show that reasonable effort has been made to eliminate residual contamination.

   c. Describe the scope of the survey and general procedures followed.

   d. State the findings of the survey in units specified in the instruction.

Following review of the report, the NRC will consider visiting the facilities to confirm the survey.

TABLE I

ACCEPTABLE SURFACE CONTAMINATION LEVELS

NUCLIDES [a]	AVERAGE [b c f]	MAXIMUM [b d f]	REMOVABLE [b e f]
U-nat, U-235, U-238, and associated decay products	5,000 dpm α/100 cm^2	15,000 dpm α/100 cm^2	1,000 dpm α/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000 dpm/100 cm^2	3,000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except SR-90 and others noted above.	5,000 dpm βγ/100 cm^2	15,000 dpm βγ/100 cm^2	1,000 dpm βγ/100 cm^2

[a] Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

[b] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c] Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

[d] The maximum contamination level applies to an area of not more than 100 cm^2.

[e] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

[f] The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/hr at 1 cm and 1.0 mrad/hr at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.

UNITED STATES NUCLEAR REGULATORY COMMISSION

ENVIRONMENTAL IMPACT APPRAISAL

BY THE

DIVISION OF WASTE MANAGEMENT

IN CONSIDERATION OF THE ISSUANCE OF

SOURCE MATERIAL LICENSE NO. SUA-1387 FOR THE

KERR-McGEE NUCLEAR CORPORATION

SOUTH POWDER RIVER BASIN "Q" SAND SOLUTION MINING PROJECT

DOCKET NO. 40-8768

Dated: June 1981

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SUMMARY AND CONCLUSIONS

This Final Environmental Impact Appraisal was prepared by the staff of the U.S. Nuclear Regulatory Commission (NRC) and issued by the Commission's Office of Nuclear Material Safety and Safeguards.

1. This action is administrative.

2. The proposed action is the issuance of Source Material and Byproduct Material License SUA-1387 to Kerr-McGee Nuclear Corporation, for implementation of the "Q" Sand Project Site, Research and Development In Situ Leach project, Docket 40-8768, in accordance with the Company's statements in its application and accompanying Environmental Report.

   The proposed project consists of solution extraction (in situ leaching) operations involving uranium ore deposits within Kerr-McGee's "Q" Sand Project Site in Converse County, Wyoming. Research and development activities will include a 100 gpm process plant, buried pipelines, two small evaporation ponds, and five (5) five-spot well field patterns not exceeding 1.0 acre in area for the requested license authorization. The project has an estimated lifetime of 2.5 to 3 years, with 1.5 to 2 years of leaching followed immediately by aquifer restoration operations.

3. Summary of environmental impacts and adverse effects:

   a. The site is primarily used as grazing land for livestock and wildlife. Initiation of the solution extraction project would result in the temporary removal of about five (5) acres of land from grazing. All disturbed surface areas will be reclaimed and returned to a condition suitable for their original use.

   b. The long-term effects of the research and development project on groundwater use are expected to be minimal. Groundwater within the immediate area of the well patterns is expected to temporarily contain increased concentrations of radioactive and toxic elements during the operation of all well fields. Restoration should return this water to a condition that is consistent with its premining use (or potential use).

   c. The only discharge of liquid effluents will be a bleed stream and a restoration stream that are discharged only after treatment in accordance with an NPDES Permit. Atmospheric effluents are expected to be within acceptable limits, and the effects will be insignificant.

4. The principal alternatives considered were the following:

   a. Alternative mining methods.

      Open-pit, underground, and solution extraction (in situ leaching) methods were considered, as well as a comparison of impacts

associated with each. Solution extraction is the selected method for mining the designated ore deposits. Surface impacts associated with in situ leaching are generally less severe than impacts associated with open-pit and underground uranium mining accompanied by conventional milling.

b. Alternative leach solutions.

Alkaline and acidic leach solutions were examined. Since laboratory analyses using an alkaline (sodium carbonate-bicarbonate) leach solution were successful, the applicant has chosen to use an alkaline leach solution. The staff concludes that an alkaline solution is suitable and environmentally more desirable than an acid solution.

c. Alternative of no licensing action.

The denial of a source material license is an alternative available to the NRC. If denied, the designated ore deposits could not be mined using the solution extraction method and probably could not, in fact, be mined using open-pit or underground mining techniques, since the ore is so deep (500 feet) and of too low grade to make it economically feasible. The staff concludes that this project can be conducted in a manner which protects public health and safety and the environment.

5. The Environmental Appraisal will be made available to the public and to government agencies in June 1981.

6. From the analysis and evaluation made in this statement, it is proposed that the source material license contain the following conditions:

(1) Authorized Use: For uranium recovery from pregnant lixiviant in accordance with statements, representations and conditions contained in Sections 1 and 3 of the licensee's March 25, 1980 Environmental Report and in supplements dated September 11 and December 5, 1980 and January 19 and April 27, 1981. Notwithstanding the above, the following conditions shall override any conflicting statements contained in the licensee's application and supplements.

(2) The uranium in-situ solution mining operations shall be performed on a maximum well field area of 1.0 acre within the area shown in Figure 3-1 of the March 25, 1980 Environmental Report submitted by Kerr-McGee to the NRC.

(3) Variation from the sodium carbonate-bicarbonate leach solution with hydrogen peroxide, oxygen, or peroxide added, as presented in Section 3, Pages 3-1 and 3-2 of the March 25, 1980 Environmental Report shall require prior NRC approval through amendment of this license. The licensee shall discuss why he proposes the variation and how it will affect groundwater quality, the pond water

characteristics, the quality of surface discharges, restoration methods and criteria, and monitoring requirements.

(4) The eleven (11) wells (8 perimeter ore zone monitor wells and 2 shallow and 1 deep monitor well) shown on Figure 2.2.07 of the Environmental Impact Appraisal (EIA) shall be used to monitor and establish the premining groundwater quality values of the test area. All the monitor wells shall be sampled prior to injection of leach solution and analyzed for all the parameters listed in Table 5.1.1.01 of the EIA.

(5) At least ninety (90) days prior to termination of mining activities, when injection of lixiviant ceases, the licensee shall file, with the NRC, a specific plan for groundwater quality restoration at the test site, to include a description of restoration steps, projected schedule of activity and plans for post restoration and restoration phase monitoring. Restoration of the production aquifer groundwater and any other groundwaters affected by mining operations shall be initiated no later than sixty (60) days after solution mining operations have been terminated. Restoration method(s) must be approved by the NRC in the form of a license amendment. The licensee shall also provide written notification to the NRC, Division of Waste Management, when restoration activities have been initiated. Proposed restoration criteria shall be submitted to the NRC for review and approval and must be approved in the form of a license amendment by the NRC prior to injection of lixiviant.

(6) During solution mining operations, the monitor wells identified in Condition (4) above shall be sampled for chloride and TDS every two (2) weeks and analyzed at least for chloride, alkalinity, carbonate, bicarbonate, selenium, sodium, uranium, sulfate and TDS, once every month. Water level elevations in these wells shall also be measured once every two weeks, at least during the first quarter of operations, prior to sampling. Once per quarter, a set of samples from all of the monitor wells shall be analyzed for the full suite of water quality parameters listed in Table 5.1.1.01 of the EIA. Results shall be reported graphically and in tabular form in the quarterly report required in Condition 21 below.

(7) Upper control limit (UCL) criteria to be applied to monitor wells to determine when action must be taken to control excursions during mining shall be determined following the pre-mining water quality data collection outlined in Condition (4) above. The UCLs shall be determined by the applicant, submitted to the NRC for review, and approved in the form of a license amendment prior to injection of lixiviant.

If two UCL values are exceeded in a well, or if one UCL value is exceeded by 20%, the licensee shall take another water sample within forty-eight (48) hours and analyze it for at least the nine constituents listed in Condition (6) above. An excursion is confirmed if

two or more UCL values are exceeded or if one UCL value is exceeded by 20% or more. Corrective action to mitigate the situation shall be initiated by the licensee when an excursion is detected and the NRC shall be notified within 48 hours by telephone and within 7 days in writing. In addition to corrective actions, monitoring of all wells on excursion shall be intensified; water level elevation measurements and sampling and analysis for the nine constituents listed in Condition (6) above, shall be conducted at least once every seven (7) days, for as long as those wells are on excursion status. A written report shall be provided to the NRC, Division of Waste Management, within thirty (30) days of confirming an excursion, describing the condition, the corrective action taken, and the results obtained. If wells are still on excursion at the time the report is filed, written progress reports concerning the excursion shall be sent to the NRC monthly until the monitor wells are no longer on excursion status.

If corrective actions have not been effective, within 90 days of the excursion verification, the injection of lixiviant, unless otherwise determined by the NRC in writing, shall be terminated until Kerr-McGee receives written approval to start up, from the NRC, in the form of a license amendment.

(8) A formal report of events describing the corrective actions taken and detailed graphs and tables of all sample analyses shall be maintained during excursions as described in Condition 7 above to document actions and the ensuing results. This report, along with pre-excursion and post-excursion data obtained from the analysis of at least two separate samples taken before and after an excursion, shall be submitted to the NRC within 30 days after an excusrion is terminated.

(9) Baseline water level elevations for each well shall be defined and submitted to the NRC for review and approval prior to injection of lixiviant. The potentiometric level of a given monitor well shall be monitored once daily for the first two (2) weeks of continuous operation of the well field. After the initial two weeks, water level monitoring can be decreased to once every two weeks, for at least the first quarter, with water levels taken just prior to sampling the wells. If the data are shown to be useful monitor criteria in the early detection of excursions, should any occur, water level measurements shall be required after the first quarter. Water level data in graphical and tabular form shall be kept for reporting to the NRC as prescribed in Condition (10) below. Net flow rates for the well field shall be recorded whenever monitor well water levels are measured.

(10) The results of the water quality and water level monitoring programs shall be submitted in a separate section of each quarterly report, as described in Condition (21) below. Monitoring data along with barometric pressure measurements and net flow from the well field shall be

reported. In the first quarterly report, the licensee shall provide a discussion that presents, summarizes and evaluates the water level and water quality data with respect to the degree of confinement of the ore zone. The licensee shall continue to measure water levels until the NRC has made written determination, based on the existing data, of whether or not continued water level monitoring is necessary.

(11) Should the potentiometric level in any of the perimeter ore-zone monitor wells rise significantly, the NRC shall be notified within one work day. The licensee shall take steps to determine the cause of the reversed hydraulic gradient and to correct potentiometric rises in the monitor wells by well field adjustment. Within thirty (30) days after first notifying the NRC of a potentiometric level problem, the licensee shall submit a report to the NRC, Division of Waste Management describing the situation from the time the NRC was initially notified until the time of report submittal. The corrective actions taken and the results of those actions shall also be a part of the report.

(12) The volume of discharges to the evaporation ponds shall be recorded. In addition, quarterly samples of solution shall be analyzed for calcium, chloride, alkalinity, sodium, gross alpha and gross beta, uranium, radium-226, selenium, arsenic, sulfate and TDS.

(13) The two evaporation ponds shall be checked for leaks on a daily basis. Any fluid detected in the standpipes of the pond leak detection system shall be analyzed initially for chloride and TDS, and if these concentrations exceed Wyoming DEQ drinking water standards, the waters shall also be analyzed for calcium, alkalinity, sodium, uranium, gross alpha, gross beta, radium-226, selenium, arsenic, and sulfate. Water quality samples taken at the standpipe shall be sampled for all 12 parameters at least every seven days during the leak period and at least two weeks following repair if any residual liquid remains in the standpipes. The results of all standpipe analysis shall be reported to the NRC in the quarterly report as per Condition (21) below.

The NRC shall be notified within forty-eight (48) hours if the chemical quality of the fluid found in the standpipe exceeds Wyoming drinking water standards for any of the parameters tested. The licensee must take immediate steps to repair the leak and not only rely on a leak "pump-back" system to intercept leakage. A report shall be filed with the NRC describing the actions taken by Kerr-McGee to repair the pond. The results of those actions shall be submitted to the NRC within thirty (30) days after initially notifying the NRC. If an evaporation pond leak is significant and conditions warrant it (i.e. large losses of very poor quality waste water to the subsurface), the NRC may, at that time, require the construction, pumping, and sampling of wells.

(14) Kerr-McGee shall comply with the following requirements regarding the evaporation ponds:

a. The site of the ponds shall be that site recommended by Chen and Associates, as discussed in the December 5, 1980 submittal from Kerr-McGee to NRC.

b. Kerr-McGee shall submit to the NRC for review and approval prior to pond construction the quality assurance program for installation and testing of the 30 mil reinforced hypalon liners for the evaporation ponds, including the liner field seams. Kerr-McGee shall also provide data documenting that the liner is compatable with the waste products and atmospheric and temperature conditions that will be encountered at the site.

The liners shall be anchored in a one foot deep trench near the crest of the impoundments, underlain throughout with bedding sand which has no more than 12 percent passing the number 200 sieve, which is at least three orders of magnitude more permeable than the subgrade, and which extends up the embankment slopes to enable detection of any leakage through the sides of the liner. Prior to placing the sand bedding layer, any sand seams and pockets that are visible should be covered by compacted clay soils and the compacted silty clay subgrade and embankment material shall be graded to a surface tolerance of less than or equal to 1 inch.

c. Kerr-McGee shall submit a QA program for installation and testing of the subgrade, underdrain, and pond slopes, with regards to excavation, fill placement, grading, compaction, and moisture control.

d. The perimeter embankments and dividing embankment shall have maximum height of 8 feet, exterior and interior slopes of 2.5H:1V, and a crest width of 10 feet. Embankment fill shall consist of sandy silty clays excavated from the site and compacted to 95 percent of the maximum dry density and placed within ±2 percent of the optimum moisture content as per ASTM D-698. Kerr-McGee shall submit a QA program outlining the embankment construction procedures and test methods for NRC approval prior to start of construction.

e. Kerr-McGee shall maintain at least two feet of freeboard between the embankment crest and the pond level.

f. The leak detection system for each pond shall consist of a 2 inch diameter PVC pipe laid in a depressed trench at the lowest point (center line) of the ponds' bottoms which slope toward the centers at 3 degrees. A 6-inch sand bedding layer will be placed below each pond floor liner, and in the trenches for securing the liner at the surface. Collector pipes will

lead to sumps, one for each pond, thereby providing two independent leak detection systems. Prior to liner placement, the leak detection system shall be tested to assure it functions properly.

g. A fence that prevents the intrusion of game animals (i.e., mule-deer and antelope) into the evaporation pond area shall be maintained.

h. Kerr-McGee shall maintain sufficient freeboard to allow for pumping the contents of one pond into the other in the event of a major leak

(15) Final disposition of any radioactive solid process or evaporation pond residues (byproduct material) shall be at a licensed NRC tailings disposal site.

(16) The licensee is exempted from the requirements of Section 20.203(e)(2) of 10 CFR Part 20 provided all entrances to the site are conspicuously posted with the warning: "CAUTION. ANY AREA OR ROOM WITHIN THIS FACILITY MAY CONTAIN RADIOACTIVE MATERIAL."

(17) The uranium recovery plant shall be operated at a maximum average flow rate of one-hundred (100) gpm. Pressures at the well heads of injection wells in the Q ore zone shall not exceed 100 psi.

(18) Flow rates on each injection and production well and injection pressures on injection wells shall be measured at least once per day and recorded graphically on a daily operating log.

(19) The licensee shall perform the radiological environmental monitoring program as outlined in Tables 5.2.1.01 and 5.2.1.01(a) of the EIA. Preoperational data from this program shall be provided to the NRC in the first quarterly report discussed in Condition 21 below.

(20) Exploration boreholes, post-test boreholes, and all wells within the well field area not used in production or monitoring and not properly cased or sealed within a specific unit shall be plugged prior to injecting lixiviant to comply with Wyoming Department of Environmental Quality (DEQ) requirements. All wells shall be plugged prior to decommissioning the site for unrestricted use.

(21) A quarterly report shall be submitted to the NRC Waste Management Division that summarizes the status of the test program, with supporting analytical data and evaluations regarding important environmental aspects of the operation, including lixiviant migration control measures, waste generation volumes, and volumes of injected lixiviant and pregnant solution produced. The quarterly report shall include all environmental monitoring and groundwater data, as well as all monitoring data and reports required under NPDES

Permit No. WY-0022411. The initial quarterly report shall include all accumulated baseline and preoperational data. All data shall be presented in tabular and graphical form, with a written summary evaluating the data.

(22) During well field operations, injection pressures shall be monitored daily. Well head pressures shall not exceed 100 psi to assure that fracture pressure in the ore zone, and adjacent confining layers are not exceeded.

(23) Notwithstanding any conflicting statements in Kerr-McGee's application or supplements, all liquid discharges from the above-ground processing facility, with the exception of the bleed stream and restoration stream which must both first be processed through the IX unit and then be treated for radium removal and discharged in accordance with NPDES Permit No. WY-0022411, shall be to the hypalon lined evaporation ponds.

(24) Kerr-McGee shall reclaim and decommission the well field and process facility sites as discussed in Section 3.7.2 of the EIA.

(25) Kerr-McGee shall maintain a surety to cover all groundwater restoration and all reclamation and decommissioning, including the cost of offsite disposal of radioactive solid process or evaporation pond residues. Kerr-McGee shall provide a copy of the surety along with a cost breakdown to the NRC and receive NRC approval of the surety in the form of a license amendment prior to injection of lixiviant.

(26) This license shall not be terminated until the NRC has determined that all site reclamation, including any necessary cleanup of the drainage way to Sage Creek, decommissioning, and well field restoration has met all applicable standards and regulations.

(27) The licensee shall remove all sediments from any of the treatment or settling ponds, associated with pretreatment of surface discharges from solution mining operations under the NPDES permit, to a licensed tailings disposal site.

(28) Upon cessation of solution mining activities, the licensee shall clean up the area of the treatment and settling ponds as well as the drainage, to which discharges are directed under the NPDES permit, to essentially preoperational levels. For Ra-226 this shall require that at least the average Ra-226 levels in soils and sediments resulting from discharges authorized under this license are no more than 5 picocuries per gram of soil. Preoperational background for these areas shall be determined by the sampling required in Table 5.2.1.01 of the EIA.

(29) The licensee shall sample soils/sediments in the drainage to which surface discharges are directed as specified in Table 5.2.1.01(a).

If at any time Ra-226 levels are greater than 5 pCi/gram above the preoperational background levels, the licensee shall notify the NRC within seven days in writing and shall initiate corrective actions to lower the Ra-226 levels in discharges and cleanup the drainage so that Ra-226 concentrations in soils/sediment from licensed discharges are no greater than 5 pCi/gm. If corrective actions do not achieve these objectives within 60 days, then all discharges from the recovery plant shall be directed to the lined evaporation ponds.

(30) The licensee shall submit to the NRC copies of any correspondence with the Wyoming Department of Environmental Quality regarding well field operations and/or monitoring.

(31) The licensee shall perform daily visual inspections of all evaporation pond embankments. Such inspections shall be performed by a qualified engineer or scientist and shall be documented. Records of all inspections shall be kept on site.

(32) The licensee shall immediately notify the U.S. Nuclear Regulatory Commission, Region IV, Office of Inspection and Enforcement, 611 Ryan Plaza Drive, Suite 1000, Arlington, Texas 76011, and the U.S. Nuclear Regulatory Commission, Uranium Recovery Licensing Branch, Washington, D.C. 20555, by telephone and telegraph, of any failure of an evaporation pond, any break or rupture of any pipeline, or any similar failure of any other fluid or material conduit or storage facility which results in an uncontrolled release of radioactive materials, or of any unusual conditions which if not corrected could lead to such a failure. Such notification shall be followed, within seven days, by submittal of a written report detailing the conditions leading to the failure or potential failure, corrective actions taken, and results achieved. This requirement is in addition to the requirements of 10 CFR Part 20.

(33) The licensee shall monitor any surface discharges from the recovery plant, prior to mixture with any other sources, for chloride, alkalinity, carbonate, bicarbonate, selenium, sodium, uranium, sulfate, and TDS at least monthly.

7. The position of the NRC is as follows:

Solution extraction of uranium is a developing technology. Uncertainties regarding environmental impacts, particularly with respect to groundwater contamination and the effectiveness of groundwater restoration techniques, have been recognized. Testing and data collection in a research and development project is proposed by the applicant to eliminate the uncertainties. The scope of the proposed project is sufficiently limited in size to enable continued development of solution mining technology without significant environmental risk.

The position of the Nuclear Regulatory Commission is that, after weighing the environmental, economic, technical, and other benefits of the Kerr-McGee "Q" Sand Project against negative environmental considerations, and considering available alternatives, the action called for under the National Environmental Policy Act of 1969 (NEPA) and 10 CFR Part 51 is the issuance of a Source Material and Byproduct Material License to the applicant, subject to conditions 6(1) through (33) above.

1.0 INTRODUCTION

1.1 BACKGROUND

Kerr-McGee Nuclear Corporation applied to the NRC for a NRC Source Material and Byproduct Material License to construct and operate an in situ leach uranium extraction and recovery facility in Converse County, Wyoming. The project, known as the "Q" Sand Project, is a research and development (R&D) project designed to develop the environmental parameters and operating characteristics expected for a full-scale operation.

The "Q" Sand R&D Project Site consists of about five (5) acres located approximately 17 air miles (27.4 Km) northeast of the town of Glenrock and 23 air miles (37 Km) northwest of Douglas.

Kerr-McGee has obtained the mining rights on a total of 73,030 acres of land designated as the Kerr-McGee Permit Area (Figure 1.1.01). The R&D project site is located in Section 36,T36N,R74W. The state of Wyoming owns the surface rights to Section 36. The R&D well field will be located about 1,500 feet south of Kerr-McGee's underground shaft (The Bill Smith shaft).

The applicant proposes to extract in situ, uranium contained in the "Q" sand zone of the top of the Fort Union Formation (geologic formation) at a depth of about 500 feet. Sodium carbonate-sodium bicarbonate solution and an oxidizing agent would be injected into the uraniferous unit of the Fort Union Formation and recovered through well patterns during the extraction process. Each well pattern would consist of four injection wells surrounding a central production well. The anticipated production flow rate will be up to 100 gallons per minute (gpm).

The applicant proposes to restore the groundwater system to its premining condition and use (or potential use) after mining is completed, by recycling mine formation water back into the formation until satisfactory water quality has been reached.

The applicant further proposes to remove solid wastes, if they exceed background soil radiation levels, to a NRC licensed disposal site.

1.2 PROPOSED ACTION

By letter to the U.S. Nuclear Regulatory Commission (NRC) dated March 25, 1980, Kerr-McGee Nuclear Corporation requested a license to receive, possess, use and transfer source material and byproduct material in the course of research and development work associated with in situ extraction of uranium at their "Q" Sand Project Site in Converse County, Wyoming.

The purpose of this proposal is to determine if the ore at the "Q" Sand Project Site can be extracted in an environmentally sound way that is economical, thereby providing added uranium production capability to meet the source material requirements for nuclear power plant operations.

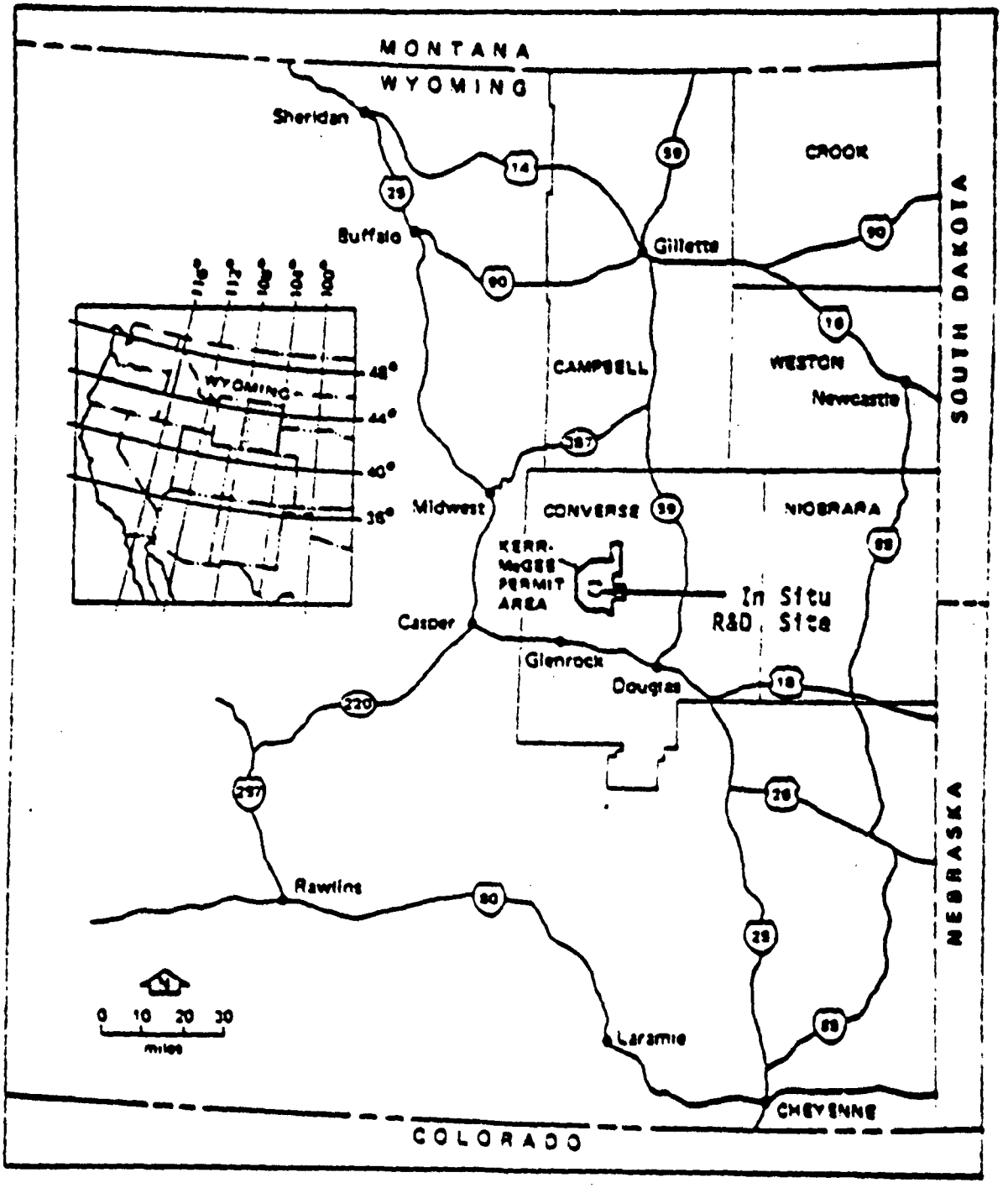


FIGURE 1.1.01 SITE LOCATION

This impact appraisal discusses the environmental aspects of the proposed application. The proposed action is to grant a license to Kerr-McGee Nuclear Corporation.

1.3 REVIEW SCOPE

1.3.1 Federal and State Authorities

Under 10 CFR Part 40, a NRC license is required in order to "...receive, possess, use, transfer...any source material..." (that is, uranium and/or thorium in any form, or ores containing 0.05% or more by weight of those substances). In addition, the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA) requires persons who conduct uranium source material operations to obtain a byproduct material license to own, use, or possess tailings and wastes generated by the operation (including above-ground wastes from in situ operations). Under 10 CFR Part 51, this environmental appraisal has been prepared. Because the subject application is not regarded as a major federal action that could significantly affect the quality of the human environment, an environmental impact statement will not be prepared.

The State of Wyoming Department of Environmental Quality (WDEQ) administers the State's Environmental Quality Act of 1973 and implementing rules and regulations. Kerr-McGee has received a license from the WDEQ to operate the proposed facility (Research and Development License No. 5RD).

1.3.2 Basis of NRC Review

An impact appraisal for the licensing has been performed by the Division of Waste Management, Uranium Recovery Licensing Branch (WMUR) of the NRC. This report documents that appraisal. The staff has performed the appraisal of environmental and safety considerations associated with the proposed license in accordance with Title 10, Code of Federal Regulations (10 CFR Part 51, Licensing and Regulatory Policy and Procedures for Environmental Protection).

In conducting this appraisal, the staff considered the following:

- Environmental information and supplements submitted by the applicant to the NRC in July 1977, March and December 1980, and January and April, 1981 to support the application for a license;
- Information supplied in discussion by the State of Wyoming, Department of Environmental Quality, Land Quality Division relating to state licensing actions; and
- Site visit by NRC staff on September 22, 1980.

2.0 SITE DESCRIPTION

2.1 LOCATION AND LAND USE

The proposed R&D license area is located in the South Powder River Basin, Wyoming, approximately 17 air miles (27.4 Km) northeast of the town of Glenrock and 23 air miles (37 Km) northwest of Douglas (Figure 1.1.01 shows the site location).

The lands contained within the license area were historically used for cattle and wildlife grazing. The land is leased by Kerr-McGee from the state of Wyoming for uranium exploration and commercial scale development. After mining, the land will be reclaimed for use as grazing land.

The total surface area affected by the test will be approximately five (5) acres. Total area of the well field will not exceed one (1) acre. The two solar evaporation ponds will occupy 0.65 acres and the processing plant, access road, parking lot, storage areas and related facilities will take up approximately 3.77 acres.

2.2 GEOLOGY AND HYDROGEOLOGY OF THE ORE BODY

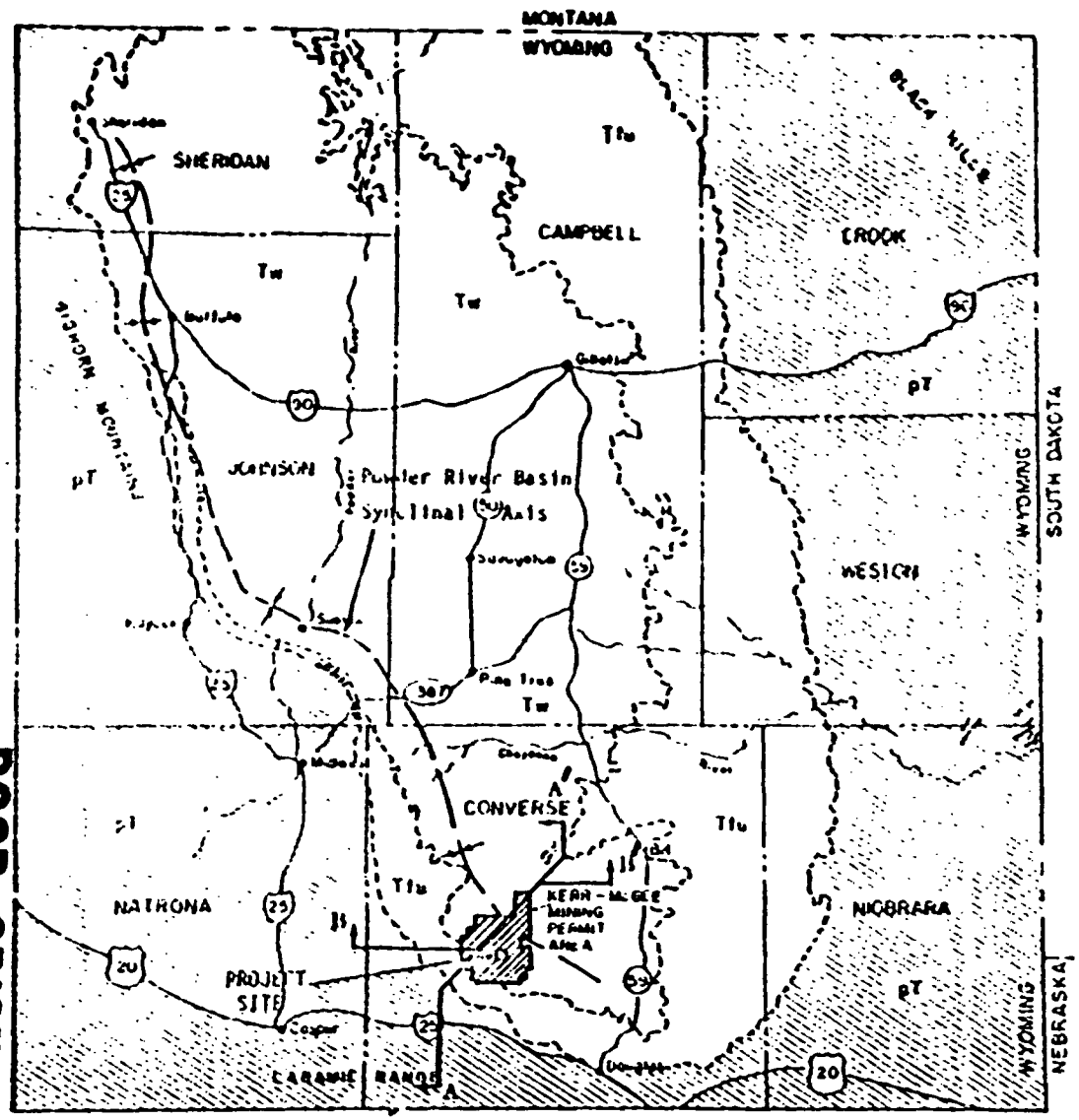
2.2.1 Hydrogeologic Setting

The project area is on the southwest flank of the Powder River Basin, near the axis of the basin. The Powder River Basin is a north-south aligned assymetric syncline. At the eastern and western boundaries of the permit area, the strata dip generally toward the axis some 2° to 5° to the west and east, respectively. Near the outcrop of the Wasatch-Fort Union formational contact, the strata dip locally as much as 20°.

The license area is located on a topographic high. There are no surface water impoundments on the site. The only adjudicated water rights in the vicinity are the water rights associated with Kerr-McGee's uranium operations.

Figure 2.2.01 shows the regional geological structures relative to the Kerr-McGee Mining Area and "Q" Sand Project Site. Figure 2.2.02 illustrates the stratigraphy at the project area. The nearest geologic structure is the Powder River Basin synclinal axis. No major faults or folds have been detected in the site area.

The Wasatch Formation of Eocene Age outcrops throughout the permit area. It consists of up to 500 feet of interbedded claystones, sandy siltstones, and relatively clean sandstones. The uranium bearing sandstone in the proposed test area has been designated by Kerr-McGee as the "Q" sandstone and is found in the top of the Fort Union Formation at a depth of approximately 500 feet. The "Q" sand averages about 25 feet in thickness and is separated from overlying and underlying aquifers at the R&D site by approximately 40 to 60 feet of low permeability shale and claystone, the "R" shales and "P" shales, respectively. Cross-sections through the Kerr-McGee property and R&D test site are presented in Figures 2.2.03-2.2.05.



LEGEND

- Tw — WASATCH FORMATION: IRREGULARLY STRATIFIED CLAYSTONES, SILTSTONES, AND SANDSTONES, WITH MINOR THIN LIMESTONES AND COALS.
- Tfu — FORT UNION FORMATION: INTERBEDDED CLAYSTONES, SILTSTONES, AND SANDSTONES WITH THICK COAL BEDS.
- pT — PRE-TERTIARY ROCKS (UNDIVIDED)
- GEOLOGIC CONTACT, APPROXIMATELY LOCATED
- SYNCLINAL AXIS, POWDER RIVER BASIN (LOCATED ON SURFACE OF PRECAMBRIAN BASEMENT COMPLEX)
- FAULTS, APPROXIMATELY LOCATED
- A — A' CROSS SECTION, APPROXIMATED (See Figure 2.2.03)

(MODIFIED FROM SHARP AND GIBBONS, 1964; SHARP ET AL., 1964)

FIGURE 2.2.01 REGIONAL GEOLOGY

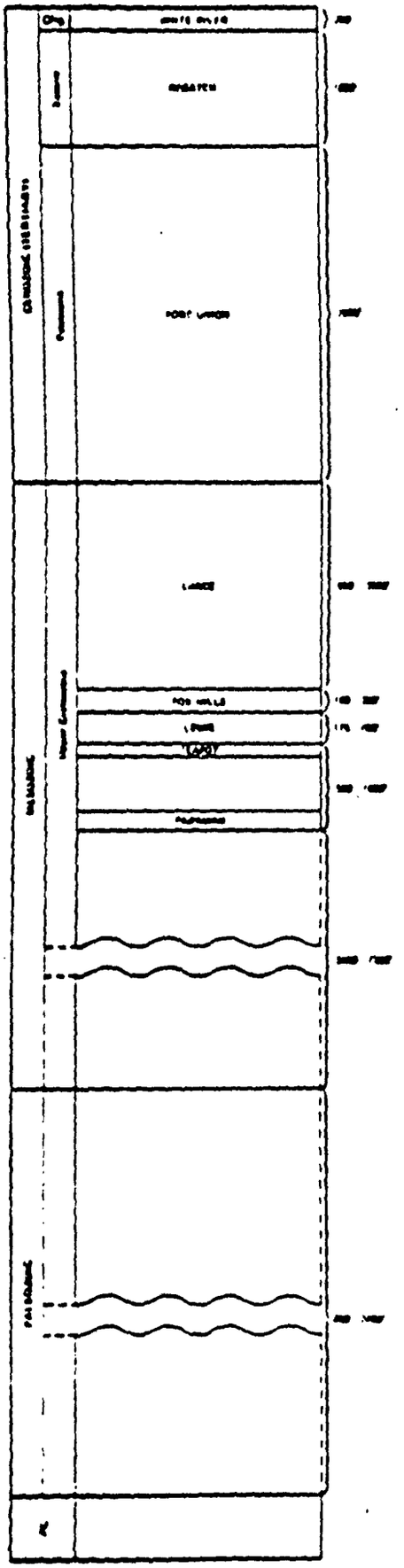


FIGURE 2.2.02 STRATIGRAPHIC COLUMN: VERTICAL SEQUENCE OF ROCK FORMATIONS IN THE SOUTH POWDER RIVER BASIN

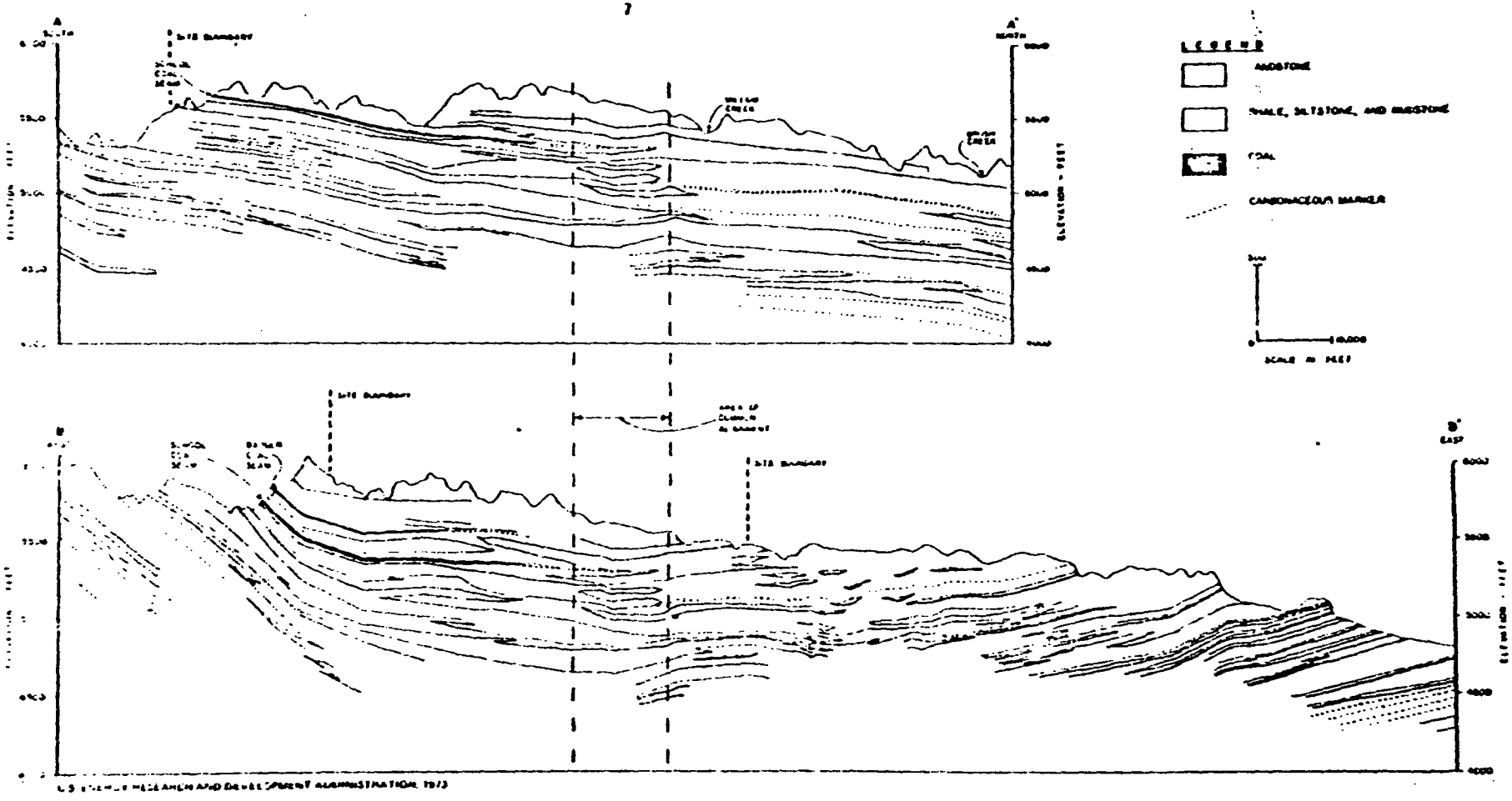


FIGURE 2.2.03 GEOLOGIC CROSS SECTIONS OF THE KERR McGEE PROPERTY (LOCATION OF CROSS SECTIONS SHOWN IN FIGURE 2.2.01)

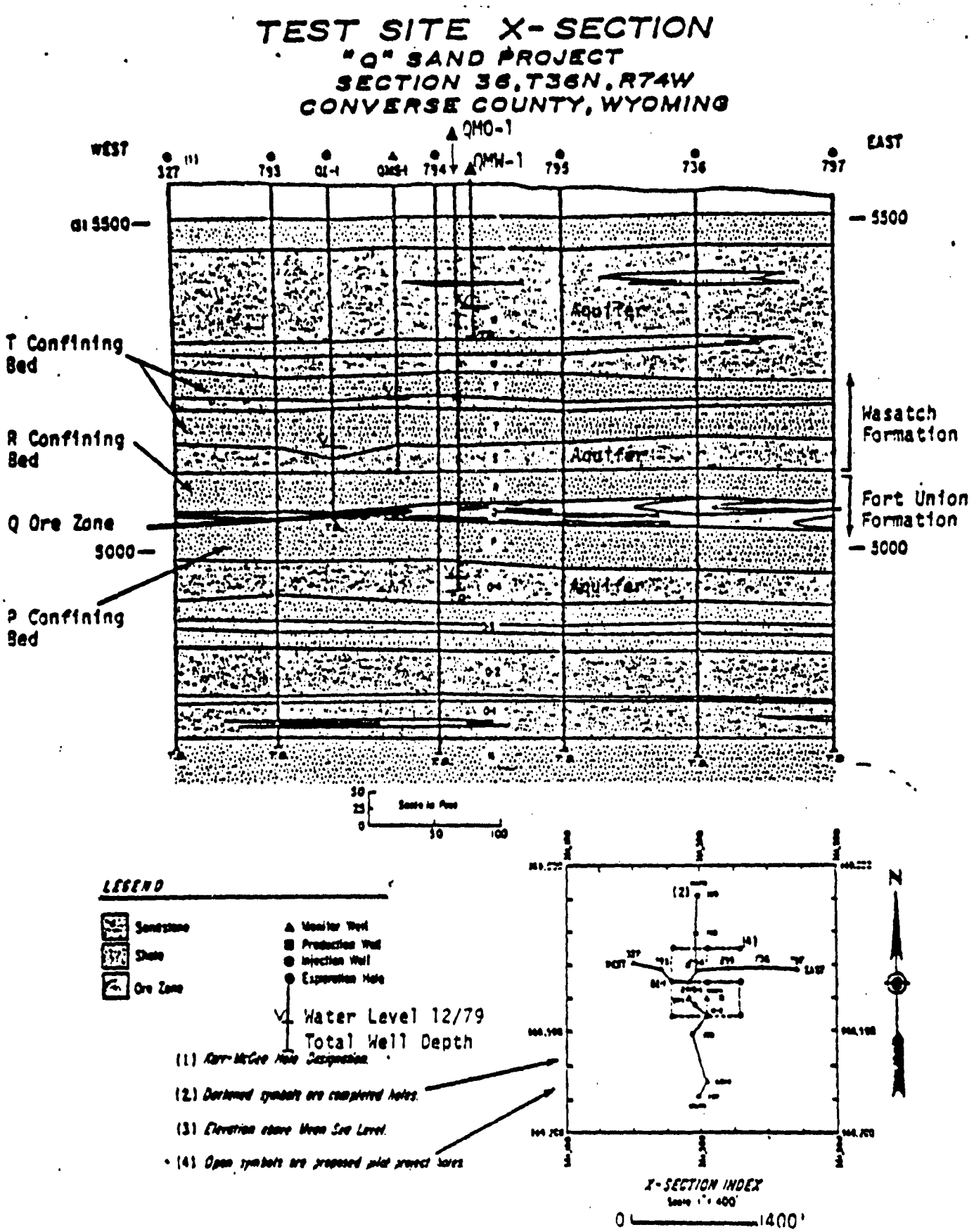


FIGURE 2.2.04 EAST-WEST GEOLOGIC CROSS SECTION OF THE KERR-McGEE "Q" SAND PROJECT SITE

TEST SITE X-SECTION

"Q" SAND PROJECT
SECTION 36, T36N, R74W
CONVERSE COUNTY, WYOMING

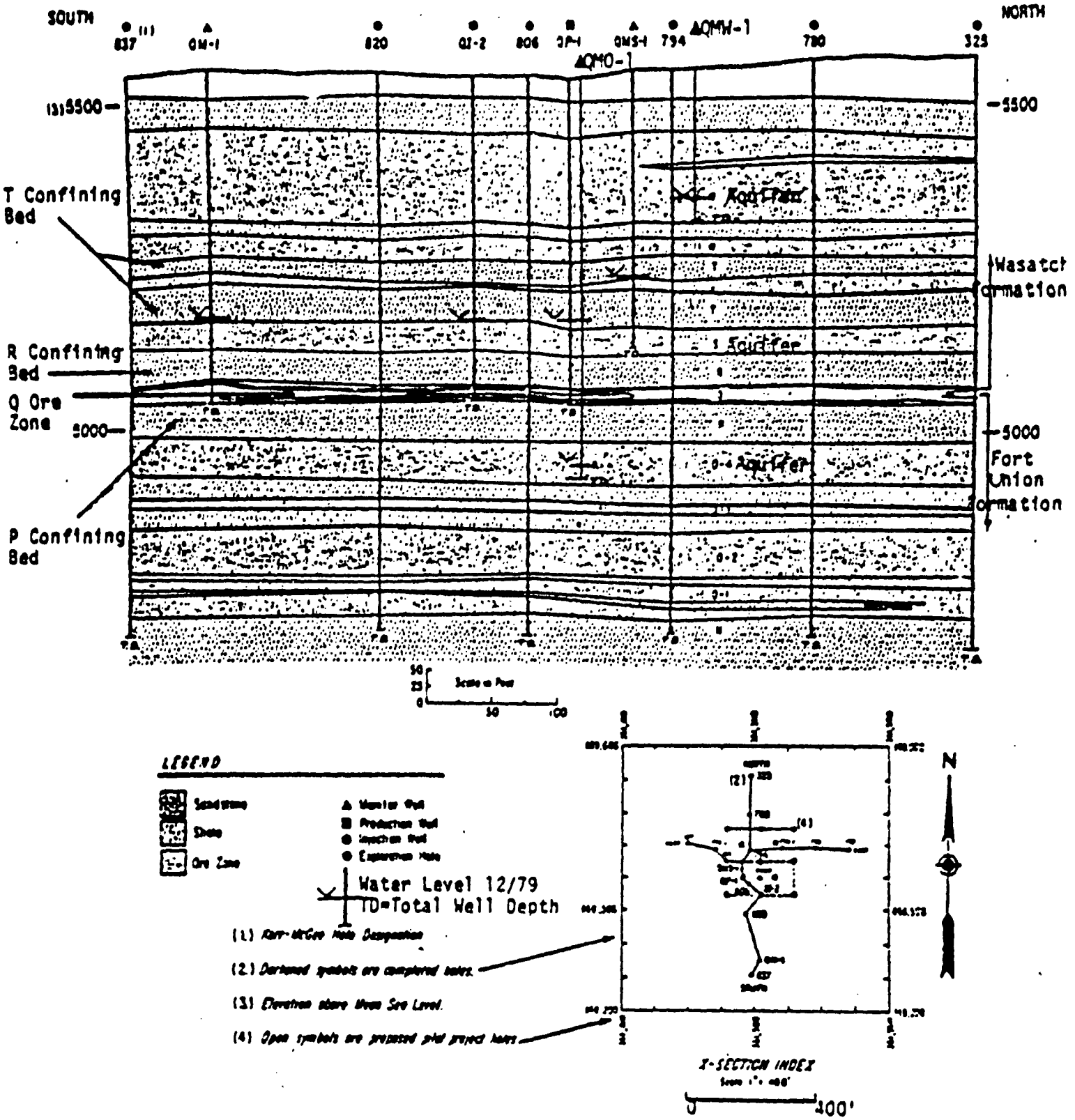


FIGURE 2.2.05 NORTH-SOUTH GEOLOGIC CROSS SECTION OF THE KERR-McGEE "Q" SAND PROJECT SITE

Groundwater units in the vicinity of the proposed test site consist of 0-30 feet of alluvium and several hundred feet of lenticular sandstones of Wasatch and Fort Union Age (see Table 2.2.01). The lenticular sandstones of the Wasatch Formation form the upper "W" aquifer at the site. It is a low-yielding aquifer that is geologically confined but not confined under pressure. The water level in the "W" aquifer at the site is approximately 190 feet below the land surface. Most water wells penetrate the Wasatch ("S" aquifer) and Fort Union Formations ("Q" and "O" aquifers). In the vicinity of the test area, such wells generally yield from 5 to 20 gallons per minute (gpm), but some wells yield in excess of 100 gpm. In general, the groundwater in the basal Wasatch ("S" aquifer) and Fort Union Formations ("Q" and "O" aquifers) is under artesian pressure and groundwater flow in each of the aquifers appears to move to the north-northeast from the proposed test area (Figure 2.2.07).

All known wells in the license area and adjacent lands are owned and operated by Kerr-McGee and are properly constructed. An inventory of the wells with the well designation, completion aquifer, surface elevation, well depth, and the water level and yield at time of completion is included in Tables 2.2.02 and 2.2.02(a). Wells which do not have a yield value were completed as observation wells and were not pumped. The approximate well locations relative to the license area are also shown in Figure 2.2.06. The only well that is being used on-site is well WW103 which is completed in the "W" sand and is pumped at around 10 gpm. The mine shaft which penetrates the lower "O" aquifer is being dewatered at a rate of around 1700 gpm.

A long-term aquifer pumping test was conducted so that evaluations could be made of the hydrogeological characteristics of the "Q" sand and of the isolation provided by the overlying and underlying shales in the test area. The pumped well and three monitor wells were completed and monitored in the "Q" sand. Two additional monitor wells were also monitored in the overlying (S-sand zone) and underlying (O-sand zone) aquifers to check for vertical communication. The locations of the wells used in the pumping test (QP-3 was pumped and wells QI-2, QI-7, QI-11, QMS-1, and QMO-1 monitored as observation wells) are shown in Figure 2.2.07. The well completion data are provided in Tables 2.2.02 and 2.2.02(a) and the pump test data, data plots, and barometric pressure readings taken for the aquifer pump test are included in Appendix 8.

The aquifer pumping test was conducted on well QP-3 for a period of nearly three days 4305 minutes (from 9:38 a.m. on April 10, 1981 to 9:23 a.m. on April 13, 1981), at a steady discharge rate of 16.7 gpm.

The results of the analyses of the "Q" sand observation well drawdown and recovery data are listed in Table 2.2.03, and log-log drawdown and recovery data plots with match points indicated are included in Appendix 8, Figures 8-1 and 8-2. These data indicate that the "Q" ore zone aquifer is a confined leaky aquifer, with an average value of transmissivity of approximately 950 gpd/ft, a permeability of around 32 gpd/ft^2 (.002 cm/sec), and a storage coefficient of around 6×10^{-5}.

TABLE 2.2.01 DESCRIPTION OF HYDROGEOLOGIC UNITS IN THE VICINITY OF THE PROPOSED SITE

Geologic Age	Hydro-geologic Unit	Approximate Thickness (feet)	Lithologic Character-istics	Hydrologic Character-istics
Eocene	Wasatch Formation	0-500	Fine- to coarse-grained lenticular arkosic sand-stone, and interbedded claystone and siltstone	Groundwater production generally good, but lenticular nature restricts aquifer use locally; yields of as much as 140 gpm have been produced
Paleocene	Fort Union Formation	3000	Fine- to coarse-grained, lenticular sandstone, and interbedded carbon-aceous shale and coal	Groundwater production good beneath site; yields of 550 gpm have been produced over prolonged periods
Cretaceous	Lance Formation	3000	Fine- to medium-grained sandstone, and inter-bedded sand, shale, and claystone	Groundwater production largely unknown in vicnity of site; probably would not yield over 20 gpm
Cretaceous	Fox Hills	500-700	Fine- to medium-grained sandstone, and inter-bedded thin sandy shale	Groundwater production largely unknown in vicinity of site; probably would not yield over 100 gpm

Sources: Hodson et al., 1973; Hodson, 1971; Harshbarger and Associates, 1974.

TABLE 2.2.02

INVENTORY OF WELLS ON THE LICENSE AREA AND ADJACENT LANDS

KERR-McGEE "Q" SAND PROJECT
CONVERSE COUNTY, WYOMING

Figure 2.2.06 Location No.	Kerr-McGee[1] Well Number	Wyoming Well Permit Number	Aquifer	Elevation of Land Surface (Feet Above MSL)	Depth of Well (Feet)	Elevation of Water Level (Feet Above MSL)	Date of Level Measurement (Month/Year)	Yield (GPM)
1	IW-2	29,277	Fort Union	5541.9	946	5054.5	7/76	560
2	OWS-4	--	Wasatch	5546.6	546	5375.6	7/76	--
3	OWD-4	--	Fort Union	5546.7	943	5107.0	7/76	--
4	OWS-3	--	Wasatch	5562.5	570	5350.6	7/76	--
5	OWD-3	--	Fort Union	5563.1	887	5057.8	7/76	--
6	IW-1	28,276	Fort Union	5599.5	1006	5030.0	7/76	425
7	OWS-1	--	Wasatch	5585.5	567	5349.7	7/76	--
8	OWD-1	--	Fort Union	5586.1	987	5060.7	7/76	--
9	OWS-2	--	Wasatch	5593.8	584	5482.0	7/76	--
10	OWD-2	--	Fort Union	5593.9	900	5070.9	7/76	--
11 (2)	WW103	2,574	Wasatch	5540	474	5280	9/69	140
12 (3)	Mine Shaft	15,500	Fort Union	5519	949	5250	11/74	850
13	OWD-6	--	Fort Union	5568	868	4955	12/79	--
14	QI-1	--	Fort Union	5555	509	5171	12/79	--
15	QP-1	--	Fort Union	5545	497	5169.5	12/79	15
16	QI-2	--	Fort Union	5541	497	5168.5	12/79	18
17	QM-1	--	Fort Union	5551	505	5174	12/79	--
18	QND-1	--	Fort Union	5543	612	4962	12/79	--
19	QMS-1	--	Wasatch	5554	421	5239.5	12/79	--
20	I-300	--	Fort Union	5570	812	-0-	11/79	--
21	I-500	--	Fort Union	5578	774	-0-	11/79	--

[1]All known wells in the license area and adjacent lands are owned and operated by Kerr-McGee.

[2]Well WW103 is the only well that Kerr-McGee is currently operating for water supply, at a rate of approximately 10 gpm from the W aquifer.

[3]The mine shaft is being pumped at around 1700 gpm, from the O aquifer.

TABLE 2.2.02(a)

ISL WELLS
KERR-McGEE Q SAND PROJECT
CONVERSE COUNTRY, WYOMING

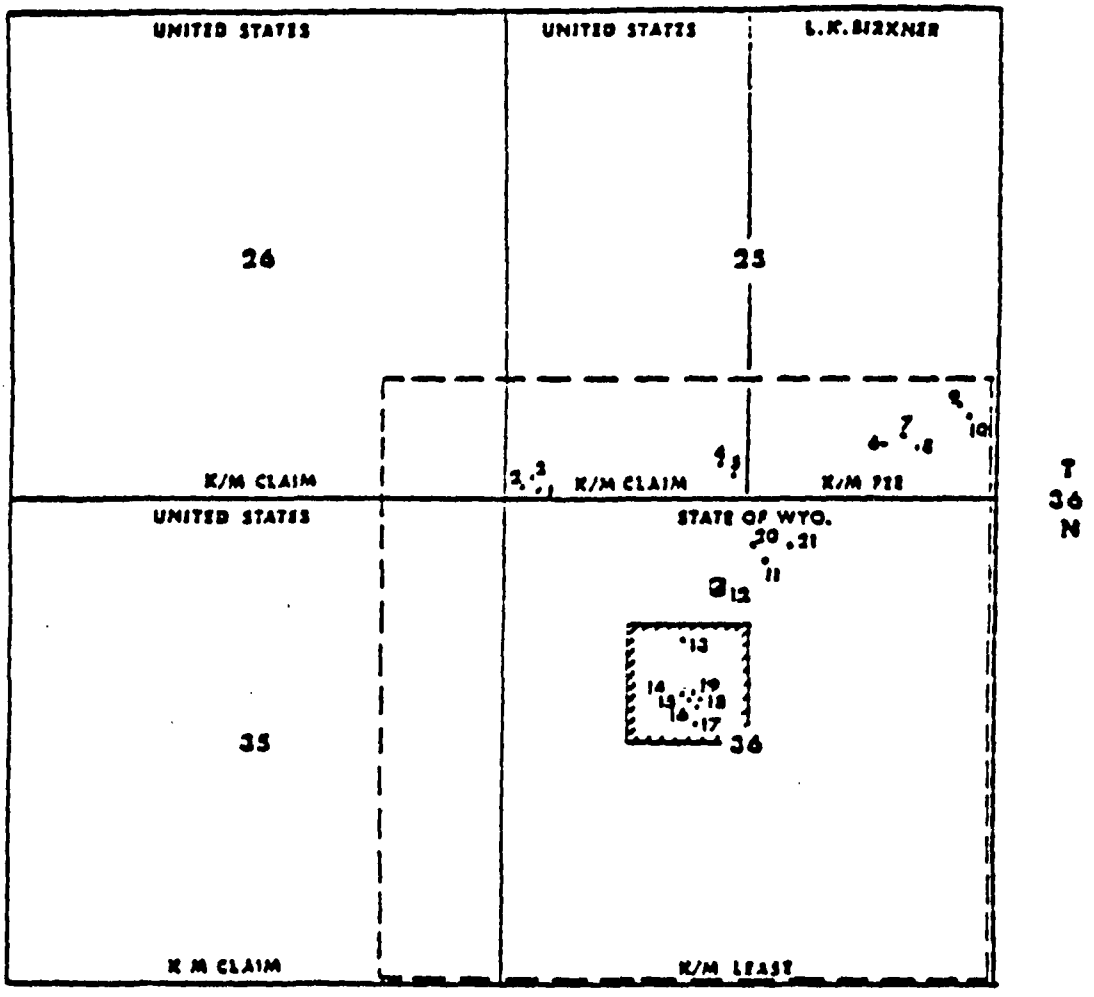
Kerr-McGee Well Number	Elevation at Top of casing (feet above MSL)	Depth of well (feet)	Depth from Casing Top 9/11/80	MSL Elevation	Completion Interval (T.D.-up)
QP-1*	5549.65	497	375.80	5173.85	497'-475'
QP-2	5544.06	495	369.40	5174.66	495'-470'
QP-3	5557.24	512	383.97	5173.27	512'-480'
QP-4	5559.96	515	386.83	5173.13	515'-490'
QP-5	5552.11	517	378.88	5173.23	517'-465'
QI-1*	5556.17	509	382.86	5173.31	509'-492'
QI-2	5546.38	496	372.45	5173.93	496'-475'
QI-4	5548.68	513	375.22	5173.46	513'-475'
QI-5	5560.62	513	387.55	5173.07	513'-490'
QI-6	5565.42	520	392.35	5173.07	520'-495'
QI-7	5567.82	522	394.88	5172.94	522'-495'
QI-8	5553.52	503	379.59	5173.94	503'-480'
QI-9	5552.04	505	378.66	5173.38	505'-480'
QI-10	5543.38	514	369.80	5173.58	514'-465'
QI-11	5554.35	525	381.28	5173.07	525'-475'
QMW-1**	5558.71	350	188.48	5370.23	350'-170'
QMS-1**	5553.63	421	315.35	5238.28	421'-393'
QMO-1**	5545.47	612	579.34	4966.13	612'-558'
QM-1	5550.53	505	375.75	5174.78	505'-475'
QM-2	5535.80	505	361.35	5174.45	505'-460'
QM-3	5528.17	505	354.65	5173.52	505'-455
QM-4	5550.72	539	378.10	5172.62	539'-475
QM-5	5582.73	537	410.9	5171.83	537'-513
QM-6	5562.61	520	390.16	5172.45	520'-495
QM-7	5562.15	514	388.81	5173.34	514'-438
QM-8	5556.75	508	380.08	5176.67	508'-494

*6" I.D. steel casing, all other holes cased with 4.33 I.D. fiberglass
**Monitor well completed in another aquifer unit. Wells QMS-1 and QMW-1 are completed in the Wasatch formation. All other wells are completed in the Fort Union formation.

FIGURE 2.2.06

APPROXIMATE WELL LOCATIONS
LICENSE AREA AND ADJACENT LANDS

KERR-McGEE 'Q' SAND PROJECT
CONVERSE COUNTY WYOMING



LICENSE AREA

LIMITS OF ADJACENT LANDS

BILL SMITH MINE SHAFT

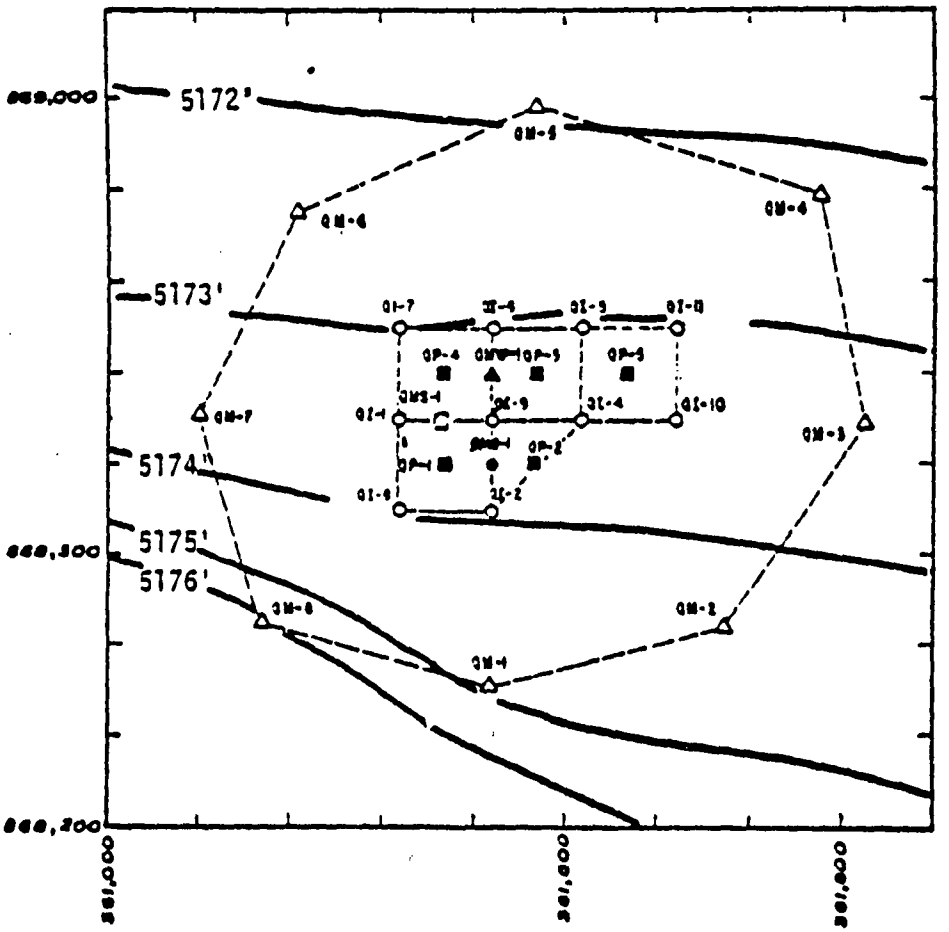
APPROXIMATE WELL LOCATION (See Table 2.2.02 for well data)

STATE — SURFACE OWNER

PROPERTY LIMITS

K/M — MINERAL OWNER OR LESSEE

Figure 2.2.07 IN SITU R&D PROJECT WELL PATTERN
"Q" SAND DEPOSIT
SECTION 36-T36N, R74W
CONVERSE COUNTY, WYOMING



LEGEND

- ■ Production Well QP
- ⬡ Injection Well QI

Monitor Wells:

- △ "Q" Ore Zone (QM-1 → 8)
- ▲ "W" Shallow Zone (QMW-1)
- □ "S" Shallow Zone (QMS-1)
- ● "O" Deep Zone (QMO-1)

—5172— WATER LEVEL ELEVATION ABOVE MSL
(Q Ore Zone Aquifer, 1980)

N

SCALE 1" = 200'

TABLE 2.2.03

"Q" SAND AQUIFER PROPERTIES
Q-SAND PILOT PROJECT

Well Number	Q-Sand Transmissivity (T, gpd/ft) Drawdown	Recovery	Q-Sand Thickness (m, feet)	Permeability (P=Tav/m, gpd/ft²)	Q-Sand Storativity (dimensionless)	r /b	p'/m' [gpd/ft²/ft]	m' ft	p' gpd/ft²	ft/yr	cm/sec
QI-2	770	1472	21		$7x10^{-5}$, $6.6x10^{-8}$	0.3, 0	.0028	40	.1	5.7	$5.6x10^{-6}$
QI-7	798	722	27		$7x10^{-5}$, $4.3x10^{-8}$	0.3, 0.3	.0029, .0026	40	.12,.10	5.8, 5	$5.6x10^{-6}$, $5x10^{-8}$
QI-11	912	1007	50		$8x10^{-8}$, $4.5x10^{-8}$	0.3, 0.3	.003, .0036	40	.13,.15	6,7.3	$6x10^{-8}$, $7x10^{-8}$
Representative Values		950	30	32	$6x10^{-5}$		.003	40	.01	6	$6x10^{-6}$

(1) Based on the thickness of the "R" Shale from Cross Sections (Figures 2.2.04 and 2.2.05).

Early drawdown and recovery data from the "Q" sand observation wells were matched to the Hantush leaky type curves ($r/B=0.3$) while later data indicated the presence of a low flow boundary. Analysis of the early data, which were analyzed assuming no water released from storage in the aquitard, indicates that the vertical permeability of the overlying "R" shale may be around 6 ft/yr (6×10^{-6} cm/sec). Although water probably was released from storage in the aquitard, the results of the pump test analysis completed are believed to be representative of the hydrogeologic properties of the Q-aquifer and the "R" confining unit. Analysis of the later data indicate the presence of at least one barrier or low flow boundary, located approximately 350, 400, and 430 feet away from observation wells QI-2, QI-7, and QI-11, respectively. Thinning of the "Q" sand aquifer to the south and west of the well field could account for the barrier boundary that was observed (see Figures 2.2.04 and 2.2.05 and Appendix B, Figures B-1 and B-2).

Water levels in the overlying and underlying S and O sand aquifers were monitored in wells QMS-1 and QMO-1, respectively. Water levels in these observation wells did not fluctuate during pumping from the "Q" ore zone aquifer, demonstrating that there is confinement of the ore zone from the surrounding aquifer units. Water level data from these wells are plotted in Figure B-3 of Appendix B.

Analyses of the aquifer pump test data indicate that the vertical permeability of the "R" confining shale unit (assuming that water flowed down through the "R" shale and not up through the "P" shale based on vertical hydraulic gradients) is around 6 ft/yr (6×10^{-6} cm/sec). Laboratory permeability tests conducted by Kerr-McGee on plugs taken from cored sections of the R and P shales indicated permeabilities of less than 5×10^{-4} ft/yr (4.7×10^{-10} cm/sec).

The NRC staff believes that the vertical permeability of the R and P shales is not as low as 5×10^{-4} ft/yr (4.7×10^{-10} cm/sec), based on: (1) the analyses of the aquifer pump test data, (2) values for permeability cited in the literature (5×10^{-4} ft/yr to 5 ft/yr for shale, Walton, 1970), and (3) the fact that most laboratory permeability tests generally indicate permeabilities that are much lower than in the field.

Realizing that some of the recharge that was observed during the early part of the aquifer pump test could have come from waters released from storage in the aquitard, and not waters "leaking" down from the S aquifer through the R shale, then a vertical permeability of 6 ft/yr may be conservative (slightly high). However, taking into account all of the information presented, the NRC staff believes that the vertical permeability of the R and P shales is low and ranges from around .06 ft/yr (6×10^{-8} cm/sec) to 6 ft/yr (6×10^{-6} cm/sec).

Based on the hydrogeologic information obtained at the site, confinement of the "Q" sand aquifer appears to be adequate.

The potentiometric water level elevations of the W,S,Q, and O sand aquifers are each distinct at the site and measure approximately 5370 feet, 5240 feet, 5168-5174 feet and 4955-4962 feet above mean sea level, respectively. Although water levels in the O aquifer have been affected by underground mine dewatering, it appears that the natural vertical hydraulic potential decreases with depth.

The lateral hydraulic gradient in the Q sand is estimated to be around .01 ft/ft in a north-northeasterly direction (see Figure 2.2.07).

Based on the water quality data collected, groundwater samples taken from 23 wells in the Q sand zone (ore zone) indicate that in all of these wells the water quality in the Q sand aquifer exceeds EPA drinking water standards for radium, and in some cases in total dissolved solids, pH, selenium, iron, cadmium, manganese, boron, and sulfate. The pH tends to be high and radium, selenium, and TDS appear to be the primary constituents found in the Q-Sand Aquifer. Appendix A lists baseline water quality data collected from the ore zone monitor wells, the shallow W sand aquifer monitor well, and the overlying S and underlying O - Sand aquifer monitor wells. The W sand aquifer water quality is good, with TDS around 265 ppm and with concentrations of selenium and radium only slightly in excess of EPA drinking water standards. The underlying O-Sand aquifer water is fairly good, and although it is high in TDS, it only slightly exceeds EPA drinking water standards for radium and chromium. The overlying S-Sand aquifer is slightly better than the O-Sand aquifer water, although it too at times exceeds EPA drinking water standards for TDS, radium, and chromium.

Proposed groundwater restoration target values will be submitted by Kerr-McGee to the NRC for review and approval by the NRC prior to lixiviant injection.

2.2.2 Confinement of the Ore Zone

Hydrologic confinement of the ore zone, with respect to in situ operations, is necessary to assure an efficient and environmentally safe in situ leaching operation. The lithologic nature of the shales, the results of the aquifer pumping test and lab permeability tests and the fact that the hydraulic potentials and water quality of the W, S, Q and O aquifers are unique for each aquifer demonstrate that the Q sand zone (ore zone) is isolated from the other aquifers. The Q sand aquifer is separated from the O, S, and W sand aquifers by approximately 40 to 60 feet-thick each, laterally continuous P, R, and T shale zones, respectively.

The vertical permeability of the shale confining units is probably around .6 ft/yr (6×10^{-7} cm/sec). Because the ore zone and surrounding aquifers are isolated by these shale beds and because the well field will be operated in such a way that the net withdrawals shall exceed injection (producing a potentiometric depression in the ore zone in the well field), lateral or vertical excursions are not expected to occur at the "Q" sand project site. Careful monitoring of the potentiometric pressures and water quality of the aquifers adjacent to and in the ore zone, during the R&D well field operations (see Section 5.1.2 for details of the hydrologic monitoring plan) will ultimately demonstrate the degree of confinement of the Q sand (ore zone) prior to any well field expansion beyond the R&D test site.

3.0 PROCESS DESCRIPTION

3.1 IN SITU LEACHING PROCESS

In situ leaching of uranium is a recent addition to the list of conventional mining methods currently used to extract uranium in Wyoming. Basically, in situ leaching involves (1) the injection of a leach solution (lixiviant) into a uranium-bearing ore body to complex the contained uranium, (2) mobilization of the uranium complex formed, and (3) surface recovery of the solution bearing the uranium complex via production wells. Uranium is then separated from the leach solution by conventional milling unit methods (ion exchange).

There can be many environmental advantages to in situ leaching of uranium. While the conventional extraction of minerals produces significant impact on the environment, if hydrogeologic conditions are favorable, the impacts of solution mining are much less. The greatest impact of in situ extraction is to ore zone groundwater quality which, in most instances, can be restored to near baseline quality or the pre-mining quality use or potential use category. Compared with the conventional uranium mining and milling operations, in situ leaching will also permit economical recovery of deep, low-grade uranium deposits, thereby enhancing the nation's uranium reserves. The extent to which in situ mining can be conducted is limited in that the ore zone conditions must be suitable for containing and controlling leach solutions during the mining process (conditions described in Section 3.2).

3.2 THE ORE BODY

At the "Q" Sand Project site, the ore sandstone contains roll-type uranium deposits which are generally associated with fluvial sandstones and conglomerates. The mineral in the ore is concentrated by a uranium rich, oxidized groundwater moving down the hydrologic gradient into a reducing environment in a host sand. Uranium is precipitated along the interface of the oxidized groundwater and groundwater in the reduced environment. The interface is referred to as the oxidizing front. The physical shape of an ore roll (ore zone) is dependent on the local permeability of the matrix material and its continuity and distribution in the geologic unit. Such ore bodies are prevalent in most of the established uranium mining districts in the western United States. In situ leaching, however, can be conducted only on those ore deposits that meet certain criteria. These generally include: (1) the ore deposit must be located in a saturated zone, (2) the ore deposit must be confined both above and below by confining layers of low permeability, (3) the ore deposit must have adequate permeability, and (4) the ore deposit must be amenable to chemical leaching.

The ore of the "Q" sand zone at the "Q" Sand Project Site" appears to have been deposited as described above and is believed to have the characteristics necessary to allow in situ leaching of uranium. The ore has been determined to be of low to medium grade. Borings taken at the site show the ore zone to be saturated. The aquifer pumping test conducted in April, 1981 indicates that the ore zone permeability is adequate and that the deposit is amenable to

chemical leaching. As discussed in Section 2.2, the ore zone is confined and leakage should not be significant at the site. The capacity of the aquitards to confine lixiviant movement to the ore zone will be verified during the R&D testing, as described in Section 5.1.2.

3.3 WELL FIELD AND RECOVERY PLANT DESIGN AND OPERATION

The R&D well field at the Kerr-McGee "Q" Sand Project site is expected to include 15 leaching wells, and 11 monitor wells both near and in the well field, (Figures 2.2.07 and 3.3.01). However, if the performance of the pilot project indicates closer well spacing is needed, additional wells may be drilled. The leaching wells in the initial program will be drilled to a depth of around 525 feet on a conventional five-spot pattern with a spacing of approximately 100 feet between like wells (see Figure 2.2.07). Eight Perimeter monitor wells will be completed in the "Q" sand around the test site. Monitor wells will be completed in each of the aquifers above (S-sand) and below (O-sand) the "Q" sand within the well field area, and one is completed in the upper W-sand aquifer.

The well field site is located about 1500 feet south of Kerr-McGee's Bill Smith Mine shaft, in Section 36, T36N, R74W. The recovery plant will be connected to the well field header building by buried pipelines (see Figure 3.3.01).

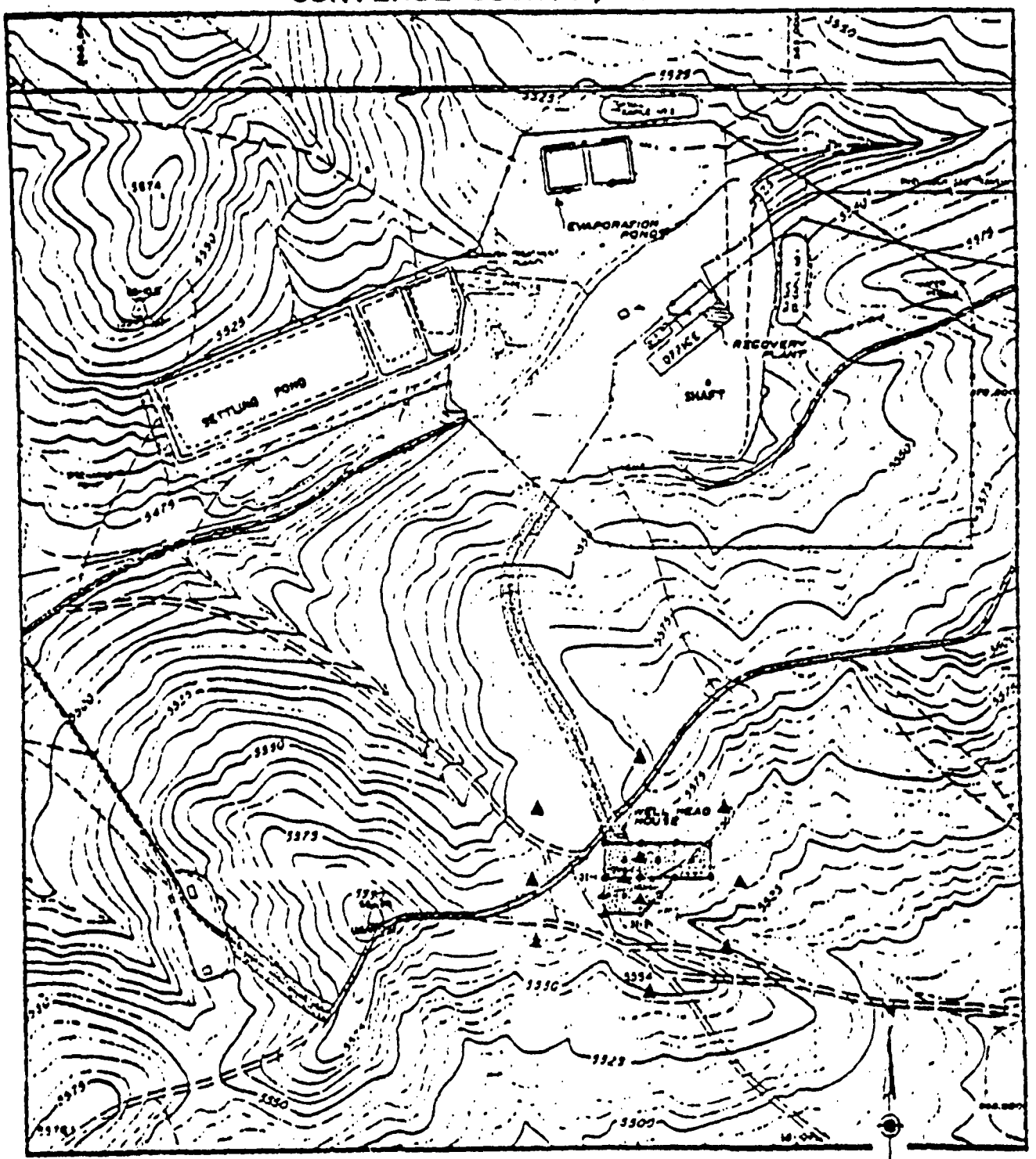
All wells will be drilled to the specified depth, cased with fiberglass, and cemented with a sufficient volume of cement to isolate the completion interval from all other aquifers. Typical well completions are illustrated in Figure 3.3.02. Data on well elevations, depths, and completion intervals for wells already drilled in the test area are listed in Tables 2.2.02 and 2.2.02(a). A small header building will be installed near the well field to house the individual well metering and control facilities to protect them from the weather. The individual flow lines will be buried and the well heads will be covered with insulated boxes to prevent freezing in the winter months.

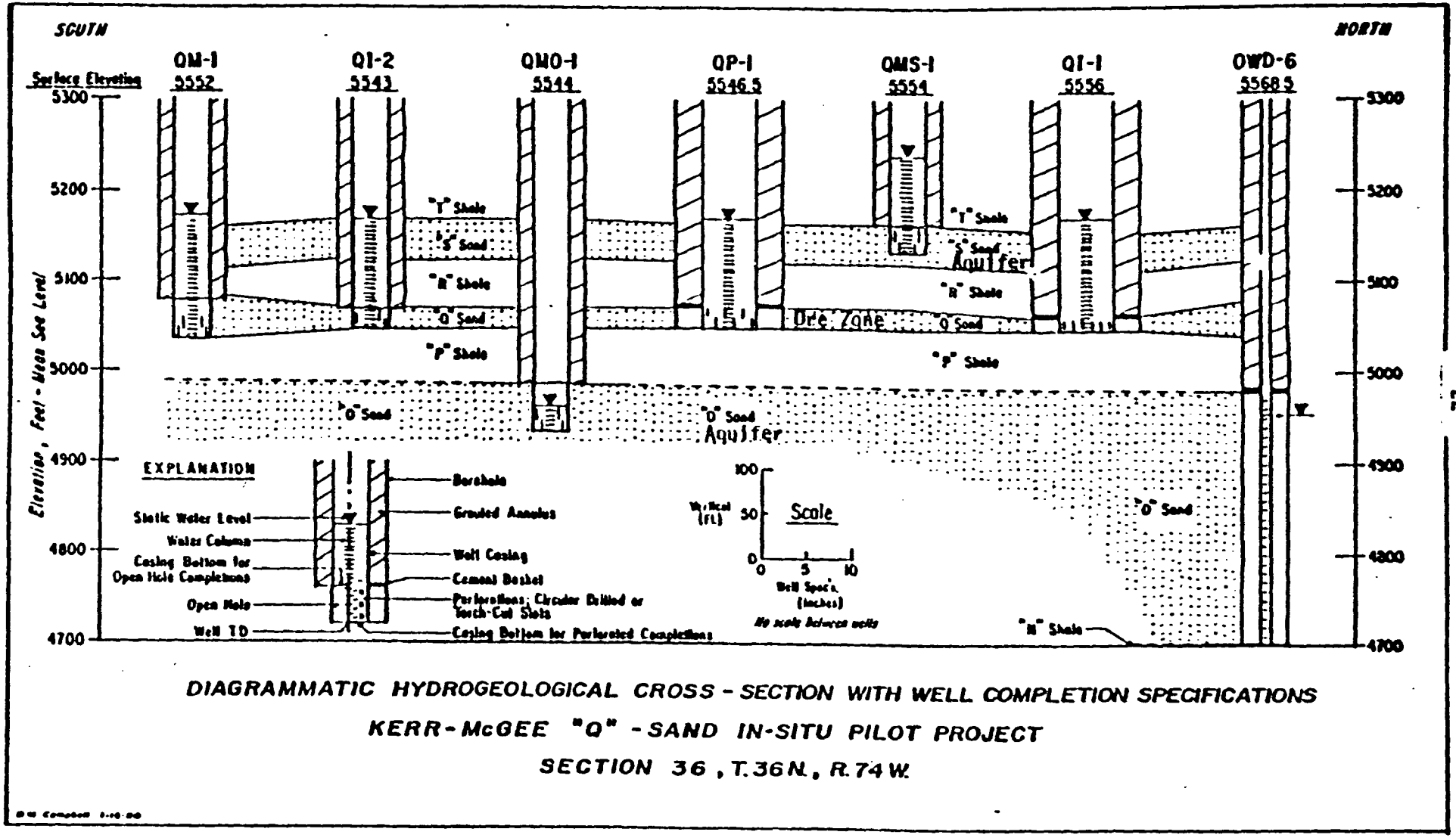
The injected fluid will be a sodium carbonate-sodium bicarbonate leach solution with hydrogen peroxide and/or oxygen added. The combined sodium-carbonate/sodium-bicarbonate concentration in the injected solution will be maintained at less than five grams per liter and the hydrogen peroxide concentration will be less than one gram per liter. It is expected that sodium carbonate or sodium hydroxide and carbon dioxide will be used to produce the sodium bicarbonate onsite.

The produced fluid will be pumped from the well field through buried pipelines to the uranium recovery facility to be constructed at the existing Bill Smith mine site. At the recovery plant, the uranium will be removed by solid resin ion exchange and the necessary chemicals (see Figure 3.3.03) will be added to the barren fluid to return it to the desired concentration. The fluid will then be reinjected in the leach zone to recover additional uranium. The production and injection rates will be metered and controlled to ensure that the groundwater flow in the area is toward the leach test area. A system

Figure 3.3.01

LOCATION OF Q-SAND PILOT WELL FIELD AND RECOVERY PLANT SOUTH POWDER RIVER BASIN SECTION 36 - T.36N., R.74W. CONVERSE COUNTY, WYOMING





DIAGRAMMATIC HYDROGEOLOGICAL CROSS - SECTION WITH WELL COMPLETION SPECIFICATIONS

KERR-McGEE "Q" - SAND IN-SITU PILOT PROJECT

SECTION 36, T.36N., R.74W.

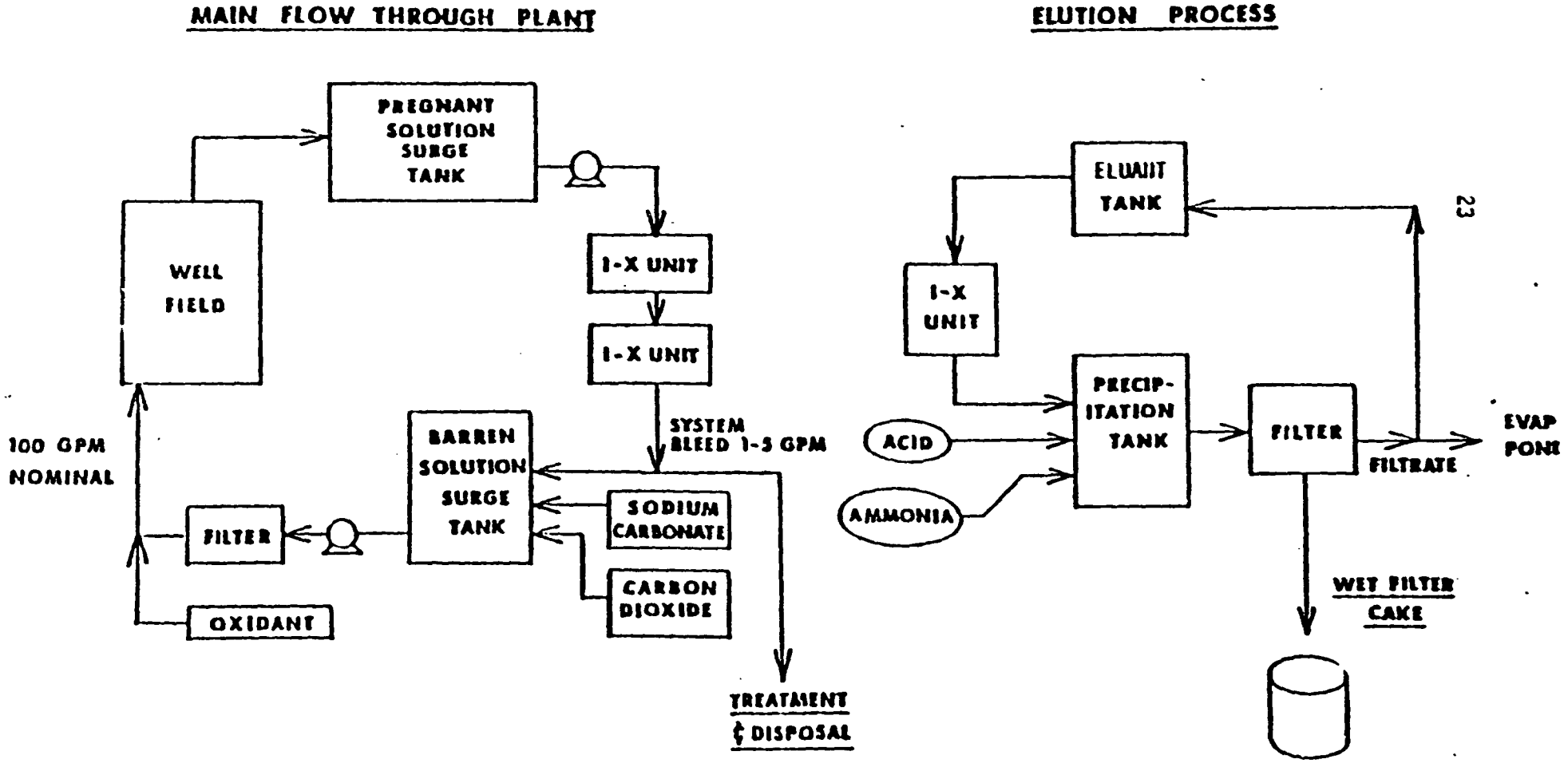
Figure 3.3.02 WELL DESIGN

FIGURE 3.3.03

SCHEMATIC FLOW DIAGRAM

SOLUTION MINE PROCESS PLANT

KERR-McGEE "Q" SAND PROJECT



bleed of one to five gpm is expected to be sufficient to provide the necessary control.

The restoration of the groundwater in the mining zone after completion of the chemical mining phase will in itself be a R&D effort to determine the most effective way to accomplish the restoration. Restoration technology is currently in the development stage and one or more combinations of existing methods will be utilized to reduce the concentration of any contaminants remaining in the groundwater to acceptable levels.

The primary restoration technique currently proposed is to use groundwater sweeping of the pilot leach area by selectively withdrawing water from the existing production and injection wells. Natural groundwater from the aquifer(s) will flow into the leached zone thereby sweeping contaminants to the wells for withdrawal from the formation. Water withdrawn from the ore zone will be processed through the IX unit to recover any contained uranium. It will then be pumped to existing mine facilities for treatment and discharge. The discharge from the Bill Smith facility is authorized by NPDES Permit No. 0022411. In addition to the use of the groundwater sweep technique described, Kerr-McGee also plans to evaluate reverse osmosis and/or other techniques which could produce a water suitable for reinjection into the aquifer to accelerate cleanup.

Before leach solution injection commences, each injection well will be field tested to demonstrate mechanical integrity of the well casing, which will be fiberglass. During the well integrity tests, a dual packer will be placed within the casing and immediately above the well screen. The second packer will be placed immediately below the well head. Groundwater derived from another well will be discharged under pressure into the well casing between the two packers so that a pressure of around 100 psi is achieved in the well. After this pressure is achieved the well will be shut in and the psi reading on the pressure gauge will be recorded every 30 seconds for a ten minute time period. If the pressure drops by greater than 2-3 psi, the well casing will be checked for cracks or holes via down-hole TV camera or other methods. If possible, the well will be repaired and the packer test will be repeated. If any well casing leakage cannot be repaired or corrected, the well will be plugged, abandoned and reclaimed. During well field operations, injection pressures will be monitored daily and should not exceed 100 psi at the injection well heads. This will assure that fracture pressure in the ore zone, and adjacent confining layers are not exceeded.

The lixiviant used by Kerr-McGee will be sodium carbonate-bicarbonate. In the event that recovery inefficiency warrants a change in the basic lixiviant character during the R&D operation, prior application to and approval by the NRC in the form of a license amendment for such a variation will be required.

3.4 LIXIVIANT CHEMISTRY

Dissolution of the uranium ore from the sand grain host of the two subsurface ore zones will be accomplished by employing either dissolved oxygen (O_2) or hydrogen peroxide (H_2O_2) as the oxidizing agent in a solution of formation

water and sodium carbonate-bicarbonate (Na_2CO_3 - $NaHCO_3$) leachant solution (lixiviant). The sodium carbonate-bicarbonate will be introduced into circulating water from the ore zone aquifer along with measured amounts of oxidant and pumped back into the ore zone. The anticipated production flow rate from the well field will not exceed 100 gpm.

3.5 URANIUM RECOVERY PROCESS

The uranium, mobilized as a carbonate-complex will be produced from the well field pattern and will be directed, at a flow rate less than the maximum plant capacity of 100 gpm, to ion exchange columns housed in a semi-mobile recovery plant. There the extracted uranium will be absorbed by the ion exchange medium and eluated with a sodium chloride (NaCl) - sodium carbonate (Na_2CO_3) solution. The resulting uranium rich eluant will be acidified with hydrochloric acid (HCl) to release the uranyl ions (UO_2^{++}) to the solution. Uranium will then be precipitated with hydrogen peroxide (H_2O_2) in the form $UO_4 \cdot nH_2O$. The precipitate will be thickened, forming a yellowcake slurry which will be transported to a nearby mill for drying and packaging or shipped as a wet product to an uranium processing plant. All yellowcake shipments will be made in compliance with applicable regulations. A block flow schematic for the recovery plant is shown in Figure 3.3.03. The barren effluent from the absorption column will be reconstituted with sodium carbonate-bicarbonate and oxidant and reinjected to the ore zone at the well field. Composition of the waste stream and flow rates from various operation steps to the evaporation ponds are given in Table 3.5.01.

3.6 DESCRIPTION OF PROCESS PLANT, PONDS AND WASTES

3.6.1 The Process Plant

The solution processing equipment, laboratory, showers, restroom and office space will be located as shown in Figure 3.6.1.01.

3.6.2 Solar Evaporation Ponds

The two solar evaporation ponds will occupy approximately 0.65 acres and shall be used for temporary disposal of solid and liquid wastes from the processing. The ponds will be located on a portion of the Bill Smith mine site already disturbed by previous operations. The ponds shall be constructed by excavation of approximately 1500 cubic yards of earth. The capacity of each pond, allowing for two feet of freeboard, will be approximately 200,000 gallons (Figure 3.6.2.01). The ponds will be partially excavated below existing grade and partially above grade, retained by embankments having interior and exterior slopes of 2.5H:1V. The depth from the embankment crest to the pond bottom will be 8 feet. The maximum water level elevations of effluent in the ponds will be aroun' 5515 feet above mean sea level, maintaining the levels well below the pond capacity with a minimum of two feet of freeboard.

Each pond shall be constructed with a liner of 30 mil impervious reinforced Hypalon, and a leak detection system consisting of a 2 inch diameter PVC pipe

TABLE 3.5.01

EXPECTED SOURCES OF WASTE LIQUIDS
ROUTED TO THE EVAPORATION PONDS
KERR-MCGEE Q SAND IN SITU R&D PROJECT
CONVERSE COUNTY, WYOMING

The anticipated waste water volumes that will result from the various process steps and the expected range of concentrations of the major ions or ions of concern in each of these streams are as follow:

Process Step	Volume	Ion	Concentration	
IX Resin Rinse	200 GPD*	Na	15,000-25,000	ppm
		NH_4	500- 1,000	ppm
		Cl	30,000-40,000	ppm
		HCO_3	8,000-12,000	ppm
		U	5-10	ppm
		Ra 226	50-100	pCi/l
Excess Eluant	20 GPD	Na	2,500- 2,500	ppm
		NH_4	20,000-30,000	ppm
		Cl	50,000-60,000	ppm
		HCO_3	200-300	ppm
		U	10-20	ppm
		Ra 226	50-100	pCi/l
Yellowcake Wash	40 GPD	Na	600- 1,000	ppm
		NH_4	5,000-10,000	ppm
		Cl	15,000-20,000	ppm
		HCO_3	200-300	ppm
		U	5-10	ppm
		Ra 226	30-40	pCi/l
Sump Liquids	50 GPD	Na	2,000- 3,000	ppm
		NH_4	3,000- 4,000	ppm
		Cl	6,000- 8,000	ppm
		HCO_3	1,000- 2,000	ppm
		U	5-10	ppm
		Ra 226	20-30	pCi/l

*Gallons per Day

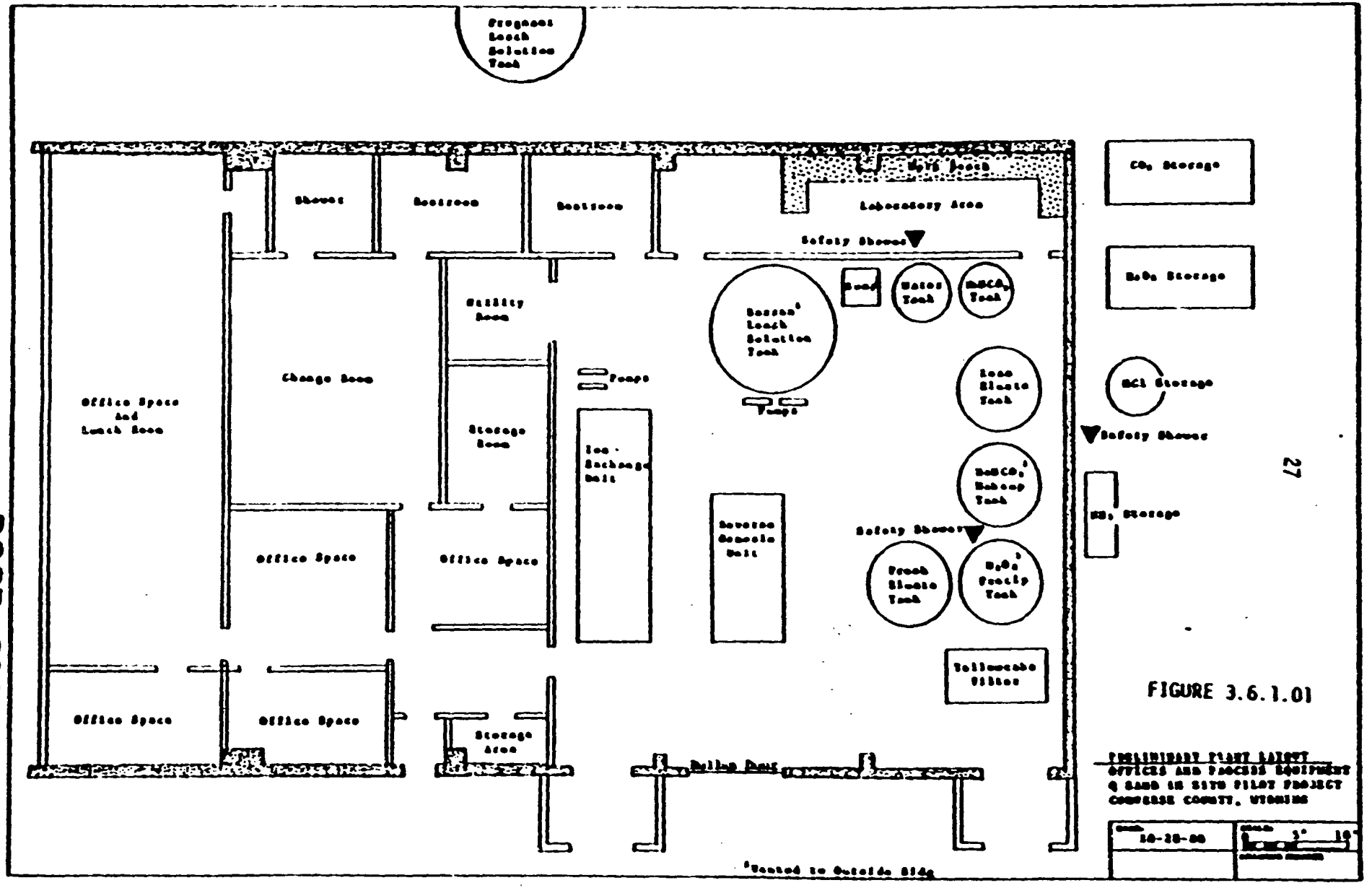
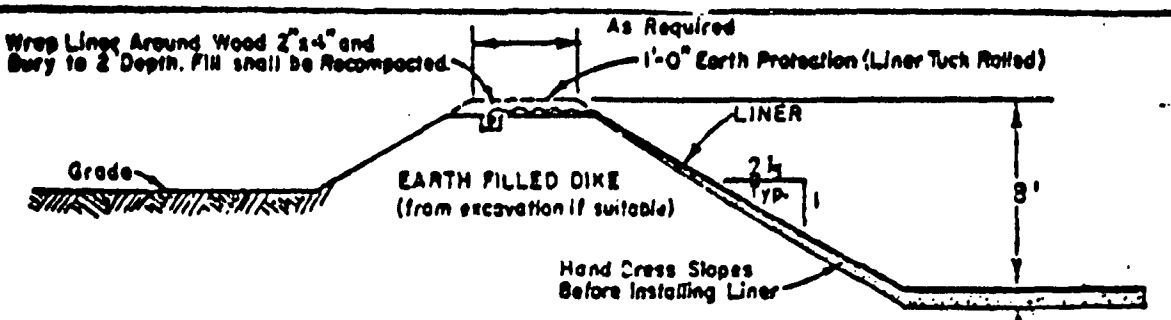


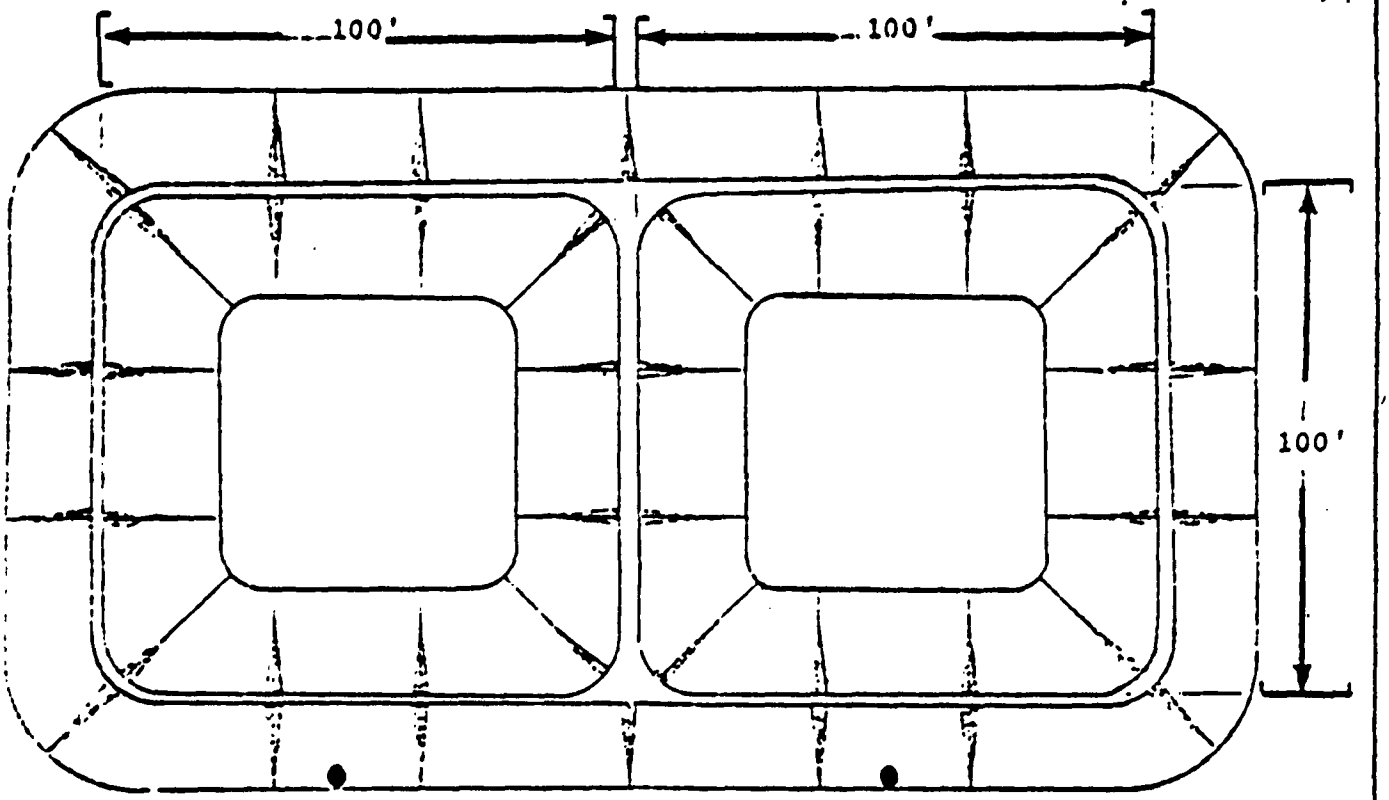
FIGURE 3.6.1.01

PRELIMINARY PLANT LAYOUT
OFFICES AND PROCESS EQUIPMENT
Q SAND IN SITU PILOT PROJECT
CONVERSE COUNTY, WYOMING

10-28-88



TYPICAL EMBANKMENT CROSS SECTION
NO SCALE



PLAN VIEW

● SUMP LOCATION FOR LEAK DETECTION

CROSS SECTION

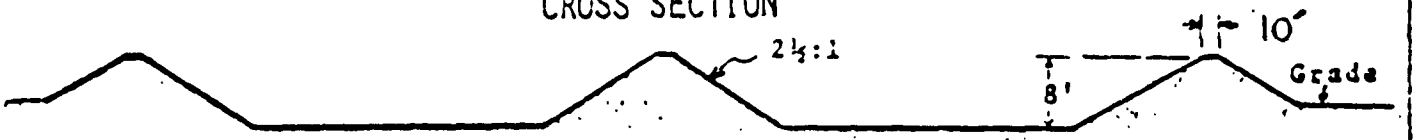


FIGURE 3.6.2.01

DRAWN	DATE	SOLAR EVAPORATION POND SOUTH POWDER RIVER BASIN, WYOMING	SCALE AS NOTED
APPROVE			DRAWING NUMBER

laid in a depressed trench at the lowest point (center line) of the pond bottom which slopes toward the center at 3 degrees. A 6-inch sand bedding layer will be placed below each pond floor liner, and in the trenches for securing the liner at the surface. Collector pipes will lead to sumps, one for each pond, thereby providing two independent leak detection systems.

Discharges to the pond will be sampled monthly for calcium, chloride, alkalinity, sodium, TDS, radium-226, sulfate, uranium, selenium, arsenic, gross alpha and gross beta. The leak detection system stand pipes will be checked daily to insure the pond liner is not leaking. Any water taken from the leak detection system will be analyzed for chloride and TDS to determine if the pond is leaking. If chloride or TDS exceed Wyoming drinking water standards the water will be analyzed within 48 hours thereafter for all of the 12 constituents listed above. Water quality samples taken at the standpipes will continue to be sampled every seven days or more frequently, if conditions warrant it, during any leak period, and two weeks following repair if any residual liquid is in the standpipes. If the leak is significant and conditions warrant it (i.e. large losses of very poor quality waste water to the subsurface) the NRC may, at that time, require the construction, pumping, and sampling of wells. The NRC will be notified immediately if fluid found in the standpipe exceeds Wyoming drinking water standards for any of the parameters tested. Kerr-McGee will take corrective action in the case of a leak, such as transferring the liquid waste to another pond and repairing the leak. Kerr-McGee will always maintain sufficient freeboard to allow for pumping the contents of one pond into the other in the event of a major leak. Kerr-McGee will be required to file a report describing the action taken to stop the leak and the results of that action. This report will be filed with the NRC within thirty (30) days of first notifying the NRC of the leak.

3.6.3 The Wastes

The liquid wastes from the system will be the one to five gallons per minute bleed stream, excess resin rinse and elution water, yellowcake wash, sump liquids, and the liquids produced during aquifer restoration. Waste liquids with high total dissolved solids such as the excess eluant will be routed to the evaporation ponds for disposal. The bleed stream and water from the groundwater sweep during restoration will be treated as necessary and discharged under the authorization and conditions of Kerr-McGee's NPDES permit. The total volume of liquid wastes over the project life is expected to be between 30 and 50 acre feet.

The solid wastes generated by the program will be waste materials such as rags, trash, and packing material and the solids remaining in the evaporation ponds after the waste liquids have evaporated. The nonradioactive wastes will be disposed of in the Bill Smith mine's existing waste disposal facilities. The solids remaining in the evaporation pond and the synthetic liner will be disposed of in a licensed mill tailings disposal facility.

3.7 GROUNDWATER RESTORATION, RECLAMATION AND DECOMMISSIONING

3.7.1 Groundwater Restoration

Restoration is defined as the returning of affected groundwater to its baseline condition or to a condition consistent with its premining use (or potential use) upon completion of leaching activities. Restoration is intended to reduce the concentration of toxic contaminants remaining in the groundwater to acceptable levels.

Kerr-McGee proposes to use groundwater sweeping as the method of restoration at the "Q" Sand Project site. Groundwater sweeping involves pumping of contaminated groundwater from the mineralized zone which then causes surrounding, uncontaminated groundwater to flow to the affected area. The volume of water expected to be produced during reclamation of the pilot area is about 30 acre-feet. This is based on a 25-foot thick ore zone, 30% porosity and replacement of four pore volumes during the restoration cycle. If the production of six pore volumes are necessary during restoration, the total withdrawal will be about 45 acre-feet. After the aquifer reclamation is completed, no significant long-term environmental impact to the groundwater is expected. If restoration criteria cannot be met otherwise, water will be recirculated through the well field with filtering by reverse osmosis. Restoration by groundwater sweeping has been effective at other R&D projects.

The restoration criteria of the groundwater at the "Q" Sand Project site has not yet been set by the Wyoming Department of Environmental Quality, Land Quality Division. Criteria are established on a well by well and parameter by parameter basis, all parameters being returned to as close to baseline as is reasonably achievable. In any case, the water must be returned to the pre-mining use standard, where baseline for the parameter is below a specific water-use standard to start with. Restoration criteria must be set and must be approved by the NRC prior to injection of lixiviant. At least sixty (60) days prior to termination of mining activities, when injection of lixiviant ceases, the licensee shall file, with the NRC, a specific plan for groundwater restoration including monitoring during and after restoration at the test site.

Restoration in each well field will begin within (60) days after leaching operations are completed. Restoration efforts will continue until the NRC finds that all parameters meet the restoration water quality criteria. Kerr-McGee will continue to monitor the restored area for at least four (4) months after completing restoration efforts, to assure stabilization of the groundwater at or below the prescribed restoration levels.

3.7.2 Reclamation and Decommissioning

At the completion of all leaching and restoration activities, Kerr-McGee will decommission the recovery facilities and reclaim all land affected by leach operations.

At the termination of the operation, all structures such as tanks, buildings, and foundations will be removed and all remaining disturbed areas will be reclaimed in accordance with the regulations of the Wyoming Department of Environmental Quality. All wells will be plugged with cement and/or other approved material and the casing will be cutoff two feet below the surface. Any solids remaining in the evaporation pond will be removed and disposed of in a licensed mill tailings pond. The evaporation pond sites will be leveled and contoured to blend with the natural terrain, covered with topsoil, and revegetated. If it is decided to expand the pilot operation into a commercial scale operation, the reclamation would be deferred and completed as per the approved plan for the commercial scale operation. A bond for the total amount of the estimated reclamation costs will be posted with the Wyoming Department of Environmental Quality, Land Quality Division, to ensure funds are available for the reclamation program.

4.0 EVALUATION OF ENVIRONMENTAL IMPACTS

4.1 INTRODUCTION

In situ leaching of uranium is a relatively new and developing technology. Major human health and environmental concerns with this technique of mining are the potential impacts of mining on groundwater quality, the impacts of evaporation pond leakage, if it were to occur, radiological impacts, and disposal of wastes.

4.2 GROUNDWATER IMPACTS

4.2.1 Excursions

Excursions of contaminated groundwater in a well field can be due to improper balances between injection/extraction rates, undetected high permeability strata or geological faults, improperly abandoned exploration drill holes, discontinuity and unsuitability of the confining units to prevent movement of lixiviant out of the ore zone, cracked well casings and faulty well construction and hydrofracturing of the ore zone or surrounding units. Based on the information previously discussed and operational controls to be implemented, none of the above are expected to be a problem. Past experience from other R&D leaching projects and commercial scale in situ leach projects indicates that if proper steps are taken in monitoring and operating the well field, excursions, if they occur, can be controlled and damage to the environment prevented. Though past experience cannot predicate the future, there are two reasons to conclude that if excursions do occur at the Kerr-McGee "Q" Sand Project Site, they will be controlled and impact minimal.

1) Compared to full scale operations, the size of the well field and the expected quantity of contaminating fluid injected into the ore zone (both variables relate to the potential to mitigate excursions) at an R&D operation are very small. Since in the past, excursions have been effectively controlled in large, full scale operations by increasing the negative potentiometric pressure in the well field, it is expected that excursions, if they occur, can be controlled at Kerr-McGee's small R&D well field in the same manner.

2) The monitoring program at the Kerr-McGee "Q" Sand Project well-field, as described in Sections 5.1.1 and 5.1.2, monitors water quality in the ore zone and adjacent aquifers and will provide early detection of any lateral and vertical excursions.

4.2.2 Evaporation Pond Seepage and Spills

Accidental leaks from the evaporation ponds could, if uncontrolled, contaminate shallow aquifers and locally reduce groundwater quality. The proper installation of impermeable synthetic bottom liners in the solar evaporation ponds should eliminate such seepage. Furthermore, if a pond leak were to develop, the monitoring program described in Sections 3.6 and 5.1.3 should allow for early detection and repair of the leak thereby minimizing the impacts and the quantity of leakage. Additionally, the depth to the shallowest aquifer is large (approximately 190 feet to the "W" aquifer) relative to the small quantity of pond leakage, should it occur. This provides additional protection to the groundwater. The use of impermeable pond liners, quality control during liner installation, the leak monitoring and repair program, and the large depth to the shallowest aquifer, will minimize the impact of any pond leaks on groundwater quality.

Spills from the evaporation ponds resulting from dam failure could result in unacceptable contamination of surface and groundwater. However, since pond effluent water levels will be kept at an elevation of approximately 5515 feet above mean sea level, or less, and the minimum acceptable freeboard from the top of the berms to the ponds' free water surfaces will be two (2) feet, as described in Section 3.6.2, spills from the evaporation ponds are unlikely.

4.2.3 Restoration of Groundwater

Groundwater restoration will include groundwater removal from the ore zone and any other zones contaminated by lixiviant migration. This may, if necessary, be followed by treatment to remove contaminants from ore zone water, with subsequent reinjection of the treated groundwater. Past experience has shown that restoration of groundwater to premining conditions is feasible. The staff believes that Kerr-McGee's proposed groundwater restoration plan, as described in Section 3.7.1, is suitable, and that the groundwater quality impacts of in situ operations at the "Q" Sand Project site will be minimal. The specific plan will be submitted to the NRC at least 60 days prior to termination of mining activities, for NRC review and approval. This is included as a license condition.

4.3 RADIOLOGICAL IMPACTS

4.3.1 Introduction

Estimates of radiation doses from the operation and the steps taken by Kerr-McGee to minimize doses will be considered in this section. Individuals living in the area may be potentially exposed to minor amounts of airborne radionuclides and deposition of radioactive material on the land surface or in groundwater.

4.3.2 Offsite Impacts

The release of airborne radioactive particles to the atmosphere from this in situ operation are substantially lower than those occurring at a conventional uranium mining-milling operation, since only solutions are brought to the surface during mining and there is no drying of the product. Radon will be released from leach solutions and vented from the building to the atmosphere. Because these releases will be very small and the nearest permanent residence is the Vollman Ranch, approximately 4.5 miles from the site, (the nearest part-time residence is approximately 2 miles south of the site), there will be no significant radiological impacts offsite. More specifically, based on comparison of this project (size, location of residents) with other in situ cases where exposures have been calculated (that is, NUREG-0489), exposures should be well below allowable limits of 10 CFR 20 and 40 CFR 190).

Additionally, Kerr-McGee will have to conduct an environmental monitoring program that will evaluate the concentrations of radionuclides in the environment that could lead to offsite exposures (See Section 5.2). The staff considers that the environmental monitoring program will be sufficient to evaluate the radiological impact of the in situ leach operations at the "Q" Sand Project Site.

4.3.3 In-Plant Safety

Kerr-McGee will establish and conduct an in-plant radiation safety program. The staff, through license conditions, is requiring a program that contains the basic elements required for, and found to be effective at, other source material extraction operations to assure that exposures are kept as low as reasonably achievable (ALARA). The scope of the program has been geared to account for the small size of the proposed R&D project. In general, the program will include the following:

1) airborne and surface contamination sampling and monitoring;

2) personnel exposure monitoring;

3) qualified management of the safety program and training of personnel;

4) written radiation protection procedures; and

5) periodic audits by individuals meeting certain qualifications and frequent inspections to assure the program is being conducted in a manner consistent with the ALARA philosophy.

The staff considers the program of in-plant safety, as required by license conditions, is sufficient to protect in-plant personnel by keeping radiation doses as low as reasonably achievable. The staff evaluation of this program and the associated license conditions are contained in a Safety Evaluation Report issued in May 1981.

4.4 WASTE DISPOSAL

The NRC has taken the position in its regulations on uranium milling 10 CFR 40, Appendix A, Criterion 2, that the small volume of wastes generated at in situ operations should preferably be disposed of at existing tailings disposal sites or other licensed burial ground to avoid proliferation of waste sites. The staff will require that the solid wastes generated at the "Q" Sand Project site described in Section 3.6.3 will be disposed of at an existing licensed tailings disposal site.

4.5 SURFACE DISCHARGES

With the exception of a 1 to 5 gpm bleed stream and a 50 gpm restoration stream, all liquid discharges will be to the hypalon lined evaporation ponds. The bleed stream and restoration stream will both first be processed through the IX unit and then pass through treatment and settling ponds for radium removal prior to being discharged to an unnamed drainage in accordance with NPDES Permit No. WY-0022411.

Prior to discharge, the ~2 gpm bleed stream and ~50 gpm restoration stream will be combined with ~1700 gpm of water from the Bill Smith mine. Based on the dilution provided by this 1700 gpm flow and the fact that the NPDES limits for the combined discharge are within Wyoming drinking water standards, the impact of surface discharge of the bleed and restoration streams will be insignificant.

5.0 MONITORING

5.1 GROUNDWATER

5.1.1 Water Quality of the Well Fields

The layout of all monitor wells is shown in Figure 2.2.07. Eight Perimeter monitor wells, to monitor lateral movement of contaminants in the ore zone (Q sand), will be located approximately 200 feet from the leach area. Two shallow (in the W-sand and in the S-sand) and one deep (in the Q sand) monitor wells will be monitored within the well field area (see Figure 2.2.07). All monitor wells will be measured for water level elevations, during at least the first quarter, and sampled routinely (once every two weeks) for water quality to provide an early indication of an excursion. If an excursion does occur, the injection and production rates will be adjusted as necessary to draw the excursion fluids back to the leach area.

During mining, all wells will be sampled once every two (2) weeks and tested for the excursion indicators chloride and TDS, and once every month for the excursion indicators: alkalinity, chloride, carbonate, bicarbonate, TDS, sodium, selenium, sulfate and uranium. The long list of parameters shown in Table 5.1.1.01 will be sampled for at each monitor well and analyzed once per quarter. All monitor wells will have water level elevation measurements taken once every two (2) weeks before water quality samples are taken for at least

the first quarter. Results of all sampling will be summarized in written form and data reported both graphically and in tabular form in a quarterly report to the NRC. The upper control limits (UCLs) for each aquifer and/or well (if there is extreme variability) will be set when all of the water quality data are in. Seasonal fluctuations in the water quality will be considered, otherwise, UCLs may be set incorrectly.

TABLE 5.1.1.01
LONG LIST OF CHEMICAL PARAMETERS TO BE SAMPLED

A. Trace and Minor Elements

Aluminum	Fluoride	Radium 226
Arsenic	Iron	Selenium
Barium	Lead (Total and-210)	Thorium 230
Boron	Manganese	Uranium
Cadmium	Mercury	Vanadium
Chromium	Molybdenum	Zinc
Cobalt	Nickel	
Copper	Polonium 210	

B. Common Constituents

Bicarbonate	Chloride	Potassium
Calcium	Magnesium	Sodium
Carbonate	Nitrate	Sulfate

C. Physical Parameters

Specific Conductivity[1]	Gross Alpha[3]	Total Dissolved
Temperature[2]	Gross Beta[3]	Solids[3]
pH[1]	Appearance, color, odor[2]	

[1]Field and laboratory determination.
[2]Field only.
[3]Laboratory only.

If any two excursion parameters exceed the upper control limit (UCL) or if one excursion parameter exceeds its UCL by 20%, and is confirmed by analyses of verification samples taken within 48 hours after results of the first analyses are received, an excursion will be declared. Corrective action will be initiated and the NRC will be notified within 48 hours. The sample frequency for the affected well(s) will be increased to once every seven days for the nine constituents previously listed, until the excursion parameter value(s) is below the UCL value(s). The UCLs for the monitor wells will be established based on the baseline water quality data for the individual monitor wells.

When a well is on excursion status, the licensee will take corrective measures and the NRC, Division of Waste Management, will be notified in writing, within seven (7) days of confirming an excursion. The report filed at that time will describe the excursion, corrective actions taken and results of corrective actions. Monthly reports on the condition of the excursion will be filed with the NRC until the water quality of the affected well(s) stabilizes to acceptable levels. If corrective actions have not been effective within a reasonable amount of time (i.e., 90 days since the first excursion verification), the wellfield production shall be terminated until such time as the problem is solved.

To date, several wells in the "Q" sand, the overlying S and W, and underlying O aquifers have been sampled and the samples were analyzed for all major elements of concern. The results of some of the sample analyses indicated the wells had not been properly cleaned prior to sampling, so that additional water quality samples were taken from all of the monitor wells after cleanup operations.

Restoration water quality levels and monitor well UCL values will be submitted by Kerr-McGee to the NRC for review and approval prior to beginning leaching operations.

5.1.2 Hydrologic Monitoring

Change in potentiometric levels in the monitor wells and ore zone perimeter monitor wells may be an early indication of an excursion. Water level data will be collected at Kerr-McGee for the first quarter of operation. If the data are shown to be useful monitor criteria in the early detection of excursions, should any occur, Kerr-McGee will continue to monitor water levels over the life of the project. However, water level changes must be regarded cautiously, since they may be associated with regional changes. If the water level in a monitor well rises or falls significantly above or below the natural premining baseline levels, for that particular time period, (i.e. seasonal level), the change may be indicating inefficiency in adjustment of well field flow rates, insufficient geologic confinement and a potential excursion. At this point, Kerr-McGee shall notify the NRC, Division of Waste Management, of the condition, and take steps to alleviate the inefficiency of the well field. A report concerning the change in water level and actions taken will be provided to the NRC within thirty (30) days of first notifying the Division of Waste Management.

5.1.3 Evaporation Ponds' Leak Detection Systems

The standpipes at the evaporation ponds (as described in Section 3.6.2) will be checked daily for fluid. If any fluid is found, water in the standpipes will be analyzed for chloride and TDS. If either of these parameters exceeds Wyoming DEQ drinking water standards, then the water shall be analyzed for arsenic, calcium, chloride, alkalinity, sodium, TDS, radium-226, selenium,

sulfate, uranium, gross alpha, and gross beta. The NRC will be notified within forty-eight (48) hours if standpipe water quality exceeds Wyoming drinking water standards for any of the parameters tested. If water is found to have leaked from the pond, the pond will be repaired. If standpipe water quality exceeds Wyoming drinking water standards for any parameter, Kerr-McGee will provide a written report to the NRC within thirty (30) days detailing the cause and corrective actions taken.

5.2 ENVIRONMENTAL MONITORING

Tables 5.2.1.01 and 5.2.1.01(a) specify the preoperational and operational radiological environmental monitoring programs. Kerr-McGee will be developing background radiation data for the atmosphere, soil, and vegetation. Results of preoperational monitoring will be reported in the first quarterly report. This program should be sufficient to confirm the assumption that there will be negligible radiological impacts from the operation and to develop information to assess potential impacts from a commercial scale operation.

6.0 ALTERNATIVES

6.1 INTRODUCTION

Alternatives applicable for the Kerr-McGee "Q" Sand Project site project are not to issue the license, to mine the ore body by conventional methods or to mine by in situ extraction using another lixiviant chemistry.

6.2 NO LICENSE ALTERNATIVE

The NRC can choose not to license the "Q" Sand Project site. Such an action would not be consistent with present or past policy. United States policy has been to encourage the development of uranium resources to the extent economically and environmentally feasible to provide fuel for nuclear reactors. If Kerr-McGee was not allowed to test the "Q" Sand Project site, nuclear fuel which could be obtained from uranium at the site would not be available.

6.3 CONVENTIONAL MINING METHODS

The uranium would probably not be economically recoverable using a conventional method (that is, surface or underground mining followed by milling) rather than by in situ leaching. Surface and underground mining are generally used for high grade ores or mineral bodies close to the surface. There is generally significant disturbance of surface environments by excavation and subsidence associated with conventional mining techniques. Additionally, the milling that follows conventional mining produces large volumes of tailings wastes. The "Q" Sand Project site has neither high grade ore nor is the ore close to the ground surface (being approximately 500 feet down). In situ leach does not disturb surface environments over large areas and produces much less waste than conventional milling methods.

TABLE 5.2.1.01 - PREOPERATIONAL SURFACE RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Type of Sample	Number	Location	Method	Frequency	Type of Analysis
Radon	2	Upwind at site boundary Downwind at site boundary	Continuous or Grab[1]	Monthly or Quarterly[2]	Rn-222 [pCi/ℓ]
Soil	6	Well field Recovery plant Evaporation ponds	Grab Samples -Surface sample 0 to 5cm depth -Subsurface sample 5 to 15cm depth	Once prior to operation	U-nat, Th-230, Ra-226 (pCi/g - dry weight)
Direct gamma	40	Plant site[3]	Survey meter	Once Prior to construction	Exposure rate (μR/hr)
	28	Evaporation ponds[4]	Survey meter	Once prior to construction	Exposure rate (μR/hr)
Vegetation	6	Well field Recovery plant Evaporation ponds 1 at each of 3 sediment/soil sites	Grab sample	Once prior to operation	Ra-226 (pCi/g - wet weight)
Sediment/soil	6	Outfall from final treatment unit 2 locations in drainage way between Outfall and Sage Creek	Grab samples -Surface sample 0 to 5cm depth -Subsurface Sample 5 to 15cm depth	Once prior to operation	U-nat, Th-230, Ra-226 (pCi/g - dry weight)

See next page for footnotes

TABLE 5.2.1.01 - Continued

[1]A grab sample shall consist of at least four (4) separate forty-eight (48) hour samples using the "Tedlar Bag Method" during a period of one (1) month.
[2]Although a monthly sampling frequency is recommended a quarterly sampling frequency is acceptable where a continuous passive radon detector is used.
[3]Plant site: The survey shall be in the four (4) main compass directions centered at the recovery facility. Survey points shall be at 10 meter intervals out to 100 meters. The survey meter shall be positioned at 1 meter from the ground surface.
[4]Evaporation ponds: The survey shall be performed on a rectangular grid pattern. Survey points shall be at all intersecting lines of the grid pattern. The grid line intervals shall be 10 meters and the survey meter shall be positioned at 1 meter from the ground surface.

TABLE 5.2.1.01(a) - OPERATIONAL SURFACE RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Type of sample	Number	Location	Method	Frequency	Type of Analysis
Radon	3	Upwind at site boundary Downwind at site boundary Pregnant leach tank	Continuous or Grab[1]	Monthly or Quarterly[2]	Rn-222 (pCi/ℓ)
Direct gamma	4	At same locations used for air sampling and at evaporation pond area	Survey meter or dosimeter	Quarterly	Gamma exposure rate (μR/hr)
Sediment/soil	3	Outfall from final treatment unit 2 locations in drainage way between Outfall and Sage Creek	Grab sample	Quarterly	Ra-226 (pCi/g - dry weight)
Water	2	Outfall of final treatment unit Prior to mixture with dilutent water or receiving stream	Grab sample	Quarterly	Total Ra-226 and Total Th-230 (pCi/mℓ)

[1]A grab sample shall consist of at least four (4) separate forty-eight (48) hour samples using the "Tedlar Bag Method" during a period of one (1) month.
[2]Although a monthly sampling frequency is recommended a quarterly sampling frequency is acceptable where a continuous passive radon detector is used.

6.4 LIXIVIANT CHEMISTRY

Kerr-McGee is proposing to use sodium carbonate-bicarbonate as lixiviant for their operation. In general, the choice of lixiviant is acidic or alkaline. At a site where the groundwater is carbonate, as at the Kerr-McGee "Q" Sand Project site, alkaline lixiviant will mobilize fewer hazardous elements from the ore body than an acidic one.

Ammonia carbonate could have been used rather than sodium carbonate; however, ammonia tends to absorb to clays (making restoration difficult) and may break down into carcenogenic nitrites. Ammonia carbonate is therefore not as desirable as sodium carbonate because of the potential environmental impacts.

In general, the alternatives offer no overriding benefit and the proposed operation as conditioned by the license is, in terms of environmental protection, acceptable.

7.0 FINDING OF NO SIGNIFICANT IMPACT

Based on this environmental appraisal, the staff finds that the proposed operation will not have a significant impact on human health or the environment. The specific reasons for drawing this conclusion are:

- The control and monitoring of the groundwater is sufficient for detecting any excursion, either vertical or horizontal;
- The evaporation ponds shall be lined to eliminate seepage of waste solutions; a monitoring system below the liner should detect any leakage which may occur to assure that corrective action is promptly taken.
- Radiological releases from the uranium extraction operations will be very small (exposures which are small fractions of radiological exposure standards will result) and closely monitored to detect any problems;
- Radioactive wastes will be disposed of at an existing, NRC licensed tailings disposal site; and
- The proposed restoration and reclamation plan should be sufficient to return the land and the groundwater to its premining use (or potential use). On a parameter by parameter basis, groundwater quality will be returned to as close to baseline as reasonably achievable.

Terry D. Vandell
Uranium Recovery Licensing Branch
Division of Waste Management

Approved: _____
John J. Linehan, Section Leader
Uranium Recovery Licensing Branch
Division of Waste Management

APPENDIX A

TABLE A-1
BASELINE GROUNDWATER QUALITY PARAMETERS
KERR-McGEE Q SAND PROJECT
CONVERSE COUNTY, WYOMING

	"Q" SAND MONITOR WELLS			
mg/ℓ	Well QM-1			
Parameter	11-29-79	12-19-79	4-14-80	4-15-80
Aluminum[1]	.24	<.05	.11	.12
Arsenic	<.001	<.001	<.002	<.002
Barium	.057	.045	.05	.015
Boron	.019	.087	<.01	<.01
Bicarbonate[2]	--	--	241	241
Carbonate	--	--	--	--
Cadmium	<.1	<.1	<.1	<.1
Calcium	147	71	91	92
Chloride	9	9	6	6
Chromium	.02	<.01	<.01	<.01
Copper	<.005	<.005	<.005	<.005
Fluoride	.30	.54	.26	.26
Iron	<.01	<.01	<.01	<.01
Lead	<.05	<.05	<.05	<.05
Manganese	<.01	<.01	.021	.026
Magnesium	<.01	<.01	18	18
Mercury	<.001	<.001	<.001	<.001
Molybdenum	<.2	<.2	<.2	<.2
Nitrates (N)	.3	.2	.2	.2
Selenium	.002	.011*	<.002	<.002
Silver	<.005	<.005	<.005	<.005
Sodium	43	39	22	20
Sulfate	200	146	120	116
Zinc	<.05	<.05	.70	.65
Uranium	<.002	<.003	.079	.082
Radium-226 pCi/ℓ	5.53*	7.8*	24.9*	25.4*
pH - Std.	11.9*	11.5*	7.7	7.6
Total Dissolved Solids	518*	394	384	357

[1]Units are mg/ℓ unless noted otherwise.
[2]Some samples show high calcium and pH values due to masking from free hydroxide.
*Exceeds EPA drinking water standards.

TABLE A-1 Cont'd.

"Q" SAND MONITOR WELLS

	QM-2 7-30-80	QM-3 7-29-80	QM-4 7-29-80	QM-5 7-28-80
Aluminum[1]	.13	.11	.26	.21
Arsenic	.008	.002	.007	.009
Barium	.034	.024	.055	.037
Boron	.12	.12	.13	.54
Bicarbonate	172	227	143	204
Carbonate	ND	ND	ND	ND
Cadmium	<.01	<.01	<.01	<.01
Calcium	74	78	57	69
Chloride	8	6	6	7
Chromium	<.01	<.01	<.01	<.01
Copper	<.005	<.005	<.005	<.005
Fluoride	.35	.29	.42	.35
Iron	.03	.01	.65*	.01
Lead	<.05	<.05	<.05	<.05
Manganese	.016	.04	.028	.014
Magnesium	17	17	14	17
Mercury	<.001	<.001	<.001	<.001
Molybdenum	<.2	<.2	<.2	<.2
Nickel	<.05	<.05	<.05	<.05
Nitrates (As N)	.2	.2	.4	.2
Potassium	10	9	10	11
Selenium	.028*	.009	.008	.009
Silver	<.005	<.005	<.005	<.005
Sodium	22	27	22	22
Sulfate	136	124	126	118
Zinc	.072	.089	.18	.21
Uranium	.12	.13	.12	.31
Vanadium	.019	<.005	<.005	<.005
Total Dissolved Solids	386	412	337	380
Conductivity (umhos)	576	610	490	552
Ra-226 (pCi/ℓ)	20	17	16	218*
pH (std. units)	8.1	8.2	8.0	8.3

[1]All units are mg/ℓ unless noted otherwise.
ND - Not Detected

*Exceeds EPA drinking water standards.

TABLE A-1 Cont'd.

	"Q" SAND MONITOR WELLS			W-AQUIFER MONITOR WELL
	QM-6 7-28-80	QM-7 7-22-80	QM-8 7-22-80	QMW-1 7-30-80
Aluminum[1]	1.0	.13	.14	.12
Arsenic	.009	.004	.005	.008
Barium	.11	.017	.043	.052
Boron	<.1	<.1	<.1	.15
Bicarbonate	184	197	211	172
Carbonate	ND	ND	ND	ND
Cadmium	.042*	<.01	<.01	<.01
Calcium	62	70	76	50
Chloride	7	12	12	4
Chromium	<.01	<.01	<.01	<.01
Copper	.011	<.005	<.005	<.005
Fluoride	.32	.33	.31	.37
Iron	.29	<.01	.078	<.01
Lead	<.05	<.05	<.05	<.05
Manganese	.035	.041	.022	<.01
Magnesium	15	15	15	14
Mercury	<.001	<.001	<.001	<.001
Molybdenum	<.2	<.2	<.2	<.2
Nickel	<.05	<.05	<.05	<.05
Nitrates (As N)	.3	.3	.3	1.4
Potassium	8	8	9	6
Selenium	.001	.001	.015*	.018*
Silver	<.005	<.005	<.005	<.005
Sodium	22	23	24	15
Sulfate	125	132	125	66
Zinc	.74	<.05	<.05	<.05
Uranium	.20	.19	.08	.042
Vanadium	<.005	<.005	<.005	<.015
Total Dissolved Solids	359	396	384	265
Conductivity (umhos)	528	586	586	432
Ra-226 (pCi/ℓ)	34*	40*	56*	7*
pH (std. units)	7.9	8.2	8.2	8.1

[1]All units are mg/ℓ unless noted otherwise.
ND - Not Detected

*Exceeds EPA drinking water standards.

TABLE A-1 Cont'd.

	"Q" SAND LEACH WELLS					
mg/ℓ	Well QP-1		Well QI-1		Well QI-2	
Parameter	9-25-79	12-19-79	10-1-79	12-19-79	11-29-79	12-19-79
Aluminum[1]	.042	.19	.025	<.05	.21	<.05
Arsenic	.005	<.001	.007	<.001	<.001	<.001
Barium	.026	2.25	.017	.022	.057	.022
Boron	.4	.453	.7	2.03	.019	.100
Bicarbonate[2]	137	--	168	--	--	--
Carbonate[2]	<5	--	12	--	--	--
Cadmium	.001	<.1	<.001	<.1	<.1	<.1
Calcium	42	516	65	24	171	76
Chloride	20	61	17	25	56	5
Chromium	<.01	<.01	.11	<.01	.12	<.01
Copper	<.005	<.005	<.005	<.005	.008	<.005
Fluoride	.24	.22	.27	.32	.40	.32
Iron	<.01	<.01	<.01	.01	.01	<.01
Lead	<.05	.96	<.05	<.05	<.05	<.05
Manganese	<.01	<.01	.057	<.01	<.01	.02
Magnesium	20	<.01	19	10.8	<.01	18.9
Mercury	<.001	<.001	<.001	<.001	<.001	<.001
Molybdenum	.017	<.2	.024	<.2	<.2	<.2
Nitrates (N)	.2	.6	.2	.2	.4	<.1
Selenium	<.001	<.001	.002	<.001	<.001	<.001
Silver	<.005	<.005	<.005	<.005	<.005	<.005
Sodium	33	87	25	31	74	19
Sulfate	114	22	117	102	430	108
Zinc	.20	.95	.012	<.05	<.05	3.72
Uranium	.10	<.002	.38	.001	<.002	.010
Radium-226 pCi/ℓ	93.9	34.2	433	184	5.65	63.7
pH - (Std. Units)	7.8	12.7	8.6	8.7	11.9	7.9
Total Dissolved Solids	331	1730	386	276	673	412

[1]All units are milligrams per liter unless noted otherwise.

[2]The carbonate and bicarbonate values were masked by free hydroxide (OH^-) in the sample. Calcium and pH values were high.

·Exceeds EPA drinking water standards.

TABLE A-1 Cont'd.

"Q" SAND LEACH WELLS

mg/ℓ	Well QP-1		Well QI-1		Well QI-2	
Parameter	4-14-80	4-15-80	2-24-80	2-25-80	2-19-80	2-21-80
Aluminum[1]	.18	.18	.02	.079	.083	.073
Arsenic	.010	.006	<.002	<.002	<.002	<.002
Barium	.12	.093	.066	.034	.038	.016
Boron	.11	.06	.12	.10	.05	.07
Bicarbonate[2]	235	245	232	227	234	232
Carbonate	--	--	--	--	--	--
Cadmium	<.1	<.1	<.1	<.1	<.1	<.1
Calcium	88	91	92	92	89	82
Chloride	6	6	5	4	7	4
Chromium	<.01	<.01	<.01	<.01	<.01	<.01
Copper	<.005	<.005	<.005	<.005	<.005	<.005
Fluoride	.25	.26	.32	.31	.30	.30
Iron	<.01	<.01	<.01	.01	.01	<.01
Lead	<.05	<.05	<.05	<.05	<.05	<.05
Manganese	<.01	.018	.024	.025	.07*	.01
Magnesium	15	17	17	18	18	18
Mercury	<.001	<.001	<.001	<.001	<.001	<.001
Molybdenum	<.2	<.2	<.2	<.2	<.2	<.2
Nitrates (N)	.4	.3	<.2	<.2	<.2	<.2
Selenium	<.002	<.002	.002	<.001	<.001	<.001
Silver	<.005	<.005	<.005	<.005	<.005	<.005
Sodium	24	22	21	21	23	19
Sulfate	115	119	140	142	148	142
Zinc	.32	.25	.056	.10	.021	.045
Uranium	.15	.082	.043	.066	.023	.040
Radium-226 pCi/ℓ	769*	757*	882*	1132*	62.2*	57.9*
pH - (Std. Units)	7.8	7.6	7.7	7.6	7.8	7.9
Total Dissolved Solids	362	374	418	410	422	433

[1]All units are milligrams per liter unless noted otherwise.

*Exceeds EPA drinking water standards.

TABLE A-1 Cont'd.

	"Q" SAND LEACH WELLS					
Parameter	QP-2 8-17-80	QP-3 7-16-80	QP-4 7-16-80	QP-5 7-30-80	QI-4 8-17-80	QI-5 7-21-80
Aluminum[1]	<.05	.15	.17	.14	.18	.14
Arsenic	<.001	.004	.004	.008	.008	.006
Barium	.034	.063	.078	.090	.090	.42
Boron	.24	.23	.17	.35	.40	.17
Bicarbonate	--	221	198	206	129	184
Carbonate	9	ND	ND	ND	ND	ND
Cadmium	<.01	<.01	<.01	<.01	<.01	<.01
Calcium	24	75	65	75	31	68
Chloride	6	6	7	7	19	13
Chromium	<.01	<.01	<.01	<.01	<.01	<.01
Copper	<.005	<.005	<.005	<.005	<.005	<.005
Fluoride	.19	.32	.34	.34	.27	.34
Iron	<.01	<.01	<.01	<.01	.028	<.01
Lead	<.05	<.05	<.05	<.05	<.05	<.05
Manganese	<.01	<.01	.016	<.01	.032	<.01
Magnesium	3	15	15	15	15	16
Mercury	<.001	<.001	<.001	<.001	<.001	<.001
Molybdenum	<.2	<.2	<.2	<.2	<.2	<.2
Nickel	<.05	<.05	<.05	<.05	<.05	<.05
Nitrates (As N)	.2	.3	.3	.2	.3	.2
Potassium	11	8	8	8	34	14
Selenium	.001	.004	.002	.005	.001	.011
Silver	<.005	<.005	<.005	<.005	<.005	<.005
Sodium	24	22	23	22	34	25
Sulfate	108	132	127	126	130	130
Zinc	<.05	<.05	<.05	<.05	<.05	<.05
Uranium	.02	.21	.14	.20	.41	.14
Vanadium	<.005	<.005	<.005	<.005	.07	.032
Total Dissolved Solids	155	351	366	374	349	392
Conductivity (umhos)	--	586	538	538	--	566
Ra-226 (pCi/ℓ)	7.5*	38/*	330*	379*	56*	257*
pH - (std. units)	10.2*	6.2	8.0	8.2	8.4	8.2

[1]All units are mg/ℓ per liter unless noted otherwise.
ND - Not Detected
-- - Not Determined

*Exceeds EPA drinking water standards.

TABLE A-1 Cont'd.

	"Q" SAND LEACH WELLS					
Parameter	QI-6 7-17-80	QI-7 7-17-80	QI-8 7-21-80	QI-9 8-17-80	QI-10 7-30-80	QI-11 7-30-80
Aluminum[1]	.15	.16	.11	.18	.20	.17
Arsenic	.008	.006	.010	.003	.013	.008
Barium	.045	.062	.066	.054	.075	.063
Boron	<.1	.17	.15	.19	.15	.15
Bicarbonate	181	223	143	--	204	209
Carbonate	ND	ND	ND	4	ND	ND
Cadmium	<.01	<.01	<.01	.01	<.01	<.01
Calcium	62	77	59	72	70	28
Chloride	16	11	12	30	11	7
Chromium	<.01	<.01	<.01	<.01	<.01	<.01
Copper	<.005	<.005	<.005	<.005	<.005	<.005
Fluoride	.35	.34	.36	.33	.36	.33
Iron	<.01	<.01	<.01	.02	.11	.03
Lead	<.05	<.05	<.05	<.05	<.05	<.05
Manganese	<.01	.059*	.019	<.01	.019	<.01
Magnesium	16	18	11	8	15	15
Mercury	<.001	<.001	<.001	<.001	<.001	<.001
Molybdenum	<.2	<.2	<.2	<.2	<.2	<.2
Nickel	<.05	<.05	<.05	<.05	<.05	<.05
Nitrates (As N)	.3	.3	.2	.3	.3	.3
Potassium	10	12	11	16	9	8
Selenium	.009	.002	.010	.024*	.002	.003
Silver	<.005	<.005	<.005	<.005	<.005	<.005
Sodium	24	24	25	31	22	22
Sulfate	136	114	128	111	138	123
Zinc	<.05	.079	.093	.069	.14	.086
Uranium	.20	.09	.07	.17	1.19	.20
Vanadium	<.005	<.005	<.005	.087	<.005	<.005
Total Dissolved Solids	368	399	343	228	399	378
Conductivity (umhos)	547	595	518	--	566	557
Ra-226 (pCi/l)	260*	198*	33	30	398*	434*
pH - (std. units)	7.9	8.3	8.1	9.4*	8.3	8.3

[1]All units are mg/l per liter unless noted otherwise.
ND - Not Detected
-- - Not Determined

*Exceeds EPA drinking water standards.

TABLE A-1 Cont'd.

	"Q" SAND LEACH WELLS			"Q"-SAND MONITOR	UNDERLYING AQUIFER	OVERLYING AQUIFER
Parameter	QP-1 6-25-80	QI-1 6-30-80	QI-2 6-30-80	QM-1 6-25-80	QMO-1 7-15-80	QMS-1 6-25-80
Aluminum[1]	.063	.13	.006	.12	.094	.063
Arsenic	.002	.005	.004	.008	.006	.002
Barium	.089	.039	.12	.043	.036	.096
Boron	<.01	<.01	<.01	<.01	<.01	<.01
Bicarbonate	218	224	234	232	206	193
Carbonate	ND	ND	ND	ND	ND	ND
Cadmium	<.01	<.01	<.01	<.01	<.01	<.01
Calcium	69	58	68	74	94	51
Chloride	7	7	6	6	3	7
Chromium	<.01	<.01	<.01	<.01	<.01	.08*
Copper	<.005	<.005	<.005	<.005	<.005	<.005
Fluoride	.29	.3	.3	.29	.31	.24
Iron	<.01	<.01	<.01	<.01	<.01	<.01
Lead	<.05	<.05	<.05	<.05	<.05	<.05
Manganese	<.01	<.01	<.01	<.01	<.01	<.01
Magnesium	12	18	20	18	31	15
Mercury	<.001	<.001	<.001	<.001	<.001	<.001
Molybdenum	<.2	<.2	<.2	<.2	<.2	<.2
Nickel	<.05	<.05	<.05	<.05	<.05	<.05
Nitrates (As N)	.2	.3	.3	.3	.2	.4
Potassium	13	12	8	7	9	16
Selenium	.004	.004	.005	.007	.004	.005
Silver	<.005	<.005	<.005	<.005	<.005	<.005
Sodium	22	29	24	22	27	39
Sulfate	118	118	124	124	234	140
Zinc	.22	.27	.56	.49	.68	.11
Uranium	.082	.11	.077	.10	.024	.017
Vanadium	<.005	<.005	<.005	<.005	<.005	<.005
Total Dissolved Solids	394	374	402	391	535*	408
Conductivity (umhos)	592	586	590	600	783	607
Ra-226 (pCi/ℓ)	604*	1017*	58	20	6	14
pH - (std. units)	8.0	7.8	7.7	7.9	7.6	7.9

[1]All units are mg/ℓ per liter unless noted otherwise.
ND - Not Detected

*Exceeds EPA drinking water standards.

TABLE A-1 Cont'd.

	UNDERLYING AQUIFER		OVERLYING AQUIFER	
mg/ℓ	QMO-1		QMS-1	
Parameter	12-7-79	12-19-79	12-7-79	12-17-79
Aluminum[1]	0.1	.13	<.05	.09
Arsenic	<.001	<.001	<.001	<.001
Barium	.279	.244	.256	.244
Boron	.005	.019	.005	<.005
Bicarbonate[2]	--	--	--	--
Carbonate[2]	--	--	--	--
Cadmium	<.1	<.1	<.1	<.1
Calcium	251	228	336	264
Chloride	23	25	5	6
Chromium	.07*	.07*	.04	.03
Copper	<.005	<.005	.026	.018
Fluoride	.47	.59	.24	.28
Iron	<.01	<.01	<.01	<.01
Lead	<.05	<.05	<.05	<.05
Manganese	<.01	<.01	<.01	<.01
Magnesium	<.01	<.01	<.01	<.01
Mercury	<.001	<.001	<.001	<.001
Molybdenum	<.2	<.2	<.2	<.2
Nitrates (N)	.9	.5	.4	.2
Selenium	<.001	<.001	<.001	<.001
Silver	<.005	<.005	<.005	<.005
Sodium	70	70	118	131
Sulfate	4	94	48	53
Zinc	<.05	<.05	<.05	<.05
Uranium	.002	<.002	<.002	<.002
Radium-226 pCi/ℓ	2.53	1.18	.37	1.94
pH - (Std. Units)	12.4*	12.3*	12.3*	12.4*
Total Dissolved Solids	836*	849*	636*	944*

[1]All units are mg/ℓ unless noted otherwise.
[2]Carbonate/bicarbonate values were masked by free hydroxide. Calcium and pH values were high.

*Exceeds EPA drinking water standards.

TABLE A-1 Cont'd.

	UNDERLYING AQUIFER		OVERLYING AQUIFER	
mg/ℓ	QMO-1		QMS-1	
Parameter	3-25-80	3-26-80	3-25-80	3-26-80
Aluminum[1]	0.1	.1	.09	.11
Arsenic	<.002	<.002	<.002	<.002
Barium	.046	.038	.034	.059
Boron	.18	.25	.18	.21
Bicarbonate	194	203	248	247
Carbonate	--	--	--	--
Cadmium	<.1	<.1	<.1	<.1
Calcium	110	120	100	110
Chloride	23	31	29	17
Chromium	<.01	<.01	<.01	<.01
Copper	<.005	<.005	<.005	<.005
Fluoride	.025	.028	.23	.22
Iron	<.01	<.01	<.01	<.01
Lead	<.05	<.05	<.05	<.05
Manganese	.025	.024	.021	.025
Magnesium	22	23	20	20
Mercury	<.001	<.001	<.001	<.001
Molybdenum	<.2	<.2	<.2	<.2
Nitrates (N)	.2	<.2	.2	.2
Selenium	<.002	<.002	<.002	<.002
Silver	<.005	<.005	<.005	<.005
Sodium	24	25	21	23
Sulfate	220	224	147	147
Zinc	.53	.60	.15	.21
Uranium	.018	.019	.042	.047
Radium-226 pCi/ℓ	.92	1.57	.95	.92
pH - (Std. Units)	7.6	7.7	7.6	7.6
Total Dissolved Solids	512*	522*	432	444

[1]All units are mg/ℓ unless noted otherwise.

*Exceeds EPA drinking water standards.

TABLE A-1 Cont'd.

BASELINE GROUNDWATER QUALITY DATA
Q SAND WELLS
CONVERSE COUNTY, WYOMING

Parameter	WELL QP-1				WELL Q1-1			
	9-25-79	12-19-79	4-14-80	4-15-80	10-1-79	12-19-79	2-24-80	2-25-80
Nickel[1]	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05
Potassium	19	213	13	11	7	14	10	10
Vanadium	<.005	<.005	<.005	<.005	<.005	<.005	.018	.025

	WELL Q1-2				WELL QM-1			
	11-29-79	12-19-79	2-19-80	2-21-80	11-29-79	12-19-79	4-14-80	4-15-80
Nickel	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05
Potassium	16	7	11	10	16	17	11	10
Vanadium	.024	<.005	<.005	<.005	.022	.071	<.005	<.005

	WELL QMO-1				QMS-1			
	12-7-79	12-19-79	3-25-80	3-26-80	12-7-79	12-17-79	3-25-80	3-26-80
Nickel	<.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05
Potassium	30	28	12	12	50	55	11	12
Vanadium	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005

[1]All units are milligrams per liter

APPENDIX B

AQUIFER PUMP TEST DATA AND DATA PLOTS

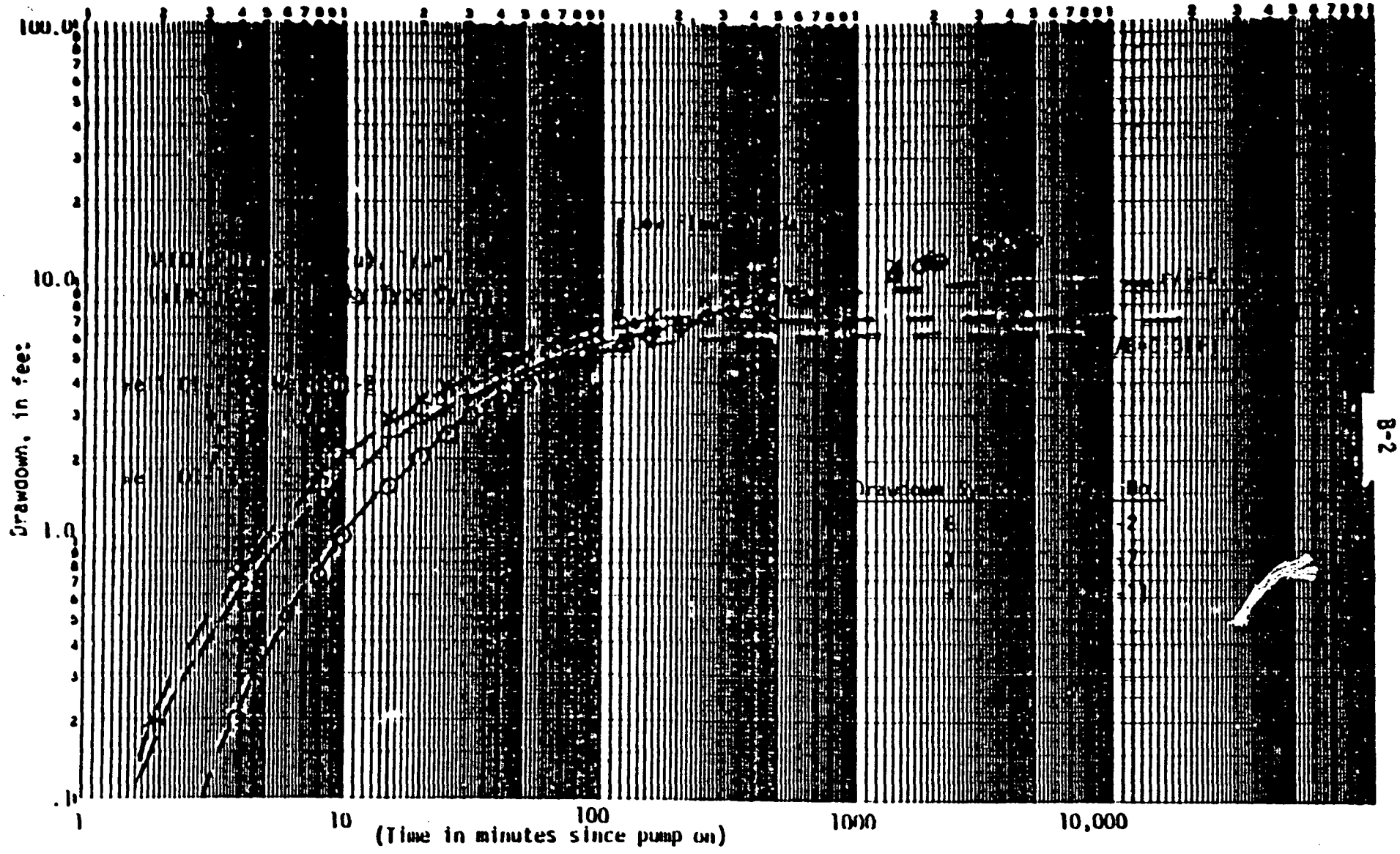


FIGURE B-1 LOG-LOG DRAWDOWN DATA PLOTS FOR Q-SAND OBSERVATION WELLS QI-2, QI-7, QI-11

B-2

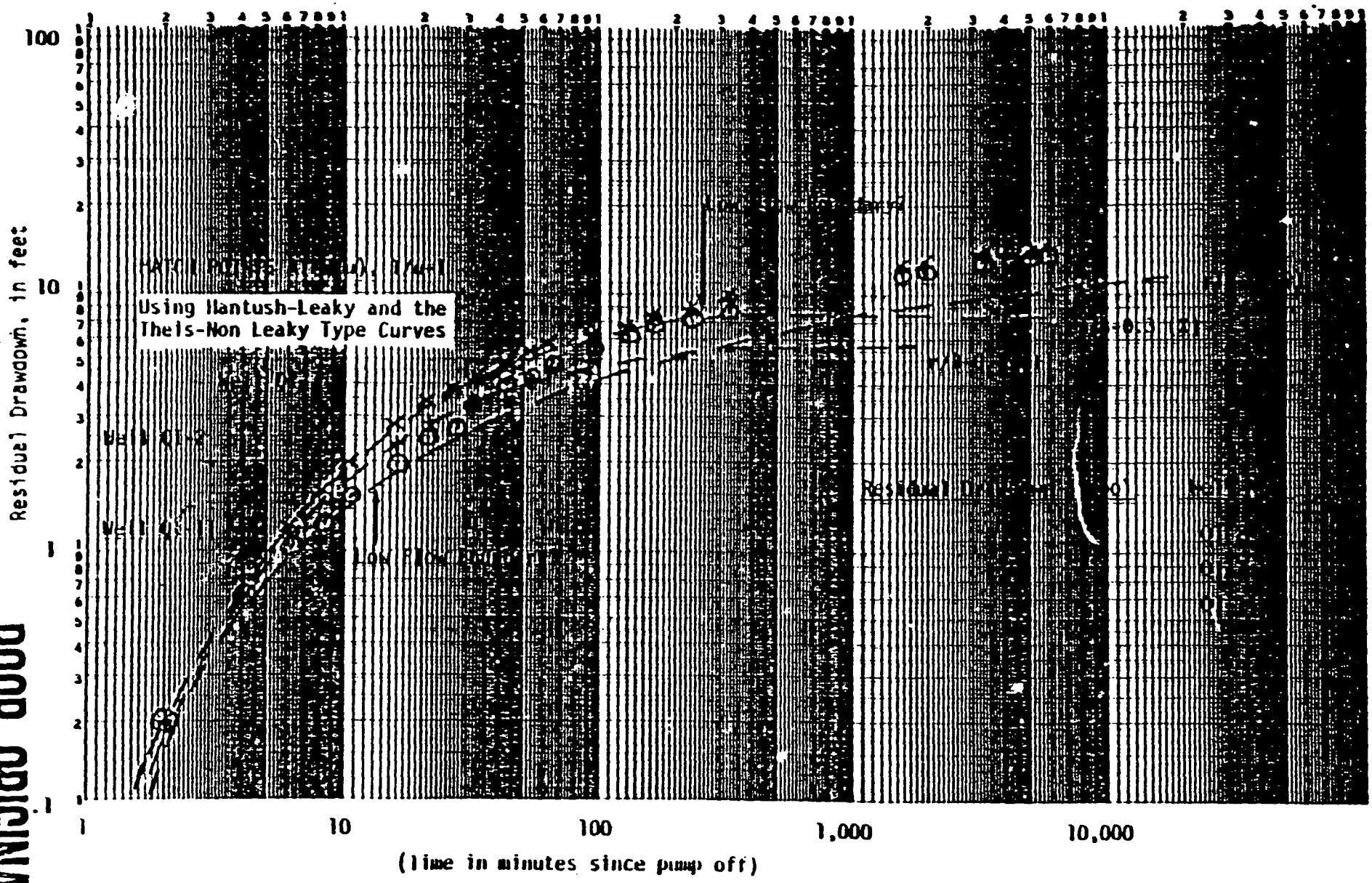


FIGURE B-2 LOG-LOG RECOVERY DRAWDOWN DATA PLOTS FOR Q-SAND OBSERVATION WELLS QI-2, QI-7, QI-11

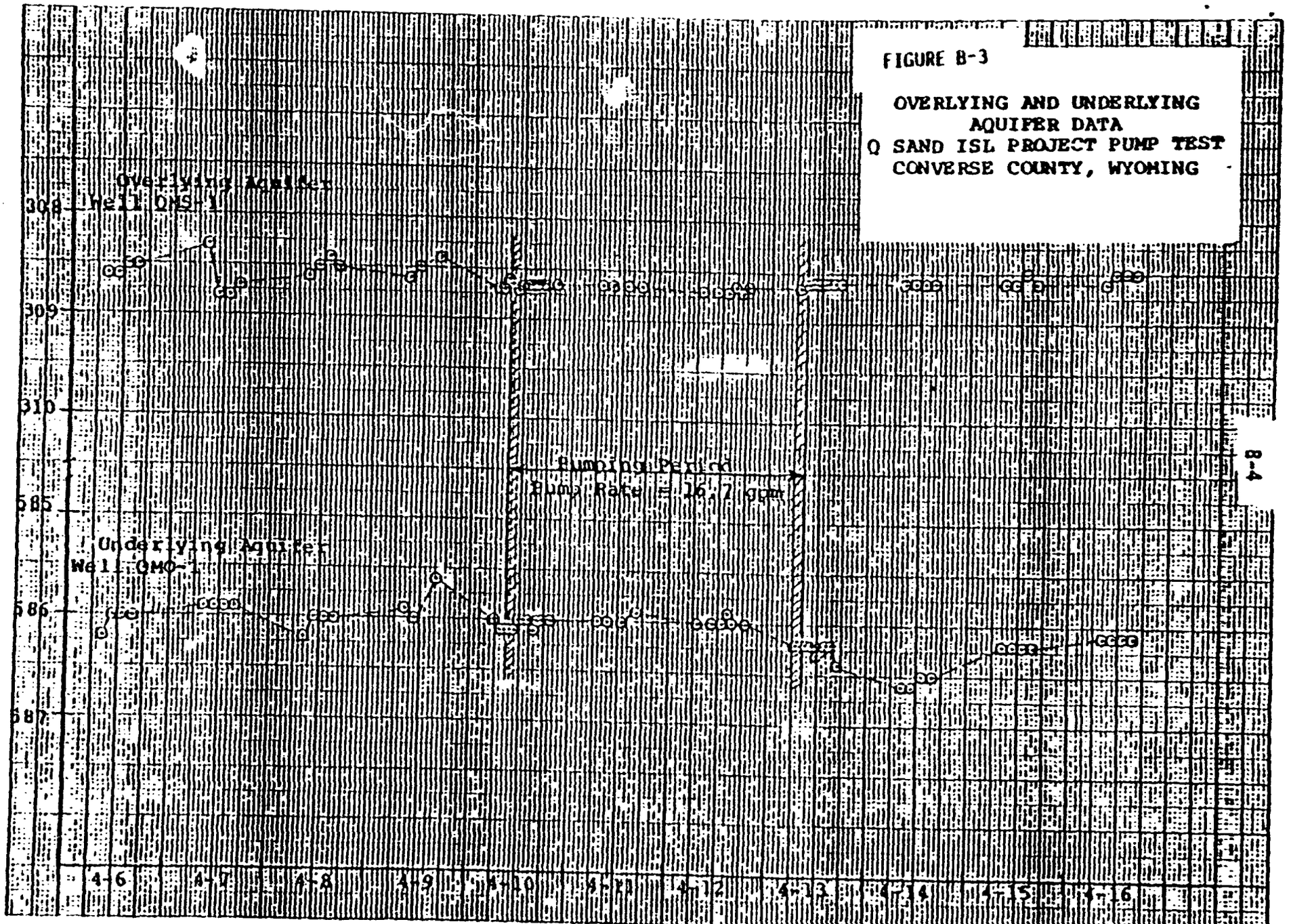


FIGURE B-3

OVERLYING AND UNDERLYING AQUIFER DATA
Q SAND ISL PROJECT PUMP TEST
CONVERSE COUNTY, WYOMING

TABLE B-1

OVERLYING AND UNDERLYING AQUIFER DATA
Q SAND ISL PROJECT PUMPT TEST
CONVERSE COUNTY, WYOMING

Date/Time	Depth to Fluid Level - Feet: Overlying Aquifer Well QMS-1	Underlying Aquifer Well QMO-1	Q Sand Aquifer Well QI-2
4-6-81			
1000	308.6	586.2	
1200	308.6	586.0	376.0
1400	308.5	586.0	375.5
1600	308.5	586.0	375.6
4-7-81			
1000	308.3	585.9	375.5
1200	308.8	585.9	373.3
1400	308.8	585.9	375.5
1600	308.7	585.9	375.4
4-8-81			
1000	308.6	586.2	375.5
1200	308.5	586.0	375.5
1400	308.4	586.0	375.5
1600	308.5	586.0	375.5
4-9-81			
1000	308.6	585.9	375.5
1200	308.5	586.0	375.4
1600	308.4	585.6	375.4
4-10-81			
818	308.7	586.0	-
836	308.7	586.1	-
914	308.6	586.1	375.7
955[1]	308.65	586.1	377.2[2]
1033	308.7	586.1	379.6
1103	308.7	586.0	380.5
1134	308.65	586.0	380.0
1206	308.65	586.0	381.5
1300	308.65	586.0	382.1
1354	308.65	586.0	382.6
1450	308.65	586.1	382.9
1540	308.65	586.0	383.3
1625	308.65	586.0	383.5
1845	308.65	586.0	384.0
4-11-81			
745	308.65	586.0	386.1
1030	308.65	586.0	386.2
1330	308.65	586.0	386.7
1620	308.65	585.9	386.9

[1]Pump started on 4-10-81 at 9:38 am
[2]Level data during test interpolated

TABLE B-1 Cont'd.

Date/Time	Depth to Fluid Level - Feet Overlying Aquifer Well QMS-1	Underlying Aquifer Well QMO-1	Q Sand Aquifer Well QI-2
4-12-81			
830	308.7	586.0	388.1
1050	308.7	586.0	388.2
1300	308.7	586.0	388.4
1400	308.65	585.9	388.4
1525	308.7	586.0	388.5
1830	308.65	586.0	388.6
4-13-81			
810	308.65	586.2	389.3
915	308.6	586.2	389.3
940[3]	308.6	586.2	387.4[3]
958	308.6	586.2	386.1
1015	308.6	586.2	385.3
1040	308.6	586.2	384.6
1120	308.6	586.2	383.6
1200	308.6	586.3	383.1
1255	308.6	586.25	382.4
1320	308.6	586.2	382.2
1420	308.6	586.2	382.0
1620	308.6	586.4	381.4
4-14-81			
1000	308.6	586.6	379.4
1200	308.6	586.6	379.2
1400	308.6	586.5	379.2
1600	308.6	586.5	379.0
4-15-81			
1000	308.6	586.2	378.2
1200	308.6	586.2	378.1
1400	308.5	586.2	378.1
1600	308.6	586.2	378.1
4-16-81			
1000	308.6	586.1	377.6
1200	308.5	586.1	377.6
1400	308.5	586.1	377.5
1600	308.5	586.1	377.5

[3]Pump shutdown on 4-13-91 at 9:23 am

TABLE 8-2

Q SAND AQUIFER DRAWDOWN DATA
Q SAND ISL PROJECT PUMP TEST
CONVERSE COUNTY, WYOMING

Time From Start of Pump Minutes	Drawdown, In Monitor Wells, In Feet			
	Pumped Well QP-3	Monitor Well QI-2	Monitor Well QI-7	Monitor Well QI-11
2	13.0	-	0.2	0.2
4	13.8	0.2	0.7	0.6
6	13.9	0.5	1.2	1.0
8	14.6	0.7	1.7	1.5
10	15.1	1.0	2.1	1.9
15	15.6	1.5	2.8	2.3
20	15.8	2.0	3.3	2.8
25	16.3	2.4	3.7	3.1
30	16.6	2.8	4.0	3.3
40	16.9	3.3	4.5	3.7
50	17.6	3.7	4.8	4.0
60	17.8	4.1	5.2	4.4
90	18.5	4.9	5.9	5.0
120	19.0	5.4	6.4	5.5
150	19.5	5.9	6.8	6.0
200	20.0	6.4	7.3	6.5
250	-	6.9	7.8	7.1
300	20.7	7.2	8.2	7.4
360	21.0	7.6	8.4	7.7
400	21.3	7.7	8.5	7.9
550	22.0	8.3	9.3	8.6
1330	24.1	10.4	11.4	10.5
1490	24.4	10.5	11.7	10.9
1670	24.8	11.0	12.0	11.1
1840	25.1	11.2	12.3	11.4
2810	26.3	12.4	13.6	12.7
2960	26.5	12.5	13.7	12.9
3090	26.6	12.7	13.8	13.0
3240	26.6	12.8	13.9	13.1
3430	26.8	12.9	14.0	13.3
4180	27.5	13.6	14.8	14.0
4300	27.6	13.6	14.9	14.0
4305		-Pump Shut Off-		

TABLE B-3

Q SAND AQUIFER RECOVERY DATA
Q SAND ISL PROJECT PUMP TEST
CONVERSE COUNTY, WYOMING

Time From Start of Pump Minutes	Time Since Pumping Stopped Minutes	Residual Drawdown in Monitor Wells - Feet			
		Pumped Well OP-3	Monitor Well OI-2	Monitor Well OI-7	Monitor Well OI-11
4307	2	16.1	0=13.8	14.7	13.8
4309	4	14.8	13.2	14.3	13.3
4311	6	14.0	12.9	13.8	13.0
4313	8	13.5	12.7	13.4	13.0
4315	10	13.1	12.4	13.0	12.3
4320	15	12.3	11.9	12.2	11.8
4325	20	11.8	11.4	11.7	11.3
4330	25	11.4	11.2	11.2	11.3
4335	30	11.0	10.7	10.9	10.9
4345	40	10.4	10.1	10.3	10.7
4355	50	10.0	9.7	9.9	10.1
4365	60	9.7	9.3	9.5	9.8
4395	90	8.9	8.6	8.9	8.0
4425	120	8.4	7.9	8.3	7.7
4455	150	7.8	7.3	8.0	7.2
4520	215	7.4	6.9	7.3	6.8
4540	235	6.7	6.5	6.8	6.8
4600	295	6.4	6.5	6.4	6.1
4720	415	5.9	5.7	6.0	5.3
5780	1475	4.0	3.7	3.9	3.3
5900	1595	3.7	3.5	3.7	3.0
6020	1715	3.5	3.5	3.5	2.9
6140	1835	3.5	3.3	3.5	2.9
7220	2915	2.7	2.5	2.7	2.1
7340	3035	2.6	2.4	2.6	2.0
7460	3155	2.5	2.4	2.6	1.8
7580	3275	2.5	2.4	2.5	1.8
8660	4355	2.0	1.9	2.0	1.4
8780	4475	2.0	1.9	2.0	1.3
8900	4595	1.9	1.8	1.9	1.3
9020	4715	1.9	1.8	1.9	1.2

TABLE B-4

BAROMETRIC PRESSURE DATA
Q SAND PUMP TEST
CONVERSE COUNTY, WYOMING

The following data was taken from a barometric pressure monitoring station located about 8 miles east of the test site. A calibration indicated the recorder was reading 0.68 inches too high, however, if corrected, all data would be adjusted accordingly.

Date	Time	Pressure in. Hg.	Date	Time	Pressure in. Hg.
4/6	8 am	25.5	4/11	8 am	25.5
	12 N	25.5		12 N	25.5
	4 pm	25.4		4 pm	25.4
4/7	8 am	25.4	4/12	8 am	25.6
	12 N	25.3		12 N	25.5
	4 pm	25.3		4 pm	25.5
4/8	8 am	25.5	4/13	8 am	25.9
	12 N	25.5		12 N	25.9
	4 pm	25.5		4 pm	26.0
4/9	8 am	25.4	4/14	8 am	26.2
	12 N	25.3		12 N	26.1
	4 pm	25.3		4 pm	26.1
4/10	8 am	25.6			
	12 N	25.5			
	4 pm	25.4			