Nuclear Assurance Corporation
24 Executive Park West
Atlanta, Georgia 30329
(404) 325-4200
Telex: 549567, 542703

715 Horizon Drive
Grand Junction, Colorado 81501
(303) 245-4320
TWX: 9109296334

Weinbergstrasse 9
8001 Zurich, Switzerland
(01) 470844
Telex: 57275

May 28, 1981

Ms. Rebecca L. Mathisen
District I Engineer
Land Quality Division
Department of Environmental Quality
401 W. 19th Street
Cheyenne, Wyoming 82002

Re: TFN 1 2/188, APS R&D License Application

Dear Ms. Mathisen:

Arizona Public Service Company (APS) and Nuclear Assurance Corporation (NAC) have carefully reviewed letters received from Mr. Patrick H. Boles dated September 9 and 15, 1980 which provide review comments on the above referenced application. Through discussions with Land Quality Division personnel and careful in-house evaluation, APS-NAC have prepared answers to your comments and questions. Where an answer required the revision of the text or an illustration in the application, replacement pages containing the response have been provided. When no change in the application was determined to be necessary, our response is summarized, herein.

APS-NAC have also provided replacement pages where appropriate to reflect a revised project schedule. The schedule that is outlined is based on a delay of approximately one year. Site construction is proposed for fall 1981 and startup of leaching operations is proposed during early spring 1982. Replacement pages 3-11 and 3-12 are provided as a result of correcting typographic errors.

Our specific comments are summarized as follows:

Letter of September 9, 1980

I. Operational Plan - Section 4.0

A. Topsoil

(1) The application has been revised on pages 4-11 and 4-13a to indicate the removal of 18 inches of topsoil from all disturbed areas with the exception of the wellfield and evaporation pond areas. Traffic to and through the wellfield will be primarily restricted to roads now shown on Figure 4.3. Therefore, little disturbance of the remainder of the designated wellfield area is expected. Five feet of topsoil will be removed from the pond area and the pond design has been revised as indicated on pages 4-18 and 4-18a.

10118

(2) Figures 4.3, 4.4 and 4.5 have been revised to indicate three topsoil stockpiles located on flat terrain immediately adjacent to the access road. The stockpiles have been positioned for economical manipulation of topsoil.

(3) The upper 60 inches of topsoil will not be used for berm construction as indicated in revisions on pages 4-18 and 4-18a.

B. General

(1) The width of access road has been left at 24 feet to allow safe travel of large vehicles along the roadway. However, the total width of the disturbed area has been reduced from about 80 to 45 feet by eliminating the topsoil berms. See page 4-13a.

(2) The application has been revised to show the position of wellfield access routes (page 4-21 and Figure 4.3) and the reclamation plan is included with those proposed for other disturbed areas (page 5-6).

(3) Figure 4.6 already indicates that perforated PVC will be positioned on a grid pattern. The text has been upgraded on page 4-18a to more completely reflect Figure 4.6.

(4) The application has been revised on page 4-16 to reflect containment of eroded material.

(5) Table 4.2 (page 4-11a) is a new table and indicates topsoil stripping volumes.

(6) Figure 4.3 has been revised and additional description provided on pages 4-13 to 4-16.

(7) The application has been revised on page 4-16.

C. Number of Tests

The application has been revised on page 4-1 to indicate that one test will be performed.

D. Test sequence

The application has been revised on page 4-21 to indicate simultaneous operation of the wellfield patterns.

E. Fluid Flow Paths

Generalized fluid flow paths have been shown on Figure 4.8.

F. Monitor Wells

(1) It has been indicated in the application on page 4-28 that monitor wells will be constructed by either Method No. 2 or Method No. 3 proposed in the application. A generalized schematic of monitor well design is shown by Figure 4.9.

(2) The application has been revised on page 4-30 and Figure 4.8.

(3) The application has been revised on Figure 4.9.

G. Mechanical Integrity Tests

(1) A pressure of 90 psi for mechanical integrity testing has been previously specified on page 4-28. The text has been supplemented on page 4-28 to indicate that the test pressure will exceed injection pressures.

(2) The specific procedures for mechanical integrity testing are described on pages 4-28 and 4-29. The results of all testing will be provided to Land Quality prior to any leaching operations. Wells not initially meeting the test criteria will be repaired before their use, or abandoned. APS believes that if Land Quality accepts the procedures outlined in the application then in essence approval of the results of the mechanical integrity tests will have been given if the tests meet the criteria outlined. See also a wording change regarding reporting on page 4-29.

H. Excursions

(1) The application has been revised on page 4-32.

(2) The application has been revised on page 4-32.

II. Reclamation Plan - Section 5.0

A. General

(1) The application has been revised on page 5-5.

(2) The application has been revised on page 5-7. Blue Grama has been substituted for Sweet Clover.

(3) The application has been revised on page 5-7.

(4) Discussions with the Solid Waste Division indicated that a permit would not be necessary for the small volume of waste involved. An estimate of the increased volume of material is given on page 5-5. The amount is small and would not create a large mound. The term miscellaneous debris has been eliminated.

The term was used to include small equipment, trash and small structural components. APS will dispose of this material in the same manner as operational wastes as described on page 4-13. A plan has been provided on page 5-4 and 5-5 for determining toxic potential and potential removal of toxic wastes to approved facilities.

(5) The application has been revised on page 5-7.

(6) Well abandonment

(a) The application has been supplemented on page 5-4.
(b) The application has been supplemented on page 4-29.

B. Ground Water Restoration

(1) A definition of baseline has been provided on page 5-2.

(2) It has previously been indicated on page 5-1 that if baseline values cannot be achieved, minimum restoration criteria will be based on the use category within which each parameter falls.

(3) It was previously indicated on pages 5-2 and 5-3 that reverse osmosis will be available for ground water restoration in addition to ground water sweep. The ground water sweep method is the most economical method of ground water restoration. Because an R&D project is designed for experimentation, APS desires to first evaluate ground water sweep as a viable restoration method followed as required by reverse osmosis.

(4) The application has been revised on page 5-4.

(5) The application has been revised on page 5-4.

(6) The application has been supplemented on page 5-3 and 5-4.

III. Geology - Section 3.8

A. Geologic Cross-Sections

(1) The geologic cross-sections shown by Figures 3.13, 3.14 and 3.15 have been revised. To preserve clarity of Figures 3.13 and 3.14, not all geophysical logs have been shown due to the close spacing of drill holes. The logs that are shown are representative of the geologic conditions.

(2) Figures 3.13, 3.14 and 3.15 have been revised.

(3) Figure 3.15a has been added. To preserve clarity of Figure 3.15a only key drill hole symbols have been labeled by number.

B. Confining Layers

During the hydrologic well construction, cores were taken from the confining claystones above and below the B Aquifer. In an attempt to comply with the WDEQ-LQD request, porosity, permeability and fracture tests were ordered for the claystones. However, because of the condition of the material porosity and permeability testing was not possible. Scattered laboratory data are available for a few claystone seams within the ore bearing sands from previous tests. This information indicates that horizontal permeability of the claystones may generally be less than 10 millidarcies with porosities ranging from 10 to 20 percent.

In addition, an attempt to determine the fracture strength of the material was performed. Three cores of the upper confining claystone were prepared with dimensions of one inch diameter and one and one-half to two inches in length. The cores were subjected to pressure (unconfined) until they fractured. Fracture strengths of the three cores were 2,725, 3,100 and 2,375 psi, respectively.

For a 4¼ inch diameter pilot drill hole 220 feet deep, the natural weight of a drill string consisting of drill stem, collars and bit is estimated to be about 3,600 pounds. This is equivalent to a pressure of 254 psi. In addition, a maximum pulldown pressure of about 800 psi may be applied by operation of the drilling rig. Thus a non-rotational pressure of about 1,054 pounds is created. This pressure is considerably less than the theoretical fracture strength of the material as indicated by the laboratory tests. The pressure applied to the formation during reaming from a 4¼ inch to 8 inch diameter drill is expected to be less than 900 psi. In addition, the rotational action of the bit shaves the cuttings from the claystone alleviating much of the downward pressure required to break the rock under non-rotational conditions.

IV. Hydrology - Section 3.9

A. Drainage Basin Map

Figure 3.15a has been added.

B. Potentiometric Map

Figure 3.15b has been added and page 3-53 revised.

C. Pump Tests

Available data for well OW-7 are provided on page D-73. Data for OW-9 are provided on pages D-36a and D-36b which are new submittals. Submittal of this information was previously overlooked.

D. Ground Water Quality

(1) Water quality samples will be collected on a periodic basis from the hydrologic test wells. Duplicates, splits, blanks or testing by two separate laboratories are always part of our sampling program. Generally, about five percent of the samples are verified in this manner. Because of the historical correlation, we don't feel the added expenses of duplicate analyses of each sample is justified.

(2) A program for obtaining baseline data from actual pattern and monitor wells is outlined on page 4-30 of the application. Clarifications have been made regarding which wells will be sampled.

IV. Water Quality Division Comments

A. Water Quality Division Permits

On pages 4-33 and 4-34, additional permits are listed that APS will apply for. The Water Quality Division permits are included on this list. Preliminary contact with the Water Quality Division has indicated that the potable water supply system will not need to be reviewed by the Division since only one connection is involved. However, the Wyoming Public Health Department will be notified.

B. Facilities Construction

The permits listed on page 4-33 will be obtained before construction begins.

C. Chemical Storage

Mr. LeRoy Feusner was contacted and referred APS-NAC to Mr. Pete Larson with EPA in Region VIII. Mr. Larson indicated that current Spill Prevention regulations concern only the handling of petroleum products on site. Volatile gases such as oxygen, carbon dixoide, and propane are not covered by the EPA regulations.

D. Radium Concentration Measures

Future radium concentrations in the ground waters will be reported as total radium-226 and radium-228.

E. Figure 4.7 has been revised.

Letter of September 15, 1980

I. Inclusion of access road into license area

We have included the access road into the proposed test site and made it part of the license area by revising all pertinent figures and legal descriptions. The cost of reclamation is included in Section 5.3.

If you have any questions, please feel free to call.

Sincerely,

NUCLEAR ASSURANCE CORPORATION

Bob Ward

Bob Ward
Manager, Safety and Environmental Affairs

Encl.

(iii) Lands which are located within other permit or license areas shall be identified and a copy of the agreement with the other permittee shall be attached as part of this application.

(iv) An original United States Geological Survey topographic map, clearly outlining and identifying the lands to be within the proposed license area, shall be provided. Photo copies or other similar copies are not acceptable unless prior approval is obtained from the Land Quality Division.

(d) APPENDIX "D"

(i) A statement of the present and proposed post-reclamation use of the land. See Section 3-1.

(ii) The vegetative cover, topsoil characteristics, location and name of present surface waters, and adjudicated water rights for affected areas.

(iii) Locations and present owners of all wells inside and within one-half (½) mile of the license area with well completion data and producing interval(s) to the extent such information is available to the applicant and the general public.

(iv) Groundwater quality data and piezometric surface elevations for aquifers that may be affected by recovery fluid injection.

4. (a) Mineral(s) to be extracted: Uranium (U_3O_8)

(b) Testing method to be used: In Situ Leaching with Sodium Bicarbonate Lixiviant

5. Estimated dates of commencement and termination of the proposed research and development testing:

Start of testing: March 1, 1981 Termination of restoration: March 1, 1982

6. The total number of acres in the proposed license area and an estimate of the total number of acres to be affected by the research and development testing.

Total license Acres: 49.0 Estimate of Affected Acres: 18.7

7. The nearest town, village, or city: Orpha; Equal Distance between Glenrock and Douglas

8. A filing fee of $25.00 is enclosed.

9. A testing plan is required including a description of the nature and scope of the testing activity, the general groundwater hydrology, the general geology, maps showing the surface facilities, access roads, communication lines, the sequence of the operation, and descriptions of the expected impacts on natural resources, mitigating measures, operational procedures and operational sequences. The testing plan must show that the test will:

(a) Evaluate minability or workability of a mineral deposit using in situ mining techniques.

(b) Affect the land surface, surface waters and groundwater of the State to the minimum extent necessary and achieve groundwater restoration.

(c) Provide premining, operational and postmining data, information and experience that would be useful for developing reclamation techniques for in situ mining.

10. A reclamation plan is required including descriptions of the methods to be used in groundwater restoration, surface restoration, the type of revegetation and practices to be used to achieve revegetation, and an estimate of the cost of restoration.

Research and Development License No. _____
TFN No. _____

Figures

1.4 PROJECT SCHEDULE

The proposed construction of the R&D facilities is scheduled to begin during August, 1981. It is the desire of APS-NAC to complete the major construction before severe winter weather. The R&D test is scheduled to start during March, 1982, or when spring weather permits. The leaching tests will be performed over a three to four month period with aquifer restoration encompassing approximately the subsequent eight to nine months. The R&D test is scheduled to be complete within one year from the start of leaching.

1.5 REGULATORY COMPLIANCE

The test will conform with the requirements of the U.S. Nuclear Regulatory Commission (NRC), Wyoming Department of Environmental Quality (WDEQ), Wyoming State Engineer and U.S. Environmental Protection Agency (EPA). A complete list of agencies contacted for permits and approvals is provided in Section 4.6 of this report.

1.6 CONTRIBUTORS TO APPLICATION REPORT

Arizona Public Service Company acts as project manager for the R&D in situ uranium extraction project. As project manager, APS determines policy, makes decisions and sets goals for project performance. As operator of the project, Nuclear Assurance Corporation is responsible for project implementation through the day to day management of project development activities and the acquisition and interpretation of technical information. In addition, NAC provides recommendations to APS on the scope and feasibility of the proposed program.

NAC assumed the primary role in the acquisition of technical information required for this application, and in assembling the application report. The work was accomplished by both NAC staff and subcontractors to NAC. International Environmental Consultants (IEC), Golden, Colorado, performed the studies on topography, soils, ecology, meteorology, and radiology. Envirosphere Company, Golden, Colorado, had primary responsibility for the

PART I - ADJUDICATION FILE

2.0 SITE LOCATION, LAND OWNERSHIP AND LEGAL DOCUMENTS

The adjudication file as presented by WDEQ - Land Quality Division (LQD) Guideline No. 6 contains important documents such as the application for testing license, public notification forms and the performance bond. In addition, land ownership and legal descriptive data are to be contained in the file. These data are included within this section.

2.1 SITE LOCATION AND LAYOUT

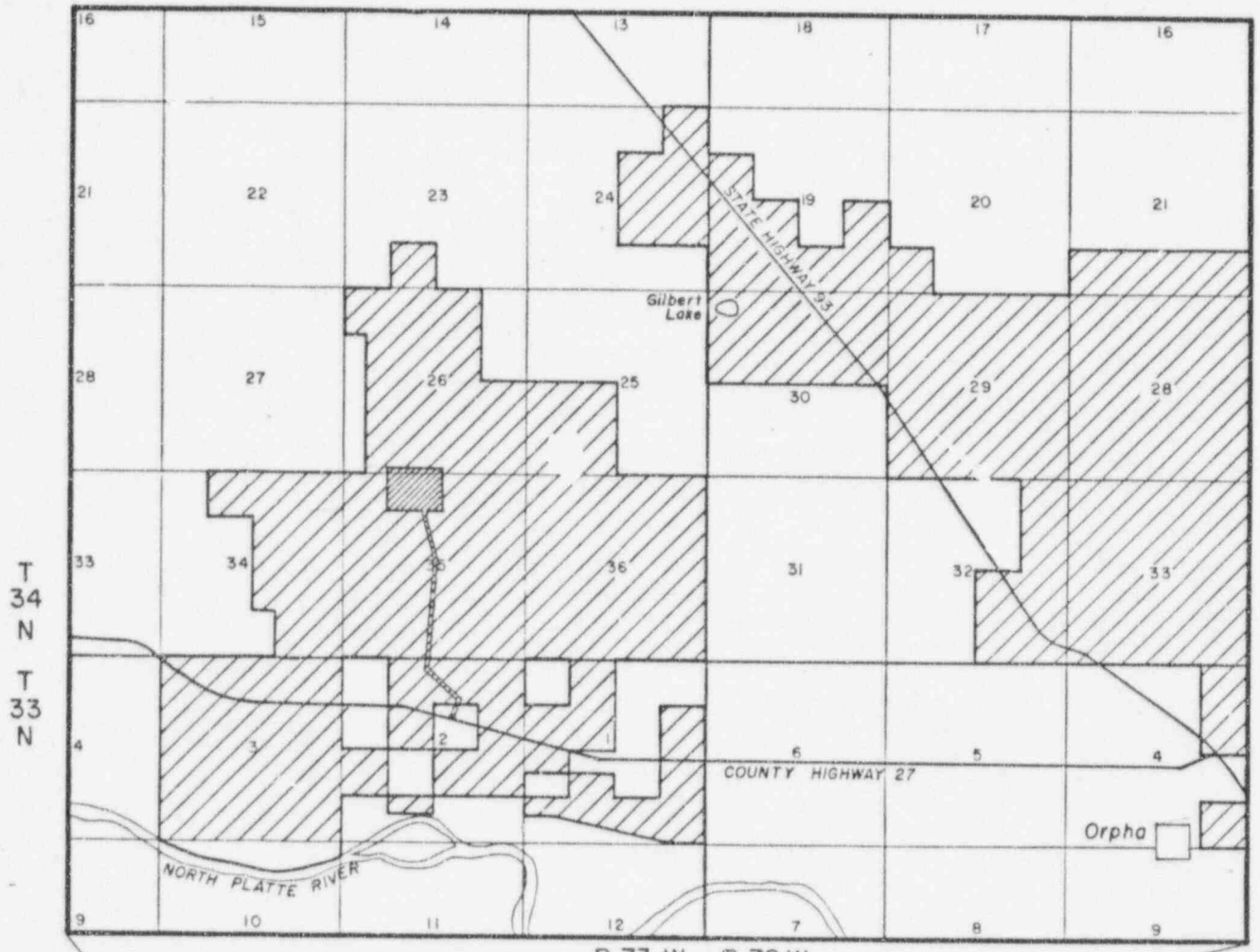
Arizona Public Service Company controls the uranium mineral rights underlying privately and state owned surface lands within the North Platte River drainage in the southern Powder River Basin, Converse County, Wyoming. The area for which APS controls the uranium mineral rights is commonly referred to as the Peterson Project. The proposed R&D Site lies within the overall Project and is located about midway between Douglas and Glenrock, Wyoming, approximately 16 road miles (26 kilometers (km)) from each town (Figure 2.1). Orpha, an unincorporated community, is located approximately four miles (6 km) east-southeast of the Test Site. The R&D Site is primarily located within SE¼ SW¼ Sec. 26 and NE¼ NW¼ Sec. 35, T34N, R73W (Figures 2.2 and 2.3). The exact location is shown in Appendix C.

2.2 APPLICATION FOR IN SITU RESEARCH AND DEVELOPMENT TESTING LICENSE

The application for the In Situ Research and Development Testing License is attached to the cover of this application report.

2.3 LEGAL ESTATES OF RECORD WITHIN R&D SITE

Names and addresses of owners of legal estates of record within the area of the proposed R&D Site are given in Appendix A. The locations of ownership are shown on Figure 2.3. One surface owner, one uranium mineral owner



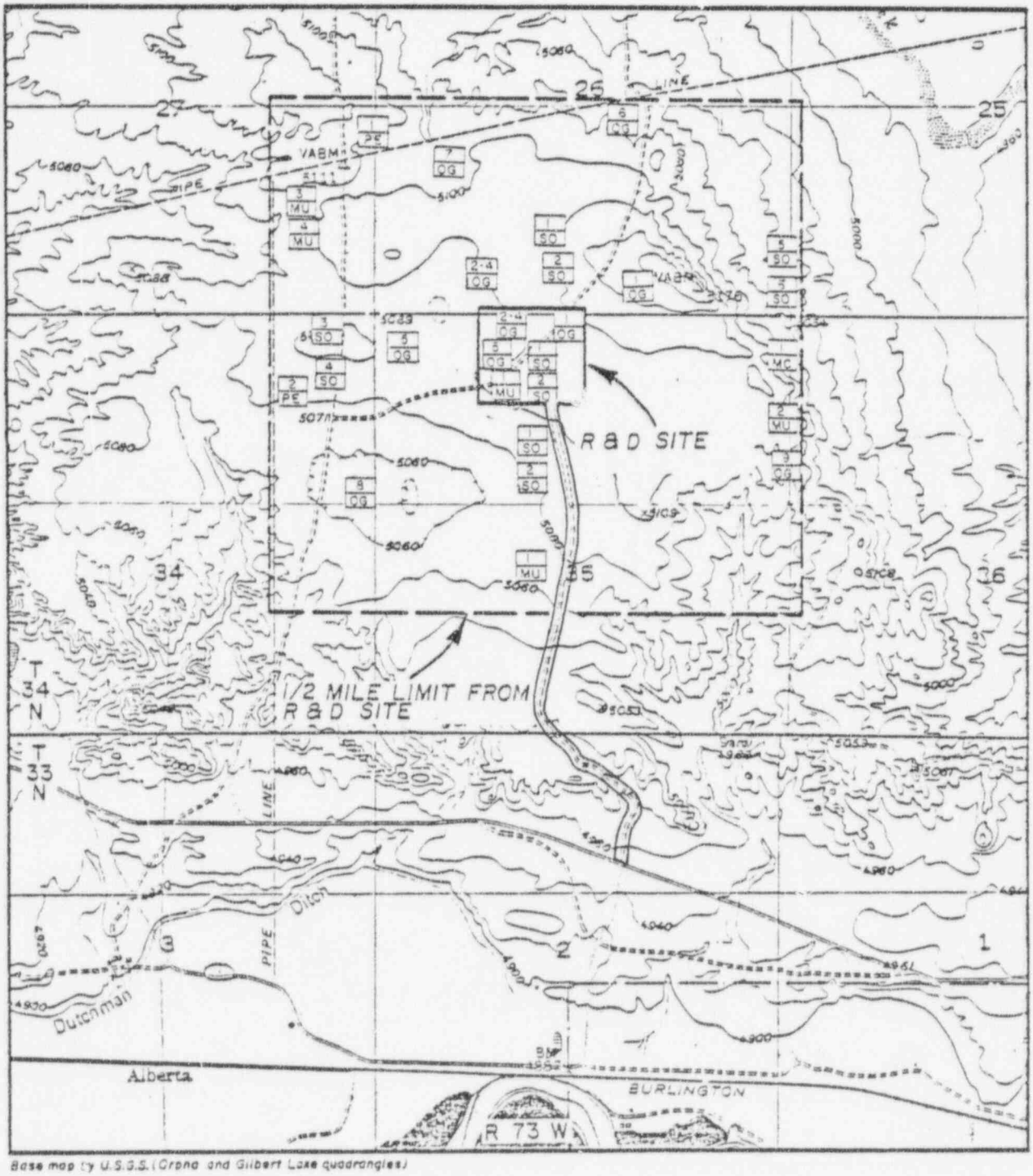
INDEX MAP

LEGEND

R & D Site

Peterson Project

ARIZONA PUBLIC SERVICE COMPANY PHOENIX, ARIZONA	LOCAL SITE LOCATION	
	PREPARED BY: B.W.	DATE: Feb. 15, 1980
NUCLEAR ASSURANCE CORPORATION GRAND JUNCTION, COLORADO	REVISED:	
	DRAWN BY: A.M. (2-20-80)	
	SCALE: 1" = 1 mile	FIGURE No. 2.2
	CONTOUR INTERVAL: N/A	



Base map by U.S.G.S. (Orona and Gilbert Lake quadrangles)

LEGEND

- OG — OIL and GAS ESTATE
- SO — SURFACE OWNERSHIP ESTATE
- MU — URANIUM MINERAL ESTATE
- MC — COAL MINERAL ESTATE
- PE — PIPELINE EASEMENT

NOTE: ESTATE NUMBERS REFER TO OWNERSHIP NUMBERS LISTED IN APPENDICES A and B.

ARIZONA PUBLIC SERVICE COMPANY PHOENIX, ARIZONA	LEGAL ESTATES OF RECORD WITHIN R & D SITE AND WITHIN 1/2 MILE OF R & D SITE
	PREPARED BY: B.W. — DATE: Feb. 15, 1980
NUCLEAR ASSURANCE CORPORATION GRAND JUNCTION, COLORADO	REVISED:
	DRAWN BY: A. M. (2-21-80)
	SCALE: 1" = 2000' — FIGURE No. 2.3
	CONTOUR INTERVAL: 20'

(APS) and three oil and gas leases are filed of record for the Test Site. APS has leased the surface rights to the Peterson Project, and the Assignment of Surface Agreement showing that APS has surface rights to the Test Site is included in Appendix A.

2.4 LEGAL ESTATES OF RECORD WITHIN ONE-HALF (½) MILE OF R&D SITE

Names and addresses of owners of legal estates of record within ½ mile (0.8 km) of the R&D Site are given in Appendix B. The locations of ownership are shown on Figure 2.3. Including those legal estates of record shown above in Section 2.3, there are three land surface owners, and three land surface leases for the area. Uranium mineral rights are owned by two public agencies and one private owner. The rights are claimed and/or leased by two companies. Seven oil and gas leases and one coal mineral lease occur within the area. Two pipeline easements are of record. Proof of notification of the proposed R&D test to owners of legal estates on or within ½ mile (0.8 km) of the Test Site is included in Appendix B.

2.5 LOCATION OF LANDS BY LEGAL SUBDIVISION

All lands included within the boundary of the R&D Site are listed by section, township, range and county in Appendix C. Original USGS 7½ minute Gilbert Lake and Orpha Quadrangle Maps outlining the proposed R&D Site are also included in Appendix C.

2.6 BOUNDARY OF AFFECTED LANDS, SURFACE DRAINAGE AND DEVELOPED AREAS

References to areas of existing land disturbance, surface drainage of adjacent lands, nearby land developments and unique land features are presented in Figures 2.1, 2.2, and 2.3. Areas of proposed land disturbance are presented in Figure 4.3 in Part II of this application. These maps present the data requested for Appendix E by WDEQ-LQD in Guideline No. 6. Therefore, no specific Appendix E is included herein.

WILDLIFE

As stated previously in the description of vegetation, the R&D Site contains sagebrush and sagebrush-grassland habitats. Several additional habitats occur in surrounding areas within the Peterson Project and include: grassland, bottomland grassland, bottomland sagebrush, cottonwood woodland, agricultural, silver sage and wet rush meadow. Not all of these are distinct wildlife habitats since wildlife species generally occupy habitats on the basis of their physiognomic appearance rather than their specific species composition. From the above lists of vegetation types, six wildlife habitats may be distinguished including: sagebrush, grassland, cottonwood woodland, agricultural, wet rush meadow and bottomland shrub. The sagebrush-grassland vegetation type would be expected to contain wildlife species representative of its two component vegetation types. Where moisture conditions are better, specimens of sagebrush and its associated shrub species grow taller and denser, and new shrub species may be present. These taller shrub associations resulting from better moisture conditions constitute the bottomland shrub wildlife habitat.

Wildlife species mentioned below as characteristic of sagebrush or grassland habitat types may be expected on and are considered characteristic of the Test Site. Other species, more characteristic of surrounding habitats, may be expected to occur occasionally on the Test Site, while in transit.

Mammals

The Converse Planning Unit provides habitat for 64 species of mammals (BLM, 1977). Species most characteristic of the sagebrush and grassland habitats which may be present on the Test Site in varying degrees of admixture include: Desert Cottontail, White-tailed Jack Rabbit, Black-tailed Jack Rabbit, Least Chipmunk, Black-tailed Prairie Dog, Northern Pocket Gopher, Deer Mouse, Sagebrush Vole, Coyote, Red Fox, Badger, Mule Deer, and Pronghorn. Cottonwood woodland and wet rush meadow habitats would be most likely to provide additions to the list of mammal species characteristic of the upland Test Site. Species likely to be added include: Vagrant Shrew, Prairie Vole, Muskrat, Raccoon, Long-tailed Weasel, Mink, Striped Skunk,

and White-tailed Deer. On rocky outcrop microhabitats, likely additional species include Ord's Kangaroo Rat and Bushy-tailed Woodrat. On a November, 1979, reconnaissance visit to the site environs, Mule Deer, Pronghorn, Muskrat, and roadkilled White-tailed Jack Rabbits were seen. Striped Skunk and Beaver sign were also observed. Three groups of mammals considered further herein are: prey and predator species; big game species; and sensitive, threatened or endangered species.

Prey and Predator Species of Mammals. Important small prey species are primarily in the orders Lagomorpha (pikas, rabbits and hares) and Rodentia (squirrels, gophers, rats, mice, Beaver and Porcupine). Small prey species which could occur on the Test Site include: Nuttall's Cottontail, Desert Cottontail, White-tailed Jack Rabbit, Black-tailed Jack Rabbit, Least Chipmunk, Thirteen-lined Ground Squirrel, Black-tailed Prairie Dog, White-tailed Prairie Dog, Northern Pocket Gopher, Olive-backed Pocket Mouse, Deer Mouse and Northern Grasshopper Mouse. In the immediate vicinity of the Peterson Project, Nuttall's Cottontail and White-tailed Prairie Dog are not expected to be common. Map 7 in the Eastern Powder River Coal ES (BLM, 1978) shows no prairie dog towns on either the Test Site or within the Peterson Project. No prairie dogs were observed on the site reconnaissance visit; however, prairie dogs are not expected to be active in early November when this visit occurred. The roadkilled White-tailed Jack Rabbits seen on this visit were along State Highways 93 (two individuals) and 95 (one individual), and Interstate 25 (one individual).

Larger prey species of importance are in the order Artiodactyla (deer, Pronghorn and other hollow-horned ruminants). Pronghorn are typical of the habitats found on the Test Site and throughout the region. The habitat on and in the immediate vicinty of the Test Site is not optimum for Mule Deer. Within the area, Mule Deer can be expected to occur most frequently along Sage Creek and along the North Platte River. These two species are discussed further under big game mammals. Occasional White-tailed Deer can be expected along the North Platte River. There are no known wild horses or burros within the planning unit (BLM, 1977).

by the Big Horn Mountains and Casper Arch. Toward the north the Powder River drains a large portion of the basin through a low structural saddle (Figure 3.10).

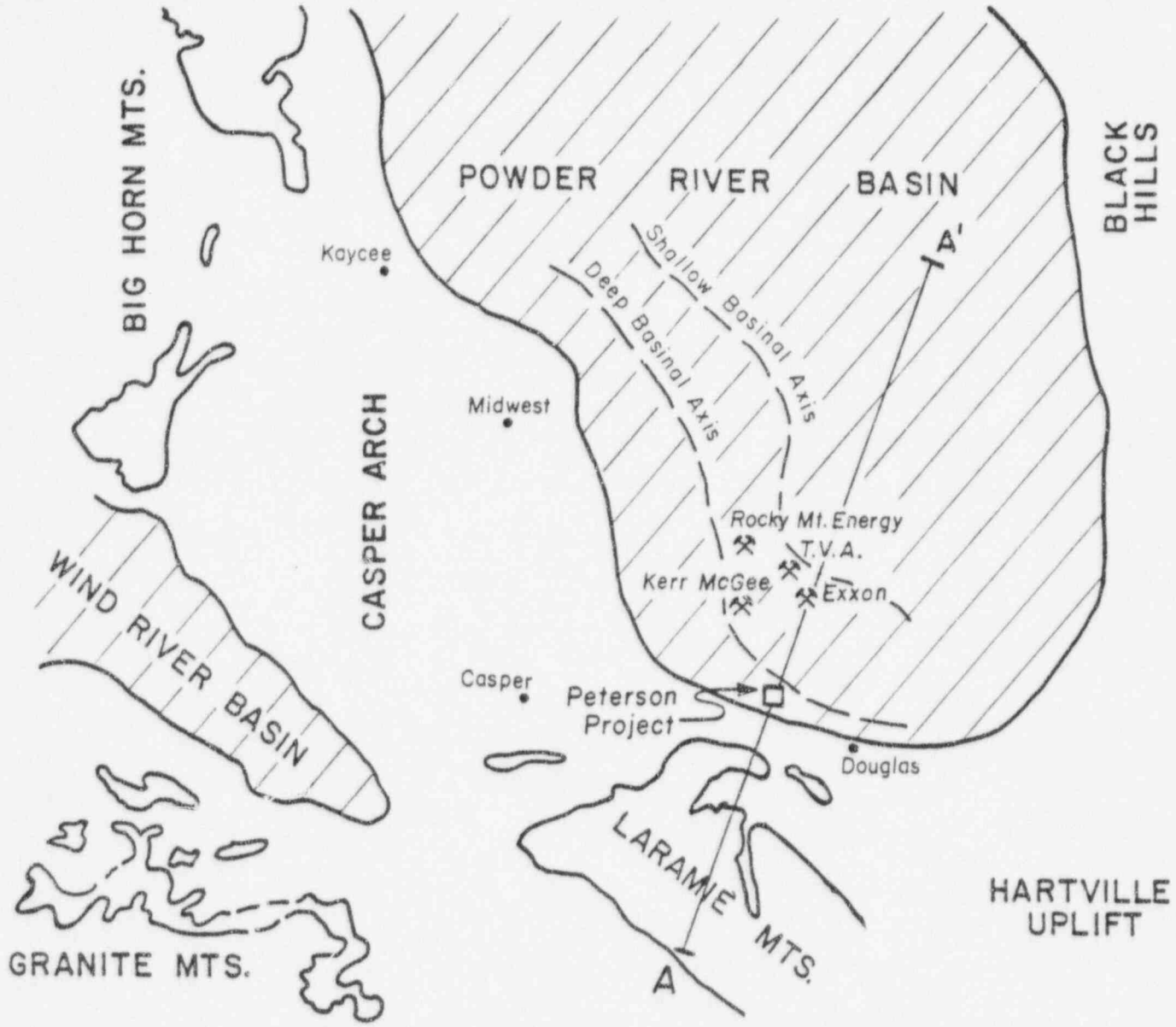
The basin is underlain by continental sedimentary rocks of the Eocene Wasatch and underlying Paleocene Fort Union Formations. These units crop out as a band around the periphery of the basin and dip gently basinward. Older rock units of Cretaceous and Paleozoic Age occur in discontinuous outcrops around the margins of the basin. Consolidated post-Wasatch units are generally grouped into the White River Formation of Oligocene Age. The White River Formation is generally limited to erosional remnants in the Pumpkin Buttes area near the center of the basin and along the eastern and southern margins of the basin.

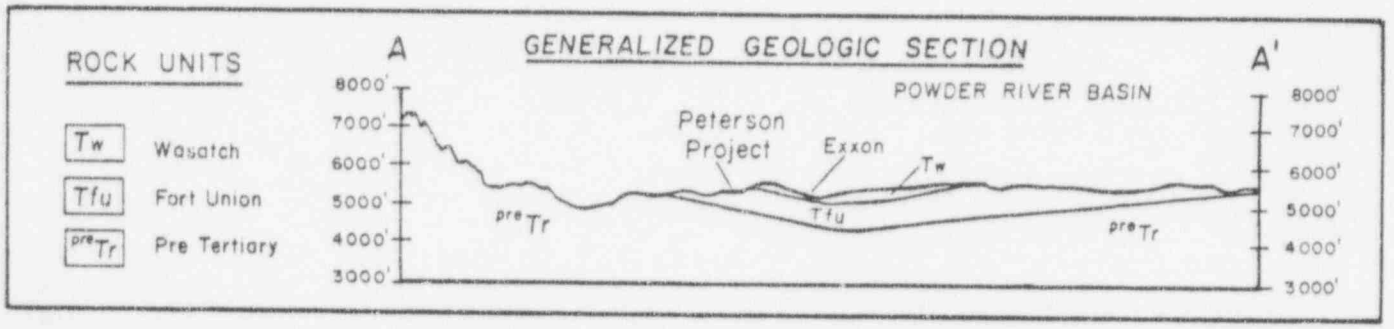
The southern portion of the Powder River Basin, including the Test Site, has been structurally stable since at least early Wasatch time. The dips of the beds in the Wasatch Formation throughout the area range from less than 1.0 degree to as much as 2.5 degrees basinward on the southern, eastern and western fringes. Portions of the Fort Union Formation dip basinward from less than 1.0 degree to, locally, as high as 20.0 degrees.

Structurally, the basin is a north-south oriented asymmetrical syncline with the projected axis trending through the Peterson Project. The depositional axis of the basin trends in a generally northerly direction and is, in part, slightly offset to the east of the axial trace as measured in the "basement" of pre-Cretaceous rocks. The position of the basin's axis has influenced the position and depositional pattern of the sedimentary rocks in the area since pre-Tertiary time.

STRATIGRAPHY

The stratigraphy of the surface rocks of the Powder River Basin and the R&D Site is summarized below. Figure 3.11 presents a stratigraphic column for the basin. A geologic map of the vicinity of the R&D Site is given in Figure 3.12. Geologic sections showing the geology in the near vicinity of the site are shown in Figures 3.13 and 3.14. Details of the geology of the R&D Site are given in Figures 3.15 and 3.15a.





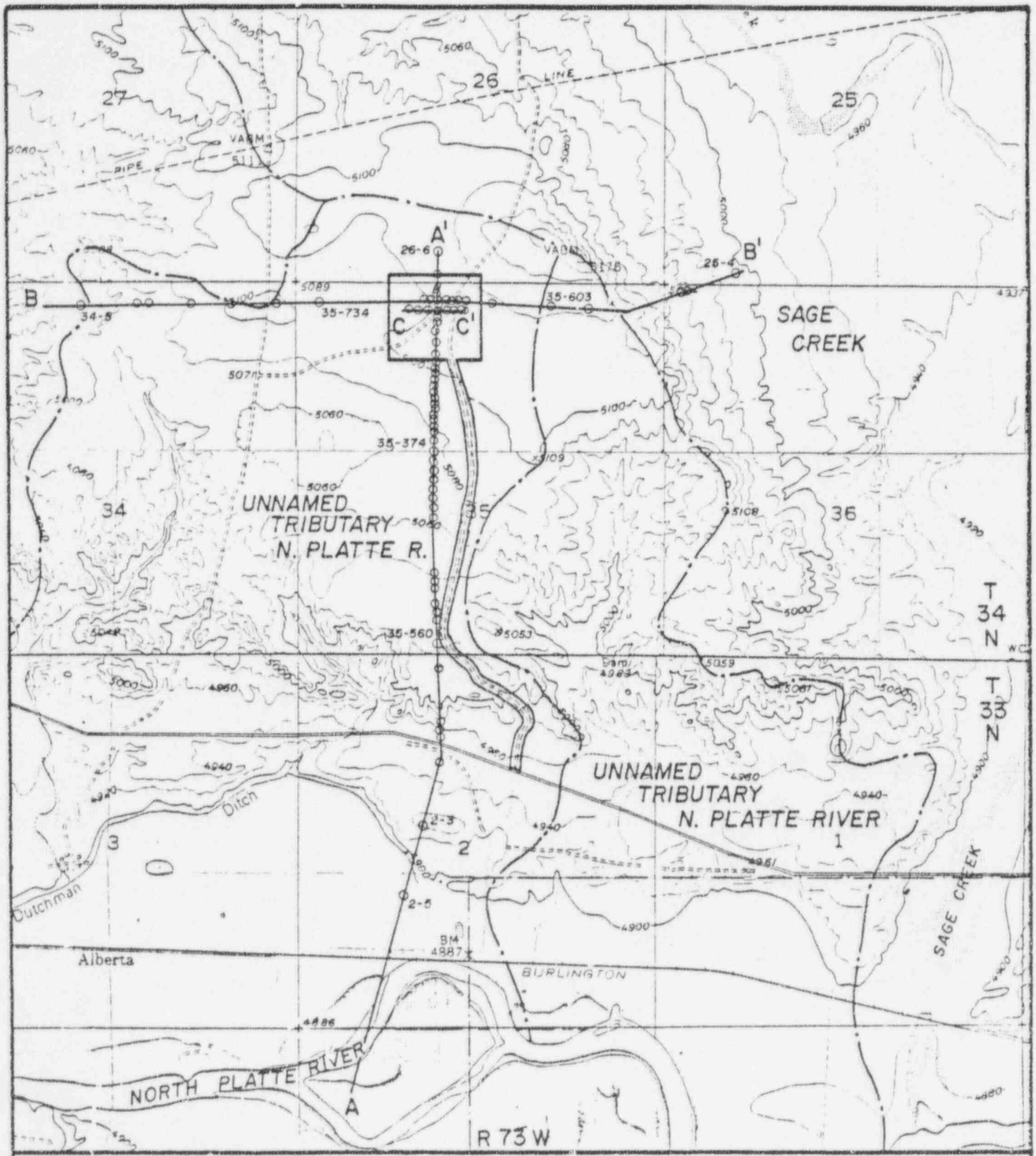
LEGEND

- Pre Tertiary
- Tertiary
- Existing Mine

N

After Galloway 1978

ARIZONA PUBLIC SERVICE COMPANY PHOENIX, ARIZONA	REGIONAL GEOLOGIC FEATURES	
	PREPARED BY: B. J. Hoover	DATE: Feb. 25, 1980
NUCLEAR ASSURANCE CORPORATION GRAND JUNCTION, COLORADO	REVISED:	DATE:
	DRAWN BY: J. E. Gronwall	DATE: Feb. 27, 1980
	SCALE: 1" = 125,000'	FIGURE NO. 3.10
	CONTOUR INTERVAL: N/A	



Base map by U.S.G.S. (Orpha and Gilbert Lake quadrangles)

Drainage basin

O_{2-5} Drill hole on cross section (not all holes are labeled)

N

ARIZONA PUBLIC SERVICE COMPANY PHOENIX, ARIZONA	LOCATION OF GEOLOGIC SECTIONS AND DRAINAGE BASIN MAP	
	PREPARED BY: B. Hoover	DATE: Oct. 9, 1980
NUCLEAR ASSURANCE CORPORATION GRAND JUNCTION, COLORADO	REVISED: B. Ward	Mar. 12, 1981
	DRAWN BY: A. Mayhew	DATE: Oct. 10, 1980
	SCALE: 1" = 2,000'	FIGURE No. 3.15 a
	CONTOUR INTERVAL: 20 feet	

the Test Site and are not included within the proposed scope of testing. Figures 3.13 to 3.15 demonstrate the wide lateral continuity of the mudstones which act as confining layers beneath the area.

No major folds or faults have been detected within the R&D Site and Peterson Project areas during previous subsurface investigations conducted by APS-NAC.
The dip of the Fort Union beds at the Test Site is about 2.0 to 2.5 degrees in a generally northeasterly direction.

3.9 HYDROLOGY

WATER RIGHTS

Records on file in the Office of the Wyoming State Engineer indicate that there are no adjudicated surface water rights within ½ mile (0.8 km) of the R&D Site boundary. A small ephemeral pond used for stock watering when water is present exists just west of the R&D Site in a natural playa depression. No water right of record exists for this water body.

With the exception of hydrologic test wells constructed by APS-NAC and described herein, no wells are registered with the Wyoming State Engineer's Office within ½ mile (0.8 km) of the site boundary. A well inventory in the field confirmed the absence of wells. Well permit numbers for the hydrologic test wells constructed by APS-NAC are provided in Table 3.10, herein.

SURFACE WATER

The R&D Site is located out of any major or minor stream channels at the head of an unnamed drainage, which is eventually tributary to the North Platte River. The North Platte River is located about 1.5 miles (2.4 km) south of the site while Sage Creek is approximately 1 mile (1.6 km) toward the east. Surface drainage from the site does not flow in the direction of Sage Creek (Figure 3.15a).

Surface runoff occurs from snowmelt and high intensity thunderstorms that are frequent during the period from April to July. The relatively low annual

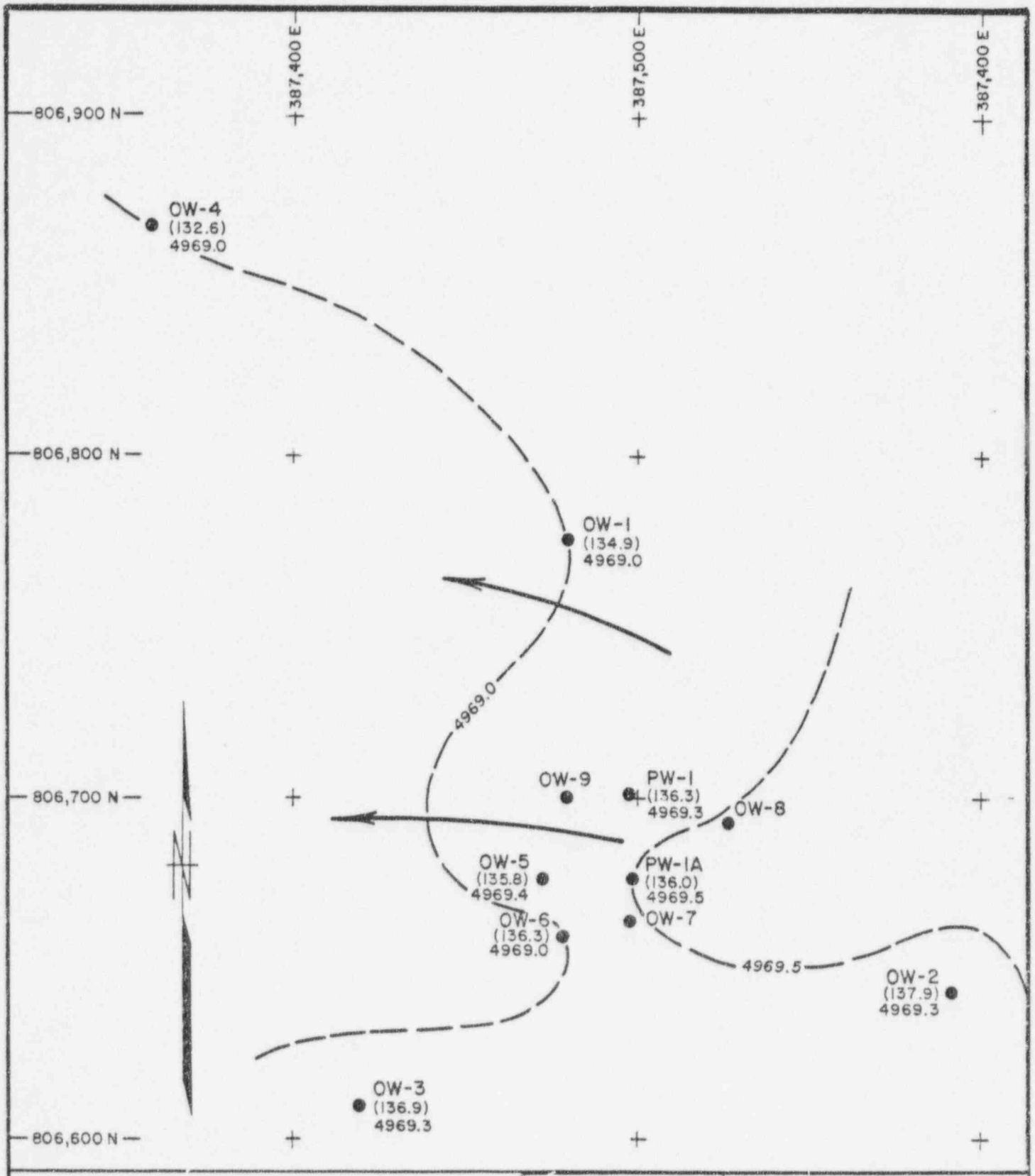
B Aquifer at the Test Site and has been designated Shallow Aquifer. Above this aquifer are several shallower lenticular sandstone layers, however, field tests indicate that these strata are unsaturated. The proposed R&D test will be performed within the B Aquifer.

The ground water that is present is not used for domestic, stock water, or other uses beneath and within ½ mile (0.8 km) of the site boundary. The reasons for this lack of use are not readily apparent although the relatively great depth (180 feet) (55 m) to the first occurrence of ground water, the relatively poor quality of the water as documented elsewhere herein, and the lack of development of this area probably are contributing factors.

Ground water in the aquifers penetrated by wells at the R&D Site is under confined conditions. Although water rises above the tops of the respective aquifers, artesian flows are not present from wells drilled at the site or from exploratory drill holes elsewhere on the Peterson Project. The piezometric levels of the ground water below the land surface at the R&D Site for the various aquifers are approximately: (1) Shallow Aquifer - 98 feet (29 m); (2) B Aquifer - 136 feet (41 m); (3) C Aquifer - 124 feet (37 m); and (4) D Aquifer - 150 feet (45 m).

Piezometric water level surfaces representing water levels in wells completed in the various aquifers at the R&D Site have been visually depicted, herein only for the B Aquifer. For the Shallow, C and D Aquifers only one data point exists which precludes the construction of a significant map. The local piezometric surface for the B Aquifer is shown in Figure 3.15b. Data for static water levels measured in monitor wells penetrating these aquifers have been given in Appendix D-6. These data and Figure 3.15b indicate that the B Aquifer piezometric water level surface is relatively level within the immediate area of the wellfield. For example, the March 6, 1980 water level data show that only a 0.5 foot (0.15 m) variation exists. From the available data, ground water flow may be inferred to be generally toward the northwest and west at the site.

The average hydraulic gradient of the piezometric surface is assumed to be about .005 based on water level data included in Appendix D-6. The hydraulic



LEGEND

OW-1 ●	WELL NUMBER AND LOCATION
(136.0)	STATIC WATER LEVEL DEPTH (in feet)
4969.5	WATER LEVEL ELEVATION (in feet)
4969.0	PIEZOMETRIC LEVEL CONTOUR
	DIRECTION OF GROUND WATER FLOW

0 5 10 20 30 40 50 100 feet

ARIZONA PUBLIC SERVICE COMPANY
PHOENIX, ARIZONA

NUCLEAR ASSURANCE CORPORATION
GRAND JUNCTION, COLORADO

LOCAL PIEZOMETRIC SURFACE
B-AQUIFER
MARCH 6, 1980

PREPARED BY: B. Ward	DATE: Oct. 7, 1980
REVISED:	
DRAWN BY: A. Mayhew	DATE: Oct. 9, 1980
SCALE: 1" = 40'	FIGURE No. 3.15b
CONTOUR INTERVAL: 0.5 feet	

4.0 OPERATIONAL PLAN

4.1 GENERAL DISCUSSION

The proposed activity at the R&D Site is a pilot test and not a commercial in situ extraction operation. Therefore, the pilot test has been designed to accomplish two things:

1. Perform research and development into the feasibility of in situ extraction of uranium.

2. Demonstrate restoration of the aquifer.

The plan outlined herein is based on the best information and projections currently available to APS-NAC. The intent of this plan and application is to allow for adequate flexibility to facilitate research into all viable aspects of commercial development and aquifer restoration within the limitations of existing regulations.

EXPECTED LIFE OF OPERATIONS

The operation of the pilot plant and wellfield is scheduled to start during March, 1982, and last approximately one year. The initial three to four months will involve leaching operations and data compilation needed to evaluate the potential commercial operations. The proposed test will comprise the basic injection and recovery of lixiviant using the leach chemistry, processing details and wellfield patterns as described in subsequent sections of this operational plan. There is no current plan to expand the operations beyond a simple injection and production test by using additional tests based on new or experimental technology. The final eight to nine months will be used to demonstrate ground water restoration. If restoration is demonstrated in less time, the R&D test will be terminated earlier than expected, and the commercial license application may be submitted. On the other hand, a period longer than outlined above may be required to accomplish leaching and restoration.

The construction of site facilities must begin prior to March, 1982. Because the R&D operation will not be winterized, it will be operated during the warmer spring and summer seasons of 1982. Construction must begin by late summer, 1981, to take maximum advantage of the warm weather months during 1982. Since plant construction will require 60 to 90 days, APS desires to

start site preparation no later than August, 1981. A start up by this date should allow construction to be completed before severe winter weather. Therefore, the plant will be ready for operation as soon as weather permit in spring, 1982.

EQUIPMENT LIST

The extraction area at an in situ operation is for all practical purposes the wellfield. The general types of equipment needed to operate the wellfield consist of:

1. Cased water wells
   a. Recovery wells with submersible pumps, pump columns and related electrical equipment.
   b. Injection wells equipped to allow introduction of fluids under pressure.
   c. Wells constructed to allow operation in either of the above modes.
2. Surface equipment in the wellfield including pipes, valves and instrumentation.
3. Electrical supply generators at the plant.

In addition, a process plant, solar evaporation ponds, chemical storage units, office/lab, sanitary leach field and potable water supply well will be constructed.

MINING OPERATIONS IN THE AREA

Currently there are no underground, open pit, or in situ extraction operations known within a radius of approximately five miles (8 km) from the Test Site.

PROTECTION OF OTHER RESOURCES

The proposed extraction activity will not require special provisions to protect other resources in the permitted area. The extraction process is

4.4 SITE FACILITIES

The process plant, office/lab, warehouse, solar evaporation ponds, topsoil stockpile, and wellfield have been located in the south-central and south-eastern portions of the R&D Site (Figure 4.3 and large scale drawing in Appendix D-7). The siting of these facilities was accomplished so as to minimize the amount of earth work required for construction. Total surface disturbance within the site boundary is estimated to be approximately 4.5 acres (1.8 hectares). In addition, it will be necessary to improve the existing access road connecting the Test Site with County Highway 27. Modifications to this road will result in the disturbance of about 9 acres (3.6 hectares) of land, less than one-half of which is new land disturbance.

PROCESS PLANT

The solution processing equipment will be placed on a 40 by 50 foot (12 by 15 m) concrete pad (Figure 4.2). A curb around the perimeter of the pad will prevent potential run off and chemical solutions from leaving the pad. Sumps are provided to collect any solutions that accumulate, and a pump and piping system will carry the liquids to the solar evaporation ponds. Two equal sized gravel surfaced areas each 20 by 25 feet (6 by 7.5 m) are provided adjacent to the plant for drummed reagent and U_3O_8 storage.

The proposed operational schedule calls for operations to begin during the spring season and continue through summer and fall. Currently there are no plans to construct a process plant building for protection from winter weather. The concrete foundation has been designed, however, to accommodate a building if one becomes necessary.

At least 18 inches (46 cm) of topsoil will be removed from the process plant site prior to construction. The volume of topsoil to be removed is detailed by Table 4.2. This soil will be placed on the small stockpile just east of the office and lab area (Figure 4.3). The soil will be broadcast seeded at a rate of 12 lb/acre (13.4 kg/hectare) of western wheatgrass and 12 lb/acre (13.4 kg/hectare) of thickspike wheatgrass, or equivalent seed mixture.

Table 4.2 - Topsoil Stripping Volumes

Project Area	Area Affected (ft^2)	Depth of Stripping (ft.)	Topsoil Volume (yd^3)*
Waste Disposal Ponds	40,600	5	7,520
Facilities Area (includes plant office, lab, warehouse, water well, chemical storage and access road within project area)	33,500	1.5	1,970
Access Road from Highway 27 to Project area	335,000	1.5	18,600
Septic Tank and Leach Field	2,400	1.5	130

* Volumes are expressed in bank yards

SUPPORT FACILITIES

Support facilities will include: office/lab, warehouse, water supply well, sanitary leach field, chemical storage facilities, fence, access road and parking area (Figure 4.3). The office/lab will consist of two or three house trailers attached as a single unit approximately 36 by 60 feet (11 by 18 m) (each modular component 12 by 60 feet) (3.6 by 18 m). In addition to the office and chemistry laboratory, a change room will be housed in this unit. A separate warehouse trailer will be located adjacent to the north side of the process plant.

A water supply well will be located in the area of the topsoil stockpile adjacent to the parking area. The well will supply potable drinking water as well as satisfy process water requirements. The total depth of the water supply well is estimated to be about 450 feet (135 m), with production from the next aquifer (E Aquifer) beneath the D Aquifer. If this proposed source of water below the production zone receiving strata does not prove satisfactory, the well will be deepened or relocated. Details of this well completion will be forwarded to the Wyoming State Engineer's Office.

Also located adjacent to and accessed directly from the parking area are chemical storage facilities for oxygen, carbon dixoide and propane.

Shower, lavatory and sewage wastes will be disposed of in an on-site sanitary leach field adjacent to and northwest of the process plant. Approval of the septic system will be obtained from the WDEQ - Water Quality Division (WQD). Chemical laboratory wastes will be piped to the solar evaporation ponds. Trash and garbage will be collected in suitable containers and hauled to an approved sanitary landfill for disposal.

A sheep tight fence (Type I) (WDEQ - LQD Guideline No. 10) will be placed around the perimeter of the area of operations on the Test Site (Figure 4.3). A deer tight fence (Type II) will be placed around the solar evaporation ponds.

An access road approximately one mile (1.6 km) in length will be required. To minimize land disturbance, the existing road will be used, however, improvements will be required to accommodate increased traffic (Figures 4.4 and 4.5). Eighteen inches (46 cm) of topsoil will be removed and will be stockpiled at three locations along side of the road. The topsoil stockpiles will be accessed directly from the parking area and access road. The stockpile located east of the wastewater ponds will be accessed as shown on Figure 4.3 These stockpile areas will be broadcast seeded at a rate of 12 lb/acre (13.4 kg/hectare) with western wheatgrass and 12 lb/acre (13.4 kg/hectare) with thickspike wheatgrass, or equivalent seed mixture. Because the topsoil will be stockpiled the temporary disturbance will encompass a strip only about 45 feet (15 m) wide including roadway and ditches. A gravel surfaced road 24 feet (7.2 m) wide is planned. This width of road is essential for safe access of large vehicles that will frequent the site. Cattle guard crossings will be placed at the existing fence line just south of the Test Site and at the site entrance. All other access roads are existing.

No power lines are anticipated as power will be generated on-site. Communication lines will be constructed as this service becomes available.

There are no streams or ditches running through the R&D Site. However, erosion control procedures will be utilized as necessary to mitigate any excess surface erosion from the wellfield and plant areas, along the access road, and for diversion around the topsoil stockpiles and solar evaporation ponds. Special emphasis will be placed on controlling erosion at the outflow of the diversion ditch around the ponds. In addition, a small catchment dike will be constructed across the drainage way near the western site boundary to prevent eroded materials from leaving the site.

The primary erosion control technique will be vegetative stabilization. Following soil removal, the disturbed areas will be ripped to relieve compaction. Ripping may not be required in certain areas depending upon the extent of compaction. Fertilizer materials will then be spread over the areas and will be disced and/or harrowed into the soil to provide a seedbed. The seed mixture previously described for use in the process plant area will be spread, and straw mulch will be spread over the seeded sites and anchored as necessary. During operations the vegetated areas will be regularly monitored by plant personnel. Where seeding attempts have failed, the soil surface will be roughened and seeded again using an appropriate method.

SOLAR EVAPORATION PONDS

Two adjacent solar evaporation ponds will contain the waste solutions produced during both leaching and restoration processes (see later discussion and Figure 4.1). There will be no discharge from the ponds. The location of the evaporation ponds is shown on Figure 4.3. Design details of the ponds are presented in Figure 4.6 (large scale drawing of Figure 4.6 in Appendix D-7).

The runoff from the drainage area above the ponds will be diverted around the ponds. The drainage area encompasses approximately 16.07 acres (6.5 hectares), and the design capacity of the diversion ditch is based on the volume of runoff from 100-year 24-hour storms on two consecutive days. This volume of runoff has been calculated to be 76.5 cubic feet per second (cfs) (2.1 m^3/sec) (Appendix D-5). This runoff will be diverted around the solar evaporation ponds.

If the process plant operates as planned at a design capacity of 50 gpm (3.2 lp with a 4 percent bleed for 90 days, the total volume of solution discharged from the process plant to the ponds will be 259,200 gallons (985,000 liters) or 0.80 acre-feet (985 m^3). The estimated pond capacity required for ground water restoration is approximately 0.63 acre-feet (777 m^3) (see Section 5.0). Therefore, the required capacity of the ponds for the R&D test is 1.43 acre-feet (1,750 m^3) if net evaporation is neglected. The total design capacity below free board for each pond is 2.1 acre-feet (2,600 m^3). Therefore, either pond is capable of containing all the waste solutions generated by the process plant in the event repairs become necessary to either pond.

The construction of the two ponds will involve the excavation of approximately 8,850 yd^3 (6,765 m^3) of earthen material. The upper 5.0 feet (152 cm) of topsoil will be removed to the stockpiles. The remaining material and any materials not classified as topsoil occurring at depths of less than 5.0 feet will be used for berm construction. Earthen material used for berm construction will be compacted to a density of 90 percent maximum density as determined by the modified American Association of State Highway Officials (AASHO) (ASTM D1557-70) test method. The ponds will have approximately 3:1 side slopes and will maintain at least one foot (30 cm) of free board when filled to capacity (4.2 acre-feet) (5,200 m^3).

Prior to construction, five feet (152 cm) of topsoil will be removed from the pond site. This material will be stockpiled to the east of the pond area and broadcast seeded at a rate of 12 lb/acre (13.4 kg/hectare) with western wheatgrass and 12 lb/acre (13.4 kg/hectare) of thickspike wheatgrass, or equivalent seed mixture. The pond berms will also be broadcast seeded as described above.

Topsoil beneath the test site is relatively thick, averaging five feet in depth. Because of the difficulty of achieving a workable construction materials balance if five feet of topsoil is removed from beneath both the pond floors and berms, the removal of only two feet of topsoil is proposed beneath the berms. Five feet of topsoil will be removed beneath the pond floors. To prevent the contamination of topsoil remaining in place beneath

the berm special precautions will be taken. Prior to installation of the leak detection system, the in-place soils will be compacted and covered with approximately one foot of compacted subsoil along the sides of the ponds. Over the compacted layers three inches of bentonite will be compacted along the walls of the ponds adjacent to in-place topsoil.

Following preparation of the berms and pond floors a leak detection system will be installed. The system will consist of 3 inch (7.6 cm) diameter PVC pipe slotted on the top and sides and installed around the perimeter and across the pond floors on a grid pattern (Figure 4.6). The pipe will be imbedded in a gravel sand at an elevation 6 to 12 inches (15 to 30 cm) below the pond base. The pipe will slope at 1/16 inch per foot so that its lowest elevation will occur at the corner of the pond nearest the inspection sump. An unperforated pipe will connect the piping system to the base of the inspection sump located on the outer side of the berms (Figure 4.6). The inspection sump will have a diameter of approximately 24 inches (61 cm) and will be covered with a removable cap at the top. A separate leak detection system will be installed for each pond.

After the leak detection system is installed, the pond bottoms will be finish-graded and covered with a 36 mil (.036 inch) (.09 cm) thick impervious Hypalon liner, or equivalent. The liners will be formed to the pond contours and will be anchored at the top of the berms in backfilled trenches.

During testing operations, the leak detection system inspection sumps will be checked at two week intervals to insure that the pond liner is not leaking. Liquid effluent wastes being discharged to the ponds will be sampled at the same frequency. The effluent waste solutions will be analyzed for calcium (Ca), chloride (Cl), sodium (Na), sulfate (SO_4), uranium (U_3O_8 alkalinity, specific conductance and pH. If water is detected in the inspection sump, this sample will be analyzed for the same constituents to attempt to determine if the water in the stand pipe may be derived from leakage of liquid wastes. It is expected that the inspection sump will be dry. If pond leakage is detected, however, the water in the leaking pond will be transferred to the adjacent pond, and the leak will be repaired.

4.5 WELLFIELD

A wellfield area of approximately one and one half acres (0.6 hectares) has been designated just west of the process plant (Figure 4.3). Within this area two wellfields will be constructed on a smaller area not to exceed one acre (0.4 hectare). Injection and recovery wells in both wellfields will be open to the B Aquifer. The B Aquifer production zone ranges between approximately 220 and 260 feet (66 and 78 m) in depth below the land surface. The injection and recovery wells will be selectively screened at the ore depth within this interval. The proposed well locations are given in Figure 4.7. The geologic rock units comprising the producing zone (B Aquifer) have been previously delineated in Figures 3.13, 3.14 and 3.15. A significant factor in the final siting of the wells within the area designated on Figure 4.3 will be the ore distribution encountered during the drilling of the initial wells. Specific access routes to and within the wellfield have been designated in Figure 4.3 and vehicular traffic will be limited to these routes.

WELLFIELD PATTERN

Within the wellfield area, two separate wellfields will be tested simultaneously. Within each wellfield, two five-spot patterns will be placed adjacent to each other so that two injection wells are shared by the two five-spot patterns in each wellfield (Figure 4.8). If only a single five-spot pattern is considered, four injection wells will form a square around the recovery well. However, for the overall wellfield six injection wells will be constructed in a rectangular configuration with dimensions as shown below. Although initially designated as injection and recovery wells, all of the wells will be capable of functioning for either purpose throughout the test. A generalized representation of anticipated injection fluid flow paths is shown on Figure 4.8.

The exact dimensions of the wellfields may vary depending on conditions encountered in the field. Current plans are for injection wells at one wellfield to be spaced on a 35 by 35 foot (10.5 by 10.5 m) square for a single pattern (two adjacent patterns are 35 by 70 feet) (10.5 by 21 m). This wellfield will be called Wellfield No. 1. Injection wells in the second wellfield will be spaced on a 70 by 70 foot (21 by 21 m) square (two adjacent patterns are 70 by 140 feet) (21 by 42 m). This wellfield will be called Wellfield No. 2.

Access roads through the well clusters have been identified in Figure 4.3. Traffic will be restricted to these roads.

If new investigations are found desirable during the operation of the wellfields, APS-NAC may desire to construct an additional pattern within the one acre (0.4 hectare) area limitation. The anticipated pattern would likely be the five-spot array, however, the exact dimensions would depend upon the desired information to be obtained.

Monitor wells open to the B Aquifer will be placed as shown on Figures 4.7 and 4.8. If the placement of the well patterns justifies, a few wells in the hydrologic test wellfield may also be used for B Aquifer monitor wells. In

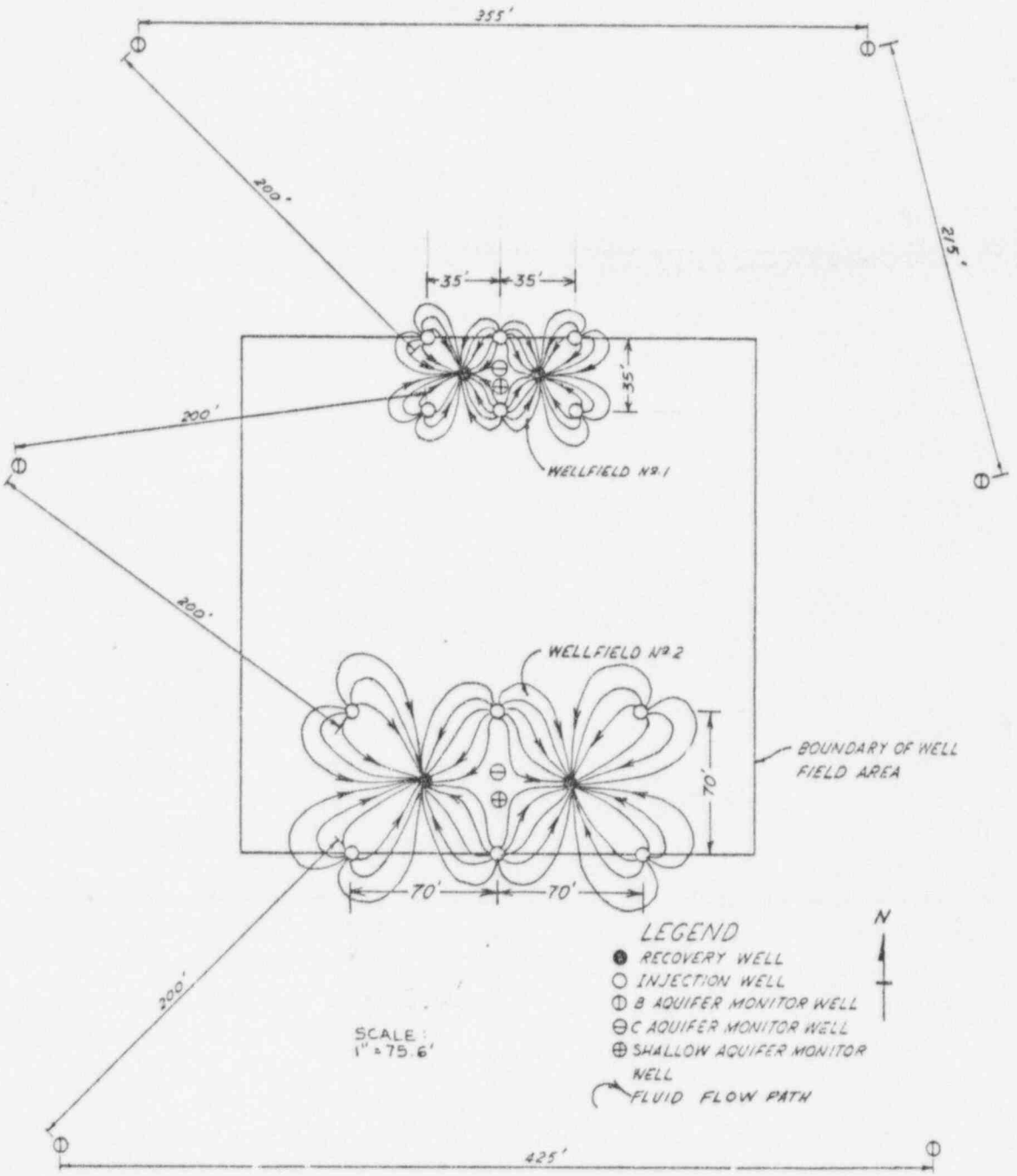


FIGURE 4.8

WELL PATTERN LAYOUT AND GENERALIZED FLUID FLOW PATHS

addition to the B Aquifer, monitor wells will be placed in the C Aquifer and Shallow Aquifer (Figures 4.8 and 4.9). All monitor wells constructed will be completed and developed prior to leach solution injection.

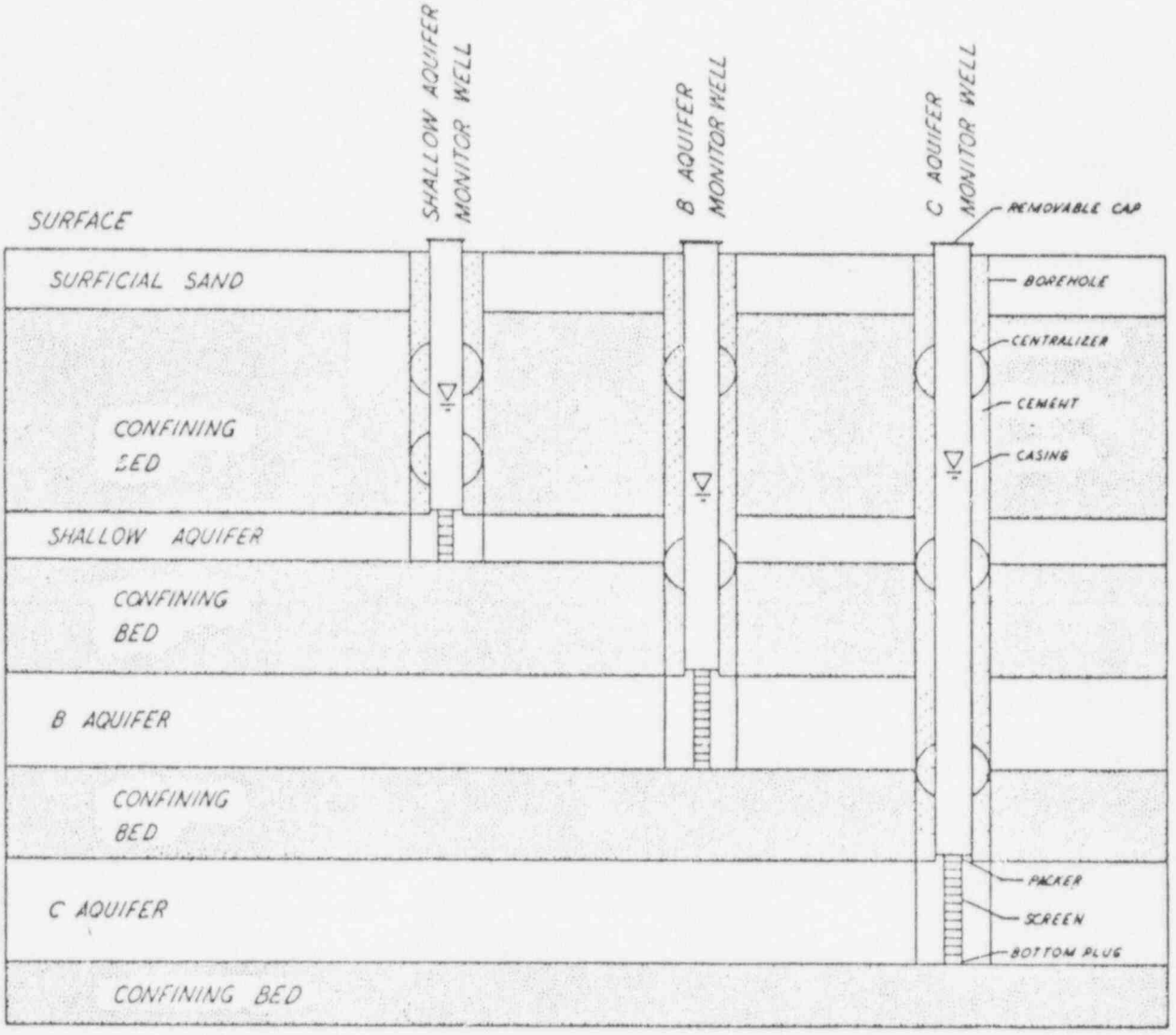
WELL COMPLETION

Several well completion procedures and casing materials may be used during the pilot test for production and injection wells. The well construction methods that will receive greatest attention are shown in Figures 4.10, 4.11 and 4.12. As these well construction methods are used, summaries of the well completion data for each well will be forwarded to the State Engineer so as to maintain acceptable documentation of project activities.

The well construction methods are not necessarily numbered herein in order of preference. Method No. 1 (Figure 4.10) involves the perforation of blank casing after it is cemented in the ground. This method involves the drilling of a pilot hole and then geophysically logging this hole. The hole would next be reamed to the optimum diameter and casing set and cemented in the hole. Next an abrasive water jet or mechanical technique would perforate the casing in the producing interval, and the well would likely be developed by air lifting and pumping.

Method No. 2 (Figure 4.11) also involves the drilling and logging of a pilot drill hole and subsequent reaming of this hole. A string of casing with a length of screen attached at the lower end would be lowered into the hole. A cement basket will be attached to the blank casing just above the screen. Cement will be pumped down the inside of the casing to a plug just above the screen, out weep holes at the base of the casing, and will be directed by the cement basket back to the surface through the annulus. Subsequently, the residual cement and plug will be drilled out, and the well will be developed.

Method No. 3 (Figure 4.12) involves drilling a pilot hole through the ore zone, logging the hole, and reaming the hole to the top of the ore zone. Casing will then be set in the reamed hole and cemented in place. Next the residual cement will be drilled out, and drilling will continue through the



SCHEMATIC
NOT TO SCALE

NOTE:
WELL CONSTRUCTION METHOD NO. 2 SHOWN; METHOD NO. 3 MAY ALSO BE USED.
▽ STATIC WATER LEVEL

FIGURE 4.9
MONITOR WELL DESIGN

production zone. Then screen will be telescoped through the casing and selectively set opposite the production zone. Well development will again be accomplished by air lifting and pumping. Upon completion of well development, the wells will be ready for injection or recovery of leach solution.

Several types of casing may be used, however, preference will be given to CPVC (Yelomine) or fiberglass construction materials. The diameter of a typical well may likely range between 4 to 6 inches (10 to 15 cm).

Monitor wells will likely be constructed by either Method No. 2 or Method No. 3, above. It is possible that the monitor wells will utilize Schedule 40, PVC for casing material.

MECHANICAL INTEGRITY

Before leach solution injection begins, field testing of the injection and recovery wells will be performed by pressure-packer tests or other acceptable methods to demonstrate mechanical integrity of the well casing. Initially, the pressure-packer test will be used. This test will involve the setting of packers inside the casing at the top and bottom and creating pressure in the casing between the packers.

Specifically, the upper packer will be set a short distance below the well head, and the lower packer will be placed directly above the well screen. Compressed air will be discharged under pressure into the well casing between the two packers until no more than 90 pounds per square inch (psi) is reached. This well head pressure will be used to insure that bottom hole pressure in the wells does not exceed 200 psi. This value is chosen because it represents the lowest pressure rating for casing materials that will be used. When this approximate 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 period. If the pressure remains constant, the well casing will be determined to be mechanically sound. The pressure of 90 psi described above is greatly in excess of the maximum expected injection pressure. Preliminary tests indicate that fluid injection may be accomplished under gravity flow.

If the pressure does not remain constant, the well casing may be checked for cracks or holes by down hole TV or other methods. When possible, the

well will be repaired, and the packer test will be repeated. If the well casing leakage cannot be repaired or corrected, the well will be plugged and reclaimed as described in Section 5.1 of this application report.

APS-NAC will make available at the site to the WDEQ-LQD, data that describes all mechanical integrity tests and their results after this testing is complete. In addition, the WDEQ-LQD will be notified when the wells initially failing tests have either been repaired or plugged.

Initially, the testing of all wells for mechanical integrity is proposed. However, through the use of the mechanical integrity tests it is intended to demonstrate to WDEQ that the well contruction materials and techniques used will result in a very high confidence level as to the mechanical integrity of the wells. Therefore APS-NAC intend to ultimately propose an alternate plan that would not require the testing of all wells for mechanical integrity.

ABANDONED EXPLORATION DRILL HOLES

Before start-up of leaching, the location and abandoned condition of exploration drill holes will be verified within 200 feet of wellfield Nos. 1 and 2. APS records show that 37 drill holes occur within this area. The average depth of these drill holes is 280 feet and none of them penetrate deeper than the B Aquifer. Where it is determined to be necessary and where the drill holes can be located, the holes will be plugged with bentonite slurry meeting the specifications of Chapter VX WDEQ-LQD Rules and Regulations.

LEACH SOLUTION CIRCULATION

Initially, formation water will be pumped from the recovery wells in the wellfield area and transferred through a pipeline to the process plant. At this point chemicals and an oxidizer will be added to the formation water, and the resulting leach solution will be returned to the wellfield injection wells. Following injection, the pregnant solution will be pumped from the recovery wells and transferred back to the process plant. After processing and chemical make-up, the leach solution will be recirculated as described.

The solution will be circulated with a bleed of waste solutions to the solar evaporation ponds. This solution bleed will be maintained by pumping more solution from the B Aquifer than is injected. Therefore, the underground process will be operating in a positive hydraulic cone of depression in which solutions surrounding the pumping wells will be drawn inward toward those wells.

LEACH SOLUTION EXCURSION

Detection

As previously discussed, monitor wells will be located in the producing zone (B Aquifer) around the perimeter of the wellfield area. A total of six monitor wells will be located in the B Aquifer, two wells in the C Aquifer below, and two wells in the Shallow Aquifer above (Figures 4.8 and 4.9). However, construction of shallow and deep aquifer monitor wells for each wellfield pattern should not necessarily mean that shallow and deep wells will be required for each pattern within a production - scale wellfield.

Prior to start-up of leaching, baseline water quality in each of the monitor, injection and production wells will be established. The data will be used for calculating excursion parameter upper control limits and establishing the occurrence of potential excursions as defined in the following section. The baseline quality and control limits will be based on sampling each well on at least three separate occasions within a two week period prior to start-up of leaching. The samples collected will be analyzed for the excursion parameters listed in the following section. Before the collection of each water quality sample, water levels will be recorded. Emphasis during sampling will be placed on the actual pattern and monitor wells rather than wells outside the wellfield area such as the hydrologic test wells.

During extraction operations, a water sample from each monitor well will be collected once every two weeks. The concentrations of the excursion parameters will be determined and compared to the upper control limits as described in the following section. Water levels will be recorded prior to obtaining water samples as described above and reviewed for indications of excursions.

Chemical analyses will be performed in the on-site laboratory. Standard methods will be used for excursion parameter analyses.

Excursion Parameters

The proposed leach solution will be composed of $NaHCO_3$ - Na_2CO_3. The

mineral to be extracted contains uranium. Oxidation of uranium ore is generally accompanied by an increase in sulfate concentrations. Chloride will likely increase because of a gradual buildup inherent in the leaching process. The total dissolved solids (conductivity) within the producing zone is also expected to increase. Therefore, the chemical species that will be excursion parameters for the R&D test will be:

Sodium (Na)
Chloride (Cl)
Specific Conductance
Sulfate (SO_4)
Uranium (U_3O_8)

Upper control limits (UCL) will be defined for all the excursion parameters in all monitor wells before start-up of leaching. The upper control limits will be an important factor in defining the occurrence of an excursion during the test.

Upper control limits as defined herein are chemical parameter values with a 20 percent chance (probability) of representing natural gound water quality. These values will be determined by selecting the factor from a Cumulative Student 't Distribution (Percentage Point) (Meyer, 1975) for a sample size of 1 and a probability of .8. The value given in the Cumulative Student t Distribution Table is 1.38. This value will be multiplied by the population standard deviation and the answer added to the population mean. The resulting chemical parameter value (UCL) has a 20 percent chance of representing natural ground water quality. Based upon these statistics, the UCL for each excursion parameter should be observed 20 percent of the time (1 sample out of every 5) when sampling monitor wells.

The probability that two excursion parameters will simultaneously exceed their respective UCL will be .04 (.20 x .20). This result should be observed 4 percent of the time when sampling monitor wells. Likewise, the probability that two consecutive samples will have any two excursion parameters exceed their respective UCL will be .16% (.04 x .04).

Consequently, if two consecutive samples have any two excursion parameters (they do not have to be the same two parameters) exceeding their UCL, then it is likely that an excursion will exist.

The proposed monitor wells discussed previously will be constructed in advance of the leaching operations to be able to document upper control limits for the excursion parameters in each well. Since data are not currently available, upper control limits and supporting data will be provided to the WDEQ - LQD before start-up of leaching.

Based upon the above analysis, the following excursion detection procedures will be used:

1. Monitor wells will be sampled once every two weeks. The static water level will be recorded before pumping at least two casing volumes prior to a sample collection.

2. If any two parameters from a well exceed their respective UCL, an additional sample will be collected from this well within 24 hours. In addition, the static water level measurements will be compared to previous readings for significant variations.

3. If the sample collected after 24 hours, as described in Item 2 above, also contains at least two parameters above their upper control limits, an excursion will be identified.

4. The WDEQ - LQD will be notified within 48 hours that an excursion has occurred, and the excursion parameter concentrations and the well(s) in excursion status will be reported.

If an excursion is detected, the following procedures will be implemented:

1. Reorder the wellfield balance and change the well functions to an equilibrium determined to be consistent with the experience gained at the site. Sample the affected well at least once per week and analyze for the excursion parameters.

2. After six weeks of excursion status increase the solution bleed to a level determined from the operating experience. If the excursion is occurring in the Shallow Aquifer, reduce injection pressure head to a level below the static water level of the Shallow Aquifer.

5.0 RECLAMATION

5.1 AQUIFER RESTORATION

WATER QUALITY CRITERIA

Based on currently available ground water quality information collected at the hydrologic test site, it appears that ground water in the B Aquifer is not suitable for human consumption. Section 3.9 provides a list of several chemical parameters whose concentration levels exceed recommended drinking water standards. In addition, the water appears to be only marginally suitable for livestock and wildlife watering and crop irrigation. The water quality sampling of monitor wells to establish baseline conditions prior to leaching will determine if the water fits these latter use categories.

Based on the data contained herein, the ground water restoration program is designed to attempt to return the water quality of the affected zones to a chemical quality consistent with the present water quality. If the water is subsequently shown to be suitable for watering livestock or crop irrigation, it will be returned to a quality consistent with the standards for these use categories. Based on the currently documented poor water quality of the B Aquifer, water use categories should not be a determining factor for restoration.

Restoration criteria for individual chemical parameters in specific water use categories are not provided herein because: (1) current information indicates that the water is not suitable or only marginally suitable for any use category, and (2) specific data are not yet available for the monitor wells to define the quality of water beneath the wellfield. When the data become available, they will be reviewed to determine any potential water use. If the water fits a use category, the WDEQ-LQD will be provided with a list of chemical parameters and their recommended minimum concentration levels to be used as restoration criteria. If no criteria concentration value is listed for a particular parameter or water use as determined by

water quality standards or criteria (Table 3.13), the recommended restoration concentration level will be the initial mean concentration plus 20 percent of the initial mean concentration. This value will be defined as the baseline value for establishing the goal of water quality restoration.

If the results of the pre-leaching water quality sampling show that the water does not fit any use category, the water quality standards and criteria for specific water use will not be considered for restoration. In this instance, restoration will be based on the initial statistical mean for individual parameters calculated from samples plus 20 percent of the initial mean concentration. As stated above, this value will define the baseline value for establishing the goal of water quality restoration.

Restoration will be achieved when the average concentration of chemical parameters analyzed from samples collected from randomly selected injection, recovery, and monitor wells is equal to or less than the criteria levels, as determined above. It is APS' understanding that when the water quality of the affected zone meets the set criteria, the requirements pursuant to the definition of restoration provided by WS 35-11-103 (f)(iii) have been met.

Before ground water restoration begins, the WDEQ-LQD will be notified so that a representative may be sent to the site to ensure that restoration efforts meet all conditions specified by this application report.

RESTORATION METHOD

APS proposes to initially select Wellfield No. 1 (overall dimensions 35 by 70 feet) (10.5 by 21 m) for demonstration of restoration. Wellfield No. 2 (70 by 140 feet) (21 by 42 m) will be incorporated into the commercial scale wellfield for additional leaching if all of the ore is not recovered during the R&D test. If commercial operations are not feasible, Wellfield No. 2 will be restored following restoration of Wellfield No. 1. If the project proves feasible, APS intends to submit the commercial in situ extraction permit application following restoration of Wellfield No. 1.

The initial method to be used for ground water restoration will be ground water sweep. If additional treatment is necessary, a reverse osmosis unit will be used to filter the contaminants out of the discharge water. This improved ground water will be recycled through injection wells into the affected zones and recovered by pumping. The fresh water recycle approach will very likely be used in combination with ground water sweep.

As indicated above, the dimensions of the well pattern to be restored will be about 35 by 70 feet (10.5 by 21 m). The ore thickness averages approximately eight feet, and the formation porosity is about 27 percent. Assuming an average leaching sweep of 20 percent in the three dimensions, the volume of ground water contained in one pattern pore volume in the B Aquifer is:

$$\text{Volume} = .27(35 + .20(35))\ (70 + .20(70))\ (8 + .20(8))\ \text{ft}^3$$

$$= 9{,}145\ \text{ft}^3$$

$$= .21\ \text{acre-ft/pore volume}\ (259\ \text{m}^3/\text{pore volume})$$

Because applicable field data have not yet been obtained, it is currently estimated that as many as 10 pore volumes of ground water may have to be flushed through the wellfield pattern to accomplish ground water restoration. A net withdrawal of ground water of 3 pore volumes during the ground water sweep phase is estimated, or a total of 0.63 acre-feet (777 m^3). During the clean water recycle phase a maximum of 7 pore volumes will consist of a brine stream resulting from the operation of the reverse osmosis unit. The solar evaporation ponds have been designed to contain the 2.1 acre-feet (2,560 m^3) of water discharged during restoration.

Although APS-NAC currently estimate as many as 10 pore volumes may have to be flushed through the wellfield pattern to accomplish restoration, it is understood that additional pore volumes, perhaps 12, may be required to achieve chemical restoration criteria. Conversely, the data may indicate that restoration criteria have been met after circulation of, say, 6 pore volumes.

Depending upon information and experience gained during ground water restoration testing, alternative methods may be implemented to improve ground water restoration. During the restoration period APS-NAC will collect water samples from the leached zone once every four weeks to monitor the progress of restoration.

After completion of ground water restoration, APS-NAC will collect water samples from the leached zones once every four weeks over a period of at least four months to determine if the concentrations of the chemical parameters of the ground water have stabilized. If chemical stabilization has not occurred after four months, additional monitoring may be necessary. When chemical stabilization is achieved, and after such stabilization is agreed to by the Wyoming Department of Environmental Quality and U.S. Nuclear Regulatory Commission, ground water restoration shall be deemed completed.

Subsequent to the completion of ground water restoration, all injection and recovery well casings will be filled with a bentonite slurry to a level seven feet (2.1 m) below the land surface. The bentonite slurry will meet the specifications of Chapter VX of the WDEQ-LQD Rules and Regulations. Next, a plug will be placed at least seven feet (2.1 m) below the land surface, and the hole above the plug will be filled with cement to within two feet (60 cm) from the land surface. The well casing will then be cut off at least two feet (60 cm) below land surface, and the remaining hole will be filled with soil. Any well not reclaimed in this manner will remain as a water well and will be permitted with the Wyoming State Engineer.

The Wyoming State Engineer will be given the location of the wellfield areas and the range of depths of the production zones prior to bond release.

5.2 SURFACE RECLAMATION

After ground water restoration is completed, the land surface of the R&D Site will be reclaimed. The reclamation will be performed on all disturbed areas of the site including the wellfield, building areas, ponds and roads.

In the wellfield area the water wells will be abandoned as described in the previous section. The land will then be scarified and prepared for seeding.

The solar evaporation ponds will be allowed to dry out. The dried solid residue remaining on the floor of the ponds and liners will be surveyed for gamma radioactivity. If from this survey and the periodic monitoring of process plant effluents the U. S. Nuclear Regulatory Commission and/or Wyoming Department of Environmental Quality determine that a significant (twice background concentration levels) radioactive waste is present, arrangements may be made to remove the residue and pond liners and dispose of them at a licensed tailings facility or other approved location. If commercial operations are conducted on the Peterson Project, the waste residues and liners will be disposed of in that commercial tailings disposal facility. Following removal of the liners, a gamma radioactivity survey will be performed on the earthen material beneath, and any contaminated material will be removed.

If the pond materials are not found to be significantly radioactive, the pond liners will be folded into the floor of the pond along with the process plant foundation. The pond area will then be regraded with the stockpiled material. Due to the small size of the disturbed area (primarily the pond site), the final contour of the affected area should be essentially the same as the original contours. Therefore, Figure 3.5 is referenced as the final contour map.

The process plant will be dismantled and removed from the site. Office and warehouse trailers and other support equipment will also be removed. The process plant foundation if not contaminated by significant gamma radioactivity will be broken into segments and disposed of in the pond area. This material will increase by only 78 yd^3 the amount of solid material, that will be backfilled into the ponds. This increased volume represents only two percent of the total soil materials that will be backfilled.

Before recovering the area with topsoil, a gamma radiation survey using equipment and procedures similar to those described in Section 3.7 will be

performed on all disturbed areas. The scintillometer used for the survey will be calibrated against baseline values from unaffected lands as shown on Figure 3.9. If gamma radiation is detected at levels significantly higher than shown in Figure 3.9, the contaminated material will be removed to a licensed tailings disposal facility.

Following removal of the facilities, the access roads and building site will be deeply ripped and retopsoiled with at least 18 inches (46 cm) of topsoil. The evaporation pond area will be regraded with at least the five feet (152 cm) of topsoil stockpiled during the project. The topsoil will be regraded approximately parallel to the existing contours.

The off-site access road may be either reclaimed or left for the land owner if he desires. The final decision for the reclamation technique will be made near the close of R&D operations. If the road is reclaimed it will be deeply ripped after the removal of the gravel base to relieve compaction before retopsoiling. The cost of reclamation has been included in Section 5.3. At the request of the surface land owner this road will be left for his use and documentation will be provided to WDEQ-LQD.

The following revegetation program will take place on each of the disturbed areas once the topsoil has been replaced, contoured and spread in satisfactory fashion, and the area is ready for planting. Planting will be completed either before mid-May or in the fall after mid-October in order to utilize the most advantageous soil moisture conditions. Seed will generally be drilled into the soils and the areas subsequently mulched, preferably with native hay, or straw if hay is not available. The following mixture and amount of percent live seed (PLS) is recommended:

Prairie sand reed (two pounds per acre) (2.2 kg/hectare).
Indian rice grass (two pounds per acre) (2.2 kg/hectare).
Green needle grass (two pounds per acre) (2.2 kg/hectare).
Sheep fescue (one pound per acre) (1.1 kg/hectare).
Slender wheatgrass (one pound per acre) (1.1 kg/hectare).
Streambank wheatgrass (one pound per acre) (1.1 kg/hectare).

Thickspike wheatgrass (one pound per acre) (1.1 kg/hectare).
Western wheatgrass (one pound per acre) (1.1 kg/hectare).
Blue Grama (one pound per acre) (1.1 kg/hectare).

Following planting, the mulch will be spread and anchored to the disturbed areas.

To protect the revegetated areas from grazing animals, the site boundary fence will be left in place for two years. Grazing animals will be restricted from the area. If the site access road is reclaimed, grazing animals may be restricted from the general area for two years by using existing fencing, however, it is more likely that the road area will be fenced and grazing animals will be restricted from the local area of the road.

APS is currently performing a comprehensive study of vegetation productivity on the Peterson Project. The results of that study will become available prior to reclamation of the Test Site. The area will have been satisfactorily revegetated when the revegetation characteristics of the disturbed areas are equivalent to the baseline vegetation conditions documented by the comprehensive study.

5.3 BONDING

AMOUNT

A Research and Development License Performance Bond will be submitted to the WDEQ-Land Quality Division prior to start up of operations. The amount of the bond will be based on the estimated cost of reclamation as follows:

	Unit Cost	Total Cost
Ground water restoration	--	$20,000
Well plugging (26 wells)	$300/well	7,800
Building and equipment removal	--	3,000
Backfilling and grading pond area (10,400 yd^3)	$0.50/$yd^3$	5,200
Scarifying wellfield and on site access road (2.0 acres)	$250/acre	500
Retopsoiling building, pond and on site access road areas (1,900 yd^3)	$0.75/$yd^3$	1,400
Retopsoiling access road (18,600 yd^3)	$0.75/$yr^3$	13,950
Seed mix (11.5 acres)	$75/acre	860
Planting (11.5 acres)	$50/acre	575
Mulch (2 tons/acre) and spreading (11.5 acres)	$350/acre	4,025
Total		$57,310

RELEASE

The Research & Development License Performance Bond shall be released by the Wyoming Department of Environmental Quality-Land Quality Division to APS when at least 12 aquifer pore volumes of ground water have been circulated through all wellfields installed or when the ground water restoration goals have been achieved; and when the surface reclamation plan (Section 5.0) is completed in its entirety.

It is APS' understanding that the ground water restoration criteria and the bond release procedures used for this R&D operation in no way serve as a precedent for any future commercial scale In Situ Mining Permit application. An application for a commercial scale operation will stand on its own merits.

Before bond release APS will submit a written report to the WDEQ-LQD and NRC to:

1. Summarize operational scheduling with respect to environmental decisions.

2. Summarize all environmental monitoring data collected in conjunction with the R&D test.

3. Summarize restoration procedures and report the results achieved using the restoration methods attempted.

4. Document the extent and success of ground water restoration.

Number*	Owner	Lands on and Within ½ Mile of R&D License Area
8 OG	Elf Aquitaine, Inc. 950 Threadneedle, Suite 200 Houston, Texas 77079	SE¼ NE¼ Sec. 34; a fraction of E½ E½ W½ NE¼ Sec. 34; a fraction of NE¼ SE¼ Sec. 34; a fraction of E½ E½ NW¼ SE¼ Sec. 34; S½ NW¼ and N½ SW¼ Sec. 35; T34N, R73W; NE¼ NE¼ Sec 2, T33N, R73W
9 OG	Donald D. Anderson LTD P. O. Box 1 Roswell, New Mexico 88201	A fraction of W½ W½ W½ SW¼ Sec. 36, T34N, R73W
	Mineral (coal)	
1 MC	Extractive Fuels, Inc. P. O. Box 9[illegible] Casper, Wyoming 82602	A fraction of W½ W½ W½ Sec. 36, T34N, R73W
	Pipeline Easement	
1 PE	Continental Oil Company 555 17th Street Denver, Colorado 80202	A fraction of N½ SW¼ Sec. 26; a fraction of N½ SE¼ Sec. 27, T34N, R73W
2 PE	McCulloch Interstate Gas Corp. P. O. Box 3099 Casper, Wyoming 82602	A fraction of E½ E½ W½, SE¼ Sec. 27; a fraction of E½ E½ W½ NE¼; a fraction of E½ E½ NW¼ SE¼, T34N, R73W

* Number refers to area designated on Figure 2.3.

Form C-2

Appendix "C"

Bearing and Distance Description

This appendix "C" represents the location of lands by legal subdivision, section, township, range, county, and municipal corporation, if any, (W.S. 35-11-406,(a),(vi)) and the number of acres in each bearing and distance description. No mining activity may take place on land for which there is not in effect a valid mining permit (W.S. 35-11-405). To include additional lands within a permit area it is necessary to amend the permit (W.S. 35-11-406,(a),(xii)), so care should be taken to include all lands necessary to the mining operation as defined in W.S. 35-11-103,(e),(viii). Each description should be sufficient to locate the area on a U.S.G.S. topographic map without reference to any additional maps, diagrams, or descriptions. Each description should state the acreage encompassed by the description and the total permit acreage should be stated. An original U.S.G.S. topographic map with the permit area clearly outline should accompany each permit application.

The R&D License Area is generally located within NE¼ NW¼ and a fraction of W½ NW¼ NE¼ Sec. 35; and a fraction of S½ SE¼ SW¼ and a fraction of SW¼ SW¼ SE¼ Sec. 26, T34N, R73W, west of the 6th Principal Meridian, Converse County, Wyoming.

This area is further defined as 41.3 acres contained within the area bounded by a line with beginning point or the section line between Sections 26 and 35, 2813.7 feet due east from the common corner of Sections 26, 27, 34 and 35, T34N, R73W; thence due north 56.7 feet to the northeast corner; thence due west 1500 feet to the northwest corner; thence due south 1200 feet to the southwest corner; thence due east 1500 feet to the southeast corner; thence due north 1143.3 feet to the point of beginning.

In addition, the R&D License Area contains 7.7 acres within a 50 foot wide corridor approximately 6,708 feet in length. The corridor provides access to the 41.3 acre area and trends due south across Section 35, T34N. R73W from a point on the south boundary line of the R&D site proper 300 feet west of the south east site corner. The corridor crosses the south line of Sec. 35 about 2,200 feet due east of the SW section corner. From this point the corridor extends southeast approximately 1,100 feet and south-southwest approximately 800 feet to it's intersection with county Highway 27 in the NW¼ SW¼ NE¼ Sec. 2, T33N, R73W.

COUNTY of Converse

Municipal Corporation _____

Description Acres 49.0

Total Permit (Amendment) Acres 49.0

Applicant Arizona Public Service Company

Date March 16, 1981

Page 1 of 1

Permit No. _____

Project: NAC Peterson

Project No.: NAC 3440.011

Pumped Well: PW-1A

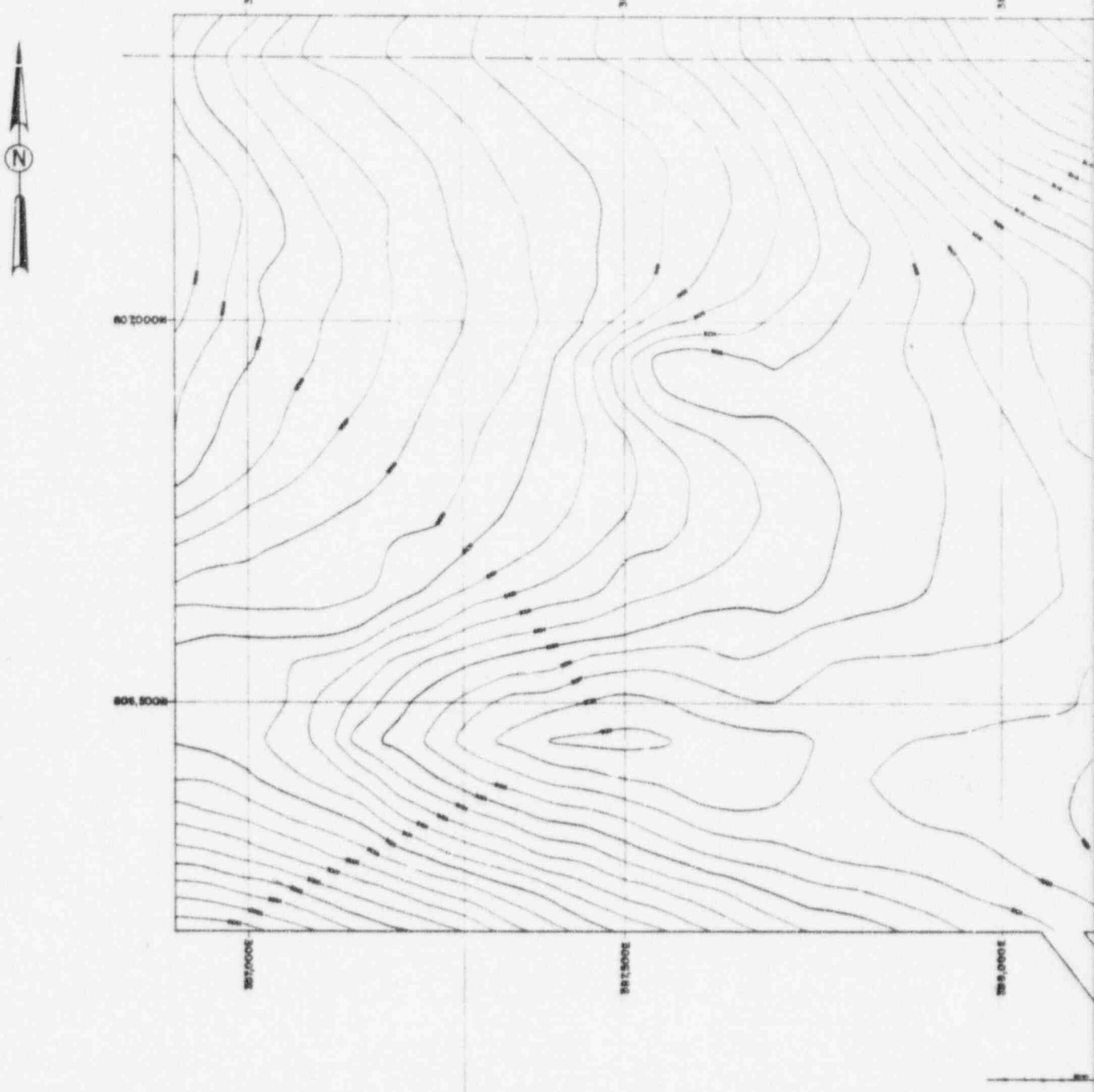
Observation Well: OW-9

Elevation of Measuring Point: 5104.6 ft.

Distance from Pumped Well: 30.0 ft.

Date	Time	t (min)	t'(min)	Depth to Water (ft)	Drawdown (ft)	Q (gpm)	Notes
11/12 1979	1320			126.0			static levels
11/13	0915			125.9			
	1010			125.9			Pump on
	1023	13		125.8			
	1035	25		125.8			
	1047	37		125.85			
	1102	52		125.8			
	1109	59		125.8			
	1116	66		125.7			
	1130	80		125.7			
	1138	88		125.7			
	1217	127		125.65			
	1244	154		125.6			
	1313	183		125.65			
	1348	219		125.6			
	1411	241		125.6			
	1515	305		125.6			
	1612	362		125.6			
	1728	438		125.6			
	1823	493		125.6			
	1925	555		125.6			
	2022	612		125.6			
	2119	669		125.6			
	2230	740		125.6			
	2325	795		125.6			

Date	Time	t(min)	t' (min)	Depth to Water (ft)	Drawdown (ft)	Q (gpm)	Notes
11/14	0137	927		125.6			
	0213	963		125.6			
	0310	1020		125.6			
	0408	1078		125.6			
	0526	1156		125.6			
	0615	1205		125.6			
	0703	1253		125.6			
	0810	1320		125.6			
	0900	1370		125.6			
	1020	1450		125.6			
	1100	1490		125.6			pump off recovery
	1610	1866	376	125.6			
	2108	2098	608	125.6			
11/15	0830	2780	1290	125.6			
	0955	2865	1375	125.6			



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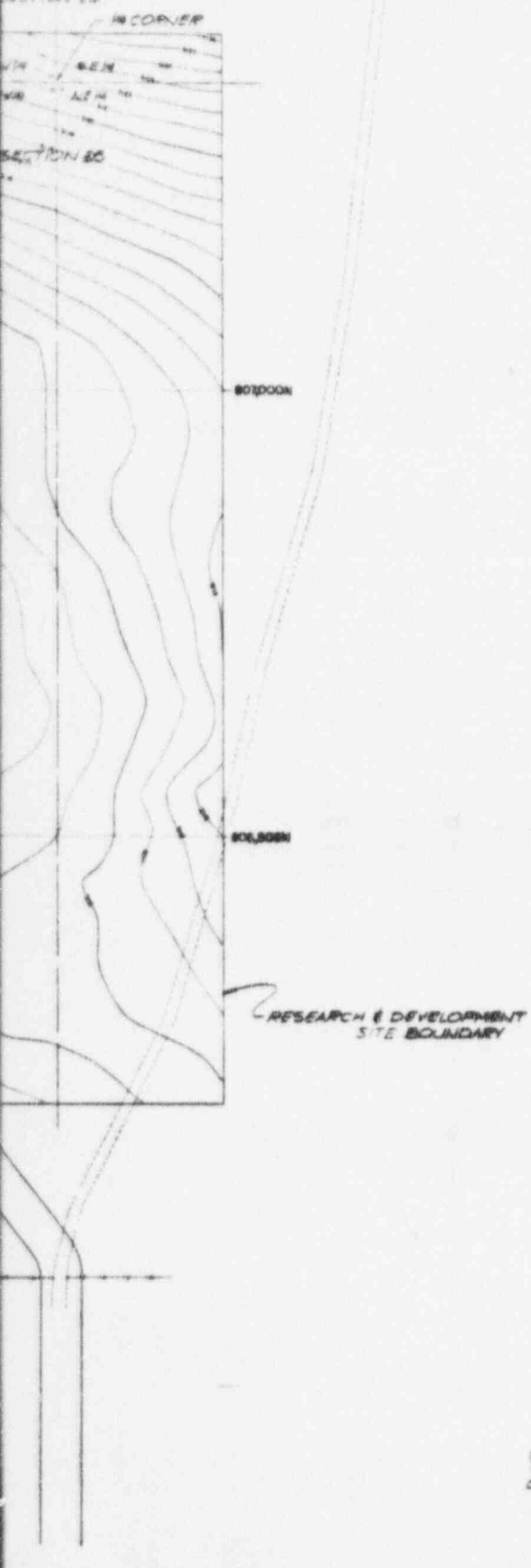

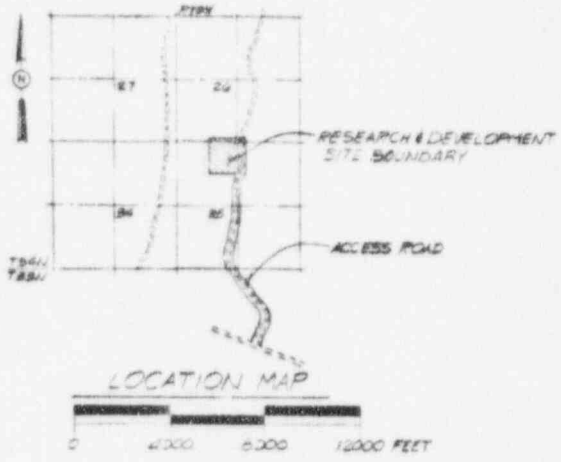

LEGEND

EXISTING CONTOURS

EXISTING ROADS

NOTES

1) THE COORDINATES USED ARE AS PER WYOMING STATE COORDINATE SYSTEM.

2) CONTOUR INTERVALS = 1'

0 100 200 500 FEET

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REFERENCE DRAWINGS	NOTICE	SCALE		DATE
	THIS DRAWING HAS NOT BEEN PUBLISHED BUT RATHER HAS BEEN ISSUED BY THE ORTLOFF MINERALS SERVICES CORPORATION FOR USE BY THE CLIENT NAMED IN THE TITLE BLOCK SOLELY IN CONNECTION WITH THE CONSTRUCTION, OPERATION AND MAINTENANCE OF THE FACILITY NAMED IN THE TITLE BLOCK AND NOT TO BE USED FOR ANY OTHER PURPOSE OR FURNISHED TO ANY OTHER PERSON OR ENTITY WITHOUT THE EXPRESS WRITTEN CONSENT OF THE ORTLOFF MINERALS SERVICES CORPORATION.	DRAWN	KP	7-86
		CHECKED		
		PROCESS		
		STRUCT		
		INSTR		
		ELECT		
		MECH		
		APP		

ARIZONA PUBLIC SERVICE COMPANY
PHOENIX, ARIZONA

ORTLOFF MINERALS SERVICES CORPORATION

PRE-TESTING CONTOUR MAP
PETERSON IN-SITU URANIUM EXTRACTION PROJECT

PROJECT NO	FIGURE NO	REV
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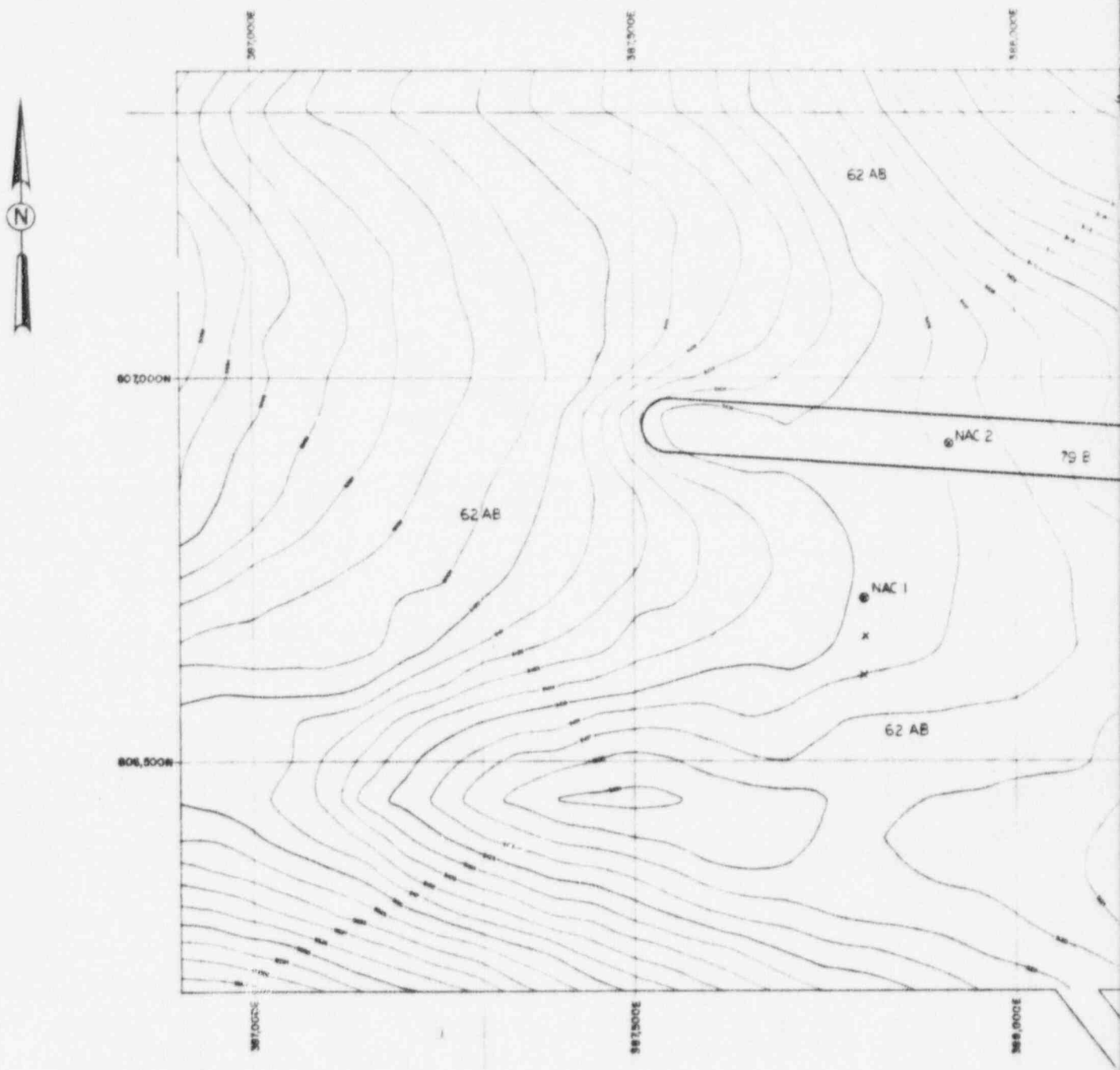

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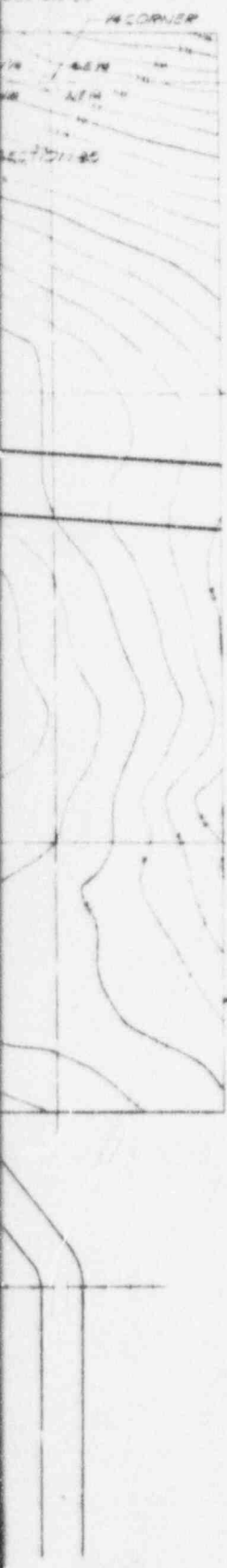

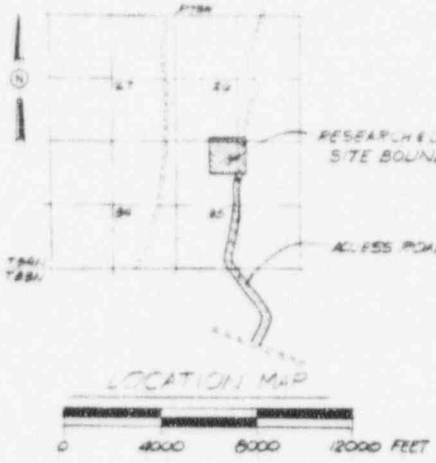

LEGEND

- EXISTING CONTOURS
- EXISTING ROADS

SOIL UNIT

62 AB	FORT COLLINS SANDY LOAM, 0 TO 6% SLOPES
79 B	TASSEL SANDY LOAM, 3 TO 6% SLOPES

- ⊕ SAMPLE LOCATIONS (MAC 1, MAC 2)
- x BACK HOE PITS

NOTES

1) THE COORDINATES USED ARE AS PER WYOMING STATE COORDINATE SYSTEM

2) CONTOUR INTERVALS = 1'

0 100 300 FEET

9609270003-02

REFERENCE DRAWINGS	NOTICE: THIS DRAWING HAS NOT BEEN PUBLISHED BUT RATHER HAS BEEN PREPARED BY THE ORTLOFF MINERALS SERVICES CORPORATION FOR USE BY THE CLIENT NAMED IN THE TITLE BLOCK AND SHALL REMAIN THE CONSTRUCTION, OPERATIONAL AND MAINTENANCE PROPERTY OF SAID CLIENT. IN THE TITLE BLOCK AND SHALL NOT BE USED FOR ANY OTHER PURPOSE OR PURPOSES AND SHALL NOT BE LOANED, COPIED OR REPRODUCED IN WHOLE OR IN PART WITHOUT THE EXPRESS WRITTEN CONSENT OF THE ORTLOFF MINERALS SERVICES CORPORATION.	SCALE		DATE	ARIZONA PUBLIC SERVICE COMPANY PHOENIX, ARIZONA	SOILS DISTRIBUTION ON TEST SITE
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		CHECKED				
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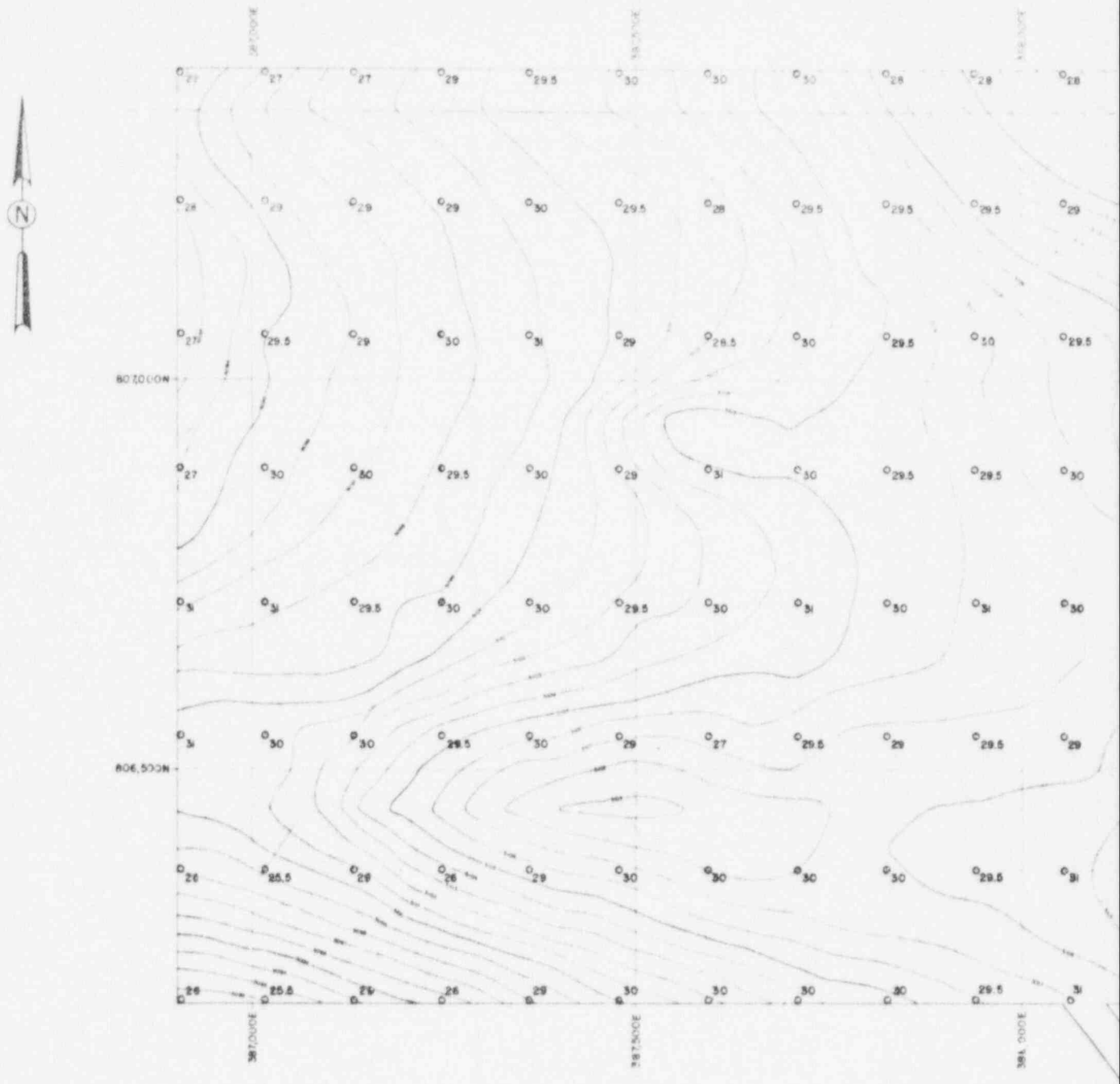
		MTCH				
		APP				
					INTERNATIONAL ENVIRONMENTAL CONSULTANTS FORT COLLINS, COLORADO	PETERSON IN-SITU URANIUM EXTRACTION PROJECT
						PROJECT NO. 88010 FIGURE NO. 36 REV.



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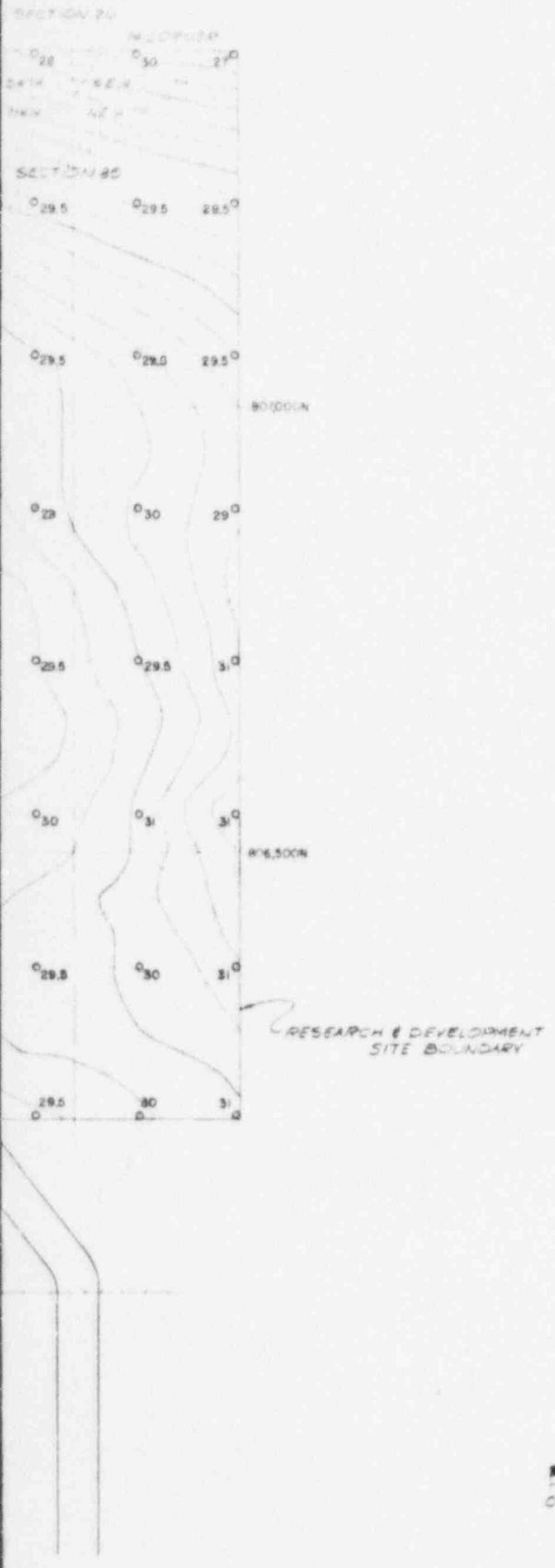

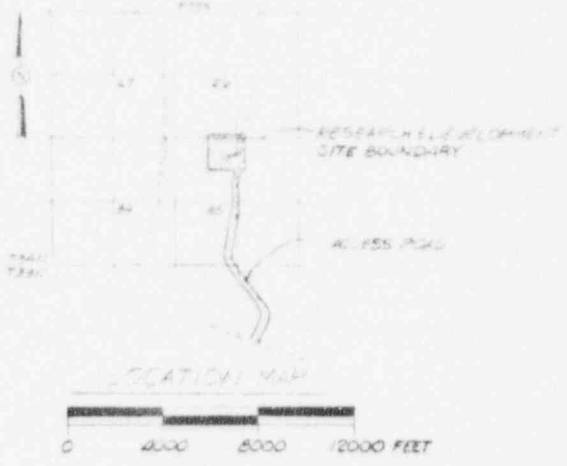

LOCATION MAP

0 4000 8000 12000 FEET

ANSTEC APERTURE CARD

Also Available on Aperture Card

LEGEND

EXISTING CONTOURS

$^{\circ}29$ GAMMA RADIATION SAMPLING POINT AND BASELINE VALUE (MICRO R/HR)

NOTES

1) THE COORDINATES USED ARE AS PER WYOMING STATE COORDINATE SYSTEM

2) CONTOUR INTERVALS = 1'

0 100 200 300 FEET

960927000 3-03

REFERENCE DRAWINGS	NOTES	SCALE / DRAWN / DESIGNED / CHECKED / DATE	ARIZONA PUBLIC SERVICE COMPANY PHOENIX, ARIZONA
			INTERNATIONAL ENVIRONMENTAL CONSULTANTS GOLDEN, COLORADO

GAMMA RADIATION ON TEST SITE

PETERSON-NYE TUNNEL

EXTRACT OF MAP SHEET

PROJECT NO. | FIGURE NO. 3.9 | REV.

OVERSIZE DOCUMENT PAGE PULLED

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NUMBER OF OVERSIZE PAGES FILMED ON APERTURE CARDS 4

9609270003-04-07

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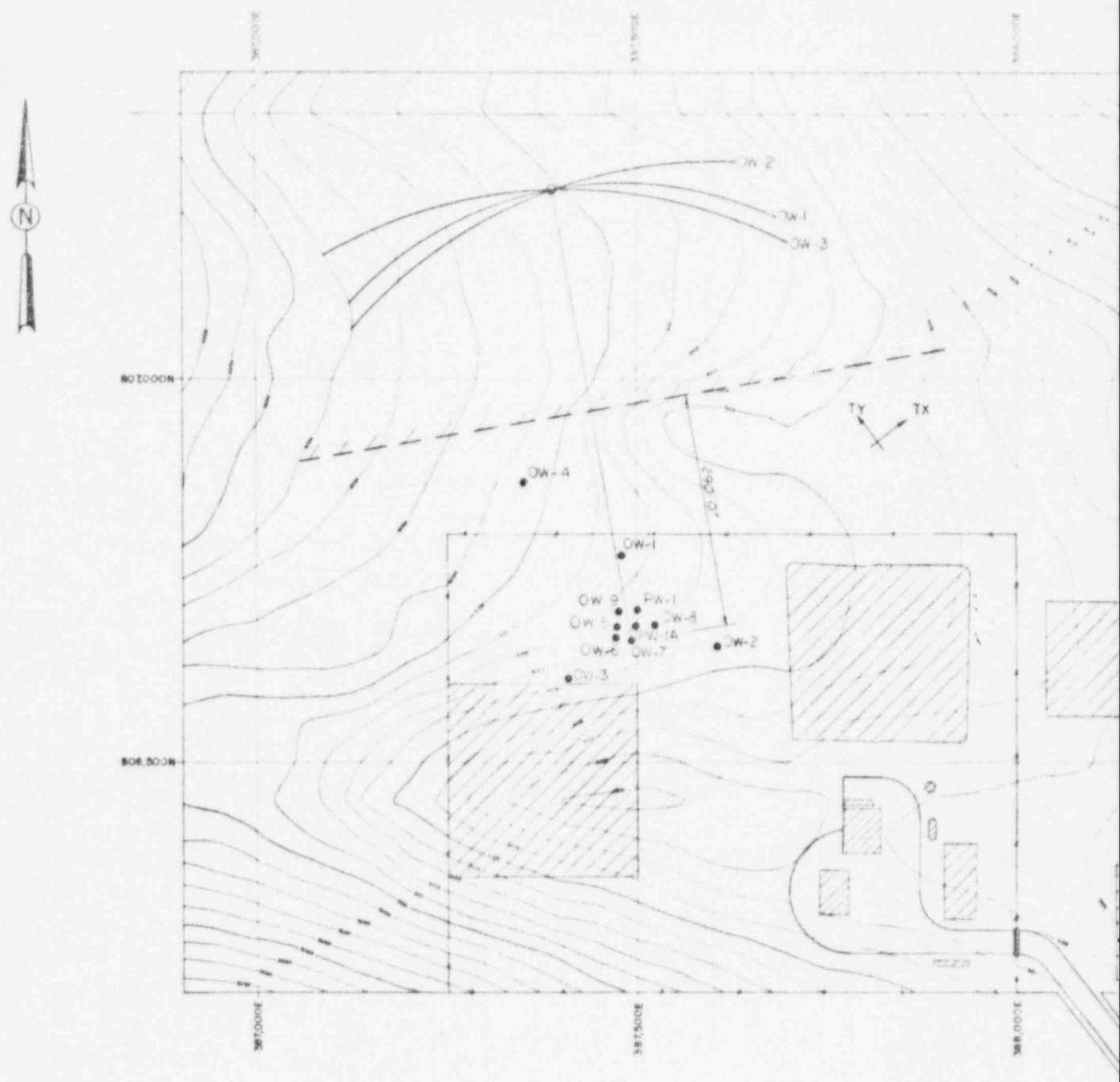

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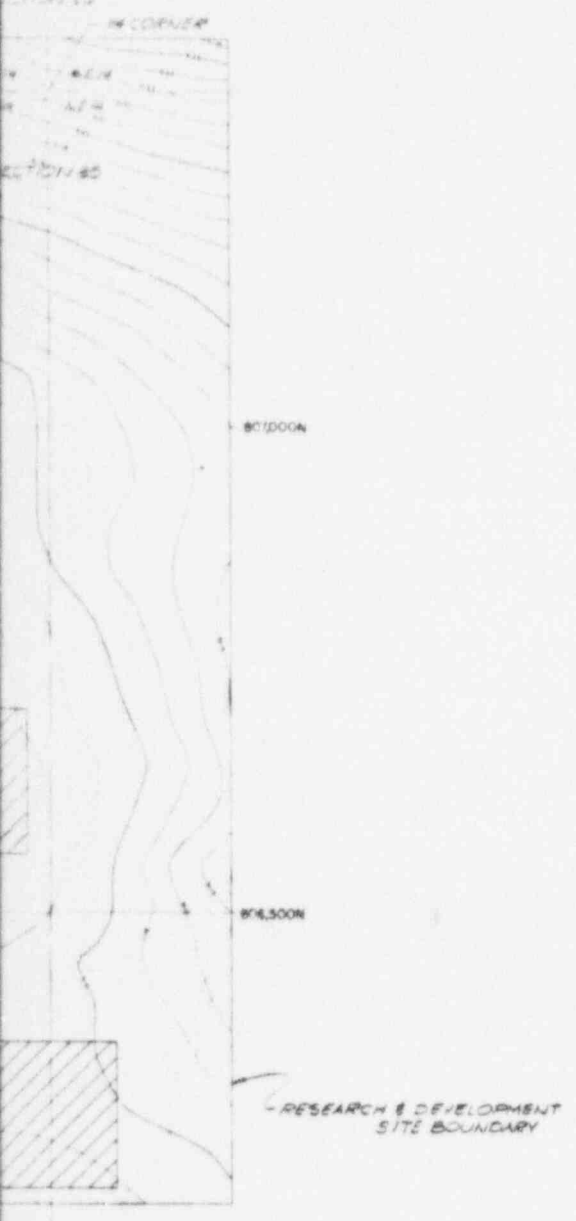
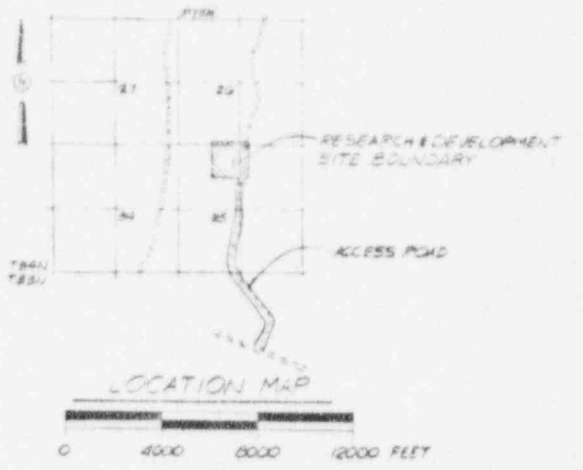




LEGEND

- EXISTING CONTOURS
- EXISTING ROADS
- HYPOTHETICAL IMAGE WELL
- OW 1 OBSERVATION WELL
- PW 1 PUMPING WELL
- OW 2 LOCUS OF POINTS FROM INDICATED WELL
- APPARENT BARRIER BOUNDARY
- PRINCIPLE DIRECTIONS OF ANISOTROPY

NOTES

1) THE COORDINATES USED ARE AS PER WYOMING STATE COORDINATE SYSTEM

2) CONTOUR INTERVALS = 1'

0 100 200 300 FEET

9609270003-08

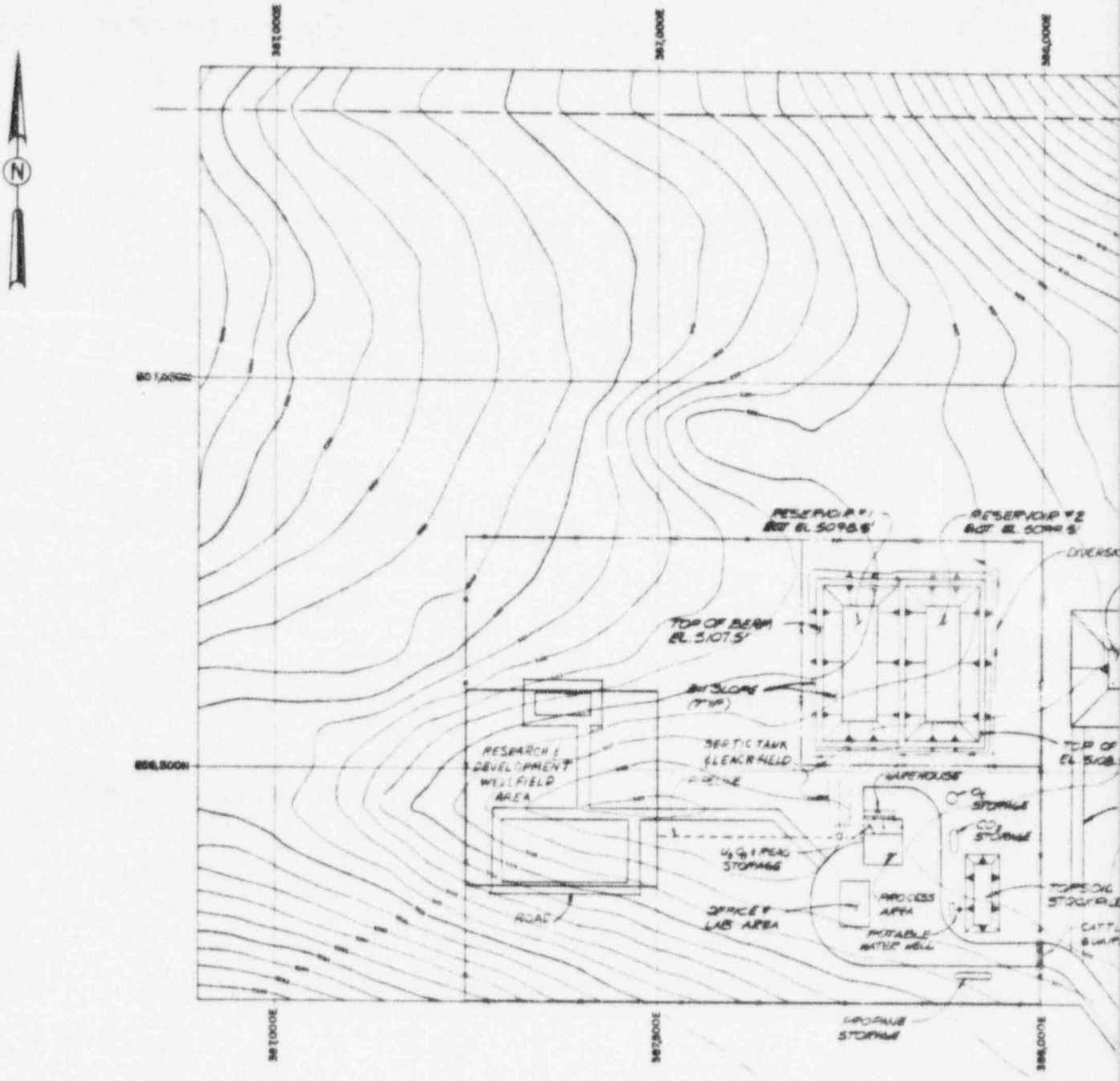
REFERENCE DRAWINGS	NOTICE	NO.	DATE		
		DRAWN	K.P.	7-30-96	

ARIZONA PUBLIC SERVICE COMPANY
PHOENIX, ARIZONA

ENVIROSPHERE COMPANY
GOLDEN, COLORADO

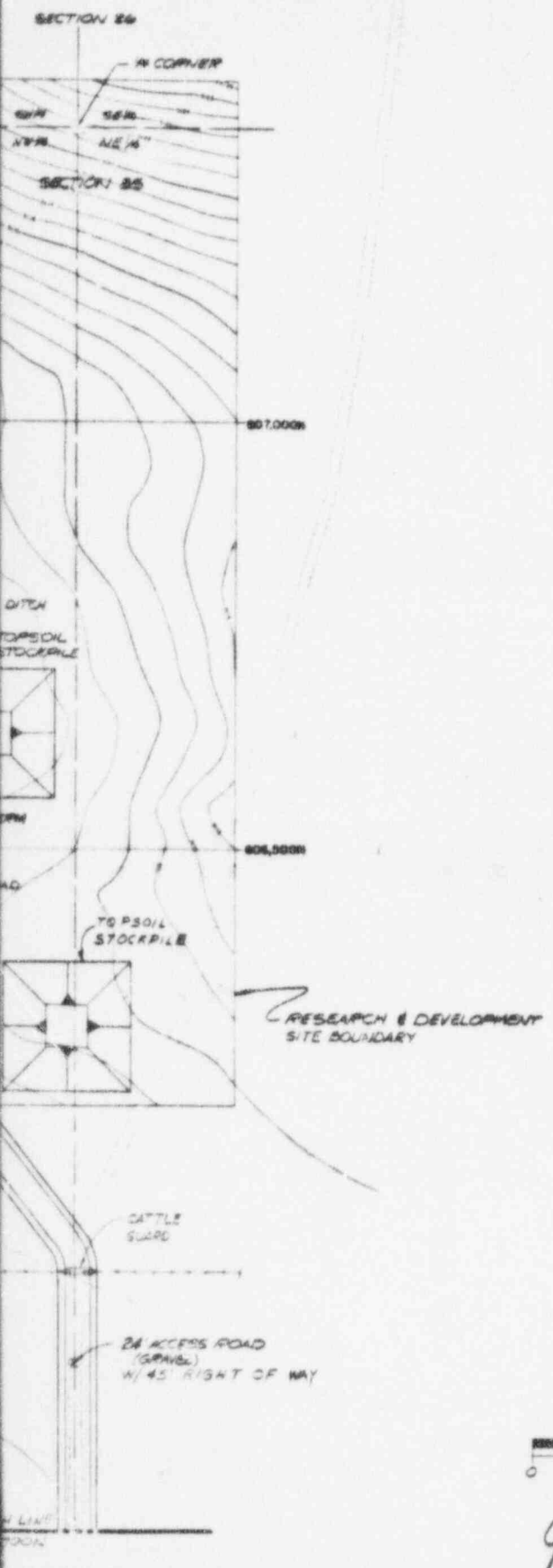
LOCATION OF NEGATIVE BOUNDARY
PETERSON IN-SITU URANIUM EXTRACTION PROJECT

PROJECT NO. 85900 | TASK NO. 3.20 | REV.



REV	DATE	REVISION	DR	CH	APP

REV	DATE	REVISION	DR	CH	APP



LEGEND

- EXISTING CONTOURS
- SHEEP TIGHT FENCE (TYPE I, SEE NOTE NO 3)
- DEER TIGHT FENCE (TYPE II, SEE NOTE NO 3)
- EXISTING ROADS
- PROPOSED ROADS
- EMBANKMENT SLOPE

NOTES:

1) THE COORDINATES USED ARE AS PER THE WYOMING STATE COORDINATE SYSTEM.
2) CONTOUR INTERVALS = 1'
3) FENCES ARE TO BE AS PER WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY-LAND QUALITY DIVISION GUIDELINE #10 FENCING.

0 100 200 300 FEET

9609270003-09

REFERENCE DRAWINGS	NOTICE	SCALE	DATE
		DRAWN JCP	8/84
		CHECKED	
		PROCESS	
		STRUCT	
		INSTR	
		ELECT	
		MECH	
		CPS	

ARIZONA PUBLIC SERVICE COMPANY
PHOENIX, ARIZONA

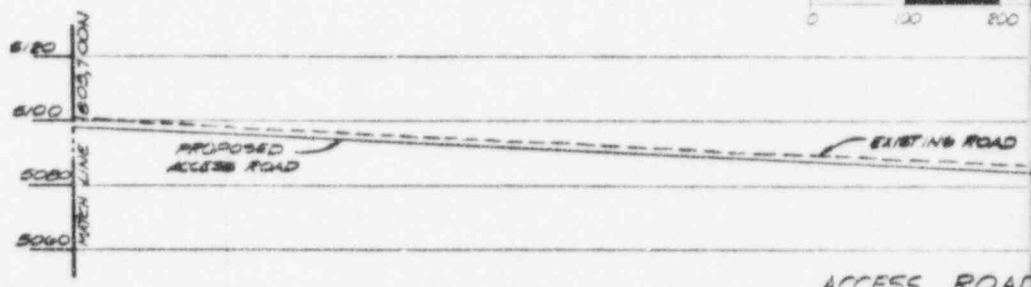
ORTLOFF MINERALS SERVICES CORPORATION

SITE FACILITY LAYOUT
PETERSON IN SITU URANIUM EXTRACTION PROJECT

PROJECT NO. 8990 | FIGURE NO. 4.3 | REV

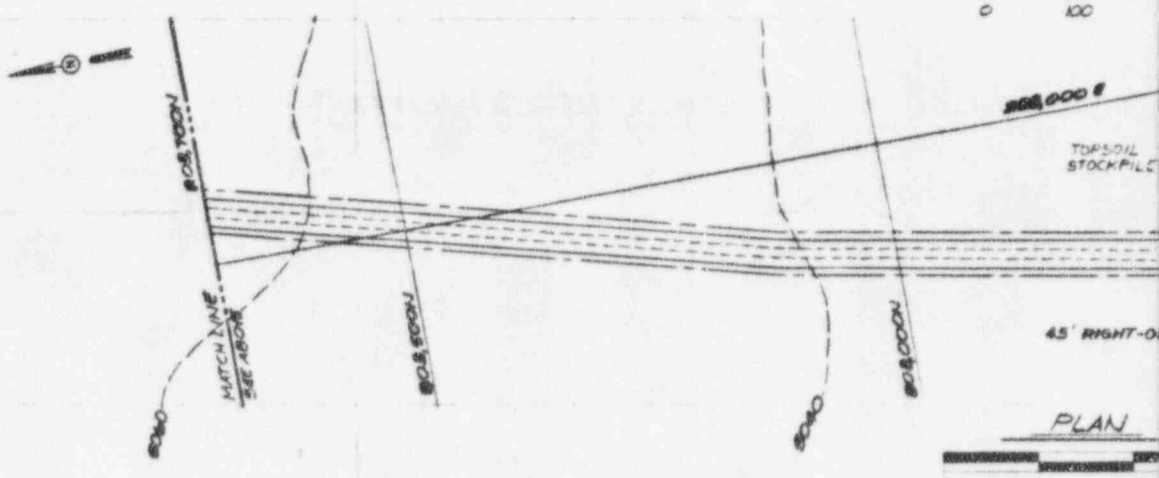
PLAN

0 100 200



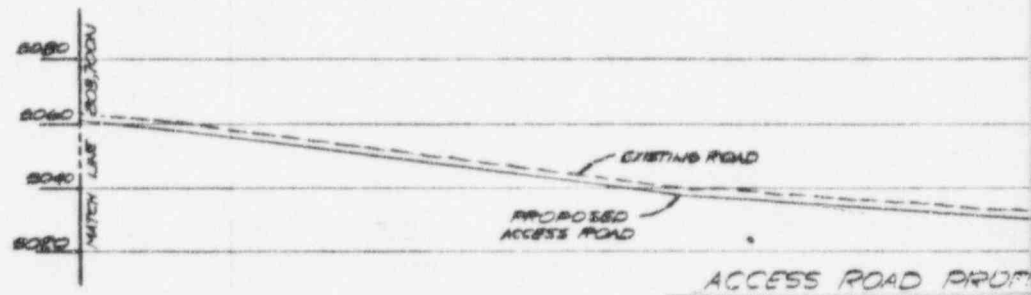
ACCESS ROAD

0 50
0 100



PLAN

0 100 200



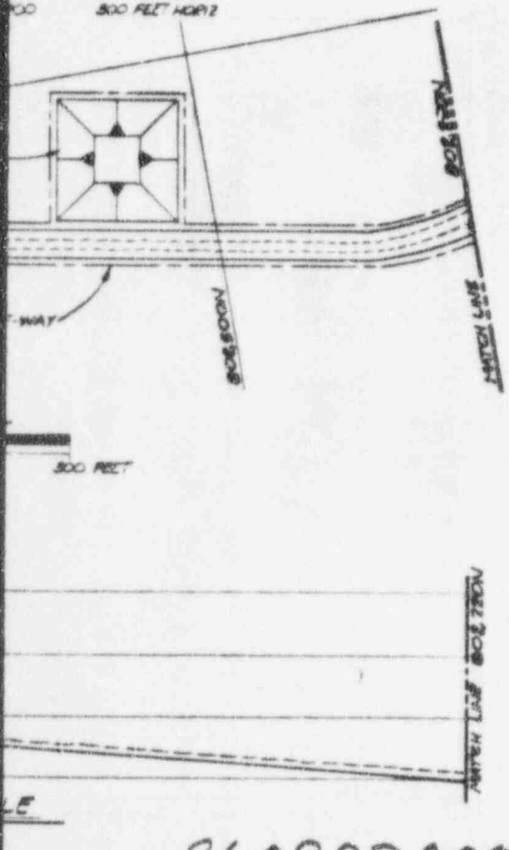
ACCESS ROAD PROFI

0 50 60
0 100 100

REV	DATE	REVISION	DR	CH	APP	REV	DATE	REVISION	DR	CH	APP	NUMB

01-2103

PROFILE



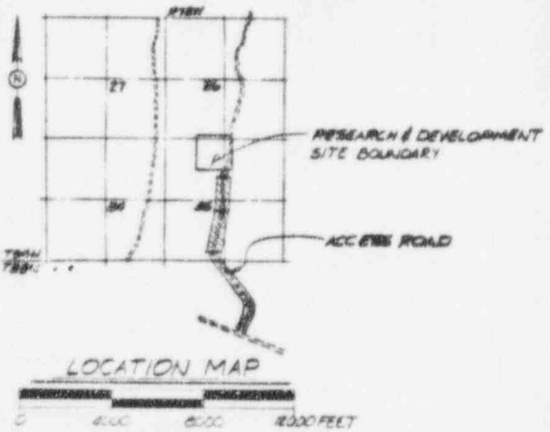
FEET VERT
FEET HORIZ

LEGEND

- EXISTING CONTOURS
- EXISTING ROADS
- PROPOSED ROADS
- TOPSOIL STOCKPILE
- SITE BOUNDARY (65 ft. R.O.W.)

NOTES:

1) THE COORDINATES USED ARE AS PER THE WYOMING STATE COORDINATE SYSTEM AND ARE APPROX. TAKEN FROM USGS MAPS.
2) CONTOUR INTERVALS = 20'



LOCATION MAP

0 4000 8000 12000 FEET

9609270003-10

REFERENCE DRAWINGS

NOTICE
THIS DRAWING HAS NOT BEEN PUBLISHED BUT RATHER HAS BEEN PREPARED BY THE ORTLOFF MINERALS SERVICES CORPORATION FOR USE BY THE CLIENT NAMED IN THE TITLE BLOCK SOLELY IN RESPECT OF THE CONSTRUCTION, OPERATION AND MAINTENANCE OF THE FACILITY NAMED IN THE TITLE BLOCK AND SHALL NOT BE USED FOR ANY OTHER PURPOSE OR FURNISHED TO ANY OTHER PARTY WITHOUT THE EXPRESS CONSENT OF THE ORTLOFF MINERALS SERVICES CORPORATION

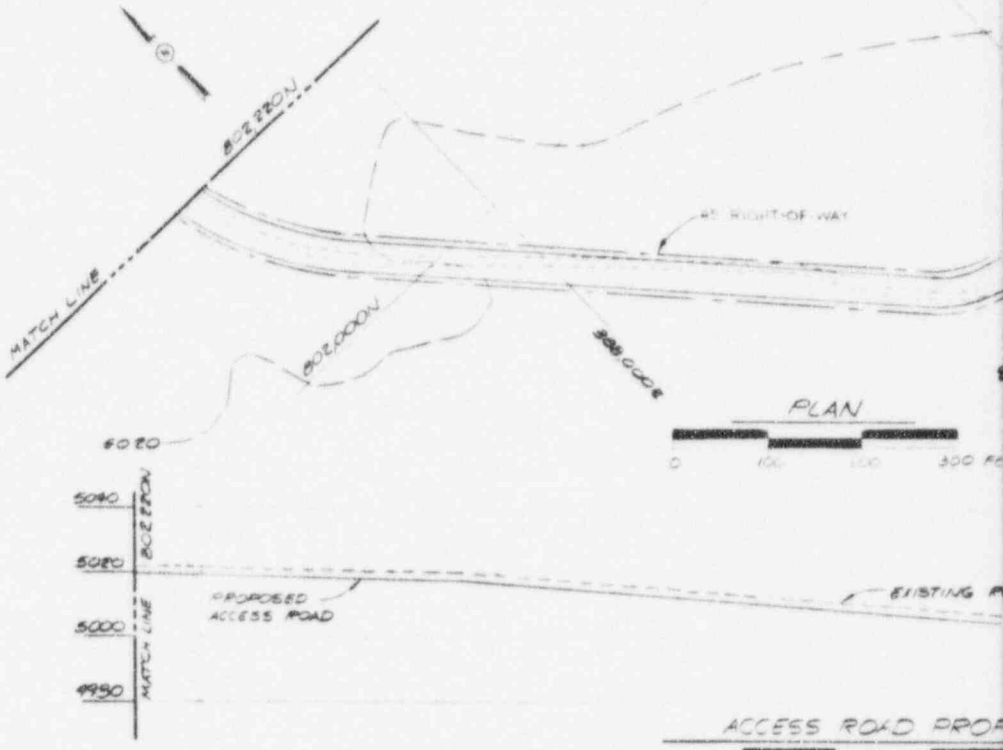
	SCALE	MODIFIED	DATE
DRAWN		JEP	7-5-90
CHECKED			
PROCESS			
STRUCT.			
INSTR.			
ELECT.			
MECH.			
APP.			

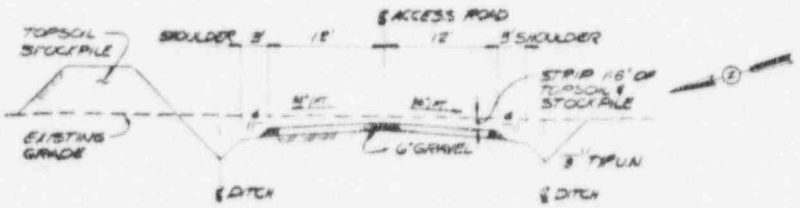
ARIZONA PUBLIC SERVICE COMPANY
PHOENIX, ARIZONA

ORTLOFF MINERALS SERVICES CORPORATION

ACCESS ROAD
PETERSON IN-SITU URANIUM EXTRACTION PROJECT

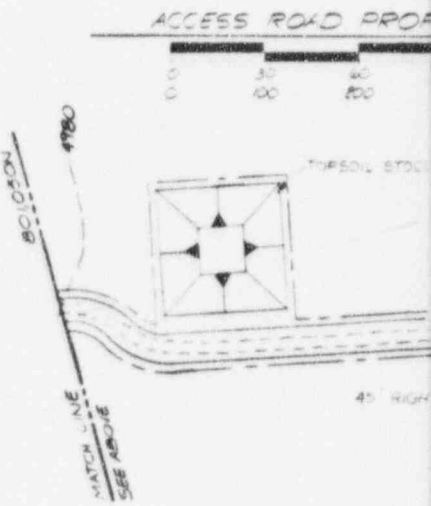
PROJECT NO.	FIGURE NO.	REV.
88900	4.4	

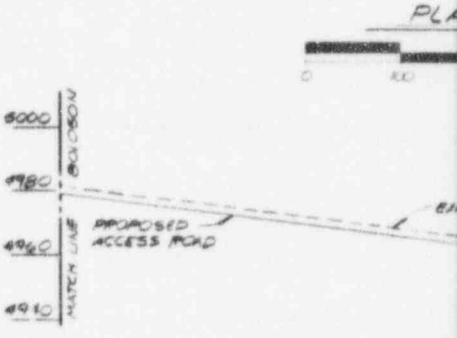


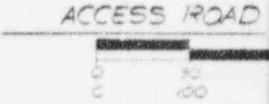


TYPICAL SECTION ℄ ACCESS ROAD

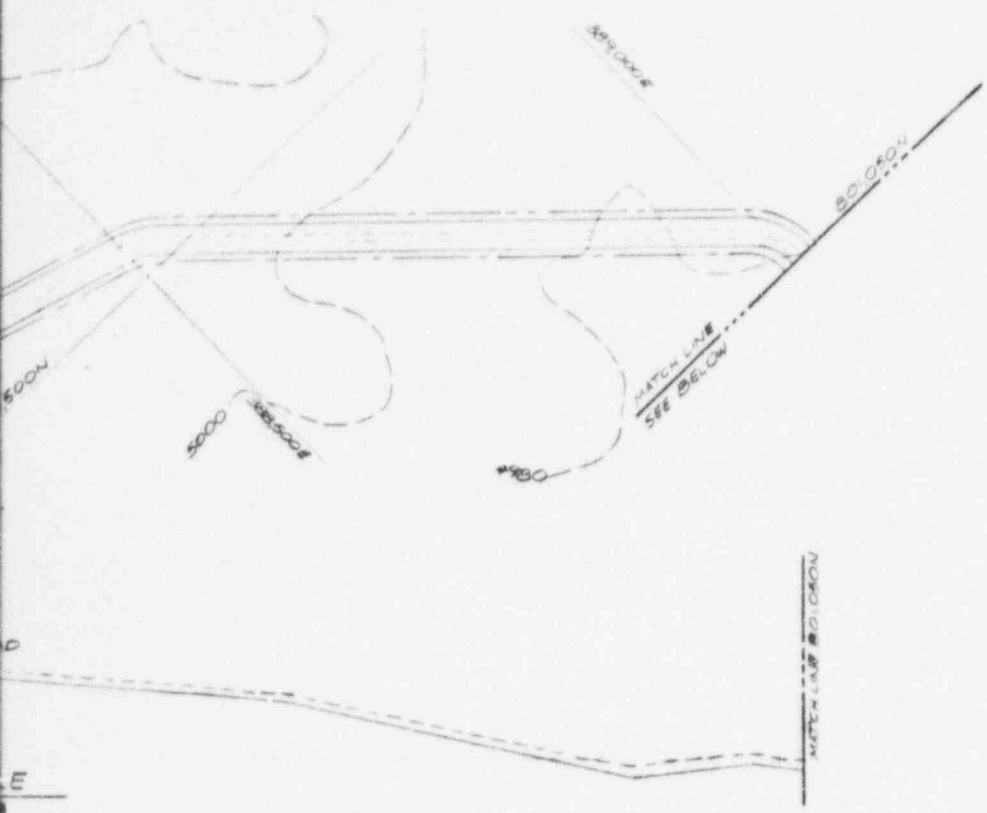
NTS

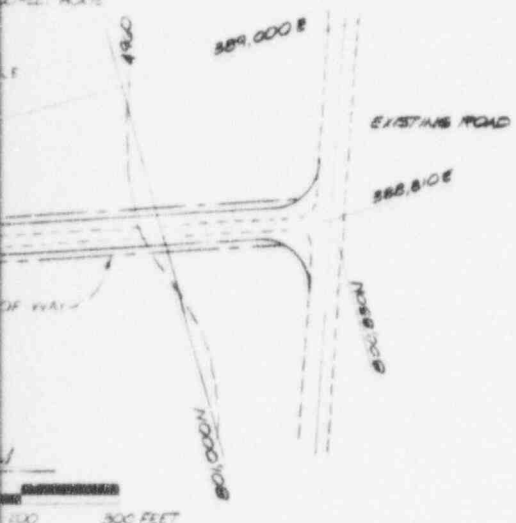






REV	DATE	REVISION	DR	CH	APP	REV	DATE	REVISION	DR	CH	APP	NUM





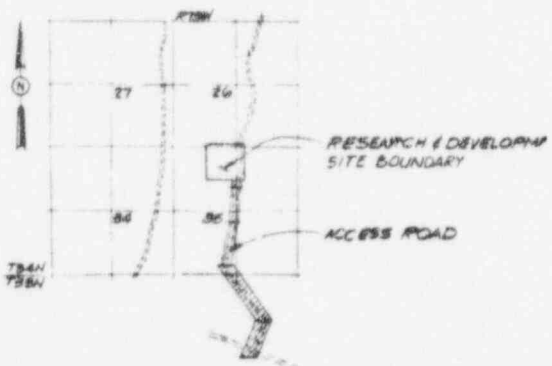
LEGEND

- EXISTING CONTOURS
- EXISTING ROADS
- PROPOSED ROADS
- TOPSOIL STOCKPILE
- SITE BOUNDARY - 45 ft R.O.W.

NOTES:

1) THE COORDINATES USED ARE AS PER THE WYOMING STATE COORDINATE SYSTEM AND ARE APPROX. TAKEN FROM USGS MAPS.

2) CONTOUR INTERVALS = 20'



LOCATION MAP

0 6000 9000 18000 FEET

EXISTING ROAD

EXISTING ROAD

PROFILE

90 FEET VERT
300 FEET HOR Z

9609270003-11

REFERENCE DRAWINGS

NOTICE
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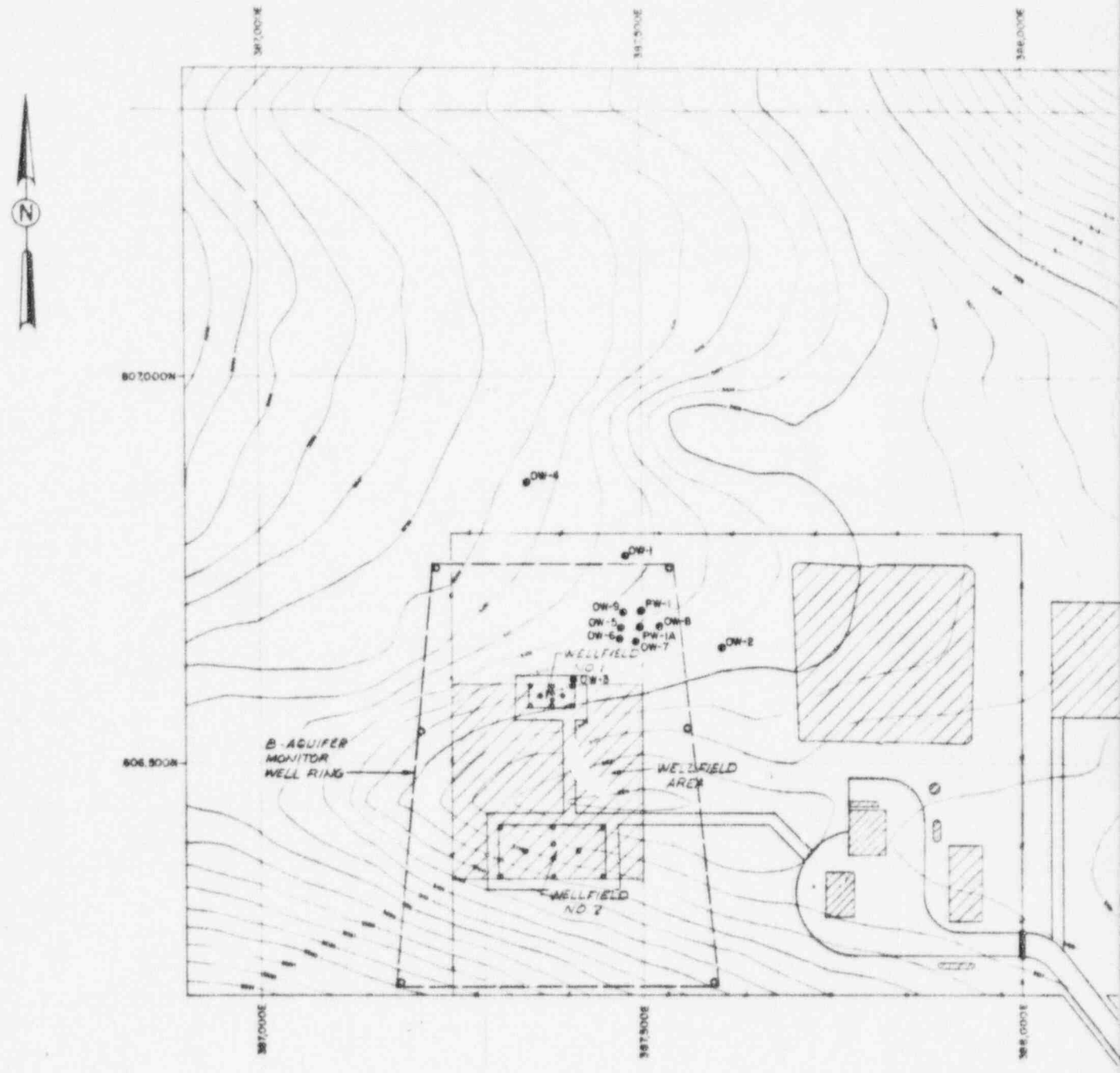
	SCALE	LOCATED	DATE
DRAWN		JCP	4/4/80
CHECKED			
PROCESS			
STRUCT			
INSTR			
ELECT			
MECH			
APP			

ARIZONA PUBLIC SERVICE COMPANY
PHOENIX, ARIZONA

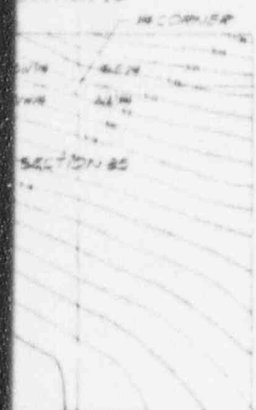
ORTLOFF MINERALS SERVICES CORPORATION

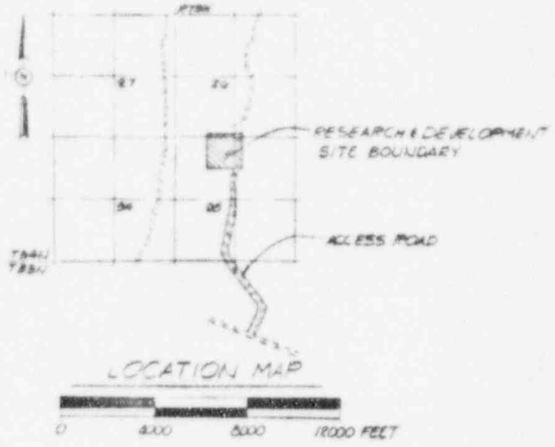
ACCESS ROAD
PETERSON IN-SITU URANIUM EXTRACTION PROJECT

PROJECT NO 8E900 | FIGURE NO 45 | REV



REV	DATE	REVISION	BY	CHK	APP	REV	DATE	REVISION	BY	CHK	APP	NUMBER





LOCATION MAP

0 4000 8000 12000 FEET

LEGEND

- EXISTING CONTOURS
- EXISTING ROADS
- ● HYDROLOGIC TEST WELLS
- ○ PROPOSED PATTERN WELLS

NOTES

1) THE COORDINATES USED ARE AS PER WYOMING STATE COORDINATE SYSTEM

2) CONTOUR INTERVALS = 1'

0 100 200 300 FEET

9609270003-12

REFERENCE DRAWINGS	NOTICE		DATE	ARIZONA PUBLIC SERVICE COMPANY PHOENIX, ARIZONA	LOCATION OF WELLFIELDS PETERSON IN-SITU URANIUM EXTRACTION PROJECT
		KR		NUCLEAR ASSURANCE CORPORATION	PROJECT NO 6590 FIGURE NO 47 REV

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