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APPENDIX B6

Historic Conoco Hydrologic Test Report

CONOCO INC.

MOORE RANCH MINE/SAND ROCK MILL PROJECT

MINE PERMIT APPLICATION

APPENDIX D-6

HYDROLOGY

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D-6 HYDROLOGY

The ground-water systems in the vicinity of the evaporation pond (Section 1, T 41 N, R 75 W), and the tailings disposal site in Pit 35N (Section 35, T 42 N, R 75 W) were investigated in detail. Numerous tests have been conducted to define the ground-water hydrology in the mine area. The description of the surface water regime in this area is also important. The relationships of the pits in Sections 34 and 35 and the mill water supply to the local hydrologic systems are addressed.

1.0 GROUNDWATER

The major topics presented in the discussion of the ground-water systems are the geologic setting, recharge areas, aquifer properties, water movement, springs, and ground-water quality.

1.1 GEOLOGIC SETTING

The site is situated in the southwestern part of the Powder River Basin approximately 12 miles east-northeast of the Tertiary Wasatch-Fort Union formation contact. The Wasatch formation, which is the surface geologic unit in this area, is part of the thick Powder River sedimentary series and consists of interbedded sandstones, siltstones, claystones and coals. Seeland (1976) found that the Wasatch sandstones were deposited in a fluvial paleo drainage system which flowed generally northward. These channel deposits are the host rocks for many uranium ore deposits.

The Fort Union formation, which lies under the Wasatch formation, consists primarily of fine grained fluvial silts and clays layered between wedges of arkosic sandstones which were deposited as alluvial fans and fore, even though the Madison and Tensleep aquifers produce large quantities of water, the quality would probably make these aquifers unusable. Only the Roland coal and the upper Wasatch formation units will be discussed further, because the lower units will not be influenced by this project.

The local surface geology consists of the Wasatch formation for several miles from the proposed mine and mill site. The top of the Roland is approximately 1,100 feet deep in this area. The dip of the top of the Roland coal is to the west-northwest at an average of one degree.

Conoco exploration nomenclature has designated most sands above the Roland coal with decreasing numbers with depth. Cross sections from exploration logs were developed for this area to evaluate the areal distribution of these sands. The 40 and 50 sands are normally separated only by a few feet of shale or mudstone and extend areally. These two sands contain some coarse material in most areas and are considered significant aquifers.

The 60 sand is fairly massive and continuous over most of the area. The 68 sand is the first sand below the 70 sand, which contains the ore deposits in the area. The thickness of the 70 sand is normally in the range of 60 to 80 feet in this area and is areally extensive. Figure D-6-1 presents the elevation of the top of the 70 sand and shows that the dip of the 70 sand is generally less than one degree toward the northwest. The average dip of the 70 sand over the area of the contour coverage is 0.006 ft/ft.

A thin coal exists normally a few feet above the top of the 70 sand and has been labeled by Conoco as the E coal. Figure D-6-1 shows contours of the top of the E coal over the area. The average dip of the E coal is one-half of one degree or 0.008 ft/ft toward the northwest.

The remainder of the lithologic section above the 70 sand consists mainly of mudstones (claystones), and interbedded sandstones and thin coal lenses. The thin sandstone lenses do not correlate well, and the thickness and aerial extent of each of these units varies considerably over the project area. These sandstone lenses and thin coal seams above the 70 sand can be seen in the cross sections presented in Appendix D-5. Piezometers were installed in a number of these upper sand lenses to determine the presence of perched water tables and the hydraulic conductivity (permeability) of these units. Basic well completion data along with static water level information are presented in Table D-6-2. Permeabilities of these upper sands are summarized in Table D-6-4. Ground water quality for several of these upper sand wells is presented in Table D-6-9. The long term effect of shallow aquifer table is discussed in Section 8.1.4 of the Reclamation Plan.

Figure D-6-2 shows a schematic of the lithologic units in the evaporation pond area. A Claystone, referred to as the Lower mudstone, exists below the E coal in the evaporation pond area. Another claystone exists above the E coal in the evaporation pond area and has been labeled the Upper mudstone.

The lithologic units above the E coal in the tailings disposal area of Pit 35N do not correlate well. Figure D-6-1 shows that the structure of the top of the E coal and 70 sand is similar to the structure in the evaporation pond area. The mudstone between the E coal and the 70 sand is not as thick in the area of Pit 35N as in the evaporation pond area. Thin, noncontinuous sandstone units are interbedded in the mudstones (claystones) above the E coal.

1.2 RECHARGE AREAS

The outcrop area of the 70 sand is important to the flow in this ground-water system. The low permeability materials above the 70 sand should essentially restrict recharge to the 70 sand except in its outcrop area. The quality of water from the claystone and coal above the 70 sand is normally poorer than the 70 sand water quality. This also indicates that very little of the 70 sand water is derived from these upper units. The upper (unsaturated) portion of the 70 sand contains very low permeabilities, which indicates very little water has flowed in this portion of the aquifer to dissolve the cementation.

Figure D-6-3 presents the outcrop of the 70 sand near the project. This outcrop includes areas of the 70 sand which are covered by alluvium and topsoil. The outcrop map is derived mainly from the 70 sand structure map and some known exposures. These areas would be susceptible to recharge to the 70 sand aquifer, also. The 70 sand crops out in a large percentage of Sections 11 and 12 of T41N-R75W and Sections 6 and 7 of T41N-R74W. Water which enters the outcrop area flows down-dip in the 70 sand. Figure D-6-1 gives the structure of the top of the 70 sand and shows that water would be expected to flow north-northwest from the outcrop area.

An outcrop line is shown on Figure D-6-3 for the E coal. This outcrop line is inferred from the structure map of the E coal in Figure D-6-1. Recharge to the E coal and the Lower mudstone should occur mainly in the area of the outcrop line in the eastern half of Section 1, T41N-R75W. Recharge to all units above the 70 sand probably occurs mainly in their outcrop areas, because of alternating low permeability materials.

1.3 PIEZOMETER AND WELL CONSTRUCTION

A total of 47 piezometers and/or wells were constructed in the evaporation pond and tailings disposal site (35N) areas; 17 in and around Pit 35N, and 30 in the area of the evaporation pond. These piezometers and wells have been used to define the static-water levels, permeabilities and water quality of the shallow geologic units. Table D-6-1 presents basic well data for the evaporation pond area, including date drilled, depth drilled, perforated interval, lithologic unit and water level for each piezometer, while Table D-6-2 gives the same data for the Pit 35N mine area. The location and perforated interval of the Pit 35N piezometer wells are depicted on the cross-sections presented in Figures D-5-16 through D-5-18. Most piezometers were bailed on several different occasions and observed to determine if their water levels would recover. A permeability test was conducted after a satisfactory static water level was established. Bailing information and water level measurements are given in the tables of Appendix A-1.

Twenty-three additional wells have been used to define the groundwater hydrology for the 70 sand and deeper units in other than the evaporation pond and tailings disposal sites. The completion details for these wells is given in Table D-6-3. The location of all wells is shown in Figure D-6-4.

1.4 SUBSOIL AND AQUIFER PROPERTIES

The transmitting (transmissivity and hydraulic conductivity) and storage (storage coefficient and specific yield) abilities of the aquifers and partially saturated material are discussed in this section. Additional material properties, moisture content, bulk density and grain sizes will also be discussed. The pump test theory, including field tests for hydraulic conductivity, is addressed in Appendix A-2.

1.4.1 TRANSMITTING PROPERTIES

The results of the constant head injection recovery tests from the low yielding wells and dry piezometers in the evaporation pond and tailings disposal areas will be presented first. The permeability and transmissivity results from the 70 sand wells will follow.

Twenty-four constant-head injection tests were conducted to determine the saturated hydraulic conductivity (permeability) of the subsoil materials in the evaporation pond area (Figure D-6-4). The procedures used in conducting the constant-head injection tests are given in Appendix A-2.

The largest permeability found in the evaporation pond area was obtained from piezometer P-18, which is completed in the alluvium of the small drainage channel through the pond area. A permeability of 470 feet/year was obtained for the alluvium at the proposed dam location.

Table D-6-4 summarizes permeabilities obtained from constant-head and pump tests in the project area. The permeabilities from packer tests in the evaporation pond area are summarized in Table D-6-5. The packer tests were normally conducted for 10 to 15 minutes and steady-state analysis was used to calculate the permeability. Therefore, some difference would be expected between the constant-head permeabilities and those obtained by packer tests. Figure D-6-5 presents horizontal permeabilities for the E coal, Upper coal, Lower and Upper mudstone units in the evaporation pond area. Coal and mudstone units in the 35N tailings disposal area are also presented on this figure, which includes permeabilities from only the constant head tests.

Results indicate that approximately one-half of the evaporation pond area has subsoils with permeabilities of less than 1 ft/yr. A zone of higher permeability was observed near the center of the evaporation pond in the E coal and Lower mudstone units. These permeabilities vary from 6.7 to 53 ft/yr. In general, the permeability of the E coal and Lower mudstone is less than 10 ft/yr.

The horizontal permeabilities for the Upper coal and Upper mudstone units are given in Figure D-6-5 in brackets. These permeabilities are listed in Tables D-6-4 and D-6-5. The packer tests on holes PD-19 and PD-24 were conducted on the mudstone next to the Upper sandstone. Generally, the Upper mudstone and Upper coal have permeabilities in the same range as the Lower mudstone and E coal.

Figure D-6-6 shows the permeabilities for the Upper sandstone and 70 sand in the evaporation pond area. This figure presents permeabilities for piezometers P-6, P-7, P-16, P-17, P-20B and P-21, where constant head injection or recovery tests were conducted. The Upper sandstone shows a much larger areal variation in permeability than the other lithologic units. The variation in permeability is probably relative to the degree of weathering of the sandstone and removal of its cementation. A permeability of 1,000 ft/yr is representative of a significant portion of the Upper sandstone.

The permeabilities of the 70 sand aquifer in the evaporation pond area are also given in Figure D-6-6. Values for the unsaturated portion of the 70 sand at piezometers P-16 and P-17 were calculated to be 1.0 and 0.65 ft/yr respectively. Both of these permeabilities are very low, which shows that the unsaturated portion of the 70 sand is not very permeable. Permeabilities of 94 ft/yr, 8.5 ft/yr and 3.7 ft/yr were determined for the saturated portion of the 70 sand near Wells P-7, P-20B and P-21, respectively, from recovery tests.

The largest permeability determined for units above the 70 sand in the tailings 35N area is 42 ft/yr for a sandstone which piezometer 35N-7E penetrates. Values for the E and Upper coals in the area of 35N-7 were determined to be 41 and 0.09 ft/yr respectively. Table D-6-4 presents these permeabilities while Figure D-6-5 shows the values on a map. Permeabilities of mudstone in the 35N area varied between 0.9 to 4.3 ft/yr. These values agree well with permeabilities which were determined for the mudstones in the evaporation pond area. Sandstones other than the 70 sand were tested at seven sites and values ranged from 0.0012 to 42.1 ft/yr. Permeabilities for the sandstones above the 70 sand in the area of Pit 35N are not as high as some of the values in the evaporation pond area. This is probably attributed to the fact that most of the sandstones in the evaporation pond area were exposed on the surface and therefore, some of their cementation was leached.

The permeability of the unsaturated 70 sand in Pit 35N is low and similar to the values determined in the evaporation pond area. Three piezometers in the unsaturated 70 sand (U70SS) were tested and yielded values of 0.78, 8.5 and 5.5 ft/yr for holes 35N-1C, 35N-2A and 35N-7B respectively. A transmissivity for the saturated 70 sand well, 35N-7A, was computed to be 1170 gal/day/ft from its recovery test. This value compares fairly well to the transmissivities which were earlier determined for other 70 sand wells (1805 and 1806) in the area. The permeability computed from the 35N-7A test is significantly higher than the values determined in the evaporation pond area, which shows that the 70 sand is more permeable in Pit 35N.

Tests on the saturated 70 sand in Wells 886, 888, 1805, 1806, 1814, 1815, 1816 and 1817 are also presented. The analyses of these tests are also presented in Appendix A-2, while Figure D-6-4 gives the location of the wells. Transmissivities ranged for the 70 sand aquifer from 800-5,500 gal/day/ft, while permeabilities varied from 140 to 6,700 ft/yr. Wells 887 and 1823 are completed in the 68 sand (the first sandstone below the 70) and recovery tests were conducted on these two wells. Permeabilities of 3.1 and 306 ft/yr and transmissivities 1.9 and 190 gal/day/ft were computed for this sand. The transmitting ability of the 68 sand is significantly less than the 70 sand. A recovery test on a 50-40 sand well indicates these sands have a permeability in the range of 300 ft/yr while a similar test on a Roland coal well produced a permeability of 850 ft/yr.

1.4.2 STORAGE PROPERTIES

Storage coefficients (the storage ability of a confined aquifer) were determined at five locations in the 70 sand aquifer. Two 70 sand tests were conducted to measure the specific yield (the storage ability of an unconfined aquifer)for the 70 sand. Table D-6-4 presents these storage values.

1.4.3 ADDITIONAL MATERIAL PROPERTIES

Additional material properties (Chen, 1980) were also used in the hydrological analysis. The porosity of the materials at the site is in the range of 40 per cent while most nonsaturated rock has moisture contents in the range of 15 per cent. The average bulk density of the material is roughly 165.4 pounds/cubic foot.

1.5 WATER LEVEL

Water level data is presented with the basic data for each piezometer in Appendix A-1. Tables D-6-1 and D-6-2 give a static-water level for each piezometer. Several 70 sand wells have been monitored since their installation in 1977, and this data is given in Table D-6-6. Figure D-6-4 gives the location of the preoperational ground-water monitoring sites. A discussion of the water level elevations and changes for each geologic unit is presented below.

The water level elevation map for the 70 sand aquifer is presented in Figure D-6-7 for the project area. The outcrop area of the 70 sand, which is the recharge area for this aquifer, is given in Figure D-6-3. This recharge area and the data points in Table D-6-6 were used to construct the piezometric surface for the 70 sand aquifer. The water level elevation contours are closely spaced next to the recharge areas where the saturated thickness is less. Therefore, steeper gradients are required to transmit the water in this area than further down gradient. The water level elevation is lower in the center of Section 1 (T41N-R75W) than in the center of Section 2 because Section 1 is farther from the outcrop area. The water level elevation varies from a high which is greater than 5,200 feet near the outcrop area to less than 5,160 feet north of the permit area.

Water level changes for six of the 70 sand wells, which have been monitored since 1977, are presented in Figures D-6-8 through D-6-13. These hydrographs show that the water levels in Wells 22-2 and 1809 have varied approximately one foot over this period. Water level fluctuations for Wells 1810, 885 and 1 have been in the range of 2, 3 and 4 feet, respectively.

Water level elevations for the E coal and Lower mudstone units are presented in Figure D-6-14 and Tables D-6-1 and D-6-2. The piezometric contours drawn from these data points are not very uniform but are probably reflective of variations in permeabilities and distances from a recharge source. The high water level elevation in the stock pond upstream from the proposed dam site has created a small local mound in the groundwater piezometric surface. Generally, higher water level elevations are found on the east side of the evaporation pond area. Significant water level changes are expected during the year for E coal and Lower mudstone wells.

Figure D-6-14 gives the water level elevation for the Upper mudstone, Upper coal and Upper sandstone in the evaporation pond area and mudstone and sandstones in the tailings disposal area. The water level elevations of the Upper coal and Upper mudstone are fairly close to the elevations in the Lower mudstone and E coal. The Upper sandstone piezometric level would be expected to be higher than the coal and mudstone levels because the sandstone is much more permeable and higher stratigraphically.

1.5.1 GROUND-WATER MONITORING

Table D-6-7 presents the results of the pre-mine monitoring of the private wells in the area. Pre-mine monitoring of the project wells are given in Tables D-6-8 and D-6-9, respectively. Figures D-6-17 and D-6-18 give the locations of the private wells while Figure D-6-4 shows the location of Conoco's wells. The mining and post-mining ground-water monitoring program will be the same and are defined in Section 3.5.6 of the Mine Plan.

1.6 WATER MOVEMENT

The rate of ground-water flow is governed by permeability, effective porosity and hydraulic gradient of the system. The following equation was used to obtain groundwater velocities:

$$V = Ki/n$$

where: V = velocity, in ft/yr

K = permeability, in ft/yr

i = hydraulic gradient, in ft/ft

n = effective porosity

The permeability and effective porosity were discussed in Section 1.4, Subsoil and Aquifer Properties, and water level elevations were presented in the Water Level section. Hydraulic gradients were obtained from water level contours.

The hydraulic gradient of the 70 sand aquifer can be obtained from Figure D-6-7. The gradient of the water table in the 70 sand varies from 0.012 to 0.0018 ft/ft with an average value of 0.006 ft/ft. An average horizontal rate of movement of the ground water in the 70 sand was estimated to be 120 ft/yr, from an average horizontal permeability of 2,000 ft/yr, an effective porosity of 0.1, and the above average gradient. In general, movement of water in the 70 sand should gradually decrease with distance from the recharge area. Flow directions in the 70 sand are shown in Figure D-6-7.

Hydraulic gradients in Figure D-6-14 vary from 0.004 to 0.05 ft/ft with an average gradient in the range of 0.015 ft/ft. The steeper and flatter gradients should be an indication of lower and higher permeabilities, respectively. An average gradient of 0.015 ft/ft and a permeability of 5 ft/yr should yield a velocity fairly representative of both the low and high permeability areas. A ground-water velocity of 1.5 ft/yr was calculated from the above hydraulic gradient and permeability values, and an effective porosity of 0.05. This shows that the ground water in the E coal and Lower mudstone moves very slowly. Flow directions for the Lower mudstone and E coal can be estimated from Figure D-6-14.

Water levels in the Upper mudstone and Upper coal piezometers are very close to the water levels in nearby Lower mudstone and E coal wells. Therefore, gradients in the Upper mudstone and Upper coal are thought to be very similar to those in the Lower mudstone and E coal. The slightly higher permeabilities observed in the Upper mudstone and Upper coal units should allow water transmission at a slightly higher rate. An average velocity of the water in the Upper mudstone and Upper coal was computed to be 3 ft/yr using a permeability of 10 ft/yr, a hydraulic gradient of 0.015 ft/ft, and an effective porosity of 0.05.

Water movement in the Upper sandstone would be expected to be significantly higher than the mudstone because of its higher permeabilities. The velocity of ground water in the Upper sandstone was estimated to be in the range of 50 ft/yr from values of 500 ft/yr, 0.01 ft/ft and 0.1 for horizontal permeability, hydraulic gradient and effective porosity. Water flow direction in the Upper sandstone would be expected to be down-dip.

Rates of water movement in the tailings disposal area for the mudstones and sandstones above the 70 sand are estimated to be in the range of the velocities for the E coal - Lower mudstone in the evaporation pond area. The gradient of the piezometric surfaces should mainly be governed by the dip of the beds, which are similar in the two sites.

1.7 GROUND-WATER QUALITY

The ground-water quality in the project area has been collected from three sources, private wells, Conoco's mine monitoring wells, and the evaporation pond and tailings disposal site wells. The water quality for the three sources are tabulated in Tables D-6-7, D-6-8 and D-6-9 respectively. Figure D-6-4 gives the location of Conoco's wells, while private wells are shown on Figures D-6-17 and D-6-18. The ground-water quality is very hard with total dissolved solids normally greater than 500 mg/l. The major cation is calcium while sulfate is the major anion. The sulfate, hardness and iron in some of the groundwater would make its use undesirable for domestic use. The nitrate concentrations in Well A2 (see Table D-6-7 and Figure D-6-17) are significantly above the recommended drinking water standard.

The conductivity, calcium, sulfate and chloride concentration of wells which penetrate the 70 sand or below is given in Figure D-6-15. Water quality from Wells 8-3, 889 and 1808 is not reflective of the 70 sand aquifer in the area of these wells because their piezometric heads indicate they are influenced by a different sand. Calcium and sulfate follow the same pattern as conductivity. Chloride values of the 70 sand aquifer are all low and are not reflective of other major constituents. The 68 sand water quality seems fairly close to the 70 sand. The water quality from the 50-40 sand, Well 1822, is better than most of the 70 sand's water quality while the Roland coal's water quality is similar to that of the 50 and 40 sands.

Radium and selenium have been detected in the wells in the ore zone. Wells centered in the three pit areas consistently produce Ra-226 concentrations at levels in excess of the 5 pCi/l standard. Selenium has been detected in Well 1 (W-2) at levels in excess of water standards.

Table D-6-9 gives the laboratory water quality results from piezometers in the evaporation pond and tailings areas while the permeability test tables in Appendix A-1 give the field parameters. The conductivity of the water from the E coal - Lower mudstone and other mudstones and sandstones above the 70 sand are plotted in Figure D-6-16. Values for conductivities other than E coal - Lower mudstone are shown in brackets. The conductivity of water in the E coal - Lower mudstone shows a definite pattern in the evaporation pond area. The concentrations around the north and east sides of the evaporation pond are the lowest, and conductivities increase toward the dam. The conductivity of the water from Well 35N-7D (E coal) is 580 umhos/cm, which indicates the concentration does not increase much from just north of the evaporation pond to this well. Conductivities of water from mudstones in the area of Pit 35N vary from 325 to 1,090 umhos/cm while the values of water from the sandstones ranged from 330 to 880 umhos/cm.

2.0 SURFACE WATER

2.1 DRAINAGE BASINS

The project area lies entirely within the drainage basin of Ninemile Creek, which is tributary to Antelope Creek. Antelope Creek flows into the South Cheyenne River (Wyoming nomenclature) which joins the Belle Fourche River in South Dakota to form the Cheyenne River. The Cheyenne River subsequently flows into the Missouri River. The entire Antelope Creek drainage basin is shown on Figure D-6-19. Ninemile Creek's drainage is shown on Figure D-6-17, and the Ninemile Creek tributaries which are relevant to the project are shown on Figures D-6-17 and D-6-18.

Antelope Creek has a drainage area of 980 square miles with an approximate channel length of 62 miles and an average gradient of 0.006 (ft/ft). The elevation at Antelope Creek's headwaters is approximately 6,225 feet above mean sea level (msl), and 4,400 feet at its confluence with the South Cheyenne River. The U.S. Geological Survey has a stream gaging station on Antelope Creek approximately ten miles upstream from its mouth. The drainage area is 959 square miles, at the gage.

Ninemile Creek has a total drainage area of 63 square miles, a channel length of approximately 20 miles, and an average channel gradient of 0.006 (ft/ft). The elevation difference from headwaters to mouth is 610 feet with a maximum basin elevation of approximately 5,500 feet above msl. Upstream of monitoring site I-7 (Figure D-6-17), 34 square miles of the Ninemile Creek basin drain the project area. The channel length within this area is approximately 10.5 miles with an average gradient of 0.007 (ft/ft).

Simmons Draw is a Ninemile Creek tributary flowing southeasterly through the project (Figures D-6-17 and D-6-18). Its total drainage area is 8.1 square miles. The channel length is 6.8 miles with an average gradient of 0.007 (ft/ft). Total basin elevation difference is 260 feet with a maximum elevation of approximately 5,475 feet above msl.

Pine Tree Draw, with a drainage area of 8.2 square miles, flows from the north into Ninemile Creek on the eastern edge of the project area (Figures D-6-17 and D-6-18). The channel length is approximately 7.6 miles, and the average gradient is 0.009 (ft/ft). The maximum basin elevation approaches 5,470 feet above msl, and the minimum is approximately 5,110 feet.

Simmons Draw has two tributaries which flow in a predominantly southerly direction in the project area. These tributaries are labeled Washes Nos. 1 and 2 on Figures D-6-17 and D-6-18. Wash No. 2 is further subdivided into Upper Wash No. 2 and Lower Wash No. 2 based on the channel reach being upstream and downstream of the proposed mining Pit 35N. Wash No. 4, which is tributary to Ninemile Creek, is also further divided into Upper Wash No. 4 and Lower Wash No. 4 at the location of the proposed mill tailings evaporation pond dam.

Wash No. 1 has a drainage area of 1.7 square miles, a channel length of 2.8 miles, and an average channel gradient of 0.014 (ft/ft). The basin elevation difference is approximately 205 feet with a maximum elevation of 5,475 feet above msl.

Upper Wash No. 2 and Lower Wash No. 2 have drainage areas of 1.9 and 0.95 square miles, respectively. Their respective channel lengths are 3.1 and 2.2 miles with average gradients of 0.012 and 0.007 (ft/ft).

The drainage areas of Upper Wash No. 4 and Lower Wash No. 4 are 0.70 and 0.53 square miles respectively. Channel lengths are 0.46 and 1.3 miles with respective gradients of 0.017 and 0.013 (ft/ft).

Wash No. 3 (see Figures D-6-17 and D-6-18) drains into Pine Tree Draw from the northwest in Section 36 of T42N-R75W. Its drainage area is 1.8 square miles, the channel length and average gradient are 3.2 miles and 0.014 (ft/ft), respectively, and the basin elevation difference is approximately 230 feet. The maximum basin elevation is approximately 5,480 feet above msl.

Drainage basin characteristics for Antelope Creek, Ninemile Creek, and all of the tributaries relevant to the Moore Ranch project area are summarized in Table D-6-10.

2.2 CHANNEL GEOMETRY

Representative channel cross sections for Upper Wash No. 2 in the area of Pit 35N, and upstream from this pit, are shown on Figures D-6-20 and D-6-21, respectively. The location of each cross section is identified with a letter and a dashed line on Figures D-6-17 and D-6-18. Figure D-6-22 shows a typical channel cross section of Upper Wash No. 4 downstream of the proposed mill evaporation pond, and Figure D-6-23 shows a channel cross section for Wash No. 1 west of the backfill storage area. Channel conveyance characteristics including discharge, cross-sectional area, velocity, channel gradient, hydraulic radius, Manning's roughness coefficient and the volumes for the 5-year and 100-year floods are also shown for each of these channel cross sections on their respective figures. Locations of each channel cross section site are shown on Figures D-6-17 and D-6-18. Additional channel cross sections for Lower Wash No. 2, Simmons Draw, Ninemile Creek, and Wash No. 3 at crest stage gage locations are shown on Figures D-6-24, D-6-25, D-6-26, and D-6-27, respectively. Figure D-6-28 shows a channel cross section with channel conveyance characteristics computed for Simmons Draw downstream from the Moore Ranch project area. These channel cross section sites are also shown on Figure D-6-18.

Samples of channel bed material from Simmons Draw, Wash No. 2, and Wash No. 3 were collected and subjected to mechanical and radiation analysis. Typically, only 10 to 15 per cent of the samples passed through the 0.1 millimeter sieve. Curves of grain size distribution are given in Figures D-6-29, D-6-30, and D-6-31.

2.3 SURFACE WATER RUNOFF

In Wyoming at least three techniques are available for estimating flood flows and volumes in ungaged basins for different recurrence intervals. Lowham (1976) presented a basin characteristics technique whereby peak flow was related to drainage area with consideration of different regions in the state. Lowham's regression equations can be used for basins with drainage areas between 5 and 5,300 square miles. However, using a graphical approach, his technique can be used for basins slightly less than one square mile in area.

For small basins (approximately 10 square miles and less) Craig and Rankl (1977) developed basin characteristics regression equations which utilize other basin parameters in addition to drainage area to compute peak flows and flood volumes. Also, for small basins, the U.S. Soil Conservation Service (SCS) has developed a technique to estimate peak flows and flood volumes. These techniques are published in their Engineering Field Manual (1969). The SCS technique utilizes peak rainfall values published by the U.S. Weather Bureau and then takes into consideration soil and vegetation characteristics and basin slope and drainage area to make the flood flow and volume estimates.

Additional Text for Section 2.2

Longitudinal profiles of local drainages within the permit area are provided in Figure D-6-36. Features of the proposed complex (Dam 1A, Dam 2 and Pit 35N) which will lie on these drainages are depicted on the appropriate profiles.

Please note that one proposed feature (Dam 1B) does not occupy a position on a major drainage. For a detailed discussion of all these features, please refer to the Mine Plan.

Table D-6-11 presents flood flow and volume estimates for the 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year events. For comparison purposes, values obtained by utilizing the three available techniques are tabulated. Mean annual flows using Lowham's technique are also shown. However, mean annual flow values are questionable for ephemeral or intermittent streams because many zero values must be averaged with the relatively infrequent runoff events.

Values listed in Table D-6-11 under the SCS method were obtained using curve number 75 and 24-hour duration precipitation values from Miller and others (1973). Table D-6-12 shows precipitation for selected recurrence intervals for different duration periods.

At the U.S. Geological Survey stream gaging site on Antelope Creek, discharge data are available for the period of record, October 1977 - September 1979. This can be seen in the Survey's annual report entitled Water Resources Data for Wyoming. Maximum flow observed during this period was 6,600 cubic feet/second, and minimum daily flow was 0.10 cubic feet/second. Mean discharge for water year 1978 was 28.7 cubuc feet/second and 7.09 cubic feet/second for water year 1979. Mean monthly discharges for water years 1978 and 1979 are shown on Figure D-6-32.

For the smaller tributaries to Ninemile creek in the project area, long periods of no flow would be expected. Runoff would be observed mainly during snowmelt and rainstorm events occurring between March and August.

2.4 SURFACE CONTROL STRUCTURES

Several small ponds exist downstream of the project. The first major surface water control structure downstream of the project is the

Angostura Reservoir on the Cheyenne River in South Dakota. This reservoir is approximately 320 river kilometers (200 river miles) downstream of the project. Storage capacity of this reservoir for different pool elevations is given in the U.S. Geological Survey Water Supply Papers on surface water data of this area.

2.5 SURFACE WATER QUALITY

The U.S. Geological Survey has operated a stream gaging and water quality monitoring site (Antelope Creek near Teckla, Wyoming) since October 1977. Total dissolved solids ranged from less than 300 to greater than 2,000 mg/l in the first two years of operation. The water is extremely hard with values often exceeding 1,000 mg/l. Calcium, magnesium, and sodium are all present in significant concentrations with no single cation being overwhelmingly dominant. Sulfate and bicarbonate are the dominant anions. With the exception of most major ions, no chemical contaminants seem to be in Antelope Creek near Teckla in excessive concentrations.

Observed suspended sediment concentrations at the Antelope Creek gage ranged from 5 to greater than 1,000 mg/l for the two-year period of record. The sediment content varies directly with water discharge. Therefore, the bulk of the sediment load is transported during spring snowmelt runoff and spring and summer thunderstorms. Figures D-6-33 and D-6-34 show the seasonal relationship and the relationship with stream discharge at the Antelope Creek gage for water years 1978 and 1979, respectively.

Table D-6-13 shows chemical analyses on samples that have been collected from surface water monitoring sites in the project area. All sites listed on this table are plotted on Figures D-6-17 and D-6-18. Total dissolved solids at these sites range from less than 50 to greater than 2,300 mg/l. Some of the lower values represent samples taken during times of snowmelt runoff. Most samples have calcium as the predominant cation with sodium and magnesium as less, but still significant cations. Sodium is not present in quantities large enough to present a hazard for irrigational use. Sulfate and bicarbonate are the dominant anions as they are downstream at the U.S.G.S. Antelope Creek gage.

Total suspended solids (TSS) in creeks draining the Moore Ranch project area are generally low except during some runoff events. During these times, TSS have exceeded 500 mg/l.

Toxic minor elements have not been detected in excessive or potentially dangerous concentrations. Iron has been occasionally observed in levels that would cause inconvenient sink or laundry staining if used as a domestic water supply.

In summary, high sulfate and hardness concentrations would make the surface water draining the project area inconvenient or unpleasant, but not unsuitable for use as a domestic supply. No trace contaminants, including boron, are present in quantities to prevent use as an agricultural water supply.

2.5.1 SURFACE WATER MONITORING PROGRAM

Table D-6-13 presents pre-mine surface water monitoring results while Figures D-6-17 and D-6-18 show the locations of these sites. The mining and post-mining surface water programs will be the same and are defined in Section 3.5.6 of the Mine Plan.

2.6 PERSPECTIVE OF STREAM CHANNELS IN RELATION TO THE FLUVIAL SYSTEM

The fluvial system in Wash 1, 2 and 4 is very small. Figures D-6-30 and D-6-31 give the grain size distribution curves for a sample from the channel bottom in Wash 2 and 3 respectively. These samples indicate the material in these two channels are mainly medium and coarse sand. A sample from Simmons Draw which is slightly coarser material then the samples from Wash 2 and 3 is given in Figure D-6-29. The arroyo channels in this area are mainly grass covered and very stable. The channel of the lower portion of Ninemile Creek has a significant fluvial system.

3.0 WATER RIGHTS

The ground-water and surface water rights for 10 miles from the project area were searched from the State Engineer's files. Ground-water and surface water rights locations are shown in Figure D-6-35 and are listed in Tables D-6-14 and D-6-15, respectively.

3.1 GROUND-WATER RIGHTS

Table D-6-14 provides well locations to the quarter-quarter section, permit number, use, user, probable aquifer, well depth, water level if reported, and additional information for each of the ground-water rights. Wells 12299 and 39648 through 39656, which are located in the permit area, are held by Conoco, Inc. for the purpose of defining the ground-water hydrology for the project. The only permitted well located in the permit area (not held by Conoco) is Well 14682. This well, which is owned by Taylor Ranch, is 158 feet deep and used for stock watering. Wells 14660 and 14681 are approximately 1/2 mile north of the permit area and are

2.6 ADDITIONAL DISCUSSION OF FLUVIAL SYSTEM

Channel characteristic information (Section 2.2, page 19) is shown on Figures 6-20 through 6-23 and Figure 6-28. Figure D-6-36 presents longitudinal profiles. Further discussion is found in Section 2.6 on page 24.

In general, the ephemeral southeastward trending drainages within and near the proposed permit area must be described as showing evidence of downcutting with no pronounced flood plains or depositional characteristics. Each of the draws or washes which passes through the area has its origin on the divide between the Cheyenne and Powder River drainage system which is located at an elevation of about 5480 feet to the north of Highway 387. Note that the area north of the divide (Figure D-6-17) which is a portion of the origin of the Powder River system, is typically more rugged and contrasts significantly with the topography of the Cheyenne drainage.

Further specific information on soils and vegetation in the drainages can be found in Appendices D-7, D-7A (Soils) and D-8, D-8A (Vegetation). Figure D-8-4 shows a photograph of a typical drainage meadow.

Additional channel information is available in an erosion study for the site which is attached for reference. This report is included as Appendix A-3 at the end of this appendix.

stock-watering wells also. Two deeper wells, Permit Numbers 35330 and 35746, which are 500 feet and 660 feet deep respectively, are located approximately 8,000 feet north of the permit area. These wells are primarily used for stock-watering. Numerous wells, 14675, 14677, 14683, 14684 and 14686, are located within 3 miles of the northeast corner of the permit area. Each of these wells is used for stock-watering. Several wells are located within 3 miles of the east side of the permit area, but only Well 6972 is used for purposes other than stock-watering. This well is used for irrigation and wildlife. Well 17305, which is 2,500 feet from the southeast corner of the permit area, is also used to water stock.

The only two permitted domestic wells within 3 miles of the permit area are Wells 12240 and 3909. The depths of these wells are 180 feet and 273 feet, respectively. A shallow stock well is located approximately 1 mile west of the permit boundary.

3.2 SURFACE WATER RIGHTS

The surface water rights for the project are given in Figure D-6-35 and Table D-6-15. Location, permit number, stream, use and user are given in the table for the surface water rights. Surface water rights north, west and east of the permit area do not receive water which drains from the permit area.

The first two surface water rights downstream of the permit area are Numbers 3308 and 14212 which are located on Ninemile Creek. These two sites are approximately 4.6 miles downstream of the permit area.

Permit 3308 covers the reservoir on Ninemile Creek which is used to store and divert water to the lands to be irrigated under Permit Number 14212. Seventy acres of land were permitted to be irrigated along Ninemile Creek from this reservoir. There is currently no evidence of active irrigation operations which were associated with these 1918 water rights.

4.0 HYDROLOGIC IMPACTS

The main impacts to the hydrologic systems from the project will be the drawdown in the aquifers from pumping. A small impact to the surface water systems will be seen from the containing of some runoff and its usage. The ground-water and surface water impacts are discussed in the Mine Plan under section 3.5.

All of the wells in the permit area are used by Conoco except well 14682. Well 14670 (Permit Number) (see Figure D-6-35 for location) is only 22 feet deep. This well could not be completed in the 70 sand because it is a long distance from the 70 sand outcrop. Mining and milling at the project site should not cause an impact on this well.

Well 17305 is located in the outcrop area of the 70 sand and is only 50 feet deep. This well is likely to be a 70 sand well. A maximum drawdown of four feet in the 70 sand aquifer is expected in this area. The Pine Tree Draw is located near this well and could be very effective in recharging this area of the aquifer. If this is the case, less drawdown should be observed. A drawdown of four feet probably would reduce the maximum yield of the 70 sand in this area by approximately 20 per cent.

Well 6973 is likely to be completed in the 70 sand. A maximum drawdown in the range of three feet is expected in the 70 sand aquifer in this area. This well has 110 feet of standing water in it. A drawdown of three feet in the aquifer in this area should not significantly reduce the maximum yield of the aquifer.

Well 14683 is a stock well and probably is a 70 sand well. A maximum drawdown of approximately seven feet is expected in the aquifer in this area. This quantity of draw-down should result in approximately ten per cent reduction in maximum yield in this well. Well 14683 (P'-8) is proposed as an operational monitoring well.

Well 14682 which is inside the permit boundary, and well 14681 are much shallower than the projected depth to the top of the 70 sand in these areas. These wells are not expected to be impacted by the project. Well 14682 (P'-26) is proposed as an operational monitoring well.

Well 14660 (see Figure D-6-35 for location) is approximately one-half mile north of the permit boundary. This well is probably completed above the 70 sand aquifer. A maximum drawdown in the range of ten feet is expected in the 70 sand aquifer in this area.

Wells which are further from the mine pits will be impacted less. An estimate of the drawdown in the 70 sand aquifer can be obtained from Figures MP-10, MP-11 and MP-12. The reduction in maximum yield for wells other than the ones discussed should be insignificant.

Pine Tree Spring is the only spring close to the project. The ground-water source for this spring is thought to be above the 70 sand aquifer. Impacts to Pine Tree Spring are therefore not expected. A flume with a continuous recorder will be installed at Pine Tree Spring to determine if any decreases of flow are attributed to the mine dewatering. Pine Tree Spring will also be included in the operational monitoring program.

A discussion of the per cent of watershed blocked by the Sand Rock project is given in Section 3.5.1 of the Mine Plan. Permits 3308 and 14212 are the only surface rights which these reductions could influence. Surface water is not presently being used under these two permits.

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TABLE D-6-1

BASIC COMPLETION AND WATER LEVEL DATA FOR THE EVAPORATION POND AREA (AREA 10)

Hole No.	Date Drilled	Depth Drilled (ft-LSD)	Perforated Interval (ft-LSD)	Lithologic Unit	Water Level			Elevation of M.P. (ft-MSL)	M.P. Above LSD (ft)
					Date	Depth (ft-MP)	Elev. (ft-MSL)		
P-1	9/79	51	38-48	LMS - E Coal	4/3/80	dry	5,236.6	5,287.9	1.6
P-2	3/9/80	50.5	35-50	LMS - E Coal*	4/2/80	43.79	5,250.5	5,294.3	1.8
P-3	3/11/80		39-49	LMS	3/27/80	50.5	5,233.4	5,283.9	2.4
P-4				LMS - E Coal*	3/24/80	23.18	5,266.7	5,289.9	1.1
P-4B	3/3/80	33.2	28-33	UMS - E Coal	3/27/80	21.80			1.8
P-4B-1	3/3/80	33	28-33	UMS - E Coal	3/27/80	20.26			3.1
P-4C	3/3/80	25	12-25	UMS - U Coal	3/27/80	19.22			2.6
P-4CA	3/25/80	30	25-30	UMS	3/27/80	22.65			3.7
P-5	3/9/80	47	43-45.5	E Coal	3/24/80	28.37	5,271.9	5,300.3	2.3
P-6	3/4/80	40	28.5-38.5	USS	3/24/80	35.75	5,278.4	5,314.1	1.7
P-7	3/4/80	160	130-160	70SS	3/4/80	133	5,175.6	5,308.6	0.5
P-7A	3/4/80	160	75-90	U70SS	4/10/80	88.49	5,220.4	5,308.9	0.8
P-8	3/9/80	59.5	32-58	LMS - E Coal	4/2/80	26.09	5,296.9	5,269.0	2.1
P-9	3/10/80	35	25-35	LMS - E Coal*	4/2/80	14.60	5,266.1	5,280.7	2.1
P-9A	3/25/80	18	12-18	UMS	4/9/80	16.04	5,264.3	5,280.3	1.7
P-10	3/10/80	59.5	33-59.5	LMS - E Coal*	3/24/80	28.30	5,268.0	5,296.3	0.5
P-11	3/7/80	20	16.5-19	E Coal	3/27/80	18.60	5,254.0	5,272.6	0.3
P-12	3/9/80	32.5	29-32	E Coal	4/9/80	30.90	5,276.5	5,307.4	1.0
P-13	3/13/80	19.5	9-19	UMS	4/11/80	17.60	5,263.6	5,281.2	0.4
P-13A	3/25/80	28	22-28	E Coal	3/27/80	19.96	5,263.9		3.1
P-15	3/11/80	35	27-35	LMS - E Coal*	3/27/80	23.03	5,263.5	5,286.5	2.0
P-15A	3/25/80	21	17-21	UMS	3/27/80	22.9	5,263.5		1.9
P-16	3/11/80	73	58-73	U 70 SS	3/24/80	75.5	5,218.9	5,294.4	2.4
P-17	3/13/80	89.5	79.5-89.5	U 70 SS	3/24/80	92.7	5,211.9	5,304.6	2.6
P-18		25	14-18	All	3/27/80	22.25	5,250.8	5,273	0.3
P-19	3/14/80	59	30-57	LMS	4/10/80	31.34	5,254.2	5,285.5	3.5
P-20	2/28/80	119.3	107-119	S 70 SS	3/27/80	97.54	5,184.5	5,282.0	0.7
P-20A		107.2	99-107	S 70 SS	3/26/80	98.18			1.1
P-20B		117.5	107-117	S 70 SS	3/26/80	98.79			1.6
P-21	3/18/80	120.4	88-118	S 70 SS	3/24/80	75.32	5,177.5	5,252.8	2.8

NOTE:

M.P. = Measuring Point
LSD = Land Surface Datum
LMS = Lower Mudstone
UMS = Upper Mudstone
E Coal = E Coal
U Coal = Upper Coal
USS = Upper Sandstone
U 70 SS = Upper (Unsaturated) 70 Sand
70 SS = 70 Sandstone
S 70 SS = Saturated 70 Sandstone

* Completion of well questionable.

TABLE D-6-2

BASIC COMPLETION AND WATER LEVEL DATA
FOR THE 35N PIT TAILINGS DISPOSAL AREA

Hole No.	Date Drilled	Depth Drilled (Ft-LSD)	Perforated Interval (Ft-LSD)	Lithologic Unit	Water Level Date	Water Level Depth (Ft-MP)	Water Level Elev. (Ft-MSL)	Elevation of M.P. (Ft-MSL)	M.P. Above LSD (Ft)
35N-1C		178.7	154-179	U70SS	5/15/80	dry	-	5354.8	1.2
35N-1D		43.2	36-44	SS	5/16/80	39.54	5314.9	5354.4	0.8
35N-1E		29.0	21-29	MS	5/15/80	28.86	5326.1	5355.0	1.4
35N-2A		159.5	145-160	U70SS	5/21/80	147.25	5191.0	5338.3	0.8
35N-2B		131.0	126-131	SS	5/19/80	124.28	5214.1	5338.4	0.9
35N-2C		73.3	64-74	MS	5/19/80	69.52	5269.4	5338.9	1.4
35N-3		29.5	20-30	SS	4/09/80	dry	-	5401.9	3.2
35N-4		131.6	112-132	SS-MS	4/09/80	dry	-	5389.3	1.0
35N-5		79.0	69-79	SS	5/19/80	78.4*	5219?	5294.7	1.3
35N-6		90.3	80-90	SS	5/15/80	86.87	5236.5	5323.4	1.2
35N-7A		182.9	143-183	70SS	5/18/80	132.30	5172.9	5305.2	1.1
35N-7B		115.4	101-116	U70SS	5/15/80	dry	-	5305.6	1.5
35N-7C		83.4	74-84	SS	5/15/80	82.09	5229.3	5311.4	4.3
35N-7D		99.0	92-99	E Coal	5/18/80	97.39	5207.9	5305.3	1.2
35N-7E		27.4	22-28	SS	5/15/80	18.90	5289.7	5308.6	1.5
35N-7F		17.7	12-18	MS	5/15/80	14.97	5294.5	5309.5	2.4
35N-7G		59.2	51-59	U Coal	5/18/80	33.14	5272.2	5305.3	1.2

NOTE:

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UMS = Upper Mudstone
E Coal = E Coal

U Coal = Upper Coal
USS = Upper Sandstone
U 70 SS = Upper (Unsaturated) 70 Sand
70 SS = 70 Sandstone
S 70 SS = Saturated 70 Sandstone

* Completion of well questionable.

TABLE D-6-3

BASIC WELL COMPLETION DATA FOR WELLS IN THE MINE AREA

Well No.	Aquifer	Collar Elevation (Ft.Abv.msl)	Depths (Ft.) Total	Depths (Ft.) Casing	Depths (Ft.) Perforated Interval	Gravel Pack	Diameters (In.) Drill Bit	Diameters (In.) Casing (I.D.)	Type Casing	State Permit	Date Drilled
1810	70SS	5378	265	265	200-260	X	8-3/4	3"	PVC	39650	07/29/77
1808	70-68SS	5377	275	275	195-275	X	9-7/8	5"	PVC	39651	07/28/77
1809	70SS	5356	230	230	135-225	X	8-3/4	3"	PVC	39652	07/28/77
889	70SS	5334	260	260	200-260	X	8-3/4	3"	PVC	39653	07/29/77
890	70-68SS	5410	330	330	240-330	X	8-3/4	3"	PVC	39654	07/29/77
22-2	70SS	5287	165	165	85-165	X	8-3/4	3"	PVC	39655	08/01/77
8-3	70-68SS	5308	175	175	105-175	X	9-7/8	5"	PVC	39656	08/01/77
885	70SS	5350	240	240	180-240	X	9-7/8	5"	PVC	39648	07/22/77
886	70SS	5349	240	240	180-240	X	8-3/4	3"	PVC	——	07/21/77
887	68SS	5347	320	320	290-320	X	8-3/4	3"	PVC	——	07/20/77
888	70SS	5352	250	250	180-240	X	8-3/4	3"	PVC	——	07/21/77
1	70SS	5331	240	240	200-240		6-1/4	5"	PVC	39649	09/17/77
1805	70SS	5331	240	240	120-240	X	8-3/4	3"	PVC	——	07/22/77
1806	70SS	5324	220	220	120-200	X	8-3/4	3"	PVC	——	07/21/77
1807	68SS	5328	290	290	250-290	X	8-3/4	3"	PVC	——	07/22/77
1814	70SS	5345	207	207	143-207		9-7/8	5"	Steel	——	11/02/78
1815	70SS	5348	208	208	142-208	X	5-1/8	3"	PVC	——	11/08/78
1816	70SS	5343	207	207	138-207	X	5-1/8	3"	PVC	——	11/08/78
1817	70SS	5350	233	233	143-233	X	5-1/8	3"	PVC	——	11/08/78
893	70SS	5348	240	240	153-240	X	9-0	5"	Steel	——	11/21/78
1821	Roland Coal	5355	1200	1200	1120-1200		8-3/4	6"	Steel	——	10/22/79
1822	50-40SS	5355	740	740	560-600 640-680 700-720		8-3/4	6"	Steel	——	10/26/79
1823	68SS	5345	240	240	210-240		8-3/4	6"	Steel	——	~~04/ /80~~ 3/30/80

NOTE:

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UMS = Upper Mudstone
E Coal = E Coal

U Coal = Upper Coal
USS = Upper Sandstone
U 70 SS = Upper (Unsaturated) 70 Sand
70 SS = 70 Sandstone
S 70 SS = Saturated 70 Sandstone

* Completion of well questionable.

TABLE D-6-4

SUMMARY OF SUBSOIL HYDRAULIC CONDUCTIVITIES
AND AQUIFER PROPERTIES
(CONSTANT-HEAD AND PUMP TEST)

Well	Lithogic	Transmissivity		Hydraulic Conductivity		Storage	Specific
No.	Unit	Gal/Day/Ft	M^2/Yr	Ft/Yr	Cm/Sec	Coefficient	Yield
P-1	LMS - E Coal	3.1	14.	15.	1.5×10^{-5}		
P-2	LMS - E Coal	0.10	0.46	0.70	6.8×10^{-7}		
P-3	LMS	1.6	7.2	7.7	7.5×10^{-6}		
P-4	LMS- E Coal	0.14	0.65	0.70	6.8×10^{-7}		
P-4B	UMS - E Coal	1.6	7.3	15.8	1.5×10^{-5}		
P-4CA	UMS	0.47	2.1	4.6	4.4×10^{-6}		
P-5	E Coal	0.32	1.4	6.2	6.0×10^{-6}		
P-6	USS	1.5	6.6	7.1	6.8×10^{-6}		
P-7	70SS	58.	262.	94.	9.5×10^{-5}		
P-8	LMS - E Coal	1.4	6.6	2.7	(2.6×10^{-6}		
P-9	LMS - E Coal	0.079	0.36	0.38	3.7×10^{-7})		
P-9A	UMS	0.31	1.4	2.5	2.4×10^{-6}		
P-10	LMS - E Coal	0.67	3.0	1.2	1.2×10^{-6}		
P-11	E Coal	2.7	12.	53.	5.1×10^{-6}		
P-12	E Coal	0.41	1.9	6.7	6.5×10^{-6}		
P-13	UMS	3.6	17.	180.	1.7×10^{-4}		
P-13A	E Coal	1.8	8.3	14.8	1.4×10^{-5}		
P-15	LMS - E Coal	0.12	0.52	0.71	6.8×10^{-7}		
P15A	UMS	4.5	20.	55.	5.3×10^{-5}		
P-16	U70SS	0.32	1.4	1.0	9.9×10^{-7}		
P-17	U70SS	0.13	0.61	0.65	6.3×10^{-7}		
P-18	ALL	25.	110.	470.	4.6×10^{-4}		
P-20B	70SS	1.7	7.7	8.5	8.2×10^{-6}		
P-21	70SS	2.3	10.3	3.7	3.6×10^{-6}		
35N1-C	U70SS	0.40	1.8	0.78	7.5×10^{-7}		
35N1-D	SS	1.20	5.2	7.0	6.8×10^{-6}		
35N1-E	MS	0.14	0.65	0.9	8.5×10^{-7}		
35N-2A	U70SS	2.6	11.9	8.5	8.2×10^{-6}		
35N-2B	SS	0.82	3.6	7.8	7.6×10^{-6}		
35N-2C	MS	0.9	4.0	4.3	4.2×10^{-6}		
35N-3	SS	7.1	32.2	34.7	3.4×10^{-5}		

TABLE D-6-4

(CONT.)

Well No.	Lithogic Unit	Transmissivity Gal/Day/Ft	Transmissivity M^2/Yr	Hydraulic Conductivity Ft/Yr	Hydraulic Conductivity Cm/Sec	Storage Coefficient	Specific Yield
35N-4	MS-SS	1.1	5.0	2.7	2.6×10^{-6}		
35N-5	SS	0.0025	0.011	0.0012	1.2×10^{-9}		
35N-6	SS	2.1	9.4	10.2	9.8×10^{-6}		
35N-7A	70SS	1170.	5320.	1430.	1.4×10^{-3}		
35N-7B	U70SS	1.7	7.7	5.5	5.4×10^{-6}		
35N-7C	SS	1.7	7.7	8.3	8.0×10^{-6}		
35N-7D	E Coal	5.8	26.4	40.6	3.9×10^{-5}		
35N-7E	SS	5.2	23.5	42.1	4.1×10^{-5}		
35N-7F	MS	0.37	1.7	3.0	2.9×10^{-6}		
35N-7G	U Coal	0.02	0.07	0.09	9.0×10^{-8}		
886	70SS	800.	3600.	650.	6.2×10^{-4}	1.0×10^{-3}	0.015
		1800.	8000.	1430.	1.4×10^{-3}		
888	70SS	170.	770.	140.	1.3×10^{-4}	2.9×10^{-3}	
887	68SS	1.9	8.5	3.1	3.0×10^{-6}		
1805	70SS	910.	4100.	560.	5.4×10^{-4}	5.2×10^{-4}	
1806	70SS	840.	3800.	510.	4.9×10^{-4}	2.8×10^{-4}	
1816	70SS	3800.	17000.	4600.	4.4×10^{-3}	7.0×10^{-4}	0.010
1821	Roland Coal	1400.	6350.	854.	8.3×10^{-4}		
1822	50-40SS	720.	3260.	351.	3.4×10^{-4}		
1823	68SS	190.	860.	306.	3.0×10^{-4}		

NOTE:

M.P. = Measuring Point
LSD = Land Surface Datum
LMS = Lower Mudstone
UMS = Upper Mudstone
E Coal = E Coal
U Coal = Upper Coal
USS = Upper Sandstone
U 70 SS = Upper (Unsaturated) 70 Sand
70 SS = 70 Sandstone
S 70 SS = Saturated 70 Sandstone

* Completion of well questionable.

TABLE D-6-5

SUMMARY OF SUBSOIL PERMEABILITIES FROM PACKER TESTS
EVAPORATION POND AREA

Hole Number	Test Interval (ft-LS)	Lithologic Unit*	Hydraulic Conductivity (Permeability) ft/yr	cm/sec
PD-3	30-40	LMS	<1.0	$<9.7 \times 10^{-7}$
PD-5	11.5-16.5	UMS	<1.4	$<1.4 \times 10^{-6}$
	17-22	UMS	63	6.1×10^{-5}
	31-36	LMS	<0.8	$<7.7 \times 10^{-7}$
PD-6	18-23	UMS	<1.5	$<1.4 \times 10^{-6}$
	25-30	E Coal	2.3	2.2×10^{-6}
	29.5-34.5	LMS	1.6	1.5×10^{-6}
PD-7	10-15	USS	330	3.2×10^{-4}
	16-21	UMS	320	3.1×10^{-4}
	25-30	E Coal	1.5	1.4×10^{-6}
PD-8	7-12	USS	5,070	4.9×10^{-3}
	24-29	UMS	<1.0	$<9.7 \times 10^{-7}$
PD-9	18-23	USS	1.5	1.4×10^{-6}
	28-33	UMS	<0.9	$<8.7 \times 10^{-7}$
	32-37	E Coal	<0.7	$<6.8 \times 10^{-7}$
PD-10	12-17	UMS	1.4	1.4×10^{-6}
	17-22	UMS	1.1	1.1×10^{-6}
	24-29	UMS	<1.0	$<9.7 \times 10^{-7}$
	29-34	UMS	<0.8	$<7.7 \times 10^{-7}$

TABLE D-6-5

(CONT.)

Hole Number	Test Interval (ft-LS)	Lithologic Unit*	Hydraulic Conductivity (Permeability) ft/yr	cm/sec
PD-11	7-12	USS	250	2.4×10^{-4}
	12-17	USS	1.4	1.4×10^{-6}
	17-22	UMS	<1.3	$<1.3 \times 10^{-6}$
PD-11	24-29	U Coal	<0.9	$<8.7 \times 10^{-7}$
	29-34	UMS	<0.8	$<7.7 \times 10^{-7}$
PD-12	17-22	LMS	1.3	1.3×10^{-6}
	26-31	LMS	<1.1	$<1.1 \times 10^{-6}$
	34-39	U70SS	490	4.7×10^{-4}
PD-14	6-11	USS	360	3.5×10^{-4}
	27-32	LMS	1.2	1.2×10^{-6}
PD-15	7-12	USS	<2.1	$<2.0 \times 10^{-6}$
	14.5-19.5	USS	<1.4	$<1.4 \times 10^{-6}$
	27-32	LMS	<1.1	$<1.1 \times 10^{-6}$
PD-16	8-13	UMS	<2.3	$<2.2 \times 10^{-6}$
	17-22	USS	430	4.2×10^{-4}
	20-25	USS-U Coal	410	4.0×10^{-4}
	30-35	UMS	<0.8	$<7.7 \times 10^{-7}$

TABLE D-6-5

(CONT.)

Hole Number	Test Interval (ft-LS)	Lithologic Unit*	Hydraulic Conductivity (Permeability)	
			ft/yr	cm/sec
PD-17	6-11	USS	6.4	6.2×10^{-6}
	8-13	USS	620	6.0×10^{-4}
	17-22	USS	240	2.3×10^{-4}
	20-25	USS-U Coal	630	6.1×10^{-4}
	25-30	UMS	<0.9	$<8.7 \times 10^{-7}$
	35-40	E Coal	0.7	6.8×10^{-7}
PD-18	11-16	USS	34	3.3×10^{-5}
	19-24	USS	1.2	1.2×10^{-6}
PD-19	12-17	USS	1,060	1.0×10^{-3}
	18-23	U Coal	800	7.7×10^{-4}
PD-20	5-10	USS	12	1.2×10^{-5}
	15-20	USS	140	1.4×10^{-4}
	22-27	UMS	1.0	9.7×10^{-7}
PD-21	8-13	USS	2,800	2.7×10^{-3}
	22-27	USS	17	1.6×10^{-5}
PD-22	14-19	USS	1.4	1.4×10^{-4}
PD-24	6-11	USS	210	2.0×10^{-4}
	17-22	UMS	59	5.7×10^{-5}
	22-27	USS	72	7.0×10^{-5}

TABLE D-6-5

(CONT.)

Hole Number	Test Interval (ft-LS)	Lithologic Unit*	Hydraulic Conductivity (Permeability) ft/yr	cm/sec
PD-26	11-16	USS	5.1	4.9×10^{-6}
	20-25	USS	13	1.3×10^{-5}
	27-32	USS	730	7.1×10^{-4}

NOTE:

M.P.	=	Measuring Point	U Coal	=	Upper Coal
LSD	=	Land Surface Datum	USS	=	Upper Sandstone
LMS	=	Lower Mudstone	U 70 SS	=	Upper (Unsaturated) 70 Sand
UMS	=	Upper Mudstone	70 SS	=	70 Sandstone
E Coal	=	E Coal	S 70 SS	=	Saturated 70 Sandstone

TABLE D-6-6

WATER LEVEL DATA FOR THE 70 SAND WELLS

Date	Well 22-2 Depth	22-2 Elev.	885 Depth	885 Elev.	889* Depth	889* Elev.	1 Depth	1 Elev.	1809 Depth	1809 Elev.	1810 Depth	1810 Elev.
8/17/77			181.3	5,168.7			159.8	5,171.2				
8/24/77							159.2	5,171.8				
9/15/77	97.9	5,189.1	180.3	5,169.7	163.3	5,170.7			187.6	5,168.4	207.2	5,170.8
10/26/77	98.1	5,188.9	180.3	5,169.7	164.1	5,169.9	158.2	5,172.8	187.5	5,168.5	207.5	5,170.5
1/24/78			180.2	5,169.8			157	5,174				
2/13/78			180.3	5,169.7			157	5,174				
3/21/78			179.8	5,170.2			156.7	5,174.3				
9/13/78	97.67	5,189.3			17.5	5,316.5			187.83	5,168.2	205.17	5,172.8
2/15/79	98.50	5,188.5	179.58	5,170.4	30.83	5,303.2					205.83	5,172.2
3/1/79	98.33	5,188.7	179.08	5,170.9	38.33	5,295.7	157.67	5,173.3	188.17	5,167.8	205.58	5,172.4
5/30/79	98.17	5,188.8	178.33	5,171.7	42.83	5,291.2	158.17	5,172.8	187.76	5,168.2	205.50	5,172.5
7/19/79	97.87	5,189.2	178.75	5,171.3	49.50	5,284.5	156.17	5,174.8	187.33	5,168.7	205.08	5,172.9
9/4/79	97.58	5,189.4	178.33	5,171.7	50.17	5,283.8	156.42	5,174.6	187.31	5,168.7	205.50	5,172.5
9/29/79							156.00	5,175.0				
11/30/79	97.67	5,189.3	179.67	5,170.3	53.62	5,280.4	156.00	5,175.0	187.71	5,168.3	205.17	5,172.8
12/21/79							156.00	5,175.0				

Date	Well 22-2 Depth	22-2 Elev.	885 Depth	885 Elev.	889 Depth	889 Elev.	1 Depth	1 Elev.	1809 Depth	1809 Elev.	1810 Depth	1810 Elev.
1/2/80	97.58	5,189.4	178.5	5,171.2	62.00	5,272.0	156.08	5,174.9	187.67	5,168.3	205.08	5,172.9
4/15/80					56.17	5,277.8	—	—	187.33	5,168.7	204.83	5,173.2
4/16/80							155.67	5,175.3				

Date	Well 893 Depth	893 Elev.	1814 Depth	1814 Elev.	1815 Depth	1815 Elev.	1816 Depth	1816 Elev.	1817 Depth	1817 Elev.
11/16/78			161.3	5,183.7	162.6	5,185.4	158.3	5,184.7	166.5	5,183.5
12/1/78			161.1	5,183.9	162.4	5,185.6	158.2	5,184.8	166.5	5,183.5
6/19/79	179.0	5,169.0	159.92	5,185.1						
9/26/79	179.0	5,169.0	159.0	5,186.0						
9/27/79	178.5	5,169.5								
12/2/79	178.0	5,170.0	159.67	5,185.3						
4/1/80			159.67	5,185.3						
4/9/80	178.08	5,169.9								

Note: Depth, in ft below LS
Elev., in ft above MSL

* Fluctuations in water level hint at improper completion of well.

TABLE D-6-7

GROUNDWATER QUALITY FOR PRIVATE WELLS NEAR CONOCO'S SAND ROCK PROJECT

Well No.	Well Location	Date	TDS	Conductivity		Temperature	Na	K	Ca	Mg	SO_4	Cl	CO_3	HCO_3	pH	
	41N-74W															
A-1 17304	04 NESE	6/26/79[a]	492	820	(705)	(17).	39	9	101	15	187	6	0	234	7.53	(7.15)
		12/7/79[b]	606	870	(839)	(7)	46	9	107	17	215	8	0	278	7.73	(7.70)
A-2 17302	04 SENE	6/26/79[c]	655	1,100	(676)	(17)	13	9	156	10	179	25	0	312	7.91	(7.00)
		8/14/79	—	—	(647)	(15)	—	—	—	—	—	—	—	—	—	(7.45)
		12/7/79	670	1,130	(1,069)	(9)	9	9	169	27	160	41	0	307	7.61	(7.70)
P'-6 9309	17 SWSE	6/28/79	831	1,270	(1,083)	(16)	107	10	128	19	460	12	0	151	7.66	(7.30)
P'-7 12240	17 SWSE	6/28/79	509	940	(795)	(14)	48	8	100	20	212	16	0	239	7.58	(7.05)
	41N-75W															
P'-9 —	03 NESW	6/20/79	1,024	1,389	(1,163)	(13)	45	13	201	48	550	7	0	312	7.32	(6.85)
		9/27/79	1,012	1,365	(1,258)	(12)	42	11	186	46	450	6	0	315	7.57	(6.95)
		3/26/80	964	1,300	(1,249)	(11)	42	13	197	47	516	6	0	327	7.61	(7.30)
P'-11 —	04 NENW	8/16/79	1,048	1,500	(1,308)	(12.5)	65	12	165	53	548	8	0	283	7.74	(7.45)
	42N-74W															
P'-8 14683	30 NWNW	6/28/79	2,339	2,770	(2,466)	(16)	16	11	512	116	1,270	4	0	366	6.95	(6.60)
I-30 — (Pine Tree Spring)	31 SWNE	6/29/79	1,030	1,450	(1,176)	(30)	31	9	211	54	467	25	0	376	7.83	(8.85)
		3/25/80	844	1,260	(1,131)	(1)	29	9	162	50	472	21	0	278	7.61	(8.6)
	42N-75W															
P'-10 —	33 SWSE	6/20/79	1,566	1,923	(1,608)	(18)	37	5	375	58	910	12	0	359	7.71	(7.45)
T-1 12299	33 SENW	6/26/79	661	1,100	(924)	(15)	87	9	106	17	270	10	0	254	7.49	(7.35)
		9/18/79	690	1,060	(896)	(14)	85	9	106	20	284	7	0	249	7.69	(6.90)
		9/25/79	—	—	(920)	(19)	—	—	—	—	—	—	—	—	—	(7.05)
P'-36 —	36 SENW	10/10/79	604	921	(801)	(15)	15	6	109	43	154	8	0	390	7.72	(7.30)
		12/10/79	693	1,070	(1,042)	(9.5)	13	5	143	51	251	7	0	398	7.80	(7.70)

Notes: Number below well number is the State Engineer's G.W. Permit Number.

All concentrations are in mg/l except Conductivity, in μmhos/cm @ 25°C; Temperature, in °C; pH in pH units, U; Pb-210, Po-210, Ra-226 and Th-230 in pCi/l; and Charge Balance = difference in major equivalents divided by sum of major equivalents times 100.

( ) Denotes field measurements.

* Denotes less than the value.

(a) Additional parameter for the sample is silver = *0.01.

(b) Additional parameters for this sample are silver = *.01 and alkalinity (as $CaCO_3$) = 228.

(c) Additional parameter for this sample is silver = *0.01.

TABLE D-6-7

(CONT.)

Well No.	Al	NH_3 (as N)	As	Ba	Be	B	Cd	Cr	Cu	F	Fe	Pb	Mn	Hg
A-1	* .05	* .05	* .002	* .02	* .005	* 1.0	* .002	* .01	* .002	0.13	0.011	* .05	0.007	* .001
17304	* .05	* .05	* .002	* .02	* .005	* 1.0	* .002	* .01	0.007	0.19	* .05	* .05	0.02	* .001
A-2	* .05	* .05	* .002	* .02	* .005	* 1.0	* .002	* .01	* .002	0.16	0.024	* .05	* .003	* .001
17302	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	* .05	0.10	* .002	* .02	* .005	* 1.0	.056	* .01	.022	.22	.17	.17	.02	* .001
P'-6	* .05	* .05	* .002	* .02	* .005	* 1.0	* .002	* .01	* .002	.08	.592	* .05	.072	* .001
9309														
P'-7	* .05	* .05	* .002	* .02	* .005	* 1.0	* .002	* .01	* .002	.14	.424	* .05	.078	* .001
12240														
P'-9	* .05	* .05	* .002	* .02	* .005	* 1.0	* .002	* .01	* .002	.13	.069	* .05	.088	* .001
—	* .05	—	* .002	* .02	* .005	* 1.0	* .002	* .01	* .002	* .05	* .05	* .05	.07	* .001
	* .05	0.10	* .002	* .02	* .005	* 1.0	* .005	* .01	0.010	0.12	0.10	0.07	0.08	* .001
P'-11	* .05	0.06	* .002	* .02	* .005	* 1.0	.008	* .01	.009	.14	.02	* .05	.02	* .001
—														
P'-8	* .05	0.09	* .002	* .02	* .005	* 1.0	* .002	* .01	* .002	.31	5.842	* .05	.856	* .001
14683														
I-30	* .05	0.07	* .002	* .02	* .005	* 1.0	* .002	* .01	* .002	0.90	0.038	* .05	0.279	* .001
—	* .05	0.57	* .002	* .02	* .005	* 1.0	* .005	* .01	0.009	0.80	0.10	0.09	0.24	* .001
(Pine Tree Spring)														
P'-10	* .05	* .05	* .002	* .02	* .005	* 1.0	.013	* .01	* .002	.36	.139	* .05	.03	* .001
—														
T-1	* .05	* .05	* .002	* .02	* .005	* 1.0	* .002	* .01	* .002	.17	.012	* .05	.016	* .001
12299	* .05	* .05	* .002	* .02	* .005	* 1.0	* .002	* .01	.005	.23	.12	* .05	.06	* .001
	—	—	—	—	—	—	—	—	—	—	—	—	—	—
P'-36	* .05	2.81	* .002	* .02	* .005	* 1.0	* .002	* .01	.002	.27	5.6	* .05	.08	* .001
—	—	0.14	—	—	—	—	—	—	—	—	—	—	—	—

TABLE D-6-7

(CONT.)

Well No.	Mo	Ni	NO_3	Se	V	Zn	U	Pb-210	Po-210	Ra-226	Th-230	Charge Balance
A-1	• .02	• .01	1.70	• .002	• .02	1.80	37 ± 2	0 ± .3	0.03 ± 0.1	0.15 ± .05	0 ± .1	1.9
17304	• .05	• .01	1.86	• .002	• .02	1.83						1.6
A-2	• .02	• .01	24.0	• .002	• .02	0.054	20 ± 1	0.3 ± .1	0 ± .04	0.15 ± .04	0.4 ± .1	0.8
17302	—	—	—	—	—	—	—	—	—	—	—	—
	• .05	• .01	36.0	• .002	• .05	.135						8.4
P'-6	• .02	• .01	.30	• .002	• .02	.054	0 ± 2	0 ± 1	0 ± .02	0.35 ± .05	0.2 ± .1	1.9
9309												
P'-7	• .02	• .01	.22	• .002	• .02	.041	6 ± 1	0 ± .05	0 ± .06	0.74 ± .07	0.3 ± .1	0.8
12240												
P'-9	• .02	• .01	1.16	.007	• .02	.024	32 ± 2	1.6 ± .2	0.4 ± .05	2.0 ± .1	0.2 ± .1	1.5
—	• .02	• .01	—	• .002	• .02	.006						1.6
	• .05	• .01	0.44	• .002	• .05	0.007						1.3
P'-11	• .02	• .01	.88	• .002	• .02	.050						1.7
—												
P'-8	• .02	• .01	.34	• .002	• .02	0.945	7 ± 1	0 ± .5	0.08 ± .02	0.75 ± .07	0 ± .1	5.1
14683												
I-30	• .02	• .01	1.61	• .002	• .02	0.007	2 ± 1	0 ± .9	0.2 ± .04	0.35 ± .05	137 ± 7	0.1
—	• .05	• .01	2.25	• .002	• .05	0.006						4.5
(Pine Tree Spring)												
P'-10	• .02	• .01	.39	• .002	• .02	.078	17 ± 1	1.9 ± .7	0.10 ± .02	0 ± .08	0 ± .1	0.1
—												
T-1	• .02	• .01	1.43	• .002	• .02	.113	44 ± 2	0 ± .4	0.02 ± .01	0.41 ± .06	0.3 ± .1	3.0
12299	• .02	• .01	3.05	• .002	• .02	.070						3.2
	—	—	—	—	—	—	—	—	—	—	—	—
P'-36	• .02	• .01	1.07	• .002	• .02	.720						0.2
—	—	—	.39	—	—	—						0.3

TABLE D-6-8

GROUNDWATER QUALITY FOR CONOCO'S SAND ROCK MONITORING WELLS

Well No.	Well Location	Date	TDS	Conductivity		Temperature	Na	K	Ca	Mg	SO_4	Cl	CO_3	HCO_3	pH	
	41N-75W															
22-2	02 NWNE	1/3/80	508	725			13	8	96	23	106	5	0	305	6.95	
8-3	03 NENW	6/28/79	1,460	1,950	(1,610)	(8)	8	12	354	58	980	6	0	361	7.10	(6.85)
(W-4A)		9/27/79	1,426	1,910	(1,660)	(12)	9	12	278	96	750	6	0	371	7.30	(6.50)
		12/6/79	1,566	1,800	(1,680)	(10)	8	13	245	120	936	6	0	361	7.23	(7.75)
		4/9/80	1,398	2,000	(1,750)	(10)	10	14	251	115	860	12	0	256	6.75	(7.1)
	42N-75W															
893	34 NESW	11/30/78	975	1,100		(11.1)	42	10	180	36	470	2	0	235	7.1	
(W-1)		6/27/79	820	1,250	(1,080)	(15)	47	12	158	35	427	6	0	264	7.54	(7.25)
		9/27/79	870	1,250	(1,150)	(13)	43	11	158	37	408	6	0	278	7.27	(6.95)
		10/10/79	914	1,240	(985)	(15)	45	12	160	34	418	6	0	266	7.45	(7.70)
		12/21/79	874	1,150	(1,120)	(11)	44	12	155	40	410	5	0	266	7.23	(7.65)
		4/9/80	842	1,350	(1,150)	(11)	47	12	159	40	460	10	0	281	7.31	(7.5)
885	34 NESW	4/12/78[a]	836	1,113		—	31.5	8.1	208	33.5	426	3.3	0	281	7.53	
886	34 NESW	4/12/78[b]	827	1,299		—	46	9.5	228	43	75	4.9	0	851	7.44	
887	34 NESW	4/12/78[c]	1,170	1,490		—	54	9.1	265	56	459	11	0	375	7.66	
888	34 NESW	4/12/78[d]	855	1,155		—	54	8.1	180	30	424	6.4	0	311	7.97	
889	34 NWSW	1/3/80	462	640		—	12	8	79	23	198	5	0	134	6.60	
		4/15/80	395	630	(570)	(11)	8	8	78	21	192	6	0	146	7.24	(7.0)
	42N-75W															
1	35 NWSE	4/12/78[a]	286	504		—	8.4	7.0	80	14.0	72.5	*2	0	228	7.87	
(W-2)		11/30/78[b]	364	510		(11.4)	14	7.7	81	15	73	1	0	172	6.7	
		6/27/79	218	440	(363)	(15)	13	8	47	14	85	6	0	195	7.90	(7.75)
		9/29/79	254	464	(442)	(14)	15	8	54	14	64	3	0	217	7.68	(7.20)
		12/21/79	352	515	(473)	(10)	14	8	67	16	71	4	0	242	7.15	(7.40)
		4/16/80	182	295		—	7	7	35	9	46	4	0	127	7.45	(7.6)
1805	35 NWSE	4/12/78[h]	765	996		—	60	7.7	143	29	433	6.4	0	178	8.06	
1806	35 SWNE	4/12/78[i]	886	1,290		—	41	9.1	234	46	28	4.9	0	975	7.25	
1807	35 SWNE	4/12/78[j]	680	1,100		—	35	8.4	187	35	98	*2.0	0	663	7.44	
1808	3~~4~~5 NWNE	6/28/79	573	950	(800)	(15)	69	9	93	19	303	10	0	161	7.45	(7.20)
(W-4B)		9/27/79	570	930	(789)	(14)	69	9	86	17	300	8	0	171	7.48	(6.45)
		12/15/79	608	900	(813)	(9)	63	8	84	17	280	6	0	159	7.34	(7.65)
		4/2/80	684	1,010	(988)	(10)	77	10	115	24	405	8	0	173	8.04	(8.2)
1809	3~~4~~5 NESE	4/15/80	877	1,220	(1,160)	(14)	59	12	104	34	432	8	0	317	7.61	(7.5)
1810	3~~4~~5 NWSW	4/15/80	824	1,350	(943)	(13)	47	12	159	40	460	10	0	281	7.31	(7.6)
1814	3~~4~~5 SWSW	11/30/78[c]	1,006	1,130		(13.5)	22	8.3	190	38	497	3	0	248	6.5	
(W-3)		6/27/79	987	1,440	(1,230)	(13)	42	12	201	45	461	8	0	307	7.29	(7.05)
		9/26/79	1,068	1,480	(1,290)	(13)	45	14	201	46	490	10	0	305	7.19	(6.80)
		12/2/79	1,104	1,380	(1,390)	(10)	41	12	197	51	508	5	0	285	7.09	(7.85)
		4/1/80	1,016	1,370	(1,380)	(10)	44	13	203	52	562	6	0	305	7.47	(7.3)
1821	3~~4~~5 NWNW	10/25/79	680	1,020	(620)	(15)	131	9	78	6	136	12	0	427	7.93	(7.55)
1822	3~~4~~5 NWNW	10/28/79	468	760	(666)	(13)	90	7	53	8	166	10	0	183	7.77	(7.60)

TABLE D-6-8

(CONT.)

Well No.	Al	NH_3 (as N)	As	Ba	Be	B	Cd	Cr	Cu	F	Fe	Pb	Mn	Hg
22-2	• .05	0.13	• .002	• .02	• .005	• 1.0	• .002	• .01	0.003	0.27	1.51	• .05	0.68	• .001
8-3	• .05	0.11	• .002	• .02	• .005	• 1.0	• .002	• .01	• .002	0.03	1.98	• .05	0.33	• .001
(W-4A)	• .05	0.81	• .002	• .02	• .005	• 1.0	• .002	0.01	0.004	0.07	2.4	• .05	0.33	• .001
	• .05	0.47	• .002	• .02	• .005	• 1.0	• .002	• .01	0.002	0.13	2.65	0.07	0.33	• .001
	• .05	0.11	• .002	• .02	• .005	• 1.0	0.006	0.03	0.010	0.09	3.75	0.08	0.32	• .001
893	0.04	0.15	• .002	0.07	—	0.1	• .005	0.01	• .02	0.1	0.3	0.03	0.03	• .0005
(W-1)	• .05	• .05	• .002	• .02	• .005	• 1.0	• .002	• .01	• .002	0.12	4.43	• .05	0.13	• .001
	• .05	0.13	—	• .02	—	• 1.0	• .02	• .01	0.002	0.15	8.7	• .05	0.17	• .001
	• .05	0.36	• .002	• .02	• .005	• 1.0	• .002	• .01	• .002	0.14	7.3	• .05	0.15	• .001
	• .05	0.13	• .002	• .02	• .005	• 1.0	• .002	• .01	0.007	0.13	7.55	• .05	0.16	• .001
	• .05	• .05	• .002	• .02	• .005	• 1.0	• .005	0.03	• .005	0.10	7.25	0.05	0.16	• .001
885	• .1	• .1	0.004	0.19	• .005	0.2	• .005	• .01	• .01	0.1	0.66	—	0.23	0.00003
886	• .1	0.18	0.008	1.5	• .005	0.2	• .005	• .01	• .01	0.4	5.2	—	2.3	• .00002
887	• .1	• .1	• .002	0.22	• .005	0.2	• .005	• .01	• .01	0.2	0.18	—	0.34	• .00002
888	• .1	0.65	0.019	0.22	• .005	0.2	• .005	• .01	• .05	0.2	0.18	—	1.5	• .00002
889	• .05	0.05	• .002	• .02	• .005	• 1.0	• .005	• .01	0.003	0.36	• .05	• .05	0.21	• .001
	• .05	0.09	• .005	• .05	• .005	• 1.0	• .005	0.02	• .005	0.34	• .05	• .05	0.23	• .001
1	• .1	• .1	• .002	0.13	• .005	0.1	• .005	• .01	• .01	0.1	• .005	—	0.02	• .00002
(W-2)	0.05	0.01	• .002	0.06	—	0.1	• .005	0.01	• .03	0.1	0.02	0.01	0.01	• .0005
	• .05	• .05	• .002	• .02	• .005	• 1.0	• .002	• .01	• .002	0.15	• .05	• .05	0.004	• .001
	• .05	0.21	• .002	• .02	• .005	• 1.0	• .002	• .01	• .002	0.17	• .05	• .05	0.02	• .001
	• .05	0.15	• .002	• .02	• .005	• 1.0	• .002	• .01	0.003	0.15	• .05	• .05	0.02	• .001
	• .05	0.05	• .002	• .02	• .005	• 1.0	• .005	0.02	• .005	0.15	• .05	• .05	• .01	• .001
1805	• .1	• .1	0.006	0.15	• .005	0.2	• .005	• .01	• .01	0.2	0.11	—	0.06	• .00002
1806	• .1	0.15	0.029	1.4	• .005	0.2	• .005	• .01	• .01	0.2	12	—	2.2	• .00002
1807	• .1	0.1	0.013	0.67	• .005	0.2	• .005	• .01	• .01	0.2	1.9	—	1.8	• .00002
1080	• .05	0.38	• .002	• .02	• .005	• 1.0	• .002	0.01	• .002	0.21	0.13	• .05	0.09	• .001
(W-4B)	• .05	1.02	• .002	• .02	• .005	• 1.0	• .002	• .01	0.003	0.27	0.21	• .05	0.13	• .001
	• .05	0.10	• .002	• .02	• .005	• 1.0	• .002	• .01	0.005	0.23	0.11	• .05	0.06	• .001
	• .05	• .05	• .002	• .02	• .005	• 1.0	• .005	0.02	• .005	0.20	• .05	0.07	0.05	• .001
1809	• .05	0.33	0.009	• .02	• .005	• 1.0	0.005	0.02	0.019	0.20	2.37	0.07	1.22	• .001
1810	• .05	0.09	• .002	• .02	• .005	• 1.0	• .005	0.02	0.010	0.34	• .05	• .05	1.22	• .001
1814	0.05	0.11	• .002	0.06	—	1.0	• .005	0.01	• .03	0.1	0.4	0.03	0.05	• .0005
(W-3)	• .05	• .05	• .002	• .02	• .005	• 1.0	• .002	• .01	• .002	0.13	5.7	• .05	0.168	• .001
	• .05	• .05	• .002	• .02	• .005	• 1.0	• .02	• .01	0,003	0.14	11.0	• .05	0.21	• .001
	• .05	0.14	• .002	• .02	• .005	• 1.0	• .002	• .01	0.008	0.12	12.1	• .05	0.20	• .001
	• .05	• .05	• .002	• .02	• .005	• 1.0	• .005	0.02	0.009	0.09	10.0	0.08	0.21	• .001
1821	• .05	0.80	• .002	0.06	• .005	• 1.0	0.004	• .01	• .002	0.40	• .05	• .05	0.05	• .001
1822	• .05	0.07	• .002	• .02	• .005	• 1.0	• .005	• .01	• .002	• .05	• .05	• .05	0.02	• .001

TABLE D-6-8

(CONT.)

Well No.	Mo	Ni	NO_3	Ag	Se	V	Zn	U	Pb-210	Po-210	Ra-226	Th-230	Charge Balance
22-2	• .05	• .01	0.89	• .01	• .002	• .05	0.035						0.7
8-3	• .02	• .01	0.58		• .002	• .02	0.047	71 ± 4	0 ± 0.6	0.12 ± .03	0.60 ± .07	0 ± .4	6.8
(W-4A)	• .02	• .01	0.51	• .01	• .002	• .02	0.021						1.4
	• .05	• .01	0.24	• .01	• .002	• .05	0.006						5.8
	• .05	• .01	0.15	• .01	• .002	• .05	0.015						2.8
893	• .01	0.02	0.64		0.0023	• .01	0.3	81	—	—	302 ± 20	—	1.0
(W-1)	• .02	• .01	0.18		• .002	• .02	0.014	58 ± 3	10 ± .5	1.5 ± .1	126 ± 6	0.3 ± .1	1.0
	• .02	• .01	4.20	• .01	—	• .02	0.038						0.5
	• .02	• .01	2.19	• .01	• .002	• .02	0.025						0.7
	• .05	• .01	0.32	• .01	• .002	• .05	0.047						0.8
	• .05	• .01	0.12	• .01	• .002	• .05	0.010						3.2
885	0.002	0.02	0.64	0.006	• .005	• .005	0.03	38			163 ± 20	—	4.5
886	0.004	0.02	0.11	0.006	• .005	• .005	0.03	6.8	—	—	170 ± 15	—	4.6
887	0.004	0.03	• .05	0.009	• .005	• .005	0.02	8.8	—	—	1.2 ± 1.2	—	12.1
888	0.003	0.02	0.21	0.006	• .005	• .005	0.03	4.1	—	—	8.2 ± 3.0	—	0.3
889	• .05	• .05	0.81	• .01	• .002	• .05	0.077						0.8
	• .05	• .01	0.26	• .01	• .002	• .05	0.023						3.0
I	• .002	• .01	0.07	• .005	0.115	• .005	0.02	338	—	—	69 ± 10	—	3.5
(W-2)	• .01	0.01	0.64		0.36	• .01	0.1	399	—	—	27.6 ± 1.7	—	16
	• .02	• .01	0.23	—	0.041	• .02	0.038	294 ± 15	0 ± .2	0.2 ± .03	8.0 ± .4	0.0 ± .1	9.2
	• .02	• .01	0.82	• .01	0.093	• .02	0.051						2.8
	• .05	• .01	0.44	• .01	0.103	• .05	0.037						0.8
	• .05	• .01	0.19	• .01	0.065	• .05	0.008						3.0
1085	0.002	0.02	• .05	• .005	• .005	• .005	0.01	10	—	—	6.6 ± 2.3	—	1.0
1806	• .005	0.03	0.07	0.009	• .005	• .005	0.03	12	—	—	125 ± 17	—	2.2
1807	• .002	0.02	• .05	0.006	• .005	• .005	0.07	3.4	—	—	6.6 ± 2.3	—	3.6
1808	• .02	• .01	0.27	—	• .002	• .02	0.016	71 ± 4	0 ± .6	0.12 ± .03	0.60 ± .07	0 ± .4	1.0
(W-4B)	• .02	• .01	0.38	• .01	• .002	• .02	0.015						1.9
	• .05	• .01	0.35	• .01	• .002	• .05	0.084						0.4
	• .05	• .01	0.16		• .002	• .05	• .005						0.7
1809	• .05	• .01	0.25	• .01	• .002	• .05	0.020						2.0
1810	• .05	• .01	0.26	• .01	• .002	• .05	0.012						3.2
1814	• .01	0.02	0.64	—	0.012	• .01	0.04	352	—	—	753 ± 45	—	-3
(W-3)	• .02	• .01	0.33	—	• .002	• .02	0.035	106 ± 5	0 ± .1	0.26 ± .05	5.1 ± .3	0 ± .1	3.3
	• .02	• .01	0.86	• .01	• .002	• .02	0.087						2.1
	• .05	• .01	0.40	• .01	• .002	• .05	0.099						2.3
	• .05	• .01	0.18		• .002	• .05	0.017						0.6
1821	• .02	• .01	0.35	• .01	• .002	• .02	0.018						1.0
1822	• .02	• .01	0.27	• .01	• .002	• .02	• .005						4.7

TABLE D-6-8

(CONT.)

Notes: Concentration in mg/l except Conductivity, in mhos/cm @ 25°C; Temperature, in °C; pH, in pH units; U, Pb-210, Po-210, Ra-226 and Th-230, in pCi/l and Charge Balance = difference in major equivalents divided by sum of major equivalents time 100.

( ) Field Measurements; (W-3) Conoco monitoring well number.

* Concentration less than value.

(a) Additional parameters for this sample are Silica (as S_iO_2) = 10; Alkalinity (as $CaCO_3$) = 188; Total Hardness (as $CaCO_3$) = 219; Redox Potential = 196; Nitrite (as N) = *.05; Phosphorus (as P) = *.02; and Total Iron = *1.0.

(b) Additional parameters for this sample are Phosphate = 0.04 and Nitrite = *.01.

(c) Additional parameters for this sample are Phosphate = 0.025 and Nitrite = *.01.

(d) Additional parameters for this sample are Silica (as S_iO_2) = 9.9; Alkalinity (as $CaCO_3$) = 232.5; Total Hardness (as $CaCO_3$) = 560; Redox Potential = 206; Nitrite (as N) = 0.13; Phosphorus (as P) = *.03 and Total Iron = 1.3.

(e) Additional parameters for this sample are Silica (as S_iO_2) = 19.2; Alkalinity (as $CaCO_3$) = 703; Total Hardness (as $CaCO_3$) = 640; Redox Potential = 208; Nitrite (as N) = *.05; Phosphorus (as P) = 0.02; and Total Iron = 49.

(f) Additional parameters for this sample are Silica (as S_iO_2) = 8.6; Alkalinity (as $CaCO_3$) = 310; Total Hardness (as $CaCO_3$) = 749; Redox Potential = 207; Nitrite (as N) = *.05; Phosphorus (as P) = *.02; and Total Iron = 1.0.

(g) Additional parameters for this sample are Silica (as S_iO_2) = 17.1; Alkalinity (as $CaCO_3$) = 257; Total Hardness (as $CaCO_3$) = 494; Redox Potential = 197; Nitrite (as N) = *.05; Phosphorus (as P) = 0.04; and Total Iron = 23.

(h) Additional parameters for this sample are Silica (as S_iO_2) = 4; Alkalinity (as $CaCO_3$) = 147; Total Hardness (as $CaCO_3$) = 418; Redox Potential = 196; Nitrite (as N) = *.05; Phosphorus (as P) = *.02; and Total Iron = 4.6.

(i) Additional parameters for this sample are Silica (as S_iO_2) = 19.9; Alkalinity (as $CaCO_3$) = 806; Total Hardness (as $CaCO_3$) = 720; Redox Potential = 227; Nitrite (as N) = *.05; Phosphorus (as P) = 0.02; and Total Iron = 54.

(j) Additional parameters for this sample are Silica (as S_iO_2) = 12.3; Alkalinity (as $CaCO_3$) = 546; Total Hardness (as $CaCO_3$) = 538; Redox Potential = 210; Nitrite (as N) = *.05; Phosphorus (as P) = 0.02; and Total Iron = 8.8.

TABLE D-6-9

GROUNDWATER QUALITY FOR THE EVAPORATION POND AND TAILINGS SITE FOR CONOCO'S SAND ROCK PROJECT

Well No.	Date	TDS	Conductivity	Temperature	Na	K	Ca	Mg	SO_4	Cl	CO_3	HCO_3	pH	Al	NH_3 (as N)	As	Ba	Be
P-9A & P-4C	4/02/80	4,028	3,700 (2,855)	(7.2 & 8.9)	90	18	532	336	2,860	38	0	281	7.41	0.06	.05*	0.003	.02*	
P-12 & P-4B1	4/02/80	2,624	2,590 (2,170)	(9.0 & 8.0)	37	17	517	131	1,635	29	0	415	7.60	.05*	0.09	0.004	.02*	
P-5	4/02/80	260	550 (420)	(8.5)	19	7	61	19	96	4	0	207	7.60	.05*	.05*	0.005	.02*	
P-13A & P-15	4/02/80	4,516	4,000 (3,160)	(8.5 & 8.0)	86	30	655	342	3,070	58	0	122	6.85	0.21	2.10	0.003	.02*	
P-2 & P-9	4/02/80	3,052	2,980 (2,385)	(8.2 & 8.1)	56	22	493	218	1,940	29	0	293	7.67	.05*	1.04	.002*	.02*	
P-10 & P-19	-	-	- (-)	(9.8 & 8.1)	-	-	-	-	-	-	-	-	-	-	-	-	-	
P-7	5/23/80	1,743	1,150 (1,462)	(11.1)	38	12	329	75	1,165	27	0	176	7.55	0.05*	.08	.002*	.02*	
P-20B	5/23/80	1,606	2,220 (1,467)	(11.1)	35	22	349	76	970	27	0	220	7.75	.05*	.15	.002*	.02*	
35N-2A	5/23/80	1,002	1,390 (972)	(11.2)	88	15	152	36	614	9	0	176	7.82	.05*	.11	.002*	.02*	
35N-6	5/23/80	724	1,050 (904)	(10.0)	28	10	149	37	374	7	0	220	8.43	.05*	.16	.002*	.02*	
35N-7A	5/23/80	327	599 (463)	(12.0)	20	10	61	13	102	2	0	215	7.85	.05*	.09	.002*	.02*	
35N-7C	5/23/80	443	680 (534)	(8.5)	24	9	80	24	197	4	0	185	7.78	.05*	.21	.002*	.02*	
35N-7E	5/23/80	288	480 (366)	(9.5)	6	5	57	22	73	4	0	215	7.59	.05*	.08	.002*	.02*	
35N-7F	5/23/80	250	410 (399)	(8.0)	8	5	59	19	40	7	0	195	7.77	.05*	.13	.002*	.02*	
35N-7G	5/23/80	256	488 (334)	(10.0)	18	7	61	16	28	4	0	239	7.72	.05*	.09	.002*	.02*	

Notes: Concentrations in mg/l, except Conductivity which is in umhos/cm @ 25°C, Temperature in °C, pH in pH units, Pb 210, Po 210, Ra 226 and Th 230 in pCi/l, and Charge Balance = Difference in major equivalents.

( ) Denotes field measurements.

* Denotes less than value.

TABLE D-6-9 (cont'd)

B	Cd	Cr	Cu	F	Fe	Pb	Mn	Hg	Mo	Ni	NO_3	Se	V	Zn	U	Pb210	Po210	Ra226	Th230	Charge Balance
1.0*	0.016	0.05	0.039	0.21	.05*	0.13	0.98	.001*	.05*	0.02	0.62	.002*	.05*	0.028	-	-	-	-	-	5.3
1.0*	0.013	0.05	0.029	0.13	.05*	0.14	1.34	.001*	.05*	.01*	1.37	.002*	.05*	0.016	-	-	-	-	-	3.8
1.0*	.005*	.01*	.05*	0.29	.05*	.05*	0.16	.001*	.05*	.01*	0.21	.002*	.05*	0.006	-	-	-	-	-	1.0
1.0*	1.129	0.05	0.036	0.51	22.9	0.17	2.57	.001*	.05*	0.51	0.46	.002*	.05*	0.666	0.12	0±1	0±.1	0.39±.04	2.0±.4	1.6
1.0*	0.014	0.04	0.031	0.20	3.50	0.17	1.50	.001*	.05*	.01*	0.23	.002*	.05*	0.012	0.025	0±1	0±.1	0.66±.06	1.5±.2	0.6
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.0*	.008	0.01*	.02	0.18	0.05*	0.10	0.12	.001*	.05*	.01*	.89	.002*	.05*	.329	-	0 ± 1	0±.1	.84±.08	0±.2	6.4
1.0	.008	.01*	.03	.08	.05*	.10	.61	.001*	.05*	.01*	.35	.002*	.05*	.092	-	4±1	0±.2	.10±.03	6.8±.2	2.4
1.0*	.005*	.01*	.02	.16	.05*	.05*	.18	.001*	.05*	.01*	.23	.002*	.05*	.005*	-	0±1	0±.1	3.6±.2	0±.2	3.8
1.0*	.005*	.01*	.01*	.13	.05*	.05*	.14	.001*	.05*	.01*	.44	.002*	.05*	.008	-	0±1	0±.2	.12±.03	1.5±.4	1.6
1.0*	.005*	.01*	.02	.15	.05*	.05*	.11	.001*	.05*	.01*	.06	.002*	.05*	.008	-	4±1	0±.1	86±4	2.0±.2	6.5
1.0*	.005*	.01*	.02	.17	.05*	.05*	.10	.001*	.05*	.01*	.22	.002*	.05*	.006	-	-	-	-	-	0
1.0*	.005*	.01*	.01*	.19	.05*	.05*	.07	.001*	.05*	.01*	.11	.002*	.05*	.101	-	-	-	-	-	1.1
1.0*	.005*	.01*	.02*	.22	.05*	.05*	.01*	.001*	.05*	.01*	.56	.002*	.05*	.005*	-	-	-	-	-	8.2
1.0*	.005*	.01*	.01*	.15	.05*	.05*	.05	.001*	.05*	.01*	.22	.002*	.05*	.005*	-	-	-	-	-	7.1

TABLE D-6-10

DRAINAGE BASIN CHARACTERISTICS FOR THE
SAND ROCK PROJECT AREA

Drainage Basin	Drainage Area (mi^2)	Channel Length (mi)	Elevation Differences (ft)	Channel Gradient (ft/mi)	Channel Gradient (ft/ft)
Antelope Creek (total)	980	62	1,825	29.4	0.006
Antelope Creek (at USGS gage)	959	52	1,775	34.1	0.006
Ninemile Creek (total)	63	20	610	30.5	0.006
Ninemile Creek (@ I-7)	34	10.5	390	37.1	0.007
Pine Tree Draw	8.2	7.6	370	48.9	0.009
Simmons Draw	8.1	6.8	260	38.2	0.007
Wash No. 1	1.7	2.8	205	73.2	0.014
Upper Wash No. 2	1.9	3.1	190	61.3	0.012
Lower Wash No. 2	0.95	2.2	80	36.4	0.007
Wash No. 3	1.8	3.2	230	71.9	0.014
Upper Wash No. 4	0.70	0.46	130	90.2	0.017
Lower Wash No. 4	0.53	1.3	90	69.2	0.013

TABLE D-6-11

PEAK FLOOD DISCHARGES AND FLOOD VOLUMES FOR SELECTED RECURRENCE INTERVALS FOR STREAMS IN THE SAND ROCK PROJECT AREA

Stream	Drainage Area (mi^2)	Lowham's Method						Craig and Rank's Method											
			Flood Discharge, ft^3/sec					Flood Discharge, ft^3/sec						Flood Volume, ac-ft					
		Qa*	5-yr	10-yr	25-yr	50-yr	100-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Antelope Creek (total)	980	20	3,000	5,400	9,500	14,000	19,000	-	-	-	-	-	-	-	-	-	-	-	-
Antelope Creek (at USGS gage)	959	20	3,000	5,400	9,400	14,000	19,000	-	-	-	-	-	-	-	-	-	-	-	-
Ninemile Creek (total)	63	4.7	1,100	2,000	3,400	5,000	6,900	2,400	4,700	6,900	9,800	14,000	18,000	630	1,100	1,500	2,000	2,400	2,800
Ninemile Creek (permit area)	34	3.4	900	1,600	2,700	3,900	5,500	2,100	3,800	5,300	7,300	10,000	13,000	580	980	1,200	1,600	1,900	2,200
Pine Tree Draw	8.2	1.6	540	930	1,600	2,300	3,200	560	1,100	1,600	2,200	3,100	3,900	98	170	230	310	380	450
Simmons Draw	8.1	1.6	540	920	1,600	2,300	3,200	790	1,400	2,000	2,600	3,600	4,500	170	280	360	470	550	640
Wash No. 1	1.7	0.69	310	520	900	1,300	1,800	220	410	580	770	1,100	1,310	32	55	73	96	110	130
Upper Wash No. 2	1.9	0.73	320	540	940	1,400	1,900	270	480	670	890	1,200	1,500	43	71	92	120	140	160
Lower Wash No. 2	0.95	0.50	250	420	730	1,000	1,500	320	500	640	770	990	1,200	70	100	120	150	170	180
Wash No. 3	1.8	0.71	310	530	920	1,300	1,800	210	400	560	760	1,000	1,300	29	51	67	90	110	130
Upper Wash No. 4	0.70	0.43	220	370	650	940	1,300	150	260	360	460	610	740	21	35	44	57	67	78
Lower Wash No. 4	0.53	0.37	200	340	590	850	1,200	160	270	350	440	570	670	27	41	51	64	73	83

*Qa = mean annual flow (ft^3/sec)

TABLE D-6-11

(CONT.)

Stream	Drainage Area (mi^2)	Soil Conservation Service Method												
			Flood Discharge, ft^3/sec						Flood Volume, ac-ft					
		Qa*	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Antelope Creek (total)	980	20	-	-	-	-	-	-	-	-	-	-	-	-
Antelope Creek (at USGS gage)	959	20	-	-	-	-	-	-	-	-	-	-	-	-
Ninemile Creek (total)	63	4.7	-	-	-	-	-	-	940	2,000	2,800	4,100	5,100	6,100
Ninemile Creek (permit area)	34	3.4	-	-	-	-	-	-	510	1,100	1,500	2,200	2,800	3,300
Pine Tree Draw	8.2	1.6	-	-	-	-	-	-	120	260	360	540	660	800
Simmons Draw	8.1	1.6	-	-	-	-	-	-	120	250	360	530	660	790
Wash No. 1	1.7	0.69	63	150	250	350	450	550	25	53	75	110	140	170
Upper Wash No. 2	1.9	0.73	68	160	260	370	480	580	28	60	84	120	150	180
Lower Wash No. 2	0.95	0.50	43	100	150	240	310	360	14	30	42	62	77	92
Wash No. 3	1.8	0.71	65	160	260	360	470	570	27	57	80	120	150	170
Upper Wash No. 4	0.70	0.43	34	85	140	190	250	300	10	22	31	46	57	68
Lower Wash No. 4	0.53	0.37	28	70	110	150	210	250	7.9	17	23	35	43	51

*Qa = mean annual flow (ft^3/sec)

TABLE D-6-12

PRECIPITATION VALUES FOR SELECTED RECURRENCE INTERVALS AND DURATIONS IN THE SAND ROCK PROJECT AREA

Duration	Precipitation, in. 2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	500-Yr	Duration
5-Min	.25	.35	.42	.52	.59	.66	.83	5-Min
10-Min	.38	.54	.65	.80	.92	1.03	1.29	10-Min
15-Min	.48	.69	.83	1.01	1.16	1.30	1.64	15-Min
30-Min	.67	.95	1.14	1.40	1.61	1.81	2.27	30-Min
1-Hour	.85	1.21	1.45	1.78	2.03	2.29	2.87	1-Hour
2-Hour	.95	1.33	1.59	1.94	2.22	2.49	3.12	2-Hour
3-Hour	1.03	1.44	1.71	2.09	2.38	2.67	3.33	3-Hour
6-Hour	1.25	1.71	2.01	2.44	2.77	3.10	3.86	6-Hour
12-Hour	1.47	2.00	2.35	2.84	3.22	3.60	4.47	12-Hour
24-Hour	1.70	2.29	2.69	3.24	3.67	4.10	5.09	24-Hour

TABLE D-6-13

SURFACE WATER ANALYSES FOR THE SAND ROCK PROJECT

Surface Site No.	Location	Date	TDS	Conductivity	Temperature	DO	TSS	Turbidity	Na	K	Ca	Mg
	41N-74W											
1-7s (-) (Old Site 4)	18 SENW	4/21/77[a]	770	935 (-)	(-)	(-)	0.0	—	39	6.3	120	33
		3/27/78[b]	322	475 (815)	(1.0)	(7.4)	1.4		14	4	68	20
		6/22/79	Dry									
		12/2/78	Dry									
		2/25/80		(-)	(-)	(-)	—	—	—	—	—	—
		3/27/80	612	990 (946)	(10)	(8.5)	—	3.0	41	10	121	36
1-7A (-)	18 SENW	2/25/80	867	1,170 (-)	(-)	(-)	—	9.5	48	17	141	44
	41N-75W											
1-34 (-)	01 SWNW	3/25/80	32	73 (56)	(2)	(13.6)		7.2	6	4	6	1
1-21 (-)	02 NENW	6/22/79	304	500 (441)	(26)	2.9	5	7.2	5	4	60	28
		9/28/79	Dry									
		10/30/79	Dry									
Site 2s	02 NESW	3/22/78[c]	54	62 (-)	—	—	3.1	—	0.3	1	14	0.5
1-22 (-)	02 NESW	6/26/79	60	94 (73)	(26)	8.6	37	34.3	2	5	10	3
		9/28/79	Dry									
1-23s (-)	02 SESW	6/26/79	Dry									
		12/2/79	Dry									
		2/20/80		(-)	(-)	(-)	—	—	—	—	—	—
1-24 (-)	02 SENE	6/26/79	Dry									
		2/20/80		(-)	(-)	(-)	—	—	—	—	—	—
1-5 (-)	03 NWNE	6/26/79	Dry									
		12/21/79	Dry									
	41N-75W											
1-6s (1631)	03 SESE	6/22/79	2,386	2,667		8.2	7	10.4	59	20	528	74
		12/21/79	Dry									
		2/20/80	—	— (-)	(-)	(-)	—	—	—	—	—	—
Site 1s	03 NWSE	3/27/78[d]	566	810 (460)	(10)	(8.5)	1.25	—	14	4	100	61
1-32 (-)	03 NWSE	6/20/79	1,914	2,130 (1,870)	(21)	3.3	• 4.0	2.3	40	13	417	77
		9/28/79	638	945 (918)	(13)	(9.3)	136	172	15	36	131	37
1-10s (-)	04 NENW	6/20/79	Dry									
		12/21/79	Dry									
1-11 (-)	04 NENE	6/22/79	1,310	1,650 (1,380)	(21)	3.9	20	2.4	56	12	195	83
		9/25/79	842	1,120 (1,060)	(19)	(9.4)	—	—	65	19	106	43
		10/30/79	Dry									
1-14 (-)	04 SESE	6/20/79	Dry									
		9/25/79	1,282	1,700			• 4.0	3.2	39	8	133	127
		2/20/80		(1,070)	(19)	(14.0)	—	—	—	—	—	—
1-15 (-)	09 NENE	6/21/79	430	645 (566)	(23)	3.3	• 4.0	5.0	26	10	96	17
		12/10/79	—	— (940)	(1)	(8.25)	—	—	—	—	—	—
1-15As (-)	10 SENW	12/21/79	Dry									
		2/25/80		(-)	(-)	(-)						
1-15Bs (-)	10 SWNE	3/25/80	1,164	(1,320)	(2)	(9.9)		2.7	32	10	225	70

TABLE D-6-13

(CONT.)

Surface Site No.	Location	Date	TDS	Conductivity		Temperature	DO	TSS	Turbidity	Na	K	Ca	Mg
	41N-75W												
1-33 (9352)	11 NWNW	6/20/79	259	437	(144)	(18)	2.9	• 4.0	3.6	22	5	54	21
		9/18/79	434	700	(586)	(18)		• 4.0	5.7	19	9	83	24
		9/27/79	—	—	(658)	(17)	(7.18)	—	—	—	—	—	—
		12/10/79			(653)	(2)	(4.20)				-		
		3/25/80	156		(258)	(2)	(5.2)		5.3	6	6	37	9
1-33Ss (-)	11 NWNE	9/18/79	314	500	—	—	—	• 4.0	6.0	9	16	52	13
		10/10/79	376	580	—	—	—	88	73	9	21	61	24
		10/30/79	—	—	(497)	(3)	(13.0)	—	—	—	—	—	—
1-31 (-)	12 NWSW	6/26/79	308	500	(400)	(25)	6.6	• 4.0	5.0	5	10	58	15
		9/18/79	422	690				• 4.0	3.6	26	8	65	31
		9/28/79	Dry										
		3/25/80	152		(228)	(0)	(11.4)		6.0	3	9	29	6
1-35 (-)	12 NWNW	3/25/80	96		(171)	(0)	(11.6)		9.5	2	7	23	4
	42N-74W												
1-30 (-)	31 SWNE	6/29/79	1,030	1,450	(1,180)	(30)	8.6	• 4.0	6.5	31	9	211	54
(Pine Tree Spring)		3/25/80	844	1,260	(1,130)	(1)	(8.6)	—	6.5	29	9	162	50
	42N-75W												
1-18 (-)	26 SWSW	6/21/79	Dry										
		9/25/79	144	208	(161)	(21)	(16.8)			2	5	32	3
1-25 (-)	26 NENW	6/21/79	88	128	(121)	(24)	3.6	7	7.9	3	7	21	2
1-26s (-)	26NESE	6/21/79	Dry										
		9/28/79	202	322	(265)	(12)	—	• 4.0	14.0	26	22	22	6
		10/30/79	Dry										
		12/21/79	Dry										
		2/20/80	—	—	(-)	(-)	(-)	—	—	—	—	—	—
1-27 (-)	26 SENE	6/29/79	84	110	(79)	(22)	7.3	228	252	4	6	10	1
		9/18/79	202	335	(247)	(21)	—	15	17.8	19	19	27	6
		9/28/79	Dry										
		10/10/79	276	341	(287)	(18)	(12.5)	516	234	32	23	20	7
		12/21/79	Dry										
		4/9/80	85		(99)	(3)	(11.4)		10.9	11	5	13	2
1-28s (-)	26 SESE	6/29/79	Dry										
		9/28/79	Dry										
		10/30/79	Dry										
		12/21/79	Dry										
		2/20/80	—	—	(-)	(-)	(-)	—	—	—	—	—	—
1-16 (-)	27 SENE	6/21/79	106	156	(131)	(22)	3.3	• 4.0	6.0	3	5	26	3
1-17s (-)	27 SESE	6/21/79	Dry										
		9/28/79	Dry										
		10/30/79	Dry										
		12/21/79	Dry										
		2/20/80	—	—	(-)	(-)	(-)	—	—	—	—	—	—
1-2 (-)	28 SESE	6/21/79	49	56	(50)	(24)	3.3	8	4.3	4	6	5	1
1-8 (-)	33 NWNW	6/21/79	83	112	(102)	(21)	2.9	• 4.0	5.0	3	5	17	2
		9/28/79	94	154	(129)	(13)	(5.9)	• 4.0	12.2	1	8	18	3
1-9 (-)	33 SWSE	6/20/79	1,614	2,000	(1,380)	(18)	—	—	—	43	11	354	71
		2/20/80	—	—	(-)	(-)	(-)	—	—	—	—	—	—

TABLE D-6-13

(CONT.)

Surface Site No.	Location	Date	TDS	Conductivity		Temperature	DO	TSS	Turbidity	Na	K	Ca	Mg
I-13 (-)	33 SENW	6/20/79	583	847	(666)	(18)	—	—	—	87	8	53	26
I-1 (-)	34 NESW	6/22/79	438	556	(464)	(24)	3.3	• 4.0	10.0	10	22	78	19
		9/25/79	402	410	—	—	—	354	163	6	34	65	3
		10/30/79	—	—	(538)	(3)	(14.3)	—	—	—	—	—	—
		2/20/80	—	—	(-)	(-)	(-)	—	—	—	—	—	—
I-1As (-)	34 NENE	12/21/79	Dry										
		2/20/80	—	—	(-)	(-)	(-)	—	—	—	—	—	—
I-3 (-)	34 SESW	6/26/79	74	97	(79)	(22)	8.3	10	16.8	1	9	8	2
		9/28/79	Dry										
I-12 (-)	34 SWSE	6/22/79	232	303	(221)	(22)	3.3	124	113	9	14	36	6
		9/28/79	Dry										
		10/30/79	Dry										
		12/21/79	Dry										
I-19 (-)	35 SWNE	6/29/79	76	114	(80)	(18)	2.9	323	440	2	5	12	2
		9/25/79	220	298	(242)	(20)	(18.6)	—	—	5	15	34	6
I-20 (-)	35 SESW	6/20/79	199	156	(144)	(18)	3.3	• 4.0	4.0	3	7	22	5
		9/27/79	—	—	(129)	(19)	(12.2)	—	—	—	—	—	—
		12/10/79	—	—	(298)	(3)	(11.70)	—	—	—	—	—	—
		3/25/80	32	90	(73)	(0)	(11.3)	—	13.0	6	6	7	2
I-19 (-)	36 SENW	6/28/79	81	133	(99)	(24)	8.0	425	510	3	5	14	3
		3/25/80	204	—	(265)	(2)	(15.5)	—	7.9	6	11	35	10
Site 3s	36 NENW	3/22/78(e)	88	96	(-)	(-)	(-)	0.9	—	1	2	16	7

TABLE D-6-13

(CONT.)

Surface Site No.	SO_4	Cl	CO_3	HCO_3	pH		Al	NH_3 (as N)	As	Ba	Be	B	Cd	Cr	Cu	F	Fe
I-7s (-)	290	16	0.0	270	8.0	(-)	• .1	–	• .05	• .5	—	39	• .01	• .1	• .01	0.4	0.25
(Old Site 4)	116	24	0	156	7.53	(6.8)	• .05	0.14	0.02	• .03		0.02	• .002	• .02	• .01	• .1	0.45
	Dry																
	Dry																
	—	—	—	—	—	(-)	—	—	—	—	—	—	—	—	—	—	—
	332	13	0	273	7.71	(7.7)	• .05	• .05	• .002	• .02	• .005	• 1.0	• .005	• .01	.005	.14	• .05
I-7A (-)	446	17	0	271	7.30	(-)	• .05	0.37	• .002	• .02	• .005	• 1.0	0.005	0.02	0.019	0.16	0.23
I-34 (-)	20	2	0	24	6.44	(7.6)	• .05	• .05	• .002	• .02	• .005	• 1.0	• .005	• .01	• .005	• .05	..11
I-21 (-)	33	4	0	300	8.24	(8.15)	• .05	• .05	• .002	• .02	• .005	• 1.0	• .002	• .01	• .002	0.33	0.029
	Dry																
	Dry																
Site 2s	5	10	0	44	6.18	(-)	0.15	• .1	0.02	• .03	—	0.03	• .002	• .02	• .01	• .1	0.47
I-22 (-)	15	4	0	39	7.00	(6.95)	• .005	• .05	• .002	• .02	• .005	• 1.0	• .002	• .01	• .002	0.03	0.083
	Dry																
I-23s (-)	Dry																
	Dry																
	—	—	—	—	—	(-)	—	—	—	—	—	—	—	—	—	—	—
I-24 (-)	Dry																
	—	—	—	—	—	(-)	—	—	—	—	—	—	—	—	—	—	—
I-5 (-)	Dry																
	Dry																
I-6s (1631)	1,500	21	0	198	7.79		• .05	0.05	• .002	• .02	• .005	• 1.0	• .002	• .01	• .002	0.06	0.031
	Dry																
	—	—	—	—	—	(-)	—	—	—	—	—	—	—	—	—	—	—
Site 1s	344	14	0	122	7.52	(6.8)	0.08	• .1	0.03	• .03	—	0.03	• .002	• .02	0.01	• .1	0.97
I-32 (-)	1,315	15	0	249	7.93	(7.85)	• .05	• .05	• .002	• .02	• .005	• 1.0	0.006	• .01	• .002	0.09	0.238
	74	17	0	527	7.91	(7.35)	• .05	0.16	0.007	• .02	• .005	• 1.0	• .002	• .01	0.004	0.14	0.05
I-10s (-)	Dry																
	Dry																
I-11 (-)	1,000	9	0	93	7.78	(7.75)	• .05	• .05	• .002	• .02	• .005	• 1.0	• .002	• .01	• .002	0.10	0.014
	410	10	0	234	7.44	(7.15)	• .05	—	• .002	• .02	• .005	• 1.0	• .002	• .01	0.004	0.16	0.06
	Dry																
I-14 (-)	Dry																
	890	17	7	107	8.43		0.08	• .05	• .002	• .02	• .005	• 1.0	• .002	0.01	0.004	0.25	0.08
	—	—	—	—	—	(8.00)	—	—	—	—	—	—	—	—	—	—	—
I-15 (-)	195	6	14	166	8.59	(8.85)	• .05	• .05	• .002	• .02	• .005	• 1.0	• .002	• .01	• .002	0.05	0.062
	—	—	—	—	—	(7.25)	—	—	—	—	—	—	—	—	—	—	—
I-15As (-)	Dry																
						(-)											
I-15Bs (-)	666	8	0	351	7.68	(7.4)	• .05	• .05	• .002	• .02	• .005	• 1.0	• .005	.02	.012	.11	• .05

TABLE D-6-13

(CONT.)

Surface Site No.	SO_4	Cl	CO_3	HCO_3	pH		Al	NH_3 (as N)	As	Ba	Be	B	Cd	Cr	Cu	F	Fe
1-33 (9352)	46	-5	0	232	8.03	(9.35)	0.10	• .05	• .002	• .02	• .005	• 1.0	0.024	• .01	• .002	0.16	0.095
	99	6	0	295	7.69	(7.05)	• .05	• .05	• .002	• .02	• .005	• 1.0	• .002	• .01	• .002	0.20	•0.05
	—	—	—	—	—	(7.00)	—	—	—	—	—	—	—	—	—	—	—
						(7.45)											
	32	3	0	144	7.14	(7.4)	• .05	• .05	• .002	• .02	• .005	• 1.0	• .005	• .01	• .005	• .05	.11
1-335s (-)	23	5	0	266	7.86		• .05	• .05		• .02		• 1.0	• .002	• .01	• .002	0.17	0.08
	19	6	0	325	8.14		• .05	.20	• .002	• .02	• .005	• 1.0	• .002	• .01	• .002	0.19	0.09
	—	—	—	—	—	(7.95)	—	—	—	—	—	—	—	—	—	—	—
1-31 (-)	143	6	0	98	8.46	(8.85)	• .05	• .05	• .002	• .02	• .005	• 1.0	• .002	• .01	• .002	.16	.055
	126	9	0	256	8.09		• .05	• .05		• .02		• 1.0	• .002	• .01	.004	.18	• .05
	Dry					(-)											
	86	2	0	32	6.61	(8.0)	• .05	.06	• .002	• .02	• .005	• 1.0	• .005	• .01	.005	• .05	• .05
1-35 (-)	47	2	0	51	7.38	(9.1)	• .05	• .05	• .002	• .02	• .005	• 1.0	• .005	• .01	• .005	• .05	.07
1-30 (-)	467	25	0	376	7.83	(8.05)	• .05	.07	• .002	• .02	• .005	• 1.0	• .002	• .01	• .002	.90	0.038
(Pine Tree Spring)	472	21	0	278	7.61	(8.6)	• .05	.057	• .002	• .02	• .005	• 1.0	• .005	• .01	.009	.80	.10
1-18 (-)	Dry																
	17	2	12	105	8.80	(8.55)	• .05		• .002	• .02	• .005	• 1.0	• .002	• .01	• .002	.09	.05
1-25 (-)	• 1.0	4	0	78	7.69	(8.45)	• .05	• .05	• .002	• .02	• .005	• 1.0	• .002	• .01	.012	.06	.076
1-26s (-)	Dry																
	26	6	0	173	7.88	(7.75)	• .05	.08	• .002	• .02	• .005	• 1.0	• .002	• .01	.002	.12	.25
	Dry																
	Dry																
	—	—	—	—	—	(-)	—	—	—	—	—	—	—	—	—	—	—
1-27 (-)	9	4	0	49	7.03	(6.55)	.10	.11	• .002	• .02	• .005	• 1.0	• .002	• .01	• .002	• .05	.126
	22	6	2	168	8.52	(8.50)	• .05	.20	• .002	• .02	• .005	• 1.0	• .002	• .01	.004	.09	.06
	Dry																
	19	8	17	168	8.76	(8.1)	• .05	.12	• .002	• .02	• .005	• 1.0	• .002	• .01	.003	0.15	.49
	Dry																
	17	8	0	68	7.00	(8.4)	• .05	.67	• .002	• .02	• .005	• 1.0	• .005	.02	• .005	• .05	• .05
1-28s(-)	Dry																
	Dry																
	Dry																
	Dry																
	—	—	—	—	—	(-)	—	—	—	—	—	—	—	—	—	—	—
1-16 (-)	9	4	24	88	9.18	(9.70)	• .05	• .05	• .002	• .02	• .005	• 1.0	• .002	• .01	• .002	.05	0.137
1-17s (-)	Dry																
	Dry																
	Dry																
	Dry																
	—	—	—	—	—	(-)	—	—	—	—	—	—	—	—	—	—	—
1-2 (-)	8	4	0	20	7.45	(9.20)	• .05	.15	• .002	• .02	• .005	• 1.0	• .002	• .01	.004	.13	.171
1-8 (-)	8	4	24	63	9.30	(9.6)	• .05	.07	• .002	• .02	• .005	• 1.0	• .002	• .01	• .002	.08	.320
	17	4	0	71	7.26	(7.55)	• .05	.08	• .002	• .02	• .005	• 1.0	• .002	• .01	• .002	.10	.38
1-9 (-)	834	15		481	8.20	(8.25)	• .05	• .05	• .002	• .02	• .005	• 1.0	.013	• .01	• .002	.27	.119
	—	—	—	—	—	(-)	—	—	—	—	—	—	—	—	—	—	—

TABLE D-6-13

(CONT.)

Surface Site No.	SO_4	Cl	CO_3	HCO_3	pH		Al	NH_3 (as N)	As	Ba	Be	B	Cd	Cr	Cu	F	Fe
1-13 (-)	426	5	10	46	9.24	(9.40)	• .05	• .05	• .002	• .02	• .005	• 1.0	.003	• .01	.010	.16	.127
1-1 (-)	114	19	53	171	9.32	(9.40)	• .05	.05	.005	• .02	• .005	• 1.0	• .002	• .01	• .002	.11	.020
	17	18	84	115	9.67	—	.17	.14	.009	• .02	• .005	• 1.0	• .002	• .01	.012	.13	.27
	—	—	—	—	—	(8.35)	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	(-)	—	—	—	—	—	—	—	—	—	—	—
1-1As (-)	Dry																
	—	—	—	—	—	(-)	—	—	—	—	—	—	—	—	—	—	—
1-3 (-)	• 1.0	2	0	44	6.88	(6.90)	• .05	• .05	• .002	• .02	• .005	• 1.0	• .002	• .01	.003	.04	.080
	Dry																
1-12 (-)	61	15	0	78	7.46	(9.65)	.30	.12	.006	• .02	• .005	• 1.0	.004	• .01	.022	.11	.382
	Dry																
	Dry																
	Dry																
1-19 (-)	• 1.0	4	0	49	7.05	(6.65)	.05	.09	• .002	• .02	• .005	• 1.0	• .002	• .01	• .002	• .05	.080
	17	8	0	146	7.52	(7.70)	• .05	—	• .002	• .02	• .005	• 1.0	• .002	• .01	.003	• .05	• .05
1-20 (-)	19	4	10	81	9.06	9.35	• .05	• .05	• .002	• .02	• .005	• 1.0	.002	• .01	.005	.08	.083
	—	—	—	—	—	(9.40)	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	(7.20)	—	—	—	—	—	—	—	—	—	—	—
	19	2	0	34	6.64	(8.0)	.08	• .05	• .002	• .02	• .005	• 1.0	• .005	• .01	• .005	• .05	.13
1-29 (-)	11	4	0	49	6.86	7.05	.70	• .05	• .002	• .02	• .005	• 1.0	• .002	• .01	• .002	.02	.416
	73	3	0	95	7.21	(9.5)	• .05	.07	• .002	• .02	• .005	• 1.0	• .005	• .01	• .005	• .05	.07
Site 3s	25	8	0	44	6.05	(-)	0.31	• .1	0.02	• .03	—	0.03	• .002	• .02	• .01	• .1	0.55

TABLE D-6-13

(CONT.)

Surface Site No.	Pb	Mn	Hg	Mo	Ni	NO_3	Se	V	Zn	U	Pb-210	Po-210	Ra-226	Th-230	Charge Balance
1-7s (-)	• .1	• .05	• .001	• .005	• .1	0.0	• .001	0.007	• .02	32	—	—	—	—	1.7
(Old Site 4)	• .05	0.06	• .001	—	• .02	• .1	• .01	—	0.05	—	—	—	—		0.9
	Dry														
	Dry														
	.06	.01	• .001	• .05	• .01	.72	• .002	• .05		.005					3.1
1-7A (-)	0.06	0.24	• .001	• .05	• .01	0.90	• .002	• .05	0.006						3.7
1-34 (-)	• .05	• .01	• .001	• .05	• .01	.14	• .002		• .05						7.5
1-21 (-)	• .05	0.015	• .001	• .02	• .01	10.0	• .002	• .02	0.006	0±.5	3.0±.3	0.07±.02	0±.05	7.5±.8	0.9
	Dry														
	Dry														
Site 2s	• .01	• .01	• .001	• .02	• .02	• .1	• .01	• .05	0.003	17	—	—	—	—	
1-22 (-)	• .05	0.006	• .001	• .02	• .01	0.31	• .002	• .02	0.007	0±1	0.9±.4	0.13±.04	0±.05	0.2±.1	5.5
	Dry														
1-23s (-)	Dry														
	Dry														
	—	—	—	—	—	—	—	—	—						
1-24 (-)	Dry														
	—	—	—	—	—	—	—	—	—						
1-5 (-)	Dry														
	Dry														
1-6s (1631)	• .05	0.074	• .001	• .02	• .01	0.61	• .002	• .02	0.27						0.7
	Dry														
	—	—	—	—	—	—	—	—	—						—
Site 1s	• .05	0.74	• .001	—	• .02	0.19	• .01	—	0.04	—	—	—	—	—	5.7
1-32 (-)	• .05	0.054	• .001	• .02	• .01	1.35	0.006	• .02	0.021	6±1	1.0±.3	0.17±.03	0±.05	0.2±.1	4.3
	• .05	0.62	• .001	• .02	• .01	4.50	• .002	• .02	0.21						2.3
1-10s (-)	Dry														
	Dry														
1-11 (-)	• .05	0.008	• .001	• .02	• .01	0.32	• .002	• .02	0.014	1.9±.4	5±1	3.2±.4	0.07±.03	13±1	7.8
	• .05	0.64	• .001	• .02	• .01	—	• .002	• .02	0.010						2.1
	Dry														
1-14 (-)	Dry														
	• .05	0.08	• .001	• .02	• .01	0.83	• .002	• .02	0.008						5.0
	—	—	—	—	—	—	—	—	—						—
1-15 (-)	• .05	0.018	• .001	• .02	• .01	0.22	• .002	• .02	0.005	0±1	0±1	0.19±.05	0±.05	0±.1	1.1
	—	—	—	—	—	—	—	—	—						—
1-15As (-)	Dry														
1-15Bs (-)	.08	.26	• .001	• .05	• .01	.17	• .002	• .05	.016						3.1

TABLE D-6-13

(CONT.)

Surface Site No.	Pb	Mn	Hg	Mo	Ni	NO_3	Se	V	Zn	U	Pb-210	Po-210	Ra-226	Th-230	Charge Balance
1-33 (9352)	• .05	0.042	• .001	• .02	• .01	1.20	• .002	• .02	0.040	0±1	0.8±.4	0.21±.04	0±.2	0.6±.1	5.7
	• .05	0.08	• .001	• .02	• .01	0.95	• .002	• .02	0.013						1.2
	—	—	—	—	—	—	—	—	—						—
	—	—	—	—	—	—	—	—	—						—
	• .05	.11	• .001	• .05	• .01	.14	• .002	• .05	• .005						1.8
1-335s (-)	• .05	0.28	• .001	• .02	• .01	0.80	• .002	• .02	0.008						5.5
	• .05	0.50	• .001	• .02	• .01	1.58	• .002	• .02	0.012						.4
	—	—	—	—	—	—	—	—	—						—
1-31 (-)	• .05	0.003	• .001	• .02	• .01	.39	• .002	• .02	0.022	0±1	0±2	0±.03	0±.05	5.8±.4	1.6
	• .05	0.19	• .001	• .02	• .01	.96	• .002	• .02	0.022						1.0
	Dry														
	• .05	.01	• .001	• .05	• .01	.19	• .002	• .05	• .005						1.5
1-35 (-)	• .05	• .01	• .001	• .05	• .01	.13	• .002	• .05	• .005						3.5
1-30 (-) (Pine Tree Spring)	• .05	0.279	• .001	• .02	• .01	1.61	• .002	• .02	.007	2±1	0±.9	0.2±.04	0.35±.05	137±7	0.1
	.09	.24	• .001	• .05	• .01	2.25	• .002	• .05	0.006						4.5
1-18 (-)	Dry														
	• .05	• .01	• .001	• .02	• .01	—	• .002	• .02	0.006						8.3
1-25 (-)	• .05	.005	• .001	• .02	• .01	.94	• .002	• .02	.008	0±1	1.9±5	0.28±.06	0±.05	1.6±.3	4.5
1-26s (-)	Dry														
	• .05	.17	• .001	• .02	• .01	1.59	• .002	• .02	.010						3.8
	Dry														
	Dry														
	—	—	—	—	—	—	—	—	—						—
1-27 (-)	• .05	.078	• .001	• .02	• .01	1.83	• .002	• .02	.009	0±1	0.5±.3	0.2±.1	0±.05	0±.1	9.6
	• .05	.06	• .001	• .02	• .01	2.54	• .002	• .02	.012						4.5
	Dry														
	• .05	.09	• .001	• .02	• .01	1.94	• .002	• .02	.022						5.2
	Dry														
	• .05	.10	• .001	• .05	• .01	.17	• .002	• .05	• .005						8.8
1-28s (-)	Dry														
	Dry														
	Dry														
	Dry														
	—	—	—	—	—	—	—	—	—						—
1-16 (-)	• .05	.015	• .001	• .02	• .01	.23	• .002	• .02	.003	2±1	0±.7	0.11±.03	0±.05	0±.1	17.0
1-17s (-)	Dry														
	Dry														
	Dry														
	Dry														
	—	—	—	—	—	—	—	—	—						—
1-2 (-)	• .05	.006	• .001	• .02	• .01	1.33	• .002	• .02	.017	0.4±1	1.2±.3	0.39±.07	0±.05	0±.2	4.1
1-8 (-)	• .05	.015	• .001	• .02	• .01	.75	• .002	• .02	.004	0±1	14±2	0.29±.05	0±.05	175±8	24.8
	• .05	.04	• .001	• .02	• .01	.36	• .001	• .02	• .005						7.9
1-9 (-)	• .05	.120	• .001	• .02	• .01	1.00	.008	• .02	.027	3±2	0±.3	0.19±.04	0±.07	38±3	0
	—	—	—	—	—	—	—	—	—						—

TABLE D-6-13

(CONT.)

Surface Site No.	Pb	Mn	Hg	Mo	Ni	NO_3	Se	V	Zn	U	Pb-210	Po-210	Ra-226	Th-230	Charge Balance
1-13 (-)	• .05	.006	• .001	• .02	• .01	.84	.011	• .02	.015	5.4±.2	0±1	0.24±.06	0±.05	0.2±.1	7.0
1-1 (-)	• .05	.020	• .001	• .02	• .01	.42	• .002	• .02	.009	0±2	1.4±.2	0.15±.03	0±.05	0±.1	7.3
	• .05	.04	• .001	• .02	• .01	1.65	• .002	• .02	.027						—
	—	—	—	—	—	—	—	—	—						—
	—	—	—	—	—	—	—	—	—						—
1-1As (-)	Dry														
	—	—	—	—	—	?	—	—	—						—
1-3 (-)	• .05	.005	• .001	• .02	• .01	.61	• .002	• .02	.010	0±1	0.7±.3	0.28±.04	1.0±.1	0.5±.1	3.6
	Dry														
1-12 (-)	• .05	.064	• .001	• .02	• .01	1.44	• .002	• .02	.060	2±1	1.2±.3	0.16±.03	0.09±.03	0.0±.1	1.1
	Dry														
	Dry														
	Dry														
1-19 (-)	• .05	.016	• .001	• .02	• .01	.83	• .002	• .02	.012	0±1	0±.7	0.32±.09	0±.05	0.7±.1	2.1
	• .05	• .01	• .001	• .02	• .01	—	• .002	• .02	.011						3.2
1-20 (-)	• .05	• .003	• .001	• .02	• .01	.63	• .002	• .02	.007	0±1	1.1±.4	0.13±.06	0±.05	2.6±.3	8.8
	—	—	—	—	—	—	—	—	—						—
	—	—	—	—	—	—	—	—	—						—
	• .05	.01	• .001	• .05	• .01	.20	• .002	• .05	• .005						4.2
1-29 (-)	• .05	.065	• .001	• .02	• .01	2.24	• .002	• .02	• .023	0±1	0.5±.3	0.13±.03	0.35±.05	0.8±.1	2.5
	• .05	.04	• .001	• .05	• .01	.18	• .002	• .05	• .005						0.8
Site 3s	• .02	0.03	• .001	• .02	• .02	• .1	• .01	• .05	0.003	10					0.1

NOTES:

- s — Denotes flowing stream, the remainder samples are from ponded water.
- • — Concentration less than this value.
- ( ) — Denotes field measurements.
- (2345) — Behind site number is State Engineer Permit Number, (-) if no permit.

All concentrations are in mg/l, except Conductivity, in µmhos/cm (@ 25°C; Temperature, in °C; DO, in dissolved oxygen units; Turbidity, in NTU; Pb-210, Po-210, Ra-226 and Th-230, in pCi/l; and Charge Balance = Difference in major equivalents divided by sum of major equivalents times 100.

(a) Additional parameters from this sample are: Cyanide - •.02, Phenols - 0.007, M.B.A.S. = •.01, Silver = •.5, Hardness ($CaCO_3$) = 440, Silica (S_iO_2) = 10, C.O.D. = 24, Total Kjeldahl Nitrogen = 1.5, Oil and grease = 0.8, Sulfide (S) = •.001 and Total CO_3 = 130.

(b) Additional parameters from this sample are: Alkalinity (as $CaCO_3$) = 128, Hardness (as $CaCO_3$) = 250, Phosphate = 0.04, Air Temperature = 10°C, @ 1,945 hours water ponded with ice cover, no flow measurement.

(c) Additional parameters from this sample are: Alkalinity (as $CaCO_3$) = 36, Hardness (as $CaCO_3$) = 38, Phosphate = •0.01.

(d) Additional parameters from this sample are: Alkalinity (as $CaCO_3$) = 100, Hardness (as $CaCO_3$) = 500, Phosphate = 0.04, @ 1,810 Flow measurement = 1.37 ft^3/sec and air temperature = 14°C.

(e) Additional parameters from this sample are: Alkalinity (as $CaCO_3$) = 36, Hardness (as $CaCO_3$) = 70, and Phosphate = •0.01.

TABLE D-6-14

GROUNDWATER RIGHTS IN AND ADJACENT TO MOORE RANCH PROJECT PERMIT AREA, FEBRUARY 6, 1980.
(NOTE: LOCATIONS ARE SHOWN BY SECTION, QUARTER SECTION, AND QUARTER-QUARTER SECTION)

LOCATION	PERMIT NUMBER	USE[3]/	USER	OTHER INFORMATION[1]/	PROBABLE AQUIFER	WELL DEPTH (ft)	WATER LEVEL (ft below LS)
T40NR73W							
29, SESE	29926	STO	Bell, R. & C.		Wasatch Sand	1,100	40
31, SWNE	43666	MIS	Woods Petr.	L	" "	810	195
33, SESW	12768	STO	U.S. Forest Service		" "		0
T40NR74W							
3, NWSW	42634	STO	Moore, W.I.	L	Wasatch Sand	600	F[2]/
4, NESW	50485	MIS	Apache Corp.				
7, NENE	16591	STO	Moore, W. I.	L	Wasatch Sand	1,120	F
12, SENW	16592	STO	Moore, W. I.	L	" "	500	F
14, SENW	46277	MIS	Woods Petr.-U.S. BLM	L	" "	596	90
26, NESW	35316	MIS	Process Equip				
T40NR75W							
8, SESW	22287	DOM	Moore, E.		Wasatch Sand	450	140
8, SESW	22286	DOM	" "		" "	440	
21, NENW	22288	STO	" "		" "	186	140
29, NENE	29439	STO	" "	L	" "	535	180
32, SESE	34197	DOM-STO	" "	L	" "	400	100
32, SESE	22301	DOM	" "		" "	210	
T40NR76W							
1, SWSW	22295	STO	Moore, E.		Wasatch Sand	300	
4, NESE	22303	STO	" "		" "	400	
8, SESE	22294	STO	" "		" "	186	
17, NENE	41146(exp)	STO	Ogalalla Ranch Co.-Moore, E.				
17, NENE	47626	STO	" " " " "				
19, NWNE	22293	STO	Moore, E.		Ft. Union Sand	200	
20, SWNW	22302	STO	" "		" " "	190	
26, SESW	22289	STO	" "		" " "	210	
28, NESW	22291	STO	" "		" " "	183	
29, SWNE	22292	STO	Moore, E.		" " "	273	
34, NWSE	22290	STO	" "		" " "	200	
T40NR77W							
13, SWSE	8368	STO	Gafford, B.		Ft. Union Sand	12	4
13, SESW	8387	DOM-STO	" "	L	" " "	262	175
24, NENW	8385	STO	" "		" " "	20	10
T41NR73W							
4, NENE	18146	STO	Reno & Sons	L	Wasatch Sand	440	150
6, NWSE	11073	DOM	Turnercrest Ranch		" "	140	5
6, NWNW	11072	STO	" "		" "	120	40
7, NENE	11074	STO	" "		" "	120	30
16, SWSE	18149	STO	Reno & Sons	L	" "	362	100
19, NWNE	9924	STO	Moore, W.I., Jr.		" "		
22, SWNE	18845	STO	Reno & Sons		" "	200	80
30, SWSW	9923	STO	Moore, W.I., Jr.		" "		
30, NWNW	9922	STO	" " " "		" "		
T41NR74W							
3, NWNE	17307	STO	Pine Tree Ranch	L	Wasatch Sand	97	60
4, SENE	17302	DOM-STO	" " "	L	" "	165	90
4, SENE	17301	STO	" " "	L	" "	130	55

TABLE D-6-14

CONT.

LOCATION	PERMIT NUMBER	USE[3]/	USER	OTHER INFORMATION[1]/	PROBABLE AQUIFER	WELL DEPTH (ft)	WATER LEVEL (ft below LS)
T41NR74W (Cont.)							
4, NESE	17304	DOM-STO	Pine Tree Ranch	L	Wasatch Sand	137	80
5, NWSW	6973	STO	" " "	L	" "	170	60
7, NWNE	17305	STO	" " "	L	" "	50	18
10, SWNW	17303	STO	" " "	L	" "	120	60
17, SWSE	12240	DOM-STO	Moore, J.W.		" "	180	40
17, SWSE	9309	DOM	" " "	L	" "	273	85
20, SENW	24924	STO	Moore, J.W. & V.R.	L	" "	230	120
26, NESE	9925	STO	Moore, W.I., Jr.		" "		
28, SWNE	24923	STO	Moore, J.W. & V.R.	L	" "	120	20
28, SESW	45915	MIS	Apache Corp.				
29, SWSW	12242	STO	Moore, J.W.		Wasatch Sand	200	
31, SWSW	27055	DRI-IND-OIL-TEM	American Quasar Petr.	L	" "	400	60
33, NWNW	12241	STO	Moore, J.W.		" "	100	
34, NWSE	47773	MIS	Apache Corp.	L	" "	340	140
T41NR75W							
2, NENW	39655	MIS	Continental Oil	L, Q	Wasatch Sand	165	99
3, NENW	39656	MIS	" "	L, Q	" "	175	70
5, SENW	14670	STO	Taylor Ranch		" "	22	5
21, SENW	48349	MIS	Woods Petroleum				
25, SENE	28332	DRI-IND-TEM	Continental Oil	L	Wasatch Sand	350	115
27, NWNW	22296	STO	Moore, E.		" "	326	
T41NR76W							
3, SWNE	14669	STO	Taylor Ranch		Wasatch Sand	260	130
4, SWSE	14667	STO	" "		" "	245	
4, SESW	14668	STO	" "		" "	245	
5, NENW	14663	DOM	Taylor Ranch		Wasatch Sand	1,000	
5, NENE	14664	DOM	" "		" "	1,000	
5, NESW	14665	DOM	" "		" "	1,010	
5, SENW	14666	DOM	" "		" "	175	
6, NENW	14661	STO	" "		" "	396	
8, SWSW	25848	STO	Moore Land Co.	L	" "	323	F
16, SENE	14671	STO	Taylor Ranch		" "	165	100
16, NWNW	49663	MIS	Woods Petr.-U.S. BLM				
17, SWSW	25845	STO	Moore Land Co.		Wasatch Sand	700	F
17, SWNW	25847	STO	" " "	L	" "	460	F
18, SENE	25844	DOM-STO	Moore Land Co.	L	" "	750	
18, SWNE	25862	STO	" " "	L	" "	243	F
22, NENW	14672	STO	Taylor Ranch		" "	185	60
23, NWNE	29095	DRI-IND-OIL-TEM	American Quasar Petr.				
28, NENW	14674	STO	Taylor Ranch		Wasatch Sand	275	100
30, NESE	25849	STO	Moore Land Co.				
34, NENW	14673	STO	Taylor Ranch		Wasatch Sand	275	75
T41NR77W							
1, NESW	25859	STO	Moore Land Co.	L	Wasatch Sand	353	F
13, NWNW	25861	STO	" " "	L	" "	266	F
35, SWNE	13630	STO	Flying Diamond Ranch		Ft. Union Sand	110	75
35, NWSW	13631	STO	" " "		" " "	110	75
T42NR73W							
5, NWNE	18851	STO	Reno & Sons		Wasatch Sand	350	110
6, SESW	17460	STO	" "	L	" "	276	130

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CONT.

LOCATION	PERMIT NUMBER	USE[3]/	USER	OTHER INFORMATION[1]/	PROBABLE AQUIFER	WELL DEPTH (ft)	WATER LEVEL (ft below LS)
T42NR73W (Cont.)							
6, NWSE	33284	STO	Reno, H.B.	L	Wasatch Sand	254	90
8, SWNE	18148	DOM	Reno & Sons		" "	450	180
20, NESW	18846	STO	" "		" "	160	60
31, SESW	11071	DOM	Turnercrest Ranch		" "	180	120
31, NENE	14885	STO	Turner, Mary, L.J. & G.W.	L	" "	210	65
31, SESE	48351	MIS	Campbell Co. School Dist.				
T42NR74W							
1, NENW	19245	STO	Laur, A.		Wasatch Sand	120	80
3, SWNE	14680	STO	Taylor Ranch		" "	275	125
3, NENE	37881	STO	Pine Tree Ranch	L	" "	185	125
5, NESE	14678	STO	Taylor Ranch		" "	64	40
7, SESW	14677	STO	" "		" "	275	180
5, NESE	14678	STO	" "		" "	64	40
7, SESW	14677	STO	" "		" "	275	180
7, NENW	14676	STO	" "		" "	275	150
8, NENW	37880	STO	Pine Tree Ranch	L	" "	283	140
9, SWNE	14679	STO	Taylor Ranch		" "	275	100
12, SENW	18852	STO	Reno & Sons		" "	350	120
13, NENW	3827	STO	Turnercrest Ranch	L	" "	237	130
16, SESW	14685	STO	Taylor Ranch		" "	275	150
17, NWNW	14686	STO	" "		" "	220	150
18, SWSW	14684	STO	" "		" "	350	235
23, SWNW	12243	STO	Moore, J.W.		" "	220	
28, SWSE	12244	STO	Moore, J.W. & V.R.		" "	200	100
29, SWNW	17306	STO	Pine Tree Ranch	L	" "	150	40
29, SWNE	37879	STO	" " "		" "	8	4
30, NWNW	14683	STO	Taylor Ranch		Wasatch Sand	275	175
33, SESW	6972	IRR-STO-WIL	Pine Tree Ranch	L	" "	210	95
36, NESW	26304	STO	Wyo Board of Land Comm.	L	" "	336	30
T42NR75W							
2, SESW	11901	STO	Brown Land Co.	L	Wasatch Sand	220	100
4, SESE	11900	STO	" " "		" "	450	140
4, SESE	21943	DOM-STO	" " "		" "	5	0
4, SESE	21942	DOM-STO	" " "		" "	5	0
12, NESE	14675	STO	Taylor Ranch		" "	275	195
14, SESE	35330	STO	" "	L	" "	500	100
22, NWSW	35746	STO	Brown Land Co.		" "	660	320
26, SENW	14682	STO	Taylor Ranch		" "	158	80
26, NWNW	14681	STO	" "		" "	158	80
28, SENE	14660	STO	" "		" "	355	150
33, SENW	12299	DOM-IND	Continental Oil		" "		
34, NESW	39648	MIS	" "	L, Q	" "	240	182
34, NENW	39654	MIS	" "	L, Q	" "	330	163
34, NWSW	39653	MIS	" "	L, Q	" "	260	164
35, NESE	39652	MIS	" "	L	" "	227	189
35, NWNE	39651	MIS	" "	L, Q	" "	275	144
35, NWSW	39650	MIS	" "	L, Q	" "	263	208
35, NWSE	39649	MIS	" "	L, Q	" "	240	160
T42NR76W							
1, NWSE	11890	STO	Brown Land Co.	L	Wasatch Sand	375	105
2, NESW	14674	STO	Taylor Ranch		" "	8	

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CONT.

LOCATION	PERMIT NUMBER	USE[3]/	USER	OTHER INFORMATION[1]/	PROBABLE AQUIFER	WELL DEPTH (ft)	WATER LEVEL (ft below LS)
T42NR76W (Cont.)							
3, NESW	14646	STO	Taylor Ranch		Wasatch Sand	383	80
4, NWNW	14648	STO	" "		" "	600	
4, SWNW	14649	STO	" "		" "	8	
5, SESE	14651	STO	" "		" "	8	
6, SWSE	16452	STO	" "		" "	275	100
8, SWSW	14655	STO	" "		" "	1266	100
13, NWNW	48014	MIS	American Nuclear		" "	500	315
14, NWSE	14675	STO	Taylor Ranch		" "	8	
16, NESE	14653	STO	" "		" "	350	200
19, SWSE	25851	STO	Moore Land Co.	L	" "	812	F
20, SWNE	14654	STO	Taylor Ranch		" "	275	100
24, NWNE	14656	STO	" "		" "	296	60
31, NWNE	25846	STO	Moore Land Co.		" "	1,000	F
32, SESW	14662	DOM	Taylor Ranch		" "	330	
33, SWNE	14658	STO	" "		" "	275	125
34, SWSE	14659	STO	" "		" "	240	
T43NR73W							
4, SESE	2902	DOM	Ed Willard	L	Wasatch Sand	95	70
4, SESE	2888	DOM	" "	L, Q	" "	165	90
4, NWNE	2886	STO	" "	L	" "	169	130
9, NENE	2887	STO	" "	L	" "	152	110
T43NR73W							
27, NWNW	45989	MIS	Rocky Mtn Energy		Wasatch Sand	405	272.65
27, NWNW	45988	MIS	" " "		" "	407	278.88
27, NWNW	45987	MIS	Rocky Mtn Energy		Wasatch Sand	383	276.4
27, NWNW	45986	MIS	" " "		" "	461	296.22
27, NWNW	45985	MIS	" " "		" "	215	183.33
27, NWNW	45984	MIS-RES	" " "	L, Q	" "	413	282.27
28, NENW	2883	STO	Ed Willard		" "	80	60
30, SENW	26955	STO	August Laur	L	" "	174	75
32, NENW	2881	STO	Ed Willard		" "	90	65
32, SWSW	18841	STO	Reno and Sons		" "	300	100
T43NR74W							
1, SENW	5429	STO	Bozwell Moore	L	Wasatch Sand	83	30
2, NWNE	3602	STO	Moore, L.W. & P.J.	L	" "	357	30
5, NWSW	12288	DOM	Ruby Ranch		" "	350	Unknown
5, SESE	37542	IRR-STO	William Camblin	L, Q	" "	555	140
6, NENW	12292	STO	Ruby Ranch		" "	240	Unknown
6, SESE	12293	STO	" "		" "	185	Unknown
7, NWSE	13342	STO	L.E. Gilbertz		" "	Unknown	60
7, SESW	35881	DRI-MIS-TEM	Cleveland Cliffs Iron Co.	L	" "	400	314
7, SESW	40283	MIS	Gilbertz, Larry	L	" "	400	314
9, NENW	35175	STO	Moore, Mike	L	" "	310	125
10, NWSE	5432	STO	Moore, Wayne	L	" "	290	150
13, SWSE	7127	IND-MIS	" "	L	" "	10	0
14, NWNE	20072	STO	Todd, Earl		" "	160	60
16, SESE	19247	STO	Roush, Robert		" "	205	190
17, SWNW	41138	MIS-STO	Van Buggenum, Leroy	L	" "	610	125
19, NESE	13344	STO	Gilbertz, L.E.		" "	116	40
20, NWNW	19240	STO	Laur, August		" "	160	18
21, NWNW	19225	DOM-STO	James H. Roush Estate		" "	80	50
21, SESW	19226	STO	" " " "	L	" "	126	60
22, NESW	20073	STO	Todd, Earl		" "	100	60

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CONT.

LOCATION	PERMIT NUMBER	USE[3]/	USER	OTHER INFORMATION[1]/	PROBABLE AQUIFER	WELL DEPTH (ft)	WATER LEVEL (ft below LS)
T43NR74W (Cont.)							
22, SWSW	36176	DRI-MIS-TEM	Inexco Oil Co.		Ft. Union Sand	2,042	500
24, NWNW	5845	STO	Moore, Wayne		Wasatch Sand	6	F
25, SENE	19244	DOM-STO	Laur, August		" "	180	30
26, SENW	19246	STO	" "	L	" "	190	110
28, SENE	20074	STO	Todd, Earl	L	" "	144	89
28, NESE	20071	DOM-STO	" "		" "	100	40
29, SENE	19239	DOM-STO	Laur, August		" "	160	120
29, SENE	19242	DOM	" "		" "	140	104
29, SWSW	35809	STO	Atwood, Velma L.	L	" "	145	60
30, SENE	26643	STO	Bing, Melissa E.	L	" "	200	90
30, SESE	31065	DRI-IND	Cleveland Cliffs Iron Co.	L	" "	505	317
32, NWNW	35742	DOM	Atwood, E. O.	L	" "	540	75
33, SWSW	35331	STO	Taylor Ranch Co. Limited	L	" "	600	90
35, NWNE	19241	STO	Laur, August		" "	120	90
T43NR75W							
1, NENE	2734	STO	Gilbertz, L.E.	L	Wasatch Sand	430	20
2, SWSW	12294	STO	Ruby Ranch, Inc.		" "	340	Unknown
5, SENW	12283	STO	" " "		" "	350	Unknown
7, NESE	33462	DRI-MIS-TEM	Cleveland Cliffs Iron Co.	L	" "	320	228
9, SESW	12289	STO	Ruby Ranch, Inc.	L	" "	703	360
13, SESW	13346	STO	Gilbertz, L.E.		" "	120	20
15, NESW	15070	STO	Brown Land Co.	L	" "	6	F
18, NENW	35984	STO	" " "		" "	700	310
22, SENW	8892	STO	Ruby Ranch	L	" "	800	400
24, SENW	19243	STO	Laur, August		" "	180	140
28, NWNW	35336	STO	Ruby Ranch, Inc.	L	" "	960	200
28, NWSE	12295	STO	" " "		" "	610	Unknown
29, SENW	12290	STO	" " "	L	" "	510	175
30, SWSW	11898	STO	Brown Land Co.		Wasatch Sand	400	115
31, NENW	12296	STO	Ruby Ranch, Inc.		" "	800	Unknown
32, SWNW	11899	STO	Brown Land Co.		" "	420	125
36, SWNE	11895	STO	" " "	L	" "	162	90
T43NR76W							
3, NESW	15106	STO	Brown Land Co.	L	Wasatch Sand	275	125
3, SWNE	29162	STO	Brown, Franklin	L	" "	720	310
7, NESE	35744	STO	Brown Land Co.	L	Wasatch Sand	740	F
10, SWNE	11897	STO	" " "	L	" "	570	50
14, NWNW	27514	IND	Cleveland Cliffs Iron Co.	L	" "	520	95
14, NWNW	28297	MIS	" " " "	L	" "	160	Unknown
14, NWNW	28298	MIS	" " " "	L	" "	160	Unknown
14, NWNW	28299	MIS	" " " "	L	" "	160	Unknown
14, NWNW	28300	MIS	" " " "	L	" "	160	Unknown
14, NWNW	28301	MIS	" " " "	L	" "	150	Unknown
14, NWNW	28302	MIS	" " " "	L	" "	160	Unknown
14, NWNW	28303	MIS	" " " "	L	" "	160	Unknown
14, NWNW	28304	MIS	" " " "	L	" "	160	Unknown
14, NWNW	28305	MIS	" " " "	L	" "	150	Unknown
14, NWNW	28306	MIS	" " " "	L	" "	175	Unknown
14, NWNE	28307	MIS	" " " "	L	" "	160	Unknown
14, NWNW	28308	MIS	" " " "	L	" "	160	Unknown
14, NWNW	35883	DRI-MIS-TEM	" " " "	L	" "	520	95
19, NENW	11894	STO	Brown Land Co.	L	" "	310	F
20, NESW	11891	STO	" " "		" "	370	F

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CONT.

LOCATION	PERMIT NUMBER	USE[3]/	USER	OTHER INFORMATION[1]/	PROBABLE AQUIFER	WELL DEPTH (ft)	WATER LEVEL (ft below LS)
T43NR76W (Cont.)							
20, SWNW	13634	STO	Flying Diamond Ranch		Wasatch Sand	360	Unknown
21, NWNE	11896	STO	Brown Land Co.		" "	405	F
22, SENE	11902	STO	" " "	L	" "	455	F
22, SENE	11904	DOM-STO	" " "	L	" "	550	90
22, SENW	15107	STO	" " "	L	" "	253	48
22, SESE	32364	MIS	American Nuclear Corp.	L	" "	820	0.00
22, SESE	33631	STO	" " "	Q	" "	820	0.00
23, SWSW	11905	STO	Brown Land Co.	L	" "	690	80
23, SWNW	45994	STO	" " "	L	" "	560	82
27, NWNW	11903	STO	" " "	L	" "	960	F
30, NWSE	13626	STO	Flying Diamond Ranch		" "	360	Unknown
31, NWNW	13637	STO	" " "		" "	490	Unknown
32, SWSE	14650	STO	Taylor Ranch Co.		" "	135	60
35, SENE	33461	DRI-MIS-TEM	Cleveland Cliffs Iron Co.	L	" "	485	82
35, SENE	41140	MIS	" " " "	L	" "	502	444
35, SENE	41141	MIS	" " " "	L	" "	504	448
35, SENE	41142	MIS	" " " "	L	" "	465	407
35, SENE	41143	MIS	" " " "	L	" "	475	428
35, SENE	41144	MIS	" " " "	L, Q	" "	396	312
35, SENE	41145	MIS	" " " "	L	" "	501	493
T42NR77W							
1, NESW	25854	STO	Moore Land Co.			Unknown	Unknown
12, NWNE	25853	STO	" " "	L	Wasatch Sand	560	F
14, NENE	25852	STO	" " "	L	" "	460	F
14, SWNE	25856	STO	" " "	L	" "	720	F
14, SENE	49722	MIS	Uranerz U.S.A., Inc.				
14, SENE	49723	MIS	Uranerz U.S.A., Inc.				
14, SENE	49724	MIS	" " "				
14, SENE	49725	MIS	" " "				
14, SENE	49727	MIS	" " "				
14, SENE	49728	MIS	" " "				
14, SENE	49729	MIS	" " "				
14, SENE	49730	MIS	" " "				
14, SENE	49731	MIS	" " "				
14, SENE	49732	MIS	" " "				
14, SENE	49733	MIS	" " "				
23, SWNE	25857	STO	Moore Land Co.	L	Wasatch Sand	585	6.00
24, SWNE	25850	STO	" " "	L	" "	530	F
25, SENE	25860	DOM-STO	" " "			Unknown	F
26, SENW	25858	STO	" " "	L	Wasatch Sand	200	F
T43NR77W							
11, SESE	13632	STO	Flying Diamond Ranch		Wasatch Sand	410	Unknown
13, SWSE	13633	STO	" " "		" "	400	Unknown
23, SWSE	13625	STO	" " "		" "	480	Unknown
23, NENE	13627	STO	" " "		" "	420	Unknown
24, NESE	13635	STO	" " "		" "	400	Unknown
35, NWNE	13622	STO	" " "		" "	655	Unknown
36, SWN	26091	STO	" " "		" "	387	360

NOTES:

1/ L = Well log available
Q = Water quality analysis available

2/ F = Piezometric evaluation greater than land-surface elevation or flowing well

3/ DOM = Domestic (Residential)
DRI = Drilling
IND = Industrial
IRR = Irrigation
MIS = Miscellaneous, includes silt storage, medicinal, institutional, highway rest area or unknown
OIL = Oil Refining/Production
RES = Reservoir Supply
STO = Stock
TEMP = Temporary Use

TABLE D-6-15

SURFACE-WATER RIGHTS WITHIN 16 KILOMETERS (10 MILES) OF THE SAND ROCK PROJECT

Location	Permit Number	Stream	Use	User
40N - 73W				
07	3251	Ellen Draw	STK	Fred Taylor
07	20371	Antelope Creek	IRR	Fred Taylor
07	26379	Ellen Draw	IND	Woods Petroleum Corp.
08	20372	Antelope Creek	IRR	Fred Taylor
08	3908	Taylor Draw	STK	USA Forest Service
17	6264	Jenson Draw	--	Fred Taylor
41N - 73W				
16	6131	Bates Creek	--	Floyd Reno & Sons
32	3159	Charley Draw	STK	Fred M. Taylor
33	3160	Fred's Draw	STK	Fred M. Taylor
42N - 73W				
18	7319	Mary Draw	STK	Turnercrest Ranch
31	7320	Turner Draw	STK	Turnercrest Ranch
32	5420	Turner Dry Lake	STK	U.S. Agri. Forest Service
43N - 73W				
05	25002	Belle Fourche R.	--	Wyoming State Highway Dept.
18	24842	Belle Fource R.	--	Wyoming State Highway Dept.
21	967	Dry Gulch to Belle Fourche	--	Geo. A. Keeline
40N - 74W				
04	4033	Berry's Draw	STK	William I. Moore
06	1960	Berry's Draw	STK	Fred M. Taylor
08	13059	Antelope Creek	--	R. L. O'Dell
14	4034	Macker Draw	STK	William I. Moore

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(cont'd)

Location	Permit Number	Stream	Use	User
41N - 74W				
01	5168	Bates Creek	STK	John W. Moore
12	5169	Mexican Springs	STK	John W. Moore
42N - 75W				
06	19788	Glen Spring	IRR	Earl Brown
06	19789	Glen Spring #2	IRR	Earl Brown
18	28	Collins Draw	STK	Earl Brown
43N - 75W				
01	14226	Four Mile Creek	--	Florence L. Eychaner
01	3315	Four Mile Creek	--	Florence L. Eychaner
11	29	South Branch 4 Mile Creek	STK	Earl Brown
17	4479	Davis Draw	--	Cecil Davis
24	5439	Little Butte Draw	STK	Lewella Laur
40N - 76W				
07	3954	Wind Creek	STK	Tye & Eddie Moore
12	2512	Spring	STK	Ogalalla Sheep & Cattle Co.
23	2511	Spring	STK	Ogalalla Sheep & Cattle Co.
24	4637	Smyth Draw	STK	Edward D. Moore
28	5147	Findley Draw	IRR	Leroy Moore
41N - 76W				
06	2542	Loading Chute Dr.	STK	Robert B. Moore
15	14431	Meadow Draw	--	Delbert Pierce
15	3365	Meadow Draw R.	--	D. Pierce
19	14063	Dry Fork Power R.	--	Nora H. McPhillamey
19	3280	Dry Fork Power R.	--	Nora H. McPhillamey
19	5217	Dry Fork Power R.	STK	Moore Sheep Co.
19	4706	Red Draw	STK	Moore Sheep Co.
31	6384	S. Prong Dry Fk. - Power R.	--	Moore Land Co.

TABLE D-6-15

(cont'd)

Location	Permit Number	Stream	Use	User
42N - 76W				
02	20567	Water stored in Artesian Lower Reservoir Supplied from Artesian Creek	STK	The Taylor Ranch Co.
02	5777	Artesian Creek	STK	The Taylor Ranch Co.
12	5776	Artesian Creek	STK	The Taylor Ranch Co.
42N - 74W				
03	12407	Belle Fourche	—	B. J. Reno
03	799	Belle Fourche	—	George A. Keeline
03	2653	Belle Fourche	—	B. J. Reno
23	1296	Ralph Draw	STK	John Moore
28	1685	West Bates Creek	STK	John Moore
32	2199	Peak Draw	STK	U. S. Archibald
43N - 74W				
07	6260	Gilbertz Draw	STK	Larry Gilbertz
13	14201	All Night Creek	—	A. H. Hoodenpyle et al.
13	1583	All Night Creek	STK	D. B. Moore
16	798	All Night Creek to Belle F.	—	George A. Keeline
28	1246	All Night Creek	—	Glenn & Graham
31	1874	Dangle Draw	STK	Claus H. Sievers
40N - 75W				
12	8935	Wind River	STK	Flyn Sheep Co.
15	2508	Br. Little Wind R.	STK	Ogalalla Sheep & Cattle Co.
17	26415	Wind Creek	IND	Spearhead Energy, Inc. & St. Bd. Land Commissioners
41N - 75W				
13	14212	Nine Mile Creek	IRR	Bernice Middaugh
13	3308	Nine Mile Creek	IRR	Bernice Middaugh

TABLE D-6-15

(cont'd)

Location	Permit Number	Stream	Use	User
42N - 75W				
04	8156	Cottonwood Creek	STK	Brown Land Co.
04	8157	Cottonwood Creek	STK	Brown Land Co.
42N - 76W				
24	3775	Wintermute Draw	STK	The Taylor Ranch Co.
28	3776	Nichols Draw	STK	The Taylor Ranch Co.
43N - 76W				
35	8099	Collins Draw	STK	Cleveland Cliffs Iron Co.
40N - 77W				
13	5700	North Fork Wind Cr.	STK	Brida and Roy Gaff
41N - 77W				
01	8064	J. J. Draw	STK	Moore Land Co.
25	6012	Bob Draw	STK	Robert Moore
42N - 77W				
12	26124	Dry Fork Powder River	IND	Woods Petroleum Corp.
26	6490	Crawford Draw	STK	Robert B. Moore

STK = Stock
IRR = Irrigation
IND = Industrial

APPENDIX A-1

CONSTANT HEAD TEST

TABLES AND FIGURES

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(cont'd)

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Figure No.

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(cont'd)

Figure No.

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(cont'd)

Figure No.

TABLE A-1.1 CONSTANT HEAD TEST DATA FOR HOLE P-1
(LOWER MUDSTONE AND E COAL)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
12/4/79					Dry
12/10/79	1231	0			Dry
	1247	16	0.276	3.62	
	1300	29	0.205	4.88	
	1313	42	0.185	5.40	
	1327	56	0.178	5.62	
	1342	71	0.170	5.88	
	1358	87	0.164	6.10	
	1418	107	0.162	6.17	
	1433	122	0.159	6.29	
	1448	137	0.157	6.37	
	1514	163	0.158	6.33	
4/3/80					Dry

TABLE A-1.2 CONSTANT HEAD TEST DATA FOR HOLE P-2 (LOWER MUDSTONE AND E COAL?)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
3/17/80	1159				42.05
	1201	Started bailing			
	1206	Stopped bailing ≈ 1 1/4 gal			
	1209				50.25
	1419				50.1
3/18/80	1053				49.05
	1055	Started bailing			
	1059	Stopped bailing ≈ 1/4 gal			
	1100				50.2
3/24/80	1241				
	1242	Started bailing			
	1249	Stopped bailing ≈ 3/4 gal			
	1251				>51.3
4/2/80	1307	T = 8.2°C Cond = 2010			43.79
4/11/80	1140				43.08
	1145	Started injection			
	1153	8	0.031	32.7	
	1220	35	0.019	53.3	
	1235	50	0.015	67.3	
	1317	92	0.013	76.0	
	1337	112	0.011	93.3	
	1403	138	0.011	89.3	
	1534	229	0.0095	105	

TABLE A-1.3 CONSTANT HEAD TEST DATA FOR HOLE P-3 (LOWER MUDSTONE)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
3/17/80	1134				47.37
	1138	Started bailing			
	1142	Stopped bailing = 3/4 gal			
	1144				51.6
	1411				51.6
3/18/80	1018				51.5
3/24/80	1509				50.8
3/27/80	1540	Bailed T = 9.1^{o}C	Cond = 3380 µmhos/cm @ 25^{o}C		50.5
4/2/80	1421				51.35
4/9/80	-	Saturated hole			
4/10/80	0853	Started injection test			
	0904	11	.0068	148	
	0920	27	.0060	165	
	0936	43	.0055	180	
	0956	63	.0055	181	
	1016	83	.0055	182	
	1047	114	.0055	182	
	1117	144	.0055	181	
	1144	171	.0055	181	
	1218	205	.0055	182	
	1245	232	.0055	182	
	1325	272	.0055	182	

TABLE A-1.3 CONSTANT HEAD TEST DATA FOR HOLE P-3 (Cont'd)
(LOWER MUDSTONE)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
4/10/80	1401	308	.0055	183	
	1443	350	.0054	184	
	1503	370	.0054	184	
	1542	409	.0054	184	

TABLE A-1.4 CONSTANT HEAD TEST DATA FOR HOLE P-4 (LOWER MUDSTONE AND E COAL)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
3/13/80	1050				19.67
	1200	Started bailing			
	1212	Stopped bailing ≈ 7.5 gal			
	1223				46.50
	1547				33.81
3/17/80	1053				23.81
3/24/80	1350				23.18
3/27/80	1612				23.19
		T = 9.9° C	Cond = 1250 μmhos/cm @ 25°C, near water level		
		T = 10.1	Cond = 1660 @ ≈ 48' below LSD		
4/2/80	1051				23.16
4/3/80	0917	T = 9.8	Cond = 1470		23.19
	0938	0	Started test		
	0953	15	.0064	157	0.0
	1021	43	.0026	380	
	1118	100	.0024	413	
	1219	161	.0022	457	
	1320	222	.0024	420	
	1421	283	.0022	452	
	1521	343	.0023	444	

TABLE A-1.5
CONSTANT HEAD TEST DATA FOR HOLE P-4B

Date	Time	Time Since Injection Started (min)	Discharge (Q, in GPM)	I/Q (min/gal)	Water Level (ft-mp)
3/13/80	1100				20.88
	1126	Started bailing			
	1131	Stopped bailing	3.0 gal		
	1217				31.83
	1549				26.83
3/17/80	1057				20.94
3/24/80	1352				21.07
	1359	Started bailing			
	1409	Stopped bailing	3.0 gal		
3/27/80	-	T = 10.0°C	Cond = 2000 umhos/cm @ 25°C near top		
		T = 10.1°C	Cond = 2220 umhos/cm @ 25°C near bottom		
	1615				21.8
4/03/80	1239				20.87
		T = 9.0°C	Cond = 1996 umhos/cm @ 25°C		
5/22/80	1019	Started test			
	1047	28	0.250	4.00	
	1114	55	0.214	4.67	
	1140	81	0.217	4.60	
	1206	107	0.207	4.83	
	1229	130	0.167	6.00	
	1304	165	0.119	8.40	
	1344	205	0.143	7.00	
	1404	225	0.136	7.33	
	1429	250	0.127	7.90	
	1454	275	0.124	8.10	

TABLE A-1.7 CONSTANT HEAD TEST DATA FOR HOLE P-4CA (UPPER MUDSTONE)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
3/27/80	1603				22.65
		T = 10.0°C Cond = 2040 μmhos/cm @ 25°C top of W.L.			
		T = 10.1 Cond = 2150 near bottom of well			
		Bailed = 3 gal T = 9.9 Cond = 2150			
	1645				32.3
4/2/80	1055				22.49
4/3/80	0910	T = 9.1 Cond = 2010			22.53
	0931	0	Test started		
	0943	12	0.0101	99.2	0.0
	1004	33	0.0094	106	
	1039	68	.0082	122	
	1100	89	.0085	117	
	1136	125	.0082	123	
	1206	155	.0077	129	
	1236	185	.0084	119	
	1306	215	.0083	120	
	1339	248	.0078	127	
	1409	278	.0072	139	
	1439	308	.0071	141	
	1509	338	.0080	126	
	1539	368	.0078	128	
	1609	398	.0076	132	

TABLE A-1.8 CONSTANT HEAD TEST DATA FOR HOLE P-5
(E COAL)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
3/17/80	1110				27.40
	1112	Started bailing			
	1118	Stopped bailing ≈ 3 gal			
	1120				46.25
	1404				40.14
3/24/80	1439				28.37
4/2/80	1105	Sample taken			28.44
		$T = 8.5^{o}C$	Cond = 420 μmhos/cm @ $25^{o}C$		
4/9/80	1010				
		T = 10.2 Cond = 390			28.54
	1016	0	Started injection		
	1043	27	0.012	82.7	
	1213	117	0.0099	101	
	1329	193	0.0091	109	
	1357	221	0.0091	110	
	1418	242	0.0090	111	
	1452	276	0.0090	111	
	1514	298	0.0088	114	
	1540	324	0.0088	113	
4/10/80	0912	1376	0.0038	267	
	1214	1558	0.0036	279	
	1554	1778	0.0033	301	

TABLE A-1.9 CONSTANT HEAD TEST DATA FOR HOLE P-6 (UPPER SANDSTONE)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
3/17/80	1313				35.58
	1317	Started bailing			
	1320	Stopped bailing ≈ 1/2 gal			
	1322				37.28
	1434				35.75
3/18/80	1108				35.72
	1110	Started bailing			
	1117	Stopped bailing ≈ 3/4 gal			
	1120				38.25
3/24/80	1343				35.75
4/3/80	0947	T = 8.5°C	Cond = 480 µmhos/cm @ 25°C		35.80
	0954	0	Started test		
	1001	7	0.96	1.04	
	1012	8	0.57	1.75	
	1022	28	0.42	2.38	
	1038	44	0.38	2.64	
	1049	55	0.31	3.19	
	1106	72	0.28	3.50	
	1116	82	0.27	3.68	
	1126	92	0.27	3.70	
	1139	105	0.26	3.88	
	1155	121	0.19	5.18	
	1210	136	0.18	5.46	

TABLE A-1.9 CONSTANT HEAD TEST DATA FOR HOLE P-6 (UPPER SANDSTONE) (Cont'd)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
4/3/80	1225	151	0.18	5.71	
	1235	161	0.19	5.20	
	1245	171	0.17	6.00	
	1255	181	0.17	5.73	
	1310	196	0.16	6.33	
	1316	202	0.16	6.27	
	1321	207	0.15	6.67	
	1336	222	0.15	6.47	
	1346	232	0.16	6.33	
	1356	242	0.16	6.27	
	1406	252	0.15	6.67	
	1416	262	0.15	6.67	
	1426	272	0.15	6.87	
	1436	282	0.14	6.93	
	1446	292	0.14	6.93	
	1501	307	0.14	7.00	
	1511	317	0.14	7.00	
	1521	327	0.14	7.07	
	1531	337	0.14	7.00	
	1541	347	0.14	7.07	
	1551	357	0.14	7.07	

TABLE A-1.10
BAILING AND RECOVERY DATA FOR WELL P-7 (70SS)

Date	Time	t (min)	t' (min)	t/t'	Water Level (ft below mp)	Drawdown (ft)	Discharge (gpm)
5/22/80	1000				33.67		
	1100				33.41		
	1402				33.47		
	1404	0	Start bailing				
	1412	8	T = 14.0°C , Cond = 1438 umhos/cm @ 25°C				0.19
	1429	25	T = 12.9°C , Cond = 1425 umhos/cm @ 25°C				0.20
	1453	49	T = 11.0°C , Cond = 1492 umhos/cm @ 25°C				0.21
	1505	61			36.24	2.74	
	1508	64	Sample collected				
	1515	71	T = 11.1°C , Cond = 1462 umhos/cm @ 25°C				0.23
	1516	72			36.87	3.37	
	1535	91	T = 11.2°C , Cond = 1485 umhos/cm @ 25°C				0.25
	1545	101			36.66	3.16	
	1555	111	0				
			T = 12.0°C , Cond = 1457 umhos/cm @ 25°C				0.25
	1600	116	5	23.2	36.40	2.90	
	1609	125	14	8.93	35.20	1.70	
	1615	131	20	6.55	34.69	1.19	
	1620	136	25	5.44	34.46	0.96	
	1629	145	34	4.26	34.18	0.68	
	1645	161	50	3.22	33.96	0.46	
	1800	236	125	1.89	33.69	0.19	

Note: t = time since pumping started
t' = time since pumping stopped

TABLE A-1.11 CONSTANT HEAD TEST DATA FOR HOLE P-8 (LOWER MUDSTONE AND E COAL)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
3/17/80	1234				26.59
	1236	Started bailing well			
	1300	Stopped bailing 15 gal			
	1301				48.26
	1427				27.19
3/24/80	1446				26.96
4/2/80	0949	T = 8.4°C C = 740 µmhos/cm @ 25°C			26.09
	0956	0	Started test		
	1013	17	0.160	6.25	0.0
	1031	35	0.166	6.03	
	1048	52	0.095	10.6	
	1103	67	0.087	11.5	
	1118	82	0.087	11.4	
	1133	97	0.089	11.2	
	1148	112	0.100	10.0	
	1203	127	0.094	10.6	
	1218	142	0.095	10.5	
	1239	163	0.097	10.3	
	1257	181	0.078	12.8	
	1309	193	0.080	12.5	
	1325	209	0.080	12.5	

TABLE A-1.11 CONSTANT HEAD TEST DATA FOR HOLE P-8 (LOWER MUDSTONE AND E COAL) (Cont'd)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
4/2/80	1333	217	0.077	12.9	
	1348	232	0.096	10.4	
	1402	246	0.102	9.8	
	1420	264	0.107	9.4	

TABLE A-1.12 CONSTANT HEAD TEST DATA FOR HOLE P-9
(LOWER MUDSTONE AND E COAL)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
3/17/80	1030				14.98
	1035	Started bailing			
	1041	Stopped bailing ≈ 4 gal			
	1043				35.2
	1359				29.48
3/18/80	1616				15.68
	1619	Started bailing			
	1623	Stopped bailing ≈ 4 gal			
	1632				35.35
3/24/80	1429				15.01
3/27/80	1551	T = 8.5°C	Cond = 2890 µmhos/cm @ 25°C near top of water		15.02
		T = 9.5	Cond = 3030 near well bottom		
4/2/80	0921	T = 8.1	Cond = 2900		14.60
		Sample collected			
	0934	Started injection			
	0941	7	0.0107	93.4	
	0958	24	.0107	93.4	
	1020	46	.0099	101	
	1055	81	.0072	139	
	1138	124	.0064	156	
	1222	168	.0055	182	

TABLE A-1.12 CONSTANT HEAD TEST DATA FOR HOLE P-9
(LOWER MUDSTONE AND E COAL) (Cont'd)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
4/2/80	1305	205	.0052	192	
	1355	255	.0046	217	
	1440	298	.0042	238	
	1507	315	.0040	250	

TABLE A-1.13 CONSTANT HEAD TEST DATA FOR HOLE P-9A
(UPPER MUDSTONE)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
3/27/80	1556				19.65
4/2/80	1243				16.98
4/9/80	0935				16.04
	0939	0	Started injection		
	0944	5	0.075	13.3	
	0949	10	0.073	13.7	
	0956	17	0.032	31.2	
	1009	30	0.014	73.7	
	1035	56	0.0050	197	
	1139	60	0.0012	823	
	1255	196	0.0012	850	
	1417	278	0.0012	848	
	1512	333	0.0012	866	

TABLE A-1.14 CONSTANT HEAD TEST DATA FOR HOLE P-10 (LOWER MUDSTONE AND E COAL)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
3/13/80	1401				28.09
	1404	Started bailing			
	1426	Stopped bailing = 15 gal			
	1429				51.78
	1556				28.65
3/17/80	1127				28.35
3/24/80	1433				28.30
4/2/80	1127	T = 9.8°C	Cond = 2010 μmhos/cm @ 25°C		28.33
		Sample taken			
	1138	0	Started injection		
	1141.6	3.6	0.019	51.5	
	1147.8	9.8	0.017	57.9	
	1154	16	0.016	61.9	
	1202	24	0.016	61.3	
	1208	30	0.016	62.9	
	1217	39	0.015	68.0	
	1227	49	0.015	67.7	
	1243	65	0.014	69.1	
	1257	79	0.015	68.3	
	1313	95	0.014	72.5	
	1331	113	0.014	72.0	

TABLE A-1.15 CONSTANT HEAD TEST DATA FOR HOLE P-11
(E COAL)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
3/17/80	1151				18.35
3/18/80	1023				18.4
	1025	Started bailing			
	1027	Stopped bailing ≈ 1/4 gal			
	1029				19.7
	1607				19.75
3/24/80	1258				18.95
3/27/80	1445	Bailed ≈ 1/4 gal			18.60
		T = 9.0°C Cond = 2990 μmhos/cm @ 25°C			
4/2/80	0855				19.1
	0900	0	Started test		
	0904	4	0.015	65.3	0.0
	0913	13	0.025	40.0	
	0924	24	0.019	51.7	
	0939	39	0.022	45.1	
	0950	50	0.027	37.1	
	1004	64	0.021	48.0	
	1009	69	0.024	41.3	
	1028	88	0.023	42.7	
	1046	106	0.024	41.6	
	1106	126	0.023	43.5	
	1128	148	0.024	41.9	

TABLE A-1.15 CONSTANT HEAD TEST DATA FOR HOLE P-11 (E COAL) (Cont'd)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
4/2/80	1146	166	0.024	41.9	
	1210	190	0.022	45.3	
	1232	212	0.028	34.7	
	1256	236	0.027	37.1	
	1315	255	0.027	37.3	
	1343	283	0.027	36.5	
	1408	308	0.029	34.7	
	1428	328	0.031	32.0	
	1450	350	0.032	31.2	
	1505	365	0.035	28.4	

TABLE A-1.16 CONSTANT HEAD TEST DATA FOR HOLE P-12
(E COAL)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
3/13/80	1347				30.61
3/24/80	1447				27.70
	1450	Started bailing			
	1454	Stopped bailing ≈ 3/4 gal			
	1457				33.3
3/27/80	1528	Bailed ≈ 3/4 gal			
		T = 10.1°C Cond - 2090 µmhos/cm @ 25°C			
		Bailed ≈ 3/4 gal T = 9.9 Cond = 2080			
4/2/80	1355	T = 9.0 Cond = 2070			30.88
4/9/80	0855				30.9
	0908	Started injection			
	0912	4	0.089	11.3	
	0927	19	0.051	19.6	
	0939	31	0.043	23.3	
	0952	44	0.036	27.9	
	1002	54	0.033	30.7	
	1012	64	0.032	31.3	
	1022	74	0.031	32.7	
	1032	84	0.029	34.1	
	1042	94	0.029	34.9	
	1052	104	0.028	35.9	
	1102	114	0.027	36.8	
	1222	194	0.022	46.4	

TABLE A-1.16 CONSTANT HEAD TEST DATA FOR HOLE P-12 (Cont'd)
(E COAL)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
4/9/80	1309	241	0.020	51.2	
	1344	276	0.019	53.3	
	1407	299	0.018	54.7	
	1434	326	0.018	55.5	
	1502	354	0.018	55.5	
	1523	375	0.018	56.0	
	1547	399	0.018	55.2	

TABLE A-1.17 CONSTANT HEAD TEST DATA FOR HOLE P-13
(UPPER MUDSTONE)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
3/17/80	1513	Bailed			18.44
	1518				19.45
3/18/80	1035	Bailed ≈ 1/4 gal			19.17
	1039				19.71
	1612				19.95
3/24/80	1306				18.08
	1307	Started bailing			
	1311	Stopped bailing ≈ 1/3 gal			
	1313				19.8
3/27/80	1410				18.4
4/2/80	1325	T = 7.0°C Cond = 3900 μmhos/cm @ 25°C			17.68
4/11/80	0945				17.60
	0948	Started injection			
	0952	4	0.091	11.0	
	1001	13	0.075	13.3	
	1008	20	0.072	13.9	
	1021	33	0.068	14.8	
	1039	51	0.067	14.9	
	1102	74	0.073	13.7	
	1112	84	0.076	13.2	
	1121	93	0.087	11.5	
	1211	143	0.100	10.0	

TABLE A-1.17 CONSTANT HEAD TEST DATA FOR HOLE P-13 (Cont'd)
(UPPER MUDSTONE)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
4/11/80	1303	195	0.144	6.93	
	1345	237	0.158	6.33	
	1413	265	0.172	5.80	
	1438	290	0.176	5.67	

TABLE A-1.18 CONSTANT HEAD TEST DATA FOR HOLE P-13A (E COAL)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
3/27/80	1414	Bailed ≈ 10 gal			20.86
		T = 9.8°C	Cond = 3210 μmhos/cm @ 25°C		
4/2/80	1331	T = 8.5°C	Cond = 3250		19.82
4/9/80	1114				19.81
	1115	Start permeability test			
	1117	2	1.82	0.55	
	1130	15	1.82	0.55	
	1140	25	2.0	0.50	
	1150	35	1.97	0.51	
	1200	45	1.94	0.52	
	1210	55	1.85	0.54	
	1220	65	1.85	0.54	
	1231	76	1.24	0.81	
	1240	85	1.74	0.575	
	1252	97	1.62	0.62	
	1305	110	1.33	0.75	
	1320	125	1.14	0.875	
	1335	140	0.56	1.78	
	1350	155	0.64	1.57	
	1405	170	0.59	1.68	
	1425	190	0.22	4.58	
	1445	210	0.39	2.54	

TABLE A-1.18 CONSTANT HEAD TEST DATA FOR HOLE P-13A (Cont'd)
(E COAL)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
4/9/80	1515	240	0.36	2.80	
	1545	270	0.25	3.96	
4/11/80	0956				19.86
	1432				19.87

TABLE A-1.19 CONSTANT HEAD TEST DATA FOR HOLE P-15 (LOWER MUDSTONE AND E COAL)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
3/17/80	1336				23.34
	1340	Started bailing			
	1345	Stopped bailing = 3 gal			
	1347				35.2
	1440				34.77
3/18/80	1004				30.42
	1006	Started bailing			
	1012	Stopped bailing = 2 gal			
	1013				35.95
	1553	Bailed			34.35
	1600				36.27
3/24/80	1504				23.10
3/27/80	1501	Bailed = 2 gal			23.03
		T = 10.0°C Cond = 3060 µmhos/cm @ 25°C			
		Bailed = 1 gal T = 9.1°C Cond = 3130 pH = 6.6			
	1521				35.8
4/2/80	1409	T = 8.0°C Cond = 3070			23.05
		Sample taken			
4/10/80	0947	Started injection test			
	0959	12	.0100	100	
	1029	42	.0065	153	
	1100	73	.0062	161	

TABLE A-1.19 CONSTANT HEAD TEST DATA FOR HOLE P-15 (Cont'd)
(LOWER MUDSTONE AND E COAL)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
4/10/80	1128	101	.0058	173	
	1236	169	.0054	184	
	1307	200	.0055	183	
	1340	233	.0053	187	
	1426	279	.0051	195	
	1526	339	.0049	206	
	1554	367	.0048	209	

TABLE A-1.20 CONSTANT HEAD TEST DATA FOR HOLE P-15A (UPPER MUDSTONE)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
3/27/80	-				dry
4/9/80	-	Saturated hole			
4/10/80	0948	Started injection test			
	0953	5	0.048	20.9	
	1006	18	0.042	24.0	
	1037	49	0.041	24.3	
	1108	80	0.040	25.2	
	1136	108	0.040	25.1	
	1151	123	0.039	25.5	
	1227	159	0.039	25.9	
	1258	190	0.040	25.1	
	1349	241	0.039	25.3	
	1416	268	0.039	25.7	
	1453	305	0.038	26.3	
	1517	329	0.038	26.4	
	1546	358	0.037	26.9	
	1607	379	0.037	27.1	
	1651	423	0.054	18.7	
	1658	430	0.053	18.8	

TABLE A-1.21 CONSTANT HEAD TEST DATA FOR HOLE P-16
(UPPER 70 SAND)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
3/13/80					75.0
3/18/80					Dry
3/24/80					Dry
4/9/80	Saturated zone				
4/10/80	1015	0	--	--	
	1023	8	0.138	7.27	
	1048	33	0.088	11.40	
	1106	51	0.064	15.73	
	1131	76	0.071	14.13	
	1155	100	0.067	14.93	
	1230	135	0.061	16.27	
	1312	177	0.058	17.20	
	1355	220	0.055	18.27	
	1445	270	0.051	19.60	
	1530	315	0.049	20.40	
	1615	360	0.046	21.73	

TABLE A-1.22 CONSTANT HEAD TEST DATA FOR HOLE P-17
(UPPER 70 SAND)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
3/17/80	-				Dry
3/24/80	1542				Dry
4/9/80	1200	Added water to begin saturating formation			
	1600	Added more water to saturate formation			
4/10/80	1600	Added water to saturate formation			
4/11/80	0935	Begin permeability test			
	0944	9	0.03	32.00	
	0952	17	0.031	32.27	
	1028	53	0.030	32.80	
	1108	93	0.026	38.93	
	1141	126	0.023	42.62	
	1217	162	0.023	42.67	
	1255	200	0.022	45.87	
	1333	238	0.019	53.33	
	1415	280	0.020	48.80	
	1451	316	0.020	49.87	
	1520	345	0.0190	52.53	

TABLE A-1.23 CONSTANT HEAD TEST DATA FOR HOLE P-18
(ALLUVIUM)

DATE	TIME	TIME SINCE INJECTION STARTED (MIN)	DISCHARGE (Q, IN GPM)	1/Q (MIN/GAL)	WATER LEVEL (FT-MP)
3/24/80	1227				22.54
	1230	Begin bailing			
	1233	End bailing (< 1/2 gal)			
	1234				24.4
3/27/80	1405				23.6
4/3/80	1409	T = 8.1°C Cond = 94 µmhos/cm @ 25°C			21.79
4/10/80	1321				22.25
4/11/80	1000	Start permeability test			
	1017	17	0.44	2.27	
	1024	24	0.42	2.40	
	1059	59	0.375	2.67	
	1116	76	0.20	4.93	
	1148	108	0.19	5.20	
	1225	145	0.20	4.93	
	1311	191	0.20	4.93	
	1341	221	0.197	5.07	
	1425	265	0.192	5.20	
	1500	300	0.192	5.20	

TABLE A-1.23A WATER-LEVEL DATA FOR WELLS P-20 AND P-20A DURING BAIL TEST OF WELL P-20B

DATE	TIME	WATER LEVEL (ft below MP)
		WELL P-20
5-21-80	1330	97.62
5-22-80	1122	97.55
	1124	START BAIL TEST ON WELL P-20B
	1141	97.54
	1204	97.56
	1244	97.57
	1304	STOP BAIL TEST ON WELL P-20B
	1313	97.57
		WELL P-20A
5-21-80	1245	98.25
	1430	98.17
5-22-80	1119	98.09
	1124	START BAIL TEST ON WELL P-20B
	1131	98.08
	1145	98.08
	1159	98.10
	1234	98.10
	1304	STOP BAIL TEST ON WELL P-20B
	1306	98.09
	1333	98.11
	1354	98.09

TABLE A-1.23B
BAILING AND RECOVERY DATA FOR WELL P-20B (70SS)

Date	Time	Time Since Bailing Started (t, in min)	Time Since Pumping Stopped (t', in min)	t/t'	Water Level (ft below mp)	Drawdown (ft)	Discharge (gpm)
5/22/80	1118				97.95		
	1124	0	Start bailing				
	1137	13			105.9	7.95	
	1143	19	T = 12.5°C , Cond = 1020 umhos/cm @ 25°C				0.26
	1156	32			111.9	13.95	
	1215	51	T = 12.8°C , Cond = 1416 umhos/cm @ 25°C				0.16
	1220	56	T = 11.0°C , Cond = 1682 umhos/cm @ 25°C				
	1228	64			116.04	18.09	
			Water sample collected				
	1302	98	T = 11.7°C , Cond = 1467 umhos/cm @ 25°C				0.10
	1304	100	0	Stop bailing			
	1311	107	7	15.3	116.15	18.20	
	1320	116	16	7.25	114.12	16.17	
	1325	121	21	5.76	113.08	15.13	
	1330	126	26	4.85	112.11	14.16	
	1340	136	36	3.78	109.99	12.04	
	1351	147	47	3.13	108.09	10.14	
	1430	186	86	2.16	103.28	5.33	
	1551	267	167	1.60	99.00	1.05	
	1655	331	231	1.43	98.53	-0.22	

TABLE A-1.23C
BAILING AND RECOVERY DATA FOR WELL P-21 (70SS)

Date	Time	t	t'	t/t'	Water Level (ft-mp)	Residual Drawdown
3/24/80	1523				75.32	
4/03/80	1302				75.57	
	Bailed 10 times		T = 9.0°C Cond = 713 umhos/cm @ 25°C			
4/10/80	1522				75.27	
5/18/80	1348				73.80	
	1440	0	Started Bailing			
			T = 11.0	Cond = 1370		
	1455		T = 10.0	Cond = 1335		
	1506		T = 10.1	Cond = 1360		
	1516		T = 10.5	Cond = 1470		
	1517		Stopped Bailing			
	1525	45	8	5.62	116.64	42.84
	1536	56	19	2.95	114.35	40.55
	1544	64	27	2.37	112.60	38.80
	1550	70	33	2.12	111.24	37.44
			AVG. Q = 0.41 gpm			
5/22/80	1541				73.40	

Note: t = time since bailing started, in min.
t' = time since bailing stopped, in min.

TABLE A-1.24
CONSTANT HEAD TEST DATA FOR HOLE 35N-1C (U 70SS)

Date	Time	Time Since Injection Started (min)	Discharge (Q, in GPM)	1/Q (min/gal)	Water Level (ft-mp)
4/09/80	1425				179.4
		Bailed dry			
5/15/80	1539				Dry
		Saturated hole			
5/16/80	1148	Started test			
	1217	29	0.149	6.73	
	1243	55	0.122	8.20	
	1303	75	0.119	8.41	
	1322	94	0.125	7.99	
	1342	114	0.113	8.83	
	1408	140	0.396	2.52	
	1410	142	0.30	3.33	
	1428	160	0.288	3.47	
	1457	189	0.30	3.33	
	1523	215	0.288	3.47	
	1611	263	0.263	3.80	
	1642	294	0.250	4.0	

TABLE A-1.25
CONSTANT HEAD TEST DATA FOR HOLE 35N-1D (SS)

Date	Time	Time Since Injection Started (min)	Discharge (Q, in GPM)	I/Q (min/gal)	Water Level (ft-mp)
4/03/80	1539				39.68
		Bailed nearly dry			
		T = 8.5°C Cond = 281 umhos/cm @ 25°C			
4/09/80	1435				39.44
		T = 9.4°C Cond = 339 umhos/cm @ 25°C			
		Bailed dry			
4/10/80	1423				39.39
5/15/80	1542				39.53
5/16/80	1152				39.54
		T = 10.5°C Cond = 405 umhos/cm @ 25°C			
					39.54
5/16/80	1301	Started test			
	1310	9	0.153	6.52	
	1324	23	0.132	7.57	
	1344	43	0.113	8.83	
	1410	69	0.113	8.83	
	1431	90	0.101	9.88	
	1459	118	0.116	8.62	
	1526	145	0.091	10.94	
	1558	177	0.086	11.56	

TABLE A-1.26
CONSTANT HEAD TEST DATA FOR HOLE 35N-1E (MS)

Date	Time	Time Since Injection Started (min)	Discharge (Q, in GPM)	I/Q (min/gal)	Water Level (ft-mp)
4/03/80	1526				27.85
		T = 6.8°C Cond = 301 umhos/cm @ 25°C			
		Bailed nearly dry			
4/09/80	1450				28.53
		T = 9.4°C Cond = 325 umhos/cm @ 25°C			
		Bailed dry			
4/10/80	1420				29.50
5/15/80	1530				28.86
		Saturated hole			
5/16/80	1151	0	Start		
	1211	10	0.0047	211	
	1238	37	0.0059	170	
	1258	57	0.0060	168	
	1318	77	0.0058	172	
	1338	97	0.0055	183	
	1401	120	0.0057	175	
	1423	142	0.0052	192	
	1453	172	0.0050	202	
	1532	211	0.0047	211	
	1603	242	0.0045	222	

TABLE A-1.27
BAILING AND RECOVERY DATA FOR WELL 35N-2A (U70SS)

Date	Time	t (min)	t' (min)	t/t'	Water Level (ft below MP)	Drawdown (ft)	Discharge (gpm)
4/11/80		Bailed - 4 gal					
5/15/80	1443				144.15		
5/19/80	1257				141.32		
	1259	Started bailing					
	1302	T = 12.0°C Cond = 953 umhos/cm @ 25°C					
	1310	T = 11.2°C Cond = 972 umhos/cm @ 25°C					
		Sample taken					
	1325	T ≐ 11.0°C Cond = 950 umhos/cm @ 25°C					
	1333	Stopped bailing - 12 gal					
	1335				154.3		
	1347	48	14	3.42	156.92		
	1352	53	19	2.79	156.51		
	1403	64	30	2.13	155.83		
	1414	75	41	1.83	155.15		
	1427	88	54	1.63	154.34		
	1546	167	133	1.26	150.86		
	1549				150.77		
	1649	230	196	1.17	149.06		
5/21/80	955				147.25		
	1010				147.22		
	1124				147.17		
	1525				146.83		

Note: t = time since pumping started
t' = time since pumping stopped

TABLE A-1.28
CONSTANT HEAD TEST DATA FOR HOLE 35N-2B (SS)

Date	Time	Time Since Injection Started (min)	Discharge (Q, in GPM)	I/Q (min/gal)	Water Level (ft-mp)
4/11/80					99.0
5/15/80	1453				124.22
5/19/80	1247				124.28
	1249	Started bailing			
	1251	T = 11.0°C Cond = 475 umhos/cm @ 25°C			
	1256	Stopped bailing			
	1329				130.19
	1338				129.88
	1343				129.77
	1350				129.58
	1418				128.87
5/20/80	1910	Saturated hole			
5/21/80	1000	Started saturation			
	1020	20	0.103	9.67	
	1045	45	0.100	10.0	
	1100	60	0.0926	10.8	
	1130	90	0.0920	10.9	
	1155	115	0.0857	11.7	
	1310	190	0.0824	12.1	
	1440	280	0.0806	12.4	

TABLE A-1.29
CONSTANT HEAD TEST DATA FOR HOLE 35N-2C (MS)

Date	Time	Time Since Injection Started (min)	Discharge (Q, in GPM)	I/Q (min/gal)	Water Level (ft-mp)
5/15/80	1457				69.4
5/19/80	1239				69.52
	1241	Started bailing			
	1243	T = 11.5°C Cond = 1086 umhos/cm @ 25°C			
	1248	Stopped bailing	2.0 gal		
	1313				72.87
	1330				72.65
	1409				72.49
5/20/80	1855	Saturated hole			
5/21/80	1010	Started injection test			
	1035	25	0.428	2.34	
	1052	42	0.341	2.93	
	1105	55	0.236	4.23	
	1135	85	0.171	5.86	
	1305	175	0.195	5.13	
	1445	275	0.168	5.97	

TABLE A-1.30
CONSTANT HEAD TEST DATA FOR HOLE 35N-3 (SS)

Date	Time	Time Since Injection Started (min)	Discharge (Q_r in GPM)	1/Q (min/gal)	Water Level (ft-mp)
4/09/80					Dry
5/15/80	-	Saturated hole			
5/19/80	-	Saturated hole			
5/20/80	1505	Start test			
	1525	20	0.660	1.52	
	1550	45	0.445	2.25	
	1620	85	0.414	2.42	
	1710	135	0.418	2.39	
	1750	165	0.410	2.44	
	1850	225	0.276	3.62	
	1915	250	0.250	4.00	
	1950	285	0.214	4.66	

TABLE A-1.31
CONSTANT HEAD TEST DATA FOR HOLE 35N-4 (MS)

Date	Time	Time Since Injection Started (min)	Discharge (Q, in GPM)	1/Q (min/gal)	Water Level (ft-mp)
4/09/80	1400				131.73
		T = 10.4°C Cond = 386 umhos/cm @ 25°C			
5/16/80	-	Saturated hole			
5/19/80	-	Saturated hole			
5/20/80	1450	Start test			
	1525	35	0.054	18.67	
	1545	55	0.054	18.67	
	1605	75	0.052	19.29	
	1640	110	0.051	19.56	
	1730	160	0.050	20.00	
	1852	242	0.049	20.33	

TABLE A-1.32
CONSTANT HEAD TEST DATA FOR HOLE 35N-5 (SS)

Date	Time	Time Since Injection Started (min)	Discharge (Q, in GPM)	1/Q (min/gal)	Water Level (ft-mp)
4/09/80	1510				23.64
		Started bailing			
		T = 9.0°C Cond = 171 umhos/cm @ 25°C			
		T = 9.0°C Cond = 428 umhos/cm @ 25°C			
		T = 8.9°C Cond = 543 umhos/cm @ 25°C			
5/15/80	1420				74.6
		Started bailing			
		T = 9.1°C Cond = 640 umhos/cm @ 25°C			
		Bailed nearly dry			
5/19/80	1433				80.2
		T = 11.8°C Cond = 732 umhos/cm @ 25°C			
5/20/80	2010	Started saturation			
5/21/80	9:40	Start test			
	1059	158	4.0×10^{-5}	24,920	
	1322	129	3.5×10^{-5}	28,725	
	1613	213	3.7×10^{-5}	26,876	

TABLE A-1.33
CONSTANT HEAD TEST DATA FOR HOLE 35N-6 (SS)

Date	Time	Time Since Injection Started (min)	Discharge (Q, in GPM)	1/Q (min/gal)	Water Level (ft-mp)
4/09/80	1600				86.70
		T = 9.0°C Cond = 841 umhos/cm @ 25°C			
		T = 8.9°C Cond = 858 umhos/cm @ 25°C			
		Bailed - ½ gal			
5/15/80	1359				86.87
		T = 9.8°C Cond = 769 umhos/cm @ 25°C			
		Sample taken			
5/16/80	0857				86.87
		T = 10.0°C , C = 904 umhos/cm @ 25°C			
		Sample taken			
		T = 10.5°C , C = 879 umhos/cm @ 25°C			
	0930	0	Start		
	1025	55	2.93	0.342	
	1056	86	1.90	0.525	
	1124	114	1.60	0.625	
	1202	152	1.20	0.833	
	1232	182	1.07	0.933	
	1300	210	1.00	1.000	
	1330	240	0.909	1.100	
	1355	265	0.858	1.165	
	1416	286	0.811	1.233	
	1437	307	0.828	1.21	

TABLE A-1.34
BAILING AND RECOVERY DATA FOR WELL 35N-7A (70SS)

Data	Time	t_1 (min)	t_2 (min)	t_3 (min)	t_4 (min)	$\frac{t_1 t_3}{t_2 t_4}$	Water Level (ft below mp)	Discharge (gpm)
5/15/80	0915						132.30	
5/19/80	1051						132.44	
	1056		Start bailing					
	1104		T = 10.9°C, C = 290 umhos/cm @ 25°C					
	1117		T = 11.1°C, C = 300 umhos/cm @ 25°C					0.48
	1136		T = 11.0°C, C = 390 umhos/cm @ 25°C					0.50
			Stop bailing					
	1138						132.58	
5/20/80	1625						132.3	
5/21/80	1150						132.3	
	1152						132.25	
	1340						132.24	
	1528						132.21	
	1545	0	Start bailing					
	1550	5	T = 11.0°C, C = 434 umhos/cm @ 25°C					0.54
	1603	18	T = 12.0°C, C = 463 umhos/cm @ 25°C					
	1610	25	T = 11.2°C, C = 452 umhos/cm @ 25°C					0.71
	1615	30	T = 11.5°C, C = 489 umhos/cm @ 25°C					0.73
	1625	40	T = 11.8°C, C = 452 umhos/cm @ 25°C					0.53
	1635	50	T = 12.0°C, C = 450 umhos/cm @ 25°C					0.49
	1650	65	T = 11.0°C, C = 468 umhos/cm @ 25°C					0.68
	1700	75	0	T = 11.0°C, C = 461 umhos/cm @ 25°C				0.79
	1740	115	40	0	T = 11.0°C, C = 414 umhos/cm @ 25°C			0.97
	1750	125	50	10	0	Stop bailing		
	1751	126	51	11	1	27.2	131.87	
	1755	130	55	15	5	7.1	132.27	
	1805	140	65	25	15	3.6	132.20	
	1810	145	70	30	20	3.1	132.19	
	1815	150	75	35	25	2.8	132.19	

Note: t_1 = Time since pumping started, first time
t_2 = Time since pumping stopped, first time
t_3 = Time since pumping started, second time
t_4 = Time since pumping stopped, second time

TABLE A-1.35
CONSTANT HEAD TEST DATA FOR HOLE 35N-7B (U70SS)

Date	Time	Time Since Injection Started (min)	Discharge (Q, in GPM)	1/Q (min/gal)	Water Level (ft-mp)
5/15/80	0925				Dry
5/19/80	-	Saturated hole			
5/20/80	1625	Saturated hole			
5/21/80	1040	Started test			
	1050	10	0.395	2.53	
	1110	30	0.288	3.47	
	1150	70	0.254	3.93	
	1237	117	0.250	4.00	
	1355	195	0.214	4.67	
	1548	308	0.214	4.67	
	1715	395	0.207	4.83	

TABLE A-1.36
CONSTANT HEAD TEST DATA FOR HOLE 35N-7C (SS)

Date	Time	Time Since Injection Started (min)	Discharge (Q, in GPM)	I/Q (min/gal)	Water Level (ft-mp)
4/09/80	1630				83.79
	Bailed - 1.5 gal	T = 8.9°C	Cond = 500 umhos/cm @ 25°C		
4/10/80	1343				83.76
5/15/80	0958				82.09
	Sample taken	T = 8.5°C	Cond = 530 umhos/cm @ 25°C		
	1105	Start permeability test			
	1132	27	1.71	0.583	
	1150	45	1.60	0.625	
	1212	67	1.60	0.625	
	1233	88	1.26	0.792	
	1336	151	0.80	1.25	
	1407	182	0.73	1.38	
	1441	216	0.65	1.54	
	1513	248	0.60	1.67	

TABLE A-1.37
CONSTANT HEAD TEST DATA FOR HOLE 35N-7D (E Coal)

Date	Time	Time Since Injection Started (min)	Discharge (Q, in GPM)	1/Q (min/gal)	Water Level (ft-mp)
5/15/80	0931				96.45
5/18/80	0911				97.39
		Bailed - ½ gal			
5/19/80	1101				97.6
	1154	Started bailing			
		T = 10.5°C Cond = 577 umhos/cm @ 25°C			
	1157	Bailed dry - 1 gal			
5/21/80	1150	Start saturation			
	1345	115	1.67	0.600	
	1450	180	1.41	0.708	
	1547	237	1.20	0.835	
	1715	325	1.20	0.835	
	1749	359	1.18	0.850	

TABLE A-1.38
CONSTANT HEAD TEST DATA FOR HOLE 35N-7E (SS)

Date	Time	Time Since Injection Started (min)	Discharge (Q, in GPM)	1/Q (min/gal)	Water Level (ft-mp)
4/03/80	1445				17.41
	Bailed nearly dry	T = 8.5°C	Cond = 380 umhos/cm @ 25°C		
4/09/80					17.56
	Bailed - 1.5 gal	T = 8.0°C	Cond = 360 umhos/cm @ 25°C		
4/10/80	1338				17.65
5/15/80	0953				18.90
	Sample taken	T = 9.5°C	Cond = 370 umhos/cm @ 25°C		
	1042	Permeability test started			
	1046	4	0.022	45.2	
	1105	23	0.016	61.5	
	1135	53	0.015	64.7	
	1155	73	0.014	69.4	
	1227	105	0.015	67.8	
	1256	134	0.014	69.4	
	1357	195	0.015	67.8	
	1436	234	0.014	72.6	
	1503	261	0.014	72.6	
	1542	300	0.014	74.1	

TABLE A-1.39
CONSTANT HEAD TEST DATA FOR HOLE 35N-7F (MS)

Date	Time	Time Since Injection Started (min)	Discharge (Q, in GPM)	I/Q (min/gal)	Water Level (ft-mp)
4/03/80	1435				13.82
	Bailed - 2 gal	T = 7.0°C	Cond = 410 umhos/cm @ 25°C		
4/09/80	1620				13.80
	Bailed - 1 gal	T = 6.8°C	Cond = 390 umhos/cm @ 25°C		
4/10/80	1336				14.10
5/15/80	0951	T = 8.0°C	Cond = 390 umhos/cm @ 25°C		14.97
		Sample taken			
	1050	Permeability test started			
	1056	6	0.007	139	
	1129	39	0.006	158	
	1148	58	0.006	164	
	1221	91	0.006	177	
	1249	119	0.005	192	
	1350	180	0.006	183	
	1430	220	0.006	183	
	1456	246	0.005	196	
	1536	286	0.005	186	