0050

ACT/007/007 #2

jbr CONSULTANTS GROUP

GEOLOGY ENGINEERING ENVIRONMENT HYDROLOGY

May 20, 1986

RECEIVED
MAY 20 1986
DIVISION OF
OIL, GAS & MINING

Mr. John Whitehead
Permit Supervisor
Division of Oil Gas and Mining
Utah Department of Natural Resources
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203

RE: Kaiser Coal Corporation, Sunnyside No. 5 Proposed Permit Area, Carbon County, Utah

Dear John:

Enclosed please find a duplicate copy of the items that were sent to your office on April 25 for review by your staff. We would appreciate it if the review of this material could be accomplished within the next couple of weeks so that we can have your staff's input prior to installing surface water monitoring points. We plan to initiate the seep and spring survey and surface water work on May 27. Your staff is most welcome to accompany our personnel in the field. We would appreciate it if you would provide us with three or four working days notice prior to the initial field session with our crews. In addition, we request that DOGM personnel not plan to accompany us during the first few days of field work; we will be involved with working out logistics and crew orientation during this time.

I believe that the accompanying materials will answer all questions that you or your staff might have. We plan to follow DOGM "Guidelines for Establishment of Surface and Ground Water Monitoring Programs for Coal Mining and Reclamation Operations" throughout all phases of preparation of the surface and groundwater sections of the PAP.

If you have any questions regarding any of these matters please contact me.

Sincerely,

R. J. Bayer

Robert J. Bayer
Vice President

Principal Office:
1841 East Fort Union Blvd.
Salt Lake City, Utah 84121
1-801-943-4144

Cedar City Office:
865 South Cedar Knolls West
Cedar City, Utah 84720
1-801-586-8793

jbr CONSULTANTS GROUP

GEOLOGY ENGINEERING ENVIRONMENT HYDROLOGY

April 25, 1986

RECEIVED
MAY 20 1986
DIVISION OF
OIL, GAS & MINING

Mr. John Whitehead
Permit Supervisor
Division of Oil Gas and Mining
Utah Department of Natural Resources
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203

RE: Kaiser Coal Corporation, Sunnyside No. 5 Proposed Permit Area, Carbon County, Utah

Dear John:

During our telephone conversation earlier this week you requested that we send you certain information for review by you and your staff prior to our meeting scheduled for May 6 at 1:30 P.M. This meeting has been arranged for the purpose of reviewing with you our plans and methodologies for the upcoming seep and spring survey and surface water sampling work in the Sunnyside No. proposed permit area. The information that you requested is enclosed and is as follows:

1) a map showing the locations of seeps and springs observed during our Fall, 1985 survey and tentative surface water sampling sites;
2) a table summarizing the results of last fall's seep and spring survey;
3) a report summarizing available geologic and hydrologic data that also discusses methodologies for gathering additional data;
4) the results of laboratory analyses on samples taken from selected springs last fall.

We hope this information will be sufficient to meet your needs. Please call either myself or Brian Buck if you have any questions regarding this matter.

Sincerely,

R. J. Bayer

Robert J. Bayer
Vice President

Principal Office:
1841 East Fort Union Blvd.
Salt Lake City, Utah 84121
1-801-943-4144

Cedar City Office:
865 South Cedar Knolls West
Cedar City, Utah 84720
1-801-586-8793

RECEIVED
MAY 20 1986
DIVISION OF
OIL, GAS & MINING

Table 1. Results of seep and spring inventory in the permit revision and adjace

Site Number	Flow (gpm)	pH (Units)	Specific Cond.[a]	Temp. (°C)	Geology	Use
K-1	<1	6.41	1176	12	From sandstone/shale interface in roadcut in North Horn Fm.	Deer, bobcat
K-2	6	6.32	426	7	From sandstone/shale interface in the Green River Fm.	Deer, cattle
K-3	7	6.57	554	7	From head scarp of landslide at Green River/Colton Fms. contact	Deer
K-4	Ø	(b)	(b)	(b)	From landslide at contact of Green River and Colton Fms.	None
K-5	2	6.94	554	6	From sandstone bedding plane in Colton Fm.	Deer
K-6	1	7.58	37Ø	4	From near toe of landslide in Colton Fm.	None
K-7	5	7.45	161Ø	8	Colluvium over sandstone in the North Horn Fm.	Deer, cattle
K-8	Ø	(b)	(b)	(b)	Colluvium over sandstone in the Colton Fm.	None
K-9	Ø	(b)	(b)	(b)	From landslide underlain by Colton Fm.	None
K-1Ø	5	6.7Ø	47Ø	7	From sandstone/shale interface at base of Green River Fm.	Deer, cattle

Table 1. (Continued).

Site Number	Flow (gpm)	pH (Units)	Specific Cond.[a]	Temp. (°C)	Geology	Use
K-11	3	6.69	582	5	From fractured sandstone in the Colton Fm.	Cattle, wildlife
K-12	4	7.04	1015	7	From sandstone/shale interface in the Colton Fm.	Cattle, wildlife
K-13	5	7.02	1318	7	From sandstone/shale interface near Green River/Colton contact	Deer, cattle
K-14	2	7.22	1253	9	From landslides sandstone/shale interface of the North Horn Fm.	Deer, cattle
K-15	<1	7.50	1501	12	From landslide in sandstone of the North Horn Fm.	Deer, cattle
K-16	3	7.70	535	7	From fractured sandstone in the Colton Fm.	None
K-17	4	7.11	650	8	From colluvium over sandstone of the North Horn Fm.	Deer, cattle
K-18	<1	6.98	859	8	From alluvium in stream channel over North Horn Fm.	Deer, cattle
K-19	1	6.91	784	9	From alluvium in stream channel over North Horn Fm.	None
K-20	1	6.92	1781	10	From sandstone/shale interface in the North Horn Fm.	Cattle

Table 1. (Continued).

Site Number	Flow (gpm)	pH (Units)	Specific Cond.[a]	Temp. (°C)	Geology	Use
K-21	2	7.22	495	5	From fractured sandstone in the Colton Fm.	Deer
K-22	<1	(b)	(b)	(b)	From sandstone bedding plane in the Colton Fm.	None
K-23	<1	(b)	(b)	(b)	From fractured sandstone in the Colton Fm.	None
K-24	2	7.06	784	8	From colluvium over sandstone of the Colton Fm.	Wildlife
K-25	1	7.06	770	7	From colluvium over sandstone of the Colton Fm.	Wildlife
K-26	<1	7.20	546	11	From fractured sandstone in the Blackhawk Fm.	None
K-27	2	7.27	899	7	From colluvium over sandstone/ shale of the Colton Fm.	Wildlife
K-28	0	(b)	(b)	12	From alluvium in stream channel over the Colton Fm.	None
K-29	4	7.60	638	10	From sandstone/shale interface in the Colton Fm.	None
K-30	<1	7.70	927	8	From slide block over shale in the Colton Fm.	Deer

Table 1. (Continued).

Site Number	Flow (gpm)	pH (Units)	Specific Cond.[a]	Temp. (°C)	Geology	Use
K-31	<1	(b)	(b)	(b)	From landslide over sandstone/ shale unit in the Colton Fm.	Deer
K-32	<1	(b)	(b)	(b)	From colluvium at contact of the Green River and Colton Fms.	Cattle, deer
K-33	<1	(b)	(b)	(b)	From colluvium at contact of the Green River and Colton Fms.	Deer
K-34	<1	(b)	(b)	(b)	From colluvium at contact of the Green River and Colton Fms.	Deer
K-35	2	7.61	885	6	From colluvium over sandstone of the Colton Fm.	Wildlife
K-36	4	8.42	570	9	From small stream fed by seeps at site K-32.	Wildlife
K-37	2	8.01	818	6	From debris flow over sandstone of the Colton Fm.	Small game
K-38	7	8.50	560	5	From headscarp at base of sandstone cliff in Colton Fm.	Deer, beaver
K-39	2	7.60	1590	8	From colluvium over sandstone of the Price River Fm.	Wildlife
K-40	1	7.90	586	10	From colluvium near sandstone/ shale interface in Colton Fm.	Deer

Table 1. (Continued).

Site Number	Flow (gpm)	pH (Units)	Specific Cond.[a]	Temp. (°C)	Geology	Use
K-41	-1	8.05	700	5	From alluvium in stream channel over Colton Fm.	Wildlife, cattle
K-42	-1	7.80	585	10	From saturated soils covering probable bedding plane source in sandstone of the Green River Fm.	Cattle, wildlife
K-43	-1	7.70	748	12	From saturated soils covering probable bedding plane source in sandstone of the Green River Fm.	Cattle, wildlife
K-44	-1	7.75	568	11	From saturated soils covering probable bedding plane source in sandstone of the Green River Fm.	Cattle, wildlife
K-45	-1	7.90	507	12	From slumped soils covering probable bedding plane source in sandstone of the Green River Fm.	Cattle, wildlife

Table 1. (Continued).

Site Number	Flow (gpm)	pH (Units)	Specific Cond.[a]	Temp. (°C)	Geology	Use
K-46	-1	8.05	928	12	From medial scarp in landslide over sandstone-dominant section of the Green River Fm.	Cattle, wildlife
K-47	3	7.69	630	9	From probable sandstone/shale interface in the Green River Fm.	Cattle, wildlife
K-48	3	8.30	564	11	From road fill at probable sandstone/shale interface in the North Horn Fm.	Deer, cattle
K-49	-1	7.80	711	4	From colluvial soils over shale/sandstone interface in Colton Fm.	Wildlife, cattle
K-50	1	7.90	581	5	From soil/sandstone bedrock interface in the Colton Fm.	Cattle
K-51	2	7.70	561	6	From soil/sandstone bedrock interface in the Colton Fm.	Cattle

Table 1. (Continued).

Site Number	Flow (gpm)	pH (Units)	Specific Cond.[a]	Temp. (°C)	Geology	Use
K-52	4	8.20	695	8	From colluvium immediately above stream channel in the Colton Formation.	Cattle, deer, beaver
K-53	4	8.40	629	9	From colluvium immediately above stream channel in the Colton Fm.	Cattle
K-54	3	8.40	548	8	From colluvium in small drainage in the Colton Fm.	Cattle, wildlife
K-55	-1	7.60	700	8	From saturated soil above alluvium over lying the Colton Fm.	Cattle, wildlife
K-56	-1	8.50	576	6	From saturated soil above alluvium overlying the Colton Fm.	Cattle, wildlife
K-57	-1	8.00	720	7	From colluvium/alluvium contact overlying the Colton Fm.	Cattle, wildlife
K-58	-1	8.40	498	2	From seep in colluvium and landslide debris overlying the Colton Fm.	Wildlife

Table 1. (Continued).

Site Number	Flow (gpm)	pH (Units)	Specific Cond.[a]	Temp. (°C)	Geology	Use
K-59	-1	8.50	422	2	From same seep as site K-58.	Wildlife
K-60	14	8.10	513	6	From fractured sandstone of the Colton Fm.	Wildlife
K-61	3	7.90	582	5	From soil/sandstone bedrock contact in the Colton Fm.	Wildlife, cattle
K-62	1	8.50	499	4	From alluvium/colluvium in drainage overlying the Colton Fm.	Wildlife
K-63	-1	8.50	495	3	From colluvium and alluvium in drainage overlying the Colton Formation.	Wildlife
K-64	-1	7.30	2470	12	From colluvium/alluvium in drainage overlying the Mancos Fm.	Wildlife
K-65	-1	8.20	2120	7	From probable sandstone/shale contact in the Price River Fm.	Deer, Bear
K-66	3	8.60	2220	9	From alluvium in stream channel overlying the Price River Fm.	Deer, bear

Table 1. (Continued).

Site Number	Flow (gpm)	pH (Units)	Specific Cond.[a]	Temp. (°C)	Geology	Use
K-67	-1	7.40	2160	8	From colluvium overlying interbedded shales and sandstones of the Price River Fm.	Wildlife
K-68	2	8.10	1310	5	From soil/sandstone bedrock contact in the price River Fm.	Wildlife, possible cattle
K-69	5	7.90	1385	8	From fractured sandstone in the Price River Fm.	Wildlife, possible cattle
K-70	3	8.00	1649	11	From fractured sandstone in the Price River Fm.	Wildlife, possible cattle
K-71	8	7.70	1368	9	From fractured sandstone in the Price River Fm.	Wildlife

(a) specific conductivities are reported in micro-mohs at 25 °C.

(b) seep flow was insufficient to allow determination of pH, conductivity, or temperature.

RECEIVED
MAY 20 1986
DIVISION OF
OIL, GAS & MINING

SUMMARY OF AVAILABLE AND PROPOSED GEOLOGIC AND HYDROLOGIC DATA SUNNYSIDE NO. 5 MINE PAP

Prepared for

KAISER COAL CORPORATION

Prepared by

JBR CONSULTANTS GROUP
2556 E. Oak Creek Circle
Sandy, Utah

1.0 GEOLOGIC DATA

The local and regional geology for the Sunnyside No. 5 permit area will be described using both published and non-published geologic data. Published data sources will be:

Economic Geology of the Castlegate, Wellington, and Sunnyside quadrangles, Carbon County, Utah (Clark, 1928)

Geology of Central Utah Coal Fields; Book Cliffs (Doelling, 1972)

Observations on the Sunnyside Coal Zone (Doelling, 1981)

Preliminary Lithologic and Structural Map of Sunnyside No. 1 Mine Area, Carbon County, Utah (Osterwald, 1962)

Bedrock, Surficial and Economic Geology of the Sunnyside Coal-Mining District, Carbon and Emery Counties, Utah (Osterwald, et. al., 1981)

Geology of the Single-Entry Project at Sunnyside Coal Mines 1 and 2, Sunnyside, Utah (Scheibner, 1979)

Coal Resource Occcurence and Coal Development Potential Maps of the Sunnyside Quadrangle, Carbon County, Utah (U.S.G.S. Open File Report 79-491)

Coal Resource Occurence and Coal Development Potential Maps of the Patmos Head Quadrangle, Carbon County, Utah (U.S.G.S. Open File Report 79-492)

Final Environmental Impact Statement, Development of Coal Resources in Central Utah (U.S. Geological Survey, 1979)

Stratigraphy of Coal-Bearing Rocks of Book Cliffs, Utah, Colorado (Young, 1966)

Unpublished data and various government agency submittals from Kaiser Coal Corporation

Stratigraphy and structural geology will be described in both a regional and local context.

1.1 Geologic Mapping.

Surface geologic maps for the area are available in Osterwald (1981) and Doelling (1972). The outcrop patterns of exposed geologic units and a number of faults with unknown displacement are shown on the maps.

These existing geologic maps will be enlarged and traced onto 7 1/2' topographic bases (1:24,000 scale). Osterwld's map will be used to prepare a geologic map of the permit area, using Doellings map as needed to help in placing contacts and faults. Placement of stratigraphic contacts on the larger scale map will be verified by study of color aerial photo graphs. A series of reconnaissance level geologic mapping traverses will be made across the Sunnyside No. 5 area as necessary to confirm the interpretation of surficial geology made by enlarging Osterwald's map and examining the available photography. In addition, the stratigraphic nomenclature used by Osterwald (1981) will be applied, to the extent possible, to the interpretation of logs from available drill holes in the new permit area (see Section 1.2). Where possible, surface contacts in areas between mapping traverses will be verified by projecting stratigraphic contacts identified in drill holes to the surface. Lines of geologic cross sections and drill hole locations will also be shown on this map.

The mapping traverse locations will be selected based upon the following criteria:

- outcrop exposure
- accesibility to foot travel
- existence of data gaps need for additional data
- the need to confirm stratigraphic occurences of seeps and springs

1.2 Stratigraphic Data

Lithologic logs and locations for nine exploratory holes drilled in A, B, C, and Bear Canyons and an unnamed canyon north of Bear Canyon are available from the records of Kaiser Coal Corporation and the Utah Geological and Mineral Survey (U.G.M.S.). In addition, logs from nine other holes drilled in Whitmore Canyon are available from these same sources. It is also likely that additional drill hole data from Rock Canyon and its side canyons, which comprise the north end of the proposed permit area, may exist in U.G.M.S., Kaiser Coal, or U.S. BLM records, but this has not yet been verified.

These data will be used to compile a statigraphic column and geologic cross sections in the Sunnyside No. 5 permit area. Also, where applicable, detailed lithologic and stratigraphic data available in measured outcrop sections on file with the U.G.M.S. will be used to supplement the drill hole data during geologic interpretation. Cross sections and lithologic descriptions will be as detailed as the available data allow. The cross sections will be used in support of both the geologic and hydrologic chapters of the PAP.

To provide rock strength information on the overburden strata, hand samples of the major sandstone units will be obtained from the outcrops and tested for uniaxial strength via the point-load method.

1.3 Coal Reserves

Coal reserve calculations for the Sunnyside No. 5 Mine that have been prepared by the Kaiser Coal Corporation will be used to present coal reserves in the PAP.

1.4 Coal Quality Data

Coal quality data from the existing Sunnyside Mine as well as that obtained from cores.

This data will be supplemented by coal quality data that is available in the files of the U.G.M.S.

1.5 Overburden Thickness and Lithology

An overburden isopach map for the Sunnyside No. 5 area will be prepared using the previously mentioned outcrop and drill hole data. The lithologies comprising the overburden will be described through narrative and geological cross sections.

1.6 Roof and Floor Characteristics

Roof and floor analyses from the Sunnyside Mine will be used to describe the clay contents and pyritic sulfur contents of the roof and floor in the adjacent Sunnyside No. 5 permit

area.

1.7 Adequacy of Available Data

The geologic data available for the proposed Sunnyside No. 5 Mine, augmented as necessary by air photo analysis and geologic mapping traverses, is considered adequate for the purposes of preparation of the "Geology" chapter of the B Canyon PAP. Requirements for additional geohydrologic data are described below.

1.8 References

Clark, F.R., 1928, Economic geology of Castlegate, Wellington and Sunnyside quadrangles, Carbon County, Utah: U.S. Geological Survey Bull. 793.

Doelling, H.H., 1972, Central Utah Coal Fields: Book Cliffs, Monograph No. 3, Utah Geological and Mineral Survey, Salt Lake City, Utah.

Doelling, H.H., et. al., 1979, Observations on the Sunnyside Coal Zone, Coal Studies, Special Studies 49, Utah Geological and Mineral Survey, Salt Lake City.

Osterwald, F.W., 1962, Preliminary lithologic and structural map of Sunnyside No. 1 area, Carbon County, Utah, showing coal outcrops: U.S. Geological Survey Coal Investigations Map C-50.

Osterwald, F.W., Mayberry, J.O., and Dunrud, C.R., 1981, Bedrock, Surficial, and Economic Geology of the Sunnyside Coal Mining District, Carbon and Emery Counties, Utah, U.S. Geological Survey Professional Paper 1166, Washington, D.C.

Scheibner, Barbee J., 1979, Geology of the Single-Entry Project at Sunnyside Coal Mines 1 and 2, Sunnyside, Utah, R.I.-8402, Bureau od Mines Report of Investigations, ashington, D.C.

U.S. Geological Survey, 1979, Coal Resource Occurence and Coal Development Potential Maps of the Sunnyside Quadrangle, Carbon County, Utah, U.S. Geological Survey Open File Report 79-491, Washington, D.C.

U.S. Geological Survey, 1979, Coal Resource Occurence and Coal Development Potential Maps of the Patmos Head Quadrangle, Carbon County, Utah, U.S. Geological Survey

Open File Report 79-492, Washington, D.C.

U.S. Geological Survey, 1979, Final Environmental Impact Statement, Development of Coal Resources in Central Utah, U.S. Geological Survey, Washington, D.C.

Young, R.G., 1966, Stratigraphy of Coal-Bearing Rocks of Book Cliffs, Utah, Colorado, in Central Utah Coals, Utah Geological and Mineral Survey Bulletin 80, Salt Lake City, Utah.

2.Ø HYDROLOGIC DATA

Regional surface water and groundwater conditions will be described from the following and published and non-published sources:

Kaiser Coal Corporation's Sunnyside Mine and B Canyon PAP submittals.

Hydrologic Reconnaissance of the Wasatch Plateau - Book Cliffs Coal Field Area, Utah (U.S. Geological Survey)

Final Environmental Impact Statement, Development of Coal Resources in Central Utah (U.S. Geological Survey)

Hydrologic Reconnaissance of the Southern Uintah Basin (Utah Dept. of Natural Res.)

Kaiser records relating to mine water inflows, shaft construction, and surface water monitoring.

2.1 Groundwater

Data currently available as well as additional data requirements for describing existing groundwater conditions in the Sunnyside No.5 permit area are presented below.

2.1.1 Available Data. Data describing current groundwater conditions is available from the following sources:

A seep and spring inventory conducted in October, 1985 by JBR that covered most of the proposed mine plan area;

Water quality and quantity monitoring data from two springs, including 3 samples taken at one month intervals during summer of 1985 by Kaiser;

Reports of the first appearance of groundwater in old exploration drill holes are available in driller's logs.

Sunnyside mine water inflow records.

Groundwater data from the Sunnyside mine will be useful in projecting groundwater conditions in the Sunnyside No. 5 permit area. Mine discharge rates and in-mine groundwater quality and quantity monitoring data soon to be collected by Kaiser from 13 permanent monitoring stations in the Sunnyside mine comprise this data base. These data will be used to help determine

the geohydrologic controls on the mine water inflow.

2.1.2 Additional Data Sources. The following additonal data are intended to be collected to complete the data base of existing groundwater conditions:

Extension of the 1985 seep and spring survey area to the north to cover the entire proposed mine permit area plus a one-mile periphery. This will be done for the Spring 1986 seep and spring survey.

Extension of the seep and spring survey to the south to cover the northwest slopes of Whitmore Canyon above the existing Sunnyside Mine workings. This will be done to determine what mining impacts, if any, can be expected on the seeps and springs in the No. 5 Mine area by comparing the relative occurrence of groundwater discharges between the two areas. Observations of the surface evidences of subsidence will also be recorded during this field work.

Completion of a Spring 1986 seep and spring survey over the balance of the permit area in conjunction with the above-mentioned additional sampling;

Investigation of the occurrence of groundwater inflow to the present service shaft. This will be done by conducting a detailed survey of the water production zones exposed on the shaft walls and gauging the inflow to the shaft sump. The construction records for this and the other shafts on the property will also be reviewed to extract any pertinent information on geology and groundwater.

An in-mine groundwater inflow study to augment, as needed, current mine records. This study would map and describe the geologic and hydrologic characteristics of all points of groundwater inflow in the existing Sunnyside mine workings. The objective of this work will be to determine the geohydrologic controls on inflow and relate these to the local hydrologic setting.

2.1.3 Groundwater Development and Mine De-watering. An assessment of the impact upon groundwater by development and dewatering of the Sunnyside No. 5 Mine will be made by analogy with data from the existing Sunnyside operations.

2.1.4 Mitigation and Control Plans. Mitigation and control plans for the Sunnyside No. 5 mine will be developed using all available geologic and hydrologic data plus information on the position of the coal seam, Sunnyside No. 5 mine plans and water inflow and discharge rates from the Sunnyside mine. The mitigation and control plans for the PAP will be adjusted as necessary by the end of the year using data gathered from the 1986 field season work.

2.1.5 Groundwater Monitoring Plan. Water samples from 11 springs in the Sunnyside No. 5 permit area were taken in early November, 1985. These samples were analyzed for all required water quality parameters (see Table 1). Data from these sites and from potential additional sites in the expanded survey area will be discussed with the Division following the Spring 1986 seep and spring inventory. Following mutual selection of any additional monitoring points, these additional points will also be monitored for water quality and discharge rates. These monitoring stations will serve as both initial and operational monitoring points for the Sunnyside No. 5 mine. These stations will be monitored four times at one month intervals during the 1986 field season and at this same interval annually during operational monitoring. It is assumed that operational monitoring of selected springs and seeps will only occur when the underground mine workings are close enough to the springs to have a potential affect.

An in-mine monitoring plan similar to that now being established in the existing Sunnyside mines will be designed in concept for the Sunnyside No. 5 area PAP.

Table 1. Water Monitoring Parameters.

Field Parameters:

Dissolved Oxygen (a)
Flow
pH
Specific Conductance
Temperature

Laboratory Analyses:

Aluminum
Ammonia (NN_3)
Arsenic
Barium
Bicarbonate
Boron
Cadmium
Calcium
Carbonate
Chloride

Chromium
Copper
Fluoride
Iron (dissolved)
Lead
Magnesium
Manganese
Mercury
Molybdenum
Nickel

Nitrate (NO_3)
Nitrite (NO_2)
Oil and Grease
Phosphate (PO_4)
Potassium
Selenium
Sodium
Sulfate
Sulfide
TDS

Total Hardness ($CaCO_3$)
Total Settleable Solids (a)
Total Suspended Solids (a)
Zinc

(a) Surface water only

2.2 Surface Water Hydrology

2.2.1 **Existing Surface Water Conditions.** Local surface water conditions will be described using monitoring data available from Kaiser Coal Corporation for the stream in Whitmore Canyon. Surface water conditions are adequately understood in Whitmore Canyon as the result of this monitoring which is associated with the existing Sunnyside mine. Mining in the Sunnyside No. 5 permit area will not affect the stream in Whitmore Canyon since the planned subsidence boundary is west of the stream channel. During the 1986 field program, sampling stations at one or two locations along the creek upstream from Grassy Trail Resevoir will be established to augment the present understanding of the surface hydrology of this stream.

Three intermittent to perennial streams are known in canyons along the Book Cliffs in the Sunnyside No. 5 permit area. One occurs in the upper reaches of the right fork of C Canyon, which is the canyon located immediately north of B Canyon. The stream in Bear Canyon exhibited flow in one or more channel segments during the November, 1986 water quality sampling program. Flow was observed coming from the right fork of Rock Canyon in January, 1986. U.S.G.S. topographic maps indicate that the streams in Rock and Bear Canyons flow for more than 1/2 of the year, therefore they could be considered perennial (subject to verification from on-site observations). A survey of the stream flow conditions in these channels will be conducted in conjuction with the seep and spring survey planned for the Spring of 1986. This work will include recording the length of the channels involved in the flow, locating and describing potential quantity and quality monitoring stations in the most appropriate locations, and obtaining water samples from these points. Water flow measurements will be conducted with a current meter or by other measurement of flow cross-section and velocity. Prior to establishing the monitoring stations, the initial inventory data will be reviewed with the Division of Oil, Gas and Mining

These data will be used to characterize the surface water conditions in the Book Cliffs side of the Sunnyside No. 5 permit area.

2.2.2 **Surface Water Development and Control, Effects of Mining on Surface Water, Mitigation and Control Plans, and Surface Water Monitoring Plan.** Sufficient data for preparation of these plans will be generated from the available and yet to be collected data that has been discussed above as well as from the mine plan that will be prepared as part of the PAP.

2.3 References

Kaiser Steel Corporation, 1984, Application for an Underground Coal Mine Permit, Kaiser Steel Corporation, Sunnyside Mines, Carbon County, Utah.

U.S. Geological Survey, 1979, Final Environmental Impact Statement, Development of Coal Resources in Central Utah, U.S. Geological Survey, Washington, D.C.

U.S. Geological Survey, 1981, Hydrologic Reconaissance of the Wasatch Plateau - Book Cliffs Coal Field Area, Utah, U.S. Geological Survey Water Supply Paper 2068, Washington, D.C.

Utah Dept. of Natural Resources, 1975, Hydrologic Reconnaissance of the Southern Uintah Basin, Utah and Colorado, Technical Publication No. 49.

CHEMTECH
28 EAST 1500 NORTH
OREM, UTAH 84057
(801) 226-8822

RECEIVED
MAY 20 1986
DIVISION OF
OIL, GAS & MINING

CERTIFICATE OF ANALYSIS

SAMPLE IDENTIFICATION

CLIENT: JBR Consultants
2556 East Oak Creek Circle
Sandy, UT 84092

LAB NO.: U009214

DATE SAMPLED: 11-5-85

TIME SAMPLED: 1530

SAMPLED BY: Martz

LOCATION: EWL-1 K-1

COMMENTS: metals - dissolved

PARAMETER	LEVEL
Alkalinity as $CaCO_3$, mg/l	426
Ammonia as NH_3-N, mg/l	<.1
Arsenic as As, mg/l	<.01
Barium as Ba, mg/l	0.120
Bicarbonate as HCO_3, mg/l	519
Boron as B, mg/l	0.41
Cadmium as Cd, mg/l	<.005
Calcium as Ca, mg/l	43.8
Carbonate as CO_3, mg/l	0
Sulfide as S, mg/l	<.05
Molybdenum as Mo, mg/l	<.005

PARAMETER	LEVEL
Chloride as Cl, mg/l	8.8
Chromium as Cr (Hex.), mg/l	<.005
Chromium as Cr (Total), mg/l	<.005
Conductivity, umhos/cm	1330
Copper as Cu, mg/l	0.013
Fluoride as F, mg/l	0.32
Hardness as $CaCO_3$, mg/l	496
Hydroxide as OH, mg/l	0
Iron as Fe (Dissolved), mg/l	0.035
Iron as Fe (Total), mg/l	--
Lead as Pb, mg/l	0.081
Magnesium as Mg, mg/l	73.9
Manganese as Mn, mg/l	0.008
Mercury as Hg, mg/l	0.0008
Nickel as Ni, mg/l	0.005
Nitrate as NO_3-N, mg/l	0.78
Nitrite as NO_2-N, mg/l	0.011
Phosphate as PO_4-P, mg/l	0.060
Potassium as K, mg/l	4.23
Selenium as Se, mg/l	0.002
Silica as SiO_2 (Dissolved), mg/l	6.97
Silver as Ag, mg/l	<.005
Sodium as Na, mg/l	166
Sulfate as SO_4, mg/l	396
Total Dissolved Solids, mg/l	1060
Turbidity, NTU	--
Zinc as Zn, mg/l	0.08
pH Units	8.05

Roy Henderson
CHEMTECH

CHEMTECH
28 EAST 1500 NORTH
OREM, UTAH 84057
(801) 226-8822

CERTIFICATE OF ANALYSIS

SAMPLE IDENTIFICATION

CLIENT: JBR Consultants
2556 East Oak Creek Circle
Sandy, UT 84092

LAB NO.: U009215

DATE SAMPLED: 11-15-85

TIME SAMPLED: 1545

SAMPLED BY: EWL

LOCATION: EWL-3 K-3

COMMENTS: metals - dissolved

PARAMETER	LEVEL
Alkalinity as $CaCO_3$, mg/l	209
Ammonia as NH_3-N, mg/l	0.61
Arsenic as As, mg/l	<.01
Barium as Ba, mg/l	0.170
Bicarbonate as HCO_3, mg/l	255
Boron as B, mg/l	0.24
Cadmium as Cd, mg/l	<.005
Calcium as Ca, mg/l	29.2
Carbonate as CO_3, mg/l	0
Sulfide as S, mg/l	<.05
Molybdenum as Mo, mg/l	<.005

PARAMETER	LEVEL
Chloride as Cl, mg/l	10.2
Chromium as Cr (Hex.), mg/l	<.005
Chromium as Cr (Total), mg/l	<.005
Conductivity, umhos/cm	470
Copper as Cu, mg/l	0.015
Fluoride as F, mg/l	0.06
Hardness as $CaCO_3$, mg/l	221
Hydroxide as OH, mg/l	0
Iron as Fe (Dissolved), mg/l	0.093
Iron as Fe (Total), mg/l	--
Lead as Pb, mg/l	0.010
Magnesium as Mg, mg/l	26.1
Manganese as Mn, mg/l	0.075
Mercury as Hg, mg/l	<.0002
Nickel as Ni, mg/l	<.005
Nitrate as NO_3-N, mg/l	0.02
Nitrite as NO_2-N, mg/l	<.005
Phosphate as PO_4-P, mg/l	<.01
Potassium as K, mg/l	1.15
Selenium as Se, mg/l	0.002
Silica as SiO_2 (Dissolved), mg/l	18.59
Silver as Ag, mg/l	<.005
Sodium as Na, mg/l	20.6
Sulfate as SO_4, mg/l	21.0
Total Dissolved Solids, mg/l	298
Turbidity, NTU	--
Zinc as Zn, mg/l	0.11
pH Units	7.65

CHEMTECH

CHEMTECH
28 EAST 1500 NORTH
OREM, UTAH 84057
(801) 226-8822

CERTIFICATE OF ANALYSIS

SAMPLE IDENTIFICATION

CLIENT: JBR Consultants
2556 East Oak Creek Circle
Sandy, UT 84092

LAB NO.: U009208

DATE SAMPLED: 11-6-85

TIME SAMPLED: 1500

SAMPLED BY: Martz

LOCATION: AM-10 K-13

COMMENTS: metals - dissolved

PARAMETER	LEVEL
Alkalinity as $CaCO_3$, mg/l	375
Ammonia as NH_3-N, mg/l	0.26
Arsenic as As, mg/l	0.011
Barium as Ba, mg/l	0.075
Bicarbonate as HCO_3, mg/l	457
Boron as B, mg/l	0.40
Cadmium as Cd, mg/l	<.005
Calcium as Ca, mg/l	45.6
Carbonate as CO_3, mg/l	0
Sulfide as S, mg/l	<.05
Molybdenum as Mo, mg/l	0.008

PARAMETER	LEVEL
Chloride as Cl, mg/l	14.8
Chromium as Cr (Hex.), mg/l	<.005
Chromium as Cr (Total), mg/l	<.005
Conductivity, umhos/cm	1420
Copper as Cu, mg/l	0.015
Fluoride as F, mg/l	0.51
Hardness as $CaCO_3$, mg/l	548
Hydroxide as OH, mg/l	0
Iron as Fe (Dissolved), mg/l	0.068
Iron as Fe (Total), mg/l	--
Lead as Pb, mg/l	0.018
Magnesium as Mg, mg/l	85.6
Manganese as Mn, mg/l	<.005
Mercury as Hg, mg/l	0.0014
Nickel as Ni, mg/l	<.005
Nitrate as NO_3-N, mg/l	0.14
Nitrite as NO_2-N, mg/l	<.005
Phosphate as PO_4-P, mg/l	0.011
Potassium as K, mg/l	3.63
Selenium as Se, mg/l	0.010
Silica as SiO_2 (Dissolved), mg/l	9.62
Silver as Ag, mg/l	<.005
Sodium as Na, mg/l	170
Sulfate as SO_4, mg/l	412
Total Dissolved Solids, mg/l	1100
Turbidity, NTU	--
Zinc as Zn, mg/l	0.00
pH Units	7.79

CHEMTECH

CHEMTECH
28 EAST 1500 NORTH
OREM, UTAH 84057
(801) 226-8822

CERTIFICATE OF ANALYSIS

SAMPLE IDENTIFICATION

CLIENT: JBR Consultants
2556 East Oak Creek Circle
Sandy, UT 84092

LAB NO.: U009216

DATE SAMPLED: 11-6-85

TIME SAMPLED: 1315

SAMPLED BY: EWL

LOCATION: EWL-6 K-17

COMMENTS: metals - dissolved

PARAMETER	LEVEL
Alkalinity as $CaCO_3$, mg/l	245
Ammonia as NH_3-N, mg/l	0.34
Arsenic as As, mg/l	0.012
Barium as Ba, mg/l	0.035
Bicarbonate as HCO_3, mg/l	299
Boron as B, mg/l	1.20
Cadmium as Cd, mg/l	<.005
Calcium as Ca, mg/l	13.1
Carbonate as CO_3, mg/l	0
Sulfide as S, mg/l	<.05
Molybdenum as Mo, mg/l	<.005

PARAMETER	LEVEL
Chloride as Cl, mg/l	16.7
Chromium as Cr (Hex.), mg/l	<.005
Chromium as Cr (Total), mg/l	<.005
Conductivity, umhos/cm	600
Copper as Cu, mg/l	<.005
Fluoride as F, mg/l	0.25
Hardness as $CaCO_3$, mg/l	282
Hydroxide as OH, mg/l	0
Iron as Fe (Dissolved), mg/l	0.043
Iron as Fe (Total), mg/l	--
Lead as Pb, mg/l	0.013
Magnesium as Mg, mg/l	35.2
Manganese as Mn, mg/l	0.005
Mercury as Hg, mg/l	0.0008
Nickel as Ni, mg/l	<.005
Nitrate as NO_3-N, mg/l	<.01
Nitrite as NO_2-N, mg/l	<.005
Phosphate as PO_4-P, mg/l	0.011
Potassium as K, mg/l	1.88
Selenium as Se, mg/l	0.004
Silica as SiO_2 (Dissolved), mg/l	10.22
Silver as Ag, mg/l	<.005
Sodium as Na, mg/l	69.9
Sulfate as SO_4, mg/l	39.4
Total Dissolved Solids, mg/l	409
Turbidity, NTU	--
Zinc as Zn, mg/l	0.06
pH Units	7.83

CHEMTECH

CHEMTECH
28 EAST 1500 NORTH
OREM, UTAH 84057
(801) 226-8822

CERTIFICATE OF ANALYSIS

SAMPLE IDENTIFICATION

CLIENT: JBR Consultants
2556 East Oak Creek Circle
Sandy, UT 84092

LAB NO.: U009229

DATE SAMPLED: 11-5-85

TIME SAMPLED: 1300

SAMPLED BY: Martz

LOCATION: RB-19 K-38

COMMENTS: metals - dissolved

PARAMETER	LEVEL
Alkalinity as $CaCO_3$, mg/l	199
Ammonia as NH_3-N, mg/l	0.13
Arsenic as As, mg/l	0.011
Barium as Ba, mg/l	0.048
Bicarbonate as HCO_3, mg/l	242
Boron as B, mg/l	0.51
Cadmium as Cd, mg/l	<.005
Calcium as Ca, mg/l	12.6
Carbonate as CO_3, mg/l	0
Sulfide as S, mg/l	<.05
Molybdenum as Mo, mg/l	<.005

PARAMETER	LEVEL
Chloride as Cl, mg/l	11.3
Chromium as Cr (Hex.), mg/l	<.005
Chromium as Cr (Total), mg/l	<.005
Conductivity, umhos/cm	567
Copper as Cu, mg/l	0.013
Fluoride as F, mg/l	0.24
Hardness as $CaCO_3$, mg/l	253
Hydroxide as OH, mg/l	0
Iron as Fe (Dissolved), mg/l	0.033
Iron as Fe (Total), mg/l	--
Lead as Pb, mg/l	0.012
Magnesium as Mg, mg/l	42.9
Manganese as Mn, mg/l	<.005
Mercury as Hg, mg/l	<.0002
Nickel as Ni, mg/l	<.005
Nitrate as NO_3-N, mg/l	0.10
Nitrite as NO_2-N, mg/l	<.005
Phosphate as PO_4-P, mg/l	0.025
Potassium as K, mg/l	1.35
Selenium as Se, mg/l	<.002
Silica as SiO_2 (Dissolved), mg/l	12.64
Silver as Ag, mg/l	<.005
Sodium as Na, mg/l	35.2
Sulfate as SO_4, mg/l	56.5
Total Dissolved Solids, mg/l	352
Turbidity, NTU	--
Zinc as Zn, mg/l	0.14
pH Units	8.04

CHEMTECH

CHEMTECH
28 EAST 1500 NORTH
OREM, UTAH 84057
(801) 226-8822

CERTIFICATE OF ANALYSIS

SAMPLE IDENTIFICATION

CLIENT: JBR Consultants
2556 East Oak Creek Circle
Sandy, UT 84092

LAB NO.: U009209

DATE SAMPLED: 11-5-85

TIME SAMPLED: 0930

SAMPLED BY: Martz

LOCATION: AM-21 K-47

COMMENTS: metals - dissolved

PARAMETER	LEVEL
Alkalinity as $CaCO_3$, mg/l	234
Ammonia as NH_3-N, mg/l	0.18
Arsenic as As, mg/l	<.01
Barium as Ba, mg/l	0.095
Bicarbonate as HCO_3, mg/l	286
Boron as B, mg/l	0.53
Cadmium as Cd, mg/l	<.005
Calcium as Ca, mg/l	35.0
Carbonate as CO_3, mg/l	0
Sulfide as S, mg/l	<.05
Molybdenum as Mo, mg/l	<.005

PARAMETER	LEVEL
Chloride as Cl, mg/l	10.2
Chromium as Cr (Hex.), mg/l	<.005
Chromium as Cr (Total), mg/l	<.005
Conductivity, umhos/cm	600
Copper as Cu, mg/l	0.008
Fluoride as F, mg/l	0.16
Hardness as $CaCO_3$, mg/l	314
Hydroxide as OH, mg/l	0
Iron as Fe (Dissolved), mg/l	0.048
Iron as Fe (Total), mg/l	--
Lead as Pb, mg/l	0.010
Magnesium as Mg, mg/l	41.2
Manganese as Mn, mg/l	<.005
Mercury as Hg, mg/l	0.0009
Nickel as Ni, mg/l	<.005
Nitrate as NO_3-N, mg/l	0.22
Nitrite as NO_2-N, mg/l	0.010
Phosphate as PO_4-P, mg/l	<.01
Potassium as K, mg/l	1.50
Selenium as Se, mg/l	0.011
Silica as SiO_2 (Dissolved), mg/l	3.75
Silver as Ag, mg/l	<.005
Sodium as Na, mg/l	23.4
Sulfate as SO_4, mg/l	51.5
Total Dissolved Solids, mg/l	440
Turbidity, NTU	--
Zinc as Zn, mg/l	0.02
pH Units	7.69

Rep Henderson
CHEMTECH

CHEMTECH
28 EAST 1500 NORTH
OREM, UTAH 84057
(801) 226-8822

CERTIFICATE OF ANALYSIS

SAMPLE IDENTIFICATION

CLIENT: JBR Consultants
2556 East Oak Creek Circle
Sandy, UT 84092

LAB NO.: U009217

DATE SAMPLED: 11-6-85

TIME SAMPLED: 1115

SAMPLED BY: EWL

LOCATION: EWL-12 K-48

COMMENTS: metals - dissolved

PARAMETER	LEVEL
Alkalinity as $CaCO_3$, mg/l	207
Ammonia as NH_3-N, mg/l	0.22
Arsenic as As, mg/l	0.018
Barium as Ba, mg/l	0.053
Bicarbonate as HCO_3, mg/l	252
Boron as B, mg/l	0.85
Cadmium as Cd, mg/l	<.005
Calcium as Ca, mg/l	28.4
Carbonate as CO_3, mg/l	0
Sulfide as S, mg/l	<.05
Molybdenum as Mo, mg/l	<.005

PARAMETER	LEVEL
Chloride as Cl, mg/l	9.4
Chromium as Cr (Hex.), mg/l	<.005
Chromium as Cr (Total), mg/l	<.005
Conductivity, umhos/cm	550
Copper as Cu, mg/l	<.005
Fluoride as F, mg/l	0.12
Hardness as $CaCO_3$, mg/l	267
Hydroxide as OH, mg/l	0
Iron as Fe (Dissolved), mg/l	0.043
Iron as Fe (Total), mg/l	--
Lead as Pb, mg/l	0.010
Magnesium as Mg, mg/l	39.0
Manganese as Mn, mg/l	0.010
Mercury as Hg, mg/l	0.0007
Nickel as Ni, mg/l	<.005
Nitrate as NO_3-N, mg/l	0.46
Nitrite as NO_2-N, mg/l	<.005
Phosphate as PO_4-P, mg/l	0.026
Potassium as K, mg/l	1.33
Selenium as Se, mg/l	<.002
Silica as SiO_2 (Dissolved), mg/l	11.56
Silver as Ag, mg/l	<.005
Sodium as Na, mg/l	26.0
Sulfate as SO_4, mg/l	56.8
Total Dissolved Solids, mg/l	394
Turbidity, NTU	--
Zinc as Zn, mg/l	0.06
pH Units	8.22

CHEMTECH

CHEMTECH
28 EAST 1500 NORTH
OREM, UTAH 84057
(801) 226-8822

CERTIFICATE OF ANALYSIS

SAMPLE IDENTIFICATION

CLIENT: JBR Consultants
2556 East Oak Creek Circle
Sandy, UT 84092

LAB NO.: U009210

DATE SAMPLED: 11-5-85

TIME SAMPLED: 1130

SAMPLED BY: Martz

LOCATION: AM-23 K-53

COMMENTS: metals - dissolved

PARAMETER	LEVEL
Alkalinity as $CaCO_3$, mg/l	220
Ammonia as NH_3-N, mg/l	0.14
Arsenic as As, mg/l	<.01
Barium as Ba, mg/l	0.030
Bicarbonate as HCO_3, mg/l	269
Boron as B, mg/l	0.99
Cadmium as Cd, mg/l	<.005
Calcium as Ca, mg/l	14.0
Carbonate as CO_3, mg/l	θ
Sulfide as S, mg/l	<.05
Molybdenum as Mo, mg/l	<.005

PARAMETER	LEVEL
Chloride as Cl, mg/l	12.8
Chromium as Cr (Hex.), mg/l	<.005
Chromium as Cr (Total), mg/l	<.005
Conductivity, umhos/cm	600
Copper as Cu, mg/l	0.008
Fluoride as F, mg/l	0.19
Hardness as $CaCO_3$, mg/l	286
Hydroxide as OH, mg/l	0
Iron as Fe (Dissolved), mg/l	0.053
Iron as Fe (Total), mg/l	--
Lead as Pb, mg/l	0.050
Magnesium as Mg, mg/l	44.5
Manganese as Mn, mg/l	<.005
Mercury as Hg, mg/l	0.0003
Nickel as Ni, mg/l	<.005
Nitrate as NO_3-N, mg/l	0.08
Nitrite as NO_2-N, mg/l	<.005
Phosphate as PO_4-P, mg/l	0.045
Potassium as K, mg/l	1.72
Selenium as Se, mg/l	0.007
Silica as SiO_2 (Dissolved), mg/l	12.38
Silver as Ag, mg/l	<.005
Sodium as Na, mg/l	42.4
Sulfate as SO_4, mg/l	56.9
Total Dissolved Solids, mg/l	425
Turbidity, NTU	--
Zinc as Zn, mg/l	0.03
pH Units	8.21

CHEMTECH

CHEMTECH
28 EAST 1500 NORTH
OREM, UTAH 84057
(801) 226-8822

CERTIFICATE OF ANALYSIS

SAMPLE IDENTIFICATION

CLIENT: JBR Consultants
2556 East Oak Creek Circle
Sandy, UT 84092

LAB NO.: U009211

DATE SAMPLED: 11-5-85

TIME SAMPLED: 1015

SAMPLED BY: Martz

LOCATION: AM-24 K-54

COMMENTS: metals - dissolved

PARAMETER	LEVEL
Alkalinity as $CaCO_3$, mg/l	223
Ammonia as NH_3-N, mg/l	0.11
Arsenic as As, mg/l	0.010
Barium as Ba, mg/l	0.085
Bicarbonate as HCO_3, mg/l	272
Boron as B, mg/l	0.25
Cadmium as Cd, mg/l	<.005
Calcium as Ca, mg/l	27.8
Carbonate as CO_3, mg/l	0
Sulfide as S, mg/l	<.05
Molybdenum as Mo, mg/l	<.005

PARAMETER	LEVEL
Chloride as Cl, mg/l	8.5
Chromium as Cr (Hex.), mg/l	<.005
Chromium as Cr (Total), mg/l	<.005
Conductivity, umhos/cm	525
Copper as Cu, mg/l	0.010
Fluoride as F, mg/l	0.09
Hardness as $CaCO_3$, mg/l	270
Hydroxide as OH, mg/l	0
Iron as Fe (Dissolved), mg/l	0.030
Iron as Fe (Total), mg/l	--
Lead as Pb, mg/l	0.013
Magnesium as Mg, mg/l	36.2
Manganese as Mn, mg/l	<.005
Mercury as Hg, mg/l	0.0005
Nickel as Ni, mg/l	<.005
Nitrate as NO_3-N, mg/l	0.32
Nitrite as NO_2-N, mg/l	<.005
Phosphate as PO_4-P, mg/l	<.01
Potassium as K, mg/l	1.46
Selenium as Se, mg/l	0.003
Silica as SiO_2 (Dissolved), mg/l	12.63
Silver as Ag, mg/l	<.005
Sodium as Na, mg/l	21.2
Sulfate as SO_4, mg/l	32.3
Total Dissolved Solids, mg/l	356
Turbidity, NTU	--
Zinc as Zn, mg/l	0.07
pH Units	7.63

CHEMTECH

CHEMTECH
28 EAST 1500 NORTH
OREM, UTAH 84057
(801) 226-8822

CERTIFICATE OF ANALYSIS

SAMPLE IDENTIFICATION

CLIENT: JBR Consultants
2556 East Oak Creek Circle
Sandy, UT 84092

LAB NO.: U009218

DATE SAMPLED: 11-6-85

TIME SAMPLED: 0915

SAMPLED BY: EWL

LOCATION: EWL-16 K-60

COMMENTS: metals - dissolved

PARAMETER	LEVEL
Alkalinity as $CaCO_3$, mg/l	210
Ammonia as NH_3-N, mg/l	0.16
Arsenic as As, mg/l	0.012
Barium as Ba, mg/l	0.080
Bicarbonate as HCO_3, mg/l	256
Boron as B, mg/l	0.44
Cadmium as Cd, mg/l	<.005
Calcium as Ca, mg/l	22.0
Carbonate as CO_3, mg/l	0
Sulfide as S, mg/l	<.05
Molybdenum as Mo, mg/l	<.005

PARAMETER	LEVEL
Chloride as Cl, mg/l	12.9
Chromium as Cr (Hex.), mg/l	<.005
Chromium as Cr (Total), mg/l	<.005
Conductivity, umhos/cm	495
Copper as Cu, mg/l	0.015
Fluoride as F, mg/l	0.15
Hardness as $CaCO_3$, mg/l	622
Hydroxide as OH, mg/l	0
Iron as Fe (Dissolved), mg/l	0.035
Iron as Fe (Total), mg/l	--
Lead as Pb, mg/l	0.028
Magnesium as Mg, mg/l	34.0
Manganese as Mn, mg/l	<.005
Mercury as Hg, mg/l	0.0007
Nickel as Ni, mg/l	<.005
Nitrate as NO_3-N, mg/l	0.76
Nitrite as NO_2-N, mg/l	<.005
Phosphate as PO_4-P, mg/l	<.01
Potassium as K, mg/l	1.04
Selenium as Se, mg/l	0.003
Silica as SiO_2 (Dissolved), mg/l	15.30
Silver as Ag, mg/l	<.005
Sodium as Na, mg/l	21.2
Sulfate as SO_4, mg/l	33.1
Total Dissolved Solids, mg/l	318
Turbidity, NTU	--
Zinc as Zn, mg/l	0.01
pH Units	7.91

CHEMTECH

CHEMTECH
28 EAST 1500 NORTH
OREM, UTAH 84057
(801) 226-8822

CERTIFICATE OF ANALYSIS

SAMPLE IDENTIFICATION

CLIENT: JBR Consultants
2556 East Oak Creek Circle
Sandy, UT 84092

LAB NO.: U009219

DATE SAMPLED: 11-5-85

TIME SAMPLED: 1115

SAMPLED BY: EWL

LOCATION: EWL-24 K-71

COMMENTS: metals - dissolved

PARAMETER	LEVEL
Alkalinity as $CaCO_3$, mg/l	333
Ammonia as NH_3-N, mg/l	0.14
Arsenic as As, mg/l	<.01
Barium as Ba, mg/l	0.078
Bicarbonate as HCO_3, mg/l	407
Boron as B, mg/l	0.71
Cadmium as Cd, mg/l	<.005
Calcium as Ca, mg/l	53.6
Carbonate as CO_3, mg/l	0
Sulfide as S, mg/l	<.05
Molybdenum as Mo, mg/l	0.008

PARAMETER	LEVEL
Chloride as Cl, mg/l	23.0
Chromium as Cr (Hex.), mg/l	<.005
Chromium as Cr (Total), mg/l	<.005
Conductivity, umhos/cm	1370
Copper as Cu, mg/l	0.015
Fluoride as F, mg/l	0.54
Hardness as $CaCO_3$, mg/l	350
Hydroxide as OH, mg/l	0
Iron as Fe (Dissolved), mg/l	0.043
Iron as Fe (Total), mg/l	--
Lead as Pb, mg/l	0.018
Magnesium as Mg, mg/l	90.4
Manganese as Mn, mg/l	<.005
Mercury as Hg, mg/l	0.0005
Nickel as Ni, mg/l	<.005
Nitrate as NO_3-N, mg/l	0.29
Nitrite as NO_2-N, mg/l	<.005
Phosphate as PO_4-P, mg/l	<.01
Potassium as K, mg/l	3.24
Selenium as Se, mg/l	<.002
Silica as SiO_2 (Dissolved), mg/l	5.31
Silver as Ag, mg/l	<.005
Sodium as Na, mg/l	105
Sulfate as SO_4, mg/l	299
Total Dissolved Solids, mg/l	1060
Turbidity, NTU	--
Zinc as Zn, mg/l	0.07
pH Units	7.83

CHEMTECH

Document Information Form

Mine Number: C/007/007

File Name: Incoming - Sunnyside

To: John Whitehead

From:

Person Robert Bayer

Company JBR Consultants Group

Date Received: 5-20-86

Explanation: Map - Location of Seeps and Springs from October, 1985 Inventory and baseline Monitoring Sites

cc:

Document Information Form

Mine Number: C/007/007

File Name: Incoming - Sunnyside

To: John Whitehead

From:

Person Robert Bayer

Company JBR Consultants Group

Date Received: 5-20-86

Explanation: Map - Location of Seeps and Springs from October, 1985 Inventory

cc:

Document Information Form

Mine Number: C/007/007

File Name: Incoming - Sunnyside

To: John Whitehead

From:

Person Robert Bayer

Company JRR Consultants Group

Date Received: Ltr (5-20-86) Map (4-28-86)

Explanation: Map - Location of seeps and Springs from October, 1985 Inventory.

cc: