CHAPTER 6

TABLE OF CONTENTS

R614-301-600. Geology

6.10 R614-301-610 Introduction
6.20 R614-301-620 Environmental Description
   R614-301-621 General Requirements
6.22 R614-301-622 Cross Sections, Maps and Plans
6.23 R614-301-623 Detail of Geologic Information
6.24 R614-301-624 Minimum Geologic Information
6.26 R614-301-626 Sampling Waivers
* 6.30 R614-301-630 Operation Plan
6.31 R614-301-631 Casing and Sealing
6.32 R614-301-632 Subsidence Monitoring
6.40 R614-301-642 Performance Standards
CHAPTER 6

R614-301-600

PERMIT APPLICATION REQUIREMENTS - GEOLOGY

July 15, 1990
The Coal Load-Out Facility of Castle Valley Resources, Inc. is located approximately 2 miles southeast of Wellington, Carbon County, Utah. The operational and support facilities are adjacent to the Price River and are serviced by the Denver and Rio Grande Western Railroad. The permit area is within sections 8, 9, 10, 15, 16, 17, of T15S, R11E, S.L.B.M.
6.20 ENVIRONMENTAL DESCRIPTION (R614-301-620)

R614-301-621 General Requirements

The Coal Load-Out Facility is sited on the Price River floodplain and the exposed rock sequence in the Castle Valley Area is of Upper Cretaceous Age, with minor coverings of Quaternary gravels to recent terrace gravels and alluvium. See Geologic Map Dwg. No. C9-1213-R, Appendix. Note that this is a revision of the original U.S.S. Drawing.

The 1957 pre-construction investigation of the Coal Load-Out site shows a 5 to 15 foot sand and gravel layer consisting of cohesive soils varying in thickness from 15 to plus 30 feet underlain by Blue Gate shale some 36 to 40 feet below the surface. The surface is a blanket of brown loam.

The investigation of the pump station site showed a surface layer of four feet of sandy loam, a 29 foot layer of sand and gravel, which is underlain by shale.

Test borings in the refuse disposal area show that the total area is underlain by shale and that the valley is underlain by a shale bowl. In the bottom of the valley, the shale is immediately overlain by water bearing sand and gravel which is variable in thickness. The sand and gravel was overlain by silty and sandy loams. The shale is exposed on the walls of the valley and is weathered to variable depths.
The sub-surface investigations concluded that the Blue Gate Shale is continuous within the refuse and clear water pond areas as well as the plant area and should provide protection to the underlying Ferron Sandstone.

Alluvium

Alluvium deposits overlie the Blue Gate Shale in portions of the permit area. The deposits range from only a few feet in depth near the shale hills to approximately 35 feet deep in the flat areas near the Price River. The alluvium was most likely deposited by the Price River and the ephemeral drainage. Near the shale hills slope, erosion material may overlie or be mixed with the alluvium.

The Price River floodplain alluvials in the site area vary from 15 feet to 42 feet and consist of (in descending order) light brown loams, brown clay loams, brown silty loams, fine sand, coarse sand gravel and fine to medium sand on top of gray shale. See cross sections on Dwg. No. E9-3428, Dwgs 1 thru 4, and the 5/90 lithographic logs from the confirmation drilling of water monitoring wells GW-3, GW-7, GW-8, GW-11, and GW-14 and highway alignment drilling, page 5 thru 8.

Mancos Shale

The Mancos Shale is exposed in the broad flat valley which includes the area occupied by the Load-Out Facilities. The Mancos shale is marine in origin and consists of grayish blue to brown clay shales and sandy shales, except for sandstone lentils near the base and the top. It aggregates 4700 to 5050 feet in thickness.
The Mancos shale has been sub-divided into five members from bottom to top as follows: Tununk shale, Ferron sandstone, Blue Gate Shale, Emery Sandstone, and Masuk Shale. All of the rocks exposed in the permit area are in the Blue Gate Shale, the surface of which has been eroded by stream flow through the permit area. The shale surface is covered by alluvium (Qal) generally paralleling the Price River with a total width of 200 to 500 feet. The alluvium is a stream deposit consisting of clay, silt, sand, and gravel derived from the disintegration of shale and sandstone beds that make up bedrock in the area. The alluvium grades to Slope Wash (Qsw) west of the river. The Slope Wash material is derived from disintegration of the Mancos Shale. The pre-construction surface in the tailings pond area east of the river was also Slope Wash. The Slope Wash materials grade to the Blue Gate Shale with the increase in elevation. See Drawings C9-1213-R and E9-3428, 1 thru 4, Appendix.

Blue Gate Shale

The Blue Gate Shale is a member of the Mancos Shale formation and overlies the Ferron Sandstone. The shale member extends to the surface forming the hills east and west of the Price River.

The core drilling information shown on Dwgs. E9-3428, 1 thru 4, shows that the Blue Gate Shale is apparently continuous throughout the permit area. The presence of a low permeability shale member above the sandstone should afford some protection from contamination at depth by percolating water.
Ferron Sandstone

The Ferron Sandstone is a member of the Mancos Shale Formation which underlies a wide area including the permit area. Three oil exploration wells have been drilled in the area of the loadout. From 1921 to 1924, Utah Oil Refining Company drilled a well in Section 12, Township 15 South, Range 11 East, which is about 3 miles east of the loadout. The collar elevation of this well is reported to be 5935 feet above sea level. A lithologic unit which matches the description of the Ferron Sandstone was recorded at a well depth of 1100 feet (elevation 4835 feet). In this well this lithologic unit has a described thickness of 45 feet and produced water at the rate of 1 barrel per hour (0.002 cubic feet per second).

In 1927 Holmes McGee drilled an exploration well in Section 14, Township 15 South, Range 10 East, which is about 4 miles west of the loadout. The reported elevation of the surface of this hole 5530 feet. According to the log of this hole the Ferron Sandstone was encountered at a depth of 500 feet (elevation 5030 feet) and was approximately 55 feet thick. It was noted that this unit produced "little fresh water".

During 1930 Carbon Dioxide & Chemical Company drilled a well in Section 12, Township 15 South, Range 11 East, about 3 miles east of the loadout. The reported elevation of this hole is approximately 5900 feet. A unit which matches the description of the Ferron Sandstone was logged at a depth of 1110 feet (elevation 4790 feet) with a thickness of 45 feet and a "show of water". This information agrees closely with the information obtained from the log of the Utah Oil Refining Company well which is close (within 750 feet) to this well.

By interpolating between the elevations of the top of the Ferron Sandstone in these wells an approximate elevation of 4905 feet above sea level is estimated for the top of the Ferron Sandstone in the area of the loadout.

Faults, folds, and joint zones have not been observed in the permit area and there is no documentation of these features in the permit area. Faulting associated with the Farnham anticline has been included on Map C9-1213-R.
General Requirements

The Coal Load-Out Facility is located on the Price River floodplain and the exposed rock sequence in this area is of Upper Cretaceous age. The Cretaceous units in places are covered with Quaternary and recent gravels and alluvium. See Geologic Map Drawing No. C9-1213-R, Appendix. Note that this is a revision of the original U.S.S. drawing.

Drill holes in the area all encountered dark gray shale at depths ranging from 31 feet to 57 feet beneath the surface. This indicates that the permit area is underlain by shale.

Alluvium

Drilling conducted during May, 1990, at the Coal Load-Out site detected alluvium ranging in thickness from 31 feet to 57 feet. The alluvium generally consists of 18 feet to 43 feet of brown clayey silt at the surface, followed by 10 feet to 15 feet of sandy gravel. Beneath the sandy gravel is a dark gray shale (Blue Gate Shale) which is not alluvial.

Cross section drawings using data collected during the 1990 drilling are contained in the Appendix as drawing E9-3428. The lithologic logs of the drill holes which were used to construct the cross sections are shown on pages 1 through 4 of Section 6.22. Also an isopach map showing thickness of the alluvium beneath the site was constructed using the same drill hole data and is contained in the Appendix as drawing 612a.
Cross sections, depicting the site geology as interpreted from 1957 investigation drill holes, are to be found on Dwg. E9-3428, 1 thru 4, with the locations shown on Dwg. E9-3343. Stratigraphy logs of these holes are not available to the current owners. In addition, 5 offset holes were drilled during May 1990 to verify the stratigraph of the water monitoring wells. See Castle Valley Resources' lithographic logs below.

**CASTLE VALLEY RESOURCES, INC.**

**GW-3 LITHOGRAPHIC LOG**

0.0-5.0' : Silt. Contains some clay. Man made berm.

5.0-16.0' : Clayey. **Silt.** Brown Alluvium.


38.0-48.0' : Contains gravel. First water encountered at 17'.

48.0-60.0' : **Shale.** Gray-dark gray. Saturated, soft.

* No returns. Gravel recovered from auger flight.

**CASTLE VALLEY RESOURCES, INC.**

**GW-7 LITHOGRAPHIC LOG**

0.0-6.0' : Clayey silt. Brown. Alluvium.


31.0-35.0' : **Shale.** Gray-dark gray. Saturated, soft.

* No returns. Gravel recovered from auger flight.
CASTLE VALLEY RESOURCES, INC.

GW-8 LITHOGRAPHIC LOG

0.0-4.0' : Clayey silt. Brown. Alluvium.
15.0-43.0' : Clayey silt. Contains gravel.
43.0-57.0' : Sandy gravel. Sand is fine grained. SA-SR.*
57.0-60.0' : Shale. Gray-dark gray. Saturated, soft.

* No returns. Gravel recovered from auger flight.

CASTLE VALLEY RESOURCES, INC.

GW-11 LITHOGRAPHIC LOGS

22.0-36.0' : Gravel. Contains sand and silt. Sand is very fine to fine grained. Alluvium.*

* No returns. Gravel recovered from auger flight.
CASTLE VALLEY RESOURCES, INC.

GW-14 LITHOGRAPHIC LOG

0.0-5.0' : Clayey silt. Brown. Alluvium.

5.0-11.0' : Silty clay. Alluvium.


18.0-33.0' : Sandy gravel. First water. Alluvium.

33.0-35.0' : Shale. Saturated, soft. Gray-dark gray.*

35.0-40.0' : Sandstone. Tan-buff color. Fine to medium grained.

* No returns. Gravel recovered from auger flight.
HIGHWAY ALIGNMENT DRILLING

Drill Hole No. 1

<table>
<thead>
<tr>
<th>Depth</th>
<th>Material/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Silty sand</td>
</tr>
<tr>
<td>5</td>
<td>Sandy silt</td>
</tr>
<tr>
<td>10</td>
<td>Silty sand w/ gravel</td>
</tr>
<tr>
<td>15</td>
<td>Clay</td>
</tr>
<tr>
<td>20</td>
<td>Sandy gravel</td>
</tr>
<tr>
<td>25</td>
<td>Dark gray highly weathered silty limy shale w/ frequent clay layers</td>
</tr>
<tr>
<td>30</td>
<td>Dark gray fossiliferous fissile shale</td>
</tr>
<tr>
<td>35</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

LEGEND

- Sample location
- Torvane value
- Undisturbed sample
- 5,6,6 no. of blows per 6" with std. s
- Groundwater elevation

6.22
622.100 Elevations and Locations of Test Borings

Elevations and areal locations of the site investigation drill holes are shown on Drawings E9-3428 and E9-3343 - Appendix. Measured elevations for the drill holes are not available so elevations must be estimated from topographic contours shown on Drawing E9-3343 or approximate elevations can be determined by scaling from Drawing E9-3428.

622.200 Nature and Depth of Coal Seam

The site is on the valley floor of the Price River flood plain in the Blue Gate member of the Mancos Shale formation, a non-coal bearing formation. Therefore, no consideration is given to the site in terms of coal mining and the projected depth of any existing coal seams preclude the possibility.

622.300 Croplines

No coal crop lines or coal to be mined exist within the permit area.

622.400 Oil and Gas Wells

No gas and oil wells exist within the permit area.
Mining is not conducted at the Wellington Plant, therefore, no acid- and toxic- forming materials are being produced in the area. The Wellington site has been in operation since 1958 and has produced coal waste products. Soil sampling has been conducted at various times during the life of the operations by various owners/operators. A summary of the known sampling has been provided in Sec. 2.22.

Based on knowledge of the previous reclamation plan and the recently approved bond (Appendix J), the following has been postulated. First, the lower slurry pond had potentially toxic levels of soluble and exchangeable salts. This area will be covered with 4 ft. of material. Second, the coarse slurry area showed no toxicities in the analyses. Therefore, some of this material will be used for cover, while the remaining will be covered with 6 inches of topsoil. Third, the coarse (plant) refuse has previously been considered non-toxic, but it apparently was recommended to receive 12 inches of topsoil at the time of final reclamation. The material that is brought to the coarse refuse pile from the Crandall Canyon Mine (see Sec. 5.28) is first analyzed for toxic- and acid- forming materials.
6.24 MINIMUM GEOLOGIC INFORMATION R614-301-624

624.100 Description of Geology

The absence of mining activity precludes any adverse impact on any aquifer/coal seam.

The regional and structural geology, as described in R614-301-621, are, however, applicable in terms of reclamation and impacted surface and ground water.

Since the load-out facility is a surface operation, the control of potential contamination from the stockpile and load-out of coal in terms of surface degradation and ground water quality must be considered and are addressed in R614-301-500 and R614-301-700. The area geology being that of alluvial flood plain deposition within the confines of the Price River valley underlaid by the Blue Gate Shale, of limited permeability, results in a configuration in which the alluvium becomes a utilized aquifer. The primary concern of potential environmental impact controlled by the areal geology is concluded to be the existence of the alluvial-shale aquifer underlying the permit area.

624.110/624.120 Cross Sections, Maps and Plans


6.24  1  7/15/90
This section of the regulations refers to underground or surface coal mining and reclamation activities in which strata down to the coal seam to be mined will be removed or exposed. This property is a loadout in which there is no coal seam to be mined so there are no strata down to a coal seam which will be removed or exposed. These regulations do not apply to this property.

**624.230 Chemical Analyses**

Presently (June 1993) and in the future, it is not anticipated that coal and/or sediment pond wastes will be received from any other site besides Genwall mine. Prior to receiving coal and/or sediment pond wastes from any other source besides Genwall, Castle Valley Resources will submit results of analyses for potentially acid- or toxic-forming materials to DOGM.

**624.300 through 624.340**

This section of the regulations refers to underground coal mining and reclamation activities in which strata above the coal seam to be mined will not be removed. This property does not contain a coal seam which will be mined so there are no strata above a coal seam to be mined. Therefore, these regulations do not apply to this property.
6.31 CASING AND SEALING (R614-301-631)

Investigation drilling was conducted within the permit area in 1957. These bore holes were of shallow depths from some 40 to 100 feet and penetrated the alluvium some distance into the Blue Gate Shale. See Drawings E9-3428, 1 through 4. The holes were not cased, plugged, or otherwise preserved and have since that time been obliterated.

631.100 Temporary Casing and Sealing

No drill holes were preserved for water return or monitoring purposes.

631.200 Permanent Casing and Sealing

No investigation drill holes were utilized for monitoring or other use.
6.40 PERFORMANCE STANDARDS (R614-301-640)

R614-301-641 Exploration Holes and Boreholes

1957 exploration holes no longer exist.

R614-301-642 Subsidence Monitoring Markers

No subsidence monitoring will be conducted.