CHAPTER 5

ENGINEERING

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CHAPTER 5
ENGINEERING

510 INTRODUCTION

This chapter provides a discussion of general engineering aspects, an operation plan, a reclamation plan, design criteria, and performance standards related to the Dugout Canyon Mine. The proposed coal mining and reclamation activities associated with the mine have been or will be designed, located, constructed, maintained, and reclaimed in accordance with the operation and reclamation plans.

Additional information can be found in the following amendments: Methane Degassification Amendment (August 2003), Refuse Pile Amendment (February 2003), and the Leachfield Addendum A-1 (March 2001). The remainder of the State Lease ML-48435-OBA (SITLA Lease) was incorporated into the Dugout Canyon Mine permit area in 2005. In 2007, 40 acres was added to Federal Coal Lease U-07064-027821 to accommodate a revised mine plan. Refer to Plate 5-7 for the location of the acreage (NW1/4NW1/4, Section 21, Township13S, Range 13E) incorporated into the permit boundary. Surface disturbance will be permitted as needed to facilitate mining activities.

In 2007 acreage (487.57 acres) was added to existing Federal Coal Lease U-07064-027821, two hundred and forty-seven acres of this added acreage is already included as part of the Dugout permitted area. Acreage was previously added to the permit area in excess of the Federal leased acreage to act as a subsidence buffer zone (207.57 acres) and to accommodate a revised mine plan (40 acres). In addition, State Lease ML-50582-OBA (320 acres, more or less) was issued to Dugout Canyon Mine in 2007. Future surface disturbance of these leases will be permitted as needed to facilitate mining activities.

511 General Requirements

This permit application includes descriptions of the proposed coal mining and reclamation operations together with the appropriate maps, plans, and cross sections. Potential environmental impacts as well as methods and calculations utilized to achieve compliance with the design criteria are also presented.

512 Certification

Where required by the regulations, cross sections and maps in this permit application have been prepared by or under the direction of, and certified by, qualified registered professional engineers or land surveyors. As appropriate, these persons were assisted by experts in the fields of hydrology, geology, biology, etc.

512.100 Cross Sections and Maps

Previously Mined Areas. A certified map showing the location of previously mined areas within the permit and adjacent areas is provided as Plate 5-1 and Plate 5-7. Plate PC5-4 in Appendix 5-10 shows the portal location for an abandoned mine in the vicinity of the Pace Canyon Fan Portal Site.

Surface Facilities. Underground development waste which is generated at the Dugout Canyon Mine will be disposed of either:

- Underground within the Dugout Canyon Mine (without bringing this waste to the surface), at the approved waste-rock disposal facility at the Dugout Canyon Mine;
- At the approved waste-rock disposal facility at the SUFCo Mine (a sister operation of SCM); or
- At the approved waste-rock disposal facility at the Skyline Mine (also a sister operation of SCM).

Copies of the Division correspondence approving the SUFCo and Skyline waste-rock disposal facilities for receipt of Dugout Canyon waste rock are provided in Appendix 5-2.

Certified maps and cross sections concerning the disposal of underground development waste at the SUFCo and Skyline Mines are provided in the respective Mining and Reclamation Plans (M&RPs) for those mines. A certified map showing the proposed location of coal storage and loading areas, and explosive storage and handling facilities, is provided as Plate 5-2. Cross sections of the proposed facilities area are provided on Plate 5-3.

A map of the existing topography prior to disturbance by SCM is provided as Plate 5-4. Also noted on Plate 5-4 is the area of disturbance which was mapped to exist at the site in 1980. Since mining ceased at the site in 1964 (as noted in section 521.100 of this M&RP), this boundary represents the

525 Subsidence

525.100 Subsidence Control Plan

Structures and Renewable Resource Lands. As noted in Section 521.100, no major electric transmission lines, pipeline, or agricultural drainage tile fields exist within the area of potential subsidence. As described in Section 527.100, the roads within the area of potential subsidence consist of private roads that are owned and maintained by the parent company of SCM and private citizens, including the Thayn family. These are unimproved dirt roads that may be used for access to the lease area. Localized damage that occurs to roads not owned by the parent company of SCM will be repaired to a condition acceptable to both the private landowner and SCM. No other structures are known to exist within the area of potential subsidence.

Renewable resource lands within the permit and adjacent areas are shown on Plate 4-1 and discussed in Section 411 of this M&RP. The area of potential subsidence is currently used for livestock grazing and wildlife habitat, with limited timber production on adjacent lands to the east of Dugout Canyon (see Section 411.120). Hydrologic resources in the area are discussed in Chapter 7 of this M&RP. Information regarding baseline groundwater conditions is provided in Section 724.100.

Mining Methods. As noted in Section 523, continuous miner and longwall mining methods will be used in the Dugout Canyon Mine. The size, sequence, and timing for the development of the underground workings are shown on Plate 5-7 and in Annual Reports.

Physical Conditions Affecting Subsidence. A detailed description of the physical conditions in the permit area that may influence subsidence (i.e., overburden lithology and thickness, coal seam thickness, etc.) is provided in Chapter 6. In particular, Plate 6-1 provides a surficial geologic map of the permit and adjacent areas, Plate 6-2 shows the locations of the coal-seam outcrops in the vicinity of the proposed surface facilities, and Figure 6-1, Plate 6-3, 6-3A and 6-3B provide geologic cross sections based on data collected from drill holes in the area. Furthermore, information related to the physical conditions which may affect mining is presented in Sections 622 (a discussion of the cross sections), 624.100 (a discussion of stratigraphic and structural conditions), and 624.300 (a discussion of rock clay content), as well as Appendix 6-1 (drill-hole logs).

Subsidence Control Measures. Most of the land within the permit area will eventually be affected by subsidence. Anticipated areas of subsidence are shown on Plate 5-7. This subsidence boundary was projected to the surface based on an angle of draw of 30 degrees as measured from the vertical as required in R645-301-525.542. It is presumed that the actual angle of draw will be less, based upon results of mining and subsidence in the general area. Plate 5-7 illustrates the projected extent of subsidence based on a 30 degree angle of draw . The primary areas where future subsidence is not anticipated are the areas overlying the previous workings shown on Plate 5-1 and 5-7(since these areas will not be re-mined). Plate 5-7 also illustrates a subsidence buffer zone that extends beyond the limits of Federal Lease U7064-027821 and State Lease ML-48435. This buffer zone does not suggest that CFC will mine outside of the lease boundaries, however, it does indicate the limit of projected subsidence.

Appendix 5-11 contains a report entitled "Prediction of Surface Deformation Resulting from Longwall Mining" which discusses subsidence. The specific sections within the report discuss, subsidence mechanism; mining, geologic conditions and subsidence characteristics; predicted ground movements and the monitoring program. This information is provided per deficiencies in the 2005 mid-term review of the M&RP.

In the "Prediction of Surface Deformation Resulting from Longwall Mining" report study "subsidence calculations (consisting of vertical movements and horizontal trains) were completed for four longwall panels of interest to this study, as illustrated in Figure 1." Mining panels GIL-5, GIL-6, GIL-7 and GIL-8 were part of the subsidence study for the Gilson Block 2 in this report located in Appendix 5-11. "The type of subsidence mechanism predicted for the study area is the trough-type subsidence. In the Gilson Block 2, CFC is utilizing panel-barrier designs to control overburden caving, seismicity and surface deformation. Considering panel width to average overburden depth rations for the project area (0.4 to 1.0), these longwall panels are considered to have a subcritical widths (Figure 3), and thus the majority of subsidence is expected during the mining of the individual longwall panels."

Section 3.3 on page 10 of the "Prediction of Surface Deformation Resulting from Longwall Mining" report discusses subsidence engineering parameters and measurements descriptions/calculations. Measured subsidence factor verses panel width to depth ratio for Utah operations is shown on Figure 5, typical subsidence profiles for the GIL- 5 through GIL-7 panels are shown on Figures 6 and 7.

Subsidence Monitoring. Numerous control points have been established within the permit and nearby areas to assist in subsidence surveys (see Plate 5-7). Coordinates and elevations of these control points (as established in January 1984) are provided in Table 5-2. Coordinates and elevations of control points are also provided in the Mine's Annual Reports. The control points consist of traverse monuments, benchmark monuments, and survey stations which have been constructed generally as follows:

- Traverse and Benchmark Monuments - These monuments are constructed with tap-on convex cap with a center punch mark and a center rod. The center rod has been emplaced in a 5.5- to 6-foot deep poured concrete casing. Where rock was encountered before the required depth, the rock was broken with a stone rod and an anchor point was grouted into the rock using a concrete patching material. Alternatively, monuments in rock were emplaced as described below ("Rock Monuments and Stations").

- Survey Stations - These stations consist of rebar rods with a length of 5 feet. Each rebar has been fitted with a aluminum cap. The caps are plain with a center punch mark and a concave label across the top. Where survey stations are installed in boulders or rock which did not allow the use of rebar, they were installed as indicated below ("Rock Monuments and Stations").

- Rock Monuments and Stations - Where survey monuments and stations are established in boulders and rock which do not allow the installation of a rod in a concrete casing, these monuments consist of an aluminum alloy convex marker with a center punch and concave label. They are secured by drilling a hole to a depth of approximately 3 inches and installing the cap in a concrete grout mixture.

Future monuments and stations that are required for proper control will be installed to provide one monitoring point per panel. Since geologic and mining uncertainties often force a change in planned mining sequences, future control points may be installed only after the mine panels are in their development phase.

Re-surveys will concentrate on areas which have been mined in the past or are anticipated to be mined within the upcoming year. Hence, the area of detailed survey may be expanded each progressive year.

Annual re-surveys of the mine permit area will produce vertical control at the same sites as the previous year. Information on each site will be produced annually while the area underlying the site is being actively mined or is still potentially subsiding. The subsiding areas which show no change for two consecutive years will be considered stable and will be omitted from further annual surveys. If additional mining is anticipated within the stable areas, these areas will again be added to the annual surveys.

In addition to the ground surveys, aerial photogrammetric methods will be included in the surveys when the areas become too large to feasiblely handle with ground surveys. This method may be added to enhance the ground surveys and to cover larger areas as the mine expands. Visual checks for subsidence will be made during all surface activities, especially during water monitoring activities. These visual surveys will be used to detect surface irregularities and surface cracks.

Visual ground checks for subsidence will be made of areas surrounding monitored seeps, springs and streams during hydrologic monitoring. In addition, roads used to access hydrologic monitoring stations will be visually checked for evidence of subsidence during monitoring activities. The observations made during hydrologic monitoring will be included in the Mine's Annual Report.

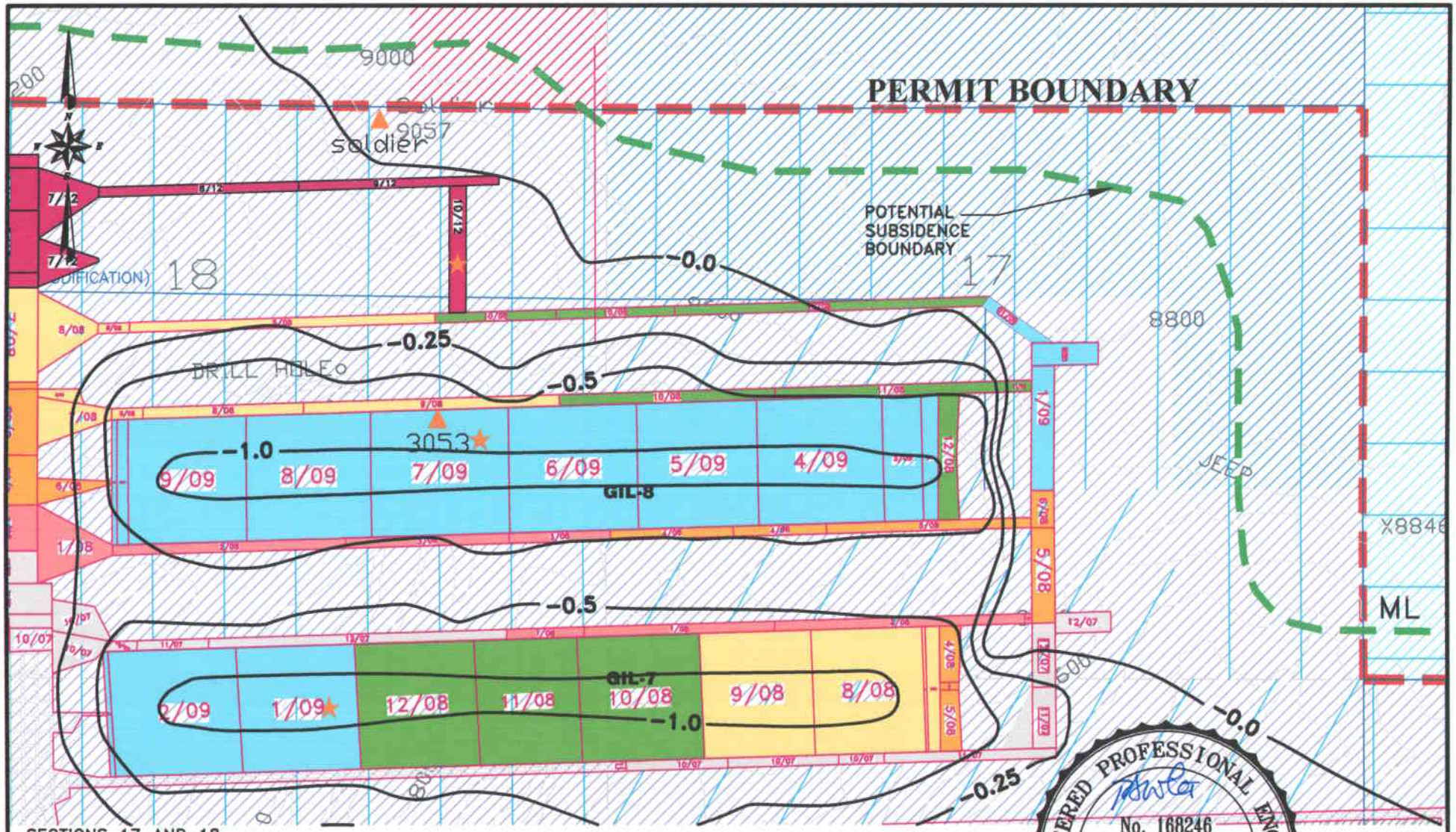
Anticipated Effects of Subsidence. Based on experience in the region and the results of investigations performed by Dunrud (1976), future subsidence in the permit area is anticipated to result in the formation of tension cracks, with these cracks healing to some degree following formation. It is further anticipated that no substantial damage will occur to rangeland conditions as a result of subsidence within the permit area. The only potential effects in that respect will be the exposure of plant roots where tension cracks form.

It is not anticipated that material damage will occur to streams as a result of subsidence. Gentry and Abel (1978) demonstrated that topographic lows (e.g., stream channels) tend to be protected by upwarping of adjacent slopes during subsidence. Therefore, mining-induced surface fracturing should be very limited (or nonexistent) within stream channel areas. Any fracturing that does occur in stream channels is likely to fill rapidly as a result of sedimentation.

It is also not anticipated that subsidence will significantly affect springs within the permit and adjacent areas. Von Schonfeldt et al. (1980) found that uniform subsidence "rarely causes problems to renewable resources such as aquifers, streams, and ranch lands." Since second mining will occur uniformly across the permit area, the resulting subsidence should also be uniform, minimizing the potential impacts to overlying springs.

APPENDIX 5-12

Miscellaneous Information - Permit Area Expansion



APPENDIX 5–12 FIGURE 1. POTENTIAL SUBSIDENCE

APPENDIX 5-12 - Figure 1

Area and depth of potential subsidence were calculated/estimated by considering the following information and data:

Prediction of Surface Deformation Resulting from Longwall Mining Over the Gilson North-East Block, prepared by Maleki Technologies, Inc, located in Appendix 5-11 of this M&RP

Geologic features of the area such as cover and structure, including information in Chapter 6 of this M&RP.

Barrier pillars between longwall panels, 425' pillar between the GIL-6 and GIL-7 panel, 600 foot barrier pillar between the GIL-7 and GIL-8 panel and 528 foot pillar between the GIL-8 and GIL-9 panel.

Subsidence data submitted to UDOGM in annual reports (2004 - 2006) by coal mines both in the Bookcliff mining area and the Wasatch Plateau mining area.

Bookcliff Mining Area

Dugout Canyon Mine: Reports cover of 1800 - 1900 feet with a surveyed subsidence depth of 0.29 feet **or less**

Tower Mine: Reports cover of 2000 - 2500 feet with a subsidence survey depth averaging **less than** 1.0 foot

Reports cover of 2500 or greater with a subsidence survey depth averaging **less than** 0.5 feet

West Ridge Mine: Reports cover of 400 feet to 2500 feet with a subsidence survey depth of **less than**1.0 foot

Subsidence prediction method developed by the British National Coal Board.