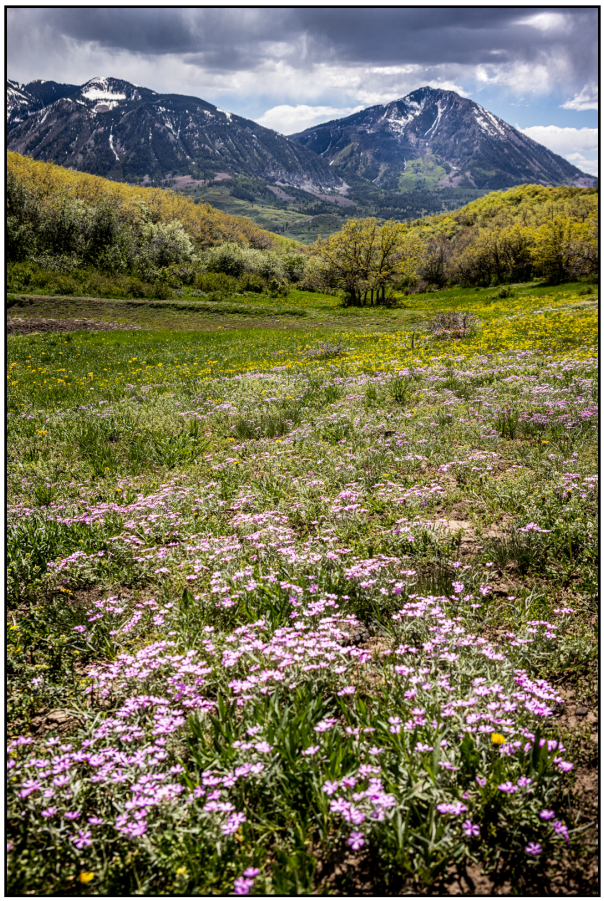
Spring 2021 Subsidence and Geologic Field Observations

Southern Panels Mining Areas

PREPARED FOR:
Mountain Coal Company, LLC
West Elk Mine

PREPARED BY:
Gary D. Witt, P.G., Hydrogeologist/Geological Engineer
Wright Water Engineers, Inc.



Wright Water Engineers, Inc.

September 2021

831-032.912

WWE
Wright Water Engineers, Inc.
2490 West 26th Ave., Suite 100A
Denver, Colorado 80211
(303) 480-1700 TEL
(303) 480-1020 FAX

www.wrightwater.com
e-mail: gwitt@wrightwater.com

September 17, 2021

Mr. Leigh Simmons
Colorado Division of Reclamation, Mining and Safety
1313 Sherman St., Rm. 215
Denver, CO 80203

Re: Spring 2021 Subsidence Monitoring Report Preparation – Mountain Coal Company, LLC.

Dear Mr. Simmons,

The following report entitled *Spring 2021 Subsidence and Geologic Field Observations – Southern Panels Mining Areas*, was prepared by, and under the supervision of, Gary D. Witt, a licensed professional geologist and employee of Wright Water Engineers, Inc.

Sincerely,

WRIGHT WATER ENGINEERS, INC.

By _____
Gary D. Witt, P.G., CPG
Vice President
Sr. Hydrogeologist/Geological Engineer

AMERICAN INSTITUTE OF PROFESSIONAL GEOLOGISTS
CERTIFICATE NUMBER
13332
AIPG
GARY D. WITT
CERTIFIED PROFESSIONAL GEOLOGIST

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Spring 2021Subsidence and Geologic Field Observations

Southern Panels Mining Areas

PREPARED FOR:
Mountain Coal Company, LLC
West Elk Mine
P.O. Box 591
Somerset, CO 81434

PREPARED BY:
Gary D. Witt, P.G., CPG
Sr. Hydrogeologist/Geological Engineer
Wright Water Engineers, Inc.

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1.0 BACKGROUND

This subsidence report is the first of two detailed documents on this subject to be generated based on 2021 calendar year observations. These reports of subsidence-related observations associated with the West Elk Mine have occurred annually between 1996 and 2006, and biannually since spring 2007. In accordance with the Mountain Coal Company, LLC (MCC) permit from Colorado Division of Reclamation, Mining and Safety (CDRMS), these subsidence reports are to be submitted by April 30 (for preceding fall monitoring) and September 30 (for preceding spring monitoring).

Prior field observations and experience in the West Elk Mine area over the last twenty-six years[2] (1996 to 2021 inclusive) indicate that subsidence-related features (cracks and bulges) are most visible on roads, well pads, and trails, where the ground is more compact and free of brush. These areas have been, and will continue to be, the focus of the biannual observations to most efficiently obtain subsidence information. Other subsidence features such as rockfalls and landslides are generally observable from overview locations along roads or on well pads and have been, and will continue to be, noted when they occur.

Spring 2021 subsidence observations were performed on May 28, 2021 in the Southern Panels Mining Area with specific focus on the most-recently mined E-seam Longwall Panel (E8) and on the first E-seam Longwall Panel of the Sunset Trail Mining Area (SS1). Traverse names used in the previous reports may not coincide with those used in this report. Pre-mining observations were

[1] The Southern Panels Mining Area includes the E-seam Longwall Panels E1 through E9 originally included in the South of Divide Mining Area, some of which were included in the Dry Fork Mining Area. The Southern Panels Mining Area also includes B-seam Longwall Panels B26 through B29 that underlie E-seam Longwall Panels E1 through E5. The term Southern Panels Mining Area will be used throughout this report to identify what was formerly referred to as the South of Divide and Dry Fork mining areas. The Sunset Trail Mining Area represents four panels located to the south of E-seam Longwall Panel E8 of the Southern Panels Mining Area.

[2] Annual subsidence and geologic hazard reports are maintained at Mountain Coal Company, LLC, and at the Colorado Division of Reclamation, Mining and Safety, and are exhibits to the permit document (Exhibits 60, 60A, 60B, 60C, 60D, and 60E).

also made of the area over unmined portions of E-seam Longwall Panel SS1. Observations associated with E-seam longwall mining of Panels E1 through E6 (mined and subsided more than two years previous) can be found in earlier reports. Observations of the Apache Rocks and Box Canyon B-seam mining areas are covered in reports prior to 2013.

During the spring 2021 field visit, accessible areas within the Southern Panels Mining Area and Sunset Trail Mining Area were visited, examined, and photographed to document subsidence-related features observed since the last field visit and to record newly observed features for future reference (see Maps 1 and 2). Field observations were made from a four-wheel drive vehicle and by foot as needed.

Thirteen photographic observation points have been established and used since 2007 to view and assess changes that may occur as a result of mining. Many of these locations were used for annual comparative purposes even before formal identification with a numeric designation. Beginning with the spring 2013 field visit, nine of these points were removed from the list of observed sites based primarily on their specificity to the terminated B-seam mining activities. Beginning in 2016, these historic photographic observation points have been used without reference to a numbered location and, if used, are called out generically in the text and on Map 1 if there is something important to note at these locations.

2.0 GENERAL SUBSIDENCE OBSERVATION AND REPORTING

On May 28, 2021, Wright Water Engineers, Inc. (WWE) observed surface subsidence and geologic field conditions of the Southern Panels Mining Area and Sunset Trail Mining Area (consistent with current Exhibit 60E) for MCC. Mining in the area is performed below the surface within the West Elk Mine using longwall mining methods. Similar surface observations have been made annually since 1996 and semi-annually since 2007 to assess potential longwall mining effects on the environment.

Based on field observations from 1996 to spring 2021, the effects of longwall mining above the West Elk Mine have been less than initially projected as reported in Exhibit 60 (Dunrud et al., 1998 rev.) and 60E (WWE, 2012). Rockfalls and/or landslides have generally been observed only sporadically since 2006 in the Box Canyon Mining Area, where the steep, upper reaches of Sylvester Gulch and Box Canyon abut the large geographic feature known as West Flatiron. In the flatter and more rounded topography of the Apache Rocks, Southern Panels, and Sunset Trail mining areas, the rockfall and landslide potential is much smaller. However, subsidence-related tension cracks have occurred in these mining areas, particularly above the active longwall mining face.

E-seam longwall mining in the Southern Panels Mining Area was initiated on Panel E1 in December 2008 beginning at the east end and progressing westward. All mining in the Southern Panels Mining Area has been planned to progress from the east to west across the panels. As of the time of WWE's spring 2021 field visit (May 28), mining was complete in E-seam Longwall Panels E1 through E8. Initial mining of the E-seam Longwall Panel SS1 in the Sunset Trail Mining Area was initiated in January 2020 and was approximately 90% complete as of the time of our spring 2021 field visit.

Beginning with the Spring 2011 Subsidence Report, an effort has been made to reduce the size of the semi-annual subsidence reports by eliminating much of the regularly included background and historical information (e.g., subsidence projections). For this reason, specific details associated with subsidence projections and field recognition of subsidence and non-subsidence features were

eliminated. Since that time, readers have been directed to Sections 1.0 and 2.0 of the Spring 2011 Subsidence Report and to Exhibits 60 and 60E of the West Elk Mine permit for this information.

Also, in keeping with the goal of reducing the report size, future reports will focus on the identification and discussion of those observations that reflect an obvious change in the conditions overlying the active portion of the mine and on documenting baseline conditions in areas that have yet to be mined. For this reason, observations from our spring 2021 field visit were focused on areas above E-seam Longwall Panel E8 in the Southern Panels Mining Area and on E-seam Longwall Panel SS1 of the Sunset Trail Mining Area. In addition, a reconnaissance-level walking visit along the road to, and partially across, E-seam Longwall Panel SS2 was completed. This route is designated as Traverse H-H' in the remainder of this report.

Readers should note that observations are discussed relative to traverses along segments of drill roads providing access to drilling pads containing mine ventilation boreholes (MVBs). Given the dynamic nature of the mining activities (i.e., adding and reclaiming of road segments and MVB pads), future naming of traverses will likely vary from report to report. Efforts will be made, as practical, to keep traverse names the same. Specific nomenclature for observed features will be provided on Map 1 of each report.

3.0 SUBSIDENCE MONITORING

MCC has been collecting data from numerous monitoring locations in and around Minnesota Reservoir, Monument Dam, and the general Dry Fork area for many years. Locations of ongoing monitoring by MCC personnel include the U.S. Forest Service (USFS) roads and stock ponds, as well as the Monument Dam and Minnesota Reservoir area. Inspection forms and survey data for these areas are provided in Appendices A, B, and C. Data and discussions associated with ongoing MCC monitoring are provided by MCC and included in this WWE report for convenience.

3.1 USFS Roads and Stock Pond Monitoring

As described in previous subsidence reports, observations by MCC personnel of the USFS roads and stock ponds in the vicinity of active mining activities have occurred for many years. Inspection forms from observations conducted during the spring of 2021 are included with this report in Appendix A.

3.2 Monument Dam/Minnesota Reservoir Monitoring

MCC has conducted monitoring of the Monument Dam and strategic locations around Minnesota Reservoir since 2006. Data collected from various monitoring locations on the Monument Dam (including Dam Inspection Forms) are provided in Appendix B. In addition, MCC has monitoring and reporting responsibilities for the land survey stations. A summary of both average height and longitudinal displacement data obtained from fall 2020 to spring 2021 is provided in Table 1 of Appendix C.

4.0 SPRING 2021 SUBSIDENCE OBSERVATIONS

During WWE's spring 2021 field visit, subsidence-related tension cracks were observed above mined E-seam Longwall Panel E7 in the Southern Panels Mining Area and above mined E-seam Longwall Panel SS1 in the Sunset Trails Mining Area as accessed by USFS Road 711 (Dry Fork Road). The observed cracks were observed both on roads and MVB pads, particularly where they exist above active mining activities.

Subsidence features were observed at various locations along the established traverses. The most notable subsidence features were located along the roadway south of MVB E7-12 above mined E-seam Longwall Panel E7, along the roadway south of MVB E6-14 above mined E-seam Longwall Panel E7, along the roadway between MVBs SS1-5 and SS1-6, and on the MVB pad for SS1-6, along the roadway immediately east of MVB SS1-7, and on MVB pad SS1-7, all above mined E-seam Longwall Panel SS1. Most of these locations are above the most recent mining activity at the time of our field visit. Details associated with the spring 2021 observation of subsidence features can be found in Sections 4.3 and 4.7 of this report.

The subsidence features observed and discussed in previous subsidence reports were all revisited and most were noticeably weathered and less discernible. Also, to date, there have been no subsidence-related features observed in alluvium, even above active longwall mining activities.

The remainder of this report is a detailed discussion of observations associated with Traverses A-A' through H-H' (see Maps 1 and 2). Map 1 shows the outline of E-seam mine workings along with surface topography and other surface features, including the named traverses. Map 2 shows the same area and detail as Map 1 (minus traverses) along with recently active, or potentially active, landslide and rockfall areas as delineated from aerial photo research and field observations. Also on Map 1, note that a designation similar to E6-1/2/3 indicates one MVB pad containing three drill holes. The surface and termination points of each drill hole are shown by small and large filled green circles, respectively, that are connected by green lines. A single, large, filled green circle represents a vertical drill hole.

Some of the numerous photographs obtained during the spring 2021 field visit have been included as figures in the following text. Where these images have notable differences from previous

photographs, the older image has been included for comparison purposes. To reduce the overall size of this document, no narrative text or photographs are provided for traverses where no noticeable change was observed.

4.1 Traverse A-A'

This traverse overlies portions of mined E-seam Longwall Panels E1 through E6. Traverse A-A' originates just south of Monument Dam (and Minnesota Reservoir) and proceeds in a southeasterly direction along Dry Fork Road a distance of approximately three miles. The western end of this traverse is adjacent to Minnesota Reservoir and outside the proposed E-seam mining influences of Longwall Panels E1 through E9 or planned Longwall Panels E10 through E12. The eastern end of this traverse is at the upper flume on the Dry Fork of Minnesota Creek (see Map 1).

Traverse A-A' is included in this report to provide context for other traverses that originate along this path and continue southward across the Southern Panels and Sunset Trail mining areas (see Maps 1 and 2).

No subsidence-related features were observed along this traverse during our spring 2021 field visit.

4.2 Traverse B-B'

Traverse B-B' begins where the Deer Creek drainage meets the Dry Fork Road (Traverse A-A'). It continues southward up the Deer Creek drainage to a gate located near two manufactured stock watering troughs (fed by a nearby spring) a distance of approximately 1.0 mile (see Map 1). Two additional stock ponds (P74 and P93) with earthen embankments are located lower in the drainage. Both of these ponds are also fed by nearby springs. This traverse is located above the E-South Mains and the western ends of mined E-seam Longwall Panels E3, E4, E5, and E6.

The only drill pad accessible from this traverse is that for MVB E5-20 which remains accessible as may be needed to help regulate outgassing from sealed E-seal Longwall Panel E5.

No subsidence-related features were observed along this traverse during the spring 2021 field visit.

Baseline observations were also made during WWE's spring 2021 field visit of the area between B′ and the area near the confluence of North and South Prong Creek including above unmined E-seam Longwall Panel E14 (see Map 1). The area traversed beyond B′ is represented on Map 1 by an orange dashed line.

4.3 Traverse C-C'

Traverse C-C' originates in the Deer Creek drainage adjacent to the lower stock pond (P74) and proceeds southward (after initially heading north and then east) over mined E-seam Longwall Panels E2, E3, E4, E5, E6, and E7 (see Map 1). E-seam overburden depths along this traverse vary from 450 feet in the Deer Creek drainage to approximately 900 feet over mined E-seam Longwall Panels E4 and E5.

Numerous MVB pads have been historically accessible from this traverse including E3-6, E3-12, E3-17.5, E3-21, E3-25, E4-15, E4-16, E4-17, E4-18, E5-17, and E5-18 over mined E-seam Longwall Panels E3 through E5. Each of these pads has now been reclaimed.

In 2016 and again in 2017, this traverse was extended southward across what is now mined E-seam Longwall Panels E6 and E7 to access MVB pads E6-13, E6-14, and E7-12. The MVB on pad E6-13 has now been plugged and abandoned, and the pad has been reclaimed. The drill pads for MVBs E6-14 and E7-12 remain accessible as may be needed to help regulate outgassing from sealed E-seal Longwall Panel E6 and E7, respectively.

During the fall 2018 field visit, a series of parallel subsidence cracks were observed in the road north of the MVB E7-12 pad. These cracks have healed and sealed to the point that they are difficult to identify. Parallel subsidence cracks with a N60°W orientation were also observed during the fall 2018 field visit along the road south of the E7-12 MVB pad. Evidence of these cracks is still observable. Observations from our spring 2021 visit to this location are provided below as Location 1.

A subsidence crack with an elevation offset was first observed during our fall 2019 field visit on the road leading to MVB E6-14 about 1,000 feet south of the pad. Details associated with our spring 2021 visit to this location are provided below as Location 2.

4.3.1 Location 1

Two parallel subsidence cracks were observed approximately 300 feet south of the E7-12 MVB pad during WWE's fall 2018 field work (Figure 1). These cracks had a N60°W orientation and an offset of about 13 feet. Observational evidence at that time (i.e., sharpness of crack edges) suggested that the cracks had not formed at the same time. The northern crack had rounded edges while the southern crack had sharp edges. E-seam overburden thickness at this location is about 800 feet.

Figure 1. Southeastward view during the fall 2018 field visit of two parallel subsidence cracks that appeared as a result of recent longwall mining beneath the area. The closer crack showed more rounded edges than the distant crack, suggesting the latter was more recently formed.

Observations made during the spring 2021 field visit found that the northern crack was nearly completely filled while the southern crack still had a measurable width and depth, particularly at the edges of the road. Both cracks showed signs of healing and weathering (Figure 2) since the previous field visit.

Figure 2. Southeastward view during the spring 2021 field visit of the same area shown in Figure 1.

4.3.2 Location 2

During the spring 2019 field visit, a subsidence crack was first observed approximately 1,000 feet north of the E6-14 MVB pad. This crack had a pronounced elevation offset across the crack of 6 inches (higher on the north) and extended completely across the road and beyond (20+ feet in length) in a N70°W orientation. The maximum dimensions were observed to be 24 inches both in width and depth. This location is over the tailgate entries of E-seam Longwall Panel E7 where tensional stresses are somewhat greater. E-seam overburden thickness at this location is about 800 feet.

Observations made during the spring 2021 field visit found that the crack was still evident with signs of weathering that had filled a large portion of the crack and rounded the edges (Figure 3).

Figure 3. Northwestward view during the spring 2021 field visit of a subsidence crack first observed during our spring 2019 field visit. The 6-inch elevation offset from north to south (right to left) is still present, but materials have filled the deepest portions of the crack and rounded the edges. This location is approximately 1,000 feet north of the MVB E6-14 pad.

4.4 Traverse D-D'

This traverse originates along the south side of the Dry Fork Road (Traverse A-A') and proceeds southward up Poison Gulch (i.e., the drainage east of Deer Creek). This traverse crosses mined E-seam Longwall Panels E3, E4, E5, E6, and E7 (see Map 1). The E-seam overburden depth along this traverse varies from less than 700 feet to almost 900 feet. This traverse leads southward from Traverse A-A', crosses the Dry Fork, and eventually leads to four MVB pads above mined E-seam Longwall Panel E7 (i.e., E7-8, E7-9, E7-10, and E7-11). The MVBs on pad E7-9, E7-10, and E7-11 have now been plugged and the pads at E7-10 and E7-11 have been reclaimed.

No subsidence features were observed along this traverse during our spring 2021 field visit.

4.5 Traverse E-E'

This traverse begins at Traverse A-A' and continues southward to an intersection with Traverse F-F' and then west and then south above mined E-seam Longwall Panels E5, E6, E7, and E8 (see

Map 1). All MVB pads along Traverse E-E' above mined E-seam Longwall Panels E5, E6, and E7 have now been reclaimed except MVB E5-11 and E7-6 (which are immediately adjacent to the road). Overburden along this traverse varies from about 900 to 1,020 feet.

This traverse provides access to MVBs E8-5 through E8-8 above mined E-seam Longwall Panel E8. MVB pad E8-5 has now been reclaimed.

Differential and subsidence cracks observed during the spring and fall 2019 field visits at the E8-6 pad could not be located during WWE's spring 2021 visit. As a result, no photographs of this location are included in this report.

Subsidence cracks had previously been observed at the fork in the road leading to the E8-7 and E8-8 pads. These cracks were difficult to identify during our spring 2021 field visit and the road leading to the MVB E8-7 pad was reclaimed.

4.6 Traverse F-F'

Traverse F-F' departs Traverse E-E' in a southeasterly direction over the east end of mined E-seam Longwall Panels E5, E6, E7, and E8. All of the MVB pads on the eastern end of mined Longwall Panels E5, E6, E7, and E8 have been reclaimed with the exception of MVB E6-4. The E-seam overburden depth along this traverse is from 1,000 feet to more than 1,200 feet. No subsidence features were observed during this spring 2021 field visit.

4.7 Traverse G-G'

Traverse G-G' departs Traverse F-F' in a southerly direction from the east end of mined E-seam Longwall Panel E7 (see Map 1). This traverse continues south over Lick Creek and to the east end of E-seam Longwall Panel SS1 of the Sunset Trail Mining Area. From this location, the traverse turns westward, and crosses mined and unmined portions of E-seam Longwall Panel SS1 to several MVB pads (i.e., SS1-1 through SS1-7). Longwall mining of E-seam Longwall Panel SS1 began in January 2020. At the time of WWE's spring 2021 field visit, the longwall face was located near the western end of the panel (i.e., west of MVB pad SS1-7).

No subsidence-related features were observed on pads SS1-1 through SS1-5. During the fall 2020 field visit, a series of small, sub-parallel cracks were observed between MVB SS1-5 and SS1-6. A follow-up visit to this location occurred during our spring 2021 field visit (Location 3) and found that these features were no longer visible.

Numerous subsidence features were observed along the remainder of this traverse as this was the area under which the most recent longwall mining occurred. Specifically, subsidence features were observed on MVB SS1-6 pad (Location 4), on the road immediately east of the MVB SS1-7 pad (Location 5), and on the MVB SS1-7 pad itself (Location 6). Specific details associated with the observations of these subsidence features are discussed below.

4.7.1 Location 3

Location 3 is a series of approximately eight small, sub-parallel cracks observed over a 60-foot reach of the road between MVB SS1-5 and SS1-6 (i.e., 240 to 300 feet east of the MVB SS1-6 pad) as initially observed during our fall 2020 field visit. Crack dimensions varied with maximum measurements of about 10 feet in length, 10 inches in depth, and 2 inches in width. At the time of our initial observation, longwall mining had recently passed beneath this area. The observed cracks overlie a portion of mined E-seam Longwall Panel SS1 that is within 200 feet of the tailgate entries and where the E-seam overburden depth is about 1,120 feet.

Attempts to relocate these same cracks during our spring 2021 field visit found little remaining evidence. As a result, no comparison images are provided.

4.7.2 Location 4

Multiple sub-parallel subsidence cracks were observed on the MVB SS1-6 pad. The most dominant cracks appear to be spaced approximately 6 to 8 feet apart and located within and north of the fenced area around the well head. These cracks are oriented in a direction between N20°W and N40°W. At the time of our spring 2021 field visit, the observed maximum dimensions of these cracks were 0.75 inch in width, 4 inches in depth and 25 feet in length. One of the cracks in the northeast portion of the pad is shown in Figure 4 with others further west shown in Figure 5. The E-seam overburden thickness beneath this pad is approximately 1,090 feet.

Figure 4. Southward view during the spring 2021 field visit of one the subsidence cracks located in the northeastern portion of the MVB SS1-6 pad. This particular crack is visible directly beneath the corner post of the fence as indicated by the black arrow. Several sub-parallel cracks (about 6-8 feet apart) were observed at this location with an orientation of about N20-40°W.

Figure 5. Southeastward view during the spring 2021 field visit of two additional sub-parallel sets of cracks located within and north of the fenced area around the wellhead on the MVB SS1-6 pad.

In addition to the larger sub-parallel subsidence cracks on the northern portion of the MVB SS1-6 pad, several additional smaller subsidence cracks were observed along the south side of the pad. These cracks were smaller in dimension but with similar orientation (Figure 6) suggesting subsidence as the source rather than differential settlement.

Figure 6. Northward view during the spring 2021 field visit of a two smaller subsidence cracks on the southern portion of the MVB SS1-6 pad (see black arrows).

4.7.3 Location 5

Location 5 is a series of at least three sub-parallel cracks observed over a distance of approximately 120 feet on the access road east of MVB SS1-7. The crack orientation in all cases is about N25°W, which is similar to that of the cracks observed on MVB SS1-7 (Location 6). One crack is located where the access road enters the pad (Figure 7) and has maximum dimensions of 0.5 inch in width and 5 inches in depth. This crack is most obvious on the north side of the road is non-contiguous and does not extend beyond the road edge. The second crack is located about 30 feet to the east of the first and has smaller maximum dimensions. This crack is also most obvious on the north side of the road (Figure 8).

Figure 7. Eastward view during the spring 2021 field visit of a subsidence crack located where the access road meets the MVB SS1-7 pad. This, and nearby cracks on the pad and road are the result of active mining occurring beneath this area.

Figure 8. Eastward view during spring 2021 of a second subsidence crack located approximately 30 feet east of the one shown in Figure 7 and with smaller maximum dimensions. Both cracks are most obvious on the north side of the road.

The third crack east of MVB SS1-7 is actually a series of three cracks located about 90 feet east of the second crack. This series crosses the road discontinuously with maximum dimensions of 1.75 inches in width, 18 inches in depth, and about 20 feet in length (Figure 9). E-seam overburden thickness in this is area varies from about 1,000 to 1,050 feet. Longwall mining had recently passed beneath this area at the time of our observations.

Figure 9. Northwestward view during the spring 2021 field visit of a subsidence crack first observed during our spring 2019 field visit. The 6-inch elevation offset from north to south (right to left) is still present, but materials have filled the deepest portions of the crack and rounded the edges. This location is approximately 1,000 feet north of the MVB E6-14 pad.

4.7.4 Location 6

A group of sub-parallel subsidence cracks with an orientation of N25°W were observed in the northwestern portion of the MVB SS1-7 pad as shown in Figure 10. The orientation was not consistent with differential settlement even though this appeared to be an area of the pad with the most fill placement. E-seam overburden thickness beneath this pad is about 1,000 feet. The maximum dimensions observed with these cracks was about 1 inch in width, 18 inches in depth, and approximately 40 feet in length.

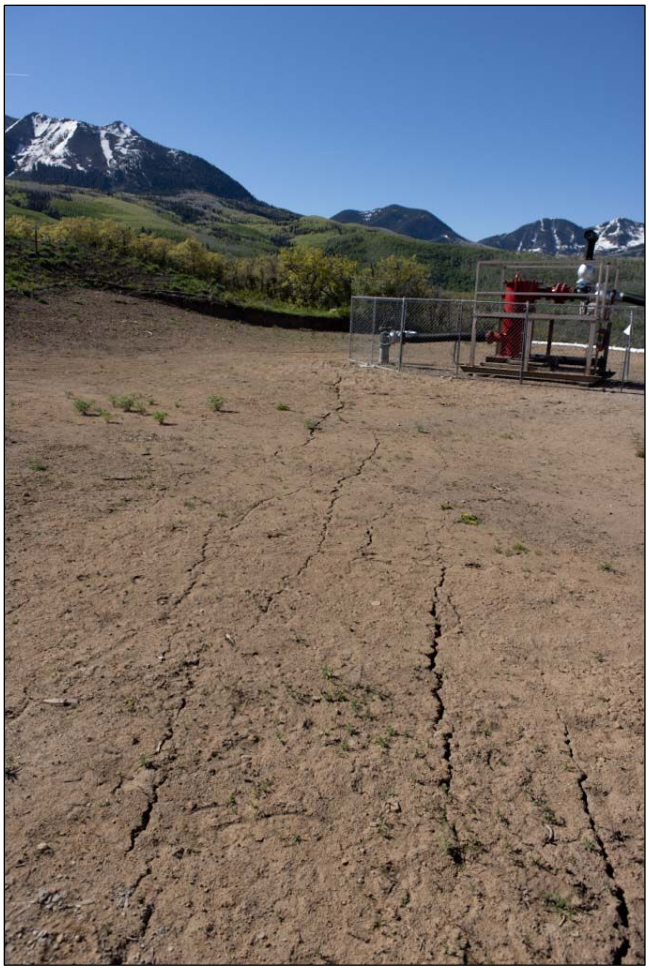

Figure 10. Southeastward view during the spring 2021 field visit of a group of sub-parallel cracks on the northwest portion of the MVB SS1-7 pad. Longwall mining had recently passed beneath this area.

4.8 Traverse H-H'

Traverse H-H' departs Traverse G-G' from a location just west of the intersection with a road leading to MVB pads SS1-2 and SS1-3. This traverse was visited on foot because vehicle access is currently restricted. This traverse follows the road, which leads south, then east, and eventually west around the headwaters of North Prong Creek and across unmined E-seam Longwall Panel SS2 to MVB SS2-5 (see Map 1). Observations made along this traverse were performed as reconnaissance of an area not previously visited.

Differential settlement cracks were observed on the largest fill portion of both completed pads (i.e., MVB SS2-3 and SS2-5). Neither of the completed pads included drilled ventilation boreholes at the time of our spring 2021 visit. No pads had been created for what will likely be MVB SS2-1, SS2-2, and SS2-4. The road across unmined E-seam Longwall Panel SS2 terminated at the MVB SS2-5 pad.

5.0 CONCLUSIONS

1. The conceptual B- and E-seam mining model presented in the Exhibit 60 series of the mining permit has been verified by annual field observations in the various West Elk Mine mining areas. With the use of longwall mining methods where the uniform downwarping of the overburden rocks and unconsolidated material act as laterally constrained plates, cracks in zones under tensile stress narrow with depth, and close at the neutral surface. Below the neutral surface, the materials are therefore in compression. This has an important bearing on the hydrologic consequences of longwall mining. Any groundwater or surface water in contact with a given subsidence crack is prevented from traveling downward beyond the neutral surface of the deformed plate. Annual field observations from 1996 to spring 2021, inclusive, verify this conceptual model in bedrock and surficial material (colluvium, alluvium, mudflow, and debris flow deposits) where the overburden is laterally constrained.

2. Typically, uniform downwarping occurs in association with longwall mining when there is lateral constraint. Where there are steep slopes and cliffs, there is little lateral support in at least one direction, which causes the associated rocks and unconsolidated materials to deform like unconstrained beams, plates, or cantilevers as the longwall mining faces move beneath them. This lack of lateral constraint allows subsidence cracks to commonly extend completely through sandstones and other brittle units, and groundwater or surface water present near or within these cracks will likely flow through and exit into existing surface drainages. The relatively few cliffs and over-steepened slopes in the Southern Panels Mining Area tend to provide the lateral constraint needed to produce a more uniform down-warping with fewer significant subsidence cracks observable at the surface.

3. To date, there have been no observed or reported surface water losses due to subsidence associated with longwall mining activities. A roof failure that happened while driving the E Mains southward in 2020 (temporarily capturing flow from S. Prong Creek) did not occur as a result of subsidence. Details surrounding this occurrence are discussed in TR-149 and resulted in revisions to Exhibit 60E regarding main entry development.

4. Continuous annual observations find substantial weathering of previously-observed subsidence cracks with edges rounding, widths reducing, and depths filling with eroded material. The only exception to these observations has been those cracks in thick, exposed, brittle sandstone units above previously mined B-seam panels (i.e., Apache Rocks) where rounding of edges and filling of cracks have occurred over time but widths have remained relatively constant.

5. The length of time that tension cracks are expected to be visible before the effects of erosion and deposition, mass wasting, infilling, and revegetation obliterate them (duration of cracks), is a function of their location with respect to the mine geometry and type of material in which the cracks formed. Crack duration in zones of permanent tensile stress, such as above mine boundaries and unmined pillars between longwall panels, commonly last: 1) from one to three years in colluvium, 2) from three to six years in soft, friable sandstone, and 3) many decades in hard, durable sandstone. However, cracks that form in the zone of temporary tensile stress, such as above moving longwall faces, commonly close again when the longwall moves out of their area of influence.

6. Observed mine-induced subsidence effects have been less in the Southern Panels Mining Area than were observed annually in the Box Canyon and Apache Rocks B-seam mining areas dating back to 1996. The more subdued topography and the fewer cliffs and ledges of the Southern Panels Mining Area reduce the potential for rockfall/landslide areas where E-seam mining has been underway since December 2008.

7. Field visits have revealed the healing and sealing capacity of cracks in surficial material by weathering, mass wasting, and crack infilling over time. This is particularly true in the colluvium that covers much of the surface of the Southern Panels Mining Area. The healing and sealing capacity of these materials cause softening and rounding of the crack edges as well as reduction of crack continuity and depth to a point of the cracks being nearly imperceptible within a year or two.

8. Mining activities within the Southern Panels Mining Area have caused no reported impacts on surface flow or induced inflows to the underground mine workings while mining

occurred directly beneath Lick Creek. A roof failure that happened while driving the E Mains southward in 2020 (temporarily capturing flow from S. Prong Creek) did not occur as a result of subsidence. Details surrounding this occurrence are discussed in TR-149 and resulted in revisions to Exhibit 60E regarding main entry development.

9. Subsidence-related effects were observed during the spring 2021 field visit at the following locations:

    - above mined E-seam Longwall Panel E7 (i.e., along Traverse C-C' on the access road south of MVB E7-12 [Location 1] and on the access road south of E6-14 [Location 2])

    - above mined E-seam Longwall Panel SS1-1 (i.e., along Traverse G-G' on the access road east of MVB SS1-6 [Location 3] and also along the access road east of MVB SS1-7 [Location 5]), and

    - above mined E-seam Longwall Panel SS1-1 (i.e., along Traverse G-G' at MVB pad SS1-6 [Location 4] and also at MVB pad SS1-7 [Location 6]).

All subsidence-related features were within the expected angle of draw for the E-seam and were generally focused in areas of maximum temporary tensile stress, such as above current or recent longwall mining activities.

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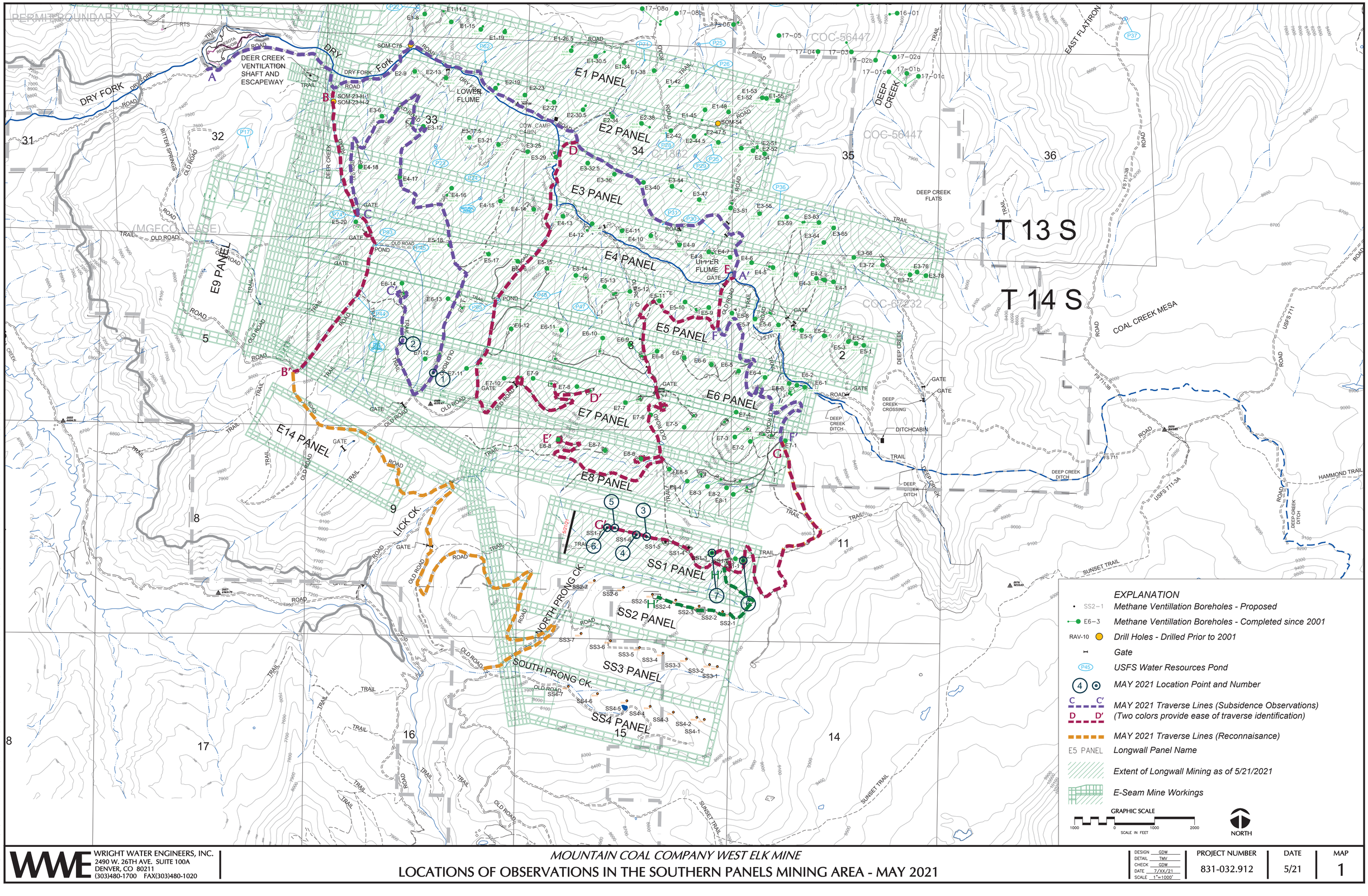
MAPS



EXPLANATION

- SS2–1 *Methane Ventillation Boreholes - Proposed*
- E6–3 *Methane Ventillation Boreholes - Completed since 2001*
- RAV-10 *Drill Holes - Drilled Prior to 2001*
- *Gate*
- P45 *USFS Water Resources Pond*
- 4 *MAY 2021 Location Point and Number*
- C C′ / D D′ *MAY 2021 Traverse Lines (Subsidence Observations) (Two colors provide ease of traverse identification)*
- *MAY 2021 Traverse Lines (Reconnaisance)*
- E5 PANEL *Longwall Panel Name*
- *Extent of Longwall Mining as of 5/21/2021*
- *E-Seam Mine Workings*

GRAPHIC SCALE
1000 0 1000 2000
SCALE IN FEET

NORTH

WRIGHT WATER ENGINEERS, INC.
2490 W. 26TH AVE. SUITE 100A
DENVER, CO 80211
(303)480-1700 FAX(303)480-1020

MOUNTAIN COAL COMPANY WEST ELK MINE

LOCATIONS OF OBSERVATIONS IN THE SOUTHERN PANELS MINING AREA - MAY 2021

DESIGN	GDW
DETAIL	TMV
CHECK	GDW
DATE	7/XX/21
SCALE	1"=1000'

PROJECT NUMBER	DATE	MAP
831-032.912	5/21	1

Plot Date/Time: 06/25/2021, 03:55:57 PM; Z:\PROJECT FILES\72-99\831-032\831-032.912\CAD-GIS\CAD\SPRING 2021\01_DWGS\BASE_2021_SPRING.DWG-SOUTH OF DIVIDE (24X36)

PERMIT BOUNDARY

VENTILATION SHAFT AND ESCAPEWAY

SHEAR ZONE

LANDSLIDE SCARP

DRY FORK

DRY FORK FORD

LOWER FLUME

UPPER FLUME

POND

GATE

OLD ROAD

ROAD

TRAIL

DEEP CREEK

DEEP CREEK FLATS

DEEP CREEK CROSSING

DEEP CREEK DITCH

DITCHCABIN

DEEP CREEK DITCH (TRANS-BASIN DIVERSION)

COAL CREEK MESA

EAST FLATIRON

SUNSET TRAIL

HAMMOND TRAIL

USFS 711

USFS 711-3A

USFS 711-38

USFS 711-3B

(MGFCO) EAST

COC-56447

COC-67230

E1 PANEL

E2 PANEL

E3 PANEL

E4 PANEL

E5 PANEL

E6 PANEL

E7 PANEL

E8 PANEL

E9 PANEL

E14 PANEL

SS1 PANEL

SS2 PANEL

SS3 PANEL

SS4 PANEL

T 13 S

T 14 S

M-H

H-VH

L-M

L

VH

SOM-075

SOM-23.3-R-1

SOM-23-H-2

SOM-54

17-08a

17-08b

17-06

17-05

17-04

17-03

17-02b

17-02d

17-01a

17-01b

17-01c

16-01

EXPLANATION

- *Landslide or Landslide Area Showing Boundary as of July 1963*
- *Renewed Activity or Change in Area after July 1963*
- *Rockfall or Rockfall Area, Showing Boundary as of July 1963*
- *Renewed Activity or Change in Area after July 1963*
- *Rockfall and Landslide Area, Showing Boundary as of July 1963*
- *Renewed Activity or Change in Area after July 1963*
- *Observed Rockfall or Landslide Area, Showing Boundary since December 2008*

L *Low* M *Moderate* H *High* VH *Very High*

NORTH

GRAPHIC SCALE
1000 0 1000 2000
SCALE IN FEET

WWE
WRIGHT WATER ENGINEERS, INC.
2490 W. 26TH AVE. SUITE 100A
DENVER, CO 80211
(303)480-1700 FAX(303)480-1020

MOUNTAIN COAL COMPANY WEST ELK MINE

LANDSLIDES AND ROCKFALLS IN THE SOUTHERN PANELS MINING AREA - MAY 2021

DESIGN	GDW
DETAIL	TMV
CHECK	GDW
DATE	07/XX/21
SCALE	1"=1000'

PROJECT NUMBER	DATE	MAP
831-032.912	5/21	2

Plot Date/Time: 06/25/2021, 03:56:15 PM; Z:\PROJECT FILES\72-99\831-032\831-032.912\CAD-GIS\CAD\SPRING 2021\01_DWGS\LSRF 2021-SPRING.DWG-SOUTH OF DIVIDE (24X36)

APPENDIX A

Forest Service Road and Stock Pond Inspection Forms

Forest Service Roads
Inspection Form

Date: 4/29/2021
Time: 11:30
Name of Inspector: Robert Munz
Current Panel and XC Being Mined: LW 551 12-13 XC
Road(s) Being Inspected: Dry Fork

Yes	No	
☐	☒	Is the Forest Service road within the projected angle of draw of subsidence? If yes, which road(s):
☐	☒	Are there visible surface cracks on the road? If yes, describe (location, width, length, etc.):
☐	☒	Is there any recent evidence of potential subsidence induced slope failure? If yes, describe:
☐	☒	Are there any other potentially damaging, subsidence induced features on or near the road? If yes, describe:
☐	☒	Is mitigation needed? If yes, list suggestions:

Notes:

Signature of Inspector: Robert Munz

* If any potential subsidence induced features are observed that could cause harm to the public or operations, notify Jessica Wilczek immediately.

Forest Service Roads
Inspection Form

Date: 5/27/2021
Time: 12:30
Name of Inspector: Robert Munz
Current Panel and XC Being Mined: LW 551 ≈10XC
Road(s) Being Inspected: Dry Fork

Yes	No	
☐	☒	Is the Forest Service road within the projected angle of draw of subsidence? If yes, which road(s):
☐	☒	Are there visible surface cracks on the road? If yes, describe (location, width, length, etc.):
☐	☒	Is there any recent evidence of potential subsidence induced slope failure? If yes, describe:
☐	☒	Are there any other potentially damaging, subsidence induced features on or near the road? If yes, describe:
☐	☒	Is mitigation needed? If yes, list suggestions:

Notes:

Signature of Inspector: _____

* If any potential subsidence induced features are observed that could cause harm to the public or operations, notify Jessica Wilczek immediately.

Forest Service Roads
Inspection Form

Date: 6/21/21
Time: 12:30
Name of Inspector: Robert Munz
Current Panel and XC Being Mined: LW552 26XC
Road(s) Being Inspected: DRY Fork & Deer Creek.

Yes	No	
☐	☒	Is the Forest Service road within the projected angle of draw of subsidence? If yes, which road(s):
☐	☒	Are there visible surface cracks on the road? If yes, describe (location, width, length, etc.):
☐	☒	Is there any recent evidence of potential subsidence induced slope failure? If yes, describe:
☐	☒	Are there any other potentially damaging, subsidence induced features on or near the road? If yes, describe:
☐	☒	Is mitigation needed? If yes, list suggestions:

Notes:

Signature of Inspector: _____

* If any potential subsidence induced features are observed that could cause harm to the public or operations, notify Jessica Wilczek immediately.

Stock Pond
Inspection Form

Date: 4/29/2021
Time: 12:00
Name of Inspector: Robert Munz
Current Panel and XC Being Mined: LW 551 between 12 & 13 XC
Stock Pond(s) Being Inspected: DF ~~MB~~ 35

Yes	No	
☐	☒	Is the stock pond within twice the projected angle of draw of subsidence? If yes, which pond(s):
☐	☒	Are there visible surface cracks in or near the stock pond? If yes, describe (location, width, length, etc.):
☐	☒	Is there any evidence of potential subsidence induced water loss? If yes, describe:
☐	☒	Is there water in the pond? If yes, describe:
☐	☒	Is mitigation needed? If yes, list suggestions:

Notes:

Signature of Inspector: _____

* If any potential subsidence induced features are observed that could cause harm to the pond, notify Jessica Wilczek immediately.

Stock Pond
Inspection Form

Date: 5/27/2021
Time: 12:00
Name of Inspector: Robert Munz
Current Panel and XC Being Mined: LW 551 approximately 10 xc
Stock Pond(s) Being Inspected: DF-~~46~~ 35

Yes	No	
☐	☒	Is the stock pond within twice the projected angle of draw of subsidence? If yes, which pond(s):
☐	☒	Are there visible surface cracks in or near the stock pond? If yes, describe (location, width, length, etc.):
☐	☒	Is there any evidence of potential subsidence induced water loss? If yes, describe:
☐	☒	Is there water in the pond? If yes, describe:
☐	☒	Is mitigation needed? If yes, list suggestions:

Notes:

Signature of Inspector: _____

* If any potential subsidence induced features are observed that could cause harm to the pond, notify Jessica Wilczek immediately.

Stock Pond
Inspection Form

Date: 6/21/2021
Time: 12:00
Name of Inspector: Robert Munz
Current Panel and XC Being Mined: LW 552 26 XC
Stock Pond(s) Being Inspected: ~~DF~~ 35

Yes	No	
☐	☒	Is the stock pond within twice the projected angle of draw of subsidence? If yes, which pond(s):
☐	☒	Are there visible surface cracks in or near the stock pond? If yes, describe (location, width, length, etc.):
☐	☒	Is there any evidence of potential subsidence induced water loss? If yes, describe:
☐	☒	Is there water in the pond? If yes, describe:
☐	☒	Is mitigation needed? If yes, list suggestions:

Notes:

Signature of Inspector: _____

* If any potential subsidence induced features are observed that could cause harm to the pond, notify Jessica Wilczek immediately.

APPENDIX B

Monument Dam Inspection Forms

Monument Dam
Inspection Form

Date: 4/29/2021
Time: 11:00
Name of Inspector: Robert Munz
Current Panel Being Mined: LW551
☐ Weekly Inspection ☒ Monthly Inspection

Yes	No	
☐	☒	Is mining within 1 mile of Monument Dam?
☐	☒	Are there visible surface cracks on the dam? If yes, indicate length and size of crack. _____.
☐	☒	Is there evidence of subsided areas on or around the dam? If yes, indicate where and degree. _____.
☐	☒	Are there bulges on the dam? If yes, indicate where and degree. _____.
☐	☒	Are there signs of seeps on the dam? If yes, indicate where and estimated flow._____.
☐	☒	Are there any other potentially damaging features on the dam? If yes, describe. _____.
☐	☒	Are there any recent evidences of slope failure on the landside south of the dam (perform visual inspection and data analysis of inclinometers)? If yes, describe. _____.

Notes:

Signature of Inspector: _____

Inspections are performed under the direction of Jessica Wilczek, P.E.

If cracks or other potentially damaging features occur, notify Jessica Wilczek immediately.

Monument Dam
Inspection Form

Date: 5/27/2021
Time: 1:00 PM
Name of Inspector: Robert Munz
Current Panel Being Mined: LW551
☐ Weekly Inspection ☒ Monthly Inspection

Yes	No	
☐	☒	Is mining within 1 mile of Monument Dam?
☐	☒	Are there visible surface cracks on the dam? If yes, indicate length and size of crack. _____.
☐	☒	Is there evidence of subsided areas on or around the dam? If yes, indicate where and degree. _____.
☐	☒	Are there bulges on the dam? If yes, indicate where and degree. _____.
☐	☒	Are there signs of seeps on the dam? If yes, indicate where and estimated flow._____.
☐	☒	Are there any other potentially damaging features on the dam? If yes, describe. _____.
☐	☒	Are there any recent evidences of slope failure on the landside south of the dam (perform visual inspection and data analysis of inclinometers)? If yes, describe. _____.

Notes:

Signature of Inspector: _____

Inspections are performed under the direction of Jessica Wilczek, P.E.

If cracks or other potentially damaging features occur, notify Jessica Wilczek immediately.

Monument Dam
Inspection Form

Date: 6/21/21
Time: 3:00PM
Name of Inspector: Robert Munz
Current Panel Being Mined: LW 552
☐ Weekly Inspection ☒ Monthly Inspection

Yes	No	
☐	☒	Is mining within 1 mile of Monument Dam?
☐	☒	Are there visible surface cracks on the dam? If yes, indicate length and size of crack. _____.
☐	☒	Is there evidence of subsided areas on or around the dam? If yes, indicate where and degree. _____.
☐	☒	Are there bulges on the dam? If yes, indicate where and degree. _____.
☐	☒	Are there signs of seeps on the dam? If yes, indicate where and estimated flow._____.
☐	☒	Are there any other potentially damaging features on the dam? If yes, describe. _____.
☐	☒	Are there any recent evidences of slope failure on the landside south of the dam (perform visual inspection and data analysis of inclinometers)? If yes, describe. _____.

Notes:

Signature of Inspector: _____

Inspections are performed under the direction of Jessica Wilczek, P.E.

If cracks or other potentially damaging features occur, notify Jessica Wilczek immediately.

APPENDIX C

Monument Dam Monitoring Data

Spring 2021 Semi- Annual Subsidence Report
Appendix C
Table 1
Monument Dam Survey Data

		Fall 2020 to Spring 2021 Easting Displacement (X)	Fall 2020 to Spring 2021 Northing Displacement (Y)	Fall 2020 to Spring 2021 Elevation Displacement (Z)
	Survey Points	Displacement (ft)	Displacement (ft)	Displacement (ft)
Monument Dam	6001	-0.12	0.00	-0.07
	6003	-0.11	-0.03	-0.19
	6004	-0.12	-0.04	-0.10
	6005	-0.07	-0.02	-0.10
	6006	Not surveyed **	Not surveyed **	Not surveyed **
	6007	-0.08	0.06	-0.07
	6008	-0.10	0.05	0.00
	6009	-0.10	-0.01	-0.09
	6010	-0.08	-0.01	-0.11
	6011	-0.05	-0.02	-0.19
	6012	-0.15	0.08	0.03
Hillside south of road past Monument Dam	7000	-0.14	-0.04	-0.04
	7001	-0.15	0.01	-0.03
	7002	-0.12	0.06	-0.08
	7003	0.00	-0.11	-0.20
	7004	Not surveyed *	Not surveyed *	Not surveyed *
	7005	Not surveyed *	Not surveyed *	Not surveyed *
	7006	-0.11	-0.03	-0.10
	7007	-0.07	0.07	-0.21
	7008	-0.32	-0.03	-0.44
	7009	-0.15	0.11	-0.06
	7010	Not surveyed **	Not surveyed **	Not surveyed **
	7011	-0.10	0.11	-0.10
	7012	0.67	0.59	0.67
	7013	0.14	0.44	1.23
	7014	0.13	0.26	0.20
	7015	0.50	1.12	-0.70
	7016	0.15	0.23	0.00
	7017	-0.22	0.07	-0.17
	7018	Not surveyed *	Not surveyed *	Not surveyed *
	7019	-0.12	0.02	-0.04
	7020	-1.07	-0.88	1.39
	7021	Not surveyed *	Not surveyed *	Not surveyed *
	7022	0.30	0.60	0.77
	7023	Not surveyed *	Not surveyed *	Not surveyed *
	7024	Not surveyed *	Not surveyed *	Not surveyed *
	7025	0.48	0.54	-0.44
	6501	-0.18	0.59	-0.41
	6502	0.14	0.34	-0.06
	6503	Not surveyed **	Not surveyed **	Not surveyed **
	6504	Not surveyed **	Not surveyed **	Not surveyed **

* Survey monument not avalible in fall due to damage, obstruction, ect.
** Survey monument not avalible in spring due to damange, obstruction, ect.

DENVER
2490 W. 26th Avenue Suite 100A
Denver, Colorado 80211
Phone: 303.480.1700
Fax: 303.480.1020

GLENWOOD SPRINGS
818 Colorado Avenue
P.O.Box 219
Glenwood Springs, Colorado 81602
Phone: 970.945.7755
Fax: 970.945.9210

DURANGO
1666 N. Main Avenue Suite C
Durango, Colorado 81301
Phone: 970.259.7411
Fax: 970.259.8758

www.wrightwater.com

Wright Water Engineers, Inc.