

OGMCOAL - West Ridge: PHC Document

From: Steve Christensen
To: jt@etv.net
Date: 4/7/2011 4:51 PM
Subject: West Ridge: PHC Document
CC: OGMCOAL
Attachments: West Ridge PHC.pdf

Mr. Johansen,

Attached is the revised PHC document. The discussion of impacts to Grassy Trail Reservoir begin on page 7-25. I went ahead and included some additional information from the hydrology section of the West Ridge Plan.

On page 7-41, the plan discusses the addition of monitoring sites LF-1 and RF-1. The sites are located on the Left Fork and Right Fork of Whitmore Canyon. Once the flumes are rehabilitated, continuous flow data collection will be begin. These are the additional monitoring sites that were established when we approved the Penta Creek lease additions.

Let me know if you have any more questions, or if you want any additional information. If you're interested, I could scan and send the RB&G Seismicity report. They discuss the extensive subsidence monitoring that has been done (and continues to this day) in the area surrounding Grassy Trail Reservoir.

Regards,
Steve

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R645-301-726 Modeling

No numerical models have been created for the permit area.

R645-301-727 Alternative Water Source Information

The determination of the probable hydrologic consequences (R645-301-728) indicates that the proposed coal mining activities will not result in the contamination, diminution, or interruption of groundwater or surface-water sources within the proposed or adjacent areas. Therefore, WEST RIDGE Resources, Inc. has not prepared information regarding alternative water sources.

R645-301-728 Probable Hydrologic Consequences (PHC) Determination

This section describes the probable hydrologic consequences (PHC) of underground coal mining in the permit area. This determination is based on the data and information presented previously in this chapter and by Mayo and Associates (1997; Appendix 7-1, 2001; Appendix 7-1A). The PHC will be updated, if needed, following the collection and analyses of information gathered during the 1998 field season.

728.310 Potential adverse impacts to the hydrologic balance

Longwall coal mining may result in land subsidence and bedrock fracturing. Subsidence and fracturing have the potential to impact the hydrologic balance if fracturing increases the vertical hydraulic conductivity of overburden rock. Possible consequences of fracturing include decreasing discharge rates of near-surface groundwater while increasing the recharge rates of deeper groundwater systems.

Mining will occur in the Lower Sunnyside Seam of the Blackhawk Formation. Over 90% of the springs in the West Ridge area discharge from near-surface groundwater systems in alluvial/colluvial materials and the Colton and North Horn Formations. The thick interburden between the mined horizon and the near-surface groundwater systems and the presence of swelling clays in the North Horn Formation will prevent fracturing and subsidence from increasing vertical hydraulic conductivities and decreasing spring discharge rates.

Groundwater that is encountered by mining operations will likely be old, meaning that recharge occurred thousands of years in the past. Well DH86-2 encountered water in the Sunnyside Sandstone below the coal seam to be mined. This water has a radiocarbon age in excess of 11,000 years.

Groundwater systems encountered in the Blackhawk Formation occur in isolated

sandstone paleochannels, fractures, and faults. These groundwater systems are not in active hydraulic communication with the surface and have limited areal and vertical extent. Mining could dewater some of these systems if they are intercepted during mining operations. Because of the limited spatial extent of these systems, discharge from these isolated groundwater systems will cease soon after interception by mine workings.

Mining could also encounter water impounded in the old Sunnyside mine workings. In order to avoid accidentally mining into flooded workings, the West Ridge mine will perform exploratory drilling ahead of development when active mine works are within 500 feet of the projected Sunnyside workings. Face drills will be used to drill at least 100 feet out in advance of the actual mine face development. The exploratory face drill will be a small diameter and if water is encountered from the old works the drill hole can easily be plugged and sealed. The West Ridge mine plan assumes that development will proceed to within 300 feet of the old works. West Ridge mine intends to stay away from the old works but will drill ahead as a precautionary measure in the event that the mine maps or surveying has a margin of error.

Based on the analysis of the probable hydrologic consequences (PHC), it has been concluded that it is highly unlikely that mining in the West Ridge area will result in the decrease of groundwater discharge rates.

Grassy Trail Creek above Grassy Trail Reservoir flows across the WEST RIDGE permit area. The stream channel in this area is underlain by approximately 2,000 feet of cover, which includes the entire thickness of relatively unfaulted and unfractured North Horn Formation, which is known to form an effective barrier to vertical groundwater migration (Mayo and Associates, 1998) and is known to contain hydrophillic clays that swell when wetted to seal any fractures that may form. Therefore, the potential for the interception and diminution of surface water flows in Grassy Trail Creek as a result of mining induced subsidence is minimal. Where differential subsidence may potentially occur beneath Grassy Trail Creek, such as along longwall panel ends or above gate roads, there is the potential for localized increases or decreases in stream gradients. These changes can result in minor changes to the stream morphology, including changes in the number of pools, runs, glides, etc. Differential subsidence of the channel substrate also has the potential to result in temporary increases or decreases in sediment yield. However, because a steep, mountain stream flowing on alluvial or soft bedrock substrate has the tendency to rapidly erode elevated areas and deposit sediment in lowered areas, these effects are commonly short-lived, as the stream system is rapidly brought back into equilibrium.

In order to assess the impacts of full extraction mining beneath perennial streams in the Utah Coal District, several comprehensive investigations of the Burnout Canyon drainage above Canyon Fuel's Skyline Mine have been conducted (Forest Sciences Laboratory, 1998; Sidel, 2000). The findings of these investigations indicated that 1) baseflow discharge rates during and after subsidence of the drainage were not statistically different at the 0.05 level, 2) there was no indication that water was lost

from Burnout Creek as a result of longwall undermining of the drainage, and 3) some minor changes in stream morphology, including changes in the pool/riffle ratio of the stream channel were noted; however, similar changes in the study's control area (James Canyon) were also noted, indicating that the observed morphological changes could have been at least in part the result of non-mining-related factors. They found that the changes in channel morphology were generally short lived. Subsequent to the publication of these investigations, the Burnout Canyon drainage has been further subsided as a result of multiple seam extraction beneath the creek. No perceptible or quantifiable impacts to the drainage have been detected as a result of this mining activity (USFS, 2001).

Burnout Creek and upper Grassy Trail Creek, both being relatively steep-gradient mountain streams, are in many senses generally comparable. However, while overburden thicknesses in the Burnout Canyon area range from about 600 to 850 feet, overburden thicknesses beneath Grassy Trail Creek are approximately 2,000 feet. Therefore, it is reasonable to assume that the hydrologic impacts to upper Grassy Trail Creek, where only single seam extraction under significantly greater cover, will be similar to (or lesser than) the minimal impacts experienced in the Burnout Canyon area.

For the reasons discussed above, it is believed that the impacts to Grassy Trail Creek above Grassy Trail Reservoir as a result of longwall mining beneath the creek will be negligible.

No mining is proposed beneath or within the angle of draw of Grassy Trail Reservoir. Therefore, the potential for loss of water from reservoir leakage is believed to be negligible.

Bear Canyon is situated in the northwest portion of the permit area within the SITLA lease area. This canyon is unique because it is within the right fork of this drainage that the cover over the longwall subsidence zone is the shallowest of anywhere in the entire permit area. In one part of the bottom of the (right fork) Bear Canyon drainage the cover over the longwall panes is approximately 325'. Due to the increased potential for the effects of subsidence to reach the surface in this area special attention has been focused on the hydrologic character of the Bear Canyon drainage.

Bear Canyon is typical of the canyons draining the southwest-facing front slopes of the Book Cliffs in this area. These canyons are generally shorter and drier than those drainages on the back-side of the Cliffs. Several baseline surveys of Bear Canyon right fork done in the late 1980's showed the drainage to be mostly dry and the canyon was identified as ephemeral along with other similar front-facing canyons in the permit area, such as "C" Canyon, "B" Canyon, and "A" Canyon. However, during site visits in June and July of 2005, substantial stream-flow was observed in the drainage. This occurrence of flow, along with the observation of riparian vegetation in the lower stretches of the canyon, has led to a re-evaluation of the classification of the drainage as intermittent. Also, because the area of the Bear

Canyon watershed is greater than one square mile the drainage is classified as intermittent under DOGM regulations.

Historical observation of Bear Canyon shows the streamflow in the bottom of the drainage to be a combination of surface flow and subsurface flow. In those areas where bedrock is at or close to the surface, flow is forced up to the surface. In other areas where the alluvium in the channel is thick and porous the flow is subsurface and the stream channel is often dry. The stretches of channel exhibiting surface flow as opposed to subsurface flow will vary from season to season, and year to year depending on prior precipitation trends in the watershed. There are times when the entire length of the channel could be expected to exhibit surface flow, and other times when surface flow is confined to certain segments. And, according to past monitoring observations, there are often times when there is no flow in the stream channel. In order to better define the hydrologic character of the canyon WEST RIDGE Resources will expand the monitoring program in Bear Canyon by adding two new monitoring sites and relocating a third site (see Map 7-7 and Table 7-1).

As mentioned previously, there is a point in the right fork of Bear Canyon where cover over the longwall panel will be about 325' which is the shallowest surface cover of any place within the current WEST RIDGE mine plan. This, along with the fact that there are state-appropriated surface water rights in this drainage (refer to Appendix 7-5), makes this an area of special interest. There is reason to expect that full-extraction longwall mining will not adversely affect the hydrologic resources of the canyon in this area. According to Syd S. Peng, ("Coal Mine Ground Control", 1978, Wiley, New York) a general rule-of-thumb is that subsidence-related fractures can be expected for a distance above the coal seam equal to 50 times the mining height, which works out to be 316' for the shallow point in Bear Canyon, which is slightly less than the cover in that area. Therefore due to the shallowness of cover in this area there could be subsidence fractures which reach the surface in the bottom of the canyon, and mitigation will be done to protect the resource.

The shallow overburden point coincides with the inflection point of the longwall subsidence profile. Based on a 22 degree angle of draw the tension zone will extend along the surface from the inflection point (shallow point) downstream approximately 130'. Areas upstream from the inflection point will be in compression as the longwall panel are extracted in progression from the southwest to the northeast according to the approved mining plan. Cracks are more likely to open up in the tension zone as compared to the compression zone where lateral forces are pushing toward each other rather than pulling apart. As mining progresses to the northeast, cover increases rapidly because of the gradient of the channel bottom and the dip of the coal seam, and surface effects of subsidence should diminish in that direction. Therefore, it is expected that any cracking which might reach the surface should most likely appear in the canyon bottom in the 130' (plus/minus) tension zone down-canyon from the inflection point. Special subsidence monitoring will be focused on this area.

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WEST RIDGE will establish two new hydrologic monitoring sites in the right fork of Bear Canyon. The first site (ST-11) will be located within the tension zone described above. This site was chosen because this location should be well-suited to determine if tension cracks have affected stream flow. It is also, coincidentally, one of the areas where the bedrock nature of the channel bottom forces water to the surface, thereby making streamflow measurements more accurate. The second site (ST-12) will be located about 2400' farther up-canyon in another area where, again, the bedrock nature of the channel allows for a more accurate streamflow measurement. A third monitoring site (ST-13) will be located below the forks of Bear Canyon just outside the permit area boundary. This site will replace the existing monitoring site ST-4.

During the flow season of 2005 and 2006 (that is, May 15 through September 15) site ST-11 will be monitored monthly as long as flow is present. This monthly monitoring will help better define the nature of streamflow prior to longwall extraction in the area, which is presently scheduled for May, 2007. Thereafter, monitoring will be done on the regular quarterly basis. Site ST-12 is more inaccessible, and could be dangerous to reach in the winter. Therefore this site will be monitored twice a year, once during late spring/early summer (expected peak flow) and once in late summer/early fall, when the canyons are normally much drier. Site ST-13 will be monitored quarterly.

The longwall is presently scheduled to pass under Bear Canyon in the spring of 2007. Prior to that, WEST RIDGE will complete a survey of a series of subsidence monitoring points established up the bottom of the drainage on either side of the inflection point. After the longwall has passed under the drainage these points will be re-surveyed and an accurate account undermined WEST RIDGE will visually inspect the area to determine if any effects of subsidence are apparent. Within thirty days of the inspection WEST RIDGE will submit a written report to the Division outlining the results of this inspection .

Recent site visits have determined the existence of riparian type vegetation in the lower reaches of Bear Canyon below the forks. WEST RIDGE commits to preparing a detailed vegetation survey and mapping of the canyon bottom with emphasis on the existence of riparian specie. This survey will be conducted during the growing season of 2005 or 2006. The survey will be done in consultation with Division biologists and the completed report will be added to the Mining and Reclamation Plan as an appendix.

If it is determined that mining-related subsidence has adversely impacted the hydrologic resources of Bear Canyon, including and state-appropriated water rights, WEST RIDGE will mitigate the damage. The first option would be to seal any cracks with the application of bentonite clay. Bentonite sealing compounds are available commercially made specifically for such applications. If bentonite sealing proved ineffective, WEST RIDGE would propose the installation of piping to

transport stream water across the fracture zone to continue the flow downstream. Any work done in the stream channel would most likely require the issuance of a channel alteration permit from the Utah Division of Water Rights.

Adverse impacts to the hydrologic balance resulting from the installation and operation of the Bear Canyon gob vent holes (GVH) are not anticipated. The basis for this conclusion is summarized below.

The gob vent holes will be constructed in a manner that minimizes the potential for adverse impacts to groundwater and surface-water resources and the hydrologic balance in the area. The proposed construction designs for the GVH holes include a nominal 20 foot length of 16-inch non-perforated steel surface casing that will be cemented in place. The surface casings will isolate the wells from surface-water, soil moisture, and any shallow groundwater potentially present in the upper 20 feet and will prevent shallow water from entering the GVH wells. From approximately 20 to 200 feet below the surface, the proposed well construction plans call for the placement of 9.625-inch non-perforated steel casing that will be cemented into place. The cemented steel well casing will isolate groundwaters that may be present in bedrock groundwater systems in the upper 200 feet from the GVH wells and prevent the inflow of groundwater into the wells.

Proposed construction plans call for the lower approximately 150 feet of the GVH wells to be cased with 8.75-inch slotted steel casing that will be left open to the rock strata and will not be cemented. The purpose of the slotted steel casing is to allow the drainage of gob gasses into the well bore in the fractured rock strata overlying the Panel 8 gob. While there is the potential for drainage of some Blackhawk Formation groundwater into the GVH holes in the 150 feet interval overlying the longwall gob, the potential for appreciable or sustained groundwater drainage through these wells is minimal. This is because 1) groundwater systems in the Blackhawk Formation occur in hydraulically isolated groundwater partitions that are not in hydraulic communication with adjacent groundwater partitions, which limits the amount of groundwater that could potentially be drained, 2) the GVH holes are situated near the up-dip ends (outcrop locations) of the Castlegate Sandstone and Blackhawk Formation which limits groundwater recharge potential and the potential for the interception of regional groundwater systems, and 3) the 150-foot interval of the Blackhawk Formation overlying the gob area was likely intensely fractured as a result of the longwall mining prior to the construction of the wells which would likely have drained the groundwater partitions immediately overlying the gob area at the time of mining. For these reasons, the potential for drainage of appreciable groundwater or surface-water resources through the GVH drill holes is considered low.

The potential for detrimental impacts to the ephemeral Bear Canyon Creek drainage or any associated alluvial groundwater systems is considered remote. Appreciable baseflow alluvial groundwater systems were not identified near the GVH location during the 7 October 2008 site visit. Additionally, because the GVH well bores will

be hydraulically isolated from the upper approximately 200 feet, the potential for impacts to water quality in the drainage are unlikely. The implementation of appropriate sediment control management practices will minimize the potential for increased sediment yield from the GVH site during the construction and operational phases of the GVH system.

Prior to final reclamation, the GVH drillholes will be plugged and sealed in accordance with State and Federal regulations. The casings will be plugged at the bottom to hold the concrete. A lean concrete mixture will be poured into the casing until the concrete is within five feet of the surface. At that time the casing will be cut off at ground level and the rest of the casing will be filled with lean concrete. The concrete will be allowed to harden before final reclamation is completed. In this manner, the potential for any long-term impacts to the hydrologic balance resulting from the GVH system will be minimized.

Spring Canyon is located in the northern part of the permit area in SITLA lease 44771. There are no state-appropriated water rights on this lease. (Refer to Appendix 7-5 for additional details.) The surface is privately owned by Penta Creek with whom WEST RIDGE maintains coal mining rights. Longwall mining in this area is not scheduled until the year 2014. In this area the coal seam is 2500' deep under the bottom of the Canyon. Spring Canyon, as the name would imply, contains several springs. The drainage area of Spring Canyon is well in excess of one square mile. The canyon supports a number of beaver dams indicative of perennial flow. WEST RIDGE will add three additional monitoring points to collect baseline water monitoring data in Spring Canyon, namely ST-15 located upstream from the junction of Grassy Trail Creek, SP-101 located on a channel-bottom spring a short ways up Little Spring Canyon (a fork of Spring Canyon), and SP-102 located about 1000' upstream from the junction of Little Spring Canyon. This spring emanates from the west side of the canyon approximately 200' up from the canyon bottom. Refer to Map 7-7 and Table 7-1 for details. For the first two years (starting with the third quarter of 2005) these sites will be monitored on a quarterly basis for baseline data according to the field measurements and laboratory measurements outlined in Table 7-2 (Surface Monitoring) and Table 7-3 (Groundwater Monitoring). Thereafter, all sites will be monitored for flow and field parameters on a quarterly basis.

The Grassy Trail Dam and Reservoir is located immediately outside the eastern boundary of the permit area. This dam/reservoir is owned and operated by the cities of East Carbon and Sunnyside, has a storage capacity of 916 acre-feet, and provides most of the culinary water supply to these municipalities. The dam lies approximately 1664' vertically and 995' horizontally away from the nearest point of projected underground mining (longwall panel #7). This equates to 31 degrees, which is greater than the normal angle of draw associated with longwall subsidence. WEST RIDGE Resources has hired R,B&G Engineering to prepare a detailed evaluation report of the potential effects of longwall mining on the dam and reservoir. This evaluation report was reviewed by the Division of Dam Safety,

DOGM, Bureau of Land Management, and the cities of East Carbon and Sunnyside. The report analyzed the potential impacts from both subsidence and seismicity associated with full extraction mining, with specific emphasis on panel #7, the longwall panel projected for mining nearest to the dam. The report concluded that the risk to the dam and reservoir is minimal, and that event the maximum probable seismic event or subsidence scenario would be well within the safety factor of the dam. In addition, there are no known faults that intercept the dam that could be encountered in the mining of Panel #7. The Division of Dam Safety, the BLM, and the cities of East Carbon and Sunnyside have all accepted the conclusions of the report. This report (Grassy Trail Dam and Reservoir Seismicity Report) is included in Appendix 5-11. This report also includes as an appendix an independent report prepared by Agapito Associates (Estimated Impacts to the Grassy Trail Reservoir due to Longwall Mining) which addresses the potential effects on the dam/reservoir due to longwall induced subsidence. A companion report (Grassy Trail Dam & Reservoir Phase II Dam Safety Study) is included as Appendix 5-12. WEST RIDGE has committed to an intensive program of monitoring of the dam and reservoir during the mining of Panel #7. This monitoring plan is outlined in section 301-114.100 of this Mining & Reclamation Plan and is included in detail in Appendix 5-13.

Based on subsequent approval of the mine plan, panel #7 was extracted starting in December, 2005, and completing in September 2006. Extraction closest to the Grassy Trail Reservoir occurred in March, 2006. Monitoring, as described above, was conducted continuously during the mining of panel #7. As predicted by the RB&G report, there was no mining related damage to the dam, although some slumpage of the adjacent hillside occurred, resulting in minor movement of the west abutment of the dam. There was no loss of integrity of the earthen structure of the dam. In January, 2008, after the area above and adjacent to panel 7 had completely stabilized, RB&G Engineering prepared a post-mining Summary Report of the mining-induced seismicity. This report is included in Appendix 5-16.

After panel 7 was completed, longwall mining moved to the west side of the mains near the outcrop (more than two miles distant from the dam), and then proceeded to the northeast. Also during this time, the company went to a panel-barrier system of longwall extraction, replacing the previous side-by-side panel method. This panel-barrier system leaves a 400' wide solid barrier pillar between each longwall panel, and has significantly reduced the magnitude and frequency of mining-related seismic events. During the ensuing five years of mining, the company has continued to monitor the dam and reservoir. Results of this monitoring have been provided to all the regulatory agencies and the owners of the reservoir on a regular basis. The results of this monitoring have shown that all mining-related effects on the reservoir have stabilized. RB&G Engineering then, in September, 2010, prepared a summary report update of the subsequent mining-induced seismicity, and this report is included in Appendix 5-17.

On July, 21, 2010, BLM approved the R2P2 for federal lease UTU-78562 and

approved mining of panels 18, 19 and 20 on the east side of the mains in the vicinity of the Grassy Trail Reservoir. In the decision document, BLM states, *"We agree with the conclusion that mining longwall panels 18 through 20 as submitted should have no adverse effects on the dam structure or reservoir. The dam structure has seen no detectable affects from the mining of panel number 7. The proposed panels are further distant from the reservoir and much further from the Grassy Trails Reservoir dam. Also, the new panel-barrier design has reduced dramatically the amount and intensity of any mining induced seismicity or subsidence. Additionally, this mining plan will comply with the lease stipulation to not subside perennial streams, unless authorized, as the Left Fork Whitmore Canyon Stream will be under a barrier pillar and no full extraction mining is planned under the stream."* A copy of the approved R2P2 for panels 18-20 is included in Appendix 5-3C. As with the previous mining of panel 7, the company commits to conducting the same level of intensive monitoring of the dam during longwall mining of panel block 18-20, as previously approved by the regulatory agencies, as stated above, and included in Appendix 5-13.

As mentioned in the BLM approval letter, mining of panel block 18-20 will be further distance away from the Grassy Trail dam than with panel 7. Panel 7 mined within 995' (horizontal) from the dam, while the closest mining from Block 18-20 would be more than 3000' (horizontal) away. Also, panel 7 was about 1664' stratigraphically lower than the dam, while panel block 18-20 is located more than 2200' lower than the dam. Also, panel 7 was mined using side-by-side panels, whereas panel block 18-20 will be mined as panel-barrier, further reducing the potential for seismicity.

728.320 Presence of acid-forming or toxic-forming materials

Acid-forming materials in western coal mines generally consist of sulfide minerals, namely pyrite and marcasite, which, when exposed to air and water, are oxidized causing the production of H^+ ions (acid). Oxidation of pyrite will occur in the mine; however, acidic waters will not be observed in the mine. The acid is quickly consumed by dissolution of abundant, naturally occurring carbonate minerals. Iron is readily precipitated, as iron-hydroxide, and excess iron will be not observed in mine discharge water.

No other acid-forming materials or any toxic-forming materials have been identified or are suspected to exist in materials to be disturbed by mining.

728.331 Sediment yield from the disturbed area

Undisturbed drainage from C Canyon upstream from the mine yard facility area will, for the most part, be culverted underneath the mine site by means of a 4' diameter corrugated metal pipe in the right fork and a 3' diameter culvert in the left fork drainage. This culvert has been sized to meet or exceed the design storm for this drainage area. Runoff from the mine site disturbed area and whatever natural runoff which flows onto the disturbed area will be channeled to the mine site sediment pond. The drainage control system for the mine site is shown on Map 7-2.

The culvert and ditch system is designed to handle drainage from a 10 year, 24 hour event. Any storm event that exceeds this amount will flow through the mine yard drainage structures to the sediment pond. If a storm should exceed the design event and the magnitude of the runoff exceeds the pond capacity, the over flow will be channeled through the pond cells and out the emergency spillway to the natural drainage channel below the sediment pond. This overflow will have a lower suspended solid content than the inflow to the pond or any drainage which may be flowing down the natural drainage channel. The sediment pond will detain the inflowing water and allow suspended solids to settle out in the pond cells prior to discharge. Given the ephemeral nature of the drainages and the fact that the sediment pond is designed for the complete retention of the 10 year, 24 hour storm event, it is unlikely that discharge from the sediment pond will occur very often if ever. Since the sediment pond is designed to completely contain the 10 year, 24 hour event, only a limited amount of outflow, that in excess of the design event, would be discharged. Excess water contained in the sediment pond following runoff events would be allowed to settle and evaporate, or be decanted in a controlled manner through the primary discharge pipe to reduce the potential for erosion downstream.

Using the Universal Soil Loss Equation (USLE), an estimate of the annual sediment yield from the mine site disturbed area (in the pre-mining condition) is 0.3082 acre-feet per year. In the operational phase, this same area (the mine yard disturbed area) would then yield 0.3090 acre-feet per year. During the postmining phase, the

estimated annual sediment yield is projected to be 0.2679 acre-feet per year. Even though the sediment yield from this area will be greater during the operational phase, the sediment pond has been designed to handle the sediment yield from the disturbed area and retain it in the pond. This will effectively reduce the sediment yield from the disturbed area to an insignificant amount during the operational phase of the mine.

The sediment pond will be constructed as soon as practical at the mine site during construction. When reclamation of the mine yard is initiated following the operational phase, the sediment pond will be removed during removal of the bypass culvert and restoration of the natural channel through the site. Silt fences will be installed adjacent to the reclaimed channel to collect and contain sediment from the regraded site. The silt fences will be constructed approximately along contour with overlapping ends to prevent drainage from going around the ends. Refer to Map 5-9. Because the surface of the regraded area will be gouged with a backhoe bucket to create large depressions, the depressions of the regraded area will also act as a sediment trap. It is anticipated that sediment yield from the reclaimed area will be similar to other adjacent undisturbed areas.

During reclamation, if it is determined that topsoil resources are needed from the topsoil borrow site to achieve reclamation of the mine site, silt fencing would be placed around the outer limits of the borrow area to be disturbed. Topsoil would be stripped and stockpiled. The required amount of topsoil would then be removed from the borrow site. Care would be taken to contour the borrow pit such that runoff infiltration would be maximized to the fullest extent within the disturbed area. This would include gouging the regraded surface with pits approximately 24" wide, 36" long and 18" deep as well as sloping the regraded slopes inward to encourage precipitation infiltration on-site.

728.332

Impacts to important water quality parameters

WEST RIDGE Resources, Inc. anticipates that at some time it may be necessary to discharge water from its proposed mine into the C Canyon drainage. The distance from the proposed discharge point in the ephemeral C Canyon to the confluence with the first perennial stream, Grassy Trail Creek near Sunnyside Junction, is approximately 10 miles. Because of the general aridity of the region, and the permeable nature of the alluvial sediments over which the discharge water will flow, it is unlikely that the above-ground flow of discharge water will persist to the confluence with Grassy Trail Creek. When mine water is discharged into an ephemeral drainage from Andalex's Tower Mine (located in the Book Cliffs 15 miles north of West Ridge), water flows in the drainage for less than one mile before the flow is entirely lost to infiltration or evapotranspiration. Likewise, Icelander Creek, which flows over alluvial sediments at the base of the Book Cliffs Escarpment just south of East Carbon, flows for only about 4 miles before being totally lost to infiltration. Therefore, there will most likely be no impacts to important water quality parameters in Grassy Trail Creek from proposed mining operations because mine discharge water will likely not reach the

creek. However, if mine discharge water were to persist in the stream channel to the confluence with Grassy Trail Creek, the volume of discharge water entering the creek will be only a fraction of that which discharged from the mine.

Discharge water from the Sunnyside Mines located southeast of West Ridge had TDS concentrations of about 1,600 mg/l, with the dominant ions being sodium, sulfate, and bicarbonate (Sunnyside Coal Company, 1993). The chemical composition of this water is similar to that of waters that have been in contact with the Mancos Shale. The TDS concentration of discharge water from WEST RIDGE Resources, Inc.'s proposed new mine will likely be similar to discharge from the Sunnyside Mines.

The TDS concentration of water in Grassy Trail Creek at the mouth of Whitmore Canyon, (USGS station 0931430) near the upper contact with the Mancos Shale, averaged 988 mg/l between 1979 and 1984, with the dominant ions being sodium, sulfate, and bicarbonate (Waddell, 1981). The water quality of Grassy Trail Creek after flowing over 11 miles of Mancos Shale sediments to the confluence with the C Canyon drainage near Sunnyside Junction is significantly degraded.

Due to the low anticipated volume of mine discharge water which will flow into Grassy Trail Creek, and the similarity of the chemistry of the mine discharge water to the water in the creek, the water quality in Grassy Trail Creek will likely not be significantly impacted by mine discharge water.

Because of the poor quality of the water naturally flowing in Grassy Trail Creek near Sunnyside Junction and the relatively small quantities of mine discharge water (if any) which will flow into the creek, important water quality parameters in Grassy Trail Creek, such as sodium, sulfate, and bicarbonate will not be significantly increased.

Most of the water from any potential discharge from WEST RIDGE Resources, Inc.'s proposed new mine will infiltrate into the alluvial sediments in Clark Valley near the Book Cliffs escarpment. This will result in a rise in the local water table, or the creation of a perched water table above impermeable layers. Shale layers in the Mancos Shale will prohibit significant downward migration of these waters. The raising of the local water table may result in increased vegetation in the area. The increase in vegetation and the presence of surface water in the drainage would be a positive impact on wildlife and the local ecosystem. There are no known water rights or surface facilities adjacent to the stream drainage that could be impacted by the rising water table. Because the water quality of groundwaters in the Mancos Shale is naturally poor (with TDS significantly greater than 1,600 mg/l), the addition of mine discharge water to this system will not have any detrimental effects on water quality.

The Sunnyside mines discharged water from the mine workings for many years. This water was put to beneficial use for agricultural purposes such as growing alfalfa crops and also for irrigating the municipal golf course, from the time it was built in 1967 up to the closure of the mine in 1993. The city park also used the mine water for irrigation

since the mid-1940's. Sunnyside Coal Company had an approved UPDES permit with a TDS concentration limit of 1,650 mg/l for the mine water discharge. Excess water was discharged into Grassy Trail Creek where it was also utilized by cattle and wildlife.

The chemical quality of groundwater discharging from springs above the proposed coal mine will not be adversely affected by underground mining operations. The chemical quality of surface water flowing in upper Grassy Trail Creek will likewise not be adversely affected by underground mining operations. It has been demonstrated (Mayo and Associates, 1997; Appendix 7-1, 2001; Appendix 7-1A) that deep groundwaters adjacent to the coal seams throughout the Book Cliffs and Wasatch Plateau coal fields are hydraulically isolated from shallow overlying groundwater systems which support springs and provide baseflow to streams at the surface. There is no mechanism by which important water quality parameters in shallow groundwater systems above WEST RIDGE Resources, Inc.'s proposed coal mine may be adversely impacted by mining operations.

There are no known springs of significance in the lease and adjacent area which discharge from locations that are stratigraphically or topographically below the coal seam to be mined. The thick Mancos Shale will prevent the migration of any mine discharge water downward to formations underlying the Mancos Shale. No seeps or spring exist within or adjacent to the proposed topsoil borrow area to the west of C Canyon.

728.333 Flooding or streamflow alteration

WEST RIDGE Resources, Inc. anticipates that at some time it may be necessary to discharge water from its proposed mine into the C Canyon drainage. The discharge point will be about 1 mile above the confluence with B Canyon. Both C and B Canyons are ephemeral drainages that rarely have flow. The stream channel in this drainage is large enough to contain torrential thunderstorm events that commonly exceed several cfs in this region. The anticipated discharge rate from the mine is unknown at this time. However, historic discharges from nearby mines in the Book Cliffs coal field (Soldier Canyon and Sunnyside) average about 300 to 400 gpm. It is possible that over the life of the mine the discharge rate from WEST RIDGE Resources, Inc.'s proposed mine could be in this same range. However, it must be noted that as new mine workings are developed in "wet" areas, the discharge rate may temporarily exceed this amount. The discharge rates from these mines have been quite variable over time due to the nature of the groundwater systems encountered in the mines. Groundwater encountered in coal mines in the Book Cliffs and Wasatch Plateau coal fields is contained mostly in sandstone channels and in fractures and faults. It is not unusual for large portions of the mines to be mostly dry. For these reasons, the mine discharge rate is more a function of the amount of new mine area recently opened than the total size of the mine. At the Soldier Canyon Mine, mining proceeded for several years before any significant water sources were encountered and thus, no discharge occurred. Similar experiences are reported at Andalex's Tower Mine. Thus, although short-term increases in mine discharge rates will likely occur,

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the long-term average will probably be in the range of 300 to 400 gpm if water is encountered.

A discharge of 300 to 400 gpm will not cause flooding or significant alteration of the streambed in the C Canyon drainage. The channel geometry in C Canyon is primarily the result of erosion which occurs during torrential thunderstorm events where the flow in the drainage is several times that anticipated from WEST RIDGE Resources, Inc.'s proposed mine. The mine discharge will easily be contained within the inner stream channel, which should be stable. Additionally, if a constant, relatively small discharge is achieved in C Canyon as a result of mine discharge, the net effect will be a positive one. Vegetation densities along the stream bank will increase causing increased bank stability and decreased erosion. Wildlife habitat will also be improved with the available water and the vegetation growing on the stream bank.

No streams exist in or adjacent to the proposed topsoil borrow area west of C Canyon in section 16, T. 14 S., R. 13 E.

728.334 Groundwater and surface water availability

Mining in the permit area will not significantly affect the availability of groundwater. Groundwaters in the Blackhawk Formation exist in highly compartmentalized partitions, both vertically and horizontally, and the formation does not act as a hydraulically continuous aquifer. Groundwater systems in the Blackhawk Formation are hydraulically isolated from overlying, modern groundwaters. The effects of locally dewatering the Blackhawk Formation adjacent to mine openings will not have any significant impact on groundwater availability in the region surrounding the mine.

There are no groundwater supply wells in the mine lease area or adjacent to it. The removal of water from horizons immediately above and below the mined horizon will not impact any water supplies. Rather, underground mining makes water available from the Blackhawk Formation that was previously inaccessible.

728.400 The hydrology and geology of the area around Grassy Trail reservoir is discussed in a seismic analysis report (see Appendix 5-11) and the Phase II dam safety report (see Appendix 512). These reports conclude that it is unlikely that mining induced seismicity or subsidence will impact the performance of the Grassy Trail Dam and Reservoir. Based on the conclusion of this study the BLM has approved the R2P2 to allow full extraction longwall mining of Panel #7. BLM also added a special stipulation #17 to the federal lease related specifically to the Grassy Trail Reservoir, stating, "*The Lessee is and will remain liable for any and all damages or hazardous conditions resulting from the mining operations under the lease.*"

Based on BLM's approval the company then successfully mined longwall panel 7 from December, 2005 through September, 2006. Soon thereafter, RB&G Engineering prepared a summary post-mining report on the mining related affects on the reservoir (see Appendix 5-16). Still later, in 2010, RB7G Engineering prepared an additional

update to the summary report (see e). Based on these reports, BLM has recently approved the R2P2 to allow additional longwall mining of panel block 18-20 on the east side of the mains in the vicinity of (i.e., west and north of) Grassy Trail reservoir (see Appendix 5-3C). This new approval contains the same reference to lease stipulation #17, as with the previous approval of panel 7.

R645-301-729 CUMULATIVE HYDROLOGIC IMPACT ASSESSMENT (CHIA)

The Division will provide an assessment of the probable cumulative hydrologic impacts of the proposed coal mining and reclamation operation and all anticipated coal mining and reclamation operations upon surface and groundwater systems in the cumulative impact area.

R645-301-730 OPERATION PLAN

R645-301-731 GENERAL REQUIREMENTS

A plan has been included to minimize disturbance to the hydrologic balance, to prevent material damage, and to support postmining land use.

731.100 Hydrologic Balance Protection

Groundwater Protection

Although testing has shown that no significant impacts from acid or toxic producing materials should occur, groundwater quality will be protected by handling runoff in a manner which minimizes the infiltration into the groundwater system. Examples of techniques that may be utilized to accomplish this would include routing disturbed area drainage to the sediment pond through properly sized ditches and culverts and diverting undisturbed drainage through a bypass pipe past the disturbed area.

Within the disturbed area, drainage will be directed to ditches by sloping the yard areas. The ditches will be appropriately sized to handle flow from the 10 year/24 hour event. Culverts within the drainage system have also been sized to meet or exceed the 10 year, 24 hour design criteria.

Surface Water Protection

Coal mining and reclamation activities will be conducted according to the following plan.

The sediment pond will be installed as soon as possible during construction of the surface facility area. The pond will be appropriately sized to handle the design storm event (10 year, 24 hour) for the mine site.

Protection of surface water will incorporate measures cited under Groundwater Protection. All surface runoff from the mine site disturbed area will be diverted to the sediment pond for treatment. The sediment pond has been designed to provide total containment for the 10 year/24 hour storm plus three years of sediment accumulation. Based on sampling of the soils in the area and the fact that waste rock material will

not be stored on the surface, it is unlikely that the sediment pond will impound acid- or toxic-drainage.

It is anticipated, based on the climate of the area, that the sediment pond will remain dry most of the time. (This has been demonstrated to be true for existing coal mining operations in central Utah.) Water in the pond should evaporate rapidly following precipitation events. Infiltration into ground water zones is not expected because of the interbedded nature of the strata below the pond. Thick sequences of shale in the bedrock below the pond will greatly limit the vertical movement of water. Also, the alkaline nature of other sediment flowing to the sediment pond would serve to neutralize any low pH materials when mingled together.

To minimize disturbance to the undisturbed drainage, large diameter bypass culverts will be installed beneath the mine yard facility to allow runoff upstream above the mine site to continue downstream without coming in contact with and becoming contaminated by the mine yard area.

The bypass culvert system will be the first structure to be installed during construction of the mine site facility. Undisturbed area drainage will be bypassed under the disturbed area to minimize the amount of drainage that must be treated by the sediment pond. The bypass culverts will allow natural drainage to continue down the drainage course unaffected by the mining operation. A 36" diameter culvert will be installed in the left fork and a 48" diameter culvert will be installed in the right fork. A 48" culvert will be installed in the main canyon below the confluence of the forks. The size of the culverts will adequately pass the 100 year, 6 hour flow event even though a smaller culvert would meet the requirements of the regulations.

At the topsoil pile locations, undisturbed drainage will be diverted around the stockpiles with ditches at the edge of the pile toward the undisturbed drainage channel. The ditches will divert water away from the stockpile to minimize erosion. The ditches have been sized to convey flow from the 10 year, 24 hour event. The ditches will slope 1% toward the natural drainage. A typical ditch design is presented in Appendix 7-4 "West Ridge Mine Sedimentation and Drainage Control Plan". The stockpiled topsoil material will be loosely piled and have an irregular, pitted surface or contour furrows to help retain runoff from precipitation events and to reduce erosion until vegetation becomes reestablished. A diversion ditch will be constructed at the edge of the stockpile to divert undisturbed drainage away from the stockpile. Silt fencing will be placed around the perimeter of the stockpile to treat any runoff from the pile.

The topsoil stockpile and test plots will be designated as Alternate Sediment Control Areas (ASCAs).

Refer to Appendix 5-5 for a complete discussion on the construction of the topsoil stockpiles. Refer to Appendix 7-4 for details of the drainage control designs. Map 2-4 depicts the drainage controls of the topsoil stockpile areas.

This section describes the hydrologic monitoring plan. Locations of operational surface-water and groundwater monitoring sites are indicated on Map 7-7. Hydrologic monitoring protocols, sampling frequencies, and sampling sites are described in Tables 7-1 through 7-4. Operational field and laboratory hydrologic monitoring parameters for surface water are listed in Table 7-2, and for groundwater in Table 7-3. The hydrologic monitoring parameters have been selected in consultation with the DOGM's directive Tech-004, *Water Monitoring Programs for Coal Mines*.

Water monitoring reports will be submitted on a quarterly basis to UDOGM. Should any ground water or surface water samples indicate noncompliance with the permit conditions, the operator will promptly notify the Division and immediately provide for any accelerated or additional monitoring necessary to determine the nature and extent of noncompliance and will provide the results of the sampling to the Division.

Operational field and laboratory parameters were measured quarterly for the first ten years of mine operation, rather than for only the first two years as originally proposed in the MRP. The original MRP stated that after a two-year period of quarterly monitoring, if sampling has adequately characterized the hydrology in the area, a request would be made to reduce monitoring to field parameters and one operational analytical sample collected during low flow (August or September). It also stated, the physical parameters and chemical composition of springs and streams in and around the permit area should be adequately characterized following the collection of three years of baseline laboratory data and two years of operational laboratory data. (The first year of field data was collected in 1985-1986. The original MRP further stated that, thereafter, continued quarterly monitoring for laboratory parameters would probably not enhance the scientific understanding of hydrologic systems in the mine permit area. Beginning in 2nd Quarter of 2011, WEST RIDGE Resources, Inc. will implement this reduced schedule for ST-10 and will officially drop stream sites ST-5, ST-6A, ST-7, ST-11, ST-12 and ST-13 and spring sites SP-15, SP-16, WR-1 and WR-2.

Each of the sampling locations and their hydrologic significance are described below. However, in order to comply with UDOGM directive Tech-004, baseline samples will be collected from each spring in the monitoring program during the low flow (fall) sampling and from each stream monitoring site during low flow every five years beginning with the first mid-term review. The five year baseline samples will be repeated every five years until reclamation is complete.

Two years of baseline monitoring has been performed at all monitoring sites; subsequently, the quarterly operational monitoring schedule was utilized through 2010. Monitoring as specified herein will continue through reclamation until bond release unless otherwise modified.

Streams

Grassy Trail Creek is the only perennial stream in the permit and adjacent areas. Four sites on Grassy Trail Creek have been monitored.

Stream site ST-10 is located on the north end of our mining panels, a reduction in laboratory analyses from quarterly to annually will be implemented beginning 2nd Quarter of 2011. Stream site ST-3 is located below the confluence with Hanging Rock Canyon. Stream site ST-8 is located just above the confluence with Water Canyon, downstream of the permit area and ST-9 is located on upper Grassy Trail Creek at the inlet to Grassy Trail Reservoir. These monitoring sites on Grassy Trail Creek will be used to document any potential changes in stream flow or water quality that may be attributable to mining at WEST RIDGE, so data collection efforts at these sites will continue, while ST-10 will be on the reduced monitoring schedule. A description of Upper Grassy Trail water quality included above, which was included in the original version of the MRP based upon two years of data, indicates that magnesium, calcium, and bicarbonate are the major ionic components, and that TDS at ST-3 is 350 mg/L. After 10 more years of data collected, analysis indicates that the assessment is still correct: those three ions still represent the majority of the dissolved solids in Upper Grassy Trail Creek, and calculated average TDS at ST-3 is 358 mg/L. Further, quarterly water quality monitoring shows that there is relatively minor temporal variation in water quality at these sites, based upon an assessment of their major ions as represented by Stiff, Piper, and Schoeller Diagrams (see Appendix 7-11). Therefore, reduction in collecting analytical samples from quarterly to annually at ST-10 is supported by the record.

One tributary to Grassy Trail Creek within Whitmore Canyon is also monitored. ST-15 is located in at the mouth of Spring Canyon, and has been monitored since 2003. No flows have been reported since that time. It will continue to be monitored quarterly, and operational samples will be collected if flow is occurring during quarterly visits.

The sample point RST-1 was added 3rd Quarter of 2010. This site is located on the right fork of Whitmore Canyon above Grassy Trail Reservoir. This site will continue to be monitored quarterly and analyzed for operational field and laboratory parameters.

On the west side of West Ridge, five stations have been monitored for many years on ephemeral drainages contributing to lower Grassy Trail Creek. They are ST-4 (lower Bear Creek), ST-5 (below confluence of B and C Canyons), ST-6A and ST-6 (above and below the mine site, respectively, in C Canyon) and ST-7 (below A Canyon). ST-4 was monitored by visual observation of the channel for flowing water. ST-5 had a crest gauge and automatic sampler while ST-6A, ST-6 and ST-7 each had a crest gauge and bottle samplers. The west side of West Ridge stream monitoring stations, are described as follows:

- ST-4 No monitoring equipment was ever located at this site. The purpose of this station was to conduct baseline observations for two years to determine whether this portion of Bear Creek acted as an ephemeral or intermittent stream channel. Based on monthly monitoring during 1997 and 1998, it has been determined that intermittent flow does not occur in the lower section of Bear Creek and the channel responds only as an ephemeral drainage following substantial rainfall events. This continued to be documented at this site until 2005, when it was officially dropped from the monitoring plan in July 2005.
- ST-5 From 1997 through 2008, this location contained the ISCO automatic sampler and a crest gage. This station monitored drainage from both the B and C Canyon drainages. However, based on field observations, virtually all of the flow comes from the B Canyon drainage, primarily the lower side drainages and adjacent Mancos slopes. Both the B and C Canyon drainages respond as ephemeral drainages. In recent years, this site typically continued flows that were 100 percent comprised of mine discharge. While originally intended to cover both B and C Canyon drainages because surface facilities were contemplated in both of these canyons, its locations below the confluence is no longer important since surface facilities are contained within C Canyon, and not in B Canyon. Because the site has served its primarily purpose (to document the ephemeral nature of flows) and because it represents essentially the same data as is also collected upstream at ST-6, this site will be dropped from the monitoring plan beginning 2nd quarter of 2011.

ST-6 and ST-6A

These two stations are located below and above the proposed mine site in C Canyon, respectively. A crest gage (as described above) and bottle samplers were installed at these sites in 1997, with only partial success at registering flows or collecting samples. Once operations began at the mine, improving access and communications, these structures were less important. The long record of data at ST-6A indicated very little, if any, flow at this site even during severe precipitation events; snow melt runoff often appears to consist of underflow through the heavy organic matter in the channel bottom. Further, once mine discharge began, ST-6 generally receives continuous flow comprised of 100 percent mine discharge. Therefore, there is no correlation between flows at ST-6A and ST-6. The area below ST-6A was last mined in February 2007. Beginning 2nd quarter of 2011 ST-6A will be dropped while ST-6 will continue to be monitored. Although there have been some changes in ionic strength of this water over the years, as shown by Stiff, Piper, and Schoeller Diagrams (see Appendix 7-11), the basic ionic makeup of the water remains fairly constant. This water is also sampled for UPDES samples just a short distance upstream from ST-6 on a monthly basis, which provides analytical data for compliance purposes.

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- ST-7 A crest gage and sampler bottles have been located in the A Canyon drainage since 1997, however equipment functionality in this very flashy and sediment-laden stream has been minimal. Originally established to document drainage, it has not served any purpose in the monitoring plan for many years, since the haul road was constructed elsewhere. Further, there are no surface facilities planned for this drainage and underground mining has been progressing in the opposite direction. This site will no longer be monitored after 2nd quarter of 2011.
- ST-11 This site, located in Bear Canyon, was added to the monitoring plan in 2005, for reasons described above in Section 728. It has been monitored since that time, but no flows have ever been reported. The area below ST-11 was mined out in November, 2006. This site will be dropped beginning 2nd quarter of 2011.
- ST-12 This site, also located in Bear Canyon and described above in Section 728, has similarly been monitored since 2005. The area below ST-12 was mined out in October 2007. No flows have been reported since that time. It will be dropped from the monitoring plan beginning in 2nd quarter 2011 as there is no longer any reason to document flow regime in this reach of Bear Canyon.
- ST-13 Similarly, this site is located in Bear Canyon, and was added to the monitoring plan in 2005, for reasons described above in Section 728. It has been monitored since that time, but no flows have been reported. This site will be dropped from the monitoring plan beginning in 2nd quarter 2011.

Springs

Eight springs in the permit and adjacent areas have been monitored since at least 1999; some of these have been monitored by WEST RIDGE since 1997, and some even earlier by other entities. Two other springs, SP-101 and SP-102 have been monitored since 2003. Four of these springs (SP-12, SP-13, SP-15, and SP-16) discharge from the lower slopes of West Ridge in Whitmore Canyon. Two springs, WR-1 and WR-2, discharge from the upper slope of West Ridge in Whitmore Canyon. Refer to Map 7-7. One spring (SP-8) discharges in the upper drainage of C Canyon. Hanging Rock Spring (S-80), SP-101 and SP-102 are located near the northeast corner of the permit area and discharges from the east slopes of Whitmore Canyon.

Most of the monitoring stations in this monitoring program are located on the east slope of West Ridge. This is because, with the exception of SP-8, there are no springs that are suitable for monitoring on the west side of West Ridge.

Beginning in 2nd Quarter of 2011, monitoring at SP-15, SP-16, WR-1 and WR-2 will be discontinued. These sites are away from the direction that mining is occurring or will occur in the future, a long record is in place to document that no impacts have occurred, and any past subsidence activities have long ceased. WR-1 is located outside the West Ridge Mine permit area. It was undermined by the adjacent Sunnyside Mine workings at a depth of more than 2000' below the surface as shown on Plate 7-7. This area was undermined at least fifteen years ago. WR-2 is located 2400' above the underlying coal seam and was undermined in June, 2004 as part of the West Ridge mining operation. Subsidence monitoring has been conducted by Ware Surveying as a part of the continuing monitoring program for the Grassy Trail Reservoir located not far away. Several of the subsidence points were located above longwall panel 7 and are less than 1700' feet from WR-2. These points were undermined in March, 2006. This survey shows that mining-induced subsidence in these areas has been completely stabilized for the past three years (see Appendix 7-13). Since WR-2 was undermined by longwall panel 5 nearly two years prior to the Grassy Trails subsidence points, this provides strong assurance that the area around WR-2 has now been similarly stabilized for an even longer time period.

At sites SP-12, SP-13, SP-101, SP-102, S-80 and SP-8, quarterly monitoring will continue.

Wells

Only one groundwater monitoring well (DH86-2) exists in the permit area. This well monitors the Sunnyside Sandstone Member of the Blackhawk Formation, which is below the coal seam that will be mined. In addition to field parameters and operational water quality parameters, water level will be measured in this well. Because data collected at this site since 1997 exhibits more variability than at the other monitoring sites, quarterly analytical sampling will continue.

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Underground Sampling

UG-1 Starting in the fall of 2010, West Ridge Resources will begin an underground monitoring program on the pre-treatment mine-water. A monthly sample of the in-mine water will be collected prior to treatment and analyzed for operational field and laboratory parameters. Parameters will include total and dissolved iron, sulfate, alkalinity, total and dissolved solids, field conductivity, field temperature, field dissolved oxygen and field pH. The sample will be collected in 9th right between the seal and treatment area. This sample point will be called UG-1. Please refer to Appendix 5-15, Attachment 10 for a description and location of UG-1.

Grassy Trial Flumes

LF-1 & RF-1 In response to an agreement between the company and the owners of the Grassy Trail Dam/Reservoir (East Carbon City, Sunnyside City and Sunnyside Cogen Power Plant) flow measurements of the right and left forks of Whitmore Canyon immediately above the reservoir will be taken. A 3' Parshall Flume or a comparable flume will be reconstructed in the right and left forks above Grassy Trail Reservoir in the Spring/Summer of 2011. Flumes will be equipped with a continuous flow monitor and will be downloaded and reported quarterly. See Appendix 7-14 for Grassy Trail Reservoir - Right Fork Historical Flow Data.

Table 7-1 HYDROLOGIC MONITORING PROTOCOLS AND LOCATIONS

Name	Sample Parameters	Sample Frequency	Location Description
Streams			
RST-1	Flow, Field, Lab Analysis	Quarterly	Right Fork - Grassy Trail
ST-3	Flow, Field, Lab Analysis	Quarterly	Grassy Trail Creek
ST-6	Flow, Field, Lab Analysis	Quarterly	C Canyon
ST-8	Flow, Field, Lab Analysis	Quarterly	Grassy Trail Creek
ST-9	Flow, Field, Lab Analysis	Quarterly	Grassy Trail Creek
ST-10	Flow, Field, Lab Analysis	Annually	Grassy Trail Creek
ST-15	Flow, Field, Lab Analysis	Quarterly	Spring Canyon Stream
Springs			
SP-8	Flow, Field, Lab Analysis	Quarterly	North Horn Fm. In C Canyon
SP-12	Flow, Field, Lab Analysis	Quarterly	Colton Fm. Upper Whitmore Canyon
SP-13	Flow, Field, Lab Analysis	Quarterly	Colton Fm. Upper Whitmore Canyon
SP-101	Flow, Field, Lab Analysis	Quarterly	Little Spring Bottom
SP-102	Flow, Field, Lab Analysis	Quarterly	Spring Canyon Hillside
S-80	Flow, Field, Lab Analysis	Quarterly	Hanging Rock Spring
Wells			
DH86-2	Water Level, Field, Lab	Quarterly	Sunnyside Sandstone in C Canyon
Underground			
UG-1	Field, Lab Analysis	Monthly	West Ridge Mine
Flumes			
LF-1	Flow only	*Quarterly	Left Fork of Grassy Trail Reservoir
RF-1	Flow only	*Quarterly	Right Fork of Grassy Trail Reservoir

* Flows are continually monitored and will be downloaded quarterly.

Note:

ST-5, ST-6A, ST-7, ST-11, ST-12, ST-13, SP-15, SP-16, WR-1 and WR-2 were dropped in 2011.