

APPENDIX D6 - HYDROLOGY

Table of Contents

D6.1.0	INTRODUCTION	1
D6.2.0	GROUNDWATER	1
D6.3.0	SURFACE WATER	2
D6.3.1	Surface Water Control During Mining.....	3
D6.4.0	WETLANDS.....	4
D6.5.0	REFERENCES	4

List of Tables

Table D6.1	Groundwater Rights Within Three Miles of the North Fork Amendment Area.....	5
Table D6.2	Surface Water Rights within One-half Mile of the North Fork Amendment Area ..	6

List of Figures

Figure D6.1	Estimated Depths to Groundwater in Johnson County	7
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List of Maps

Map D6-1	Surface and Groundwater Rights	8
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APPENDIX D-6

HYDROLOGY

D6.1.0 INTRODUCTION

This appendix, on the hydrology of the North Fork Amendment Area (NFAA), has been prepared by the staff of Black Hills Bentonite in order to provide baseline groundwater and surface water hydrology information for the two hundred acres of land that will be incorporated into Wyoming Department of Environmental Quality/Land Quality Division Permit to Mine No. 339C as the North Fork Amendment Area (NFAA). BHB's proposed mining activities on the NFAA will affect approximately eighteen acres of land administered by the Bureau of Land Management, Buffalo Field Office. (BLM/BFO).

The NFAA is positioned on semi-arid foot-slope topography adjacent to the southeastern edge of the Big Horn Mountain Range in the western Powder River Basin. The proposed amendment area is characterized by Cretaceous deposits intermittently capped by upland terrace benches and low, gravel-capped ridges of alluvial origin. Within the study area, these ridges are periodically dissected by gullies and draws creating areas of rough, eroded and broken terrain, generally with bentonite outcrops present. Drainage of the study area is southerly and westerly toward the North Fork of the Powder River.

The NFAA contains several ephemeral drainage basins, generally less than forty acres in size. These washes normally flow only in direct response to a significant rainfall event or rapid melting of a significant accumulation of snow. For most of these highly localized, short-duration precipitation events, the runoff water never reaches the mainstem channel downstream (the North Fork of the Powder River). Flows typically run above ground for short to moderate distances and gradually dissipate into the channel beds as the channel slopes flatten out.

D6.2.0 GROUNDWATER

Groundwater rights within three miles of the NFAA are tabulated in Table D6.1, and groundwater rights within one-half mile of the NFAA are illustrated on Map D6-1. According to water rights information provided by the Wyoming State Engineer's Office (SEO), twenty eight (28) wells are located within a three mile radius of the NFAA. Two permitted water wells, the Cash No. 1 well and the Cash No. 2 well, are located within one-half mile of the NFAA. The Cash No. 1 well is located one-half mile from the nearest pit which will be excavated on the NFAA, while the Cash No. 2 well is located one mile from the nearest pit excavation area. BHB contacted the Cash family concerning the need for a formal BLM water well agreement. A representative for the Cash family indicated that a water well agreement was not needed (*personal communication between Bruce Lawson, BHB and Tom Cash, Cash Family Limited Partnership*).

The Cash No. 1 well was developed in 2008 in the alluvium along the North Fork of the Powder River. According to the well log obtained from the SEO, the well was drilled to 50 feet. The

depth to the water bearing formation was reported from twenty to thirty feet below the surface of the well, which lies at an approximate elevation of 5340 feet above sea level. BHB's proposed mining will occur one half mile to the northeast of the well, at an elevation ranging from 5520 to 5480 feet above sea level. Mining will take place above the completed interval of the Cash No. 1 alluvial well in shale of the Frontier formation. Therefore, mining will not affect this well. The Cash No. 2 well was developed in 1957 to a total depth of 240 feet. This well is located approximately one mile north of proposed mine disturbances on the NFAA. No well log is available for this well

The shallowest known bedrock aquifer in the NFAA area is in the Dakota Aquifer System which contains groundwater in the Muddy Sandstone¹, more than 500 feet stratigraphically lower than the shallow mining proposed by BHB. Figure D6.1, which was obtained from Chapter 4 of the Johnson County Land Use Plan, illustrates that depths to groundwater in the vicinity of the NFAA generally range from 401 to 1000 feet.

Mining will be in the relatively impervious shale, silt, clay and bentonite of the Frontier formation where no aquifers are present. Due to the shallow mining depths (less than 50 feet) on the NFAA, and the geology of the area, aquifers and groundwater will not be intercepted or affected in conjunction with the mining operation. BHB has been mining bentonite in the immediate vicinity of the NFAA for over thirty years and has never encountered groundwater while mining bentonite in the same geological strata and at depths relative to proposed pits on the NFAA.

Exploration drilling on the area did not encounter water. Due to the relatively shallow depth to which mining will occur, groundwater will not be impacted. As no groundwater is present, no pit dewatering will be required which could potentially impact groundwater, aquifers, existing water wells or springs in the vicinity of the NFAA.

D6.3.0 SURFACE WATER

There are no perennial streams or permitted reservoirs within the amendment area. A records search of the Wyoming State Engineers database was completed for surface water rights within one-half mile of the amendment area. Three surface water rights within one-half mile of the amendment area are listed on Table D6.2 and illustrated on Map D6-1.

The NFAA is characterized by finger ridges with steep slopes covered in exposed cobble fields separated by ephemeral drainages. No perennial or intermittent streams will be disturbed by the mining operation. Only ephemeral channels which infrequently carry water in direct response to a significant rainfall event or rapid snowmelt will be affected by mining activities. These ephemeral drainages will be reestablished after mining is completed.

¹ Johnson County Comprehensive Land Use Plan, March 2005, Prepared by Pederson Planning Consultants, Chapter Four, Environment and Natural Resources, Page 4-7, Dakota Aquifer System.

D6.3.1 Surface Water Control During Mining

Best management practices (BMPs) described below and in the Storm Water Pollution Prevention Plan for WDEQ/LQD Permit to Mine No. 339C (WYR320097), will be implemented to minimize the effect of runoff from mined lands onto undisturbed lands. If erosion/sediment deposition becomes a concern, BHB may install erosion control devices such as certified weed-free straw bales, sediment fences, rock check dams, small catch basins and/or water bars. Additionally, diversion ditches may be constructed to divert water away from mining activities.

Overburden and topsoil stockpiles will be located and constructed so that they will not block drainages. Topsoil and subsoil will be removed from the base of all overburden stockpiles in order to protect the topsoil resources from "sloughing" which may occur on the side slopes of the overburden stockpiles. This topsoil/subsoil removal area, which is commonly referred to as a "topsoil buffer", surrounding the base of the overburden stockpiles also forms a basin which will collect and retain sediments originating from the overburden stockpiles as a result of storm water runoff.

Topsoil will also be removed from the edges of all pits in order to create a topsoil "buffer area" ranging in width from ten to approximately thirty feet wide. These topsoil buffer areas also serve as storm water runoff collection basins.

Properly sized culverts will be installed, as needed, during construction of access roads. The following criteria will be utilized in calculating peak storm water discharges for culvert sizing determinations. This method was approved by LQD as the recommended procedure for calculating peak storm water discharges, and determining the volume and rate of runoff in small (<2,000 acre) watersheds. The depth of cover over the culverts will be no less than twelve (12) inches or a minimum of one-half the diameter of the culvert, whichever is greater. The culvert length will be dependent on the geometry of the drainage channel and the culvert diameter. In all cases the culvert length will never be less than forty feet. Installed culverts will be no less than eighteen inches in diameter, in order to meet the recommended minimum culvert size described in the 2007 BLM Gold Book and LQD Guideline 8. Refer to Mine Plan Figure MP-2 for typical culvert installation details.

Peak discharge information for proper culvert sizing is based on information presented in the U.S.D.A./Soil Conservation Service Publication SCS-TP-149, "A Method for Estimating Volume and Rate of Runoff in Small Watersheds," January 1968.

Peak discharge rates are based on the following criteria:

Type II Storm Distribution
Land Use: Pasture or Range, No Mechanical treatment
Hydrologic Condition: Poor
Hydrologic Soils Group: B (from SCS Handbook NEH-4)
Rainfall Event: 10 Year, 24 Hour, 2.6 inches based on Wyoming Isopluvials
Steep Slopes
Curve Number: 79

No culvert installations are required on the NFAA. However, if it becomes necessary to install a culvert along the access road segment in the NE¹/₄NE¹/₄ Section 26, the culvert will be no less than eighteen inches in diameter.

D6.4.0 WETLANDS

Appendix D10, Wetlands, indicates that no perennial streams or riparian areas exist on the NFAA, and therefore, none of these types of resources or hydrologic features will be impacted by mining activities.

D6.5.0 REFERENCES

Johnson County Comprehensive Land Use Plan, Chapter 4, Environment and Natural Resources, Pedersen Planning Consultants, 2005.

Table D6.1 Groundwater Rights Within Three Miles of the North Fork Amendment Area

Table D6.2 Surface Water Rights within One-half Mile of the North Fork Amendment Area

Figure D6.1 Estimated Depths to Groundwater in Johnson County

Map D6-1 Surface and Groundwater Rights