into areas covered by the Grazing Management Plan should receive proper management and declining range condition and trend should be reversed.

The Grazing Management Plan should be evaluated on an ongoing basis. Thus, customary use areas/allotments where the management plan has been implemented may be evaluated for effectiveness and practicability. Since customary use areas/allotments will be established on a continuing basis as newly released reclaimed lands are returned to the Navajo Tribe, necessary changes or adjustments in the plan and its implementation can be made based on the ongoing evaluations. Peabody will be available on an advisory basis to assist in the evaluation and any necessary adjustment of the plan.

This grazing management plan for reclaimed land units is a program of action designed to achieve specific objectives. The following objectives were considered during the development of this plan: 1) secure proper and sustained utilization of the forage resource; 2) avoid unnecessary impacts to related resources (wildlife, soils, watersheds, aesthetics); 3) insure compatibility with existing native resources, the management skills of operators and existing classes of livestock; 4) obtain uniform use of the forage resource through proper distribution of livestock; 5) provide for a stable forage supply (quantity and quality) throughout the grazing season; and 6) improve range condition on adjacent native ranges through reduced grazing pressure. Coordination between the various agencies, proper stocking, and the deferred rotation grazing system described herein should insure that the objectives are being met. Theoretically, the plan (with any necessary modifications or adjustments) should be functionally accurate for an indefinite period of time if properly administrated.

Postmining Water Sources

Pre-existing water sources for livestock and wildlife are shown on Drawing 85322. A description of these water sources and an assessment of mining related impacts is contained in Chapters 15, 17, 18, and 23.

Five types of water sources for wildlife and livestock will exist or are being proposed in the postmining landscape. They include pre-existing springs, wells (pre-existing and replacement), pre-existing intermittent reaches of ephemeral washes, public water standpipes, and ponds. The ponds include pre-existing surface water structures, existing pre-law internal impoundments, existing and proposed postlaw internal impoundments, and

existing and proposed sediment control structures. The water sources are shown on Drawing 85324. This section discusses the adequacy of these water sources (water availability, distribution, and viability) to support the proposed postmining land uses.

The locations, sources, yields, and assessments of water quality for the springs existing within or adjacent to the leasehold are discussed in Chapter 15, Hydrologic Description, and Chapter 17, Protection of the Hydrologic Balance. Annual Hydrology Reports (see Preface to Chapter 15, Hydrologic Description) present monitoring data collected each year at several springs within and adjacent to the leasehold, as well as assessments of water quality trends and suitability for livestock and wildlife. The water quality information for many of the springs identified is qualitative in nature and is the only information available from the period when these springs flowed. With the possible exceptions of springs DM-20 and 8A-144 or 8A-145, these springs are currently dry or exist only as damp spots. This is not surprising as springs are sensitive to climatic and ground-water fluctuations. Springs DM-20 and 8A-144 or 8A-145 probably correspond to PWCC monitoring site numbers NSPG140 and NSPG91, respectively. A discussion of the springs currently monitored on the leasehold is contained in the 2002 Annual Hydrology Report (AHR). These springs exhibit variable discharge, and water from these springs is classified as marginal for livestock use based upon comparisons of spring water quality with recommended livestock drinking water limits. Past evaluations of the suitability of springs identified within and adjacent to the leasehold (Chapter 15, AHR's prior to 2002) support the recent classification. Therefore, the springs shown on Drawing 85324 are relatively poor sources for livestock drinking water due to: 1) variable or diffuse discharge (short term); 2) inconsistent discharge (long term); and 3) marginal water quality.

Pre-existing well water quality and quantity is dependent upon the aquifer(s) penetrated. Aquifer water quality and yield, and local well completion information are discussed in Chapter's 15 and 17. To Peabody's knowledge, none of the local wells on the leasehold are operable with the possible exception of Well 8T-504. This well is known to be completed in the Toreva formation. The Toreva formation yields good water quality at a sufficient rate for livestock use. The replacement wells that Peabody has proposed will also be completed in the Toreva formation and will yield adequate amounts and quality of water for livestock use. Well 4T-402, located between the east and west leasehold tracts, is completed in the Dakota aquifer and is currently operable. The status of the other off-lease local wells shown on Drawing 85324 is unknown, but it is assumed they are still operable. The remaining local wells (see Drawing 85324) cannot be considered viable livestock drinking water sources because they are inoperable, or do not exist. Those

completed in the alluvium and Wepo aquifer would also possess marginal water quality and yield, should they be made operable.

Water quality and discharge information related to the intermittent reaches of the washes is discussed in Chapter's 15 and 17. The intermittent reaches are caused primarily from daylighting of the alluvial ground water. Certain chemical parameters in the alluvial ground water and in stream baseflows exceed the recommended livestock drinking water limits from time to time, which would render the water marginal for livestock uses. However, when dissolved analyses (in lieu of total recoverable or total analyses) for trace metals are used for comparing baseflow and alluvial ground water quality with livestock limits, the water is generally suitable for livestock use. The 2002 Annual Hydrology Report presents comparisons of recent and historic baseflow water quality measured at several stream monitors where baseflow occurs, as well as alluvial ground water quality, and the comparisons support this observation. Based upon Peabody's period of record pertaining to the extent and fluctuations of the intermittent reaches (see Drawing 85324) and the available water quality data (Annual Hydrology Reports from 1986 through 2002), it appears that these water sources are viable. Considerable use of these sources by livestock has been observed on the leasehold, reflecting upon their relative importance.

The public water standpipes (see Drawing 85324) provide sources of drinking, general use and livestock water. Water is routinely hauled to local residences for use in troughs at the corrals and sheep pens. This water is available on a 24-hour basis and is potable.

Peabody has no information regarding the water quality or viability of pre-existing surface water structures. These structures were built on very small watersheds, and their water holding capacity is slight. Water quality is presumed to be sufficient for livestock uses during the short durations that these structures impound water.

Nineteen permanent internal impoundments currently exist that are available for livestock and/or wildlife use as a part of the postmining landscape (Drawing 85324). Two livestock and wildlife sources (N2-RB and N2-RC) and one wildlife habitat area (N2-RA) are approved, permanent internally draining ponds located in the N-2 coal resource area. Sixteen are pre-law internal impoundments located in the J-3 coal resource area (J3-G and five other unnamed impoundments), J-1 coal resource area (J1-RA and J1-RB), N-8 coal resource area (N8-RA), and N-1 coal resource area (N1-RA and six unnamed impoundments). Additional pre-law depressions exist that hold water from time to time. However, they are not considered reliable water sources due primarily to restricted watersheds.

The water chemistry at the N2-RA impoundment is principally controlled by the N-2 mining area spoil aquifer water quality as the pond intercepts a portion of the spoil aquifer. As a result, total dissolved solids concentrations in the pond frequently exceeds the recommended livestock drinking water limit of 6999 mg/l; although, interception of ground water provides excellent water quantity and persistence. The perennial water supply provides valuable resting and feeding habitat for migratory birds. Such conditions did not exist in this area prior to mining. For these reasons, N2-RA is designated for wildlife habitat use and not livestock use. The immediate area of the pond has been fenced to prevent livestock access.

Peabody is also proposing to build one additional internal impoundment in the J-19 coal

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resource area (J19-RB). This structure is intended to improve the distribution of postmining water sources in that area of the leasehold (see Drawing 85324).

Peabody also proposes the retention of 31 existing and future sediment control structures (ponds) to provide surface water bodies for livestock and wildlife in addition to those previously identified. The proposed facilities include nine existing MSHA structures, which include J7-DAM, J7-JR, J2-A, J16-L, J16-A, N-14H, N14-G, N14-F, and N14-D. Twenty smaller existing sediment control structures are also proposed. They include J3-D, J3-E, J7-R, N11-G, N6-L, N11-A, J21-A, J21-C, J27-RA, J27-RB, J27-RC, N5-A, TPF-D, TPF-E, N7-D, J16-G, N7-E, N10-A1, N10-D, and N12-C. Two sediment ponds scheduled for construction during the remaining life-of-mining activities are also proposed, and they are N10-G and J21-I. These existing and proposed ponds all meet or will be upgraded to meet the permanent pond design criteria. Their size, configuration, and upstream watersheds indicate persistent water retention (see the discussion of Permanent Impoundments, Chapter 6 and Appendix E). They will also provide water of good quality for their intended uses based upon analysis contained in Chapter 15 and recent assessments of additional water quality data collected (see 1986 through 2002 Annual Hydrology Reports).

Based upon the previous discussion and comparison of Drawings 85322 and 85324, it can be seen that considerably more water sources with much greater viability will exist in the postmining landscape. The distribution of the viable pre-existing sources will be greatly enhanced with the addition of replacement ponds and wells, public water standpipes, and enhancement ponds.

Land Use Summary

In summary, the postmining land uses of livestock grazing and wildlife habitat represent no change from the premining land uses. The postmining land uses will be achieved through implementation of the reclamation plan discussed in detail elsewhere in this document. The management plan for postmining lands consists of the reclamation plan including revegetation maintenance activities. No formal land use plans or policies have been developed by land management agencies specific to the Black Mesa leasehold. Therefore, the reclamation plan has been designed to produce lands which will be compatible with and will support the existing land uses. The reclamation plan has been previously approved by the Bureau of Indian Affairs and the Navajo and Hopi Tribes (see Permit Application Approval Packages for Permits AZ-0001 and AZ-0001D).

CHAPTER 15

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INDEX (Cont.)

LIST OF ATTACHMENTS (CONT.)

PREFACE

Following the development of the original 1981-1985 Mining and Reclamation Plan (MRP), Peabody Western Coal Company (PWCC) compiled several annual Hydrologic Data reports to expand and further detail the data base which was presented in the original MRP. As of the submittal of the Mining and Reclamation Plan Permit Application Package (PAP) for the Black Mesa and Kayenta Mines in 1985, PWCC had submitted four annual reports to OSM. They were entitled the "1980-1981 Hydrological Data" report, the "1981-1982 Hydrological Data" report, the "1983 Hydrological Data" report, and the "1984 Hydrological Data" report. Throughout the following chapter, these four reports will be referred to as the HDR's. All data plots referred to in this Chapter can be found in the HDR's or the original MRP.

Following submittal of the PAP in 1985, PWCC developed eighteen additional annual Hydrology Data Reports for the years 1985 through 2002. These eighteen reports were compiled in response to commitments contained in Chapter 16, Hydrologic Monitoring Program (Volume 11, PAP). Data presented in these subsequent reports are considered to be an extension of information presented in the following chapter that describes the hydrology of the Black Mesa leasehold.

Attachment 25 to the following chapter provides summary descriptions and references to reports and studies conducted after the submittal of the PAP that are pertinent to the Navajo Aquifer. The more recent information referenced in the attachment provides additional data specific to the Navajo Aquifer for description purposes and impact assessments recently updated in Chapter 18, Probable Hydrologic Consequences.

Revised 11/21/03

ATTACHMENT 25

Updated Information since 1985 Pertinent to the Navajo Aquifer

INTRODUCTION

A significant amount of additional data has been collected and studies performed regarding the Navajo Aquifer since Peabody Western Coal Company (PWCC) submitted the Mining and Reclamation Plan Permit Application Package (PAP) for the Black Mesa and Kayenta Mines in 1985. This attachment to Chapter 15, Hydrologic Description, is provided in order to summarize or provide reference to the data collected and studies performed since 1985 (or those prior to 1985 not mentioned in the chapter), which supplement information pertinent to the Navajo Aquifer presented in the Hydrologic Description.

PWCC ANNUAL HYDROLOGY DATA REPORTS

Beginning with the first annual Hydrological Data Report ("1980-1981 Hydrological Data"), PWCC has submitted twenty-two annual reports to the Office of Surface Mining. The reports are required in part due to commitments contained in Chapter 16, Hydrologic Monitoring Program. The most recent report, entitled "2002 Annual Hydrology Report", was submitted in June of 2003. This report contains average non-pumping static water levels for PWCC's Navajo Wells from 1971 through 2002, quantities of ground water pumped from each well from 1992 through 2002, and water chemistry collected from the Navajo Wells during 2002.

Previous annual reports include water quality data collected at each well during the reported year. Quantities of ground water pumped from each Navajo Well prior to 1992 and following 1985 can be found in quarterly pumpage and drawdown reports submitted by PWCC to the Navajo Nation, Hopi Tribe, BIA, and the USGS, and in the annual USGS progress reports.

USGS ANNUAL PROGRESS REPORTS

In 1971 the USGS began a cooperative basin-wide monitoring program, which initially included compilation of discharge estimates of N-Aquifer pumping by the Arizona Department of Health, Navajo Tribal Utility Authority, the Hopi Tribe, and Indian Health Services. Beginning in 1983 the Bureau of Indians Affairs joined the cooperative. The level of monitoring efforts increased in later years with further assistance from PWCC, NTUA, the Hopi Tribe, the Western Navajo Agency, Chinle Agency, and the Hopi Agency of the BIA. The USGS has published many progress data reports on an approximate annual basis after the program began, containing information on both community and industrial well locations and construction characteristics, quantity of ground water pumped, water levels and changes, water quality, surface water discharge, and spring discharge. References for each of the USGS progress reports published since 1984 are presented at the end of this attachment.

N-AQUIFER STUDIES AND REPORTS

Geology. Additional geologic studies of the Navajo Sandstone and related formations have been conducted since 1985. Samples from rock outcrops were examined in the lab for stress analysis, and to aid interpretation of ground water chemistry (GeoTrans, 1993;

Peabody Western Coal Company, 1994). The geology of Tsegi Canyon was mapped in 1996 to provide a better understanding of geologic controls on the locations of springs and seeps (Waterstone, 1996). Further mapping was conducted recently throughout the basin to further delineate prominent geologic structures and to better map the Navajo Sandstone outcrops and related formations (Waterstone, 1999; Peabody Western Coal Company, 1999).

Aquifer Properties. Measurements of hydraulic conductivity in the Navajo Aquifer exist from laboratory analyses of cores and outcrop samples, and from pumping tests at several wells (GeoTrans, 1993). Hydraulic conductivity estimates for the Navajo Sandstone and related formations are also available from regional studies performed (Blanchard, 1986a; Uygar, 1980; Kernodle, 1996; and Heilweil and Freethey, 1992). Eychaner (1983) developed the original estimate of recharge to the Navajo Aquifer. GeoTrans (1987) developed another estimate of recharge to the Navajo Aquifer using concepts developed by Maxey and Eakin (1949). Tree-ring data and related information was collected and analyzed to develop a better understanding of the magnitude and timing of changes in precipitation to further understand recharge (Kirk, 1987; GeoTrans, 1993; Peabody Western Coal Company, 1994; and HSI GeoTrans, 1997). Geochemical studies, including the analysis of carbon-14 data, were used to develop several estimates of recharge rates for the Navajo Aquifer (Lopes and Hoffmann, 1997; Zhu and others, 1998; Peabody Western Coal Company, 1999; Zhu, 2000). Lopes and Hoffmann (1997) and Peabody Western Coal Company (1999) have investigated leakage of water from the Dakota Aquifer to the Navajo Aquifer through the Carmel formation.

Numerical Modeling and Related Reports. Numerical models have been developed to estimate the impacts of pumping by PWCC and the tribal communities on the Navajo Aquifer. Reports associated with each of the models reference numerous studies and data related to the Navajo Aquifer too voluminous to mention here. As mentioned in Chapter 15, Hydrologic Description, the first model developed was by Eychaner of the USGS (1983). Soon thereafter, the USGS (Brown and Eychaner, 1988) updated this model. Concurrently, an independent modeling effort was conducted by PWCC (GeoTrans, 1987).

In 1993, under the auspices of the coal leases and authorized by the Secretary of Interior, a study was conducted that reviewed the USGS model for appropriateness, application, calibration, and results (S.S. Papadopulos and Associates, 1993). An important result of the S.S. Papadopulos study was the development of a database for the Navajo Aquifer that was more comprehensive that the one used by Brown and Eychaner (1988). PWCC initiated a modeling study in 1994 in which the sensitivity of modeling predictions to the estimated recharge rate used by the USGS was tested (Peabody Western Coal Company, 1994; GeoTrans, 1994; Waterstone, 1995).

Finally, and most recently, PWCC substantially revised the modeling of the flow system by developing a three-dimensional representation of the Navajo and Dakota Aquifers, separated by the intervening low-permeability Carmel Formation (Peabody Western Coal Company, 1999). This work was based on a database that included and went beyond the one compiled by S.S. Papadopulos (1993), in part, by adding information for adjoining formations, and including eleven additional years of pumping stresses, water-level measurements, and spring and stream flow measurements. The modeling report, entitled "A Three-Dimensional Flow Model of the D and N Aquifers, Black Mesa Basin, Arizona",

contains a significant amount of updated information related to the Navajo Aquifer above and beyond what is presented in Chapter 15. The report contains twenty-four pages of references, all of which are considered pertinent to describing the geology and hydrogeology of the Navajo Aquifer.

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