3.0 CBM WATER HANDLING SCENARIOS

Three alternatives were analyzed in detail in the PRB O&G FEIS. The alternatives analyzed were: (1) Proposed Action, (2) Proposed Action with Reduced Emission Levels and Expanded Produced Water Handling Scenarios [2A and 2B], and (3) No Action. These alternatives are described in detail in Chapter 2 of the FEIS.

The method of handling CBM-produced water would vary with changes in the quality and volume of water and desires of the surface owner. Potential water handling methods are summarized in Tables 2-9, 2-21, and 2-22 of the FEIS and include:

- Direct surface discharge (with or without prior treatment),
- Discharge to infiltration impoundments,
- Containment of produced water in impoundments (negligible infiltration),
- Land application, and
- Injection into the Fort Union Formation below the coal zone or a lower injection zone via wells

The method of water handling significantly influences the amount of CBM-produced water that is likely to recharge the shallow groundwater system as a result of infiltration.

Discharge to surface streams is currently the primary method of handling CBM-produced water. Discharges are permitted by the WDEQ under a National Pollutant Discharge Elimination System (NPDES) permit. Field measurements of flow loss during dry weather along the reaches of various ephemeral streams that receive CBM discharge water indicate that significant conveyance losses (70 to 95 percent) occur (AHA 2001, Meyer 2000b) within a few miles of the discharge point. Most of the conveyance loss, estimated to average about 82 percent, is a result of infiltration into the alluvium and underlying shallow Wasatch sandstone aquifers. The remainder of the conveyance loss occurs through direct evaporation or consumption by vegetation (evapotranspiration).

The modeling analysis assumed that discharge of CBM-produced water to surface drainages results in a 20 percent conveyance loss, 82 percent of which is attributable to infiltration and 18 percent a result of evapotranspiration. It is therefore estimated that about 16 percent of the CBM-produced water that is discharged to ephemeral creeks infiltrates to recharge the shallow groundwater system within a few miles of the point of discharge.

Another common method of handling CBM water is to discharge the produced water into infiltration impoundments. These impoundments are typically unlined; in some cases, the bottom surface of an impoundment area may contain key trench-type excavations or closely spaced boreholes to enhance infiltration. Evaporation also may be enhanced by atomizers placed on towers situated on floating islands, with spray from these units directed above the water surface only. Water balance studies on existing reservoirs (Meyer 2000b) indicate that rates of infiltration range from 4 feet to more than 20 feet per year, depending on the soil type that underlies the impoundments. In areas of sandy soil, the rate of infiltration may be considerably higher than 20 feet per year. An average rate of infiltration of 8 feet per year is assumed for the regional modeling analysis. In contrast, average evaporation rates from a reservoir are about 4 feet per year. This analysis estimated that 15 percent of the water that is discharged to impoundments would resurface and enter the surface drainage system. Of the remaining 85 percent,

about 67 percent would infiltrate to recharge the shallow groundwater system, and the remaining 33 percent would evaporate.

Containment impoundments, which are designed for complete containment so that only negligible infiltration occurs, would be considered as an alternative for water management in areas where discharge of produced water to surface streams or infiltration to shallow groundwater is not desirable based on water quality concerns. It is assumed that no leakage from these impoundments would occur. This analysis also assumed that none of the water discharged to containment impoundments infiltrates into the shallow groundwater system.

Produced water can be managed by land application. These methods involve spreading the water over the ground using atomizers or irrigation equipment. This analysis assumed that 100 percent of the water handled in this manner would be consumptively used and, consequently, none of the water would infiltrate into the shallow groundwater system.

In the case of water management by injection, the produced water would be returned directly to the subsurface, into the geologic units where the injection wells are completed. This analysis assumed that all injection wells would be completed in Fort Union sandstone units below the coal zone or lower injection zones. All injection would occur below the coal units developed for CBM.

The percentage of produced water that may infiltrate or recharge the groundwater system has been estimated for each water handing method, as summarized in Table 3-1.

Table 3-1
Summary of the Percentage Recharge for Each Water Handling Method

Water Management Method	Description of Percentage Recharge
Surface Discharge	20 percent of conveyance loss in surface discharge; 82 percent of conveyance loss infiltrates and 18 percent of the loss is evapotranspired.
Infiltration Impoundment	Of the water discharged to impoundments, 15 percent resurfaces and enters drainage; of the remaining 85 percent, 67 percent is lost to infiltration, 33 percent is stored or lost to evaporation.
Containment Impoundment	100 percent is stored or lost to evaporation and soil moisture
Land Application	100 percent of water is consumptively used
Injection	100 percent of water injected into disposal wells recharges groundwater below the Fort Union coal zone.