Groundwater quality reported from the Oxbow Mine near the Bear Creek Drainage (WWE 2003a) shows the "B" coal seam with TDS values ranging from 644 to 2,792 mg/l, bicarbonate ranging from 489 to 2,331 mg/l, and sulfate at values below 50 mg/l. The water is sodium-calcium bicarbonate dominated and typical of water in the Mesaverde Formation. Dissolved iron can range up to 0.267 mg/l and total iron up to 46.9 mg/l. The water is not sulfate dominated, suggesting that the water samples are either from unoxidized coal seams or from sand lenses interbedded with the coal seams. When the iron sulfides in the coal oxidize, the water will become sulfate dominated. Waters discharging from old mine workings often show surface dominance of bicarbonate.

Groundwater in the Rollins Sandstone at the Oxbow Mine has TDS values ranging from 6,925 to 13,828 mg/l; chloride values of 1,917 to 6,569 mg/l; sulfate up to 384 mg/l; and bicarbonate values from 1,796 to 4,524 mg/l. The pH values range from 7.6 to 9.6. Iron ranges up to 4.5 mg/l. Based on this water chemistry, the groundwater in the Rollins Sandstone in this part of the project area is suspected to be connate marine water dominated by sodium chloride (WWE 2003a).

3.4.2 Environmental Consequences

3.4.2.1 Surface Water

Proposed Action

Impacts Applicable to All Sites. Short-term increases in sediment loading could occur within adjacent and downstream portions of perennial drainages (Surface, Terror, and Hubbard creeks) and intermittent drainages (Bear and Hawksnest creeks) due to surface disturbance from construction and possibly from vegetation removal near drainages. The magnitude of sediment increase would depend upon the proximity of the disturbance to a stream channel, construction duration, and stream flow conditions. Well pad placement meets the lease stipulations of "no surface occupancy in floodplains" (Powerline, Bull Park, Hubbard Creek, Oakbrush, Thompson Creek, and Hawksnest sites). Therefore, any increased sedimentation would be localized. The relatively small acreages of vegetation cleared for the well pads and new spur roads would represent a very small portion of the watershed project area. Therefore, any changes in runoff characteristics due to vegetation removal in the watershed project area would be minor. Construction at two sites (Leon Lake #4 and Bull Park) would occur in areas that drain toward perennial streams. However, the presence of vegetation in the drainage area would minimize sediment runoff. The Leon Lake #4 site is located approximately 1,300 feet from Surface Creek. The beginning of the new access road to this site is located approximately 400 feet from Surface Creek. The beginning of the new access road to the Bull Park site is located within approximately 220 feet of an unnamed tributary to the West Fork of Terror Creek. Surface disturbance in these construction areas could result in temporary erosion. By implementing design features such as the SWPPP, Grading and Surface Hydrology Plan, and reclamation of disturbed areas, sediment levels would be minimized and kept from entering perennial streams. In addition, a water quality monitoring plan would be conducted in stream segments and springs to confirm impact predictions and identify and mitigate any sediment concerns.

Traffic use on unpaved portions of the existing access roads also could contribute sediment in areas adjacent to perennial streams. However, any road damage or erosion hazards would be repaired on the existing access roads as part of design features of the Proposed Action. Erosion control and reclamation procedures must conform with standards identified in the USFS's *Watershed Conservation Practices Handbook* (2509.25-99-1). Applicable standards relate to the hydrologic function of streams, sediment control, and water purity. Sedimentation is expected to be minimal.

The evaluation of potential impacts of drilling, completion, and testing operations on surface water quality focused on chemical use and storage, produced water disposal, and surface and groundwater relationships. Produced water would not affect surface water quality because it would be contained and transported to a disposal site. No spillage is anticipated during transport because the produced water would be contained. Withdrawals of groundwater from the Mesaverde Formation would not affect the hydrological regime of surface water features. None of the surface waters in the analysis area have a hydraulic connection to groundwater in the Mesaverde Formation. Therefore, drilling or testing would not introduce contaminants into surface water through the groundwater. There would be no potential for increased selenium loading in surface water because of the disposal method for produce water and the fact that there is no hydrological connection between surface and groundwater. Additional discussion of groundwater effects on springs and seeps is provided in Section 3.4.2.2. Chemical use and storage could potentially result in a leak or spill at the well pad site. The use of berms and BMPs for using chemicals would reduce the risk of a spill or leak. If a spill is detected, the SPCC Plan would be implemented to minimize, control, and cleanup the affected area. These measures would ensure that spilled material did not enter a surface water feature.

A potential impact to surface water quality would be from the possible but unlikely event that a vehicular accident would occur at a drainage crossing where drilling chemicals or motor fuels are spilled into a drainage. Trucks and other vehicles would make regular daily trips to each drill pad during drilling operations to transport water for drilling (about 150,000 gallons per drill site), drilling mud and other chemicals, and chemicals to be used in hydrofracturing. GEC has prepared and would implement a SPCC Plan to minimize potential impacts to surface water resources in the event of a spill. As a result, any impact to surface water resources would be temporary and localized in nature.

Surface water quantity would not be affected by project activities. Studies by WWE (2003a) and Brooks and Ackerman (1985) have shown that groundwater is not directly connected to surface water resources in the proposed project areas. The closest area with hydraulic connection between the groundwater and surface water is near the North Fork of the Gunnison River; no drilling would occur in this area. Hydrofracturing of the Mesaverde Formation and its various members in the area of the proposed new wells would not affect surface water resources or municipal water supplies for towns and communities along the North Fork of the Gunnison River. Since there is no connection to surface water, drilling would not affect four water rights located within 1 mile of several proposed wells (i.e., Carol Spring and Cole reservoirs #4 and #5 for the Leon Lake #4 and #5 sites and Garvin Mesa Pipeline Company for the Bull Park site). Other reservoirs, stock water sources, irrigation water supplies and ditches (e.g., Terror Ditch, Overland Ditch, and Leroux Creek), pipelines (e.g., Pitkin Mesa and Sunshine Mesa), and municipal supplies and water wells (e.g., Town of Cedaredge, Surface Creek Water Users Association) are greater than 1 mile from the proposed new wells, and the hydrofracturing would occur at depths that are at least 1,000 feet or more from the surface. Therefore, the proposed drilling and hydrofracturing would not affect surface water quantity

during all types of water years including drought conditions. As discussed above, produced water would not be discharged into surface streams. In addition, water used for drilling would be obtained by an existing water right owned by Oxbow Mining from the North Fork of the Gunnison River. Therefore, no new depletion would occur in the North Fork of the Gunnison River or the Colorado River Basin. Water use for the project is described in Section 2.1.2.5. Effects of water use on endangered fish species is discussed in Section 3.7.2.1.

Reclamation of project disturbance areas would involve the use of fertilizers to enhance the re-establishment of vegetation. Surface runoff from the reclaimed areas would be diverted away from surface water resources; these runoff control practices would not create any water depletion in the Colorado River basin. Although the use of fertilizers could result in increased nutrient levels in surface runoff, the effect to surface water resources is anticipated to be minimal based on the diversion of disturbance area runoff away from drainages, the short-term nature of fertilizer usage, and the small acreage that would require fertilizer application.

Site-specific Impacts.

Leon Lake #4. The Leon Lake #4 well would be drilled in the Spaulding Peak area, as shown in Appendix G, **Figure G-1**. The new road spur to this proposed drill site would be located within about 250 feet of Surface Creek. Potential impacts to surface water resources in Surface Creek, including potential sediment increases and fertilizer- and spill-related effects, would be the same as described above under Impacts Applicable to All Sites. This site would require an exception since an unnamed pond is located within 500 feet of the proposed pad. The lease stipulation specifies that the pad is located at least 500 feet from the high water levels of ponds and streams. No water quality effects from project activities are expected for an unnamed pond, which is located approximately 460 feet from the well pad. The pond is located upgradient from the pad, and thus, drainage from the well site to the pond would not occur.

Leon Lake #5. The Leon Lake #5 well would be drilled in the Spaulding Peak area, as shown in Appendix G, **Figure G-1**. This new drill site and the new spur access road would be about 2,300 feet from Surface Creek. Two intermittent streams are located near the pad site: 1) an unnamed tributary to Cole Reservoir No. 5 is about 400 feet east of the proposed drill site and 2) an unnamed stream is located about 97 feet west of the pad. This site also would require and exception for the intermittent streams being less than 500 feet from the pad. No impacts to surface water resources in Surface Creek would be expected from exploration activity at this site. During heavy rainfall, there may be some increase in sediment loading to the closest tributary near the drill site. Potential impacts to surface water resources in these tributaries, including potential sediment increases and fertilizer- and spill-related effects, would be the same as described above under Impacts Applicable to All Sites. By implementing the design features discussed above, water quality effects would be minor and short-term in duration.

Powerline. The Powerline well would be drilled in the vicinity of the East Fork of Terror Creek and Hubbard Creek, as shown in Appendix G, **Figure G-2**. Exploration activities could result in effects to the upper reaches of intermittent streams within the East Fork of Terror Creek and Hubbard Creek drainages, especially during periods of heavy rainfall. These potential impacts, including potential sediment increases

and fertilizer- and spill-related effects, would be the same as described above under Impacts Applicable to All Sites.

Bull Park. The Bull Park well would be drilled in Bull Park as shown in Appendix G, **Figure G-2**. The new road spur would be about 220 feet from an unnamed tributary to the West Fork of Terror Creek. Exploration activities could result in effects to the tributary and the West Fork of Terror Creek. These potential impacts, including potential sediment increases and fertilizer- and spill-related effects, would be the same as described above under Impacts Applicable to All Sites.

Hubbard Creek. The Hubbard Creek well would be drilled in upper Hubbard Creek as shown in Appendix G, **Figure G-2**. This drill site is not near any drainages; the closest drainage is Lone Pine Creek at a distance of 1,600 feet. The proposed drill site is on a plateau. As a result, no impacts to Lone Pine Creek or Hubbard Creek are anticipated. Potential impacts, including potential sediment increases and fertilizer- and spill-related effects, to Bear or Lone Pine creeks as a result of project-related activity along the access road would be the same as described above under Impacts Applicable to All Sites.

Oakbrush. The Oakbrush well would be drilled near the headwaters of Lone Pine Creek, about 4,000 feet southeast of the Hubbard Creek well site, as shown in Appendix G, **Figure G-2**. The closest drainage is that of upper Lone Pine Creek at a distance of 1,300 feet. This drill site is on a plateau. As a result, no impacts to Lone Pine Creek are anticipated. Potential impacts, including potential sediment increases and fertilizer- and spill-related effects, to Bear or Lone Pine creeks as a result of project-related activity along the access road would be the same as described above under Impacts Applicable to All Sites.

Hawksnest and Thompson Creek. The Hawksnest and Thompson Creek wells would be drilled near Thousand Acre Flats, as shown in Appendix G, **Figure G-3**. No perennial streams are located within 3 miles of these two drill sites. As a result, no impacts to perennial streams are anticipated at these sites. Any fuel or chemical spill that may occur along the access roads to these two drill sites would be contained and cleaned up as specified in the SPCC Plan.

No Action

Under the No Action Alternative, water would not be used for drilling or be produced as part of testing.

3.4.2.2 Groundwater

Proposed Action

The Proposed Action would drill eight new gas exploration wells in the project area as discussed in detail in Sections 2.1.3 through 2.1.5 and shown on **Figure 1-1**. All of these proposed eight wells would extend to the Mancos Shale. The Barren and Cameo Members of the Mesaverde Formation would be the primary target for natural gas evaluation and this stratigraphic member of the Mesaverde Formation would be hydrofractured in each of the proposed eight wells. Secondary target formations that may be hydrofractured include the Cozzette and the Corcoran members of the Mesaverde Formation and the Rollins Sandstone.

The proposed wells and the geologic units that would be penetrated and potentially evaluated for natural gas by the proposed drilling are shown in Appendix J.

Hydrofracturing of a sedimentary formation is used to enhance the permeability of the lithologic unit and to enhance the flow of gas from the lithologic unit into the well bore. The hydrofracturing method proposed is discussed in detail in Section 2.1.4. The hydrofracturing would create horizontal and vertical fractures in the targeted stratigraphic horizon that extend laterally outward from the well bore for about 500 feet. As shown in the figures in Appendix H, the fractured rock would form a zone shaped similar to a rectangle around the well bore. The created fractures would be held open by the proppant used to create the fractures and by sand injected into the fractures after they are formed. Thus, hydrofracturing potentially affects the target horizon for approximately 500 feet from the well bore. To be conservative, the potential impact area analyzed for each of the proposed eight wells was extended to 5,000 feet, or 1 mile from the well bore. This is ten times the expected extent of the fractures created by hydrofracturing of the proposed wells and should encompass the entire area of potential impacts expected from the hydrofracturing.

Impacts Applicable to All Sites

Groundwater data on the project area come mainly from WWE (2003a) and USGS reports by Brooks and Ackerman (1985) and Brooks (1983). There are no data on the effects of hydrofracturing for the Mesaverde Formation in the project area. The expected impacts of hydrofracturing presented below are based on information provided by GEC (McCallister 2003) during March of 2003, a report prepared by WWE for four exploration wells on private land in the project area (WWE 2003b), and a report on hydrofracturing and CBM development published by the USEPA (2002). A description of hydrofracturing is given in Section 2.1.2.3.

Groundwater resources in the Mesaverde Formation would not be impacted by drilling and hydrofracturing except within about 500 feet of the well bore. Because most of the hydrofracturing would be done at considerable depths (2,000 feet or more below ground surface), groundwater resources near the surface, such as springs, would not be affected by the hydrofracturing. Coal mine workings and geologic faults greater than 1,000 feet from the well bore should not be affected by hydrofracturing. Those workings and faults less than 1,000 feet and especially those workings and faults less than 500 feet from the well bore may be affected. Hydrofracturing would be expected to increase the permeability of a geologic fault if the fault is less than 500 feet from the well bore. If this fault has open communication with the surface, this could lead to natural gas escape to the surface if natural gas is encountered in the hydrofractured zone. Coal mine workings that are not stable, may suffer induced collapse if they are within 500 feet of the well bore. For coal mine workings and geologic faults between 500 feet and 1,000 feet from the well bore, the potential impact of hydrofracturing is uncertain due to a lack of site-specific data for the Mesaverde Formation in the project area. The impact of hydrofracturing depends largely on two factors: 1) the structural grain of the rocks being hydrofractured and 2) the stress field operating on the rocks at the time of the hydrofracturing. Neither of these factors are known for the Mesaverde Formation in the project area. However, it is not expected that hydrofracturing effects would extend beyond 500 feet as discussed by WWE (2003b) and the USEPA (2002).

Groundwater intercepted during drilling of the eight natural gas exploration wells would be pumped to tanks and removed from the site. No groundwater would be discharged down surface drainages or allowed to flow

out onto the surface around the drill pads. Thus, there would be no contamination of surface water resources by produced water. Groundwater rights would not be affected by this removal of groundwater, because the eight proposed wells are not near domestic or municipal wells, and are 2,000 feet deeper than domestic wells (see Appendix J). The expected maximum pumping rate of groundwater is about 5 gpm and this is based on a compilation of data from other natural gas wells in the Mesaverde Formation in the area (WWE 2003a). Groundwater removed during drilling would not affect surface water flow because of the depth of the wells, and because groundwater in the Mesaverde Formation in the area of the proposed eight wells is considered non-tributary and does not interact with surface water. What groundwater there is in the area of the eight proposed wells is isolated in pockets of higher permeability in the Mesaverde Formation due to the presence of sand zones or the presence of increased fracturing and fracture density. Because of the isolated nature of groundwater in the Wasatch, Green River, Uinta, and Mesaverde formations, which generally do not contain groundwater except in areas of increased permeability due to sand layers and fracturing, the use of fertilizer during reclamation of the drill pads would not affect groundwater quality in these formations. Drill sites that are constructed on unconsolidated colluvium may have shallow groundwater beneath the drill pad. Use of fertilizer in these locations may result in a short-term temporary localized increase in nutrient levels, particularly those constituents involving nitrogen, as a result of infiltration. The project would not affect recharge to bedrock units because of proposed drilling and hydrofracturing would occur at least 2 miles from the recharge zone to those units, which is located along the North Fork of the Gunnison River. In addition, there would be no basin translocation of groundwater. Furthermore, groundwater in the Mesaverde Formation is considered non-tributary groundwater to surface water drainages and the flow rate is extremely low due to low permeabilities. Groundwater potentially removed from the hydrofractured intervals would be disposed of within the Colorado River Basin. Hydrofracturing would not affect groundwater resources during all types of water years including drought conditions due to the limited hydrofrac area of 500 feet.

The proposed wells at the eastern side of the project area, mainly the Hawksnest and Thompson Creek wells, would be near coalbeds that outcrop along the North Fork of the Gunnison River. Potential impacts to coalbeds are discussed for these wells under site-specific impacts. The remaining wells in the Proposed Action area would not affect outcropping coalbeds and thus should not affect groundwater recharge to the coalbeds that recharge creeks, because the coalbeds that may be intercepted and hydrofractured in the remaining wells would be too deep to have any connection with surface water features. Hydrofracturing would not increase the potential for gas to migrate through coalbeds to recharge streams because this process occurs at depths of at least 1,000 feet from any streambeds.

Site-specific Impacts

The potential impacts of each of the eight proposed natural gas exploration wells on groundwater resources are summarized below:

Proposed Wells Leon Lake #4 and #5. Two proposed natural gas exploration wells would be drilled on public land in the Spaulding Peak area. These are referred to as Leon Lake #4 and Leon Lake #5. Plan view and cross sectional maps for the proposed wells in the Spaulding Peak area are shown in Appendix J, **Figures J-1, J-2, J-3,** and **J-4**.

Leon Lake #4 Well. This proposed natural gas exploration well would be started in unconsolidated colluvium at an elevation of 8,965 feet amsl. The well would be drilled to a total depth of about 4,780 feet and bottomed in the Mancos Shale at an elevation of 4,185 feet amsl. The Cameo Member of the Mesaverde Formation would be intercepted at an elevation of 5,300 feet amsl and the Rollins Sandstone would be intercepted at an elevation of 4,875 feet amsl. This leaves approximately 425 feet of the Cameo Member that would be hydrofractured. There are no springs and seeps or domestic wells within 3,500 feet of Leon Lake #4 (Appendix J, **Figure J-3**). There are no coal mine workings within 1 mile of the Leon Lakes area. Thus, natural gas evaluation of the Mesaverde Formation utilizing hydrofracturing would not affect any groundwater resources in the vicinity of the Leon Lake #4 well. The Rollins Sandstone, the Cozzette and Corcoran members of the Mesaverde Formation, and the lower part of the Barren Member of the Mesaverde Formation also may be hydrofractured in this proposed well, as shown in Appendix J, **Figure J-2**.

Leon Lake #5 Well. This well would be started in unconsolidated colluvium at an elevation of 8,758 feet amsl. The well would be drilled to a depth of about 4,458 feet and bottomed in the Mancos Shale at an elevation of 4,300 feet amsl. The Cameo Member of the Mesaverde Formation would be intercepted at an elevation of 5,425 feet amsl and the underlying Rollins Sandstone would be intercepted at an elevation of 5,000 feet amsl, leaving approximately 425 feet of the Cameo Member available for natural gas evaluation. The Cameo Member would be hydrofractured to enhance the flow of gas to the well bore. There is a spring (SP-SG1) and a seep (SP-SP1) within 1,000 feet of Leon Lake #5 (Appendix J, **Figure J-3**) that flow from the unconsolidated deposits. These two surface water features would not be affected by hydrofracturing in the Cameo Member of the Mesaverde Formation because the unconsolidated alluvium is over 3,000 feet above the hydrofracturing zone. There are no coal mine workings within 1 mile of the Leon Lake #5 drill pad. Thus, the Leon Lake #5 well would not affect groundwater resources, coal mine workings, or water-bearing zones within coal mines. The Rollins Sandstone, the Cozzette and Corcoran members of the Mesaverde Formation, and the lower part of the Barren Member of the Mesaverde Formation also may be hydrofractured in this proposed well, as shown in Appendix J, **Figure J-4**.

Drilling activities would not affect the Surface Creek fault, since the closest well sites, Leon Lake #4 and #5, are located greater than 1 mile from the fault. Hydrofracturing lengths would extend no more than 500 feet in horizontal distance from the borehole.

The use of fertilizers during reclamation may result in a short-term temporary localized increase in nutrient levels in the shallow groundwater within the unconsolidated colluvium beneath Leon Lake #5, and as a result, a corresponding short-term temporary increase in nutrient levels in the seeps and springs near this well site that receive their flow from this groundwater source.

Bull Park Proposed Well. One natural gas exploration well is proposed for the Bull Park area as shown in Appendix J, **Figures J-5** and **J-6**. This well would be started in the Wasatch Formation at an elevation of 8,588 feet amsl. The total depth would be about 3,380 feet and the well would bottom in the Mancos Shale at an elevation of 5,150 feet amsl. The Cameo Member of the Mesaverde Formation would be intercepted at an elevation of 6,375 feet and the underlying Rollins Sandstone would be intercepted at 5,725 feet amsl, leaving 650 feet of the Cameo Member available for hydrofracturing. There is one private domestic water well (SEO #207078) within 1 mile of the proposed drill pad that is 171 feet deep and screened in the

Wasatch Formation. There are no springs or coal mine workings within 1 mile of the proposed well pad. There are two normal faults within 1 mile of the proposed drill pad. One fault is located within 500 feet of the proposed well site (Appendix J, **Figure J-5**). This fault is not known to be water-bearing, although there are no data on the fault or its permeability. Hydrofracturing may increase the permeability of the fault but only in the zone of hydrofracturing, which would have a vertical extent that would not go any higher than the lower part of the Mesaverde Formation. The domestic water well obtains water from the Wasatch Formation and is over 1,000 feet above the Cameo Member, so that hydrofracturing of the Cameo Member would not affect the water well. Thus, the proposed Bull Park well would not affect groundwater resources or any coal mines. The Rollins Sandstone, the Cozzette and Corcoran members of the Mesaverde Formation, and the lower part of the Barren Member of the Mesaverde Formation also may be hydrofractured in this proposed well, as shown is Appendix J, **Figure J-6**. Hydrofracturing of these units would have impacts similar to hydrofracturing of Cameo Members.

Powerline Proposed Well. One natural gas exploration well is proposed for the Powerline area as shown in Appendix J, **Figures J-7** and **J-8**. This well would be started in the unconsolidated colluvium at an elevation of 8,952 feet amsl. The well would be drilled to a total depth of about 4,502 feet and bottomed in the Mancos Shale at an elevation of 4,450 feet amsl. The Cameo Member of the Mesaverde Formation would be intercepted at an elevation of 5,700 feet amsl and the underlying Rollins Sandstone would be intercepted at 5,050 feet amsl, leaving 650 feet of the Cameo Member available for hydrofracturing. There are no private water wells, springs, or coal mines within 1 mile of the proposed drill pad. Thus, drilling of the Powerline well and hydrofracturing of the Cameo Member would not affect groundwater resources or any coal mines. The Rollins Sandstone, the Cozzette and Corcoran members of the Mesaverde Formation, and the lower part of the Barren Member of the Mesaverde Formation also may be hydrofractured in this proposed well, as shown is Appendix J, **Figure J-8**. Hydrofracturing of these units would have impacts similar to hydrofracturing of Cameo Members.

Hubbard Creek Proposed Well. One natural gas exploration well is proposed for the Hubbard Creek area as shown in Appendix J, **Figures J-9** and **J-10**. This well would be started in the Wasatch Formation at an elevation of 7,880 feet amsl. The well would be drilled to a total depth of about 3,155 feet and bottomed in the Mancos Shale at an elevation of 4,725 feet amsl. The Cameo Member of the Mesaverde Formation would be intercepted at an elevation of 5,850 feet amsl and the underlying Rollins Sandstone would be intercepted at 5,300 feet amsl, leaving 550 feet of the Cameo Member available for hydrofracturing. There are no domestic water wells, springs, or coal mines within 1 mile of the proposed drill pad. Thus, no impacts to groundwater resources or coal mines are expected from the hydrofracturing of the Cameo Member. The Rollins Sandstone, the Cozzette and Corcoran members of the Mesaverde Formation, and the lower part of the Barren Member of the Mesaverde Formation also may be hydrofractured in this proposed well, as shown is Appendix J, **Figure J-10**.

Oakbrush Proposed Well. One natural gas exploration well is proposed for the Oakbrush area as shown in Appendix J, **Figures J-11** through **J-13**. This well would be started in the Wasatch Formation at an elevation of 8,104 feet amsl. The well would be drilled to a total depth of about 3,279 feet and bottomed in the Mancos Shale at an elevation of 4,825 feet. The Cameo Member of the Mesaverde Formation would be intercepted at an elevation of 5,950 feet and the underlying Rollins Sandstone would be intercepted at an elevation of 5,400 feet, leaving 550 feet of the Cameo Member available for hydrofracturing. The proposed Oakbrush

drill pad is within approximately 1.5 miles of active workings of the Bowie Mine and 2 miles of abandoned working of the Blue Ribbon Mine. Hydrofracturing would not extend these distances; therefore, no impacts are expected (Appendix J, **Figure J-12**). Also, Hubbard Creek drains the Wasatch Formation and the Ohio Creek and Barren Members of the Mesaverde Formation in this area (Appendix J, **Figure J-12** and **J-13**) Two normal faults are within 1,000 feet of the proposed drill pad. Hydrofracturing is expected to extend a maximum of 500 feet from the drill hole and should not affect these two normal faults. However, there is a remote possibility that the hydrofracturing could extend up to 1,000 feet and reach the faults. The Rollins Sandstone, the Cozzette and Corcoran members of the Mesaverde Formation, and the lower part of the Barren Member of the Mesaverde Formation also may be hydrofractured in this proposed well, as shown is Appendix J, **Figure J-12**. Hydrofracturing of these units would have impacts similar to hydrofracturing of Cameo Members.

The Cameo Member is about 1,800 to 2,000 feet below the elevation of Hubbard Creek in this area. Thus, hydrofracturing of the Cameo Member should not affect flow in Hubbard Creek. The normal faults and the Elk Creek Mine permit boundary are 1,000 and 1,800 feet from the proposed drill pad, respectively. Hydrofracturing has an expected radius of influence of approximately 500 feet from the well bore; therefore, hydrofracturing of the Cameo Member should not affect either the normal faults or any mine workings that may extend to the permit boundary of the Elk Creek Mine.

Hawksnest Proposed Well. One natural gas exploration well is proposed for the Hawksnest area as shown in Appendix J, **Figures J-14** and **J-15**. This well would be started in unconsolidated alluvium at an elevation of 8,204 feet amsl. The well would be drilled to a total depth of 3,414 feet and bottomed in the Mancos Shale at an elevation of 4,800 feet amsl. The Cameo Member of the Mesaverde Formation would be intercepted at an elevation of 5,900 feet and the underlying Rollins Sandstone would be intercepted at an elevation of 5,350 feet, leaving 550 feet of the Cameo Member available for hydrofracturing. The proposed Hawksnest drill pad is within approximately 1,500 feet of inactive mine workings of the Hawksnest Mine and within the mine permit boundary for the Sanborn Creek Mine (Appendix J, **Figure J-15**). The Sanborn Creek Mine workings are about 1,200 feet south and 500 feet east of the proposed Hawksnest drill pad. There is a groundwater monitoring well (WSC-DH12) within 1 mile of the proposed Hawksnest drill pad at an elevation of 7,480 feet amsl that is 1,440 feet in depth (bottom at 6,040 feet amsl) and screened in the upper Mesaverde Formation. This well is approximately 140 vertical feet from the Cameo Member. There is a normal fault approximately 2,500 feet to the southwest of the proposed drill pad. The Rollins Sandstone, the Cozzette and Corcoran members of the Mesaverde Formation, and the lower part of the Barren Member of the Mesaverde Formation also may be hydrofractured in this proposed well, as shown is Appendix J, **Figure J-15**.

The normal fault may not be present, even though it was originally mapped by the USGS (WWE 2003a). The author of the USGS mapping, Mr. Richard Dunrud, suggested that this fault may not be present because it has not been found in mine workings (Dunrud 2003). There are no groundwater resources within 1 mile of the proposed Hawksnest drill pad. Water-bearing sand units may be present in the Hawksnest Mine workings approximately 1,500 feet to the south of the proposed drill pad, but at this distance they probably would not be affected by hydrofracturing. The groundwater monitoring well is dry and is not likely to be affected by hydrofracturing. The Sanborn Creek Mine workings are 500 feet from the Hawksnest well and may be affected by hydrofracturing that has an expected maximum length of 500 feet. If hydrofracturing

should reach these sealed workings, this may result in flooding of and/or gas release into these sealed workings due to the increased permeability caused by hydrofracturing.

Thompson Creek Proposed Well. One natural gas exploration well is proposed for the Thompson Creek area as shown in Appendix J, **Figures J-16** and **J-17**. This well would be started in the Wasatch Formation at an elevation of 8,270 feet amsl. The well would be directionally drilled with an inclination to the vertical increasing to 28 degrees as the hole is deepened. The total depth of the well would be approximately 3,890 feet and the well would be bottomed in the Mancos Shale at an elevation of 4,700 feet amsl. The Cameo Member of the Mesaverde Formation would be intercepted at an elevation of 5,800 feet and the underlying Rollins Sandstone would be intercepted at an elevation of 5,250 feet, leaving 550 feet of the Cameo Member available for hydrofracturing. The proposed Thompson Creek drill pad is within approximately 3,500 feet of the existing mine workings (inactive) of the Hawksnest Mine and just outside of the Sanborn Creek Mine permit boundary (Appendix J, **Figure J-17**). The distance to the Sanborn Creek Mine workings is about 2,000 feet from the bottom of the proposed directional hole. There are no springs or domestic water wells within 1 mile of the proposed drill pad. The normal fault discussed under the Hawksnest Well section above is about 4,000 feet from the Thompson Creek drill pad. The Thompson Creek well would be drilled on a northerly bearing and thus away from the Hawksnest Mine workings and away from the Sanborn Creek Mine permit boundary. The Thompson Creek well is not expected to impact any groundwater resources or water-bearing units in coal mine workings, because the hole would be being drilled on a bearing away from all mine workings. The Rollins Sandstone, the Cozzette and Corcoran members of the Mesaverde Formation, and the lower part of the Barren Member of the Mesaverde Formation also may be hydrofractured in this proposed well, as shown is Appendix J, **Figure J-17**. Impacts to these units would be the same as for the Cameo Member.

In summary, none of the eight proposed natural gas wells should measurably impact groundwater resources. If water is encountered during the drilling or hydrofracturing, the groundwater would be pumped out of the formation and into tanks located near the drill rig. Water production from natural gas wells in the Mesaverde Formation in the Piceance Basin historically has been very low. Maximum flow rates reported have been approximately 5 gpm (see Section 3.4.1.2). It can be expected that similar flow rates may be encountered in the eight proposed wells, should groundwater be intercepted during drilling. This low a flow rate would not affect groundwater flow, groundwater quantity, or any seeps and springs that may be part of the formation being pumped. Private domestic water supply wells would not be affected.

Groundwater quality would not be affected by the hydrofracturing of the proposed gas wells because the Mesaverde Formation is not a regional aquifer, is not transmissive to groundwater, and is not a source of water supply. Groundwater in the Mesaverde and other formations that may be intercepted during drilling is localized in permeable sand units or fractures. The hydrofracturing would introduce chemicals (Appendix C) into the fractured horizons. About 30 percent of these chemicals would not be removed. The low permeability and low transmissivity of the Mesaverde Formation would keep these chemicals from moving beyond the hydrofractured zones. Thus, groundwater quality in the Mesaverde Formation would not be affected beyond about 500 feet from any of the proposed wells.

No Action

Under the No Action Alternative, drilling, completion, and testing activities would not occur with geologic formations and their associated groundwater.

3.4.3 Cumulative Impacts

Activities contributing to cumulative effects on water resources in the study area include mining, oil and gas development, agriculture, recreation, municipal and domestic water uses, and logging. Based on a review of existing water uses, agriculture represents the largest user in terms of water quantity. This trend would continue under future conditions. Present and future actions related to mining, oil and gas development, agriculture, recreation, and logging could contribute erosion potential from surface disturbance in the Surface, Terror, and Hubbard Creek drainages and the North Fork of the Gunnison River. Based on information presented in **Table 2-9**, cumulative impacts to surface water quality are as follows:

- Leon Lake #4 and #5 – Surface disturbance associated with the Leon Lake #2 well and road use (FR 125, FR 127, and 127.1A) and grazing could result in minimal localized increase in sediment loading to the Surface Creek drainage. Drilling of exploration well Spaulding Peak #1 on private land also may contribute to sediment loading to the Surface Creek drainage. By implementing erosion control measures for the gas drilling operations, any sediment impacts would be localized and temporary in duration.

- Bull Park and Powerline – Surface disturbance associated with the Stevens Gulch #1 gas well and road, timber harvesting (Terror Creek Green Oak Area, East Terror Sale, Stevens Gulch Tree Removal, and Stevens Gulch Area), timber hauling, grazing, oakbrush control, and vehicle traffic on unpaved portions of FR 701 could result in a temporary and localized minor increase in sediment loading to the Terror Creek drainage.

- Hubbard Creek and Oakbrush – Surface disturbance associated with grazing, outfitter guides, gas development at the Lone Pine #1 well site and road, coal mine exploration, and road use (Bear Creek Road) could contribute to a temporary and localized increase in sediment loading to the Hubbard and Bear Creek drainages.

- Hawksnest and Thompson Creek – Grazing, vehicle travel on Coal Gulch Jeep Trail Road, and coal mine exploration could contribute to a localized increase in sediment loading to Hawksnest and Thompson creeks; however, no fisheries are present in these intermittent streams.

Numerous design features such as SWPPP and erosion control would be required. Future oil and gas development would require water for drilling and produced water from testing. The effects on groundwater quantity would depend upon the number of wells and the amount of water in the geological formations. Three private GEC gas wells would be located within 1 to 2 miles of five of the well sites on federal lands (Spaulding Peak #1, Leon Lake #4 and #5 sites; Lone Pine #1, Hubbard Creek, and Oakbrush sites; and Stevens Gulch #1 and the Bull Park sites). However, the proposed wells would not add incremental effects

to groundwater quality or quantity within the cumulative effects area because of low permeability of the formations and spatial distance between wells.

3.4.4 Potential Mitigation Measures

The following additional mitigation would be implemented to further reduce potential impacts on water resources.

WR-1: No refueling or lubricating would take place within 100 feet of wetlands and other waterbodies or drainages. Hazardous materials, chemicals, fuels, etc. would not be stored within 100 feet of wetlands or surface waters.

WR-2: Pit water (if present) would be tested for hazardous constituents prior to covering.

WR-3: Surface water flow and water quality data would be obtained on all drainages within a 1-mile radius of the proposed new drill areas within 3 months prior to commencement of drill pad construction. Surface water flow and water quality data would be monitored at these same sampling sites on a quarterly basis during drilling and on a semi-annual basis after completion of drilling up to the point where the BLM/USFS release the bond for the reclamation of the drill sites. All data collected would be supplied to the BLM/USFS within 1 month of measurement.

WR-4: Sedimentation devices will be used along roads and drill pads as directed by the USFS or BLM representatives. Devices may include, but are not limited to silt fence, excelsior bales, straw wattles, etc.

WR-5: Groundwater intercepted during drilling would be analyzed for its major and minor constituents and TDS in accordance with guidelines to be provided by the BLM/USFS. If groundwater flow greater than 3 gpm is encountered during drilling, the stratigraphic horizon providing the water flow would be isolated with packers and tested for permeability.

WR-6: Groundwater monitoring wells would be installed after the completion of drilling and well development in all exploration wells that experience groundwater inflow of 3 gpm or greater. The monitoring wells would be installed in the stratigraphic horizon providing the groundwater inflow and would be sampled on an annual basis for constituents to be provided by the BLM/USFS.

WR-7: All reserve pits would be made impervious to leaks. The liner would be underlain by a suitable bedding material, and other measures would be taken as needed to protect the integrity of the liner. Pit liners must be approved by the USFS or BLM, and be impermeable and resistant to weather, sunlight, hydrocarbons, aqueous acids, alkali, salt, fungi, or other substances likely to be contained in the drilling fluids or production water.

WR-8: Use of a reserve pit would only be allowed between June 15 and October 15. During the restricted period (after October 15 and before June 15) a closed drilling system would be required. If a reserve pit is used, all fluids would be pumped out and hauled to an approved disposal site off the National Forest. The reserve and flare pits must be reclaimed within one month of completing the proposed operations. The

reserve pit would be lined with an impermeable liner with heat-treated seams and a minimum of 125 psi burst strength. During reclamation, the pit liner would be removed to a certified disposal site.

WR-9: A minimum of 2 feet of freeboard would be maintained between the maximum fluid level and the top of the berm. Pits would be designed to exclude all surface runoff.

WR-10: The flare pit may need to be lined, if any fluids would be produced to it.

WR-11: The operator would monitor and record cumulative water production.

WR-12: If a well produces water at volumes greater than 1,500 bpd after 60 days of continuous operation, and if this water is less than 2,000 mg/l TDS, the gas well would be shut in until it can be determined whether the source of the water is or is not interconnected with shallow water-bearing units or surface water.

3.5 Vegetation

3.5.1 Affected Environment

General Vegetation

The study area for vegetation includes the well pad sites and new road spurs where surface disturbance would occur. The cumulative effects area is the same study area, with the addition of surface disturbance areas associated with past, present, and future actions.

Based on field visits conducted in July and October 2002, four primary vegetation communities (oakbrush, aspen, mountain meadow, and mountain shrub) are present at the well sites and new road segments. Some small pockets of piñon-juniper woodland, a fifth vegetation type, also occur adjacent to the Coal Gulch Jeep Trail (proposed for road upgrade).

Plant nomenclature used in this document follows Weber and Wittman (1996). The oakbrush community is dominated by dense stands of Gambel's oak (*Quercus gambellii*) with a relatively sparse understory of grasses and forbs. Characteristic understory species include silvery lupine (*Lupinus argenteus*), white-flowered peavine (*Lathyrus leucanthus*), western wheatgrass (*Pascopyrum smithii*), and needle-and-thread (*Hesperostipa comata*).

The aspen community is dominated by varying age classes of aspen (*Populus tremuloides*) stands at the sites. Characteristic understory species for the aspen community include snowberry (*Symphoricarpos rotundifolius*), serviceberry (*Amelanchier alnifolia*), silvery lupine (*Lupinus argenteus*), lovage (*Ligusticum porteri*), mountain brome (*Bromus marginatus*) and Kentucky bluegrass (*Poa pratensis*).

The mountain meadow community is typically dominated by mule's-ear wyethia (*Wyethia complexicaudis)* or snowberry and grasses. Snowberry, serviceberry, silvery lupine, and mules-ear wyethia dominate the mountain shrub community.

Piñon-juniper woodlands in the area are typically associated with steep west and southwest facing slopes below 7,000-feet in elevation. Piñon pine (*Pinus edulis*) and juniper (*Sabina osteosperma*) codominate this vegetation community.

Vegetation characteristics of the well sites and new road segments are listed in **Table 3.5-1**, and described below for each site. TES plant species are discussed in Section 3.7.

The well site for Leon Lake #4 is entirely within a mountain meadow with adjacent habitats of mature aspen and mountain shrub. The access road passes primarily through mountain shrub and wyethia-dominated meadow.

The well site for Leon Lake #5 is primarily within a relatively recent aspen clearcut area and is dominated by a dense regrowth of sapling aspens. Mature aspen and a wetland (see **Table 3.5-3**) are located near the

east side of the proposed well site. The access is primarily from an existing USFS road (FR 127) with a short spur of existing ATV trail through young aspen.

Table 3.5-1
Vegetation Types Present at Each Proposed Well Site and Access Road

Well Sites		Vegetation Type			
Name	**Elevation**	**Aspen**	**Oak**	**Meadow**	**Shrub**
Leon Lake #4	8,980			X	X
Leon Lake #5	8,760	X			
Powerline	8,895	X			
Bull Park	8,580	X			
Hubbard Creek	7,800	X	X	X	
Oakbrush	8,120	X	X		
Thompson Creek	8,200		X	X	
Hawksnest	8,200		X	X	

The access road and well site for the Bull Park site are located entirely within aspen habitat. Aspen trees at this site are dominated primarily by relatively young trees with very open canopy cover.

The entire access road and well site at the Powerline site are within aspen habitat. Aspen in the immediate vicinity of the well site are relatively young trees with open canopy and dense understory of snowberry. The surrounding area and access road are composed mostly of mature to old growth aspen stands. There is one relatively recent clearcut area on the east side of the access road south of the well site. The clearcut is dominated by dense stands of sapling aspen. Vegetation along the existing WAPA maintenance road consists of grasses and shrubs within an existing transmission line corridor.

The well site and access road for the Hubbard Creek site are in a mixture of aspen, mountain meadow, and oakbrush types. Aspen stands are primarily on north-facing slopes. Aspen in the immediate vicinity of the well site are 4 to 8 inches diameter at breast height (dbh), with a few larger trees (12 to 14 dbh). Similar stands of aspen are located along the proposed access route.

The proposed Oakbrush site is located in a mature to old-growth stand of aspen with trees ranging in size from 8 to 15 inches dbh and 50 to 70 feet tall. The lower half of the access road is in oakbrush habitat; the upper half traverses primarily mature aspen habitat.

At the proposed Thompson Creek site, the access road passes through a mixture of oakbrush and meadow habitats, while the well site is entirely in oakbrush habitat. A narrow, linear stand of mature aspen is located approximately 500 feet north of the proposed well site.

The access road and well site for Hawksnest are in a mixture of oakbrush and meadow habitats. The nearest aspen stand is over 1,000 feet north of the well site. Existing road work to widen and upgrade 0.5 mile of the existing Coal Gulch Jeep Trail at Hawksnest and Thompson Creek would occur in oakbrush and at least some adjacent areas dominated by piñon-juniper woodland.

The remaining access road system from SH 133 to the proposed new access road spurs also traverses other vegetation types such as spruce fir and Douglas fir communities. The Douglas fir community is present along the canyon portion of Bear, Hubbard, and Terror creeks at or below elevations of 7,000 feet. The spruce/fir community is in canyon sections of Hubbard Creek at elevations from about 6,800 to 8,000 feet. No construction would occur in these community types, but project-related traffic would use the roads.

Noxious Weeds

The Colorado Noxious Weed Law (Colorado Department of Agriculture 2002) or county ordinances classify noxious weeds. A number of noxious weed species are known to be present in the general area in Delta and Gunnison counties. These include Russian knapweed (*Centaurea repens*), hoary cress (*Cardaria draba*), yellow toadflax (*Linaria vulgaris*), Canada thistle (*Cirsium arvense*), musk thistle (*Carduus nutans*), scotch thistle (*Onopordum acanthium*), downy brome (*Bromus tectorum*), oxeye daisy (*Chrysanthemum leucanthemum*), field bindweed (*Convuluvus arvensis*), mullein (*Verbascum thapsus*), and houndstongue (*Cynoglossum officinale*) (BLM and USFS 2000; ENSR 2002). Previous observations along the (Stevens Gulch Road [FR 701]) noted infestations of field bindweed, hoary cress, mullein, and musk thistle (ENSR 2002). No site-specific information is available for the well sites and new road spurs. Noxious weeds are prone to establishment and proliferation in newly disturbed areas.

Timber Resources

Approximately 42 percent of the GMUG National Forests is classified as tentatively suited for commercial timber harvest (USFS 1991). The two sites on BLM-administered lands (Hawksnest and Thompson Creek) and the sites proposed on USFS-administered lands at Hubbard Creek and Oakbrush have no commercial timber value identified (USFS 1991). In contrast, the sites proposed at Leon Lake #4 and #5, Bull Park, and Powerline all lie within lands designated as tentatively suited for timber production. Only the proposed Powerline site lies within an area delineated by the USFS as having commercial sales in the foreseeable future. Site visits indicated that recent timber harvesting activities were conducted in the area of the Leon Lake #5 and the Powerline sites.

Potential Conservation Areas

The Colorado Natural Heritage Program (CNHP) identifies areas of the state that are of particular value for conservation of biodiversity. The purpose of these areas is to capture the ecological processes that are necessary to support the continued existence of a particular element of natural heritage, such as species and vegetation communities. Potential conservation areas (PCAs) identified by CNHP were reviewed to determine their proximity or potential relationship to the Proposed Action. One PCA is delineated in the Surface Creek drainage approximately 0.25 mile from the proposed well site at Leon Lake #4. The Surface Creek PCA was selected because of the importance of Surface Creek to the hydrology of Grand Mesa and for its riparian community. Subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmanni*), thin leaf alder (*Alnus tenuifolia*), and willows (*Salix* spp.) characterize the PCA.

Rangeland

All of the proposed well sites are located within areas grazed by livestock permitted by the USFS and/or the BLM. All of the USFS-administered sites lie within Management Areas 4B (Leon Lake #4 and #5, Bull Park, Hubbard Creek, and Oakbrush sites) and 6B (Powerline site) (USFS 1991; Bradford 2003b). Management Area 4B is managed with an emphasis on biodiversity values, while livestock grazing is the focus for 6B.

The proposed well sites and their associated access roads lie within portions of five grazing allotments. **Table 3.5-2** identifies each proposed well pad site, the allotment name, the responsible agency, type of livestock grazed, the agency management category that identifies the general quality of the range, total preferred Animal Unit Months (AUMs), and the acres per AUM. It is assumed that the access roads associated with each proposed pad site lie in the same allotment as the pad unless otherwise indicated.

The management of livestock includes controlling the location of the animals and systematically grazing different pasture areas to allow forage to recover. In the project area, livestock are generally moved by trucking or trailing stock along roadsides to a new pasture. Livestock movement is generally limited through the use of fences and gates, and by access to water sources and salt licks. Gates can be an unreliable control method; if left open by the general public, and according to the USFS (Bradford 2003a), gates have not been effective control measures in the project area in the past. Gates left open allow unplanned livestock movement and keep planned range objectives from being met. According to the USFS, this currently appears to be a concern in the Electric Mountain and East Terror allotments.

Range improvements currently located near the proposed well sites include:

- West Fork-West Aspen Pasture Division Fence and East Terror-Electric Mountain Allotment Boundary Fence. The West Fork-Aspen Pasture Division Fence is located approximately 100 yards south of the proposed Bull Park well site in the East Terror Allotment. The access road to the proposed Powerline well site would cross the East Terror-Electric Mountain Allotment fenceline.

- A reservoir and spring located approximately 300 feet east of Hawksnest and approximately 300 feet south of the access road to the proposed Thompson Creek and Hawksnest well sites in the Coal Gulch Allotment.

- Milk Creek Range Facility (No. 306) and Stockpond #1 (No. 310). These improvements are located in Section 13, T12 S, R94W near the proposed Leon Lake #4 and #5 well pad locations in the Milk Creek Allotment. The Milk Creek Range Facility is a fenced holding pasture located in the northeast quarter of the section. Permittees use the facility in early spring and fall to hold cattle and horses for about one week between moves to new pasture. The location of Stockpond #1 is not clearly identified on maps of the area; however, USFS representatives believe it is a small pond located adjacent to FR 127 and approximately 800 feet southwest of the proposed Leon Lake #5 well site in Section 13 (Klingler 2003).

Table 3.5-2
Summary of USFS and BLM Grazing Allotments
Associated with Proposed Well Pad Sites

Well Pad Site[1]	Allotment/ Number of Permittees	Responsible Agency	Dates of Use	Management Category	Stock Type Grazed	Total AUMs or Ewe/Lamb Pairs	Acres per AUM
Leon Lake #4 and #5	Milk Creek/5	USFS-Grand Valley District	6/16 – 10/15	Satisfactory	Cattle	2,150	3[2]
Powerline	Electric Mountain/2	USFS-Paonia District	6/ 26 –9/15	Satisfactory	Sheep and cattle	1,800 ewe/lamb pairs (2 bands), 100 cow/calf pairs	2/sheep month
Bull Park	East Terror/2	USFS-Paonia District	6/26 –10/05	Satisfactory	Cattle and Sheep	500 cow/calf pairs, 800 ewe/lamb pairs	7/cow month
Hubbard Creek	Hotchkiss/1	USFS-Paonia District	6/21 – 9/20	Satisfactory	Sheep	800 ewe/lamb pairs	1.5-2/sheep month
Oakbrush	Hotchkiss/1	USFS-Paonia District	6/21 – 9/20	Satisfactory	Sheep	800 ewe/lamb pairs	1.5-2/sheep month
Thompson Creek	Coal Gulch/1	BLM	5/15–1/15	Maintain	Sheep	587	13
Hawksnest	Coal Gulch/1	BLM	5/15-11/15	Maintain	Sheep	587	13

[1]Access roads into the proposed well pad sites would be located in the same allotment as the pad site unless otherwise indicated.
[2]Based upon acres of suitable range in the allotment.

Sources: Kubik 2003; Bradford 2003a,b; and Perkins 2003.

The BLM has indicated that the Coal Gulch Jeep Road, the proposed access road for the Thompson Creek and Hawksnest well sites, may be used periodically by the permittee on the Coal Gulch Allotment to move stock into the area (Kubik 2003). A stock trail is located approximately 1,000 feet east of the proposed Powerline well site on the Electric Mountain Allotment.

Sheep and cattle are the predominant livestock grazed in the project area, with grazing occurring on USFS-managed lands mainly between the months of June and October (Bradford 2003a; Perkins 2003). Grazing occurs on BLM-managed lands from May to November (Kubik 2003). Range conditions for all of the allotments have been classified by the agencies as "satisfactory" or "maintain" and are not in need of major improvement.

Wetlands and Waters of the U.S.

Field delineations of waters of the United States (U.S.) and wetlands were performed in June and October of 2002 at the well pad sites and along associated access roads to be constructed. Investigations were conducted within a 700-foot radius around the well pad sites and new spur road segments. No waters of the U.S. or wetlands are located within the pad boundaries or are crossed by the proposed new road segments. However, ponds, wetlands, and/or stream segments are located near four of the sites, as listed in **Table 3.5-3**.

Table 3.5-3
Waters of the U.S. Located Near the Well Pad Sites and New Roads

Site	Water Feature	Approximate Distance from Project Component
Leon Lake #4	• Pond	• 460 feet north of pad
Leon Lake #5	• Wetland • Intermittent stream channel	• 143 feet west of pad • 97 feet west of pad
Powerline	• Wetland • Wetland • Pond	• 194 feet west of pad • 385 feet southwest of pad • 400 feet north of pad
Oakbrush	• Intermittent stream channel	• Crossed by new spur road
Hawksnest	• Stock pond • Stock pond	• 172 feet north of access road • 83 feet west of pad

Waters of the U.S. are defined as intermittent drainage channels, perennial rivers and creeks, and pond and lake features. Although wetlands also are classified as waters of the U.S., they are discussed separately in this section. Due to the topographic gradients throughout the area, several intermittent channels are present. These channels demonstrate well-developed banks with beds consisting of gravel and cobble. Because of the intermittent nature of these channels, the majority do not support riparian wetland species. The perennial waters of the U.S. within the area can support wetland vegetation within their riparian zones as previously discussed.

Numerous man-made stock pond impoundments are located in the area (see **Table 3.5-3**), and are typically associated with grazing lands and open meadows. These features receive flow from springs or overland

runoff. The majority of stock ponds observed were dry at the time of field surveys. The isolated stock ponds generally do not support wetland vegetation. When present, wetland vegetation is limited to a thin fringe along the bank of the stock pond, or within drainages leading into the stock pond. These wetlands are dominated by herbaceous species including various sedge (*Carex*) and rush (*Juncus*) species. Shrub and tree species within the vegetated fringe of stock ponds are rare.

The results of the field delineations indicated that no waters of the U.S. were located within the proposed well pad sites. One water of the U.S., an intermittent drainage channel, would be crossed by the proposed new spur road at the Oakbrush site.

Wetland communities within the area are typically located within riparian areas along the borders of creeks and drainages. These wetlands receive water from the associated channels through flooding and lateral flow and are dominated by shrub and tree species. Common tree species include narrow-leaf cottonwood (*Populus agustifolia*) and boxelder (*Acer negundo*) at lower elevation wetlands. Aspen is common in higher elevation wetlands. Various willow species, including mountain willow (*Salix monticola*) and coyote willow (*Salix exigua*), as well as red-osier dogwood (*Cornus stolonifera*) typically dominate wetland shrub species. Herbaceous species are not prevalent in the majority of these riparian areas. The steep gradients associated with the creeks and drainage channels in the area prevent the establishment of herbaceous species. However, herbaceous species have developed in locations where the gradient is reduced, such as in floodplains. Herbaceous species include California false-hellebore (*Veratrum califonicum*) and various sedge and rush species.

3.5.2 Environmental Consequences

3.5.2.1 Proposed Action

The following information describes the effects of the Proposed Action on general vegetation, noxious weeds, timber, rangeland, and wetlands.

General Vegetation

Impacts Applicable to All Sites. Vegetation would be removed during ground clearing for new access roads and well pad construction. Approximately 10 acres of aspen forest would be removed at five of the eight proposed sites (**Table 3.5-1**). In addition, approximately 10 acres of oakbrush, 9 acres of meadow, and 1 acre of mountain shrub habitat types would be cleared. These totals include acreage that would be disturbed along the WAPA maintenance road to access the Powerline site and Coal Gulch Jeep Road to the Thompson Creek and Hawksnest sites. An incidental amount of piñon-juniper woodland may be affected by the proposed widening of the Coal Gulch Road.

The removal of vegetation would be a temporary result of the Proposed Action because all sites would be reclaimed after the exploration, or in some cases subsequent to production activities. Reclamation is required as soon as possible after the completion of drilling activities (see **Figure 2-6** for potential timeframes). Reclamation of the mountain meadows would be achieved primarily through seeding, whereas reclamation of the oak, mountain shrub, and aspen sites would be achieved largely through the natural

re-establishment of native species by suckering and sprouting from root materials left in the soil. There has been natural gas drilling completed in the vicinity of the project area in the past (see Appendix F, **Figure F-1**). These sites have had various rates of reclamation success. On coal-related drilling projects in the area, reclamation is generally observed to be successful in 3 to 5 years. Success of woody species depends on the vegetation type and location. Experience in the area shows that oakbrush tends to regenerate within a couple of years. Generally, surface disturbance and compaction damages aspen root systems to preclude sprouting. Conversion to another species would then be very likely. This loss of aspen acreage represents less than 1 percent of aspen.

In all cases, the success of reclamation would require protection of the site from grazing animals such as livestock, deer, and elk. The Proposed Action is to fence each site, which facilitates revegetation efforts. The fence would be retained until reclamation is successfully achieved. This fence would be high enough and strong enough to be both stock- and wildlife-proof thereby preventing both undesired entries by animals as well as damages to the fence. The requirement for a reclamation bond would help ensure implementation effectiveness.

A reclamation bond can be required by the surface management agency to ensure that reclamation of disturbed lands occurs. Regulation 36 CFR 228.109 allows the USFS to require reclamation bonds if the lease bond is determined to be inadequate. These are separate from the lease bond a lessee is required to post with the BLM. Reclamation standards and requirements would be defined by the USFS and BLM.

Interim and final reclamation would be done according to reclamation plans in the APDs as detailed in Section 2.1.2.11. Reclamation also would be done in accordance with standards of the land management plan in effect at the time. Various standards are currently in place in the GMUG Oil and Gas Final EIS, and are included as Potential Mitigation Measures. Experience on the GMUG has indicated that allowing fluids in the reserve pits to evaporate is not effective based on elevation, shade, and generally cooler temperatures that inhibit evaporation. To ensure reclamation (interim or final) can begin in a timely manner, it may be necessary to require that the pits be pumped.

Residual woody material (slash) and brush removed from the site would be largely retained onsite to be used in the reclamation process. It would be windrowed around the perimeter of each well pad where it would facilitate infiltration and reduce soil loss from unvegetated areas. Scattering a layer of downed woody material over the reclaimed site would increase moisture retention, decrease wind scouring, enhance infiltration, and return organic material to the soil.

Chemicals used to conduct the exploratory drilling operation and saline water that is extracted in the process could adversely affect onsite and offsite vegetation in the event of a spill or release. The Proposed Action stipulates that reserve pits be lined, vegetation be cleared around the pit, liquids evaporated or decanted, and residual drilling muds removed from the site or buried. In the event of a release or spill, the project's SPCC Plan would be implemented to minimize impacts. As a result, the potential for adverse impacts to vegetation are expected to be minor. As discussed in water resources (Section 3.4), no increased selenium levels would occur as a result of drilling and completion operations. Therefore, riparian vegetation would not be affected by selenium.

Operation of heavy equipment, vehicles, and the use of flammable fuels such as diesel would potentially increase the potential for fire to spark and for accidental explosions. Fire hazards would be relatively low at elevations above 8,000 feet because this is a cool, montane environment. However, Colorado is currently undergoing a prolonged drought, and coniferous forests are increasingly flammable due to fuel build-ups that have occurred over the past century. The fire hazards at each of the exploratory well sites would be expected to be highest primarily during dry periods in spring and fall. The potential for human caused fires also would increase slightly under the Proposed Action due to increased human access by work crews as well as the public. The increased risk of fire due to increased human activity in the project areas would be offset to some degree by the fact that increased miles of roads improves access for fire suppression activities.

In order to minimize the risk of fire, a vegetation-free zone in the immediate well pad area would be maintained. The operator would be subject to all fire restrictions promulgated by the USFS or BLM. In order to minimize the potential effects of accidental fire, each operator would have water and fire control equipment in working order onsite at all times. Therefore, the probability of fire ignitions would increase; however, the potential for uncontrolled fire to occur would be low due to implementation of GEC's Fire Prevention Plan.

As discussed in Section 3.1.2.1, project-related construction activities and vehicle traffic would result in dispersed, transitory increases in fugitive dust that would be limited in duration. These emissions would be minimized through implementation of dust control measures, and the effects on air quality would be very minor. In addition, project-related gaseous pollutant emissions also would be minor (i.e., below reportable levels and below the PSD threshold for major stationary sources) and limited in duration. As a result, no related impacts to vegetation have been identified.

As discussed in Section 3.4.2, project-related drilling, completion, and testing operations would not result in impacts to surface water or groundwater quality or quantity (including agricultural water supplies). As a result, no impacts to agricultural productivity have been identified.

Site-specific Impacts. No specific or unique vegetation impacts were identified for individual well sites and roads.

Noxious Weeds

Impacts Applicable to All Sites. Noxious weeds may be directly introduced to an area through transportation of vehicles and machinery. In order to preclude this from occurring, the operator would be required to clean all vehicles and equipment before entering the project area. Noxious weeds also may be introduced at a proposed construction site from the use of hay or straw bales used for sediment capture. This would be prevented at the proposed sites by requiring the use of only certified weed-free bales. Unwanted plants also can be transported to construction areas through contaminated fill material brought into a new area. There are no provisions in the Proposed Action to prevent this from occurring, nor are there fail-safe methods for obtaining fill material that is weed-free. Unwanted plants that may currently exist at each site can proliferate following disturbance because a seedbed is prepared and/or plant parts (e.g., seeds and roots) are disseminated.

Post-construction monitoring would determine if noxious weeds have become established or increased as a result of the Proposed Action. Appropriate treatments would be prescribed if results showed noxious weeds were present.

Site-specific Impacts. No specific or unique noxious weed impacts were identified for individual well sites and roads.

Timber Resources

Impacts Applicable to All Sites. There are no coniferous timber-producing species, such as pines (*Pinus* spp.), firs (*Abies* spp.), or spruces (*Picea* spp.), at any of the proposed drill sites. The aspen, mountain shrub, and oakbrush types contain woody species, some of which attain tree stature such as aspen. The aspen trees at the proposed Hubbard Creek and Oakbrush sites are of a commercial size. The proponent would pay for timber of merchantable size and quality trees that are cut or destroyed incident to any authorized use of National Forest land at its appraised value. In addition, the permittee would pay for cut or destroyed young growth that is part of a stand of young growth with 25 percent or more stocking (USFS Handbook 2409.18_80). The USFS would appraise the timber and issue a direct timber sale contract, including a bill, to the permittee. It would be the permittee's responsibility to either remove or destroy the timber. The timber sale contract and/or permit would specify the mitigation measures that must be followed when the timber is cut and removed.

Indirect effects from road building and well pad construction would include inadvertent damages to standing trees adjacent to the site as well as soil compaction. Both superficial damages to trees and soil compaction in immediately adjacent areas would increase potential for insect and disease attacks due to stress and the opening of pathways for infection. In all cases, such indirect impacts would be highly localized. Soil compaction would be remedied during reclamation by scarifying the site and by segregating and storing topsoil prior to well pad construction. GEC activities may indirectly affect the administration of timber sale contracts if they coincide in space and time. In such an event, the USFS would coordinate conflicting activities.

Site-specific Impacts. The following impacts are specific to particular well sites.

Leon Lake #4 and #5, Powerline, and Bull Park. The direct effect of the Proposed Action would be to remove an additional 7 acres of land tentatively suited for timber production at these four sites.

Hubbard Creek and Oakbrush. The direct effect of the Proposed Action would be the removal of merchantable aspen trees from approximately 3 acres at these two sites, neither of which are located in lands identified to contain suitable timber. Each of the aspen sites has potential to support coniferous timber species in the future following successional processes. For this reason, approximately 3 acres of commercial forestland would be precluded from timber production purposes for approximately 25 years.

Rangeland

Impacts Applicable to All Sites. Vegetation clearing necessary to implement the Proposed Action would reduce the number of acres of forage available to permitted livestock. Forage reductions that substantially reduce the carrying capacity of an allotment would necessitate adjustments in animal stocking rates.

Indirect effects of the Proposed Action would include increased human activity and vehicle traffic in the project areas. Increased traffic from construction as well as from increased public access would increase the probability that gates would be left open. Open gates would disrupt allotment administration and result in the need for unplanned roundups. In order to preclude such problems from developing, the Proposed Action would replace all gates on access roads to the well sites with cattleguards. In addition, human activity would have short-term effects on livestock distribution because cattle and sheep may stay away from busy, noisy areas. Uneven livestock distribution would have a negative effect upon allotment administration.

As discussed in Section 3.4.2, project-related drilling, completion, and testing operations would not result in impacts to surface water or groundwater quality or quantity. As a result, no project-related impacts to stock water supplies have been identified.

Site-specific Impacts. Approximate forage reductions are shown in **Table 3.5-4.** The temporary loss of 1 AUM or less on the Milk Creek, East Terror, and Coal Gulch allotments and 2 AUMs on the Electric Mountain allotment are minor portions of the permits held on those allotments. Therefore, no measurable loss of capacity would result from the implementation of the Proposed Action on the Electric Mountain, East Terror, and Coal Gulch allotments. A reduction of approximately 1 AUM on the Milk Creek Allotment is a fraction of a percent of the total AUMs permitted. For this reason, a 3.7-acre loss of forage would not constitute a substantial loss necessitating stocking reductions. The greatest forage reduction would occur on the Hotchkiss Allotment; however, the loss of 4 AUMs is less than one percent of the total permitted. In conclusion, direct losses of forage production would be expected to occur as a result of the Proposed Action; however, none of the forage reductions would necessitate stocking adjustments because they would be small proportions of the available grazing land.

Table 3.5-4
Potential Forage Reductions at Each Well Site and Access Road

Proposed Well Sites	Allotment	Acres Affected (approximate)	AUM Reduction (approximate)
Leon Lake #4 and #5	Milk Creek	3.69	1 AUM
Powerline	Electric Mountain	3.43	2 AUMs
Bull Park and Powerline	East Terror	2.43	<1 AUM
Hubbard Creek and Oakbrush	Hotchkiss	6.80	4 AUMs
Thompson Creek and Hawksnest	Coal Gulch	13.85	1 AUM

Forage reductions resulting from implementation of the Proposed Action on each allotment would be temporary. Each site would be reclaimed and revegetated as soon as possible within 1 year of activity completion. If future well production is approved under separate permitting, the exploratory wells that would be placed into production would not be expected to be reclaimed for approximately 25 to 30 years.

Range allotment improvements may be structural or non-structural. Structural improvements that facilitate allotment administration include fences, water developments, and holding facilities. The proposed access road for the Powerline site would cross an existing internal pasture division fence. Under the Proposed Action, a cattle-guard would be placed at the fence crossing.

The proposed use of roads on the grazing allotments would have potential to interfere with operations to drive cattle from one pasture to another by road. The intermittent use of the Coal Gulch Jeep Trail to trail stock would be affected if it coincided with the timing of proposed roadwork and subsequent use of the road by drilling-related traffic. The proposed activities within the Mill Creek Range Facility (Leon Lake #4 and #5) would have potential to interfere with the use of that holding facility for short periods of time.

Waters of the U.S. and Wetlands

Waters of the U.S. and wetlands would not be directly affected by the Proposed Action. There are no waters of the U.S. or wetlands within the proposed well pad locations, which meets the lease stipulation of "no surface occupancy within wetlands." The proposed Oakbrush spur road would cross an intermittent stream channel. However, installation of a culvert would maintain flow within the channel, and implementation of BMPs during road construction would prevent sedimentation impacts to the channel.

Potential indirect impacts for waters of the U.S. and wetlands would include the transport of sediment from the well pad sites, spills associated with well pad development and operations, increased surface water runoff associated with the construction of new spur roads, and increased runoff due to soil compaction caused by road and well pad construction. However, with design features of the Proposed Action (i.e., Erosion Control Plan, SWPPP, Grading and Surface Hydrology Plan, Water Quality Monitoring, and SPCC Plan), waters of the U.S. and wetlands would be protected from these impacts.

As discussed in Section 3.4.2.1, there would be no potential for increased selenium loading in surface waters as a result of the proposed project. As a result, there also would be no project-related selenium effects on riparian areas.

Site-specific Impacts. No specific wetland impacts were identified for individual well sites or roads.

3.5.2.2 No Action

Under the No Action Alternative, no effects to vegetation, timber resources, rangeland, wetlands, or waters of the U.S. would result from the proposed activities. There would be no need to conduct reclamation activities, and there would be no increased risk of fire due to the operation of heavy equipment, increased human activity, and public access. In addition, noxious weeds would not be introduced or exacerbated by the activities.

3.5.3 Cumulative Impacts

The past, present, and foreseeable future actions identified in the vicinity of each of the proposed wells and access roads (see **Table 2-9**) were reviewed in relation to vegetation resources, including noxious weeds, timber values, range management, and wetlands. Primary activities that affect local vegetation include livestock grazing, road management and use, mining, oil and gas exploration, timber management, and recreation. Changes in types and abundance of vegetation and the quality of their habitat are the focus of this cumulative assessment.

All of the past, present, and foreseeable future actions evaluated would individually and collectively increase the probability for noxious weeds to be introduced into the project area. For this reason, the requirement to monitor the sites for noxious weeds and perform reclamation immediately after the cessation of activities is critical to minimizing the potential for cumulative effects to the existing problems with noxious weeds in the Grand Mesa area.

All of these actions would involve increased levels of human presence in the project areas and incrementally remove vegetation from the forage base for the local grazing allotment. There is no clear threshold for the amount of activity that would render allotment management to be inviable due to disturbances that may affect animal distribution. The Proposed Action would contribute low levels of temporary (up to several years) forage loss, until reclamation has been completed and vegetation has been re-established, and increased human disturbances during construction, completion, and testing in the immediate vicinity of each proposed well site. Cumulative losses of forage resources are not predicted as a result of the Proposed Action in combination with other activities to the level where allotment stocking adjustments would be needed.

The Proposed Action would make possible minor contributions to cumulative effects to timber resources as a result of increased fire risk and loss of productivity due to construction of wells and roads or associated residual compaction. Although these impacts are expected to be temporary in nature, site compaction could potentially preclude tree establishment in the short- or mid-term (1 to several years). In combination with road construction, increased risk of catastrophic wildfire, and timber harvest, the Proposed Action could contribute to some minor incremental losses in land productivity.

Potential cumulative impacts to wetlands and waters of the U.S. would include a short-term temporary incremental increase in sedimentation, particularly during high intensity storm events. Implementation of the SWPPP would minimize project-related sedimentation impacts to these resources.

The potential cumulative impacts identified above apply generally to the eight proposed exploratory gas well sites. Based on the information presented in **Table 2-9**, which describes the nature, location, and timing of these actions, well sites could specifically contribute to cumulative vegetation impacts as follows:

- Leon Lake #4 and #5 - The effects of the Proposed Action may combine with livestock grazing; public use of jeep trails; and GEC exploration at Spaulding Peak #1 (including 1.1 acre pad and 0.5 mile of new road), well recompletion at Leon Lake #2, and abandonment and reclamation activities at Leon Lake #1 resulting in temporary (several months to several years) cumulative effects. These effects

would include the potential incremental increase in noxious weeds, fire risk, vegetation removal, and livestock distribution, as well as the potential incremental reduction in wetland quality, forage, and timber resources.

- Powerline - The residual effects of the Proposed Action may combine with the effects of livestock grazing, timber clearing for the Stevens Gulch Personal Use Area and the Rifle-Curecanti Powerline, past clearcuts in the Alder Creek, Surface Creek and Terror Creek watersheds, and the drilling of 18 exploratory wells with road access under the Alder Creek Coal Exploration License to result in temporary (several months to several years) cumulative effects. These effects would include the potential incremental increase in noxious weeds, fire risk, vegetation removal, and livestock distribution, as well as the potential incremental reduction in wetland quality, forage, and timber management.

  Trees, such as aspen, have been or would be removed for forest management, personal fuelwood, and to clear the Rifle-Curecanti Powerline, as well as hazard trees along Stevens Gulch Road. The estimated cumulative acreage of timber management identified within a 2-mile radius of the proposed Powerline well site is 1,576 acres. The Proposed Action would contribute approximately 4 acres of vegetation management to this total.

- Bull Park - The effects of the Proposed Action may combine with the effects of livestock grazing; public use of jeep trails; the proposed Terror Creek Green Oak Area timber management project; the East Terror Timber Sale and Personal Use Firewood project; timber clearing for the Stevens Gulch Personal Use Area and the Rifle-Curecanti Powerline; past clearcuts in the Alder Creek, Terror Creek, and Surface Creek watersheds; the drilling of 18 exploratory wells with road access under the Alder Creek Coal Exploration Lease; and the proposed GEC exploratory well at Stevens Gulch #1, including 1.1 acre pad and 0.2 mile of new road, to result in temporary (several months to several years) cumulative effects. These effects would include the potential incremental increase in noxious weeds, fire risk, vegetation removal, and livestock distribution, as well as the potential incremental reduction in wetland quality, forage, and timber management.

  Trees, such as aspen, have been or would be removed for forest management, personal fuelwood, and to clear the Rifle-Curecanti Powerline, as well as hazard trees along the Stevens Gulch Road. The Terror Creek Green Oak Area is proposed for implementation in the foreseeable future. The estimated cumulative acreage of timber management within a 2-mile radius of Bull Park is 517 acres. The Proposed Action would contribute less than 2 acres of vegetation management to this total.

- Hubbard Creek and Oakbrush - The effects of the Proposed Action may combine with the effects of livestock grazing, timber clearing for the Stevens Gulch Personal Use Area, the proposed 2-acre disturbance for a coal exploration hole and associated road access by Oxbow Coal Exploration, and the proposed GEC exploratory well at Lone Pine #1, including 1.1 acre pad and 0.4 mile of new road, to result in temporary (several months to several years) cumulative effects. These sites are within 1 mile of 3 approved coal exploration holes. The exploration holes have been eliminated from the exploration program, and will not likely be drilled. These effects would include the potential incremental increase in noxious weeds, fire risk, vegetation removal, and livestock distribution, as well as the potential incremental reduction in wetland quality, forage, and timber management.

The 5-acre Stevens Gulch Personal Use Area is the only timber resource management identified within a 2-mile radius of the proposed Hubbard Creek well site. In combination with the Proposed Action, a cumulative total of 9.25 acres of timber management would result.

- Hawksnest and Thompson Creek - The effects of the Proposed Action may combine with the effects of livestock grazing, vehicle use and maintenance on Coal Gulch Road, the inactive Hawksnest and Sanborn Mines, authorized coal exploration activities in approximately eight sections, and all-terrain vehicle use on the Pilot Knob/Coal Gulch ATV Trail to result in temporary (several months to several years) cumulative effects. These effects would include the potential incremental increase in noxious weeds, fire risk, vegetation removal, and livestock distribution, as well as the potential incremental reduction in wetland quality, forage, and timber management.

3.5.4 Potential Mitigation Measures

Impacts to vegetation would be minimized by implementing the following mitigation measures.

V-1: Reclamation would be completed within 60 days after well completion, or as soon there after within the appropriate spring or fall planting season, unless an extension is granted in writing by the USFS or BLM, as applicable.

V-2: Vegetation removal would be minimized by lopping and scattering slash to a depth of no more than 18 inches.

V-3: A surface reclamation bond would be required to ensure drill sites are returned to pre-existing land use.

V-4: The operator may be required to construct waterbars on abandoned roads. The waterbars shall be constructed to drain freely to the natural ground level to prevent siltation and clogging.

V-5: All pits, cellars, rat holes, or other holes unnecessary for further operations would be backfilled immediately after the drill rig is released.

V-6: If a site is reclaimed for the interim, the unused portion of the pad would be recontoured, seeded, and removed vegetation scattered over the recontoured area.

V-7: To facilitate timely reclamation, reserve pits may need to be pumped of fluids. After reshaping the site, the topsoil material should be distributed to a uniform depth to allow establishment of desirable vegetation. The disturbed area would be scarified prior to placement of surface soil material.

V-8: If a site is to be abandoned, immediately after seeding, stockpiled trees and slash would be lopped and scattered evenly over the disturbed area. The new spur access road would be blocked to prevent vehicle access.

V-9: Cut and fill slopes shall be reduced and graded to conform with the adjacent terrain. The disturbed sites would be prepared to provide a seedbed for reestablishment of desirable vegetation and reshaped to blend with the natural contour.

V-10: Reclamation would use the following approved USFS seed mixes.

Table 3.5-5
Approved USFS Seed Mixes

Habitat Type	Species	lb/acre	Percent of Mixture
Mountain Shrub (7,000 to 8,000 feet)	Mountain brome (*Bromus marginatus*)	4	20
	Prairie junegrass (*Koeleria cristata*)	3	15
	Western wheatgrass (*Agropyron smithii*)	4	20
	Indian ricegrass (*Oryzopsis hymenoides*)	3	15
	Sandberg bluegrass (*Poa sandbergii*)	3	15
	Bluebunch wheatgrass (*Pseudoroegneria spicata* spp. *spicata*)	3	15
Total		**20**	**100**
Aspen/Spruce-Fir (8,000 to 9,500 feet)	Mountain brome (*Bromus marginatus*)	5	26
	Slender wheatgrass (*Agropyron trachycaulum*)	3	16
	Thickspike wheatgrass (*Elymus lanceolatus* spp. *dasystachyum*)	3	16
	Canby bluegrass (*Poa canbyi*)	3	16
	Blue Wildrye (*Elymus glaucus*)	5	26
Total		**19**	**100**

Temporary Revegetation[1]	Species	lb/acre
Regreen (brand name)	Tall wheatgrass/winter wheatgrass (*Elytrigia elongata*)	20
Pioneer (brand name)	Tritacale/winter wheat (*Triticum aestivum*)	20

[1]For temporary revegetation to reduce noxious weed infestations.

Impacts to timber resources would be minimized by implementing the following mitigation measure:

V-11: Coordinate with USFS to avoid conflicts with the administration of timber sale contracts in the area, including road use issues. A timber contract would be required to ensure that tree removal would follow USFS timber management practices.

Impacts to rangeland would be reduced by implementing the following mitigation measure:

V-12: Require coordination with the USFS annually to schedule use of the Mill Creek Range Facility and permittee driving operations.

V-13: Require coordination with BLM annually to avoid conflicting with grazing permittee's uses of the Coal Gulch Road.

3.6 Wildlife and Fisheries

3.6.1 Affected Environment

3.6.1.1 Wildlife

The analysis area for the majority of wildlife species, including TES species addressed in Section 3.7 included all proposed well sites and new access road segments and an approximate 0.25-mile zone around these disturbance areas. For most wildlife, potential direct and indirect effects would be confined within this analysis area. However, for some wider-ranging species such as elk, mule deer, black bear, lynx, golden eagle, bald eagle, and peregrine falcon, larger areas were evaluated to assess potential project related impacts. For elk, mule deer, and black bear, a 0.5-mile radius around proposed disturbance areas was used to define the analysis area since studies indicate that these species could be displaced up to 0.5 mile from project activities (see species discussions in Section 3.6.2.1). A 0.5-mile radius analysis area also was used for bald eagle, golden eagle, and peregrine falcon since a 0.5-mile buffer is typically recommended for activities near nest or important roost sites. The analysis area for bald eagle also included downstream portions of the North Fork of the Gunnison River since potential offsite water impacts could affect bald eagle winter use of the North Fork of the Gunnison River. Because of the very wide-ranging nature of lynx, the USFS's LAU mapping was used to evaluate potential impacts to this species. LAUs identify landscape level blocks of land that contain suitable lynx habitats. The lynx analysis area for the proposed action includes the Crater Lake LAU and Green Mountain LAU. The cumulative effects area used for this analysis includes the watersheds containing the well sites: Surface Creek – Leon Lake #4 and #5, Terror Creek – Powerline and Bull Park, Hubbard Creek and Bear Creek – Hubbard Creek and Oakbrush, Hawksnest Creek – Thompson Creek and Hawksnest.

Wildlife species and issues of concern addressed by this analysis were determined through consultation with state and federal agency personnel, a review of agency and public comments received during the EA scoping process, and evaluation of potential species presence provided based on wildlife species' ranges and other pertinent information sources

Information regarding wildlife species and current habitat conditions within the analysis area was obtained from field surveys, a review of existing published sources, USFS file information, CNHP occurrence data, and CDOW Water Resources Information System (WRIS) mapping data. General habitat and breeding bird surveys were conducted at Leon Lake #4 and #5 well sites and access roads from June 24 through June 28, 2002. General habitat and wildlife presence surveys were conducted at the remaining well sites and access roads from October 14 through October 17, 2002. Discussions of wildlife populations within the analysis area are provided under the following categories: Big Game; Raptors; Songbirds and Other Avian Species; and USFS MIS. TES wildlife species are discussed in Section 3.7. Four types of habitat are present in the analysis area (oakbrush, aspen, mountain shrub, and meadow), as discussed in Section 3.5.

Big Game

The analysis area occurs within CDOW Game Management Units 52 and 521. Mule deer, elk, black bear, and mountain lion occur within the analysis area. Mountain lion is discussed in this section. Information on mule deer, elk, and black bear is presented in greater detail in a subsequent section on MIS.

Mountain lion occur throughout the analysis area region with their range being closely tied to that of elk and mule deer. Mountain lion prey primarily on mule deer and young elk in this region and, like their prey, are typically wide-ranging. Mountain lions will follow their prey's seasonal movement and inhabit summer range or winter range in conjunction with deer and elk. They are typically shy and avoid areas with human activity. As a result of their wide-ranging habits, population densities are usually low. Documented home ranges for mountain lion in the western U. S. range from 32.5 to 479 square kilometers (Anderson 1983). Preferred habitat of mountain lions consists of rough or steep terrain in remote areas with suitable rock or vegetation cover. CDOW WRIS mapping indicates the entire analysis area is classified as mountain lion overall range. Because of the mountain lion's dependence on mule deer and elk populations, the effects assessment for mule deer and elk (Section 3.6.2.1) will apply to mountain lion as well, and no further discussion of this species will be provided in this EA.

Raptors

Numerous raptor species are known to occur and nest within the region of the analysis area. Potential breeders within 0.25 mile of the proposed well sites include northern goshawk, Cooper's hawk, sharp-shinned hawk, golden eagle, red-tailed hawk, American kestrel, and great horned owl. Northern goshawk is discussed separately in the MIS section.

Nest site preferences of raptors potentially breeding in the area vary considerably. Red-tailed hawk and great horned owl typically nest in relatively large trees with open crowns or on cliff ledges and areas of rock outcrop. Great horned owls do not build their own nests and often occupy old nests of eagles, hawks, ravens, crows, and tree squirrels in larger trees or on cliff faces. Both of these species prefer primarily open shrublands and meadow areas for hunting. Suitable nesting habitat for these species in the analysis area is provided primarily by large aspen trees. No suitable cliff nest sites are located within direct line-of-sight or within 0.5 mile of the potential disturbance areas. No nests were located in aspen trees within 0.25 mile of disturbance sites.

Raptor nest data collected by the U.S. Fish and Wildlife Service (USFWS) in the 1980s found a golden eagle nest about 0.36 mile southwest of the Oakbrush well site. There are eight historic records of golden eagle or buteo nests within a 2-mile radius of the all the well sites. The non-forested well site locations also represent year-round foraging areas for golden eagle and red-tailed hawk.

The remaining potential breeding raptors in the analysis area are associated primarily with forested habitats. Cooper's hawks nest in aspen or in deciduous trees in riparian situations but also are known to nest in mature conifers (Ehrlich et al. 1988; Terres 1980). Nests are typically constructed in an upper crotch of a tree near the trunk and below the canopy top. Sharp-shinned hawks, unlike Cooper's, nest in a wide variety of wooded habitats ranging from mountain mahogany stands to conifers. Nest configuration and placement

is similar to Cooper's hawk. The American kestrel is a cavity nester, and abandoned woodpecker holes are used as nest sites. A variety of open and wooded habitats are occupied by the American kestrel, although it avoids densely forested habitats. No nests of sharp-shinned hawk, Cooper's hawk, or American kestrel were located in aspen trees within 0.25 mile potential disturbance sites.

Songbirds and Other Avian Species

A variety of songbird and similar species reside within the analysis area. The majority of these species migrate south or to lower elevations for the winter months, and only a few remain in the analysis area during the winter months. Woodpeckers, jays, chickadees, nuthatches, and finches are representative year-round residents. Many of the migrants are neotropical species, which winter in Central and South America. Neotropical migratory birds include a full array of species that require habitats ranging from early seral or successional stages to old growth. Others prefer edge habitat areas that occur between forested and more open habitats. House wren, American robin, yellow warbler, warbling vireo, and western wood pewee are common summer residents in aspen habitat. House wren, blue-gray gnatcatcher, and spotted towhee are typical summer residents in oakbrush. Potential MIS avian species in the analysis area are discussed in the following section.

Management Indicator Species

A number of MIS are potential inhabitants of the analysis area. MIS are species whose response to land management activities can be used to predict the likely response of a wide range of similar species with similar habitat requirements (USFS 1991). **Table 3.6-1** summarizes the initial process used to determine which MIS would be addressed by this analysis. All MIS with a low, moderate, or high probability of occurrence within the analysis area were carried forward in the EA process. Species with an occurrence probability of "none" were eliminated from further evaluation. Bald eagle, northern goshawk, peregrine falcon, hairy woodpecker, American marten, black bear, elk, and mule deer were carried forward in this analysis. Information on bald eagle and peregrine falcon is presented in the following Section 3.7.

Northern Goshawk

The northern goshawk inhabits coniferous and mixed forests in much of the northern hemisphere. In Colorado, northern goshawks nest in dense coniferous forest, often on north slopes and near water. Nesting also has been documented in aspen and in trees in riparian habitats at the lower elevations (Bailey and Niedrach 1965). They can be found in any forested ecosystems in the Gunnison Basin area, but blocks of mature and old growth forest habitats (200 acres or greater) with a relatively open understory and small openings are preferred (Hayward et al. 1990; Finch 1992; Andrews and Righter 1992). Old growth conifer stands are preferred for nesting, but goshawks also may use mixed conifer-aspen stands or aspen stands associated with conifers. The majority of known nest sites in the GMUG National Forests are in aspen trees (Holland 2000). Mature stands of aspen within the analysis area (i.e., Leon Lake #4, Leon Lake #5, Powerline, Hubbard Creek, and Oakbrush sites) represent potential foraging and nesting habitat. However, the lack of adjacent areas of mature to old-growth conifer habitats may limit the suitability of the analysis area to support nesting and foraging by northern goshawk.

Table 3.6-1
GMUG Management Indicator Species
Initial Screening Process for Potential Species Presence
in the EA Analysis Area

Common Name / Scientific Name	Habitat Indicator Significance	Probability of Occurrence in Analysis Area	Potential Habitat in Analysis Area
Fish			
Rainbow trout *Oncorhynchus mykiss*	Economically important	High	Surface, Terror, and Hubbard Creek drainages.
Brown trout *Oncorhynchus trutta*	Represents requirements of other species	High	Surface, Terror, and Hubbard Creek drainages.
Colorado River cutthroat trout *Oncorhynchus clarki pleuriticus*	Forest Sensitive & State Candidate	High	Conservation populations occur in upper mainstem Hubbard Creek and West Fork Terror Creek. The remaining portions of the Hubbard and Terror Creek drainages are managed under the Conservation Agreement (Colorado River Cutthroat Trout [CRCT] Task Force 2001).
Birds			
Bald eagle *Haliaeetus leucocephalus*	Threatened	Low	None.
Northern goshawk *Accipiter gentilis*	Represents requirements of other species	Moderate	Mature Douglas-fir, spruce/fir, and aspen forest.
Peregrine falcon *Falco peregrinus*	Recently delisted as Endangered	Low	None; possible flyover; nests on high cliffs; forages over riparian and aquatic habitats.
Gunnison sage grouse *Centrocercus minimum*	Represents requirements of other species	None	None; lower elevation sagebrush habitat.
Hairy woodpecker *Picoides villosus*	Represents requirements of other species	None	None; late succession lodgepole pine forest.
Lewis' woodpecker *Melanerpes lewis*	Represents requirements of other species	None	None; lowland and foothill cottonwood riparian forests; ponderosa pine woodland; urban and agricultural areas with tall deciduous trees.
Pinyon jay *Gymnorhinus cyaneophalus*	Represents requirements of other species	None	None; mature piñon-juniper woodland.
Red crossbill *Loxia curvirostra*	Represents requirements of other species	None	None; inhabits a variety of coniferous forest types and conditions depending on cone crops.
Mammals			
Abert's squirrel *Sciurus aberti*	Special habitat needs	None	None; late succession ponderosa pine forest.
Black bear *Ursus americanus*	Economically important	High	Inhabits a wide variety of habitats including those present in the analysis area.
American marten *Martes americana*	Special habitat needs	Low	Mature and mixed-age stands of spruce-fir and lodgepole pine.
Elk *Cervus elaphus*	Economically important	High	Inhabits a wide variety of habitats including those present in the analysis area.
Mule deer *Odocoileus hemionus*	Economically important	High	Inhabits a wide variety of habitats including those present in the analysis area.
Mountain sheep *Ovis canadensis*	Economically important	None	None; high visibility habitat dominated by grass, shrubs, and rock cover.

Hairy Woodpecker

This species inhabits a variety of forested habitats including aspen, ponderosa pine, Douglas-fir, lodgepole pine, spruce-fir, riparian, piñon-juniper woodlands, and wooded urban areas. Key features of occupied habitats are suitable cavity nest sites in association with insect prey populations. Local mountain populations fluctuate in response to insect infestations and fire. Dead standing trees (snags) often provide suitable foraging and nest cavity sites, although live trees are used as well. Mature aspen stands within the analysis area provide suitable habitat for the species.

American Marten

The marten inhabits late successional coniferous or mixed forests throughout northern North America. Martens are most abundant in mature to old-growth true fir and spruce-fir forests in the western United States. They prefer mature, mesic coniferous or mixed forests with at least a 30 to 50 percent crown density (Koehler et al. 1975; Allen 1982). Martens avoid large, open areas and clearings, but may use small riparian areas and meadows for foraging (Spencer et al. 1983). They feed on a wide variety of foods including squirrels, voles, mice, birds, reptiles, amphibians, insects, and fruits and berries (Clark et al. 1987), but voles are often cited as the marten's preferred food source (Koehler et al. 1975; Gordon 1986). The marten's preference for moist sites may be related to the fact that the lush stands of herbaceous vegetation growing at mesic sites often support large populations of voles. The availability of suitable den sites also is a key habitat component. Dens can be above ground in a tree hollow or on or under the ground in association with rock piles or hollow logs. Snags, woody forest debris, rock slides, and rock outcrops are considered important habitat components for this species (Holland 2000). Martens occur throughout Colorado in suitable forested habitats. Although martens are known to use aspen habitat in association with coniferous forest, the general lack of conifer stands in the analysis area reduces the likelihood of its presence.

Black Bear

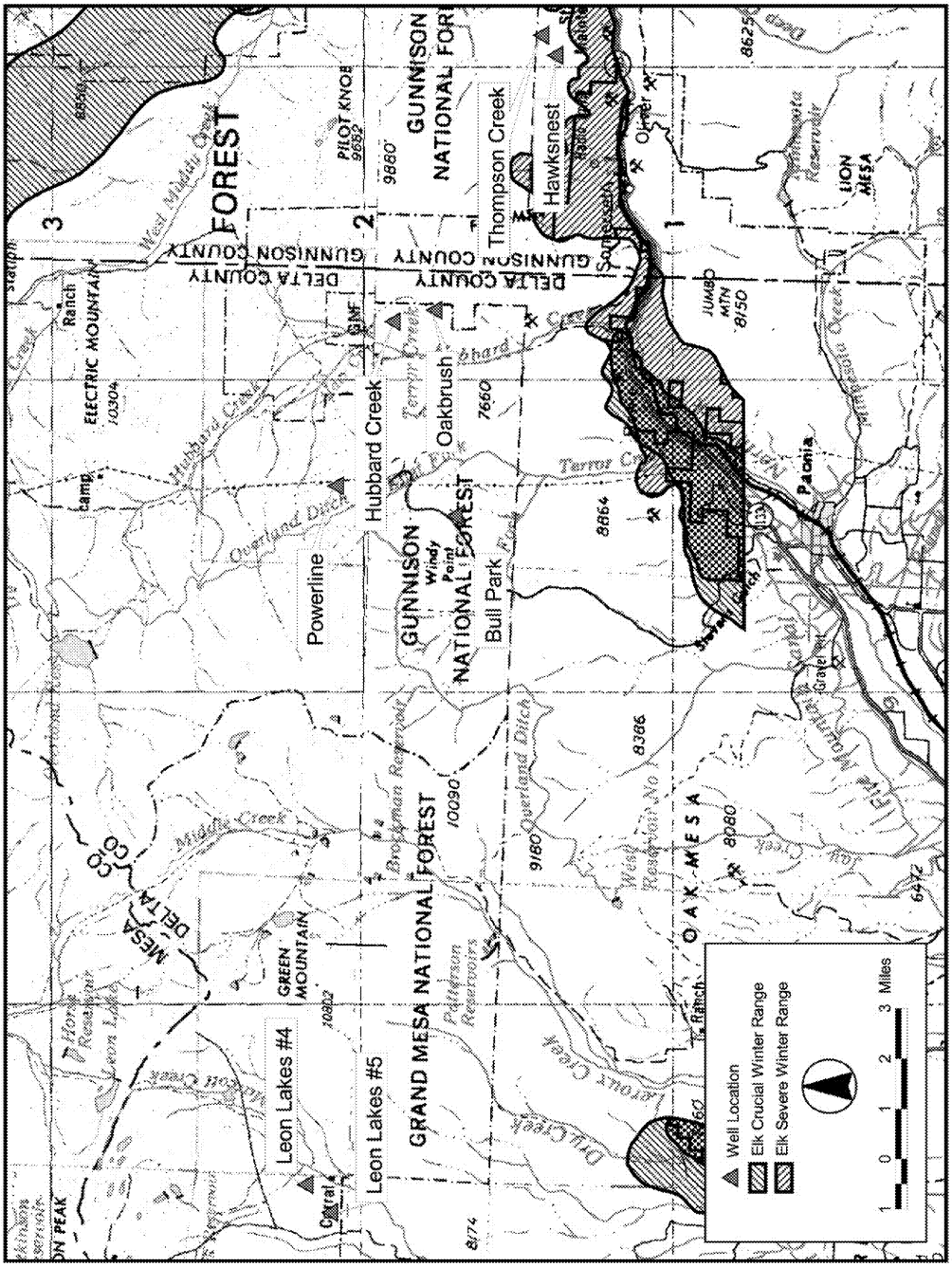
The life history requirements of black bear are satisfied by a variety of habitats, including those present within the analysis area. Prime black bear habitat is characterized by relatively inaccessible terrain, thick understory vegetation, and abundant sources of shrub or tree borne soft or hard mast (Pelton 1982). Black bears are omnivorous but feed primarily on herbaceous vegetation and berries. They become carnivores only when prey or carrion is readily available. Habitat areas of relative refuge from human populations are considered a prime requirement for sustaining stable black bear populations, although black bears can habituate to human presence (Pelton 1982). Black bears are opportunistic and easily attracted by the presence of human food and garbage that is not properly stored. They can become a nuisance around areas of human habitation, especially in years when natural food availability is reduced. Black bears are relatively common in the analysis area, and CDOW WRIS mapping designates the entire analysis area as overall range for black bear. CDOW WRIS mapping also indicates there is a black bear fall concentration area in the upper Terror Creek drainage around the confluence of the East and West Fork of Terror Creek.

Elk and Mule Deer

Elk and mule deer populations within the analysis area region exhibit seasonal movements to and from higher to lower elevation habitats, with most shifts in distribution occurring as a result of elevational migration in response to weather patterns and snow cover. Elk winter range extends to higher elevations than mule deer winter range since elk are not as restricted by snow cover as are mule deer. Elk summer range also does not extend to as low as elevations as mule deer summer range since elk prefer the higher and cooler elevations where aspen and spruce/fir habitats provide thermal and security cover. Elk winter range generally occurs below the 8,000- to 8,400-foot elevation level and is typified by oakbrush and mixed shrub slopes where exposure limits snow accumulation. Elk Severe Winter Range and Winter Concentration Areas are located on the lower elevation slopes within the Elk Creek drainage and along SH 123 and the North Fork Gunnison River below the confluence of Bear Creek and the North Fork Gunnison River. In the Cedaredge area, elk winter range is at the lower elevations south of the National Forest boundary (**Figure 3.6-1**). Areas of severe winter range and winter concentration areas are identified by CDOW WRIS mapping along the Surface Creek drainage northeast of Cedaredge but south of the National Forest Boundary. All of the proposed well sites are within elk summer range except for Thompson Creek and Hawksnest (**Figure 3.6-1**). These well sites are in elk winter range, but are not within severe winter range or winter concentration areas. The proposed access road to these two sites, however, traverses elk severe winter range.

Elk calving or production areas are defined by the CDOW as the portion of the range traditionally occupied by concentrations of cow elk from May 15 to June 15. No elk production areas have been identified by the CDOW near the six proposed Gunnison County well sites. The only known production area in the Gunnison County portion of the analysis area is at higher elevations within the uppermost portions of the Terror Creek and Hubbard Creek watersheds. Only known production areas are mapped by the CDOW, however, and elk calving activities are likely to take place in other areas of suitable habitat. It is probable that some level of elk calving activity occurs in lower elevation aspen habitats within the Gunnison County portions of the analysis area especially in years with heavier accumulations of snow and delayed spring snowmelt. In contrast, the two Leon Lake well sites (#4 and #5) in Delta County are both just outside of the eastern edge of a CDOW designated elk production area (**Figure 3.6-2**).

For mule deer preferred winter range areas are provided primarily by south and west-facing slopes of oakbrush, mixed shrub, and piñon-juniper habitats where browse is plentiful, typically at the lower elevations below approximately 7,400 feet. The Hawksnest site is within winter range while the Thompson Creek site is just outside of winter range. Both sites may be used as winter range during milder winters with reduced snow cover. Neither site is within severe winter range or winter concentration areas (**Figure 3.6-3**). These areas are located along SH 133 and the North Fork of the Gunnison River below the confluence of Bear Creek and the North Fork Gunnison River in the Gunnison County portions of the analysis area. In the Delta County portion of the analysis area, severe winter range and winter concentration areas are located in areas surrounding the Town of Cedaredge. Severe Winter Range is defined as that part of the range where 90 percent of the individuals are located when the annual snow pack is at its maximum and/or temperatures are at a minimum in the two worst winters out of ten.

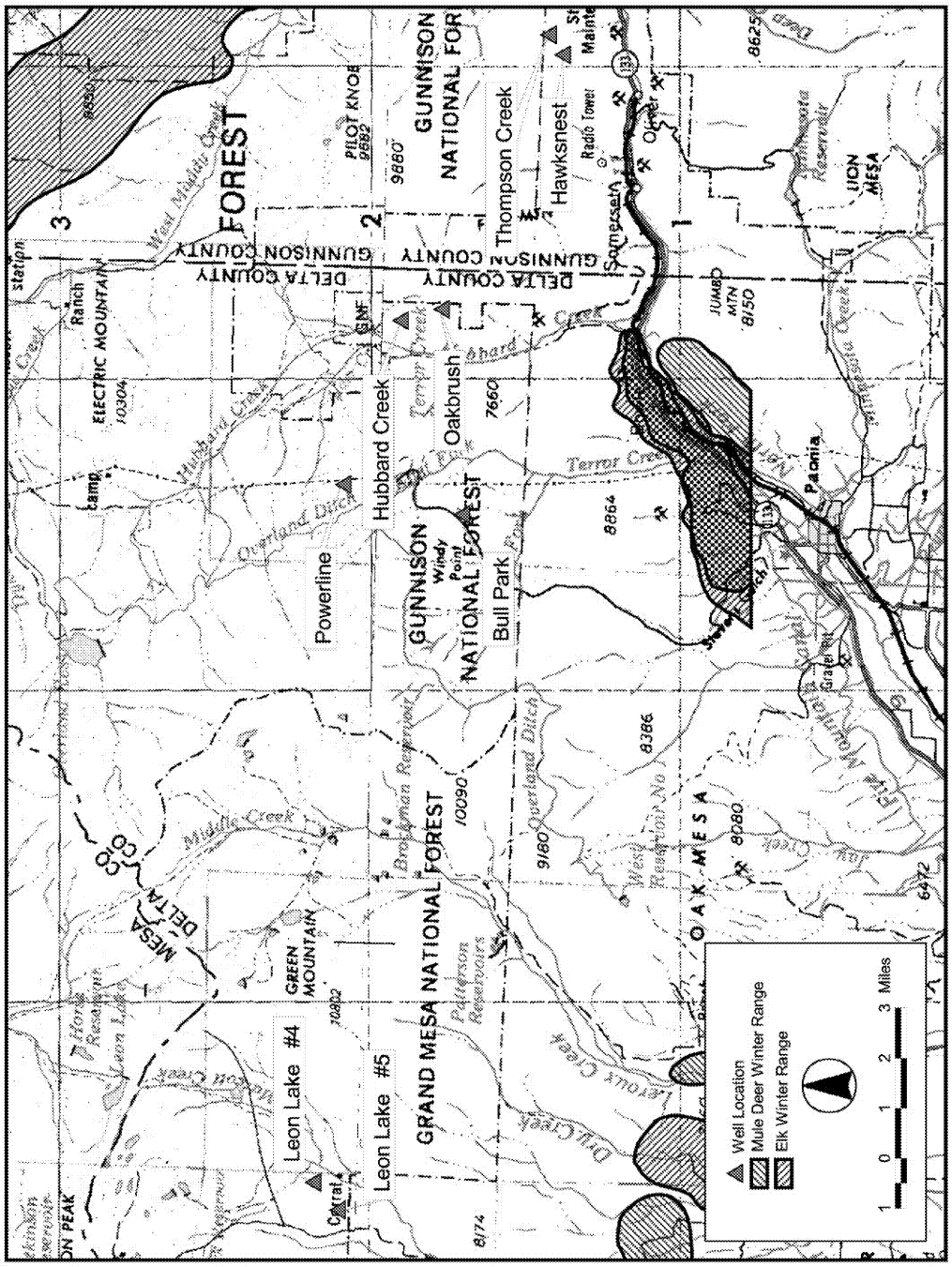


Source: CDOW 2003.

Natural Gas Exploratory Drilling Project

Figure 3.6-1

Elk Crucial Winter Range

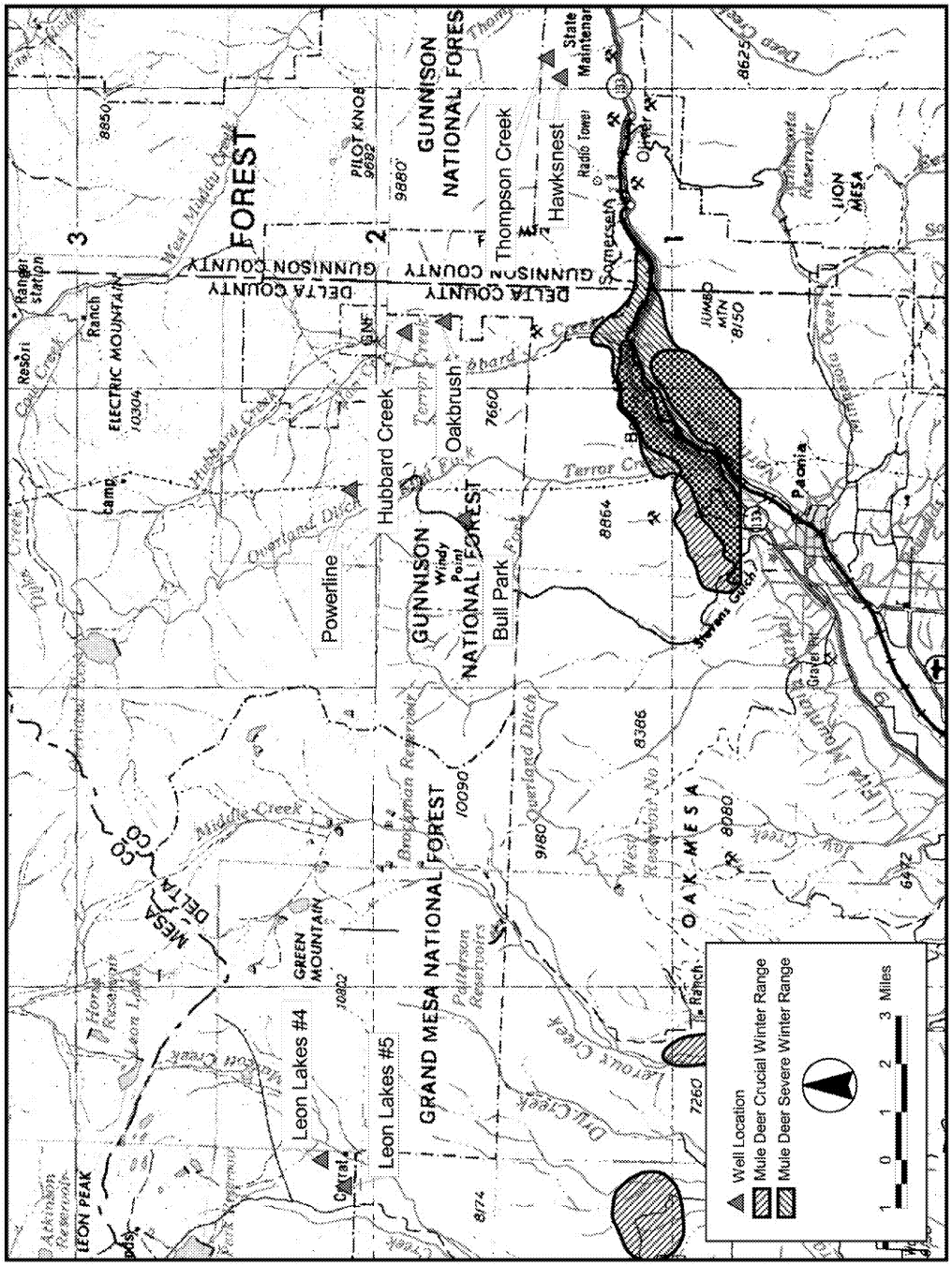


Source: CDOW 2003.

Natural Gas Exploratory Drilling Project

Figure 3.6-2

Elk and Mule Deer Winter Range in Relation to the Exploratory Well Sites



Natural Gas Exploratory Drilling Project

Figure 3.6-3

Mule Deer Crucial Winter Range

Source: CDOW 2003.

3.6.1.2 Fisheries

The study area for fisheries includes three perennial (Surface, Terror, and Hubbard creeks) drainages that encompass the well sites and new road spurs and the North Fork of the Gunnison River. The cumulative effects area includes these four drainages in relation to the past, present, and future actions.

The drilling sites and roads are located within three perennial drainages that support fisheries. These include Surface Creek (Leon Lake #4 and #5), Terror Creek (Powerline and Bull Park), and Hubbard Creek (Hubbard Creek). The Oakbrush site is located in a drainage area for Lone Pine Creek (Hubbard Creek drainage) and the Bear Creek drainage. No perennial streams are located near the Thompson Creek and Hawksnest sites. Other intermittent and ephemeral streams are located in the general area, but they do not support year-round habitat for aquatic species. Fish resources also exist in the North Fork of the Gunnison River, which receives water from Surface, Terror, and Hubbard Creeks. The following information provides a summary of fish species present in these streams.

Surface Creek is a coldwater fishery comprised of game and nongame species. The stream supports rainbow, brown, and cutthroat trout (Brow 2002; CDOW 1975). In 1975, CDOW sampled five locations in the mainstem portion of Surface Creek to inventory species presence. The sampling sites extended approximately 10 miles upstream of Cedaredge to just above the confluence with the North Fork of the Gunnison River. One or two trout species were collected at all sites except near Eckert. Recent fish sampling efforts by CDOW and the USFS have focused on cutthroat trout occurrence and genetic characteristics. Sampling in the upper portion of Surface Creek in 2000 by the USFS noted the presence of cutthroat trout and rainbow trout (USFS 2000). Genetic analyses on cutthroat trout collected from Surface Creek in 2001 did not show pure populations, but the drainage is still managed under the Conservation Agreement for this subspecies (Brow 2002; CRCT Task Force 2001). Other species in Surface Creek include white sucker, speckled dace, and mottled sculpin (CDOW 1975).

Hubbard Creek provides habitat for native fish and four trout species (rainbow, brown, brook, and cutthroat (Wang 1998). Several varieties of cutthroat trout and rainbow trout were stocked by the CDOW in 1973 through 1996. Recent genetic analyses in 2002 indicated that pure Colorado River cutthroat trout occur in the upper mainstem portion of Hubbard Creek (Brow 2002). These results mean that this subspecies is managed as a ”conservation population” under the Conservation Agreement (CRCT Task Force 2001). A conservation population of Colorado River cutthroat trout is defined as genetic purity ratings of A, A-, B+, and B, which range from no hybridization to less than 10 percent hybridization with non-native salmonids. The primary goal of the conservation strategy is to ensure the long-term prosperity of this trout species throughout its historic range. The conservation objective is to maintain and restore conservation populations within its historic range. Additional information concerning this species importance as a MIS is provided at the end of this section. Other fish species in the stream include bluehead sucker, white sucker, speckled dace, and mottled sculpin (BLM and USFS 2000). Two instream flow recommendations were appropriated in 1984 by the Colorado Water Conservation Board (1984) to “preserve the natural environment to a reasonable degree”. These include 4 cfs for an 8.1-mile segment in the headwaters and 3 cfs in a 2.5-mile segment in the mid-portion of the drainage (T12S, R91W, Sections 14, 23, 26, and 35).

Terror Creek is a moderately steep stream with gradients exceeding 10 percent in the middle and upper portions. Based on sampling in two tributaries West Fork Terror and East Fork Terror Creeks), fish species likely consist of cutthroat trout and speckled dace. Historically, CDOW stocked cutthroat trout in Terror Creek, but stocking has not been done since 1996. Deoxyribonucleic acid analyses also indicated that pure strain Colorado River cutthroat trout also occur in West Fork Terror Creek (Brow 2002).

North Fork of the Gunnison River contains rainbow trout, brown trout, cutthroat trout, and brook trout (Hebein 1999). Rainbow and brown trout usually are the most abundant game fish species. Trout populations have developed from historic stocking efforts (1973 through 1995) and natural reproduction. Northern pike and green sunfish, which originate from Paonia Reservoir, also are present in low numbers. Native species known to be present include roundtail chub, bluehead sucker, flannelmouth sucker, speckled dace, longnose dace, and mottled sculpin.

Colorado River cutthroat trout is a USFS MIS and it also is a surrogate indicator species for brown trout and rainbow trout habitat. Colorado River cutthroat trout is a native of the Colorado River Basin, occurring mainly in upper headwater streams and rivers in northwest Colorado. Preferred stream habitat includes cobble/boulder substrates, riffles, deep pools, and cover provided by logs and undercut banks (Sigler and Miller 1963; Behnke 1992). Pool density, pool depth, and large woody debris are important components of cutthroat trout habitat (USFS 2001a). Spawning typically occurs in headwater areas in June and July in the GMUG National Forests. Habitat for juvenile rearing in May through October consists of a variety of riffle, run, and pool areas. During the winter (October through April) juvenile fish tend to use substrate and bank cover in slow-moving pools. As of 2000, Colorado River cutthroat conservation populations on or adjacent to GMUG National Forests lands are limited to 13 sub-watersheds and 3 lakes totaling 50 miles and 80 acres (USFS 2001). Ongoing studies are planned to identify additional conservation populations in the GMUG National Forests.

3.6.2 Environmental Consequences

3.6.2.1 Wildlife

Proposed Action

Impacts Applicable to All Sites. Determination of effects for wildlife species addressed by this analysis is based upon existing habitat conditions and changes to habitats that would occur with implementation of the Proposed Action. Information presented in this section emphasizes habitat considerations and other factors which research has indicated to be limiting or of greatest management concern related to maintaining population viability of a given species or group of species. For those species that are commonly hunted (game species) or that have widespread stable populations, population viability is not a concern because of their overall abundance. However reductions in habitats considered limiting (winter range) or in security with increased hunting pressure are management concerns. For species identified as USFS sensitive, threatened or endangered, population viability is a concern because habitat changes could affect individuals of small local populations (see Section 3.7.2.1). For those species that are present only seasonally to breed and raise young (neotropical migratory birds), impact assessments relate to the dependency of these species on their preferred habitat conditions within the analysis area.

The drilling of eight exploration holes, road upgrades, and construction of new spur access roads would create 30.1 acres of new surface disturbance in currently undisturbed areas of vegetation communities/wildlife habitats. New roads would account for 6.7 acres of this disturbance. The principal wildlife habitats to be affected would be aspen and meadow habitats. Minor amounts of oakbrush and mountain shrub habitat would be affected as well (see Section 3.5.2). These relatively small and short-term losses of habitat would be widely dispersed and would not result in any barriers to wildlife movement or fragmentation of larger blocks of habitat. Project activities and short-term habitat losses also would not create any barriers across wildlife corridors or block any linkages between important habitat areas. All new access roads would be gated and locked to prevent public access so there would be no decrease in big game security related to new road construction.

Habitat loss from well pad and access road construction could result in minor direct losses to smaller, less mobile species of wildlife, such as small mammals and reptiles, and displacement of more mobile species to adjacent undisturbed habitats until operations cease and reclamation is complete. Populations of most small mammals and reptiles would be expected to rapidly recover once construction is completed due to their relatively high reproductive potentials. Displacement could result in some local reductions in wildlife populations if adjacent undisturbed habitats are at carrying capacity. Any losses would be relatively minor, since the total acreage of disturbance would be very small in relation to available undisturbed habitats. There would be no effect on wildlife species diversity in the analysis area. Populations of more mobile species of wildlife may be positively or negatively affected once reclamation is complete. At the end of the well testing period when closure operations are complete, reclamation would result in a conversion to mid-successional grass/herbaceous and shrub communities (see Section 3.5) in the short term and forage conditions for mule deer and elk would be slightly improved. Over time some woody species eventually would regenerate in reclaimed areas through natural invasion and regeneration.

In addition to short-term habitat loss, human presence and noise associated with construction and drilling operations have the potential to displace wildlife from a larger area than the actual disturbance. The most common wildlife responses to noise and human presence are avoidance or accommodation. Avoidance would result in displacement of animals from an area larger than the actual disturbance area. Reaction of animals to noise varies depending on the intensity of the noise source and whether it is continuous or intermittent. Transient loud noises generally provoke alarm responses, while many animals apparently learn to ignore more constant, lower level noise sources that are not associated with negative experiences such as being chased or hunted (Busnel 1978). The total extent of habitat lost as a result of wildlife avoidance response is impossible to predict for most species, since the severity of this response varies from species to species and can even vary between different individuals of the same species. Also, after initial avoidance of human activity and noise producing areas, certain wildlife species may acclimate to the activity and begin to reoccupy areas formerly avoided. In addition to avoidance response, increased human presence intensifies the potential for wildlife/human interactions ranging from harassment of wildlife to poaching and legal harvest. Increased human presence and related increases in traffic levels on project access roads also increases the potential for wildlife/vehicle collisions.

No hazardous waste is expected to be generated by project operations. Produced water would be contained onsite in tanks and transported to a certified disposal facility. Wildlife exposure to reserve pits as well as

potentially toxic materials used during drilling operations would be minimized since fencing would be placed around the entire well pad site after pad construction is complete. During drilling and completion activities, the presence of crews onsite in 24-hour shifts would make the well pad and reserve pit areas unattractive to songbird use. At the cessation of completion activities, the reserve pit would be allowed to dry out and reclaimed.

Black Bear. Project development would not occur within any areas designated as black bear concentration areas. The small acreages of vegetation disturbance would have only minimal effect on the mix of vegetation cover types or vegetation structure. Numerous studies have documented black bear avoidance of roads, mineral exploration and development, and non-motorized human activities (Pelton 1982; Tietje and Ruff 1983). Bears tend to avoid areas of activity, and consequently could lose available habitat, or habitat would be less effective. While disturbance to potential foraging habitat and increased human access could displace individual bears, it is unlikely that the small amount of disturbance associated with the Proposed Action would adversely affect local populations of black bear.

In many instances, the direct effects of mineral exploration and development may be less significant than the secondary effects of increased human access and habitation. Limited displacement of bears in conjunction with the fact that black bears can habituate to human presence (Pelton 1982) increases the potential for bear/human interactions and bear mortality through illegal or defense-of-life-or-property kills. Waste disposal can be a major problem associated with human development and bears. Human garbage is cited as one of the major contributors to bear conflicts with humans (Herrero 1985). Garbage habituated bears can be relocated, but a nuisance bear often has to be destroyed. Bear/human interactions and resulting bear mortalities would be minimized by maintaining all trash and other solid waste in expandable wire cages within the fenced enclosures encircling each well pad. All solid waste would be trucked offsite at regular intervals to be disposed in an approved sanitary landfill..

American Marten. The Proposed Action would not have any effect on preferred foraging or denning habitat for marten. Areas of aspen habitat to be disturbed by project development are unlikely to be used by marten because of a lack of adjacent areas of preferred spruce-fir forest. Clearings to be created by project development in aspen habitat would be small and would not be avoided by marten. Once reclamation is complete, created small openings of grassland/herbaceous habitat may improve habitat conditions for animals such as voles that represent important prey species for marten. Overall, the Proposed Action would not have any adverse effects on local populations of marten.

Elk and Mule Deer. All well sites and access roads, except for Thompson Creek and Hawksnest, would be in elk and mule deer summer range. Thompson Creek and Hawksnest would be in or near elk and mule deer winter range. The relatively small amounts of habitat disturbance in summer and winter range are unlikely to have any measurable direct effect on local elk and mule deer populations. Especially since standard BLM lease stipulations regarding timing restrictions for surface disturbance and occupancy in elk winter range would eliminate any potential risk of direct and indirect impacts to wintering elk and mule deer from human presence (see Section 2.1.2.12). Summer range is generally considered non-limiting for mule deer and elk populations in the Rocky Mountain region.

Of greater concern than direct habitat loss is the potential for displacement of elk and mule deer as a result of human presence and noise. The distribution of hunted populations of deer and elk are usually sensitive to human presence and can be displaced by human activity. Therefore, it is likely that elk and mule deer would be displaced from a larger area than the actual disturbance sites due to avoidance response. On the other hand, elk and mule deer also have demonstrated the ability to acclimate to a variety of development activities in the West, as long as intentional human harassment activities, such as direct chasing and interactions with domestic dogs, do not increase significantly.

It is assumed that the footprint of the facilities would have no habitat value during operations. In addition, habitat value near disturbance sites would be reduced by human presence and noise. Increased noise levels associated with well site construction would be less than 55 dBA at a distance of 500 feet from the source (see Section 3.9.2). Since the Colorado standard for noise at noise sensitive receptors is 55 dBA at a distance of 25 feet from the noise source, drill rig operations have the potential of affecting more sensitive wildlife such as elk up to 400 to 500 feet from well sites during the 2-week drilling and completion period. After these activities are completed, testing activities are expected to generate much lower noise levels and potential disturbances for elk would be reduced.

Although it is generally assumed that changes in big game movements and distribution are detrimental to individuals and populations, displacement from preferred habitats and increased stress due to human harassment (intentional or otherwise) rarely have been linked to changes in reproduction, survival, or any other demographic parameters. Therefore, the extent to which displacement would adversely affect these species is difficult to determine. In addition, the total extent of habitat lost as a result of wildlife avoidance response is impossible to predict for most species since the severity of this response varies from species to species and can even vary between different individuals of the same species. Also, after initial avoidance of human activity and noise producing areas, certain wildlife species may acclimate to the activity and return to areas formerly avoided. Published studies for big game suggest that displacement from noise may range from 0.125 to 0.5 mile (Ward 1985; Rost and Bailey 1979). Potential displacement during the summer season is unlikely to have a measurable effect on elk and mule deer populations, since summer habitat availability is not considered limiting for these species.

The potential for displacement is a concern for the two Leon Lake sites (#4 and #5), which are located in or near an identified elk production area. Displacement impacts to elk production areas also may be a concern for the Powerline well site, which is near or in an area of aspen habitat potentially suitable for elk calving activities. Forage provided by production area habitats during the calving season is especially important, since elk nutritional demands for successful calving, cow recovery, and early calf growth are higher than those associated with any other season. Research completed by Phillips (1998) indicated that dispersed human activities in elk production areas might cause substantial declines in elk reproductive success. If construction and well operation activities occur at the Leon Lake and other potential elk production sites during the calving season (May 15 through June 15), elk reproductive success for the season of disturbance could be adversely affected.

Maintenance of secure unroaded blocks of habitat is another important consideration in the stability of hunted populations of mule deer and elk. The Proposed Action would not result in any increase in vehicle access into secure areas previously inaccessible to motorized vehicles during the hunting season since all

new access roads would be gated and locked to preclude unauthorized vehicle access. Therefore, the Proposed Action would not result in an increase in hunting pressure due to improved vehicle access.

The Proposed Action also would not have any effect on the Wildlife Habitat Improvement Area in the Stevens Gulch area. The USFS has implemented a number of road closures in this area to improve big game security. The Powerline site is the closest well site to this area, but it is nearly a mile south of this habitat improvement area. The Proposed Action would not create any new roads in the Stevens Gulch Wildlife Habitat Improvement Area.

Open road and motorized trail densities can directly influence habitat effectiveness for big game species such as elk and deer. The GMUG Amended LRMP (FLMP) contains General Direction to "Manage public motorized use on roads and trails to maintain or enhance effective habitat for elk" (FLMP III-76, USFS 1991). Habitat effectiveness is the "degree to which a physical wildlife habitat is free from man-caused disturbances and therefore attractive to wildlife occupancy" (FLMP Appendix D, USFS 1991). Standard and guidelines associated with this management direction include: 1) objective level of habitat effectiveness for elk within each fourth order watershed is at least 40 percent and 2) determine habitat effectiveness by evaluating a combination of hiding and thermal cover, forage, and road-density and human activity on roads. Since the GMUG FLMP directs the evaluation of road densities in combination with vegetative structure, the definition of habitat effectiveness is synonymous with habitat capability.

The HabCap computer model was used to evaluate the effects of new road construction for the Proposed Action and No Action on elk and deer habitat capability/effectiveness (Wang 2003). A detailed description of the model including assumptions is provided in the HABCAP 3.02 PCHABCAP Habitat Capability Model Documentation and Users Guide (USFS 1994). The analysis was conducted for two watersheds relative to the proposed well sites and their new road spurs: Surface Creek (Leon Lake #4 and #5) and Terror/Hubbard Creek (Bull Park, Hubbard Creek, Oakbrush, and Powerline). This analysis tiered to previous HabCap analyses conducted in the Terror/Hubbard Creek watershed (North Fork EIS and the Iron Point Coal Exploration License [COC-61945] Drilling Plan and Exploration Plan and Gob Ventilation Borehole Installation on Iron Point Federal Coal Lease [COC-61209] EA [BLM and USFS 2000; USFS 2001]).

The HabCap model calculated the percentage of habitat capability/effectiveness related to the length of road types in each analysis area. Three types of roads were used in the analysis: primary (greater than 5 vehicles per day), secondary (1 to 5 vehicles per day), and primitive (less than 1 vehicle per day). In the Terror/Hubbard Creek analysis area, the Proposed Action met the habitat objective of 40 percent for deer and elk. Linear distance for the road types in this watershed analysis area included 6.5 miles of primary roads, 5.4 miles of secondary roads, and 18.2 miles of primitive roads. The Proposed Action added 1.4 miles of primary road. The Proposed Action also met the habitat objective for deer in the Surface Creek analysis area, but the objective was not met for elk. The Proposed Action would result in a 1 percent decrease (30 to 29 percent) in elk habitat effectiveness during drilling and completion activities. This level of change represents a slight reduction compared to existing conditions. Linear distance for the road types in the Surface Creek analysis area included 21.5 miles of primary roads, 6.2 miles of secondary roads, and 2.8 miles of primitive roads. The Proposed Action added 0.4 mile of primary road.

An additional indirect effect that could affect local big game populations is the potential for an increase in vehicle-killed mule deer and elk due to increased levels of construction and employee traffic. The potential for wildlife/vehicle collisions is typically highest in the early morning and evening hours and where roads traverse ranges or areas where big game concentrate. In the analysis area, the risk of vehicle/big game collisions would be highest during the winter months through elk and mule deer severe winter range and winter concentration areas along SH 133 and the Surface Creek access road in the vicinity of Cedaredge. Based on conversations with Kirk Madariaga, District Wildlife Manager, CDOW (Madariaga 1999), it could be expected that the number of vehicle/big game collisions would increase proportionately with the level of increase in passenger vehicle trips. According to Madariaga, approximately 5 to 10 elk and 20 to 30 mule deer are killed per year along SH 133 in the general vicinity of the analysis area. Although the potential for vehicle/elk or deer collisions could increase slightly with the Proposed Action. The increased risk would likely be minor, since drilling/completion activities would occur outside of the winter season and vehicle traffic associated with winter well maintenance would be relatively small. It is estimated that testing activities required during the winter months would require 2 light-duty truck round trips per day per well site.

Northern Goshawk and Other Raptors. Northern goshawk is known to nest in mature and old-growth stands of aspen, and stands of mature aspen could be directly or indirectly affected by project development at the Leon Lake #4, Leon Lake #5, Oakbrush, and Powerline sites. Direct removal of mature aspen trees or noise from construction and well drilling or testing during the nesting season could have an impact on breeding pairs of northern goshawk if they nested within 0.25 mile of development. Surveys at these proposed well sites did not locate any nests of northern goshawk or other potential nesters such as Cooper's hawk and sharp-shinned hawk.

In order to preclude any potential disturbance to nesting raptor species, a design feature would be implemented in areas where the Proposed Action would affect suitable mature aspen stands. Additional nest surveys be performed prior to construction to identify raptor nesting activity within 0.25 mile of development activities. If any nest sites are located, well or access road development plans could be modified so that nest sites are not adversely affected.

Hairy Woodpecker. Cavities in larger live- or dead-standing aspen trees represent potential breeding sites for hairy woodpeckers. Dead and dying trees with insect infestations also provide foraging sites for this species. Stands of mature aspen could be directly or indirectly affected by project development at the Leon Lake #4, Leon Lake #5, Oakbrush, and Powerline drill sites. Direct removal of mature aspen trees or noise from construction and well operation during the nesting season could have an impact on breeding pairs of hairy woodpecker if they nested within 0.25 mile of development.

Neotropical Migratory Birds. Recent reductions in neotropical migratory bird populations have been documented in the U.S. by the North American Breeding Bird Survey. The causes of these reductions are not fully understood but have been attributed to a variety of factors including: reduction and fragmentation of forested breeding habitat in the U.S., nest predation and parasitism, and use of pesticides and deforestation in Central and South America. Loss or fragmentation of forested habitat in the Rocky Mountain Region is not believed to be as much of a limiting factor in neotropical migrant bird populations as it is in the eastern U.S.

Project development would result in minor losses of breeding habitat for neotropical migratory birds such as house wren, yellow warbler, warbling vireo, and western wood pewee in aspen habitats and blue-gray gnatcatcher and spotted towhee in oakbrush habitat. Minor reductions in habitats preferred by aspen and oakbrush associated birds would result, but more open and edge habitats preferred by neotropical migratory species such as orange-crowned warbler and white-crowned sparrow would be increased. Project development would not result in any large-scale conversion or fragmentation of habitats that would threaten the viability of neotropical migratory bird species.

Site-specific Impacts.

Leon Lake #4 and #5, Powerline, and Oakbrush. The Leon Lake #4 and #5 sites are near a CDOW identified elk production area. Well development and operation could have a detrimental effect on elk reproductive success if project activities occur from May 15 through June 15. Development and operation of the Leon Lake #4 and #5, Powerline, and Oakbrush well sites during the summer and fall season could result in short-term, relatively minor losses in habitat due to elk and mule deer displacement from human activities. Potential northern goshawk nesting habitat exists within 0.25 mile of these proposed well sites and access roads. Well site and access road construction during the songbird breeding season could result in adverse effects of an individual nesting pair, if activities occur during the nesting season.

Bull Park and Hubbard Creek. Development and operation of these well sites during the summer and fall season could result in short-term, relatively minor losses in habitat due to elk and mule deer displacement from human activities.

Hawksnest and Thompson Creek. The Hawksnest site is within mule deer and elk winter range. The Thompson Creek site is within elk winter range and immediately adjacent to mule deer winter range. The access road to both sites would traverse elk severe winter range as well as winter range. BLM lease stipulations preclude use between December 1 and April 30 to protect big game on winter range. Well site development and access road upgrades would result in relatively minor, short-term losses in elk and mule deer winter range and elk severe winter range. Forage conditions at these sites would be improved once site closure and reclamation is complete.

No Action

Under the No Action Alternative, there would be no effects to wildlife habitat or wildlife species resulting from the proposed activities. As a result, wildlife habitat distribution, extent, and condition as well as wildlife populations would remain similar to existing conditions, assuming there are no major alterations in current land use activities. Wildlife habitats within the analysis area would continue to be subject to low levels of use in the form of coal mine operations, recreation, grazing, logging, and other incidental activities such as firewood harvesting.

3.6.2.2 Fisheries

Proposed Action

Impacts Applicable to All Sites. Potential impacts to aquatic habitat for fish and other aquatic communities are related to impacts described for surface water quality and quantity in Section 3.4.2. The following impact discussion applies to aquatic species and their habitat in Surface, Terror Creek, and Hubbard Creeks. Well pad and new road construction would not directly remove any aquatic habitat in perennial streams at any of the sites.

Short-term, localized increases in sediment could occur within drainages from the construction of the well pads and new access roads. Potential sediment effects would depend upon the distance of the disturbed area to a stream segment and flow conditions in the stream. If sediment reached a stream, habitat could be affected by material deposition on bottom substrates and increased levels of suspended solids. Traffic use on unpaved portions of the existing access roads also could contribute sediment in areas adjacent to perennial streams. By implementing design features of the Proposed Action such as the SWPPP, Grading and Surface Hydrology Plan, reclamation of disturbed areas, road repairs, and a surface water monitoring plan, sediment levels would be minimized and kept from entering perennial streams.

Aquatic habitat in relation to surface water quantity would not be affected by project activities (i.e., change in surface flows in Surface, Terror, and Hubbard creeks or the North Fork of the Gunnison River). Water used for drilling and completion and dust control would be provided by Oxbow Mining. This water is derived from the North Fork of the Gunnison River under an exiting water right. In addition, water potentially produced from well completion and testing would not affect surface water flows because there is no connection between groundwater in the drill locations to surface water quantity. Since produced water resulting from completion and testing would be transported by truck to the Black Mesa Facility, surface flows would not change due to produced water discharge.

Aquatic communities would not be affected by changes in surface water quality from drilling, completion, or testing activities. Although these activities could result in localized effects on groundwater quality from chemical use, surface water quality in Surface, Terror, and Hubbard creeks or the North Fork of the Gunnison River would not be affected because there is no hydrological connection between groundwater in the drill locations and surface water.

The use and transport of fuels and drilling materials to the construction and drilling sites would represent a potential risk to aquatic species and their habitat, if a spill or leak occurred. By implementing a project-committed measure from the SPCC Plan, the effects of potential spills or leaks would be minimized.

Potential impacts to the MIS Colorado River cutthroat trout populations in Surface, Terror, and Hubbard Creeks would be the same as discussed above. Project activities would not remove habitat, alter flows, or affect water quality in Hubbard and Terror Creeks that support conservation populations, or in Surface Creek where the species is managed under the Conservation Agreement.