# APPENDIX E

# BUREAU OF LAND MANAGEMENT
# BUFFALO FIELD OFFICE

# FORTIFICATION CREEK RESOURCE MANAGEMENT PLAN AMENDMENT

# METHODOLOGIES AND CALCULATIONS

**March 2010**

This appendix presents calculations and methodologies used in the Fortification Creek Planning Area (FCPA) Resource Management Plan Amendment (RMPA)/Environmental Assessment (EA) alternative evaluation.

## Methodology for Identifying Existing Oil and Gas Roads Within the FCPA/Elk Yearlong Range

I. Start mapping program such as ArcMap.

   A. Load all wells from Wyoming Oil and Gas Conservation Commission (WOGCC) database.

      1. Select by location within the FCPA/Yearlong range for all existing wells removing all wells in unapproved permits to drill (UAPD), application for permits to drill (APD)/Notice of Staking (NOS) or plugged and abandoned (P&A) well status.

   B. Load all wells from Automated Fluid Minerals Support System (AFMSS) database.

      1. Select by location within the FCPA/Yearlong range for all existing wells removing all wells in UAPD, APD, NOS, or P&A well status.

   C. Cross reference the results from the two databases because well status from the WOGCC is not always current to AFMSS (i.e., wells PGW status by WOGCC may be P&A in AFMSS).

      1. These are the locations that need to be verified either by satellite imagery (Google Earth), digital-ortho photos (2009) or field work.

II. Load imagery for the FCPA/Yearlong range to the mapping program.

   A. Load the most current Existing Oil & Gas Roads shapefile.
   B. Zoom to those locations identified above in **C** to verify the location(s) exist (they may be abandoned or they may have never been drilled.).

      1. The imagery will show a disturbance foot print for existing wells. This can be further verified if a well house or tank battery is present.
      2. If the well exits, a road to the location should be obvious.

         a. Use editing tools to draw the road and add it to the Existing Oil & Gas Roads shapefile.

      3. If the well does not exist, confirm that the Existing Oil & Gas Roads shapefile does not include a road to the location.

         a. If the shape file includes a road that does not exist, use editing tools to remove that road segment from the Existing Oil & Gas Roads shapefile.

III. Existing Non Oil & Gas Roads

   A. "Existing Roads" that show up clearly on the imagery may not be associated with Oil & Gas development. These include:

      1. Trespass roads

2. Utility corridors (i.e., overhead power lines, high pressure gas line, stock water improvements)
3. Abandoned Oil & Gas roads used for livestock operations

B. These are roads that may go for miles without an existing well as described above along their alignment. These may be "good" roads to use in planning Coal Bed Natural Gas (CBNG) development but are being utilized at this time for current Oil & Gas. They may require field verification for confirmation. It is probably best to keep them in the Existing Oil & Gas Roads shape file until confirmed otherwise. Some of this has been done already.

## Elk Habitat Model

Four scenarios (Baseline, Alternative I, Alternative II, and Alternative III) were modeled to identify current elk effective and security habitats and potential habitat losses in the FCPA. Effective habitat is considered as all areas within the elk yearlong and crucial ranges that are 0.5 miles from roads or less than 0.5 miles where visibility of the road is obscured by topography. It was assumed that by calculating the loss of effective habitat around roads, the loss of effective habitat around wells would be accommodated. Security habitat was modeled as a contiguous block of effective habitat of 250 or more acres. Two hundred and fifty acres is a common minimum security patch size that has been used in other studies (Christensen et al. 1991, Leege 1984). The model did not account for vegetation.

The visibility model used a 98-foot digital elevation model (DEM) to account for topography (U.S. Geological Survey National Elevation Database). Because no development will occur in the WSA, it was assumed that no roads occurred, were used, or would be added in the WSA. The model was run for the entire yearlong elk range and subsequently clipped to the FCPA. This ensured that roads immediately outside of the FCPA but within 0.5 mile would show the loss of effective habitat within the FCPA. The same algorithm was used for the elk crucial range.

The baseline model was designed to show probable current elk habitats. Effective and security habitats were used as the baseline against which to measure changes in habitats for the three alternatives outlined below.

Alternative I was designed using an 80-acre grid that was superimposed on the FCPA. Potential roads terminated in an empty 80-acre cell that was at least 50 percent federal minerals. Potential roads avoided slopes greater than 25 percent, could not cross into isolated areas, and were required to reach a theoretical well location.

The Alternative II model was designed to retain security habitat within non-overlapping crucial range (that is, parturition *or* critical winter range) by 75 percent and within yearlong range (outside of crucial range) by 50 percent. Habitat loss was attained by methodically adding hypothetical roads to the existing BLM road layer. Potential roads avoided slopes greater than 25 percent, could not cross into isolated areas, and were required to reach a theoretical well location.

Potential roads were added to the area outside of all elk ranges that terminated in an empty 80-acre cell that was at least 50 percent federal minerals. Roads were added

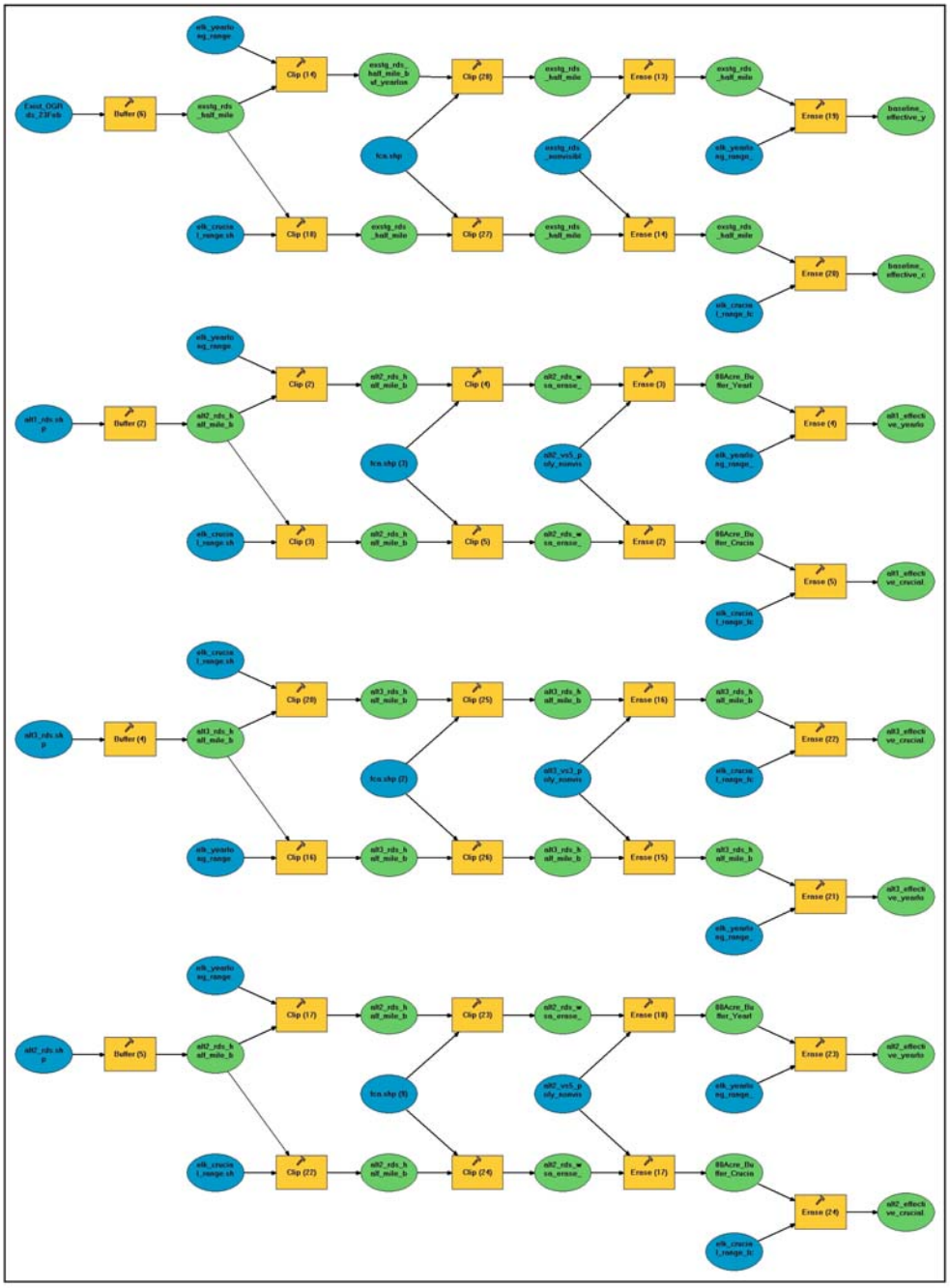
within both the non-overlapping crucial and yearlong (minus crucial) ranges to attain a 25 percent and 50 percent loss of habitat, respectively. Roads in the existing road coverage that fell more than 200 feet from an existing road were deleted. Within non-overlapping crucial range, 80-acre spacing roads were added to attain a 25 percent loss, though it should be noted that all roads that fell within a 0.5 mile buffer around the overlapping crucial range were excluded to avoid any loss to overlapping crucial range habitat. Remaining 80-acre spacing roads were all candidates to be added to attain the 25 percent loss in non-overlapping crucial range. At this point an algorithm was implemented that deleted the shorter roads first until the desired percent increase in roads was attained. To attain the 50 percent loss of security habitat within the yearlong range outside of the crucial range, a similar process was implemented. Eighty-acre spacing roads that connected with an existing road and ended in an empty 80-acre cell that was at least 50 percent federal minerals were all candidates. The same algorithm was used to achieve the 25 percent loss of security habitat in non-overlapping crucial. Because changes in the percentage of roads did not result in an equivalent percentage of change to elk habitat, the model was run iteratively until the desired percentage of change in elk habitat was reached.

Alternative III was designed to retain 80 percent of security habitat in the yearlong range while protecting overlapping crucial range. Similar to Alternative II, existing roads were used as a base layer. Outside of all elk ranges 80-acre spacing roads were added to the existing road layer. As with Alternative II, only those roads that fell within 200 feet of an existing road and terminated in an empty 80-acre cell that was at least 50 percent federal minerals were included. Overlapping crucial range was protected by not placing new roads within a half mile buffer. The algorithm that was used for Alternative II was also used within the yearlong range for Alternative III, selecting the longest hypothetical additional roads until the 20 percent loss of habitat was achieved. Because changes in the percentage of roads did not result in an equivalent percentage of change to elk habitat, the model was run iteratively until the desired percentage of change in elk habitat was reached.

All modeling and spatial analyses were completed in ArcInfo 9.3.1.

Christensen, A.G., L.J. Lyon, and T.N. Lonner. 1991. Proceedings of Elk Vulnerability – A Symposium. Montana State University. Bozeman, MT.

Leege, T.A. 1984. Guidelines for Evaluating and Managing Summer Elk Habitat in Northern Idaho. Idaho Department of Fish and Game Wildlife Bulletin Number 11. Idaho Department of Fish and Game, Boise, Idaho.



Elk Habitat Modeling

## Disturbance Calculations

Assumptions for CBNG disturbance calculations were derived, for the most part, from the Powder River Basin Oil and Gas Final Environmental Impact Statement (BLM 2003). Assumptions based on specific Fortification Creek Planning Area information are noted.

The following assumptions were used.

| Facility | Initial Disturbance |
|---|---|
| Well Pads | 0.7 acres per pad |
| Roads | The roads will be 24' road width and 48' disturbance width; for every mile of road approximately 5.8 acres of ground is disturbed |
| 3" pipeline | 20 foot width disturbance |
| 12 " poly pipeline | 50 foot width disturbance |
| 12" steel | 100 foot width disturbance |
| Overhead electric | 0.1 mile from drop for each well (FCPA assumption) |
| | 3.6 acres of disturbance each mile |
| Booster Stations | 0.017 acres per well |
| Reciprocating Stations | 0.0124 acres per well pad |
| Central Metering Stations | 0.2 acres for every 10 well |
| Water Facilities | 1 facility for 6.7 wells |
| | 3.6 acres for each facility |
| Long-Term Disturbance | |
| Well Pads | 0.7 acres per pad |
| Roads | The roads will be 24' road width; for every mile of road approximately 2.9 acres of ground is disturbed |
| 3" pipeline | 20 foot width disturbance |
| 12 " poly pipeline | 50 foot width disturbance |
| 12" steel | 100 foot width disturbance |
| Overhead electric | 0.1 mile from drop for each well (FCPA assumption) |
| | 3.6 acres of disturbance each mile |
| Booster Stations | 0.017 acres per well |
| Reciprocating Stations | 0.0124 acres per well pad |
| Central Metering Facilities | 0.1 acres for every 10 well |
| Water Facilities | 1 for every 6.7 wells |
| | 3.6 acres per facility |

Central Metering Facilities are not generally used by most operators. However, because of well visitation restrictions and rough topography resulting in less effective telemetry, they have been included in disturbance calculations.

## Water Discharge and Storage Calculations

Water discharge and storage were calculated assuming average discharge and storage rates from WDEQ permits in the FCPA. Using the information in the following table, the average well flow rate was divided by the number of permitted wells to get an average rate for the FCPA.

**Table 4-11 Fortification Creek Planning Area CBNG 2008 Groundwater Extraction Wells and Flow Rates[1]**

| Permit Number | Number of Groundwater Wells | Groundwater Well Flow Rate (mgd) | Drainage Channel Discharge Point (discharge type)[2] |
|---|---|---|---|
| WY0039616 | 180 | 4.16 | (2 OCR/1A) |
| WY0046485 | 111 | 2.01 | (2 OCR/1A) |
| WY0047538 | 32 | 0.1 | (2 OCR/1A) |
| WY0047546 | 24 | 0.52 | (2 OiCR/1B) |
| WY0047554 | 36 | 0.52 | (2 OCR/1B/1A) |
| WY0048097 | 33 | 1.01 | (2 OCR) |
| WY0048593 | 48 | 0.32 | (1A/1B) |
| WY0050156 | 58 | 0.13 | (2 OCR) |
| WY0050211 | 33 | 0.32 | (1A/1B) |
| WY0051985 | 624 | 16.16 | (2 DD) |
| WY0052809 | 122 | 1.55 | (2 OCR/2 DD) |
| WY0053601 | 26 | 0.55 | (1B) |
| WY0053953 | 10 | 0.25 | (2 OCR) |
| WY0054780 | 184 | 13.9 | (2 DD) |
| WY0055115 | 22 | 0.934 | (2 OCR) |
| WY0055352 | 45 | 0.878 | (2 OCR) |
| WY0055441 | 7 | 0.35 | (2 OCR) |
| WY0056081 | 212 | 3.9 | (2 DD) |

[1] Extraction Well and Flow Rates table summarized from WDEQ and BLM 2008 permit holder data.
[2] Discharge Types defined as: 2 OCR = Option 2 on-channel reservoirs; 2 DD = Option 2 direct discharge; 1B = Option 1B full containment-class 4; 1A = Option 1A full containment-class 3.