

## **APPENDIX L**

### Spatial Analysis of Future Surface Disturbance



## Spatial Analysis of Future Surface Disturbance

The inventory of wellfield disturbance since 2005 and by the end of 2006 is the baseline for the accumulation of all future natural gas development in the PAPA, whether by the No Action Alternative, the Proposed Action Alternative, or Alternative C. In the future, each Operator in the PAPA has different plans for numbers and dimensions of new well pads and the numbers and dimensions of existing well pads that will be expanded. To approximate the spatial distribution of those future developments it was assumed that all disturbances would occur within each Operator's current leasehold. For the most part, current leases are sub-divided as quarter-sections which are approximately 160-acre parcels but there is considerable variation in that area across the PAPA. For some Operators, most of their leased lands are contiguous, for others the lease is patchy, forming a checkerboard pattern of leased quarter-sections across portions of the PAPA.

The Operators provided their respective plans for new and expanded well pads and locations by quarter-section in 2006. Specific locations within those quarter sections were not provided. Therefore, a model was developed to evaluate the accumulation of surface disturbance in each quarter-section in 2006 and into the future with development by the No Action Alternative, the Proposed Action Alternative, and Alternative C.

The following assumptions were applied in the model used to develop the distribution of surface disturbances in 2006 and future outcomes for each alternative.

- Each existing well pad could only be assigned to one quarter-section. Well pads that overlap two or more quarter-sections would be assigned to the one with most of the pads' area.
- All expansion acreage of an existing pad would occur within the quarter-section in which the expanded pad was assigned.
- Expansion acreage would be applied to the smallest existing pad if there was more than one existing pad in the quarter-section.
- Each new well pad and its specified (by the Operators) acreage would be placed entirely within a quarter-section. Any future expansion of the pad also would be entirely within that quarter-section.
- No pad could be expanded to exceed 30 acres.
- Whenever possible, new pads would not be placed in situations with No Surface Occupancy (Lander Trail 0.25-mile buffer, greater sage-grouse leks 0.25-mile buffer, and residence 0.25-mile buffer).
- Whenever possible, new pads would not be placed in quarter-sections with existing pads but no more than four new pads would be placed in any quarter-section (maximum allowed by PAPA ROD was 16 pads per section or 16 pads per square mile).

Proposed condensate and produced water pipelines were placed in quarter-sections where new pads would be constructed (Questar) or in quarter-sections with existing and new pads (Shell and Ultra). Central gathering facilities were distributed throughout an Operator's lease. New facilities with specific locations were placed in those quarter-sections and expansions of existing facilities were within the quarter-sections where those facilities were originally located. In the model, no quarter-section could be disturbed by more than 100 percent.

Areas of disturbance by new gas gathering pipelines and new local and/or resource roads to new pads were estimated from patterns of development through 2005. In general, the acres disturbed by roads and pipelines within a quarter-section increase linearly with the number of well pads in the quarter-section. However, as the number of pads within a quarter-section increases, the disturbance (acres) by roads and pipelines **per pad** decreases. Areas of new disturbance by roads and pipelines were added to existing disturbance by roads and pipelines on a **per pad** basis. For example, there would be one existing pad in a quarter-section with 2 acres disturbed by roads and 2.5 acres disturbed by pipelines. A second well pad would be placed in that quarter-section which would result in 2 acres + 2.65 new acres (from Table 1) = 4.65 acres of total road disturbance and 2.5 acres + 2.65 new acres (from Table 1) = 5.15 acres of total pipeline disturbance in the quarter-section. A well pad placed in a quarter-section with no existing pads would result in an additional 3.07 acres disturbed by roads and that same amount disturbed by pipelines, regardless of the size of the well pad.

**Table 1**  
**Relationship of Areas Disturbed by Roads and Gas Gathering Pipelines in Quarter-Sections with Varying Numbers of Well Pads**

Well Pads per Quarter-Section	Total Area (acres) in Quarter-Section	Area (acres) per Well Pad
1	3.07	3.07
2	5.31	2.65
3	7.55	2.52
4	9.80	2.45