Wyoming
Area Designations for the
2008 Ozone National Ambient Air Quality Standards

The table below identifies the areas and associated counties or parts of counties in Wyoming that EPA is designating as nonattainment for the 2008 ozone national ambient air quality standards (2008 NAAQS). In accordance with section 107(d) of the Clean Air Act, EPA must designate an area (county or part of a county) "nonattainment" if it is violating the 2008 ozone NAAQS or if it is contributing to a violation of the 2008 ozone NAAQS in a nearby area. The technical analyses supporting the boundaries for this area are provided below.

Table 1. State's Recommended and EPA's Designated Nonattainment Counties for the Upper Green River Basin (UGRB) of Wyoming.

Area	Wyoming's Recommended Nonattainment Counties	EPA's Nonattainment Counties
Upper Green River Basin Area	Sublette County (all) Lincoln County (partial) Sweetwater County (partial)	Sublette County (all) Lincoln County (partial) Sweetwater County (partial)

EPA is designating all areas of the State of Wyoming that are not listed in the table above as "unclassifiable/attainment" for the 2008 ozone NAAQS.

The analysis below provides the basis for the nonattainment area boundaries. It relies on our analysis of whether and which monitors are violating the 2008 ozone NAAQS, based on certified air quality monitoring data from 2008-2010 and an evaluation of whether nearby areas are contributing to such violations. EPA has evaluated contributions from nearby areas based on a weight of evidence analysis considering the factors identified below. EPA issued guidance on December 4, 2008 that identified these factors as ones EPA would consider in determining nonattainment area boundaries and recommended that states consider these factors in making their designations recommendations to EPA.[1]

1. Air quality data (including the design value calculated for each FRM or FEM monitor in the area);
2. Emissions and emissions-related data (including location of sources and population, amount of emissions and emissions controls, and urban growth patterns);
3. Meteorology (weather/transport patterns);
4. Geography and topography (mountain ranges or other basin boundaries);
5. Jurisdictional boundaries (e.g., counties, air districts, existing nonattainment areas, Indian country, metropolitan planning organizations (MPOs))

Ground-level ozone is not emitted directly into the air, but is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC) in the presence of sunlight. Because NOx and VOC emissions from a broad range of sources over a wide area typically contribute to

[1] The December 4, 2008 guidance memorandum "Area Designations for the 2008 Revised Ozone National Ambient Air Quality Standards" refers to 9 factors. In this technical support document we have grouped the emissions-related factors together under the heading of "Emissions and Emissions-Related Data," which results in five categories of factors.

violations of the ozone standards, EPA believes it is important to consider whether there are contributing emissions from a broad geographic area. Accordingly, EPA chose to examine the five factors with respect to the larger of the Combined Statistical Area (CSA) or Core Based Statistical Area (CBSA) associated with the violating monitor(s).[2] All data and information used by EPA in this evaluation are the latest available to EPA and/or provided to EPA by states or tribes.

In EPA's designations guidance for the 2008 ozone NAAQS EPA recommended examining CSA/CBSAs because certain factors used to establish CSAs and CBSAs are similar to the factors EPA is using in this technical analysis to determine if a nearby area is contributing to a violation of the 2008 ozone NAAQS. EPA used the same basic approach in the designation process for the 1997 ozone NAAQS. For areas such as Wyoming, where a violating monitor is not located in a CSA or CBSA, EPA's guidance recommended using the boundary of the county containing the violating monitor as the starting point for considering the nonattainment area's boundary.

Elevated ozone in the UGRB is associated with distinct meteorological conditions that occur only in wintertime, primarily during the first quarter of the year. Wyoming recommended the designation of its nonattainment area on a county and partial county basis that reflects the local meteorological conditions conducive to wintertime ozone formation, and the likely sources of ozone and ozone precursors. The UGRB's east, north and west county boundaries are natural boundaries of high mountains or elevated terrain. The geographical and jurisdictional boundaries also coincide with population and emission source boundaries. To the south, the topographical boundaries are less obvious, but there are rivers, valleys and buttes that form geographic boundaries near the southern border of Sublette County, extending slightly into Lincoln and Sweetwater Counties which define the area where emissions contribute to nearby violations. As part of its nine-factor analysis, the State evaluated the following counties: Sublette, Lincoln and Sweetwater Counties. In tables 4 and 6, Wyoming provided additional data on Uinta, Fremont and Teton Counties, which we've included in our TSD. Our analysis examines the same area evaluated by the State; there is no evidence to support including additional, more distant areas as part of our analysis.

[2] Lists of CBSAs and CSAs and their geographic components are provided at www.census.gov/population/www/metroareas/metrodef.html . The lists are periodically updated by the Office of Management and Budget. EPA used the most recent update, based on 2008 population estimates, issued on December 1, 2009 (OMB Bulletin No. 10-02).

Technical Analysis for the UGRB

Figure 1A is a map of the UGRB nonattainment area. The map provides other relevant information including the locations of WDEQ, EPA and National Park Service (NPS) air quality monitors, county and other jurisdictional boundaries, including the Wind River Indian Reservation, and the Forest Service and NPS Class 1 Areas, but does not show the southern boundary defining the portions of Lincoln and Sweetwater counties we are including as part of the designated nonattainment area. Figure 1B was provided by Wyoming, and shows that southern boundary, as well as the local topography.

Figure 1A Upper Green River Basin Nonattainment Area (all of Sublette County, plus parts of Lincoln and Sweetwater Counties)

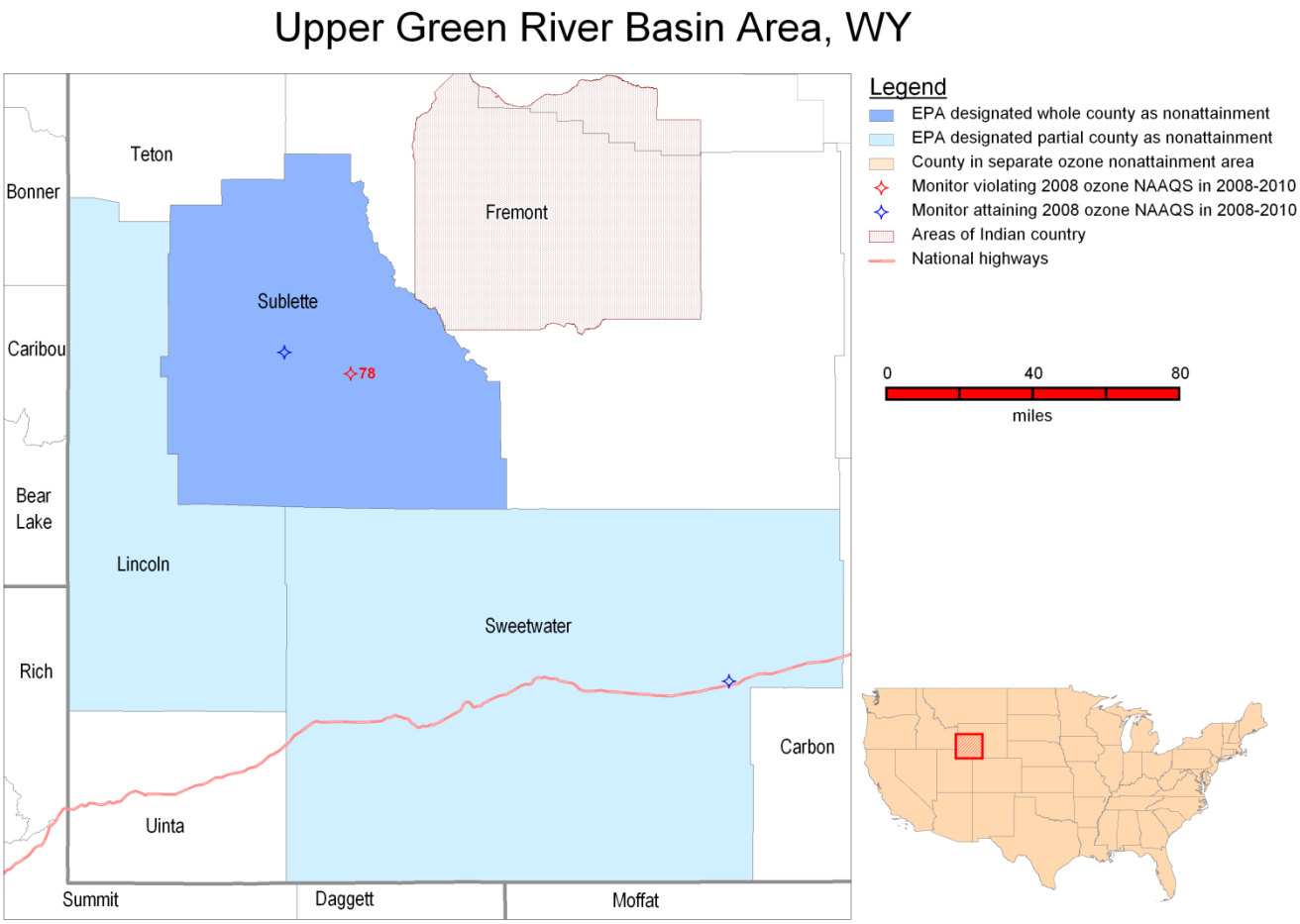


Figure 1B Upper Green River Basin Nonattainment Area (all of Sublette County, plus parts of Lincoln and Sweetwater Counties)

In March 2009, the Wyoming Department of Environmental Quality, Air Quality Division (AQD) recommended that the UGRB, comprising Sublette County and parts of Lincoln and Sweetwater Counties, be designated as nonattainment for the 2008 ozone NAAQS based on air quality data from 2006-2008. Ozone at levels exceeding the standard has been monitored at the Boulder monitor, which is located in the center of the UGRB nonattainment area.. Measured ozone levels have not violated the standard in the counties adjacent to the UGRB. The highest ozone levels within the UGRB typically occur in January, February or March, and VOCs detected in ambient air in the UGRB have a strong oil and gas signature.

Elevated ozone episodes are associated with very light low-level winds, sunshine and snow cover, in conjunction with a strong low-level surface-based temperature or "capping" inversion. The longest such event (February 19-24, 2008) resulted in a measured ozone level of 122 ppb as an 8-hour average at the Boulder station. These data are from monitors sited and operated in accordance with 40 CFR Part 58. EPA received certification letters from AQD for 2008, 2009 and 2010 data on March 15, 2011, October 13, 2011 and July 26, 2011, respectively. These certification letters are available in the docket.

The AQD's analysis provided with its recommendation shows that elevated ozone at the Boulder monitor is primarily due to local emissions from oil and gas development activities: drilling, production, storage, transport and treating of oil and natural gas. The ozone exceedances almost always occur when winds are low indicating that there is little to no transport of ozone or precursors from distant sources outside the proposed nonattainment area. The ozone exceedances predominantly occur in the winter when the following conditions are present: strong temperature inversions, low winds, cold temperatures, clear skies and snow cover.

After considering the AQD's recommendations and based on EPA's technical analysis described below, EPA is designating Sublette County and parts of Lincoln and Sweetwater Counties as nonattainment for the 2008 ozone NAAQS as together they make up the whole UGRB nonattainment area.

Factor Assessment

Factor 1: Air Quality Data

For this factor, we considered 8-hour ozone design values (in ppb) for air quality monitors in counties in the UGRB area based on data for the 2008-2010 period (i.e., the 2010 design value, or DV), which are the most recent years with fully-certified air quality data. A monitor's DV is the metric or statistic that indicates whether that monitor attains a specified air quality standard. The 2008 ozone NAAQS are met when the annual fourth-highest daily maximum 8-hour average concentration, averaged over 3 years is 0.075 ppm or less. A DV is only valid if minimum data completeness criteria are met. See 40 CFR part 50 Appendix P. Where several monitors are located in a county (or a designated nonattainment area or maintenance area), the DV for the county or area is determined by the monitor with the highest level.

The 2010 DVs for the ozone NAAQS for counties in the UGRB and nearby surrounding area are shown in Table 2. The WDEQ has flagged a few days in the three-year design set of 2008-2010 as exceptional events, but the State has not yet submitted demonstrations for the exceptional event claims at the Boulder monitor.

Table 2. Air Quality Data.

County	State Recommended Nonattainment?	2008-2010 Design Value (ppb)
Lincoln, WY (Part)	Yes	--
Sublette, WY	Yes	78
Sweetwater, WY (Part)	Yes	64

The Boulder monitor in Sublette County shows a violation of the 2008 ozone NAAQS, therefore Sublette County is included in the nonattainment area. A county (or partial county) must also be designated nonattainment if it contributes to a violation in a nearby area. Each county without a violating monitor that is located near a county with a violating monitor has been evaluated based on the weight of evidence of the five factors and other relevant information to determine whether it contributes to the nearby violation.

All data are collected by Reference or Equivalent Method monitors and meet EPA's criteria for quality and completeness unless otherwise noted.

Factor 2: Emissions and Emissions-Related Data

EPA evaluated emissions of ozone precursors (NO_x and VOC) and other emissions-related data that provide information on whether nearby areas are contributing to exceedances of the ozone standard at violating monitors.

Emissions Data

EPA evaluated county-level emission data for NO_x and VOC derived from the 2008 National Emissions Inventory (NEI), version 1.5. This is the most recently available NEI. (See http://www.epa.gov/ttn/chief/net/2008inventory.html) Significant emissions levels in a nearby area indicate the potential for the area to contribute to observed violations.

Table 3 shows emissions of NO_x and VOC (given in tons per year) for violating and potentially contributing counties in the UGRB area. For the two counties we are designating as partial counties (Lincoln and Sweetwater), the table includes all emissions within the counties, not just the emissions from the partial county areas. These emissions include some very large point source emissions distant from the violating monitor.

Table 3. Total 2008 NO_x and VOC Emissions.

County	State Recommended Nonattainment?	NOx (tpy)	VOC (tpy)
Lincoln, WY	Yes	17,014	10,150
Sublette, WY	Yes	7,802	17,765
Sweetwater, WY	Yes	43,635	30,823
	Areawide:	68,451	58,738

As part of its nine-factor analysis, the AQD compiled emission estimates for VOCs and NOx for 10 source categories in the partial county area the state recommended as nonattainment, and counties and portions of counties surrounding the nonattainment area. The AQD used emissions information from 2007, which was the most recently available data for all source sectors. Emissions estimates were provided only for the first quarter because elevated ozone in the UGRB occurs primarily during limited episodes in the first three months of the calendar year. These data are shown in Table 4.

Table 4 1st Quarter 2007 emissions within UGRB and in surrounding counties outside UGRB

	Upper Green River Basin		Lincoln Outside of Upper Green River Basin		Sweetwater Outside of Upper Green River Basin		Uinta		Fremont		Teton	
Emissions Sources	NOx	VOCs	NOx	VOCs	NOx	VOCs	NOx	VOCs	NOx	VOCs	NOx	VOCs
On-Road Mobile Emissions	136	79	155	89	1,727	308	655	122	242	138	157	90
Non-Road Mobile Emissions	36	473	593	208	2,000	174	604	157	101	104	34	256
O&G Well Construction, Drilling & Completion	915	166	243	227	747	870	12	13	102	254	0	0
O&G Production Emissions	327	20,550	148	7,074	460	21,232	133	4,095	281	10,005	0	0
O&G Major Sources	481	198	488	63	9,631	2,200	174	196	111	20	0	0
EGUs Major Sources	0	0	3,151	24	6,335	75	0	0	0	0	0	0
Other Major Sources	0	0	0	0	2,445	1,929	0	0	0	0	0	0
Non-O&G Minor Sources	17	86	346	31	171	56	22	60	10	33	3	0
Biogenic Emissions	0	2,957	0	2,376	0	2,184	0	816	0	5,354	0	3,268
Fire Emissions	5	4	0	0	0	0	0	0	317	232	0	0
Total Emissions	**1,917**	**24,514**	**5,124**	**10,092**	**23,516**	**29,027**	**1,600**	**5,458**	**1,163**	**16,142**	**194**	**3,614**

While some surrounding areas (Lincoln and Sweetwater outside of the UGRB) show relatively high VOC and NOx emissions when compared to the total emissions within the UGRB, the very large sizes of the counties involved and the detailed meteorological and topographical analyses described in later sections support the boundary proposed by Wyoming.

Population density and degree of urbanization

EPA evaluated the population and vehicle use characteristics and trends of the area as indicators of the probable location and magnitude of non-point source emissions. These include ozone-creating emissions from on-road and off-road vehicles and engines, consumer products, residential fuel combustion, and consumer services. Areas of dense population or commercial development are an indicator of area source and mobile source NO_x and VOC emissions that may contribute to ozone formation. Rapid population or VMT growth (see below) in a county on the urban perimeter signifies increasing integration with the core urban area, and indicates that the associated area source and mobile source emissions may be appropriate to include in the nonattainment area. The area under consideration here has no urban core; therefore, these considerations are less relevant than in an urban nonattainment area. Table 5 shows the population, population density and population growth information for each county in the area.

Table 5. Population and Growth.

County	State Recommended Nonattainment?	2010 Population	2010 Population Density (pop/sq mi)	Absolute Change in Population (2000-2010)	Population % Change (2000-2010)
Lincoln, WY	Yes	18,106	4.4	3,492	+24%
Sublette, WY	Yes	10,247	2.1	4,301	+72%
Sweetwater, WY	Yes	43,806	4.2	6,323	+17%
	Areawide:	72,159	3.7	14,116	+24%

Sources: U.S. Census Bureau population estimates for 2010 as of August 4, 2011 (http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_PL_GCTPL2.STO5&prodType=table)

Sublette County and the surrounding counties are rural with a low overall population density. There are no metropolitan areas with a population of 50,000 or more in this six-county area. The largest community in Sublette County is Pinedale, which had a population in 2010 of 2,030. The largest communities in the counties surrounding Sublette County are Rock Springs (population 23,036, Sweetwater County), Green River (population 12,515, Sweetwater County) and Evanston (population 12,359, Uinta County). Those communities are classified by the U.S. Census Bureau as Micropolitan Statistical Areas.

Population in Sublette County is expected to increase at a rate of approximately 5% over the next 23 years. Population in surrounding counties is expected to increase more slowly at rates of 2% or less. Sublette County does not have any urbanized areas and the urbanized areas in the surrounding area are geographically distant from the Boulder monitor which had the ozone violation in Sublette County. As described in Factor 3 Meteorology, meteorological conditions associated with elevated ozone episodes greatly limit the possibility of emissions transport.

Table 6 Population Density Data Provided by Wyoming

Population Density						
	Sublette	Sweetwater	Lincoln	Uinta	Fremont	Teton
Estimated 2007 Population	7,925	39,305	16,171	20,195	37,479	20,002
Area (square miles)	4,882	10,426	4,069	2,082	9,183	4,008
Population/square mile	2	4	4	10	4	5
Percent in Urbanized Area*	0	89	20	59	48	56
Percent in Rural Area*	100	11	80	41	52	44

* Based on 2000 Census

Traffic and commuting patterns

EPA evaluated the commuting patterns of residents in the area, as well as the total annual Vehicle Miles Traveled (VMT) for each county. In combination with the population/population density data (see above) and the location of main transportation arteries, this information helps identify the probable location of non-point source emissions. A county with high VMT and/or a high number of commuters is generally an integral part of an urban area and indicates the presence of motor vehicle emissions that may contribute to ozone formation. Rapid population or VMT growth in a county on the urban perimeter signifies increasing integration with the core urban area, and indicates that the associated area source and mobile source emissions may be appropriate to include in the nonattainment area. In the case of the UGRB, with no urbanized areas and a small population, considering those emissions has little relevance for this nonattainment area. Table 7 shows traffic and commuting pattern data, including the total vehicle miles traveled (VMT) for each county.

Table 7. Traffic and Commuting Patterns.

County	State Recommended Nonattainment?	2008 Annual VMT* (million miles)
Lincoln, WY	Yes	321
Sublette, WY	Yes	198
Sweetwater, WY	Yes	787
	Areawide:	1,306

* MOBILE model VMTs are those inputs into the NEI version 1.5.

The number of commuters into or out of Sublette County and the UGRB is small and does not support adding other counties or parts of counties into the nonattainment area based on contribution of emissions from commuters from those counties. The percent of emissions from on-road mobile sources is small within the proposed nonattainment area: 7% of NOx and 0.3% of VOCs. Even if this source of emissions increases, it will remain a small percentage of total emissions.

Approximately 90% of the traffic volume in Sweetwater and Uinta Counties is interstate traffic. Interstate 80 is located approximately 80 miles south of the violating Boulder monitor. Five ozone monitors located closer to the interstate have operated at times between 2005 and 2010, and none of them have shown an ozone violation. Therefore, I-80 traffic is not considered a significant contributor of emissions that impact the Boulder monitor during ozone events.

Consistent with the rural character of the counties in southwest Wyoming, including Sublette County, traffic volumes are low. Emissions from this sector are of a much lower significance than is typically seen in urban nonattainment areas.

Factor 3: Meteorology (weather/transport patterns)

EPA evaluated available meteorological data to help determine how meteorological conditions, such as weather, transport patterns and stagnation conditions, would affect the fate and transport of precursor emissions contributing to ozone formation. The unique meteorology in the UGRB creates conditions favorable to wintertime ozone formation. The meteorology within the UGRB during winter ozone episodes is much different than on non-high ozone days in the winter, and is also much different than the regional meteorology that exists outside of the UGRB during the wintertime high ozone episodes.

There is significant topographic relief in Wyoming which affects climate and daily temperature variation. This is a semiarid, dry, cold, mid-continental climate regime. July and August are generally the hottest months of the year, while December and January are the coldest. Pinedale's mean temperature in January is 12.5°F with a mean of 60°F in July (Western Regional Climate Center, 2009). The high elevation and dry air contribute to a wide variation between daily minimum and maximum temperatures. At Pinedale, the total annual average precipitation is about 10.9 inches and an average of 61 inches of snow falls during the year.

The State's TSD provides a thorough examination of the meteorological conditions and this portion of the State's TSD is reproduced below. Table numbers have been changed to conform with the structure of this TSD:

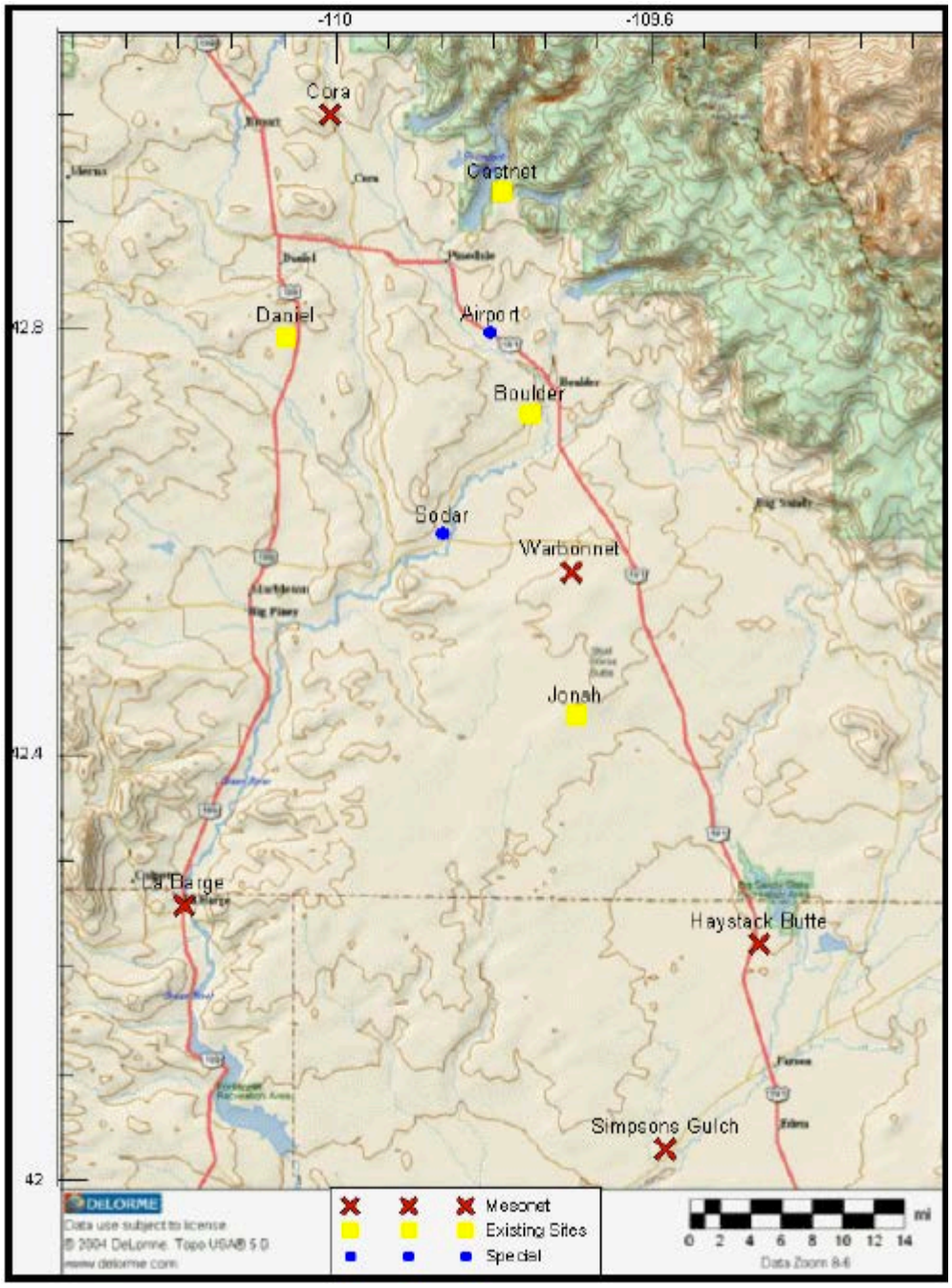
Strong winds are common in Wyoming, especially in the south. Wind velocity can be attributable, in part, to the prevailing westerly winds being funneled through the Rocky Mountains at a low point in the Continental Divide. The meteorological conditions conducive to the formation of high ozone levels in the UGRB during the winter and early spring are characterized by:

- *a stable atmosphere, characterized by light low-level winds*
- *clear or mostly sunny skies*
- *low mixing heights or capping inversions*
- *extensive snow cover*
- *low temperatures*

Because these conditions are common to all of the high ozone episodes in the UGRB, the ozone episode of February 19-23, 2008, a five-day period marking the longest consecutive ozone episode observed, is considered to be representative of the other ozone episodes.

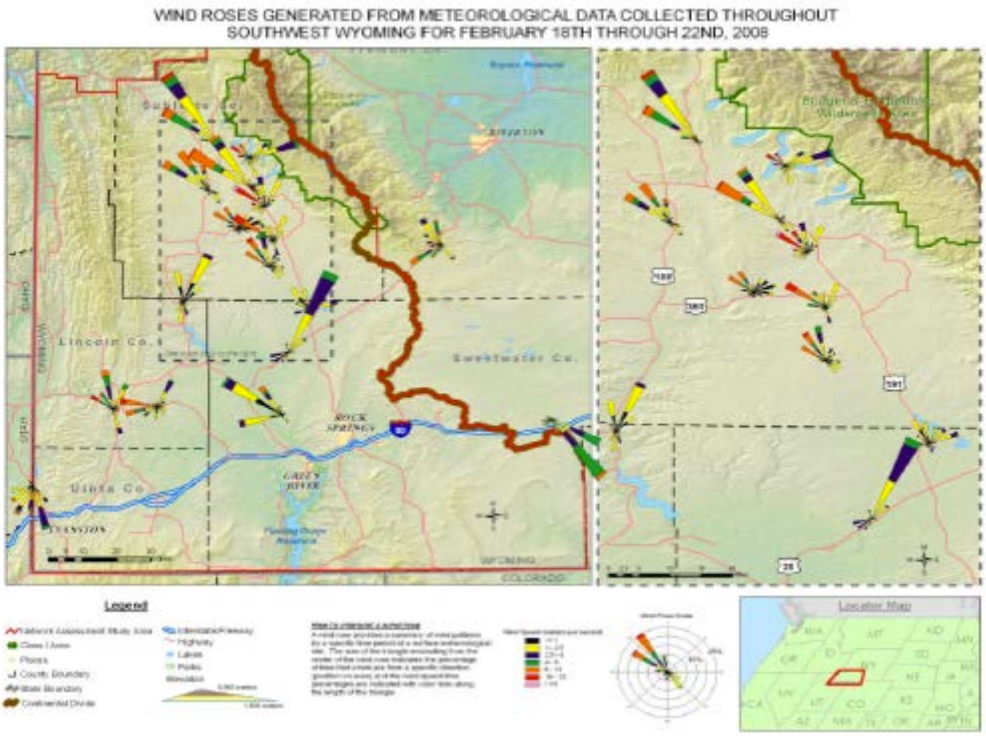
After elevated ozone levels were monitored in the winter of 2005 and 2006, the AQD initiated intensive field studies to collect meteorological and ambient data in the first quarter of 2007, 2008 and 2009 throughout the Green River Basin to better understand the relationships between winter meteorological conditions and high ozone levels versus low ozone levels. The winter of 2008 included several high ozone episodes which provided a significant amount of data on ozone formation. A map showing the monitoring sites employed in the 2008 field study and regional terrain features in the 2008 study area is shown in Figure 2.

Figure 2. Surface and upper air monitoring sites employed in the 2008 field study.



With the addition of the temporary mesonet monitoring sites to the existing permanent meteorological monitoring stations in the 2007 and 2008 field studies, a fairly detailed picture of wind flow patterns within the UGRB was obtained, revealing that the wind flow patterns were distinctly different throughout the northern and southern portions of southwest Wyoming. A composite map of wind rose plots generated from meteorological data collected throughout southwest Wyoming during the time period 18 – 22, February 2008 is provided in Figure 3.

Figure 3. Composite wind rose map for February 18 – 22, 2008 at monitoring sites located throughout southwest Wyoming



CalDESK Trajectory Analysis

AQD developed a high resolution (spatial and temporal) 3-dimensional wind field that uses the National Center for Environmental Prediction (NCEP) Rapid Update Cycle (RUC) model at 20 kilometer resolution, coupled with the high resolution observational database of surface and upper air meteorological data measurements obtained during the 2008 field study. It should be noted that the terrain elevation data used in this wind field is based on much higher terrain resolution than is currently used in the HYSPLIT model. The RUC and field meteorological data were processed through the CALMET diagnostic wind model to generate a 1 kilometer gridded wind field, using high resolution terrain and land use/land cover data, and actual observations of daily snow cover to account for actual snow cover (and albedo effects) within the CALMET domain. The complexity of the terrain, as represented in this 3-dimensional (3-D) CALMET wind field in shown in Figure 4.

Figure 4. Terrain features in CALMET modeling domain (464 km x 400 km)

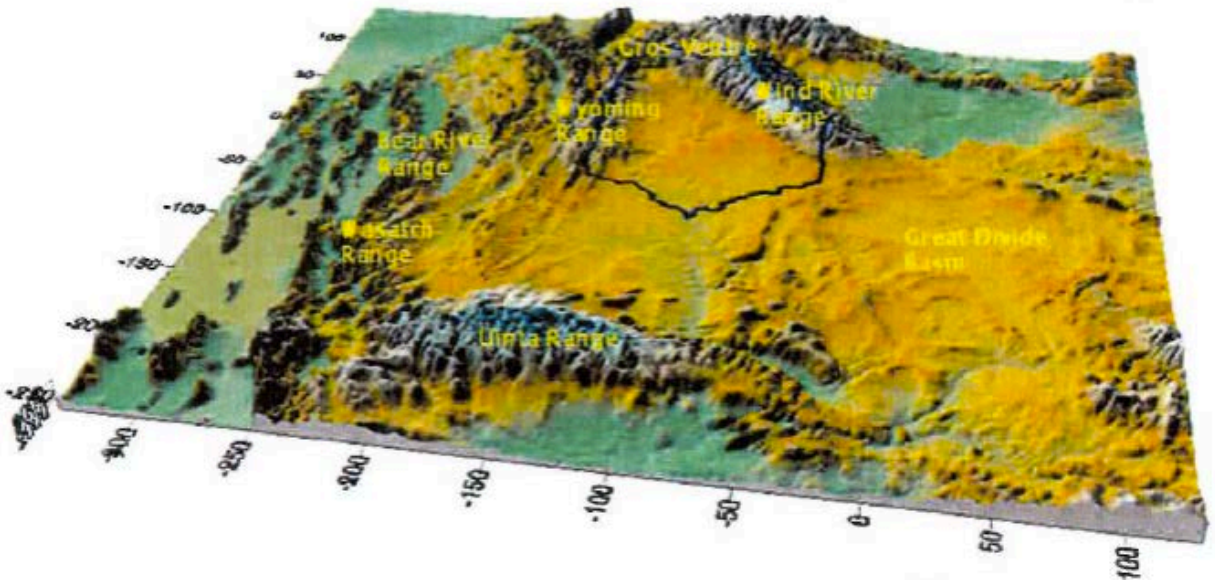
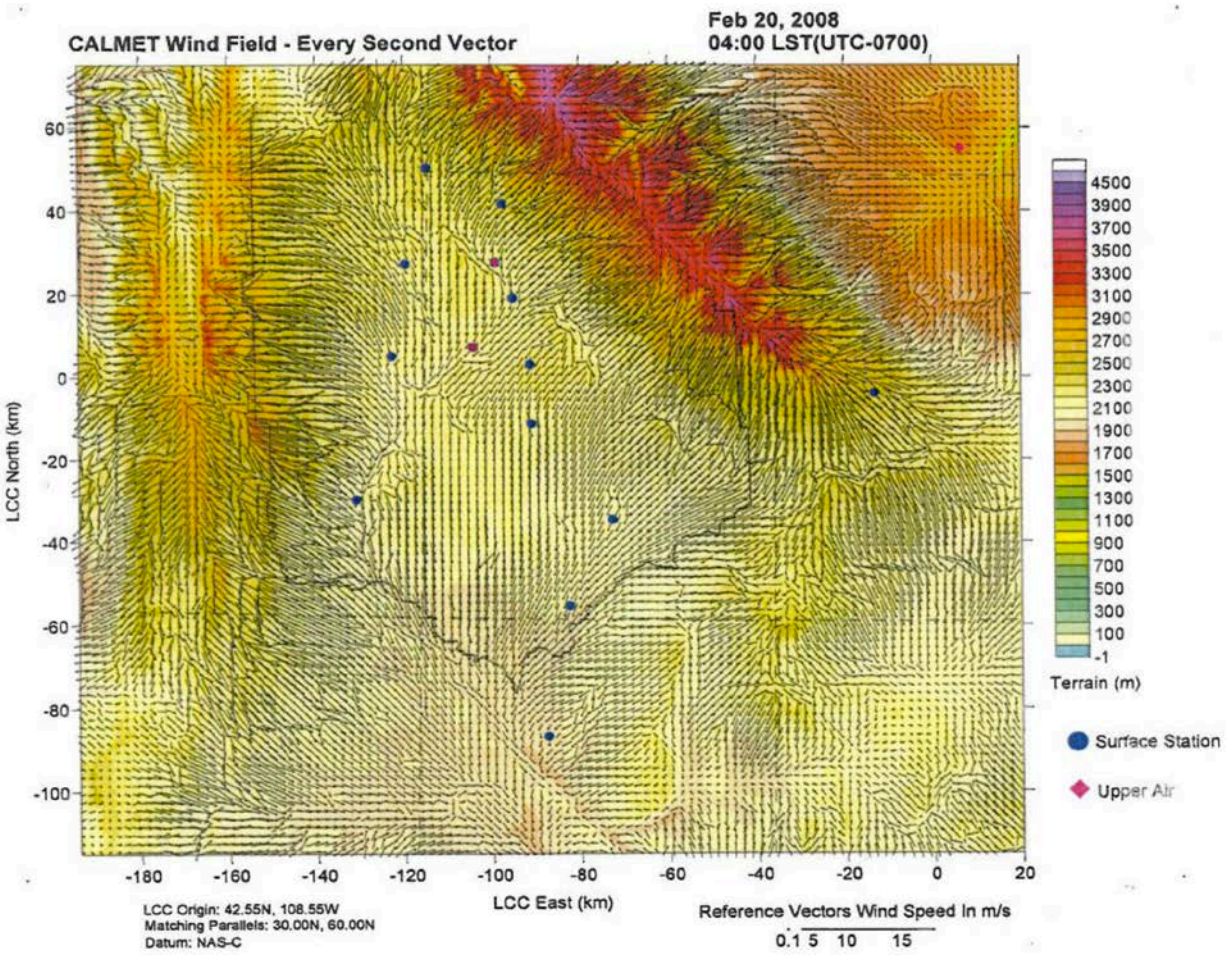


Figure 5 provides a snapshot of the wind field based on the winds at 4:00 am (MST) on February 20, 2008, and shows the complexity of the terrain surrounding the UGRB is very well represented in the CALMET wind field. The wind field captures the strong terrain-dominated down slope winds during the early morning hours, and the strong channeling and drainage effects which are exhibited throughout the UGRB – CALMET "sees" the influence of the terrain.

Figure 5. CALMET wind field at 4:00 am (MST) on February 20, 2008. The 2008 field study meteorological monitoring sites are shown for reference



The trajectory analyses using this wind field lead to the conclusion that regional transport is insignificant, and local-scale precursor emissions transport is the dominant means of precursor transport during the high ozone periods. The trajectory analyses that follow were a key factor in selection of an appropriate southern boundary of the nonattainment area. The trajectory analyses demonstrate that the proposed southern boundary of the nonattainment area is reasonable, and that there is no significant contribution of ozone or ozone precursors from areas or sources outside the proposed nonattainment area during elevated ozone events.

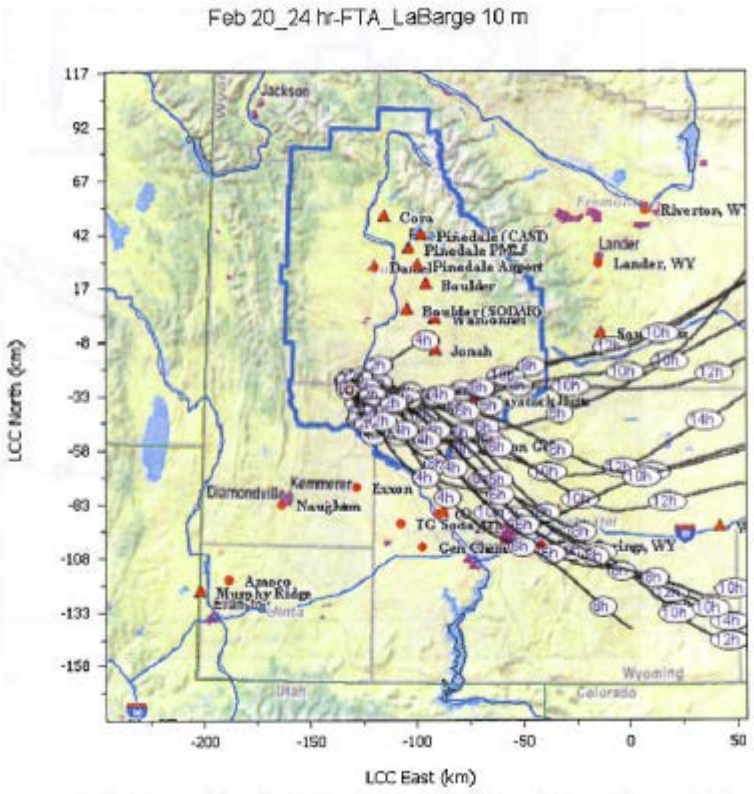
Based on this wind field, AQD used the CalDESK visualization software to run forward trajectory analyses to evaluate air parcel transport into and out of the UGRB, specifically with respect to air parcels from large stationary sources (power plants and Trona plants) located to the south of the UGRB, and to evaluate the southern extent of air parcel inflow into the UGRB.

An extensive series of CalDESK forward trajectory analyses were conducted for high ozone days throughout the winter days of 2008. The analyses consistently showed that emissions from large point sources south of the state-recommended nonattainment area boundary did not reach the central portion of the nonattainment area with ozone violations. The boundary was therefore defined to include those

point and area emissions sources consistently constrained and transported within the ozone impacted area by local winds, and to exclude more remote sources which were never seen to transport into the ozone impacted area.

Representative forward trajectories for source regions within and outside the nonattainment area are shown below for February 20, 2008. Very similar trajectories for the other high ozone days, consistent with the trajectories shown are included within the Wyoming recommendation supporting materials included in the docket but omitted here for brevity.

Figure 6. 24-hour forward trajectory analysis at Labarge, Wyoming (oil and gas production area) on February 20, 2008.



A point at the northernmost location in the Moxa Arch oil and gas field (located in Lincoln County, south of the nonattainment area boundary), the point nearest the violating monitor, was selected for evaluation of the potential for Moxa Arch emissions to travel to the area violating the ozone standard. No trajectories were observed which suggested emissions from this gas field contribute to the measured violations. In its response to EPA's proposed boundary, Wyoming noted that a new monitor just east of the Moxa Arch field recorded no ozone exceedances in 2011 at a time the monitors within the UGRB nonattainment area were recording very high exceedances (based on preliminary, uncertified data). In addition, Wyoming provided wind roses for each of the high ozone days in 2011 for each monitor in the area. The wind roses showed patterns of flow in 2011 consistent with the earlier trajectory analyses for 2008 (see Feb. 29, 2012 letter from John V. Corra, Director, Wyoming DEQ, in the docket).

Figure 7. 24-hour forward trajectory analysis at Moxa Arch (oil and gas production area) on February 20, 2008.

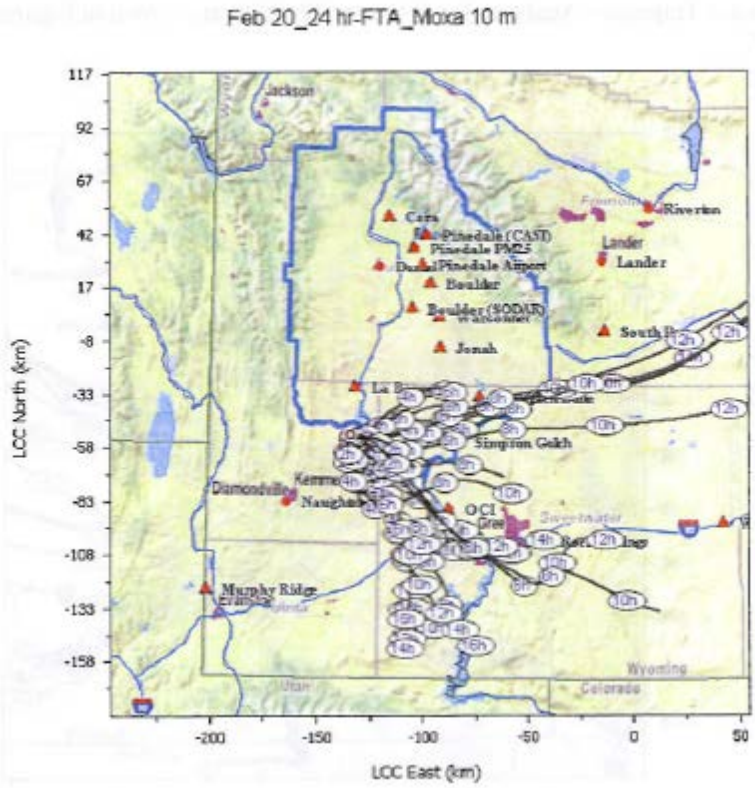


Figure 8. 24-hour forward trajectory analysis at Naughton Power Plant on February 20, 2008.

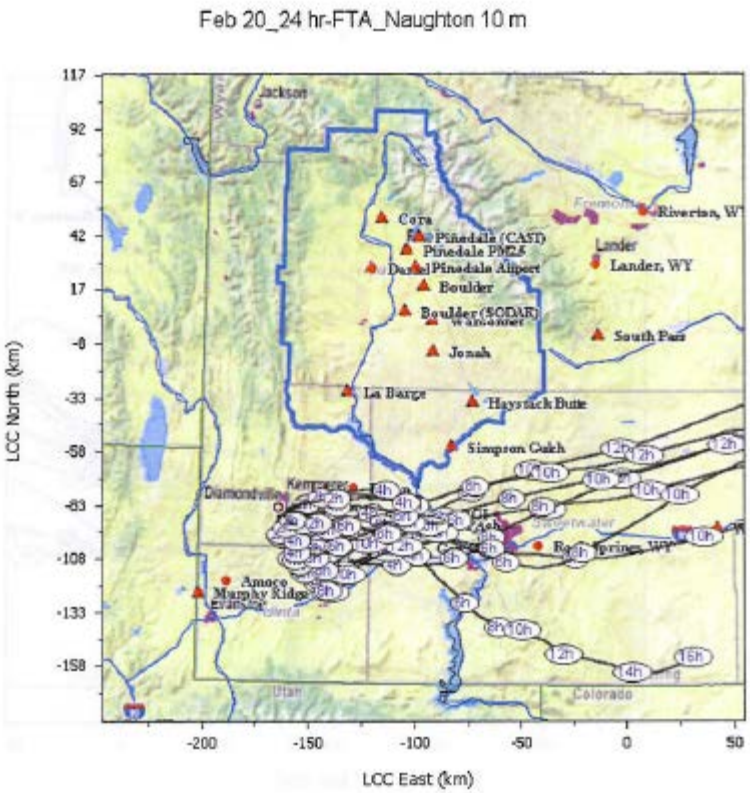


Figure 9. 24-hour forward trajectory analysis at OCI Trona Plant on February 20, 2008.

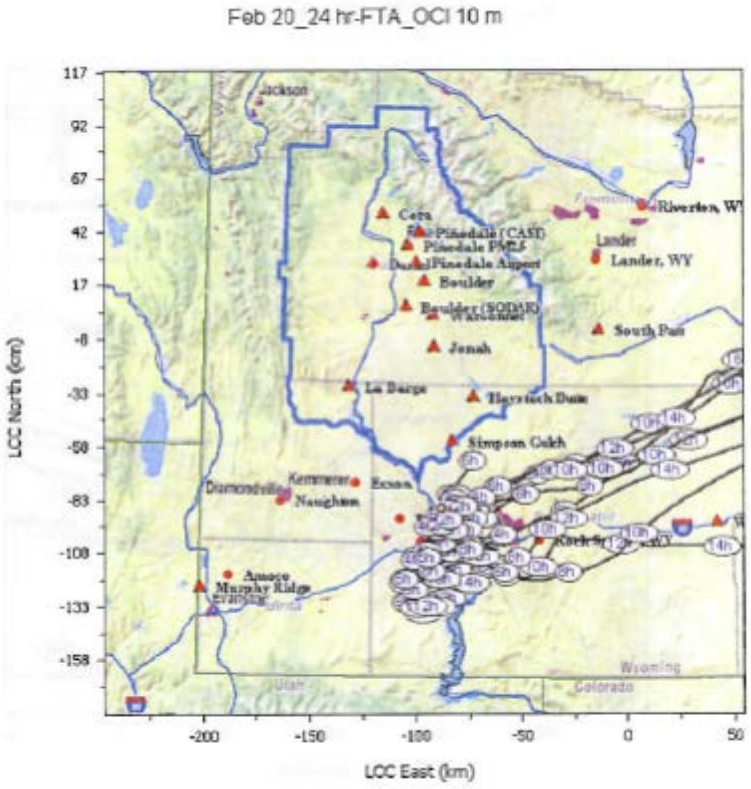
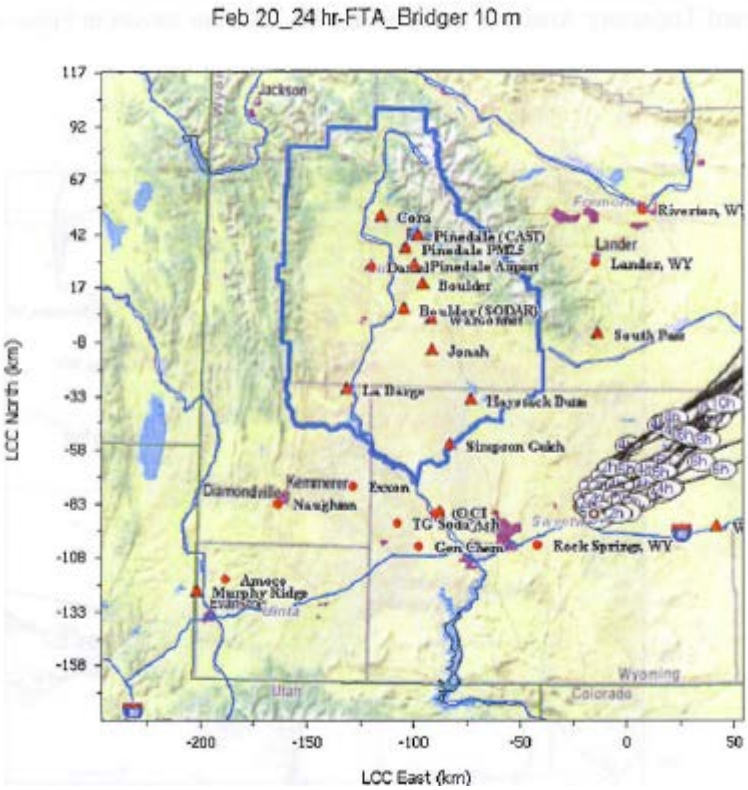


Figure 10. 24-hour forward trajectory analysis at Bridger Power Plant on February 20, 2008.



In summary, the high fidelity trajectory analysis conducted by Wyoming in support of its recommendation for the southern boundary of the Upper Green River nonattainment area shows some minor transport of emissions from areas just north of the boundary toward the most impacted ozone monitors, but also showed that emissions from sources south of the boundary were consistently transported east and out of the region without entering the area with the violating monitor.

Factor 4: Geography/topography (mountain ranges or other air basin boundaries)

The State's recommendation included a detailed description of the UGRB terrain, some of which is reproduced here:

The geography/topography analysis evaluates the physical features of the land that might affect the airshed and, therefore, the distribution of ozone over the area. Southwest Wyoming and the UGRB are within the Wyoming Basin Physiographic Province. Topography in the UGRB is characterized by low, gently rolling hills interspersed with buttes. Elevations range from approximately 7,000 to 7,400 feet above mean sea level (AMSL) in the lowest portion of the UGRB. The Wind River Range, with peaks up to 13,800 feet, bounds the UGRB to the east and north. The Wyoming Range, with peaks up to 11,300 feet, bounds the UGRB to the west. There are also important low terrain features such as the Green River Basin and the Great Divide Basin. Other terrain features such as river and stream valleys also influence local wind patterns. Mountain-valley weather patterns in the UGRB tend to produce limited atmospheric mixing during periods when a high pressure system is in place, setting up conditions for temperature inversions, which are enhanced by the effect of snow cover.

Mountain elevations decrease moving south along both the Wyoming and Wind River ranges. Along the western boundary of the Green River Basin, in the southern part of the Wyoming Range, the elevation decreases to about 6,900 feet AMSL with some peaks in the 7,500 to 8,000-foot range. Moving south along the Wind River Range, the elevation decreases to 7,800 feet at South Pass.

The surrounding significant terrain features effectively create a bowl-like basin in the northern portion of the Green River Basin, which greatly influences localized meteorological and climatological patterns relative to geographical areas located outside of the UGRB. Although difficult to quantify over the entire UGRB valley, the UGRB is roughly 3,000 to 4,300 feet lower than the terrain features bounding the UGRB to the east and west.

The southern boundary of the area is defined by river and stream channels. To the east the Big Sandy, Little Sandy and Pacific Creek drainages define the boundary and to the west the Green River and Fontenelle Creek drainages define the boundary.

Significant terrain in the UGRB has an impact on the local meteorology (wind speed, wind direction and atmospheric stability). In the mountain-valley areas such as the UGRB, during the night cold air will accelerate down the valley sides (downslope winds), while during the day warmer air will flow up the valley sides (upslope winds). At night, this can create a cold pool of air within the UGRB that stratifies the atmosphere (inhibits mixing) since colder, denser air exists at the surface with warmer air above. Further, at the valley floor, the wind speed is likely to be lower than in the open plain as the roughness of the surrounding terrain tends to decrease wind speeds at the surface. The terrain obstacles surrounding the UGRB also tend to cut-off, block or redirect air that might normally flow through the valley. This effect is exacerbated by during times of calm weather, such as the passage of a high pressure system that tends to set up conditions for strong surface-based temperature inversions.

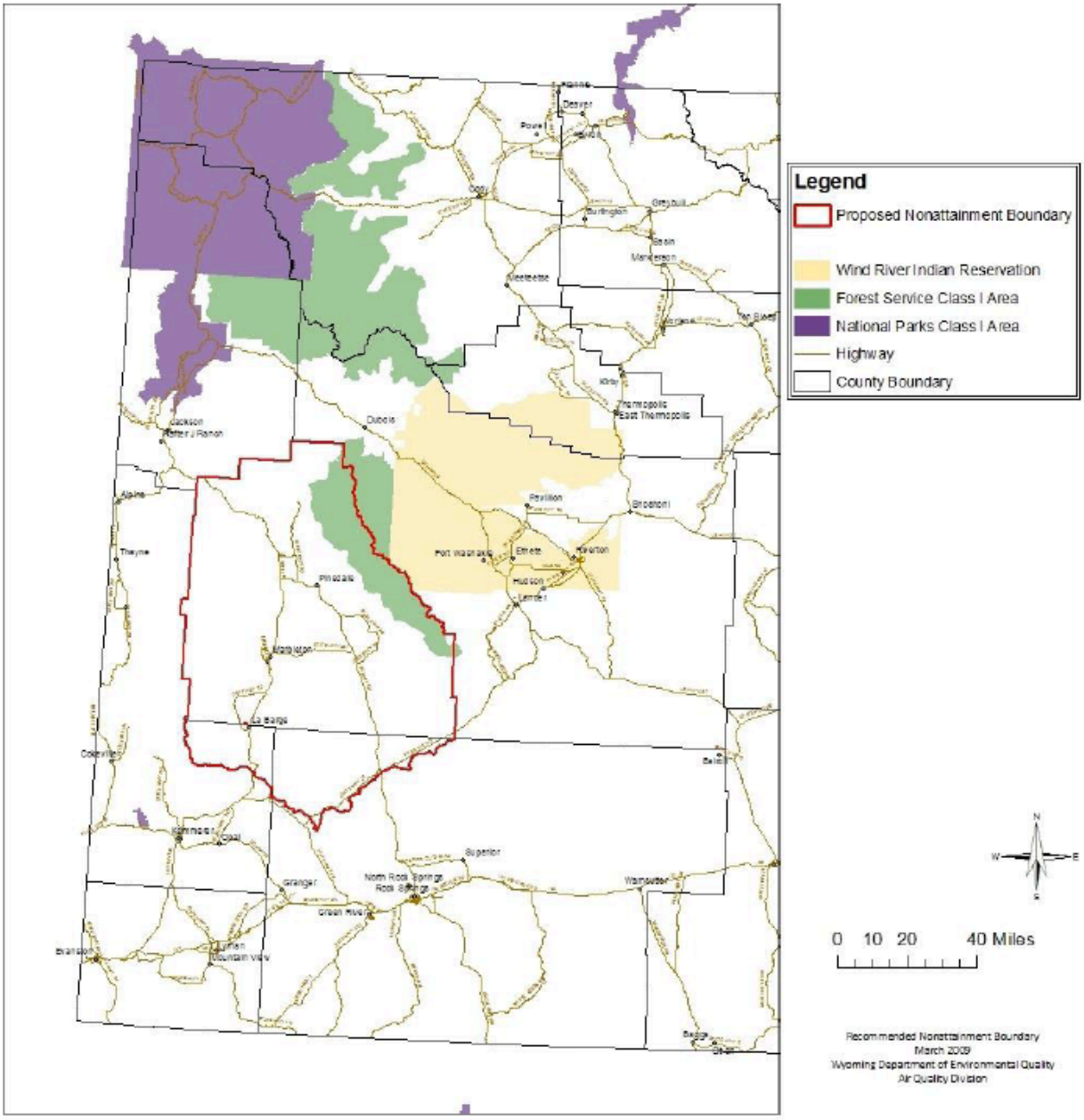
The Wind River Range on the east and the Wyoming Range on the west provide significant barriers to movement of ozone and ozone precursors into the nonattainment area. Although the southern boundary is not bordered by a mountain range, the southern boundary lies along two significant drainages: the Fontenelle/Green River to the southwest and the Pacific/Big Sandy River to the southeast. These geographic features influence air flow, although they do not provide an absolute barrier to migration. The influence of these geographic features on wind flows, especially during periods of low winds which are needed for ozone formation is illustrated by figure 5. This figure shows winds generally conforming to the drainages which establish the southern boundary of the nonattainment area. The nonattainment area is outlined in blue below against an aerial view of the topography in the UGRB in Figure 11.

Figure 11: Nonattainment area shown (blue outline) against an aerial view of the topography in the UGRB and adjacent areas

Factor 5: Jurisdictional boundaries

Once the general areas to be included in the nonattainment area were determined, EPA considered existing jurisdictional boundaries for the purposes of providing a clearly defined legal boundary and carrying out the air quality planning and enforcement functions for nonattainment areas. Examples of jurisdictional boundaries include existing/prior nonattainment areas for ozone or other urban-scale pollutants, counties, air districts, townships, metropolitan planning organizations, state lines, areas of Indian country, urban growth boundary, etc. Where existing jurisdictional boundaries are not adequate to describe the nonattainment area, other clearly defined and permanent landmarks or geographic coordinates were considered.

Figure 12: Nonattainment Boundary and Jurisdictions



The Sublette County jurisdictional boundary forms the northern and most of the western and eastern boundaries of the nonattainment area. The remainder of the boundary is not jurisdictional but is based on topographical and meteorological considerations. There is no existing local authority that transcends county boundaries, so the nonattainment area has no single local administrative authority other than the state of Wyoming.

The nonattainment area includes all of Sublette County; the portion of Lincoln County northeast of the waterways of Aspen, Fontenelle and Roney Creeks, and northeast of Fontenelle Reservior and the Green River; and the portion of Sweetwater County northwest of the waterways of the Green River, the Big Sandy

River, Little Sandy Creek, Pacific Creek, and Whitehorse Creek. This area includes the town of LaBarge in Lincoln County. The southern boundary of the nonattainment area is defined based on topographical and meteorological considerations rather than jurisdictional boundaries.

The Sublette County borders to the north, east and west follow topographic features (mountain ranges) and are appropriate boundaries for the nonattainment area. The five counties in Southwest Wyoming which were also included in the analysis are: Teton, Lincoln, Uinta, Sweetwater and Fremont. Two Indian Tribal Nations are also located near the nonattainment area, the Northern Arapahoe and Eastern Shoshone, at the Wind River Reservation in Fremont County. The reservation and the counties are shown in Figure 12. We did not include the Wind River Reservation as part of the nonattainment area.

Conclusion

Based on the assessment of factors described above, EPA has concluded that the following counties meet the CAA criteria for inclusion in the UGRB nonattainment area: Sublette County and portions of Lincoln and Sweetwater Counties. Based on monitoring results from 2006 through 2010, the state of Wyoming is in compliance with the 2008 0.075 ppm ozone standard with the exception of the Boulder monitor in Sublette County. The 2010 DV for the ozone NAAQs at the Boulder monitor was 0.078 ppm. The AQD performed a nine-factor analysis that formed the basis of the state's recommendation that this area be designated for nonattainment and EPA is adopting the AQD's recommendation. Because this is a low-population, rural area, EPA agrees with the state's conclusion that elevated ozone at the Boulder monitor is primarily due to local emissions from oil and gas development activities: drilling, production, storage, transport and treatment of oil and natural gas.

The boundary recommendations are based on meteorological conditions that occur in the first quarter of the year, when elevated ozone events occur. The nonattainment area boundary includes the violating monitor and the sources which are most likely to contribute ozone and ozone precursors to the monitored area. While the east, north and west boundaries are natural geographic boundaries of high mountains, they also coincide with population, jurisdictions, growth and emission source boundaries. Meteorology provided the strongest basis for setting the southern boundary, which includes portions of Lincoln and Sweetwater Counties.