Air Emissions Inventory Development of Criteria and Hazardous Air Pollutants on the Southern Ute Indian Reservation for 2002

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ABSTRACT

In 2005, the Southern Ute Air Quality Program along with Air Resource Specialists prepared a 2002 emissions inventory for the Southern Ute Indian Tribe in Southwestern Colorado. The Southern Ute Indian Reservation is located on and surrounded by one of the largest natural gas and oil fields in the United States. The Southern Ute Indian Tribe is experiencing consistent growth in the development and extraction of these natural resources within their reservation's exterior boundaries. This 2002 air emissions inventory can serve as an updated baseline for the Southern Ute Indian Tribe's permitting involvement regarding the regulation of this area's industrial emissions and future developments. Point sources, area sources, mobile sources, and biogenic sources were inventoried and the criteria pollutants, volatile organic compounds (VOC) and hazardous air pollutants (HAP) emissions were quantified for 2002. Point sources include 37 Title V sources, which constitute nearly 1/3 of all Title V sources in U.S. Indian country. Area sources include oil and gas wells, well-head compressors, oil and gas drilling operations, fireplace and wood burning stoves, propane, airports, and landfill gas emissions. Mobile sources include on-road emissions for both paved and unpaved roadways. Emissions estimates were calculated for some of the point, area, mobile, and biogenic sources using various methodologies. This paper will discuss the data collection, calculations, methodologies, and assumptions used in this study to formulate an emissions baseline for 2002.

BACKGROUND

The Southern Ute Indian Tribe (SUIT) Air Quality Program composed a 2002 Emissions Inventory (EI) as an update of the latest Emissions Inventory (1992). The purpose of the 2002 EI was to detail air pollution source emission quantities and locations within the Reservation for 2002. The Reservation is located in southwestern Colorado. It stretches approximately 75 miles latitudinal and 15 miles longitudinal, spans three counties (La Plata, Archuleta, and Montezuma), and borders New Mexico to the south. Situated directly in between the San Juan National Forest, to the north, and the northwestern New Mexico desert, to the south the Reservation natural environment is quit diverse. The total area covered by this inventory is approximately 685,000 acres, which encompasses all land within the external boundaries of the Reservation. The Tribe and/or Tribal members

own approximately 316,000 acres, while the remaining land mass is comprised of non-Indian and U.S. Government land in a checkerboard fashion. The primary land use is agricultural and the predominant industry is natural gas production. The SUIT has 36 permitted Title V sources within its exterior boundaries; this constitutes nearly 1/3 of all Title V sources in Indian country in the U.S.

The geology of the reservation plays a very important role in the pollution emissions related to the development and extraction of oil and natural gas. Located at the northern edge of the San Juan Basin is an asymmetrical paleogeographic low measuring approximately 100 miles at its widest point. This basin encompasses an area of about 22,000 sq. mi. The basin is a tectonic feature that was formed as a result of crustal flexure. At its deepest point, in the northeastern corner, the sedimentary rocks of the San Juan Basin reach a thickness of approximately 15,000 ft. The San Juan and Rocky Mountain ranges, as well as other Larimide age uplifts, supplied the sediment from which the Mesozoic age sedimentary rocks within the basin were formed. This sedimentary package contains both the source rocks from which the hydrocarbons were formed and the reservoir rocks in which the hydrocarbons are contained. Reservoir rocks have the ability to store hydrocarbons due to certain physical properties such as permeability and porosity.

The Southern Ute Tribe, while producing some oil and natural gas by conventional methods, garners most of its natural gas from unconventional coal bed methane production from the Fruitland Coal. The combination of the relatively shallow and geographically uniform Fruitland Coal beds makes the San Juan basin unique. As a result it is one of the largest producing natural gas fields in the world.

The purpose of the 2002 EI is to obtain and update baseline emissions data within the exterior boundaries of the Reservation. This includes annual emissions from major point, area, mobile (on-road and non-road), and biogenic sources for the year 2002. The EI data will be used for network review purposes as well tracking the total emissions within Reservation boundaries; it will also be available for future fee analysis and modeling that may be done. The primary pollutants that will be included in the EI are Nitric Oxides (NO_x), Carbon Monoxide (CO), Particulate Matter ($PM_{10/2.5}$), Volatile Organic Compounds (VOC's), and Hazardous Air Pollutants (HAPs). This inventory was developed to meet the following objectives:

- Identify and quantify air emissions generated within the Reservation boundary;
- Acknowledge EPA recommendation that tribes conduct an inventory; and
- Fulfill Commitment 3 under Component B of the FY '05 SUIT air quality program's work plan which reads; "Update latest Emissions Inventory (1992) to detail air pollution source emission quantities and locations within the Reservation for 2002 emissions".

METHODS

Methods used for data collection in this inventory differ between the various pollutant categories. The data collection responsibilities were divided between the Southern Ute Indian Tribe (SUIT) Air Quality Program and Air Resource Specialists, Inc. (ARS). The Tribe collected data for major point sources, landfills, airports, biogenic sources, and some area sources. ARS collected data for some area sources (excluding landfills), on-road sources and non-road sources (excluding airports).

The SUIT 2002 EI includes quantifiable air emissions from multiple sources on the Southern Ute Indian Reservation (Reservation) based on emissions estimates calculated using the following methods:

1. Emissions factors published in Compilation of Air Pollutant Emission Factors, AP-42;
2. The EPA's computer model for biogenic sources, BEIS 2.3;
3. The EPA's computer model for landfill gas, LandGEM Version 2.01;
4. The EPA's computer model for non-road mobile sources, Nonroad Emissions model, Version 2.2;
5. The FAA's computer model for airplane and associated emissions, EDMS Version 4.2
6. Lakes Environmental's Tribal Emissions Inventory Software Solution, TEISS Version 1.6.0
7. Lakes Environmental's MOBILE View, an interface for the U.S EPA's Mobile Source Emission Factor Model (MOBILE6), Version 1.0
8. The Northern San Juan Basin DEIS for well head emissions.
9. State of Wyoming DEQ Emissions factors for Condensate Tanks, Dehydrators, Heaters, and Oil Tanks.
10. SUIT generated emissions factors based from 2002 EI data collection for minor source compressor engines.

During the compilation of the appropriate emission factors data collection was also taking place for point, area, mobile and biogenic sources. The data collection process are shown below for each source:

Point sources:

Point sources on the Southern Ute Indian Tribe Reservation consist of compressor stations and gas treatment facilities for natural gas production and distribution. All of these sources operate under Title V Operating Permits, which are administered by the U.S. EPA. Data for the major point sources were taken from the Title V permits that are currently being administered by the U.S. EPA. All emissions data for the Title V sources on the Reservation were taken directly from the Title V permits or obtained from the source operators, therefore, no emissions calculations were made for this section. Since the actual emissions for 2002 were not available for all of the Title V sources potential emissions, as stated in the Title V permit, were used.

Area sources:

Oil and gas well emissions data for all the producing well in 2002 within the exterior boundaries of the Reservation were compiled from the Colorado Oil & Gas Conservation Commission website. The total number of wells was multiplied by emissions factors retrieved from the Northern San Juan Basin DEIS for well-head engine emissions. Emissions factors for the other processes associated with the wells including condensate tank, dehydrators, heaters, completion, flaring and venting, were taken from the State of Wyoming DEQ.

The emissions factors for wellhead engines assume a 48 hp 4 stroke, rich burn wellhead engine and 24/7 operation. For the other processes, such as dehydrators, it is assumed that each million cubic feet (MMCF) of gas passes through the process one time.

The emission factors for condensate tanks' VOC emissions assume a weighted average of condensate composition, average statewide temperature and pressure of upstream separator. Additionally the emissions factors assume controls being administered with an efficiency of 98% on wells producing over 18.3 BPD of condensate.

Well-head and minor source compression data for the minor source compressor was provided by the natural gas production companies. For the compressor engines where no emissions data were not provided by the production companies, basic averaging calculations were made to fill in the data gaps. The following general emissions factors were generated:

Emissions Factors for compressor engines greater than 600hp
CO 0.02208 tpy/hp
NO_x 0.01516 tpy/hp
VOC 0.00724 tpy/hp

Emissions factors for compressor engines up to 600hp
CO 0.03134 tpy/hp
NO_x 0.05007 tpy/hp
VOC 0.02379 tpy/hp

When only potential to emit values were available, rather than actual emissions data, the emission levels were assumed to be the same as the PTE limits. When emissions data were available for a certain compressor model, they were assumed to be applicable to other compressor units of the same model and hp rating.

For compressors where no emissions were provided and similar models were not available, emissions data were averaged for a representative group of compressors of greater than 600hp, and for a group of less than or equal to 600hp. For each group, average emissions factors in tpy/hp were derived. Emissions data for both standard and low-emissions compressor models were included in the averages and

compressors were assumed to run constantly, or for 8760 hours per year. The emissions factors were then applied to the horsepower totals for companies for which complete compressor emissions data were not available, or in some cases to individual compressor units.

Fireplace and wood-burning stove emissions data, utilized tons of fuel (wood) used in 2002, employing 2000 U.S. Census population and housing data for the Reservation. Fuel usage and number of fireplaces and wood-burning stoves was determined based on US EPA's Office of Air Quality Planning and Standards document, *Updated Emission Data for Revision of AP-42 Section 1.9, Residential Fireplaces*. Calculations for emissions from residential fireplace and wood burning stoves were made using the TEISS emissions calculators. The calculator employed emissions factors from AP-42 section 1.10-4. No growth factor was assumed to correct population figures to 2002, since no reliable available information was available, and given the characteristics of the Reservation, it was reasonable to expect that there would not be any significant change.

Propane emissions data, utilized the gallons of fuel used for residential heating in 2002 for air emissions, employing 2000 U.S. Census population and housing data for the Reservation. Fuel usage was determined by ARS based on a calculator at the Propane Education & Research Council's website. Calculations for emissions from residential propane use were made using the TEISS emissions calculators. The calculator employed emissions factors from AP-42 section 1.5-3. Again no growth factor was assumed to correct population figures to 2002, since no reliable available information was available, and given the characteristics of the Reservation, it was reasonable to expect that there would not be any significant change. Non-residential propane sources, such as industrial, commercial, and institution heating, likely from propane furnaces, were not considered for this EI due to lack of time and resources.

Airport emissions data for LaPlata County Airport were supplied by the airport's Director. The data included total landings for 2002, categorized using aircraft ID, for the commercial flights into LaPlata County Airport. Data for the Animas Air Park was obtained via phone conversation with Colorado Department of Transportation-Aeronautics. This data included total operations for 2002 and the total numbers of single engine planes, multi-engine planes, and helicopters located at the air park during 2002. Calculations for airport emissions were made using the Emissions and Dispersions Modeling System (EDMS) software supplied by the Federal Aviation Authority (FAA). Aircraft landing/takeoff/idle times were not available for either of the airports inventoried so EDMS defaults for times in mode were used for all aircraft. Additionally, EDMS defaults were used for all ground support equipment (GSE) activities at each airport. Due to the fact that not all of the aircraft IDs supplied by LaPlata County Airport were complete IDs, or did not appear in the EDMS software, some assumptions were made in regards to the aircraft/engine type for some of the aircraft. These assumptions were based on three criteria: the aircraft ID was slightly different but

engine types were identical, the closest available engine type was used or, the closest available aircraft make/model was used. In most cases where a different engine type was used this engine was the default engine type for the aircraft in EDMS. For the Animas Air Park multiple assumptions were taken. Since operations were not broken down for each aircraft type is was assumed that the operations were proportional to the number of that type of aircraft. Also, the aircraft types supplied differentiated only single engine planes, multi-engine planes, and helicopters. For each of these a default aircraft type was used: single engine planes (Cessna 208 Caravan), multi-engine planes (EMB-120), and helicopters (Bell 206). These defaults were based on the most common aircraft of each type that is usually found at the Animas Air Park.

Landfill emissions data for the two Class II municipal solid waste landfills located on the Reservation for 2002 were obtained via phone conversations with the plant managers of each landfill. The data collected included design capacity, annual acceptance rates, start dates, and information on co-disposal. All calculations were made using the US EPA's Landfill Gas Emissions Model (LANDGEM). LANDGEM calculated emissions for non-methane organic compounds (NMOC). The AP-42 emissions factor which gives the default volatile organic compound (VOC) portion on NMOC as 39 percent for non co-disposal landfills was used to calculate VOC emissions for 2002. Assumptions were made regarding both landfills due to a lack of available data. For landfill #1, the design capacity was being worked on so, a capacity of 2 million cubic yards was used. Also, annual acceptance rates were unknown for 1997 – 1999 so the acceptance rate from 2000 of 142 thousand cubic yards was used for these years. The exact design capacity and annual acceptance rates were also unknown for landfill #2; thus a design capacity of 2.9 million cubic yards was used based on a 40 year operational period with an annual acceptance rate of approx. 73,000 cubic yards. (It should be noted that the plant manager for landfill #2 did not anticipate reaching the expected 40 year operational period as they were accepting more waste than had been expected and this was the reason for using an annual acceptance rate that was lower than the current acceptance rate). As a result an annual acceptance rate of 85,000 cubic yards was used.

Mobile sources:

Onroad paved emission data used the total mileage for all paved roads on the Reservation calculated using Spatial Sciences & Imaging from geographic information systems (GIS) files provided by the SUIT Environmental Programs Division. The average daily vehicle miles traveled (VMT) for state and US highways were obtained from the Colorado Department of Transportation (CDOT) website. To determine emissions for vehicles on paved roads VMT, total mileage of paved roads, and an emission factor are needed. Annual VMT were calculated from the average daily VMT which was then multiplied by the emissions factors obtained from Mobile6. The emissions factors are:

VOC	1.760 g/mi
CO	26.850 g/mi

NO_x 2.739 g/mi
PM_{10} 0.0705 g/mi

The VMT for all paved roads that were not found on the CDOT website were calculated by reducing the VMT/mile of road from Highway 151 by 20%. The roads that could not be found on the CDOT website are assumed to be minor paved roads and therefore have less traffic than Highway 151, which had the lowest VMT of the major highways.

Onroad unpaved emissions data used total mileage for all unpaved roads on the Reservation calculated using Spatial Sciences & Imaging from (GIS) files provided by the SUIT Environmental Programs Division. The average daily VMT for unpaved roads in Archuleta and La Plata counties were obtained from the CDOT. Some of the data needed to calculate emission factors were obtained from the Natural Resources Conservation Service. The VMT that were obtained from the CDOT were for the entire counties. These VMT and the length of unpaved roads for the counties were used to calculate an average VMT/ mile of unpaved road for the entire Reservation. This was then multiplied by the total number of miles of unpaved roads on the Reservation to get an annual average VMT for the Reservation. These calculations are:

Archuleta County
757,716.27 *VMT*/ 511.78 *mi of unpaved roads* = 148.55 *VMT*/*mi*

La Plata County
1,082,873.62 *VMT*/ 558.45 *mi of unpaved roads* = 1,939.09 *VMT*/*mi*

Reservation Average

$$\frac{(148.55\,VMT/mi + 1939.09\,VMT/mi)}{2} = 1709.82\,VMT/mi$$

3,777 *mi of unpaved roads on Reservation* * 1709.82 *VMT*/*mi* = 6,458,000 *VMT*

Emissions factors for PM_{10} emissions from unpaved roads were calculated using equation 1b from AP-42 section 13.2.2. Equation 1b from AP-42 was then adjusted to incorporate the effect of precipitation on the fugitive dust emissions. This was done, using equation 2 from AP-42 section 13.2.2, as follows:

$$E_{ext} = E[(365 - P)/365]$$

where:

E_{ext} = annual size-specific emission factor extrapolated for natural mitigation (lb/VMT)
E = emission factor from Equation 1a or 1b
P = number of days in a year with at least 0.254 mm (0.01 in) of precipitation

The above equation was used with the following values for the variables:
s = Surface material silt content = 25%

S = Mean vehicle speed = 40 mph
M = Surface material moisture content = 2%
P = # of days in a year w/ at least 0.01 inches of precipitation = 49 days

Using these values results in the final emissions factor equation of:

$$E_{ext} = \left[\frac{1.8(25/12)^{1}(35/30)^{0.5}}{(2/0.5)^{0.2}} - 0.00047 \right] [(365-49)/365] = 2.66 lbs PM_{10} / VMT$$

This emissions factor was then multiplied by the VMT for unpaved roads to estimate total PM_{10} emissions.

Emissions factors for vehicle exhaust emissions were generated by Mobile6 using adjusted vehicle miles traveled by average speed based on an average speed on unpaved roads of 35mph. These emissions factors were then multiplied by the VMT for unpaved roads to estimate total vehicle exhaust emissions. Those emissions factors are:

VOC 1.758 g/mi
CO 25.843 g/mi
NO_x 2.602 g/mi

Two main assumptions were taken to produce the above equation for PM_{10} emissions. These assumptions were made for surface material silt content and surface material moisture content. There were no data available for the surface material silt content of the unpaved roads on the Reservation. Silt content was found for the native soil in La Plata County in a soil survey done by the United States Department of Agriculture which showed the silt content for the area of the Reservation within La Plata County to be primarily in two ranges of 20 – 50% and 40 – 70%. Due to the wide range of silt content percentages a simple average of 35% was assumed for the average silt content of the native soil on the Reservation. An additional assumption taken assumes that the silt content of unpaved roads is approximately 30% less than that of the native soil due to loss of silt from vehicle traffic. Therefore, a surface material silt content of 25% was used for unpaved roads on the Reservation.

The surface material moisture content for the equation from AP-42 is given a range of 0.03 – 13%. Based on the arid region that the Reservation is located in a surface material moisture content of 2% was used for the unpaved roads on the Reservation.

Non-road emissions for non-road mobile sources were calculated using the US EPA Non-Road Emissions Model. This required very limited data input and therefore is a rough estimate of non-road emissions for the Reservation.

The non-road model produced emissions on a county level. These data were adjusted for the Reservation by taking into account the percentage of the county that is covered by the Reservation.

Biogenic sources:

Biogenic source data utilized solar radiation data and temperature data for each hour of each day for 2002. These data were taken from the SUIT's air quality site, Ute 1, using Environmental Systems Corporation's (ESC) data acquisition system software. Conversions were made to the raw data in order to convert the solar radiation data that was available to the solar radiation data that was needed. Solar radiation data at Ute 1 is collected in Langleys/minute; however, BEIS utilizes Photosynthetically Active Radiation (PAR), or µmol/m^2/sec, for its calculations. The conversion from Langleys/min to PAR was accomplished using the following equation:

$$Langley/\min \times \left(\frac{698 Watts/meter^2}{1 Langley/\min}\right)\left(\frac{4.57 \mu mol/m^2/\sec}{1 Watt/m^2}\right) \times 50\% = \mu mol/m^2/\sec(PAR)$$

The equation was multiplied by 50% due to the fact that only ~50% of the total solar radiation is in the visible, i.e. PAR, region of the light spectrum.

All calculations for emissions from biogenic sources were performed by the BEIS software. The BEIS software makes calculations based on individual counties. Because the Reservation spans three different counties multiple calculations had to be made using BEIS. It was assumed that the emissions for a given county were evenly distributed throughout the county. For example, the Reservation covers 29% of Archuleta County so the emissions for Archuleta County were multiplied by .29 to give emissions for the section of the Reservation located within Archuleta County. The area of the Reservation that is located in Montezuma County (~4 acres) was included with the LaPlata county calculations. It was decided that using the La Plata County info rather than the Montezuma County info. would not significantly change the results.

Quality Assurance:

Following the completion of all conversions and data calculation the results were checked for quality assurance (QA). The QA procedures for all sections of the EI consist of:

- Check of emissions factors and calculations used for appropriateness,
- Review of emission models inputs and outputs,
- Completeness checks,
- Reality checks (believability in a real world setting),
- Double checking calculations for accuracy and reproducibility, and
- Peer review

Additional QA checks were applied to both the point and biogenic source sections due to large amounts of input data or multiple individuals inputting data. Initial QA checks for point sources entered into TEISS were performed by the ITEP Program Manager following initial entry of data. In addition to the initial QA checks each facility's emissions were double checked following the final emissions data entry. Once this check was completed, 10% of the facilities (4) were checked completely for all parameters that were entered into TEISS to ensure accuracy and completeness. Biogenic QA procedures were implemented due to the large number of data points that were input into the BEIS and because multiple individuals entered the data. Data were checked by re-entering 10% of the days into BEIS and re-running the calculations. These results were compared to the original results for precision. If a significant discrepancy was found it was corrected and the days following and preceding the discrepancy day were also checked. A discrepancy was defined as anytime the sum of the originally estimated emissions for any hour differed by more than ±0.5 from the re-calculated emissions. The value of ±0.5 represents 1% of the lowest hourly sum of emissions for the year.

RESULTS AND DISSCUSSION

The results for the specified sources following calculations and QA were placed into tables and figures. Each table included the source, pollutants, and there corresponding amounts inventoried. These results were then placed into table and figures using "Microsoft Excel". The tables generated included both specific and general sources. (see table 1.1).

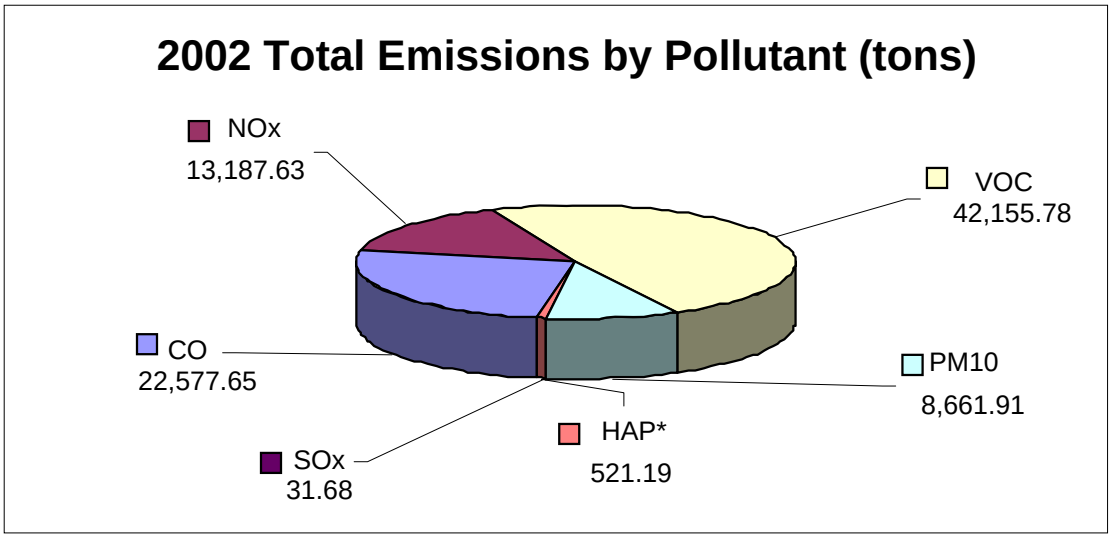
Table 1.1 General Total Emissions on the Southern Ute Indian Reservation in 2002 (tons)

Source Types	Emissions Source	CO	NO_x	VOC	PM_{10}	SO_x	HAP*
Point Sources	Title V facilities	5,063.64	5,535.97	2,005.35	39.58	11.93	307.49
Area Sources	Oil & Gas wells	8,548.00	3,820.90	33,785.10	-	-	213.7
	Well-head compressors	2,766.1	3,099.9	1,204.1			
	Fireplace & Wood Burning Stoves	26.84	0.33	-	3.56	-	-
	Propane use	11.23	66.67	-	-	-	-
	Airports	118.33	17.56	4.83	0.23	2.35	-
	Landfills	-	-	13.07	-	-	-
On-Road Mobile Sources	On-road Mobile (paved)	3,862.95	394.06	253.21	10.14	-	-
	On-road Mobile (unpaved)	184.0	18.52	12.51	8,589.00	-	-
Non-Road Mobile Sources	Non-road Mobile	1,996.56	167.38	302.78	19.40	17.40	-
Biogenic Sources	Biogenic	-	66.34	4,574.83	-	-	-
	Total Reservation Emissions	**22,577.65**	**13,187.63**	**42,155.78**	**8,661.91**	**31.68**	**521.19**

*HAP values include all hazardous air pollutants. This does not include any THC, NMOC, or NMHC since these may consist of an unknown ratio of hazardous air pollutants and other compounds.

Figures were used to show the total emission by pollutants (see Figure 1.1), and also by source.

Figure 1.1 Total SUIT 2002 Emissions (tons)



*HAP values include all hazardous air pollutants. This does not include any THC, NMOC, or NMHC since these may consist of an unknown ratio of hazardous air pollutants and other compounds.

The results of the SUIT 2002 Emissions Inventory indicate a best estimate to what the majority of pollutants on the SUIT Reservation are for 2002. It is very important to understand the nature of an emissions inventory. The results are part of a living document that is constantly evolving. With this understanding, some sections of the EI are more accurate than others. It is the desire of the SUIT Air Quality Program to revise these sections in the future to produce the most accurate EI possible.

IT should be noted that upon review of our EI by industry professionals found the results of our 2002 EI to be significantly lower in several areas. The Area Source emissions data directly related to the number of producing wells on the reservation is questionable due to the rapidly increasing number of wells within the Reservation's exterior boundaries. As a result the data for these wells was not included.

Similarly the number of minor source compressors located at each of the wells is questionably low. This data was provided by the major gas producing companies on the Reservation. However, without minor sources requiring operating permits on the Reservation a precise number of operating compressors is lacking and directly related to the documentation of companies and not the actual counts.

CONCLUSION

The Southern Ute Indian Tribe's 2002 Air Emissions Inventory serves as an updated baseline for the Southern Ute Indian Reservation's emissions sources specifically industrial emissions. The Reservation's point sources, area sources, mobile sources, and biogenic sources inventoried for criteria pollutants, volatile organic compounds and

hazardous air pollutants emissions were gathered and included in the SUIT 2002 EI. The 2002 EI helped to indicate the primary emitters of pollutants within the Reservation exterior boundaries. Directly following the completions of the 2002, EI the gathering of data for the SUIT 2005 EI began. Some areas of focus for the 2005 EI include the emissions from the two airports represent a significant amount of air pollution within the Reservation. It would be ideal to have more precise counts for takeoffs and landings and for types of aircraft, especially for the Animas Air Park. This could be accomplished by visiting the airpark on designated days throughout the year and recording all take offs and landing as well as aircraft types. Another area of focus is the biogenic emissions section. A more accurate biogenic estimate accompanying the use of BIES will also incorporate a more detailed vegetation assessment. The will include breaking the Reservation land into categories more specifically by land and vegetation type. Additionally, agricultural activities potentially affect air quality through the emissions of ammonia (NH_3), NO_x, particulate matter (PM), and other pollutants. These emission sources may be from fertilizers and livestock, and fuel combustion in farm equipment. Ammonia emissions from fertilizers and livestock are the key producers of fine particulate matter. Furthermore, dust from the cultivation of agricultural land and soil erosion results in a large portion of the coarse particulate matter in the air, which can cause haze and visibility issues. These issues should be addressed in the SUIT 2005 EI. The 2002 EI did not include data or estimates of emissions from vehicle refueling operations, i.e. gas stations. For the 2005 EI the gas stations on the Reservation should be inventoried. This also holds true for the marina refueling operations and vehicle operations located on the Navajo Reservoir. Finally prescribed burn and forest fire data should be included in the 2005 SUIT EI.

REFERENCES

Air Resource Specialist, Inc. July 2005. *Southern Ute Indian Reservation 2002 Air Pollution Source Inventory*. Fort Collins, CO

Baars, Donald L. 1983. The Colorado Plateau, A Geologic History. University of New Mexico Press. p. 193, 200-202.

BP America Production Company. November 1, 2001. *Parametric Monitoring Table for the Compression Team*.

CDOT Aeronautics. January 27, 2005. Animas Air Park Operations. Personal Communications

Colorado Department of Natural Resources. Colorado Oil & Gas Conservation Commission. COGIS – Facility Inquiry. http://www.oil-gas.state.co.us/.

Colorado Department of Transportation website. Traffic Data. http://www.dot.state.co.us/app_DTD_DataAccess/Traffic/index.cfm?fuseaction=TrafficMain&MenuType=Traffic.

Dent, Ron. La Plata County Airport. October 3, 2005. La Plata County Airport Commercial Operations. Email

Four Star Oil & Gas. September 13, 2005. *Southern Ute Indian Tribe Request: 2002 Emissions Inventory.*

Hemington, Matt. Bondad Landfill. January 27, 2005. Bondad Landfill Capacity. Personal Communications

Huffman, A. Curtis, Jr.; Condon, Steven M. 1993. *Stratigraphy, structure, and paleogeography of Pennsylvanian and Permian rocks, San Juan Basin and adjacent areas, Utah, Colorado, Arizona, and New Mexico.* 1808-O. p. O1-O44

James Jefferson et al. 1972. The Southern Utes – A Tribal History. p. 29-31, 43.

Lucero, Clifford. Archuleta County Landfill. February 28, 2005. Archuleta County Landfill Capacity. Personal Communications

Moss, Sterling. United States Department of Agriculture. Natural Resources Conservation Service. 1989. La Plata County Soil Survey map.

Pierce, Tom. NOAA/Atmospheric Sciences Modeling Division, Air-Surface Processes Modeling Branch. March 14, 2005. Solar Radiation Conversion. Email

Red Willow Production Company. August 10, 2005. Compressor Station Table.

Red Willow. 2002. Final Environmental Impact Statement, Oil and Gas Development on the Southern Ute Indian Reservation, Chapter 1 – Purpose and Need, p. 1-6 & 1-7.

Southern Ute Indian Lands; An Overview; A seminar designed for Tribal employees. 2005. Thomas H. Shipps. History of the Southern Ute Indian Reservation. p.1-7.

Southern Ute Indian Lands; An Overview; A seminar designed for Tribal employees. 2005. Patricia A. Hall, Esq. Tribal Sovereignty. p. 4.

Southern Ute Reservation and San Juan Basin General Reference Document, Red Willow Production Co. p. 1-2.

Southern Ute Tribe website. Tribal Government Background. http://www.southern-ute.nsn.us/government/background.html.

State of Montana. Department of Environmental Quality. Air Quality Permit. http://www.deq.mt.gov/AirQuality/arm_permits/2822-02.pdf

State of Montana. Department of Environmental Quality. Air Quality Permit. http://www.deq.state.mt.us/AirQuality/ARM_Permits/2772-07.pdf

State of Wyoming. Department of Environmental Quality. http://wrapair.org/forums/ssjf/documents/eictts/OilGas/2002_Oil&Gas_Emissions_report.072505.pdf

U.S. Environmental Protection Agency. Technology Transfer Network. Clearinghouse for Inventories and Emissions Factors. AP-42, Vol. 1, 5th Edition, Chapters 1 & 13. 1995. http://www.epa.gov/ttn/chief/ap42/.

Western Regional Climate Center. www.wrcc.dri.edu/cgi-bin.cliMAIN.pl?coigna. information on Reservation (Ignacio) climate.