3.1 Air and Atmospheric Values

3.1.1 Affected Environment

3.1.1.1 Overview

Nevada air quality airsheds are defined by hydrologic basin boundaries. Thus, the study area for air quality consists of the hydrologic basins within which project facilities would be constructed. Because of the potential for indirect effect on soils from groundwater level declines, the air quality study area also encompasses the region of study shown in **Figure 3.3.1-1** of Section 3.3, Water Resources. This section describes air quality on a regional level without distinguishing between the ROWs, groundwater development areas and the larger area that may be affected indirectly by groundwater pumping.

3.1.1.2 Air Quality and Air Quality Related Values

Regulatory Framework

Air quality is defined by the concentration of various pollutants and their interactions in the atmosphere. Pollution effects on receptors have been used to establish a definition of air quality. Measurement of pollutants in the atmosphere is expressed in units of parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). Both long-term climatic factors and short-term weather fluctuations are considered part of the air quality resource because they control dispersion and affect concentrations. Physical effects of air quality depend on the characteristics of the receptors and the type, amount, and duration of exposure. Ambient Air Quality Standard (AAQS) specify acceptable upper limits of pollutant concentrations and duration of exposure. Air pollutant concentrations below the standards generally are not considered to be detrimental to public health and welfare.

Ambient air quality and the emission of air pollutants are regulated under both federal and State of Nevada laws and regulations. A summary of the pertinent federal and state regulations governing air pollutant emissions (including particulates, such as construction generated dust) is contained in **Appendix F3.1**.

The relative importance of pollutant concentrations can be determined by comparison with an appropriate national and/or state AAQS. An area is designated by the USEPA as being in attainment for a pollutant if ambient concentrations of that pollutant are below the National Ambient Air Quality Standard (NAAQS). An area is not in attainment if violations of the NAAQS for that pollutant occur. Areas where insufficient data are available to make an "attainment" status designation are listed as unclassifiable and are treated as being in attainment for regulatory purposes.

QUICK REFERENCE

AAQS – Ambient Air Quality Standard
AQRV – Air Quality Related Values
CCA – Clean Air Act
CDE – Carbon dioxide equivalent
CO – Carbon monoxide
CO_2 – Carbon Dioxide
ET– Evapotranspiration
GBNP – Great Basin National Park
GWD – Groundwater Development
HB – Hydrologic Basin
IPCC – Intergovernmental Panel on Climate Change
Mm^{-1} – Inverse Megameters
NAAQS – National Ambient Air Quality Standard
NDEP – Nevada Division of Environmental Protection
NO_2 – Nitrogen dioxide
NO_x – Nitrogen oxides
NRCS – Natural Resources Conservation Service
PM_{10} – Particles of 10 microns or less
PM – Particulate matter
$PM_{2.5}$ – Particles of 2.5 microns or less
ppm – Parts per million
ppmw – Parts per million by weight
SO_2 – Sulfur dioxide
TSP – Total Suspended Particulate
VOCs – Volatile Organic Compounds
$\mu g/m^3$ micrograms per cubic meter
USEPA – United States Environmental Protection Agency

USEPA regulations allow exceptional events, if properly documented and approved, to be excluded from attainment status designation. An exceptional event refers to high pollution levels caused by a natural or human activity, such as a wildfire or high wind event, which is not reasonably controllable or preventable and is unlikely to reoccur at a particular location (USEPA 2007).

Regional Air Quality

The existing air quality of most of the project area is typical of the largely undeveloped regions of the western U.S. Current sources of air pollutants in the region include wildland fire, mining, agriculture, industrial sources, urban transportation, rural transportation on unpaved roads, construction activities, and disturbed land. With the exception of urban transportation, which emits other air pollutants, all of these sources predominately emit PM. Urban transportation combined with naturally occurring sources of volatile organic compounds (VOCs) react and create tropospheric ozone. PM and ozone are the primary pollutants of concern in the ROW/groundwater development area.

For the purposes of statewide regulatory planning, all of the northern portions of the project area have been designated as attainment areas for all pollutants that have an AAQS; however, parts of Nevada and Utah are designated as nonattainment or maintenance areas for specific pollutants as described below.[1]

Particulate Matter

Natural sources of particulate matter (PM) are dust generated by wind across unvegetated soil surfaces and wildland fire. Dry playa basins and areas cleared of vegetation are particularly susceptible to dust generation, particularly where soils are silty. In the Las Vegas area, most PM air pollution is a result of windblown dust from disturbed ground.

The size of PM is important from a human health perspective. There are three common size classifications of PM: the largest size classification is total suspended particulate (TSP), the second largest classification is PM with an aerodynamic diameter of particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}), and the smallest classification is PM with an aerodynamic diameter of particulate matter with an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$).

The current AAQS for PM are: the 24-hour average PM_{10} concentration is not to exceed 150 $\mu g/m^3$ more than once per year; the 3 year average of the 98^{th}-percentile 24-hour average $PM_{2.5}$ concentration is not to exceed 35 $\mu g/m^3$ more than once per year; the annual average PM_{10} concentration is not to exceed 50 $\mu g/m^3$; and the 3-year average of the annual mean $PM_{2.5}$ concentration is not to exceed 15 $\mu g/m^3$. For a complete listing of all applicable state and national AAQS, see **Appendix F3.1**. Particulate data collected by NDEP at a site in McGill are listed in **Table 3.1-1**.

Table 3.1-1 McGill, Nevada PM_{10} Concentrations 1993-1998

Year	24-hour PM_{10} ($\mu g/m^3$)			Annual PM_{10} ($\mu g/m^3$)
	Maximum	Day Maximum Recorded	Second Highest	
1993	26	08/11/93	23	15.9
1994	60	12/22/94	49	14.3
1995	149	04/27/95	66	20.0
1996	185[1]	08/13/96	55	22.2
1997	25	12/12/97	24	13.7
1998	22	02/28/98	19	10.9

[1]Includes exceptional events.

[1] Attainment, maintenance, and nonattainment designations as described throughout the text are based on the current status of these areas as of April 4, 2011.

Air quality monitoring also occurs at GBNP, approximately 50 miles from the McGill monitoring site. PM_{10} data collected at GBNP shown in **Table 3.1-2**, are somewhat lower than the concentrations measured at McGill. $PM_{2.5}$ also is measured at Great Basin. **Tables 3.1-1** and **3.1-2** show that concentrations of both PM_{10} and $PM_{2.5}$ are well below applicable AAQS.

Table 3.1-2 Great Basin National Park, Nevada PM_{10} and $PM_{2.5}$ Concentrations 1998-2008

Year	24-hour PM_{10} ($\mu g/m^3$)		Annual PM_{10} ($\mu g/m^3$)	24-hour $PM_{2.5}$ ($\mu g/m^3$)	Annual $PM_{2.5}$ ($\mu g/m^3$)
	Maximum	Second Highest			
1998	20.6	17.1	6.0	6.2	2.7
1999	18.5	16.5	6.3	7.4	3.3
2000	28.9	22.8	5.9	7.4	2.6
2001	34.9	24.0	5.8	5.8	2.8
2002	104.6	22.0	7.2	7.9	3.0
2003	17.5	14.8	5.1	5.7	2.5
2004	17.0	12.7	4.5	4.7	2.1
2005	29.4	20.0	4.9	5.5	2.5
2006	24.2	18.6	4.6	5.5	2.4
2007	14.7	13.1	5.1	6.0	2.5
2008	104.9	47.6	7.3	6.6	3.6

Source: IMPROVE 2010.

While Great Basin and McGill monitoring sites are the most representative of the groundwater development areas, the southern portion of the project area is in Clark County, where the air quality is very different due to the influence of the Las Vegas metropolitan area. Particulate data collected by Clark County at a site in Apex near Highway 93 and Interstate 15 (I-15) are listed in **Table 3.1-3**. The second highest 24-hour PM_{10} concentrations measured at USEPA monitoring stations in Clark County have exceeded 150 $\mu g/m^3$, which is above both national and State of Nevada AAQS. This has caused a portion of Clark County to be designated as a nonattainment area for PM_{10} (see **Appendix F3.1** for additional information regarding attainment designations). Average annual PM_{10} concentrations in this region generally range from 20 to 30 $\mu g/m^3$, which is below the 50 $\mu g/m^3$ State of Nevada AAQS (USEPA 2008a).

Table 3.1-3 Intersection of Highway 93 and I-15 Apex, Nevada PM_{10} Concentrations 2002-2007

Year	24-hour PM_{10} ($\mu g/m^3$)			Annual PM_{10} ($\mu g/m^3$)
	Maximum	Day Maximum Recorded	Second Highest	
2002	465[1]	04/15/02	176	26.4
2003	348[1]	10/30/03	105	23.8
2004	150	05/10/04	85	19.1
2005	97	05/16/05	72	18.9
2006	152[1]	09/15/06	97	17.7
2007	255[1]	06/05/07	96	23.2

[1]Includes exceptional events.
Source: USEPA 2008a.

Maximum measured values of 24-hour PM_{10} shown in **Tables 3.1-1** and **3.1-3** include exceptional events such as wildfires and dust storms. The frequency and severity of exceptional events can be an indicator of regional dust storm activity. At McGill, Nevada, exceptional events occurred once in a 6 year period from 1993-1998, as shown in **Table 3.1-1**. In Clark County, Nevada exceptional events occurred 4 times in a 6 year period from 2002-2007, as shown in **Table 3.1-3**.

While the GBNP and McGill monitoring stations are considered to be the most representative of the groundwater development areas, data collected in Utah are shown for informational purposes. Data from the Utah Division of Air Quality $PM_{2.5}$ monitoring station in Tooele, Utah, for the period 2005 through 2008 are listed in **Table 3.1-4**. The Tooele, Utah monitoring site is influenced by its proximity to Salt Lake City, Utah, which is approximately 15 miles away, while the groundwater development area's northeastern boundary is approximately 70 miles away. Portions of Tooele County, Utah, recently have been designated as nonattainment for 24-hour $PM_{2.5}$; however, the portion of Tooele County that is designated as nonattainment is well outside of the groundwater development areas.

Table 3.1-4 Tooele, Utah $PM_{2.5}$ Concentrations 2005-2008

Year	24-hour $PM_{2.5}$ ($\mu g/m^3$)		Annual $PM_{2.5}$ ($\mu g/m^3$)
	98th Percentile	Number of Exceedences	
2005	45.5	1	9.0
2006	22.8	0	6.6
2007	23.3	0	7.15
2008	36.0	1	6.47

Source: USEPA 2008a.

Ozone

Monitoring results in Las Vegas Valley (HB 212) in Clark County have exceeded the current 8-hour ozone standard for nonattainment. In 2004, the USEPA designated hydrograhic basins 164A, 164B, 165, 166, 167, 212, 213, 214, 216, 217, and 218 as nonattainment for the 8-hour ozone standard.[2] Current levels of ozone monitored in the groundwater development area are also of concern. Ozone is monitored at GBNP and values are close to the current 8-hour AAQS, as shown in **Table 3.1-5**. The USEPA is currently considering revisions to the 8-hour ozone National Ambient Air Quality Standard (NAAQS). If the standard is lowered to 0.070 ppm or below, the region surrounding the Great Basin monitoring station and portions of Clark County will likely be classified as a nonattainment area for the new 8-hour ozone standard.

Table 3.1-5 Great Basin National Park 8-hour Ozone Concentrations 1998-2008

Year	8-hour Ozone (ppm)	
	Fourth Highest Daily Maximum	Number of Exceedences[1]
1998	0.070	0
1999	0.072	0
2000	0.077	0
2001	0.067	0
2002	0.074	0
2003	0.071	0
2004	0.072	0
2005	0.073	0
2006	0.072	0
2007	0.075	0
2008	0.071	0

[1] The current form of the 8-hour ozone standard is that the 3-year average of the fourth-highest daily maximum 8-hour average ozone must not exceed 0.075 ppm. Therefore, although the fourth-highest daily maximum 8-hour average value exceeded 0.075 ppm in 2000, there has not been a 3-year period with an average over the AAQS.
Source: USEPA 2008a.

[2] Federal Register Volume 69, Number 180. September 17, 2004. p. 55956.

Prevention of Significant Deterioration

In addition to the designations relative to attainment of conformance with the NAAQS, the CAA requires the USEPA to place selected areas within the U.S. into one of three categories, which are designed to limit the deterioration of air quality when it is better than the NAAQS. Class I is the most restrictive air quality category. It was created by Congress to prevent further deterioration of air quality in national parks and wilderness areas of a given size, which were in existence prior to 1977, or those additional areas that have since been designated Class I under federal regulations (40 CFR 52.21). The Jarbidge Wilderness northeast of Elko is the only Federal Class I area in Nevada. The closest Class I area in Utah is Zion National Park, which lies about 90 miles east of the project area. All remaining areas outside of the designated Class I boundaries are designated as Class II areas, which are allowed a relatively greater deterioration of air quality, although it must still be maintained below NAAQS. The GBNP is a Class II area, based on the Congressional legislation that brought the park into existence. Additionally, Lake Mead National Recreation Area is a Class II area. No Class III areas have been designated in the U.S.

The project impacts to the GBNP are analyzed due to the proximity of the park to the project area. Project impacts to all other designated Class I and Class II area are anticipated to be less than the impacts predicted at the GBNP.

Regional Air Quality Related Values

Air quality related values include changes in visibility or atmospheric deposition of pollutants to soils and waterbodies. Regional haze is visibility impairment caused by the cumulative air pollutant emissions from numerous sources over a wide geographic area. Visibility impairment is caused by particles and gases in the atmosphere. Some particles and gases scatter light while others absorb light. The primary cause of regional haze in many parts of the country is light scattering resulting from fine particles (i.e., $PM_{2.5}$) in the atmosphere. Additionally, coarse particles between 2.5 and 10 microns in diameter can contribute to light extinction. Coarse particulates and $PM_{2.5}$ can be naturally occurring or the result of human activity. The natural levels of these species result in some level of visibility impairment, in the absence of any human influences, and will vary with season, daily meteorology, and geography (Malm 1999).

The visibility at the GBNP is one of the best in the nation.[3] In other words, at the GBNP, one can see farther distances than in other areas of the U.S. During the regional haze baseline period from 2000-2004, the total light extinction for the 20 percent best days was 13.4 Mm^{-1}, for the worst 20 percent days it was 29.2 Mm^{-1}, and averaged over the whole baseline period, it was 19.7 inverse megameters (Mm^{-1}) (IMPROVE 2010). Most of the particulate matter at the GBNP is composed of organic material, sulfates, and soil. The relative fractions of each component vary seasonally. The summer season is typically the time of year when the Great Basin region experiences the greatest reduction in visible range (IMPROVE 2010). Currently, there are no concerns regarding the atmospheric deposition of pollutants to soils or waterbodies in Class II areas of Nevada and there are no Class I areas of concern for this project. The total nitrogen deposition trend is relatively stable at around 2.0 kilograms per hectare (approximately 40 percent from dry deposition and the remaining 60 percent from wet deposition). The total sulfur deposition trend is relatively stable, perhaps decreasing slightly over the last 10 years, and is approximately 0.7 kilograms per hectare (approximately 30 percent from dry deposition and the remaining 70 percent from wet deposition) (CASTNet 2010).

3.1.1.3 Climate

The climate study area is part of two different climate regions: the Southwest and Great Basin Desert. The Southwest climate region generally is a low-elevation area extending from the Mohave Desert in southern California in the west to the western edge of Texas, reaching as far north as the Four Corners area and extending into the northern portions of Mexico. The Great Basin Desert is a mountainous desert, primarily contained within the state of Nevada, bordered by the Sierra Nevada mountain range on the west and the Great Salt Lake Desert on the east.

Generally, the Southwest climate region is warmer in the summer and drier in the winter than the Great Basin Desert. The Southwest also experiences summer precipitation associated with the North American Monsoon system, a system that does not reach as far north as the Great Basin Desert.

[3] Maps of regional haze measured across the U.S. can be viewed at http://vista.cira.colostate.edu/improve/Data/Graphic_Viewer/seasonal.htm.

The climatic conditions across the hydrologic study area are highly variable and reflect the wide variations in elevation, the presence of numerous mountain ranges, and the wide range in latitude. Precipitation generally increases with elevation (Welch and Bright 2007, Figure 20). In the Great Basin, the mean annual precipitation ranges from less than 5 inches to 16 inches in the valleys and approximately 16 inches to 60 inches in the mountains (Harrill and Prudic 1998).

Meteorological stations within the region typically are located at lower elevations. This is due to access and maintenance difficulties at higher elevations and because more intensive land uses commonly take place in valleys. Precipitation estimates at high elevations are largely based on snowpack measurements taken by the Natural Resources Conservation Service (NRCS) or other agencies.

Average annual precipitation values for selected monitoring stations distributed throughout the project study area are shown in **Table 3.1-6**. The station locations are listed from north to south. Most of these station locations are situated in valley settings. Elevation and precipitation generally decreases from north to south across the region. An example of localized effects of mountainous terrain and elevation on precipitation is made evident by comparison of the average annual precipitation for the GBNP (13.24 inches) with Garrison, Utah (7.61 inches), which is located approximately 10 miles east of the park.

Table 3.1-6 Average Annual Precipitation for Selected Meteorological Stations in the Region of Study

Station Location	Elevation (feet)	Average Annual Precipitation (inches)
Lages, Nevada	5,960	8.2
Ely, Nevada	6,250	9.6
GBNP, Nevada	6,830	13.2
Garrison, Utah	5,280	7.6
Lund, Nevada	5,570	10.2
Pioche, Nevada	6,170	13.2
Pahranagat Wildlife Refuge, Nevada	3,400	6.3
Overton, Nevada	1,290	4.4
Las Vegas, Nevada	2,160	4.2

In addition to the trend of increasing precipitation with increasing elevation, the seasonal distribution of precipitation changes generally from north to south. In the northern portion of the hydrologic study area, the greatest amount of precipitation normally falls in March, April, and May. This is illustrated by data for Ely, the GBNP, and Garrison in **Table 3.1-7**. The months of June and July typically are drier, and a slight increase in rainfall occurs in the late summer and early fall. Further south, precipitation is greatest in January and February at Overton and Las Vegas. Precipitation dramatically decreases in April, May, and June, and then recovers to mid-range levels for the rest of the year. In the extreme south, at Las Vegas, an increase in mid- to late-summer precipitation (July and August) is typical.

Table 3.1-7 Monthly Precipitation at Lower Elevations in the Study Area

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ely	0.74	0.74	0.97	1.02	1.09	0.68	0.60	0.81	0.75	0.85	0.68	0.62
GBNP	1.02	1.11	1.41	1.18	1.24	0.90	0.97	1.18	1.08	1.26	1.00	0.87
Garrison	0.45	0.45	0.86	0.76	0.73	0.50	0.57	0.77	0.69	0.78	0.58	0.46
Overton	0.56	0.67	0.46	0.33	0.13	0.07	0.31	0.27	0.34	0.33	0.48	0.45
Las Vegas	0.51	0.58	0.46	0.21	0.15	0.07	0.44	0.44	0.32	0.26	0.36	0.39

Regional trends in precipitation and temperature over a 66-year period of record were evaluated for Las Vegas, Caliente, and Ely. The purpose of this analysis was to provide background on the annual precipitation input to the region over time and to provide data for a discussion of potential climate change.

Variations in mean annual precipitation from 1930 through 2007 for Ely, Caliente, and Las Vegas are shown in **Figure 3.1-1**. The graph illustrates that all of the sites have experienced wet and dry cycles lasting up to a decade or more.

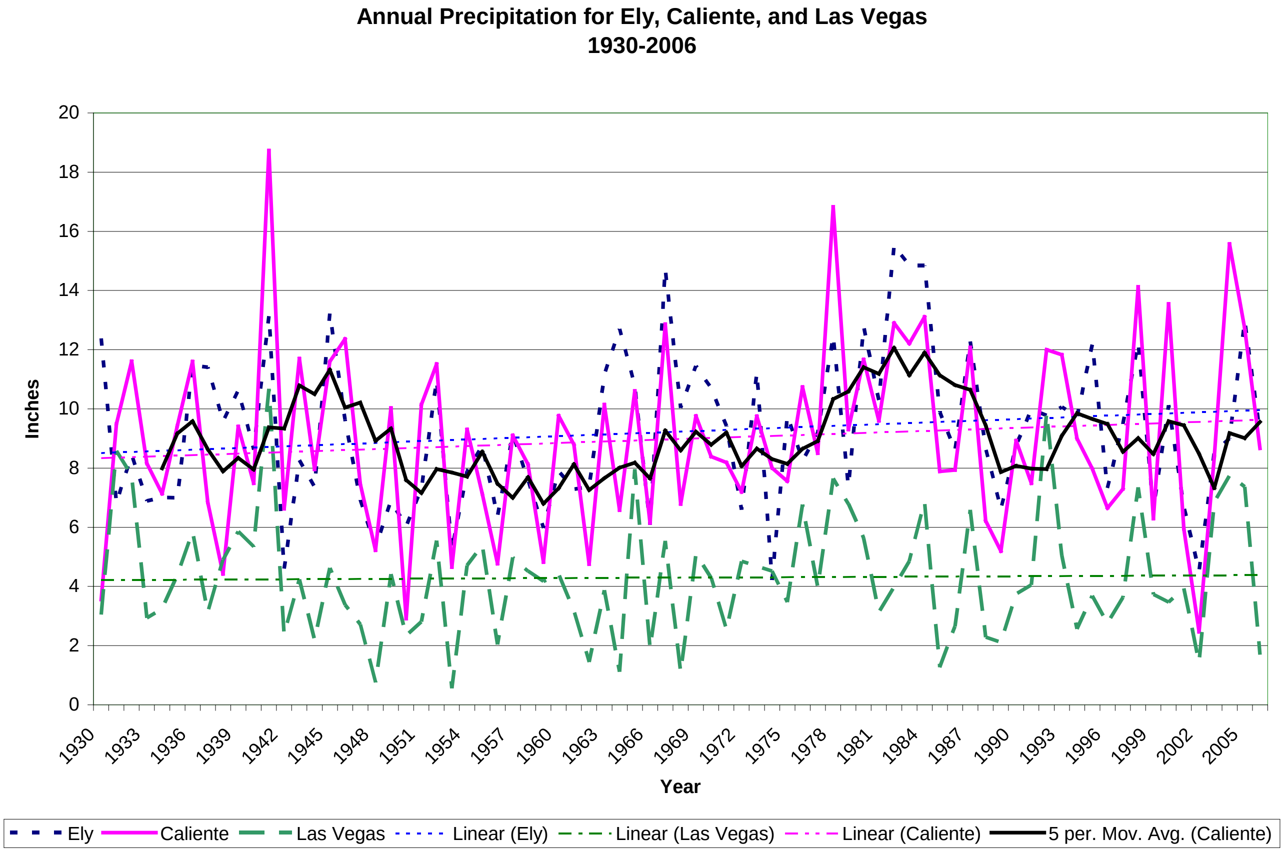

Figure 3.1-1 Annual Precipitation for Ely, Caliente, and Las Vegas with 5 Year Moving Average for Caliente and Linear Trend Line

In addition, there was a slight trend towards wetter conditions over the period for both Ely and Caliente while the overall precipitation trend for Las Vegas essentially was flat (i.e., does not exhibit a long-term trend towards either wetter or drier conditions).

Average annual temperatures at these three stations have shown a slight upward trend for Caliente and Ely and a 3 to 4 degrees Fahrenheit (ºF) average annual increase in Las Vegas over the 66-year period of record illustrated on **Figure 3.1-2**. An analysis of the annual maximum temperatures at the three stations indicates little or no difference over the period of record (**Figure 3.1-3**). However, the analysis of the annual minimum temperatures indicates a very strong upward trend in Las Vegas (nearly 10°F), and a moderate upward trend in Caliente (2 to 3°F), and no trend in Ely (**Figure 3.1-4**). One possible explanation for the upward temperature trend in Las Vegas annual minimum temperatures is the increasing urbanization of this area, with an associated increase in relative humidity and greater area of heat absorbing surfaces.

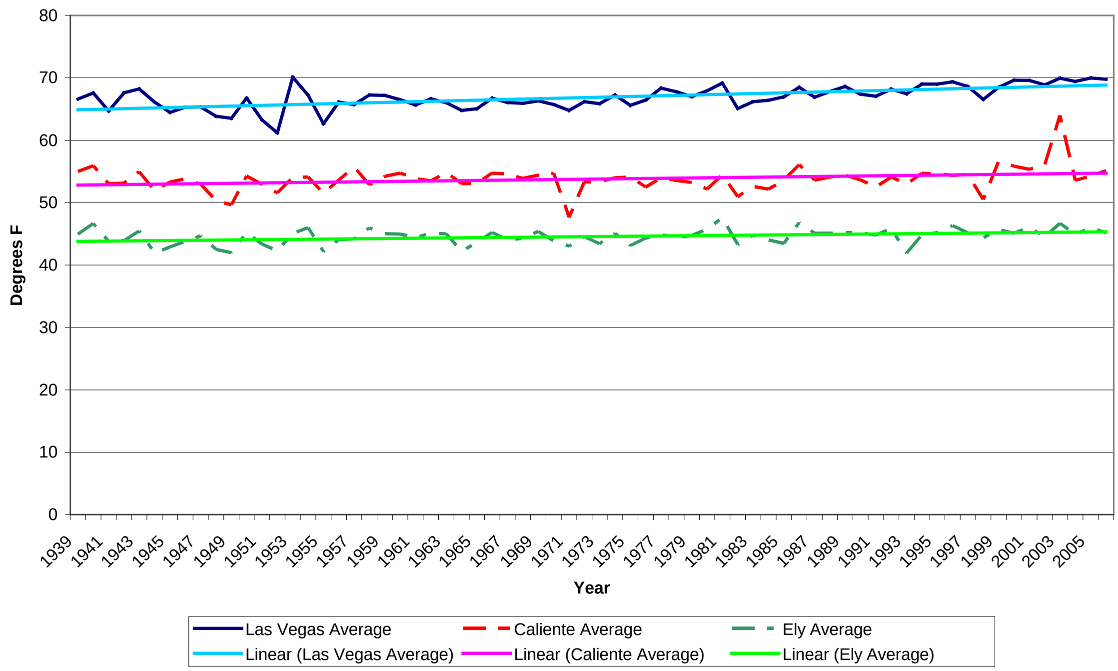

Figure 3.1-2 Average Annual Temperature 1938-2006, Las Vegas, Caliente, and Ely

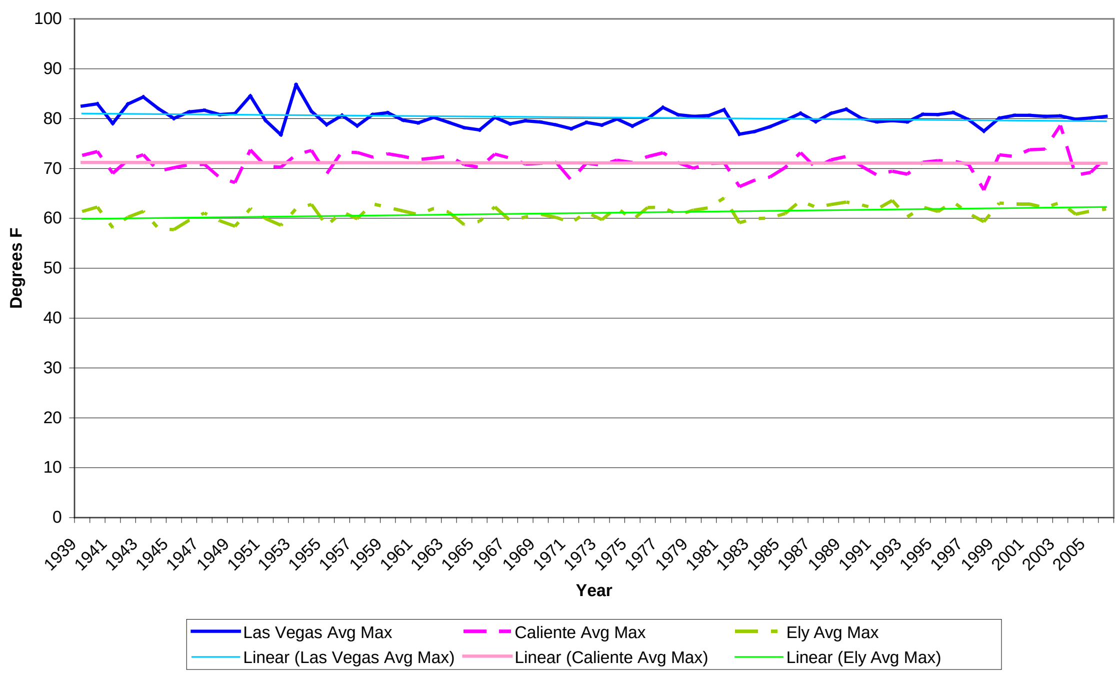

Figure 3.1-3 Annual Average Maximum Temperature 1938-2006, Las Vegas, Caliente, and Ely

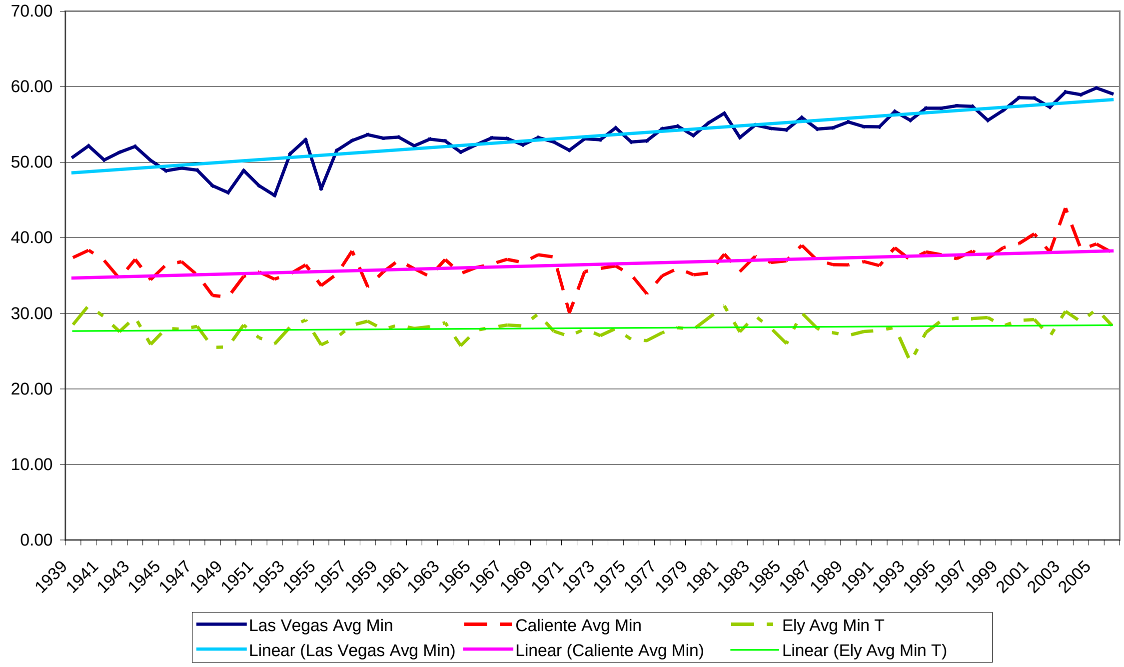

Figure 3.1-4 Annual Average Minimum Temperature 1938-2006, Las Vegas, Caliente, Ely

3.1.1.4 Climate Change Trends

Global Changes

Ongoing scientific research has identified the potential impacts of anthropogenic (man-made) greenhouse gas emissions and changes in biological carbon sequestration due to land management activities on global climate. Through complex interactions on a regional and global scale, these greenhouse gas emissions and net losses of biological carbon sinks (e.g., vegetation) could cause a net warming effect of the atmosphere, primarily by decreasing the amount of heat energy radiated by the earth back into space. Although greenhouse gas levels have varied for millennia, recent industrialization and burning of fossil carbon sources have caused carbon dioxide equivalent (CDE) concentrations to increase dramatically, and are likely to contribute to overall global climatic changes. The Intergovernmental Panel on Climate Change recently concluded that "warming of the climate system is unequivocal" and "most of the observed increase in globally average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentration" (Intergovernmental Panel on Climate Change [IPCC- 2007).

Global mean surface temperatures have increased nearly 1.8ºF from 1890 to 2006. From the IPCC (2007), Global Climate Models indicate that average temperature changes are likely to be greater in the Northern Hemisphere. Northern latitudes (above 24 degrees north) have exhibited temperature increases of nearly 2.1ºF since 1900, with nearly a 1.8ºF increase since 1970 alone. Without additional meteorological monitoring systems, it is difficult to determine the spatial and temporal variability and change of climatic conditions, but increasing concentrations of greenhouse gases are anticipated to accelerate the rate of climate change.

In 2001, the Intergovernmental Panel on Climate Change indicated that by the year 2100, the global average surface temperatures would increase 2.5 to 10.4ºF above 1990 levels. The National Academy of Sciences has confirmed these findings, but has also indicated there are uncertainties regarding how climate change may affect different regions. Global climate model predictions indicate that increases in temperature will not be equally distributed, but are likely to be accentuated at higher latitudes (IPCC 2007). Warming during the winter months is expected to be greater than increases in daily maximum temperatures. Increases in temperatures would increase water vapor in the atmosphere and reduce soil moisture, increasing generalized drought conditions, while at the same time enhancing heavy storm events. Although large-scale spatial shifts in precipitation distribution may occur, these changes are more uncertain and difficult to predict.

As with any field of scientific study, there are uncertainties associated with the science of climate change. This does not imply that scientists do not have confidence in many aspects of climate change science. Some aspects of the science are known with virtual certainty, because they are based on well-known physical laws and documented trends (USEPA 2008b).

Several activities contribute to the phenomena of climate change, including emissions of greenhouse gases (especially carbon dioxide (CO_2) and methane) from fossil fuel development, large wildfires, and activities using combustion engines; changes to the natural carbon cycle; and changes to radiative forces and surface reflectivity (i.e., albedo). It is important to note that greenhouse gases will have a sustained climatic impact over different temporal scales. For example, recent emissions of CO_2 can influence climate for hundreds of years.

It may be difficult to discern whether global climate change is already affecting resources, let alone the study area. In most cases, there is more information about potential or projected effects of global climate change on resources. It is important to note that projected changes are likely to occur over several decades to a century. Therefore, many of the projected changes associated with climate change described below may not be measurably discernable within the reasonably foreseeable future.

Existing and anticipated effects of climate change on regional natural resources and resource uses are described in the Regional Predicted Trends section below.

Historic Regional Climate

The climate in the Southwest and Great Basin Desert is and historically has been highly variable due to their locations with respect to atmospheric circulation patterns and complex topography. Historic precipitation and temperature events have been assessed using many types of paleoclimate indicators, including tree-ring chronologies, packrat middens, pollen records, and oxygen 18 ($\delta^{18}O$) data from sediment cores.

Based on paleoclimate records, both the Southwest and Great Basin Desert have experienced several “megadroughts” over the last millennia (Mensing et al. 2008; Benson et al. 2002; Ni et al. 2002; Herweijer et al. 2007; Sheppard et al. 2002). Megadrought is defined as a drought with the severity of present-day major droughts, but lasting 20 to 40 years. Less severe, but longer lasting droughts of 100 years or more, also have been documented as occurring in the regions (Mensing et al. 2008; Benson et al. 2002; Sheppard et al. 2002). Generally, precipitation events simultaneously affect both the Southwest and the Great Basin Desert, such as the severe droughts documented in the late 1500s and 1950s (Benson et al. 2002; Ni et al. 2002; Swetnam and Betancourt 1998), and anomalously wet periods in the 1330s, 1610s, and the 1910s-1920s (Ni 2002; Schwinning et al. 2008).

As is discussed throughout this EIS, the timing, amount, and form of precipitation are important factors for groundwater recharge rates, and temperature plays an important role in the form of precipitation. Temperature records typically have an inverse relationship to precipitation (i.e., lower temperatures during periods of higher than normal precipitation). This pattern is consistent with observed present day climate influenced by the El Nino/La Nina cycles (Jin et al. 2006; Sheppard et al. 2002; Cayan et al. 1999). Evidence suggests that multi-decade periods of warmer or cooler than normal temperatures have been increasing in their severity since the 1700s and temperature is increasing to an unprecedented extent in the last 400 years (Sheppard et al. 2002).

A historical analysis of temperature in White Pine County conducted by Redmond (2009) indicates that decadal means since the late 1990s are higher than any other decadal mean on record, with spring time temperatures rising more than other seasons. Data from 1948 to 2009 were used to analyze seasonal changes in freezing levels in White Pine County (Redmond 2009) and spring is the season that shows the greatest rise in the freezing level. Spring time temperatures and freezing levels are important considerations for the timing and rate of spring snowmelt and the manner that snow is converted into soil moisture, groundwater, and streamflow.

State-wide decadal precipitation has increased in Arizona, New Mexico, Utah, and Nevada each 30-year "normal" period from 1930 through 2000 as shown in **Figure 3.1-5**[4]. The measured average annual precipitation has increased approximately 1 to 1.5 inches in each state over this 70-year period. Precipitation has changed the least amount in Utah, while precipitation in New Mexico increased the most over this same period of time. Annual average 30-year normal state-wide precipitation increased by 1.25 inches in Nevada.

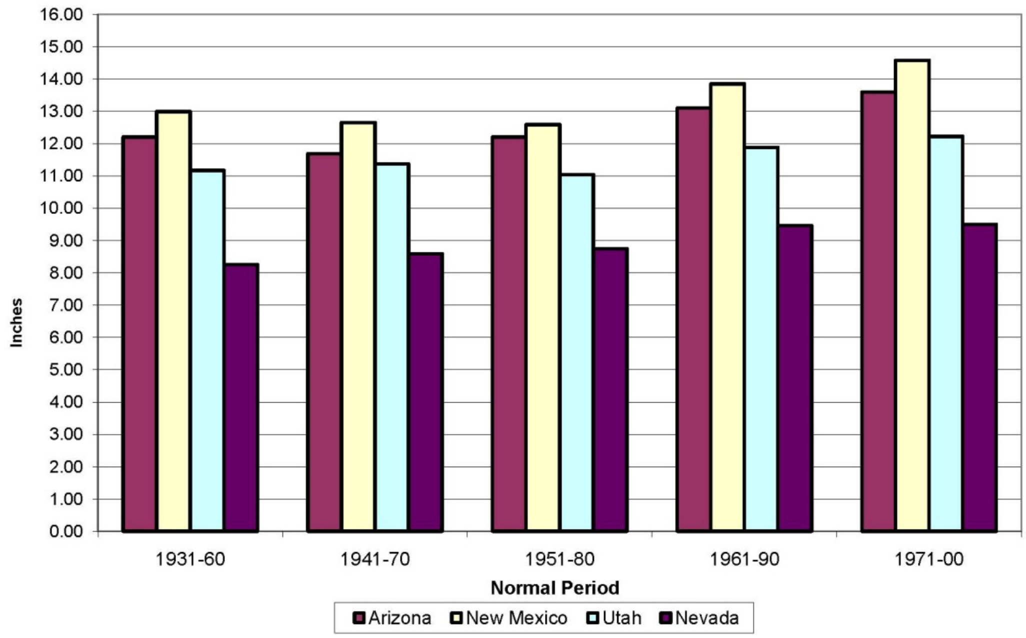

Figure 3.1-5 Southwest Statewide Normal Precipitation, 1931 to 2000

Predicted Future Trends

Temperature

Temperatures in North America are projected to increase with a greater than 66 percent probability (Christensen et al. 2007). Global climate models predict that temperatures in the western U.S. will increase between 2.5 and 6 degrees Celsius (°C), relative to pre-1900 levels, over the next 100 years (Christensen et al. 2007). The largest summertime changes in North America are predicted to occur in the American Southwest. Model-predicted temperatures in the Great Basin are anticipated to increase as well; however, the change in temperature is not predicted to be as large as the predicted changes in the Southwest. It is predicted that warm extremes will be more frequent and last longer (Field et al. 2007).

The Redmond Report (2009) analyzed results from 15 different global climate models for a grid cell containing Spring Valley. The 15 global climate models all were in agreement that temperatures in Spring Valley will likely increase for all seasons relative to the 1971-2000 period. The magnitude of this increase varied by model; however, the median increase for all 15 models suggest that annual average temperature in Spring Valley will increase approximately 4ºC in the next century.

Monitored temperatures in valleys within the region of study during the last 65 years generally support global climate model predictions for the Great Basin. Temperature records are widely available for much of the 20th century. As

[4] These statewide averages are obtained as follows: Each state is divided into climate divisions and an average precipitation value is calculated for each division. These division averages are then weighted by the amount of area within each division. Source: National Climatic Data Center, Historical Climatography Series 4-2. http://www.wrcc.dri.edu/htmlfiles/avgstate.ppt.html.

shown in **Figure 3.1-2**, these records demonstrate that annual average temperatures have increased between 1º and 4ºF in the region of study. However, the predicted changes in maximum summer temperatures are not reflected in current trends of the annual maximum temperatures at two of the three monitoring stations. Instead, 1º to 10ºF increases in the annual average minimum temperatures are shown for all three monitoring stations over the last 65 years (see **Figure 3.1-4**).

Precipitation

The confidence in precipitation predictions for the Southwest is somewhat weaker than the confidence in temperature predictions due to the complexity of circulation patterns bringing moisture to the area. Generally, global climate models predict that arid regions of the world will experience decreased precipitation levels and the Southwest is no exception (Christensen et al. 2007; Seager et al. 2007). The available moisture (precipitation minus evaporation) in the Southwest is predicted to decrease by 0.01 to 0.18 millimeters per day relative to available moisture during the period 1950-2000, with an average decrease of 0.1 millimeters per day. This change is predicted to occur sometime mid-21st century, with a quarter of the global climate models predicting this decrease over the next several decades (Seager et al. 2007). As a reference, precipitation between 1948 and 1957 (the 1950s drought) decreased by 0.13 millimeters per day, indicating that the recent year droughts may become the new baseline level of precipitation. As shown in **Figure 3.1-1**, monitored precipitation at sites in the Great Basin region has shown an increased level of precipitation relative to the 1948-1957 drought.

The Redmond report (2009) analyzed results from 15 global climate models for a grid cell containing Spring Valley. The 15 global climate models generally agreed that there will be no net annual change in precipitation in Spring Valley in the next century. However, the seasonal distribution of precipitation could potentially change. The Redmond Report (2009) suggests that the Great Basin is likely to experience an increase in winter precipitation amount in the latter part of the 21st century, which may be offset by reduced precipitation in the spring and summer seasons (Redmond 2009).

Water Availability (Combination of Precipitation and Temperature)

There is a high level of confidence that due to increasing temperatures, western mountains will experience a change in the timing, amount, and form of precipitation (Field et al. 2007). The Great Basin region might not see any change in the amount of annual precipitation (neither an increase nor decrease, which is supported by the Redmond report [2009]); however, water resources still could be diminished due to the higher temperatures alone (affecting evaporation, transpiration rates, etc.) (Christensen et al. 2007). The distribution of precipitation over the year is important for plant growing cycles and water availability. Generally, it is predicted (with >66 percent probability) that summertime precipitation in the Southwest associated with the North American Monsoon System will be reduced as the circulation system is forced northward due to differences in land/sea heating (Christensen et al. 2007). How this will impact the Great Basin Desert (located to the north of the Southwest) is dependent upon how far to the north the North American Monsoon is displaced. Wintertime precipitation in the Great Basin Desert typically is in the form of snow, and the accumulation and timing of snow melt are important for ecological and economic resources. It is predicted that there will be a decline in snowpack associated with warmer temperatures due to a latter onset and earlier spring melting (Field et al. 2007). A declining snowpack already has been documented in much of the western U.S. (Miller and Piechota 2008; Pierce et al. 2008; Jin et al. 2006; McCabe and Wolock 1999; Regonda et al. 2005).

Anticipated effects of climate change on resources and resource uses in the region of study are described and analyzed in Section 3.1.3, Climate Change Effects. The following resources have been or are anticipated to be affected by climate change: air quality, aquatic resources, range and livestock grazing/wild horses and burros, soil, vegetative communities, water resources, wildlife, and wildland fire ecology and management.

3.1.2 Environmental Consequences

3.1.2.1 Rights-of-way

Issues

- Air pollutants emitted from the tailpipes of construction equipment, including criteria pollutants, ozone precursors, and greenhouse gas emissions.
- Fugitive dust generated during construction and facility maintenance.
- Windblown dust generated due to wind erosion of disturbed surfaces.
- Impairment of visibility conditions at the GBNP.
- Conformity requirements in nonattainment areas.
- Entrainment and transport of radioactive material and erionite due to wind erosion of disturbed surfaces.

Assumptions

Assumptions regarding compliance with regulatory requirements, detailed project operations, inputs for emission factors, and future conditions are required to estimate impacts to air quality and climate.

Key assumptions regarding compliance with regulatory requirements include:

- All state and local air quality construction permits will be received prior to initiation of project construction.
- Any operating permits or dust control plans required in nonattainment areas will address conformity requirements or demonstrate that total emissions in nonattainment areas will be below applicable thresholds.

In order to estimate emission rates of air pollutants and greenhouse gases, two types of data are required: activity data and emission factors. To develop activity data, several operational assumptions were necessary due to a lack of detailed project information at this stage. Additionally, in some cases, site-specific information is required to develop accurate emission factors. The following assumptions will be revised, as required, based on project-specific data during the permit application phase:

- For tailpipe emissions from construction equipment, assumptions include:
  - All construction equipment, except for pick-up trucks, will consume ultra low sulfur diesel fuel. Pick-up trucks are assumed to be equivalent to light-duty, gasoline powered, passenger vehicles.
  - Construction activities will occur for 12 hours per day, 6 days a week, 50 weeks per year.
  - Not all pieces of construction equipment will operate simultaneously. At any given time, roughly a third of the equipment will be operating; thus, it is assumed that each piece of equipment operates 4 hours out of a 12-hour construction day. This is a conservative approach since a particular piece of equipment, such as a crane, has a very specific function and must remain on-site to perform this function, but this function is not required to occur continuously.
  - Pick-up trucks used for transporting crew and as lead cars for road closers will make 2 trips per hour on average over a 12-hour work day (24 trips per day). Each trip is assumed to be 4 miles on average.
  - Emission factors for year 2012 are used since this is predicted to be the first year of construction. Future years are anticipated to have lower emission rates due to federal and state emission reduction programs for mobile equipment.
- For fugitive dust from construction and maintenance, assumptions include:
  - One mile of pipeline and 1 mile of power line are actively being constructed per day. With the requested ROWs for construction, this equates to 36 acres per day. This is a conservative assumption for the purposes of estimating the maximum daily emissions of fugitive dust from construction equipment.

- For ancillary facilities, 2.5 acres are actively being constructed per day. This is a conservative assumption for the purposes of estimating the maximum daily emissions of fugitive dust from construction equipment.
- For the purposes of estimating the PM_{10} emissions associated with construction fugitive dust, it is assumed that 75 percent of the fugitive dust is in the PM_{10} size range (USEPA 1998). Similarly, the USEPA recommends that 10 percent of the PM_{10} is in the $PM_{2.5}$ size range (WRAP 2006).
- A control efficiency of 50 percent is assumed for purposes of emission calculations. Controls will be described in the dust control plan.
- Maintenance of equipment is independent of pumping (e.g., once the facilities are built they will require maintenance regardless of groundwater pumping actions). It is assumed that the ROW facilities will be regularly maintained and a light-duty truck will travel the length of the pipeline and power line once per month.

Methodology for Analysis

For the estimation of air quality related impacts, the methodology depends on the activity (construction equipment, windblown dust, etc.) and the type of air impacts (criteria emissions, greenhouse gases, etc.). The activity/air impact combinations are grouped together based on the issues identified above. The calculation methodology for each activity impacting air quality is described below.

Tailpipe Emissions from Construction Equipment and Facility Maintenance

Tailpipe emissions from construction are based on equipment-specific emission factors, the equipment type, the number of each type of equipment, and estimated hours of operation. Equipment-specific emission factors are from the California Environmental Quality Act, Air Quality Handbook (South Coast Air Quality Management District 2010). The estimated amount and type of construction equipment is provided in the POD in **Appendix E**, **Tables 4-3**, **4-4**, and **4-5** for the pipeline, power line, and ancillary facilities, respectively. The hours of operation were calculated based on assumptions regarding typical construction activities.

Tailpipe emissions from maintenance vehicles are calculated the same as for construction equipment. Emissions are based on the emission factors for light-duty passenger vehicles (South Coast Air Quality Management District 2010) and the calculated maintenance trips.

Fugitive Dust Emissions from Construction Equipment and Facility Maintenance

Fugitive dust is lofted into the air by construction equipment during many types of activities: driving over unpaved surfaces, excavation of top soil and rock, and transfer of excavated material from one place to another, etc. The USEPA has developed a generic emission factor for fugitive dust that includes all construction activities (USEPA 1995). The emission calculations for fugitive dust associated with ROW construction activities are based on the estimated acres of land actively undergoing construction and emission factors for heavy construction operations from the USEPA (USEPA 1995). The estimate of area actively constructed on includes the pipeline ROW plus the temporary ROW, power line ROW, temporary construction staging areas and access roads, and other ancillary facilities. However, all this area is not undergoing construction simultaneously; for the purposes of project emission calculations, it is estimated that approximately 40 acres per day (36 acres for pipelines and power lines, and 2.5 acres for ancillary facilities) are under active construction. Fugitive dust emissions during construction will be controlled as specified in the required dust control plan. For the purposes of emission calculations, the estimated fugitive dust emissions are assumed to be reduced by 50 percent through use of appropriate control measures.

Fugitive dust from maintenance of project facilities is expected to be minimal. As a result, emissions calculations were not performed; impacts were qualitatively compared with fugitive dust generated by construction activities.

Wind Erosion from Disturbed Surfaces

In addition to fugitive dust that is lofted into the air from construction equipment, construction activities disturb the soil surface, leaving the surface susceptible to wind erosion. Emissions calculations for windblown dust are based on the total estimated acres of land disturbed from construction and generic annual TSP emission factors for wind erosion from the USEPA (USEPA 1998). The fraction of TSP that is in the PM_{10} or $PM_{2.5}$ size range is estimated based on USEPA guidance (USEPA 1998; WRAP 2006).

Conformity Requirements in Non-attainment Areas

As described in Section 3.1.1.1 and **Appendix F3.1**, portions of Clark County, Nevada, and Tooele County, Utah, are designated nonattainment or maintenance for one or more federally regulated pollutants.[5] Portions of Clark County are either designated as nonattainment or maintenance for carbon monoxide (CO), PM_{10}, and ozone. Portions of Tooele County, Utah, are nonattainment for sulfur dioxide (SO_2). Since the project is predicted to emit all of these emissions (or precursors in the case of ozone), a conformity review was conducted based on USDOE guidance (USDOE 2000). To conduct the conformity review, the impact of the project ROW construction and facility maintenance activities was assessed in the nonattainment areas. The nonattainment areas are a small subset of the whole project area. Emissions in these nonattainment areas were calculated using the methodology described above for tailpipe emission and fugitive dust emissions, except calculations were limited to the nonattainment areas. Estimated emissions were compared with the emissions threshold for conformity determinations as published by USDOE (2000).

Radionuclides and Erionite

There is not anticipated to be re-suspension and transport of radionuclides from past nuclear testing at levels considered to be harmful to human health. Erionite has not been identified in the project area and is not expected to be an air contaminant resulting from project activities. For more information on these compounds, please refer to Sections 3.2.1.4, Geologic Resources and 3.4.1.2, Soil Resources.

3.1.2.2 Proposed Action, Alternatives A through C

The development associated with the primary pipeline and power line ROWs would be the same for the Proposed Action and Alternatives A through C. The proposed development within the ROW areas is described in detail in Chapter 2. Chapter 2 also provides estimates of surface disturbance from construction related activities. In summary, the development would include construction of 306 miles of pipeline, 323 miles of overhead power lines, and two primary and five secondary electrical substations. Ancillary facilities that would be developed include five pumping stations, six regulating tanks, three pressure reducing stations, a water treatment facility, a buried storage reservoir, access roads, and communication facilities.

The proposed GWD Project would generate air emissions through short-term construction activities. Construction air emissions include criteria pollutants, ozone precursors, fugitive dust, and greenhouse gas emissions. The actual fugitive dust emissions would depend on many site-specific factors such as the moisture content and texture of the soils that would be disturbed. Continued air quality impacts due to wind erosion of surfaces disturbed during construction will occur, at decreasing levels, until most surfaces are revegetated.

Emissions from all phases of construction would be subject to applicable state, local, and federal air regulations.

Construction and Facility Maintenance

Tailpipe Emissions from Construction Equipment and Facility Maintenance

Localized air quality emissions at a given location due to construction activities are expected to be short term, which is consistent with the project schedule shown in **Figure 2.5-7**. Short-term impacts are defined as being 5 years or less for all resources. Emissions from construction equipment will be controlled by following state and local regulations. As part of the ACMs, the SNWA will complete a final POD (ACM A.1.1), which will detail actual construction control measures as part of a Construction Plan and a Dust Control Plan (ACM A.10.1). In addition, operating permits for stationary sources, such as aggregate handling equipment, and operating permits for major combustion sources, such as engines greater than 250 horsepower, will be obtained prior to construction activities (ACMs A.10.4 and A.10.5). The development of a Construction Traffic Management Plan (ACM A.1.28) with measures to reduce the number of construction trips will also reduce air emissions from construction transportation vehicles.

[5] Attainment, maintenance, and nonattainment designations as described throughout the text are based on the current status of these areas as of April 4, 2011.

Based on the POD presented in **Appendix E**, the proposed construction equipment is comprised primarily of heavy-duty, non-road mobile equipment powered by diesel fuel. Only pick-up trucks will operate on gasoline rather than diesel fuel. Emissions from diesel engines would be minimized because engines must be built to meet the standards for mobile sources established by the USEPA mobile source emissions regulations (40 CFR Part 85). In addition, the USEPA is requiring that the maximum sulfur content of diesel fuel for highway vehicles be reduced from 500 ppm by weight (ppmw) to 15 ppmw, making ultra low sulfur diesel available nationwide.

Table 3.1-8 shows the construction emissions for each criteria pollutant, ozone precursors, and greenhouse gases that are estimated to result for the Proposed Action and Alternatives A through C.

Greenhouse gas emissions from construction would be short term and have an inconsequential contribution to long-term global climate change. For context, the estimated greenhouse gas emissions from construction equipment (in CDE) are less than 0.0005 percent of the CDE estimated to be emitted by the U.S, and 0.04 percent of the of the CDE estimated to be emitted in the state of Nevada. The total estimated annual emissions of CDE associated with construction activities are approximately 24,000 metric tons (tonnes), which is less than the recommended threshold of 25,000 metric tons, a USEPA reporting threshold for certain industrial and intensive agricultural activities (40 CFR 98.2; 74 FR 56374).

The estimated emissions published in **Table 3.1-8** are based on very general information and cover the whole project area. In many cases the assumptions lead to a large over-prediction of the values. Therefore, it is reasonable to assume that the actual emissions would potentially be much lower than is reported in **Table 3.1-8**. Emissions will be calculated as required for project permits and will comply with applicable local, state, and federal air regulations. Emissions from construction are not expected to cause or contribute to exceedences of any AAQS. Emissions from construction are not expected to impair visibility conditions at GBNP.

While most emissions shown in **Table 3.1-8** are expected to be short-term in duration and impact local air quality only during periods of construction, the emissions from maintenance vehicles are anticipated to last the life of the project.

Conclusion. Localized air quality emissions due to construction activities are expected to be short term (5 years or less). Conservative assumptions were used to estimate tailpipe emissions from construction and maintenance vehicles. Based on these assumptions, the potential annual emissions vary from less than 1 ton per year of SO_2, to approximately 24,000 metric tons of CDE. Emissions from construction are not expected to cause or contribute to exceedences of any AAQS nor impair visibility conditions at GBNP because the construction equipment would be operated in accordance with required permits on an as-needed-basis over a large project area.

Application of the ACMs to obtain required air permits should minimize the potential impacts to local air quality and ensure protection of applicable AAQS. Although the ACMs would minimize air quality impacts, some criteria pollutants may have elevated concentrations locally.

Proposed mitigation measures:

None.

Residual impacts include:

- In close proximity to construction sites, some criteria pollutants may have elevated concentrations relative to current background conditions; however, any elevated concentrations are expected to be limited to construction areas, be short-term in duration, and below applicable AAQS. Long-term impacts to air quality from maintenance vehicles are minimal and range from close to 0 tons per year of SO_2 up to approximately 8 metric tons per year of CDE.

Table 3.1-8 Emissions from Right-of-way Construction Equipment for Proposed Action, Alternatives A through C

Source	CO		VOC		Nitrogen Oxides (NO_X)		SO_2		PM_{10} and $PM_{2.5}$		CDE	
	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tonnes per Year
Pipeline Construction Equipment Operations	254	38.1	75	11.3	608	91.3	0.69	0.10	29	4.3	64,514	8,777.5
Power line Construction Equipment Operations	86	12.9	26	3.8	220	33.1	0.27	0.04	10	1.4	25,541	3,475.0
Facilities Construction Equipment Operations	297	44.5	88	13.3	723	108.5	0.83	0.12	33	5.0	78,157	10,633.6
Construction Transportation Vehicles	56	8.3	6	0.9	6	0.9	0.07	0.01	0.60	0.09	7,419.67	1,009.48
Maintenance Vehicles	2	0.3	0	0.0	0	0.0	0	0.0	0	0.0	240	32.7
Total Tailpipe Emissions	**694**	**104**	**195**	**29**	**1,558**	**234**	**2**	**0.3**	**72**	**11**	**175,873**	**23,896**

Fugitive Dust from Construction and Facility Maintenance Activities

Construction of the proposed pipeline and ancillary facilities would result in intermittent and short-term fugitive emissions. Dust control permits (required in Clark County) and Surface Area Disturbance permits (required in Lincoln and White Pine counties) will be obtained prior to construction activities (ACMs A.1.1 and A.10.1). Dust control permits require a Dust Control Plan and description of all the BMPs that will be used to minimize fugitive dust from construction. The Dust Control Plan will detail the use and application of an approved dust suppression method (ACMs A.10.1 and A.10.3). The application of a dust suppressant (e.g., water, or appropriate tackifier) will be added to active construction sites (ACM A.10.6), unpaved roads (ACM A.10.6), and soil stockpiles (ACM A.10.8). In addition to these ACMs specifically designed to protect air resources, there are several ACMs developed for other purposes (e.g., protection of other resources, safety, etc.) that also will control fugitive dust from construction and maintenance activities. Additional ACMs that will reduce fugitive dust emissions include: crushing rather than removing vegetation when possible (ACM A.1.20), the development of a Construction Traffic Management Plan (ACM A.1.28), limiting the vehicle speeds on unpaved roads (ACM A.1.29), and minimization and removal of dust from paved surfaces (ACMs A.1.33 and A.1.34).

The fugitive dust emissions associated with active construction activities can be calculated by making conservative assumptions of daily construction rates. A rate of construction of 1 mile per day was assumed for the pipeline and 1 mile per day for the power line. This assumption results in a conservatively high estimate of emissions of fugitive dust. When this assumed construction rate is combined with the requested permanent and temporary construction ROW width, a total of 36 acres is under active construction on any given day. In addition, it is assumed that 2.5 acres for building required ancillary facilities are under active construction on any given day. Altogether, approximately 40 acres per day are under active construction. Based on this estimate, the total fugitive dust emission rate can be calculated by multiplying the active construction area by the appropriate emission factor for uncontrolled heavy construction operations (USEPA 1995). By applying water or other dust suppressants as an ACM (ACM A.10.6), potential emissions may be reduced 50 to 80 percent. For the purposes of estimating emissions, it is assumed that ACM A.10.6 will control fugitive dust emissions by 50 percent. Based on these calculations and assumptions, it is estimated that 1,172 pounds per day of PM_{10} (176 tons per year) and 117 pounds per day of $PM_{2.5}$ (18 tons per year) will be emitted in the project area due to fugitive dust during construction activities.

Emissions from construction activities would be restricted to the short-term construction period along the pipeline and power line routes or near the proposed locations of ancillary facilities. Construction impacts would diminish once construction activities end.

Fugitive dust from maintenance of project facilities is expected to be minimal. Tailpipe emissions from maintenance vehicles were estimated to be approximately 1 percent of tailpipe emissions from construction transportation vehicles. Similarly, it is anticipated that fugitive dust from maintenance will be one percent of the construction fugitive dust. Therefore, it is estimated that 1 ton per year of PM_{10} and 0.1 ton per year of $PM_{2.5}$ will be emitted in the project area due to fugitive dust associated with maintenance vehicles. At these low levels, fugitive dust emissions from maintenance vehicles are not expected to impair visibility conditions at the GBNP. Emissions from maintenance activities are anticipated to be long-term (lasting the life of the project).

<u>Conclusion</u>. Localized fugitive dust emissions due to <u>construction activities</u> are expected to be short term (5 years or less). Conservative assumptions were used to estimate fugitive dust emissions from construction activities. Based on these assumptions, it is estimated that 1,172 pounds per day of PM_{10} (176 tons per year) and 117 lbs/day of $PM_{2.5}$ (18 tons per year) will be emitted in the project area.

Localized fugitive dust emissions due to <u>maintenance activities</u> are expected to continue for the life of the project. It is estimated that 1 ton per year of PM_{10} and 0.1 ton per year of $PM_{2.5}$ will be emitted in the project area due to fugitive dust associated with maintenance vehicles. At these low levels, fugitive dust emissions from maintenance vehicles are not expected to impair visibility conditions at the GBNP.

Application of the ACMs to develop a Dust Control Plan and obtain required air permits should minimize the potential impacts to local air quality and ensure protection of applicable AAQS. Although the ACMs would minimize impacts from fugitive dust, areas in close proximity to construction sites and the ROW may experience elevated concentrations of PM during periods of construction or maintenance activities.

Proposed mitigation measures:

The following proposed mitigation measures are not currently addressed in SNWA's ACMs and are intended to bring SNWA's ACMs into conformance with the BLM RMPs.

ROW-AQ-1: Project Road Inspections to Reduce Wind and Water Erosion. The SNWA and the BLM's Environmental Compliance Monitor shall inspect project roads in areas prone to air and water erosion bi-weekly during construction, or more frequently during periods of adverse weather conditions. Repairs shall be completed within 5 working days of notification to the SNWA or sooner depending on public safety and the nature of the issue detected. SNWA shall make a photographic documentation of the road condition prior to and immediately after road repairs. Effectiveness: This mitigation measure would be very effective at reducing construction related fugitive dust impacts. Implementation of this mitigation measure combined with other federal and state requirements, would likely result in a substantial reduction of short-term fugitive dust impacts. Effects on other resources: This mitigation measure would have a small (negligible) increase in vehicular traffic along the ROW during construction activities.

ROW-AQ-2: **Alternative Dust Control Measures**. Areas where soil tackifiers are prohibited (e.g., threatened and endangered species habitat, perennial stream drainages) shall be determined in cooperation with the BLM and the USFWS prior to construction, and identified in both the Construction and Mitigation Plans. Other mitigation (e.g., gravel application) may be required to reduce impacts and to ensure protection of public safety. This measure would supplement SNWA ACM A.10.3. Effectiveness: This mitigation measure would be moderately effective at reducing construction related fugitive dust impacts. Implementation of this mitigation measure combined with other federal and state requirements, would likely result in a noticeable reduction of short-term fugitive dust impacts. Effects on other resources: This measure would have a minor positive effect on threatened and endangered species habitat by reducing dust cover and on sensitive aquatic species by reducing water contamination by chemicals.

Residual impacts include:

- Implementation of the federal and state requirements, ACMs, and proposed mitigation measures should effectively mitigate fugitive dust impacts to air quality. It is estimated that 1 ton per year of PM_{10} and 0.1 ton per year of $PM_{2.5}$ will be emitted long-term in the project area due to fugitive dust associated with maintenance vehicles. In close proximity to construction sites and the ROW, there may be elevated concentrations of PM relative to current background conditions; however, any elevated concentrations are expected to be limited to areas in close proximity to construction and the ROW, be short-term in duration, and below applicable AAQS.

Wind Blown Dust from Disturbed Surfaces

Construction of the proposed pipeline and ancillary facilities would result in tracts of disturbed surfaces that are prone to wind erosion. Dust control permits (required in Clark County) and Surface Area Disturbance permits (required in Lincoln and White Pine counties) will be obtained prior to construction activities (ACMs A.1.1 and A.10.1). Dust control permits require a Dust Control Plan and description of all the BMPs that will be used to minimize windblown dust from disturbed surfaces. The Dust Control Plan will detail the use and application of an approved dust suppression method (ACMs A.10.1 and A.10.3). The application of a dust suppressant (e.g., water, or appropriate tackifier) will be added to active construction sites (ACM A.10.6), unpaved roads (ACM A.10.6), and soil stockpiles (ACM A.10.8). Since the generation of windblown dust is strongly dependent on wind speed, the Dust Control permit will include measures for assessing the need to stop work or increase dust control measures based on wind and/or air quality monitoring (ACMs A.10.2 and A.10.7).

In addition to these ACMs specifically designed to protect air resources, there are several ACMs developed for other purposes (e.g., protection of other resources, safety, etc.) that will also control windblown dust from disturbed surfaces. Additional ACMs that will reduce windblown dust include: crushing rather than removing vegetation when possible (ACM A.1.20), minimization and removal of dust from paved surfaces (ACMs A.1.33 and A.1.34), and the development of a Restoration Plan (ACM A.1.69).

Based on the estimated total acres of surface disturbed during construction of ROW and ancillary facilities (12,303 acres) and the USEPA emission factors for windblown dust of open exposed land (0.38 tons TSP per acre-year) (USEPA 1998), the total windblown dust emission rate can be calculated. Given the level of ACMs aimed to minimize windblown dust, it is reasonable to assume a 50 percent control efficiency will be obtained. By multiplying the emission factor by the estimated total acres of disturbed surface and applying a 50 percent control efficiency, a maximum TSP emission rate for the project is approximately 2,350 tons TSP per year. For the western region, it is a conservative assumption that PM_{10} is less than 75 percent of TSP (USEPA 1998), and $PM_{2.5}$ is 10 percent of PM_{10} (WRAP 2006). Therefore, the PM_{10} emission rate is estimated to be 1,750 tons per year and the $PM_{2.5}$ emission rate is estimated to be 175 tons per year.

Windblown dust impacts would diminish once construction activities end and after disturbed areas are reclaimed. Revegetation measures will be conducted as part of the reclamation process (ACM A.1.69). Disturbed soils would be protected by mulches and other surface treatments as specified in the approved POD, thereby reducing the risk of wind erosion.

Emission impacts from facility maintenance would be much less than those impacts during the construction phase. Only 1,014 acres (primarily access roads) of the original 12,303 acres of disturbed surfaces would remain prone to wind erosion. Long-term windblown dust impacts would be approximately 8 percent (1,014 acres ÷ 12,303 acres) of the estimated maximum windblown dust impacts. Therefore, the long-term PM_{10} emission rate is estimated to be 144 tons per year and the $PM_{2.5}$ emission rate is estimated to be 14 tons per year over the project area. Windblown dust emissions from disturbed surfaces are not expected to impair visibility conditions at the GBNP.

Conclusion. A majority of the windblown dust emissions due to surfaces disturbed due to construction are expected to be short term (5 years or less) until surfaces are revegetated. It is estimated the short-term PM_{10} windblown dust would be 1,750 tons per year and the $PM_{2.5}$ windblown dust would be 175 tons per year over the whole project area. The windblown dust over the ROW areas that will not be revegetated (and the impacts are therefore long-term) is estimated to be 144 tons per year of PM_{10} and 14 tons per year of $PM_{2.5}$ near the permanent ROW. Windblown dust emissions from disturbed surfaces are not expected to impair visibility conditions at the GBNP.

Application of the ACMs to develop a Dust Control Plan and obtain required air permits should minimize the potential impacts to local air quality and ensure protection of applicable AAQS. Although the ACMs would minimize impacts from windblown dust, areas in close proximity to construction sites and the ROW may experience elevated concentrations of PM during periods of high winds.

Proposed mitigation measures:

None.

Residual impacts include:

- Implementation of the federal and state requirements and ACMs should effectively mitigate windblown dust impacts to air quality in the short-term. Revegetation measures should effectively mitigate of windblown dust impacts to air quality in the long-term. The long-term windblown dust over the permanent ROW areas, which will not be revegetated, is estimated to be 144 tons per year of PM_{10} and 14 tons per year of $PM_{2.5}$. There may be elevated concentrations of PM relative to current background conditions caused by windblown dust near the permanent ROW; however, any elevated concentrations are expected to be limited to areas in close proximity to the ROW, be short-term in duration, and below applicable AAQS.

Conformity Review for Non-attainment Areas

Portions of Clark County, Nevada, are designated as nonattainment areas for ozone and PM_{10} and designated maintenance for CO.[6] There are no areas of the ROW that extend into Utah; therefore, Utah nonattainment designations are not considered in the evaluation of the ROW impacts. For areas classified as nonattainment, a conformity review is required. As part of the conformity review, the emission rates of the project are compared with thresholds defined

[6] Attainment, maintenance, and nonattainment designations as described throughout the text are based on the current status of these areas as of April 4, 2011.

under 40 CFR 93.153(b); if the project emissions exceed the thresholds, a conformity determination is required. For the purposes of the conformity review, estimates of the project emissions are conducted following the approach outlined above for tailpipe emissions, fugitive dust, and windblown dust.

For CO in maintenance areas, the emission threshold is 100 tons per year. The Nevada maintenance area for CO is limited to Hydrologic Basin (HB) 212, Las Vegas Valley.

The conformity threshold for the ozone precursors, VOCs, or NO_X, emitted in the ozone nonattainment area is 100 tons per year for each type of precursor. The Nevada nonattainment area for ozone that also contains the ROW development areas includes HB 212, Las Vegas Valley; HB 216, Garnet Valley; HB 217, Hidden Valley; and HB 218, California Wash Valley.

For areas classified as serious nonattainment for PM_{10}, a conformity determination would be required if the PM_{10} emission rates exceed 70 tons per year. The portion of Clark County, Nevada, that is designated as a serious nonattainment area for PM_{10}, is limited to HB 212, Las Vegas Valley.

Using the approach presented in the preceding sections to estimate the impacts to air quality due to ROW construction and facility maintenance, the emissions in the nonattainment areas can be calculated and compared with the applicable thresholds. Since the emissions thresholds defined under 40 CFR 93.153(b) are for any given year of the project, the maximum possible annual emissions are calculated for the nonattainment and maintenance areas.

Only tailpipe emissions from construction equipment emit CO (i.e., fugitive dust and windblown dust do not produce CO). The amount of CO emitted by construction equipment in the nonattainment area is based on the proposed length of pipeline (8.8 miles) and power line (0) to be constructed in Las Vegas Valley. It can be conservatively assumed that construction of 8.8 miles of pipeline will take less than 100 days. One hundred days of pipeline construction and associated construction transportation would emit 15 tons per year of CO in the nonattainment area, which is well below the 100 tons per year conformity threshold. Therefore, a conformity determination is not required for this project for CO.

Only tailpipe emissions from construction equipment emit ozone precursors (i.e., fugitive dust and windblown dust do not produce NO_X or VOC emissions). The amount of NO_X and VOC emitted by construction equipment in the nonattainment area is based on the proposed length of pipeline (28.1 miles) and power line (14.6 miles) to be constructed in HB 212, Las Vegas Valley; HB 216, Garnet Valley; HB 217, Hidden Valley; and HB 218, California Wash Valley. It can be conservatively assumed that construction of 28.1 miles of pipeline and 14.6 miles of power line will take less than 150 days. One hundred and fifty days of pipeline construction, power line construction, and associated construction transportation would emit 8 tons per year of VOC and 63 tons per year of NO_X in the nonattainment area, well below the 100 tons per year conformity threshold. Therefore, a conformity determination is not required for this project for ozone.

To assess the PM_{10} project emissions in the nonattainment area, all sources of PM_{10} were estimated, including tailpipe emissions, fugitive dust, and windblown dust. The Nevada PM_{10} nonattainment area is limited to HB 212, Las Vegas Valley. Therefore, the same method described above to calculate CO tailpipe emissions was used to calculate PM_{10} tailpipe emissions. One hundred days of pipeline construction and associated construction transportation would emit 2 tons per year of PM_{10} in the nonattainment area. To calculate the fugitive and windblown dust in the Nevada PM_{10} nonattainment area, the estimated area of surface disturbance during construction is 241 acres in Las Vegas Valley. If this whole area was actively being constructed in a year, the USEPA emission factor for fugitive dust could be multiplied by the estimated acres of active construction and applying a 50 percent control efficiency. With these assumptions, the maximum fugitive dust PM_{10} emission rate for the nonattainment portions of the project area is 4 tons per year. Similarly, the PM_{10} emissions from windblown dust can be calculated by multiplying the USEPA emission factor for windblown dust by the estimated acres of surface disturbance and applying a 50 percent control efficiency. The resulting estimated PM_{10} windblown dust emissions for the nonattainment portions of the project area are 34 tons per year.

Altogether the maximum annual PM_{10} emission rate within the nonattainment area due to ROW activities would be 40 tons per year, this includes tailpipe emissions, fugitive dust, and windblown dust. The PM_{10} emissions in the nonattainment area are less than the conformity threshold of 70 tons per year. Therefore, a conformity determination is not required for this project for PM_{10}.

<u>Conclusion</u>. Portions of Clark County, Nevada, are designated as nonattainment areas for CO and PM_{10} and a designation of nonattainment for ozone is expected shortly. There are no areas of the ROW that extend into Utah; therefore, Utah nonattainment designations are not considered in the evaluation of the ROW impacts. It is estimated that the project would emit 15 tons of CO per year, 8 tons of VOC per year, 63 tons of NO_X per year, and 40 tons of PM_{10} per year in the Nevada nonattainment areas. This is well below the conformity threshold for each pollutant. Therefore, a conformity determination is not required for this project.

Proposed mitigation measures:

None.

Residual impacts include:

None.

Entrainment of Radionuclides or Erionite from Construction Activities

As described in Section 3.4, Soils, soil testing for radioactive nuclides in the project area has shown that any fallout from nuclear testing conducted in the past has decayed to low levels that are not considered harmful to human health. Likewise, any fugitive dust generated by construction activities will not contain radioactive material from past nuclear testing at levels that are harmful to human health.

As described in Section 3.2, Geology, erionite has not been identified in the project area. Therefore, it not expected that erionite deposits will be exposed and suspended into the air during construction activities.

<u>Conclusion</u>. The project is not expected to contribute to increases in radionuclides or erionite.

Proposed mitigation measures:

None.

Residual impacts include:

None.

<u>Summary of Proposed Action and Alternatives A, B, and C</u>

The estimated long-term (residual) emissions from construction and maintenance of the ROW are shown in **Table 3.1-9**.

Tailpipe Emissions from Construction Equipment and Facility Maintenance

It is assumed that construction occurs 12 hours per day, 300 days per year. It is assumed that only a third of the construction fleet is operating at a given time. Maintenance vehicles will inspect the length of the pipeline and power line once a week. ACMs include measures that are required by state and local regulations, such as obtaining dust control permits and operating permits. Implementation of these measures would result in estimated annual emissions from construction and maintenance activities varying between less than 1 ton per year of SO_2 to approximately 24,000 metric tons of CDE. Localized air emissions due to construction activities are expected to be short term (5 years or less), while maintenance activities are expected to occur for the life of the project. Long-term impacts to air quality from maintenance vehicles are minimal and range from close to 0 tons per year of SO_2 up to approximately 8 metric tons per year of CDE. Emissions from construction and maintenance are not expected to cause or contribute to exceedences of any AAQS. Emissions from construction and maintenance are not expected to impair visibility conditions at the GBNP.

Table 3.1-9 Long-term Emissions from Right-of-way Construction and Maintenance for Proposed Action, Alternatives A through C

Source	CO		VOC		NO_X		SO_2		PM_{10}		CDE	
	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tonnes per Year
Tailpipe Emissions from Maintenance Vehicles	0	0.06	0.04	0.01	0.04	0.01	0.00	0.00	0.00	0.00	55	7.55
Fugitive Dust from Maintenance	-	-	-	-	-	-	-	-	9	1	-	-
Windblown Dust from Permanent ROW	-	-	-	-	-	-	-	-	792	144	-	-
Total Long-term Emissions	**0**	**0.06**	**0.04**	**0.01**	**0.04**	**0.01**	**0.00**	**0.00**	**801**	**146**	**55**	**8**

Fugitive Dust from Construction and Facility Maintenance Activities

The construction of 306 miles of pipeline, 322 miles of power lines, and ancillary facilities requires disturbance of a large surface area. Fugitive dust is generated during construction and maintenance activities. Mitigation measures ROW-AQ-1 (inspection and repair of project roads) and ROW-AQ-2 (application of tackifiers and gravel) can be effective at minimizing fugitive dust. Implementation of the federal and state requirements, ACMs, and proposed mitigation measures should effectively mitigate fugitive dust impacts to air quality. Localized fugitive dust emissions due to construction activities are expected to be short term (5 years or less). It is estimated that 176 tons per year of PM_{10} and 18 tons per year of $PM_{2.5}$ will be emitted in the project area during construction. Localized fugitive dust emissions due to maintenance activities are expected to continue for the life of the project. It is estimated that 6 tons per year of PM_{10} and 1 ton per year of $PM_{2.5}$ will be emitted in the project area due to fugitive dust associated with maintenance vehicles. Fugitive dust emissions from maintenance vehicles are not expected to impair visibility conditions at the GBNP.

Wind Blown Dust from Disturbed Surfaces

The construction activities are anticipated to disturb the surface of 12,303 acres and create a permanent ROW of 1,014 acres. Disturbed surfaces are more prone to wind erosion. A majority of the windblown dust emissions due to surfaces disturbed during construction are expected to be short term (5 years or less) until surfaces are revegetated as part of ACMs. It is estimated the short-term PM_{10} windblown dust would be 1,750 tons per year and the $PM_{2.5}$ windblown dust would be 175 tons per year over the whole project area. The windblown dust over the ROW areas that will not be revegetated (and the impacts are therefore long-term) is estimated to be 144 tons per year of PM_{10} and 14 tons per year of $PM_{2.5}$ near the permanent ROW. Windblown dust emissions from disturbed surfaces are not expected to impair visibility conditions at the GBNP.

Conformity Review for Non-attainment Areas

Portions of Clark County, Nevada, are designated as nonattainment areas for ozone and PM_{10} and as maintenance for CO. There are no areas of the ROW that extend into Utah; therefore, Utah nonattainment designations are not considered in the evaluation of the ROW impacts. The construction duration was estimated for each nonattainment and maintenance area. In the CO maintenance and PM_{10} nonattainment areas, it is estimated that the construction duration is 100 days. In the ozone nonattainment area, it is estimated that the construction duration is 150 days. In addition, the total surface area disturbed in the PM_{10} nonattainment area is estimated to be 241 acres. Based on these conservative assumptions, the project would emit 15 tons of CO per year, 8 tons of VOC per year, 63 tons of NO_X per year, and 40 tons of PM_{10} per year in the Nevada nonattainment and maintenance areas. This is well below the conformity threshold for each pollutant. Therefore, a conformity determination is not required for this project.

Entrainment of Radionuclides or Erionite from Construction Activities

The project is not expected to contribute to increases in radionuclides or erionite.

3.1.2.3 Alternative D

The proposed development of Alternative D within the ROW areas is described in detail in Chapter 2. Chapter 2 also provides estimates of surface disturbance from construction related activities. In summary, the development would include construction of 225 miles of pipeline, 208 miles of overhead power lines, and 2 primary and 2 secondary electrical substations. Ancillary facilities that would be developed include two pumping stations, five regulating tanks, three pressure reducing stations, a water treatment facility, a buried storage reservoir, access roads, and communication facilities.

The proposed GWD Project would generate air emissions through short-term construction activities. Construction air emissions include criteria pollutants, ozone precursors, fugitive dust, and greenhouse gas emissions. The actual fugitive dust emissions would depend on many site-specific factors such as the moisture content and texture of the soils that would be disturbed. Continued air quality impacts due to wind erosion of surfaces disturbed during construction will continue, at decreasing levels, until most surfaces are revegetated. The estimated long-term emissions from construction and maintenance of the ROW for Alternative D are shown in **Table 3.1-10**.

Table 3.1-10 Long-term Emissions from Right-of-way Construction and Maintenance for Alternative D

Source	CO		VOC		NO_X		SO_2		PM_{10}		CDE	
	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tonnes per Year
Tailpipe Emissions from Maintenance Vehicles	0	0.04	0.03	0.00	0.03	0.00	0.00	0.00	0.00	0.00	38	5.20
Fugitive Dust from Maintenance	-	-	-	-	-	-	-	-	6	1	-	-
Windblown Dust from Permanent ROW	-	-	-	-	-	-	-	-	643	117	-	-
Total Long-term Emissions	0	0.04	0.03	0.00	0.03	0.00	0.00	0.00	649	118	38	5

Summary of Alternative D

Tailpipe Emissions from Construction Equipment and Facility Maintenance

It is assumed that construction occurs 12 hours per day, 300 days per year. It is assumed that only a third of the construction fleet is operating at a given time. Maintenance vehicles will inspect the length of the pipeline and power line once a week. ACMs include measures that are required by state and local regulations, such as obtaining dust control permits and operating permits. Implementation of these measures would result in an estimated annual emissions from construction and maintenance activities varying between less than 1 ton per year of SO_2 to approximately 24,000 metric tons of CDE. Localized air emissions due to construction activities are expected to be short term (5 years or less), while maintenance activities are expected to occur for the life of the project. Long-term impacts to air quality from maintenance vehicles are minimal and range from close to 0 tons per year of SO_2 up to approximately 5 metric tons per year of CDE. Emissions from construction and maintenance are not expected to cause or contribute to exceedences of any AAQs. Emissions from construction and maintenance are not expected to impair visibility conditions at the GBNP.

Fugitive Dust from Construction and Facility Maintenance Activities

The construction of 225 miles of pipeline, 208 miles of power lines, and ancillary facilities require disturbance of a large surface area. Fugitive dust is generated during construction and maintenance activities. Mitigation measures ROW-AQ-1 (inspection and repair of project roads) and ROW-AQ-2 (application of tackifiers and gravel) can be effective at minimizing fugitive dust. Implementation of the federal and state requirements, ACMs, and proposed mitigation measures should effectively mitigate fugitive dust impacts to air quality. Localized fugitive dust emissions due to construction activities are expected to be short term (5 years or less). It is estimated that 174 tons per year of PM_{10} and 17 tons per year of $PM_{2.5}$ will be emitted in the project area during construction. Localized fugitive dust emissions due to maintenance activities are expected to continue for the life of the project. It is estimated that 1 ton per year of PM_{10} and less than 1 ton per year of $PM_{2.5}$ will be emitted in the project area due to fugitive dust associated with maintenance vehicles. Fugitive dust emissions from maintenance vehicles are not expected to impair visibility conditions at the GBNP.

Wind Blown Dust from Disturbed Surfaces

The construction activities associated with this alternative are anticipated to disturb the surface of 8,843 acres and have a permanent ROW of 823 acres. Disturbed surfaces are more prone to wind erosion. A majority of the windblown dust emissions due to surfaces disturbed during construction are expected to be short term (5 years or less) until surfaces are revegetated as part of ACMs. It is estimated the short-term PM_{10} windblown dust would be 1,260 tons per year and the $PM_{2.5}$ windblown dust would be 126 tons per year over the whole project area. The windblown dust over the ROW areas that will not be revegetated (and the impacts are therefore long-term) is estimated to be 117 tons per year of PM_{10} and 12 tons per year of $PM_{2.5}$ near the permanent ROW. Windblown dust emissions from disturbed surfaces are not expected to impair visibility conditions at the GBNP.

Conformity Review for Non-attainment Areas

Portions of Clark County, Nevada, are designated as nonattainment areas for ozone and PM_{10} and as maintenance for CO. There are no areas of the ROW that extend into Utah; therefore, Utah nonattainment designations are not considered in the evaluation of the ROW impacts. The construction duration was estimated for each nonattainment and maintenance area. In the CO maintenance and PM_{10} nonattainment areas, it is estimated that the construction duration is 100 days. In the ozone nonattainment area, it is estimated that the construction duration is 150 days. In addition, the total surface area disturbed in the PM_{10} nonattainment area is estimated to be 241 acres. Based on these conservative assumptions, the project would emit 15 tons of CO per year, 8 tons of VOC per year, 63 tons of NO_x per year, and 40 tons of PM_{10} per year in the Nevada nonattainment and maintenance areas. This is well below the conformity threshold for each pollutant. Therefore, a conformity determination is not required for this project.

Entrainment of Radionuclides or Erionite from Construction Activities

The project is not expected to contribute to increases in radionuclides or erionite.

3.1.2.4 Alternative E

The proposed development of Alternative E within the ROW areas is described in detail in Chapter 2. Chapter 2 also provides estimates of surface disturbance from construction related activities. In summary, the development would include construction of 263 miles of pipeline, 280 miles of overhead power lines, and two primary and four secondary electrical substations. Ancillary facilities that would be developed include three pumping stations, five regulating tanks, three pressure reducing stations, a water treatment facility, a buried storage reservoir, access roads, and communication facilities.

The proposed GWD Project would generate air emissions through short-term construction activities. Construction air emissions include criteria pollutants, ozone precursors, fugitive dust, and greenhouse gas emissions. The actual fugitive dust emissions would depend on many site-specific factors such as the moisture content and texture of the soils that would be disturbed. Continued air quality impacts due to wind erosion of surfaces disturbed during construction will continue, at decreasing levels, until most surfaces are revegetated. The estimated long-term emissions from construction and maintenance of the ROW for Alternative E are shown in **Table 3.1-11**.

Summary of Alternative E

Tailpipe Emissions from Construction Equipment and Facility Maintenance

It is assumed that construction occurs 12 hours per day, 300 days per year. It is assumed that only a third of the construction fleet is operating at a given time. Maintenance vehicles will inspect the length of the pipeline and power line once a week. ACMs include measures that are required by state and local regulations, such as obtaining dust control permits and operating permits. Implementation of these measures would result in an estimated annual emissions from construction and maintenance activities varying between less than 1 ton per year of SO_2, to approximately 24,000 metric tons of CDE. Localized air emissions due to construction activities are expected to be short term (5 years or less), while maintenance activities are expected to occur for the life of the project. Long-term impacts to air quality from maintenance vehicles are minimal and range from close to 0 tons per year of SO_2 up to approximately 7 metric tons per year of CDE. Emissions from construction and maintenance are not expected to cause or contribute to exceedences of any AAQs. Emissions from construction and maintenance are not expected to impair visibility conditions at the GBNP.

Fugitive Dust from Construction and Facility Maintenance Activities

The construction of 263 miles of pipeline, 280 miles of power lines, and ancillary facilities require disturbance of a large surface area. Fugitive dust is generated during construction and maintenance activities. Mitigation measures ROW-AQ-1 (inspection and repair of project roads) and ROW-AQ-2 (application of tackifiers and gravel) can be effective at minimizing fugitive dust. Implementation of the federal and state requirements, ACMs, and proposed mitigation measures should effectively mitigate fugitive dust impacts to air quality. Localized fugitive dust emissions due to construction activities are expected to be short term (5 years or less). It is estimated that 175 tons per year of PM_{10} and 18 tons per year of $PM_{2.5}$ will be emitted in the project area during construction. Localized fugitive dust emissions due to maintenance activities are expected to continue for the life of the project. It is estimated that 1 ton per year of PM_{10} and less than 1 ton per year of $PM_{2.5}$ will be emitted in the project area due to fugitive dust associated with maintenance vehicles. Fugitive dust emissions from maintenance vehicles are not expected to impair visibility conditions at the GBNP.

Windblown Dust from Disturbed Surfaces

The construction activities associated with this alternative are anticipated to disturb the surface of 10,696 acres and creat a permanent ROW of 960 acres. Disturbed surfaces are more prone to wind erosion. A majority of the windblown dust emissions due to surfaces disturbed during construction are expected to be short term (5 years or less) until surfaces are revegetated as part of ACMs. It is estimated the short-term PM_{10} windblown dust would be 1,525 tons per year and the $PM_{2.5}$ windblown dust would be 152 tons per year over the whole project area. The windblown dust over the ROW areas that will not be revegetated (and the impacts are therefore long-term) is estimated to be 137 tons per year of PM_{10} and 14 tons per year of $PM_{2.5}$ near the permanent ROW. Windblown dust emissions from disturbed surfaces are not expected to impair visibility conditions at the GBNP.

Table 3.1-11 Long-term Emissions from Right-of-way Construction and Maintenance for Alternative E

Source	CO		VOC		NO_x		SO_2		PM_{10}		CDE	
	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tonnes per Year
Tailpipe Emissions from Maintenance Vehicles	0	0.05	0.04	0.01	0.04	0.01	0.00	0.00	0.00	0.00	48	6.53
Fugitive Dust from Maintenance	-	-	-	-	-	-	-	-	8	1	-	-
Windblown Dust from Permanent ROW	-	-	-	-	-	-	-	-	750	137	-	-
Total Long-term Emissions	0	0.05	0.04	0.01	0.04	0.01	0.00	0.00	757	138	48	7

Conformity Review for Non-attainment Areas

Portions of Clark County, Nevada, are designated as nonattainment areas for ozone and PM_{10} and as maintenance for CO. There are no areas of the ROW that extend into Utah; therefore, Utah nonattainment designations are not considered in the evaluation of the ROW impacts. The construction duration was estimated for each nonattainment and maintenance area. In the CO maintenance and PM_{10} nonattainment areas, it is estimated that the construction duration is 100 days. In the ozone nonattainment area, it is estimated that the construction duration is 150 days. In addition, the total surface area disturbed in the PM_{10} nonattainment area is estimated to be 241 acres. Based on these conservative assumptions, the project would emit 15 tons of CO per year, 8 tons of VOC per year, 63 tons of NO_X per year, and 40 tons of PM_{10} per year in the Nevada nonattainment and maintenance areas. This is well below the conformity threshold for each pollutant. Therefore, a conformity determination is not required for this project.

Entrainment of Radionuclides or Erionite from Construction Activities

The project is not expected to contribute to increases in radionuclides or erionite.

3.1.2.5 Alignment Options 1 through 4

There is a negligible change to air quality impacts for Alignment Options 1 through 4 relative to the Proposed Action. The change in the acres of surface disturbance for these alignment options is less than 1 percent, which is less than the uncertainty in the emission factors used to estimate emissions. For all intents and purposes, the air quality impacts estimated for the ROW Proposed Action are considered to be applicable to Alignment Options 1 through 4.

3.1.2.6 No Action

Under the No Action Alternative, the proposed project would not be constructed or maintained. No project-related surface disturbance would occur. Natural (biogenic) and human (anthropogenic) sources of pollutant emissions would continue. Anthropogenic emissions are expected to increase in proportion to projected population increases in Lincoln County (see Section 3.18). Without project surface disturbance, there would be some increase in current levels of fugitive dust generation due to continued groundwater pumping activities. Current anthropogenic activities, as well as natural wind conditions, would continue to generate dust as discussed in Section 3.1.1.1. Climate changes would continue; the scale of these changes would depend on the interactions of the atmospheric and oceanic circulation patterns and level of future anthropogenic emissions of greenhouse gases.

3.1.2.7 Comparison of Alternatives

Generally, the impacts to air quality from the ROW construction and maintenance are very similar among alternatives. **Table 3.1-12** shows the estimated maximum annual construction emissions for each alternative for each pollutant. Only the emissions of PM_{10} and $PM_{2.5}$ vary between alternatives since PM emissions depend on the acres of surface disturbance. The emissions of all other pollutants depend on the tailpipe emissions from construction activities, which, over a year, are the same for each alternative. **Table 3.1-13** shows the estimated long-term (residual) maintenance emissions for each alternative for each pollutant. The maintenance emissions for all pollutants depend on the length and area of the permanent ROWs for the pipeline and power line, which vary slightly for each alternative. **Table 3.1-14** summarizes the impacts to all air quality metrics from ROW construction and maintenance activities for each alternative.

Table 3.1-12 Estimated Maximum Annual Emissions from Right-of-way Construction of the Proposed Action, Alternatives A through E and Alignment Options 1 through 4

	CO	VOC	NO_X	SO_2	PM_{10}	$PM_{2.5}$	CDE
Alternative	**Tons per Year**	**Tons per Year**	**Tons per Year**	**Tons per Year**	**Tons per Year**	**Tons per Year**	**Tonnes per Year**
Proposed Action, Alternatives A through C, and Alignment Options 1 through 4	104	29	234	0.3	1,940	204	23,896
Alternative D	104	29	234	0.3	1,445	154	23,896
Alternative E	104	29	234	0.3	1,710	181	23,896

Table 3.1-13 Estimated Long-term (Residual) Annual Emissions from Right-of-way Maintenance of the Proposed Action, Alternatives A through E and Alignment Options 1 through 4

	CO	VOC	NO_X	SO_2	PM_{10}	$PM_{2.5}$	CDE
Alternative	**Tons per Year**	**Tons per Year**	**Tons per Year**	**Tons per Year**	**Tons per Year**	**Tons per Year**	**Tonnes per Year**
Proposed Action, Alternatives A through C, and Alignment Options 1 through 4	0.06	0.01	0.01	8.1E-05	146	15	8
Alternative D	0.04	0.00	0.00	5.6E-05	118	12	5
Alternative E	0.05	0.01	0.01	7.0E-05	138	14	7

Table 3.1-14 Summary of Impacts to Air Quality from Right-of-way Construction and Maintenance of the Proposed Action and Alternatives A through E, and Alignment Options 1 through 4

Parameter	Proposed Action, Alternatives A through C, and Alignment Options 1 through 4	Alternative D	Alternative E
Tailpipe emissions	Maximum annual emissions from construction equipment range from less than 1 ton per year of SO_2, to approximately 24,000 metric tons of CDE. Long-term annual emissions from maintenance equipment range from close to 0 tons per year of SO_2 up to approximately 8 metric tons per year of CDE.	Maximum annual emissions from construction equipment range from less than 1 ton per year of SO_2, to approximately 24,000 metric tons of CDE. Long-term annual emissions from maintenance equipment range from close to 0 tons per year of SO_2 up to approximately 5 metric tons per year of CDE.	Maximum annual emissions from construction equipment range from less than 1 ton per year of SO_2, to approximately 24,000 metric tons of CDE. Long-term annual emissions from maintenance equipment range from close to 0 tons per year of SO_2 up to approximately 7 metric tons per year of CDE.
Fugitive Dust	Maximum annual emissions from construction fugitive dust are 176 tons per year of PM_{10} and 18 tons per year of $PM_{2.5}$. Long-term annual emissions from maintenance fugitive dust are 1 ton per year of PM_{10} and less than 1 ton per year of $PM_{2.5}$.	Maximum annual emissions from construction fugitive dust are 174 tons per year of PM_{10} and 17 tons per year of $PM_{2.5}$. Long-term annual emissions from maintenance fugitive dust are 1 ton per year of PM_{10} and less than 1 ton per year of $PM_{2.5}$.	Maximum annual emissions from construction fugitive dust are 175 tons per year of PM_{10} and 18 tons per year of $PM_{2.5}$. Long-term annual emissions from maintenance fugitive dust are 1 ton per year of PM_{10} and less than 1 ton per year of $PM_{2.5}$.
Windblown Dust	Maximum annual emissions from windblown dust due to surfaces disturbed by construction activities are 1,750 tons per year of PM_{10} and 175 tons per year of $PM_{2.5}$. Long-term annual emissions of windblown dust from surfaces disturbed by maintenance activities are 144 tons per year of PM_{10} and less than 14 tons per year of $PM_{2.5}$.	Maximum annual emissions from windblown dust due to surfaces disturbed by construction activities are 1,260 tons per year of PM_{10} and 126 tons per year of $PM_{2.5}$. Long-term annual emissions of windblown dust from surfaces disturbed by maintenance activities are 117 tons per year of PM_{10} and 12 tons per year of $PM_{2.5}$.	Maximum annual emissions from windblown dust due to surfaces disturbed by construction activities are 1,525 tons per year of PM_{10} and 152 tons per year of $PM_{2.5}$. Long-term annual emissions of windblown dust from surfaces disturbed by maintenance activities are 137 tons per year of PM_{10} and 14 tons per year of $PM_{2.5}$.
Conformity Review	All project emissions in nonattainment areas are less than conformity thresholds. No conformity determination is required for this project.	All project emissions in nonattainment areas are less than conformity thresholds. No conformity determination is required for this project.	All project emissions in nonattainment areas are less than conformity thresholds. No conformity determination is required for this project.
Radionuclides and erionite	The project is not expected to contribute to increases in radionuclides or erionite.	The project is not expected to contribute to increases in radionuclides or erionite.	The project is not expected to contribute to increases in radionuclides or erionite.

3.1.2.8 Groundwater Development and Groundwater Pumping

Issues

Groundwater Development Construction and Facility Maintenance

- Air pollutants emitted from the tailpipes of construction equipment, including criteria pollutants, ozone precursors, and greenhouse gas emissions.
- Fugitive dust generated during construction and facility maintenance.
- Windblown dust generated due to wind erosion of surfaces disturbed by construction and facility maintenance.
- Impairment of visibility conditions at the GBNP due to construction and facility maintenance.
- Entrainment and transport of radioactive material and erionite due to wind erosion of disturbed surfaces.

Groundwater Pumping

- Windblown dust generated due to wind erosion of surfaces disturbed from groundwater pumping.
- Impairment of visibility conditions at the GBNP due to wind erosion of surfaces disturbed from groundwater pumping.
- Indirect greenhouse gas emissions from groundwater pumping energy requirements.
- Changes in Salt Lake City's PM_{10} air quality due to the effects of groundwater pumping on soils and vegetation.

Assumptions

Assumptions regarding compliance with regulatory requirements, detailed project operations, inputs for emission factors, and future conditions are required to estimate impacts to air quality and climate.

Key assumptions regarding compliance with regulatory requirements include:

- All state and local air quality construction permits will be received prior to initiation of project construction.
- Any operating permits or dust control plans required in nonattainment areas will address any conformity requirements (although no groundwater development activities are planned in nonattainment areas at this time) or demonstrate that total emissions in nonattainment areas will be below applicable thresholds.

Groundwater Development Construction and Facility Maintenance

- The Ely and Las Vegas RMP management actions and BMPs would be applied to all proposed construction activities, based on the most current RMPs – Ely 2008; Las Vegas 1998 (BLM 2008, 1998).
- The ACMs included in the SNWA POD to manage surface disturbance effects for ROWs provide a basis for appropriate measures that may be submitted in future SNWA ROW applications. For purposes of impact analysis, it has been assumed that measures appropriate for ROW construction would be applied to construction in groundwater development areas.
- In order to estimate emission rates of air pollutants and greenhouse gases, two types of data are required: activity data and emission factors. In the absence of actual activity data (e.g., estimates of the number and types of required construction equipment), emissions calculations for groundwater development construction activities cannot be performed. Rather, it is assumed that the magnitude of groundwater development construction emissions will be qualitatively similar to the ROW construction on a short-term annual basis. This assumption implies that the assumptions made in the estimation of ROW construction emissions are appropriate for groundwater development construction emissions.
- Similarly, the long-term impacts associated with maintenance of groundwater development wells and collector pipelines are assumed to be qualitatively similar to the ROW maintenance impacts. This assumption implies that the assumptions made in the estimation of ROW maintenance emissions are appropriate for groundwater development maintenance emissions.

Assumptions regarding future conditions are required to estimate future long-term project impacts. Importantly, the expected changes in soil surface conditions are critical for the estimation of future fugitive dust impacts due to groundwater drawdown. Soil surface conditions were categorized based on ET units defined for the groundwater modeling analysis (see Section 3.3, Water Resources) and vegetation analysis (see Section 3.5, Vegetation Resources). ET units and assumptions regarding their capability to generate fugitive dust are further explained in the next section.

Changes in Salt Lake City's PM_{10} air quality, due to the effects of groundwater pumping on soils and vegetation, will be addressed in the cumulative impacts Section 3.1.2.3.

Methodology for Analysis

For the estimation of air quality related impacts, the methodology depends on the activity (construction, pumping, etc.) and the type of air impacts (criteria emissions, greenhouse gases, etc.). The activity/air impact combinations are grouped based on the methodology used to estimate impacts. The calculation methodology for each category is described below.

The different methodologies for developing air impacts are grouped into the following categories:

- Groundwater Development Construction and Operational Maintenance
  - Tailpipe emissions
  - Fugitive dust
  - Greenhouse gases
  - Radionuclides and erionite
  - Fugitive dust from maintenance activities
- Groundwater Pumping
  - Windblown dust from soils exposed as a result of groundwater pumping
  - Indirect greenhouse gas emissions from groundwater pumping energy requirements

Groundwater Development Construction and Facility Maintenance

In the absence of actual estimates of the number and type of required construction equipment, actual emissions estimates from construction activities cannot be calculated. Rather, it is assumed that the magnitude of groundwater field development construction and maintenance emissions will be qualitatively similar to the ROW construction and maintenance. Actual emissions calculations for groundwater development construction and maintenance activities will be revised, as required, based on project-specific data during the permit application phase. The methods outlined for ROW emissions calculations are applicable to emissions calculations for groundwater development surface development.

Groundwater Pumping

<u>Windblown Dust Emissions from Groundwater Drawdown</u>

Future windblown dust estimates are based on the primary ET units that were used for estimating water losses from the groundwater system via evaporation from soils and playas, and via vegetation transpiration, as described in Section 3.5, Vegetation Resources. Windblown dust impacts for each alternative are estimated based on the change in area for each ET unit. The percent of the area that is estimated to become susceptible to wind erosion is calculated for each ET unit as described below.

Playas: It is assumed that the soil binding properties of this cover type would not change as a result of groundwater drawdown. It is assumed that windblown dust from playa surfaces would remain at baseline levels.

Bare soil/sparse vegetation: It is assumed that these areas would become more susceptible to dust generation because wetted soils would dry out and become less cohesive. It is assumed for analysis that the entire surface area of this ET unit affected by groundwater drawdown would be susceptible to wind erosion.

Phreatophyte/medium vegetation: It is predicted that the composition and structure of this cover type may change toward higher dominance by upland and exotic annual species, and lower dominance by existing phreatophytic shrubs under long-term pumping regimes. It is expected that annual species would continuously bind the soil surface with living or dead root systems, even though the individual annual plants would not act as long-term barriers to wind. As is discussed in Section 3.5, Vegetation Resources, it is not expected that these affected areas would become barren of vegetation, rather there would be changes to species composition over time. In addition, plant canopy and soil stabilization by plant roots may vary from place to place. For a conservative estimate of air impacts, based on the possible changes in vegetative cover and soil structure the soil loss ratio is predicted to be 10 percent of bare soil conditions (Papendick 2004). Therefore, 10 percent of the surface area composed of this ET unit and affected by groundwater drawdown would be susceptible to wind erosion.

Wetland/meadow: It is predicted that this cover type may change in species composition toward a greater fraction of shrubs and drought tolerant grasses and forbs. It is assumed that the soil binding properties of this cover type would not change, even though species composition may change. None of the surface area composed of this ET unit would be susceptible to wind erosion.

The change in area for each ET unit is calculated relative to the No Action Alternative for a 10-foot groundwater drawdown for each alternative, similar to the calculations shown for consolidated ET units in Section 3.5, Vegetation Resources. The estimated change in surface area for each ET unit is projected for three periods: at full build out, at full build out plus 75 years, and at full build out plus 200 years. The percent of this area that will become susceptible to wind erosion is calculated for each ET unit as described above. The area that is susceptible to wind erosion is multiplied by the emission factor for wind erosion from the USEPA (USEPA 1998) to estimate total emissions of windblown dust. The fraction of TSP that is in the PM_{10} or $PM_{2.5}$ size range is estimated based on USEPA guidance (USEPA 1998; WRAP 2006), whereby 75 percent of the fugitive dust is in the PM_{10} size range and 10 percent of the PM_{10} is in the $PM_{2.5}$ size range.

<u>Greenhouse Gas Emissions</u>

The amount of electricity required to operate the pumps was estimated for each alternative. Annual electricity consumption was then used to estimate how much CDE would be released annually during the generation of the electricity based on the typical emissions of CDE from natural gas combustion in the project area.

3.1.2.9 Proposed Action

The construction and maintenance methods for well pad, collector pipelines, access roads, and distribution power lines are anticipated to be the same as those described for the mainline pipeline and ancillary facilities. Effects on air quality would also be similar, since the same activities will be conducted, with the exception that no construction will occur in Clark County nonattainment areas and therefore, a conformity review is not required. The major effect of future groundwater field development would be an expansion of surface disturbance activities over a large area within each hydrographic basin. Consequently, the ACMs for ROWs are applicable, and likely to be proposed as part of future ROW applications to the BLM.

Groundwater Development Area

Groundwater Development Construction and Facility Maintenance

<u>Short-term Emissions from Construction Equipment</u>

Localized air quality emissions due to construction activities are expected to be short term (5 years or less). Qualitatively, emissions will be similar to the values estimated for ROW construction activities for the Proposed Action (shown in **Table 3.1-9**), except for construction fugitive and windblown dust (PM_{10} and $PM_{2.5}$) which are a function of surface disturbance. Under the Proposed Action, groundwater development construction of well pads, access roads, collector pipelines, and power lines would result in an estimated maximum surface disturbance of approximately 8,400 acres. Based on the estimated disturbed surface area, fugitive and windblown dust emissions due to construction activities in the groundwater development areas would be approximately two-thirds of the emissions estimated for ROW construction activities for the Proposed Action (shown in **Table 3.1-14**). Maximum annual emissions from ROW construction activities are 176 tons per year of PM_{10} and 18 tons per year of $PM_{2.5}$ from fugitive dust and 1,750 tons per year of PM_{10} and 175 tons per year of $PM_{2.5}$ from windblown dust. Therefore, maximum annual emissions from groundwater development construction activities are 120 tons per year of PM_{10} and 12 tons per year of $PM_{2.5}$ from fugitive dust and 1,200 tons per year of PM_{10} and 120 tons per year of $PM_{2.5}$ from windblown dust. Emissions from construction are not expected to impair visibility conditions at the GBNP.

Proposed mitigation measures:

GW-AQ-1: Road Inspection and Repair. The SNWA and the BLM's Environmental Compliance Monitor shall inspect and repair project roads in areas prone to air and water erosion bi-weekly during construction. Effectiveness: This mitigation measure would be very effective at reducing construction related fugitive dust impacts. Implementation of this mitigation measure, combined with other federal and state requirements, would likely result in a substantial reduction of short-term fugitive dust impacts. This recommended measure would have a small (negligible) increase in vehicular traffic along the ROW during construction activities. Effect on other resources: Increased traffic will impact air, soils, water, and biological resources.

GW-AQ-2: Use of Soil Tackifiers. Soil tackifiers and other mitigation (e.g., gravel) may be selected in consultation with the BLM to reduce impacts and to ensure protection of public safety. This measure would replace the SNWA ACM A.10.3. Effectiveness: This mitigation measure would be moderately effective at reducing construction related fugitive dust impacts. Implementation of this mitigation measure, combined with other federal and state requirements, would likely result in a noticeable reduction of short-term fugitive dust impacts. This recommended measure would have a small (negligible) increase in construction activities and an increased requirement for raw materials (e.g., gravel).

Residual impacts:

- Impacts to air quality from groundwater development construction activities are predicted to range from less than 1 ton per year of SO_2 up to approximately 24,000 metric tons per year of CDE. Importantly, no construction activity is proposed for the nonattainment hydrologic basins; therefore, construction emissions do not need to be compared with conformity thresholds.

Long-term Emissions from Facility Maintenance

Long-term air pollutant emissions in the groundwater development areas from maintenance activities would be much less than the emissions generated from construction activities. Maintenance vehicles would generate small volumes of fugitive dust and tailpipe emissions, and groundwater development maintenance emissions are assumed to be qualitatively similar to the ROW maintenance emissions for the Proposed Action (shown in **Table 3.1-13**). Air emissions from groundwater development maintenance activities are predicted to range from almost 0 tons per year of SO_2 up to approximately 150 tons per year of PM_{10}. Emissions from maintenance are not expected to cause or contribute to exceedences of any AAQS. Emissions from maintenance are not expected to impair visibility conditions at the GBNP.

Entrainment of Radionuclides or Erionite from Construction Activities

Similar to the analysis for the ROW impact, there would not be re-suspension and transport of radionuclides from past nuclear testing at levels considered to be harmful to human health.

Conclusion. Construction of well pads, access roads, collector pipelines, and power lines would result in an estimated maximum surface disturbance of approximately 8,300 acres. It is assumed that short-term construction emissions will be qualitatively similar to the values estimated for ROW construction activities for the Proposed Action, although somewhat reduced levels of PM will be emitted due to the smaller amount of disturbed surface area. Long-term emissions from groundwater development maintenance activities are anticipated to be similar to the long-term emissions from ROW maintenance activities. The project is not expected to contribute to increases in radionuclides or erionite. It is assumed that: 1) SNWA would implement its ROW ACMs, including measures required as part of Dust Control Permits and other required operating permits; 2) SNWA would routinely inspect and repair project roads with a BLM inspector; and 3) SNWA would use soil tackifiers and other materials to suppress dust in accordance with the BLM approval. Based on these measures, it is expected that impacts due to construction would be minimized and short-term in nature and impacts are not expected to impair visibility conditions at GBNP. There would be a small incremental increase in the concentration of air pollutants in areas near the permanent groundwater development ROW during periods of maintenance.

Groundwater Pumping

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust would be generated from bare soil/sparse vegetation and phreatophyte ET units as the result of 10-foot or greater drawdown over different pumping time frames (**Table 3.1-15**). The Proposed Actions incremental PM_{10} emissions due to windblown dust after full build out are estimated to be approximately 1,800 tons per year more than the No Action Alternative. Given that the USEPA estimates $PM_{2.5}$ to be 10 percent of PM_{10} (WRAP 2006), the corresponding increase in $PM_{2.5}$ emissions due to windblown dust after full build out under the Proposed Action are estimated to be approximately 180 tons per year. The increase in PM_{10} emissions are estimated to be 24,000 tons per year and 34,700 tons per year, after full build out plus 75 and full build out plus 200 years, respectively. The increase in $PM_{2.5}$ emissions are estimated to be 2,400 tons per year and 3,470 tons per year after full build out plus 75 years and full build out plus 200 years, respectively. At these levels, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at the GBNP. The extent of possible visibility impairment is highly uncertain.

Table 3.1-15 Proposed Action, Estimated Increases in Windblown Dust from Evapotranspiration Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

ET Unit	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 75 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation[1]	4,901	78,821	114,168	1,397	22,464	32,538
Phreatophyte/ Medium Vegetation[1,2]	12,801	58,169	77,338	365	1,658	2,204
Total				**1,762**	**24,122**	**34,742**

[1] Components of the Basin Shrubland cover type (see Section 3.5, Vegetation Resources).

[2] For the purposes of calculating fugitive dust emissions from disturbed surfaces, 10 percent of the surface area of the "Phreatophyte/Medium Vegetation" ET unit is assumed to be susceptible to wind erosion.

Greenhouse Gas Emissions from Groundwater Pumping

Since the pump stations would be electrically powered and greenhouse gases are emitted during the generation of most electricity, the power requirements of this project have an indirect contribution to the emissions of greenhouse gases. The continuous power requirements to operate the pump stations and other ancillary equipment are estimated to be approximately 97 MW (**Table 2.6-1**). The continuous generation of this electricity amount is estimated to release approximately 327,000 tonnes of CDE per year, and is comparable to the emissions from the electricity use of nearly 35,000 homes for 1 year. For context, the estimated indirect greenhouse gas emissions from electricity generation for this alternative are less than 0.006 percent of the CDE estimated to be emitted by the U.S. and less than 0.6 percent of the CDE estimated to be emitted in Nevada.

These power requirements, and thus the associated CDE emissions, would be offset by electrical generation as part of the project via installation of hydroturbines (detailed in **Appendix E**) and solar panels to the extent possible. It is estimated that as much as 40 percent of the project's power requirements could be provided by the installation of hydroturbines at the three pressure reducing stations.

Monitoring and Mitigation. The stipulated agreements for Spring, Cave, Dry Lake, and Delamar valleys do not specify the development of air monitoring programs to respond to changes identified. In the draft Utah-Nevada Snake Valley agreement, the development of an air monitoring program is addressed, although until this agreement is final, there is no legal commitment to the measures identified in the agreement.

In its Protection Measures, **Appendix E**, SNWA outlined measures that could be used to mitigate adverse effects resulting from groundwater pumping. As part of measure B.1.2, solar panels will be used at monitoring wells to the extent possible to reduce power requirements. This measure would offset the estimated indirect greenhouse gas emissions associated with power needs.

SNWA also has developed an adaptive management program, whereby threshold values would be established and specific mitigation measures would go into effect when monitored values exceed the thresholds. SNWA has identified the protection of air quality as a goal in the adaptive management program. The specific measures relevant to air resources that are highly or somewhat dependent on groundwater sources include:

- C.2.5 Conduct large scale seeding to assist with vegetation transition from phreatophytic communities in Spring and Snake valleys, to benefit wildlife and reduce potential air resources impacts.

The monitoring, mitigation, and management plan for Snake Valley (3M plan) will include an air monitoring component as part of a broader program to monitor effects of groundwater drawdown (Section 3.3, Water Resources, Measure GW-WR-3). Specifically, the monitoring program will include the following elements: 1) development of a monitoring plan; and 2) siting and operation of at least one PM_{10} air monitoring station on the Utah side of Snake Valley.

Given the potential for large quantities of windblown dust to be generated as a result of groundwater pumping, the following mitigation measure is recommended:

GW-AQ-3: Monitoring, Mitigation, and Management Plan for Air Quality. SNWA will develop an air monitoring plan approved by the BLM, which will detail the siting and operation of at least three collocated PM_{10} and $PM_{2.5}$ air montiroing stations, one of which will be upwind of the project area. Recommended monitoring locations include Snake, Spring, and Lake valleys. These valleys are selected for consideration based on predicted changes to the Bar Soil/sparse vegetation ET unit, which has the greatest potential for windblown dust impacts. Baseline air measurements will be initiated at least a year prior to groundwater pumping construction activities, since these activities may increase measured particulate values. Once baseline air quality levels are established, monitoring will continue for the duration of groundwater pumping activities. Finally, the monitoring plan will comply with USEPA monitoring guidance[7] when selecting the site locations, and instruments, developing the data management plan, and establishing quality assurance criteria. Effectiveness: It is anticipated that the Plan would be effective in identifying early warning of potentially undesirable impacts to air resources and provide a substantial amount of time and flexibility to implement management measures and gage their effects. However, since groundwater development presumes some level of change to air quality and visibility, not all impacts would be avoided by this mitigation measure. Effects on other resources: This measure would have minor effects on resources impacted by proximity to the monitoring sites. In addition, this measure increases the project's overall power requirements due to power required for operation of the monitoring equipment.

Residual impacts include:

- Implementation of the air monitoring plan does not necessarily require a change to proposed groundwater pumping activities; therefore, the residual impacts may be identical to the predicted impacts.

[7] USEPA 2006. Quality Assurance Handbook for Air Pollution Measurement Systems. EPA-454/D-06-001. October 2006.

Conclusion

- It is predicted from model simulations that pumping drawdown of 10-feet and greater would potentially lead to changes in vegetation that could increase windblown dust emissions. The level and extent of these impacts are highly uncertain and the following estimated impacts should be used for comparison purposes only. It is estimated that an additional 1,700 tons of PM_{10} would be emitted per year after full build out, 24,000 tons of PM_{10} would be emitted per year for full build out plus 75 years, and 34,700 tons of PM_{10} would be emitted per year for full build out plus 200 years. Also, it is estimated that an additional 170 tons of $PM_{2.5}$ would be emitted per year after full build out, 2,400 tons of $PM_{2.5}$ would be emitted per year for full build out plus 75 years, and 3,470 tons of $PM_{2.5}$ would be emitted per year for full build out plus 200 years. At these levels, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at GBNP. The extent of possible visibility impairment is highly uncertain.
- Based on predicted power requirements for pumping activities, indirect emissions of greenhouse gases associated with electricity generation would be approximately 327,000 tonnes of CDE per year. These power requirements would be offset by electrical generation via installation of hydroturbines (**Appendix E**) and solar panels to the extent possible.
- The monitoring, mitigation, and management plan for Snake Valley will include PM_{10} and meteorological monitoring in Snake Valley, Utah. In order to strengthen the SNWA's adaptive management program, mitigation measure GW-AQ-3 is recommended.

3.1.2.10 Alternative A

Groundwater Development Area

Construction of well pads, access roads, collector pipelines, and power lines would result in an estimated maximum surface disturbance of approximately 4,700 acres. It is assumed that short-term construction emissions will be qualitatively similar to the values estimated for ROW construction activities for the Proposed Action, although somewhat reduced levels of PM will be emitted due to the smaller amount of disturbed surface area. Long-term emissions from groundwater development maintenance activities are anticipated to be similar to the long-term emissions from ROW maintenance activities. The project is not expected to contribute to increases in radionuclides or erionite.

It is assumed that: 1) the SNWA would implement its ROW ACMs, including measures required as part of Dust Control Permits and other required operating permits; 2) the SNWA would routinely inspect and repair project roads with a BLM inspector; and 3) the SNWA would use soil tackifiers and other materials to suppress dust in accordance with the BLM approval. Based on these measures, it is expected that impacts due to construction would be minimized and short-term in nature and impacts are not expected to impair visibility conditions at the GBNP. There would be a small incremental increase in the concentration of air pollutants in areas near the permanent groundwater development ROW during periods of maintenance.

Groundwater Pumping

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust would be generated from bare soil/sparse vegetation and phreatophyte ET units as the result of 10-foot or greater drawdown over different pumping time frames (**Table 3.1-16**). The incremental increase in PM_{10} emissions due to windblown dust after full build out are estimated to be approximately 1,000 tons per year relative to the No Action Alternative. Given that the USEPA estimates $PM_{2.5}$ to be 10 percent of PM_{10} (WRAP 2006), the corresponding increase in $PM_{2.5}$ emissions due to windblown dust after full build out under Alternative A are estimated to be approximately 100 tons per year. The increase in PM_{10} emissions are estimated to be 17,000 tons per year and 21,000 tons per year for full build out plus 75 years and full build out plus 200 years, respectively. The increase in $PM_{2.5}$ emissions are estimated to be 1,700 and 2,100 tons per year for after full build out plus 75 years and full build out plus 200 years, respectively. At these levels, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at the GBNP. The extent of possible visibility impairment is highly uncertain.

Table 3.1-16 Alternative A, Estimated Increases in Windblown Dust from Evapotranspiration Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

ET Unit	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 75 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 200 years)
Bare Soil/Sparse[1] Vegetation	2,785	55,224	67,743	794	15,739	19,307
Phreatophyte/ Medium Vegetation[1,2]	9,274	51,190	55,972	264	1,459	1,595
Total				**1,058**	**17,198**	**20,902**

[1] Component of the basin shrubland cover type (see Section 3.5).

[2] For the purposes of calculating fugitive dust emissions from disturbed surfaces, 10 percent of the surface area of the "Phreatophyte/Medium Vegetation" ET unit is assumed to be susceptible to wind erosion.

Greenhouse Gas Emissions from Groundwater Pumping

Since the pump stations would be electrically powered and greenhouse gases are emitted during the generation of most electricity, the power requirements of this project have an indirect contribution to the emissions of greenhouse gases. The continuous power requirements to operate the pump stations and other ancillary equipment are estimated to be approximately 74.4 MW (**Table 2.6-1**). The continuous generation of this electricity amount is estimated to release approximately 250,400 tonnes of CDE per year, and is comparable to the emissions from the electricity use of nearly 27,000 homes for 1 year. For context, the estimated indirect greenhouse gas emissions from electricity generation for this alternative are less than 0.0005 percent of the CDE estimated to be emitted by the U.S. and less than 0.5 percent of the CDE estimated to be emitted in Nevada.

These power requirements, and thus the associated CDE emissions, would be offset by electrical generation as part of the project via installation of hydroturbines (detailed in **Appendix E**) and solar panels to the extent possible. It is estimated that as much as 40 percent of the project's power requirements could be provided by the installation of hydroturbines at the three pressure reducing stations.

Conclusion

- It is predicted from model simulations that pumping drawdown of 10-feet and greater would potentially lead to changes in vegetation that could increase windblown dust emissions. The level and extent of these impacts are highly uncertain and the following estimated impacts should be used for comparison purposes only. It is estimated that an additional 1,000 tons of PM_{10} would be emitted per year after full build out, 17,000 tons of PM_{10} would be emitted per year for full build out plus 75 years, and 21,000 tons of PM_{10} would be emitted per year for full build out plus 200 years. Also, it is estimated that an additional 100 tons of $PM_{2.5}$ would be emitted per year after full build out, 1,700 tons of $PM_{2.5}$ would be emitted per year for full build out plus 75 years, and 2,100 tons of $PM_{2.5}$ would be emitted per year for full build out plus 200 years. At these levels, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at GBNP. The extent of possible visibility impairment is highly uncertain.
- Based on predicted power requirements for pumping activities, indirect emissions of greenhouse gas associated with electricity generation would be approximately 250,400 tonnes of CDE per year. These power requirements would be offset by electrical generation via installation of hydroturbines (**Appendix E**) and solar panels to the extent possible.

- The monitoring, mitigation, and management plan for Snake Valley will include PM_{10} and meteorological monitoring in Snake Valley, Utah. In order to strengthen SNWA's adaptive management program, mitigation measure GW-AQ-3 is recommended.

3.1.2.11 Alternative B

Groundwater Development Area

Construction of well pads, access roads, collector pipelines, and power lines would result in an estimated maximum surface disturbance of approximately 4,600 acres. It is assumed that short-term construction emissions will be qualitatively similar to the values estimated for ROW construction activities for the Proposed Action, although somewhat reduced levels of PM will be emitted due to the smaller amount of disturbed surface area. Long-term emissions from groundwater development maintenance activities are anticipated to be similar to the long-term emissions from ROW maintenance activities. The project is not expected to contribute to increases in radionuclides or erionite.

It is assumed that: 1) the SNWA would implement its ROW ACMs, including measures required as part of Dust Control Permits and other required operating permits; 2) the SNWA would routinely inspect and repair project roads with a BLM inspector; and 3) the SNWA would use soil tackifiers and other materials to suppress dust in accordance with the BLM approval. Based on these measures, it is expected that impacts due to construction would be minimized and short-term in nature and impacts are not expected to impair visibility conditions at the GBNP. There would be a small incremental increase in the concentration of air pollutants in areas near the permanent groundwater development ROW during periods of maintenance.

Groundwater Pumping

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust would be generated from bare soil/sparse vegetation and phreatophyte ET units as the result of 10-foot or greater drawdown over different pumping time frames (**Table 3.1-17**). It is estimated that an additional 1,700 tons of PM_{10} would be emitted per year after full build out, 14,000 tons of PM_{10} would be emitted per year after full build out plus 75 years, and 22,700 tons of PM_{10} would be emitted per year after full build out plus 200 years. Also, it is estimated that an additional 170 tons of $PM_{2.5}$ would be emitted per year after full build out, 1,400 tons of $PM_{2.5}$ would be emitted per year after full build out plus 75 years, and 2,300 tons of $PM_{2.5}$ would be emitted per year after full build out plus 200 years. At these levels, it is possible that windblown dust emission from groundwater drawdown could impair visibility conditions at the GBNP. The textent of possible visibility impairment is highly uncertain.

Table 3.1-17 Alternative B, Estimated Increases in Windblown Dust from Evapotranspiration Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

ET Unit	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 75 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation[1]	4,759	42,781	72,112	1,356	12,193	20,552
Phreatophyte/ Medium Vegetation[1,2]	13,545	54,393	74,886	386	1,550	2,134
Total				**1,742**	**13,743**	**22,686**

[1] Components of the basin shrubland cover type (see Section 3.5).
[2] For the purposes of calculating fugitive dust emissions from disturbed surfaces, 10 percent of the surface area of the "Phreatophyte/Medium Vegetation" ET unit is assumed to be susceptible to wind erosion.

Greenhouse Gas Emissions from Groundwater Pumping

Since the pump stations would be electrically powered and greenhouse gases are emitted during the generation of most electricity, the power requirements of this project have an indirect contribution to the emissions of greenhouse gases. The continuous power requirements to operate the pump stations and other ancillary equipment are estimated to be approximately 97 MW (**Table 2.6-1**). The continuous generation of this electricity amount is estimated to release approximately 327,000 tonnes of CDE per year, and is comparable to the emissions from the electricity use of nearly 35,000 homes for 1 year. For context, the estimated indirect greenhouse gas emissions from electricity generation for this alternative are less than 0.0006 percent of the CDE estimated to be emitted by the U.S. and less than 0.6 percent of the CDE estimated to be emitted in Nevada.

These power requirements, and thus the associated CDE emissions, would be offset by electrical generation as part of the project via installation of hydroturbines (detailed in **Appendix E**) and solar panels to the extent possible. It is estimated that as much as 40 percent of the project's power requirements could be provided by the installation of hydroturbines at the three pressure reducing stations.

Conclusion

- It is predicted from model simulations that pumping drawdown of 10-feet and greater would potentially lead to changes in vegetation that could increase windblown dust emissions. The level and extent of these impacts are highly uncertain and the following estimated impacts should be used for comparison purposes only. It is estimated that an additional 1,700 tons of PM_{10} would be emitted per year after full build out, 14,000 tons of PM_{10} would be emitted per year for full build out plus 75 years, and 22,700 tons of PM_{10} would be emitted per year for full build out plus 200 years. Also, it is estimated that an additional 170 tons of $PM_{2.5}$ would be emitted per year after full build out, 1,400 tons of $PM_{2.5}$ would be emitted per year for full build out plus 75 years, and 2,300 tons of $PM_{2.5}$ would be emitted per year for full build out plus 200 years. At these levels, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at the GBNP. The extent of possible visibility impairment is highly uncertain.
- Based on predicted power requirements for pumping activities, indirect emissions of greenhouse gases associated with electricity generation would be approximately 327,000 tonnes of CDE per year. These power requirements would be offset by electrical generation via installation of hydroturbines (**Appendix E**) and solar panels to the extent possible.
- The monitoring, mitigation, and management plan for Snake Valley will include PM_{10} and meteorological monitoring in Snake Valley, Utah. In order to strengthen the SNWA's adaptive management program, mitigation measure GW-AQ-3 is recommended.

3.1.2.12 Alternative C

Groundwater Development Area

Construction of well pads, access roads, collector pipelines, and power lines would result in an estimated maximum surface disturbance of approximately 4,800 acres. It is assumed that short-term construction emissions will be qualitatively similar to the values estimated for ROW construction activities for the Proposed Action, although somewhat reduced levels of PM will be emitted due to the smaller amount of disturbed surface area. Long-term emissions from groundwater development maintenance activities are anticipated to be similar to the long-term emissions from ROW maintenance activities. The project is not expected to contribute to increases in radionuclides or erionite.

It is assumed that: 1) the SNWA would implement its ROW ACMs, including measures required as part of Dust Control Permits and other required operating permits; 2) the SNWA would routinely inspect and repair project roads with a BLM inspector; and 3) the SNWA would use soil tackifiers and other materials to suppress dust in accordance with the BLM approval. Based on these measures, it is expected that impacts due to construction would be minimized and short-term in nature and impacts are not expected to impair visibility conditions at the GBNP. There would be a small incremental increase in the concentration of air pollutants in areas near the permanent groundwater development ROW during periods of maintenance.

Groundwater Pumping

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust would be generated from bare soil/sparse vegetation and phreatophyte ET units as the result of 10-foot or greater drawdown over different pumping time frames (**Table 3.1-18**). It is estimated that an additional 1,000 tons of PM_{10} would be emitted per year after full build out, 6,000 tons of PM_{10} would be emitted per year for full build out plus 75 years, and 7,000 tons of PM_{10} would be emitted for full build out plus 200 years. Also, it is estimated that an additional 100 tons of $PM_{2.5}$ would be emitted per year after full build out, 600 tons of $PM_{2.5}$ would be emitted for full build out plus 75 years, and 700 tons of $PM_{2.5}$ would be emitted for full build out plus 200 years. At these levels, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at GBNP. The extent of possible visibility impairment is highly uncertain.

Table 3.1-18 Alternative C, Estimated Increases in Windblown Dust from Evapotranspiration Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

ET Unit	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 75 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 200)
Bare Soil/Sparse Vegetation[1]	2,785	19,262	22,017	794	5,490	6,275
Phreatophyte/ Medium Vegetation[1,2]	9,274	23,440	28,059	264	668	800
Total				**1,058**	**6,158**	**7,075**

[1] Components of the basin shrubland cover type (see Section 3.5).

[2] For the purposes of calculating fugitive dust emissions from disturbed surfaces, 10 percent of the surface area of the "Phreatophyte/Medium Vegetation" ET unit is assumed to be susceptible to wind erosion.

Greenhouse Gas Emissions from Groundwater Pumping

Since the pump stations would be electrically powered and greenhouse gases are emitted during the generation of most electricity, the power requirements of this project have an indirect contribution to the emissions of greenhouse gases. The continuous power requirements to operate the pump stations and other ancillary equipment are estimated to be approximately 74.4 MW (**Table 2.6-1**). The continuous generation of this electricity amount is estimated to release approximately 250,400 tonnes of CDE per year, and is comparable to the emissions from the electricity use of nearly 27,000 homes for 1 year. For context, the estimated indirect greenhouse gas emissions from electricity generation for this alternative are less than 0.0005 percent of the CDE estimated to be emitted by the U.S. and less than 0.5 percent of the CDE estimated to be emitted in Nevada.

These power requirements, and thus the associated CDE emissions, would be offset by electrical generation as part of the project via installation of hydroturbines (detailed in **Appendix E**) and solar panels to the extent possible. It is estimated that as much as 40 percent of the project's power requirements could be provided by the installation of hydroturbines at the three pressure reducing stations.

Conclusion

- It is predicted from model simulations that pumping drawdown of 10-feet and greater would potentially lead to changes in vegetation that could increase windblown dust emissions. The level and extent of these impacts are highly uncertain and the following estimated impacts should be used for comparison purposes only. It is estimated that an additional 1,000 tons of PM_{10} would be emitted per year after full build out, 6,000 tons of PM_{10} would be emitted per year for full build out plus 75 years, and 7,000 tons of PM_{10} would be emitted per year for full build out plus 200 years. Also, it is estimated that an additional 100 tons of $PM_{2.5}$ would be emitted per year after full build out, 600 tons of $PM_{2.5}$ would be emitted per year for full build out plus 75 years, and 700 tons of $PM_{2.5}$ would be emitted per year for full build out plus 200 years. At these levels, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at the GBNP. The extent of possible visibility impairment is highly uncertain.

- Based on predicted power requirements for pumping activities, indirect emissions of greenhouse gases associated with electricity generation would be approximately 250,400 tonnes of CDE per year. These power requirements would be offset by electrical generation via installation of hydroturbines (**Appendix E**) and solar panels to the extent possible.
- The monitoring, mitigation, and management plan for Snake Valley will include PM_{10} and meteorological monitoring in Snake Valley, Utah. In order to strengthen the SNWA's adaptive management program, mitigation measure GW-AQ-3 is recommended.

3.1.2.13 Alternative D

Groundwater Development Area

Construction of well pads, access roads, collector pipelines, and power lines would result in an estimated maximum surface disturbance of approximately 4,000 acres. It is assumed that short-term construction emissions will be qualitatively similar to the values estimated for ROW construction activities for the Proposed Action, although somewhat reduced levels of PM will be emitted due to the smaller amount of disturbed surface area. Long-term emissions from recommended monitoring maintenance activities are anticipated to be similar to the long-term emissions from ROW maintenance activities. The project is not expected to contribute to increases in radionuclides or erionite.

It is assumed that: 1) the SNWA would implement its ROW ACMs, including measures required as part of Dust Control Permits and other required operating permits; 2) the SNWA would routinely inspect and repair project roads with a BLM inspector; and 3) the SNWA would use soil tackifiers and other materials to suppress dust in accordance with the BLM approval. Based on these measures, it is expected that impacts due to construction would be minimized and short-term in nature and impacts are not expected to impair visibility conditions at GBNP. There would be a small incremental increase in the concentration of air pollutants in areas near the permanent recommended monitoring ROW during periods of maintenance.

Groundwater Pumping

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust would be generated from bare soil/sparse vegetation and phreatophyte ET units as the result of 10-foot or greater drawdown over different pumping time frames (**Table 3.1-19**). It is estimated that no additional PM_{10} would be emitted per year after full build out, 2,000 tons of PM_{10} would be emitted per year after full build out plus 75 years, and 11,000 tons of PM_{10} would be emitted per year after full build out plus 200 years. Also, it is estimated that no additional $PM_{2.5}$ would be emitted per year after full build out, 200 tons of $PM_{2.5}$ would be emitted per year after full build out plus 75 years, and 1,100 tons of $PM_{2.5}$ would be emitted per year after full build out plus 200 years. At these levels, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at the GBNP. The extent of possible visibility impairment is highly uncertain.

Table 3.1-19 Alternative D, Estimated Increases in Windblown Dust from Evapotranspiration Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

ET Unit	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 75 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation[1]	0	5,901	35,066	0	1,682	9,994
Phreatophyte/ Medium Vegetation[1,2]	0	10,846	46,282	0	309	1,319
Total				**0**	**1,991**	**11,313**

[1] Components of the basin shrubland cover type (see Section 3.5).

[2] For the purposes of calculating fugitive dust emissions from disturbed surfaces, 10 percent of the surface area of the "Phreatophyte/Medium Vegetation" ET unit is assumed to be susceptible to wind erosion.

Greenhouse Gas Emissions from Groundwater Puming

Since the pump stations would be electrically powered and greenhouse gases are emitted during the generation of most electricity, the power requirements of this project have an indirect contribution to the emissions of greenhouse gases. The continuous power requirements to operate the pump stations and other ancillary equipment are estimated to be approximately 54 MW (**Table 2.6-1**). The continuous generation of this electricity amount is estimated to release approximately 182,000 tonnes of CDE per year, and is comparable to the emissions from the electricity use of nearly 19,000 homes for 1 year. For context, the estimated indirect greenhouse gas emissions from electricity generation for this alternative are less than 0.0004 percent of the CDE estimated to be emitted by the U.S. and less than 0.4 percent of the CDE estimated to be emitted in Nevada.

These power requirements, and thus the associated CDE emissions, would be offset by electrical generation as part of the project via installation of hydroturbines (detailed in **Appendix E**) and solar panels to the extent possible. It is estimated that as much as 40 percent of the project's power requirements could be provided by the installation of hydroturbines at the three pressure reducing stations.

<u>Conclusion</u>

- It is predicted from model simulations that pumping drawdown of 10-feet and greater would potentially lead to changes in vegetation that could increase windblown dust emissions. The level and extent of these impacts are highly uncertain and the following impacts should be used for comparison purposes only. It is estimated that no additional PM_{10} would be emitted per year after full build out, 2,000 tons of PM_{10} would be emitted per year after full build out plus 75 years, and 11,000 tons of PM_{10} would be emitted per year after full build out plus 200 years. Also, it is estimated that no additional $PM_{2.5}$ would be emitted per year after full build out, 200 tons of $PM_{2.5}$ would be emitted per year for full build out plus 75 years, and 1,100 tons of $PM_{2.5}$ would be emitted per year for full build out plus 200 years. At these levels, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at the GBNP. The extent of possible visibility impairment is highly uncertain.
- Based on predicted power requirements for pumping activities, indirect emissions of greenhouse gases associated with electricity generation would be approximately 182,000 tonnes of CDE per year. These power requirements would be offset by electrical generation via installation of hydroturbines (**Appendix E**) and solar panels to the extent possible.

- The monitoring, mitigation, and management plan for Snake Valley will include PM_{10} and meteorological monitoring in Snake Valley, Utah. In order to strengthen the SNWA's adaptive management program, mitigation measure GW-AQ-3 is recommended.

3.1.2.14 Alternative E

Groundwater Development Area

Construction of well pads, access roads, collector pipelines, and power lines would result in an estimated maximum surface disturbance of approximately 4,000 acres. It is assumed that short-term construction emissions will be qualitatively similar to the values estimated for ROW construction activities for the Proposed Action, although somewhat reduced levels of PM will be emitted due to the smaller amount of disturbed surface area. Long-term emissions from groundwater development maintenance activities are anticipated to be similar to the long-term emissions from ROW maintenance activities. The project is not expected to contribute to increases in radionuclides or erionite.

It is assumed that: 1) the SNWA would implement its ROW ACMs, including measures required as part of Dust Control Permits and other required operating permits; 2) the SNWA would routinely inspect and repair project roads with a BLM inspector; and 3) the SNWA would use soil tackifiers and other materials to suppress dust in accordance with the BLM approval. Based on these measures, it is expected that impacts due to construction would be minimized and be short-term in nature and impacts are not expected to impair visibility conditions at GBNP. There would be a small incremental increase in the concentration of air pollutants in areas near the permanent groundwater development ROW during periods of maintenance.

Groundwater Pumping

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust would be generated from bare soil/sparse vegetation and phreatophyte ET units as the result of 10-foot or greater drawdown over different pumping time frames (**Table 3.1-20**). It is estimated that an additional 1,000 tons of PM_{10} would be emitted per year after full build out, 10,000 tons of PM_{10} would be emitted per year after full build out plus 75 years, and 13,000 tons of PM_{10} would be emitted per year after full build out plus 200 years. Also, it is estimated that an additional 100 tons of $PM_{2.5}$ would be emitted per year after full build out, 1,000 tons of $PM_{2.5}$ would be emitted per year for full build out plus 75 years, and 1,300 tons of $PM_{2.5}$ would be emitted per year for full build out plus 200 years. At these levels, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at the GBNP. The extent of possible visibility impairment is highly uncertain.

Table 3.1-20 Alternative E, Estimated Increases in Windblown Dust from Evapotranspiration Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

ET Unit	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 75 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation[1]	2,785	32,882	40,586	794	9,371	11,567
Phreatophyte/ Medium Vegetation[1,2]	9,274	38,548	42,803	264	1,099	1,220
Total				**1,058**	**10,470**	**12,787**

[1] Components of the basin shrubland cover type (see Section 3.5).

[2] For the purposes of calculating fugitive dust emissions from disturbed surfaces, 10 percent of the surface area of the "Phreatophyte/Medium Vegetation" ET unit is assumed to be susceptible to wind erosion.

Greenhouse Gas Emissions from Groundwater Pumping

Since the pump stations would be electrically powered and greenhouse gases are emitted during the generation of most electricity, the power requirements of this project have an indirect contribution to the emissions of greenhouse gases. The continuous power requirements to operate the pump stations and other ancillary equipment are estimated to be an additional 55 MW (**Table 2.6-1**). The continuous generation of this electricity amount is estimated to release approximately 185,000 tonnes of CDE per year, and is comparable to the emissions from the electricity use of nearly 20,000 homes for 1 year. For context, the estimated indirect greenhouse gas emissions from electricity generation for this alternative are less than 0.0004 percent of the CDE estimated to be emitted by the U.S. and less than 0.4 percent of the CDE estimated to be emitted in Nevada.

These power requirements, and thus the associated CDE emissions, would be offset by electrical generation as part of the project via installation of hydroturbines (detailed in **Appendix E**) and solar panels to the extent possible. It is estimated that as much as 40 percent of the project's power requirements could be provided by the installation of hydroturbines at the three pressure reducing stations.

<u>Conclusion</u>

- It is predicted from model simulations that pumping drawdown of 10-feet and greater would potentially lead to changes in vegetation that could increase windblown dust emissions. The level and extent of these impacts are highly uncertain and the following impacts should be used for comparison purposes only. It is estimated that an additional 1,000 tons of PM_{10} would be emitted per year after full build out, 10,000 tons of PM_{10} would be emitted per year after full build out plus 75 years, and 13,000 tons of PM_{10} would be emitted per year after full build out plus 200 years. Also, it is estimated that an additional 100 tons of $PM_{2.5}$ would be emitted per year after full build out, 1,000 tons of $PM_{2.5}$ would be emitted per year after full build out plus 75 years, and 1,300 tons of $PM_{2.5}$ would be emitted per year after full build out plus 200 years. At these levels, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at the GBNP. The extent of possible visibility impairment is highly uncertain.
- Based on predicted power requirements for pumping activities, indirect emissions of greenhouse gases associated with electricity generation would be approximately 185,000 tonnes of CDE per year. These power requirements would be offset by electrical generation via installation of hydroturbines (**Appendix E**) and solar panels to the extent possible.
- In order to strengthen SNWA's adaptive management program, mitigation measure GW-AQ-3 is recommended.

3.1.2.15 No Action

Groundwater Development Area

Under the No Action Alternative, the proposed project would not be constructed or maintained. No project-related surface disturbance would occur. Without project construction and operation activities, there are no emissions of criteria pollutants, fugitive dust, or greenhouse gases. It is expected that natural (biogenic) and human (anthropogenic) sources of pollutant emissions would continue. Anthropogenic emissions are expected to increase in proportion to projected population increases in Lincoln County (see Section 3.18, Socioeconomics and Environmental Justice). Current anthropogenic activities, as well as natural wind conditions, would continue to generate dust as discussed in Section 3.1.1.1. Climate change would continue but the scale of these changes would depend on the interactions of the atmospheric and oceanic circulation patterns and the level of future anthropogenic emissions of greenhouse gases.

Groundwater Pumping

Windblown Dust Emissions from Groundwater Drawdown

Current groundwater pumping for agricultural and municipal purposes would continue, without addition of new wells, pipelines or pumping stations from the proposed project. There would be some increase in current levels of fugitive dust generation due to continued groundwater pumping activities. The amount of dust generated by areas affected by a 10-foot or greater drawdown are shown in **Table 3.1-21**.

Table 3.1-21 No Action, Estimated Increases in Windblown Dust from Evapotranspiration Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

ET Unit	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	PM_{10} Emissions from Windblown Dust (tons per year)	PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation[1]	4,296	14,966	18,830	1,224	4,265	5,367
Phreatophyte/ Medium Vegetation[1,2]	6,298	17,263	22,606	179	492	644
Total				**1,404**	**4,757**	**6,011**

[1] Components of the basin shrubland cover type (see Section 3.5).

[2] For the purposes of calculating fugitive dust emissions from disturbed surfaces, 10 percent of the surface area of the "Phreatophyte/Medium Vegetation" ET unit is assumed to be susceptible to wind erosion.

The potential increases in dust generation from areas affected by a 10-foot or greater drawdown under the No Action Alternative are estimated to be approximately 1,000 tons of PM_{10} per year gradually increasing to 5,000 tons of PM_{10} per year in roughly 75 years, and would reach 6,000 tons of PM_{10} per year in roughly 200 years. Also, it is estimated that approximately 100 tons of $PM_{2.5}$ would be emitted per year, 500 tons of $PM_{2.5}$ would be emitted per year after 75 years, and 600 tons of $PM_{2.5}$ would be emitted per year after 200 years. Windblown dust emissions from groundwater drawdown under the No Action Alternative are not likely to impair visibility conditions at the GBNP.

Greenhouse Gas Emissions from Groundwater Pumping

Since there would be no pump stations constructed under the No Action alternative, there would be no increase to greenhouse gas emissions from power requirements.

Conclusion. Without project construction and operation activities, there are no additional emissions of criteria, fugitives dust, nor greenhouse gas pollutants from the proposed project. It is expected that:

- Natural (biogenic) and human (anthropogenic) sources of pollutant emissions would continue. Anthropogenic emissions are expected to increase in proportion to projected population increases in Lincoln County.
- Current anthropogenic activities, as well as natural wind conditions, would continue to generate dust as discussed in Section 3.1.1.1.
- Climate change would continue but the scale of these changes would depend on the interactions of the atmospheric and oceanic circulation patterns and level of future anthropogenic emissions of greenhouse gases.
- Current groundwater pumping for agricultural and municipal purposes would continue. At current levels of groundwater pumping, there would be some increase in current levels of windblown dust generation due to changes in vegetation and groundcover. The potential increases in dust generation from areas affected by a 10-foot or greater drawdown are estimated to be approximately 1,000 tons of PM_{10} per year gradually increasing to 5,000 tons of PM_{10} per year in roughly 75 years, and would reach 6,000 tons of PM_{10} per year in roughly 200 years. Also, it is estimated that approximately 100 tons of $PM_{2.5}$ would be emitted per year, 500 tons of $PM_{2.5}$ would be emitted per year after 75 years, and 600 tons of $PM_{2.5}$ would be emitted per year after 200 years. Windblown dust emissions from groundwater drawdown under the No Action Alternative are not likely to impair visibility conditions at the GBNP.

3.1.2.16 Alternatives Comparison

Generally, the impacts to air quality from the groundwater field development construction and maintenance are very similar between alternatives. **Table 3.1-22** shows the estimated maximum annual construction emissions for each alternative for PM_{10} and $PM_{2.5}$. Only the emissions of PM_{10} and $PM_{2.5}$ vary between alternatives since PM emissions depend on the acres of surface disturbance. The emissions of all other pollutants depend on the tailpipe emissions from construction activities which over a year, are the same for each alternative.

Table 3.1-22 Estimated Maximum Annual PM_{10} and $PM_{2.5}$ Emissions from Groundwater Field Development Construction of the Proposed Action and Alternatives A through E

Alternative	PM_{10} (tons per year)	$PM_{2.5}$ (tons per year)
Proposed Action	1,329	143
Alternative A	766	86
Alternative B	742	84
Alternative C	766	86
Alternative D	639	74
Alternative E	650	75

Table 3.1-23 shows the estimated windblown dust emissions that would result from groundwater drawdown for each alternative. As described in the preceding sections, the impacts for the alternatives are the project-alone impacts (i.e. the total impacts for an alternative would be the No Action impact plus the alternative's impacts). Generally, the impacts to air quality vary considerably between the groundwater drawdown alternatives. The Proposed Action is predicted to have the highest cumulative impacts to air quality. The air quality impacts due to the Proposed Action may be up to two-thirds higher than any other alternative. Alternative C is predicted to have the lowest air quality impacts out of the project alternatives.

Table 3.1-23 Estimated Long-Term Windblown Dust Emissions from Groundwater Drawdown for the Proposed Action and Alternatives A through E

Alternative	PM_{10} Emissions from Windblown Dust (tons per year) (full build out)	PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 200 years)	$PM_{2.5}$ Emissions from Windblown Dust (tons per year) (full build out)	$PM_{2.5}$ Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	$PM_{2.5}$ Emissions from Windblown Dust (tons per year) (full build out plus 200 years)
No Action	1,404	4,757	6,011	140	476	601
Proposed Action[1]	1,762	24,122	34,742	176	2,412	3,474
Alternative A[1]	1,058	17,198	20,902	106	1,720	2,090
Alternative B[1]	1,742	13,743	22,686	174	1,374	2,269
Alternative C[1]	1,058	6,158	7,075	106	616	707
Alternative D[1]	0	1,991	11,313	0	199	1,131
Alternative E[1]	1,058	10,470	12,787	106	1,047	1,279

[1] Project-alone impacts are shown for each alternative. Total impacts for each alternative are the No Action impacts plus the Alternative's impact.

3.1.3 Climate Change Effects

Climate change already appears to be influencing both natural and managed ecosystems of the American Southwest (Breshears et al. 2005, Westerling et al. 2006, Seager et al. 2007) and models indicate the likelihood of the Southwest being a climate change "hotspot" in the coming decades (Diffenbaugh et al. 2008). Recent warming in the Southwest is among the most rapid in the nation, significantly more than the global average in some areas (USGCRP 2009). Projections suggest continued strong warming in the region, with significant increases in temperature (USGCRP 2009) and decreases in precipitation (Seager et al. 2007). In the coming century, mean global temperature could increase significantly, with an associated increase in both the frequency of extreme events (heat waves, droughts, storms) and the frequency and extent of wildfire (IPCC 2007; Westerling & Bryant 2008; Krawchuk et al. 2009). Under such conditions, future impacts could be substantial for some resources, impacting biodiversity, protected areas, and agricultural lands. As described below, if the rate of global climate change exceeds the pace of biological response, especially the capacity of populations to migrate or undergo adaptive evolutionary change, impacts on species distributions, community structure and ecosystem function may be significant.

Climate change effects are evaluated separately for air impacts versus all other resources. While air resources may directly affect the magnitude of climate change with the emissions of greenhouse gases, other resources are affected by climate change. Due to the nature of greenhouse gas emissions into the atmosphere, it is impossible to link a specific greenhouse emissions emission and a specific climate change.

3.1.3.1 Air Resources

Proposed Project's Air Impacts Relative to Climate Change

The USEPA has new regulations that now require mandatory reporting of greenhouse gases if production exceeds 25,000 metric tons of CDE per year for certain industrial and intensive agricultural activities (40 CFR 98.2; 74 FR 56374). Twenty-five thousand metric tons represent approximately 0.0000041 of 1 percent of annual national emissions, which is estimated to be six billion metric tons (USEPA 2009). It is important to note that this new USEPA reporting requirement does not apply to any of the actions proposed and it is shown here to give a sense of scope and scale to potential impacts. It is for comparison purposes only.

Table 3.1-24 shows the estimated annual greenhouse gas emissions for each project alternative. The estimated maximum annual greenhouse gas emissions during the ROW construction and maintenance activities for all alternatives are anticipated to be less than 25,000 metric tons (tonnes) a year in terms of CDE, while indirect emissions of greenhouse gases from power generation required for groundwater pumping could be as high as 327,000 metric tons of CDE, which is less than 0.006 of 1 percent of annual U.S. emissions and less than 0.6 percent of Nevada emissions. The greenhouse gas emissions would be highest for the Proposed Action and lowest for Alternative D.

Table 3.1-24 Estimated Direct and Indirect Greenhouse Gas Emissions for the Proposed Action and Alternatives A through E

Alternative	Maximum Emissions from ROW Construction and Maintenance (tonnes of CDE per year)	Long-term Direct Emissions from ROW Maintenance (tonnes of CDE per year)	Long-term Indirect Emissions from Groundwater Pumping (tonnes of CDE per year)
No Action	0	0	0
Proposed Action	23,896	8	327,000
Alternative A	23,896	8	250,400
Alternative B	23,896	8	327,000
Alternative C	23,896	8	250,400
Alternative D	23,896	5	182,000
Alternative E	23,896	7	185,000

The power requirements, and therefore the greenhouse gas emissions, for all alternatives would be offset by electrical generation as part of the project via installation of hydroturbines and solar panels (detailed in **Appendix D**) to the extent possible. It is estimated that as much as 40 percent of the project's power requirements could be provided by the installation of hydroturbines at the three pressure reducing stations.

Climate Change Effects to Air Resources

Climate change is not shown to have a direct effect on any criteria pollutants other than ozone. It has been found that concentrations of ground level ozone are likely to increase due to increasing temperatures (Wise 2009). This indicates that areas currently designated as "maintenance" status for ozone are likely to have added difficulty maintaining levels below the ozone standard. Although no other criteria pollutants have been shown to be directly impacted by climate change, potential future regulations aimed to reduce greenhouse gas emissions may have an indirect effect on other pollutants (such as [nitrogen dioxide] NO_2 or SO_2) co-emitted with greenhouse gas. Increases in wildland fire, described below, also will contribute in increased emissions of air pollutants.

3.1.3.2 Climate Change Effects to All Other Resources

Water Resources

Global climate change models predict potential alterations in the distribution and seasonality of precipitation (Houghton et al. 1996; Mahlman 1997; Giorgi et al. 1998). The effects of this climate change are already being observed in the western U.S., including the reduction and earlier melting of mountain snowpacks, earlier timing of spring runoff, and associated declines in river flows (Dettinger et al. 2004; Stewart et al. 2004; Barnett et al. 2008). Climate change simulations also clearly indicate a general, large-scale warming over the western U.S. (Barnett et al. 2004), which will likely lead to more widespread drought. Paradoxically, a warmer atmosphere and an intensified water cycle are likely to mean not only a greater likelihood of drought for the Southwest, but also an increased risk of flooding (U.S. Global Change Research Program [USGCRP] 2009). Patterns of precipitation are currently changing, with more rain falling in heavy downpours that can also lead to such flooding events (IPCC 2007; Allan and Soden 2008). Moreover, increased flood risk in the Southwest is likely to result from a combination of decreased snow cover on the lower slopes of high mountains and an increased fraction of winter precipitation falling as rain and therefore running off more rapidly (Knowles et al. 2006). This increase in rain-on-snow events could also result in rapid runoff and flooding (Bales et al. 2006). Winter precipitation in Arizona is becoming increasingly variable, with a trend toward both more frequent, extremely dry and extremely wet winters (Goodrich and Ellis 2008). Greater variability in patterns of precipitation can be anticipated in the future. Rapid landscape transformation due to vegetation die-off and wildfire as well as loss of wetlands along rivers is also likely to reduce flood-buffering capacity.

The effect of climate change on streamflow and groundwater recharge will vary regionally and locally, likely following projected changes in precipitation. The impact of climate change on water resources depends not only on changes in the volume, timing, and quality of streamflow and recharge but also on system characteristics, changing pressures on the system, how the management of the system evolves, and what adaptations to climate change are implemented (Arnell et al. 2001). Recent studies from the Sierra Nevada of California indicate that climate change will lead to increasing winter streamflow and decreasing late spring and summer flow (Miller et al. 2003; Maurer 2007). The amount and timing of runoff are dependent on the characteristics of each basin, especially elevation. Increased temperatures lead to a higher freezing line, and therefore, less snow accumulation and increased melting below the freezing height (Miller et al. 2003). These studies suggest that a decrease in late winter snow accumulation is a confident projection, as is earlier arrival of the annual flow volume.

Climate change could affect water resources in the Project Area by impacting:

- Surface hydrology (volume and timing of surface flows, rainfall-runoff response, flood events, water quality, sediment and contaminant transport);
- Vadose zone hydrology (runoff, ET, infiltration, groundwater recharge); and
- Hydrogeology (groundwater flow).

Warmer atmospheric temperatures associated with global climate change are expected to lead to a more vigorous hydrological cycle, including more extreme rainfall events (IPCC 2007). This change in precipitation, along with expected changes in temperature, solar radiation, and atmospheric CO_2 concentrations, will likely have significant impacts on both soil moisture and soil erosion rates. A change in soil moisture is simply calculated as a difference between the input to- and output of- the soil system. Input to the soil system is primarily precipitation, while output includes evaporation, transpiration, surface runoff, drainage, and deep percolation to groundwater. Soil moisture is a critical factor for the growth of food crops as well as supporting natural vegetation and determining its type and extent.

Increasing variability of precipitation patterns and ET rates due to climate change will directly affect soil moisture in addition to surface runoff and groundwater recharge. In regions with decreasing precipitation, soil moisture may be substantially reduced. It could also be reduced in regions with increasing precipitation as long as the evaporation due to high temperatures is greater than the increase in precipitation. Soil moisture is expected to increase in areas where precipitation significantly outweighs the increase in ET. At the same time, a large-scale drying of the soil surface is expected due to higher temperatures during summer and insufficient precipitation increases or reduction in rainfall. An indirect effect of reduced soil moisture is increased air temperature. Air temperature increases when regional soils are dry, as energy from the sun is not evaporating soil water, but rather heating the ambient atmosphere. Fischer et al. (2007) recently found that land-atmosphere interactions have had a major contribution on the spatial and temporal extent of recent heat waves in Europe.

The processes involved in the impact of climate change on soil erosion by water are complex, involving changes in rainfall amounts and intensities, number of days of precipitation, ratio of rain to snow, plant biomass production, plant residue decomposition rates, soil microbial activity, ET rates, and shifts in land use (Nearing 2004). In regions where rainfall amounts increase, erosion and runoff will also likely increase. Even in cases where annual rainfall would decrease, system feedbacks related to decreased biomass production, surface roughness, or site condition could lead to greater susceptibility of the soil to erode. In general, erosion/climate change studies to date suggest that increased rainfall amounts and intensities will lead to greater rates of erosion (Nearing 2004).

Climate change could affect soil resources in the Project Area by impacting:

- Soil moisture – projections of decreasing or more variable precipitation could lead to lower soil moistures, potentially affecting agriculture, regional plant and animal species composition, and regional weather patterns; and
- Erosion – projections of increasing rates or amounts of precipitation and/or changes in vegetation as a result of synergistic climate changes could lead to significant increases in erosion rates.

Climate, more than any other factor, controls the broadscale distributions of plant species and vegetation. At finer scales, other factors such as local environmental conditions including soil nutrient status, pH, water-holding capacity and the physical elements of aspect or slope influence the potential presence or absence of a species. However, intra- and inter-specific interactions, such as competition for resources (light, water, nutrients), ultimately determine whether an individual plant is actually found at any particular location (Sykes 2009). Rapid climate change associated with increasing greenhouse gas emissions (IPCC 2007) influences current and future vegetation patterns. Other human-influenced factors are, however, also involved. Sala et al. (2000) identified five different drivers of change that can be expected to affect global biodiversity over the next 100 years. Globally, land use change was considered the most important driver of change, followed by climate change, airborne nitrogen deposition, biotic interactions (invasive species) and direct CO_2 (fertilizing or water use efficiency effects).

Predicted changes in climate that may occur in the southwestern U.S. include increased atmospheric concentrations of CO_2, increased surface temperatures, changes in the amount, seasonality, and distribution of precipitation, more frequent climatic extremes, and a greater variability in climate patterns. Recent temperature increases have made the current drought in the region more severe than the natural droughts of the last several centuries. This drought has caused substantial die-off of piñon trees in approximately 4,600 square miles of piñon-juniper woodland in the Four Corners region (Breshears et al. 2005). The specific physiological effects of increasing greenhouse gas emissions (particularly CO_2) on vegetation include increased net photosynthesis, reduced photorespiration, changes in dark respiration, and reduced stomatal conductance which decreases transpiration and increases water use efficiency (Patterson and Flint 1990). Ambient temperature affects plants directly and indirectly at each stage of their life cycle (Morison and Lawlor 1999). Water (i.e. soil moisture) is usually the abiotic factor most limiting to vegetation, especially in arid and semi-arid regions. CO_2, temperature, and soil moisture effects on plant physiology are exhibited at the whole-plant level in terms of growth and resource acquisition. In addition to the individual effects of increasing temperatures and CO_2, there is the additional interactive effect on photosynthetic productivity and ecosystem-level process (Long 1991).

Plants are finely tuned to the seasonality of their environment and shifts in the timing of plant activity (i.e. phenology) provide some of the most compelling evidence that species and ecosystems are being influenced by global environmental change (Cleland et al. 2007). Changes in the phenology of plants have been noted in recent decades in regions around the world (Bradley et al. 1999; Fitter & Fitter 2002; Walther et al. 2002; Parmesean & Yohe 2003). Phenology of plant species is important both at the individual and population levels. Specific timing is crucial to optimal seed set for individuals and populations; variation among species in their phenology is an important mechanism for maintaining species coexistence in diverse plant communities by reducing competition for pollinators and other resources. Global climate change could significantly alter plant phenology because temperature influences the timing of development, both alone and through interactions with other cues, such as photoperiod.

Shifts in the relative competitive ability of plants that experience changes in CO_2, surface temperatures, or soil moisture may result in changes to their spatial distribution (Bazzaz 1990, Long and Hutchin 1991, Neilson and Marks 1994). In California, two-thirds of the more than 5,500 native plant species are projected to experience range reductions up to 80 percent before the end of this century under projected warming (Loarie et al. 2008). Current research, for example, indicates that temperature increases resulting from climate change in the Southwest will likely eliminate Joshua trees from 90 percent of their current range in 60 to 90 years (Cole et al. 2011). Increases in atmospheric CO_2 and possible increases in winter precipitation would favor woody plant establishment and growth at the expense of grasses and may cause woodland boundaries to shift downslope (Weltzin and McPherson 1994). However, increases in temperature may enhance the competitive ability of C4 plants (such as grasses) relative to C3 plants (shrubs and trees), especially where soil moisture (Neilson 1993) or temperature (Esser 1992) are limiting. In their search for optimal conditions, some species may shift ranges if corridors to do so are present. The potential for successful plant and animal adaptation to coming change is further hampered by existing regional threats such as human-caused fragmentation of the landscape, invasive species, river-flow reductions, and pollution (USGCRP 2009).

Climate change could affect vegetation resources in the Project Area by:

- Altering the distribution of vegetation at local spatial scales; and
- Altering vegetation types and spatial arrangements (i.e., woody vs. herbaceous species).

Aquatic Biological Resources

Since 1950, there has been an increase from 6 to 16 percent in annual precipitation for most of the Great Basin. This has been accompanied by a decrease in snowpack at most monitoring sites and an earlier spring snowmelt contribution to stream flow (Chambers 2008). The extent of climate-related precipitation change on aquatic habitats would depend on the water source (runoff or groundwater), magnitude, and timing of the precipitation regime (Grimm et al 1997). As the seasonal variability increases and the amount and form of precipitation changes, aquatic species and their habitat likely would be impacted. Impacts to species could include changes in abundance, distribution, phenology, community composition, and the introduction of noxious species in the ephemeral pools, playas, springs, streams, lakes, and reservoirs in the region of study.

Climate change is predicted to increase water temperature in most regions including the arid Southwest (Meyer et al. 1999). The effect of increased water temperature on aquatic habitat and species could include changes in water quality conditions (e.g., dissolved oxygen) and biological conditions such as direct mortality from acute temperature stress, sublethal stress on physiological functions, and shifts in species distributions. In North America, the Intergovernmental Panel on Climate Change predicted that coldwater fisheries would likely be adversely affected, warmwater fish species generally would be positively affected, and cool water fisheries would have a mixture of positive and negative changes in terms of habitat conditions and species distribution and diversity. In general, climatic warming would result in a general shift in species distributions northward, with extinctions of cool-water species at lower altitudes and range expansion of warmwater and cool-water species into higher altitudes (Meyer et al 1999).

Climate change effects on amphibian species are related to habitat factors and ecological requirements. As mentioned for other aquatic species, temperature and precipitation changes can affect population abundance and distribution patterns. Other climate-related changes can include effects on survival, growth, reproduction, food availability, predator-prey relationships, and increased risk to disease (Blaustein et al. 2010). Changes in ambient temperature also may influence the timing of breeding and periods of hibernation (Field et al. 2007; Blaustein et al. 2010).

As a means of assessing the vulnerability of species to climate change, NatureServe initiated a collaborative effort to develop a Climate Change Vulnerability Index (Young et al. 2009). The Index was applied to a selection of test species in Nevada, where it will be used to modify the State Wildlife Action Plan by incorporating climate change species information. Based on this initial case study (Young et al. 2009) and subsequent analyses by the Nevada Natural Heritage Program (NNHP) (2011), vulnerability index ratings for aquatic species provide some indication of potential effects of climate change in the region of study. Index scores were highly vulnerable for White River desert sucker, Lahontan cutthroat trout, and Columbia spotted frog and moderately vulverable for Pahrump poolfish, White River speckled dace, California floater, and northern leopard frog. These species are representative of a variety of habitats in the region of study including streams (Lahontan cuttthroat trout, White River speckled dace, and White River desert sucker), springs and wetlands (northern leopard frog and Columbia spotted frog), ponds (Pahrump poolfish), and rivers and lakes (California floater). The factors that were identified as vulnerable for these species included macro-scale temperature requirements, micro- and macro-scale precipitation requirements, migration movements, and physiological and historical hydrological niches.

Climate change could affect aquatic biological resources in the Project Area by:

- Modification or alternation of aquatic habitats due to changes in precipitation;
- Potential changes in water temperature and other water quality parameters such as dissolved oxygen; and
- Potential changes in aquatic species abundance, distribution, phenology, and community composition in response to habitat and water quality changes.

Wildland Fire

Anthropogenically-induced changes in climate are likely to affect fire frequency and extent. The specific effects of climate change on fire regimes will be spatially variable throughout the Southwest and impacted by a number of factors. In general, total area burned is projected to increase (Lenihan et al. 2008), though regional differences in fuel loading, temperature, and precipitation all influence the likelihood of possible ignition and subsequent fire spread (Westerling and Bryant 2008). Climate change could also cause changes in fire behavior once ignition has occurred (Fried et al. 2008). Alterations in community structure caused by changes in atmospheric composition or climate may have substantial effects on fire regimes. A shift from grassland to woodland could reduce herbaceous biomass and thus reduce fire frequency because of decreased accumulation of fine fuel. Conversely, increased surface temperatures may either increase fire frequency (because hotter, drier conditions cure fuel more quickly) or decrease fire frequency (because of decreased fine fuel production caused by hotter, drier conditions). Increases in summer precipitation may also increase fine fuel loading and thus increase fire frequency.

Climate-fire dynamics will also be affected by changes in the distribution of ecosystems across the Southwest. Increasing temperatures and shifting precipitation patterns will drive declines in high-elevation ecosystems such as alpine forests and tundra (Rehfeldt et al. 2006; Lenihan et al. 2008), while other high-elevation forests are projected to decline by 60 to 90 percent before the end of the century (Hayhoe et al. 2004). At the same time, grasslands are projected to expand, another factor likely to increase fire risk. The effects of changing climate on future fire regimes are difficult to predict, not only due to uncertainties associated with future climate, but because of interactive effects of climate change, biological factors, and activities related to management activities and politics.

Climate change could affect fire ecology and management in the Project Area by impacting:

- The amount, spatial arrangement, connectivity and types of surface fuels; and
- Precipitation patterns, which could lead to prolonged drought, exacerbating the risk of wildland fire.

Wildlife

Recent empirical studies strongly suggest that wildlife species are already responding to recent global warming trends with significant shifts in range distribution (generally northward) and phenology (i.e., seasonal timing of biological activities) (McCarty 2001; Walther et al. 2002; Root et al. 2003). These effects include earlier breeding, changes in timing of migration, changes in breeding performance (egg size, nesting success), changes in population sizes, changes in population distributions; and changes in selection differentials between components of a population. These responses are being seen in all different types of taxa, from insects to mammals, in North America (Field et al. 2007). Research suggests that the effects of global climate change on wildlife communities in parks and protected areas may be most noticeable, not as a drastic loss of species from their current ranges, but instead as a fundamental change in community structure as species associations shift due to influxes of new species (Burns et al. 2003). This trend may also be applicable to non-reserve landscapes as well.

Several traits may make wildlife species especially susceptible to climate change (Foden et al. 2008). These traits include specialized habitat and/or microhabitat requirements; narrow environmental tolerances or thresholds that are likely to be exceeded due to climate change at any stage in the life cycle; dependence on specific environmental triggers or cues that are likely to be disrupted by climate change; dependence on inter-specific interactions that are likely to be disrupted by climate change; and a poor ability to disperse to or colonize a new or more suitable range.

Climate change, in combination with other stresses to the landscapes in the project region, is predicted to exacerbate species declines, sedimentation, species invasions, disease, and other impacts (BLM 2010). Current and proposed land use activities (e.g., development, road building, etc.) could create additional habitat fragmentation and reduce movement corridors, limiting the ability for wildlife to shift their ranges in response to climate change (BLM 2010).

Climate change could affect wildlife in the Project Area by:

- Altering or restricting the physical ranges of species present;
- Modifying, shifting, or eliminating habitats; and
- Altering species' phenology.

Land Use/Agriculture

Changes in climate are currently impacting landscapes of the Southwest and this trend is projected to increase in the coming decades. Higher temperatures, increased drought, and more intense thunderstorms will very likely decrease the cover of vegetation that protects the ground surface, increase erosion, and promote invasion of exotic grass species in arid landscapes. Climate change will also likely create physical conditions conducive to wildfire, including the proliferation of exotic grasses, thus causing fire frequencies to increase. In areas such as the Mojave Basin ecoregion which has not coevolved with fire, the probability of loss of iconic, charismatic megaflora such as Joshua trees is very likely. In addition, river and riparian ecosystems in the Project area will very likely be negatively impacted by decreased stream flow, increased water removal, and greater competition from non-native species (Ryan et al. 2008).

Crop responses in a changing climate reflect the interplay among three factors: changing temperatures, increasing CO_2 concentrations, and changing water resources. Higher temperatures will mean a longer growing season for crops that do well in the heat but a shorter growing season for crops more suited to cooler conditions. Higher temperatures also cause plants to increase water use water to keep cool. Higher CO_2 levels generally cause plants to grow larger. For some crops, this is not necessarily a benefit because they are often less nutritious, with reduced nitrogen and protein content. Water resources are critical for crop production, as plants need adequate water to maintain their temperature within an optimal range. Without water for cooling, plants will suffer heat stress. In many regions, irrigation water is used to maintain adequate temperature conditions for the growth of cool season plants (such as many vegetables), even in warm environments. With increasing demand and competition for freshwater supplies, the water needed for these crops might be increasingly limited. If water supply variability increases, it will affect plant growth and cause drastically reduced yields. The amount and timing of precipitation length of the growing season are also critical factors and will likely be significantly affected by climate change (Hatfield et al. 2008).

Climate change could affect land use and agriculture in the Project Area by impacting:

- Temperature and atmospheric CO_2: while some crops show positive responses to elevated CO_2 and lower levels of warming, higher levels of warming often negatively affect growth and yields.
- Precipitation: extreme events such as heavy downpours and droughts are likely to reduce crop yields because excesses or deficits of water have negative impacts on plant growth.

- Invasive species: weeds, diseases, and insect pests benefit from warming and weeds also benefit from a higher CO_2 concentration, increasing stress on crop plants and requiring more attention to pest and weed control.
- Forage: quality in pasture and rangeland generally declines with increasing CO_2 concentration because of the effects on plant nitrogen and protein content, reducing the land's ability to supply adequate livestock feed.

3.1.4 Cumulative Impacts

3.1.4.1 Issues

Rights-of-way and Groundwater Development Area Construction and Maintenance

- Short-term air pollutants emitted from the tailpipes of construction equipment, including criteria pollutants, ozone precursors, and greenhouse gas emissions.
- Short-term fugitive dust generated during construction and long-term fugitive dust generated during facility maintenance.
- Short-term and long-term windblown dust generated due to wind erosion of surfaces disturbed during construction and maintenance.
- Entrainment and transport of radioactive material and erionite due to wind erosion of disturbed surfaces.

Groundwater Pumping

- Short-term, long-term, and permanent windblown dust generated due to wind erosion of surfaces disturbed due to groundwater drawdown.
- Short-term, long-term, and permanent impairment of visibility conditions at GBNP due to wind erosion of surfaces disturbed from groundwater pumping.
- Changes in Salt Lake City's PM_{10} air emissions due to the effects of groundwater pumping on soils and vegetation.

3.1.4.2 Assumptions

Assumptions regarding compliance with regulatory requirements, detailed project operations, inputs for emission factors, and future conditions are required to estimate impacts to air quality and climate.

Key assumptions regarding compliance with regulatory and the BLM requirements include:

- All state and local air quality construction permits will be received prior to initiation of project construction.
- Any operating permits or dust control plans required in nonattainment areas will address any conformity requirements (although no groundwater development activities are planned in nonattainment areas at this time) or demonstrate that total emissions in nonattainment areas will be below applicable thresholds.
- The Ely and Las Vegas RMP management actions and best management practices would be applied to all proposed construction activities, based on the most current RMPs – Ely 2008; Las Vegas 1998 (BLM 2008, 1998).
- The ACMs included in the SNWA POD to manage surface disturbance effects for ROWs provide a basis for appropriate measures that may be submitted in future SNWA ROW applications. For purposes of impact analysis, it has been assumed that measures appropriate for ROW construction would be applied to construction in groundwater development areas.

Rights-of-way and Groundwater Development Area Construction and Maintenance

- Construction and maintenance impacts for the groundwater development phase are assumed to be qualitatively similar to the ROW construction and maintenance impacts. This implies that the assumptions made in the estimation of ROW construction and maintenance emissions are appropriate for groundwater development maintenance emissions.
- Total construction and maintenance emissions are such a negligible fraction of total emissions in the project area that the project has a negligible contribution to cumulative air quality.

Groundwater Pumping

- The cumulative surface disturbance effects were estimated by overlaying the existing surface disturbances for past and present actions (PPAs), RFFAs, and the development areas for the project alternative being evaluated (**Figure 3.1-6**). The expected cumulative changes in vegetation communities and soil surface conditions are used to estimate future fugitive dust impacts for each alternative due to groundwater drawdown. Surface conditions were categorized based on ET units defined for the groundwater modeling analysis in the manner identical to the estimation of project-specific windblown dust due to groundwater pumping in Section 3.1.2.2. Impacts are reported for the total cumulative impact due to the project alternative and any past and present actions and RFFAs.

3.1.4.3 Methodology for Analysis

For the estimation of air quality related impacts, the methodology depends on the activity (construction, pumping, etc.) and the type of air impacts (criteria emissions, greenhouse gases, etc.). The activity/air impact combinations are grouped based on the methodology used to estimate impacts. The calculation methodology for each category is described below.

The different methodologies for developing air impacts are grouped into the following categories:

- Groundwater Development Area Construction and Operational Maintenance
  - Tailpipe emissions
  - Fugitive dust
  - Greenhouse gases
- Groundwater Pumping
  - Windblown dust from soils exposed as a result of groundwater pumping
  - Windblown dust impacts to Utah

Rights-of-way and Groundwater Development Area Construction and Maintenance

Estimated project air quality impacts are presented in the form of total estimated ROW and groundwater field development construction and operational maintenance emissions for each alternative. For every alternative, the construction emissions are temporary and transient. The emissions from maintenance are minimal. Total project emissions for each alternative are predicted to be much less than 1 percent of total future emissions in the project area. Therefore, the cumulative impacts to air quality due to ROW and groundwater development construction and maintenance are anticipated to be negligible. Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change as a result of ROW and groundwater field development construction and maintenance activities. A formal cumulative air quality impact analysis to demonstrate compliance with applicable AAQS will be conducted with project-specific emissions as part of any required operating permits.

Groundwater Pumping

Windblown Dust Emissions from Groundwater Drawdown

Future fugitive dust estimates are based on the primary ET units that were used for estimating water losses from the groundwater system via evaporation from soils and playas and via vegetation transpiration.

The area for each ET unit affected by a 10-foot groundwater drawdown is estimated for each alternative with all known past and present actions and RFFAs. The estimated area is projected for three periods: at full build out, at full build out plus 75 years, and at full build out plus 200 years. The percent of the area that will become susceptible to wind erosion is calculated for each ET unit. The total area that is susceptible to wind erosion is multiplied by the emission factor for wind erosion from the USEPA (USEPA 1998) to estimate total emissions of windblown dust. The fraction of TSP that is in the PM_{10} or $PM_{2.5}$ size range is estimated based on USEPA guidance (USEPA 1998; WRAP 2006), whereby 75 percent of the fugitive dust is in the PM_{10} size range and 10 percent of the PM_{10} is in the $PM_{2.5}$ size range.

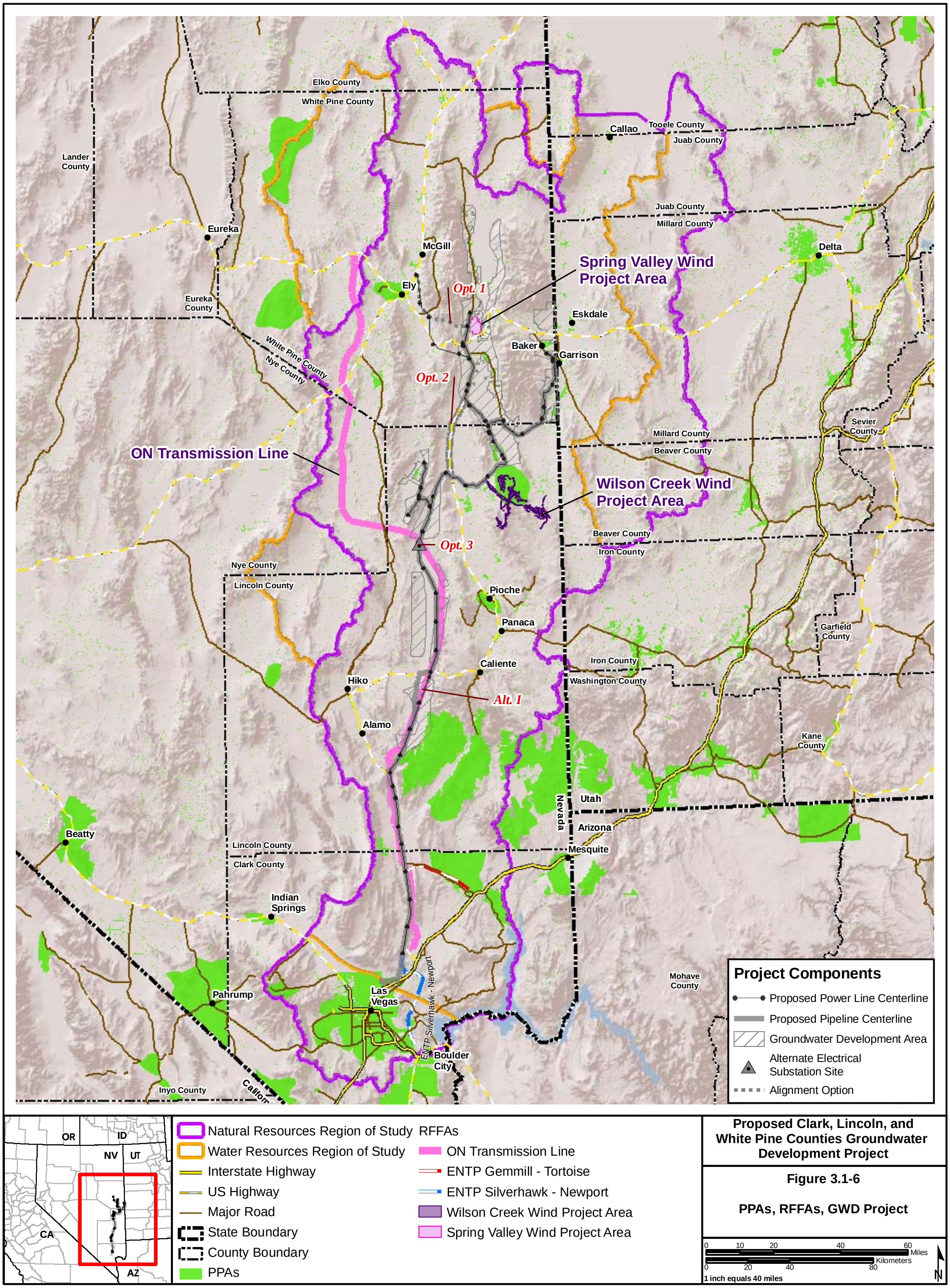

Figure 3.1-6

PPAs, RFFAs, GWD Project

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

3.1.4.4 Proposed Action

Past and present actions consist primarily of existing roads, energy utility corridors, mining districts, and recent wildfires (**Figures 2.12-4** and **2.12-5**). Other activities that have influenced vegetation community composition and area include livestock grazing over nearly all public lands, and the development of towns and rural communities (Ely, McGill, Baker, Garrison, Pioche, Panaca). The primary future actions consist of construction of new utilities (pipelines and electrical distribution lines), roads and turbine pads for wind energy projects, and collector fields for solar energy projects, which would be located in Spring, Dry Lake, Muleshoe, Delamar, and Coyote Springs valleys.

Groundwater Development Area

The cumulative impacts to air quality due to ROW and groundwater field development construction and maintenance and known past and present actions and RFFAs are anticipated to be negligible. Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably. A formal cumulative air quality impact analysis to demonstrate compliance with applicable AAQS will be conducted with project-specific emissions as part of any required operating permits.

Groundwater Pumping Effects

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust would be generated from bare soil/sparse vegetation and phreatophyte ET units as the result of cumulative drawdown over different pumping time frames (**Table 3.1-25**). After full build out, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be approximately 300 percent more than the project-only windblown dust emissions. A majority of this increase is attributable to cumulative impacts from other projects (see Section 3.1.4.7, No Action Cumulative Impacts). In full build out plus 75 years, emissions are predicted to be 40 percent more than project-only emissions. In full build out plus 200 years, emissions are predicted to be 15 percent more than project-only emissions. At these levels, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at the GBNP. The extent of possible visibility impairment is highly uncertain.

Table 3.1-25 Proposed Action, Estimated Cumulative Increases in Windblown Dust From Evapotranspiration Affected By 10-foot Or Greater Pumping Drawdown Over Different Time Periods

Cumulative ET Unit	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	Total PM_{10} Emissions from Windblown Dust (tons per year)	Total PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	Total PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation[1]	20,391	108,370	129,876	5,811	30,886	37,015
Phreatophyte/ Medium Vegetation[1,2]	24,417	79,517	87,620	696	2,266	2,497
Total Cumulative (tons per year)	--	--	--	6,507	33,152	39,512
Percent Change Relative to Project-only Emissions (%)	--	--	--	269	37	14

[1] Components of the basin shrubland cover type (see Section 3.5).

[2] For the purposes of calculating fugitive dust emissions from disturbed surfaces, an additional 10 percent of the surface area of the "Phreatophyte/Medium Vegetation" ET unit is assumed to be unvegetated and susceptible to wind erosion.

Most emissions in the PM_{10} size range will decrease exponentially during downwind transport as they are removed from the atmosphere due to gravitational forces (Hinds 1999). Ultra fine particles, less than 0.1 micron in diameter, are removed from the atmosphere by diffusion to surfaces and also do not travel very far downwind (Hinds 1999). Only a very small fraction of wind erosion emissions from the cumulative project area are expected to be transported into Salt Lake County, Utah, which is over 50 miles from the closest area expected to be impacted by groundwater drawdown. An adaptive management program for Snake Valley is currently under development. As currently proposed, the adaptive management program would include continuous air quality monitoring of PM_{10} to assess air pollutant transport more accurately and develop thresholds at which specific mitigation measures would be required of SNWA in order to avoid further impacts to air quality.

Cumulative Effects

- Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably due to ROW and groundwater field development construction and maintenance activities.
- It is predicted from model simulations that pumping drawdown of 10-feet and greater would potentially lead to changes in vegetation that could increase windblown dust emissions. The level and extent of these impacts are highly uncertain and estimated impacts should be used for comparison purposes only. After full build out, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be approximately 300 percent more than the project-only windblown dust emissions. In full build out plus 75 years, emissions are predicted to be 40 percent more than project-only emissions. In full build out plus 200 years, emissions are predicted o be 15 percent more than project-only emissions. At these levels, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at the GBNP. The extent of possible visibility impairment is highly uncertain.
- Only a very small fraction of wind erosion emissions from the cumulative project area is expected to be transported into Salt Lake County, Utah. As currently proposed, the adaptive management program would include continuous air quality monitoring of PM_{10} to assess air pollutant transport more accurately and develop thresholds at which specific mitigation measures would be required of the SNWA in order to avoid further impact to air quality.

3.1.4.5 Alternative A

Rights-of-way and Groundwater Development Area Construction and Maintenance

The cumulative impacts to air quality due to ROW and groundwater development construction and maintenance and known past and present actions and RFFAs are anticipated to be negligible. Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably. A formal cumulative air quality impact analysis to demonstrate compliance with applicable AAQS will be conducted with project-specific emissions as part of any required operation permits.

Groundwater Pumping Effects

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust would be generated from bare soil/sparse vegetation, and phreatophyte ET units as the result of cumulative drawdown over different pumping time frames (**Table 3.1-26**). At build out, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be approximately 400 percent more than the project-only windblown dust emissions. At full build out plus 75 years, emissions are predicted to be 55 percent more than project-only emissions. At full build out plus 200 years, emissions are predicted to be 45 percent more than project-only emissions. At these levels, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at the GBNP. The extent of possible visibility impairment is highly uncertain.

Table 3.1-26 Alternative A. Estimated Cumulative Increases in Windblown Dust from Evapotranspiration Affected By 10-foot or Greater Pumping Drawdown Over Different Time Periods

Cumulative ET Unit	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	Total PM_{10} Emissions from Windblown Dust (tons per year)	Total PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	Total PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation[1]	17,808	86,408	99,359	5,075	24,626	28,317
Phreatophyte/ Medium Vegetation[1,2]	21,707	72,144	80,691	619	2,056	2,300
Total Cumulative (tons per year)				5,694	26,682	30,617
Percent Change Relative to Project-only Emissions (%)				438	55	46

[1] Components of the basin shrubland cover type (see Section 3.5).

[2] For the purposes of calculating fugitive dust emissions from disturbed surfaces an additional 10 percent of the surface area of the “Phreatophyte/Medium Vegetation” ET unit is assumed to be unvegetated and susceptible to wind erosion.

Most emissions in the PM_{10} size range will decrease exponentially during downwind transport as they are removed from the atmosphere due to gravitational forces (Hinds 1999). Ultra fine particles, less than 0.1 micron in diameter, are removed from the atmosphere by diffusion to surfaces and also do not travel very far downwind (Hinds 1999). Only a very small fraction of wind erosion emissions from the cumulative project area are expected to be transported into Salt Lake County, Utah, which is over 50 miles from the closest area expected to be impacted by groundwater drawdown. An adaptive management program for Snake Valley is currently under development. As currently proposed, the adaptive management program would include continuous air quality monitoring of PM_{10} to assess air pollutant transport more accurately and develop thresholds at which specific mitigation measures would be required of the SNWA in order to avoid further impacts to air quality.

Cumulative Effects

- Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably due to ROW and groundwater field development construction and maintenance activities.
- It is predicted from model simulations that pumping drawdown of 10-feet and greater would potentially lead to changes in vegetation that could increase windblown dust emissions. The level and extent of these impacts are highly uncertain and estimated impacts should be used for comparison purposes only. At full build out, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be approximately 400 percent more than the project-only windblown dust emissions. At full build out plus 75 years, emissions are predicted to be 55 percent more than project-only emissions. At full build out plus 200 years, emissions are predicted to be 45 percent more than project-only emissions.
- Only a very small fraction of wind erosion emissions from the cumulative project area is expected to be transported into Salt Lake County, Utah. As currently proposed, the adaptive management program would include continuous air quality monitoring of PM_{10} to assess air pollutant transport more accurately and develop thresholds at which specific mitigation measures would be required of the SNWA in order to avoid further impact to air quality.

3.1.4.6 Alternative B

Rights-of-way and Groundwater Development Area Construction and Maintenance

The cumulative impacts to air quality due to ROW and groundwater development construction and maintenance and known past and present actions and RFFAs are anticipated to be negligible. Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably. A formal cumulative air quality impact analysis to demonstrate compliance with applicable AAQS will be conducted with project-specific emissions as part of any required operation permits.

Groundwater Pumping Effects

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust would be generated from bare soil/sparse vegetation, and phreatophyte ET units as the result of cumulative drawdown over different pumping time frames (**Table 3.1-27**). At full build out, emissions are predicted to be approximately 250 percent more than project-only emissions. At full build out plus 75 years, emissions are predicted to be 70 percent more than project-only emissions. At full build out plus 200 years, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be approximately 20 percent less than the project-only windblown dust emissions. This decrease in cumulative impacts is due to an estimated reduction in "Bare Soil/Sparse Vegetation" (**Table 3.1-27**) relative to Alternative B (**Table 3.1-17**). It is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at the GBNP. The extent of possible visibility impairment is highly uncertain.

Most emissions in the PM_{10} size range will decrease exponentially during downwind transport as they are removed from the atmosphere due to gravitational forces (Hinds 1999). Ultra fine particles, less than 0.1 micron in diameter, are removed from the atmosphere by diffusion to surfaces and also do not travel very far downwind (Hinds 1999). Only a very small fraction of wind erosion emissions from the cumulative project area are expected to be transported into Salt Lake County, Utah, which is over 50 miles from the closest area expected to be impacted by groundwater drawdown. An adaptive management program for Snake Valley is currently under development. As currently proposed, the adaptive management program would include continuous air quality monitoring of PM_{10} to assess air pollutant transport more accurately and develop thresholds at which specific mitigation measures would be required of the SNWA in order to avoid further impacts to air quality.

Table 3.1-27 Alternative B, Estimated Cumulative Increases in Windblown Dust from ET Units Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

Cumulative ET Unit	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	Total PM_{10} Emissions from Windblown Dust (tons per year)	PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation[1]	19,806	74,151	57,575	5,645	21,133	16,409
Phreatophyte/ Medium Vegetation[1,2]	26,546	75,506	85,131	757	2,152	2,426
Total Cumulative (tons per year)				6,401	23,285	18,835
Percent Change Relative to Project-only Emissions (%)				267	69	-17

[1] Components of the basin shrubland cover type (see Section 3.5).

[2] For the purposes of calculating fugitive dust emissions from disturbed surfaces an additional 10 percent of the surface area of the "Phreatophyte/Medium Vegetation" ET unit is assumed to be unvegetated and susceptible to wind erosion.

Cumulative Effects

- Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably due to ROW and groundwater field development construction and maintenance activities.
- It is predicted from model simulations that pumping drawdown of 10-feet and greater would potentially lead to changes in vegetation that could increase windblown dust emissions. The level and extent of these impacts are highly uncertain and estimated impacts should be used for comparison purposes only. At full build out, emissions are predicted to be approximately 250 percent more than project-only emissions. At full build out plus 75 years, emissions are predicted to be 70 percent more than project-only emissions. At full build out plus 200 years, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be approximately 20 percent less than the project-only windblown dust emissions. This decrease in cumulative impacts is due to an estimated reduction in “Bare Soil/Sparse Vegetation” (**Table 3.1-27**) relative to Alternative B (**Table 3.1-17**). It is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at the GBNP. The extent of possible visibility impairment is highly uncertain.
- Only a very small fraction of wind erosion emissions from the cumulative project area is expected to be transported into Salt Lake County, Utah. As currently proposed, the adaptive management program would include continuous air quality monitoring of PM_{10} to assess air pollutant transport more accurately and develop thresholds at which specific mitigation measures would be required of the SNWA in order to avoid further impact to air quality.

3.1.4.7 Alternative C

Rights-of-way and Groundwater Development Area Construction and Maintenance

The cumulative impacts to air quality due to ROW and groundwater development construction and maintenance and known past and present actions and RFFAs are anticipated to be negligible. Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably. A formal cumulative air quality impact analysis to demonstrate compliance with applicable AAQS will be conducted with project-specific emissions as part of any required operation permits.

Groundwater Pumping Effects

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust would be generated from bare soil/sparse vegetation, and phreatophyte ET units as the result of cumulative drawdown over different pumping time frames (**Table 3.1-28**). After full build out, cumulative emissions are predicted to be 450 percent more than project-only emissions. At full build out plus 75 years, cumulative emissions are predicted to be 150 percent more than project-only emissions. At full build out plus 200 years, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be approximately double the project-only windblown dust emissions. At these levels, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at the GBNP. The extent of possible visibility impairments is highly uncertain.

Most emissions in the PM_{10} size range will decrease exponentially during downwind transport as they are removed from the atmosphere due to gravitational forces (Hinds 1999). Ultra fine particles, less than 0.1 micron in diameter, are removed from the atmosphere by diffusion to surfaces and also do not travel very far downwind (Hinds 1999). Only a very small fraction of wind erosion emissions from the cumulative project area are expected to be transported into Salt Lake County, Utah, which is over 50 miles from the closest area expected to be impacted by groundwater drawdown. An adaptive management program for Snake Valley is currently under development. As currently proposed, the adaptive management program would include continuous air quality monitoring of PM_{10} to assess air pollutant transport more accurately and develop thresholds at which specific mitigation measures would be required of the SNWA in order to avoid further impacts to air quality.

Table 3.1-28 Alternative C, Estimated Cumulative Increases in Windblown Dust from Evapotranspiration Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

Cumulative ET Unit	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	Total PM_{10} Emissions from Windblown (tons per year)	PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation[1]	17,808	49,665	63,009	5,075	14,155	17,958
Phreatophyte/ Medium Vegetation[1,2]	26,546	47,246	58,774	757	1,346	1,675
Total Cumulative (tons per year)				5,832	15,501	19,633
Percent Change Relative to Project-only Emissions (%)				451	152	178

[1] Components of the basin shrubland cover type (see Section 3.5).

[2] For the purposes of calculating fugitive dust emissions from disturbed surfaces an additional 10 percent of the surface area of the "Phreatophyte/Medium Vegetation" ET unit is assumed to be unvegetated and susceptible to wind erosion.

Cumulative Effects

- Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably due to ROW and groundwater field development construction and maintenance activities.
- It is predicted from model simulations that pumping drawdown of 10-feet and greater would potentially lead to changes in vegetation that could increase windblown dust emissions. The level and extent of these impacts are highly uncertain and estimated impacts should be used for comparison purposes only. After full build out, cumulative emissions are predicted to be 450 percent more than project-only emissions. At full build out plus 75 years, cumulative emissions are predicted to be 150 percent more than project-only emissions. At full build out plus 200 years, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be approximately 178 percent more than project-only windblown dust emissions. At these levels, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at GBNP. The extent of possible visibility impairment is highly uncertain.
- Only a very small fraction of wind erosion emissions from the cumulative project area is expected to be transported into Salt Lake County, Utah. As currently proposed, the adaptive management program would include continuous air quality monitoring of PM_{10} to assess air pollutant transport more accurately and develop thresholds at which specific mitigation measures would be required of the SNWA in order to avoid further impact to air quality.

3.1.4.8 Alternative D

Rights-of-way and Groundwater Development Area Construction and Maintenance

The cumulative impacts to air quality due to ROW and groundwater development construction and maintenance and known past and present actions and RFFAs are anticipated to be negligible. Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably. A formal cumulative air quality impact analysis to demonstrate compliance with applicable AAQS will be conducted with project-specific emissions as part of any required operation permits.

Groundwater Pumping Effects

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust would be generated from bare soil/sparse vegetation, and phreatophyte ET units as the result of cumulative drawdown over different pumping time frames (**Table 3.1-29**). At full build out, cumulative emissions are predicted to be approximately the same as project-only emissions. At full build out plus 75 years, cumulative emissions are predicted to be approximately 450 percent more than project-only emissions. At full build out plus 200 years, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be approximately 50 percent more than the project-only windblown dust emissions. At these levels, it is possible that windblown dust emissions from groundwater could impair visibility conditions at the GBNP. The extent of possible visibility impairment is high uncertain.

Table 3.1-29 Alternative D, Estimated Cumulative Increases in Windblown Dust from ET Units Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

Cumulative ET Unit	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	Total PM_{10} Emissions from Windblown (tons per year)	Total PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	Total PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation[1]	10,291	36,131	51,043	2,933	10,297	14,547
Phreatophyte/ Medium Vegetation[1,2]	6,147	35,406	61,272	175	1,009	1,746
Total Cumulative (tons per year)				3,108	11,306	16,294
Percent Change Relative to Project-only Emissions (%)				--	468	44

[1] Components of the basin shrubland cover type (see Section 3.5).

[2] For the purposes of calculating fugitive dust emissions from disturbed surfaces an additional 10 percent of the surface area of the "Phreatophyte/Medium Vegetation" ET unit is assumed to be unvegetated and susceptible to wind erosion.

Most emissions in the PM_{10} size range will decrease exponentially during downwind transport as they are removed from the atmosphere due to gravitational forces (Hinds 1999). Ultra fine particles, less than 0.1 micron in diameter, are removed from the atmosphere by diffusion to surfaces and also do not travel very far downwind (Hinds 1999). Only a very small fraction of wind erosion emissions from the cumulative project area are expected to be transported into Salt Lake County, Utah, which is over 50 miles from the closest area expected to be impacted by groundwater drawdown. An adaptive management program for Snake Valley is currently under development. As currently proposed, the adaptive management program would include continuous air quality monitoring of PM_{10} to assess air pollutant transport more accurately and develop thresholds at which specific mitigation measures would be required of the SNWA in order to avoid further impacts to air quality.

Cumulative Effects

- Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably due to ROW and groundwater field development construction and maintenance activities.
- It is predicted from model simulations that pumping drawdown of 10-feet and greater would potentially lead to changes in vegetation that could increase windblown dust emissions. The level and extent of these impacts are highly uncertain and estimated impacts should be used for comparison purposes only. At full build out, cumulative emissions are predicted to be approximately the same as project-only emissions. At full build out plus 75 years, cumulative emissions are predicted to be approximately 450 percent more than project-only emissions. At full build out plus 200 years, windblown dust emissions due to the cumulative effects of groundwater drawdown are

predicted to be approximately 50 percent more than the project-only windblown dust emissions. At these levels, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at GBNP. The extent of possible visibility impairment is high uncertain.

- Only a very small fraction of wind erosion emissions from the cumulative project area is expected to be transported into Salt Lake County, Utah. As currently proposed the adaptive management program would include continuous air quality monitoring of PM_{10} to assess air pollutant transport more accurately and develop thresholds at which specific mitigation measures would be required of the SNWA in order to avoid further impact to air quality.

3.1.4.9 Alternative E

Rights-of-way and Groundwater Development Area Construction and Maintenance

The cumulative impacts to air quality due to ROW and groundwater development construction and maintenance and known past and present actions and RFFAs are anticipated to be negligible. Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably. A formal cumulative air quality impact analysis to demonstrate compliance with applicable AAQS will be conducted with project-specific emissions as part of any required operation permits.

Groundwater Pumping Effects

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust would be generated from bare soil/sparse vegetation, and phreatophyte ET units as the result of cumulative drawdown over different pumping time frames (**Table 3.1-30**). At full build out, cumulative emissions are predicted to be 400 percent more than project-only emissions. At full build out plus 75 years, cumulative emissions are predicted to be 90 percent more than project-only emissions. At full build out plus 200 years, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be approximately 80 percent more than the project-only windblown dust emissions. At these levels, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at the GBNP. The extent of possible visibility impairment is highly uncertain.

Table 3.1-30 Alternative E, Estimated Cumulative Increases in Windblown Dust from ET Units Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

Cumulative ET Unit	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	Total PM_{10} Emissions from Windblown Dust (tons per year)	Total PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	Total PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation[1]	17,671	63,455	73,554	5,036	18,085	20,963
Phreatophyte/ Medium Vegetation[1,2]	21,335	59,349	68,013	608	1,691	1,938
Total Cumulative (tons per year)				5,644	19,776	22,901
Percent Change Relative to Project-only Emissions (%)				433	89	79

[1] Components of the basin shrubland cover type (see Section 3.5).

[2] For the purposes of calculating fugitive dust emissions from disturbed surfaces an additional 10 percent of the surface area of the "Phreatophyte/Medium Vegetation" ET unit is assumed to be unvegetated and susceptible to wind erosion.

Most emissions in the PM_{10} size range will decrease exponentially during downwind transport as they are removed from the atmosphere due to gravitational forces (Hinds 1999). Ultra fine particles, less than 0.1 micron in diameter, are removed from the atmosphere by diffusion to surfaces and also do not travel very far downwind (Hinds 1999). Only a very small fraction of wind erosion emissions from the cumulative project area are expected to be transported into Salt Lake County, Utah, which is over 50 miles from the closest area expected to be impacted by groundwater drawdown. An adaptive management program for Snake Valley is currently under development. As currently proposed, the adaptive management program would include continuous air quality monitoring of PM_{10} to assess air pollutant transport more accurately and develop thresholds at which specific mitigation measures would be required of the SNWA in order to avoid further impacts to air quality.

Cumulative Effects

- Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably due to ROW and groundwater field development construction and maintenance activities.
- It is predicted from model simulations that pumping drawdown of 10-feet and greater would potentially lead to changes in vegetation that could increase windblown dust emissions. The level and extent of these impacts are highly uncertain and estimated impacts should be used for comparison purposes only. At full build out, cumulative emissions are predicted to be 400 percent more than project-only emissions. At full build out plus 75 years, cumulative emissions are predicted to be 90 percent more than project-only emissions. At full build out plus 200 years, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be approximately 80 percent more than the project-only windblown dust emissions. At these levels, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at GBNP. The extent of possible visibility impairment is highly uncertain.
- Only a very small fraction of wind erosion emissions from the cumulative project area is expected to be transported into Salt Lake County, Utah. As currently proposed, the adaptive management program would include continuous air quality monitoring of PM_{10} to assess air pollutant transport more accurately and develop thresholds at which specific mitigation measures would be required of the SNWA in order to avoid further impact to air quality.

3.1.4.10 No Action

Groundwater Development Area

The cumulative impacts to air quality due to already authorized activities, and known past and present actions and RFFAs are anticipated to be negligible. Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably.

Groundwater Pumping Effects

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust would be generated from bare soil/sparse vegetation, and phreatophyte ET units as the result of cumulative drawdown over different pumping time frames (**Table 3.1-31**). This table shows that approximately 4,000 tons of PM_{10} per year, 8,000 tons of PM_{10} per year, and 10,000 tons of PM_{10} per year are due to non-project impacts at the full build out timeframe, full build out plus 75 years timeframe and at full build out plus 200 years timeframe, respectively. In 200 years, windblown dust emissions due to the cumulative effects of groundwater drawdown without the project are predicted to be approximately 65 percent more than the No Action alternative, shown in Section 3.1.2.6, which doesn't include past and present actions and RFFAs, but does include authorized pumping quantities. Cumulative windblown dust emissions from groundwater drawdown under the No Action Alternative are not likely to impair visibility conditions at the GBNP.

Most emissions in the PM_{10} size range will decrease exponentially during downwind transport as they are removed from the atmosphere due to gravitational forces (Hinds 1999). Ultra fine particles, less than 0.1 micron in diameter, are removed from the atmosphere by diffusion to surfaces and also do not travel very far downwind (Hinds 1999). Only a very small fraction of wind erosion emissions from the cumulative project is expected to be transported into Salt Lake County, Utah, which is over 50 miles from the closest area expected to be impacted by groundwater drawdown.

Table 3.1-31 No Action, Estimated Cumulative Increases in Windblown Dust from ET Units Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

Cumulative ET Unit	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	Total PM_{10} Emissions from Windblown Dust (tons per year)	Total PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	Total PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation[1]	13,047	26,802	31,911	3,718	7,639	9,095
Phreatophyte/ Medium Vegetation[1,2]	9,174	20,556	26,578	261	586	757
Total Cumulative without Project (tons per year)	0	0	0	3,980	8,225	9,852
Percent Change Relative to No Action (%)	0	0	0	183	73	64

[1] Components of the basin shrubland cover type (see Section 3.5).
[2] For the purposes of calculating fugitive dust emissions from disturbed surfaces an additional 10 percent of the surface area of the "Phreatophyte/Medium Vegetation" ET unit is assumed to be unvegetated and susceptible to wind erosion.

Cumulative Effects.

- Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably in the future with cumulative impacts from other projects.
- Current groundwater pumping for agricultural and municipal purposes would continue. At current levels of groundwater pumping and the addition of other projects, there would be an increase in current levels of windblown dust generation due to changes in vegetation and groundcover. The level and extent of these impacts are highly uncertain and estimated impacts should be used for comparison purposes only.
- Only a very small fraction of wind erosion emissions are expected to be transported into Salt Lake County, Utah. Under the No Action Alternative, no monitoring or mitigation measures would be enacted.

3.1.4.11 Alternatives Comparison

Generally, the cumulative impacts to air quality vary considerably between the alternatives. The Proposed Action is predicted to have the highest cumulative, long-term impact to air quality. The cumulative air quality impacts due to the Proposed Action may be as much as 25 percent more than any other alternative. Alternative D is predicted to have the lowest cumulative impacts out of the project alternatives; however, the impacts for full build out plus 200 years could still be 50 percent more than the No Action Alternative. **Table 3.1-32** shows the estimated cumulative windblown dust emissions that would result from groundwater drawdown for each alternative combined with currently approved activities, past and present actions, and RFFAs.

Table 3.1-32 Estimated Cumulative Windblown Dust Emissions from Cumulative Groundwater Drawdown for the Proposed Action and Alternatives A through E

Alternative	PM_{10} Emissions from Windblown Dust (tons per year) (full build out)	PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 200 years)	$PM_{2.5}$ Emissions from Windblown Dust (tons per year) (full build out)	$PM_{2.5}$ Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	$PM_{2.5}$ Emissions from Windblown Dust (tons per year) (full build out plus 200 years)
No Action	3,980	8,225	9,852	398	822	985
Proposed Action	6,507	33,152	39,512	651	3,315	3,951
Alternative A	5,694	26,682	30,617	569	2,668	3,062
Alternative B	6,401	23,285	18,835	640	2,328	1,884
Alternative C	5,832	15,501	19,633	583	1,550	1,963
Alternative D	3,108	11,306	16,294	311	1,131	1,629
Alternative E	5,644	19,776	22,901	564	1,978	2,290

For comparison purposes, the estimated potential impacts to PM_{10} and $PM_{2.5}$ are presented for each alternative in **Figures 3.1-7** and **3.1-8**, respectively. **Figures 3.1-7** and **3.1-8** show the impacts estimated to occur at full build out (FB), after full build out plus 75 years (FB+75), and after full build out plus 200 years (FB+200) for each alternative. The impacts in blue are the estimated impacts due to the currently approved activities (i.e., No Action Alternative) with all past and present actions and RFFAs. The estimated incremental impact due to the project alternatives are shown in red, and the green bars represent the total cumulative impact with all approved activities, past and present actions, RFFAs and the project alternative.

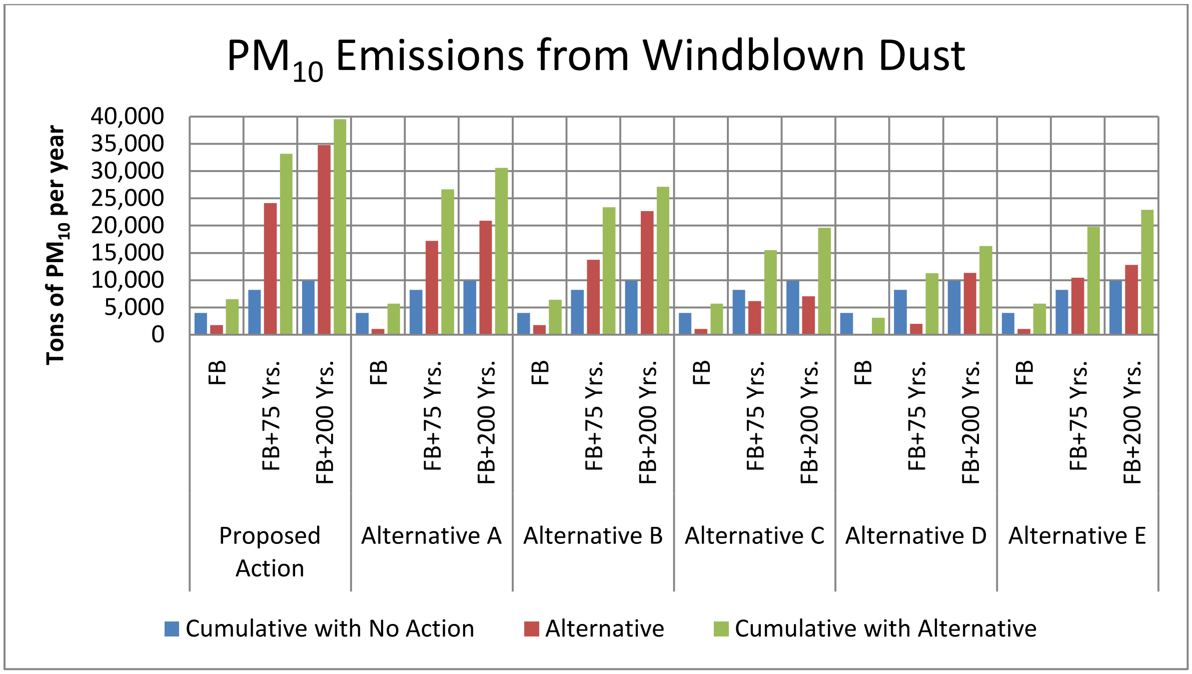

Figure 3.1-7 Comparison of Estimated PM_{10} Emissions from Cumulative Groundwater Drawdown Windblown Dust for the Proposed Action and Alternatives A through E for Three Timeframes

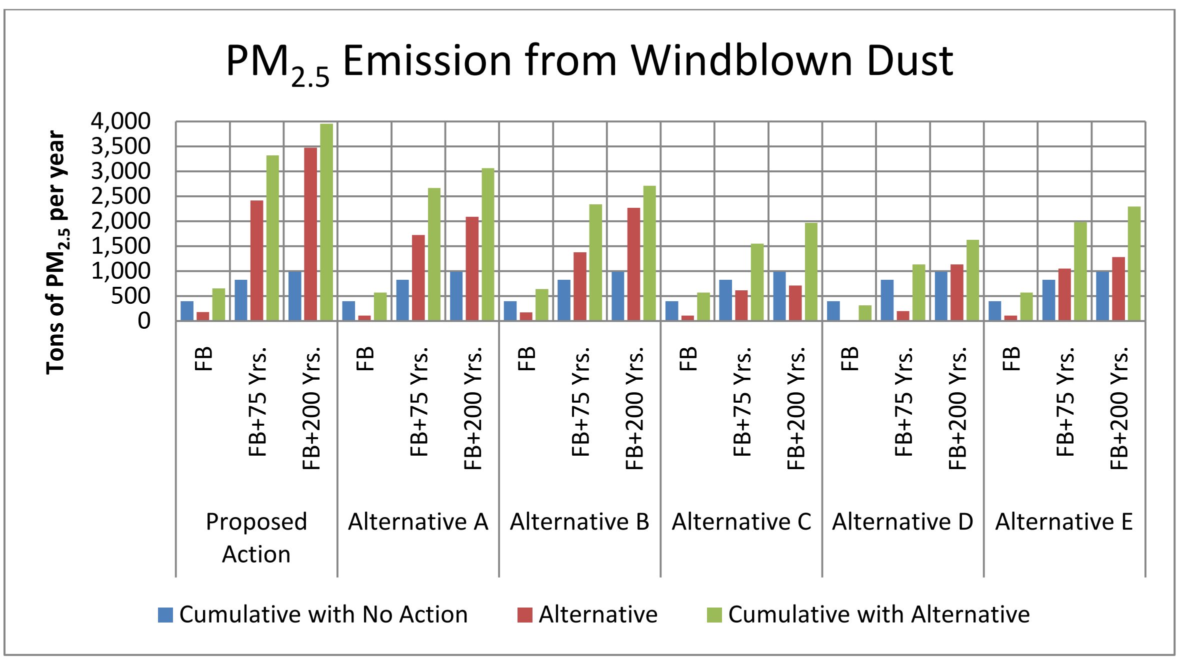

Figure 3.1-8 Comparison of Estimated $PM_{2.5}$ Emissions from Cumulative Groundwater Drawdown Windblown Dust for the Proposed Action and Alternatives A through E for Three Timeframes