
**DUST CONTROL PLAN FOR
THE ARMSTRONG PARCEL
SWINGLE BENCH AREA,
CHURCHILL COUNTY, NEVADA**

Prepared for
LOCAL GOVERNMENT OVERSIGHT COMMITTEE

**Washoe County
and
Cities of Reno and Sparks**

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EXECUTIVE SUMMARY

A dust study was developed for Churchill County, Nevada to assist Churchill County in quantifying dust emissions. As a follow-up to the study, Tetra Tech EM, Inc. developed a series of mitigation measures for the Pyramid Lake Paiute Tribe and the Local Government Oversight Committee in 2004 regarding the Swingle Bench Parcels located west of Fallon, Nevada. This dust control plan has been developed to identify mitigation measures specified in the 2004 Tetra Tech study that would reduce the amount of fugitive dust at the "Armstrong Parcel" in Swingle Bench.

The Swingle Bench area is located on an extensive sand sheet. The soils and arid climate that characterize Swingle Bench make the area susceptible to episodes of windblown sand and dust. A variety of natural and anthropogenic land uses on Swingle Bench result in areas with low vegetation cover that are susceptible to wind erosion. The background level of blowing sand and dust from areas with native vegetation is unknown, but these lands will contribute to the sand and dust load.

Best management practices may be implemented to reduce the amount and frequency of windblown dust. Standard measures identified based on the Tetra Tech (2004) dust study included fostering and/or replenishing the current vegetative cover, covering the land surface with gravel or other materials (e.g., mulch, straw), and/or applying dust suppressants or surfactants, constructing physical wind barriers, and mechanically treating the soil. Based on the longevity of some of the treatment technologies, some of the mitigation measures may be limited and must be repeated in order to remain effective. Furthermore, a combination of one or more mitigation measures may be needed to control windborne sand and dust at the Armstrong Parcel in the Swingle Bench area.

A dust control plan and permit are not presently required by NDEP for the Armstrong Parcel, as it has not had a surface disturbance after the cessation of its use for agricultural purposes. If it is desired to seek such a permit on a voluntary basis or if a surface disturbance of more than five acres is contemplated in the future, a dust control plan and draft application materials have been prepared. It is not clear that NDEP would issue a dust permit without an associated surface disturbance. For the Armstrong Parcel, this dust control plan is presented in two phases: the emergency plan and the long-term plan. The emergency plan presents options that when implemented will initially control the fugitive dust, but present immediate fixes for the parcel. The long-term plan presents viable options that when implemented will reduce the amount of dust and will control it over time. Both plans include revegetation of the parcel with native and adapted species, augmented by localized physical controls, which include

**DUST CONTROL PLAN FOR THE ARMSTRONG PARCEL
SWINGLE BENCH AREA, CHURCHILL COUNTY, NEVADA**

application of gravels, mulch, or organic plant-based surfactants, that are likely to provide the best long-term solution for fugitive dust. The combination of dust control measures was determined based on soil type, topography, and climate (precipitation and wind). The success of revegetation in controlling dust must be complemented by a land management plan to ensure that vegetation is protected from destruction associated with improper grazing, vehicle impacts, or other disturbances.

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
EXECUTIVE SUMMARY	I
1.0 INTRODUCTION.....	1
2.0 PROJECT BACKGROUND.....	3
2.1 Geology	4
2.2 Soils and vegetation	4
2.3 Climate	6
2.3.1 Precipitation	6
2.3.2 Wind.....	7
2.4 Regulatory Requirements.....	7
2.4.1 Dust Control Plan Components.....	8
3.0 DUST CONTROL MEASURES	9
3.1 Vegetation Cover	9
3.1.1 Effectiveness of Vegetation Cover.....	11
3.2 Gravel Covers.....	11
3.2.1 Effectiveness of Gravel Cover	12
3.3 Mulching and Alternative Covers	12
3.3.1 Effectiveness of Mulching and Alternative Covers	13
3.4 SOIL Stabilizers	13
3.4.1 Effectiveness of Soil Stabilizers.....	14
3.5 Comparison of Methods and Costs	14
4.0 DUST CONTROL PLAN	16
5.0 CONCLUSION	18
6.0 BIBLIOGRAPHY	19

Attachments

- A OVERVIEW OF WIND EROSION
- B INFORMATION FOR VOLUNATARY SURFACE AREA DISTURBANCE PERMIT
APPLICATION BASED ON THE NDEP DUST CONTROL PREPARATION GUIDELINES

TABLES

<u>Table</u>	<u>Page</u>
1 SUMMARY OF PRECIPITATION AND TEMPERATURES FOR SELECTED STATIONS NEAR SWINGLE BENCH	7
2 COMPARISON OF WIND EROSION CONTROL METHODS AND ASSOCIATED COSTS.....	15

FIGURES

<u>Figures</u>	<u>Page</u>
1 MAP OF SWINGLE BENCH AND VICINITY.....	3
2 RUSSIAN THISTLE (SALSOLA TRAGUS L.).....	5
3 CURRENT VEGETATION OBSERVED AT THE ARMSTRONG THE WITHIN SWINGLE BENCH.....	6
4 VOLUNTEER VEGETATION ON THE ARMSTRONG PARCEL	10

**DUST CONTROL PLAN FOR THE ARMSTRONG PARCEL
SWINGLE BENCH AREA, CHURCHILL COUNTY, NEVADA**

ACRONYMS AND ABBREVIATIONS

BAT	Best Available Technology
BMP	Best Management Practice
BSNE	Big Springs Number Eight
EPA	U.S. Environmental Protection Agency
LGOC	Local Government Oversight Committee
mph	Mile per hour
NAC	Nevada Administrative Code
NAS	Naval Air Station
NDEP	Nevada Department of Environmental Protection
NOAA	National Oceanic and Atmospheric Administration
NRS	Nevada Revised Statutes
NSS	Near surface sampler
RWEQ	Revised wind erosion equation
SCS	Soil Conservation Service
Tetra Tech	Tetra Tech EM, Inc.
WEQ	Wind erosion equation
WRCC	Western Regional Climate Center
WRD	Water Research and Development, Inc.

1.0 INTRODUCTION

This dust control plan has been developed for the Armstrong Parcel of Swingle Bench in Churchill County, Nevada. Churchill County prepared a dust study, and Tetra Tech EM, Inc. developed mitigation measures for parcels in the Swingle Bench area of Churchill County in March 2004. The mitigation measures identified by Tetra Tech complied with the Nevada Administrative Code (NAC) 445B.22037 for particulate matter emissions as established by the State of Nevada Division of Environmental Protection (NDEP) (NDEP 2005).

Dust control measures are intended to reduce the amount of particulate matter greater than 10 micrometers in diameter, which is commonly referred to as “fugitive dust” and other particulates that may be above the threshold values established for an area. Historically, much of Churchill County, Nevada has had nuisance fugitive dust that has the potential to cause harm to human health and the environment. The dust control measures as established in this plan will reduce the amount of particulates as produced in relation to the undeveloped fallowed property known as Armstrong Parcel within Swingle Bench in Churchill County, Nevada.

This plan was developed based on the mitigation measures that were identified for Swingle Bench in the *Review of the Churchill County Dust Study and Development of Mitigation Measures for the Swingle Bench Area, Nevada* (Tetra Tech 2004). Data on geology, topography, climate, regulatory documents, and background on wind erosion (see Attachment A) in this plan were initially developed in the 2004 report (Tetra Tech 2004). In the report on the mitigation measures, data from the Local Government Oversight Committee (LGOC), Pyramid Lake Paiute Tribe, Churchill County, and Water Research and Development, Inc. (WRD) were used. Guidance for this dust control plan was obtained from the *Surface Area Disturbance Permit Dust Control Plan (Plan) Preparation Guidelines* from NDEP (NDEP 2002). The same data and additional site visits have been conducted when developing this dust control plan. Based on regulatory research, field observations, and best available technologies (BAT) for dust control, this plan was developed to address the current condition of the Armstrong Parcel. Those measures selected for the Armstrong Parcel include a combination of industry accepted dust control measures, which include fostering/revitalizing natural vegetation, covering the land surface with gravel or other materials (that is., mulch, straw), and/or applying dust suppressants or surfactants.

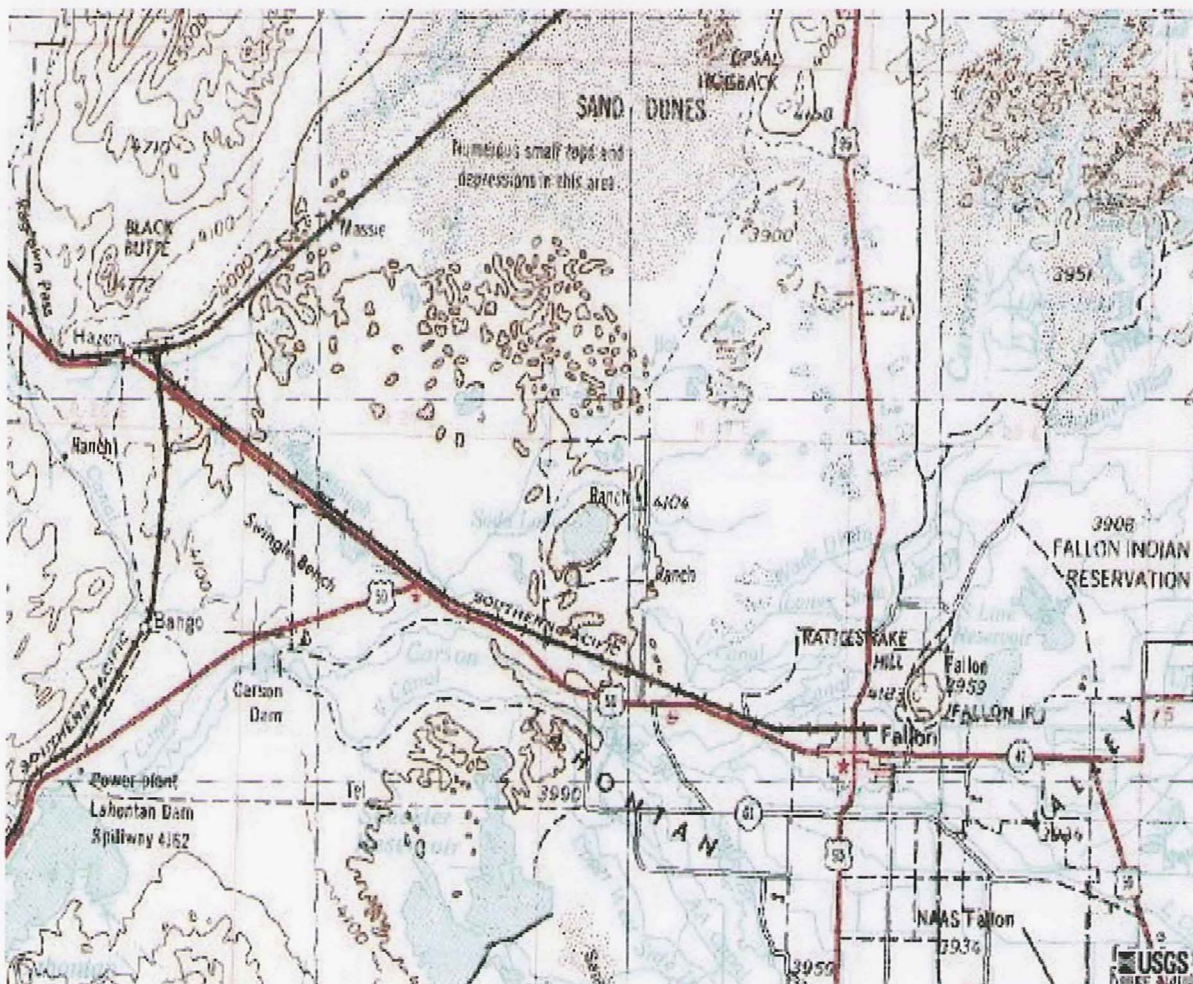
**DUST CONTROL PLAN FOR THE ARMSTRONG PARCEL
SWINGLE BENCH AREA, CHURCHILL COUNTY, NEVADA**

This plan will discuss the general background of the project and a discussion of each dust control measure established by NDEP in the *Surface Area Disturbance Permit Dust Control Plan (Plan) Preparation Guidelines* (NDEP 2002). The discussion of the management techniques will provide information to address the fugitive dust control issues associated with the Swingle Bench location. The discussion of the management techniques will illustrate how, if implemented, the control strategy to reduce the amount of fugitive dust from the Armstrong Parcel will be successful.

2.0 PROJECT BACKGROUND

The Swingle Bench project area is in Churchill County, about 10 miles west of Fallon, Nevada (Figure 1). Swingle Bench is shown on the Soda Lake West, Nevada and Hazen, Nevada U.S. Geological Survey 7.5-minute quadrangle maps. The elevation of the area is about 4,100 feet above mean sea level. This section provides an overview of the geology, soils and vegetation, and climate of the Swingle Bench project area. In addition, pertinent regulatory information is provided in the *Review of the Churchill County Dust Study and Development of Mitigation Measures for the Swingle Bench Area, Nevada* (Tetra Tech 2004).

**FIGURE 1
MAP OF SWINGLE BENCH AND VICINITY**



Map courtesy of U.S. Geological Survey and Microsoft Terraserver

2.1 GEOLOGY

The Swingle Bench area is located within the Carson Desert, which was a major drainage sump of the northwestern Great Basin fed by the Humboldt and Carson Rivers. The Carson Desert is one of the largest and deepest basins of northern Nevada that was inundated by Lake Lahontan. The Swingle Bench area is underlain by the Sehoo Formation of the Lahontan Valley group (Morrison 1964). The Sehoo Formation consists of interbedded sand, silt, clay, and gravel, with intertongues of volcanic sand complexes of Soda Lake. The surface of the Swingle Bench area and vicinity includes dunes, stabilized dune fields, and fluvial deposits from the Carson River.

2.2 SOILS AND VEGETATION

The soils in the Swingle Bench area were mapped by the Soil Conservation Service (SCS 1975). The Swingler series is the predominant soil underlying the parcels of interest. Several phases of the Swingler series were identified, including sand, sandy loam, clay loam, and slightly-to-strongly saline clay loams. However, many of the lands have been cleared and leveled to facilitate irrigation, and the surface textures may have changed as a result. Furthermore, the Swingler map units contain unmapped inclusions of similar and dissimilar soils. Thus, the character of the soils on the lands of interest and their inherent potential for wind transport are unknown. Under irrigation, a perched water table may be present seasonally at about 3 to 6 feet below the ground surface. In a native condition, Swingler soils may support Indian ricegrass, dalea, white sage, horsebrush, black greasewood, big sagebrush, and shadscale (SCS 1975).

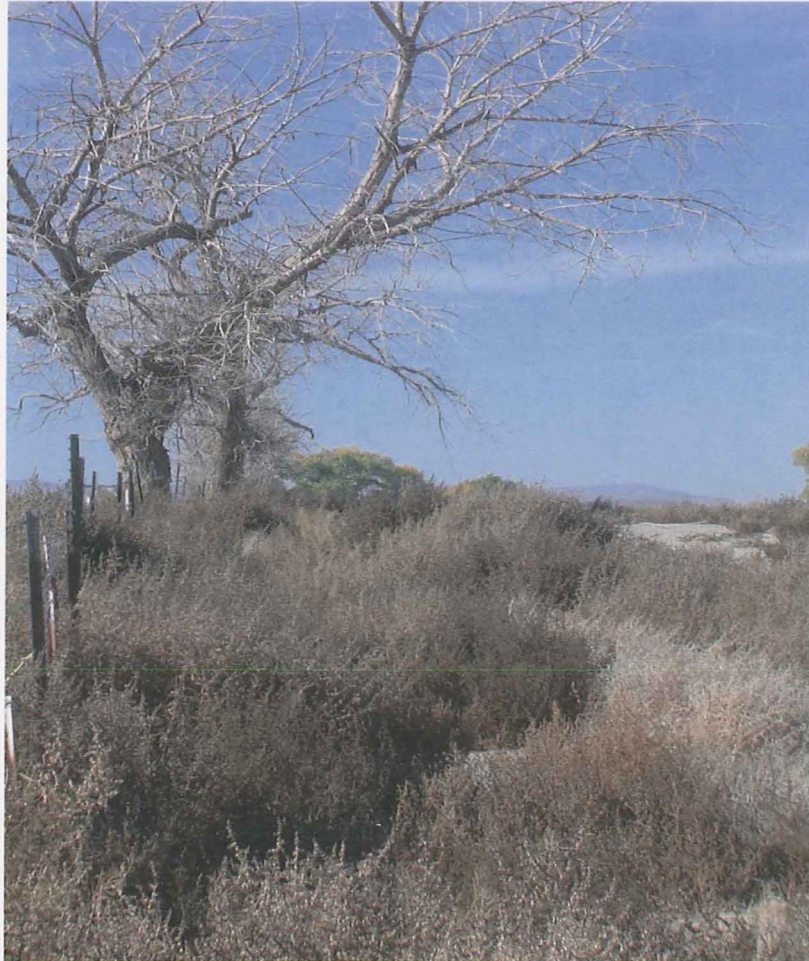
Tetra Tech EM, Inc. conducted a site visit at the Armstrong Parcel in October 2005. The current state of the parcel was overgrown with dried prickly Russian thistle (*Salsola tragus* L.) Figure 2 depicts Russian thistle in its live vegetative state. Some bushes can exceed 4 feet in height after they are fully grown.

The vegetation was approximately 3 to 4 feet in height and was contiguous throughout the perimeters of the parcel. The following photograph (Figure 3) was taken on October 31, 2005 at the Armstrong Parcel from the eastern side (facing west).

FIGURE 2
RUSSIAN THISTLE (*Salsola tragus* L.)



FIGURE 3
**CURRENT VEGETATION OBSERVED AT THE ARMSTRONG PARCEL WITHIN SWINGLE
BENCH (OCTOBER 31, 2005)**
(Photo taken facing west at the entrance gate)



2.3 CLIMATE

2.3.1 PRECIPITATION

West central Nevada lies in the rain shadow of the Sierra Nevada, and the climate is arid. Precipitation is consistently low throughout the year, with a subtle hiatus in July through September. On average, this region receives about 0.5 to 0.75 inches of precipitation per month, with somewhat lower amounts in the summer. Long-term climatic data are not available specifically for Swingle Bench. However, historical meteorological records exist for nearby stations at Fernley, Fallon, and Lahontan Dam. The Lahontan station, which is about 5 miles southwest of Swingle Bench, is the closest to the project area. Table 1 lists

the mean, maximum, and minimum annual precipitation and mean annual temperatures for the nearby stations. From a short-term perspective, Nevada has experienced drought with below-normal precipitation since about 1999 (NOAA 2003).

**TABLE 1
SUMMARY OF PRECIPITATION AND TEMPERATURES FOR SELECTED STATIONS
NEAR SWINGLE BENCH**

Station Location	Mean Annual Precipitation (inch)	Maximum Annual Precipitation (inch)	Minimum Annual Precipitation (inch)	Mean Annual Temperature (°F)	Period of Record
Fernley	6.05	11.63	2.70	52.6	1949 to 1974
Lahontan	4.56	10.92	1.81	54.8	1948 to 2003
Fallon Express Station	4.97	9.18	1.66	51.2	1903 to 2003

Source: NOAA. 2003. Climate of 2002 – Annual Review U.S. Drought.” National Climatic Data Center. January 23.

2.3.2 WIND

Long-term records that describe wind conditions on the Swingle Bench are not available. Wind speed averages were used from Fallon Naval Air Station (NAS) and the Churchill Vineyards. The annual average wind speed (at 10 meters) for the Fallon NAS is 5.9 miles per hour (mph). Monthly average wind speed ranges between 4.5 and 7.6 mph, with the higher average wind speeds occurring during the spring and early summer (March through July). The highest wind gust measured at the Fallon NAS between 1955 and 1996 was 56 knots (64.6 mph).

The Western Regional Climate Center (WRCC) reports wind data collected between January 2001 and February 2004 for the station at Churchill Vineyards in Fallon. Average annual wind speed was 3.5 mph. Predominant wind direction varies seasonally from the west, southwest, and west-northwest.

2.4 REGULATORY REQUIREMENTS

Churchill County and NDEP have promulgated regulations and ordinances concerning nuisance dust. Dust control for the Armstrong Parcel within Swingle Bench will be managed according to the *Surface Area Disturbance Permit Dust Control Plan (Plan) Preparation Guidelines* as established by NDEP (NDEP 2002).

2.4.1 DUST CONTROL PLAN COMPONENTS

When state, local, and federal governments require a dust control plan, it normally includes specific procedures and policies to reduce dust emissions. Information normally in a plan includes:

- Description of the project
- Location of the project and areas disturbed
- Types of disturbances
- Objectives of the dust control plan; such as to minimize dust-related impacts and ensure that construction does not result in significant impacts to air quality, and to maintain consistency with the practices and mitigation measures specified for the project
- List of responsible parties and description of their responsibilities
- Dust mitigation measures that will be taken:
 - Use of water or chemical stabilizers to control dust
 - Curtailing certain activities during periods of extremely high wind conditions
 - Reseeding following construction to establish effective vegetative cover
 - Limiting vehicle travel speeds on site
 - Material handling and storage
 - Paving roads
- Training personnel will receive to ensure the dust control plan is implemented properly and effectively

The NDEP has prepared guidelines for developing dust control plans. The guidance includes 16 requirements for a dust control plan when it is prepared as part of an application to obtain a surface disturbance permit (see Attachment B). This dust control plan will address the requirements as established by NDEP.

3.0 DUST CONTROL MEASURES

This section discusses dust control practices that have been selected for consideration to reduce the level of blowing sand and fugitive dust for the Armstrong Parcel. A wide variety of measures were examined that prevent or reduce wind erosion, including establishing vegetation cover, covering the soil with mulch or other materials, applying dust suppressants or surfactants, constructing physical wind barriers, gravel placement, and mechanically treating the soil. Tetra Tech (2004) discussed these practices in the mitigation measures report. This document discusses the techniques that were selected for consideration for the Armstrong Parcel, which are vegetation cover, gravel placement, mulching and alternative covers, and soil stabilizers.

3.1 VEGETATION COVER

Bare, unprotected soil is extremely vulnerable to wind erosion (see Attachment A). The most effective way to prevent wind erosion is to establish and maintain a permanent cover over the soil surface. Temporary covers, such as straw or wood mulching, manure, crop residues, or synthetic matting, can be effective in the short term; however, they require periodic reapplication and can be expensive. A more permanent and aesthetic solution is to establish a natural vegetative cover over the surface. Vegetation protects the surface from wind erosion by reducing wind speed at the soil surface. Volunteer vegetation is growing at the Armstrong Parcel within the Swingle Bench (Figure 4).

Revegetation of wind-eroded soils will require development of a drought-tolerant seed mix that can rapidly establish without irrigation. A diverse mix of native and non-native species and grasses should be emphasized that will hold the soil and compete vigorously with undesirable weeds. Non-native species can be helpful because many of the native range species in Nevada are especially poor competitors with noxious weeds, particularly in the initial phases of establishment (McAdoo 2003). The goal of revegetation will be to establish a diverse and self-sustaining plant community that is structurally and functionally similar to surrounding undisturbed communities. Management of the vegetation is necessary when it becomes overgrown or dies. It is advised that periodic monitoring include evaluation of the vegetation and controls be implemented to ensure that a fire hazard does not exist.

FIGURE 4
VOLUNTEER VEGETATION ON THE ARMSTRONG PARCEL
OCTOBER 31, 2005
(Photo taken facing east from the western side of the property)



The existing soils may require amendments, such as gypsum and fertilizer. However, application of fertilizer on arid rangelands after seeding can result in a significant weed infestation because most annual weeds (such as cheatgrass) thrive on high nutrient availability. Seedbed preparation should consist of discing or harrowing compacted areas and slightly roughing other areas, if necessary. Overall surface disturbance should be minimized to retain soil moisture and organic material and prevent bringing competitive weed seeds to the surface.

In coarse-textured soils such as sands, the seed depth should be slightly deeper than in lighter-textured soils such as clay and silt (McAdoo 2003). Seeds should be planted in the fall, preferably between mid-October and mid-November, to ensure successful germination in the spring. Local erosion control contractors may seed areas as late as January or February.

Currently, the vegetation appears to be abundant on the parcel; however, without adequate rainfall the vegetation is becoming brittle/dry and will soon uproot and may become a nuisance.

3.1.1 EFFECTIVENESS OF VEGETATION COVER

A plan for vegetative cover as an effective dust control would require that 50 percent of the land would be covered. This cover would include dead and dormant stems that would provide erosion protection without presenting a transpirative surface. This level can be maintained during the growing season with enhancement of precipitation. In recent years, it has been documented that since 1999 the precipitation levels have been down for Churchill County. Based on a study of the Lake Texcoco region near Mexico City, 30 percent vegetative cover of the area resulted in a reduction of fugitive dust due to wind erosion as much as 99 percent (Buckley 1987). Similar studies conducted at Owens Lake, California determined that similar amounts of ground cover would reduce wind erosion in sandy soil conditions (Grantz and others 1995). Both studies conducted accounted for wind speeds up to 48 mph.

Typically, 2 to 3 years are required before a healthy and permanent stand of vegetation can be established. During this period, interim measures may be necessary to prevent wind erosion and ensure successful revegetation. Based on observations of the natural vegetation on undisturbed areas near the site, it may not be possible to achieve adequate vegetation cover to entirely prevent wind erosion; however, the presence of even limited vegetation will help reduce fugitive dust emissions and establish an environment similar to the naturally occurring surroundings.

3.2 GRAVEL COVERS

When a living, vegetation cover is not possible, wind erosion of bare soils can be prevented or reduced by covering the surface with mulching material such as gravel or other resistant materials. The material is best spread mechanically.

A gravel cover is an effective management method for wind erosion. The thickness and frequency of the gravel can be adjusted to accommodate future land use scenarios. By providing a gravel layer on the

sandy soils, the threshold wind velocity is raised and the wind speeds that are required to move soils are higher. The wind data provided in the mitigation measures report identified that the wind speeds for the Fallon NAS and Churchill Vineyards are high only sporadically and the mean constant wind speed for the site is typically under 5 mph.

Gravel placement on the soils at the Armstrong Parcel will need to be durable enough to resist wind erosion for the climate conditions for the Swingle Bench; however, if future land use for the parcel is agriculture/farming, then this alternative is not recommended. The surface soils for this area will be impacted during the gravel placement. Subsequent removal of the gravel, if desired to facilitate a future land use, will further destroy the integrity of the surface soils. Also, in studies of the Owens Lake area, it was suggested that in Sandy conditions, gravel cover could lose its effectiveness over time (Great Basin Unified Air Pollution Control District 2005). Large pore spaces between gravel deposits should be maintained to ensure that the gravel blanket will remain effective.

3.2.1 EFFECTIVENESS OF GRAVEL COVER

Gravel provides a non-erodible cover when the proper placement and frequency are determined based on the soil conditions of a site. The size of the gravel and the wind speeds at a site can provide adequate protection against erosion. Gravel and rock covering at a mine tailings site in Arizona have been successful (Chow and Ono 1992). The potential for dust emissions can be determined based on the US U.S. Environmental Protection Agency (EPA) emissions calculation for industrial wind erosion for wind speeds above the threshold for the surface (EPA 1985). Fugitive dust will not be emitted if the wind speed is below the threshold value.

3.3 MULCHING AND ALTERNATIVE COVERS

When a living, vegetation cover is not possible, wind erosion of bare soils can be prevented or reduced by covering the surface with mulching material such as straw, hay, corn stalks, crop residues, gravel, or other resistant materials. Approximately 2,000 to 4,000 pounds per acre of plant material is needed to provide sufficient protection, depending on the soil texture (Smith and others 1992). The material can be spread by hand or mechanically. Lighter materials such as hay or straw may require anchoring in place using a stubble puncher or discing into the soil. This solution is short term, and reapplication of new material is typically required every 3 to 6 months.

Vertical mulching, or placement of vertical strands of straw, sticks, or brush in the soil, has been successful in controlling wind erosion from desert areas in California (Bainbridge 1994). Vertical strands or bunches of the material about 18 to 24 inches long are inserted into holes punched in the soil. The material increases storage of moisture in the soil substantially while providing an effective windbreak and erosion trap. Reed bundles are durable and have been effective in desert areas with shifting sands. However, unless they are adequately anchored, strong winds can dislodge the vertical strands. This alternative would likely require experimentation to identify the optimum material and spacing for site-specific conditions. Considerable maintenance and reapplication may also be required in areas of strong winds.

The application of mulching or a surface tackifier immediately after seeding is highly recommended. The freshly seeded surfaces will be especially prone to wind and water erosion if one is not applied. Mulching is commonly composed of hay, straw, or wood fibers applied via mechanical spreaders or special blowers. The mulching can be crimped or disced into the soil, if necessary. Commercial seeding applications that combine hydroseeding with mulch and tackifiers are also available.

3.3.1 EFFECTIVENESS OF MULCHING AND ALTERNATIVE COVERS

Plant residue in the surface soils increase moisture by increasing infiltration and reducing evaporation. Mulch is often applied only on lower slope positions or in areas of a field that experience highly erodible concentrated flows. Mulch is only effective for sheet and rill erosion control. If the erosion rate on the upper slope is too severe, either the mulch on the lower slope will wash away with the flow; the soil will erode beneath the mulch; or the mulch will become buried with sediment (DeHaan 1996). Mulching has proven to be an effective wind erosion control method.

3.4 SOIL STABILIZERS

A broad range of commercially available dust suppressant products is available. These products, which include polymers, petroleum emulsions, surfactants, and adhesives, generally work by binding the soil particles together to create a crust over the soil surface. Each product has advantages and disadvantages, depending on the soil type, climate, desired longevity, and type of application. Whatever product is used, economical and proper application is essential.

Dust suppressants are widely used in the mining and construction industries as alternatives to frequent watering. Most are water soluble and can be easily applied using traditional water trucks. Aerial applications are also available. Most solutions are biodegradable and can last from 3 months up to 4 years per application if the surface is not disturbed and the initial application is heavy.

3.4.1 EFFECTIVENESS OF SOIL STABILIZERS

Dust suppressants provide an effective option for preventing wind erosion. For longer-term stabilization on disturbed soils that will not sustain traffic, Plas-Tex, a gypsum-based product was developed and is now distributed throughout the West. The product is biodegradable and will allow evaporation, infiltration, and penetration by plants. However, soil stabilizers are most effective when applied during optimum climate as identified for each individual product. Typically, before ambient temperature is below 40°F (check manufacture suggestion prior to scheduling). Ground must not be frozen in most cases. Setting time and soil moisture allowable conditions vary for individual products. Soil stabilizers provide a low cost and effective method for wind erosion control.

3.5 COMPARISON OF METHODS AND COSTS

Table 2 compares the wind erosion control methods discussed previously and their approximate unit costs. A permanent, vegetated cover would be the preferred and probably least expensive method of controlling wind erosion at the site; however, because of native soil and climate conditions, it may not be possible to achieve sufficient canopy cover to completely eliminate dust generation. In addition, at least 2 to 3 years would be required to establish adequate vegetation cover, and interim measures would likely be required.

Dust suppressants also would provide an immediate solution and potentially less frequent reapplication; however, concurrent land uses would be prohibited. Other cover alternatives, such as gravel or synthetic mats, can be cost prohibitive for large areas and could significantly limit or prevent concurrent land uses.

Most likely, the solution for controlling windborne dust at Swingle Bench will consist of a combination of one or more of the standard mitigation measures discussed in the mitigation measure report (Tetra Tech, 2004). Emergency and long-term management of the parcel have been identified to provide the best management practice (BMP) to properly control the fugitive dust at the Armstrong Parcel. As of October 2005, the condition of the parcel would be described as having natural vegetative cover over more than 50 percent of the parcel. However, the vegetative cover of this parcel was in the process of dying and

**DUST CONTROL PLAN FOR THE ARMSTRONG PARCEL
SWINGLE BENCH AREA, CHURCHILL COUNTY, NEVADA**

**TABLE 2
COMPARISON OF WIND EROSION CONTROL METHODS AND ASSOCIATED COSTS**

Method	Approximate Unit Cost	Anticipated Longevity	Pros	Cons
Revegetating	\$600 - \$2,500/acre	Permanent	<ul style="list-style-type: none">• Permanent• Low maintenance• Aesthetically pleasing• Low costs	<ul style="list-style-type: none">• Not immediate solution• May require interim measures• Sufficient vegetative cover not guaranteed
Gravel Placement	\$500 - \$1,000/acre	Permanent (complete cover)	<ul style="list-style-type: none">• Permanent• Low maintenance• Low cost• Can be placed anytime	<ul style="list-style-type: none">• Will destroy surface soil• Will not facilitate future agriculture
Mulching and Alternative Covers	\$500 - \$5,000/acre	3 to 6 months	<ul style="list-style-type: none">• Immediate results• Relatively easy application• Low to medium costs	<ul style="list-style-type: none">• Temporary• High long-term costs• Blowing debris instead of dust• Prevents concurrent land uses
Soil Stabilizers	\$500 - \$1,500/acre	6 months to 4 years	<ul style="list-style-type: none">• Immediate results• Relatively easy application• Low costs	<ul style="list-style-type: none">• Temporary• Potentially high long-term costs• Low costs• Prevents concurrent land uses• Temporal constraints

uprooting. The recommended BMP for the Armstrong Parcel is to continue the management of the current vegetation combined with the use of soil stabilizers. Temporal constraints on soil stabilizers may impede the process during the winter months; however, the current state of the site provides sufficient cover at the parcel. The other alternative is to use mulching or placement of alternative covers to the site (for example, gravel); however, depending on the future land use of the site, alternative covers are not favorable to future agricultural use of the land. Regardless of the approach taken, factors such as aesthetics, available funding, required longevity, future land uses, and desired future conditions will all be critical in selecting the most appropriate solution.

4.0 DUST CONTROL PLAN

This suggested dust control plan was established based on the criteria from NDEP's *Surface Area Disturbance Permit Dust Control Plan (Plan) Preparation Guidelines* (NDEP 2002). The information may be used to complete the permit for a surface area disturbance of more than 5 acres but no more than 20 acres of land per parcel. The Armstrong Parcel is approximately 18.64 acres according to the Churchill County Assessor's Office (Churchill County Assessor 2005). Based upon the parcel size and the lack of surface disturbance, a dust control plan and permit are not required at this time for the Armstrong Parcel. If it is desired to apply for an NDEP permit, completed NDEP dust permit information for this parcel is provided in Appendix B.

Implementation of a successful dust control plan may feature two phases: emergency and long-term plans. The emergency plan would look at the immediate condition of the parcel and based on an evaluation of the site on a monthly basis, mitigation measures identified in this document may be implemented as the condition of the site changes. The long-term plan would identify the mitigation measures that would need to be implemented to provide solutions based on the future land use of the property to reduce the amount of fugitive dust from the Armstrong Parcel.

The emergency plan would include the following options to temporarily reduce the amount of fugitive dust at the Armstrong Parcel within the Swingle Bench area:

- Survey the property and identify the current condition of the vegetative cover that currently exists at the site (access of the entire property would be required).
- Based on the survey, identify the area that is not currently covered and determine (based on the temporal constraints) if a plant-based soil stabilizer can be applied to the site.
- Monthly monitoring of the site will ensure that the current site conditions are stabilized and not enhancing the fugitive dust problem or promoting fire (e.g., dead vegetation).
- During winter months, it is expected that precipitation levels and snowfall will facilitate the dust control for the parcel. Snow cover and rain will not promote wind erosion.

The long-term management plan would include the following to reduce the amount of fugitive dust at the Armstrong Parcel at Swingle Bench:

**DUST CONTROL PLAN FOR THE ARMSTRONG PARCEL
SWINGLE BENCH AREA, CHURCHILL COUNTY, NEVADA**

- Promoting vegetation (e.g., hydroseeding) the area would promote vegetative cover and significantly diminish the amount of dust that would be produced at the site. This method is sensitive to temporal boundaries for the location. For best results, seeding should occur during October through November to obtain best results. It is estimated that to foster a healthy cover for this location, 2 to 3 years are needed; however, native species are abundant at the site naturally. Hydroseeding would enhance the natural vegetative cover.
- In addition to vegetative cover, mulching or alternative covers in addition to seeding may be necessary to foster the process. It is common for a straw or manure cover to be applied during the seeding process to promote seed development.
- Depending on the future land use, soil stabilizers may be applied to the site that would be effective for the long term (e.g., 1 to 2 years). Additionally, gravel is an effective method to reduce wind erosion; however, this alternative should be selected based on the future land use as well.
- Monthly monitoring would ensure that the methods implemented are successful and adjustments to the site may be required based on current site conditions.

Appendix B provides additional requirements for the site. A NDEP dust permit requires notification of subcontractors of the dust control plan and reducing site access. Additional requirements are identified by the NDEP's *Surface Area Disturbance Permit Dust Control Plan (Plan) Preparation Guidelines* (NDEP, 2002).

5.0 CONCLUSION

The soils and arid climate that characterize the Swingle Bench area are likely to result in episodes of windblown sand and dust. Future sources of blowing sand and dust may include fallowed lands within the Swingle Bench, as well as other surrounding undisturbed properties where the vegetation cover is sparse. Land use practices on Swingle Bench result in some areas with low vegetation cover. The background level of blowing sand and dust from areas with sparse native vegetation is unknown, but these lands will contribute to the sand and dust load in the area.

A number of management practices could be implemented to reduce the amount and frequency of windblown dust and maintain the integrity of the soil. Standard measures may include establishing a vegetative cover, covering the land surface with gravel cover, and applying dust suppressants or surfactants. Mitigation costs can range from \$500 to \$5,000 per acre, and the longevity of some treatments is limited and must be repeated. A combination of one or more mitigation measures therefore may be needed to control windborne sand and dust in the Swingle Bench area. The recommended BMP for the Armstrong Parcel is to continue the management of the current vegetation combined with the use of soil stabilizers.

The voluntary dust control plan (Appendix B) provides alternatives to control fugitive dust based on emergency and long-term plans. Both plans include promoting native vegetation as the primary control. Other controls to stabilize the soil are identified as appropriate to the time and depend on future land use. This plan has been developed based on the criteria established by the NDEP's guidance, but is not required at this time by NDEP due to the lack of surface disturbance.

Monitoring current vegetation along with application of soil stabilizers may be implemented for the emergency (short-term) plan. However, climate may prevent the application of hydroseeding and certain soil stabilizers. Revegetation of the fallowed lands with native and adapted species, augmented by localized physical controls (e.g., artificial cover in areas that do not have a vegetative cover), is likely to provide the best long-term solution for blowing dust. Factors that include aesthetics, funding, longevity, future land uses, and desired future conditions will all be critical in selecting the most appropriate mitigation solution. The success of revegetation in controlling dust must be complemented by a land management plan to ensure that vegetation is protected from destruction associated with improper grazing and vehicle impacts.

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SWINGLE BENCH AREA, CHURCHILL COUNTY, NEVADA**

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**DUST CONTROL PLAN FOR THE ARMSTRONG PARCEL
SWINGLE BENCH AREA, CHURCHILL COUNTY, NEVADA**

ATTACHMENT A
OVERVIEW OF WIND EROSION



A.1 OVERVIEW OF WIND EROSION

This section provides an overview of wind erosion processes, including methods of investigation and control of wind erosion. The discussion of field investigation methods focuses on the types of sampling equipment used in Churchill County's Swingle Bench dust study.

A.1.1 WIND EROSION PROCESSES

Wind erosion occurs whenever bare, loose, dry soil is exposed to wind of sufficient speed to cause movement of soil. The basic mechanisms of wind erosion consist of breakdown of soil clods and aggregates into single particles, detachment and transport of the particles by wind energy, and deposition. Overall, soil erodability depends largely on the mechanical stability of the soil, which in turn depends on the size, density, and shape of the particles and the agents that bind the particles into aggregates. Other important factors in wind erosion include climate, soil roughness, vegetation cover, and field width.

Soil materials may be transported by wind in one of three modes: surface creep, saltation, or suspension. The specific mode of transport depends on the aerodynamic properties of the particle, including size, shape, density, and the transport capacity of the wind as influenced by turbulence, velocity, and viscosity (Bagnold 1943). The minimum velocity where the most unstable particles are dislodged is called the threshold velocity. The threshold velocity for a soil covered by plants, mulch, or sources that create surface roughness will be higher than if the same soil is bare, smooth, and loose.

Surface creep occurs when large particles that are too heavy to be entrained into the air move across the surface by rolling or sliding. Surface creep accounts for a relatively minor fraction of the materials moved by the wind. **Saltation** occurs when particles move by bouncing along the soil surface. The bouncing particles transfer momentum to other grains by collisions, causing these particles to be temporarily entrained in the air. The diameters of saltating particles range from about 0.2 to 1.0 millimeters and can account for the major fraction of soil moved by the wind (Fryrear and others 1991). **Suspension** affects particles that are smaller than 0.2 millimeters, which can be kept in suspension by upward components of atmospheric eddies. The suspended fraction is dust that may grade to extremely fine particulate matter (haze) that can be carried long distances.

Saltation changes the vertical wind profile because of the energy required for the wind to sustain particle movement. Suspension requires considerably less energy, so there is an abrupt change in wind velocity gradient going from saltation to suspension flux (Fryrear and Saleh 1993). It is difficult to set a limit on the boundary between the zones dominated by saltation flow versus suspension flow (Zobeck and others 2002). The vertical distribution of suspended sediment mass differs for materials in suspension or in saltation. Transport of material in saltation and suspension zones is limited and will reach a maximum transport capacity that depends on surface roughness, soil type, availability of loose material, and distance upwind from the non-erodible boundaries. In the field, erodability is extremely dynamic and varies seasonally, yearly, and as the result of management operations (Skidmore, 1994).

A.1.2 FIELD INVESTIGATIONS AND ANALYSIS

A variety of methods are available for field measurement and data analysis of wind erosion. Examples of the objectives of a wind erosion study may include support of erosion models, assessment of eolian processes and erosion damage, and investigation of erosion sources. The specific objectives of a wind erosion study drive the sampling apparatus and methods, field characteristics, and analysis methods to be used (Zobeck and others 2002). The various processes that compose wind erosion are difficult to study at a point in space and time, so measurements usually represent either quasi-steady state or time integrations of detachment and transport processes over some finite space (Skidmore and others 1994). This section presents results a brief review of wind erosion studies and instrument evaluations. The types of measurements and instruments that were used in Churchill County's Swingle Bench study are emphasized.

A.1.2.1 FIELD INSTRUMENTATION

Soil samplers and sensors have been developed to measure surface creep and airborne particles to detect moving soil particles and field erosion. The initial research on wind erosion processes was performed by Chepil and Milne (1939) and Bagnold (1943). The researchers used wind tunnels in these studies to identify the basic physical processes in the transport of loose sand or soil material by wind. Today, field instruments are used that are designed to sample eroding, windborne soil in each of the separate transport modes (creep, saltation, or suspension). Overall, accurate measurement of soil particle flux is a delicate procedure. Wind tunnels may be used either in the field or in the laboratory to quantify fluxes under controlled conditions. When wind tunnels are not used, however, flux measurements are complicated because of high temporal and spatial variability under natural conditions.

Field investigations generally require instrumentation for measuring soil flux, soil properties, and meteorological variables (Fryrear and others 1991). Samplers for measuring soil flux may be passive or active. Passive samplers rely on natural ambient wind conditions to collect samples. Active samplers use vacuum pumps or other devices and are most often selected for collecting fine particles in suspension (Zobeck 2002). A passive sampler will usually measure horizontal flux or vertical flux, which means the sampling orifice is either in a horizontal or vertical position (Goossens and Offer 2000). According to Zobeck (2002), the best method of collecting horizontally moving suspended sediment is an active impinger-type device. In these devices, a vacuum source is connected to filtered sampling tubes pointed into the wind. Furthermore, sensors can be used in addition to sampling devices. One example is the SENSIT, which counts eroded soil particles that strike a piezoelectric quartz sensor.

In Churchill County's Swingle Bench dust study, two types of passive samplers are used: the Big Spring Number Eight (BSNE) and the near surface sampler (NSS). The BSNE was developed and first introduced by Fryrear (1986). The NSS was developed and first introduced by Stout and Fryrear (1989). Both samplers are described in J.E. Stout's *Measuring the Mass Flux Profile*. The NSS measures windblown sediment within the lowest 20 millimeters above the land surface. The BSNE is a saltation sampler and collects windblown sediment above the range of the NSS via an array of samplers that can be adjusted up or down along a support pole. However, the BSNE does not sample surface creep or saltation flux below 0.05 meters. The BSNE and NSS are both equipped with pivoting wind vanes that orient the orifices into the direction of the erosive winds. Samplers rarely need to exceed 1.0 meter in height for studies of saltation flux (Zobeck and others 2000) because a majority of total soil movement occurs within 1.0 meter of the soil surface. The performance of the BSNE has been evaluated in a number of published reviews (Fryrear 1986; Shao and others, 1993; Stout and Zobeck 1996; Goossens 2000).

A.1.2.2 IMPORTANT CRITERIA AND FACTORS FOR FIELD INVESTIGATIONS

To be considered accurate, a sampler must meet three criteria by sampling (1) isokinetically, (2) efficiently, and (3) nonselectively. In an isokinetic sampler, the flow velocity through the orifice or intake is equal to the local instantaneous ambient wind velocity. Stout and Fryrear (1989) indicated that no sampler is capable of completely satisfying all of these criteria. As a result, a sediment collector can not be always 100 percent efficient, but the efficiency must always be known for the sampling conditions. Efficiency of a sampler can decrease as filters and traps in samplers can become saturated. When a sampler is not emptied between individual wind erosion events, the accumulated mass in the sampler must be averaged over time (Goossens 2000).

A number of factors regarding the source area must be considered for field-scale wind erosion studies. These factors include soil surface properties, field geometry, and orientation to prevailing wind direction, length, boundaries, and surface variability. Fryrear and others (1991) recorded field conditions to characterize soil surface properties, in a typical field investigation. These properties included aggregate size distribution of the surface soil; soil roughness and whether the roughness has changed as a result of rainfall or erosion since the last measurement; the quantity and orientation of surface residues; the status of any growing vegetation; the presence of non-erodible clods or rocks; and, if a crust is present, the percentage of the crusted soil that is covered with loose material. Sampling fetch distance should be clearly identified and requires a non-erodible upwind area. In situations when the non-erodible boundary is difficult to define, input from upwind sources should be quantified. Typically, the surfaces of agricultural fields vary spatially; therefore, the factors that determine soil erodability also vary. This variation can result in significant spatial variation in observed saltation flux (Zobeck and others 2002).

Meteorology is another important factor in field investigations of wind erosion. In a typical investigation, one meteorological tower is used that is instrumented with a variety of sensors and gauges. Anemometers and direction sensors are used to evaluate wind shear stresses.

A.1.2.3 WIND EROSION MODELS

Wind erosion rates can be simulated using empirically based models. The wind erosion equation (WEQ) was originally developed to estimate potential erosion in tons per acre per year from a specific field under certain field conditions (Chepil and Woodruff 1963). The principal variables in the equation include soil erodability, ridge roughness, vegetation cover, climate factors, and the unsheltered length of the field. Proper solution of the WEQ requires site-specific information, including percentage of soil aggregates that exceed 0.84 millimeters in diameter, field width, and the type and quantity of vegetation cover. Computer programs are available to assist in solving the WEQ.

The revised wind erosion equation (RWEQ) is a process-oriented model with underlying empirical components (Fryrear and others 2001). RWEQ requires information on the soil erodability, soil crusts, surface roughness, weather conditions, field size, crop cover, and topographic factors to determine average soil erosion. RWEQ can simulate the effects of different management regimes on rates of soil erosion. A comparison of WEQ and RWEQ simulations to measured soil erosion indicated that RWEQ is more accurate than WEQ (Fryrear and others 2001). However, the RWEQ tends to overpredict soil

**DUST CONTROL PLAN FOR THE ARMSTRONG PARCEL
SWINGLE BENCH AREA, CHURCHILL COUNTY, NEVADA**

erosion compared with the measured data at 10 of the 15 calibrations sites. Thus, these models have value in assessing relative soil loss rates, but should be used with caution in evaluating the absolute magnitude of soil loss.

**DUST CONTROL PLAN FOR THE ARMSTRONG PARCEL
SWINGLE BENCH AREA, CHURCHILL COUNTY, NEVADA**

ATTACHMENT B

**INFORMATION FOR VOLUNTARY SURFACE AREA DISTURBANCE PERMIT
APPLICATION**

BASED ON THE NDEP DUST CONTROL PREPARATION GUIDELINES

**PLAN AND PERMIT ARE NOT CURRENTLY REQUIRED BY NDEP
AS THERE HAS BEEN NO SURFACE DISTURBANCE**



**DUST CONTROL PLAN FOR THE ARMSTRONG PARCEL
SWINGLE BENCH AREA, CHURCHILL COUNTY, NEVADA**

**DUST PLAN AND PERMIT ARE NOT CURRENTLY REQUIRED BY NDEP AS THERE
HAS BEEN NO SURFACE DISTURBANCE**

Dust Control Plan for the Armstrong Parcel, Swingle Bench, Churchill County, Nevada

- 1) The Responsible Official (RO) for the property is:

Name of Owner's Representative
Address
Address
Address
Phone number
- 2) Highway 50 and Bench Road
Swingle Bench
Churchill County, Nevada
- 3) Currently, there is no use scheduled for the property. It was previously used for agriculture which has been terminated without further surface disturbance. A solution to maintain the fugitive dust for the property has been identified and is presented in the *Dust Control Plan for Armstrong Parcel, Swingle Bench, Churchill County, Nevada*. The plan was based on Nevada Administrative Code (NAC) Section 445B.22037 "Emissions of Particulate Matter; Fugitive Dust" and the NDEP's *Surface Area Disturbance Permit Dust Control Plan (Plan) Preparation Guidelines* (NDEP 2002).
- 4) This dust control plan has been developed to address management of fugitive dust for the "Armstrong Parcel" located in the Swingle Bench area of Churchill County, Nevada. Assessor's information on the Parcel is:

A portion of Township 19N, Range 27E, Section, 8
The Churchill County Assessor's Parcel number is designated as 07-111-51
The total acreage identified by the Churchill County Assessor's office is 18.64 acres
- 5) Maps required for management within a subdivision include a tract map and a site map.
- 6) The RO for the project has read and understands the provisions of the NAC Section 445B.22037 "Emissions of Particulate Matter; Fugitive Dust" and is aware that the Project is responsible for preventing controllable fugitive dust from the project's disturbed areas to become airborne on a 7-day/week, 24-hr/day basis.
- 7) Subcontractors and others accessing the disturbed areas will be notified of their responsibilities to control fugitive dust when working on site. This plan does not cover access to adjacent properties and prohibits disturbing (driving over, grading, or spreading dirt) adjacent properties not covered by the permit.
- 8) The best practical methods for maintaining dust on the Armstrong Parcel at Swingle Bench were identified. The methods were identified as presented in the "Review of the Dust Study and Development of Mitigation Measures for the Swingle Beach Area, Nevada" as prepared for the Local Government Oversight Committee, County of Washoe, and Cities of Reno and Sparks,



**DUST CONTROL PLAN FOR THE ARMSTRONG PARCEL
SWINGLE BENCH AREA, CHURCHILL COUNTY, NEVADA**

Nevada (March 2004) and were identified in the "Dust Control Plan for the Armstrong Parcel, Swingle Bench Area, Churchill County, Nevada" (December 2005).

For the Armstrong Parcel, a combination of dust control methods would provide the best management practice. As of November 2005, the property is covered (more than 75%) with native vegetation. The current state of the vegetation is overgrown. Based on field observations, Russian thistle is the dominant species at the site. Russian thistle was observed throughout the site that was in excess of 2 to 3 feet in height. For the Parcel, native vegetation is abundant and growing without mechanical seeding or added water; however, the vegetation lifespan is seasonal and creates a potential nuisance from the dead vegetation.

***Note:** The dust control plan presents the recommended alternatives for an emergency and long-term plan for the Parcel. Measures identified for those plans are presented in the document and can be replaced in this section dependent upon the application.

- 9) The dust control measures will be implemented for the following measures:

Emergency

- Vegetation control- monthly site surveys will be completed and can start at the beginning of this plan.
- During winter months, the precipitation is higher and no additional measures will be required for dust control (during October through February).

Long Term

- Monthly vegetation surveys will be conducted and can be started immediately.
- Hydroseeding has temporal constraints. The operation must be performed in October to mid-November to achieve optimal results.
- Mulching can be performed at any time of the year (based on research of available technologies).
- Surface dust suppressants (tackifiers) depend on ambient air temperatures and ground temperatures. Temperatures must be above 40 degrees Fahrenheit. October through February is not optimal times of the year for application based on the types identified.

- 10) The previous explanation on application and temporal constraints for the selected measures addresses the time frame for application (See number 9).
- 11) Local water supplies are not expected to be used for any of the dust control measures selected for this site. If water is required, the owner will be notified prior to application of hydroseeding or soil suppressants.
- 12) A water truck or similar supply will be used at this site for the application of hydroseeding or soil suppressants if local water sources are not available.
- 13) During application of suppressants, hydroseeding, or vegetation removal, an on-site representative will be present from the ROs office to ensure that practices are being conducted in agreement with the NAC Section 445B.22037 "Emissions of Particulate Matter; Fugitive Dust" and the Churchill County Dust Control measures. A daily log will be kept of the activities on site and will be maintained in the project files.



**DUST CONTROL PLAN FOR THE ARMSTRONG PARCEL
SWINGLE BENCH AREA, CHURCHILL COUNTY, NEVADA**

- 14) A fugitive dust training plan will be developed based on applicable State and County codes and will be presented to all contractors working on the site. The training of personnel and contractors working on the site will be maintained in the daily log. Items in the training plan include:
- Overview of the applicable NAC and Churchill County Codes
 - Contractor responsibility of driving in and around the area to prevent fugitive dust emissions
 - Identifying the dust control method being performed and identifying any hazards that may be present during the application.
 - Emergency routes and hospital identification.
- 15) The on-site representative from the ROs office has the authority to suspend or stop work when unsafe working conditions are observed. Unsafe working conditions include fugitive dust emissions created by manmade sources or by wind in the area of Swingle Bench.
- 16) Provisions of this plan may change based on site conditions at the "Armstrong Parcel" within Swingle Bench in Churchill County, Nevada. Changes will be submitted to NDEP for approval prior to implementation at the site. Verbal approvals will be documented in the daily log and a signature will be obtained for the approval and maintained in the appropriate project files.