NOTICE

All drawings located at the end of the document.

REMEDIAL ACTION, 881 HILLSIDE

CONSTRUCTION DUST SUPPRESSION FEASIBILITY STUDY

PREPARED FOR

EG & G ROCKY FLATS, INC.
ROCKY FLATS PLANT

JULY 1990

PREPARED BY

ENGINEERING-SCIENCE, INC.
Denver, Colorado
IN CONJUCTION WITH

THE RALPH M. PARSONS COMPANY
Pasadena, California

ES ENGINEERING-SCIENCE

CONSTRUCTION DUST SUPPRESSION FEASIBILITY STUDY

881 HILLSIDE REMEDIAL ACTION
ROCKY FLATS PLANT
GOLDEN, COLORADO

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EXECUTIVE SUMMARY

This Construction Dust Suppression Feasibility Study will provide guidance for dust control procedures for construction of the influent collection gallery and effluent discharge pipeline (surface discharge configuration) for the 881 Hillside Remedial Action at Rocky Flats Plant. This investigation is limited to control of potentially contaminated dust which may occur in surficial soils at the above locations and does not address disposal of contaminated soil. Dust control measures for general construction in uncontaminated areas are required in the construction specifications for the project.

There is no data to support the areal distribution, concentrations or existence of surficial contamination at 881 Hillside. There is concern that contamination in the top six inches of surficial soil could have occurred due to deposition of fugitive airborne particulates from other plant areas over the operating life of the plant. ES recommends a comprehensive testing program to identify the existence, concentration amount and areal distribution of contaminated soil. A vertical profile of the top foot of surficial soil to determine the depth of the problem is necessary.

The recommendations of this report should be incorporated into a Dust Control Plan for construction of all facilities. A Dust Control Plan for each phase of construction should emphasize fugitive dust control specific to each application. The Dust Control Plan should utilize several of the dust control alternatives investigated here, including watering, air monitoring, petroleum resin-based or pine tar-based surface treatment, and windscreens. Siting of construction staging areas and roads out of wind is critical to dust control in a windy area such as Rocky Flats.

The dust control program recommended here applies the technology of several control alternatives for specific applications. The specific type of application where each method is most effective follows:

- Watering for general construction and trench construction is an effective and economical dust control measure and is standard industry practice with minimal environmental and health and safety drawbacks. Combined with air monitoring, it is the recommended alternative for construction of the influent collection trench and effluent discharge trench.
- Air and weather monitoring is a dust control measure which should be included in all dust control programs. Work stoppage is the actual dust control measure for this alternative. As such, it is not a stand alone solution, and must be combined with other control measures.

- Petroleum resin-based or pine tar-based additives are recommended for unpaved roads, construction staging areas, storage piles, and high traffic areas.
- Windscreens are appropriate for small control areas, and could be used for high wind areas, critical areas, or high traffic areas. Windscreens would be most effective when used in combination with other dust control measures.

This investigation concluded that the first priority for dust control is to prevent spread of contamination at the source. Consequently, the segregation of contaminated soil from uncontaminated soil was the basis for each dust control alternative. As such, contaminated soil would be excavated in a carefully controlled removal operation prior to general trench construction. This separate removal operation would insure that contaminated soil was excavated and removed so that it would not mix and spread contamination to previously uncontaminated soil. Once contaminated soil is removed from the construction site, excavation of trenches should proceed using more standard construction techniques.

Disposal of contaminated soil was not part of the scope of this project. On-site burial of contaminated soil was used to provide a fair comparison of dust control alternatives. On-site burial was chosen for fair comparison because it meets the objective of segregation of contaminated soil from uncontaminated soil, while not burdening the comparison with off-site disposal costs or alternatives.

1.0 INTRODUCTION

This Construction Dust Suppression Feasibility Study will provide guidance for dust control procedures during construction of the influent collection gallery and effluent discharge pipeline (surface discharge configuration) for the 881 Hillside Remedial Action at Rocky Flats Plant. This investigation is limited to control of potentially contaminated dust which may be generated from surficial soils at the above locations. The scope of this report is limited to fugitive dust control and does not address disposal of contaminated soil. Construction of facilities at 881 Hillside will specifically avoid excavation at Solid Waste Management Units (SWMUs). Consequently, excavation of contaminated soils other than potentially contaminated surficial soils should not occur during construction. The direction given by EG&G for development of this feasibility study limited this study to evaluating dust control for the top six inches of surficial soil for the influent gallery and effluent discharge pipeline. There is concern that contamination in the top six inches of surficial soil could have occurred due to deposition of fugitive airborne particulates from other plant areas over the operating life of the plant. As an additional precaution, dust control measures for general construction in uncontaminated areas are required in the construction specifications for the project.

The recommendations of this report should be incorporated into a Dust Control Plan for construction of the project. Implementation and enforcement of the Dust Control Plan will provide the measures necessary to control fugitive dust effectively during construction.

The Construction Dust Suppression Feasibility Study began with the conceptual identification of seven dust control and mitigation procedures, identified by the letters A through H, as follows:

A. Containment structure;

B. Air monitoring;

C. Watering combined with air monitoring;

D. Chemical or foam dust suppression;

E. Soil cementation/coherex additive;

F. Winter excavation of frozen ground;

G. Vacuum removal; and

H. Windscreens.

A description of each measure and the costs of implementation for each were then developed. A comparative analysis was undertaken in matrix form to determine the relative advantages and disadvantages of each alternative measure. Evaluation factors included:

A. Cost impacts;

B. Constructability;

C. Operability during construction;

D. Maintainability;

E. Availability of technology;

F. Worker health and safety; and

G. Seasonal/weather considerations; and

H. Control efficiency.

A discussion of each of these issues is included in the respective descriptions of alternatives.

2.0 PROJECT DESCRIPTION AND LOCATION

2.1 BACKGROUND

The primary objective of the Building 881 Hillside Remedial Action Plan (project) is to collect contaminated ground water from the 881 Hillside and treat it to acceptable levels for surface discharge. A feasibility study investigating and selecting a preferred method for dust suppression during construction was required as a result of public concern that dust raised during excavation would be a public health risk. This approach was approved in principle by Rockwell International, as operators of Rocky Flats Plant, at a meeting on 27 November 1989. In addition, Rockwell directed Engineering-Science Inc. (ES) to examine other innovative technologies or combinations of technologies.

A conceptual design for the ground water collection and treatment project was developed as a result of Remedial Investigation/Feasibility Study (RI/FS) procedures. A Health Risk Assessment performed in conjunction with the RI/FS concluded that a small, identifiable health risk to the public would occur in the future if no remedial action was performed at the site. Implementation of the recommended remedial action will eliminate the future risk and result in the removal of the contaminants identified as contributing to the risk.

Preliminary process design and selection for volatile organics removal was performed as a part of the RI/FS and subsequently verified through independent treatability studies initiated by Rockwell and performed by a manufacturer of the selected system. The selected process for treatment of the volatile organics is an ultraviolet light (UV)/hydrogen peroxide (H_2O_2) system and is discussed in detail in the RI/FS. Rockwell subsequently directed that the treatment plant be expanded to include ion exchange for metals and radioactive contaminant removal.

In order to meet an accelerated schedule for construction of the treatment plant, the project has been divided into four phases of construction. Plans and specifications for construction of facilities associated with phased construction of the 881 Hillside Remedial Action include the following:

- Phase IA Construction - Building 891 foundation.
- Phase IB Construction
  - Erection of a pre-engineered Building 891.
  - Erection of influent storage tanks.
  - Construction of storage tank foundations and containment structures.

- Construction of water supply pipeline, sewer pipeline, natural gas service pipeline, electrical service, and telephone service to Building 891.
- Construction of Building 891 heating, ventilation, and air conditioning (HVAC), plumbing, and electrical.

. Phase IIA Construction

- Process treatment equipment, including electrical and controls.
- Indoor and outdoor transfer piping.
- Tank electrical and controls.
- Chemical storage and transfer facilities.
- Completion of Building 891 electrical and outdoor lighting.

. Phase IIB Construction

- Influent collection gallery, sumps, wells, and pipeline, and electrical.
- Effluent discharge pipeline and structure.
- Secondary waste discharge system.
- Apron and truck loading containment.
- Site cleanup, final grading, and landscaping.

Separate engineering packages which include plans and specifications for the following equipment have been developed. This equipment will be procured as Government Furnished Equipment.

. Four 15,000-gallon influent storage tanks.

. A UV/hydrogen peroxide treatment system.

. An ion exchange treatment system.

. Three effluent storage tanks and foundations.

The design is based upon information developed in the Title I, Preliminary Design Basis Document for the 881 Remedial Action Plan, June 1988. Further design criteria for the treatment process are presented in the Basis of Design Report for Ion Exchange System, 881 Hillside Remedial Action, December 1989.

2.2 PROJECT LOCATION

The 881 Hillside Remedial Action is located near the southeast corner of Rocky Flats Plant next to Building 881. A plan indicating the location of the project is presented in Figure 2.1. A site plan indicating locations of facilities associated with 881 Hillside Remedial Action is presented in Figure 2.2. The locations shown on Figure 2.2 are approximate, since the final design of these facilities is not completed.

2.3 SITE CHARACTERIZATION

This site characterization of Rocky Flats Plant and the 881 Hillside Area describes local demography, land use, and climatology in the vicinity of Rocky Flats

Plant, and surficial soils and geology at 881 Hillside area. The information presented here is taken from "Interim Measures/Interim Remedial Action Plan and Decision Document 881 Hillside Area, Operable Unit No. 1, Volume 1," U.S. Department of Energy, January 1990, and "Remedial Investigation Report for High Priority Sites (881 Hillside Area)," Rockwell International, 1 March 1988. There is no data to support the existence of contaminated soil at the location of the influent trench and effluent discharge trench.

2.3.1 Surrounding Land Use and Population Density

The Rocky Flats Plant is located in a rural area. There are eight public schools, within six miles of RFP. The closest hospital to RFP is Centennial Peaks Hospital located approximately seven miles northeast. The closest park and recreational area is the Standley Lake Area, which is approximately five miles southeast of the RFP site. Boating, picnicking, and limited overnight camping are permitted. Several other small parks are located in the mountains west of RFP, but all are more than 15 miles away.

Some of the land adjacent to RFP is zoned for industrial development. Industrial facilities within five miles of RFP include the TOSCO laboratory (40-acre site located two miles south), the Great Western Inorganics Plant (two miles south), the Frontier Forest Products yard (two miles south), the Idealite Lightweight Aggregate Plant (2.4 miles northwest), and the Jefferson County Airport and Industrial Park (990-acre site located 4.8 miles northeast).

Several ranches are located within ten miles of RFP, primarily in Jefferson and Boulder Counties. They are operated to produce crops, raise beef cattle, supply milk, and breed and train horses. According to the 1987 Colorado Agricultural Statistics, 20,758 acres of crops were planted in Jefferson County (total land area of approximately 475,000 acres) and 68,760 acres of crops were planted in Boulder County (total land area of 405,760 acres). Crops consisted of winter wheat, corn, barley, dry beans, sugar beets, hay, and oats. Livestock consisted of 5,314 head of cattle, 113 hogs, and 346 sheep in Jefferson County, and 19,578 head of cattle, 2,216 hogs, and 12,133 sheep in Boulder County.

Approximately 50 percent of the area within ten miles of RFP is in Jefferson County. The remainder is located in Boulder County (40 percent) and Adams County (10 percent). According to the 1973 Colorado Land Use Map, 75 percent of this land was unused or was used for agriculture. Since that time, portions of this land have been converted to housing, with several new housing subdivisions being started within a few miles of the buffer zone. One such subdivision is located south of the Jefferson County Airport and several are located southeast of RFP.

A demographic study using 1980 census data shows that approximately 1.8 million people lived within 50 miles of RFP in 1980 (Rockwell International, 1987b). Approximately 9,500 people lived within five miles of RFP in 1980. The most populous sector was to the southeast, toward the center of Denver. This sector had a 1980 population of about 555,000 people living between 10 and 50 miles from RFP. Recent population estimates registered by the Denver Regional Council of Governments for the eight county Denver Metro region have shown distinct

patterns of growth between the first and second halves of the decade. Between 1980 and 1985, the population of the eight county region increased by 197,890, a 2.4 percent annual growth rate. Between 1985 and 1989 a population gain of 71,575 was recorded, representing a 1.0 percent annual increase (the national average). The 1989 population showed an increase of 2,225 (or 0.1 percent) from the same date in 1988.

2.3.2 Site Topography and Geology

2.3.2.1 Topography

The Rocky Flats Plant is located at an elevation of approximately 6,000 feet above mean sea level. The site is on the western margin of the Colorado Piedmont section of the Great Plains Physiographic Province. The piedmont represents an old erosional surface along the eastern margin of the Rocky Mountains. It is underlain by gently dipping sedimentary rocks (Paleozoic to Cenozoic in age) which are abruptly upturned at the Front Range (just west of RFP) to form hogback ridges parallel of the mountain front. The piedmont surface is broadly rolling and slopes gently to the east with a topographic relief of only several hundred feet. This relief is due both to resistant bedrock units that locally rise above the surrounding landscape and to the presence of incised stream valleys.

The topography of the 881 Hillside Area is shown in Figure 2.2. The hillside slopes from the top of the flat (elevation 5992 feet m.s.l.) on the north to Woman Creek (elevation 5890 to 5840 feet m.s.l.) on the south. The north-south slope ranges from approximately 9 to 28 percent at different locations over its length. The north-south slope is interrupted by a man-made ditch running east-west called the South Interceptor Ditch. The hillside also slopes downward from west to east as it follows the slope of Woman Creek. Undulations in the slope of the hillside are caused by several side gullies feeding into Woman Creek.

2.3.2.2 881 Hillside Area Geology

The following geologic information is based on the RI Report (Rockwell International, 1988a), and the reader is referred to this report for additional details.

Surficial Materials

Surficial materials at the 881 Hillside Area consist of the Rocky Flats Alluvium, colluvium, valley fill alluvium, and artificial fill overlying bedrock. In addition, there are a few isolated exposures of claystone bedrock. The study area is located on the south-facing hillside which slopes down from the Rocky Flats terrace surface toward Woman Creek on the south side of RFP. Rocky Flats Alluvium caps the top of the slope, and colluvium (slope wash) covers the hillside. Artificial fill and disturbed surficial materials are present around Building 881 and south of the building to the South Interceptor Ditch. Artificial fill overlies colluvium in some areas of the 881 Hillside, and surficial materials are disturbed others. Valley fill alluvium is present along the drainage of Woman Creek south of the 881 Hillside Area, and terrace alluvium occurs on the north side of the Woman Creek valley fill alluvium.

Of particular significance with respect to contaminant transport in alluvial ground water are the presence of gravel layers in colluvial materials overlying bedrock and near surface. These gravels were likely deposited in a south (downslope) direction by creek and slope wash erosion of the Rocky Flats Alluvium and can be expected to be elongated in the north-south direction with rather limited extent in the east-west. The gravel layers range between 1.3 feet to 5.5 feet in thickness.

Bedrock Material

The Cretaceous Arapahoe Formation underlies surficial materials at the 881 Hillside Area. Six wells were completed in various zones of the bedrock in the 1986 and 1987 drilling programs. The Arapahoe Formation beneath the 881 Hillside Area consists of claystones with interbedded lenticular sandstones, siltstones, and occasional lignite deposits. The Arapahoe Formation was deposited by meandering streams flowing generally from west to east off the Front Range. Sandstones were deposited in stream channels and as overbank splays, and claystones were deposited in back swamp and floodplain areas. Leaf fossils, organic matter, and lignite beds were encountered within the claystones during drilling at the 881 Hillside. Contacts between various lithologies are both gradational and sharp. Bedrock is estimated to dip approximately 7 degrees to the east.

Claystone bedrock was the most frequently encountered lithology of the Arapahoe Formation immediately below the bedrock contact. Weathered bedrock was encountered directly beneath surficial materials in all of the boreholes and wells, and weathering appears to penetrate as much as 60 feet below ground surface. The weathered claystone is also characterized by moderate fracturing and thus exhibits higher hydraulic conductivities than unweathered claystone.

Arapahoe sandstones were encountered beneath the 881 Hillside Area. These sandstones range from poorly-sorted to well-sorted, subrounded to rounded, very fine-to medium-grained, poorly- to moderately-well-cemented quartz sand with up to 100% lithic fragments. The thickness of individual sandstones beds ranged between 5 to 12 feet.

2.3.3 Surface and Ground Water Hydrology

2.3.3.1 Surface Water

Woman Creek is an eastward-flowing, ephemeral stream located to the south of the 881 Hillside. The stream drains the southern portion of the Rocky Flats Plant site, and delivers water to Mower Reservoir and Standley Lake which are respectively used for agricultural and domestic water supply (see Figure 2-3). The South Interceptor Ditch, located between the 881 Hillside and Woman Creek, extends from south of the inner west gate entrance to Pond C-2 in the Woman Creek drainage. The ditch isolates runoff from the south side of RFP (including the 881 Hillside) form Woman Creek. Surface water following in an easterly direction along the South Interceptor Ditch is collected in Pond C-2, from which it is discharged to Woman Creek in accordance with the RFP National Pollutant Discharge Elimination System (NPDES) permit. The permitted discharge point is designated as 007. Pond C-1 receives flow from Woman Creek. A diversion

structure located upstream of Pond C-2 diverts flow in Woman Creek around Pond C-2 and into the Woman Creek channel downstream. Along Woman Creek and the South Interceptor Ditch, retention ponds C-1 and C-2, and the associated diversion structures, control surface water discharge from the RFP site.

2.3.3.2 Ground Water

Ground water occurs in surficial materials (Rocky Flats Alluvium, colluvium, terrace alluvium, valley fill alluvium, and artificial fill) and in Arapahoe sandstones and claystones at the 881 Hillside Area. These two hydraulically connected flow systems are discussed separately below.

Ground Water in Surficial Materials

Ground water is present in surficial materials at the 881 Hillside under unconfined conditions. Recharge to the water table occurs as infiltration of incident precipitation and as seepage from ditches and creeks. The shallow ground water flow system is quite dynamic, with large water level changes occurring in response to precipitation events and to stream and ditch flow.

Ground water flows from the Rocky Flats Alluvium at the top of the 881 Hillside south through colluvial materials toward Woman Creek. Ground water in Rocky Flat Alluvium or colluvium is hereinafter referred to as alluvial ground water. Flow through colluvial materials primarily occurs in the gravel within the colluvium. At the Rocky Flats terrace edges, ground water emerges as seeps and springs at the contact between the alluvium and claystone bedrock (contact seeps), is consumed by evapotranspiration, or flows through colluvial materials following topography toward the valley fill and terrace alluviums. The maximum and mean ground water velocities through colluvial materials are estimated at 780 ft/yr and 150 ft/yr, respectively. Once ground water reaches the valley, it either flows down-valley in the alluvium, is consumed by evapotranspiration, or discharges to Woman Creek. The maximum and ground water velocities in Woman Creek valley fill have been estimated at 650 ft/yr and 145 ft/yr, respectively.

Bedrock Ground Water Flow System

Ground water flow in the Arapahoe Formation occurs primarily in the sandstones contained within the claystones. Ground water recharge to sandstones occurs as infiltration from an alluvial ground water where sandstones subcrop beneath the alluvium and by leakage through the claystones overlying the sandstones.

There is a strong downward gradient between ground water in surficial materials and bedrock. Vertical gradient data are provided in the RI report (Rockwell International, 1988a). Calculated vertical gradients ranging from about 2 to 0.3 ft/ft indicate a hydraulic potential for downward flow. The presence of unsaturated conditions in some locations and high vertical gradients where subsurface materials are continuously saturated indicates that the intervening material (claystone) has a very low hydraulic conductivity. Ground water flow within individual sandstones is from west to east. The maximum horizontal ground water velocity in sandstone is estimated at about 36 ft/yr while the mean velocity is estimated to 12 ft/yr. Ground

water moves at these rates only if the sandstone unit is continuous or has good interconnection with an adjacent unit. To date, lateral continuity of sandstone units along strike has been demonstrated to be small and only a few correlations have been made along dip.

Usable ground water occurs in the Arapahoe Aquifer. Water from the sandstones of the Arapahoe Aquifer is used for irrigation, livestock watering, and domestic purposes east of RFP.

2.3.4 Climatology

The following climatology information is taken from "Remedial Investigation Report for High Priority Sites (881 Hillside Area)," Rockwell International, 1 March 1988.

The area surrounding Rocky Flats Plant has a semiarid climate typical of the Rocky Mountain region. However, the elevation of the plant and the nearby slopes of the Front Range slightly modify the regional climate.

Winds at Rocky Flats Plant, although variable, are predominantly westerly and northwesterly. Stronger winds occur during the winter, and the area occasionally experiences Chinook winds with gusts up to 100 miles per hour because of its location near the Front Range. Figure 2.4 shows the wind direction, frequency, and average velocity for each direction as recorded in 1985.

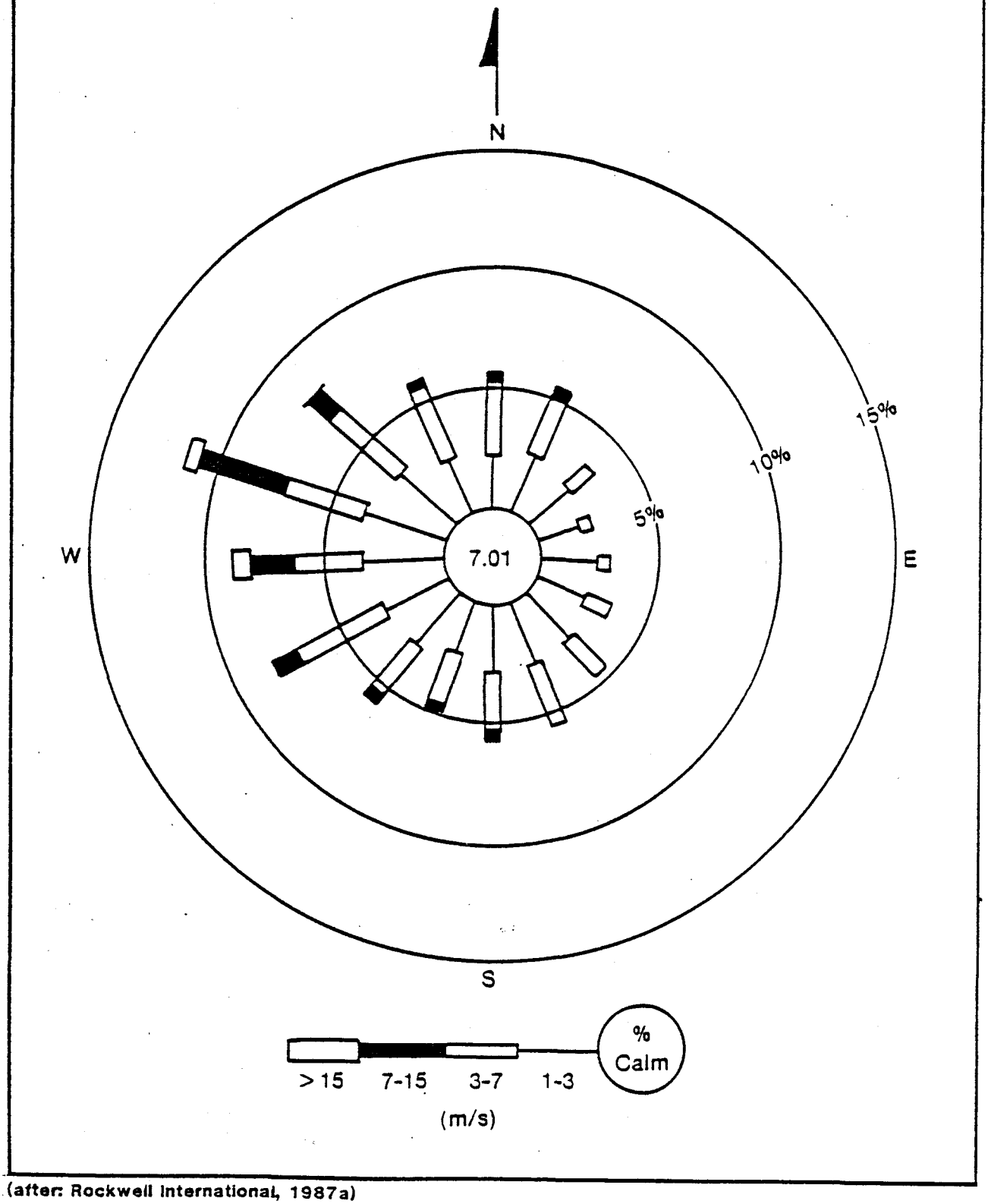
Temperatures are moderate; extremely warm or cold weather is usually of short duration. On the average, daily summer temperatures range from 55 to 85 degrees Fahrenheit (F) and winter temperatures range from 20 to 45 degrees F. Temperature extremes recorded at the plant have ranged from 102 degrees F on 12 July 1971 to -26 degrees F on 12 January 1962. The 24-year average maximum temperature for the period 1952 to 1976 was 76 degrees F, the average minimum was 22 degrees F, and the average annual mean was 50 degrees F. Average relative humidity was 46 percent.

Average annual precipitation at the plant is 15 inches. Approximately 40 percent of the precipitation falls during the spring season, much of it as snow. Thunderstorms from June to August account for an additional 30 percent of precipitation. Autumn and winter are drier seasons, accounting for approximately 20 and 10 percent of the annual precipitation, respectively. Snowfall averages 85 inches per year, generally occurring between October and May.

2.4 DESCRIPTION OF FACILITIES AND CONSTRUCTION ACTIVITIES

The influent collection system is a french drain system (perforated drain pipe and gravel bed) which is keyed into the bedrock, approximately 20 to 25 feet below grade. The drain system is designed to be 2650 feet long (approximately one-half mile).

The influent collection system consists of a perforated drain collection pipe on a gravel bedding overlying an impermeable membrane. The downgradient side of the collection system has an impermeable membrane wall from the top surface to bedrock, cutting off all groundwater movement. Groundwater movement is stopped



(after: Rockwell International, 1987a)

FIGURE 2.4

1986 Annual Wind Rose for the Rocky Flats Plant

at the cutoff wall and directed to the drain, and subsequently to a collection sump and forwarded to the treatment plant.

Due to site soil conditions and worker safety considerations, the trench must be laid back at a 2:1 slope during construction. Consequently, while the trench is only four feet wide at bedrock, it can be up to 120 feet wide at the top in some areas. The trench should be designed and constructed so as to minimize its top width. In addition, a twenty five foot wide work zone along side the trench has been included in this analysis. The total width of the construction and work zone can be up to 145 feet wide.

The influent delivery pipeline and effluent discharge pipeline will be constructed in a common trench, for economy and to minimize soil disturbance. At the south end of these pipelines, they will diverge to their respective end points, at the collection sump for the influent pipeline, and at the proposed surface discharge structure for the effluent pipeline.

The influent/effluent pipeline trench is four feet wide and approximately four feet deep with vertical walls. With a twenty foot work zone on each side, the total construction and work zone is 45 feet wide. The length of the influent/effluent pipeline trench is 930 feet. To avoid confusion with the influent collection trench, the influent/effluent pipeline trench is termed the effluent discharge trench in this report, since the influent and effluent pipelines are in the same trench.

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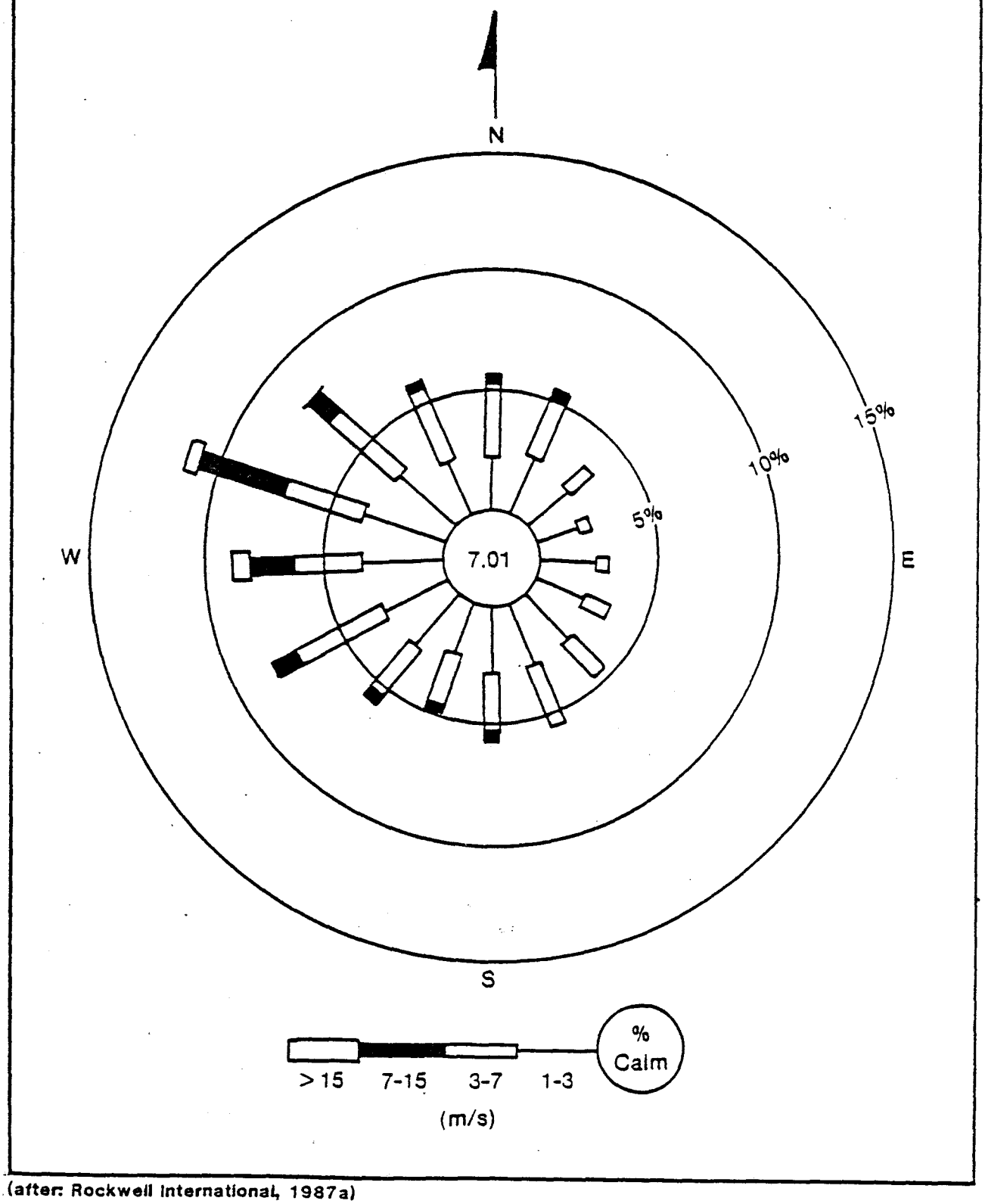

(after: Rockwell International, 1987a)

FIGURE 2.4

1986 Annual Wind Rose for the Rocky Flats Plant

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The influent delivery pipeline and effluent discharge pipeline will be constructed in a common trench, for economy and to minimize soil disturbance. At the south end of these pipelines, they will diverge to their respective end points, at the collection sump for the influent pipeline, and at the proposed surface discharge structure for the effluent pipeline.

The influent/effluent pipeline trench is four feet wide and approximately four feet deep with vertical walls. With a twenty foot work zone on each side, the total construction and work zone is 45 feet wide. The length of the influent/effluent pipeline trench is 930 feet. To avoid confusion with the influent collection trench, the influent/effluent pipeline trench is termed the effluent discharge trench in this report, since the influent and effluent pipelines are in the same trench.

3.0 FUGITIVE DUST CONTROL AT 881 HILLSIDE

3.1 BASIC APPROACH TO CONTAMINATED DUST CONTROL AT 881 HILLSIDE

The design and location of all facilities for 881 Hillside Remedial Action has specifically avoided construction in Solid Waste Management Units (SWMUs). Consequently, excavation of contaminated soil is not expected to occur during construction, other than potentially contaminated surficial soil. The occurrence of low levels of surficial contamination at 881 Hillside is suspected due to contaminated airborne particulates deposited at the site from other areas of the plant. Previous borings and testing at the excavation sites for the influent collection trench and effluent discharge line have indicated that deeper soils (below six inches) are not contaminated.

The scope of this report is limited to fugitive dust control, and does address disposal of contaminated soil. In order to provide a fair comparison of dust control alternatives irrespective of contaminated soil disposal options, on-site burial of contaminated soil was used in all alternatives.

The basic approach to dust control presented here is to segregate uncontaminated soil excavation operations from excavation of potentially contaminated soil. The reasoning behind this segregation is twofold. First, dust control measures for uncontaminated soil excavation are less labor and equipment intensive than the more rigorous contaminated soil excavation dust control measures, and consequently less expensive. Secondly, if contaminated soil and uncontaminated soil are mixed together, the resulting soil mixture must be considered contaminated, compounding the dust control problem from several aspects. These include the increased volume of contaminated soil, increased areal contamination, and increased construction time necessary for dust control. If potentially contaminated soil is removed in a carefully controlled removal operation, excavation of deeper soil can occur without fear of compounding or spreading contamination. This basic approach to contaminated dust control applies to all dust control alternatives examined in this report.

Dust control measures for general excavation of uncontaminated soils is stated in the Specifications under Earthwork, Section 02200 and under Health Science Measures, Section 01106, part C.7. These measures are summarized below:

02200 Earthwork

Part III: Execution

3.1 General

F. ...The Contractor shall conduct all excavation and soil moving and storage activities so as to minimize the generation of fugitive dust. In addition, the Contractor shall comply with the Dust Control Plan for all construction activities. Prior to excavation, soils shall be wetted to a moisture content exceeding the optimum moisture as defined by Standard Proctor Compaction Testing, ASTM D-698. In general, during handling, the excavated materials shall be thoroughly wetted but shall not contain moisture to the extent which will interfere with the Contractor's handling equipment. Excavated materials in stockpiles shall be immediately stabilized by covering or other approved means immediately upon conclusion of work at that particular stockpile. During final placement of waste excavation, add such covering as may be necessary so that aeolian dispersion is minimized. No earthwork shall be permitted during periods in which the wind velocity exceeds 15 mph. Long-term erosion protection shall be provided by seeding and irrigation as required or by other means approved by the Buyer. Irrigation shall not begin until after the French drain and treatment unit are functional. Earthwork operations shall be planned and conducted in a manner to promote maximum handling efficiency. Materials shall be immediately placed and compacted after initial excavation where practicable.

01106 Health Science Measures

C.7 A continuously recording anemometer, with high level audible alarm and warning light set at 15 mph, will be required during excavation activities.

C.8 The Contractor shall comply with the Dust Control Plan during all construction activities.

Evaluation of off-site disposal alternatives for contaminated soil is not within the scope of this study. In order to provide a fair comparison of dust control alternatives, on-site burial of contaminated soil was used for all alternatives. This is consistent with the fundamental rule of dust control. That is, soil disturbance and soil movement unit operations should be minimized in order to minimize fugitive dust generation. Consequently, the alternatives examined herein are based on contaminated soil being stripped and buried upgradient of the influent collection system. Since the 881 Hillside Remedial Action is a groundwater and soil treatment system, soil buried in the treatment zone will have the benefit of treatment. The treatment plant at 881 Hillside Remedial Action is designed to remove contaminants from the soil in the construction zone. Consequently, soil and water quality outside the treatment zone will not be impacted, while dust generation is minimized.

Removal of soil to off-site disposal has not been evaluated for this report, because transportation and dumping off-site are intrinsically dust generating operations. As such, they are contrary to the dust control objectives of this analysis, in addition to being outside the scope of this report.

The specific unit operations for contaminated soil dust control and on-site burial are listed as follows:

- Locate a soil burial trench parallel to and immediately north of the influent collection trench.
- Remove the top six inches of contaminated soil from the burial trench and store soil (temporarily) south of the burial trench over the influent trench location. Use dust control measures for storage pile.
- Dig burial trench and store uncontaminated (deeper) soil north of the burial trench for use as future cover.
- Remove the top six inches of contaminated soil from the influent trench and place in burial trench.
- Cover burial trench with uncontaminated soil from stockpile.

Once the contaminated soil is buried, construction can proceed using conventional dust control, without potential for spread of contamination or risk of public health or worker health and safety. The same general arrangement for a burial trench for burial of contaminated soil from the effluent discharge pipeline trench can be used. This contaminated soil burial program was used in all dust control alternatives examined in this report.

4.0 GENERAL DUST CONTROL GUIDELINES AND DUST CONTROL PLAN

In order to maximize the control efficiency of the dust control program, there are some general guidelines for dust control which can be followed during any construction activity, or any dust control program. These general guidelines should be followed during construction of facilities at 881 Hillside Remedial Action in addition to specific control measures to maximize control efficiency of the program.

These guidelines are mitigative measures which should be incorporated into a Dust Control Plan for all construction activities. Construction contractors for each phase of construction should be required in the specifications to adhere to a Dust Control Plan for construction. The Dust Control Plan should contain the basic measures for dust control, in addition to specific dust control procedures tailored to the site, construction activity, seasonal conditions and contractor equipment and procedures. This report is not a Dust Control Plan, but can be used as guidance or for review of the plan.

The Dust Control Plan will be used by the construction foreman during daily operations to conduct construction activities in such a manner to minimize the generation of fugitive dust. The EG&G Construction Manager should become familiar with the dust control plan, and insure that it is being executed during the course of the work. The EG&G Construction Manager or site Health and Safety Officer should have the authority to stop work in the event that the contractor violates the Dust Control Plan.

Some general rules of thumb for dust control are presented here for reference. While these guidelines are not intended to be all inclusive, they should be helpful in developing or evaluating a Dust Control Plan. Some general dust control guidelines for 881 Hillside Remedial Action include:

- The number of times that contaminated soil is moved or disturbed should be minimized. Each unit operation has the potential to generate dust. Dust control measures are appropriate for each unit operation.
- The land surface area which is disturbed or cleared should be minimized as much as possible. The area for disturbance should be surveyed and clearly marked. Vehicles and equipment should restricted to these areas. The trench should be designed to minimize its width and disturbance area.
- Work should proceed expeditiously once initiated. Unpaved work zones, staging areas, excavations, storage piles and roads are dust generators when open. Work stoppages should be avoided.

- Vegetative cover outside the construction area should be protected. Construction vehicles and equipment should be prohibited outside the construction zone.
- In the case of 881 Hillside Remedial Action, the construction specifications require that all excavation be halted when wind velocity exceeds 15 mph at the site. A continuously recording anemometer with high level alarm is required in the specifications for monitoring wind.
- Vehicle and equipment movement in the construction zone should be minimized. Unnecessary vehicular movement should be prohibited.
- Storage piles should be quickly processed and non-working storage should be avoided.
- Storage piles of contaminated soil should be covered with impermeable material or dust suppressant. Vehicles transporting contaminated soil should be covered. Freeboard in the truck may be required between the top of soil and the top of the truck hopper. Wetting of soil or dust suppressant may be required for the truck hopper.
- Track vehicles create more dust than wheeled vehicles. Wheeled vehicles are preferred for dust minimization when possible.
- Batch drop or dumping operations are high dust generators. Low profile activities such as pushing or grading are preferred.
- Soil movement activities and storage piles should be kept low profile and close to the ground. High profile activities or piles are dust generators.

Dust control measures for unpaved roads, construction staging areas and work areas is a serious consideration. Chemical soil stabilizers, such as Coherex, ENTAC, or Prokrete's Soiltex, can be applied and reapplied as necessary to provide effective dust control for unpaved roads and areas outside the immediate construction zone. Additional dust control measures for these areas include:

- Speed reduction of vehicular traffic on unpaved roads or contaminated soil areas is a viable dust control measure. Speed limits may be imposed and enforced.
- Mud and dirt carryout from construction sites to paved roads should be minimized. This mud and dirt on a paved road will become fugitive dust when it drys or as subsequent vehicles pass. Vehicles entering and leaving the construction site should be minimized or restricted. Facilities for washing of exiting vehicles should be required.
- Unpaved roads are the greatest source of fugitive dust in industrial settings. Unnecessary vehicle movement or traffic should be minimized or prohibited. Particular attention must be paid to vehicular movement on unpaved roads in any Dust Control Plan.

The dust control plan should have provisions for record keeping; enforcement of dust control provisions; physical description and maps indicating work areas, contaminated zones, roads and other features. Specific records in the dust control plan should include date and time of dust control application, type of application and suppressant/water ratio, application rate, precise location of application, speed, number of passes, equipment description and maintenance and downtime records, source of water supply if appropriate, and traffic records, and meteorological records. The name or initials of the person performing the dust control procedure or recordkeeping should also be recorded.

Implementation of the dust control plan is the responsibility of the contractor. However, EG&G Construction Manager or Health and Safety Officer should oversee the contractor and have authority to enforce the plan and insure it is implemented. Minimum physical or testing requirements for enforcement may be part of the plan. These would provide a measure for effectiveness of the plan. These may include a minimum moisture content in soil in the work zone, taken in grab soil samples, or instantaneous particulate air monitors which indicate the level in dust in air. In addition, anemometers indicate that wind speed has exceeded a critical speed for dust control. Any of these indicators could provide cause for adding or changing dust control measures or temporarily ceasing work. Examination of record keeping also affords another compliance tool indicating the adequacy of dust control on a long-term basis.

The above general dust control guidelines were considered in evaluating the specific alternatives and technologies for dust control at 881 Hillside presented below.

5.0 DUST CONTROL ALTERNATIVES AND AVAILABLE TECHNOLOGIES

A description of dust control alternatives and discussion of relative merits, disadvantages and cost is presented here.

A. ALTERNATIVE A - CONTAINMENT STRUCTURE

Construction of a temporary building over excavation sites is a dust control method which has successfully been used at hazardous sites in recent years. Two types of temporary buildings were considered in this investigation: a fabric building with metal ribbed structural support and air-supported fabric building (tennis-bubble type).

The air-supported fabric building was eliminated from consideration due to a fatal flaw in its application. Because of the positive pressure required to the support an air-supported structure, they tend to leak air (and dust) along their base. This is particularly true on sloped or uneven terrain such as 881 Hillside. This severely detracts from efficiency of air-supporter buildings for use in dust control.

The ribbed fabric building has had numerous applications for dust control throughout the U.S., and a manufacturer's conceptual rendering is presented in the Appendix under Manufacturers Information. The fabric is typically a PVC coated polyester, supported by aluminum or steel ribs, or lattice structure. A foundation for the structure is required in the windy conditions experienced at Rocky Flats. The foundation consists of concrete pilings located on fifteen foot centers around the perimeter of the structure.

According to the manufacturer, the standard (off-the-shelf) ribbed structure is limited to slopes of less than six percent. Since the slope at 881 Hillside varies from 9 to 28 percent, and is uneven, a standard construction building is not feasible. In addition, the influent collection trench is wider than the largest standard width offered by the manufacturer. Consequently, a specially engineered and constructed building which is tailored to this application was investigated.

The special construction building has a lattice support structure to support its additional width. It is constructed and relocated in 60 foot long modules in a stepped arrangement, as shown in the Manufacturers Information to make up for variation in terrain. Otherwise, the corners would be elevated thirty feet in the air in some areas. Even with these measures, the building will still be constructed with a lateral and longitudinal tilt. To anchor and support the building, concrete pilings would be constructed at fifteen foot intervals along both sides of the building. The

pilings would vary in height from flush to the ground up to ten feet high, customized as required by the terrain to minimize the lateral and longitudinal tilt of the building. A flap of building material would hang down to the ground from elevated sections closing the building at the ground. The flap would be anchored by sandbags on the ground.

As far as post-construction activity is concerned, the building will be disassembled and disposed as hazardous material. In addition, the elevated concrete pilings will have to be demolished after completion and the concrete debris disposed of as hazardous material.

Due to the special construction of the building and foundation, this alternative is very expensive. The estimated cost of the structure alone is $1.4 Million. Complete cost for the dust control operation is estimated to be $2.7 Million, including foundation, demolition and disposal, and contaminated soil disposal. Delivery on the building is an estimated two to three months.

Health and safety of workers inside the containment structure is a serious consideration. Class C worker protection is the minimum protection level necessary and was used as the basis for this evaluation and cost estimate. In addition, Class C protection will be required during relocation of the structure, demolition and disposal operations. The necessity for Class C worker protection has an additional cost associated with it, in terms of cost for the worker protection measures, additional time for implementation, and decreased worker efficiency due to restrictive clothing and heat stress protection.

Considering the large size of the required structure, foundation requirements, necessity for several relocations, erection and relocation of the proposed containment structure is a major construction activity. This activity is major fugitive dust generator extraneous to 881 Hillside Remedial Action. As such, this additional dust generation is contrary to the fundamental rule for dust control, minimization of extraneous construction activity and detracts from the viability of containment structures for dust control. Construction of containment structure foundation, consisting of pilings drilled at fifteen foot intervals on either side of the containment building along the entire length of both trenches will potentially be a major dust generator. Dust will be generated during both boring of pilings and truck and equipment movement. Other dust control measures for foundation drilling, structure erection, several structure relocation and vehicular activity will be required, such as watering and air monitoring.

A drawback to the containment structure concept is the disposition of the structure and foundation demolition debris after use. The structure and debris will presumably be contaminated after construction is completed and will have to be disposed as hazardous material.

By nature, the skin material of the containment structure is somewhat fragile in an environment of working heavy equipment. Special care will be required during building relocation or the contaminated soil removal operation, particularly when operations are in close proximity to the structure so that the building is not

damaged. This fact will detract from the efficiency of the removal operation and building relocation. When damage to the fabric occurs, maintenance repair to the fabric will be required.

There is no control efficiency data available for containment structures for dust control. Theoretically, this dust control method is considered an effective means for off-site fugitive dust control.

B. ALTERNATIVE B - AIR MONITORING

Air monitoring for dust control considered here is a combination of weather monitoring and real-time particulate monitoring. The actual method for dust control is work stoppage when wind speed or ambient air conditions exceed an acceptable level.

Weather monitoring is the dust control measure presently included in all phases of construction of the facility. As stated in the Specifications, Section 01106, Health Science Measures, Part c-7, a continuously recording anemometer, with high level audible alarm and warning light set at 15 mph, will be required during excavation activities. In addition, Specification Section 02200, Earthwork, Part III.3.1 states that no earthwork shall be permitted during periods in which the wind velocity exceeds 15 mph.

Due to the size of the influent trench excavation, a second anemometer with high level alarm set for 15 mph is considered prudent. This is recommended to monitor the wind conditions over the entire construction zone, and to provide redundancy.

For real-time monitoring of particulate concentrations, standard particulate monitors such as high-volume samplers are not applicable, due to the turnaround time for laboratory analysis. However, a real-time particulate monitor with high level audible and visual alarm is available from MIE, Inc. Model PDM-3 with Alarm Relay Module Model ARM-1. Manufacturer's Information for these units are included in the Appendix.

The equipment required for air and weather monitoring included two wind and dust monitors each. The purchase price for this equipment is $23,000. Cost for instrument calibration and setup is negligible. The total cost for this dust control measures is $117,000 including contaminated soil burial.

The air monitoring equipment may be rented to save capital cost. A hidden cost for this alternative which is not included here is the mobilization/demobilization cost for the contractor to shutdown and startup construction when the instrument alarms dictate. Construction delays have an undesirable environmental consequence, when potentially contaminated soil is exposed to wind and rain erosion.

Seasonal weather conditions affect the viability of this alternative, since the operating temperature range of the particulate monitor is 32 to 120 degrees F. As a practical application, this precludes the use of the particulate monitor in the coldest winter months. Also, construction in the windy winter season runs the risk of frequent work stoppages, which will be expensive.

Worker health and safety protection measures (Level C Protection) is included as a precaution for this alternative, because no dust control measures are implemented when the wind speed is less than 15 mph, or ambient particulates are less than the maximum allowable.

The equipment required for this dust control alternative is very simple to install, operate and maintain. The equipment will require initial and periodic calibration, but otherwise will not require personnel attention for operation or maintenance. As such, this alternative is the least labor intensive of all those evaluated. It is recommended that the Health and Safety Officer or other personnel check the air monitoring equipment at periodic intervals to insure proper operation. There is no historic control efficiency data reported for this alternative.

Under this alternative, no direct physical dust control measures are implemented, other than work stoppage when wind speed exceeds 15 mph and acceptable ambient particulates are exceeded. However, work stoppage alone is an inadequate control, since wind erosion of disturbed ground will continue during windy periods, whether construction is taking place or not. Consequently, air monitoring alone is not considered a comprehensive dust control program due to this deficiency. Therefore, air monitoring alone is not considered an acceptable alternative for dust control, and must be used.

C. ALTERNATIVE C - WATERING COMBINED WITH AIR MONITORING

Watering of soil for dust control can be combined with the air monitoring program described above to result in a comprehensive dust control program. Water is applied by watering truck using either pressure or gravity feed. The water prevents or suppresses fine particulates in the soil becoming airborne due to the disturbance by vehicles or wind erosion. The water acts to bind small particles of soil to larger particles and dust emissions are subsequently reduced. The control efficiency of water as a dust control measure is a direct function of the amount of water applied, the frequency of application, traffic volume, and meteorological conditions.

Between a moisture content less than 2 percent, and 3 or 4 percent, a great increase in control efficiency is experienced with a small increase in moisture content. Above 4 percent, control efficiency increases very slowly with increasing moisture. Depending on soil type, excessive water content will result in soil conditions, such as mud, soft sand or grease-like clay, which are unsuitable for construction.

Seasonal considerations are a major factor with regard to watering for dust control. Weather is a governing factor in control efficiency and application frequency for watering as a dust control measure. Control efficiency is a function of average evaporation rate and water for dust control in hot summertime conditions must be reapplied several times an hour. Consequently, cooler periods are less susceptible to dust generation since soil is more likely to maintain moisture content when evaporation rates are lower.

In winter, excavation of frozen ground will be expensive, time consuming and require special equipment. This operation is discussed in more detail in Alternative F. In addition, a heated watering truck or other special precautions must be taken to prevent tank, hose or nozzle freezing.

In spring or summer, natural precipitation may substitute for or enhance a watering program. A balance must be maintained such that natural rainfall combined with manual watering does not create over-watering and soil conditions unsuitable for construction (mud). Rainfall has the additional benefit of scrubbing background particulates from the air, further reducing ambient dust.

Watering for dust control is a standard industry construction practice and as such is a familiar operation for contractors. It requires no special equipment or procedures.

The air monitoring program recommended here is identical to that described in Alternative B. This consists of redundant anemometers with high level alarms, and redundant real-time particulate monitors with high level alarms.

For worker health and safety, dust control by watering combined with air monitoring results in an working environment which is relatively safe for workers without protection. This is due to the dust control measures which control low level dust emissions (watering) combined with the air monitoring which controls higher levels of exposure by work stoppage. In general, watering for dust control may not be the most attractive control alternative during periods of extreme heat or extreme cold.

The cost for the watering/air monitoring dust control program is estimated to be $123,000 including on-site soil burial.

EPA estimates that the efficiency of watering for dust control measure is typically 50 to 90 percent. A combined watering/air monitoring dust control program is considered an effective alternative for dust control in this application. The addition of water would overcome the deficiencies of the air monitoring only program described above.

D. ALTERNATIVE D - CHEMICAL OR FOAM DUST SUPPRESSION

Chemicals, additives or foams have found wide use as dust suppressing agents. They generally use water as a vehicle for application, and enhance the dust suppressing qualities of water.

Chemical foams or micronized foams may be added to water and applied to surfaces to enhance the dust control properties of the water. Surfactants added to water increase the ease with which particulates can penetrate water droplets and result in more, smaller water droplets, increasing contact surface area. Dust suppressing foam is produced by adding a detergent-like chemical to a small amount of water and shaking vigorously producing the foam. The use of foam for hazardous applications is mostly directed at soil gas control. For dust control, the foam/water mixture is controlled such that the resulting mixture is closer to a liquid than foam, forming a skin when dried.

Watering for dust control may be enhanced by the addition of salts, surfactants or wetting agents to the water. These increase control efficiency by reducing surface tension to allow better penetration by the water. However, the addition of salts or surfactants to the soil may result in an increase in salts or Total Dissolved Solids (TDS) in the groundwater to be treated, resulting in increased TDS loading at the treatment plant and possibly higher ion exchange resin usage. This undesirable side effect of eliminated Alternative D from further consideration.

The primary advantage of chemical or foam dust suppression methods over water is a longer lasting control efficiency over extended periods of time, with attendant reduction in frequency of application and cost. The control efficiency of chemical or foam dust suppression is dependant upon the amount of water and chemical applied per unit of surface area, the frequency of application, traffic volume, and meteorological conditions. EPA reports the control efficiency of chemicals for dust control at a wide range of 0 to 95 percent.

The application of chemicals for the contaminated soil removal operation required for contaminated dust control at 881 Hillside is not appropriate for several reasons. First, the normal penetration for such chemicals is approximately one-half to one inch. Since the objective of the soil removal operation is to strip six inches, numerous passes would be required, which is not cost effective, and each pass is an additional dust generator. Secondly, chemical dust suppression is generally not considered a viable alternative for dust control during construction. The temporary nature of construction activity precludes their use, since their value is found to be cost-effectiveness over extended periods of time. Also, numerous applications of chemicals to the soil at 881 Hillside will contribute additional total dissolved solids to the groundwater, increasing loading on treatment plant and creating increased secondary waste generation and ion exchange resin usage.

Numerous types of chemicals were investigated for this application and several manufacturers were consulted. After receiving a complete description of the removal operation, each of the chemical manufacturers did not recommend use of their product for this particular application. Each of the manufacturers recommended the use of water only for maximum penetration and dust control for this application.

For the above reasons, chemical or additive application is not considered an effective dust control measure for the contaminated soil operation and were not considered further in this investigation. Some types of chemicals or additives are more appropriate for inactive work areas or storage piles and should be considered in a comprehensive Dust Control Program. For applications where chemicals or foams were appropriate, Coherex-type additives (Alternative E) was preferred because of higher control efficiency, lower mobility in the environment, and ease and consistency of operating procedures. With a variety of chemical and foam products on the market, and various field application rates, a cost estimate was not prepared for this alternative.

E. ALTERNATIVE E - SOIL CEMENTATION/COHEREX ADDITIVE

Surface treatment with such substances as asphalt emulsions, petroleum resins, or acrylic cements is an effective dust control for certain applications. These substances use water as a vehicle for application, and chemically stabilize the physical makeup of the soil and thereby reduce its dust generating potential.

The primary advantage of petroleum based additives is a long lasting control efficiency over extended periods of time, with attendant reduction in frequency of application and cost. There has been considerable favorable experience at Rocky Flats Plant with a product called Coherex, manufactured by Witco Corporation, for dust control of unpaved roads and surfaces.

The application of Coherex-type additives for dust control for the contaminated soil removal operation at 881 Hillside is not appropriate since it is a surficial application with little penetration. Since the objective of the soil removal operation is to strip six inches, numerous passes would be required, which is not cost effective. Each pass is an additional dust generator. Two types of petroleum based dust control products were investigated for this application, Coherex and Prokrete's Soiltex. After receiving a complete description of the removal operation, both manufacturers did not recommend use of their product for the soil removal operation.

Petroleum based additives, such as Coherex, are considered appropriate for unpaved roads, unpaved staging areas and working zones, and should be included in a comprehensive Dust Control Program for this type of application. They are not considered an effective dust control measure for the contaminated soil operation.

EPA reports the control efficiency of petroleum based resins for dust control on unpaved surfaces to be typically 50 to 98 percent. The cost is $0.12 per square foot applied, based on two applications. The technology uses standard construction equipment and procedures, and requires no maintenance. The effectiveness for dust control is reduced over time, and construction should be initiated soon after application. Additional applications will be required if work stoppages delay the project over six months. Coherex is available for immediate delivery.

The application of petroleum based resins to the roads or soil at 881 Hillside may have environmental consequences due to surface diffusion or leaching of the petroleum product. Due to the sensitive environment at 881 Hillside, the application of these products may not be acceptable in the long term.

A new dust suppression product has recently been introduced, which is pine tar based, derived from tree sap. The product, called Entac, is a 100% organic emulsion which is non-toxic and non-hazardous, and avoids the potential environmental consequences of petroleum based products. The product is applied in a manner similar to petroleum based resins, using a water emulsion applied by spray truck. The surface of the ground or road will require scarifying in order to allow penetration of the product. Three applications are normally required to provide a long lasting surface, with compaction and curing between each pass. The

end result is a hard, durable epoxy-like surface which is waterproof and not sticky. Periodic reapplication will be required over the long term to maintain the surface.

Entac is immobile in the environment after it is cured according to the manufacturer. There are no health or safety hazards to workers during or after application. The product has only recently been marketed in western states, but has considerable experience in the south, mid-west and Canada. A partial list of successful applications is presented in the Appendix under Manufacturer's Information. The finished applied cost of Entac at Rocky Flats Plant is estimated to be $1.52 per square yard, including surface preparation. As a new product, a test program to determine the effectiveness of Entac is recommended before wide scale use.

F. ALTERNATIVE F - WINTER EXCAVATION OF FROZEN GROUND

Winter excavation of frozen ground was considered for the soil removal operation. This dust control method would rely on frozen moisture in soil to bind soil particles together during the removal operation. The natural soil moisture content may be sufficient for this purpose, or water may be added, in which case this alternative is similar in many respects to the watering operation described under Alternative C. This alternative is feasible in theory, but has no successful experience record.

There are several variables related to the weather which make this alternative unreliable or difficult to schedule. The temperature during winter could be too warm to freeze the ground, or too cold and require heating of soil to excavate. In addition, winter is the windiest season and wind restrictions are placed on all excavation activities at the site. Construction shutdowns will be expensive.

Winter excavation or excavation of frozen ground will be a difficult, time-consuming, and expensive operation. The operation will be extremely hard on equipment and personnel, due to both the cold weather and shock from loosening of frozen. A heated watering truck or other special precautions must be taken to prevent tank, hose or nozzle freezing. Maintenance cost for equipment will be very high, and under normal conditions excavating contractors try to avoid such construction conditions.

This alternative may create a scheduling problem for timely completion of the project. By placing a seasonal restriction on time of construction for the collection system, project completion could be delayed as much as nine months. In addition, this alternative cannot be combined with use of a real-time particulate monitor since the monitor is restricted to use above 32 degrees F.

As a dust control measure, this alternative is not judged to be very effective. Frozen soil in a cold dry climate is known to sublimate and release dust. No experience record or data exists to quantify this. The health and safety of workers at the site for this alternative will require Level C protection.

The cost for execution of the soil removal operation under Alternative F is $156,000.

Due to suspected ineffectiveness, lack of successful experience record, difficult construction conditions, and scheduling problems, Alternative F is not considered a viable alternative for dust control at 881 Hillside.

G. ALTERNATIVE G - VACUUM REMOVAL

Vacuum removal of the contaminated soil was also investigated for dust control. This technology has been used for control of soil gas at hazardous sites, but its use for contaminated soil removal or dust control is not proven.

Several manufacturers of truck mounted vacuum removal systems indicate that there is considerable interest in use of their equipment for contaminated soil removal, but no experience record.

In this system, dirt would be stripped at the surface with a small rototiller fitted with a dust hood. A truck-mounted vacuum module would follow the rototiller, and transport tilled soil to a portable storage bin (two). A rolloff dump truck would alternately remove and dump the two storage bins, allowing the vacuum module to work efficiently without interruption for dump runs. The air pollution control equipment on the vacuum exhaust would include a cyclone, baghouse and HEPA filter.

A conceptual design of necessary equipment was developed for evaluation here. The equipment includes:

- A truck-mounted vacuum module and hose assembly.
- A roll-off bin dump truck, and 2 20-yard rolloff bins.
- Air pollution control system including cyclone, baghouse and HEPA filter.
- A small sized self-powered tilling machine with dust hood.

The vacuum equipment required for Alternative G is standard equipment and has a successful experience record at Rocky Flats Plant for storm sewer and catch basin cleaning. However it is unproven technology for soil removal, and no data exists for operation and maintenance of equipment. The self-powered rototiller fitted with dust hood is not standard equipment, and would require development time and cost.

There is no data for control efficiency for Alternative G. A small amount of dust leakage is anticipated at the rototiller and watering of soil may enhance the control efficiency. Level C Protection for worker health and safety is assumed without watering.

The purchase price for equipment alone for Alternative G is estimated to be $375,000. The cost including labor for this alternative is estimated to be $599,000.

With out a proven experience record, vacuum removal was eliminated from consideration for dust control at 881 Hillside.

H. ALTERNATIVE H - WINDSCREENS

Windscreens have found successful use for dust control in many applications. The windscreen consists of a perforated fabric material or wood slat arrangement with spaces in between slats. The screen is porous to allow passage of some wind to counteract the effect of eddying and backwash of the wind. A porosity near 50 percent is most effective allowing the proper mixture of air bleeding through the screen and blocked out. The screen is typically effective for dust control for a downwind distance of approximately five times the screen height.

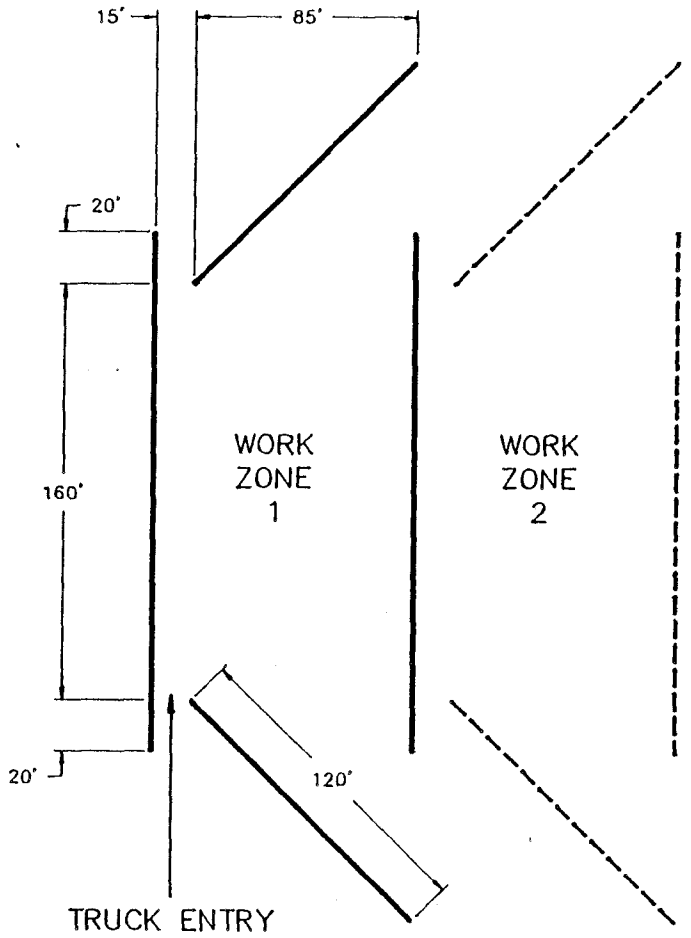
For this application, a preliminary design of a windscreen system was selected and is described as follows. Temporary windscreens would be placed on four sides of a work zone covering the trench width and approximately 100 feet along the trench. A polyester fabric windscreen was selected to be 21 feet tall, supported by poles surrounding the working area. The fabric has been wind tunnel tested to 150 mph. The arrangement of the windscreens and work zone is presented in Figure 5.1. The temporary wind shelters would be first be constructed on the west end of the influent trench and relocated to the east as work proceeds. Twenty six relocations will be required for influent trench alone, and twelve for the effluent discharge trench. Poles would be drilled on ten foot centers surrounding each work area over the length of each trench. The east windscreen from one work area would be "leapfrogged" to become the west windscreen for the subsequent work area, economizing on some pole drilling and relocation work. The screens are built slightly longer in width than the controlled zone, and a control length of five times the screen height (105 feet control zone length for a 21 foot high screen).

In general, the windscreens are easily constructed and relocated using standard construction technique. They require no maintenance once erected. The windscreens require two to four weeks for delivery.

Terrain roughness greatly detracts from the control efficiency of windscreens for dust control. This is particularly true when the leeward terrain rises in elevation above the top of the screen. Above the top of the screen, the wind is typically 110 or 120 percent of ambient velocity and turbulent. This would locally increase the generation of fugitive dust if terrain caused this turbulent wind impinged the ground. In some areas, the undulating terrain at 881 Hillside could detract from the effectiveness of this alternative.

Since windscreens reduce wind rather than eliminate it, the use of windscreens should be supplemented with the use of air monitoring, watering or other measures. As such windscreens are not a stand alone dust control solution. The use of natural windscreens such as tree or terrain windbreaks is important in siting construction staging areas and roads. Sites located out of wind in low side gulleys of Woman Creek should be considered.

Windscreens if properly used can reduce the wind inside the work zone, and reduce wind inside the work area below 15 mph, the preset wind maximum for work stoppage. For timely project completion and avoid work stoppage, construction could continue as long as the wind inside the work zone is below 15 mph.



0 75

FEET

1 INCH

NOTE: THE ABOVE LINE IS EXACTLY ONE INCH LONG AT DESIGNATED SCALE. IF ANY OTHER LENGTH, DRAWING SCALE MUST BE ADJUSTED PROPORTIONALLY.

FIGURE 5.1

ALTERNATIVE H
WINDSCREEN LAYOUT PLAN

ENGINEERING–SCIENCE, INC.
Denver, Colorado

ES

Windscreens provide an adequate worker health and safety environment and no personnel protection equipment is included for this alternative.

The EPA has reported control efficiencies of 70 percent immediately downwind of the screen, and 40 percent at a distance of 14 screen heights downwind. No other data is available for windscreen effectiveness. This information indicates that windscreens are a moderately efficient control method inside their control zone. For effective control, EPA recommends a control zone length of five times the screen height, which was used here for conceptual design purposes.

There is considerable construction activity associated with construction and numerous relocations of the windscreen. This is particularly true due the number of times the windscreen and pole structure must be relocated. Thirty eight relocation operations were required in Alternative H. This extraneous construction activity is inherently a dust generator, and therefore detracts from the overall efficiency of Alternative H.

The cost of the windscreen dust control program described here is $524,000, much of which is the result of windscreen relocation.

A relatively small control zone for this alternative suggests that it is a useful dust control measure for small critical areas, such as construction staging areas or exposed windy areas. Alternative H is not effective for large areas because the amount of construction activity associated with erection and relocation of the windscreen detracts from its overall control efficiency. In addition, Alternative H is not cost effective for large areas.

6.0 CONCLUSIONS AND RECOMMENDATIONS

ES recommends that a comprehensive dust control program should be undertaken during construction of all phases of 881 Hillside Remedial Action. A Dust Control Plan for each phase of construction should emphasize fugitive dust control specific to each application. The Dust Control Plan should utilize several of the dust control alternatives investigated here, including watering, air monitoring, coherex surface treatment, and windscreens. Siting of construction staging areas and roads out of wind is critical to dust control in a windy area such as Rocky Flats. Planning should also include materials and equipment scheduling, control and enforcement.

The dust control program recommended here applies the technology of several control alternatives for specific applications. The specific type of application where each method is most effective follows:

-	Watering	General Construction and trench construction.
-	Air monitoring	General Construction and trench construction.
-	Coherex Additive	Upaved roads, work areas, staging areas and non-working storage piles.
-	Windscreens	High traffic or wind areas.
-	Planning	Site staging areas, high traffic areas, and roads out of wind using terrain as shelter.

ES recommends a comprehensive testing program to identify the existence of contaminated soil. The concentration amount and areal distribution of contaminated soil is not known at present and must be determined. A surficial vertical profile of the top foot to determine the depth of the problem is necessary.

This investigation concluded that the first priority for dust control is to prevent spread of contamination at the source. Consequently, the segregation of contaminated soil from uncontaminated soil was the basis for each dust control alternative. As such, a contamination removal and burial operation is integral to each dust control alternative. Truck hauling off-site was regarded as an uncontrolled dust generation activity and contrary to the dust control objective of this report.

A spreadsheet indicating the relative merits and applications for the dust control alternatives examined in this report is presented in Table 6-1. A brief discussion of each of the alternatives is presented here.

TABLE 6.1

COMPARISON OF DUST CONTROL ALTERNATIVES

ALT.	DESCRIPTION	COST	EASE TO CONSTRT	EASE OF OPERATN, MAINTNCE	AVAILBLE TECHNLGY	WORKER HEALTH& SAFETY	WEATHER RESTRICT	CONTROL EFFICNCY	SPECIAL USES	RESTRICTIONS/ LIMITATIONS
A	CONTAINMENT STRUCTURE	$2.7 M	1	5	2	1	5	4	Trench	Non-standard construction.
B	AIR MONITORING	$117,000	5	5	5	1	3	2	General	Cold weather restricted.
C	WATERING/AIR MONITORS	$123,000	5	5	5	4	3	4	General	Cold weather restricted.
D	CHEMICAL/FOAM	varies	5	5	5	3	3	3	Roads,staging	Not for trench construction.
E	COHEREX ADDITIVE	$0.12/sf	5	5	5	4	3	5	Roads,staging	Not for trench construction.
F	WINTER EXCAVATION	$153,000	2	2	5	2	1	-	None	No efficiency data.
G	VACUUM REMOVAL	$599,000	4	4	2	3	4	3	None	Technology not proven.
H	WINDSCREENS	$524,000	1	5	5	2	5	3	Small areas	Small control zone.

NOTE: Ratings are the subjective opinion of ES and are for comparative purposes.

RATING CODE KEY

1 POOR
2 FAIR
3 AVERAGE
4 GOOD
5 EXCELLENT

Watering is an effective and economical dust control measure for all purposes. Watering is standard industry practice with minimal environmental and health and safety drawbacks. Combined with air monitoring, it is the recommended alternative for construction of the influent collection trench and effluent discharge trench.

Air and weather monitoring is a dust control measure which should be included in all dust control program. Work stoppage is the actual dust control measure for this alternative. As such, it is not a stand alone solution, and must be combined with other control measures.

Coherex-type additives are recommended for unpaved roads, construction staging areas, storage piles, and high traffic areas.

Windscreens are appropriate for small control areas, and could be used for high wind areas, critical areas, or high traffic areas. Windscreens would be most effective when used in combination with other dust control measures.

Containment structures for dust control were not considered appropriate for dust control at construction sites of this large size and steep undulating terrain. A specially engineered and constructed lattice structure building was required. With numerous relocations of this building required, the cost for this alternative was extremely high. Other environmental drawbacks such as massive foundation construction activity, worker health and safety in the contained building, and demolition and disposal of the building further detracted from this alternative.

Vacuum removal using truck mounted vacuum modules was considered for dust control, but was determined to be unproven technology.

There are a variety of chemicals available for dust control, and generally could be applied for unpaved roads, construction staging areas, and storage piles. Their types of application are similar to those of Coherex, which was preferred because of higher control efficiency and lower mobility in the environment.

A large width of the influent trench will create a high potential for fugitive dust generation. The trench should be designed to minimize trench width, and thereby minimizing fugitive dust potential during construction.

APPENDIX

COST ESTIMATES

The cost estimates are planning estimates based on preliminary design concept for dust control alternatives. These estimates are for comparative purposes and not for budgeting of facilities. The estimates do not include cost for security, training, work stoppage, or off-site disposal of soil.

PROJECT		DATE	ES ENGINEERING-SCIENCE COMPANIES					ENGINEER		CHECKED		PAGE
RF 881 HS DUST STUDY		05/17/90						DJH				1/3
REF.	DESCRIPTION	QUAN	UNIT	LABOR		MATERIAL		EQUIPMENT		OTHER		TOTAL COST
	ALTERNATE A			UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
	CONTAINMENT STRUCTURE											
	Mobilization:											
1	Drill Rig (Boring Machine)	1	EA	900	900			710	710			1610
2	Crane	1	EA	2350	2350			2025	2025			4375
3	300 HP Bulldozer with Ripper Attachment	1	EA	38	38			175	175			213
4	1-1/2 CY Backhoe	1	EA	48	48			225	225			273
5	Surveying ((3850' x 145')/43,560 SF/AC = 13 AC)	13	ACRE	135	1755			12.75	166			1921
6	Cast in Place 12" Dia. Concrete Piles: (no reinforcing)											
	(2650'+930')(1pile/15')(6'/pile) = 1432 lf											
	(2650'+930')(1pile/15')(6'/pile) = 1432 lf	2864	LF	2.34	6702	6.1	17470	2.04	5843			30015
7	5/8" Dia. Anchor Bolts (4 ea pile):	478	EA	2.47	1181	1.8	860					2041
8	Structural Steel Columns on Downside (w8x48):											
	(478 ea)(10') = 4780 lf	4780	LF	1.25	5975	25	119500	1.02	4876			130351
9	Install Initial Sprung Structure	1	EA							1.4E+06	1400000	1400000
	(150 ft. X 450 ft.)											
18	Sandbags (1 every 5 feet)	240	EA			2	480					480
10	Move Structure											
	Total 8 Moves											
	(Assume 10 Laborers @ 8 Hours Each Move)	640	HRS	17.15	10976			34	21760			32736
11	Loosen Topsoil with Bulldozer/Ripper											
	(3850 X 145)(0.5)/27 = 10,338 cy	10338	CY	0.45	4652			1.52	15714			20366
13	Remove Topsoil for Burial Trench											
	(3850 X 20)(0.5)/27 = 1,426 cy	1426	CY	0.28	399			0.88	1255			1654
12	Excavate Burial Trench with Backhoe											
	(3850 X 20)(5)/27 = 14,260 cy	14260	CY	0.62	8841			1.24	17682			26524
	PAGE TOTAL				43817		138311		70430		1400000	$1,652,558

PROJECT		DATE	ES ENGINEERING-SCIENCE COMPANIES					ENGINEER		CHECKED		PAGE
RF 881 HS DUST STUDY		05/17/90						DJH				2/3
REF.	DESCRIPTION	QUAN	UNIT	LABOR		MATERIAL		EQUIPMENT		OTHER		TOTAL COST
				UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
	ALTERNATE A											
	CONTAINMENT STRUCTURE											
13	Remove and Stockpile Topsoil for Construction											
	(10,338 - 1,426) = 8,912 cy	8912	CY	0.28	2495			0.88	7843			10338
14	Place Topsoil in Burial Trench	10338	CY	0.08	827			0.28	2895			3722
15	Place Uncontaminated Soil Over Burial Trench											
	(14,260 - 10,338) = 3,922 cy	3922	CY	0.08	314			0.28	1098			1412
16	Demolition of Structure and Misc.	11940	LF	1.6	19104			1.3	15522			34626
17	Transportation to disposal Site											
	(11940')(48#/')(1/2000) = 1079 tons	1079	TONS							270	291330	291330
	PAGE TOTAL				22740				27357		291330	$341,428

PROJECT	DATE	ES ENGINEERING-SCIENCE COMPANIES	ENGINEER	CHECKED	PAGE
RF 881 HS DUST STUDY	05/17/90		DJH		3/3

REF.	DESCRIPTION	QUAN	UNIT	LABOR		MATERIAL		EQUIPMENT		OTHER		TOTAL COST
				UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
	ALTERNATE A											
	CONTAINMENT STRUCTURE											
	Summary Sheet:											
	Page 1											1652558
	Page 2											341427.52
	Subtotal											1993985
	+15% Contingency											299098
	Sub-Subtotal											2293083
	+ 8% Overhead											183447
	+10% Profit											229308
	TOTAL											2705838
	PAGE TOTAL											$2,705,838

ROCKY FLATS 881 HILLSIDE REMEDIAL ACTION
CONTAINMENT STRUCTURE

REF. NO.	ITEM	COST CODE
	Mobilization:	
1	Drill Rig	023-554-0600
2	Crane	023-554-0200
3	300 HP Bulldozer/Ripper	022-274-0100
4	1-1/2 CY Backhoe	022-274-1000
5	Surveying	013-306-0010
6	Cast-In-Place 12" Dia. Piles	023-604-0300
7	5/8" Anchor Bolts 18" Long	031-110-0250
8	Structural Steel Columns (W8x48)	051-220-6900
9	Sprung Structure	Vendor's Estimate
10	Move Structure	Crew A-1A & 016-460-1100
11	Ripping Topsoil	022-278-1700
12	Excavation	022-254-0130
13	Removal of Topsoil	022-286-0020
14	Place Contaminated Soil in Burial Trench	022-208-5020
15	Place Uncontaminated Soil over Burial Trench	022-208-5020
16	Demolition	ES Estimate
17	Transportation to Disposal Site	020-717-1130
18	Sandbags	ES Estimate

Note: Cost Codes Taken From "Mean's Heavy Construction Cost Data, 1990."

PROJECT		DATE	ES ENGINEERING-SCIENCE COMPANIES					ENGINEER		CHECKED		PAGE
RF 881 HS DUST STUDY		05/17/90						DJH				1/2
REF.	DESCRIPTION	QUAN	UNIT	LABOR		MATERIAL		EQUIPMENT		OTHER		TOTAL COST
				UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
	ALTERNATE B											
	AIR MONITORING											
	Mobilization:											
1	Bulldozer with Ripper Attachment	1	EA	38	38			175	175			213
2	1-1/2 CY Backhoe	1	EA	48	48			225	225			273
3	Surveying	13	ACRE	135	1755			12.75	166			1921
4	Loosen Topsoil with Bulldozer/Ripper:											
	(3850 x 145)(0.5)/27 = 10,338 cy	10338	CY	0.45	4652			1.52	15714			20366
5	Remove Topsoil for Burial Trench											
	(3850 X 20)(0.5)/27 = 1,426 cy	1426	CY	0.28	399			0.88	1255			1654
6	Excavate Burial Trench with Backhoe											
	(3850 X 20)(0.5)/27 = 14,260 cy	14260	CY	0.62	8841			1.24	17682			26524
5	Remove and Stockpile Topsoil for Construction											
	(10,338 - 1,426) = 8,912 cy	8912	CY	0.28	2495			0.88	7843			10338
7	Place Contaminated Topsoil in Burial Trench	10338	CY	0.08	827			0.28	2895			3722
8	Place Uncontaminated Soil Over Burial Trench											
	(14,260 - 10,338) = 3,922 cy	3922	CY	0.08	314			0.28	1098			1412
9	Weather Monitoring: Anemometer	2	EA			6425	12850					12850
	15 mph											
10	Air Monitoring	2	EA			3430	6860					6860
	PAGE TOTAL				19370		19710		47052			$86,132

PROJECT	DATE	ES ENGINEERING-SCIENCE COMPANIES							ENGINEER		CHECKED		PAGE
RF 881 HS DUST STUDY	05/17/90								DJH				2/2

REF.	DESCRIPTION	QUAN	UNIT	LABOR		MATERIAL		EQUIPMENT		OTHER		TOTAL COST
				UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
	ALTERNATE B											
	AIR MONITORING											
	SUMMARY SHEET:											
	Subtotal											86132
	+15% Contingency											12920
	Sub-Subtotal											99052
	+ 8% *Overhead*											7924
	+10% Profit											9905
	Total											116881
	PAGE TOTAL											$116,881

ROCKY FLATS 881 HILLSIDE REMEDIAL ACTION
AIR MONITORING

REF. NO.	ITEM	COST CODE
	Mobilization:	
1	300 HP Bulldozer/Ripper	022-274-0100
2	1-1/2 CY Backhoe	022-274-1000
3	Surveying	013-306-0010
4	Ripping Topsoil	022-278-1700
5	Removal of Topsoil	022-286-0020
6	Excavation	022-254-0130
7	Place Contaminated Soil in Burial Trench	022-208-5020
8	Place Uncontaminated Soil over Burial Trench	022-208-5020
9	Weather Monitoring	010-092-0100
10	Air Monitoring	Vendor's Estimate

Note: Cost Codes Taken From "Mean's Heavy Construction Cost Data, 1990."

PROJECT	DATE	ES ENGINEERING-SCIENCE COMPANIES	ENGINEER	CHECKED	PAGE
RF 881 HS DUST STUDY	05/17/90		DJH		1/3

REF.	DESCRIPTION	QUAN	UNIT	LABOR		MATERIAL		EQUIPMENT		OTHER		TOTAL COST
				UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
	ALTERNATE C											
	WATERING COMBINED WITH AIR MONITORING											
	Mobilization:											
1	Water Truck	1	EA	40	40			175	175			215
2	Bulldozer with Ripper Attachment	1	EA	38	38			175	175			213
3	1-1/2 CY Backhoe	1	EA	48	48			225	225			273
4	Surveying	13	ACRE	135	1755			12.75	166			1921
5	Water Excavation Area Prior to Excavation:											
	Influent Trench: (930)(44)/1000 = 40.92 msf											
	French Drain: (2650)(116)/1000 = 307.40 msf	348	MSF	1.54	536			1.54	536			1072
6	Loosen Topsoil with Bulldozer/Ripper:											
	(3850 x 145)(0.5)/27 = 10,338 cy	10338	CY	0.45	4652			1.52	15714			20366
7	Water Truck Application Time between Ripper Passes:	80	HRS	38.25	3060							3060
	- Full Time Application for Entire Length of Job											
	- Includes: Stop time for refueling											
	Equipment Maintenance											
	1 Operator											
	Other											
8	Remove Topsoil for Burial Trench											
	(3850 X 20)(0.5)/27 = 1,426 cy	1426	CY	0.28	399			0.88	1255			1654
9	Excavate Burial Trench with Backhoe											
	(3850 X 20)(0.5)/27 = 14,260 cy	14260	CY	0.62	8841			1.24	17682			26524
8	Remove and Stockpile Topsoil for Construction											
	(10,338 - 1,426) = 8,912 cy	8912	CY	0.28	2495			0.88	7843			10338
10	Place Contaminated Topsoil in Burial Trench	10338	CY	0.08	827			0.28	2895			3722
	PAGE TOTAL				22692				46665			$69,357

PROJECT	DATE	ES ENGINEERING-SCIENCE COMPANIES	ENGINEER	CHECKED	PAGE
RF 881 HS DUST STUDY	05/17/90		DJH		2/3

REF.	DESCRIPTION	QUAN	UNIT	LABOR		MATERIAL		EQUIPMENT		OTHER		TOTAL COST
				UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
	ALTERNATE C											
	WATERING COMBINED WITH AIR MONITORING											
11	Place Uncontaminated Soil Over Burial Trench											
	(14,260 – 10,338) = 3,922 cy	3922	CY	0.08	314			0.28	1098			1412
12	Weather Monitoring: Anemometer	2	EA			6425	12850					12850
	15 mph											
13	Air Monitoring	2	EA			3430	6860					6860
	PAGE TOTAL				314		19710		1098			$21,122

PROJECT	DATE	ES ENGINEERING-SCIENCE COMPANIES	ENGINEER	CHECKED	PAGE
RF 881 HS DUST STUDY	05/17/90		DJH		3/3

REF.	DESCRIPTION	QUAN	UNIT	LABOR		MATERIAL		EQUIPMENT		OTHER		TOTAL COST
				UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
	ALTERNATE C											
	WATERING COMBINED WITH AIR MONITORING											
	SUMMARY SHEET:											
	Page 1											69357
	Page 2											21122
	Subtotal											90479
	+15% Contingency											13572
	Sub-Subtotal											104051
	+ 8% Overhead											8324
	+10% Profit											10405
	Total											122780
	PAGE TOTAL											$122,780

ROCKY FLATS 881 HILLSIDE REMEDIAL ACTION
WATER COMBINED WITH AIR SAMPLING

REF. NO.	ITEM	COST CODE
	Mobilization:	
1	Water Truck	022-274-0900
2	300 HP Bulldozer/Ripper	022-274-0100
3	1-1/2 CY Backhoe	022-274-1000
4	Surveying	013-306-0010
5	Watering	029-760-4920
6	Ripping Topsoil	022-278-1700
7	Water Truck Crew	Crew B-6
8	Removal of Topsoil	022-286-0020
9	Excavation	022-254-0130
10	Place Contaminated Soil in Burial Trench	022-208-5020
11	Place Uncontaminated Soil over Burial Trench	022-208-5020
12	Weather Monitoring	010-092-0100
13	Air Monitoring	Vendor's Estimate

Note: Cost Codes Taken From "Mean's Heavy Construction Cost Data, 1990."

PROJECT	DATE	ES ENGINEERING-SCIENCE COMPANIES	ENGINEER	CHECKED	PAGE
RF 881 HS DUST STUDY	05/17/90		DJH		1/3

REF.	DESCRIPTION	QUAN	UNIT	LABOR		MATERIAL		EQUIPMENT		OTHER		TOTAL COST
	ALTERNATE F			UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
	WINTER EXCAVATION OF FROZEN GROUND											
	Mobilization:											
1	Water Truck	1	EA	40	40			175	175			215
2	Bulldozer with Ripper Attachment	1	EA	38	38			175	175			213
3	1-1/2 CY Backhoe	1	EA	48	48			225	225			273
4	Surveying	13	ACRE	135	1755			12.75	166			1921
5	Water Excavation Area 24 Hours before Excavation:											
	Allow Water to Freeze Prior to Excavation											
	Influent Trench: (930)(44)/1000 = 40.92 msf											
	French Drain: (2650)(116)/1000 = 307.40 msf	348	MSF	1.54	536			1.54	536			1072
6	Loosen Topsoil with Bulldozer/Ripper: (x 2)											
	(3850 X 145)(0.5)/27 = 10,338 cy	10338	CY	0.9	9304			3.04	31428			40732
7	Water Truck Application Time between Ripper Passes:	240	HRS	38.25	9180							9180
	- Full Time Application for Entire Length of Job											
	- Includes: Stop time for refueling											
	Equipment Maintenance											
	1 Operator											
	Other											
8	Remove Topsoil for Burial Trench											
	(3850 X 20)(0.5)/27 = 1,426 cy	1426	CY	0.56	799			1.76	2510			3308
9	Excavate Burial Trench with Backhoe											
	(3850 X 20)(5)/27 = 14,260 cy	14260	CY	0.62	8841			1.24	17682			26524
8	Remove and Stockpile Topsoil for Construction											
	(10,338 - 1,426) = 8,912 cy	8912	CY	0.56	4991			1.76	15685			20676
10	Place Topsoil in Burial Trench	10338	CY	0.16	1654			0.56	5789			7443
	PAGE TOTAL				37186				74371			$111,556

PROJECT	DATE	ES ENGINEERING-SCIENCE COMPANIES	ENGINEER	CHECKED	PAGE
RF 881 HS DUST STUDY	05/17/90		DJH		2/3

REF.	DESCRIPTION	QUAN	UNIT	LABOR		MATERIAL		EQUIPMENT		OTHER		TOTAL COST
				UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
	ALTERNATE F											
	WINTER EXCAVATION OF FROZEN GROUND											
11	Place Uncontaminated Soil Over Burial Trench											
	(14,260 – 10,338) = 3,922 cy	3922	CY	0.08	314			0.28	1098			1412
	PAGE TOTAL				314				1098			$1,412

PROJECT	DATE	ES ENGINEERING-SCIENCE COMPANIES	ENGINEER	CHECKED	PAGE
RF 881 HS DUST STUDY	05/17/90		DJH		3/3

REF.	DESCRIPTION	QUAN	UNIT	LABOR		MATERIAL		EQUIPMENT		OTHER		TOTAL COST
				UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
	ALTERNATE F											
	WINTER EXCAVATION OF FROZEN GROUND											
	SUMMARY SHEET:											
	Page 1											111556
	Page 2											1412
	Subtotal											112968
	+15% Contingency											16945
	Sub-Subtotal											129914
	+ 8% Overhead											10393
	+10% Profit											12991
	Total											153298
	PAGE TOTAL											$153,298

ROCKY FLATS 881 HILLSIDE REMEDIAL ACTION
WINTER EXCAVATION OF FROZEN GROUND

REF. NO.	ITEM	COST CODE
	Mobilization:	
1	Water Truck	022-274-4920
2	300 HP Bulldozer/Ripper	022-274-0100
3	1-1/2 CY Backhoe	022-274-1000
4	Surveying	013-306-0010
5	Watering	029-760-4920
6	Ripping Topsoil	022-278-1700
7	Water Truck Crew	Crew B-6
8	Removal of Topsoil	022-286-0020
9	Excavation	022-254-0130
10	Place Contaminated Soil in Burial Trench	022-208-5020
11	Place Uncontaminated Soil over Burial Trench	022-208-5020

Note: Cost Codes Taken From "Mean's Heavy Construction Cost Data, 1990."

PROJECT		DATE	ES ENGINEERING-SCIENCE COMPANIES					ENGINEER		CHECKED		PAGE
RF 881 HS DUST STUDY		05/17/90						DJH				1/2
REF.	DESCRIPTION	QUAN	UNIT	LABOR		MATERIAL		EQUIPMENT		OTHER		TOTAL COST
				UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
	ALTERNATE G											
	VACUUM REMOVAL											
	Mobilization:											
1	Vacuum Equipment	1	EA	38	38			175	175			213
2	Backhoe	1	EA	48	48			225	225			273
3	Surveying	13	ACRE	135	1755			12.75	166			1921
4	Loosen Topsoil with Rototiller:											
	(3850 x 145)(0.5)/27 = 10,338 cy	10338	CY	0.45	4652			1.52	15714			20366
5	Remove Topsoil for Burial Trench											
	(3850 X 20)(0.5)/27 = 1,426 cy	1426	CY	0.28	399			0.88	1255			1654
6	Excavate Burial Trench with Backhoe											
	(3850 X 20)(0.5)/27 = 14,260 cy	14260	CY	0.62	8841			1.24	17682			26524
5	Remove and Stockpile Topsoil for Construction											
	(10,338 - 1,426) = 8,912 cy	8912	CY	0.28	2495			0.88	7843			10338
7	Place Contaminated Topsoil in Burial Trench	10338	CY	0.08	827			0.28	2895			3722
8	Place Uncontaminated Soil Over Burial Trench											
	(14,260 - 10,338) = 3,922 cy	3922	CY	0.08	314			0.28	1098			1412
9	Vacuum Truck and Equipment	1	EA			*****	375000					375000
	PAGE TOTAL				19370		375000		47052			$441,422

PROJECT	DATE	ES ENGINEERING-SCIENCE COMPANIES	ENGINEER	CHECKED	PAGE
RF 881 HS DUST STUDY	05/17/90		DJH		2/2

REF.	DESCRIPTION	QUAN	UNIT	LABOR		MATERIAL		EQUIPMENT		OTHER		TOTAL COST
				UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
	SUMMARY SHEET:											
	Subtotal											441422
	+15% Contingency											66213
	Sub-Subtotal											507635
	+ 8% Overhead											40611
	+10% Profit											50764
	Total											599010
	PAGE TOTAL											$599,010

ROCKY FLATS 881 HILLSIDE REMEDIAL ACTION
VACUUM REMOVAL

REF. NO.	ITEM	COST CODE
	Mobilization:	
1	Vacuum Equipment	022-274-0100
2	1-1/2 CY Backhoe	022-274-1000
3	Surveying	013-306-0010
4	Ripping Topsoil	022-278-1700
5	Removal of Topsoil	022-286-0020
6	Excavation	022-254-0130
7	Place Contaminated Soil in Burial Trench	022-208-5020
8	Place Uncontaminated Soil over Burial Trench	022-208-5020
9	Vacuum Equipment	Vendor's Estimate

Note: Cost Codes Taken From "Mean's Heavy Construction Cost Data, 1990."

PROJECT	DATE	ES ENGINEERING-SCIENCE COMPANIES	ENGINEER	CHECKED	PAGE
RF 881 HS DUST STUDY	05/17/90		DJH		1/3

REF.	DESCRIPTION	QUAN	UNIT	LABOR		MATERIAL		EQUIPMENT		OTHER		TOTAL COST
	ALTERNATE H			UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
	WINDSCREEN											
	Mobilization:											
1	Drill Rig	1	EA	900	900			710	710			1610
2	Bulldozer with Ripper Attachment	1	EA	38	38			175	175			213
3	1-1/2 CY Backhoe	1	EA	48	48			225	225			273
4	Surveying	13	ACRE	135	1755			12.75	166			1921
5	Bore for Pipe Supports											
	640 lf/10' o.c. @ 4' Deep	256	LF	9.65	2470			15.1	3866			6336
6	Install Pipe Supports											
	3" Dia. Schedule 40 Pipe (25 lf ea. X 64)	1600	LF	0.5	800	6.1	9760					10560
7	Install Windscreen											
	(640' X 21') = 13,440 sf	13440	SF	0.1	1344	2.07	27821					29165
	Move Structure 37 More Times											
5	Bore for Pipe supports											
	(256 lf X 37) = 9,472 lf	9472	LF	9.65	91405			15.1	143027			234432
6	Install Pipe Suports	59200	LF	0.5	29600							29600
	Salvage Pipe Supports											
7	Install New Windscreen											
	(13,440 sf X 6) = 80,640 sf	80640	SF	0.1	8064							8064
	Salvage windscreen											
	PAGE TOTAL				136424		37581		148169			$322,174

PROJECT		DATE	ES ENGINEERING-SCIENCE COMPANIES					ENGINEER		CHECKED		PAGE
RF 881 HS DUST STUDY		05/17/90						DJH				2/3
REF.	DESCRIPTION	QUAN	UNIT	LABOR		MATERIAL		EQUIPMENT		OTHER		TOTAL COST
				UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
	ALTERNATE H											
	WIND SCREEN											
8	Loosen Topsoil with Bulldozer/Ripper:											
	(3850 x 145)(0.5)/27 = 10,338 cy	10338	CY	0.45	4652			1.52	15714			20366
9	Remove Topsoil for Burial Trench											
	(3850 X 20)(0.5)/27 = 1,426 cy	1426	CY	0.28	399			0.88	1255			1654
10	Excavate Burial Trench with Backhoe											
	(3850 X 20)(0.5)/27 = 14,260 cy	14260	CY	0.62	8841			1.24	17682			26524
9	Remove and Stockpile Topsoil for Construction											
	(10,338 - 1,426) = 8,912 cy	8912	CY	0.28	2495			0.88	7843			10338
11	Place Contaminated Topsoil in Burial Trench	10338	CY	0.08	827			0.28	2895			3722
12	Place Uncontaminated Soil Over Burial Trench											
	(14,260 - 10,338) = 3,922 cy	3922	CY	0.08	314			0.28	1098			1412
	PAGE TOTAL				17529				46486			$64,015

PROJECT	DATE	ES ENGINEERING-SCIENCE COMPANIES								ENGINEER		CHECKED		PAGE
RF 881 HS DUST STUDY	05/17/90									DJH				3/3

REF.	DESCRIPTION	QUAN	UNIT	LABOR		MATERIAL		EQUIPMENT		OTHER		TOTAL COST
				UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
	ALTERNATE H											
	WIND SCREEN											
	SUMMARY SHEET:											
	Page 1											322174
	Page 2											64015
	Subtotal											386189
	+15% Contingency											57928
	Sub-Subtotal											444117
	+ 8% Overhead											35529
	+10% Profit											44412
	Total											524058
	PAGE TOTAL											$524,058

ROCKY FLATS 881 HILLSIDE REMEDIAL ACTION
WINDSCREEN

REF. NO.	ITEM	COST CODE
	Mobilization:	
1	Drill Rig	
2	300 HP Bulldozer/Ripper	022-274-0100
3	1-1/2 CY Backhoe	022-274-1000
4	Surveying	013-306-0010
5	Drill Holes for Pipe Supports	020-123-1050
6	Install Pipe Supports	151-701-0630
7	Install Windscreen	Vendor's Estimate
8	Ripping Topsoil	022-278-1700
9	Removal of Topsoil	022-286-0020
10	Excavation	022-254-0130
11	Place Contaminated Soil in Burial Trench	022-208-5020
12	Place Uncontaminated Soil over Burial Trench	022-208-5020

Note: Cost Codes Taken From "Mean's Heavy Construction Cost Data, 1990."

MANUFACTURERS INFORMATION

TEL. (415) 543-6288
1 (800) 7-SPRUNG

FAX (415) 543-6572

Sprung Instant Structures Inc.

330 TOWNSEND STREET, #216, SAN FRANCISCO, CALIFORNIA 94107

April 19, 1990

Mr. Bill Kelso
Engineering Science, Inc.
1100 Stout St., Suite 1100
Denver, CO 80204

Dear Bill:

Further to our conversation today, I would like to express my thanks for your consideration of Sprung and your patience in discussing the various opportunities.

Attached is some additional information for your review and files and I have enclosed a conceptual drawing of what we propose.

In rethinking the problem a little further I think (as the drawing shows) 60' sections of structure 140' wide could be set on a steel frame and then pilings may only be required every 60' to support either end of the section. Sections would then lock together and an infill panel would be installed to make up any difference. A hand sketch is attached to give you an idea of what I mean.

One 60'x 140' module could then be "leapfrogged" in front of the last module and you could work your way down the gully. Also, special angled pieces could be supplied to be installed at the turning points. We could utilize the same beams -just insert a special fabric panel and spreader bars to make the angle.

For budgeting purposes each 60' section is estimated at $180,000.00. You can determine the ideal length and multiply the cost by the modules required. Two flat ends will be required at an estimated cost of $150,000.00 (all prices include delivery).

Installation costs normally average $3 - $4 per square foot and moving modules is mainly a cost of crane rental and nominal manpower.

6 modules - Total length 360'

6 x $180,000 =	$1,080,000.00
2 Flat Ends =	150,000.00
Erection (estimate)	200,000.00
TOTAL	$1,430,000.00

Note: Pilings & crane activity not included

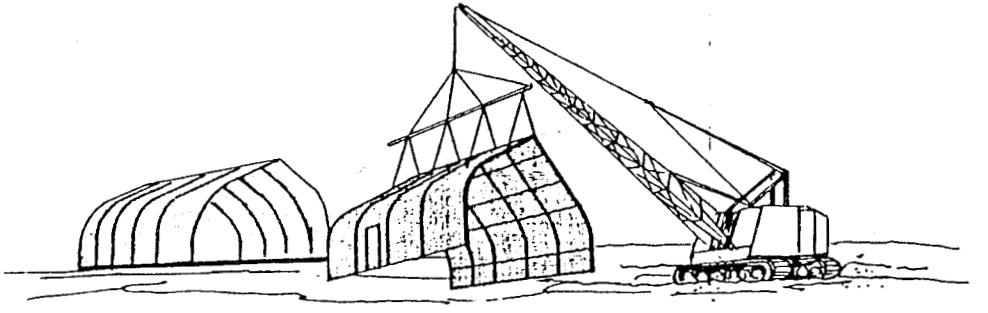
I hope this gives you a better picture of what we would propose and will allow you the opportunity to present all of the options available to Rocky Flats.

Again, many thanks for your consideration, and I look forward to meeting you in the near future.

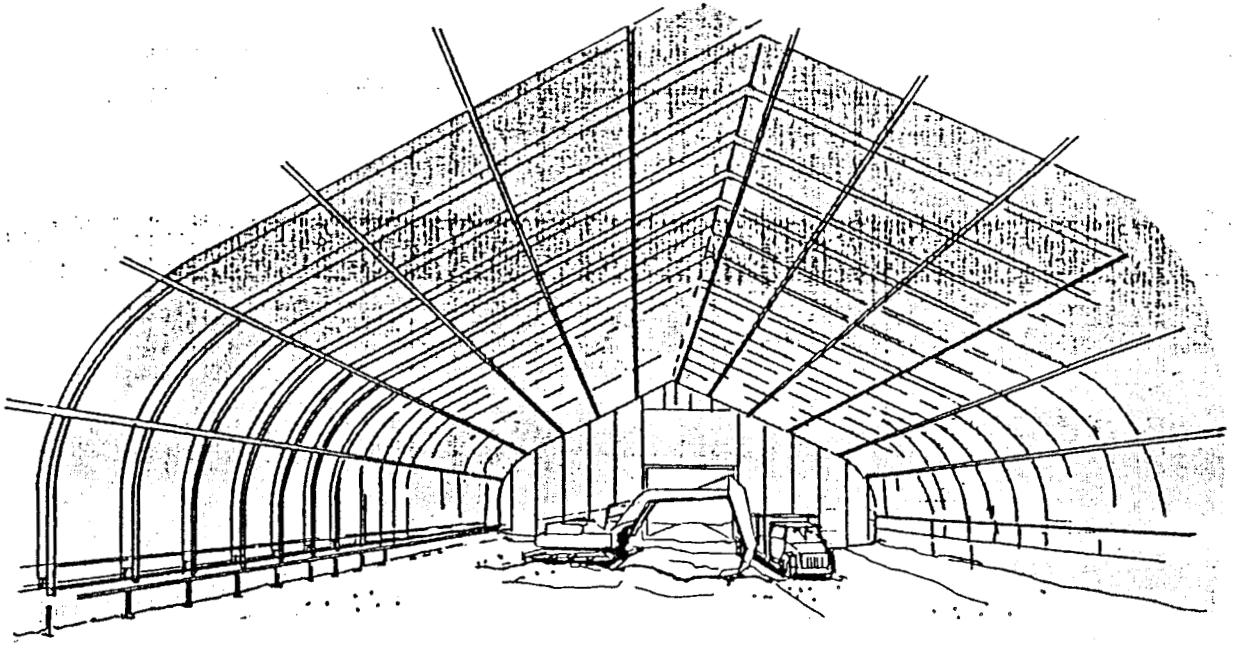
Sincerely,

CHARLES BALLANTYNE
Vice President

CB:mht



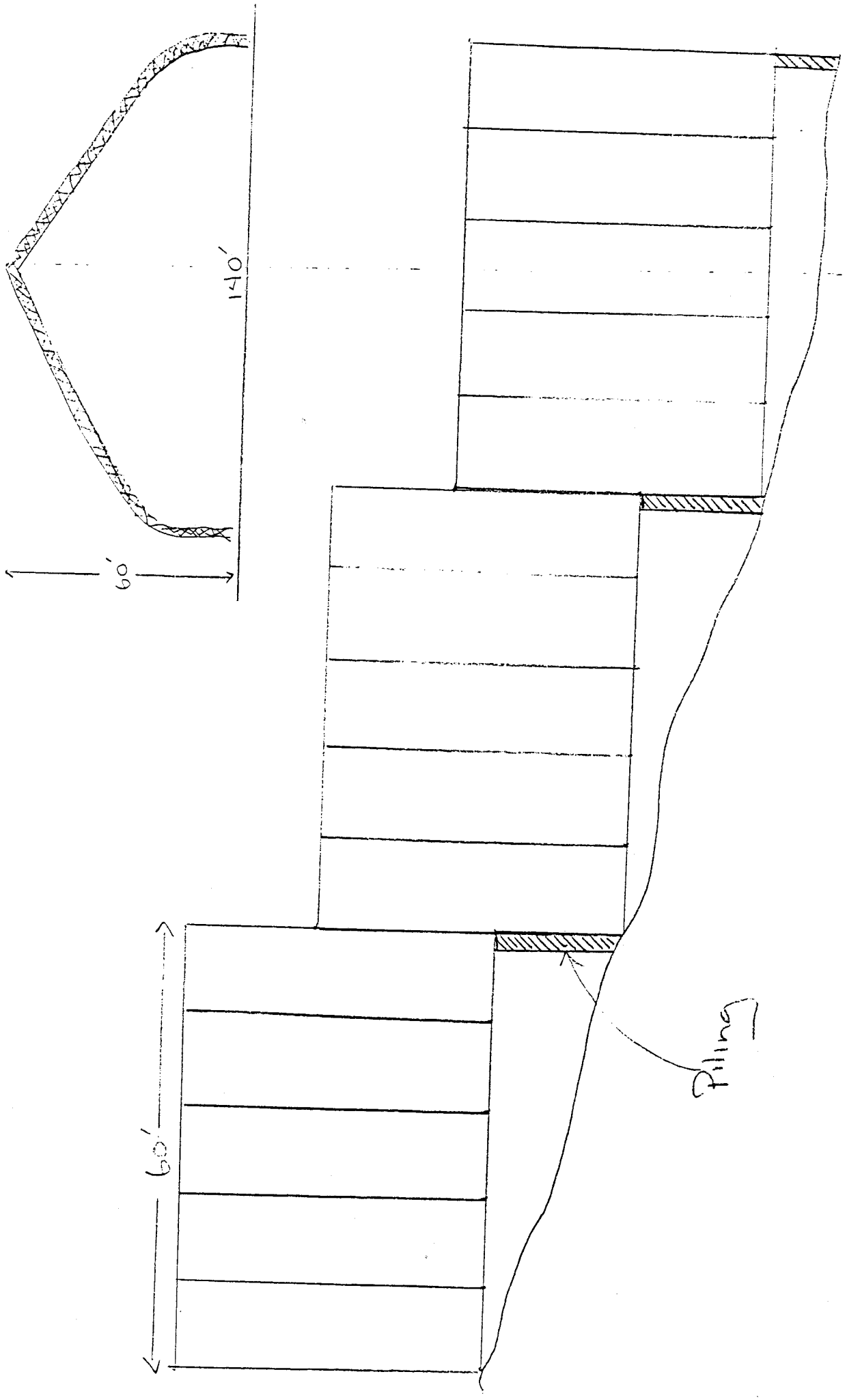
TYPICAL STRUCTURE SET-UP/RELOCATION OPERATION



CONCEPTUAL VIEW OF ENCLOSED EXCAVATION/HAULING OPERATIONS

ENCLOSED EXCAVATION/HAULING OPERATIONS

EXHIBIT 3.6-2


140'
60'
60'
Piling

HAZCO

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QUOTE

DATE: APRIL 12, 1990

TO: MR. BILL KELSO/ ENGINEERING SCIENCE

RE: MIE AEROSOL MONITOR & ALARM

MINIRAM MODEL PDM-3 REALTIME AEROSOL MONITOR	$2900.00
ALARM/RELAY MODULE FOR ABOVE, MODEL ARM-1	$ 530.00

DELIVERY: APPROX. 4-5 WKS

F.O.B: SHIPPING POINT

TERMS: 1%10N30, FRGT PPD & ADD

*ALL ORDERS SUBJECT TO CREDIT APPROVAL

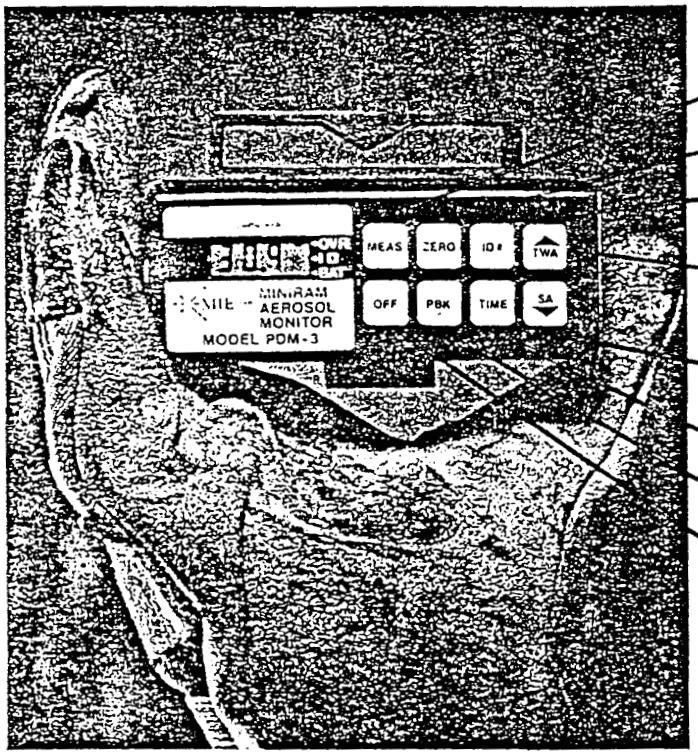
Linda M Fey

LINDA M. FEY
HAZCO SERVICES, INC.

MINIRAM
(Miniature Real-Time Aerosol Monitor)

MODEL PDM-3

THE WORLD'S SMALLEST, FASTEST, SMARTEST DIRECT READING MONITOR FOR DUST, SMOKE FUMES, AND MISTS



MEAS . . . MINIRAM turns on

Zero . . . . Sets automatic zero

ID# . . . . . Programs individual unit identification number, and user selectable functions

TWA . . . . Displays up to the moment time weighted average

SA . . . . . Displays shift averaged concentration up to the minute average over 8 hours

TIME . . . . Displays elapsed measurement time

PBK . . . . Plays back stored data

OFF . . . . MINIRAM turns off. Shift or time weighted averages remain in storage for up to 6 months

APPLICATIONS

- Personal exposure monitoring
- Walk-through surveys
- Indoor air quality monitoring
- Time and motion studies
- Workplace monitoring
- Hazardous waste removal surveillance
- Mobile monitoring in vehicles and airplanes
- High level alarm
- Ventilation monitoring

DESCRIPTION

The MINIRAM is an advanced, completely self contained miniaturized real-time monitoring instrument capable of sensing and measuring aerosol concentrations over the range of 0.01 to 100 mg/m³.

Sensing Principle

The MINIRAM incorporates a pulsed near-infrared light emitting diode source, a silicon detector, and collimating and filtering optics to sense the light scattered over the forward angle of 45° to 95° by airborne particles passing through an open sensing volume. The scattering configuration has been designed for preferential response to particles in the size range of 0.1 to 10 μm, ensuring high correlation with standard gravimetric measurements of both the respirable and inhalable fractions.

Passive Air Sampling Method

Air surrounding the MINIRAM passes freely through its open sensing chamber by natural convection and circulation. No pump is required. The MINIRAM operates silently and with minimum battery power. Optional accessories are available for active (with external pump) sampling for concurrent filter collection, extractive sampling, etc. One of the advantages of the nephelometric sensing method of the MINIRAM is that the air velocity through the sensing chamber has no effect on the measured concentration.

Microprocessor Signal Processing

A single-chip proprietary-design microprocessor within the MINIRAM provides unprecedented operational versatility such as automatic zeroing, time-weighted averaging, shift averaging, elapsed time indication, selectable alarm level, data storage, diagnostic indications, etc. The digital readout of the concentration in milligrams per cubic meter is automatic-ranging and is updated every 10 seconds. In addition, the MINIRAM has analog and digital output ports.

Intrinsic Safety Approved

The MINIRAM has been approved by the U.S. Mine Safety and Health Administration for use in coal mines (approval 2G-3532-0) as a permissible personal dust monitor.

SPECIFICATIONS

- Measurement Ranges (auto-ranging):
  0.01 to 10 mg/m³
  0.1 to 100 ug/m³
- Precision (2-sigma):
  ± 0.02 mg/m³ (10-sec. measurement at constant temperature)
- Particle Size Range of Max. Response:
  0.1 to 10 μm
- Display Selection:
  10-second concentration, time-weighted average, 8-hour shift average, elapsed sample time, zero level ID number, program code
- Data Storage:
  7 concentration averages (500 minutes max. each) with timing
- Outputs:
  Analog (0 to −1.5V), digital ASCII, switched alarm
- Operating Time:
  12 hours (fully charged battery), continuously with included charger
- Operating Temperature:
  0 to 50 °C (32 to 120 °F)
- Dimensions:
  10 × 10 × 5 cm (4″ × 4″ × 2″)
- Weight:
  0.45 kg (16 oz.)

HAZCO Services, Inc.
2006 Springboro West
Dayton, Ohio 45439

Phone: 513/293-2700
FAX: 513/293-9227

Nationwide Hotline 1-800-332-0435 (In Ohio 1-800-343-0256)

MONITORING INSTRUMENTS for the ENVIRONMENT, INC.

MIE

ALARM/ RELAY MODULE

MODEL ARM-

10-AMP RELAY AND AUDIO/VISUAL ALARM ACCESSORY FOR MIE'S PARTICULATE MONITORS

DESCRIPTION

The ARM-1 is a universal optional accessory specifically designed to interface with MIE's line of particulate monitoring instruments. The ARM-1 contains a power relay that can be activated by any of the low power alarm switching outputs of the MIE monitors, and can thus control the operation of loads up to 10 amperes. In addition, the ARM-1 incorporates both a visual (LED) as well as an audible alarm which are actuated whenever the relay input is enabled. The audible alarm can be switched off, if so desired.

The ARM-1 can be actuated directly from the alarm outputs of the RAM-S, RAS-1, RAS-2, PDM-3 (MINIRAM) and PDL-1 instruments. The RAM-1 in combination with the PDL-1 Portable Data Logger can also used to control the ARM-1. Similarly, the FAM-1 requires a FAM-AI and a PDL-1 to actuate the ARM-1 as an alarm level controller.

Typical uses of the ARM-1, in combination with the MIE particulate monitors, include feedback control ventilation fans and blowers actuated when a prese concentration of airborne particles is exceeded: initiation of operation of sampling equipment at prese levels; and equipment shut off and/or alarm at conc tions of excess concentration (e.g., critical systems contamination alarms).

FEATURES

- High power relay (up to 10 amps)
- Audible alarm (defeatable)
- Visual alarm indication
- Can be driven by any of the following MIE instruments: RAM-S•RAS-1•RAS-2•PDM-3•PDL-1 FAM-1 (with FAM-AI and PDL-1): RAM-1 (with PDL-1)
- Powered from a.c. line
- Normally open or normally closed relay operation (user selectable)
- All solid-state design

APPLICATIONS

- Control of blowers, fans, motors, valves, solenoids, etc. triggered by dust, smoke, and fume concentrations exceeding preset levels
- Control of high-power and high sensitivity smoke alarm systems
- Ventilation systems control
- Aerosol generation systems control
- Automatic control of air sampling equipment

SPECIFICATIONS

- **Input Trigger:**
  6 volt @ 50 mA, or on/off switching with less than 150 ohm resistance
- **Output Load**
  115 or 220 VAC, 50-60 Hz, 10 amperes (max.)
- **Input Power:**
  115 or 220 VAC, 50-60 Hz, .01 amperes standby current
- **Indicators:**
  LED activated when triggered Sonalert audio alarm when triggered (85 dB @ 2 feet)
- **Switches:**
  Audio alarm enable/disable
  Relay enable/disable
  Relay output contacts normally open/closed
- **Connections:**
  Three strain-relieved feed-throughs for: trigger signal, a.c. input, and a.c. switched output
  Optional: Conduit Fitting (½ inch thread)
- **Size:**
  18.8 × 8.1 × 11.9 cm (7.4 × 3.2 × 4.7 in.)
- **Weight:**
  1 Kg (2.2 lbs.)
- **Fuses:** (externally accessible)
  10 ampere-ABC and 0.5 ampere 3AG
- **Mounting Holes:**
  Two ¼-20 female inserts @ 13.65 cm (5.375 in.) between centers.

HAZCO

HAZCO Services, Inc.
2006 Springboro West
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MONITORING INSTRUMENTS for the ENVIRONMENT, INC.

Witco

Golden Bear Division
Witco Corporation, P.O. Box 456, Chandler, AZ 85244-0161 Telephone 602-963-2267

March 5, 1990

Mr. Doug Henrichsen
Engineering Science
1100 Stout St., Ste. 1100
Denver, CO 80204
(303) 825-8100 ext. 226

Reference: Coherex Dust Control Agent

Dear Mr. Henrichsen:

Thank you for calling Witco Corporation - Golden Bear Division expressing interest in Coherex which you indicated you read about in the 1985 Edition of the EPA Handbook on dust control. I am pleased to enclose literature concerning Coherex for your review and consideration.

For price and availability, please contact our distributor/manufacturer in your area:

Mr. Bud Morgan
COBITCO, INC.
5301 N. Bannock Street
Denver, CO 80216-1623
(303) 296-8575

Again, thank you for calling and please let me know if I can be of further assistance.

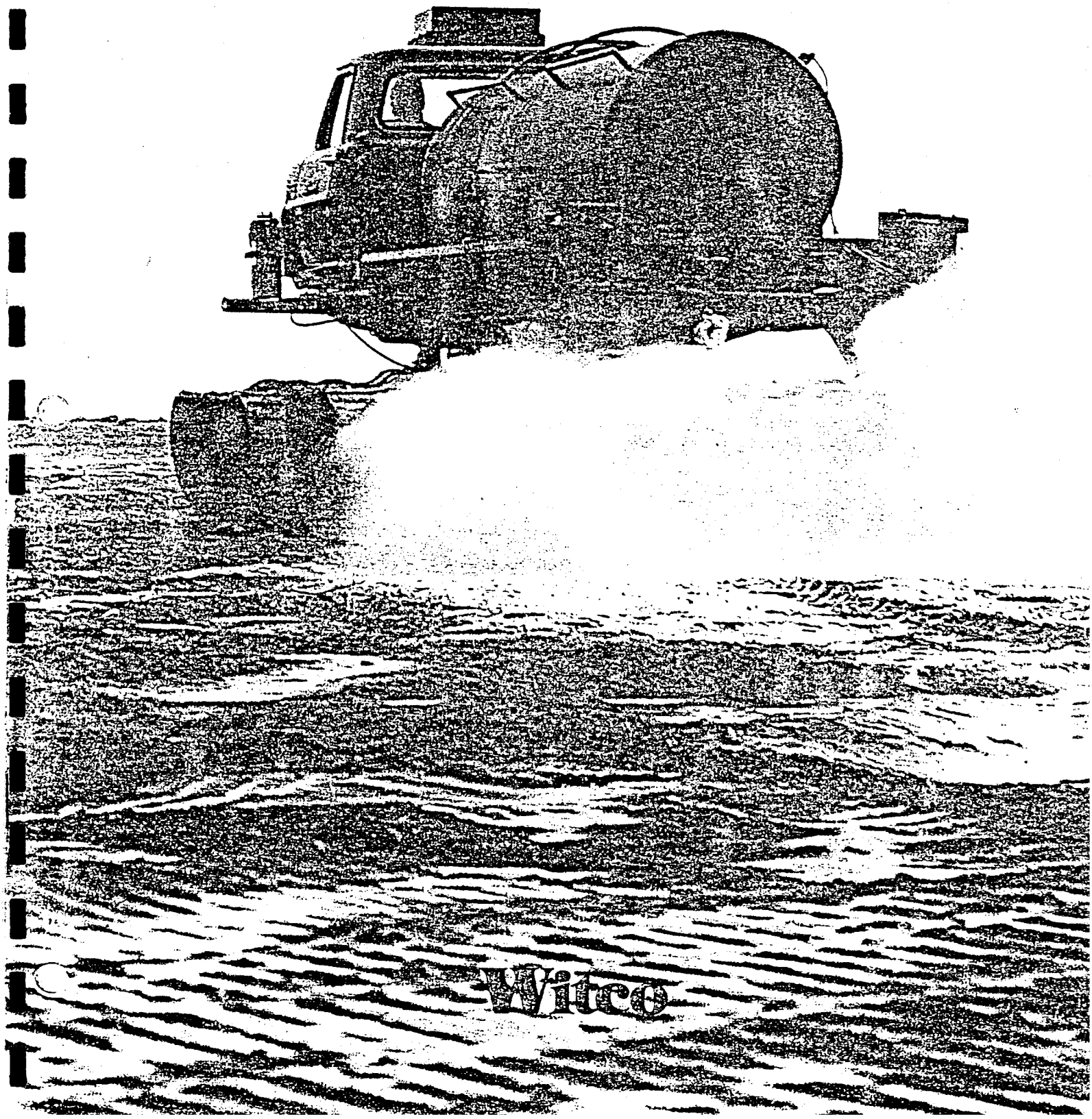
Cordially,

Judy Nelson
Products Engineering
Department

enclosures

cc: Bud Morgan

The Coherex® dust control manual.



Witco

What Coherex is and how it works.

Coherex is an effective dust control and wind erosion agent and is a stable, concentrated, nonvolatile emulsion consisting of approximately 60 percent semiliquid natural petroleum resins and 40 percent wetting solution.

In this special patented formula, the nonvolatile resins are the film-forming, dust-binding portion of the preparation.

The wetting solution is water containing a combination of wetting agents and sequestering agents which serves four purposes:

(1) Disperses the resins into fine particles which can be kept suspended in the emulsion, making Coherex a preparation readily miscible with water in all proportions.

(2) Increases the spreading power of the diluted emulsion.

(3) Facilitates penetration of the resinous particles into soils.

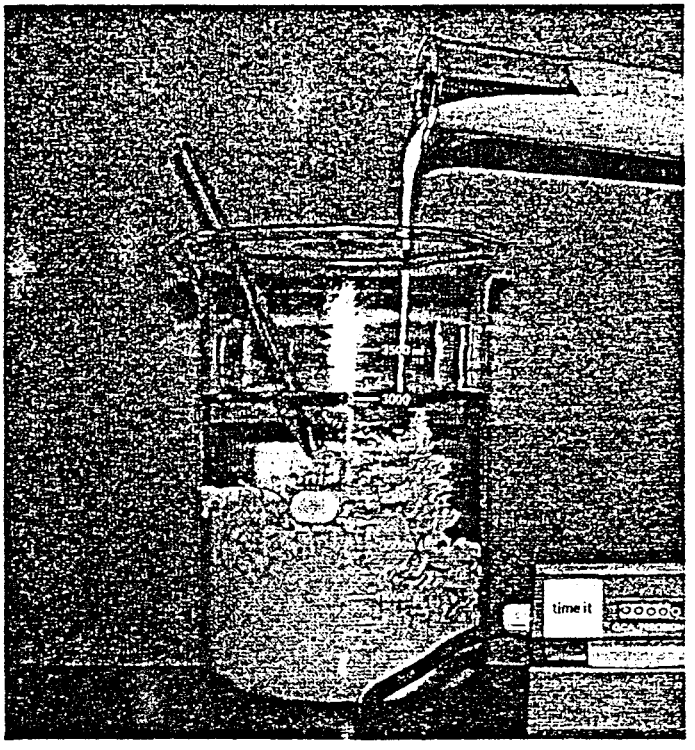
(4) Stabilizes the preparation against hard water, permitting dilution of the emulsion with almost any water available.

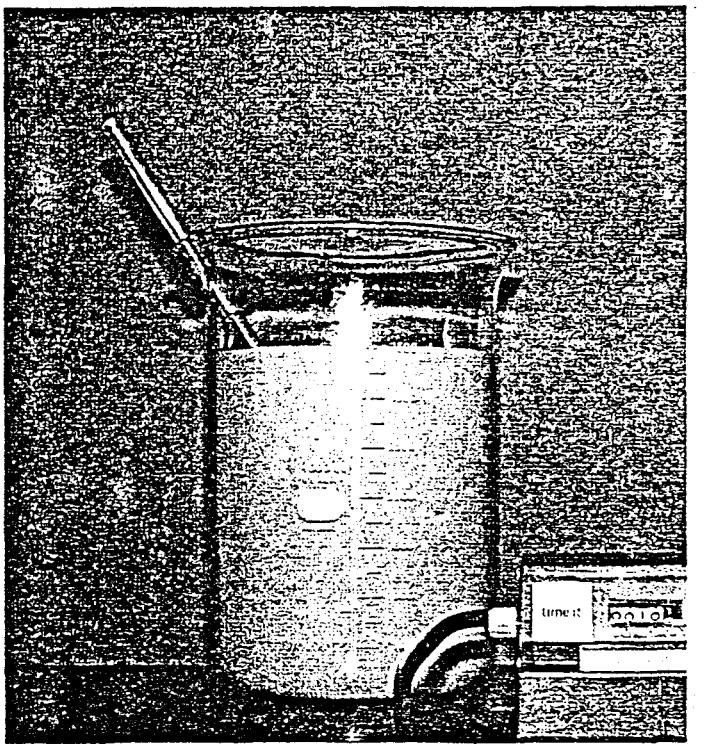
The water contained in the concentrate is an integral part of the preparation. It is the solvent for the wetting and sequestering agents and is proportioned in the concentrate in an amount assuring greatest storage stability and ease of handling.

Additional water added to the concentrate before use, in amounts recommended at the end of this manual, serves as a diluent to assure greatest economy and increase penetration into the dust layer.

The cohesive approach.

Soil conditioning: Coherex provides a modern method for erosion control through proper soil conditioning. In wind-resistant native soils, a correct balance of fine and coarse particles provides the required cohesiveness to resist the impact of saltation, the start of all erosion. Obviously, it would be hardly economical or feasible to change, on a large scale, the given composition of soils in order to establish the desired particle size distribution. Such measures would, for instance, require the addition of 10 to 15 parts of silt and clay-size particles to sand dunes or, vice-versa, the incorporation of large amounts of sand into clay and silty soils.





Coherex's free miscibility in almost any water—even sea water—makes it easily handled. If left in spray equipment or storage tanks over long periods, simple agitation or circulation quickly returns it to its original state.

Soil stabilization: Treatment of soils with Coherex represents an entirely new approach to soil stabilization in that the required cohesiveness is imparted to the soil without drastically altering its original make-up. The concept that this effect would be desirable is not new, but a truly effective product to achieve the result economically was not previously available. Asphalt has been used in various forms as a kind of adhesive, but it was found that it loses its stickiness quickly on exposure to the elements. Decomposition products of vegetable matter (mulch residue) were also found to function as adhesives, but only for a short period of time. Furthermore, most of these materials proved not only ineffective, but detrimental to the soil shortly after application as well.

Development of Coherex for treatment of soils started with the realization that the three types of movement of soil can be arrested by imparting such strong and prolonged cohesiveness to the soil that:

(1) Particles in saltation cannot dislodge other soil particles, but become trapped by the strongly cohesive, nonelastic soil.

(2) Creep, which is movement of the soil under the impact of saltation and the forces of wind, cannot take place as the upper layer of the soil itself is converted into a cohesive soil cover that is difficult to move.

(3) The fines, which are susceptible to air suspension, are eliminated from the soil by agglomeration into larger coherent particles.

This concept of arresting the three modes of soil movement by the introduction of a resinous adhesive constitutes the theoretical foundation for the method of dust control developed by the Golden Bear Division of Witco Chemical Corporation. In other words, the Coherex approach to stabilization of soils against wind erosion is the substitution of a resinous cementing agent for the fines which are required for the apparent cohesiveness in naturally wind-stable soils.

Coherex's ease of handling lends itself to being sprayed with most any type of equipment, even hand-held hoses.

Performance characteristics of Coherex.

Coherex is superior to conventional dust palliatives in several respects. It is clean, efficient, economical, easy to apply, and safe. It is clean because it is light in color, and when properly applied does not excessively soil or stain clothing or equipment. It is efficient and economical, because only the amount required to bind the individual dust particles is needed. Ease of application is assured by its free-flowing characteristics under normal conditions. It is safe, because it is nontoxic to plants and animals and is nonflammable.

A surface treated with Coherex can usually be opened to foot traffic immediately after application—no muddy or sticky clods are formed to cling to shoes or wheels. In soils containing high amounts of clay, however, the surface should be allowed to dry somewhat before exposing it to traffic.

Coherex concentrate can be stored for long periods of time (up to one year or more) if kept in clean containers and if protected from boiling or freezing. Diluted Coherex should be used within one day, since prolonged storage might result in stratification. If a batch of diluted Coherex should stratify, the batch can be restored to usable condition by stirring or agitation—there is no need to re-emulsify the product. The high stability of Coherex in storage and handling contributes greatly to the economic value of the product, assuring no loss of material by spoilage.

Since treatment with Coherex leaves a cumulative residue of the resins deposited on the soil particles, areas once conditioned with Coherex require only occasional re-treatment to bind "new" dust which has blown or drifted onto the area or which has been stirred up from beneath. Under normal atmospheric conditions, and if the recommendations outlined in this manual are followed, the first application will be fully effective for six to ten months and each succeeding application for approximately one year. If undisturbed by traffic, the initial treatment may last for three or more years. The lasting effect of regular treatments can be observed at Edwards Air Force Base, California, which is today a dust-free area in the middle of the desert, requiring only infrequent applications to maintain dust control.

Coherex has great flexibility in application, because the thickness of the resinous coating and the depth of the penetration into the soil can be readily controlled by varying the ratio of water to concentrate, as well as the total volume of fluid used per unit of surface. Thus, the applicator is able to design the application to provide highest efficiency combined with greatest possible economy.

When determining the amount of Coherex concentrate and the amount of water to be used, it should be kept in mind that depth of penetration is controlled by the total amount of fluid applied (concentrate plus water) and that the thickness of the deposit of resins on the dust particles is controlled by the amount of Coherex concentrate in the fluid applied. The amounts of concentrate and water to be used in each particular case will depend on the prevailing dust conditions, the anticipated traffic, and the type of soil.

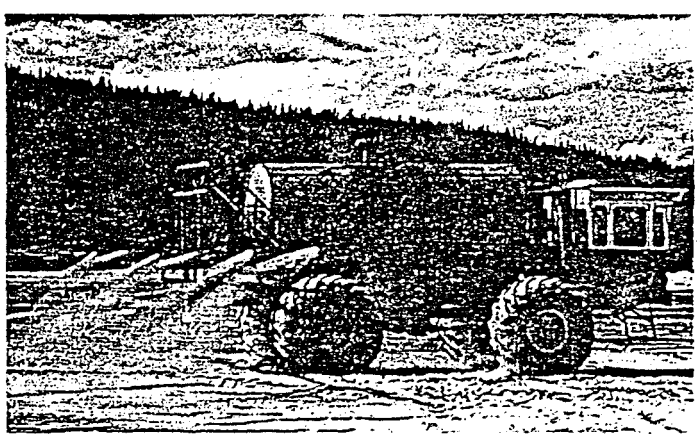
The type of soil influences both the amount of fluid required to saturate it and the time required to reach the depth of penetration desired. The following figures might serve as a guide for determining how various types of soils should be treated. The approximate amounts of fluid required for total wetting of the three basic types of soil are:

Sand	17 gal. per cu. yd.
Silt	27 gal. per cu. yd.
Clay	44 gal. per cu. yd.

The approximate depth of penetration attained by the use of 1½ gallons of fluid per square yard is:

Sand	2 in.
Silt	1.5 in.
Clay	0.8 in.

Since the rate of penetration is rapid in sand, moderately fast in silt, and slow in clay, satisfactory results



Spraying Coherex at a large tailing pond with specially designed equipment.

are obtained in predominantly sandy soil with one application consisting of the total amount of fluid to be applied. In soils containing high amounts of clay, it is advisable to apply the total amount required in several applications. If only one or two applications are to be made on clay-containing soils, penetration and wetting can best be accomplished by disking or by mixing with a blade or both while applying the Coherex. In all cases it will be found advantageous to drag or level the area to be treated to avoid formation of puddles or run-off.

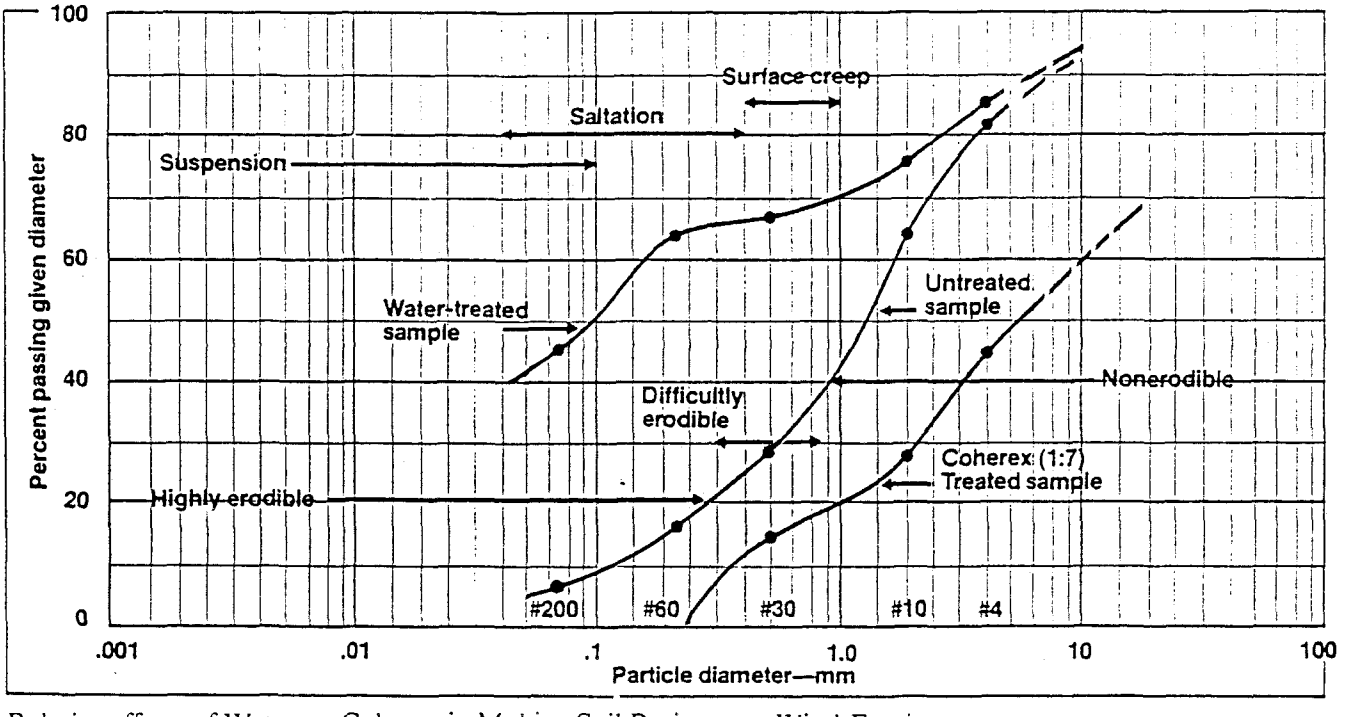
If the soil to be treated consists of loose dust more than one inch deep, the whole area should be thoroughly watered several days before application of the Coherex to create a solidly compacted subsurface and to reduce the dust layer to a thickness of about one inch. In such cases it is advantageous to add a small amount of Coherex to the water—approximately 1 part of Coherex to 20 parts of water.

The resinous particles carried into the ground by the wetting solution coat the individual soil particles with a thin film which acts as an adhesive, binding the small particles together and making them adhere to other particles. The physical and chemical properties of the resins are such that the adhesive coating formed is strongly affixed to the soil, is resistant to bacterial action and weathering, cannot be displaced by rain, and does not evaporate or percolate away.

Surprisingly enough, Coherex is even more economical to use than water, since repeated sprinkling with water alone is costly in terms of time and labor. A study made by the Materials and Research Department of the California Division of Highways showed that dust control with water alone during highway construction is very uneconomical. Water by itself is effective as a dust control agent only until it evaporates; it actually aggravates the dust condition over the long term.

Tests carried out on soils treated with water have shown that the amount of fines (dust) increases, in many cases, as much as 600 percent after the water evaporates, while in the same soils, properly treated with Coherex, the content of fines is reduced to less than 1 percent of the amount present before treatment.

The usefulness of Coherex as an effective agent for the agglomeration of dust particles is not confined to soils. Many materials which are water-insoluble, such as coal dust, can be made dust-proof.



Relative effects of Water vs. Coherex in Making Soil Resistant to Wind-Erosion.

Coherex solves dust problems for a wide range of applications.

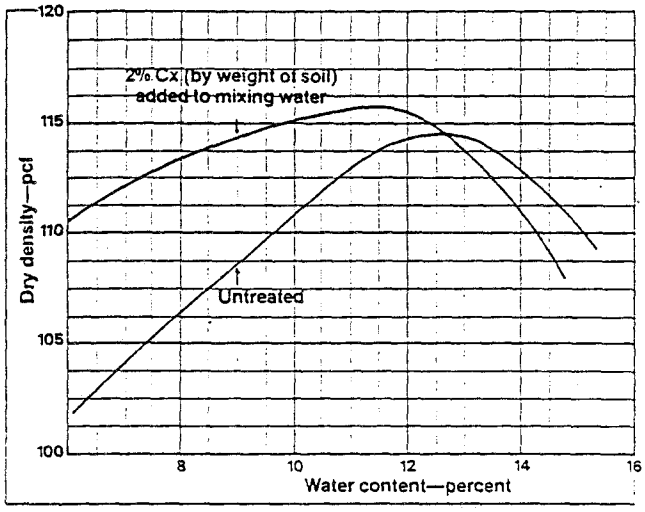
By now you have a general understanding of the way Coherex interacts with soils and conditions them by stabilization. This section of the manual will deal with the many practical applications possible with Coherex, developed by the Golden Bear Division of Witco Chemical Corporation, as the most modern and efficient dust control agent. Not only is Coherex useful in the treatment of soils, but also of ores, coal, and other matter in which dust is undesirable or where an over-all increase in particle size is desired.

The ability of Coherex to transform small particles into larger ones and to set up chain- or net-like structures makes it useful also as a soil compacting agent. Another application is its use to prevent seeds from blowing away from newly seeded areas.

Coherex can also be used in conjunction with other products. With asphalt, it can serve as a prime or tack coat; in conjunction with water-permeable membranes, it is useful as a compacting and binding agent for overlaying soil structures; as an additive to soil sterilants, it increases their effectiveness; as an additive to water used in compaction of soils, it results in increased dry density.

Coherex solves dust problems in:

Athletic fields
Auto parking lots
Airfields
Barbecue areas
Baseball parks
Bridle paths
Camps
Cemeteries
Coal preparation
Construction areas
Country clubs
Dairies
Dirt floors
Drive-in restaurants
Drive-in theatres
Driveways
Estates
Fairgrounds
Football fields
Fruit stands
Gasoline stations
Walks
Hotels
Laundries
Military centers
Orchards
Ore treatment plants
Parade grounds
Parks
Playgrounds
Polo fields
Poultry litter houses
Race tracks
Railroads
Roads
Road shoulders
Rodeo grounds
Schools
Tennis courts
Tourist camps
Unpaved areas around industrial plants
Vineyards



Coherex can be used to obtain greater compaction of problem soils than is obtainable with water alone.

General recommendations for dilution and application.

Since Coherex is a concentrate, it is always diluted with water. Application is made by sprinkling the area with an amount of the diluted concentrate sufficient to penetrate the layer of dust to whatever depth required. Spreader trucks, hand sprayers, orchard sprayers, or other standard equipment is used. For best application, spraying pressure should be approximately 25 to 30 psi.

How much water should be used to dilute Coherex?

Three concentrations have been found to be most practical for all applications:

One part Coherex to four parts water.
One part Coherex to seven parts water.
One part Coherex to ten parts water.

The ratio of dilution selected depends upon the specific application and desired results.

Depth of penetration is controlled by the total amount of fluid applied, and the thickness of the coating is controlled by the amount of Coherex concentrate in the fluid. Actual amount of concentrate in each particular case will depend on the prevailing dust conditions, anticipated traffic, and type of soil.

Under average conditions, such as those existing in parking lots and packed dirt roads, one to one-and-a-half gallons of the 1:4 dilution per square yard will do an

effective job. If accumulated loose dirt is not thicker than one-half inch and traffic is light, one gallon of the 1:7 dilution per square yard will be sufficient.

Where dust conditions are severe, such as on service roads and sandy vineyards, several applications are recommended. A one or one-and-a-half gallon per square yard application of the 1:7 dilution; followed preferably after several hours by a one gallon per square yard application of the 1:4 dilution.

In many cases, it will be advantageous to make the second application after several days, when traffic over the area has packed the dust.

When alleviating dust conditions is to be combined with packing down of an area over which a hard-surface highway is to be constructed, drenching the area with a 1:10 solution to the point of complete saturation is recommended. Under continued traffic any area will have to occasionally be retreated.

The area to be treated with Coherex should be dragged or leveled so that runoff and formation of puddles will be avoided.

The following examples may serve as further illustrations: On ball parks and playgrounds, for instance, deep penetration on a thin coating of dust particles can be obtained by drenching the ground with a highly diluted mixture. (A 1:7 dilution will immobilize the dust only, and will maintain the soft free-flowing properties of the sand.) Somewhat less penetration and a heavier coating can be obtained by using a more concentrated mixture of Coherex and water. (A 1:4 dilution applied at a lower rate will give a surface which will better withstand wear, and will bind dust blown onto the treated area.)

On dirt roads, driveways, and utility yards, with relatively thin layers of dust over hard subsurfaces, application of a more concentrated mixture in moderate amounts will produce the desired complete penetration down to the hard subsurface with a sufficiently heavy coating of the dirt particles. (A 1:4 dilution applied one-half gallon per square yard will suffice to treat a dust layer of approximately ½ inch thickness.) Re-treatment will be necessary.

On areas covered with large amounts of loose dust, which should be settled or packed down, high dilution with water is recommended. (A 1:10, or even a 1:15 dilution, of Coherex will be found advantageous in all cases where water is at present used as a temporary dust palliative or as a means of packing a road sub-surface.) It will be found that this application will save considerable time, labor and water. The highly diluted Coherex gives better penetration, better wetting, tighter packing, improved adhesion, and a reduction in rate of evaporation of the water. All of which amounts to a considerable saving of money.

Gallons of Coherex concentrate required for areas of various sizes.

Dilution		Coherex/Water 1:4.					Coherex/water 1:7.				
Rate of application of diluted mixture (gal./sq. yd.)		1/2	3/4	1	1¼	1½	1/2	3/4	1	1¼	1½
Size of Area (sq. yds.)	100	10	15	20	25	30	6	9	13	16	19
	200	20	30	40	50	60	13	19	25	31	38
	500	50	75	100	125	150	31	47	63	78	94
	1,000	100	150	200	250	300	63	94	125	156	188
	2,000	200	300	400	500	600	125	188	250	313	375
	(acre) 4,840	484	726	968	1,210	1,452	303	454	605	756	908
	5,000	500	750	1,000	1,250	1,500	313	469	625	781	938
	10,000	1,000	1,500	2,000	2,500	3,000	625	938	1,250	1,563	1,875
	20,000	2,000	3,000	4,000	5,000	6,000	1,250	1,875	2,500	3,125	3,750
	50,000	5,000	7,500	10,000	12,500	15,000	3,125	4,688	6,250	7,813	9,375

Example: An area of 20,000 sq. yds. treated at the rate of 3/4 gal. per sq. yd. of a 1:4 dilution of Coherex will require 3,000 gals. concentrate and 12,000 gals. of water.

Specifications for Coherex®

Dust Control Agent and Base

Golden Bear Division, Witco Corporation
P.O. Box 456, Chandler, AZ 85244 602-963-2267

2845

Coherex Dust Control Agent

Tests	Test Method		Requirements	
	ASTM	AASHTO	Min.	Max.
Viscosity @ 25 °C, SFS	D-244	T-59	15	40
Sieve Test, %w[1]	D-244	T-59	—	0.1
Residue, %w[2]	D-244	T-59	60	65
Particle Charge Test	D-244	T-59	Positive	

[1]Test procedure identical with ASTM except that distilled water shall be used in place of 2 %w sodium oleate solution.

[2]ASTM D-244 Evaporation Test for percent of residue is modified by heating 50 gram sample to 149 °C (300 °F) until foaming ceases, then cooling immediately and calculating results.

Note: For gal/ton conversion use 242 gal/ton.

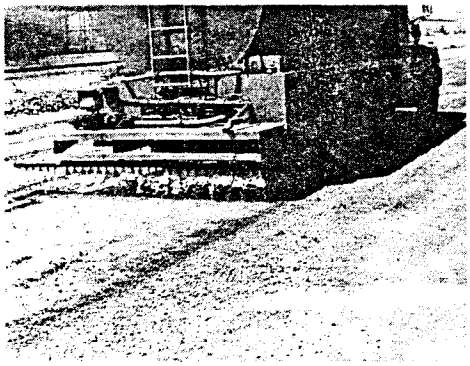
Coherex Base

Tests	Test Method		Requirements	
	ASTM	AASHTO	Min.	Max.
Viscosity @ 100 °C, cSt	D-445	—	17.17	23.83
Flash Point, COC, °C	D-92	T-48	208	—
Asphaltenes, %w	D-2006-70	—	—	0.75
Saturated Hydrocarbons, %w	D-2006-70	—	—	20
Specific Gravity	D-1298	T-277	1.000	1.040

Witco

The Entac Corporation, P.O. Box 201, One Entac Place, Lynchburg, Tn. 37352 • 1-800-233-3878 • 615-759-4633 • Fax 615-759-4636

Complete Dust Control • Road Surface Stabilizer Soil Stabilizer • Coal and Ash Stockpile Sealant



Entac application at steel mill

Features

- environmentally safe
- 100% organic
- non-corrosive
- non-flammable
- no offensive odour
- ecologically safe
- will not leach
- easily mixed with water
- non-tracking—will not stick to shoes or tires after curing
- ***safe, clean, and easy to use***

Product Description

Entac is a 100% organic emulsion produced from naturally occurring resins (treesap), which has gained widespread use for fugitive dust control, the sealing of coal and ash stockpiles, soil stabilization and cold pothole patching. It is dilutable with water for easy application.

Product Uses

Entac's principal use is to maintain unpaved roads by controlling dust, stabilizing and sealing the road surfaces. With proper application the surface becomes dust-free, waterproof, and suitable for foot or vehicular traffic. A properly maintained surface will last indefinitely. **Entac** is also used to seal coal and ash stockpiles by forming a waterproof skin, which prevents leaching and erosion.

Performance

Entac works better than petroleum-based emulsions, chlorides, and lignosulfonates previously used for dust suppression.

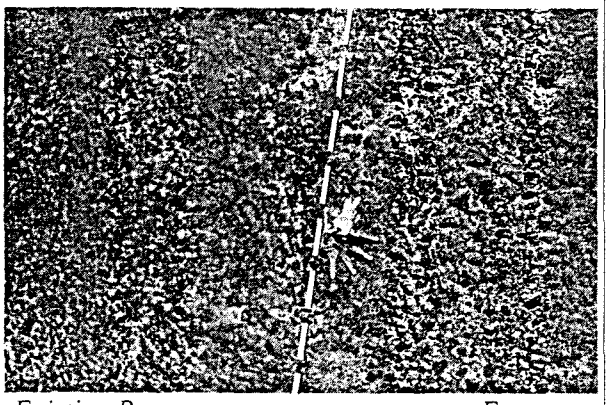
Environmental

Entac is completely organic and non-hazardous to workers and the environment. Replaces chlorides, lignosulphonates, oil products, oil and asphalt emulsions.

Entac is a state-of-the-art, environmentally friendly complete dust control product. When applied to gravel roads it will circulate, penetrate and extend down into the foundation and bond dust to stone. This will build a durable and waterproof surface that will be plyable yet hard enough to actually spin tires and burn rubber without causing surface damage. **Entac** surfaces can be vacuumed, swept or flushed, the same as paved surfaces, when periodically maintained.

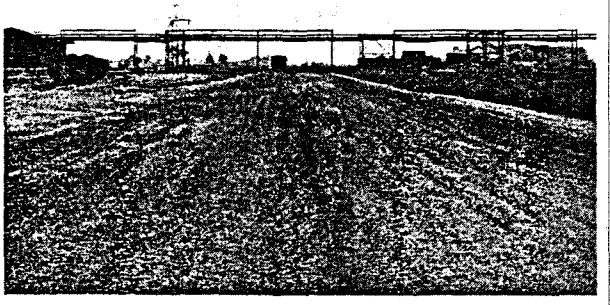
Advantages

Product Characteristics



Existing Pavement *Entac*

Treated haul road, Nanticoke, Ontario



Finished Entac haul road
(Note: no dust on road after passage)

Application Procedures

Supplied as a concentrate for economical shipping. It is diluted for specific uses.

Entac can be stored for long periods of time in concentrated or diluted form.

Entac is simple and easy to use in dilutions of 5:1, 8:1, 10:1 and 20:1, depending on the application required.

Entac is superior to conventional dust palliatives in several respects. Only the amount required to bind the individual dust particles is needed.

Entac leaves a cumulative residue of treesap deposited on the soil particles. Areas once conditioned required only occasional re-treatment to bind fugitive dust, which has blown onto the area or which has been stirred up from beneath.

The thickness of the **Entac** coating and depth of penetration into the soil to be treated can be controlled by varying the dilution with water and the total volume of liquid applied per unit of surface. The type of soil influences the amount of liquid required to achieve the desired penetration.

Entac is not restricted to agglomerating dust particles on soils. For example, **Entac** is an excellent stockpile sealant for coal and fly ash providing freeze protection and erosion protection.

Entac can also be sprayed over large reclamation areas with seed. The **Entac** will prevent the seed from being blown away and aids germination.

Entac is stable for storage. The only requirement in storing **Entac** is that the storage facility always be above freezing. **Entac** is a stable product with a long shelf life.

Entac is safe to handle. Because **Entac** is 100% organic, non-toxic and non-hazardous, it poses no safety problems in handling.

Entac is easy to use. **Entac** does not require intense equipment clean up and maintenance and is not messy at application, compared to other products.

Opacity Testing

To determine effective dust control

Figure 1.
***Entac** Efficiency Control Curve*
Notes

*i) There is no discernable decay rate after 12,000 vehicle passes for **Entac.***

ii) The maximum control for calcium chloride and lignon sulphonate is 50 - 65%.

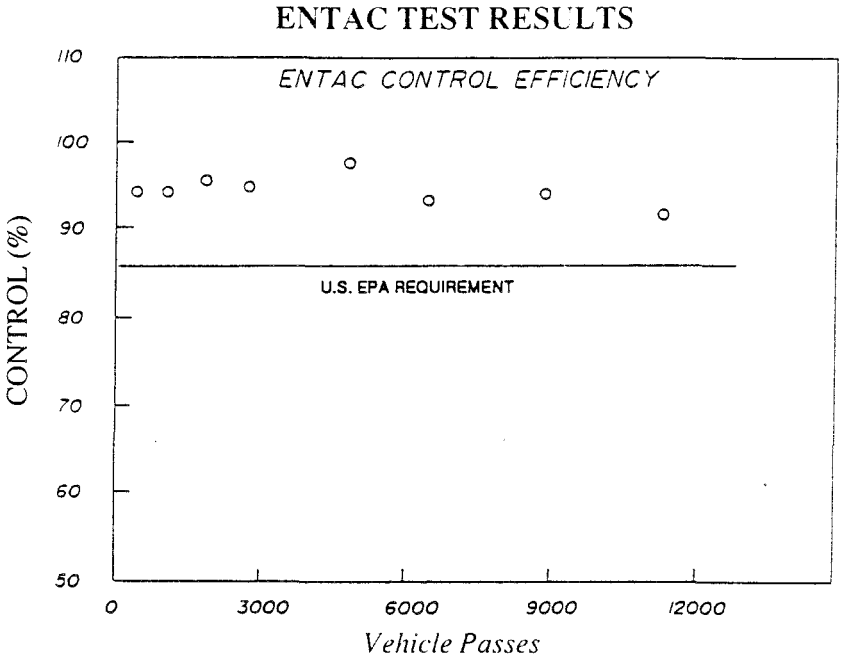
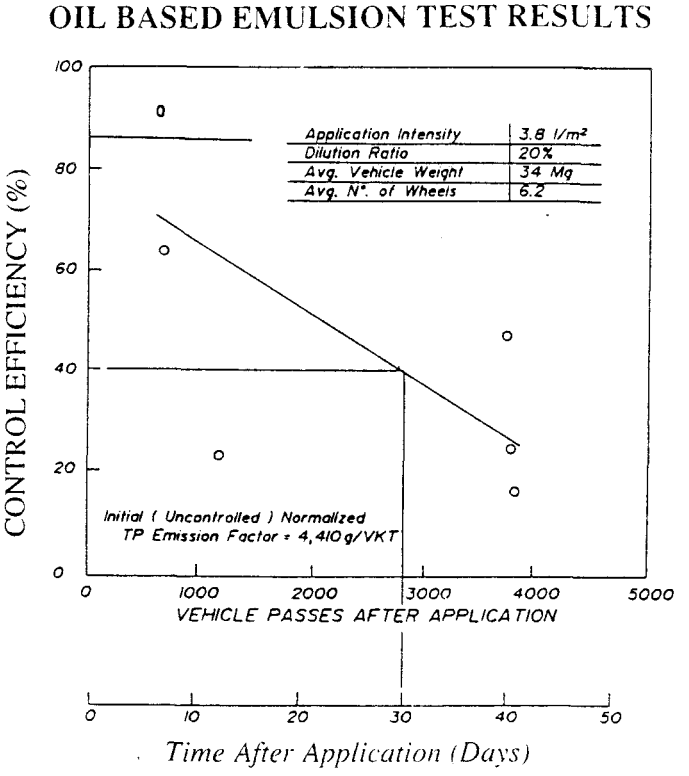


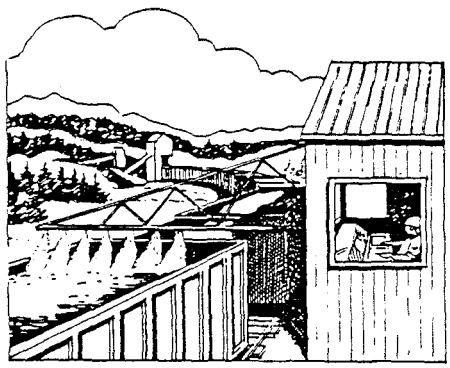
Figure 2.
Control Efficiency Decay
(oil based emulsion)



The Entac Corporation, P.O. Box 201, One Entac Place, Lynchburg, Tn. 37352 • 1-800-233-3878 • 615-759-4633 • Fax 615-759-4636

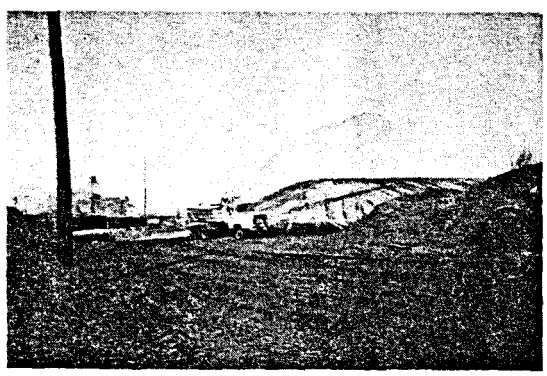
Principle Uses

STABILIZING Soils, Ores, Coals, and other matter in which dust is undesirable.



Recommended practices for loading, unloading and transporting coal by rail

- Coal and ash stockpile sealing
- Short term or long term dust control
- Stabilizing and sealing surfaces of unpaved roads
- Stabilizing road shoulders and slopes along highways
- Sealing and waterproofing road base prior to paving
- Providing dust control and stable surfaces for parking lots, remote helicopter landing sites and similar areas
- Patching and filling potholes
- Providing dust control and stable surfaces for unpaved areas near industrial plants and mining areas
- Sealing land fill sites
- Airport pads sealing
- Wind and moisture erosion controlling
- Stockpile freeze control
- Sealing tailings – ponds
- Hydroseeding
- Sealing construction areas



*Application of **Entac** on coal stockpile*

For further information please contact

ENTAC WEST CORP.
1242 PIONEER WAY
EL CAJON, CA 92020
(619) 442-9231 Fax (619) 440-5673
1-800 350-6822

The Entac Corporation
P.O. Box 201
One Entac Place, Lynchburg, Tn. 37352
1-800-233-3878 • 615-759-4633 • Fax 615-759-4636

Entac Canada, Inc.
P.O. Box 508, Station "B"
Hamilton, Ontario L8L 7W9 Canada
Tel.: 416-577-6988 Fax: 416-577-6996

ENTAC PROFILE

PRODUCT DESCRIPTION

ENTAC is a 100% organic emulsion produced from naturally occurring resins (treesap). It is easily diluted with water for easy application.

PRODUCT USES

ENTAC'S is a state-of-the-art, environmentally friendly product developed to maintain unpaved roads by controlling dust, stabilizing and sealing the road surfaces. With proper application on properly prepared roads or other areas, Entac will circulate, penetrate and extend down into the foundation and bond dust to stone. This will build a hard, dry, durable and waterproof surface that will be hard enough to spin tires and burn rubber without causing surface damage. Entac surfaces can be vacuumed, swept or flushed, the same as paved surfaces, and when periodically maintained, Entac will provide perpetual dust control.

ENTAC is also used to seal off coal and ash stockpiles by forming a skin around the stockpile to prevent leaching and erosion, to waterproof for efficiency and freeze prevention and to control fugitive dust created from stockpiles.

ENTAC can also be applied over large reclamation areas with seed to prevent the seed from being blown or washed away and aids in germination.

ENTAC is simple and easy to use by diluting with water. The standard dilution rates of 5:1, 8:1, 10:1 and 20:1 are used depending on the application and the end result desired.

Principal Uses

--Coal and Ash Stockpile Sealant
--Short term or long term dust control
--Stabilizing and sealing surfaces of unpaved roads
--Stabilizing road shoulders and banks along highways
--Sealing and waterproofing road base prior to paving
--Providing dust control and stable surfaces for parking lots, remote helicopter landing sites and similar areas
--Patching and filling potholes
--Providing dust control and stable surfaces for unpaved areas near industrial plants and mining areas

PRODUCT PERFORMANCE

ENTAC works better than petroleum/oil based emulsions, chlorides and ligno sulfonates, previously used for dust suppression.

ENVIRONMENTAL

ENTAC is completely organic and non-hazardous to workers and the environment and replaces chlorides, lignosulfonates, oil products and oil and asphalt emulsions.

TECHNICAL DATA AND CHARACTERISTICS

Physical Properties

Form	Liquid
Color	Light Brown
Density	8.33 lbs/gal
Specific Gravity	1.00
Viscosity at 77 degrees F	300 CPS
Boiling Point	212 Degrees F
Freezing Point	32 Degrees F
Flash Point (COC)	550 Degrees F

Characteristics

100% organic
Non-corrosive
Non-flammable
No Offensive Odor
Ecologically Safe
Clean and Easy to Apply
Will Not Leach
Non-Tracking, Will Not Stick To Shoes or Tires
Easily Mixed With Water

THE ENTAC CORPORATION
PARTIAL CLIENT LIST

NATIONAL STEEL CORPORATION
GRANITE CITY, ILLINOIS

USX CORPORATION
PHILADELPHIA, PENNSYLVANIA

MOBIL OIL CORP.
BEAUMONT, TX

OCCIDENTAL CHEMICAL
COLUMBIA, TENNESSEE

PENNSYLVANIA POWER & LIGHT
MARTINS CREEK, PENNSYLVANIA

HINKLE METALS
BIRMINGHAM, ALABAMA

KANSAS CITY POWER
KANSAS CITY, MISSOURI

ALABAMA POWER & LIGHT
GORGAS, ALABAMA

STELCO STEEL
HAMILTON, ONTARIO

STELCO STEEL
NANTICOKE, ONTARIO

ONTARIO HYDRO
TORONTO, ONTARIO

STATELINE SYSTEMS
NASHVILLE, TENNESSEE

entac west inc.
entac corporation: an environmentally conscious company

July 13, 1990

Dear Bill,

Here is the total cost of applied product which includes product, shipping, application equipment and personnel, per square yard: $1.52.

Thank you. T.

1242 pioneer way el cajon, california 92020 tel: (619) 442-9231 out of state: 1 (800) 350-NTAC fax: (619) 440-5673

entac west inc.
entac corporation: an environmentally conscious company

July 12, 1990

Dear Bill,
Here is a general description of application and a cost estimate for Entac.

The application is done usually in a two step, three day process. Day one is to spray a series of passes of diluted Entac at a 5 parts water to 1 part Entac conc. ratio until the surface is saturated. Compaction of the wet surface then takes place with rolling equipment or even normal traffic tires, depending on the site size. Roads normally remain fully open to traffic during the application process. Day two we let the product settle and cure. Day three we reapply the same 5 to 1 ratio with spray passes till again the surface is saturated. This completes the application process under most conditions. Periodic passes of Entac at a 10 parts water to 1 part Entac conc. on a per need basis will indefinitely maintain the established Entac surface. We train the end user personnel to apply the maintenance coats.

COST ESTIMATE:
Most haul road surfaces take between .25 and .35 of Entac conc. gal. per sq. yd. to "bring in" the Entac surface. I have given higher conc. gal. figures to cover current unknowns: type and condition of roads and type of vehicles and use. A 1000 gallon test is usually made to determine accurate requirements before any commitments on either side are made.

2 miles by 25 feet wide = 29,333 sq.yd.

Entac conc. gal. per sq. yd. % est.	Entac conc. gal.	Cost at $1.90 per conc. gal.
.3	8,800	$16,720
.4	11,733	22,292
.5	14,666	27,865
Staging Area, 200 feet x 200 feet x two =		
" "	"	" "
.3	2,666	$5,066
.4	3,555	6,754
.5	4,444	8,443

1242 pioneer way el cajon, california 92020 tel: (619) 442-9231 out of state: 1 (800) 350-NTAC fax: (619) 440-5673

entac west inc.

entac corporation: an environmentally conscious company

The above rates reflect product only, application supervision is included.

The above rates do not reflect any freight costs. Approximate freight cost from California to Colorado is $5,500 - $6,000 per 20,000 gal. shipped via rail.

For Entac West to apply the product, there is a $0.80 per conc. gal. application fee.

* OPTION TO FREIGHT: If the total gallons needed exceeds 60,000 conc. gal., we will transport our manufacturing unit to on site and produce Entac concentrate to be stored in end user's storage tanks or rail tanker cars. This saves several thousands of dollars in freight fees.

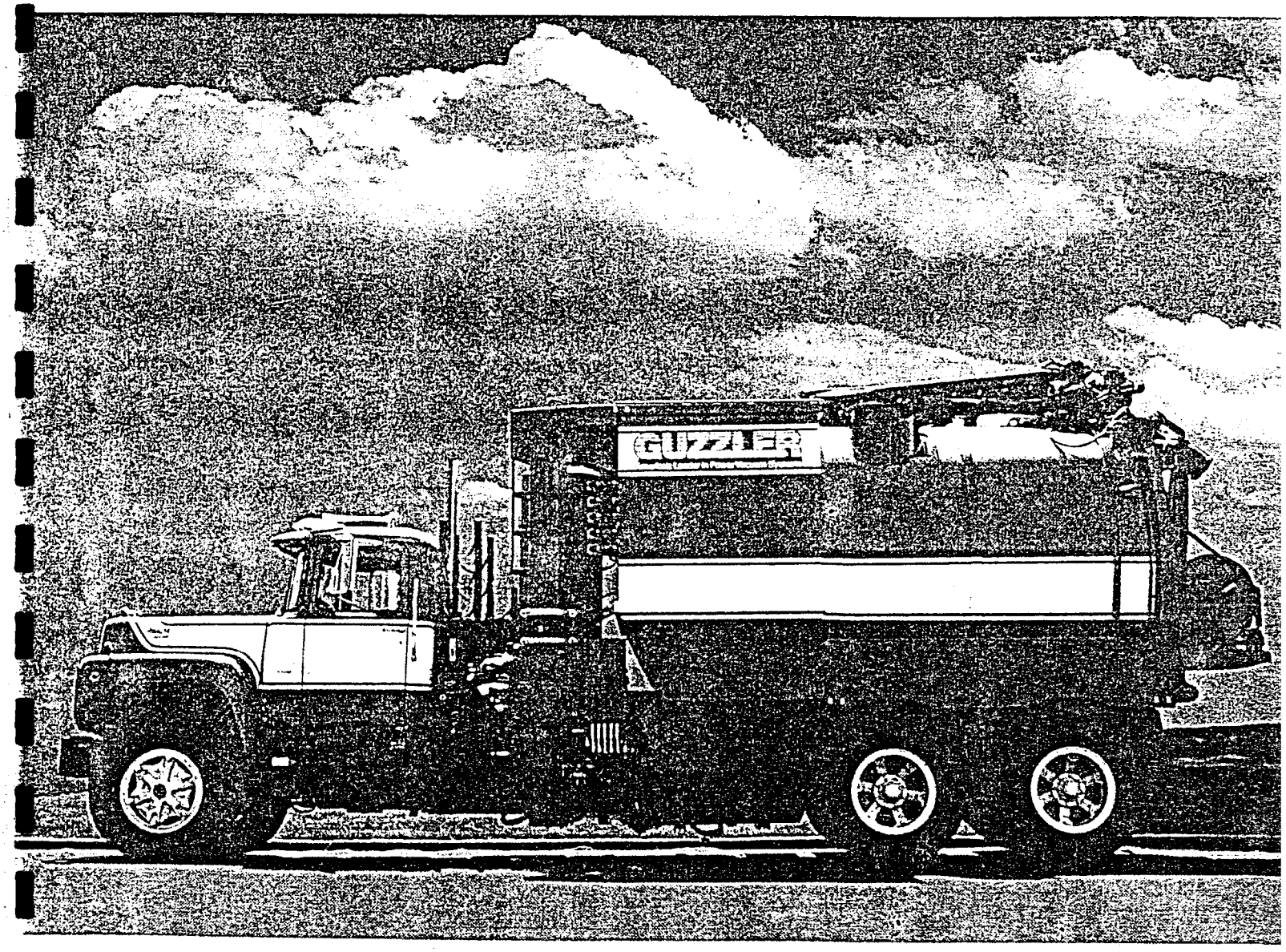
Thank you Bill for the opportunity to give these estimates.

Sincerely,

Terry Cross, Entac West

1242 pioneer way el cajon, california 92020 tel: (619) 442-9231 out of state: 1 (800) 350-NTAC fax: (619) 440-5673

Mobile Power Vacuum Systems



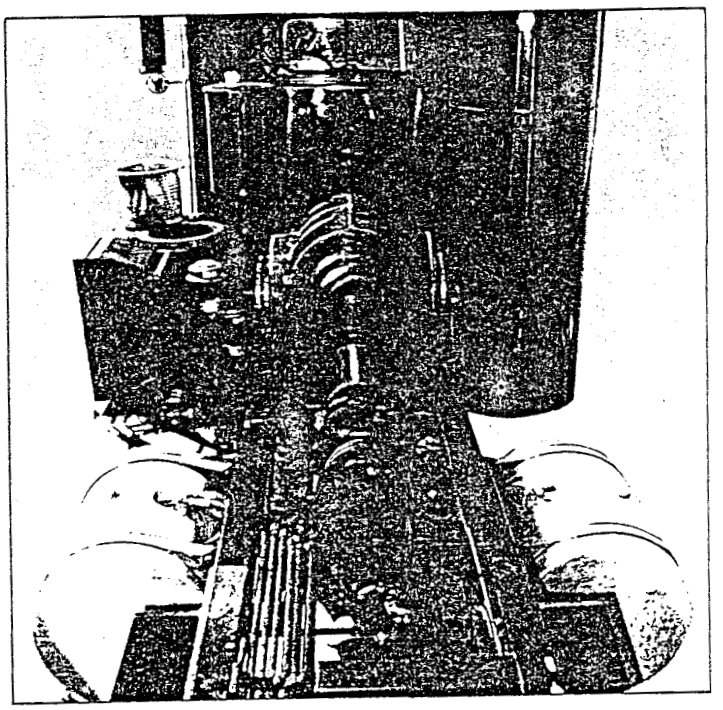
GUZZLER®

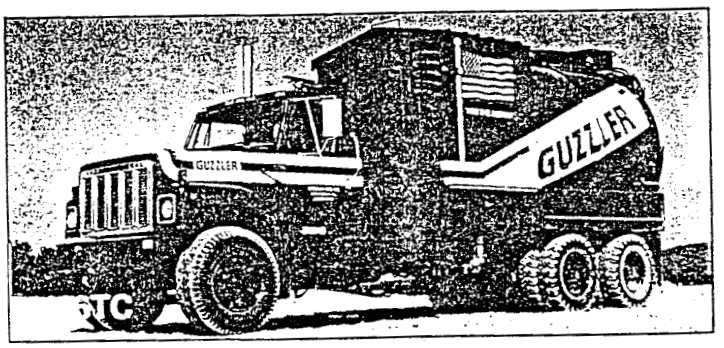
America's Leader in Power Vacuum Systems

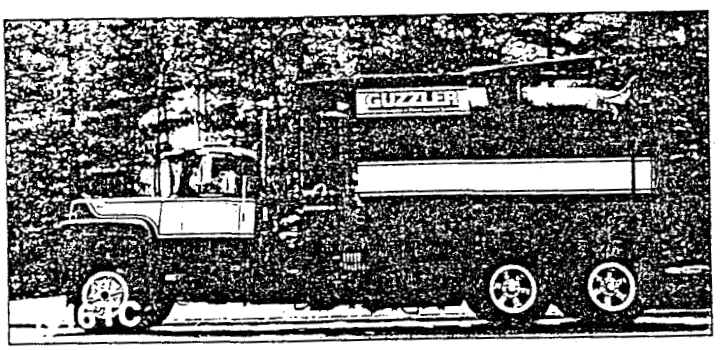
Truck Chassis Mounted/ Transfer Case Driven

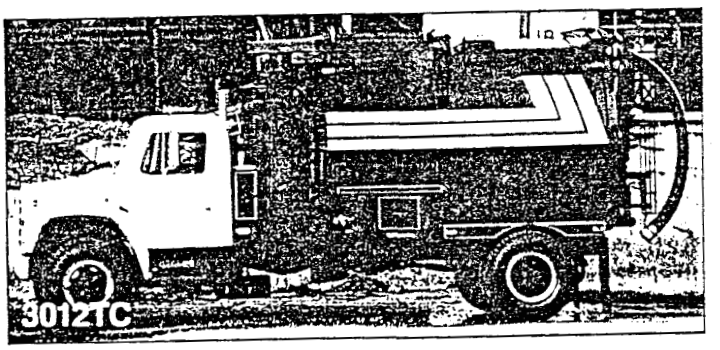
The **GUZZLER's** durable high torque transfer case (TC) directly couples the positive displacement vacuum pump to the chassis engine. No right angle problems. The weight and maintenance associated with a separate auxiliary engine is eliminated.

The universally available transfer case is mounted on vibration isolators to accommodate truck frame movement. Unlike competition, the vacuum pump's inlet strainer and silencer are isolated to prevent pump case distortion. The truck chassis engine also powers the air compressor for bag cleaning, the hydraulics for operating the tailgate, body hoist and other optional **GUZZLER** equipment. All components are independently mounted with planned accessibility making the **GUZZLER** especially quick and easy to service.









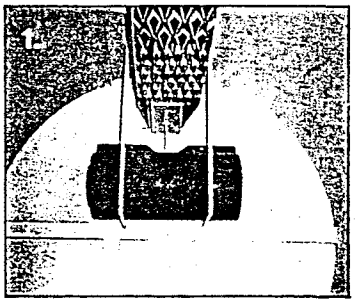
You can choose the truck chassis you prefer. Diamond Reo, Kenworth, GMC, Ford, Mack, Peterbilt, International and White are among the makes available.

Air Flow Range: 3000 CFM (85m^3/min) to 7000 CFM (197m^3/min)

Maximum Vacuum: 15" Hg(5180mm H_2O)—22"Hg(7597mm H_2O)

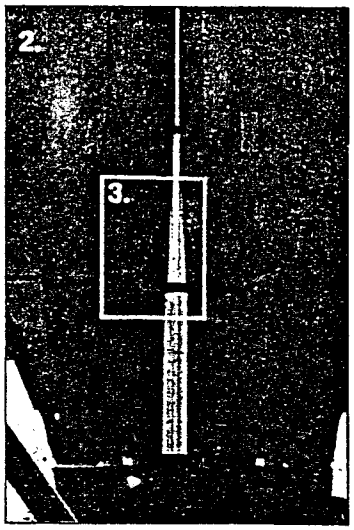
Payload Capacity: 12 cu. yds. (9.18 m^3) to 21 cu. yds. (16.05 m^3)

Features and Benefits



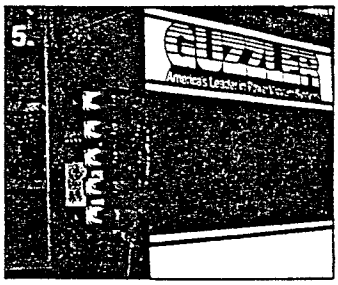
1. Wet Level Float Shut-Off– A foam-filled polyurethane float rated at 300 pounds (136 Kg) buoyancy closes the air exit port when the main collector tank is full. The open float design ensures reliable operation.

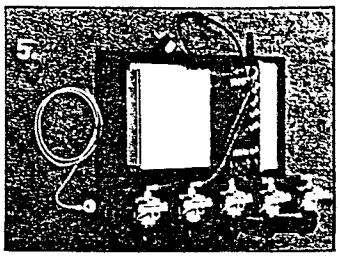
2. Single or Dual Hydraulic Dump Cylinders– These powerful, stable, three-stage telescopic cylinders provide a 50° dump angle to empty collected materials. The cylinders can be removed or serviced without using a crane to lift the bed.



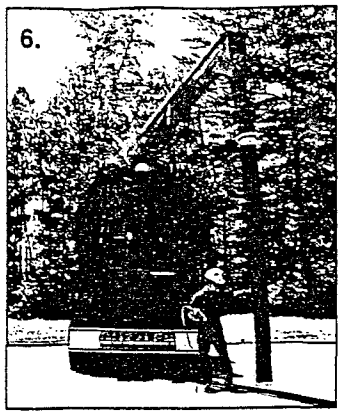
3. Electric or Hydraulic Vibrator–GUZZLER vibrators help remove wet or clinging material during the payload dumping process. These rugged rail car vibrators ensure material discharge.

4. Expansion Joint– A rugged polyester and wire-reinforced expansion joint guarantees a positive vacuum-tight seal when the **GUZZLER** is operated on rough terrain.

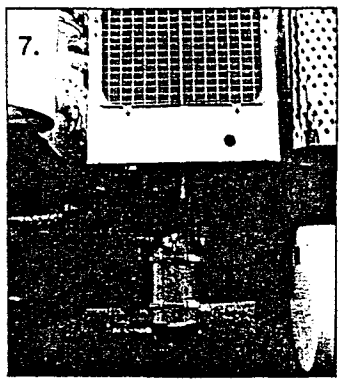




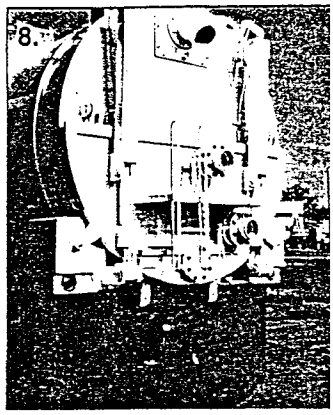
5. Modular Filter Bag Cleaning System– Only the **GUZZLER** has a modular air pulsation system for bag cleaning. The water-tight, dust-tight NEMA 4 components are assembled in an accessible, low maintenance package. GUZZLER Manufacturing, Inc., uses 1" (2.54 cm) diaphragm valves; proven more efficient than the ¾" (1.91 cm) diaphragm valves used on competitive equipment. Manifolded pulsation system reduces the chance of failure.



6. Loading Boom– The **GUZZLER** loading boom has an operating range of more than 300°, 13 feet (3.96 meters) of vertical play and a half ton lift capacity. Available with boom telescope, horizontal lock and power winch. This versatile boom can be mounted on the driver's side, the curb side or in the center of the tank. Boom and tailgate cylinders are interchangeable.



7. Air Dryer/Integral Heater – The air in the filter/bag cleaning system is dried by a cyclone-type air dryer to prevent moisture from reaching the filter bags. There are no pellets or cartridges to replace. Moisture is continuously discharged while the system is in operation. An integral heater prevents system freeze-up in cold climates.



8. Tailgate– The **GUZZLER'** tailgate unlocks, opens, closes, and locks with a hydraulic over mechanical mechanism. This tailgate is a reinforced ⅜" (.95 cm) thick assembly specifically designed to prevent deflection and warpage. The **GUZZLER's** unique tailgate uses a hollow core D-shaped gasket for a positive, leak-tight seal.

Other Features and Benefits

Vertical Hydraulic Tank– This unique tank provides a positive surge of oil to the hydraulic pump to reduce cavitation and wear. Only **GUZZLER** provides a level/temperature gauge.

Cages– Filter bag cages are coated for corrosion resistance.

Conservative Air-to-Cloth Ratios.

Vertical Silencer– Vertical exhaust for quiet operation.

Round Body and Continuous Welds– Unlike other designs, the **GUZZLER** round body dumps easy. There are no pockets for materials to collect, build up and cause corrosion.

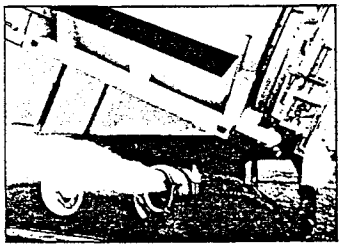
Dupont Imron Polyurethane Paint–Standard on all GUZZLER products.

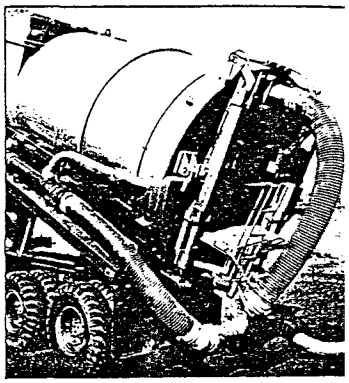
Options

1. **Wash-Down System**– Designed for quick **GUZZLER** clean-up, decontamination or for dislodging materials for easier vacuuming. The high pressure water system generates flows up to 10 GPM (37.9 liters/min.) and pressures to 2000 PSI (138 bar). A surge reservoir removes air and cools the water to increase pump life. The system can include spring loaded or hydraulic hose reels and has a hand-held gun with full gun shut-off.

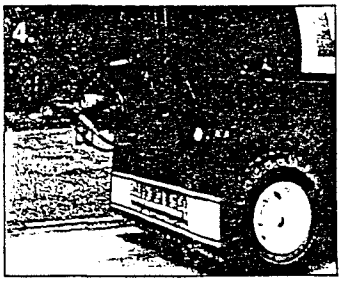
2. **Axial Auger System**– Controls off-loading of dry material or sludge for product recovery or drumming operations. Unlike competition, no set-up time is needed to change from the conventional vacuum system to the auger system. The auger's forward and reverse action is controlled by a lever at the operator's station. Material emptied through the auger's flanged connection on the tailgate may be channeled into the airstream of the pneumatic offload system.

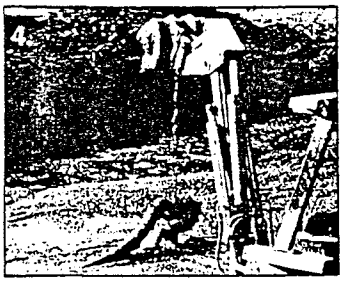
3. **Pneumatic Off-Load System**–Designed for pneumatically conveying material (collected in the **GUZZLER** and, subsequently, emptied by the auger), into a storage silo or other vessel.





4. **Hydraulic Submersible Sludge Pump**–Designed to pump trash, liquids, slurries and sludges. A high-torque hydraulic motor driven impeller-style pump can be mounted on the **GUZZLER** tailgate for simultaneous vacuum loading and sludge pump off-loading. Or use it independently for remote applications, such as pumping from lagoon to **GUZZLER** or into another suitable container.





Other Options–

Tailor **GUZZLER** equipment to your needs with a wide variety of options–Underbody Tool Box; Vacuum Accessory Inventory System; TAGG Sweep System; High Rail System; Stainless or Corten Steel Module; Explosion Vent; Catalyst Recovery System; Interior Protective Coatings; Tailgate Decant Valves; Load Level Indicator; Special Filter Bags and Cages; and Custom Painting and Striping.

GUZZLER Products

- GUZZLER® Mobile Power Vacuum Systems
- GUZZLE-UP™ Vacuum Loader Refurbishing
- REACH™ Hazardous Waste Removal Systems
- SLUDGE GUZZLER™ Hydraulic Submersible Pumping Systems
- RAMRODDER™ Combination Vacuum System/Sewer & Drain Flusher
- Sewer Jetters
- Hoses & Accessories

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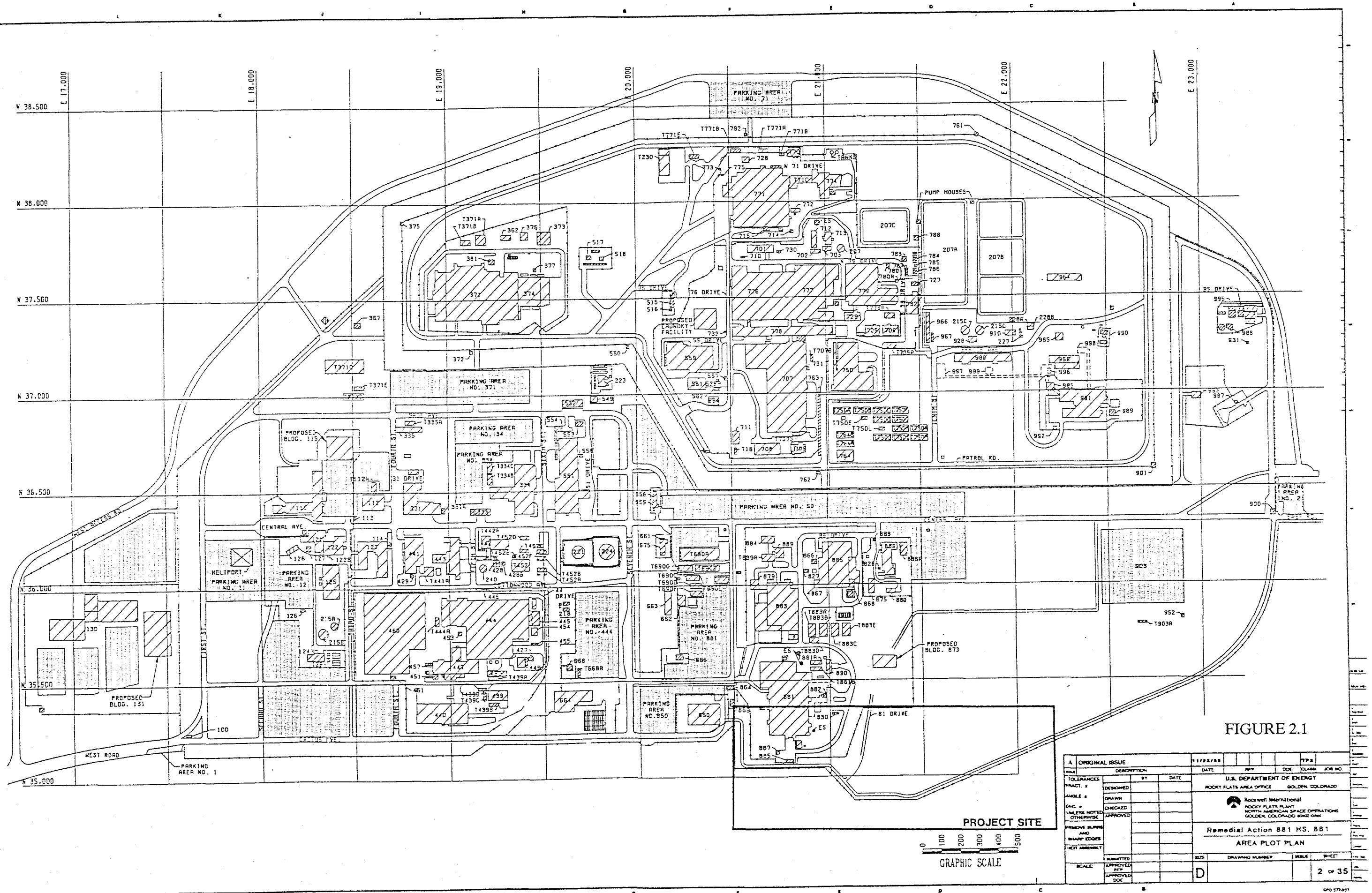
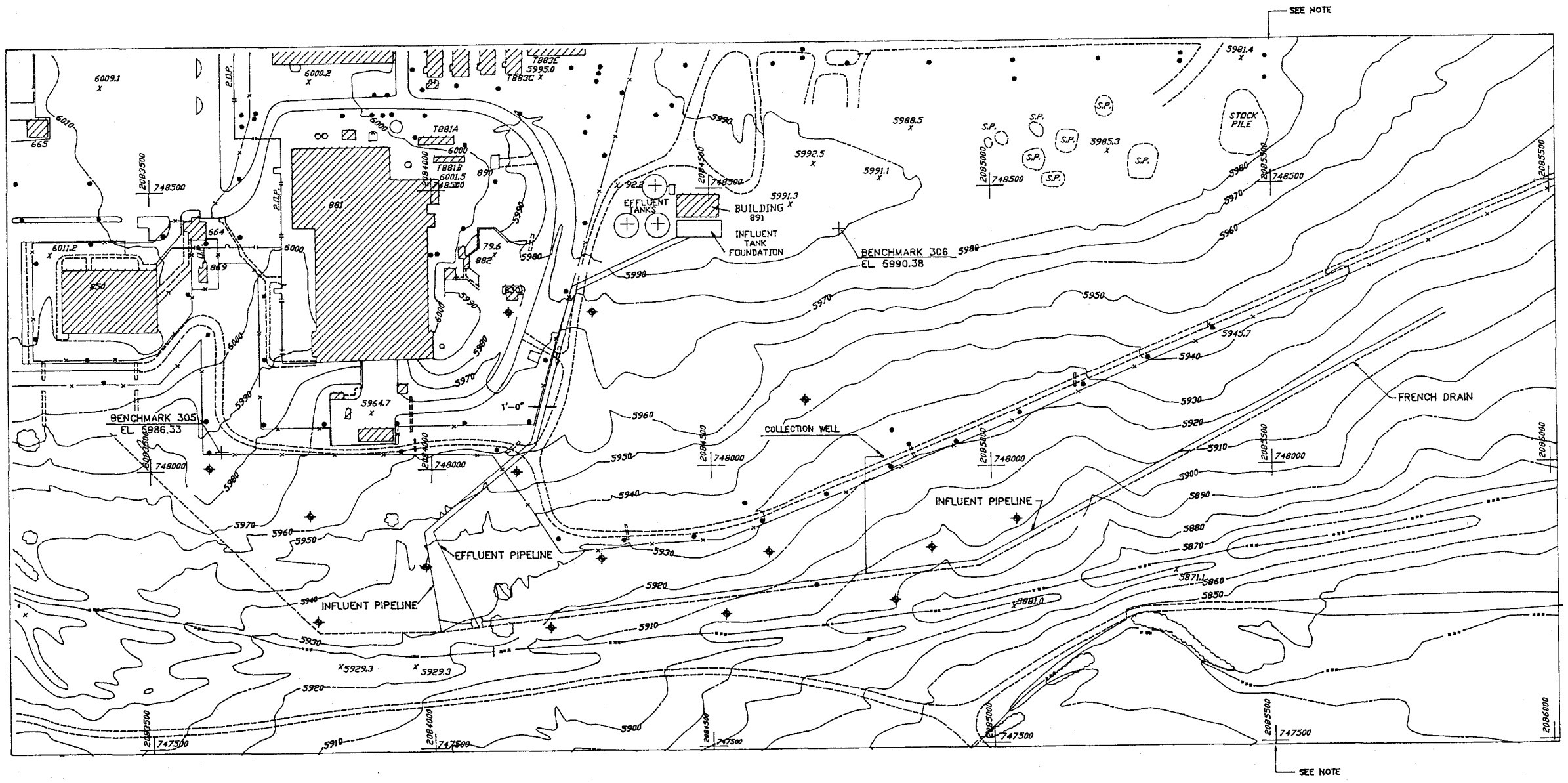


FIGURE 2.1

A	ORIGINAL ISSUE			11/28/88				TP2	
MARK	DESCRIPTION	BY	DATE	DATE	INIT		DOE	CLASS	JOB NO
TOLERANCES				U.S. DEPARTMENT OF ENERGY					
FRACT. ±	DESIGNED			ROCKY FLATS AREA OFFICE GOLDEN, COLORADO					
ANGLE ±	DRAWN								
DEC. ±	CHECKED			Rockwell International					
UNLESS NOTED OTHERWISE	APPROVED			ROCKY FLATS PLANT NORTH AMERICAN SPACE OPERATIONS GOLDEN, COLORADO 80402-0464					
REMOVE BURRS AND SHARP EDGES				Remedial Action 881 HS, 881					
NEXT ASSEMBLY				AREA PLOT PLAN					
	SUBMITTED			SIZE	DRAWING NUMBER			REVISE	SHEET
SCALE:	APPROVED RFP			D					2 OF 35
	APPROVED DOE								

GPO 577-927



NOTE:

PHYSICAL AND TOPOGRAPHICAL FEATURES EAST OF COORDINATE EASTING 2085500 HAVE BEEN ESTIMATED FROM "PROPOSED INTERIM MEASURES/INTERIM REMEDIAL ACTION PLAN AND DECISION DOCUMENT, 881 HILLSIDE AREA, HIGH PRIORITY SITES, US DOE, FIGURE 4-6, OCT. 1989.

1 INCH

NOTE: THE ABOVE LINE IS EXACTLY ONE INCH LONG AT DESIGNATED SCALE. IF ANY OTHER LENGTH, DRAWING SCALE MUST BE ADJUSTED PROPORTIONALLY.

FIGURE 2.2

ISSUE	DESCRIPTION	DATE	RFP	DOE CLASS	JOB NO.
A	ORIGINAL ISSUE	01/19/90			TPB 986147

KEYWORDS	TOLERANCES		BY	DATE
881 HILLSIDE	FRACT. ±	DESIGNED	DJH	01/18/90
CIVIL	ANGLE ±	DRAWN	MAR	01/18/90
	DEC. ±	CHECKED	SRH	01/18/90
	UNLESS NOTED OTHERWISE	APPROVED	WJK	01/18/90
	REMOVE BURRS AND SHARP EDGES			
	NEXT ASSEMBLY			
MASTER	SCALE: 1"=100'	SUBMITTED	WJK	01/18/90
		APPROVED RFP		
		APPROVED DOE		

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

ROCKY FLATS PLANT
P.O. BOX 464
GOLDEN, COLORADO 80402

Remedial Action 881 HS, 881
General Site Plan and
French Drain Re-Survey

SIZE	DRAWING NUMBER	ISSUE	SHEET
D	38548-127		1 OF 1

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COMPUTER GENERATED DRAWING NO MANUAL CHANGES ALLOWED

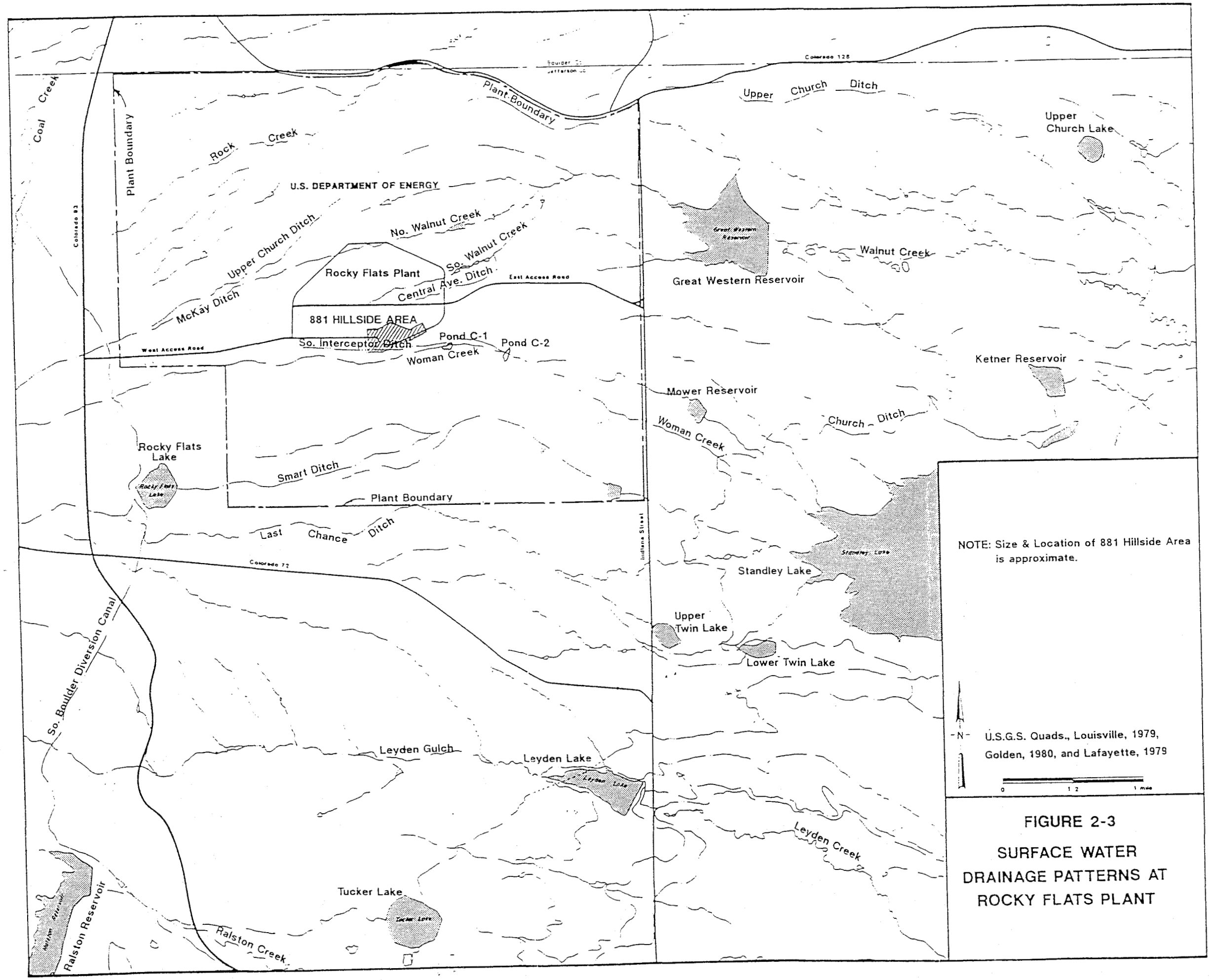

FIGURE 2-3

SURFACE WATER DRAINAGE PATTERNS AT ROCKY FLATS PLANT