ODOR STUDY REPORT
WESTERN REGIONAL SANITARY LANDFILL
PLACER COUNTY, CALIFORNIA

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EXECUTIVE SUMMARY

Western Regional Sanitary Landfill (WRSL) is owned and operated by Western Placer Waste Management Authority (WPWMA). WRSL is located approximately 5.5 miles north-northeast of the city of Roseville, and encompasses an area of 291 acres, of which 231 acres are permitted for disposal activities. WRSL has been operating as a Class II and Class III Waste Management Unit (WMU), and consists of 14 modules. The Class II WMU is comprised of Modules 5, 6, 7, 8, 9, 14, 15, and 16. The Class III WMU is comprised of Modules 1, 2, 10, 11, 12, and 13. Modules 1 and 2 were closed in 1998, and Modules 10 and 11 were closed in 1999. Modules 5 through 9 are undeveloped. Module 16 is developed, but it has not yet received waste.

The site includes a Materials Recovery Facility (MRF), designed to recover recyclable materials (including newspaper, cardboard, metals, glass, plastics, green waste, and wood waste) from the trash to reduce the amount of material placed in WRSL. The MRF operations include a composting facility to produce compost suitable for use as topsoil amendment, and a chipping and grinding operation.

Feedstock for the composting and chipping and grinding operations consist of source-separated green waste from commercial and residential haulers and green waste recovered from the MSW sorting process. The composting process is a turned windrow process. The turning provides aeration which minimizes odors.

A power plant facility and an off-site composting facility are located approximately 1.5 miles to the southeast of WRSL. One mile south and southeast of WRSL are residential developments named Crocker Ranch and Diamond Creek. These developments include residential housing and schools. These residential and commercial receptor locations are directly in the primary path of the air movement in relation to WRSL and the chicken and dairy farms (see Section 2.4 for a discussion of other possible sources of odor), which are located farther northwest from WRSL.

Other locations that are not in the primary path of air movement but are also of concern since the wind direction sometimes moves towards these locations in relation to WRSL are established residential neighborhoods approximately 2 miles north of WRSL and a casino approximately 1.5 miles to the northeast of WRSL. One occupied farm is located one mile to the west of WRSL.

In January 2007, SCS Engineers (SCS) completed a preliminary odor study for the purposes of identifying the major sources of odor and the likely receptors that would be impacted by odor. This included site inspection, review of facility operations, review of odor complaint history, inspection of other possible sources of odor, interviews with residents, and a field survey and screening for hydrogen sulfide and volatile organics (VOCs), which are odorous gasses in landfill gas (LFG) and resulting from composting. The 2007 preliminary study concluded that surface emissions of LFG from the landfill and composting operations are the most likely onsite sources of odor.

In September 2007, SCS conducted a modeling study on behalf of WPWMA. The object of the modeling study was to use an air dispersion model created by the United States Environmental

Protection Agency (USEPA) to estimate downwind concentration of gasses derived from LFG and composting. The modeling study concluded that hydrogen sulfide, a representative sulfur compound emitted in LFG, may be present at downwind residential areas at concentrations that could cause odor. As such, hydrogen sulfide was identified as a target chemical for ongoing odor analysis.

In March 2008, SCS collected and analyzed air samples at WRSL and downwind from WRSL. This sampling was conducted to look for specific compounds likely to cause odor. The sampling found acetone, 2-butanone, and carbon disulfide, but concentrations were below the levels where they are expected to cause odor. The detections are consistent with the results of the 2007 study which concluded surface emissions of LFG from the landfill and composting operations were the most likely onsite causes of offsite odor since all of the detected compounds are components of LFG and are emitted by composting as well.

In June 2008, WPWMA worked with Integrated Waste Management Consulting, LLC (IWMC) on odor issues for the composting facility. IWMC issued the report *Odor Evaluation of the Western Placer Waste Management Authority Composting Facility*, which was most recently updated in July 2009 (Odor Evaluation, IWMC 2008), which discussed specific composting operations likely to result in offsite odor and steps that could be taken to reduce offsite odor from the WRSL. Many of these recommended measures have been implemented and will continue to occur.

The MRF composting facility and the landfill itself are still considered the most likely sources of odor. Other potentially contributing sources at the site are the MRF, storage and use of MRF fines at the active landfill face, odors from the active landfill face, sludge loads, and LFG collection and control system (GCCS) downtime. WPWMA has implemented several measures to reduce offsite odor, including additional documentation of odor complaints, reviewing the Odor Impact Minimization Plan (OIMP), conducting ambient air sampling, reviewing the LFG system design, enlisting a third party to evaluate the composting operation, adding a meteorological station and wind sock, and adding a new compost turner.

The recommended near-term measures to further characterize or reduce odors from WRSL include continued implementation of the recommendations in the 2007 LFG Master Plan, continued implementation of recommendations in the Odor Evaluation of the composting facility, continued implementation of the recommendations in the updated OIMP, continued documentation of odor complaints, arranging a tour of WRSL and associated operations for residents, development of additional air monitoring programs including during off hours, and continued monitoring to determine the effectiveness of actions WRSL has already taken.

Mitigating odor at WPWMA will be an ongoing process. Several near term-actions have been taken, and their effectiveness is being evaluated. Ongoing control of odor will require continuous maintenance, monitoring, and improvement. Off-site odors from farms and businesses can contribute to local odors and may be beyond the ability of WPWMA to control.

1.0 INTRODUCTION

In April 2007, SCS Engineers (SCS) completed a preliminary study, which identified potential odor sources at and near the Western Regional Sanitary Landfill (WRSL). The preliminary study included the results of field monitoring for odorous compounds conducted on January 17 and February 19, 2007 at the WRSL and associated facilities. This report continues the effort to identify and identify potential mitigation measures for odor sources at or near WRSL. This report includes the results of additional odor sampling that occurred the night of March 17 to the morning of March 18, 2008 as well as other studies conducted and mitigation measures implemented subsequent to the preliminary study. The work performed in this study included:

- 2007 field survey of odor causing compounds at the landfill and surrounding area including:
    - Preliminary odor study,
    - Site inspection,
    - Review of facility operations,
    - Review of complaint history,
    - Inspection of other possible odor sources,
    - Interviews with local residents,
    - Field survey and screening;
- 2008 field ambient air study of odor causing compounds at the landfill and surrounding area
- Air dispersion modeling and report
- Updated landfill gas (LFG) master plan
- Odor evaluation of the composting facility
- Updated Odor Impact Minimization Plan (OIMP)

The objectives of this odor study are to verify the odor impacts, which have been reported by residents in the area surrounding WRSL and to conduct an analysis of potential on- and off-site sources of this odor. The findings of this report include a detailed investigation of the likely sources of the odor, as initially identified in the preliminary study. It also lists the actions that have been taken since April 2007 to reduce odor.

1.1 Site Description and History

WRSL is owned and operated by Western Placer Waste Management Authority (WPWMA). WRSL is located approximately 5.5 miles north-northeast of the city of Roseville, and encompasses an area of 291 acres, of which 231 acres are permitted for disposal activities. The site location is shown in Figure 1. WRSL has been operating as a Class II and Class III Waste Management Unit (WMU), and consists of 14 modules (Figure 2). The Class II WMU is comprised of Modules 5, 6, 7, 8, 9, 14, 15, and 16. The Class III WMU is comprised of Modules 1, 2, 10, 11, 12, and 13. Modules 1 and 2 were closed in 1998, and Modules 10 and 11 were closed in 1999. Modules 5 through 9 are undeveloped. Module 16 is developed, but it has not yet received waste.

Solid waste collected in western Placer County is processed at the WPWMA's Material Recovery Facility (MRF). The MRF receives, separates, processes and markets recyclable materials removed from the waste stream. The facility also processes source separated wood waste, green waste, and construction and demolition debris. Hazardous waste from households and Conditionally Exempt Small Quantity Generators is accepted at the Permanent Household Hazardous Waste Facility (PHHWCF), located next to the MRF.

Residual waste from the MRF is transported to the WRSL. WRSL is specified as a Class II/Class III non-hazardous site and a private firm, under contract with WPWMA, manages its operation.

The WRSL's maximum permitted disposal is 1,900 tons per day and currently receives approximately 1,000 tons per day. Based on a 2007 capacity study, WRSL has a total capacity of 36,350,000 cubic yards, used capacity of 12,551,577 cubic yards, and remaining capacity of 23,798,423 cubic yards. Under current land use and development conditions, WRSL has a projected lifespan extending to 2042.

1.1.1 Landfill Gas Collection and Control System

The existing LFG collection, control and monitoring system, as of this study, installed at WRSL consists of the following components:

- A system of 42 vertical extraction wells installed in the existing waste mass;
- A total of 8 test wells that are connected to the conveyance system to provide some additional coverage in Module 2;
- A system of 69 vertical extraction wells installed in native soils outside the limit of fill (perimeter system);
- A limited number of horizontal collectors installed in the existing waste mass (Module 13) to help control surface emissions;

- A system of lateral piping which connects the vertical wells and horizontal collectors to a main header system;

- Three main collection headers (one for the perimeter extraction system and two for the infill extraction system) which transports LFG to the blower/flare station;

- A total of 7 sumps for collection of condensate. Three are equipped with automated pumps and four are pumped manually. A 4,300-gallon condensate holding tank is located at the blower/flare station. Condensate is treated and discharged into the public sewer system at the site;

- A blower/flare station with a flare capacity of 2,500 standard cubic feet per minute (scfm), three blowers (two with a capacity of 1,200 scfm each and one with a 2,500 scfm capacity), and two condensate separators;

- A network of 18 perimeter LFG monitoring probes;

- A landfill gas to energy (LFGTE) plant (Energy 2001) which consists of the following components:

    - Three LFG fueled engines which can control approximately 960 scfm of LFG;

    - A small flare which can control from 50 to 450 scfm of LFG.

1.1.2 Materials Recovery Facility (MRF) and Composting Facility

The MRF is designed to recover recyclable materials (including newspaper, cardboard, metals, glass, plastics, green waste, and wood waste) from the trash to reduce the amount of material placed in WRSL. The MRF operates under the solid waste facility permit number 31-AA-0001. The permitted area of the MRF is 39.9 acres and includes 5.6 acres located within the WRSL boundary adjacent to the MRF's southern boundary. The maximum tonnage allowed at the MRF is 1,750 tons per day, while the design capacity is 3,850 tons per day.

The MRF processing lines alone divert approximately 25 percent of the solid waste received. Combined with the source-separated wood waste, green waste, and inerts diversion programs, the facility as a whole diverted 48.98 percent of the waste received.

The MRF is permitted to accept 1,750 tons and 1,014 vehicles per day. Based on current data, the MRF currently receives and processes approximately 1,100 tons per day

The MRF operations include a composting facility to produce compost suitable for public use as topsoil amendment, and a chipping and grinding operation.

Feedstock for the composting and chipping and grinding operations consist of source-separated green waste from commercial and residential haulers and green waste recovered from the MSW sorting process. The composting process is a turned windrow process. The turning provides aeration which minimizes odors. The composting and chipping and grinding operations are

conducted on concrete pads that were constructed to minimize ponding and graded to drain to a properly designed drainage containment pond. All existing finished product storage areas are concrete pads that also drain to the containment pond. Drainage facilities are designed so that all contact water is separated from storm water. The facilities were constructed with a capacity of 75,000 cubic yards for compost storage and processing and for finished product storage. Approximately 50,000 tons of feedstock per year are delivered to the composting facility.

1.2 Meteorological Conditions

WRSL lies in the Sacramento River Hydrologic area, which is classified as an Intermediate / Semi-Mediterranean climate. It is Mediterranean in the sense that there is a dry season and a wet season. The dry season usually lasts from four to five months and the wet season lasts from seven to eight months. Average yearly rainfall for the nearby town of Lincoln is 24.62 inches.

Summers are much like coastal Southern California, only slightly warmer, with "Delta" maritime breezes present. The Delta breezes flow from the southwest to the northeast, traveling up the Sacramento River delta. Because of the river delta and the absence of coastal mountains blocking ocean maritime breezes, cooling takes place during the normally hot summer months in the Sacramento Valley and Sierra Nevada Foothills. When Delta breezes aren't blowing, the winds frequently come overland from the north, and generally hot conditions prevail.

Winters are more characteristic of Oregon and Washington, with rain and fog. The difference is slightly warmer temperatures, due to more southerly latitude. Winter storms can come from three different sources. The first and the most common of storms, is the North Pacific Storm. This type of storm brings rain and fog to the coast, and then they track right through the Sacramento River Delta and on up into the foothills. The second type of winter storm comes from the Gulf of Alaska. These are much colder storms than the first type. The third type of winter storm comes from Canada and is rare because these winter storms must cross Idaho, Montana and Nevada and the barrier mountains to the east. These storms are very cold and can result in snowfall as low as the Sacramento Valley floor.

Historical wind directional data have been compiled for the surrounding area near WRSL. Figures 3a through 3l shows the wind speed and direction for each month with direction estimated as emanating from a particular direction. The general directions of the wind during the winter months are to the southwest or northeast, depending on the time of day. During the summer, winds come predominantly from the southwest to the northeast. The most likely impacted receptor locations have been estimated based upon these data.

Three different mechanisms may be causing odor complaints within the surrounding residential areas: inversion, diffusion, and advection.

Inversions are stable atmospheric conditions associated with limited vertical air movement. Certain atmospheric conditions can cause a temperature inversion to occur, trapping gasses near the ground. A temperature inversion is a situation where a warmer body of air is located above a colder air mass, inhibiting the vertical movement of gases. One situation in which a low level, or surface inversion, might take place is on a clear night, when the earth's surface radiates heat

away rapidly. If the air is clear, the ground and the air directly above it can be cooler than the air at higher altitudes. In many cases, temperature inversions are most prevalent from the evening to the early morning. This is a likely explanation as to why odor complaints are typically more prevalent at these times.

Diffusion is the process whereby compounds move from a region of higher concentration to one of a lower concentration. Diffusion would cause odors to be detected even upwind of the source. Evaluating odor complaint data shows odor complaints while the wind is coming from varying directions. Upwind odor complaints can be an indication of diffusion causing dispersion of odors.

The third pathway is advection. Odors can be carried large distances by the wind. Based upon the review of meteorological data in the vicinity of WRSL, the wind frequently blows from WRSL toward the residential developments to the south and southeast. These winds may result in advection causing the dispersion of odors and impacts to residents at longer distances from the source.

1.3 Receptors

Based upon the wind directional data provided in Figures 3a through 3l, receptor locations have been identified and include residential, commercial, and industrial neighborhoods.

One mile south and southeast of WRSL are residential developments named Crocker Ranch and Diamond Creek. These developments include residential housing and schools. A power plant facility and a composting facility not associated with WRSL are located approximately 1.5 miles to the southeast of WRSL. These receptor locations are directly in the primary path of the air movement in relation to WRSL and the chicken and dairy farms (see Section 2.4 for a discussion of other possible sources of odor), which are located farther northwest from WRSL. The power plant and the other composting facility, as well as the chicken and dairy farms, are also potential sources of odor.

Other locations that are not in the primary path of air movement but are also of concern since the wind direction sometimes moves towards these locations in relation to WRSL are established residential neighborhoods approximately 2 miles north of WRSL and a casino approximately 1.5 miles to the northeast of WRSL. One occupied farm is located one mile away to the west of WRSL. The next closest receptor to the west is the Amoruso Way neighborhood.

2.0 STUDIES AND SURVEYS BEFORE THE APRIL 2007 PRELIMINARY ODOR STUDY

Prior to the April 2007 study, SCS completed a preliminary odor study for the purposes of identifying the major source of odor and the likely receptors that would be impacted by odor. This included:

- Site inspection,
- Review of facility operations,
- Review of complaint history,
- Inspection of other possible sources of odor,
- Interviews with residents,
- 2007 field survey and screening.

The results of the preliminary odor study are described in the following subsections.

2.1 Site Inspection

On January 17, 2007, SCS and WPWMA staff inspected the WRSL, MRF, and compost operation and likely sources of odor in the surrounding areas in order to identify source areas of odor on-site and measures in place to control those odors (or lack thereof). This included identifying the characteristics of the odors emanating from each facility and investigating the control measures utilized to reduce the intensity of the odors.

Upon inspection of WRSL itself, a mild LFG odor was present in the vicinity of the exterior slope of the eastern side of WRSL. The eastern slope of WRSL was generally downwind of the MRF, composting operations, and disposal areas during the inspection. The likely source of the odor on WRSL was LFG escaping through the intermediate cover of Modules 12 through 15 or venting from leachate riser pipes. Based on the site inspection, LFG emissions were identified as a potential source of odors, for which additional study was warranted.

During the inspection of the MRF, SCS did not detect any odor outside of the MRF building. In general, we do not expect the MRF to be a major source of odors since the operation is enclosed within a building; however, there have been past reports of odor on streets outside of the MRF. The MRF fines are collected and used at the active face of the landfill.

Upon inspection of the compost facility, a strong odor downwind of the operation (south) was detected. Therefore, the composting operation was also a candidate for further odor investigation.

2.2 Review of Facility Operations

2.2.1 LFG Collection and Control System

The LFG collection and control system generally has been operating continuously since it was implemented (1996). The LFG system is the primary means of LFG control with proper cover practices of the landfill as a secondary method.

LFG collection at the site is also diverted to Energy 2001. Energy 2001 is located adjacent to the blower/flare station on the landfill property. The WPWMA leases the controllers of the LFGTE plant, and the property and receives a monthly rent payment and a small royalty on the electricity sold. Energy 2001 includes three Caterpillar engines that can generate approximately 0.83 megawatts (MW) each for a total of 2.5 MW. Each engine consumes 300-350 scfm of LFG depending on the gas quality. There is also a small flare to handle excess gas not handled by the engines. The flare has a range of 50 to 450 scfm. With just the three engines running approximately 960 scfm LFG was controlled. With the engines and small flare running, about 1,300 to 1,400 scfm LFG is controlled. The large flare can also run in conjunction with the engines to get the flow higher than 1,400 scfm. Both flares can act as a back up to the engines. If the engines fail, the large and small flares can combine to control up to 2,950 scfm. At this time, operation of the three engines is generally sufficient to control the quantity of gas generated and collected.

Review of monthly operation, monitoring, and maintenance (O&M) reports of the LFG migration control facilities revealed that the LFG collection and control system capacity is sufficient for the amount of LFG being collected. Federal regulations require WRSL to monitor methane concentrations at the landfill surface and at wellheads. Surface and wellhead monitoring and reporting has been in compliance with federal, state, and local requirements. . Specific shutdown events were also observed where the LFG system was off-line for less than 24 hours. These types of events can be sources of individual odor incidents due to excess LFG emissions. Note that LFG contains concentrations of hydrogen sulfide, mercaptans, and various other sulfur-containing compounds that are highly odorous with low detection thresholds for odors. Downtime or reduced operation flow periods can result in increased emissions of LFG to the atmosphere.

2.2.2 Composting Operations

Prior to December 5, 2002, WRSL used a 3.1-acre pad for its composting operation. On December 5, 2002, the local enforcement agency (LEA) approved an addition of 1.3 acres to the existing 3.1 acre composting pad, which was permitted and in operation before that time. This expansion was completed in the summer of 2003. In 2003, WPWMA proposed an additional 2.6-acre compost pad to allow for the growing compost operation at WRSL. In addition, a new compost curing and temporary finished compost storage area encompassing 0.6 acres was also proposed in 2003. The construction of the expansion of the composting operations was completed in 2005. Control of composting emissions is through best management practices, such as watering the windrows, turning the windrows, and other measures to ensure adequate aeration, moisture balance, and nutrient levels. Since the potential emissions associated with the composting operation are directly related to the surface area of the materials being composted, the expansion of the composting operation – which served to increase the facility's capacity – has likely resulted in an increase in the emissions and potential for odors from the facility. Composting creates emissions of organosulfur compounds, esters, volatile fatty acids, and other highly odorous substances. The green waste processing portion of the composting is also a source of terpenes, an odorous group of compounds.

2.3 Review of Complaint History

WPWMA began receiving complaints about an odor coming from the direction of WRSL in 2003 from residents in the surrounding areas. The number of complaints increased by a factor of seven from 2005 to 2006, indicating a potential increase of the magnitude of odors and/or a heightened awareness of odor issues, which has led to more reporting. However, recently it was reported by some residents that they do not report all instances of odor. The Crocker Ranch area was also developed during this period. The homes in the area were built in 2004 and 2005, resulting in an increase in the number of residents near the WRSL immediately preceding the increase in the number of odor complaints.

WPWMA has been documenting the complaints filed by residents near WRSL in order to track the changes in the location, intensity and frequency of the odors being detected, along with the weather conditions identified at the time of detection. Each complaint filed with WPWMA or Placer County Air Pollution Control District (APCD) has been recorded and logged. Table 1 describes the complaints as they were recorded. Table 2 shows the frequency of the complaints in regards to the quarter and year that they were reported.

Odor complaints recorded by WPWMA contain the location and time that the odor was detected, the weather conditions at the time the odor complaint was received, a general description of the odor, and follow up summary after investigation and response. In general, the reported odors were described as having the general characteristics of decomposing organics which can encompass a large range of odorous compounds from landfill and recycling operations. The odors have primarily been detected in the early morning or evening, and only a very few complaints have been filed from outside of the subdivision south of WRSL.

The period of increased complaints coincides with the period of expanded composting operations at WRSL and immediately follows an increase in the number of residents near the WRSL. The description of the odors in the complaints generally matches the typical odors generated by composting operations and several interviewed residents specifically mentioned the composting operation.

SCS evaluated the available weather data with regard to the odor complaints, specifically looking for information or patterns that might suggest a potential source as being a likely contributor to odors. In particular, SCS reviewed wind and precipitation data for correlations with odor complaints. While correlating wind data to individual odor complaints, it was observed that the majority of the complaints occurred when the wind direction was coming from the north, north western area, which is directly in line with WRSL and the dairy and chicken farms. However, complaints at the same location occurred at times with different wind directions. These complaints with winds from multiple directions could be an indication of multiple odor sources (i.e. propane dealer, Mallard Creek composting manufacturer, etc., as discussed below in Section 2.4).

Most of the odor complaints were made during periods with little or no wind (0-5 miles per hour). These complaints indicate odor may be travelling by diffusion or an inversion may be trapping odor at the ground level.

SCS has reviewed the date of events against the LFG system downtime and were able to find some correlation. Some odor events occur during or shortly after LFG system downtime, but many complaints occur when the GCCS has been operating as designed. While LFG may not be a constant source of odor, LFG emissions can make the odor situation worse, particularly when the LFG system is temporarily offline for routine maintenance or due to minor system malfunctions. These offline periods generally last for less than 4 hours and in any case do not last for more than 24 hours.

2.4 Inspection of Other Possible Sources of Odor

On January 17, 2007, SCS and WPWMA personnel conducted an inspection of the surrounding area to determine the extent of the odor and other possible sources of odor. This included inspecting the residences directly south of WRSL; the dairy and chicken farms northwest of WRSL; the casino to the northeast of WRSL; various industrial plants, a propane dealer, and biomass plant to the east, and a power plant and composting facility (Mallard Creek) directly southeast of WRSL. A summary of the possible odor sources in addition to WRSL is detailed below:

- Power plant facility
  - 1.5 miles southeast of the active face of the WRSL;
  - 0.35 miles northeast of Crocker Ranch;
- Mallard Creek composting facility
  - 1.75 miles southeast of the active face of WRSL;
  - 0.70 miles east of Crocker Ranch;
- Placer Propane – propane dealer
  - 1.75 miles southeast of the active face of the WRSL;
  - 1.0 miles east of Crocker Ranch;
- Rio Bravo – a biomass dealer
  - 1.75 miles east-northeast of the active face of the WRSL;
  - 2.0 miles northeast of Crocker Ranch;
- Thunder Valley Casino -including an on-site wastewater treatment plant
  - 2.0 miles northeast of the active face of the WRSL;
  - 2.25 miles north-northeast of Crocker Ranch;
- Invirotech –accepts and process septic sludge waste
  - 1.5 miles northeast of the active face of the WRSL;
  - 2.0 miles north-northeast of Crocker Ranch;
- Chicken farm
  - 0.75 miles northwest of the northwestern corner of WRSL;
  - 2.4 miles north-northwest of Crocker Ranch;
- Dairy farm
  - 2.75 miles west-northwest of the northwestern corner of WRSL;

    - 3.6 miles northwest of Crocker Ranch
- Roseville sludge deliveries

These sources are noted on Figure 4, showing the location of the WRSL and the Crocker Ranch neighborhood.

The dairy and chicken farms are located at a greater distance from the primary residential receptors than WRSL, which would allow for increased dilution of the emissions before impact. In addition, during our inspection, SCS did not detect any odors at these source locations, and it is unclear whether the chicken farm was still in operation as no exterior activity was noted. However, dairy and chicken farms, mostly due to their manures, cannot be discounted as contributors to the regional odor situation and may warrant further investigation. The dairy farm has been documented by the Placer County Environmental Health Department as emitting strong odors. Though agricultural facilities can be sources of odor, they are exempt from APCD odor nuisance rules, unlike solid waste facilities. Further, both facilities are directly upwind of the Crocker Ranch neighborhood but farther upwind than WRSL.

The Roseville sludge deliveries may contribute to odor levels, but the deliveries are periodic and do not correlate strongly to the timing of odor complaints; however, they could contribute to individual odor events.

SCS has reviewed the records, odor complaints, and the location of other potential odor sources and concluded they are not the major sources of odor identified in the majority of complaints. However, this conclusion does not mean that they would never produce any odors that receptors would find offensive, but SCS does not believe these sources are major contributors to the continuous odor problem that has been identified. Of these additional sources, Mallard Creek composting facility, the dairy farm, and the Rio Bravo biomass facility may warrant additional investigation. The facility is known to have generated odors, especially in the early spring.

2.5 Interviews

To further investigate the source and characteristics of the odor, SCS interviewed six residents that have complained about the odor. Five of the residents interviewed live approximately 1.5 miles south of the active face of WRSL in the Crocker Ranch neighborhood. One resident lives approximately 2.3 miles north of the northern boundary of WRSL. Summaries of the interviews were recorded on the conversation logs included in Appendix A.

When asked how they would describe the odor, the answers were generally consistent. Of the six people selected for the interview, five of them described the smell as that of decomposing or rotting vegetation, and one described the smell as propane gas. When asked under what wind or weather conditions do they smell the odor, the residents all had different responses ranging from in the summer, in the winter, during cold weather, hot weather, rainy conditions, windy conditions, and calm conditions.

Four of the six people have lived in their homes for a period of four or more years. All of those people, in their opinion have said that the odor has become worse over the past two to three years (starting in 2004-2005). The other two people have lived in their home for two years and have confirmed that the smell was definitely worse in 2006 compared to the first quarter of 2007.

Of the six people interviewed, four of them said that the odor is most common in the early morning and in the late afternoon. The remaining two said that the odor is sensed mainly during the afternoon.

The overall results of the interviews indicated that the odor description is most similar to the smell of the solid waste related operations at WRSL, the odor has gotten worse over the past three years (2004 to 2007, which is the same time period of composting operation expansion), the odor seems to be worse in the early morning and the late afternoon, and the odor can be sensed during any weather event, except high winds.

Since the composting facility was expanded in 2003 in response to the expansion of curbside greenwaste programs and the number of odor complaints indicate the odor has gotten worse in recent years, it is possible that a portion of the odor is coming from composting operations; however, other landfill sources, such as LFG, active face operations, and sludge disposal would also fit the descriptions provided by residents.

2.6 2007 Field Survey and Screening

In 2007, SCS conducted a field survey of WRSL. A field survey is a sampling where SCS personnel go into the field to take measurements of compounds representative of LFG, composting, or otherwise likely to contribute to odor. In the 2007 field survey, all the measurements were taken at WRSL and surrounding areas. The measurements were used to screen out likely odor sources. If measureable amounts of odor related compounds were detected at a source, it would be considered for further investigation, but if no odor related compounds were found, the source would not be considered for further investigation.

SCS conducted a field survey of WRSL, composting operations, MRF, neighboring subdivisions, and other possible sources of odors in the area surrounding WRSL. The field survey included testing the air quality at 20 locations within the WRSL boundary, 10 locations within the residential subdivision and borders of WRSL, and 4 locations offsite of possible source odors to quantify hydrogen sulfide and VOC concentrations, which would indicate the likely presence of LFG or other odor causing gasses.

Hydrogen sulfide sampling was performed using a Jerome Model 631X hydrogen sulfide meter, capable of measuring hydrogen sulfide from a concentration of 1.0 parts per billion (ppb) to a concentration of 50 ppm. Hydrogen sulfide is a representative sulfur compound with a very low odor threshold that is generated from LFG, composting, and manures. The recognition threshold (the concentration at which 50% of humans can detect the characteristic of a gas) is 4.7 ppb for hydrogen sulfide. Within the WRSL boundary, there were six locations that had a concentration of hydrogen sulfide above the recognition threshold; downwind (south) of the compost

operations (0.008 ppm), near monitoring well MW-14 (0.010 ppm), MW-15 (0.024 ppm), MW-16 (0.016 ppm), perimeter extraction well 58E (0.005 ppm), and extraction well A17 (1.23 ppm). Only one location (1/4 mile north of WRSL) outside of WRSL had a concentration of hydrogen sulfide greater than the recognition threshold (0.005 ppm). All of the locations monitored in the subdivision and possible sources of odor south of WRSL had hydrogen sulfide concentrations ranging from less than 0.001 to 0.004 ppm. These data would suggest that sources of hydrogen sulfide exist at WRSL, including LFG surface emissions and composting operations. However, the detectable levels of hydrogen sulfide were not found at the receptors locations during the monitoring event. The most likely reason no hydrogen sulfide was detected at the receptor locations is that it had dispersed to concentrations below the detection limit of the instrument by the time it reached the receptor locations. Also, the monitoring was conducted on a single day, which may not have been worst-case conditions for high concentrations of odorous compounds.

Organic compound sampling was performed using a MiniRAE Photo Ionization Detector (PID) for VOCs, and a PhotoVAC MICRO FID Model MX10 for total organic gases (TOG), including methane. VOCs and TOG are a mixture of gasses. As such, they do not have a defined odor threshold, but they are representative of LFG and the odorous compounds in LFG as well as VOCs from composting. TOG and VOCs are formed during the decomposition of waste and are found in LFG and composting emissions. VOC, as measured with the PID, is a measure of a specific grouping of VOCs that can cause odor. Because VOCs are a mixture of many different gasses, there is no odor threshold. No VOCs were detected at any location other than extraction well A17 on the top deck of WRSL and on Mt. Tamalpias Drive in the subdivision to the south. The VOC concentrations that were detected were approximately 0.4 ppm and 0.2 ppm, respectively. It is noteworthy that the monitoring location on Mt. Tamalpias Drive is at the edge of the development with no obstructions between it and WRSL. These data show some evidence of VOC emissions from the facility; however, the single detection of VOCs in the residential neighborhood probably does not have any significance since no other elevated readings were found. If VOCs are present on- or off-site, they are likely present below the detection limit of the field instrument and would need to be measured with laboratory methods. More sampling and laboratory analysis for was done in 2008 and is discussed in Section 3.1

These compounds were selected for analysis since they represent the major groups of compounds that are known to cause odors. Sampling was performed on January 26, 2007. Three readings were collected from each location in the morning and two readings were collected from each location in the afternoon. Table 3 shows the results of all the sampling. Figure 4 shows the location of other potential odor sources outside the WRSL boundary. Figure 2 shows the locations of the 20 samples taken within WRSL's boundary. The weather during the sampling was sunny, with wind varying from northeast to west ranging from calm to 10 miles per hour.

TOG is a measure of the total amount of volatile organic gases in the air. Because TOG is a mixture of many different gasses, there is no odor threshold. TOG concentrations measured with the FID were detected at every location and ranged from 5.3 ppm (near Mallard Creek) to 442 ppm (MW-6). There are ambient concentrations of TOG throughout the County, which constitute background levels for this group of total organics. As such, it is not unexpected to detect TOG at every location. For TOG, the relative concentrations between locations (e.g., upwind and

downwind) are more important than the actual concentrations themselves. These data would not appear to show TOG impacts from WRSL since levels upwind of the site are approximately 6.0 ppm with similar levels in the residential neighborhood. On-site readings for TOG range up to 442 ppm, mostly attributable to LFG emissions, which contain significant quantities of methane, although elevated readings (up to 75 ppm) were also found near the compost pads. Downwind concentrations of TOG at residences ranged from 5.5 to 6.3 ppm.

The results from the January 2007 field survey indicate that the surface emissions of the LFG and compost operations are generally at concentrations high enough to be detected from an odor standpoint. The survey indicates that composting and surface emissions from the LFG are a potential source of odor complaints attributable to WRSL operations.

2.7 Regulatory Compliance Status

WRSL is required to comply with federal, state, and local regulations. Major regulations that WRSL must comply with include:

- New Source Performance Standards (NSPS) for landfills;
- Solid Waste Facility Permit (SWFP) and landfill regulations under Title 27 of the California Code of Regulations (CCR), and;
- Title V Permit.

The NSPS requires the WRSL to monitor emissions of LFG at the landfill surface and from the GCCS. Emissions over the 500 ppm TOC regulatory threshold require mitigation and documentation that the mitigation has resulted in emissions less than 500 ppm. The primary purpose of the NSPS is to reduce VOC emissions from the landfill, but compliance also results in reduced emissions of odorous gasses from the site.

The SWFP is the permit required by California for a site to operate as a solid waste landfill. The permit defines the types of operations that the site may conduct and limits the operations of the site. The SWFP contains specific requirements, as detailed in 27CCR, for reducing and mitigating any odors from solid waste operations.

The Title V permit is an air permit for the entire site and includes odor and nuisance requirements. All sources that require an air permit are controlled by the Title V permit.

WRSL is currently in compliance with all its major permits and the regulations identified above.

3.0 STUDIES AND SURVEYS SINCE THE 2007 ODOR STUDY REPORT

3.1 2008 Ambient Air Study

On the night of March 17 to the morning of March 18, 2008, SCS conducted ambient air sampling. The ambient air sampling differs from the screening sampling in that the samples

were collected overnight and are more representative of overnight conditions. The samples were collected overnight because many odor complaints occur during the evening and morning, and the weather conditions are most likely to create an inversion at night. The samples were analyzed in a laboratory capable of analyzing individual compounds. The purpose of the ambient air sampling was to identify specific compounds that may be causing odor related to WRSL.

The field survey included the testing of air quality at 16 locations, including two locations within the WRSL boundary. The majority of samples were collected outside the WRSL boundary to determine what compounds may be causing odor where the complaints were made. Samples were collected overnight in Tedlar bags and stainless steel Summa canisters. A calibrated pump was used to collect the samples in the Tedlar bags, and a flow controller was used to limit flow into the Summa canister, which resulted in the sample being collected throughout the night.

The workplan for the 2008 Ambient Air Study is shown in Appendix C. Table 4 shows the detected compounds from the sampling. Figure 5 shows the sample locations. The following compounds were analyzed but not detected in any samples:

- Hydrogen Sulfide
- Carbonyl Sulfide
- Methyl Mercaptan
- Ethyl Mercaptan
- Dimethyl Sulfide
- Carbon Disulfide
- Isopropyl Mercaptan
- tert-Butyl Mercaptan
- n-Propyl Mercaptan
- Thiophene
- Isobutyl Mercaptan
- 3-Methyl Thiophene/n-Butyl Mercaptan/Ethyl Methyl Sulfide
- Diethyl Sulfide
- Dimethyl Disulfide
- Tetrahydrothiophene
- 2-Ethylthiophene
- 2,5-Dimethylthiophene
- Diethyl Disulfide
- Freon 12
- Freon 114
- Chloromethane
- Vinyl Chloride
- 1,3-Butadiene
- Bromomethane
- Chloroethane
- Freon 11
- Ethanol
- Freon 113
- 1,1-Dichloroethene
- 2-Propanol
- 3-Chloropropene
- Methylene Chloride
- Methyl tert-butyl ether
- trans-1,2-Dichloroethene
- Hexane
- 1,1-Dichloroethane
- cis-1,2-Dichloroethene
- Tetrahydrofuran
- Chloroform
- 1,1,1-Trichloroethane
- Cyclohexane
- Carbon Tetrachloride
- 2,2,4-Trimethylpentane
- Benzene
- 1,2-Dichloroethane
- Heptane
- Trichloroethene
- 1,2-Dichloropropane
- 1,4-Dioxane
- Bromodichloromethane
- cis-1,3-Dichloropropene
- 4-Methyl-2-pentanone
- Toluene

- trans-1,3-Dichloropropene
- 1,1,2-Trichloroethane
- Tetrachloroethene
- 2-Hexanone
- Dibromochloromethane
- 1,2-Dibromoethane (EDB)
- Chlorobenzene
- Ethyl Benzene
- m,p-Xylene
- o-Xylene
- Styrene
- Bromoform
- Cumene
- 1,1,2,2-Tetrachloroethane
- Propylbenzene
- 4-Ethyltoluene
- 1,3,5-Trimethylbenzene
- 1,2,4-Trimethylbenzene
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene
- alpha-Chlorotoluene
- 1,2-Dichlorobenzene
- 1,2,4-Trichlorobenzene
- Hexachlorobutadiene
- alpha-Pinene
- beta-Pinene
- D-Limonene

Many of these compounds are odorous, but not all are related to operations at WRSL. The only detected compounds were acetone, 2-butanone (methyl ethyl ketone), and carbon disulfide. The detected compounds are expected in LFG and composting emissions and may indicate migration of LFG and composting emissions to the sample locations; however, the detected concentrations of acetone, 2-butanone, and carbon disulfide are well below odor detection thresholds. These results are consistent with the screening results discussed in Section 2.6.

SCS also attempted to sample for volatile fatty acids (VFA) on April 9, but winds shifted away from the receptor areas during the night, and the samples were not analyzed. VFA are odorous compounds that may be emitted from greenwaste processing and composting operations. No screening analysis exists for VFA, and the ambient air sampling for VFA was aborted; therefore, it is not known whether VFA contribute significantly to odor related to WRSL.

3.2 Modeling Study

In September 2007, SCS completed a modeling study on behalf of WPWMA. The modeling was conducted using the SCREEN3 model, which calculates a concentration of gasses downwind from a source such as the WRSL. SCREEN3 was developed by the United States Environmental Protection Agency to model the dispersion and diffusion of gases from sources such as WRSL.

A copy of the report developed from that study is attached in Appendix D. The modeling report concluded that ammonia and VOCs were not likely to cause detectable odors in receptor areas This result indicates ammonia and VOC emissions from LFG and composting are not expected to result in odor complaints; however, other compounds emitted from composting such as volatile fatty acids (VFAs) may contribute to odor. Hydrogen sulfide from LFG and composting emissions was identified in the modeling report as a potential odor causing compound. Hydrogen sulfide is an odorous sulfur compound representative of the other sulfurous compounds found in LFG and composting emissions. Based on the modeling review, hydrogen sulfide concentrations can be expected to be above the odor detection threshold at times within

the Crocker Ranch and Diamond Creek residential developments and commercial and industrial development to the east of WRSL.

3.3 Odor Evaluation of the Composting Facility

In June 2008, Integrated Waste Management Consulting, LLC (IWMC) issued its report *Odor Evaluation of the Western Placer Waste Management Authority Composting Facility*. The report was most recently updated in July 2009 and is included in Appendix E (Odor Evaluation, IWMC 2009). The purpose of the Odor Evaluation was to identify potential causes of odor and potential mitigation measures to reduce odors related to composting activities at WRSL. The Odor Evaluation discussed the potential for composting operations to emit odorous compounds at WRSL. The report also contains several recommended measures that could reduce odors from composting activities at WRSL including:

- Continued odor monitoring
- Comparing actual operations against odor complaints
- Improvement of and training on the Odor Impact Minimization Plan (OIMP)
- Implementing the odor mitigation matrix
- Implementing an improved marketing plan
- Off-peak grinding, turning, and screening of composted materials
- Screening the southern perimeter of the site to facilitate dilution of odors
- Identification of off-site feedstock options such as less odorous feed stock
- Investigation of forced aeration of compost piles
- Investigation of additional composting area

All of these recommendations are intended to directly result in fewer offsite odor impacts.

The Odor Evaluation also described recently completed activities or ongoing efforts that have potential to reduce offsite odor impacts. These activities are:

- Addition of a weather station to monitor on-site wind conditions; this station would enable composting activities to be conducted when wind is not blowing toward receptors.
- Addition of a wind sock to visually indicate wind direction without having to access the weather station data; this sock would also enable composting activities that have a higher potential to result in odorous emissions to be conducted when wind is not blowing toward

receptors (or when wind conditions are less likely to produce odor impacts) and is easily visible without having to access the weather station data.

- Use of a new specialized compost turner; the turner will be able to turn the bottom of the pile which the old turner frequently missed. Turning the bottom will keep the piles more aerated, thus reducing odorous emissions due to anaerobic conditions.

- Use of the odor complaint log; the log allows the site operator to correlate facility activities and odor complaints.

3.3.1 Odor Impact Minimization Plan

IWMC presented a revised OIMP along with its Odor Evaluation. An OIMP is required by Title 14, CCR Section 17863.4 for all compostable material handling operations, and it contains a description of composting activities and actions that are taken to reduce offsite odor impacts. The OIMP lists additional measures that can be implemented, if/when appropriate, to reduce off-site impact from odorous compounds resulting from composting operations. These measures are summarized in Table 5.

3.4 Odor Evaluation Limitations

The ambient air study is an actual measurement of the concentration of components that may contribute to odor. However, the results of the study detailed here include concentrations measured over one night. The odor complaint logs indicate the level of odor is not constant. No single monitoring event is likely to observe the worst odor conditions, and continuous monitoring is prohibitively expensive.

The air dispersion modeling study attempts to model the conditions that will lead to the worst possible odor downwind of the plant, but no direct measurement is used in the model. The model uses a conservative approach that is likely to overestimate downwind concentrations of modeled compounds.

Odor complaints are self reported. As such, they are not a complete record of odor in the areas surrounding WRSL. Furthermore, odor is a subjective measurement; what one resident finds offensive may not be offensive to a less sensitive resident.

Assessing odor is complicated by the large number of sources that can contribute to odor at a large integrated solid waste facility like WRSL. Further, assessing odor from a landfill or composting operation is further complicated by the complex mixtures of gasses emitted by the sources.

4.0 UPDATED LFG MASTER PLAN

In August 2007, SCS completed an updated LFG Collection and Control System (GCCS) Master Plan for WPWMA. The updated Master Plan re-reviewed historic information pertaining to the LFG collection system. It also re-evaluated the radius of influence of the existing GCCS and updated the LFG recoverability estimates. The updated Master Plan also considered input from SCS personnel responsible for the operation and maintenance of the LFG CCS at WRSL.

The 2007 Master Plan recommends several improvements to the existing LFG system, including:

- Construct replacement wells for EW-A19 and EW-A22 when control of these wells becomes a problem. These wellheads are buried and are controlled with a butterfly valve, not standard wellhead valves. Replacing the wells will allow control of LFG in the areas currently controlled by the existing wells. SCS believes LFG collection in this area can be optimized with replacement wells.

- Installation of an above-grade 12-inch diameter SDR 17 HDPE header along with the top of the eastern slopes of Modules 2, 10, 11, 12, 13, and 14. This will facilitate the application of adequate vacuum to the well field areas that are distant from the blower system (it will allow for bypass of the underground header when blockages occur). This header also allows for creation of a loop header system, which is desirable from an operational standpoint in that it allows for maintenance or repair of a small portion of the well field without disabling a large percentage of the entire well field.

- Install an 8-inch cross connection between LFG-37 and CS-2 to improve the vacuum distribution in Modules 13, 14, and 15. A 6-inch cross connection between LFG-37 and CS-2 has been added.

- Add horizontal wells in Modules 13, 14, and 15 to reduce surface emissions/odors between now and placement of the final cover.

- Add vertical wells in areas at or near final grade or at interim grade to increase LFG recovery. These wells should be installed as soon as practical once the final interim grade is reached.

- Replace existing PVC header pipe with HDPE header pipe. Some of the PVC piping has been replaced and WPWMA has requested proposals for a project that would replace all of the PVC piping because HDPE piping is less prone to cracking. Cracked piping allows LFG to escape.

- Automate the Energy 2001 small 450 scfm flare to start if the large flare or an engine goes down.

These actions are intended to reduce LFG emissions, which will reduce the potential for offsite odor impacts.

5.0 CONCLUSIONS

Several potential sources of odor were identified in the region around WRSL, including the WRSL landfill itself and several of the operations related to the WRSL. While some of these sources may contribute to a background odor level or to intermittent odor emissions, the WRSL composting facility is a likely source of odor because:

- During the site inspections, the strongest odors seem to come from the composting operation;
- Odors noted by residents have increased over the last several years, which is the same time period where the composting operation saw a substantial increase in throughput;
- Field screening indicated that the onsite concentration of hydrogen sulfide directly downwind of the compost facility is above the recognition threshold;
- Interviews with residents in the direct path of the average wind direction and historical observations filed by residents and staff at WRSL, who have complained about the odor, indicate that the odors are commonly identified as coming from composting;
- The odors have been detected at different times throughout the day and even on weekends, and composting is a source that is constantly emitting as compared to other sources, (e.g. active face operations, LFG system downtime events, etc.);
- Ambient air sampling detected acetone, 2-butanone, and carbon disulfide, which can be emitted during composting.

LFG from WRSL itself is also of the likely odor sources.

- Field screening and observations of WRSL itself indicated that concentrations of hydrogen sulfide are slightly over its recognition threshold at six of the 20 screening locations around the landfill itself;
- LFG was detected on the top deck of the landfill during odor surveys and surface emissions monitoring;
- Review of LFG extraction system data indicates that the system has not been fully operational since system startup, which would increase the chance of escaping gases through the soil cover, and several of the odor events seem to correlate with LFG system downtime;
- The LFG system may not be sufficient in its current state to handle the full amount of LFG produced from the landfill. This is especially true in newer cells that are not required to have control but may be producing LFG. The GCCS was recently expanded into these newer areas, so LFG control is likely to have improved.

- The odors have been detected at different times throughout the day and even on weekends, and LFG is a source that is constantly emitting.

It is SCS' experience that odors can still come from a landfill even with an active gas collection and control system in operation. Through proper operation, maintenance, and testing, odors should be reduced while the system is in operation, but landfill operations and unexpected system outages can potentially cause odors.

Other on-site activities that can contribute to individual odor events, but did not appear to be constant sources of odor include:

- MRF;
- Use of MRF fines at the active face;
- Odor from the active face itself;
- Roseville sludge deliveries, and;
- GCCS downtime.

Off-site sources of odor that may warrant additional investigation, but were not studied as major contributors during the preliminary study, include:

- Dairy farm;
- Chicken farm;
- Mallard Creek composting operation;
- Propane facility;
- Septic processing facility;
- Rio Bravo biomass facility.

6.0 RECOMMENDATIONS

6.1 Recommendations Implemented Since 2007 Odor Study Report

Since the 2007 preliminary odor study, WPWMA has implemented the following recommendations:

- Continued to document odor complaints from the residents. This documentation continues to yield valuable information and fosters good relations with its neighbors;
- Correlated complaint information with meteorological data and any upset conditions or operations at the landfill and composting facility;
- Conducted a detailed review of its OIMP for the composting facility and updated it where necessary to reflect the results of the preliminary odor study, provide additional mitigation options, and to better address citizen complaints;

- Conducted ambient air monitoring for specific target compounds for laboratory analysis. The monitoring identified acetone, 2-butanone, and carbon disulfide at sampling locations. These gasses are emitted by landfills and composting operations;
- Conducted a detailed review of the LFG system design, operations, and monitoring to identify possible deficiencies for possible improvements. Some improvements have already been implemented, as noted above and below;
- Identified and mitigated several potential LFG emission sources adding additional intermediate cover soil to Modules 12 through 15, sealing around probable odor-source extraction wells, and increasing the flow to the LFG collection system;
- Enlisted the services of a third-party expert in composting to conduct a detailed evaluation of possible design/operation changes to the composting operation to reduce odors. The study revealed operations that could lead to odor emissions as well as mitigation measures to minimize odor;
- Added a meteorological station to monitor weather conditions at WRSL. Weather conditions can be added to the complaint log to correlate weather and complaints and composting and other potential odor generating activities can be conducted when weather conditions are less likely to generate off-site odors.
- Added a wind sock to visually indicate the wind direction without having to access weather station data. By quickly determining weather conditions, composting operations likely to emit odor during conditions that will carry odors to nearby receptors can be reduced;
- Added a specialized compost turner that should reduce odor emissions by reducing the amount of unturned compost.

Some of these actions were recommended in the preliminary study such as the review of the LFG system design and additional monitoring and were implemented prior to the preparation of this report.

6.2 Near-Term

These near-term recommendations should help to further characterize or mitigate the odors from the various sources and assist in collecting information necessary to develop mitigation measures for the significant sources. The near-term recommendations constitute an outline of a work plan for the next phase of the odor investigation as discussed above. WPWMA should:

- Fully implement the recommendations in the 2007 LFG Master Plan
- Implement the recommendations in the Compost Facility Odor Evaluation.
- Implement the recommendations in the updated OIMP.
- Continue to document odor complaints from the residents and correlate the complains with meteorological data and site operations. This has yielded valuable information in the past.
- Arrange a tour of WRSL and associated operations for a select group of residents in order to obtain their assistance in verifying the specific source(s) of odor they smell as well as to engage them in the process of investigating the odors. This can provide

further confirmation of the conclusions, which have been reached above regarding the sources of odor.

- Develop a long-term ambient air monitoring program. Compounds to be monitored include odorous compounds such as hydrogen sulfide, mercaptans, VOCs, terpenes, and VFAs.

If continued monitoring demonstrates the near term measures are not sufficient to reduce odors from the WRSL, long term measures should be evaluated. There is insufficient data available to begin an evaluation of long term measures at this time, and a feasibility study would be recommended prior to implementing any long-term measures to ensure they will be cost effective and have the desired effect.

FIGURES

SCS ENGINEERS

ENVIRONMENTAL CONSULTANTS

3050 FITE CIRCLE, SUITE 106
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PH. (916) 361-1297 FAX. (916) 361-1299

PROJ. NO. 01203013.01	DWN. BY: CRD	ACAD FILE: FIG 1 TITTLE SHEET.DWG
DATE 6/30/04	CHK. BY: AAM	APP. BY: A. McCREADY

SHEET TITLE: VICINITY MAP

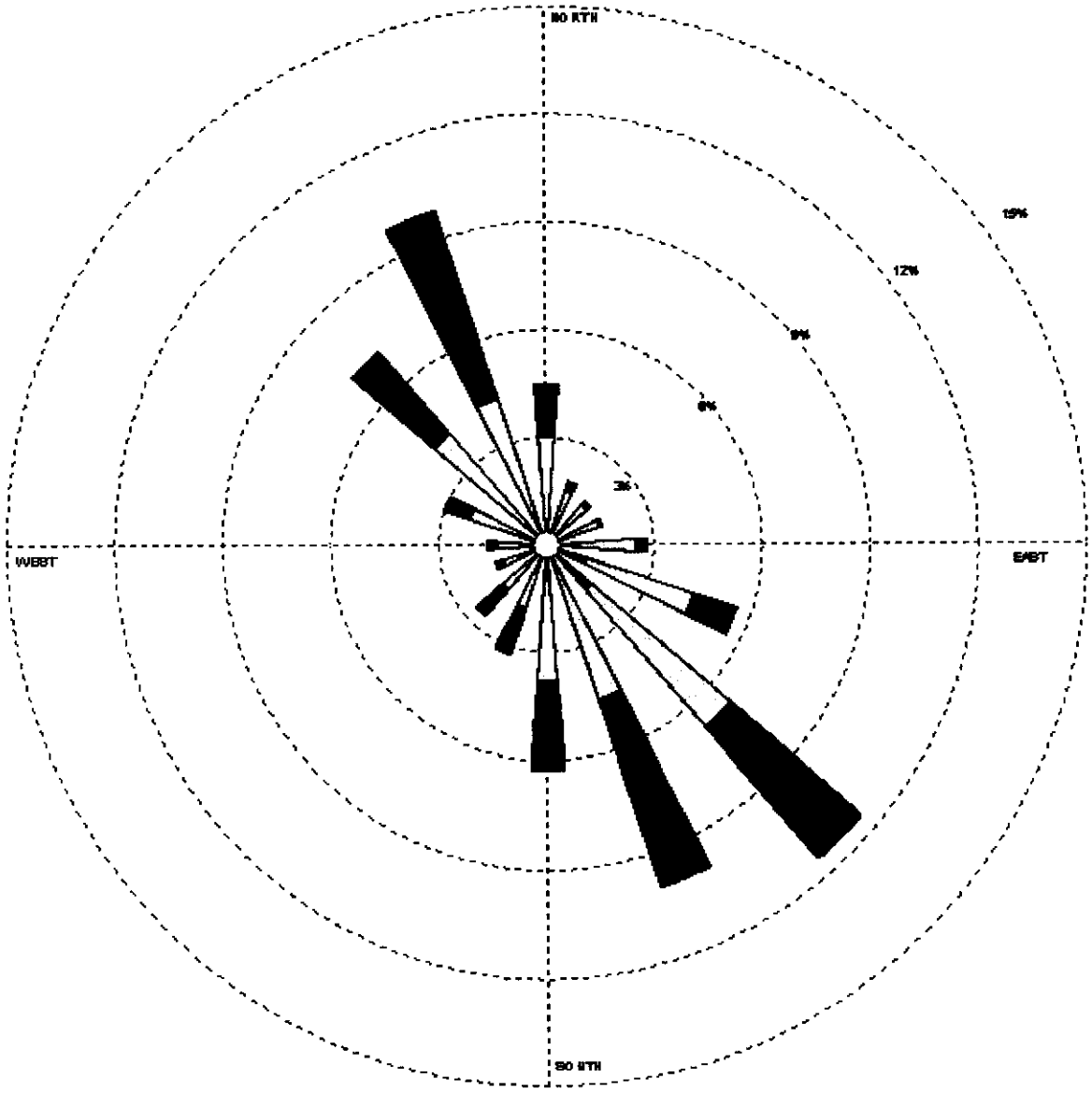
PROJECT TITLE: WESTERN REGIONAL SANITARY LANDFILL
PLACER COUNTY, CALIFORNIA

SCALE: NTS

FIGURE: 1

WIND ROSE PLOT

Station #23232 - SACRAMENTO/EXECUTIVE ARPT, CA

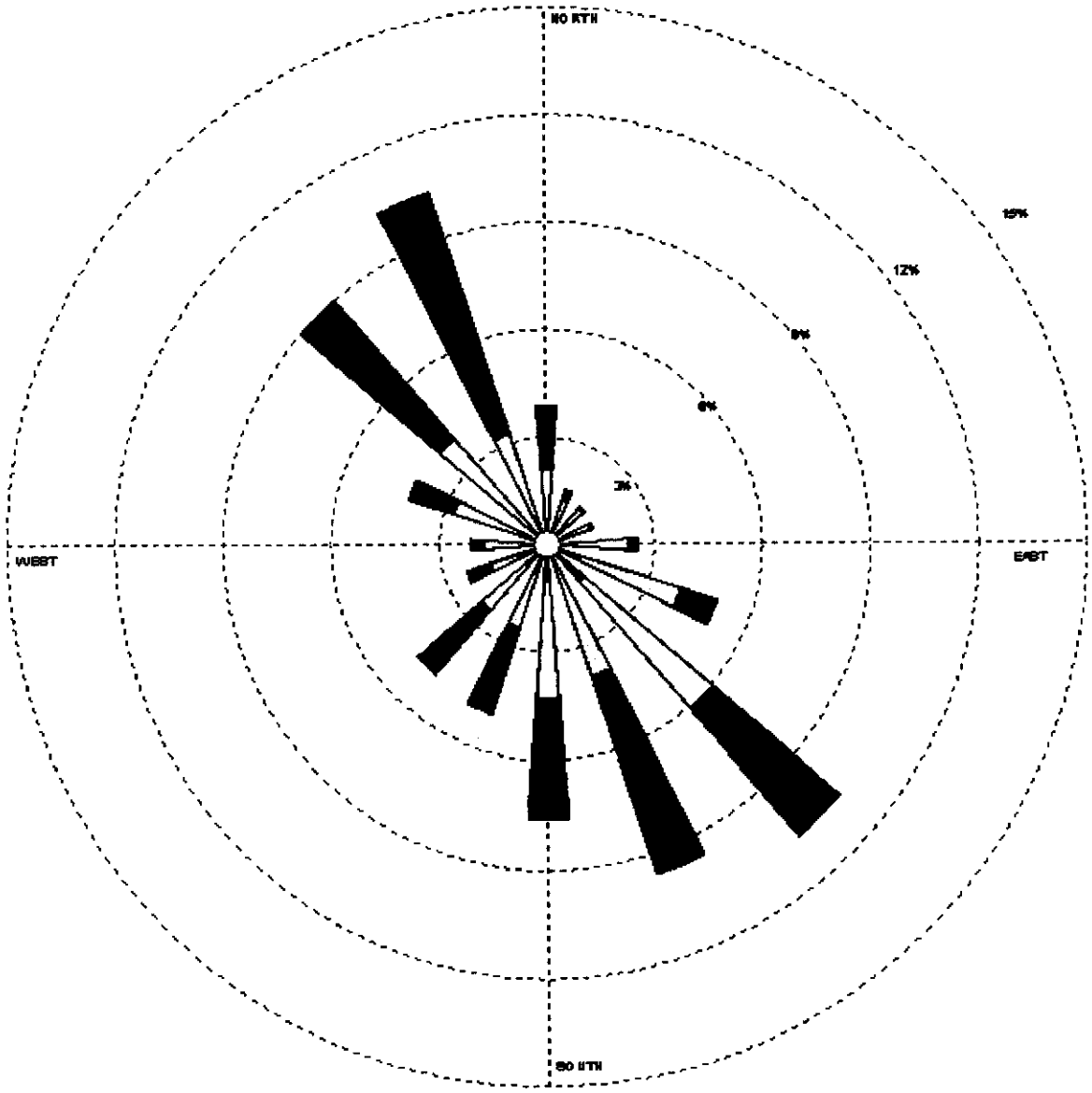


Wind Speed (m/s) > 11.06 8.49 - 11.06 5.40 - 8.49 3.34 - 5.40 1.80 - 3.34 0.51 - 1.80	MODELER Sara West	DATE 8/19/2002	COMPANY NAME USDA-ARS
	DISPLAY Wind Speed	UNIT m/s	COMMENTS Rose Diagram for Month of January
	AVG. WIND SPEED 3.47 m/s	CALM WINDS 25.31%	
	ORIENTATION Direction (blowing from)	PLOT YEAR-DATE-TIME 1961 Jan 1 - Jan 31 Midnight - 11 PM	Figure 3a

WRPLOT View 3.1 by Lakes Environmental Software - www.lakes-environmental.com

WIND ROSE PLOT

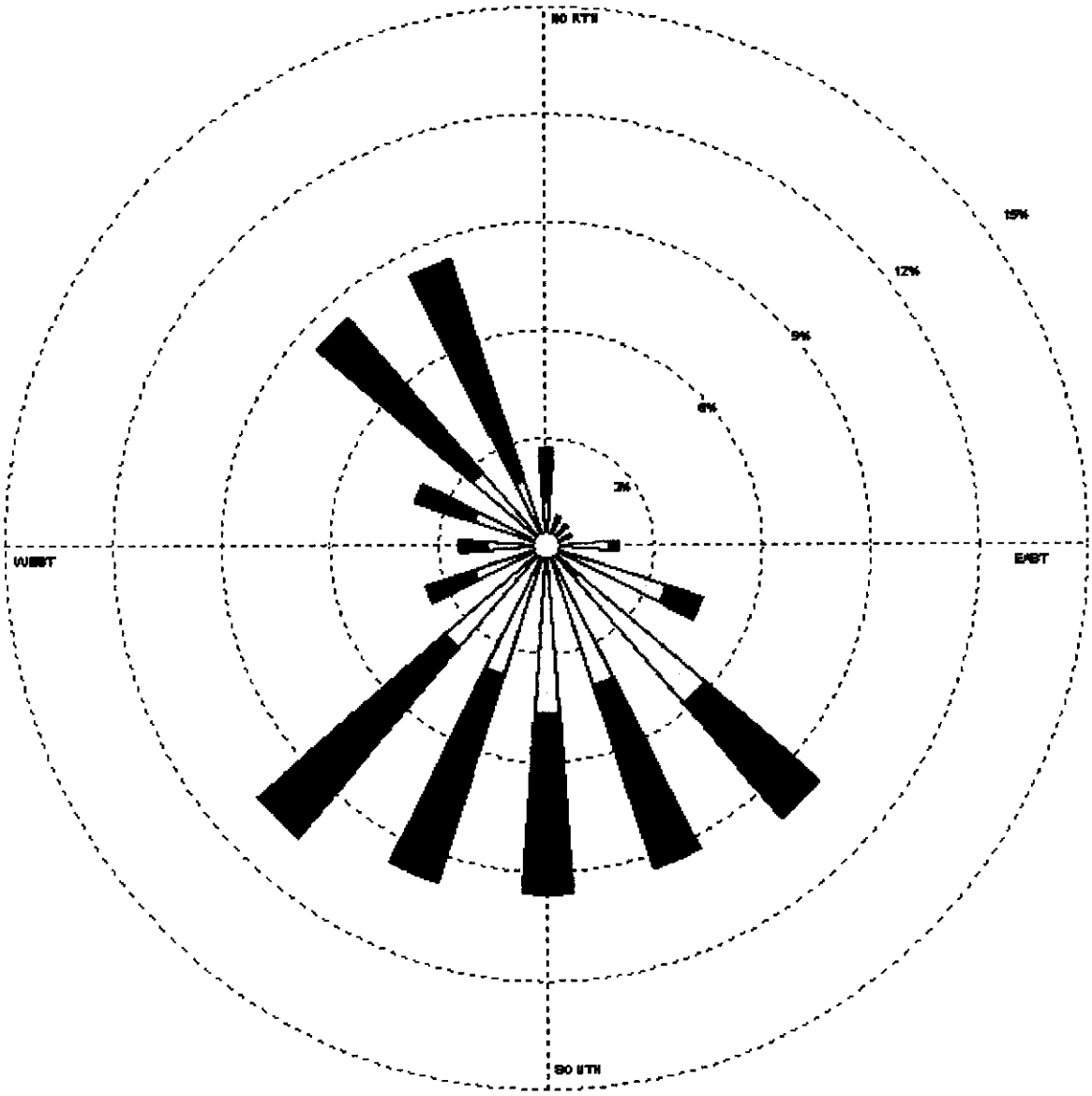
Station #23232 - SACRAMENTO/EXECUTIVE ARPT, CA



Wind Speed (m/s)	MODELER Sara West	DATE 8/19/2002	COMPANY NAME USDA-ARS
> 11.06 8.49 - 11.06 5.40 - 8.49 3.34 - 5.40 1.80 - 3.34 0.51 - 1.80	DISPLAY Wind Speed	UNIT m/s	COMMENTS Rose Diagram for month of February
	AVG. WIND SPEED 3.78 m/s	CALM WINDS 18.74%	
	ORIENTATION Direction (blowing from)	PLOT YEAR-DATE-TIME 1961 Feb 1 - Feb 28 Midnight - 11 PM	Figure 3b

WIND ROSE PLOT

Station #23232 - SACRAMENTO/EXECUTIVE ARPT, CA



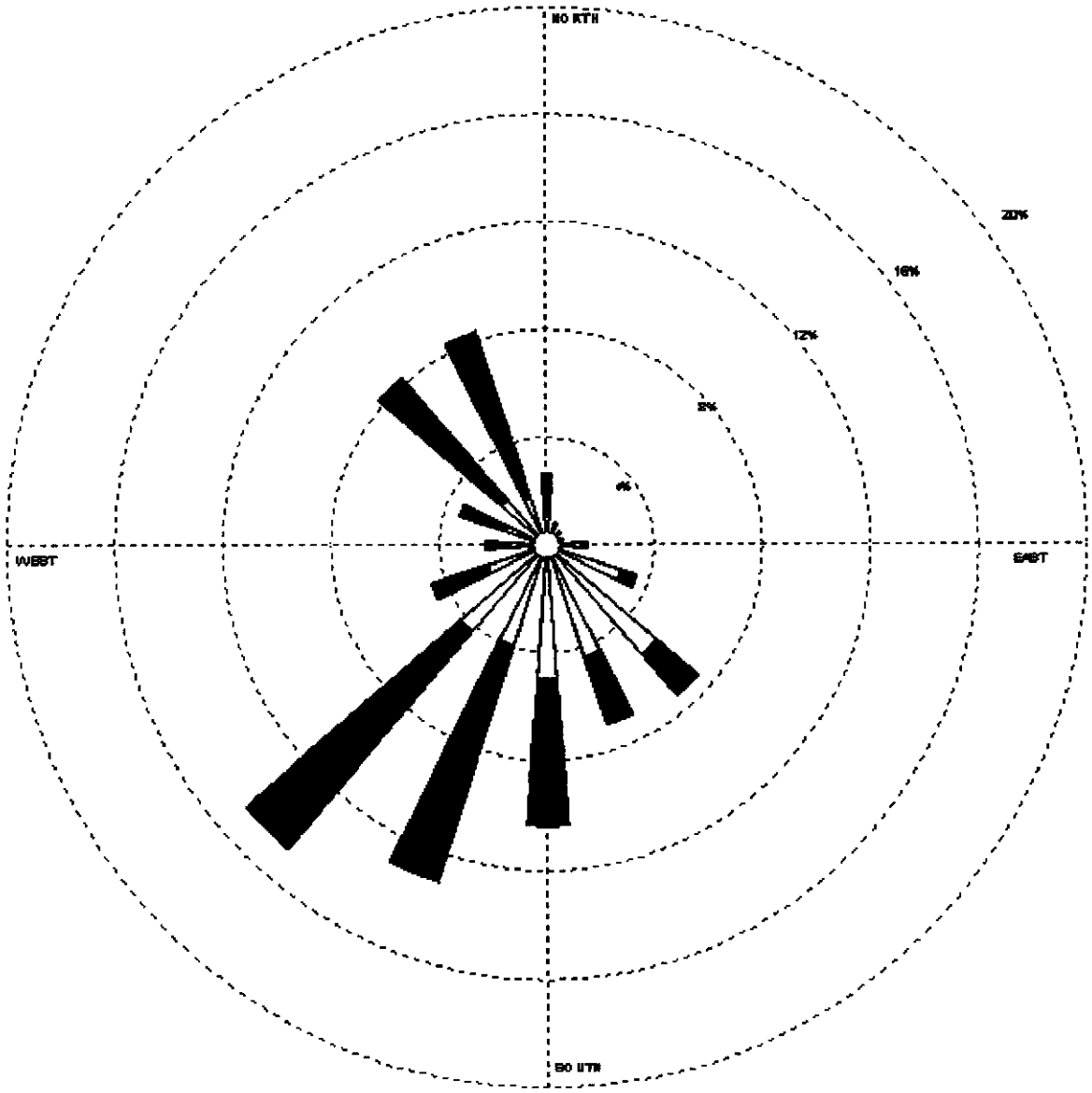
Wind Speed (m/s)

- > 11.06
- 8.49 - 11.06
- 5.40 - 8.49
- 3.34 - 5.40
- 1.80 - 3.34
- 0.51 - 1.80

MODELER Sara West	DATE 8/19/2002	COMPANY NAME USDA-ARS
DISPLAY Wind Speed	UNIT m/s	COMMENTS Rose Diagram for Month of March
AVG. WIND SPEED 4.01 m/s	CALM WINDS 12.31%	
ORIENTATION Direction (blowing from)	PLOT YEAR-DATE-TIME 1981 Mar 1 - Mar 31 Midnight - 11 PM	Figure 3c

WIND ROSE PLOT

Station #23232 - SACRAMENTO/EXECUTIVE ARPT, CA

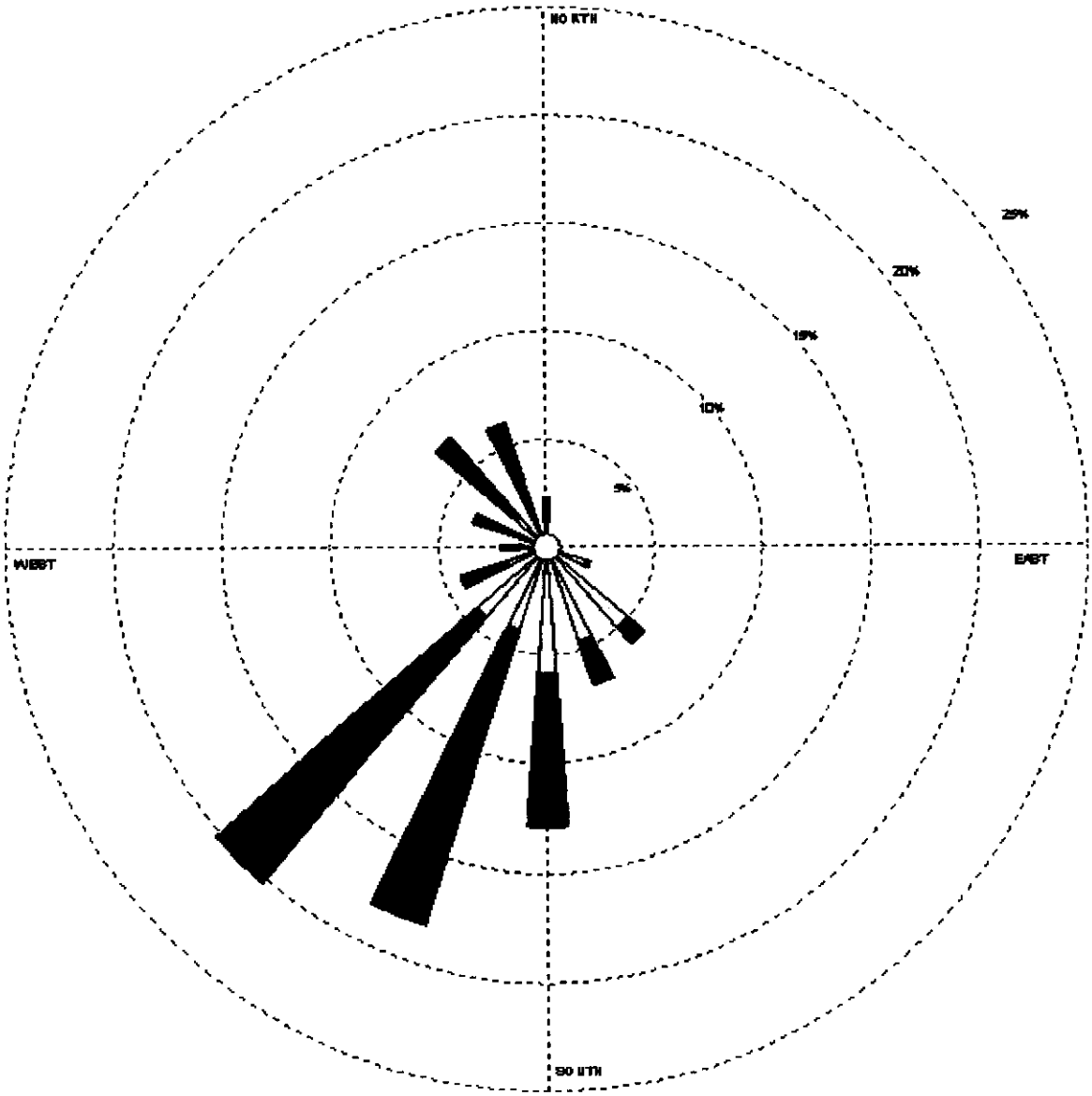


Wind Speed (m/s)	MODELER Sara West	DATE 8/19/2002	COMPANY NAME USDA-ARS
> 11.06 8.49 - 11.06 5.40 - 8.49 3.34 - 5.40 1.80 - 3.34 0.51 - 1.80	DISPLAY Wind Speed	UNIT m/s	COMMENTS Rose Diagram for Month of April
	AVG. WIND SPEED 4.09 m/s	CALM WINDS 10.68%	
	ORIENTATION Direction (blowing from)	PLOT YEAR-DATE-TIME 1961 Apr 1 - Apr 30 Midnight - 11 PM	Figure 3d

WRPLOT View 3.3 by Lakes Environmental Software - www.lakes-environmental.com

WIND ROSE PLOT

Station #23232 - SACRAMENTO/EXECUTIVE ARPT, CA

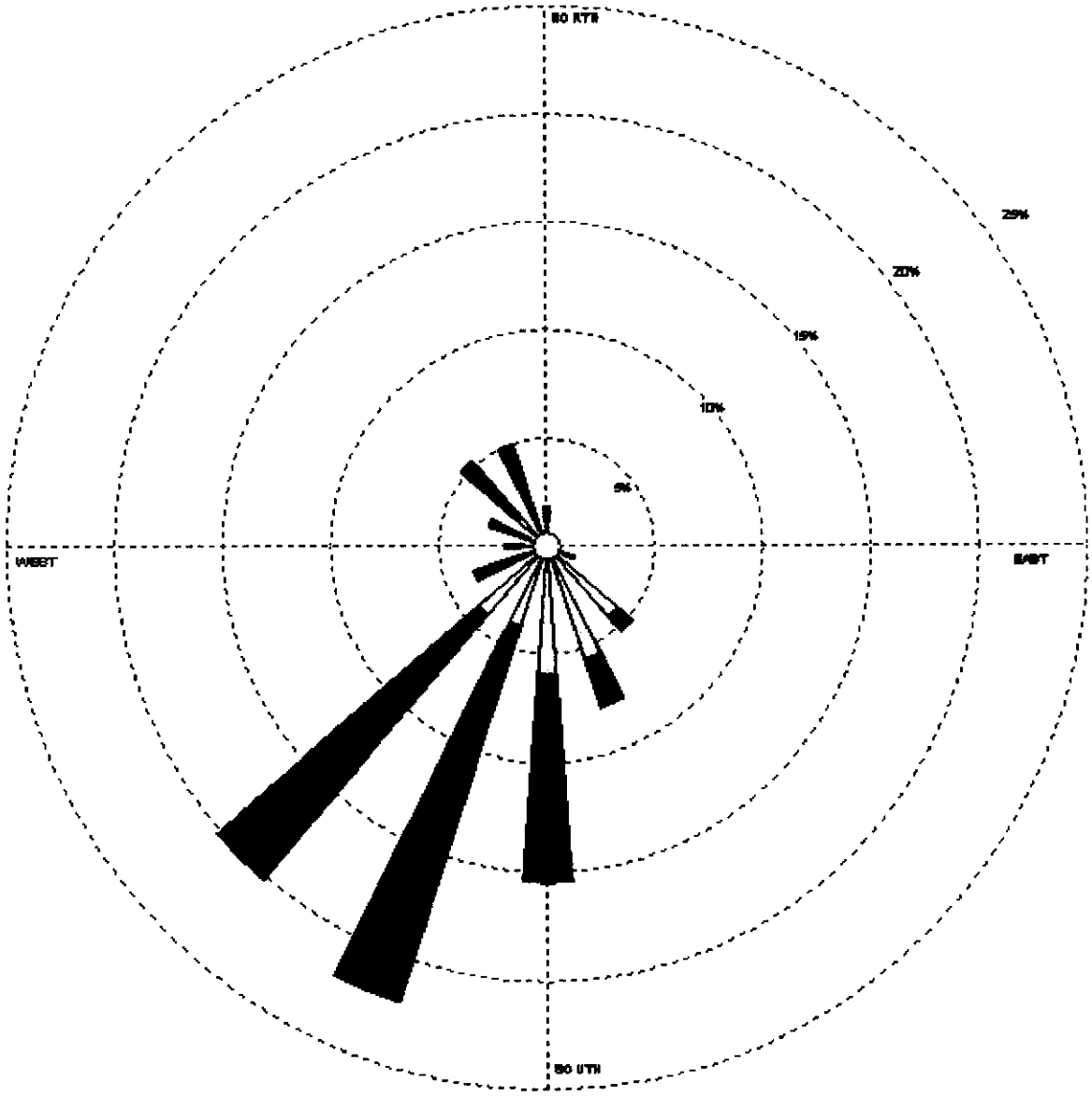


Wind Speed (m/s)	MODELER Sara West	DATE 8/19/2002	COMPANY NAME USDA-ARS
> 11.06 8.49 - 11.06 5.40 - 8.49 3.34 - 5.40 1.80 - 3.34 0.51 - 1.80	DISPLAY Wind Speed	UNIT m/s	COMMENTS Rose Diagram for Month of May
	AVG. WIND SPEED 4.20 m/s	CALM WINDS 6.55%	
	ORIENTATION Direction (blowing from)	PLOT YEAR-DATE-TIME 1961 May 1 - May 31 Midnight - 11 PM	Figure 3e

WRPLOT View 3.3 by Lakes Environmental Software - www.lakes-environmental.com

WIND ROSE PLOT

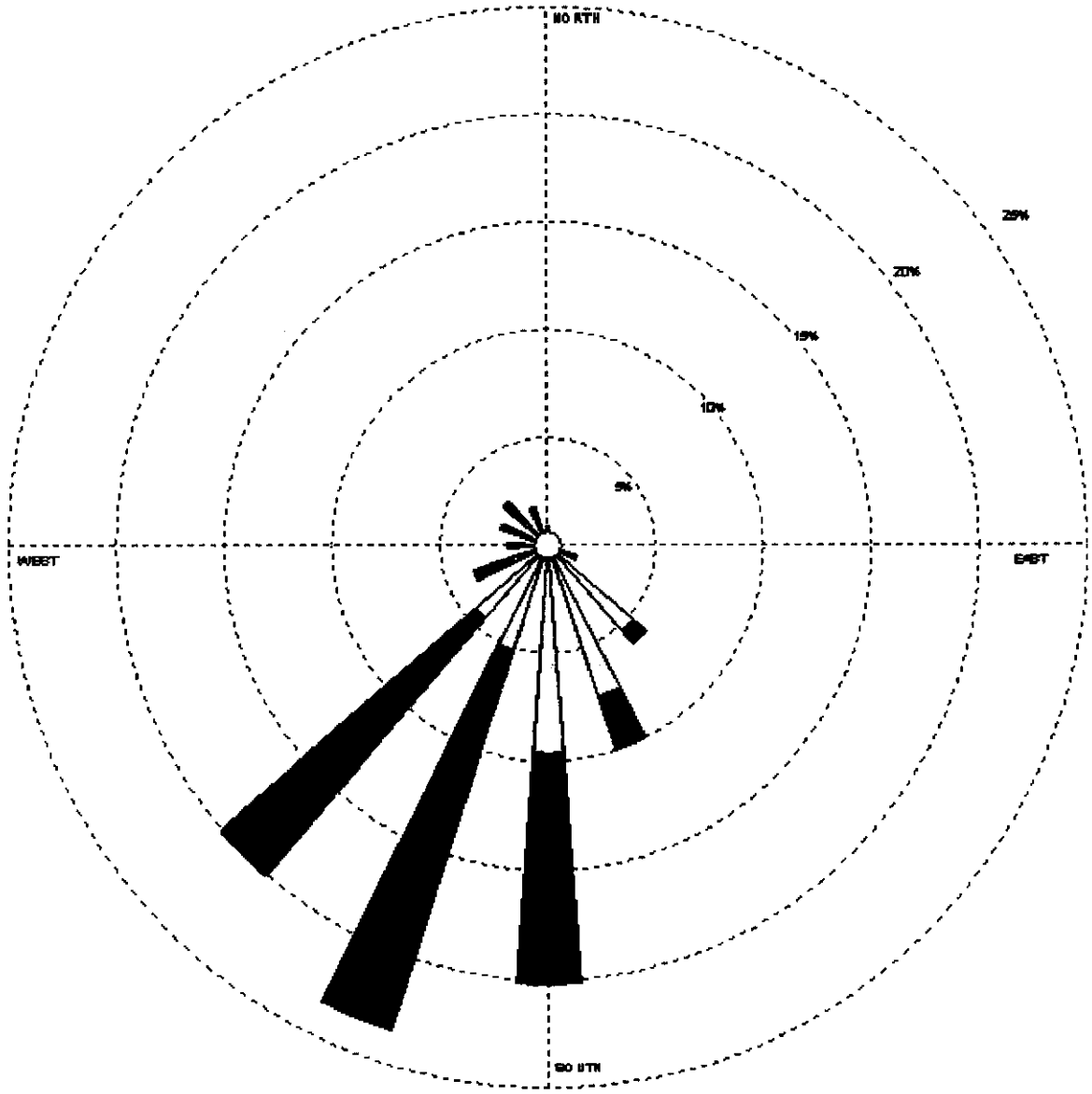
Station #23232 - SACRAMENTO/EXECUTIVE ARPT, CA



Wind Speed (m/s) > 11.06 8.49 - 11.06 5.40 - 8.49 3.34 - 5.40 1.20 - 3.34 0.51 - 1.20	MODELER Sara West	DATE 8/19/2002	COMPANY NAME USDA-ARS
	DISPLAY Wind Speed	UNIT m/s	COMMENTS Rose Diagram for Month of June
	AVG. WIND SPEED 4.29 m/s	CALM WINDS 5.59%	
	ORIENTATION Direction (blowing from)	PLOT YEAR-DATE-TIME 1961 Jun 1 - Jun 30 Midnight - 11 PM	Figure 3f

WIND ROSE PLOT

Station #23232 - SACRAMENTO/EXECUTIVE ARPT, CA

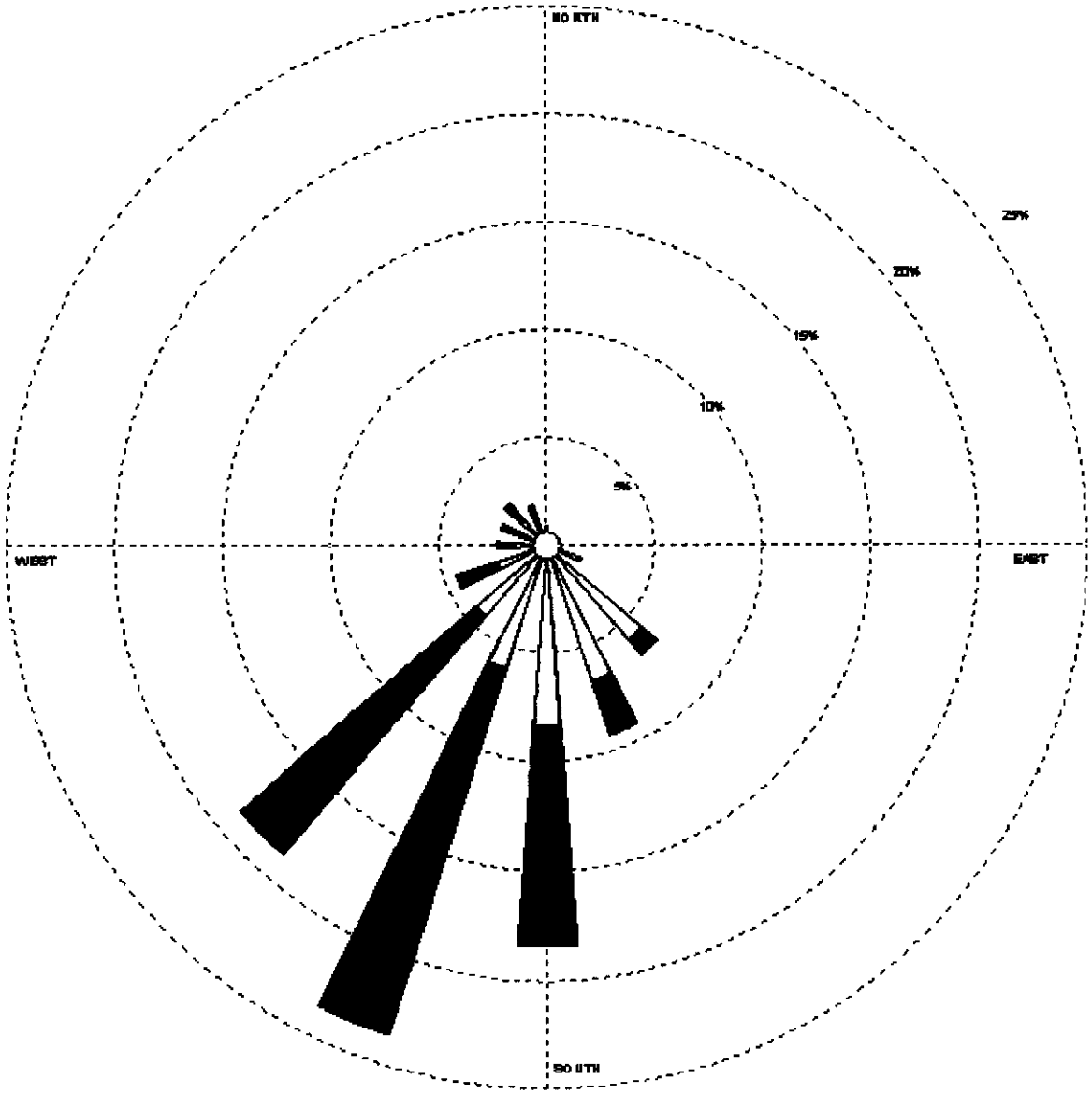


Wind Speed (m/s)	MODELER Sara West	DATE 8/19/2002	COMPANY NAME USDA-ARS
> 11.06 8.49 - 11.06 5.40 - 8.49 3.34 - 5.40 1.80 - 3.34 0.51 - 1.80	DISPLAY Wind Speed	UNIT m/s	COMMENTS Rose Diagram for Month of July
	AVG. WIND SPEED 3.92 m/s	CALM WINDS 4.29%	
	ORIENTATION Direction (blowing from)	PLOT YEAR-DATE-TIME 1961 Jul 1 - Jul 31 Midnight - 11 PM	Figure 3g

WRPLOT View 3.3 by Lakes Environmental Software - www.lakes-environmental.com

WIND ROSE PLOT

Station #23232 - SACRAMENTO/EXECUTIVE ARPT, CA

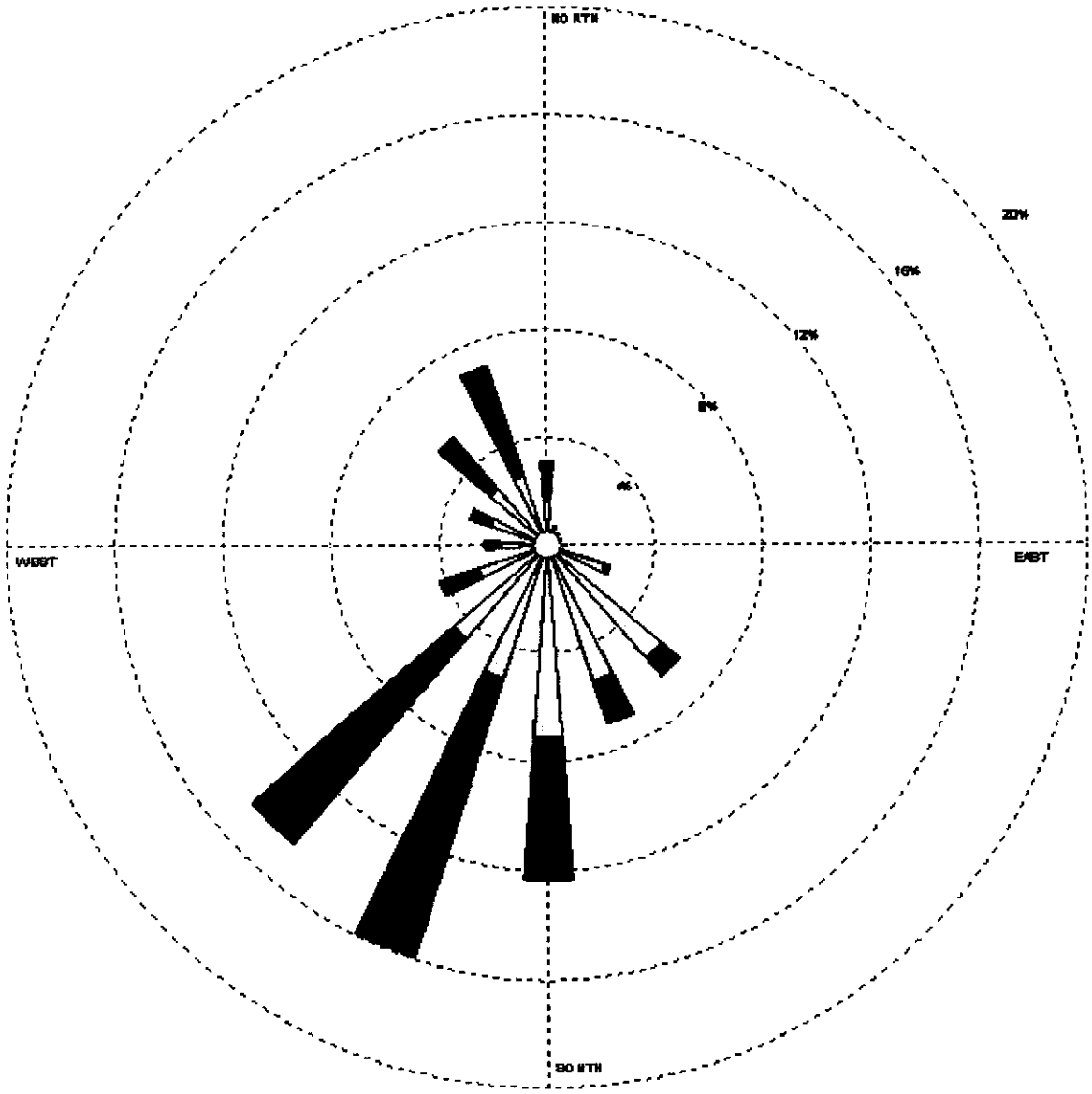


Wind Speed (m/s)	MODELER Sara West	DATE 8/19/2002	COMPANY NAME USDA-ARS
> 11.06 8.49 - 11.06 5.40 - 8.49 3.34 - 5.40 1.80 - 3.34 0.51 - 1.80	DISPLAY Wind Speed	UNIT m/s	COMMENTS Rose Diagram for Month of August
	AVG. WIND SPEED 3.84 m/s	CALM WINDS 6.18%	
	ORIENTATION Direction (blowing from)	PLOT YEAR-DATE-TIME 1961 Aug 1 - Aug 31 Midnight - 11 PM	Figure 3h

WRPLOT View 3.3 by Lakes Environmental Software - www.lakes-environmental.com

WIND ROSE PLOT

Station #23232 - SACRAMENTO/EXECUTIVE ARPT, CA

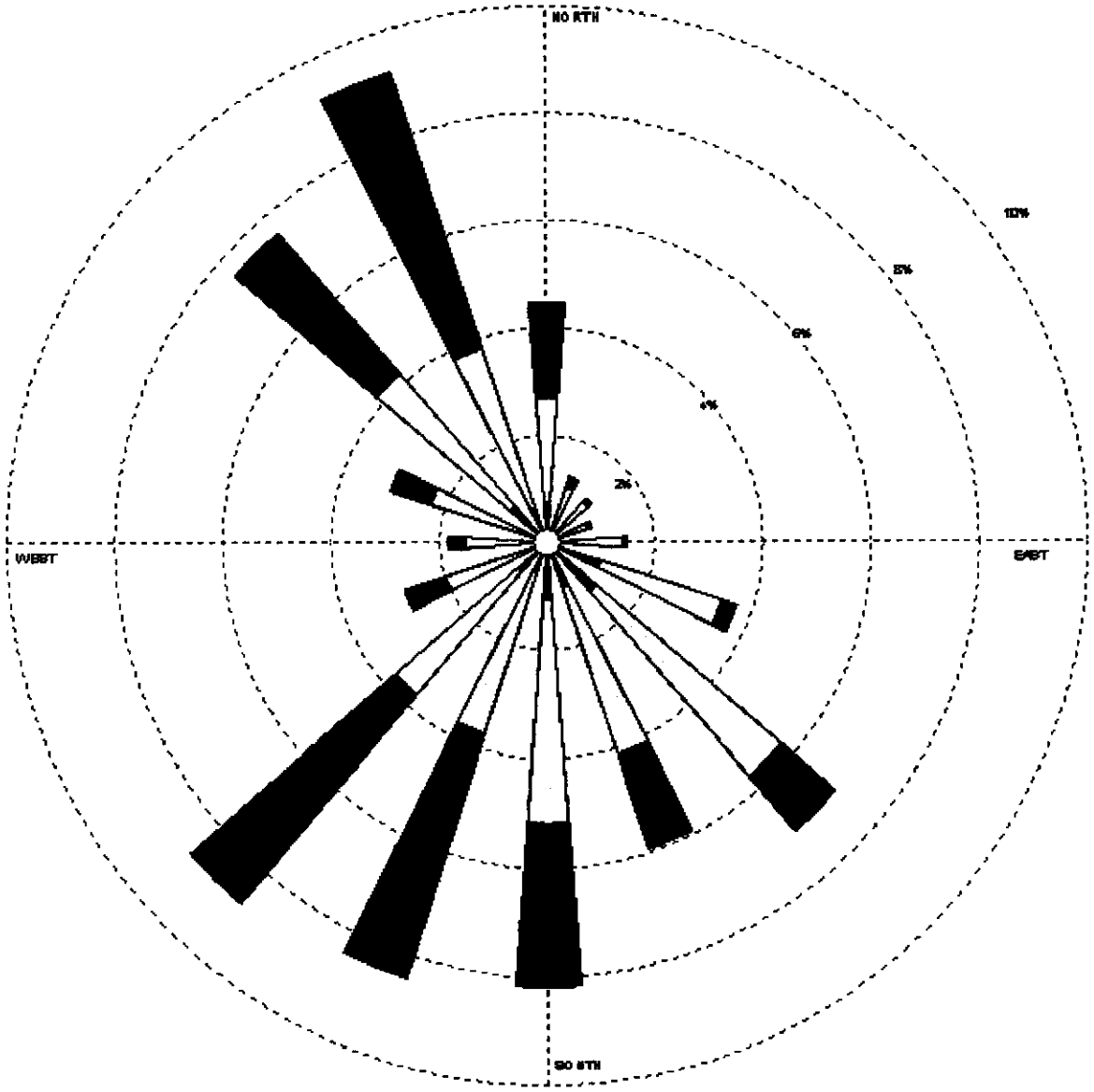


Wind Speed (m/s)	MODELER Sara West	DATE 8/19/2002	COMPANY NAME USDA-ARS
> 11.06 8.49 - 11.06 5.40 - 8.49 3.34 - 5.40 1.80 - 3.34 0.51 - 1.80	DISPLAY Wind Speed	UNIT m/s	COMMENTS Rose Diagram for Month of September
	AVG. WIND SPEED 3.65 m/s	CALM WINDS 13.59%	
	ORIENTATION Direction (blowing from)	PLOT YEAR-DATE-TIME 1961 Sep 1 - Sep 30 Midnight - 11 PM	Figure 3i

WRPLOT View 3.3 by Lakes Environmental Software - www.lakes-environmental.com

WIND ROSE PLOT

Station #23232 - SACRAMENTO/EXECUTIVE ARPT, CA



Wind Speed (m/s)

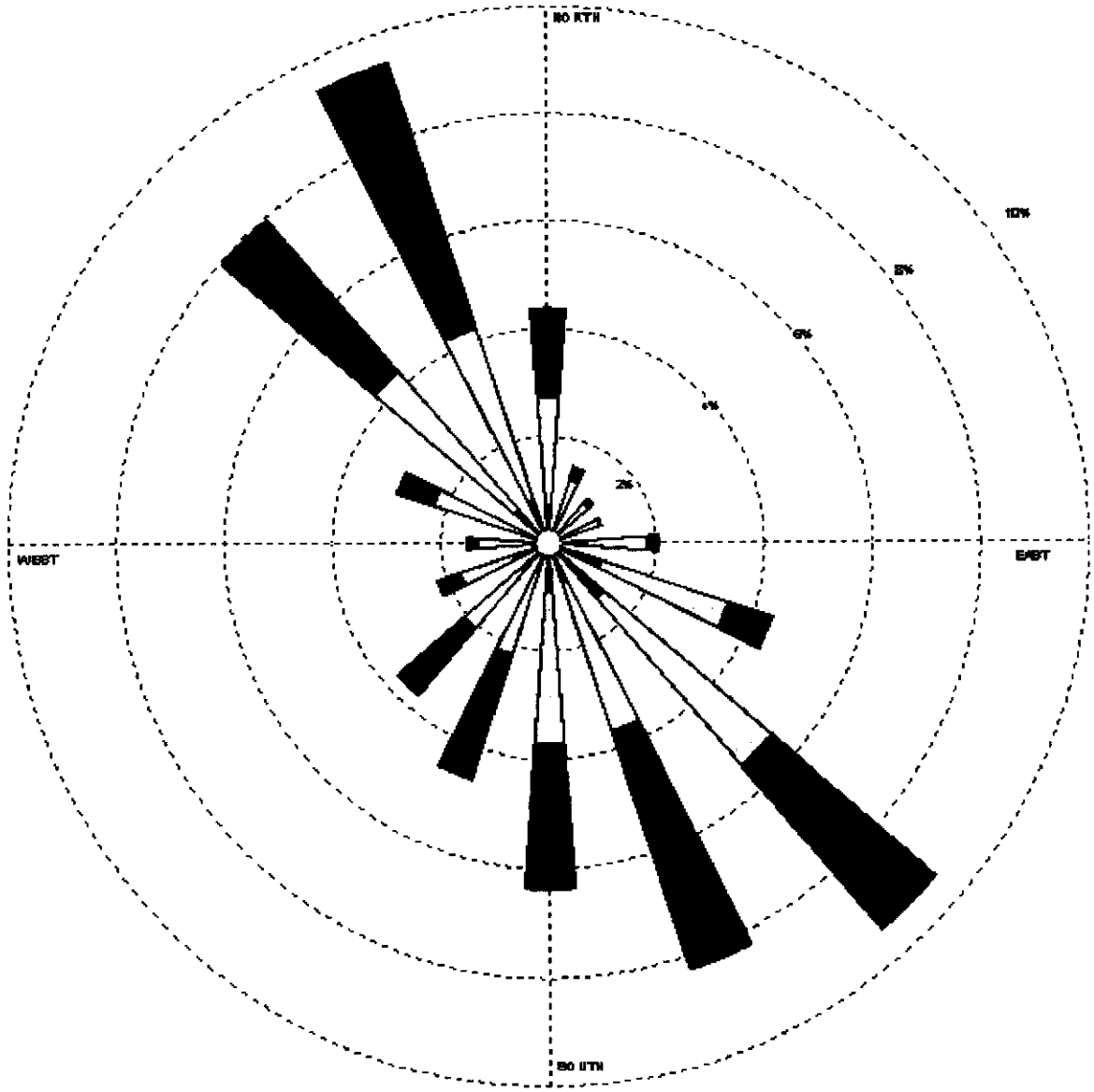
- > 11.06
- 8.49 - 11.06
- 5.40 - 8.49
- 3.34 - 5.40
- 1.80 - 3.34
- 0.51 - 1.80

MODELER Sara West	DATE 8/19/2002	COMPANY NAME USDA-ARS
DISPLAY Wind Speed	UNIT m/s	COMMENTS Rose Diagram for Month of October
AVG. WIND SPEED 3.39 m/s	CALM WINDS 24.25%	
ORIENTATION Direction (blowing from)	PLOT YEAR-DATE-TIME 1961 Oct 1 - Oct 31 Midnight - 11 PM	Figure 3j

WRPLOT View 3.3 by Lakes Environmental Software - www.lakes-environment.com

WIND ROSE PLOT

Station #23232 - SACRAMENTO/EXECUTIVE ARPT, CA



Wind Speed (m/s) > 11.06 8.49 - 11.06 5.40 - 8.49 3.34 - 5.40 1.80 - 3.34 0.51 - 1.80	MODELER Sara West	DATE 8/19/2002	COMPANY NAME USDA-ARS
	DISPLAY Wind Speed	UNIT m/s	COMMENTS Rose Diagram for Month of November
	AVG. WIND SPEED 3.47 m/s	CALM WINDS 29.14%	
	ORIENTATION Direction (blowing from)	PLOT YEAR-DATE-TIME 1961 Nov 1 - Nov 30 Midnight - 11 PM	Figure 3k

WRPLOT View 3.3 by Lakes Environmental Software - www.lakes-environmental.com

SCALE IN FEET

3500 0 3500 7000 10500

N

NO.	REVISION	DATE

SHEET TITLE: POTENTIAL ODOR SOURCES

PROJECT TITLE: WESTERN REGIONAL SANITARY LANDFILL
PLACER COUNTY, CALIFORNIA

WESTERN PLACER WASTE
MANAGEMENT AUTHORITY

SCS ENGINEERS
Environmental Consultants
3117 Fite Circle, Suite 108
Sacramento, California 95827
(916) 361-1297 FAX: (916) 361-1299

PROJ. NO. 01203013.01 | DWN. BY: ATV | ACAD FILE: FIGURE 5
DSN. BY: ATV | CHK. BY: PSS | APP. BY: P. SULLIVAN

DATE: 07/01/08

SCALE: 1" = 3500'

FIGURE NO. 4

MAP OBTAINED FROM MICROSOFT VIRTUAL EARTH

SCALE IN FEET

1/2 mile 0 1/2 mile 1 mile 1 1/2 miles

NO.	REVISION	DATE
1	REV. PER ACTUAL LOCATIONS	6/18/08
2		
3		
4		
5		

SHEET TITLE: MARCH 2008 SAMPLE LOCATIONS

PROJECT TITLE: WESTERN REGIONAL SANITARY LANDFILL
PLACER COUNTY, CALIFORNIA

WESTERN PLACER WASTE MANAGEMENT AUTHORITY

SCS ENGINEERS
Environmental Consultants
3117 Fite Circle, Suite 108
Sacramento, California 95827
(916) 361-1297 FAX: (916) 361-1299

PROJ. NO: 01203013.01 | DWN. BY: ATV | ACAD FILE: FIGURE 1
DSN. BY: N/A | CHK. BY: AMM | APP. BY: P. SULLIVAN

DATE: 03/06/08

SCALE: AS SHOWN

FIGURE NO. 5