Niemi et al. v. Northwest Cascade, Inc., et al.

Expert Report

Prepared by

Dr. Paolo Zannetti, QEP

EnviroComp Consulting, Inc.
500 Stone Pine Road, #3038
Half Moon Bay, CA 94019
http://www.envirocomp.com

Prepared for

Gordon Thomas Honeywell LLP
https://www.gth-law.com/

11 September 2018

Project: EC-17-004
Report: 18-09-11

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1. Introduction and Overview

The law firm Gordon Thomas Honeywell, LLP[1] ("Gordon Thomas") requested the assistance of Dr. Paolo Zannetti, QEP, and his Associates at EnviroComp Consulting, Inc.[2] ("EnviroComp"), to investigate technical issues - such as odors, air quality, and meteorological phenomena - related to an ongoing litigation case. The case is a class action brought on behalf of people living in a designated Class Area adjacent to the boundaries of the properties located at 250 Roy Rd. SW, and 210 and 230 County Line Rd. SW, in the city of Pacific, Pierce County, Washington (collectively, the "Honey Bucket Facility" property).

By this action, Plaintiffs seek to recover, on behalf of themselves and the class they represent, damages and injunctive relief. Plaintiffs stated[3] hazardous odors, gases, fumes, and contaminants have been and are being released from the Honey Bucket Facility property, which are interfering with the use and enjoyment of the Plaintiffs' and the Class Members' properties, have substantially impaired the value of their properties, and have caused adverse personal impacts such as annoyance, irritation, discomfort and other similar physical ailments.

Accordingly, EnviroComp was retained by Gordon Thomas in April 2017 and asked to work on:

> *SAMANTHA NIEMI; CHRIS SCHNEIDER; STACEY JACKSON SR.; GANNA SHTOGRYN, individuals,*
> *Plaintiffs, V.*
> *NORTHWEST CASCADE, INC., a Washington corporation, dba HONEY BUCKET and FLOHAWKS; NWC #5 Partnership LLP, a Washington limited liability partnership, Defendants.*
>
> *Superior Court State of WA for Pierce County No. 16-2-11216-7*

As part of this work request, EnviroComp performed several tasks, including:

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[1] https://gth-law.com/

[2] http://www.envirocomp.com

[3] Class Action Complaint for Damages and injunctive relief. Superior Court of the State of Washington for Pierce County. No. 16-2-11216-7, September 19, 2016.

1. Review of materials received from the client (Section 1.1 of this report).
2. Collection and review of additional data and publications (Section 1.2 of this report).
3. Collection of available meteorological and topographical data in the region of interest.
4. Data analysis of wind measurements versus odor complaints.
5. Development of a scientific opinion on these matters.
6. Preparation of a technical report (this report).

Dr. Zannetti[4] is the principal author of this report. A summary of Dr. Zannetti's experience and qualifications is presented in Appendix A together with his CV. Compensation details related to his consulting services are enclosed as Appendix B. His testimonies in the last four years are listed in Appendix C.

This report presents the current results of our investigation and our opinions, based upon the materials reviewed and the analyses performed to date. EnviroComp reserves the right to supplement this report in the event new information is presented. EnviroComp also intends to perform additional work in response to reports submitted by defendants' experts. Any of the figures referenced in or attached to this report and accompanying model may be used as exhibits at trial.

EnviroComp is fully committed to the highest ethical standards of scientific and professional integrity - these standards are enforced through a rigorous internal and external peer-review of assumptions, calculations, opinions, and results.

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[4] http://envirocomp.com/people1/zannetti.html

1.1 Documents Received from Client

A list of the documents received by EnviroComp from the client is presented below.

NW CascadeDeclaration of Thomas R. Card, PE - 6194661v1.PDF

Odor complaints (*04 - Complaints.pdf*)

Odor complaints (*2015.pdf*, *2016.pdf*, *2017.pdf*, *2018.pdf*, *PSCAA Reports 03.08.2016 - 04.30.2018.pdf*)

Odor complaints (*Additional Complaints.pdf*)

Odor complaints (*Odor Complaint - 622 Chicago Blvd. - 11-15-16.pdf*)

Odor maps prepared by Mr. Dodge (*Dodge Maps.pdf*)

Performance test of May 27, 2016 NO P15110a (*2016 05 27 Chemical Performance Test Report.pdf*)

Performance test of January 20, 2016 NO P16103 (*2016 01 20 Performance Test Report.pdf*)

Odor study and engineering evaluation report NO P16116 (*2016 10 16 Odor Study and Eng. Eval report.pdf*)

1.2 Additional Data and Publications Acquired and Examined by EnviroComp

A list of documents and data collected during this project is presented below.

1. Integrated Surface Database (ISD) meteorological data of Seattle-Tacoma Airport[5] (KSEA), McChord Field Airport / Joint Base Lewis-McChord (KTCM), and Pierce County Airport - Thun Field (KPLU)
2. ASOS 1-minute meteorological data of the Seattle-Tacoma Airport[6]

[5] https://www1.ncdc.noaa.gov/pub/data/noaa/
[6] ftp://ftp.ncdc.noaa.gov/pub/data/asos-onemin/

(Cont'd on next page)

3. Weather Underground meteorological data for various Personal Weather Stations (PWS)[7]

4. Upper air radiosonde data for Quillayute, WA (KUIL)

[7] https://www.wunderground.com/wundermap. To date, EnviroComp has not received meteorological data from the Honey Buckets facility in a usable form. EnviroComp reserves the right to analyze meteorological data from defendants' facility once it is available in usable form.

2. The Region

Figure 1 shows the area of interest in the city of Pacific, which is partly in Pierce County and partly in King County, Washington. The "Honey Bucket Facility" and the Class Area (a residential area located just north of the facility) are shown in Figure 2 by a yellow rectangle and a blue rectangle, respectively. It is observed that the facility is in Pierce County, while the Class Area is in King County.

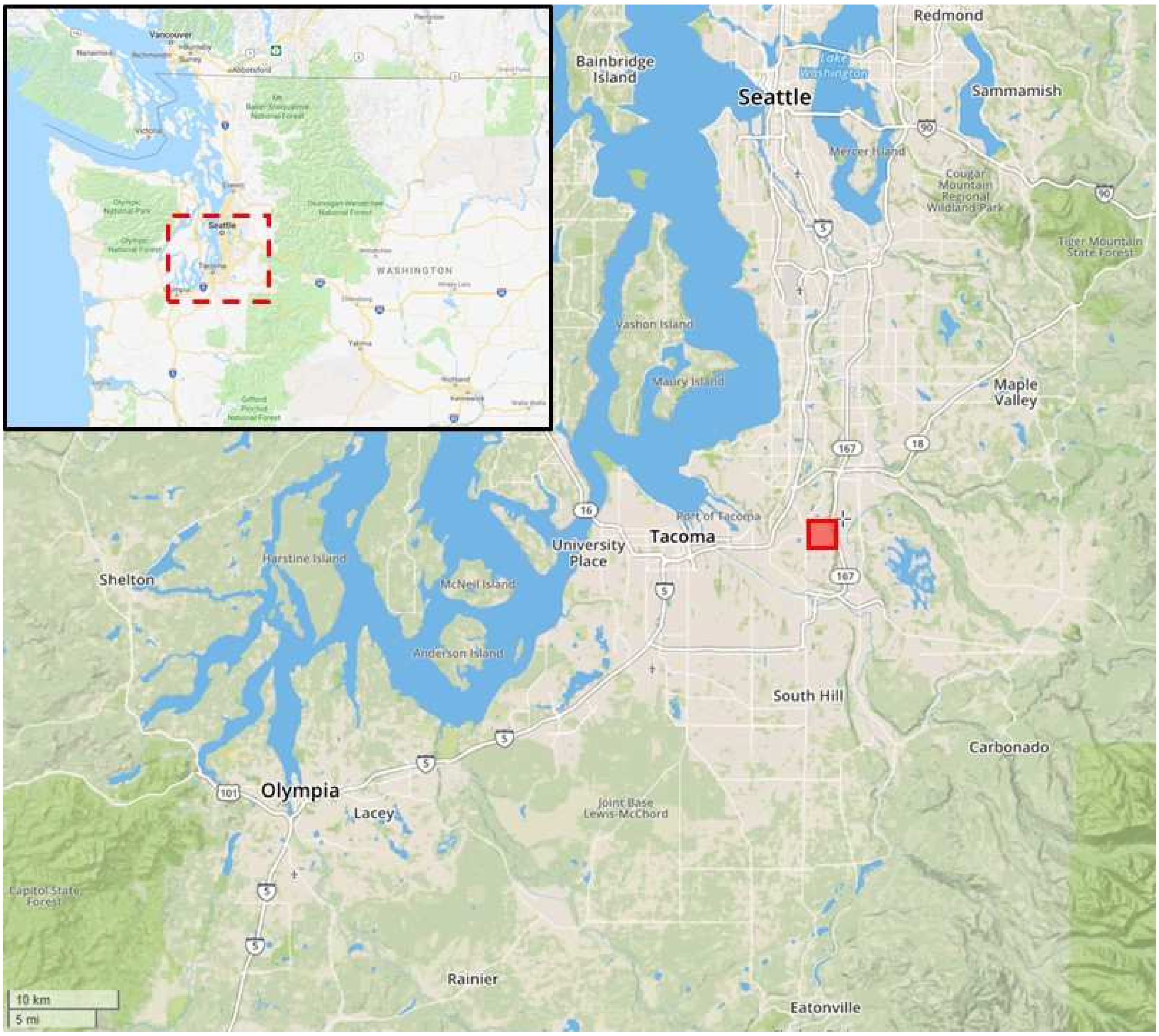

Figure 1. Area of interest.

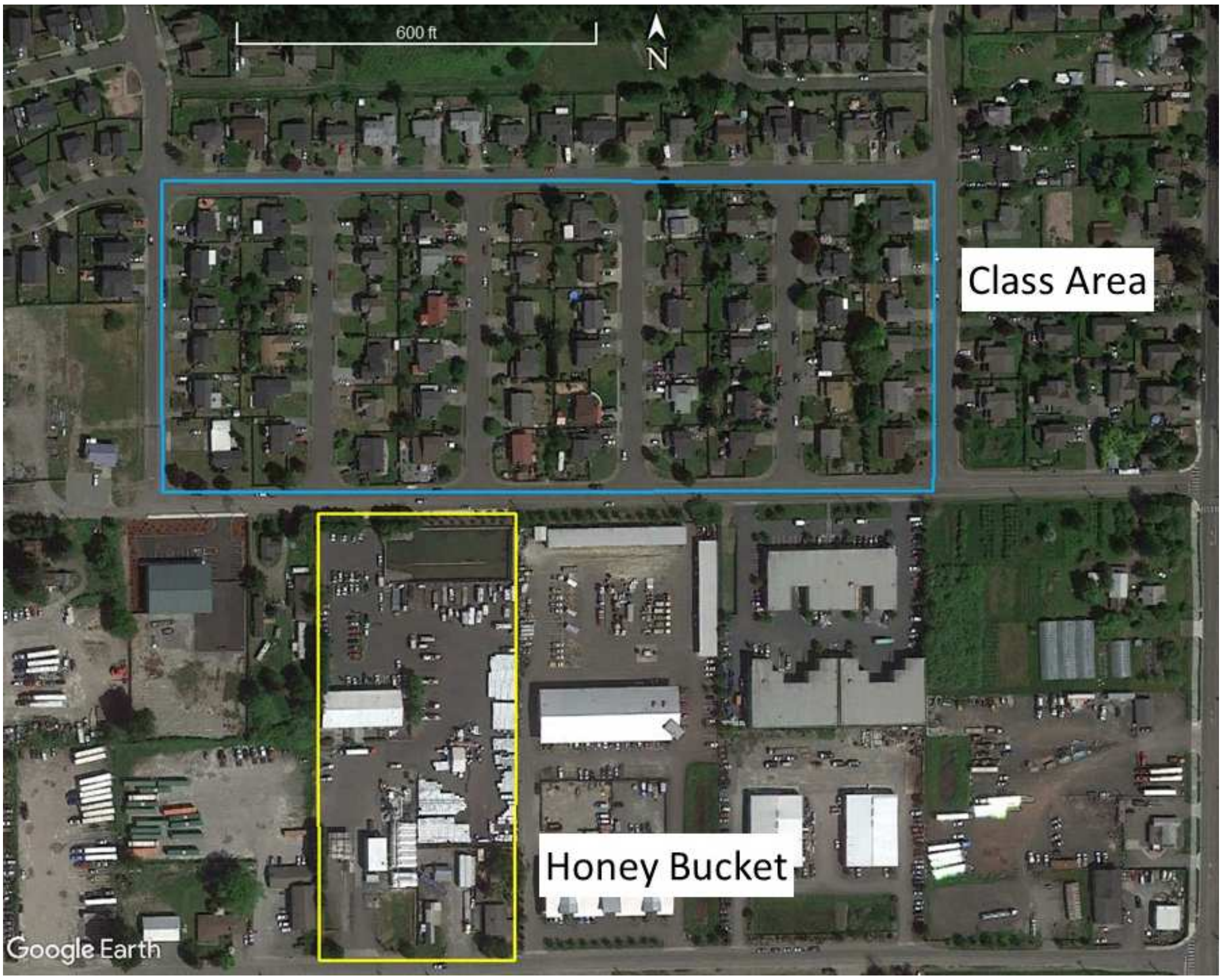

Figure 2. Class Area (blue rectangle) and Honey Bucket facility (yellow rectangle).[8]

As described by the Western Regional Climate Center[9], the prevailing directions of the wind is from South or Southwest during the wet season and from Northwest in summer. The average wind velocity is less than 10 mph. Although the City of Pacific is part of the most densely populated and industrialized area in the State, there is sufficient wind most of the year to disperse air pollutants released into the atmosphere. Air pollution is usually most noticeable in the late fall and winter season, under conditions of clear skies, light wind and a sharp temperature inversion. These conditions only prevail a few days before a weather system moves through removing the pollution by wind and rain. Annual precipitation ranges from 32 to 35

[8] *2017 07 14 Motion for Class Certification.pdf*, page 3.
[9] https://wrcc.dri.edu/narratives/WASHINGTON.htm

inches from the Canadian Border to Seattle, then gradually increases to 45 inches in the vicinity of Centralia. The winter season snowfall ranges from 10 to 20 inches. Both rainfall and snowfall increase with a slight increase in elevation and distance from Puget Sound. Snow generally melts rather quickly and depths seldom exceed six to 15 inches. The greatest snow depth recorded in Seattle is 29 inches. Most of this area is near the eastern edge of the "rain shadow" of the Olympic Mountains. The average January maximum temperature ranges from 41° to 45° F and minimum temperatures from 28° to 32° F. With an increase in distance from Puget Sound, winter temperatures decrease and summer temperatures increase. Minimum temperatures ranging from 0° to -10° F have been recorded; however, temperatures seldom drop lower than 10° to 15° F. During July, the average maximum temperature ranges from 73° F near the Canadian Border to 78° F in the vicinity of Olympia, and the minimum temperature is near 50° F. Maximum temperatures have reached 100° F; however, during an average summer, 90° or higher is only recorded on three to five days. The growing season is from the latter half of April until the middle of October.

We identified several meteorological stations in the region. The METAR[10] stations are shown in Figure 3, while the Weather Underground[11] personal weather stations (PWS) are shown in Figure 4. In both figures the Honey Bucket position is shown by a yellow circle. Most of these stations are located at higher elevation above sea level than the Honey Bucket Facility, as shown in Figure 5. After examining the meteorological data, we concluded that the METAR data are the most reliable and representative. We present in Figure 6, Figure 7 and Figure 8 the annual wind roses (2015 to 2018), respectively, of KPLU (Pierce County Airport - Thun Field), KTCM (McChord Field Airport - Joint Base Lewis-McChord), and KSEA (Seattle-Tacoma International Airport). The 2018 wind roses refer to the period January-July. These wind roses have been created starting from the NOAA ISH/ISD[12] (Integrated Surface Database) data[13]. It is noticeable that winds from South

[10] https://aviationweather.gov/metar

[11] Data from the Weather Underground stations are not always reliable since they are often managed by private citizens and may not be correctly positioned and maintained.

[12] "ISH" (Integrated Surface Hourly) was renamed around 2004 with "ISD" (Integrated Surface Data) when daily and monthly summary observations were added to the dataset https://www1.ncdc.noaa.gov/pub/data/noaa/readme.txt

[13] https://www1.ncdc.noaa.gov/pub/data/noaa/

– Southwest arc are very frequent in the region. The Pierce County Airport is characterized by a low percentage of valid data.

We found that the KSEA station at Seattle-Tacoma International Airport has the highest percentage of data availability among closest measuring stations. Therefore, we used the wind data at this station in our subsequent meteorological analyses and compared the odor complaints from June 2015 to June 2018 with the ASOS 1-minute wind data[14] collected at KSEA. However, it should be noted that the Class and the Honey Buckets facility are both located on a valley floor that runs generally north to south. This can have the effect of channeling or funneling winds into a greater north-south frequency than would be experienced at a higher elevation site not bordered by ridges, such as the KSEA station. Also note that the KSEA station has a higher frequency of stronger winds than surrounding stations, which may have the effect of over-predicting the dilution of odorous air.

[14] ftp://ftp.ncdc.noaa.gov/pub/data/asos-onemin/

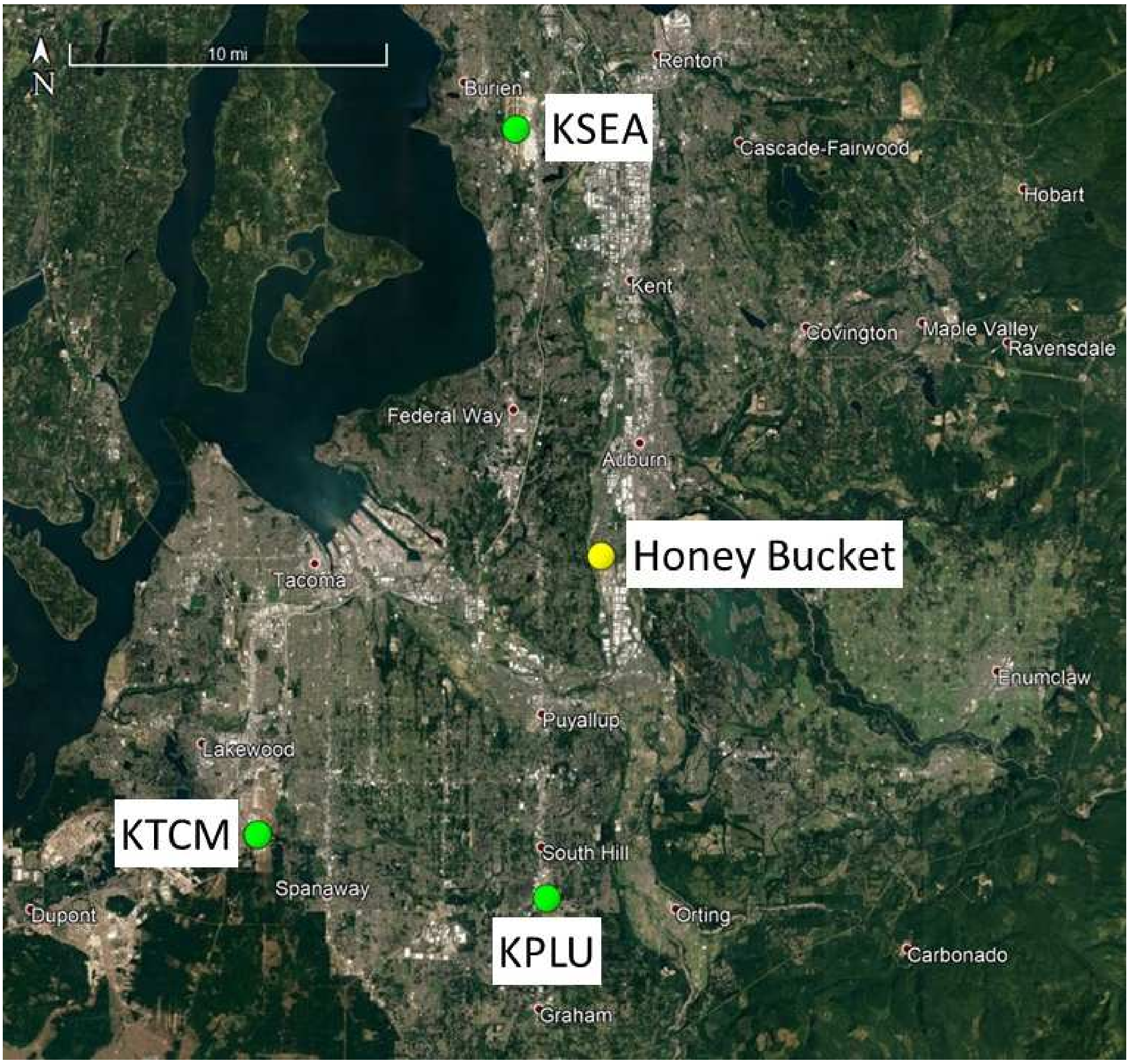

Figure 3. METAR stations near the facility (green circles).

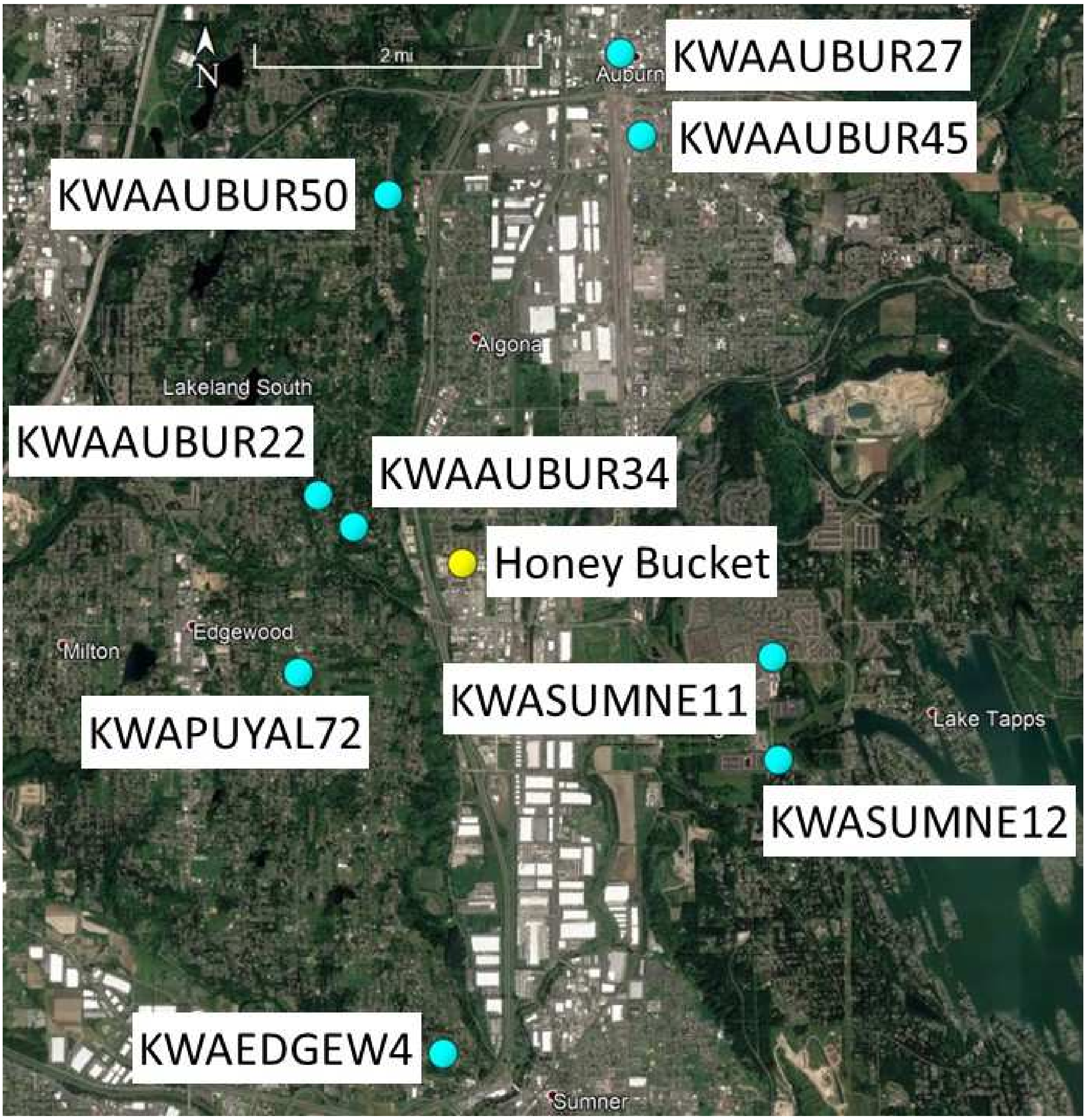

Figure 4. Weather Underground personal weather stations (cyan circles).

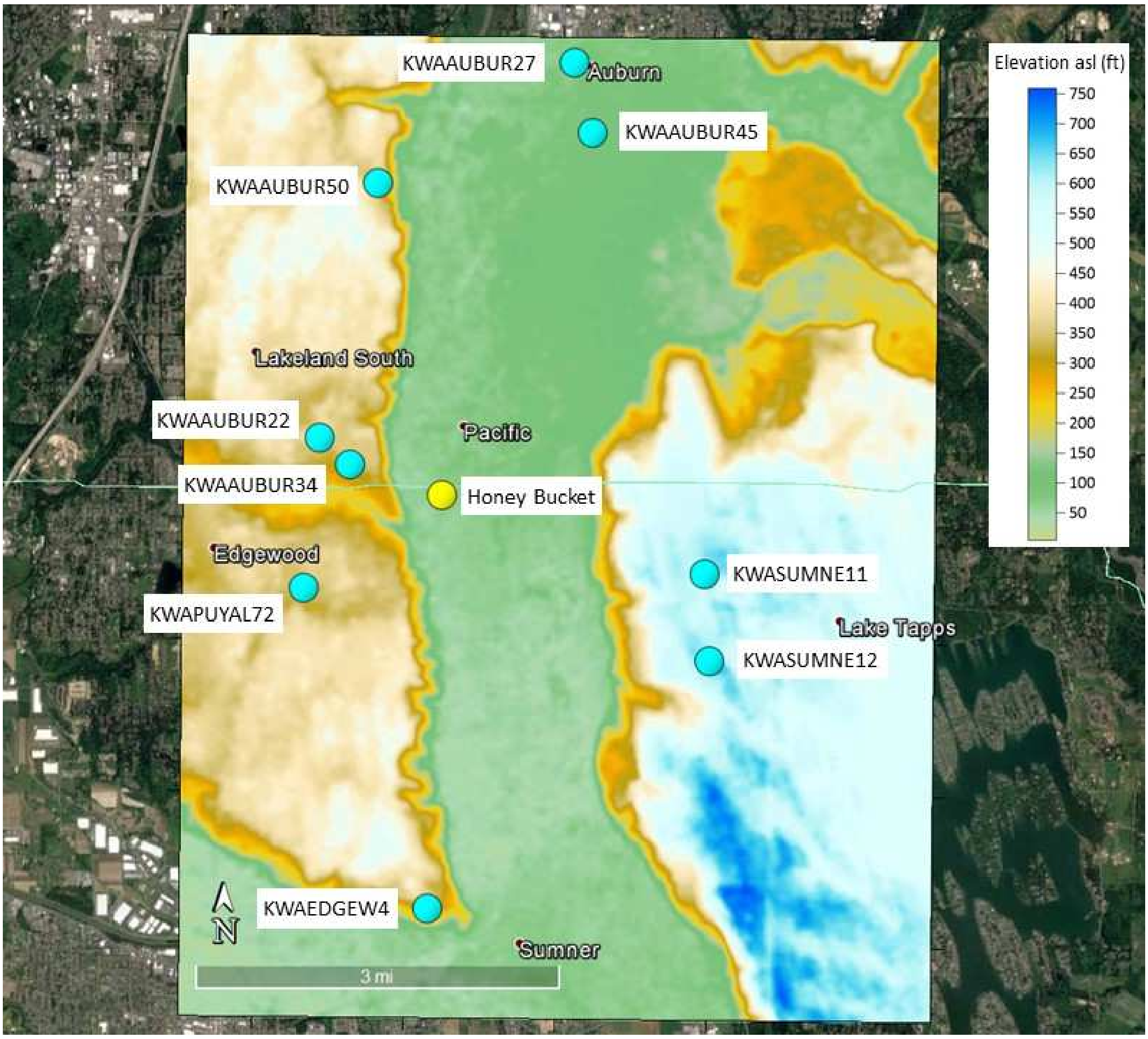

Figure 5. Terrain elevation at Weather Underground personal weather stations (cyan circles).

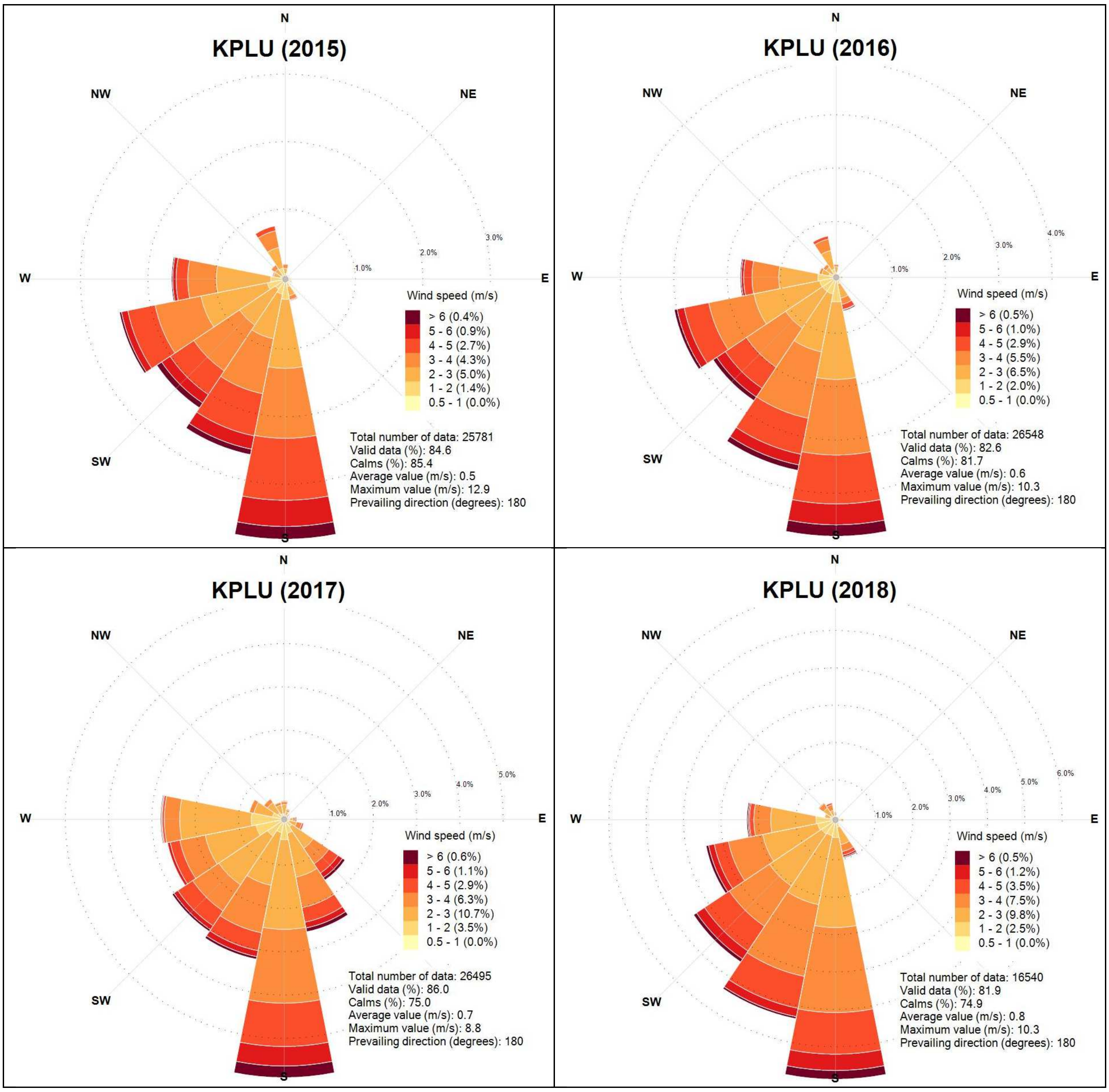

Figure 6. Wind roses of KPLU (Pierce County Airport - Thun Field) for years 2015, 2016, 2017 and 2018 (Jan-Jul).

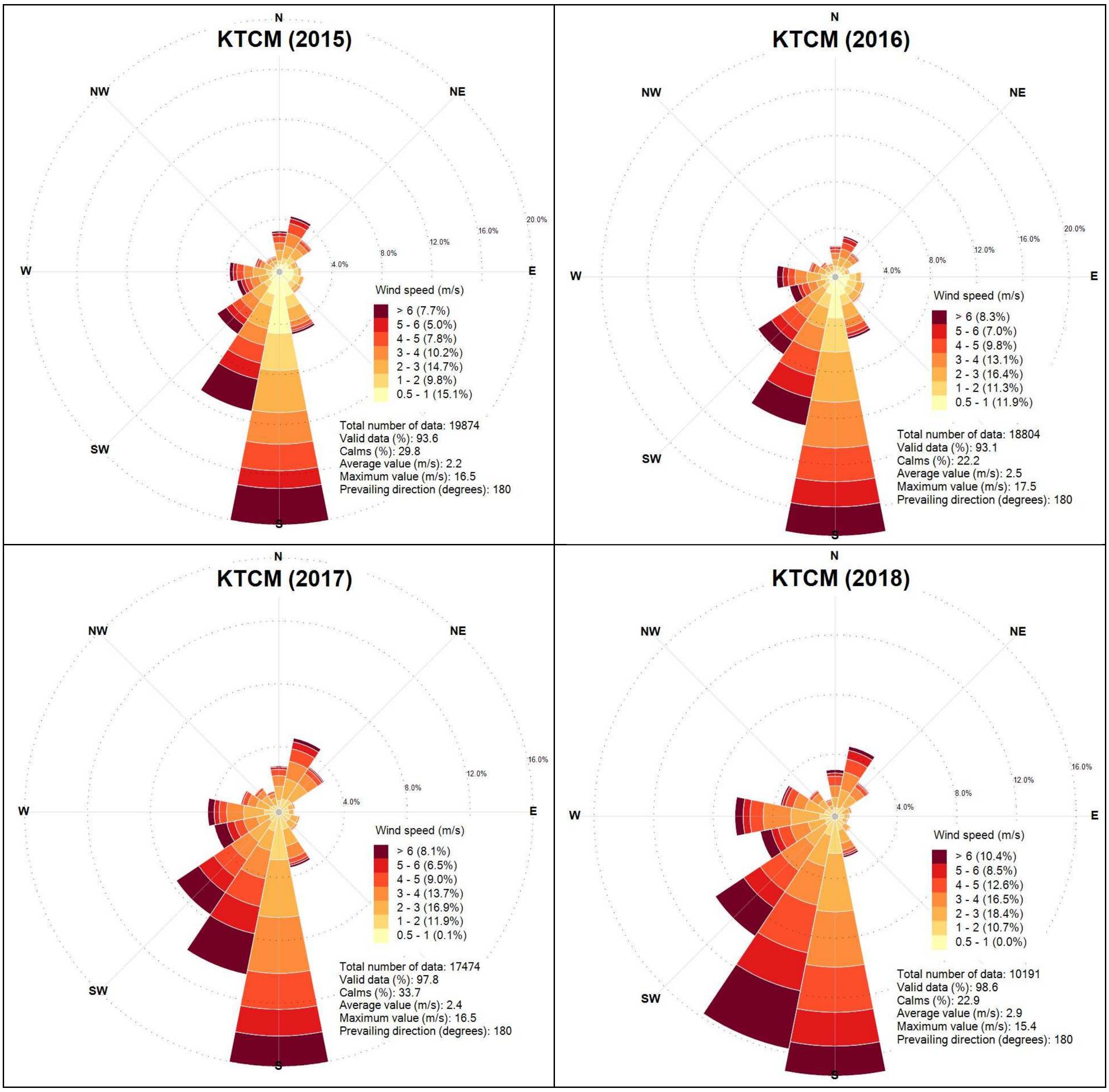

Figure 7. Wind roses of KTCM (McChord Field Airport - Joint Base Lewis-McChord) for years 2015, 2016, 2017 and 2018 (Jan-Jul).

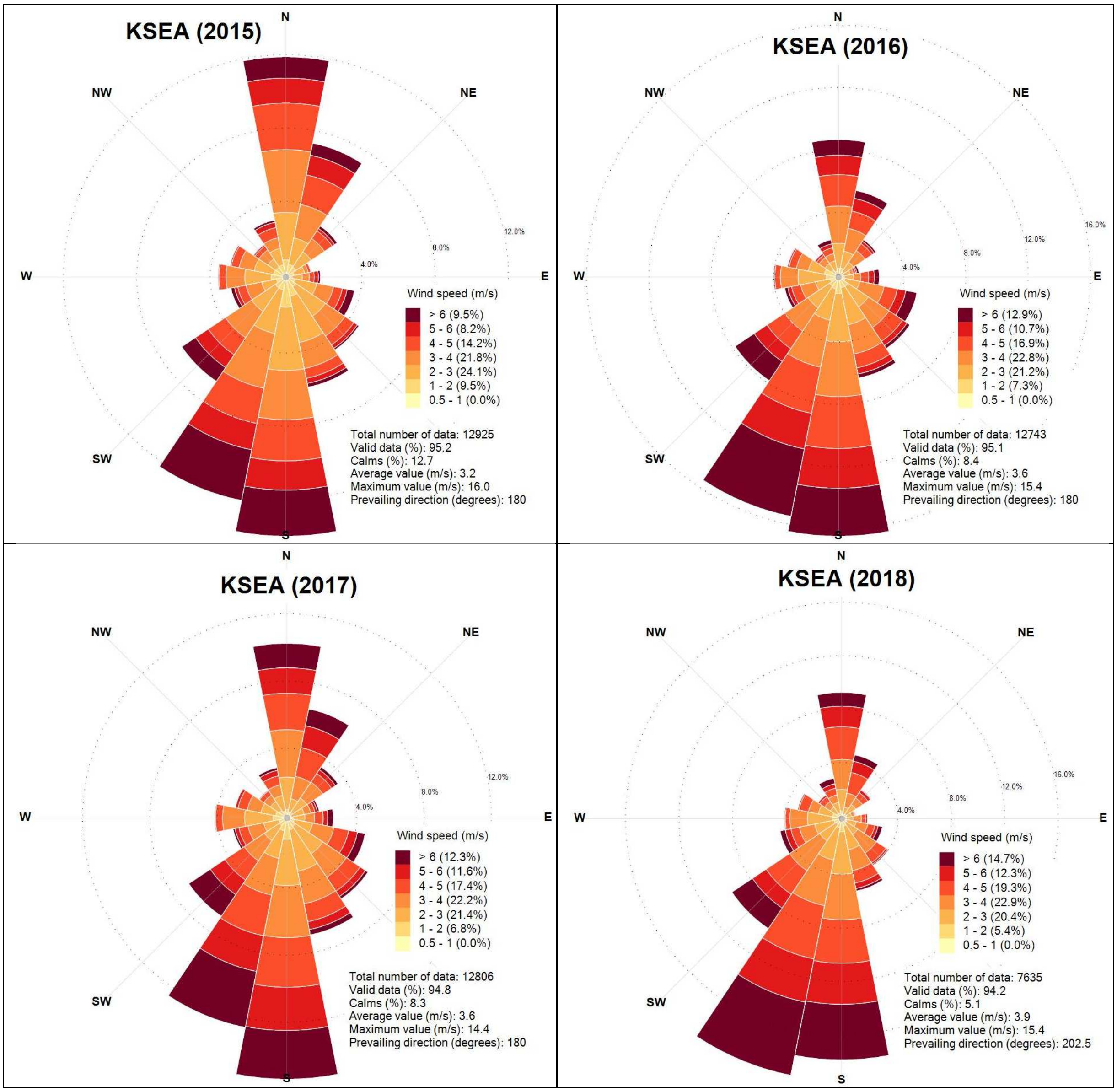

Figure 8. Wind roses of KSEA (Seattle-Tacoma International Airport) for years 2015, 2016, 2017 and 2018 (Jan-Jul).

3. The Odor Complaints

We received the original odor complaints from residents in the Class Area as PDF files[15]. We organized the complaints in an Excel file with a specific structure, as illustrated in the screenshot in Figure 9.

	A	B	C	D	E	F	G	H	I	J	
1	Complaint #	PDF page #	Date	Time LT (final)	Comments	Hours	Duration (min)	From	To	Input	File
2	1	1	09/07/2015	12:00			20	09/07/2015 11:40	09/07/2015 12:00	['09/07/2015','11:40','09/07/2015','12:00',1],	2015.pdf
3	2	1	09/07/2015	16:30			20	09/07/2015 16:10	09/07/2015 16:30	['09/07/2015','16:10','09/07/2015','16:30',1],	2015.pdf
4	3	1	10/07/2015	09:30			20	10/07/2015 09:10	10/07/2015 09:30	['10/07/2015','09:10','10/07/2015','09:30',1],	2015.pdf
5	4	1	10/07/2015	13:45			20	10/07/2015 13:25	10/07/2015 13:45	['10/07/2015','13:25','10/07/2015','13:45',1],	2015.pdf
6	5	1	13/07/2015	07:30			20	13/07/2015 07:10	13/07/2015 07:30	['13/07/2015','07:10','13/07/2015','07:30',1],	2015.pdf
7	6	1	13/07/2015	09:00			20	13/07/2015 08:40	13/07/2015 09:00	['13/07/2015','08:40','13/07/2015','09:00',1],	2015.pdf
8	7	1	13/07/2015	14:30			20	13/07/2015 14:10	13/07/2015 14:30	['13/07/2015','14:10','13/07/2015','14:30',1],	2015.pdf
9	8	1	14/07/2015	13:30			20	14/07/2015 13:10	14/07/2015 13:30	['14/07/2015','13:10','14/07/2015','13:30',1],	2015.pdf
10	9	2	16/07/2015	08:40			20	16/07/2015 08:20	16/07/2015 08:40	['16/07/2015','08:20','16/07/2015','08:40',1],	2015.pdf
11	10	2	16/07/2015	09:50			20	16/07/2015 09:30	16/07/2015 09:50	['16/07/2015','09:30','16/07/2015','09:50',1],	2015.pdf

Figure 9. Screenshot of the Excel file with organized complaints.

We used the following assumptions and procedures:

- For each odor complaint when the initial and final times were recorded, we used the exact time interval to define the duration of the complaint.
- Otherwise, if only one time was given, we assumed that this value represents the final time of the complaint and used two possible episode durations: 20-minute and 40-minute.
- We downloaded the ASOS 1-minute/5-minute data[16], at the KSEA station at Seattle-Tacoma International Airport, and analyzed them with AERMINUTE software[17] in order to delete invalid and suspicious data.
- One of the output files of AERMINUTE was used to create the wind roses for our analyses. (The final output file of AERMINUTE contains 1-hour average meteorological data that are used as input by AERMET. However, one of the intermediate files contains the “good” 1-minute meteorological data; we used this file to extract meteorology during odor complaints and to create the corresponding wind roses.)
- We created three types of wind roses using the one-minute wind data contained in the AERMINUTE intermediate output file:

[15] See section 1.1 of this report.

[16] As explained in the AERMINUTE user’s guide, the 1-minute ASOS wind data consists of running 2-minute average winds, reported every minute, for commissioned ASOS stations. The 1-minute ASOS wind data can be obtained through the National Climatic Data Center (NCDC) website at ftp://ftp.ncdc.noaa.gov/pub/data/asos-onemin/

[17] https://www.epa.gov/scram/meteorological-processors-and-accessory-programs

(Cont’d on next page)

1. A wind rose for all the one-minute intervals of the whole period of analysis (June 2015 – June 2018)[18] showing the general wind behavior in the region.
2. A wind rose just using all the one-minute time intervals during days when at least one odor complaint was recorded.
3. A wind rose only using the wind measured during the specific one-minute time intervals of the complaints. For complaints of unknown duration, we assumed both 20-minute and 40-minute durations, thus creating two different wind roses.

The four wind roses are presented in Figure 10, Figure 11, Figure 12 and Figure 13, respectively. The purpose of these figures is to ascertain whether or not the complaints show meaningful correlation with meteorology, i.e., whether or not people in the Class filed odor complaints more frequently when the winds were actually moving air masses from the South-Southwest arc. It must be noted, however, that a higher occurrence of odors in the Class Area is not limited to the presence of winds from South. In fact, calm conditions and low winds with fluctuating wind direction, may also favor possible local movements of air masses from the South-Southwest arc, thus impacting the Class Area.

The analysis of the four wind roses shows a clear correlation between odor complaints and an increased frequency of winds from the arc Southeast–Southwest (135 to 225 degrees from North). This is also confirmed by another plot, in Figure 14, showing that the frequency of winds from Southeast-Southwest increases from 47.5% to about 59% - a 24% increase - for time intervals covering the odor complaints. The wind direction interval for this analysis has been selected by basic geometrical considerations, as depicted in Figure 15.

[18] We received a complaint dated August 1, 2018, but the ASOS data for August 2018 are not available yet.

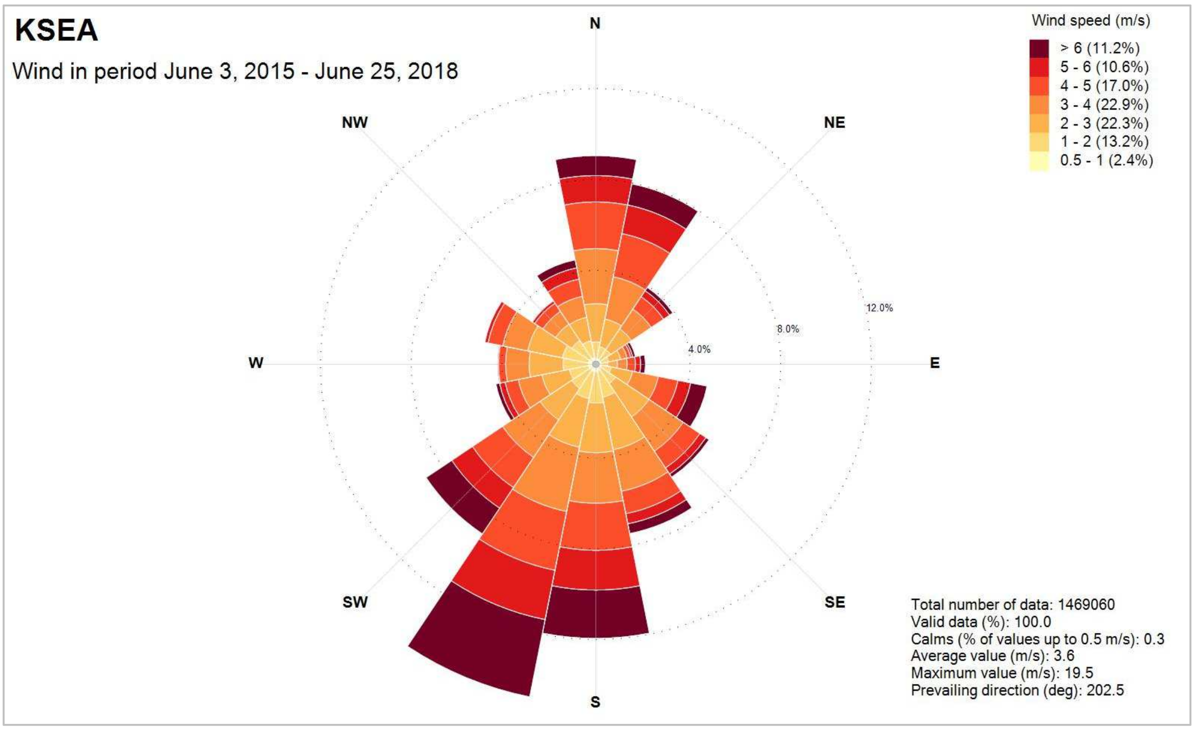

Figure 10. Whole period wind rose (June 2015 – June 2018). ASOS 1-minute data.

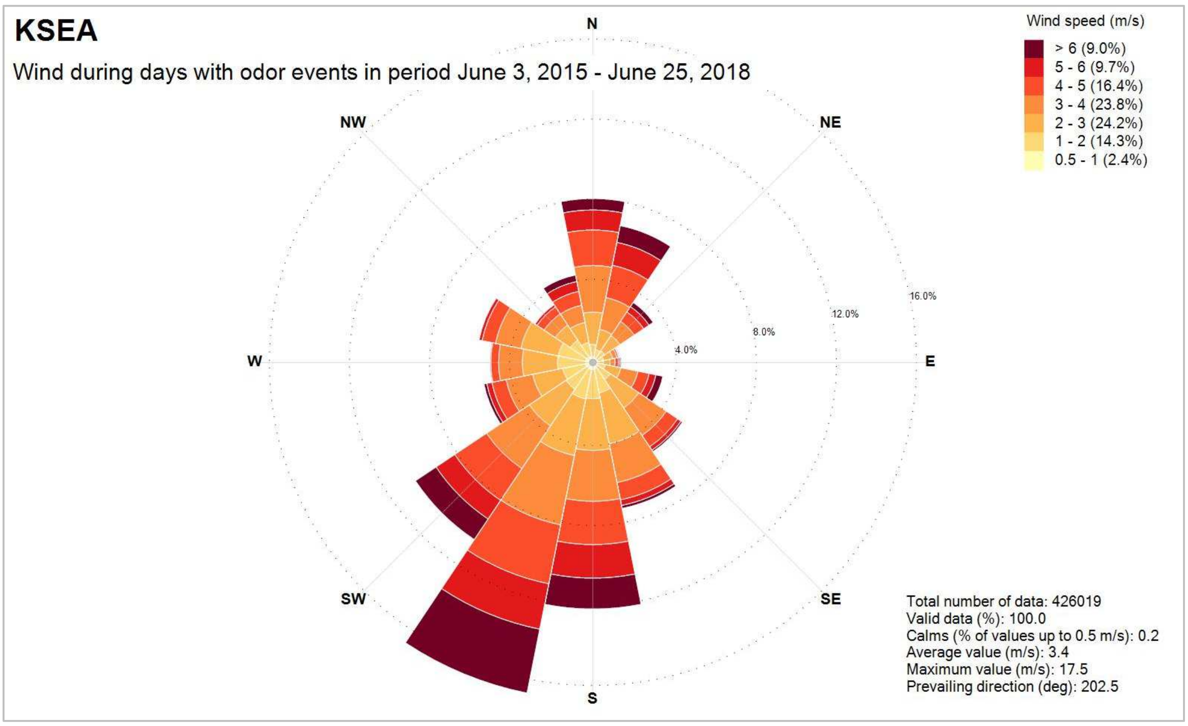

Figure 11. Wind rose with meteorology of the days at which at least one complaint was registered. ASOS 1-minute data.

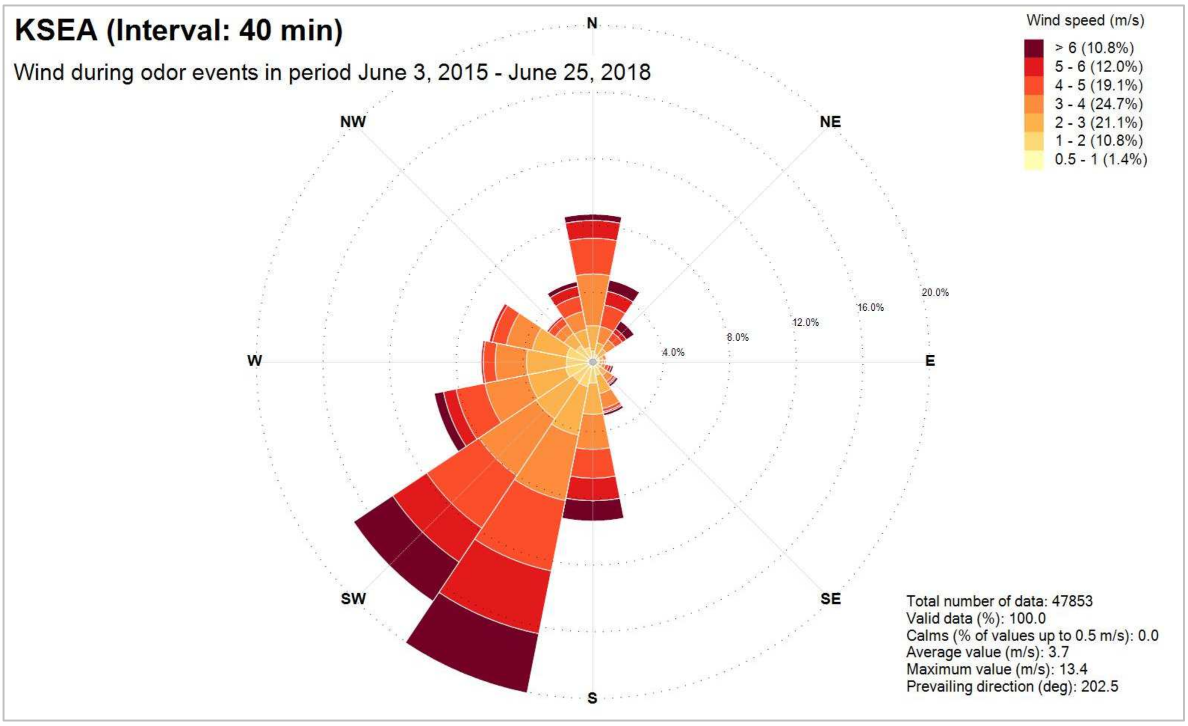

Figure 12. Wind rose with meteorology during the complaints (assuming 40 minutes for unknown durations). ASOS 1-minute data.

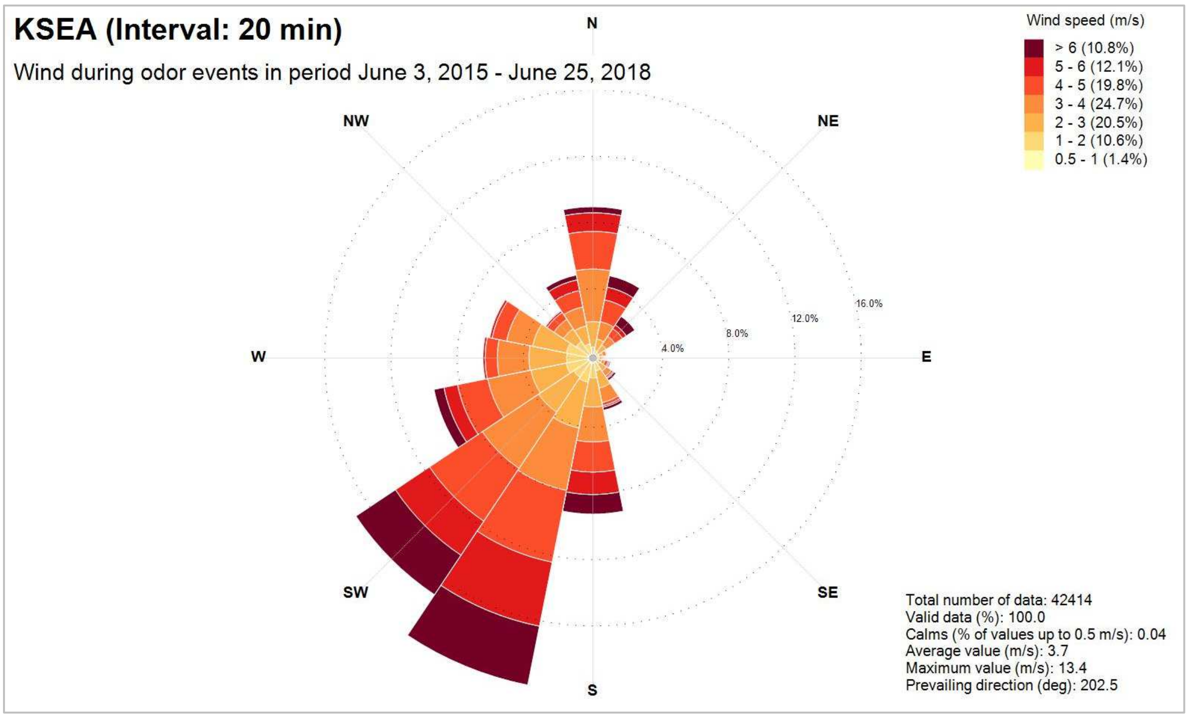

Figure 13. Wind rose with meteorology during the complaints (assuming 20 minutes for unknown durations). ASOS 1-minute data.

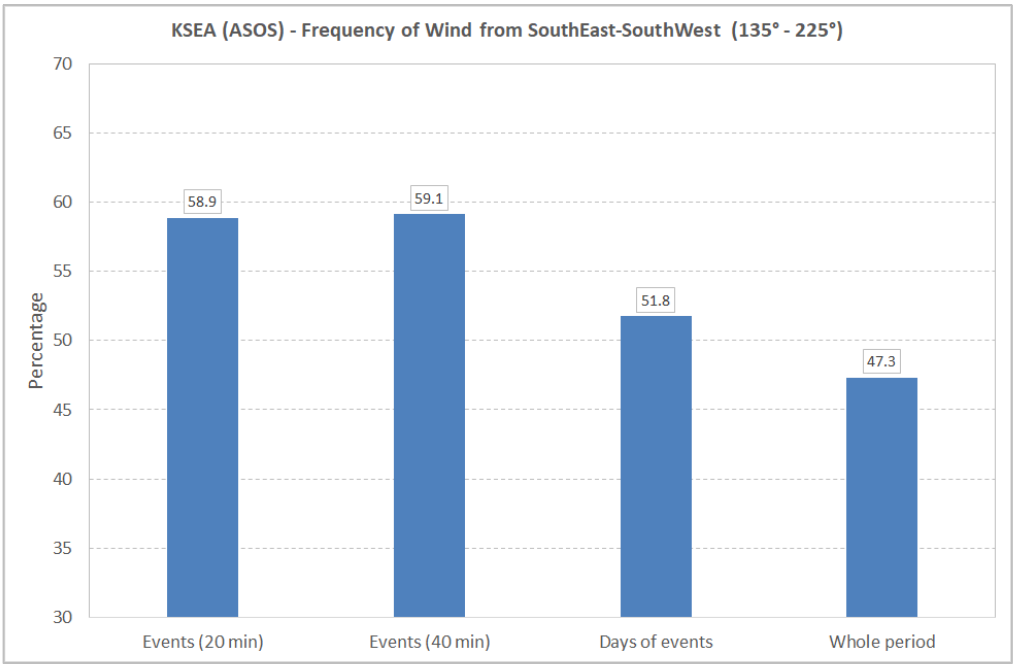

Figure 14. Frequency of winds blowing from SE-SW. KSEA (ASOS 1-minute data).

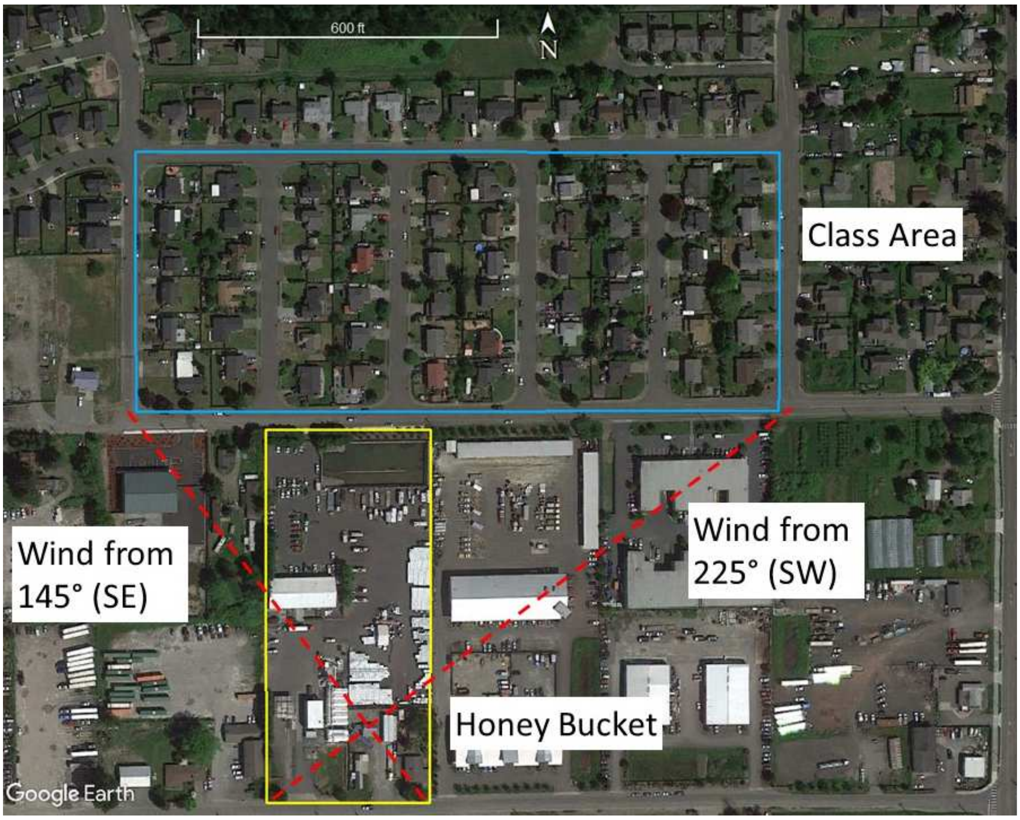

Figure 15. Wind directions blowing odor from the facility over the Class Area.

The increase in frequency of odor complaints when winds blow from the arc Southeast–Southwest is confirmed by repeating the analysis with the ISH wind data of KSEA (Figure 16) and KTCM (Figure 17) airports.

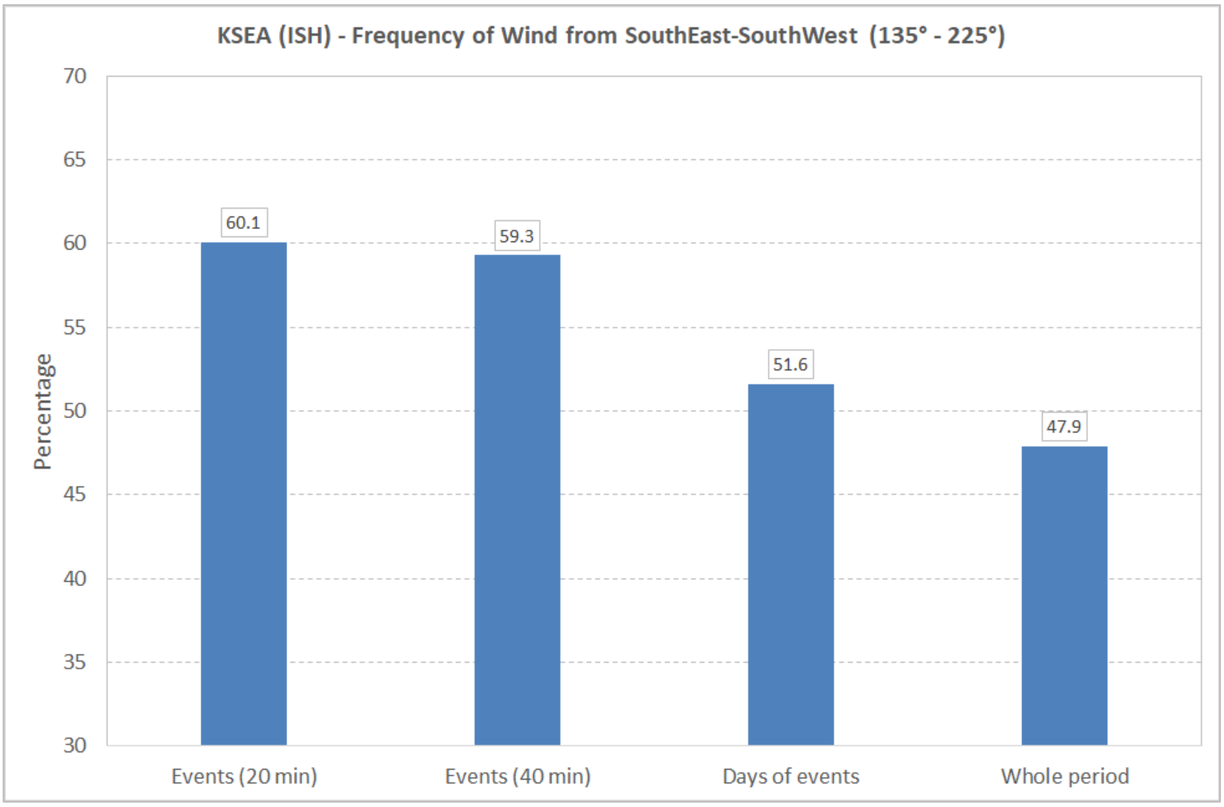

Figure 16. Frequency of winds blowing from SE-SW. KSEA (ISH data).

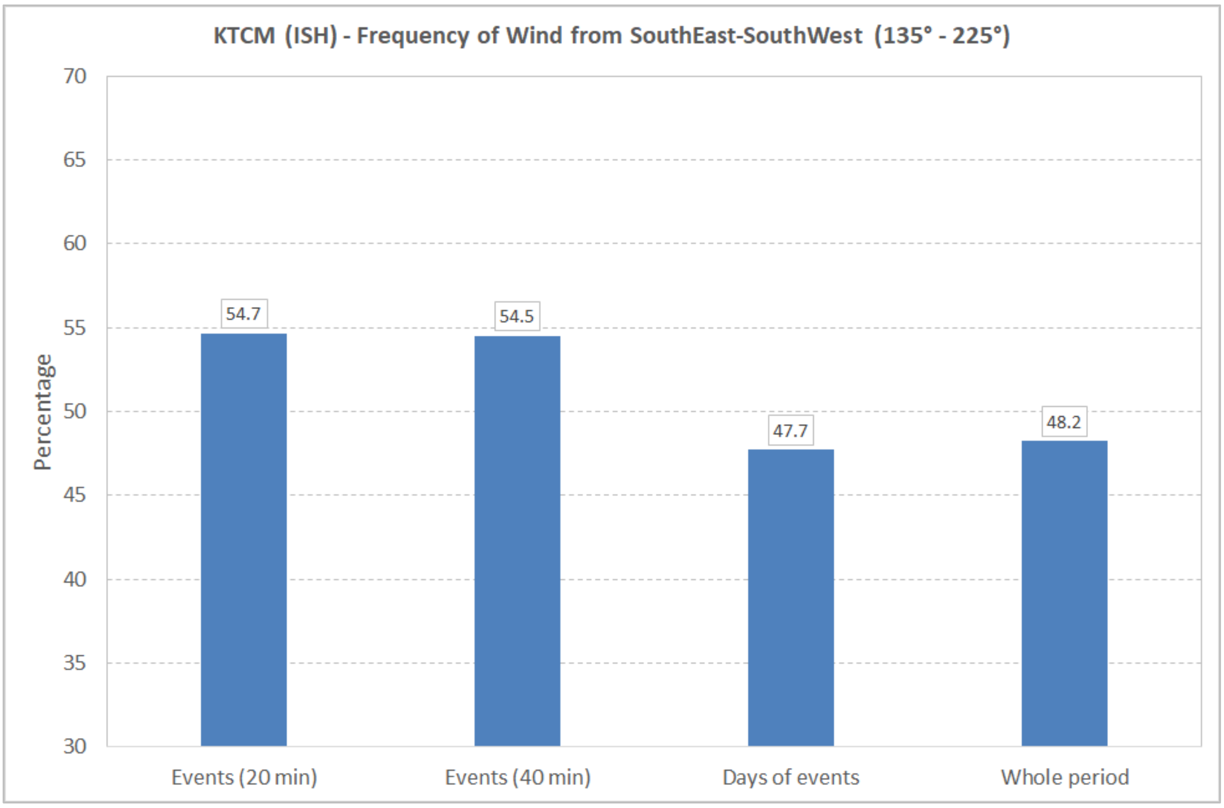

Figure 17. Frequency of winds blowing from SE-SW. KTCM (ISH data).

4. Analysis of Mr. Dodge's Maps

Mr. Jack Dodge is the Community Development Manager[19] of City of Pacific, Washington. He was notified in many occasions when the plaintiffs filed an odor complaint, and at other times apparently made visits to the Class area on his own. On some of the occasions when he personally experienced odors he prepared hand-drawn odor maps based upon his evaluation of the area of odor impact.

We examined the maps prepared by Mr. Dodge showing his estimates of odor impacts in the area during several days. We assumed that the times he reported were in local time and extracted the meteorological data measured at those times[20] at the Seattle Tacoma airport (KSEA), located about 13.5 miles from the area of interest.

From Figure 18 to Figure 28 we show the 11 maps prepared by Mr. Dodge, with the meteorological data we extracted (wind speed and wind direction). In the following maps the facility is located in the area numbered 230, which, in some figures, is colored in brown/pink. In summary:

- For August 2, 2016: there is excellent correlation between Mr. Dodge's odor map and wind direction (from Southwest)
- For August 9, 2016: there is excellent correlation between Mr. Dodge's odor map and wind direction (from South-Southwest)
- For September 1, 2016: there is excellent correlation between Mr. Dodge's odor map and wind direction (from Southwest)
- For September 5, 2016: there is excellent correlation between Mr. Dodge's odor map and wind direction (from South)
- For February 7, 2017: there is a poor correlation between Mr. Dodge's odor map and wind direction (from South).

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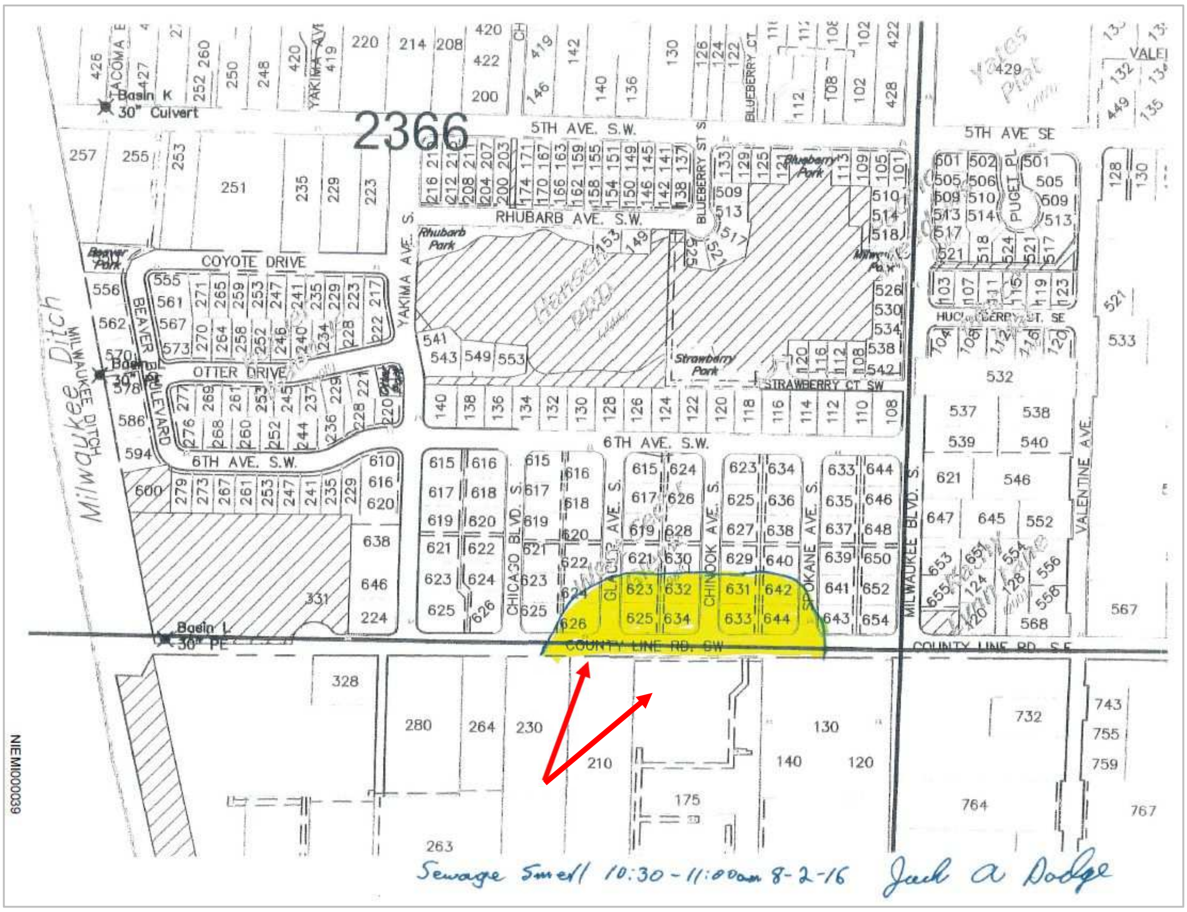
[19] http://www.pacificwa.gov/contact_us/staffdirectory.htm

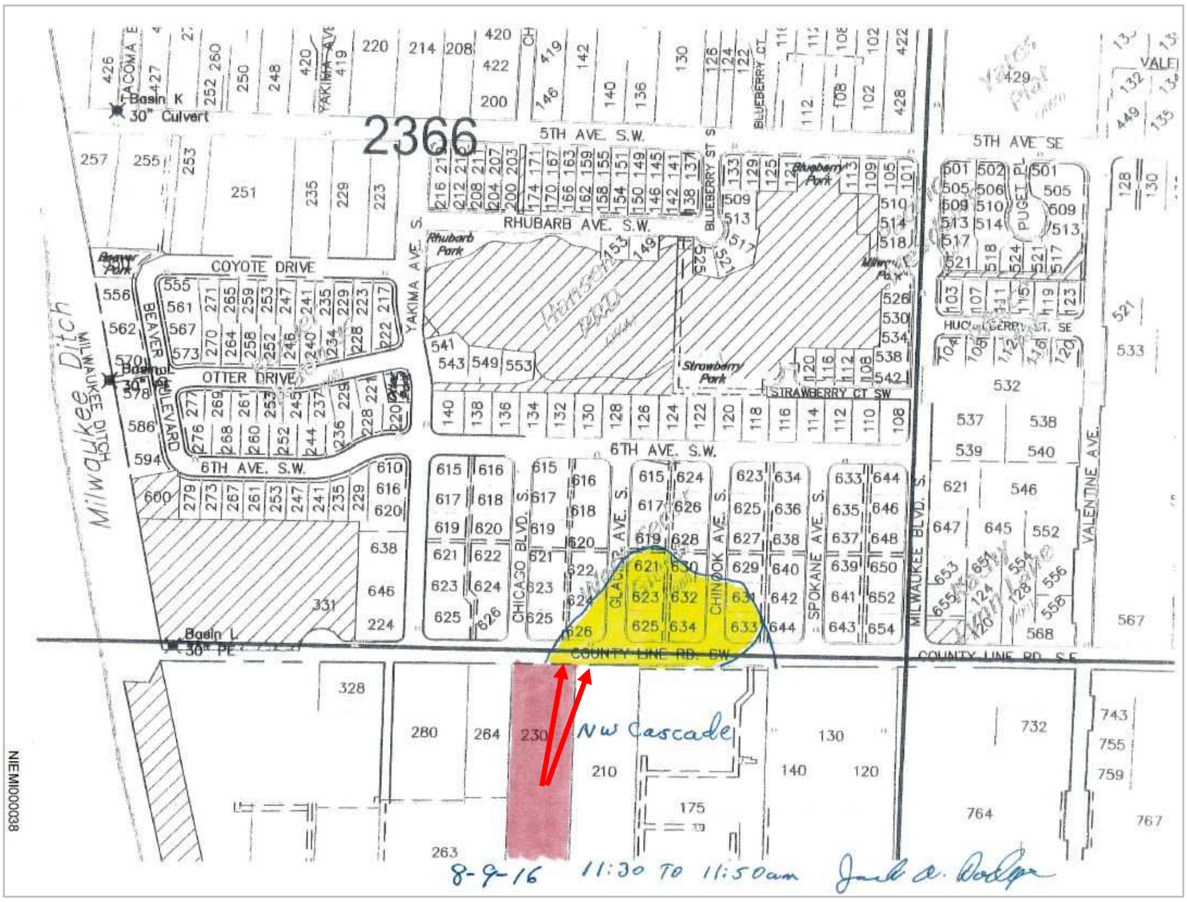
[20] Note that times of meteorological data at KSEA are in Coordinated Universal Time (UTC). Therefore, we considered a difference of 7 or 8 hours, depending on Daylight saving time (DST) active or not.

- For February 9, 2017: there is a good correlation between Mr. Dodge's odor map and wind direction (from South-Southwest)
- For February 21, 2017: there is a poor correlation between Mr. Dodge's odor map and wind direction (from East); however, winds are very low and, in these conditions, wind direction can strongly fluctuate
- For August 9, 2017: there is a weak correlation between Mr. Dodge's odor map and wind direction (from Northwest); however, winds are very low and, in these conditions, wind direction can strongly fluctuate
- For August 11, 2017: 2016: there is excellent correlation between Mr. Dodge's odor map and wind direction (from Southwest)
- September 15, 2017: there is excellent correlation between Mr. Dodge's odor map and wind direction (from North). This map is particularly important because it is the only one related to a complaint south of the plant.
- March 30, 2018: there is excellent correlation between Mr. Dodge's odor map and wind direction (from South)



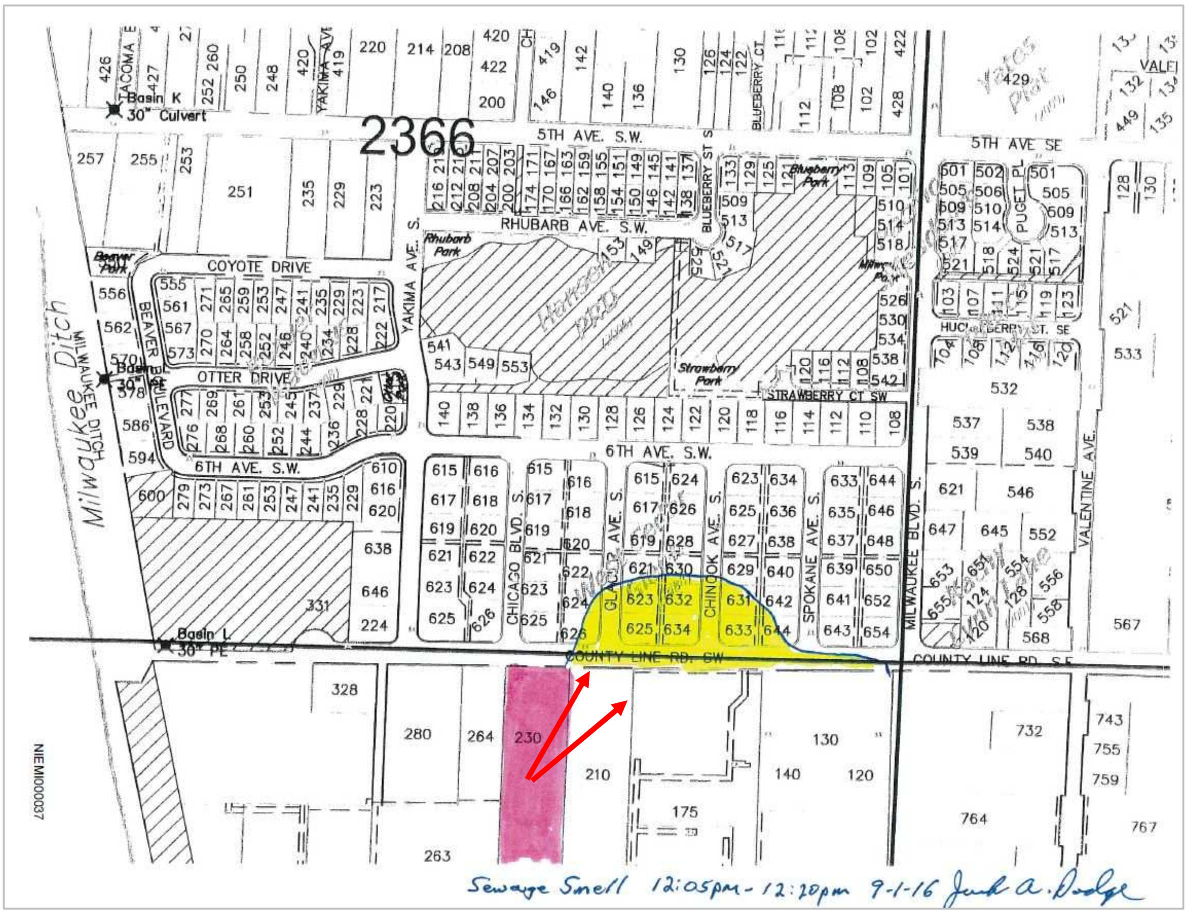
Date/Time (UTC)	WD (deg)	WS (m/s)
2016-08-02T16:53	200	4.6
2016-08-02T17:53	210	5.1
2016-08-02T18:00	210	5.1
2016-08-02T18:53	230	4.6

Figure 18. Mr. Dodge odor map of August 2, 2016, and corresponding wind data. The two red arrows indicate the directions 200 degrees and 230 degrees.



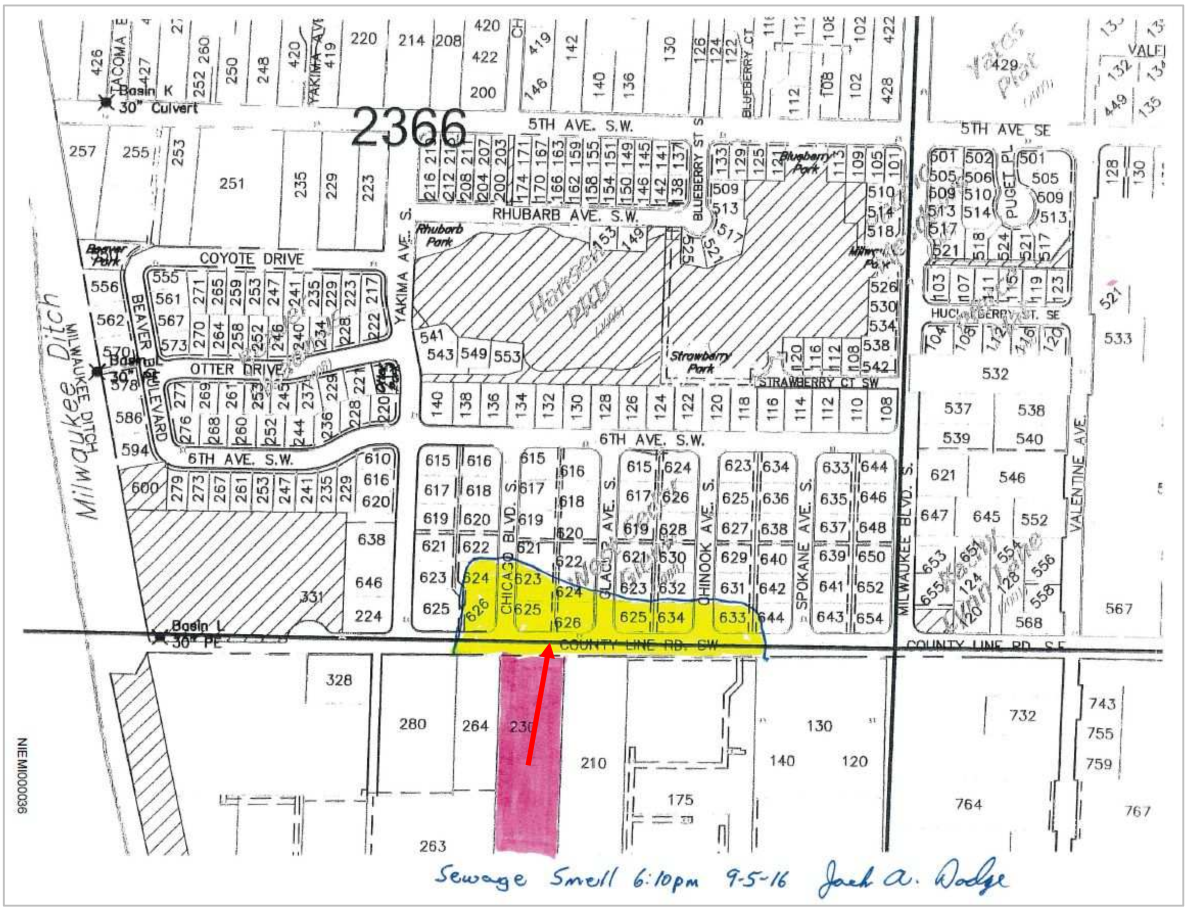
Date/Time (UTC)	WD (deg)	WS (m/s)
2016-08-09T18:14	200	3.1
2016-08-09T18:53	190	3.1

Figure 19. Mr. Dodge odor map of August 9, 2016, and corresponding wind data. The two red arrows indicate the directions 190 degrees and 200 degrees.



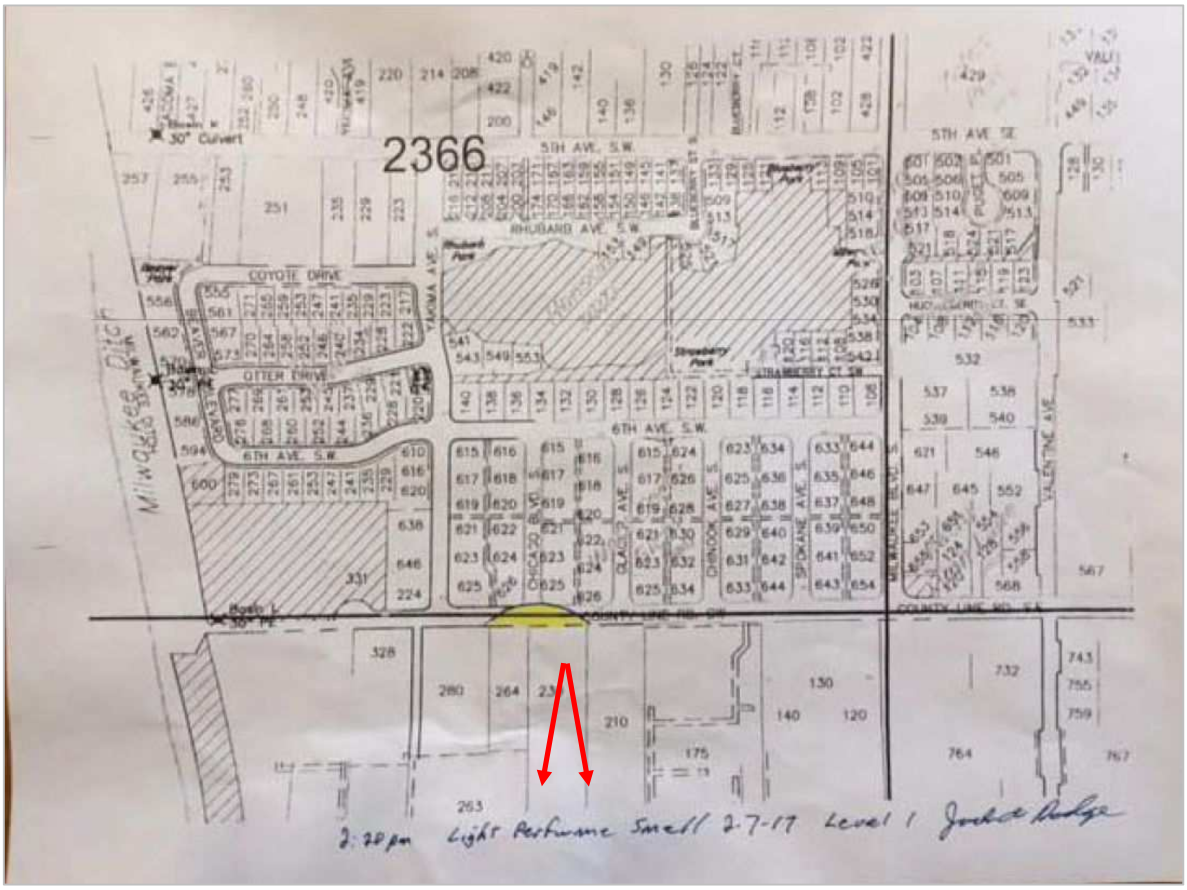
Date/Time (UTC)	WD (deg)	WS (m/s)
2016-09-01T18:53	210	3.6
2016-09-01T19:53	230	3.1

Figure 20. Mr. Dodge odor map of September 1, 2016, and corresponding wind data. The two red arrows indicate the directions 210 degrees and 230 degrees.



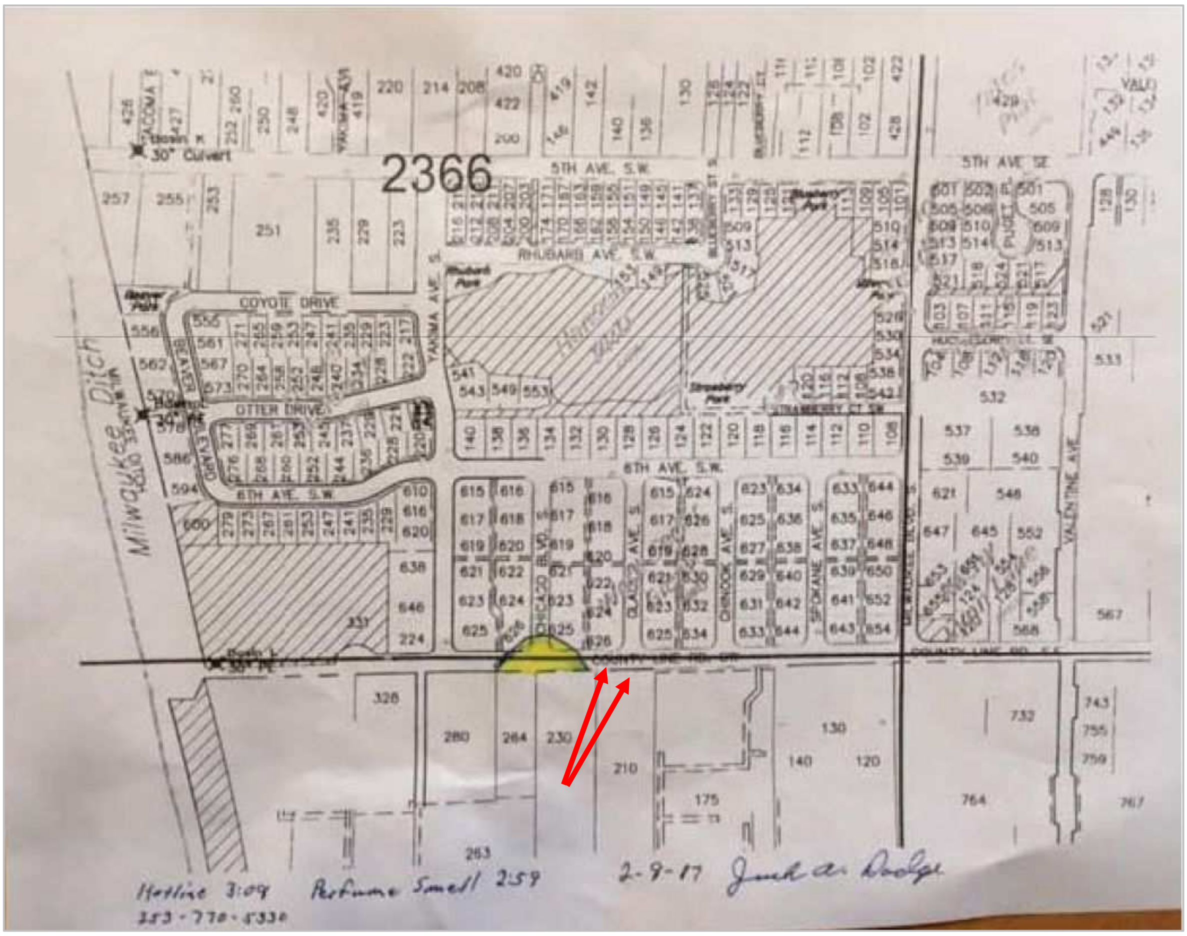
Date/Time (UTC)	WD (deg)	WS (m/s)
2016-09-06T00:53	190	2.1
2016-09-06T01:53	190	2.6

Figure 21. Mr. Dodge odor map of September 5, 2016, and corresponding wind data. The red arrow indicates the direction 190 degrees.



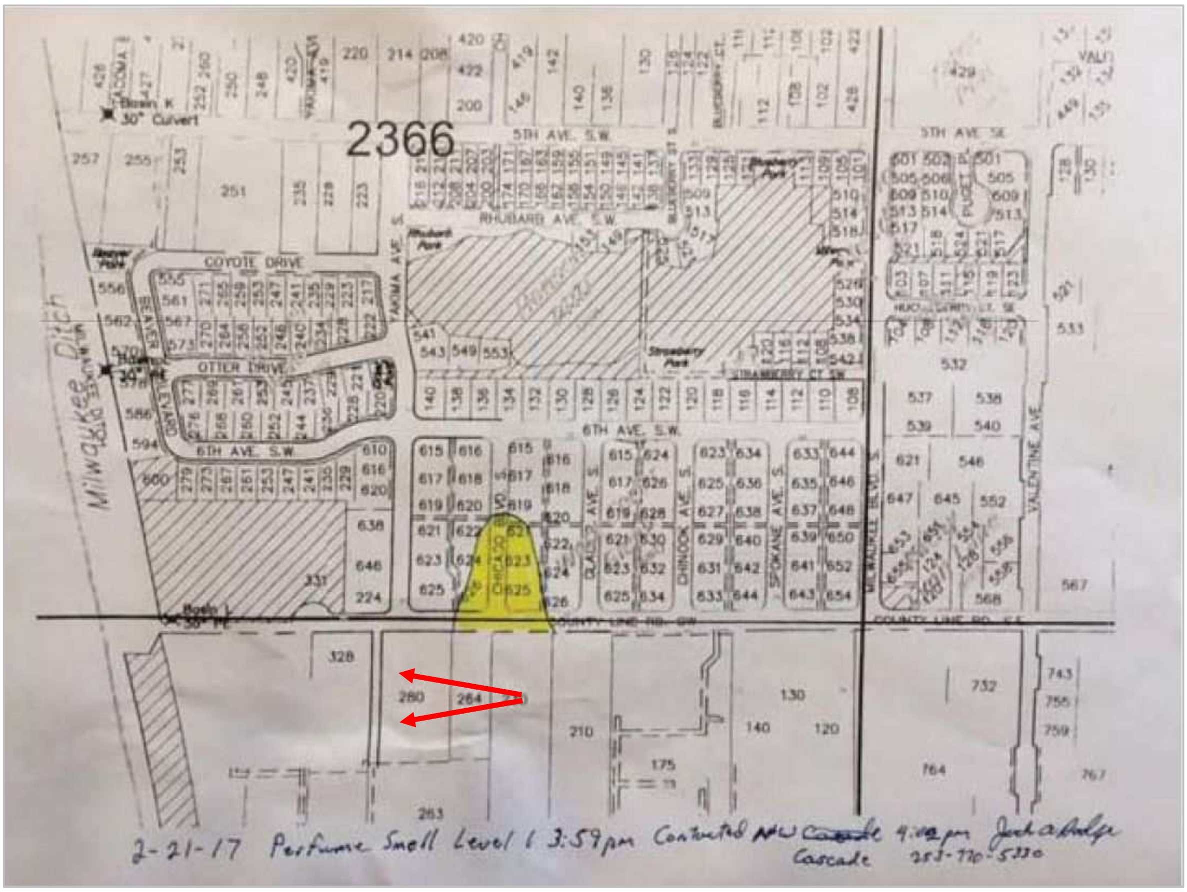
Date/Time (UTC)	WD (deg)	WS (m/s)
2017-02-07T21:53	350	5.1
2017-02-07T22:53	10	3.1

Figure 22. Mr. Dodge odor map of February 7, 2017, and corresponding wind data. The two red arrows indicate the directions 10 degrees and 350 degrees.



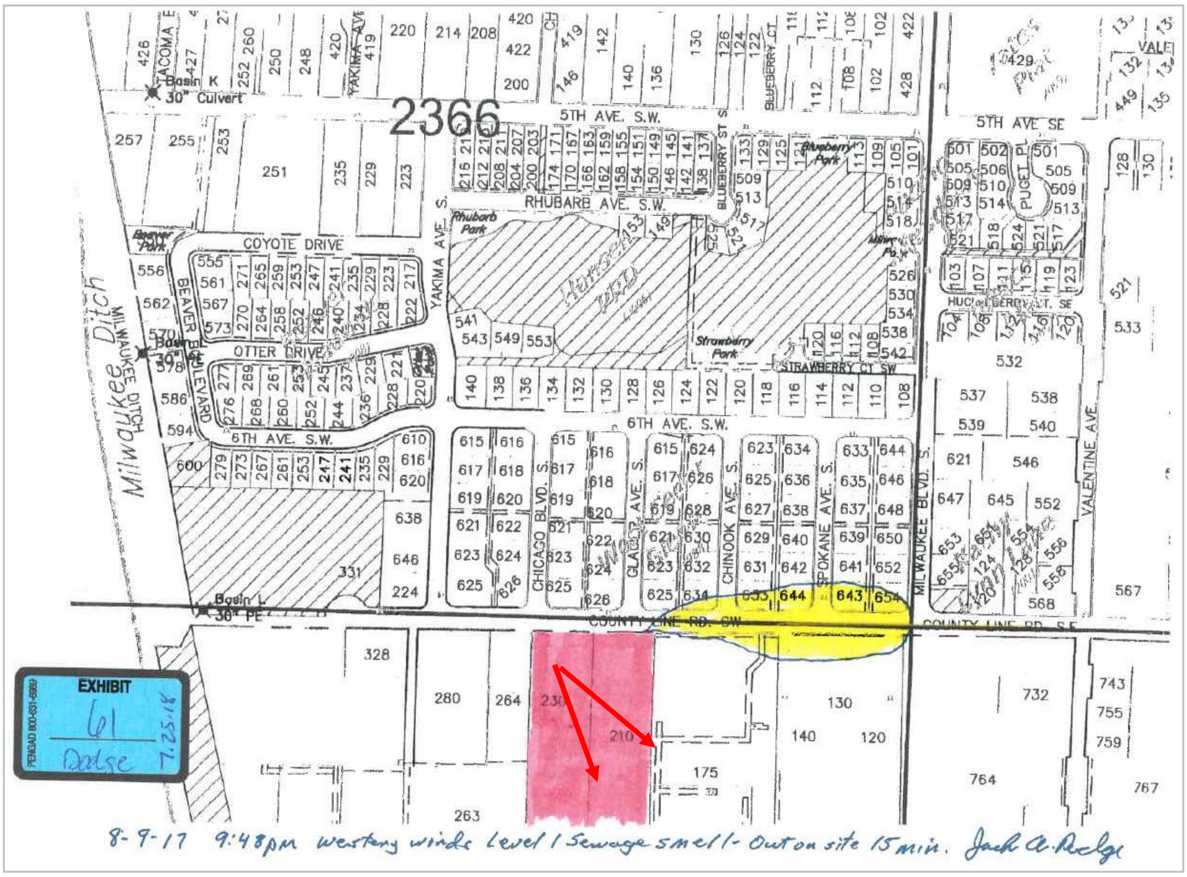
Date/Time (UTC)	WD (deg)	WS (m/s)
2017-02-09T22:53	200	10.8
2017-02-09T23:53	210	5.7

Figure 23. Mr. Dodge odor map of February 9, 2017, and corresponding wind data. The two red arrows indicate the directions 200 degrees and 210 degrees.



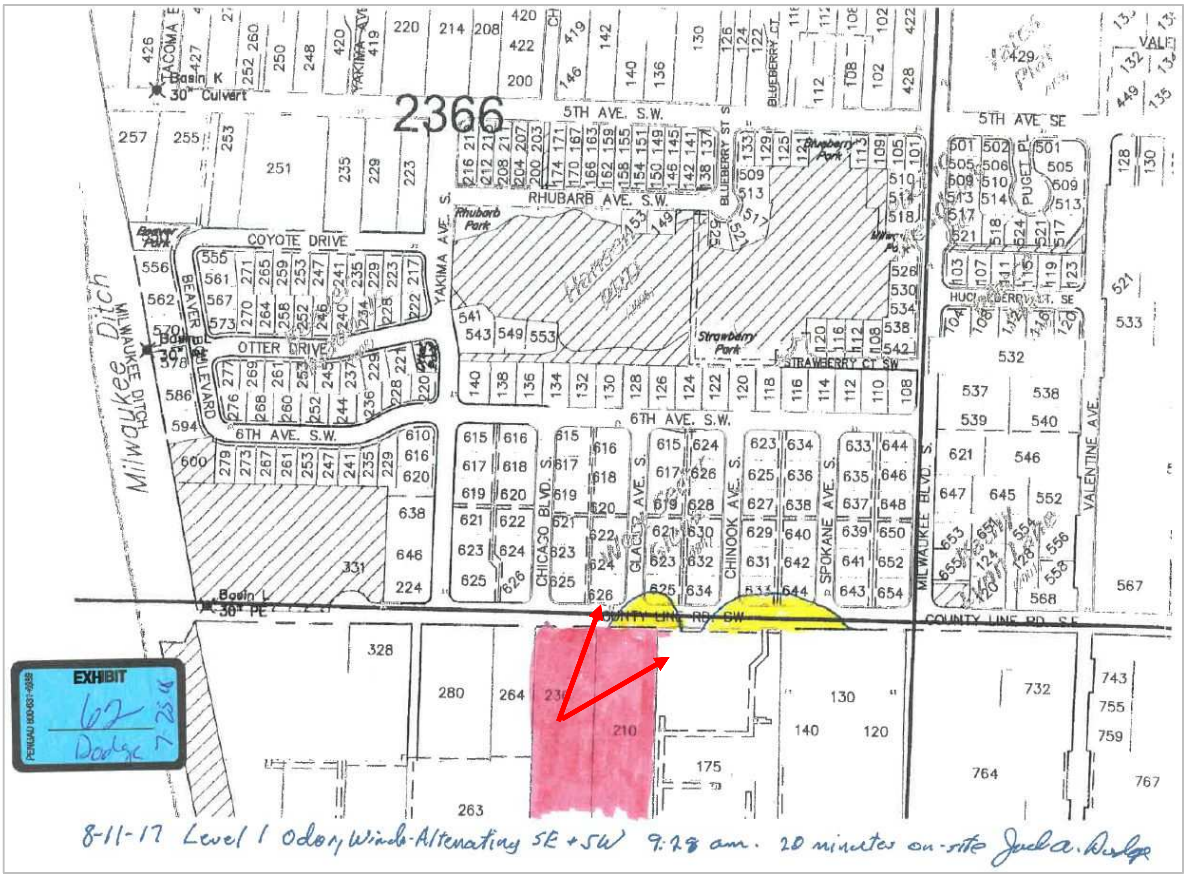
Date/Time (UTC)	WD (deg)	WS (m/s)
2017-02-21T23:51	80	2.1
2017-02-21T23:53	100	1.5
2017-02-22T00:00	100	1.5
2017-02-22T00:28	Calm	Calm

Figure 24. Mr. Dodge odor map of February 21, 2017, and corresponding wind data. The two red arrows indicate the directions 80 degrees and 100 degrees.



Date/Time (UTC)	WD (deg)	WS (m/s)
2017-08-10T03:53	340	3.1
2017-08-10T04:53	Calm	Calm
2017-08-10T05:53	310	2.1

Figure 25. Mr. Dodge odor map of August 9, 2017, and corresponding wind data. The two red arrows indicate the directions 310 degrees and 340 degrees.

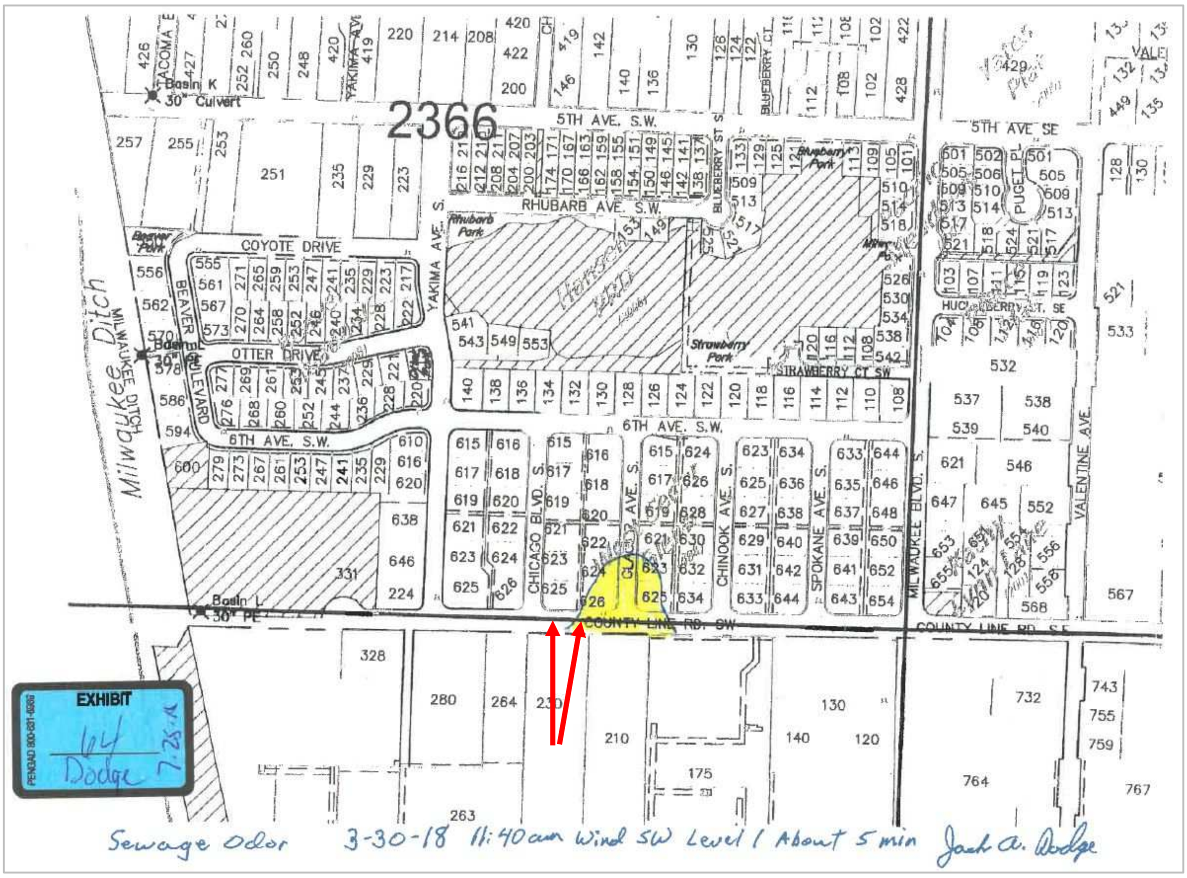


Date/Time (UTC)	WD (deg)	WS (m/s)
2017-08-11T16:10	220	2.6
2017-08-11T16:38	200	2.1
2017-08-11T16:53	240	2.6

Figure 26. Mr. Dodge odor map of August 11, 2017, and corresponding wind data. The two red arrows indicate the directions 200 degrees and 240 degrees.

Date/Time (UTC)	WD (deg)	WS (m/s)
2017-09-15T19:53	310	3.6
2017-09-15T20:53	320	3.1
2017-09-15T21:53	310	4.1

Figure 27. Mr. Dodge odor map of September 15, 2017, and corresponding wind data. The two red arrows indicate the directions 310 degrees and 320 degrees.



Date/Time (UTC)	WD (deg)	WS (m/s)
2018-03-30T18:00	190	6.2
2018-03-30T18:45	180	6.2
2018-03-30T18:53	190	7.2

Figure 28. Mr. Dodge odor map of March 30, 2018, and corresponding wind data. The two red arrows indicate the directions 180 degrees and 190 degrees.

5. Modeling of the Dependence of Impacts on Distance

In order to evaluate the dependence on distance of the impact of the facility, we have carried out a simulation with the AERMOD[21] Modeling System, the "preferred/recommended" model by the US Environmental Protection Agency (EPA) for short-range dispersion studies, such as the case under examination here.

5.1 The AERMOD modeling system

This model is fully accepted in the scientific community as a reliable method for simulating atmospheric transport of pollutants. AERMOD has been developed, accepted, and recommended by the EPA after decades of extensive peer-reviewed research, testing, validation, and calibration with actual measurements in many sites[22]. In other words, the AERMOD modeling system has been validated[23], with actual concentration measurements, by several experimental studies at different locations. AERMOD is routinely used, without any additional recalibration with local data, in the US and abroad for regulatory studies, urban and industrial planning, permitting, and research.

AERMOD is a steady-state plume model and is typically used to simulate a series of 1-hour average concentrations covering the entire duration of an emission scenario. In the stable boundary layer (SBL), it assumes the concentration distribution to be Gaussian in both the vertical and horizontal. In the convective boundary layer (CBL), the horizontal distribution is also assumed to be Gaussian, but the vertical distribution is described with a bi-Gaussian probability density function (pdf). Additionally, in the CBL, AERMOD treats "plume lofting," whereby a portion of plume mass, released from a buoyant source, rises to and remains near the top of the boundary layer before becoming mixed into the CBL. AERMOD also tracks any plume mass that penetrates into the elevated stable layer, and then allows it to re-enter the boundary layer when

[21] https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models
[22] http://www.epa.gov/ttn/scram/7thconf/aermod/aermod_mep.pdf
[23] https://www3.epa.gov/ttn/scram/models/aermod/aermod_mfed.pdf

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and if appropriate. For sources in both the CBL and the SBL, AERMOD treats the enhancement of lateral dispersion resulting from plume meander[24].

5.2 Odor Sources and Modeled Area Source

The facility presents various processing areas that can be sources of odors, including[25] the Receiving area, the Process building and tankage and the Portable toilet cleaning area (Figure 29, left). For the purpose of evaluating the pattern and relative impact on distance of the facility emissions, an area source S (Figure 29, right) has been defined and used in AERMOD for calculating the maximum one hour concentrations over the domain as shown in Figure 30. Odors, in fact, manifest their nuisance over very short exposure times and, therefore, short-term modeled concentrations are the most appropriate for such assessment.

In our AERMOD simulation, we used a constant, unit emission rate from the area source S to simulate the relative odor impact in the Class Area. This area source is located at ground level and has an initial vertical dispersion size equal to 3 m.

[24] https://www3.epa.gov/scram001/7thconf/aermod/aermod_mfd.pdf, p 12
[25] NW CascadeDeclaration of Thomas R. Card, PE - 6194661v1.PDF

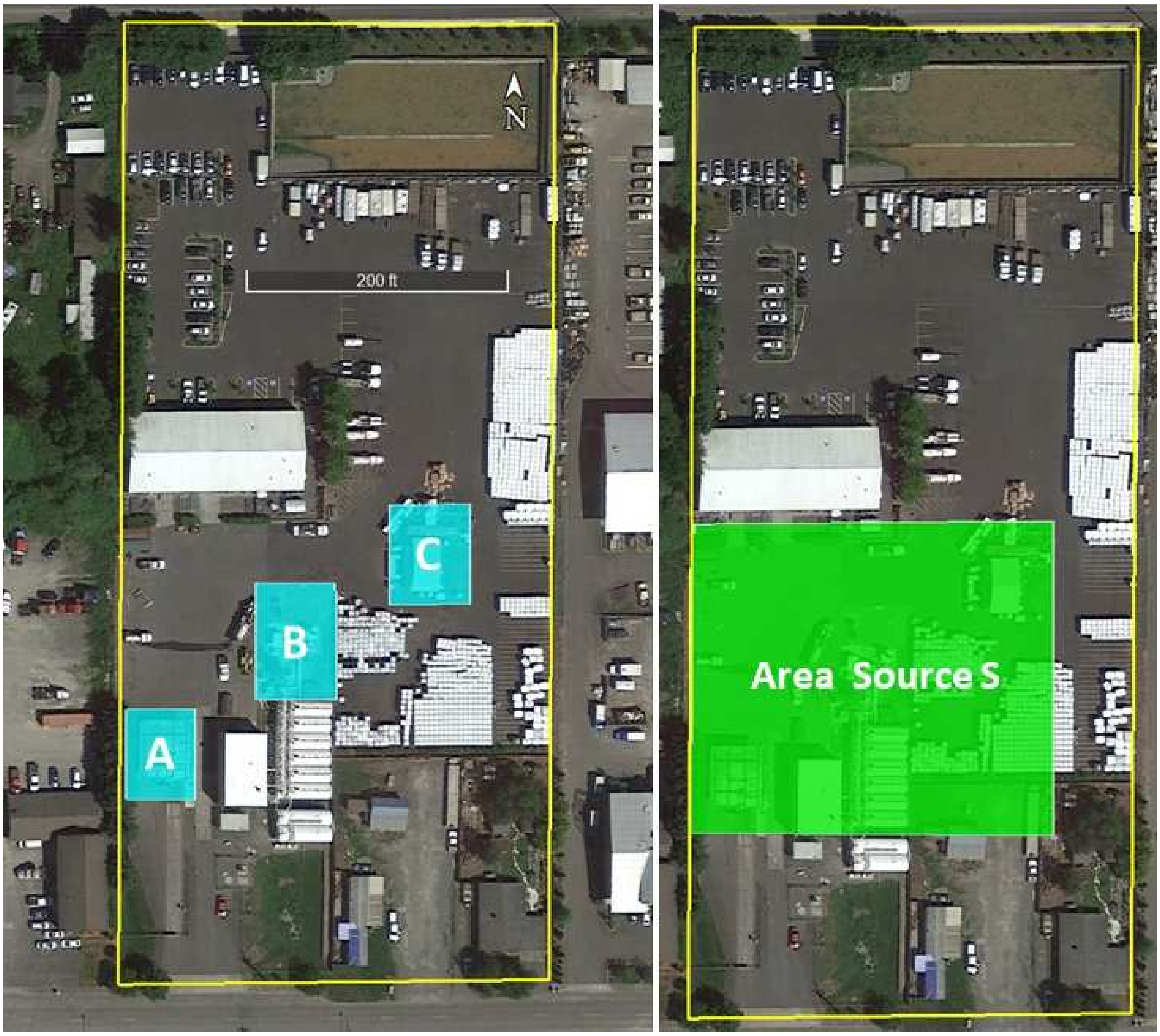

Figure 29. Left: Possible areas of odor emissions: Receiving area (A), Process building and tankage (B), Portable toilet cleaning area (C). Right: area source used for modeling with AERMOD.

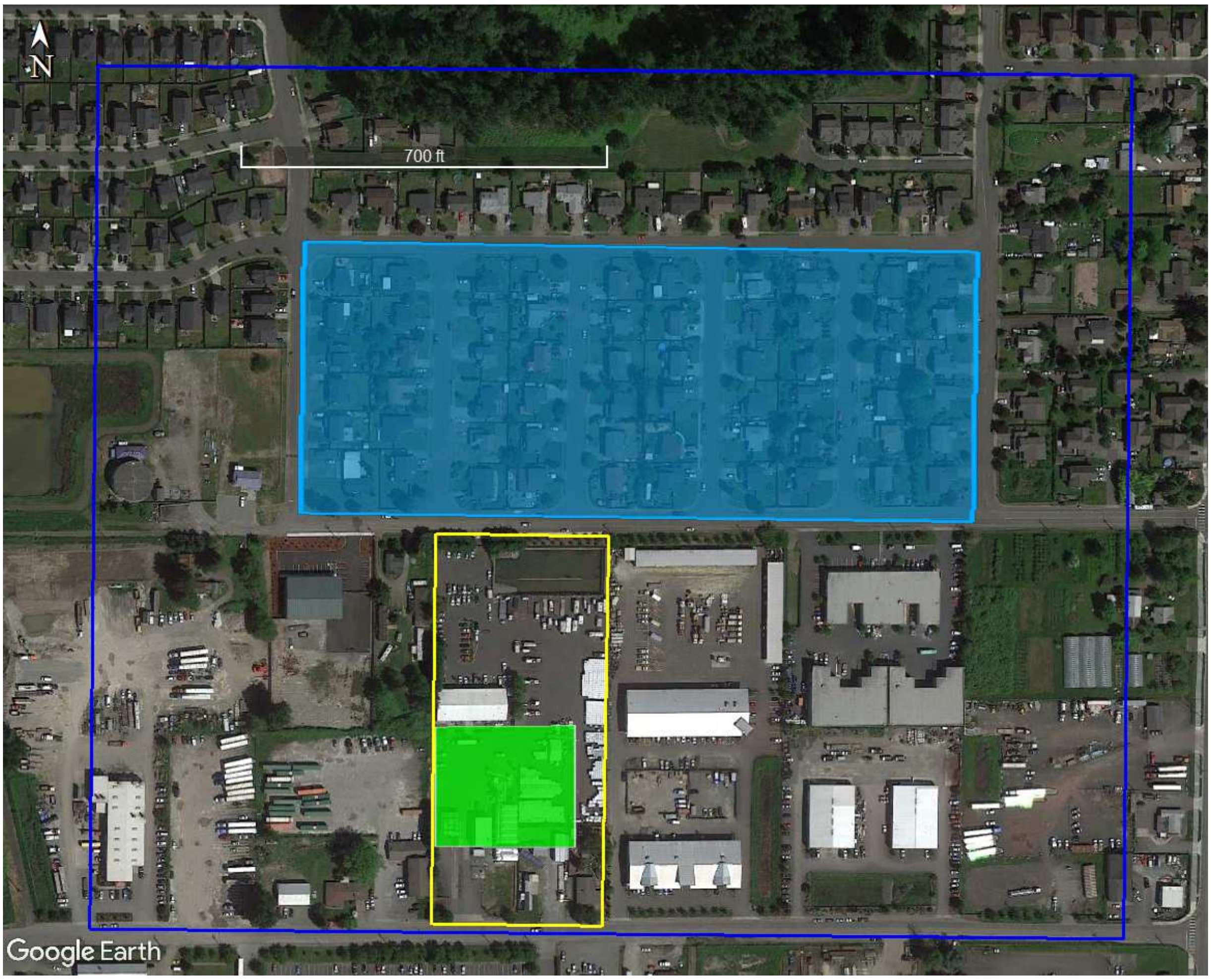

Figure 30. AERMOD modeling domain (blue line) encompassing facility (yellow line), area source (green rectangle) and class area (blue rectangle).

5.3 Meteorological input

AERMOD requires hourly inputs of meteorological data from a representative station at surface level and aloft. The AERMET[26] meteorological preprocessor of AERMOD was then applied using the meteorological surface data from station KSEA (Seattle-Tacoma International Airport) and

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26 https://www3.epa.gov/ttn/scram/7thconf/aermod/aermet_userguide.pdf

the radio sounding profile data from station KUIL (Quillayute, WA) for the whole year 2016. The wind rose obtained from the hourly output of AERMET is shown in Figure 31.

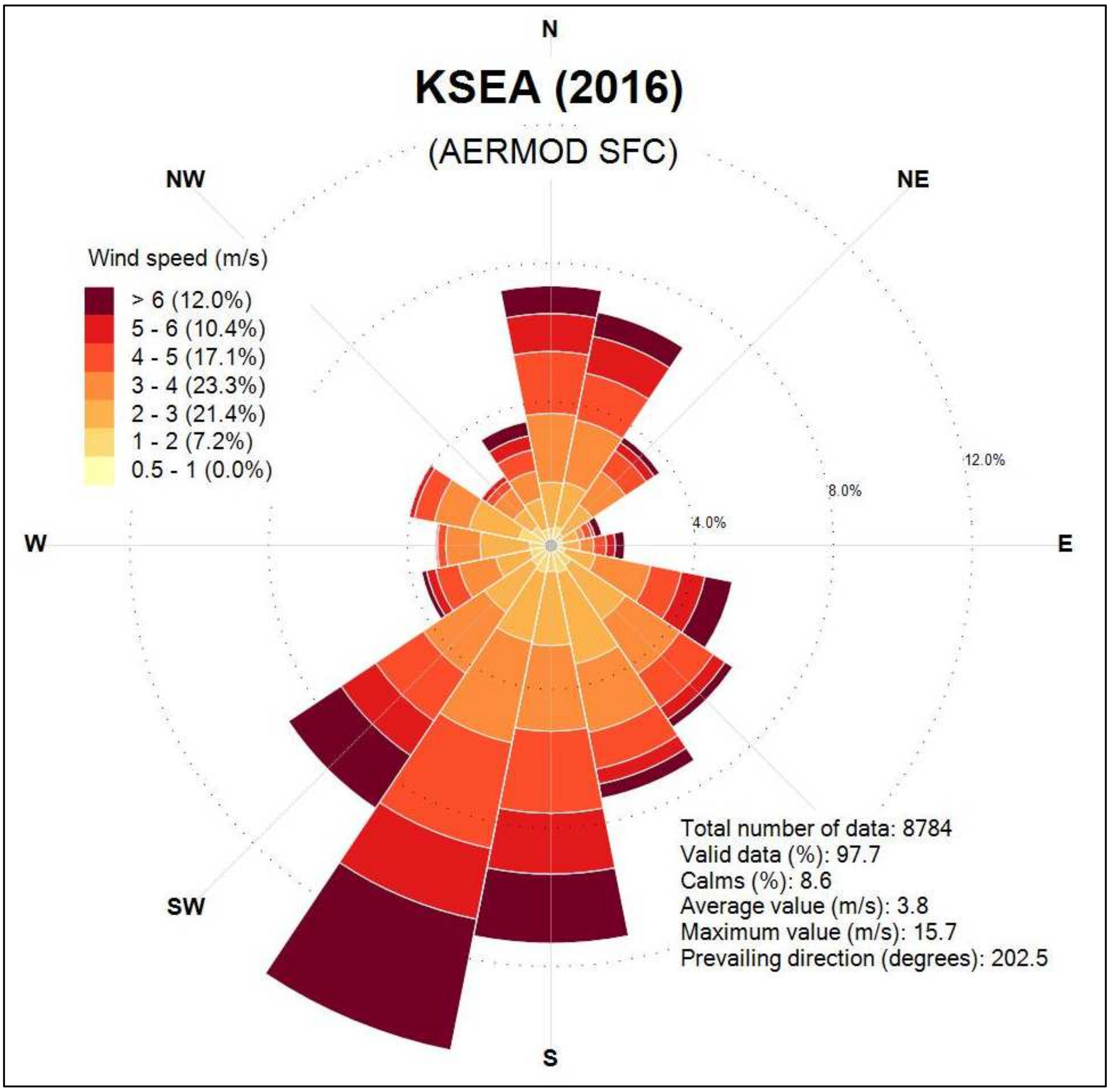

Figure 31. Wind rose of KSEA (Seattle-Tacoma International Airport) data for year 2016, after AERMET processing.

5.4 Maximum 1-hour concentrations

AERMOD maximum 1-hour concentrations contours are shown in Figure 32. These concentration contour levels are generated from a regular grid of AERMOD predicted values where for each grid point the maximum calculated hourly concentration over one year is used. The plot shows that the maximum concentration impact varies with distance. The variation can exceed 50% between closest and farthest points in the class area.

Figure 32. AERMOD maximum 1-hour concentrations.

6. Review of Performance test reports and Odor Study

BioAir Solutions, LLC conducted an Odor study[27] for two consecutive days (September 14 and 15, 2016) including: 1) the collection of ammonia, hydrogen sulfide, volatile organic compounds and reduced sulfur compound data from the headworks; 2) the assessment of the performance of the existing two stage chemical scrubber at the headworks; and 3) the designing of a system capable of fully eliminating the residual odors.

The study focused on the initial stages of the process: stage 1, Inlet Channel and Screen, and stage 2, Lift Station (Pre-mixing Chamber)[28]:

The outcomes of the study are set forth in a series of recommendations[29] that acknowledge the presence of problems both at design level and operational/maintenance level:

- *BioAir Recommendation 1: BioAir recommends updating the ductwork to ensure negative pressure for the Inlet Channel and Screen Building.*
- *BioAir Recommendation 2: BioAir recommends including separate ventilation duct for the Lift Station.*
- *BioAir Recommendation 3: BioAir recommends fixing ORP and pH controls for the second stage of the Chemical Scrubber.*
- *BioAir Recommendation 4: BioAir recommends evaluating adsorption system on the outlet from the Chemical Scrubbers.*
- *BioAir Recommendation 5: BioAir recommends evaluating a cover that would provide a tight, small ventilation space for the Solids Bin, to assure proper ventilation is being provided and sent through the existing acid chemical scrubber pre-treatment prior to adsorption system.*

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[27] 2016 10 16 Odor Study and Eng. Eval report.pdf

[28] *Ibid*. (NWC_0007860) "Inlet Channel and Screen, where incoming trucks initially discharge the contents, are fully enclosed spaces with constant ventilation. Lift-station, that also serves as a Pre-mixing chamber, is where the screened contents of the truck go before they get pumped into the Liming Stations. Under regular operating conditions, the contents of already cured Liming Stations also get mixed with the inlet.".

[29] *Ibid*. (NWC_0007864)

- *BioAir Recommendation 6: If Recommendation 5 is unattainable - it is possible to evaluate increasing the size of the chemical scrubber system to combine both individual process streams and building vent in to the chemical scrubber pretreatment.*

BioAir Solutions, LLC also conducted two Performance tests to assess (1) the odor removal efficiency of the chemical scrubber odor control system and (2) the removal efficiency of the exhaust stack designed to ventilate the air from the solids processing building[30].

Both these testing reports and the odor study fail to provide a Process Flowsheet for the facility. This would be useful to determine the release potential. In addition, it is likely that there is a major release when the trucks come in and empty the portable units. A photo of that portion of the facility along with a video that shows an actual unloading process would be useful in defining release potential.

It would also be useful to have a description of the actual treatment process in the facility. It is likely that it is basically a batch process and there is a potential for greater or lesser releases as the flows stop and start.

[30] 2016 01 20 Performance Test Report.pdf (NWC_00016567), page 2.

7. Conclusions

Our meteorological analysis, using a wind rose methodology, has identified a strong and very credible correlation between days/times of odor complaints and air flows directly aligned from the Honey Bucket Facility to the Class Area. This correlation is very strong, and is particularly evident when the odor impact maps prepared by Mr. Dodge are compared with wind observations.

This is a technical report based upon currently available information and work performed to date. Any of the figures referenced in or attached to this report and accompanying model may be used as exhibits at trial.

EnviroComp reserves the right to supplement this report in the future if new data, information, or reports are made available to us and additional work is performed. In particular, we plan to perform additional work in response to expected technical reports to be prepared by defense experts.

Dr. Paolo Zannetti, QEP
President
EnviroComp Consulting, Inc.

Half Moon Bay, California
11 September 2018

Appendix A

Dr. Paolo Zannetti, QEP

Dr. Zannetti has dedicated his entire professional career over four decades to the study of air pollution and atmospheric sciences. His main field of expertise is Air Quality Modeling. His full CV is presented below and is available online[31], where most of his publications are downloadable[32].

Dr. Zannetti started his scientific career in 1971 at the IBM Research Center in Venice, Italy, at a time when IBM was sponsoring advanced computer simulation activities in environmental sciences at several of its Research Centers throughout the world. Since the early-1970s, he has focused his scientific research toward the development of advanced computer simulation techniques with practical applications to air quality problems in the international arena. In particular, he performed pioneering work for the development of new Lagrangian modeling techniques in which air pollution is simulated by computer methods using a series of independent segments[33], puffs[34], or particles[35].

Dr. Zannetti has been employed with IBM Research (IBM Scientific Centers of Venice, Italy; Palo Alto, California; and Bergen, Norway), consulting companies (AeroVironment, Inc.[36] and Failure Analysis/Exponent, Inc.[37]), and government organizations (Kuwait Institute for Scientific Research[38], Kuwait, and CRTN-ENEL, Milan, Italy). He is President of EnviroComp Consulting, Inc.[39], a company he founded in 2001, and The EnviroComp Institute[40], a non-profit research organization he founded in 1996.

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31 http://www.envirocomp.com/people1/zannetti.html

32 http://www.envirocomp.com/zcv/zannetti.pdf

33 Zannetti P, 1986b, "A new mixed segment-puff approach for dispersion modeling," Atmospheric Environment, **20**(6):1121-1130. (http://www.envirocomp.com/zcv/JA.17.PDF)

34 Zannetti P, 1981a, "An improved puff algorithm for plume dispersion simulation," J Applied Meteorology, **20**(10):1203-1211. (http://www.envirocomp.com/zcv/JA.10.PDF)

35 Zannetti P, 1984, "New Monte Carlo scheme for simulating Lagrangian particle diffusion with wind shear effects," Applied Mathematical Modeling, **8**:188-192. (http://www.envirocomp.com/zcv/JA.14.PDF)

36 https://www.avinc.com/

37 http://www.exponent.com/

38 http://www.kisr.edu.kw/en/

39 www.envirocomp.com

40 www.envirocomp.org

(Cont'd on next page)

Dr. Zannetti has written more than 300 publications, including 40+ books and book chapters. Particularly important are: 1) the book[41] "Air Pollution Modeling" completed in 1990, which was the first comprehensive book in the field and is still a widely used textbook today; and 2) the 4-volume book series[42] "Air Quality Modeling," which is today the most updated and complete publication series on computer methods for air pollution studies.

Dr. Zannetti has studied many air pollution cases throughout the world. In particular, in his early scientific endeavors, he studied and modeled[43] the air pollution problems affecting the city of Venice, Italy, and was the project manager of the first comprehensive air pollution study[44] (monitoring and modeling) in the Persian Gulf.

As a consulting expert in the last 25 years, Dr. Zannetti has investigated more than a hundred complex legal disputes and air pollution claims related to industrial, transportation, and agricultural activities, in the US and abroad, including short-term and long-term emissions and accidental releases[45]. In most of these cases, he simulated ambient concentrations and depositions caused by chemical emissions using his own computer models and/or those developed and recommended by government agencies, such as the US Environmental Protection Agency (US EPA).

Dr. Zannetti is often asked to present talks at conferences and seminars throughout the world. In particular, he has taught air pollution courses in Italy (University of Bari[46]), California (Berkeley

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41 Zannetti P, 1990, *Air Pollution Modeling – Theories, Computational Methods, and Available Software*, Computational Mechanics Publications, Southampton, and Van Nostrand Reinhold, NY: 450 pp (http://www.springer.com/us/book/9781475744675); this book is out of print but is freely available in PDF format (http://www.envirocomp.com/pops/airpollution.html).

42 A multi-volume, multi-author, comprehensive book series on air quality modeling published in 2003-2010 under Dr. Zannetti's direction and editorial management (http://www.envirocomp.org/aqm).

43 Zannetti P, Melli P, Runca E, 1977, "Meteorological factors affecting SO_2-pollution level in Venice," Atmospheric Environment, **11**:605-616. (http://www.envirocomp.com/zcv/JA.5.PDF)

44 Zannetti P, Sudairawi M, Al-Madani N, El-Karmi N, 1983, "Air Pollution Dispersion and Prediction Model for Shuaiba Industrial Area," prepared for the Shuaiba Area Authority, Kuwait, Kuwait Institute for Scientific Research, Document KISR 1090A, 5 volumes.

45 See "Selected Projects" at http://www.envirocomp.com/

46 http://www.uniba.it/

(Cont'd on next page)

Extension[47]), Kuwait (Kuwait Institute for Scientific Research[48]), and England (Wessex Institute of Technology[49]) where he is Professor of Environmental Sciences[50].

Dr. Zannetti's professional credentials have been certified[51] with the title of Qualified Environmental Professional (QEP), given by the Institute of Professional Environmental Practice (IPEP)[52]. The QEP certification recognizes professional achievements for environmental professionals and their compliance with the highest of ethical and professional standards[53]. Since 1997, Dr. Zannetti has been the Regional Coordinator for IPEP in the San Francisco Bay Area.

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47 http://extension.berkeley.edu/index.jsp
48 http://www.kisr.edu.kw/en/
49 http://www.wessex.ac.uk/
50 http://www.wessex.ac.uk/research/wit-staff/862-dr-paolo-zannetti
51 Certificate #029440029 (02/1994) – Recertified on 07/2007.
52 http://www.ipep.org
53 http://ipep.org/about/code-of-ethics/