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1700 Webster Street  
Oakland, CA

# Final Report

## Pedestrian Wind Conditions Consultation Wind Tunnel Tests

RWDI # 1501611  
July 16, 2015

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## 1. INTRODUCTION

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Rowan Williams Davies & Irwin Inc. (RWDI) was retained by Lamphier-Gregory to conduct a Pedestrian Wind Study for the proposed 1700 Webster Street in Oakland, California. The purpose of the study was to assess the wind environment around the development in terms of pedestrian comfort and hazard relative to wind metrics specified in the City of Oakland Significant Wind Impact Criterion. The study objective was achieved through wind tunnel testing of a 1:400 (1" = 33') scale model for the following two development configurations:

- |                                |   |
|--------------------------------|---|
| <b>A – Existing:</b>           | all existing buildings on-site and in the surroundings; and,  |
| <b>B – Existing + Project:</b> | proposed 1700 Webster Street project, including the proposed landscaping plan (50% SD Pricing Package) with existing surrounding buildings. |

The development site is located in the City of Oakland's downtown core, at the northeast corner of the intersection of Webster and 17<sup>th</sup> Street. The proposed tower is approximately 265 feet tall. The test model was constructed using the design information and drawings listed in Appendix A.

This report summarizes the methodology of the wind tunnel studies for pedestrian wind conditions, describes the wind comfort and wind hazard criteria, and presents the test results.

The placement for wind measurement locations was based on our experience and understanding of pedestrian usage for this site, and was reviewed by Lamphier-Gregory prior to the wind tunnel test.

## 2. PRINCIPLE RESULTS

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The results of the tests are discussed in detail in Section 5 of this report and may be summarized as follows:

- Wind speeds on the Existing project site are currently low with a few of the test locations exceeding the comfort criterion, but with no hazard exceedances.
- Wind comfort conditions for the Existing + Project configuration would generally remain the same relative to the Existing conditions. The number of comfort criterion exceedances would increase slightly with the addition of the proposed development, but the number of hazard exceedance locations would remain at zero.

## 3. METHODOLOGY

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### 3.1 Wind Tunnel Testing

As shown in Figures 1a and 1b, the wind tunnel model included the project site and all relevant surrounding buildings and topography within a 1600 foot radius of the study site. The mean speed profile and turbulence of the natural wind approaching the modelled area were simulated in RWDI's boundary-layer wind tunnel. The model was instrumented with 48 wind speed sensors to measure mean and gust wind speeds at a full-scale height of approximately 5 ft. These measurements were recorded for 36 equally incremented wind directions.

### 3.2 Local Climate

Wind statistics recorded at the Metropolitan Oakland International Airport between 1984 and 2014 were analyzed for annual wind conditions. Figure 2 graphically depicts the directional distributions of annual wind frequencies and speeds. Winds are frequent from the northwest through west-southwest directions throughout the year, as indicated by the wind rose. Strong winds of a mean speed greater than 20 mph measured at the airport (at an anemometer height of 33ft) occur 2.6% of the time annually.

Wind statistics from the Metropolitan Oakland International Airport were combined with the wind tunnel data in order to predict the frequency of occurrence of full-scale wind speeds. The full-scale wind predictions were then compared with the City of Oakland Significant Wind Impact Criterion for pedestrian comfort and safety.

### 3.3 Planning Code Requirements

For the purposes of this study, the City of Oakland considers a significant wind impact to occur if a project were to "Create winds exceeding 36 mph for more than one hour during daylight hours during the year". A wind analysis only need to be done if the project's height is 100 feet or greater (Measured to the roof) and one of the following conditions exists: (a) the project is located adjacent to a substantial water body (i.e. Oakland Estuary, Lake Merritt or San Francisco Bay); or (b) the project is located in Downtown. Since the proposed project exceeds 100 feet in height and is located in Downtown, it is subject to the thresholds of significance.

The equivalent wind speeds were calculated according to the specifications in the City of Oakland Significant Wind Impact Criterion, whereby the mean hourly wind speed is increased when the turbulence intensity is greater than 15% according to the following formula:

$$EWS = V_m \times (2 \times TI + 0.7)$$

Where

$EWS$	= equivalent wind speed
$V_m$	= mean pedestrian-level wind speed
$TI$	= turbulence intensity

## 4. TEST RESULTS

---

Wind speed measurements were taken at 46 locations for the Existing configuration and 48 locations for the Existing + Project configuration (see Figure 3). Table 1, located in the tables section of this report, presents the wind comfort results for the two configurations tested. For each measurement point, the measured 10% exceeded (90<sup>th</sup> percentile) equivalent wind speed and the percentage of time that the wind speed exceeds 11 mph are shown for areas considered to be used primarily for walking.

Table 2 presents the wind hazard results, and lists the predicted wind speed to be exceeded one hour per year. The predicted number of hours per year that the City of Oakland Significant Wind Impact Criterion (one minute wind speed of 36 mph) is exceeded is also provided.

### 4.1 Wind Comfort Conditions

For the Existing Configuration in the vicinity of the project site, wind speeds are generally low with wind speeds averaging 9.4 mph for the measurement locations. The highest wind speeds occur near the intersection of 19<sup>th</sup> and Harrison Streets (Locations 31 through 34 in Figure 3 and Table 1). The higher than desired wind speeds in this area are due to the accelerations of the prevailing westerly winds around an existing tower. In the Existing Configuration, wind speeds at most of the test locations (38 out of 46) are below 11 mph.

For the Existing + Project Configuration, wind speeds would remain similar and the majority would remain below 11 mph on average (34 of 48). The average wind speed for all test locations would be slightly increased from 9.1 mph to 10.4 mph. The highest wind speed (16 mph) would occur at the intersection of 19<sup>th</sup> and Harrison Streets (Location 34), similar to the existing conditions. The 11 mph criterion would be exceeded 9.7% of the time, which is a minor increase relative to the existing conditions on and around the project site.

### 4.2 Wind Hazard Conditions

Of the 46 locations tested for the Existing Configuration, none currently exceed the hazard criterion (presented in Table 2). In the Existing + Project Configuration, the number of hazard exceedances would remain at zero for all 48 test locations.

## 5. APPLICABILITY OF RESULTS

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The results presented in this report pertain to the model of the proposed 1700 Webster Street development, constructed using the architectural design drawings listed in Appendix A. Should there be design changes that deviate from this list of drawings, the results presented may change. Therefore, if substantial changes in the design are made, it is recommended that RWDI be contacted and requested to review their potential effects on wind conditions.

# TABLES



**Table 1:** Wind Comfort Results

References	Existing			Existing + Project			
Location Number	Wind Speed Exceeded 10% of Time (mph)	Percent of Time Wind Speed Exceeds 11 mph	Exceeds	Wind Speed Exceeded 10% of Time (mph)	Percent of Time Wind Speed Exceeds 11 mph	Speed Change Relative to Existing	Exceeds
1	8	2	-	9	4	1	-
2	8	1	-	10	5	2	-
3	7	0	-	8	2	1	-
4	7	1	-	10	6	3	-
5	6	1	-	9	5	3	-
6	-	-	-	7	2	-	-
7	-	-	-	7	2	-	-
8	7	1	-	11	10	4	-
9	6	1	-	9	5	3	-
10	6	0	-	8	1	2	-
11	8	2	-	13	20	5	e
12	8	1	-	8	3	0	-
13	7	2	-	7	2	0	-
14	7	1	-	7	1	0	-
15	8	2	-	8	2	0	-
16	9	3	-	9	3	0	-
17	8	2	-	10	6	2	-
18	8	2	-	12	14	4	e
19	10	6	-	10	6	0	-
20	10	5	-	10	6	0	-
21	7	1	-	12	12	5	e
22	7	1	-	10	8	3	-
23	7	2	-	9	5	2	-
24	8	2	-	12	12	4	e
25	10	7	-	10	5	0	-
26	8	2	-	9	3	1	-
27	10	6	-	10	6	0	-
28	10	6	-	10	6	0	-
29	13	22	e	13	19	0	e
30	14	22	e	13	21	-1	e
31	16	36	e	15	34	-1	e
32	15	28	e	14	25	-1	e
33	17	37	e	15	34	-2	e
34	16	38	e	16	34	0	e
35	9	5	-	10	7	1	-



**Table 1:** Wind Comfort Results

References	Existing			Existing + Project			
Location Number	Wind Speed Exceeded 10% of Time (mph)	Percent of Time Wind Speed Exceeds 11 mph	Exceeds	Wind Speed Exceeded 10% of Time (mph)	Percent of Time Wind Speed Exceeds 11 mph	Speed Change Relative to Existing	Exceeds
36	14	24	e	14	24	0	e
37	9	5	-	11	9	2	-
38	11	11	-	11	11	0	-
39	8	1	-	9	3	1	-
40	11	11	-	11	12	0	-
41	8	4	-	10	6	2	-
42	10	5	-	9	5	-1	-
43	11	11	-	12	14	1	e
44	13	22	e	13	22	0	e
45	8	2	-	8	2	0	-
46	8	1	-	8	1	0	-
47	9	3	-	9	4	0	-
48	8	1	-	13	18	5	e
Average mph, Average % and Total exceedances	9.4	7.6	8	10.4	9.7	1.1	14





**Table 2:** Wind Hazard Results

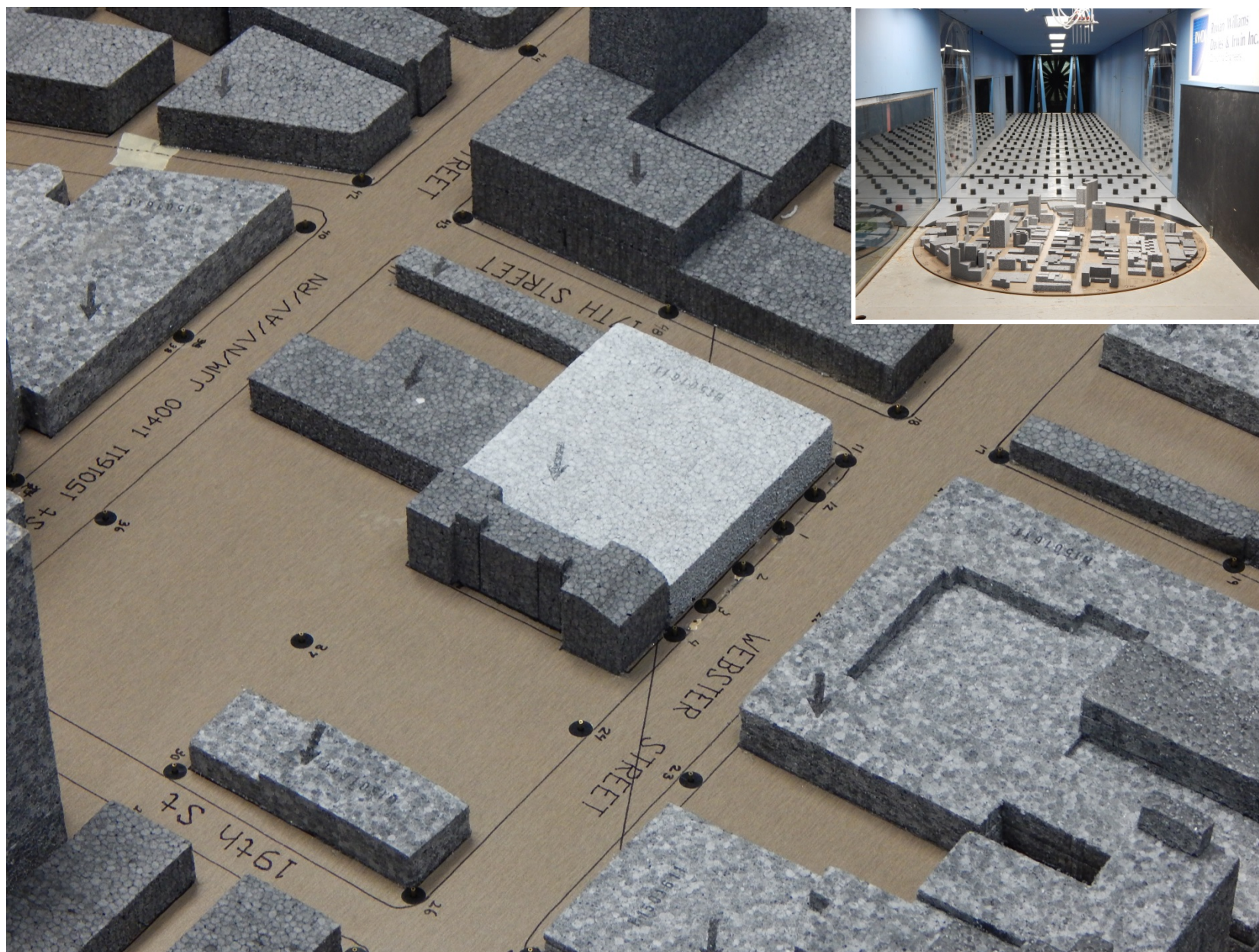
References	Existing			Existing + Project			
Location Number	Wind Speed Exceeded 1hr/year (mph)	Hours per Year Wind Speeds Exceed Hazard Criteria	Exceeds	Wind Speed Exceeded 1 hour/year (mph)	Hours per Year Wind Speeds Exceed Hazard Criteria	Hours Change Relative to Existing	Exceeds
1	20	0	-	26	0	0	-
2	17	0	-	24	0	0	-
3	15	0	-	23	0	0	-
4	16	0	-	21	0	0	-
5	20	0	-	31	0	0	-
6	-	-	-	23	0	0	-
7	-	-	-	22	0	0	-
8	19	0	-	26	0	0	-
9	17	0	-	22	0	0	-
10	15	0	-	22	0	0	-
11	20	0	-	30	0	0	-
12	19	0	-	21	0	0	-
13	22	0	-	21	0	0	-
14	23	0	-	24	0	0	-
15	22	0	-	21	0	0	-
16	23	0	-	24	0	0	-
17	19	0	-	22	0	0	-
18	20	0	-	27	0	0	-
19	24	0	-	23	0	0	-
20	22	0	-	23	0	0	-
21	18	0	-	25	0	0	-
22	19	0	-	33	0	0	-
23	20	0	-	22	0	0	-
24	22	0	-	27	0	0	-
25	24	0	-	24	0	0	-
26	21	0	-	21	0	0	-
27	25	0	-	25	0	0	-
28	25	0	-	25	0	0	-
29	30	0	-	30	0	0	-
30	31	0	-	31	0	0	-
31	35	0	-	34	0	0	-
32	34	0	-	34	0	0	-
33	34	0	-	32	0	0	-
34	36	0	-	36	0	0	-
35	24	0	-	26	0	0	-



**Table 2:** Wind Hazard Results

References	Existing			Existing + Project			
Location Number	Wind Speed Exceeded 1hr/year (mph)	Hours per Year Wind Speeds Exceed Hazard Criteria	Exceeds	Wind Speed Exceeded 1 hour/year (mph)	Hours per Year Wind Speeds Exceed Hazard Criteria	Hours Change Relative to Existing	Exceeds
36	32	0	-	30	0	0	-
37	26	0	-	29	0	0	-
38	24	0	-	23	0	0	-
39	19	0	-	19	0	0	-
40	24	0	-	26	0	0	-
41	27	0	-	24	0	0	-
42	23	0	-	23	0	0	-
43	28	0	-	28	0	0	-
44	28	0	-	27	0	0	-
45	20	0	-	19	0	0	-
46	17	0	-	18	0	0	-
47	24	0	-	24	0	0	-
48	18	0	-	31	0	0	-
Average mph, Average hours and Total exceedances	23.1	0	0	25.5	0	0	0

# FIGURES



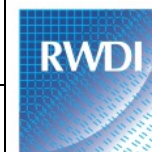
**Wind Tunnel Study Model  
Existing**

1700 Webster Street – Oakland, CA

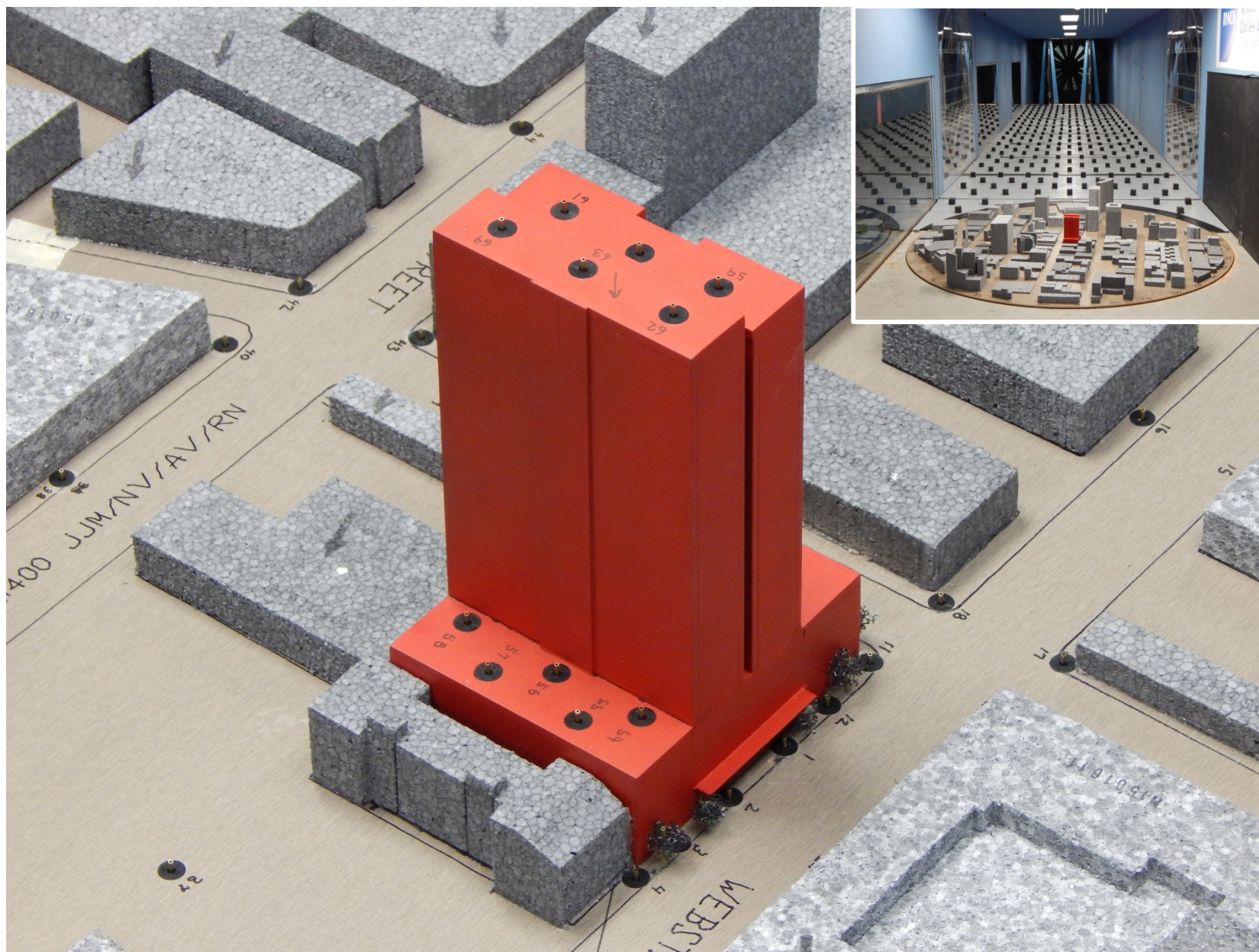
Figure No. 1a

Project #1501611

Date: July 16, 2015







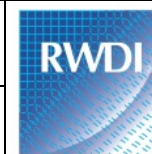
# **Wind Tunnel Study Model** Existing + Project

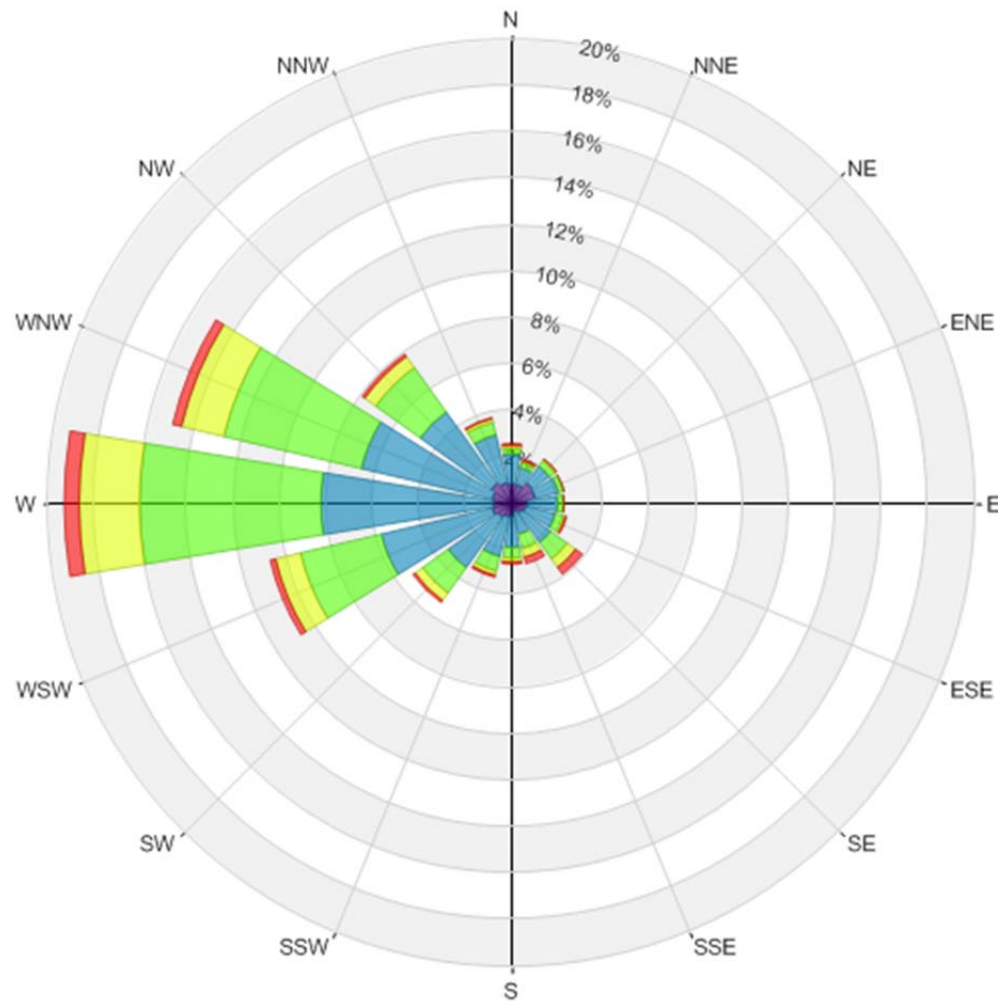
1700 Webster Street – Oakland, CA

Project #1501611

Figure No. 1b

Date: July 16, 2015





Annual Winds

Wind Speed (mph)	Probability (%)
Calm	11.8
1-5	12.4
6-10	39.0
11-15	26.0
16-20	8.3
>20	2.6

**Directional Distribution (%) of Winds (Blowing From)**  
**Metropolitan Oakland International Airport (1984 - 2014)**

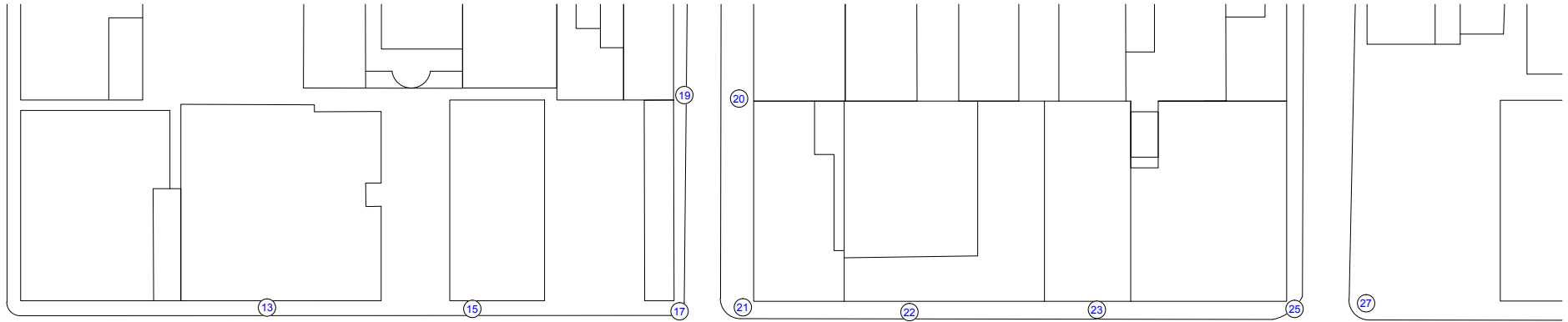
1700 Webster Street – Oakland, CA

Project #1501611

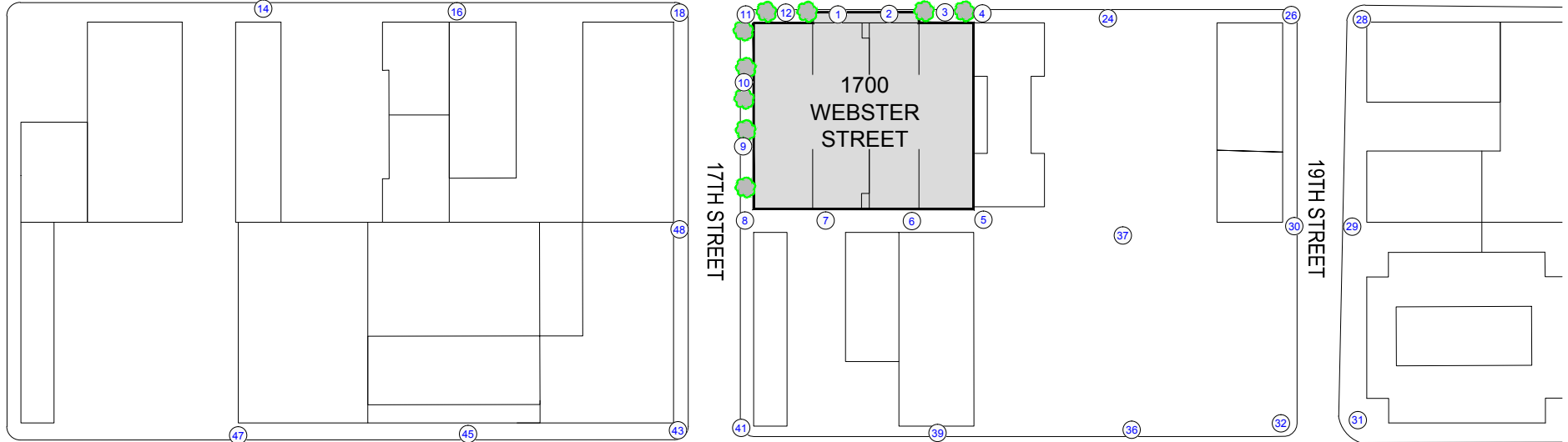
Figure No. 2

Date: July 16, 2015





WEBSTER STREET



15TH STREET

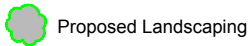
17TH STREET

19TH STREET

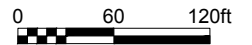
1700  
WEBSTER  
STREET

HARRISON STREET

**LEGEND:**



Proposed Landscaping



Sensor Plan (Existing + Project Configuration shown)

True North



Drawn by: ARM Figure: 3

Approx. Scale: 1"=120'

Date Revised: July 16, 2015

1700 Webster Street - Oakland, CA, USA

Project #1501611



# APPENDIX A



## **APPENDIX A: DRAWING LIST FOR MODEL CONSTRUCTION**

The drawings and information listed below were received from Lamphier - Gregory and were used to construct the scale model of the proposed 1700 Webster Street development. Should there be any design changes that deviate from this list of drawings, the results may change. Therefore, if changes in the design area made, it is recommended that RWDI be contacted and requested to review their potential effects on the pedestrian wind conditions presented in this report.

File Name	File Type	Date Received (dd/mm/yyyy)
150616_RWDI Model	.3dm	22/06/2015
L2 from Landscape dwgs	.pdf	17/06/2015