FORMER WESTFERRY PRINTWORKS

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ENVIRONMENTAL STATEMENT REGULATION 22 ADDENDUM - MARCH 2016
REVISED CHAPTER 17.0, REVISED APPENDIX 17.2, APPENDIX 17.3
& APPENDIX 17.4

A Development by: L&R

Document	Description
Revised Chapter 17.0	Revised version of Chapter 17.0 taking account of DSWC criteria
Revised Appendix 17.2	Revised Appendix 17.2, taking account of the adoption of DSWC criteria by Wolfson Unit Southampton University
Appendix 17.3	Former Westferry Printworks: Massing Variations and Sailing Conditions by RWDI and EPAL
Appendix 17.4	Sailing Quality Assessment of M1 – M5 configurations by Wolfson Unit Southampton University
Plan 3886-320 P6	Revised Drainage Plan Walsh & Partners

Revised version of Chapter 17.0 taking account of DSWC criteria

17.1 Introduction

17.1.1 This revised chapter assesses the potential effects of the Development on sailing conditions in the Millwall Outer Dock. It forms a counterpart to the previous chapter 16, dealing with pedestrian wind conditions. This assessment has been laid out separately because of the differences in the approach to assessment required and for reasons of clarity.

17.1.2 This chapter is accompanied by four appendices.

- Appendix 17.1 provides a factual report on the wind tunnel measurements made by RWDI Anemos in relation to conditions on the dock. This essentially reports the impacts of the Development on wind conditions.
- Appendix 17.2 (revised) provides an interpretive report by the Wolfson Unit of the University of Southampton on the effects of the changes in wind with regard to sailing quality in the Millwall Outer Dock.
- Appendix 17.3 includes additional testing of varied massing on the wind conditions carried out by RWDI Anemos and then analysed using the updated DSWC criteria by the Wolfson Unit of Southampton University;
- Appendix 17.4 includes the Wolfson Unit's analysis of the above wind tunnel test data.

17.2 Planning Policy and Legislative Framework

17.2.1 The main elements of the policy context are set in Chapter 16.0, Section 16.2.

17.3 Assessment Methods and Significance Criteria

17.3.1 The methods of wind tunnel measurement adopted are unchanged from those set out in Chapter 17.0, as originally submitted in August 2015. However, as noted in Appendix 17.3, the testing of massing variations involved testing of a more restricted area of the dock and twelve 30 degree increments of wind direction rather than10 degree increments.

Wind Speed and Direction Measurement Method

17.3.2 The measurements were taken using Wu Tubes. These are a proprietary design of probe that is a development of the well-known Irwin probe, as used for the tests reported in Chapter 16.0. The Wu tube is able to undertake six separate pressure measurements that allow, following appropriate transforms, the direction of the wind and the speed to be determined. Fuller details of the method are found in Section 3.0 of Appendix 17.1.

Wind Tunnel Model

17.3.3 A 1:300 scale model was tested by RDWI, and the speed and direction of the wind were measured at up to 48 locations on a grid, at a range of wind directions, at a height representing 2.4 metres above the water surface. This height is representative of the centre of the sail plan of a dinghy typical of those sailed there. The tests did not include measurement of the vertical component of the wind, or of the large scale turbulence or variation in the local wind, both of which might affect the handling of a dinghy.

17.3.4 The model extended to a full-scale radius of 360m, centred on the dock (see Figure 17.1).

17.3.5 The output data were supplied to the Wolfson Unit in digital form as a spreadsheet, with values for each of up to 48 locations at wind direction increments of 10 degrees – or 30 degrees for the massing a variation tests.

17.3.6 The wind speeds were presented as a ratio of the local speed to the nominal free stream speed and as would be measured at a reference height of 10 metres.

Scenarios Tested

17.3.7 Four configurations of the Development were tested:

- Configuration 1 – the former Westferry Printworks building (the 'existing Site');
- Configuration 2 – the cleared Site;
- Configuration 3 – the majority of the phase 1 of the proposed Development, with the rest of the Site being clear, including tall buildings T03 and T04; and
- Configuration 4 – the completed Development.

17.3.8 Figure 17.1 and 17.2 show the models tested in the wind tunnel for the existing Site and with the Development. Further detail on the models is given in Appendix 17.1 and Appendix 17.3

17.3.9 Results are presented in a series of 'vector-plots' to indicate both the measured wind speed and direction at each location and for each wind direction. The measured wind speeds and directions are presented graphically in Appendix 17.1.

Visualisation Tests

17.3.10 In order to visualise the wind effects over the dock, additional tests were conducted which involved releasing visible smoke over the wind tunnel model. Photographs from these tests are included in Appendix 17.1 to illustrate the effects.

17.3.11 Finally, a 'tuft test' (in which lengths of wool were attached to the model at each measurement location) was used to visualise the directional variability and level of turbulence over the dock.

17.3.12 Video footage of this test has been issued in electronic format to support the assessment. The use of this test procedure was agreed with LBTH's advisors BMT (see Appendix 2.1). The video data from both sets of tests are available on request and will be issued to the Docklands Sailing and Watersports Centre and LBTH.

Interpretation of Effects on Sailing

17.3.13 The objective of the process is to assess the effects that the Westferry Printworks Development would have on the ability to sail in the Millwall Outer Dock after completion of the Development in comparison to the existing Site.

17.3.14 No adequate regulatory parameters or guidelines exist that can be used to assess the sailing quality of a particular location across a range of wind speeds, directions and durations of time. Therefore, the Wolfson Unit used a number of criteria in order to apply some quantitative parameters to what is a relatively qualitative subject area. Particular attention was paid to wind speed characteristics that would affect novice sailors. Subsequent to the submission of the ES, and following consultations with the DSWC, a set of criteria was developed by the DSWC. These have similarities to those developed by the Wolfson Unit but include some differences. The DSWC criteria have been use to reanalyse the test data from the wind tunnel.

17.3.15 The test data from the wind tunnel have been processed to allow evaluation against the following criteria:

- Two wind speed ranges; one for Adults and another for juniors
    - Novice Adults – from 3 to 14 knots
    - Novice Juniors – from 3 to 9 knots
- Change of wind speed between locations of no greater than 30%
  A wind speed change of 30% between adjacent measurement locations within 40 metres (nearest adjacent location for those in with greater spacing at Eastern end of dock).

Figure 17.1: Wind Tunnel Test Model for Existing Site

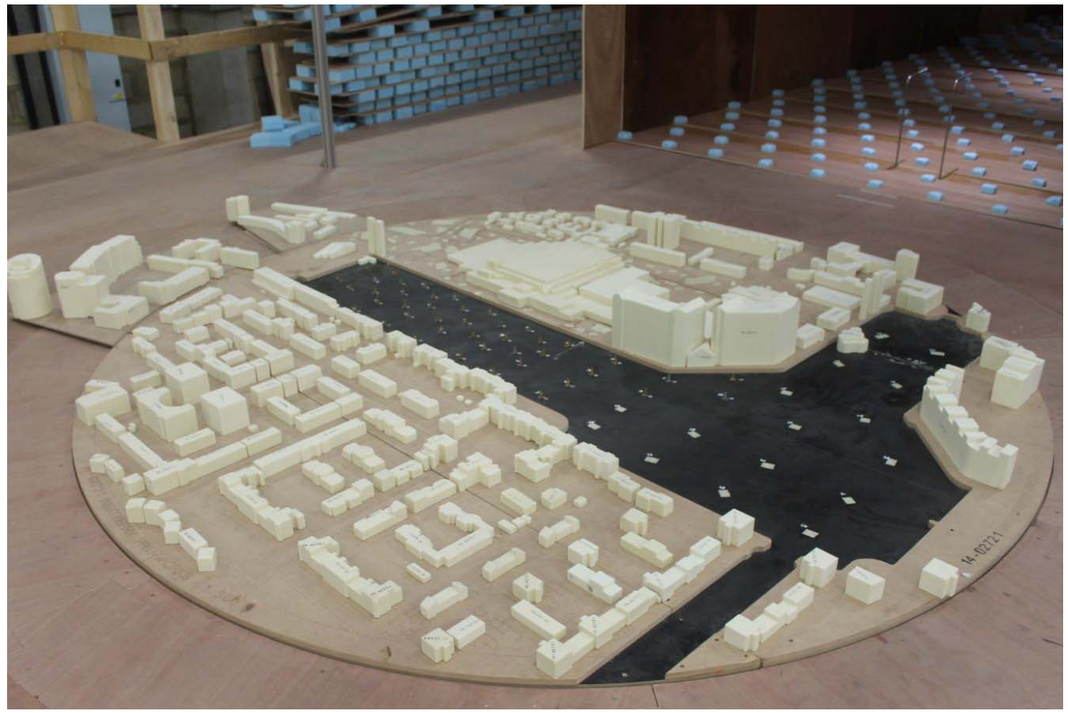
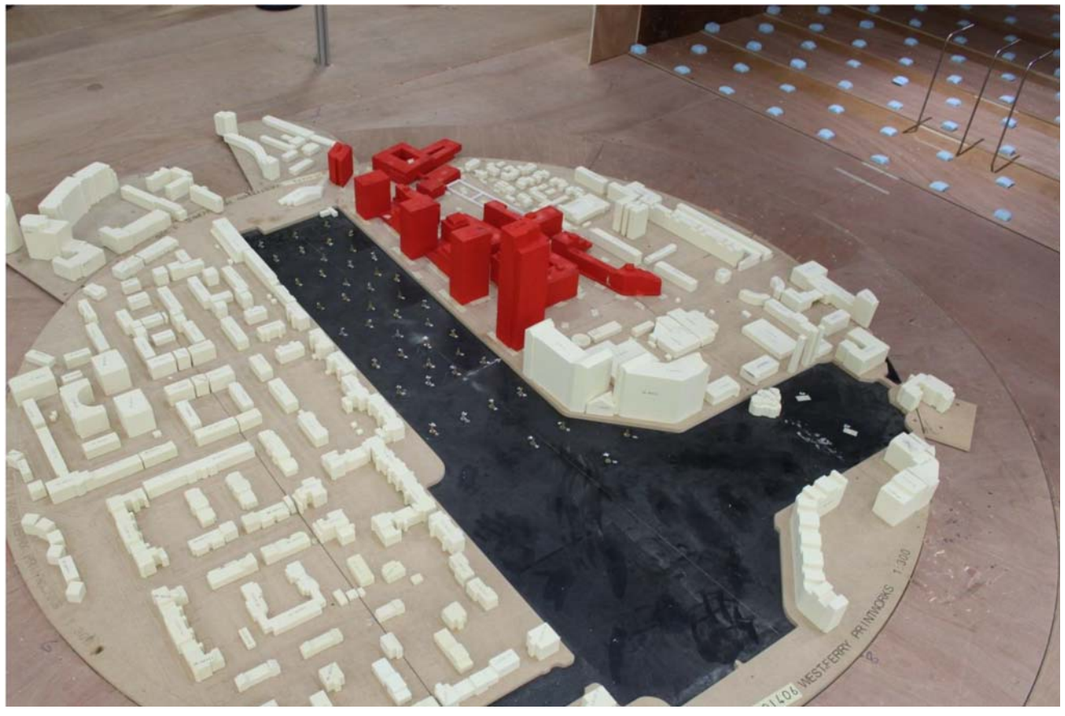


Figure 17.2: Wind Tunnel test Model for the Development



- Change of wind direction of no greater than 20 degrees between adjacent points

  A direction change of 20˚ between adjacent measurement locations within 40 metres (nearest adjacent location for those with greater spacing at Eastern end of dock).

17.3.16 These criteria relate to the quality of sailing conditions not the change from the existing condition. It should not be assumed that a change from the present is by nature adverse. This assessment compares the quality of sailing before and after development rather than assuming that any change in wind speed or direction from the current situation must be adverse. This is analogous to how pedestrian wind comfort is assessed. In the case of pedestrian wind comfort what is important is not whether wind is changed by a new structure (the wind impact) but whether the resulting *effect* is appropriate given the intended use of an area subject to change (impact). In the case of sailing quality, however, the wind speed and direction are important, as reflected in the criteria.

Data Analysis

17.3.17 The above criteria have been applied to each of the discrete wind angle data sets from the wind tests. These have then been combined with the wind rose data shown in Figure 17.3 to estimate the proportion of good sailing quality time, displayed as a percentage of the time, for a (1) typical sailing season of March to November and (2) individual monthly breakdown, as discussed in the meeting at DSWC on 28th July 2015. These are included in Figures A8 – A18 in the Appendix 17.2 (Revised).

17.3.18 Each page of plots shows; on the left, the existing site (baseline) results; the middle, the results with the proposed Development; on the right, the difference between the existing Site and proposed Development ; positive values represent a reduction in sailing quality, negative is an increase in sailing quality compared with the existing site. Figure 17.4 shows the probe locations for the plots

17.4 Baseline Conditions

17.4.1 The baseline wind roses for London are shown in Figure 17.3.

Figure 17.3: Monthly Wind Rose Data (in Beaufort Force) (Hours that wind speed is greater than the stated Beaufort Force)

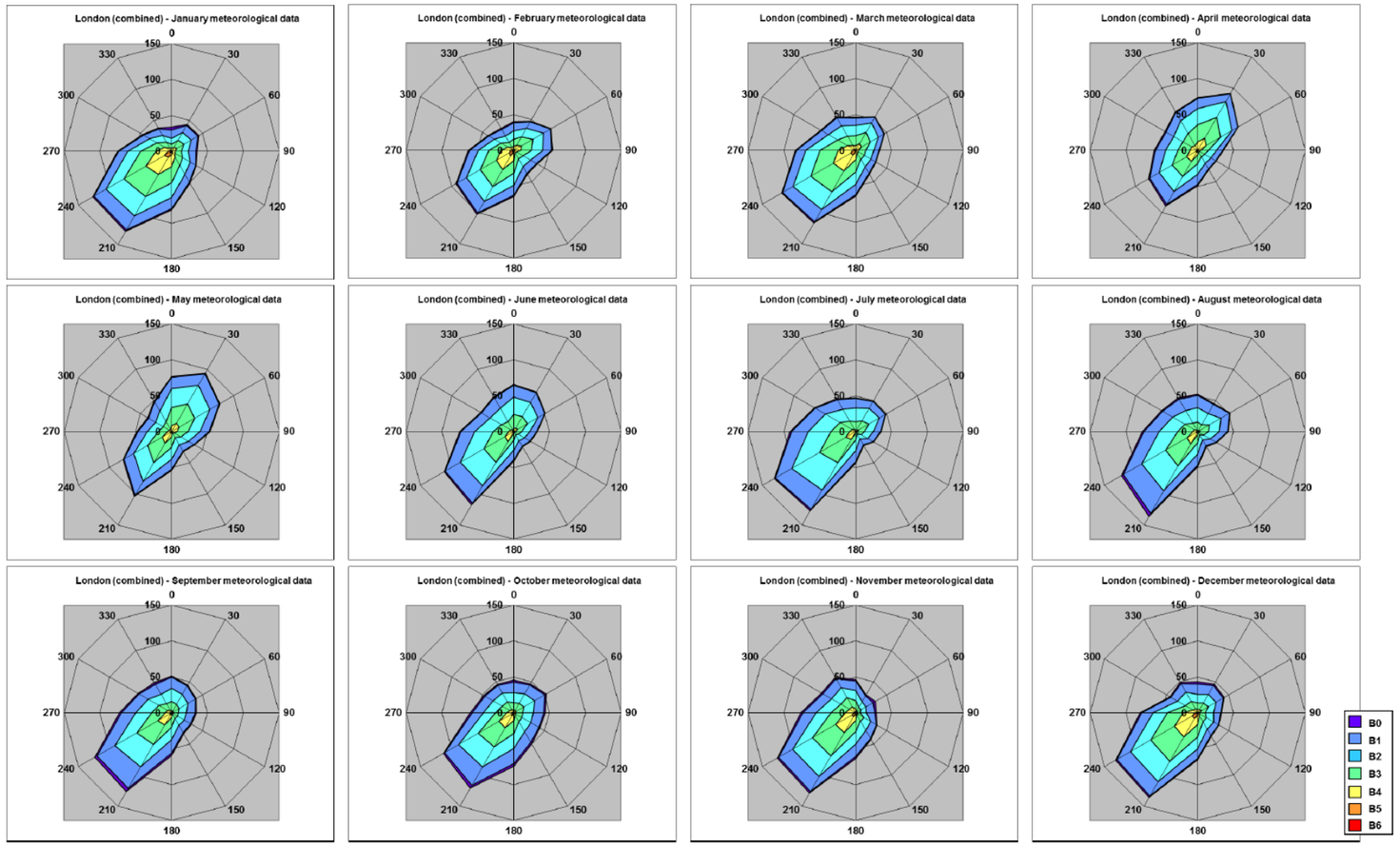
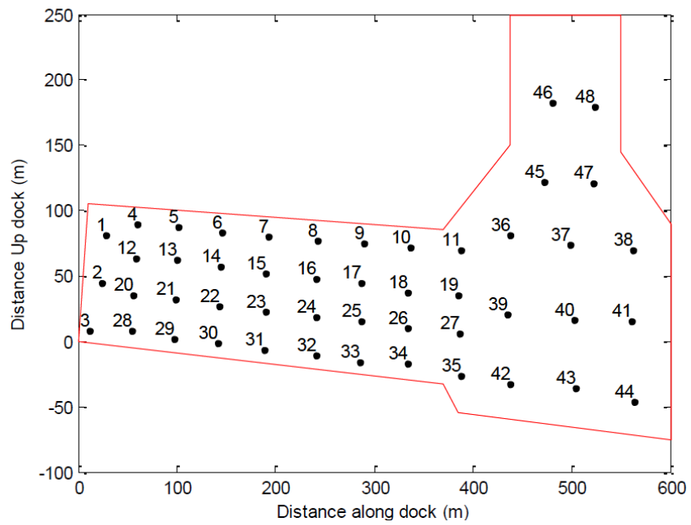


Figure 17.4: Plan showing Wind Probe Locations



17.4.2 These show that winds from the south west quarter are predominant, with north easterlies being of similar importance in certain months of the spring, especially April and May. It should be stressed though that south westerly winds are still important in these months. Thus some variation in wind conditions is experienced at the dock and given the orientation of the Development to the dock it can adduced that there will be some differences between months in terms of how this might affect sailing.

17.4.3 The Former Westferry Printworks Site is to the north of the Millwall Outer Dock where sailing and other watersports activities are undertaken from the DSWC. The DSWC uses the dock for sailing activities throughout the year, primarily February to November and their cohort of users includes a high proportion of novice and youth sailors.

17.4.4 The remainder of assessment concentrates on comparing the existing and Development Conditions.

17.5 Assessment of Effects of the Development

Changes in Wind Conditions

17.5.1 The full results of the various tests for the various configurations are provided in Appendix 17.1:

- Figures 4-39 show plots showing in different colours of the cleared Site (representing the condition post-demolition in green), the partially completed Development with buildings (magenta) at the western end of the Site only and the final completed Development (blue)

- Figure 40-74 show the comparison of the existing Site (orange) and the completed Development (blue)

17.5.2 Figure 17.5 shows the plots during the building phases for a wind from 40 degrees, which being a north easterly direction is most affected by the Development.

17.5.3 Figure 17.6 shows the corresponding plot for the comparison of the present Site and the completed Development.

17.5.4 These plots show that change in the wind conditions for this wind direction is clearly evidenced. For the more frequent south westerlies the changes are less clearly evident (see Appendix 17.1).

17.5.5 A brief outline of changes for different wind direction is set out below.

South West to West

17.5.6 The wind vector comparisons for this sector are shown in Figures 26 to 31 and Figures 52 to 67 (220° to 270°) of Appendix 17.1. Whilst a small change in wind direction between the conditions in each configuration, the overall the wind speed remains approximately the same and the wind direction across the length of the dock remain consistent; i.e. the flow progresses smoothly from west to east across the main part of the dock without any abrupt changes in direction.

17.5.7 Only the 'empty site' scenario stands out as being slightly different from the other configurations at the west end of the dock (visible in the green arrows in Figures 26 to 31). This is because the absence of buildings to the north of the dock allows winds to blow relatively unimpeded across the site.

17.5.8 In all the assessed scenarios (except for the cleared site), the alignment of the dock and the surrounding buildings tends to steer the wind along the dock from west to east. This effect was observed in a flow visualisation test, photographs of which are shown below. Wind that approaches close to the Development tends to be entrained into the turbulent wake behind the towers; however, this localised effect does not affect conditions above the dock.

North easterly

17.5.9 These winds occur frequently during spring and early summer, as shown in the wind roses in Figure 17.3, particularly in April and May. The wind vector comparison for this sector is shown in Appendix 17.1: Figures 7 to 10 and Figures 43 to 46 (30° to 60°). From these figures, it can be noted that the Development wind conditions diverge from the existing and cleared Site conditions in a region directly south of the Site. Furthermore, the conditions in the Development configuration are characterised by abrupt changes in wind speed and directions over this area, to a greater extent than is shown in the existing configuration. It is notable that in the north western part of the Dock, the wind vectors for the partially completed Site with buildings B01, B02, T01 and T02 in place are very similar to those for the completed Development. This can be seen in Figure 17.4.

Other Wind Directions

17.5.10 Winds from the north (shown in Appendix 17.1: Figures 4, 5 and 39 and Figures 40, 41 and 75) and south (shown in Appendix 17.1: Figures 22 to 23 and Figures 58 to 60) are generally light and inconsistent over the western part of the dock in all configurations. This is due to the prevalence of urban and suburban terrain to the north and south of the dock. It can be noted from the wind roses in Figure 17.3 that winds from these directions do not occur frequently when compared to the prevailing southwest and secondary northeast sectors.

17.5.11 Winds from the east and southeast occur infrequently, as can be noted from the wind roses in Figure 17.3. However, particular wind effects have been found to occur in the area of the dock around the existing City Reach building (located to the east of the Westferry site at the corner of the dock) when the wind blows from this direction. Some 're-circulation' of the wind occurs in the area around the base of the City Reach building, as the wind abruptly changes direction or reverses entirely when approaching the building.

17.5.12 This effect can be seen as a deflection in the wind direction at probe locations 10, 11, 36, 45 and 46 in Figures 14 to 20 and Figures 50 to 56 (100° to 160°). The effect was also observed in the smoke visualisation tests (see Appendix 17.1 page 5). A comparison of the existing site conditions to the Proposed Development conditions suggest that winds from these directions are not significantly affected by the Proposed Development. Wind speed and direction remains consistent over much of the dock, and the pre-existing effects around the base of the City Reach Building follow the same pattern as shown in the existing configuration.

Figure 17.5: Wind climate at 40˚ during Construction Phases

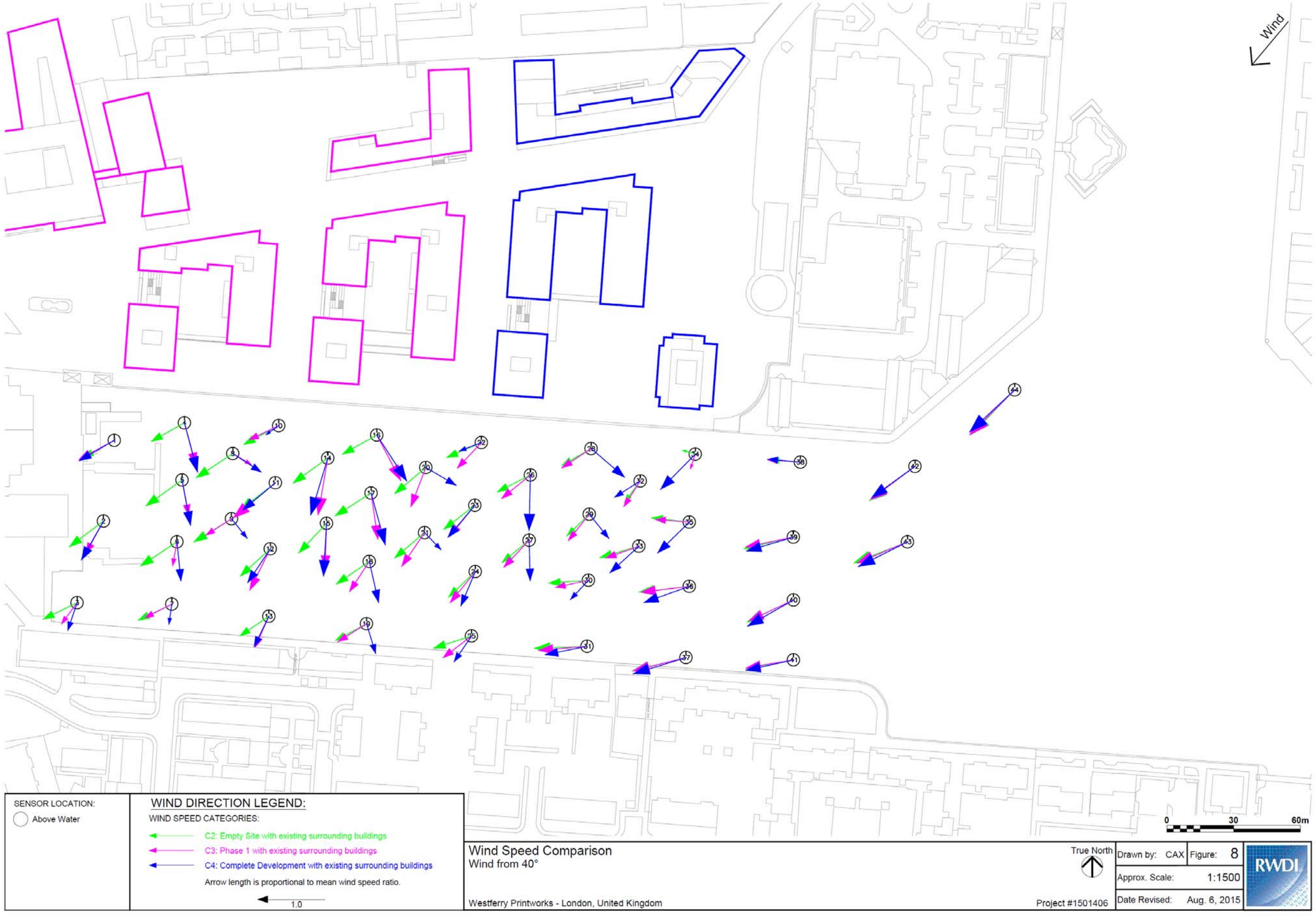
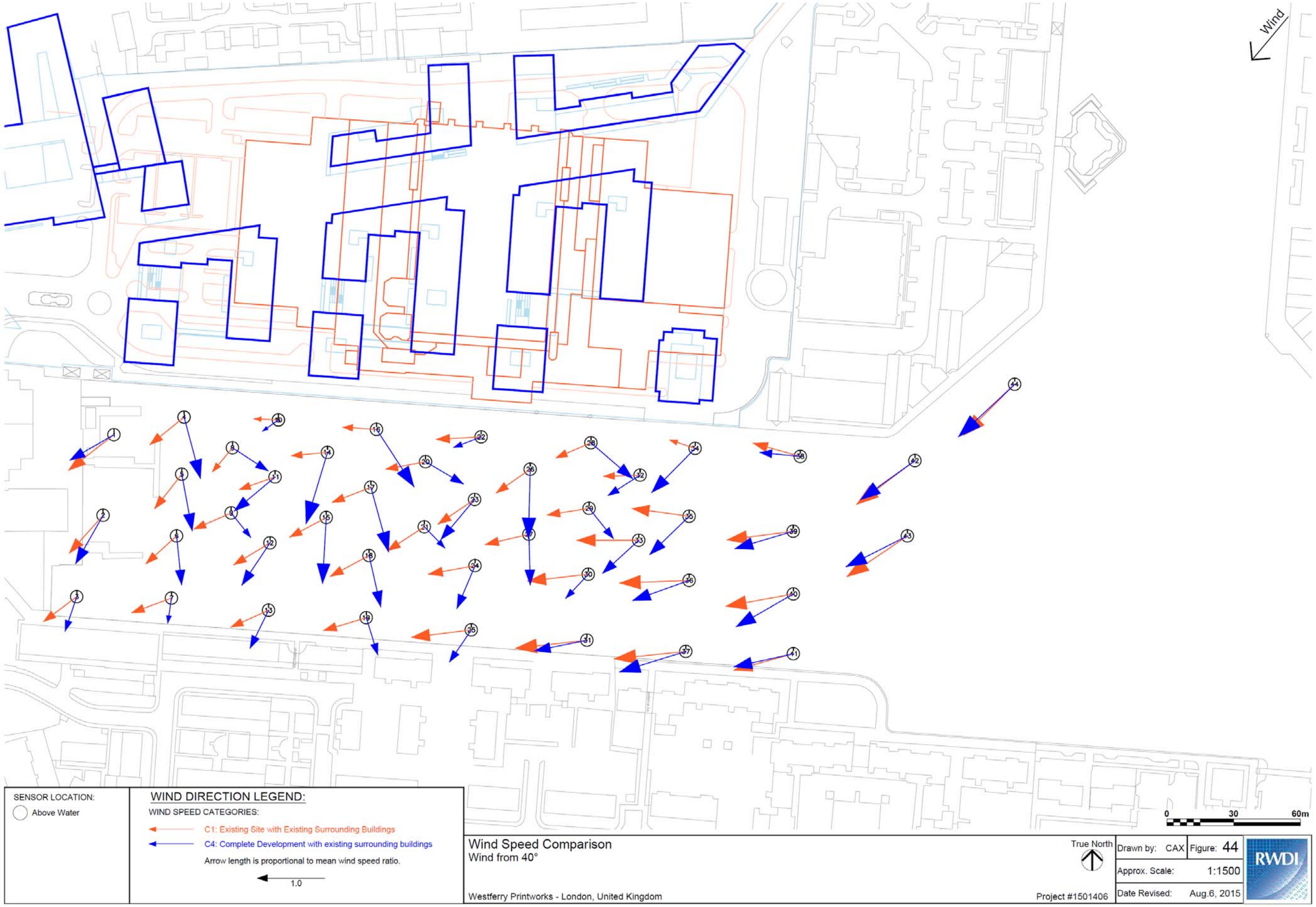


Figure 17.6: Wind climate comparing Existing Site and Completed Development



17.5.13 Winds from the northwest (shown in Appendix 17.1: Figures 33 to 36 and figures 69 to 72) generate similar conditions on the dock as winds from northeast, as discussed above in These conditions are characterised by abrupt changes in local wind speed and direction, due to the influence of the proposed towers. However, it can be seen from the wind roses in Figure 17.3 that north westerly winds do not occur frequently at any time of the year.

Assessment of Effects of Sailing Quality

17.5.14 The assessment of effects on sailing quality takes account of the changes in wind patterns, but also considered whether the changes are likely to be adverse or beneficial with regard to sailing quality. The assessment by the Wolfson Unit has been based on the revised DSWC criteria set out in paragraph 17.3.15.

17.5.15 The above criteria have been applied to each of the discrete wind angle data sets from the wind tests (see Appendix 17.1 and the foregoing section), and these have then been combined with the wind rose data (Figure 17.3) to estimate the proportion of good sailing quality time, displayed as a percentage (%) time, for a typical sailing season of March to November and individual monthly breakdown, as discussed in the meeting at DSWC on 28th July 2015. These are included in Figures A8 – A18 in the Appendix 17.2 (Revised). Each page of plots shows; on the left, the existing site (baseline) results; the middle, the proposed development results; on the right, the difference between the existing site and proposed development (positive values represent a reduction in sailing quality, negative is an increase in sailing quality over the existing site).

17.5.16 Elements of this data have been summarised in Tables (Revised) 17.1-17.3.

17.5.17 The changes in sailing quality over a whole year are shown in Figure 17.7, and are compared with the changes predicted for April on Figure 17.8 when north easterly winds are more prevalent. In these the more purple the colour in the top 2 plots, the better the sailing. In the final; panel on change a more purple colour indicates lessened sailing quality and a bluer colour an improvement in sailing quality

Table 17.1 (Revised): Percentage time during which Original Wolfson or DSWC Sailing Quality criteria are met In February-November Period

February – November (As requested by DWSC)						
	Western Dock End (Extents 7/15/23/31)			Main Dock Area (All points to 35)		
	Existing (%)	Developed Site (%)	Change in quality (%)	Existing (%)	Developed Site (%)	Change in quality (%)
Original Wolfson Criteria	72.7	63.0	9.7	72.2	68.1	4.1
DSWC Junior Criteria	61.9	50.3	11.6	64.0	58.9	5.1
DSWC Adult Criteria	56.5	46.4	10.1	57.4	53.1	4.3

Table 17.2 (Revised): Percentage time during which Original Wolfson or DSWC Sailing Quality criteria are met April, the month during which north easterlies are most frequent

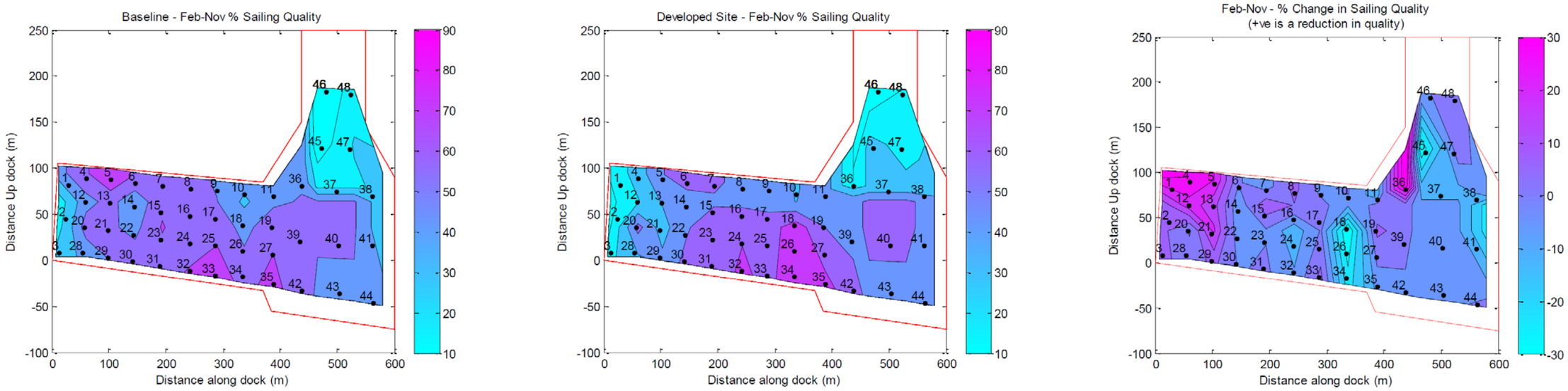
April (highest % of North Eastern sector wind)						
	Western Dock End (Extents 7/15/23/31)			Main Dock Area (All points to 35)		
	Existing (%)	Developed Site (%)	Change in quality (%)	Existing (%)	Developed Site (%)	Change in quality (%)
Original Wolfson Criteria	71.6	59.0	12.6	70.1	64.1	6.0
DSWC Junior Criteria	57.8	42.7	15.1	58.2	50.9	7.3
DSWC Adult Criteria	61.4	45.3	16.1	62.7	54.7	8.0

Table 17.3 (Revised): Percentage time during which Original Wolfson or DSWC Sailing Quality criteria are met In August, the during which south westerlies are most frequent

August (highest % of South Western sector wind)						
	Western Dock End (Extents 7/15/23/31)			Main Dock Area (All points to 35)		
	Existing (%)	Developed Site (%)	Change in quality (%)	Existing (%)	Developed Site (%)	Change in quality (%)
Original Wolfson Criteria	73.7	64.6	9.1	73.6	69.8	3.8
DSWC Junior Criteria	57.6	48.3	9.3	59.2	55.4	3.8
DSWC Adult Criteria	62.1	51.6	10.5	64.4	59.9	4.5

Figure 17.7 (Revised): Changes in Sailing Quality for Junior Sailor Criteria

(a) February- November



(b) April

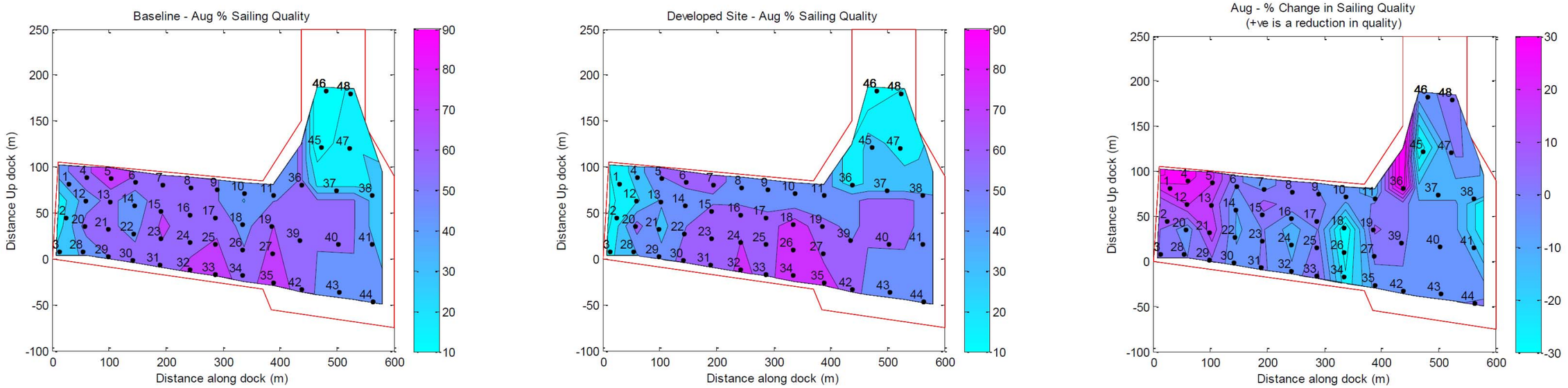
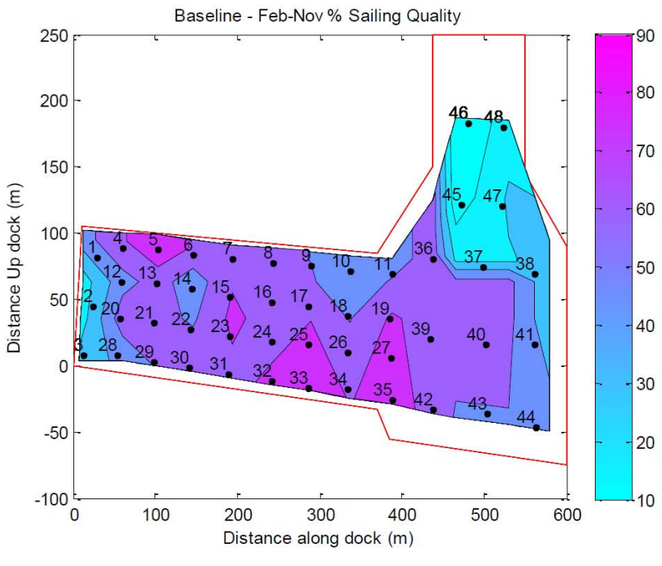
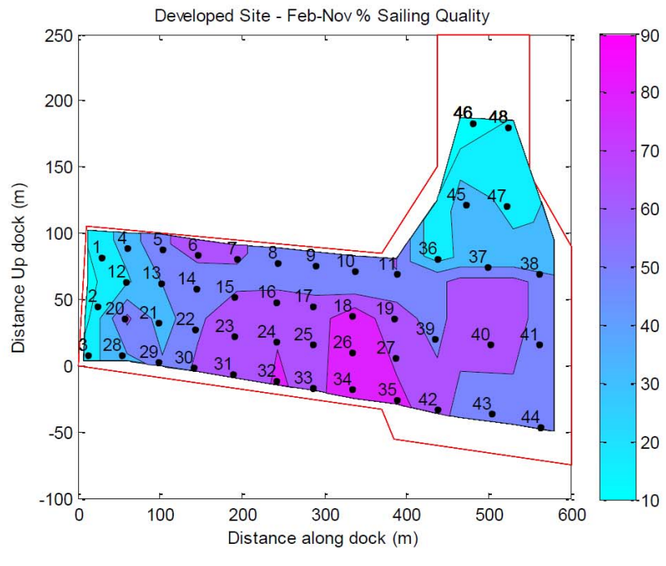
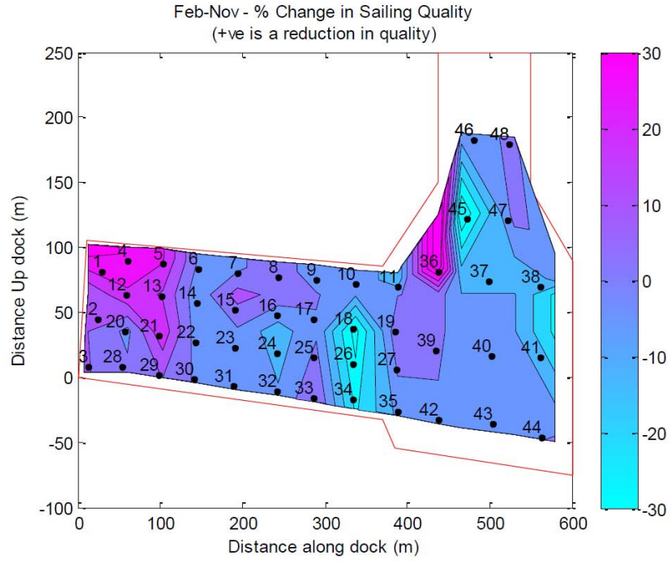


Figure 17.8 (Revised): Changes in Sailing Quality for Adult Sailor Criteria

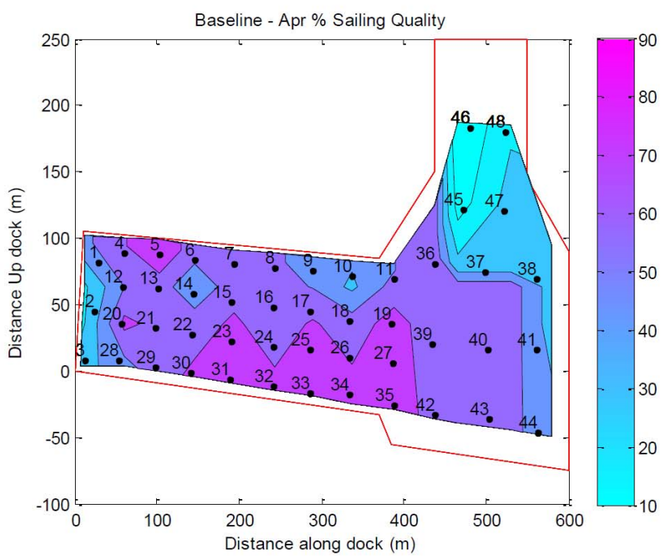
(c) February- November

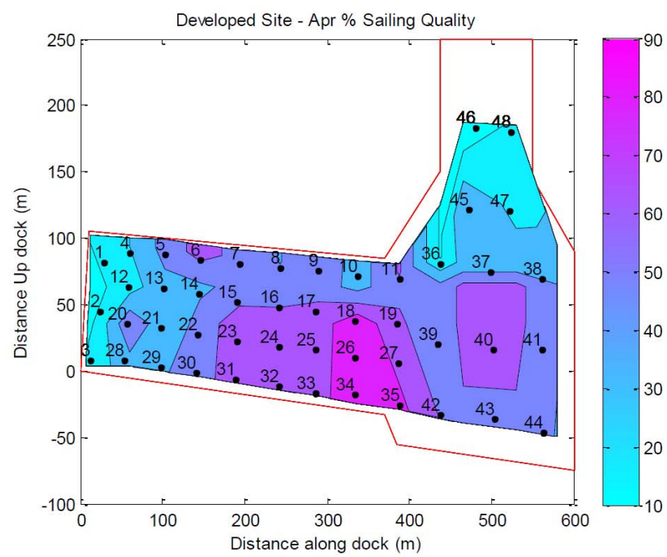


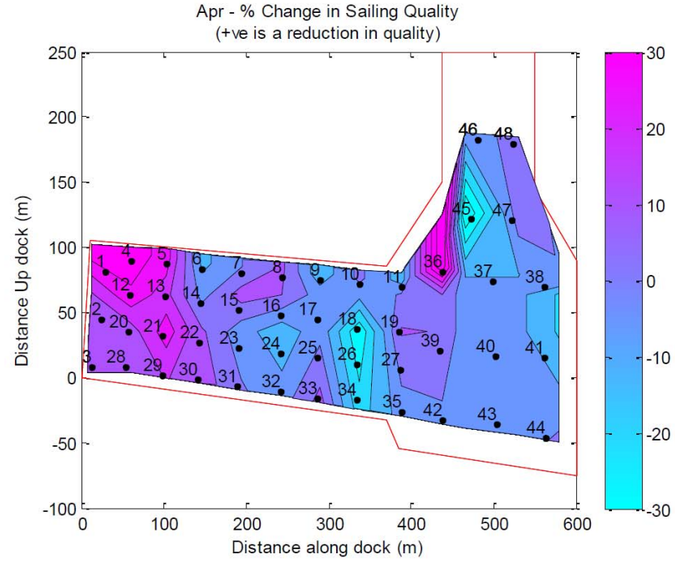




(d) April







Discussion of the Results

17.5.18 With the completed Development, over the entire sailing season, the results show a reduction (based on percentage of total time) in the sailing quality in the western sector of the dock delineated by a line joining points 7, 15 ,23 and 31 (see Table 17.1 (revised)). The changes range from 10.1% to 11.6% for these locations, based on the DSWC criteria. In the month of April this rises to 12.6% to 15.1%, as can be seen in Table 17.2 (revised). The original Wolfson Unit show a slightly lower degree of impact, but only marginally so (see Tables 17.1-3 (revised).

17.5.19 The principal locations that exceed a 20% reduction in the sailing quality criteria are 1, 4, 5 and 12, although the effects at locations 13 and 21 are notable. A plan of the relevant probe positions can be seen in Figure 17.4.

17.5.20 The main dock area (east up to point 35) is predicted to be subject to an average of 4.3-5.1% reduction of the time during which the sailing quality criteria are satisfied over the sailing season(February-November), raising to 7.3-8.0% in April.

17.5.21 This latter effect, which is also apparent in May to a lesser extent, can be attributed to the North East wind direction, which has a more notable influence in the periods of April and May.

17.5.22 In southerly wind directions, in particular the south west predominant wind direction, there are minimal differences between the wind climate between the proposed Development and the existing Site. The reductions in sailing quality are of the order of 3.8%-4.5%, depending on the criteria adopted.

17.5.23 If a threshold of 20% (relative reduction in total time when the sailing quality criteria are not met) is applied as a quantitative measure beyond which a significant impact on sailing would occur, then the following conclusions could be drawn[1].

- There is a significant effect arising from impact of wind on the north-west sector of the dock in the vicinity of measurement point locations 1, 4, 5 and 12 (see Figure 17.4 for locations).
- The effect of the wind impact on the remaining locations is not significant. However, in the western part of the dock, as delineated by a line joining points 7, 15 ,23 and 31 the impact may be notable (10-20% change in quality), and on occasion noticeable

Unsteady Flow Analysis

17.5.24 The video of the tuft tests captured by RWDI give an indication the flow unsteadiness for a complete range of wind angles in 10˚ increments. It can be seen that when the wind direction has a northerly component, the majority of the tufts fluctuate over a greater angle range, particularly those to the north edge of the dock.

17.5.25 No video test information was available for the comparable condition with the existing Site.

Phasing Implications

17.5.26 The results highlighted in Figure 17.5 and Figure 17.6 show the wind climate at 40˚ wind direction (near NE). Figure 17.5, taken from Appendix 17.1 shows the cleared Site (with existing surrounding buildings) in green, Phase 1 in magenta and the completed development in blue. Figure 17.6, from Appendix, shows the existing site in orange, with the proposed Development in blue.

17.5.27 By using both figures together, it can be seen that the cleared Site offers a more uniform wind climate over the dock in the NE wind direction, over that of the proposed Development phases I and II and that of the existing Site.

17.5.28 It is notable that in the north west corner of the Dock where the greatest change in sailing conditions are expected, the wind conditions for the partially developed Site - with the relatively low buildings T01 (ground+8 floors), T02 (ground + 12 floors) B02 (ground +3 floors) and B03 (ground + 4 floors) - are essentially the same as those for the completed Development. This indicates that the influence of the later taller buildings (T03 and T04) on these wind conditions is limited.

17.6 Potential for Mitigation

17.6.1 There are important differences between the present assessment and typical pedestrian wind comfort assessments. This is due to the following factors:

- The relevant wind conditions for sailing quality are those winds that are of ‘typical’ strength and constitute frequently experienced winds, whilst for pedestrian comfort and safety the winds of interest are the less frequent and (much)stronger. The part of the ‘wind spectrum’ that is of interest is thus quite different.
- Mitigation measures such as tree planting, which are often very effective for pedestrian comfort and safety, may be less useful for sailing quality and are only effective quite locally. These measures again deal with the less frequent part of the ‘wind spectrum’ that is of interest with regard to pedestrian comfort and safety.
- Use of features such as canopies is also unlikely to be of relevance. These, like other conventional treatments, are related to localised effects in more infrequent conditions. Safety issues are not considered to be a consideration for sailing conditions, since sailing by novices is unlikely to take place during periods of unsuitable wind strengths. During the typical, more frequent, wind conditions it is the bulk impact of the overall Development that is important.

17.6.2 The evidence of the assessment is that buildings at the dock edge, as might be expected with any development of this strategic site for housing, could affect the winds over the dock. The testing of wind effects to reflect phased development confirms this. The significant effects on sailing quality with this Development appear to be related to some of the lower buildings. However, clearly for winds with a northerly component any substantially denser development of the Site would affect wind conditions more than the current building.

[1] The rationale of this percentage criteria is broadly analogous that adopted in assessing whether the impact of light loss is noticeable or not

Variations in Massing

17.6.3 As indicated above the scope for the use of design interventions, such as canopies and planting are unlikely to be applicable to the mitigation of the types of impacts on winds of the dock.

17.6.4 Appendices 17.3 and 17.4 provide further assessment of massing options requested by the GLA to help elucidate how variations in massing might affect the wind environment of the Dock.

17.6.5 Addendum Table 17.4 summarises the massing variants tested (see Appendix 17.3). These do not represent schemes alternatives that can provide the quantum of development proposed but sought to test factors that might affect the wind, by removing buildings, restricting the block heights to 25m, and re-orientating blocks of development.

Addendum Table 17.4: Configurations Tested

Configuration	Description
C1	Existing Buildings at the Site
C2	Cleared (Empty) Site
C3	Phase 1 buildings (Buildings B04, B07, T03 & T04 absent)
C4	Completed Development as proposed
M1	Completed Development with building T01 deleted
M2	Completed Development with buildings T01 and B02 deleted
M3	The Masterplan layout is retained with Buildings B03, B03, B04, T01, T02, T03 and T02 at 25m height
M4	The tower buildings (T01-T04) are moved northward to the edge of the internal road, with the courtyard blocks (B02-B04) moved southward toward the dock and some minor mass redistributed to allow buildings of similar mass to be achieved.
M5	This is a variant of M4, wherein the towers (T01-T04) and courtyard blocks (B02-B04) have been orientated at an angle aligning with an axis from north east and south west. The massing of the courtyard blocks required adjustment with B02 having a much reduced footprint and B04 a substantial elongation.

17.6.6 The sailing quality assessment by the Wolfson Unit compares massing configurations M1-M5 with the C4 application scheme configuration. In their assessment (Appendix 17.4) a notable effect is reported as one where a 10% change in sailing quality relative to the application scheme is indicated and a significant effect is one where a 20% change in sailing quality is indicated. The conclusions of their assessment are as follows:

- M1 – Removal of the western-most tower (T01) would lead to an improvement in the localised sailing quality at location 2, for example, but would not lead to notable differences on the western dock, in general.

- M2 – Removal of Tower 1 (T01)and Building 2 (B02) would also lead to improved localised sailing quality in the north western corner, such as location 2, but would not lead to notable differences in the effects on the western dock, in general.

- M3 – The limitation of the height of structures on the same Masterplan to 25m would have an effect in the April period, improving the total percentage of above sailing threshold conditions by 5%, but averaged over the sailing season this would be less than 5%.

- M4 – Moving the towers North wards would have a notable effect on the Western Dock, increasing the total percentage of above sailing threshold conditions by over 7% in April and 8% over the main dock.

- M5 – Moving Towers to the North and re-aligning the Towers and courtyard buildings to the North-Easterly direction has a notable impact on the sailing quality over the entire dock. This increases the total percentage of above threshold sailing quality time of 14% when compared to the completed development (application scheme C4 configuration).

The results indicate that some improvements in sailing quality can be achieved with a significant realignment of buildings. Reducing massing to a uniform height of 25m with the same Masterplan layout has a slight effect but less than the radical realignment of the buildings indicated by configuration M5.

17.7 Residual Effects and Summary

17.7.1 The modification of the wind climate due to the Development and its effects on the sailing quality for junior and novice adult sailors is significant at locations 1, 4, 5 and 12. It would be challenging for a novice sailor to sail in the North West portion of the dock when the wind has a northerly component, this is based the evidence from the video footage and the analysis detailed in Section 7.5. This is primarily due to large the changes in local wind direction angle between locations in this vicinity.

17.7.2 The wind climate over the dock for the duration of wind directions that have a northerly component is governed principally by the volume and height of the structures upstream. Minor alterations to the Development will not have a significant effect on the sailing area. The radical step of limiting the height of development with the same Masterplan, or omitting buildings, has been found to yield a relatively modest improvements in wind conditions

17.7.3 It is notable that the effects of relatively low buildings are significant even when only Phase 1 if the Development has been completed. The tallest building at this stage would be ground plus 12 storeys.

17.7.4 Due to the location of the Development, the impact on predominant wind direction from the south west is minimal, and the effect on the sailing quality of the dock is less than on those winds with northerly components.

17.7.5 Table 17.5 overleaf replaces and revises Table 17.3 in the August 2015 ES.

Table 17.5 : Summary of Effects of the Development on Sailing

Issue	**Predicted Effect**
Impact of Demolition	Beneficial, temporary **and negligible**
Effects of Phase 1 of development	**Adverse and significant** at north west of dock (locations 1,4, 5 and 12)
	Not significant at other locations
Effects of Completed Development	**Adverse and significant** at north west of dock (locations 1,4, 5 and 12); no significant change indicated from Phase 1 condition with completed Development in this zone of the dock
	Not significant at other locations, albeit that wind change will be greater on the northern edge of the dock for north easterly (and north westerly) winds, where changes may be notable.

Revised Appendix 17.2: Sailing Quality Assessment, using of DSWC criteria

by Wolfson Unit Southampton University

WOLFSON UNIT
FOR MARINE TECHNOLOGY & INDUSTRIAL AERODYNAMICS

Report No. 2385 Addendum

Date : 24/09/15
Compiled By : TP
Verified By : MP

PLP Architecture

The effects of a proposed development of the Westferry Printworks site on nearby sailing activities with additional Docklands Sailing & Watersports Centre sailing criteria

1 INTRODUCTION

This report addendum presents the effects of additional sailing criteria received by e-mail from the Docklands Sailing & Watersports Centre (DSWC) on 22nd September 2015.

2 ANALYSIS

The objective of this process is to assess the effects that the Westferry Printworks Development would have on the ability to sail in the Millwall Outer Dock after completion of the development in comparison to the existing site under the sailing criteria provided by DWSC.

These criteria will also be compared against the original criteria set out by the Wolfson Unit in the original report number 2385. A comprehensive description of the processes has been detailed in report 2385.

2.1 DWSC Criteria

- Two wind speed ranges; one for Adults and another for juniors
    - Novice Adults – from 3 to 14 knots
    - Novice Juniors – from 3 to 9 knots
- Change of wind speed between locations of no greater than 30%

  A wind speed change of 30% between adjacent measurement locations within 40 metres (nearest adjacent location for those in with greater spacing at Eastern end of dock).
- Change of wind direction of no greater than 20 degrees between adjacent points

  A direction change of 20˚ between adjacent measurement locations within 40 metres (nearest adjacent location for those with greater spacing at Eastern end of dock).

2.2 Results

Presentation of the summary results is included in the Appendix.

The table in 4.1 shows the influence of the DWSC Novice Adult and Novice Junior criteria against the critical set out by the Wolfson Unit. The data is displayed over three different periods, February to November, April and August.

Revised Appendix 17.2

WOLFSON UNIT
FOR MARINE TECHNOLOGY & INDUSTRIAL AERODYNAMICS

Graphical display of the sailing quality for both Novice Adult and Novice Junior are displayed in Appendix 4.2 – 4.7.

3 CONCLUSION

The DSWC criteria do not alter the conclusions presented in the original report. These criteria are more onerous than the original therefore the extent of good sailing quality on both the existing and proposed sites is decreased. The relative differences between the developed and existing site remain reasonably consistent across the two sets of criteria.

4 APPENDIX

4.1 Tables of Data

February – November (As requested by DWSC)

	Western Dock End (Extents 7/15/23/31)			Main Dock Area (All points to 35)		
	Existing (%)	Developed Site (%)	Change in quality (%)	Existing (%)	Developed Site (%)	Change in quality (%)
Original Wolfson Criteria	72.7	63	9.7	72.2	68.1	4.1
New Junior Criteria	61.9	50.3	11.6	64	58.9	5.1
New Adult Criteria	56.5	46.4	10.1	57.4	53.1	4.3

April (highest % of North Eastern sector wind)

	Western Dock End (Extents 7/15/23/31)			Main Dock Area (All points to 35)		
	Existing (%)	Developed Site (%)	Change in quality (%)	Existing (%)	Developed Site (%)	Change in quality (%)
Original Wolfson Criteria	71.6	59	12.6	70.1	64.1	6
New Junior Criteria	57.8	42.7	15.1	58.2	50.9	7.3
New Adult Criteria	61.4	45.3	16.1	62.7	54.7	8

August (highest % of South Western sector wind)

	Western Dock End (Extents 7/15/23/31)			Main Dock Area (All points to 35)		
	Existing (%)	Developed Site (%)	Change in quality (%)	Existing (%)	Developed Site (%)	Change in quality (%)
Original Wolfson Criteria	73.7	64.6	9.1	73.6	69.8	3.8
New Junior Criteria	57.6	48.3	9.3	59.2	55.4	3.8
New Adult Criteria	62.1	51.6	10.5	64.4	59.9	4.5

4.2 Junior - February – November Statistical Data

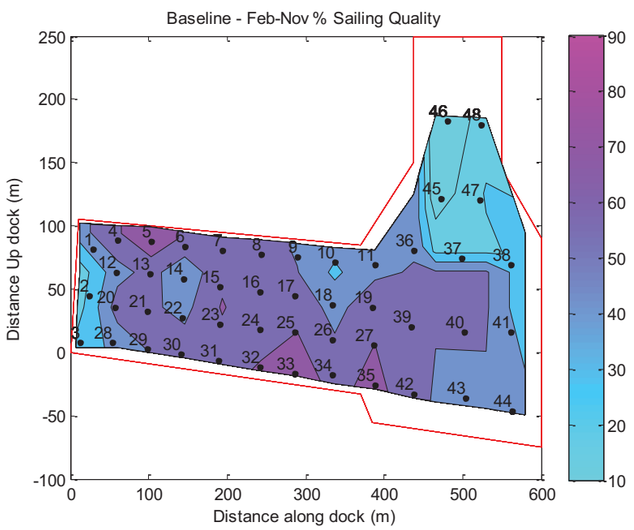


Figure A1

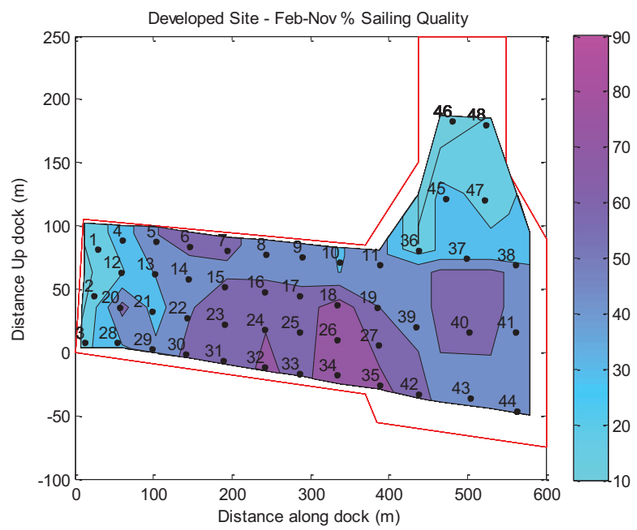


Figure A2

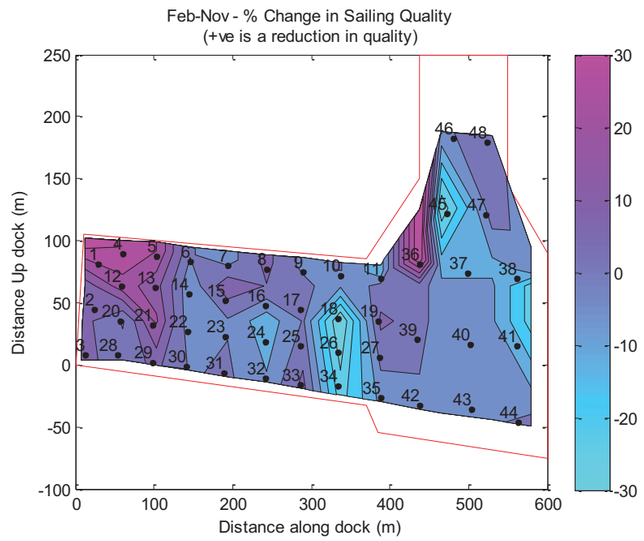


Figure A3

4.3 Junior - April Statistical Data

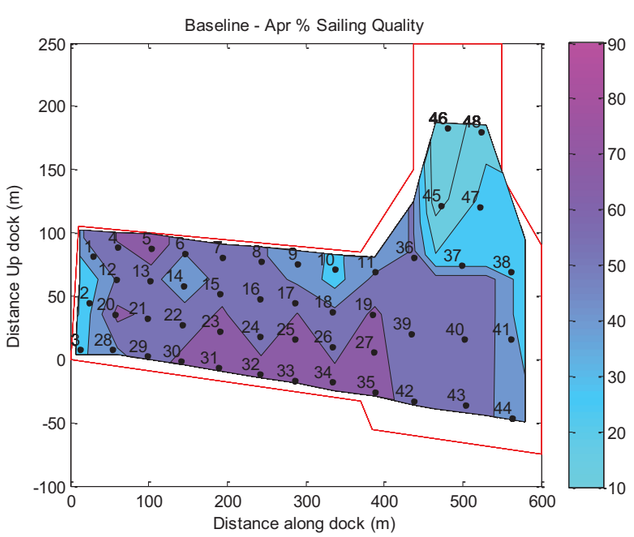


Figure A4

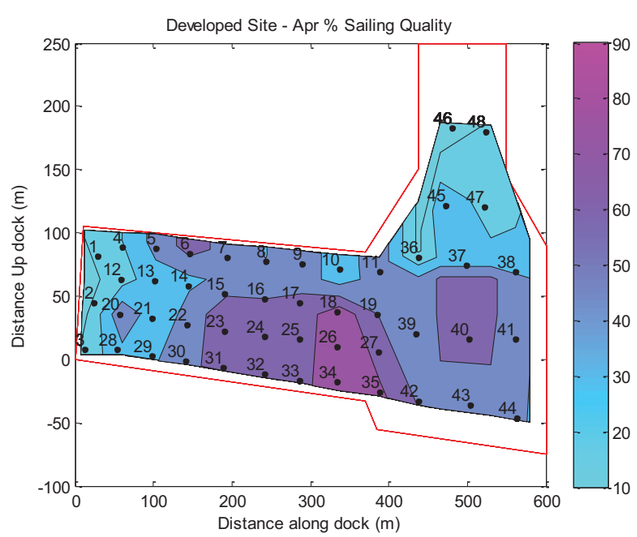


Figure A5

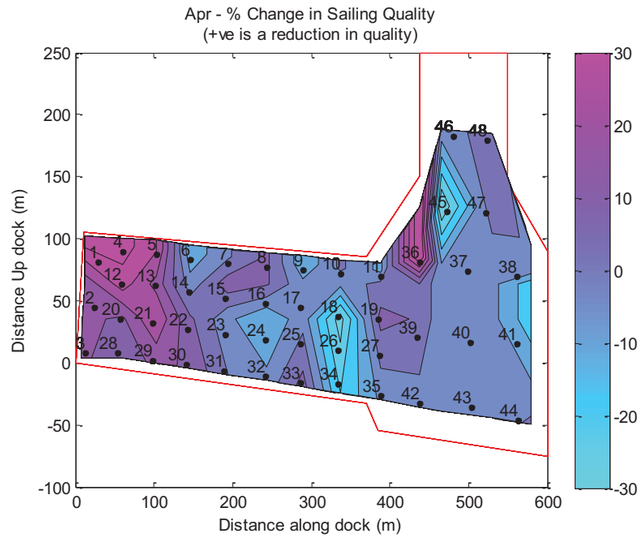


Figure A6

4.4 Junior – August Statistical Data

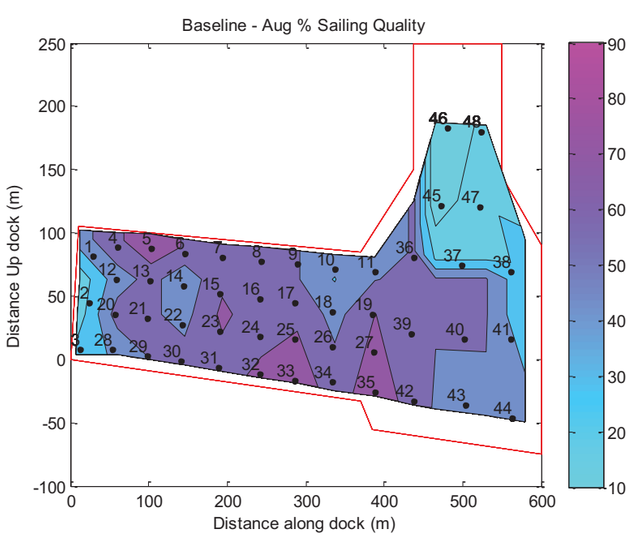


Figure A7

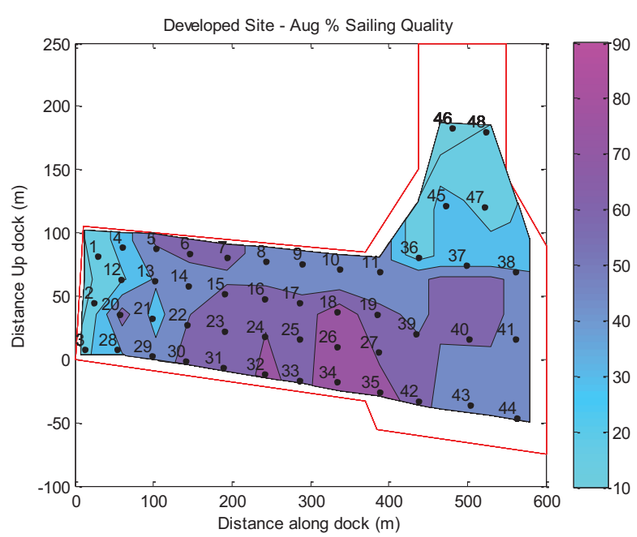


Figure A8

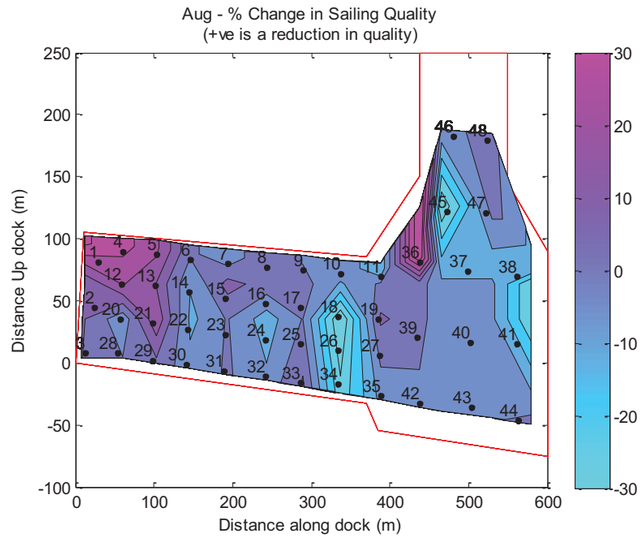


Figure A9

4.5 Adult – February - November Statistical Data

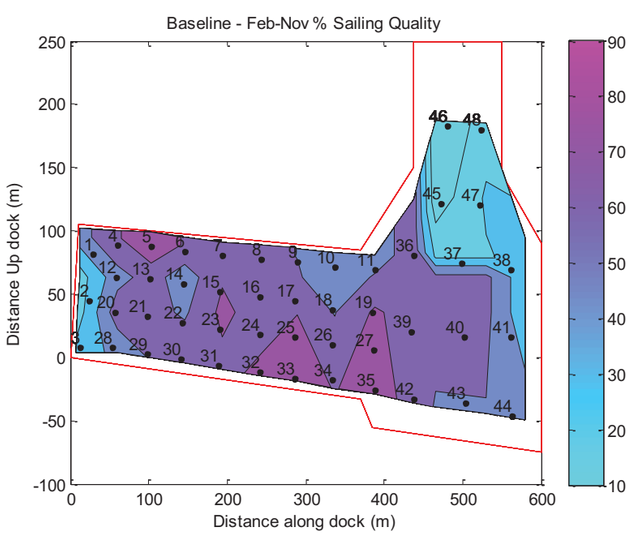


Figure A10

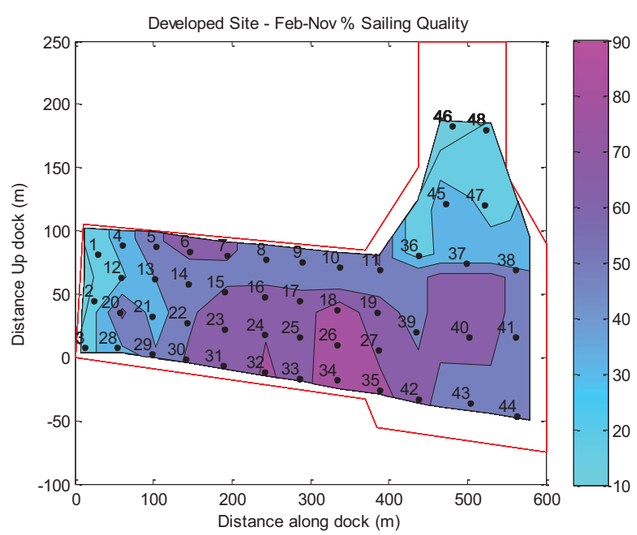


Figure A11

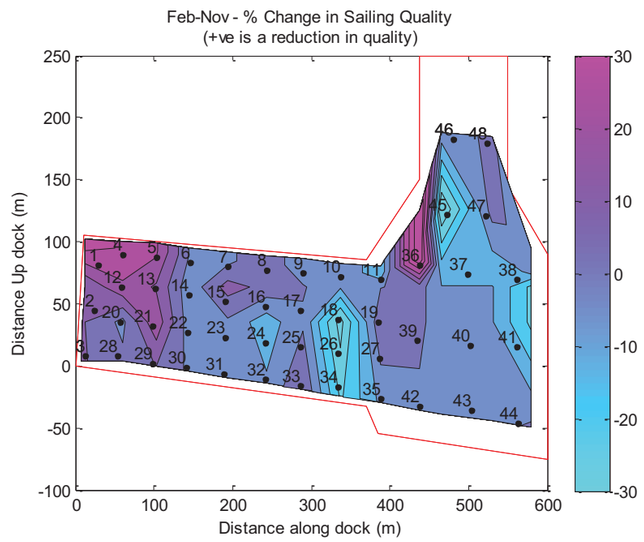


Figure A12

4.6 Adult – April Statistical Data

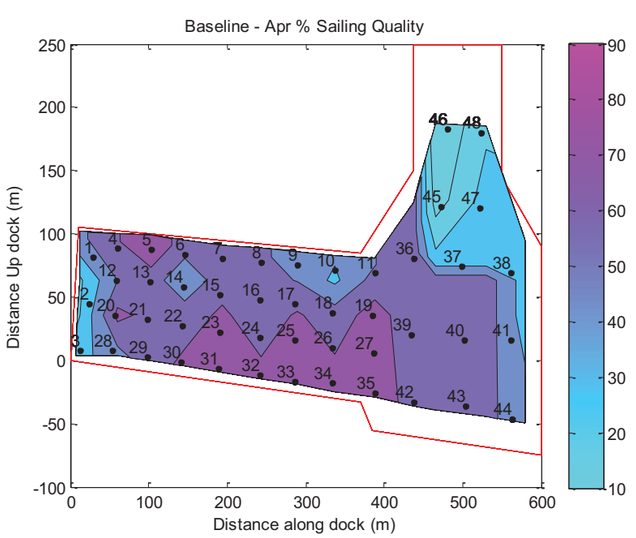


Figure A13

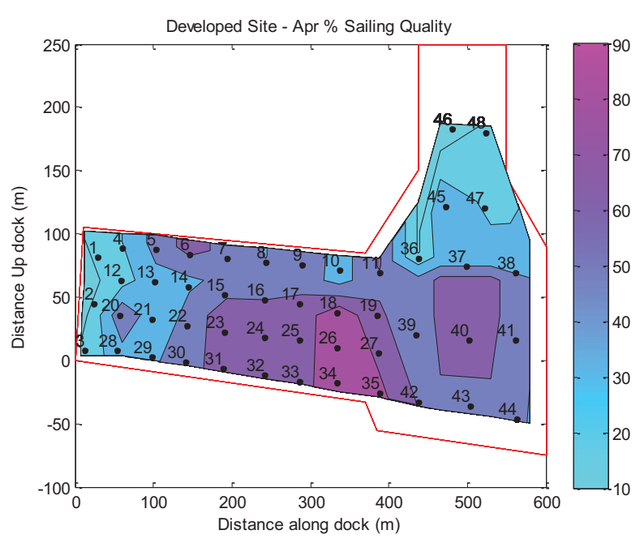


Figure A14

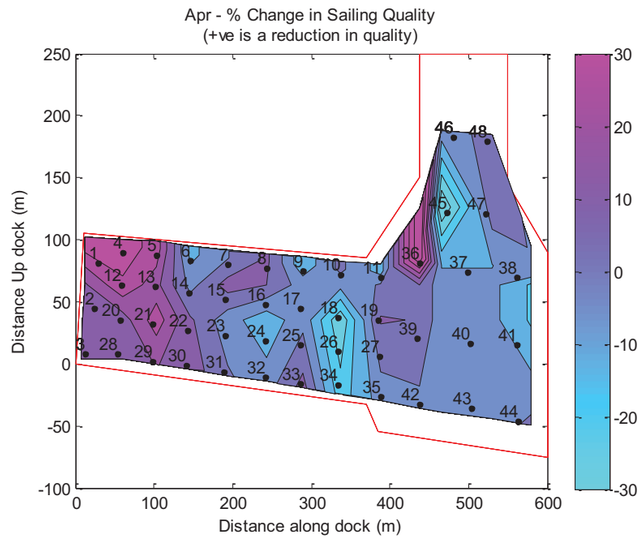


Figure A15

4.7 Adult – August Statistical Data

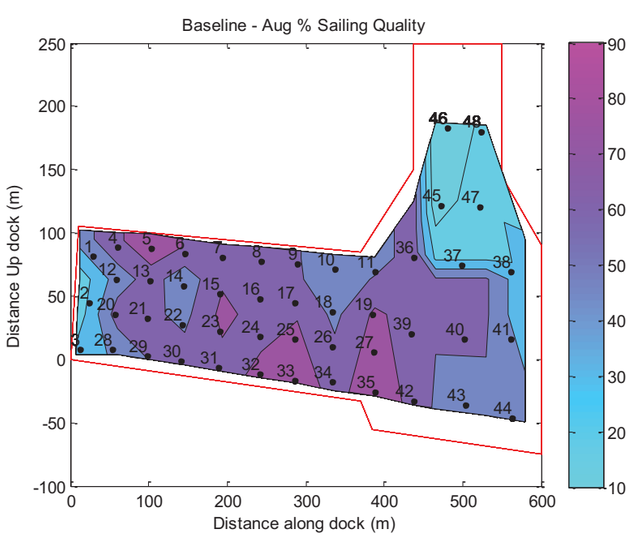


Figure A16

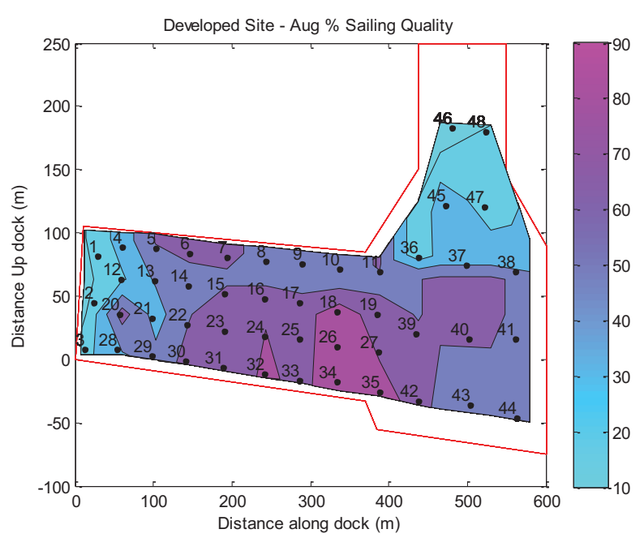


Figure A17

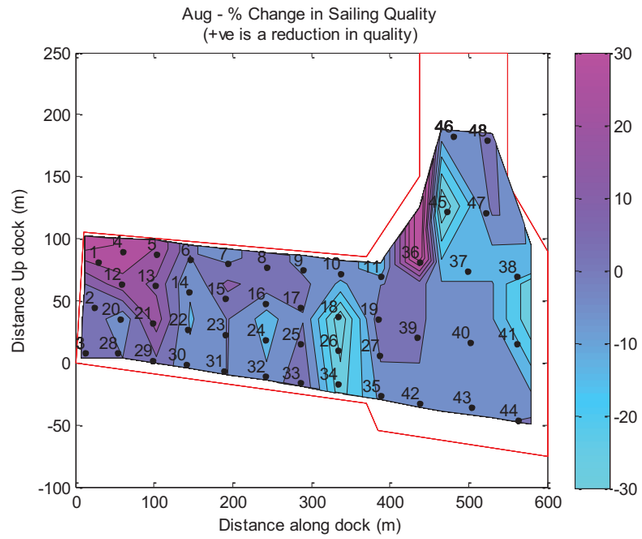


Figure A18

Appendix 17.3: Former Westferry Printworks: Massing Variations and Sailing Conditions by RWDI and EPAL

Former Westferry Printworks: Massing Variations and Sailing Conditions

1.0 Introduction

1.1 Extensive testing has been carried out of the impacts of the proposed Development at the former Westferry Printworks Site on wind over the dock. The purpose of this work has been to assess how winds might be impacted in a manner that affects the 'Sailing Quality' of the Dock with particular reference to the Docklands Sailing and Watersports Centre (DSWC).

1.2 Four separate sets of wind tunnel tests have been undertaken with regard to this matter; this is in addition to pedestrian comfort wind tunnel testing. The four sets of tests are as follows:

- Tests carried out on a scheme similar to that for the planning application, except for slight differences in Blocks 1, 6 and 7, the results of which were presented at the 4th November 2014. Tests were also carried out for the existing buildings at the Site.
- Tests carried out on a larger scheme (in terms of both height and bulk) with only blocks 1, 6 and 7 being of the same massing as the submission scheme of August 2015. The results of this scheme were not reported in the ES (in respect of wind on the docks, as this scheme had been superseded (this is referred to as the June 2015 in the following text). These data have not been presented previously but a selection of wind plots from the RWDI Anemos wind data set was provided in the last response (February 2016) to the LBTH IRR relating to the ES for the Development.
- Tests carried out on the submission scheme (August 2015), which included tests on: the cleared Site with no buildings; the existing buildings; a partially completed Development with all buildings to the west on Block 4 in place (to represent a condition during construction); and the completed Development. The results of the wind testing are reported in Chapter 17.0 and Appendix 17.1 of the ES, although the fuller analysis of the partially developed site and cleared site are expanded on in the material presented here with regard to sailing conditions. Appendix 17,2 of the ES concentrated on the change from the existing condition to the final completed Development
- Tests carried out on 22nd February 2016 to assess five different massing options, following comments from the DSWC and meetings held with the GLA. These examine various changes in massing, ranging from simple deletion of blocks to relocation and reorientation of buildings (as described below). The objective of this work was to ascertain the sensitivity of the winds to these changes, given that any development of the site will change conditions from the baseline of the existing Westferry Printworks building.

1.3 In addition smoke test videos and tuft test videos have been produced and have been made available to all parties. The smoke testing was also undertaken as part of a workshop held on 4th November 2014 at the RWDI Anemos testing facility, to which members of the DSWC were invited and were present (including Councillor Chesterton); LBTH officers and the advisors BMT were also present. During these latter tests, which included a presentation of the results of the first set of wind tests (using Wu tubes), the buildings were moved around the Site to gain a qualitative feel for how the redistribution of buildings might affect the wind distribution over the dock.

1.4 This document provides an overview of the results of the various tests carried out. The aim is to provide, in conjunction with the detailed analyses by the Wolfson Unit at University of Southampton, an understanding of how developing the Site may affect the quality of winds for sailing ('Sailing Quality'). It must be emphasised that the way that this is examined differs quite markedly from the more familiar assessment of pedestrian level comfort. Issues of wind speed variability and changes of direction are considerations that typically are of less concern for pedestrian level wind assessment, where light winds are not an issue normally. Moreover, the conventional approaches to mitigation such as landscaping and canopies, which may be useful to mitigate local pedestrian wind comfort or safety issues, are unlikely to be effective at the scale of wind over the docks.

1.5 Finally it is worth making a point on semantic distinctions used. The term impact relates to how the wind in the dock is altered by changes to the built environment at the Site (including clearance during demolition). The term effect is used to express whether these impacts cause beneficial, neutral or adverse effects on sailing quality, and whether these are significant or not. This is important, since the redevelopment of the Site will have an impact on the wind environment but the effects may be acceptable. In this regard the results of the demolition of the existing buildings are a notable consideration.

2.0 Summary of Testing Methods and Sailing Quality Assessment Criteria

RWDI Testing Methods

2.1 The Testing by RWDI Anemos has included wind tunnel measurements of wind speed and direction at up to 45 locations throughout the dock using a Wu tube probes. The model used is 1:300 scale. The Wu tubes provide a method for simultaneously measuring mean wind speed and direction; Appendix 17.1 of the ES describes the methods in greater detail. The test locations initially covered most of the area of the dock to Glengall Bridge. These test locations were mapped and this was sent to the DSWC for their comments. Later tests have increased the density of probe locations in the western part of the dock, once it became apparent that the effects of the Development to the east of Greenwich View Place are minor. Thus more recent tests increase the density of probes where the impact is greatest.

2.2 The RWDI Anemos results are presented in the form of wind speed and vector plots. These compare the various stages of development against the winds currently experienced with

the existing building. For the testing of the main Development, these results are presented for each of the 36 wind directions tested; these represent 10 degree segments of the full 360 degrees of the compass. For the more recent testing of massing options 30 degree segments were tested to allow more rapid reporting of the results and allow more options to be analysed.

2.3 The results do not, however, reflect to distribution of wind throughout the year. Thus, for example, the relatively infrequent north westerly wind may indicate a large change for a particular building configuration but less for another. However, due to the infrequency of this direction the actual effect on Sailing Quality may be very limited. Similarly, the predominant wind directions from the south westerly quarter may have limited effects, but are also far more frequent. For this reason the raw RWDI Anemos wind vector plots are useful for understanding the *impact* of different building configurations for the various wind directions, but they do not provide any weighting of these wind directions in relation to wind frequency distributions (as indicated by a wind rose). Thus, without this weighting applied the results, the effects on Sailing Quality cannot be properly understood.

2.4 The results of the first 3 sets of testing have indicated that for the completed development the winds affected to the greatest degree are those from the north easterly quarter, which is an important wind direction in the London area during the spring (April-May). The predominant wind direction -the prevailing winds – is from the south west quarter. When compared with the existing situation, winds from these directions are affected to a much lesser degree by the completed development. The results of the most recent testing are provided in Figures 4-27 attached to this document.

2.5 Flow visualisation tests have also been carried out using smoke tests, which were attended by the DWSC in November 2014. In July 2015 further tests using a 'tufting method ' were carried out, following a meeting with LBTH and their expert advisors BMT. These tests involved video analysis to identify areas where there may be particular patterns of turbulence that may not be detected by the Wu tubes.

2.6 The basic methods of measurement and testing were agreed with LBTH and their advisors BMT. Issues over sensor height, the wind dataset for analysis and related technical matters have been reviewed and are considered to be immaterial to the overall results. There is consensus that the testing methods are appropriate.

Wind Data Interpretation and Sailing Quality Criteria

2.7 The data from the wind tunnel tests have been analysed by a team led by Martyn Prince of the Wolfson Institute at the University of Southampton. The test data from the wind tunnel have been processed to allow evaluation against the criteria provided by the DWSC to as follows:

- Two wind speed ranges; one for Adults and another for juniors
    - Novice Adults – from 3 to 14 knots
    - Novice Juniors – from 3 to 9 knots

- Change of wind speed between locations of no greater than 30%

  A wind speed change of 30% between adjacent measurement locations within 40 metres (nearest adjacent location for those in with greater spacing at Eastern end of dock).

- Change of wind direction of no greater than 20 degrees between adjacent points

  A direction change of 20˚ between adjacent measurement locations within 40 metres (nearest adjacent location for those with greater spacing at Eastern end of dock).

2.8 These criteria relate to the quality of sailing conditions not the change (*impact*) from the existing condition. It should not be assumed that a change from the present is by nature adverse. This assessment compares the quality of sailing before and after development rather than assuming that any change in wind speed or direction from the current situation must be adverse. This is analogous to how pedestrian wind comfort is assessed. In the case of pedestrian wind comfort what is important is not whether wind is changed by a new structure (the wind impact) but whether the resulting *effect* is appropriate given the intended use of an area subject to change (*impact*). In the case of sailing quality, however, the wind speed and direction are important, as reflected in the criteria.

2.9 In order to assess sailing quality, the data from the wind analysis are initially processed to provide the appropriate frequency distribution for wind speeds and directions, according to the data presented graphically in Appendix B. This exercise has been carried out for each month, annually and for the main sailing season February-November. This encompasses the main April-May period when north easterlies would be more prevalent.

2.10 The data derived from this process has then been subject to further analysis by the Wolfson Unit at University of Southampton to assess the results against the Sailing Quality criteria. This is described further in the Wolfson Unit's flow chart (overleaf). The output from the analyses are presented as charts, which present the results in terms of a proportion of the time (percentage) during the relevant period that the wind conditions meet the Sailing Quality criteria.

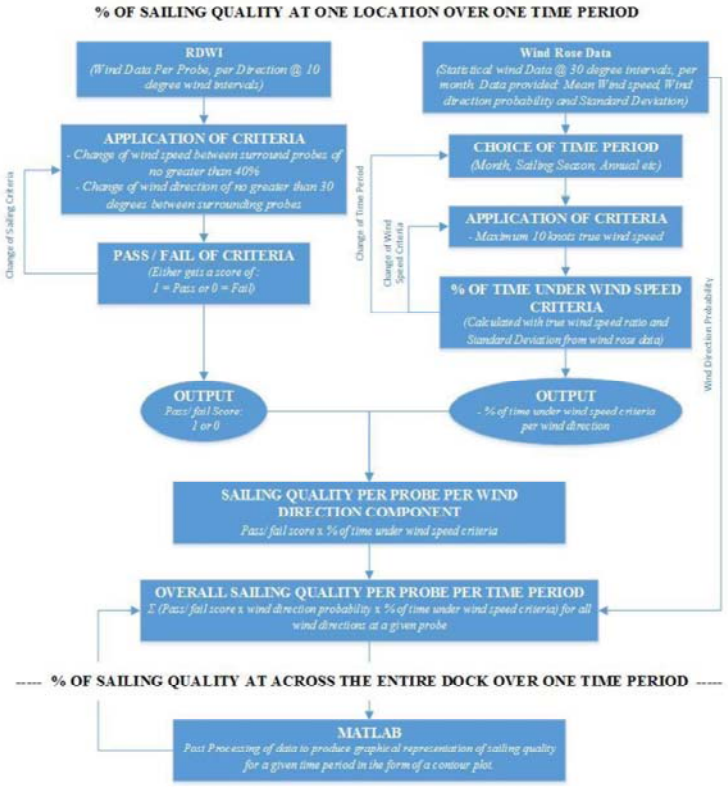
2.11 This data processing provides contour maps showing the sailing quality (i.e. where the criteria are met) as a percentage of the time for the main sailing season, based on the results of wind tests for the existing situation and the completed development.

Tests Carried Out

2.12 The tests carried out for different massing and configurations are tabulated below (Table 1). All of the tests have adopted the existing surrounding buildings as the built environment context. A tower is proposed adjacent to Glengall Bridge - Glengall Quay (45-59 Millharbour)(ref: PA/14/03585). Paragraph 16.13 of the supplementary response to the FRR sets out reasons why this cumulative scheme is not likely to be material to the assessment of Sailing Quality. Regardless, the aim of the assessments discussed herein is to compare various massing configurations for the Site, and for this the existing surroundings has been used consistently for all tests. The school block and Blocks B01, B06 and B07 have been represented, where present, as in the application scheme in all cases.

Table 1: Configurations Tested

Configuration	Description
C1	Existing Buildings at the Site
C2	Cleared (Empty) Site
C3	Phase 1 buildings (Buildings B04, B07, T03 & T04 absent)
C4	Completed Development as proposed
M1	Completed Development with building T01 deleted
M2	Completed Development with buildings T01 and B02 deleted
M3	The Masterplan layout is retained with Buildings B03, B03, B04, T01, T02, T03 and T02 at 25m height
M4	The tower buildings (T01-T04) are moved northward to the edge of the internal road, with the courtyard blocks (B02-B04) moved southward toward the dock and some minor mass redistributed to allow buildings of similar mass to be achieved.
M5	This is a variant of M4, wherein the towers (T01-T04) and courtyard blocks (B02-B04) have been orientated at an angle aligning with an axis from north east and south west. The massing of the courtyard blocks required adjustment with B02 having a much reduced footprint and B04 a substantial elongation.



2.13 The massing configurations for M1-M5 are shown in Appendix A (wind tunnel models at Figures 28-32) and Appendix C (PLP supplied plans), respectively. Figures 2 and 3 show the existing (C1) and completed development (C4) models, respectively.

2.14 The results of the wind tunnel tests are presented as a series of vector plots (Figures 4-27) produced by RWDI for 30 degree wind segments for massing configurations M1-M5. Additional plots for earlier tests, concentrating on the north easterly wind directions are provided in Appendix D (labelled in **red** as Figures 33-47).

3.0 Overview of the Past Test Results

3.1 The assessments of wind and also the Sailing Quality assessments have indicated that the north easterly wind direction is the most significantly impacted wind direction. The far more frequent south westerly conditions are less affected, and the impacts of the Development are limited. The impact on northerly and north westerly are affected but due to their relatively low frequencies are of substantially less important than the north easterlies. Figures 33-47 show wind vector plots for the north easterly wind directions (20-60 degrees) for:

- The August 2015 application scheme (Figures 33, 36, 39, 42 and 45), comparing the cleared site (C2) , Phase 1 developed site (C3) and completed Development (C4)
- The August 2015 application (Figures 34, 37, 40, 43 and 46), comparing the existing Site (C1) and completed Development (C4);
- The June 2015 Larger Massing Scheme application (Figures 35, 38, 41, 44 and 47), comparing the cleared site and the completed Larger Massing Development , which included a G+32 storey T04, G+19 storey T03, G+15 storey T02 and G+11 storey T01 on larger footprints, whilst blocks B02-B04 were also 1 floor higher with larger building footprints.

3.2 The analysis demonstrates that at different locations in the dock the completed development will change the sailing quality, in some places negatively and in others positively. The greatest adverse effects on sailing quality have been generally found at the western end of the dock.

3.3 In terms of the impact on wind, the results indicated that the cleared site (C2) gives rise to altered winds from the existing Site condition (C1), especially along the northern boundary of the dock, for the north easterlies.

3.4 For the partially developed site it was evident that the impacts and effects at the head of the dock are in many respects similar to those of the completed Development but as expected tend towards the cleared site condition to the east, where there is no development. The analysis of sailing quality indicated that in the impacted zone the effects on sailing quality are broadly similar to those of the completed Development.

3.5 The test result of the larger scheme were also notable in bearing strong similarities to the application scheme for the Development, indicating that the impact Masterplan layout on wind over the dock was not especially sensitive to the increase in the massing of the towers; this is notwithstanding some change in detail at certain locations.

3.6 Assessments were made - as reported in the ES and subsequent submitted material using the DSWC criteria - of the differences in sailing quality between the existing situation and that pertaining with the completed development. This shows that the largest negative change in sailing quality is expected at the north west of the dock, adjacent to buildings of not more than 10 storeys. This suggests that the massing profile adopted with an increase in height towards the east is appropriate. An increase in massing towards the west of the dock would be likely to give rise to a more negative outcome for sailing quality based on the analyses carried out to date.

3.7 The assessments have shown that the greatest effects on sailing quality coincide, as expected, with the months of April and May. The assessment of a longer proportion of the year (February to November) increases the contribution of south westerlies to the analysis, resulting in a lessened relative impact of the Development.

4.0 Overview of Results of the Massing Configuration Tests

4.1 The vector plots for the massing configuration tests are shown in Figures 4-27 attached herewith.

Prevailing Wind Directions (South West to West)

4.2 The prevailing (i.e. most frequently occurring) winds blow from the South West and West throughout the year, as shown in the wind roses in Appendix B. These winds account for approximately 40% of all wind annually.

4.3 The wind vector comparisons for this sector are shown in Figures 11 to 13 and Figures 23 to 25 (210° to 270° in 30° intervals). While there is a some change in wind direction between the conditions in each configuration, overall the wind speed remains approximately the same and the wind direction across the length of the dock remains consistent (i.e. the flow progresses smoothly from West to East across the main part of the dock without any abrupt changes in direction), when wind blows from the South West sector. In all the assessed scenarios, the alignment of the dock and the surrounding buildings tends to steer the wind from the South West along the dock from West to East.

4.4 It is noted that while in C3 the winds from the west deflect around Block T01 at the west end of dock (which is in the region of the launching area used by the sailing club) in M1 when Block T01 is removed this deflection shifts Eastward, with wind deflecting around Block T02 (when winds blow from the West, as shown in Figure 13).

4.5 This effect becomes more prominent in M2 when Block B02 is removed, which indicates that winds from the west are predominantly affected by whichever tower is furthest upwind (which in this case is the most western along the dock).

Secondary Wind Directions (North East)

4.6 Winds from the North East occur frequently during spring and early summer, as shown in the wind roses in Appendix B, particularly in April and May.

4.7 The wind vector comparison for this sector is shown in Figures 5 and 6 and Figures 17 and 18 (30° and 60°). From these Figures, it can be noted that the wind conditions in the alternative configurations diverge from the completed Proposed Development conditions in a region directly south of the Site. These effects are likely to be caused by the interaction of the buildings T01-T04 along the dockside with the approaching wind, generating turbulent wakes on the down-wind side extending across the dock in some cases. Notably the wind direction changes local to T03 and T04 with M3 (25m buildings) and the Development (C4) are consistent, and the assessment of sailing quality by the Wolfson Unit indicate that the changes in sailing quality with this reduced massing scheme are modest given the radical reduction in building height.

Other Wind Directions

North and South

4.8 The effect of removing Blocks T01 and B02 (in configurations M1 and M2) is limited to the West of the Site, when winds blow from the North (shown in Figures 4) and South (shown in Figures 10). This is reflected in Figures 16 and 22 (for winds from the North and south respectively) for configuration M3 where the reduced mass of Blocks does not significantly alter magnitude of localised wind flows across the dock, with the main changes in the resulting wind direction recorded limited to the North of the dock along the frontage of the Proposed Development.

4.9 Notable changes in the local wind direction and magnitude are recorded in configurations M4 and M5 (when compared to configuration C3), when winds blow from the North or South (as shown in Figures 16 and 22 respectively). This is the result of the changes in massing associated with configurations M4 and M5, but are less evident with the reduced height M3 configuration. Moreover, it should be noted from the wind roses in Appendix B that winds from these directions do not occur frequently, when compared with the prevailing South West and secondary North East sectors.

East to South East

4.10 Winds from the East and South East occur infrequently, as can be noted from the wind roses in Appendix B. The effect of the Proposed Development on wind conditions from this sector is limited as shown in Figures 7 to 9 and Figures 19 to 21. Wind speed and direction remains consistent over much of the dock.

North West

4.11 As shown for winds from the South West and West the effect of removing Blocks T01 and B02 (in configurations M1 and M2) is limited to the West of the dock, when winds blow from the North West sector (as shown in Figures 14 and 15). In M1 when Block T01 is removed the deflection previously recorded around T01 in configuration C3 shifts Eastward, with wind

deflecting around Block T02. This effect becomes more prominent in M2 when Block B02 is removed (as shown in Figures 14 and 15).

4.12 In configurations M4 and M5 notable changes in the local wind direction and magnitude are recorded (when winds blow from the North West sector) when compared to configuration C3, as shown in Figures 26 and 27. As previously discussed these changes in directionality and magnitude are the result of the changes in massing associated with configurations M4 and M5. It is noted from the wind roses in Appendix B that winds from these directions do not occur frequently, when compared to the prevailing South West and secondary North East sectors).

5.0 Summary

5.1 For the south westerlies the subtle differences in impact on wind speed and direction are indicated for the various configurations. The alignment of the dock and the surrounding buildings tends to steer the wind along the dock from West to East. While there is a some change in wind direction between each tested configuration, overall the wind speed and direction across the length of the dock remain consistent; i.e. the flow progresses smoothly from West to East across the main part of the dock without any abrupt changes in direction.

5.2 For the north easterlies, the removal of buildings T01 and B02 (configurations M1 and M2) do not greatly alter the situation. The reduced massing Masterplan configuration M3 (no buildings >25m height) indicates some consistency in the changes in wind direction to the application scheme. The work by the Wolfson Unit indicates that the sailing quality is marginally improved but not markedly given the change in massing. To a degree this is consistent with the tests results for the increase massing June 2015 scheme.

5.3 For configurations M4 (northern towers) and M5 (angled scheme with northern towers), the latter shows a lessened impact on wind directions and speeds, when compared with the applications scheme. This indicates that moving the taller buildings to the north of the Site has a lesser effect than the angling of the buildings. The M5 configuration gives rise to the lowest degree of effects on sailing quality of the configurations tested, and this may arise from the general northward shift of overall development mass towards the existing residential areas to the north.

5.4 For other wind directions of lower frequency the changes in winds as reported in paragraphs 4.8-4.12 would be of lessened significance, since these directions are of relatively low frequency of occurrence.

5.5 The sailing quality assessment by the Wolfson Unit compares massing configurations M1-M5 with the C4 application scheme configuration. In their assessment a notable effect is reported as one where a 10% change in sailing quality relative to the application scheme is indicated and a significant effect is one where a 20% change in sailing quality is indicated. The conclusions are as follows:

- M1 – Removal of the western-most tower (T01) would lead to an improvement in the localised sailing quality at location 2, for example, but would not lead to notable differences on the western dock, in general.
- M2 – Removal of Tower 1 (T01)and Building 2 (B02) would also lead to improved localised sailing quality in the north western corner, such as location 2, but would not lead to notable differences in the effects on the western dock, in general.
- M3 – The height limited structures on the same Masterplan would have an effect in the April period, improving the total percentage of above sailing threshold conditions by 5%, averaged over the sailing season this is less than 5%.
- M4 – Moving the towers North wards would have a notable effect on the Western Dock, increasing the total percentage of above sailing threshold conditions by over 7% in April and 8% over the main dock.
- M5 – Moving Towers to the North and re-aligning the Towers and courtyard buildings to the North-Easterly direction has a notable impact on the sailing quality over the entire dock. This increases the total percentage of above threshold sailing quality time of 14% when compared to the completed development (application scheme C4 configuration).

5.6 The results indicate that some improvements in sailing quality can be achieved with a significant realignment of buildings. Reducing massing to a uniform height of 25m with the same Masterplan layout has a slight effect but less than the radical realignment of the buildings indicated by configuration M5. The issue of the urban design implications of the radically realigned scheme is not addressed here.

Figures

Figure 1: Aerial photograph of the existing site (approx. site highlighted in yellow)

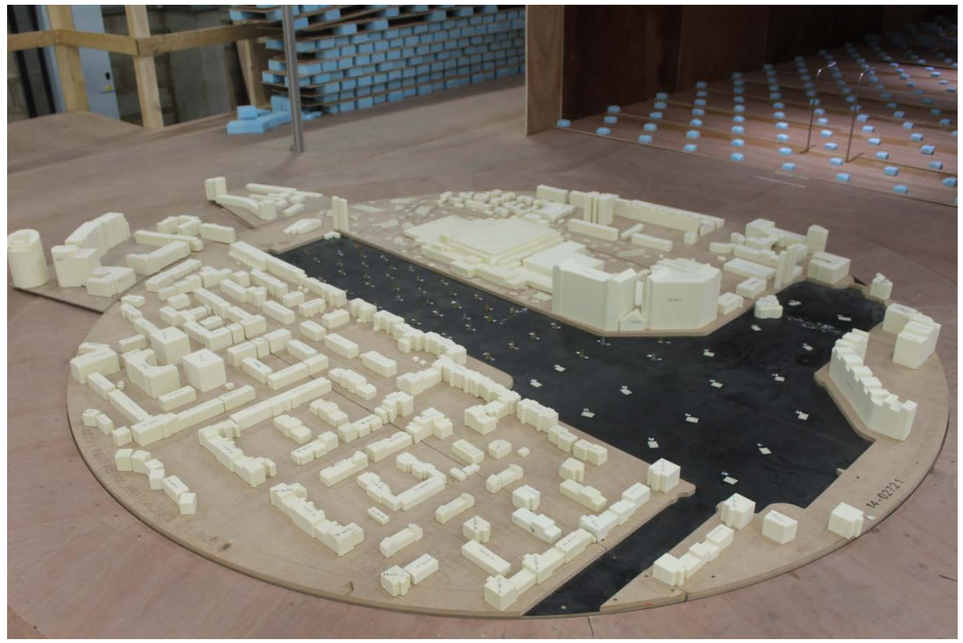


Figure 2: Image of the existing site, view from the South East

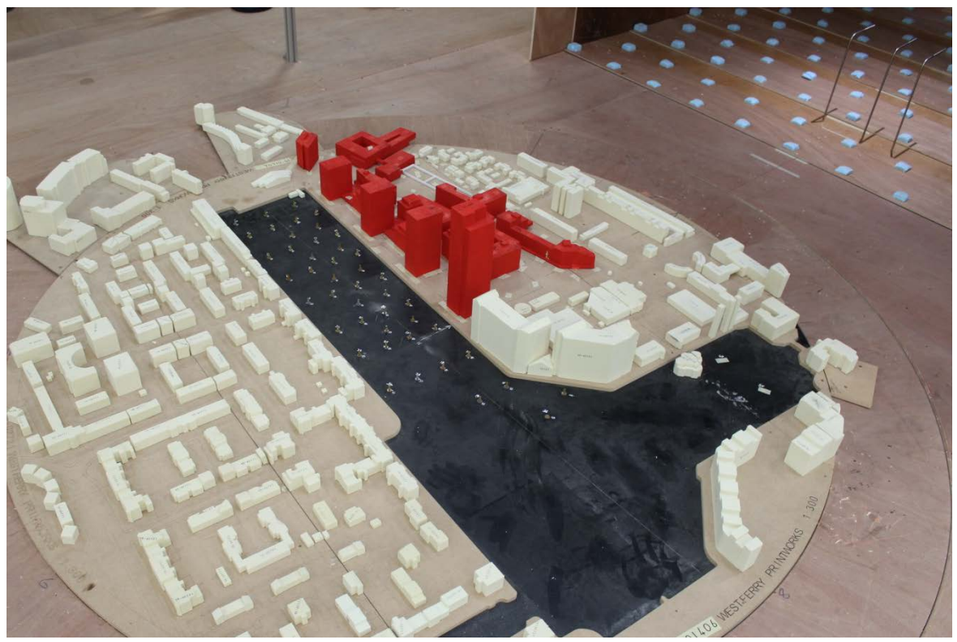
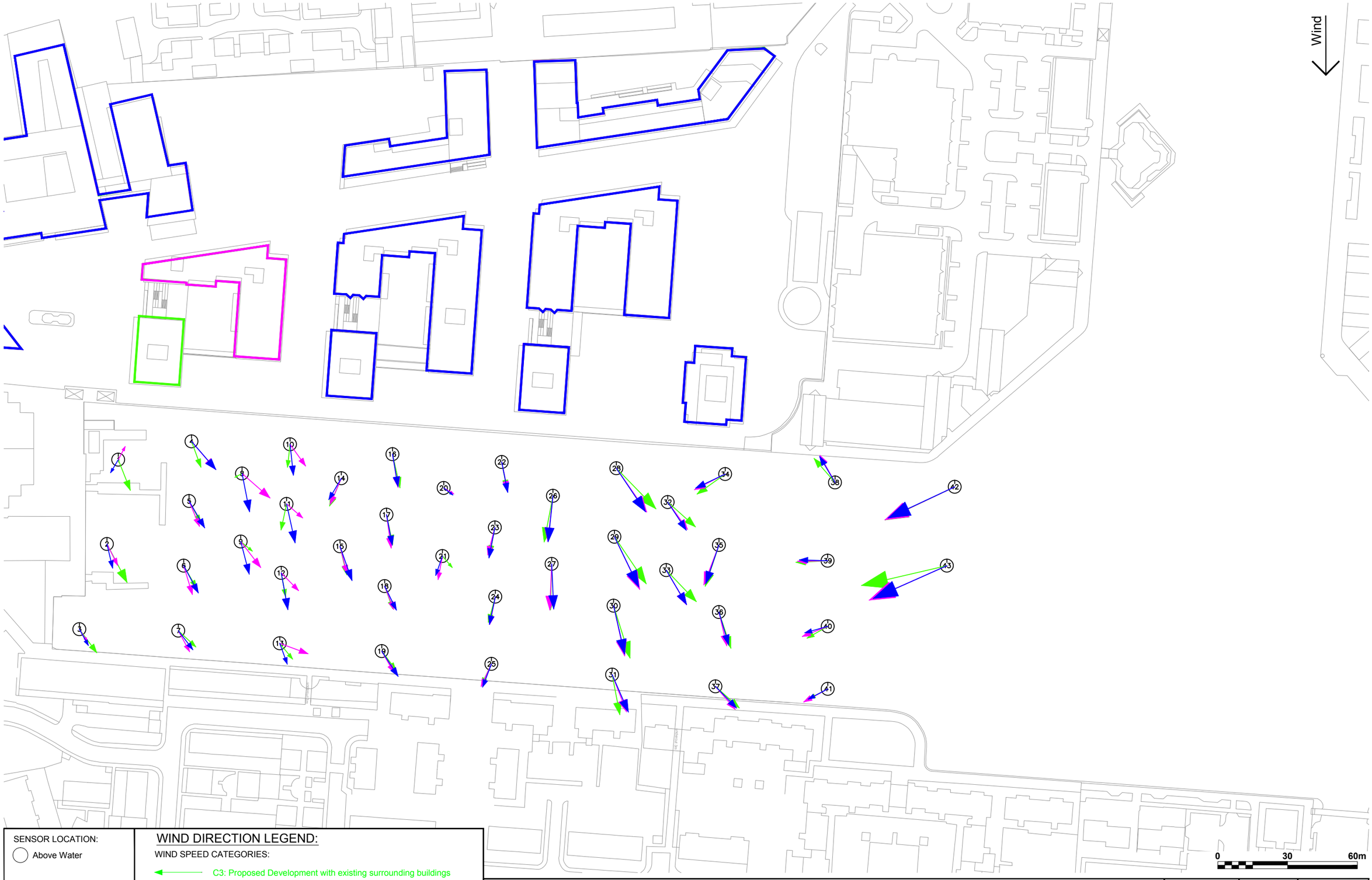


Figure 3: Image of the Proposed Development, view from the South East



SENSOR LOCATION:
Above Water

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

C3: Proposed Development with existing surrounding buildings

M1: Option 1 with existing surrounding buildings

M2: Option 2 with existing surrounding buildings

Arrow length is proportional to mean wind speed ratio.

1.0

Wind Speed Comparison (Mitigation Workshop)

Wind from 0°

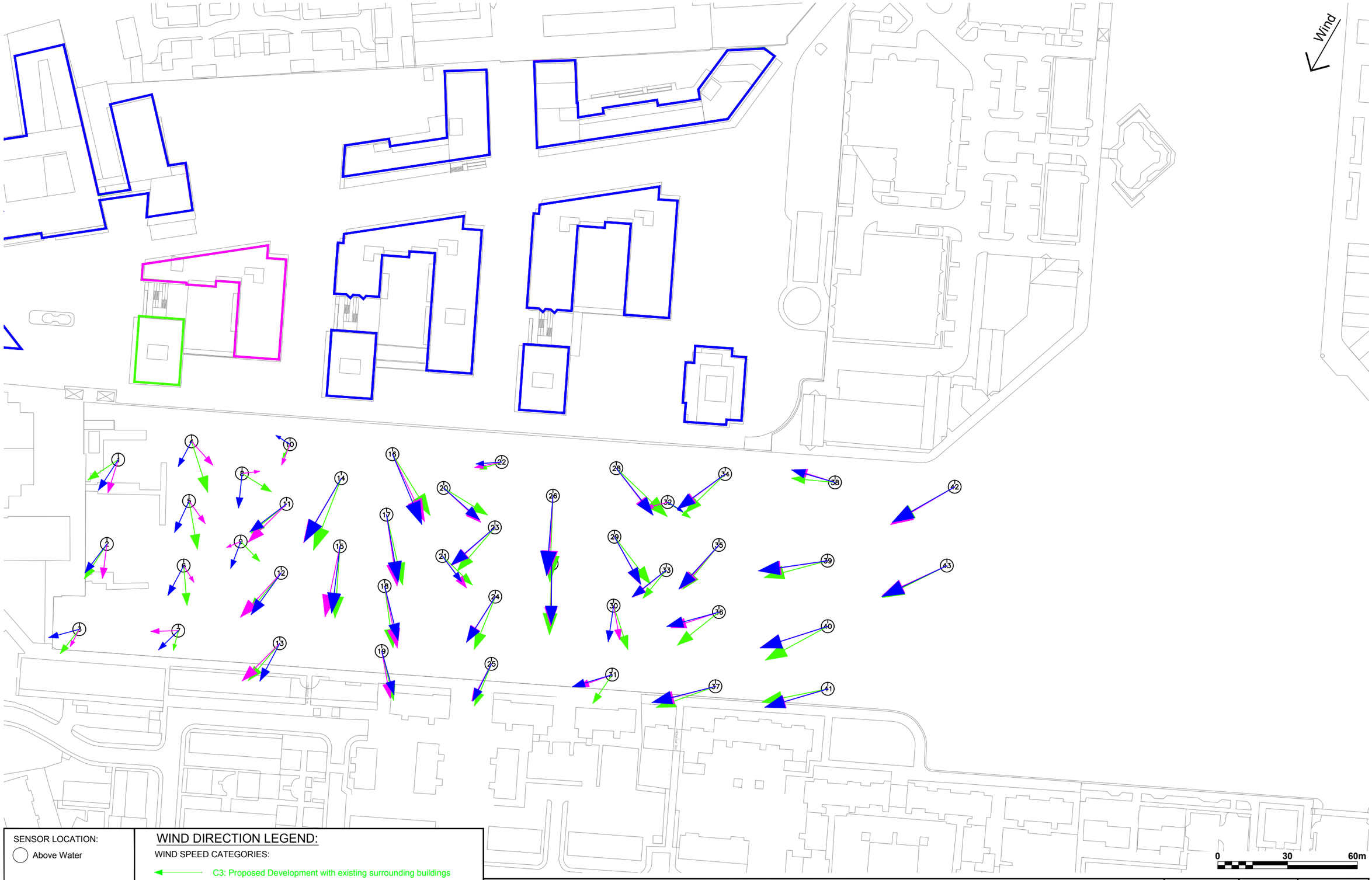
Westferry Printworks - London, United Kingdom

Project #1501406

True North

Drawn by:	SM	Figure:	4
Approx. Scale:			1:1500
Date Revised:			Mar. 01, 2016

RWDI



SENSOR LOCATION:
Above Water

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

C3: Proposed Development with existing surrounding buildings

M1: Option 1 with existing surrounding buildings

M2: Option 2 with existing surrounding buildings

Arrow length is proportional to mean wind speed ratio.

1.0

Wind Speed Comparison (Mitigation Workshop)

Wind from 30°

Westferry Printworks - London, United Kingdom

Project #1501406

True North

Drawn by:	SM	Figure:	5
Approx. Scale:			1:1500
Date Revised:			Mar. 01, 2016

RWDI

Wind

SENSOR LOCATION:
Above Water

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

C3: Proposed Development with existing surrounding buildings

M1: Option 1 with existing surrounding buildings

M2: Option 2 with existing surrounding buildings

Arrow length is proportional to mean wind speed ratio.

1.0

0 30 60m

Wind Speed Comparison (Mitigation Workshop)

Wind from 60°

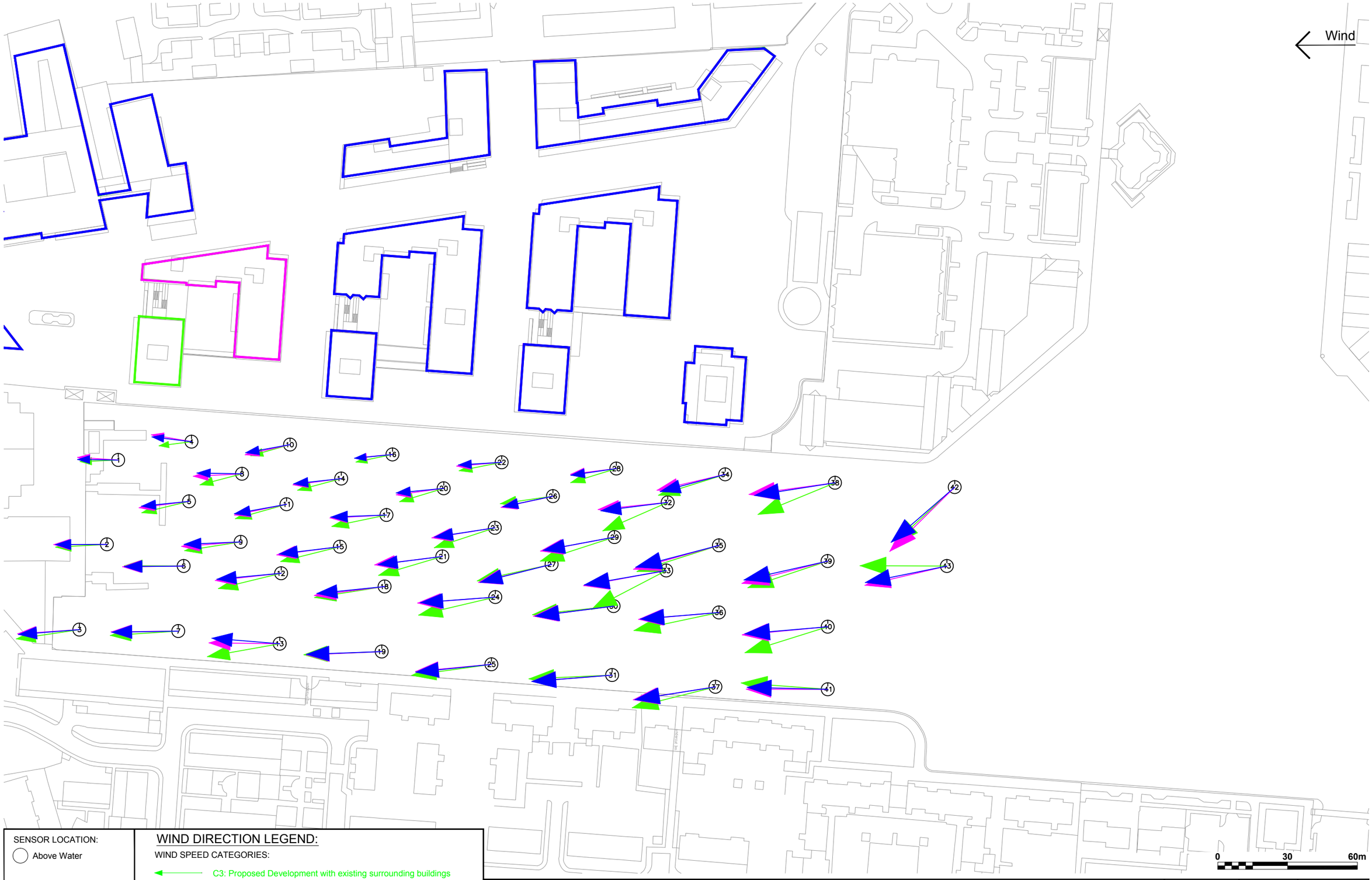
Westferry Printworks - London, United Kingdom

Project #1501406

True North

Drawn by:	SM	Figure:	6
Approx. Scale:			1:1500
Date Revised:			Mar. 01, 2016

RWDI



SENSOR LOCATION:
Above Water

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

C3: Proposed Development with existing surrounding buildings

M1: Option 1 with existing surrounding buildings

M2: Option 2 with existing surrounding buildings

Arrow length is proportional to mean wind speed ratio.

1.0

Wind Speed Comparison (Mitigation Workshop)

Wind from 90°

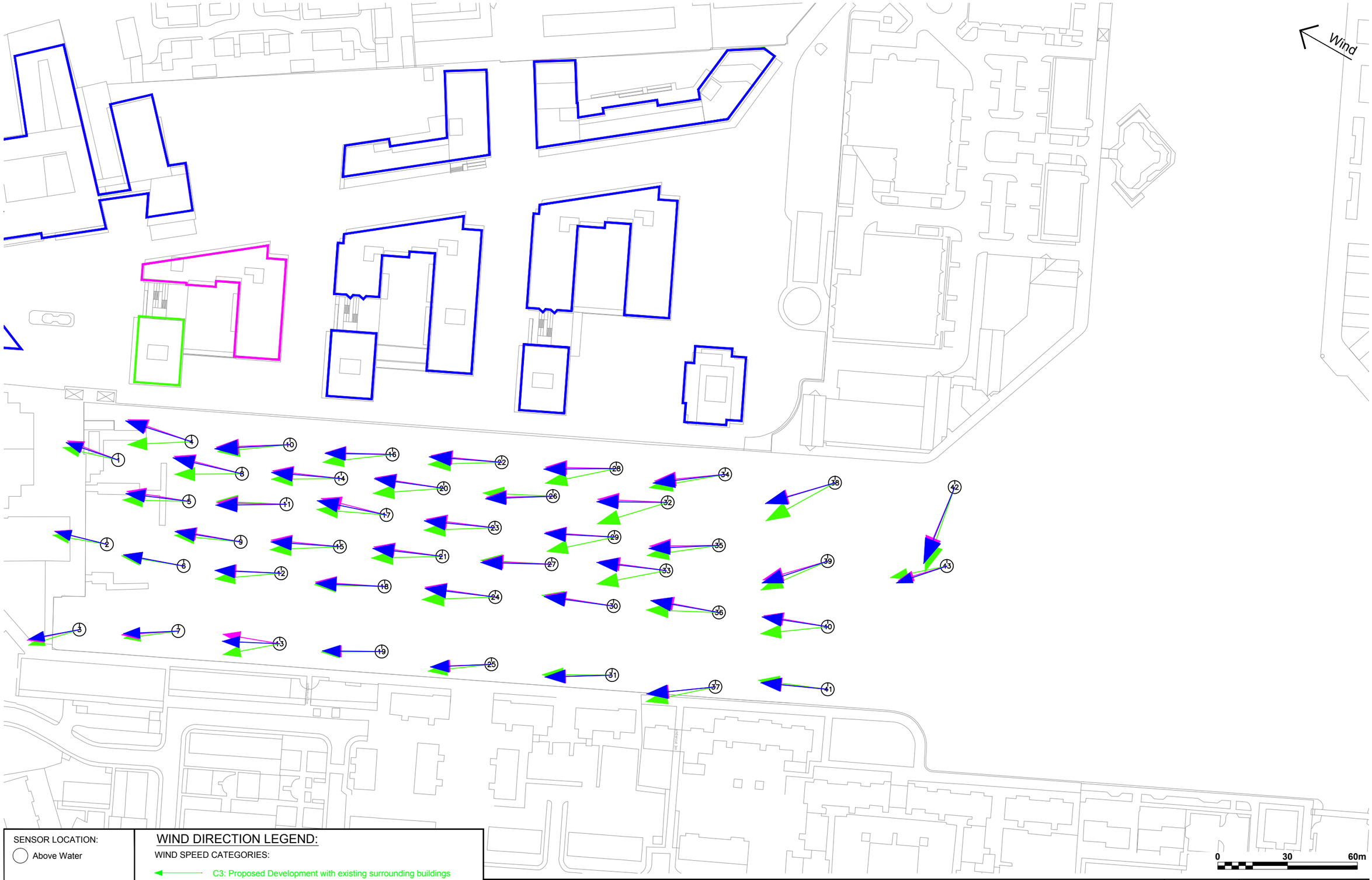
Westferry Printworks - London, United Kingdom

Project #1501406

True North

Drawn by:	SM	Figure:	7
Approx. Scale:			1:1500
Date Revised:			Mar. 01, 2016

RWDI



SENSOR LOCATION:
Above Water

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

C3: Proposed Development with existing surrounding buildings

M1: Option 1 with existing surrounding buildings

M2: Option 2 with existing surrounding buildings

Arrow length is proportional to mean wind speed ratio.

1.0

Wind Speed Comparison (Mitigation Workshop)

Wind from 120°

Westferry Printworks - London, United Kingdom

True North

Project #1501406

Drawn by:	SM	Figure:	8
Approx. Scale:			1:1500
Date Revised:			Mar. 01, 2016

RWDI

Wind

SENSOR LOCATION:
Above Water

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

C3: Proposed Development with existing surrounding buildings

M1: Option 1 with existing surrounding buildings

M2: Option 2 with existing surrounding buildings

Arrow length is proportional to mean wind speed ratio.

1.0

0 30 60m

Wind Speed Comparison (Mitigation Workshop)

Wind from 150°

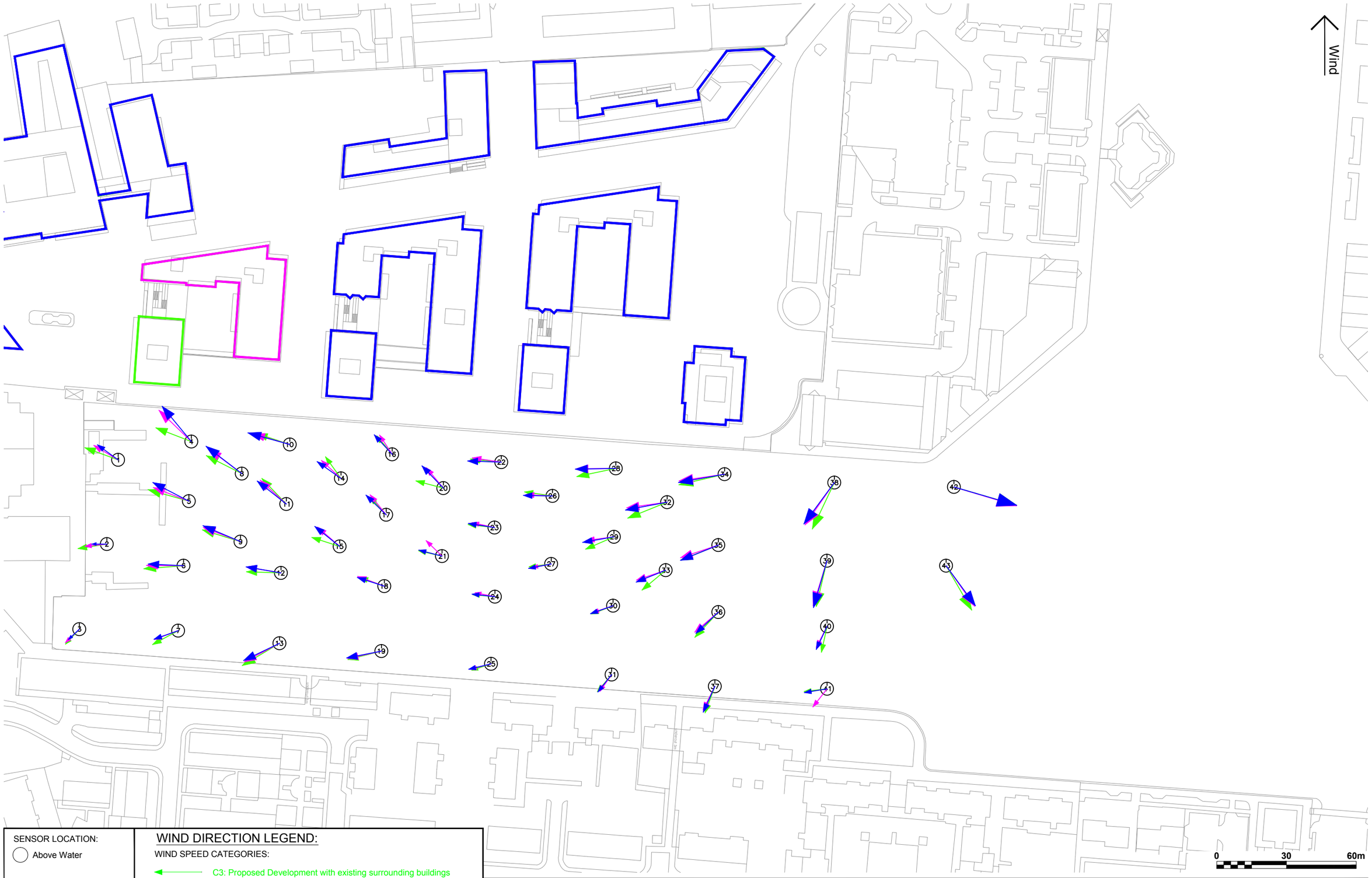
Westferry Printworks - London, United Kingdom

True North

Project #1501406

Drawn by:	SM	Figure:	9
Approx. Scale:			1:1500
Date Revised:			Mar. 01, 2016

RWDI



SENSOR LOCATION:
Above Water

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

C3: Proposed Development with existing surrounding buildings

M1: Option 1 with existing surrounding buildings

M2: Option 2 with existing surrounding buildings

Arrow length is proportional to mean wind speed ratio.

1.0

Wind Speed Comparison (Mitigation Workshop)

Wind from 180°

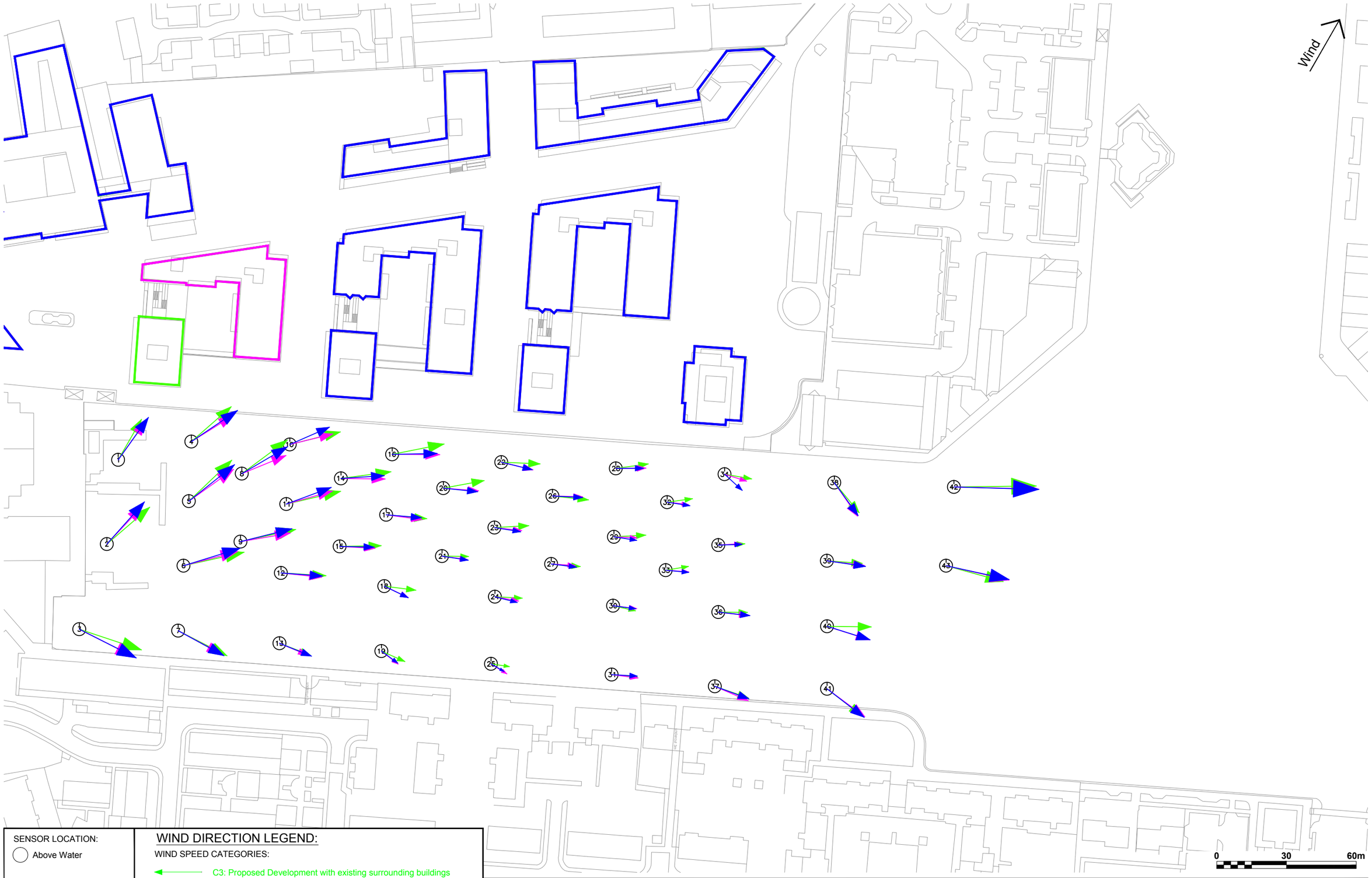
Westferry Printworks - London, United Kingdom

True North

Project #1501406

Drawn by:	SM	Figure:	10
Approx. Scale:			1:1500
Date Revised:			Mar. 01, 2016

RWDI



SENSOR LOCATION:
Above Water

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

C3: Proposed Development with existing surrounding buildings

M1: Option 1 with existing surrounding buildings

M2: Option 2 with existing surrounding buildings

Arrow length is proportional to mean wind speed ratio.

1.0

Wind Speed Comparison (Mitigation Workshop)

Wind from 210°

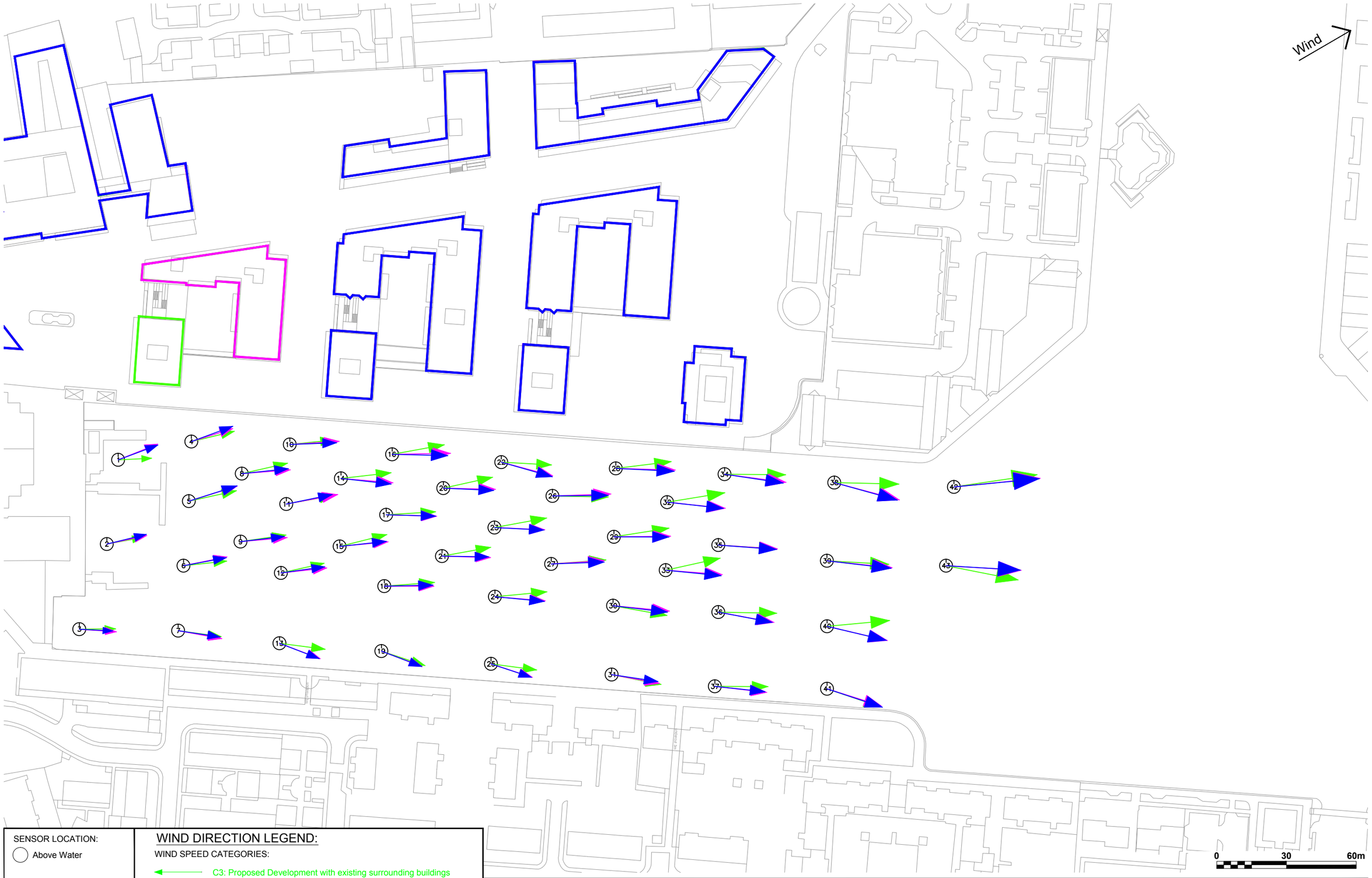
Westferry Printworks - London, United Kingdom

True North

Project #1501406

Drawn by:	SM	Figure:	11
Approx. Scale:		1:1500	
Date Revised:		Mar. 01, 2016	

RWDI



SENSOR LOCATION:
Above Water

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

C3: Proposed Development with existing surrounding buildings

M1: Option 1 with existing surrounding buildings

M2: Option 2 with existing surrounding buildings

Arrow length is proportional to mean wind speed ratio.

1.0

Wind Speed Comparison (Mitigation Workshop)

Wind from 240°

Westferry Printworks - London, United Kingdom

True North

Project #1501406

Drawn by:	SM	Figure:	12
Approx. Scale:			1:1500
Date Revised:	Mar. 01, 2016		

RWDI

Wind

SENSOR LOCATION:
Above Water

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

C3: Proposed Development with existing surrounding buildings

M1: Option 1 with existing surrounding buildings

M2: Option 2 with existing surrounding buildings

Arrow length is proportional to mean wind speed ratio.

1.0

0 30 60m

Wind Speed Comparison (Mitigation Workshop)

Wind from 270°

Westferry Printworks - London, United Kingdom

True North

Project #1501406

Drawn by: SM	Figure: 13
Approx. Scale:	1:1500
Date Revised:	Mar. 01, 2016

RWDI

Wind

SENSOR LOCATION:
Above Water

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

C3: Proposed Development with existing surrounding buildings

M1: Option 1 with existing surrounding buildings

M2: Option 2 with existing surrounding buildings

Arrow length is proportional to mean wind speed ratio.

1.0

0 30 60m

Wind Speed Comparison (Mitigation Workshop)

Wind from 300°

Westferry Printworks - London, United Kingdom

True North

Project #1501406

Drawn by: SM	Figure: 14
Approx. Scale:	1:1500
Date Revised:	Mar. 01, 2016

RWDI

Wind

SENSOR LOCATION:
Above Water

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

C3: Proposed Development with existing surrounding buildings

M1: Option 1 with existing surrounding buildings

M2: Option 2 with existing surrounding buildings

Arrow length is proportional to mean wind speed ratio.

1.0

0 30 60m

Wind Speed Comparison (Mitigation Workshop)

Wind from 330°

Westferry Printworks - London, United Kingdom

Project #1501406

True North

Drawn by:	SM	Figure:	15
Approx. Scale:			1:1500
Date Revised:			Mar. 01, 2016

RWDI

Wind

SENSOR LOCATION:
Above Water

Arrow length is proportional to mean wind speed ratio.
1.0

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

- C3: Proposed Development with existing surrounding buildings
- M3: Option 3 with existing surrounding buildings
- M4: Option 4 with existing surrounding buildings
- M5: Option 5 with existing surrounding buildings

0 30 60m

Wind Speed Comparison (Mitigation Workshop)

Wind from 0°

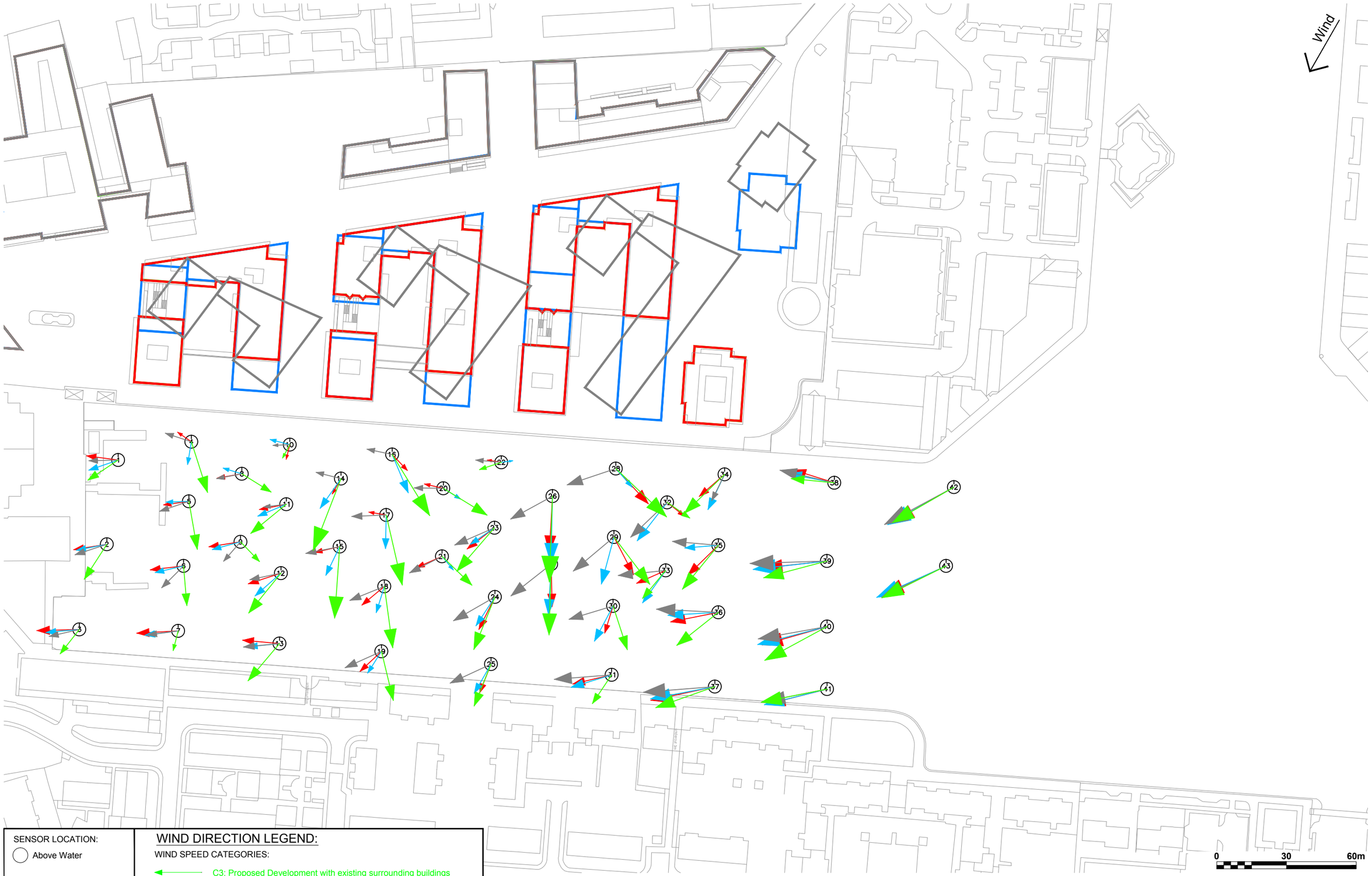
Westferry Printworks - London, United Kingdom

True North

Project #1501406

Drawn by:	SM	Figure:	16
Approx. Scale:			1:1500
Date Revised:			Feb. 24, 2016

RWDI



SENSOR LOCATION:
Above Water

Arrow length is proportional to mean wind speed ratio.
1.0

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

- C3: Proposed Development with existing surrounding buildings
- M3: Option 3 with existing surrounding buildings
- M4: Option 4 with existing surrounding buildings
- M5: Option 5 with existing surrounding buildings

Wind Speed Comparison (Mitigation Workshop)

Wind from 30°

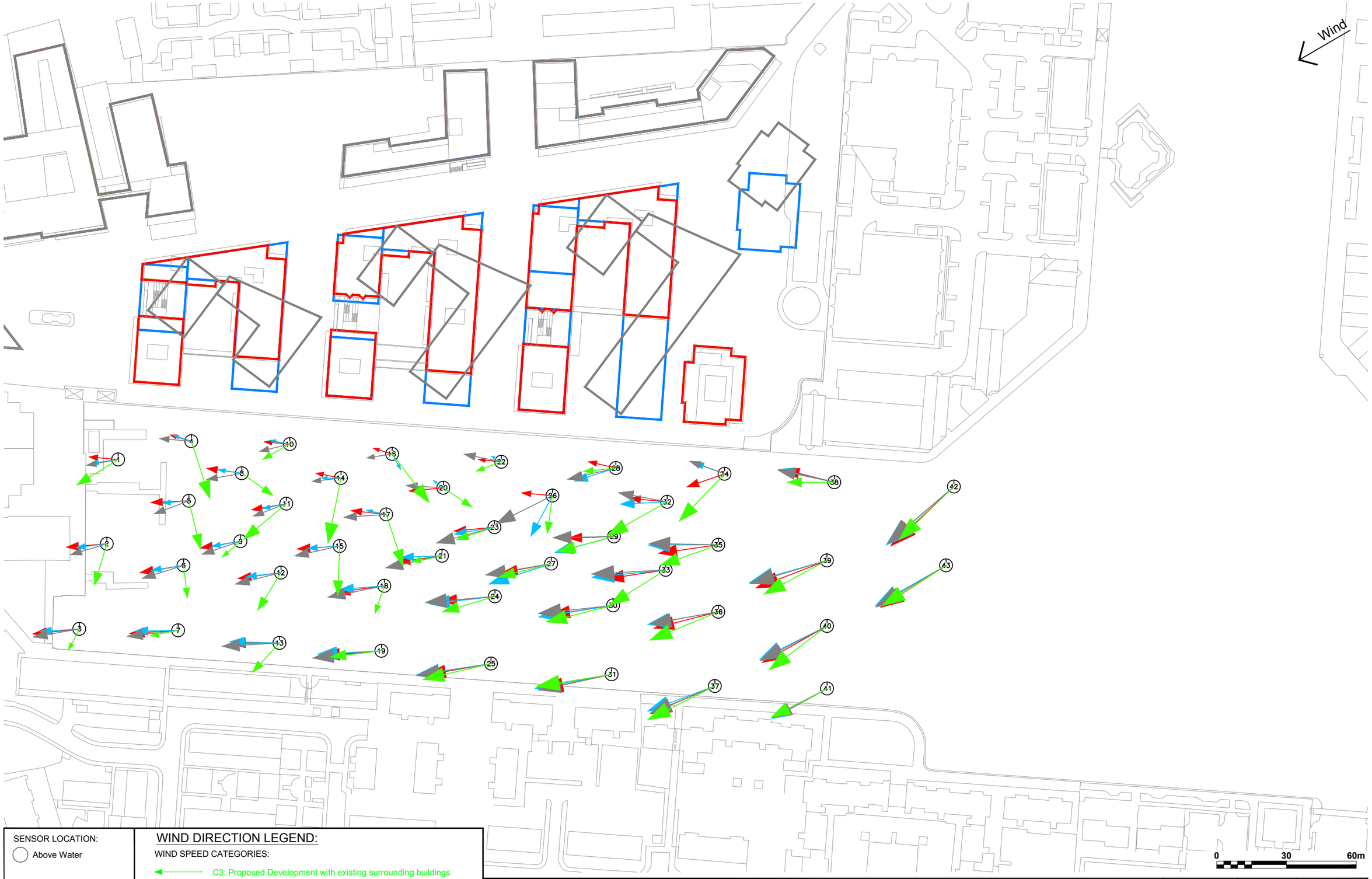
Westferry Printworks - London, United Kingdom

True North

Project #1501406

Drawn by:	SM
Figure:	17
Approx. Scale:	1:1500
Date Revised:	Mar. 01, 2016

RWDI



SENSOR LOCATION:
Above Water

Arrow length is proportional to mean wind speed ratio.
1.0

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

- C3: Proposed Development with existing surrounding buildings
- M3: Option 3 with existing surrounding buildings
- M4: Option 4 with existing surrounding buildings
- M5: Option 5 with existing surrounding buildings

Wind Speed Comparison (Mitigation Workshop)

Wind from 60°

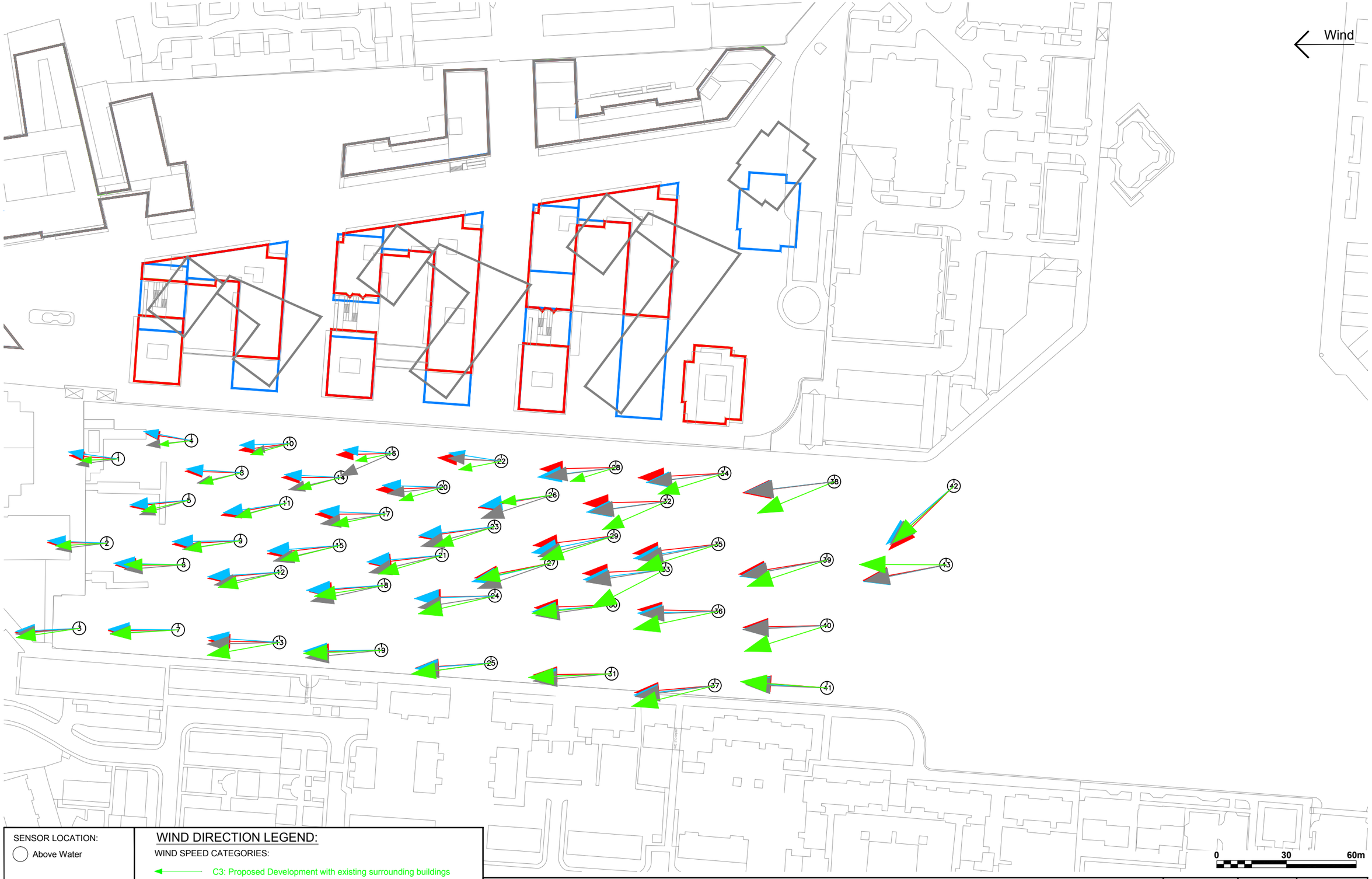
Westferry Printworks - London, United Kingdom

True North

Project #1501406

Drawn by:	SM
Figure:	18
Approx. Scale:	1:1500
Date Revised:	Mar. 01, 2016

RWDI



SENSOR LOCATION:
Above Water

Arrow length is proportional to mean wind speed ratio.
1.0

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

- C3: Proposed Development with existing surrounding buildings
- M3: Option 3 with existing surrounding buildings
- M4: Option 4 with existing surrounding buildings
- M5: Option 5 with existing surrounding buildings

Wind Speed Comparison (Mitigation Workshop)

Wind from 90°

Westferry Printworks - London, United Kingdom

True North

Project #1501406

Drawn by:	SM	Figure:	19
Approx. Scale:			1:1500
Date Revised:			Mar. 01, 2016

RWDI

Wind

SENSOR LOCATION:
Above Water

Arrow length is proportional to mean wind speed ratio.
1.0

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

- C3: Proposed Development with existing surrounding buildings
- M3: Option 3 with existing surrounding buildings
- M4: Option 4 with existing surrounding buildings
- M5: Option 5 with existing surrounding buildings

0 30 60m

Wind Speed Comparison (Mitigation Workshop)

Wind from 120°

Westferry Printworks - London, United Kingdom

True North

Project #1501406

Drawn by:	SM	Figure:	20
Approx. Scale:			1:1500
Date Revised:			Mar. 01, 2016

RWDI

Wind

SENSOR LOCATION:
Above Water

Arrow length is proportional to mean wind speed ratio.
1.0

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

- C3: Proposed Development with existing surrounding buildings
- M3: Option 3 with existing surrounding buildings
- M4: Option 4 with existing surrounding buildings
- M5: Option 5 with existing surrounding buildings

0 30 60m

Wind Speed Comparison (Mitigation Workshop)

Wind from 150°

True North

Westferry Printworks - London, United Kingdom

Project #1501406

Drawn by:	SM	Figure:	21
Approx. Scale:			1:1500
Date Revised:			Mar. 01, 2016

RWDI

SENSOR LOCATION:

Above Water

Arrow length is proportional to mean wind speed ratio.

1.0

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

- C3: Proposed Development with existing surrounding buildings
- M3: Option 3 with existing surrounding buildings
- M4: Option 4 with existing surrounding buildings
- M5: Option 5 with existing surrounding buildings

Wind Speed Comparison (Mitigation Workshop)

Wind from 180°

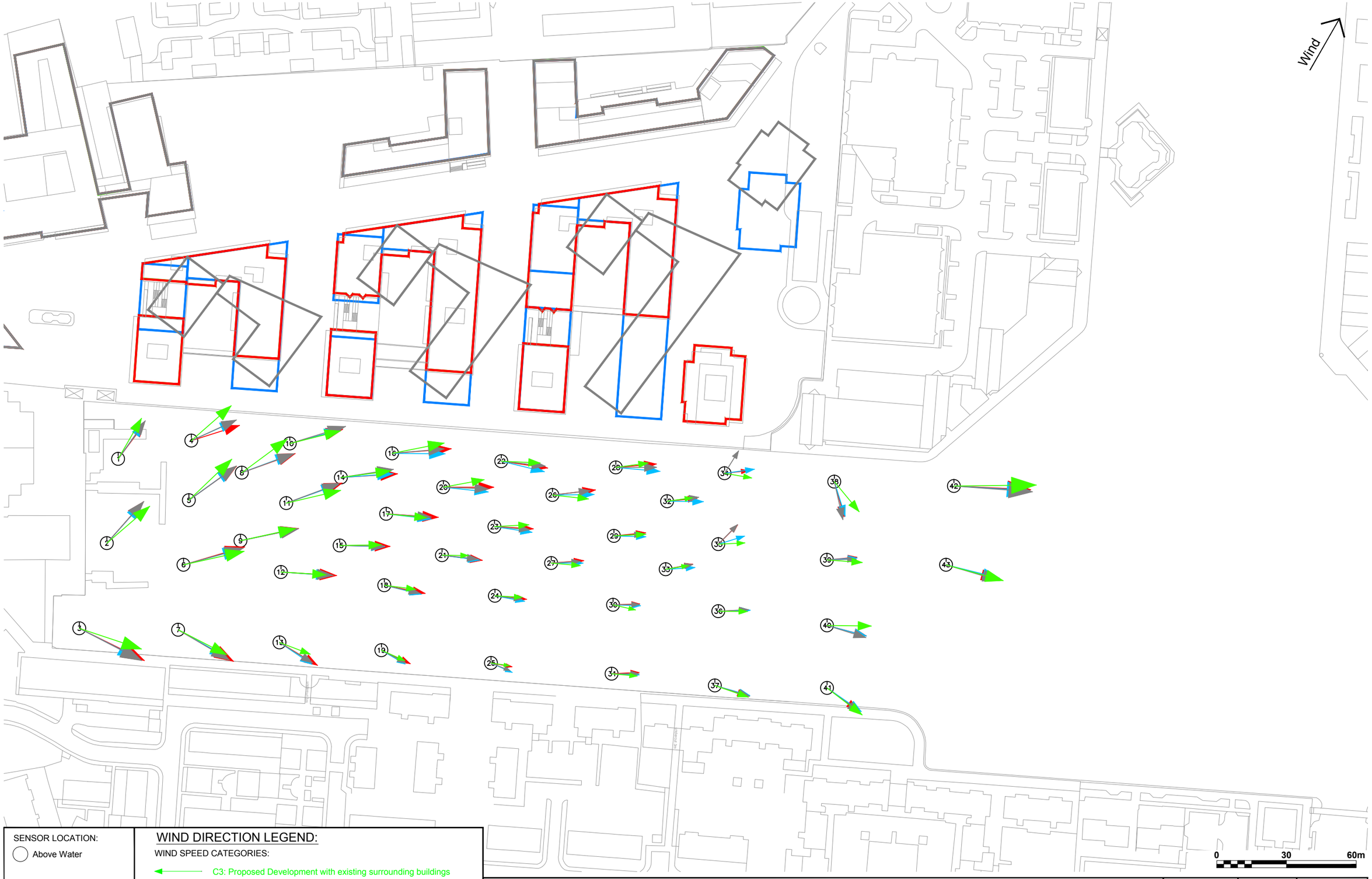
Westferry Printworks - London, United Kingdom

True North

Project #1501406

Drawn by:	SM	Figure:	22
Approx. Scale:			1:1500
Date Revised:			Mar. 01, 2016

RWDI



SENSOR LOCATION:

Above Water

Arrow length is proportional to mean wind speed ratio.

1.0

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

- C3: Proposed Development with existing surrounding buildings
- M3: Option 3 with existing surrounding buildings
- M4: Option 4 with existing surrounding buildings
- M5: Option 5 with existing surrounding buildings

Wind Speed Comparison (Mitigation Workshop)

Wind from 210°

Westferry Printworks - London, United Kingdom

True North

Project #1501406

Drawn by:	SM	Figure:	23
Approx. Scale:			1:1500
Date Revised:			Mar. 01, 2016

RWDI

SENSOR LOCATION:
Above Water

Arrow length is proportional to mean wind speed ratio.
1.0

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

- C3: Proposed Development with existing surrounding buildings
- M3: Option 3 with existing surrounding buildings
- M4: Option 4 with existing surrounding buildings
- M5: Option 5 with existing surrounding buildings

Wind Speed Comparison (Mitigation Workshop)

Wind from 240°

Westferry Printworks - London, United Kingdom

Project #1501406

True North

Drawn by:	SM
Figure:	24
Approx. Scale:	1:1500
Date Revised:	Mar. 01, 2016

RWDI

Wind

SENSOR LOCATION:
Above Water

Arrow length is proportional to mean wind speed ratio.
1.0

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

- C3: Proposed Development with existing surrounding buildings
- M3: Option 3 with existing surrounding buildings
- M4: Option 4 with existing surrounding buildings
- M5: Option 5 with existing surrounding buildings

0 30 60m

Wind Speed Comparison (Mitigation Workshop)

Wind from 270°

Westferry Printworks - London, United Kingdom

True North

Project #1501406

Drawn by: SM	Figure: 25
Approx. Scale:	1:1500
Date Revised:	Mar. 01, 2016

RWDI

Wind

SENSOR LOCATION:
Above Water

Arrow length is proportional to mean wind speed ratio.
1.0

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

- C3: Proposed Development with existing surrounding buildings
- M3: Option 3 with existing surrounding buildings
- M4: Option 4 with existing surrounding buildings
- M5: Option 5 with existing surrounding buildings

0 30 60m

Wind Speed Comparison (Mitigation Workshop)

Wind from 300°

Westferry Printworks - London, United Kingdom

True North

Project #1501406

Drawn by: SM	Figure: 26
Approx. Scale:	1:1500
Date Revised:	Mar. 01, 2016

RWDI

Wind

SENSOR LOCATION:
Above Water

Arrow length is proportional to mean wind speed ratio.
1.0

WIND DIRECTION LEGEND:

WIND SPEED CATEGORIES:

- C3: Proposed Development with existing surrounding buildings
- M3: Option 3 with existing surrounding buildings
- M4: Option 4 with existing surrounding buildings
- M5: Option 5 with existing surrounding buildings

0 30 60m

Wind Speed Comparison (Mitigation Workshop)

Wind from 330°

Westferry Printworks - London, United Kingdom

True North

Project #1501406

Drawn by: SM	Figure: 27
Approx. Scale:	1:1500
Date Revised:	Mar. 01, 2016

RWDI

Appendix A: Photographs of the Wind Tunnel Model

Figure 28: M1 - Option 1 (Block T01 removed) with existing surrounding buildings – View in the wind tunnel (from the north and west)

Figure 29: M2 - Option 2 (Blocks T01 and B02 removed) with existing surrounding buildings– View in the wind tunnel (from the north and west)

Figure 30: M3 - Option 3 (Blocks T01, T02, T03, T04, B02, B03 and B04 height reduced to 25m) with existing surrounding buildings – View in the wind tunnel (from the north and west)

Figure 31: M4 - Option 4 (Blocks T01, T02, T03, T04 relocated and Blocks B02, B03 and B04 massing changed) with existing surrounding buildings – View in the wind tunnel (from the north and west)

Figure 32: M5 - Option 5 (Blocks T01, T02, T03, T04 relocated and Blocks B02, B03 and B04 massing changed and relocated) with existing surrounding buildings – View in the wind tunnel (from the north and west)

Appendix B: Meteorological Data

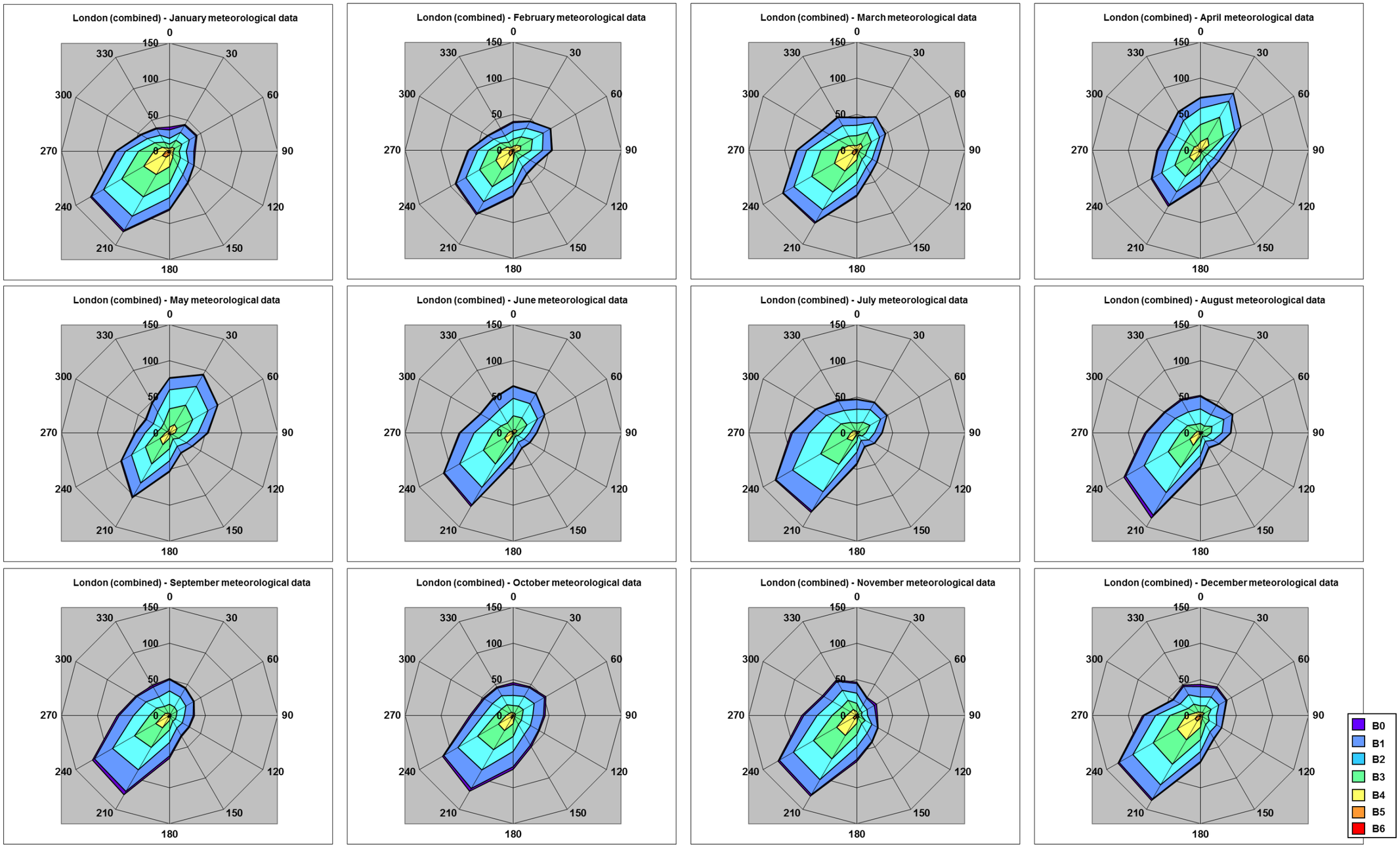
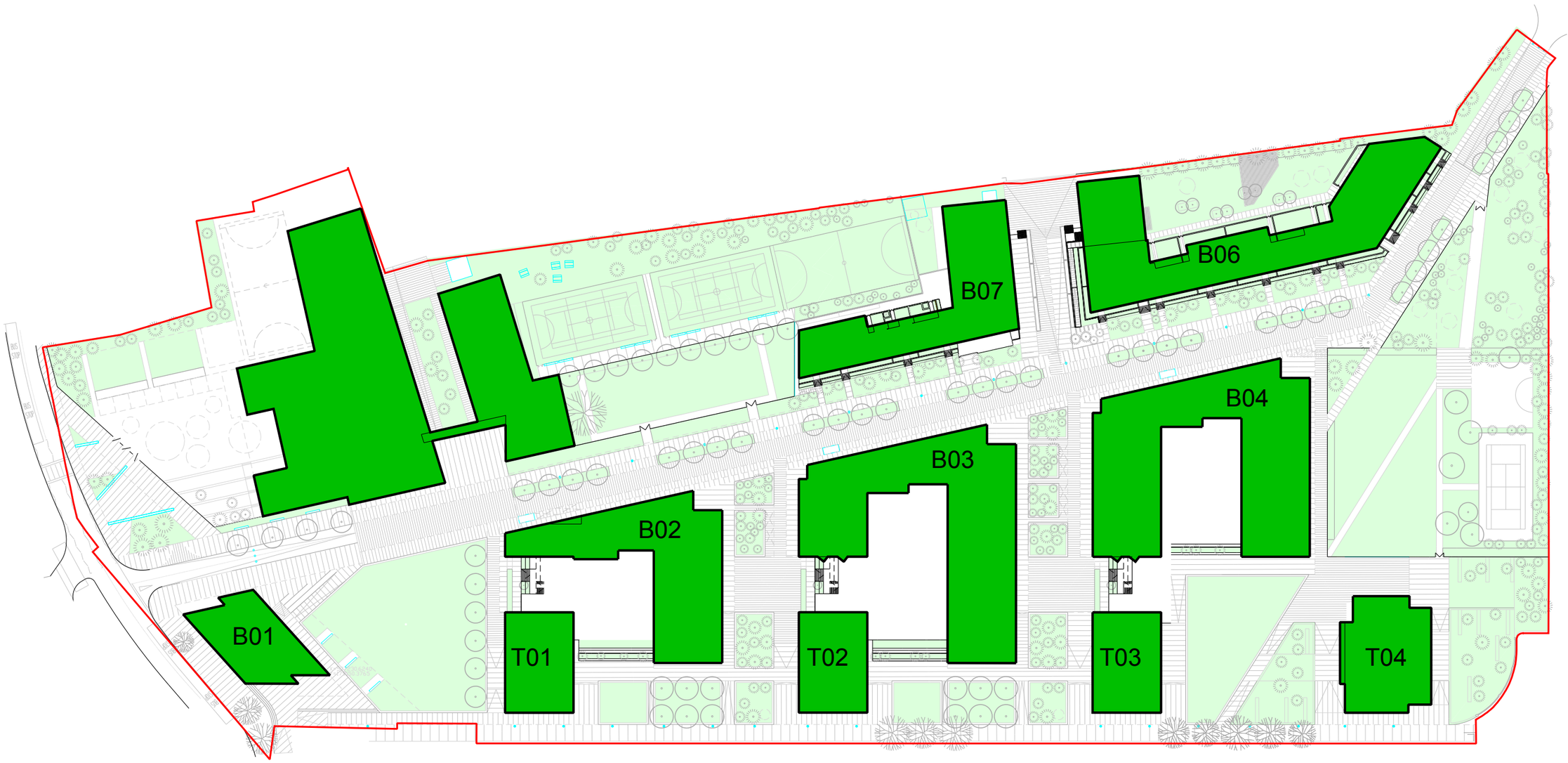


Figure 33: Monthly wind roses for London (in Beaufort Force) (Hours that wind speed is greater than the stated Beaufort Force)

Appendix C: Drawings of massing options taken from '*PLP-1164-WFP_160212-massing options*' received by RWDI February 15, 2016

Current Scheme



Current Scheme

Option 01

Current Scheme

Removed Building

Option 02

Current Scheme

Removed Building

Option 03

Current Scheme

Building height as per the Existing Printworks Building (+24.0m)

Option 04

Current Scheme

Relocated Tower; Building height as per current

Relocated Courtyard Building; Building height as per current

Option 05

Current Scheme

Relocated Tower; Building height as per current

Relocated Courtyard Building; Building height as per current

Appendix 17.4: Sailing Quality Assessment of M1 – M5 configurations

by Wolfson Unit Southampton University

Report No. 2610_Draft

Date : 04/03/16
Compiled By : MP
Verified By : TP

PLP Architecture

Sailing Quality Assessment of M1 – M5 configurations

1 SUMMARY

The following document contains a summary of a sailing quality analysis as part of the proposed Westferry Printworks Development project. This has been prepared in addition to previous Wolfson Unit reports dated 07/08/15, 24/09/15 and 07/12/15. It is based on the M1 – M5 configurations wind tunnel tested by RWDI in late February 2016 and detailed in their report "160304 RWDI Project #1501406 Westferry Printworks - Sailing Study Mitigation Rev A". It also includes further sailing analysis work carried out on configurations C1-C4. The features of each configuration are detailed below.

The previously tested configuration used for comparison is referred to as:
• C1 – the existing site.

Five configurations of the proposed massing changes were tested, namely:
• M1 - Option 1 (Block T01 removed) with existing surrounding buildings;
• M2 - Option 2 (Blocks T01 and B02 removed) with existing surrounding buildings;
• M3 - Option 3 (Blocks T01, T02, T03, T04, B02, B03 and B04 height reduced to 25m) with existing surrounding buildings;
• M4 - Option 4 (Blocks T01, T02, T03, T04 relocated and Blocks B02, B03 and B04 massing changed) with existing surrounding buildings; and
• M5 - Option 5 (Blocks T01, T02, T03, T04 relocated and Blocks B02, B03 and B04 massing changed and relocated) with existing surrounding buildings.

Other previously tested configurations include:
• C2 – Empty site;
• C3 – Phase 1 construction;
• C4 – Completed Development

All the above configurations used the same measurement locations. It must be borne in mind that all configurations are using a higher density of measurement locations in the main dock area over previous analysed datasets.

2 ANALYSIS

The objective of this process is to assess the effects that various site configurations would be predicted to have on the ability to sail in the Millwall Outer Dock in comparison to the existing site.

No adequate regulatory parameters or guidelines exist that can be used to assess the sailing quality of a particular location across a range of wind speeds, directions and durations of time. Therefore a number of criteria have been developed in agreement with DWSC in order to apply some quantitative parameters to what is a relatively qualitative subject area. Particular attention has been paid to wind

Appendix 17.4

speed characteristics that would affect novice sailors. Therefore these criteria relate to the ease with which a novice sailor could sail in a particular condition.

2.1 Criteria

- Wind speed limit of 3- 9 knots for a novice junior sailor
- Change of wind speed between locations of no greater than 30%

  A wind speed change of 30% between adjacent measurement locations within 40 metres (nearest adjacent location for those in with greater spacing at Eastern end of dock).

- Change of wind direction of no greater than 20˚ between adjacent points

  A direction change of 20˚ between adjacent measurement locations within 40 metres (nearest adjacent location for those with greater spacing at Eastern end of dock).

2.2 Method

The above criteria have been applied to each of the discrete wind angle data sets from the RWDI test data these have then been combined with the wind rose data provided in "Directional Wind Assessment (Sailing Study), RWDI#1402721-SAIL, 24th December 2014" to estimate the proportion of good sailing quality time, displayed as a % time, for a typical sailing season of February to November and individual per month. All this data is available in electronic form and presented in this report are the results averaged over the typical sailing season, for the month of April with the highest percentage of North Easterly wind direction components and for the month of August.

The results have been presented in Figures 1 – 51 at the end of this report. Each page (per configuration) of plots show; on the top left, the sailing quality results for April; top middle, August; top right, average over the sailing season of February to November. The respective plots at the bottom represent the difference between the existing site and test configuration (positive values represent an increase in sailing quality over the existing site). The Change in Quality is presented as a percentage value, this is the percentage of total time affected, (% Configuration X - % Configuration Y). The results of this can therefore be used directly to determine the number of days (or length of time) affect be below threshold wind conditions.

Table 1 contains a summary of the data averaged over the Western End of the Dock, over the Main Dock Area and identifies the results of the location with the lowest sailing quality.

3 DISCUSSION

M1 – Removal of the western most tower (T1) improves the localised sailing quality at location 2, for example, but does not have a notable difference on the western dock, in general.

M2 – Removal of Building 2 (B2) improved the localised sailing quality in the north western corner, such as location 2, but does not have a notable difference on the western dock, in general.

M3 – The height limited structures is having an effect in the April period, improving the total percentage of above sailing threshold conditions by 5%, averaged over the sailing season this is less than 5%.

M4 – Moving the towers North wards has a notable effect on the Western Dock, increasing the total percentage of above sailing threshold conditions by over 7% in April and 8% over the main dock.

M5 – Moving Towers to the North and re-aligning the Towers and courtyard buildings to the North-Easterly direction has a notable impact on the sailing quality over the entire dock. This increases the

total percentage of above threshold sailing quality time of 14% when compared to the completed development.

4 CONCLUSIONS

Based solely on the sailing quality assessment criteria, configuration M5, with its combination of towers to the North and re-alignment of the structures to the North Easterly direction has the least impact on sailing quality on the dock in comparison to the other M1 – 4 options and C4, the existing site.

Appendix 17.4

Table 1 Comparison of proposed sites against existing site (C1) for the Western and Main Dock areas and lowest location sailing quality value

April

Site Condition	Western Dock (Points 1 - 25) *Change in Quality compared to C1 (%)*	Main Dock Area (Points 1 - 41) *Change in Quality compared to C1 (%)*	Lowest S.Q Value	Point No.
C1	-	-	30.8%	2
C2	13.3%	6.4%	19.4%	33
C3	-17.9%	-14.6%	10.9%	2
C4	-19.0%	-16.2%	8.0%	2
M1	-18.8%	-13.7%	14.3%	2
M2	-17.4%	-12.9%	20.0%	2
M3	-13.6%	-10.2%	21.6%	4
M4	-11.9%	-7.7%	21.2%	2
M5	-5.6%	-2.2%	23.5%	6

August

Site Condition	Western Dock (Points 1 - 25) *Change in Quality compared to C1 (%)*	Main Dock Area (Points 1 - 41) *Change in Quality compared to C1 (%)*	Lowest S.Q Value	Point No.
C1	-	-	33.7%	39
C2	8.1%	4.4%	20.0%	33
C3	-14.2%	-11.3%	11.9%	2
C4	-13.9%	-10.5%	9.8%	2
M1	-13.4%	-7.1%	17.8%	2
M2	-13.4%	-7.5%	19.5%	2
M3	-11.9%	-6.0%	23.4%	4
M4	-7.9%	-2.2%	18.9%	2
M5	-4.3%	1.2%	25.5%	6

February – November

Site Condition	Western Dock (Points 1 - 25) *Change in Quality compared to C1 (%)*	Main Dock Area (Points 1 - 41) *Change in Quality compared to C1 (%)*	Lowest S.Q Value	Point No.
C1	-	-	30.8%	2
C2	8.7%	2.8%	20.0%	33
C3	-14.0%	-12.8%	11.9%	2
C4	-13.4%	-12.2%	9.8%	2
M1	-13.1%	-9.3%	17.8%	2
M2	-12.8%	-9.3%	19.5%	2
M3	-11.2%	-7.8%	23.4%	4
M4	-7.6%	-4.3%	18.9%	2
M5	-3.6%	-0.7%	25.5%	6

NOTE: +ve represents an increase in sailing quality for that given area or point

Junior Criteria – Condition C1

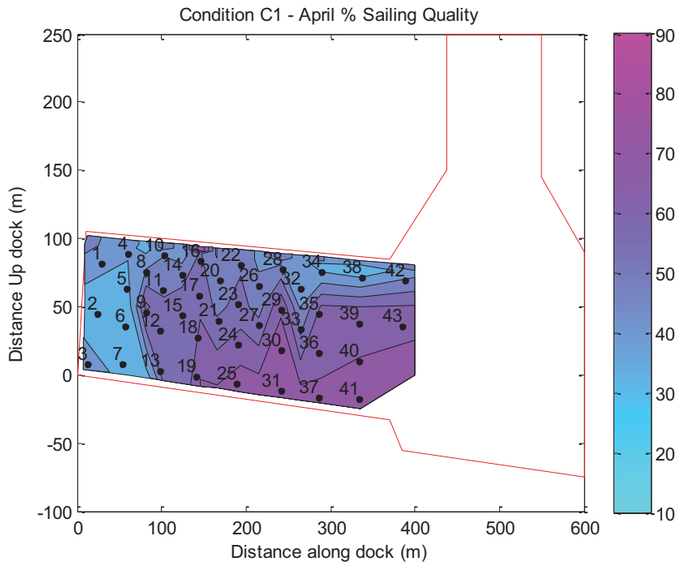


Figure 1

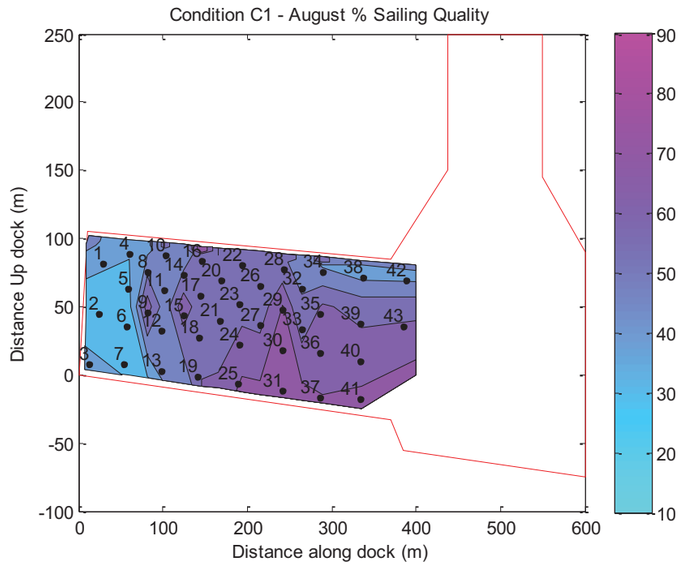


Figure 2

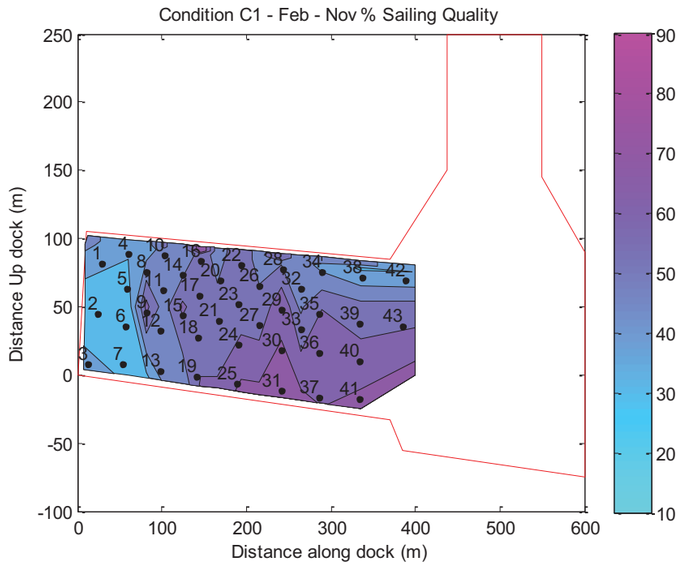


Figure 3

Junior Criteria – Condition C2

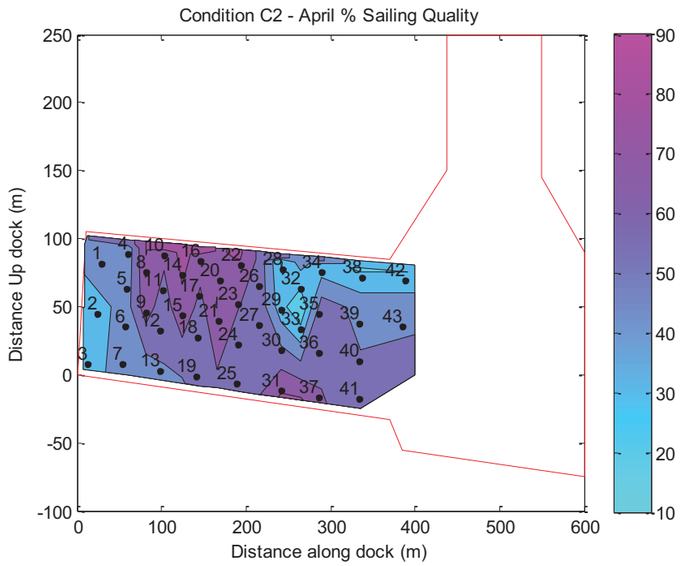
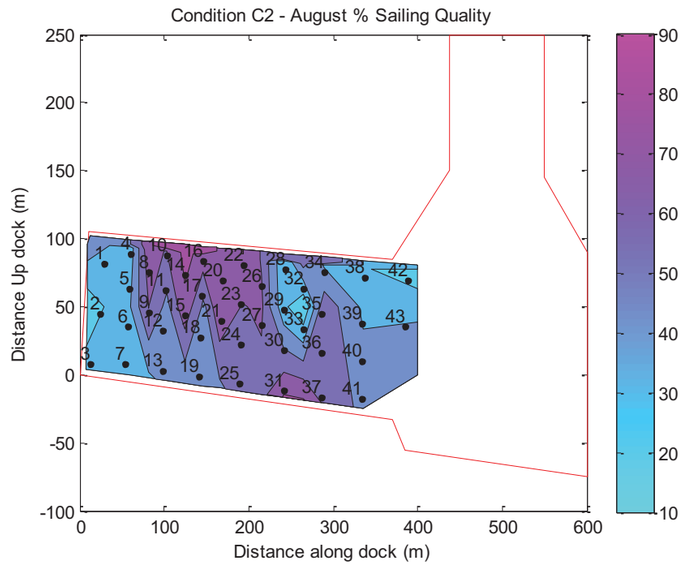


Figure 4



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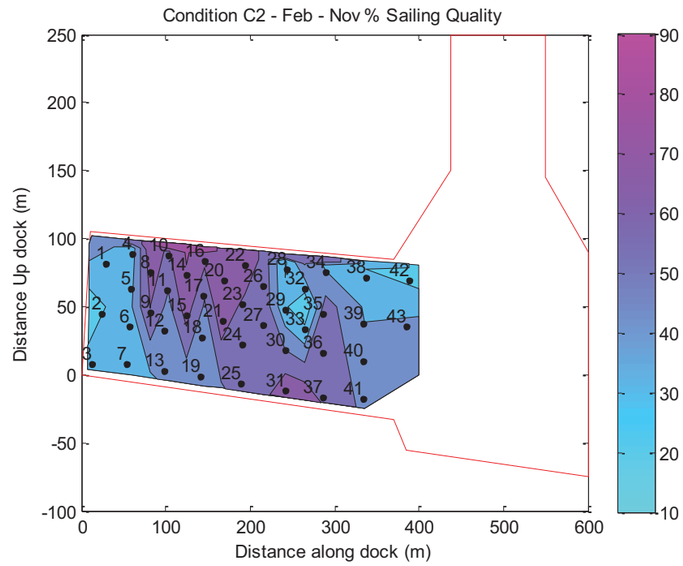

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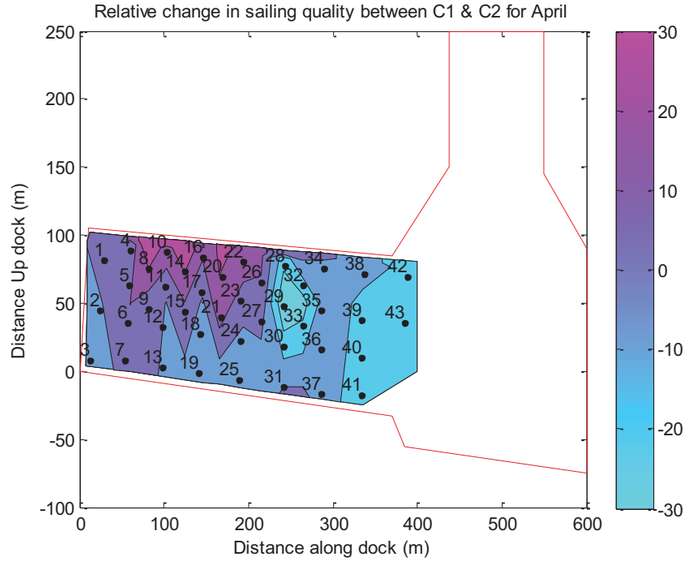

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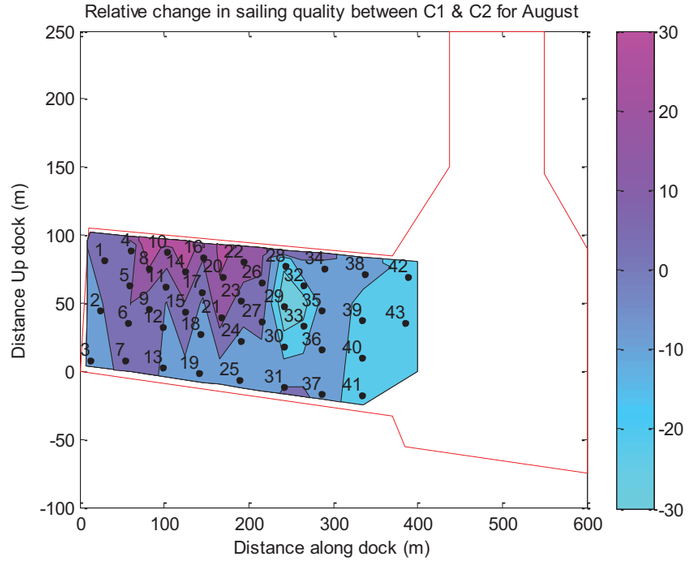

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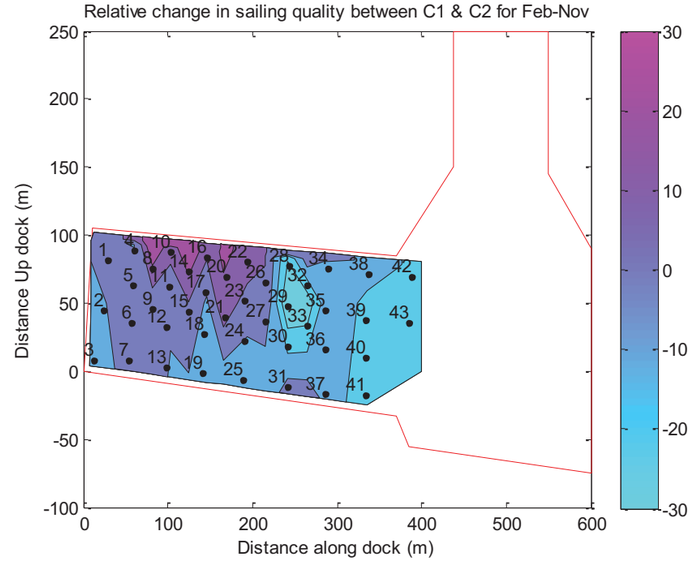


Figure 9

Junior Criteria – Condition C3

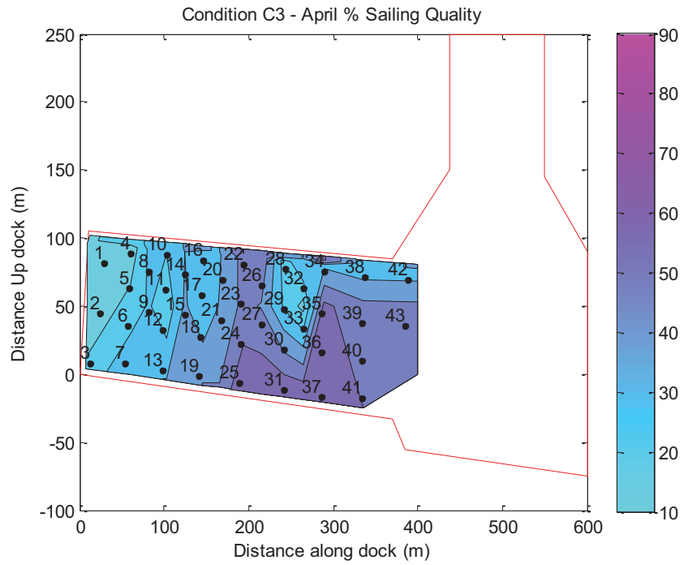


Figure 10

Relative change in sailing quality between C1 & C3 in April

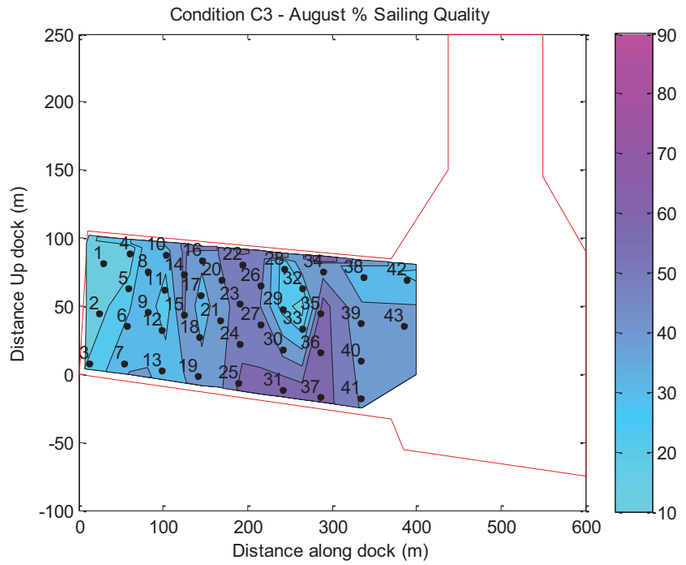


Figure 11

Relative change in sailing quality between C1 & C3 in August

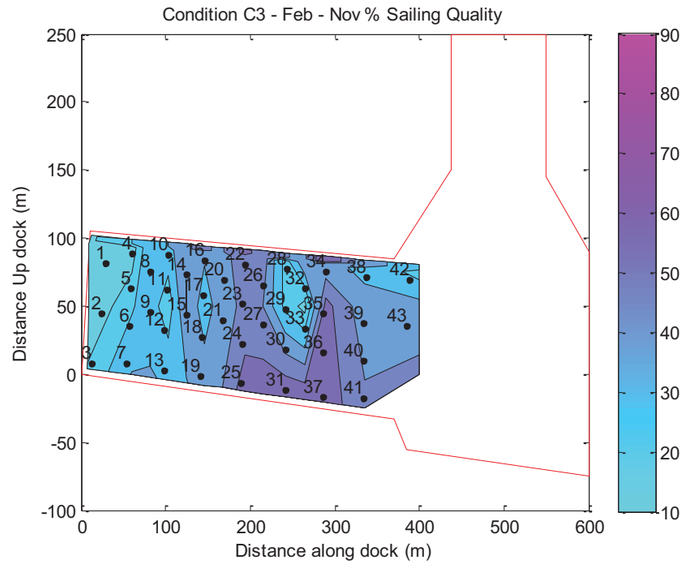


Figure 12

Relative change in sailing quality between C1 & C3 for Feb-Nov

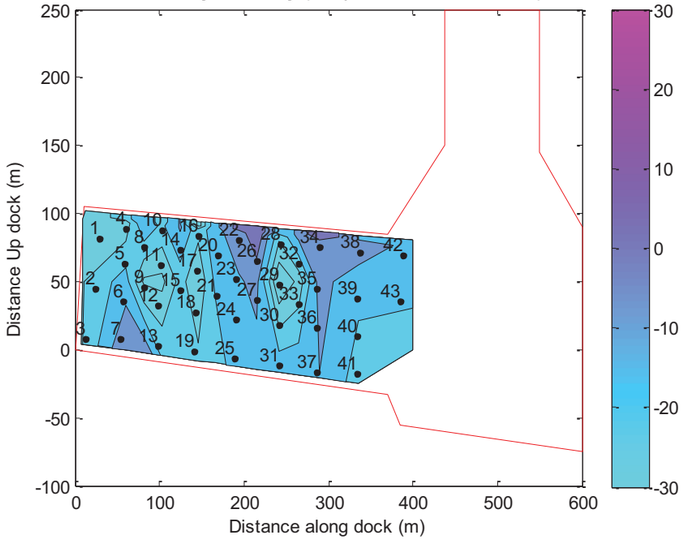
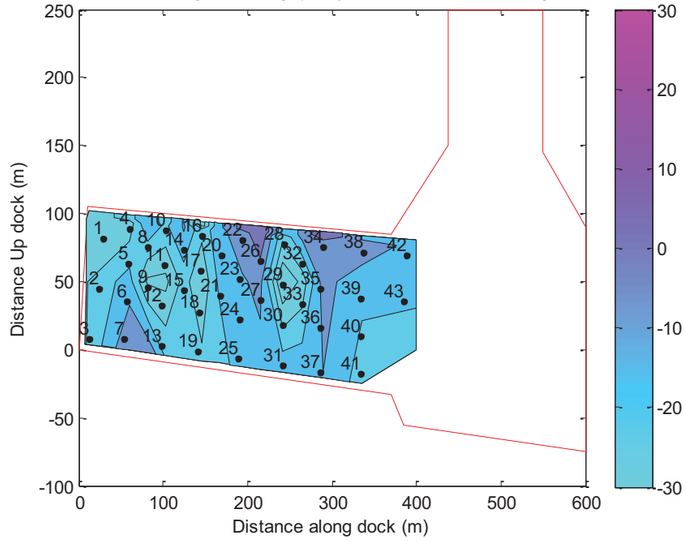


Figure 13



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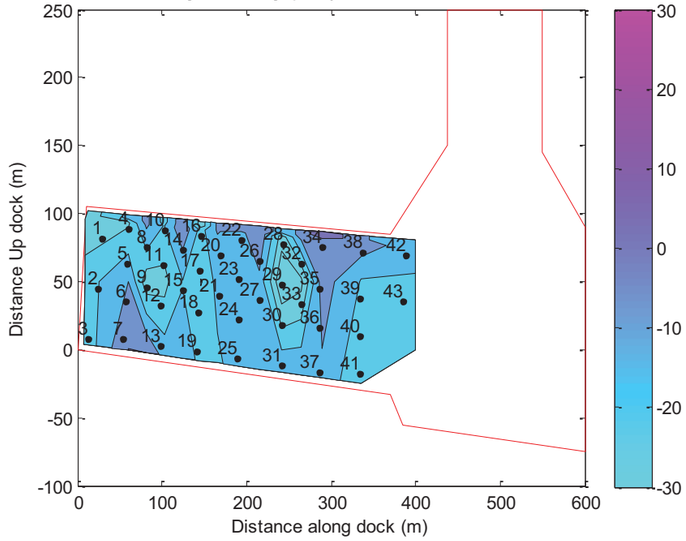


Figure 15

Junior Criteria – Condition C4

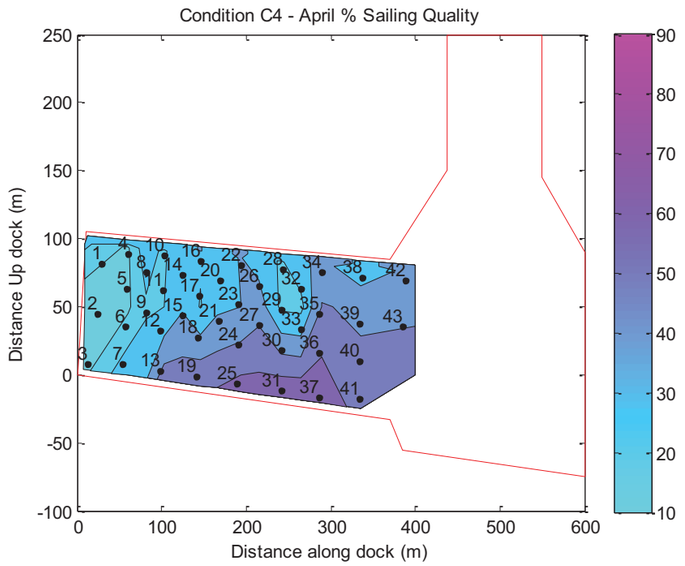
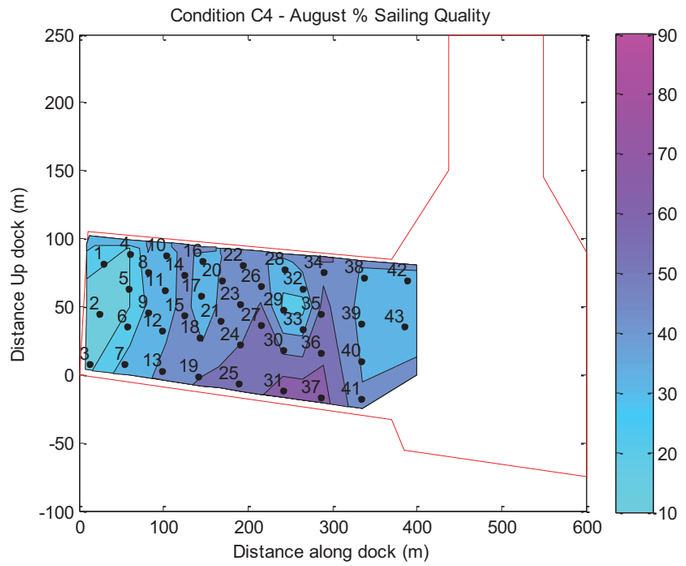


Figure 16



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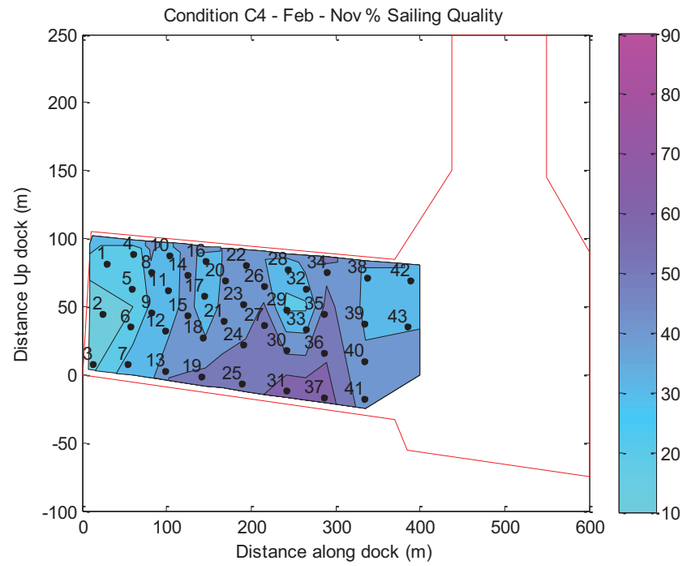

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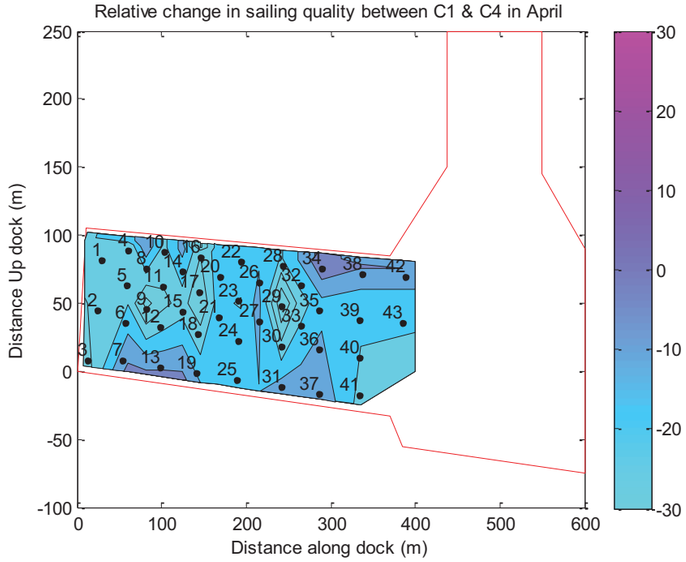

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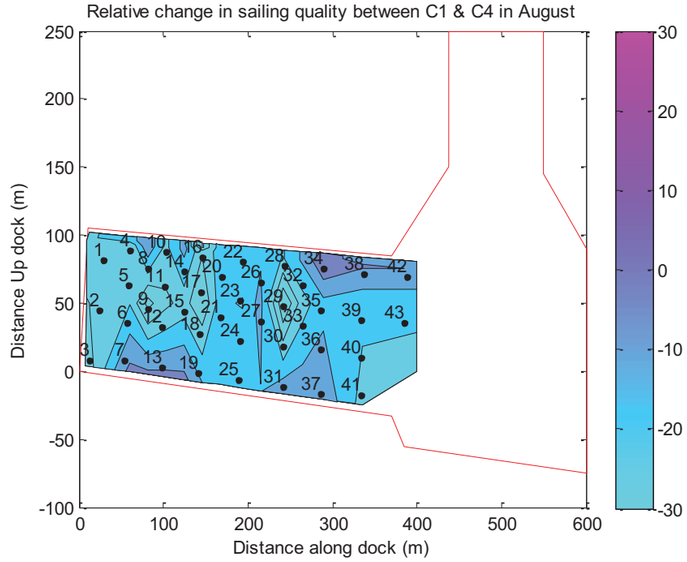

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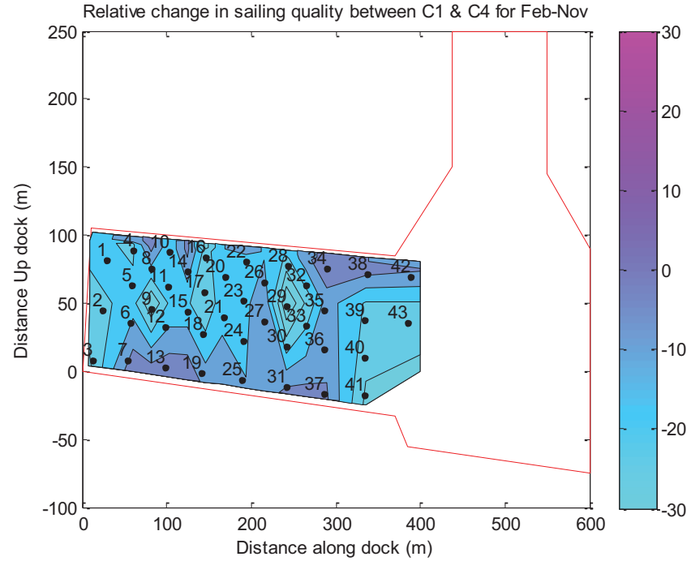


Figure 21

Junior Criteria – Condition M1

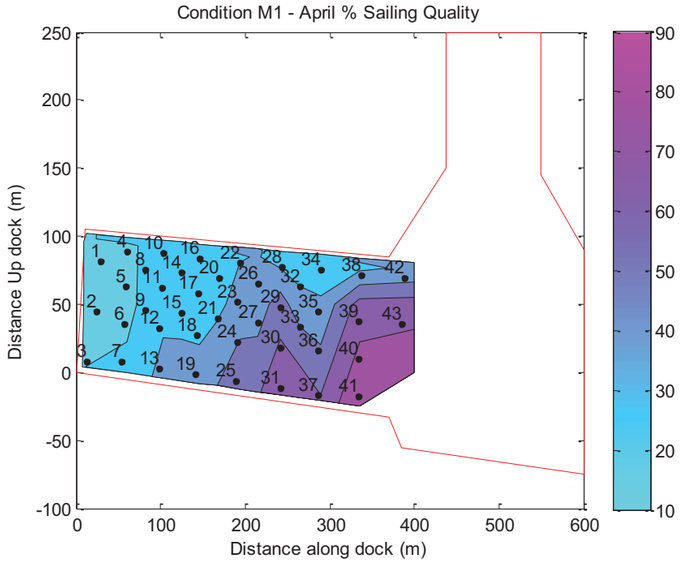
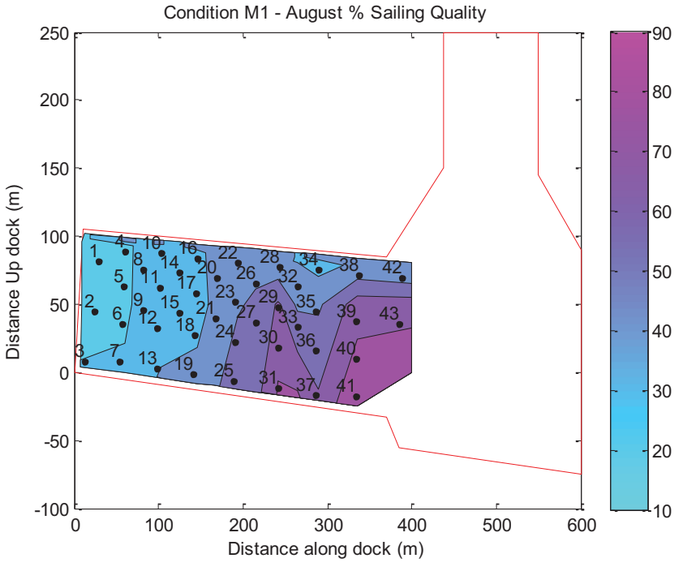


Figure 22



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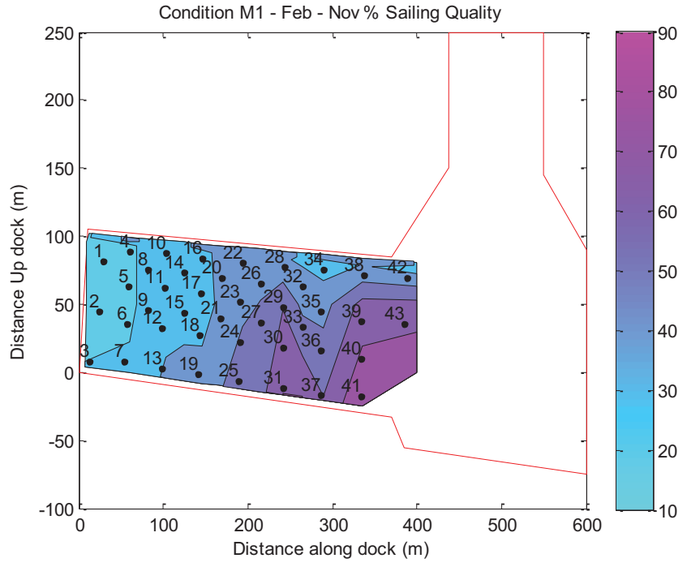
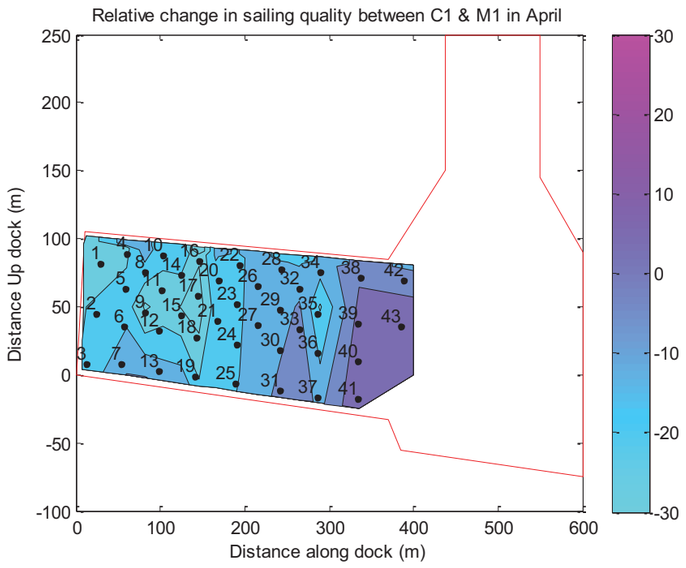


Figure 24



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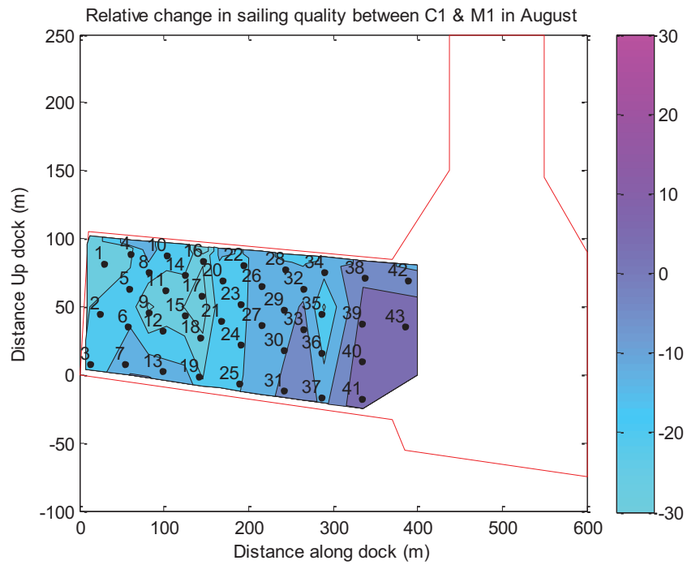

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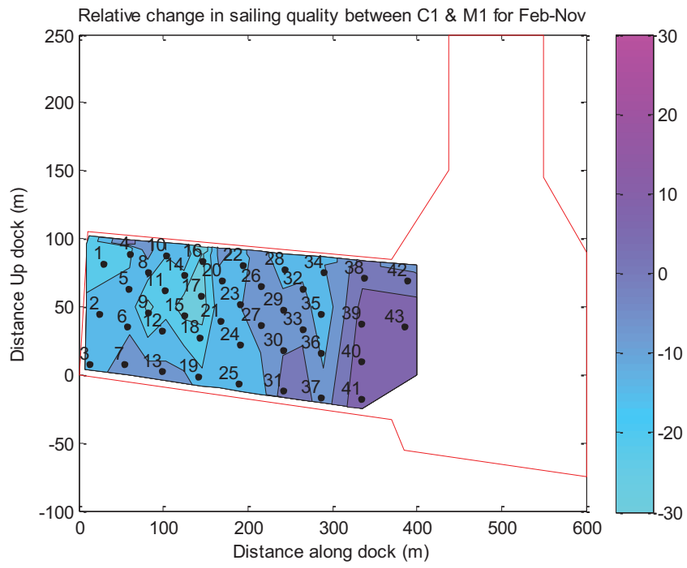


Figure 27

Junior Criteria – Condition M2

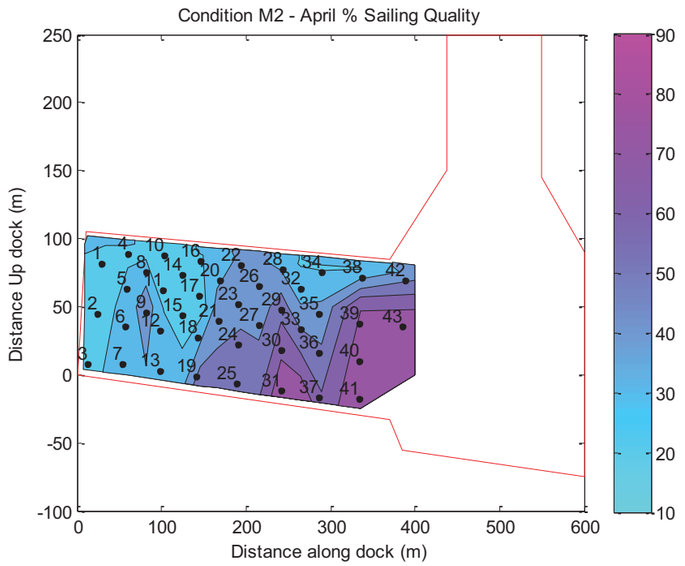
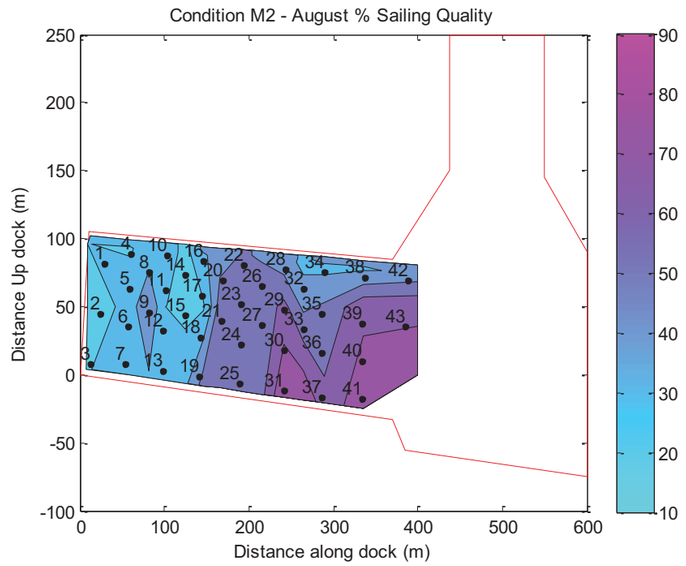


Figure 28



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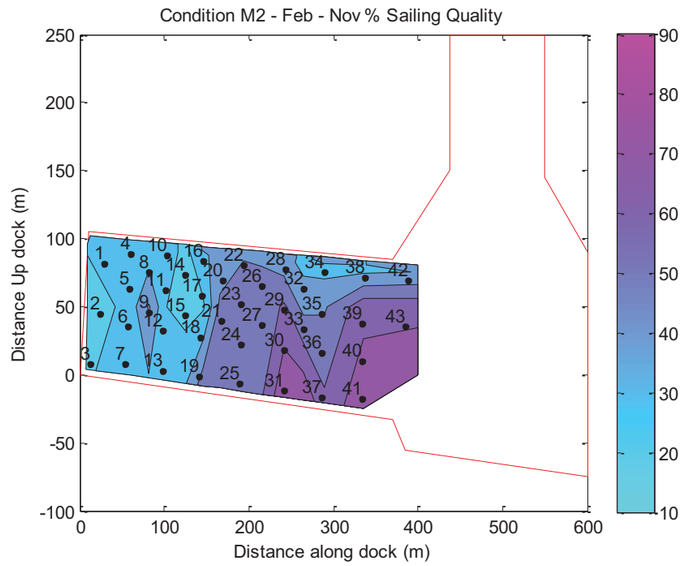

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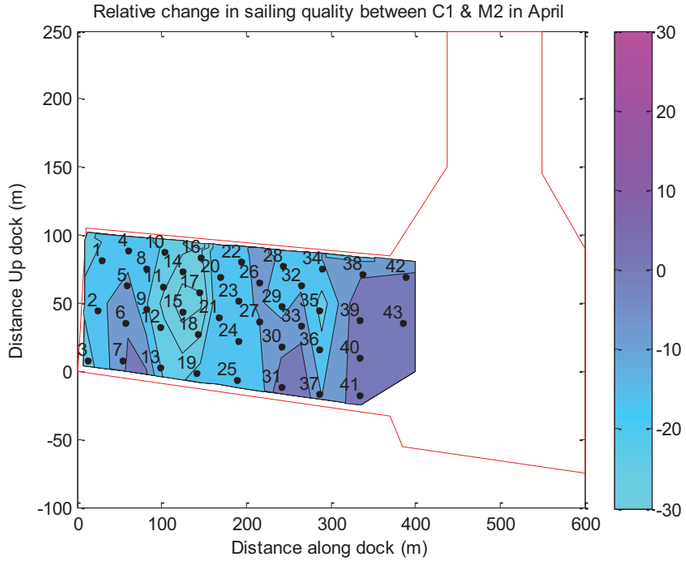

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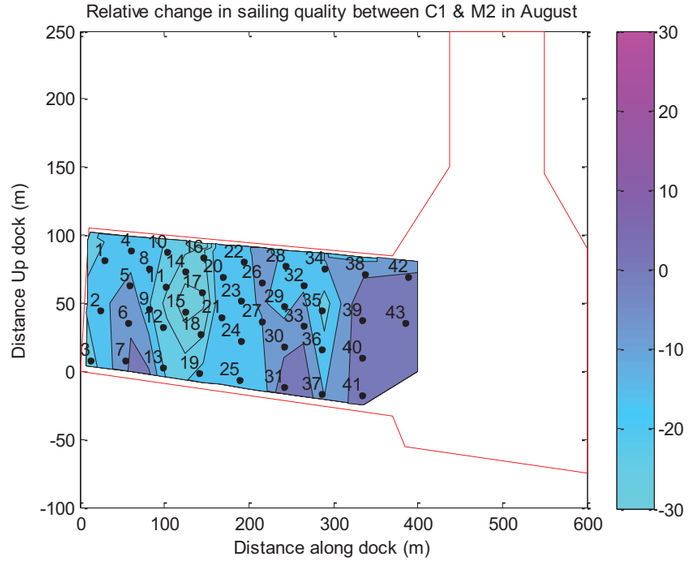


Figure 32

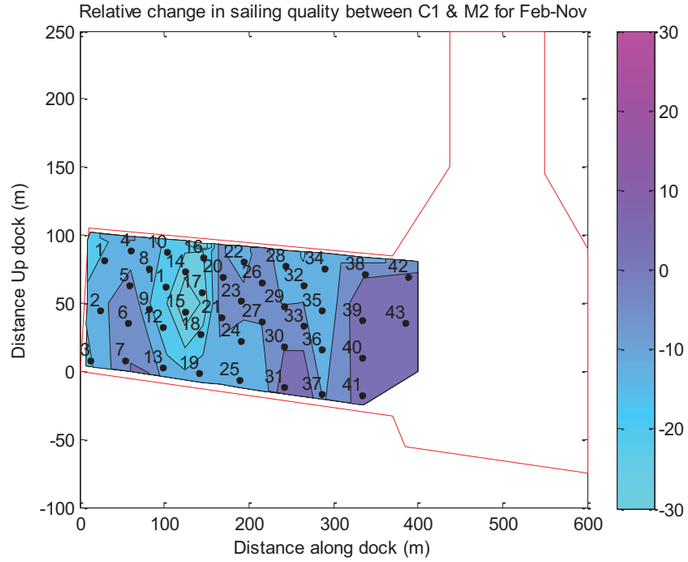


Figure 33

Junior Criteria – Condition M3

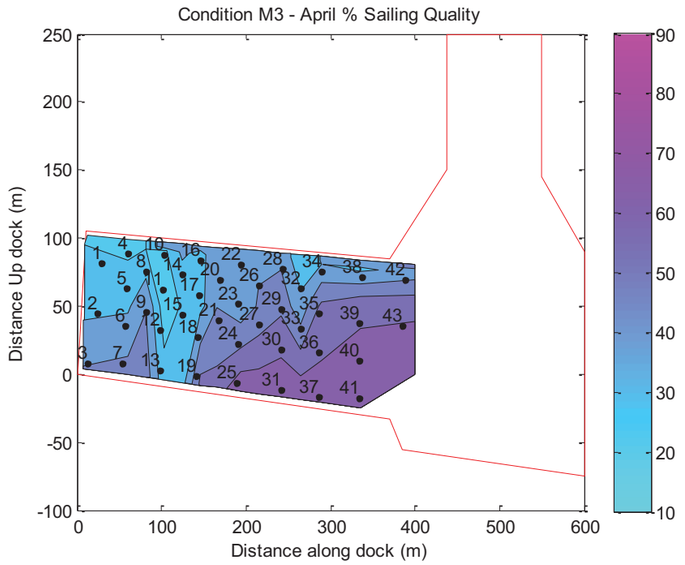


Figure 34

Relative change in sailing quality between C1 & M3 in April

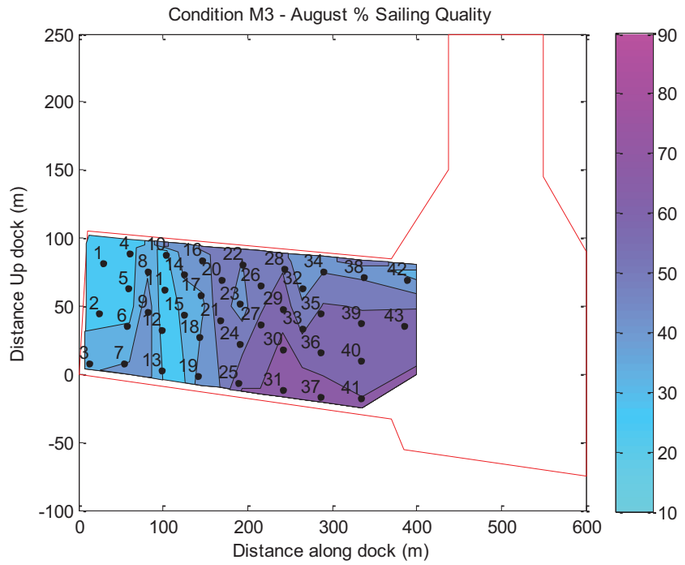


Figure 35

Relative change in sailing quality between C1 & M3 in August

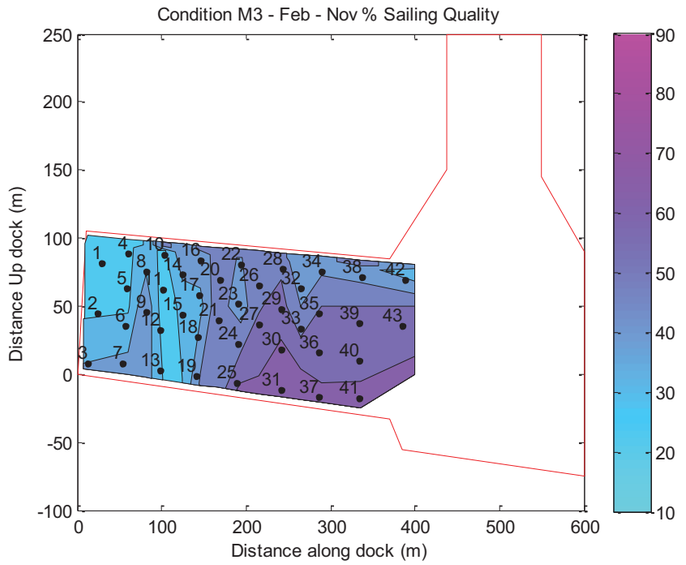


Figure 36

Relative change in sailing quality between C1 & M3 for Feb-Nov

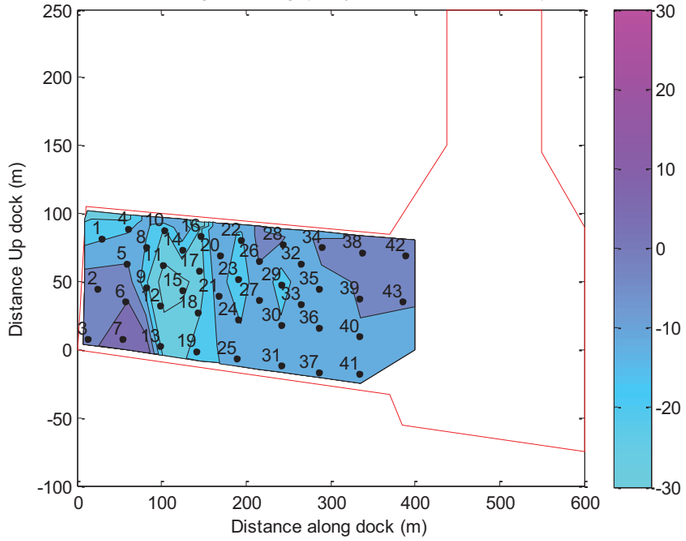


Figure 37

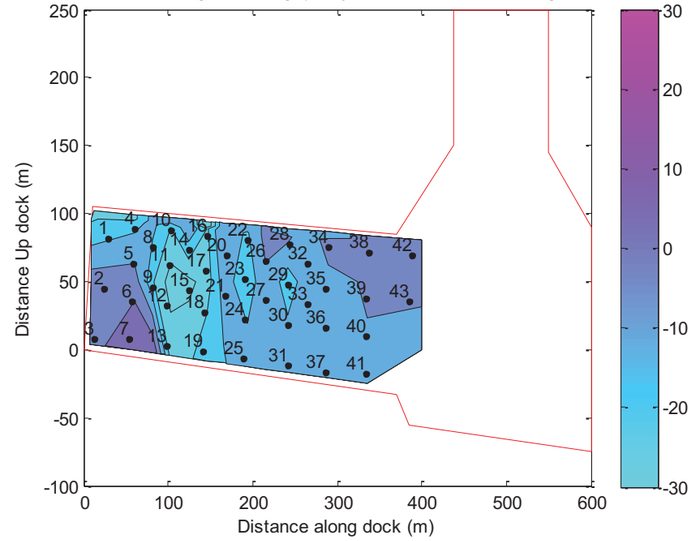


Figure 38

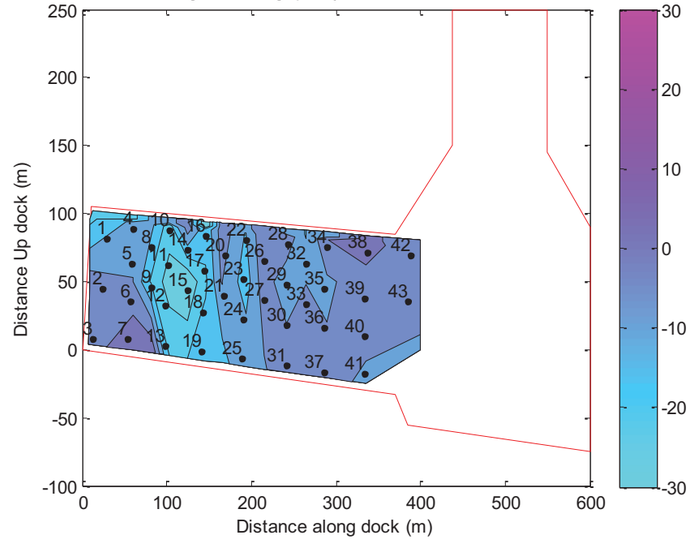


Figure 39

Junior Criteria – Condition M4

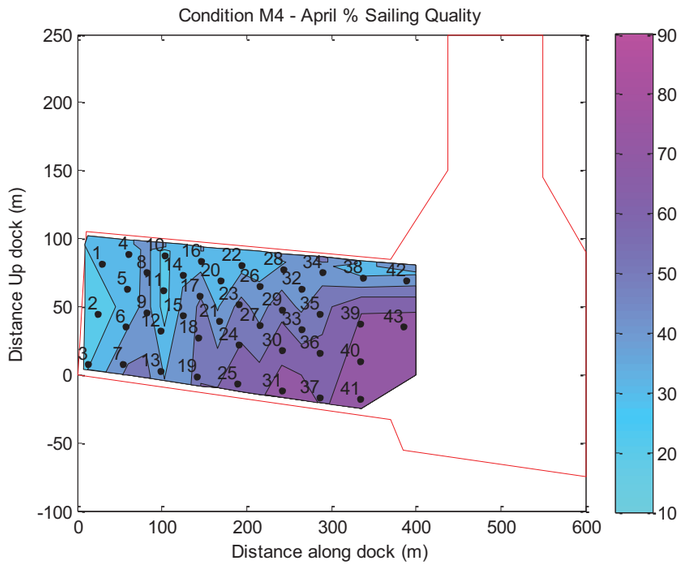


Figure 40

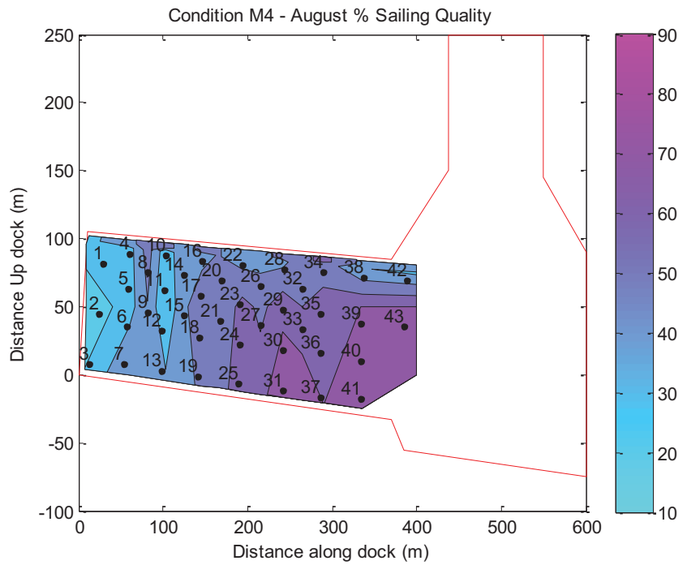


Figure 41

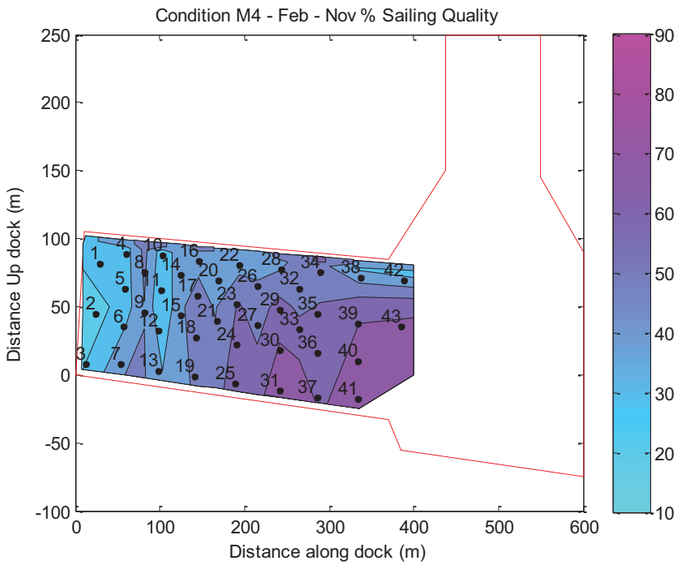


Figure 42

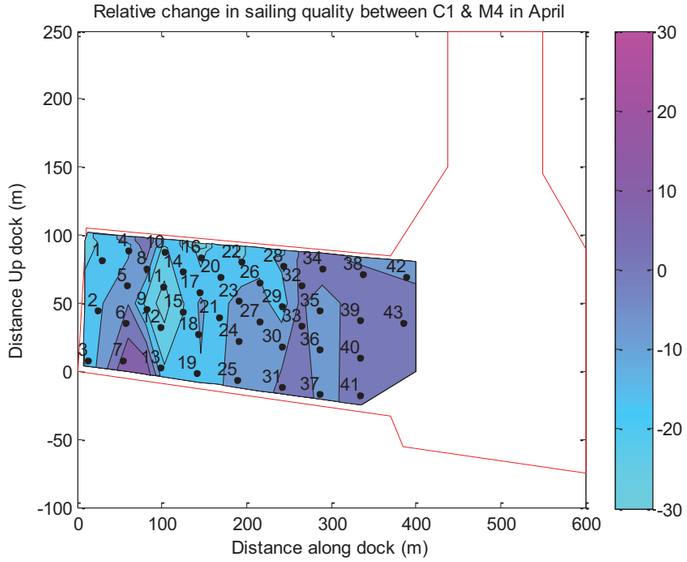


Figure 43

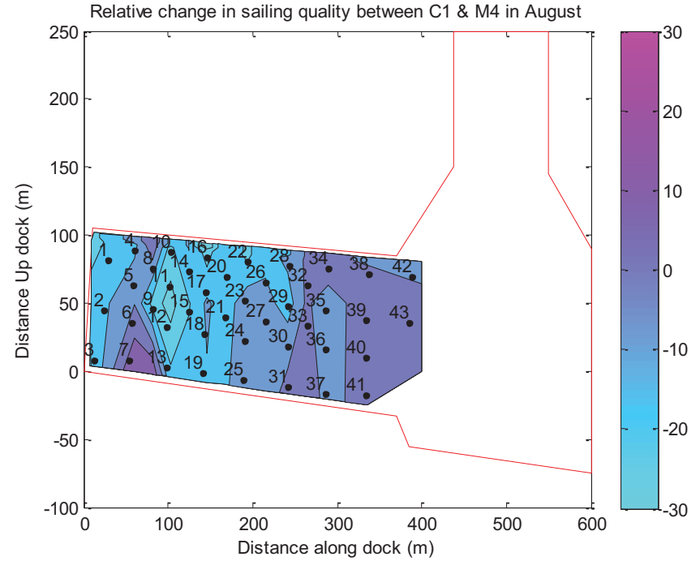


Figure 44

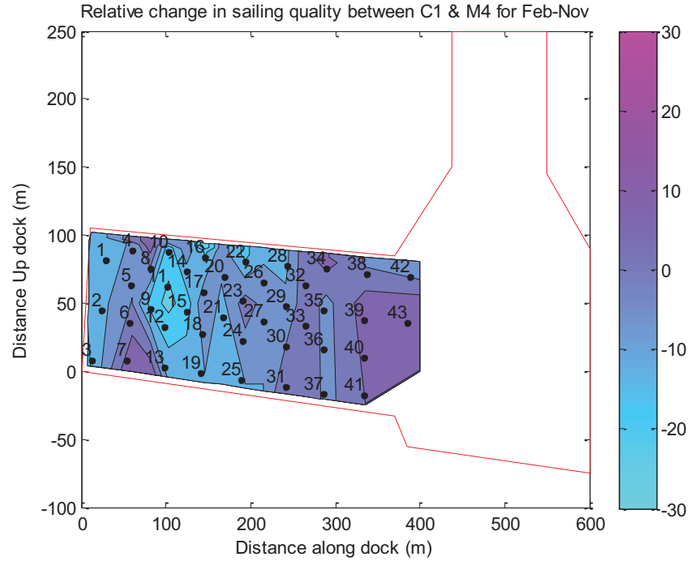


Figure 45

Junior Criteria – Condition M5

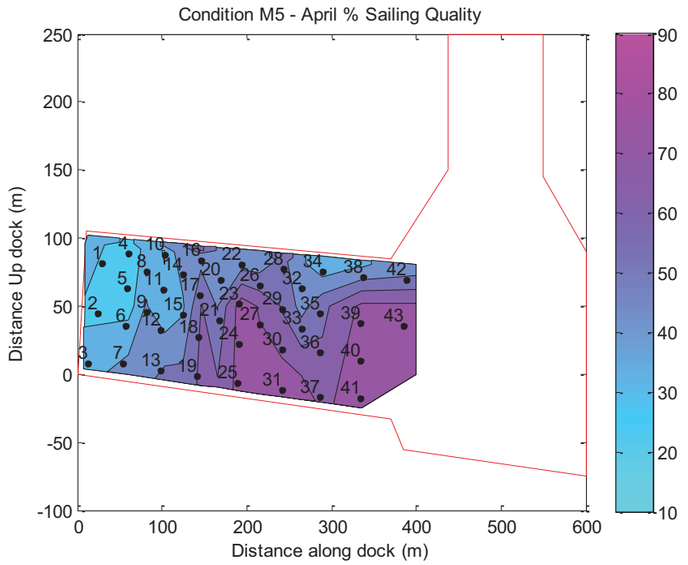


Figure 46

Relative change in sailing quality between C1 & M5 in April

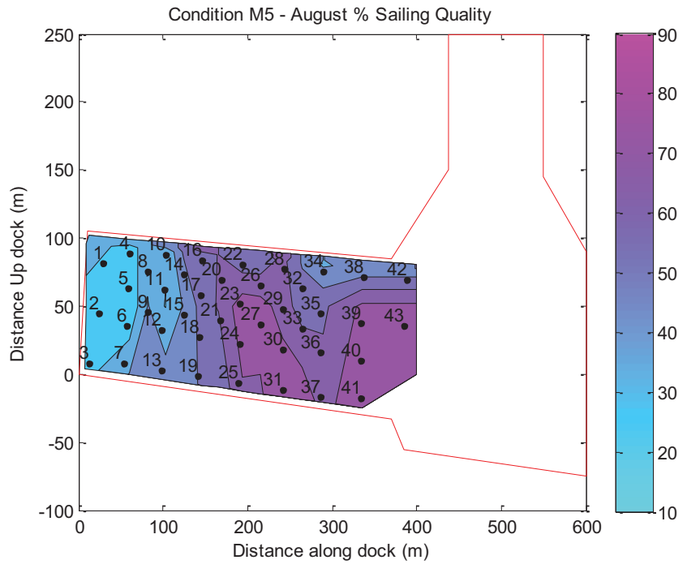


Figure 47

Relative change in sailing quality between C1 & M5 in August

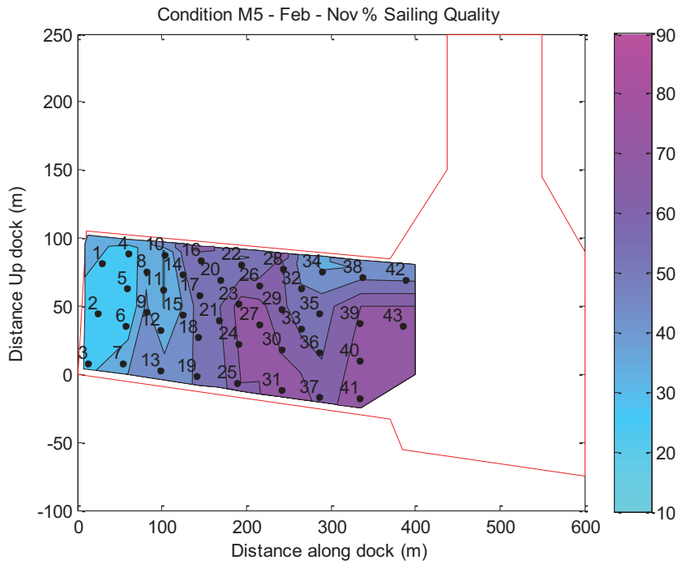


Figure 48

Relative change in sailing quality between C1 & M5 for Feb-Nov

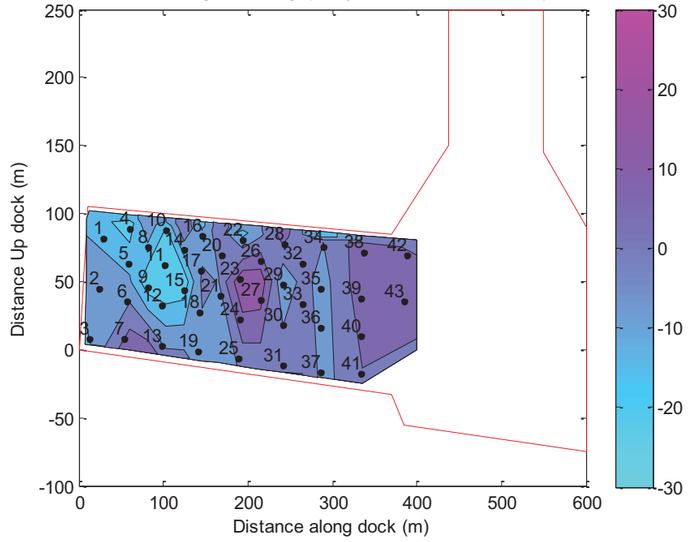


Figure 49

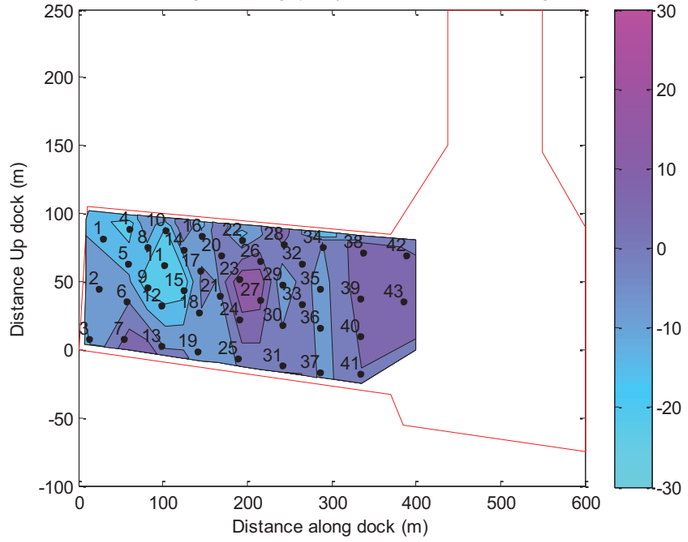


Figure 50

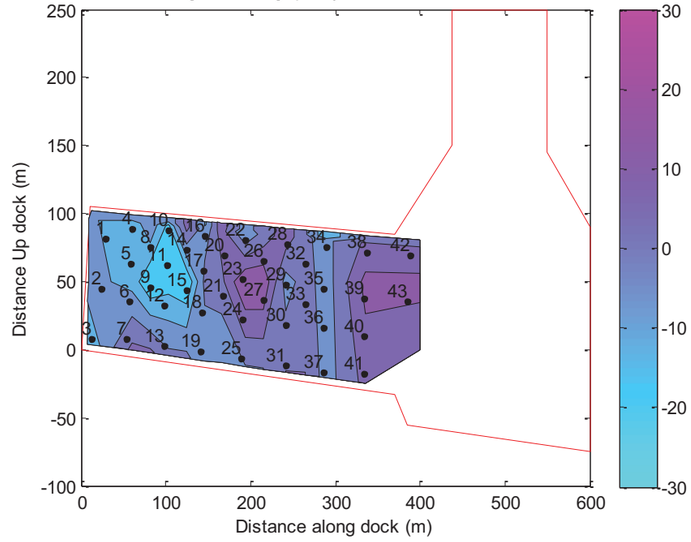
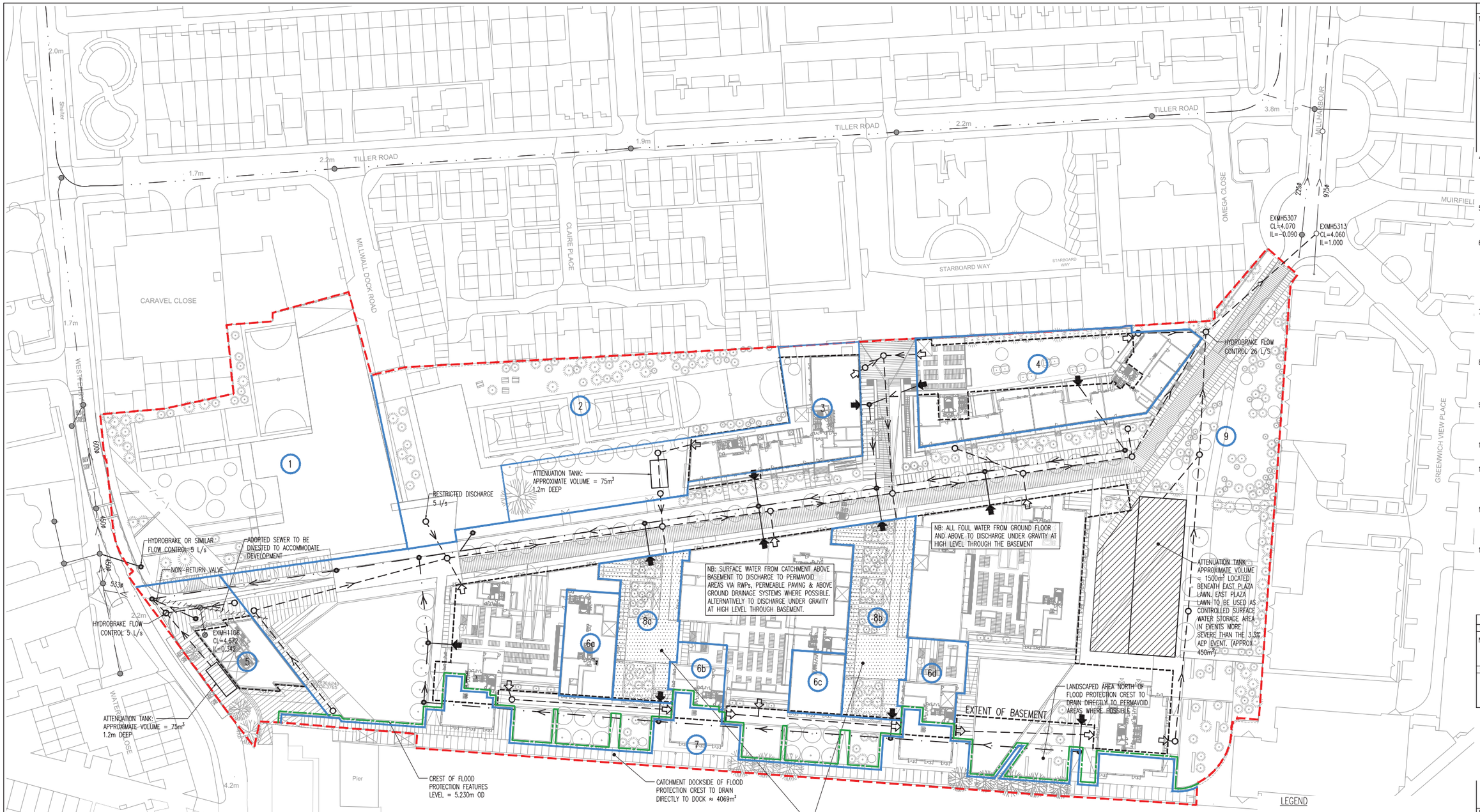


Figure 51

Plan 3886-320 P6 Revised Drainage Plan Walsh & Partners



CATCHMENT	PEAK FLOW RESTRICTION (L/s)	ATTENUATION STORAGE VOLUME	DESCRIPTION
1	5	370m³	SCHOOL CATCHMENT, DESIGN BY OTHERS
2	5	340m³	SCHOOL CATCHMENTS, DESIGN BY OTHERS, HYDROBRAKE OR PERMAVOID FLOW RESTRICTION
3	5	75m³	HYDROBRAKE CONTROL, TANK UNDER LAWN TO PROVIDE ATTENUATION FOR ROOF RUNOFF
4	5	150m³	LOCALISED RESTRICTION FROM PERMAVOID ABOVE BASEMENT
5	5	75m³	HYDROBRAKE FLOW CONTROL, STORAGE TANK TO WEST OF BUILDING
6	–	PERMAVOID	ROOF WATER TO DISCHARGE TO PERMAVOID (CATCHMENT 8)
7	–	–	CATCHMENTS DOCKSIDE OF FLOOD PROTECTION CREST TO DRAIN DIRECTLY TO DOCK
8	–	PERMAVOID	PEMAVOID TO DISCHARGE TO DOCK, DETAILS DETERMINED FOLLOWING SURVEY OF EXISTING GAS LINE IN TOW PATH
9	26	1950m³	ROAD AND REMAINING CATCHMENTS, INCLUDING RESTRICTED DISCHARGE FROM CATCHMENTS 2,3 AND 4 TO BE RESTRICTED BY HYDROBRAKE BEFORE DISCHARGE TO MILLHARBOUR SEWER, ATTENUATION PROVIDED BY TANK, WITH OPEN SPACE STORAGE AREA FOR EVENTS LESS FREQUENT THAN THE 3% AEP.

MILLWALL OUTER DOCK

NORMAL TOP OPERATING
LEVEL = ~4.23m OD

WESTFERRY (533ø COMBINED SEWER)			MILLHARBOUR (675ø SW SEWER + 225ø FW SEWER	
	EXISTING	PROPOSED	EXISTING	PROPOSED
FW	0 L/S	40 L/S	1.2 L/S	1.2 L/S
SW	164 L/S	10 L/S	551 L/S	26 L/S

- EXISTING FW FLOWS BASED ON 2160.3m² EXISTING WAREHOUSE AT 0.6 L/S/Ha.
- PROPOSED FW FLOWS BASED ON 741 UNITS & 338 PUPIL SCHOOL.
- EXISTING SW FLOWS BASED ON ESTIMATED CATCHMENTS FROM TOPOGRAPHICAL SURVEY AT 50mm RAINFALL/m²/HR.
- ALL EXISTING SEWER OUTFALLS AND CATCHMENTS HAVE BEEN ASSUMED AND SHOULD BE CONFIRMED BY CCTV SURVEY OF EXISTING DRAINAGE NETWORK.
- PROPOSED SW DISCHARGE TO SEWER FOR EVENTS UP TO INCLUDING THE 1% AEP RAINFALL LIMITED TO ~1% AEP GREENFIELD RATE OR 3xQBAR GREENFIELD RATE FOR THE SITE.

0 10 20 30 40 50
1:500

Notes

1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS IN METRES.
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH RELEVANT ARCHITECT'S AND ENGINEER'S DRAWINGS AND SPECIFICATIONS.
3. THIS DRAWING HAS BEEN PRODUCED ELECTRONICALLY AND MAY HAVE BEEN PHOTO REDUCED OR ENLARGED WHEN COPIED. HENCE, DO NOT RELY ON ANY SCALES QUOTED. WORK ONLY TO FIGURED DIMENSIONS (DO NOT SCALE). ALL DIMENSIONS TO BE CHECKED ON SITE. ANY ERRORS OR OMISSIONS TO BE REPORTED TO THE ENGINEER IMMEDIATELY.
4. PROPOSED SURFACE WATER DISCHARGE TO SEWER IN MILLHARBOUR = 26 L/S & WESTFERRY COMBINED SEWER = 10 L/s. TOTAL BASED ON RESTRICTING DISCHARGE RATES TO SIMILAR TO GREENFIELD RUNOFF.
5. ESTIMATED EXISTING IMPERMEABLE AREA OF 51064m² GENERATES APPROXIMATELY 715 L/S @ 50mm/RAINFALL/m²/Hr.
6. IT IS ASSUMED THAT APPROXIMATELY 39371m² CATCHMENT AREA DISCHARGES VIA 675mm EXISTING CONNECTION TO SW SEWER IN MILLHARBOUR AND 11693m² CATCHMENT TO SEWER WESTFERRY ROAD (COMBINED SEWER) VIA CURRENT SITE STRATEGY
7. THERE IS APPROXIMATELY 5100m² ADDITIONAL IMPERMEABLE AREA TO BE MITIGATED THROUGH RAINWATER HARVESTING GREEN PODIUM AREAS/ROOFS AND PERMEABLE PAVING.
8. ESTIMATED 60 L/S PROPOSED FW FLOW TO COMBINED SEWER IN WESTFERRY ROAD BASED ON 907 RESIDENTIAL UNITS, 2618m² OFFICE/RETAIL AREA & 50 PUPIL CRECHE.
9. POSSIBLE SMALL VOLUME FW DISCHARGE TO 225ø FW SEWER IN MILLHARBOUR SUBJECT TO CONFIRMATION OF CAPACITY BY THAMES WATER.
10. ALL SEWER CONNECTIONS SUBJECT TO S106 CONSENT BY THAMES WATER.
11. SEWER DIVERSIONS AND DIVESTMENTS SUBJECT TO THAMES WATER APPROVALS UNDER SECTION 185 OF WATER INDUSTRY ACT.
12. EXISTING GAS MAIN IN TOW PATH TO BE LOCATED. RUNOFF FROM CATCHMENTS 6, 8 & 9 TO DISCHARGE TO DOCK WHERE POSSIBLE.
13. DRAINAGE SYSTEM, ATTENUATION & POSITIVE MITIGATION TO BE DESIGNED FOR STORM EVENTS UP TO AND INCLUDING THOSE WITH AN AEP OF 1% (PLUS CLIMATE CHANGE ALLOWANCE). CONSIDERATION TO BE GIVEN TO EXCEEDANCE DURING DETAILED DESIGN OF SITE LEVELS.

C.D.M.
SIGNIFICANT RISKS AND HAZARDS:
NO ABNORMAL RISKS IDENTIFIED
KEY DESIGN DECISIONS TO REDUCE OR ELIMINATE HAZARDS:

LEGEND

- FWMH — FOUL WATER MANHOLES
- SWMH — SURFACE WATER MANHOLES
- CWMH — COMBINED WATER MANHOLES
- EXSWMH — EXISTING STORM WATER MANHOLES
- EXFWMH — EXISTING FOUL WATER MANHOLES
- SITE BOUNDARY
- CREST OF FLOOD PROTECTION FEATURES
- BASEMENT EXTENTS
- CATCHMENT BOUNDARY
- POLYPROPYLENE INSPECTION CHAMBER
- FLOW ARROW
- FOUL / STORM — CONNECTIONS FROM HIGH LEVEL BASEMENT DRAINAGE TO ABOVE GROUND DRAINAGE THROUGH BASEMENT WALL (POSITIONS TBC BY ARCHITECT/M&E ENGINEER)

Rev.	Date	By	Details Of Revision
P6	11.12.15	MDL	REVISED TO REFLECT CURRENT SCHEME
P5	23.07.15	MDL	RAIN WATER DISCHARGE ARRANGEMENT AMENDED
P4	16.07.15	MDL	REVISED TO REFLECT CURRENT SCHEME
P3	01.05.15	MDL	REVISED TO REFLECT CURRENT SCHEME
P2	17.11.14	MDL	STRATEGY REVISED TO REFLECT LATEST ARCHITECT PLANS
P1	04.04.14	MDL	FIRST ISSUE

Client: LONDON AND REGIONAL

Project: WESTFERRY

Title: DRAINAGE STRATEGY

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Structural and Civil Engineers
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SE1 2LX
t: +44(0)20 7089 6800
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Status: **INFORMATION**

Drawn	MDL	A0 Scales	1:500		
Date	31.03.14	Eng.	JK	Chk.	JK	App'd.

File Ref.

ACTUAL DIMENSION = 50mm

Drawing No. 3886-320 Rev. P6

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