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Turbulence Intensity at Inlet of 80- by 120-Foot Wind Tunnel Caused by Upwind Blockage

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NOMENCLATURE

I_u	relative turbulence intensity in x-direction, $\sigma_u / \bar{u}$ (%)
I_v	relative turbulence intensity in y-direction, $\sigma_v / \bar{u}$ (%)
I_w	relative turbulence intensity in z-direction, $\sigma_w / \bar{u}$ (%)
I_{vel}	total relative turbulence intensity, $\sigma_{vel} / \overline{vel}$ (%)
u, v, w	velocity components in the x, y and z directions (m/s)
$\bar{u}, \bar{v}, \bar{w}$	mean velocity components in x, y and z directions (m/s)
vel	instantaneous total velocity, $\sqrt{(u^2 + v^2 + w^2)}$ (m/s)
$\overline{vel}$	average total velocity (m/s)
x_b	distance between front face of inlet bell-mouth and upstream blockage (ft)
σ_u	rms fluctuation in x-component of velocity (m/s)
σ_v	rms fluctuation in y-component of velocity (m/s)
σ_w	rms fluctuation in z-component of velocity (m/s)
σ_{vel}	rms fluctuation in total velocity (m/s)
CFM	cubic feet per minute
NFAC	National Full-Scale Aerodynamics Complex
40 x 80	40- by 80-Foot Wind Tunnel
80 x 120	80- by 120-Foot Wind Tunnel
40 x 80 x 120	40- by 80- by 120-Foot Wind Tunnel Complex

TURBULENCE INTENSITY AT INLET OF 80- BY 120-FOOT WIND TUNNEL CAUSED BY UPWIND BLOCKAGE

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Ames Research Center

SUMMARY

In order to estimate the magnitude of turbulence in the National Full-Scale Aerodynamics Complex (NFAC) 80- by 120-Foot Wind Tunnel (80 x 120) caused by buildings located upwind from the 80 x 120 inlet, a 1/50th-scale study was performed that utilized a nominal two-dimensional (2D) blockage placed ahead of the inlet. The distance of the blockage ahead of the inlet was varied. This report describes velocity measurements made in the plane of the 80 x 120 model inlet for the case of zero ambient (atmospheric) wind.

INTRODUCTION

Multiple buildings currently exist upwind from the 80 x 120 inlet, and additional buildings are planned for the near future. At the present time, no quantitative information is currently available describing the effect on 80 x 120 test section turbulence due to the presence of these structures.

A study was proposed early in 2013 to measure 80 x 120 inlet (and test section) turbulence, both with and without upwind buildings and with and without ambient wind, using a 1/50th-scale model of the 80 x 120 installed on the turntable of the full-scale 80- by 120-Foot Wind Tunnel. Scale models of both existing and proposed buildings were constructed out of foam-core poster-board. These were placed on the floor of the NFAC test section at the required distance and orientation relative to the model inlet and tested either alone, or in combinations. This study is documented in reference 1.

This report describes a secondary study that was carried out later in 2013 in order to document the 80 x 120 inlet turbulence levels associated with an essentially "two-dimensional" building positioned directly ahead of the 80 x 120 inlet. A model building height of 1 foot was selected for the study, corresponding to 50 feet at full-scale. Since the building was directly ahead of the inlet and nominally two-dimensional, testing would yield a "worst-case" scenario for the expected turbulence. Importantly, it was hoped that such a building would no longer be detectable once the distance between the inlet and the building exceeded some critical yet finite distance. This would be a very meaningful result for selecting locations for future buildings.

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TEST FACILITY AND TEST HARDWARE

NFAC Wind Tunnel and 1/50th-Scale Model

Even at 1/50th-scale, the size of the 40 x 80 x 120 complex is significant. Outside “atmospheric” testing was considered, but quickly eliminated from consideration as this would place testing at the vagaries of the atmospheric wind. Clearly it would be advantageous to test in a controlled wind environment (including the case of zero ambient wind velocity).

The NFAC 80 x 120 test-section was selected as optimal for testing. The 1/50th-scale model can be mounted on the NFAC turntable and the NFAC fan drive used to provide the desired ambient wind speed, with turntable rotation providing the desired oncoming wind direction relative to the model inlet. Zero ambient wind can be obtained by closing NFAC Vane Set 4, thereby closing the duct downstream from the NFAC test section and eliminating the possibility of any net flow through the NFAC test section. Recirculation would always be present, by necessity, and this would act as a minimum level of ambient wind that could be tested for the current test configuration. The physical size of the NFAC test section fortunately minimizes any recirculation velocities.

Use of a ground plane to raise the model out of the NFAC test section boundary layer was considered. A thick boundary layer on the NFAC 80 x 120 test section floor is more representative of the atmospheric boundary layer that is ingested into the full-scale inlet than a thin boundary layer that would grow on a ground plane. In addition, since the goal of the study was to investigate the effects of upwind buildings at significant upwind distances, these upwind structures would also have to be on the same ground plane, implying a ground plane of enormous size. Fortunately, it was deemed unnecessary to mount the 1/50th-scale model on a raised ground plane. The 1/50th-scale model could be installed directly on top of the NFAC test section floor.

The complete 1/50th-scale 40 x 80 x 120 model that dates to 1976 is shown in Figure 1. References 2 and 3 describe the design study that led to the final selection of inlet geometry, and Figure 1 shows the simple egg-crate honeycomb inlet treatment that was used for the 1/50th-scale testing at that time. Figure 2 shows the test setup of the 1/50th-scale model in the 40- by 80-Foot Wind Tunnel in 1976. Additional model-scale studies are described in reference 4. For this study, the optimal location for the 1/50th-scale inlet is immediately above the NFAC 80 x 120 turntable axis in order to eliminate any sideways motion of the model inlet associated with turntable rotation. Unfortunately, the footprint of the 1/50th-scale 40 x 80 x 120 model is so large that it is not possible to fit the model on the NFAC 80 x 120 turntable if the model inlet is required to be above the turntable axis. This is a complication of testing with the complete 40 x 80 x 120 circuit.

In the interest of keeping the cost down and making the test more efficient, it was decided that the 40 x 80 circuit components could be completely eliminated without compromising the planned measurements. The plan was modified to simply test the 80 x 120 leg at 1/50th-scale. The 1976 model 80 x 120 leg had S-shaped sidewalls to the inlet contraction and an egg-crate inlet. The six electric motors used to power the model in 1976 were insufficient at that time to reach the design speed of 100 knots in the test section and were high risk for any further testing due to age and disuse. Instead, an alternative approach was suggested that used a spare NFAC motor cooling fan as the power plant for the model 80 x 120 wind tunnel.

Modeling of the 80 x 120 was thereby reduced to the original bell-mouth inlet, contraction cone modified for straight sidewalls, new inlet treatment to represent the vertical inlet guide vanes, horizontal splitters and both leading edge and trailing edge screens instead of the original egg-crate honeycomb, the original test section, and a new transition (diffuser) section between the test section and blower. The proposed installation is shown in Figure 3.

This report covers testing of the 1/50th-scale model of the 80 x 120 without any inlet treatment as shown in Figure 4. Because of the lack of inlet guide vanes, splitters, and screens on the 1/50th-scale model, the measurements in the test section are invalid for interpretation due to lack of geometric similarity between the two scales. No turbulence measurements were made in the test section due to this lack of geometric similarity. While testing could have been postponed until the installation of the model inlet hardware, it was deemed that design, fabrication, and installation of the additional hardware would delay initial findings and insights into the potential issues to be uncovered. Consideration was also given to the future use of computational fluid dynamics (CFD) modeling to simulate the 1/50th-scale model 2D testing. Because of the geometric complexity of the inlet treatment, significant effort would be required to accurately model the inlet guide vanes, splitters, and screens, and could lead to modeling issues.

Blower

The blower was a D/47 vane axial fan from Chicago Blower Corporation rated at 40,000 CFM, satisfying the requirement for a maximum speed of 100 knots in the test section. In Figure 5 the blower is shown mounted in a cradle that aligns the longitudinal axis of the blower with the centerline of the test section.

The 47-inch blower diameter necessitated a transition section be built between the original test section and the blower inlet, keeping the diffuser angles small so as to prevent diffuser stall. This resulted in a relatively long transition section as shown in Figure 6. In addition, the blower was partially submerged beneath the test section floor in order to align the longitudinal axis of the blower with the 1/50th-scale test section centerline such that the inlet rests directly on the NFAC test section floor. The actual installation required shims (plywood panels) to be placed on the NFAC test section floor beneath the 1/50th-scale inlet. This, in turn, required additional plywood panels, of reduced thickness, to be installed upwind to move the discontinuity between the floor of the inlet and the NFAC test section floor away from the inlet. To help smooth the transition across the various plywood panels, the floor ahead of the inlet was covered by a heavy duty, smooth-faced plastic tarp.

Test section velocity was controlled by using a variable frequency drive for blower speed control. Blower calibration data in Table 1 indicates a nearly 1:1 relationship between blower frequency in Hz and test section speed in m/s. Maximum speed in the NFAC 80 x 120 test section is 100 kts (51.44 m/s). The goal was to acquire turbulence measurements in the 1/50th-scale model at both 50 percent and 100 percent of maximum rated test section speed. For simplicity, blower frequencies of 25 Hz and 50 Hz were chosen for testing.

During the blower calibration, the 1/50th-scale test section Cobra probe was seen to saturate below 50 Hz so no dependable test section velocities are available corresponding to 50-Hz blower frequency. After the blower calibration yet prior to the current investigation, the A/D converter range was adjusted to ±10 V from ±5 V, reducing the sensitivity of the transducers but eliminating the problem with A/D overvoltage.

Cobra Probes

Two Cobra probes were available for velocity measurements in the current study. One was mounted on the centerline of the test section; the other was mounted 0.5 inches ahead of the inlet plane, defined as the front face of the inlet bell-mouth, on the inlet centerline (Figs. 7 and 8). The test section probe was in the wake of the inlet probe used for the measurements in the current report, and measurements from the test section probe are therefore not described.

The minimum velocity that a Cobra probe can measure is around 2 m/s (see Appendix A for manufacturer's specifications). For a maximum test section velocity of 100 kts (51.44 m/s) and a contraction area ratio of 5, an inlet velocity of 10.3 m/s can be expected. For 50 percent of maximum rated test section speed, we can expect an inlet velocity of 5.1 m/s. Both conditions are amenable for measurement using a Cobra probe.

Cobra probe software provided by the manufacturer provides instantaneous simultaneous velocity measurements for all three velocity components u, v, and w in the x, y, and z directions respectively (Figure 9) with measurement resolution of 0.1 m/s in each component.

The Cobra probe has several limitations. First, it can only measure flow angles in a ±45-degree cone. Instantaneous velocity measurements with flow angle outside of this cone are output as null data for each of the three velocity components. This is important for the inlet probe with the blockage located close to the inlet. The second limitation of the Cobra probe is the effective minimum velocity of 2 m/s, below which the probe is unreliable; this meant that the Cobra probe could not measure the induced velocity ahead of the inlet. Also, the maximum and minimum A/D converter voltage range must be specified before data collection starts. If the voltage saturates during data collection, the Cobra probe software indicates that an "A/D overvoltage has occurred," but there is no indication of precisely when the overvoltage occurred or how often. There is no possibility of recovery from such an occurrence. During the blower calibration with the A/D converter set to ±5 V for the test section probe, the A/D overvoltage warning was received when attempting to achieve 100 kts in the test section. All later tests, including the 2D blockage study, were performed with the A/D converter set to ±10 V for both the test section probe and the inlet probe. Data from each Cobra probe were collected for two minutes at a sampling rate of 1250 Hz. Only the turbulence data from the Cobra probe at the inlet are analyzed in this report.

Alnor Probe

The Cobra probe has a minimum velocity below which it becomes unreliable. In order to measure ambient wind speed in the NFAC test section before starting the model blower, and in order to measure the induced velocity field ahead of the inlet with the model blower operational, a more sensitive instrument was required—one capable of measuring much smaller velocities than the lower limit of 2 m/s available from a Cobra probe.

The Alnor probe satisfied the requirements for such an instrument, capable of measuring from zero to 30 m/s with velocity resolution of 0.01 m/s, albeit with a lower accuracy of ±3 percent of reading. The Alnor probe is also capable of measuring air temperature and hence provides thermally compensated velocity measurements. The manufacturer specifications for the Alnor probe can be found in Appendix A.

The Alnor probe, shown in Figure 10, provides instantaneous measurements of wind speed in the plane perpendicular to the axis of the probe, being insensitive to the velocity component parallel to the probe axis. The present study used the Alnor probe in a "hand-held" fashion with the probe axis vertical, thereby providing a total velocity measurement in the horizontal plane only. Current measurements were restricted to a single height of 78 inches above the NFAC 80 x 120 test-section floor as shown in Figure 11.

Table 2 provides Alnor measurements of ambient velocity made 67 feet upwind from the inlet on the inlet centerline, at a height of 78 inches above the NFAC 80 x 120 test-section floor for various blockage conditions. These measurements were always made with the blower turned off. For consistency, a single team member made all the Alnor measurements.

Blockage

Upwind blockage was simulated using six metal U-shaped channels arranged parallel to the inlet face plane. Each channel used in the study was 12 ft x 1 ft x 0.5 ft wide. They were arranged to form a blockage of 36 ft x 1 ft x 1 ft as shown in Figure 12.

Blockage location is defined as the distance between the front face of the inlet bell mouth and the near face of the blockage, x_b. Typical uncertainty in blockage placement was ±1 inch.

TEST PROCEDURE

Two-dimensional blockage testing was accomplished during 3.5 hours of testing on the morning of 12 September 2013 with only a short 30-minute break between Runs 341 and 342.

The blockage was initially positioned at a predetermined value of x_b upwind from the inlet, perpendicular to the inlet centerline. The first run was conducted at a blower frequency of 50 Hz. Once the blower operator indicated that the blower was "on condition," team members inside the NFAC test section waited a predetermined amount of time before initiating data acquisition from the Cobra probe. This pause prior to data acquisition was to ensure that the wake from the upwind blockage had been given sufficient time to reach the inlet plane. Wait times were based on an observed smoke convection time of 48 seconds from 28 feet ahead of the inlet for a blower frequency of 50 Hz. These Cobra-probe wait times are recorded in Table 2 along with other discrete Alnor probe measurements.

After a measurement was completed at the initial blower frequency of 50 Hz, measurements were then repeated at a blower frequency of 25 Hz. As with all such measurements, a pause was enforced before acquiring Cobra probe measurements at the new test condition. After completing inlet Cobra probe velocity measurements at two test section speeds for the chosen blockage location, the blockage was relocated to a new upwind location, and the process was repeated. Each run collected data for 2 minutes.

Cobra probe data collection was monitored at the computer station shown in Figure 13. The computer was positioned behind the 1/50th-scale test section, downwind of the inlet, to minimize any interference with the testing. Earlier smoke flow visualization experiments indicated that smoke released close to the computer station was not entrained into the inlet.

Ambient temperature measurements were occasionally taken 38.5 feet to the left of the computer station when the blower was at idle in order to document any drift in the air temperature. These measurements are listed in Table 2 and are identified with an asterisk. Alnor measurements, both velocity and temperature, were made based on observation of the hand-held probe display for a typical period of at least 20 seconds, or until the values stabilized. Estimated uncertainty in mean velocity is ±0.02 m/s.

Appendix B provides a photographic summary of the 2D blockage study.

RESULTS

Cobra probe velocity measurements made on the inlet centerline for various upwind blockage locations are listed in Appendix C for blower frequencies of both 25 Hz and 50 Hz. Data from each run are presented in tables and as plots. Data from Run 327 presented in Appendix C are described in detail below.

Table C1 contains minimum, maximum, mean, and standard deviation values for the *total* velocity measurement in meters per second based on analysis of the full 2-minute data record. Blockage location, x_b, is listed as 1 ft. With the blockage immediately ahead of the inlet, large changes in the instantaneous velocity vector were observed causing the velocity vector to lie outside the ±45-degree cone of acceptance. These occurrences were associated with null data being recorded. Table C1 indicates that only a small fraction of the measurements were null (612 out of 150,000). The presence of null data renders the measurements as corrupt, but the data were not discarded. The null data were eliminated and statistical information provided for the remaining population. Minimum velocity table entries reflect the population remaining after the removal of all null data. As such, mean values and standard deviations should be regarded only as “indicative” of the average velocity and turbulence level. Similar information is provided for the raw velocity components u, v and w. Note that the minimum and maximum values for the individual velocity components are only provided to one decimal place, defined by the Cobra probe velocity measurement resolution.

Examination of Appendix C shows that only Cobra probe measurements from runs 327 through 331 were corrupted by null data caused by large instantaneous flow angles relative to the probe measurement axis, this problem being caused by blockage proximity to the probe.

The 2-minute record described above for Run 327 was split into 12 equal 10-second-duration periods, and each 10-second period was examined independently. The results are shown in Table C2. Column 4 of Table C2 shows the results of analyzing the 12 mean velocity values, indicating an average velocity of 11.977 m/s (in agreement with the mean obtained from the 2-minute analysis shown in Table C1). Column 4 also shows the standard deviation in the 10-second-duration average velocity values. Column 5 shows the results of analyzing the 12 measurements of standard deviation about the 10-second mean velocity measurements. Note that the average standard deviation from analysis of the 12 discrete intervals is 0.951 m/s (compared with 0.979 m/s from analysis of the single 2-minute-duration record). The 2-minute-duration sample is quite long, and can be subject to significant changes in mean velocity (as indicated by the individual mean values for each of the 12 intervals). Any change in the mean velocity increases the standard deviation (and is then falsely interpreted as turbulence). The effect of drift in the mean velocity is minimized by splitting the 2-minute record into 12 equal 10-second-duration intervals and analyzing each interval separately. For this particular run, the mean value changes little between 10-second intervals. Hence the standard deviation measurements show little change between Tables C1 and C2. Note that the average and standard deviation of column 6 entries for the twelve 10-second intervals allows computation of 95-percent confidence intervals for the measured turbulence level based on a 10-second-duration measurement.

Table C3 presents measurements for the mean and standard deviation about the mean for all three velocity components *u*, *v,* and *w*. Relative turbulence intensity values are also tabulated (for comparison with test section measurements to be made at a later date after honeycomb and screen are added to the model inlet).

Figures C1 and C2 show histograms for the total velocity for each 10-second-duration interval. These histograms are useful in understanding the amount of drift between intervals and the total amount of drift over the 2-minute duration of the measurement.

The average velocity and standard deviation about the average velocity are shown plotted in Figure C3(a) based on analysis of both 2-minute and twelve 10-second intervals. Figure C3(b) shows similar data for the standard deviation. Note that analysis of the 12 intervals allows inclusion of information about the variability in the standard deviation not available from analysis of the full 2-minute record in isolation. Finally, Figure C3(c) shows the variation of mean velocity with time. Standard deviation limits of ±1 are included to provide an indication of the amount of scatter about the mean for each interval.

Baseline (no blockage) runs 340–343 inclusive are of particular interest as well. Consider Run 341, a low-velocity run at a blower frequency of 25 Hz. Table C43 indicates that $\sigma_{vel} = 0.1347$ m/s and $\overline{vel} = 5.6497$ m/s resulting in $I_{rel} = 2.384$ percent based on the analysis of the 2-minute record. Histograms shown plotted in Figure C43 reveal a significant drift in velocity throughout the run. Figure C46 illustrates the change in mean velocity that occurred during the ninth 10-second interval, and the increased standard deviation associated with that interval. Table C44 indicates the benefit of breaking the 2-minute record into 12 equal 10-second intervals for analysis, resulting in a more appropriate $I_{rel} = 1.850$ percent. The same can be said for analysis of run 343. Analyzing the 10-second intervals instead of the full 2-minute record results in much better agreement between the 25- and 50-Hz data for baseline turbulence values.

DISCUSSION

Variations in the relative turbulence intensity (for the total velocity vector) with distance of the blockage upwind from the inlet are shown in Figure 14 for blower frequencies of 25 Hz and 50 Hz based on analysis of 2-minute intervals of signal. Figure 14 shows poor repeatability in the turbulence measurement when the blockage is close to the inlet, as expected, but also for the case of zero blockage. Data plotted at x_b = 30 feet are runs 340–343 with "zero blockage" and, as such, represent an asymptotic value appropriate to $x_b \rightarrow \infty$. Triangular symbols are used to identify data where the measurements were contaminated by velocity vectors lying outside the ±45-degree acceptance cone.

False contributions to turbulence estimates caused by a slow drift in the mean velocity can be eliminated by analyzing shorter records. Figure 15 shows relative turbulence intensity measurements for the total velocity vector based on analysis of 12 equal 10-second-duration signals. Figure 14 and Figure 15 together demonstrate the success of using the 10-second-interval analysis to improve the repeatability in the turbulence measurements, especially for the zero-blockage case.

Agreement between repeat points at any given blockage location are now much improved, especially the zero blockage turbulence measurements. There does not appear to be any systematic difference in inlet turbulence measurements with blower frequency when normalized by the mean local velocity, as expected. Of particular note is that there does not appear to be any meaningful increase in inlet turbulence above the zero-blockage value for blockage x_b > 20 feet (1,000 feet at full scale).

Analysis of the 2-minute record in terms of 12 equal intervals of 10-second each not only helps remove false contributions to turbulence caused by slow drift in the mean velocity but allows the computation of 95-percent-probability estimates for the turbulence level, as shown plotted in Figure 16.

The confidence intervals shown in Figure 16 were calculated using the following equation[3]

$$\bar{X} - t_{\alpha/2}\left(\frac{s}{\sqrt{n}}\right) < \mu < \bar{X} + t_{\alpha/2}\left(\frac{s}{\sqrt{n}}\right)$$

where μ might represent the expected value for the mean relative turbulence intensity from analysis of a 10-sec interval, $\bar{X}$ would represent the mean relative turbulence intensity (from 12 such measurements), s would represent the standard deviation in the 12 measurements of relative turbulence intensity and n, the number of samples, would be 12. For a 2-tail confidence level of 95 percent and a sample size of 12 (11 degrees of freedom) the t value from the student-t distribution table is 2.2010.[4]

Data shown plotted in Figures 14–16 are also tabulated in Appendix D (Tables D1 and D2).

[3] http://highered.mcgraw-hill.com/sites/dl/free/0072549076/79745/ch07.pdf
[4] http://growingknowing.com/GKStatsBookStudentTTable.html

Inclusion of the 95-percent confidence intervals in Figure 16 shows that for the blockage close to the inlet, repeat measurements may not be from the same population; data did not repeat as well as hoped indicating some uncontrollable factor at play. This is not totally unexpected since NFAC test-section turbulence values are notoriously difficult to make with acceptable repeatability due to the variability of atmospheric turbulence being ingested through the full-scale inlet, with the knowledge that the atmospheric turbulence has a vast range of scales and that these are continually changing with time. The same problem appears to affect inlet measurements at 1/50th-scale presumably caused by sensitivity to external atmospheric wind effects and random recirculation ahead of the inlet. Indeed, the problem is primarily choosing the optimal duration for such measurements. Evidently, to achieve acceptable repeatability, a longer sample duration is required for $x_b < 6$ feet.

It is often useful to study the waveform itself, as illustrated in Figure 17 for Run 333. The upper plot in Figure 17 shows the result of computing the mean and standard deviation for each of the twelve 10-second intervals of Run 333. The mean shows little variation with time (interval number) but intervals 5 and 6 show a marked increase in turbulence level. It is evident that the increase in turbulence is not due to a moving mean. The lower plot shows a scatter plot of velocity measurements within the red box shown in the upper plot. The scatter plot shows what appears to be a discrete turbulent burst without any apparent change in local mean value.

Run 334 presents a different scenario in Figure 18. Two areas of increased turbulent activity are highlighted in red in the upper plot. The first scatter plot runs from t = 34 seconds to t = 44 seconds and shows a slow change in mean velocity that occurs over about 2 or 3 seconds with the high-frequency turbulence remaining essentially unchanged. This accounts for the increased relative turbulence intensity measured in interval 4. Clearly, a sample duration less than 10 seconds is needed in order to more completely remove the influence of drift in the mean. The second scatter plot runs from t = 60 seconds to t = 80 seconds and shows similar behavior, namely a brief excursion in mean velocity while the turbulent amplitude remains unchanged. The problem lies in choosing the optimal sample duration for analysis (or pre-filtering the signal to remove the low-frequency mean velocity drift). The increase in turbulence level for intervals 4 and 7 of Run 334 is shown to be artificial and is caused by low-frequency drift in the mean velocity.

Of note in Figure 18 are the areas in the scatter plot that show “banding” identified by green boxes. These areas do not appear to be totally random in character and show some form of organized structure that requires further study. This “banding” was only observed for runs at 50 Hz.

Figure 19(a) shows the total velocity waveform from Run 334 for a region of banding from t = 62.0 to 62.1 seconds and appears to indicate a dominant frequency of about 220 Hz. Two spectra computed from the data of Figure 18 are also included. Figures 19(b) and 19(c) show the turbulent spectrum for two distinct time periods in Run 334. In each case, the signal duration of the spectral analysis is limited to only 4,096 samples (4,096/1,250 = 3.2678 sec). The two spectra both show a significant response at about 220 Hz. The turbulent spectrum for Run 334 could have been improved by repeating the analysis on successive samples throughout the length of the 2-minute record and summing the result, but this was deemed unnecessary for the purposes of this study. Of special note is that the two spectra refer to specific time intervals in

Figure 18 where banding is either present or not in the waveform, yet the spectra are quite similar.

Run 341 (Figure 20) also offers an interesting scenario similar to the one shown in Figure 18. The upper plot of Figure 20 shows a uniformly low turbulence level throughout the full 2-minute record apart from interval 9. Interval 9 shows an increased turbulence level and an increase in mean velocity relative to intervals on either side. The associated scatter plot confirms observations in the upper plot, showing both a slow drift in mean velocity plus meaningful changes in the amplitude of the turbulent fluctuations.

Similar data from Run 351 are shown in Figure 21 illustrating an apparent quiescent flow with low turbulence and constant mean velocity with occasional short turbulent bursts. The increased turbulence measurement from interval 8 is therefore real, although the origin of the turbulent bursts is not identified.

Returning to the intermittent periodicity observed in the total velocity time history for 50 Hz (not observed for 25 Hz) illustrated in Figure 19, the contribution of this periodic signal to the measured turbulence level is expected to be small based on the agreement between turbulence measurements made at both 25 Hz and 50 Hz (Figure 16). It is still worthwhile to investigate the source of this periodic signal, and several possibilities exist:

i. Vortex shedding from upwind blockage.

   A spectral analysis of the Cobra probe signal indicated a spectral peak at 200 Hz for blower speeds of 25 Hz and 50 Hz *with no blockage present*. Clearly vortex shedding from upwind blockage is not the cause.

ii. Forced vibration of the Cobra probe at the Strouhal shedding frequency of the probe support, where bluff-body aerodynamics would indicate that the Strouhal Number (*S*) remains constant, independent of Reynolds Number.

$$S = \frac{fd}{u} = constant$$

or $f \sim u$

   This implies that shedding frequency is proportional to the local free-stream velocity (or, in this case, blower frequency). A spectral peak was observed at 200 Hz for no blockage, *independent of blower speed*. Hence, forced vibration of the Cobra probe at the Strouhal frequency can be ruled out.

iii. Probe vibration at natural frequency of probe support.

   If the probe is modeled as a cantilevered beam, the first natural frequency occurs at

$$\Omega = 2\pi f = 3.516\sqrt{\left(\frac{EI}{mL^4}\right)}$$

where *I* is the moment of inertia of the beam cross section, *E* is Young's Modulus for the beam material, *m* is the mass per unit length of the beam, and *L* is the length of the beam. This implies:

$$\frac{f_1}{f_2} = \left(\frac{L_2}{L_1}\right)^2$$

or, if L_2 is twice L_1 then f_1 should be $4f_2$.

Examination of Cobra probe signals obtained during an inlet-plane survey (unsupported probe length of 8 to 27 inches) revealed no dependence of spectral peak location on probe length. It is therefore unlikely that the source of the periodic signal content is due to probe *support* vibration.

iv. Vibration of the Cobra probe caused by blower vibration or inlet structure vibration.

v. Electro-magnetic interference between blower motor and the Cobra probe electronics/data acquisition system.

Items (iv) and (v) were not investigated due to lack of time. They must be investigated prior to the planned test section turbulence measurements in order to eliminate, or at worst mitigate, the periodicity in the Cobra probe signal.

CONCLUSIONS

Evaluation of turbulence intensity based on the twelve 10-second-duration intervals improved repeatability in the measurements of turbulence over the analysis of the single, unbroken 2-minute-duration signal. In general, this is attributed to successful removal of the effects of a slow drift in the mean velocity.

At model scale, no meaningful change in inlet centerline turbulence level was caused by blockage for $x_b > 20$ ft for the case of zero ambient wind. This conclusion is likely valid at full-scale for quiescent atmospheric conditions (late evening through early morning) for a building height of 50 feet located more than 1000 feet upwind of the inlet.

FUTURE WORK

Similar model-scale turbulence measurements are planned for the test section centerline with the same 2D blockage, both with and without ambient wind, once the inlet screens and honeycomb, correctly modeling the existing full-scale inlet, are in place.

The prior investigation of the effect of current upwind buildings and planned future buildings in the inlet turbulence (briefly described in Appendix E) will be extended in order to make equivalent test-section turbulence measurements once inlet screens and honeycomb are installed.

REFERENCES

1. Oaks, B.: Aerodynamic Characteristics of the 80- by 120-Foot Wind Tunnel. NASA Ames Research Center, 2013.

2. Eckert, W. T. and Mort, K. W.: Earth Winds, Flow Quality, and the Minimum-Protection Inlet Treatment for the NASA Ames 80- by 120-Foot Wind Tunnel Nonreturn Circuit. NASA TM 78600, 1979.

3. Eckert, W. T. and Mort, K. W.: Wind vs. Wind Tunnel: The Aerodynamics of the Inlet for NASA's New, Very Large, Nonreturn-Flow Facility. 1982.

4. Schmidt, G.; Rossow, V.; Van Aken, J.; and Parrish, C.: One-Fiftieth Scale Model Studies of 40- by 80-Foot and 80- by 120-Foot Wind Tunnel Complex at NASA Ames Research Center. NASA TM 89405, 1987.

Table 1. Blower calibration.

Blower Frequency (Hz)	Velocity in Model Test Section (m/s)	Cobra Probe Warnings
13	12.7	None
24	24.9	None
36	36.0	None
48	47.5	A/D overvoltage
50	49.2	A/D overvoltage

Table 2. Run table.

Run	Date/Time Executed	Description	Wait Time (sec)	Inlet Temp (°C)	Inlet Wind Speed (m/s)	Ambient Temp (°C)	Ambient Wind Speed (m/s)
327	12 Sept 2013, 7:26AM	Blockage @ 1 ft, 50 Hz	15	17.8	0.01	17.7	0.20
328	12 Sept 2013, 7:30AM	Blockage @ 1 ft, 25 Hz	30	--	--	--	--
329	12 Sept 2013, 7:40AM	Blockage @ 2 ft, 50 Hz	20	--	--	--	--
330	12 Sept 2013, 7:43AM	Blockage @ 2 ft, 50 Hz	40	--	--	--	--
331	12 Sept 2013, 7:47AM	Blockage @ 2 ft, 25 Hz	40	--	--	--	--
332	12 Sept 2013, 7:59AM	Blockage @ 4 ft, 50 Hz	40	--	--	--	--
333	12 Sept 2013, 8:04AM	Blockage @ 4 ft, 25 Hz	80	--	--	--	--
334	12 Sept 2013, 8:23AM	Blockage @ 8 ft, 50 Hz	80	--	--	--	--
335	12 Sept 2013, 8:29AM	Blockage @ 8 ft, 25 Hz	160	--	--	17.8*	--
336	12 Sept 2013, 8:41AM	Blockage @ 12 ft, 50 Hz	120	--	--	--	--
337	12 Sept 2013, 8:48AM	Blockage @ 12 ft, 25 Hz	240	--	--	--	--
338	12 Sept 2013, 8:58AM	Blockage @ 16 ft, 50 Hz	120	--	--	--	--
339	12 Sept 2013, 9:05AM	Blockage @ 16 ft, 25 Hz	240	--	--	17.6*	--
340	12 Sept 2013, 9:12AM	No blockage, 50 Hz	0	--	--	--	--
341	12 Sept 2013, 9:16AM	No blockage, 25 Hz	0	--	--	18.0*	--
342	12 Sept 2013, 9:46AM	No blockage, 50 Hz	0	18.2	0	18.0	0.05
343	12 Sept 2013, 9:49AM	No blockage, 25 Hz	0	--	--	--	--
344	12 Sept 2013, 10:06AM	Blockage @ 20 ft, 50 Hz	120	18.4	0.01	18.4	0.17
345	12 Sept 2013, 10:13AM	Blockage @ 20 ft, 25 Hz	240	--	--	--	--
346	12 Sept 2013, 10:24AM	Blockage @ 12 ft, 50 Hz	120	--	--	--	--
347	12 Sept 2013, 10:31AM	Blockage @ 12 ft, 25 Hz	240	--	--	--	--
348	12 Sept 2013, 10:42AM	Blockage @ 8 ft, 50 Hz	80	--	--	--	--
349	12 Sept 2013, 10:47AM	Blockage @ 8 ft, 25 Hz	160	--	--	--	--
350	12 Sept 2013, 10:55AM	Blockage @ 4 ft, 50 Hz	40	--	--	--	--
351	12 Sept 2013, 10:59AM	Blockage @ 4 ft, 25 Hz	80	--	--	--	--

* Measurements taken 38.5 feet to the left of the computer station when the blower was at idle.

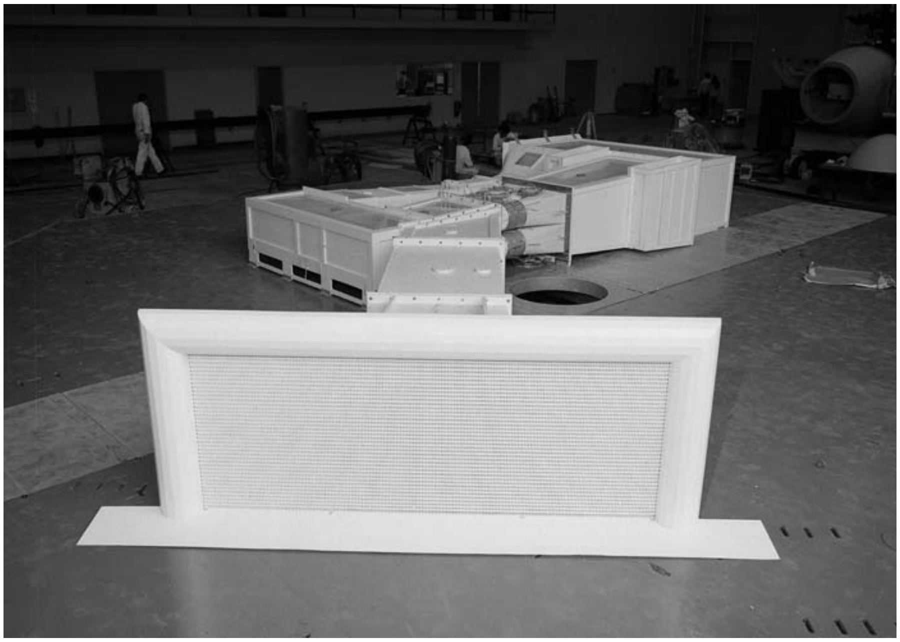


Figure 1. 1/50th-scale model of the NFAC 40 x 80 x 120 as tested in 1976.


Figure 2. 1/50th-scale model of the NFAC 40 x 80 x 120 in the 40- by 80-Foot Wind Tunnel for testing in 1976.

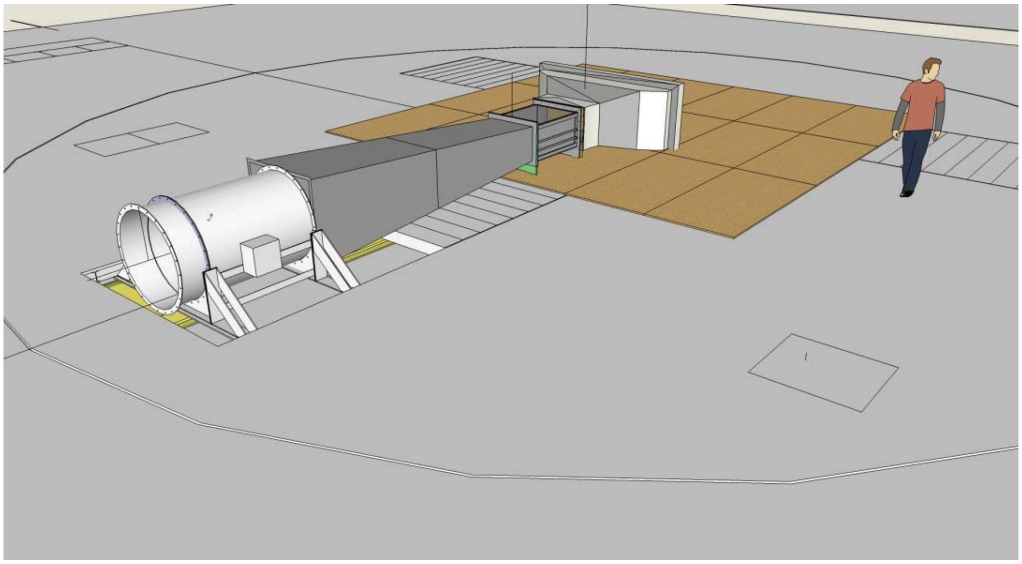


Figure 3. 1/50th-scale 80 x 120 leg installed inside full-scale 80- x 120-Foot Wind Tunnel.

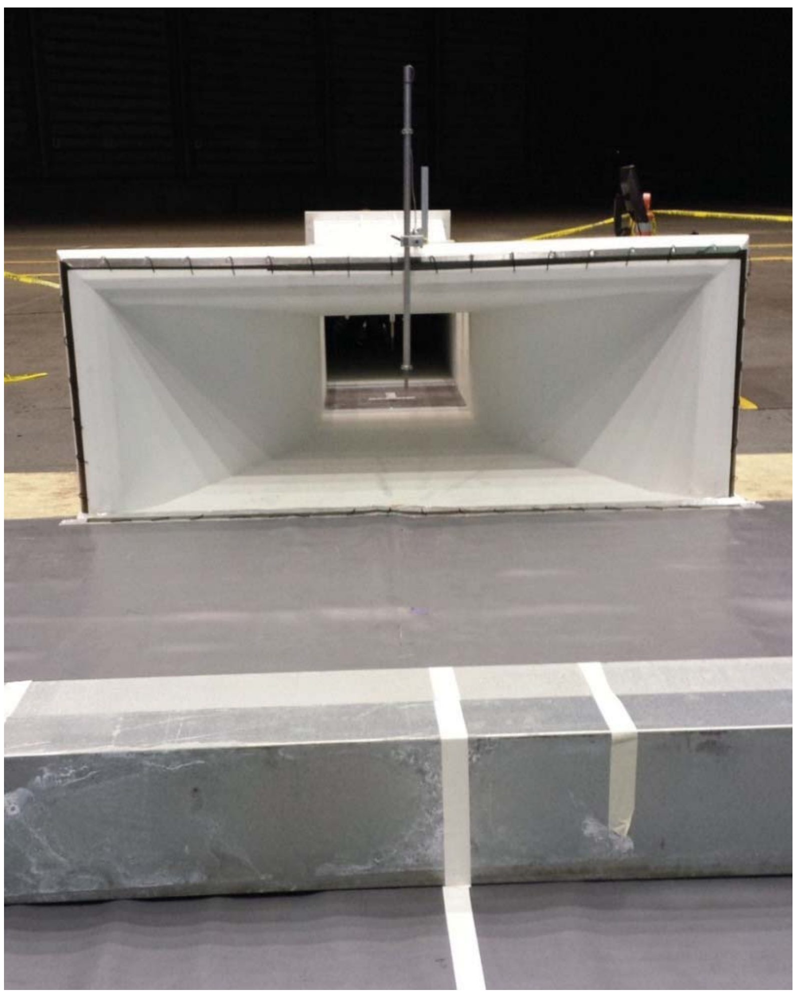


Figure 4. 1/50th-scale model of 80 x 120 inlet (no inlet treatment) with box beam in front of inlet.

Figure 5. D/47 vane axial fan from Chicago Blower Corporation attached to rear of 1/50th-scale model.

Figure 6. 1/50th-scale model of 80 x 120 leg with blockage positioned 4 feet in front of inlet.

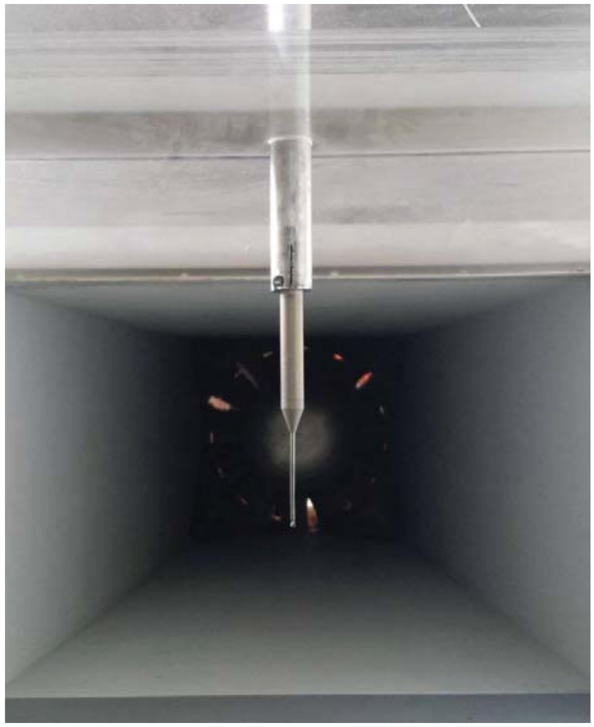


Figure 7. Cobra probe in test section of 1/50th-scale model.

Figure 8. Cobra probe mounted at centerline of 1/50th-scale model inlet.

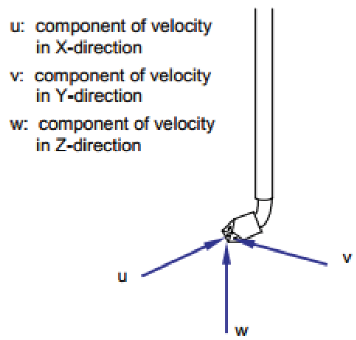


Figure 9. Cobra probe face with labeled velocity components.

Figure 10. Alnor probe face and sensor.

Figure 11. Alnor probe held by Jillian Yuricich.

Figure 12. Box beam used to simulate blockage in front of inlet.

Figure 13. Computer station located adjacent to 1/50th-scale model.

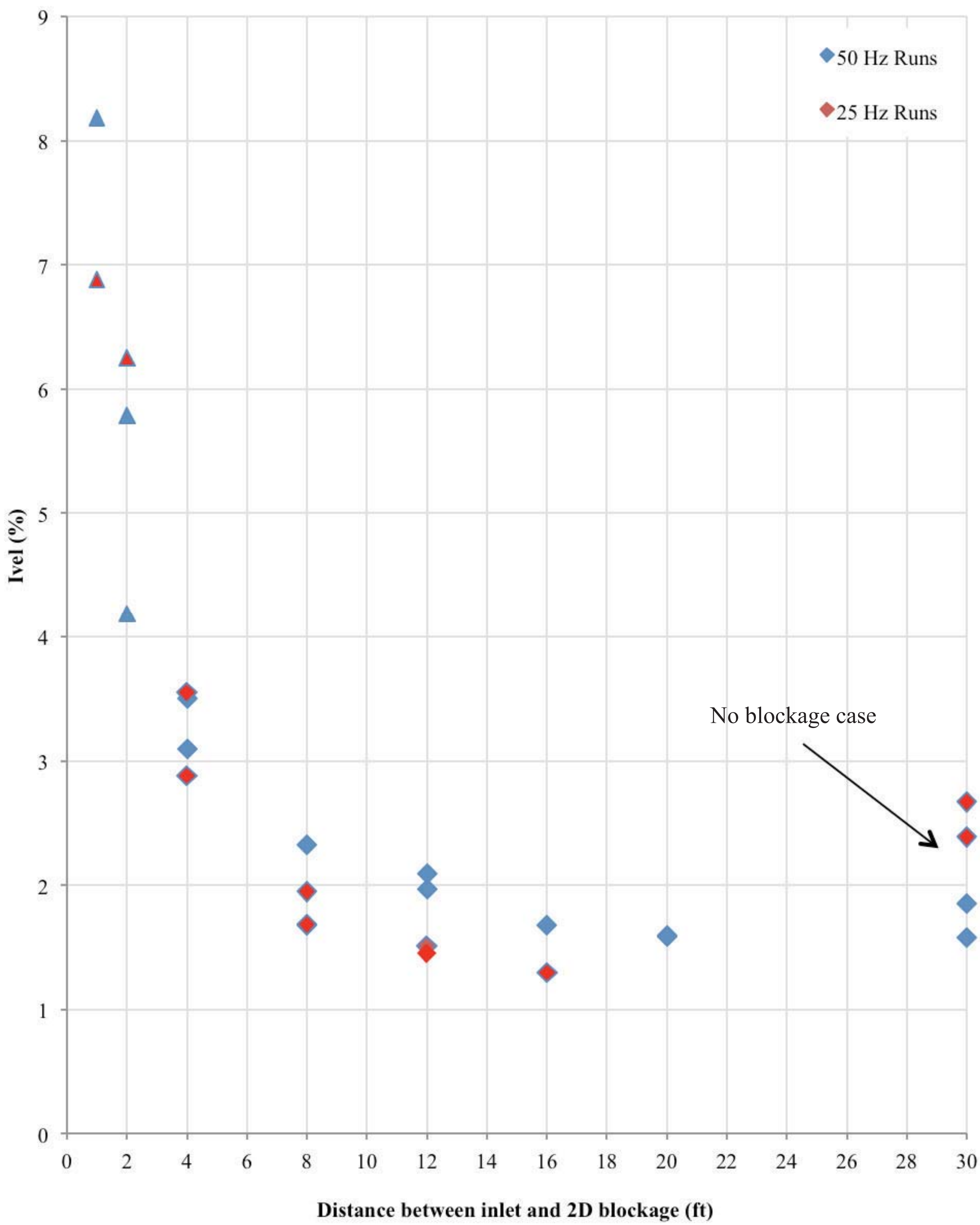


Figure 14. Relative turbulence intensity measurements at inlet centerline (analysis of single 2-minute record).

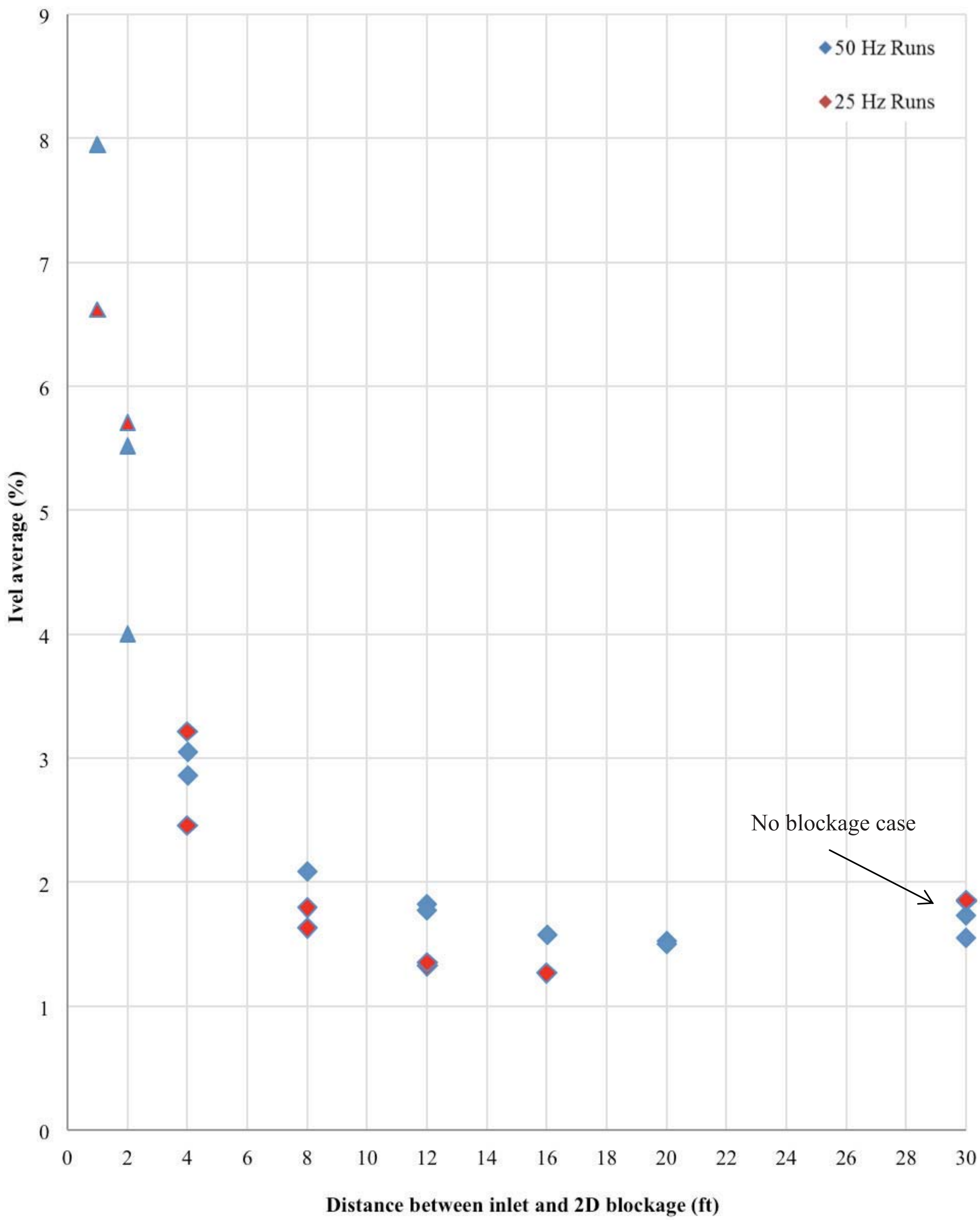


Figure 15. Relative turbulence intensity measurements at inlet (analysis of twelve 10-second records).

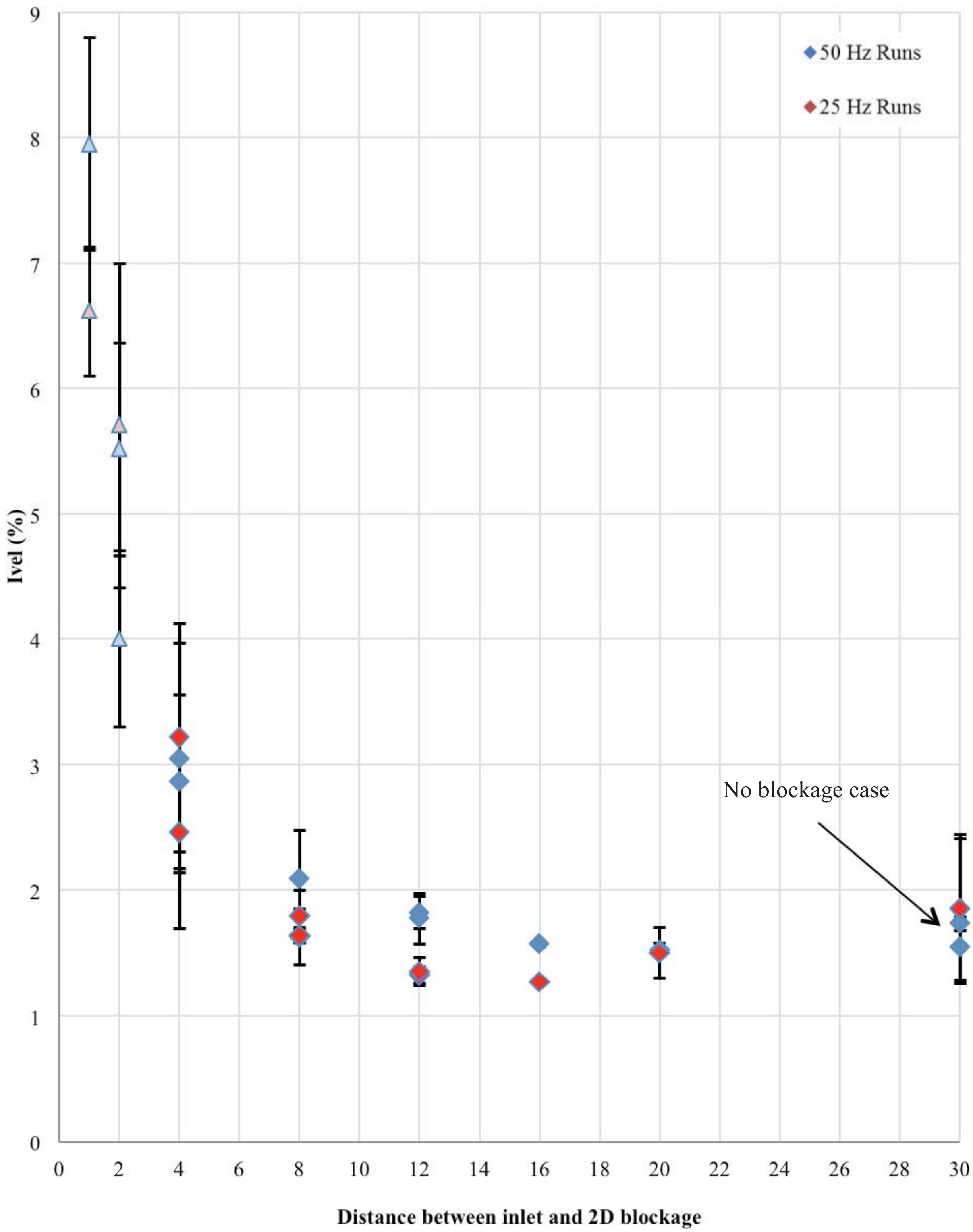
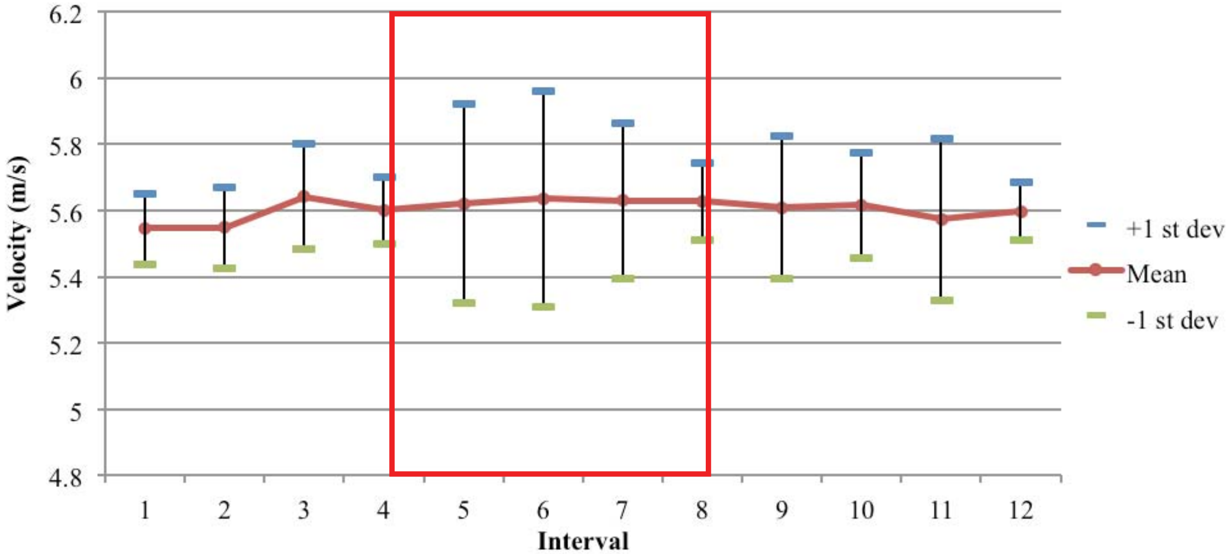
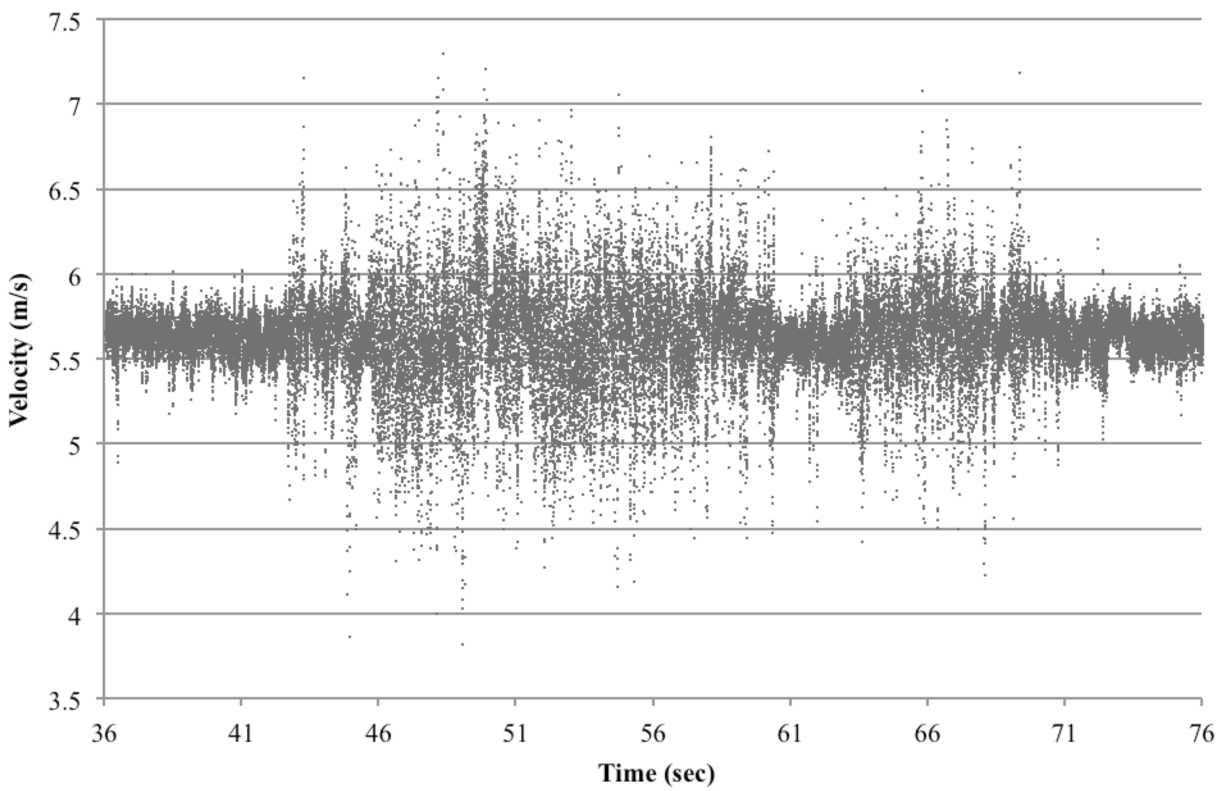


Figure 16. Relative turbulence intensity measurements at inlet centerline with 95-percent confidence intervals.

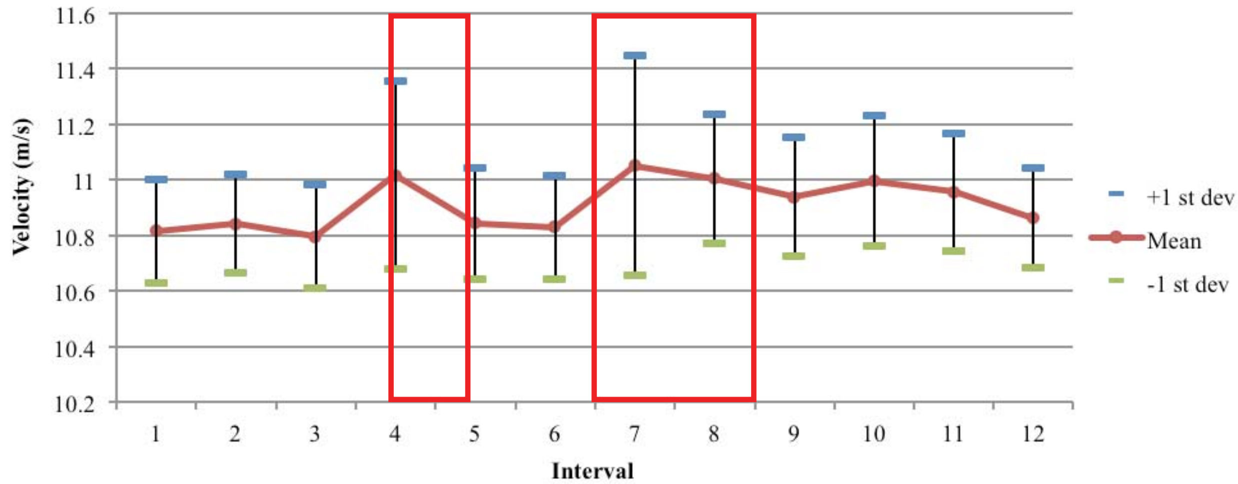


a) Run 333 average velocity from each 10-second interval.

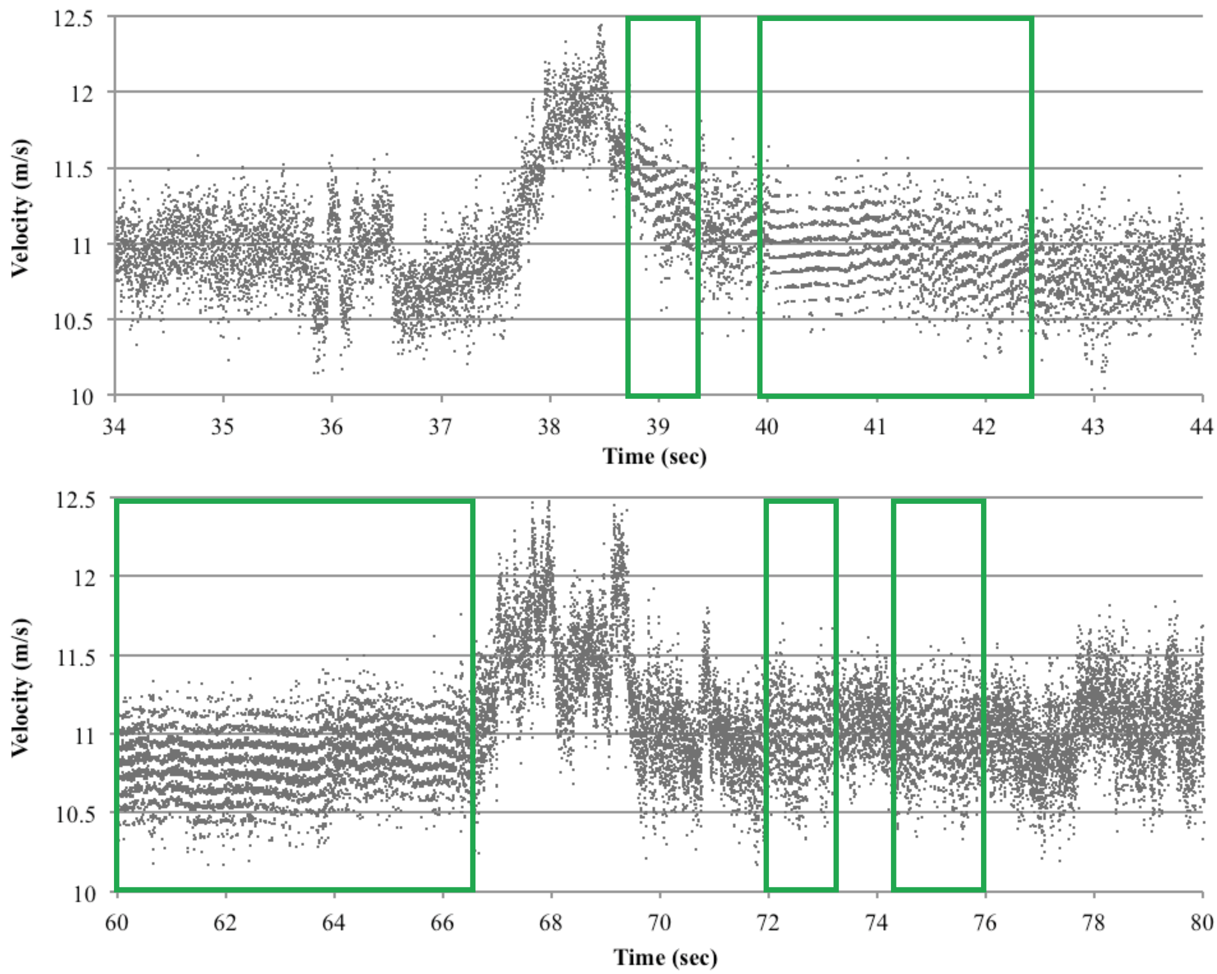


b) Run 333 time history for 36 to 76 seconds.

Figure 17. Run 333 measurements of total velocity.

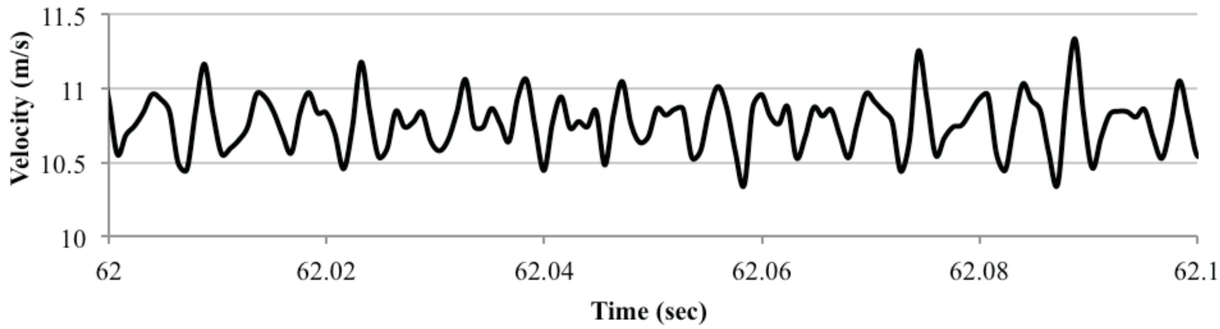


a) Run 334 average velocity from each 10-second interval.

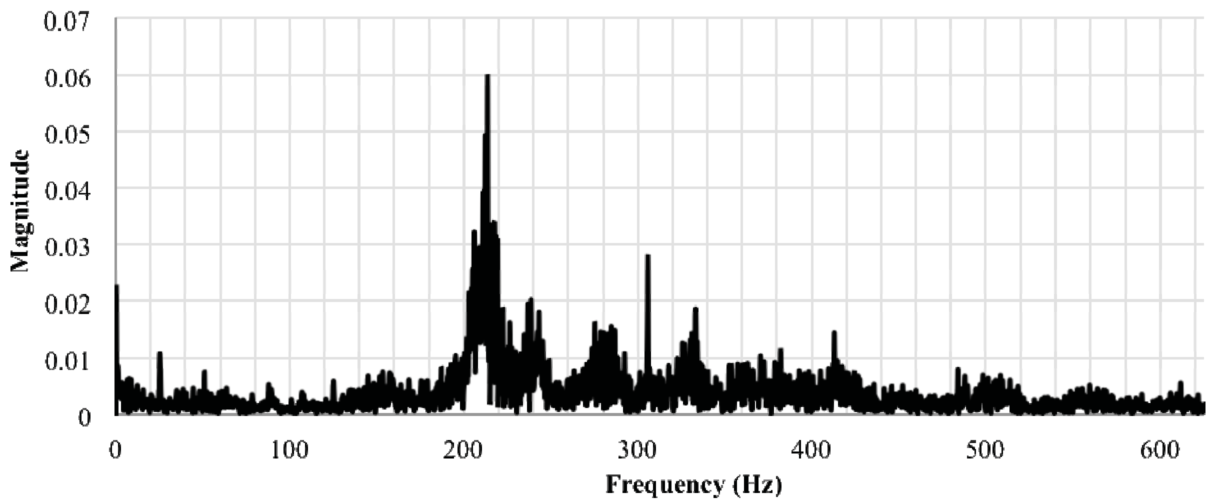


b) Run 334 time histories for 34 to 44 seconds and 60 to 80 seconds.

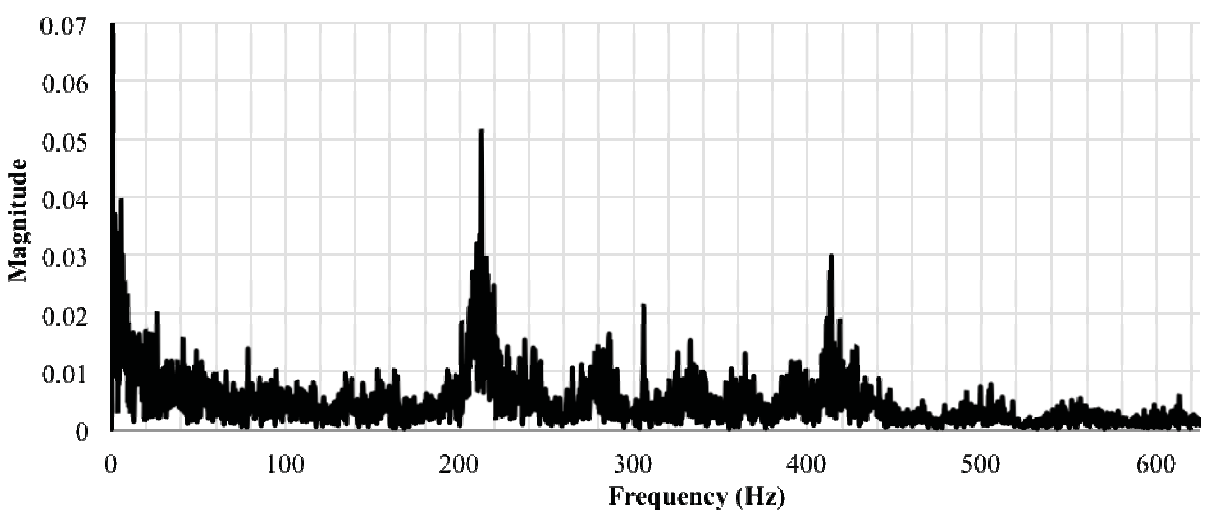
Figure 18. Run 334 measurements of total velocity.



a) Run 334 waveform from 62 < t < 62.1 seconds.

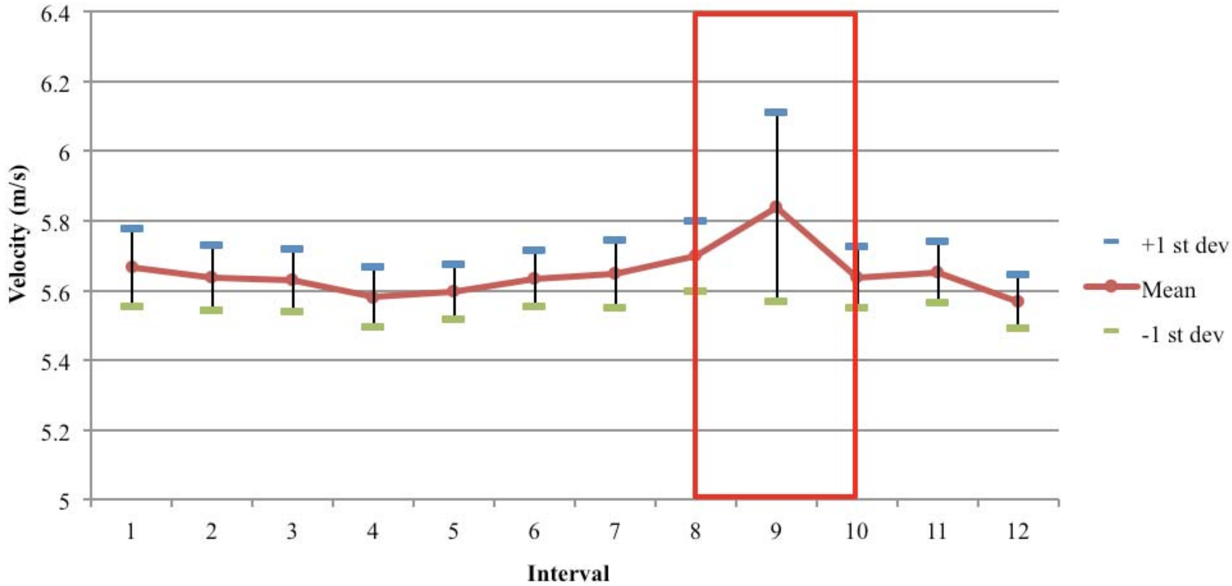


b) Run 334 spectrum for 60.000 to 63.276 seconds (banding present).

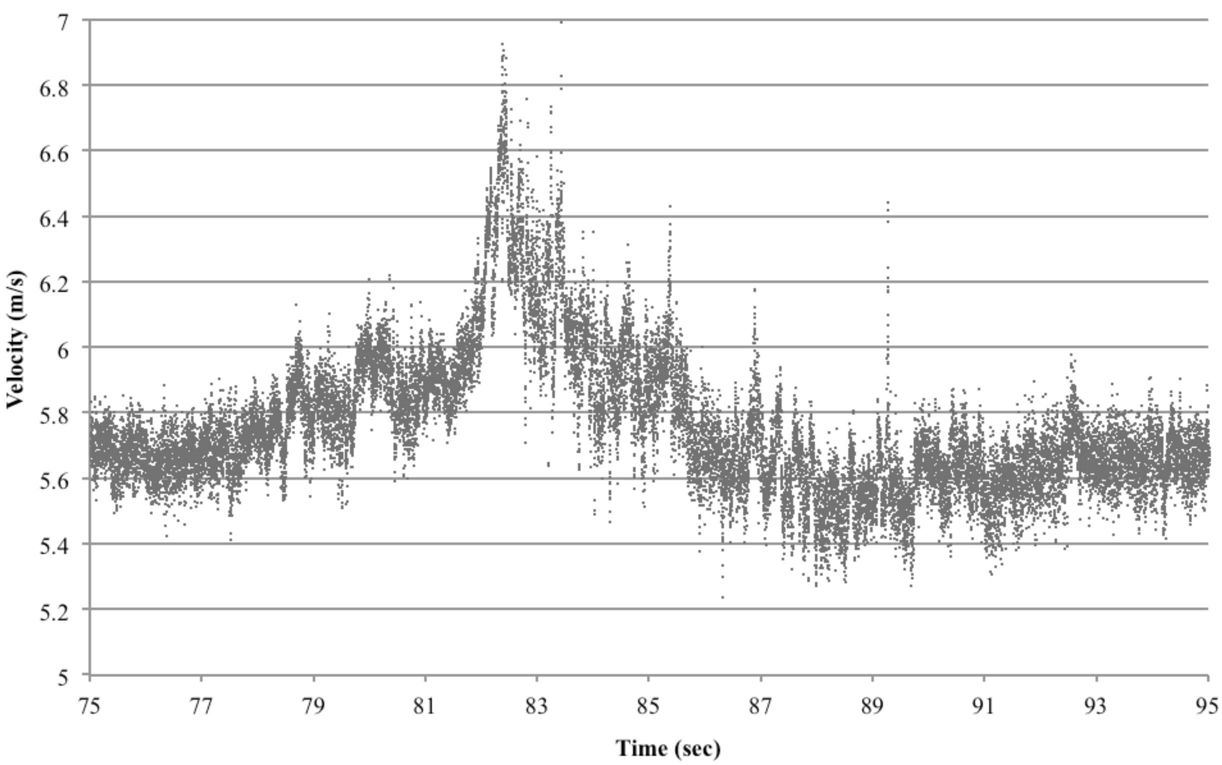


c) Run 334 spectrum for 76.000 to 79.276 seconds (banding not evident).

Figure 19. Run 334 waveform and spectra.

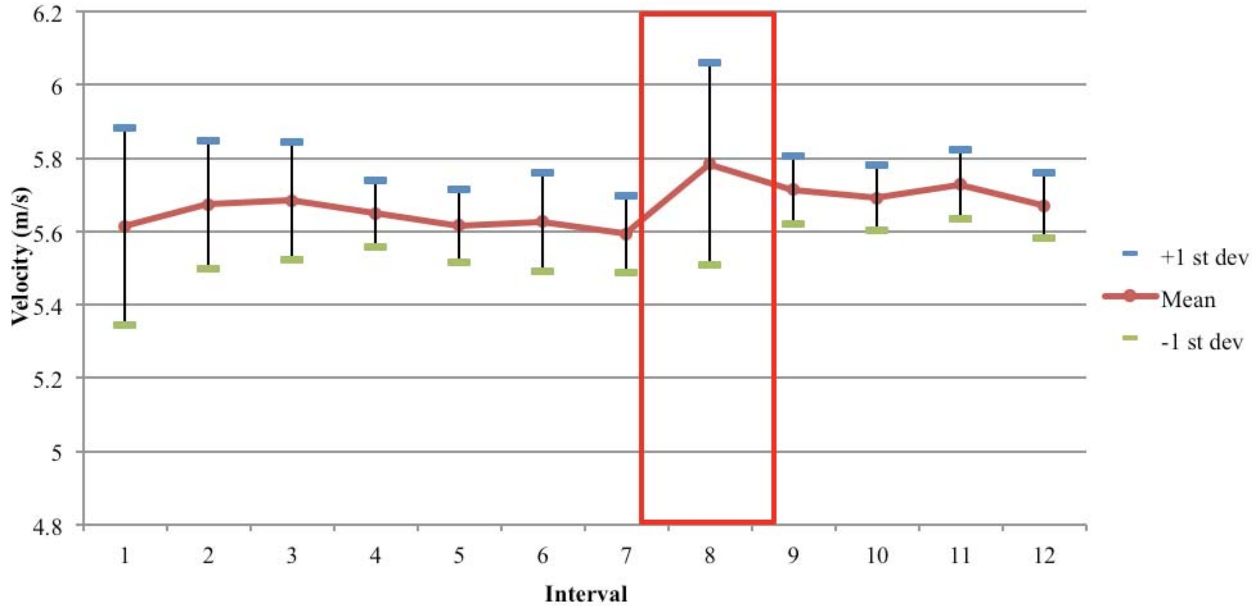


a) Run 341 average velocity from each 10-second interval.

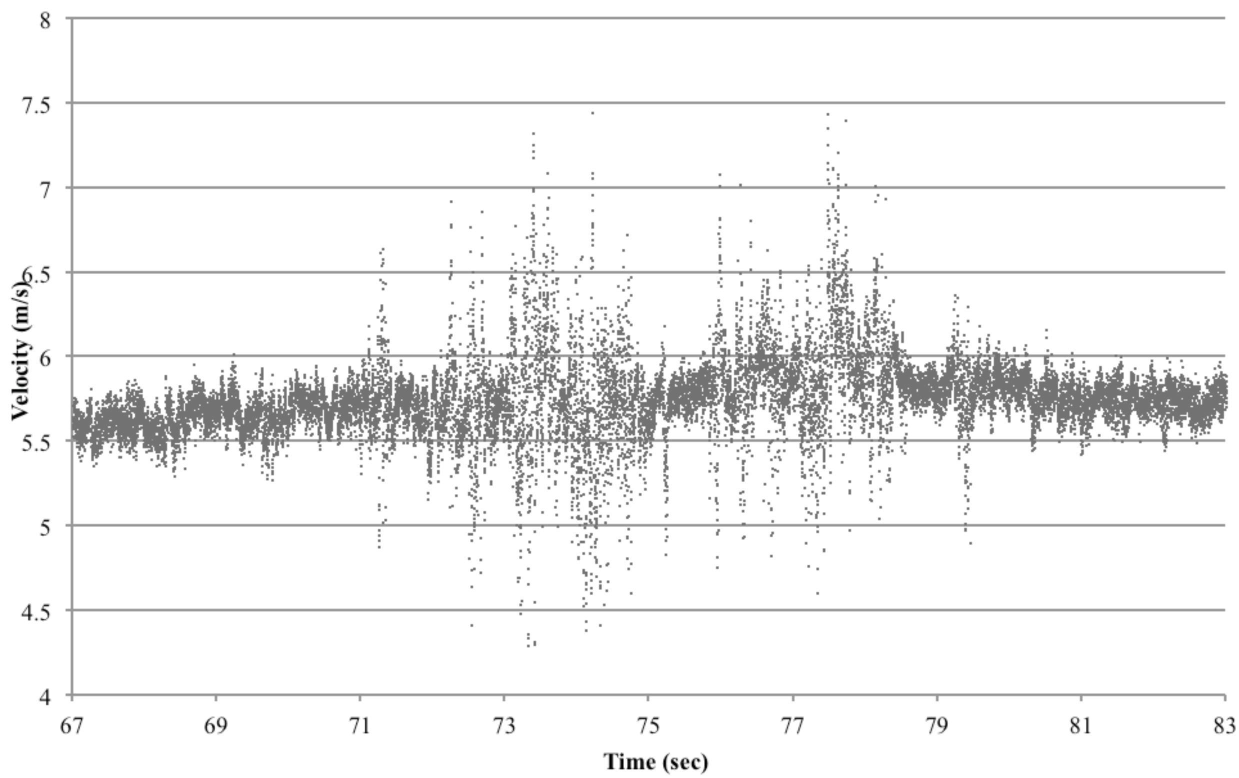


b) Run 341 time history for 75 to 95 seconds.

Figure 20. Run 341 measurements of total velocity.



a) Run 351 average velocity from each 10-second interval.



b) Run 351 time history for 67 to 83 seconds.

Figure 21. Run 351 measurements of total velocity.

APPENDIX A—INSTRUMENTATION SPECIFICATIONS

Specifications for Alnor AVM440 probe:[1]

- Velocity range: 0 to 30 m/s
- Velocity resolution: 0.01 m/s
- Velocity accuracy: ±3% of reading in the range 0.15 m/s to 30 m/s
- Temperature range: 14 to 140°F (5 to 60°C)
- Temperature resolution: 0.1°F (0.1°C)
- Temperature accuracy: ±0.5°F (±0.3°C)

Specifications for Series 100 Cobra probe:[2]

- Cobra probe length: approximately 160 mm
- Cobra probe maximum diameter: 14 mm
- Measures flow angles within ±45-degree cone
- Velocity range: 2 to 100 m/s
- Velocity resolution: 0.1 m/s in *u*, *v*, and *w* components
- Velocity typically accurate to ±0.5 m/s
- Pitch and yaw typically accurate to ±1.0 degree

[1] *Turbulent Flow Instrumentation (TFI), Air Velocity Meter, Alnor Model AVM440/AVM440A, AIRFLOW Model TA440/ TA440A, Operation and Service Manual*. TSI Alnor from TSI Incorporated at 500 Cardigan Road, Shoreview, MN, 55126 USA. TSI AIRFLOW instruments from TSI Instruments Ltd., Stirling Road, Cressex Business Park, High Wycombe, Bucks, HP12 3RT United Kingdom.

[2] *Getting Started: Series 100 Cobra Probe (v3.7)*. Turbulent Flow Instrumentation Pty Ltd.

APPENDIX B—PHOTO SUMMARY OF 2D TESTING

a) Runs 327–328 (1 foot between blockage and inlet).

Figures B1 and B2 show side view and front view of installation with the blockage 1 foot ahead of the inlet. The blockage is comprised of three identical sections, each 12-feet long. Each section is constructed from a pair of sheet metal C-channels positioned so as to form a closed box-beam of cross-section 1 foot x 1 foot. No attempt was made to seal any gaps between sections or along the upper surface of the box beam.

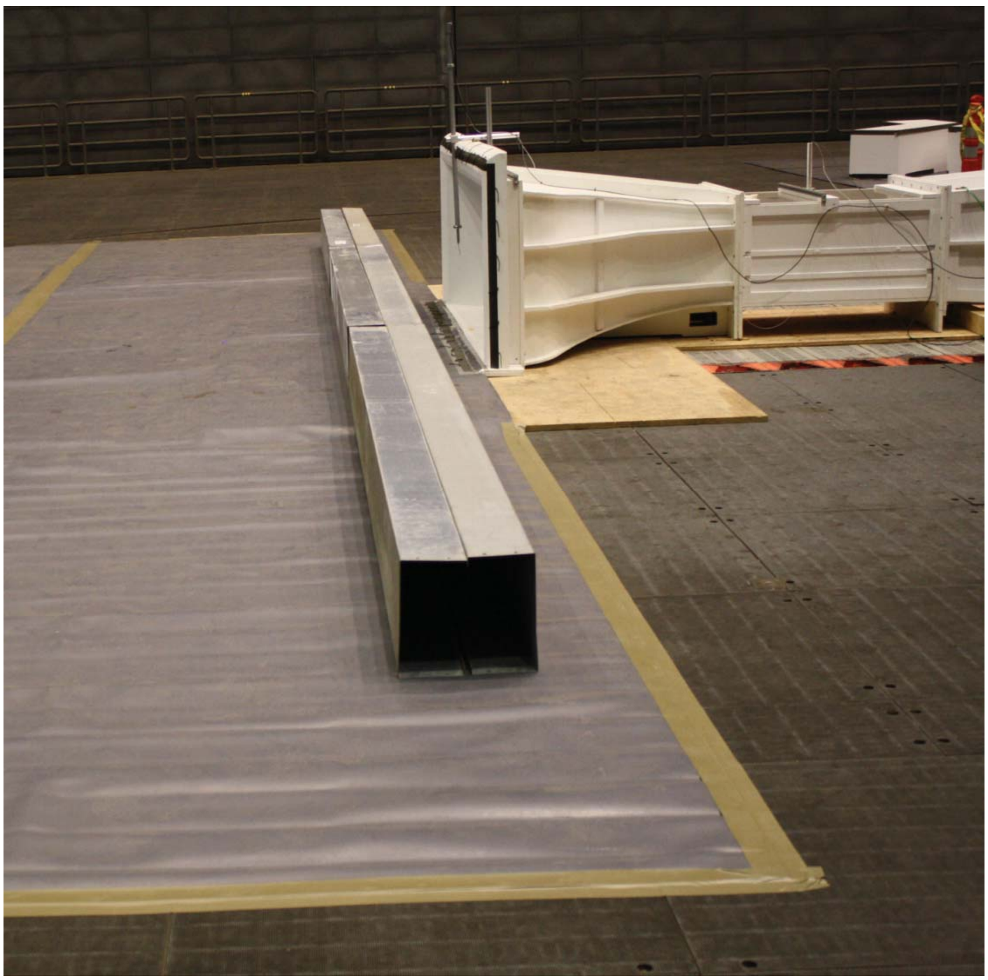


Figure B1. Side view of blockage 1 foot upstream from inlet (runs 327, 328).

Figure B2. View looking towards inlet (runs 327, 328).

b) Runs 329–331 (2 feet between blockage and inlet).

Figure B3 shows that the port side box beam does not sit flush with the floor, due to the plywood panels immediately ahead of the inlet. The same is true for the starboard box beam. The plywood panels ahead of the inlet also cause a mismatch between the central section and the two outer sections of the box beam blockage. Figure B4 shows the blockage 2 feet ahead of the inlet.

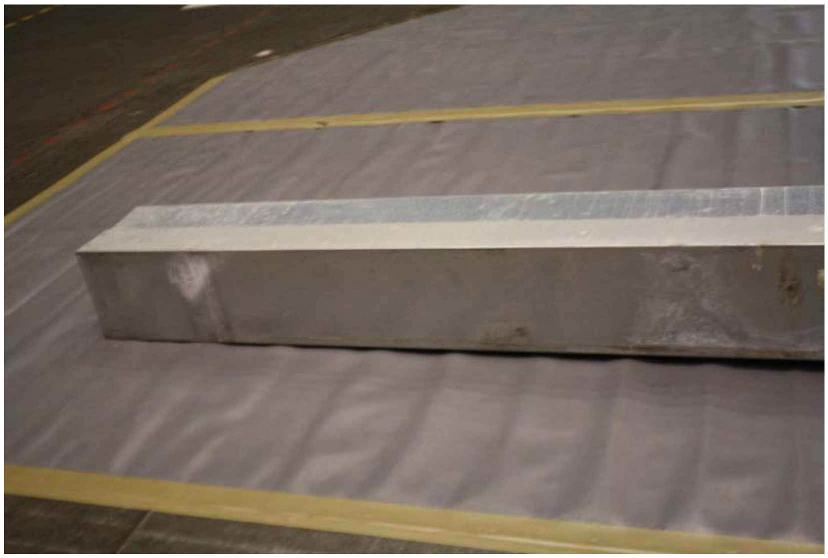


Figure B3. Outer sections of blockage are not flush with the floor (runs 329–331).

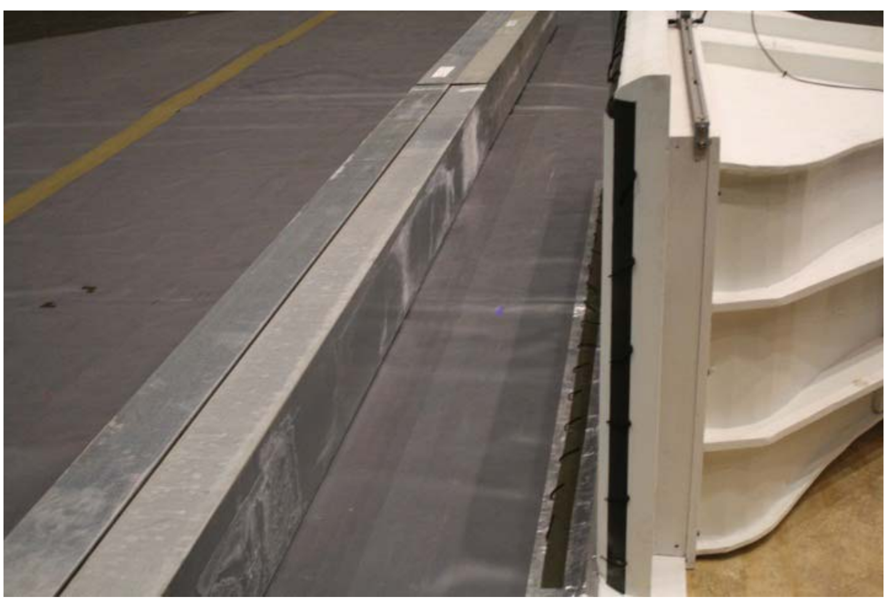


Figure B4. Side-view showing open gap in top of blockage (runs 329–331).

c) Runs 332–333 (4 feet between blockage and inlet).

Figure B5 corresponds to runs 332 and 333 in which the box beam was 4 feet away from the model inlet. Figure B5 illustrates the use of tape to mitigate the mismatch between inner and outer box-beam sections.

Figure B5. Blockage 4 feet ahead of inlet (runs 332, 333).

d) Runs 334–335 (8 feet between blockage and inlet).

Tape was applied to the floor ahead of the inlet to define the inlet centerline and assist in blockage placement. Figures B6 and B7 show mismatched sheet metal panels, primarily between the central and outboard sections.

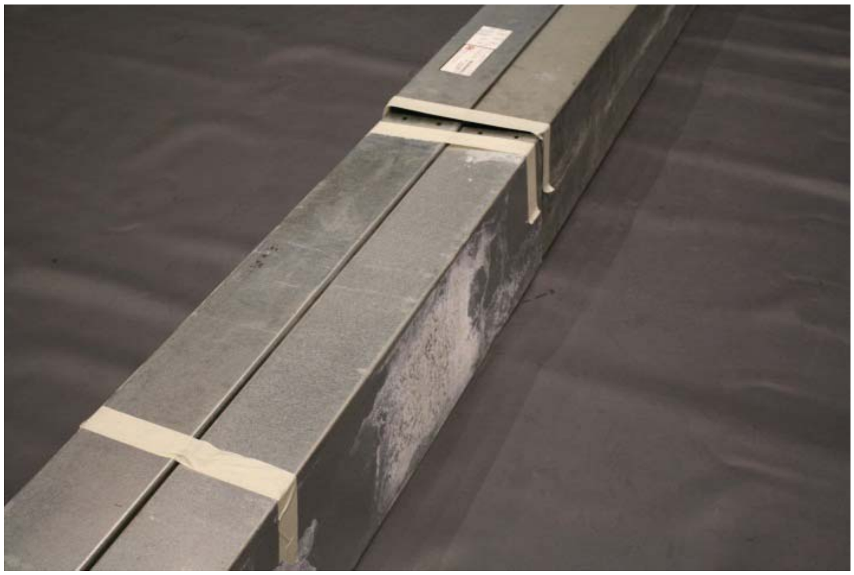


Figure B6. Tape on the center and starboard box-beams (runs 334, 335).

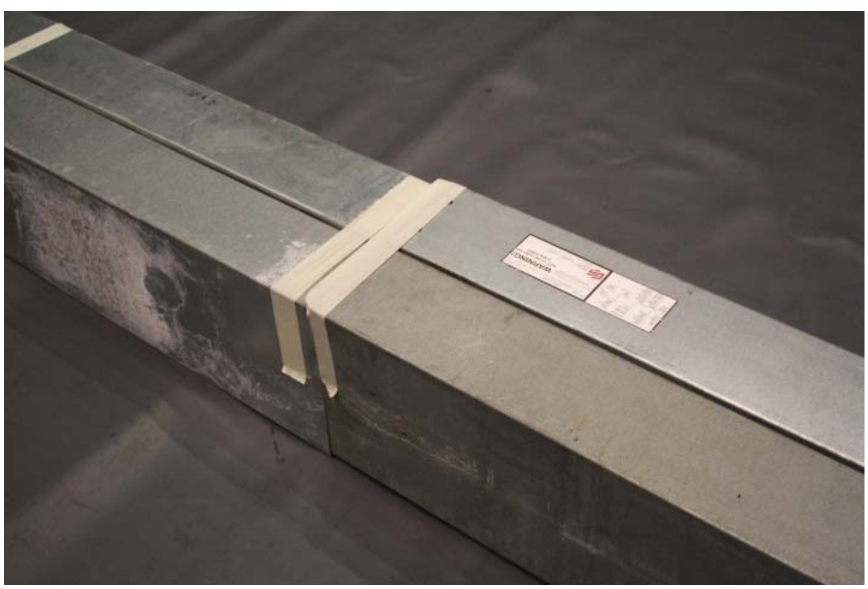


Figure B7. Tape on the center and starboard box-beams (runs 334, 335).

e) Runs 336–337 (12 feet between blockage and inlet).

Blockage is now sufficiently far ahead of inlet that the plywood panels beneath the tarp no longer present a problem. All three sections of the box beam are now flush with the floor. Figure B8 shows the use of tape on the floor and middle beams to align the center of the beam with the centerline of the inlet

Figure B8. Blockage 12 feet upwind from inlet (runs 336, 337).

f) Runs 338–339 (16 feet between blockage and inlet).

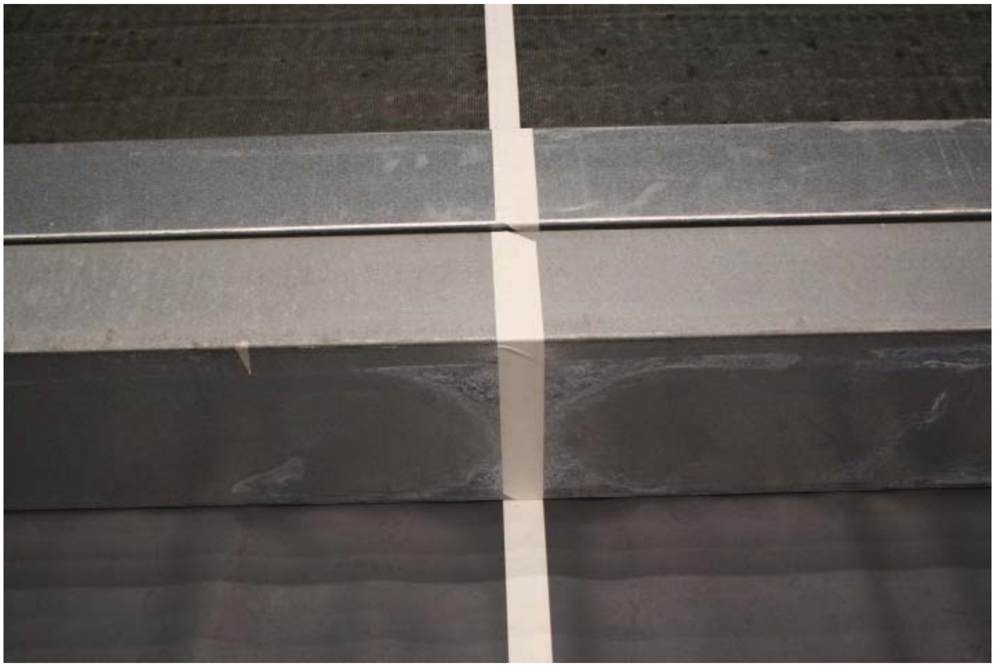


Figure B9. Alignment of box-beam mid-point with inlet centerline tape on floor (runs 338, 339).

Figure B10. Inlet centerline tape on floor with NFAC inlet in background (runs 338, 339).

g) Runs 340–343 (no blockage).

Figure B11 shows the model inlet with no upwind blockage. The "bump" in the tarp close to the inlet can easily be identified with the plywood panels that surround the inlet.

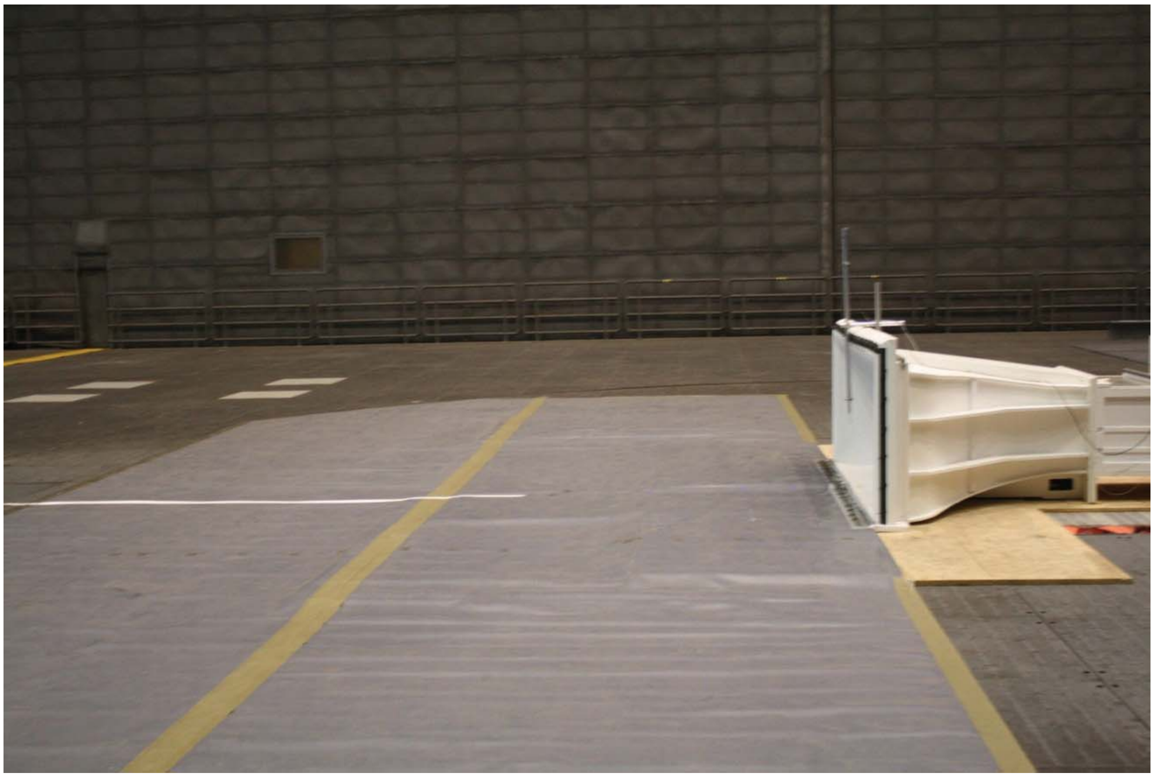


Figure B11. Model inlet with no upwind blockage (340–343).

h) Runs 344–345 (20 feet between blockage and inlet).

Note that the blockage is far enough ahead of the model inlet that it is no longer sitting on top of the tarp as can be seen in Figure B12.

Figure B12. Blockage 20 feet upwind from inlet (runs 344, 345).

i) Runs 346–347 (12 feet between blockage and inlet).

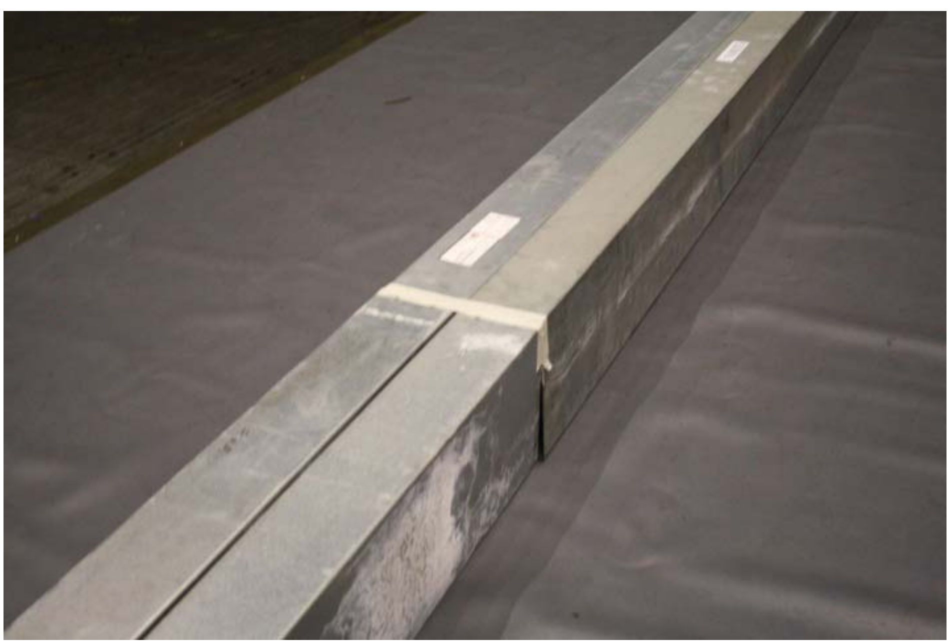


Figure B13. A section of the box-beam (runs 346, 347).

j) Runs 348–349 (8 feet between blockage and inlet).

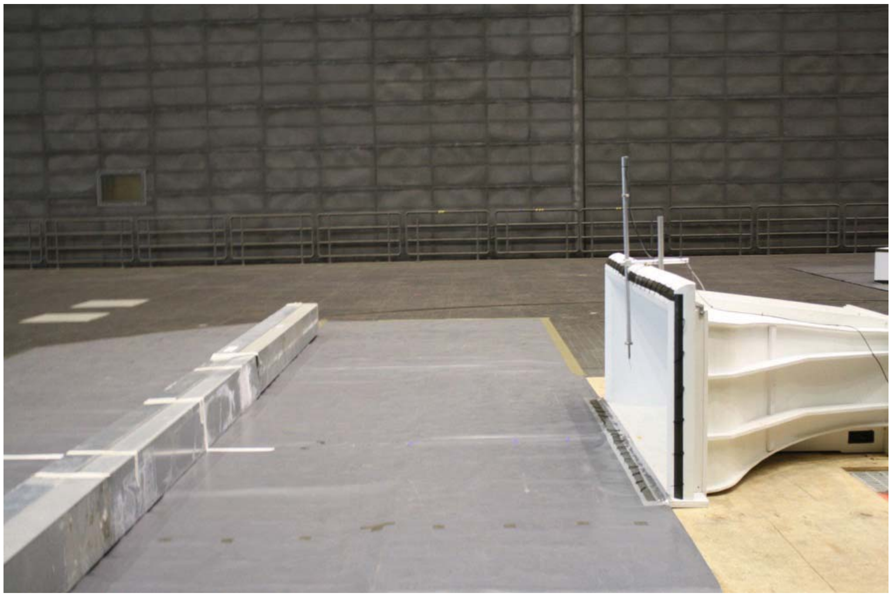


Figure B14. Box-beam 8 feet upwind from the inlet (runs 348, 349).

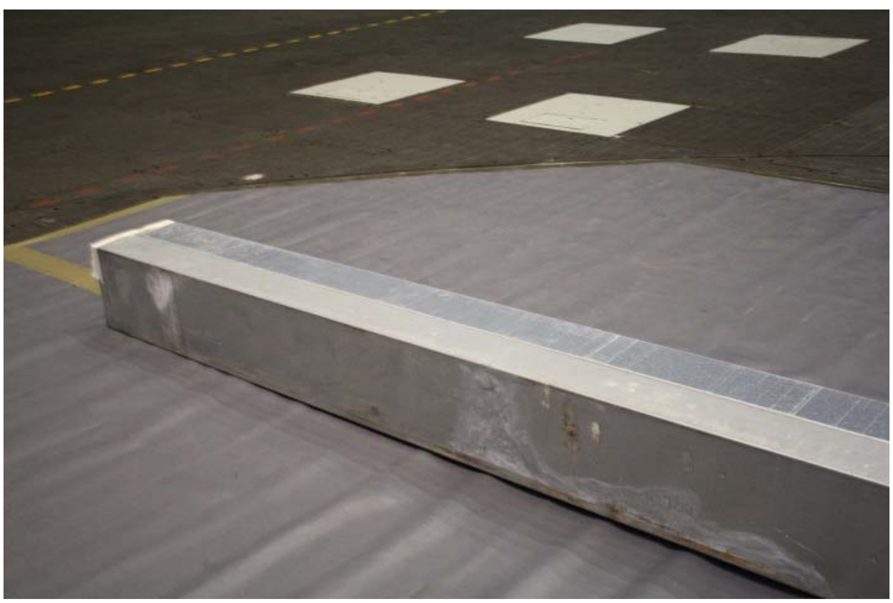


Figure B15. Base of box-beam not flush with floor (runs 348, 349).

k) Runs 350–351 (4 feet between blockage and inlet).

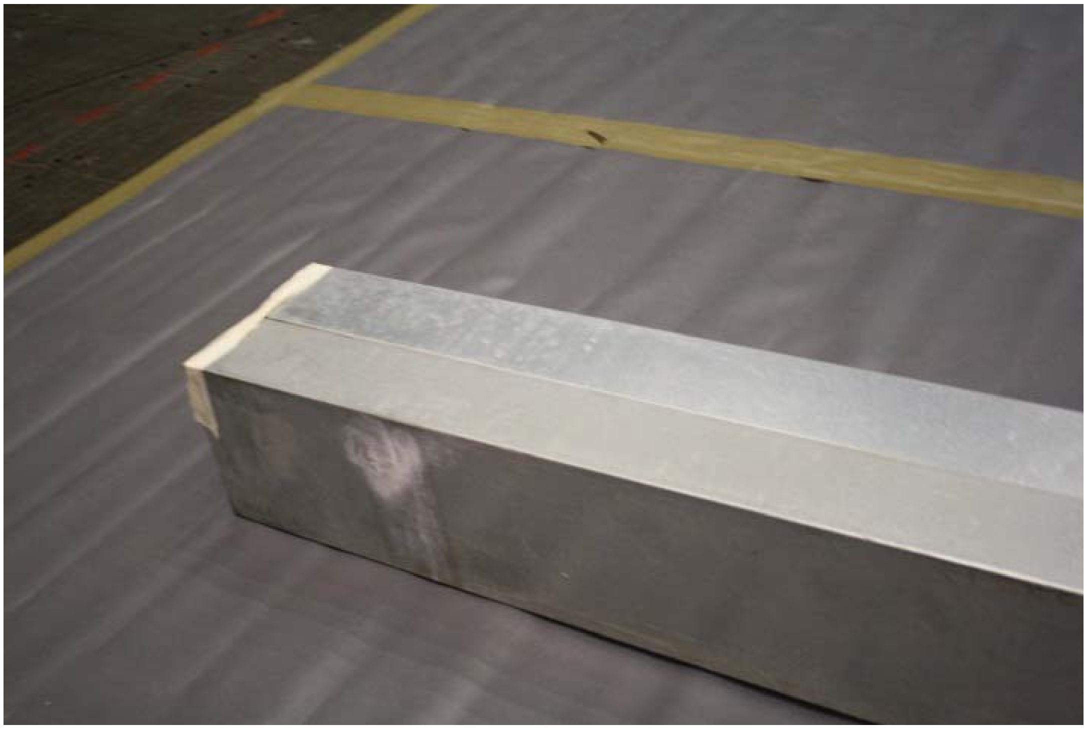


Figure B16. Base of box-beam not flush with floor (runs 350, 351).

APPENDIX C—VELOCITY MEASUREMENTS

Run 327
Blockage Location: x_b = 1 ft
Blower Frequency: 50 Hz
Time: 7:26 AM

Cobra probe measurements contain samples where the instantaneous flow direction exceeded the acceptance angle of ±45°. Such measurements were automatically set to zero by probe software. All statistics and plots generated for this run use the non-zero data. Cobra probe software warning for A/D overvoltage also occurred during data acquisition.

Table C1. Run 327 velocity data from 2-minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	# Zero Values	% Zero Values
Total Vel	3.0083	24.4000	11.9776	0.9794	612	0.41%
u	2.3	21.9	11.5431	0.9802	--	--
v	-15.2	11.6	-1.3945	1.9413	--	--
w	-10.2	14.3	-0.8101	1.9616	--	--

Table C2. Run 327 total velocity data for each 10-second interval and mean and standard deviation data for each interval.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	[illegible] (%)	# Zero Values	% Zero Values
1	3.0083	22.6924	12.0484	1.1031	9.156	55	0.440 %
2	4.5794	24.4000	11.9331	1.0909	9.142	35	0.280 %
3	5.4961	20.6667	12.1862	0.8896	7.300	13	0.104 %
4	4.4113	21.6116	12.0416	0.8495	7.055	27	0.216 %
5	5.5676	15.6703	12.0744	0.6528	5.406	1	0.008 %
6	5.0020	20.4161	12.1514	0.7542	6.207	49	0.392 %
7	3.9212	22.1286	11.7992	1.1352	9.621	132	1.056 %
8	5.1660	23.6069	11.6505	1.0183	8.740	113	0.904 %
9	4.1645	22.2515	11.8234	0.9966	8.429	55	0.440 %
10	3.8195	19.0951	11.7756	0.8966	7.614	64	0.512 %
11	4.8438	19.8318	12.2970	0.9107	7.406	16	0.128 %
12	4.8195	20.5394	11.9447	1.1172	9.353	52	0.416 %
		Average	**11.9771**	**0.9512**	**7.952**		
		St Dev	**0.1908**	**0.1529**	**1.335**		

Table C3. Run 327 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u (%)	I_v (%)	I_w (%)
1	11.5189	-1.9444	-0.9960	1.0698	1.9344	2.0097	9.29 %	16.79 %	17.45 %
2	11.4779	-1.0756	-0.6374	1.0298	2.2367	2.0546	8.97 %	19.49 %	17.90 %
3	11.7088	-2.2574	-1.1584	0.8792	1.3682	1.7658	7.51 %	11.68 %	15.08 %
4	11.6190	-1.9455	-1.3005	0.8806	1.4750	1.5143	7.58 %	12.69 %	13.03 %
5	11.7668	-1.6792	-1.5579	0.6518	0.9108	1.1220	5.54 %	7.74 %	9.53 %
6	11.7047	-1.8972	-1.4337	0.8071	1.3888	1.7292	6.90 %	11.87 %	14.77 %
7	11.3405	-1.0398	-0.2696	1.1256	2.1085	2.2447	9.93 %	18.59 %	19.79 %
8	11.2949	-0.8134	-0.1177	1.0635	1.8278	2.0125	9.42 %	16.18 %	17.82 %
9	11.4152	-1.6472	-0.3356	0.9492	1.8411	1.8343	8.32 %	16.13 %	16.07 %
10	11.4628	-0.1736	-0.4527	1.0139	1.8989	1.7907	8.85 %	16.57 %	15.62 %
11	11.8397	-1.2600	-1.4815	0.8315	2.2244	1.5648	7.02 %	18.79 %	13.22 %
12	11.3659	-0.9851	0.0262	1.1505	2.4408	2.5473	10.12 %	21.47 %	22.41 %

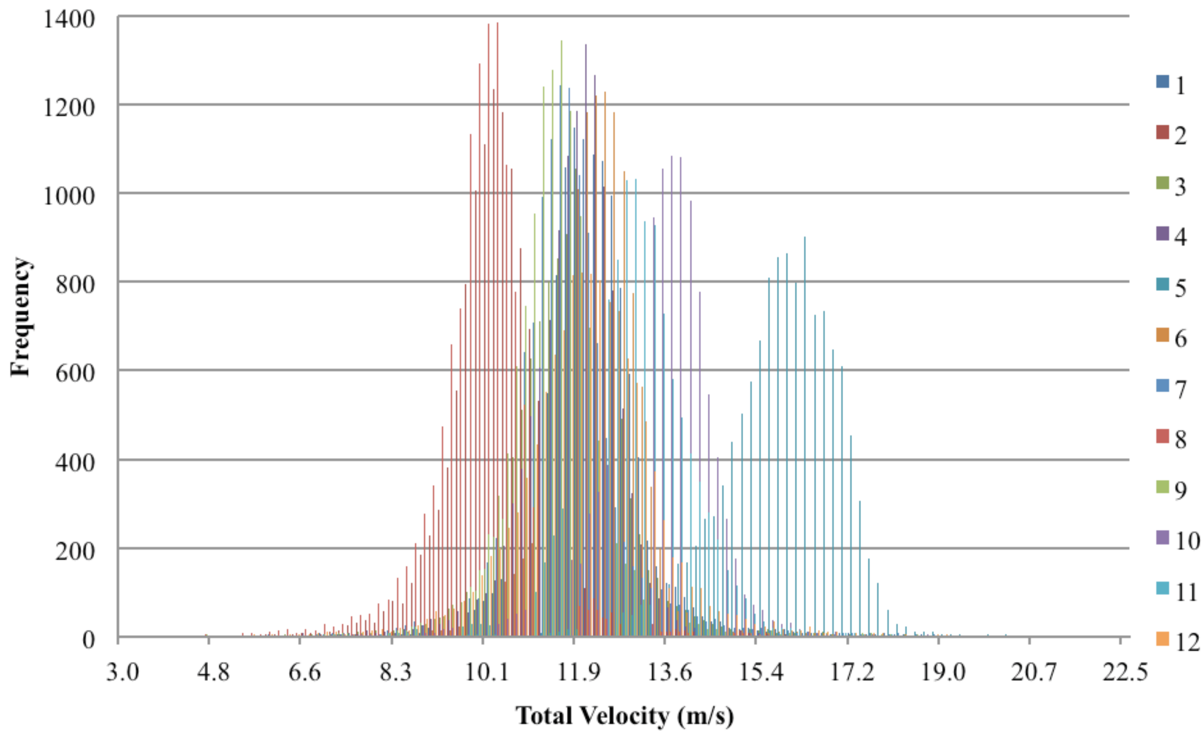


Figure C1. Histogram for each 10-second interval (x_b = 1 ft, blower frequency = 50 Hz, 100 bins).

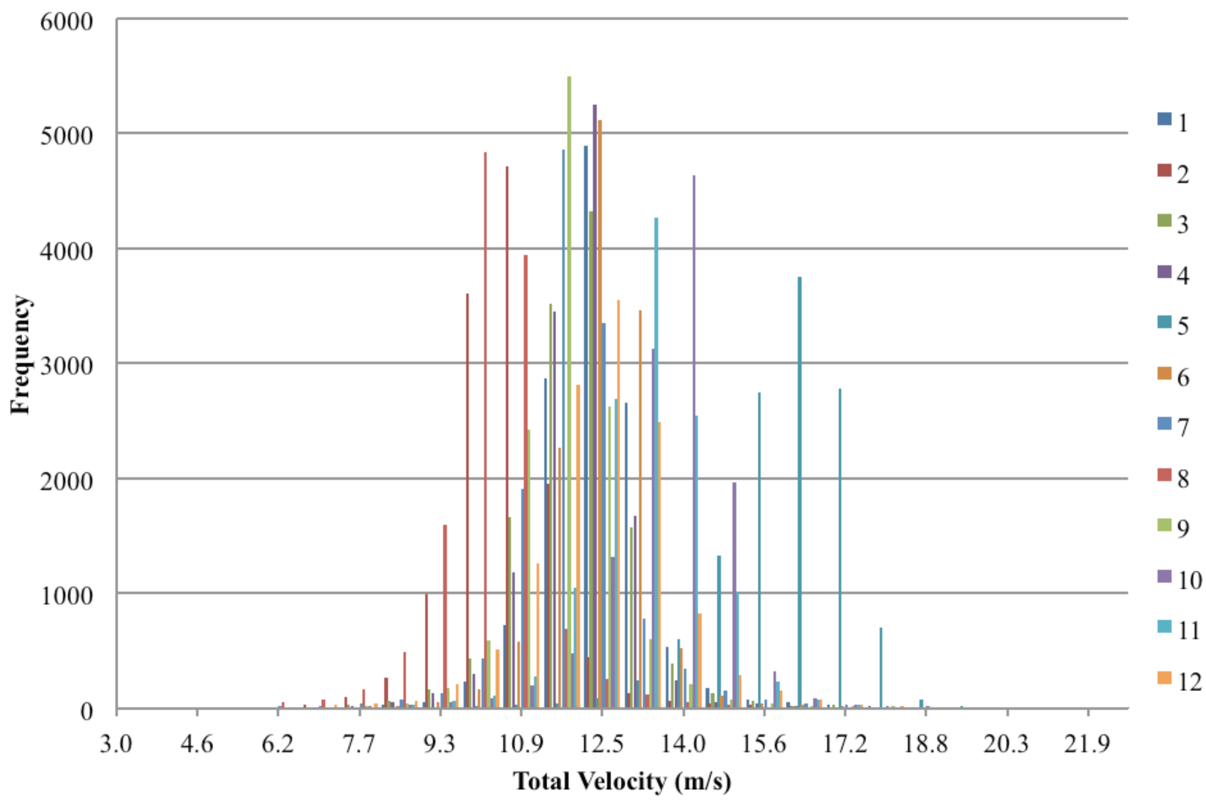
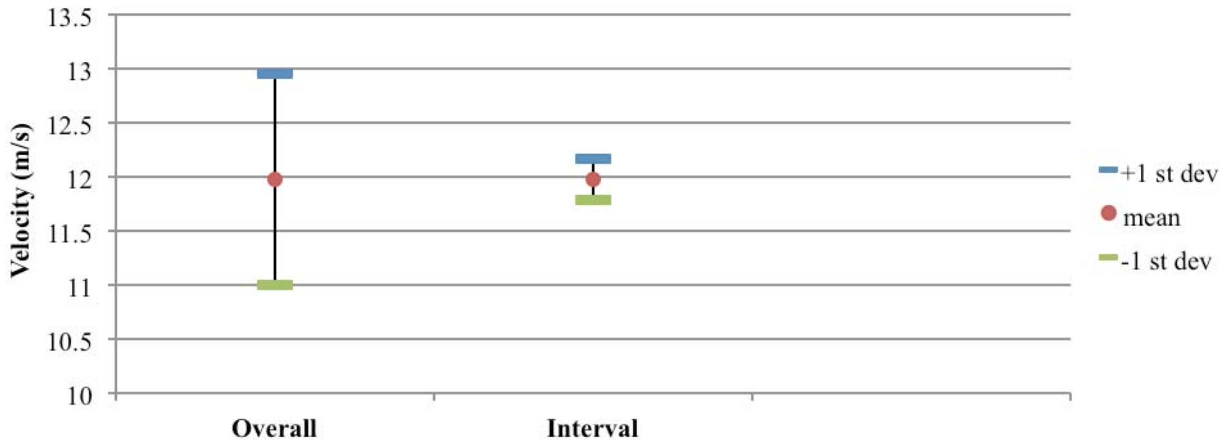
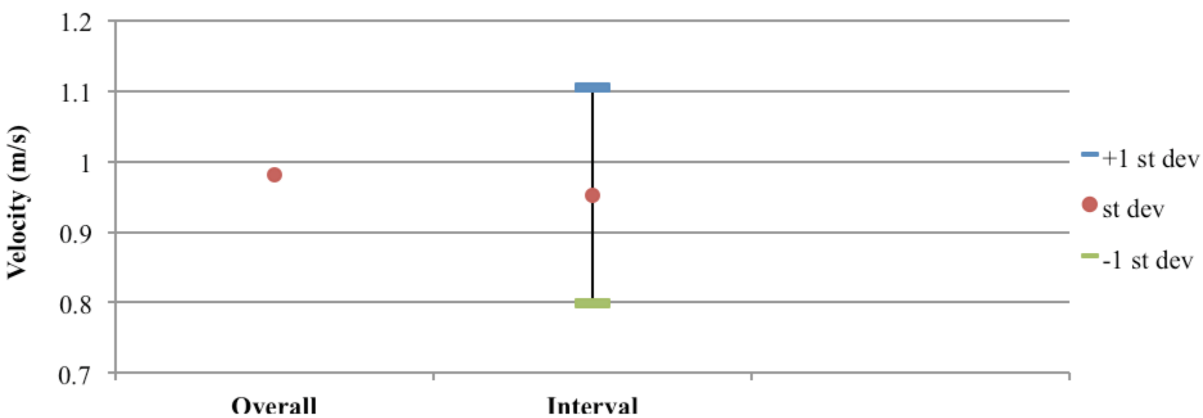


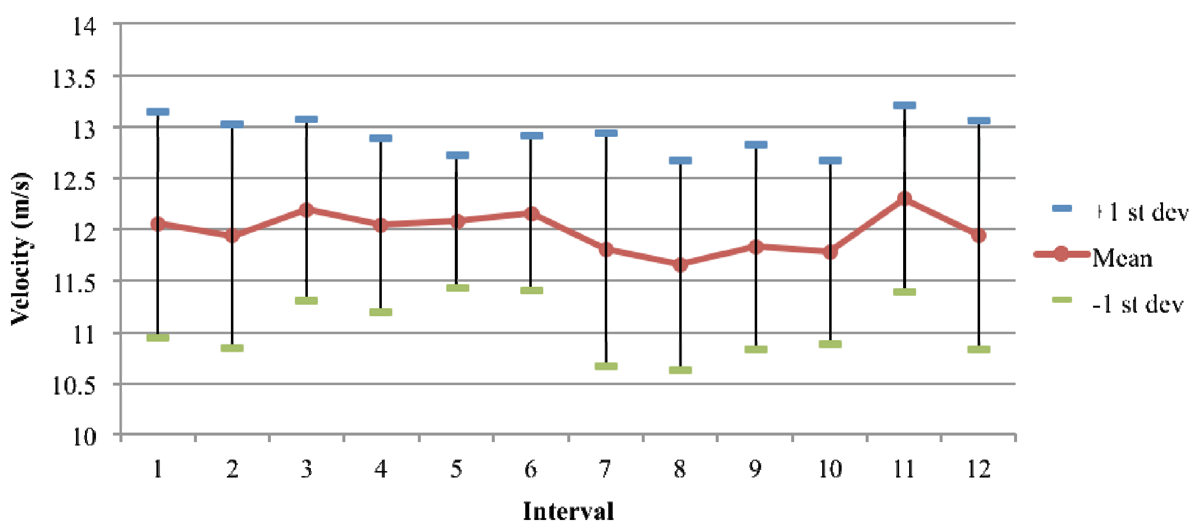
Figure C2. Histogram for each 10-second intervals (x_b = 1 ft, blower frequency = 50 Hz, 25 bins).



a) Run 327 average velocity and standard deviation about the average velocity.



b) Run 327 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 327 average velocity from each 10-second interval.

Figure C3. Run 327 total velocity measurements.

Run 328
Blockage Location: x_b = 1 ft
Blower Frequency: 25 Hz
Time: 7:30 AM

Cobra probe measurements contain samples where the instantaneous flow direction exceeded the acceptance angle of ±45°. Such measurements were automatically set to zero by probe software. All statistics and plots generated for this run use the non-zero data. Cobra probe software warning for A/D overvoltage also occurred during data acquisition.

Table C4. Run 328 velocity data from 2-minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	# Zero Values	% Zero Values
Total Vel	2.1120	11.60684	6.2197	0.4276	170	0.11 %
u	1.55	9.92	5.9647	0.4514	--	--
v	-5.18	7.78	1.2339	0.7358	--	--
w	-4.51	5.11	-0.6566	0.7696	--	--

Table C5. Run 328 total velocity data for each 10-second interval and mean and standard deviation data for each interval.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	[illegible] (%)	# Zero Values	% Zero Values
1	2.5522	10.0328	6.3416	0.5226	8.241	52	4.16 %
2	3.8177	10.0136	6.4273	0.3949	6.144	36	2.88 %
3	2.7502	11.6068	6.2165	0.4159	6.691	16	1.28 %
4	2.5519	10.0014	6.2901	0.3797	6.037	5	0.40 %
5	3.0323	8.9198	6.2781	0.3699	5.892	9	0.72 %
6	3.4242	9.3046	6.2929	0.4017	6.383	12	0.96 %
7	2.1120	9.7881	6.0555	0.4637	7.657	3	0.24 %
8	3.1180	9.0652	6.1125	0.4520	7.395	15	1.20 %
9	2.9438	9.1695	6.1033	0.4299	7.044	8	0.64 %
10	3.0509	8.9896	6.1758	0.3986	6.454	5	0.40 %
11	3.3100	8.3806	6.1231	0.3413	5.575	8	0.64 %
12	3.4904	8.3101	6.2210	0.3692	5.936	1	0.08 %
		Average	**6.2198**	**0.4116**	**6.621**		
		St Dev	**0.1107**	**0.0495**	**0.810**		

Table C6. Run 328 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u (%)	I_v (%)	I_w (%)
1	6.0016	1.4862	-0.8058	0.4665	0.8204	0.8498	7.77 %	13.67 %	14.16 %
2	6.0702	1.5209	-1.0916	0.3891	0.7159	0.6722	6.41 %	11.79 %	11.07 %
3	5.9377	1.3212	-0.6241	0.4390	0.7699	0.8013	7.39 %	12.97 %	13.50 %
4	6.0318	1.2894	-0.7103	0.4122	0.6534	0.7506	6.83 %	10.83 %	12.44 %
5	5.9924	1.5014	-0.8033	0.4022	0.5066	0.5707	6.71 %	8.45 %	9.52 %
6	5.9986	1.4345	-0.7765	0.4426	0.6611	0.6967	7.38 %	11.02 %	11.61 %
7	5.8271	1.0121	-0.2805	0.5246	0.8709	0.8907	9.00 %	14.95 %	15.29 %
8	5.8182	1.4864	-0.3409	0.5218	0.6648	0.8220	8.97 %	11.43 %	14.13 %
9	5.8624	1.2825	-0.4254	0.5069	0.6071	0.7851	8.65 %	10.36 %	13.39 %
10	5.9962	0.9994	-0.6130	0.4359	0.6273	0.6232	7.27 %	10.46 %	10.39 %
11	6.0177	0.5559	-0.5342	0.3529	0.5766	0.5875	5.86 %	9.58 %	9.76 %
12	6.0226	0.9192	-0.8744	0.3996	0.5542	0.6996	6.63 %	9.20 %	11.62 %

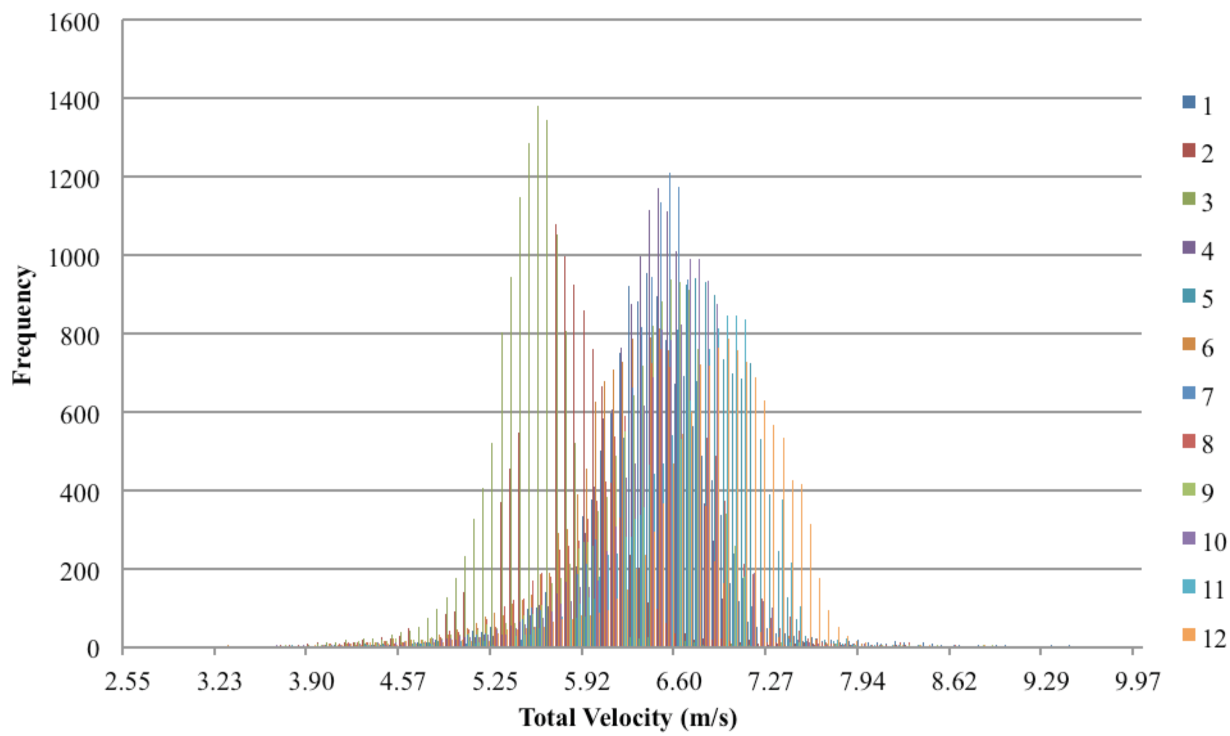


Figure C4. Histogram of 10-second intervals (x_b = 1 ft, blower frequency = 25 Hz, 100 bins).

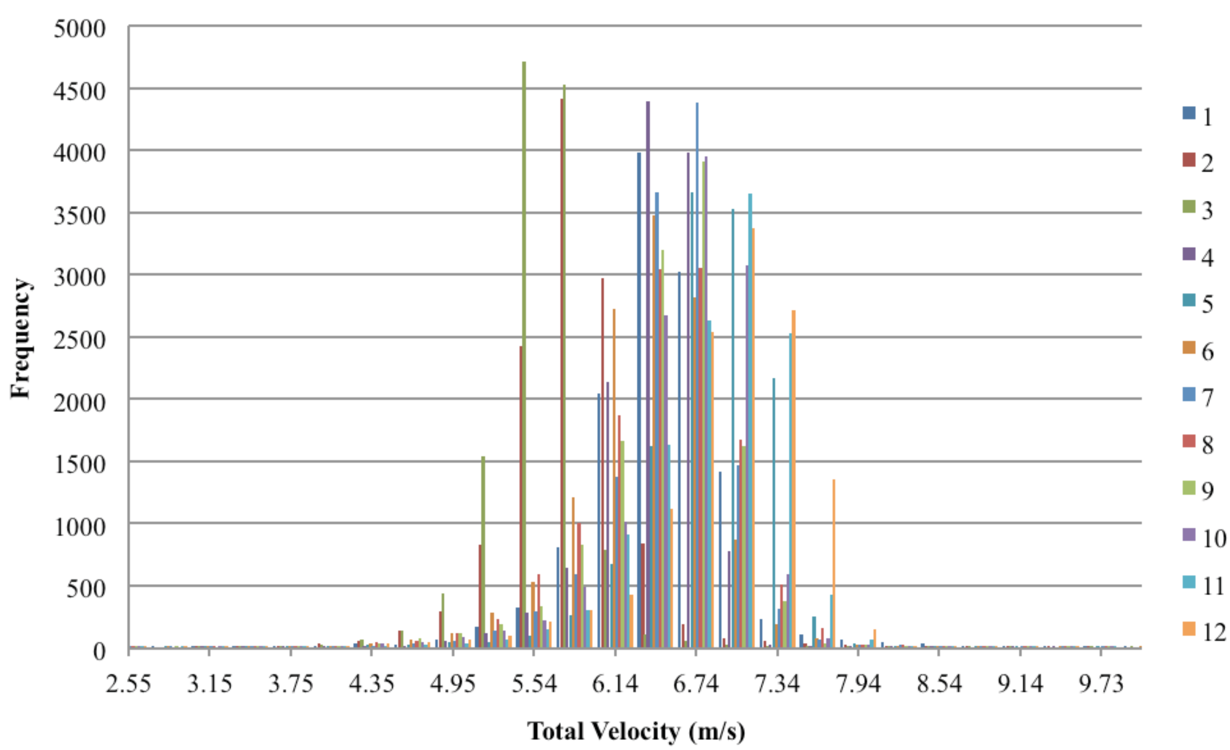
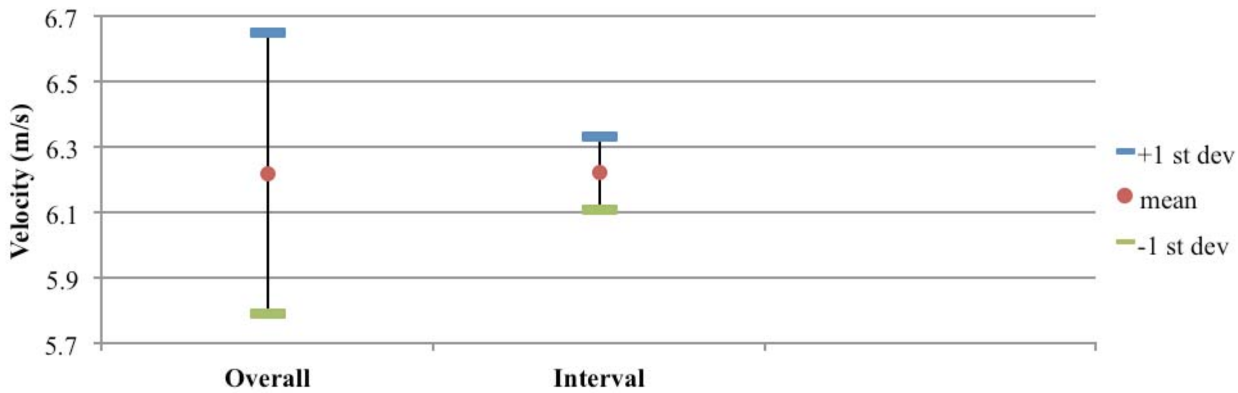
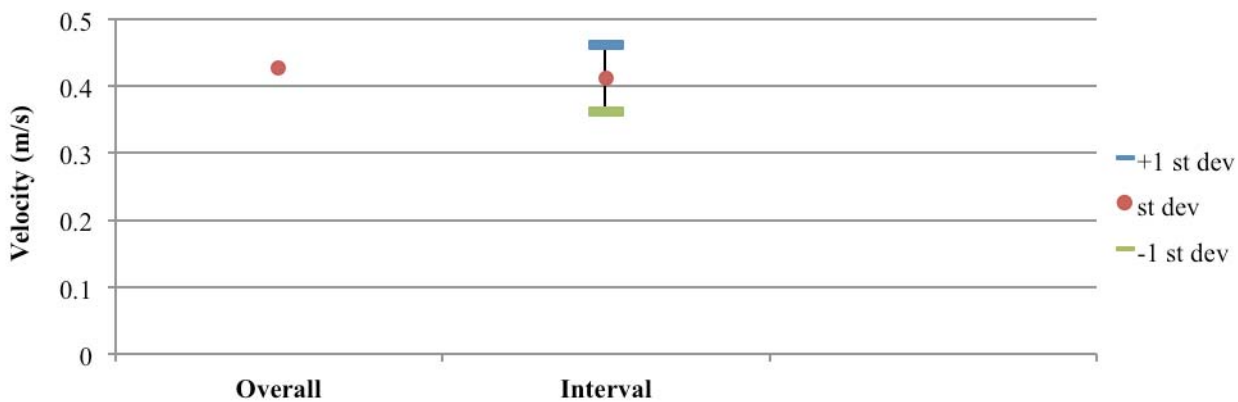


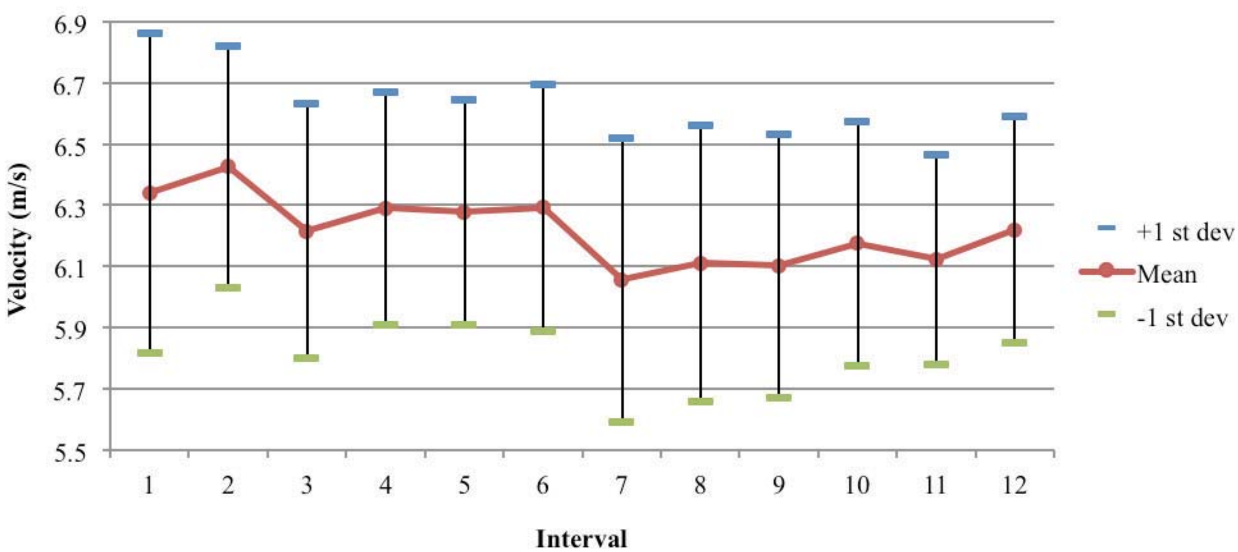
Figure C5. Histogram of 10-second intervals (x_b = 1 ft, blower frequency = 50 Hz, 25 bins).



a) Run 328 average velocity and standard deviation about the average velocity.



b) Run 328 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 328 average velocity from each 10-second interval.

Figure C6. Run 328 total velocity measurements.

Run 329
Blockage Location: x_b = 2 ft
Blower Frequency: 50 Hz
Time: 7:40 AM

Cobra probe measurements contain samples where the instantaneous flow direction exceeded the acceptance angle of ±45°. Such measurements were automatically set to zero by probe software. All statistics and plots generated for this run use the non-zero data. Cobra probe software warning for A/D overvoltage also occurred during data acquisition.

Table C7. Run 329 velocity data from 2-minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	# Zero Values	% Zero Values
Total Vel	5.3638	17.3869	11.3456	0.4745	31	0.02%
u	4.71	17	10.7628	0.4653	--	--
v	-6.87	11.8	1.7409	0.7906	--	--
w	-7.74	8.59	-2.8485	1.0593	--	--

Table C8. Run 329 total velocity data for each 10-second interval and mean and standard deviation data for each interval.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	[illegible] (%)	# Zero Values	% Zero Values
1	7.3673	16.7446	11.3519	0.4385	3.862	7	0.56 %
2	5.3637	15.4338	11.2556	0.7330	6.512	1	0.08 %
3	8.2906	15.8868	11.3770	0.3957	3.478	0	0.00 %
4	7.2362	13.8957	11.3463	0.3572	3.148	1	0.08 %
5	6.4692	15.3564	11.3290	0.4720	4.166	2	0.16 %
6	5.7359	16.3052	11.2374	0.5869	5.223	4	0.32 %
7	6.6681	16.3607	11.2481	0.5648	5.021	6	0.48 %
8	6.9403	15.0597	11.2871	0.4772	4.228	5	0.40 %
9	10.1828	16.1305	11.4341	0.2986	2.611	2	0.16 %
10	8.4730	17.3868	11.4713	0.3710	3.234	2	0.16 %
11	8.1013	16.6168	11.4031	0.4019	3.525	1	0.08 %
12	8.3604	14.5317	11.4049	0.3478	3.050	0	0.00 %
		Average	**11.3455**	**0.4537**	**4.005**		
		St Dev	**0.0765**	**0.1230**	**1.111**		

Table C9. Run 329 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u (%)	I_v (%)	I_w (%)
1	10.7732	1.8441	-2.9135	0.4196	0.6778	0.6881	3.89 %	6.29 %	6.39 %
2	10.7304	1.3433	-2.2359	0.7209	1.2158	1.8123	6.72 %	11.33 %	16.89 %
3	10.7830	1.6321	-2.9284	0.4030	0.8086	1.1250	3.74 %	7.50 %	10.43 %
4	10.7757	1.6513	-3.0374	0.3490	0.5065	0.6483	3.24 %	4.70 %	6.02 %
5	10.7811	1.6031	-2.7737	0.4484	0.6404	1.2099	4.16 %	5.94 %	11.22 %
6	10.8021	1.7668	-2.1296	0.5726	0.8759	1.0890	5.30 %	8.11 %	10.08 %
7	10.8038	1.8148	-2.2111	0.5438	0.8861	0.9246	5.03 %	8.20 %	8.56 %
8	10.8168	1.5717	-2.6059	0.4417	0.7010	0.8217	4.08 %	6.48 %	7.60 %
9	10.6673	1.8978	-3.5726	0.3462	0.6249	0.4020	3.25 %	5.86 %	3.77 %
10	10.6924	2.2127	-3.4064	0.3793	0.6617	0.5671	3.55 %	6.19 %	5.30 %
11	10.7393	1.8408	-3.1883	0.4203	0.7461	0.7578	3.91 %	6.95 %	7.06 %
12	10.7885	1.7110	-3.1786	0.3674	0.5638	0.5632	3.41 %	5.23 %	5.22 %

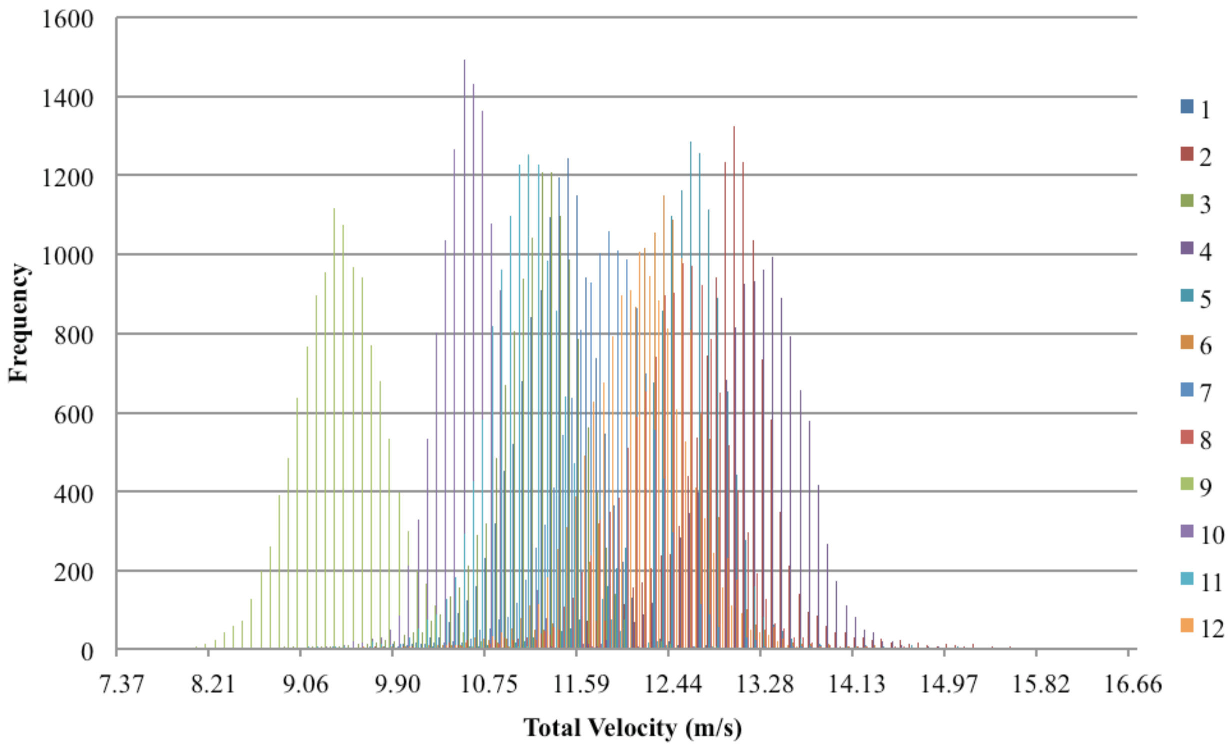


Figure C7. Histogram of 10-second intervals (x_b = 2 ft, blower frequency = 50 Hz, 100 bins).

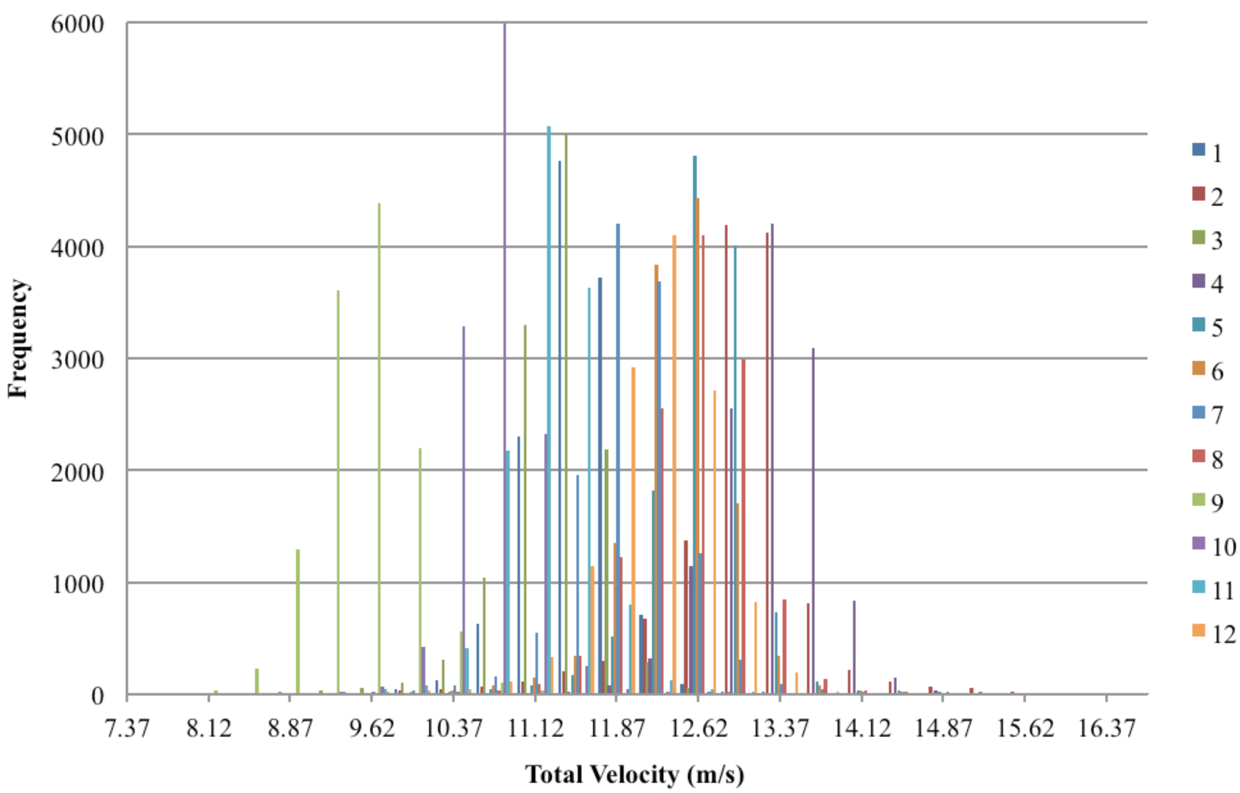
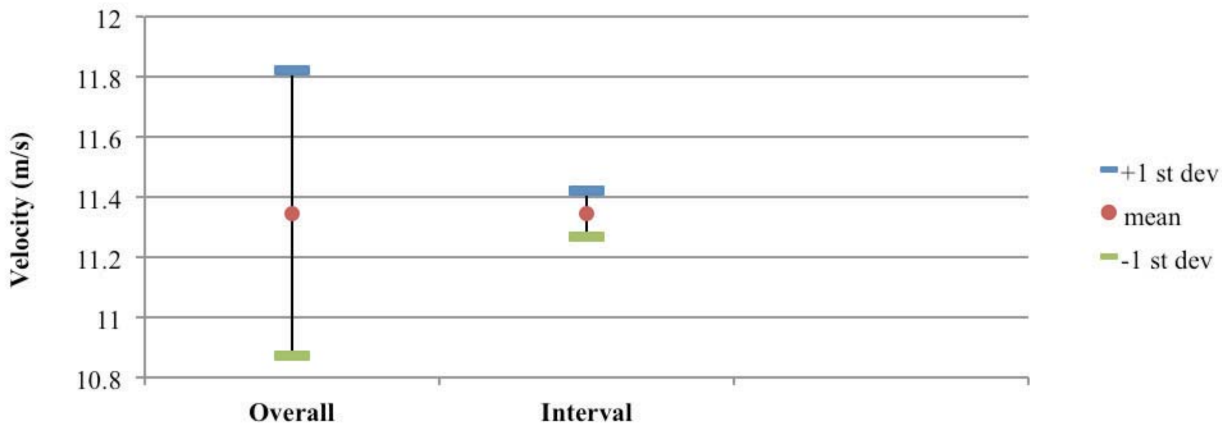
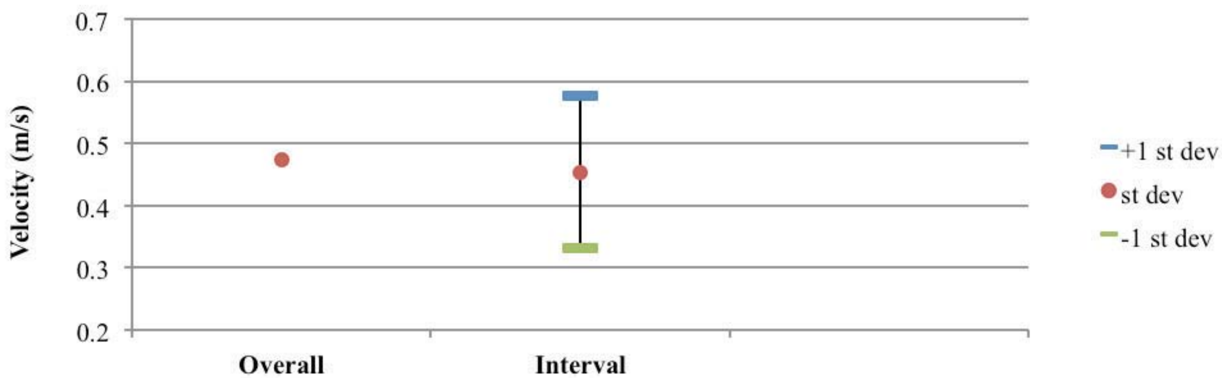


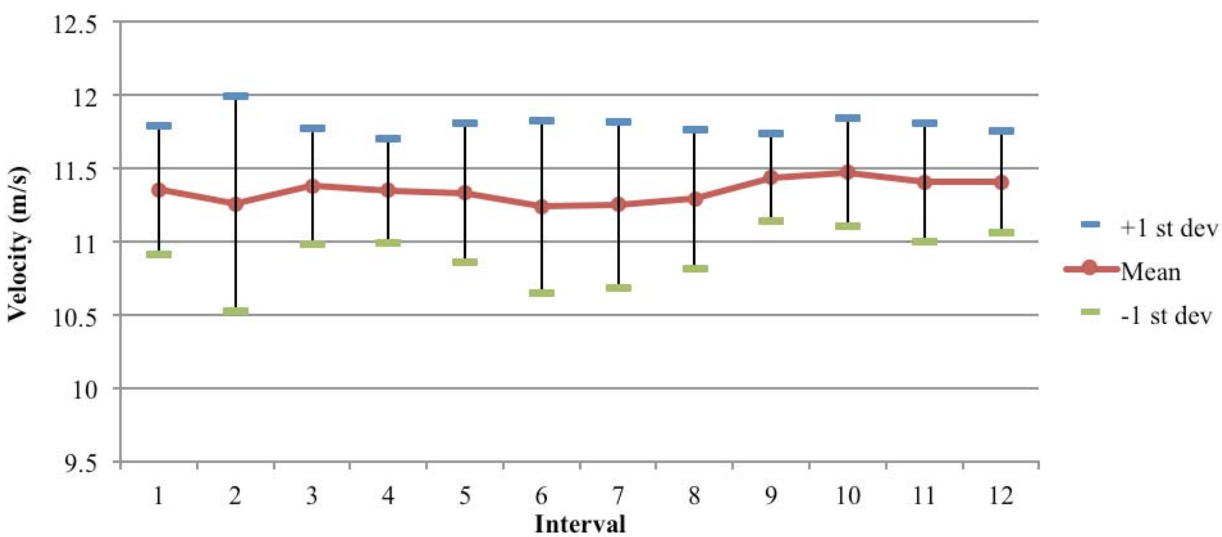
Figure C8. Histogram of 10-second intervals (x_b = 2 ft, blower frequency = 50 Hz, 25 bins).



a) Run 329 average velocity and standard deviation about the average velocity.



b) Run 329 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 329 average velocity from each 10-second interval.

Figure C9. Run 329 total velocity measurements.

Run 330
Blockage Location: x_b = 2 ft
Blower Frequency: 50 Hz
Time: 7:43 AM

Cobra probe measurements contain samples where the instantaneous flow direction exceeded the acceptance angle of ±45°. Such measurements were automatically set to zero by probe software. All statistics and plots generated for this run use the non-zero data. Cobra probe software warning for A/D overvoltage also occurred during data acquisition.

Table C10. Run 330 velocity data from 2-minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	# Zero Values	% Zero Values
Total Vel	4.1308	19.6851	11.4110	0.6599	49	0.03 %
u	3.62	17.7	10.7892	0.6575	--	--
v	-5.78	11.7	2.0974	1.2066	--	--
w	-8.46	7.74	-2.4394	1.4146	--	--

Table C11. Run 330 total velocity data for each 10-second interval and mean and standard deviation data for each interval.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	[illegible] (%)	# Zero Values	% Zero Values
1	4.8489	16.3667	11.2304	0.9911	8.825	18	1.44 %
2	6.1632	16.8181	11.5349	0.5548	4.810	1	0.08 %
3	7.7841	17.3358	11.5935	0.4848	4.181	8	0.64 %
4	5.8991	16.4800	11.3922	0.7056	6.193	2	0.16 %
5	6.8964	16.6137	11.6508	0.5932	5.091	4	0.32 %
6	4.1308	18.6402	11.4884	0.7011	6.103	2	0.16 %
7	5.9503	18.1242	11.4630	0.6896	6.016	7	0.56 %
8	4.8354	14.3315	11.3823	0.4212	3.700	0	0.00 %
9	6.6611	15.8333	11.2254	0.6371	5.675	0	0.00 %
10	4.8736	16.6281	11.2821	0.7015	6.218	5	0.40 %
11	5.5787	19.6850	11.2307	0.5547	4.939	1	0.08 %
12	5.9496	15.3825	11.4577	0.5170	4.512	1	0.08 %
		Average	**11.4110**	**0.6293**	**5.522**		
		St Dev	**0.1459**	**0.1477**	**1.335**		

Table C12. Run 330 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u (%)	I_v (%)	I_w (%)
1	10.7777	1.7232	-1.1432	1.0160	1.5959	1.7585	9.43 %	14.81 %	16.32 %
2	10.7378	2.6856	-2.9036	0.5588	0.9011	1.1380	5.20 %	8.39 %	10.60 %
3	10.5964	3.0129	-3.4069	0.4963	0.7934	0.8957	4.68 %	7.49 %	8.45 %
4	10.8267	2.5725	-1.7948	0.7151	0.9242	1.3642	6.60 %	8.54 %	12.60 %
5	10.8642	2.8185	-2.7854	0.5726	0.9451	1.0667	5.27 %	8.70 %	9.82 %
6	10.7779	2.2817	-2.6403	0.7223	1.0377	1.5925	6.70 %	9.63 %	14.78 %
7	10.7360	2.5652	-2.3620	0.7690	1.0960	1.6318	7.16 %	10.21 %	15.20 %
8	10.7517	1.6548	-3.0252	0.5097	0.7499	1.1925	4.74 %	6.97 %	11.09 %
9	10.8521	0.9894	-2.1193	0.5700	1.2481	1.1382	5.25 %	11.50 %	10.49 %
10	10.8679	1.6902	-1.9226	0.6876	1.0400	1.2492	6.33 %	9.57 %	11.49 %
11	10.8299	1.2159	-2.3590	0.5214	0.8914	1.0204	4.81 %	8.23 %	9.42 %
12	10.8519	1.9600	-2.8093	0.5003	0.8698	1.0223	4.61 %	8.02 %	9.42 %

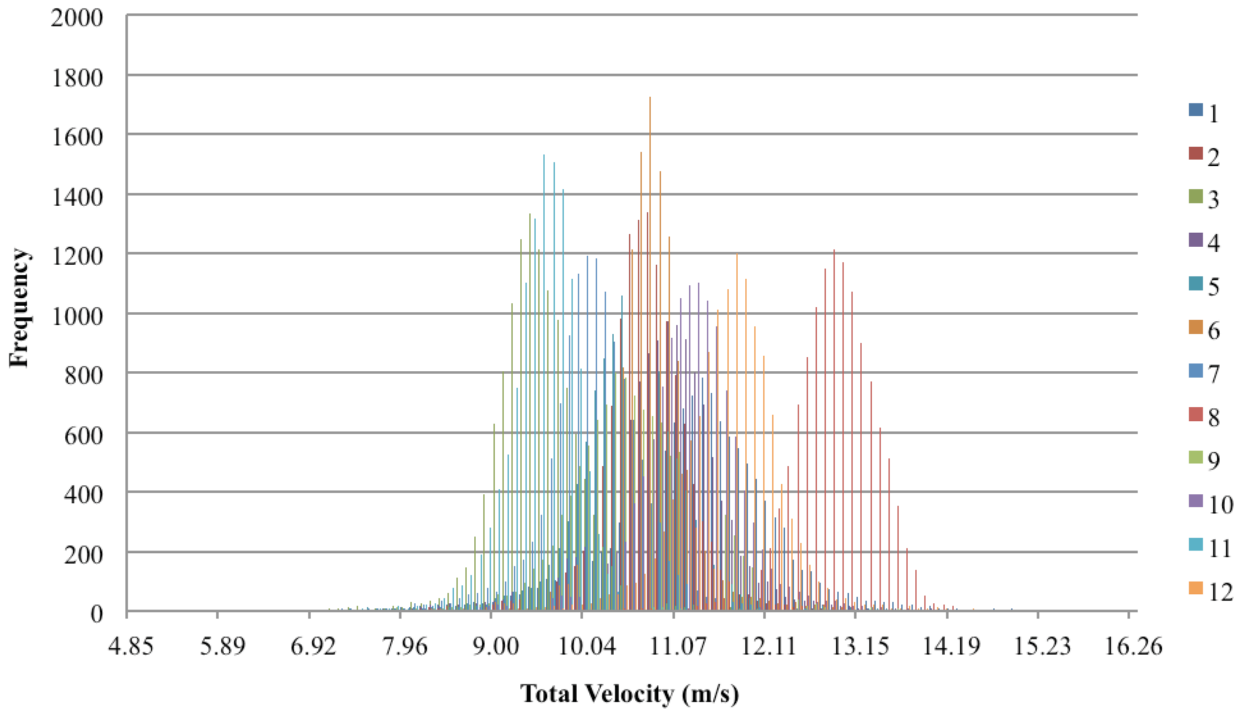


Figure C10. Histogram of 10-second intervals (x_b = 2 ft, blower frequency = 50 Hz, 100 bins).

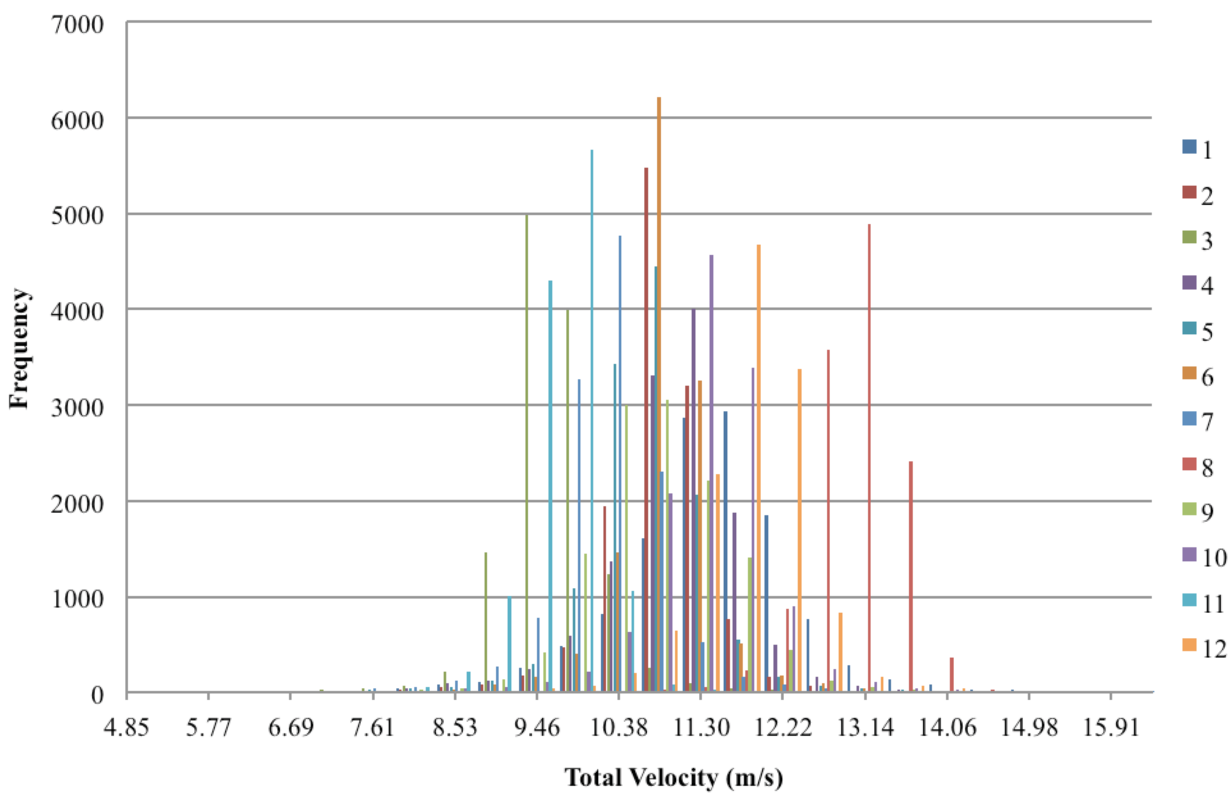
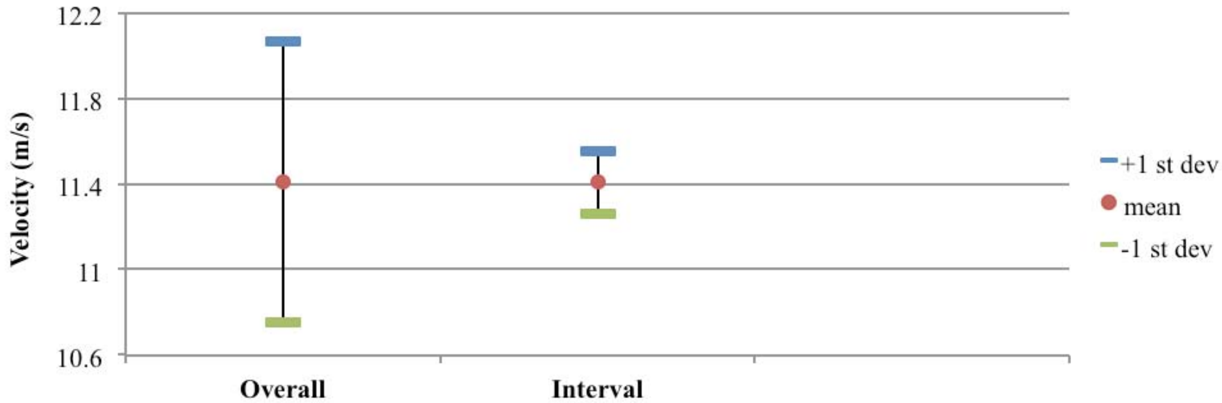
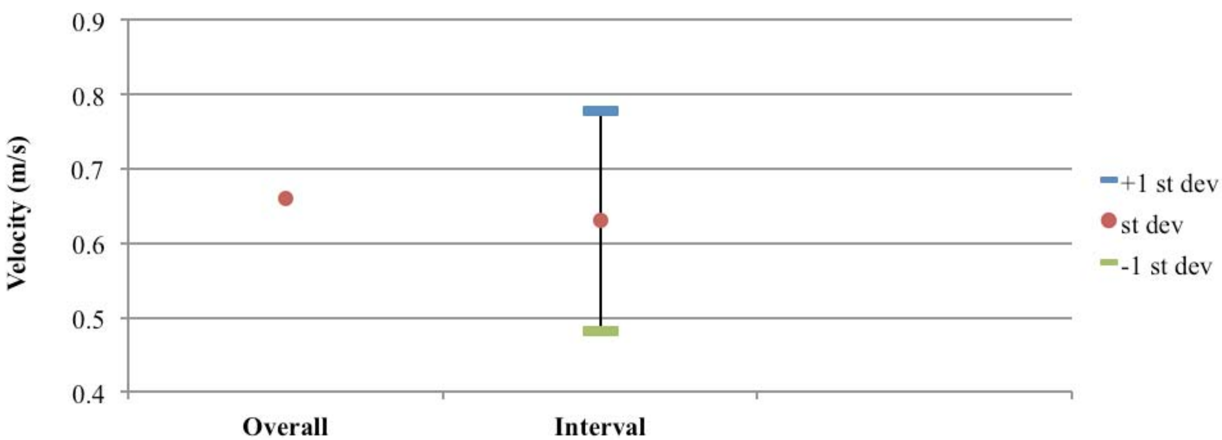


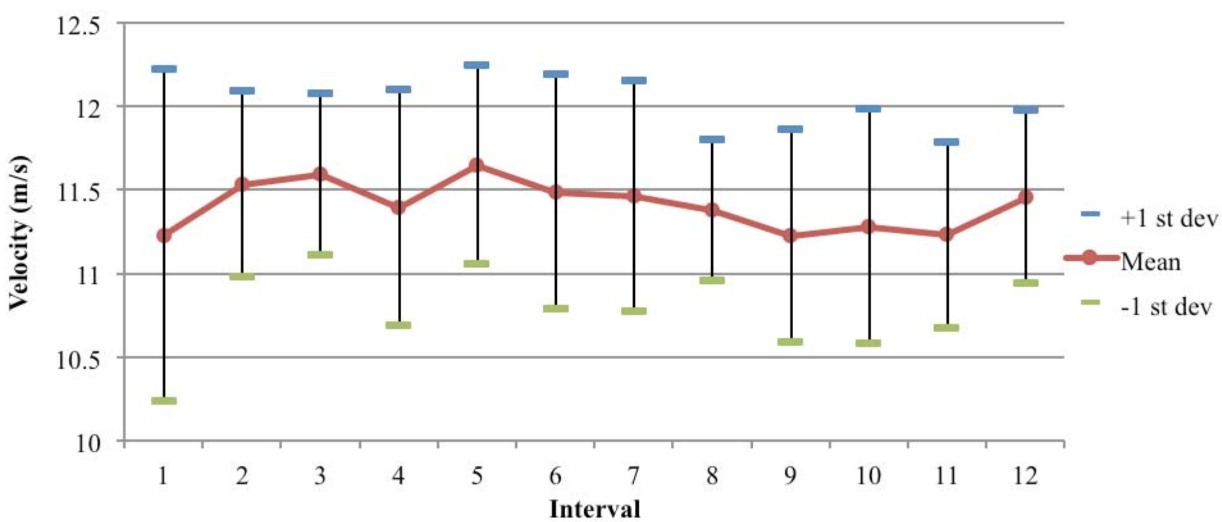
Figure C11. Histogram of 10-second intervals (x_b = 2 ft, blower frequency = 50 Hz, 25 bins).



a) Run 330 average velocity and standard deviation about the average velocity.



b) Run 330 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 330 average velocity from each 10-second interval.

Figure C12. Run 330 total velocity measurements.

Run 331
Blockage Location: x_b = 2 ft
Blower Frequency: 25 Hz
Time: 7:26 AM

Cobra probe measurements contain samples where the instantaneous flow direction exceeded the acceptance angle of ±45°. Such measurements were automatically set to zero by probe software. All statistics and plots generated for this run use the non-zero data. Cobra probe software warning for A/D overvoltage also occurred during data acquisition.

Table C13. Run 331 velocity data from 2-minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	# Zero Values	% Zero Values
Total Vel	2.5319	9.7413	5.8343	0.3644	99	0.07 %
u	1.8	9.7	5.5903	0.3680	--	--
v	-2.88	5.87	0.6387	0.7806	--	--
w	-4.91	5.2	-1.0640	0.7974	--	--

Table C14. Run 331 total velocity data for each10-second interval and mean and standard deviation data for each interval.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	[illegible] (%)	# Zero Values	% Zero Values
1	3.2659	7.6675	5.6940	0.3469	6.093	0	0.00 %
2	3.1865	8.7227	5.8045	0.3903	6.725	8	0.64 %
3	2.8761	8.7144	5.8985	0.4095	6.942	0	0.00 %
4	2.5420	9.7412	5.9553	0.6283	10.551	86	6.88 %
5	3.3321	8.5548	5.9495	0.2627	4.416	0	0.00 %
6	2.5319	8.9616	5.9183	0.4227	7.143	2	0.16 %
7	2.7074	7.9705	5.7295	0.3342	5.833	0	0.00 %
8	2.7745	7.8251	5.7648	0.3001	5.206	1	0.08 %
9	3.4395	6.7978	5.7761	0.2187	3.787	0	0.00 %
10	4.6706	6.5696	5.7499	0.1655	2.878	0	0.00 %
11	3.5317	8.0590	5.9290	0.2312	3.900	0	0.00 %
12	3.2601	7.6733	5.8422	0.2948	5.046	2	0.16 %
		Average	**5.8343**	**0.3337**	**5.710**		
		St Dev	**0.0929**	**0.1219**	**2.035**		

Table C15. Run 331 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u (%)	I_v (%)	I_w (%)
1	5.5044	0.1116	-1.0803	0.3414	0.6431	0.7305	6.20 %	11.68 %	13.27 %
2	5.5328	0.9590	-1.0214	0.4105	0.7134	0.7703	7.42 %	12.89 %	13.92 %
3	5.6365	0.9371	-1.0072	0.4142	0.6195	0.8622	7.35 %	10.99 %	15.30 %
4	5.5724	1.2866	-0.4418	0.6819	0.8923	1.3029	12.24 %	16.01 %	23.38 %
5	5.5457	1.3600	-1.4415	0.2594	0.5751	0.6210	4.68 %	10.37 %	11.20 %
6	5.6064	1.1505	-0.9783	0.4193	0.7700	0.8508	7.48 %	13.73 %	15.18 %
7	5.6029	0.1006	-0.8239	0.3351	0.6506	0.5683	5.98 %	11.61 %	10.14 %
8	5.6043	0.2398	-0.8593	0.3051	0.6781	0.7529	5.44 %	12.10 %	13.43 %
9	5.6011	0.1726	-1.2114	0.2212	0.3931	0.5820	3.95 %	7.02 %	10.39 %
10	5.5148	0.0595	-1.5110	0.1848	0.3223	0.5014	3.35 %	5.84 %	9.09 %
11	5.7254	0.7403	-1.1905	0.2200	0.4313	0.4768	3.84 %	7.53 %	8.33 %
12	5.6363	0.5507	-1.1970	0.2894	0.5207	0.5998	5.13 %	9.24 %	10.64 %

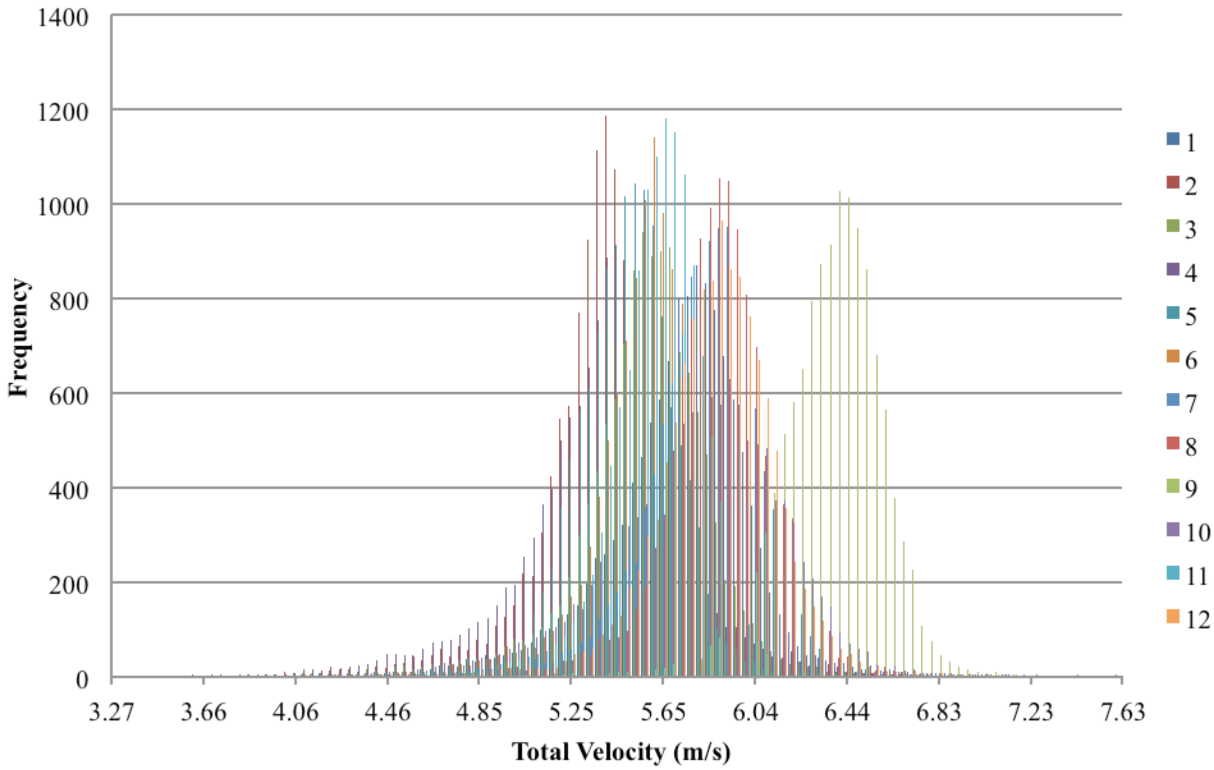


Figure C13. Histogram of 10-second intervals (x_b = 2 ft, blower frequency = 25 Hz, 100 bins).

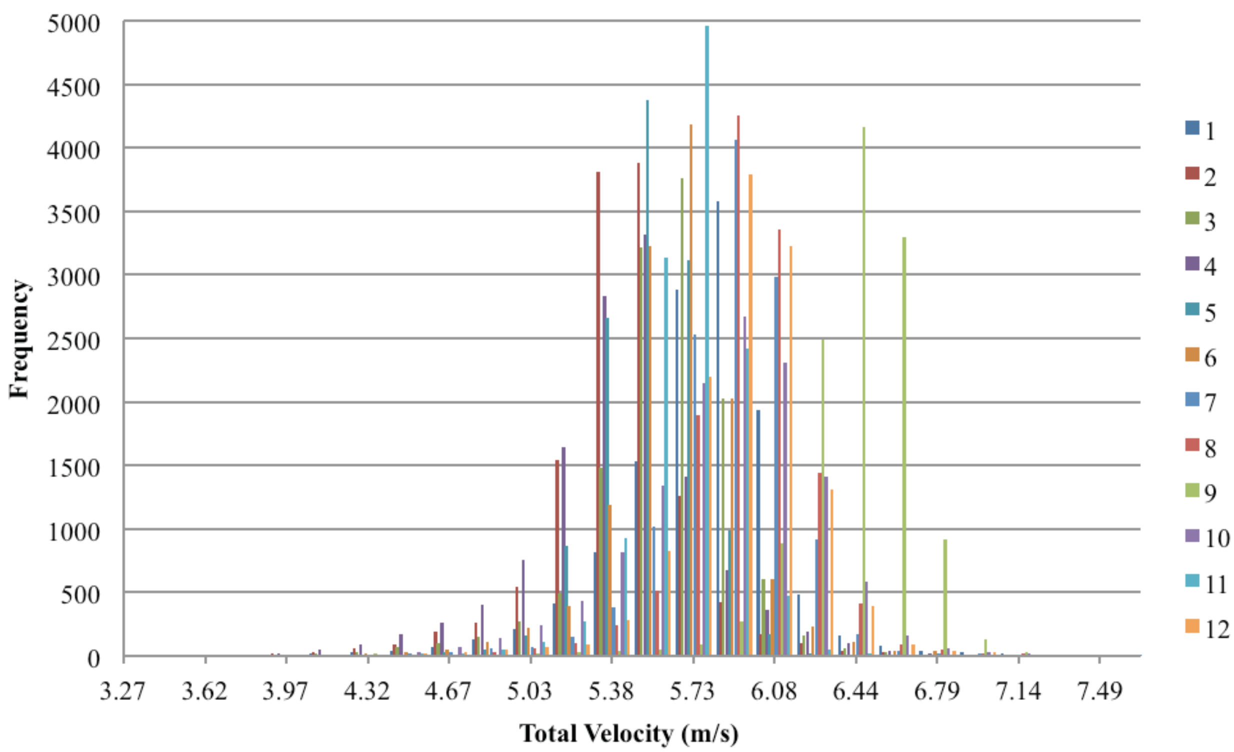
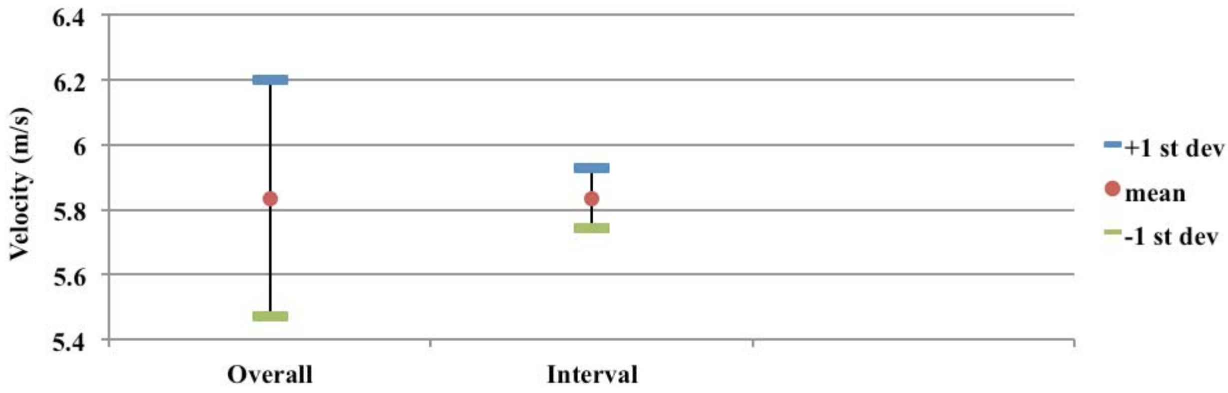
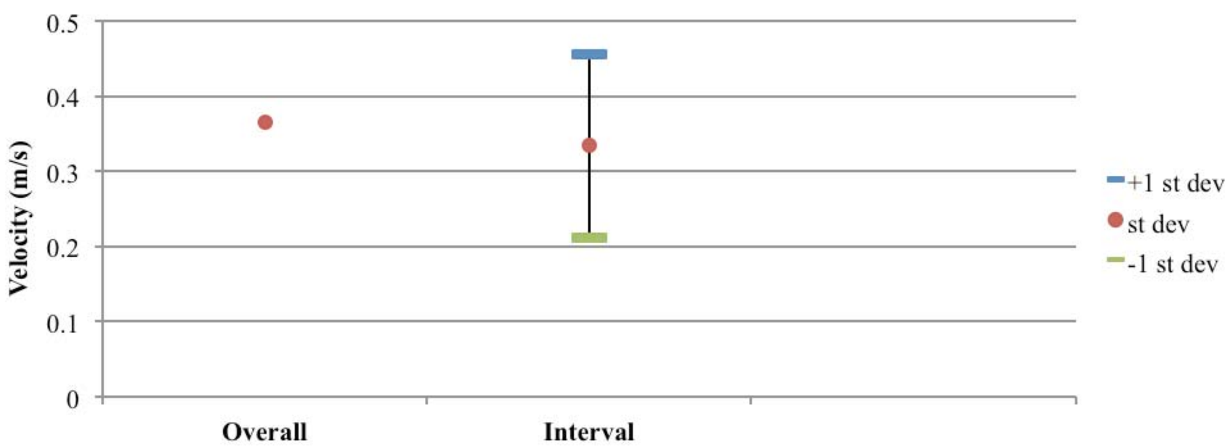


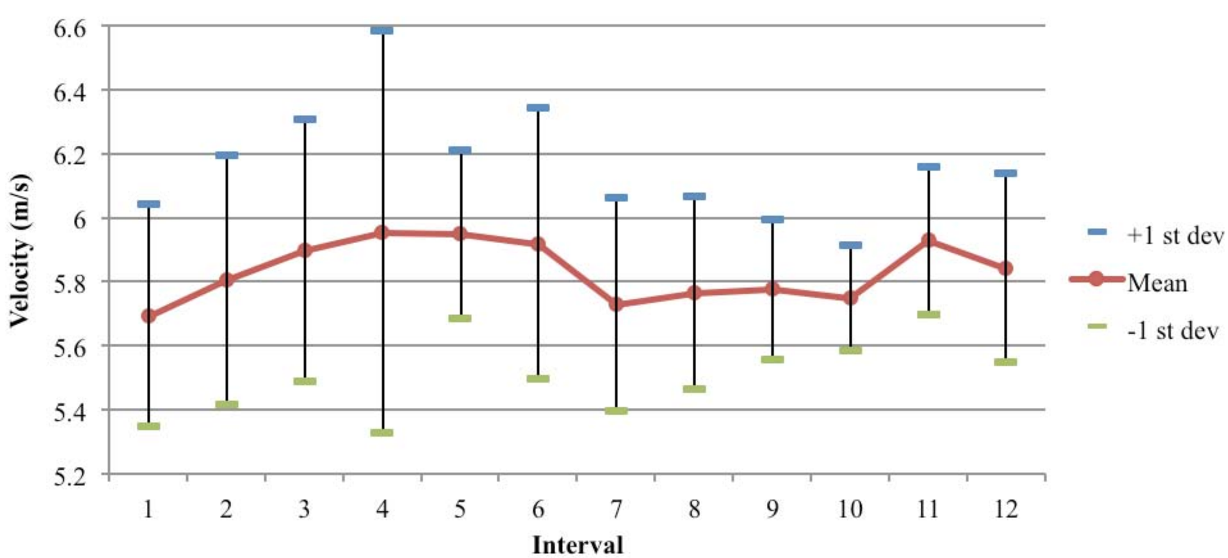
Figure C14. Histogram of 10-second intervals (x_b = 2 ft, blower frequency = 25 Hz, 25 bins).



a) Run 331 average velocity and standard deviation about the average velocity.



b) Run 331 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 331 average velocity from each 10-second interval

Figure C15. Run 331 total velocity measurements.

Run 332
Blockage Location: x_b = 4 ft
Blower Frequency: 50 Hz
Time: 7:59 AM

Table C16. Run 332 velocity data from 2-minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)
Total Vel	6.7743	15.8523	10.9082	0.3818
u	6.51	14.9	10.6264	0.3701
v	-6.28	4.78	-0.0065	0.6871
w	-5.14	5.48	-2.0232	1.2294

Table C17. Run 332 total velocity data for each 10-second interval and mean and standard deviation data for each interval.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	I_{tot} (%)
1	7.5326	15.8523	10.8830	0.4473	4.110
2	7.7559	13.1210	10.7619	0.4059	3.772
3	6.8751	14.6562	10.7250	0.6054	5.645
4	7.0035	12.9512	10.7827	0.4078	3.782
5	6.7742	14.1109	10.7667	0.5625	5.224
6	8.8513	12.5136	10.9308	0.3174	2.904
7	9.3392	12.6105	11.1031	0.2963	2.668
8	10.2484	11.7753	11.0637	0.1876	1.695
9	10.2400	11.6513	10.9936	0.1836	1.670
10	10.1663	11.6874	10.9813	0.1898	1.728
11	10.1786	11.8807	10.9690	0.1921	1.752
12	10.1897	11.5963	10.9367	0.1841	1.683
		Average	**10.9081**	**0.3316**	**3.053**
		St Dev	**0.1247**	**0.1474**	**1.441**

Table C18. Run 332 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u (%)	I_v (%)	I_w (%)
1	10.7480	-0.2543	-1.2090	0.4350	0.7286	0.9358	4.05 %	6.78 %	8.71 %
2	10.6345	-0.4685	-1.1493	0.4006	0.6804	0.8538	3.77 %	6.40 %	8.03 %
3	10.6084	0.1507	-0.4031	0.6090	1.0308	1.1121	5.74 %	9.72 %	10.48 %
4	10.6046	0.4080	-1.4921	0.3943	0.7895	0.8969	3.72 %	7.44 %	8.46 %
5	10.6434	-0.2429	-0.9847	0.5622	0.8314	0.9599	5.28 %	7.81 %	9.02 %
6	10.6532	0.3336	-2.2172	0.2746	0.4465	0.8889	2.58 %	4.19 %	8.34 %
7	10.6005	-0.2279	-3.0510	0.3495	0.4784	1.1339	3.30 %	4.51 %	10.70 %
8	10.4811	-0.4290	-3.4901	0.1943	0.2851	0.3236	1.85 %	2.72 %	3.09 %
9	10.5399	-0.2468	-3.0701	0.1857	0.3677	0.3855	1.76 %	3.49 %	3.66 %
10	10.6025	0.1126	-2.8013	0.1969	0.2709	0.4913	1.86 %	2.55 %	4.63 %
11	10.6654	0.3536	-2.4397	0.2108	0.4236	0.5525	1.98 %	3.97 %	5.18 %
12	10.7353	0.4312	-1.9706	0.1967	0.3626	0.3999	1.83 %	3.38 %	3.72 %

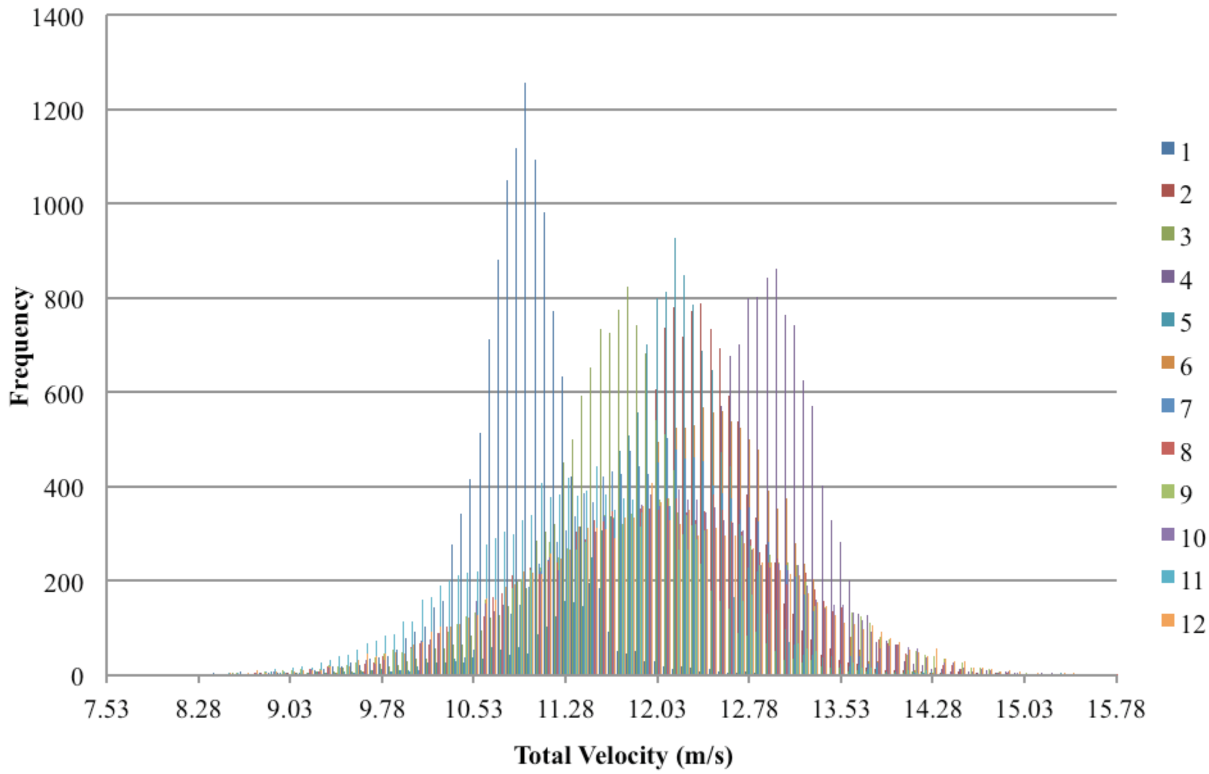


Figure C16. Histogram of 10-second intervals (x_b = 4 ft, blower frequency = 50 Hz, 100 bins).

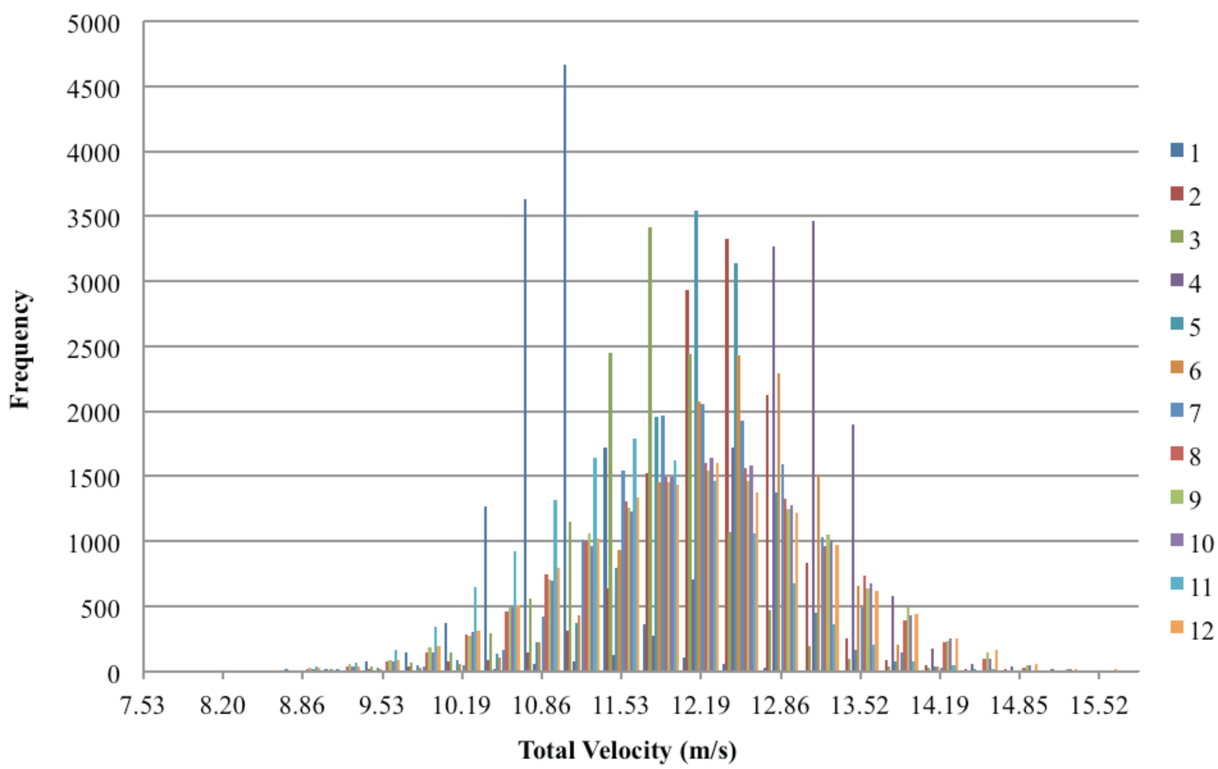
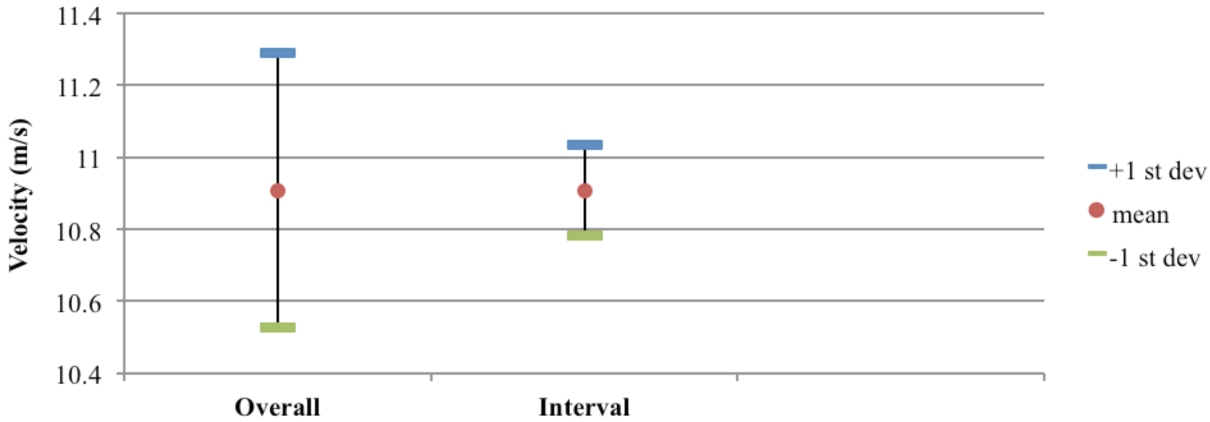
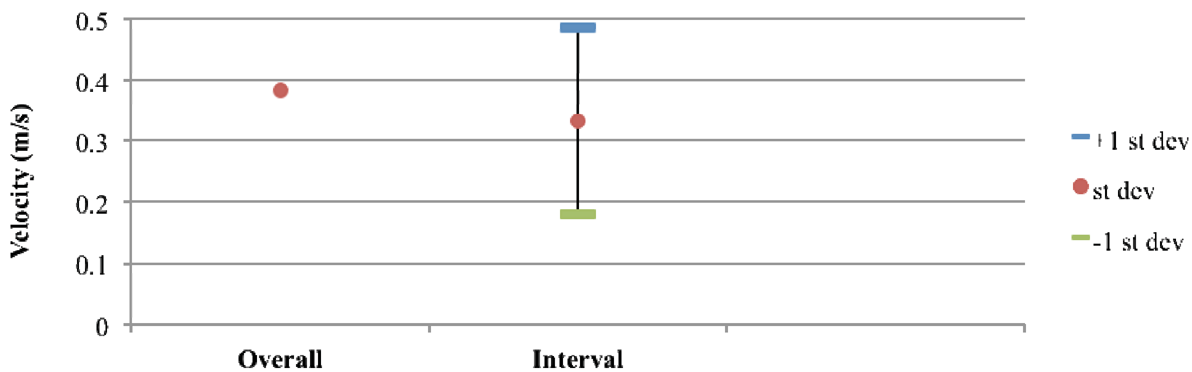


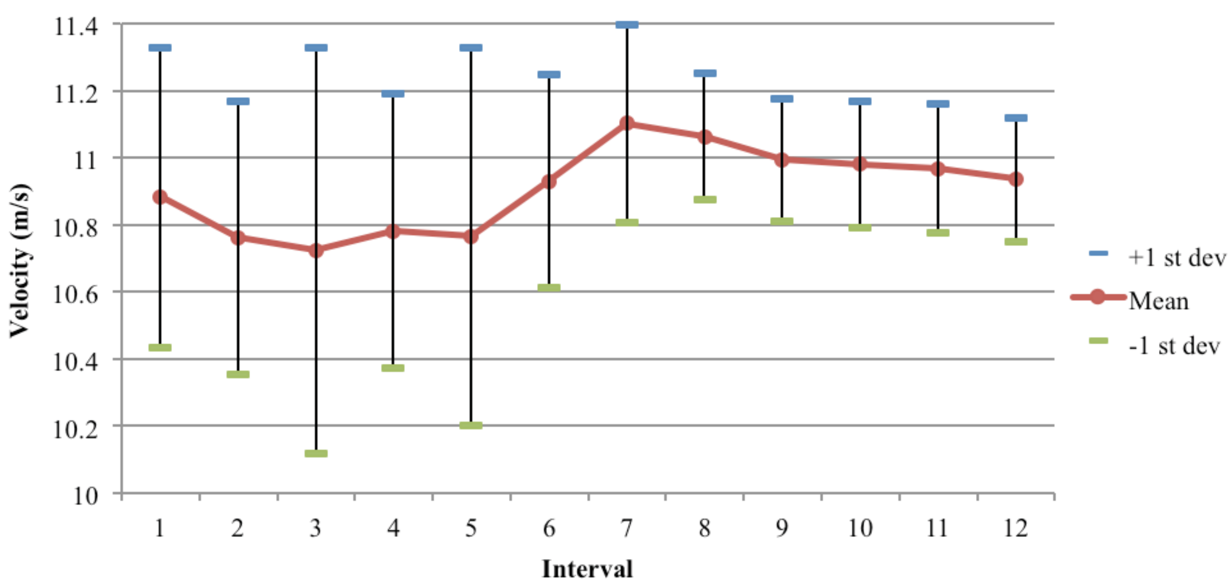
Figure C17. Histogram of 10-second intervals (x_b = 4 ft, blower frequency = 50 Hz, 25 bins).



a) Run 332 average velocity and standard deviation about the average velocity.



b) Run 332 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 332 average velocity from each 10-second interval.

Figure C18. Run 332 total velocity measurements.

Run 333
Blockage Location: x_b = 4 ft
Blower Frequency: 25 Hz
Time: 8:04 AM

Table C19. Run 333 velocity data from 2-minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)
Total Vel	3.8162	7.2955	5.6025	0.1987
u	3.29	7.29	5.4980	0.2218
v	-2.12	2.52	0.1564	0.4478
w	-3.63	2.85	-0.7630	0.5859

Table C20. Run 333 total velocity data for each 10-second interval and mean and standard deviation data for each interval.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	I_{tot} (%)
1	4.6545	6.4264	5.5440	0.1060	1.912
2	4.1513	6.7292	5.5474	0.1226	2.211
3	5.0561	6.7710	5.6408	0.1580	2.801
4	4.8891	6.0098	5.5985	0.1011	1.805
5	3.8161	7.2955	5.6196	0.2994	5.327
6	4.1615	7.0552	5.6333	0.3245	5.760
7	4.2254	7.1822	5.6285	0.2330	4.140
8	4.7493	6.2286	5.6268	0.1167	2.075
9	4.0244	6.9662	5.6075	0.2147	3.829
10	4.2465	6.4411	5.6143	0.1594	2.839
11	4.0376	7.0828	5.5724	0.2426	4.353
12	5.1682	5.8638	5.5970	0.0868	1.551
		Average	**5.6025**	**0.1804**	**3.217**
		St Dev	**0.0324**	**0.0807**	**1.431**

Table C21. Run 333 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u(%)	I_v (%)	I_w (%)
1	5.4521	0.3889	-0.8867	0.1090	0.1686	0.2102	2.00 %	3.09 %	3.86 %
2	5.4654	0.0016	-0.8861	0.1215	0.2579	0.2272	2.22 %	4.72 %	4.16 %
3	5.2911	0.1777	-1.7636	0.2792	0.4552	0.6497	5.28 %	8.60 %	12.28 %
4	5.5312	-0.1578	-0.8058	0.1057	0.2187	0.1620	1.91 %	3.95 %	2.93 %
5	5.5509	0.1441	-0.2452	0.3036	0.5236	0.6407	5.47 %	9.43 %	11.54 %
6	5.5364	0.5445	-0.1851	0.3284	0.5644	0.6569	5.93 %	10.19 %	11.86 %
7	5.5244	0.6830	-0.5784	0.2365	0.3451	0.4903	4.28 %	6.25 %	8.88 %
8	5.5545	0.2535	-0.7572	0.1187	0.3172	0.2637	2.14 %	5.71 %	4.75 %
9	5.5343	-0.0641	-0.6816	0.2211	0.3640	0.4599	4.00 %	6.58 %	8.31 %
10	5.5442	0.0728	-0.7603	0.1609	0.3063	0.3231	2.90 %	5.53 %	5.83 %
11	5.5009	-0.1242	-0.5692	0.2471	0.4435	0.5037	4.49 %	8.06 %	9.16 %
12	5.4909	-0.0429	-1.0366	0.0996	0.1812	0.2563	1.81 %	3.30 %	4.67 %

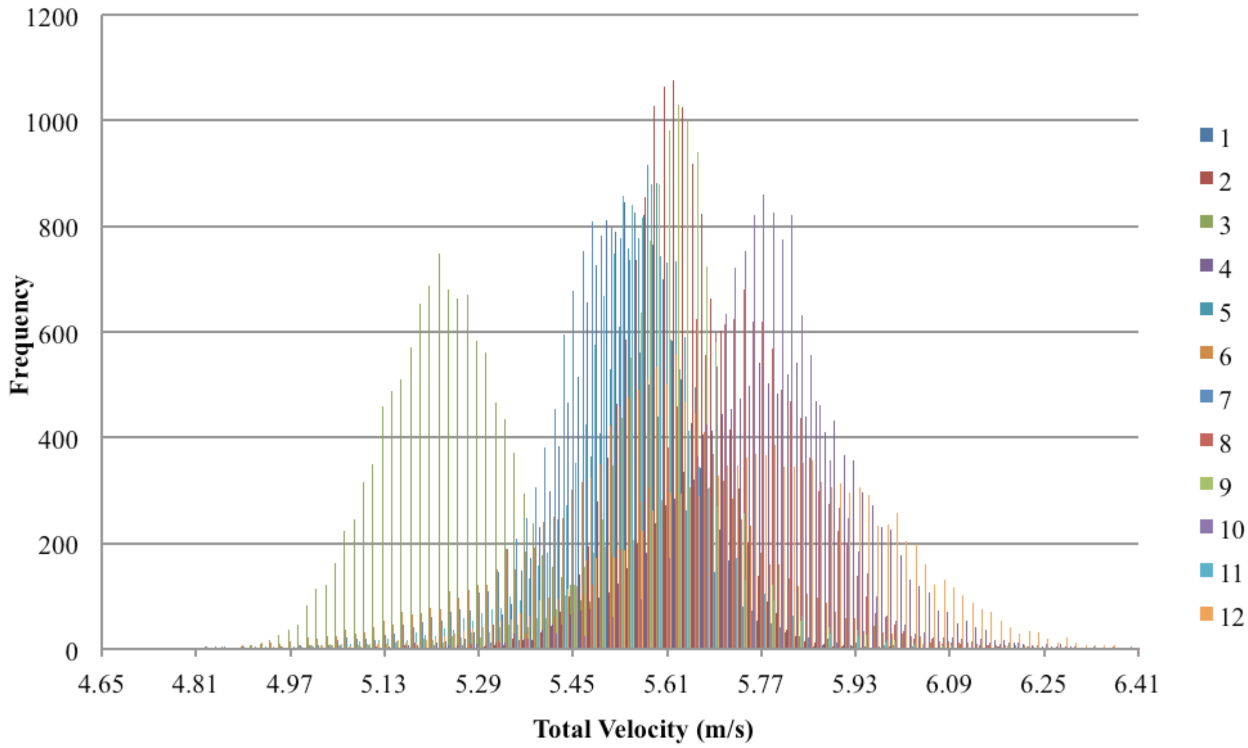


Figure C19. Histogram of 10-second intervals (x_b = 4 ft, blower frequency = 25 Hz, 100 bins).

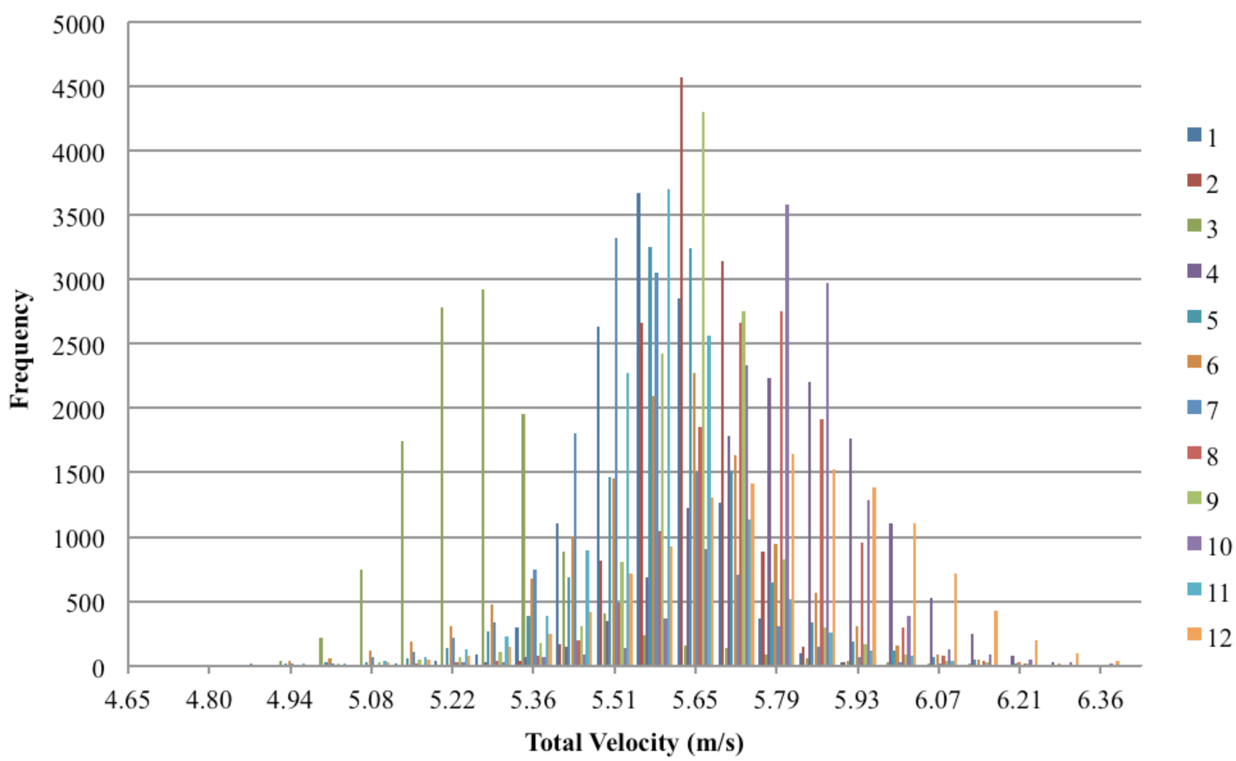
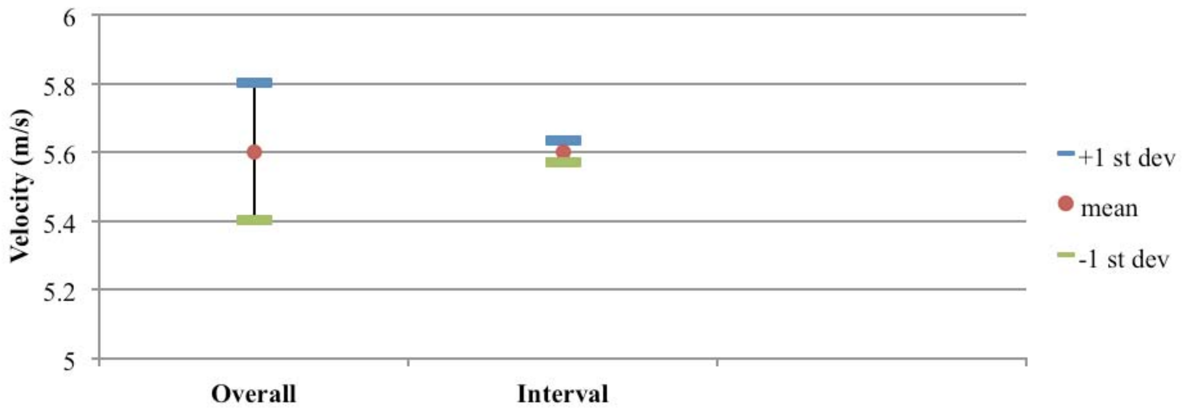
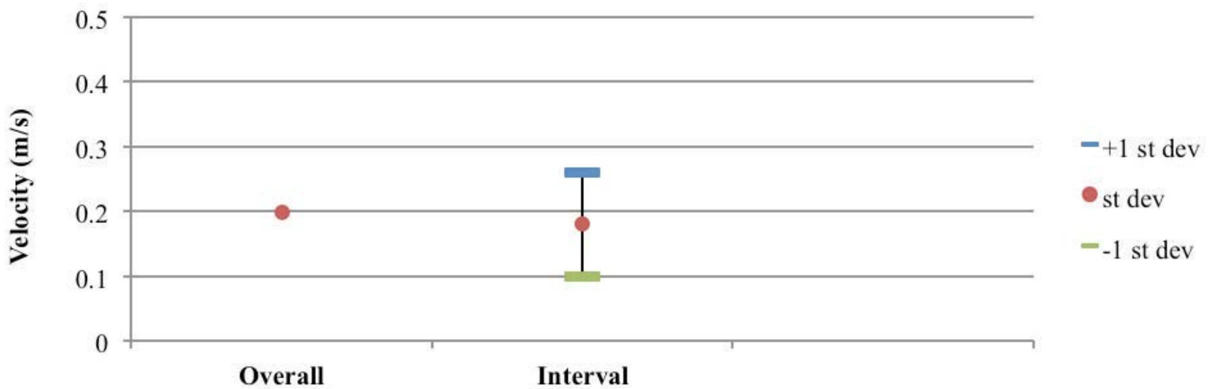


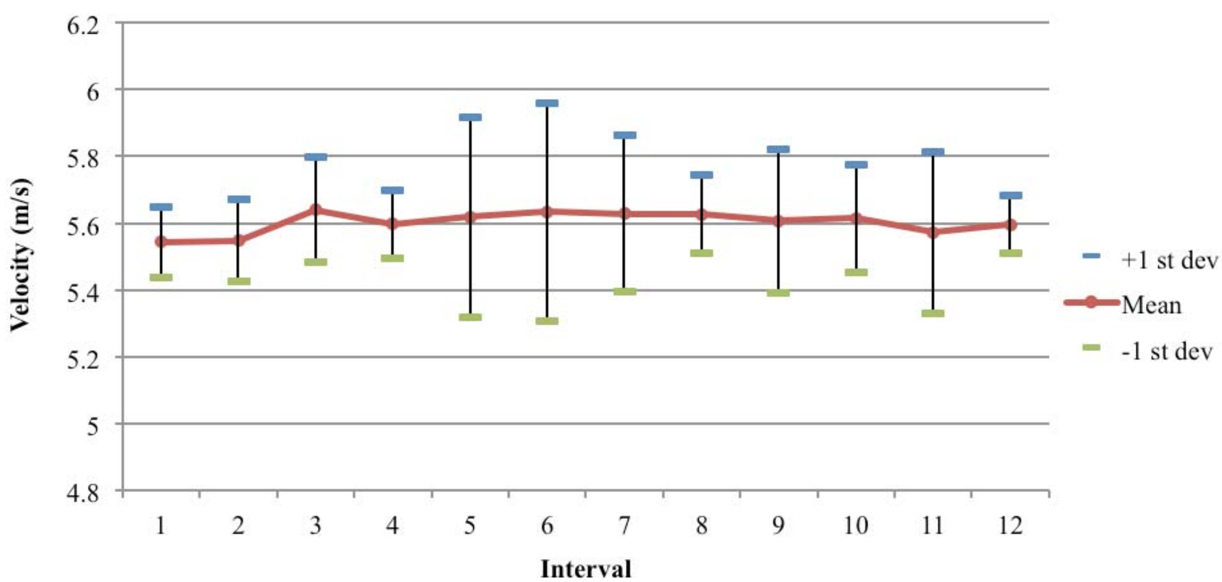
Figure C20. Histogram of 10-second intervals (x_b = 4 ft, blower frequency = 25 Hz, 25 bins).



a) Run 333 average velocity and standard deviation about the average velocity.



b) Run 333 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 333 average velocity from each 10-second interval.

Figure C21. Run 333 total velocity measurements.

Run 334
Blockage Location: x_b = 8 ft
Blower Frequency: 50 Hz
Time: 8:23 AM

Table C22. Run 334 velocity data from 2-minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)
Total Vel	9.9737	13.3955	10.9133	0.2533
u	8.84	13	10.6187	0.2873
v	-4.08	3.72	-0.0109	0.8262
w	-5.78	1.38	-2.2167	0.8528

Table C23. Run 334 total velocity data for each10-second interval and mean and standard deviation data for each interval.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	I_{vel} (%)
1	10.0920	11.4698	10.8165	0.1859	1.719
2	10.1834	11.4732	10.8423	0.1770	1.632
3	10.0449	11.4375	10.7965	0.1861	1.724
4	10.1411	12.4374	11.0177	0.3375	3.063
5	9.9737	11.6551	10.8446	0.1995	1.839
6	10.1038	11.6259	10.8294	0.1880	1.736
7	10.1712	13.3955	11.0526	0.3975	3.597
8	10.1702	11.8442	11.0049	0.2314	2.102
9	10.0759	11.9151	10.9386	0.2146	1.962
10	10.1544	11.8024	10.9958	0.2349	2.136
11	10.2122	11.6677	10.9563	0.2100	1.917
12	10.2118	11.4763	10.8634	0.1810	1.666
		Average	**10.9132**	**0.2286**	**2.091**
		St Dev	**0.0905**	**0.0687**	**0.611**

Table C24. Run 334 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u (%)	I_v (%)	I_w (%)
1	10.6600	0.0418	-1.7457	0.2093	0.2746	0.4796	1.96 %	2.58 %	4.50 %
2	10.6105	-0.0288	-2.1814	0.1820	0.3096	0.3406	1.72 %	2.92 %	3.21 %
3	10.6697	-0.1231	-1.6090	0.1913	0.2732	0.2045	1.79 %	2.56 %	1.92 %
4	10.5614	0.3034	-2.7902	0.4528	0.6303	1.2182	4.29 %	5.97 %	11.53 %
5	10.6032	-0.2506	-2.0644	0.2557	0.4958	0.7640	2.41 %	4.68 %	7.21 %
6	10.6018	-0.3413	-2.0965	0.2011	0.3611	0.4796	1.90 %	3.41 %	4.52 %
7	10.8181	0.4015	-1.7836	0.3504	0.9730	0.9354	3.24 %	8.99 %	8.65 %
8	10.5377	-0.5601	-2.5675	0.4169	1.2923	1.1706	3.96 %	12.26 %	11.11 %
9	10.6143	0.1335	-2.0384	0.2544	1.4031	0.9113	2.40 %	13.22 %	8.59 %
10	10.7009	0.6951	-2.2587	0.2279	0.5300	0.7331	2.13 %	4.95 %	6.85 %
11	10.5316	-0.5967	-2.8588	0.1926	0.4332	0.6455	1.83 %	4.11 %	6.13 %
12	10.5156	0.1936	-2.6048	0.1909	0.6804	0.3834	1.82 %	6.47 %	3.65 %

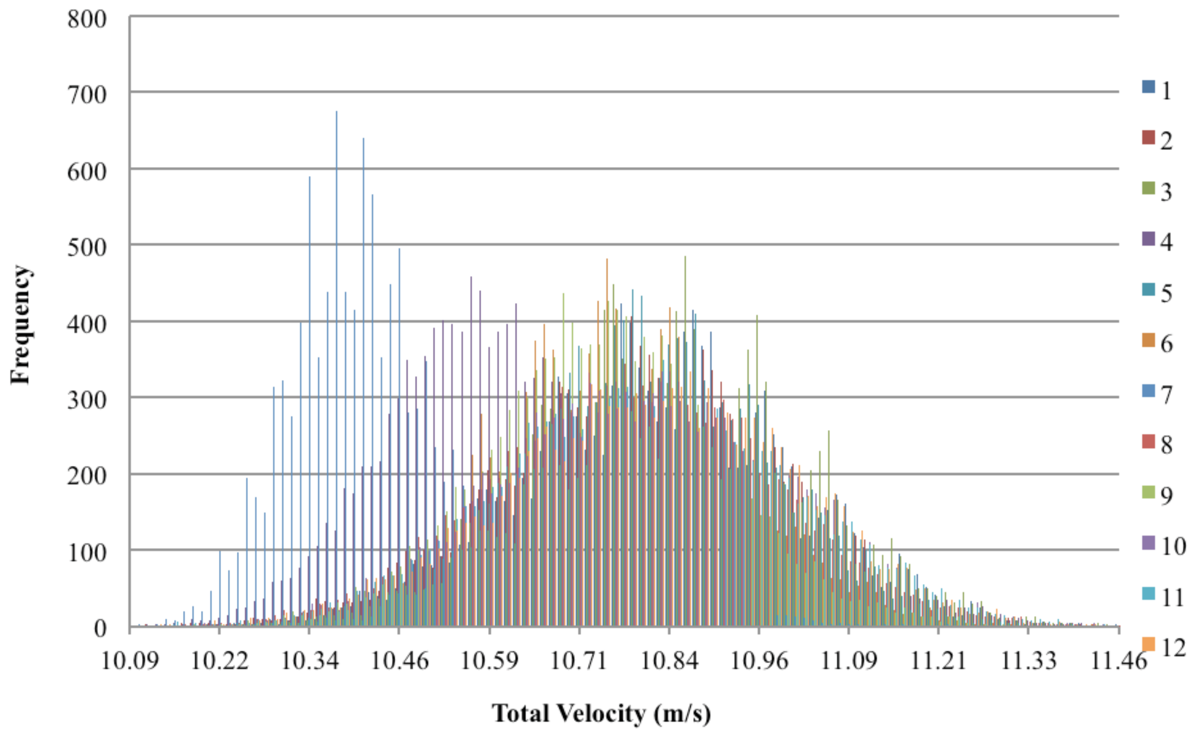


Figure C22. Histogram of 10-second intervals (x_b = 8 ft, blower frequency = 50 Hz, 100 bins).

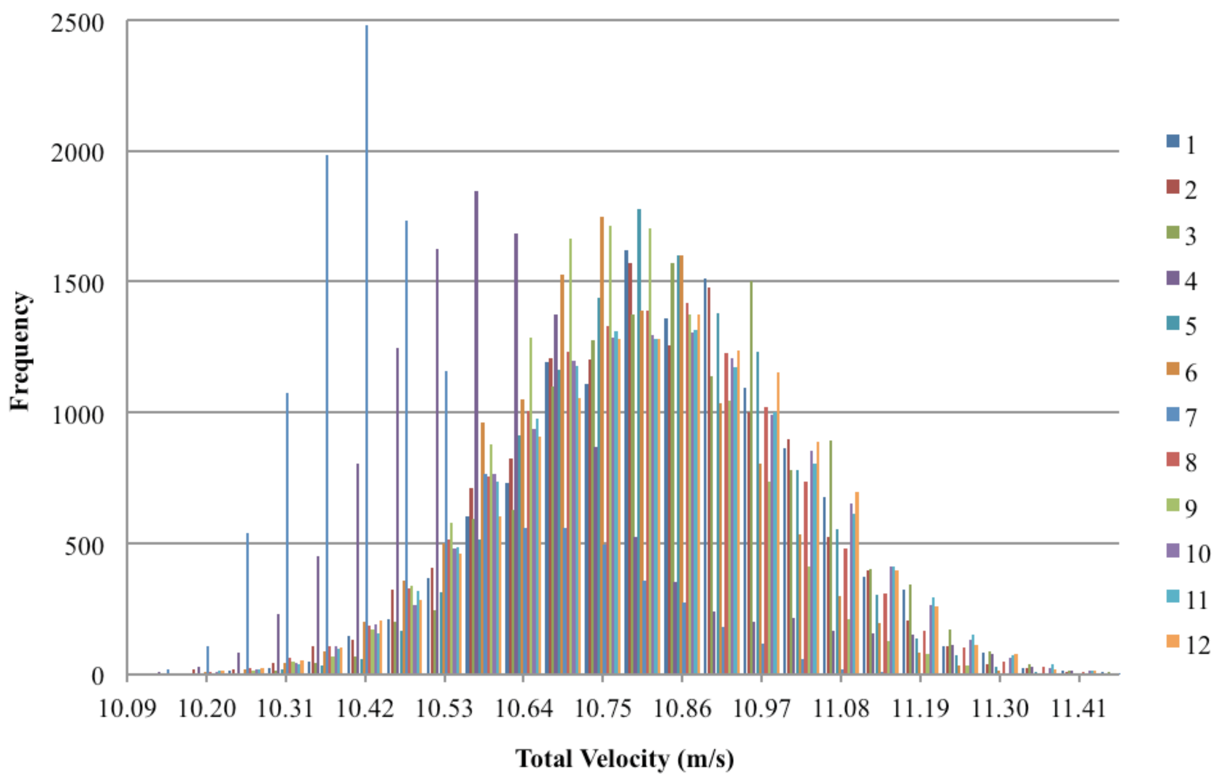
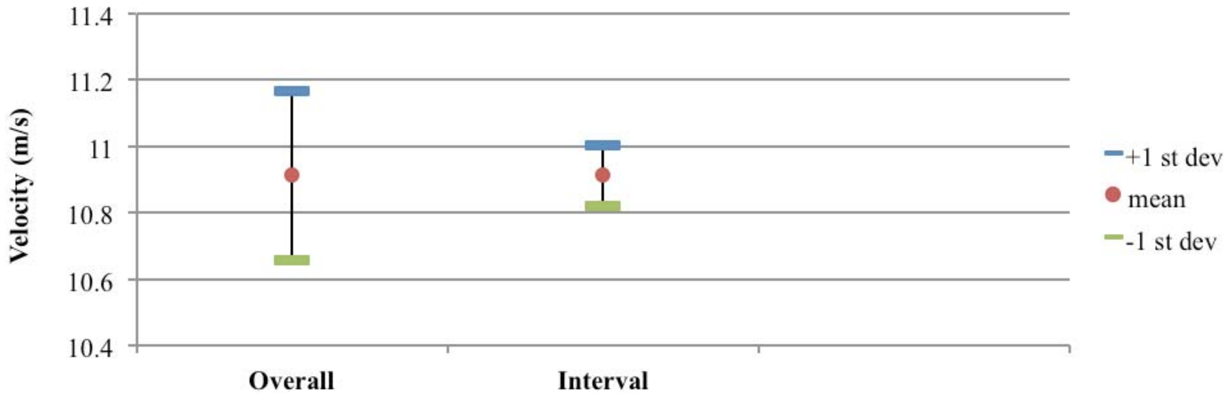
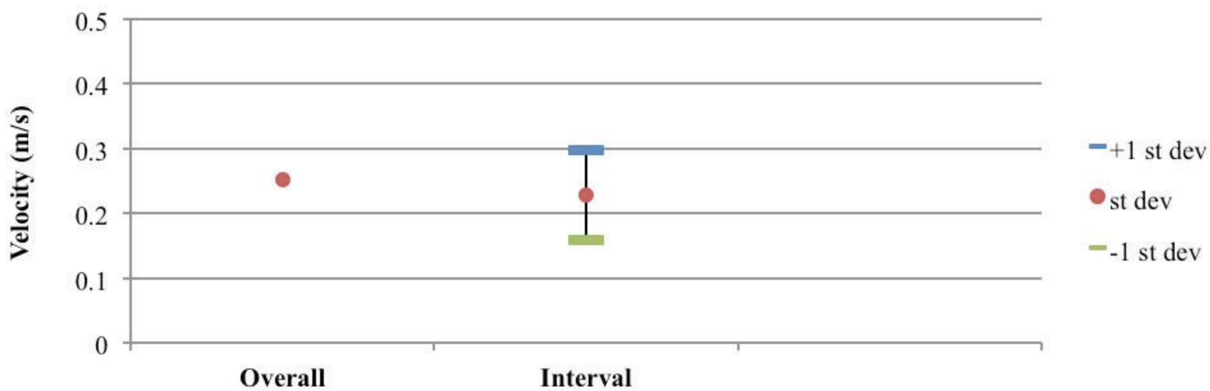


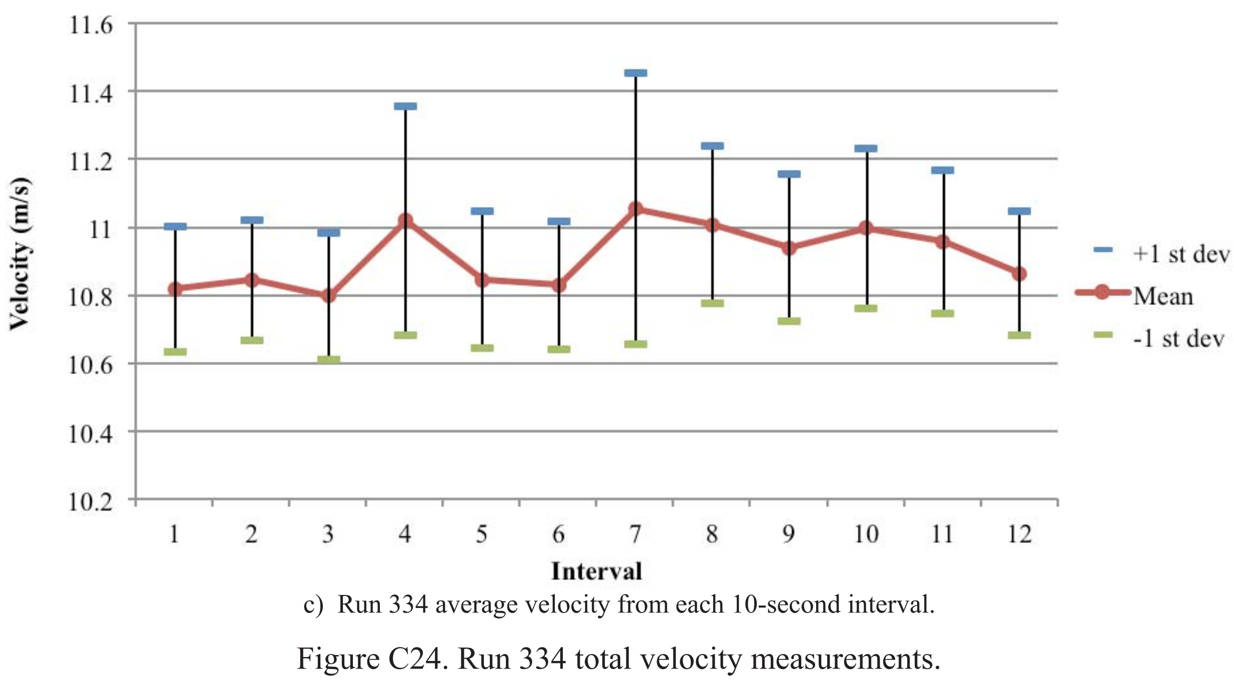
Figure C23. Histogram of 10-second intervals (x_b = 8 ft, blower frequency = 50 Hz, 25 bins).



a) Run 334 average velocity and standard deviation about the average velocity.



b) Run 334 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 334 average velocity from each 10-second interval.

Figure C24. Run 334 total velocity measurements.

Run 335
Blockage Location: x_b = 8 ft
Blower Frequency: 25 Hz
Time: 8:29 AM

Table C25. Run 335 velocity data from 2-minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)
Total Vel	4.4715	6.2408	5.5453	0.0931
u	4.42	6.21	5.4385	0.1090
v	-0.737	1.26	0.1083	0.1888
w	-2.3	0.853	-1.0171	0.2981

Table C26. Run 335 total velocity data for each 10-second interval and mean and standard deviation data for all intervals.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	I_{vel} (%)
1	5.1922	5.8328	5.5295	0.0793	1.435
2	5.2410	5.8151	5.5359	0.0793	1.432
3	5.1949	5.8692	5.5486	0.0837	1.508
4	5.3006	5.9120	5.5685	0.0735	1.320
5	4.7952	6.2104	5.5668	0.1029	1.848
6	4.4715	6.1702	5.5346	0.1416	2.560
7	4.7409	6.2408	5.5400	0.1126	2.033
8	5.1802	5.8499	5.5384	0.0793	1.433
9	5.0962	5.9430	5.5471	0.0897	1.617
10	5.2240	5.8344	5.5381	0.0772	1.394
11	4.9330	5.9555	5.5451	0.0813	1.466
12	4.8917	6.0400	5.5508	0.0844	1.521
		Average	**5.5453**	**0.0904**	**1.631**
		St Dev	**0.0121**	**0.0197**	**0.356**

Table C27. Run 335 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u (%)	I_v (%)	I_w (%)
1	5.4335	0.1747	-0.9958	0.0856	0.1189	0.1280	1.58 %	2.19 %	2.35 %
2	5.4240	0.0841	-1.0788	0.0897	0.1509	0.1770	1.65 %	2.78 %	3.26 %
3	5.3232	0.1661	-1.5186	0.1221	0.1923	0.2708	2.29 %	3.61 %	5.09 %
4	5.4262	-0.0768	-1.2301	0.0817	0.1355	0.1594	1.51 %	2.50 %	2.94 %
5	5.5075	0.1049	-0.7587	0.1072	0.2092	0.1614	1.95 %	3.80 %	2.93 %
6	5.4848	0.2140	-0.5627	0.1433	0.2430	0.3571	2.61 %	4.43 %	6.51 %
7	5.4510	0.2155	-0.9104	0.1155	0.2082	0.2438	2.12 %	3.82 %	4.47 %
8	5.4297	0.1739	-1.0707	0.0853	0.0782	0.0925	1.57 %	1.44 %	1.70 %
9	5.4424	0.2075	-1.0304	0.0943	0.1358	0.1626	1.73 %	2.50 %	2.99 %
10	5.4406	-0.0712	-1.0239	0.0795	0.1059	0.0795	1.46 %	1.95 %	1.46 %
11	5.4267	0.0092	-1.1177	0.0865	0.1212	0.1855	1.59 %	2.23 %	3.42 %
12	5.4718	0.0972	-0.9074	0.0898	0.1319	0.1415	1.64 %	2.41 %	2.59 %

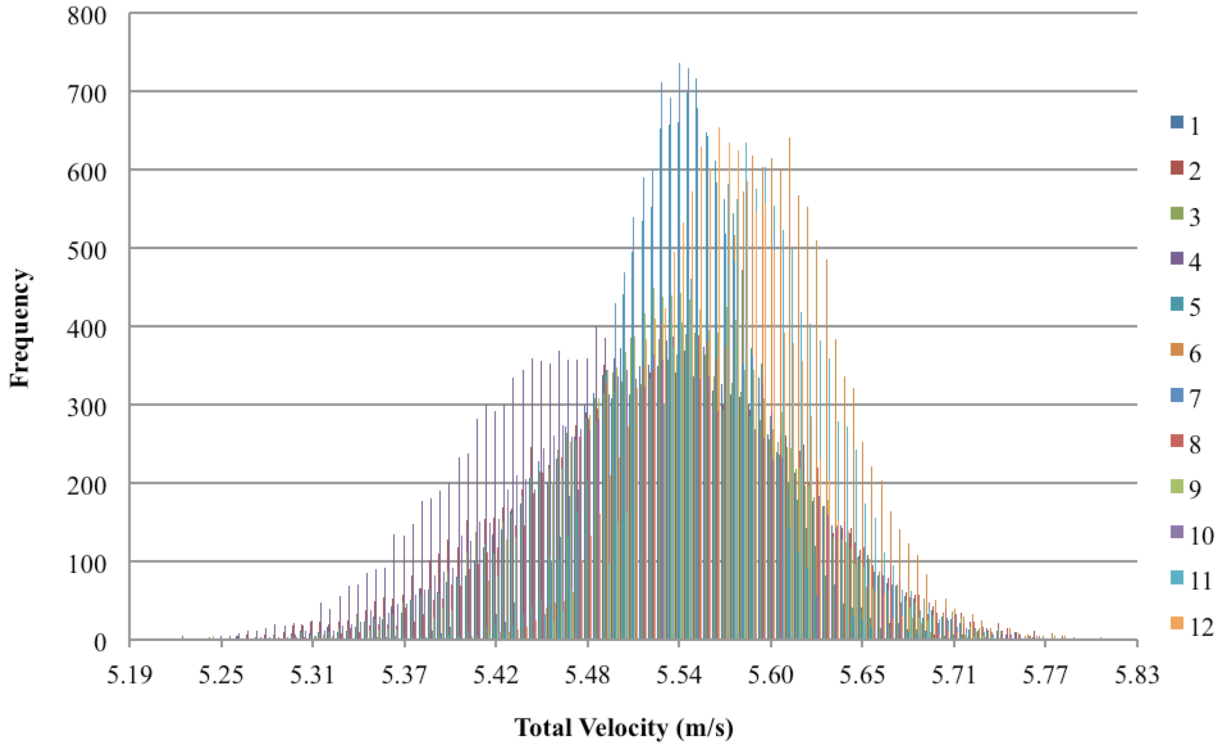


Figure C25. Histogram of 10-second intervals (x_b = 8 ft, blower frequency = 25 Hz, 100 bins).

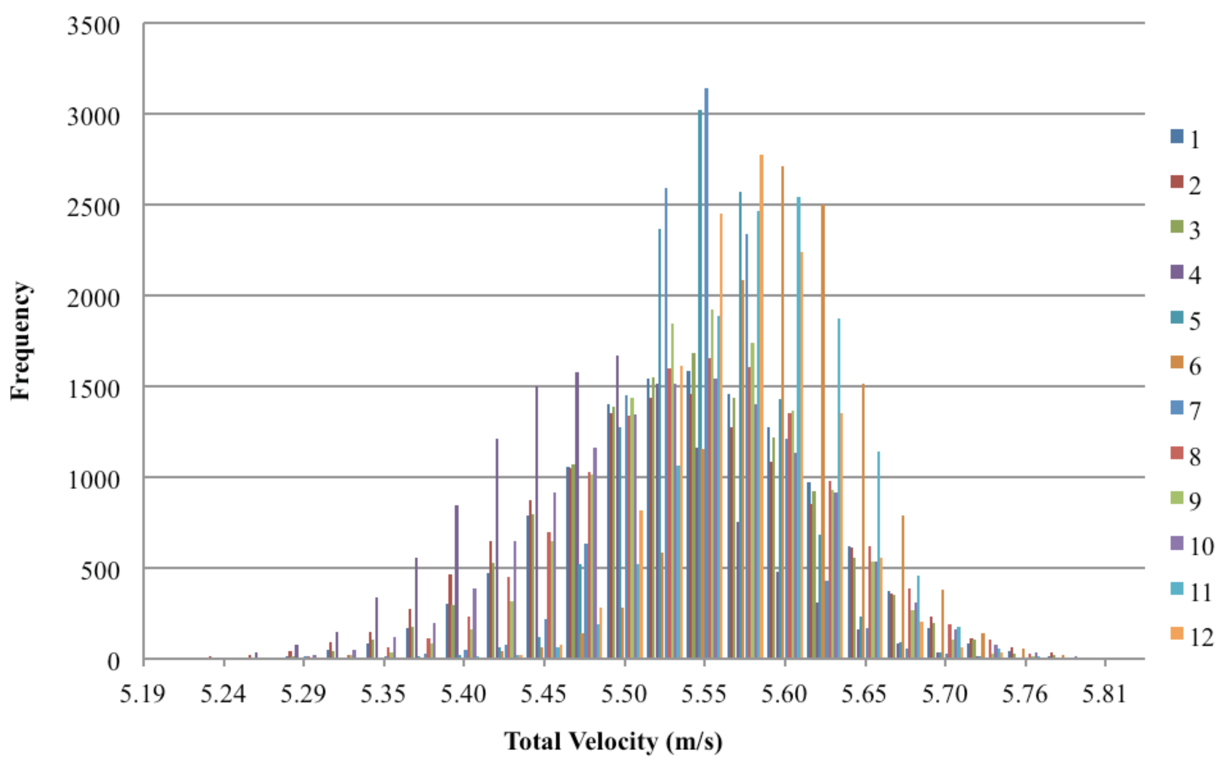
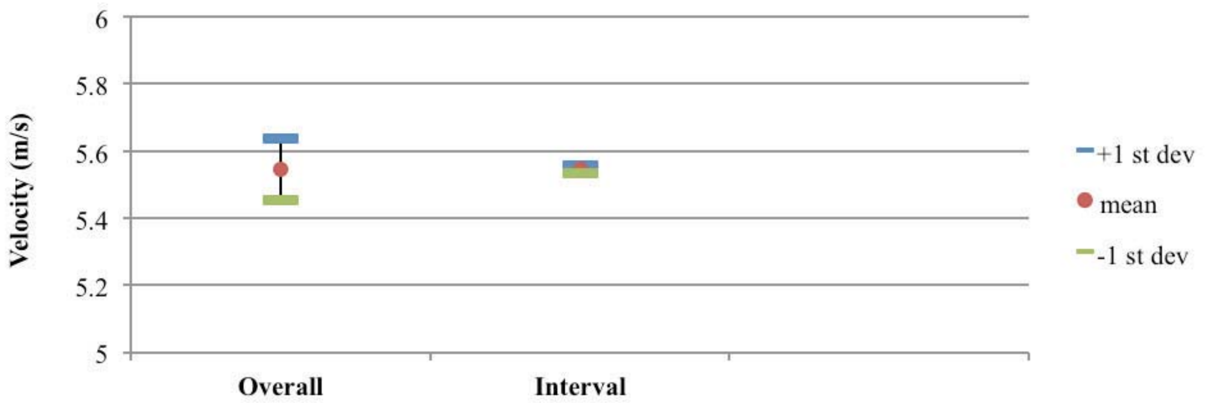
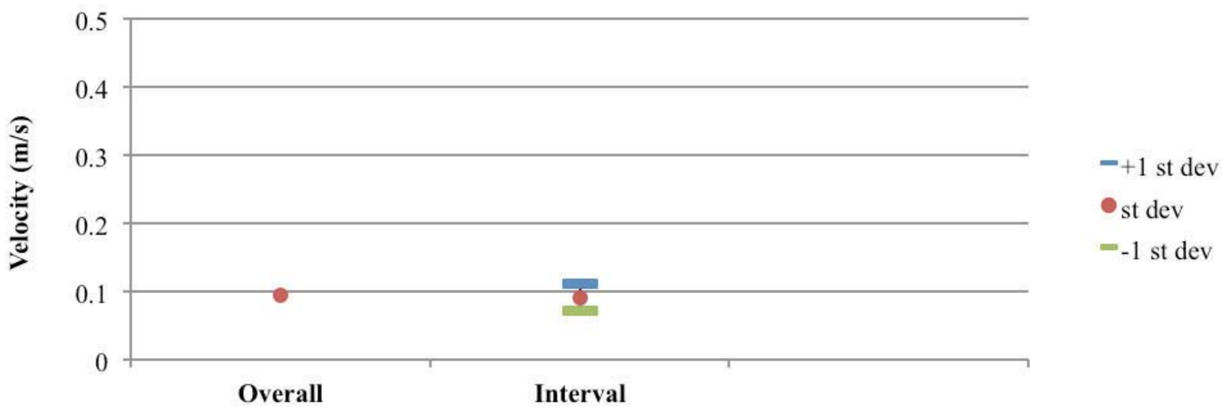


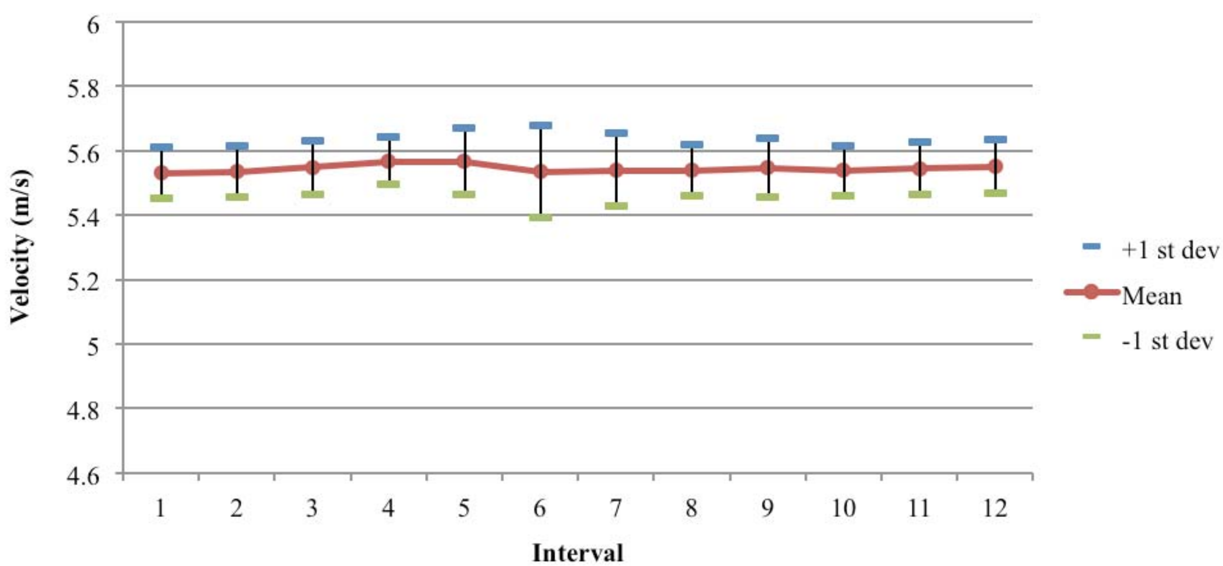
Figure C26. Histogram of 10-second intervals (x_b = 8 ft, blower frequency = 25 Hz, 25 bins).



a) Run 335 average velocity and standard deviation about the average velocity.



b) Run 335 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 335 average velocity from each 10-second interval.

Figure C27. Run 335 total velocity measurements.

Run 336
Blockage Location: x_b = 12 ft
Blower Frequency: 50 Hz
Time: 8:41 AM

Table C28. Run 336 velocity data from 2-minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)
Total Vel	9.9480	12.2172	10.8924	0.2141
u	8.18	11.8	10.5670	0.2906
v	-4.01	5.42	0.3120	0.9213
w	-5.77	1.03	-2.2958	0.8535

Table C29. Run 336 total velocity data for each 10-second interval and mean and standard deviation data for each interval.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	I_{tot} (%)
1	10.0725	12.2172	10.9843	0.2372	2.160
2	10.0103	11.5298	10.8581	0.1792	1.650
3	10.1604	11.9038	10.9085	0.1945	1.783
4	9.9513	12.0345	10.8523	0.2482	2.287
5	9.9479	11.4637	10.7677	0.1795	1.667
6	10.1498	11.5140	10.7761	0.1808	1.678
7	10.0478	11.4802	10.8245	0.1879	1.736
8	10.1377	11.5659	10.8879	0.1955	1.796
9	10.0253	11.6061	10.9129	0.1825	1.672
10	10.1063	11.6636	10.9600	0.1914	1.747
11	10.2557	11.6885	10.9826	0.1931	1.758
12	10.1523	11.7879	10.9940	0.2180	1.983
		Average	**10.8924**	**0.1990**	**1.826**
		St Dev	**0.0789**	**0.0230**	**0.207**

Table C30. Run 336 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u (%)	I_v (%)	I_w (%)
1	10.1542	1.8927	-3.5490	0.4127	0.8368	0.7460	4.06 %	8.24 %	7.35 %
2	10.5964	0.0943	-2.2268	0.2036	0.6510	0.4645	1.92 %	6.14 %	4.38 %
3	10.7642	-0.3901	-1.4151	0.2164	0.8567	0.4809	2.01 %	7.96 %	4.47 %
4	10.6104	-0.2125	-1.9256	0.1998	1.0071	0.6682	1.88 %	9.49 %	6.30 %
5	10.5629	-0.1337	-2.0385	0.1821	0.3482	0.2745	1.72 %	3.30 %	2.60 %
6	10.6402	-0.3291	-1.6233	0.1929	0.2412	0.3244	1.81 %	2.27 %	3.05 %
7	10.6512	0.0803	-1.8222	0.1863	0.5799	0.2481	1.75 %	5.44 %	2.33 %
8	10.6385	0.4753	-1.9916	0.2028	0.9723	0.4778	1.91 %	9.14 %	4.49 %
9	10.5046	0.2975	-2.8600	0.2142	0.4560	0.5072	2.04 %	4.34 %	4.83 %
10	10.7375	0.5878	-1.9502	0.1974	0.6541	0.4999	1.84 %	6.09 %	4.66 %
11	10.6036	0.6150	-2.6190	0.2223	0.7439	0.6159	2.10 %	7.02 %	5.81 %
12	10.3413	0.7661	-3.5251	0.3448	0.5353	0.7440	3.33 %	5.18 %	7.19 %

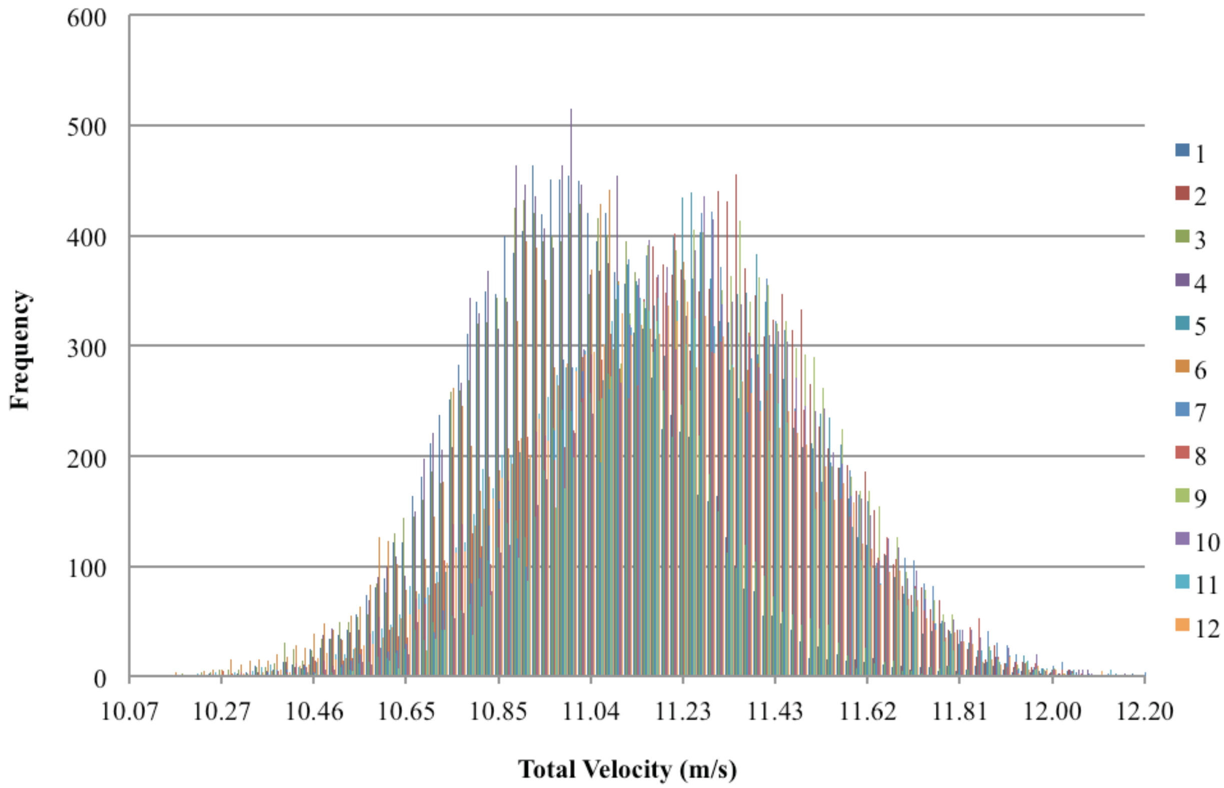


Figure C28. Histogram of 10-second intervals (x_b = 12 ft, blower frequency = 50 Hz, 100 bins).

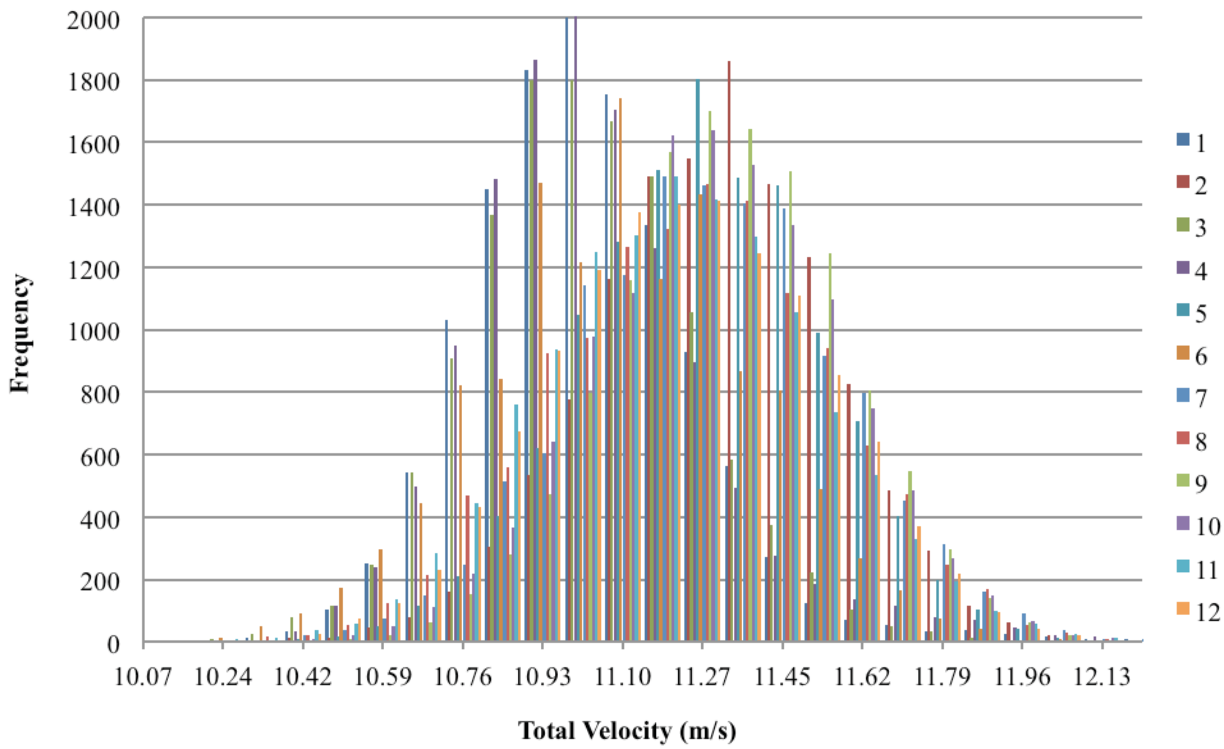
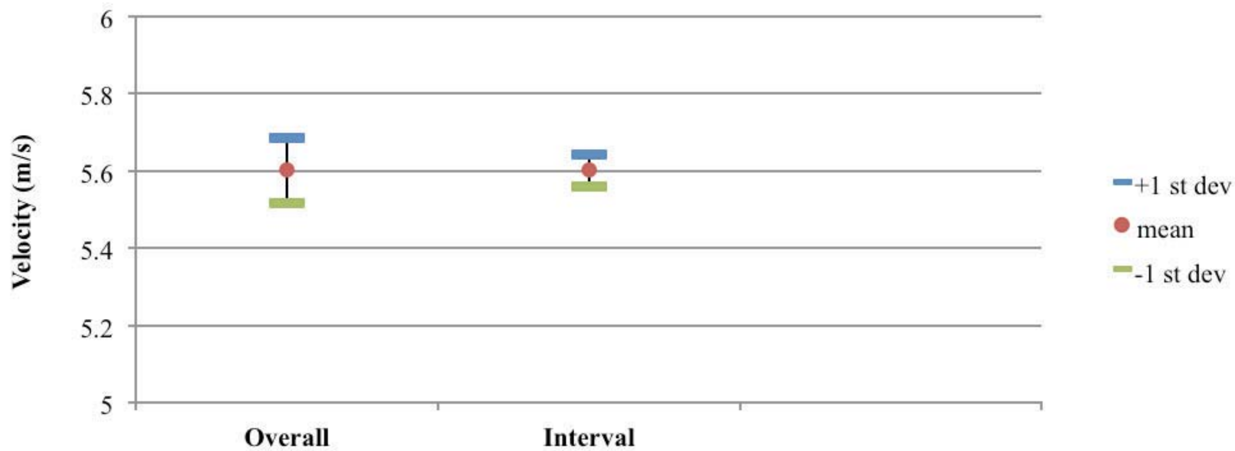
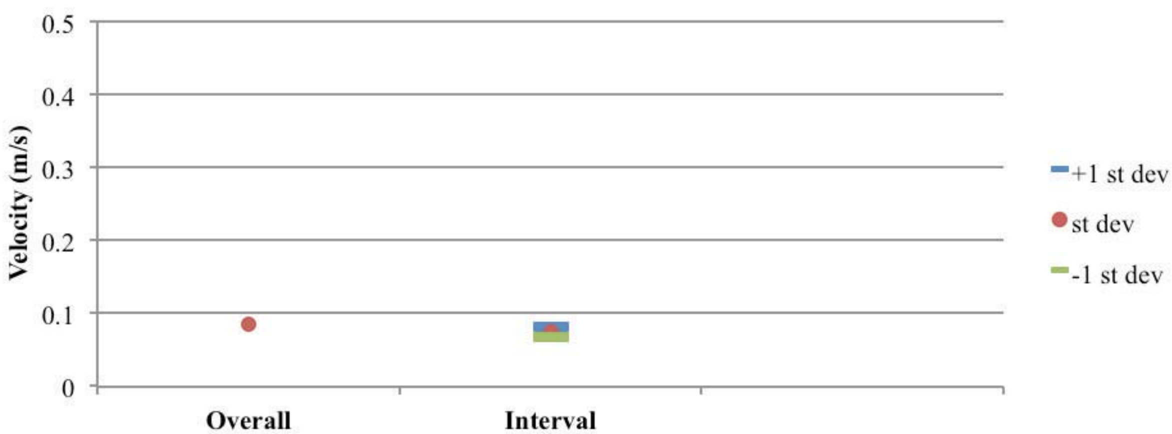


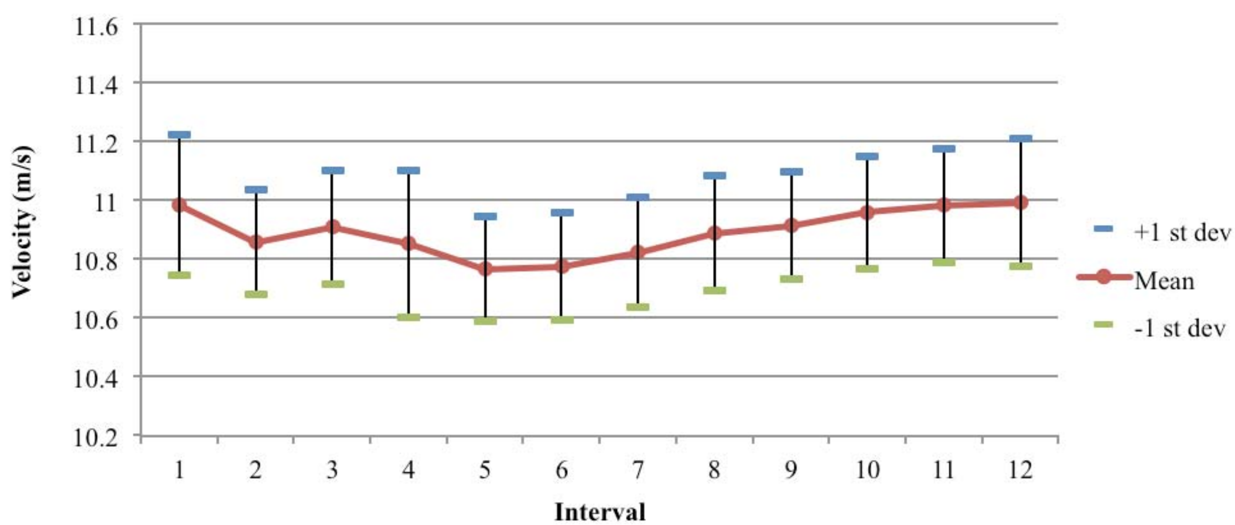
Figure C29. Histogram of 10-second intervals (x_b = 12 ft, blower frequency = 50 Hz, 25 bins).



a) Run 336 average velocity and standard deviation about the average velocity.



b) Run 336 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 336 average velocity from each 10-second interval.

Figure C30. Run 336 total velocity measurements.

Run 337
Blockage Location: x_b = 12 ft
Blower Frequency: 25 Hz
Time: 8:48 AM

Table C31. Run 337 velocity data from 2-minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)
Total Vel	5.2856	6.0680	5.6027	0.0844
u	5.1	5.99	5.4817	0.0967
v	-0.55	1.48	0.1799	0.2213
w	-1.91	-0.145	-1.0916	0.2553

Table C32. Run 337 total velocity data for each 10-second interval and mean and standard deviation data for each interval.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	I_{vel} (%)
1	5.3108	5.8593	5.6034	0.0719	1.283
2	5.4008	5.9178	5.6689	0.0702	1.238
3	5.3572	6.0679	5.6885	0.0917	1.612
4	5.2961	5.9006	5.5981	0.0763	1.364
5	5.2856	5.8662	5.5732	0.0802	1.439
6	5.3286	5.8589	5.6015	0.0761	1.359
7	5.3200	5.8652	5.6151	0.0755	1.346
8	5.3333	5.9027	5.6155	0.0716	1.275
9	5.2974	5.8391	5.5808	0.0691	1.238
10	5.3124	5.8357	5.5630	0.0685	1.231
11	5.3186	5.8578	5.5705	0.0708	1.272
12	5.3032	5.8116	5.5527	0.0708	1.275
		Average	**5.6026**	**0.0744**	**1.328**
		St Dev	**0.0410**	**0.0064**	**0.109**

Table C33. Run 337 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u (%)	I_v (%)	I_w (%)
1	5.4580	-0.0586	-1.2467	0.0746	0.1224	0.1893	1.37 %	2.24 %	3.47 %
2	5.5111	0.2174	-1.2895	0.0789	0.1611	0.1679	1.43 %	2.92 %	3.05 %
3	5.6135	0.3705	-0.7557	0.0929	0.3049	0.2150	1.66 %	5.43 %	3.83 %
4	5.4964	0.4022	-0.9561	0.0894	0.1363	0.1786	1.63 %	2.48 %	3.25 %
5	5.4824	0.2747	-0.9307	0.0962	0.2006	0.1421	1.75 %	3.66 %	2.59 %
6	5.5287	0.0033	-0.8743	0.0845	0.1664	0.1336	1.53 %	3.01 %	2.42 %
7	5.4518	0.1913	-1.2814	0.0966	0.1557	0.3192	1.77 %	2.86 %	5.85 %
8	5.4238	0.2709	-1.3964	0.0784	0.2340	0.1973	1.45 %	4.31 %	3.64 %
9	5.4496	0.1154	-1.1694	0.0744	0.2006	0.1605	1.37 %	3.68 %	2.95 %
10	5.4564	0.0494	-1.0717	0.0734	0.1048	0.1109	1.35 %	1.92 %	2.03 %
11	5.4722	0.1517	-1.0196	0.0767	0.1162	0.0955	1.40 %	2.12 %	1.75 %
12	5.4371	0.1702	-1.1073	0.0769	0.0946	0.0767	1.41 %	1.74 %	1.41 %

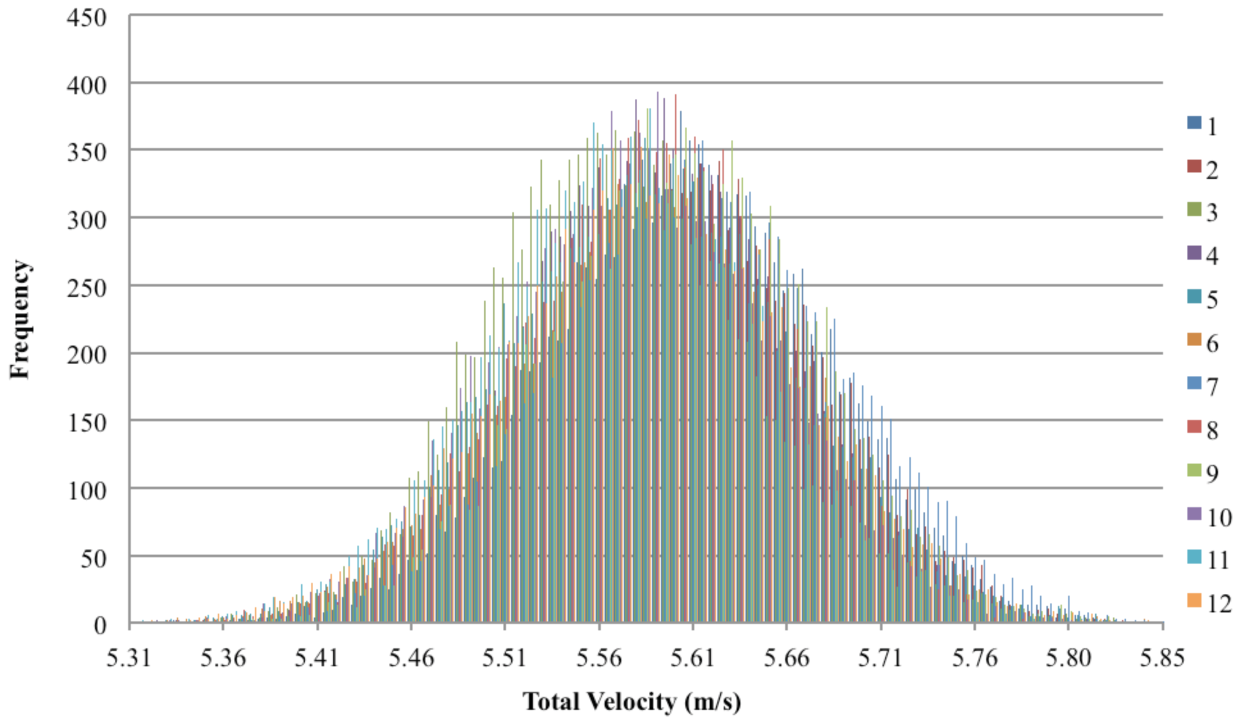


Figure C31. Histogram of 10-second intervals (x_b = 12 ft, blower frequency = 25 Hz, 100 bins).

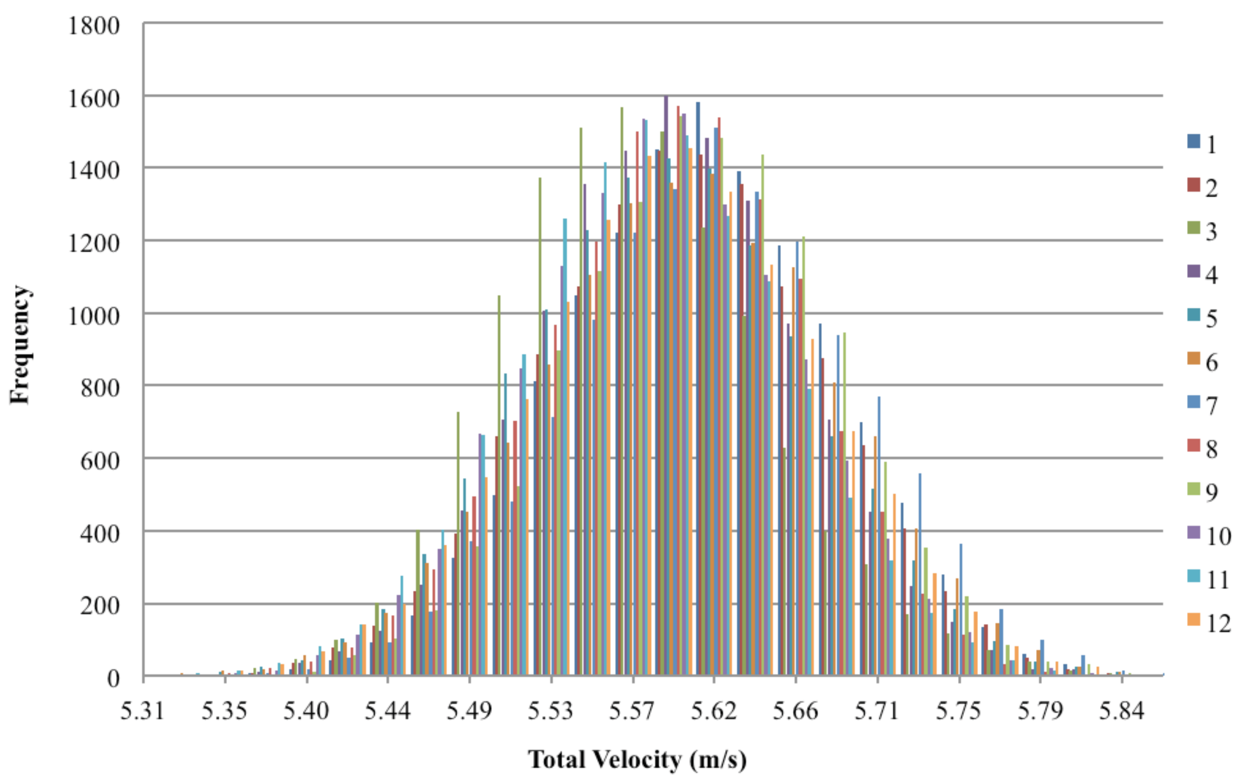
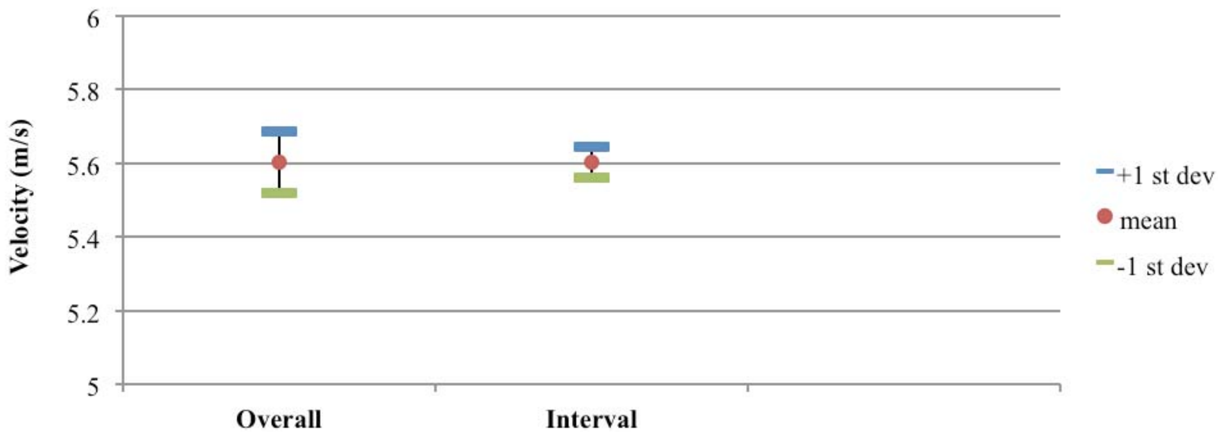
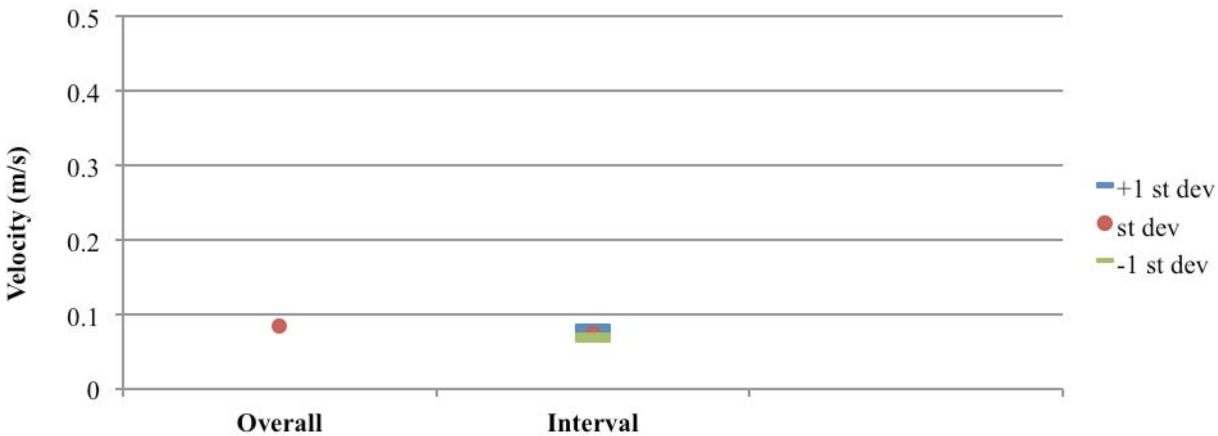


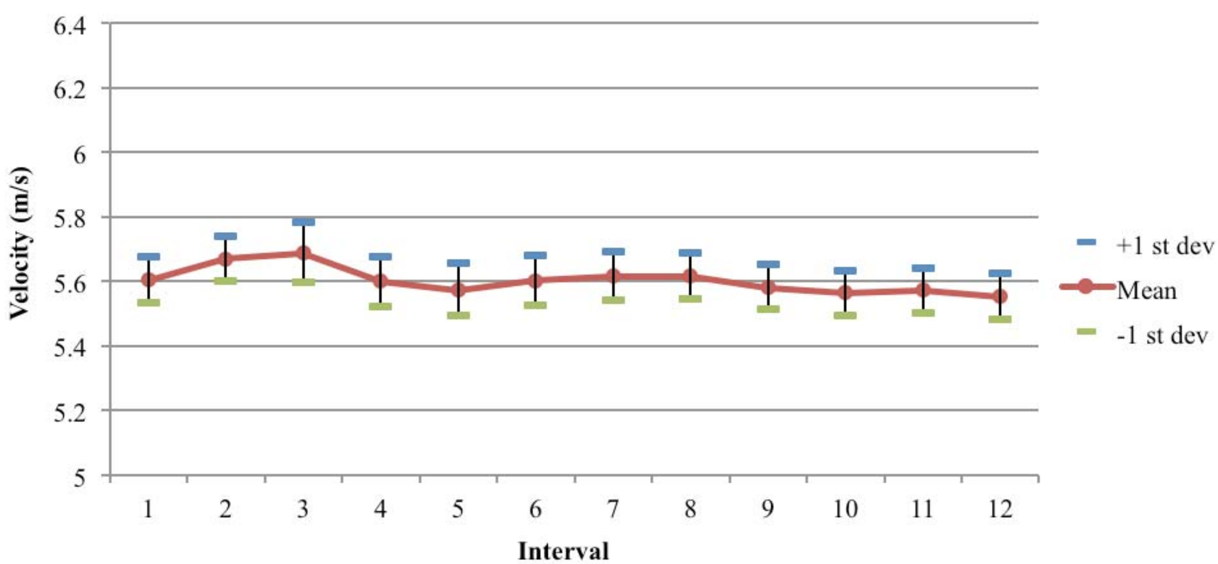
Figure C32. Histogram of 10-second intervals (x_b = 12 ft, blower frequency = 25 Hz, 25 bins).



a) Run 337 average velocity and standard deviation about the average velocity.



b) Run 337 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 337 average velocity from each 10-second interval.

Figure C33. Run 337 total velocity measurements.

Run 338
Blockage Location: x_b = 20 ft
Blower Frequency: 50 Hz
Time: 8:58 AM

Table C34. Run 338 velocity data from 2-minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)
Total Vel	10.0856	11.5957	10.8803	0.1826
u	9.71	11.5	10.6340	0.1995
v	-1.46	2.03	0.1377	0.3974
w	-3.73	0.216	-2.1921	0.5568

Table C35. Run 338 total velocity data for each 10-second interval and mean and standard deviation data for each interval.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	I_{tot} (%)
1	10.0856	11.4543	10.8231	0.1755	1.622
2	10.2056	11.5502	10.9164	0.1765	1.617
3	10.2195	11.5540	10.8853	0.1786	1.640
4	10.2117	11.4586	10.8450	0.1747	1.611
5	10.2330	11.4540	10.8953	0.1720	1.579
6	10.3310	11.5956	10.9867	0.1633	1.486
7	10.2918	11.5450	10.9558	0.1732	1.581
8	10.2518	11.5133	10.9085	0.1684	1.543
9	10.2658	11.5355	10.9444	0.1663	1.519
10	10.1248	11.3960	10.8179	0.1706	1.577
11	10.1085	11.4243	10.7956	0.1688	1.564
12	10.1491	11.3860	10.7890	0.1688	1.565
		Average	**10.8802**	**0.1714**	**1.575**
		St Dev	**0.0656**	**0.0045**	**0.044**

Table C36. Run 338 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u (%)	I_v (%)	I_w (%)
1	10.6822	0.0549	-1.6226	0.1866	0.3837	0.4931	1.75 %	3.59 %	4.62 %
2	10.8237	0.2612	-1.3058	0.1855	0.3868	0.3016	1.71 %	3.57 %	2.79 %
3	10.7217	0.5143	-1.7461	0.1921	0.4285	0.1829	1.79 %	4.00 %	1.71 %
4	10.6630	0.2848	-1.9352	0.1850	0.2535	0.1463	1.73 %	2.38 %	1.37 %
5	10.6044	0.2529	-2.4400	0.1800	0.2888	0.3871	1.70 %	2.72 %	3.65 %
6	10.6144	0.1952	-2.8035	0.1771	0.3042	0.2176	1.67 %	2.87 %	2.05 %
7	10.6334	0.2940	-2.5400	0.2007	0.3401	0.5441	1.89 %	3.20 %	5.12 %
8	10.6072	0.3813	-2.4847	0.1804	0.2551	0.3086	1.70 %	2.41 %	2.91 %
9	10.5450	0.1280	-2.9032	0.1891	0.2273	0.2789	1.79 %	2.16 %	2.65 %
10	10.5819	-0.0691	-2.2281	0.1784	0.2112	0.1857	1.69 %	2.00 %	1.76 %
11	10.5965	-0.1595	-2.0374	0.1785	0.1897	0.2139	1.68 %	1.79 %	2.02 %
12	10.5345	-0.4854	-2.2582	0.1749	0.2370	0.1831	1.66 %	2.25 %	1.74 %

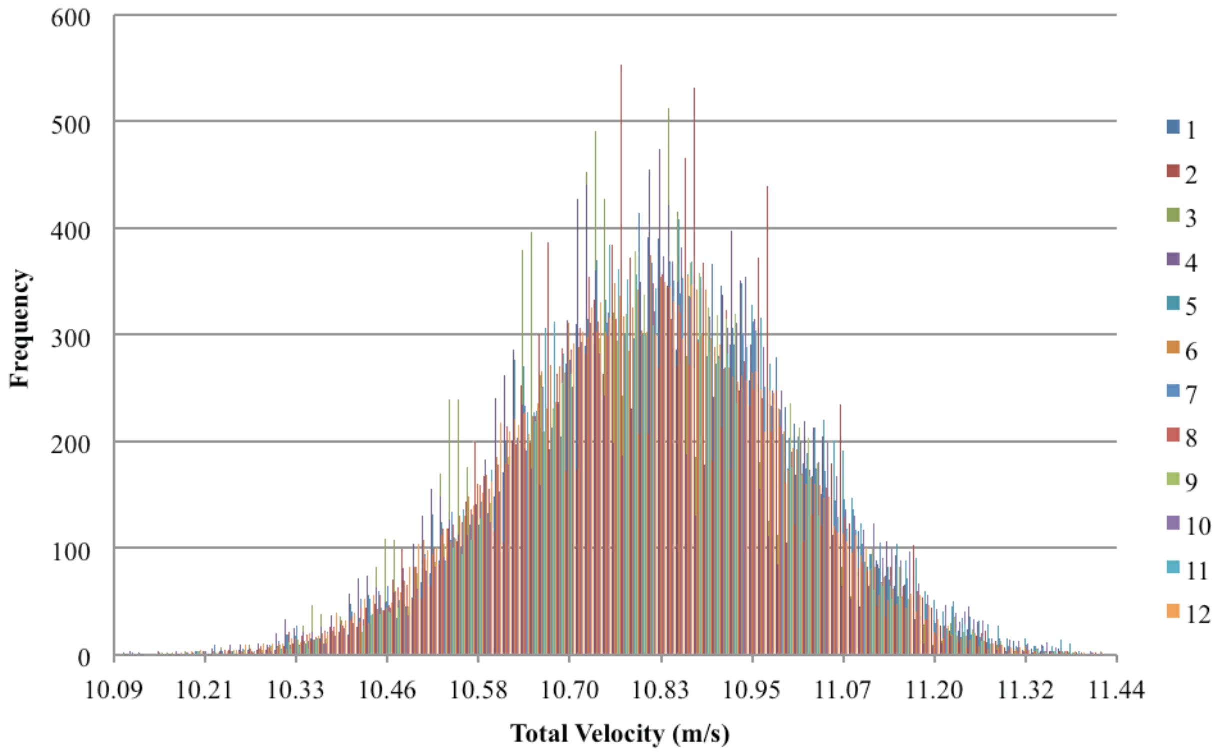


Figure C34. Histogram of 10-second intervals (x_b = 20 ft, blower frequency = 50 Hz, 100 bins).

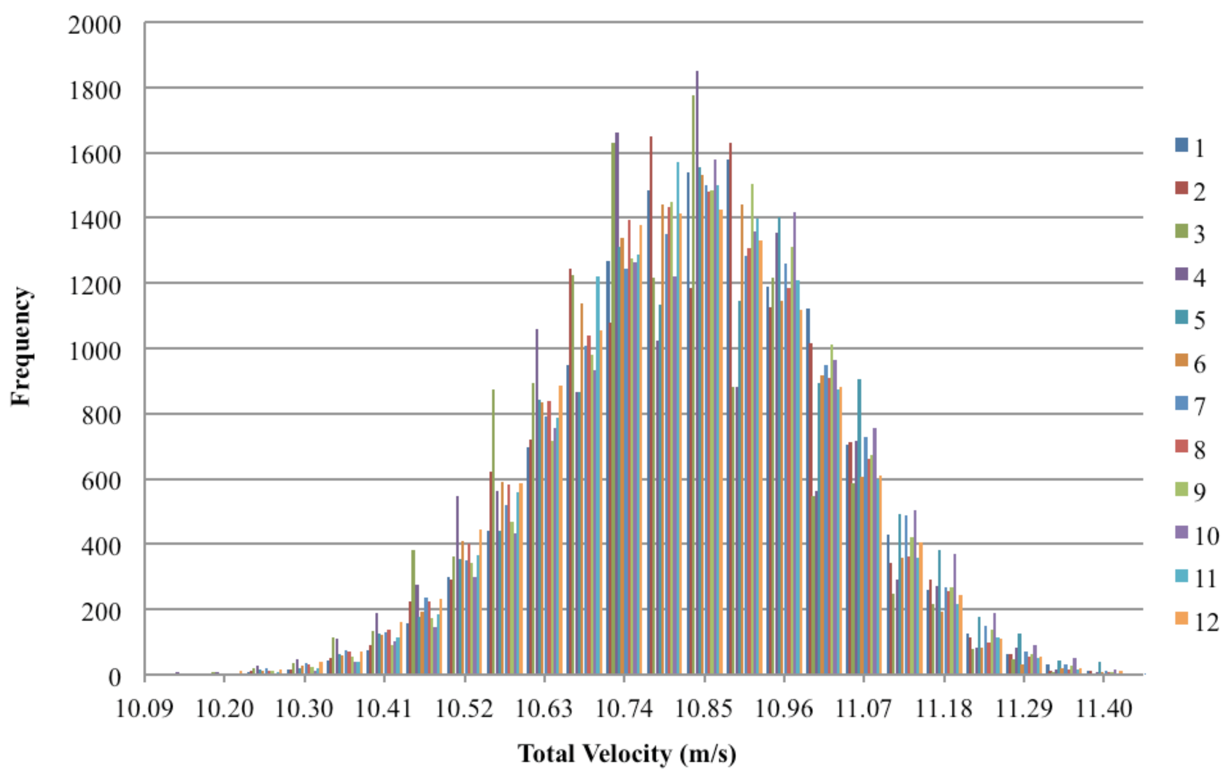
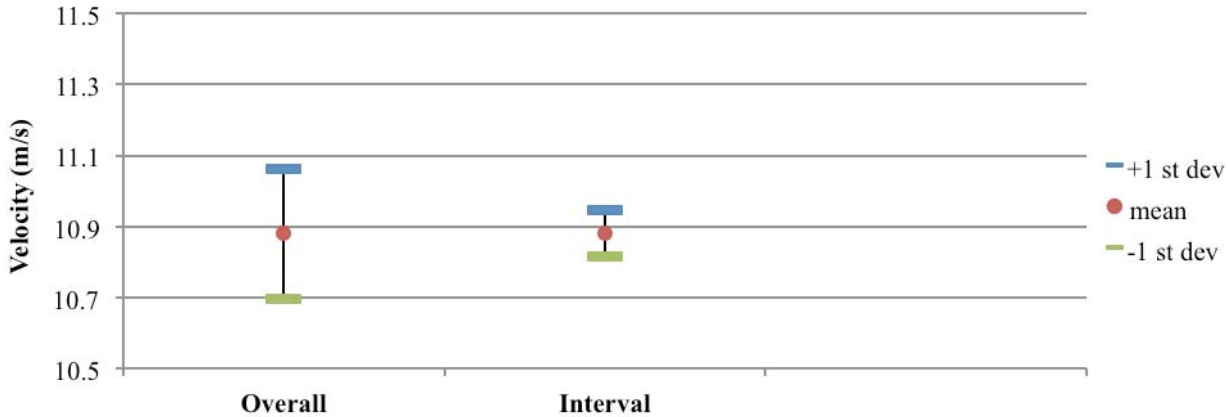
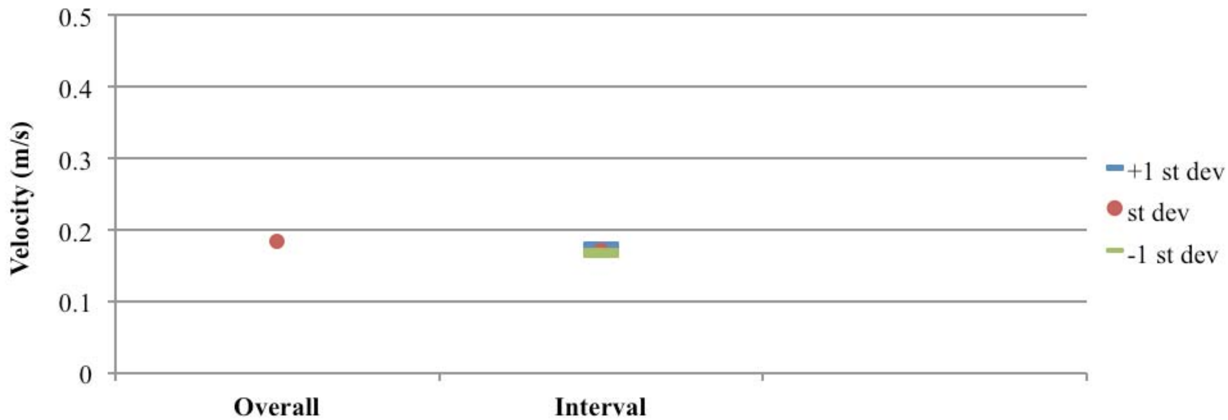


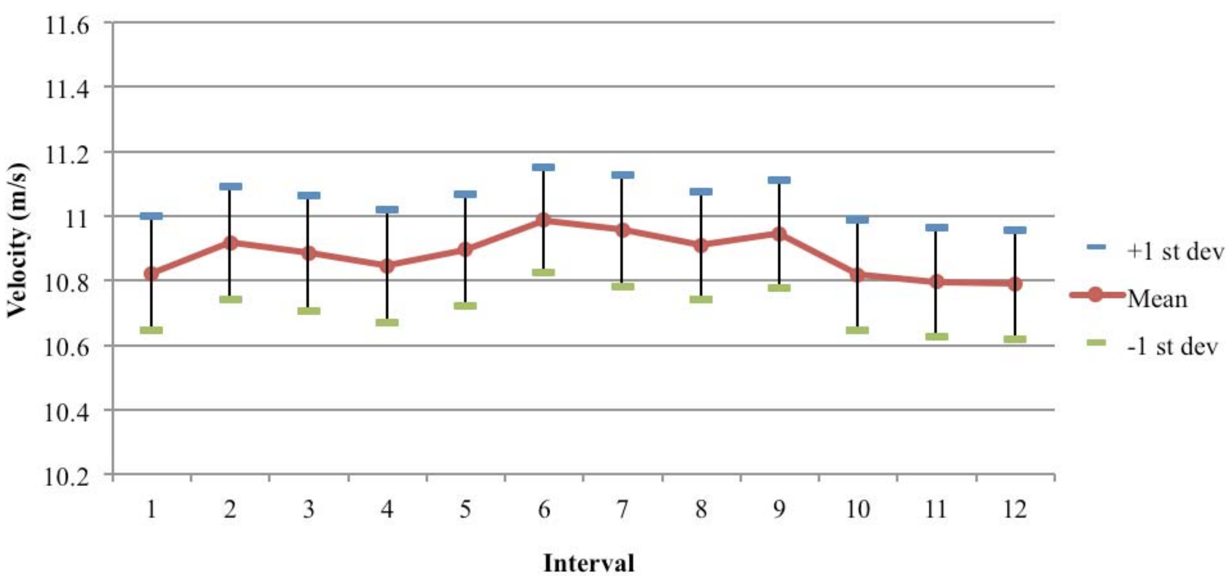
Figure C35. Histogram of 10-second intervals (x_b = 20 ft, blower frequency = 50 Hz, 25 bins).



a) Run 338 average velocity and standard deviation about the average velocity.



b) Run 338 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 338 average velocity from each 10-second interval.

Figure C36. Run 338 total velocity measurements.

Run 339
Blockage Location: x_b = 20 ft
Blower Frequency: 25 Hz
Time: 9:05 AM

Table C37. Run 339 velocity data from 2-minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)
Total Vel	5.2100	5.8598	5.5189	0.0714
u	5.1	5.75	5.4096	0.0750
v	-0.412	0.475	-0.0079	0.1314
w	-1.61	-0.725	-1.0788	0.1141

Table C38. Run 339 total velocity data for each 10-second interval and mean and standard deviation data for each interval.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	I_{tot} (%)
1	5.2883	5.8319	5.5571	0.0684	1.231
2	5.2579	5.8597	5.5207	0.0739	1.340
3	5.2405	5.8040	5.5142	0.0711	1.290
4	5.2600	5.7848	5.5250	0.0691	1.250
5	5.2529	5.8203	5.5099	0.0712	1.292
6	5.2477	5.8001	5.5114	0.0718	1.303
7	5.2578	5.7525	5.5153	0.0697	1.264
8	5.2099	5.7565	5.5024	0.0684	1.243
9	5.2358	5.7793	5.5146	0.0696	1.262
10	5.2185	5.8273	5.5207	0.0708	1.282
11	5.2406	5.7589	5.5191	0.0713	1.292
12	5.2694	5.7567	5.5158	0.0665	1.207
		Average	**5.5189**	**0.0701**	**1.271**
		St Dev	**0.0133**	**0.0019**	**0.035**

Table C39. Run 339 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u (%)	I_v (%)	I_w (%)
1	5.4132	-0.0184	-1.2461	0.0725	0.1064	0.1179	1.34 %	1.97 %	2.18 %
2	5.4154	-0.0961	-1.0606	0.0772	0.0950	0.0944	1.43 %	1.75 %	1.74 %
3	5.4051	-0.1802	-1.0722	0.0738	0.0746	0.0577	1.36 %	1.38 %	1.07 %
4	5.4124	-0.1052	-1.0990	0.0725	0.0763	0.0824	1.34 %	1.41 %	1.52 %
5	5.3938	-0.1008	-1.1145	0.0759	0.0926	0.0747	1.41 %	1.72 %	1.38 %
6	5.4238	0.0123	-0.9705	0.0763	0.0808	0.0908	1.41 %	1.49 %	1.67 %
7	5.4164	0.0940	-1.0276	0.0741	0.0978	0.0812	1.37 %	1.81 %	1.50 %
8	5.4005	0.0848	-1.0440	0.0737	0.0962	0.0706	1.36 %	1.78 %	1.31 %
9	5.4069	0.1016	-1.0723	0.0741	0.0838	0.0922	1.37 %	1.55 %	1.71 %
10	5.4149	0.1172	-1.0594	0.0744	0.0938	0.1101	1.37 %	1.73 %	2.03 %
11	5.4224	-0.0424	-1.0149	0.0761	0.1150	0.1142	1.40 %	2.12 %	2.11 %
12	5.3902	0.0384	-1.1639	0.0711	0.0810	0.0826	1.32 %	1.50 %	1.53 %

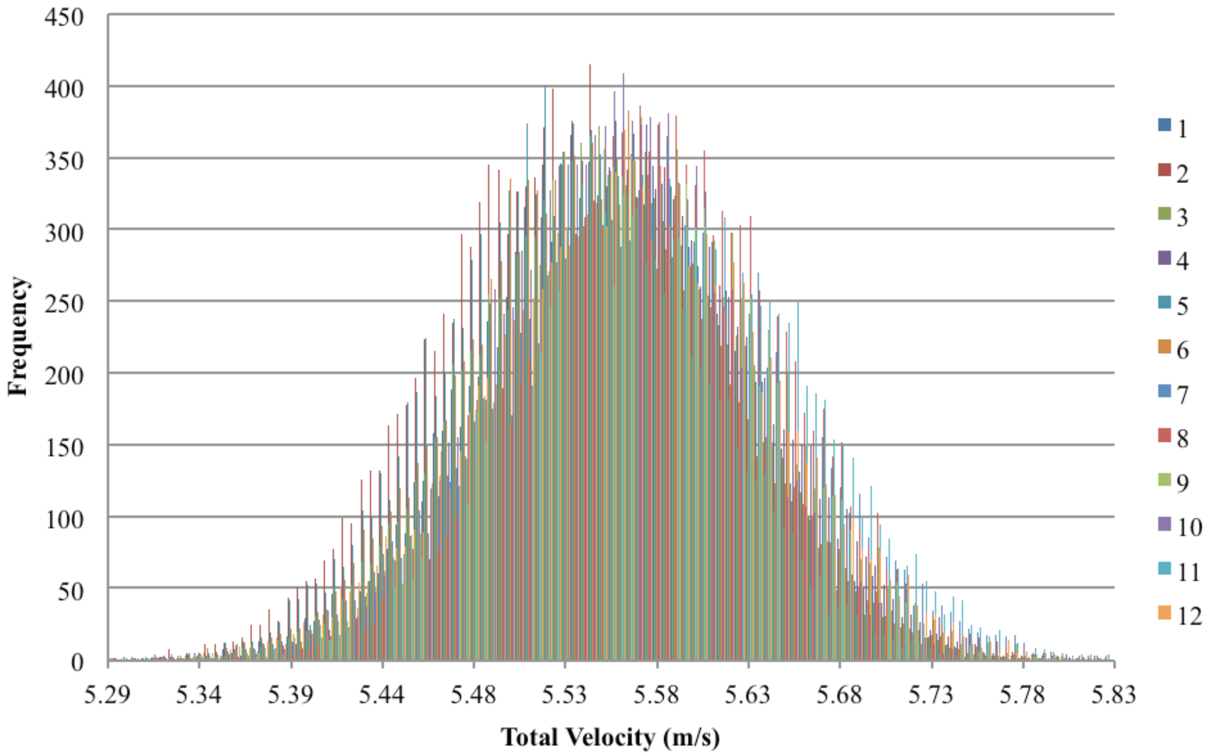


Figure C37. Histogram of 10-second intervals (x_b = 20 ft, blower frequency = 25 Hz, 100 bins).

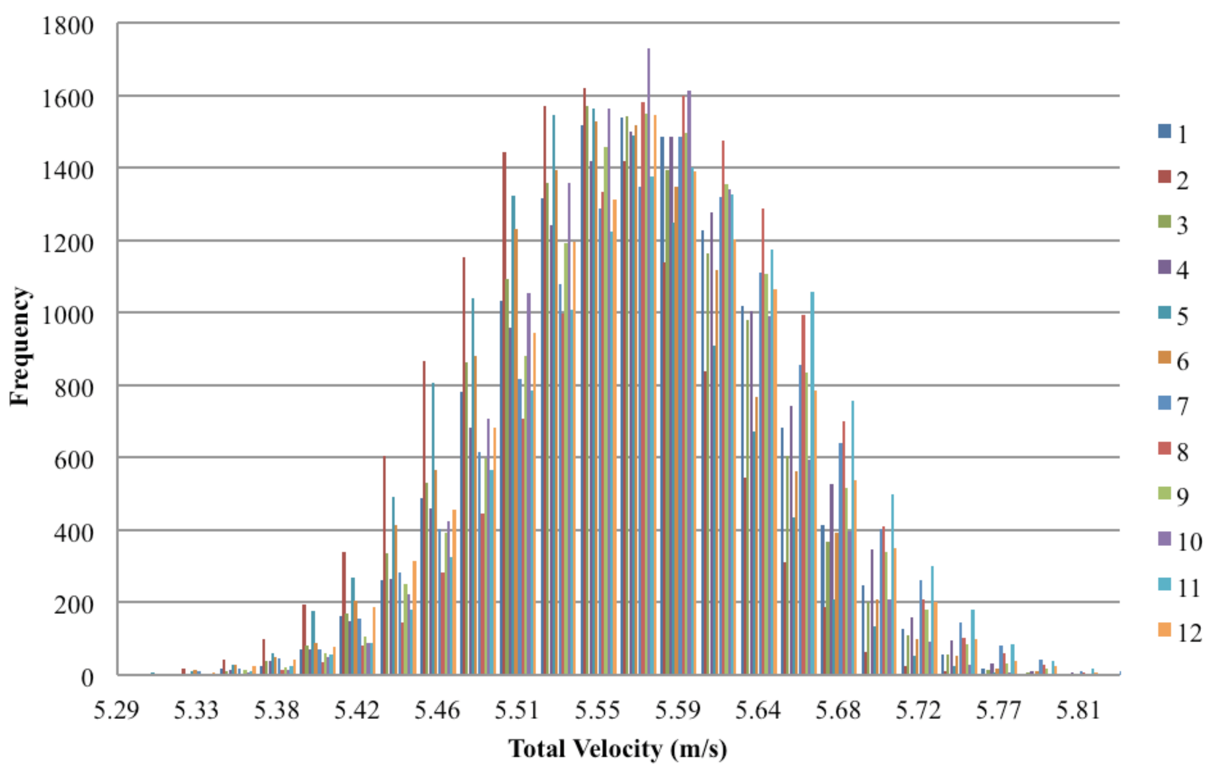
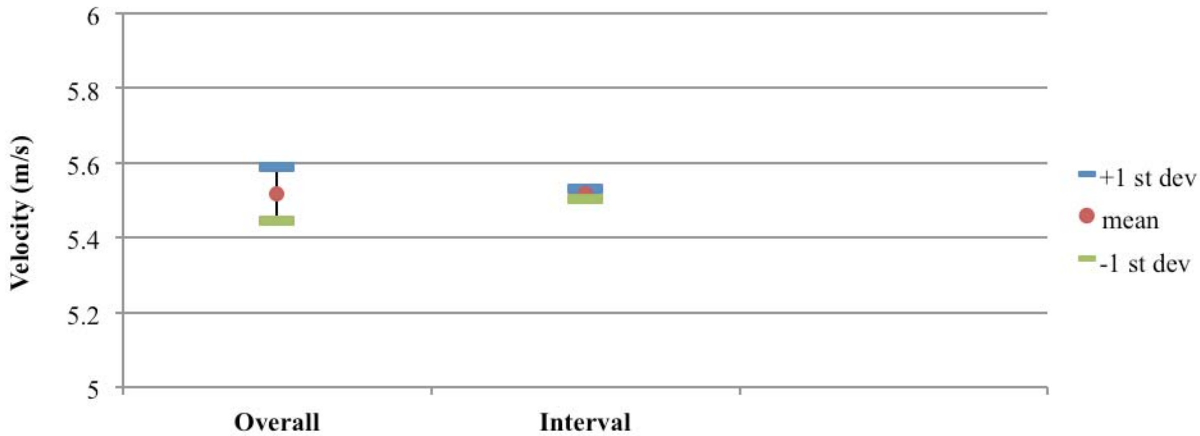
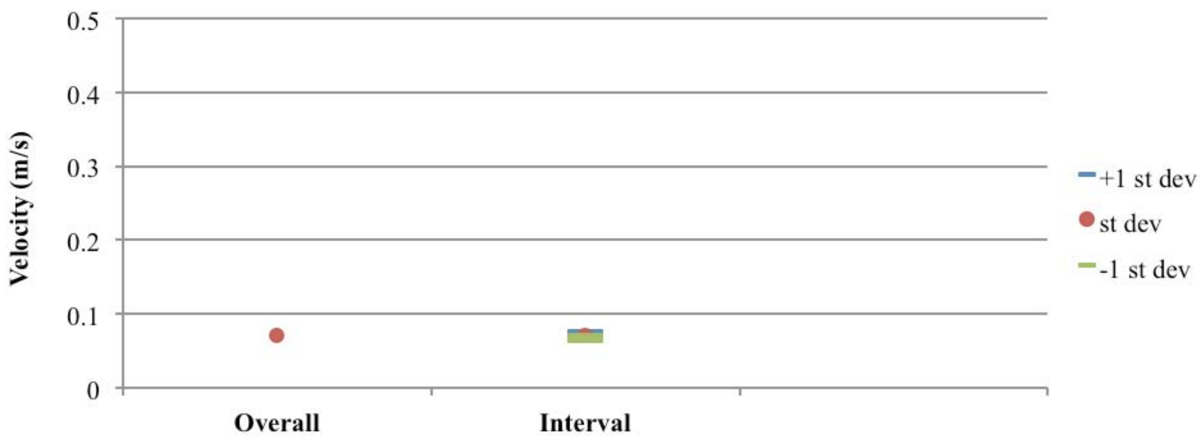


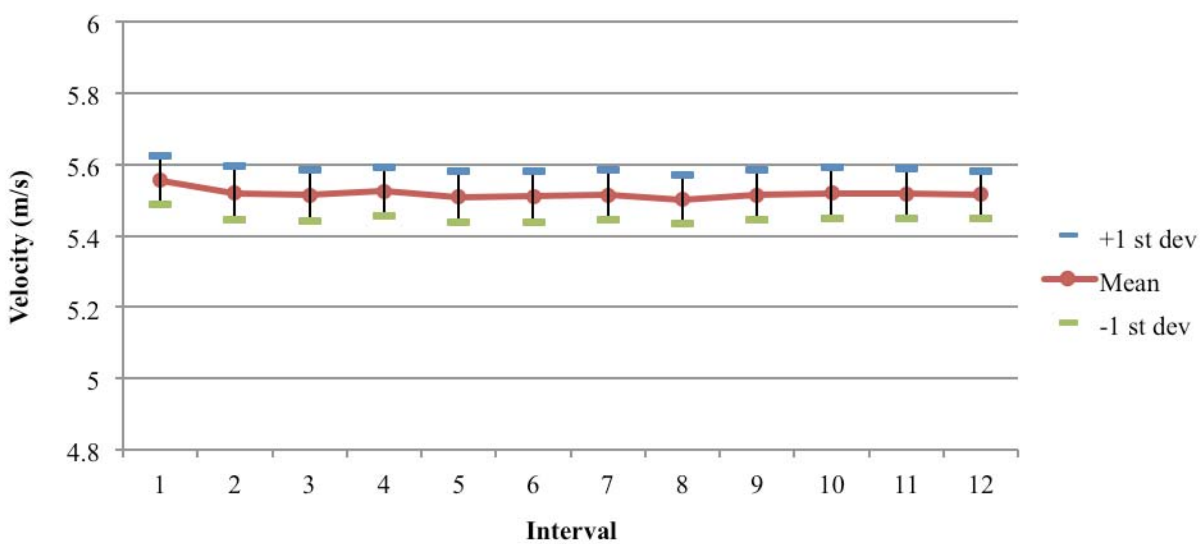
Figure C38. Histogram of 10-second intervals (x_b = 20 ft, blower frequency = 25 Hz, 25 bins).



a) Run 339 average velocity and standard deviation about the average velocity.



b) Run 339 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 339 average velocity from each 10-second interval.

Figure C39. Run 339 total velocity measurements.

Run 340
Blockage Location: No blockage
Blower Frequency: 50 Hz
Time: 9:12 AM

Table C40. Run 340 velocity data from 2-minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)
Total Vel	10.0765	11.5801	10.8477	0.1709
u	9.82	11.4	10.5959	0.1764
v	-0.942	1.23	-0.1620	0.2798
w	-3.35	-1.54	-2.2892	0.2276

Table C41. Run 340 total velocity data for each 10-second interval and mean and standard deviation data for each interval.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	I_{tot} (%)
1	10.0765	11.4004	10.8274	0.1710	1.580
2	10.1374	11.4500	10.8269	0.1746	1.612
3	10.1841	11.4631	10.8338	0.1668	1.540
4	10.2724	11.4275	10.8590	0.1609	1.482
5	10.1385	11.5065	10.8421	0.1686	1.555
6	10.1910	11.4851	10.8423	0.1710	1.577
7	10.1277	11.5168	10.8636	0.1706	1.570
8	10.2125	11.5801	10.8779	0.1667	1.533
9	10.2111	11.4865	10.8889	0.1632	1.499
10	10.1822	11.5430	10.8896	0.1731	1.589
11	10.1534	11.4249	10.8039	0.1659	1.536
12	10.1848	11.5272	10.8160	0.1713	1.584
		Average	**10.8476**	**0.1686**	**1.555**
		St Dev	**0.02823**	**0.0040**	**0.038**

Table C42. Run 340 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u (%)	I_v (%)	I_w (%)
1	10.5999	-0.2283	-2.1835	0.1775	0.1703	0.1567	1.67 %	1.61 %	1.48 %
2	10.6039	-0.1766	-2.1653	0.1827	0.1896	0.1428	1.72 %	1.79 %	1.35 %
3	10.5856	-0.3237	-2.2680	0.1726	0.1953	0.1710	1.63 %	1.85 %	1.62 %
4	10.5795	-0.2415	-2.4230	0.1677	0.1758	0.1768	1.59 %	1.66 %	1.67 %
5	10.5936	-0.1891	-2.2855	0.1758	0.1768	0.1870	1.66 %	1.67 %	1.76 %
6	10.5900	-0.2423	-2.2947	0.1783	0.1686	0.2274	1.68 %	1.59 %	2.15 %
7	10.6132	-0.1131	-2.2920	0.1752	0.2306	0.2424	1.65 %	2.17 %	2.28 %
8	10.6008	-0.1842	-2.4010	0.1768	0.2580	0.2891	1.67 %	2.43 %	2.73 %
9	10.6073	0.3003	-2.4210	0.1772	0.2405	0.2031	1.67 %	2.27 %	1.92 %
10	10.6054	0.0730	-2.4339	0.1765	0.3418	0.2512	1.66 %	3.22 %	2.37 %
11	10.5604	-0.4070	-2.2339	0.1706	0.1509	0.1536	1.62 %	1.43 %	1.45 %
12	10.6111	-0.2119	-2.0692	0.1783	0.2243	0.1097	1.68 %	2.11 %	1.03 %

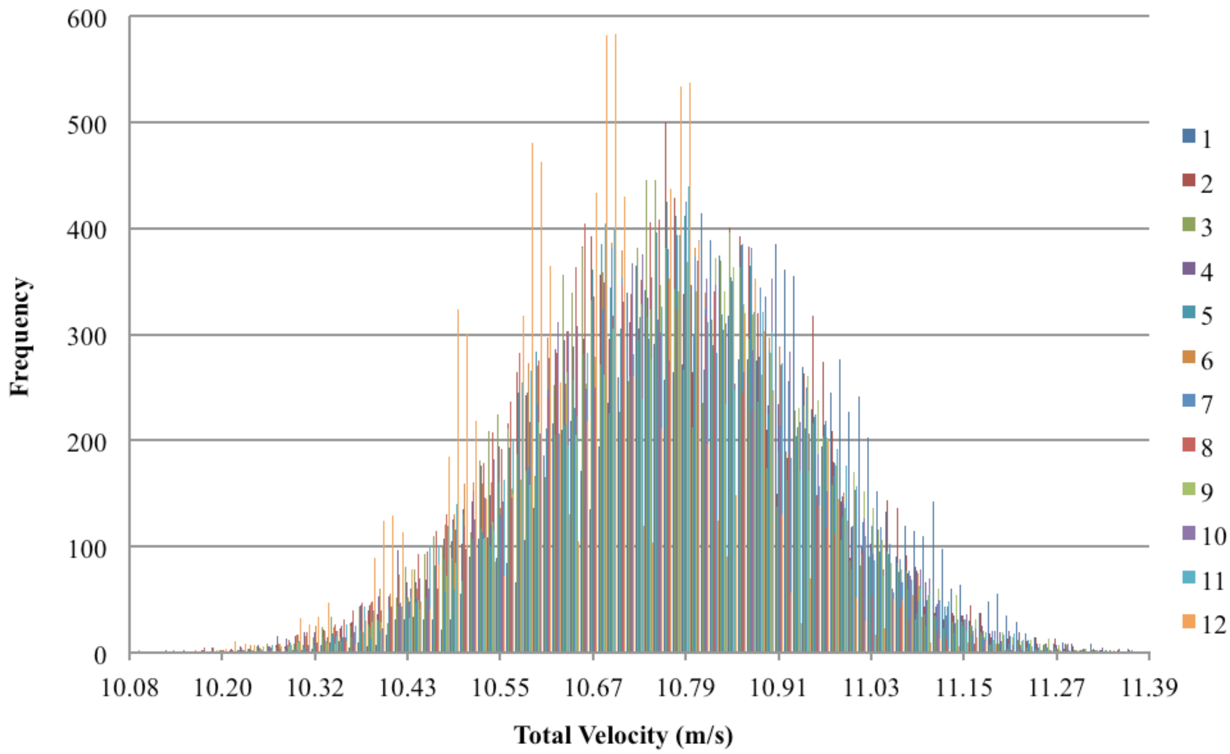


Figure C40. Histogram of 10-second intervals (no wall, blower frequency = 50 Hz, 100 bins).

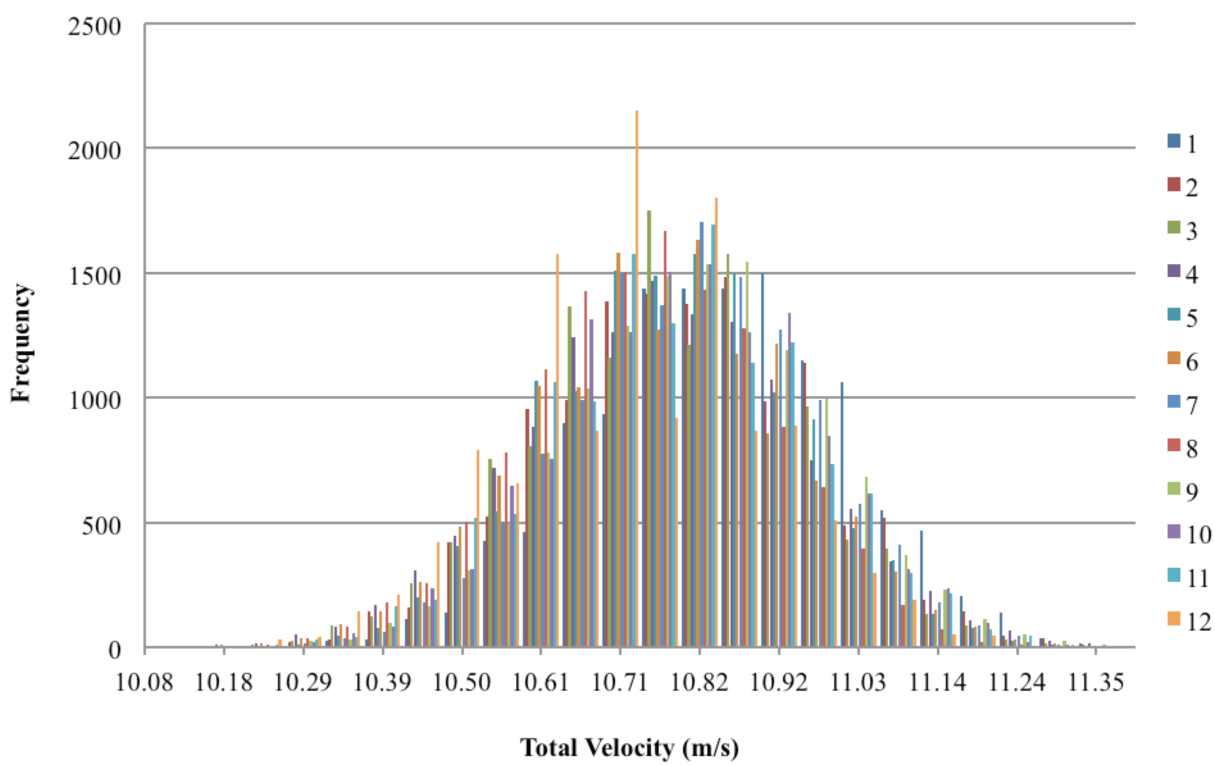
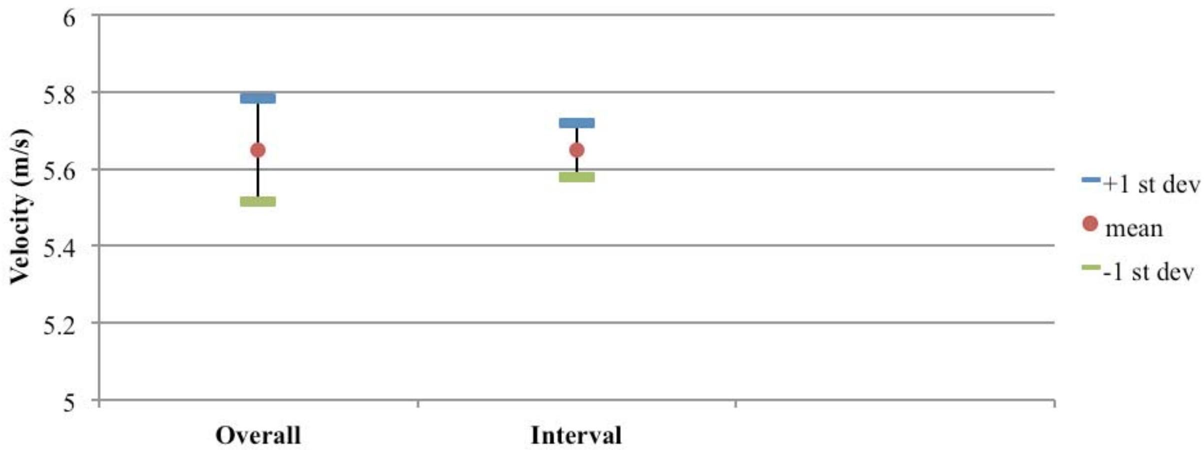
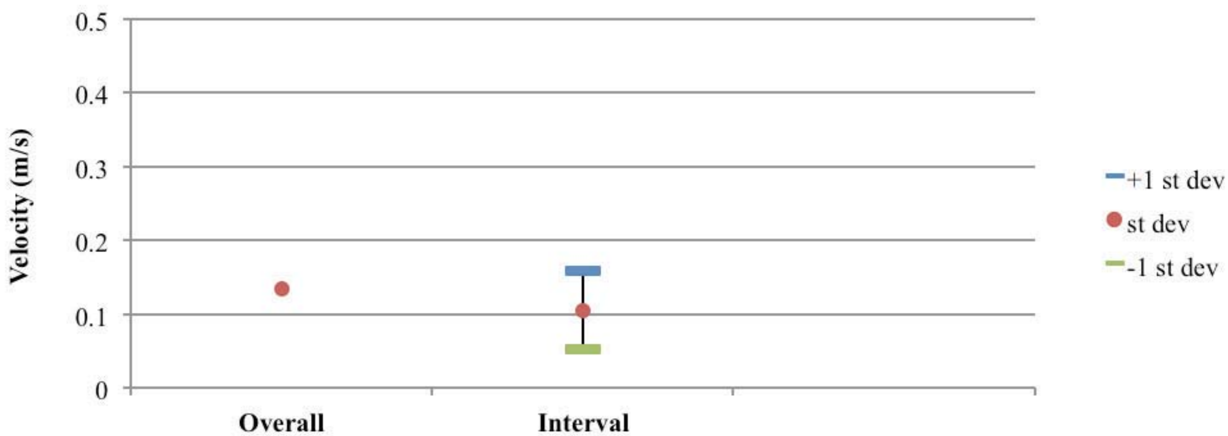


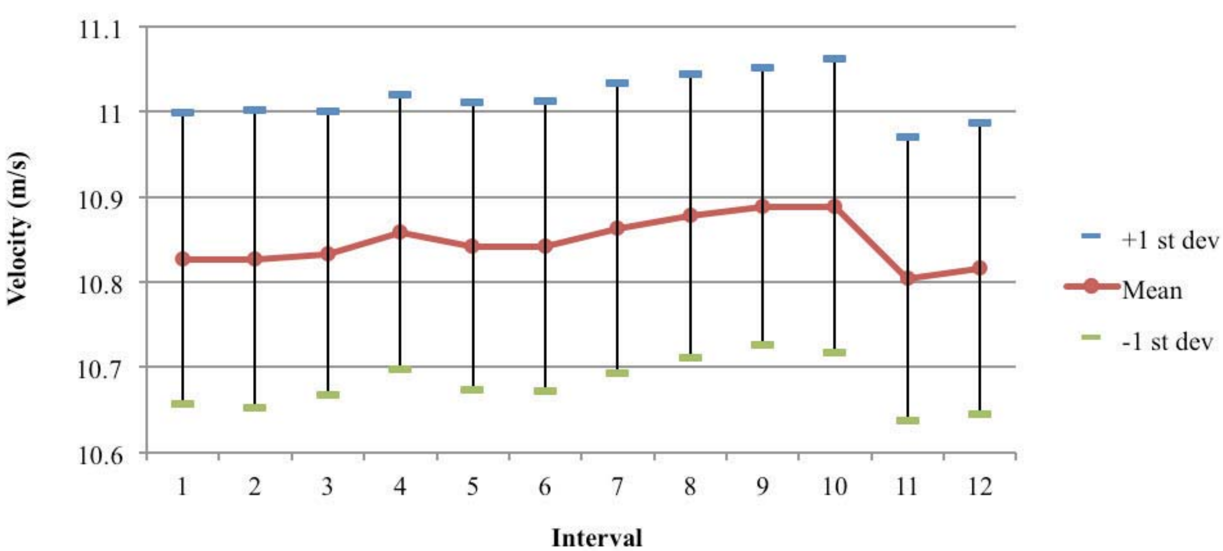
Figure C41. Histogram of 10-second intervals (no wall, blower frequency = 50 Hz, 25 bins).



a) Run 340 average velocity and standard deviation about the average velocity.



b) Run 340 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 340 average velocity from each 10-second interval.

Figure C42. Run 340 total velocity measurements.

Run 341
Blockage Location: No blockage
Blower Frequency: 25 Hz
Time: 9:16 AM

Table C43. Run 341 velocity data from two minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)
Total Vel	5.2066	6.9952	5.6497	0.1347
u	4.38	6.2	5.4652	0.1597
v	-1.11	3.25	0.4731	0.4480
w	-3.49	0.544	-1.1778	0.4812

Table C44. Run 341 total velocity data for each 10-second interval and mean and standard deviation data for each interval.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	I_{tot} (%)
1	5.2734	6.1947	5.6667	0.1124	1.984
2	5.2521	5.9900	5.6369	0.0922	1.636
3	5.3186	5.9636	5.6297	0.0893	1.586
4	5.2462	5.9533	5.5816	0.0843	1.511
5	5.2745	5.8774	5.5970	0.0795	1.421
6	5.3242	6.0060	5.6346	0.0797	1.416
7	5.3342	6.0727	5.6490	0.0968	1.714
8	5.3591	6.2098	5.6996	0.1013	1.777
9	5.2374	6.9952	5.8406	0.2708	4.636
10	5.2066	5.9809	5.6381	0.0891	1.581
11	5.3123	6.0810	5.6539	0.0872	1.543
12	5.2414	5.8573	5.5688	0.0779	1.399
		Average	**5.6497**	**0.1050**	**1.850**
		St Dev	**0.0701**	**0.0531**	**0.893**

Table C45. Run 341 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u (%)	I_v (%)	I_w (%)
1	5.5210	0.4928	-1.0075	0.1247	0.4782	0.3753	2.26 %	8.66 %	6.80 %
2	5.3725	0.3733	-1.5717	0.1541	0.4037	0.3516	2.87 %	7.51 %	6.55 %
3	5.3863	0.7543	-1.3789	0.0921	0.2622	0.3772	1.71 %	4.87 %	7.00 %
4	5.3835	0.4761	-1.3403	0.0895	0.2901	0.2525	1.66 %	5.39 %	4.69 %
5	5.4516	0.4470	-1.0736	0.1152	0.3215	0.3800	2.11 %	5.90 %	6.97 %
6	5.5529	0.3030	-0.8276	0.0950	0.2560	0.2646	1.71 %	4.61 %	4.77 %
7	5.5514	0.5713	-0.6950	0.1042	0.3912	0.3607	1.88 %	7.05 %	6.50 %
8	5.5128	0.6503	-1.1711	0.1096	0.4211	0.3488	1.99 %	7.64 %	6.33 %
9	5.3619	1.0355	-1.9184	0.3317	0.5159	0.5540	6.19 %	9.62 %	10.33 %
10	5.4579	0.1014	-1.3170	0.1098	0.3938	0.3097	2.01 %	7.22 %	5.67 %
11	5.5765	0.1292	-0.8138	0.1012	0.3556	0.2478	1.81 %	6.38 %	4.44 %
12	5.4545	0.3428	-1.0193	0.0857	0.2607	0.1876	1.57 %	4.78 %	3.44 %

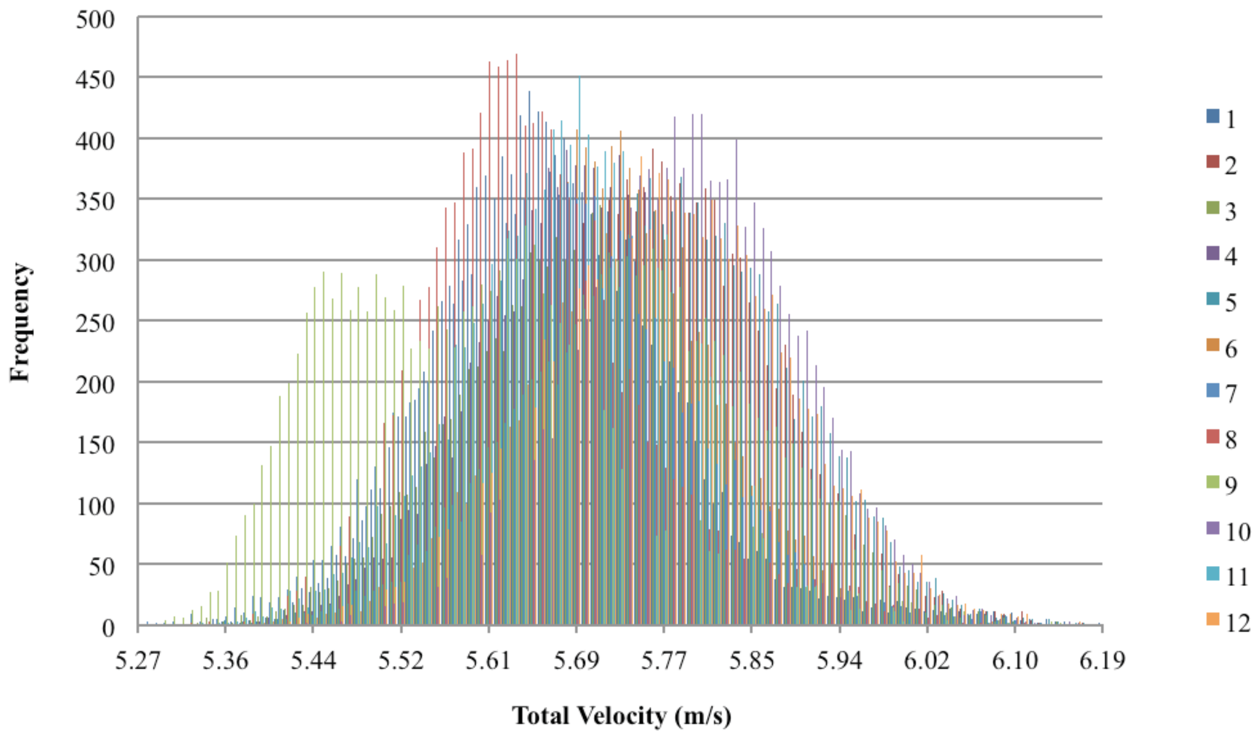


Figure C43. Histogram of 10-second intervals (no wall, blower frequency = 25 Hz, 100 bins).

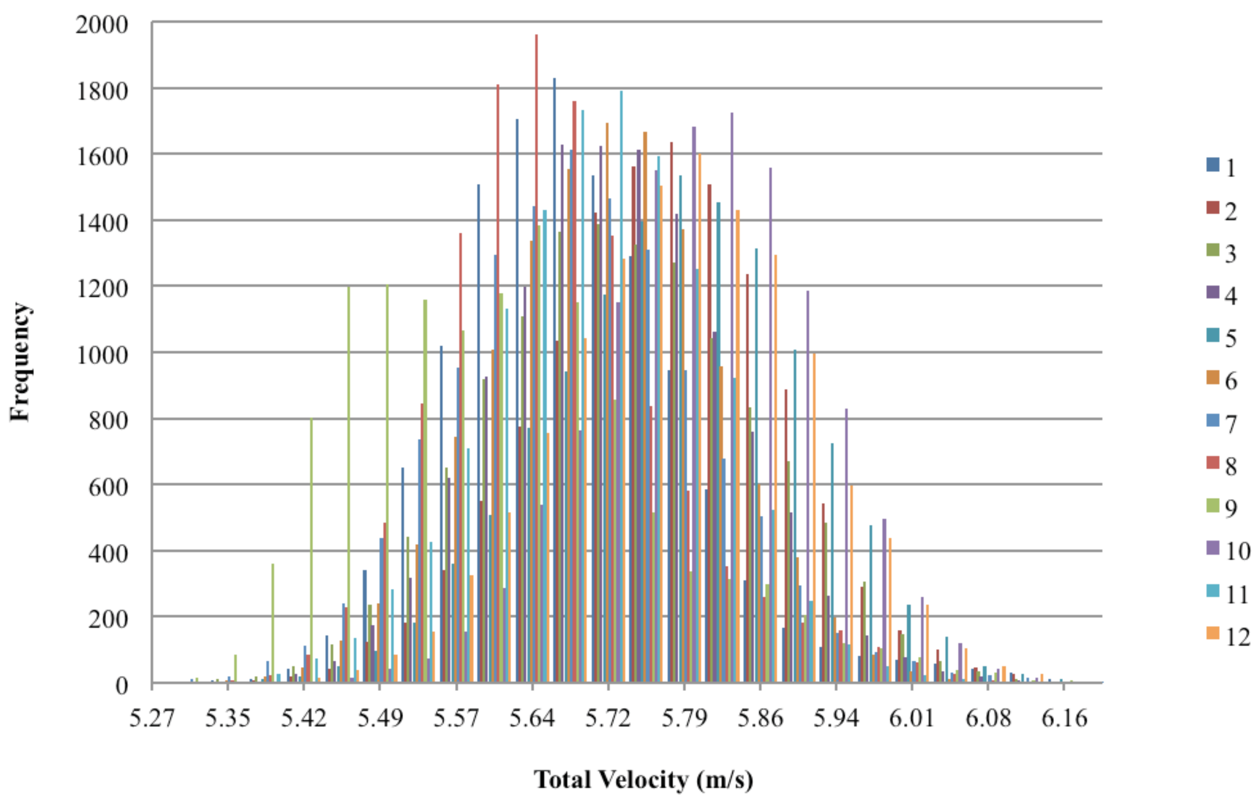
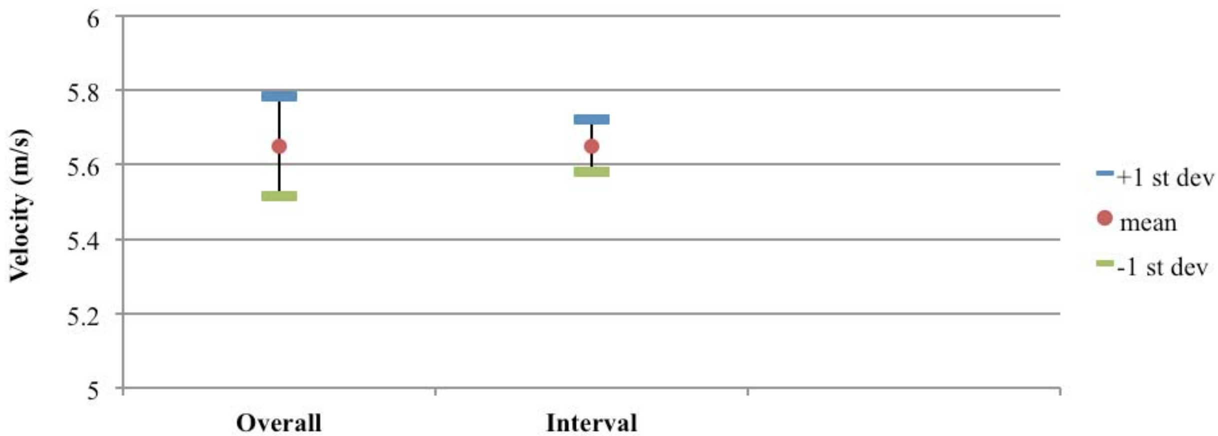
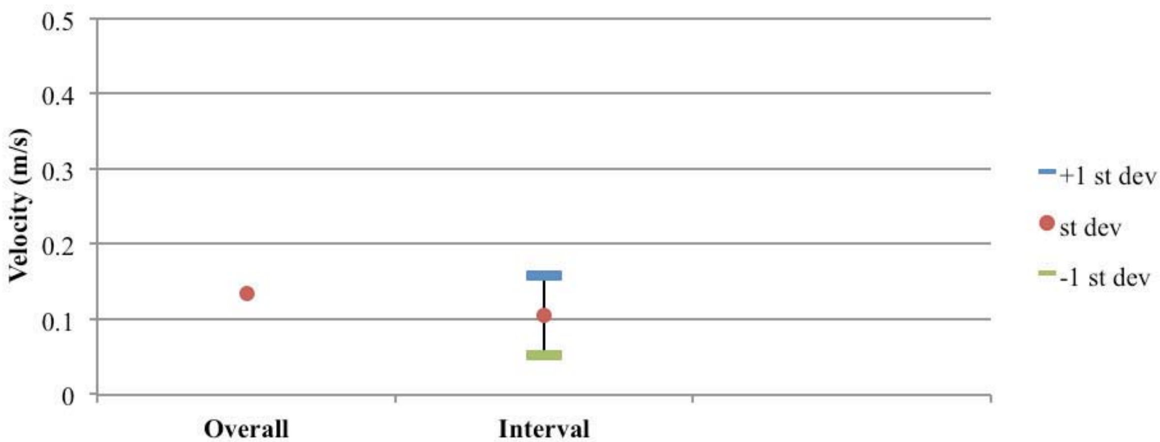


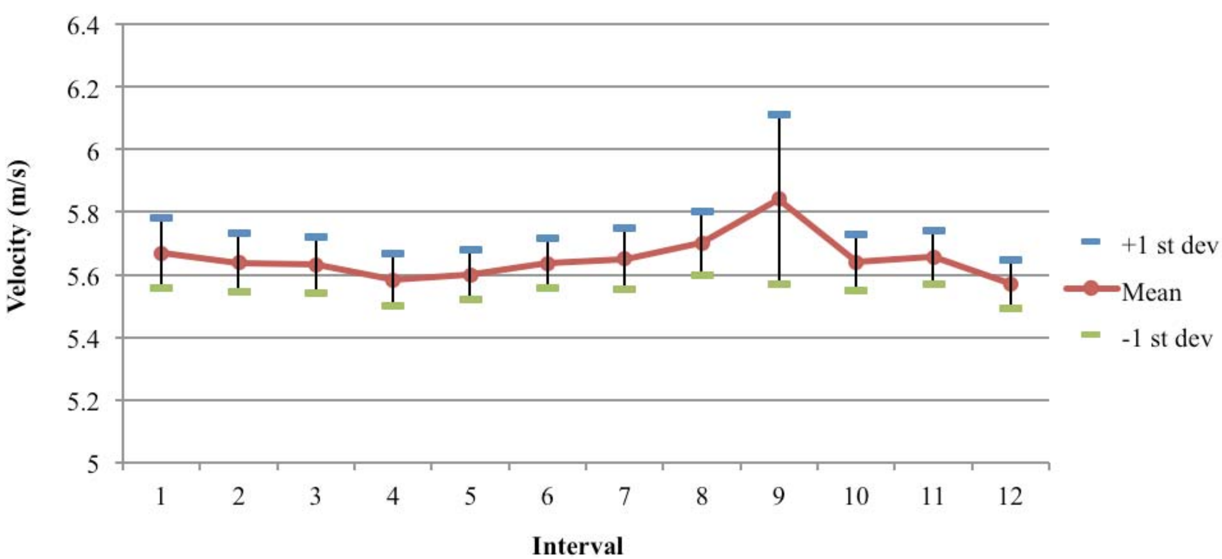
Figure C44. Histogram of 10-second intervals (no wall, blower frequency = 25 Hz, 25 bins).



a) Run 341 average velocity and standard deviation about the average velocity.



b) Run 341 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 341 average velocity from each 10-second interval.

Figure C45. Run 341 total velocity measurements.

Run 342
Blockage Location: No blockage
Blower Frequency: 50 Hz
Time: 7:59 AM

Table C46. Run 342 velocity data from two minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)
Total Vel	10.0245	11.7184	10.8626	0.2004
u	9.85	11.6	10.6886	0.2030
v	-3.16	2.56	-0.5528	0.7952
w	-3.93	1.29	-1.4877	0.7727

Table C47. Run 342 total velocity data for each 10-second interval and mean and standard deviation data for each interval.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	I_{tot} (%)
1	10.1426	11.5589	10.8741	0.1747	1.607
2	10.1765	11.4527	10.8757	0.1715	1.577
3	10.2387	11.5142	10.8524	0.1812	1.670
4	10.2453	11.6199	10.9916	0.1910	1.737
5	10.1690	11.7183	10.9704	0.2004	1.827
6	10.0944	11.5426	10.8547	0.1981	1.825
7	10.0244	11.4658	10.7845	0.1880	1.744
8	10.1106	11.5403	10.7727	0.1815	1.685
9	10.1044	11.4931	10.8028	0.2000	1.852
10	10.1105	11.5705	10.8012	0.1965	1.819
11	10.1261	11.6991	10.9155	0.1910	1.750
12	10.1786	11.6145	10.8546	0.1912	1.761
		Average	**10.8625**	**0.1888**	**1.738**
		St Dev	**0.0694**	**0.0096**	**0.088**

Table C48. Run 342 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u (%)	I_v (%)	I_w (%)
1	10.6542	0.3233	-2.1161	0.1820	0.2342	0.3108	1.71 %	2.20 %	2.92 %
2	10.6262	0.0091	-2.2790	0.1741	0.3012	0.2835	1.64 %	2.83 %	2.67 %
3	10.6445	-0.0147	-2.0039	0.1822	0.6172	0.2690	1.71 %	5.80 %	2.53 %
4	10.7298	0.5873	-2.1803	0.2062	0.4747	0.5977	1.92 %	4.42 %	5.57 %
5	10.6636	-0.9964	-2.0687	0.1969	0.9247	0.7154	1.85 %	8.67 %	6.71 %
6	10.6933	-0.9730	-1.4342	0.2052	0.5476	0.4150	1.92 %	5.12 %	3.88 %
7	10.6521	-0.3978	-1.5633	0.2009	0.2650	0.4013	1.89 %	2.49 %	3.77 %
8	10.6720	-0.9865	-0.8219	0.1790	0.5509	0.4563	1.68 %	5.16 %	4.28 %
9	10.6509	-1.3027	-0.9589	0.2035	0.6264	0.4997	1.91 %	5.88 %	4.69 %
10	10.6806	-1.1026	-0.9317	0.1992	0.3652	0.6114	1.87 %	3.42 %	5.72 %
11	10.8687	-0.6976	-0.4588	0.1868	0.3619	0.4416	1.72 %	3.33 %	4.06 %
12	10.7272	-1.0814	-1.0355	0.1988	0.4790	0.5277	1.85 %	4.46 %	4.92 %

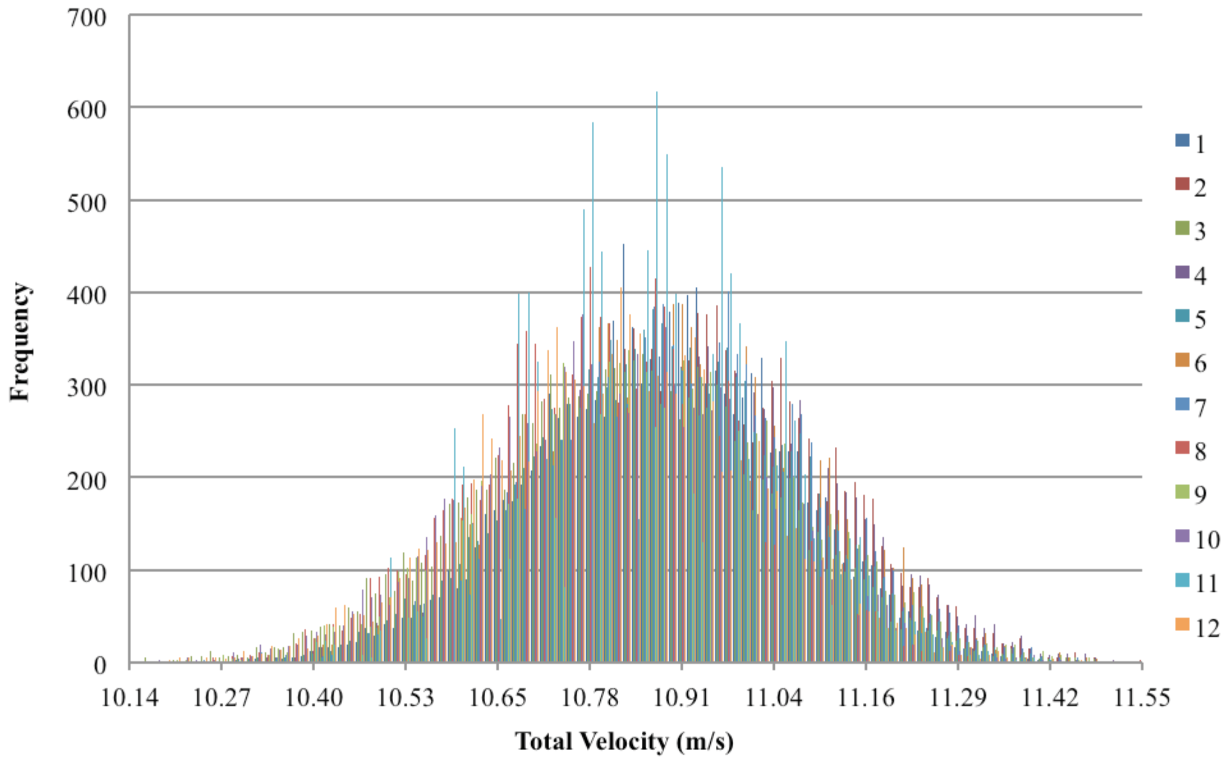


Figure C46. Histogram of 10-second intervals (no wall, blower frequency = 50 Hz, 100 bins).

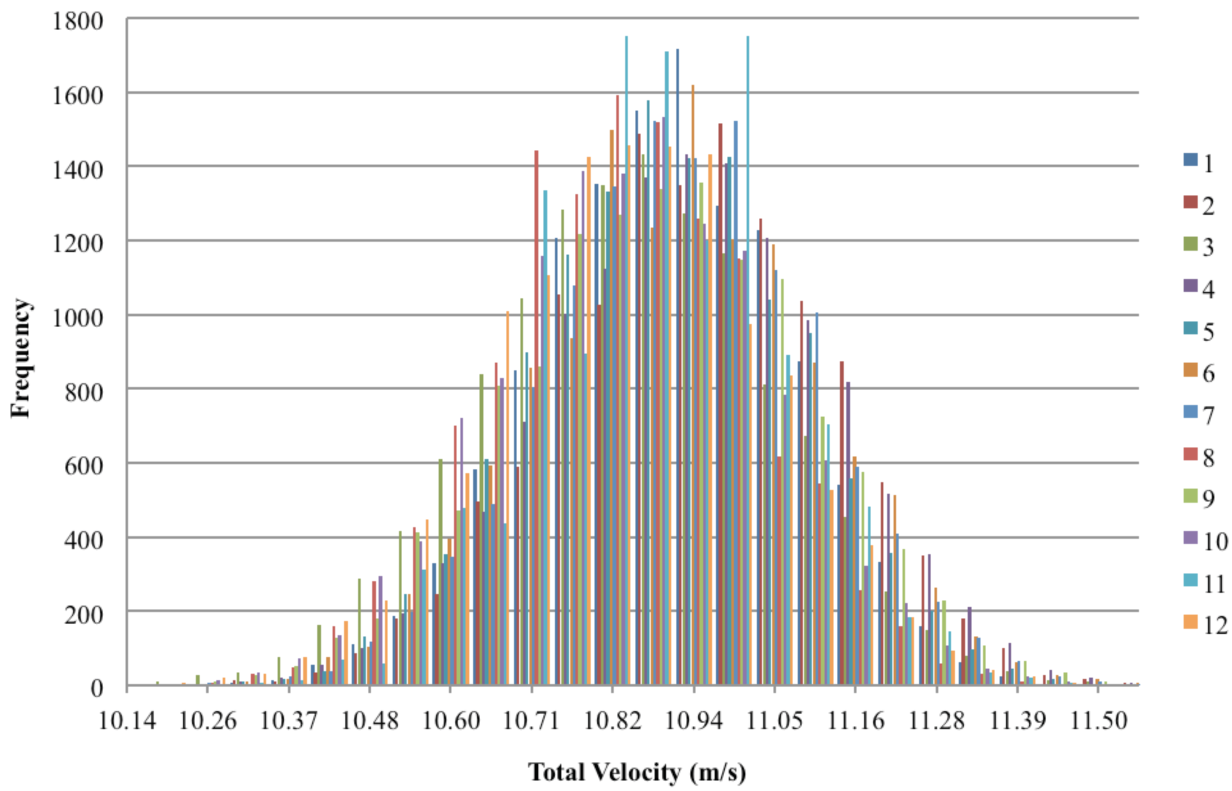
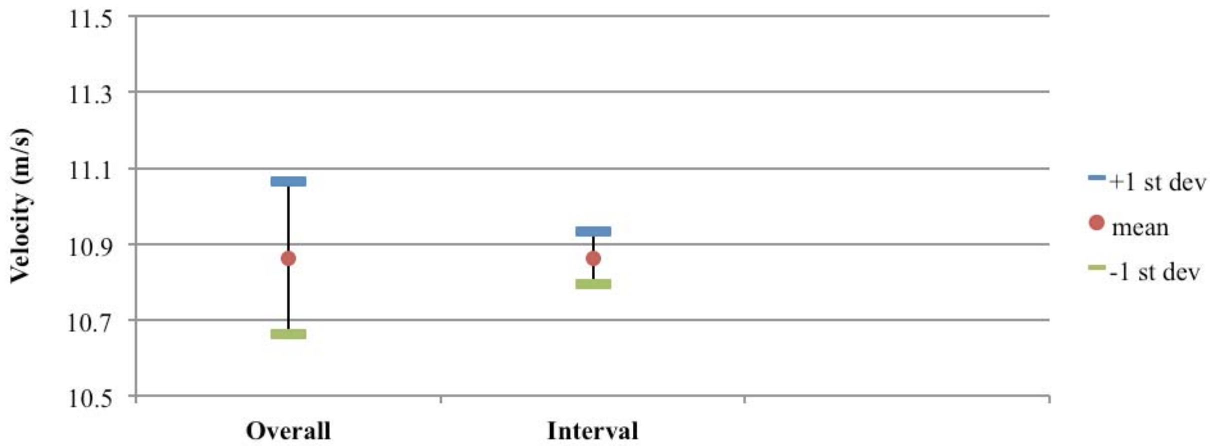
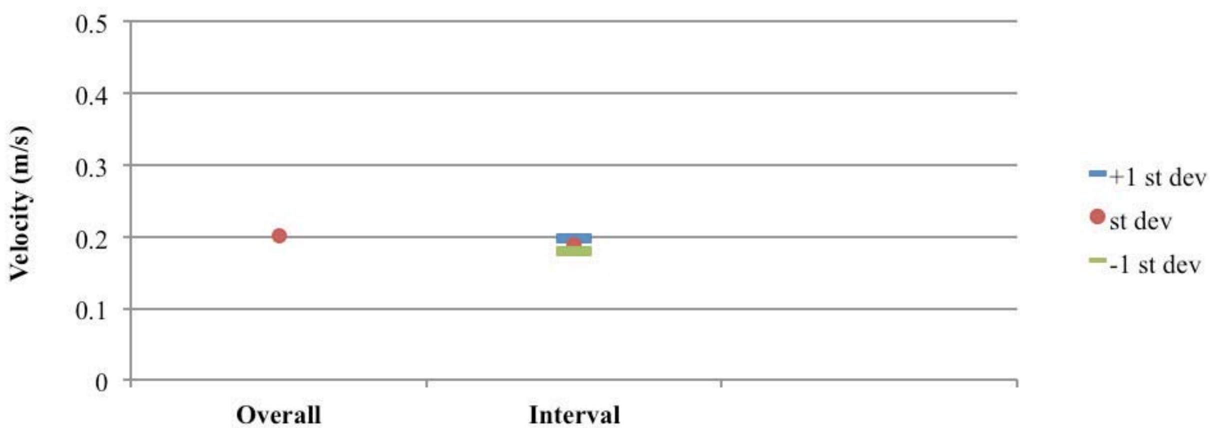


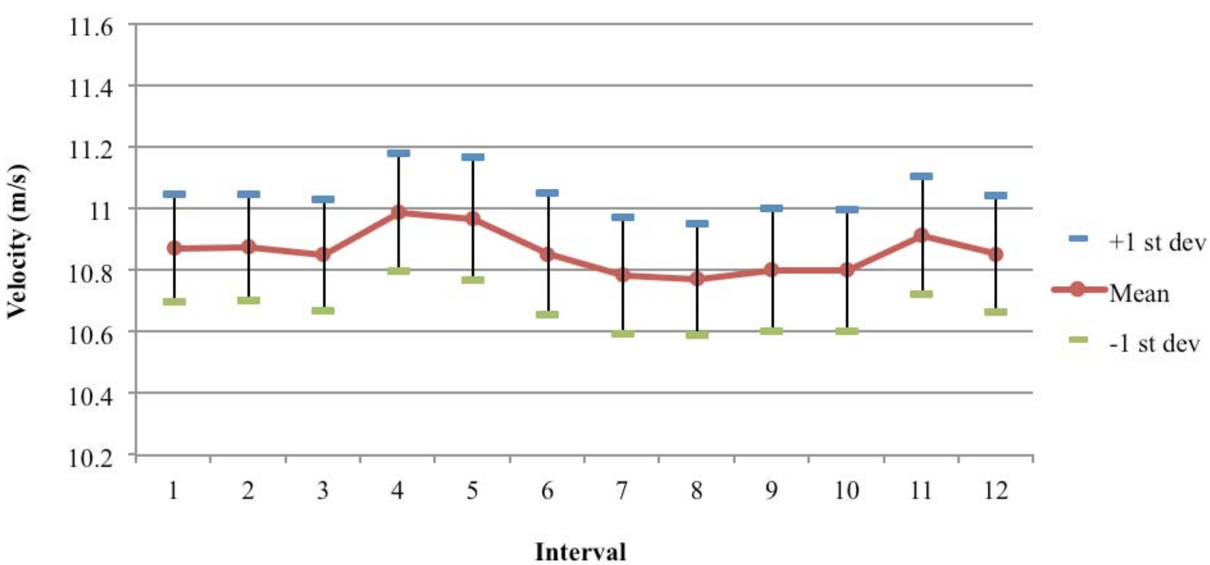
Figure C47. Histogram of 10-second intervals (no wall, blower frequency = 50 Hz, 25 bins).



a) Run 342 average velocity and standard deviation about the average velocity.



b) Run 342 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 342 average velocity from each 10-second interval.

Figure C48. Run 342 total velocity measurements.

Run 343
Blockage Location: No blockage
Blower Frequency: 25 Hz
Time: 9:49 AM

Table C49. Run 343 velocity data from 2-minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)
Total Vel	5.0256	8.2935	5.7227	0.1527
u	4.05	6.85	5.4813	0.1752
v	-1.8	4.26	0.3299	0.4535
w	-4.71	0.156	-1.4548	0.5163

Table C50. Run 343 total velocity data for each 10-second interval and mean and standard deviation data for each interval.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	I_{tot} (%)
1	5.3611	8.2934	6.0060	0.2810	4.679
2	5.0256	6.6724	5.7683	0.1166	2.021
3	5.3423	6.1886	5.7616	0.1062	1.844
4	5.3983	6.0769	5.6942	0.0934	1.640
5	5.4082	6.0407	5.6852	0.0871	1.533
6	5.3315	6.1302	5.7150	0.0837	1.465
7	5.1010	6.1613	5.7175	0.1149	2.010
8	5.2376	6.1502	5.6976	0.0951	1.669
9	5.3592	6.1570	5.6844	0.0998	1.756
10	5.4135	5.8889	5.6688	0.0648	1.143
11	5.3843	5.9176	5.6453	0.0725	1.284
12	5.3197	5.8804	5.6284	0.0697	1.239
		Average	**5.7227**	**0.1071**	**1.857**
		St Dev	**0.0981**	**0.0572**	**0.933**

Table C51. Run 343 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u (%)	I_v (%)	I_w (%)
1	5.4290	0.8827	-2.0914	0.4418	0.5298	1.0238	8.14 %	9.76 %	18.86 %
2	5.3837	0.5973	-1.8956	0.1950	0.4040	0.3895	3.62 %	7.50 %	7.23 %
3	5.4349	0.6269	-1.7565	0.1389	0.3166	0.2667	2.56 %	5.83 %	4.91 %
4	5.5128	0.1652	-1.3870	0.0818	0.1765	0.2319	1.48 %	3.20 %	4.21 %
5	5.5303	0.0613	-1.2239	0.0881	0.3989	0.2766	1.59 %	7.21 %	5.00 %
6	5.4676	0.3890	-1.5370	0.0988	0.4094	0.2879	1.81 %	7.49 %	5.27 %
7	5.4848	0.5913	-1.3379	0.1426	0.4627	0.4956	2.60 %	8.44 %	9.04 %
8	5.4816	0.5970	-1.3672	0.1060	0.2725	0.3369	1.93 %	4.97 %	6.15 %
9	5.5941	-0.1112	-0.9085	0.1147	0.2669	0.3273	2.05 %	4.77 %	5.85 %
10	5.4810	0.1308	-1.4320	0.0700	0.0841	0.1384	1.28 %	1.53 %	2.52 %
11	5.4767	0.1035	-1.3381	0.0766	0.1630	0.2181	1.40 %	2.98 %	3.98 %
12	5.4991	-0.0743	-1.1827	0.0726	0.1288	0.1340	1.32 %	2.34 %	2.44 %

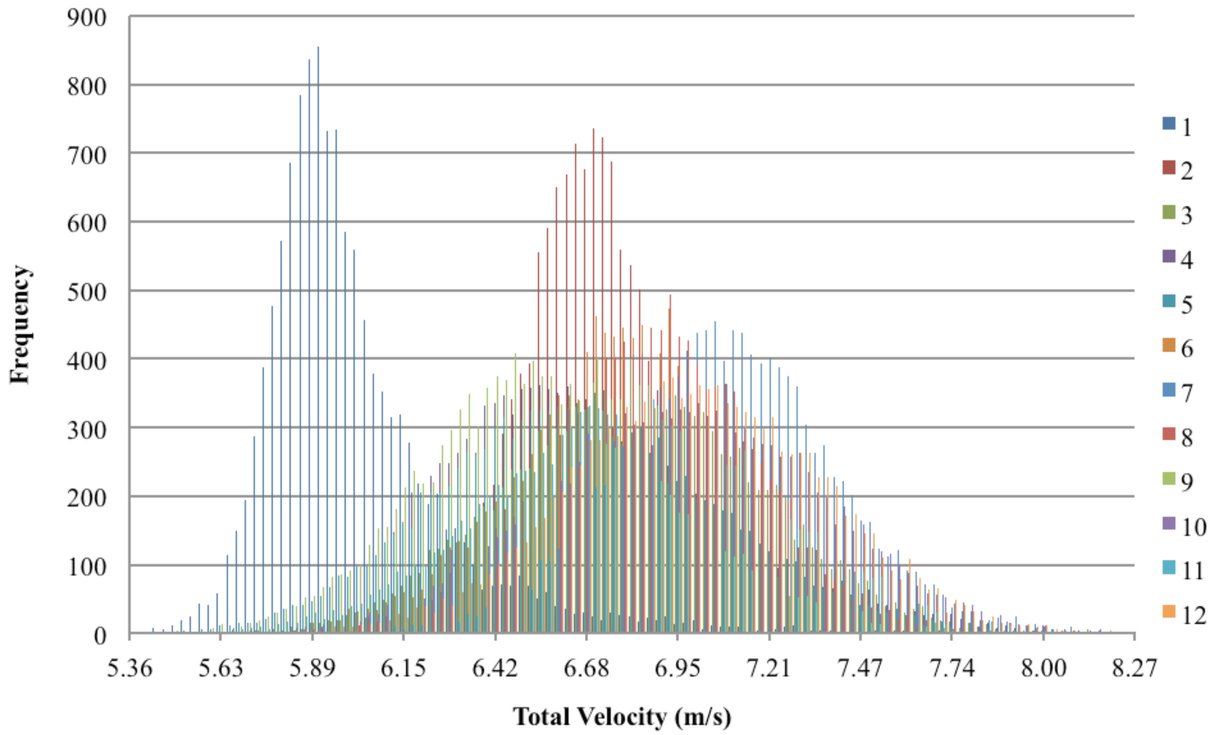


Figure C49. Histogram of 10-second intervals (no wall, blower frequency = 25 Hz, 100 bins).

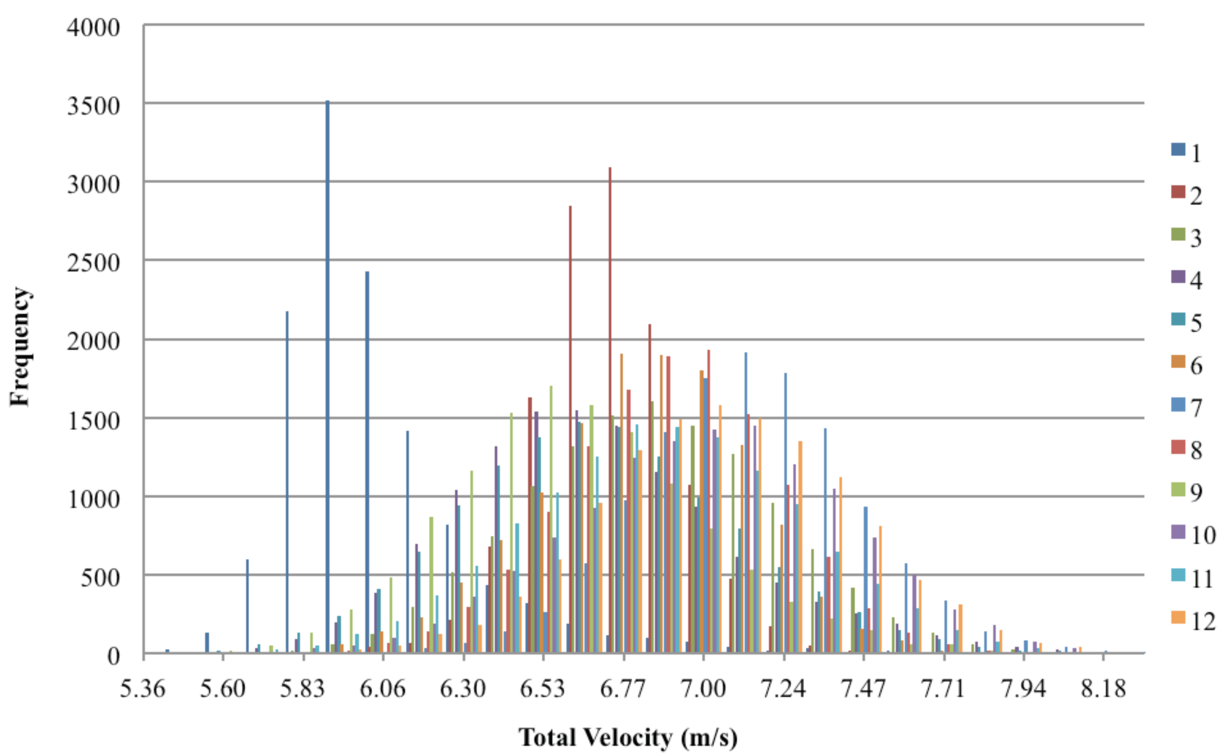
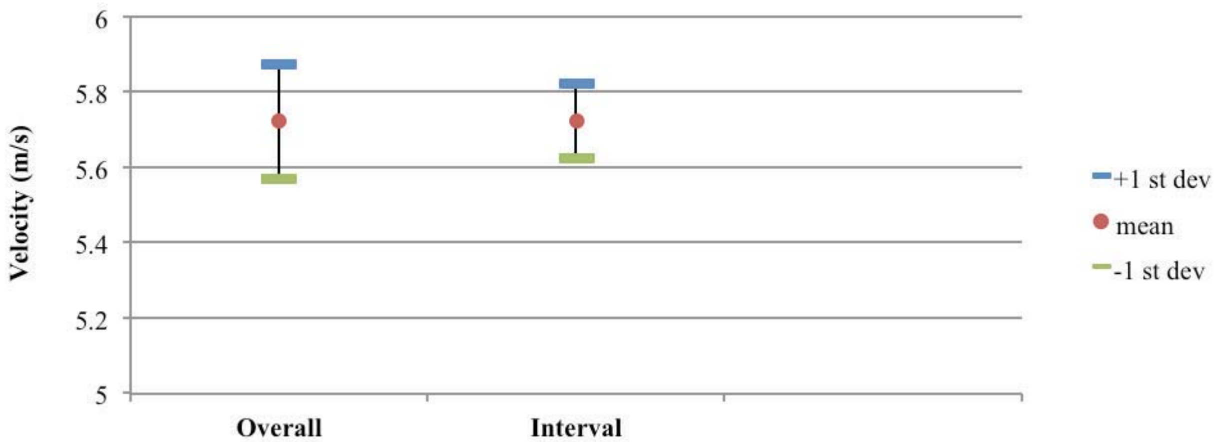
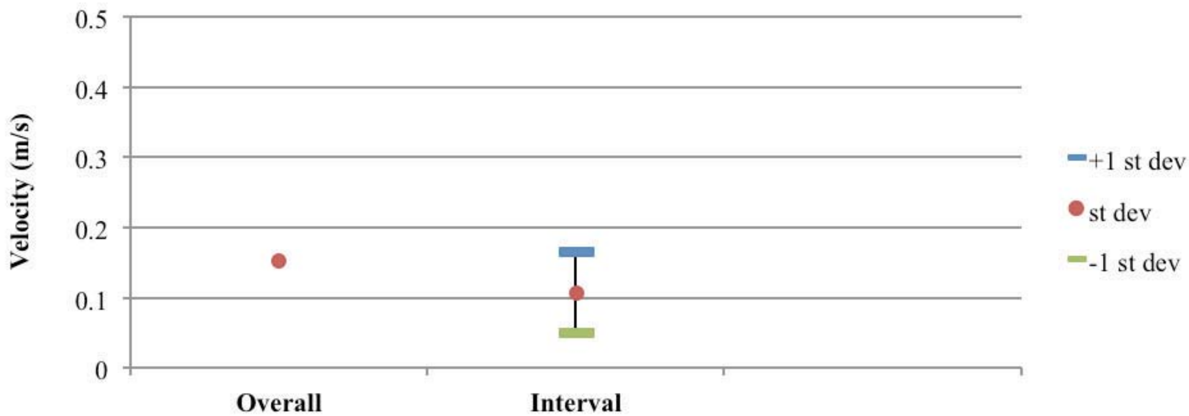


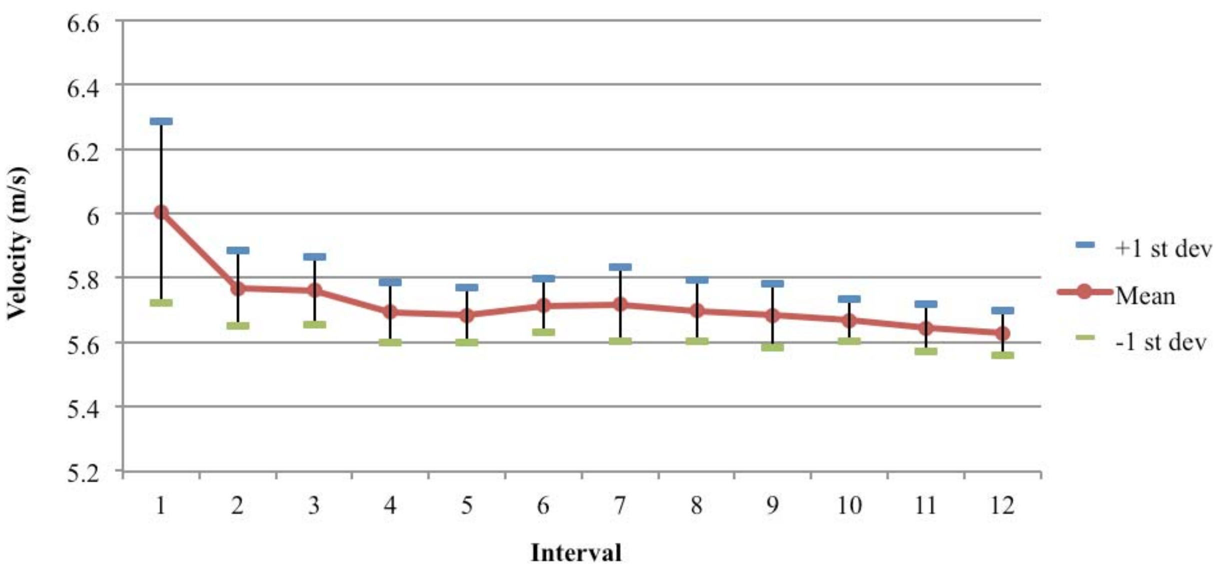
Figure C50. Histogram of 10-second intervals (no wall, blower frequency = 25 Hz, 25 bins).



a) Run 343 average velocity and standard deviation about the average velocity.



b) Run 343 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 343 average velocity from each 10-second interval.

Figure C51. Run 343 total velocity measurements.

Run 344
Blockage Location: x_b = 20 ft.
Blower Frequency: 50 Hz
Time: 10:06 AM

Table C52. Run 344 velocity data from 2-minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)
Total Vel	10.1968	11.7739	10.9923	0.1746
u	9.48	11.4	10.5536	0.1934
v	-2.17	2.01	-0.4647	0.5778
w	-4.82	-1.31	-2.9496	0.4405

Table C53. Run 344 total velocity data for each 10-second interval and mean and standard deviation data for each interval.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	I_{tot} (%)
1	10.2473	11.6399	10.9864	0.1735	1.579
2	10.3423	11.6841	11.0331	0.1732	1.570
3	10.4380	11.7084	11.1068	0.1745	1.571
4	10.4914	11.6174	11.0544	0.1505	1.361
5	10.3251	11.5087	10.9636	0.1532	1.397
6	10.3557	11.5422	10.9627	0.1577	1.439
7	10.2408	11.5279	10.9450	0.1625	1.484
8	10.2964	11.5627	10.9480	0.1672	1.527
9	10.1967	11.5168	10.9606	0.1690	1.542
10	10.3515	11.7738	10.9696	0.1721	1.569
11	10.3465	11.6976	10.9837	0.1806	1.644
12	10.3691	11.6740	10.9931	0.1805	1.642
		Average	**10.9923**	**0.1679**	**1.527**
		St Dev	**0.0487**	**0.0099**	**0.090**

Table C54. Run 344 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u (%)	I_v (%)	I_w (%)
1	10.6082	-0.5120	-2.7563	0.1836	0.3165	0.4536	1.73 %	2.98 %	4.28 %
2	10.5397	0.3749	-3.1548	0.2489	0.6038	0.3929	2.36 %	5.73 %	3.73 %
3	10.5011	0.0754	-3.5554	0.2020	0.6168	0.2275	1.92 %	5.87 %	2.17 %
4	10.4691	-0.8361	-3.4418	0.1646	0.1730	0.1383	1.57 %	1.65 %	1.32 %
5	10.5224	-0.6093	-3.0086	0.1655	0.1688	0.1560	1.57 %	1.60 %	1.48 %
6	10.5740	-0.4143	-2.8504	0.1719	0.1689	0.2052	1.63 %	1.60 %	1.94 %
7	10.5456	-0.5295	-2.8666	0.1709	0.2013	0.2085	1.62 %	1.91 %	1.98 %
8	10.5585	-0.7037	-2.7873	0.1711	0.2022	0.2677	1.62 %	1.92 %	2.54 %
9	10.5608	-0.8446	-2.7884	0.1743	0.2379	0.2383	1.65 %	2.25 %	2.26 %
10	10.4905	-0.9954	-3.0164	0.1685	0.2285	0.3764	1.61 %	2.18 %	3.59 %
11	10.5651	-0.8984	-2.7904	0.1797	0.5254	0.3890	1.70 %	4.97 %	3.68 %
12	10.7084	0.3155	-2.3795	0.1898	0.4035	0.4997	1.77 %	3.77 %	4.67 %

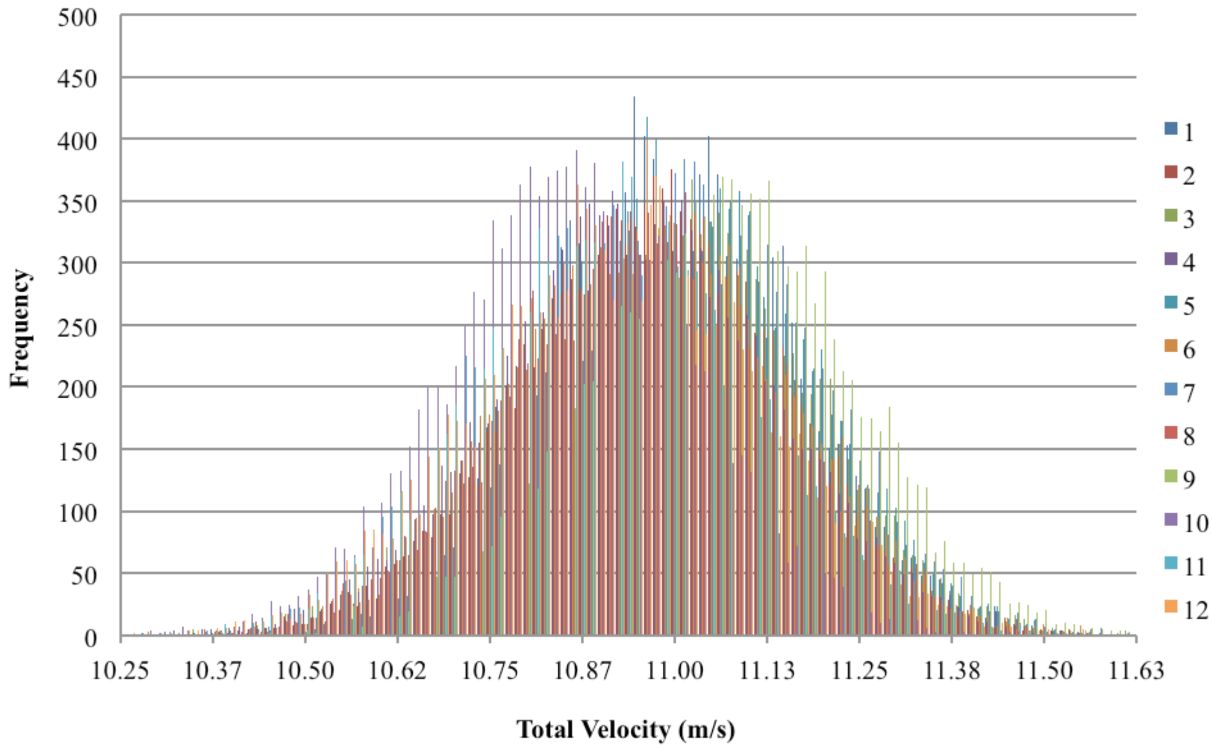


Figure C52. Histogram of 10-second intervals (x_b = 20 ft, blower frequency = 50 Hz, 100 bins).

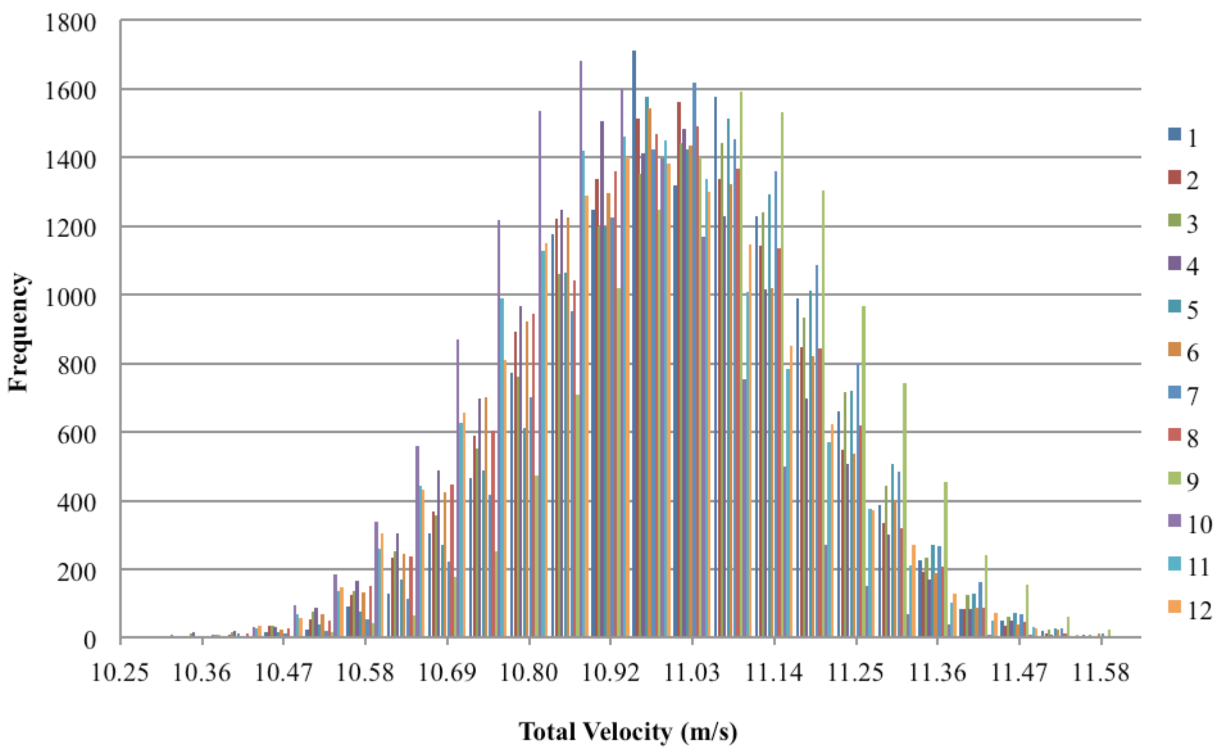
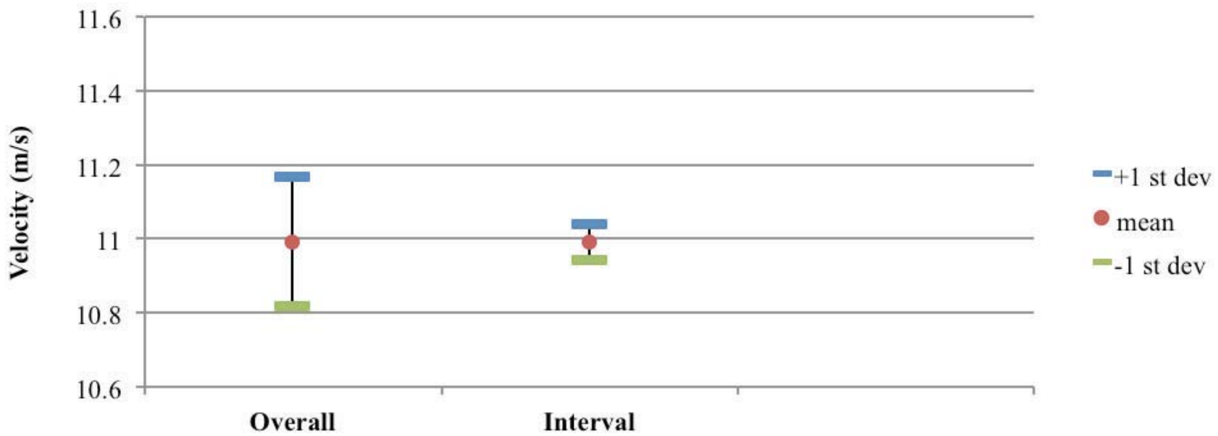
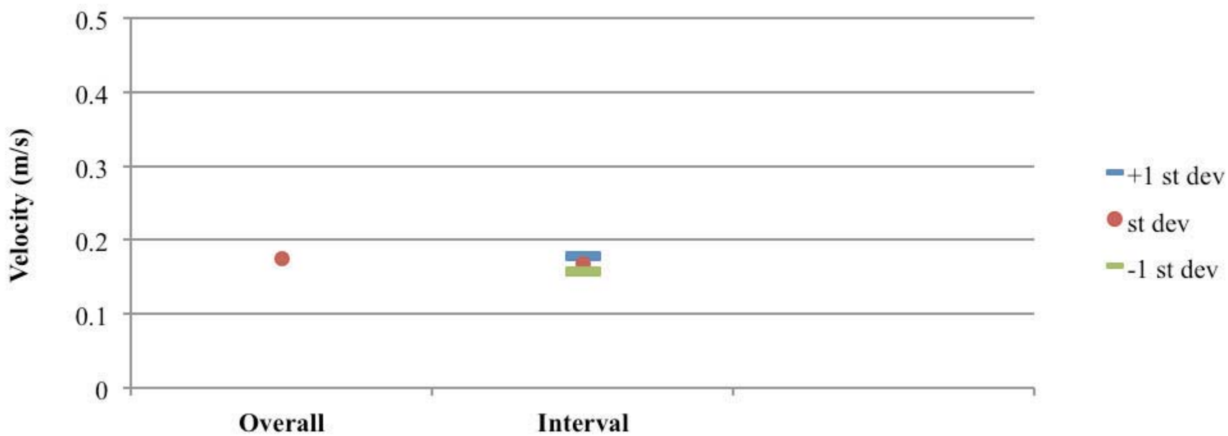


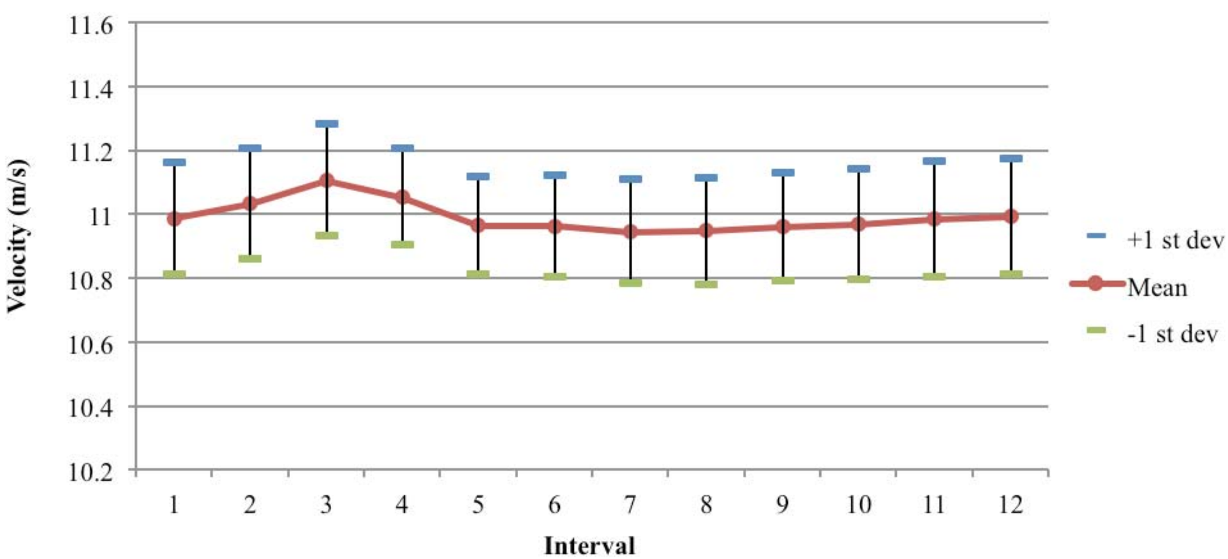
Figure C53. Histogram of 10-second intervals (x_b = 20 ft, blower frequency = 50 Hz, 25 bins).



a) Run 344 average velocity and standard deviation about the average velocity.



b) Run 344 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 344 average velocity from each 10-second interval.

Figure C54. Run 344 total velocity measurements.

Run 345
Blockage Location: x_b = 20 ft
Blower Frequency: 25 Hz
Time: 10:13 AM

Table C55. Run 345 velocity data from 2-minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)
Total Vel	4.9626	6.4702	5.7439	0.0911
u	4.96	6.47	5.6402	0.1014
v	-1.53	1.25	-0.1603	0.3375
w	-1.93	1.11	-0.8563	0.5532

Table C56. Run 345 total velocity data for each 10-second interval and mean and standard deviation data for each interval.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	I_{tot} (%)
1	5.2871	6.2789	5.7300	0.0949	1.656
2	5.1924	6.2315	5.7434	0.1072	1.867
3	4.9626	6.4702	5.7189	0.1154	2.019
4	5.0942	6.4163	5.7328	0.1185	2.068
5	5.1307	6.0718	5.7223	0.0824	1.440
6	5.4695	6.0365	5.7487	0.0769	1.338
7	5.5061	6.0028	5.7561	0.0694	1.207
8	5.4740	6.0151	5.7658	0.0683	1.184
9	5.5556	6.0283	5.7998	0.0661	1.140
10	5.4764	6.0088	5.7611	0.0769	1.335
11	5.4037	5.9768	5.7102	0.0767	1.344
12	5.4379	6.0158	5.7374	0.0816	1.422
		Average	**5.7439**	**0.0862**	**1.502**
		St Dev	**0.0245**	**0.0183**	**0.323**

Table C57. Run 345 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u (%)	I_v (%)	I_w (%)
1	5.6767	-0.6231	-0.2280	0.0944	0.2617	0.3163	1.66 %	4.61 %	5.57 %
2	5.6909	-0.4861	-0.3172	0.1103	0.3543	0.3707	1.94 %	6.23 %	6.51 %
3	5.6860	-0.4686	-0.1574	0.1155	0.2782	0.2335	2.03 %	4.89 %	4.11 %
4	5.7106	-0.1901	-0.2763	0.1176	0.3029	0.2237	2.06 %	5.30 %	3.92 %
5	5.6474	-0.2987	-0.8014	0.0856	0.2143	0.2726	1.52 %	3.80 %	4.83 %
6	5.6026	-0.1522	-1.2559	0.0758	0.1390	0.1982	1.35 %	2.48 %	3.54 %
7	5.5970	-0.1161	-1.3285	0.0717	0.1244	0.1149	1.28 %	2.22 %	2.05 %
8	5.5994	0.0547	-1.3564	0.0729	0.1684	0.1410	1.30 %	3.01 %	2.52 %
9	5.5809	-0.0107	-1.5701	0.0777	0.1025	0.1174	1.39 %	1.84 %	2.10 %
10	5.6403	0.0324	-1.0763	0.0934	0.2258	0.4059	1.66 %	4.00 %	7.20 %
11	5.6614	0.0982	-0.6750	0.0866	0.1896	0.2290	1.53 %	3.35 %	4.04 %
12	5.5895	0.2366	-1.2318	0.0827	0.1705	0.2720	1.48 %	3.05 %	4.87 %

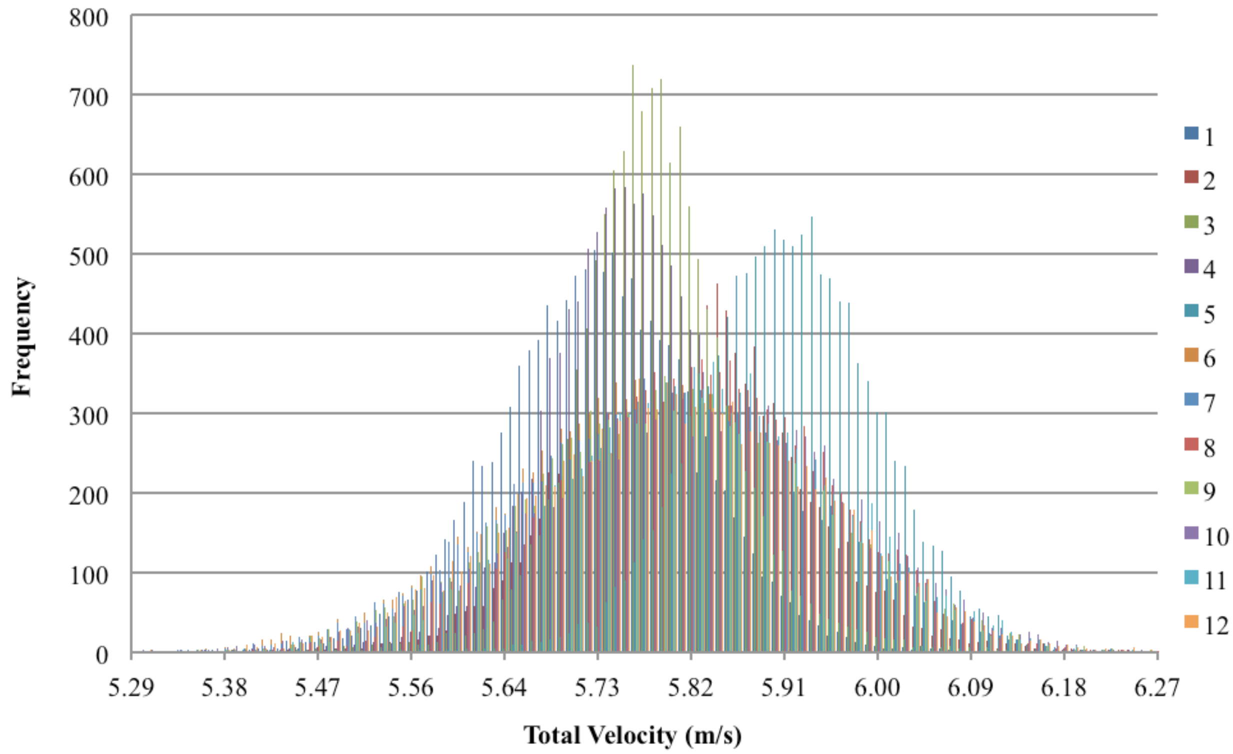


Figure C55. Histogram of 10-second intervals (x_b = 20 ft, blower frequency = 25 Hz, 100 bins).

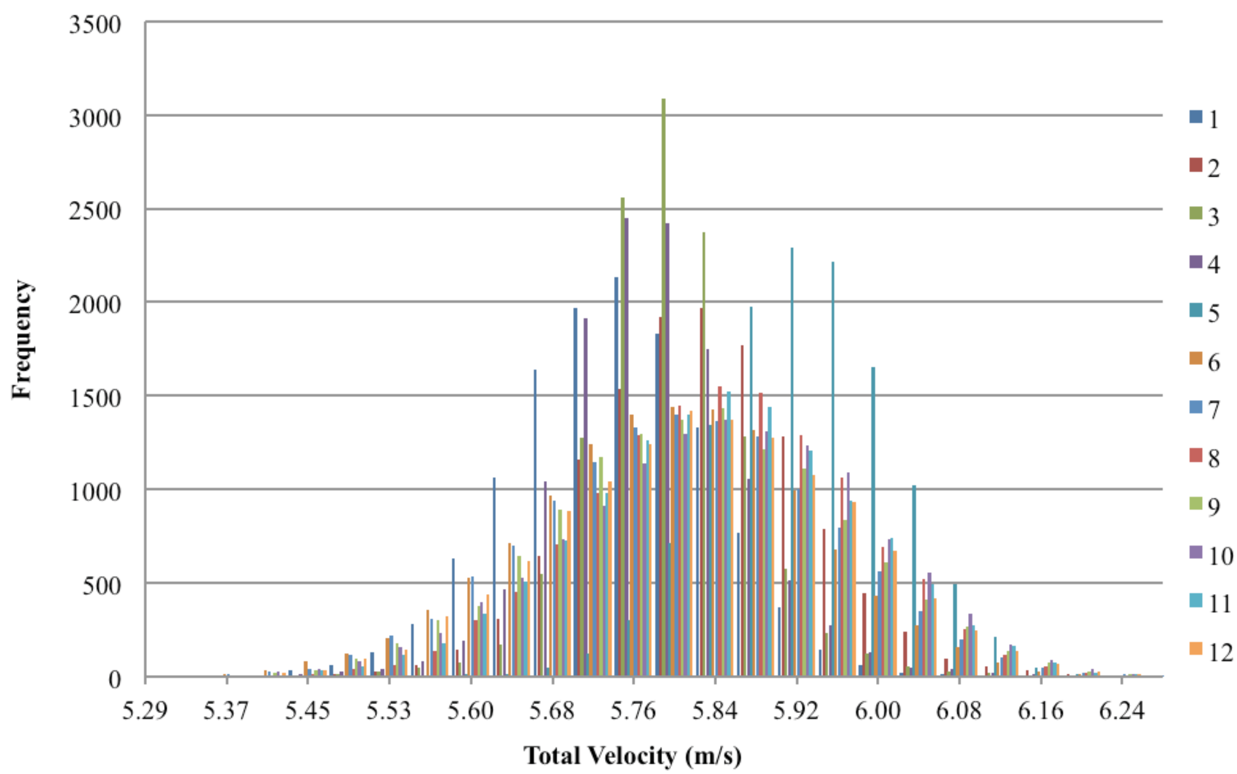
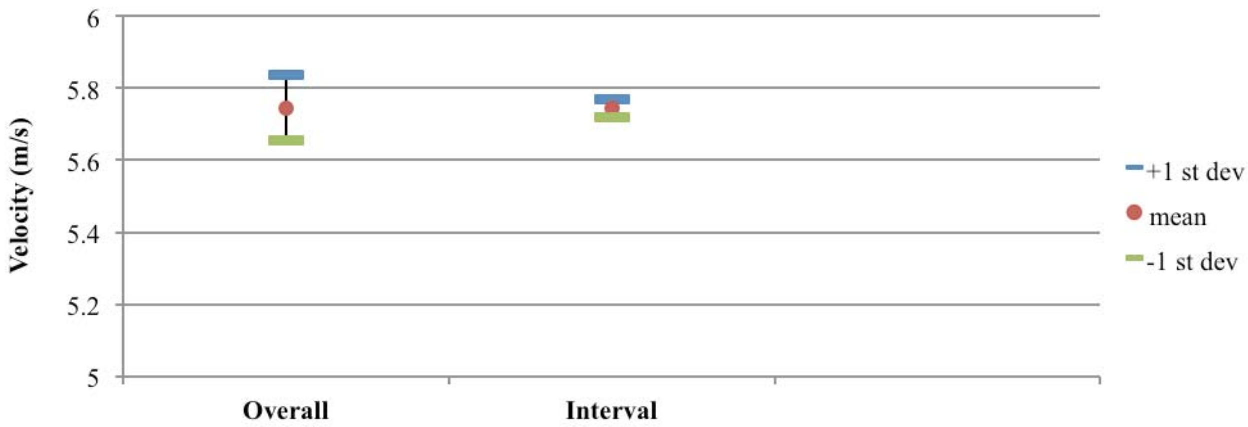
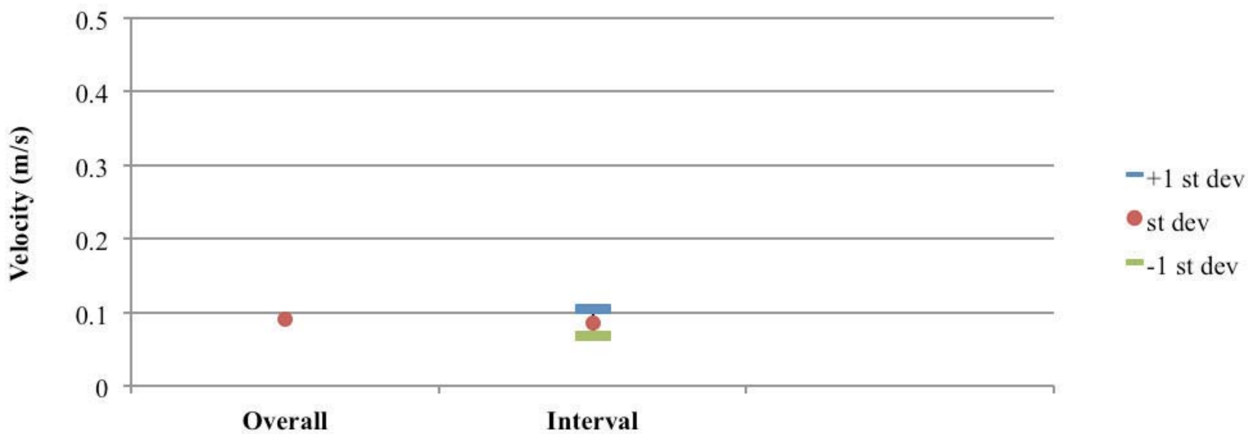


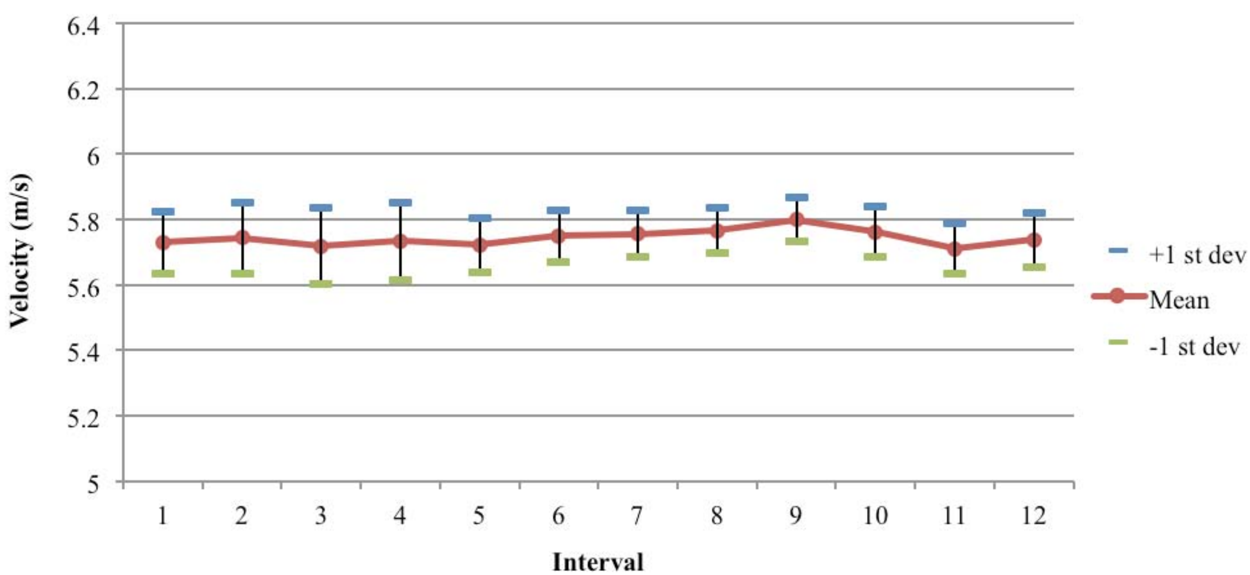
Figure C56. Histogram of 10-second intervals (x_b = 20 ft, blower frequency = 25 Hz, 25 bins).



a) Run 345 average velocity and standard deviation about the average velocity.



b) Run 345 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 345 average velocity from each 10-second interval.

Figure C57. Run 345 total velocity measurements.

Run 346
Blockage Location: x_b = 12 ft
Blower Frequency: 50 Hz
Time: 10:24 AM

Table C58. Run 346 velocity data from 2-minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)
Total Vel	9.9214	13.1783	10.9855	0.2293
u	7.55	11.7	10.5843	0.2768
v	-2.29	5.83	-0.0018	0.8605
w	-7.61	0.00294	-2.7196	0.7021

Table C59. Run 346 total velocity data for each 10-second interval and mean and standard deviation data for each interval.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	f_{tot} (%)
1	10.3193	11.4415	10.8736	0.1611	1.481
2	10.3238	11.6027	10.9333	0.1705	1.560
3	10.1203	11.6093	11.0054	0.1802	1.638
4	10.3089	11.9406	10.9678	0.1843	1.680
5	10.1299	11.5672	10.8488	0.1801	1.660
6	10.2243	11.4091	10.8726	0.1618	1.488
7	10.2044	11.5805	10.8758	0.1700	1.563
8	10.2482	11.6612	10.9290	0.1846	1.689
9	10.2303	11.9155	11.0486	0.2118	1.917
10	10.3153	12.0535	11.1446	0.2320	2.082
11	10.4165	12.2026	11.1855	0.2261	2.021
12	9.9214	13.1783	11.1403	0.2859	2.566
		Average	**10.9854**	**0.1957**	**1.779**
		St Dev	**0.1190**	**0.0369**	**0.317**

Table C60. Run 346 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	f_u (%)	f_v (%)	f_w (%)
1	10.5650	-0.6761	-2.4617	0.1698	0.2028	0.2368	1.61 %	1.92 %	2.24 %
2	10.5126	-0.8884	-2.8223	0.1706	0.4367	0.2796	1.62 %	4.15 %	2.66 %
3	10.4687	-0.2156	-3.3205	0.2389	0.5283	0.3870	2.28 %	5.05 %	3.70 %
4	10.4935	-0.6894	-3.0531	0.2011	0.3258	0.5216	1.92 %	3.10 %	4.97 %
5	10.5963	-0.5675	-2.1962	0.1864	0.3953	0.3370	1.76 %	3.73 %	3.18 %
6	10.6119	-0.2999	-2.3290	0.1684	0.1952	0.2160	1.59 %	1.84 %	2.04 %
7	10.6010	-0.1801	-2.3597	0.1831	0.4058	0.3639	1.73 %	3.83 %	3.43 %
8	10.5922	0.0174	-2.5191	0.2448	0.6119	0.7083	2.31 %	5.78 %	6.69 %
9	10.6870	0.6598	-2.5144	0.2222	0.7536	0.7274	2.08 %	7.05 %	6.81 %
10	10.6805	0.8396	-2.8877	0.2431	0.8581	0.5868	2.28 %	8.03 %	5.49 %
11	10.7994	0.8704	-2.6079	0.2274	0.6422	0.7191	2.11 %	5.95 %	6.66 %
12	10.4037	1.1074	-3.5624	0.5653	0.6935	1.1116	5.43 %	6.67 %	10.69 %

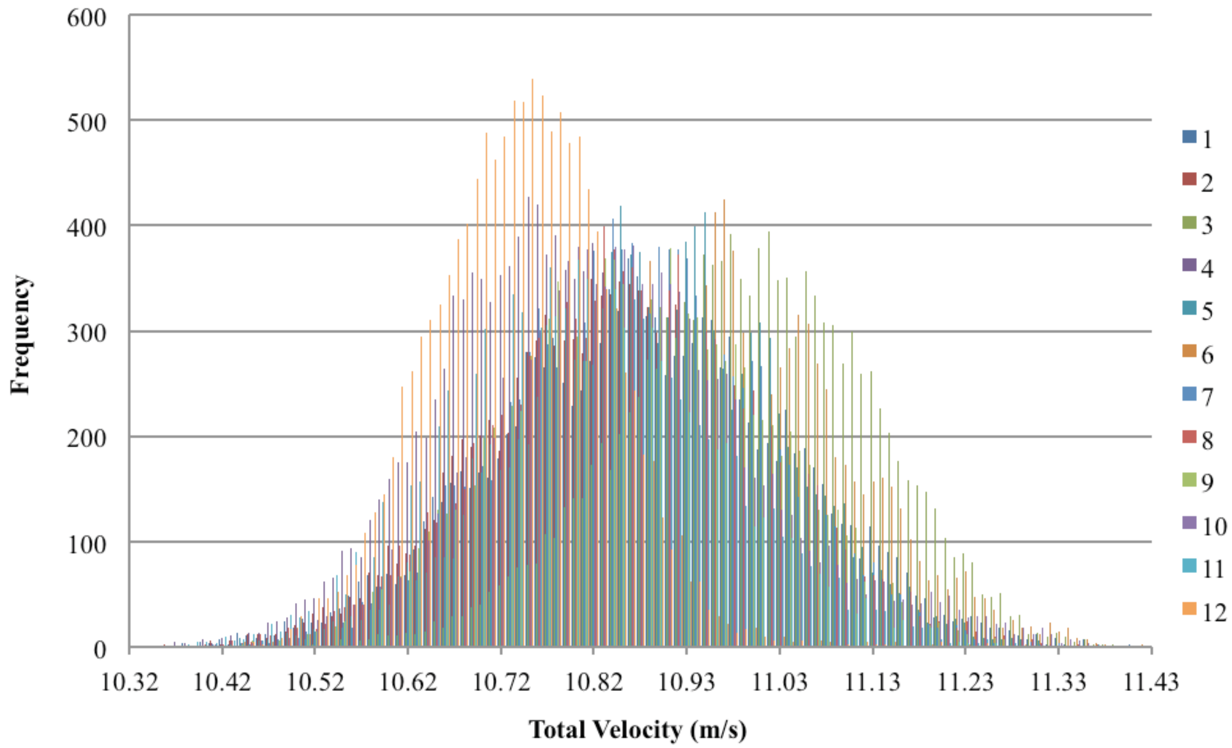


Figure C58. Histogram of 10-second intervals (x_b = 12 ft, blower frequency = 50 Hz, 100 bins).

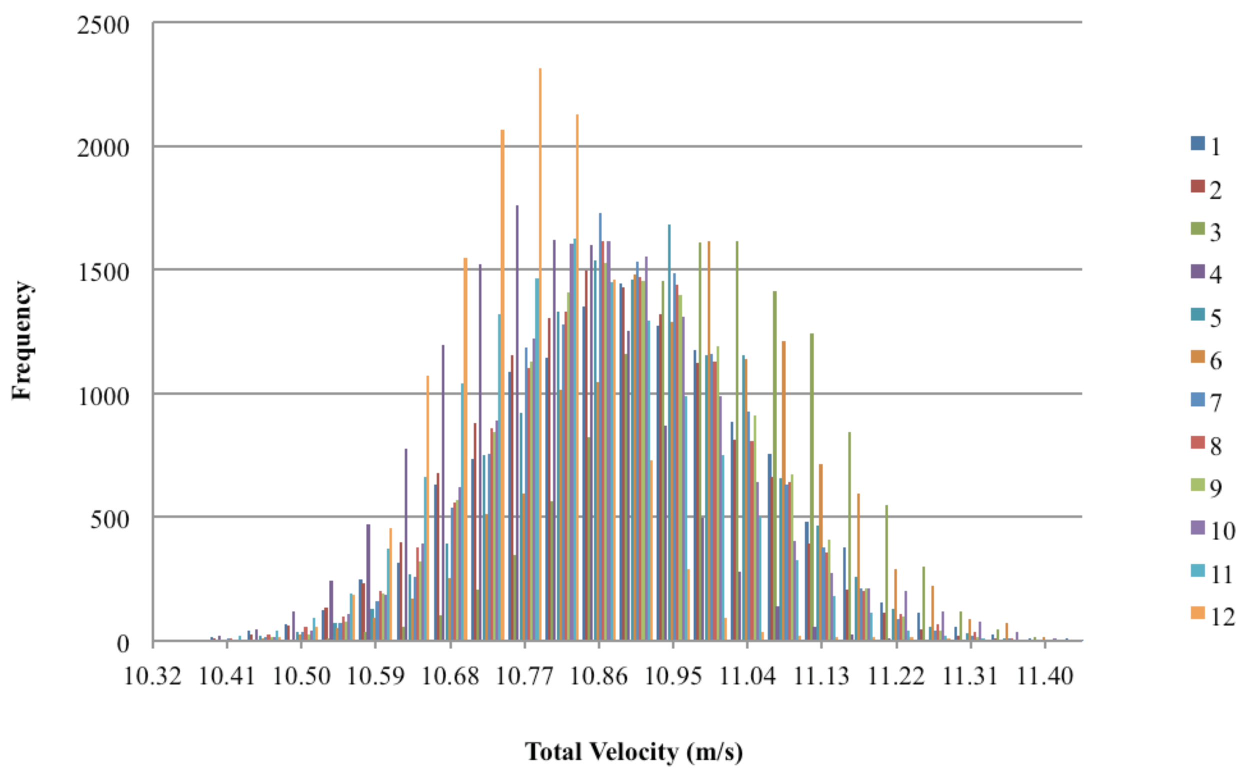
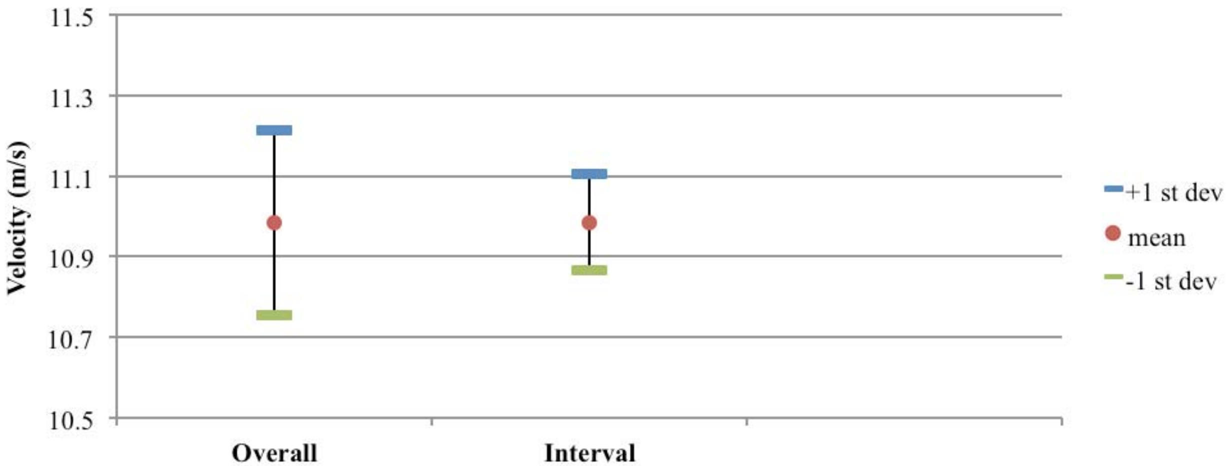
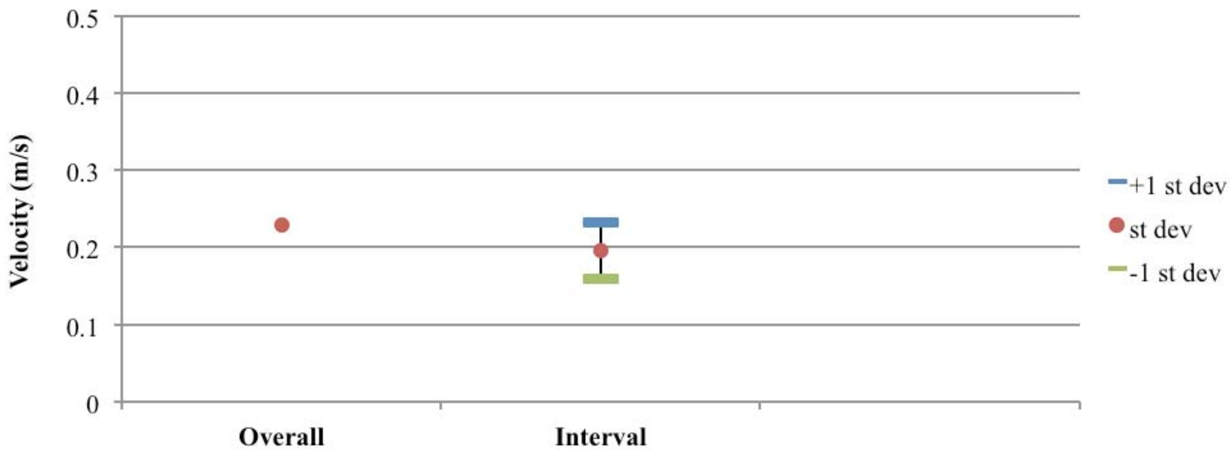


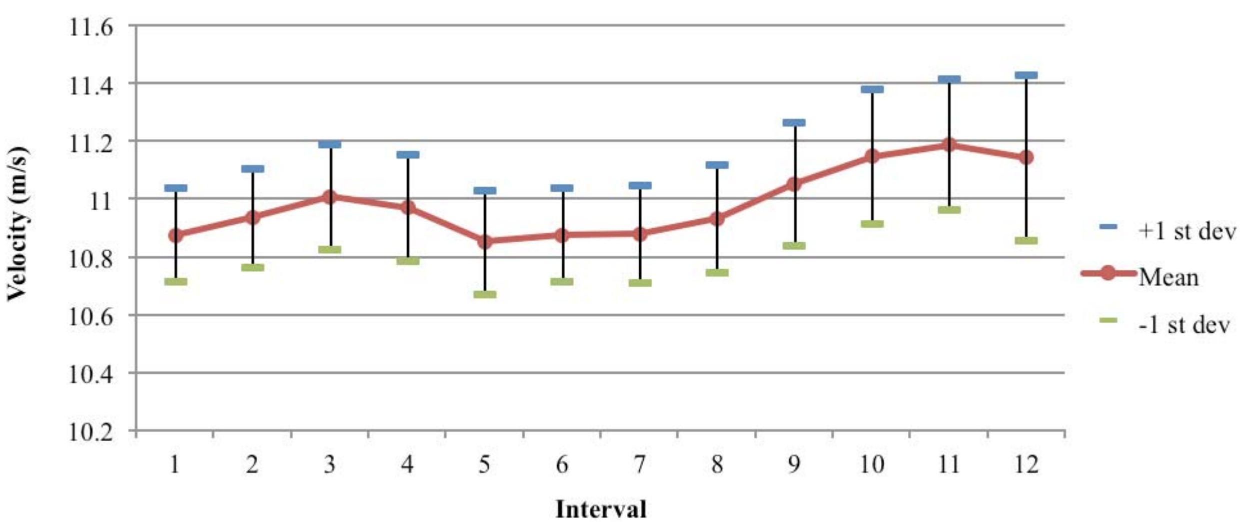
Figure C59. Histogram of 10-second intervals (x_b = 12 ft, blower frequency = 50 Hz, 25 bins).



a) Run 346 average velocity and standard deviation about the average velocity.



b) Run 346 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 346 average velocity from each 10-second interval.

Figure C60. Run 346 total velocity measurements.

Run 347
Blockage Location: x_b = 12 ft
Blower Frequency: 25 Hz
Time: 10:31 AM

Table C61. Run 347 velocity data from 2-minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)
Total Vel	5.3635	6.1689	5.7080	0.0828
u	4.92	5.99	5.5315	0.1029
v	-0.975	1.01	-0.1462	0.2882
w	-2.41	0.135	-1.3277	0.3363

Table C62. Run 347 total velocity data for each 10-second interval and mean and standard deviation data for each interval.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	I_{tot} (%)
1	5.3896	6.0040	5.7013	0.0749	1.315
2	5.4091	6.0890	5.7201	0.0895	1.564
3	5.4153	6.1689	5.7845	0.1014	1.754
4	5.3696	6.0556	5.6838	0.0888	1.563
5	5.4121	5.9332	5.6717	0.0680	1.199
6	5.3993	5.9883	5.7104	0.0710	1.244
7	5.3635	5.9733	5.6894	0.0733	1.289
8	5.4374	5.9630	5.7094	0.0753	1.320
9	5.4188	5.9898	5.7060	0.0740	1.297
10	5.3710	5.9165	5.6825	0.0728	1.281
11	5.4598	5.9519	5.7151	0.0685	1.199
12	5.4640	5.9979	5.7218	0.0701	1.226
		Average	**5.7080**	**0.0773**	**1.354**
		St Dev	**0.0289**	**0.0103**	**0.175**

Table C63. Run 347 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u (%)	I_v (%)	I_w (%)
1	5.5518	-0.1644	-1.2570	0.0852	0.1708	0.2115	1.53 %	3.08 %	3.81 %
2	5.4170	0.0075	-1.7876	0.1075	0.3810	0.1780	1.99 %	7.03 %	3.29 %
3	5.5254	0.3350	-1.5582	0.1758	0.2527	0.5529	3.18 %	4.57 %	10.01 %
4	5.6155	-0.2095	-0.7878	0.0995	0.1979	0.2572	1.77 %	3.52 %	4.58 %
5	5.5232	-0.0955	-1.2694	0.0709	0.1436	0.1454	1.28 %	2.60 %	2.63 %
6	5.5288	-0.1217	-1.3897	0.0741	0.2690	0.1517	1.34 %	4.87 %	2.74 %
7	5.5364	-0.3496	-1.2321	0.0806	0.1459	0.2344	1.46 %	2.64 %	4.23 %
8	5.5495	-0.2979	-1.2853	0.0777	0.1233	0.2099	1.40 %	2.22 %	3.78 %
9	5.5297	-0.3347	-1.3502	0.0724	0.1387	0.1636	1.31 %	2.51 %	2.96 %
10	5.5419	-0.3292	-1.1787	0.0757	0.1608	0.2317	1.37 %	2.90 %	4.18 %
11	5.5118	-0.2972	-1.4552	0.0737	0.2238	0.1649	1.34 %	4.06 %	2.99 %
12	5.5472	0.1028	-1.3805	0.0791	0.1177	0.1921	1.43 %	2.12 %	3.46 %

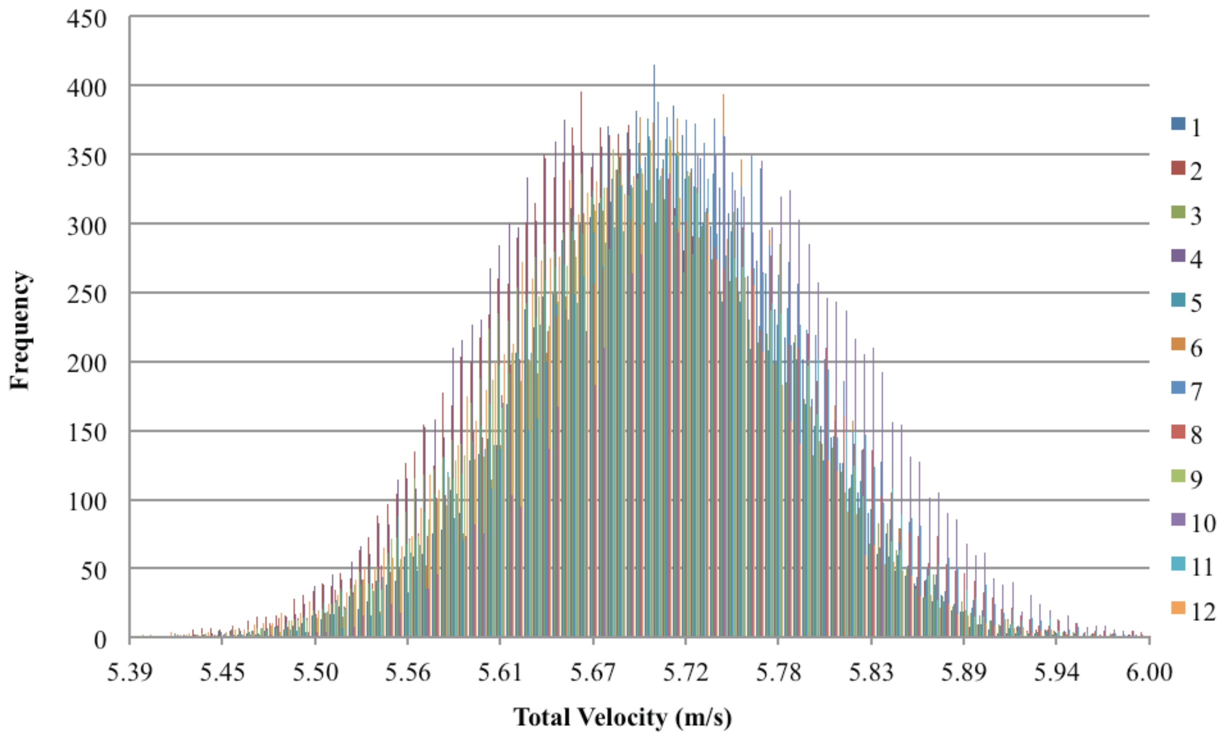


Figure C61. Histogram of 10-second intervals (x_b = 12 ft, blower frequency = 25 Hz, 100 bins).

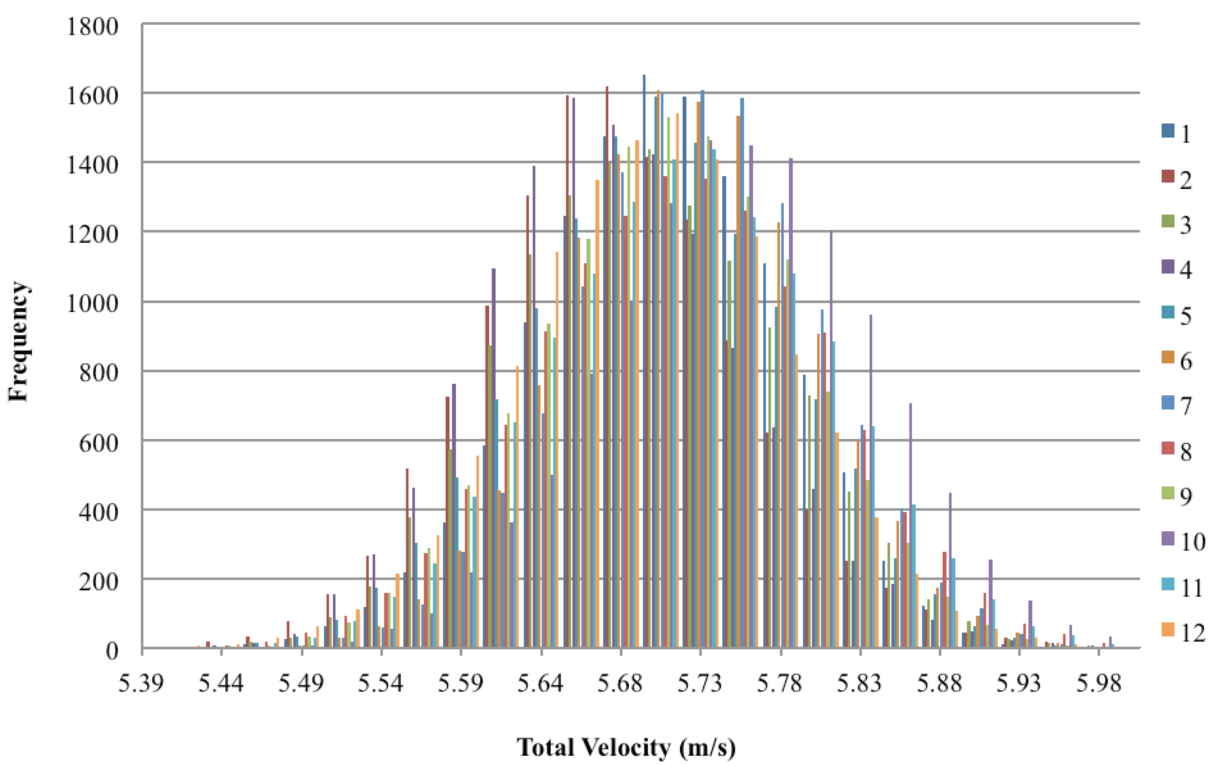
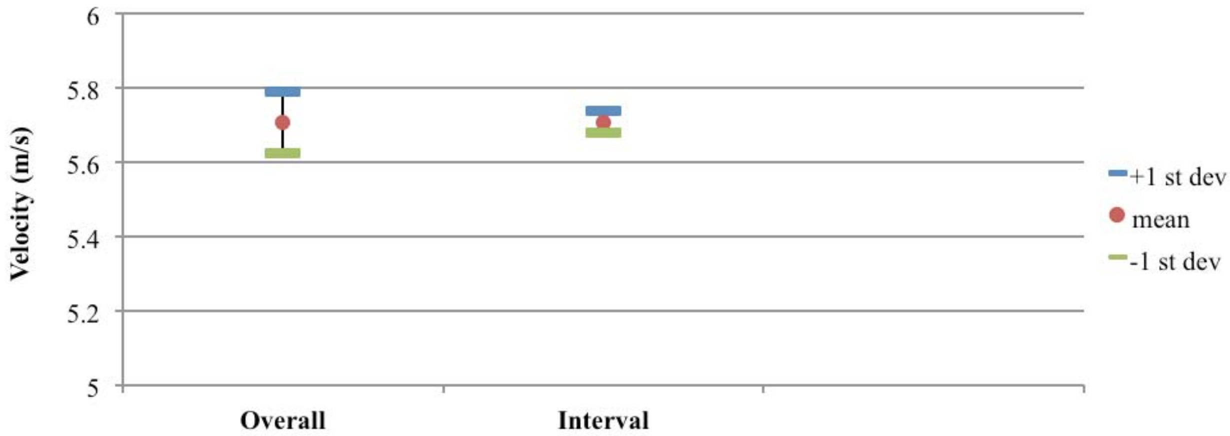
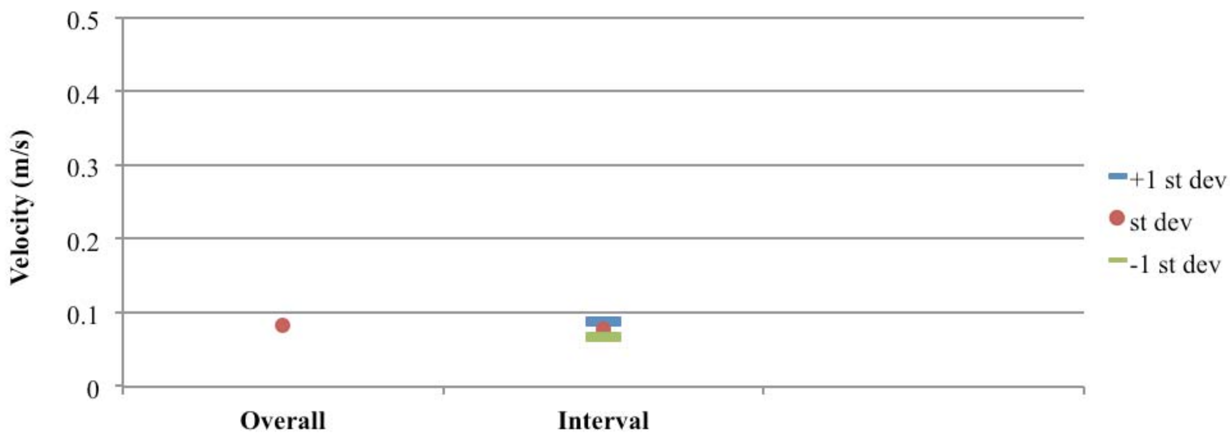


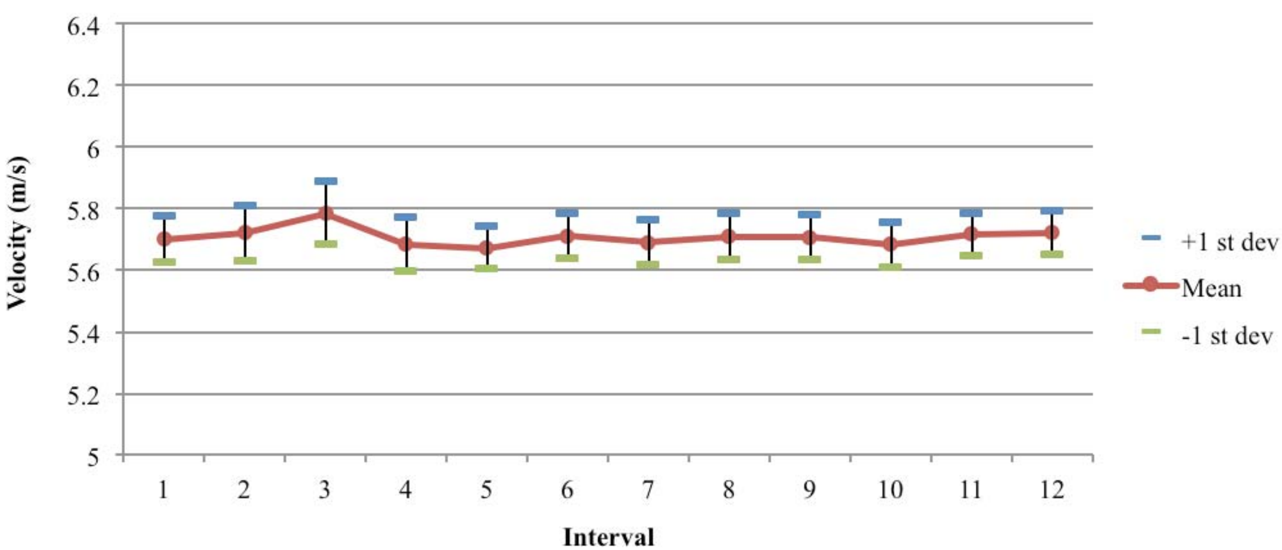
Figure C62. Histogram of 10-second intervals (x_b = 12 ft, blower frequency = 25 Hz, 25 bins).



a) Run 347 average velocity and standard deviation about the average velocity.



b) Run 347 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 347 average velocity from each 10-second interval.

Figure C63. Run 347 total velocity measurements.

Run 348
Blockage Location: x_b = 8 ft
Blower Frequency: 50 Hz
Time: 10:42 AM

Table C64. Run 348 velocity data from 2-minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)
Total Vel	9.7276	11.6552	10.8779	0.1824
u	9.68	11.5	10.6211	0.1891
v	-2.13	1.37	-0.3929	0.4216
w	-3.82	0.697	-2.2369	0.4275

Table C65. Run 348 total velocity data for each 10-second interval and mean and standard deviation data for all intervals.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	I_{tot} (%)
1	10.2320	11.6552	10.9600	0.1760	1.606
2	10.2265	11.4422	10.8707	0.1673	1.539
3	10.1842	11.5760	10.9147	0.1655	1.516
4	10.1304	11.5638	10.8622	0.1816	1.671
5	10.1117	11.5684	10.8932	0.1867	1.714
6	9.72764	11.5231	10.8282	0.1956	1.806
7	10.2193	11.5379	10.9149	0.1758	1.611
8	10.0504	11.4361	10.8700	0.1742	1.603
9	10.0873	11.4955	10.8188	0.1743	1.611
10	10.1491	11.5253	10.8471	0.1751	1.615
11	10.1440	11.5251	10.8873	0.1829	1.680
12	10.0282	11.5683	10.8674	0.1838	1.691
		Average	**10.8779**	**0.1782**	**1.639**
		St Dev	**0.0395**	**0.0083**	**0.079**

Table C66. Run 348 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u (%)	I_v (%)	I_w (%)
1	10.6121	-0.1588	-2.7072	0.1741	0.2637	0.2852	1.64 %	2.48 %	2.69 %
2	10.6139	-0.4330	-2.2882	0.1772	0.2116	0.2171	1.67 %	1.99 %	2.05 %
3	10.5570	-0.5793	-2.6779	0.1745	0.3363	0.2450	1.65 %	3.19 %	2.32 %
4	10.6481	-0.0468	-2.1040	0.1861	0.2523	0.3346	1.75 %	2.37 %	3.14 %
5	10.6002	-0.5411	-2.3747	0.1913	0.4471	0.4054	1.80 %	4.22 %	3.82 %
6	10.6462	-0.5141	-1.8416	0.2045	0.3257	0.3802	1.92 %	3.06 %	3.57 %
7	10.6429	-0.5650	-2.3036	0.1889	0.2095	0.4361	1.77 %	1.97 %	4.10 %
8	10.6256	-0.6436	-2.1736	0.1792	0.1907	0.2792	1.69 %	1.79 %	2.63 %
9	10.5815	-0.8761	-2.0433	0.1856	0.2805	0.2329	1.75 %	2.65 %	2.20 %
10	10.6434	-0.3359	-2.0420	0.1804	0.2447	0.1873	1.70 %	2.30 %	1.76 %
11	10.6436	0.1583	-2.1747	0.1981	0.5030	0.4852	1.86 %	4.73 %	4.56 %
12	10.6391	-0.1800	-2.1113	0.2009	0.3716	0.5255	1.89 %	3.49 %	4.94 %

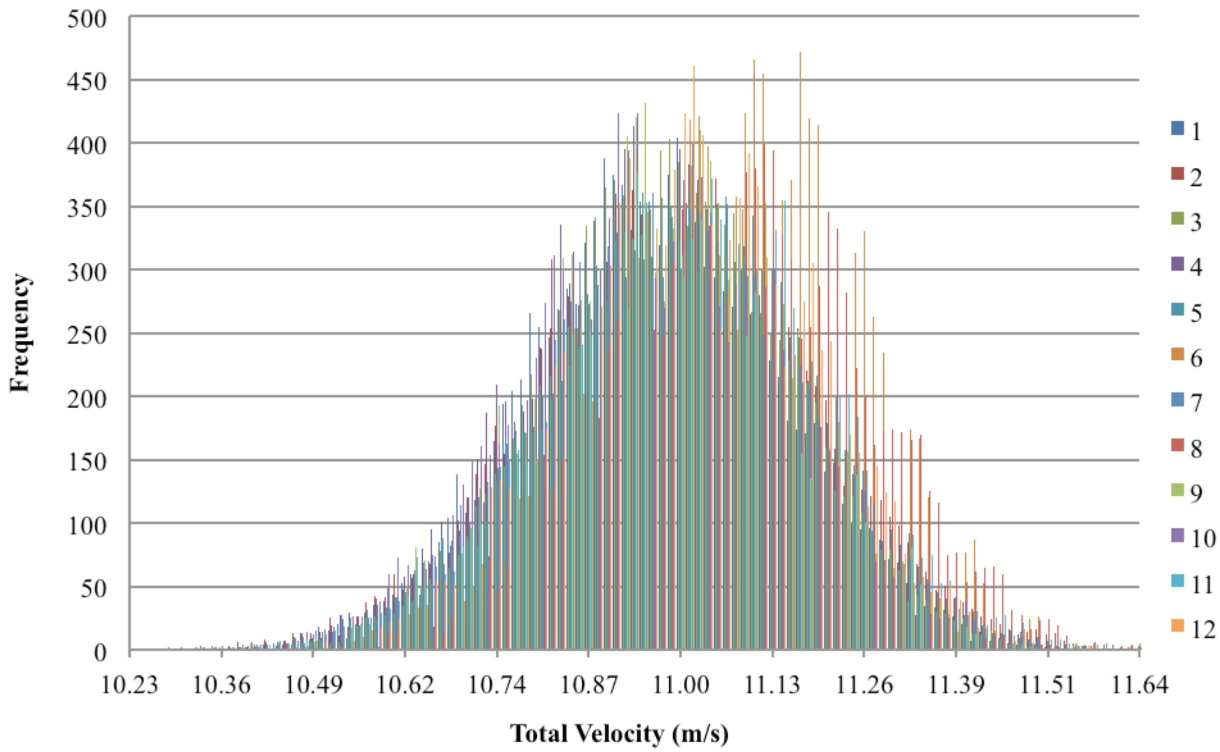


Figure C64. Histogram of 10-second intervals (x_b = 8 ft, blower frequency = 50 Hz, 100 bins).

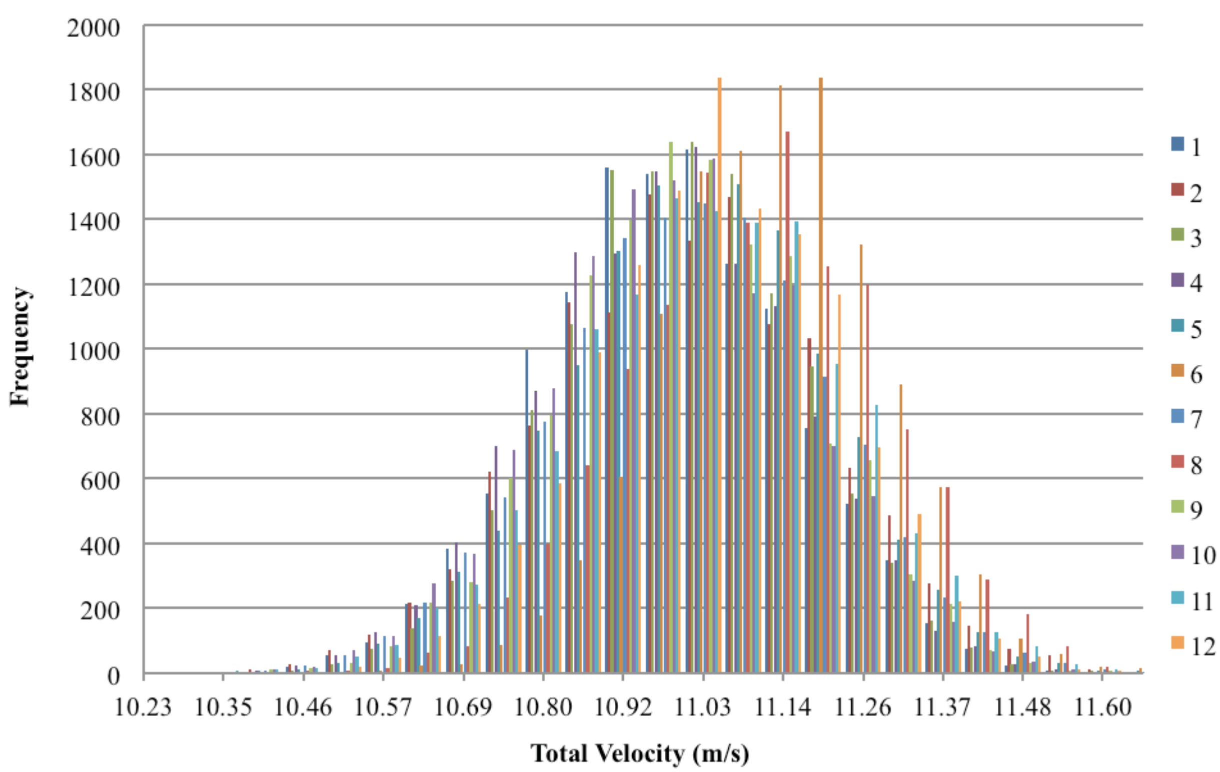
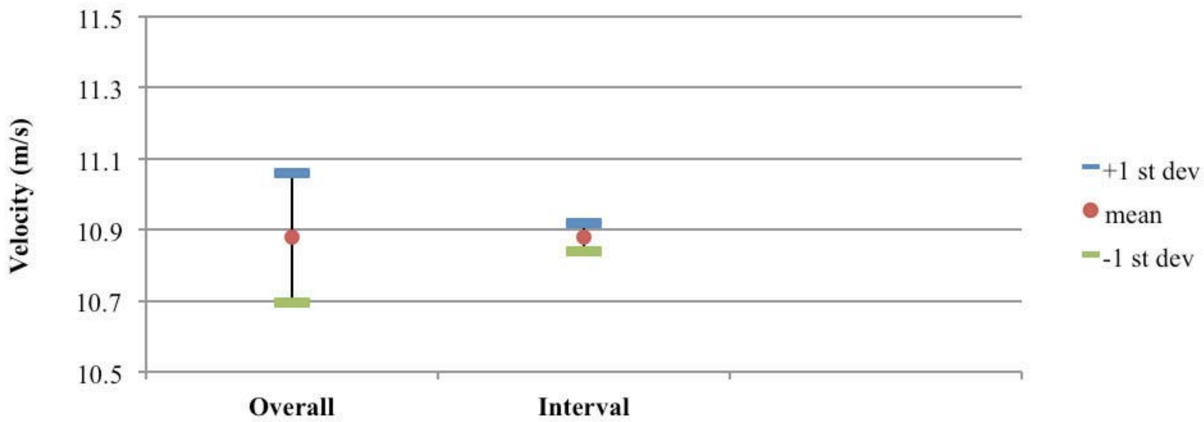
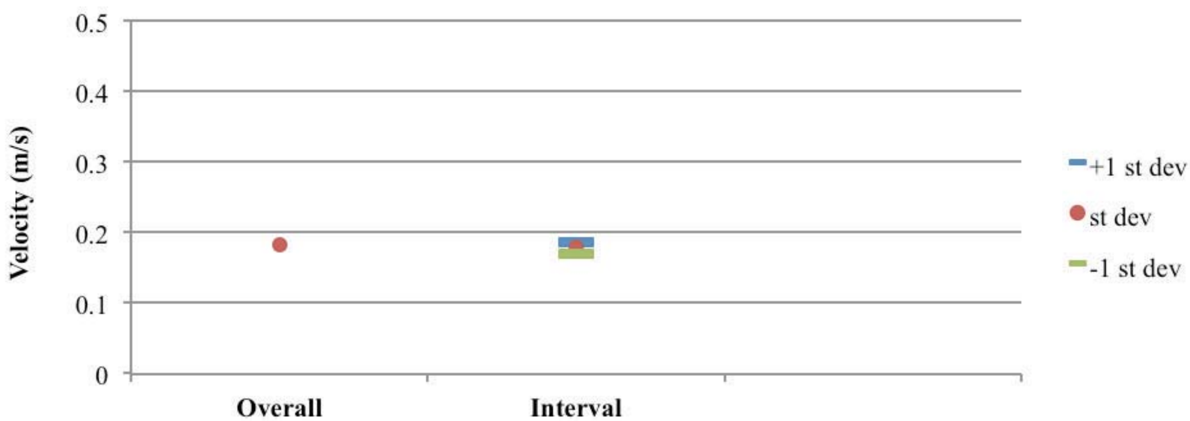


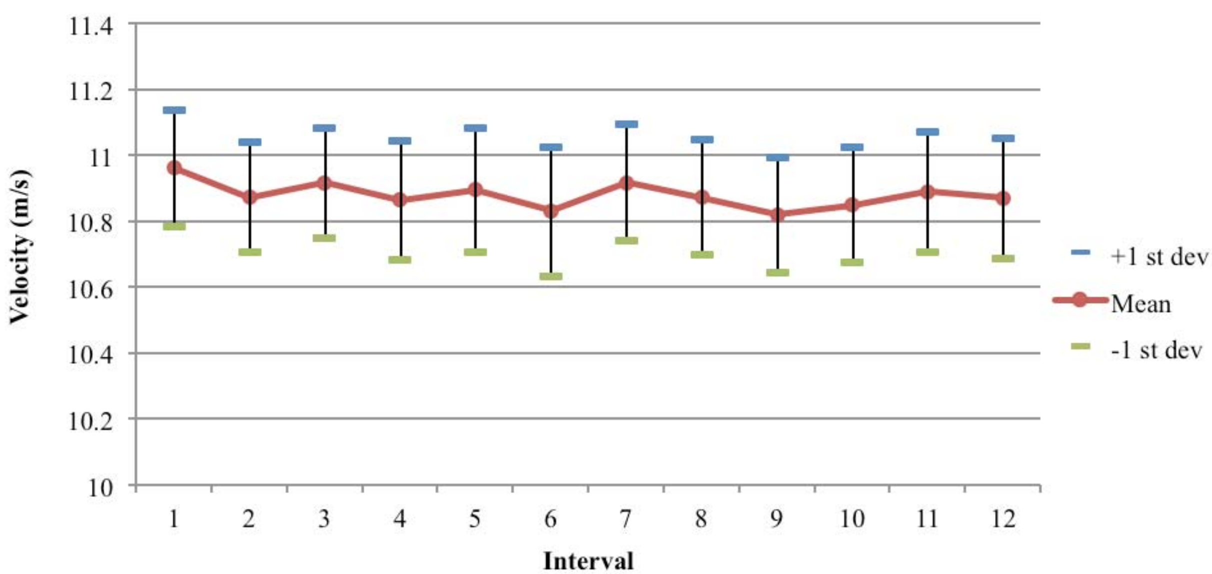
Figure C65. Histogram of 10-second intervals (x_b = 8 ft, blower frequency = 50 Hz, 25 bins).



a) Run 348 average velocity and standard deviation about the average velocity.



b) Run 348 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 348 average velocity from each 10-second interval.

Figure C66. Run 348 total velocity measurements.

Run 349
Blockage Location: x_b = 8 ft
Blower Frequency: 25 Hz
Time: 10:47 AM

Table C67. Run 349 velocity data from 2-minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)
Total Vel	4.8542	6.4006	5.6955	0.1109
u	4.69	6.38	5.6239	0.1114
v	-2.25	1.68	-0.0019	0.3879
w	-2.13	1.12	-0.7486	0.3148

Table C68. Run 349 total velocity data for each 10-second interval and mean and standard deviation data for each interval.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	I_{tot} (%)
1	5.3532	6.2163	5.7722	0.0929	1.610
2	5.3769	6.1039	5.7506	0.0870	1.513
3	5.2870	6.1905	5.7288	0.0927	1.619
4	5.2289	6.1285	5.6887	0.0937	1.648
5	5.0627	6.4005	5.6735	0.1118	1.971
6	4.9892	6.3966	5.7323	0.1057	1.845
7	5.2758	6.0353	5.6964	0.0849	1.491
8	5.2763	6.0627	5.6729	0.0900	1.586
9	4.8541	6.3974	5.6475	0.1482	2.625
10	4.9720	6.3268	5.6689	0.1262	2.226
11	5.2811	6.0857	5.6494	0.0926	1.640
12	5.0106	6.2464	5.6642	0.0989	1.747
		Average	**5.6954**	**0.1021**	**1.794**
		St Dev	**0.0410**	**0.0186**	**0.335**

Table C69. Run 349 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u (%)	I_v (%)	I_w (%)
1	5.6506	0.3491	-0.9896	0.1034	0.4387	0.3050	1.83 %	7.76 %	5.40 %
2	5.6733	0.4337	-0.6754	0.0996	0.3441	0.3451	1.76 %	6.07 %	6.08 %
3	5.6635	0.1954	-0.7215	0.1000	0.3092	0.2987	1.77 %	5.46 %	5.27 %
4	5.6442	0.1680	-0.4965	0.0982	0.3853	0.2843	1.74 %	6.83 %	5.04 %
5	5.5977	-0.1311	-0.7316	0.1164	0.4752	0.2770	2.08 %	8.49 %	4.95 %
6	5.6377	-0.3560	-0.9238	0.1102	0.2165	0.2204	1.96 %	3.84 %	3.91 %
7	5.6077	-0.2402	-0.9461	0.0902	0.1546	0.1564	1.61 %	2.76 %	2.79 %
8	5.6204	-0.0627	-0.7269	0.0919	0.1927	0.1548	1.64 %	3.43 %	2.75 %
9	5.5987	0.0993	-0.4564	0.1470	0.3678	0.4423	2.63 %	6.57 %	7.90 %
10	5.6185	-0.1067	-0.6582	0.1247	0.2521	0.2474	2.22 %	4.49 %	4.40 %
11	5.5730	-0.2242	-0.8683	0.0968	0.1444	0.1796	1.74 %	2.59 %	3.22 %
12	5.6018	-0.1472	-0.7895	0.0995	0.1497	0.1909	1.78 %	2.67 %	3.41 %

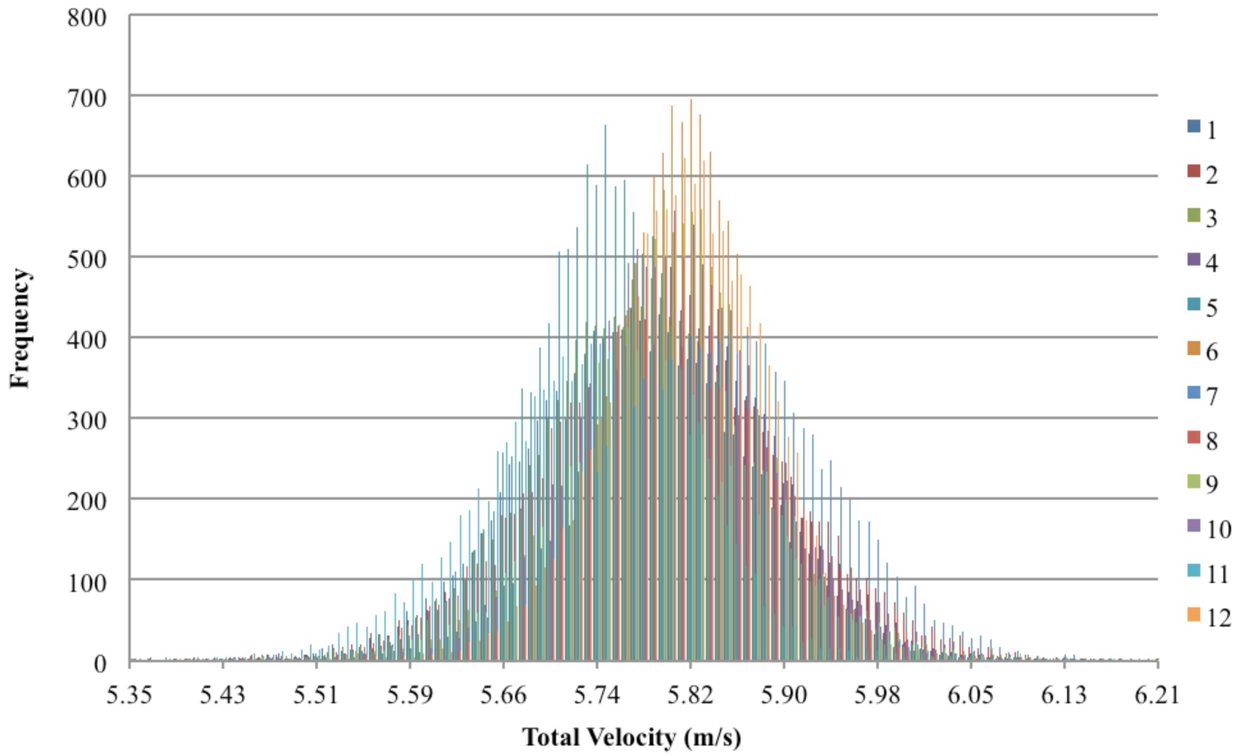


Figure C67. Histogram of 10-second intervals (x_b = 8 ft, blower frequency = 25 Hz, 100 bins).

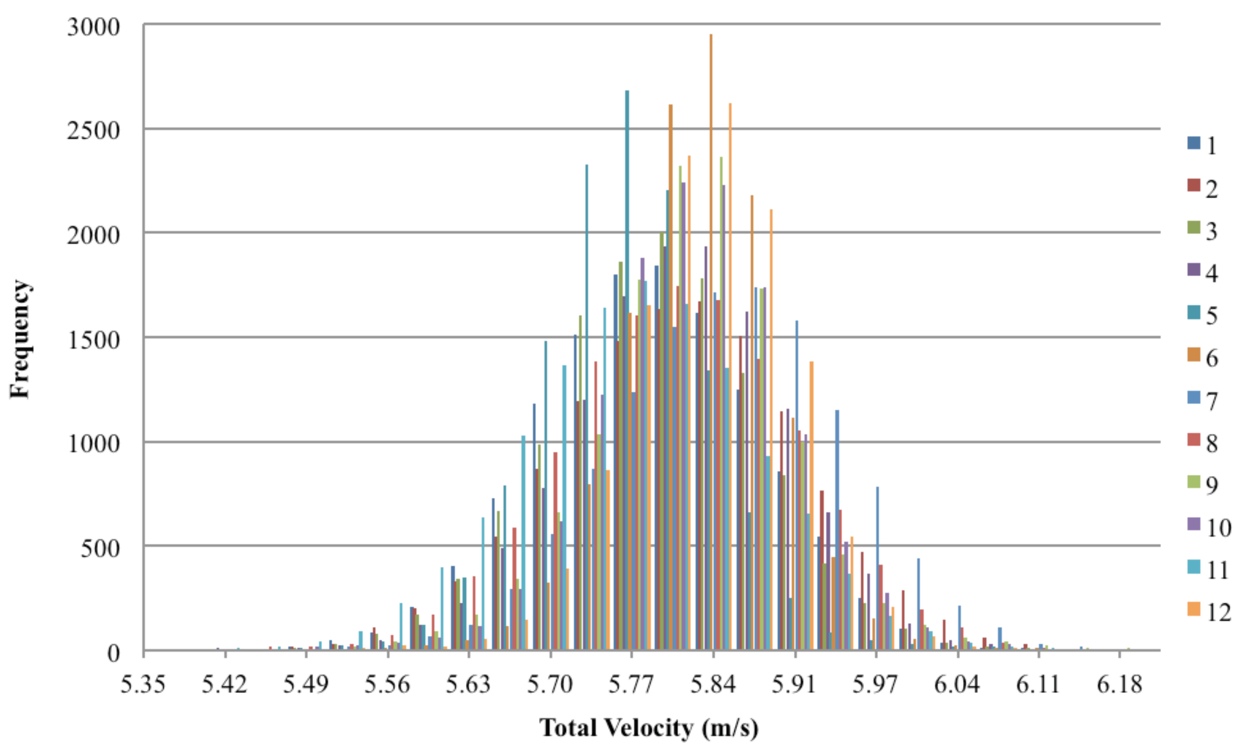
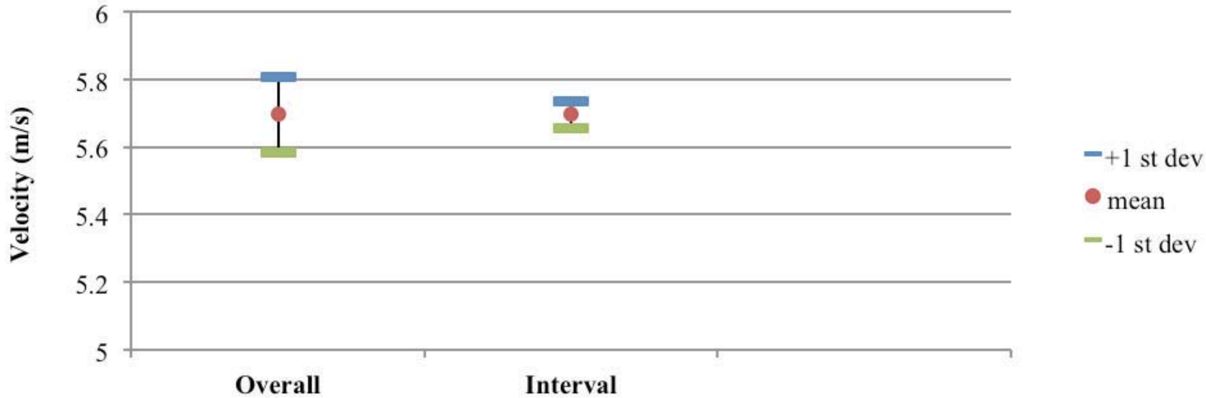
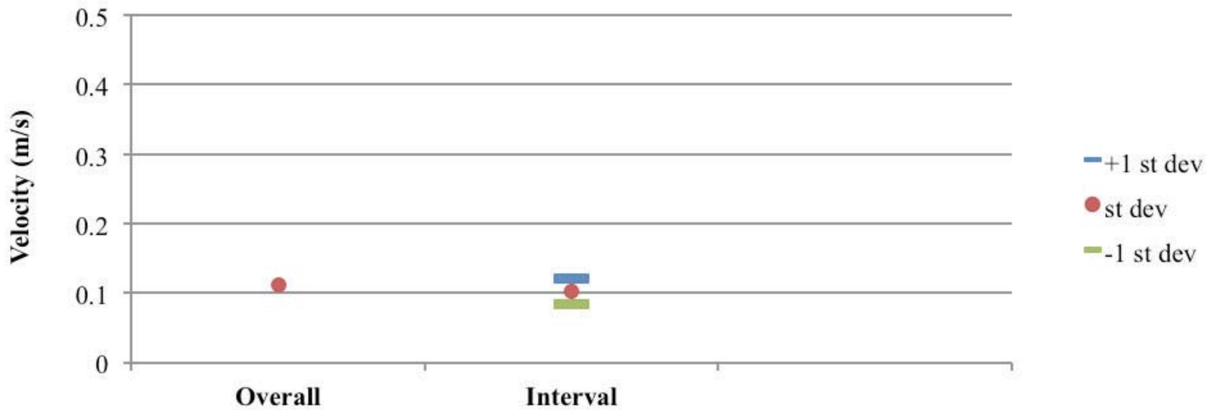


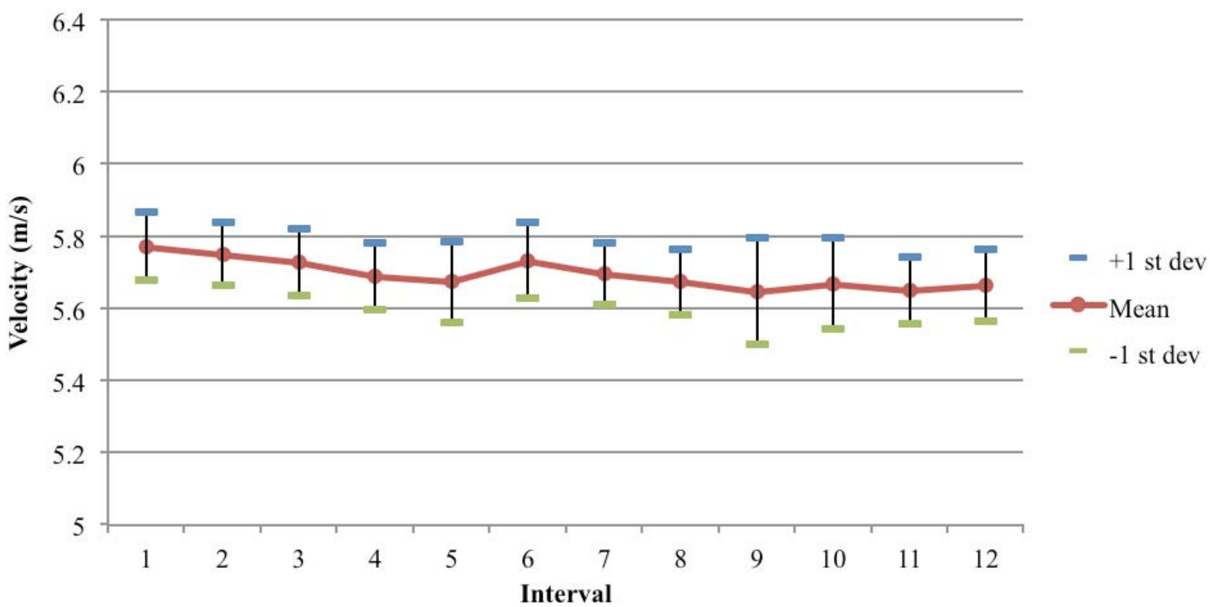
Figure C68. Histogram of 10-second intervals (x_b = 8 ft, blower frequency = 25 Hz, 25 bins).



a) Run 349 average velocity and standard deviation about the average velocity.



b) Run 349 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 349 average velocity from each 10-second interval.

Figure C69. Run 349 total velocity measurements.

Run 350
Blockage Location: x_b = 4 ft
Blower Frequency: 50 Hz
Time: 10:55 AM

Table C70. Run 350 velocity data from 2-minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)
Total Vel	6.8145	14.5289	10.8909	0.3372
u	6.8	14.1	10.6955	0.3376
v	-4.08	3.96	-0.1381	0.6958
w	-4.32	5.15	-1.6386	1.0146

Table C71. Run 350 total velocity data for each 10-second interval and mean and standard deviation data for each interval.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	I_{tot} (%)
1	6.814488	13.27879	10.9145	0.430088	3.940
2	7.376321	14.52889	10.85391	0.601688	5.543
3	7.685196	13.08191	10.84056	0.393441	3.629
4	9.338907	12.72613	10.77712	0.247585	2.297
5	7.85674	13.02472	10.85332	0.295804	2.725
6	7.791092	13.10991	10.8181	0.323623	2.991
7	9.316449	11.79925	10.92469	0.23841	2.182
8	10.18435	11.76844	10.99204	0.192368	1.750
9	8.18151	12.83151	10.92268	0.22088	2.022
10	9.611513	11.85197	10.94769	0.220724	2.016
11	8.119104	11.9262	10.93389	0.227727	2.082
12	7.326283	12.98213	10.9132	0.351638	3.222
		Average	**10.8909**	**0.3119**	**2.866**
		St Dev	**0.0618**	**0.1183**	**1.093471**

Table C72. Run 350 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u (%)	I_v (%)	I_w (%)
1	10.8208	0.4736	-0.7267	0.4243	0.8408	0.7634	3.92 %	7.77 %	7.05 %
2	10.7120	-0.3691	0.1283	0.6132	0.9718	1.3960	5.72 %	9.07 %	13.03 %
3	10.7075	-0.4369	-1.2858	0.3926	0.7069	0.7241	3.67 %	6.60 %	6.76 %
4	10.6192	-0.1175	-1.7352	0.2462	0.4302	0.4127	2.32 %	4.05 %	3.89 %
5	10.7341	0.0131	-1.4590	0.2914	0.4316	0.5119	2.71 %	4.02 %	4.77 %
6	10.7020	-0.0389	-1.3523	0.3214	0.5946	0.5625	3.00 %	5.56 %	5.26 %
7	10.6805	0.2613	-2.1952	0.2288	0.4810	0.4013	2.14 %	4.50 %	3.76 %
8	10.6163	-0.0431	-2.7914	0.2113	0.3159	0.4660	1.99 %	2.98 %	4.39 %
9	10.6460	-0.0879	-2.3769	0.2158	0.3688	0.4200	2.03 %	3.46 %	3.95 %
10	10.7283	-0.0213	-2.0446	0.2275	0.5476	0.5208	2.12 %	5.10 %	4.85 %
11	10.6726	-0.6159	-2.1384	0.2291	0.6840	0.4751	2.15 %	6.41 %	4.45 %
12	10.7075	-0.6743	-1.6881	0.3559	0.6700	0.8317	3.32 %	6.26 %	7.77 %

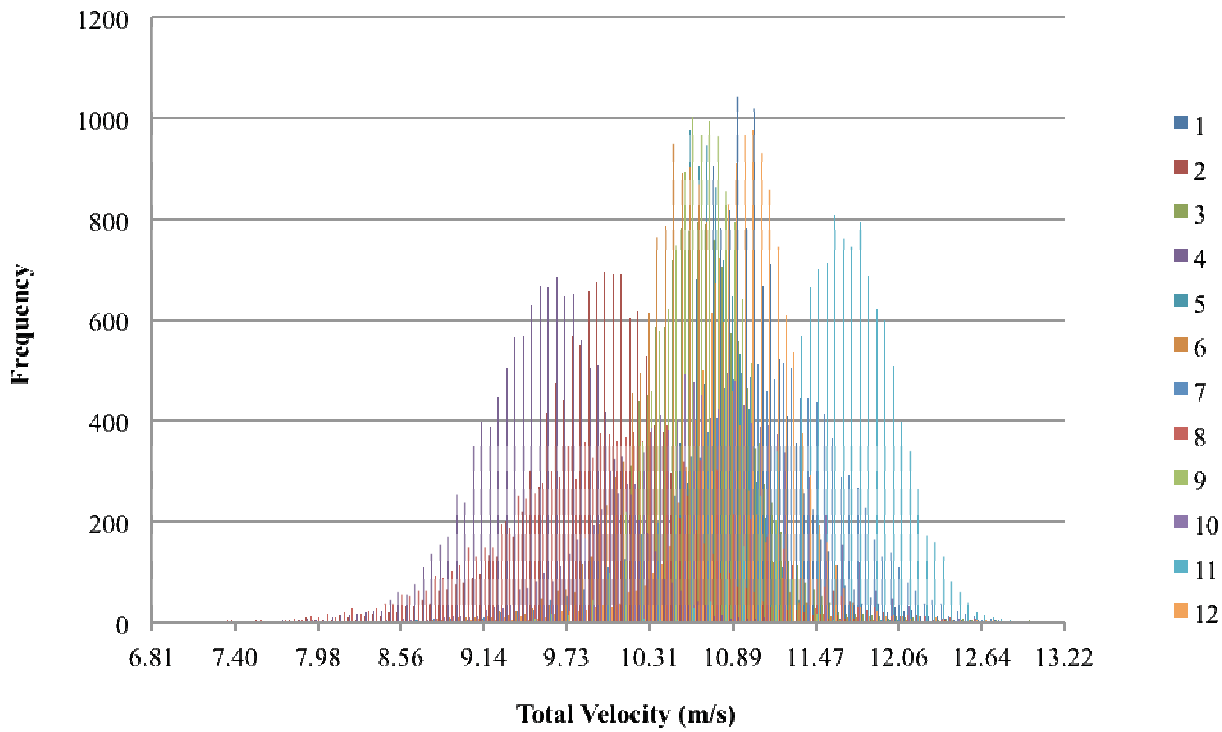


Figure C70. Histogram of 10-second intervals (x_b = 4 ft, blower frequency = 50 Hz, 100 bins).

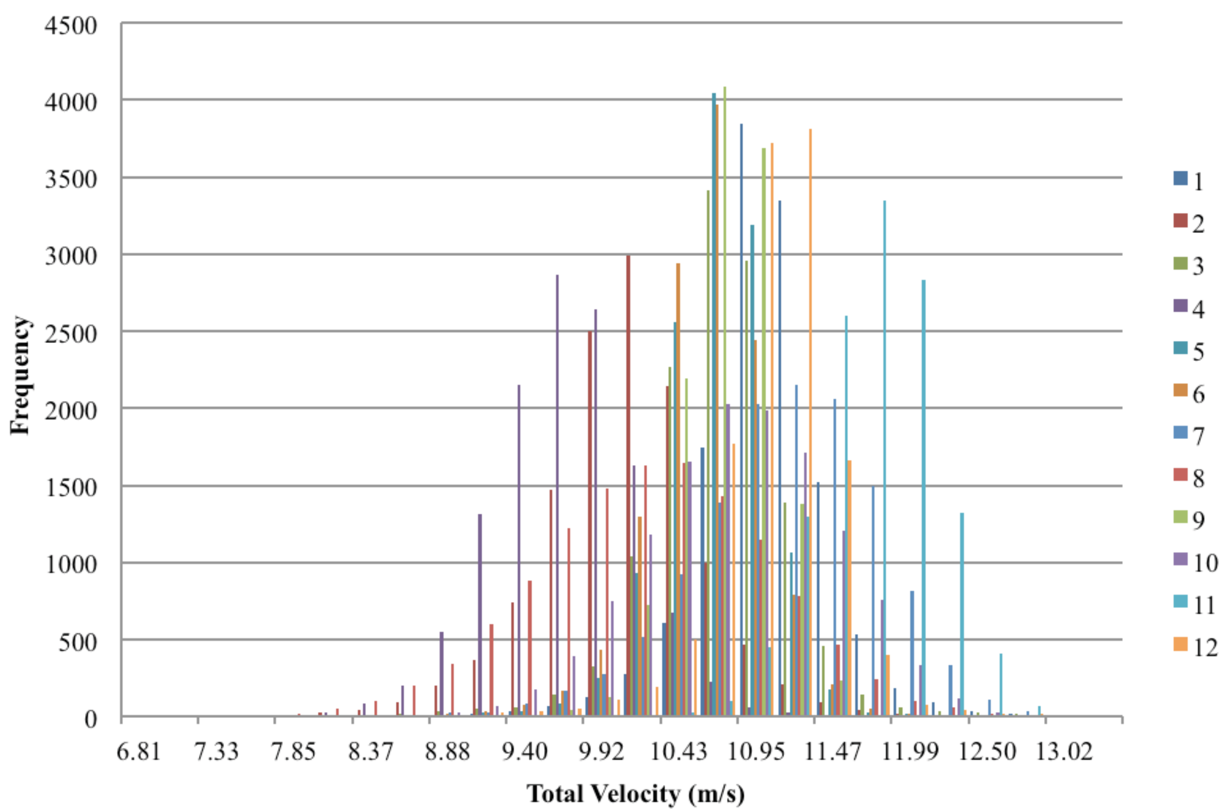
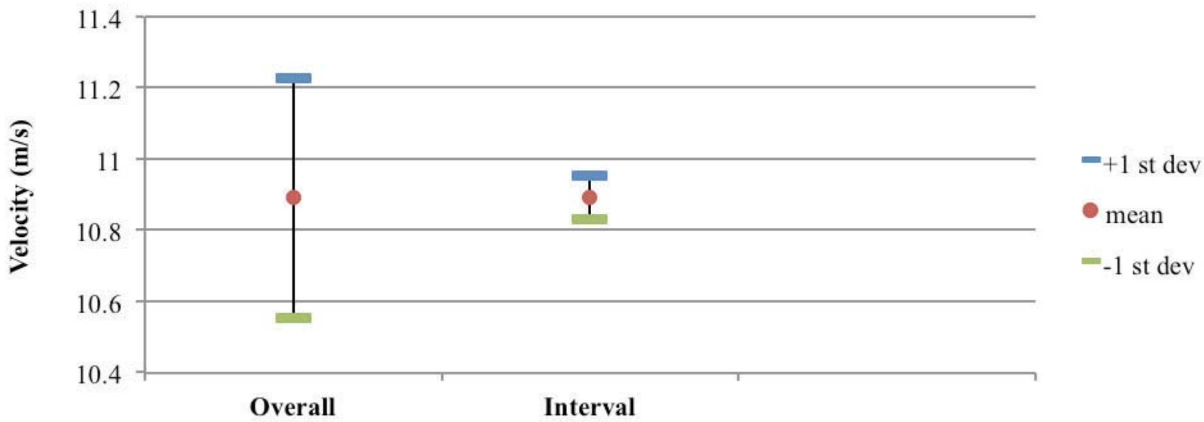
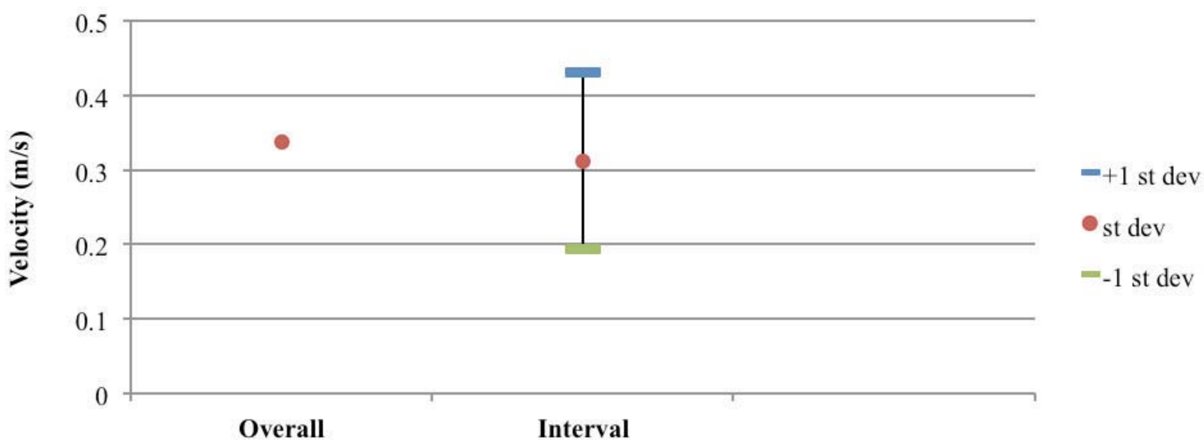


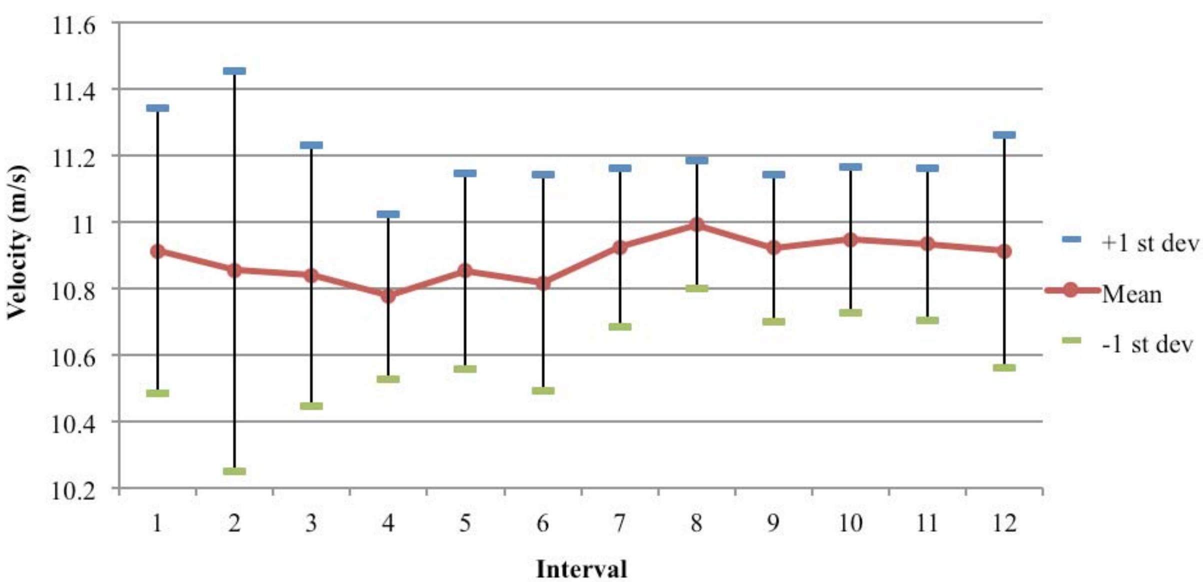
Figure C71. Histogram of 10-second intervals (x_b = 4 ft, blower frequency = 50 Hz, 25 bins).



a) Run 350 average velocity and standard deviation about the average velocity.



b) Run 350 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 350 average velocities from 10-second intervals

Figure C72. Run 350 total velocity measurements.

Run 351
Blockage Location: $x_b = 4$ ft
Blower Frequency: 25 Hz
Time: 10:59 AM

Table C73. Run 351 velocity data from 2-minute run.

	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)
Total Vel	3.9345	7.4430	5.6698	0.1631
u	3.77	7.41	5.5534	0.1702
v	-2.22	2.19	-0.2816	0.3918
w	-2.9	2.05	-0.9245	0.4644

Table C74. Run 351 total velocity data for each 10-second interval and mean and standard deviation data for each interval.

Interval	Min (m/s)	Max (m/s)	Mean (m/s)	St Dev (m/s)	I_{tot} (%)
1	3.9344	7.4429	5.6133	0.2699	4.809
2	4.5918	7.0407	5.6725	0.1740	3.068
3	4.0093	7.0964	5.6836	0.1612	2.837
4	5.2525	6.0188	5.6481	0.0911	1.613
5	4.9859	6.2188	5.6158	0.0999	1.780
6	4.2168	6.9226	5.6255	0.1338	2.379
7	5.1490	6.0125	5.5928	0.1052	1.882
8	4.2888	7.4377	5.7838	0.2761	4.774
9	5.3525	6.1515	5.7128	0.0922	1.615
10	5.3367	6.2253	5.6910	0.0886	1.557
11	5.0106	6.0495	5.7275	0.0943	1.647
12	5.3009	6.0166	5.6700	0.0884	1.560
		Average	**5.6697**	**0.1396**	**2.460**
		St Dev	**0.0550**	**0.0687**	**1.202**

Table C75. Run 351 individual component means and standard deviations for each interval.

Interval	$\bar{u}$ (m/s)	$\bar{v}$ (m/s)	$\bar{w}$ (m/s)	σ_u (m/s)	σ_v (m/s)	σ_w (m/s)	I_u (%)	I_v (%)	I_w (%)
1	5.5534	0.0171	-0.4830	0.2665	0.4531	0.4821	4.80 %	8.16 %	8.68 %
2	5.5770	0.1657	-0.9264	0.1749	0.2589	0.3486	3.14 %	4.64 %	6.25 %
3	5.5922	-0.2711	-0.8466	0.1620	0.3587	0.3343	2.90 %	6.41 %	5.98 %
4	5.4719	-0.4444	-1.2910	0.0798	0.2155	0.2268	1.46 %	3.94 %	4.14 %
5	5.5313	-0.2058	-0.8734	0.1061	0.1746	0.3243	1.92 %	3.16 %	5.86 %
6	5.5376	-0.4098	-0.7871	0.1415	0.2574	0.3555	2.56 %	4.65 %	6.42 %
7	5.4924	-0.5585	-0.8112	0.1135	0.2226	0.3042	2.07 %	4.05 %	5.54 %
8	5.6856	-0.1663	-0.6059	0.2782	0.5784	0.6299	4.89 %	10.17 %	11.08 %
9	5.6118	-0.6677	-0.7736	0.0922	0.2213	0.2269	1.64 %	3.94 %	4.04 %
10	5.5754	-0.1881	-1.0777	0.1081	0.1757	0.2680	1.94 %	3.15 %	4.81 %
11	5.4591	-0.2681	-1.6152	0.1340	0.3745	0.4166	2.45 %	6.86 %	7.63 %
12	5.5536	-0.3821	-1.0031	0.1025	0.3133	0.2301	1.85 %	5.64 %	4.14 %

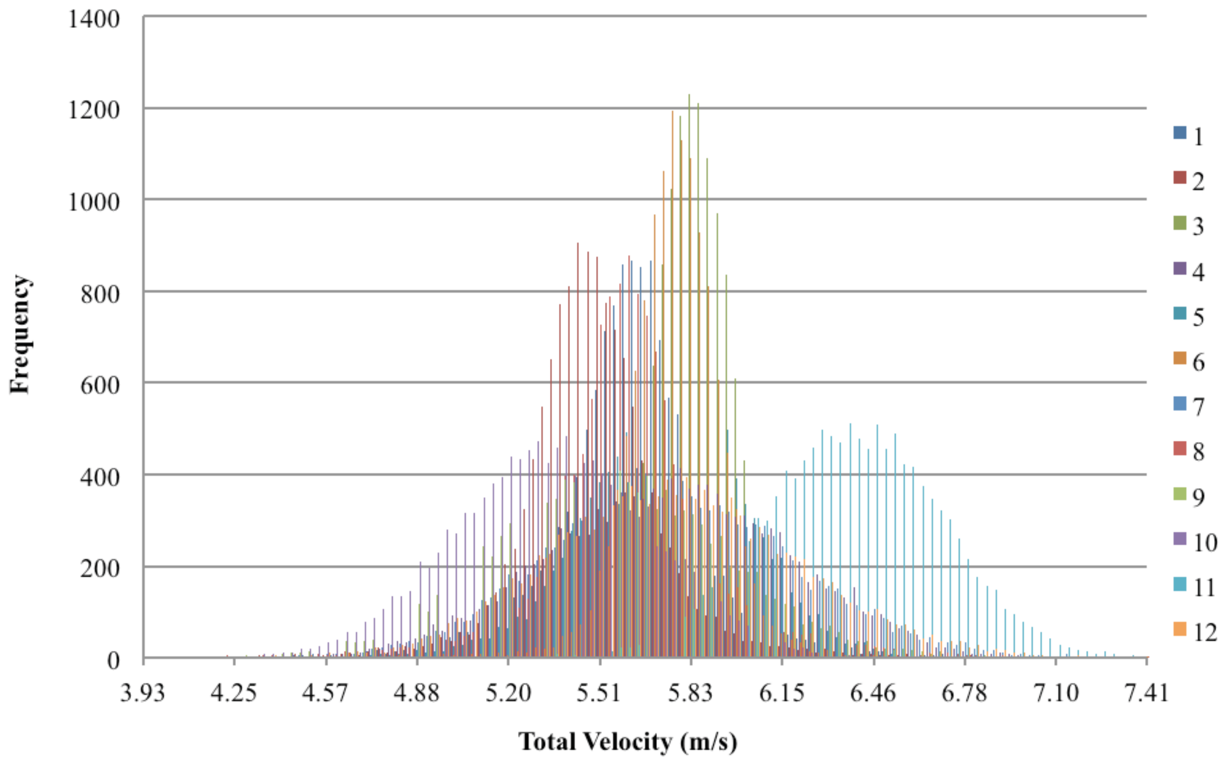


Figure C73.Histogram of 10-second intervals (x_b = 4 ft, blower frequency = 25 Hz, 100 bins).

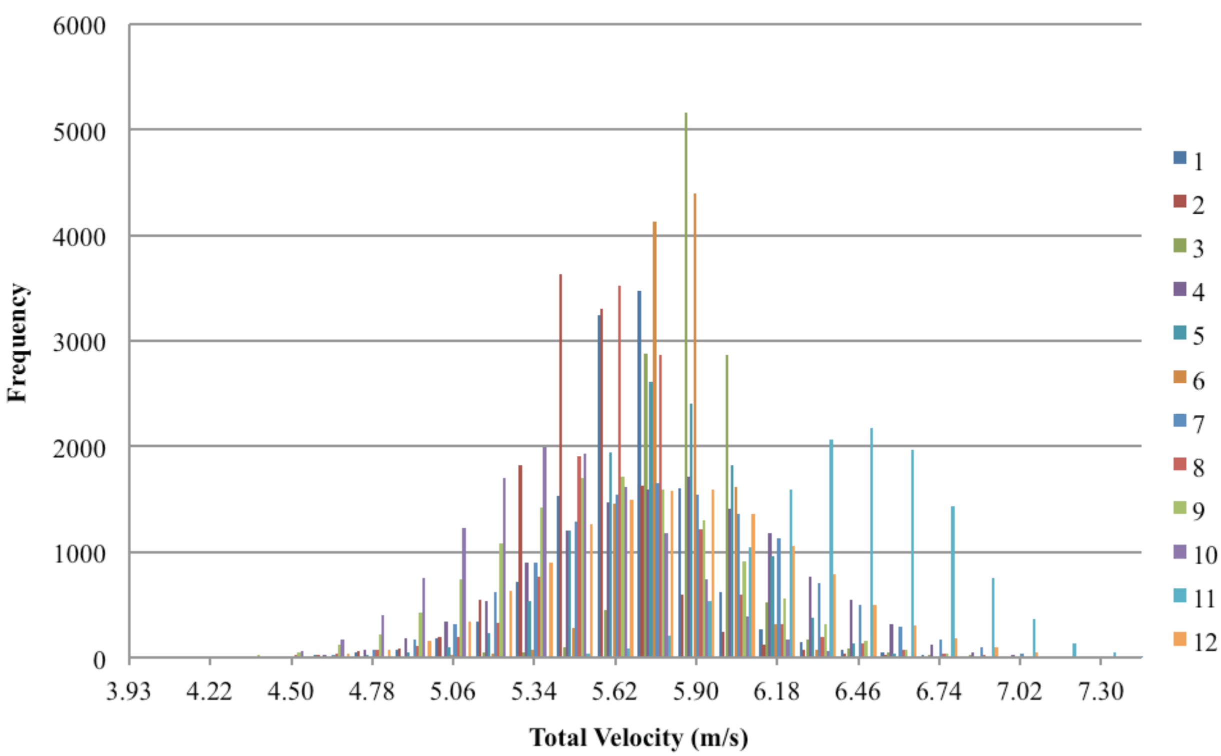
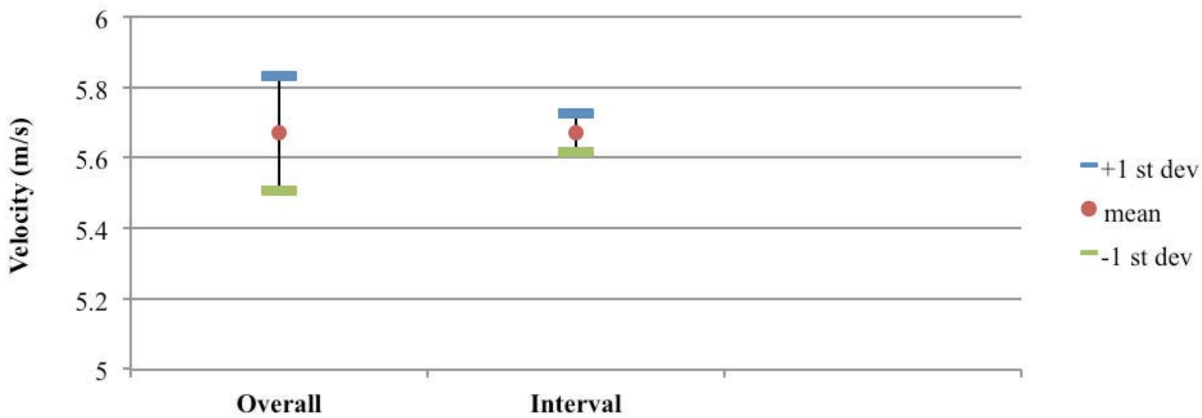
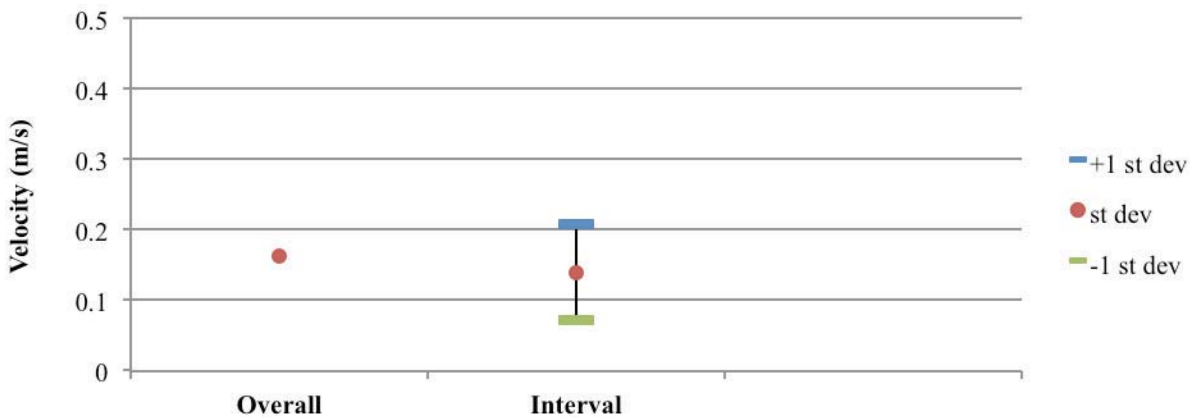


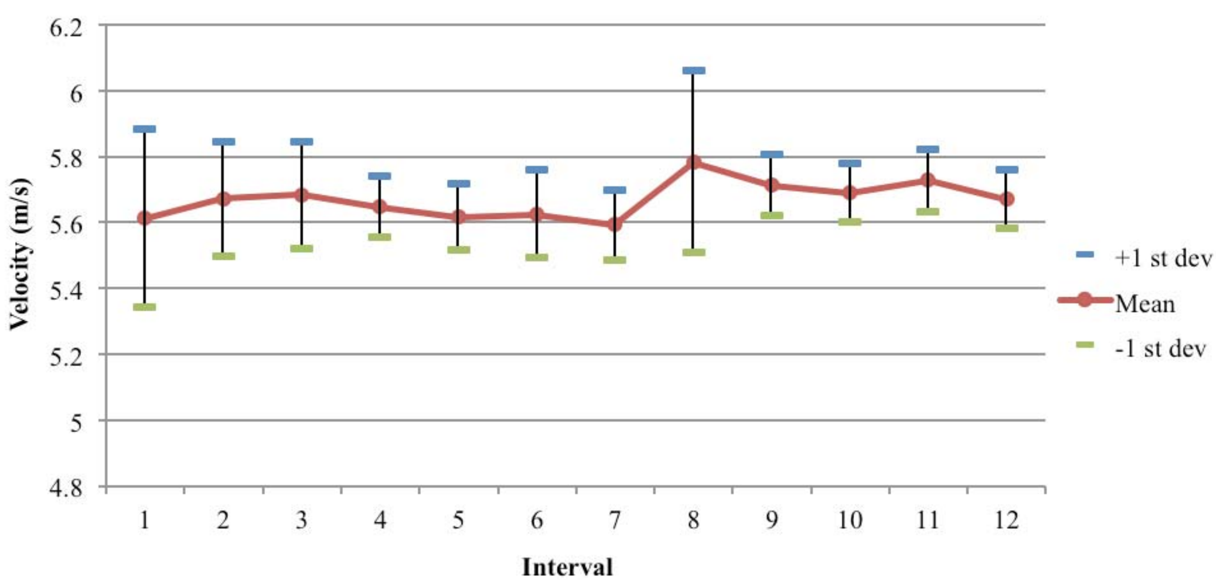
Figure C74. Histogram of 10-second intervals (x_b = 4 ft, blower frequency = 25 Hz, 25 bins).



a) Run 351 average velocity and standard deviation about the average velocity.



b) Run 351 RMS velocity fluctuation and standard deviation about the average RMS velocity fluctuation.



c) Run 351 average velocity from each 10-second interval

Figure C75. Run 351 total velocity measurements.

APPENDIX D—TURBULENCE DATA

Table D1. Relative turbulence intensity measurements from 2-minute records.

Run	$\overline{vel}$ (m/s)	σ_{vel}(m/s)	I_{vel}(%)	x_b (ft)
327	11.9776	0.9795	8.1776	1
328	6.2198	0.4277	6.8761	1
329	11.3456	0.4745	4.1822	2
330	11.4110	0.6599	5.7832	2
331	5.8343	0.3644	6.2463	2
332	10.9082	0.3818	3.5006	4
333	5.6025	0.1987	3.5467	4
334	10.9133	0.2533	2.3207	8
335	5.5453	0.0931	1.6792	8
336	10.8924	0.2141	1.9652	12
337	5.6027	0.0844	1.5065	12
338	10.8803	0.1826	1.6786	16
339	5.5189	0.0714	1.2933	16
340	10.8477	0.1709	1.5753	∞
341	5.6497	0.1347	2.3839	∞
342	10.8626	0.2004	1.8449	∞
343	5.7227	0.1527	2.6682	∞
344	10.9923	0.1746	1.5880	20
345	5.7439	0.0911	1.5862	20
346	10.9855	0.2293	2.0869	12
347	5.7080	0.0828	1.4497	12
348	10.8779	0.1824	1.6770	8
349	5.6955	0.1109	1.9466	8
350	10.8909	0.3372	3.0963	4
351	5.6698	0.1631	2.8759	4

Table D2. Relative turbulence intensity measurements from 10-second intervals.

Run	Mean I_{vel} (%)	95% Confidence Interval (%)	[illegible] (ft)
327	7.9528	0.8488	1
328	6.6212	0.5151	1
329	4.0053	0.7062	2
330	5.5225	0.8485	2
331	5.7105	1.2931	2
332	3.0533	0.9157	4
333	3.2175	0.9096	4
334	2.0916	0.3886	8
335	1.6312	0.2263	8
336	1.8268	0.1316	12
337	1.3282	0.0696	12
338	1.5758	0.0283	16
339	1.2718	0.0228	16
340	1.5552	0.0244	∞
341	1.8507	0.5676	∞
342	1.7382	0.0563	∞
343	1.8575	0.5930	∞
344	1.5276	0.0573	20
345	1.5021	0.2057	20
346	1.7793	0.2018	12
347	1.3547	0.1118	12
348	1.6391	0.0502	8
349	1.7940	0.2130	8
350	2.8669	0.6948	4
351	2.4605	0.7640	4

APPENDIX E—PHOTO SUMMARY OF UPWIND BUILDINGS TESTING

In the 2 days prior to the turbulence intensity measurements with the two-dimensional blockage, three different configurations of blockage in front of the 1/50th-scale inlet were tested in the 80- by 120-Foot Wind Tunnel. The first was a baseline indicator and had no buildings or blockage in front of the inlet face. The second tested the existing buildings of Mountain View (four low warehouse buildings) plus two NASA buildings (N258 and the trailers), and the weather tower. The final configuration tested all existing buildings plus the future Google complex. Table E1 describes the run matrix for the 2 days of testing. For the ambient and inlet measurements, the Alnor probe was used. Measurements for the ambient wind and temperature values were made 67 feet ahead of the inlet on the centerline at 78 inches above the full-scale test section floor. These values were collected with the blower off. Values marked with asterisks in Table E1 were measured 38.5 feet on the port side of the inlet while the blower was on idle.

As can be seen from runs 381–284 in Table E1, the weather tower was accidentally included in what should have been a “No-Building” scenario. The following photos show the configurations that were used throughout testing.

Table E1. Run table for Google complex testing (day 1).

Run	Date/Time Executed	Description	Inlet Temp (°C)	Inlet Wind Speed (m/s)	Ambient Temp (°C)	Ambient Wind Speed (m/s)
277	10 Sept 2013, 7:20AM	All Buildings	17.0	0.03	17.1	0.13
278	10 Sept 2013, 7:25AM	All Buildings	--	--	--	--
279	10 Sept 2013, 8:12 AM	Existing Buildings	17.5	0.12	17.1	0.15
280	10 Sept 2013, 8:18AM	Existing Buildings	--	--	--	--
281	10 Sept 2013, 8:29AM	Weather Tower Only	--	--	17.1*	--
282	10 Sept 2013, 8:34AM	Weather Tower Only	--	--	--	--
283	10 Sept 2013, 8:38AM	Weather Tower Only	--	--	--	--
284	10 Sept 2013, 8:43AM	Weather Tower Only	--	--	--	--
285	10 Sept 2013, 8:55AM	Existing Buildings	17.2	0.12	17.2	0.23
286	10 Sept 2013, 8:59AM	Existing Buildings	--	--	--	--
287	10 Sept 2013, 9:14AM	All Buildings	17.5	0.01	17.4	0.03
288	10 Sept 2013, 9:17AM	All Buildings	--	--	--	--
289	10 Sept 2013, 9:21AM	All Buildings	--	--	17.8*	--
290	10 Sept 2013, 9:25AM	All Buildings	--	--	--	--
291	10 Sept 2013, 9:36AM	Existing Buildings	17.9	0.02	18.0	0.17
292	10 Sept 2013, 9:39AM	Existing Buildings	--	--	--	--
293	10 Sept 2013, 9:49AM	No Buildings	--	--	18.0*	--
294	10 Sept 2013, 9:53AM	No Buildings	--	--	--	--
295	10 Sept 2013, 9:57AM	No Buildings	--	--	18.1*	--
296	10 Sept 2013, 10:01AM	No Buildings	--	--	--	--
297	10 Sept 2013, 10:04AM	No Buildings	--	--	18.2*	--
298	10 Sept 2013, 10:08M	No Buildings	--	--	--	--
299	10 Sept 2013, 10:17AM	Existing Buildings	18.3	--	18.3	0.12
300	10 Sept 2013, 10:20AM	Existing Buildings	--	--	--	--
301	10 Sept 2013, 10:34AM	All Buildings	18.5	0.04	18.6	0.13
302	10 Sept 2013, 10:38AM	All Buildings	--	--	--	--
303	11 Sept 2013, 7:22AM	All Buildings	15.2	--	15.2	0.41

Table E2. Run table for Google complex testing (day 1) (cont.)

Run	Date/Time Executed	Description	Inlet Temp (°C)	Inlet Wind Speed (m/s)	Ambient Temp (°C)	Ambient Wind Speed (m/s)
304	11 Sept 2013, 7:28AM	All Buildings	--	--	--	--
305	11 Sept 2013, 7:39AM	Existing Buildings	15.1	0.04	15.0	0.28
306	11 Sept 2013, 7:46AM	Existing Buildings	--	--	--	--
307	11 Sept 2013, 7:57AM	No Buildings	15.1	--	15.1	0.27
308	11 Sept 2013, 8:02AM	No Buildings	--	--	--	--
309	11 Sept 2013, 8:08AM	No Buildings	--	--	15.6	--
310	1 Sept 2013, 8:14AM	No Buildings	--	--	--	--
311	11 Sept 2013, 8:25AM	Existing Buildings	15.9	--	15.9	0.32
312	11 Sept 2013, 8:32AM	Existing Buildings	--	--	--	--
313	11 Sept 2013, 8:50AM	All Buildings	16.7	0.02	16.7	0.31
314	11 Sept 2013, 8:55AM	All Buildings	--	--	--	--
315	11 Sept 2013, 9:00AM	All Buildings	--	--	16.7*	--
316	11 Sept 2013, 9:07AM	All Buildings	--	--	--	--
317	11 Sept 2013, 9:19AM	Existing Buildings	17.1	0.12	17.1	0.31
318	11 Sept 2013, 9:25AM	Existing Buildings	--	--	--	--
319	11 Sept 2013, 9:36AM	No Buildings	17.7	0.05	17.7	0.25
320	11 Sept 2013, 9:44AM	No Buildings	--	--	--	--
321	11 Sept 2013, 9:50AM	No Buildings	--	--	17.9*	--
322	11 Sept 2013, 9:57AM	No Buildings	--	--	--	--
323	11 Sept 2013, 10:13AM	Existing Buildings	18.2	0.20	18.1	0.24
324	11 Sept 2013, 10:18AM	Existing Buildings	--	--	--	--
325	11 Sept 2013, 10:31AM	All Buildings	18.8	0.01	18.8	0.45
326	11 Sept 2013, 10:38AM	All Buildings	--	--	--	--

a) No-building scenario

Figure E1. No-building scenario beyond turntable.

Figure E2. Turntable and tarp in front of inlet.

b) Existing building scenario

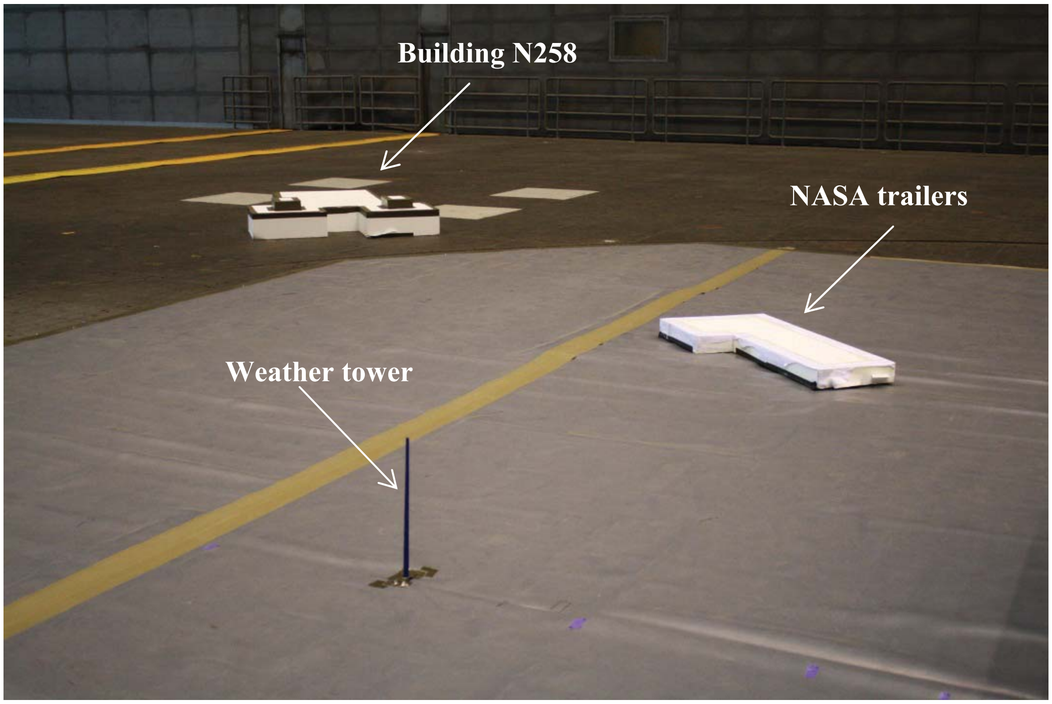


Figure E3. Existing NASA buildings in front of the inlet.

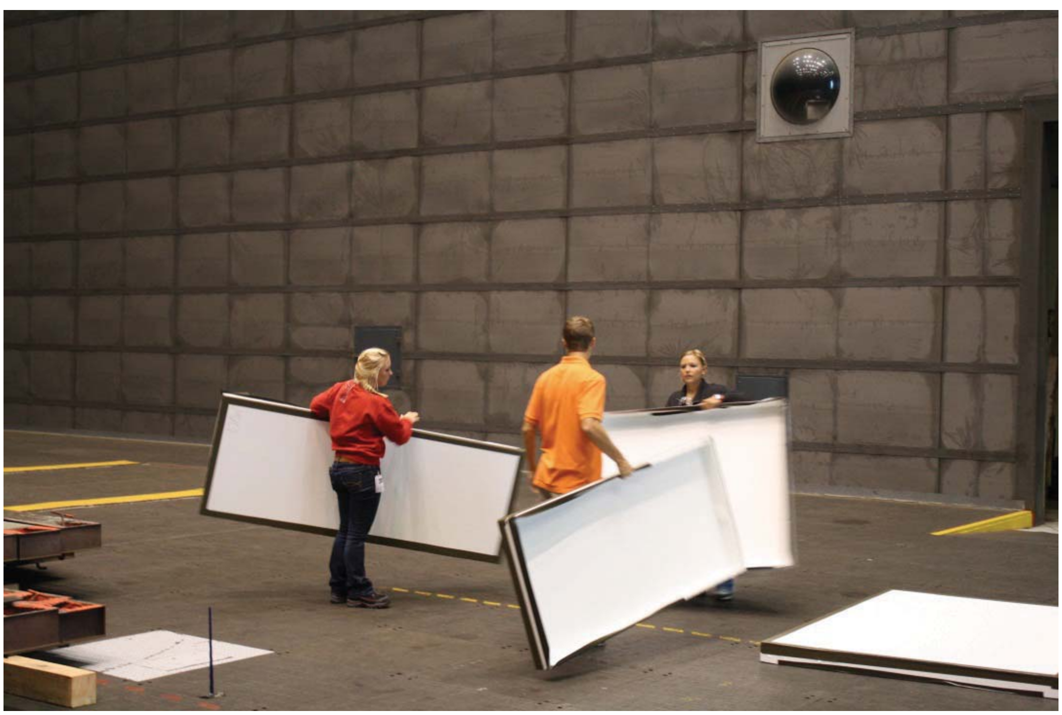


Figure E4. Example of relative size of the Mountain View buildings.

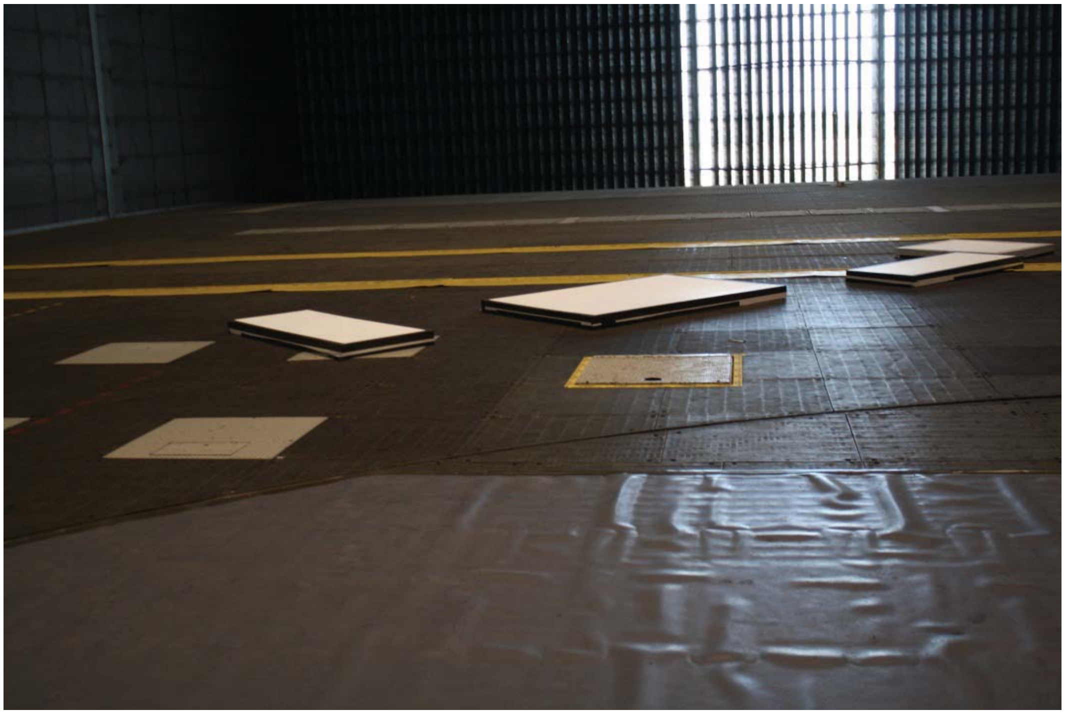


Figure E5. Mountain View buildings (four total).

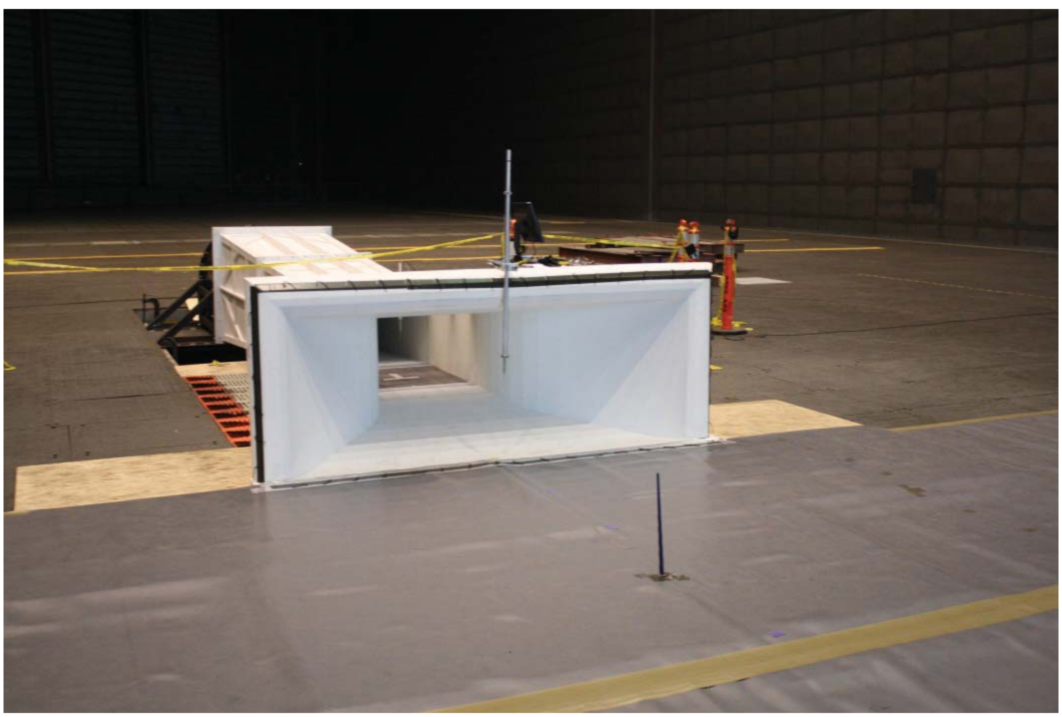


Figure E6. Inlet with weather tower. Note: the weather tower is slightly offset from the inlet centerline.

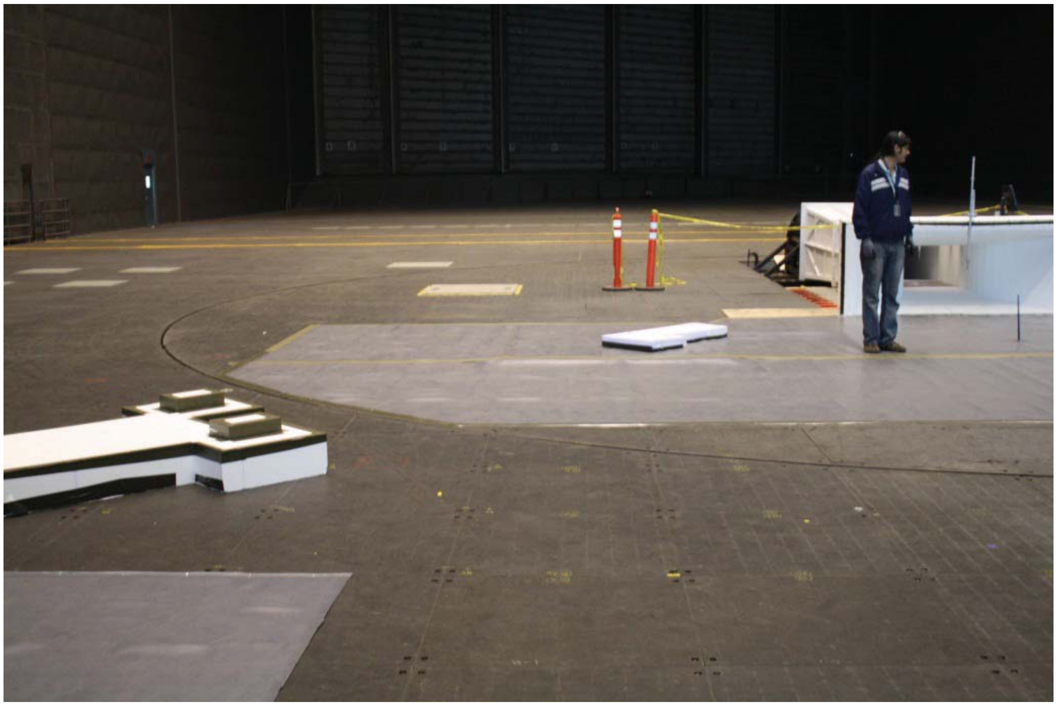


Figure E7. View from NASA buildings towards inlet and weather tower.

c) Future building scenario

Figure E8. View from Google buildings towards the inlet.

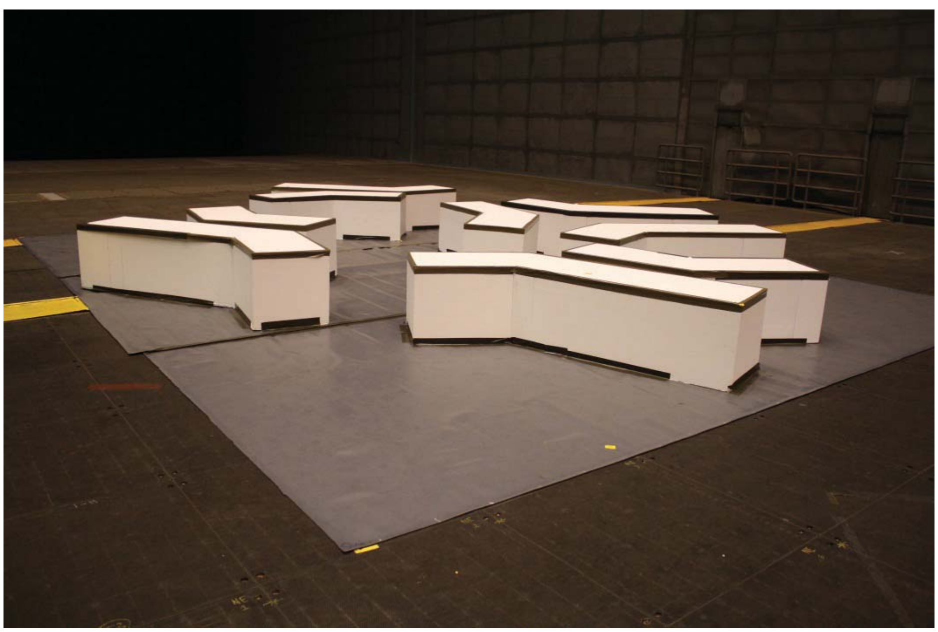


Figure E9. Google buildings taped to tarp.


Figure E10. View towards inlet for “all buildings” installation.


Figure E11. Google buildings and NASA building N258 beyond the tarp.

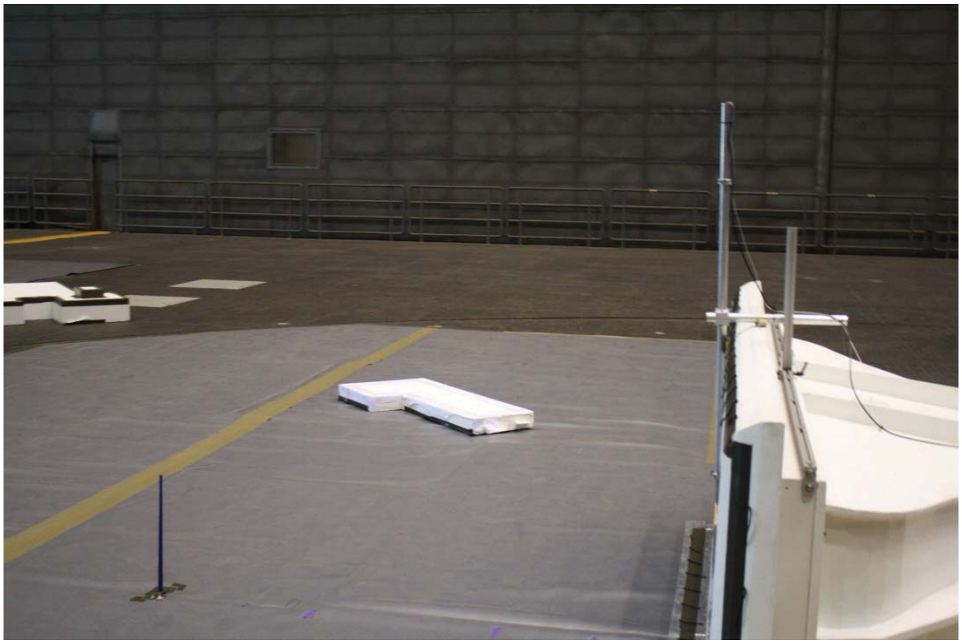


Figure E12. NASA buildings and weather tower in front of inlet.

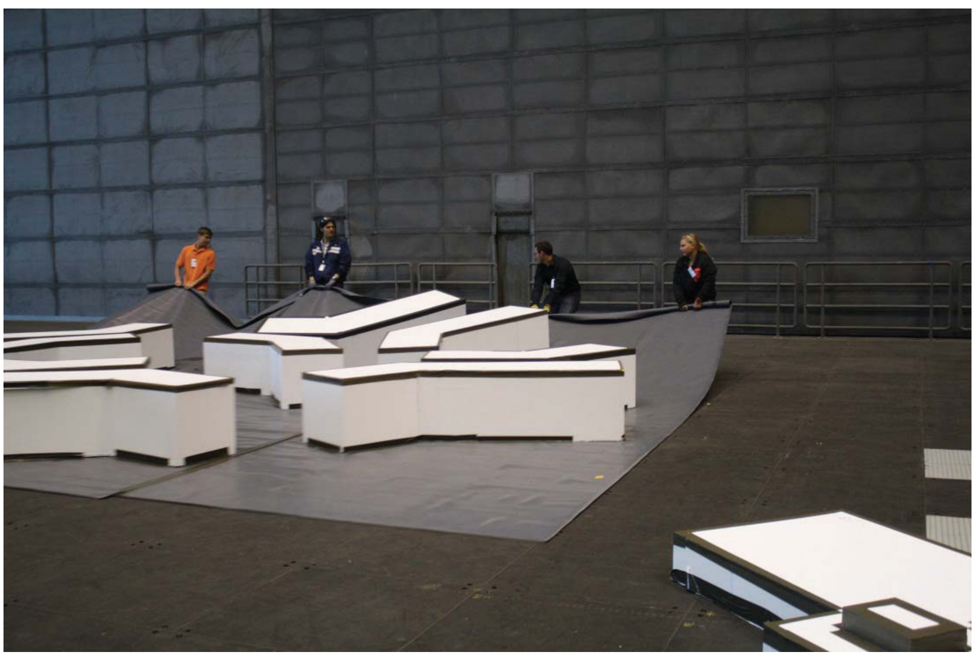


Figure E13. Moving the Google buildings.