SOUND LEVEL COMPLIANCE EVALUATION REPORT

Scituate Wind
Town of Scituate, Massachusetts

Prepared for:

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1.0 EXECUTIVE SUMMARY

Scituate Wind is a 1.5-megawatt (MW) wind power generation facility composed of a single Sinovel wind turbine located on land located next to the Wastewater Treatment Plant in the Town of Scituate, Massachusetts. Epsilon Associates, Inc. (Epsilon) has been retained by the Town of Scituate (the Town) to conduct a post-construction sound level compliance assessment for the wind turbine.

A post-construction compliance study was performed by Tech Environmental in 2013 through 2015 following the commissioning of the wind turbine.[1] That study sampled noise during four nights at five locations and found the wind turbine in compliance with the Massachusetts Department of Environmental Protection (MassDEP) Noise Policy at all locations for all four nights.

As a result of noise complaints from residents in the Town of Scituate, the Town requested another compliance study be performed. The sound level measurement locations were selected by the Town of Scituate's Special Projects Director based on the noise complaints received regarding the wind turbine. Two of the four locations were the same as in the TechEnvironmental study.

The results of the current program show that sound pressure levels due to the wind turbine, under wind conditions identified as conditions resulting in maximum sound power levels[2] and wind conditions identified by residents filing noise complaints, meet the requirements set forth in the MassDEP Noise Policy at each of the monitoring locations with the exception of one (1) location. Following measurement methodologies agreed upon by the MassDEP, Scituate Wind was determined to be in non-compliance at the nearest residence to the wind turbine during one of the four nights of measurements. The residence (151 Driftway) is 650 feet to the northeast of the wind turbine and it is Epsilon's understanding that the owners of the residence were recipients of mitigation funds by Scituate Wind, LLC.

[1] TechEnvironmental. (2015). Scituate Wind Compliance Sound Monitoring Study Scituate, Massachusetts. Waltham, MA.

[2] As defined by the MassDEP Wind Turbine Noise Study Protocol

2.0 INTRODUCTION

Scituate Wind is a wind energy facility, owned by Scituate Wind, LLC, that is comprised of a single wind turbine situated on a parcel leased from the Town of Scituate at the Town's Wastewater Treatment Plant (WWTP) located at 161 Driftway in Scituate, MA. The wind turbine is a Sinovel SL1500 1.5MW unit with a hub height (HH) of 80 meters. The wind turbine became commercially operational in March 2012.

A post-construction compliance study was performed by Tech Environmental in 2013 through 2015 following the commissioning of the wind turbine. That study sampled noise during four nights at five locations and found the wind turbine in compliance with the MassDEP Noise Policy at all locations on all nights.

As a result of noise complaints from residents in the Town of Scituate, the Town requested another compliance study be performed.

In order to determine compliance with the MassDEP Noise Policy, this post-construction sound level measurement program was conducted by Epsilon in 2019. The details and findings of this measurement program are presented within this report.

3.0 SOUND TERMINOLOGY

There are several ways in which sound (noise) levels are measured and quantified. All of them use the logarithmic decibel (dB) scale. The following information defines the sound level measurement terminology used in this analysis.

The decibel scale is logarithmic to accommodate the wide range of sound intensities found in the environment. A property of the decibel scale is that the sound pressure levels of two separate sounds are not directly additive. For example, if a sound of 50 dB is added to another sound of 50 dB, the total is only a three-decibel increase (to 53 dB), not a doubling to 100 dB. Thus, every three-dB change in sound levels represents a doubling or halving of sound energy. Related to this is the fact that a change in sound levels of less than three dB is imperceptible to the human ear.

Another property of decibels is that if one source of noise is 10 dB (or more) louder than another source, then the total sound level is approximately the sound level of the louder source. For example, a source of sound at 60 dB plus another source of sound at 47 dB is 60 dB.

The sound level meter used to measure noise is a standardized instrument.[3] It contains "weighting networks" (e.g., A-, C-, Z-weightings) to adjust the frequency response of the instrument. Frequencies, reported in Hertz (Hz), are detailed characterizations of sounds, often addressed in musical terms as "pitch" or "tone". The most commonly used weighting network is the A-weighting because it most closely approximates how the human ear responds to sound at various frequencies. The A-weighting network is the accepted scale used for community sound level measurements; therefore, sounds are frequently reported as detected with a sound level meter using this weighting. A-weighted sound levels emphasize middle frequency sounds (i.e., middle pitched – around 1,000 Hz), and de-emphasize low and high frequency sounds. These sound levels are reported in decibels designated as "dBA". Z-weighted sound levels are measured sound levels without any weighting curve and are otherwise referred to as "unweighted". Sound pressure levels for some common indoor and outdoor environments are shown in Figure 3-1.

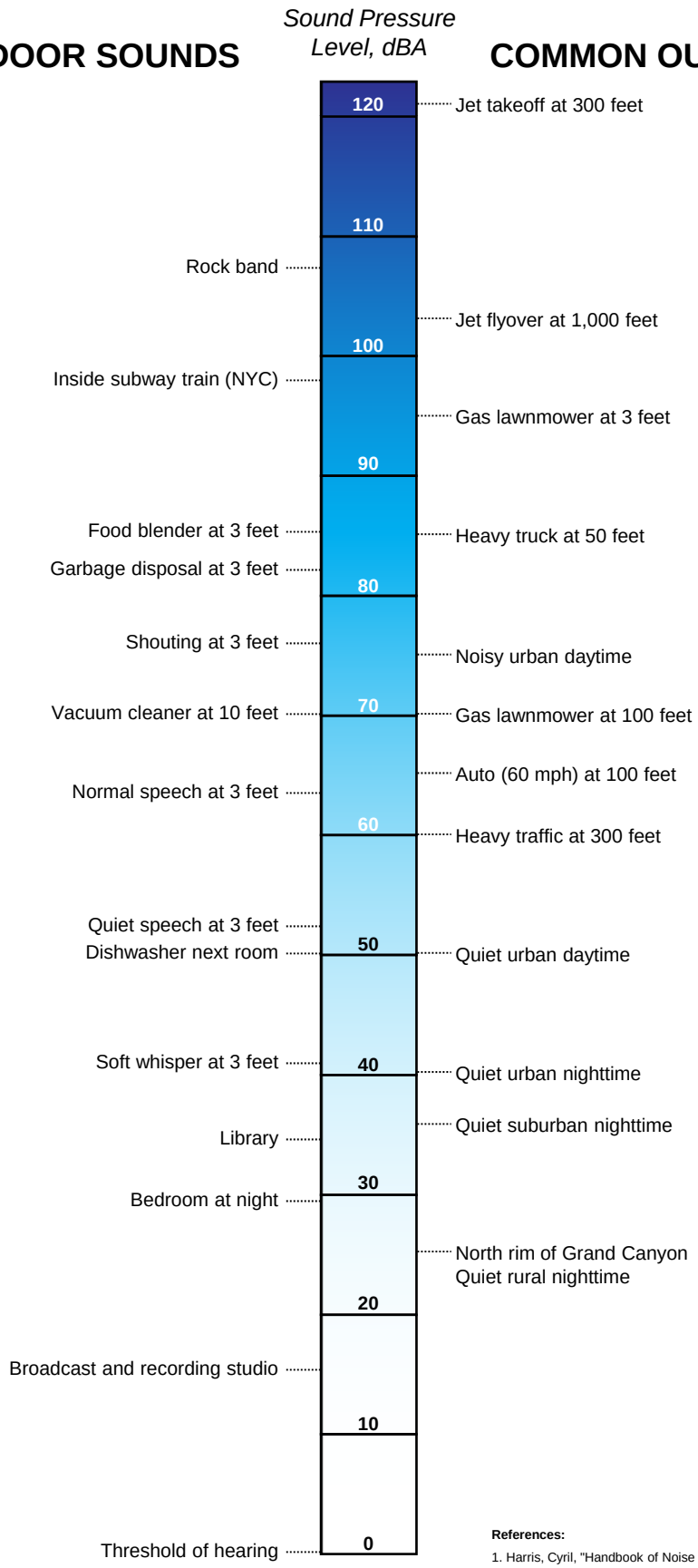
Because the sounds in our environment vary with time they cannot simply be described with a single number. Two methods are used for describing variable sounds. These are exceedance levels and the equivalent level, both of which are derived from some quantity of moment-to-moment sound level measurements. Exceedance levels are values from the cumulative amplitude distribution of all of the sound levels observed during a measurement period. Exceedance levels are designated L_n, where n can have a value between 0 and 100 in terms of percentage. Several sound level metrics that are commonly reported in community noise monitoring are described below.

[3] *American National Standard Electroacoustics - Sound Level Meters*, ANSI S1.4-2014 (R2019), published by the Standards Secretariat of the Acoustical Society of America, Melville, NY.

- L_{90} is the sound level in dBA exceeded 90 percent of the time during the measurement period. The L_{90} is close to the lowest sound level observed. It is essentially the same as the residual sound level, which is the sound level observed when there are no obvious nearby intermittent noise sources. The L_{90} is used to describe background sound levels in accordance with the MassDEP Noise Policy.

- L_{eq}, the equivalent level, is the level of a hypothetical steady sound that would have the same energy (*i.e.,* the same time-averaged mean square sound pressure) as the actual fluctuating sound observed. The equivalent level is designated L_{eq} and is also A-weighted. The equivalent level represents the time average of the fluctuating sound pressure, but because sound is represented on a logarithmic scale and the averaging is done with linear mean square sound pressure values, the L_{eq} is mostly determined by loud noises if there are fluctuating sound levels.

- L_{max} is the maximum sound level over a given time period. The L_{max} is typically due to discrete, identifiable events such as an airplane overflight, car or truck passby, or a dog bark for example. An alternate meaning and definition of 'L_{max}' is used in this assessment as described in later sections.



References:

1. Harris, Cyril, "Handbook of Noise Acoustical Measurements and Noise Control", p 1-10., 1998
2. "Controlling Noise", USAF, AFMC, AFDTC, Elgin AFB, Fact Sheet, August 1996
3. California Dept. of Trans., "Technical Noise Supplement", Oct, 1998

Figure 3-1

Common Indoor and Outdoor Sound Levels

4.0 NOISE REGULATIONS

4.1 Federal Regulations

There are no federal community noise regulations applicable to this Project.

4.2 State of Massachusetts Regulations

The Massachusetts Department of Environmental Protection (MassDEP) has the authority to regulate noise under 310 CMR 7.10, which is part of the Commonwealth's air pollution control regulations. Under the MassDEP regulations, noise is considered to be an air contaminant and, thus, 310 CMR 7.10 prohibits "unnecessary emissions" of noise.

MassDEP administers this regulation through Noise Policy DAQC 90-001 dated February 1, 1990 which limits a source to a 10-dBA increase in the ambient sound level measured at the project property line and at the nearest residences. The ambient level is defined as the background A-weighted sound level that is exceeded 90% of the time (L_{90}) measured during operational hours. For a source which will or could operate 24-hours per day, the lowest ambient level typically occurs during the quietest nighttime period (12 AM to 4 AM).

The MassDEP policy further prohibits "pure tone" conditions where the sound pressure level in any octave band is at least 3 dB greater than the sound levels in each of the two adjacent octave bands. An example of a potential "pure tone" is a fan with a bad bearing that produces an objectionable squealing sound.

4.3 Town of Scituate Bylaws

The Section 740.6 of the Town of Scituate Massachusetts Zoning Bylaws contains the following language pertaining to sound from a Wind Energy Conversion System (WECS) for the purpose of obtaining a Special Permit:

> *The wind facility and associated equipment shall conform to the provisions of the Department of Environmental Protection Division of Air Quality Noise Regulations (310 CMR 7.10). An analysis prepared by the registered qualified engineer will be required to demonstrate compliance with the above standards.*

Pre-permitting modeling was performed by Atlantic Design Engineers[4] and followed the then generally acknowledged interpretation of the MassDEP's Noise Policy. The MassDEP has since changed its interpretation of how sound data are collected and analyzed as it relates to wind energy. This methodology was formalized in the "Current Wind Turbine

[4] Atlantic Design Engineers, LLC, Acoustic Analysis, Scituate Community Wind Project, 167 Driftway, Scituate, MA, prepared for Town of Scituate, March 3, 2010, with Addendum dated March 18, 2010.

Noise Study Protocol (generic)" initially created for the Falmouth wind turbines. This study follows that updated data collection and analysis process, as modified and discussed herein.

5.0 SOUND LEVEL MEASUREMENT PROGRAM

5.1 Overview

In order to determine compliance with the MassDEP Noise Policy in response to concern from residents in the Town, a sound level measurement program was conducted in 2019.

Prior to the commencement of the sound level measurement program, a protocol was developed by Epsilon. The protocol was originally designed to meet the conditions specified in the MassDEP's 2013 Wind Turbine Noise Study Protocol ("WTNSP"). A program kickoff meeting occurred on August 7, 2018 between the Town, Scituate Wind, LLC, the residential coordinator[5], and Epsilon to discuss the details of the preliminary measurement protocol and visit[6] each of the proposed residential locations to select specific measurement points. Following the meeting, a draft of the measurement protocol was submitted to the MassDEP on August 28, 2018. A round of comments was received by the Town on September 19 but was then supplemented on September 21. Epsilon provided comment responses on September 26 that were forwarded to the MassDEP on October 2 and the protocol was revised. On November 6, 2018, Epsilon received additional comments from MassDEP on the revised protocol. Responses to the November comments were provided by Epsilon and forwarded to the MassDEP. The final Protocol[7], approved by the MassDEP, outlined the measurement locations, measurement methodology, data evaluation methodology, and instrumentation to be used in the study. The Protocol, attachments[8], and final comments from the MassDEP have been included in this report as Appendix A.[9]

5.2 Sound Level Measurement Locations

The Town of Scituate, through the Special Projects Director, identified the four locations for sound testing that were included in the Protocol. These locations are shown in Figure 5-1. Permission for sound level monitoring on the private properties was acquired prior to the commencement of the measurement program. Photos of the sound level measurement locations are presented in Figures 5-2 through 5-5.[10]

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5 Resident whom provided notice to the other residents when measurements would be performed.

6 Scituate Wind, LLC did not attend the measurement location visits.

7 Town of Scituate Sound Level Compliance Monitoring Protocol – Massachusetts Department of Environmental Protection, October 18, 2018.

8 Includes the MassDEP WTNSP.

9 NOTE: Comments from the MassDEP allowed for "fast" sound level meter setting as requested by the residents as opposed to the "slow" setting in the MassDEP's "Current Wind Turbine Noise Study Protocol".

10 Field photos were taken at night when testing occurred, so the photos are generally dark.

- Location 1: 151 Driftway - This residence is approximately 650 feet to the north-northeast of the wind turbine and is the nearest residence to the wind turbine. This site was also modeled by Atlantic Design Engineers pre-permitting and tested by Tech Environmental post construction.

- Location 2: 26 Hewes Road - This residence is approximately half a mile to the northeast of the wind turbine and is representative of the impacts at the residential properties on Hewes Road.

- Location 3: 122 Gilson Road - This residence is approximately 0.6 miles to the northeast of the wind turbine and is representative of the impacts at the residential properties on Gilson Road. This site was also tested by Tech Environmental post construction.

- Location 4: 34 Driftway - This residence is approximately half a mile to the east-northeast of the wind turbine.

5.3 Field Program and Methodology

Per the MassDEP-approved Protocol, short-term (5-minute) A-weighted broadband and unweighted octave-band sound level measurements were made at the four locations under operational and ambient conditions (i.e., with the wind turbine shutdown). Measurements were made at the four locations simultaneously[11] and attended by four Epsilon staff who noted the sound sources during the testing as well as the time and description of any specific episodic sound events (e.g., car passby). Field sheets for operational period testing were designed to ensure that sufficient and detailed notes could be taken by each field technician with some uniformity across all measurements. The sheets contained tables that were sectioned into 5-second time intervals such that key sound sources could be identified efficiently during each 5-second time slice. This time interval was selected as a convenient and reasonable spacing for notetaking. A sample field sheet is attached to this report as Appendix B.

Three (3) 5-minute operational measurements were made at all four locations on each night. These measurements were generally consecutive as there may have been a few minutes in between each period for the technician to prepare the note sheets before starting the next 5-minute measurement. Immediately following the operational measurements, Epsilon requested that the wind turbine be shutdown. Upon receipt of confirmation that the wind turbine was completely shut down, Epsilon staff members performed three consecutive 5-minute ambient measurements and documented the sound sources observed.

[11] Within approximately 15 minutes.

Scituate Wind **Scituate, Massachusetts**

Epsilon Associates Inc.

Figure 5-1

Sound Level Measurement Locations

Figure 5-2 Location 1 - Photo of Sound Level Measurement Location

Figure 5-3 Location 2 - Photo of Sound Level Measurement Location

Figure 5-4 Location 3 - Photo of Sound Level Measurement Location

Figure 5-5 Location 4 - Photo of Sound Level Measurement Location

For the duration of measurements on each night, Scituate Wind, LLC collected data with the supervisory control and data acquisition (SCADA) system to determine whether the wind turbine was operating under the desired conditions outlined in the Protocol. Additionally, Scituate Wind, LLC was standing by each night to implement the shutdowns when requested by Epsilon.[12] Wind speed and wind turbine output conditions were periodically relayed to Epsilon throughout the course of the measurements each night. Following each night of sound level measurements, Scituate Wind, LLC provided the SCADA data recorded at hub height to Epsilon in spreadsheet format. Hub height wind speed was measured by an anemometer on top of the wind turbine's nacelle.

For the sound level data to be considered valid, measurements had to occur with no precipitation, the roads had to be dry, and ground-level wind speeds needed to be less than 5 m/s (11 mph) as per the Protocol. Ground-level wind speed and wind direction data were measured continuously and logged at Location 3 on each night.[13] Handheld wind speed measurements and other meteorological observations were made at the other three locations.

Based on input from the residents involved in the study, the targeted wind direction for operational measurements was WSW which generally corresponds to the downwind direction of the residences to the wind turbine. Therefore, the targeted wind direction for measurements was WSW (247.5° ± 45°). Upwind measurements were avoided in this measurement program.

Per the Protocol and guidance from the MassDEP, testing was conducted between the hours of 1 AM and 4 AM to coincide with the quietest background levels and to be consistent with the MassDEP WTNSP. The Protocol required that sound levels be captured on two (2) nights with hub height wind speeds at least 9 m/s and that sound levels be captured on two (2) nights with hub height winds speeds between 5 and 10 m/s. Therefore, a total of four (4) nights were sampled. Through diligent weather forecast monitoring, the dates shown in Table 5-1 were selected for the measurements. Delays between monitoring events were generally the result of inadequate meteorological conditions, staffing/equipment unavailability, or wind turbine maintenance. The hub height wind speeds targeted on each night are also identified in Table 5-1. Actual recorded wind speeds and additional data from these nights are presented in Section 6 of this report.

[12] Scituate Wind, LLC was present at Location 1 during the first night of measurements but controlled the wind turbine from a remote (off-site) location during the other 3 nights. Communication between Epsilon and Scituate Wind, LLC was via mobile phone during the last 3 nights.

[13] Wind direction was not measured on the second night.

Table 5-1 Measurement Dates and Targeted Conditions

Date	Targeted HH Wind Speed Conditions
April 19, 2019	≥ 9 m/s
July 31, 2019	5 to 10 m/s
October 2, 2019	≥ 9 m/s
December 6, 2019	5 to 10 m/s

5.4 Measurement Equipment

Sound level and meteorological data collection instrumentation are described in Sections 5.4.1 and 5.4.2, respectively.

5.4.1 Sound Level Instrumentation

Four (4) Larson Davis model 831 sound level meters (SLM's) were used for the monitoring on each night. The Larson Davis model 831 sound level meters measured broadband, full octave band, and one-third octave band sound levels. All instruments have data logging capability. The SLM's were attended during each measurement and were programmed to summarize statistical data in 5-minute periods with a 1-second resolution. All microphones were tripod mounted at a height of approximately 1.3 meters as per the WTNSP. The measurement equipment was calibrated in the field before and after the surveys with the manufacturer's acoustical calibrator which meets the standards of IEC 942 Class 1L and ANSI S1.40-2006 (R2016). All calibrations were within $\pm$ 1.0 dB from the most recent calibration. Additionally, the meters were calibrated and certified as accurate to standards set by the National Institute of Standards and Technology by an independent laboratory within the past 12 months of the measurement periods. The sound level instrumentation used for the measurement program is summarized for each night in Tables 5-2 through 5-5.

Audio recordings were collected for all sampling periods (both operational and ambient) for quality assurance/quality control purposes using external audio recorders connected to each sound level meter.[14] The clocks on the audio recorders were synchronized with the clocks on the SLM's.

[14] On the 4th night, 2 of the 4 audio recorders were not connected directly to the SLM but were positioned close to the microphone for a representative audio signal.

Table 5-2 Sound Level Measurement Instrumentation – Night 1

Equipment	Model	Serial Number
Meter	Larson Davis 831	4374
Microphone	PCB Piezotronics 377C20	165110
Preamp	PCB Piezotronics PRM831	046515
Meter	Larson Davis 831	3047
Microphone	PCB Piezotronics 377B20	LW130579
Preamp	PCB Piezotronics PRM831	023825
Meter	Larson Davis 831	4373
Microphone	PCB Piezotronics 377C20	165061
Preamp	PCB Piezotronics PRM831	046514
Meter	Larson Davis 831	3751
Microphone	PCB Piezotronics 377C20	162996
Preamp	PCB Piezotronics PRM831	029562

Table 5-3 Sound Level Measurement Instrumentation – Night 2

Equipment	Model	Serial Number
Meter	Larson Davis 831	2155
Microphone	PCB Piezotronics 377B20	112256
Preamp	PCB Piezotronics PRM831	016478
Meter	Larson Davis 831	4373
Microphone	PCB Piezotronics 377C20	165061
Preamp	PCB Piezotronics PRM831	046514
Meter	Larson Davis 831	1993
Microphone	PCB Piezotronics 377B20	110889
Preamp	PCB Piezotronics PRM831	015260
Meter	Larson Davis 831	3044
Microphone	PCB Piezotronics 377C20	170889
Preamp	PCB Piezotronics PRM831	023824

Table 5-4 Sound Level Measurement Instrumentation – Night 3

Equipment	Model	Serial Number
Meter	Larson Davis 831	1992
Microphone	PCB Piezotronics 377B20	112340
Preamp	PCB Piezotronics PRM831	015258
Meter	Larson Davis 831	4373
Microphone	PCB Piezotronics 377C20	165061
Preamp	PCB Piezotronics PRM831	046514
Meter	Larson Davis 831	4375
Microphone	PCB Piezotronics 377C20	165757
Preamp	PCB Piezotronics PRM831	046516
Meter	Larson Davis 831	4374
Microphone	PCB Piezotronics 377C20	165110
Preamp	PCB Piezotronics PRM831	046515

Table 5-5 Sound Level Measurement Instrumentation – Night 4

Equipment	Model	Serial Number
Meter	Larson Davis 831	2155
Microphone	PCB Piezotronics 377B20	112256
Preamp	PCB Piezotronics PRM831	016478
Meter	Larson Davis 831	1993
Microphone	PCB Piezotronics 377B20	110889
Preamp	PCB Piezotronics PRM831	015260
Meter	Larson Davis 831	3751
Microphone	PCB Piezotronics 377C20	162996
Preamp	PCB Piezotronics PRM831	029562
Meter	Larson Davis 831	2154
Microphone	PCB Piezotronics 377B20	112245
Preamp	PCB Piezotronics PRM831	016477

5.4.2 Meteorological Instrumentation

Continuous ground-level wind data were collected at measurement Location 3 on each of the four measurement nights. The meteorological instrumentation used on each night is summarized in Table 5-6. The wind sensors were mounted at a height of approximately 2 meters above ground level and data were logged every 1 minute.[15] A HOBO H21-002 micro-weather station (manufactured by Onset Computer Corporation) was used to continuously measure the wind data on Nights 1 and 2. A combination wind speed and direction sensor was used on Night 1 that has a wind speed measurement range of 0 to 44 m/s (99 mph) and an accuracy of ±0.5 m/s (1.1 mph). The starting threshold is 0.5 m/s (1.1 mph). The wind direction measurement range is 0 to 358 degrees (2-degree dead band), with an accuracy of ±5 degrees. On Night 2, a wind speed-only[16] sensor was used that has a measurement range of 0 to 45 m/s (100 mph), an accuracy of ±1.1 m/s (2.4 mph), and a starting threshold of less than 1 m/s (2.2 mph). On Nights 3 and 4, wind speed and wind direction data were collected using an ATMOS 41 weather station and EM60 data logger (manufactured by Meter Group, Inc.). The weather station has a wind speed measurement range of 0 to 30 m/s (67 mph) and an accuracy of ±0.3 m/s (0.67 mph). The wind direction measurement range is 0 to 359 degrees with an accuracy of ±5 degrees. Figures 5-6 and 5-7 show the ground-level meteorological equipment setups on Night 2 and 3, respectively.[17]

At the three other measurement locations (Locations 1, 2, and 4), brief meteorological observations were made using handheld instrumentation. Wind speed measurements were made with a Davis Instruments TurboMeter electronic wind speed indicator or a Kestrel 3000 Weather Meter. Temperature and humidity measurements were made using a General Tools digital psychrometer or a Kestrel 3000 Weather Meter. Unofficial observations about meteorology were made to characterize the conditions.

Meteorological data from the closest National Weather Service (NWS) station in Marshfield, MA (Marshfield Municipal Airport) provided by the National Centers for Environmental Information (NCEI) were archived for all four measurement nights and are provided in Appendix C.

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[15] 1-second logging was implemented on Nights 1 and 2 which was averaged into 1-minute data bins.

[16] This deviates from the Protocol.

[17] Field photos were taken at night when testing occurred, so the photos are generally dark.

Table 5-6 Ground-level Meteorological Instrumentation

Night	Equipment	Model	Serial Number
1	Logger	Onset H21-002	1159087
	Sensor	Onset S-WCA-003	9877585
2	Logger	Onset H21-002	1159089
	Sensor	Onset S-WSA-M003	10481215
3	Logger	METER Em60	z6-03114
	Sensor	METER ATMOS 41	ATM-410002535
4	Logger	METER Em60	z6-03114
	Sensor	METER ATMOS 41	ATM-410002535

Figure 5-6 Epsilon Meteorological Instrumentation – Location 3 (HOBO)

Figure 5-7 Epsilon Meteorological Instrumentation – Location 3 (ATMOS)

6.0 EVALUATION OF SOUND LEVELS

The intent of the sound level measurement program was to collect sound data during periods that would be representative of worst-case conditions based on the potential maximum sound power output from the wind turbine[18] and representative of conditions when noise complaints were filed to the Town.

The Project is subject to the MassDEP Noise Policy limiting sound levels from the wind turbine to 10 dBA over ambient. As discussed in the MassDEP-approved Protocol, compliance must be evaluated by calculating an 'L_{max}'[19] sound pressure level by averaging the three (3) highest representative 1-second L_{eq} sound levels and calculating the difference between the 'L_{max}' and the lowest measured 5-minute ambient L_{90} sound level. The 'L_{max}' sound levels are 'total' sound levels (wind turbine + ambient) and have been used in the evaluations. This is conservative since it includes both wind turbines and ambient (non-wind turbine) sound levels. If necessary, the ambient L_{90} sound level may be subtracted (on an energy basis) from the operational sound level to obtain the "wind-turbine-only" sound pressure level. This wind-turbine-only sound level would then be used in the evaluation.

In addition, compliance has been evaluated against the MassDEP-defined 'pure tone' conditions as described in the Protocol. Operational, unweighted octave band L_{eq} sound pressure levels, averaged over 1-minute intervals, have been used to determine whether the wind turbine causes any octave band center frequency sound level to exceed the two adjacent center frequency sound level by 3 dB or more. Octave band L_{eq} sound levels from the ambient measurements were evaluated using the same methodology.

6.1 Data Processing and Evaluation Methodology

Sound level data from each night of measurements were processed using three different methods. The methods were determined based on the availability of data where the sound level would be most representative of the contribution to the sound level from the wind turbine. The three data processing methods are listed below in order of most representative to least representative. Conservatism in the evaluation results increases with the higher methodology number (e.g., Method 3 provides the least representative, and the most conservative, results). The data processing methods are based on the details provided in the field notes for each location on each night. To build on the details provided in Section 5.3 of this report, sound sources were documented during each 5-second period during operational measurements. The field sheets indicated one or more of the following sound sources during any given 5-second period: wind turbine, wind gusts, cars, insects/vegetation, or other. The field technician could specify an occurrence of a noise event. In periods when the wind turbine was clearly the dominant sound

[18] As defined by the WTNSP.

[19] This terminology usage differs from the statistical definition of L_{max}.

source, the technician indicated the period with a star (or some other emphasis) in the wind turbine field column on the note sheet. The following three methods were used for processing the operational data only. The ambient sound levels were determined using the 5-minute L_{90} values measured by the meters, and observations were documented by the field technicians.

- **Method 1** – A data processing method where the evaluation only considers periods when the wind turbine is noted with emphasis as the dominant noise source during a given 5-second period. This allows for an analysis that is the most representative of the wind-turbine-attributable sound levels with minimal influence from other external noise sources that are unrelated to the wind turbine. If no periods were noted with emphasis on wind turbine sound contribution during an operational period, Method 2 was used to process the data for that 5-minute operational period, which is more conservative.

- **Method 2** – A data processing method where the evaluation only considers periods when the wind turbine was noted as a noise source without other noise sources indicated on the notes (i.e., no emphasis added). This method incorporates all the data points included in Method 1 but also includes any periods when the wind turbine field column was checked on the note sheet without indication of other sources (i.e., no wind, cars, vegetation, or other noise events noted). In periods during the warmer months (Night 2 and Night 3) when insects were prevalent, the insects were not considered a disqualifying noise source as they were present in ambient and operational data periods relatively consistently. This is a conservative approach. If less than 5% of the data points (15 seconds, or three 5-second periods) in a given 5-minute operational measurement met the criteria of Method 2, Method 3 was used to process the data for that 5-minute operational period, which is more conservative.

- **Method 3** – A data processing method where the evaluation considers all of the data points included in Method 2 but also includes any data point when the wind turbine was noted with wind noise also noted. This method still excludes any periods when other external noise events (a car or vegetation for example) were indicated on the field notes. This method is the least representative and most conservative of the three methodologies but allows for a higher number of data points to be included in the analysis.

If the linear difference between the 'L_{max}' and the minimum L_{90} sound level was found to exceed the 10-dBA threshold during data processing, a refined analysis was performed on the data to ensure that the periods were attributable to the wind turbine per the Protocol. The refined analysis consisted of listening to the applicable audio recordings. For each of the maximum 1-second L_{eq} data points identified using Method 1, the audio recording was consulted to determine whether some noise event, unrelated to the wind turbine, was identifiable. If an alternate sound source (e.g., wind gust or field technician movement) was clearly identifiable, that L_{eq} sound level was eliminated from the evaluation. The 1-second periods selected using Method 1 were analyzed, starting with the highest sound level, until no alternate sound source was identifiable. The highest 1-second L_{eq} sound level without an identifiable alternate sound source was selected for calculating the 'L_{max}' that was used in the sound level evaluation.

6.2 Evaluation of Sound Levels on Individual Nights

Short-term attended sound level measurements were conducted at four locations in the Town of Scituate within approximately 0.6 miles of the Scituate Wind site on four separate nights. The focus of this analysis was on evaluating sound level compliance based on the methodologies set forth in the MassDEP-approved Protocol.

6.2.1 Night 1 – April 19, 2019 (Hub Height Wind Speed > 9 m/s)

Operational and ambient sound level measurements were performed at all four locations between 2:30 AM and 4:00 AM on April 19, 2019. Conditions with hub height wind speeds over 9 m/s were targeted.

6.2.1.1 Measured Meteorological and Wind Turbine Conditions

Ground-level wind conditions measured at Location 3 on April 19, 2019 are presented in Figure 6-1. One-minute averaged wind speeds ranged from 2.7 to 5.1 m/s and the average wind direction was 247° (WSW). The NWS station in Marshfield indicated a SW wind direction and field observations indicated S to SW.

SCADA data were provided by Scituate Wind, LLC for the full duration of the measurements on Night 1. These data were provided in 10-minute time-synchronized averages. The average wind speeds at hub height and the average power output from the wind turbine during the operational and ambient measurements are provided in Table 6-1. These conditions were generally steady during the course of the measurements. The table also summarizes the ground-level conditions during the measurements and indicates whether each of the conditions meet the parameters identified in the Protocol. The SCADA wind direction data for this period, as adjusted based on Scituate Wind's field observations, were consistent with the data collected by Epsilon and the NWS.

Figure 6-1 Ground-Level Meteorological Data – Night 1 (April 19, 2019)

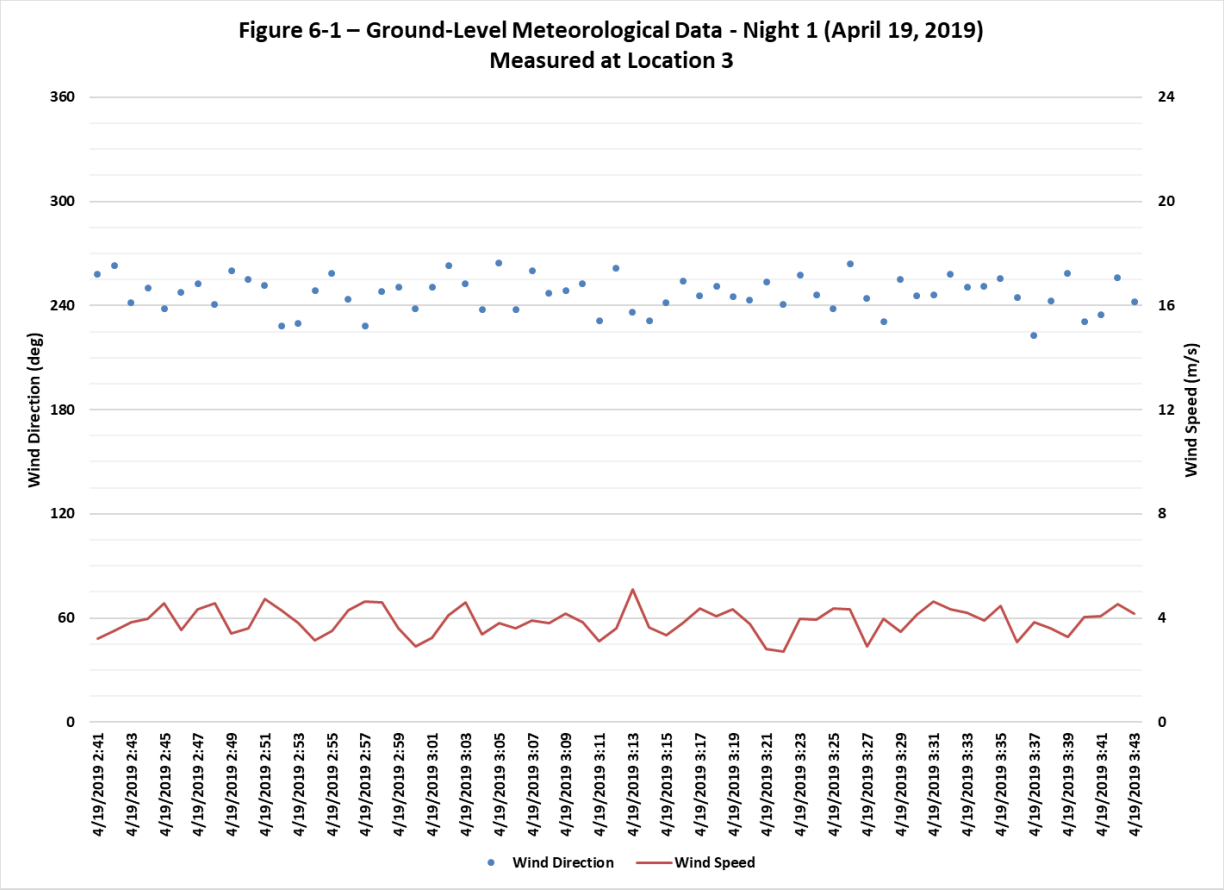


Table 6-1 Meteorological and Wind Turbine Conditions - Night 1 (April 19, 2019)

Condition	Measurement Period		Meets Parameters in the Protocol?
	Operational	Ambient	
Average HH Wind Speed	14.7 m/s	14.8 m/s	Yes
Average Wind Turbine Output	1500 kW	0	Yes
Ground-Level Wind Speed[1]	2.7 – 5.1		Yes
Wind Direction[1]	WSW		Yes

Notes:

1. As measured at Location 3.

6.2.1.2 Sound Level Results

Sound levels on April 19, 2019 were significantly impacted by ambient sound sources including wind and rustling vegetation. Although winds at the ground were within the appropriate range for sound level measurements, stronger winds around hub height and at the treetops made it difficult to clearly identify sound from the wind turbine at the measurement locations. At three of the four measurement locations, the wind turbine was audible at times, but ambient noise generally contributed to the sound levels. Therefore, the 1-second L_{eq} sound levels were mainly determined through the data processing Method 2 or 3 (as described in Section 6.1). The highest representative 1-second L_{eq} sound levels measured during the three 5-minute operational periods are presented in Table 6-2. The timeframe in which each 5-minute measurement was captured is included in the table. The average of the three L_{eq} sound levels, or 'L_{max}', is presented in the right-most column. The wind turbine was never audible at Location 2 during Night 1, so no L_{eq} sound levels could be evaluated.

The three ambient L_{90} sound levels measured at each location on Night 1 are presented in Table 6-3. The timeframe in which each 5-minute measurement was captured is included in the table. The minimum measured L_{90} sound level to be used in the evaluation is presented in the right-most column of the table.

The Protocol specifies that the wind-turbine-attributable 'L_{max}' shall be used in the compliance evaluation. The 'L_{max}' sound levels in Table 6-2 are 'total' sound levels (wind turbine + ambient). For informational purposes, the minimum L_{90} ambient from Table 6-3 was subtracted, on an energy basis, from the 'L_{max}' sound level to provide a closer representation of wind-turbine-attributable sound levels as shown in Table 6-4. According to ANSI S12.18-1994 (R2019), this procedure is possible when the 'total' sound level is at least 3 dBA higher than the ambient sound level. For Location 4, total sound is only 1 dBA higher than ambient sound, therefore, no wind-turbine-attributable 'L_{max}' can be calculated for Location 4.

Table 6-2 Operational Sound Pressure Levels - Night 1 (April 19, 2019)

Location	Sound Pressure Level (dBA)			
	Operational #1 L_{eq} (2:41-3:02 AM)	Operational #2 L_{eq} (2:47-3:09 AM)	Operational #3 L_{eq} (2:58-3:18 AM)	'L_{max}'[2]
1 - 151 Driftway	53	58	57	56
2 - 26 Hewes	N/A	N/A	N/A	N/A[1]
3 - 122 Gilson	55	55	57	56
4 - 34 Driftway	56	54	52	54

Notes:

1. No L_{max} was attainable at this location.
2. Only whole numbers are shown; calculations are performed using values with additional precision.

Table 6-3 Ambient Sound Pressure Levels - Night 1 (April 19, 2019)

Location	Sound Pressure Level (dBA)			
	Ambient #1 L_{90} (3:24-3:30 AM)	Ambient #2 L_{90} (3:29-3:36 AM)	Ambient #3 L_{90} (3:34-3:43 AM)	Minimum Ambient L_{90}
1 - 151 Driftway	51	49	49	49
2 - 26 Hewes	50	50	49	49
3 - 122 Gilson	51	54	51	51
4 - 34 Driftway	53	57	54	53

Table 6-4 Wind-Turbine-Attributable Sound Pressure Levels - Night 1 (April 19, 2019)

Location	Sound Pressure Level (dBA)		
	'L_{max}'	Ambient L_{90}	Wind-Turbine-Attributable 'L_{max}'[3]
1 - 151 Driftway	56	49	55
2 - 26 Hewes	N/A	49	N/A[1]
3 - 122 Gilson	56	51	55
4 - 34 Driftway	54	53	N/A[2]

Notes:
1. No L_{max} was attainable at this location.
2. Cannot be calculated per ANSI S12.18-1994 (R2019).
3. Only whole numbers are shown; calculations are performed using values with additional precision.

6.2.1.3 Evaluation of Compliance

An evaluation of broadband sound level compliance was performed for all four locations using data measured on April 19, 2019 and is presented in Table 6-5. The total 'L_{max}' sound levels shown in the earlier Table 6-2 have been conservatively used in the evaluation. All locations meet the MassDEP requirement of no more than a 10-dBA difference between the 'L_{max}' sound level and the ambient L_{90} sound level. A difference of no more than 7 dBA was measured at the four locations.[20] In addition, no MassDEP-defined pure tones were observed during testing on Night 1.

[20] A conclusion cannot be drawn at Location 2 as 'L_{max}' could not be determined.

Table 6-5 Broadband Sound Level Evaluation - Night 1 (April 19, 2019)

Location	Sound Pressure Level (dBA)			Complies?
	'L_{max}'	Ambient L_{90}	Difference Between 'L_{max}' and Ambient L_{90}[1]	
1 - 151 Driftway	56	49	7	Yes
2 - 26 Hewes	N/A	49	N/A	Inconclusive
3 - 122 Gilson	56	51	5	Yes
4 - 34 Driftway	54	53	1	Yes

Notes:

1. Only whole numbers are shown; calculations are performed using values with additional precision.

6.2.2 Night 2 – July 31, 2019 (Hub Height Wind Speed 5-10 m/s)

Operational and ambient sound level measurements were performed at all four locations between 1:00 AM and 2:30 AM on July 31, 2019. Conditions with hub height wind speeds between 5 and 10 m/s were targeted.

6.2.2.1 Measured Meteorological and Wind Turbine Conditions

Ground-level wind conditions measured at Location 3 on July 31, 2019 are presented in Figure 6-2. One-minute averaged wind speeds ranged from 0.1 to 1.1 m/s. Continuous ground-level wind direction data were not collected during this night of measurements; however, the NWS station in Marshfield indicated a SW wind direction and field observations indicated a SW wind direction.

SCADA data were provided by Scituate Wind, LLC for the full duration of the measurements on Night 2. These data were provided in 1-minute time-synchronized averages. The average wind speeds at hub height and the average power output from the wind turbine during the operational and ambient measurements are provided in Table 6-6. These conditions were generally steady during the course of the measurements. The table also summarizes the ground-level conditions during the measurements and indicates whether each of the conditions meet the parameters identified in the Protocol. The SCADA wind direction data for this period, as adjusted based on Scituate Wind's field observations, were consistent with the data collected by Epsilon and the NWS.

Figure 6-2 Ground-Level Meteorological Data – Night 2 (July 31, 2019)

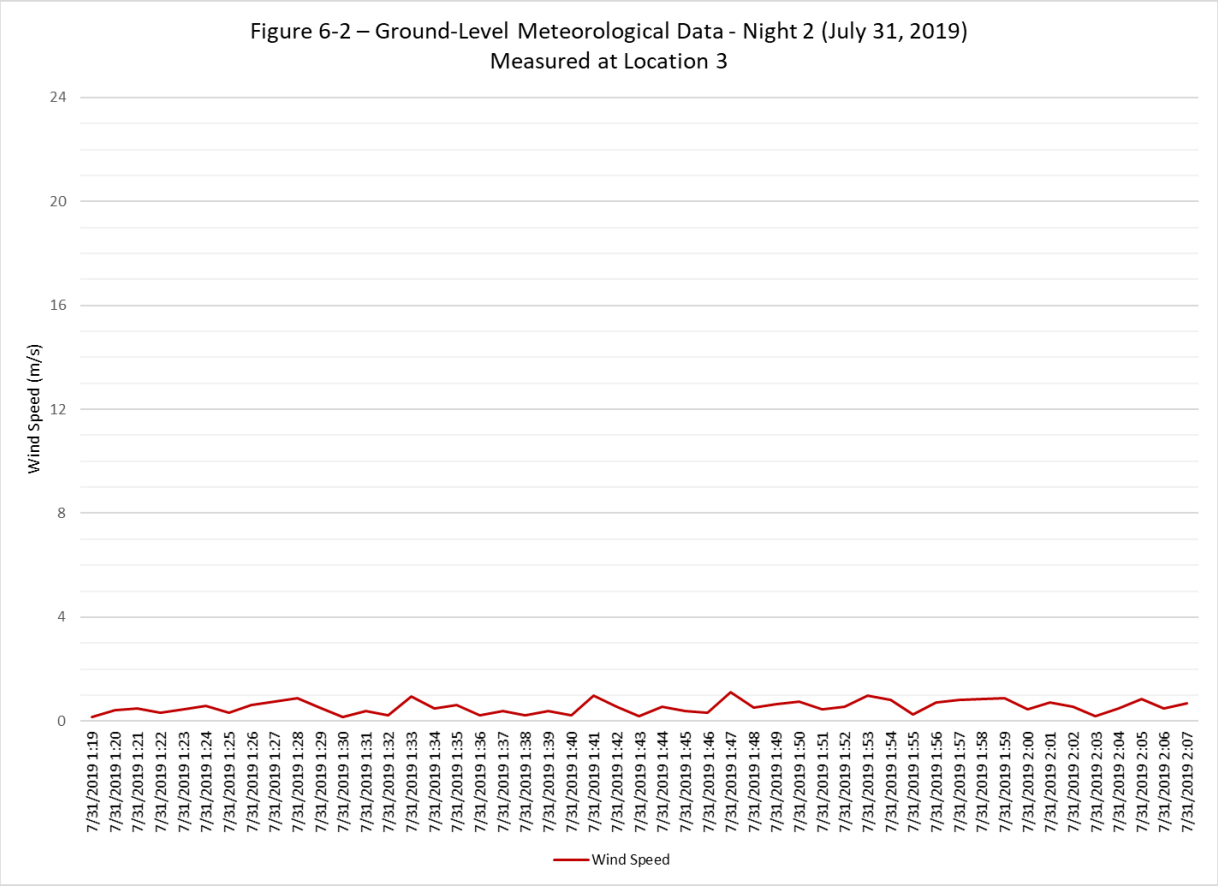


Table 6-6 Meteorological and Wind Turbine Conditions - Night 2 (July 31, 2019)

Condition	Measurement Period		Meets Parameters in the Protocol?
	Operational	Ambient	
Average HH Wind Speed	7.6 m/s	8.2 m/s	Yes
Average Wind Turbine Output	814 kW	0	Yes
Ground-Level Wind Speed[1]	0.1 – 1.1 m/s		Yes
Wind Direction[2]	SW		Yes[3]

Notes:

1. As measured at Location 3.
2. As indicated by field observations and the NWS station in Marshfield, MA.
3. Is within 45° of WSW.

6.2.2.2 Sound Level Results

Sound levels on July 31, 2019 were the result of sound from the wind turbine, wind gusts, vegetation, insects, and some cars and/or aircraft. Data processing for the operational sound levels was based on Methods 1 and 2 described in Section 6.1. At three of the four measurement locations, the field notes had periods that showed emphasis on wind turbine contribution. Field notes from Location 1 provided no periods with emphasis on wind turbine sound; however, Location 1 is the closest location to the wind turbine and at least half of the 5-second periods during each of the three operational periods indicated only wind turbine sound.[21] Audio recordings at Location 1 were reviewed to verify that no non-wind turbine noise sources were clearly contributing to the 1-second L_{eq} sound levels. The highest representative 1-second L_{eq} sound levels measured during the three 5-minute operational periods are presented in Table 6-7. The timeframe in which each 5-minute measurement was captured is included in the table. The average of the three L_{eq} sound levels, or 'L_{max}', is presented in the right-most column.

The three ambient L_{90} sound levels measured at each location on Night 2 are presented in Table 6-8. The timeframe in which each 5-minute measurement was captured is included in the table. The minimum measured L_{90} sound level to be used in the evaluation is presented in the right-most column of the table.

The Protocol specifies that the wind-turbine-attributable 'L_{max}' shall be used in the compliance evaluation. The 'L_{max}' sound levels in Table 6-7 are 'total' sound levels (wind turbine + ambient). For informational purposes, the minimum L_{90} ambient was subtracted, on an energy basis, from the 'L_{max}' sound level to provide a closer representation of wind-turbine-attributable sound levels as shown in Table 6-9.

Table 6-7 Operational Sound Pressure Levels - Night 2 (July 31, 2019)

Location	Sound Pressure Level (dBA)			
	Operational #1 L_{eq} (1:19-1:25 AM)	Operational #2 L_{eq} (1:25-1:32 AM)	Operational #3 L_{eq} (1:31-1:38 AM)	'L_{max}'[1]
1 - 151 Driftway	51	51	51	51
2 - 26 Hewes	48	46	52	49
3 - 122 Gilson	41	42	43	42
4 - 34 Driftway	41	44	43	43

Notes:

1. Only whole numbers are shown; calculations are performed using values with additional precision.

[21] I.e., at least 2.5 minutes of each 5-minute measurement indicated only wind turbine sound.

Table 6-8 Ambient Sound Pressure Levels - Night 2 (July 31, 2019)

Location	Sound Pressure Level (dBA)			
	Ambient #1 L_{90} (1:51-1:58 AM)	Ambient #2 L_{90} (1:56-2:03 AM)	Ambient #3 L_{90} (2:01-2:08 AM)	Minimum Ambient L_{90}
1 - 151 Driftway	38	39	37	37
2 - 26 Hewes	41	41	41	41
3 - 122 Gilson	39	39	39	39
4 - 34 Driftway	38	39	38	38

Table 6-9 Wind-Turbine-Attributable Sound Pressure Levels - Night 2 (July 31, 2019)

Location	Sound Pressure Level (dBA)		
	'L_{max}'	Ambient L_{90}	Wind-Turbine-Attributable 'L_{max}'[1]
1 - 151 Driftway	51	37	51
2 - 26 Hewes	49	41	48
3 - 122 Gilson	42	39	39
4 - 34 Driftway	43	38	41

Notes:

1. Only whole numbers are shown; calculations are performed using values with additional precision.

6.2.2.3 Evaluation of Compliance

An evaluation of broadband sound level compliance was performed for all four locations using data measured on July 31, 2019 and is presented in Table 6-10. The total 'L_{max}' sound levels shown in the earlier Table 6-7 have been conservatively used in the evaluation. All locations meet the MassDEP requirement of no more than a 10-dBA difference between the 'L_{max}' sound level and the ambient L_{90} sound level with the exception of Location 1.

Table 6-10 Broadband Sound Level Evaluation - Night 2 (July 31, 2019)

Location	Sound Pressure Level (dBA)			
	'L_{max}'	Ambient L_{90}	Difference Between 'L_{max}' and Ambient L_{90}[1]	Complies?
1 - 151 Driftway	51	37	13	No
2 - 26 Hewes	49	41	8	Yes
3 - 122 Gilson	42	39	3	Yes
4 - 34 Driftway	43	38	4	Yes

Notes:

1. Only whole numbers are shown; calculations are performed using values with additional precision.

In addition to the broadband analysis, the octave-band sound level data were analyzed for MassDEP-defined pure tones on a 1-minute basis for both operational and ambient measurement periods. Three of the four locations had pure tones present as described herein.

A pure tone was present in the 63 Hz octave band during all the 1-minute ambient periods at Location 1 (151 Driftway). The field notes indicate the presence of a hum from the nearby wastewater treatment plant (WWTP). This hum is the likely cause of the 63 Hz pure tone during the ambient measurement periods. The pure tone measured at this location during the ambient tests is not attributable to the wind turbine.

At Location 2 (26 Hewes Rd), a pure tone was measured in all but one minute of testing (operational and ambient) in the 8,000 Hz octave band. Field notes indicated high frequency insect noise was present consistently throughout testing which is the likely cause of the 8,000 Hz pure tone as insect noise is characteristically in frequencies above the 1,000 Hz octave band,[22] and is typically present during warmer months. A pure tone at 63 Hz was also measured during the last minute of the ambient testing. The field notes indicated sound from an "AC" (air-conditioner) unit for a substantial duration of the testing and ambient temperatures during the testing were above 70° Fahrenheit. The air conditioner is likely the cause of the 63 Hz pure tone. The pure tones measured at this location are not attributable to the wind turbine.

A pure tone in the 1,000 Hz octave band was measured during a single operational minute at Location 4 (34 Driftway). The field notes indicated that a car was the primary sound source for approximately 45 seconds of the minute that contained the pure tone.[23] Based on prior sound level measurement experience by Epsilon, it can be concluded that the pure tone was attributable to the car observed. No other operational period contained a pure tone on Night 2 at Location 4. The pure tone measured at this location is not attributable to the wind turbine.

All 1-minute periods with pure tones on Night 2 are presented in Appendix D.

6.2.3 Night 3 – October 2, 2019 (Hub Height Wind Speed > 9 m/s)

Operational and ambient sound level measurements were performed at all four locations between 1:00 AM and 2:00 AM on October 2, 2019. Conditions with hub height wind speeds over 9 m/s were targeted.

[22] Support for this statement may be found in ANSI S12.100-2014 (R2019).

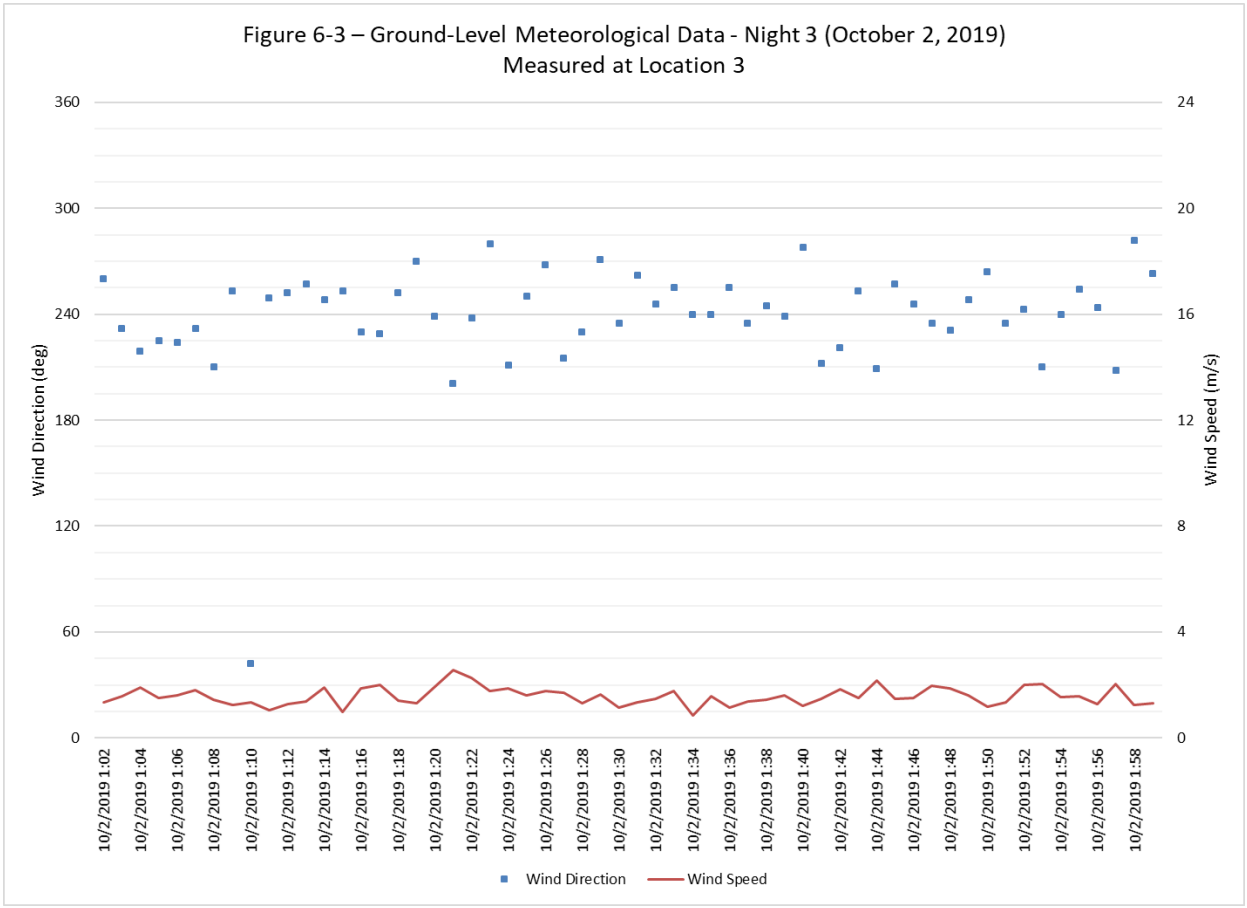
[23] A vehicular passby was confirmed in a review of the audio recording.

6.2.3.1 Measured Meteorological and Wind Turbine Conditions

Ground-level wind conditions measured at Location 3 on October 2, 2019 are presented in Figure 6-3. One-minute averaged wind speeds ranged from 0.8 to 2.6 m/s and the average wind direction was 238° (SW). The NWS station in Marshfield indicated a SW wind direction and field observations indicated S to SW.[24]

SCADA data were provided by Scituate Wind, LLC for the full duration of the measurements on Night 3. These data were provided in 1-minute time-synchronized averages. The average wind speeds at hub height and the average power output from the wind turbine during the operational and ambient measurements are provided in Table 6-11. These conditions were generally steady during the course of the measurements. The table also summarizes the ground-level conditions during the measurements and indicates whether each of the conditions meet the parameters identified in the Protocol.

Figure 6-3 Ground-Level Meteorological Data – Night 3 (October 2, 2019)



[24] The SCADA data indicated a northwesterly wind direction, which is not supported by the other data sources and field observations.

Table 6-11 Meteorological and Wind Turbine Conditions - Night 3 (October 2, 2019)

Condition	Measurement Period		Meets Parameters in the Protocol?
	Operational	Ambient	
Average HH Wind Speed	10.3 m/s	9.7 m/s	Yes
Average Wind Turbine Output	1378 kW	0	Yes
Ground-Level Wind Speed[1]	0.8 – 2.6		Yes
Wind Direction[1]	SW		Yes[2]

Notes:

1. As measured at Location 3.
2. Is within 45° of WSW.

6.2.3.2 Sound Level Results

Sound levels on October 2, 2019 were the result of sound from insects, the wind turbine, wind gusts, vegetation, and some cars. Data processing for the operational sound levels were based on all three methods described in Section 6.1. At three of the four measurement locations, the field notes had periods that showed emphasis on wind turbine contribution.[25] The only location without any wind-turbine-emphasized periods was Location 4, so Method 3 was conservatively used for all 3 operational periods. The highest representative 1-second L_{eq} sound levels measured during the three 5-minute operational periods are presented in Table 6-12. The timeframe in which each 5-minute measurement was captured is included in the table. The average of the three L_{eq} sound levels, or 'L_{max}', is presented in the right-most column.

The three ambient L_{90} sound levels measured at each location on Night 3 are presented in Table 6-13. The timeframe in which each 5-minute measurement was captured is included in the table. The minimum measured L_{90} sound level to be used in the evaluation is presented in the right-most column of the table.

The Protocol specifies that the wind-turbine-attributable 'L_{max}' shall be used in the compliance evaluation. The 'L_{max}' sound levels in Table 6-12 are 'total' sound levels (wind turbine + ambient). For informational purposes, the minimum L_{90} ambient was subtracted, on an energy basis, from the 'L_{max}' sound level to provide a closer representation of wind-turbine-attributable sound levels as shown in Table 6-14. According to ANSI S12.18-1994 (R2019), this procedure is possible when the 'total' sound level is at least 3 dBA higher than the ambient sound level. Since total sound is within 3 dBA of ambient sound at all four locations, no wind-turbine-attributable 'L_{max}' can be calculated for any of the four locations.

[25] Not necessarily during all 3 of the 5-minute operational periods.

Table 6-12 Operational Sound Pressure Levels - Night 3 (October 2, 2019)

Location	Sound Pressure Level (dBA)			
	Operational #1 L_{eq} (1:02-1:12 AM)	Operational #2 L_{eq} (1:08-1:17 AM)	Operational #3 L_{eq} (1:14-1:23 AM)	'L_{max}'[1]
1 - 151 Driftway	61	59	59	60
2 - 26 Hewes	54	55	57	55
3 - 122 Gilson	52	53	52	53
4 - 34 Driftway	55	55	54	55

Notes:

1. Only whole numbers are shown; calculations are performed using values with additional precision.

Table 6-13 Ambient Sound Pressure Levels - Night 3 (October 2, 2019)

Location	Sound Pressure Level (dBA)			
	Ambient #1 L_{90} (1:40-1:46 AM)	Ambient #2 L_{90} (1:46-1:51 AM)	Ambient #3 L_{90} (1:51-1:58 AM)	Minimum Ambient L_{90}
1 - 151 Driftway	57	57	57	57
2 - 26 Hewes	54	54	54	54
3 - 122 Gilson	51	51	51	51
4 - 34 Driftway	53	53	53	53

Table 6-14 Wind-Turbine-Attributable Sound Pressure Levels - Night 3 (October 2, 2019)

Location	Sound Pressure Level (dBA)		
	'L_{max}'	Ambient L_{90}	Wind-Turbine-Attributable 'L_{max}'[2]
1 - 151 Driftway	60	57	N/A[1]
2 - 26 Hewes	55	54	N/A[1]
3 - 122 Gilson	53	51	N/A[1]
4 - 34 Driftway	55	53	N/A[1]

Notes:

1. Cannot be calculated per ANSI S12.18-1994 (R2019).
2. Only whole numbers are shown; calculations are performed using values with additional precision.

6.2.3.3 Evaluation of Compliance

An evaluation of broadband sound level compliance was performed for all four locations using data measured on October 2, 2019 and is presented in Table 6-15. The total 'L_{max}' sound levels shown in the earlier Table 6-12 have been conservatively used in the evaluation. All locations meet the MassDEP requirement of no more than a 10-dBA difference between the 'L_{max}' sound level and the ambient L_{90} sound level. A difference of no more than 3 dBA was measured at the four locations.

Table 6-15 Broadband Sound Level Evaluation - Night 3 (October 2, 2019)

Location	Sound Pressure Level (dBA)			Complies?
	'L_{max}'	Ambient L_{90}	Difference Between 'L_{max}' and Ambient L_{90}[1]	
1 - 151 Driftway	60	57	3	Yes
2 - 26 Hewes	55	54	1	Yes
3 - 122 Gilson	53	51	2	Yes
4 - 34 Driftway	55	53	2	Yes

Notes:

1. Only whole numbers are shown; calculations are performed using values with additional precision.

In addition to the broadband analysis, the octave-band sound level data were analyzed for MassDEP-defined pure tones on a 1-minute basis for both operational and ambient measurement periods. All four locations had pure tones present as described below.

On Night 3 of testing, all four locations had a pure tone in the 4,000 Hz octave band. As discussed for Night 2, high frequency pure tones are commonly caused by insects. A cross-comparison with the field notes from those locations indicated insect noise consistently throughout testing across all four locations which is the probable cause for the pure tones. The 4,000 Hz pure tones are not attributable to the wind turbine.

There were also four (4) minutes of ambient testing at Location 1 that had pure tones at 63 Hz. A cross-comparison of the field notes and the time stamps of the pure tones indicates that these pure tones occurred during periods when cars were a noted sound source. The cars noted during these periods are the probable cause for the 63 Hz pure tones.[26] The 63 Hz pure tones measured during the ambient tests are not attributable to the wind turbine.

All 1-minute periods with pure tones on Night 3 are presented in Appendix D.

6.2.4 Night 4 – December 6, 2019 (Hub Height Wind Speed 5-10 m/s)

Operational and ambient sound level measurements were performed at all four locations between 1:00 AM and 2:00 AM on December 6, 2019. Conditions with hub height wind speeds between 5-10 m/s were targeted.

6.2.4.1 Measured Meteorological and Wind Turbine Conditions

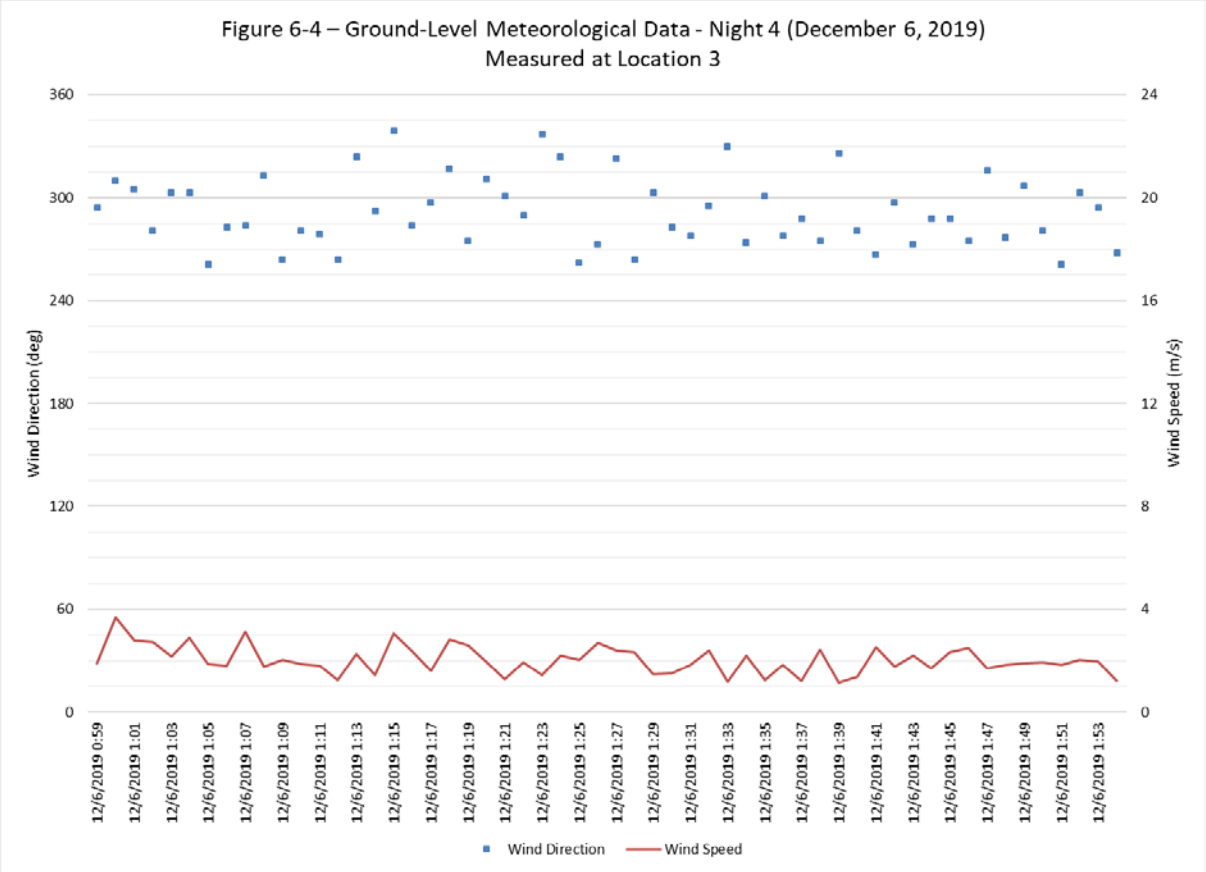
Ground-level wind conditions measured at Location 3 on December 6, 2019 are presented in Figure 6-4. One-minute averaged wind speeds ranged from 1.1 to 3.7 m/s and the average wind direction was 292° (WNW). The NWS station in Marshfield indicated a variable wind direction;

[26] Although not indicated in the field notes from Night 3, the nearby WWTP may have been contributing to the ambient sound levels this night as it was prevalent during other measurement nights.

therefore, data from the second most representative NWS station (Plymouth Municipal Airport) were reviewed and indicated wind to be coming from the west. These data are included in Appendix C of this report. Field observations indicated W to NW.[27]

SCADA data were provided by Scituate Wind, LLC for the full duration of the measurements on Night 4. These data were provided in 1-minute time-synchronized averages. The average wind speeds at hub height and the average power output from the wind turbine during the operational and ambient measurements are provided in Table 6-16. It can be seen in the table that the hub height wind speed dropped substantially between the operational measurements and the ambient measurements. The difference between the average wind speeds is 2.9 m/s, which exceeds the condition of ±2 m/s specified by the MassDEP staff in their final comments on the Protocol. Ground-level wind speeds remained relatively constant during both sets of measurements. Table 6-16 summarizes the ground-level conditions during the measurements and indicates whether each of the conditions meet the parameters identified in the Protocol.

Figure 6-4 Ground-Level Meteorological Data – Night 4 (December 6, 2019)



[27] The SCADA data indicated a northerly wind direction, which is not supported by the other data sources and field observations.

Table 6-16 Meteorological and Wind Turbine Conditions - Night 4 (December 6, 2019)

Condition	Measurement Period		Meets Parameters in the Protocol?
	Operational	Ambient	
Average HH Wind Speed	7.8 m/s	4.9 m/s	No[2]
Average Wind Turbine Output	799 kW	0	Yes
Ground-Level Wind Speed[1]	1.1 – 3.7		Yes
Wind Direction[1]	WNW		Yes[3]

Notes:

1. As measured at Location 3.
2. Difference is greater than the ±2 m/s condition.
3. Is within 45° of WSW.

6.2.4.2 Sound Level Results

Sound levels on December 6, 2019 were the result of sound from the wind turbine, wind gusts, vegetation, and some cars/aircraft. Data processing for the operational sound levels were all based on Method 1 as described in Section 6.1 because the field notes at all four measurement locations had periods that showed emphasis on wind turbine contribution. In addition, audio recordings at all four locations were reviewed to verify that no non-wind turbine noise sources were clearly contributing to the 1-second L_{eq} sound levels. The highest representative 1-second L_{eq} sound levels measured during the three 5-minute operational periods are presented in Table 6-17. The timeframe in which each 5-minute measurement was captured is included in the table. The average of the three L_{eq} sound levels, or 'L_{max}', is presented in the right-most column.

The three ambient L_{90} sound levels measured at each location on Night 4 are presented in Table 6-18. The timeframe in which each 5-minute measurement was captured is included in the table. As noted in the previous section, the hub height wind speeds were stronger during the operational measurements than during the ambient measurements. Therefore, the ambient sound levels do not provide an apples-to-apples comparison to the background sound levels that may have been present during the operational measurements. Using the minimum measured L_{90} sound level in the evaluation would be overly conservative and does not meet the Protocol. Therefore, the L_{90} sound level measured during the first 5-minute period (i.e., measured closest in time to the operational measurements) at each of the four locations have been used in the evaluation and are presented in the right-most column of Table 6-18.

The Protocol specifies that the wind-turbine-attributable 'L_{max}' shall be used in the compliance evaluation. The 'L_{max}' sound levels in Table 6-17 are 'total' sound levels (wind turbine + ambient). For informational purposes, the minimum L_{90} ambient was subtracted, on an energy basis, from the 'L_{max}' sound level to provide a closer representation of wind-turbine-attributable sound levels as shown in Table 6-19.

Table 6-17 Operational Sound Pressure Levels - Night 4 (December 6, 2019)

Location	Sound Pressure Level (dBA)			
	Operational #1 L_{eq} (1:00-1:13 AM)	Operational #2 L_{eq} (1:07-1:19AM)	Operational #3 L_{eq} (1:14-1:25 AM)	'L_{max}'[1]
1 - 151 Driftway	45	45	45	45
2 - 26 Hewes	42	40	41	41
3 - 122 Gilson	40	40	42	40
4 - 34 Driftway	41	40	40	41

Notes:

1. Only whole numbers are shown; calculations are performed using values with additional precision.

Table 6-18 Ambient Sound Pressure Levels - Night 4 (December 6, 2019)

Location	Sound Pressure Level (dBA)			
	Ambient #1 L_{90} (1:34-1:43 AM)	Ambient #2 L_{90} (1:39-1:48 AM)	Ambient #3 L_{90} (1:44-1:53 AM)	Representative Ambient L_{90}[1]
1 - 151 Driftway	36	34	34	36
2 - 26 Hewes	32	31	32	32
3 - 122 Gilson	31	32	32	31
4 - 34 Driftway	31	33	31	31

Notes:

1. Period closest in time to the operational measurements.

Table 6-19 Wind-Turbine-Attributable Sound Pressure Levels - Night 4 (December 6, 2019)

Location	Sound Pressure Level (dBA)		
	'L_{max}'	Ambient L_{90}	Wind-Turbine-Attributable 'L_{max}'[1]
1 - 151 Driftway	45	36	45
2 - 26 Hewes	41	32	40
3 - 122 Gilson	40	31	40
4 - 34 Driftway	41	31	40

Notes:

1. Only whole numbers are shown; calculations are performed using values with additional precision.

6.2.4.3 Evaluation of Compliance

An evaluation of broadband sound level compliance was performed for all four locations using data measured on December 6, 2019 and is presented in Table 6-20. The total 'L_{max}' sound levels shown in the earlier Table 6-17 have been conservatively used in the evaluation. All locations meet the MassDEP requirement of no more than a 10-dBA difference between the 'L_{max}' sound level and the ambient L_{90} sound level.

Table 6-20 Broadband Sound Level Evaluation - Night 4 (December 6, 2019)

Location	Sound Pressure Level (dBA)			Complies?
	'L_{max}'	Ambient L_{90}	Difference Between 'L_{max}' and Ambient L_{90}[1]	
1 - 151 Driftway	45	36	9	Yes
2 - 26 Hewes	41	32	9	Yes
3 - 122 Gilson	40	31	9	Yes
4 - 34 Driftway	41	31	9	Yes

Notes:

1. Only whole numbers are shown; calculations are performed using values with additional precision.

In addition to the broadband analysis, the octave-band sound level data were analyzed for MassDEP-defined pure tones on a 1-minute basis for both operational and ambient measurement periods. All four locations had pure tones present as described below.

On Night 4, Location 1 had two (2) minutes of ambient testing that had pure tones. The pure tones occurred at 63 Hz during one minute and 1,000 Hz in the subsequent minute. The field notes indicate the presence of a hum from the nearby wastewater treatment plant. This hum is the likely cause of the 63 Hz pure tone during the ambient measurement periods. The field notes indicated vehicles passing during the time that the pure tones were measured.[28] Based on prior sound level measurement experience by Epsilon, it can be concluded that the 1,000 Hz pure tone was attributable to the vehicles observed. The pure tones measured at this location during the ambient testing are not attributable to the wind turbine.

Location 2 had one (1) operational minute with a 63 Hz pure tone. This location also had two (2) ambient minutes with a 63 Hz pure tone and two (2) ambient minutes with a 500 Hz pure tone. During the operational period with the pure tone, the field technician noted aircraft as a primary sound source. A similar tone was present during ambient testing and aircraft was also noted. Another sound source noted during the ambient testing was 'possible traffic'. The measurement location is approximately 1.5 miles from Route 3A. The probable causes for the pure tones observed at this location are the overhead aircrafts and distant vehicles. No other operational periods contained a pure tone on Night 4 at Location 2. The pure tones measured at this location are not attributable to the wind turbine.

Location 3 had a pure tone at 63 Hz during a single minute of the ambient. Similar to Location 2, the field notes indicated distant traffic and an aircraft overhead during the ambient measurements. The pure tones measured at this location during the ambient testing are not attributable to the wind turbine.

[28] A vehicular passby was confirmed with a review of the audio recording.

Location 4 had six (6) minutes (3 operational, 3 ambient) with an observed pure tone at 63 Hz. The field notes for Location 4 indicated distant traffic during the ambient measurements and aircraft, similar to the other locations. The measurement location is approximately 1.5 miles from Route 3A. The probable causes for the pure tones observed at this location are distant vehicles and aircraft as the pure tones were also present during ambient measurements. The pure tones measured at this location are not attributable to the wind turbine.

All 1-minute periods with pure tones on Night 4 are presented in Appendix D.

6.3 Summary of Wind-Turbine-Only Sound

Though not required for the compliance evaluation, examination of the wind-turbine-only sound levels is insightful. Table 6-21 summarizes the wind-turbine-only sound levels from all four nights as presented in Tables 6-4, 6-9, 6-14, and 6-19, respectively. In addition, the average wind turbine power output of each night during the operational measurements is shown. Nights where ambient background and total sound were within 3 dBA at any given location are shown as N/A since a source-only sound cannot be calculated. Table 6-21 shows how important background is to a source-only calculation. Nights 2 and 4 had virtually identical average power output and thus should have had the same wind-turbine-only sound levels. However, at Locations 1 and 2 they differ by 6-8 dBA from one night to the other. A closer review of the SCADA data on Night 2 revealed that winds at the hub, coupled to the power output, were generally steady during the operational measurements. Conversely, winds at the hub, as well as the power output, on Night 4 fluctuated over the course of the operational measurements. The differences shown at these two locations on these nights may also be due to non-wind-turbine sound sources. Locations 3 and 4 were within 1 dBA from one to the other. Similarly, under high wind conditions (Nights 1 and 3), the background is so high that it makes determination of a wind-turbine-only sound level nearly impossible due to the correspondingly high ambient sound levels.

Table 6-21 Summary of Wind-Turbine-Only Sound – All Four Nights (dBA)

Location	Night 1 (1500 kW)	Night 2 (814 kW)	Night 3 (1378 kW)	Night 4 (799 kW)
1 - 151 Driftway	55	51	N/A	45
2 - 26 Hewes	N/A	48	N/A	40
3 - 122 Gilson	55	39	N/A	40
4 - 34 Driftway	N/A	41	N/A	40

6.4 Residual Sound Level (L_{90}) Comparison

When a source of sound is steady and dominating, the L_{90} provides a good indicator of sound levels from that specific source. Therefore, when an "on/off" test is done in real time for a source of source such as wind turbines, a comparison of the L_{90} values is a good indicator of the impact of that sound source. Table 6-22 below provides this L_{90} to L_{90} comparison for informational purposes. In this table, the highest of the three measured L_{90} "on" periods is used to be

conservative, while the ambient values are the same as the previous evaluation tables. The same L_{90} to L_{90} comparison was done in the 2015 Tech Environmental report and has been historically used by the MassDEP in evaluating noise compliance at fossil-fueled power plants.

The results in Table 6-22 show that during high power output (Nights 1 and 3) the increase over background was very small—0 to 3 dBA in Night 1 and 0 to 1 dBA in Night 3. During moderate power output (Nights 2 and 4) the increase over background (except for Location 1) ranged from 1 to 2 dBA (Night 2) and 4 to 6 dBA (Night 4). At Location 1, the increases ranged from 9 to 11 dBA during Nights 2 and 4. Although power output was very similar between Night 2 (814 kW) and Night 4 (799 kW) the operational sound levels were louder by 3 to 7 dBA on Night 2 compared to Night 4 suggesting that something else may have influenced sound levels besides the wind turbine.

Table 6-22 Measured L_{90} to L_{90} Comparison

Night	Location	Sound Pressure Level (dBA)		
		Maximum Operational L_{90}	Ambient L_{90}	Difference[1]
Night 1 (April 19, 2019)	1 - 151 Driftway	52	49	3
	2 - 26 Hewes	51	49	2
	3 - 122 Gilson	51	51	0
	4 - 34 Driftway	54	53	0
Night 2 (July 31, 2019)	1 - 151 Driftway	49	37	11
	2 - 26 Hewes	43	41	2
	3 - 122 Gilson	40	39	1
	4 - 34 Driftway	40	38	1
Night 3 (October 2, 2019)	1 - 151 Driftway	58	57	1
	2 - 26 Hewes	53	54	--[2]
	3 - 122 Gilson	51	51	0
	4 - 34 Driftway	53	53	0
Night 4 (December 6, 2019)	1 - 151 Driftway	43	36	9
	2 - 26 Hewes	36	32	4
	3 - 122 Gilson	37	31	6
	4 - 34 Driftway	37	31	6

Notes:

1. Only whole numbers are shown; calculations are performed using values with additional precision.
2. Operational sound level is lower than the ambient sound level.

7.0 CONCLUSIONS

At the request of the Town of Scituate, a post-construction sound level measurement program was conducted in 2019 for Scituate Wind. The 4-night program followed methodologies outlined in the measurement Protocol that was approved by MassDEP staff. The measurement data were analyzed and evaluated per the Protocol against the MassDEP Noise Policy.

The results of this program show that sound pressure levels due to the wind turbine, under wind conditions identified as resulting in maximum sound power levels[29] and under wind conditions identified by residents filing noise complaints, meet the requirements set forth in the MassDEP Noise Policy at each of the monitoring locations with the exception of one (1) location during one of the four nights. Scituate Wind did not comply with the MassDEP Noise Policy at the nearest residence to the wind turbine during one (1) night of measurements. The residence (151 Driftway) is 650 feet to the northeast of the wind turbine and it is Epsilon's understanding that the owners of the residence were recipients of mitigation funds by Scituate Wind, LLC.

Table 7-1 summarizes the evaluations at the four measurement locations on all four nights of measurements.

Table 7-1 Summary of Scituate Wind Sound Level Evaluations

Location	Demonstrates Compliance with MassDEP Noise Policy?			
	Night 1 (April 19, 2019)	Night 2 (July 31, 2019)	Night 3 (October 2, 2019)	Night 4 (December 6, 2019)
1 - 151 Driftway	YES	NO	YES	YES
2 - 26 Hewes	YES	YES	YES	YES
3 - 122 Gilson	YES	YES	YES	YES
4 - 34 Driftway	YES	YES	YES	YES

[29] As defined by the MassDEP WTNSP.

Appendix A

Sound Level Compliance Monitoring Protocol (and Attachments)

Town of Scituate

Sound Level Compliance Monitoring Protocol – Massachusetts Department of Environmental Protection October 18, 2018

Introduction

Epsilon Associates, Inc. ("Epsilon") will perform sound monitoring, in accordance with this MassDEP-reviewed protocol, to assess off-property sound levels from operation of the single wind turbine owned by Scituate Wind located in Scituate, MA. This document describes the sound level measurement locations, measurement methodology, data evaluation methodology, and acoustical equipment utilized.

Epsilon proposes to coordinate with the Town of Scituate, Scituate Wind LLC, and the Resident Coordinator to conduct the monitoring on four (4) weeknights. The wind turbine will be shut down for at least one (1) monitoring interval each night in order to establish the background (ambient) sound levels under the same conditions as the operational sound level measurements. The intent is to identify off-property sound levels that are representative of wind turbine contribution only, excluding impacts from other sound sources, and to compare those sound levels to MassDEP guidance thresholds. This measurement protocol has been designed to conform to DEP's 2013 generic Wind Turbine Noise Study Protocol ("WTNSP") attached for reference.

Measurement Locations

The Town of Scituate, through the Special Projects Director, identified the four locations for sound testing. Permission for sound level monitoring has been granted[1] by the landowners at all locations identified below:

1: 151 Driftway - This residence is approximately 650 feet to the north-northeast of the wind turbine and is the nearest residence to the wind turbine.

2: 26 Hewes Road - This residence is approximately half a mile to the northeast of the wind turbine and is representative of the impacts at the residential properties on Hewes Road.

3: 122 Gilson Road - This residence is approximately 0.6 miles to the northeast of the wind turbine and is representative of the impacts at the residential properties on Gilson Road.

4: 34 Driftway - This residence is approximately half a mile to the east-northeast of the wind turbine.

[1] As of August 14, 2018.

Figure 1 shows the measurement locations overlaid on an aerial orthophoto. These locations were refined with a site visit by Epsilon, the Town's Special Projects Director, and the Resident Coordinator on August 7, 2018. Specific microphone locations will have a minimum setback distance of 25 feet from structures that could cause reflection (in compliance with ANSI 12.9 Part 3 standards).

Photographs will be taken at each sampling location that indicate the location and set-up of the sound meter. These photographs shall be included in the final report submitted to the MassDEP.

Measurement Methodology

Short-term (5-minute) A-weighted broadband and un-weighted octave-band sound level measurements will be made at four locations. Measurements will be made at each location simultaneously and will be attended by Epsilon staff who will note the dominant sound sources during the testing as well as the time and description of any specific episodic sound events.

Using the 'fast' sound meter setting, the 1-second sound levels shall be recorded which will include at a minimum L_{max}, L_{eq}, and L_{90} data over 5-minute sampling periods. Operational testing will aim to be done under targeted hub height wind speeds and calm to light ground-level winds with no precipitation. At least three (3) 5-minute operational measurements will be made each night. Epsilon staff members attending each of the monitoring locations will closely monitor background (non-wind turbine) sounds during both the "turbine off' as well as "turbine on" sampling periods and will cancel or restart any 5-minute sampling period that is determined to include excessive levels of persistent, or otherwise significant, off-site contamination. The three (or more) operational measurements will be made consecutively before shutdowns occur for ambient measurements.

Based on input from the home owners involved in the study, the targeted wind direction for operational measurements will be WSW. This is generally the downwind direction of the residences to the wind turbine; therefore, the targeted wind direction range for measurements will be WSW (247.5°) $\pm$45°. Upwind measurements will be avoided in this measurement program.

Ambient sound level measurements will be made with the wind turbine shut down immediately following the operational measurements. Scituate Wind, LLC, is expected to collect data during each night of measurements to determine whether the wind turbine was operating under the desired conditions for the operational measurements and to be available to perform the shutdowns. Targeted operational conditions are when hub height wind speeds are at least 9 m/s (i.e., during maximum sound power conditions) and when hub height wind speeds are comparable to the speeds during which noise complaints were filed to the Town (5-10 m/s). It will be confirmed with Scituate Wind LLC immediately following the ambient measurements that hub height wind speeds during the ambient period were similar to the operational periods. Scituate Wind LLC shall provide information about wind turbine operation as requested by Epsilon, including wind speed

and direction at hub height, blade pitch setting, and generator output or load following each night of monitoring.

All raw data collected during the sound study will be made available to the Town upon request. All sound level meter readings will be reported in a manner consistent with the accuracy of the meter being used.

Measurement Time Periods

Testing will generally be conducted during the hours of 1 AM to 4 AM to coincide with the quietest background levels and to be consistent with the DEP WTNSP. A total of four (4) nights will be sampled; 2 nights with hub height wind speeds at least 9 m/s, 2 nights with hub height winds speeds between 5 and 10 m/s. The Town of Scituate and Scituate Wind LLC will be invited to observe each sampling event. MassDEP personnel may be invited to observe each sampling event at the invitation of the Town of Scituate. All four monitoring locations will be sampled concurrently for operational then ambient sound. It is anticipated that the monitoring will take place during the summer and/or fall of 2018.

Weather Considerations

In order for the data to be considered valid, the following conditions will be confirmed:

- No precipitation.
- Dry roads.
- Ground-level wind speed less than 5 m/s (11 mph) as per ANSI standards.

The ground level wind speed and wind direction will be continuously measured and logged at one of the test locations. Handheld wind speed measurements will be made at the other three locations. Testing will aim to be done under hub height wind speeds described in the prior text. Epsilon will monitor the weather forecasts on a weekly basis, and will coordinate with the Town, Scituate Wind LLC, and the Resident Coordinator when favorable conditions appear imminent.

Instrumentation

Acoustical instrumentation during the measurement periods will conform to American National Standards Institute (ANSI) S1.4-1983 for Type 1 (precision) sound measurement instrumentation. Instrumentation for measuring octave-band sound levels will conform to ANSI S1.11-1986 for Octave-Band and Fractional-Octave-Band Analog and Digital Filters. The instrumentation will be capable of measuring the following descriptors over 5-minute intervals with a 1-second time history: L_{max}, L_{90}, and L_{eq}. For each descriptor type, A-weighted sound levels and un-weighted octave-band sound levels will be measured. All microphones will be tripod-mounted at a height of approximately 1.3 meters as per the WTNSP, will utilize the manufacturer's windscreen, and will be oriented toward the wind turbine. The locations will be sited away from structures in compliance with ANSI standards.

Audio recordings will be collected for all sampling periods (both operational and ambient) for quality assurance/quality control purposes using external audio recorders connected to each sound level meter.

A HOBO H21-002 micro-weather station (by Onset Computer Corporation) will be deployed at one of the sound measurement locations each night to measure ground-level wind speed and direction at a 2-meter height.

Documentation of Compliance

To evaluate the collected data for comparison with requirements under 310 CMR 7.10 and MassDEP's Noise Policy, Epsilon will perform the following steps for each monitoring location (each monitoring location is analyzed separately and independently):

- Following guidance from the MassDEP, the wind turbine-attributable operational 'L_{max}' sound level will be calculated by averaging the three (3) highest 1-second L_{eq} (dBA) sound levels on each night for each location.
- The broadband ambient sound levels will be determined using the L_{90} (dBA) sound level metric.
- Evaluate compliance with the MassDEP guidance by calculating the difference between the A-weighted ambient and operational sound levels, and comparing against a standard of a 10-dBA difference. Compliance will be determined by comparing the 'L_{max}' values to the ambient L_{90} values.
- Evaluate compliance with requirements regarding "pure tone" conditions as defined in the MassDEP Noise Policy using measured octave band spectra. Un-weighted octave-band L_{eq} sound pressure levels, averaged over 1-minute intervals, will be used for a pure tone analysis. The WTNSP requires the measurement of 10 octave bands[2]. These levels will be measured concurrently with the broadband sound levels during the operational and the ambient measurement periods. Compliance will be achieved based on documentation that no octave-band center frequency sound pressure level exceeds the two adjacent center frequency sound pressure levels by three decibels or more, in a manner that does not already exist in the ambient sound.
- A sound report will be generated to document the results of the measurement program and the compliance evaluation. The report will contain graphs, tables, power production data, hub height wind speed, wind direction, and sound level data. A copy of the report will be provided to the MassDEP as requested.

[2] Assumed by Epsilon to be 31.5 Hz through 16,000 Hz octave bands.

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

Scituate Wind **Scituate, Massachusetts**

Epsilon Associates Inc.

Figure 1

Proposed Sound Measurement Locations

Current Wind Turbine Noise Study Protocol (generic)

Equipment:

- Sampling will be performed with a Type I digital Meter with accuracy to +/- 1 dB. The sampler will be set to collect data on the "A" weighted scale in "slow" response mode with a one second recording interval (log period). The sampler will have received a factory calibration certificate within 12 months of the date of the study and will be field calibrated before and after each sampling event.
- The Wind Turbine Operator shall provide hub-height wind speeds (10 minute averages) obtained from equipment on either the north or south turbine.

Sampling Sites and Operating Conditions:

- Three to five sites will be sampled at the point of perceived maximum impact from the wind turbines. At minimum, the sites to be sampled including the home closest to the wind turbine from each affected neighborhood. Additional sites may be added as conditions during sampling warrant and at the discretion of MassDEP.
- MassDEP will coordinate with the residents at the selected site to determine the point of greatest sound impact and will conduct the sampling at or near that location or at the property line, whichever is practicable. Sampling will not be conducted indoors.
- The sampler will be mounted at a height of approximately 1.3 meters and shall be located so as to comply with offsets from vertical reflecting surfaces as specified in ANSI 12.9, Part 3.
- Multiple operating conditions (wind speeds/ wind direction) will be evaluated including the following:
    1. At or near the cut-in wind speed where background sound will be the lowest (4-5 m/s wind speed at hub height) and the affected residences will be downwind or perpendicular and to the right of the turbine (to the right when facing the turbine)
    2. At the wind speed where manufacturer data indicates there will be the greatest sound power level from the turbine (9-11 m/s) and the affected residences will be downwind or perpendicular and to the right of the turbine (to the right when facing the turbine)
    3. Sampling of multiple wind directions may be required to capture these conditions at the selected sampling sites.

Procedure:

- Sampling will start with data collection during the quietest overnight hours to be determined on a site specific basis (generally 1am-4am). Should sampling during that time period reveal no exceedence of MassDEP's noise policy at one or more locations for the given wind conditions sampled, additional daytime and evening sampling will not be conducted for those locations.
- Sampling days will be selected based on predicted wind conditions. MassDEP will make every effort to notify The Town, the turbine owner/operator and residents at whose properties sampling will be conducted at least 24 hours in advance of a sampling event.
- To evaluate the effect of wind speed on turbine sound emission levels (impact sound), three sampling runs will be conducted at each site under each operating condition to establish an L_{max}

for each respective operating condition. L_{max} is the highest sampled sound level attributed to the sound source (wind turbines) during the sampling run on a one second average. The L_{max} from each of three runs at a single site and operating condition will be averaged to create a single L_{max} for that sampling site under the select wind conditions.

- Each sampling run will be 5 minutes in duration. Samples will be collected manually every 5 seconds (60 sound measurements). Consistent with current MassDEP guidance, any peak sound levels that can be attributed to another sound source (e.g. local traffic, resident generated sounds, etc.) will be identified by the study attendant and discarded from the data set before determining L_{max}.
- At each site, background sampling shall be performed to determine the L_{90} background against which the L_{max} will be compared. The study attendant shall coordinate with the wind turbine owner/ operator to shut down the wind turbine for the purpose of sampling background. If MassDEP is unable to collect background samples at each site or if the wind turbine cannot be shut down, MassDEP reserves the right to define the background sound levels by sampling at a surrogate site of similar land use and proximity to other local sound sources (but not impacted by the wind turbine)
- As the sampling will be done under conditions where the wind might significantly contribute to total sound recorded, MassDEP will make an effort to exclude data from analysis where the sound of the wind is dominant over the sound of the wind turbines.
- At selected sites, a pure tone analysis will be conducted. For pure tone analysis, the meter will be set to collect linear sound on a "slow" response and an octave band filter will be employed to speciate sound pressure levels for 10 octave bands. Pure tone analysis will include collection of one minute L_{eq} sound pressure levels with the wind turbines operating and without the wind turbines operating to evaluate the impact of the wind turbines to pure tone.

Assessment of Results

Once the data is collected and quality control review is complete, MassDEP will analyze all of the data to determine if the sound levels from the wind turbines comply with MassDEP's Noise Policy Threshold for impact sound of 10 dB(A) at each of the sampling sites and under each of the defined operating scenarios. The pure tone data will be analyzed to determine if any octave band center frequency sound pressure level attributable to the wind turbines exceeds the two adjacent center frequency sound pressure level by three decibels or more. The results will be compiled into a single report to be provided to the Town once the sampling and data quality review is complete.

Responses to DEP Comments on Proposed Protocol for Scituate Wind

Comments Provided: 9/21/2018

Responses Dated: 9/26/2018

MassDEP Southeast Regional Office has reviewed the proposed protocol dated August 28, 2018, prepared by Epsilon Associates, Inc., and offers the following comments/questions/recommendations:

1. The 'fast' meter setting is the appropriate setting for both ambient and operational sound monitoring.
   Response: Okay

2. Page 1, first paragraph: strike the reference of MassDEP approving the monitoring protocol. MassDEP is providing comments on the protocol.
   Response: Okay

3. Since the MassDEP 2013 generic Wind Turbine Noise Sound Study Protocol is frequently referenced in the proposed protocol, the document should be attached to the protocol for reference.
   Response: Okay, will attach

4. Lmax should be further defined. The MassDEP monitoring method used for recent wind turbine monitoring programs is based on a maximum sound level Lmax. This Lmax is represented by the average of the three highest 1-second LEQ (turbine ON) values and compared to a baseline (turbine OFF) L90 sound level to determine compliance with the MassDEP Noise Policy.
   Response: Okay, operational sound levels will be calculated using the average of the three highest 1-second Leq values as described in the comment.

5. MassDEP recommends that sampling not be limited to direct downwind conditions and that Epsilon consider a range around the downwind direction. MassDEP has found that in other similar studies worse case sound impacts were not located directly downwind of the sound source.
   Response: Okay, will specify

6. What are the elevations of the sample locations and how does elevation play a role in choosing potential monitoring locations?
   Response: Locations were selected based on input from the community/town.

7. Will any noise reduced operation modes, curtailment plans, etc. be enacted during the sound testing?
   Response: There will not be any noise reduced operation modes, curtailment plans, etc. be enacted during the sound testing

8. MassDEP recommends that the full range of power production be evaluated (low, medium, high) during the sound monitoring, and the low, medium, and high power production ranges should be clearly defined.
   Response: Power production conditions have been selected based on actual conditions experienced during which complaints have been filed. As described in the Scituate Wind protocol, wind speeds as low as 5 m/s will be tested as well as wind speeds during maximum wind turbine sound power.

9. How was it determined what the quietest ambient hours are in the target areas? Also, a +/- 2 hours in the proposed 1 am to 4 am range could result in a monitoring window of 11 pm to 6am. There could be a significant difference in ambient within this period of time. MassDEP recommends that supporting documentation/data be provided which identifies the quietest ambient hours, and that the monitoring window be shortened to ensure that monitoring is conducted during the quietest ambient hours.
   Response: The Protocol will be revised to state a measurement timeframe of 1am to 4am without the ±2 hour flexibility.

10. Regarding ambient measurement, <u>persistent</u> uncharacteristic sound sources (e.g. persistent barking dogs, etc.) should be flagged and excluded from the data.
    Response: Okay

11. Describe how the data will be reported in the final report (i.e. graphs, tables, power production data, hub height wind speed, wind direction, sound levels, etc.).
    Response: The final sound report will contain graphs, tables, power production data, hub height wind speed, wind direction, and sound levels.

12. MassDEP requests that sound turbine power curves be provided with the completed sound monitoring report.
    Response: Wind turbine power curves are typically confidential by the turbine manufacturer and will therefore not be included in the sound report.

13. MassDEP requests that a copy of the complete sound monitoring report be submitted to MassDEP.

Response: Okay

Responses to DEP Comments on Protocol for Scituate Wind

Comments Provided: 10/31/2018

Responses Dated: 11/27/2018

MassDEP Southeast Regional Office has reviewed the proposed protocol, revised October 18, 2018, prepared by Epsilon Associates, Inc., and offers the following comments/questions/recommendations:

1. MassDEP previously recommended that "the full range of power production be evaluated (low, medium, high) during the sound monitoring, and the low, medium, and high power production ranges should be clearly defined." The Town of Scituate responded to this recommendation as follows: "Power production conditions have been selected based on actual conditions experienced during which complaints have been filed. As described in the Scituate Wind protocol, wind speeds as low as 5 m/s will be tested as well as wind speeds during maximum wind turbine sound power."

   At the bottom of page 2 of the protocol it states, "Targeted operational conditions are when hub height wind speeds are at least 9 m/s (i.e., during maximum sound power conditions) and when hub height wind speeds are comparable to the speeds during which noise complaints were filed to the Town (5-10 m/s)."

   Similarly, page 3 of the protocol states, "A total of four (4) nights will be sampled; 2 nights with hub height wind speeds at least 9 m/s, 2 nights with hub height winds speeds between 5 and 10 m/s."

   The above two paragraphs are written in such a way that the two targeted ranges for hub height wind speed (at least 9 m/s and 5-10 m/s) could potentially be the same (i.e. 9 or 10 m/s fall under both ranges). If the intent is to target two distinct ranges of hub height wind speed, perhaps the two ranges should be "at least 9 m/s" and "5-8 m/s". In addition, the WTNSP states, in part, that multiple hub height wind speeds be evaluated, including when background sound will be the lowest and when manufacturer data indicates there will be the greatest sound power level from the turbine. Current language in the Protocol does not ensure compliance with this WTNSP provision.

   Response: Background sound levels will be lowest during the quietest nighttime hours and when ground level winds are light which is when background measurements will be performed. As described in the Protocol, manufacturer data indicate the greatest sound power level from the turbine will be when hub height wind speeds are at least 9 m/s. Measurements will be performed under

these conditions. The hub height wind speed ranges identified in the Protocol are designed for two scenarios; when complaints occur and when the sound power output from the wind turbine is greatest. Evaluations will be performed in that manner.

2. MassDEP previously commented that "Lmax should be further defined. The MassDEP monitoring method used for recent wind turbine monitoring programs is based on a maximum sound level Lmax. This Lmax is represented by the average of the three highest 1-second LEQ (turbine ON) values and compared to a baseline (turbine OFF) L90 sound level to determine compliance with the MassDEP Noise Policy." The Town of Scituate responded to this recommendation as follows: "Okay, operational sound levels will be calculated using the average of the three highest 1-second Leq values as described in the comment."

   To further clarify this procedure, the highest 1-second Leq from each 5-minute sampling period will be averaged to create a single Lmax for that sampling site under the select wind conditions. (i.e. the highest 1-second Leqs to be averaged cannot be from within the same 5-minute sampling period or represent different operating conditions). The WTNSP describes this procedure in detail.

   Response: Okay

3. MassDEP previously commented, "How was it determined what the quietest ambient hours are in the target areas? Also, a +/- 2 hours in the proposed 1 am to 4 am range could result in a monitoring window of 11 pm to 6am. There could be a significant difference in ambient within this period of time. MassDEP recommends that supporting documentation/data be provided which identifies the quietest ambient hours, and that the monitoring window be shortened to ensure that monitoring is conducted during the quietest ambient hours." The Town of Scituate responded to this comment as follows: "The Protocol will be revised to state a measurement timeframe of 1am to 4am without the ±2 hour flexibility."

   The WTNSP states, "Sampling will start with data collection during the quietest overnight hours **to be determined on a site specific basis** (generally 1 am-4 am)." Again, MassDEP recommends that supporting documentation/data be provided which identifies the quietest ambient hours at the target areas.

   Response: Please see the attached pre-construction sound study report which documents ambient sound levels. Appendix B of the study presents hourly L90 sound levels measured in the vicinity of the site. It can be derived from these data that 1 am to 4 am are generally the quietest hours in the area.

4. At the bottom of page 2 of the protocol it states, "It will be confirmed with Scituate Wind LLC immediately following the ambient measurements that hub height wind speeds during the

ambient period **were similar to** the operational periods." MassDEP recommends that "similar" be further defined (i.e. +/- 2 m/s).

Response: Okay

5. On page 4 of the protocol it states, "The broadband ambient sound levels will be determined using the L90 (dBA) sound level metric." MassDEP recommends including additional description of how L90 will be determined/calculated. It is unclear whether multiple 5-minute sampling periods will be utilized for ambient sound level measurements, similar to operational testing, or whether an alternate scenario is proposed.

   Response: The L90 will be the measured L90 sound level of the one 5-minute ambient measurement collected that night. The ambient measurement will be canceled or restarted if any sampling period is determined to include excessive levels of persistent, or otherwise significant, off-site contamination, or not representative of the operational weather conditions. A new L90 ambient will be measured for each of the four nights of testing.

6. On page 4 of the protocol it states, "Compliance will be determined by comparing the 'Lmax' values to the ambient L90 values." MassDEP recommends further clarifying that Lmax and L90 values will be compared under the same wind conditions, monitoring locations, etc.

   Response: Okay

7. MassDEP requests clarification as to whether the residence located at Monitoring Location #1, 151 Driftway, has previously been subject to an agreement/buyout with the Town regarding sound created by the Scituate Wind LLC turbine. If an agreement/buyout was previously established, how would that affect any potential noise issues documented at Monitoring Location #1 by the sound level compliance monitoring?

   Response: Mitigation funds were provided to the resident at 151 Driftway by Scituate Wind, LLC; however, the Town has elected to measure at this residence during this program.

Appendix B

Sample Field Note Sheet (Operational)

Sound Monitoring Form Page____ of____ Epsilon

Msmt Start Time:	1:00	SLM Msmt ID:	011

Operation Condition: Operational ☐Same as previous

Run Time	Wind Turbine	Wind Gusts	Cars	Other (e.g. insects, vegetation, etc.)
0:00:00 - 0:00:05		✓		✓
0:00:05 - 0:00:10	WT clearly audible at times	✓		✓ some
0:00:10 - 0:00:15		✓		✓ vegetation,
0:00:15 - 0:00:20		✓		✓ chimes,
0:00:20 - 0:00:25		✓		✓
0:00:25 - 0:00:30				✓ leaves
0:00:30 - 0:00:35	✓			✓
0:00:35 - 0:00:40	✓	✓		✓
0:00:40 - 0:00:45	✓	✓		
0:00:45 - 0:00:50	✓			
0:00:50 - 0:00:55	✓			
0:00:55 - 0:01:00	✓			✓
0:01:00 - 0:01:05	✓			✓
0:01:05 - 0:01:10	✓ ✱			
0:01:10 - 0:01:15	✓			
0:01:15 - 0:01:20	✓	✓		
0:01:20 - 0:01:25	✓			✓
0:01:25 - 0:01:30	✓			✓
0:01:30 - 0:01:35		✓		✓
0:01:35 - 0:01:40	✓			
0:01:40 - 0:01:45	✓			✓
0:01:45 - 0:01:50	✓			✓
0:01:50 - 0:01:55	✓			✓
0:01:55 - 0:02:00	✓			✓
0:02:00 - 0:02:05	✓			✓
0:02:05 - 0:02:10	✓	✓		
0:02:10 - 0:02:15				✓
0:02:15 - 0:02:20				
0:02:20 - 0:02:25	✓			
0:02:25 - 0:02:30	✓			✓
0:02:30 - 0:02:35	✓			
0:02:35 - 0:02:40	✓ ✱			
0:02:40 - 0:02:45	✓			✓
0:02:45 - 0:02:50	✓			✓
0:02:50 - 0:02:55	✓			✓
0:02:55 - 0:03:00	✓			
0:03:00 - 0:03:05				✓
0:03:05 - 0:03:10	✓			
0:03:10 - 0:03:15	✓			
0:03:15 - 0:03:20				✓
0:03:20 - 0:03:25	✓			✓
0:03:25 - 0:03:30	✓			✓
0:03:30 - 0:03:35	✓			✓
0:03:35 - 0:03:40	✓			✓
0:03:40 - 0:03:45	✓			✓
0:03:45 - 0:03:50	✓			✓
0:03:50 - 0:03:55	✓			
0:03:55 - 0:04:00				✓
0:04:00 - 0:04:05	✓			
0:04:05 - 0:04:10	✓			✓
0:04:10 - 0:04:15	✓			✓
0:04:15 - 0:04:20	✱ ✓			
0:04:20 - 0:04:25	✓			
0:04:25 - 0:04:30	✓	✓		✓
0:04:30 - 0:04:35		✓ ✱		✓
0:04:35 - 0:04:40				
0:04:40 - 0:04:45				
0:04:45 - 0:04:50	✓			
0:04:50 - 0:04:55	✓			
0:04:55 - 0:05:00	✱ ✓			

5-Minute Result: L_{eq} L_{90} (dBA)

Appendix C

National Weather Service Data (Marshfield Municipal Airport)

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Local Climatological Data
Hourly Observations
April 2019

Generated on 01/06/2020

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 11 ft. Lat: 42.0983° N Lon: -70.6722° W

Station: **MARSHFIELD MUNICIPAL AIRPORT, MA US WBAN: 72225664774 (KGHG)**

Date	Time (LST)	Station Type	Sky Conditions	Visibility	Weather Type (see documentation)	Dry Bulb Temp		Wet Bulb Temp		Dew Point Temp		Rel Hum %	Wind Speed (MPH)	Wind Dir (Deg)	Wind Gusts (MPH)	Station Press (inHg)	Press. Tend	Net 3-Hr Change (inHg)	Sea Level Press. (inHg)	Report Type	Precip Total (in)	Altimeter Setting (inHg)
					AU | AW | MW	(F)	(C)	(F)	(C)	(F)	(C)											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
18	0010	7	CLR:00	10.00		43	6.1	41	5.0	39	3.9	87	5	220		30.26				FM-15		30.27
18	0035	7	CLR:00	10.00		43	6.1	41	5.0	39	3.9	87	6	220		30.26				FM-15		30.27
18	0055	7	CLR:00	10.00		43	6.1	41	5.0	39	3.9	87	6	210		30.26				FM-15		30.27
18	0115	7	CLR:00	10.00		43	6.1	41	5.0	39	3.9	87	6	220		30.25				FM-15		30.26
18	0135	7	CLR:00	10.00		43	6.1	41	5.0	39	3.9	87	6	220		30.25				FM-15		30.26
18	0155	7	CLR:00	10.00		43	6.1	41	5.0	39	3.9	87	6	220		30.25				FM-15		30.26
18	0215	7	CLR:00	10.00		43	6.1	41	5.0	39	3.9	87	6	220		30.24				FM-15		30.25
18	0235	7	CLR:00	10.00		41	5.0	40	4.4	39	3.9	93	5	230		30.24				FM-15		30.25
18	0255	7	CLR:00	10.00		41	5.0	40	4.4	39	3.9	93	3	230		30.24				FM-15		30.25
18	0315	7	CLR:00	10.00		39	3.9	38	3.3	37	2.8	93	3	230		30.24				FM-15		30.25
18	0335	7	CLR:00	10.00		39	3.9	38	3.3	37	2.8	93	0	000		30.24				FM-15		30.25
18	0355	7	CLR:00	10.00		37	2.8	37	2.8	37	2.8	100	0	000		30.25				FM-15		30.26
18	0415	7	CLR:00	10.00		37	2.8	37	2.8	36	2.2	93	3	240		30.25				FM-15		30.26
18	0435	7	CLR:00	10.00		36	2.2	36	2.2	36	2.2	100	0	000		30.26				FM-15		30.27
18	0455	7	CLR:00	10.00		36	2.2	36	2.2	36	2.2	100	0	000		30.26				FM-15		30.27
18	0515	7	CLR:00	10.00		36	2.2	36	2.2	36	2.2	100	0	000		30.27				FM-15		30.28
18	0535	7	CLR:00	10.00		37	2.8	37	2.8	37	2.8	100	0	000		30.27				FM-15		30.28
18	0555	7	CLR:00	10.00		41	5.0	40	4.4	39	3.9	93	0	000		30.27				FM-15		30.28
18	0615	7	SCT:04 100	10.00		45	7.2	42	5.6	39	3.9	81	3	200		30.28				FM-15		30.29
18	0635	7	FEW:02 100	10.00		45	7.2	41	5.0	37	2.8	76	3	160		30.28				FM-15		30.29
18	0655	7	FEW:02 85	10.00		46	7.8	42	5.6	37	2.8	71	5	180		30.27				FM-15		30.28
18	0715	7	BKN:07 85	10.00		46	7.8	42	5.6	36	2.2	66	5	170		30.27				FM-15		30.28
18	0735	7	BKN:07 75 OVC:08 85	10.00		46	7.8	42	5.6	37	2.8	71	7	160		30.26				FM-15		30.27
18	0755	7	OVC:08 70	10.00		46	7.8	41	5.0	34	1.1	62	9	150		30.26				FM-15		30.27
18	0815	7	OVC:08 65	10.00		46	7.8	40	4.4	32	0.0	57	9	VRB		30.25				FM-15		30.26
18	0835	7	OVC:08 65	10.00		46	7.8	42	5.6	36	2.2	66	7	VRB		30.26				FM-15		30.27
18	0855	7	OVC:08 65	10.00		48	8.9	42	5.6	34	1.1	58	9	VRB		30.26				FM-15		30.27
18	0915	7	FEW:02 55 OVC:08 65	10.00		48	8.9	41	5.0	32	0.0	54	6	VRB	*	30.26				FM-15		30.27
18	0935	7	FEW:02 40 FEW:02 50 OVC:08 65	10.00		48	8.9	42	5.6	34	1.1	58	7	140	*	30.24				FM-15		30.25
18	0955	7	OVC:08 60	10.00		48	8.9	43	6.1	37	2.8	66	8	140		30.24				FM-15		30.25
18	1015	7	OVC:08 60	10.00		48	8.9	43	6.1	37	2.8	66	9	150		30.24				FM-15		30.25
18	1035	7	FEW:02 49 OVC:08 60	10.00		46	7.8	43	6.1	39	3.9	76	11	130		30.22				FM-15		30.23
18	1055	7	FEW:02 48 OVC:08 55	10.00		46	7.8	43	6.1	39	3.9	76	8	160		30.24				FM-15		30.25
18	1115	7	OVC:08 55	10.00		46	7.8	43	6.1	39	3.9	76	8	140	17	30.23				FM-15		30.24
18	1135	7	OVC:08 55	10.00		48	8.9	44	6.7	39	3.9	71	9	140		30.23				FM-15		30.24
18	1155	7	OVC:08 55	10.00		48	8.9	44	6.7	39	3.9	71	10	140	17	30.22				FM-15		30.23
18	1215	7	BKN:07 50 BKN:07 100	10.00		50	10.0	45	7.2	39	3.9	67	15	140		30.20				FM-15		30.21
18	1235	7	BKN:07 49 BKN:07 80 BKN:07 100	10.00		52	11.1	47	8.3	41	5.0	67	14	130		30.20				FM-15		30.21
18	1255	7		10.00		50	10.0	46	7.8	41	5.0	71	11	140	18	30.19				FM-15		30.20
18	1315	7		9.00		50	10.0	46	7.8	41	5.0	71	9	140		30.18				FM-15		30.19

18	1335	7	OVC:08 46	10.00		52	11.1	46	7.8	39	3.9	62	13	VRB	24	30.17				FM-15		30.18
18	1355	7	BKN:07 42 OVC:08 50	10.00		52	11.1	46	7.8	39	3.9	62	14	160	23	30.14				FM-15		30.15
18	1415	7	OVC:08 38	10.00		52	11.1	46	7.8	39	3.9	62	14	180	25	30.14				FM-15		30.15
18	1435	7	OVC:08 33	10.00		52	11.1	46	7.8	39	3.9	62	14	VRB	21	30.13				FM-15		30.14
18	1455	7	OVC:08 32			52	11.1	46	7.8	39	3.9	62	13	170	23	30.13				FM-15		30.14
18	1515	7	OVC:08 31	10.00		52	11.1	47	8.3	41	5.0	67	8	170	18	30.13				FM-15		30.14
18	1535	7	OVC:08 28	10.00		50	10.0	47	8.3	43	6.1	76	10	VRB	22	30.12				FM-15		30.13
18	1555	7		10.00		50	10.0	46	7.8	41	5.0	71	6	150	18	30.11				FM-15		30.12
18	1615	7		10.00		50	10.0	47	8.3	43	6.1	76	8	140	*	30.09				FM-15		30.10
18	1635	7	BKN:07 18 OVC:08 23	10.00		48	8.9	47	8.3	45	7.2	87	7	130		30.08				FM-15		30.09
18	1655	7	OVC:08 15	10.00		48	8.9	47	8.3	45	7.2	87	7	140		30.06				FM-15		30.07
18	1715	7	OVC:08 14	10.00		48	8.9	47	8.3	46	7.8	94	6	150	*	30.05				FM-15		30.06
18	1735	7	OVC:08 15	10.00		48	8.9	47	8.3	46	7.8	94	6	VRB		30.04				FM-15		30.05
18	1755	7	OVC:08 16	9.00		50	10.0	49	9.4	48	8.9	94	5	170		30.03				FM-15		30.04
18	1815	7	OVC:08 16	10.00		52	11.1	51	10.6	50	10.0	94	9	VRB		30.01				FM-15		30.02
18	1835	7	OVC:08 16	10.00		54	12.2	52	11.1	50	10.0	88	10	VRB	18	30.00				FM-15		30.01
18	1855	7	OVC:08 15	10.00		55	12.8	53	11.7	52	11.1	88	9	VRB		29.99				FM-15		30.00
18	1915	7	OVC:08 14	10.00		57	13.9	54	12.2	52	11.1	82	7	VRB	20	29.99				FM-15		30.00
18	1935	7	OVC:08 14	10.00		57	13.9	55	12.8	54	12.2	88	9	VRB	16	29.98				FM-15		29.99
18	1955	7	OVC:08 13	10.00		57	13.9	55	12.8	54	12.2	88	14	VRB	25	29.96				FM-15		29.97
18	2015	7	OVC:08 11	10.00		57	13.9	56	13.3	55	12.8	94	16	190	26	29.95				FM-15		29.96
18	2035	7	OVC:08 10	10.00		59	15.0	57	13.9	55	12.8	88	16	200	28	29.94				FM-15		29.95
18	2055	7	OVC:08 10	10.00		59	15.0	58	14.4	57	13.9	94	15	200	25	29.93				FM-15		29.94
18	2115	7	OVC:08 9	10.00		61	16.1	59	15.0	57	13.9	88	20	210	30	29.92				FM-15		29.93
18	2135	7	OVC:08 9	10.00		61	16.1	60	15.6	59	15.0	94	15	VRB	29	29.91				FM-15		29.92
18	2155	7	OVC:08 8	9.00		61	16.1	60	15.6	59	15.0	94	17	VRB	30	29.90				FM-15		29.91
18	2215	7	OVC:08 7	9.00		61	16.1	60	15.6	59	15.0	94	16	200	30	29.89				FM-15		29.90
18	2235	7	OVC:08 7	8.00		61	16.1	61	16.1	61	16.1	100	21	210	29	29.89				FM-15		29.90
18	2255	7	OVC:08 8	10.00		63	17.2	62	16.7	61	16.1	94	21	210	30	29.88				FM-15		29.89
18	2315	7	OVC:08 8	10.00		63	17.2	62	16.7	61	16.1	94	21	220	32	29.89				FM-15		29.90
18	2335	7	OVC:08 9	10.00		63	17.2	62	16.7	61	16.1	94	17	210	25	29.89				FM-15		29.90
18	2355	7	OVC:08 10	10.00		63	17.2	62	16.7	61	16.1	94	18	210	28	29.88				FM-15		29.89
19	0015	7	BKN:07 12 OVC:08 19	10.00		63	17.2	62	16.7	61	16.1	94	22	220	36	29.88				FM-15		29.89
19	0035	7	BKN:07 14 OVC:08 23	10.00		64	17.8	62	16.7	61	16.1	88	18	220	33	29.87				FM-15		29.88
19	0055	7	BKN:07 16 OVC:08 22	10.00		64	17.8	62	16.7	61	16.1	88	15	220	30	29.86				FM-15		29.87
19	0115	7	BKN:07 15 OVC:08 21	10.00		64	17.8	62	16.7	61	16.1	88	18	220	34	29.85				FM-15		29.86
19	0135	7	BKN:07 13 OVC:08 18	10.00		64	17.8	62	16.7	61	16.1	88	18	VRB	31	29.84				FM-15		29.85
19	0155	7	BKN:07 13 OVC:08 20	10.00		64	17.8	62	16.7	61	16.1	88	23	220	37	29.84				FM-15		29.85
19	0215	7	BKN:07 13 OVC:08 19	10.00		64	17.8	62	16.7	61	16.1	88	23	220	52	29.83				FM-15		29.84
19	0235	7	OVC:08 12	10.00		64	17.8	62	16.7	61	16.1	88	18	VRB	44	29.83				FM-15		29.84
19	0255	7	OVC:08 13	10.00		64	17.8	62	16.7	61	16.1	88	17	230	31	29.82				FM-15		29.83
19	0315	7	OVC:08 12	10.00		64	17.8	62	16.7	61	16.1	88	17	230	33	29.82				FM-15		29.83
19	0335	7	BKN:07 13 OVC:08 20	10.00		64	17.8	62	16.7	61	16.1	88	16	230	33	29.81				FM-15		29.82
19	0355	7	BKN:07 15 BKN:07 21	10.00		63	17.2	61	16.1	59	15.0	88	23	230	34	29.82				FM-15		29.83
19	0415	7	SCT:04 14 BKN:07 19	10.00		63	17.2	61	16.1	59	15.0	88	13	VRB	31	29.82				FM-15		29.83
19	0435	7	SCT:04 15	10.00		63	17.2	61	16.1	59	15.0	88	20	VRB	30	29.82				FM-15		29.83
19	0455	7	SCT:04 17 SCT:04 24	10.00		64	17.8	61	16.1	59	15.0	83	20	VRB	31	29.82				FM-15		29.83

19	0515	7	FEW:02 17 SCT:04 24	10.00		63	17.2	61	16.1	59	15.0	88	22	220	38	29.82				FM-15		29.83
19	0535	7	FEW:02 16 FEW:02 23	10.00		64	17.8	61	16.1	59	15.0	83	17	230	36	29.82				FM-15		29.83
19	0555	7	FEW:02 16 FEW:02 23	10.00		64	17.8	61	16.1	59	15.0	83	17	VRB	28	29.82				FM-15		29.83
19	0615	7	FEW:02 16	10.00		64	17.8	61	16.1	59	15.0	83	20	220	33	29.81				FM-15		29.82
19	0635	7	FEW:02 18	10.00		64	17.8	61	16.1	59	15.0	83	21	VRB	33	29.82				FM-15		29.83
19	0655	7	FEW:02 19	10.00		66	18.9	62	16.7	59	15.0	78	16	220	26	29.82				FM-15		29.83
19	0715	7	FEW:02 36	10.00		66	18.9	62	16.7	59	15.0	78	18	220	39	29.82				FM-15		29.83
19	0735	7	CLR:00	10.00		66	18.9	62	16.7	59	15.0	78	16	220	39	29.83				FM-15		29.84
19	0755	7	CLR:00	10.00		66	18.9	62	16.7	59	15.0	78	22	230	32	29.83				FM-15		29.84
19	0815	7	FEW:02 24 FEW:02 49	10.00		68	20.0	63	17.2	59	15.0	73	14	VRB	32	29.82				FM-15		29.83
19	0835	7	FEW:02 22 FEW:02 26 SCT:04 70	10.00		68	20.0	63	17.2	59	15.0	73	16	VRB	36	29.82				FM-15		29.83
19	0855	7	SCT:04 21 SCT:04 27 BKN:07 50	10.00		70	21.1	64	17.8	61	16.1	73	21	220	34	29.82				FM-15		29.83
19	0915	7	BKN:07 16 BKN:07 22 BKN:07 26	10.00		68	20.0	64	17.8	61	16.1	78	22	220	38	29.82				FM-15		29.83
19	0935	7	BKN:07 17 OVC:08 22	10.00		68	20.0	64	17.8	61	16.1	78	24	220	38	29.82				FM-15		29.83
19	0955	7	OVC:08 19	10.00		70	21.1	66	18.9	63	17.2	78	14	230	30	29.83				FM-15		29.84
19	1015	7	BKN:07 19 OVC:08 24	10.00		70	21.1	66	18.9	63	17.2	78	15	220	37	29.82				FM-15		29.83
19	1035	7	BKN:07 20 BKN:07 25 BKN:07 42	10.00		70	21.1	66	18.9	63	17.2	78	24	220	37	29.82				FM-15		29.83
19	1055	7	SCT:04 20 BKN:07 25 BKN:07 29	9.00		70	21.1	66	18.9	63	17.2	78	20	220	39	29.82				FM-15		29.83
19	1115	7	BKN:07 20 BKN:07 26 BKN:07 90	10.00		72	22.2	66	18.9	63	17.2	73	25	VRB	43	29.82				FM-15		29.83
19	1135	7	BKN:07 21 BKN:07 90 BKN:07 110	10.00		72	22.2	66	18.9	63	17.2	73	20	230	33	29.82				FM-15		29.83
19	1155	7	BKN:07 20 BKN:07 27 BKN:07 90	10.00		70	21.1	66	18.9	63	17.2	78	22	VRB	38	29.81				FM-15		29.82
19	1215	7	BKN:07 22 BKN:07 27 BKN:07 35	10.00		72	22.2	66	18.9	63	17.2	73	18	VRB	33	29.81				FM-15		29.82
19	1235	7	BKN:07 22 BKN:07 29 BKN:07 37	9.00		70	21.1	66	18.9	63	17.2	78	22	220	33	29.81				FM-15		29.82
19	1255	7	BKN:07 21 BKN:07 28 BKN:07 37	10.00		70	21.1	66	18.9	63	17.2	78	24	210	32	29.81				FM-15		29.82
19	1315	7	BKN:07 19 BKN:07 24 BKN:07 37	10.00		70	21.1	66	18.9	63	17.2	78	21	220	32	29.81				FM-15		29.82
19	1335	7		10.00		70	21.1	66	18.9	63	17.2	78	22	210	37	29.81				FM-15		29.82
19	1355	7		6.00	HZ:7 |FU |HZ	70	21.1	66	18.9	63	17.2	78	18	210	30	29.81				FM-15		29.82
19	1415	7	BKN:07 17 OVC:08 22	5.00	BR:1 ||	66	18.9	64	17.8	63	17.2	88	16	VRB	28	29.81				FM-15		29.82
19	1435	7	OVC:08 14	7.00		66	18.9	64	17.8	63	17.2	88	16	210	28	29.82				FM-15		29.83
19	1455	7	OVC:08 13	4.00	BR:1 ||	66	18.9	64	17.8	63	17.2	88	20	220	30	29.82				FM-15		29.83
19	1515	7	OVC:08 12	2.00	BR:1 ||	66	18.9	64	17.8	63	17.2	88	21	210	31	29.82				FM-15		29.83
19	1535	7	BKN:07 10 OVC:08 15	2.00	BR:1 ||	64	17.8	64	17.8	64	17.8	100	15	VRB	25	29.82				FM-15		29.83

19	1555	7	BKN:07 10 OVC:08 15	4.00	BR:1 ||	64	17.8	64	17.8	64	17.8	100	15	VRB	25	29.82				FM-15	0.01	29.83
19	1615	7	BKN:07 10 OVC:08 15	9.00		64	17.8	64	17.8	64	17.8	100	18	210	31	29.82				FM-15		29.83
19	1635	7	BKN:07 8 OVC:08 11	3.00	BR:1 ||	64	17.8	64	17.8	64	17.8	100	15	220	28	29.82				FM-15		29.83
19	1655	7	OVC:08 8	7.00		64	17.8	64	17.8	64	17.8	100	17	220	34	29.82				FM-15		29.83
19	1715	7	OVC:08 9	7.00		66	18.9	65	18.3	64	17.8	94	15	220	24	29.82				FM-15		29.83
19	1735	7	OVC:08 8	6.00	BR:1 ||	66	18.9	65	18.3	64	17.8	94	16	220	29	29.82				FM-15		29.83
19	1755	7	OVC:08 8	6.00	BR:1 ||	66	18.9	65	18.3	64	17.8	94	14	210	26	29.82				FM-15		29.83
19	1815	7	OVC:08 10	6.00	BR:1 ||	66	18.9	65	18.3	64	17.8	94	15	VRB	31	29.83				FM-15		29.84
19	1835	7	OVC:08 10	7.00		66	18.9	65	18.3	64	17.8	94	14	210	25	29.83				FM-15		29.84
19	1855	7	OVC:08 11	5.00	BR:1 ||	66	18.9	65	18.3	64	17.8	94	20	210		29.83				FM-15		29.84
19	1915	7	OVC:08 11	7.00		66	18.9	65	18.3	64	17.8	94	16	210	23	29.84				FM-15		29.85
19	1935	7	OVC:08 11	7.00		66	18.9	65	18.3	64	17.8	94	13	210	24	29.85				FM-15		29.86
19	1955	7	OVC:08 12	7.00		66	18.9	65	18.3	64	17.8	94	11	VRB	20	29.85				FM-15		29.86
19	2015	7	OVC:08 12	8.00		66	18.9	65	18.3	64	17.8	94	14	210	23	29.86				FM-15		29.87
19	2035	7	OVC:08 12	9.00		66	18.9	65	18.3	64	17.8	94	16	210	23	29.85				FM-15		29.86
19	2055	7	OVC:08 13	10.00		68	20.0	66	18.9	64	17.8	88	16	200	29	29.85				FM-15		29.86
19	2115	7	OVC:08 13	10.00		68	20.0	66	18.9	64	17.8	88	18	210	29	29.84				FM-15		29.85
19	2135	7	OVC:08 13	10.00		68	20.0	66	18.9	64	17.8	88	16	200	26	29.84				FM-15		29.85
19	2155	7	OVC:08 12	10.00		68	20.0	66	18.9	64	17.8	88	16	210	29	29.84				FM-15		29.85
19	2215	7	OVC:08 11	10.00		68	20.0	66	18.9	64	17.8	88	15	200	30	29.84				FM-15		29.85
19	2235	7	OVC:08 12	10.00		68	20.0	66	18.9	64	17.8	88	14	VRB	25	29.83				FM-15		29.84
19	2255	7	OVC:08 14	9.00		66	18.9	65	18.3	64	17.8	94	21	200	32	29.83				FM-15		29.84
19	2315	7	OVC:08 14	9.00		68	20.0	66	18.9	64	17.8	88	25	200	38	29.82				FM-15		29.83
19	2335	7	OVC:08 14	5.00	BR:1 ||	66	18.9	65	18.3	64	17.8	94	18	190	33	29.82				FM-15		29.83
19	2355	7	OVC:08 11	6.00	BR:1 ||	66	18.9	66	18.9	66	18.9	100	17	VRB	30	29.81				FM-15		29.82

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Current Location: Elev: 11 ft. Lat: 42.0983° N Lon: -70.6722° W

Station: **MARSHFIELD MUNICIPAL AIRPORT, MA US WBAN: 72225664774 (KGHG)**

Local Climatological Data
Hourly Precipitation
April 2019

Generated on 01/06/2020

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Date	For Hour (LST) Ending at																							Date
	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	NOON	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	MID	
01	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	01
02	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0.02	02
03	0.06	0.07	0.18	0.13	0.11	0.04	0.03	0.03	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	03
04	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	04
05	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0.03	0.03	0.02	0.03	05
06	0.03	0.02	M	0.02	0.03	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	06
07	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	07
08	M	M	M	0.01	0.01	0.01	0.04	0.07	0.05	0.11	0.01	0.01	M	M	M	0.01	M	M	M	M	M	M	M	M	08
09	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0.04	0.04	0.01	M	M	M	09
10	M	M	M	M	M	M	0.01	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	10
11	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	11
12	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0.02	0.04	12
13	0.01	0.01	M	0.01	0.02	0.08	0.10	0.14	0.04	M	0.01	M	M	M	M	M	M	M	M	M	M	M	M	M	13
14	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0.02	M	0.03	14
15	0.01	M	0.02	M	0.10	0.27	0.57	0.15	0.01	M	M	M	M	M	M	0.01	M	M	M	M	M	M	M	M	15
16	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	16
17	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	17
18	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	18
19	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0.01	M	M	M	M	M	M	M	M	19
20	0.01	M	M	M	M	M	M	M	M	M	M	M	M	M	0.01	M	0.01	0.08	0.01	M	0.04	0.03	M	M	20
21	0.01	M	M	M	M	M	M	0.02	0.09	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	21
22	M	M	M	M	M	M	M	M	M	M	0.04	0.21	0.15	0.08	0.01	0.17	0.24	0.15	0.13	0.11	0.05	0.01	M	0.01	22
23	M	M	M	M	0.01	0.01	M	0.03	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0.01	23
24	M	M	0.01	0.02	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	24
25	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	25
26	M	M	M	M	M	M	M	0.01	0.05	M	M	M	M	M	M	M	M	0.01	0.01	0.10	M	M	M	0.05	26
27	0.03	0.01	0.02	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	27
28	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0.01	0.01	0.01	0.01	M	0.02	M	M	M	M	28
29	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	29
30	M	0.02	0.04	0.01	0.01	0.01	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	30

Maximum Short Duration Precipitation

Time Period (Minutes)	5	10	15	20	30	45	60	80	100	120	150	180
Precipitation (inches)												
Ending Date Time (yyyy-mm-dd hh:mi)												

Hourly, daily, and monthly totals on the Daily Summary page and the Hourly Precipitation Table are shown as reported by the instrumentation at the site. However, NWS does not edit hourly values for its ASOS sites, but may edit the daily and monthly totals for selected sites which will be reflected on the Daily Summary page.

T = Trace
s = Suspect
* = Erroneous
blank = No precipitation observed
M = Missing

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Local Climatological Data
Hourly Observations
July 2019

Generated on 01/06/2020

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 11 ft. Lat: 42.0983° N Lon: -70.6722° W

Station: **MARSHFIELD MUNICIPAL AIRPORT, MA US WBAN: 72225664774 (KGHG)**

Date	Time (LST)	Station Type	Sky Conditions	Visibility	Weather Type (see documentation)	Dry Bulb Temp		Wet Bulb Temp		Dew Point Temp		Rel Hum %	Wind Speed (MPH)	Wind Dir (Deg)	Wind Gusts (MPH)	Station Press (inHg)	Press. Tend	Net 3-Hr Change (inHg)	Sea Level Press. (inHg)	Report Type	Precip Total (in)	Altimeter Setting (inHg)
					AU | AW | MW	(F)	(C)	(F)	(C)	(F)	(C)											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
30	0015	7	CLR:00	10.00		75	23.9	73	22.8	72	22.2	89	3	230		29.95				FM-15		29.96
30	0035	7	CLR:00	10.00		75	23.9	73	22.8	72	22.2	89	5	220		29.95				FM-15		29.96
30	0055	4		10.00		75	23.9			72	22.2	89	5	VRB						FM-15		29.95
30	0115	7	CLR:00	10.00		73	22.8	72	22.2	72	22.2	94	5	230		29.94				FM-15		29.95
30	0135	7	CLR:00	10.00		73	22.8	72	22.2	72	22.2	94	5	VRB		29.94				FM-15		29.95
30	0155	4		10.00		73	22.8			72	22.2	94	3	230						FM-15		29.95
30	0215	7	CLR:00	10.00		73	22.8	72	22.2	72	22.2	94	5	VRB		29.94				FM-15		29.95
30	0235	7	CLR:00	10.00		73	22.8	72	22.2	72	22.2	94	5	240		29.94				FM-15		29.95
30	0255	4		10.00		73	22.8			72	22.2	94	0	000						FM-15		29.95
30	0315	7	CLR:00	10.00		73	22.8	72	22.2	72	22.2	94	3	250		29.94				FM-15		29.95
30	0335	7	CLR:00	10.00		73	22.8	72	22.2	72	22.2	94	3	260		29.95				FM-15		29.96
30	0355	4		10.00		73	22.8			72	22.2	94	0	000						FM-15		29.96
30	0415	7	CLR:00	10.00		73	22.8	72	22.2	72	22.2	94	3	240		29.95				FM-15		29.96
30	0435	7	CLR:00	10.00		73	22.8	72	22.2	72	22.2	94	3	240		29.96				FM-15		29.97
30	0455	4		10.00		73	22.8			73	22.8	100	0	000						FM-15		29.97
30	0515	7	CLR:00	10.00		73	22.8	73	22.8	73	22.8	100	6	VRB		29.96				FM-15		29.97
30	0535	7	CLR:00	10.00		73	22.8	73	22.8	73	22.8	100	3	230		29.96				FM-15		29.97
30	0555	4		10.00		75	23.9			73	22.8	94	5	VRB						FM-15		29.98
30	0615	7	CLR:00	10.00		77	25.0	74	23.3	73	22.8	89	6	230		29.97				FM-15		29.98
30	0635	7	CLR:00	10.00		79	26.1	75	23.9	73	22.8	84	7	240		29.97				FM-15		29.98
30	0655	4		10.00		79	26.1			73	22.8	84	7	230						FM-15		29.99
30	0715	7	CLR:00	10.00		81	27.2	75	23.9	73	22.8	79	7	230	*	29.98				FM-15		29.99
30	0735	7	CLR:00	10.00		82	27.8	76	24.4	73	22.8	74	7	VRB		29.98				FM-15		29.99
30	0755	4		10.00		82	27.8			73	22.8	74	6	220						FM-15		29.99
30	0815	7	CLR:00	10.00		82	27.8	76	24.4	73	22.8	74	7	VRB		29.98				FM-15		29.99
30	0835	7	CLR:00	10.00		82	27.8	77	25.0	75	23.9	79	3	210		29.99				FM-15		30.00
30	0855	4		10.00		86	30.0			75	23.9	70	8	250						FM-15		29.99
30	0915	7	CLR:00	10.00		88	31.1	79	26.1	75	23.9	66	5	VRB		29.98				FM-15		29.99
30	0935	7	CLR:00	10.00		88	31.1	77	25.0	73	22.8	62	5	VRB		29.98				FM-15		29.99
30	0955	4		10.00		90	32.2			73	22.8	59	6	VRB						FM-15		29.99
30	1015	7	CLR:00	10.00		90	32.2	78	25.6	73	22.8	59	7	VRB		29.98				FM-15		29.99
30	1035	7	CLR:00	10.00		91	32.8	78	25.6	73	22.8	56	5	VRB	*	29.98				FM-15		29.99
30	1055	4		10.00		91	32.8			73	22.8	56	6	210	11					FM-15		29.99
30	1115	7	FEW:02 44 FEW:02 95	10.00		91	32.8	78	25.6	73	22.8	56	6	210		29.97				FM-15		29.98
30	1135	7	FEW:02 43 FEW:02 75 SCT:04 95	10.00		91	32.8	78	25.6	72	22.2	52	6	VRB	*	29.97				FM-15		29.98
30	1155	4		10.00		91	32.8			72	22.2	52	7	VRB						FM-15		29.98
30	1215	7	FEW:02 49	10.00		93	33.9	78	25.6	72	22.2	49	8	VRB		29.97				FM-15		29.98
30	1235	7	FEW:02 48 FEW:02 70 FEW:02 80	10.00		93	33.9	77	25.0	70	21.1	47	6	VRB		29.96				FM-15		29.97
30	1255	4		10.00		93	33.9			72	22.2	49	7	VRB	15					FM-15		29.97
30	1315	7	CLR:00	10.00		93	33.9	77	25.0	70	21.1	47	9	VRB		29.96				FM-15		29.97
30	1335	7	FEW:02 60 FEW:02 100	10.00		91	32.8	78	25.6	72	22.2	52	6	210	*	29.96				FM-15		29.97
30	1355	4		10.00		93	33.9			72	22.2	49	7	220						FM-15		29.96

30	1415	7	CLR:00	10.00		93	33.9	78	25.6	72	22.2	49	8	VRB		29.95				FM-15		29.96
30	1435	7	FEW:02 55	10.00		93	33.9	78	25.6	72	22.2	49	8	220	18	29.94				FM-15		29.95
30	1455	4		10.00		93	33.9			73	22.8	53	8	VRB	15					FM-15		29.95
30	1515	7	SCT:04 50 SCT:04 60	10.00		93	33.9	79	26.1	73	22.8	53	10	VRB		29.93				FM-15		29.94
30	1535	7	FEW:02 50	10.00		93	33.9	78	25.6	72	22.2	49	10	200	18	29.93				FM-15		29.94
30	1555	4		10.00		91	32.8			72	22.2	52	10	220	20					FM-15		29.94
30	1615	7	CLR:00	10.00		91	32.8	78	25.6	72	22.2	52	10	220		29.93				FM-15		29.94
30	1635	7	CLR:00	10.00		91	32.8	78	25.6	72	22.2	52	10	VRB		29.93				FM-15		29.94
30	1655	4		10.00		90	32.2			72	22.2	55	9	200	15					FM-15		29.94
30	1715	7	CLR:00	10.00		90	32.2	77	25.0	72	22.2	55	7	VRB	*	29.93				FM-15		29.94
30	1735	4		10.00		88	31.1			70	21.1	55	10	220	17					FM-15		29.94
30	1755	4		10.00		88	31.1			70	21.1	55	9	220	18					FM-15		29.95
30	1815	4		10.00		86	30.0			70	21.1	59	7	210	14					FM-15		29.95
30	1835	4		10.00		84	28.9			70	21.1	62	9	220	15					FM-15		29.96
30	1855	4		10.00		82	27.8			70	21.1	66	8	210						FM-15		29.97
30	1915	7	CLR:00	10.00		82	27.8	74	23.3	70	21.1	66	6	220		29.96				FM-15		29.97
30	1935	7	CLR:00	10.00		81	27.2	74	23.3	70	21.1	70	7	220		29.97				FM-15		29.98
30	1955	4		10.00		81	27.2			72	22.2	74	7	220						FM-15		29.98
30	2015	7	CLR:00	10.00		81	27.2	75	23.9	72	22.2	74	7	VRB		29.97				FM-15		29.98
30	2035	7	CLR:00	10.00		79	26.1	74	23.3	72	22.2	79	7	220	*	29.97				FM-15		29.98
30	2055	4		10.00		79	26.1			72	22.2	79	7	220						FM-15		29.99
30	2115	7	CLR:00	10.00		79	26.1	74	23.3	72	22.2	79	7	VRB		29.98				FM-15		29.99
30	2135	7	CLR:00	10.00		79	26.1	74	23.3	72	22.2	79	8	220		29.98				FM-15		29.99
30	2155	4		10.00		79	26.1			72	22.2	79	7	VRB						FM-15		29.99
30	2215	7	CLR:00	10.00		77	25.0	74	23.3	72	22.2	83	6	230		29.99				FM-15		30.00
30	2235	7	CLR:00	10.00		77	25.0	74	23.3	72	22.2	83	8	220	*	29.98				FM-15		29.99
30	2255	4		10.00		77	25.0			72	22.2	83	7	220						FM-15		30.00
30	2315	7	CLR:00	10.00		77	25.0	74	23.3	72	22.2	83	6	220		29.99				FM-15		30.00
30	2335	7	CLR:00	10.00		77	25.0	74	23.3	72	22.2	83	8	220		29.99				FM-15		30.00
30	2355	4		10.00		77	25.0			72	22.2	83	7	230						FM-15		30.00
31	0015	7	CLR:00	10.00		75	23.9	73	22.8	72	22.2	89	7	220		29.99				FM-15		30.00
31	0035	7	CLR:00	10.00		75	23.9	73	22.8	72	22.2	89	5	230		29.99				FM-15		30.00
31	0055	4		10.00		75	23.9			72	22.2	89	7	230						FM-15		30.00
31	0115	7	CLR:00	10.00		75	23.9	73	22.8	72	22.2	89	7	VRB		29.98				FM-15		29.99
31	0135	7	CLR:00	10.00		75	23.9	73	22.8	72	22.2	89	7	220		29.98				FM-15		29.99
31	0155	4		10.00		75	23.9			72	22.2	89	6	230						FM-15		29.99
31	0215	7	CLR:00	10.00		75	23.9	73	22.8	72	22.2	89	7	VRB		29.98				FM-15		29.99
31	0235	7	CLR:00	10.00		75	23.9	73	22.8	72	22.2	89	6	220		29.97				FM-15		29.98
31	0255	4		10.00		75	23.9			72	22.2	89	5	220						FM-15		29.98
31	0315	7	CLR:00	10.00		75	23.9	73	22.8	72	22.2	89	7	240		29.97				FM-15		29.98
31	0335	7	CLR:00	10.00		75	23.9	73	22.8	72	22.2	89	6	230		29.97				FM-15		29.98
31	0355	4		10.00		73	22.8			72	22.2	94	6	250						FM-15		29.99
31	0415	7	CLR:00	10.00		73	22.8	72	22.2	72	22.2	94	6	250		29.98				FM-15		29.99
31	0435	7	CLR:00	10.00		73	22.8	72	22.2	72	22.2	94	5	VRB		29.98				FM-15		29.99
31	0455	4		10.00		73	22.8			72	22.2	94	5	240						FM-15		29.99
31	0515	7	CLR:00	10.00		73	22.8	72	22.2	72	22.2	94	5	250		29.98				FM-15		29.99
31	0535	7	CLR:00	10.00		75	23.9	73	22.8	72	22.2	89	6	240		29.99				FM-15		30.00
31	0555	4		10.00		75	23.9			72	22.2	89	6	240						FM-15		30.00
31	0615	7	CLR:00	10.00		77	25.0	74	23.3	72	22.2	83	6	230		29.99				FM-15		30.00
31	0635	7	CLR:00	10.00		79	26.1	74	23.3	72	22.2	79	8	240		29.99				FM-15		30.00
31	0655	4		10.00		79	26.1			73	22.8	84	6	240						FM-15		30.00
31	0715	7	CLR:00	10.00		81	27.2	75	23.9	73	22.8	79	8	250		29.99				FM-15		30.00
31	0735	7	CLR:00	10.00		81	27.2	75	23.9	73	22.8	79	8	230		29.99				FM-15		30.00
31	0755	7	CLR:00	10.00		82	27.8	76	24.4	73	22.8	74	7	VRB		29.99				FM-15		30.00
31	0815	7	CLR:00	10.00		84	28.9	76	24.4	73	22.8	70	6	260		29.99				FM-15		30.00
31	0835	7	CLR:00	10.00		84	28.9	76	24.4	73	22.8	70	7	230		29.99				FM-15		30.00

31	0855	4		10.00		86	30.0			73	22.8	66	6	VRB						FM-15		30.01
31	0915	7	CLR:00	10.00		86	30.0	77	25.0	73	22.8	66	6	VRB	*	30.00				FM-15		30.01
31	0935	7	CLR:00	10.00		88	31.1	77	25.0	72	22.2	59	6	VRB	*	30.00				FM-15		30.01
31	0955	4		10.00		90	32.2			73	22.8	59	5	VRB						FM-15		30.01
31	1015	7	CLR:00	10.00		90	32.2	77	25.0	72	22.2	55	5	VRB	*	29.99				FM-15		30.00
31	1035	7	CLR:00	10.00		90	32.2	77	25.0	72	22.2	55	10	230		29.99				FM-15		30.00
31	1055	4		10.00		90	32.2			70	21.1	52	6	VRB	14					FM-15		30.00
31	1115	7	CLR:00	10.00		91	32.8	76	24.4	70	21.1	49	10	210		29.98				FM-15		29.99
31	1135	7	CLR:00	10.00		91	32.8	76	24.4	70	21.1	49	3	VRB	*	29.98				FM-15		29.99
31	1155	4		10.00		93	33.9			70	21.1	47	10	210	17					FM-15		29.99
31	1215	7	FEW:02 41 FEW:02 70 FEW:02 110	10.00		91	32.8	76	24.4	70	21.1	49	9	210		29.98				FM-15		29.99
31	1235	7	FEW:02 42 FEW:02 50 SCT:04 110	10.00		93	33.9	77	25.0	70	21.1	47	10	240		29.97				FM-15		29.98
31	1255	4		10.00		93	33.9			70	21.1	47	9	VRB	15					FM-15		29.97
31	1315	7	CLR:00	10.00		93	33.9	76	24.4	68	20.0	44	13	210	18	29.95				FM-15		29.96
31	1335	7	CLR:00	10.00		90	32.2	79	26.1	75	23.9	63	6	VRB	*	29.95				FM-15		29.96
31	1355	7	CLR:00	10.00		91	32.8	78	25.6	72	22.2	52	6	VRB	*	29.94				FM-15		29.95
31	1415	7	CLR:00	9.00		93	33.9	76	24.4	68	20.0	44	8	VRB	17	29.94				FM-15		29.95
31	1435	7	FEW:02 50 FEW:02 75	10.00		93	33.9	77	25.0	70	21.1	47	10	210		29.93				FM-15		29.94
31	1455	7	FEW:02 50 FEW:02 65 FEW:02 75	10.00		91	32.8	78	25.6	72	22.2	52	10	230	17	29.94				FM-15		29.95
31	1515	7	CLR:00	10.00	VCTS:7 ||	91	32.8	78	25.6	72	22.2	52	15	210		29.94				FM-15		29.95
31	1535	7	CLR:00	10.00	VCTS:7 ||	91	32.8	76	24.4	70	21.1	49	9	220	20	29.95				FM-15		29.96
31	1555	7	FEW:02 40 SCT:04 48	10.00		82	27.8	73	22.8	68	20.0	62	13	VRB	30	29.99				FM-15		30.00
31	1615	7	FEW:02 42 SCT:04 70 SCT:04 85	10.00		79	26.1	72	22.2	68	20.0	70	8	VRB	24	29.99				FM-15		30.00
31	1635	7	FEW:02 110	10.00		79	26.1	73	22.8	70	21.1	74	8	VRB	*	29.99				FM-15		30.00
31	1655	4		10.00		77	25.0			66	18.9	69	6	270	11					FM-15		30.00
31	1715	7	CLR:00	10.00		77	25.0	70	21.1	66	18.9	69	0	000		29.99				FM-15		30.00
31	1735	7	CLR:00	10.00		77	25.0	70	21.1	66	18.9	69	0	000		29.99				FM-15		30.00
31	1755	4		10.00		77	25.0			68	20.0	74	3	VRB						FM-15		30.01
31	1815	7	CLR:00	10.00		77	25.0	71	21.7	68	20.0	74	0	000		30.00				FM-15		30.01
31	1835	4		10.00		77	25.0			68	20.0	74	0	000						FM-15		30.01
31	1855	4		10.00		77	25.0			68	20.0	74	0	000						FM-15		30.02
31	1915	7	SCT:04 44 BKN:07 50 SCT:04 55	10.00		75	23.9	70	21.1	68	20.0	78	0	000		30.00				FM-15		30.01
31	1935	7	FEW:02 49	10.00		75	23.9	72	22.2	70	21.1	83	5	180		30.00				FM-15		30.01
31	1955	4		10.00		75	23.9			68	20.0	78	0	000						FM-15		30.01
31	2015	7	CLR:00	10.00		73	22.8	70	21.1	68	20.0	83	0	000		30.00				FM-15		30.01
31	2035	7	FEW:02 37	10.00		75	23.9	70	21.1	68	20.0	78	5	190		30.00				FM-15		30.01
31	2055	4		10.00		73	22.8			68	20.0	83	0	000						FM-15		30.00
31	2115	7	FEW:02 40	10.00		73	22.8	70	21.1	68	20.0	83	0	000		29.99				FM-15		30.00
31	2135	7	BKN:07 41	10.00		73	22.8	71	21.7	70	21.1	89	3	170		29.99				FM-15		30.00
31	2155	4		10.00		73	22.8			70	21.1	89	0	000						FM-15		30.00
31	2215	7	CLR:00	10.00		73	22.8	71	21.7	70	21.1	89	0	000		29.99				FM-15		30.00
31	2235	7	FEW:02 39	10.00		73	22.8	71	21.7	70	21.1	89	0	000		29.99				FM-15		30.00
31	2255	4		10.00		72	22.2			70	21.1	94	0	000						FM-15		30.00
31	2315	7	CLR:00	10.00		73	22.8	71	21.7	70	21.1	89	0	000		29.98				FM-15		29.99
31	2335	7	CLR:00	10.00		73	22.8	71	21.7	70	21.1	89	0	000		29.99				FM-15		30.00
31	2355	7	CLR:00	10.00		73	22.8	72	22.2	72	22.2	94	3	250		29.98				FM-15		29.99

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Local Climatological Data
Hourly Precipitation
July 2019

Generated on 01/06/2020

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 11 ft. Lat: 42.0983° N Lon: -70.6722° W

Station: **MARSHFIELD MUNICIPAL AIRPORT, MA US WBAN: 72225664774 (KGHG)**

Date	For Hour (LST) Ending at																							Date
	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	NOON	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	MID	
01	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	01
02	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	02
03	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	03
04	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	04
05	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	05
06	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0.29	0.13	0.03	0.01	M	M	M	06
07	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	07
08	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	08
09	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	09
10	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	10
11	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	11
12	0.02	0.02	0.65	0.48	0.74	0.10	0.25	0.02	M	0.12	M	M	M	M	M	M	0.01	M	M	M	M	M	0.01	M	12
13	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	13
14	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	14
15	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	15
16	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	16
17	M	M	M	M	M	M	M	M	M	M	0.03	M	M	M	M	M	M	0.53	0.07	0.02	M	M	M	M	17
18	M	0.01	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	18
19	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	19
20	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	20
21	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	21
22	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0.51	0.17	0.06	M	22
23	M	M	M	0.01	0.01	0.07	0.02	0.03	0.05	0.29	0.22	0.11	0.01	M	M	M	M	M	M	M	M	M	M	M	23
24	M	M	M	M	0.01	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	24
25	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	25
26	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	26
27	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	27
28	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	28
29	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	29
30	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	30
31	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	31

Maximum Short Duration Precipitation

Time Period (Minutes)	5	10	15	20	30	45	60	80	100	120	150	180
Precipitation (inches)												
Ending Date Time (yyyy-mm-dd hh:mi)												

Hourly, daily, and monthly totals on the Daily Summary page and the Hourly Precipitation Table are shown as reported by the instrumentation at the site. However, NWS does not edit hourly values for its ASOS sites, but may edit the daily and monthly totals for selected sites which will be reflected on the Daily Summary page.

T = Trace
s = Suspect
* = Erroneous
blank = No precipitation observed
M = Missing

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Local Climatological Data
Hourly Observations
October 2019

Generated on 01/06/2020

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 11 ft. Lat: 42.0983° N Lon: -70.6722° W

Station: **MARSHFIELD MUNICIPAL AIRPORT, MA US WBAN: 72225664774 (KGHG)**

Date	Time (LST)	Station Type	Sky Conditions	Visibility	Weather Type (see documentation)	Dry Bulb Temp		Wet Bulb Temp		Dew Point Temp		Rel Hum %	Wind Speed (MPH)	Wind Dir (Deg)	Wind Gusts (MPH)	Station Press (inHg)	Press. Tend	Net 3-Hr Change (inHg)	Sea Level Press. (inHg)	Report Type	Precip Total (in)	Altimeter Setting (inHg)
					AU | AW | MW	(F)	(C)	(F)	(C)	(F)	(C)											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
01	0015	7	BKN:07 70	10.00		55	12.8	52	11.1	50	10.0	82	3	180		30.20				FM-15		30.21
01	0035	7	SCT:04 70	10.00		55	12.8	52	11.1	50	10.0	82	3	210		30.21				FM-15		30.22
01	0055	7	BKN:07 65 BKN:07 75	10.00		55	12.8	52	11.1	50	10.0	82	0	000		30.19				FM-15		30.20
01	0115	7	BKN:07 65 OVC:08 75	10.00		57	13.9	53	11.7	50	10.0	77	0	000		30.18				FM-15		30.19
01	0135	7	OVC:08 65	10.00		57	13.9	53	11.7	50	10.0	77	6	190		30.17				FM-15		30.18
01	0155	7	OVC:08 65	10.00		57	13.9	53	11.7	50	10.0	77	5	190		30.16				FM-15		30.17
01	0215	7	FEW:02 55 OVC:08 65	10.00		57	13.9	53	11.7	50	10.0	77	0	000		30.16				FM-15		30.17
01	0235	7	BKN:07 50 OVC:08 65	10.00		57	13.9	53	11.7	50	10.0	77	0	000		30.16				FM-15		30.17
01	0255	7	OVC:08 50	10.00		55	12.8	53	11.7	52	11.1	88	5	210		30.16				FM-15		30.17
01	0315	7	FEW:02 37 BKN:07 50 OVC:08 65	10.00		57	13.9	54	12.2	52	11.1	82	0	000		30.15				FM-15		30.16
01	0335	7	BKN:07 47 OVC:08 65	10.00		57	13.9	54	12.2	52	11.1	82	3	180		30.14				FM-15		30.15
01	0355	7	OVC:08 44	10.00		57	13.9	54	12.2	52	11.1	82	5	200		30.14				FM-15		30.15
01	0415	7	OVC:08 42	10.00		57	13.9	54	12.2	52	11.1	82	3	200		30.13				FM-15		30.14
01	0435	7	OVC:08 39	10.00		57	13.9	54	12.2	52	11.1	82	0	000		30.13				FM-15		30.14
01	0455	7	OVC:08 38	10.00		57	13.9	55	12.8	54	12.2	88	0	000		30.13				FM-15		30.14
01	0515	7	OVC:08 36	10.00		57	13.9	55	12.8	54	12.2	88	0	000		30.13				FM-15		30.14
01	0535	7	OVC:08 36	10.00		57	13.9	55	12.8	54	12.2	88	5	190		30.13				FM-15		30.14
01	0555	7	FEW:02 19 FEW:02 29 OVC:08 36	3.00	BR:1 ||	57	13.9	55	12.8	54	12.2	88	6	190		30.13				FM-15		30.14
01	0615	7	FEW:02 20 FEW:02 29 OVC:08 35	7.00		57	13.9	55	12.8	54	12.2	88	0	000		30.13				FM-15		30.14
01	0635	7	FEW:02 21 SCT:04 29 OVC:08 35	2.50	BR:1 ||	57	13.9	56	13.3	55	12.8	94	6	160		30.12				FM-15		30.13
01	0655	7	FEW:02 20 OVC:08 35	10.00		57	13.9	56	13.3	55	12.8	94	5	170		30.12				FM-15	0.02	30.13
01	0715	7	BKN:07 33	10.00		57	13.9	56	13.3	55	12.8	94	0	000		30.12				FM-15		30.13
01	0735	7	OVC:08 33	10.00		57	13.9	57	13.9	57	13.9	100	0	000		30.12				FM-15		30.13
01	0755	7	BKN:07 33	10.00		59	15.0	58	14.4	57	13.9	94	5	150		30.12				FM-15		30.13
01	0815	7	OVC:08 32	3.00	BR:1 ||	59	15.0	58	14.4	57	13.9	94	6	170		30.11				FM-15		30.12
01	0835	7	OVC:08 30	10.00		59	15.0	58	14.4	57	13.9	94	0	000		30.10				FM-15		30.11
01	0855	7	OVC:08 27	10.00		59	15.0	59	15.0	59	15.0	100	5	VRB		30.10				FM-15		30.11
01	0915	7	OVC:08 25	10.00		61	16.1	60	15.6	59	15.0	94	7	180		30.09				FM-15		30.10
01	0935	7	BKN:07 24 OVC:08 31	9.00		61	16.1	60	15.6	59	15.0	94	7	180		30.08				FM-15		30.09
01	0955	7	BKN:07 24 BKN:07 30 OVC:08 49	10.00		63	17.2	61	16.1	59	15.0	88	7	VRB	*	30.07				FM-15		30.08
01	1015	7	BKN:07 23 BKN:07 39 OVC:08 47	6.00	BR:1 ||	63	17.2	61	16.1	59	15.0	88	10	200		30.06				FM-15		30.07

01	1035	7	BKN:07 24 OVC:08 44	10.00		63	17.2	62	16.7	61	16.1	94	8	180		30.05				FM-15		30.06
01	1055	7	OVC:08 22	10.00		63	17.2	62	16.7	61	16.1	94	8	VRB		30.04				FM-15		30.05
01	1115	7	OVC:08 22	10.00		64	17.8	62	16.7	61	16.1	88	7	200		30.03				FM-15		30.04
01	1135	7	OVC:08 21	10.00		66	18.9	63	17.2	61	16.1	83	8	210		30.03				FM-15		30.04
01	1155	7	OVC:08 21	10.00		66	18.9	63	17.2	61	16.1	83	8	200	*	30.01				FM-15		30.02
01	1215	7	BKN:07 21 BKN:07 28	10.00		68	20.0	64	17.8	61	16.1	78	8	VRB	18	30.00				FM-15		30.01
01	1235	7	BKN:07 20 BKN:07 28	10.00		68	20.0	65	18.3	63	17.2	83	8	VRB	20	30.00				FM-15		30.01
01	1255	7	OVC:08 19	10.00		68	20.0	65	18.3	63	17.2	83	9	VRB	17	29.99				FM-15		30.00
01	1315	7	OVC:08 19	10.00		68	20.0	65	18.3	63	17.2	83	10	VRB		29.98				FM-15		29.99
01	1335	7	OVC:08 18	10.00		70	21.1	66	18.9	63	17.2	78	11	200	17	29.96				FM-15		29.97
01	1355	7	OVC:08 17	10.00		70	21.1	66	18.9	63	17.2	78	10	210	16	29.95				FM-15		29.96
01	1415	7	OVC:08 17	10.00		70	21.1	66	18.9	63	17.2	78	13	210	21	29.94				FM-15		29.95
01	1435	7	OVC:08 17	10.00		70	21.1	66	18.9	63	17.2	78	13	210	21	29.94				FM-15		29.95
01	1455	7		10.00		70	21.1	66	18.9	63	17.2	78	10	220	20	29.93				FM-15	0.01	29.94
01	1515	7	OVC:08 17	10.00		70	21.1	66	18.9	63	17.2	78	10	VRB		29.93				FM-15		29.94
01	1535	7	OVC:08 17	10.00		70	21.1	66	18.9	63	17.2	78	10	210		29.93				FM-15		29.94
01	1555	7	OVC:08 17	10.00		70	21.1	66	18.9	64	17.8	83	8	220	16	29.93				FM-15		29.94
01	1615	7	OVC:08 18	10.00		70	21.1	66	18.9	64	17.8	83	11	220		29.91				FM-15		29.92
01	1635	7	BKN:07 18	10.00		70	21.1	66	18.9	64	17.8	83	9	VRB	*	29.91				FM-15		29.92
01	1655	7	FEW:02 18	10.00		68	20.0	66	18.9	64	17.8	88	13	210	20	29.90				FM-15		29.91
01	1715	7	CLR:00	10.00		68	20.0	66	18.9	64	17.8	88	8	220	*	29.90				FM-15		29.91
01	1735	7	CLR:00	10.00		68	20.0	66	18.9	64	17.8	88	10	210	22	29.88				FM-15		29.89
01	1755	7	CLR:00	10.00		68	20.0	66	18.9	64	17.8	88	11	VRB		29.89				FM-15		29.90
01	1815	7	CLR:00	10.00		68	20.0	66	18.9	64	17.8	88	11	220		29.89				FM-15		29.90
01	1835	7	CLR:00	10.00		68	20.0	66	18.9	64	17.8	88	10	VRB	18	29.88				FM-15		29.89
01	1855	7	CLR:00	10.00		68	20.0	66	18.9	64	17.8	88	11	VRB		29.86				FM-15		29.87
01	1915	7	CLR:00	10.00		68	20.0	66	18.9	64	17.8	88	13	220	18	29.87				FM-15		29.88
01	1935	7	CLR:00	10.00		68	20.0	66	18.9	64	17.8	88	10	VRB	17	29.87				FM-15		29.88
01	1955	7	CLR:00	10.00		68	20.0	66	18.9	64	17.8	88	8	VRB	17	29.86				FM-15		29.87
01	2015	7	CLR:00	10.00		68	20.0	66	18.9	64	17.8	88	11	220	18	29.85				FM-15		29.86
01	2035	7	CLR:00	10.00		68	20.0	66	18.9	64	17.8	88	13	220	18	29.84				FM-15		29.85
01	2055	7	CLR:00	10.00		68	20.0	66	18.9	64	17.8	88	10	230	21	29.83				FM-15		29.84
01	2115	7	CLR:00	10.00		68	20.0	67	19.4	66	18.9	94	11	220	22	29.83				FM-15		29.84
01	2135	7	CLR:00	10.00		68	20.0	67	19.4	66	18.9	94	10	VRB	21	29.83				FM-15		29.84
01	2155	7	CLR:00	10.00		68	20.0	67	19.4	66	18.9	94	13	220	21	29.81				FM-15		29.82
01	2215	7	CLR:00	10.00		68	20.0	67	19.4	66	18.9	94	9	VRB	17	29.81				FM-15		29.82
01	2235	7	CLR:00	10.00		68	20.0	67	19.4	66	18.9	94	11	230	21	29.80				FM-15		29.81
01	2255	7	CLR:00	10.00		68	20.0	67	19.4	66	18.9	94	9	230	21	29.78				FM-15		29.79
01	2315	7	CLR:00	10.00		68	20.0	67	19.4	66	18.9	94	8	230	16	29.78				FM-15		29.79
01	2335	7	CLR:00	10.00		68	20.0	67	19.4	66	18.9	94	10	VRB	21	29.76				FM-15		29.77
01	2355	7	CLR:00	10.00		70	21.1	67	19.4	66	18.9	88	7	VRB	17	29.75				FM-15		29.76
02	0015	7	CLR:00	10.00		70	21.1	67	19.4	66	18.9	88	11	VRB	20	29.75				FM-15		29.76
02	0035	7	CLR:00	10.00		70	21.1	67	19.4	66	18.9	88	11	VRB	18	29.74				FM-15		29.75
02	0055	7	CLR:00	10.00		70	21.1	69	20.6	68	20.0	94	10	VRB		29.73				FM-15		29.74
02	0115	7	CLR:00	10.00		70	21.1	69	20.6	68	20.0	94	13	240	25	29.72				FM-15		29.73
02	0135	7	CLR:00	10.00		72	22.2	69	20.6	68	20.0	88	11	VRB	20	29.72				FM-15		29.73
02	0155	7	CLR:00	10.00		72	22.2	69	20.6	68	20.0	88	11	240	21	29.73				FM-15		29.74
02	0215	7	CLR:00	10.00		72	22.2	69	20.6	68	20.0	88	9	240	18	29.72				FM-15		29.73
02	0235	7	CLR:00	10.00		72	22.2	69	20.6	68	20.0	88	9	VRB	17	29.72				FM-15		29.73
02	0255	7	CLR:00	10.00		72	22.2	69	20.6	68	20.0	88	9	VRB	18	29.72				FM-15		29.73
02	0315	7	CLR:00	10.00		72	22.2	69	20.6	68	20.0	88	10	240		29.72				FM-15		29.73
02	0335	7	CLR:00	10.00		72	22.2	69	20.6	68	20.0	88	8	VRB	16	29.71				FM-15		29.72
02	0355	7	CLR:00	10.00		72	22.2	69	20.6	68	20.0	88	9	VRB	16	29.71				FM-15		29.72
02	0415	7	CLR:00	10.00		72	22.2	69	20.6	68	20.0	88	9	VRB	17	29.72				FM-15		29.73

02	0435	7	CLR:00	10.00		72	22.2	69	20.6	68	20.0	88	10	VRB	17	29.72				FM-15		29.73
02	0455	7	CLR:00	10.00		72	22.2	69	20.6	68	20.0	88	10	VRB		29.72				FM-15		29.73
02	0515	7	CLR:00	10.00		72	22.2	69	20.6	68	20.0	88	8	240		29.73				FM-15		29.74
02	0535	7	CLR:00	10.00		72	22.2	69	20.6	68	20.0	88	7	VRB	*	29.73				FM-15		29.74
02	0555	7	CLR:00	10.00		72	22.2	69	20.6	68	20.0	88	7	250		29.73				FM-15		29.74
02	0615	7	FEW:02 90	10.00		72	22.2	69	20.6	68	20.0	88	9	240		29.74				FM-15		29.75
02	0635	7	FEW:02 85 FEW:02 110	10.00		72	22.2	69	20.6	68	20.0	88	6	VRB	*	29.75				FM-15		29.76
02	0655	7	CLR:00	10.00		73	22.8	70	21.1	68	20.0	83	7	VRB	*	29.74				FM-15		29.75
02	0715	7	CLR:00	10.00		73	22.8	70	21.1	68	20.0	83	7	VRB	*	29.75				FM-15		29.76
02	0735	7	CLR:00	10.00		73	22.8	70	21.1	68	20.0	83	6	VRB	*	29.76				FM-15		29.77
02	0755	7	CLR:00	10.00		75	23.9	72	22.2	70	21.1	83	6	VRB	*	29.77				FM-15		29.78
02	0815	7	FEW:02 33 FEW:02 110	10.00		75	23.9	72	22.2	70	21.1	83	5	VRB	*	29.76				FM-15		29.77
02	0835	7	FEW:02 33 FEW:02 110	10.00		77	25.0	72	22.2	70	21.1	79	5	VRB		29.76				FM-15		29.77
02	0855	7	FEW:02 27	10.00		77	25.0	72	22.2	70	21.1	79	6	290		29.76				FM-15		29.77
02	0915	7	FEW:02 35	10.00		77	25.0	72	22.2	70	21.1	79	5	VRB		29.77				FM-15		29.78
02	0935	7	FEW:02 35	10.00		77	25.0	72	22.2	70	21.1	79	5	310		29.76				FM-15		29.77
02	0955	6	SCT:04 29 SCT:04 90	10.00		77	25.0	72	22.2	70	21.1	79	0	000		29.76				FM-15		29.77
02	1015	6	BKN:07 27 BKN:07 90	10.00		77	25.0	72	22.2	70	21.1	79	0	000		29.77				FM-15		29.78
02	1035	6	BKN:07 26 BKN:07 31	9.00		77	25.0	71	21.7	68	20.0	74	0	000		29.75				FM-15		29.76
02	1055	6	FEW:02 27 SCT:04 31 SCT:04 44	10.00		77	25.0	72	22.2	70	21.1	79	0	000		29.76				FM-15		29.77
02	1115	7	FEW:02 43 FEW:02 80 FEW:02 100	10.00		75	23.9	70	21.1	68	20.0	78	5	VRB		29.76				FM-15		29.77
02	1135	6	FEW:02 24 FEW:02 43 SCT:04 55	10.00		73	22.8	69	20.6	66	18.9	78	5	VRB		29.76				FM-15		29.77
02	1155	6	FEW:02 23 FEW:02 35 SCT:04 55	9.00	-DZ:01 |DZ |DZ	73	22.8	70	21.1	68	20.0	83	3	VRB		29.74				FM-15		29.75
02	1215	6	CLR:00	10.00		75	23.9	70	21.1	68	20.0	78	7	050		29.74				FM-15		29.75
02	1235	6	FEW:02 21 BKN:07 28 BKN:07 120	10.00		73	22.8	67	19.4	64	17.8	74	5	VRB	*	29.75				FM-15		29.76
02	1255	6	BKN:07 21 OVC:08 27	10.00		70	21.1	66	18.9	64	17.8	83	13	050	21	29.76				FM-15		29.77
02	1315	6	OVC:08 24	10.00		68	20.0	66	18.9	64	17.8	88	9	050		29.76				FM-15		29.77
02	1335	7	OVC:08 26	10.00		68	20.0	66	18.9	64	17.8	88	13	060		29.78				FM-15		29.79
02	1355	7	OVC:08 26	10.00		66	18.9	64	17.8	63	17.2	88	15	060		29.79				FM-15		29.80
02	1415	7	FEW:02 1 FEW:02 20 OVC:08 28	3.00	-RA:02 |RA |RA	64	17.8	62	16.7	61	16.1	88	13	060		29.79				FM-15		29.80
02	1435	7	SCT:04 1 BKN:07 19 OVC:08 29	1.25	RA:02 |RA |RA	63	17.2	63	17.2	63	17.2	100	11	060	18	29.79				FM-15		29.80
02	1455	7	BKN:07 3 BKN:07 9 OVC:08 17	1.25	RA:02 |RA |RA	63	17.2	63	17.2	63	17.2	100	10	070		29.79				FM-15	0.13	29.80
02	1515	7	BKN:07 4 OVC:08 10	1.00	RA:02 |RA |RA	63	17.2	63	17.2	63	17.2	100	7	080	16	29.81				FM-15		29.82
02	1535	7	BKN:07 4 OVC:08 10	2.50	-DZ:01 |DZ |DZ	63	17.2	63	17.2	63	17.2	100	8	070		29.82				FM-15		29.83
02	1555	7	OVC:08 4	7.00		63	17.2	63	17.2	63	17.2	100	9	060		29.83				FM-15	0.08	29.84

02	1615	7	BKN:07 4 BKN:07 8 OVC:08 13	1.50	-RA:02 |RA |RA	63	17.2	63	17.2	63	17.2	100	8	060		29.84				FM-15		29.85
02	1635	7	BKN:07 5 BKN:07 9 OVC:08 13	10.00		63	17.2	63	17.2	63	17.2	100	9	060		29.85				FM-15		29.86
02	1655	7	OVC:08 4	5.00	BR:1 ||	63	17.2	63	17.2	63	17.2	100	11	070	17	29.86				FM-15	0.01	29.87
02	1715	7	OVC:08 5	4.00	-RA:02 |RA |RA	63	17.2	63	17.2	63	17.2	100	11	060		29.87				FM-15		29.88
02	1735	7	BKN:07 5 OVC:08 9	10.00		61	16.1	61	16.1	61	16.1	100	11	060	18	29.88				FM-15		29.89
02	1755	7	OVC:08 7	10.00		61	16.1	61	16.1	61	16.1	100	11	060	18	29.89				FM-15	0.01	29.90
02	1815	7	FEW:02 1 BKN:07 8 OVC:08 13	1.25	BR:1 ||	61	16.1	61	16.1	61	16.1	100	14	060	21	29.90				FM-15		29.91
02	1835	7	FEW:02 8 SCT:04 12 OVC:08 19	9.00		61	16.1	61	16.1	61	16.1	100	13	060	21	29.90				FM-15		29.91
02	1855	7	BKN:07 10 OVC:08 19	10.00		61	16.1	60	15.6	59	15.0	94	11	050	17	29.92				FM-15		29.93
02	1915	7	BKN:07 10 OVC:08 16	10.00		61	16.1	60	15.6	59	15.0	94	17	060		29.93				FM-15		29.94
02	1935	7	OVC:08 13	10.00		59	15.0	58	14.4	57	13.9	94	14	050	24	29.95				FM-15		29.96
02	1955	7	OVC:08 14	10.00		59	15.0	57	13.9	55	12.8	88	16	060	23	29.97				FM-15		29.98
02	2015	7	OVC:08 17	10.00		59	15.0	56	13.3	54	12.2	82	15	050	24	29.98				FM-15		29.99
02	2035	7	OVC:08 18	10.00		59	15.0	56	13.3	54	12.2	82	11	VRB	23	30.00				FM-15		30.01
02	2055	7	OVC:08 20	10.00		59	15.0	55	12.8	52	11.1	77	11	040	22	30.00				FM-15		30.01
02	2115	7	OVC:08 24	10.00		59	15.0	54	12.2	50	10.0	72	10	VRB	21	30.01				FM-15		30.02
02	2135	7		10.00		59	15.0	54	12.2	50	10.0	72	9	VRB	17	30.01				FM-15		30.02
02	2155	7	OVC:08 26	10.00		59	15.0	54	12.2	50	10.0	72	11	050	17	30.03				FM-15		30.04
02	2215	7	OVC:08 25	10.00		57	13.9	52	11.1	48	8.9	72	15	050	22	30.03				FM-15		30.04
02	2235	7	OVC:08 29	10.00		57	13.9	51	10.6	46	7.8	67	8	040	18	30.04				FM-15		30.05
02	2255	7	BKN:07 30 OVC:08 34	10.00		57	13.9	51	10.6	46	7.8	67	9	VRB	18	30.05				FM-15		30.06
02	2315	7	BKN:07 28 OVC:08 33	10.00		57	13.9	51	10.6	46	7.8	67	9	VRB	18	30.06				FM-15		30.07
02	2335	7	SCT:04 28 OVC:08 34	10.00		55	12.8	49	9.4	43	6.1	63	10	VRB	21	30.06				FM-15		30.07
02	2355	7	OVC:08 35	10.00		55	12.8	49	9.4	43	6.1	63	13	VRB	21	30.07				FM-15		30.08

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Local Climatological Data
Hourly Precipitation
October 2019

Generated on 01/06/2020

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 11 ft. Lat: 42.0983° N Lon: -70.6722° W

Station: **MARSHFIELD MUNICIPAL AIRPORT, MA US WBAN: 72225664774 (KGHG)**

Date	For Hour (LST) Ending at																							Date
	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	NOON	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	MID	
01	M	M	M	M	M	M	0.02	M	M	M	M	M	M	M	0.01	M	M	M	M	M	M	M	M	M	01
02	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0.13	0.08	0.01	0.01	M	M	M	M	M	M	02
03	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0.01	0.01	03
04	M	M	0.03	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	04
05	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	05
06	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	06
07	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0.12	0.06	0.06	07
08	0.04	0.02	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	08
09	M	M	M	M	M	0.02	0.01	0.01	M	M	M	M	0.03	0.06	0.12	0.09	0.07	M	M	M	M	M	M	M	09
10	M	M	M	M	M	M	0.02	0.02	0.03	0.03	0.01	M	M	M	M	M	M	M	M	M	M	M	M	M	10
11	M	M	M	M	M	M	0.01	M	M	0.01	0.08	0.03	0.05	0.05	0.04	M	M	0.01	0.01	0.05	0.02	0.02	0.02	0.01	11
12	M	M	M	M	M	0.01	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	12
13	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	13
14	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	14
15	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	15
16	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0.03	0.05	0.22	0.44	16
17	0.46	M	M	M	M	M	M	M	M	M	M	M	M	0.95	M	M	M	M	M	M	M	M	M	M	17
18	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	18
19	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	19
20	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	20
21	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	21
22	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	22
23	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	23
24	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	24
25	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	25
26	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	26
27	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	27
28	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	28
29	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	29
30	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	30
31	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	31

Maximum Short Duration Precipitation

Time Period (Minutes)	5	10	15	20	30	45	60	80	100	120	150	180
Precipitation (inches)												
Ending Date Time (yyyy-mm-dd hh:mi)												

Hourly, daily, and monthly totals on the Daily Summary page and the Hourly Precipitation Table are shown as reported by the instrumentation at the site. However, NWS does not edit hourly values for its ASOS sites, but may edit the daily and monthly totals for selected sites which will be reflected on the Daily Summary page.

T = Trace
s = Suspect
* = Erroneous
blank = No precipitation observed
M = Missing

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Local Climatological Data
Hourly Observations
December 2019

Generated on 01/06/2020

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 11 ft. Lat: 42.0983° N Lon: -70.6722° W

Station: **MARSHFIELD MUNICIPAL AIRPORT, MA US WBAN: 72225664774 (KGHG)**

Date	Time (LST)	Station Type	Sky Conditions	Visibility	Weather Type (see documentation)	Dry Bulb Temp		Wet Bulb Temp		Dew Point Temp		Rel Hum %	Wind Speed (MPH)	Wind Dir (Deg)	Wind Gusts (MPH)	Station Press (inHg)	Press. Tend	Net 3-Hr Change (inHg)	Sea Level Press. (inHg)	Report Type	Precip Total (in)	Altimeter Setting (inHg)
					AU | AW | MW	(F)	(C)	(F)	(C)	(F)	(C)											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
05	0015	7	CLR:00	10.00		34	1.1	33	0.6	32	0.0	93	5	250		29.46				FM-15		29.47
05	0035	7	CLR:00	10.00		34	1.1	33	0.6	32	0.0	93	5	250		29.45				FM-15		29.46
05	0055	7	CLR:00	10.00		34	1.1	33	0.6	32	0.0	93	5	240		29.46				FM-15		29.47
05	0115	7	CLR:00	10.00		34	1.1	33	0.6	32	0.0	93	6	240		29.46				FM-15		29.47
05	0135	7	CLR:00	10.00		34	1.1	33	0.6	32	0.0	93	5	250		29.46				FM-15		29.47
05	0155	7	CLR:00	10.00		34	1.1	33	0.6	32	0.0	93	5	VRB		29.47				FM-15		29.48
05	0215	7	CLR:00	10.00		32	0.0	31	-0.6	30	-1.1	93	5	250		29.47				FM-15		29.48
05	0235	7	CLR:00	10.00		32	0.0	31	-0.6	30	-1.1	93	5	240		29.47				FM-15		29.48
05	0255	7	FEW:02 70	10.00		32	0.0	31	-0.6	30	-1.1	93	3	250		29.47				FM-15		29.48
05	0315	7	BKN:07 70	10.00		32	0.0	32	0.0	32	0.0	100	3	VRB		29.47				FM-15		29.48
05	0335	7	FEW:02 70	10.00		32	0.0	31	-0.6	30	-1.1	93	6	250		29.47				FM-15		29.48
05	0355	7	CLR:00	10.00		32	0.0	31	-0.6	30	-1.1	93	5	250		29.48				FM-15		29.49
05	0415	7	CLR:00	10.00		32	0.0	31	-0.6	30	-1.1	93	5	250		29.48				FM-15		29.49
05	0435	7	CLR:00	10.00		32	0.0	32	0.0	32	0.0	100	5	VRB		29.49				FM-15		29.50
05	0455	7	CLR:00	10.00		32	0.0	31	-0.6	30	-1.1	93	6	260		29.49				FM-15		29.50
05	0515	7	CLR:00	10.00		32	0.0	31	-0.6	30	-1.1	93	6	250		29.50				FM-15		29.51
05	0535	7	CLR:00	10.00		32	0.0	31	-0.6	30	-1.1	93	5	VRB		29.51				FM-15		29.52
05	0555	7	CLR:00	10.00		32	0.0	31	-0.6	30	-1.1	93	3	260		29.51				FM-15		29.52
05	0615	7	CLR:00	10.00		32	0.0	31	-0.6	30	-1.1	93	6	260		29.52				FM-15		29.53
05	0635	7	CLR:00	10.00		32	0.0	31	-0.6	30	-1.1	93	6	260		29.53				FM-15		29.54
05	0655	7	CLR:00	10.00		32	0.0	31	-0.6	30	-1.1	93	6	VRB		29.54				FM-15		29.55
05	0715	7	CLR:00	10.00		32	0.0	31	-0.6	30	-1.1	93	3	VRB		29.54				FM-15		29.55
05	0735	7	CLR:00	10.00		32	0.0	31	-0.6	30	-1.1	93	5	250		29.55				FM-15		29.56
05	0755	7	CLR:00	10.00		34	1.1	33	0.6	32	0.0	93	5	VRB		29.56				FM-15		29.57
05	0815	7	CLR:00	10.00		34	1.1	32	0.0	30	-1.1	87	6	240		29.56				FM-15		29.57
05	0835	7	CLR:00	8.00		36	2.2	34	1.1	32	0.0	87	6	VRB	*	29.57				FM-15		29.58
05	0855	7	CLR:00	10.00		36	2.2	34	1.1	30	-1.1	81	6	VRB	*	29.57				FM-15		29.58
05	0915	7	CLR:00	10.00		36	2.2	34	1.1	32	0.0	87	7	260		29.57				FM-15		29.58
05	0935	7	CLR:00	10.00		37	2.8	35	1.7	32	0.0	81	8	VRB	16	29.58				FM-15		29.59
05	0955	7	CLR:00	10.00		39	3.9	36	2.2	32	0.0	75	8	VRB	*	29.58				FM-15		29.59
05	1015	7	CLR:00	10.00		41	5.0	37	2.8	32	0.0	70	11	VRB	18	29.58				FM-15		29.59
05	1035	7	CLR:00	10.00		41	5.0	37	2.8	30	-1.1	66	10	250		29.58				FM-15		29.59
05	1055	7	CLR:00	10.00		41	5.0	37	2.8	30	-1.1	66	8	VRB	18	29.58				FM-15		29.59
05	1115	7	CLR:00	10.00		43	6.1	38	3.3	30	-1.1	61	8	VRB	17	29.58				FM-15		29.59
05	1135	7	CLR:00	10.00		43	6.1	38	3.3	30	-1.1	61	11	VRB		29.58				FM-15		29.59
05	1155	7	CLR:00	10.00		45	7.2	39	3.9	30	-1.1	57	10	VRB	20	29.58				FM-15		29.59
05	1215	7	CLR:00	10.00		43	6.1	38	3.3	30	-1.1	61	9	VRB	17	29.59				FM-15		29.60
05	1235	7	CLR:00	10.00		45	7.2	39	3.9	30	-1.1	57	11	VRB	17	29.58				FM-15		29.59
05	1255	7	CLR:00	10.00		45	7.2	39	3.9	30	-1.1	57	8	VRB	17	29.59				FM-15		29.60
05	1315	7	CLR:00	10.00		45	7.2	39	3.9	30	-1.1	57	10	VRB	20	29.59				FM-15		29.60
05	1335	7	FEW:02 39	10.00		43	6.1	37	2.8	28	-2.2	57	8	VRB	18	29.60				FM-15		29.61
05	1355	6	BKN:07 43	10.00		43	6.1	37	2.8	28	-2.2	57	9	300	16	29.61				FM-15		29.62
05	1415	7	OVC:08 48	10.00		43	6.1	37	2.8	28	-2.2	57	8	VRB	*	29.62				FM-15		29.63
05	1435	7	OVC:08 50	10.00		43	6.1	37	2.8	27	-2.8	53	11	VRB	21	29.63				FM-15		29.64
05	1455	7	OVC:08 50	10.00		43	6.1	37	2.8	27	-2.8	53	7	VRB	16	29.64				FM-15		29.65
05	1515	7	OVC:08 50	10.00		43	6.1	37	2.8	27	-2.8	53	8	280		29.65				FM-15		29.66
05	1535	7	OVC:08 55	10.00		41	5.0	35	1.7	27	-2.8	57	8	VRB		29.67				FM-15		29.68

05	1555	7	OVC:08 55	10.00		41	5.0	35	1.7	27	-2.8	57	7	280		29.68				FM-15		29.69
05	1615	7	OVC:08 55	10.00		41	5.0	35	1.7	27	-2.8	57	7	VRB	*	29.69				FM-15		29.70
05	1635	7	OVC:08 60	10.00		41	5.0	35	1.7	27	-2.8	57	8	VRB	16	29.70				FM-15		29.71
05	1655	7	OVC:08 60	10.00		39	3.9	34	1.1	27	-2.8	61	7	VRB		29.72				FM-15		29.73
05	1715	7	OVC:08 60	10.00		39	3.9	34	1.1	27	-2.8	61	9	280	18	29.74				FM-15		29.75
05	1735	7	OVC:08 60	10.00		39	3.9	34	1.1	25	-3.9	56	9	VRB	17	29.75				FM-15		29.76
05	1755	7	OVC:08 65	10.00		39	3.9	32	0.0	21	-6.1	48	6	VRB	16	29.76				FM-15		29.77
05	1815	7	OVC:08 65	10.00		39	3.9	32	0.0	21	-6.1	48	8	VRB	16	29.78				FM-15		29.79
05	1835	7	OVC:08 65	10.00		39	3.9	32	0.0	21	-6.1	48	9	VRB	16	29.78				FM-15		29.79
05	1855	7	BKN:07 70	10.00		37	2.8	31	-0.6	21	-6.1	52	10	VRB	18	29.79				FM-15		29.80
05	1915	7	SCT:04 75	10.00		37	2.8	31	-0.6	19	-7.2	48	11	VRB	17	29.80				FM-15		29.81
05	1935	7	FEW:02 75	10.00		36	2.2	30	-1.1	19	-7.2	52	8	270	20	29.81				FM-15		29.82
05	1955	7	CLR:00	10.00		36	2.2	30	-1.1	19	-7.2	52	8	VRB	16	29.82				FM-15		29.83
05	2015	7	CLR:00	10.00		36	2.2	30	-1.1	19	-7.2	52	8	VRB	*	29.83				FM-15		29.84
05	2035	7	CLR:00	10.00		34	1.1	29	-1.7	19	-7.2	56	6	VRB	16	29.84				FM-15		29.85
05	2055	7	CLR:00	10.00		34	1.1	29	-1.7	19	-7.2	56	10	VRB	17	29.84				FM-15		29.85
05	2115	7	CLR:00	10.00		34	1.1	29	-1.7	19	-7.2	56	10	VRB		29.85				FM-15		29.86
05	2135	7	CLR:00	10.00		34	1.1	29	-1.7	19	-7.2	56	9	VRB	17	29.86				FM-15		29.87
05	2155	7	CLR:00	10.00		34	1.1	29	-1.7	19	-7.2	56	8	VRB	18	29.88				FM-15		29.89
05	2215	7	CLR:00	10.00		34	1.1	29	-1.7	18	-7.8	51	9	VRB		29.88				FM-15		29.89
05	2235	7	CLR:00	10.00		34	1.1	29	-1.7	19	-7.2	56	8	VRB	16	29.89				FM-15		29.90
05	2255	7	CLR:00	10.00		32	0.0	28	-2.2	19	-7.2	60	10	VRB	17	29.90				FM-15		29.91
05	2315	7	CLR:00	10.00		32	0.0	28	-2.2	19	-7.2	60	8	VRB	*	29.92				FM-15		29.93
05	2335	7	CLR:00	10.00		32	0.0	28	-2.2	19	-7.2	60	5	VRB	*	29.93				FM-15		29.94
05	2355	7	CLR:00	10.00		32	0.0	28	-2.2	19	-7.2	60	6	VRB		29.94				FM-15		29.95
06	0015	7	CLR:00	10.00		32	0.0	27	-2.8	16	-8.9	51	10	VRB	20	29.95				FM-15		29.96
06	0035	7	CLR:00	10.00		32	0.0	27	-2.8	16	-8.9	51	5	VRB	16	29.96				FM-15		29.97
06	0055	7	CLR:00	10.00		32	0.0	27	-2.8	16	-8.9	51	5	VRB	*	29.97				FM-15		29.98
06	0115	7	CLR:00	10.00		30	-1.1	26	-3.3	16	-8.9	55	7	VRB	*	29.98				FM-15		29.99
06	0135	7	CLR:00	10.00		30	-1.1	26	-3.3	16	-8.9	55	9	VRB		29.99				FM-15		30.00
06	0155	7	CLR:00	10.00		30	-1.1	26	-3.3	16	-8.9	55	7	VRB	*	30.01				FM-15		30.02
06	0215	7	CLR:00	10.00		30	-1.1	26	-3.3	16	-8.9	55	0	000		30.02				FM-15		30.03
06	0235	7	CLR:00	10.00		30	-1.1	26	-3.3	18	-7.8	59	3	VRB		30.02				FM-15		30.03
06	0255	7	CLR:00	10.00		28	-2.2	25	-3.9	18	-7.8	64	0	000		30.03				FM-15		30.04
06	0315	7	CLR:00	10.00		28	-2.2	25	-3.9	18	-7.8	64	0	000		30.03				FM-15		30.04
06	0335	7	CLR:00	10.00		28	-2.2	25	-3.9	18	-7.8	64	6	VRB		30.03				FM-15		30.04
06	0355	7	CLR:00	10.00		28	-2.2	25	-3.9	18	-7.8	64	0	000		30.04				FM-15		30.05
06	0415	7	CLR:00	10.00		28	-2.2	25	-3.9	18	-7.8	64	5	VRB	*	30.03				FM-15		30.04
06	0435	7	CLR:00	10.00		28	-2.2	25	-3.9	18	-7.8	64	8	VRB	16	30.04				FM-15		30.05
06	0455	7	CLR:00	10.00		28	-2.2	25	-3.9	18	-7.8	64	5	VRB	*	30.05				FM-15		30.06
06	0515	7	CLR:00	10.00		28	-2.2	25	-3.9	18	-7.8	64	6	VRB		30.05				FM-15		30.06
06	0535	7	CLR:00	10.00		28	-2.2	25	-3.9	18	-7.8	64	5	VRB		30.06				FM-15		30.07
06	0555	7	CLR:00	10.00		28	-2.2	25	-3.9	18	-7.8	64	0	000		30.07				FM-15		30.08
06	0615	7	CLR:00	10.00		28	-2.2	25	-3.9	18	-7.8	64	0	000		30.07				FM-15		30.08
06	0635	7	CLR:00	10.00		28	-2.2	25	-3.9	18	-7.8	64	5	240		30.08				FM-15		30.09
06	0655	7	CLR:00	10.00		28	-2.2	25	-3.9	19	-7.2	69	3	250		30.08				FM-15		30.09
06	0715	7	CLR:00	10.00		28	-2.2	25	-3.9	19	-7.2	69	5	VRB		30.08				FM-15		30.09
06	0735	7	CLR:00	10.00		28	-2.2	25	-3.9	19	-7.2	69	5	240		30.08				FM-15		30.09
06	0755	7	CLR:00	10.00		30	-1.1	26	-3.3	19	-7.2	64	3	VRB		30.09				FM-15		30.10
06	0815	7	CLR:00	10.00		30	-1.1	26	-3.3	19	-7.2	64	3	VRB		30.09				FM-15		30.10
06	0835	7	CLR:00	10.00		32	0.0	28	-2.2	19	-7.2	60	6	VRB	*	30.09				FM-15		30.10
06	0855	7	CLR:00	10.00		32	0.0	28	-2.2	21	-6.1	64	6	VRB	*	30.09				FM-15		30.10
06	0915	7	CLR:00	10.00		32	0.0	28	-2.2	21	-6.1	64	6	VRB		30.10				FM-15		30.11
06	0935	7	CLR:00	10.00		32	0.0	28	-2.2	21	-6.1	64	7	230		30.09				FM-15		30.10
06	0955	7	CLR:00	10.00		34	1.1	29	-1.7	21	-6.1	60	6	VRB	*	30.09				FM-15		30.10
06	1015	7	FEW:02 70 FEW:02 80	10.00		34	1.1	29	-1.7	21	-6.1	60	5	220	*	30.08				FM-15		30.09

06	1035	7	FEW:02 70 FEW:02 80	10.00		34	1.1	29	-1.7	21	-6.1	60	6	VRB	*	30.07				FM-15		30.08
06	1055	7	CLR:00	10.00		36	2.2	31	-0.6	21	-6.1	56	7	220	*	30.06				FM-15		30.07
06	1115	7	FEW:02 70 FEW:02 85	10.00		36	2.2	31	-0.6	21	-6.1	56	10	230	18	30.06				FM-15		30.07
06	1135	7	BKN:07 70	10.00		36	2.2	31	-0.6	21	-6.1	56	11	220		30.04				FM-15		30.05
06	1155	7	OVC:08 70	10.00		36	2.2	31	-0.6	21	-6.1	56	8	VRB	*	30.04				FM-15		30.05
06	1215	7	OVC:08 65	9.00		36	2.2	31	-0.6	21	-6.1	56	7	VRB	16	30.03				FM-15		30.04
06	1235	7	OVC:08 65	10.00		36	2.2	31	-0.6	21	-6.1	56	8	220		30.02				FM-15		30.03
06	1255	7	BKN:07 65	10.00		36	2.2	31	-0.6	21	-6.1	56	5	220	*	30.01				FM-15		30.02
06	1315	7	FEW:02 60	10.00		36	2.2	31	-0.6	23	-5.0	60	6	220		30.01				FM-15		30.02
06	1335	7	CLR:00	10.00		36	2.2	31	-0.6	23	-5.0	60	6	210		30.00				FM-15		30.01
06	1355	7	CLR:00	10.00		36	2.2	31	-0.6	23	-5.0	60	3	VRB		29.99				FM-15		30.00
06	1415	7	CLR:00	10.00		37	2.8	32	0.0	23	-5.0	56	5	VRB		29.97				FM-15		29.98
06	1435	7	CLR:00	10.00		37	2.8	32	0.0	23	-5.0	56	5	180		29.97				FM-15		29.98
06	1455	7	SCT:04 15 SCT:04 20	10.00		37	2.8	33	0.6	25	-3.9	60	0	000		29.97				FM-15		29.98
06	1515	7	FEW:02 2 BKN:07 9 OVC:08 19	4.00	* |* |	37	2.8	33	0.6	27	-2.8	65	5	170		29.97				FM-15		29.98
06	1535	7	BKN:07 2 BKN:07 9 BKN:07 16	2.50V	* |* |	36	2.2	33	0.6	28	-2.2	75	5	VRB		29.95				FM-15		29.96
06	1555	7	FEW:02 2 SCT:04 11 BKN:07 24	8.00		36	2.2	34	1.1	30	-1.1	81	0	000		29.94				FM-15		29.95
06	1615	7	FEW:02 20 SCT:04 24 BKN:07 41	9.00		36	2.2	34	1.1	32	0.0	87	0	000		29.94				FM-15		29.95
06	1635	7	FEW:02 24 FEW:02 29 BKN:07 45	10.00		36	2.2	34	1.1	32	0.0	87	0	000		29.93				FM-15		29.94
06	1655	7	SCT:04 46	10.00		36	2.2	34	1.1	32	0.0	87	0	000		29.92				FM-15		29.93
06	1715	7	CLR:00	10.00	* |* |	34	1.1	33	0.6	32	0.0	93	5	350		29.92				FM-15		29.93
06	1735	7	BKN:07 38 BKN:07 46	10.00		36	2.2	35	1.7	34	1.1	93	0	000		29.92				FM-15		29.93
06	1755	7	SCT:04 38 BKN:07 47 OVC:08 55	10.00		36	2.2	35	1.7	34	1.1	93	0	000		29.91				FM-15	0.01	29.92
06	1815	7	FEW:02 46 OVC:08 50	10.00		36	2.2	35	1.7	34	1.1	93	0	000		29.90				FM-15		29.91
06	1835	7	FEW:02 36 BKN:07 55	10.00		36	2.2	35	1.7	34	1.1	93	3	300		29.90				FM-15		29.91
06	1855	7	FEW:02 33 SCT:04 40 SCT:04 55	10.00		36	2.2	35	1.7	34	1.1	93	0	000		29.90				FM-15		29.91
06	1915	7	FEW:02 32 SCT:04 43 BKN:07 50	10.00		36	2.2	35	1.7	34	1.1	93	0	000		29.90				FM-15		29.91
06	1935	7	BKN:07 49	10.00		36	2.2	35	1.7	34	1.1	93	0	000		29.90				FM-15		29.91
06	1955	7	OVC:08 49	10.00		36	2.2	35	1.7	34	1.1	93	0	000		29.91				FM-15		29.92
06	2015	7	OVC:08 47	10.00		36	2.2	35	1.7	34	1.1	93	3	260		29.91				FM-15		29.92
06	2035	7	OVC:08 43	10.00		36	2.2	35	1.7	34	1.1	93	3	VRB		29.92				FM-15		29.93
06	2055	7	BKN:07 42 BKN:07 75	10.00		34	1.1	34	1.1	34	1.1	100	3	260		29.92				FM-15		29.93
06	2115	7	FEW:02 42 FEW:02 70	10.00		34	1.1	34	1.1	34	1.1	100	3	VRB		29.93				FM-15		29.94
06	2135	7	CLR:00	10.00		34	1.1	34	1.1	34	1.1	100	5	VRB		29.95				FM-15		29.96
06	2155	7	CLR:00	10.00		34	1.1	33	0.6	32	0.0	93	5	VRB		29.96				FM-15		29.97
06	2215	7	FEW:02 34	10.00		34	1.1	33	0.6	32	0.0	93	7	VRB	*	29.98				FM-15		29.99
06	2235	7	SCT:04 36	10.00		34	1.1	34	1.1	34	1.1	100	9	VRB	17	29.99				FM-15		30.00

06	2255	7	SCT:04 11 SCT:04 17 BKN:07 39	10.00		34	1.1	33	0.6	32	0.0	93	9	VRB	16	30.01				FM-15		30.02
06	2315	7	BKN:07 12 BKN:07 18	10.00		34	1.1	33	0.6	32	0.0	93	14	310	22	30.01				FM-15		30.02
06	2335	7	FEW:02 12 FEW:02 18	10.00		34	1.1	32	0.0	28	-2.2	81	9	VRB	24	30.03				FM-15		30.04
06	2355	7	CLR:00	10.00		32	0.0	31	-0.6	28	-2.2	87	11	VRB	20	30.03				FM-15		30.04

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Local Climatological Data
Hourly Precipitation
December 2019

Generated on 01/06/2020

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 11 ft. Lat: 42.0983° N Lon: -70.6722° W

Station: **MARSHFIELD MUNICIPAL AIRPORT, MA US WBAN: 72225664774 (KGHG)**

Date	For Hour (LST) Ending at																							Date
	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	NOON	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	MID	
01	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0.02	0.03	0.02	0.08	0.14	0.12	0.06	01
02	0.02	0.01	M	0.03	0.01	0.02	M	0.03	0.01	0.02	0.02	0.02	0.03	0.03	0.06	0.08	0.04	0.03	0.04	0.03	0.02	0.01	0.03	0.01	02
03	0.03	0.06	0.05	0.03	0.01	0.01	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0.01	M	M	M	03
04	M	M	M	M	M	M	M	M	M	M	M	M	0.04	0.03	M	M	M	M	M	M	M	M	M	M	04
05	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	05
06	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0.01	M	M	M	M	M	M	06
07	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	07
08	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	08
09	M	M	M	M	M	M	M	0.01	0.02	0.03	0.05	0.11	0.03	0.07	0.02	0.02	M	0.10	0.12	0.03	0.10	0.11	0.05	0.06	09
10	0.04	0.04	0.03	M	M	M	M	M	M	M	M	M	M	M	0.05	0.03	0.03	0.01	M	M	M	M	M	0.01	10
11	0.02	0.01	0.01	0.04	M	M	M	M	M	M	M	M	0.01	M	0.01	0.01	M	M	M	M	M	M	M	M	11
12	M	M	M	M	M	M	M	M	M	M	M	M	M	0.03	M	M	M	M	M	M	M	M	M	M	12
13	M	M	M	M	M	M	M	M	M	M	0.01	M	M	M	M	M	M	M	M	0.02	0.01	0.01	M	M	13
14	0.02	0.11	0.19	0.14	0.15	0.16	0.08	0.12	0.13	0.10	0.01	M	M	M	M	M	M	M	M	M	M	M	M	M	14
15	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	15
16	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	16
17	M	M	M	M	M	M	M	M	M	M	0.02	0.07	0.15	0.09	0.02	M	0.06	0.05	0.02	0.01	0.04	0.01	0.01	0.01	17
18	0.05	0.01	M	0.01	M	M	M	M	M	M	0.03	M	M	M	M	M	M	M	M	M	M	M	M	M	18
19	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	19
20	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	20
21	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	21
22	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	22
23	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	23
24	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	24
25	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	25
26	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	26
27	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	27
28	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	28
29	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0.03	0.03	0.03	29
30	0.04	0.06	0.12	0.06	0.05	0.01	0.01	0.04	0.05	0.04	0.06	0.06	0.06	0.03	M	0.01	0.02	0.03	0.01	0.01	0.06	0.03	0.02	0.02	30
31	0.04	0.02	0.04	0.03	0.05	0.02	0.07	0.03	0.02	0.01	M	M	M	M	M	M	M	M	M	M	M	M	M	M	31

Maximum Short Duration Precipitation

Time Period (Minutes)	5	10	15	20	30	45	60	80	100	120	150	180
Precipitation (inches)												
Ending Date Time (yyyy-mm-dd hh:mi)												

Hourly, daily, and monthly totals on the Daily Summary page and the Hourly Precipitation Table are shown as reported by the instrumentation at the site. However, NWS does not edit hourly values for its ASOS sites, but may edit the daily and monthly totals for selected sites which will be reflected on the Daily Summary page.

T = Trace
s = Suspect
* = Erroneous
blank = No precipitation observed
M = Missing

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Local Climatological Data
Hourly Observations
December 2019

Generated on 02/04/2020

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 149 ft. Lat: 41.9097° N Lon: -70.7294° W

Station: **PLYMOUTH MUNICIPAL AIRPORT, MA US WBAN: 72506454769 (KPYM)**

Date	Time (LST)	Station Type	Sky Conditions	Visibility	Weather Type (see documentation)	Dry Bulb Temp		Wet Bulb Temp		Dew Point Temp		Rel Hum %	Wind Speed (MPH)	Wind Dir (Deg)	Wind Gusts (MPH)	Station Press (inHg)	Press. Tend	Net 3-Hr Change (inHg)	Sea Level Press. (inHg)	Report Type	Precip Total (in)	Altimeter Setting (inHg)
					AU | AW | MW	(F)	(C)	(F)	(C)	(F)	(C)											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
05	0052	7	SCT:04 90	10.00		31	-0.6	30	-1.1	28	-2.2	89	5	240		29.31	8	0.00	29.47	FM-15	0.00	29.47
05	0152	7	CLR:00	3.00	BR:1 ||	28	-2.2	28	-2.2	28	-2.2	100	3	270		29.32			29.48	FM-15	0.00	29.48
05	0252	7	CLR:00	8.00		29	-1.7	28	-2.2	27	-2.8	92	5	250		29.32			29.49	FM-15	0.00	29.48
05	0316	7	CLR:00	1.75	BR:1 ||	26	-3.3	26	-3.3	26	-3.3	100	3	250		29.32				FM-16		29.48
05	0325	7	CLR:00	0.50	FZ:8 FG:2 |FG |	26	-3.3	26	-3.3	26	-3.3	100	3	270		29.33				FM-16		29.49
05	0335	7	CLR:00	2.50	BR:1 ||	29	-1.7	28	-2.2	27	-2.8	92	5	250		29.33				FM-16		29.49
05	0342	7	SCT:04 110	8.00		29	-1.7	28	-2.2	27	-2.8	92	5	250		29.33				FM-16		29.49
05	0352	7	BKN:07 110	10.00		30	-1.1	29	-1.7	28	-2.2	92	6	240		29.33	1	-0.02	29.49	FM-15	0.00	29.49
05	0452	7	SCT:04 75 BKN:07 100 OVC:08 120	8.00		28	-2.2	28	-2.2	27	-2.8	96	3	260		29.34			29.51	FM-15	0.00	29.50
05	0552	7	FEW:02 120	9.00		28	-2.2	28	-2.2	27	-2.8	96	3	270		29.37			29.53	FM-15	0.00	29.53
05	0652	7	CLR:00	10.00		29	-1.7	28	-2.2	27	-2.8	92	6	240		29.39	3	-0.06	29.56	FM-15	0.00	29.55
05	0752	7	CLR:00	9.00		29	-1.7	28	-2.2	27	-2.8	92	6	240		29.41			29.57	FM-15	0.00	29.57
05	0852	7	CLR:00	10.00		34	1.1	32	0.0	29	-1.7	82	9	270		29.42			29.59	FM-15	0.00	29.58
05	0952	7	CLR:00	10.00		36	2.2	34	1.1	30	-1.1	79	10	270		29.44	1	-0.05	29.60	FM-15	0.00	29.60
05	1052	7	CLR:00	10.00		39	3.9	35	1.7	30	-1.1	70	10	290		29.44			29.60	FM-15	0.00	29.60
05	1152	7	CLR:00	10.00		40	4.4	35	1.7	28	-2.2	63	13	300	22	29.44			29.60	FM-15	0.00	29.60
05	1252	7	CLR:00	10.00		41	5.0	36	2.2	28	-2.2	60	14	280	23	29.44	3	0.00	29.60	FM-15	0.00	29.60
05	1352	7	BKN:07 44	10.00		41	5.0	35	1.7	26	-3.3	55	14	290	28	29.47			29.63	FM-15	0.00	29.63
05	1452	7	OVC:08 50	10.00		40	4.4	35	1.7	26	-3.3	58	11	290		29.49			29.66	FM-15	0.00	29.65
05	1552	7	OVC:08 55	10.00		39	3.9	34	1.1	26	-3.3	60	9	270		29.53	3	-0.09	29.70	FM-15	0.00	29.69
05	1652	7	OVC:08 60	10.00		38	3.3	33	0.6	25	-3.9	60	10	270		29.58			29.74	FM-15	0.00	29.74
05	1752	7	OVC:08 65	10.00		37	2.8	32	0.0	23	-5.0	57	10	270		29.63			29.79	FM-15	0.00	29.79
05	1852	7	OVC:08 70	10.00		36	2.2	31	-0.6	21	-6.1	55	9	270	22	29.65	1	-0.12	29.81	FM-15	0.00	29.81
05	1952	7	CLR:00	10.00		34	1.1	29	-1.7	18	-7.8	52	15	270	22	29.67			29.84	FM-15	0.00	29.83
05	2052	7	CLR:00	10.00		32	0.0	27	-2.8	18	-7.8	56	14	270	21	29.70			29.86	FM-15	0.00	29.86
05	2152	7	FEW:02 60	10.00		32	0.0	27	-2.8	18	-7.8	56	13	280		29.73	3	-0.08	29.89	FM-15	0.00	29.89
05	2252	7	CLR:00	10.00		31	-0.6	27	-2.8	18	-7.8	59	8	270		29.76			29.92	FM-15	0.00	29.92
05	2352	7	CLR:00	10.00		30	-1.1	26	-3.3	17	-8.3	58	7	280		29.79			29.95	FM-15	0.00	29.95
06	0052	7	CLR:00	10.00		30	-1.1	26	-3.3	17	-8.3	58	10	280		29.82	3	-0.09	29.99	FM-15	0.00	29.98
06	0152	7	CLR:00	10.00		28	-2.2	25	-3.9	17	-8.3	63	7	270		29.86			30.02	FM-15	0.00	30.02
06	0252	7	CLR:00	10.00		27	-2.8	24	-4.4	17	-8.3	66	8	260		29.88			30.04	FM-15	0.00	30.04
06	0352	7	CLR:00	10.00		28	-2.2	25	-3.9	17	-8.3	63	10	260		29.89	1	-0.06	30.05	FM-15	0.00	30.05
06	0452	7	CLR:00	10.00		26	-3.3	23	-5.0	17	-8.3	69	8	250		29.91			30.07	FM-15	0.00	30.07
06	0552	7	CLR:00	10.00		25	-3.9	22	-5.6	16	-8.9	69	7	240		29.92			30.08	FM-15	0.00	30.08
06	0652	7	CLR:00	10.00		26	-3.3	23	-5.0	17	-8.3	69	6	240		29.93	1	-0.05	30.09	FM-15	0.00	30.09
06	0752	7	CLR:00	10.00		27	-2.8	24	-4.4	19	-7.2	72	7	230		29.93			30.10	FM-15	0.00	30.09
06	0852	7	CLR:00	10.00		31	-0.6	28	-2.2	21	-6.1	67	10	230		29.94			30.11	FM-15	0.00	30.10
06	0952	7	FEW:02 70	10.00		33	0.6	29	-1.7	22	-5.6	64	9	230		29.94	1	-0.01	30.11	FM-15	0.00	30.10
06	1052	7	BKN:07 80 OVC:08 90	10.00		34	1.1	30	-1.1	22	-5.6	61	9	220		29.91			30.08	FM-15	0.00	30.07
06	1152	7	OVC:08 70	10.00		34	1.1	30	-1.1	22	-5.6	61	8	230		29.89			30.05	FM-15	0.00	30.05
06	1252	7	BKN:07 55 OVC:08 75	10.00		35	1.7	30	-1.1	22	-5.6	59	7	220		29.86	6	+0.08	30.03	FM-15	0.00	30.02
06	1352	7	SCT:04 60 OVC:08 80	10.00		36	2.2	32	0.0	24	-4.4	62	5	200		29.84			30.00	FM-15	0.00	30.00

06	1452	7	FEW:02 37 BKN:07 47 OVC:08 60	10.00		37	2.8	33	0.6	26	-3.3	65	5	VRB		29.82			29.98	FM-15	0.00	29.98
06	1552	7	OVC:08 50	10.00		37	2.8	34	1.1	28	-2.2	70	0	000		29.79	8	+0.07	29.95	FM-15	0.00	29.95
06	1652	7	OVC:08 55	10.00		36	2.2	34	1.1	30	-1.1	79	0	000		29.76			29.93	FM-15	T	29.92
06	1752	7	SCT:04 36 OVC:08 49	10.00	-RA:02 |RA |RA	35	1.7	34	1.1	33	0.6	93	3	100		29.75			29.91	FM-15	T	29.91
06	1852	7	OVC:08 60	10.00		35	1.7	35	1.7	34	1.1	96	0	000		29.74	6	+0.05	29.91	FM-15	T	29.90
06	1952	7	SCT:04 43 BKN:07 55 OVC:08 100	10.00		35	1.7	34	1.1	33	0.6	93	3	240		29.75			29.91	FM-15	0.00	29.91
06	2052	7	BKN:07 46 OVC:08 70	10.00		34	1.1	33	0.6	32	0.0	92	3	280		29.77			29.94	FM-15	0.00	29.93
06	2152	7	FEW:02 40	10.00		35	1.7	33	0.6	31	-0.6	85	8	290		29.81	3	-0.06	29.97	FM-15	0.00	29.97
06	2252	7	SCT:04 28	10.00		35	1.7	33	0.6	30	-1.1	82	16	300	23	29.85			30.02	FM-15	0.00	30.01
06	2325	7	BKN:07 16 BKN:07 22	10.00		33	0.6	31	-0.6	29	-1.7	85	13	310	22	29.87				FM-16		30.03
06	2344	7	OVC:08 14	10.00		32	0.0	31	-0.6	28	-2.2	85	13	320	20	29.88				FM-16		30.04
06	2352	7	OVC:08 14	10.00		32	0.0	31	-0.6	28	-2.2	85	14	310	24	29.88			30.04	FM-15	0.00	30.04

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Local Climatological Data
Hourly Precipitation
December 2019

Generated on 02/04/2020

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 149 ft. Lat: 41.9097° N Lon: -70.7294° W

Station: **PLYMOUTH MUNICIPAL AIRPORT, MA US WBAN: 72506454769 (KPYM)**

Date	For Hour (LST) Ending at																							Date
	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	NOON	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	MID	
01																	T	0.03	0.04	0.06	0.27	0.17	0.12	0.09	01
02	0.04	0.03	0.04	0.03	0.04	0.04	0.02	0.02	0.06	0.06	0.05	0.06	0.05	0.07	0.04	0.05	0.06	0.13	0.12	0.14	0.12	0.10	0.09	0.10	02
03	0.05	0.05	0.02	0.04	0.01	0.02	0.03	0.02	0.01	0.02	0.02	0.03	T	T	T	T	T				M	M			03
04	M					M	M																		04
05																									05
06																	T	T	T						06
07																									07
08																									08
09				T	T	T	T	0.06	0.03	0.04	0.11	M	M	M	M	M	M	M	M	M	0.19	M	0.07	0.10	09
10	0.05	0.07	0.04	T											0.05	0.01	0.01	T			0.01	T	0.01	0.01	10
11	0.01	0.01	0.03	0.05	T	0.02	0.03	0.03	0.06	0.07	0.06	0.04	T												11
12					M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M				12
13															M	M	M	M	T	0.03	0.01	T	M	M	13
14	0.07	0.15	0.26	0.22	0.13	0.17	0.12	0.15	0.15	0.11	0.03	T			T	0.01			T	0.01	T	M	M	M	14
15	M					M	M	M																	15
16								M	M	M	M														16
17						T	0.05s	0.03	0.04	0.09	0.04	0.05	0.09	0.08	0.05	T	0.08	0.04	0.04	0.02	0.01	0.02	0.01	0.01	17
18	0.02	0.02	0.03	0.01	T				T									T	T						18
19		T																							19
20																									20
21																									21
22																									22
23																									23
24																									24
25																									25
26																									26
27																									27
28																									28
29																				T	T	0.01	0.02	0.04	29
30	0.06	0.09	0.15	0.09	0.04	0.03	0.02	0.16	0.10	0.13	0.04	0.09	0.10	0.02	0.01	T	0.05	0.01	0.07	0.03	0.13	0.03	0.03	0.05	30
31	0.05	0.05	0.07	0.02	0.04	0.01	0.04	T								T									31

Maximum Short Duration Precipitation

Time Period (Minutes)	5	10	15	20	30	45	60	80	100	120	150	180
Precipitation (inches)	0.05	0.09	0.11	0.13	0.18	0.26	0.31	0.35	0.40	0.50	0.60	0.67
Ending Date Time (yyyy-mm-dd hh:mi)	2019-12-14 05:24	2019-12-14 02:29	2019-12-14 02:33	2019-12-14 02:39	2019-12-14 02:33	2019-12-14 02:31	2019-12-14 02:39	2019-12-14 03:02	2019-12-14 03:27	2019-12-14 03:46	2019-12-14 04:17	2019-12-14 04:38

Hourly, daily, and monthly totals on the Daily Summary page and the Hourly Precipitation Table are shown as reported by the instrumentation at the site. However, NWS does not edit hourly values for its ASOS sites, but may edit the daily and monthly totals for selected sites which will be reflected on the Daily Summary page.

T = Trace
s = Suspect
* = Erroneous
blank = No precipitation observed
M = Missing

Appendix D
MassDEP Pure Tone Periods

Appendix D – MassDEP Pure Tone Periods

Table 1a - Measured Pure Tones - Night 2 (July 31, 2019) - Location 1

		1-Minute Leq Sound Pressure Level (dB) by Octave-Band Center Frequency (Hz)									
Measurement	**Start Time**	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**16k**
Ambient	1:51 AM	45	54	39	36	35	34	31	31	28	23
Ambient	1:52 AM	45	54	40	35	35	34	31	29	28	22
Ambient	1:53 AM	45	54	39	35	34	34	31	29	27	22
Ambient	1:54 AM	45	54	40	36	35	35	32	31	28	23
Ambient	1:55 AM	46	54	40	36	36	35	33	32	29	23
Ambient	1:56 AM	45	54	39	35	35	35	33	33	30	24
Ambient	1:57 AM	46	54	40	41	35	34	32	31	28	23
Ambient	1:58 AM	48	54	46	42	35	34	32	31	29	23
Ambient	1:59 AM	47	54	40	36	35	34	31	30	29	23
Ambient	2:00 AM	46	54	39	36	35	35	31	31	30	23
Ambient	2:01 AM	46	54	40	35	35	34	31	29	29	22
Ambient	2:02 AM	45	54	40	35	34	34	32	31	30	23
Ambient	2:03 AM	45	53	40	33	33	32	30	29	29	23
Ambient	2:04 AM	45	53	40	33	33	32	30	29	29	23
Ambient	2:05 AM	45	54	41	33	34	32	30	29	29	22

Table 1b - Measured Pure Tones - Night 2 (July 31, 2019) - Location 2

		1-Minute Leq Sound Pressure Level (dB) by Octave-Band Center Frequency (Hz)									
Measurement	**Start Time**	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**16k**
Operational	1:19 AM	51	50	47	42	43	34	31	30	41	25
Operational	1:20 AM	50	50	47	41	42	34	31	31	41	26
Operational	1:21 AM	50	49	45	40	42	34	30	32	41	26
Operational	1:22 AM	50	50	46	40	43	35	31	32	42	26
Operational	1:23 AM	50	50	45	41	42	35	32	33	42	26
Operational	1:26 AM	51	50	46	40	41	34	30	32	41	27
Operational	1:27 AM	55	52	49	42	44	37	30	32	41	27
Operational	1:28 AM	51	51	48	43	44	34	30	32	41	27
Operational	1:29 AM	51	52	48	42	44	34	28	30	41	26
Operational	1:30 AM	51	51	47	41	43	34	31	32	41	26
Operational	1:32 AM	50	51	48	42	43	35	32	34	39	28
Operational	1:33 AM	50	50	46	41	43	34	30	31	40	26
Operational	1:34 AM	51	50	47	42	44	35	30	32	40	26
Operational	1:36 AM	51	50	47	42	42	34	31	32	39	26
Ambient	1:53 AM	47	48	39	35	36	32	31	35	40	25
Ambient	1:54 AM	46	47	39	36	36	33	32	36	41	26
Ambient	1:55 AM	49	47	40	35	37	34	32	35	41	26
Ambient	1:56 AM	50	46	39	35	36	32	31	35	39	26
Ambient	1:57 AM	49	48	45	44	35	31	29	34	39	26
Ambient	1:58 AM	48	49	42	41	38	33	31	35	39	25
Ambient	1:59 AM	46	48	39	35	35	32	29	34	39	25
Ambient	2:00 AM	47	48	39	35	35	31	29	34	40	26
Ambient	2:01 AM	46	48	40	35	36	32	29	34	40	26
Ambient	2:02 AM	46	47	39	34	35	32	30	35	40	26
Ambient	2:03 AM	46	46	39	35	36	32	30	34	39	26
Ambient	2:04 AM	46	46	39	35	36	32	31	35	40	26
Ambient	2:05 AM	46	47	39	36	36	33	31	35	39	26
Ambient	2:06 AM	45	48	39	35	36	32	31	35	39	26
Ambient	2:07 AM	46	49	39	35	35	32	30	34	39	26

Note: Highlighting indicates pure tone

Appendix D – MassDEP Pure Tone Periods

Table 1c - Measured Pure Tones - Night 2 (July 31, 2019) - Location 4

		1-Minute Leq Sound Pressure Level (dB) by Octave-Band Center Frequency (Hz)									
Measurement	**Start Time**	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**16k**
Operational	1:28 AM	50	48	45	42	42	45	39	33	29	26

Table 1d - Measured Pure Tones - Night 3 (October 2, 2019) - Location 1

		1-Minute Leq Sound Pressure Level (dB) by Octave-Band Center Frequency (Hz)									
Measurement	**Start Time**	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**16k**
Operational	1:02 AM	63	58	54	51	51	44	47	57	37	29
Operational	1:03 AM	63	58	55	52	52	45	47	57	40	31
Operational	1:04 AM	63	59	55	52	52	45	47	57	37	29
Operational	1:05 AM	64	59	55	51	52	45	47	57	35	28
Operational	1:06 AM	63	59	55	51	52	46	48	57	41	33
Operational	1:08 AM	63	58	54	51	51	44	47	57	37	29
Operational	1:09 AM	60	59	55	51	51	45	47	57	37	29
Operational	1:10 AM	60	60	55	52	51	45	47	57	38	30
Operational	1:11 AM	60	59	55	51	52	44	47	57	36	28
Operational	1:12 AM	61	60	56	52	52	45	48	57	39	31
Operational	1:15 AM	60	59	55	52	51	45	47	57	39	30
Operational	1:16 AM	59	59	55	52	51	45	47	57	39	30
Operational	1:17 AM	59	58	54	51	51	45	47	57	38	30
Operational	1:18 AM	60	59	55	52	51	44	47	57	37	29
Operational	1:19 AM	60	59	56	52	51	46	47	57	38	30
Ambient	1:40 AM	50	52	42	39	41	41	45	57	35	29
Ambient	1:41 AM	54	53	42	42	42	42	46	57	39	31
Ambient	1:42 AM	49	52	42	40	40	41	46	57	35	29
Ambient	1:43 AM	54	52	42	38	39	39	46	57	36	29
Ambient	1:44 AM	51	52	43	42	43	43	46	57	40	31
Ambient	1:45 AM	48	51	41	38	39	39	45	57	35	29
Ambient	1:46 AM	48	51	42	41	41	40	45	57	36	29
Ambient	1:47 AM	48	52	44	42	42	42	45	57	35	29
Ambient	1:48 AM	50	51	42	42	42	40	45	57	37	29
Ambient	1:49 AM	51	52	44	43	43	42	46	57	38	31
Ambient	1:50 AM	49	51	43	39	40	39	45	57	37	29
Ambient	1:51 AM	55	51	41	38	38	38	45	57	36	29
Ambient	1:52 AM	60	51	41	37	38	37	45	57	35	28
Ambient	1:53 AM	60	51	41	38	39	39	45	57	36	29
Ambient	1:54 AM	60	51	42	38	39	38	45	57	36	29

Note: Highlighting indicates pure tone

Appendix D – MassDEP Pure Tone Periods

Table 1e - Measured Pure Tones - Night 3 (October 2, 2019) - Location 2

		1-Minute Leq Sound Pressure Level (dB) by Octave-Band Center Frequency (Hz)									
Measurement	**Start Time**	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**16k**
Operational	1:11 AM	53	52	48	42	43	38	46	50	40	32
Ambient	1:41 AM	51	47	42	39	42	41	49	52	41	31
Ambient	1:42 AM	49	50	44	40	41	40	48	52	41	30
Ambient	1:43 AM	51	48	42	40	41	40	48	52	42	31
Ambient	1:44 AM	52	48	41	37	38	37	48	52	41	30
Ambient	1:45 AM	47	46	40	37	39	38	48	52	42	32
Ambient	1:46 AM	52	47	41	40	41	38	48	52	41	30
Ambient	1:47 AM	56	49	43	39	40	39	48	52	41	31
Ambient	1:48 AM	47	46	42	41	42	40	49	52	41	31
Ambient	1:49 AM	46	46	41	38	39	38	48	52	42	31
Ambient	1:50 AM	55	48	42	38	40	39	49	52	42	31
Ambient	1:51 AM	60	52	42	37	38	36	49	52	42	30
Ambient	1:52 AM	47	47	40	37	38	37	49	52	42	31
Ambient	1:53 AM	47	46	40	36	37	36	49	52	42	30

Table 1f - Measured Pure Tones - Night 3 (October 2, 2019) - Location 3

		1-Minute Leq Sound Pressure Level (dB) by Octave-Band Center Frequency (Hz)									
Measurement	**Start Time**	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**16k**
Operational	1:02 AM	51	47	44	43	43	42	45	48	42	33
Operational	1:04 AM	55	48	44	42	42	41	45	48	40	31
Operational	1:09 AM	54	49	45	44	44	42	45	48	42	33
Operational	1:14 AM	56	48	45	45	45	44	46	49	44	36
Operational	1:16 AM	54	49	45	44	44	43	46	49	44	34
Operational	1:17 AM	54	48	44	43	43	41	45	48	42	32
Operational	1:18 AM	53	48	44	43	43	42	45	49	43	33
Ambient	1:43 AM	56	48	42	41	41	40	45	48	42	32
Ambient	1:46 AM	54	48	43	43	44	43	46	49	44	34
Ambient	1:48 AM	55	46	43	43	43	42	46	49	44	34
Ambient	1:50 AM	48	45	41	41	42	41	45	48	43	33

Table 1g - Measured Pure Tones - Night 3 (October 2, 2019) - Location 4

		1-Minute Leq Sound Pressure Level (dB) by Octave-Band Center Frequency (Hz)									
Measurement	**Start Time**	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**16k**
Operational	1:19 AM	53	50	47	42	42	40	47	50	39	30
Ambient	1:51 AM	51	48	43	40	42	41	47	50	41	31
Ambient	1:54 AM	53	48	44	41	43	42	47	51	41	32
Ambient	1:55 AM	57	50	44	42	43	43	47	51	41	33
Ambient	1:57 AM	56	50	44	41	43	42	47	51	41	32

Table 1h - Measured Pure Tones - Night 4 (December 6, 2019) - Location 1

		1-Minute Leq Sound Pressure Level (dB) by Octave-Band Center Frequency (Hz)									
Measurement	**Start Time**	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**16k**
Ambient	1:50 AM	53	60	40	35	33	31	26	24	22	22
Ambient	1:51 AM	61	58	42	35	37	43	38	26	22	22

Note: Highlighting indicates pure tone

Appendix D – MassDEP Pure Tone Periods

Table 1i - Measured Pure Tones - Night 4 (December 6, 2019) - Location 2

		1-Minute Leq Sound Pressure Level (dB) by Octave-Band Center Frequency (Hz)									
Measurement	**Start Time**	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**16k**
Operational	1:15 AM	53	58	46	39	40	39	39	41	39	28
Ambient	1:36 AM	53	57	43	36	34	30	25	22	21	23
Ambient	1:40 AM	52	57	41	38	42	35	28	25	24	23
Ambient	1:41 AM	52	51	42	42	46	39	32	28	25	24

Table 1j - Measured Pure Tones - Night 4 (December 6, 2019) - Location 3

		1-Minute Leq Sound Pressure Level (dB) by Octave-Band Center Frequency (Hz)									
Measurement	**Start Time**	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**16k**
Ambient	1:44 AM	51	55	38	33	32	27	23	22	21	23

Table 1k - Measured Pure Tones - Night 4 (December 6, 2019) - Location 4

		1-Minute Leq Sound Pressure Level (dB) by Octave-Band Center Frequency (Hz)									
Measurement	**Start Time**	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**16k**
Operational	1:02 AM	54	57	44	41	39	34	30	27	24	23
Operational	1:14 AM	54	58	45	40	38	32	27	25	23	22
Operational	1:21 AM	51	57	40	35	33	28	24	22	20	21
Ambient	1:38 AM	51	55	39	33	31	26	25	23	21	21
Ambient	1:39 AM	50	54	39	31	30	26	22	21	19	21
Ambient	1:42 AM	52	58	40	35	33	30	27	24	21	21

Note: Highlighting indicates pure tone