Safe and Effective Threshold Determination Report Job Aid

By

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Publication Information

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Introduction

A Safe and Effective Threshold Determination Report (S&E Report) is required for vessel companies and facilities that deliver oil at a rate of 500 gallons per minute or higher, on or over waters of the state. The report must include data on current, wind, and sea state for each oil transfer site, as described in Chapter 173-180-224 and Chapter WAC 173-180-130 Washinton Administrative Code (WAC).

This job aid is intended to help submitters use weather data sites to meet weather data requirements. Step-by-step examples illustrate how to find, download, and process data for transfer locations. Submitters are not required to use the sources described in this job aid. They may use other sources of data, including data collected at their facility or onboard company vessels.

Ecology does not endorse the use of any particular product or service. The products linked in this job aid are examples only.

Data Requirements

The inclusion of weather data in S&E Reports helps companies determine appropriate threshold values. Threshold values for current, wind, and sea state are used by delivering vessels and facilities to make decisions about when it is safe and effective to preboom an oil transfer. S&E Reports are required to use data specific to the transfer location, recent (less than 10 years old), and spanning multiple years.

Evaluating Data Collected

We encourage companies to consider the reliability and suitability of the data they use in their S&E Reports. Ecology suggests prioritizing data in the following order:

1. Data collected at the transfer location (e.g., a weather station at the facility, observations recorded on a vessel).
2. A transparently vetted and freely available source (e.g., National Oceanic and Atmospheric Administration/ National Weather Service, United States Geological Survey, Midwestern Regional Climate Center).
3. If needed, supplement locally collected or public data sources with information from a commercial provider (e.g., Weather Underground, Windy, Open-Meteo). This option may be helpful to show conditions at transfer locations, if other data is not sufficient.

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Water Current Velocity

The S&E Reports must include data on water current velocity. The data should include peak currents, sustained currents in hourly increments, and direction of flow during typical oil transfer operations.

For Washington waters, the National Oceanographic and Atmospheric Association (NOAA) and the United States Geological Survey (USGS) are the primary sources of water velocity data. The NOAA produces current predictions for tidal waters (link). If you do not have a source for observed current data, you can use the NOAA predictions for your S&E Report. The USGS records water velocity data for certain locations on the Columbia River (link).

NOAA current data

To find data for a NOAA current station, follow the directions below.

1. On the NOAA webpage (link), select the station closest to the relevant oil transfer location, for example "Harbor Island West (Depth 9ft)":

Alki Point, West of (Depth 38ft)	PUG1516	17	47.5761° N	122.4278° W	**Harmonic**
Alki Point, West of (Depth 103ft)	PUG1516	12	47.5761° N	122.4278° W	**Harmonic**
Alki Point, West of (Depth 195ft)	PUG1516	5	47.5761° N	122.4278° W	**Harmonic**
Alki Point, 1 mile West of (Depth 76ft)	PUG1502	44	47.5837° N	122.4518° W	**Harmonic**
Alki Point, 1 mile West of (Depth 194ft)	PUG1502	35	47.5837° N	122.4518° W	**Harmonic**
Alki Point, 1 mile West of (Depth 483ft)	PUG1502	13	47.5837° N	122.4518° W	**Harmonic**
Harbor Island West (Depth 9ft)	PUG1507	13	47.5831° N	122.3602° W	**Harmonic**
Harbor Island West (Depth 22ft)	PUG1507	9	47.5831° N	122.3602° W	**Harmonic**
Harbor Island East (Depth 6ft)	PUG1506	12	47.5885° N	122.3440° W	Weak and Variable

2. Select "Annual Prediction Tables":

Back / Home / Products / Current Predictions / Harbor Island West (PUG1507) Depth: 9 feet

Stations   Help   FAQ   Prediction Plots   Annual Prediction Tables

Harbor Island West (PUG1507) Depth: 9 feet

LAT/LON: 47.5831° N 122.3602° W

Note: Depth source is measured below chart datum.

3. Use the fields to produce a CSV file for the report year and the preceding year. Also produce a PDF of the same two years, as it will produce additional information:

Harbor Island West (PUG1507) Depth: 9 feet
LAT/LON: 47.5831° N 122.3602° W

Note: Depth source is measured below chart datum.

Prediction Uncertainty

Year:	Format:	Time Zone:	Units:	Time Units:	
2024	CSV	LST/LDT	knots	AM/PM	Create

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4. In your downloaded CSV file, use the filter tool to reveal and remove all slack tide rows. Use the IMABS formula to convert negative (ebbing) current values into positive values. Use the QUARTILE and AVG formulas to analyze the current data. Use IF, COUNTIF, and COUNT formulas to produce a percentage of time over a relevant threshold velocity. In this example, the threshold is 1.5 knots.

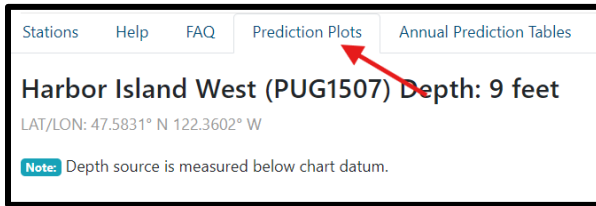| C	D	E	F	G	H
Speed (kts)	Absolute Value (kts)		Statistics		
-0.5	=IMABS(C2)		Average	=AVERAGE(D:D)	knots
0.1	=IMABS(C3)		1st Quartile	=QUARTILE(D:D,1)	knots
-0.2	=IMABS(C4)		Median	=QUARTILE(D:D,2)	knots
-0.4	=IMABS(C5)		3rd Quartile	=QUARTILE(D:D,3)	knots
0.1	=IMABS(C6)		Maximum	=MAX(D:D)	knots
-0.2	=IMABS(C7)		Total measurements	=COUNT(D:D)	
-0.3	=IMABS(C8)		Measurements over 1.5 kts	=COUNTIF(D:D,1)	
0.1	=IMABS(C9)		Percentage over 1.5 kts	=G8/G7	

5. The resulting values provide insight into the overall frequency of different water currents at the location of the station. Looking at the frequency of values over the proposed threshold value provides perspective on how often the selected threshold may be exceeded in the oil transfer area.

| C	D	E	F	G	H
Speed (kts)	Absolute Value (kts)		Statistics		
-0.5	0.5		Average	0.3	knots
0.1	0.1		1st Quartile	0.2	knots
-0.2	0.2		Median	0.2	knots
-0.4	0.4		3rd Quartile	0.4	knots
0.1	0.1		Maximum	0.9	knots
-0.2	0.2		Total measurements	1275	
-0.3	0.3		Measurements over 1.5	0	
0.1	0.1		Percentage over 1.5 kts	0.0%	

6. Step three describes how to produce a PDF of the available data. This PDF shows the mean flood direction and mean ebb direction.

NOAA Tidal Current Predictions

Harbor Island West, 2024

Latitude: 47.5831° N Longitude: 122.3602° W

Mean Flood Dir. 178° (T) Mean Ebb Dir. 1° (T)

Times and speeds of maximum and minimum current, in knots

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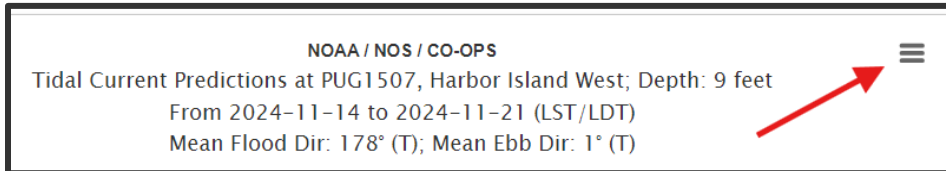March 2025 (Rev.)

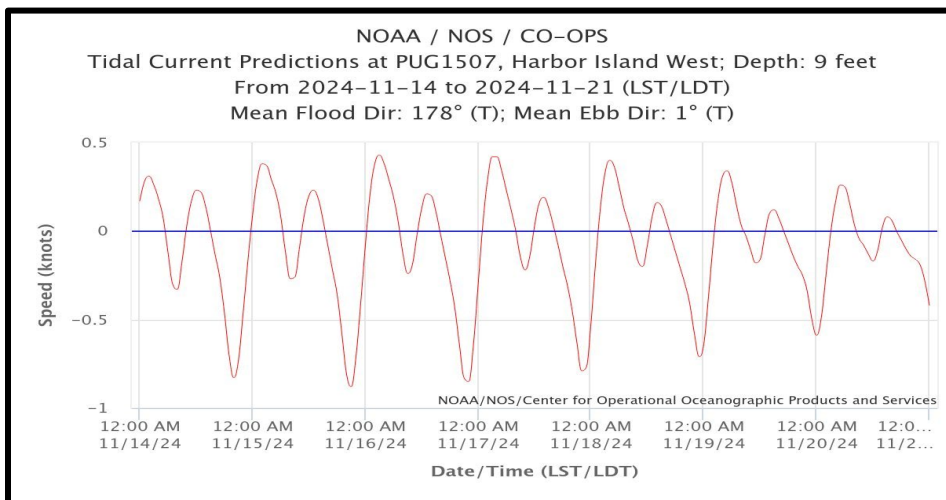7. To produce current data at hourly increments, select "Prediction Plots."

8. Hourly data can only be plotted for weekly increments. Choosing a week with a king tide will highlight stronger currents. This Sea Grant page shows dates when king tides are occurring (link).
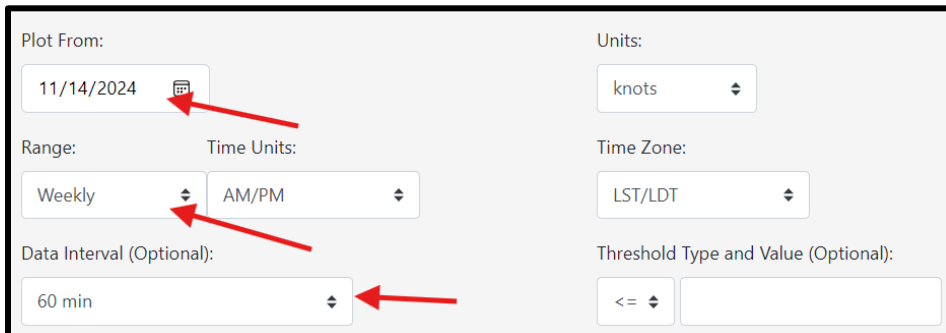
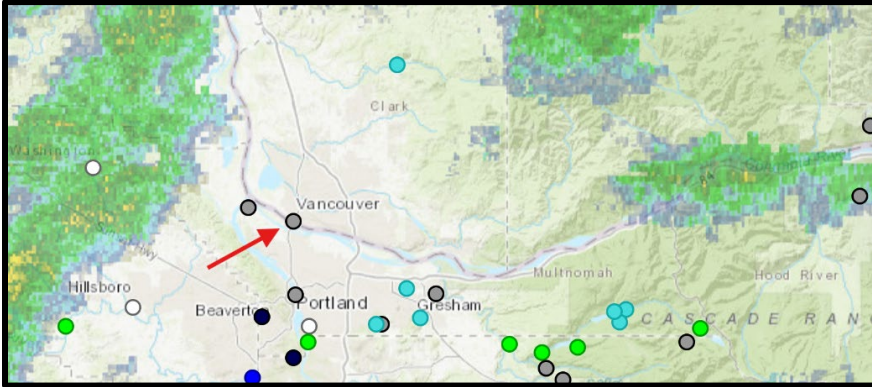9. Download the image showing the graphed currents by clicking the 3 bars and selecting "Download JPEG image."

10. The resulting image provides the hourly increments for velocity required by the WAC.

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USGS current data

To find data for a USGS river gauge, follow the directions below.

1. On the USGS webpage (link), select the monitoring location closest to the planned oil transfer location:

2. On the resulting pop-up, select "Current / Historical Observations."

3. Select "mean water velocity." Select "change time span" and select dates spanning the year preceding the report year. Select "download data." Repeat for an additional year of data when complete.

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4. Review water velocity data on new tab. Save as a "text" file. Open text file into Excel and follow the import wizard. Start the import at row 30.
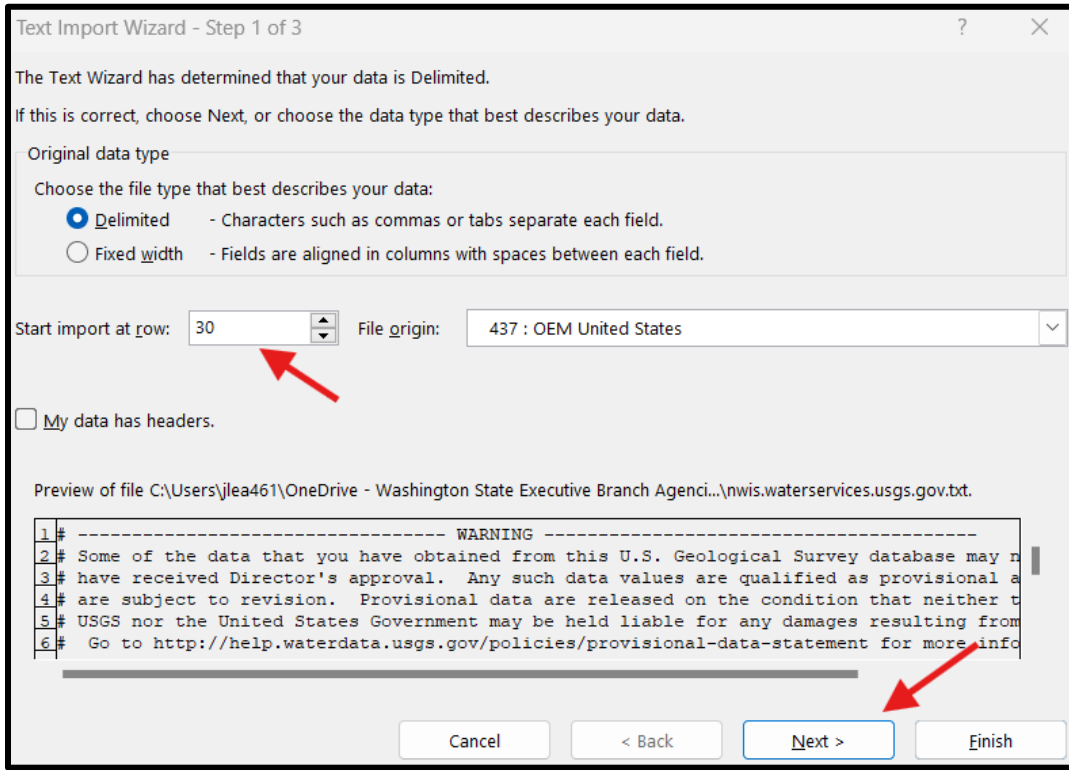
5. Multiply feet/second values by 0.592 to convert into knots. Use the IMABS formula to convert negative (ebbing) velocity values into positive values. Use the QUARTILE and AVG formulas to analyze the velocity data. Use IF, COUNTIF, and COUNT formulas to produce a percentage of time over a relevant threshold velocity. In this example, the threshold is 1.5 knots.

E	F	G	H	I	J	K	L
Water Velocity (ft/sec)	Water Velocity (kts)	Absolute Velocity (kts)	Over 1.5 knots		Statistics		
1.23	=E2*0.592484	=IMABS(F2)	=IF(G2>1.5,1,0)		Average	=AVERAGE(G:G)	knots
1.19	=E3*0.592484	=IMABS(F3)	=IF(G3>1.5,1,0)		1st Quartile	=QUARTILE(G:G,1)	knots
1.14	=E4*0.592484	=IMABS(F4)	=IF(G4>1.5,1,0)		Median	=QUARTILE(G:G,2)	knots
1.09	=E5*0.592484	=IMABS(F5)	=IF(G5>1.5,1,0)		3rd Quartile	=QUARTILE(G:G,3)	knots
1.03	=E6*0.592484	=IMABS(F6)	=IF(G6>1.5,1,0)		Maximum	=MAX(G:G)	knots
0.98	=E7*0.592484	=IMABS(F7)	=IF(G7>1.5,1,0)		Total measurements	=COUNT(H:H)	
0.92	=E8*0.592484	=IMABS(F8)	=IF(G8>1.5,1,0)		Measurements over 1.5 kts	=COUNTIF(H:H,1)	
0.88	=E9*0.592484	=IMABS(F9)	=IF(G9>1.5,1,0)		Percentage over 1.5 kts	=K8/K7	

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6. The resulting values provide insight into the overall frequency of different water velocities at the location of the river gauge. Looking at the frequency of values over the proposed threshold value provides perspective on how often the selected threshold may be exceeded in the oil transfer area.

E	F	G	H	I	J	K	L
Water Velocity (ft/sec)	Water Velocity (kts)	Absolute Velocity (kts)	Over 1.5 knots		Statistics		
1.23	0.73	0.73	0		Average	1.1	knots
1.19	0.71	0.71	0		1st Quartile	0.9	knots
1.14	0.68	0.68	0		Median	1.1	knots
1.09	0.65	0.65	0		3rd Quartile	1.3	knots
1.03	0.61	0.61	0		Maximum	1.8	knots
0.98	0.58	0.58	0		Total measurements	106114	
0.92	0.55	0.55	0		Measurements over 1.5 kts	8993	
0.88	0.52	0.52	0		Percentage over 1.5 kts	8.5%	

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Wind Speed

The S&E Reports must include data on wind speed in knots, and prevailing directions. There are a number of sources of wind data that may be suitable for evaluation as part of an S&E Report. The NOAA maintains weather buoys, some of which record wind speed (link).
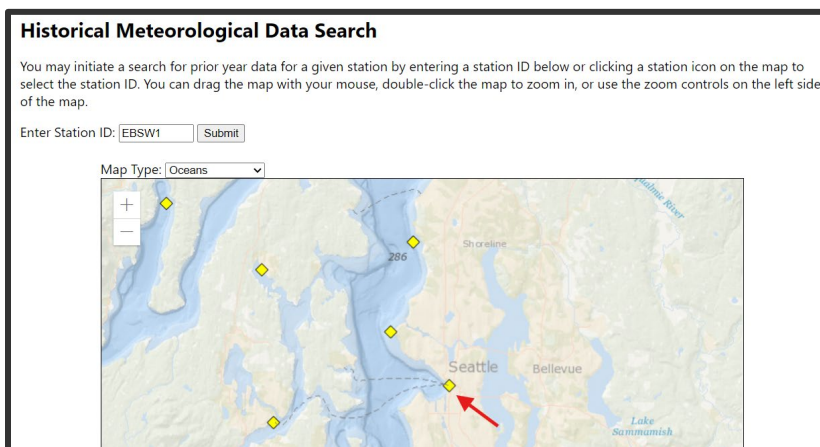
There are other potential sources of wind data for oil transfer locations that are not near a NOAA Buoy. The Midwestern Regional Climate Center (MRCC) provides weather information from additional land-based stations (link). For the local area, these stations are all located at airports. Two non-governmental sources of wind data are Windy (link) and Weather Underground (link), which has a network of weather stations. These networked stations include a number operated by private parties. For those locations where there are no readily accessible historical observations, it may be worth exploring modeled data. Open-Meteo offers free access to estimated historical weather data for non-commercial use (link).

NOAA wind data

The NOAA national data buoy center has historical data for its buoys, some of which record wind speed and direction. A map showing buoy locations is available here (link).

To find data for a given buoy, follow the directions below.

1. Select the station closest to the relevant oil transfer location, for example EBSW1:

2. Select the most recent year, and press submit.

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3. Click on "View all meteorological observations for station…"

Historical Meteorological Data Search - Station EBSW1

Station EBSW1 Change Station ID
9447130 - Seattle, WA

Select Year: 2018 ⌄ View all meteorological observations for station EBSW1 in 2018

4. Save the resulting file and open in Excel. Remove any erroneous values. Multiply meters/second values by 1.94384 to convert into knots. Use the QUARTILE and AVG formulas to analyze the data. Use IF, COUNTIF, and COUNT formulas to produce a percentage of time over a threshold velocity. In this example, the threshold is 20 knots for sustained winds, and 30 knots for gusts.

G	H	I	J	K	L	M	N	O	P	Q
WND	WSPD	WSPD	Over 20?	GST	GST	Over 30?				
	m/s	knots	1 = yes	m/s	knots	1 = yes		**Sustained Wind Statistics**		
=IF(OR(F3>315,F3<	1.6	=H3*1.94384	=IF(I3>20,1,0)	5.7	=K3*1.94384	=IF(L3>30,1,0)		Average	=AVERAGE(I:I)	knots
=IF(OR(F4>315,F4<	1.5	=H4*1.94384	=IF(I4>20,1,0)	3.9	=K4*1.94384	=IF(L4>30,1,0)		1st Quartile	=QUARTILE(I:I,1)	knots
=IF(OR(F5>315,F5<	1.5	=H5*1.94384	=IF(I5>20,1,0)	4.6	=K5*1.94384	=IF(L5>30,1,0)		Median	=QUARTILE(I:I,2)	knots
=IF(OR(F6>315,F6<	1.6	=H6*1.94384	=IF(I6>20,1,0)	2.9	=K6*1.94384	=IF(L6>30,1,0)		3rd Quartile	=QUARTILE(I:I,3)	knots
=IF(OR(F7>315,F7<	1.6	=H7*1.94384	=IF(I7>20,1,0)	3.2	=K7*1.94384	=IF(L7>30,1,0)		Maximum	=MAX(I:I)	knots
=IF(OR(F8>315,F8<	1.7	=H8*1.94384	=IF(I8>20,1,0)	3.3	=K8*1.94384	=IF(L8>30,1,0)		Total measurements	=COUNT(J:J)	
=IF(OR(F9>315,F9<	2.2	=H9*1.94384	=IF(I9>20,1,0)	5.4	=K9*1.94384	=IF(L9>30,1,0)		Measurements over 20 kts	=COUNTIF(J:J,1)	
=IF(OR(F10>315,F1	2.4	=H10*1.94384	=IF(I10>20,1,0)	4.9	=K10*1.94384	=IF(L10>30,1,0)		Percentage over 20 kts	=P9/P8	
=IF(OR(F11>315,F1	1.9	=H11*1.94384	=IF(I11>20,1,0)	4.2	=K11*1.94384	=IF(L11>30,1,0)				
=IF(OR(F12>315,F1	2.9	=H12*1.94384	=IF(I12>20,1,0)	5.3	=K12*1.94384	=IF(L12>30,1,0)		**Gust Statistics**		
=IF(OR(F13>315,F1	2.8	=H13*1.94384	=IF(I13>20,1,0)	4.6	=K13*1.94384	=IF(L13>30,1,0)		Average	=AVERAGE(L:L)	knots
=IF(OR(F14>315,F1	2.5	=H14*1.94384	=IF(I14>20,1,0)	4.9	=K14*1.94384	=IF(L14>30,1,0)		1st Quartile	=QUARTILE(L:L,1)	knots
=IF(OR(F15>315,F1	3	=H15*1.94384	=IF(I15>20,1,0)	4.8	=K15*1.94384	=IF(L15>30,1,0)		Median	=QUARTILE(L:L,2)	knots
=IF(OR(F16>315,F1	1.5	=H16*1.94384	=IF(I16>20,1,0)	3.8	=K16*1.94384	=IF(L16>30,1,0)		3rd Quartile	=QUARTILE(L:L,3)	knots
=IF(OR(F17>315,F1	2.1	=H17*1.94384	=IF(I17>20,1,0)	4.2	=K17*1.94384	=IF(L17>30,1,0)		Maximum	=MAX(L:L)	knots
=IF(OR(F18>315,F1	1.5	=H18*1.94384	=IF(I18>20,1,0)	6.4	=K18*1.94384	=IF(L18>30,1,0)		Total measurements	=COUNT(M:M)	
=IF(OR(F19>315,F1	2.2	=H19*1.94384	=IF(I19>20,1,0)	3.6	=K19*1.94384	=IF(L19>30,1,0)		Measurements over 30 kts	=COUNTIF(M:M,1)	
=IF(OR(F20>315,F2	1.2	=H20*1.94384	=IF(I20>20,1,0)	2.5	=K20*1.94384	=IF(L20>30,1,0)		Percentage over 30 kts	=P19/P18	

5. Use the IF, COUNTIF and COUNT formulas to produce a percentage of time for general direction of wind.

F	G	R	S
WDIR	Wind Cardinal Direction		
degT		**Wind Direction**	
334	=IF(OR(F3>315,F3<45),"N",IF(AND(F3>225,F3<=315),"E",IF(AND(F3>135,F3<=225),"S","W")))	Total measurements	=P8
346	=IF(OR(F4>315,F4<45),"N",IF(AND(F4>225,F4<=315),"W",IF(AND(F4>135,F4<=225),"S","E")))	Percentage Northerly	=(COUNTIF(G:G,"N"))/S3
346	=IF(OR(F5>315,F5<45),"N",IF(AND(F5>225,F5<=315),"W",IF(AND(F5>135,F5<=225),"S","E")))	Percentage Easterly	=(COUNTIF(G:G,"E"))/S3
333	=IF(OR(F6>315,F6<45),"N",IF(AND(F6>225,F6<=315),"W",IF(AND(F6>135,F6<=225),"S","E")))	Percentage Southerly	=(COUNTIF(G:G,"S"))/S3
345	=IF(OR(F7>315,F7<45),"N",IF(AND(F7>225,F7<=315),"W",IF(AND(F7>135,F7<=225),"S","E")))	Percentage Westerly	=(COUNTIF(G:G,"W"))/S3

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6. The resulting values provide insight into the overall frequency of different wind speeds and directions at the location of the buoy. Looking at the frequency of values over the proposed threshold value provides perspective on how often the selected threshold may be exceeded in the oil transfer area.

| Sustained Wind Statistics			Gust Statistics			Wind Direction	
Average	4.1	knots	Average	6.8	knots	Total measurements	78914
1st Quartile	2.1	knots	1st Quartile	3.9	knots	Percentage Northerly	18%
Median	3.7	knots	Median	6.0	knots	Percentage Easterly	14%
3rd Quartile	5.4	knots	3rd Quartile	8.9	knots	Percentage Southerly	43%
Maximum	15.9	knots	Maximum	19.2	knots	Percentage Westerly	25%
Total measurements	78914		Total measurements	78914			
Measurements over 20 kts	0		Measurements over 30 kts	0			
Percentage over 20 kts	0.0%		Percentage over 30 kts	0.0%			

Midwestern Regional Climate Center (MRCC) wind data

If buoy data is not available for the planned transfer location, MRCC data may be a good alternative. To use the airport data provided via MRCC, you must first register for a free account (link). After logging in, use the following link to access the station map (link).
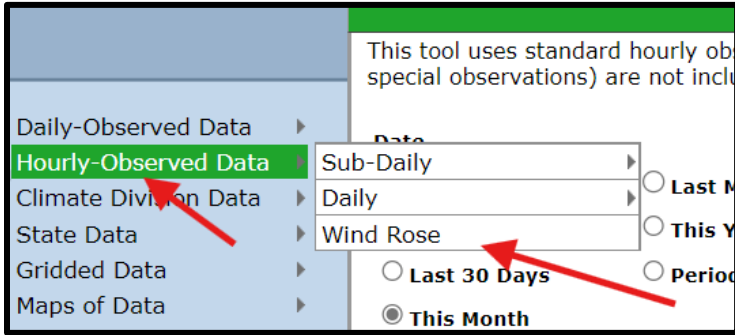
1. Choose the station closest to the relevant transfer location, and click "Select."
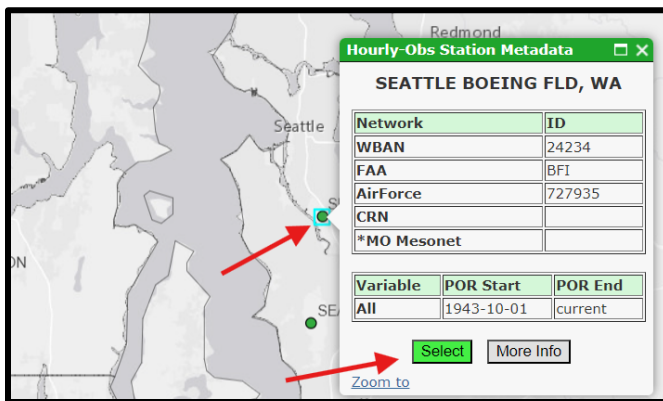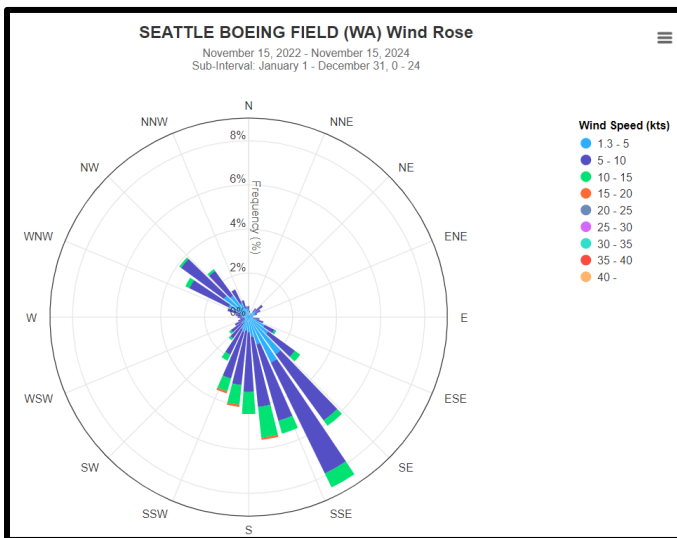

2. Select "Go."
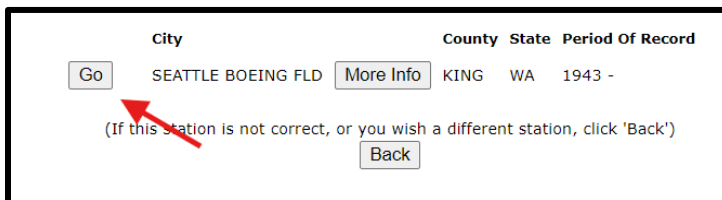
3. Select "Hourly-Observed Data," and "Wind Rose" from the resulting drop-down menu.
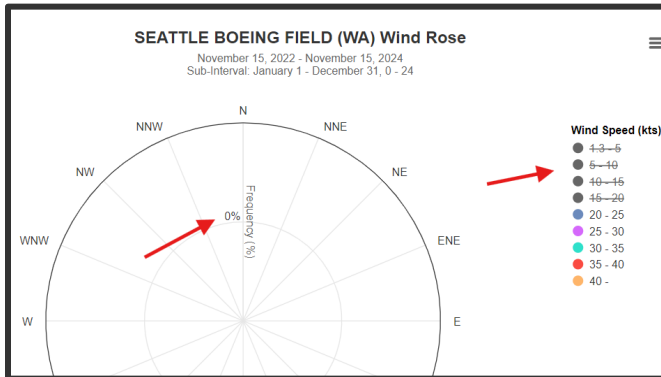

4. Select "Custom" time frame, to allow for two years of recent data. Select "knots" as the unit of measure. Select a "Wind Speed Division" that allows a selected threshold value to be evaluated. In this case, a wind speed division of 0-5, 5-10, 10-15, 15-20, 20-25, etc. will allow an example 20 knot threshold to be evaluated.
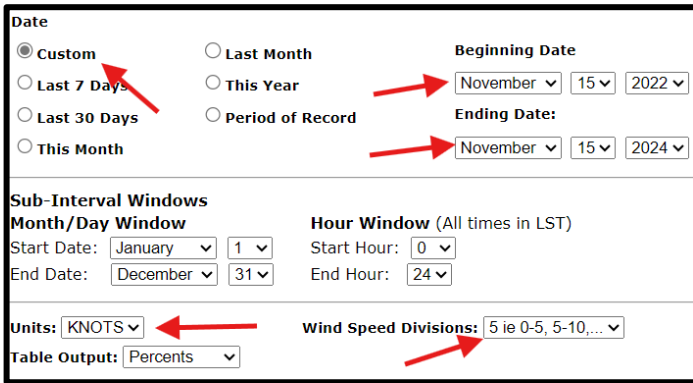
5. The resulting wind rose shows the predominant wind direction, and the percentage of time winds are above the 20 knot threshold.

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6. To focus on just those winds that exceed the example threshold, click on the lower values under "Wind Speed." This will provide the frequency of winds that exceed the threshold, which in this case is 0 percent of the time.

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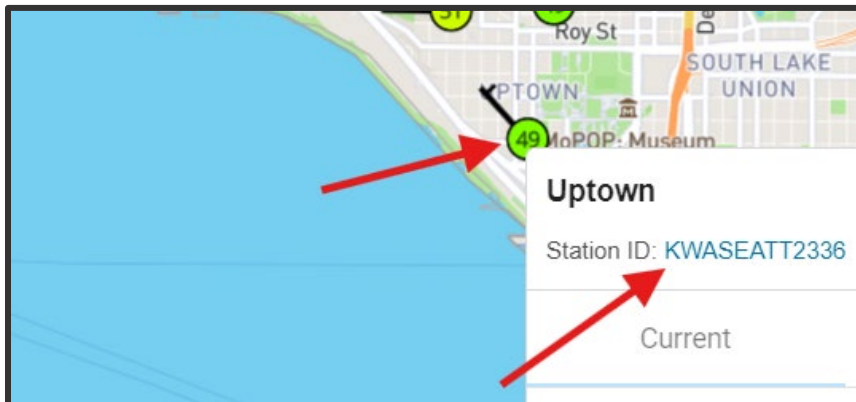March 2025 (Rev.)

Commercial providers

If data available via the NOAA National Data Buoy Center or local airports via MRCC is insufficient, due to recency or location, data from commercial providers may be worth exploring as a way to supplement the use of other data sources. Two examples are shown below. Ecology does not endorse the use of any particular product or service for the production of this report. The products linked in this job aid are examples only.

Weather Underground wind data. Their webpage has a map (link) that allows you to select nearby/relevant weather stations, and will show historical data for that station. To find data for a given location, follow the directions below.
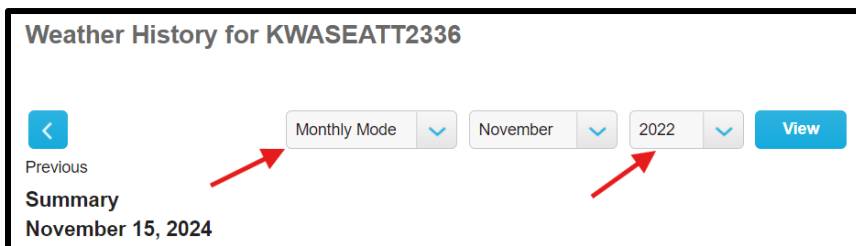
1. Select "Weather Stations" and "Temperature/Wind."
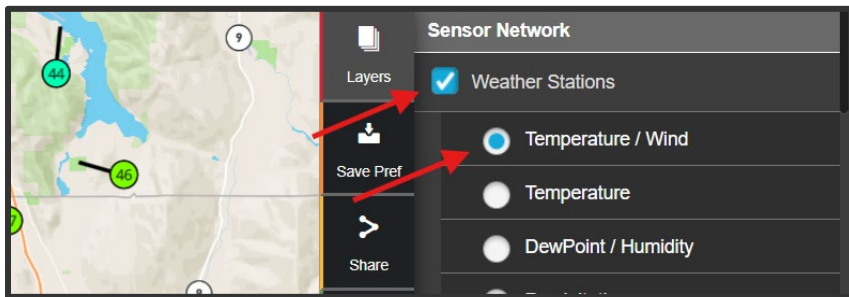
2. Click on the green station location icon, and then select the station ID link in the pop up.

3. Select "Monthly" and choose a month/year two years prior to the report date. Click view.

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4. Select "table" to show data for the month. Copy and paste the month's data into an Excel sheet. Go to the next month's data by clicking the "Next" button. Continue copying data until you have 24 months of data available in Excel for analysis.

5. Remove text from the wind speed cells and convert miles per hour into knots.

K	L	M
High (mph)	Daily High Windspeed (No Text)	Daily High Windspeed (kts)
9.6 mph	=TEXTJOIN("", TRUE, IFERROR(MID(K2, SEQUENCE(LEN(K2)), 1) *1, ""))/10	=L2*0.869
12.3 mph	=TEXTJOIN("", TRUE, IFERROR(MID(K3, SEQUENCE(LEN(K3)), 1) *1, ""))/10	=L3*0.869
11.2 mph	=TEXTJOIN("", TRUE, IFERROR(MID(K4, SEQUENCE(LEN(K4)), 1) *1, ""))/10	=L4*0.869
29.5 mph	=TEXTJOIN("", TRUE, IFERROR(MID(K5, SEQUENCE(LEN(K5)), 1) *1, ""))/10	=L5*0.869

6. Use the QUARTILE and AVG formulas to analyze the data. Use the IF, COUNTIF, and COUNT formulas to produce a percentage of time over a threshold velocity. In this example, the threshold is 20 knots for sustained winds.

M	N	O	P	Q	
Daily High Windspeed (kts)	Over 20 kts		Sustained Wind Statistics		
=L2*0.869	=IF(M3>20,1,0)		Average	=AVERAGE(M:M)	knots
=L3*0.869	=IF(M4>20,1,0)		1st Quartile	=QUARTILE(M:M,1)	knots
=L4*0.869	=IF(M5>20,1,0)		Median	=QUARTILE(M:M,2)	knots
=L5*0.869	=IF(M6>20,1,0)		3rd Quartile	=QUARTILE(M:M,3)	knots
=L6*0.869	=IF(M7>20,1,0)		Maximum	=MAX(M:M)	knots
=L7*0.869	=IF(M8>20,1,0)		Total measurements	=COUNT(M:M)	
=L8*0.869	=IF(M9>20,1,0)		Measurements over 20 kts	=COUNTIF(N:N,1)	
=L9*0.869	=IF(M10>20,1,0)		Percentage over 20 kts	=Q8/Q7	

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7. The resulting values provide insight into the overall frequency of different wind speeds and directions at the location of the buoy. Looking at the frequency of values over the proposed threshold value provides perspective on how often the selected threshold may be exceeded in the oil transfer area.

M	N	O	P	Q	R
Daily High Windspeed (kts)	Over 20 kts		Sustained Wind Statistics		
8.3	0		Average	10.9	knots
10.7	0		1st Quartile	7.7	knots
9.7	1		Median	9.7	knots
25.6	0		3rd Quartile	12.4	knots
11.3	0		Maximum	36.3	knots
10.9	0		Total measurements	723	
8.0	0		Measurements over 20 kts	37	
15.1	0		Percentage over 20 kts	5.1%	

Open-Meteo wind data. For those locations where there are no readily accessible historical observations, it may be worth exploring modeled data. Open-Meteo offers free access to estimated historical weather data for non-commercial use (link). To produce historical estimates, they combine weather models with weather station, aircraft, buoy, radar, and satellite observations. When considering the use of Open-Meteo estimates, be aware that they are produced at a nine-kilometer resolution. To find data for a given area, follow the directions below.

1. Enter the latitude and longitude for the oil transfer location. Modify the start and end date to include the two most recent years of data available. The example latitude is for Smith Cove East anchorage.

Location and Time

Location: ● **Coordinates** ≡ List

Latitude
47.62

Longitude
-122.37

Start Date
2022-11-13

End Date
2024-11-13

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2. Select Wind Speed (10 m), Wind Direction (10 m), and Wind Gusts (10 m).

Hourly Weather Variables

☐ Temperature (2 m)	☐ Weather code	☑ Wind Speed (10 m)
☐ Relative Humidity (2 m)	☐ Sealevel Pressure	☐ Wind Speed (100 m)
☐ Dewpoint (2 m)	☐ Surface Pressure	☑ Wind Direction (10 m)
☐ Apparent Temperature	☐ Cloud cover Total	☐ Wind Direction (100 m)
☐ Precipitation (rain + snow)	☐ Cloud cover Low	☑ Wind Gusts (10 m)
☐ Rain	☐ Cloud cover Mid	
☐ Snowfall	☐ Cloud cover High	
☐ Snow depth	☐ Reference Evapotranspiration (ET$_0$)	
	☐ Vapour Pressure Deficit	

3. Select "knots" as the Wind Speed Unit.

Settings

Temperature Unit	Wind Speed Unit	Precipitation Unit
Celsius °C ⌄	Knots ⌄	Millimeter ⌄

4. Select "download xlsx" to download the excel file containing the estimated wind speeds for the general vicinity of the selected latitude/longitude.

Jan '21   Mar '21   May '21   Jul '21   Sep '21

[Download XLSX]   [Download CSV]

5. Use the QUARTILE, AVERAGE, and MAX formulas to analyze the data. Use the IF, COUNTIF, and COUNT formulas to produce a percentage of time over a threshold velocity. In this example, the threshold is 20 knots for sustained winds, and 30 knots for gusts.

B Wind (kn)	C Over 20?	F Gusts (kn)	G Over 30?	H	I Sustained Wind Statistics	J	K	L	M Gust Statistics	N	O
2.5	=IF(B2>20,1,0)	10.9	=IF(F2>30,1,0)		Average	=AVERAGE(B:B)	knots		Average	=AVERAGE(F:F)	knots
3.9	=IF(B3>20,1,0)	5.8	=IF(F3>30,1,0)		1st Quartile	=QUARTILE(B:B,1)	knots		1st Quartile	=QUARTILE(F:F,1)	knots
4.1	=IF(B4>20,1,0)	5.8	=IF(F4>30,1,0)		Median	=QUARTILE(B:B,2)	knots		Median	=QUARTILE(F:F,2)	knots
4.1	=IF(B5>20,1,0)	6	=IF(F5>30,1,0)		3rd Quartile	=QUARTILE(B:B,3)	knots		3rd Quartile	=QUARTILE(F:F,3)	knots
4.3	=IF(B6>20,1,0)	6.2	=IF(F6>30,1,0)		Maximum	=MAX(B:B)	knots		Maximum	=MAX(F:F)	knots
4.9	=IF(B7>20,1,0)	6.4	=IF(F7>30,1,0)		Total measurements	=COUNT(B:B)			Total measurements	=COUNT(G:G)	
4.3	=IF(B8>20,1,0)	6.2	=IF(F8>30,1,0)		Measurements over 20 kts	=COUNTIF(C:C,1)			Measurements over 30 kts	=COUNTIF(G:G,1)	
4.1	=IF(B9>20,1,0)	5.2	=IF(F9>30,1,0)		Percentage over 20 kts	=J8/J7			Percentage over 30 kts	=N8/N7	

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6. Use the IF, COUNTIF and COUNT formulas to produce a percentage of time for general direction of wind.

D	E	H	Q	R
Direction	Cardinal Direction		Wind Direction	
356	=IF(OR(D2>315,D2<45),"N",IF(AND(D2>225,D2<=315),"E",IF(AND(D2>135,D2<=225),"S","W")))		Total measurements	=J7
360	=IF(OR(D3>315,D3<45),"N",IF(AND(D3>225,D3<=315),"E",IF(AND(D3>135,D3<=225),"S","W")))		Percentage Northerly	=(COUNTIF(E:E,"N"))/R2
5	=IF(OR(D4>315,D4<45),"N",IF(AND(D4>225,D4<=315),"E",IF(AND(D4>135,D4<=225),"S","W")))		Percentage Easterly	=(COUNTIF(E:E,"E"))/R2
3	=IF(OR(D5>315,D5<45),"N",IF(AND(D5>225,D5<=315),"E",IF(AND(D5>135,D5<=225),"S","W")))		Percentage Southerly	=(COUNTIF(E:E,"S"))/R2
18	=IF(OR(D6>315,D6<45),"N",IF(AND(D6>225,D6<=315),"E",IF(AND(D6>135,D6<=225),"S","W")))		Percentage Westerly	=(COUNTIF(E:E,"W"))/R2

7. The resulting values provide insight into the overall frequency of different wind speeds and directions in the selected area. Looking at the frequency of values over the proposed threshold value provides perspective on how often the selected threshold may be exceeded in the oil transfer area.

I	J	K	L	M	N	O	P	Q	R
Sustained Wind Statistics				Gust Statistics				Wind Direction	
Average	6.1	knots		Average	11.9	knots		Total measurements	17568
1st Quartile	3.5	knots		1st Quartile	7.2	knots		Percentage Northerly	35%
Median	5.3	knots		Median	10.8	knots		Percentage Easterly	6%
3rd Quartile	8.1	knots		3rd Quartile	15.3	knots		Percentage Southerly	42%
Maximum	28.1	knots		Maximum	48.8	knots		Percentage Westerly	18%
Total measurements	17568			Total measurements	17568				
Measurements over 20 kts	47			Measurements over 30 kts	206				
Percentage over 20 kts	0.3%			Percentage over 30 kts	1.2%				

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Sea State

The S&E Reports must include data on sea state values in feet including typical wave periods. Supporting data must cover multiple years, and cannot be more than 10 years old.

The NOAA national data buoy center has historical data for its buoys, some of which record wave height and period. There are only a handful of buoys in Washington waters that record wave height. A map showing buoy locations is available here (link). Iowa State University also archives National Weather Service marine weather forecasts that contain forecasts of wave heights for inland waters. The archived versions of the Washington Coastal Waters Forecast are available for download here (link). The available forecasts are embedded in prose, so they can be challenging to process to a point that would allow for bulk evaluation. If you do not have a source for observed wave height data for a transfer location, you can use the NWS predictions for your S&E Report.

To find data for a NOAA buoy, follow the directions below.

1. Station 46088 New Dungeness is one of the few buoy stations that records wave height in the Salish Sea. Click on it, and click submit.
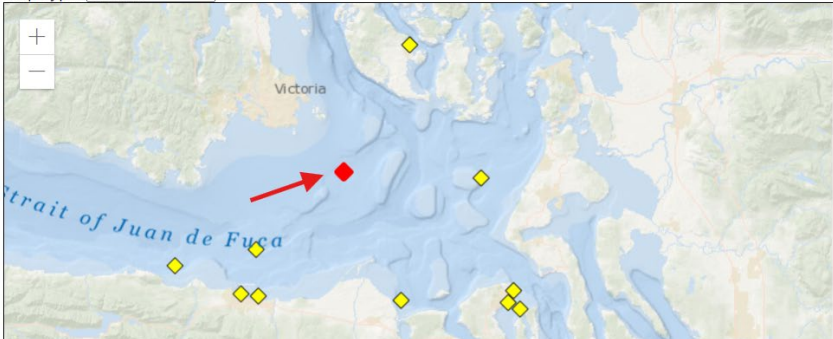
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2. Select the most recent year, and press submit.

3. Click on "View all meteorological observations for station…"

4. Save the resulting file and import into Excel to analyze. The station should show wave height in meters and dominant wave period in seconds.

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5. Create one tab for wave height, and another tab for wave period data. Remove rows with invalid height measurements, shown as "99.00" meters, from the first tab. Remove rows with invalid dominant wave period measurements, show as "99.00" seconds, from the second tab. Convert wave heights in meters into feet by multiplying by 3.28.

WVHT	Height in Feet
0.87	=G2*3.28
0.87	=G3*3.28
0.85	=G4*3.28
0.8	=G5*3.28

DPD	APD	MWD
sec	sec	deg
17.39	8.1	210
17.39	7.84	192
17.39	8	239
17.39	7.94	203

6. Use the QUARTILE, AVERAGE, and MAX formulas to analyze the wave height data. Use the IF, COUNTIF, and COUNT formulas to produce a percentage of time over a threshold velocity. In this example, the threshold is wave height of 2 feet.

WVHT	Height in Feet	Over 2ft?		Height Statistics		
0.87	2.9	1		Average	0.4	feet
0.87	2.9	1		1st Quartile	0.2	feet
0.85	2.8	1		Median	0.3	feet
0.8	2.6	1		3rd Quartile	0.6	feet
0.77	2.5	1		Maximum	3.2	feet
0.77	2.5	1		Total measurements	17440	
0.73	2.4	1		Measurements over 2 feet	4251	
0.7	2.3	1		Percentage over 2 feet	24.4%	

7. Use the QUARTILE, AVERAGE, and MAX formulas to analyze the wave period data.

DPD	APD	MWD	Period Statistics	
sec	sec	deg	Average	4.8
17.39	8.1	210	1st Quartile	3.3
17.39	7.84	192	Median	4.0
17.39	8	239	3rd Quartile	5.0
17.39	7.94	203	Maximum	17.4
16	3.32	339		

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