FEMA HANDOUT

Special Wind Region (SWR) Maps for the Commonwealth of the Northern Mariana Islands (CNMI)

This handout offers guidance on how design professionals, planners, citizens, and other stakeholders can use an alternative method to determine design wind speeds for various types of buildings in the CNMI. It references the Special Wind Region maps produced by the Federal Emergency Management Agency (FEMA), which are captured in a user-friendly interface on the ATC Hazards by Location website. Reference Appendix A in this handout for guidance on how to easily determine design wind speeds by using the website.

How To Determine Your Design Wind Speed

For better building construction and greater public safety, the Twenty-First Northern Marianas Commonwealth Legislature adopted the 2018 International Building Code (IBC) through Public Law No. 21-14 as signed by the governor on December 19, 2019. Soon afterwards, the Department of Public Works updated the Building Safety Code Rules and Regulations (Sec. 155-10.1-601) to use the 2018 IBC and 2018 International Residential Code (IRC). The IBC and IRC govern the design and construction of buildings in the CNMI and in the process utilize design wind speeds.[1] Design wind speeds often need to be adjusted (increased) for wind speed-up due to hills, ridges, and escarpments which exist in the topography of the islands. This code update will help improve building performance and apply the latest information on hazard identification for guiding design and construction in the future.

In support of applying the building code as it relates to wind hazards, FEMA developed the 2020 CNMI Special Wind Region (SWR) maps to simplify the process of determining the design wind speeds. The SWR maps for the CNMI include the effects of island topography and provide an alternative method to the guidance found in *Minimum Design Loads and Associated Criteria for Buildings and Other Structures* (ASCE/SEI 7-16), which is referenced by the adopted 2018 IBC and 2018 IRC. In the engineering standard ASCE/SEI 7-16, the procedures require using a site coefficient, K_{zt}, to adjust the design wind speed values for topography for the effects of wind speed-up across terrain when hills, ridges, or escarpments are present at or near the building site. The SWR maps utilize the latest science of wind speed behavior

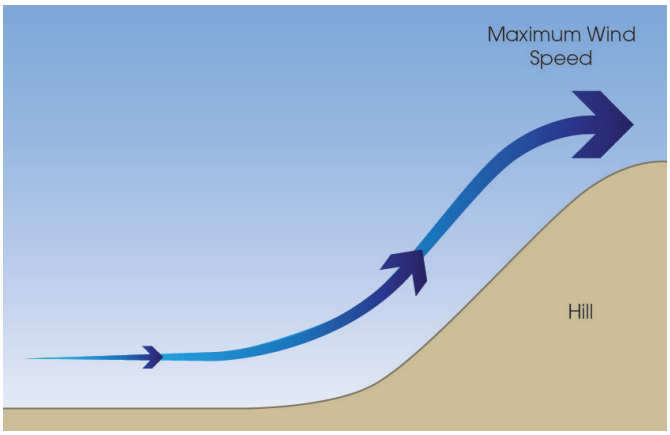

Figure 1. Wind speed-up effects at hills, ridges, and escarpments with maximum wind speeds occurring at the top.

[1] For simplification, the terms “basic design wind speed” and “design wind speed” are considered equivalent in this handout.

to assist design professionals in determining the appropriate design wind speed for any site on the islands of Saipan, Tinian, and Rota. As described in ASCE/SEI 7-16 Section 26.5.3, this is an alternative method for determining design wind speeds by using historical typhoon weather data. These SWR maps and the associated design wind speeds enable design professionals to simply select a design wind speed for a building at a site from the SWR maps and obtain results similar to those of ASCE/SEI 7-16's methodology, yet without performing the additional, complex calculations it requires. Using the SWR maps for the design of buildings and structures helps optimize designs and avoids unnecessary costs. These efforts have culminated in the opportunity for these SWR maps to be adopted for use as an alternative method for calculating design wind pressures on buildings and structures.

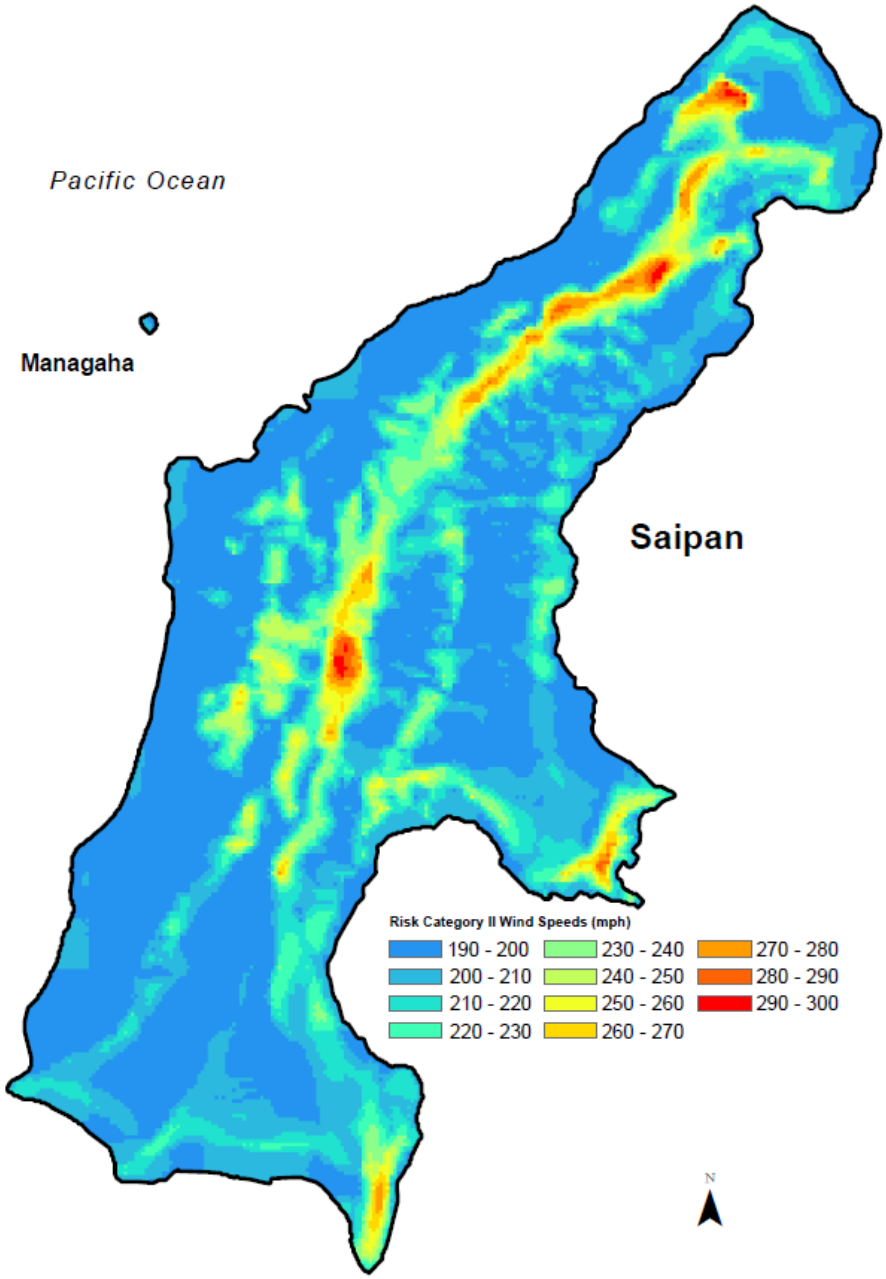

Figure 2. Risk Category II (appropriate for buildings such as 1- and 2-family dwellings, office buildings, and retail buildings) color-coded Special Wind Region map of Saipan in miles per hour (mph) displaying colors assigned to a range of design wind speeds. The regions in green, yellow, orange, and red illustrate areas with higher wind speeds because of wind speed-up at hills, ridges, and escarpments. This map provides a color-coded example of how the FEMA design wind speed data can be represented.

FEMA produced four sets of SWR maps for each of the islands of Saipan, Tinian, and Rota, for a total of twelve SWR maps. There are four SWR maps for each island to show the wind speeds related to each of the four Risk Categories of ASCE/SEI 7-16. The design wind speed values will increase for a particular location as the Risk Category number increases from I to IV to provide higher performance of more important buildings and structures. Each Risk Category map is associated with a mean recurrence interval (MRI), which simply means the average expected period of time between occurrences for that wind intensity. The mean recurrence intervals can also be described in terms of how often the winds will be expected to exceed the design values within a 50-year period. See Table 1 for a summary of the MRI values and probability of exceedance for each Risk Category.

Table 1. Summary of ASCE/SEI 7-16 Risk Categories

Risk Category	Description	Building Examples	Mean Recurrence Interval (MRI)	Probability of Exceedance in 50 Years
I	Buildings and other structures that represent a low hazard to human life in the event of failure	Agricultural facilities, certain temporary facilities, minor storage facilities	300 years	15%
II	Buildings and other structures except those listed in Risk Categories I, III, IV	1- and 2-family dwellings, office buildings, retail buildings	700 years	7%
III	Buildings and other structures that represent a substantial hazard to human life in the event of failure	Educational facilities, buildings with public assembly loads greater than 300	1,700 years	3%
IV	Buildings and other structures designated as essential facilities	Ambulatory care facilities, fire and police stations, emergency shelters	3,000 years	1.6%

Each SWR map provides design wind speed contours associated with the topography of the islands. The contour lines on the maps connect points of equal design wind speed, such that as one physically follows the contour line, the design wind speed remains constant. In general, areas of hills and mountains will have higher design wind speed values because of wind speed-up effects. See Figures 3 and 4 for an illustration of how the topography of the CNMI creates higher design wind speeds shown as contour lines.

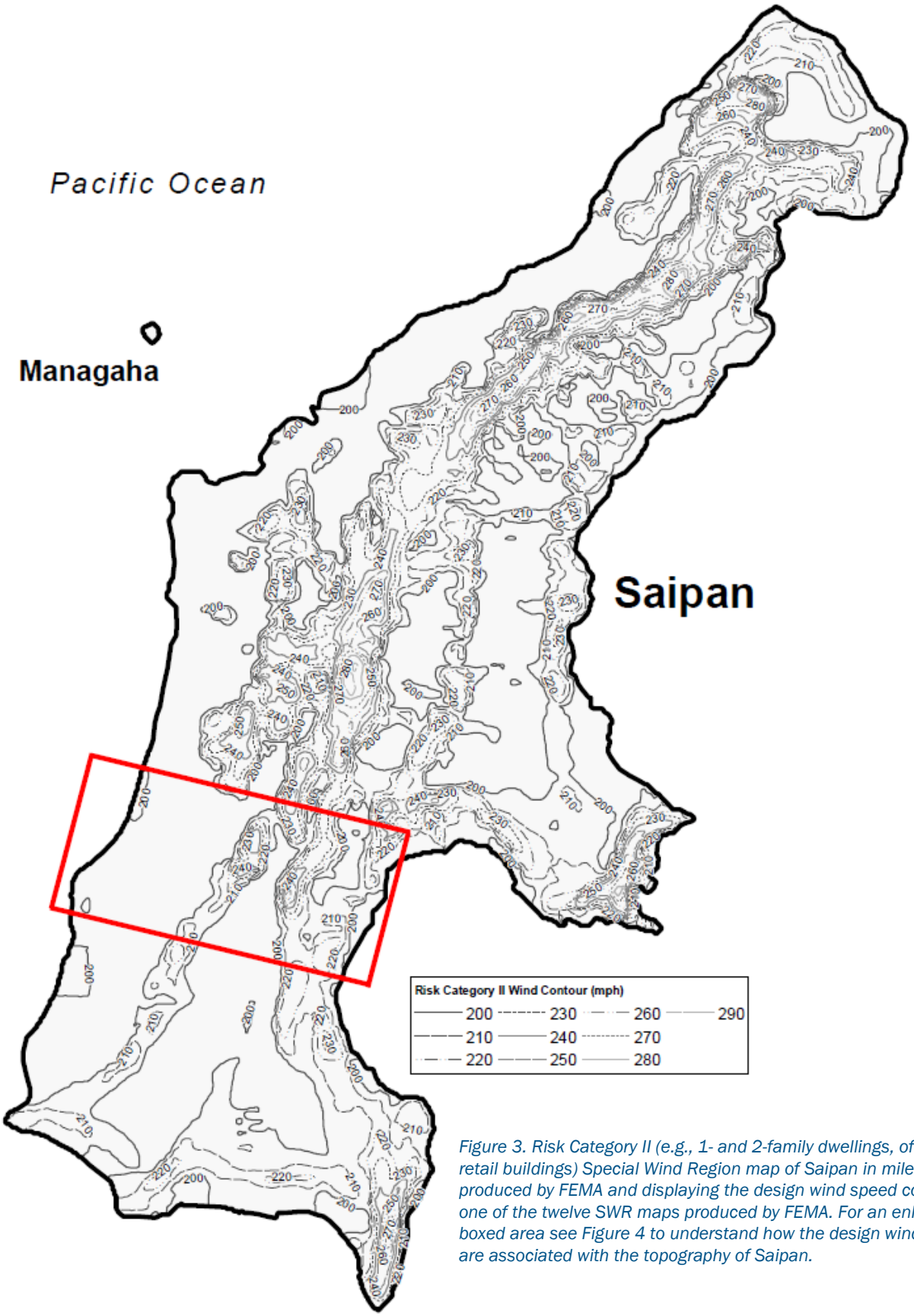

Figure 3. Risk Category II (e.g., 1- and 2-family dwellings, office buildings, and retail buildings) Special Wind Region map of Saipan in miles per hour (mph) produced by FEMA and displaying the design wind speed contour lines. This is one of the twelve SWR maps produced by FEMA. For an enlarged view of the red boxed area see Figure 4 to understand how the design wind speed contour lines are associated with the topography of Saipan.

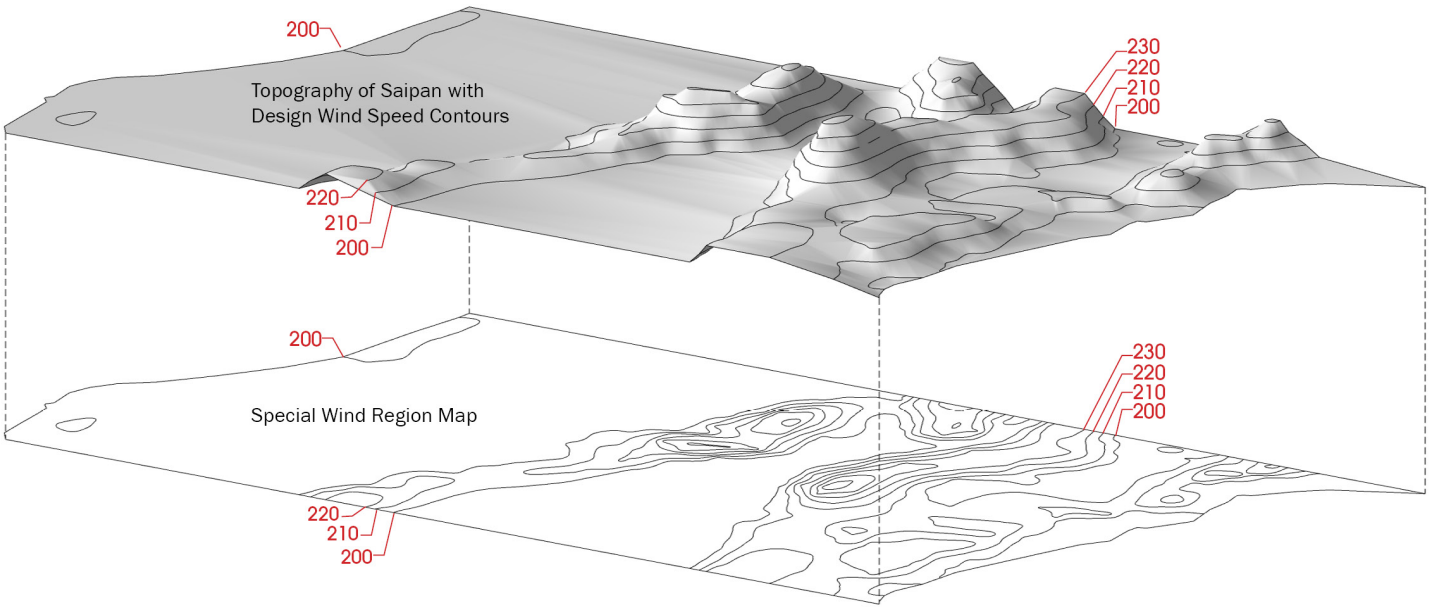

Figure 4. Enlarged view of the Special Wind Region map of Saipan for Risk Category II. The topography of Saipan, with its hills and mountains, could be projected onto a flat surface to view the design wind speed contour lines as a SWR map. The illustration above is an example of what that projection would look like for a small area of Saipan. All design wind speeds shown in mph.

References and Resources

American Society of Civil Engineers (ASCE). 2017. *Minimum design loads and associated criteria for buildings and other structures.* ASCE/SEI 7-16. https://www.asce.org/structural-engineering/asce-7-and-sei-standards/.

Applied Technology Council (ATC). 2020. *ATC Hazards by Location*. https://hazards.atcouncil.org/

CNMI Department of Public Works. https://opd.gov.mp/library/agency/department-of-public-works/.

CNMI Office of Planning and Development. https://opd.gov.mp/.

CNMI Office of the Governor. https://governor.gov.mp/.

Federal Emergency Management Agency (FEMA). 2011. *Coastal Construction Manual*, 4th ed. https://www.fema.gov/media-library-data/20130726-1510-20490-2899/fema55_voli_combined.pdf

International Code Council (ICC). 2018a. 2018 IBC: International Building Code. https://codes.iccsafe.org/public/document/IBC2018.

International Code Council (ICC). 2018b. 2018 IRC: International Residential Code. https://codes.iccsafe.org/public/document/IRC2018.

For more information, see the FEMA Building Science Frequently Asked Questions Web site at https://www.fema.gov/frequently-asked-questions-building-science.

If you have any additional questions on FEMA Building Science Publications, contact the helpline at

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Appendix A

Step 1

Go to the ATC Hazards by Location website at https://hazards.atcouncil.org/. Select either the "Search by Coordinate" tab or "Search by Address" tab and enter the information for the location of interest. To drop a red pin on one of the islands as a location, begin by selecting the "Search by Address" tab and type "Saipan, CNMI" or "Tinian, CNMI" or "Rota, CNMI." Click "Search." The map image will bring up a view of the location. When entering coordinates, be sure to use decimal degrees to at least five decimal places.

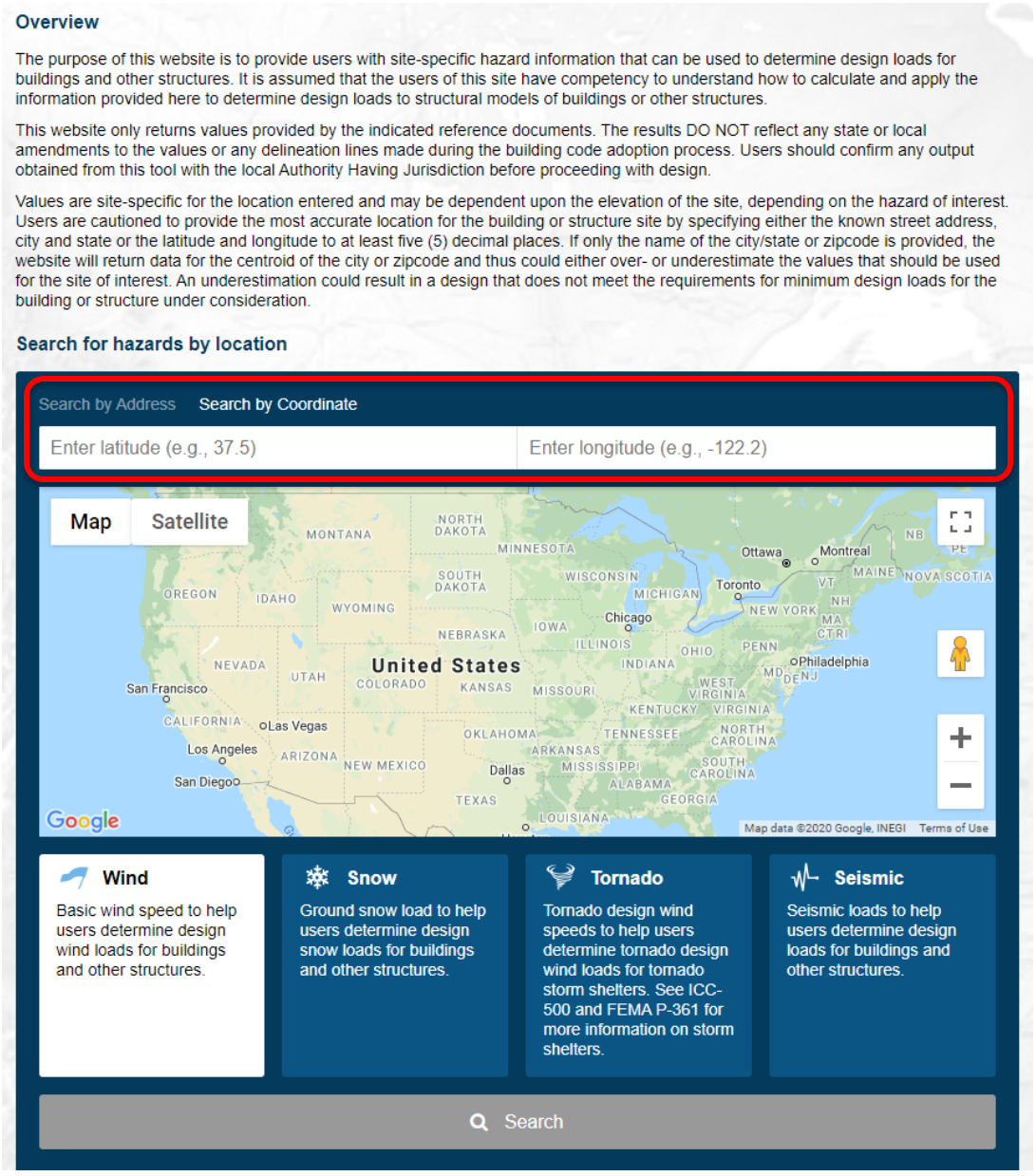

Figure A-1. ATC Hazards by Location welcome screen.

Step 2

To zoom in on the map, click on the "+" symbol. To zoom out on the map click on the "-" symbol. To adjust the location of the red pin, click and hold. Once the pin is moved from the original location, a hand grab icon will appear. While holding the pin, move it to the location desired on the map. Then, release the pin.

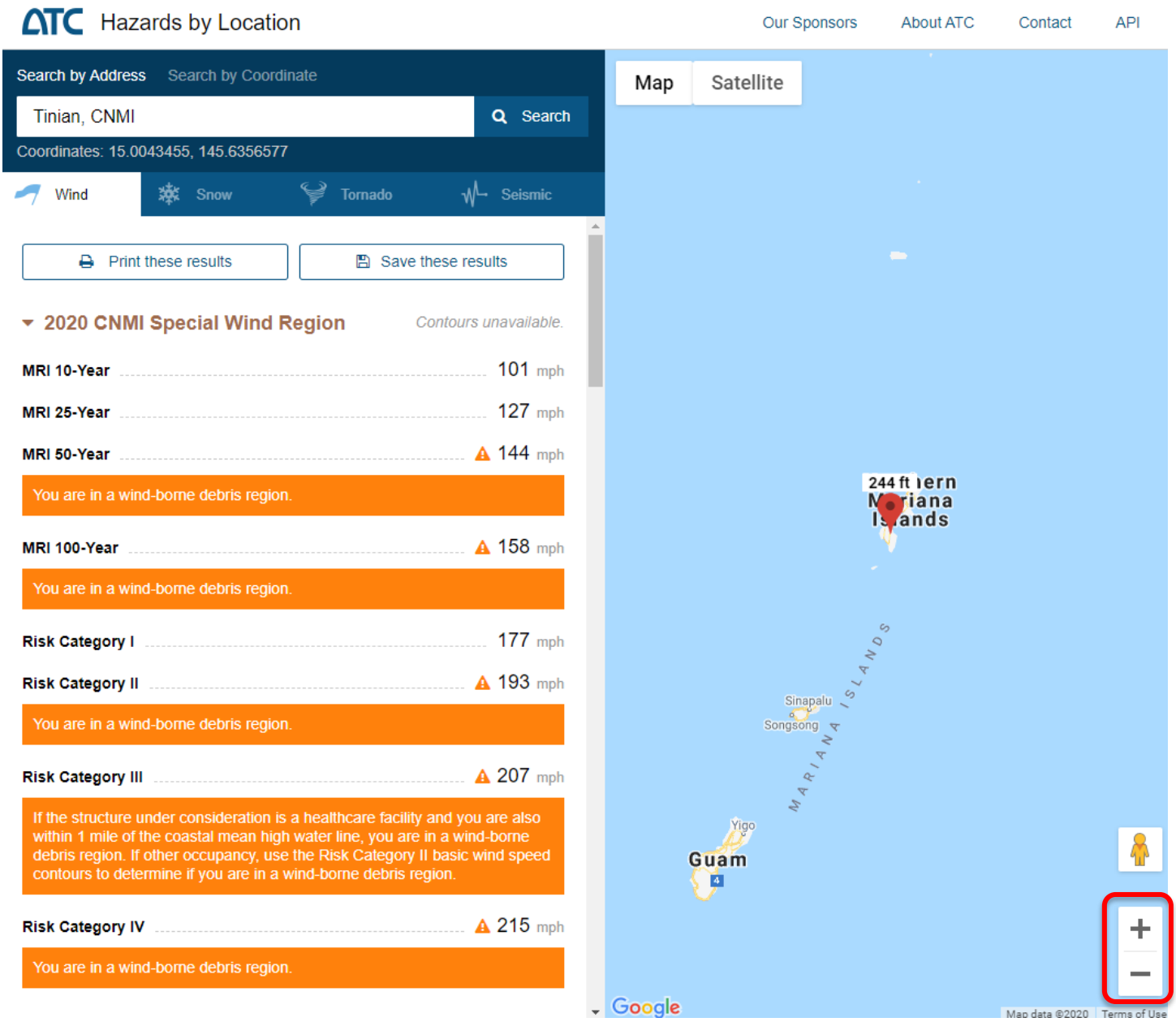

Figure A-2. View of wind data after performing Search by Address using ATC Hazards by Location website. Notice the zoom buttons on the right side of the view.

Step 3

Select the Wind tab to see available MRIs and Risk Categories. Design wind speeds are provided for each of the Risk Categories of I to IV. The design wind speeds in this user-friendly interface reflect the same values of the Special Wind Region maps produced by FEMA.

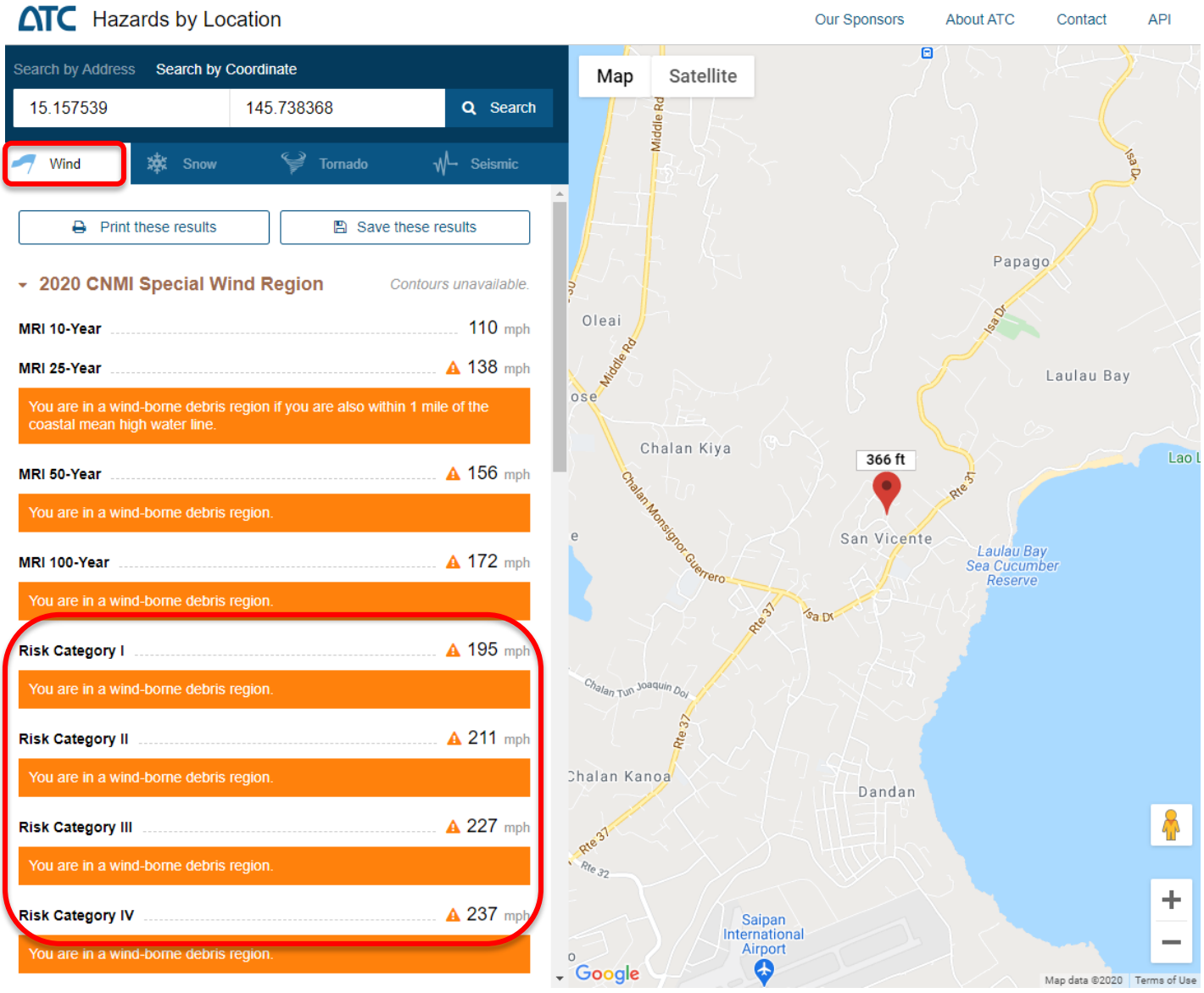

Figure A-3. View of wind data after performing Search by Coordinate using ATC Hazards by Location website. Notice the Wind tab is selected, see small red box, and shows the design wind speeds associated with each of the Risk Categories, as designated by the large red box.

Step 4

Review the design wind speed associated with the MRIs and Risk Categories of interest. All areas in Saipan, Tinian, and Rota are classified as windborne debris regions because they have design wind speeds of 140 mph or greater. Windborne debris regions are defined in Chapter 2 of the 2018 edition of the International Building Code (IBC) and International Residential Code (IRC) as:

> Areas within hurricane-prone regions located:
>
> 1. Within 1 mile (1.61 kilometers) of the coastal mean high-water line where the design wind speed, *V*, is 130 mph (58 meters/second) or greater; or
> 2. In areas where the design wind speed is 140 mph (63.6 meters/second) or greater.

The IBC and IRC include specific provisions for windborne debris regions. Section 1609.2 of the 2018 IBC and Section R301.2.1.2 of the IRC provide requirements for glazing in buildings located in windborne debris regions. Section 2407.1.4 of the IBC provides requirements for glazing in in-fill panels or balusters in windborne debris regions. Section R609.6 of the IRC addresses protection of exterior windows, glass doors, and doors with glass.

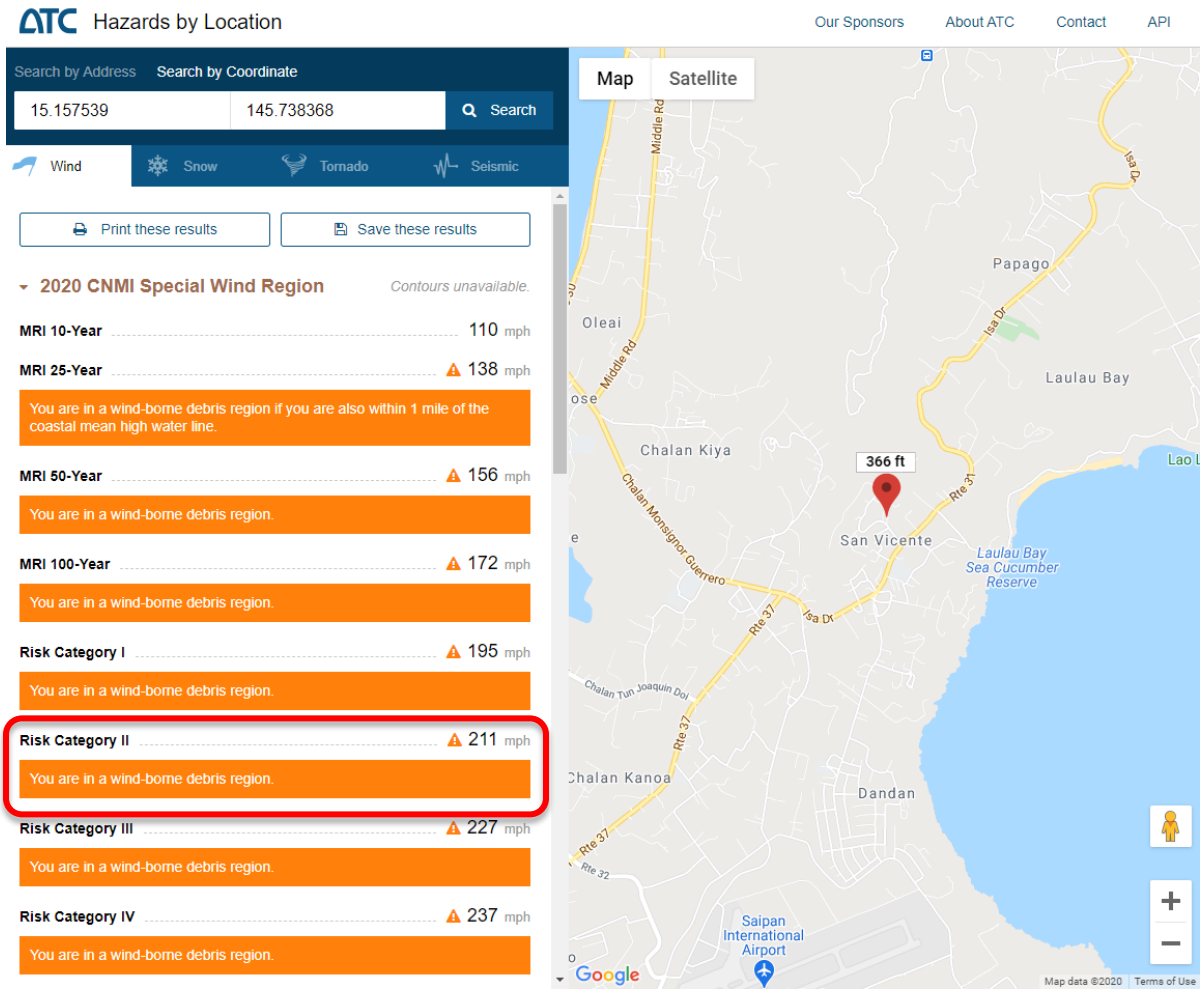

Figure A-4. Select the Risk Category for the building or structure to determine the appropriate design wind speed. Each Risk Category comes with a note saying "You are in a wind-borne debris region" as shown on the ATC Hazards by Location website.

Step 5

Click on the minimize arrow found adjacent to the data-set name to hide unnecessary data-sets.

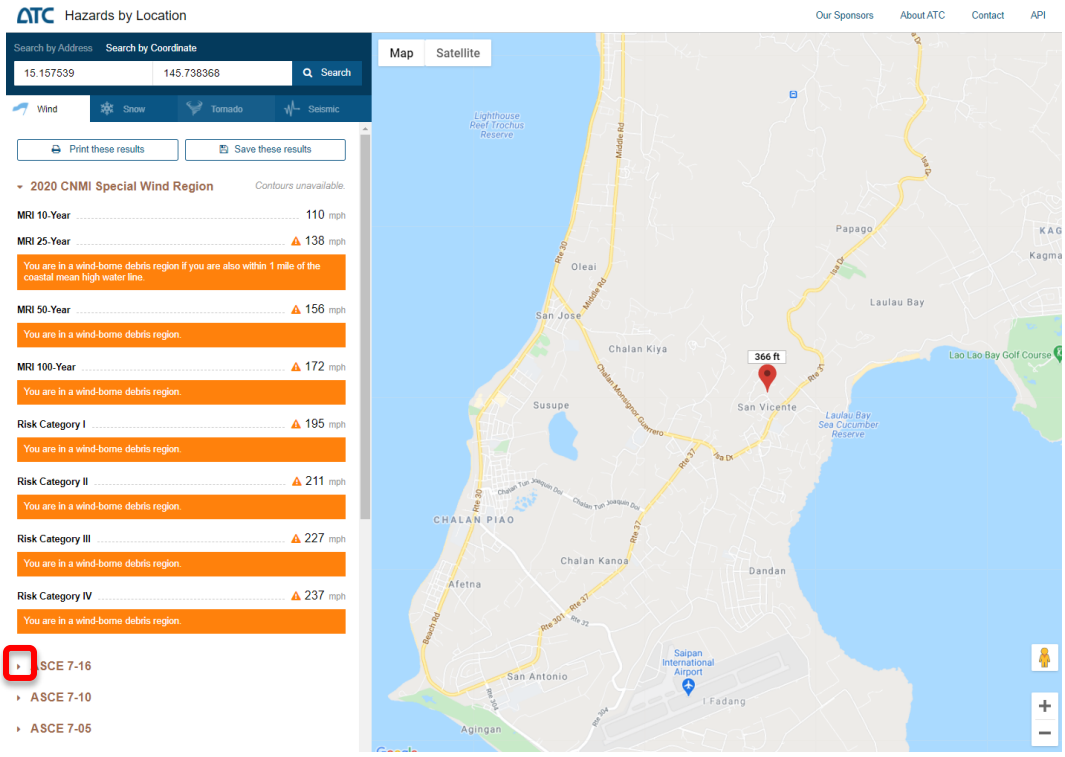

Figure A-5. View of the data-sets after minimizing unnecessary sets on the ATC Hazards by Location website.

Step 6

To save results to a file, click on “Save these results.” The tool output is saved as two Excel files; one includes the results data, and the other includes the input data. To print results, click on “Print these results.” Results can be printed to a PDF file or to a printer.

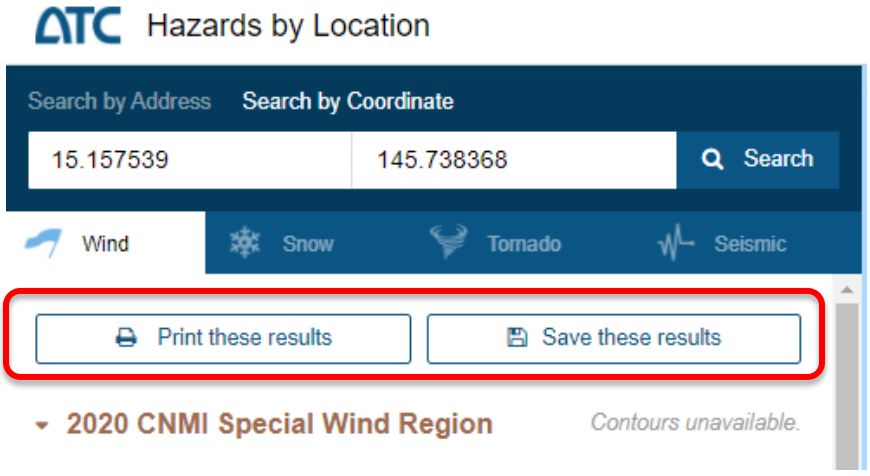

Figure A-6. Click on either “Print these results” or “Save these results” to keep a record of the data-sets as shown on the ATC Hazards by Location website.