ANNEX A: STORM TRACK AND INTENSITY CALCULATION METHODOLOGY

Data Source

As part of its standard operating procedure the U.S. National Hurricane Center (D1) (NHC) publishes ongoing reports describing the current characteristics of a storm (tropical systems). Each storm is recorded within its own comma delimited file known as a B-Deck Report(D2). Each report contains rows in chronological order with each row representing a B-Deck Observation(D3) detailing the date and time, position, wind speed, as well as other defining characteristics of the storm.

B-Deck Reports contain observations recorded at standard synoptic reporting times of 0000 UTC, 0600 UTC, 1200 UTC, and 1800 UTC. In addition to these standard hours, the NHC may opt to include intermediate observations (non-standard times) if conditions warrant. These additional observations are provided at the sole discretion of the NHC.

NHC publishes B-Deck Reports on a storm-by-storm basis for the life of a storm, from storm Genesis(D4) to Dissipation(D5). New observations are appended to the file in "real-time". Once a storm dissipates, NHC will cease appending new observations. At its discretion, the NHC may modify the previously issued observations.

Speedwell Settlement Services, Ltd. (the "Weather Data Provider") will obtain the B-Deck Report (described below as "Capture") for each storm and extract the following variables for each B-Deck Observation:

- Date and Time(D6)
- Position(D7)
- Wind Speed(D8)

Each variable is processed through Data Quality Control to detect and correct any Gross Errors occurring in the dataset.

Data Capture, Quality Control, and Certification

On the fourth Business Day(D9) after the Dissipation of a storm, the Weather Data Provider will Capture(D10) the current B-Deck Report for the storm. Any modifications to the B-Deck Report after this time (or prior B-Deck Reports) are not considered for the purposes of this methodology.

The Weather Data Provider performs Data Quality Control(D11) on the Captured B-Deck Observations, specifically the Date and Time, Position, and Wind Speed. The quality control methodology is designed to detect Gross Errors. If a Gross Error is detected, the Weather Data Provider will attempt to recover the correct observation from the NHC. If this is not possible, the Weather Data Provider will generate a replacement value based upon industry standard practices.

By the end of the third Business Day after the Capture of the B-Deck Report the Weather Data Provider will certify the B-Deck Observations (inclusive of any modification made pursuant to this methodology) as Certified Observations(D12). For the avoidance of doubt, Certified Observations will not change. No additional extraneous evidence will be considered by the Weather Data Provider in making its determination of Certified Observations.

For purposes of this analysis the following variables from each B-Deck Observation are provided by the Weather Data Provider as Certified Observations:

- Certified Date and Time(D13)

- Certified Position(D14)
- Certified Category(D16) (derived from Certified Wind Speed(D15))

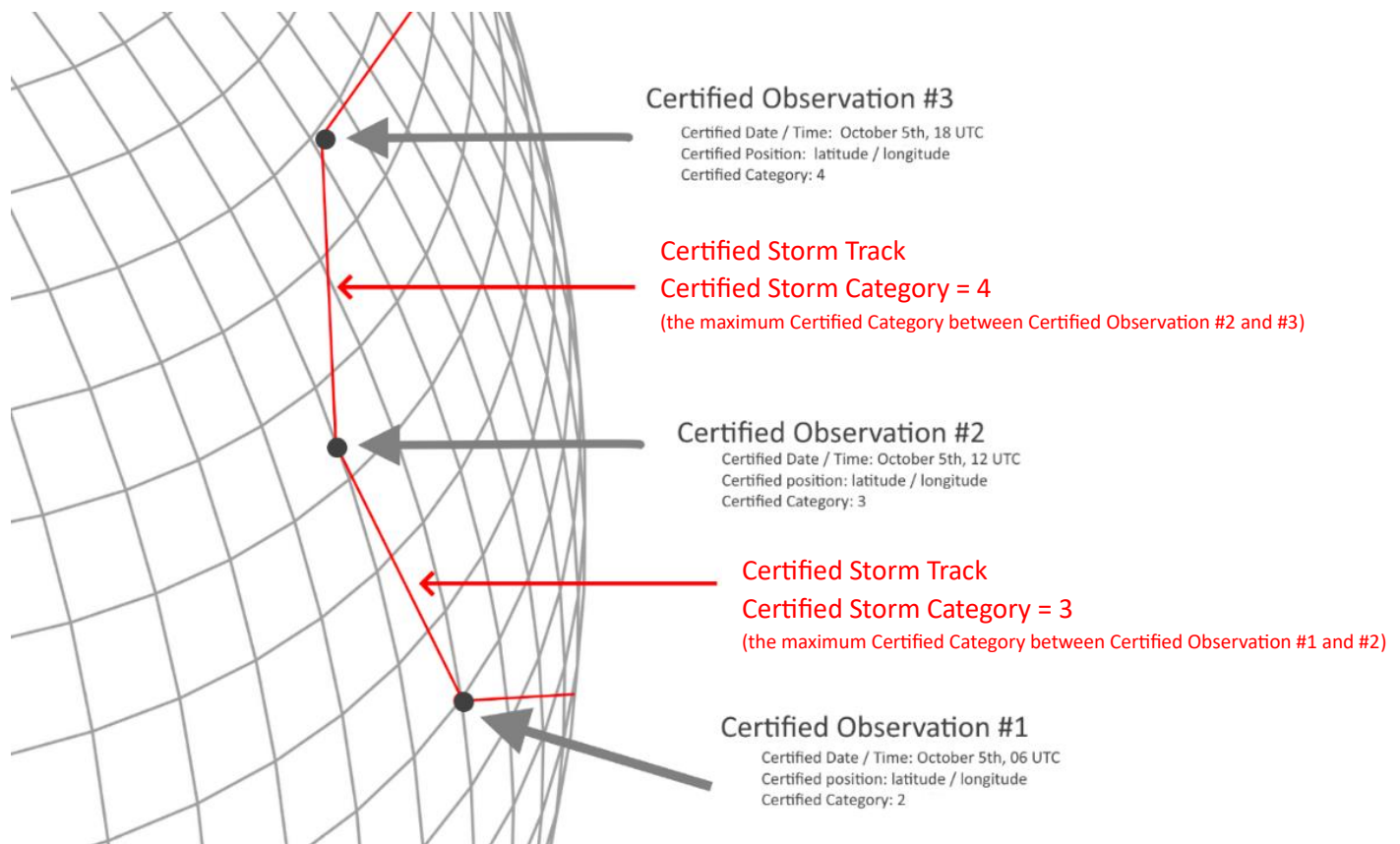## Determination of Certified Storm Track and Certified Storm Category

Certified Observations provide a snapshot of a storm at regular intervals. Consecutive Certified Observations are used to determine the theoretical track and category of a hurricane / tropical cyclone. Concurrently with the preparation of the Certified Observations, the Weather Data Provider will also calculate the following:

Certified Storm Track(D17)

A theoretical path representing the location of a storm as it moves across the earth. This track is determined by connecting the Certified Positions to produce a continuous storm track (concatenation of arc segments).

Certified Storm Category(D18)

Theoretical storm intensity during the life of the storm. Segments of the Certified Storm Track are assigned an intensity (Certified Storm Category) based upon the maximum Certified Category of the two Certified Observations marking the beginning and end of each arc segment.

Certified Observation #3
Certified Date / Time: October 5th, 18 UTC
Certified Position: latitude / longitude
Certified Category: 4

Certified Storm Track
Certified Storm Category = 4
(the maximum Certified Category between Certified Observation #2 and #3)

Certified Observation #2
Certified Date / Time: October 5th, 12 UTC
Certified position: latitude / longitude
Certified Category: 3

Certified Storm Track
Certified Storm Category = 3
(the maximum Certified Category between Certified Observation #1 and #2)

Certified Observation #1
Certified Date / Time: October 5th, 06 UTC
Certified position: latitude / longitude
Certified Category: 2

Access to Certified Storm Category Data

In the event that the Calculated Distance$_{(C1)}$ between a point identified by the insurer and the Certified Storm Track of a tropical storm/hurricane is less than or equal to a threshold (in statute miles) defined by the insurer, the Weather Data Provider will supply (the insurer) with the Certified Storm Category associated with the segment of the Certified Storm Track that passes within such area. For the avoidance of doubt, in the event there are multiple segments of a Certified Storm Track that pass within such defined area, the Weather Data Provider shall report the highest Certified Storm Category associated with such segments.

For the avoidance of doubt, the Weather Data Provider shall not (a) participate in the ascertainment or determination of any claim, loss, or damage payable under the Policy, or (b) effect the settlement of such claim, loss, or damage.

Definitions

D1	National Hurricane Center	A division of the National Oceanic and Atmospheric Administration, or any successor-in-interest thereto.
D2	B-Deck Report	A comma separated file provided for each storm monitored by the NHC which contains synoptic hour characteristics and is updated in real time throughout the life of a system. B-Deck Reports can be found here for the most recent storm season: https://ftp.nhc.noaa.gov/atcf/btk/.
D3	B-Deck Observation	Storm characteristics as reported within a given row of a B-Deck Report. Characteristics include Date and Time, Position, Wind Speed as well as many other pieces of information falling outside the scope of this Policy.
D4	Genesis	Determined by the date and time of the first updated B-Deck Observation associated with a storm.
D5	Dissipation	Determined by the date and time of the last updated B-Deck Observation associated with a storm.
D6	Date and Time	YYYYMMDDHHMM (UTC)
D7	Position	Latitude 0-900 tenths of degrees, N/S is the hemispheric index. Longitude 0-1800 tenths of degrees, E/W is the hemispheric index.
D8	Wind Speed	The maximum sustained wind speed of the storm in knots (0-300 kts) as reported by the NHC for a specific day and time.
D9	Business Day	Refer to the Speedwell Settlement Services Calendar: https://www.speedwellsettlementservices.com/en/HowItWorks/Holidays
D10	Capture	On the fourth Business Day after Dissipation, at 1800 UTC, the Weather Data Provider downloads the B-Deck report for the storm from the source linked in the B-Deck Report definition.
D11	Data Quality Control	Raw Data (D6-D8) shall be processed to detect Gross Errors and Missing Data. Data Errors and Missing Data will be replaced / filled with Estimated Values. ***Gross Error*s** Raw Data will be quality controlled. Where the Weather Data Provider deems that a Gross Error exists in the Raw Data, an Estimated Value will be generated and delivered.

Speedwell Settlement Services Limited is registered in England number 10135203
Its registered address is Mardall House, 9-11 Vaughan Road, Harpenden, Hertfordshire AL5 4HU
Speedwell Settlement Services Limited is authorized by the FCA to administer regulated benchmarks.
U.S. office address: 418 King Street, Charleston, SC, 29403

Error Checking Scope – The ability to detect errors in the dataset is dependent upon many factors (inputs to the analysis, type of variable / index…). As used in this context, Error Checking is not designed to determine the exactness of an observation, but rather to guard against Gross Errors that are obviously detectable. The inherent philosophy of this process is to avoid change unless the error is manifest based upon Weather Data Provider Checking Techniques. Where the National Hurricane Center has published a value that is plausible, then it is outside the scope of the Weather Data Provider's work to second guess the observation and replace it.

Error Checking Technique – Techniques used to determine the plausibility of an observation are industry standard quality control checks including as appropriate, data from nearby sites, forecast data, satellite images, radar images, reanalysis data, and output from the Weather Data Provider's proprietary quality control software.

Missing Data
Missing Data means a data point which has not been reported. Where the Weather Data Provider determines that a Missing Data point exists in the Raw Data, an Estimated Value will be generated and delivered.

Estimated Value
An Estimated Value represents an estimate of the value for a given period at a given location. Where reasonably possible the Weather Data Provider will discuss the error / missing value with the originating institution. The goal of this process is to recover accurate observation where possible. For values that cannot be recovered then a synthetic data point will be generated using industry standard techniques including as appropriate, data from nearby sites, forecast data, satellite images, radar images, reanalysis data, and output from Speedwell proprietary quality control software.

D12	Certified Observation	The Weather Data Provider Certified Date, Time, Position, and Wind Speed. For every B-Deck Observation (see D3), there will be an equivalent Certified Observation, albeit the Certified Observation only contains the limited characteristics listed in D13-D15.
D13	Certified Date and Time	The Date and Time (D6) as processed through Data Quality Control and certified by the Weather Data Provider (YYYYMMDDHHMM in UTC)
D14	Certified Position	The Position (D7) as processed through Data Quality Control and certified by the Weather Data Provider. Latitude 0-900 tenths of degrees, N/S is the hemispheric index. Longitude 0-1800 tenths of degrees, E/W is the hemispheric index.
D15	Certified Wind Speed	The Wind Speed (D8) as processed through Data Quality Control and certified by the Weather Data Provider (0-300 kts).

D16	Certified Category	Certified Wind Speed (D15) converted to a Saffir Simpson Category based upon the following conversion: 64-82 knots = Category 1 83-95 knots = Category 2 96-112 knots = Category 3 113-136 knots = Category 4 >= 137 knots = Category 5
D17	Certified Storm Track	A theoretical path representing the location of a storm as it moves across the earth. This track is calculated as a theoretical arc connecting two chronological Certified Positions, these arcs are then concatenated (across all Certified Positions) to produce a path representing the track of a storm. The storm Genesis represents the beginning of the track with storm Dissipation being the end point. The length of the track can vary from a single Certified Position (extremely rare) to dozens of connected Certified Positions as a storm moves across hundreds of miles. For the avoidance of doubt, no additional information shall be used to further refine the Certified Storm Track.
D18	Certified Storm Category	Each Certified Position (the connecting points for the Certified Storm Track) has an associated Certified Category. The Certified Storm Category of the theoretical arc between each set of Certified Positions is defined as the maximum of the Certified Category of the two Certified Positions which are the endpoints of the arc in question. If a Certified Storm Track consists of a single point, then the Category of the track is the Certified Category of the Certified Position. For the avoidance of doubt, no additional information shall be used to further refine the Certified Storm Category.
C1	Calculated Distance	Using the Vincenty Method for calculating distances between two points on the surface of the earth, we calculate the distance between a location identified by the insurer and the Certified Storm Track.