2020 Hurricane Season Flood Alert System
Final Report

Department of Environment, Climate Change and Municipalities

Confederation Building, 4th Floor
St. John's, NL,
A1B 4J6

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FINAL REPORT

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1 Flood Alerts Summary

The Wood Hurricane Season Flood Alert System (HSFAS) Product is the result of professionally trained meteorologists applying their full knowledge of atmospheric science to Newfoundland and Labrador's weather patterns and pairing that with existing trends, known observations, and weather prediction models. Examining maximum precipitation predictions from many different dynamic models allows forecasters to produce a better forecast of the maximum precipitation potential based on the strength of different models in handling the atmospheric physics of differing weather patterns.

From June 2020 to December 2020, 78 alerts were issued in total. There were no missed alerts (i.e., the case when observations from a station trigger an alert that had not been issued). Monthly PDF reports containing all alerts have been provided to WRMD, and a summary of these alerts is below. Note that some communities have two alerts issued in one day. The second of the alerts was issued with the afternoon forecast.

Table 1 Summary of Flood Alerts

		Issue Date	12-hourly Precipitation Forecast (mm)	24-hourly Precipitation Forecast (mm)
1	Stephenville	06-01-2020	139.0	139.0
2	Trout River	06-01-2020	132.0	132.0
3	Deer Lake, Steady Brook	06-01-2020	153.0	153.0
4	St. Lawrence (ST LAWRENCE)	06-01-2020	126.0	126.0
5	Daniel's Harbour (DANIELS HARBOUR)	06-01-2020	110.0	110.0
6	Gander (GANDER AIRPORT CS)	06-01-2020	78.0	78.0
7	Happy Valley-Goose Bay (GOOSE A)	06-01-2020	81.0	81.0
8	Stephenville Crossing, Black Duck Siding	06-01-2020	139.9	139.0
9	Corner Brook	06-01-2020	155.0	155.0
10	Whitbourne	06-01-2020	83.0	83.0
11	Churchill Falls	06-01-2020	59.0	59.0
12	Burgeo (BURGEO NL)	06-01-2020	174.0	174.0
13	Heart's Delight-Islington (Heart's Delight)	06-01-2020	94.0	94.0
14	Bishops Falls	06-01-2020	64.0	64.0
15	St. Alban's (ST ALBANS)	06-01-2020	136.0	136.0
16	Wabush (WABUSH LAKE A)	07-10-2020	43.0	60.0
17	Wabush (WABUSH LAKE A)	07-10-2020	43.0	65.0
18	Churchill Falls	07-10-2020	38.0	55.0
19	Wabush (WABUSH LAKE A)	07-11-2020	62.4	80.0
20	Wabush (WABUSH LAKE A)	07-11-2020	80.0	90.0
21	Churchill Falls	07-11-2020	57.8	78.5

		Issue Date	12-hourly Precipitation Forecast (mm)	24-hourly Precipitation Forecast (mm)
22	Churchill Falls	07-11-2020	45.0	70.0
23	Wabush (WABUSH LAKE A)	07-12-2020	70.0	88.0
24	Wabush (WABUSH LAKE A)	07-12-2020	52.0	55.0
25	Churchill Falls	07-12-2020	49.0	77.0
26	Churchill Falls	07-12-2020	45.0	70.0
27	Burgeo (BURGEO NL)	08-24-2020	109.2	109.2
28	Burgeo (BURGEO NL)	08-24-2020	99.4	100.4
29	St. Anthony (ST ANTHONY)	08-24-2020	59.4	82.1
30	Battle Harbour (BATTLE HARBOUR LOR)	08-24-2020	52.8	64.7
31	Deer Lake, Steady Brook	08-24-2020	62.3	64.8
32	Channel-Port aux Basques (Port Aux Basques)	08-25-2020	92.6	103.4
33	Burgeo (BURGEO NL)	08-25-2020	93.4	108.3
34	Burgeo (BURGEO NL)	08-25-2020	93.4	108.3
35	Deer Lake, Steady Brook	08-25-2020	61.4	69.9
36	Deer Lake, Steady Brook	08-25-2020	54.1	63.5
37	Mary's Harbour (MARY'S HARBOUR A)	08-25-2020	58.4	71.2
38	Battle Harbour (BATTLE HARBOUR LOR)	08-25-2020	58.4	71.2
39	Burgeo (BURGEO NL)	08-26-2020	123.6	124.1
40	Heart's Delight-Islington (Heart's Delight)	09-16-2020	68.4	95.3
41	Winterton	09-16-2020	84.4	95.0
42	Winterton	09-16-2020	73.1	96.0
43	St. Lawrence (ST LAWRENCE)	09-17-2020	90.4	116.1
44	Gander (GANDER AIRPORT CS)	09-17-2020	60.6	80.6
45	Gander (GANDER AIRPORT CS)	09-17-2020	69.1	81.4
46	Glovertown	09-17-2020	74.6	99.7
47	Glovertown	09-17-2020	68.9	85.9
48	St. Lawrence (ST LAWRENCE)	09-18-2020	88.8	120.0
49	St. Lawrence (ST LAWRENCE)	09-18-2020	90.0	120.0
50	Bay Roberts (Shearstown)	09-18-2020	80.0	110.0
51	Bay Roberts (Shearstown)	09-18-2020	75.0	95.0
52	Glovertown	09-18-2020	65.0	85.0
53	Glovertown	09-18-2020	65.0	85.0
54	Hant's Harbour	09-18-2020	90.0	105.0
55	Hant's Harbour	09-18-2020	90.0	105.0
56	Winterton	09-18-2020	90.0	110.0
57	Salmon Cove	09-18-2020	90.0	110.0
58	Carbonear	09-18-2020	90.0	110.0
59	Carbonear	09-18-2020	80.0	100.0
60	Gander (GANDER AIRPORT CS)	09-18-2020	65.0	79.0

		Issue Date	12-hourly Precipitation Forecast (mm)	24-hourly Precipitation Forecast (mm)
61	Heart's Delight-Islington	09-18-2020	83.1	105.0
62	Heart's Delight-Islington	09-18-2020	90.0	110.0
63	Victoria	09-18-2020	90.0	115.0
64	Victoria	09-18-2020	80.0	100.0
65	Whitbourne	09-18-2020	90.0	110.0
66	Winterton	09-18-2020	90.0	110.0
67	Wabush (WABUSH LAKE A)	09-29-2020	43.9	46.4
68	Burgeo (BURGEO NL)	12-19-2020	97.0	112.0
69	Burgeo (BURGEO NL)	12-19-2020	88.4	124.3
70	Deer Lake, Steady Brook	12-19-2020	51.2	64.2
71	Burgeo (BURGEO NL)	12-20-2020	93.1	113.5
72	Burgeo (BURGEO NL)	12-20-2020	89.4	116.9
73	Deer Lake, Steady Brook	12-20-2020	51.3	65.2
74	Deer Lake, Steady Brook	12-20-2020	49.7	72.6
75	Burgeo (BURGEO NL)	12-21-2020	90.9	117.2
76	Burgeo (BURGEO NL)	12-21-2020	87.1	123.0
77	Deer Lake, Steady Brook	12-21-2020	55.2	71.6
78	Deer Lake, Steady Brook	12-21-2020	56.5	67.1

Exceeded 12-Hourly 20-yr flood limit	Exceeded 24-Hourly 20-yr flood limit
Exceeded 12-Hourly 100-yr flood limit	Exceeded 24-Hourly 100-yr flood limit
WRMD or EC Exceeded flood limit	

The 2020 season was more active than the 2019 season (78 vs 59 alerts). This is a result of a relatively active late summer last season. A large portion of the 2020 alerts were issued in the fall/winter, specifically September and December.

Table 2 Monthly Analysis of Flood Alerts

Month	Total Alerts	12-hourly 20-yr alerts	12-hourly 100-yr alerts	24-hourly 20-yr alerts	24-hourly 100-yr alerts	Env. Can. & WRMD Obs.
June	15	0	8	0	7	0
July	11	6	2	1	2	0
August	13	11	2	0	0	0

Month	Total Alerts	12-hourly 20-yr alerts	12-hourly 100-yr alerts	24-hourly 20-yr alerts	24-hourly 100-yr alerts	Env. Can. & WRMD Obs.
September	28	19	1	7	1	0
October	0	0	0	0	0	0
November	0	0	0	0	0	0
December	11	8	0	3	0	0
Total:	78	44	13	11	10	0

The geographical spread of the alerts this season was large, spanning most of Newfoundland and Labrador.

Table 3 Regional Analysis of Flood Alerts

Community	Region	Total Number of Alerts
Battle Harbour	Labrador	2
Churchill Falls	Labrador	5
Happy Valley-Goose Bay	Labrador	1
Mary's Harbour	Labrador	1
Wabush	Labrador	7
Corner Brook	Western	1
Daniel's Harbour	Western	1
Deer Lake, Steady Brook	Western	9
St. Anthony	Western	1
Stephenville	Western	1
Stephenville Crossing, Black Duck Siding	Western	1
Trout River	Western	1
Bishop's Falls	Central	1
Gander	Central	4
Glovertown	Central	4
Burgeo	Southern	12
Channel Port aux Basques	Southern	1
St. Alban's	Southern	1
Bay Roberts	Eastern	2
Carbonear	Eastern	2
Hant's Harbour	Eastern	2
Heart's Delight-Islington	Eastern	4
Salmon Cove	Eastern	2
St. Lawrence	Eastern	4
Victoria	Eastern	2
Whitbourne	Eastern	2

Community	Region	Total Number of Alerts
Winterton	Eastern	4

From a geographic perspective, fifteen (15) alerts were triggered for the Western region, twenty-four (24) alerts were issued for the Eastern Region, nine (9) alerts were issued for the Central Region, fourteen (14) alerts were raised for the Southern Region, and sixteen (16) alerts were issued for Labrador. This season's geographic variability is much smaller compared to previous years, meaning that the alerts were spread out across the Province as all areas saw a fair number of alerts. Most of the alerts this year were issued for Eastern and Labrador, with a general equal spread for other parts of the island. This is a reflection of the weather pattern during this period whereby the storm track was further west earlier in the season and further east later in the season.

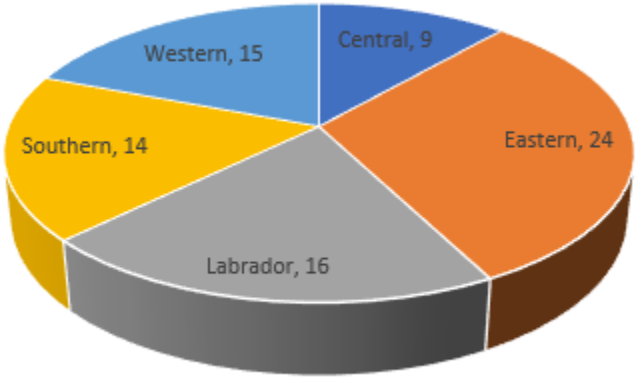

Figure 1 Alerts by Region

2 Verification of Alerts

The flood alerts were verified on a monthly basis using three data sources/methods to compare with the forecasted values: ECCC rain gauge data, WRMD rain gauge data, and qualitative community-based reports. However, there remain some significant challenges with verification. Rainfall has very high spatial variability, meaning that stations only a few kilometres apart may record vastly different values. Nearby gauge comparison is a limited verification method due to the intense variability of precipitation over the changing terrain and within small (meso-) scale atmospheric features.

Also, due to the risk involved with missed alerts, the forecasting approach that was implemented represents a worst-case scenario. The forecast is essentially the highest possible rainfall based on the current conditions as opposed to the most likely scenario rainfall. Every season, by design, there is a large

number of alerts issued that are not required. As such, any issued alert will generally overestimate what is observed, creating a large number of alerts that will not verify. The system was designed in this manner to avoid missing an alert as the consequence for missed alerts are very serious for the people and resources involved.

2.1 Community Based Flood Reports

Wood works with Fire & Emergency Services – NL (FES-NL) whenever there are reports of flooding that may not have been forecasted. The concept was to create a qualitative field verification measurement that could further validate the statistical methods. Following a forecasted flood event, the intention was for local officials to classify the event as having no, minor, or catastrophic flooding, and these eyewitness reports would be noted on the monthly verification. In the absence of community accounts, local newspapers and social media were scanned to verify the alerts qualitatively. This season, there were no reports of flooding that was not forecasted.

Scattered thunderstorms moved over central Newfoundland on June 29, 2020, and produced 47 mm of rain over Millertown, NL, which caused some areas of localized flooding.

2.2 Potential Missed Alerts

There were no events triggered by stations exceeding the 20-year or 100-year limit amounts.

Table 4 Potential Missed Alerts

Community	Nearby Flood Report	Issue Date	12-hour Precip Forecast	24-hour Precip Forecast	EC Observed	WRMD Observed	Conclusion
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

2.3 Climate Normals

Airport reports of rainfall across NL were examined to determine how the 2020 HSFAS season compared to the climatological normals. 2020 months are colour-coded in red if they were substantially above normal and blue if they were substantially below normal.

Table 5 Monthly Rainfall Totals (in millimetres) compared to climate normals

Location	Jun 2020	Jun Norm	Jul 2020	Jul Norm	Aug 2020	Aug Norm	Sep 2020	Sep Norm	Oct 2020	Oct Norm	Nov 2020	Nov Norm	Dec 2020	Dec Norm
St. John's	154.1	97.5	180.4	91.6	135.8	100.0	100.1	129.6	129.5	153.7	87.5	124.8	103.4	102.9
Gander	98.7	85.7	53.9	95.4	90.8	104.2	85.2	114.7	44.9*	102.3	16.5*	75.2	11.8*	48.9
Deer Lake	20.5*	87.8	0*	95.1	78.8*	109.6	35.8	99.9	97.3	84.9	29.2*	60.2	13.5*	27.6
Goose Bay	NA	90.0	NA	121.3	NA	99.3	56.2	90.6	124.2^	63.3	153.7^	22.7	159.6^	6.6

* Note that data was missing at the site for one or multiple days

^ Note that amounts are total precipitation, not total rainfall

NA Note that data was not reporting at the site.

2.4 Summary

June was above normal for rainfall across the Province, especially in the central and eastern portions. July was wetter than normal in eastern Newfoundland but drier than normal in central Newfoundland. August was significantly wetter than normal across eastern Newfoundland and again drier over central and western Newfoundland. September was generally drier than normal across the Province. October was drier than normal over central and eastern Newfoundland, but rainfall amounts were above average in western Newfoundland and Labrador. For November and December, precipitation amounts were generally below normal over Newfoundland but above normal in Labrador. Please note that there were missing data for some of the sites, as noted in the table above.

Despite being one of the most active tropical weather seasons on record, only one actual tropical storm system reached Newfoundland's vicinity this season, that being Hurricane Teddy. Teddy weakened to a Post-Tropical Storm and moved just off the west coast of Newfoundland late on September 23 and into early September 24. The storm had weakened enough by that point that the impacts to western Newfoundland were only minor as Deer Lake recorded 12.2 mm of rain on September 23-24.

3 Lessons Learned

The geographic spread of alerts and flooding events from this season are unique compared to previous seasons. As individual seasons continue to depart further from climate normals, customized alerting services such as this become more critical. Record-breaking dry or wet spells emphasize the growing importance of nowcasting and advanced weather monitoring on a very local scale.

Flooding is a complex phenomenon and can occur with amounts significantly less than the 20-year or 100-year thresholds and vice versa – no flooding may occur with amounts significantly higher than those.

The HSFAS product, along with the services provided by WRMD, such as water level monitoring and reporting are key components that work well together to help provide advance warnings to communities to better prepare for potentical flooding.

Validation and incremental improvements to the HSFAS service is aidded by having a network of observations. While a product such as the ECCC Canadian Precipitation Analysis (CaPA) would help, this still represents a precipitation model which could vary significenly from true observations. As we have indicated in the past , the best solution would be to fill the gaps in the available monitoring networks. Using only the ECCC and WRMD gauge data limits our ability to verify the forecasts in some areas. Many communities require additional measurements, access, and/or studies. Without adequate instrumentation for measuring precipitation, it can be almost impossible to know for certain in high terrain areas whether the forecasted precipitation was accurate. Attempts have been made to fill these gaps through community-based flood reports and the use of local media sources to try to corroborate sparse gauge data.

More accurate monitoring solutions have been developed in recent years, and with increasing communication options across the Province, with the expansion of cellular coverage, it may be the time to revisit additional investment in quantitative measuring equipment. To advance the service, additional rain gauges should be installed, particularly in the regions that have generated significant alerts in the past. One posibility would be to negotiate access to other gauge networks in use across the Province by commercial/private agencies.

4 Conclusion

It would be beneficial to pursue additional improvements to the data sources:

1. Additional rain gauges could be installed, particularly in the regions that generated significant alerts.
2. Access could be obtained for other rain gauge networks in use across the Province. For example, a joint funding arrangement could be considered with the Department of Transportation Road Weather Information System monitoring network where by funds were made available to help install rain gauges to their existing weather stations.
3. Flood Risk Mapping Studies could be considered for the communities that triggered alerts based on Intensity-Duration-Frequency (IDF) curves.

5 Closure

We trust that this report meets your needs. Please do not hesitate to contact the undersigned if you have any questions or comments regarding the hurricane season outlook.

Yours sincerely,

Wood Environment & Infrastructure,
a Division of Wood Americas Limited

Prepared by:

Robert Giglio
Forecast Lead

Reviewed by:

Digitally signed by chris.innes
Reason: I am approving this document
Date: 2021-02-13 07:28-05:00

J. Chris Innes
Discipline Lead