FINAL

Hurricane Season Flood Alert System
End of Season Report 2015 - 2016

Submitted to:

Water Resources Management Division
Department of Environment and Conservation

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1.0 FLOOD ALERTS SUMMARY

The Amec Foster Wheeler 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 July 2015 – December 2015, 70 alerts were issued in total. There were also 3 potential events where the Water Resources Management Division (WRMD) or Environment Canada (EC) data exceeded alert limits. An excel spreadsheet of all the flood alerts issued has been provided to WRMD, and here is a summary of these alerts:

Table 1-1: Summary of Flood Alerts

Site Name	Issue Date	12-hourly Forecast	24-hourly Forecast
Nain (NAIN A)	2015-07-07 16:00	53	70
Nain (NAIN A)	2015-07-08 09:00	53	70
Comfort Cove (COMFORT COVE)	2015-07-22 09:00	65	72
Glovertown	2015-07-22 09:00	60	65
La Scie (LA SCIE)	2015-07-22 09:00	75	85
Comfort Cove (COMFORT COVE)	2015-07-22 16:00	62	72
Gander (GANDER AIRPORT CS)	2015-07-22 16:00	61	68
Glovertown	2015-07-22 16:00	67	74
La Scie (LA SCIE)	2015-07-22 16:00	75	85
Appleton/Glenwood	2015-07-23 09:00	60	70
Bishops Falls	2015-07-23 09:00	60	72
Comfort Cove (COMFORT COVE)	2015-07-23 09:00	63	72
Gander (GANDER AIRPORT CS)	2015-07-23 09:00	61	68
Glovertown	2015-07-23 09:00	67	74
La Scie (LA SCIE)	2015-07-23 09:00	70	80
Deer Lake, Steady Brook	2015-07-23 16:00	12	18
La Scie (LA SCIE)	2015-07-23 16:00	66	71
Burgeo (BURGEO NL)	2015-08-10 09:00	76	102
Deer Lake, Steady Brook	2015-08-10 09:00	52	63
Channel-Port aux Basques (Port Aux	2015-08-10 09:00	78	115
Corner Brook	2015-08-10 09:00	53	66
Cold Brook, Kippens (Gaudon's Brook)	2015-08-23 09:00	27	27

Site Name	Issue Date	12-hourly Forecast	24-hourly Forecast
Happy Valley-Goose Bay (GOOSE A)	2015-08-30 09:00	60	68
Mary's Harbour (MARY'S HARBOUR	2015-08-30 09:00	51	66
Wabush (WABUSH LAKE A)	2015-08-30 09:00	53	79
Happy Valley-Goose Bay (GOOSE A)	2015-08-30 16:00	50	65
Mary's Harbour (MARY'S HARBOUR	2015-08-30 16:00	51	59
Appleton/Glenwood	2015-09-14 09:00	62	66
Bishops Falls	2015-09-14 09:00	59	79
Carbonear	2015-09-14 09:00	73	95
Gander (GANDER AIRPORT CS)	2015-09-14 09:00	62	66
Glovertown	2015-09-14 09:00	62	72
Hant's Harbour	2015-09-14 09:00	67	96
Heart's Delight-Islington	2015-09-14 09:00	73	95
Hodges Cove	2015-09-14 09:00	61	83
Salmon Cove	2015-09-14 09:00	73	95
Clarenville (Shoal Harbour)	2015-09-14 09:00	57	82
St. Lawrence (ST LAWRENCE)	2015-09-14 09:00	87	108
Victoria	2015-09-14 09:00	70	95
Winterton	2015-09-14 09:00	73	95
Bay Roberts (Shearstown)	2015-09-14 09:00	75	90
Appleton/Glenwood	2015-09-14 16:00	58	78
Bishops Falls	2015-09-14 16:00	59	90
Carbonear	2015-09-14 16:00	73	95
Comfort Cove (COMFORT COVE)	2015-09-14 16:00	57	75
Deer Lake, Steady Brook	2015-09-14 16:00	39	40
Gander (GANDER AIRPORT CS)	2015-09-14 16:00	56	95
Glovertown	2015-09-14 16:00	62	80
Hant's Harbour	2015-09-14 16:00	60	96
Heart's Delight-Islington	2015-09-14 16:00	60	96
Hickman's Harbour-Robinson	2015-09-14 16:00	60	89
Hodges Cove	2015-09-14 16:00	60	89
La Scie (LA SCIE)	2015-09-14 16:00	60	90
Salmon Cove	2015-09-14 16:00	60	95
Clarenville (Shoal Harbour)	2015-09-14 16:00	68	92
St. Lawrence (ST LAWRENCE)	2015-09-14 16:00	87	108
Victoria	2015-09-14 16:00	60	95
Whitbourne	2015-09-14 16:00	65	95
Winterton	2015-09-14 16:00	60	95

Site Name	Issue Date	12-hourly Forecast	24-hourly Forecast
Bay Roberts (Shearstown)	2015-09-14 16:00	75	90
Hickman's Harbour-Robinson	2015-09-15 09:00	60	90
Hodges Cove	2015-09-15 09:00	60	90
Bay Roberts (Shearstown)	2015-09-15 09:00	60	90
Burgeo (BURGEO NL)	2015-10-28 09:00	90	97
Burgeo (BURGEO NL)	2015-10-29 09:00	85	92
Mary's Harbour (MARY'S HARBOUR	2015-11-23 10:00	54	67
Mary's Harbour (MARY'S HARBOUR	2015-11-23 16:00	66	77
Battle Harbour (BATTLE HARBOUR	2015-11-23 16:00	66	77
Mary's Harbour (MARY'S HARBOUR	2015-11-24 10:00	65	70
Battle Harbour (BATTLE HARBOUR	2015-11-24 10:00	66	76
Deer Lake, Steady Brook	2015-11-27 10:00	48	63
Deer Lake, Steady Brook	2015-11-27 17:00	62	74
Corner Brook	2015-11-27 17:00	54	74

Note:

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	

During this period of July 2015 – December 2015 there were nearly the same number of 12-hourly alerts and 24-hourly alerts, and almost all of the alerts were 20-year alerts. For the 70 alerts issued, 37 were 24-hourly 20-year alerts, 28 were 12-hourly 20-year alerts, 5 were 12-hourly 100-year alerts, and there were no 24-hourly 100-year alerts.

Examining the monthly breakdown, it is evident that most of the season's alerts occurred in September:

Table 1-2: Monthly Analysis of Flood Alerts

Month	Total Alerts	24-hourly 20-yr alerts	12-hourly 20-yr alerts	24-hourly 100-yr alerts	12-hourly 100-yr alerts
July	16	0	16	0	0
August	9	5	3	0	1
September	35	31	4	0	0
October	2	0	2	0	0
November	8	1	3	0	4
December	0	0	0	0	0

There were fourteen 12-hour 20-yr alerts on July 22 - 23, followed by fewer alerts in August. All 35 of the September alerts occurred on September 14 – 15, making it the busiest two days of the season. October was fairly quiet, with only two alerts issued, and November was only slightly rainier, with a total of 8 alerts issued. No alerts were issued at all in December.

There was a greater geographical spread of the alerts this season, compared to last season:

Table 1-3: Regional Analysis of Flood Alerts

Community	Region	Total # of Alerts
Mary's Harbour	Labrador	5
Battle Harbour	Labrador	2
Happy Valley – Goose Bay	Labrador	2
Nain	Labrador	2
Wabush	Labrador	1
Deer Lake, Steady Brook	Western	3
Corner Brook	Western	2
Channel – Port aux Basques	Western	1
La Scie	Central	5
Glovertown	Central	5
Gander	Central	4
Comfort Cove	Central	4
Appleton/Glenwood	Central	3
Bishop's Falls	Central	3
Burgeo	Southern	3
St. Lawrence	Southern	2
Hodges Cove	Eastern	3
Bay Roberts (Shearstown)	Eastern	3
Hickman's Harbour-Robinson	Eastern	2
Carbonear	Eastern	2
Hant's Harbour	Eastern	2
Heart's Delight - Islington	Eastern	2
Salmon Cove	Eastern	2
Clarenville (Shoal Harbour)	Eastern	2
Victoria	Eastern	2
Winterton	Eastern	2
Whitbourne	Eastern	1

Battle Harbour, Glovertown, and La Scie each received the highest number of alerts, five in total for each community. The West Coast was distinctly less active than last season, with no alerts triggered

for Stephenville or Corner Brook this season. No alerts were issued for the Northern Peninsula this season.

Central Newfoundland received the most alerts overall, as well as the majority of the 12-hourly, 20-year alerts. Central NL in total received 24 of the 70 alerts issued. No alerts were issued over the Avalon or Burin Peninsulas last year, but the Avalon was comparatively active this year with 23 alerts. There were no alerts last season for the Baie Verte Peninsula and the Port aux Basques area, but both of those areas received alerts this season.

All of the alerts issued to the Eastern region were 24-hourly 20-year alerts. Conversely, the 12-hourly 100-year alerts were exclusively issued in Labrador. From the end of October through the end of December, Labrador and the West Coast of Newfoundland were the only areas to receive alerts.

2.0 VERIFICATION OF ALERTS

The flood alerts were verified on a monthly basis using three data sources/methods to compare with the forecasted values: EC rain gauge data, WRMD rain gauge data, and qualitative community-based reports. The addition of the WRMD gauges and the removal of the Capa and radar verification methods resulted in a significant improvement over last year, and this year we were able to verify an alert. The 24-hour, 20-year limit for Burgeo on August 9, 2015 was likely exceeded. Amec Foster Wheeler forecasted 102 mm while the EC gauge reported 111 mm which is in excess of the 102 mm limit. This level of agreement is high, so for the first time since the inception of this service, this alert was validated.

However, there are still some significant challenges with verification. Validation was not possible for 45 of the alerts because there were no nearby gauges to compare with. Five of the WRMD gauges were within 10 kilometres of the communities of concern, so Amec Foster Wheeler was able to fully utilize this data. Attempts were made to utilize the Hinds Lake WRMD station as a comparison to the Deer Lake community, but the 20 km distance coupled with the rapidly changing topography of the area proved that this was not a reliable match. Another five of the WRMD gauges were 40 – 50 km away from the nearest communities of concern. Amec Foster Wheeler attempted to utilize this data but it mainly led to inconsistency between the EC gauge data and the WRMD gauge data. The remaining WRMD gauges were more than 50 km away from the communities of concern and could not be utilized.

The available data indicated that 24 of the 70 alerts issued were not required. However, only 7 of these 24 occasions were corroborated by two gauges, and sometimes the two gauge totals varied dramatically from one another due to the distance between them. In order for verification to be irrefutable, ideally we would compare forecasted values to all three verification sources and the sources would report comparable figures. Often, Amec Foster Wheeler only had a single gauge verification source for an alert or there was a substantial discrepancy between the EC and WRMD gauges. Often one source agreed better with the forecast, but it is difficult to determine which should be considered the correct measurement.

Often the extreme precipitation events that are predicted do happen, yet the band of heaviest precipitation narrowly misses the alert locations. For example, the precipitation was over-forecasted for November 27 for Deer Lake, Steady Brook and Corner Brook. According to our best guidance, there was a strong possibility for fairly intense precipitation to fall over the West Coast. The system tracked slightly farther north with the heaviest bands of precipitation staying northwest of Deer Lake, Steady Brook and Corner Brook as this system moved through the area.

In this case, the forecasting team erred on the side of caution and the heaviest precipitation just narrowly avoided the areas of interest. Areas to the northwest, where we do not have trigger alerts, may have experienced flooding, but the net result is to show an over-prediction for the alert area.

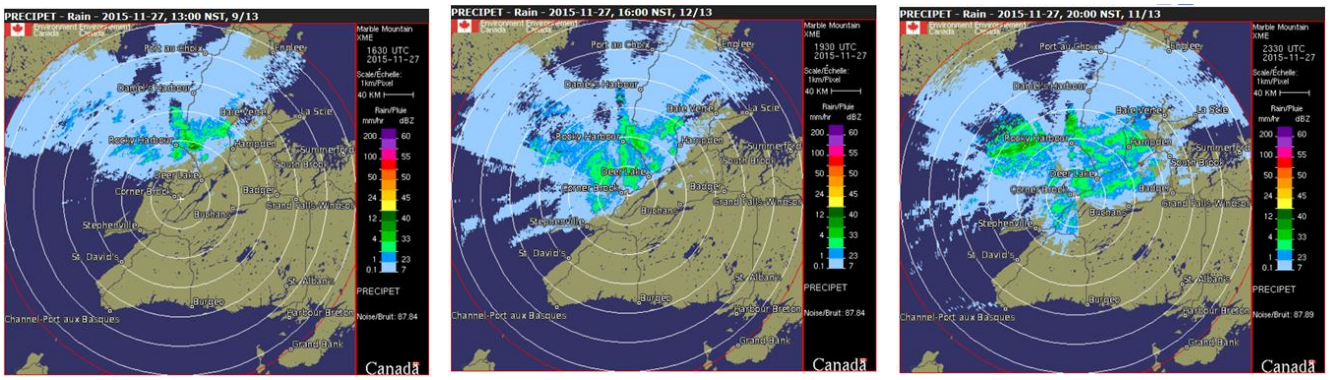


Figure 2-1: Radar Return from November 27, 2015 Rainfall

Lastly, one WRMD gauge reported data that is likely erroneous: Upper Humber River above Black Brook. The gauge reported over 400 mm's in each 24 hour periods over several weeks, which is likely incorrect. We omitted this gauge from our reports but it would be greatly beneficial if it could be repaired for use in future comparisons.

2.1 Community Based Flood Reports

Amec Foster Wheeler worked closely with Fire & Emergency Services – NL (FES-NL) this season, with monthly calls to discuss the alerts. 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. FES-NL contacted several communities throughout the season based on the flood alert forecasts, but they did not receive any feedback or calls for assistance from any communities. In the absence of community accounts, local newspapers were checked to qualitatively verify the alerts.

2.2 Potential Missed Alerts

There were three occasions where the WRMD or EC gauges recorded amounts that exceeded the threshold limits while there were no corresponding alerts for these amounts. There was one occasion where there was a newspaper-based report of flooding that did not correspond to an alert. These are the four potential missed alerts:

Table 2-2: Potential Missed Alerts

Community	Issue Date	Potential Miss	Conclusion
Deer Lake, Steady Brook	July 23, 2015	WRMD Exceeded 24-hourly 20-year limit	WRMD gauge is too far away from community, alert was not missed
Cold Brook, Kippens (Gaudon's Brook)	August 23, 2015	EnvCan Exceeded 12-hourly 20-year limit	EC gauge may not be the best match for the community, inconclusive
Corner Brook	September 2, 2015	Western Star reports localized flooding	No gauge data supports this, must have been very localized
Deer Lake, Steady Brook	September 14, 2015	WRMD Exceeded 12-hourly 20-year limit	WRMD gauge is too far away from community, alert was not missed

In the July case, Amec Foster Wheeler forecasted 18 mm for Deer Lake. The nearby EC gauge registered 34 mm, and the WRMD gauge registered 67 mm, which was over the 24-hourly 20-year limit of 63 mm. The WRMD gauge data exceeded the 24 hourly 20 year limit. However, the EC gauge data for that location is well below the limit and there was no flooding reported by the community or the media. The WRMD gauge is 20 km away and due to the rapidly changing topography of the area, it is not an adequate match for this location and no alerts were actually missed on this date. Similarly, for the September case, the Amec Foster Wheeler forecast and the nearby EC gauge were in agreement that no alert was required. The WRMD gauge indicated a possible missed alert, but due to the distance between this gauge and the area of concern, this potential alert should also be discarded.

In the August case, Amec Foster Wheeler forecasted 27 mm for Cold Brook, Kippens (Gaudon's Brook). The WRMD gauge registered 41 mm, and the nearby EC gauge registered 70 mm, which was over the 12-hourly 20-year limit of 69 mm. The EC data indicated that there was a 12-hourly 20-yr alert that was potentially missed. However, the WRMD gauge data for that location was well below the limit and there was no flooding reported by the community. The EC gauge totals were 29 mm higher than the WRMD gauge, so the EC gauge may not be the best match for this location.

On September 2, there were reports of localized flooding in Corner Brook on Randolph Place, Mount Bernard, and East Valley Road in the Western Star. In this case neither the EC gauge nor the WRMD gauge recorded any significant precipitation. Paul Peddle of FES-NL said that no concerns were reported by the municipality, so he assumes if there was any action taken by Corner Brook, it was minimal and did not require any government assistance.

2.3 Climate Normals

Airport reports of rainfall across NL were examined to determine how the 2015 HSFAS season compared to the climatological normals. 2015 Months are colour-coded in red if they were substantially above normal and blue if they were substantially below normal.

Table 2-3: Monthly Rainfall Totals (in millimetres) compared to climate normals

Location	Jul 2015	Jul Norm	Aug 2015	Aug Norm	Sep 2015	Sep Norm	Oct 2015	Oct Norm	Nov 2015	Nov Norm	Dec 2015	Dec Norm
St. John's	181.1	91.6	48.7	100.0	163.2	129.6	110.2	153.7	64.1	124.8	29.3	102.9
Gander	108.5	95.4	55.2	104.2	93.9	114.7	64.3	102.3	85.4	75.2	37.7	48.9
Deer Lake	87.0	95.1	83.4	109.6	101.1	99.9	111.3	84.9	74.8	60.2	36.4	27.6
Goose Bay	67.4	121.3	168.2	99.3	77.8	90.6	19.2	63.3	13.2	22.7	2.6	6.6

St. John's experienced a rainy July, followed by a dry August. Most of the Avalon alerts occurred in September, which coincided with above-normal rainfall for St. John's.

Gander recorded mostly normal rainfalls aside from a significantly dry August and October. Most of the Central NL alerts occurred in July and September, which correlates well. Deer Lake experienced a generally normal season for rainfall, which may explain why the area experienced fewer alerts compared to last year.

Goose Bay recorded low rainfall totals in July and again in October. Goose Bay experienced a rainy August during which is when the only two alerts of the season were issued. Overall, this season's alerts showed much more correlation with the climate data than in the previous season.

2.4 Case Studies

The storm that caused the most alerts occurred on September 14 – 15, with the second most significant storm of the season occurring on July 22 – 23. Amec Foster Wheeler examined the weather analysis charts from the US National Centers for Environmental Prediction (NCEP) to determine if these two storms had repetitive characteristics that could help identify risk factors ahead of time for advanced warning. As expected, neither of these storms were tropical in nature. Included below are NCEP images of the 500 milibar height contours, which indicate upper level jet patterns.

The September event shows the upper-level low over Central Canada five days prior to the storm. The system becomes double-barreled the day before the event, with the lower trough dipping southward over the US before moving over Newfoundland on September 14 – 15. The July event shows the upper-level low over Central Canada three days prior to the storm. The system becomes double-barreled the day before the event, with the lower trough located over Ontario/Quebec before moving over Newfoundland on July 22 - 23.

These two events exhibit the same general pattern. The upper-level charts indicate a strong low over Central Canada 3 – 5 days prior to the storm. In both cases, the system becomes double-barreled the day before the event. In the more extreme case, the lower trough traversed southward over the US before moving over Newfoundland on September 14 – 15. In the less extreme case, the lower trough remained over Canada. Forecasters can watch for this pattern in the coming seasons to provide an indication of how intense the precipitation may be. It should be noted, however, that this pattern is fairly common in the winter.

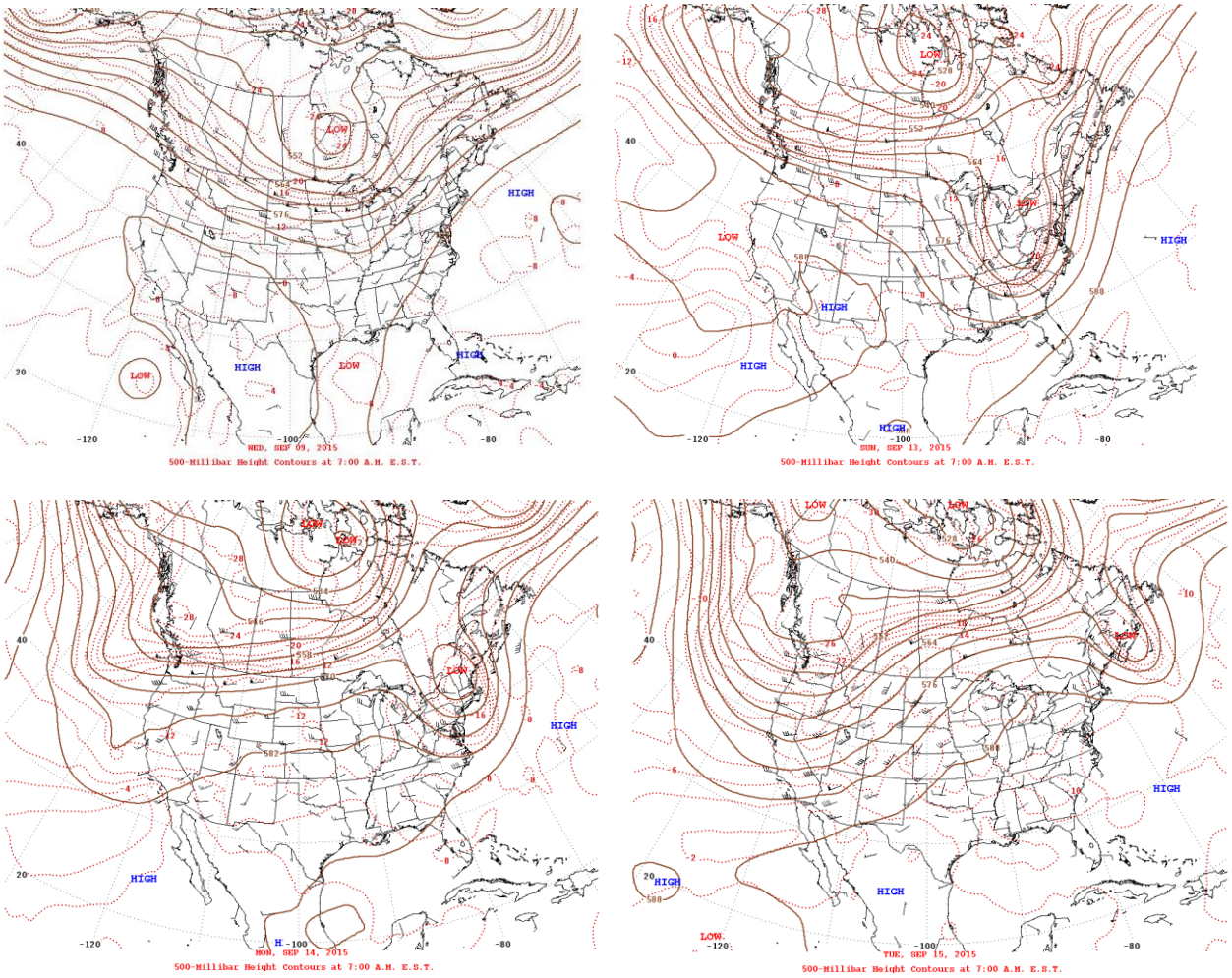


Figure 2-4: NCEP 500 mb Height Contours for September Event

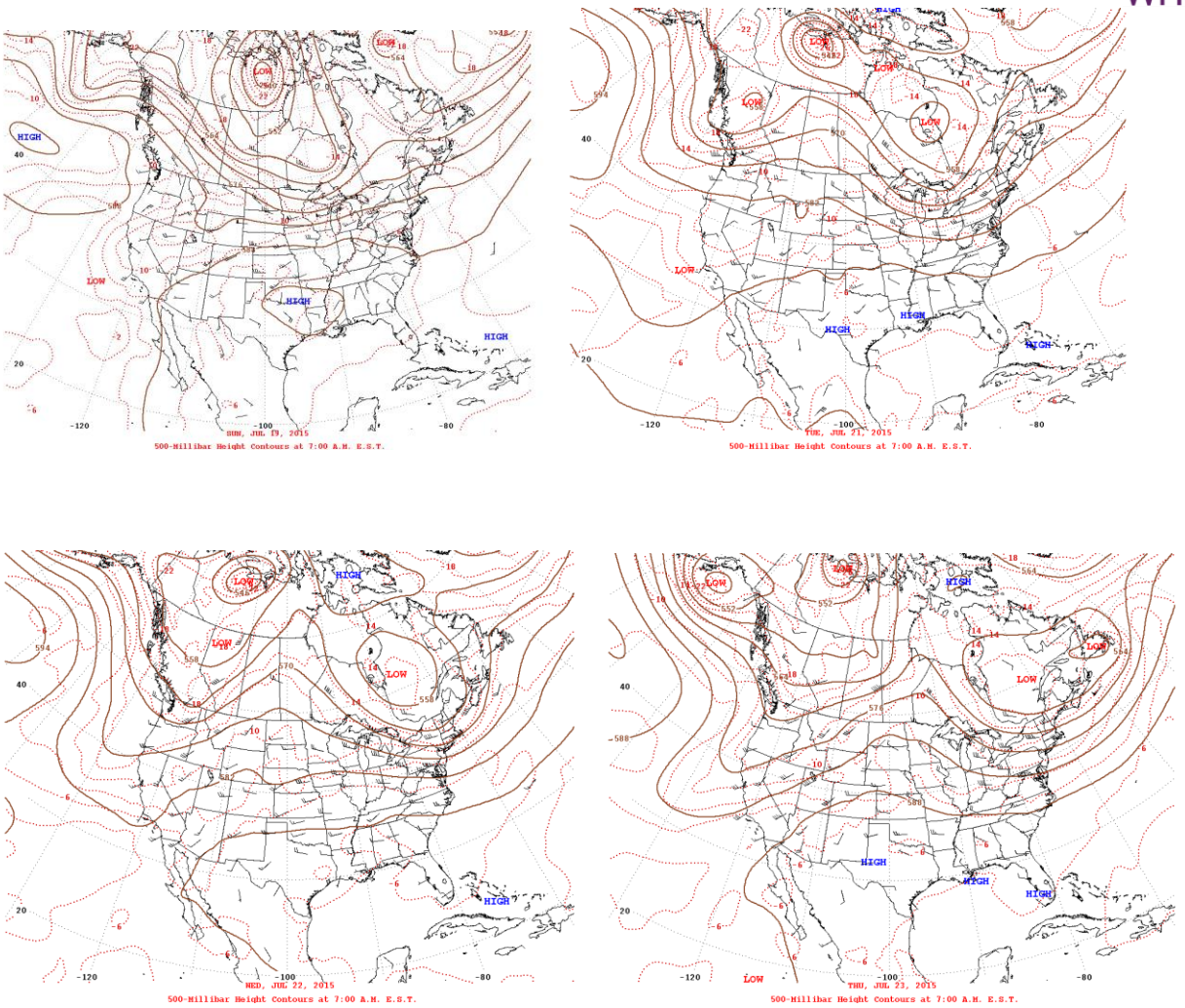


Figure 2-5: NCEP 500 mb Height Contours for July Event

3.0 GIS PRODUCTS

In an attempt to make the HSFAS available to a wider audience, several GIS products were added to the service this year. These products were designed to allow users outside of WRMD to view and consume the data produced by the service in a simple and efficient manner. Each of the services displays the same information.

The data displayed by the service included:

- Color coded points for each community supported by the service. The point color was determined by the flood alert level and matched to the colors used in the PDF version of the forecast.
- For each community the following details were included in the service:
    - Community name
    - Forecasted 12 hour precipitation
    - 20 year 12 hour precipitation limits
    - 100 year 12 hour precipitation limits
    - Start time for the 12 hour precipitation
    - Forecasted 24 hour precipitation
    - 20 year 24 hour precipitation limits
    - 100 year 24 hour precipitation limits
    - Start time for the 24 hour precipitation
    - Link to the NL Rain gauge station web page, should one exist for that community.

This year the forecast data was made available to WRMD in a Shapefile format. The Esri Shapefile is a set of files which allow for the storage of geometry as well as attribution. The .dbf file contains the attribution while the .shp file contains the geometry and the .shx file is used to link the geometry to the attribution. Amec Foster Wheeler created a new Shapefile daily which contained the location of the communities and the details listed above. The Shapefile was available for download from the Amec Foster Wheeler FTP site. The Shapefile can be used within a GIS desktop package or made available to the Internet through a web service.

While experienced users can work with Esri Shapefiles, non-experienced users will have a more difficult time. To help expand the user base for the data, Amec Foster Wheeler made the data available through our custom Weather Web Portal and through web services following two common data standard. Details on the Amec Foster Wheeler Weather Web Portal and the data standard used are as follows:

Data Service	Description
Weather Web Portal	The Weather Web Portal is a GIS enable website which displays the HSFAS data, current radar data along with Environment Canada public weather station current observations.
Google KMZ Service	The Google KMZ file was designed by Google to allow for the storage of geometry as well as attribution all within a single file. Amec Foster Wheeler designed the service in such a manner to permit the user to download the Google KMZ file once and always have access to the most recent data. This was accomplished by adding a pointer in the KMZ file that the client downloads to a second KMZ file that resides on the Amec Foster Wheeler server. The second KMZ file is updated daily with the most recent alerts.
OGC WMS Data Service	The OGC WMS (Web Mapping Service) Data Service is an IESO standard and common method of distributing live access to geospatial data without the need to copy the data, i.e., accessing the data at source. The data service contained the same list of communities and the details

Data Service	Description
	listed above. The data service can be embedded directly into a desktop application or web application compatible with the WMS standard

3.1 Summary

This year through the use of the Weather Web Portal, the raw Esri Shapefiles and the data services the forecast details were available to a larger audience. It would benefit WRMD to solicit feedback from the users of the service to determine the effectiveness of the current data distribution formats. Feedback from the users can then be taken into consideration for enhancements to the services. It is also recommended to consider adding the WRMD rain gauge data to these data services thus providing users with another source of near real-time validation of an ongoing event.

4.0 LESSONS LEARNED

There does not appear to be a consistent trend in the geographical spread of the alerts from season to season. Central Newfoundland was the hardest hit this season, a major departure from last year's results. The Avalon, Burin, Baie Verte, and the Port aux Basques area were much more active than last year. Conversely, the west coast of Newfoundland had a much less intense season this year. Labrador was the only area to continue its trend from last year, with many alerts received.

Mary's Harbour, La Scie, and Glovertown all received 5 alerts this season with only Glovertown's triggers based on complete Flood Risk Mapping Studies (FRMS). The Mary's Harbour and La Scie alerts were based on Intensity-Duration-Frequency (IDF) curves, which may be exacerbating the over-issue of alerts. It is recommended that WRMD follow up with these communities and perhaps initiate a case study with them to determine how they use the alerts and if they are finding them a crucial part of their emergency response. This may help to prioritize flood risk mapping studies for the future.

From a forecasting perspective, the team relied more on the GEM-LAM atmospheric model, which provided increased accuracy. In general the verification was greatly improved from last year and the use of the WRMD gauges was a major improvement for the verification. The forecasting team must continue to reduce the over-forecasting of alerts, but in honing forecasting practices to reduce false alarms, care must be taken to ensure that forecasters do not start missing flood events.

There are still several gaps in the monitoring networks that inhibit our ability to verify the forecasts in some areas. Many communities require additional measurements, access, and/or studies. There are only a limited number of rain gauges in the areas that had the most alerts, which makes it very difficult to determine if those alerts were warranted. 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. Additional rain gauges could be installed, particularly in the regions that

generated significant alerts, and access must be obtained for other gauge networks in use across the Province by commercial/private agencies.

More access to restricted precipitation observing networks would improve both verification and forecasting. There would be a cost associated with integrating and validating new data sources, but the benefits could be significant. The Department of Transportation's Road Weather Information System network has 28 stations across the province that could easily host rain gauges without too much additional cost. The benefit in terms of forecasting accuracy and improved historical climate record would be substantial. NL Hydro's network would fill many gaps in the public observation system if access could be obtained. It would be ideal if there was a central website that gathered and displayed all of the weather data from the various branches of Government. This is inherently challenging due to the fact that there is no established format for rain gauge data, but still a worthwhile venture to standardize throughout the Province.

5.0 CONCLUSION

The addition of the WRMD gauge network was a significant gain to the verification. The changes made to the verification system this season enabled the confirmation of an alert for the first time since the forecasting started. It would be highly 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, and the existing Department of Transportation Road Weather Information System monitoring network could add rain gauges to their existing stations.

3. Flood Risk Mapping Studies could be considered for the communities that triggered alerts based on Intensity-Duration-Frequency (IDF) curves.

Without the implementation of several of these recommendations, it will remain difficult to accurately verify the flood alerts in some regions.

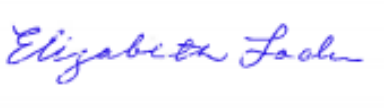
6.0 CLOSURE

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,

Amec Foster Wheeler Environment & Infrastructure,
a Division of Amec Foster Wheeler Americas Limited

Prepared by:



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