

# June 23<sup>rd</sup> 2017 Record Rainfall Flood Event West Montrose Debriefing



24 July 2017

Dwight Boyd, GRCA Director of Engineering



# Overview



- Weather warnings
- Record Rainfall
- Monitoring System Alerts
- Grand River watershed response
- History of flooding in West Montrose
- Flood Operations
- Roles in flood management
- Flood Warnings
- Township flood impact
- Preliminary outcomes
- Next steps

# Weather Warnings

# Weather forecast, watches, and warnings

## The Weather Network

- The **Weather Network** forecast issued during the afternoon of June 22:
- **5 – 10mm** of rainfall expected for Friday, June 23



# Weather forecast, watches, and warnings

## Environment Canada

Generic Weather Watch messages are seen on a regular basis.

Typically they imply localize heavy rain not widespread heavy rain seen June 23<sup>rd</sup>.

- **Environment Canada** issued the following on June 22:

### **Orangeville - Grand Valley - Southern Dufferin County**

Issued at 23:11 Thursday 22 June 2017

Conditions are favourable for the development of severe thunderstorms that may be capable of producing strong wind gusts, large hail and heavy rain.

Severe thunderstorms are possible tonight. ### Large hail can damage property and cause injury. Strong wind gusts can toss loose objects, damage weak buildings, break branches off trees and overturn large vehicles.

Remember, severe thunderstorms can produce tornadoes. Heavy downpours can cause flash floods and water pooling on roads. Severe thunderstorm watches are issued when atmospheric conditions are favourable for the development of thunderstorms that could produce one or more of the following: large hail, damaging winds, torrential rainfall. Please continue to monitor alerts and forecasts issued by Environment Canada.

---

### **Kitchener - Cambridge - Region of Waterloo**

Issued at 21:24 Thursday 22 June 2017

Conditions are favourable for the development of severe thunderstorms that may be capable of producing strong wind gusts, large hail and heavy rain.

Severe thunderstorms are possible tonight. ### Large hail can damage property and cause injury. Strong wind gusts can toss loose objects, damage weak buildings, break branches off trees and overturn large vehicles.

Remember, severe thunderstorms can produce tornadoes. Heavy downpours can cause flash floods and water pooling on roads. Severe thunderstorm watches are issued when atmospheric conditions are favourable for the development of thunderstorms that could produce one or more of the following: large hail, damaging winds, torrential rainfall. Please continue to monitor alerts and forecasts issued by Environment Canada.

# Weather forecast, watches, and warnings

## Environment Canada

- **Environment Canada** issued the following on June 23:

### **Orangeville - Grand Valley - Southern Dufferin County**

Issued at 00:14 Friday 23 June 2017

At 12:14 a.m. EDT, Environment Canada meteorologists are tracking a line of severe thunderstorms capable of producing strong wind gusts, pea to dime size hail and torrential rain. ### Heavy downpours can cause flash floods and water pooling on roads. Severe thunderstorm warnings are issued when imminent or occurring thunderstorms are likely to produce or are producing one or more of the following: large hail, damaging winds, torrential rainfall. [Find out more >](#)

From Environment Canada - Ontario Region    Fri Jun 23 03:13:27 2017    Page 1 of 6

ENVIRONMENT CANADA HAS UPDATED A SEVERE WEATHER BULLETIN FOR SOUTHERN ONTARIO AT 11:11 P.M. EDT THURSDAY 22 JUNE 2017.

A SEVERE THUNDERSTORM WATCH IS CONTINUED FOR DUNNVILLE - CALEDONIA - HALDIMAND.

CONDITIONS ARE FAVOURABLE FOR THE DEVELOPMENT OF SEVERE THUNDERSTORMS THAT MAY BE CAPABLE OF PRODUCING STRONG WIND GUSTS, LARGE HAIL AND HEAVY RAIN.

SEVERE THUNDERSTORMS ARE POSSIBLE TONIGHT.

From Environment Canada - Ontario Region    Fri Jun 23 03:13:27 2017    Page 2 of 6

ENVIRONMENT CANADA HAS UPDATED A SEVERE WEATHER BULLETIN FOR SOUTHERN ONTARIO AT 11:11 P.M. EDT THURSDAY 22 JUNE 2017.

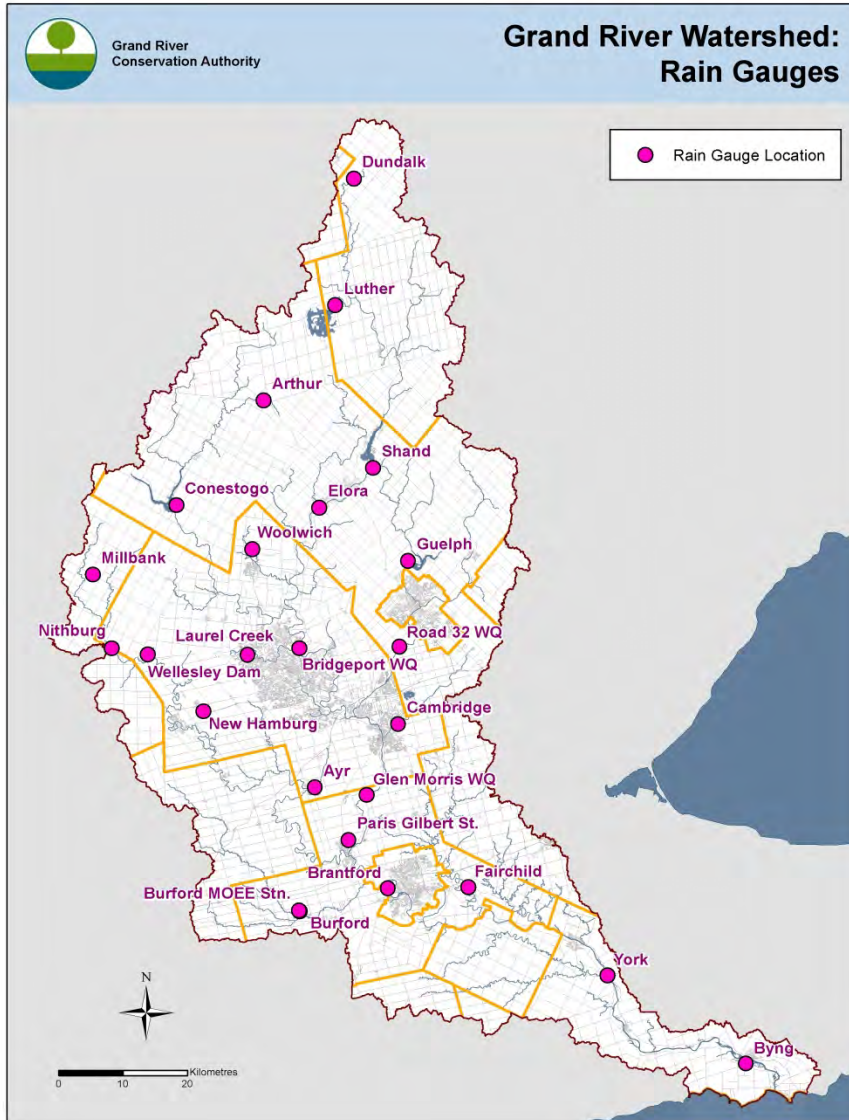
A SEVERE THUNDERSTORM WATCH IS CONTINUED FOR OWEN SOUND - BLUE MOUNTAINS - NORTHERN GREY COUNTY SAUGEEN SHORES - KINCARDINE - SOUTHERN BRUCE COUNTY HANOVER - DUNDALK - SOUTHERN GREY COUNTY WINGHAM - BLYTH - NORTHERN HURON COUNTY LISTOWEL - MILVERTON - NORTHERN PERTH COUNTY CODERICH - BLUEWATER - SOUTHERN HURON COUNTY STRATFORD - MITCHELL - SOUTHERN PERTH COUNTY MOUNT FOREST - ARTHUR - NORTHERN WELLINGTON COUNTY GUELPH - ERIN - SOUTHERN WELLINGTON COUNTY

The severe weather bulletin issued by Environment Canada was not picked up and issued by the Weather Network. A severe thunder storm warning was issued at 12:14 am.

These are generic messages issued on a regular basis and spoke to localized heavy rainfall.

# Record Rainfall

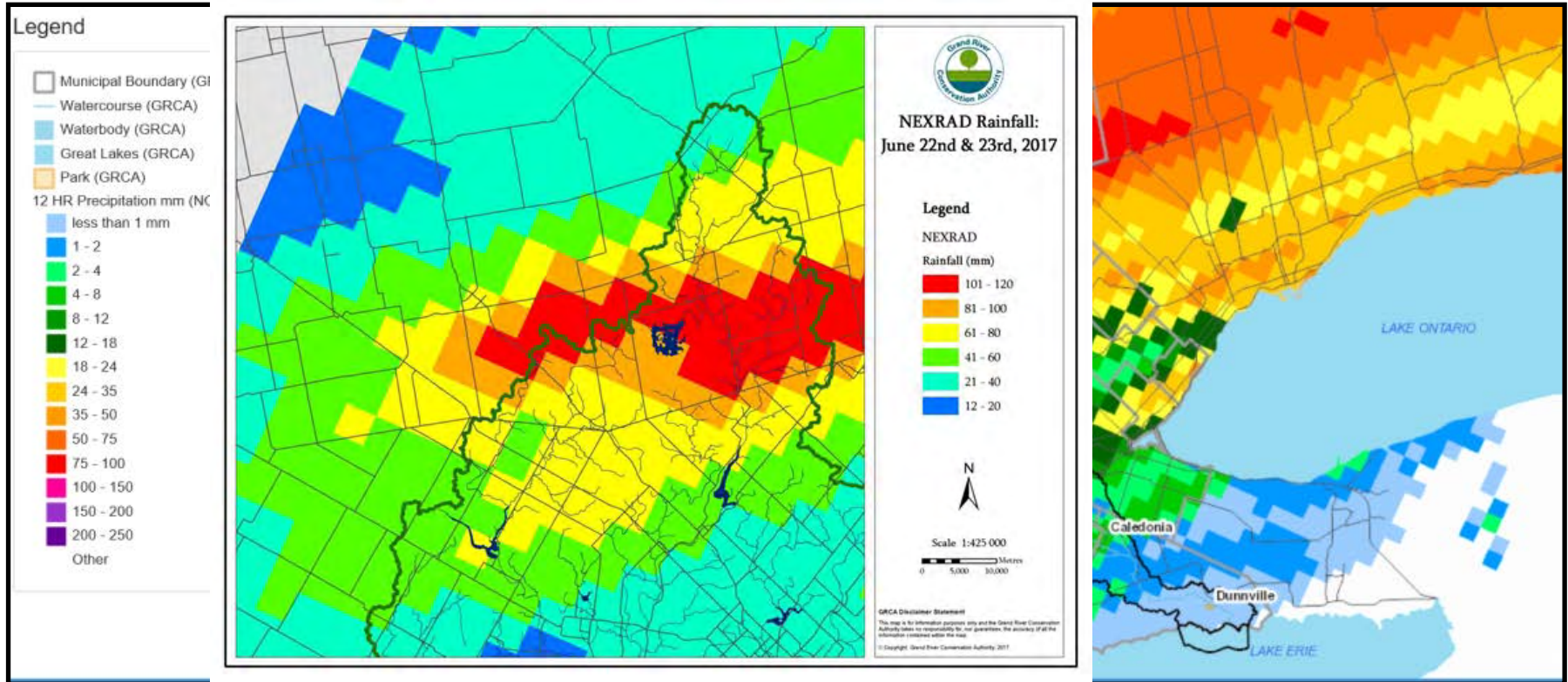
# Real-time Rainfall – June 23



- GRCA operators a number of **real-time rain gauges**. This network provided information about the June 23<sup>rd</sup> event, but did not provide a full picture of the extent and magnitude of the rainfall.
- **Tipping bucket rain gauges** are mechanical devices. They can be less accurate in extreme rainfall events.
- Arthur rain gauge, record **84mm**, manual totals in that area indicated rainfall in excess of **120mm**.
- Rain gauge **network is critical**.
- They are checked and maintained on a regular basis.



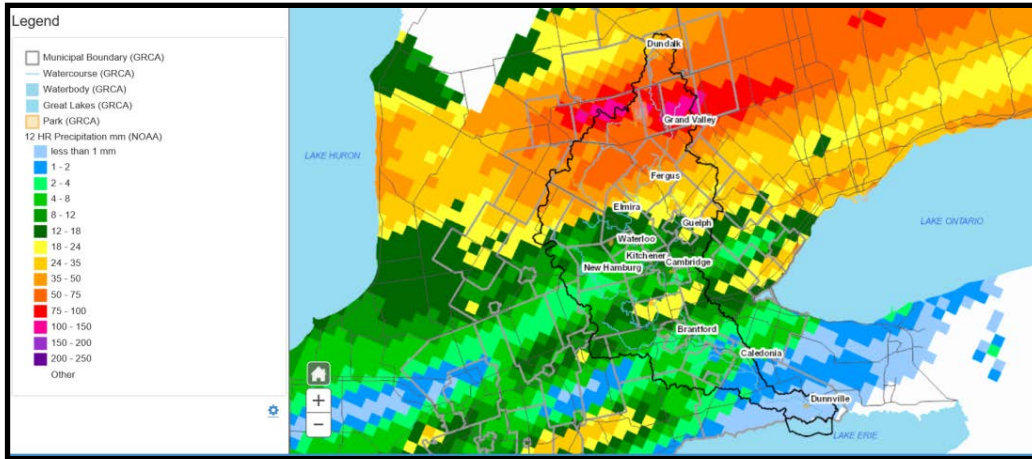
# Record Rainfall – June 23



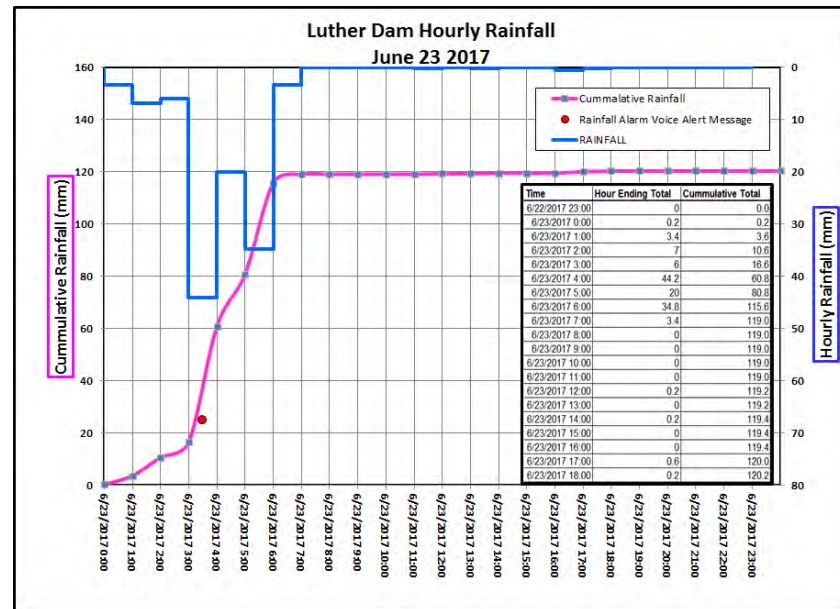
Twelve Hour Precipitation Totals June 22<sup>nd</sup> 8:00 p.m. to June 23<sup>rd</sup> 08:00 a.m.

Provided a better indication of extent of storm but still under estimated the volume of rainfall associated with this storm.

# Record Rainfall – June 23



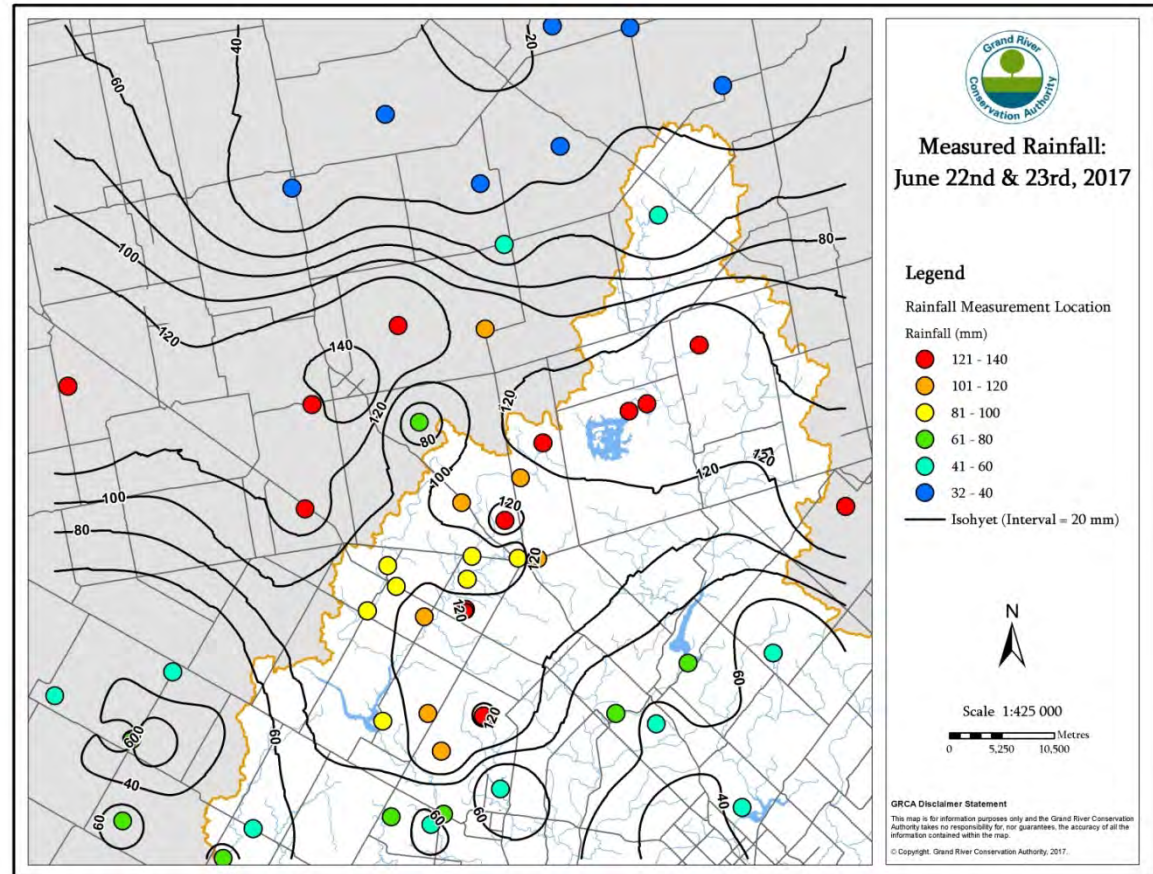
- Radar illustrates the amount and extent of heavy rainfall over the northern Grand River watershed
- Weather radar is based in Buffalo, NY.
- Not always reliable depending on heavy rainfall between Buffalo and the northern watershed.





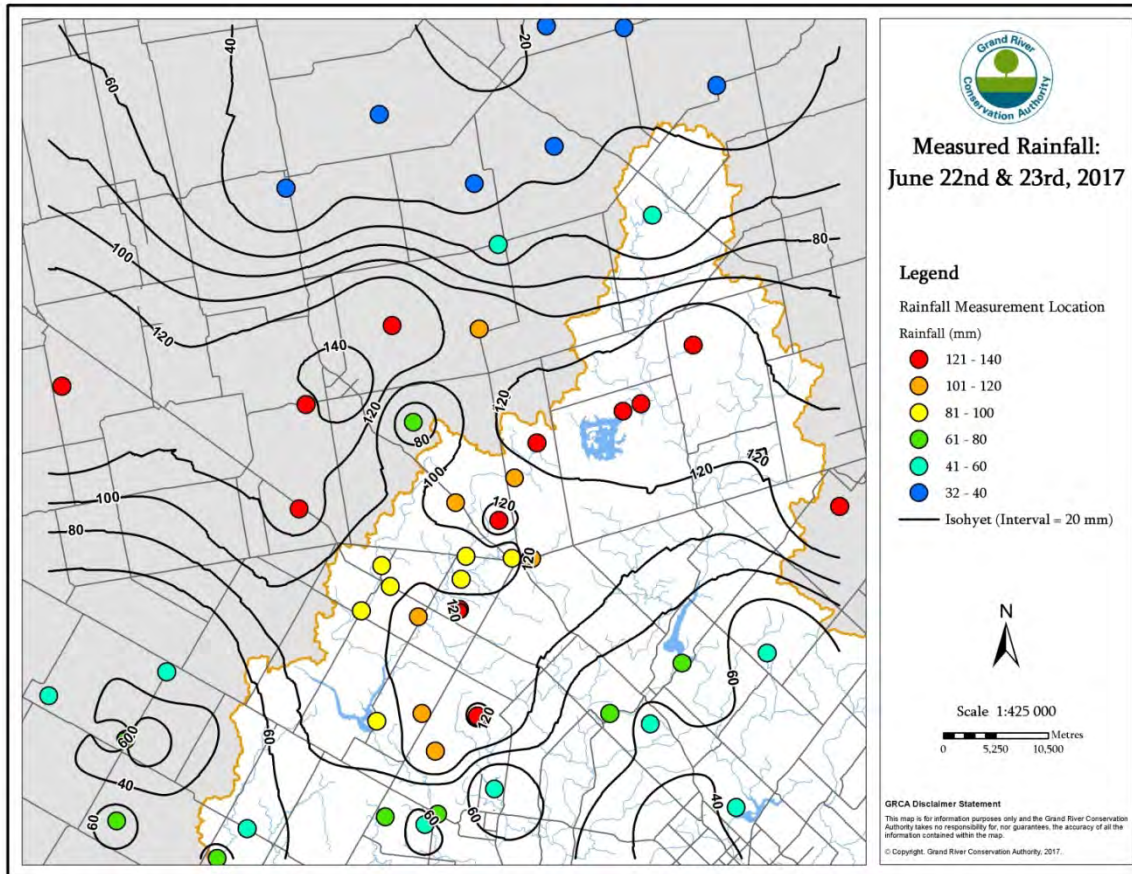
# Record Rainfall – June 23

- Rainfall information has been compiled from a range of sources to document this event
- Sources include monitoring sites at: GRCA dams, Maitland Valley CA, private land owners, CoCoRaHS and Environment Canada
- Over a two day period, totals exceeding **100mm** and in some case **130mm** were exceeded
- Majority of rainfall occurred between **3:00 and 6:00 a.m.** based on rain gauge data over a large area
- Luther Dam recorded **100 mm** over a three hour period of time.



Source: CoCoRaHS – Community Collaborative Rain Hail and Snow Network <https://cocorahs.org/>

# Record Rainfall – June 23



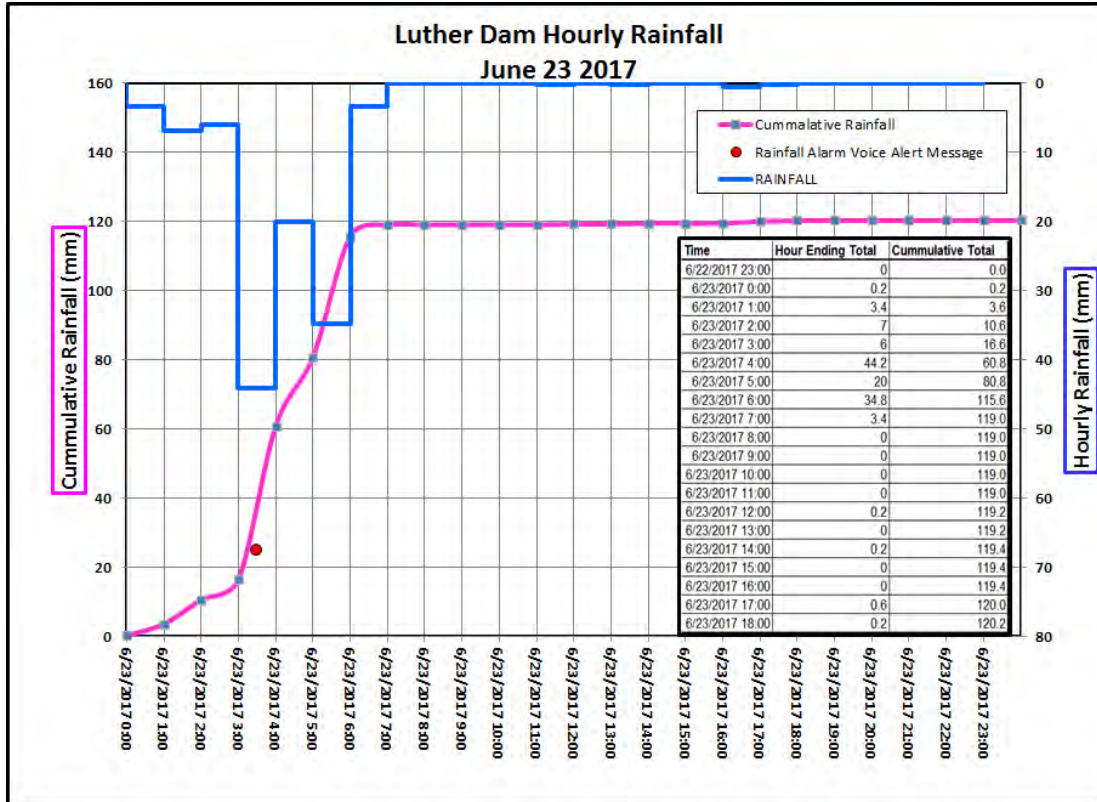
- One-day rainfall total at Luther Dam is the **highest daily total rainfall recorded since 1950.**
- **Three characteristics** made this storm very **uncommon**:
  1. 126mm is a **very large volume** of rainfall
  2. 3 – 4 hours is a **very condensed time period**
  3. This storm covered a **very large area** (approximately one-third of the watershed, several thousand km<sup>2</sup>)

Source: CoCoRaHS – Community Collaborative Rain Hail and Snow Network <https://cocorahs.org/>

# **Grand River monitoring system alerts**



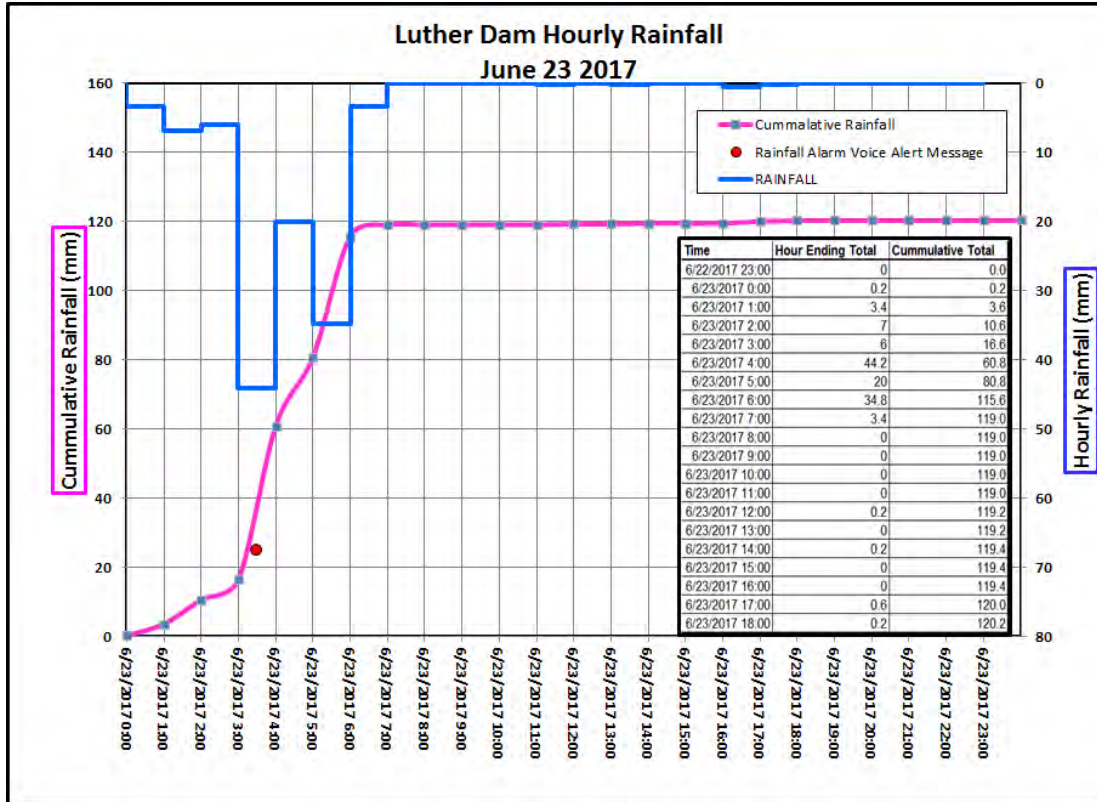
# Monitoring system alerts



- First voice alert notified GRCA duty officer of **25mm of rain received in 24 hours**

Voice alert first notified GRCA duty officer at **3:15 a.m.**

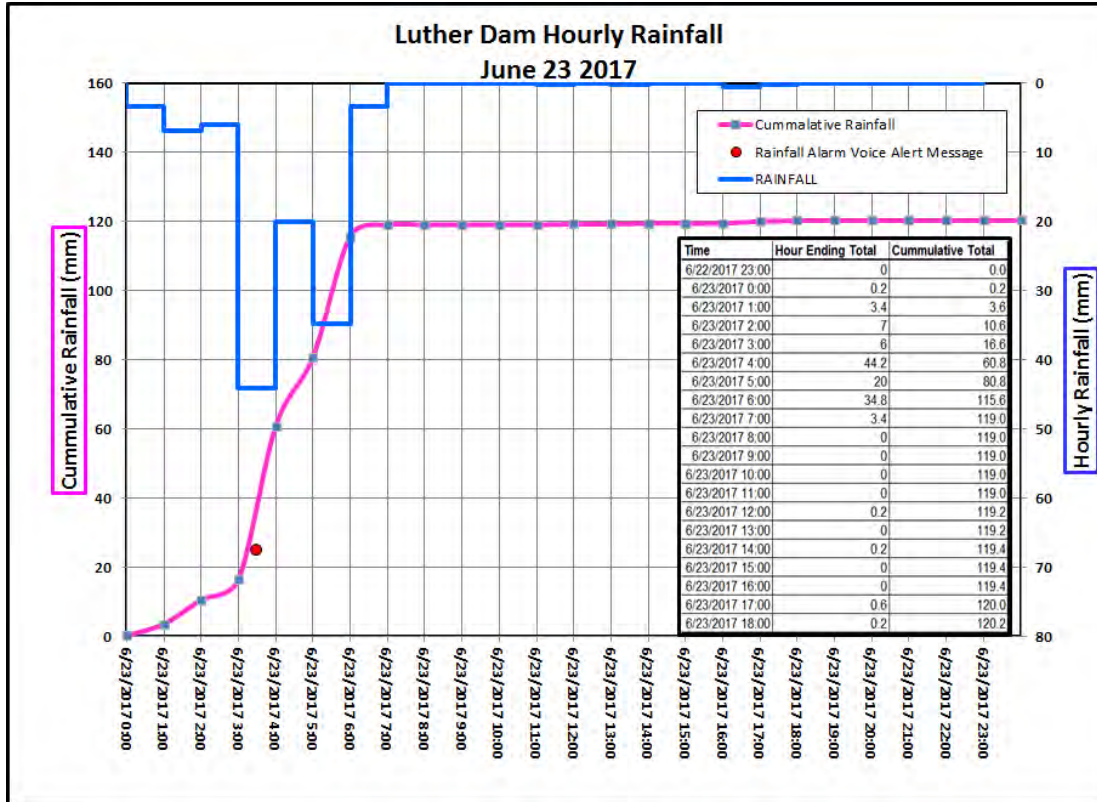
# Monitoring system alerts



- First voice alert notified GRCA duty officer of **25mm of rain received in 24 hours**
- Senior operator on-call notified shortly after 3:30 a.m. by duty officer -- **dam operators dispatched at 4:00 a.m.**

Dam operators dispatched at 4:00 a.m.

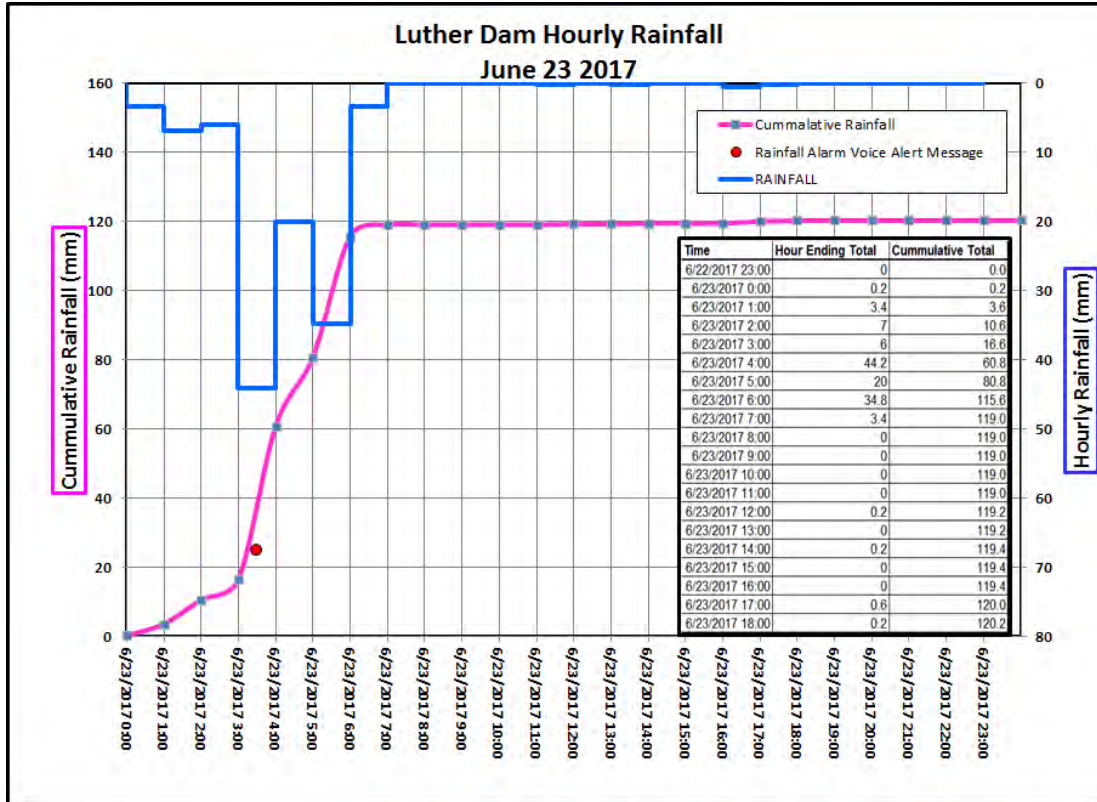
# Monitoring system alerts



- First voice alert notified GRCA duty officer of **25mm of rain received in 24 hours**
- Senior operator on-call notified shortly after 3:30 a.m. -- **dispatched dam operators at 4:00 a.m.**
- Director of Engineering notified at 4:50 a.m. – **initiated GRCA flood operations centre at 5:40 a.m.**

GRCA flood operations centre opened at **5:40 a.m.**

# Monitoring system alerts



- First voice alert notified GRCA duty officer of **25mm of rain received in 24 hours**
- Senior operator on-call notified shortly after 3:30 a.m. -- **dispatched dam operators at 4:00 a.m.**
- Director of Engineering notified at 4:50 a.m. – **initiated GRCA flood operations centre at 5:40 a.m.**
- By **6:00 a.m.** rainfall total was **120mm** at Luther Dam
- Inflows already rising to large dams, Hwy 25 flooding in Grand Valley.

More than 100mm of rain fell in 3 hours following first voice alert



# Monitoring system challenges



- Upper Belwood flow gauge station was lost between 6:00 a.m. – 7:00 a.m. due to washout of roadway embankment.
- This gauge is the inflow gauge to Shand Dam.
- Backup methods and data from Marsville were used to estimate flows into Belwood Lake reservoir
- Flows into Shand Dam from Marsville were **350 cms**. An additional **200 cms** of flow was estimated between Marsville and Shand Dam. Peak inflows into Shand Dam are estimated to have been in the **550 cms** range.

Upper Belwood inflow flow gauge station to Shand Dam was lost between 6:00 a.m. – 7:00 a.m. due to washout of roadway embankment.



# Summary of severity

Large volume of rainfall (120mm) is the **highest daily total in 63 years of records**

More than **1.5 months of rain fell in 4 hours**

Unforecast, intense rainfall covered almost **one-third of the watershed** – a very unusual weather pattern

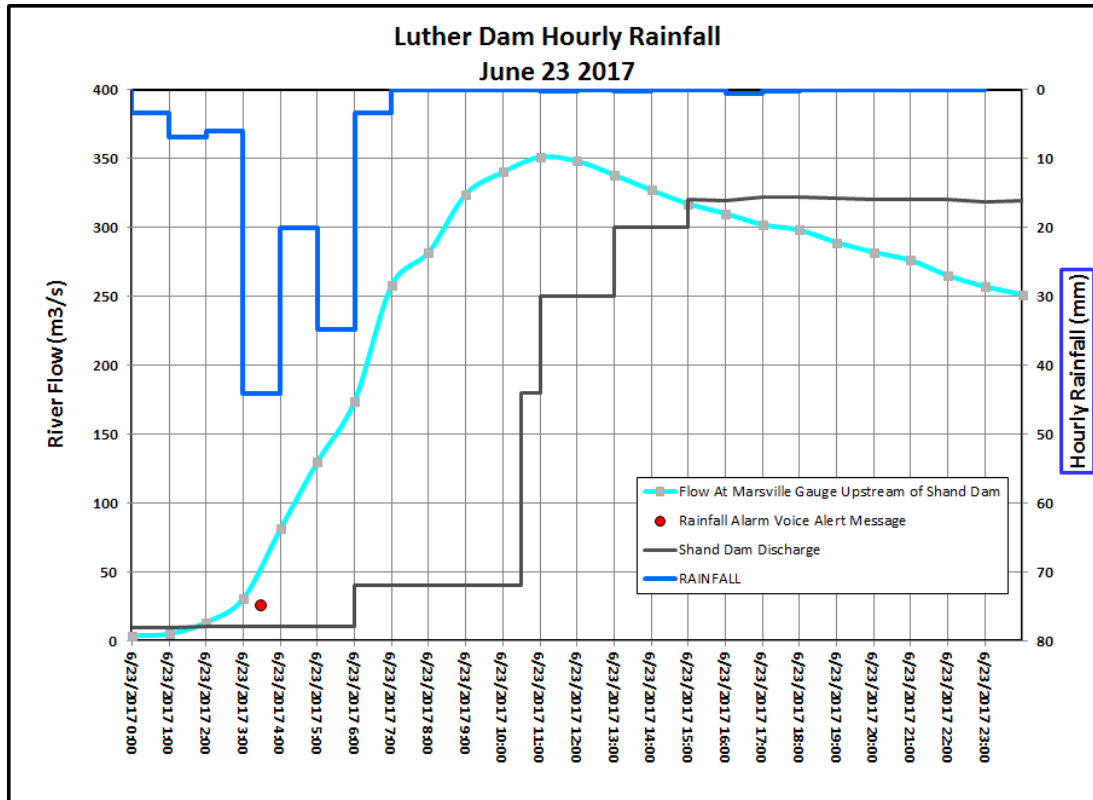
Wet ground conditions after 38mm of rain fell on June 18 increased rate of runoff – northern Grand River watershed was still recovering from that event.

No indication that this event was going to be as severe as it was.

Highest estimated inflow to Shand Dam since 1948.

# Grand River watershed response

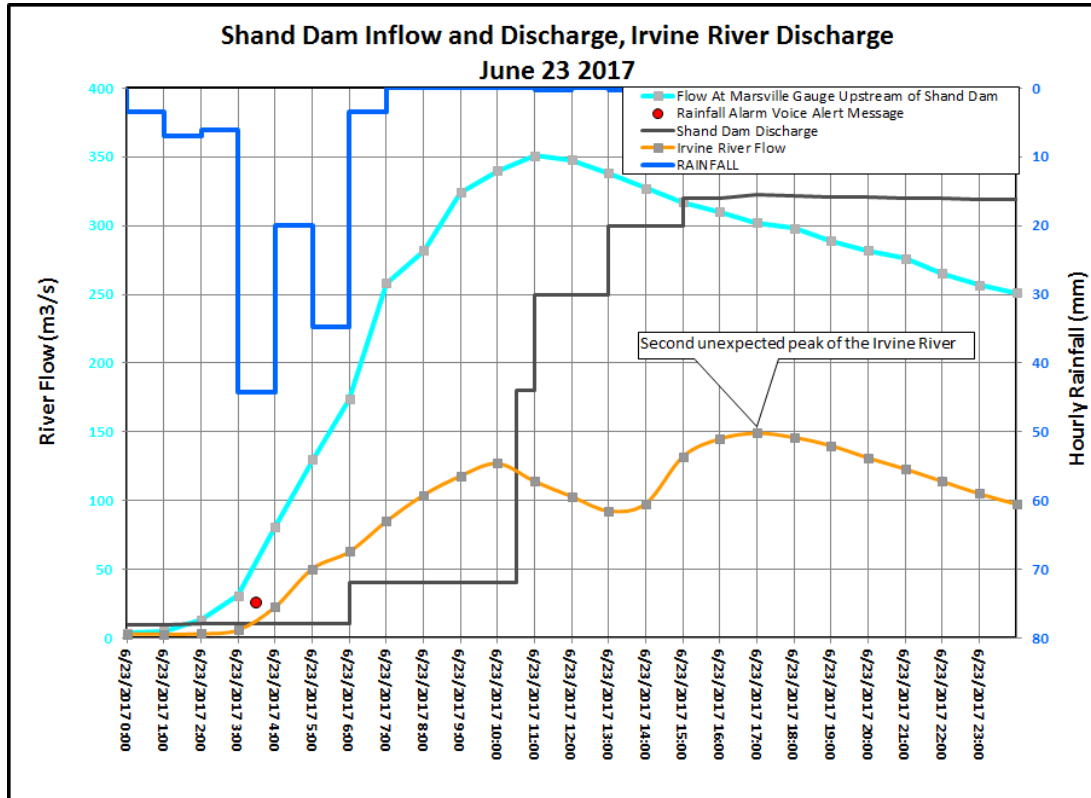
# Shand Dam inflow



- River system above Belwood Lake responded very quickly to rainfall event
- Flow into reservoir increased from **5 cms** (cubic metres/second) at 1:00 a.m. to **400 cms** by 11:00 a.m. Post event analysis now estimate inflows to Shand Dam were in the **550 cms** range.
- **Unexpected double peak** on Irvine River presented a challenge for operator – Increased flows through West Montrose.

Shand dam helped delay peak flows downstream of reservoir

# Shand Dam discharge



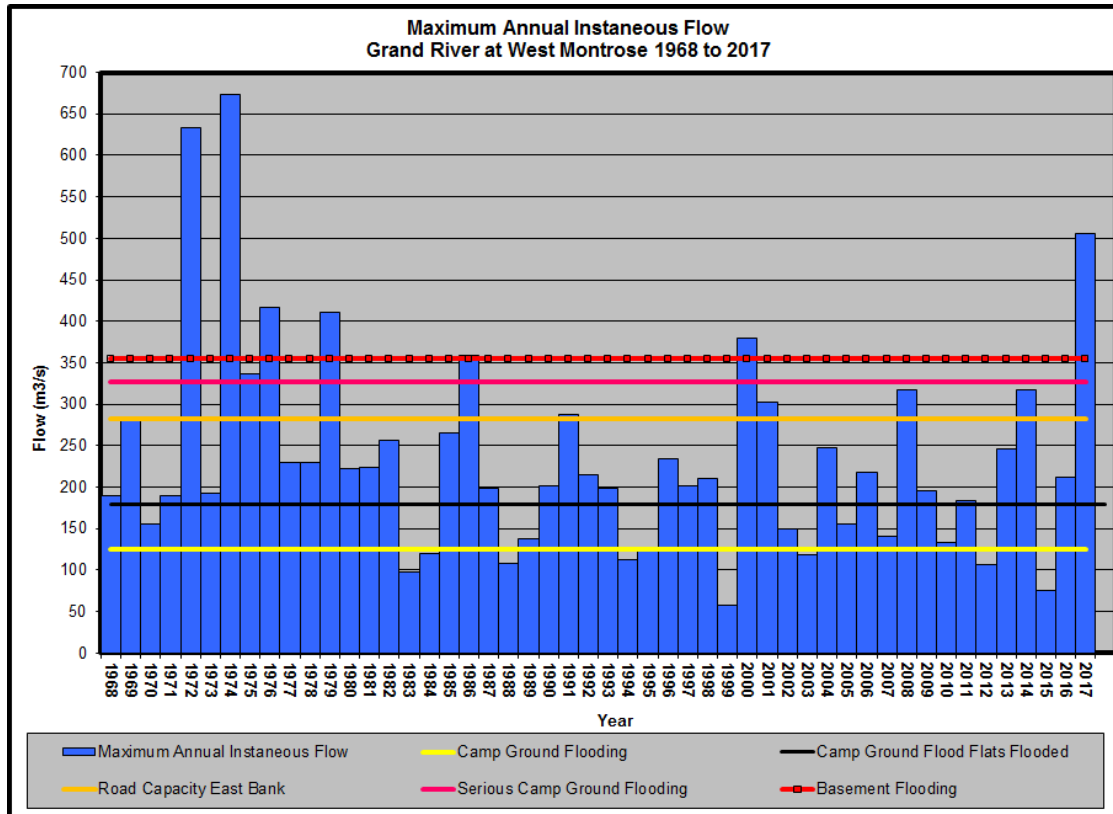
- Delaying discharge from Shand allows for Irvine River to peak downstream of Elora
- Discharge was increased (stepped up) gradually
- Second peak on the Irvine River was unexpected and increased peak through West Montrose from the forecast 400 cms to 500 cms.

Discharge from Shand dam did not exceed water flowing into reservoir

# History of flooding in West Montrose



# West Montrose flood history



- River flows through West Montrose **peaked just above 500 cms**
- The last time rainfall caused flows through West Montrose to **exceed 500 cms** was May 1974. In May 1974 flows peaked at **674 cms**.
- West Montrose is also subject to ice jam flooding. Water levels during ice jams may temporarily exceed those seen in June.
- The highest recorded ice jam occurred in February 1981, observed water elevation **322.896 m**, equivalent open water flow **552 cms**)

Significant flooding due to rainfall in West Montrose is a rare occurrence

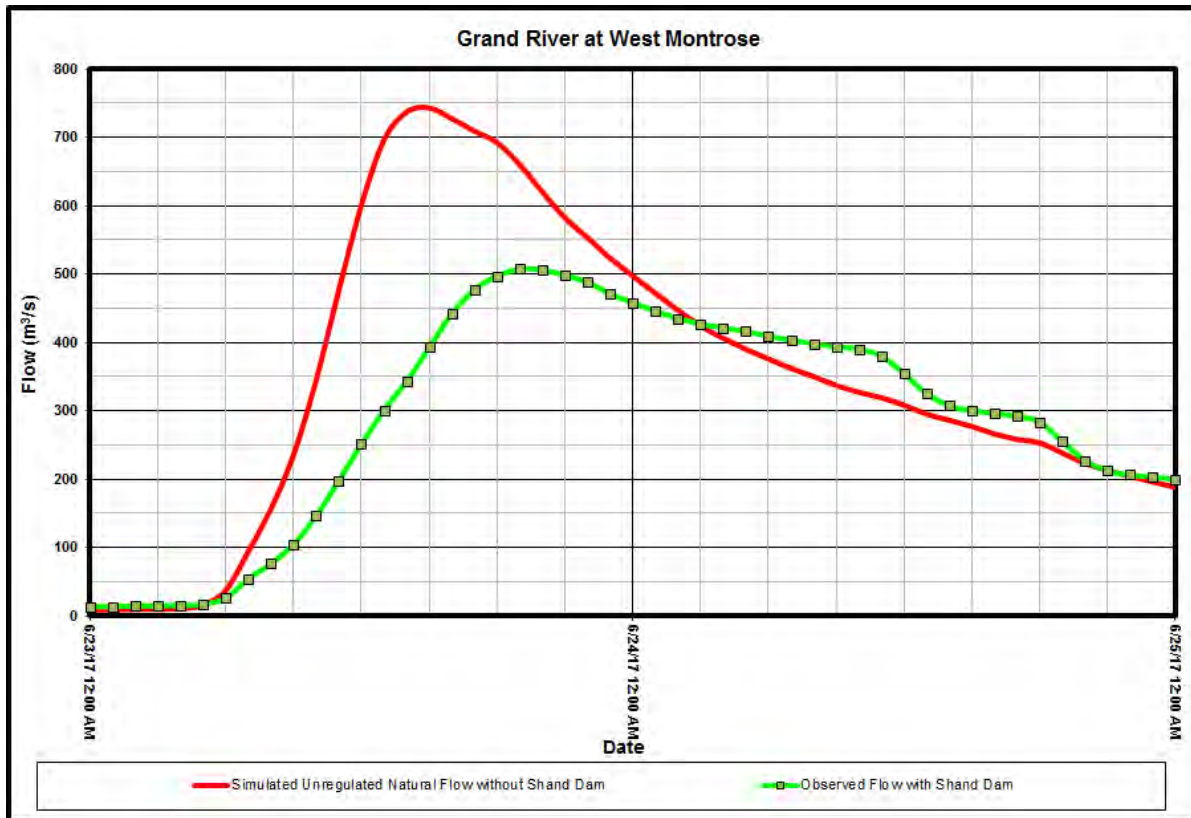
# West Montrose Ice Jam Flood



- The highest recorded ice jam occurred in February 1981, observed water elevation **322.896 m**, equivalent open water flow **552 cms**)

There is a history of ice jam flooding in West Montrose.

# Shand Dam discharge



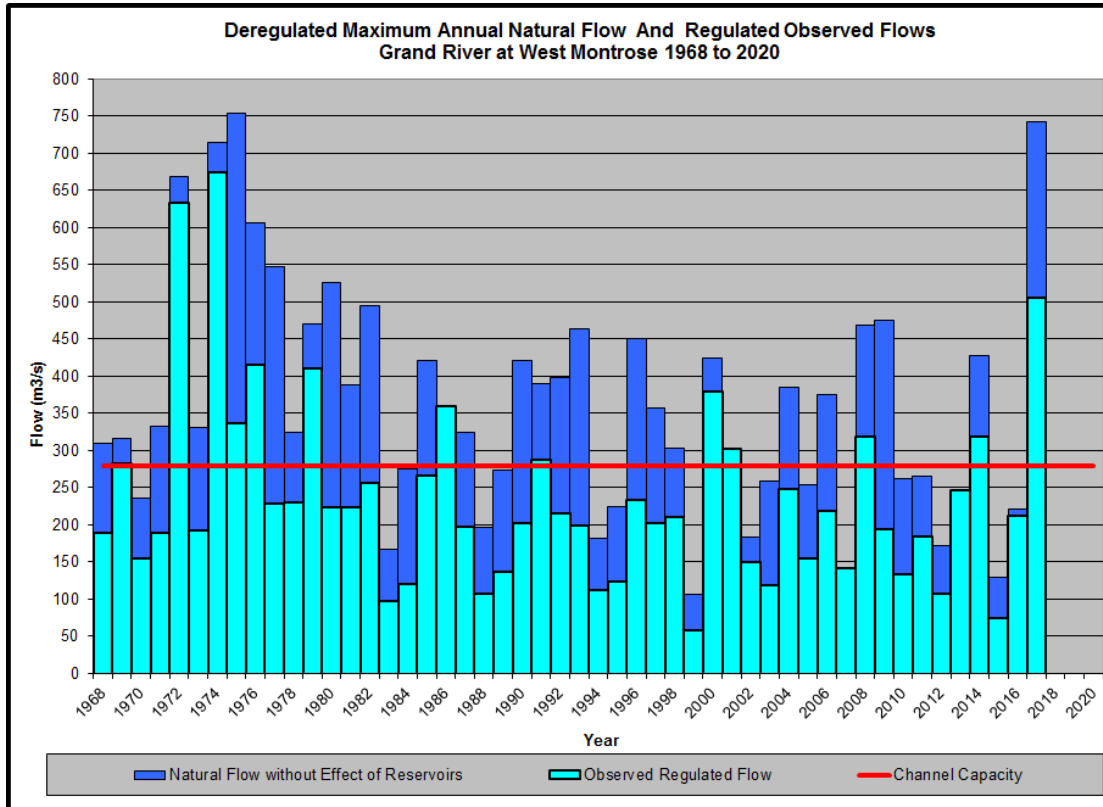
Its estimated the peak flow through West Montrose would have reached **743 cms** without the flow reduction provided by Shand Dam.

The observed peak reached **507 cms**, a **32%** reduction.

Operation of Shand Dam also delayed the peak until **7 pm** the evening of June 23<sup>rd</sup>. The peak without the dam would have occurred a **3 pm** in the afternoon, **4 hours** earlier.

Its estimated flows through West Montrose were reduced by 32% and delayed by 4 hours as a result of Shand Dam.

# West Montrose flood history



- Over the past **49 years**, the village of West Montrose has **flooded at least 13 times**.
- Without Shand Dam, the village would have flooded **at least 32 times**. *Excluding ice jam flooding*
- Even with limited flood storage capacity, Shand Dam helps reduce downstream flooding
- Without Shand Dam, flows during this event would have **exceeded May 1974**

Shand Dam reduced flows through West Montrose by **32%** during the June 23, 2017 event.



# Map of June 23<sup>rd</sup> Flood Extent



- The hydraulic model used to estimate flood levels through West Montrose was refined and calibrated.
- A digital elevation surface was created to layout flood elevations and estimate extent and depth of flooding.
- The adjacent map illustrates best efforts to date to estimate the extent of the June 23<sup>rd</sup> flood.
- A larger version is available for viewing later in the meeting. Your comment and feedback is welcome.

An updated digital floodplain model has been created to model flood extent and flood depth through West Montrose.

# Map of June 23<sup>rd</sup> Flood Depth

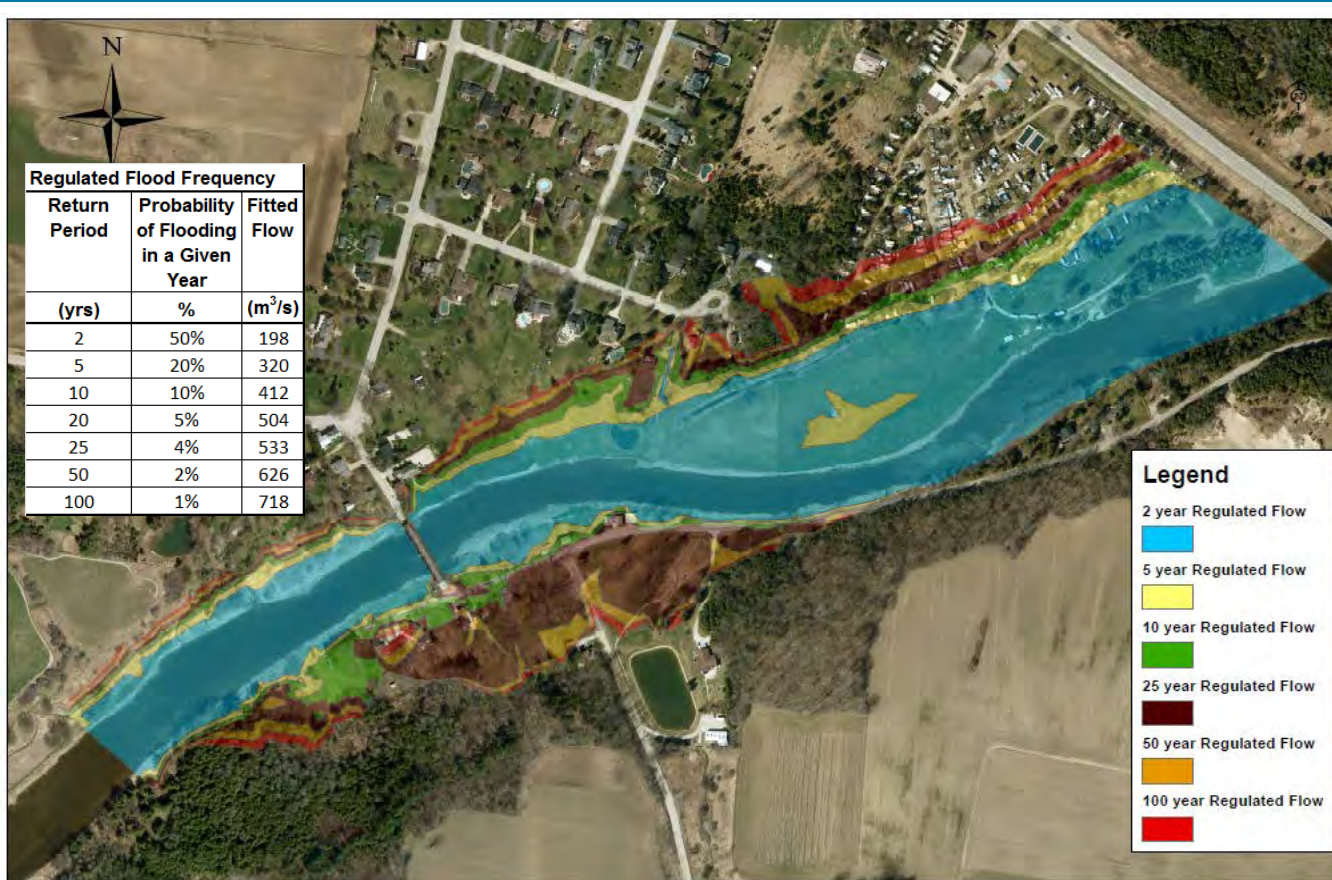


- The new floodplain model was used estimated flood depths.
- The adjacent map illustrates best efforts to date to estimate the depth of flooding during the June 23<sup>rd</sup> event.
- A larger version is available for viewing later in the meeting. Your comment and feedback are welcome and will help us further verify and refine the new floodplain model.

The new updated floodplain model can be used to estimate flood depths through West Montrose.



# Frequency of Flooding Mapping



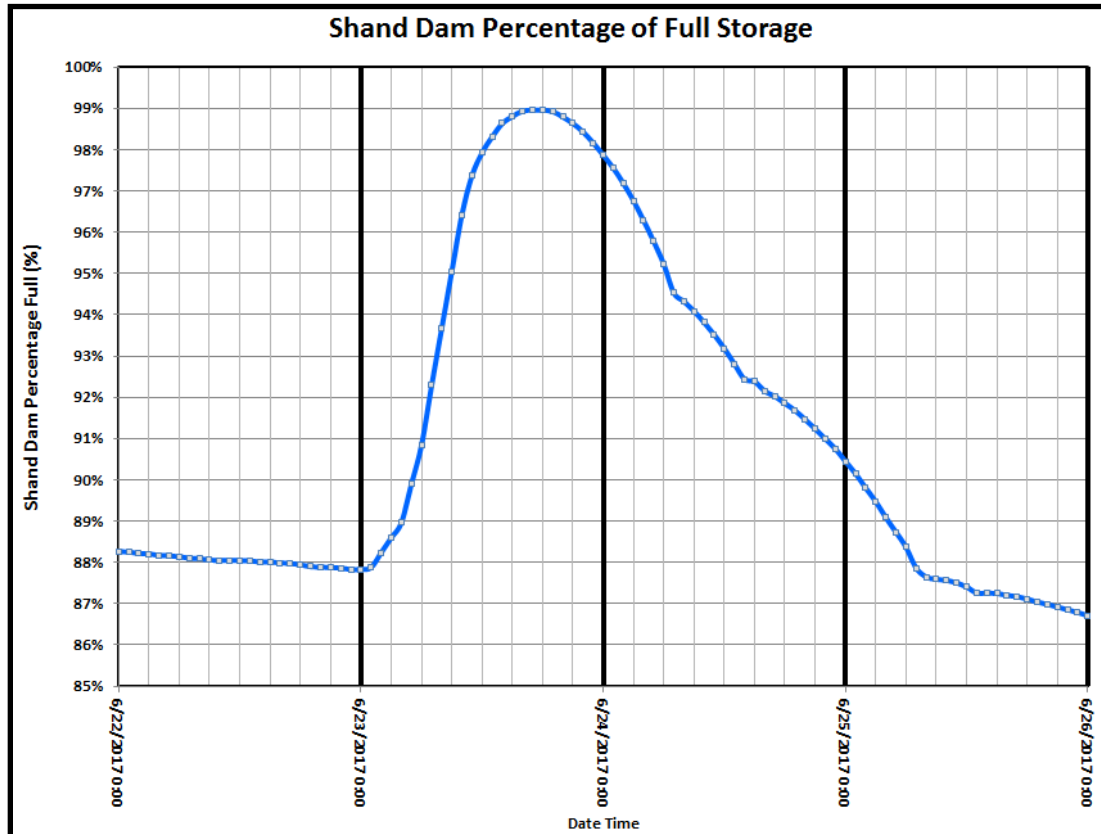
- The adjacent map illustrates the risk of flooding for different areas of the floodplain through West Montrose.
- A 2 year flood implies in any given year there is a 50% chance of being flooded.
- This type of mapping helps communicate the risk of flooding.
- A larger version is available for viewing later in the meeting.

Flood frequency mapping helps identify risk in different areas of the floodplain. A 5 year flood has a 20% chance of occurring in a given year.

# Flood Operations



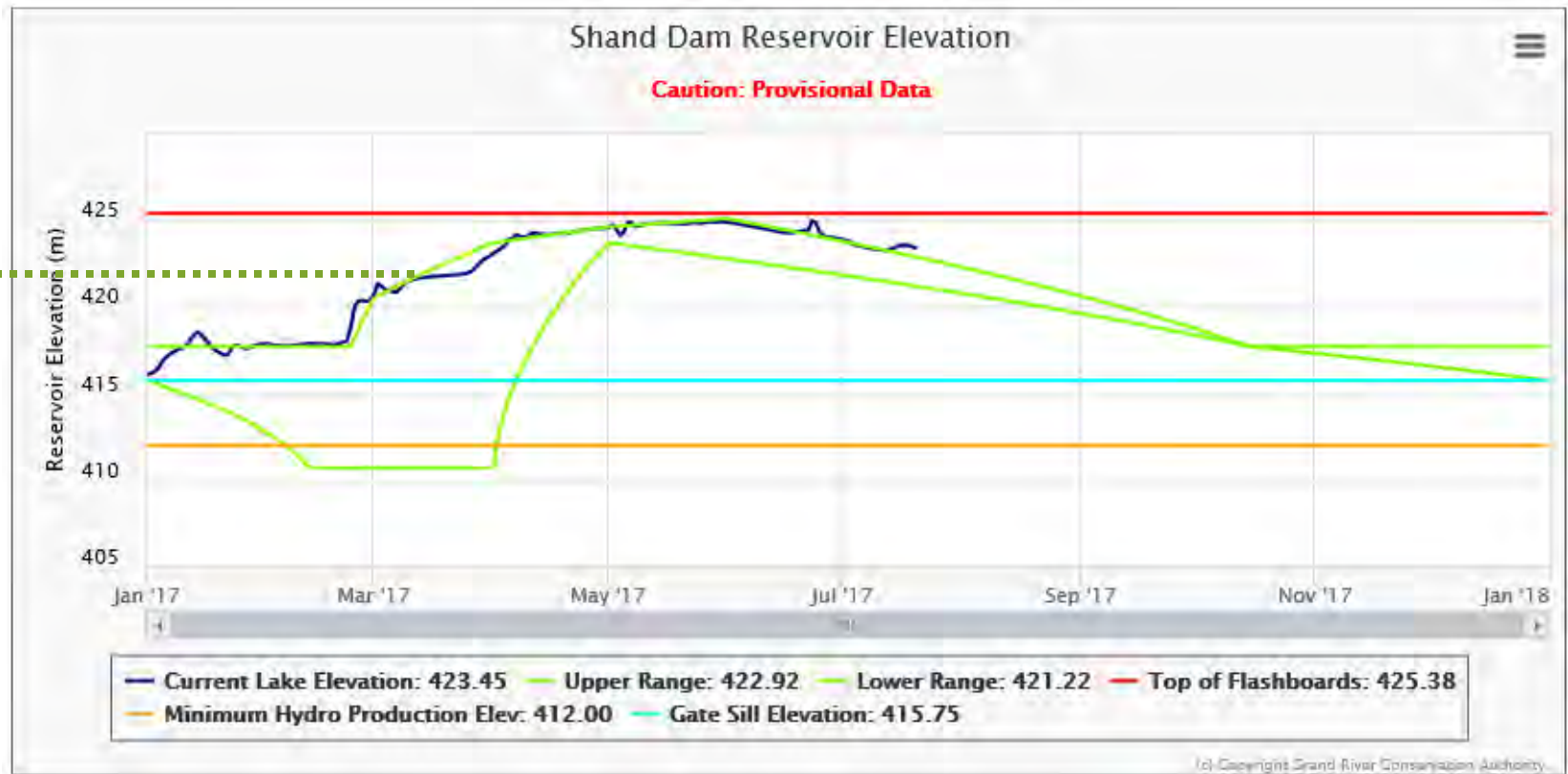
# Shand Dam Flood Storage



- Belwood Lake reservoir was approximately **88% full** prior to record rainfall event.
- Flood storage available was normal for time of year based on the reservoir operating policy
- Reservoir serves dual purposes of flood mitigation and flow augmentation. The operating policy balances these two competing roles

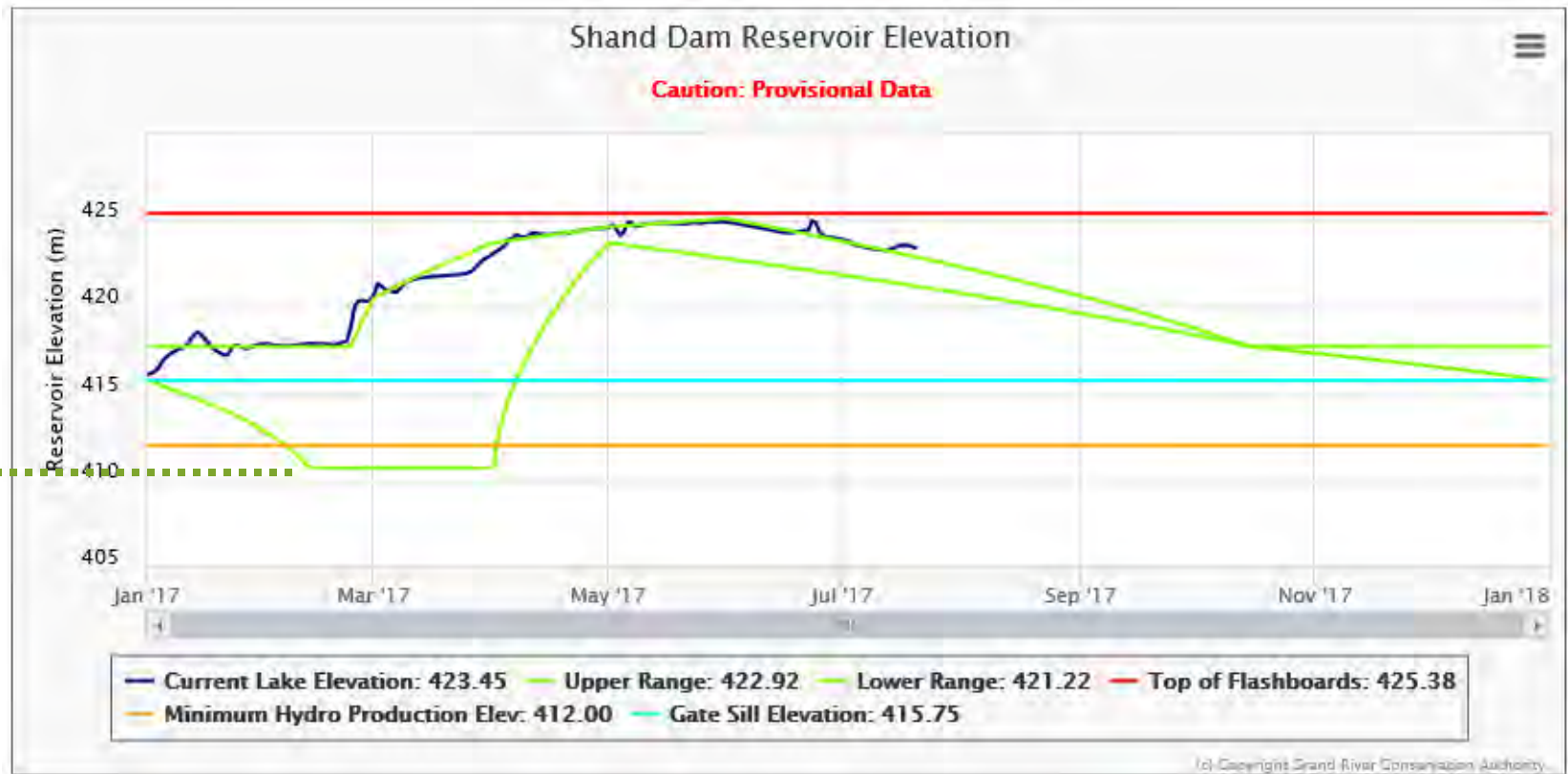
Reservoir was taken up to 99% full to help reduce downstream flooding

# Reservoir operations (upper)



Upper Rule Curve (green line) defines 'optimal' reservoir level. This is the level that operating policies determine most effectively balances flood mitigation and flow augmentation throughout the year. **Our goal is to remain as close to this line as possible.** Reservoir levels may exceed this line for short periods of time during flooding events.

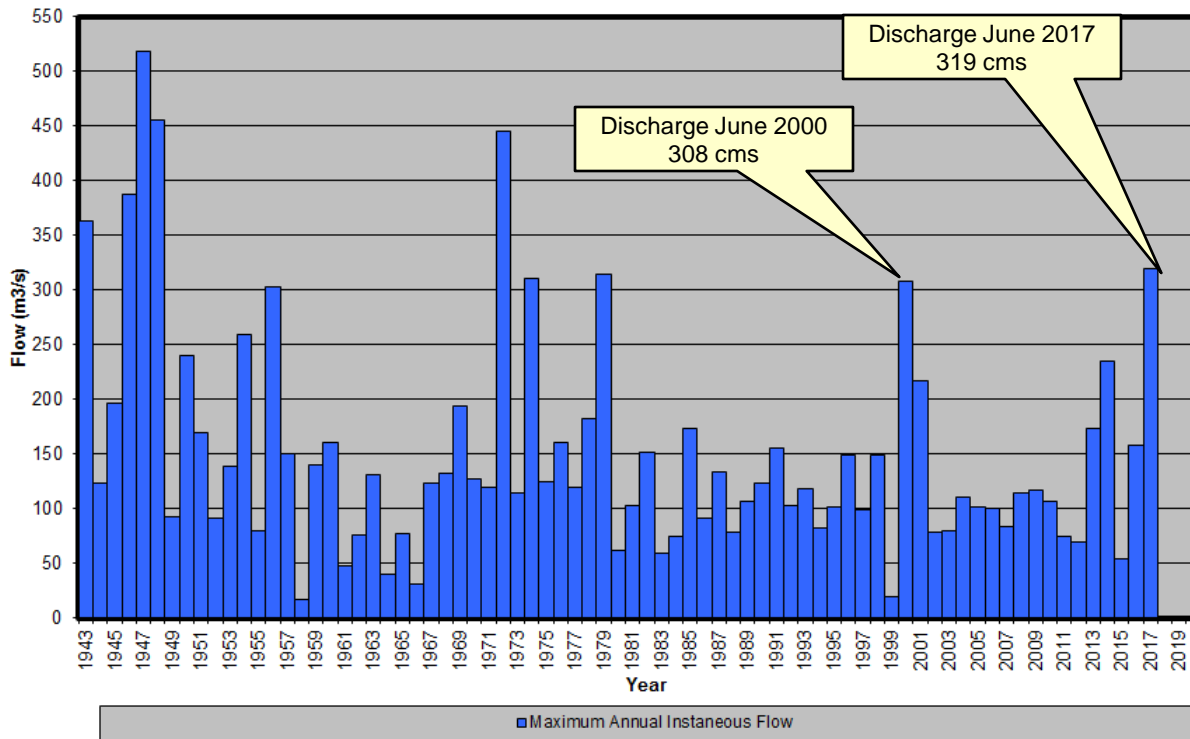
# Reservoir operations (lower)



Lower Rule Curve (green line) defines 'drought' reservoir level. This level guides senior engineers on how to operate the reservoir during periods of drought or water shortage. Upper and lower lines are not considered a 'range'. These two lines are different operating strategies based on environmental conditions.

# Shand Dam discharge

Maximum Annual Instantaneous Flow  
Grand River at Below Shand (Shand Discharge) 1943 to 2020



Shand discharge in June 2000 was **308 cms**, in June 2017 Shand dam discharge was **319 cms**.

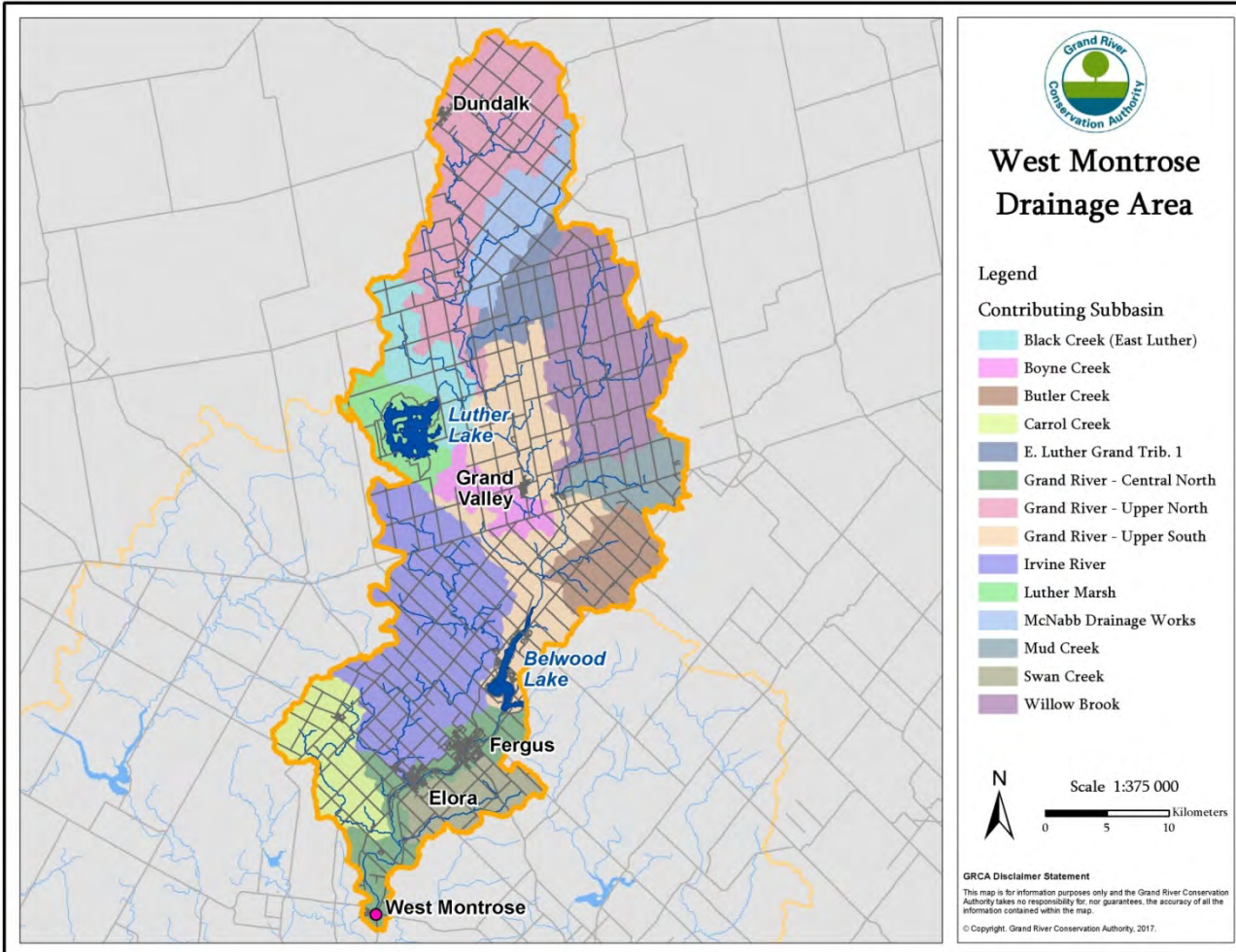
Similar discharges for the two events, very different flooding in West Montrose. In June 2000 peak flows reached **380 cms** through West Montrose in June 2017 they reached **507cms**.

The difference was caused by **unregulated** tributary flow from the Irvine River and Carrol Creek.

Discharge from Shand Dam in 2017 was very similar to discharge in June 2000.



# Areas Draining to West Montrose



The adjacent map illustrate the drainage area upstream of West Montrose.

Approximately **800 km<sup>2</sup>** drainage to Shand Dam. The drainage area at West Montrose is **1170 km<sup>2</sup>**.

The drainage area downstream of Shand Dam from the Irvine River, Carrol Creek and Swan Creek account of **32%** of the drainage area to West Montrose.

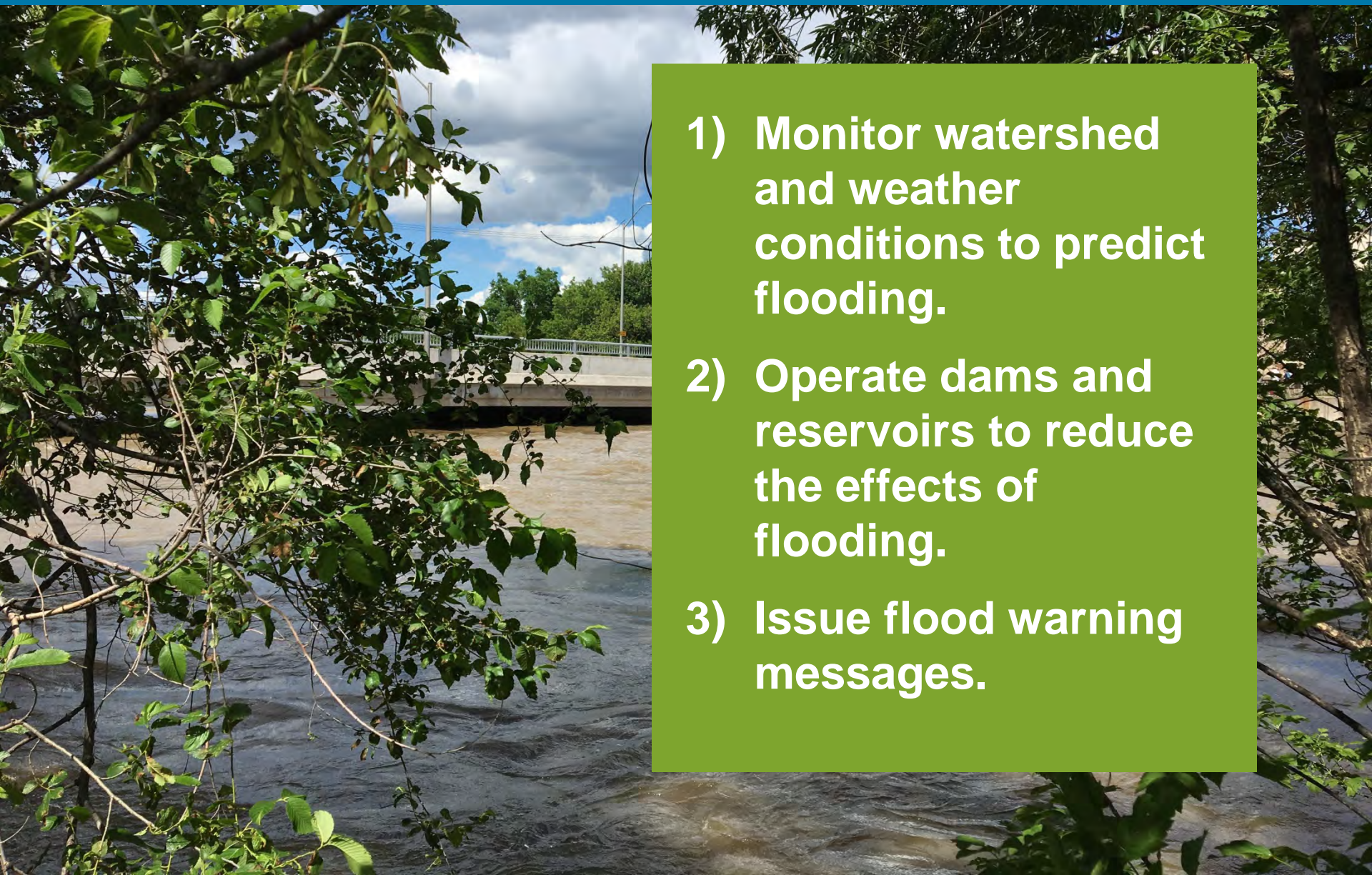
Areas downstream of Shand Dam accounted for about **40%** of the peak flow through West Montrose separate from the area upstream of Shand Dam.

About 40% of the peak flow through West Montrose on June 23<sup>rd</sup> resulted from the unregulated drainage to West Montrose downstream of Shand Dam.

# Roles in Flood Management



# GRCA's Role

- 
- 1) Monitor watershed and weather conditions to predict flooding.
  - 2) Operate dams and reservoirs to reduce the effects of flooding.
  - 3) Issue flood warning messages.



# Township Role

Upon receipt of a Flood Message “Watch” or “Warning” the Municipal Officials should:

1. Enact the Municipal Fan Out System to warn Municipal Officials, affected citizens, businesses and the general public in the flood plain.
2. Coordinate flood watch and Municipal Emergency Flood Response.
3. Assess the flood situation and liaise with GRCA Flood Coordinators.



# **Flood Warning Messages and Communications**

# Flood Warnings and Communications During the Event

**June 23, 2017 06:17 am** Contacted Dale Martin Flood Co-Ordinator for Woolwich Township asked him to arrange closure of Three Bridges Road indicated West Montrose campground would be flooded, Indicated GRCA would call camp ground directly to request removal of trailers on the flood flats below 180 cms.

**June 23, 2017 06:22 am** Contacted West Montrose campground requested trailers be removed from the flood flats below 180 cms.

## **Flood Message #1 June 23, 2017 09:00 am**

The trailer park in West Montrose will be flooded early this afternoon, the trailer park operator has been advised. Township staff are asked to monitoring conditions in the Village of West Montrose; it is expected that levels will peak later this evening through West Montrose.

**June 23, 2017 10:00 am** Contacted Woolwich Township Flood Co-ordinator provided flood maps for West Montrose indicated 280 cms flood goes up to 4th line in West Montrose Trailer park.

**June 23, 2017 11:00 am** Call from West Montrose Campground, informed them to move people out of lower area, effective flooding to 4th Street later today

**June 23, 2017 1:15 pm** Contacted Woolwich Township Flood Co-ordinator expect West Montrose peak to reach 400 cms @ 6 pm. Requested Glasgow Street be closed.

## **Flood Message #2 June 23, 2017 1:30 pm**

The trailer park and portions of the Village of West Montrose will be flooded Friday afternoon. Flood co-ordinators in Woolwich Township are asked to warn residents as necessary. This magnitude of flooding through West Montrose was last experienced in May 2000.

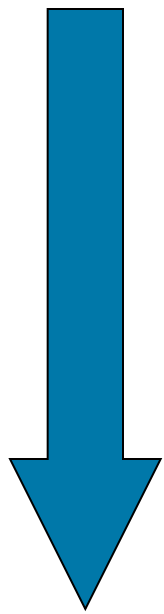
**June 23, 2017 4:50 pm** Status requested by Woolwich Township Flood Co-ordinator forecast update for West Montrose and St. Jacobs, concern about flooding of the long facility in St. Jacobs, confirmed long term care facility in St. Jacobs would not be flooded. Updated forecast for West Montrose 460 cms.

**Flood Message #3 June 23, 2017 5:00pm** The trailer park and portions of the Village of West Montrose flooded Friday afternoon and levels are expected to peak Friday evening. Flood co-ordinators in Woolwich Township have warned residents.

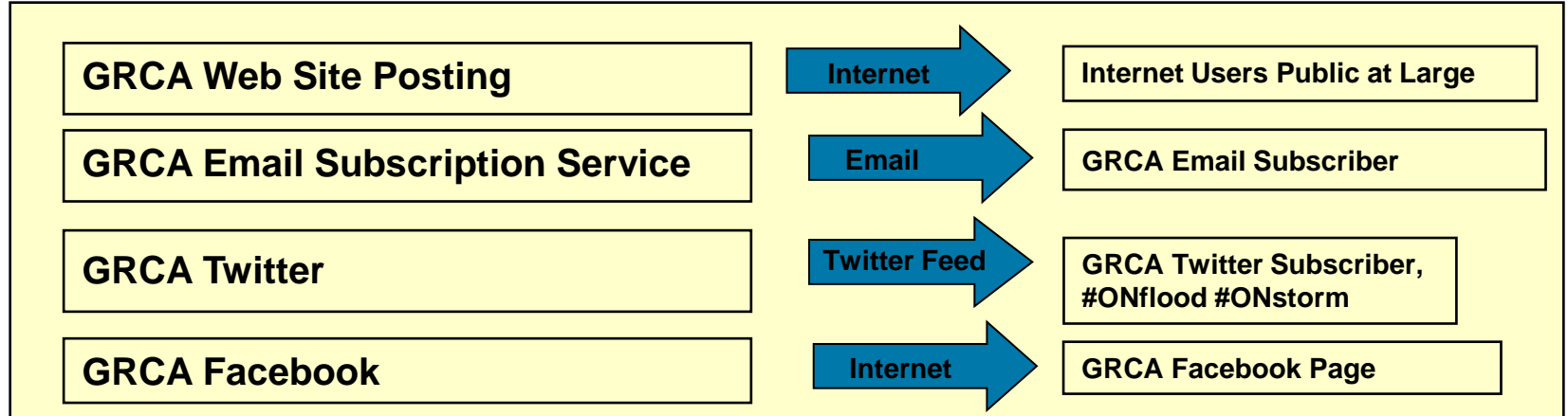
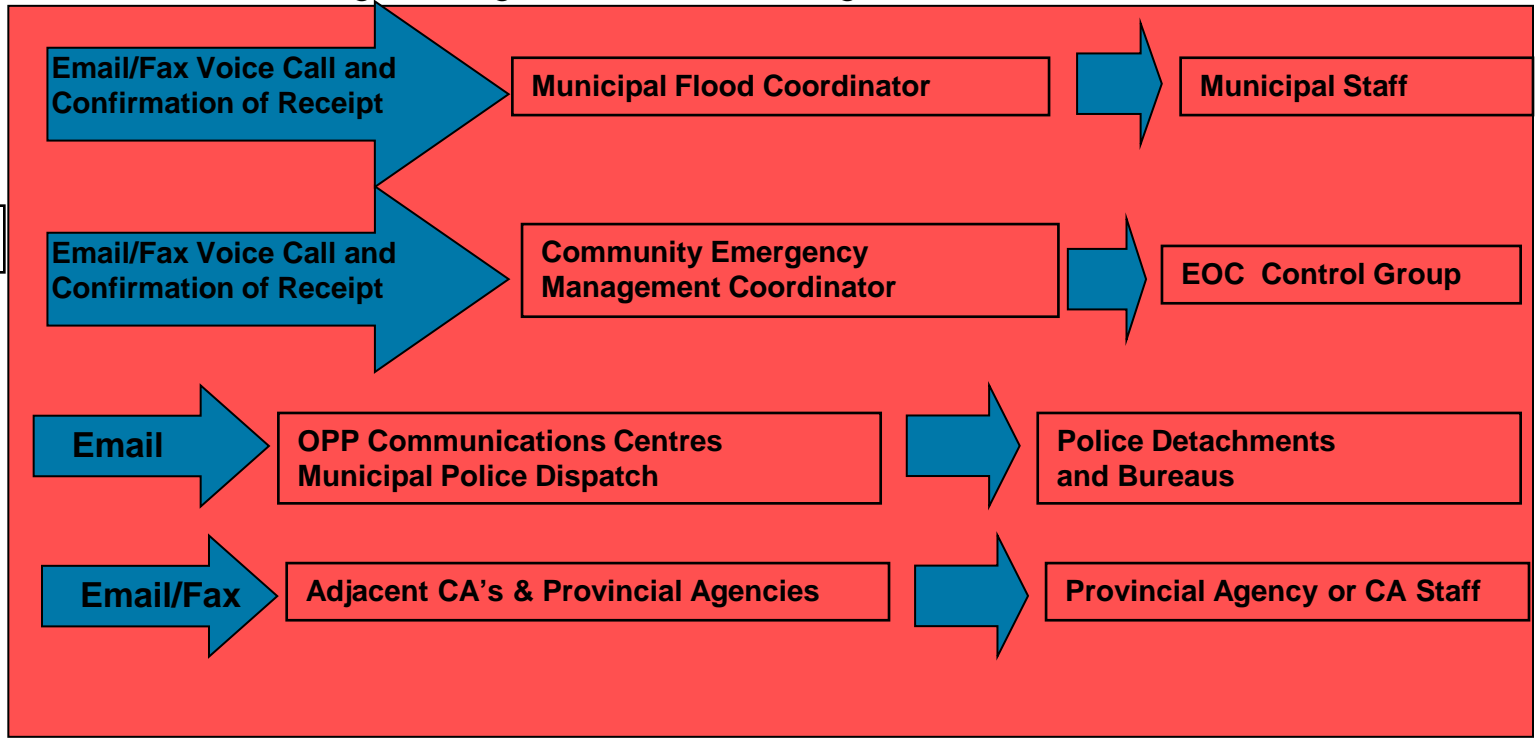
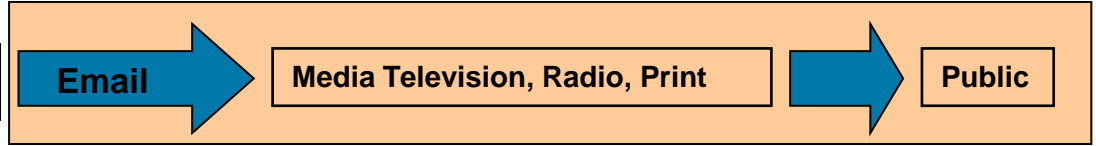
Note information on this slide summarizes actions with respect to West Montrose, other communications were going on at the same time with other affected communities and parts of the watershed.

# GRCA Flood Warning Message Fan Out Illustrating Social Media Fan Out

**Flood Warning**



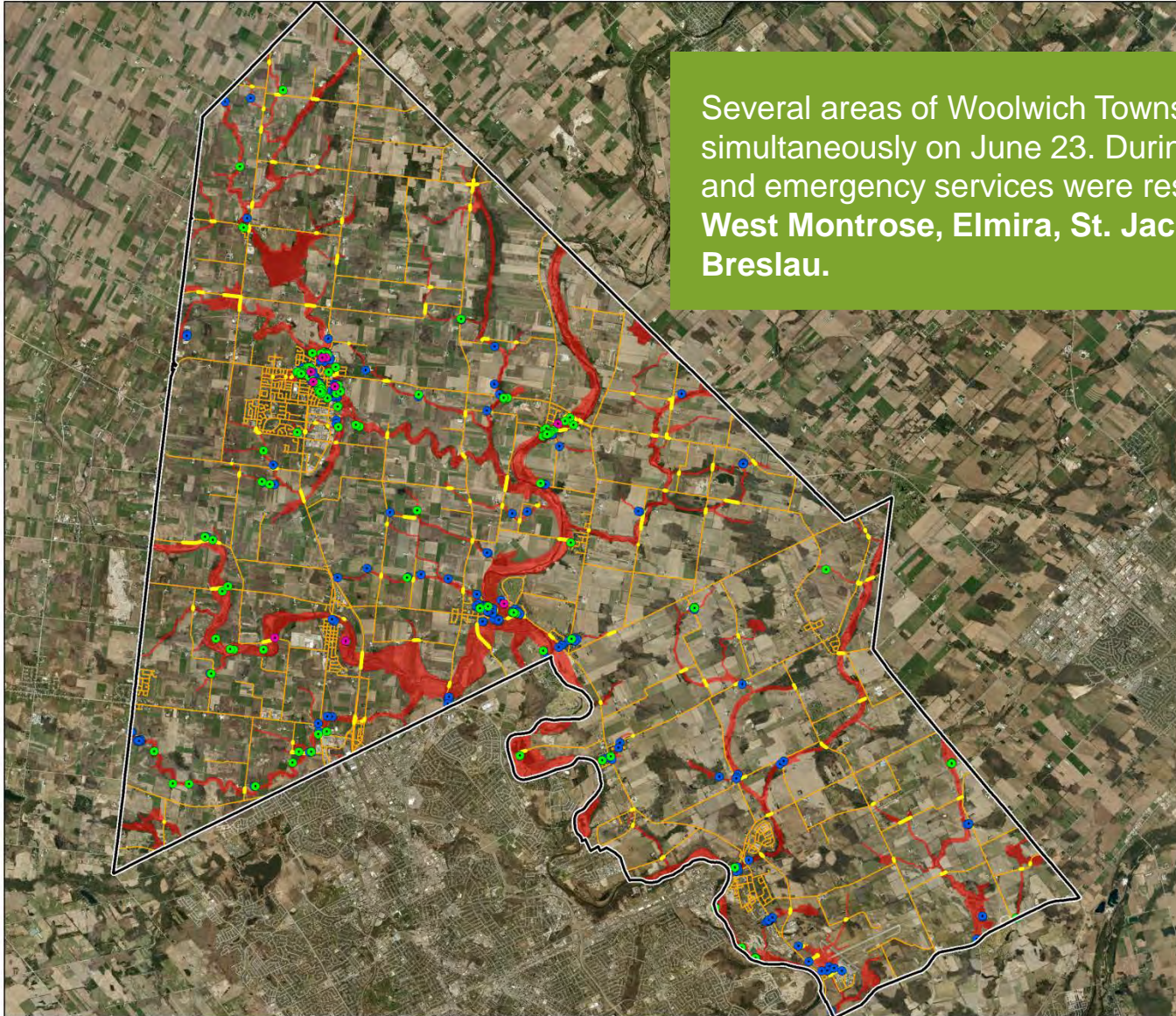
**GRCA Press Release**



# Township Flood Impact



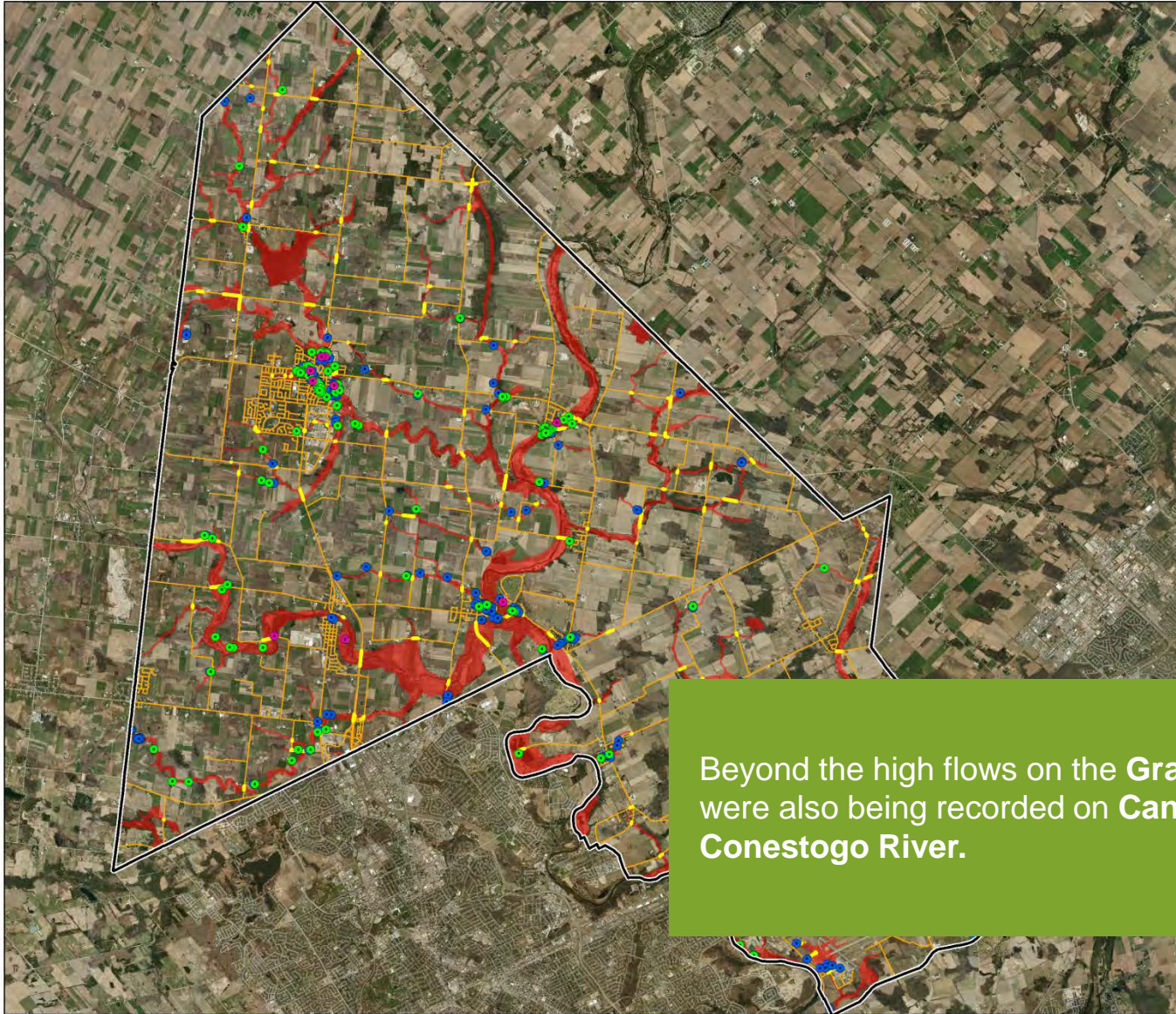
# Flood Impact - Township



Several areas of Woolwich Township were flooding simultaneously on June 23. During this event, township staff and emergency services were responding to flooding in **West Montrose, Elmira, St. Jacobs, Conestogo, and Breslau.**



# Flood Impact - Township



# Preliminary Outcomes

# Preliminary Outcomes

- Need to develop and implement flood inundation mapping for the Village of West Montrose similar to that in place for the Town of New Hamburg, Village of Ayr and Town of Drayton. The inundation mapping needs to include both those residents that need to be warned and those the need to be evacuated.
- A plain language public brochure needs to accompany inundation mapping to explain mapping and flood zones in plain language.
- Need to review how forecast flows can be shared in real-time with municipal staff and public to reduce the time needed to communicate information. Real-time posting of flow forecast being investigated.
- Dedicated flood page on the GRCA web site for West Montrose to organize and convey information for residents of West Montrose and for municipal staff.
- Channel capacities through Elmira and St Jacobs need to be confirmed and inundation mapping similar to described in the above need to be developed for the Town of Elmira and Village of St. Jacobs.

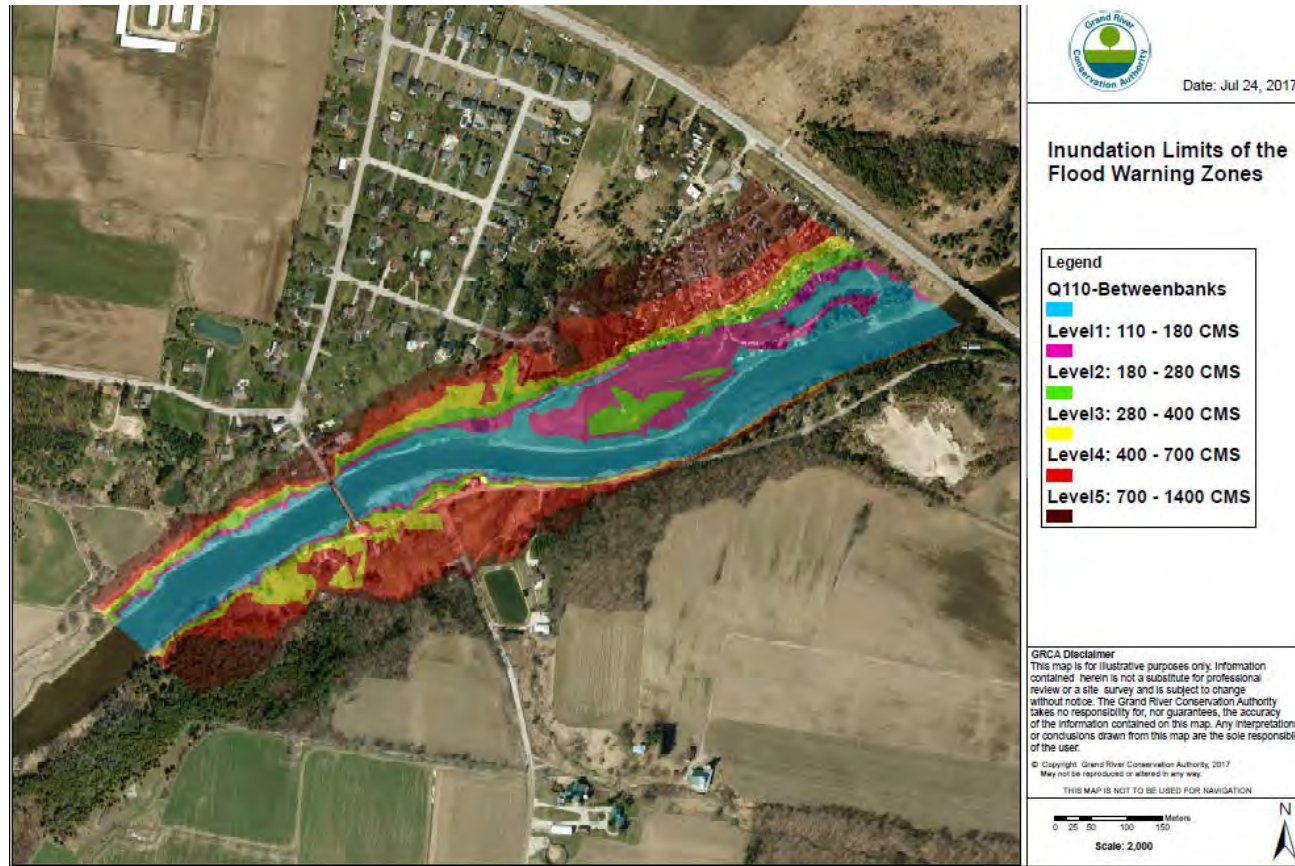


# Preliminary Outcomes

- Broader township mapping along major water courses identifying structure and road flooding for a range of flows needs to be developed. Mapping currently developed for the Regulatory flood.
- Refine reservoir charts on GRCA web site to better communicate reservoir operating policy.
- Delay in flood messages issued to subscribers was identified at the recent township council meeting. Measures have been taken to correct any delays from GRCA's end. Keep in mind delays can occur through recipient's provider and high speed coverage does not cover the whole township or watershed.
- Discussions have been initiated with Environment Canada and Province of Ontario to review the rainfall event that caused the June 23<sup>rd</sup> 2017 flood to understand why more early warning was not provided and how the system can be improved to manage future events of this type. Potential use of the Canadian Alert Ready System is being pursued, it has provision for a flash flood warning. The June 23<sup>rd</sup> 2017 event could be classified as a flash flood given the rapid response, this event will be used to analyze and develop criteria to issue a flash flood through the Canadian Alert ready system.

# Next Steps

# West Montrose Flood Warning Mapping



- The new digital floodplain model was used to map 5 zones of flooding.
- These five zones cover a range of flood conditions up to the Regulatory flood.
- The attached map illustrates the extent of these flood zones.
- Once implemented these flood zones would be used in future flood warning messages.
- A larger version of this map is available for viewing and commenting.

New flood warning mapping has been created for West Montrose identifying specific flood zones.

# West Montrose Flood Warning Mapping Flood Zones and Flood Messages

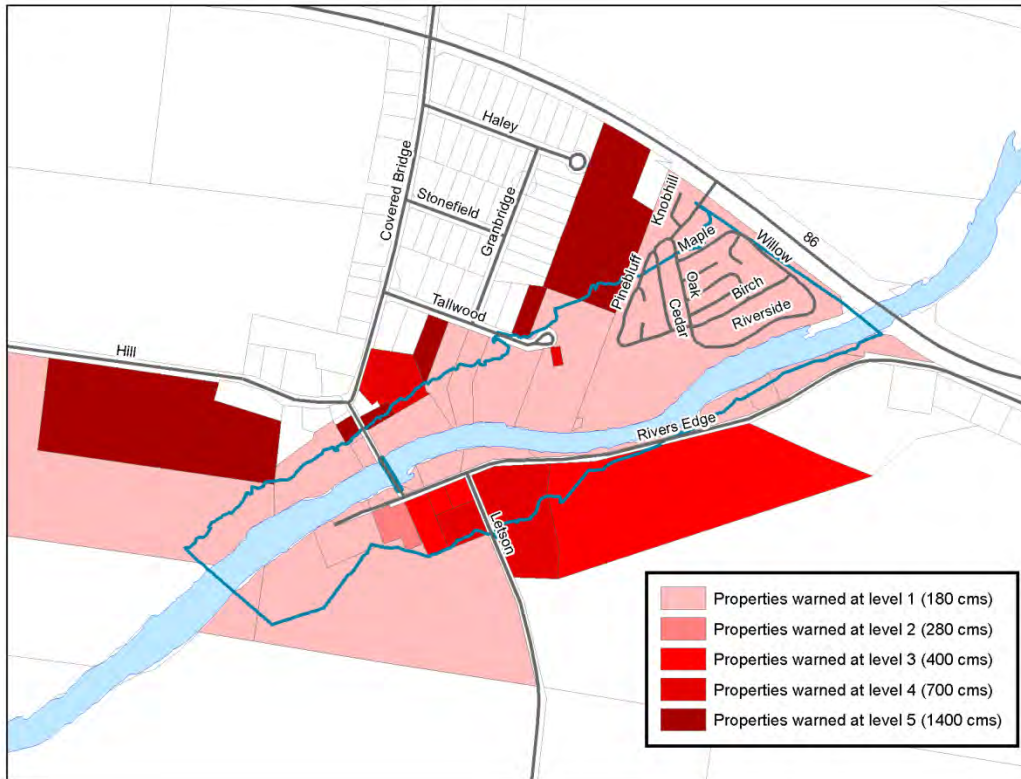
Flood Warning Zone	Description	Flood Warning Zone Flow Threshold (cms)	West Montrose Campground	Village of West Montrose
<b>Between the Banks</b>	<b>Bank full flow 0 -110 cms. (non flood condition)</b>	Up to 110	Normal condition no watch or warnings	Normal condition no watch or warnings
<b>Level 1</b>	<b>Flow 110 to 180 cms (level 1 flood flats flood)</b>	Up to 180	Flood Warning Flood Flats Campground	Flood Watch
<b>Level 2</b>	<b>Flow 180 to 280 cms (level 2 flood flats flood to channel capacity)</b>	Up to 280	Flood Warning Entire Campground	Flood Watch Entire Village
<b>Level 3</b>	<b>Flow 280 to 400cms (level 3 flooding of houses in West Montrose, closure of Rivers Edge Drive)</b>	Up to 400	Flood Warning Entire Campground	Flood Warning Entire Village
<b>Level 4</b>	<b>Flow 400 to 800 cms (level 4 severe flooding of residents, potential for loss of covered bridge. 1974 Maximum observed was 674 cms, also cover area affected by Feb 1981 ice jam flooding 322.9 m)</b>	Up to 800	Flood Warning Entire Campground	Flood Warning Entire Village
<b>Level 5</b>	<b>Flow 800 to 1400 cms (level 5 severe flooding of residents, potential for flooding to the limits of the Regulatory Floodplain)</b>	Up to 1400	Flood Warning Entire Campground	Flood Warning Entire Village

- New flood zone mapping will be provided to the township and used as input to the community alert systems.
- This mapping can also be used to plan actions during a flood such who needs to be warned versus who needs to be evacuated.

New flood zones will be integrated with Municipal Emergency Plans for flood emergencies



# West Montrose Flood Warning Mapping

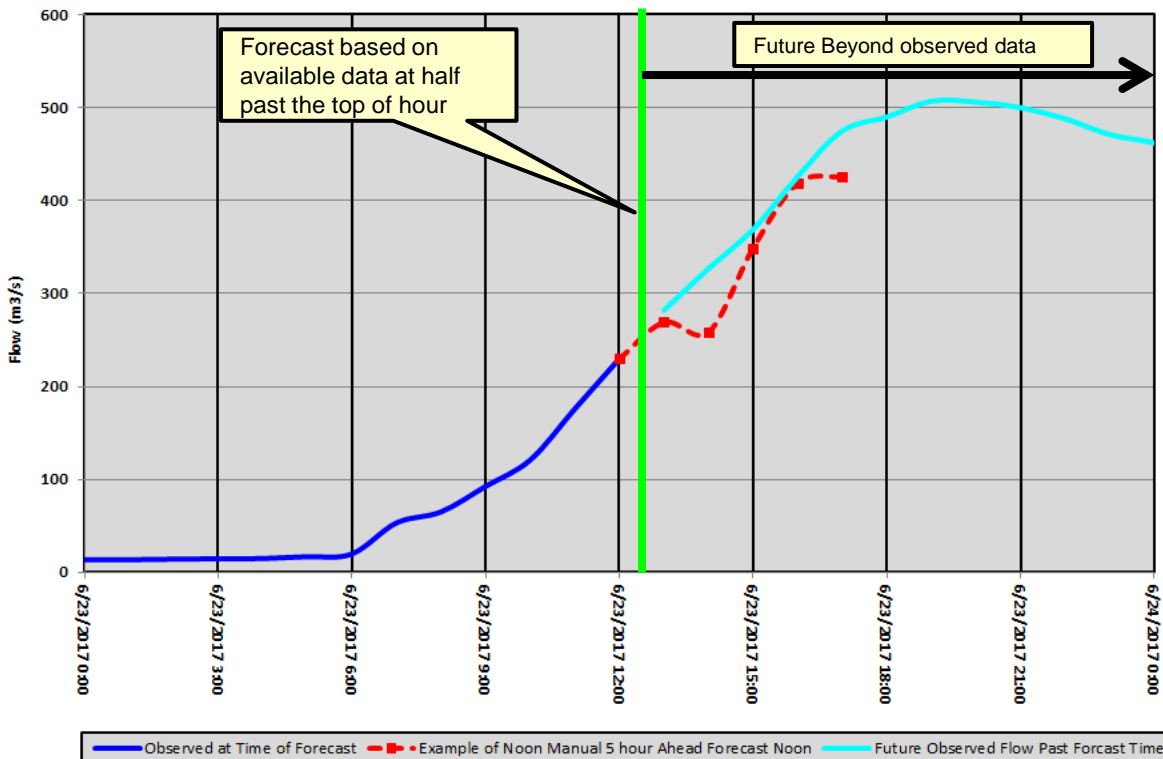


- Property parcels have been identified in each flood zone.
- The attached maps illustrates which property parcels are located in specific flood zones.
- The list of properties in each flood zone will be integrated into the municipal community alerting system.
- A residents guide explaining the flood zones will be prepared and made available for the GRCA web site.
- The attached map will be included in the residents guide.

A new residents guide to flood warning mapping in West Montrose will be created.

# West Montrose Flow Forecast

Example of West Montrose Continuous 5 Hour Ahead Forecast  
Based on Observed Upstream Gauge Data



- A new continuous forecast has been created for testing and feedback.
- The new forecast is based up observed stream flow data from the Irvine River at Salem, Grand River below Shand Dam and Grand River at West Montrose.
- The forecast would run continuously during the non ice cover period of the year.
- A chart of the five hour ahead forecast would be posted hourly to the GRCA web site.
- The new forecast would provide additional lead time to residents and township staff.

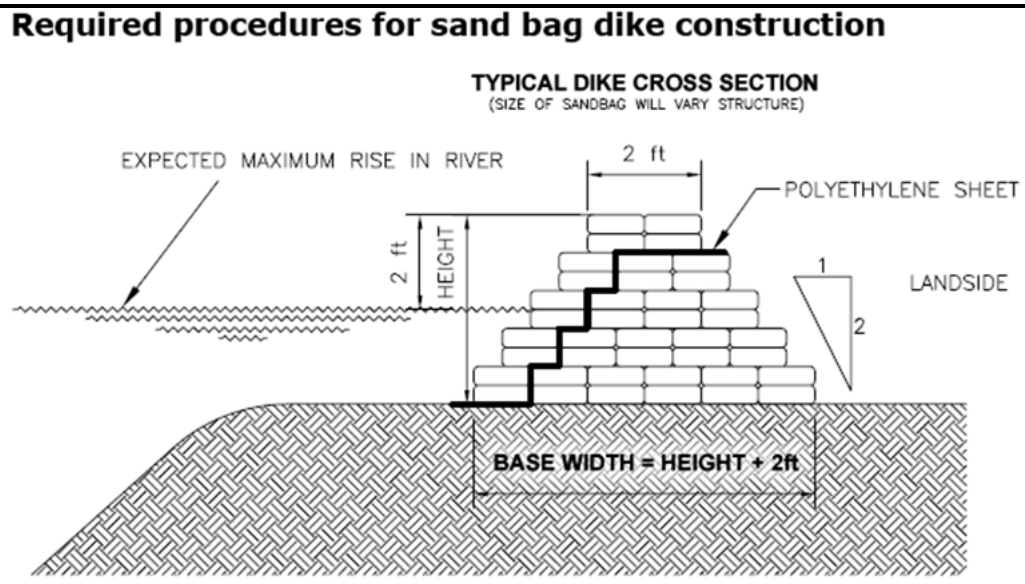
The new 5 hour ahead continuous forecast would complement the new flood warning map for West Montrose.

# Sand Bag Dike Information

- City of Winnipeg publishes sand bag dike information. The web links are included in the following.
- These links provide information regarding proper construction of a sand bag dike and tables to estimate the number of sand bags required.
- These links will be included on the GRCA web site.

<http://www.winnipeg.ca/emergweb/flood/buildingadike.stm>

<http://www.winnipeg.ca/emergweb/pdfs/SandbaggingSafetyTips.pdf>



**Number of Sandbags Required - Lengths in feet**

Height of dike	Length of dike													
	50	100	150	200	250	300	350	400	450	500	550	600	650	700
0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.5	210	430	640	850	1070	1280	1500	1710	1920	2140	2350	2560	2780	2990
1.0	470	950	1420	1900	2370	2850	3320	3800	4270	4750	5220	5700	6170	6650
1.5	780	1570	2350	3130	3920	4700	5480	6270	7050	7830	8620	9400	10190	10970
2.0	1100	2300	3400	4600	5700	6800	8000	9100	10300	11400	12500	13700	14800	16000
2.5	1500	3100	4600	6200	7700	9300	10800	12300	13900	15400	17000	18500	20100	21600
3.0	2000	4000	6000	8000	10000	12000	14000	16000	17900	19900	21900	23900	25900	27900
3.5	2500	5000	7500	10000	12500	15000	17500	19900	22400	24900	27400	29900	32400	34900

# West Montrose Flood Warning Tool

New Tab

Search or enter address

## Woolwich: Current Flood Warning

Last updated: June 23 @ 14:00 (est)

# Level 3

358 cms

Current Level	<u>288 cms</u>	Forecast Level (max)	<u>350 cms</u>
---------------	----------------	----------------------	----------------

Latest Updates (News)

**Flood Message #2 June 23, 2017 1:30 pm:** The trailer park and portions of the Village of West Montrose will be flooded Friday afternoon. Flood co-ordinators in Woolwich Township are asked to warn residents as necessary. This magnitude of flooding through West Montrose was last experienced in May 2000.

**Flood Message #1 June 23, 2017 09:00 am:** The trailer park in West Montrose will be flooded early this afternoon, the trailer park operator has been advised. Township staff are asked to monitoring conditions in the

Twitter Feed

[@grca\\_flood\\_msg](#)  
#GRCA Combined Flood Warning/Flood Watch message issued for the #GrandRiver watershed: LINK [#ONFlood](#)

Level Map | Chart Forecast | Weather Radar | Live Camera | About

- In development
- Uses forecast and real-time information to convey simple water flow and flood message updates
- Provides one-stop location for links to further resources

New Tab

Search or enter address

## Woolwich: Normal Status

Last updated: June 23 @ 14:00 (est)

# Normal

Level 0

Current Level	<u>25 cms</u>	Forecast Level (max)	<u>25 cms</u>
---------------	---------------	----------------------	---------------

Latest Updates (News)

**Flood Message #8 June 27, 2017 1:30 pm:** GRCA Flood Message #8: Flood Warning terminated; Water Safety message remains

Twitter Feed

[@grca\\_flood\\_msg](#)  
#GRCA Caution urged on #GrandRiver watershed waterways and trails in wake of flooding

Level Map | Chart Forecast | Weather Radar | Live Camera | About

## Woolwich Flood Status: Active Warning

# Level 3

Last updated: June 23 @ 14:00 (est)

Current Flow (cms)	Max 5h flow forecast
<u>312</u>	<u>288</u>

News

**Flood Message #2 June 23, 2017 1:30 pm:** The trailer park and portions of the Village of West Montrose will be flooded Friday afternoon. Flood co-ordinators in Woolwich Township are asked to warn residents as necessary. This magnitude of flooding through West Montrose was last experienced in May 2000.

**Flood Message #1 June 23, 2017 09:00 am:** The trailer park in West Montrose will be flooded early this afternoon...

Level Map | Chart Forecast | About



# Next Steps

- Obtain input from public meeting to refine inundation mapping and proposed West Montrose web page.
- Activate web page and obtain input over coming months to refine and finalize West Montrose web page.
- Develop time lines for inundation mapping for other parts of the township and watershed.
- Submit funding application to update floodplain mapping along large rivers in the watershed to the National Damage Mitigation Program.
- A copy of this presentation will be posted to the GRCA web site at <https://www.grandriver.ca/en/our-watershed/Flood-events.aspx>

# Questions Feedback