Probable Tornado
Beeton, Ontario
July 17, 2000

Date- Local: Monday, July 17th, 2000
UTC: Monday, July 17th, 2000
Time- Local: 1915
UTC: 2315
Location: Beeton
Region: Dufferin-Innisfil
Classification: Probable Tornado
Category: H
Casualties: None
Track Length: None available
Width: None available
Motion: None available
Damage Estimate: None available
F-Scale Rating: F0
Code: NI
Damage Survey: None, but a summary report was done by Rebecca Schneider and Dave Sills on the events of July 17, 2000.
Spotter Reports: One
Other Documents:

Report which outlines the meteorological conditions the morning of as well as time of the event, and outlines all tornados and damages

OSPC report detailing what witnesses observed as a swirling dirty cloud, which looked like whirling dirt and rain.

Tornado F-Scale Assessment

Brad L. Rousseau
Tornado Data Production Assistant, Environment Canada
June 10th, 2010

Classification: Probable Tornado
Date: Monday, July 17th, 2000
Location: Beeton, Dufferin-Innisfil Region

Assessment: F0
F-Code: NI
Explanation of Assessment: Only very minor damage was reported (Schneider and Sills report), but nothing was specified.

SJS

Tornadoes Strike Southern Ontario July 17, 2000

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1. Introduction

At the mention of tornadoes, one probably thinks of 'tornado alley' in the mid-western United States. Yet, as the Pine Lake tornado in Alberta demonstrated on 15 July 2000, Canada also gets its share of tornadic activity. This was also the case a mere two days after the Pine Lake event when several tornadoes struck southern Ontario. The weather situation on the morning of July 17th in southern Ontario did not at first appear to be potentially severe. However, by the end of the day, multiple supercell thunderstorms struck southern Ontario, some of which produced tornadoes.

The first tornado occurred near Melduf, which is located in northern Simcoe County near the south shore of Georgian Bay (see Figure 1 for locations). A second tornado occurred near Beeton in southern Simcoe County inland from Lake Simcoe. A third tornado later struck Guelph, which is located in Wellington County inland from the western end of Lake Ontario. Pictures of the Guelph supercell thunderstorm and tornado are shown on the cover.

2. Chronology of Events for July 17th

The 12Z map prepared by Environment Canada severe weather meteorologists Phil Chadwick and Rob Kuhn at RCTO (Regional Centre Toronto) (cover) shows a polar wave centred over southwestern Michigan with a narrow warm sector to the southwest and a trowal (trough of warm air aloft) extending to the northeast. The highest dew points in the warm sector were up to 21°C while surrounding dew points were no higher than 17°C. The wave was forecast to dive south of southern Ontario, and possibly be 'pinched off', so the meteorologists were not too concerned about its potential to cause severe weather. As well, pressure over southwestern Ontario was rising on the 12Z surface map supporting the forecast track of the wave (one would have expected falling pressures to precede the wave if it was going to track northeastward).

Between 16Z and 17Z, the convective available potential energy in the wave's warm sector was estimated to be approximately 2000 to 2500 J kg-1. As well, dew points over the thumb of Michigan and southwestern Ontario were rising. After the 18Z surface map was analyzed, it was clear that the

wave was pushing northeast, not southeast as forecast. In addition to the rising dew points and the incoming wave, lake breezes had developed over each of the Great Lakes as well as over Lake St. Clair and Lake Simcoe. Lake breezes suppress convection over the lakes and near-shore regions due to the extremely stable marine air they circulate. However, they also enhance lift, moisture and local vorticity along their leading edges or 'lake breeze fronts'. Thus, the combination of high buoyant energies, rising dew points in the warm sector, the incoming wave and the lake breezes prompted the meteorologists to re-assess the situation as one that could become severe. Indeed, when the first thunderstorm developed over central Lake Huron in the mid-afternoon, the stage was set for the ensuing weather event. By the end of the day, RCTO had received numerous reports of severe weather including strong wind gusts, heavy rain, hail up to 50 mm in diameter, and several tornadoes.

The chronology of this severe weather event as it was monitored on July 17th can be seen in the following two tables. These tables list the bulletins issued by RCTO for southern Ontario as well as selected severe weather reports received by RCTO during the event. The map in Figure 1 shows the locations of counties / regions and some of the damage sites referred to in the tables. Both a severe thunderstorm warning and a tornado warning were issued prior to the Melduf and Beeton tornadoes in Simcoe County with lead times of about 60 and 180 minutes, respectively, for the severe thunderstorm warning and about 10 and 120 minutes, respectively, for the tornado warning. A severe thunderstorm warning was first issued for Wellington County at 1711 EDT giving a lead time of about 180 minutes for the Guelph tornado. Note that a tornado warning was not issued prior to this event. However, a standard mention of the possibility of tornadoes was included with the severe thunderstorm warning.

TIME (EDT)	BULLETIN TYPE	COUNTY/REGION
1621	Special Weather Statement	Southern Ontario
1628	Severe Thunderstorm Warning	Simcoe County
1650	Severe Thunderstorm Watch	Toronto, Waterloo-Wellington-Dufferin, Halton-Peel, York-Durham, Huron-Perth,Grey-Bruce, Barrie-Huroni
1711	Severe Thunderstorm Warning	York, Dufferin, Wellington, eastern Grey, Simcoe
1719	Tornado Warning	Eastern Grey, Simcoe
1822	Tornado Warning	Dufferin, northern York, Simcoe
1849	Severe Thunderstorm Warning	Toronto, Peel, Durham, York, Wellington

1911	Severe Thunderstorm Watch	Hamilton-Wentworth, Brantford-Haldimand-Norfolk, Niagara, Toronto, Waterloo-Wellington-Dufferin, Halton-Peel,York-Durham, Huron-Perth, Barrie-Huronia
2035	Severe Thunderstorm Warning	Halton, Toronto, Peel, Durham, York, Wellington
2053	Severe Thunderstorm Watch	Toronto, Niagara, Hamilton-Wentworth, Halton-Peel, York-Durham
2133	Severe Thunderstorm Watch	Niagara
2202	General Weather Statement	Ontario

Table 1. Bulletins issued by RCTO for southern Ontario on 17 July 2000. Note that the table indicates the time at which a watch / warning was continued if a watch / warning had already been issued.

TIME (EDT)	EVENT DESCRIPTION	COUNTY/REGION
1630	45 mm diameter hail	Penetang (Simcoe)
1630	25-50 mm hail seen by pilot and storm spotter	Midland (Simcoe)
1645	Numerous large trees down	Rugby (Simcoe)
1730	Several hundred trees down, large hay bales tossed up to 250 m, large aluminum shed moved	Melduf (Simcoe)
1737	Flash flooding and small hail	Rama (Grey)
1800	90 km/h winds, 12 mm hail	Ruskview (Simcoe)
1850	Funnel cloud spotted	Innisfil (Simcoe)
1855	20 mm hail	Beeton (Simcoe)
1915	Tornado spotted	Beeton (Simcoe)
1920	45 mm hail	Schomberg (York)
1925	Funnel clouds spotted	Maple (York)
2000-2035	Tornado and funnel clouds spotted, trees down, cars damaged, homes and church damaged	Guelph (Wellington)

2030	50 mm hail	Richmond Hill (York)
2100	Funnel cloud spotted	Burlington (Halton)

Table 2. Selected severe weather reports received at RCTO on 17 July 2000.

3. Damage Investigations

A team from Environment Canada (Dave Sills, Phil Chadwick, Caroline Floyd, Paul Campbell) was sent to investigate the damage in Guelph. Evidence of tornadic activity included a narrow damage path with indications of rotation and photographs and video of the tornado. The heaviest damage, consistent with F2 intensity on the Fujita scale (Fujita, 1981), began just south of Arkell Road and included considerable structural damage to houses (see example on cover) and barns as well as numerous large trees snapped and uprooted). Damage from missiles was also evident in this area.

The tornado track was found to begin in central Guelph near Silvercreek Park. Video evidence puts the tornado at this location near 2012 EDT. The tornado moved from approximately 310° through southern Guelph and northern Puslinch Township and dissipated shortly after 2035 EDT just north of Highway 401. The entire track was approximately 13 km in length and its maximum width was 600 m.

From photo and video evidence, it appears that for most of its life, the tornado consisted of a cone-shaped funnel that extended about half way from the cloud base to the ground. Only occasionally did the funnel cloud make contact with the surface (examples are shown on the cover). However, dust and debris could be seen under the funnel cloud through much of its track. There were several other low-hanging clouds that nearly reached ground level but did not appear to rotate. These may have led to the many reports of multiple funnel clouds with this storm. Initially, damage tracks and witness reports appeared to indicate two separate tornadoes but video evidence obtained after the initial investigation confirmed that the damage was result of only one.

One person reportedly suffered a minor injury though one witness described seeing a cyclist thrown from his bicycle by the tornado. Damage was estimated by Guelph officials at over $2 000 000. Damage survey reports were prepared (Sills and Campbell, 2000; Chadwick and Floyd, 2000) and are available via the Toronto weather office.

Another damage investigation by Dave Sills found a narrow damage path and evidence of rotation about 2 km southeast of Melduf. No photograph or video evidence was available for this event. Damage included several hundred trees, including large trees, that were snapped or uprooted, a large aluminum shed that was destroyed, and large bales of hay weighing several hundred kilograms that were lifted and moved several hundred metres. It was concluded that the damage was consistent with a tornado of F1 intensity on the Fujita scale. It appears that the tornado occurred near 1730 EDT with a path length of approximately 3 km and a maximum path width of 400 m. The tornado moved from 315°, nearly the same direction as the Guelph tornado. Damage from this tornado was estimated at $10 000 and there were no injuries.

Only very minor damage was reported with the tornado near Beeton so no investigation was undertaken. However, the witness account clearly describes a very weak and brief tornado. We have thus assessed this tornado at F0 intensity.

A third on-site investigation was conducted in Burlington since a storm spotter reported a funnel cloud in the area but no damage could be found.

4. Discussion

Looking at these events climatologically, the F2 tornado in Guelph was only the second F2 tornado to hit Ontario so far this year (a tornado on May 23rd in Appin, southwest of London, was also assessed at F2 and caused over $1 000 000 in damages). As well, no tornadoes of F3 intensity or higher have occurred in Ontario since 1996.

However, strong tornadoes in the Guelph area are not unusual. On 4 August 1999, an F2 tornado tracked from south of Guelph to Burlington. Further, on 2 June 1998, an F2 tornado hit Norwich, located roughly 70 km to the south-southwest of Guelph. Later that year, on 30 June 1998, Guelph was hit by an F2 tornado. In fact, this F2 tornado struck the same subdivision as the 17 July 2000 F2 tornado. An F3 tornado also struck Wellington County on 20 April 1996 in Arthur, situated approximately 40 km to the north-northwest of Guelph. Additionally, from 1979-1998 the region of Waterloo-Wellington-Dufferin recorded 98 severe thunderstorm events. (See the Appendix for the definition of severe thunderstorm as used at RCTO.) Of these events, 25 were reports of tornadoes, 24 of which were confirmed and ranged in intensity from F0 to F3.

The tornadoes in Melduf and Beeton, both in Simcoe County, were also not rarities. In fact, the public region of Barrie-Huronia (which encompasses Simcoe County) has 136 severe thunderstorm events recorded from 1979-1998. Of these 136 events, 21 are reports of tornadoes, 16 of which were confirmed and ranged in intensity from F0 to F4. On 2 June 1998, an F2 tornado hit Elmvale, located 30 km north-northwest of Barrie. As well, the infamous Barrie tornado occurred on 31 May 1985. This tornado was identified as having F4 intensity on the Fujita scale. It claimed eight lives and left tens of millions of dollars in damage in its wake.

One of the most interesting aspects of this event is the significant role that appears to have been played by lake breezes. On days with a moderate southwest synoptic-scale wind (including July 17th), convective suppression due to lake breeze circulations tends to confine most severe convective activity to a swath running roughly from Windsor to Barrie. Lake breeze fronts, stretched far inland by the southwesterly winds, have a strong influence on where within that swath storms develop and are most intense. Also, it is possible that enhanced vertical vorticity along these fronts and other low-level boundaries may have been critical to tornado formation. Indeed, at least two of the tornadoes on this day appear to have occurred in the vicinity of a lake breeze front. A more detailed investigation of the role of lake breezes on this day will be undertaken. In addition, a pilot research project was conducted in 1997 to investigate the role of lake breezes in severe weather in this area (King et al., 1999) and an expanded project is being planned for summer 2001.

5. Summary

Supercell thunderstorms that occurred over southern Ontario on 17 July 2000 generated three tornadoes: an F1 tornado near Melduf, an F0 tornado near Beeton, and an F2 tornado in Guelph. The Melduf tornado occurred near 1730 EDT, and left behind an estimated $10 000 in damages, though no injuries were reported. The Beeton F0 tornado occurred at about 1915 EDT and was associated

with only very minor damage. Guelph's F2 tornado was the most destructive of the day and left behind $2 000 000 in damages and one minor injury. Both the Melduf and Beeton tornadoes were preceded by a tornado warning (by 10 and 120 minutes respectively). A severe thunderstorm warning was disseminated before the Guelph tornado with a lead time of about 180 minutes. Climatologically, these tornadoes were not unusual since this region experiences several F0-F2 tornadoes per year. Lake breezes appeared to play a significant role in the development of the severe thunderstorms, and possibly even the tornadoes, on this day.

Acknowledgements
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References

Fujita, T.T. 1981. Tornadoes and Downbursts in the Context of Generalized Planetary Scales. J. Atmos. Sci. 38: 1511-1534.

Floyd, C. and P. Chadwick. 2000. 17 July 2000 Guelph Tornado Damage Survey Report #2. Internal HTML Document.

King, P. and D. Sills, D. Hudak, P. Joe, N. Donaldson, P. Taylor, X. Qiu, P. Rodriguez, M. Leduc, R. Synergy and P. Stalker. 1999. ELBOW: An Experiment to Study the Effects of Lake Breeze on Weather in Southern Ontario. CMOS Bulletin 27:35-41. Sills, D. and P. Campbell. 2000. 17 July 2000 Guelph Tornado Damage Survey Report #1. Internal HTML Document.

Sills, D. 2000. 17 July 2000 Melduf Tornado Damage Survey Report. Internal HTML Document.

Appendix

In Ontario, the criteria used for severe thunderstorms are:

* Tornadoes
* Hail greater than 20 mm or more in diameter
* Damaging thunderstorm wind gusts or, if winds measured, gusts greater than 90 km h-1
* Flooding downpours of 50 mm or more in one hour or 75 mm or more in three hours, or damaging flooding

Captions

Cover -

Top Left: Video capture by Bradley Ivany of the tornado in Guelph backlit by lightning (facing southeast).

Bottom Left: 18Z surface analysis prepared by Phil Chadwick and Rob Kuhn showing isobars and the locations of fronts prior to the development of severe weather.

Top Right: Photograph by Dave Sills of considerable structural damage to a house in Guelph.

Centre Right: Photograph by Dave Sills of the supercell thunderstorm near Guelph while the tornado was still causing damage (facing southwest). The rear flank of the storm, including the main updraft region, is shown.

Bottom Right: Photograph by Lesley Ord of the tornado in Guelph (facing northeast). The low-hanging cloud behind the tornado appears to be a tail cloud.

Figure 1. Map of selected counties / regions in southern Ontario. The locations of the Melduf, Beeton and Guelph tornadoes are labelled.

Significant Wx Event Display - 2000.0/7.0/17.0

CLASSIFICATION: Severe Thunderstorm **SOURCE/WATCHER ID:** Heather Kastner (odie@simcoe.igs.net) **EVENT TIME (UTC):** 23-15 **EVENT DAY:** 17.0 **MONTH:** 7.0 **YEAR:** 2000.0 **EVENT DURATION (HR):** 0.0 **(MIN):** 0.0 **DAY OF THE WEEK: EVENT LOCALE:** Between Beeton and Bond Head **ASOCTD PUBLIC RGN:** Barrie-Huronia

DETAILED DESCRIPTION: Saw tornado. "What seemed to be the end of the storm,we had rain,winds,hail,then a noise,...of heavy traffic,that got to the sound of a train behind our barn...saw whirling dark, dirty cloud,(looked like whirling dirt & rain)..."

INITIAL ASSESSMENT: YES

SPL WX STATEMENT IN EFFECT ?: YES **STATEMENT LEAD TIME (HR):** **(MIN):**

WATCH IN EFFECT ?: YES **WATCH LEAD TIME (HR):** **(MIN):**

WARNING IN EFFECT ?: YES **WARNING LEAD TIME (HR):** **(MIN):**

TORNADO: F?

WINDSPEED:

RAINFALL: MM **RAIN DURATION:**

HAIL DIAMETER: MM **HAIL DESCRIPTION:**

EVENT DESCRIPTION: Tornado

Mesoscale ?: **Synoptic ?:** **Big Event ?:**

Statement Est Hit/Miss: YES

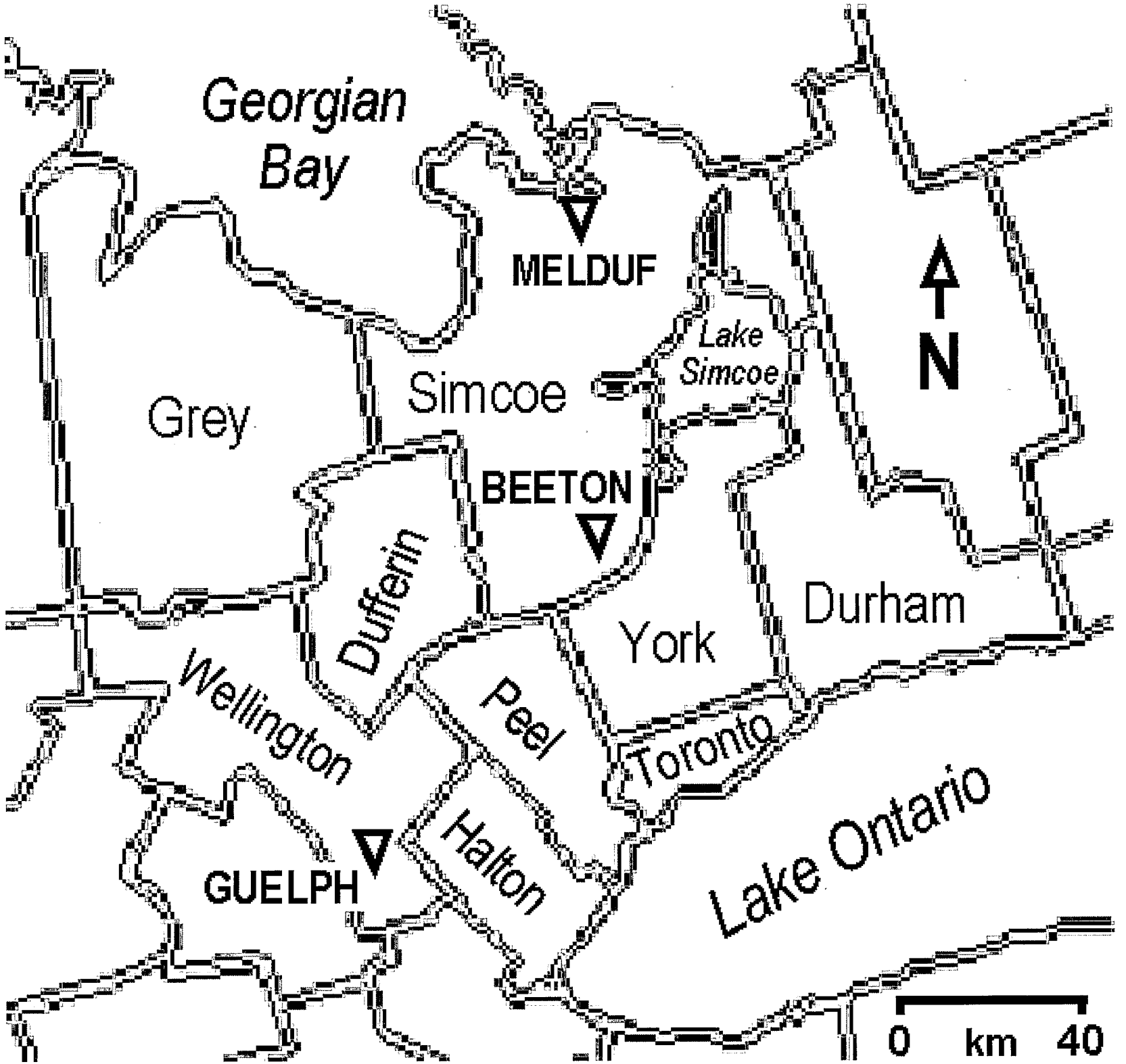
Watch Est Hit/Miss: YES

Warning Est Hit/Miss: YES

Separate Event (30km/30min): UK N

Vetted by: CF

Vetted date: 22/08/00


Georgian Bay
MELDUF
Lake Simcoe
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Grey
Simcoe
BEETON
Dufferin
Durham
York
Wellington
Peel
Toronto
Halton
GUELPH
Lake Ontario
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