Ontario

GTA DEM 2002

User Guide

Spatial Data Infrastructure
Mapping and Information Resources Branch
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Ministry of Natural Resources and Forestry

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Executive Summary

Key Words

DEM, Digital Elevation Model, WRIP, Water Resources Information Program, Spatial Data Infrastructure, SDI, Digital Terrain Model, Terrain, DTM, TIN, Triangulated Irregular Network.

Abstract

A three-dimensional raster data set which represents a continuous elevation surface. This data set encompasses the Greater Toronto Area (GTA) and surrounding area extending from the Niagara region to Port Severn, the Kawartha Highlands and the Bay of Quinte regions.

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List of Acronyms

CGVD: Canadian Geodetic Vertical Datum

DEM: Digital Elevation Model

DTM: Digital Terrain Model

GIS: Geographic Information Systems

GTA: Greater Toronto Area

LIO: Land Information Ontario

NAD: North American Datum

SDI: Spatial Data Infrastructure

TIN: Triangulated Irregular Network

UTM: Universal Transverse Mercator

1. Product Description

In the spring of 2002, a project was initiated to acquire leaf-off photography for the Greater Toronto Area (GTA) and to generate a highly accurate and precise elevation data set using softcopy photogrammetric techniques. This terrain data was designed to support the generation of a Digital Elevation Model (DEM) and other elevation data product derivatives (Regional Municipality of York, 2001).

1.1 Geographic Extent

The elevation data is organized into 20km x 20km tiles that encompass the GTA and the surrounding area from the Niagara region to Port Severn, the Kawartha Highlands and Bay of Quinte regions.

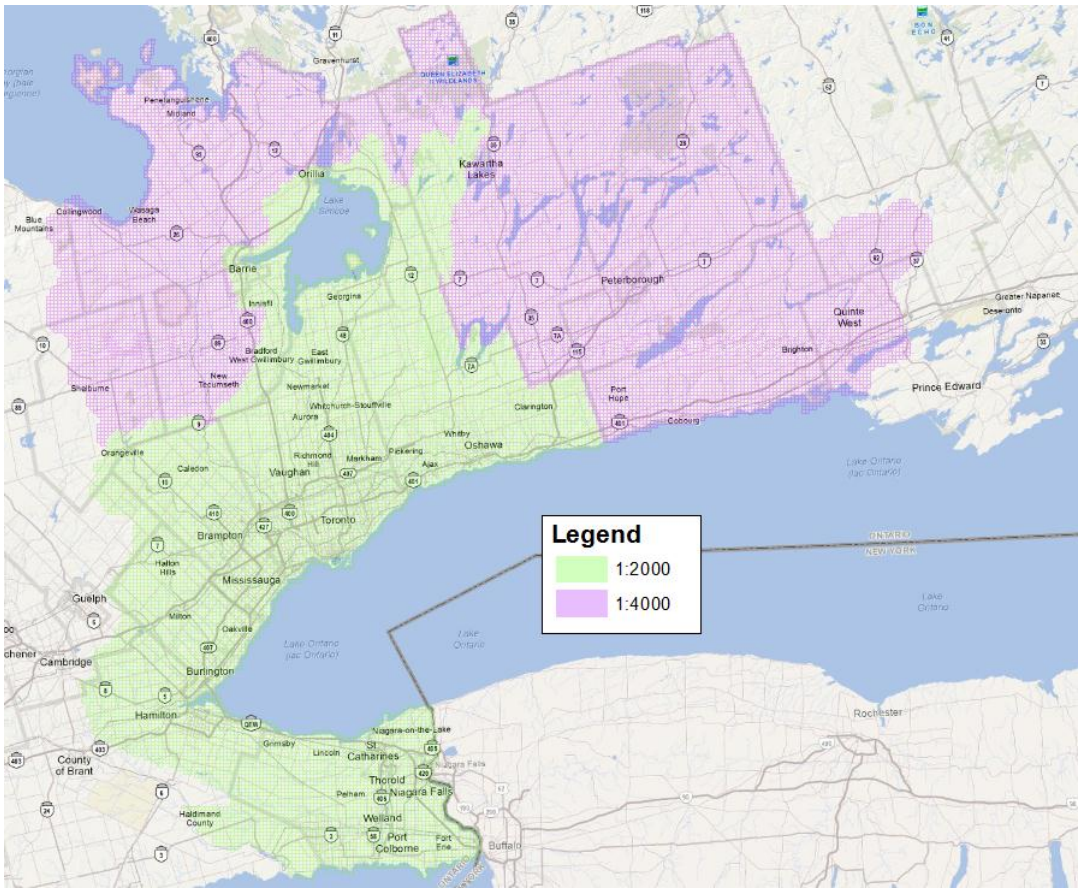

Figure 1: Extent of GTA 2002 Project Area

This data is intended to be used for pre-engineering survey and design as well as the production of planimetric mapping at differing accuracies with the following specifications for each:

- 1:2000 Scale Mapping: Horizontal and vertical accuracy 0.5m, suitable for 1m contour generation. Final point spacing of Digital Terrain Model (DTM) is 10m.
- 1:4000 Scale Mapping: Horizontal and vertical accuracy 1m, suitable for 2m contour generation. Final point spacing of DTM is 20m.

1.2 Reference System

Horizontal Reference System

The horizontal coordinate system of the DEM is the Universal Transverse Mercator (UTM) and covers zones 17 and 18. The horizontal datum of the DEM is the North American Datum of 1983 (NAD83).

The horizontal unit of measure (coordinate system axis units) for all raster grid cells in the DEM is meters (m).

Vertical Reference System

The vertical coordinate system of the DEM is based on the Canadian Geodetic Vertical Datum 1928 (CGVD28) of the Geodetic Survey Division, and is measured in metres above mean sea level. For more information please see the Geodetic Survey Division of Natural Resources Canada (http://webapp.geod.nrcan.gc.ca/geod/).

The vertical unit of measure (coordinate system axis units) for all raster grid cells in the DEM is meters (m). One single vertical elevation value represents each raster grid cell in the DEM.

1.3 Resolution

Spatial Resolution

The grid spacing is based on Universal Transverse Mercator (UTM) projection with a raster cell resolution of 5 metres.

Temporal Resolution

Source elevation data was captured using softcopy photogrammetry in 2002.

2. Product Details

2.1 TIN and DEM Products

The GTA 2002 vector elevation data was delivered in a format best modeled using a Triangulated Irregular Network (TIN) data model. A TIN and DEM have been generated to honour the original vector data as much as possible. The DEM has been generated from the vector data by first creating an ArcGIS Terrain using the elevation points, lines and polygons then this Terrain was converted to a DEM using a Natural Neighbours interpolation algorithm.

Breaklines are a key dataset that is used when creating a TIN as they define rapid or sharp changes in elevation. Without the use of breaklines, a TIN will yield a poor representation of the terrain surface. Figure 2 demonstrates the level of detail added within a TIN by including breaklines.

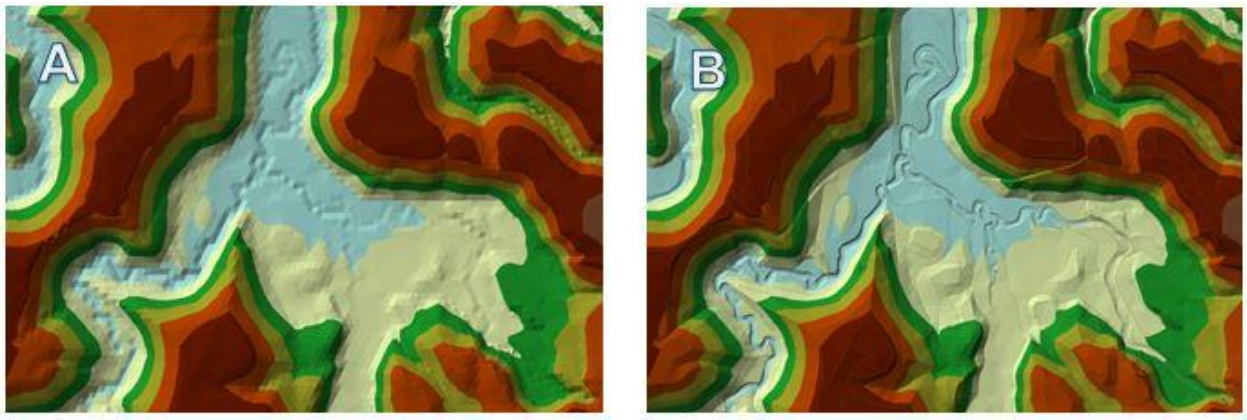

Figure 2: A TIN without breaklines (A) and a TIN with breaklines (B).

Prior to TIN modeling, each coded breakline feature that was captured had to be designated to an appropriate TIN category based on their use as a hard or soft breakline feature before they were used in the TIN modeling process (see Table 1). Decisions were made based on whether the features were coded as approximate or actual and using a basic understanding of hydrology.

Table 1: Breakline classification used to create the GTA TIN model.

Classification Code	Feature Class	TIN Input	Description
Ditch C/L	Polyline	Hard Breakline	All major ditch centerlines that will ensure the proper generation of 1.0m contours.
Marsh/Swamp	Polygon	Soft Replace	The outline of visible interpretable marshes/swamps. Avoid wet areas that are likely seasonal.
Creek/Stream C/L	Polyline	Hard Breakline	The centerline of creeks and streams that are less than 4 meters wide.
Creek/Stream C/L approx	Polyline	Soft Breakline	Where the creek/streams are difficult to accurately compile (i.e. tree cover), or where the path may be uncertain.
River/Shoreline	Polygon	Hard Replace	Both sides of rivers greater than 4 meters wide, also contains ponds and reservoirs.
River/Shoreline approx	Polygon	Soft Replace	Where the river/shoreline may be difficult to accurately compile (i.e. tree cover).
WaterBody	Polygon	Hard Replace	All identifiable water bodies such as Lake Ontario, Lake Scugog, Lake Wilcox.
Headwall/Culv	Polygon	Hard Replace	Outline of all headwalls and culverts to scale (concrete box culverts, not corrugated steel culverts)
Dam2Sc.	Polygon	Hard Replace	The outline of all Dams to Scale.
AccWay	Polygon	Hard Replace	All major access ways required to ensure the proper generation of 1.0m contours.
RoadEdgPv	Polygon	Hard Replace	All paved road edges
RoadEdgCb	Polygon	Hard Replace	All curbed road edges.
RoadEdgGr	Polygon	Hard Replace	All gravel road edges
RailC/L	Polygon	Hard Replace	All rail centerlines
Bridge	Polygon	Hard Replace	All bridges which service roads or rails.

Classification Code	Feature Class	TIN Input	Description
RetWall	Polygon	Hard Replace	All significant retaining walls.
Breakline	Polygon	Soft Replace	Generic breaklines for all pits/piles, top of bluff, gullies etc. to ensure the proper generation of 1.0m contours.
Mass Points	Point	Mass Points	Not Applicable

Once the polygons and lines were divided into their respective layers, a single DTM point layer was generated that was comprised of soft and hard breakline layers and hard and soft polygon layers. These datasets were then used as input for the TIN creation. The final DEM product was created by converting the TIN model to a 5m raster elevation surface using a Natural Neighbours interpolation algorithm (ESRI, 2014).

2.2 Data Delivery Format

The GTA DEM 2002 data is currently stored and distributed through Land Information Ontario (LIO) Metadata Tool (https://www.javacoeapp.lrc.gov.on.ca/geonetwork?uuid=6a7a7e71-f502-4336-bba2-364c7eefd950).

The GTA DEM 2002 can be downloaded in three packages NE, NW and SW (see Figure 3). Each package contains multiple DEM tiles in floating point file (.FLT) format.

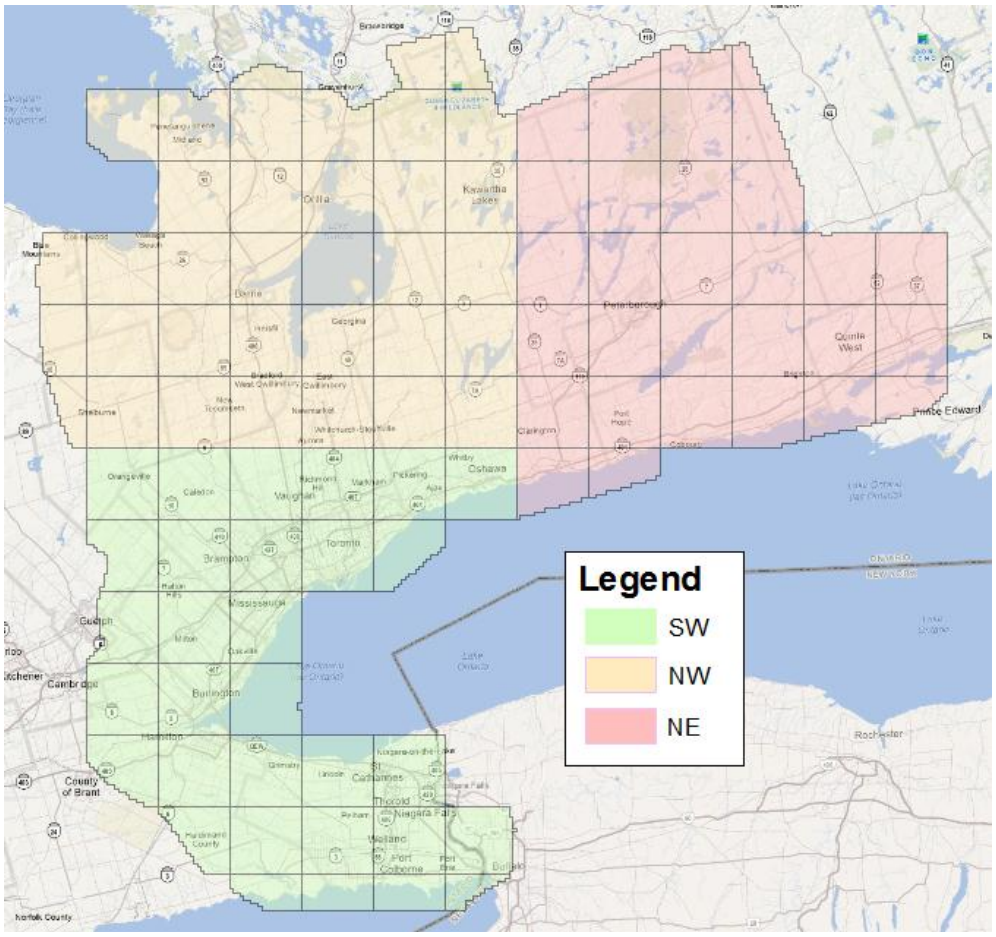

Figure 3: Three Downloadable Package Areas

2.3 Use Restrictions

The GTA DEM 2002 is considered Open Data and has no restrictions.

3. References

Earth Science Research Institute (ESRI). 2014. Terrain to Raster Function for ArcGIS software (http://resources.arcgis.com/en/help/main/10.1/index.html#//009t00000206000000)

Earth Science Research Institute (ESRI). 2014. Natural Neighbors Interpolation Algorithm (http://resources.arcgis.com/en/help/main/10.1/index.html#//005v00000027000000)

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