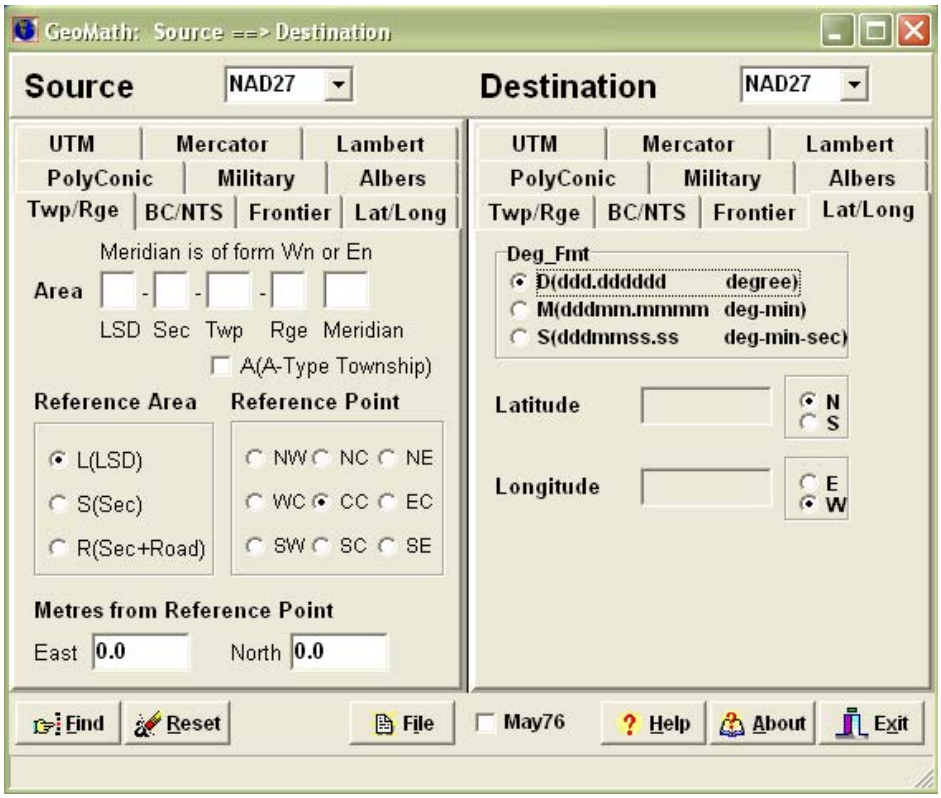
MathTool: Geographic Location Conversion Tool (Open File 3939)

Processing locations using the File option

File input/output for:

Source: Township/Range **Destination**: Latitude/Longitude



Note: Optional values not provided in the input file default to screen values.

1. Source Screen:

(a) **Source**: Check source datum then select **NAD27** or **NAD83** as default if not specified in file.

(b) **Area** and **A-Type**: Ignore screen settings. Must be specified in file, see section **3. File Record Format**.

(c) **Reference Area**: Select **L** (LSD), **S** (Section), or **R** (Section augmented by any road allowance on south and west sides) as default if not specified in file.

(d) **Reference Point**: Select one of the 9 points: **NW**, **NC**, **NE**, **WC**, **CC**, **EC**, **SW**, **SC**, **SE** as default if not specified in file. N, S, E, W, C represent north, south, east, west, centre respectively. Both section choices have identical points except for the south and west extremes which delimit the boundary.

(e) **Metres from Reference Point**: Enter metres **East** and **North** of reference point to location of source point as default if not specified in file. Note: (0, 0) is the usual default that specifies the selected **Reference Point** location.

2. Destination Screen:

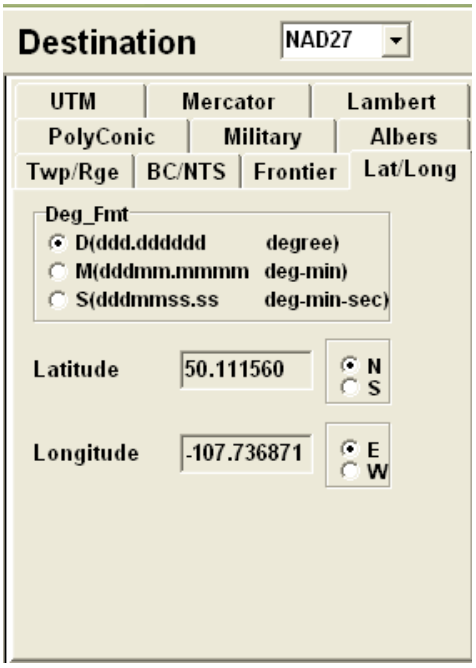
(a) **Destination**: Check destination datum then select **NAD27** or **NAD83** as default if not specified in file. NTv2 datum transformation will be performed if destination datum differs from the source datum.

(b) **Deg_Fmt**: Select **D** (decimal degrees), **M** (degrees-decimal minutes), or **S** (degrees-minutes-decimal seconds) as default if not specified in file. Depends on data requirements and software used, e.g. ArcMap requires decimal degrees.

(c) **Latitude**: Select **N** or **S** if not specified in file.

(d) **Longitude**: Select **E** or **W** if not specified in file.

To obtain the usual signed values for Canada set the Latitude button to **N** and the Longitude button to **E** (produces positive latitude and negative longitude output).



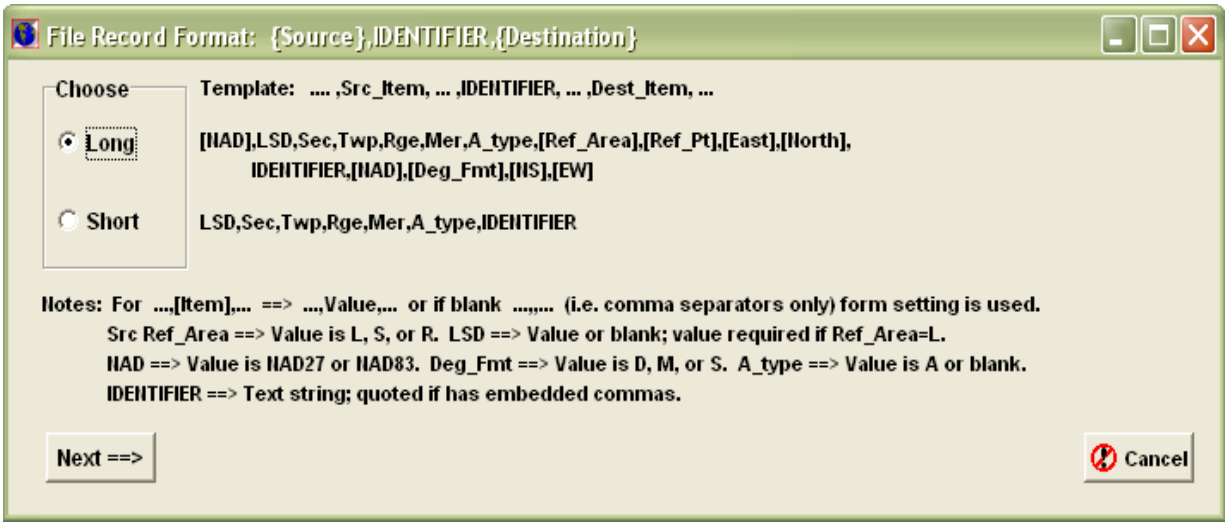
Output shown for the **N** and **E** setting. This ensures output values will be signed as shown in Figure 1. The global NE system is the coordinate system used by most mapping applications.

NW (-x, y)	NE (x, y)
SW (-x, -y)	SE (x, -y)

Figure 1. Signed values of the global NE system: **x** = longitude, **y** = latitude. Greenwich is 0° E and the equator is 0° N.

3. File Record Format:

Once input has been provided for all required fields select the File button at the bottom of the Source and Destination screen and the File Record Format screen will appear. Choose **Long** or **Short** format and file templates that show the required fields for the selected format are displayed.



Note: **[ ]** *denotes optional fields. In the Long format, comma delimiters are still required for fields where optional data are not provided and left blank. MathTool identifies which optional template fields have missing data and uses MathTool screen values.*

It is best to construct a table with columns for each optional and required field included. Excel automatically includes commas for missing values in existing columns if the file is saved as a comma separated value file (*.csv).

Choose:

- **Long Format:** If one or more of the optional fields have data.
- **Short Format:** If optional fields are completely omitted. Values are retrieved from MathTool's **Source** and **Destination** screen.

Long Format Template:

[NAD], LSD, Sec, Twp, Rge, Mer, A_Type, [Ref_Area], [Ref_Pt], [East], [North], IDENTIFIER, [NAD], [Deg_Fmt], [NS], [EW]

Short Format Template:

LSD, Sec, Twp, Rge, Mer, A_Type, IDENTIFIER

Note: Whether using long or short format, the input file must include all fields of the template in sequential order.

Template Glossary:

[NAD]: NAD27 or NAD83 {**Source**}
LSD: Legal Subdivision; may be left blank if Ref_Area is not L
Sec: Section
Twp: Township
Rge: Range
Mer: Meridian (e.g. W4 or E1); must include W or E
A_Type: Alternate township (A or blank) is rare in Saskatchewan and Manitoba and does not occur in Alberta.
[Ref_Area]: L (LSD), S (Section), or R (Section augmented with Road)
[Ref_Pt]: NW, NC, NE, WC, CC, EC, SW, SC, or SE
[East]: Distance East in metres from reference point (signed: E positive, W negative)
[North]: Distance North in metres from reference point (signed: N positive, S negative)

IDENTIFIER: Identifying code for the corresponding data, unique for each location

[NAD]: NAD27 or NAD83 {**Destination**}
[Deg_Fmt]: Indicates the format for latitude and longitude in D (decimal degrees), M (degrees-decimal minutes), or S (degrees-minutes-decimal seconds)
[NS]: Latitude direction (N or S)
[EW]: Longitude direction (E or W)

The following table was created for **Long** format input. All fields left blank are optional fields for data specified in the source and destination screen**. A_Type** is not an optional field but leaving the column blank specifies a normal township rather than an alternate township. Distance values were provided for **[East]** and **[North]** columns, therefore **Long** format must be chosen.

[NAD]	LSD	Sec	Twp	Rge	Mer	A_type	[Ref_Area]	[Ref_Pt]	[East]	[North]	IDENTIFIER	[NAD]	[Deg_Fmt]	[NS]	[EW]
	16	9	2	27	W2				100.5	100.5	19980204427				
	8	29	13	13	W3				100.5	-100.5	19980204433				
	6	13	20	21	W3				-100.5	-100.5	19980204434				

Table 1. Sample of Excel worksheet for MathTool **Long** format.

Note: The MathTool input file must not include column headings for your table. MathTool will read the input file and associate the columns in the same order as the selected file format.

Example of Table 1 converted to input text file for Long format:

```
,16,9,2,27,W2, , , ,100.5,100.5,19980204427, , , ,
,8,29,13,13,W3, , , ,100.5,-100.5,19980204433, , , ,
,6,13,20,21,W3, , , ,-100.5,-100.5,19980204434, , , ,
```

Text file Details:

- Columns where data are missing still require commas to separate fields from one another.

- **Source Values**:
  Leading comma in example indicates a blank value for **[NAD]** input, which means Source datum set in MathTool screen is used:

  ,16,9,2,27,W2, , , ,100.5,100.5,19980204427,

  LSD = 16, **Sec** = 9, **Twp** = 2, **Rge** = 27, **Mer** = W2 (must include the "W"), **A_type** is blank (not A_type), **[Ref_Area]** is blank (MathTool screen value used), **[Ref_Pt]** is blank (MathTool screen value used), **[East]** = 100.5, **[West]** = 100.5, **IDENTIFIER** = 19980204427 (must be unique for each location).

- **Destination Values**:
  Long format is selected and three trailing commas follow the IDENTIFIER comma

  19980204427,_,_,_,

  as destination settings **[NAD]**, **[Deg_Fmt]**, **[NS]**, **[EW]** taken from the MathTool screen. No comma after the last **[EW]** field is required regardless of whether or not a value is given.

- In the Short format there are no optional values for destination and source fields but there will be blank values for **A_Type**.

4. Completing the Input File:

In some cases a complete set of DLS values is not available. At a minimum **Twp**, **Rge**, and **Mer** must be given. If the **Sec** is missing the center of the **Twp** can be calculated; if the **LSD** is missing and no **Sec** reference point is given the centre of the **Sec** can be calculated and so on. In other cases input values that do not match what is required by MathTool are available: e.g. **Quarter Section** = **NW** (NW ¼), or **Quarter LSD** = **NW** (NW¼). In these cases a reference point is not available and the usual practice is to specify the centre of the area. In order to process such values the data must be converted to include field values used by MathTool. Five cases provide MathTool settings and the corresponding values that must be added to the input file. Figure 2 illustrates two examples and provides reference.

Optional default values that apply globally to your file can be set using the MathTool screen. In the following tables italic text indicates values to be converted; bold text indicates required file values; regular text indicates default screen values.

1. **Twp, Rge, Mer** are provided. Locate centre of **Twp** with any one of the table settings for **Sec**, **Ref_Area**, and **Ref_Pt**. Note: **R** is used to account for road allowances:

Sec	Ref_Area	**Ref_Pt**
16	R	**NE**
15	R	**NW**
22	R	**SW**
21	R	**SE**

2. **Sec, Twp, Rge, Mer** are provided. Locate centre of **Sec**. Set **Ref_Area** to **S** or **R** and **Ref_Pt** to **CC**. **LSD** is not required.

3. **LSD, Sec, Twp, Rge, Mer** are provided. Locate centre of **LSD**. Set **Ref_Area** to **L** and **Ref_Pt** to **CC**.

4. **Quarter Section** is provided. Locate centre of **Quarter Section** using **LSD**, **Ref_Area**, and **Ref_Pt** as in table:

Section Qtr	**LSD**	Ref_Area	**Ref_Pt**
NE 1/4	**10**	L	**NE**
NW 1/4	**11**	L	**NW**
SW 1/4	**6**	L	**SW**
SE 1/4	**7**	L	**SE**

5. **Quarter LSD** is provided. Locate the centre of the **Quarter LSD** using **Ref_Area**, **Ref_Pt**, **East**, and **North** as in table:

LSD Qtr	Ref_Area	Ref_Pt	**East (m)**	**North (m)**
NE ¼	L	CC	**100.5**	**100.5**
NW ¼	L	CC	**-100.5**	**100.5**
SW ¼	L	CC	**-100.5**	**-100.5**
SE ¼	L	CC	**100.5**	**-100.5**

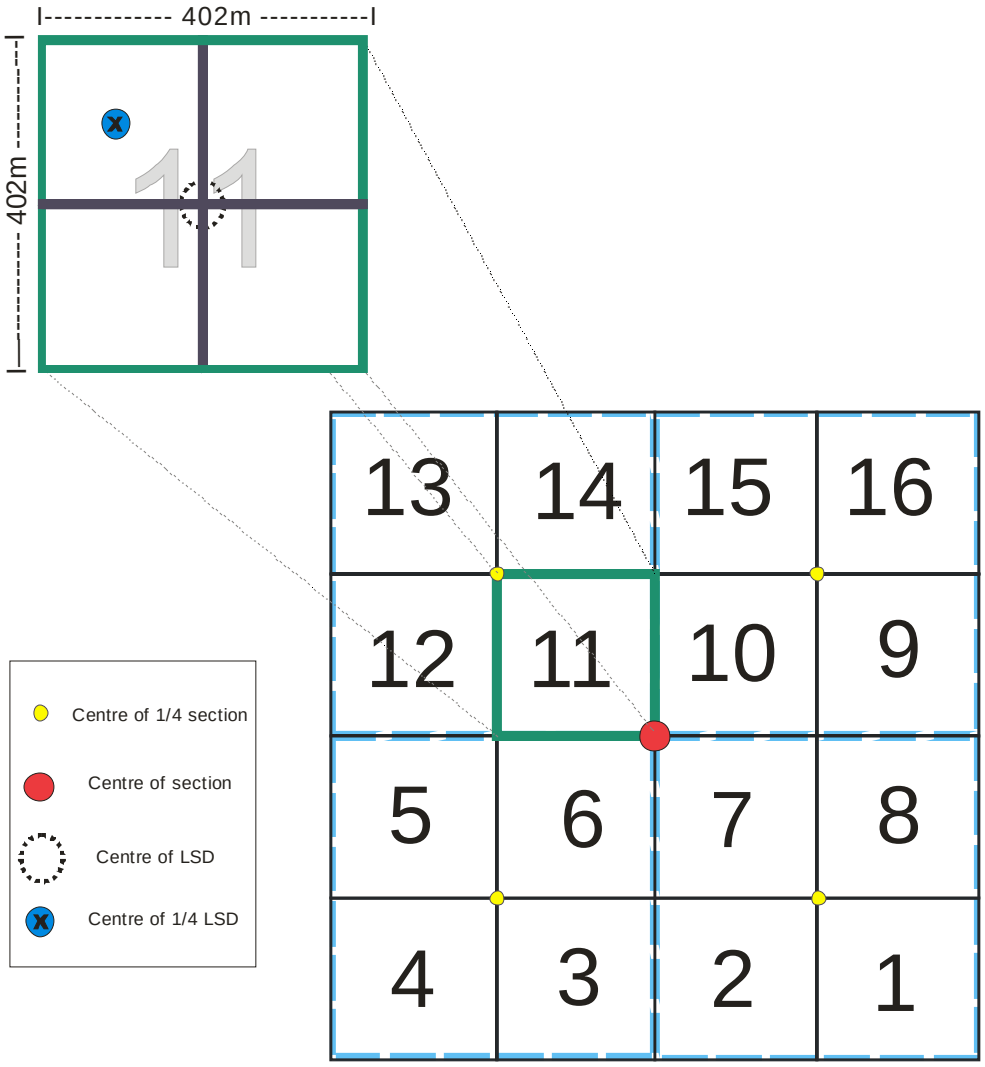


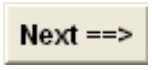
Figure 2. A Section contains 16 LSD's. MathTool can calculate the centre of a Section, the centre of a Quarter Section, the centre of LSD and the centre of Quarter LSD.

Example 1: Section reference point is given as *NW ¼*. Locate the centre of the NW **Quarter Section** using the NW corner of LSD 11. Set **LSD** to **11**, **Ref_Area** to **L,** and **Ref_Pt** to **NW**.

Example 2: LSD reference point is given as *NW ¼*. Locate the centre of the **Quarter LSD** by specifying -100.5 metres East and 100.5 metres North from the LSD centre reference point. Set **Ref_Pt** to **CC**, **East** to **-100.5**, and **North** to **100.5**.

5. Select File:

Once the table is complete it must be converted to a text file. If there is more than one reference area and/or reference point in the data you may choose to create separate files to take advantage of global MathTool screen settings.

Select the 

button on the File Record Format window to locate the file. A message at the bottom of the source and destination window should appear with the name of the output file.

All township and range data from the input file have then been converted to latitude and longitude values in separate columns. The new output file will default to the same location as the input file but will have the suffix ".new". This file is always in **Long** format. The first record gives the data headings. The data records include all missing file values that were taken from the screen defaults. Change the file suffix to ".csv" for opening in Excel, ArcMap, or other applications.

* GeoMathTool (Version 4.21) was developed September 2006 by David Lepard, Ph.D., Geological Survey of Canada, Calgary. Guidelines compiled by Miriel Ko, Paul Wozniak and David Lepard, GSC Calgary, June 2007. *