Calibrate a Site

You can calibrate a site to minimize residuals between WGS-84 RTK data collected in the field and local control coordinates. To perform a site calibration, you associate GNSS points with grid points at the same positions. These point pairs are used to compute and apply mathematic transformations (using least squares) to determine the transformation that provides adjustment parameters that best fit the control grid coordinates when applied to GNSS positions.

You should calibrate a site if any of the following are true:

- It was not calibrated in the field.
- You require a report of quality control records.
- You need to transfer a calibration to the field software (for example, Trimble Access).
- You need to add extra points to a calibration in the field software.

A horizontal calibration consists of three parameters:

- Translation (move)
- Rotation (turn)
- Scale (shrink or stretch)

A vertical calibration consists of two parameters:

- Lift (raise or lower)
- Tilt (change the northing and easting incline of the geoid or local plane)

The site calibration process creates a set of local site settings. When a site calibration is complete, the site settings are used in the computation of all other imported GNSS data.

Prerequisites:

- License; See Licensed Features to determine if your license supports this feature.

To calibrate a site:

1. Import into your project the GNSS data to be used in the site calibration.

   **Note:** If you are importing NGS Data Sheets or NGS OPUS data to use in the site calibration, see the note in step 5 below.

2. Import the grid points to be used in the calibration, or add the grid points using the Create Point command.

3. Select Site Calibration to display the Site Calibration command pane.

4. On the Calibration Settings tab, do the following to specify the type of site calibration you want to perform:

   a. Ensure that the Horizontal Calibration check box is checked if you want to compute a horizontal shift consisting of translations in the north/south and east/west directions, a rotation around a defined origin, and a scale factor. If you...
want to maintain the scale of the horizontal distances, check the **Set scale factor to 1** check box.

The transformation parameters are computed using least-squares methods to find the transformation that gives the adjustment parameters that, when applied to the GNSS positions, best fit the control grid coordinates. The horizontal adjustment reduces any residual error between the control coordinates and the grid coordinates calculated from the GNSS positions.

**Note:** You might try computing a horizontal adjustment without the scale factor set to 1 to check the computed scale factor on the Results tab. If the computed scale factor is not close to 1, it could indicate a problem in the selected calibration point pairs.

b. Ensure that the **Vertical Calibration** check box is checked to compute a vertical shift at a defined origin. If you want to include inclinations in the north and east directions in the vertical calibration, select **Vertical Shift + Incline Plane** in the list. Otherwise, select **Vertical Shift Only** to simply compute a vertical shift at a defined origin.

The parameters for this adjustment are computed using least-squares methods to find an adjustment plane that best fits the elevations derived from the GNSS heights with the control point elevations. This requires three 3D calibration point pairs. With a single 3D calibration point pair, only the vertical shift parameter can be computed. If there are two 3D calibration point pairs available, the system defines a correction plane that exactly fits these pairs.

If the project uses a geoid model, the vertical adjustment is computed and applied on top of the geoid model corrections.

c. Optionally, click the **Browse** button to display the **Project Settings** dialog, where you can define a geoid model for the site calibration.

d. If you want to move the false northing and easting coordinates that were specified in the **Project Definition** dialog when you imported the GNSS data (for example, you entered coordinates that do not appropriately center the projection to where the grid coordinates are located, resulting in poor projection scale factors), check the **Update Projection Definition** check box. Then select the appropriate option:

- **First Point Pair** - Sets the projection origin to the first point pair. The false northing and easting coordinates come from the grid point in the first pair; the origin latitude and longitude come from the GNSS point in the first pair.

- **Mean of Point Pairs** - Sets the projection origin to the mean of the point pairs. The false northing and easting coordinates come from the mean of the grid points in the first pair; the origin latitude and longitude come from the mean of the GNSS points.

**Notes:**
- To view the projection scale factors for all of the GNSS and grid points in a single report, select the points in the **Project Explorer**, right-click, and
select **Point List**.
- The **Update Projection Definition** option is recommended only if the project definition was previously specified in the field or on import of the GNSS data into the project. Updating standard or predefined projections is not recommended.

5. On the **Point List** tab, do the following to select the calibration point pairs that will be used in the site calibration computations:

   a. Click in the **GNSS Point** field. Then type the point ID for the first GNSS point you want to pair, or select the GNSS point in a graphic view.

   b. Press the tab key or click in the **Grid Point** field. Then type the point ID for the grid point you want to pair with the selected GNSS point, or select the grid point in a graphic view.

   c. Press the tab key to automatically select the **Horizontal and vertical** option in the **Type** drop-down list and move the cursor to the next **GNSS Point** field.

   The default **Horizontal and vertical** option is applicable when the point pair is suitable for determining both horizontal and vertical adjustments. Optionally, change the **Type** option as follows:

   - **Horizontal only** - Select this when the point pair is suitable only for determining a horizontal adjustment (the elevation value for the grid point is not reliable).

   - **Vertical only** - Select this when the point pair is suitable only for determining a vertical adjustment (the northing and easting values for the grid point are not reliable).

   - **Ignored** - Select this when the point pair is not to be used in the computation of any transformation parameters. This option is useful if you have a problem in your calibration computation and are trying to locate a suspect calibration point pair. You can use this to remove a calibration point pair temporarily from the computation to see if the results are improved.

   d. Repeat these steps to define additional point pairs for the site calibration.

   There is no limit to the number of point pairs that may be defined to compute a calibration. Adding more pairs will not always improve the calibration results, but it will provide additional checks on the validity of the computed parameters. At minimum, you need three pairs of points for a horizontal calibration, and four pairs of points for a vertical calibration with an incline shift.

   You can click ![icon](icon.png) to expand any point to view related coordinate information.

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**Note:** To be used in the site calibration, a GNSS point must have a global coordinate. If you imported **NGS Data Sheets** or **NGS OPUS** data to use in the site calibration, you can easily convert the GNSS local coordinates used in those solutions to global coordinates. To do this, expand each applicable GNSS point node in the **Project Explorer**, right-click the local coordinate, and select **Change Local to Global**. This adds a new office-entered global coordinate for the point.
using the same latitude, longitude, and height as the imported local coordinate. Another solution is to disable the grid/local coordinate or terrestrial station for the point.

6. Click **Compute** to compute the GNSS calibration parameters.

The **Results** tab displays the following information:
- Computed scale factor for the horizontal adjustment
- Horizontal rotation
- Maximum inclination for the computed height adjustment, based on the computed slope north and slope east values
- Vertical shift at origin
- Maximum horizontal and vertical residuals between paired points
- Horizontal and vertical residuals between paired points, which are also expressed graphically:
  - Relative magnitude of the vertical shift
  - Investigate and resolve the reported point pairs with the longest arrows first.
  - Relative magnitude and direction of the horizontal shift
  - Investigate and resolve the reported point pairs with the longest arrows and directions that do not match the other residuals first.

7. If necessary, based on the results of the computation, you can make changes on the **Calibration Settings** and **Point List** tabs and re-compute the calibration.

8. If you want to make the calibrated site available to use as a coordinate system in other projects, click the **Save as Site** button.

   In the **Save as Site** command pane, type a name for the site and click **OK**.

9. Click **OK** to save the site calibration and close the **Site Calibration** command pane.

*Note:* A site can be re-calibrated at any time.

**To remove a site calibration and, if applicable, a projection definition update:**

- If you did not select to update the project definition by checking the **Update Projection Definition** check box, select **Clear Site Calibration** to remove the site calibration.

- If you selected to update the project definition by checking the **Update Projection Definition** check box and you want to remove the site calibration but not the project definition update, select **Clear Site Calibration**.
If you selected to update the project definition by checking the **Update Projection Definition** check box and you want to remove both the site calibration and the projection definition update, select **Undo** in the **Quick Access** toolbar. (If you simply select **Clear Site Calibration**, the project definition update will not be removed.)