A Guide to network adjustment settings

(for propagating positional uncertainty in Australia)

SBQ_example - Trimble Business Center

File | Home | View | Data | Survey | GIS | CAD | Edit | Surfaces | Corridor | Drafting | Photogrammetry | Point Clouds | Machine Control | Support

Import | Export | Merge Survey Projects — Import/Export

Process Baselines | Send to RTX-PP — GNSS

Total Station Editor | Adjust Traverse | Level Editor — Optical

Adjust Network | Site Calibration | Local Site Settings — Network

Transform Survey Points — COGO

Process Feature Codes — Features

Measure Distance — Measure

Reports | Job Report Generator — Reports

Project Explorer

- SBQ_example
  - Points
  - Sessions
  - Imported Files

Plan View [My Filter] | Start Page

52485

107706

105468

6941000
6940000
6939000
6938000
6937000
6936000
6935000

487000 488000 489000 490000 491000 492000 493000 494000 495000

500m

Adjust Network

Constraints | Weighting

Fixed Coordinates

Point ID	Type	2D	h	e
52485	Global			
Horizontal σ:	0.004 m			
Height σ:	0.010 m			
105468	Global			
Horizontal σ:	0.004 m			
Height σ:	0.011 m			
107706	Global			
Horizontal σ:	0.004 m			
Height σ:	0.011 m			

Add Azimuth Constraint

Fixed Azimuths and Horizontal Distances (grid)

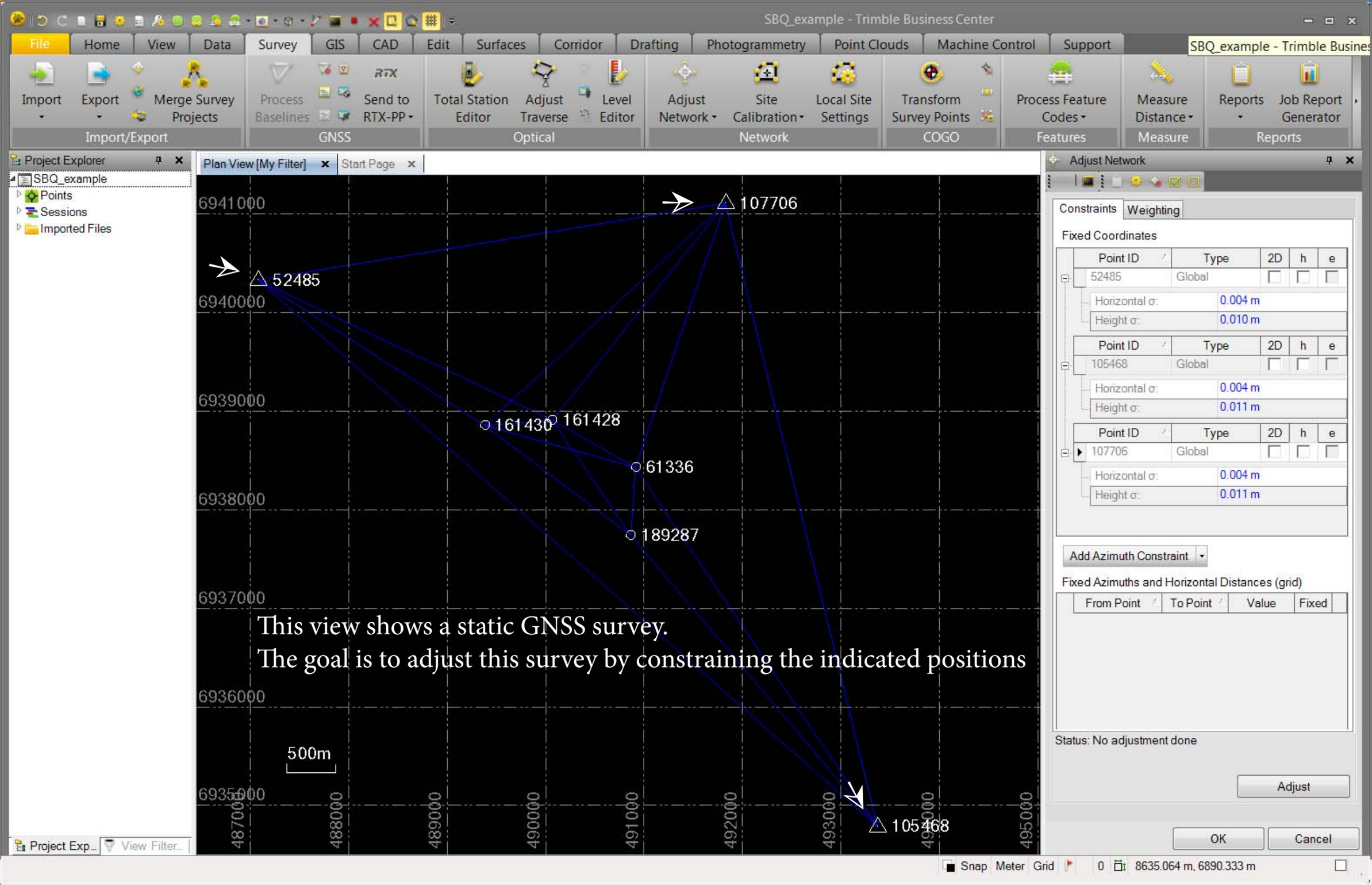
From Point	To Point	Value	Fixed

Status: No adjustment done

Adjust

OK | Cancel

Snap | Meter | Grid | 0 | 8635.064 m, 6890.333 m


SBQ_example - Trimble Business Center
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Surfaces
Corridor
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Merge Survey Projects
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Process Baselines
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Transform Survey Points
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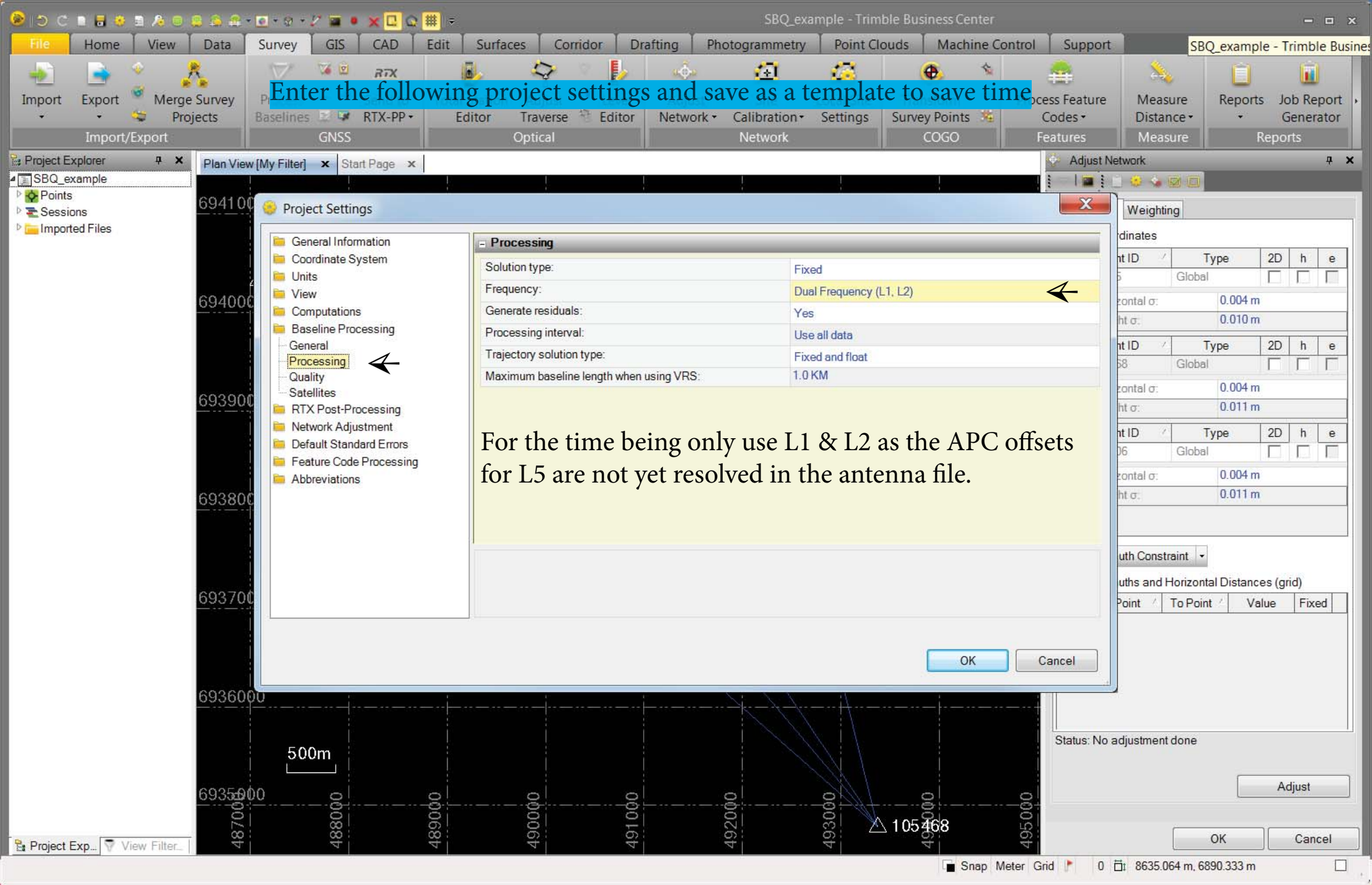
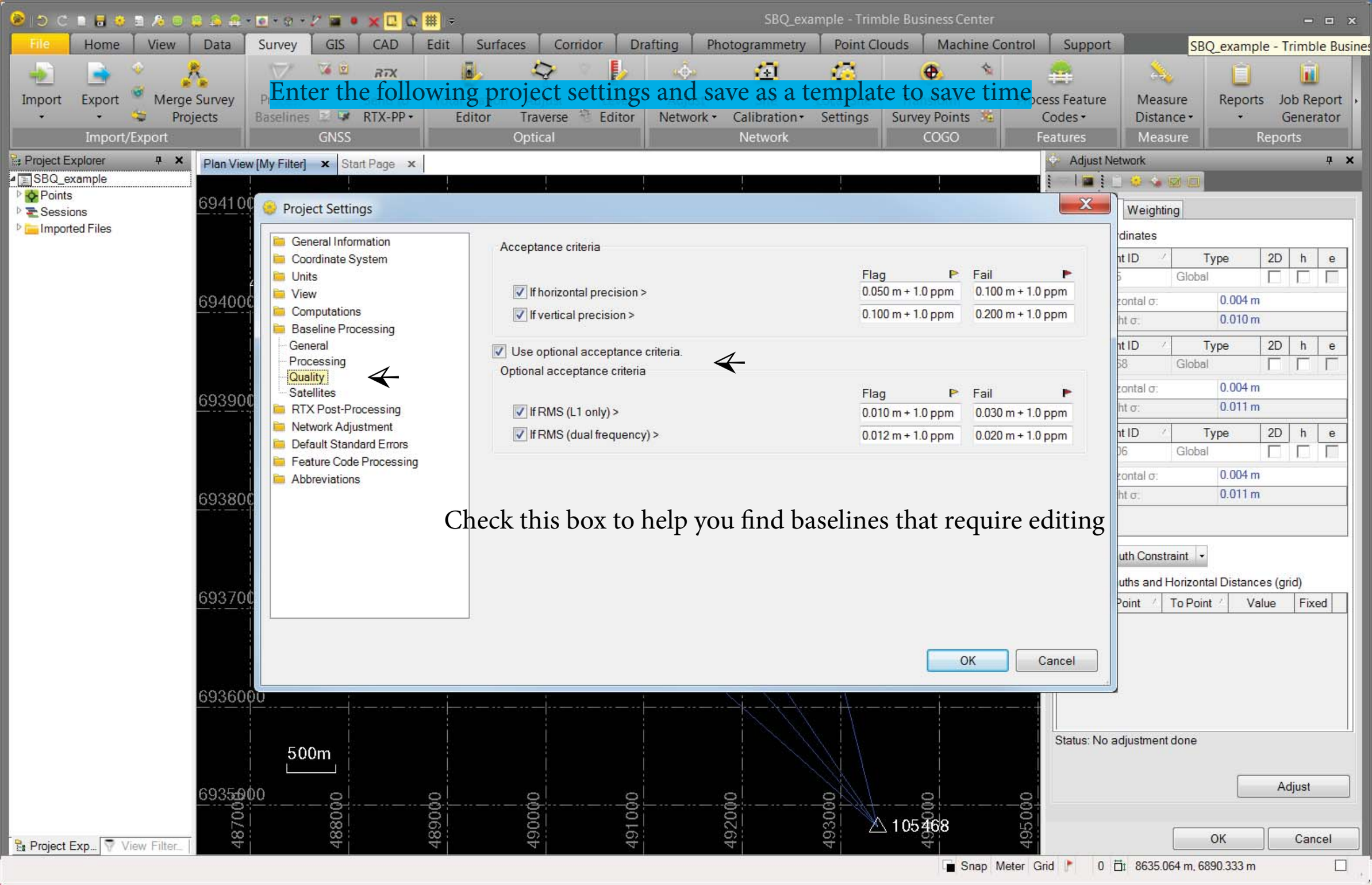
6941000
6940000
6939000
6938000
6937000
6936000
6935000
107706
52485
161430
161428
61336
189287
105468
This view shows a static GNSS survey.
The goal is to adjust this survey by constraining the indicated positions
500m
487000
488000
489000
490000
491000
492000
493000
494000
495000
Adjust Network
Constraints
Weighting
Fixed Coordinates
Point ID
Type
2D
h
e
52485
Global
Horizontal σ:
0.004 m
Height σ:
0.010 m
105468
Global
0.004 m
0.011 m
107706
Global
0.004 m
0.011 m
Add Azimuth Constraint
Fixed Azimuths and Horizontal Distances (grid)
From Point
To Point
Value
Fixed
Status: No adjustment done
Adjust
OK
Cancel
Snap
Meter
Grid
0
8635.064 m, 6890.333 m


SBQ_example - Trimble Business Center
Enter the following project settings and save as a template to save time
Project Settings
General Information
Coordinate System
Units
View
Computations
Baseline Processing
General
Processing
Quality
Satellites
RTX Post-Processing
Network Adjustment
Default Standard Errors
Feature Code Processing
Abbreviations
Processing
Solution type: Fixed
Frequency: Dual Frequency (L1, L2)
Generate residuals: Yes
Processing interval: Use all data
Trajectory solution type: Fixed and float
Maximum baseline length when using VRS: 1.0 KM
For the time being only use L1 & L2 as the APC offsets for L5 are not yet resolved in the antenna file.
OK
Cancel
Adjust Network
Status: No adjustment done
Adjust
OK
Cancel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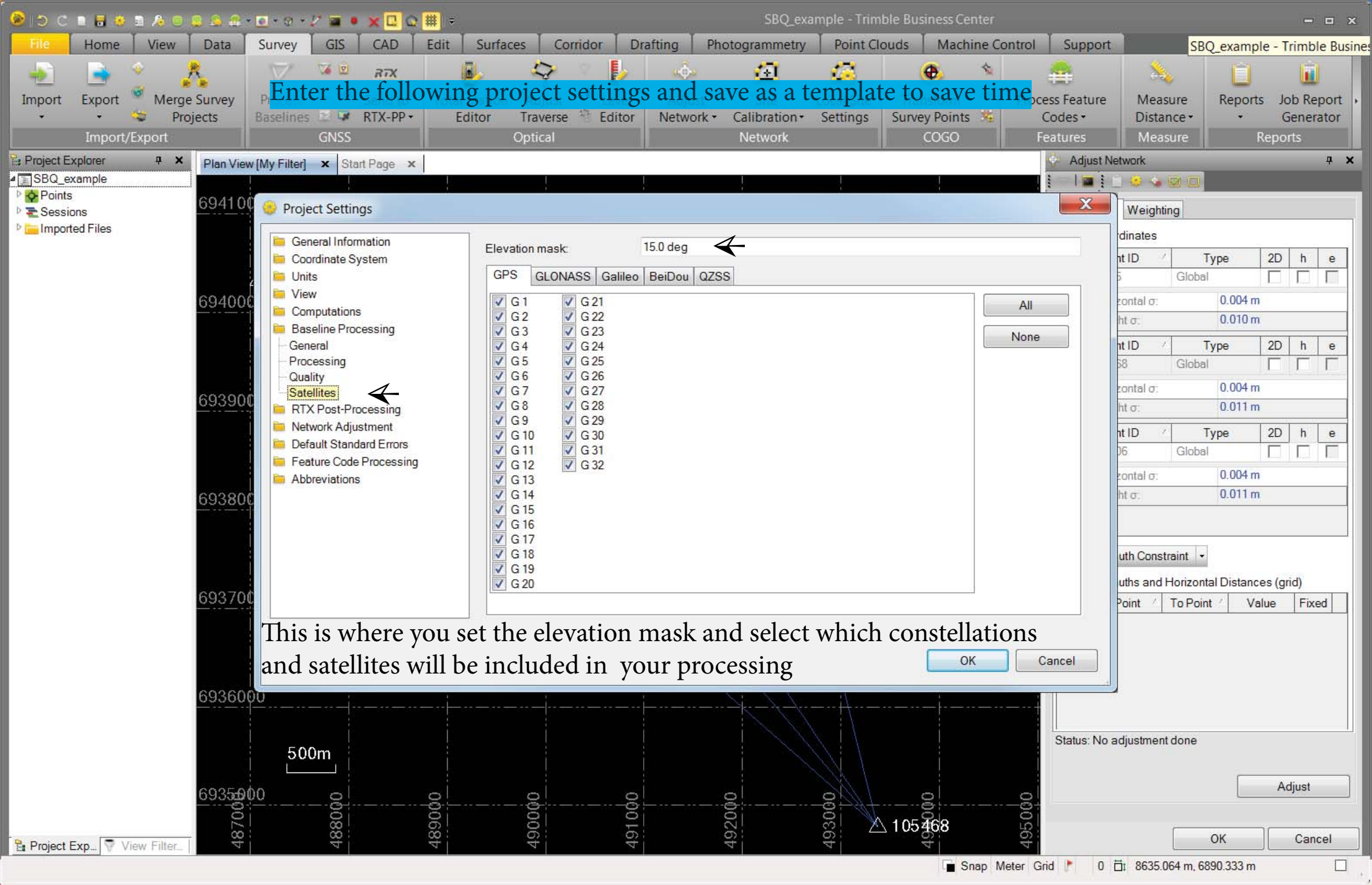
Quality
Satellites
RTX Post-Processing
Network Adjustment
Default Standard Errors
Feature Code Processing
Abbreviations
Acceptance criteria
Flag
Fail
If horizontal precision >
0.050 m + 1.0 ppm
0.100 m + 1.0 ppm
If vertical precision >
0.100 m + 1.0 ppm
0.200 m + 1.0 ppm
Use optional acceptance criteria.
Optional acceptance criteria
If RMS (L1 only) >
0.010 m + 1.0 ppm
0.030 m + 1.0 ppm
If RMS (dual frequency) >
0.012 m + 1.0 ppm
0.020 m + 1.0 ppm
Check this box to help you find baselines that require editing
OK
Cancel
Adjust Network
Weighting
Status: No adjustment done
Adjust
OK
Cancel
500m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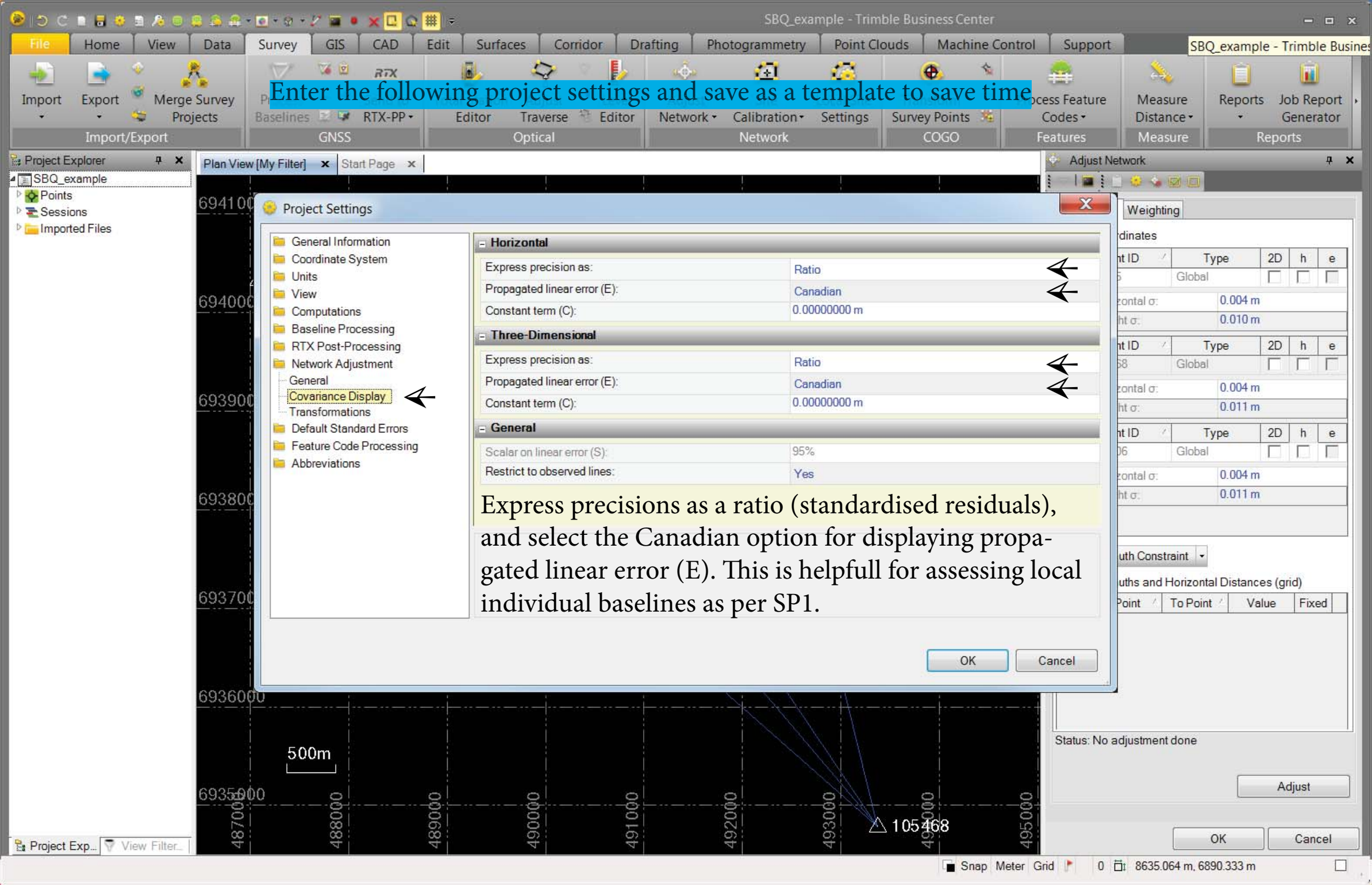
Default Standard Errors
Feature Code Processing
Abbreviations
Elevation mask:
15.0 deg
GPS
GLONASS
Galileo
BeiDou
QZSS
All
None
This is where you set the elevation mask and select which constellations and satellites will be included in your processing
OK
Cancel
Adjust Network
Status: No adjustment done
Adjust
OK
Cancel
500m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Enter the following project settings and save as a template to save time
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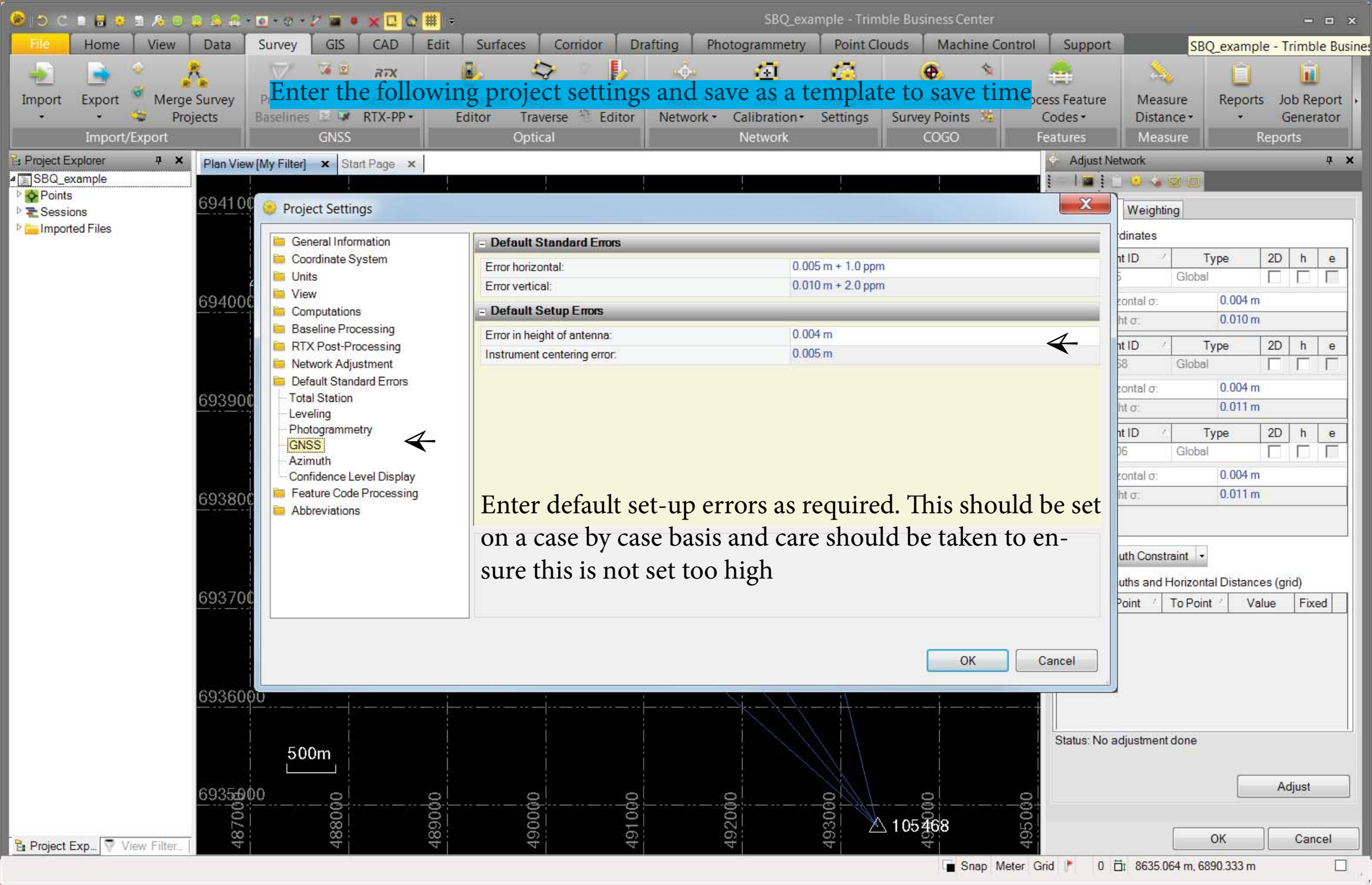
RTX Post-Processing
Network Adjustment
General
Covariance Display
Transformations
Default Standard Errors
Feature Code Processing
Abbreviations
Horizontal
Express precision as: Ratio
Propagated linear error (E): Canadian
Constant term (C): 0.00000000 m
Three-Dimensional
Express precision as: Ratio
Propagated linear error (E): Canadian
Constant term (C): 0.00000000 m
General
Scalar on linear error (S): 95%
Restrict to observed lines: Yes
Express precisions as a ratio (standardised residuals), and select the Canadian option for displaying propagated linear error (E). This is helpfull for assessing local individual baselines as per SP1.
OK
Cancel
Adjust Network
Weighting
Status: No adjustment done
Adjust
OK
Cancel
500m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Enter the following project settings and save as a template to save time
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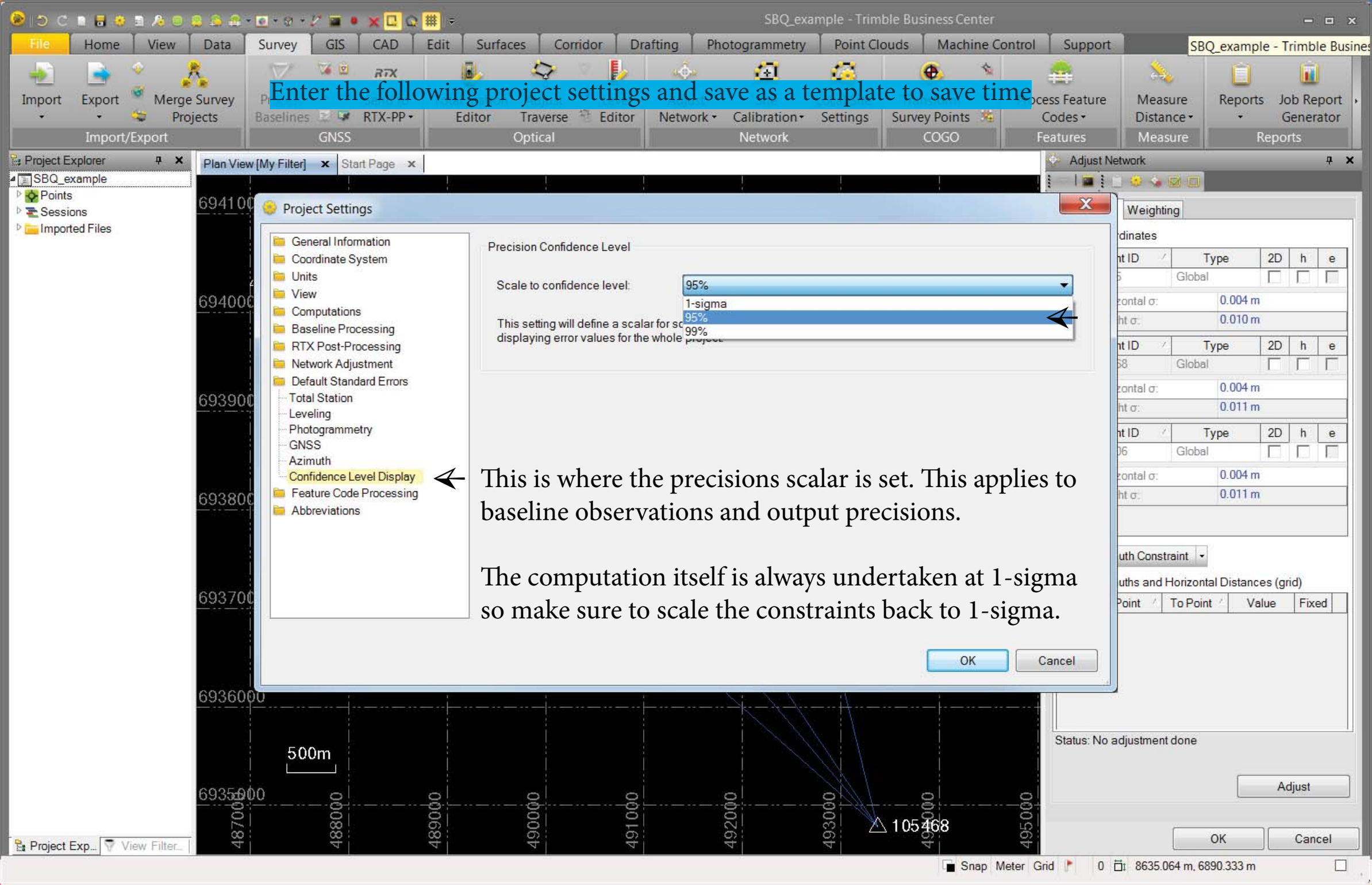
Network Adjustment
Default Standard Errors
Total Station
Leveling
Photogrammetry
GNSS
Azimuth
Confidence Level Display
Feature Code Processing
Abbreviations
Default Standard Errors
Error horizontal: 0.005 m + 1.0 ppm
Error vertical: 0.010 m + 2.0 ppm
Default Setup Errors
Error in height of antenna: 0.004 m
Instrument centering error: 0.005 m
Enter default set-up errors as required. This should be set on a case by case basis and care should be taken to ensure this is not set too high
OK
Cancel
Adjust Network
Weighting
Adjust
OK
Cancel
Status: No adjustment done
500m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Enter the following project settings and save as a template to save time
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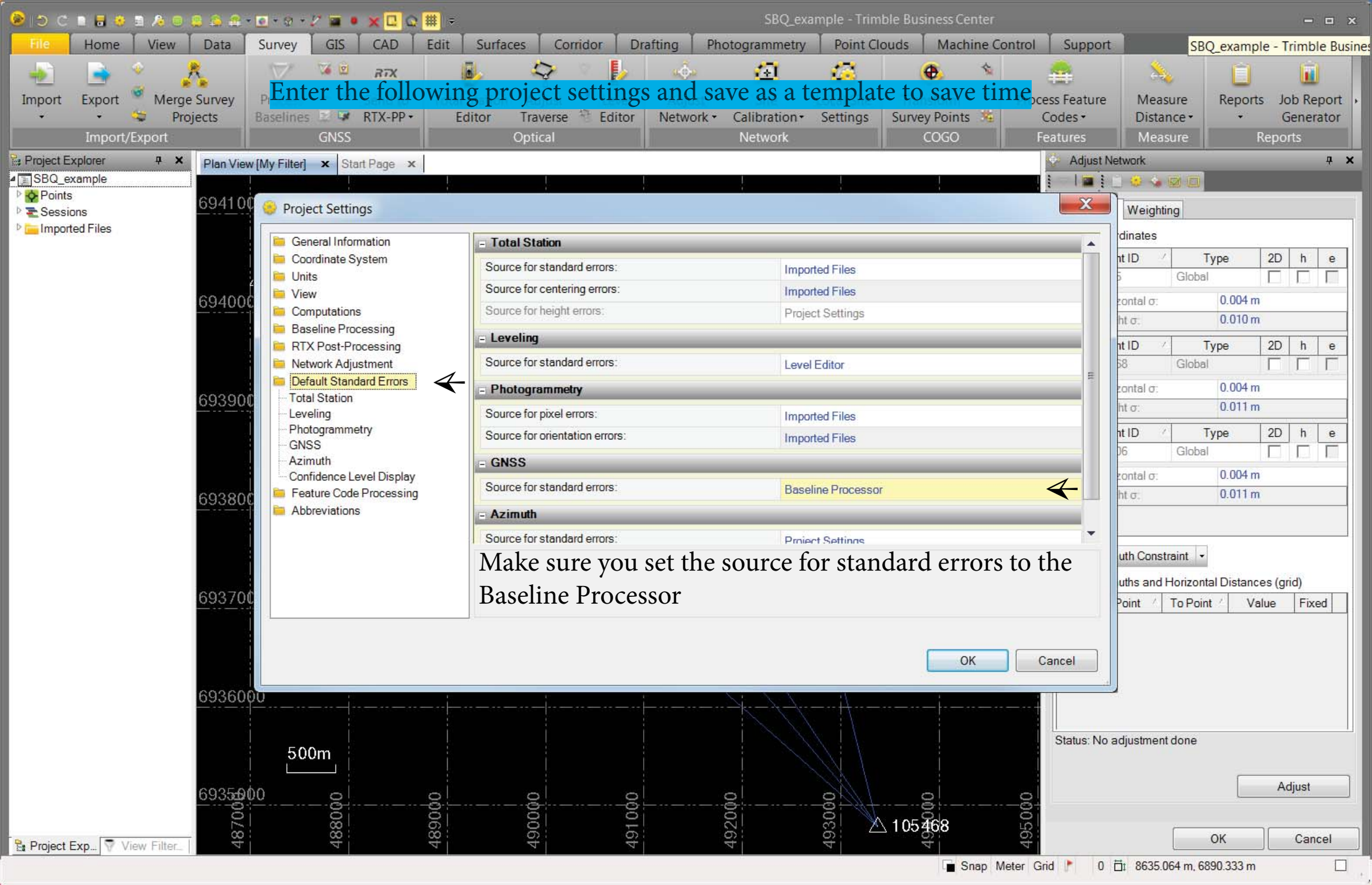
Abbreviations
Precision Confidence Level
Scale to confidence level:
95%
1-sigma
95%
99%
This setting will define a scalar for sc
displaying error values for the whole
OK
Cancel
This is where the precisions scalar is set. This applies to baseline observations and output precisions.
The computation itself is always undertaken at 1-sigma so make sure to scale the constraints back to 1-sigma.
Adjust Network
Weighting
Status: No adjustment done
Adjust
OK
Cancel
500m
105468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Enter the following project settings and save as a template to save time
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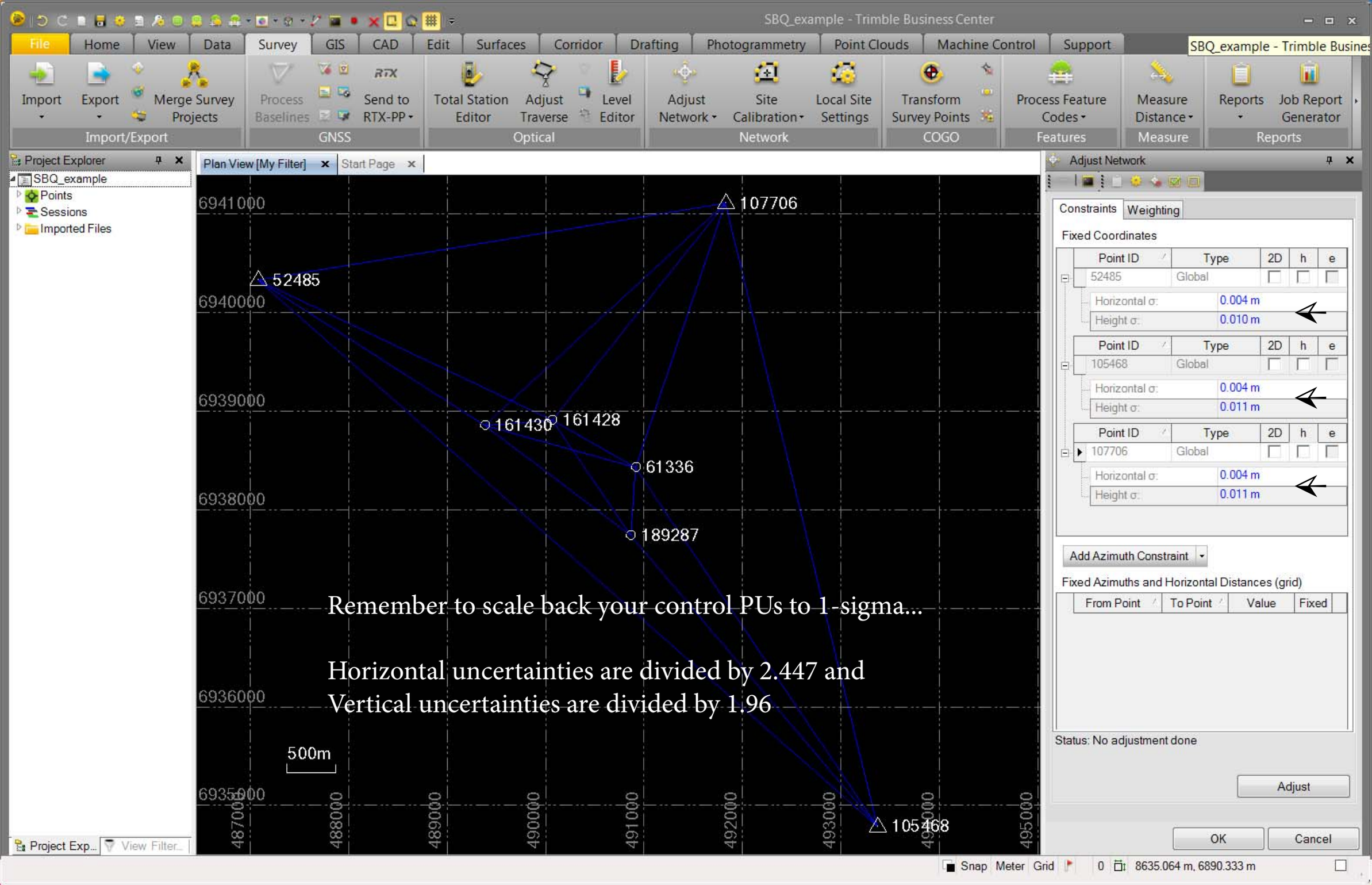
Abbreviations
Total Station
Source for standard errors: Imported Files
Source for centering errors: Imported Files
Source for height errors: Project Settings
Leveling
Source for standard errors: Level Editor
Photogrammetry
Source for pixel errors: Imported Files
Source for orientation errors: Imported Files
GNSS
Source for standard errors: Baseline Processor
Azimuth
Source for standard errors: Project Settings
Make sure you set the source for standard errors to the Baseline Processor
OK
Cancel
Adjust Network
Weighting
Status: No adjustment done
Adjust
OK
Cancel
500m
105468


SBQ_example - Trimble Business Center
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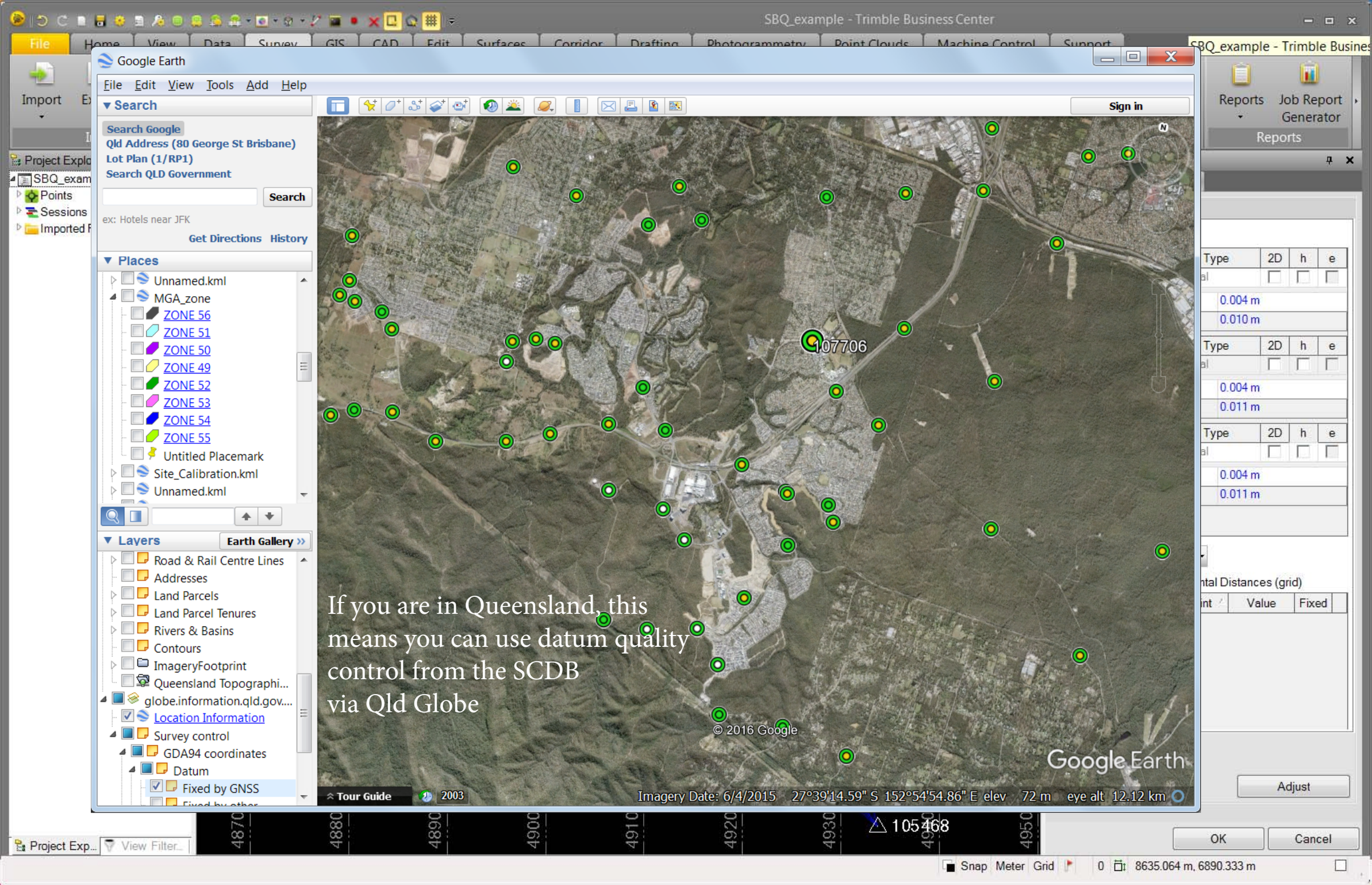
6941000
6940000
6939000
6938000
6937000
6936000
6935000
107706
52485
161430
161428
61336
189287
105468
500m
Remember to scale back your control PUs to 1-sigma...
Horizontal uncertainties are divided by 2.447 and
Vertical uncertainties are divided by 1.96
Adjust Network
Constraints
Weighting
Fixed Coordinates
Point ID
Type
2D
h
e
52485
Global
Horizontal σ:
0.004 m
Height σ:
0.010 m
105468
Global
0.004 m
0.011 m
107706
Global
0.004 m
0.011 m
Add Azimuth Constraint
Fixed Azimuths and Horizontal Distances (grid)
From Point
To Point
Value
Fixed
Status: No adjustment done
Adjust
OK
Cancel
Snap
Meter
Grid
0
8635.064 m, 6890.333 m


SBQ_example - Trimble Business Center
Google Earth
File Edit View Tools Add Help
Search
Search Google
Qld Address (80 George St Brisbane)
Lot Plan (1/RP1)
Search QLD Government
Search
ex: Hotels near JFK
Get Directions History
Places
Unnamed.kml
MGA_zone
ZONE 56
ZONE 51
ZONE 50
ZONE 49
ZONE 52
ZONE 53
ZONE 54
ZONE 55
Untitled Placemark
Site_Calibration.kml
Unnamed.kml
Layers
Earth Gallery
Road & Rail Centre Lines
Addresses
Land Parcels
Land Parcel Tenures
Rivers & Basins
Contours
ImageryFootprint
Queensland Topographi...
globe.information.qld.gov....
Location Information
Survey control
GDA94 coordinates
Datum
Fixed by GNSS
Sign in
107706
If you are in Queensland, this means you can use datum quality control from the SCDB via Qld Globe
© 2016 Google
Google Earth
Tour Guide
2003
Imagery Date: 6/4/2015 27°39'14.59" S 152°54'54.86" E elev 72 m eye alt 12.12 km
Import
Reports
Job Report Generator
Reports
Project Explo
SBQ_exam
Points
Sessions
Imported F
Type 2D h e
0.004 m
0.010 m
0.004 m
0.011 m
0.004 m
0.011 m
ntal Distances (grid)
Value Fixed
Adjust
105468
OK
Cancel
Project Exp...
View Filter...
Snap Meter Grid
8635.064 m, 6890.333 m

Survey Control Mark Report

ADMINISTRATIVE

Mark Number	**107706**		
Alternate Names	**SPRINGFIELD**	Town	**IPSWICH**
		Local Authority	**IPSWICH CITY**
Locality Description	**SPRINGFIELD PARKWAY R/ABOUT**		
Related Information	**Mark suitable for GPS. VISITED KEN COOPER 5/4/2001 GPS SUITABLE**		

DETAILS

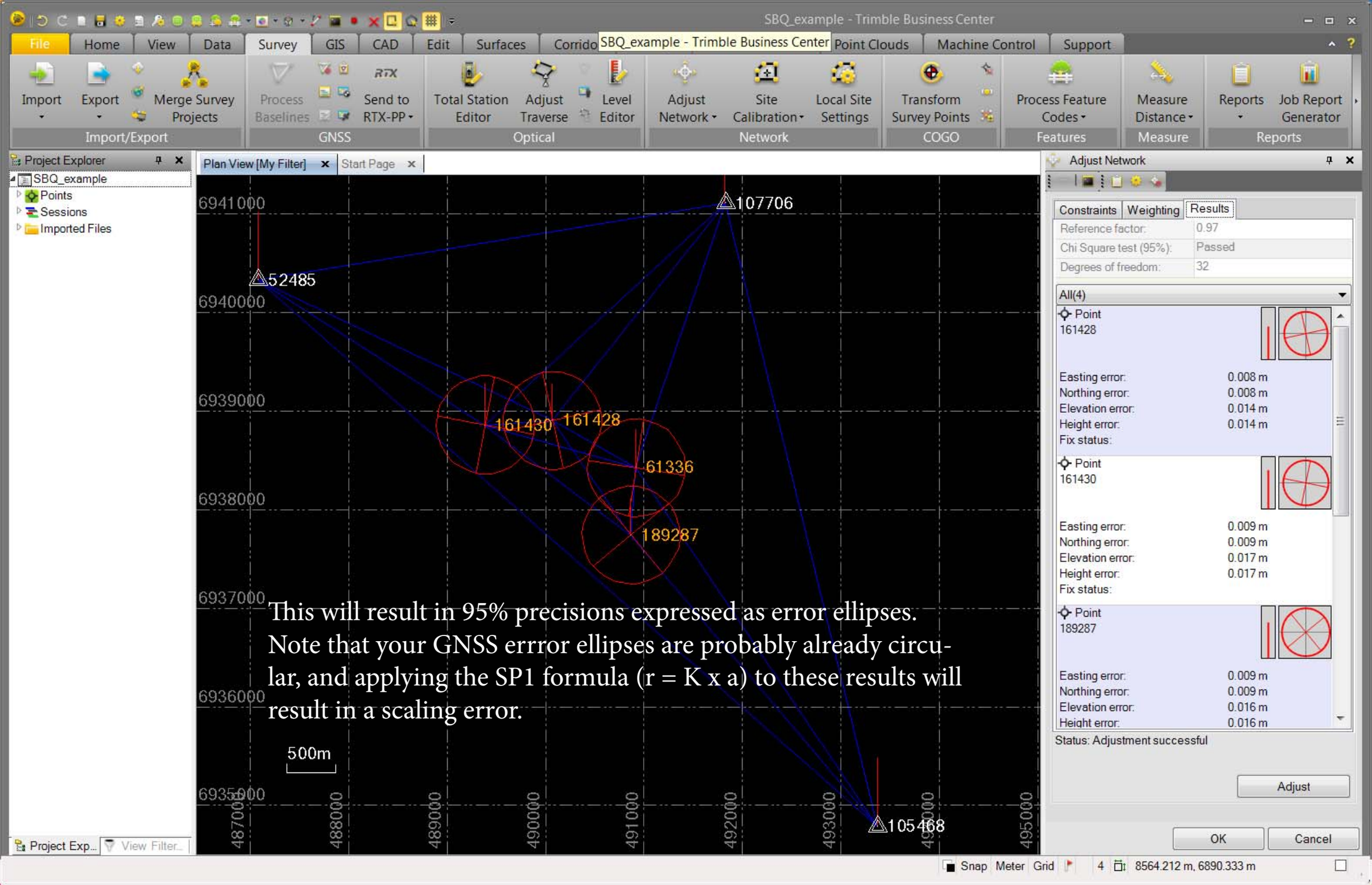
Mark Type	**STAND**			
Installed By	**JONES WRIGHT**	Connections	**IS253083**	22-Oct-2015
Installed Date	**19-Jul-1994**		**SP249095**	26-Aug-2011
Mark Condition	**GOOD**		**SP158940**	11-Mar-2010
Last Visited	**22-Oct-2015**		**SP163097**	23-Mar-2005
Sketch Available	**Yes**		**SP163096**	03-Nov-2004
			(18 connections)	

GDA94 COORDINATES

Lineage	**Datum**		
Latitude	**27° 39' 15.15560" S**	Horizontal Uncertainty	**0.010m** ← divide this by 2.447
Longitude	**152° 55' 01.56959" E**		
Ellipsoidal Height	**110.836m**	Vertical Uncertainty	**0.021m** ← and this by 1.96
MGA94 Easting	**491823.453m**	MGA94 Point Scale	**0.99960083**
MGA94 Northing	**6941098.865m**	MGA94 Grid Conv	**-0° 02' 18.51"**
MGA94 Zone	**56**		
Published	**04-Oct-2016**	Fixed By	**GPS**
Adjustment	**QLD ANJ 16.09**		

AHD HEIGHT

Lineage	**Derived**		
Height	**69.394m**	Vertical Uncertainty	**Class D / 4th ORDER**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500m
487000
488000
489000
490000
491000
492000
493000
494000
495000
This will result in 95% precisions expressed as error ellipses. Note that your GNSS errror ellipses are probably already circular, and applying the SP1 formula (r = K x a) to these results will result in a scaling error.
Adjust Network
Constraints
Weighting
Results
Reference factor: 0.97
Chi Square test (95%): Passed
Degrees of freedom: 32
All(4)
Point
161428
Easting error: 0.008 m
Northing error: 0.008 m
Elevation error: 0.014 m
Height error: 0.014 m
Fix status:
Point
161430
Easting error: 0.009 m
Northing error: 0.009 m
Elevation error: 0.017 m
Height error: 0.017 m
Fix status:
Point
189287
Easting error: 0.009 m
Northing error: 0.009 m
Elevation error: 0.016 m
Height error: 0.016 m
Status: Adjustment successful
Adjust
OK
Cancel
Project Exp...
View Filter...
Snap
Meter
Grid
4
8564.212 m, 6890.333 m

Adjustment Settings

Set-Up Errors

GNSS

Error in Height of Antenna: 0.004 m

Centering Error: 0.005 m

Covariance Display

Horizontal:

Propagated Linear Error [E]: Canadian

Constant Term [C]: 0.000 m

Scale on Linear Error [S]: 2.447

Three-Dimensional

Propagated Linear Error [E]: Canadian

Constant Term [C]: 0.000 m

Scale on Linear Error [S]: 2.800

Using these settings will return an adjustment report showing 95% precisions which can be used "as is" for horizontal (2D) error. Vertical is another story...

Adjustment Statistics

Number of Iterations for Successful Adjustment: 2

Network Reference Factor: 0.97

Chi Square Test (95%): Passed

Precision Confidence Level: 95%

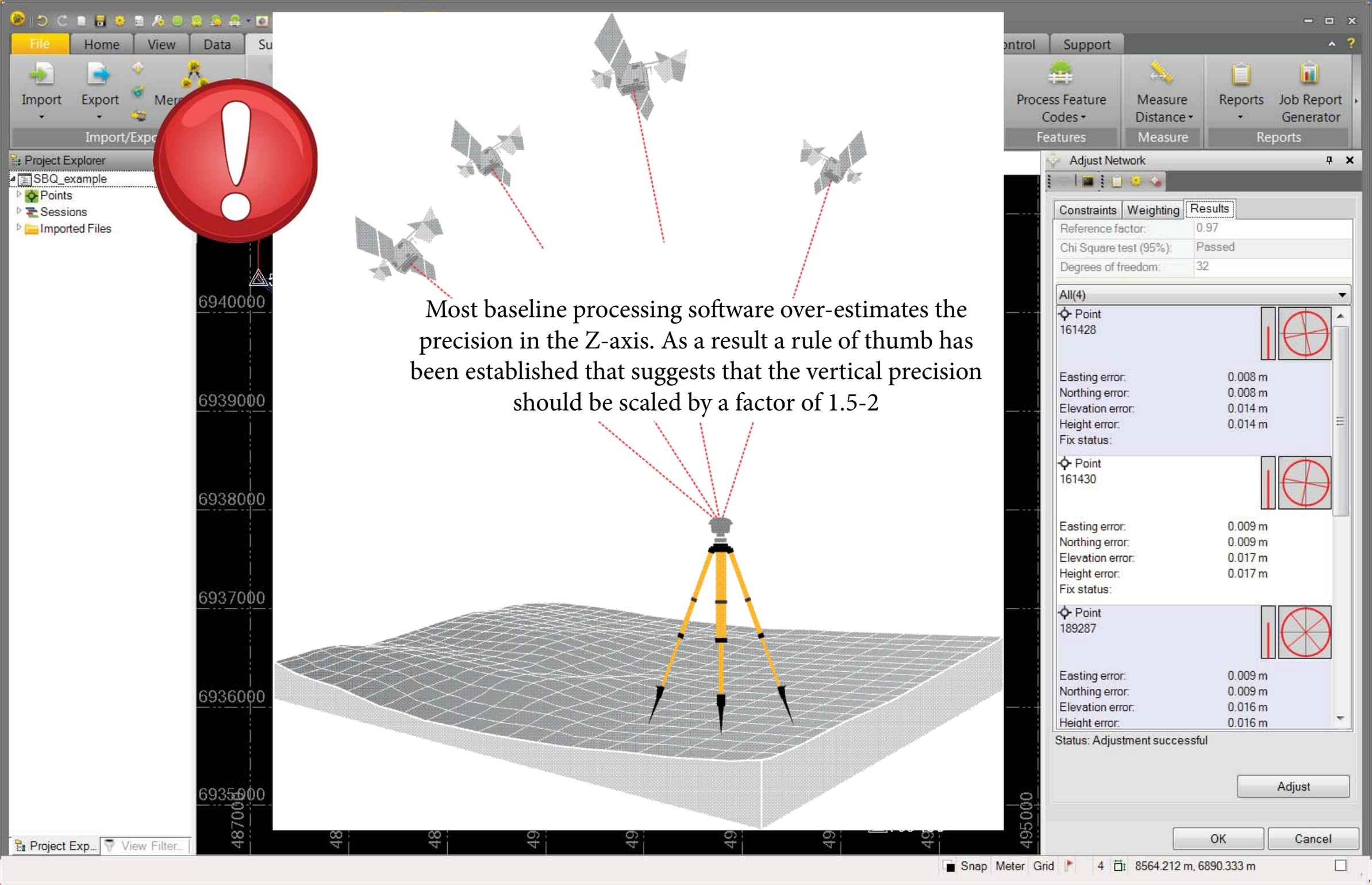
Degrees of Freedom: 32

Post Processed Vector Statistics

Reference Factor: 0.98

Redundancy Number: 30.76

A Priori Scalar: 1.00


Most baseline processing software over-estimates the precision in the Z-axis. As a result a rule of thumb has been established that suggests that the vertical precision should be scaled by a factor of 1.5-2
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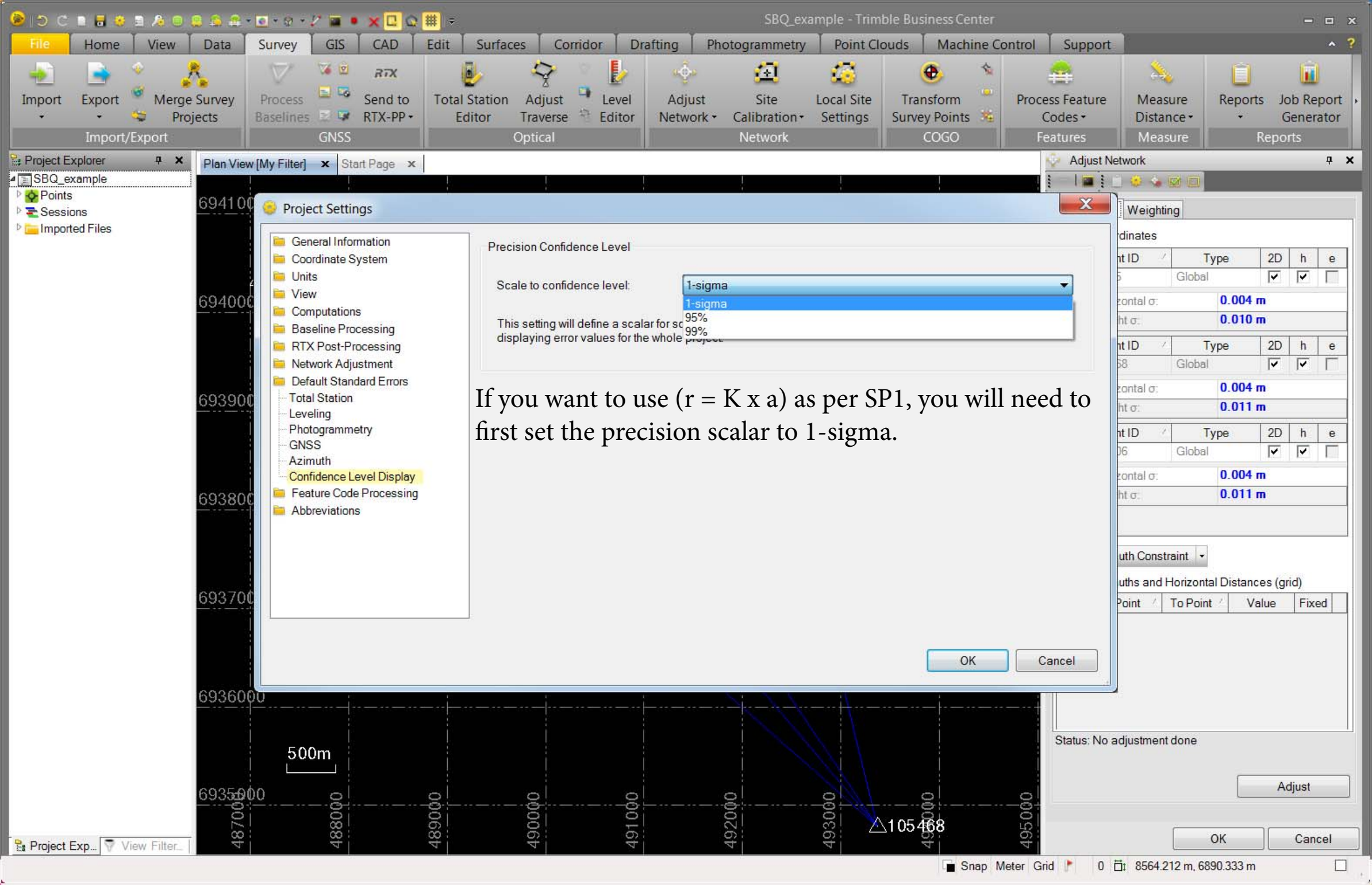
Chi Square test (95%): Passed
Degrees of freedom: 32
All(4)
Point 161428
Easting error: 0.008 m
Northing error: 0.008 m
Elevation error: 0.014 m
Height error: 0.014 m
Fix status:
Point 161430
Easting error: 0.009 m
Northing error: 0.009 m
Elevation error: 0.017 m
Height error: 0.017 m
Fix status:
Point 189287
Easting error: 0.009 m
Northing error: 0.009 m
Elevation error: 0.016 m
Height error: 0.016 m
Status: Adjustment successful
Adjust
OK
Cancel
6940000
6939000
6938000
6937000
6936000
6935000
Snap
Meter
Grid
8564.212 m, 6890.333 m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Abbreviations
Precision Confidence Level
Scale to confidence level:
1-sigma
1-sigma
95%
99%
This setting will define a scalar for sc
displaying error values for the whole
OK
Cancel
If you want to use (r = K x a) as per SP1, you will need to first set the precision scalar to 1-sigma.
Adjust Network
Weighting
Type
2D
h
e
Global
0.004 m
0.010 m
0.011 m
Status: No adjustment done
Adjust
OK
Cancel
500m
105468
Snap
Meter
Grid
8564.212 m, 6890.333 m

To express standard deviations for one dimensional components at the 95% confidence level, the uncertainty value is simply computed by scaling the estimated (1 sigma) standard deviation by coverage factor k = 1.960.

To express the (two dimensional) standard error ellipse at the 95% confidence level, the axes of the 95% error ellipse are obtained by scaling the (1 sigma) axes by coverage factor k = 2.448.

Similarly, the axes of the (three dimensional) 95% error ellipsoid are obtained by scaling the (1 sigma) axes by coverage factor k = 2.796.

For the horizontal circular confidence region, the 95% uncertainty value is calculated from the standard (1 sigma) error ellipse and is expressed as a single quantity, being the radius of the circular confidence region. The radius (r) of the circular confidence region is computed by:

$$r = a \times K$$

$$K = q_0 + q_1 C + q_2 C^2 + q_3 C^3$$

$$C = {}^{b}/_{a}$$

Where:

a = semi-major axis of the standard error ellipse

b = semi-minor axis of the standard error ellipse

q_0 = 1.960790

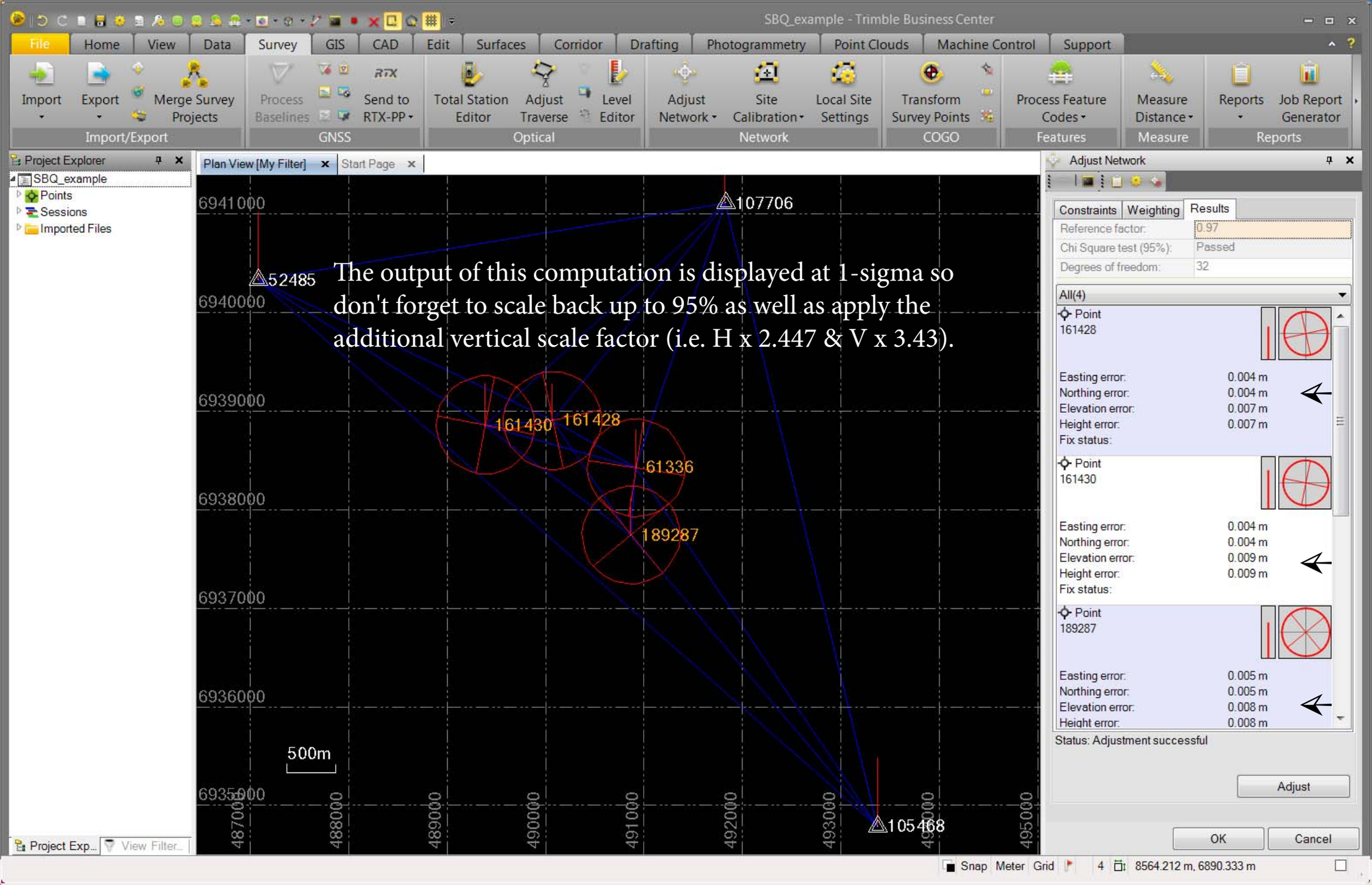
q_1 = 0.004071

q_2 = 0.114276

q_3 = 0.371625

note: the equation (r = K x a) as per SP1, will scale 2D results from 1-sigma to 95% as well as convert ellipses to circles. Vertical should be scaled by 1.96 and 1.75 = 3.43

Applying this equation to the previous results will return 95% circular confidence regions.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Optical
Adjust Network
Site Calibration
Local Site Settings
Network
Transform Survey Points
COGO
Process Feature Codes
Features
Measure Distance
Measure
Reports
Job Report Generator
Reports
Project Explorer
SBQ_example
Points
Sessions
Imported Files
Plan View [My Filter]
Start Page
6941000
6940000
6939000
6938000
6937000
6936000
6935000
107706
52485
161430
161428
61336
189287
105468
500m
487000
488000
489000
490000
491000
492000
493000
494000
495000
The output of this computation is displayed at 1-sigma so don't forget to scale back up to 95% as well as apply the additional vertical scale factor (i.e. H x 2.447 & V x 3.43).
Adjust Network
Constraints
Weighting
Results
Reference factor: 0.97
Chi Square test (95%): Passed
Degrees of freedom: 32
All(4)
Point
161428
Easting error: 0.004 m
Northing error: 0.004 m
Elevation error: 0.007 m
Height error: 0.007 m
Fix status:
Point
161430
Easting error: 0.004 m
Northing error: 0.004 m
Elevation error: 0.009 m
Height error: 0.009 m
Fix status:
Point
189287
Easting error: 0.005 m
Northing error: 0.005 m
Elevation error: 0.008 m
Height error: 0.008 m
Status: Adjustment successful
Adjust
OK
Cancel
Project Exp...
View Filter...
Snap
Meter
Grid
4
8564.212 m, 6890.333 m

There is currently no rigourous propagation of error available for Australia in TBC but the two options shown here give a resonable approximation of positional uncertainty