

**MCGS Monument Re-Establishment  
Elmgrove Road Over Elmford Creek  
Culvert Improvements  
4115 (MCGS) 1983**

**Town of Gates  
Capital Improvement Project No. 1934.01  
GdB Project No. 10713**

**Prepared for:  
Monroe County Department of Transportation**



**February 2022**

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## Section II – Field Operation

- **Summary**

In November of 2021 GdB Geospatial, LS PC performed a Horizontal and Vertical Re-Establishment of MCGS monument 4115. The existing monument was determined to have moved during construction activities, therefore horizontal coordinates and elevation were established using the methods and data shown hereon.

The Geodetic Monument and Capped Rebars were occupied and measured employing TPS survey techniques using a 1” Total Station. The GPS and TPS survey data were combined and adjusted by a minimally constrained least squares analysis and adjusted in 3D. The resulting adjusted coordinates are shown on Page 4 of this report.

- **Personnel**

#### **Justin Roloson, L.S.**

- *Project Manager* – Oversaw Project, authored report, and reviewed data prior to submittal.

#### **Christopher Locke, L.S.**

- *Project Manager* – Coordinated logistics; Reduced baselines observed during the field work; analyzed the baselines; performed the least squares adjustment of the GPS and Total Station network and presented the results.

**Robbie Klotz**

- *GPS Observer / Survey Control Baseline Party Chief* – Conducted GPS observations as part of the control survey campaign and ran the Total Station and Data Collector for the Traverse performed on the survey baseline control points. Also ran the Digital Level Rod that was used to perform the conventional leveling for the project.

**Dom Passafiume**

- *GPS Observer / Survey Control Baseline Instrument Man* – Conducted GPS observations as part of the control survey campaign and setup the foresights and backsights for the Traverse performed on the survey baseline control points. Also ran the Digital Level that was used to perform the conventional leveling for the project.

**Section III – Data**

- **Adjusted Geodetic Monument Coordinates**

Point #	Northing	Easting	Elevation	Desc.
4115	1156305.473	1375321.968	568.758	MCGS
4	1156335.240	1375162.722	569.292	CAPPED REBAR
100	1156254.745	1375583.353	568.581	CAPPED REBAR

- **Rounds Report**

OCCUPATION DATA

```
=====
Occ Pt:   4
HI:      5.360
SET:     1
-----
```

Results

```
Point 4115
      H Angle   V Angle   S Dist   H Dist   V Dist   BS Circle
Dir   359°45'13"  90°08'49"  162.000  161.999  -0.415  0°00'00"
Rev   179°45'14"  269°51'03"  162.005  162.004  -0.422  0°00'00"
Mean   359°45'14"  90°08'53"  162.002  162.002  -0.418
Std Dev 1.00000  4.25000  0.00250  0.00000  0.00250
```

```
Point 4115
      Ang Rt   BS H Dist  FS H Dist
Avg   359°45'14" 428.272  162.002
Hi    359°45'14" 428.275  162.004
```

Low 359°45'13" 428.270 161.999  
Diff 0°00'02" 0.005 0.005

Point North East Height  
4115 1156305.420 1375321.964 -0.518

Obs Point	H Circle	Z Angle	S Dist	H Dist	V Dist	BS Circle	HA Res
VA Res	SD Res	HD Res	VD Res	HR	Prism Type	PC	
BSD 100	0°00'00"	90°02'59"	428.275	428.275	-0.373	0°00'00"	-0°00'01"
0°00'11"	-0.003	5.660	Prism	-30 Offset			
FSD 4115	359°45'13"	90°08'49"	162.000	161.999	-0.415	0°00'00"	0°00'01"
0°00'04"	0.002	5.460	Prism	-30 Offset			
FSR 4115	179°45'12"	269°51'03"	162.005	162.004	-0.422	0°00'00"	-0°00'01"
-0°00'04"	-0.002	5.460	Prism	-30 Offset			
BSR 100	179°59'58"	269°56'39"	428.270	428.270	-0.416	0°00'00"	0°00'01"
-0°00'11"	0.003	5.660	Prism	-30 Offset			

OCCUPATION DATA

Occ Pt: 4115  
HI: 5.360  
SET: 1

Results

Point 100A

	H Angle	V Angle	S Dist	H Dist	V Dist	BS Circle
Dir	180°23'38"	90°01'43"	266.275	266.275	-0.134	0°00'00"
Rev	0°23'44"	269°58'08"	266.275	266.275	-0.145	0°00'00"
Mean	180°23'41"	90°01'48"	266.275	266.275	-0.139	
Std Dev	3.00000	4.50000	0.00000	0.00000	0.00000	

Point 100A

	Ang Rt	BS H Dist	FS H Dist
Avg	180°23'41"	162.012	266.275
Hi	180°23'44"	162.015	266.275
Low	180°23'38"	162.010	266.275
Diff	0°00'06"	0.005	0.000

Point North East Height  
100A 1156254.703 1375583.364 -0.758

Obs Point	H Circle	Z Angle	S Dist	H Dist	V Dist	BS Circle	HA Res
VA Res	SD Res	HD Res	VD Res	HR	Prism Type	PC	
BSD 4	0°00'00"	89°57'55"	162.015	162.015	0.099	0°00'00"	-0°00'01"
0°00'06"	-0.002	5.660	Prism	-30 Offset			
FSD 100A	180°23'38"	90°01'43"	266.275	266.275	-0.134	0°00'00"	0°00'03"
0°00'04"	0.000	5.460	Prism	-30 Offset			

FSR 100A	0°23'42"	269°58'08"	266.275	266.275	-0.145	0°00'00"	-0°00'03"
-0°00'04"	0.000	5.460	Prism	-30 Offset			
BSR 4	179°59'58"	270°01'54"	162.010	162.010	0.089	0°00'00"	0°00'01"
0°00'06"	0.002	5.660	Prism	-30 Offset			

• Field Notes

○ Total Station

Station	HT	HD	Z	Time	Remarks
10713-0100-315-A	5.416	0.002	2.0m	12:17 PM	12:47 PM
10713-0100-315-B	5.416	0.002	2.0m	12:19 PM	12:55 PM
10713-0004-315-B	5.36	0.002	2.0m	12:53 PM	1:31 PM
10713-4116-315-B	5.416	0.002	2.0m	12:57 PM	1:33 PM
10713-0100-315-C	5.416	0.002	2.0m	1:54 PM	1:29 PM
10713-0004-315-C	5.36	0.002	2.0m	1:32 PM	2:09
10713-4116-315-C	5.416	0.002	2.0m	1:35 PM	2:11
10713-0100-315-D	5.416	0.002	2.0m	1:39 PM	2:09
TKD 4	5.36	0.002			
BSΔ100	5.66	0.002			
FSΔ4116	5.416				
TKD 4116					
BSΔ4		0.002			
FSΔ100A					

○ Digital Level

Point #	BS	FS	Elev	Desc.
4	✓		100	REBAR w/CAP
4116	✓	✓	99.467	MON
100	✓	✓	99.292	REBAR w/CAP
4116	✓	✓	99.471	MON
4		✓	100.06	REBAR w/CAP

- Digital Level Closure Report

# GdB Geospatial

MCDOT - ELMGROVE ROAD - LEVEL RUN CLOSURE ERROR REPORT			
FROM - TO	ELEVATION DIFFERENCE (FT)	LENGTH (FT)	DESCRIPTION
4-4115	-0.533	168.9	MCGS MON
4115-100	-0.175	272.4	CAPPED REBAR
100-4115	0.179	272.5	MCGS MON
4115-4	0.535	168.9	CAPPED REBAR
	0.006	882.7	

SUM ELEVATION DIFFERENCES (RAW MISCLOSURE) = **0.006 FT.**  
TOTAL LEVEL RUN DISTANCE = 882.7' (0.167 Miles)  
FORMULA FOR ALLOWABLE MISCLOSURE =  $0.03' \sqrt{D}$  (D=DISTANCE IN MILES)  
ALLOWABLE MISCLOSURE =  $0.03' \sqrt{0.167} = 0.012'$   
**LEVEL RUN IS WITHIN TOLERANCE SPECIFICATIONS**

- **StarNet 2D Adjustment Report**

MicroSurvey STAR\*NET-PRO Version 9,2,6,556  
Run Date: Fri Nov 19 2021 11:48:14

Summary of Files Used and Option Settings  
=====

Project Folder and Data Files

Project Name 10713 - MCDOT MON 4115 ADJUSTMENT - 2021-11-15  
Project Folder P:\10713\SURVEY\STARNET\HORIZONTAL  
Data File List 1. P:\10713\...\Traverse\10713 ELMGROVE RD MON 2D.dat

Project Option Settings

STAR\*NET Run Mode : Adjust with Error Propagation  
Type of Adjustment : 2D  
Project Units : FeetUS; DMS  
Coordinate System : NY83-W  
Default Project Elevation : 568.8870 FeetUS  
Geoid Height Model : H:\GEOID18\G2018U0.BIN  
Longitude Sign Convention : Positive West  
Input/Output Coordinate Order : North-East  
Angle Data Station Order : At-From-To  
Distance/Vertical Data Type : Slope/Zenith  
Convergence Limit; Max Iterations : 0.010000; 10  
Default Coefficient of Refraction : 0.070000  
Create Coordinate File : Yes  
Create Geodetic Position File : No  
Create Ground Scale Coordinate File : No  
Create Dump File : No

Instrument Standard Error Settings

Project Default Instrument  
Distances (Constant) : 0.009843 FeetUS  
Distances (PPM) : 2.000000  
Angles : 1.000000 Seconds  
Directions : 1.000000 Seconds  
Azimuths & Bearings : 1.000000 Seconds  
Centering Error Instrument : 0.005000 FeetUS  
Centering Error Target : 0.005000 FeetUS

↑

Listing of Input Data  
=====

[File: P:\10713\SURVEY\FieldWrk\2021-11-12 RK DP (Mon)\Traverse\10713 ELMGROVE RD  
MON 2D.dat]  
# STAR\*CARLSON Version 9.2.6.556  
# Copyright 2019 MicroSurvey Software Inc.

# Input Field File : P:\10713\Survey\FieldWrk\2021-11-12 RK DP (Mon)\Traverse\10713  
ELMGROVE RD MON.RW5  
# Date Processed : 11-17-2021 09:30:03

.Units FeetUS  
.Units DMS  
.Order AtFromTo  
.Sep -  
.2D

C 4 1156335.241 1375162.719 0.010801 0.009537  
C 100 1156254.744 1375583.356 0.011692 0.009143

# .2D

# Job : 10713 ELMGROVE RD MON  
# Date : 11-12-2021  
# Time : 16:14:45

D	4-100		428.2673	
D	4-100		428.2723	
M	4-100-4115	359-45-13.50	162.0020	
D	4115-4		162.0150	'CAPPED REBAR
D	4115-4		162.0125	'CAPPED REBAR
M	4115-4-100	180-23-41.00	266.2750	

↑

Adjustment Solution Iterations

=====

Iteration # 1

Changes from Last Iteration (FeetUS)

Station	dN	dE
4	-0.0007	0.0028
100	0.0008	-0.0026
4115	-0.0028	0.0086
Previous Sigma:	3.780448	
Current Sigma:	1.555366	
Convergence Test:	2.225082	

Iteration # 2

Changes from Last Iteration (FeetUS)

Station	dN	dE
4	0.0000	-0.0000
100	-0.0000	0.0000
4115	0.0000	-0.0000
Previous Sigma:	1.555366	



Current Sigma: 1.555366  
Convergence Test: -0.000000

↑

Summary of Unadjusted Input Observations  
=====

Number of Entered Stations (FeetUS) = 2

Partially Fixed	N StdErr	E StdErr	Description
4	1156335.2410 0.0108	1375162.7190 0.0095	
100	1156254.7440 0.0117	1375583.3560 0.0091	

Number of Measured Angle Observations (DMS) = 2

At	From	To	Angle	StdErr	t-T
4	100	4115	359-45-13.50	7.94	-0.00
4115	4	100	180-23-41.00	12.70	0.00

Number of Measured Distance Observations (FeetUS) = 6

From	To	Distance	StdErr	Comb Grid
4	100	428.2723	0.0128	0.9999748
4	100	428.2673	0.0128	0.9999748
4	4115	162.0020	0.0124	0.9999748
4115	4	162.0125	0.0124	0.9999748
4115	4	162.0150	0.0124	0.9999748
4115	100	266.2750	0.0126	0.9999749

↑

Adjustment Statistical Summary  
=====

Iterations = 2  
Number of Stations = 3  
Number of Observations = 12  
Number of Unknowns = 6  
Number of Redundant Obs = 6

Observation	Count	Sum Squares of StdRes	Error Factor
Coordinates	4	0.178	0.298
Angles	2	0.073	0.271
Distances	6	1.304	0.659
Total	12	1.555	0.509

The Chi-Square Test at 5.00% Level Passed  
Lower/Upper Bounds (0.454/1.552)

↑

Adjusted Station Information

=====

Coordinate Changes from Entered Provisionals (FeetUS)

Station	dN	dE
4	-0.0007	0.0028
100	0.0008	-0.0026

Adjusted Coordinates (FeetUS)

Station	N	E	Description
4	1156335.2403	1375162.7218	CAPPED REBAR
100	1156254.7448	1375583.3534	
4115	1156305.4734	1375321.9676	

Adjusted Positions (FeetUS)

Station	Latitude	Longitude
4	43-10-13.479583	77-43-58.378833
100	43-10-12.642347	77-43-52.714083
4115	43-10-13.169615	77-43-56.234128

Convergence Angles (DMS) and Grid Factors at Stations  
(Grid Azimuth = Geodetic Azimuth - Convergence)  
(Elevation Factor Includes a Geoid Height Correction at Each Station))

Station	Convergence	----- Factors -----			
	Angle	Scale	x	Elevation	= Combined
4	0-34-54.75	0.99999630		0.99997837	0.99997468
100	0-34-58.62	0.99999652		0.99997837	0.99997489
4115	0-34-56.22	0.99999638		0.99997837	0.99997476
Project Averages:	0-34-56.53	0.99999640		0.99997837	0.99997478

↑

Adjusted Observations and Residuals

=====

Adjusted Coordinate Observations (FeetUS)  
(Stations with Partially Fixed Coordinate Components)

Station File:Line	Component	Adj Coordinate	Residual	StdErr	StdRes
4 1:14	N	1156335.2403	-0.0007	0.0108	0.1
	E	1375162.7218	0.0028	0.0095	0.3
100 1:15	N	1156254.7448	0.0008	0.0117	0.1

E 1375583.3534 -0.0026 0.0091 0.3

Adjusted Measured Angle Observations (DMS)

At Distance	From StdErr	StdRes	To File:Line	Angle	Residual
4	100		4115	359-45-15.02	0-00-01.52
0.0012	7.94	0.2	1:25		
4115	4		100	180-23-43.44	0-00-02.44
0.0031	12.70	0.2	1:28		

Adjusted Measured Distance Observations (FeetUS)

StdRes	From File:Line	To	Distance	Residual	StdErr
0.2	4	100	428.2752	0.0029	0.0128
	1:24				
	4	100	428.2752	0.0079	0.0128
0.6	1:23				
	4	4115	162.0081	0.0061	0.0124
0.5	1:25				
	4115	4	162.0081	-0.0044	0.0124
0.4	1:27				
	4115	4	162.0081	-0.0069	0.0124
0.6	1:26				
	4115	100	266.2696	-0.0054	0.0126
0.4	1:28				

↑

Adjusted Bearings (DMS) and Horizontal Distances (FeetUS)

=====

(Relative Confidence of Bearing is in Seconds)

From	To	Grid Bearing	Grid Dist	95% RelConfidence
			Grnd Dist	Brg Dist PPM
4	4115	S79-24-44.00E	162.0040	23.13 0.0157
97.0534			162.0081	
100	4	N79-09-59.02W	428.2645	18.63 0.0163
38.0294			428.2752	
100	4115	N79-01-00.56W	266.2629	20.41 0.0196
73.4579			266.2696	

↑

Error Propagation

=====

Station Coordinate Standard Deviations (FeetUS)

Station	N	E
---------	---	---

4	0.010706	0.007562
100	0.011572	0.007421
4115	0.009201	0.009215

Station Coordinate Error Ellipses (FeetUS)  
Confidence Region = 95%

Station	Semi-Major Axis	Semi-Minor Axis	Azimuth of Major Axis
4	0.026340	0.018320	8-03
100	0.028430	0.017999	6-23
4115	0.022998	0.022068	133-56

Relative Error Ellipses (FeetUS)  
Confidence Region = 95%

Stations From	To	Semi-Major Axis	Semi-Minor Axis	Azimuth of Major Axis
4	4115	0.018165	0.015721	9-06
100	4	0.038683	0.016275	9-49
100	4115	0.026350	0.019552	9-17

Elapsed Time = 00:00:02

```

B31
47
01 00000001 Top of File
01 00000005 Summary of Files Used and Option Settings
02 00000008 Project Folder and Data Files
02 00000014 Project Option Settings
02 00000033 Instrument Standard Error Settings
03 00000035 Project Default Instrument
01 00000044 Listing of Input Data
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02 00000080 Iteration # 1
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01 00000102 Summary of Unadjusted Input Observations
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02 00000175 Convergence Angles and Grid Factors at Stations
01 00000186 Adjusted Observations and Residuals
02 00000189 Adjusted Coordinate Observations
    
```

```
02 00000198 Adjusted Measured Angle Observations
02 00000204 Adjusted Measured Distance Observations
01 00000214 Adjusted Bearings and Horizontal Distances
01 00000227 Error Propagation
02 00000230 Station Coordinate Standard Deviations
02 00000237 Station Coordinate Error Ellipses
02 00000246 Relative Error Ellipses
01 00000254 End of File
00002DD0
STAR*NET
000189B5
```

- **StarNet Static 3D Adjustment Report**

MicroSurvey STAR\*NET-PRO Version 9,2,6,556  
Run Date: Wed Nov 17 2021 10:02:24

Summary of Files Used and Option Settings  
=====

Project Folder and Data Files

Project Name 10713 - MCDOT MON 4115 ADJUSTMENT - 2021-11-15  
Project Folder P:\10713\SURVEY\STARNET\HORIZONTAL  
Data File List 1. Observations\2021-11-15\4.gps  
2. Observations\2021-11-15\100.gps

Project Option Settings

STAR\*NET Run Mode : Adjust with Error Propagation  
Type of Adjustment : 3D  
Project Units : FeetUS; DMS  
Coordinate System : NY83-W  
Geoid Height Model : H:\GEOID18\G2018U0.BIN  
Longitude Sign Convention : Positive West  
Input/Output Coordinate Order : North-East  
Angle Data Station Order : At-From-To  
Distance/Vertical Data Type : Slope/Zenith  
Convergence Limit; Max Iterations : 0.010000; 10  
Default Coefficient of Refraction : 0.070000  
Create Coordinate File : Yes  
Create Geodetic Position File : No  
Create Ground Scale Coordinate File : No  
Create Dump File : No

↑

Listing of Input Data  
=====

[File: P:\10713\SURVEY\StarNet\Horizontal\Observations\2021-11-15\4.gps]  
.Units Meters

.OPUS FACTOR 4.025

## File: p:\10713\survey\fieldwrk\2021-11-12 rk dp  
(mon)\gps\emails\10713\_0004\_315\_a.txt  
## GH 1071 -35.487  
P 4 43-10-13.47978 77-43-58.37866 173.525  
WV1 2.6917000000E-06 1.9893000000E-06 6.6072000000E-05  
WV2 1.0382000000E-06 -2.0800000000E-07 -1.8090000000E-07

## File: p:\10713\survey\fieldwrk\2021-11-12 rk dp  
(mon)\gps\emails\10713\_0004\_315\_b.txt  
## GH 1071 -35.487

```
P 4 43-10-13.47931 77-43-58.37902 173.530
WV1 2.0937000000E-06 1.4852000000E-06 1.2070410000E-04
WV2 -1.6150000000E-07 -8.4084000000E-06 1.7446000000E-06
```

```
## File: p:\10713\survey\fieldwrk\2021-11-12 rk dp
(mon)\gps\emails\10713_0004_315_c.txt
## GH 1071 -35.487
```

```
P 4 43-10-13.47992 77-43-58.37898 173.478
WV1 4.5871000000E-06 2.3075000000E-06 3.1995530000E-04
WV2 -1.7142000000E-06 -2.9526800000E-05 9.8898000000E-06
```

```
[File: P:\10713\Survey\StarNet\Horizontal\Observations\2021-11-15\100.gps]
.Units Meters
```

```
.OPUS FACTOR 3.929
```

```
## File: p:\10713\survey\fieldwrk\2021-11-12 rk dp
(mon)\gps\emails\10713_0100_315_a.txt
## GH 1071 -35.488
```

```
P 100 43-10-12.64253 77-43-52.71366 173.296
WV1 3.7298000000E-06 2.9425000000E-06 8.5857700000E-05
WV2 1.5900000000E-06 9.2100000000E-08 3.7100000000E-08
```

```
## File: p:\10713\survey\fieldwrk\2021-11-12 rk dp
(mon)\gps\emails\10713_0100_315_b.txt
## GH 1071 -35.488
```

```
P 100 43-10-12.64235 77-43-52.71434 173.265
WV1 2.1584000000E-06 1.1575000000E-06 1.2599900000E-04
WV2 1.5460000000E-07 -8.5136000000E-06 2.1046000000E-06
```

```
## File: p:\10713\survey\fieldwrk\2021-11-12 rk dp
(mon)\gps\emails\10713_0100_315_c.txt
## GH 1071 -35.488
```

```
P 100 43-10-12.64220 77-43-52.71384 173.274
WV1 5.5478000000E-06 2.4560000000E-06 2.8321620000E-04
WV2 -2.1363000000E-06 -3.0768700000E-05 1.7518600000E-05
```

↑

Adjustment Solution Iterations

=====

Iteration # 1

Changes from Last Iteration (FeetUS)

Station	dN	dE	dZ
4	-0.0195	-0.0156	-0.0144
100	-0.0201	-0.0288	-0.0737
Previous Sigma:	32.317340		
Current Sigma:	11.997537		
Convergence Test:	20.319803		

Iteration # 2  
Changes from Last Iteration (FeetUS)

Station	dN	dE	dZ
4	-0.0000	0.0000	0.0000
100	0.0000	0.0000	-0.0000
Previous Sigma:	11.997537		
Current Sigma:	11.997537		
Convergence Test:	0.000000		

↑

Summary of Unadjusted Input Observations  
=====

Number of Entered Stations (FeetUS) = 2

StdErr/Correlation	Latitude	Longitude	Elev	Description
	N-StdErr	E-StdErr	StdErr	
	NE-Correl	NZ-Correl	EZ-Correl	
4	43-10-13.479780	77-43-58.378660	569.3066	
	0.0217	0.0186	0.1073	
	0.4487	-0.0156	-0.0158	
4	43-10-13.479310	77-43-58.379020	569.3230	
	0.0191	0.0161	0.1451	
	-0.0916	-0.5289	0.1303	
4	43-10-13.479920	77-43-58.378980	569.1524	
	0.0283	0.0201	0.2362	
	-0.5269	-0.7707	0.3640	
100	43-10-12.642530	77-43-52.713660	568.5553	
	0.0249	0.0221	0.1194	
	0.4800	0.0051	0.0023	
100	43-10-12.642350	77-43-52.714340	568.4536	
	0.0189	0.0139	0.1447	
	0.0978	-0.5163	0.1743	
100	43-10-12.642200	77-43-52.713840	568.4831	
	0.0304	0.0202	0.2169	
	-0.5787	-0.7762	0.6642	

↑

Adjustment Statistical Summary  
=====

Iterations	=	2
Number of Stations	=	2
Number of Observations	=	18
Number of Unknowns	=	6
Number of Redundant Obs	=	12

Observation	Count	Sum Squares	Error
-------------	-------	-------------	-------



		of StdRes	Factor
Coordinates	18	11.998	1.000
Total	18	11.998	1.000

The Chi-Square Test at 5.00% Level Passed  
Lower/Upper Bounds (0.606/1.395)

↑

Adjusted Station Information

=====

Coordinate Changes from Entered Provisionals (FeetUS)

Station	dN	dE	dZ
4	-0.0195	-0.0156	-0.0144
100	-0.0201	-0.0288	-0.0737

Adjusted Coordinates (FeetUS)

Station	N	E	Elev	Description
4	1156335.2409	1375162.7189	569.2922	
100	1156254.7436	1375583.3558	568.4816	

Adjusted Positions and Ellipsoid Heights (FeetUS)

Station	Latitude	Longitude	Ellip Ht	Geoid Ht
4	43-10-13.479589	77-43-58.378873	452.8639	-116.4283
100	43-10-12.642334	77-43-52.714051	452.0506	-116.4310
			Average:	-116.4297

Convergence Angles (DMS) and Grid Factors at Stations  
(Grid Azimuth = Geodetic Azimuth - Convergence)  
(Elevation Factor Includes a Geoid Height Correction at Each Station))

Station	Convergence Angle	Scale	x	Elevation	=	Combined
4	0-34-54.75	0.99999630		0.99997835		0.99997466
100	0-34-58.62	0.99999652		0.99997839		0.99997491
Project Averages:	0-34-56.69	0.99999641		0.99997837		0.99997479

↑

Adjusted Observations and Residuals

=====

Adjusted Coordinate Observations (FeetUS)  
(Stations with Partially Fixed Coordinate Components)

Station File:Line	Component	Adj Coordinate	Residual	StdErr	StdRes	
4	N	1156335.2409	-0.0195	0.0217	0.9	1:7

	E	1375162.7189	-0.0156	0.0186	0.8	
	Elev	569.2922	-0.0144	0.1073	0.1	
4	N	1156335.2409	0.0284	0.0191	1.5	
1:13						
	E	1375162.7189	0.0106	0.0161	0.7	
	Elev	569.2922	-0.0308	0.1451	0.2	
4	N	1156335.2409	-0.0334	0.0283	1.2	
1:19						
	E	1375162.7189	0.0083	0.0201	0.4	
	Elev	569.2922	0.1398	0.2362	0.6	
100	N	1156254.7436	-0.0201	0.0249	0.8	2:7
	E	1375583.3558	-0.0288	0.0221	1.3	
	Elev	568.4816	-0.0737	0.1194	0.6	
100	N	1156254.7436	-0.0014	0.0189	0.1	
2:13						
	E	1375583.3558	0.0214	0.0139	1.5	
	Elev	568.4816	0.0280	0.1447	0.2	
100	N	1156254.7436	0.0134	0.0304	0.4	
2:19						
	E	1375583.3558	-0.0158	0.0202	0.8	
	Elev	568.4816	-0.0015	0.2169	0.0	

↑

Error Propagation

=====

Station Coordinate Standard Deviations (FeetUS)

Station	N	E	Elev
4	0.010801	0.009537	0.077521
100	0.011692	0.009143	0.078261

Station Coordinate Error Ellipses (FeetUS)

Confidence Region = 95%

Station	Semi-Major Axis	Semi-Minor Axis	Azimuth of Major Axis	Elev
4	0.026466	0.023313	174-23	0.151939
100	0.028725	0.022243	7-49	0.153390

Elapsed Time = 00:00:02

]23

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- 01 00000001 Top of File
- 01 00000005 Summary of Files Used and Option Settings
- 02 00000008 Project Folder and Data Files
- 02 00000015 Project Option Settings
- 01 00000033 Listing of Input Data

```
01 00000083 Adjustment Solution Iterations
02 00000086 Iteration # 1
02 00000096 Iteration # 2
01 00000106 Summary of Unadjusted Input Observations
02 00000109 Entered Stations
03 00000111 StdErr/Correlation Positions
01 00000133 Adjustment Statistical Summary
01 00000153 Adjusted Station Information
02 00000156 Coordinate Changes from Entered Provisionals
02 00000162 Adjusted Coordinates
02 00000168 Adjusted Positions and Ellipsoid Heights
02 00000175 Convergence Angles and Grid Factors at Stations
01 00000185 Adjusted Observations and Residuals
02 00000188 Adjusted Coordinate Observations
01 00000211 Error Propagation
02 00000214 Station Coordinate Standard Deviations
02 00000220 Station Coordinate Error Ellipses
01 00000227 End of File
00002AD1
STAR*NET
000127F6
```

- **StarNet Level Run Adjustment Report**

MicroSurvey STAR\*NET-PRO Version 9,2,6,556  
Run Date: Thu Feb 3 2022 09:44:54

Summary of Files Used and Option Settings  
=====

Project Folder and Data Files

Project Name 10713 - ELMGROVE ROAD LEVEL RUN ADJUSTMENT  
Project Folder P:\10713\SURVEY\STARNET\VERTICAL  
Data File List 1. 10713 - Elmgrove Road Level Run Adjustment.dat

Project Option Settings

STAR\*NET Run Mode : Adjust with Error Propagation  
Type of Adjustment : Lev  
Project Units : FeetUS  
Input/Output Coordinate Order : North-East  
Create Coordinate File : Yes

Instrument Standard Error Settings

Project Default Instrument  
Differential Levels : 0.010000 FeetUS / Mile

↑

Listing of Input Data  
=====

[File: P:\10713\SURVEY\StarNet\Vertical\10713 - Elmgrove Road Level Run Adjustment.dat]

# MicroSurvey STAR\*NET 11

#Converted November 15, 2021 -- 10:52:53 AM PST

#SDR to STAR\*NET script by Jacob Wall -- helpdesk@microsurvey.com

#Script Version 0.2 -- December 3, 2015

.UNITS FeetUS

E 4 569.292 ! 'CAPPED REBAR  
E 100 568.482 \*

L 4-4115 -0.53300 168.9 'MCDOT MON  
L 4115-100 -0.17500 272.4 'CAPPED REBAR  
L 100-4115 0.17900 272.5 'MCDOT MON  
L 4115-4 0.53500 168.9 'CAPPED REBAR

↑

Summary of Unadjusted Input Observations  
=====

Number of Entered Stations (FeetUS) = 2

Fixed Stations	Elev	Description
4	569.2920	CAPPED REBAR
Free Stations	Elev	Description
100	568.4820	CAPPED REBAR

Number of Differential Level Observations (FeetUS) = 4

From	To	Elev Diff	StdErr	Length
4	4115	-0.5330	0.0018	169
100	4115	0.1790	0.0023	273
4115	4	0.5350	0.0018	169
4115	100	-0.1750	0.0023	272

↑

Adjustment Statistical Summary  
=====

Number of Stations = 3  
Number of Observations = 4  
Number of Unknowns = 2  
Number of Redundant Obs = 2

Observation	Count	Sum Squares of StdRes	Error Factor
Level Data	4	2.176	1.043
Total	4	2.176	1.043

The Chi-Square Test at 5.00% Level Passed  
Lower/Upper Bounds (0.159/1.921)

↑

Adjusted Station Information  
=====

Coordinate Changes from Entered Provisionals (FeetUS)

Station	dZ
4	-0.0000
100	0.0990

Adjusted Elevations and Error Propagation (FeetUS)

Station	Elev	StdDev	95%	Description
4	569.2920	0.000000	0.000001	CAPPED REBAR
100	568.5810	0.002044	0.004007	CAPPED REBAR
4115	568.7580	0.001265	0.002479	MCDOT MON

↑

Adjusted Observations and Residuals

=====

Adjusted Differential Level Observations (FeetUS)

From File:Line	To	Elev Diff	Residual	StdErr	StdRes
4 1:13	4115	-0.5340	-0.0010	0.0018	0.6
100 1:15	4115	0.1770	-0.0020	0.0023	0.9
4115 1:16	4	0.5340	-0.0010	0.0018	0.6
4115 1:14	100	-0.1770	-0.0020	0.0023	0.9

Elapsed Time = 00:00:02

[]19

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01 00000001 Top of File  
01 00000005 Summary of Files Used and Option Settings  
02 00000008 Project Folder and Data Files  
02 00000014 Project Option Settings  
02 00000022 Instrument Standard Error Settings  
03 00000024 Project Default Instrument  
01 00000027 Listing of Input Data  
01 00000048 Summary of Unadjusted Input Observations  
02 00000051 Entered Stations  
03 00000053 Fixed Elevations  
03 00000056 Free Elevations  
02 00000059 Differential Level Observations  
01 00000067 Adjustment Statistical Summary  
01 00000085 Adjusted Station Information  
02 00000088 Coordinate Changes from Entered Provisionals  
02 00000094 Adjusted Elevations and Error Propagation  
01 00000101 Adjusted Observations and Residuals  
02 00000104 Adjusted Differential Level Observations  
01 00000111 End of File  
000011C7  
STAR\*NET  
0000DFFB

- **OPUS Extended Reports**

From: opus <opus@ngs.noaa.gov>  
Sent: Monday, November 15, 2021 8:10 AM  
To: David Zuber  
Subject: OPUS-RS solution : 10713\_0004\_315\_A.tps OP1636981651712

FILE: 10713\_0004\_315\_A.tps OP1636981651712

NGS OPUS-RS SOLUTION REPORT  
=====

All computed coordinate accuracies are listed as 1-sigma RMS values.  
For additional information: <https://www.ngs.noaa.gov/OPUS/about.jsp#accuracy>

USER: dzuber@gdbgeospatial.com                      DATE: November 15, 2021  
RINEX FILE: 1071316r.21o                              TIME: 13:08:39 UTC

SOFTWARE: rsgps 1.38 RS292.pr1 1.99.3                      START: 2021/11/12 17:10:20  
EPHEMERIS: igr21835.eph [rapid]                              STOP: 2021/11/12 17:51:55  
NAV FILE: brdc3160.21n                                      OBS USED: 3177 / 4095 : 78%  
ANT NAME: TPSHIPER\_V                                      QUALITY IND. 10.90/ 24.25  
ARP HEIGHT: 2                                              NORMALIZED RMS:              0.386

REF FRAME: NAD\_83(2011)(EPOCH:2010.0000)                      ITRF2014 (EPOCH:2021.86501)

X:	989921.834(m)	0.008(m)	989920.871(m)	0.008(m)
Y:	-4552743.428(m)	0.015(m)	-4552742.045(m)	0.015(m)
Z:	4341422.757(m)	0.024(m)	4341422.731(m)	0.024(m)

LAT:	43 10 13.47978	0.008(m)	43 10 13.51366	0.008(m)
E LON:	282 16 1.62134	0.007(m)	282 16 1.59269	0.007(m)
W LON:	77 43 58.37866	0.007(m)	77 43 58.40731	0.007(m)
EL HGT:	138.038(m)	0.028(m)	136.885(m)	0.028(m)
ORTHO HGT:	173.525(m)	0.033(m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 18)	SPC (3103 NY W)
Northing (Y) [meters]	4783364.988	352451.692
Easting (X) [meters]	277858.287	419150.440
Convergence [degrees]	-1.87051944	0.58187500
Point Scale	1.00020708	0.99999630
Combined Factor	1.00018543	0.99997465

US NATIONAL GRID DESIGNATOR: 18TTN7785883364(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DI0628	NYWT WATERTOWN CORS ARP	N440141.658	W0755515.948	174590.1





3.0170E-07 -3.5650E-07 -1.5570E-07 3.6750E-07 -4.5470E-07 -6.3230E-08 4.0900E-07  
-3.0250E-07 -  
7.6480E-08 2.5950E-07 -3.8240E-07 -5.7480E-08 2.7500E-07 -2.4590E-07  
4 -3.7820E-08 8.2940E-08 -1.1010E-07 3.2090E-07 -5.9270E-07 6.8320E-07  
-1.6020E-08 5.8440E-08  
-6.7540E-08 -1.2930E-08 5.0990E-08 -6.1680E-08 -3.5290E-08 8.6480E-08 -1.0220E-07  
-3.0060E-08  
8.5990E-08 -8.9910E-08 -1.5130E-08 6.2740E-08 -6.3450E-08 -3.2940E-08 7.3710E-08  
-1.0380E-07 -  
2.9530E-08 9.1390E-08 -8.4400E-08 1.9540E-08 -3.6230E-08 3.4200E-08  
5 5.1850E-08 -3.9190E-07 3.0060E-07 -5.9270E-07 3.3370E-06 -2.7390E-06  
9.3170E-08 -4.2320E-07  
3.6580E-07 9.9170E-08 -4.3460E-07 3.7360E-07 5.7070E-08 -3.8700E-07 3.1830E-07  
6.7020E-08 -  
3.8650E-07 3.4090E-07 9.5170E-08 -4.1750E-07 3.7700E-07 6.0790E-08 -4.0390E-07  
3.0600E-07  
6.8600E-08 -3.8120E-07 3.5690E-07 2.5960E-08 -1.4530E-07 1.2860E-07  
6 -1.1880E-07 3.5130E-07 -4.0470E-07 6.8320E-07 -2.7390E-06 2.8550E-06  
-5.6590E-08 3.1400E-07  
-3.0480E-07 -4.7600E-08 2.9730E-07 -2.9220E-07 -1.1110E-07 3.6360E-07 -3.8090E-07  
-9.5960E-08  
3.6880E-07 -3.4780E-07 -5.3540E-08 3.2730E-07 -2.9060E-07 -1.0570E-07 3.3350E-07  
-3.9550E-07 -  
9.3660E-08 3.8270E-07 -3.2750E-07 2.0040E-08 -9.0550E-08 1.0480E-07  
7 -6.4240E-08 7.1520E-08 -1.5150E-07 -1.6020E-08 9.3170E-08 -5.6590E-08  
3.3820E-07 -5.7750E-07  
6.7870E-07 2.0490E-08 5.5350E-09 -1.7700E-08 -5.6060E-08 9.0450E-08 -1.2790E-07  
-3.8870E-08  
1.0070E-07 -9.2870E-08 1.2460E-08 4.6810E-08 -2.1490E-08 -4.7890E-08 4.6620E-08  
-1.3660E-07 -  
3.7170E-08 1.2240E-07 -7.3760E-08 4.3960E-08 -1.6290E-07 1.4720E-07  
8 1.1330E-07 -3.6150E-07 4.0560E-07 5.8440E-08 -4.2320E-07 3.1400E-07  
-5.7750E-07 3.1840E-06  
-2.7120E-06 1.4300E-08 -3.1100E-07 2.6100E-07 1.0470E-07 -3.9570E-07 3.8540E-07  
8.5210E-08 -  
4.2140E-07 3.5180E-07 2.4220E-08 -3.6910E-07 2.7130E-07 9.3790E-08 -3.3130E-07  
3.8680E-07  
8.4130E-08 -4.5910E-07 3.3620E-07 -3.7560E-08 1.7290E-07 -1.4970E-07  
9 -1.3370E-07 3.3840E-07 -4.3820E-07 -6.7540E-08 3.6580E-07 -3.0480E-07  
6.7870E-07 -2.7120E-06  
2.8780E-06 -2.0100E-08 2.5310E-07 -2.5880E-07 -1.2200E-07 3.6270E-07 -4.0380E-07  
-9.8350E-08  
3.7550E-07 -3.5420E-07 -3.0020E-08 3.0630E-07 -2.6040E-07 -1.1220E-07 3.0680E-07  
-4.2040E-07 -  
9.5410E-08 4.0320E-07 -3.2570E-07 4.1760E-08 -1.9160E-07 1.8680E-07  
10 -7.5770E-08 6.6740E-08 -1.6910E-07 -1.2930E-08 9.9170E-08 -4.7600E-08  
2.0490E-08 1.4300E-  
08 -2.0100E-08 3.5760E-07 -5.9150E-07 6.9230E-07 -6.5120E-08 9.2300E-08  
-1.3870E-07 -4.2750E-08  
1.0720E-07 -9.3830E-08 2.4370E-08 4.0280E-08 -3.1490E-09 -5.4450E-08 3.5170E-08

-1.5060E-07 -  
4.0540E-08 1.3600E-07 -6.8760E-08 5.4440E-08 -2.1720E-07 1.9610E-07  
11 1.3250E-07 -3.5380E-07 4.3810E-07 5.0990E-08 -4.3460E-07 2.9730E-07  
5.5350E-09 -3.1100E-07  
2.5310E-07 -5.9150E-07 3.1980E-06 -2.7240E-06 1.1950E-07 -4.0040E-07 4.0560E-07  
9.0510E-08 -  
4.3450E-07 3.5390E-07 7.3900E-10 -3.5610E-07 2.3640E-07 1.0390E-07 -3.1030E-07  
4.1180E-07  
8.8550E-08 -4.8570E-07 3.2790E-07 -5.8470E-08 2.7280E-07 -2.4010E-07  
12 -1.4820E-07 3.3160E-07 -4.6300E-07 -6.1680E-08 3.7360E-07 -2.9220E-07  
-1.7700E-08 2.6100E-  
07 -2.5880E-07 6.9230E-07 -2.7240E-06 2.8940E-06 -1.3310E-07 3.6530E-07  
-4.1930E-07 -1.0220E-07  
3.8450E-07 -3.5590E-07 -1.1940E-08 2.9550E-07 -2.3390E-07 -1.1970E-07 2.8990E-07  
-4.3960E-07 -  
9.8610E-08 4.2250E-07 -3.1950E-07 5.7880E-08 -2.6880E-07 2.5570E-07  
13 2.4010E-09 9.8250E-08 -4.9000E-08 -3.5290E-08 5.7070E-08 -1.1110E-07  
-5.6060E-08 1.0470E-  
07 -1.2200E-07 -6.5120E-08 1.1950E-07 -1.3310E-07 3.6980E-07 -6.8020E-07  
7.9530E-07 -1.7180E-08  
6.0980E-08 -8.8450E-08 -5.8440E-08 8.5550E-08 -1.3190E-07 -1.0450E-08 1.1350E-07  
-5.6050E-08 -  
1.8490E-08 4.1010E-08 -1.0400E-07 -1.8660E-08 1.5580E-07 -1.4210E-07  
14 7.5630E-08 -3.7040E-07 3.3220E-07 8.6480E-08 -3.8700E-07 3.6360E-07  
9.0450E-08 -3.9570E-07  
3.6270E-07 9.2300E-08 -4.0040E-07 3.6530E-07 -6.8020E-07 3.1980E-06 -2.8430E-06  
8.1870E-08 -  
3.7880E-07 3.5340E-07 9.1390E-08 -3.9760E-07 3.6910E-07 7.8820E-08 -3.7580E-07  
3.3440E-07  
8.2810E-08 -3.8110E-07 3.6200E-07 2.3970E-08 -7.0280E-08 8.5580E-08  
15 -5.8800E-08 3.6870E-07 -3.1160E-07 -1.0220E-07 3.1830E-07 -3.8090E-07  
-1.2790E-07 3.8540E-  
07 -4.0380E-07 -1.3870E-07 4.0560E-07 -4.1930E-07 7.9530E-07 -2.8430E-06  
3.0830E-06 -8.0780E-08  
3.2050E-07 -3.5270E-07 -1.3020E-07 3.6020E-07 -4.1230E-07 -7.4820E-08 3.9230E-07  
-3.2530E-07 -  
8.1470E-08 2.9210E-07 -3.6650E-07 -4.8310E-08 2.1850E-07 -1.9270E-07  
16 -1.4680E-08 9.1980E-08 -7.4700E-08 -3.0060E-08 6.7020E-08 -9.5960E-08  
-3.8870E-08 8.5210E-  
08 -9.8350E-08 -4.2750E-08 9.0510E-08 -1.0220E-07 -1.7180E-08 8.1870E-08  
-8.0780E-08 3.3760E-07 -  
6.5200E-07 7.2520E-07 -3.9850E-08 7.6070E-08 -1.0220E-07 -1.9960E-08 9.6780E-08  
-7.6050E-08 -  
2.3090E-08 6.2750E-08 -9.5170E-08 -2.2800E-09 7.4260E-08 -6.6580E-08  
17 5.5320E-08 -3.8520E-07 3.0170E-07 8.5990E-08 -3.8650E-07 3.6880E-07  
1.0070E-07 -4.2140E-07  
3.7550E-07 1.0720E-07 -4.3450E-07 3.8450E-07 6.0980E-08 -3.7880E-07 3.2050E-07  
-6.5200E-07  
3.3020E-06 -2.8090E-06 1.0290E-07 -4.1420E-07 3.8710E-07 6.5260E-08 -3.9970E-07  
3.0890E-07

7.3530E-08 -3.7040E-07 3.6170E-07 3.3600E-08 -1.5130E-07 1.4470E-07  
18 -8.8890E-08 3.6100E-07 -3.5650E-07 -8.9910E-08 3.4090E-07 -3.4780E-07  
-9.2870E-08 3.5180E-  
07 -3.5420E-07 -9.3830E-08 3.5390E-07 -3.5590E-07 -8.8450E-08 3.5340E-07  
-3.5270E-07 7.2520E-07 -  
2.8090E-06 2.9340E-06 -9.2540E-08 3.4550E-07 -3.5130E-07 -9.0530E-08 3.6450E-07  
-3.5930E-07 -  
8.7810E-08 3.3750E-07 -3.4560E-07 -1.4870E-08 6.7320E-08 -4.4970E-08  
19 -6.7290E-08 7.0680E-08 -1.5570E-07 -1.5130E-08 9.5170E-08 -5.3540E-08  
1.2460E-08 2.4220E-  
08 -3.0020E-08 2.4370E-08 7.3900E-10 -1.1940E-08 -5.8440E-08 9.1390E-08  
-1.3020E-07 -3.9850E-08  
1.0290E-07 -9.2540E-08 3.4250E-07 -5.5580E-07 6.8590E-07 -4.9610E-08 4.3960E-08  
-1.3980E-07 -  
3.8000E-08 1.2650E-07 -7.1820E-08 4.6770E-08 -1.7660E-07 1.6050E-07  
20 8.9440E-08 -3.7670E-07 3.6750E-07 6.2740E-08 -4.1750E-07 3.2730E-07  
4.6810E-08 -3.6910E-07  
3.0630E-07 4.0280E-08 -3.5610E-07 2.9550E-07 8.5550E-08 -3.9760E-07 3.6020E-07  
7.6070E-08 -  
4.1420E-07 3.4550E-07 -5.5580E-07 3.2410E-06 -2.6990E-06 7.9580E-08 -3.6030E-07  
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21 -1.4630E-07 3.3750E-07 -4.5470E-07 -6.3450E-08 3.7700E-07 -2.9060E-07  
-2.1490E-08 2.7130E-  
07 -2.6040E-07 -3.1490E-09 2.3640E-07 -2.3390E-07 -1.3190E-07 3.6910E-07  
-4.1230E-07 -1.0220E-07  
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-4.3310E-07 -  
9.8630E-08 4.2240E-07 -3.1570E-07 5.4060E-08 -2.4770E-07 2.4500E-07  
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08 -1.1220E-07 -5.4450E-08 1.0390E-07 -1.1970E-07 -1.0450E-08 7.8820E-08  
-7.4820E-08 -1.9960E-08  
6.5260E-08 -9.0530E-08 -4.9610E-08 7.9580E-08 -1.1930E-07 3.5330E-07 -6.2680E-07  
7.8720E-07 -  
2.0920E-08 5.0700E-08 -1.0190E-07 -1.0730E-08 1.1410E-07 -1.0640E-07  
23 1.2080E-07 -3.4540E-07 4.0900E-07 7.3710E-08 -4.0390E-07 3.3350E-07  
4.6620E-08 -3.3130E-07  
3.0680E-07 3.5170E-08 -3.1030E-07 2.8990E-07 1.1350E-07 -3.7580E-07 3.9230E-07  
9.6780E-08 -  
3.9970E-07 3.6450E-07 4.3960E-08 -3.6030E-07 2.9850E-07 -6.2680E-07 3.0700E-06  
-2.7460E-06  
9.5850E-08 -4.3230E-07 3.5100E-07 -1.8470E-08 1.5590E-07 -1.0580E-07  
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-1.3660E-07 3.8680E-  
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-3.2530E-07 -7.6050E-08  
3.0890E-07 -3.5930E-07 -1.3980E-07 3.5640E-07 -4.3310E-07 7.8720E-07 -2.7460E-06  
3.1660E-06 -  
7.7370E-08 2.7580E-07 -3.7960E-07 -5.5960E-08 2.5580E-07 -2.3900E-07

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-7.7370E-08  
3.3540E-07 -6.6120E-07 7.0920E-07 -7.5660E-10 6.7530E-08 -5.8990E-08  
26 3.0280E-08 -4.0210E-07 2.5950E-07 9.1390E-08 -3.8120E-07 3.8270E-07  
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4.0320E-07 1.3600E-07 -4.8570E-07 4.2250E-07 4.1010E-08 -3.8110E-07 2.9210E-07  
6.2750E-08 -  
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2.7580E-07 -  
6.6120E-07 3.4610E-06 -2.7950E-06 5.4720E-08 -2.7410E-07 2.4380E-07  
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-3.7960E-07  
7.0920E-07 -2.7950E-06 2.8730E-06 2.9820E-09 -1.8020E-08 4.1600E-08  
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08 4.1760E-08 5.4440E-08 -5.8470E-08 5.7880E-08 -1.8660E-08 2.3970E-08  
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-5.5960E-08 -  
7.5660E-10 5.4720E-08 2.9820E-09 3.2130E-06 -6.4680E-06 7.3350E-06  
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-1.6290E-07 1.7290E-  
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2.1850E-07 7.4260E-08 -  
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2.5580E-07  
6.7530E-08 -2.7410E-07 -1.8020E-08 -6.4680E-06 3.5600E-05 -3.0740E-05  
30 -1.6410E-07 -4.8240E-08 -2.4590E-07 3.4200E-08 1.2860E-07 1.0480E-07  
1.4720E-07 -1.4970E-  
07 1.8680E-07 1.9610E-07 -2.4010E-07 2.5570E-07 -1.4210E-07 8.5580E-08  
-1.9270E-07 -6.6580E-08  
1.4470E-07 -4.4970E-08 1.6050E-07 -5.8850E-08 2.4500E-07 -1.0640E-07 -1.0580E-07  
-2.3900E-07 -  
5.8990E-08 2.4380E-07 4.1600E-08 7.3350E-06 -3.0740E-05 3.1940E-05

Covariance Matrix for the xyz OPUS Rover Position (meters^2).  
0.0000032130 -0.0000064680 0.0000073350  
-0.0000064680 0.0000356000 -0.0000307400  
0.0000073350 -0.0000307400 0.0000319400

Covariance Matrix for the enu OPUS Position (meters^2).  
0.0000019893 0.0000010382 -0.0000001809

```

0.0000010382    0.0000026917    -0.0000002080
-0.0000001809   -0.0000002080     0.0000660720

```

```

Horizontal network accuracy = 0.00387 meters.
Vertical network accuracy   = 0.01594 meters.

```

		Vectors		
To	From	X	Y	Z
nywt	1071	127454.330	97339.778	69007.545
nydv	1071	12790.381	-45316.999	-50575.969
nylp	1071	-81187.419	-17319.610	-399.886
pwel	1071	-119415.906	-19130.995	5306.464
nymx	1071	113469.562	49712.551	24191.915
nywl	1071	74554.877	-4285.635	-22085.365
nyhb	1071	-82024.149	-52070.987	-36789.182
kngs	1071	77589.645	100329.053	84150.487
nywg	1071	82037.966	-44974.060	-66729.826

Covariance matrix of the 9 vectors

```

1  3.6465E-06 -7.3134E-06  8.4067E-06  3.1769E-06 -6.6236E-06  7.3603E-06
3.1260E-06 -6.4986E-06
7.3236E-06  3.1040E-06 -6.4585E-06  7.2930E-06  3.2553E-06 -6.5978E-06  7.4886E-06
3.2218E-06 -
6.6278E-06  7.4251E-06  3.1202E-06 -6.5411E-06  7.2987E-06  3.2390E-06 -6.5102E-06
7.5081E-06
3.2186E-06 -6.6739E-06  7.3873E-06
2  -7.3134E-06  3.8520E-05 -3.3781E-05 -6.3439E-06  3.5264E-05 -3.0250E-05
-6.2287E-06  3.4977E-05
-3.0162E-05 -6.1792E-06  3.4884E-05 -3.0091E-05 -6.5207E-06  3.5211E-05 -3.0542E-05
-6.4454E-06
3.5277E-05 -3.0398E-05 -6.2158E-06  3.5073E-05 -3.0107E-05 -6.4831E-06  3.5010E-05
-3.0581E-05 -
6.4387E-06  3.5383E-05 -3.0315E-05
3  8.4067E-06 -3.3781E-05  3.5657E-05  7.2482E-06 -3.0843E-05  3.1676E-05
7.0938E-06 -3.0460E-05
3.1561E-05  7.0273E-06 -3.0337E-05  3.1467E-05  7.4856E-06 -3.0768E-05  3.2067E-05
7.3844E-06 -
3.0858E-05  3.1874E-05  7.0763E-06 -3.0589E-05  3.1486E-05  7.4356E-06 -3.0500E-05
3.2122E-05
7.3750E-06 -3.0999E-05  3.1762E-05
4  3.1769E-06 -6.3439E-06  7.2482E-06  3.4948E-06 -7.0504E-06  7.9640E-06
3.1335E-06 -6.3358E-06
7.1915E-06  3.1261E-06 -6.3223E-06  7.1812E-06  3.1768E-06 -6.3693E-06  7.2469E-06
3.1657E-06 -
6.3794E-06  7.2258E-06  3.1316E-06 -6.3501E-06  7.1833E-06  3.1712E-06 -6.3396E-06
7.2530E-06
3.1647E-06 -6.3951E-06  7.2134E-06
5  -6.6236E-06  3.5264E-05 -3.0843E-05 -7.0504E-06  3.9228E-05 -3.3517E-05
-6.2379E-06  3.5149E-05

```

-3.0311E-05 -6.1776E-06 3.5038E-05 -3.0226E-05 -6.5927E-06 3.5429E-05 -3.0769E-05  
-6.5012E-06  
3.5510E-05 -3.0595E-05 -6.2222E-06 3.5266E-05 -3.0244E-05 -6.5473E-06 3.5185E-05  
-3.0818E-05 -  
6.4929E-06 3.5638E-05 -3.0494E-05  
6 7.3603E-06 -3.0250E-05 3.1676E-05 7.9640E-06 -3.3517E-05 3.4585E-05  
7.1112E-06 -3.0186E-05  
3.1344E-05 7.0713E-06 -3.0112E-05 3.1287E-05 7.3460E-06 -3.0371E-05 3.1647E-05  
7.2856E-06 -  
3.0425E-05 3.1532E-05 7.1009E-06 -3.0263E-05 3.1300E-05 7.3157E-06 -3.0210E-05  
3.1679E-05  
7.2803E-06 -3.0511E-05 3.1466E-05  
7 3.1260E-06 -6.2287E-06 7.0938E-06 3.1335E-06 -6.2379E-06 7.1112E-06  
3.4633E-06 -6.8450E-06  
7.8247E-06 3.1351E-06 -6.2411E-06 7.1122E-06 3.1316E-06 -6.2386E-06 7.1082E-06  
3.1324E-06 -  
6.2380E-06 7.1098E-06 3.1347E-06 -6.2393E-06 7.1123E-06 3.1319E-06 -6.2400E-06  
7.1072E-06  
3.1326E-06 -6.2374E-06 7.1111E-06  
8 -6.4986E-06 3.4977E-05 -3.0460E-05 -6.3358E-06 3.5149E-05 -3.0186E-05  
-6.8450E-06 3.8438E-05  
-3.3111E-05 -6.1989E-06 3.4843E-05 -3.0061E-05 -6.4815E-06 3.5102E-05 -3.0423E-05  
-6.4195E-06  
3.5157E-05 -3.0306E-05 -6.2296E-06 3.4996E-05 -3.0071E-05 -6.4508E-06 3.4940E-05  
-3.0459E-05 -  
6.4138E-06 3.5242E-05 -3.0236E-05  
9 7.3236E-06 -3.0162E-05 3.1561E-05 7.1915E-06 -3.0311E-05 3.1344E-05  
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3.4444E-05 7.0770E-06 -3.0055E-05 3.1239E-05 7.3133E-06 -3.0271E-05 3.1542E-05  
7.2615E-06 -  
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7.0443E-06  
3.1188E-06 -6.1695E-06 7.0672E-06  
11 -6.4585E-06 3.4884E-05 -3.0337E-05 -6.3223E-06 3.5038E-05 -3.0112E-05  
-6.2411E-06 3.4843E-  
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7.1111E-06 -3.0236E-05  
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7.3034E-06 -  
3.0505E-05 3.1598E-05 7.0997E-06 -3.0322E-05 3.1338E-05 7.3365E-06 -3.0265E-05  
3.1758E-05  
8.1002E-06 -3.3761E-05 3.4730E-05

Correlation matrix of the 9 vectors

1 1.0000E+00 -6.1708E-01 7.3725E-01 8.8992E-01 -5.5381E-01 6.5541E-01  
8.7966E-01 -5.4891E-01  
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6.5912E-01  
8.9459E-01 -5.5533E-01 6.5645E-01  
2 -6.1708E-01 1.0000E+00 -9.1149E-01 -5.4677E-01 9.0719E-01 -8.2877E-01  
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-8.2600E-01 -  
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7 8.7966E-01 -5.3927E-01 6.3836E-01 9.0068E-01 -5.3518E-01 6.4976E-01  
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G-FILE for the vectors

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C00100004 -1194159058 18 -191309947  61  53064637  58
C00100005 1134695616 19  497125505  62  241919145  59
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D 6 17 -8262674 6 18 9067760 6 19 6489439 6 20 -8270176 6 21 9085797 D 6  
22 6567429 6 23 -  
8294254 6 24 9030120 6 25 6570424 6 26 -8243385 D 6 27 9079153 7 8  
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10 9054411 7 11 -5422351 D 7 12 6523359 7 13 8844362 7 14 -5372232 7 15  
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8927107 D 7 17 -5353441 7 18 6461054 7 19 9053058 7 20 -5388159 7 21  
6524299 D 7 22  
8884840 7 23 -5413926 7 24 6402136 7 25 8934205 7 26 -5325533 D 7 27  
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5491480 8 17 9056528 D 8 18 -8266741 8 19 -5400313 8 20 9071654 8 21  
-8280209 8 22 -5493093  
D 8 23 9099363 8 24 -8235899 8 25 -5490700 8 26 9031964 8 27 -8275472 D 9  
10 6481064 9 11 -  
8280011 9 12 9085389 9 13 6549301 9 14 -8265735 D 9 15 9031879 9 16  
6561991 9 17 -8250247  
9 18 9060827 9 19 6504356 D 9 20 -8265165 9 21 9089307 9 22 6555472 9 23  
-8290759 9 24  
9018050 D 9 25 6562633 9 26 -8227332 9 27 9074529 10 11 -5895214 10 12  
7131329 D 10 13  
8791158 10 14 -5325079 10 15 6366462 10 16 8888185 10 17 -5302457 D 10 18  
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8896709 10 26 -5268747 10 27 6445367 D 11 12 -9095010 11 13 -5477571 11 14  
9068021 11 15 -  
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7349296 13 16  
8966595 13 17 -5537048 D 13 18 6580616 13 19 8831388 13 20 -5506619 13 21  
6541910 13 22  
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6572972 D 14 15 -  
9126222 14 16 -5511218 14 17 9071295 14 18 -8276787 14 19 -5360647 D 14 20  
9068470 14 21 -

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8264448 14 22 -5522409 14 23 9092119 14 24 -8260096 D 14 25 -5508765 14 26
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9118782 17 19 -5340813 17 20 9054183 17 21 -8247571 D 17 22 -5523193 17 23
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8254678 17 25 -5506072 17 26 9048027 D 17 27 -8267060 18 19 6450497 18 20
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6388490 D 19 25
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-8293443 21 24
9015010 21 25 6561125 21 26 -8222645 D 21 27 9077925 22 23 -6129344 22 24
7332133 22 25
8976627 22 26 -5524842 D 22 27 6572447 23 24 -9104327 23 25 -5502738 23 26
9052615 23 27 -
8292070 D 24 25 6559688 24 26 -8247623 24 27 9033829 25 26 -6115302 25 27
7295182 D 26 27 -
9102554

```

ITRF position of 1071 as determined by individual baselines

	X	Y	Z
nywt	989920.876	-4552742.064	4341422.762
nydv	989920.871	-4552742.050	4341422.731
nylp	989920.858	-4552742.047	4341422.726
pwe1	989920.869	-4552742.016	4341422.692
nymx	989920.868	-4552742.049	4341422.722
nywl	989920.880	-4552742.049	4341422.731
nyhb	989920.879	-4552742.054	4341422.753
kngs	989920.875	-4552742.062	4341422.765
nywg	989920.859	-4552742.032	4341422.707

Residuals of position determined by individual baselines from the final position

	X	Y	Z	East	North
Up					
nywt	0.006	-0.019	0.031	0.001	0.009
0.035					
nydv	0.000	-0.005	0.000	-0.001	-0.003
0.004					
nylp	-0.012	-0.002	-0.005	-0.012	-0.003

-0.004					
pwe1	-0.001	0.029	-0.039	0.005	-0.009
-0.047					
nymx	-0.003	-0.004	-0.009	-0.003	-0.008
-0.004					
nyw1	0.009	-0.005	-0.000	0.008	-0.005
0.005					
nyhb	0.008	-0.009	0.022	0.006	0.009
0.023					
kngs	0.005	-0.018	0.034	0.001	0.012
0.037					
nywg	-0.011	0.013	-0.024	-0.008	-0.007
-0.027					

STATE PLANE COORDINATES - U.S. Survey Foot  
SPC (3103 NY W)  
Northing (Y) [feet] 1156335.260  
Easting (X) [feet] 1375162.735  
Convergence [degrees] 0.58187500  
Point Scale 0.99999630  
Combined Factor 0.99997465

\*\*\*\*\* New Reference Frame Preview \*\*\*\*\*

We are replacing the nation's NAD 83 and NAVD 88 datums, to improve access and accuracy of the National Spatial Reference System. More at <https://geodesy.noaa.gov/datums/newdatums/>

Below are approximate coordinates for this solution in the new frames:

APPROX ORTHO HGT: 173.057 (m) [PROTOTYPE (Computed using xGeoid19B,GRS80,ITRF2014)]

dop from interpolation is 0.345  
scatter (mean square distance from rover) is 13994.189  
average edop for rover is 1.010  
average ndop for rover is 1.110  
average hdop for rover is 1.501  
average vdop for rover is 2.150  
average gdop for rover is 3.090

This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.



From: opus <opus@ngs.noaa.gov>  
Sent: Monday, November 15, 2021 8:10 AM  
To: David Zuber  
Subject: OPUS-RS solution : 10713\_0004\_315\_B.tps OP1636981686549

FILE: 10713\_0004\_315\_B.tps OP1636981686549

NGS OPUS-RS SOLUTION REPORT

=====

All computed coordinate accuracies are listed as 1-sigma RMS values.  
For additional information: <https://www.ngs.noaa.gov/OPUS/about.jsp#accuracy>

USER: dzuber@gdbgeospatial.com                      DATE: November 15, 2021  
RINEX FILE: 1071316r.21o                              TIME: 13:09:39 UTC

SOFTWARE: rsgps 1.38 RS294.pr1 1.99.3              START: 2021/11/12 17:53:40  
EPHEMERIS: igr21835.eph [rapid]                    STOP: 2021/11/12 18:31:45  
NAV FILE: brdc3160.21n                              OBS USED: 3375 / 3888 : 87%  
ANT NAME: TSHIPPER\_V                              NONE                      QUALITY IND.    3.26/ 19.08  
ARP HEIGHT: 2                                        NORMALIZED RMS:           0.417

REF FRAME: NAD\_83(2011)(EPOCH:2010.0000)                      ITRF2014 (EPOCH:2021.86509)

X:	989921.829(m)	0.011(m)	989920.866(m)	0.011(m)
Y:	-4552743.443(m)	0.029(m)	-4552742.060(m)	0.029(m)
Z:	4341422.750(m)	0.026(m)	4341422.724(m)	0.026(m)
LAT:	43 10 13.47931	0.008(m)	43 10 13.51319	0.008(m)
E LON:	282 16 1.62098	0.008(m)	282 16 1.59233	0.008(m)
W LON:	77 43 58.37902	0.008(m)	77 43 58.40767	0.008(m)
EL HGT:	138.043(m)	0.039(m)	136.890(m)	0.039(m)
ORTHO HGT:	173.530(m)	0.043(m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 18)	SPC (3103 NY W)
Northing (Y) [meters]	4783364.973	352451.678
Easting (X) [meters]	277858.278	419150.432
Convergence [degrees]	-1.87051944	0.58187500
Point Scale	1.00020708	0.99999630
Combined Factor	1.00018543	0.99997465

US NATIONAL GRID DESIGNATOR: 18TTN7785883364(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DI0628	NYWT WATERTOWN CORS ARP	N440141.658	W0755515.948	174590.1

DI1870	NYDV	DANSVILLE	CORS	ARP	N423256.093	W0774152.595	69102.5
DI0596	NYLP	LOCKPORT	CORS	ARP	N430954.854	W0784513.357	83015.2
DF5379	PWEL	PORT WELLER	CORS	ARP	N431412.202	W0791310.777	121055.0
DI0604	NYMX	MEXICO NY	CORS	ARP	N432812.379	W0761354.886	126221.7
DI0626	NYWL	WATERLOO	CORS	ARP	N425355.227	W0765107.302	77875.3
DI0458	NYHB	HAMBURG	CORS	ARP	N424302.663	W0785047.273	103888.3
DF5367	KNGS	KINGSTON	CORS	ARP	N441307.253	W0763102.143	152208.4
DK7408	NYWG	WATKINS GLEN	CORS	ARP	N422103.796	W0765233.300	114916.3

NEAREST NGS PUBLISHED CONTROL POINT							
OF2376	665	1A	MCGS	1971	N430952.413	W0774357.160	650.7

OPUS-RS Extended Output, Level 2

FINAL COORDINATES (ITRF at epoch of observations)

nywt	1117375.199	-4455402.267	4410430.282
nydv	1002711.247	-4598059.026	4290846.747
nylp	908733.456	-4570061.672	4341022.853
pwel	870504.961	-4571872.980	4346729.139
nymx	1103390.425	-4503029.486	4365614.630
nywl	1064475.747	-4557027.673	4319337.364
nyhb	907896.729	-4604813.064	4304633.591
kngs	1067510.520	-4452413.001	4425573.237
nywg	1071958.840	-4597716.137	4274692.918
1071	989920.866	-4552742.060	4341422.724

Covariance matrix of the stations:

1	8.5130E-07	-2.1360E-06	2.0460E-06	-1.1880E-07	3.2300E-07	-3.6110E-07	-1.5890E-07	2.6770E-07
	-2.9410E-07	-1.8560E-07	2.7700E-07	-3.1180E-07	1.2780E-08	1.9470E-07	-9.9180E-08	-5.1310E-08
	2.6170E-07	-2.4310E-07	-1.8140E-07	3.3110E-07	-3.9260E-07	2.2420E-08	1.4010E-07	2.0960E-08
	7.9020E-08	3.4140E-07	-3.6520E-07	-1.3500E-07	5.3790E-07	-4.8300E-07		
2	-2.1360E-06	7.4310E-06	-6.5890E-06	2.8430E-07	-9.4650E-07	8.9350E-07	3.2240E-07	-9.6470E-07
	8.9120E-07	3.4360E-07	-9.9160E-07	9.1960E-07	1.8400E-07	-8.1430E-07	6.7060E-07	2.3190E-07
	8.7560E-07	7.8650E-07	3.3620E-07	-1.0030E-06	9.5570E-07	1.8400E-07	-8.0260E-07	6.0650E-07
	2.4850E-07	-9.2110E-07	8.6570E-07	1.5400E-07	-4.3840E-07	4.4440E-07		
3	2.0460E-06	-6.5890E-06	6.3040E-06	-3.0110E-07	9.1160E-07	-9.5360E-07	-3.8200E-07	8.6830E-07
	-8.7930E-07	-4.3190E-07	9.0320E-07	-9.2590E-07	-6.0090E-08	6.5450E-07	-4.5900E-07	-1.7640E-07

7.8140E-07 -7.2420E-07 -4.1990E-07 9.7080E-07 -1.0460E-06 -5.0550E-08 5.8970E-07  
-2.7200E-07 -  
2.2310E-07 9.1020E-07 -9.3260E-07 -2.9070E-07 9.9400E-07 -8.9560E-07  
4 -1.1880E-07 2.8430E-07 -3.0110E-07 5.2320E-07 -1.5520E-06 1.2920E-06  
-6.6600E-09 1.5430E-07  
-9.8150E-08 5.6510E-09 1.4330E-07 -8.4580E-08 -9.3710E-08 2.4340E-07 -2.3170E-07  
-5.8300E-08  
1.8670E-07 -1.4600E-07 5.3060E-09 1.1730E-07 -4.8980E-08 -1.0300E-07 2.8320E-07  
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4.2750E-08 1.3970E-07 -8.3680E-08 6.3550E-08 -1.8720E-07 1.6890E-07  
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8.0400E-07

1.9430E-07 -7.4070E-07 5.9590E-07 -1.0120E-09 4.9120E-08 -3.3270E-08  
18 -2.4310E-07 7.8650E-07 -7.2420E-07 -1.4600E-07 6.1460E-07 -4.9150E-07  
-1.4090E-07 6.8410E-  
07 -5.5430E-07 -1.3180E-07 6.8860E-07 -5.5350E-07 -2.1360E-07 7.2540E-07  
-6.4150E-07 1.3930E-06 -  
5.5300E-06 4.7890E-06 -1.2570E-07 6.3030E-07 -4.9390E-07 -2.3450E-07 8.1010E-07  
-7.4230E-07 -  
1.5710E-07 5.9050E-07 -4.7680E-07 1.3030E-08 -7.5260E-08 7.9710E-08  
19 -1.8140E-07 3.3620E-07 -4.1990E-07 5.3060E-09 8.4960E-08 7.7450E-09  
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-4.3810E-08 6.8990E-08 1.0730E-07 -1.9120E-08 -1.3380E-07 2.6900E-07 -2.8930E-07  
-6.4300E-08  
1.7140E-07 -1.2570E-07 5.5600E-07 -1.5160E-06 1.3080E-06 -1.4890E-07 3.3950E-07  
-4.1740E-07 -  
3.4050E-08 8.1610E-08 -3.4630E-10 1.3230E-07 -4.3980E-07 3.9150E-07  
20 3.3110E-07 -1.0030E-06 9.7080E-07 1.1730E-07 -7.2400E-07 4.9010E-07  
8.5590E-08 -8.2880E-07  
5.9410E-07 5.8920E-08 -8.2830E-07 5.8170E-07 2.7400E-07 -9.1860E-07 8.1590E-07  
1.9410E-07 -  
8.0760E-07 6.3030E-07 -1.5160E-06 6.9450E-06 -5.5490E-06 3.0070E-07 -1.0340E-06  
9.9090E-07  
1.5560E-07 -6.8950E-07 4.7570E-07 -1.2610E-07 3.8590E-07 -3.5970E-07  
21 -3.9260E-07 9.5570E-07 -1.0460E-06 -4.8980E-08 4.8560E-07 -2.5820E-07  
8.9400E-09 6.1500E-  
07 -3.9620E-07 5.3640E-08 5.9910E-07 -3.6520E-07 -3.0190E-07 8.1900E-07  
-7.9640E-07 -1.7380E-07  
6.3460E-07 -4.9390E-07 1.3080E-06 -5.5490E-06 4.7830E-06 -3.3980E-07 9.8750E-07  
-1.0640E-06 -  
1.1450E-07 4.5260E-07 -2.5130E-07 2.1150E-07 -7.2100E-07 6.6930E-07  
22 2.2420E-08 1.8400E-07 -5.0550E-08 -1.0300E-07 2.9820E-07 -3.1920E-07  
-1.3240E-07 2.5470E-  
07 -2.6720E-07 -1.5210E-07 2.6000E-07 -2.7910E-07 -7.2460E-09 2.1060E-07  
-1.3100E-07 -5.3680E-08  
2.5630E-07 -2.3450E-07 -1.4890E-07 3.0070E-07 -3.3980E-07 7.6010E-07 -2.0780E-06  
1.9460E-06 -  
7.3790E-08 3.1390E-07 -3.2410E-07 -1.0660E-07 4.3530E-07 -3.9090E-07  
23 1.4010E-07 -8.0260E-07 5.8970E-07 2.8320E-07 -9.7920E-07 9.2510E-07  
3.2370E-07 -9.8970E-07  
9.1460E-07 3.4690E-07 -1.0170E-06 9.4360E-07 1.7300E-07 -8.3780E-07 6.8330E-07  
2.2580E-07 -  
9.0450E-07 8.1010E-07 3.3950E-07 -1.0340E-06 9.8750E-07 -2.0780E-06 7.6330E-06  
-6.7540E-06  
2.4490E-07 -9.5750E-07 8.9970E-07 1.8050E-07 -5.8700E-07 5.6780E-07  
24 2.0960E-08 6.0650E-07 -2.7200E-07 -2.9730E-07 9.3430E-07 -9.7330E-07  
-3.7870E-07 8.8600E-  
07 -8.9400E-07 -4.2930E-07 9.2030E-07 -9.4030E-07 -5.3290E-08 6.7600E-07  
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8.0400E-07 -7.4230E-07 -4.1740E-07 9.9090E-07 -1.0640E-06 1.9460E-06 -6.7540E-06  
6.4260E-06 -  
2.1870E-07 9.3600E-07 -9.5470E-07 -3.0820E-07 1.1050E-06 -9.9220E-07

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-2.1870E-07  
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26 3.4140E-07 -9.2110E-07 9.1020E-07 1.3970E-07 -6.6810E-07 4.6280E-07  
1.1090E-07 -7.8040E-07  
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7.4070E-07 5.9050E-07 8.1610E-08 -6.8950E-07 4.5260E-07 3.1390E-07 -9.5750E-07  
9.3600E-07 -  
1.5730E-06 6.4930E-06 -5.2530E-06 -9.9280E-08 4.1530E-07 -3.6660E-07  
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-3.9360E-08 5.9910E-07  
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-7.2450E-07 -1.8490E-07  
5.9590E-07 -4.7680E-07 -3.4630E-10 4.7570E-07 -2.5130E-07 -3.2410E-07 8.9970E-07  
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1.2910E-06 -5.2530E-06 4.5450E-06 1.5190E-07 -5.9960E-07 5.4900E-07  
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-1.6680E-07 -1.3830E-08 -  
1.0120E-09 1.3030E-08 1.3230E-07 -1.2610E-07 2.1150E-07 -1.0660E-07 1.8050E-07  
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29 5.3790E-07 -4.3840E-07 9.9400E-07 -1.8720E-07 3.4350E-07 -5.8570E-07  
-3.4130E-07 9.7910E-07  
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5.6280E-07 9.6540E-08  
4.9120E-08 -7.5260E-08 -4.3980E-07 3.8590E-07 -7.2100E-07 4.3530E-07 -5.8700E-07  
1.1050E-06 -  
2.7490E-08 4.1530E-07 -5.9960E-07 -1.6310E-05 7.0120E-05 -5.7000E-05  
30 -4.8300E-07 4.4440E-07 -8.9560E-07 1.6890E-07 -3.1060E-07 5.4200E-07  
3.0330E-07 -9.6400E-07  
08 2.9420E-07 3.9840E-07 -1.3850E-07 3.6450E-07 -3.3370E-07 2.9260E-07  
-4.9960E-07 -8.3280E-08 -  
3.3270E-08 7.9710E-08 3.9150E-07 -3.5970E-07 6.6930E-07 -3.9090E-07 5.6780E-07  
-9.9220E-07  
2.8230E-08 -3.6660E-07 5.4900E-07 1.3490E-05 -5.7000E-05 4.8830E-05

Covariance Matrix for the xyz OPUS Rover Position (meters^2).  
0.0000053330 -0.0000163100 0.0000134900  
-0.0000163100 0.0000701200 -0.0000570000  
0.0000134900 -0.0000570000 0.0000488300

Covariance Matrix for the enu OPUS Position (meters^2).  
0.0000014852 -0.0000001615 0.0000017446

```

-0.0000001615    0.0000020937    -0.0000084084
 0.0000017446    -0.0000084084     0.0001207041
    
```

```

Horizontal network accuracy = 0.00328 meters.
Vertical network accuracy   = 0.02154 meters.
    
```

		Vectors		
To	From	X	Y	Z
nywt	1071	127454.333	97339.792	69007.558
nydv	1071	12790.381	-45316.966	-50575.977
nylp	1071	-81187.410	-17319.612	-399.870
pwel	1071	-119415.904	-19130.920	5306.415
nymx	1071	113469.559	49712.573	24191.906
nywl	1071	74554.881	-4285.613	-22085.360
nyhb	1071	-82024.137	-52071.004	-36789.133
kngs	1071	77589.654	100329.059	84150.513
nywg	1071	82037.974	-44974.078	-66729.805

Covariance matrix of the 9 vectors

```

 1  6.4543E-06 -1.9138E-05  1.6310E-05  5.2856E-06 -1.6430E-05  1.3452E-05
5.2028E-06 -1.6531E-05
1.3578E-05  5.1469E-06 -1.6502E-05  1.3533E-05  5.5714E-06 -1.6758E-05  1.4041E-05
5.4305E-06 -
1.6585E-05  1.3717E-05  5.1543E-06 -1.6391E-05  1.3369E-05  5.5970E-06 -1.6888E-05
1.4302E-05
5.3696E-06 -1.6407E-05  1.3456E-05
 2  -1.9138E-05  7.8428E-05 -6.5027E-05 -1.5992E-05  6.9268E-05 -5.5965E-05
-1.5800E-05  6.9496E-05
-5.6251E-05 -1.5671E-05  6.9426E-05 -5.6147E-05 -1.6656E-05  7.0039E-05 -5.7337E-05
-1.6329E-05
6.9634E-05 -5.6583E-05 -1.5688E-05  6.9169E-05 -5.5768E-05 -1.6715E-05  7.0343E-05
-5.7943E-05 -
1.6188E-05  6.9222E-05 -5.5979E-05
 3  1.6310E-05 -6.5027E-05  5.6925E-05  1.3311E-05 -5.6772E-05  4.8230E-05
1.3095E-05 -5.7029E-05
4.8552E-05  1.2950E-05 -5.6952E-05  4.8435E-05  1.4054E-05 -5.7632E-05  4.9766E-05
1.3688E-05 -
5.7179E-05  4.8922E-05  1.2969E-05 -5.6664E-05  4.8010E-05  1.4121E-05 -5.7972E-05
5.0446E-05
1.3529E-05 -5.6717E-05  4.8244E-05
 4  5.2856E-06 -1.5992E-05  1.3311E-05  5.7291E-06 -1.7580E-05  1.4453E-05
5.1565E-06 -1.5919E-05
1.3122E-05  5.1396E-06 -1.5911E-05  1.3108E-05  5.2663E-06 -1.5984E-05  1.3256E-05
5.2250E-06 -
1.5935E-05  1.3162E-05  5.1425E-06 -1.5879E-05  1.3061E-05  5.2730E-06 -1.6020E-05
1.3332E-05
5.2073E-06 -1.5884E-05  1.3086E-05
 5  -1.6430E-05  6.9268E-05 -5.6772E-05 -1.7580E-05  7.6127E-05 -6.1487E-05
-1.5762E-05  6.8870E-05
    
```

-5.5791E-05 -1.5677E-05 6.8824E-05 -5.5723E-05 -1.6318E-05 6.9201E-05 -5.6477E-05  
-1.6109E-05  
6.8953E-05 -5.6000E-05 -1.5691E-05 6.8667E-05 -5.5483E-05 -1.6353E-05 6.9384E-05  
-5.6860E-05 -  
1.6019E-05 6.8693E-05 -5.5612E-05  
6 1.3452E-05 -5.5965E-05 4.8230E-05 1.4453E-05 -6.1487E-05 5.2386E-05  
1.2995E-05 -5.5704E-05  
4.7572E-05 1.2936E-05 -5.5671E-05 4.7525E-05 1.3379E-05 -5.5932E-05 4.8044E-05  
1.3235E-05 -  
5.5763E-05 4.7717E-05 1.2946E-05 -5.5565E-05 4.7361E-05 1.3402E-05 -5.6057E-05  
4.8307E-05  
1.3173E-05 -5.5585E-05 4.7451E-05  
7 5.2028E-06 -1.5800E-05 1.3095E-05 5.1565E-06 -1.5762E-05 1.2995E-05  
5.6632E-06 -1.7452E-05  
1.4374E-05 5.1360E-06 -1.5773E-05 1.3008E-05 5.1974E-06 -1.5807E-05 1.3079E-05  
5.1773E-06 -  
1.5783E-05 1.3033E-05 5.1374E-06 -1.5757E-05 1.2984E-05 5.2009E-06 -1.5826E-05  
1.3116E-05  
5.1688E-06 -1.5759E-05 1.2995E-05  
8 -1.6531E-05 6.9496E-05 -5.7029E-05 -1.5919E-05 6.8870E-05 -5.5704E-05  
-1.7452E-05 7.7061E-05  
-6.2333E-05 -1.5681E-05 6.8991E-05 -5.5843E-05 -1.6401E-05 6.9404E-05 -5.6684E-05  
-1.6164E-05  
6.9123E-05 -5.6144E-05 -1.5695E-05 6.8807E-05 -5.5568E-05 -1.6442E-05 6.9619E-05  
-5.7123E-05 -  
1.6062E-05 6.8826E-05 -5.5705E-05  
9 1.3578E-05 -5.6251E-05 4.8552E-05 1.3122E-05 -5.5791E-05 4.7572E-05  
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1.2942E-05 5.6289E-06 -1.7301E-05 1.4248E-05 5.1511E-06 -1.5689E-05 1.2960E-05  
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1.2970E-05  
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11 -1.6502E-05 6.9426E-05 -5.6952E-05 -1.5911E-05 6.8824E-05 -5.5671E-05  
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Correlation matrix of the 9 vectors

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7.4409E-01  
8.7526E-01 -7.4187E-01 7.3254E-01  
2 -8.5062E-01 1.0000E+00 -9.7322E-01 -7.5446E-01 8.9646E-01 -8.7312E-01  
-7.4972E-01 8.9393E-01  
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-8.6480E-01 -  
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7.5976E-01 7.5209E-01 9.0592E-01 -7.5954E-01 7.5470E-01 8.7727E-01 -7.5337E-01  
7.3621E-01  
9.0093E-01 -7.6230E-01 7.5612E-01  
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G-FILE for the vectors

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C00100004 -1194159044 23 -191309203 87 53064148 72
C00100005 1134695589 24 497125733 88 241919063 74
C00100006 745548809 24 -42856129 87 -220853596 73
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-8713599 2 10 -7458520 2 11 8929953 D 2 12 -8705425 2 13 -7538689 2 14
8967043 2 15 -8709134
2 16 -7568754 D 2 17 8973247 2 18 -8738470 2 19 -7469550 2 20 8942041 2 21
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5 -8624045 3 6 8831965 3 7 7293492 D 3 8 -8610491 3 9 8827929 3 10
7234676 3 11 -8598418
3 12 8814773 D 3 13 7466640 3 14 -8660745 3 15 8872791 3 16 7447041 3 17
-8648725 D 3 18
8868218 3 19 7248133 3 20 -8598212 3 21 8801113 3 22 7452936 D 3 23
-8648762 3 24 8837336
3 25 7425827 3 26 -8635317 3 27 8843734 D 4 5 -8418059 4 6 8342883 4 7
9052739 4 8 -
7576472 4 9 7520471 D 4 10 9050538 4 11 -7571856 4 12 7519740 4 13
8819308 4 14 -7571465 D
4 15 7449959 4 16 8960883 4 17 -7597602 4 18 7520872 4 19 9059188 D 4 20
-7595353 4 21
7547029 4 22 8772661 4 23 -7533715 4 24 7362084 D 4 25 9009290 4 26
-7623029 4 27 7561230
5 6 -9736530 5 7 -7591272 D 5 8 8991721 5 9 -8771985 5 10 -7573116 5 11
8985262 5 12 -
8769319 D 5 13 -7496772 5 14 8992579 5 15 -8707205 5 16 -7578787 5 17
9018804 D 5 18 -
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5 25 -7603076 5 26 9043979 5 27 -8815500 D 6 7 7544840 6 8 -8767121 6 9  
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D 6 17 -8792268 6 18 9016766 6 19 7542317 6 20 -8789149 6 21 9050324 D 6  
22 7373461 6 23 -  
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10 9096720 7 11 -7549776 D 7 12 7505487 7 13 8754352 7 14 -7531298 7 15  
7392846 7 16  
8930692 D 7 17 -7568979 7 18 7490193 7 19 9102732 7 20 -7580536 7 21  
7546363 D 7 22  
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D 8 23 8926877 8 24 -8600799 8 25 -7577240 8 26 9006436 8 27 -8776477 D 9  
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8805388 12 25 7510482 12 26 -8784219 D 12 27 9025303 13 14 -8496932 13 15  
8457007 13 16  
8862343 13 17 -7522763 D 13 18 7454191 13 19 8717058 13 20 -7473582 13 21  
7379234 13 22  
8815620 D 13 23 -7531730 13 24 7458928 13 25 8857191 13 26 -7504953 13 27  
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9741692 14 16 -7581701 14 17 8996605 14 18 -8760257 14 19 -7508610 D 14 20  
8971083 14 21 -



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-8696373 21 24
8791216 21 25 7523684 21 26 -8811494 D 21 27 9059735 22 23 -8518053 22 24
8492450 22 25
8816498 22 26 -7470868 D 22 27 7382797 23 24 -9734004 23 25 -7559742 23 26
8965004 23 27 -
8728725 D 24 25 7417340 24 26 -8624445 24 27 8832970 25 26 -8446681 25 27
8362631 D 26 27 -
9737050

```

ITRF position of 1071 as determined by individual baselines

	X	Y	Z
nywt	989920.873	-4552742.071	4341422.745
nydv	989920.874	-4552742.072	4341422.725
nylp	989920.840	-4552742.027	4341422.694
pwe1	989920.869	-4552742.095	4341422.745
nymx	989920.872	-4552742.065	4341422.723
nywl	989920.868	-4552742.043	4341422.694
nyhb	989920.867	-4552742.035	4341422.701
kngs	989920.866	-4552742.059	4341422.734
nywg	989920.852	-4552742.004	4341422.679

Residuals of position determined by individual baselines from the final position

	X	Y	Z	East	North
Up					
nywt	0.007	-0.011	0.021	0.005	0.007
0.023					
nydv	0.008	-0.012	0.001	0.006	-0.009
0.010					
nylp	-0.026	0.033	-0.030	-0.018	0.003

	-0.048					
pwe1	0.004	-0.035	0.021	-0.004	-0.009	
	0.040					
nymx	0.007	-0.005	-0.001	0.005	-0.005	
	0.004					
nyw1	0.003	0.017	-0.030	0.006	-0.011	
	-0.032					
nyhb	0.002	0.025	-0.023	0.007	-0.001	
	-0.033					
kngs	0.000	0.001	0.010	0.001	0.007	
	0.006					
nywg	-0.014	0.056	-0.045	-0.001	0.006	
	-0.073					

STATE PLANE COORDINATES - U.S. Survey Foot  
SPC (3103 NY W)  
Northing (Y) [feet] 1156335.214  
Easting (X) [feet] 1375162.709  
Convergence [degrees] 0.58187500  
Point Scale 0.99999630  
Combined Factor 0.99997465

\*\*\*\*\* New Reference Frame Preview \*\*\*\*\*

We are replacing the nation's NAD 83 and NAVD 88 datums, to improve access and accuracy of the National Spatial Reference System. More at <https://geodesy.noaa.gov/datums/newdatums/>

Below are approximate coordinates for this solution in the new frames:

APPROX ORTHO HGT: 173.062 (m) [PROTOTYPE (Computed using xGeoid19B,GRS80,ITRF2014)]

dop from interpolation is 0.345  
scatter (mean square distance from rover) is 13994.189  
average edop for rover is 0.910  
average ndop for rover is 0.990  
average hdop for rover is 1.345  
average vdop for rover is 2.270  
average gdop for rover is 3.140

This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.

From: opus <opus@ngs.noaa.gov>  
Sent: Monday, November 15, 2021 8:11 AM  
To: David Zuber  
Subject: OPUS-RS solution : 10713\_0004\_315\_C.tps OP1636981724038

FILE: 10713\_0004\_315\_C.tps OP1636981724038

NGS OPUS-RS SOLUTION REPORT

=====

All computed coordinate accuracies are listed as 1-sigma RMS values.  
For additional information: <https://www.ngs.noaa.gov/OPUS/about.jsp#accuracy>

USER: dzuber@gdbgeospatial.com                      DATE: November 15, 2021  
RINEX FILE: 1071316s.21o                              TIME: 13:10:07 UTC

SOFTWARE: rsgps 1.38 RS251.pr1 1.99.3              START: 2021/11/12 18:33:10  
EPHEMERIS: igr21835.eph [rapid]                    STOP: 2021/11/12 19:09:25  
NAV FILE: brdc3160.21n                              OBS USED: 2592 / 3339 : 78%  
ANT NAME: TSHIPPER\_V                              NONE                      QUALITY IND. 19.84/ 28.01  
ARP HEIGHT: 2                                        NORMALIZED RMS:           0.379

REF FRAME: NAD\_83(2011)(EPOCH:2010.0000)                      ITRF2014 (EPOCH:2021.86517)

X:	989921.819(m)	0.011(m)	989920.856(m)	0.011(m)
Y:	-4552743.393(m)	0.022(m)	-4552742.010(m)	0.022(m)
Z:	4341422.729(m)	0.013(m)	4341422.703(m)	0.013(m)
LAT:	43 10 13.47992	0.008(m)	43 10 13.51380	0.008(m)
E LON:	282 16 1.62102	0.007(m)	282 16 1.59236	0.007(m)
W LON:	77 43 58.37898	0.007(m)	77 43 58.40764	0.007(m)
EL HGT:	137.991(m)	0.025(m)	136.839(m)	0.025(m)
ORTHO HGT:	173.478(m)	0.031(m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 18)	SPC (3103 NY W)
Northing (Y) [meters]	4783364.992	352451.697
Easting (X) [meters]	277858.279	419150.432
Convergence [degrees]	-1.87051944	0.58187500
Point Scale	1.00020708	0.99999630
Combined Factor	1.00018544	0.99997466

US NATIONAL GRID DESIGNATOR: 18TTN7785883364(NAD 83)

BASE STATIONS USED			
PID	DESIGNATION	LATITUDE	LONGITUDE DISTANCE(m)
DI0628	NYWT WATERTOWN CORS ARP	N440141.658	W0755515.948 174590.0

DI1870	NYDV	DANSVILLE CORS ARP	N423256.093	W0774152.595	69102.5
DI0596	NYLP	LOCKPORT CORS ARP	N430954.854	W0784513.357	83015.2
DF5379	PWEL	PORT WELLER CORS ARP	N431412.202	W0791310.777	121055.0
DI0604	NYMX	MEXICO NY CORS ARP	N432812.379	W0761354.886	126221.7
DI0626	NYWL	WATERLOO CORS ARP	N425355.227	W0765107.302	77875.3
DI0458	NYHB	HAMBURG CORS ARP	N424302.663	W0785047.273	103888.3
DF5367	KNGS	KINGSTON CORS ARP	N441307.253	W0763102.143	152208.3
DK7408	NYWG	WATKINS GLEN CORS ARP	N422103.796	W0765233.300	114916.3

NEAREST NGS PUBLISHED CONTROL POINT					
OF2376	665	1A MCGS 1971	N430952.413	W0774357.160	650.7

OPUS-RS Extended Output, Level 2

FINAL COORDINATES (ITRF at epoch of observations)

nywt	1117375.202	-4455402.286	4410430.300
nydv	1002711.246	-4598059.023	4290846.743
nylp	908733.451	-4570061.659	4341022.843
pwel	870504.970	-4571873.025	4346729.170
nymx	1103390.424	-4503029.490	4365614.641
nywl	1064475.742	-4557027.653	4319337.350
nyhb	907896.721	-4604813.022	4304633.557
kngs	1067510.527	-4452413.028	4425573.258
nywg	1071958.838	-4597716.121	4274692.901
1071	989920.856	-4552742.010	4341422.703

Covariance matrix of the stations:

1	1.4350E-06	-4.4520E-06	3.6060E-06	-1.7450E-07	5.9150E-07	-4.6320E-07
	-1.6400E-07	6.0970E-07				
	-4.8610E-07	-1.6010E-07	6.1850E-07	-4.9110E-07	-1.6050E-07	4.7040E-07
	-1.7010E-07					
	5.3410E-07	-4.3510E-07	-1.6870E-07	6.2850E-07	-4.8680E-07	-1.4970E-07
	-4.0440E-07					
	1.7560E-07	5.5300E-07	-4.3460E-07	7.0540E-08	-2.6080E-07	1.8920E-07
2	-4.4520E-06	1.6560E-05	-1.3370E-05	6.3150E-07	-2.3250E-06	1.7180E-06
	5.5440E-07	-2.7000E-06				
	2.1220E-06	5.1990E-07	-2.8420E-06	2.2180E-06	5.0840E-07	-1.1380E-06
	5.9330E-07					
	1.7450E-06	1.4370E-06	5.8300E-07	-2.8030E-06	2.0500E-06	4.2680E-07
	1.2940E-06					
	6.3200E-07	-1.8590E-06	1.3600E-06	-1.0620E-06	4.3790E-06	-3.4480E-06
3	3.6060E-06	-1.3370E-05	1.1210E-05	-4.8240E-07	1.7800E-06	-1.3930E-06
	-4.5910E-07	2.0270E-06				
	-1.6400E-06	-4.4610E-07	2.1160E-06	-1.7020E-06	-4.2130E-07	1.1960E-06
	-4.6120E-07					

1.4870E-06 -1.2470E-06 -4.6910E-07 2.0600E-06 -1.5900E-06 -3.9100E-07 1.1840E-06  
-1.2120E-06 -  
4.7410E-07 1.5190E-06 -1.1920E-06 4.2920E-07 -1.8310E-06 1.4290E-06  
4 -1.7450E-07 6.3150E-07 -4.8240E-07 1.5290E-06 -5.1140E-06 3.9120E-06  
-1.7850E-07 6.3900E-07  
-4.8780E-07 -1.7870E-07 6.3740E-07 -4.8590E-07 -1.7630E-07 6.3860E-07 -4.8940E-07  
-1.7770E-07  
6.4380E-07 -4.9430E-07 -1.7990E-07 6.4590E-07 -4.9420E-07 -1.7450E-07 6.2880E-07  
-4.7900E-07 -  
1.7860E-07 6.4860E-07 -4.9920E-07 -6.6550E-08 3.1730E-07 -2.4480E-07  
5 5.9150E-07 -2.3250E-06 1.7800E-06 -5.1140E-06 1.9790E-05 -1.5320E-05  
6.8440E-07 -2.5860E-06  
2.0230E-06 7.0140E-07 -2.6440E-06 2.0670E-06 6.0070E-07 -2.3500E-06 1.8190E-06  
6.1870E-07 -  
2.3970E-06 1.8750E-06 6.8960E-07 -2.6100E-06 2.0510E-06 6.0890E-07 -2.3610E-06  
1.8070E-06  
6.1930E-07 -2.4030E-06 1.8950E-06 3.9630E-07 -1.5700E-06 1.2330E-06  
6 -4.6320E-07 1.7180E-06 -1.3930E-06 3.9120E-06 -1.5320E-05 1.2160E-05  
-5.1050E-07 2.0970E-06  
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1.8220E-07 6.5890E-07 -4.9210E-07 6.0550E-08 -1.5550E-07 1.3340E-07  
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-4.7410E-07 -  
1.8430E-07 6.6320E-07 -4.8500E-07 1.1960E-07 -3.7750E-07 3.1430E-07  
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6.9090E-07 -2.6480E-06  
2.1110E-06 -5.1040E-06 2.1840E-05 -1.7040E-05 6.1100E-07 -2.7730E-06 2.1250E-06  
6.1380E-07 -  
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6.0870E-07 -2.6820E-06 2.1800E-06 7.0230E-07 -3.0050E-06 2.4020E-06  
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2.0840E-06 5.7810E-07 -2.7730E-06 2.1670E-06 -4.6180E-06 1.7070E-05 -1.3730E-05  
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1.9130E-06 1.5470E-06 6.1870E-07 -2.7330E-06 2.0420E-06 4.8180E-07 -1.4010E-06  
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15 -4.0490E-07 1.1690E-06 -1.1200E-06 -4.8940E-07 1.8190E-06 -1.4140E-06  
-4.7690E-07 2.0450E-  
06 -1.6330E-06 -4.6840E-07 2.1250E-06 -1.6900E-06 3.6900E-06 -1.3730E-05  
1.1360E-05 -4.7020E-07  
1.5750E-06 -1.2900E-06 -4.8390E-07 2.0660E-06 -1.5900E-06 -4.1640E-07 1.3410E-06  
-1.2700E-06 -  
4.7870E-07 1.5940E-06 -1.2410E-06 2.7860E-07 -1.2190E-06 9.6060E-07  
16 -1.7010E-07 5.9330E-07 -4.6120E-07 -1.7770E-07 6.1870E-07 -4.8520E-07  
-1.7810E-07 6.1320E-  
07 -4.7800E-07 -1.7900E-07 6.1380E-07 -4.7790E-07 -1.7240E-07 6.0210E-07  
-4.7020E-07 1.5150E-06 -  
4.8720E-06 3.8030E-06 -1.8010E-07 6.2240E-07 -4.8660E-07 -1.7060E-07 5.9160E-07  
-4.5860E-07 -  
1.7620E-07 6.1710E-07 -4.8520E-07 -7.1950E-08 3.1640E-07 -2.5490E-07  
17 5.3410E-07 -1.7450E-06 1.4870E-06 6.4380E-07 -2.3970E-06 1.8520E-06  
6.4560E-07 -2.6010E-06  
2.0400E-06 6.4660E-07 -2.6900E-06 2.1040E-06 5.6970E-07 -1.9130E-06 1.5750E-06  
-4.8720E-06  
1.8180E-05 -1.4400E-05 6.5870E-07 -2.6510E-06 2.0360E-06 5.4940E-07 -1.8890E-06  
1.6090E-06

6.2350E-07 -2.1870E-06 1.6920E-06 -6.6460E-08 3.5980E-07 -2.8210E-07  
18 -4.3510E-07 1.4370E-06 -1.2470E-06 -4.9430E-07 1.8750E-06 -1.4510E-06  
-4.9600E-07 2.0640E-  
06 -1.6250E-06 -4.9370E-07 2.1310E-06 -1.6730E-06 -4.5630E-07 1.5470E-06  
-1.2900E-06 3.8030E-06 -  
1.4400E-05 1.1670E-05 -4.9900E-07 2.0710E-06 -1.5910E-06 -4.4730E-07 1.5660E-06  
-1.3580E-06 -  
4.8080E-07 1.7040E-06 -1.3200E-06 9.5570E-08 -4.4550E-07 3.7480E-07  
19 -1.6870E-07 5.8300E-07 -4.6910E-07 -1.7990E-07 6.8960E-07 -5.0960E-07  
-1.6900E-07 6.9250E-  
07 -5.1810E-07 -1.6440E-07 6.9240E-07 -5.1630E-07 -1.7550E-07 6.1870E-07  
-4.8390E-07 -1.8010E-07  
6.5870E-07 -4.9900E-07 1.4980E-06 -5.2050E-06 3.9750E-06 -1.6690E-07 6.0010E-07  
-4.8350E-07 -  
1.8330E-07 6.6930E-07 -4.9510E-07 4.1940E-08 -8.1340E-08 8.1570E-08  
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2.0670E-06 7.2770E-07 -2.6590E-06 2.0900E-06 6.2030E-07 -2.7330E-06 2.0660E-06  
6.2240E-07 -  
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2.0150E-06  
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21 -4.8680E-07 2.0500E-06 -1.5900E-06 -4.9420E-07 2.0510E-06 -1.6060E-06  
-5.1900E-07 2.1370E-  
06 -1.6670E-06 -5.2730E-07 2.1660E-06 -1.6890E-06 -4.8560E-07 2.0420E-06  
-1.5900E-06 -4.8660E-07  
2.0360E-06 -1.5910E-06 3.9750E-06 -1.6570E-05 1.3030E-05 -4.9780E-07 2.0820E-06  
-1.6160E-06 -  
4.7900E-07 2.0070E-06 -1.5740E-06 -2.6480E-07 1.1790E-06 -8.8940E-07  
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-1.6210E-07 6.2600E-  
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-4.1640E-07 -1.7060E-07  
5.4940E-07 -4.4730E-07 -1.6690E-07 6.4510E-07 -4.9780E-07 1.4300E-06 -4.5410E-06  
3.6740E-06 -  
1.7650E-07 5.6920E-07 -4.4570E-07 7.8040E-08 -2.8410E-07 2.0790E-07  
23 4.4710E-07 -1.0360E-06 1.1840E-06 6.2880E-07 -2.3610E-06 1.8050E-06  
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2.1280E-06 5.5220E-07 -2.7890E-06 2.2110E-06 5.2000E-07 -1.4010E-06 1.3410E-06  
5.9160E-07 -  
1.8890E-06 1.5660E-06 6.0010E-07 -2.7590E-06 2.0820E-06 -4.5410E-06 1.7000E-05  
-1.3830E-05  
6.2350E-07 -1.9850E-06 1.5160E-06 -7.2320E-07 2.9790E-06 -2.3100E-06  
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-4.7690E-07 1.9930E-  
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1.6090E-06 -1.3580E-06 -4.8350E-07 2.0150E-06 -1.6160E-06 3.6740E-06 -1.3830E-05  
1.1690E-05 -  
4.6540E-07 1.6260E-06 -1.3270E-06 1.2930E-07 -5.8810E-07 4.1500E-07

25 -1.7560E-07 6.3200E-07 -4.7410E-07 -1.7860E-07 6.1930E-07 -4.8240E-07  
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-4.7870E-07 -1.7620E-07  
6.2350E-07 -4.8080E-07 -1.8330E-07 6.1580E-07 -4.7900E-07 -1.7650E-07 6.2350E-07  
-4.6540E-07  
1.5430E-06 -4.9620E-06 3.7980E-06 -1.0600E-07 4.5040E-07 -3.5430E-07  
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6.5890E-07 -2.5970E-06  
2.0090E-06 6.6320E-07 -2.6820E-06 2.0700E-06 5.8220E-07 -1.9940E-06 1.5940E-06  
6.1710E-07 -  
2.1870E-06 1.7040E-06 6.6930E-07 -2.6370E-06 2.0070E-06 5.6920E-07 -1.9850E-06  
1.6260E-06 -  
4.9620E-06 1.8450E-05 -1.4370E-05 2.4910E-08 5.4200E-09 -3.0940E-08  
27 -4.3460E-07 1.3600E-06 -1.1920E-06 -4.9920E-07 1.8950E-06 -1.4190E-06  
-4.9210E-07 2.1080E-  
06 -1.6230E-06 -4.8500E-07 2.1800E-06 -1.6740E-06 -4.6040E-07 1.4990E-06  
-1.2410E-06 -4.8520E-07  
1.6920E-06 -1.3200E-06 -4.9510E-07 2.1140E-06 -1.5740E-06 -4.4570E-07 1.5160E-06  
-1.3270E-06  
3.7980E-06 -1.4370E-05 1.1480E-05 2.1370E-07 -9.2170E-07 7.8730E-07  
28 7.0540E-08 -1.0620E-06 4.2920E-07 -6.6550E-08 3.9630E-07 -7.2180E-08  
6.0550E-08 6.3880E-07  
-3.8770E-07 1.1960E-07 7.0230E-07 -4.2160E-07 -1.4840E-08 -6.0940E-07 2.7860E-07  
-7.1950E-08 -  
6.6460E-08 9.5570E-08 4.1940E-08 6.9840E-07 -2.6480E-07 7.8040E-08 -7.2320E-07  
1.2930E-07 -  
1.0600E-07 2.4910E-08 2.1370E-07 1.4850E-05 -4.9280E-05 3.8340E-05  
29 -2.6080E-07 4.3790E-06 -1.8310E-06 3.1730E-07 -1.5700E-06 2.9370E-07  
-1.5550E-07 -2.6870E-  
06 1.6720E-06 -3.7750E-07 -3.0050E-06 1.8600E-06 7.4420E-08 2.5720E-06  
-1.2190E-06 3.1640E-07  
3.5980E-07 -4.4550E-07 -8.1340E-08 -2.9220E-06 1.1790E-06 -2.8410E-07 2.9790E-06  
-5.8810E-07  
4.5040E-07 5.4200E-09 -9.2170E-07 -4.9280E-05 1.9030E-04 -1.5050E-04  
30 1.8920E-07 -3.4480E-06 1.4290E-06 -2.4480E-07 1.2330E-06 -1.8850E-07  
1.3340E-07 2.1520E-06  
-1.3160E-06 3.1430E-07 2.4020E-06 -1.4620E-06 -7.1810E-08 -2.0220E-06 9.6060E-07  
-2.5490E-07 -  
2.8210E-07 3.7480E-07 8.1570E-08 2.3060E-06 -8.8940E-07 2.0790E-07 -2.3100E-06  
4.1500E-07 -  
3.5430E-07 -3.0940E-08 7.8730E-07 3.8340E-05 -1.5050E-04 1.2170E-04

Covariance Matrix for the xyz OPUS Rover Position (meters^2).  
0.0000148500 -0.0000492800 0.0000383400  
-0.0000492800 0.0001903000 -0.0001505000  
0.0000383400 -0.0001505000 0.0001217000

Covariance Matrix for the enu OPUS Position (meters^2).  
0.0000023075 -0.0000017142 0.0000098898



```
-0.0000017142    0.0000045871    -0.0000295268  
0.0000098898    -0.0000295268    0.0003199553
```

```
Horizontal network accuracy = 0.00478 meters.  
Vertical network accuracy = 0.03507 meters.
```

		Vectors		
To	From	X	Y	Z
nywt	1071	127454.347	97339.725	69007.597
nydv	1071	12790.391	-45317.013	-50575.960
nylp	1071	-81187.405	-17319.649	-399.860
pwel	1071	-119415.886	-19131.014	5306.467
nymx	1071	113469.569	49712.520	24191.938
nywl	1071	74554.887	-4285.643	-22085.353
nyhb	1071	-82024.134	-52071.012	-36789.146
kngs	1071	77589.671	100328.983	84150.555
nywg	1071	82037.982	-44974.110	-66729.801

Covariance matrix of the 9 vectors

```
1  1.6144E-05 -5.2409E-05  4.1328E-05  1.4672E-05 -4.8824E-05  3.7760E-05  
1.4555E-05 -4.9048E-05  
3.8052E-05  1.4500E-05 -4.9103E-05  3.8081E-05  1.4634E-05 -4.7939E-05  3.7467E-05  
1.4681E-05 -  
4.8419E-05  3.7620E-05  1.4569E-05 -4.9089E-05  3.7929E-05  1.4552E-05 -4.7849E-05  
3.7617E-05  
1.4710E-05 -4.8491E-05  3.7503E-05  
2  -5.2409E-05  1.9810E-04 -1.5859E-04 -4.7904E-05  1.8517E-04 -1.4563E-04  
-4.7508E-05  1.8591E-04  
-1.4660E-04 -4.7321E-05  1.8608E-04 -1.4669E-04 -4.7784E-05  1.8221E-04 -1.4466E-04  
-4.7941E-05  
1.8382E-04 -1.4517E-04 -4.7554E-05  1.8604E-04 -1.4618E-04 -4.7507E-05  1.8191E-04  
-1.4517E-04 -  
4.8036E-05  1.8406E-04 -1.4477E-04  
3  4.1328E-05 -1.5859E-04  1.3005E-04  3.7673E-05 -1.4812E-04  1.1907E-04  
3.7318E-05 -1.4879E-04  
1.1995E-04  3.7150E-05 -1.4895E-04  1.2003E-04  3.7561E-05 -1.4545E-04  1.1819E-04  
3.7705E-05 -  
1.4690E-04  1.1865E-04  3.7360E-05 -1.4892E-04  1.1957E-04  3.7312E-05 -1.4517E-04  
1.1864E-04  
3.7791E-05 -1.4712E-04  1.1829E-04  
4  1.4672E-05 -4.7904E-05  3.7673E-05  1.6512E-05 -5.5108E-05  4.2569E-05  
1.4677E-05 -4.9597E-05  
3.8485E-05  1.4618E-05 -4.9662E-05  3.8521E-05  1.4755E-05 -4.8349E-05  3.7817E-05  
1.4811E-05 -  
4.8887E-05  3.7995E-05  1.4695E-05 -4.9650E-05  3.8355E-05  1.4664E-05 -4.8245E-05  
3.7977E-05  
1.4844E-05 -4.8974E-05  3.7872E-05  
5  -4.8824E-05  1.8517E-04 -1.4812E-04 -5.5108E-05  2.1323E-04 -1.6735E-04  
-4.8836E-05  1.9197E-04
```

-1.5138E-04 -4.8597E-05 1.9223E-04 -1.5153E-04 -4.9150E-05 1.8695E-04 -1.4870E-04  
-4.9374E-05  
1.8911E-04 -1.4941E-04 -4.8905E-05 1.9218E-04 -1.5086E-04 -4.8783E-05 1.8653E-04  
-1.4934E-04 -  
4.9507E-05 1.8946E-04 -1.4892E-04  
6 3.7760E-05 -1.4563E-04 1.1907E-04 4.2569E-05 -1.6735E-04 1.3424E-04  
3.7768E-05 -1.5085E-04  
1.2157E-04 3.7585E-05 -1.5105E-04 1.2168E-04 3.8010E-05 -1.4700E-04 1.1951E-04  
3.8182E-05 -  
1.4866E-04 1.2006E-04 3.7821E-05 -1.5101E-04 1.2117E-04 3.7729E-05 -1.4668E-04  
1.2001E-04  
3.8284E-05 -1.4893E-04 1.1968E-04  
7 1.4555E-05 -4.7508E-05 3.7318E-05 1.4677E-05 -4.8836E-05 3.7768E-05  
1.6207E-05 -5.4872E-05  
4.2546E-05 1.4509E-05 -4.9136E-05 3.8107E-05 1.4632E-05 -4.7918E-05 3.7451E-05  
1.4683E-05 -  
4.8412E-05 3.7615E-05 1.4579E-05 -4.9121E-05 3.7952E-05 1.4549E-05 -4.7826E-05  
3.7600E-05  
1.4713E-05 -4.8491E-05 3.7501E-05  
8 -4.9048E-05 1.8591E-04 -1.4879E-04 -4.9597E-05 1.9197E-04 -1.5085E-04  
-5.4872E-05 2.1687E-04  
-1.7090E-04 -4.8827E-05 1.9334E-04 -1.5240E-04 -4.9387E-05 1.8776E-04 -1.4939E-04  
-4.9622E-05  
1.9003E-04 -1.5014E-04 -4.9145E-05 1.9328E-04 -1.5169E-04 -4.9009E-05 1.8734E-04  
-1.5007E-04 -  
4.9760E-05 1.9038E-04 -1.4962E-04  
9 3.8052E-05 -1.4660E-04 1.1995E-04 3.8485E-05 -1.5138E-04 1.2157E-04  
4.2546E-05 -1.7090E-04  
1.3759E-04 3.7877E-05 -1.5246E-04 1.2279E-04 3.8320E-05 -1.4807E-04 1.2042E-04  
3.8505E-05 -  
1.4985E-04 1.2102E-04 3.8128E-05 -1.5241E-04 1.2224E-04 3.8021E-05 -1.4773E-04  
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1.4509E-05 -4.8827E-05  
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-1.5025E-04 -  
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4.8718E-05 3.7860E-05 1.4647E-05 -4.9433E-05 3.8191E-05 1.4626E-05 -4.8111E-05  
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14 -4.7939E-05 1.8221E-04 -1.4545E-04 -4.8349E-05 1.8695E-04 -1.4700E-04  
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Correlation matrix of the 9 vectors

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8.0739E-01 9.0003E-01 -8.2742E-01 8.0621E-01 9.0057E-01 -8.3901E-01 8.1430E-01  
8.9929E-01 -  
8.3604E-01 8.1304E-01 8.9909E-01 -8.2796E-01 8.0795E-01 9.0193E-01 -8.3927E-01  
8.1316E-01  
8.9843E-01 -8.3533E-01 8.1361E-01  
2 -9.2674E-01 1.0000E+00 -9.8804E-01 -8.3758E-01 9.0093E-01 -8.9302E-01  
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9.0361E-01  
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8.1108E-01 -
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8.9626E-01 8.1150E-01 -8.8409E-01 8.9498E-01 8.1340E-01 -8.9530E-01 9.0363E-01  
8.1301E-01 -  
8.9265E-01 9.0240E-01 8.1162E-01 -8.8474E-01 8.9699E-01 8.1347E-01 -8.9539E-01  
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G-FILE for the vectors

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8124659 3 11 -8843393
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9044078 D 26 27 -
9889768

```

ITRF position of 1071 as determined by individual baselines

	X	Y	Z
nywt	989920.860	-4552742.012	4341422.715
nydv	989920.864	-4552742.035	4341422.715
nylp	989920.844	-4552742.002	4341422.694
pwe1	989920.850	-4552742.015	4341422.708
nymx	989920.868	-4552742.038	4341422.714
nywl	989920.871	-4552742.047	4341422.725
nyhb	989920.867	-4552742.034	4341422.718
kngs	989920.850	-4552742.005	4341422.710
nywg	989920.845	-4552741.991	4341422.694

Residuals of position determined by individual baselines from the final position

	X	Y	Z	East	North
Up					
nywt	0.004	-0.001	0.013	0.004	0.008
nydv	0.009	-0.025	0.012	0.003	-0.009
nylp	-0.012	0.008	-0.008	-0.010	0.001

```
-0.013
pwe1 -0.005 -0.004 0.006 -0.006 0.002
0.006
nymx 0.012 -0.028 0.011 0.006 -0.012
0.029
nyw1 0.016 -0.036 0.023 0.008 -0.010
0.044
nyhb 0.011 -0.023 0.016 0.006 -0.006
0.029
kngs -0.005 0.005 0.008 -0.004 0.010
0.000
nywg -0.010 0.019 -0.009 -0.006 0.008
-0.022
```

```
STATE PLANE COORDINATES - U.S. Survey Foot
SPC (3103 NY W)
Northing (Y) [feet] 1156335.276
Easting (X) [feet] 1375162.709
Convergence [degrees] 0.58187500
Point Scale 0.99999630
Combined Factor 0.99997466
```

\*\*\*\*\* New Reference Frame Preview \*\*\*\*\*

We are replacing the nation's NAD 83 and NAVD 88 datums, to improve access and accuracy of the National Spatial Reference System. More at <https://geodesy.noaa.gov/datums/newdatums/>

Below are approximate coordinates for this solution in the new frames:

APPROX ORTHO HGT: 173.011 (m) [PROTOTYPE (Computed using xGeoid19B,GRS80,ITRF2014)]

```
dop from interpolation is 0.345
scatter (mean square distance from rover) is 13994.189
average edop for rover is 0.800
average ndop for rover is 1.030
average hdop for rover is 1.304
average vdop for rover is 2.320
average gdop for rover is 3.130
```

This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.

From: opus <opus@ngs.noaa.gov>  
Sent: Monday, November 15, 2021 8:26 AM  
To: David Zuber  
Subject: OPUS-RS solution : 10713\_0100\_315\_A.tps OP1636982664493

FILE: 10713\_0100\_315\_A.tps OP1636982664493

NGS OPUS-RS SOLUTION REPORT

=====

All computed coordinate accuracies are listed as 1-sigma RMS values.  
For additional information: <https://www.ngs.noaa.gov/OPUS/about.jsp#accuracy>

USER: dzuber@gdbgeospatial.com                      DATE: November 15, 2021  
RINEX FILE: 1071316r.21o                              TIME: 13:25:34 UTC

SOFTWARE: rsgps 1.38 RS271.pr1 1.99.3              START: 2021/11/12 17:17:30  
EPHEMERIS: igr21835.eph [rapid]                    STOP: 2021/11/12 17:47:55  
NAV FILE: brdc3160.21n                              OBS USED: 2403 / 3069 : 78%  
ANT NAME: TPSHIPER\_V                                QUALITY IND. 11.04/ 26.11  
ARP HEIGHT: 2                                         NORMALIZED RMS: 0.351

REF FRAME: NAD\_83(2011)(EPOCH:2010.0000)                      ITRF2014 (EPOCH:2021.86502)

X:	990050.594(m)	0.008(m)	990049.631(m)	0.008(m)
Y:	-4552733.348(m)	0.008(m)	-4552731.965(m)	0.008(m)
Z:	4341403.756(m)	0.017(m)	4341403.730(m)	0.017(m)
LAT:	43 10 12.64253	0.009(m)	43 10 12.67640	0.009(m)
E LON:	282 16 7.28634	0.008(m)	282 16 7.25768	0.008(m)
W LON:	77 43 52.71366	0.008(m)	77 43 52.74232	0.008(m)
EL HGT:	137.808(m)	0.017(m)	136.655(m)	0.017(m)
ORTHO HGT:	173.296(m)	0.025(m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 18)	SPC (3103 NY W)
Northing (Y) [meters]	4783334.982	352427.157
Easting (X) [meters]	277985.360	419278.654
Convergence [degrees]	-1.86943333	0.58295000
Point Scale	1.00020639	0.99999652
Combined Factor	1.00018477	0.99997491

US NATIONAL GRID DESIGNATOR: 18TTN7798583334(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DI0628	NYWT WATERTOWN CORS ARP	N440141.658	W0755515.948	174498.0

DI1870	NYDV	DANSVILLE CORS ARP	N423256.093	W0774152.595	69071.5
DI0596	NYLP	LOCKPORT CORS ARP	N430954.854	W0784513.357	83143.2
DF5379	PWEL	PORT WELLER CORS ARP	N431412.202	W0791310.777	121184.4
DI0604	NYMX	MEXICO NY CORS ARP	N432812.379	W0761354.886	126105.7
DI0626	NYWL	WATERLOO CORS ARP	N425355.227	W0765107.302	77747.2
DI0458	NYHB	HAMBURG CORS ARP	N424302.663	W0785047.273	103988.4
DF5367	KNGS	KINGSTON CORS ARP	N441307.253	W0763102.143	152146.6
DK7408	NYWG	WATKINS GLEN CORS ARP	N422103.796	W0765233.300	114817.3

NEAREST NGS PUBLISHED CONTROL POINT					
OF2376	665	1A MCGS 1971	N430952.413	W0774357.160	632.3

OPUS-RS Extended Output, Level 2

FINAL COORDINATES (ITRF at epoch of observations)

nywt	1117375.201	-4455402.266	4410430.276
nydv	1002711.251	-4598059.044	4290846.762
nylp	908733.452	-4570061.655	4341022.845
pwel	870504.965	-4571873.040	4346729.195
nymx	1103390.432	-4503029.493	4365614.645
nywl	1064475.747	-4557027.679	4319337.365
nyhb	907896.721	-4604813.033	4304633.551
kngs	1067510.516	-4452412.992	4425573.219
nywg	1071958.837	-4597716.104	4274692.905
1071	990049.631	-4552731.965	4341403.730

Covariance matrix of the stations:

1	5.2100E-07	-8.3340E-07	1.0900E-06	-5.4950E-08	6.8060E-08	-1.4880E-07
	-8.0250E-08	1.2930E-07				
	-1.5860E-07	-9.1830E-08	1.4850E-07	-1.7230E-07	-1.3250E-08	1.0530E-07
		-3.1250E-08				
	7.8710E-08	-1.2270E-07	-8.4270E-08	1.0210E-07	-1.7170E-07	-1.9810E-08
		-7.7510E-08				
	3.4160E-08	5.1580E-08	-1.4470E-07	-2.6900E-08	2.3910E-07	-2.1290E-07
2	-8.3340E-07	3.8540E-06	-3.5000E-06	1.0220E-07	-4.9800E-07	4.3470E-07
	8.5050E-08	-4.5120E-07				
	4.1980E-07	7.7450E-08	-4.3880E-07	4.0960E-07	1.2840E-07	-4.6050E-07
		1.1730E-07				
	4.8520E-07	4.4930E-07	8.2810E-08	-4.7550E-07	4.1610E-07	1.2340E-07
		4.6560E-07				
	1.1610E-07	-5.1100E-07	4.4150E-07	-1.3970E-08	1.5280E-07	-1.0130E-07
3	1.0900E-06	-3.5000E-06	4.0600E-06	-1.4070E-07	3.8460E-07	-5.0600E-07
	-1.7670E-07	4.8230E-07				
	-5.3290E-07	-1.9260E-07	5.1240E-07	-5.5510E-07	-8.4180E-08	4.3030E-07
		-4.3050E-07				
	-1.0830E-07					

3.9420E-07 -4.6750E-07 -1.8160E-07 4.4280E-07 -5.4710E-07 -9.5020E-08 5.0150E-07  
-4.1860E-07 -  
1.1120E-07 3.5210E-07 -4.9190E-07 -6.2210E-08 3.3490E-07 -2.9700E-07  
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-3.0340E-08 7.6450E-08  
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-5.4130E-07 -  
1.2060E-07 5.0190E-07 -4.1380E-07 6.1640E-08 -3.0990E-07 2.8940E-07  
13 -1.3250E-08 1.2840E-07 -8.4180E-08 -5.1780E-08 7.4470E-08 -1.3980E-07  
-7.1140E-08 1.2050E-  
07 -1.4630E-07 -8.0020E-08 1.3460E-07 -1.5640E-07 4.9650E-07 -8.4460E-07  
1.0290E-06 -3.3750E-08  
8.4280E-08 -1.2100E-07 -7.4200E-08 9.9040E-08 -1.5620E-07 -2.5160E-08 1.4040E-07  
-8.7270E-08 -  
3.5940E-08 6.3090E-08 -1.3770E-07 -2.4160E-08 1.9950E-07 -1.8050E-07  
14 1.0530E-07 -4.6050E-07 4.3030E-07 1.0630E-07 -4.9290E-07 4.4820E-07  
1.0470E-07 -4.8830E-07  
4.4320E-07 1.0420E-07 -4.8940E-07 4.4290E-07 -8.4460E-07 3.9740E-06 -3.5350E-06  
1.0640E-07 -  
4.8190E-07 4.4320E-07 1.0500E-07 -4.9670E-07 4.4800E-07 1.0510E-07 -4.6210E-07  
4.3050E-07  
1.0700E-07 -4.9110E-07 4.4880E-07 2.2460E-08 -5.5680E-08 7.5190E-08  
15 -9.4510E-08 4.6290E-07 -4.3050E-07 -1.3130E-07 4.0550E-07 -4.7930E-07  
-1.5200E-07 4.6470E-  
07 -4.9840E-07 -1.6090E-07 4.8220E-07 -5.1150E-07 1.0290E-06 -3.5350E-06  
3.9040E-06 -1.1330E-07  
4.1290E-07 -4.5940E-07 -1.5440E-07 4.3990E-07 -5.0400E-07 -1.0740E-07 4.8160E-07  
-4.4030E-07 -  
1.1440E-07 3.8560E-07 -4.7000E-07 -5.2540E-08 2.5250E-07 -2.2350E-07  
16 -3.1250E-08 1.1730E-07 -1.0830E-07 -4.5650E-08 8.5950E-08 -1.2330E-07  
-5.3300E-08 1.0160E-  
07 -1.2320E-07 -5.6850E-08 1.0590E-07 -1.2620E-07 -3.3750E-08 1.0640E-07  
-1.1330E-07 4.6180E-07 -  
8.1350E-07 9.5320E-07 -5.4460E-08 9.1690E-08 -1.2650E-07 -3.5750E-08 1.2000E-07  
-1.0750E-07 -  
3.9590E-08 8.4720E-08 -1.2520E-07 -4.1400E-09 9.0570E-08 -8.0600E-08  
17 7.8710E-08 -4.8520E-07 3.9420E-07 1.0630E-07 -4.9190E-07 4.5640E-07  
1.1780E-07 -5.2090E-07  
4.5870E-07 1.2310E-07 -5.3280E-07 4.6620E-07 8.4280E-08 -4.8190E-07 4.1290E-07  
-8.1350E-07  
4.1160E-06 -3.5100E-06 1.2010E-07 -5.1640E-07 4.7050E-07 8.6790E-08 -4.9700E-07  
3.9870E-07



9.6270E-08 -4.7900E-07 4.5260E-07 3.8070E-08 -1.8780E-07 1.7570E-07  
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-1.1760E-07 4.3680E-  
07 -4.5230E-07 -1.1730E-07 4.3700E-07 -4.5280E-07 -1.2100E-07 4.4320E-07  
-4.5940E-07 9.5320E-07 -  
3.5100E-06 3.7470E-06 -1.1670E-07 4.3200E-07 -4.4650E-07 -1.2270E-07 4.5150E-07  
-4.7040E-07 -  
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1.2010E-07 -1.1670E-07 4.6500E-07 -6.9480E-07 8.9950E-07 -6.7320E-08 5.8800E-08  
-1.6990E-07 -  
5.1300E-08 1.4450E-07 -9.3000E-08 5.2990E-08 -2.2880E-07 2.0590E-07  
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4.0400E-07 6.4880E-08 -4.7500E-07 3.9570E-07 9.9040E-08 -4.9670E-07 4.3990E-07  
9.1690E-08 -  
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4.3560E-07  
9.1260E-08 -5.3960E-07 4.3050E-07 -1.5570E-08 3.3240E-08 -3.6900E-08  
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07 -3.7440E-07 -3.5200E-08 3.3800E-07 -3.5090E-07 -1.5620E-07 4.4800E-07  
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-5.3470E-07 -  
1.2100E-07 5.0430E-07 -4.0750E-07 5.8960E-08 -2.9120E-07 2.8380E-07  
22 -1.9810E-08 1.2340E-07 -9.5020E-08 -4.9790E-08 7.7480E-08 -1.3630E-07  
-6.4910E-08 1.1230E-  
07 -1.4010E-07 -7.1870E-08 1.2290E-07 -1.4760E-07 -2.5160E-08 1.0510E-07  
-1.0740E-07 -3.5750E-08  
8.6790E-08 -1.2270E-07 -6.7320E-08 9.5060E-08 -1.4780E-07 4.8320E-07 -7.9290E-07  
1.0320E-06 -  
3.7480E-08 6.9940E-08 -1.3580E-07 -1.6950E-08 1.5780E-07 -1.4550E-07  
23 1.5010E-07 -4.2320E-07 5.0150E-07 9.2740E-08 -5.1020E-07 4.2010E-07  
6.3110E-08 -4.2640E-07  
3.9510E-07 4.9950E-08 -4.0240E-07 3.7650E-07 1.4040E-07 -4.6210E-07 4.8160E-07  
1.2000E-07 -  
4.9700E-07 4.5150E-07 5.8800E-08 -4.6400E-07 3.8500E-07 -7.9290E-07 3.8340E-06  
-3.4450E-06  
1.1740E-07 -5.3740E-07 4.3350E-07 -2.5720E-08 2.2740E-07 -1.6190E-07  
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-1.6590E-07 4.6930E-  
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-4.4030E-07 -1.0750E-07  
3.9870E-07 -4.7040E-07 -1.6990E-07 4.3560E-07 -5.3470E-07 1.0320E-06 -3.4450E-06  
4.0320E-06 -  
1.0990E-07 3.6330E-07 -4.9110E-07 -6.7330E-08 3.3080E-07 -3.1030E-07

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-5.0450E-08 9.9400E-  
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-1.1440E-07 -3.9590E-08  
9.6270E-08 -1.1750E-07 -5.1300E-08 9.1260E-08 -1.2100E-07 -3.7480E-08 1.1740E-07  
-1.0990E-07  
4.5800E-07 -8.1790E-07 9.3270E-07 -1.0650E-09 7.4660E-08 -6.4530E-08  
26 5.1580E-08 -5.1100E-07 3.5210E-07 1.1220E-07 -4.8660E-07 4.7030E-07  
1.3960E-07 -5.6050E-07  
4.8410E-07 1.5200E-07 -5.8670E-07 5.0190E-07 6.3090E-08 -4.9110E-07 3.8560E-07  
8.4720E-08 -  
4.7900E-07 4.2910E-07 1.4450E-07 -5.3960E-07 5.0430E-07 6.9940E-08 -5.3740E-07  
3.6330E-07 -  
8.1790E-07 4.3030E-06 -3.4900E-06 6.3720E-08 -3.5290E-07 3.0820E-07  
27 -1.4470E-07 4.4150E-07 -4.9190E-07 -1.1010E-07 4.5040E-07 -4.2060E-07  
-9.6200E-08 4.2190E-  
07 -4.2160E-07 -8.9340E-08 4.1060E-07 -4.1380E-07 -1.3770E-07 4.4880E-07  
-4.7000E-07 -1.2520E-07  
4.5260E-07 -4.4280E-07 -9.3000E-08 4.3050E-07 -4.0750E-07 -1.3580E-07 4.3350E-07  
-4.9110E-07  
9.3270E-07 -3.4900E-06 3.6700E-06 9.0550E-09 -5.4350E-08 7.7730E-08  
28 -2.6900E-08 -1.3970E-08 -6.2210E-08 2.1730E-08 3.4440E-08 2.3400E-08  
4.8720E-08 -3.9450E-  
08 4.3540E-08 6.0830E-08 -6.4060E-08 6.1640E-08 -2.4160E-08 2.2460E-08  
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3.8070E-08 -1.4420E-08 5.2990E-08 -1.5570E-08 5.8960E-08 -1.6950E-08 -2.5720E-08  
-6.7330E-08 -  
1.0650E-09 6.3720E-08 9.0550E-09 4.5200E-06 -8.3110E-06 9.8670E-06  
29 2.3910E-07 1.5280E-07 3.3490E-07 -5.2610E-08 -2.1450E-07 -1.1490E-07  
-2.0560E-07 1.9040E-  
07 -2.1550E-07 -2.7430E-07 3.1820E-07 -3.0990E-07 1.9950E-07 -5.5680E-08  
2.5250E-07 9.0570E-08 -  
1.8780E-07 6.7520E-08 -2.2880E-07 3.3240E-08 -2.9120E-07 1.5780E-07 2.2740E-07  
3.3080E-07  
7.4660E-08 -3.5290E-07 -5.4350E-08 -8.3110E-06 4.6020E-05 -3.9780E-05  
30 -2.1290E-07 -1.0130E-07 -2.9700E-07 4.8750E-08 1.8570E-07 1.2860E-07  
1.8390E-07 -1.6500E-  
07 2.0610E-07 2.4530E-07 -2.7970E-07 2.8940E-07 -1.8050E-07 7.5190E-08  
-2.2350E-07 -8.0600E-08  
1.7570E-07 -4.3720E-08 2.0590E-07 -3.6900E-08 2.8380E-07 -1.4550E-07 -1.6190E-07  
-3.1030E-07 -  
6.4530E-08 3.0820E-07 7.7730E-08 9.8670E-06 -3.9780E-05 4.1990E-05

Covariance Matrix for the xyz OPUS Rover Position (meters^2).  
0.0000045200 -0.0000083110 0.0000098670  
-0.0000083110 0.0000460200 -0.0000397800  
0.0000098670 -0.0000397800 0.0000419900

Covariance Matrix for the enu OPUS Position (meters^2).  
0.0000029425 0.0000015900 0.000000371

```

0.0000015900    0.0000037298    0.0000000921
0.0000000371    0.0000000921    0.0000858577

```

```

Horizontal network accuracy = 0.00463 meters.
Vertical network accuracy   = 0.01817 meters.

```

		Vectors		
To	From	X	Y	Z
nywt	1071	127325.569	97329.699	69026.546
nydv	1071	12661.620	-45327.080	-50556.968
nylp	1071	-81316.180	-17329.690	-380.885
pwel	1071	-119544.667	-19141.075	5325.465
nymx	1071	113340.801	49702.471	24210.915
nywl	1071	74426.115	-4295.714	-22066.365
nyhb	1071	-82152.910	-52081.069	-36770.179
kngs	1071	77460.885	100318.973	84169.489
nywg	1071	81909.206	-44984.140	-66710.825

Covariance matrix of the 9 vectors

```

1  5.0948E-06 -9.3695E-06 1.1232E-05 4.4702E-06 -8.5165E-06 9.9077E-06
4.4179E-06 -8.3814E-06
9.8778E-06 4.3942E-06 -8.3375E-06 9.8460E-06 4.5578E-06 -8.4673E-06 1.0038E-05
4.5198E-06 -
8.5095E-06 9.9716E-06 4.4096E-06 -8.4324E-06 9.8492E-06 4.5440E-06 -8.3743E-06
1.0070E-05
4.5138E-06 -8.5622E-06 9.9261E-06
2  -9.3695E-06 4.9568E-05 -4.3514E-05 -8.1422E-06 4.5584E-05 -3.9129E-05
-8.0064E-06 4.5226E-05
-3.9043E-05 -7.9453E-06 4.5110E-05 -3.8959E-05 -8.3681E-06 4.5462E-05 -3.9468E-05
-8.2703E-06
4.5570E-05 -3.9297E-05 -7.9854E-06 4.5358E-05 -3.8971E-05 -8.3314E-06 4.5217E-05
-3.9544E-05 -
8.2556E-06 4.5709E-05 -3.9183E-05
3  1.1232E-05 -4.3514E-05 4.6644E-05 9.7398E-06 -3.9916E-05 4.1652E-05
9.5686E-06 -3.9468E-05
4.1548E-05 9.4913E-06 -3.9323E-05 4.1443E-05 1.0026E-05 -3.9760E-05 4.2080E-05
9.9015E-06 -
3.9896E-05 4.1863E-05 9.5417E-06 -3.9635E-05 4.1456E-05 9.9797E-06 -3.9451E-05
4.2179E-05
9.8825E-06 -4.0071E-05 4.1717E-05
4  4.4702E-06 -8.1422E-06 9.7398E-06 4.9208E-06 -9.0384E-06 1.0701E-05
4.4192E-06 -8.1425E-06
9.6803E-06 4.4105E-06 -8.1264E-06 9.6686E-06 4.4707E-06 -8.1746E-06 9.7395E-06
4.4568E-06 -
8.1902E-06 9.7154E-06 4.4162E-06 -8.1614E-06 9.6701E-06 4.4654E-06 -8.1399E-06
9.7506E-06
4.4547E-06 -8.2099E-06 9.6991E-06
5  -8.5165E-06 4.5584E-05 -3.9916E-05 -9.0384E-06 5.0642E-05 -4.3298E-05
-8.0258E-06 4.5513E-05

```

-3.9295E-05 -7.9506E-06 4.5372E-05 -3.9192E-05 -8.4705E-06 4.5797E-05 -3.9813E-05  
-8.3501E-06  
4.5930E-05 -3.9602E-05 -7.9998E-06 4.5676E-05 -3.9206E-05 -8.4258E-06 4.5497E-05  
-3.9908E-05 -  
8.3317E-06 4.6101E-05 -3.9461E-05  
6 9.9077E-06 -3.9129E-05 4.1652E-05 1.0701E-05 -4.3298E-05 4.5396E-05  
9.5759E-06 -3.9094E-05  
4.1246E-05 9.5237E-06 -3.8996E-05 4.1174E-05 9.8843E-06 -3.9292E-05 4.1606E-05  
9.8009E-06 -  
3.9384E-05 4.1460E-05 9.5580E-06 -3.9207E-05 4.1185E-05 9.8528E-06 -3.9083E-05  
4.1670E-05  
9.7885E-06 -3.9503E-05 4.1363E-05  
7 4.4179E-06 -8.0064E-06 9.5686E-06 4.4192E-06 -8.0258E-06 9.5759E-06  
4.8823E-06 -8.7876E-06  
1.0534E-05 4.4148E-06 -8.0141E-06 9.5714E-06 4.4243E-06 -8.0232E-06 9.5836E-06  
4.4221E-06 -  
8.0257E-06 9.5799E-06 4.4156E-06 -8.0200E-06 9.5719E-06 4.4233E-06 -8.0166E-06  
9.5845E-06  
4.4219E-06 -8.0295E-06 9.5778E-06  
8 -8.3814E-06 4.5226E-05 -3.9468E-05 -8.1425E-06 4.5513E-05 -3.9094E-05  
-8.7876E-06 4.9640E-05  
-4.2813E-05 -7.9600E-06 4.5086E-05 -3.8944E-05 -8.3506E-06 4.5397E-05 -3.9403E-05  
-8.2605E-06  
4.5497E-05 -3.9246E-05 -7.9975E-06 4.5312E-05 -3.8953E-05 -8.3171E-06 4.5176E-05  
-3.9477E-05 -  
8.2468E-06 4.5622E-05 -3.9139E-05  
9 9.8778E-06 -3.9043E-05 4.1548E-05 9.6803E-06 -3.9295E-05 4.1246E-05  
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9.7809E-06 -  
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4.1571E-05  
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05 -3.9196E-05 -7.9550E-06 4.5268E-05 -3.9102E-05 -9.3776E-06 5.0105E-05  
-4.3643E-05 -8.3176E-06  
4.5782E-05 -3.9480E-05 -7.9997E-06 4.5546E-05 -3.9116E-05 -8.3862E-06 4.5386E-05  
-3.9755E-05 -  
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4.1731E-05  
1.0855E-05 -4.3524E-05 4.5505E-05

Correlation matrix of the 9 vectors

1 1.0000E+00 -5.8959E-01 7.2862E-01 8.9278E-01 -5.3020E-01 6.5148E-01  
8.8582E-01 -5.2703E-01  
6.5036E-01 8.8160E-01 -5.2560E-01 6.4938E-01 8.9724E-01 -5.2995E-01 6.5328E-01  
8.9640E-01 -  
5.3045E-01 6.5261E-01 8.8445E-01 -5.2810E-01 6.4982E-01 8.9699E-01 -5.2787E-01  
6.5322E-01  
8.9610E-01 -5.3103E-01 6.5191E-01  
2 -5.8959E-01 1.0000E+00 -9.0495E-01 -5.2134E-01 9.0981E-01 -8.2488E-01  
-5.1466E-01 9.1173E-01  
01 -8.2414E-01 -5.1105E-01 9.1170E-01 -8.2378E-01 -5.2813E-01 9.1224E-01  
-8.2350E-01 -5.2585E-01  
9.1071E-01 -8.2453E-01 -5.1349E-01 9.1072E-01 -8.2432E-01 -5.2726E-01 9.1377E-01  
-8.2240E-01 -  
5.2544E-01 9.0885E-01 -8.2502E-01  
3 7.2862E-01 -9.0495E-01 1.0000E+00 6.4288E-01 -8.2128E-01 9.0518E-01  
6.3407E-01 -8.2021E-01  
9.0409E-01 6.2933E-01 -8.1926E-01 9.0334E-01 6.5227E-01 -8.2244E-01 9.0510E-01  
6.4901E-01 -  
8.2194E-01 9.0550E-01 6.3250E-01 -8.2038E-01 9.0395E-01 6.5107E-01 -8.2187E-01  
9.0428E-01  
6.4841E-01 -8.2134E-01 9.0551E-01  
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-5.0871E-01 9.0646E-  
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9.0953E-01 6.3931E-01 -8.2340E-01 9.0943E-01 6.5217E-01 -8.2413E-01 9.0734E-01  
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G-FILE for the vectors

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ITRF position of 1071 as determined by individual baselines

	X	Y	Z
nywt	990049.637	-4552731.982	4341403.759
nydv	990049.630	-4552731.969	4341403.731
nylp	990049.618	-4552731.962	4341403.719
pwe1	990049.633	-4552731.955	4341403.707
nymx	990049.629	-4552731.969	4341403.722
nywl	990049.643	-4552731.967	4341403.729
nyhb	990049.637	-4552731.959	4341403.740
kngs	990049.628	-4552731.967	4341403.750
nywg	990049.620	-4552731.958	4341403.711

Residuals of position determined by individual baselines from the final position

	X	Y	Z	East	North
Up					
nywt	0.006	-0.017	0.028	0.002	0.008
0.033					
nydv	-0.001	-0.004	0.001	-0.002	-0.002
0.004					
nylp	-0.013	0.003	-0.011	-0.012	-0.004

	-0.011				
pwe1	0.002	0.010	-0.024	0.004	-0.011
	-0.023				
nymx	-0.002	-0.005	-0.008	-0.003	-0.009
	-0.003				
nyw1	0.011	-0.002	-0.001	0.011	-0.004
	0.002				
nyhb	0.006	0.005	0.009	0.007	0.010
	0.004				
kngs	-0.003	-0.003	0.020	-0.004	0.013
	0.015				
nywg	-0.011	0.006	-0.019	-0.010	-0.008
	-0.019				

STATE PLANE COORDINATES - U.S. Survey Foot  
SPC (3103 NY W)  
Northing (Y) [feet] 1156254.764  
Easting (X) [feet] 1375583.384  
Convergence [degrees] 0.58295000  
Point Scale 0.99999652  
Combined Factor 0.99997491

\*\*\*\*\* New Reference Frame Preview \*\*\*\*\*

We are replacing the nation's NAD 83 and NAVD 88 datums, to improve access and accuracy of the National Spatial Reference System. More at <https://geodesy.noaa.gov/datums/newdatums/>

Below are approximate coordinates for this solution in the new frames:

APPROX ORTHO HGT: 172.827 (m) [PROTOTYPE (Computed using xGeoid19B,GRS80,ITRF2014)]

dop from interpolation is 0.345  
scatter (mean square distance from rover) is 13988.216  
average edop for rover is 0.900  
average ndop for rover is 1.060  
average hdop for rover is 1.391  
average vdop for rover is 2.020  
average gdop for rover is 2.880

This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.

From: opus <opus@ngs.noaa.gov>  
Sent: Monday, November 15, 2021 8:27 AM  
To: David Zuber  
Subject: OPUS-RS solution : 10713\_0100\_315\_B.tps OP1636982699312

FILE: 10713\_0100\_315\_B.tps OP1636982699312

NGS OPUS-RS SOLUTION REPORT

=====

All computed coordinate accuracies are listed as 1-sigma RMS values.  
For additional information: <https://www.ngs.noaa.gov/OPUS/about.jsp#accuracy>

USER: dzuber@gdbgeospatial.com                      DATE: November 15, 2021  
RINEX FILE: 1071316r.21o                              TIME: 13:26:30 UTC

SOFTWARE: rsgps 1.38 RS252.pr1 1.99.3              START: 2021/11/12 17:59:45  
EPHEMERIS: igr21835.eph [rapid]                    STOP: 2021/11/12 18:29:35  
NAV FILE: brdc3160.21n                              OBS USED: 3357 / 3420 : 98%  
ANT NAME: TPSHIPER\_V                              NONE                      QUALITY IND.    3.87/ 18.90  
ARP HEIGHT: 2                                        NORMALIZED RMS:        0.407

REF FRAME: NAD\_83(2011)(EPOCH:2010.0000)                      ITRF2014 (EPOCH:2021.86510)

X:	990050.575(m)	0.009(m)	990049.612(m)	0.009(m)
Y:	-4552733.333(m)	0.031(m)	-4552731.950(m)	0.031(m)
Z:	4341403.731(m)	0.025(m)	4341403.705(m)	0.025(m)
LAT:	43 10 12.64235	0.007(m)	43 10 12.67626	0.007(m)
E LON:	282 16 7.28566	0.008(m)	282 16 7.25700	0.008(m)
W LON:	77 43 52.71434	0.008(m)	77 43 52.74300	0.008(m)
EL HGT:	137.777(m)	0.039(m)	136.625(m)	0.039(m)
ORTHO HGT:	173.265(m)	0.043(m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 18)	SPC (3103 NY W)
Northing (Y) [meters]	4783334.977	352427.151
Easting (X) [meters]	277985.345	419278.639
Convergence [degrees]	-1.86943611	0.58295000
Point Scale	1.00020639	0.99999652
Combined Factor	1.00018478	0.99997491

US NATIONAL GRID DESIGNATOR: 18TTN7798583334(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DI0628	NYWT WATERTOWN CORS ARP	N440141.658	W0755515.948	174498.0

DI1870	NYDV	DANSVILLE CORS ARP	N423256.093	W0774152.595	69071.5
DI0596	NYLP	LOCKPORT CORS ARP	N430954.854	W0784513.357	83143.2
DF5379	PWEL	PORT WELLER CORS ARP	N431412.202	W0791310.777	121184.4
DI0604	NYMX	MEXICO NY CORS ARP	N432812.379	W0761354.886	126105.7
DI0626	NYWL	WATERLOO CORS ARP	N425355.227	W0765107.302	77747.2
DI0458	NYHB	HAMBURG CORS ARP	N424302.663	W0785047.273	103988.4
DF5367	KNGS	KINGSTON CORS ARP	N441307.253	W0763102.143	152146.6
DK7408	NYWG	WATKINS GLEN CORS ARP	N422103.796	W0765233.300	114817.4

NEAREST NGS PUBLISHED CONTROL POINT					
OF2376	665	1A MCGS 1971	N430952.413	W0774357.160	632.3

OPUS-RS Extended Output, Level 2

FINAL COORDINATES (ITRF at epoch of observations)

nywt	1117375.200	-4455402.272	4410430.286
nydv	1002711.246	-4598059.023	4290846.744
nylp	908733.456	-4570061.671	4341022.853
pwel	870504.961	-4571872.981	4346729.139
nymx	1103390.425	-4503029.487	4365614.631
nywl	1064475.746	-4557027.670	4319337.363
nyhb	907896.728	-4604813.061	4304633.589
kngs	1067510.520	-4452413.001	4425573.238
nywg	1071958.840	-4597716.139	4274692.918
1071	990049.612	-4552731.950	4341403.705

Covariance matrix of the stations:

1	8.7050E-07	-2.2500E-06	2.1210E-06	-1.0260E-07	2.8760E-07	-3.1580E-07	-1.6340E-07	2.9300E-07
	-2.8910E-07	-1.9560E-07	3.2310E-07	-3.1570E-07	-2.9210E-09	2.3980E-07	-1.7360E-07	-4.7340E-08
	2.6270E-07	-2.5280E-07	-1.7310E-07	3.1510E-07	-3.4330E-07	-1.1710E-08	2.1890E-07	-9.4710E-08
	6.2360E-08	3.1070E-07	-3.3630E-07	-1.1940E-07	4.2170E-07	-3.7660E-07	-	-
2	-2.2500E-06	7.6900E-06	-6.7050E-06	2.8350E-07	-9.4320E-07	8.5360E-07	3.1570E-07	-9.9690E-07
	8.8300E-07	3.2980E-07	-1.0260E-06	9.0680E-07	2.3740E-07	-8.8660E-07	7.6590E-07	2.5700E-07
	9.0690E-07	8.0740E-07	3.1840E-07	-1.0030E-06	9.0180E-07	2.4700E-07	-9.0180E-07	7.5290E-07
	2.5990E-07	-9.1500E-07	8.3280E-07	1.1640E-07	-2.3100E-07	2.5870E-07	-	-
3	2.1210E-06	-6.7050E-06	6.2530E-06	-2.7200E-07	8.2790E-07	-8.1930E-07	-3.6480E-07	9.0370E-07
	-8.3980E-07	-4.0960E-07	9.6440E-07	-8.9160E-07	-1.3620E-07	7.4190E-07	-6.1290E-07	-1.9470E-07



7.7360E-07 -7.1890E-07 -3.7430E-07 9.1930E-07 -8.9920E-07 -1.5980E-07 7.5830E-07  
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10 -1.9560E-07 3.2980E-07 -4.0960E-07 -1.8820E-10 1.3500E-07 -3.9010E-08  
8.7960E-08 8.2010E-  
08 -3.3830E-08 5.5980E-07 -1.5450E-06 1.3400E-06 -1.5480E-07 2.8600E-07  
-2.9800E-07 -8.4010E-08  
2.1310E-07 -1.5830E-07 1.0170E-07 4.7030E-08 3.9750E-08 -1.4240E-07 3.1140E-07

-3.9910E-07 -  
6.1540E-08 1.4010E-07 -4.1690E-08 1.5750E-07 -4.7030E-07 4.0940E-07  
11 3.2310E-07 -1.0260E-06 9.6440E-07 1.4050E-07 -8.5960E-07 6.3000E-07  
6.2670E-08 -8.4620E-07  
6.5270E-07 -1.5450E-06 7.4220E-06 -6.0000E-06 2.8380E-07 -9.8350E-07 8.5890E-07  
2.1740E-07 -  
9.1870E-07 7.3090E-07 4.8680E-08 -8.0920E-07 5.8010E-07 2.7650E-07 -1.0250E-06  
9.6790E-07  
1.9400E-07 -8.4120E-07 6.1510E-07 -1.3160E-07 2.9660E-07 -2.6260E-07  
12 -3.1570E-07 9.0680E-07 -8.9160E-07 -1.0550E-07 6.6990E-07 -4.8280E-07  
-2.5320E-08 6.6230E-  
07 -5.1340E-07 1.3400E-06 -6.0000E-06 5.1530E-06 -2.6760E-07 8.4030E-07  
-7.5950E-07 -1.9080E-07  
7.4950E-07 -6.0400E-07 -7.7460E-09 6.1000E-07 -4.2530E-07 -2.6610E-07 9.0710E-07  
-8.9690E-07 -  
1.6220E-07 6.5330E-07 -4.6890E-07 1.4240E-07 -3.5150E-07 3.2990E-07  
13 -2.9210E-09 2.3740E-07 -1.3620E-07 -8.7950E-08 2.6300E-07 -2.7200E-07  
-1.3170E-07 2.6400E-  
07 -2.4990E-07 -1.5480E-07 2.8380E-07 -2.6760E-07 7.6160E-07 -2.0880E-06  
1.8590E-06 -4.9290E-08  
2.5100E-07 -2.3130E-07 -1.3820E-07 2.7800E-07 -2.8780E-07 -2.6040E-08 2.2820E-07  
-1.2440E-07 -  
5.9480E-08 2.8330E-07 -2.8990E-07 -9.2710E-08 3.3820E-07 -2.9640E-07  
14 2.3980E-07 -8.8660E-07 7.4190E-07 2.5980E-07 -9.0760E-07 7.8680E-07  
2.7910E-07 -9.6180E-07  
8.2330E-07 2.8600E-07 -9.8350E-07 8.4030E-07 -2.0880E-06 7.4780E-06 -6.3030E-06  
2.4750E-07 -  
8.8500E-07 7.6160E-07 2.7860E-07 -9.5770E-07 8.2580E-07 2.5090E-07 -9.0870E-07  
7.5930E-07  
2.4550E-07 -8.7670E-07 7.6360E-07 1.0130E-07 -2.2640E-07 2.2570E-07  
15 -1.7360E-07 7.6590E-07 -6.1290E-07 -2.3130E-07 7.6190E-07 -6.9890E-07  
-2.7790E-07 8.2600E-  
07 -7.3200E-07 -2.9800E-07 8.5890E-07 -7.5950E-07 1.8590E-06 -6.3030E-06  
5.6330E-06 -1.9940E-07  
7.4300E-07 -6.5930E-07 -2.7900E-07 8.1900E-07 -7.4670E-07 -1.9860E-07 7.8650E-07  
-6.2780E-07 -  
2.0050E-07 7.4240E-07 -6.8510E-07 -1.3460E-07 3.7350E-07 -3.2660E-07  
16 -4.7340E-08 2.5700E-07 -1.9470E-07 -6.4340E-08 2.2610E-07 -2.0600E-07  
-7.7130E-08 2.1630E-  
07 -1.8960E-07 -8.4010E-08 2.1740E-07 -1.9080E-07 -4.9290E-08 2.4750E-07  
-1.9940E-07 6.2130E-07 -  
1.8700E-06 1.5840E-06 -7.8560E-08 2.1730E-07 -1.9990E-07 -5.2460E-08 2.4650E-07  
-1.8390E-07 -  
5.7100E-08 2.4220E-07 -2.1990E-07 -3.0990E-08 1.4140E-07 -1.1970E-07  
17 2.6270E-07 -9.0690E-07 7.7360E-07 2.2400E-07 -8.6600E-07 7.0440E-07  
2.1910E-07 -9.1250E-07  
7.4600E-07 2.1310E-07 -9.1870E-07 7.4950E-07 2.5100E-07 -8.8500E-07 7.4300E-07  
-1.8700E-06  
7.2560E-06 -5.9120E-06 2.1380E-07 -8.9460E-07 7.2380E-07 2.5920E-07 -9.2760E-07  
7.9150E-07

2.2700E-07 -8.3410E-07 6.8010E-07 3.6560E-08 -6.3170E-08 5.9840E-08  
18 -2.5280E-07 8.0740E-07 -7.1890E-07 -1.8010E-07 6.8920E-07 -5.6340E-07  
-1.6870E-07 7.3370E-  
07 -6.0770E-07 -1.5830E-07 7.3090E-07 -6.0400E-07 -2.3130E-07 7.6160E-07  
-6.5930E-07 1.5840E-06 -  
5.9120E-06 5.1120E-06 -1.5980E-07 7.0060E-07 -5.6890E-07 -2.4370E-07 8.2560E-07  
-7.3560E-07 -  
1.8940E-07 6.6290E-07 -5.4280E-07 -1.2200E-08 1.9090E-09 1.5550E-08  
19 -1.7310E-07 3.1840E-07 -3.7430E-07 -8.4880E-09 1.4530E-07 -5.8020E-08  
6.4240E-08 1.0020E-  
07 -5.2340E-08 1.0170E-07 4.8680E-08 -7.7460E-09 -1.3820E-07 2.7860E-07  
-2.7900E-07 -7.8560E-08  
2.1380E-07 -1.5980E-07 5.3150E-07 -1.5590E-06 1.3580E-06 -1.2870E-07 3.0180E-07  
-3.6430E-07 -  
5.9490E-08 1.5160E-07 -6.2120E-08 1.3030E-07 -3.8090E-07 3.3510E-07  
20 3.1510E-07 -1.0030E-06 9.1930E-07 1.4900E-07 -8.4160E-07 6.1040E-07  
8.3400E-08 -8.4490E-07  
6.4250E-07 4.7030E-08 -8.0920E-07 6.1000E-07 2.7800E-07 -9.5770E-07 8.1900E-07  
2.1730E-07 -  
8.9460E-07 7.0060E-07 -1.5590E-06 7.2900E-06 -5.8220E-06 2.7550E-07 -1.0090E-06  
9.2810E-07  
1.9460E-07 -8.1860E-07 5.9220E-07 -1.0930E-07 2.5770E-07 -2.4120E-07  
21 -3.4330E-07 9.0180E-07 -8.9920E-07 -1.0210E-07 6.3580E-07 -4.3170E-07  
-1.1150E-08 6.3490E-  
07 -4.7420E-07 3.9750E-08 5.8010E-07 -4.2530E-07 -2.8780E-07 8.2580E-07  
-7.4670E-07 -1.9990E-07  
7.2380E-07 -5.6890E-07 1.3580E-06 -5.8220E-06 4.9780E-06 -2.8740E-07 9.0700E-07  
-9.0980E-07 -  
1.6650E-07 6.1180E-07 -4.1160E-07 1.6070E-07 -4.4880E-07 4.2360E-07  
22 -1.1710E-08 2.4700E-07 -1.5980E-07 -8.5780E-08 2.6770E-07 -2.7780E-07  
-1.2250E-07 2.6140E-  
07 -2.5250E-07 -1.4240E-07 2.7650E-07 -2.6610E-07 -2.6040E-08 2.5090E-07  
-1.9860E-07 -5.2460E-08  
2.5920E-07 -2.4370E-07 -1.2870E-07 2.7550E-07 -2.8740E-07 7.4280E-07 -2.1270E-06  
1.9820E-06 -  
6.1850E-08 2.8920E-07 -2.9650E-07 -8.2200E-08 3.0830E-07 -2.7750E-07  
23 2.1890E-07 -9.0180E-07 7.5830E-07 2.7070E-07 -9.5940E-07 8.6710E-07  
2.9860E-07 -1.0010E-06  
8.8690E-07 3.1140E-07 -1.0250E-06 9.0710E-07 2.2820E-07 -9.0870E-07 7.8650E-07  
2.4650E-07 -  
9.2760E-07 8.2560E-07 3.0180E-07 -1.0090E-06 9.0700E-07 -2.1270E-06 7.7820E-06  
-6.7910E-06  
2.5000E-07 -9.3790E-07 8.5170E-07 1.2410E-07 -3.2890E-07 3.3880E-07  
24 -9.4710E-08 7.5290E-07 -5.4680E-07 -2.6180E-07 8.4370E-07 -8.3540E-07  
-3.5390E-07 9.0940E-  
07 -8.4680E-07 -3.9910E-07 9.6790E-07 -8.9690E-07 -1.2440E-07 7.5930E-07  
-6.2780E-07 -1.8390E-07  
7.9150E-07 -7.3560E-07 -3.6430E-07 9.2810E-07 -9.0980E-07 1.9820E-06 -6.7910E-06  
6.3440E-06 -  
1.9950E-07 8.3860E-07 -8.3420E-07 -2.2300E-07 6.9880E-07 -6.3010E-07

25 -6.2360E-08 2.5990E-07 -2.0900E-07 -5.6800E-08 2.0980E-07 -1.7880E-07  
-5.9900E-08 1.9860E-  
07 -1.6600E-07 -6.1540E-08 1.9400E-07 -1.6220E-07 -5.9480E-08 2.4550E-07  
-2.0050E-07 -5.7100E-08  
2.2700E-07 -1.8940E-07 -5.9490E-08 1.9460E-07 -1.6650E-07 -6.1850E-08 2.5000E-07  
-1.9950E-07  
5.8950E-07 -1.7790E-06 1.4720E-06 -1.1440E-08 7.4600E-08 -5.7790E-08  
26 3.1070E-07 -9.1500E-07 8.1640E-07 1.9890E-07 -8.1050E-07 6.1180E-07  
1.6300E-07 -8.5300E-07  
6.6570E-07 1.4010E-07 -8.4120E-07 6.5330E-07 2.8330E-07 -8.7670E-07 7.4240E-07  
2.4220E-07 -  
8.3410E-07 6.6290E-07 1.5160E-07 -8.1860E-07 6.1180E-07 2.8920E-07 -9.3790E-07  
8.3860E-07 -  
1.7790E-06 6.9980E-06 -5.6030E-06 -2.6940E-08 1.5400E-07 -1.4350E-07  
27 -3.3630E-07 8.3280E-07 -8.1280E-07 -1.4480E-07 6.1770E-07 -4.4060E-07  
-8.0330E-08 6.4920E-  
07 -5.0010E-07 -4.1690E-08 6.1510E-07 -4.6890E-07 -2.8990E-07 7.6360E-07  
-6.8510E-07 -2.1990E-07  
6.8010E-07 -5.4280E-07 -6.2120E-08 5.9220E-07 -4.1160E-07 -2.9650E-07 8.5170E-07  
-8.3420E-07  
1.4720E-06 -5.6030E-06 4.8070E-06 8.9090E-08 -3.4660E-07 3.2940E-07  
28 -1.1940E-07 1.1640E-07 -2.1110E-07 4.1900E-08 -3.2330E-08 9.2050E-08  
1.1820E-07 -7.8610E-  
08 9.6610E-08 1.5750E-07 -1.3160E-07 1.4240E-07 -9.2710E-08 1.0130E-07  
-1.3460E-07 -3.0990E-08  
3.6560E-08 -1.2200E-08 1.3030E-07 -1.0930E-07 1.6070E-07 -8.2200E-08 1.2410E-07  
-2.2300E-07 -  
1.1440E-08 -2.6940E-08 8.9090E-08 5.1750E-06 -1.7040E-05 1.4510E-05  
29 4.2170E-07 -2.3100E-07 5.9650E-07 -9.3080E-08 9.7710E-08 -2.9620E-07  
-3.3970E-07 1.5570E-  
07 -2.2730E-07 -4.7030E-07 2.9660E-07 -3.5150E-07 3.3820E-07 -2.2640E-07  
3.7350E-07 1.4140E-07 -  
6.3170E-08 1.9090E-09 -3.8090E-07 2.5770E-07 -4.4880E-07 3.0830E-07 -3.2890E-07  
6.9880E-07  
7.4600E-08 1.5400E-07 -3.4660E-07 -1.7040E-05 7.2920E-05 -5.9440E-05  
30 -3.7660E-07 2.5870E-07 -5.3970E-07 8.6710E-08 -9.7470E-08 2.8770E-07  
2.9660E-07 -1.3910E-  
07 2.2110E-07 4.0940E-07 -2.6260E-07 3.2990E-07 -2.9640E-07 2.2570E-07  
-3.2660E-07 -1.1970E-07  
5.9840E-08 1.5550E-08 3.3510E-07 -2.4120E-07 4.2360E-07 -2.7750E-07 3.3880E-07  
-6.3010E-07 -  
5.7790E-08 -1.4350E-07 3.2940E-07 1.4510E-05 -5.9440E-05 5.1220E-05

Covariance Matrix for the xyz OPUS Rover Position (meters^2).

0.0000051750	-0.0000170400	0.0000145100
-0.0000170400	0.0000729200	-0.0000594400
0.0000145100	-0.0000594400	0.0000512200

Covariance Matrix for the enu OPUS Position (meters^2).

0.0000011575	0.0000001546	0.0000021046
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0.0000001546    0.0000021584    -0.0000085136
0.0000021046   -0.0000085136     0.0001259990

```

```

Horizontal network accuracy = 0.00319 meters.
Vertical network accuracy   = 0.02201 meters.

```

		Vectors		
To	From	X	Y	Z
nywt	1071	127325.588	97329.679	69026.582
nydv	1071	12661.634	-45327.073	-50556.961
nylp	1071	-81316.156	-17329.721	-380.852
pwel	1071	-119544.651	-19141.031	5325.434
nymx	1071	113340.813	49702.463	24210.926
nywl	1071	74426.134	-4295.720	-22066.342
nyhb	1071	-82152.884	-52081.111	-36770.116
kngs	1071	77460.908	100318.949	84169.534
nywg	1071	81909.228	-44984.189	-66710.787

Covariance matrix of the 9 vectors

```

1  6.2843E-06 -1.9828E-05  1.7219E-05  5.1499E-06 -1.7142E-05  1.4479E-05
5.0128E-06 -1.7090E-05
1.4501E-05  4.9413E-06 -1.7007E-05  1.4428E-05  5.3842E-06 -1.7323E-05  1.4848E-05
5.2780E-06 -
1.7236E-05  1.4646E-05  4.9910E-06 -1.7037E-05  1.4383E-05  5.3649E-06 -1.7367E-05
1.5015E-05
5.2435E-06 -1.7124E-05  1.4461E-05
2  -1.9828E-05  8.1072E-05 -6.7000E-05 -1.6780E-05  7.2110E-05 -5.8549E-05
-1.6501E-05  7.1998E-05
-5.8588E-05 -1.6356E-05  7.1828E-05 -5.8440E-05 -1.7257E-05  7.2491E-05 -5.9306E-05
-1.7041E-05
7.2307E-05 -5.8893E-05 -1.6457E-05  7.1890E-05 -5.8348E-05 -1.7218E-05  7.2578E-05
-5.9645E-05 -
1.6971E-05  7.2082E-05 -5.8519E-05
3  1.7219E-05 -6.7000E-05  5.8552E-05  1.4362E-05 -5.9111E-05  5.0653E-05
1.4060E-05 -5.8994E-05
5.0699E-05  1.3902E-05 -5.8809E-05  5.0538E-05  1.4881E-05 -5.9520E-05  5.1473E-05
1.4646E-05 -
5.9323E-05  5.1025E-05  1.4012E-05 -5.8876E-05  5.0437E-05  1.4839E-05 -5.9617E-05
5.1843E-05
1.4570E-05 -5.9077E-05  5.0618E-05
4  5.1499E-06 -1.6780E-05  1.4362E-05  5.6214E-06 -1.8604E-05  1.5753E-05
5.0019E-06 -1.6706E-05
1.4202E-05  4.9754E-06 -1.6675E-05  1.4175E-05  5.1379E-06 -1.6788E-05  1.4327E-05
5.0997E-06 -
1.6759E-05  1.4255E-05  4.9943E-06 -1.6689E-05  1.4160E-05  5.1295E-06 -1.6800E-05
1.4384E-05
5.0877E-06 -1.6721E-05  1.4189E-05
5  -1.7142E-05  7.2110E-05 -5.9111E-05 -1.8604E-05  7.9896E-05 -6.4774E-05
-1.6513E-05  7.1795E-05

```

-5.8433E-05 -1.6402E-05 7.1666E-05 -5.8321E-05 -1.7083E-05 7.2141E-05 -5.8954E-05  
-1.6923E-05  
7.2019E-05 -5.8655E-05 -1.6481E-05 7.1723E-05 -5.8258E-05 -1.7048E-05 7.2192E-05  
-5.9198E-05 -  
1.6872E-05 7.1858E-05 -5.8378E-05  
6 1.4479E-05 -5.8549E-05 5.0653E-05 1.5753E-05 -6.4774E-05 5.5542E-05  
1.4046E-05 -5.8341E-05  
5.0198E-05 1.3970E-05 -5.8251E-05 5.0120E-05 1.4442E-05 -5.8583E-05 5.0560E-05  
1.4332E-05 -  
5.8499E-05 5.0353E-05 1.4025E-05 -5.8292E-05 5.0077E-05 1.4418E-05 -5.8616E-05  
5.0727E-05  
1.4297E-05 -5.8388E-05 5.0162E-05  
7 5.0128E-06 -1.6501E-05 1.4060E-05 5.0019E-06 -1.6513E-05 1.4046E-05  
5.4651E-06 -1.8199E-05  
1.5474E-05 4.9873E-06 -1.6506E-05 1.4046E-05 5.0178E-06 -1.6522E-05 1.4070E-05  
5.0107E-06 -  
1.6518E-05 1.4057E-05 4.9907E-06 -1.6508E-05 1.4042E-05 5.0165E-06 -1.6526E-05  
1.4082E-05  
5.0083E-06 -1.6510E-05 1.4044E-05  
8 -1.7090E-05 7.1998E-05 -5.8994E-05 -1.6706E-05 7.1795E-05 -5.8341E-05  
-1.8199E-05 8.0008E-05  
-6.5057E-05 -1.6409E-05 7.1622E-05 -5.8287E-05 -1.7036E-05 7.2029E-05 -5.8848E-05  
-1.6886E-05  
7.1915E-05 -5.8569E-05 -1.6480E-05 7.1662E-05 -5.8217E-05 -1.7008E-05 7.2092E-05  
-5.9090E-05 -  
1.6837E-05 7.1757E-05 -5.8305E-05  
9 1.4501E-05 -5.8588E-05 5.0699E-05 1.4202E-05 -5.8433E-05 5.0198E-05  
1.5474E-05 -6.5057E-05  
5.5916E-05 1.3970E-05 -5.8297E-05 5.0156E-05 1.4460E-05 -5.8615E-05 5.0594E-05  
1.4343E-05 -  
5.8527E-05 5.0376E-05 1.4026E-05 -5.8329E-05 5.0101E-05 1.4438E-05 -5.8665E-05  
5.0782E-05  
1.4305E-05 -5.8403E-05 5.0169E-05  
10 4.9413E-06 -1.6356E-05 1.3902E-05 4.9754E-06 -1.6402E-05 1.3970E-05  
4.9873E-06 -1.6409E-05  
1.3970E-05 5.4198E-06 -1.7983E-05 1.5298E-05 4.9554E-06 -1.6385E-05 1.3937E-05  
4.9645E-06 -  
1.6393E-05 1.3954E-05 4.9889E-06 -1.6413E-05 1.3980E-05 4.9573E-06 -1.6382E-05  
1.3925E-05  
4.9674E-06 -1.6403E-05 1.3970E-05  
11 -1.7007E-05 7.1828E-05 -5.8809E-05 -1.6675E-05 7.1666E-05 -5.8251E-05  
-1.6506E-05 7.1622E-  
05 -5.8297E-05 -1.7983E-05 7.9749E-05 -6.4826E-05 -1.6963E-05 7.1866E-05  
-5.8692E-05 -1.6832E-05  
7.1768E-05 -5.8448E-05 -1.6479E-05 7.1556E-05 -5.8149E-05 -1.6940E-05 7.1927E-05  
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1.6789E-05 7.1628E-05 -5.8216E-05  
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1.4321E-05 -  
5.8473E-05 5.0332E-05 1.4024E-05 -5.8260E-05 5.0055E-05 1.4402E-05 -5.8580E-05  
5.0687E-05  
1.5951E-05 -6.4553E-05 5.5368E-05

Correlation matrix of the 9 vectors

1 1.0000E+00 -8.7845E-01 8.9763E-01 8.6646E-01 -7.6501E-01 7.7499E-01  
8.5537E-01 -7.6217E-01  
7.7357E-01 8.4668E-01 -7.5969E-01 7.7111E-01 8.6805E-01 -7.6852E-01 7.8103E-01  
8.6988E-01 -  
7.6724E-01 7.7863E-01 8.5315E-01 -7.6130E-01 7.7116E-01 8.6776E-01 -7.6805E-01  
7.8094E-01  
8.6946E-01 -7.6559E-01 7.7526E-01  
2 -8.7845E-01 1.0000E+00 -9.7245E-01 -7.8601E-01 8.9598E-01 -8.7252E-01  
-7.8393E-01 8.9397E-01  
01 -8.7018E-01 -7.8029E-01 8.9330E-01 -8.6956E-01 -7.7462E-01 8.9538E-01  
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8.9615E-01 -8.7171E-01 -7.8322E-01 8.9438E-01 -8.7102E-01 -7.7537E-01 8.9365E-01  
-8.6369E-01 -  
7.8349E-01 8.9724E-01 -8.7344E-01  
3 8.9763E-01 -9.7245E-01 1.0000E+00 7.9165E-01 -8.6424E-01 8.8822E-01  
7.8597E-01 -8.6192E-01  
8.8605E-01 7.8040E-01 -8.6062E-01 8.8485E-01 7.8600E-01 -8.6507E-01 8.8706E-01  
7.9080E-01 -  
8.6514E-01 8.8870E-01 7.8466E-01 -8.6189E-01 8.8596E-01 7.8631E-01 -8.6376E-01  
8.8336E-01  
7.9149E-01 -8.6529E-01 8.8899E-01  
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9.0242E-01 -7.8772E-01  
8.0106E-01 9.0140E-01 -7.8755E-01 8.0100E-01 8.7582E-01 -7.8749E-01 7.9683E-01  
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-8.6445E-01 -  
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G-FILE for the vectors

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ITRF position of 1071 as determined by individual baselines

	X	Y	Z
nywt	990049.618	-4552731.958	4341403.721
nydv	990049.626	-4552732.000	4341403.741
nylp	990049.600	-4552731.958	4341403.711
pwel	990049.617	-4552732.010	4341403.752
nymx	990049.617	-4552731.956	4341403.707
nywl	990049.621	-4552731.956	4341403.700
nyhb	990049.621	-4552731.945	4341403.698
kngs	990049.610	-4552731.962	4341403.724
nywg	990049.604	-4552731.914	4341403.682

Residuals of position determined by individual baselines from the final position

	X	Y	Z	East	North
Up					
nywt	0.006	-0.008	0.017	0.004	0.006
0.018					
nydv	0.014	-0.050	0.036	0.003	-0.009
0.063					
nylp	-0.012	-0.008	0.006	-0.014	0.001

	0.008				
pwe1	0.005	-0.060	0.047	-0.008	-0.006
	0.076				
nymx	0.005	-0.006	0.002	0.004	-0.003
	0.007				
nyw1	0.009	-0.006	-0.005	0.008	-0.009
	0.002				
nyhb	0.009	0.005	-0.007	0.010	-0.003
	-0.007				
kngs	-0.002	-0.012	0.019	-0.004	0.006
	0.021				
nywg	-0.008	0.037	-0.022	-0.000	0.009
	-0.043				

STATE PLANE COORDINATES - U.S. Survey Foot  
SPC (3103 NY W)  
Northing (Y) [feet] 1156254.745  
Easting (X) [feet] 1375583.335  
Convergence [degrees] 0.58295000  
Point Scale 0.99999652  
Combined Factor 0.99997491

\*\*\*\*\* New Reference Frame Preview \*\*\*\*\*

We are replacing the nation's NAD 83 and NAVD 88 datums, to improve access and accuracy of the National Spatial Reference System. More at <https://geodesy.noaa.gov/datums/newdatums/>

Below are approximate coordinates for this solution in the new frames:

APPROX ORTHO HGT: 172.797 (m) [PROTOTYPE (Computed using xGeoid19B,GRS80,ITRF2014)]

dop from interpolation is 0.345  
scatter (mean square distance from rover) is 13988.217  
average edop for rover is 0.650  
average ndop for rover is 0.860  
average hdop for rover is 1.078  
average vdop for rover is 1.850  
average gdop for rover is 2.450

This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.



From: opus <opus@ngs.noaa.gov>  
Sent: Monday, November 15, 2021 8:27 AM  
To: David Zuber  
Subject: OPUS-RS solution : 10713\_0100\_315\_C.tps OP1636982729073

FILE: 10713\_0100\_315\_C.tps OP1636982729073

NGS OPUS-RS SOLUTION REPORT

=====

All computed coordinate accuracies are listed as 1-sigma RMS values.  
For additional information: <https://www.ngs.noaa.gov/OPUS/about.jsp#accuracy>

USER: dzuber@gdbgeospatial.com                      DATE: November 15, 2021  
RINEX FILE: 1071316s.21o                              TIME: 13:26:31 UTC

SOFTWARE: rsgps 1.38 RS272.pr1 1.99.3              START: 2021/11/12 18:39:25  
EPHEMERIS: igr21835.eph [rapid]                    STOP: 2021/11/12 19:02:10  
NAV FILE: brdc3160.21n                              OBS USED: 2286 / 2412 : 95%  
ANT NAME: TPSHIPER\_V                              NONE                      QUALITY IND: 20.59/ 26.26  
ARP HEIGHT: 2                                        NORMALIZED RMS:           0.372

REF FRAME: NAD\_83(2011)(EPOCH:2010.0000)                      ITRF2014 (EPOCH:2021.86517)

X:	990050.588(m)	0.012(m)	990049.625(m)	0.012(m)
Y:	-4552733.340(m)	0.028(m)	-4552731.957(m)	0.028(m)
Z:	4341403.734(m)	0.018(m)	4341403.708(m)	0.018(m)
LAT:	43 10 12.64220	0.009(m)	43 10 12.67612	0.009(m)
E LON:	282 16 7.28616	0.007(m)	282 16 7.25750	0.007(m)
W LON:	77 43 52.71384	0.007(m)	77 43 52.74250	0.007(m)
EL HGT:	137.786(m)	0.033(m)	136.634(m)	0.033(m)
ORTHO HGT:	173.274(m)	0.038(m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 18)	SPC (3103 NY W)
Northing (Y) [meters]	4783334.972	352427.147
Easting (X) [meters]	277985.356	419278.650
Convergence [degrees]	-1.86943333	0.58295000
Point Scale	1.00020639	0.99999652
Combined Factor	1.00018478	0.99997491

US NATIONAL GRID DESIGNATOR: 18TTN7798583334(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DI0628	NYWT WATERTOWN CORS ARP	N440141.658	W0755515.948	174498.0

DI1870	NYDV	DANSVILLE	CORS	ARP	N423256.093	W0774152.595	69071.5
DI0596	NYLP	LOCKPORT	CORS	ARP	N430954.854	W0784513.357	83143.2
DF5379	PWEL	PORT WELLER	CORS	ARP	N431412.202	W0791310.777	121184.4
DI0604	NYMX	MEXICO NY	CORS	ARP	N432812.379	W0761354.886	126105.7
DI0626	NYWL	WATERLOO	CORS	ARP	N425355.227	W0765107.302	77747.2
DI0458	NYHB	HAMBURG	CORS	ARP	N424302.663	W0785047.273	103988.4
DF5367	KNGS	KINGSTON	CORS	ARP	N441307.253	W0763102.143	152146.6
DK7408	NYWG	WATKINS GLEN	CORS	ARP	N422103.796	W0765233.300	114817.3

NEAREST NGS PUBLISHED CONTROL POINT							
OF2376	665	1A	MCGS	1971	N430952.413	W0774357.160	632.3

OPUS-RS Extended Output, Level 2

FINAL COORDINATES (ITRF at epoch of observations)

nywt	1117375.202	-4455402.287	4410430.301
nydv	1002711.246	-4598059.020	4290846.740
nylp	908733.451	-4570061.658	4341022.842
pwel	870504.970	-4571873.025	4346729.169
nymx	1103390.424	-4503029.490	4365614.641
nywl	1064475.742	-4557027.653	4319337.350
nyhb	907896.721	-4604813.021	4304633.556
kngs	1067510.527	-4452413.029	4425573.260
nywg	1071958.839	-4597716.123	4274692.903
1071	990049.625	-4552731.957	4341403.708

Covariance matrix of the stations:

1	1.5480E-06	-4.2840E-06	3.3550E-06	-2.0580E-07	6.1260E-07	-4.5370E-07
	-1.9180E-07	7.4270E-07				
	-5.8300E-07	-1.8240E-07	7.9740E-07	-6.2890E-07	-1.4790E-07	2.4010E-07
	-1.7810E-07					
	4.0540E-07	-3.1350E-07	-2.0560E-07	8.0970E-07	-6.1000E-07	-1.3260E-07
	-2.2980E-07					
	1.9200E-07	4.5250E-07	-3.2540E-07	1.7930E-07	-6.0790E-07	4.5890E-07
2	-4.2840E-06	1.4180E-05	-1.0870E-05	7.0670E-07	-2.2440E-06	1.5370E-06
	6.5070E-07	-3.4150E-06				
	2.6680E-06	5.9610E-07	-3.9020E-06	3.0720E-06	2.9390E-07	4.9560E-07
	5.0660E-07					
	7.0550E-07	5.0130E-07	7.3220E-07	-3.8350E-06	2.8000E-06	2.0440E-07
	-9.4810E-09					
	5.9100E-07	-9.9300E-07	5.3410E-07	-1.5130E-06	5.1180E-06	-3.9150E-06
3	3.3550E-06	-1.0870E-05	8.7200E-06	-5.2540E-07	1.6540E-06	-1.1750E-06
	-5.0660E-07	2.4890E-06				
	-1.9680E-06	-4.7660E-07	2.8340E-06	-2.2530E-06	-2.5340E-07	-1.4880E-07
	-3.9130E-07					

6.3480E-07 -4.8730E-07 -5.5550E-07 2.7480E-06 -2.0410E-06 -2.0440E-07 -1.4160E-07  
-1.7900E-07 -  
4.4060E-07 8.0490E-07 -4.9500E-07 9.7670E-07 -3.3320E-06 2.5700E-06  
4 -2.0580E-07 7.0670E-07 -5.2540E-07 1.8090E-06 -5.5620E-06 4.1980E-06  
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-2.0920E-07  
7.2700E-07 -5.5830E-07 -2.1450E-07 8.1600E-07 -6.2420E-07 -1.9230E-07 6.6530E-07  
-5.1950E-07 -  
2.1520E-07 7.4690E-07 -5.6930E-07 -2.9150E-08 2.0560E-07 -1.5880E-07  
8 7.4270E-07 -3.4150E-06 2.4890E-06 6.7940E-07 -2.4280E-06 1.9930E-06  
-5.8620E-06 2.2270E-05  
-1.7120E-05 8.6230E-07 -2.1840E-06 1.6800E-06 7.0740E-07 -3.1890E-06 2.4080E-06  
6.7430E-07 -  
2.8240E-06 2.2280E-06 7.9290E-07 -2.1690E-06 1.7700E-06 7.4690E-07 -3.1880E-06  
2.2760E-06  
6.5700E-07 -2.7620E-06 2.2750E-06 1.0880E-06 -3.7260E-06 2.8910E-06  
9 -5.8300E-07 2.6680E-06 -1.9680E-06 -5.1350E-07 1.8470E-06 -1.5380E-06  
4.5130E-06 -1.7120E-05  
1.3500E-05 -6.6540E-07 1.7000E-06 -1.3290E-06 -5.4930E-07 2.4760E-06 -1.8910E-06  
-5.1600E-07  
2.1720E-06 -1.7340E-06 -6.0230E-07 1.6520E-06 -1.3690E-06 -5.8950E-07 2.5050E-06  
-1.8140E-06 -  
4.9460E-07 2.0990E-06 -1.7510E-06 -8.3500E-07 2.8730E-06 -2.2100E-06  
10 -1.8240E-07 5.9610E-07 -4.7660E-07 -2.2060E-07 8.2910E-07 -6.2590E-07  
-2.0420E-07 8.6230E-07  
07 -6.6540E-07 1.7360E-06 -5.9620E-06 4.5980E-06 -1.9470E-07 6.4940E-07  
-5.0780E-07 -2.0960E-07  
7.3270E-07 -5.6050E-07 -2.1200E-07 8.9880E-07 -6.8220E-07 -1.8330E-07 6.3100E-07

-5.0810E-07 -  
2.1830E-07 7.6150E-07 -5.7120E-07 3.2610E-08 4.0040E-08 -3.1990E-08  
11 7.9740E-07 -3.9020E-06 2.8340E-06 6.7840E-07 -2.5450E-06 2.1160E-06  
7.9380E-07 -2.1840E-06  
1.7000E-06 -5.9620E-06 2.4180E-05 -1.8650E-05 7.4710E-07 -3.6030E-06 2.7180E-06  
6.9290E-07 -  
3.1080E-06 2.4610E-06 7.9100E-07 -2.1100E-06 1.7530E-06 7.9460E-07 -3.5980E-06  
2.5530E-06  
6.6810E-07 -3.0190E-06 2.5110E-06 1.2960E-06 -4.5330E-06 3.5200E-06  
12 -6.2890E-07 3.0720E-06 -2.2530E-06 -5.1180E-07 1.9340E-06 -1.6320E-06  
-6.1210E-07 1.6800E-  
06 -1.3290E-06 4.5980E-06 -1.8650E-05 1.4720E-05 -5.8220E-07 2.8170E-06  
-2.1460E-06 -5.3080E-07  
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-2.0410E-06 -  
5.0280E-07 2.3060E-06 -1.9420E-06 -1.0140E-06 3.5560E-06 -2.7420E-06  
13 -1.4790E-07 2.9390E-07 -2.5340E-07 -2.0690E-07 6.1870E-07 -4.6310E-07  
-1.9950E-07 7.0740E-  
07 -5.4930E-07 -1.9470E-07 7.4710E-07 -5.8220E-07 1.6050E-06 -4.4560E-06  
3.4620E-06 -1.8560E-07  
4.7450E-07 -3.6430E-07 -2.1050E-07 7.5840E-07 -5.7310E-07 -1.5320E-07 3.4810E-07  
-3.0090E-07 -  
1.9570E-07 5.0880E-07 -3.7580E-07 7.8830E-08 -2.7770E-07 2.0930E-07  
14 2.4010E-07 4.9560E-07 -1.4880E-07 7.0470E-07 -2.2260E-06 1.5620E-06  
6.8100E-07 -3.1890E-06  
2.4760E-06 6.4940E-07 -3.6030E-06 2.8170E-06 -4.4560E-06 1.4420E-05 -1.1100E-05  
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9.9630E-07 7.2760E-07 7.4960E-07 -3.5350E-06 2.5960E-06 2.9490E-07 -2.6870E-08  
3.1150E-07  
6.0100E-07 -1.2240E-06 7.6060E-07 -1.0550E-06 3.6090E-06 -2.7640E-06  
15 -2.1110E-07 -2.3020E-07 -1.0870E-08 -5.2980E-07 1.6730E-06 -1.2010E-06  
-5.2680E-07 2.4080E-  
06 -1.8910E-06 -5.0780E-07 2.7180E-06 -2.1460E-06 3.4620E-06 -1.1100E-05  
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8.0370E-07 -6.1220E-07 -5.6910E-07 2.6300E-06 -1.9570E-06 -2.5480E-07 1.5730E-07  
-3.5140E-07 -  
4.5100E-07 9.4370E-07 -6.1900E-07 7.3760E-07 -2.5310E-06 1.9550E-06  
16 -1.7810E-07 5.0660E-07 -3.9130E-07 -2.0920E-07 6.4230E-07 -4.8770E-07  
-2.0920E-07 6.7430E-  
07 -5.1600E-07 -2.0960E-07 6.9290E-07 -5.3080E-07 -1.8560E-07 5.3430E-07  
-4.1060E-07 1.7020E-06 -  
4.8770E-06 3.7320E-06 -2.1630E-07 7.0430E-07 -5.3540E-07 -1.8110E-07 5.2430E-07  
-4.0590E-07 -  
2.0190E-07 5.9860E-07 -4.5410E-07 -3.1000E-08 9.9700E-08 -7.4210E-08  
17 4.0540E-07 -7.0550E-07 6.3480E-07 6.9950E-07 -2.2220E-06 1.6290E-06  
7.2700E-07 -2.8240E-06  
2.1720E-06 7.3270E-07 -3.1080E-06 2.4020E-06 4.7450E-07 -9.9630E-07 8.0370E-07  
-4.8770E-06  
1.5640E-05 -1.1970E-05 7.7390E-07 -3.0440E-06 2.2720E-06 4.4590E-07 -9.8940E-07  
8.8010E-07

6.1820E-07 -1.6440E-06 1.1730E-06 -3.5210E-07 1.2850E-06 -9.9150E-07  
18 -3.1350E-07 5.0130E-07 -4.8730E-07 -5.3200E-07 1.7030E-06 -1.2600E-06  
-5.5830E-07 2.2280E-  
06 -1.7340E-06 -5.6050E-07 2.4610E-06 -1.9230E-06 -3.6430E-07 7.2760E-07  
-6.1220E-07 3.7320E-06 -  
1.1970E-05 9.4960E-06 -5.8750E-07 2.3760E-06 -1.7870E-06 -3.4890E-07 7.5070E-07  
-7.0340E-07 -  
4.6650E-07 1.2200E-06 -8.7820E-07 3.2710E-07 -1.1580E-06 9.1330E-07  
19 -2.0560E-07 7.3220E-07 -5.5550E-07 -2.2120E-07 8.0070E-07 -6.0740E-07  
-2.1450E-07 7.9290E-  
07 -6.0230E-07 -2.1200E-07 7.9100E-07 -6.0100E-07 -2.1050E-07 7.4960E-07  
-5.6910E-07 -2.1630E-07  
7.7390E-07 -5.8750E-07 1.8170E-06 -6.1650E-06 4.6790E-06 -2.0540E-07 7.3620E-07  
-5.5880E-07 -  
2.2040E-07 7.8750E-07 -5.9740E-07 -6.6350E-08 3.3530E-07 -2.5040E-07  
20 8.0970E-07 -3.8350E-06 2.7480E-06 6.9220E-07 -2.4940E-06 2.0400E-06  
8.1600E-07 -2.1690E-06  
1.6520E-06 8.9880E-07 -2.1100E-06 1.5900E-06 7.5840E-07 -3.5350E-06 2.6300E-06  
7.0430E-07 -  
3.0440E-06 2.3760E-06 -6.1650E-06 2.3790E-05 -1.7930E-05 8.0990E-07 -3.5420E-06  
2.4770E-06  
6.7710E-07 -2.9490E-06 2.4190E-06 1.3000E-06 -4.4500E-06 3.4190E-06  
21 -6.1000E-07 2.8000E-06 -2.0410E-06 -5.2840E-07 1.9200E-06 -1.5740E-06  
-6.2420E-07 1.7700E-  
06 -1.3690E-06 -6.8220E-07 1.7530E-06 -1.3460E-06 -5.7310E-07 2.5960E-06  
-1.9570E-06 -5.3540E-07  
2.2720E-06 -1.7870E-06 4.6790E-06 -1.7930E-05 1.3870E-05 -6.1590E-07 2.6300E-06  
-1.8820E-06 -  
5.1130E-07 2.1900E-06 -1.8010E-06 -8.7540E-07 3.0300E-06 -2.3070E-06  
22 -1.3260E-07 2.0440E-07 -2.0440E-07 -2.0630E-07 6.3430E-07 -4.7650E-07  
-1.9230E-07 7.4690E-  
07 -5.8950E-07 -1.8330E-07 7.9460E-07 -6.2950E-07 -1.5320E-07 2.9490E-07  
-2.5480E-07 -1.8110E-07  
4.4590E-07 -3.4890E-07 -2.0540E-07 8.0990E-07 -6.1590E-07 1.5600E-06 -4.4210E-06  
3.4810E-06 -  
1.9430E-07 4.9070E-07 -3.6150E-07 1.4180E-07 -4.6740E-07 3.4610E-07  
23 2.2410E-07 5.2870E-07 -1.4160E-07 6.9590E-07 -2.2340E-06 1.5940E-06  
6.6530E-07 -3.1880E-06  
2.5050E-06 6.3100E-07 -3.5980E-06 2.8440E-06 3.4810E-07 -2.6870E-08 1.5730E-07  
5.2430E-07 -  
9.8940E-07 7.5070E-07 7.3620E-07 -3.5420E-06 2.6300E-06 -4.4210E-06 1.4390E-05  
-1.1130E-05  
5.9410E-07 -1.2260E-06 7.8850E-07 -1.0850E-06 3.6720E-06 -2.7820E-06  
24 -2.2980E-07 -9.4810E-09 -1.7900E-07 -5.1460E-07 1.6350E-06 -1.2170E-06  
-5.1950E-07 2.2760E-  
06 -1.8140E-06 -5.0810E-07 2.5530E-06 -2.0410E-06 -3.0090E-07 3.1150E-07  
-3.5140E-07 -4.0590E-07  
8.8010E-07 -7.0340E-07 -5.5880E-07 2.4770E-06 -1.8820E-06 3.4810E-06 -1.1130E-05  
9.0150E-06 -  
4.4190E-07 1.0040E-06 -7.1530E-07 5.9440E-07 -2.0470E-06 1.5570E-06

25 -1.9200E-07 5.9100E-07 -4.4060E-07 -2.1090E-07 6.4510E-07 -4.8800E-07  
-2.1520E-07 6.5700E-  
07 -4.9460E-07 -2.1830E-07 6.6810E-07 -5.0280E-07 -1.9570E-07 6.0100E-07  
-4.5100E-07 -2.0190E-07  
6.1820E-07 -4.6650E-07 -2.2040E-07 6.7710E-07 -5.1130E-07 -1.9430E-07 5.9410E-07  
-4.4190E-07  
1.7600E-06 -5.0510E-06 3.7970E-06 -7.9230E-08 2.5540E-07 -1.8640E-07  
26 4.5250E-07 -9.9300E-07 8.0490E-07 7.0530E-07 -2.2310E-06 1.6320E-06  
7.4690E-07 -2.7620E-06  
2.0990E-06 7.6150E-07 -3.0190E-06 2.3060E-06 5.0880E-07 -1.2240E-06 9.4370E-07  
5.9860E-07 -  
1.6440E-06 1.2200E-06 7.8750E-07 -2.9490E-06 2.1900E-06 4.9070E-07 -1.2260E-06  
1.0040E-06 -  
5.0510E-06 1.6160E-05 -1.2200E-05 -1.8660E-07 7.5110E-07 -6.0410E-07  
27 -3.2540E-07 5.3410E-07 -4.9500E-07 -5.4220E-07 1.7400E-06 -1.2680E-06  
-5.6930E-07 2.2750E-  
06 -1.7510E-06 -5.7120E-07 2.5110E-06 -1.9420E-06 -3.7580E-07 7.6060E-07  
-6.1900E-07 -4.5410E-07  
1.1730E-06 -8.7820E-07 -5.9740E-07 2.4190E-06 -1.8010E-06 -3.6150E-07 7.8850E-07  
-7.1530E-07  
3.7970E-06 -1.2200E-05 9.5810E-06 3.2560E-07 -1.1500E-06 9.2630E-07  
28 1.7930E-07 -1.5130E-06 9.7670E-07 -1.1540E-07 5.0610E-07 -2.3670E-07  
-2.9150E-08 1.0880E-  
06 -8.3500E-07 3.2610E-08 1.2960E-06 -1.0140E-06 7.8830E-08 -1.0550E-06  
7.3760E-07 -3.1000E-08 -  
3.5210E-07 3.2710E-07 -6.6350E-08 1.3000E-06 -8.7540E-07 1.4180E-07 -1.0850E-06  
5.9440E-07 -  
7.9230E-08 -1.8660E-07 3.2560E-07 1.6620E-05 -5.0860E-05 3.9110E-05  
29 -6.0790E-07 5.1180E-06 -3.3320E-06 4.1570E-07 -1.6130E-06 7.6090E-07  
2.0560E-07 -3.7260E-  
06 2.8730E-06 4.0040E-08 -4.5330E-06 3.5560E-06 -2.7770E-07 3.6090E-06  
-2.5310E-06 9.9700E-08  
1.2850E-06 -1.1580E-06 3.3530E-07 -4.4500E-06 3.0300E-06 -4.6740E-07 3.6720E-06  
-2.0470E-06  
2.5540E-07 7.5110E-07 -1.1500E-06 -5.0860E-05 1.7070E-04 -1.3100E-04  
30 4.5890E-07 -3.9150E-06 2.5700E-06 -3.1160E-07 1.2250E-06 -5.5240E-07  
-1.5880E-07 2.8910E-  
06 -2.2100E-06 -3.1990E-08 3.5200E-06 -2.7420E-06 2.0930E-07 -2.7640E-06  
1.9550E-06 -7.4210E-08 -  
9.9150E-07 9.1330E-07 -2.5040E-07 3.4190E-06 -2.3070E-06 3.4610E-07 -2.7820E-06  
1.5570E-06 -  
1.8640E-07 -6.0410E-07 9.2630E-07 3.9110E-05 -1.3100E-04 1.0390E-04

Covariance Matrix for the xyz OPUS Rover Position (meters^2).  
0.0000166200 -0.0000508600 0.0000391100  
-0.0000508600 0.0001707000 -0.0001310000  
0.0000391100 -0.0001310000 0.0001039000

Covariance Matrix for the enu OPUS Position (meters^2).  
0.0000024560 -0.0000021363 0.0000175186

```

-0.0000021363    0.0000055478    -0.0000307687
 0.0000175186    -0.0000307687    0.0002832162

```

```

Horizontal network accuracy = 0.00521 meters.
Vertical network accuracy   = 0.03300 meters.

```

		Vectors		
To	From	X	Y	Z
nywt	1071	127325.577	97329.670	69026.593
nydv	1071	12661.621	-45327.063	-50556.968
nylp	1071	-81316.175	-17329.702	-380.865
pwel	1071	-119544.655	-19141.068	5325.461
nymx	1071	113340.799	49702.467	24210.933
nywl	1071	74426.117	-4295.696	-22066.358
nyhb	1071	-82152.904	-52081.064	-36770.151
kngs	1071	77460.902	100318.928	84169.552
nywg	1071	81909.213	-44984.166	-66710.805

Covariance matrix of the 9 vectors

```

 1  1.7809E-05 -5.3023E-05  4.1029E-05  1.6350E-05 -5.0146E-05  3.8434E-05
1.6278E-05 -5.0597E-05
 3.8903E-05  1.6226E-05 -5.0751E-05  3.9036E-05  1.6214E-05 -4.8957E-05  3.7702E-05
1.6294E-05 -
 4.9495E-05  3.8011E-05  1.6301E-05 -5.0742E-05  3.8917E-05  1.6166E-05 -4.8943E-05
 3.7827E-05
 1.6328E-05 -4.9613E-05  3.8000E-05
 2  -5.3023E-05  1.7464E-04 -1.3462E-04 -4.9056E-05  1.6495E-04 -1.2631E-04
-4.8902E-05  1.6589E-04
-1.2729E-04 -4.8791E-05  1.6621E-04 -1.2757E-04 -4.8775E-05  1.6247E-04 -1.2478E-04
-4.8940E-05
 1.6359E-04 -1.2543E-04 -4.8950E-05  1.6620E-04 -1.2732E-04 -4.8675E-05  1.6244E-04
-1.2505E-04 -
 4.9011E-05  1.6384E-04 -1.2540E-04
 3  4.1029E-05 -1.3462E-04  1.0748E-04  3.7920E-05 -1.2724E-04  1.0071E-04
 3.7786E-05 -1.2807E-04
 1.0157E-04  3.7689E-05 -1.2835E-04  1.0182E-04  3.7671E-05 -1.2505E-04  9.9364E-05
 3.7816E-05 -
 1.2604E-04  9.9929E-05  3.7828E-05 -1.2834E-04  1.0160E-04  3.7583E-05 -1.2503E-04
 9.9594E-05
 3.7879E-05 -1.2626E-04  9.9909E-05
 4  1.6350E-05 -4.9056E-05  3.7920E-05  1.8660E-05 -5.7344E-05  4.3856E-05
 1.6547E-05 -5.1684E-05
 3.9743E-05  1.6482E-05 -5.1893E-05  3.9924E-05  1.6450E-05 -4.9516E-05  3.8154E-05
 1.6557E-05 -
 5.0224E-05  3.8563E-05  1.6581E-05 -5.1883E-05  3.9769E-05  1.6387E-05 -4.9495E-05
 3.8313E-05
 1.6604E-05 -5.0384E-05  3.8554E-05
 5  -5.0146E-05  1.6495E-04 -1.2724E-04 -5.7344E-05  1.9267E-04 -1.4709E-04
-5.0791E-05  1.7361E-04

```

-1.3325E-04 -5.0577E-05 1.7430E-04 -1.3385E-04 -5.0470E-05 1.6648E-04 -1.2802E-04  
-5.0823E-05  
1.6881E-04 -1.2936E-04 -5.0901E-05 1.7427E-04 -1.3334E-04 -5.0264E-05 1.6641E-04  
-1.2854E-04 -  
5.0976E-05 1.6933E-04 -1.2934E-04  
6 3.8434E-05 -1.2631E-04 1.0071E-04 4.3856E-05 -1.4709E-04 1.1598E-04  
3.8910E-05 -1.3266E-04  
1.0512E-04 3.8753E-05 -1.3316E-04 1.0556E-04 3.8674E-05 -1.2743E-04 1.0130E-04  
3.8933E-05 -  
1.2914E-04 1.0228E-04 3.8990E-05 -1.3314E-04 1.0519E-04 3.8524E-05 -1.2738E-04  
1.0168E-04  
3.9045E-05 -1.2952E-04 1.0226E-04  
7 1.6278E-05 -4.8902E-05 3.7786E-05 1.6547E-05 -5.0791E-05 3.8910E-05  
1.8433E-05 -5.8016E-05  
4.4617E-05 1.6412E-05 -5.1568E-05 3.9671E-05 1.6371E-05 -4.9330E-05 3.8004E-05  
1.6471E-05 -  
4.9986E-05 3.8383E-05 1.6501E-05 -5.1550E-05 3.9520E-05 1.6315E-05 -4.9315E-05  
3.8155E-05  
1.6513E-05 -5.0132E-05 3.8374E-05  
8 -5.0597E-05 1.6589E-04 -1.2807E-04 -5.1684E-05 1.7361E-04 -1.3266E-04  
-5.8016E-05 2.0042E-04  
-1.5388E-04 -5.1126E-05 1.7678E-04 -1.3577E-04 -5.0963E-05 1.6763E-04 -1.2895E-04  
-5.1373E-05  
1.7032E-04 -1.3051E-04 -5.1490E-05 1.7671E-04 -1.3515E-04 -5.0734E-05 1.6757E-04  
-1.2957E-04 -  
5.1546E-05 1.7091E-04 -1.3047E-04  
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4.2768E-05 -1.4145E-04 1.1163E-04

Correlation matrix of the 9 vectors

1 1.0000E+00 -9.5074E-01 9.3779E-01 8.9691E-01 -8.5606E-01 8.4565E-01  
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8.3522E-01 8.9901E-01 -8.4209E-01 8.3033E-01 9.0389E-01 -8.6976E-01 8.5615E-01  
9.0048E-01 -  
8.6516E-01 8.5272E-01 8.9639E-01 -8.4310E-01 8.3358E-01 9.0553E-01 -8.6989E-01  
8.5541E-01  
8.9861E-01 -8.6351E-01 8.5226E-01  
2 -9.5074E-01 1.0000E+00 -9.8260E-01 -8.5933E-01 8.9924E-01 -8.8748E-01  
-8.6188E-01 8.8670E-01  
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9.1316E-01 -8.9854E-01 -8.5956E-01 8.8182E-01 -8.7084E-01 -8.7066E-01 9.2196E-01  
-9.0302E-01 -  
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3 9.3779E-01 -9.8260E-01 1.0000E+00 8.4673E-01 -8.8421E-01 9.0198E-01  
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8.8767E-01 8.5002E-01 -8.6694E-01 8.8160E-01 8.5485E-01 -9.0436E-01 9.1849E-01  
8.5073E-01 -  
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9.1678E-01  
8.4859E-01 -8.9453E-01 9.1212E-01  
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G-FILE for the vectors

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ITRF position of 1071 as determined by individual baselines

	X	Y	Z
nywt	990049.630	-4552731.945	4341403.709
nydv	990049.634	-4552731.998	4341403.736
nylp	990049.616	-4552731.958	4341403.706
pwe1	990049.614	-4552731.953	4341403.714
nymx	990049.636	-4552731.971	4341403.705
nywl	990049.640	-4552731.983	4341403.721
nyhb	990049.639	-4552731.997	4341403.736
kngs	990049.621	-4552731.942	4341403.704
nywg	990049.609	-4552731.915	4341403.681

Residuals of position determined by individual baselines from the final position

	X	Y	Z	East	North
Up					
nywt	0.004	0.012	0.001	0.007	0.009
-0.007					
nydv	0.009	-0.041	0.028	-0.000	-0.008
0.050					
nylp	-0.009	-0.001	-0.002	-0.009	-0.000

	-0.002				
pwe1	-0.011	0.004	0.006	-0.010	0.009
	-0.000				
nymx	0.011	-0.014	-0.002	0.007	-0.012
	0.010				
nyw1	0.015	-0.026	0.014	0.009	-0.009
	0.030				
nyhb	0.014	-0.040	0.029	0.005	-0.008
	0.050				
kngs	-0.005	0.015	-0.003	-0.001	0.008
	-0.014				
nywg	-0.016	0.042	-0.026	-0.007	0.011
	-0.050				

STATE PLANE COORDINATES - U.S. Survey Foot  
SPC (3103 NY W)  
Northing (Y) [feet] 1156254.731  
Easting (X) [feet] 1375583.371  
Convergence [degrees] 0.58295000  
Point Scale 0.99999652  
Combined Factor 0.99997491

\*\*\*\*\* New Reference Frame Preview \*\*\*\*\*

We are replacing the nation's NAD 83 and NAVD 88 datums, to improve access and accuracy of the National Spatial Reference System. More at <https://geodesy.noaa.gov/datums/newdatums/>

Below are approximate coordinates for this solution in the new frames:

APPROX ORTHO HGT: 172.806 (m) [PROTOTYPE (Computed using xGeoid19B,GRS80,ITRF2014)]

dop from interpolation is 0.345  
scatter (mean square distance from rover) is 13988.217  
average edop for rover is 0.660  
average ndop for rover is 0.990  
average hdop for rover is 1.190  
average vdop for rover is 2.110  
average gdop for rover is 2.800

This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.

From: opus <opus@ngs.noaa.gov>  
Sent: Monday, November 15, 2021 8:31 AM  
To: David Zuber  
Subject: OPUS-RS solution : 10713\_4116\_315\_A.tps OP1636982933328

FILE: 10713\_4116\_315\_A.tps OP1636982933328

NGS OPUS-RS SOLUTION REPORT

=====

All computed coordinate accuracies are listed as 1-sigma RMS values.  
For additional information: <https://www.ngs.noaa.gov/OPUS/about.jsp#accuracy>

USER: dzuber@gdbgeospatial.com                      DATE: November 15, 2021  
RINEX FILE: 1071316r.21o                              TIME: 13:30:01 UTC

SOFTWARE: rsgps 1.38 RS272.pr1 1.99.3              START: 2021/11/12 17:15:15  
EPHEMERIS: igr21835.eph [rapid]                    STOP: 2021/11/12 17:55:40  
NAV FILE: brdc3160.21n                              OBS USED: 2880 / 4428 : 65%  
ANT NAME: TSHIPPER\_V                              NONE                      QUALITY IND. 11.34/ 16.81  
ARP HEIGHT: 2                                          NORMALIZED RMS:           0.435

REF FRAME: NAD\_83(2011)(EPOCH:2010.0000)                      ITRF2014 (EPOCH:2021.86502)

X:	989970.537(m)	0.009(m)	989969.574(m)	0.009(m)
Y:	-4552739.365(m)	0.024(m)	-4552737.982(m)	0.024(m)
Z:	4341415.632(m)	0.020(m)	4341415.606(m)	0.020(m)
LAT:	43 10 13.17000	0.012(m)	43 10 13.20388	0.012(m)
E LON:	282 16 3.76648	0.009(m)	282 16 3.73782	0.009(m)
W LON:	77 43 56.23352	0.009(m)	77 43 56.26218	0.009(m)
EL HGT:	137.815(m)	0.028(m)	136.662(m)	0.028(m)
ORTHO HGT:	173.303(m)	0.033(m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 18)	SPC (3103 NY W)
Northing (Y) [meters]	4783353.849	352442.625
Easting (X) [meters]	277906.412	419198.988
Convergence [degrees]	-1.87010833	0.58228333
Point Scale	1.00020682	0.99999638
Combined Factor	1.00018520	0.99997477

US NATIONAL GRID DESIGNATOR: 18TTN7790683353(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DI0628	NYWT WATERTOWN CORS ARP	N440141.658	W0755515.948	174555.1

DI1870	NYDV	DANSVILLE CORS ARP	N423256.093	W0774152.595	69090.9
DI0596	NYLP	LOCKPORT CORS ARP	N430954.854	W0784513.357	83063.7
DF5379	PWEL	PORT WELLER CORS ARP	N431412.202	W0791310.777	121104.0
DI0604	NYMX	MEXICO NY CORS ARP	N432812.379	W0761354.886	126177.7
DI0626	NYWL	WATERLOO CORS ARP	N425355.227	W0765107.302	77826.9
DI0458	NYHB	HAMBURG CORS ARP	N424302.663	W0785047.273	103926.3
DF5367	KNGS	KINGSTON CORS ARP	N441307.253	W0763102.143	152184.8
DK7408	NYWG	WATKINS GLEN CORS ARP	N422103.796	W0765233.300	114879.0

NEAREST NGS PUBLISHED CONTROL POINT					
OF2376	665	1A MCGS 1971	N430952.413	W0774357.160	640.9

OPUS-RS Extended Output, Level 2

FINAL COORDINATES (ITRF at epoch of observations)

nywt	1117375.200	-4455402.262	4410430.273
nydv	1002711.252	-4598059.046	4290846.763
nylp	908733.451	-4570061.655	4341022.843
pwel	870504.965	-4571873.041	4346729.194
nymx	1103390.432	-4503029.493	4365614.643
nywl	1064475.747	-4557027.677	4319337.363
nyhb	907896.723	-4604813.036	4304633.557
kngs	1067510.517	-4452412.992	4425573.221
nywg	1071958.836	-4597716.105	4274692.904
1071	989969.574	-4552737.982	4341415.606

Covariance matrix of the stations:

1	4.4040E-07	-6.0670E-07	9.0580E-07	-3.9820E-08	6.7810E-08	-1.2430E-07
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	-9.3090E-08	-6.6180E-08	4.9960E-08	-9.1640E-08	-2.2410E-08	1.0830E-07
	-2.9500E-08					
	9.3030E-08	-1.3000E-07	-5.7470E-08	4.2580E-08	-1.0310E-07	-2.5930E-08
	-8.9620E-08	-				
	3.0600E-08	9.9980E-08	-1.5160E-07	-4.0920E-09	6.5450E-08	-4.9070E-08
2	-6.0670E-07	3.5260E-06	-2.4890E-06	7.6820E-08	-4.3930E-07	2.9040E-07
	5.0310E-08	-4.8090E-07				
	3.5000E-07	3.6140E-08	-4.8600E-07	3.5550E-07	1.0630E-07	-3.6100E-07
	9.3790E-08	-				
	3.9000E-07	2.7860E-07	4.9120E-08	-4.9390E-07	3.3240E-07	1.0260E-07
	3.4980E-07					
	9.0780E-08	-3.7810E-07	2.4110E-07	-2.0060E-08	1.6470E-07	-1.0410E-07
3	9.0580E-07	-2.4890E-06	2.8230E-06	-1.1090E-07	2.9900E-07	-3.3230E-07
	-1.1940E-07	3.2310E-07				
	-3.4850E-07	-1.2240E-07	3.3190E-07	-3.5520E-07	-1.0770E-07	3.0670E-07
	-1.0810E-07					

3.0010E-07 -3.3070E-07 -1.1790E-07 3.1400E-07 -3.4360E-07 -1.1290E-07 3.2250E-07  
-3.4220E-07 -  
1.0610E-07 2.9180E-07 -3.2720E-07 -5.8130E-09 -1.2590E-08 2.4120E-08  
4 -3.9820E-08 7.6820E-08 -1.1090E-07 3.8490E-07 -5.5310E-07 8.0820E-07  
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6.7450E-08 -  
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3.0670E-07  
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6 -1.2430E-07 2.9040E-07 -3.3230E-07 8.0820E-07 -2.5090E-06 2.6840E-06  
-8.1640E-08 3.5000E-07  
-3.4370E-07 -7.2870E-08 3.5360E-07 -3.4870E-07 -1.1810E-07 2.8550E-07 -3.0880E-07  
-1.0830E-07  
2.9170E-07 -2.9310E-07 -7.9800E-08 3.4800E-07 -3.2530E-07 -1.1830E-07 3.1610E-07  
-3.5940E-07 -  
1.0480E-07 2.7360E-07 -2.6180E-07 1.1910E-08 -4.1840E-08 5.2670E-08  
7 -5.7290E-08 5.0310E-08 -1.1940E-07 -2.9040E-08 7.1620E-08 -8.1640E-08  
3.8440E-07 -4.8780E-07  
7.7330E-07 3.9140E-09 6.7090E-08 -1.0060E-07 -5.2460E-08 5.0320E-08 -9.9700E-08  
-4.2750E-08  
5.7260E-08 -8.4500E-08 -6.6780E-09 8.0520E-08 -9.2200E-08 -4.7560E-08 6.2610E-08  
-1.3550E-07 -  
4.1590E-08 4.7760E-08 -5.9350E-08 3.2250E-08 -7.0200E-08 5.4770E-08  
8 4.9780E-08 -4.8090E-07 3.2310E-07 6.3150E-08 -4.9620E-07 3.5000E-07  
-4.8780E-07 4.0630E-06  
-2.7270E-06 8.0800E-08 -5.1160E-07 3.4860E-07 5.1820E-08 -4.8670E-07 3.3450E-07  
5.6280E-08 -  
4.9190E-07 3.4450E-07 7.4870E-08 -5.0480E-07 3.5110E-07 5.5530E-08 -4.7980E-07  
3.1810E-07  
5.6110E-08 -4.9990E-07 3.5690E-07 1.1230E-08 -9.3710E-08 7.8660E-08  
9 -9.3090E-08 3.5000E-07 -3.4850E-07 -9.5980E-08 3.2960E-07 -3.4370E-07  
7.7330E-07 -2.7270E-06  
2.8930E-06 -1.0780E-07 3.5010E-07 -3.5510E-07 -9.2360E-08 3.4310E-07 -3.4680E-07  
-9.3040E-08  
3.3510E-07 -3.4480E-07 -1.0320E-07 3.3580E-07 -3.4780E-07 -9.7000E-08 3.5340E-07  
-3.5050E-07 -  
9.1340E-08 3.2950E-07 -3.4430E-07 -7.0520E-09 6.7400E-08 -4.1590E-08  
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-9.5180E-08 -4.6070E-08  
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-1.4620E-07 -  
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5.4310E-08 -  
4.9970E-07 3.4850E-07 6.6720E-08 -5.1560E-07 3.5570E-07 5.3950E-08 -4.8620E-07  
3.2890E-07  
5.4100E-08 -5.0710E-07 3.5740E-07 4.1440E-09 -9.0130E-08 7.5310E-08  
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-1.0060E-07 3.4860E-  
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-3.5720E-07 -  
8.9390E-08 3.3620E-07 -3.4920E-07 -3.6500E-09 7.0150E-08 -4.4740E-08  
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-5.2460E-08 5.1820E-  
08 -9.2360E-08 -5.9490E-08 5.1350E-08 -9.0760E-08 4.2690E-07 -5.9670E-07  
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-9.2030E-08 -  
3.1500E-08 9.4000E-08 -1.4050E-07 -6.5150E-09 6.4950E-08 -5.2420E-08  
14 1.0830E-07 -3.6100E-07 3.0670E-07 7.4630E-08 -4.4490E-07 2.8550E-07  
5.0320E-08 -4.8670E-07  
3.4310E-07 3.7200E-08 -4.9260E-07 3.4910E-07 -5.9670E-07 3.5730E-06 -2.4640E-06  
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3.4080E-07  
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15 -1.2280E-07 2.9040E-07 -3.3260E-07 -1.0610E-07 3.0060E-07 -3.0880E-07  
-9.9700E-08 3.3450E-  
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-3.5300E-07 -  
1.0950E-07 2.7110E-07 -2.8410E-07 -4.0320E-09 -2.1720E-08 2.3500E-08  
16 -2.9500E-08 9.3790E-08 -1.0810E-07 -3.6420E-08 6.7450E-08 -1.0830E-07  
-4.2750E-08 5.6280E-  
08 -9.3040E-08 -4.6070E-08 5.4310E-08 -9.1030E-08 -3.0650E-08 9.0310E-08  
-1.1250E-07 4.0460E-07 -  
5.8280E-07 8.2980E-07 -4.2780E-08 5.2430E-08 -9.6540E-08 -3.1880E-08 8.4980E-08  
-9.9170E-08 -  
3.3320E-08 8.3380E-08 -1.2130E-07 1.7610E-09 3.6080E-08 -2.8080E-08  
17 9.3030E-08 -3.9000E-07 3.0010E-07 7.1630E-08 -4.5630E-07 2.9170E-07  
5.7260E-08 -4.9190E-07  
3.3510E-07 4.9080E-08 -4.9970E-07 3.4150E-07 8.8740E-08 -3.9750E-07 2.8620E-07  
-5.8280E-07  
3.6750E-06 -2.4610E-06 5.6150E-08 -5.0080E-07 3.2410E-07 8.7800E-08 -4.1600E-07  
3.2500E-07

7.8900E-08 -4.1200E-07 2.5730E-07 -2.7190E-09 5.1150E-08 -3.2280E-08  
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-8.4500E-08 3.4450E-  
07 -3.4480E-07 -7.5050E-08 3.4850E-07 -3.5030E-07 -1.2350E-07 2.7360E-07  
-3.0570E-07 8.2980E-07 -  
2.4610E-06 2.6770E-06 -8.2620E-08 3.4270E-07 -3.2530E-07 -1.2350E-07 3.0620E-07  
-3.5990E-07 -  
1.0960E-07 2.6160E-07 -2.5600E-07 9.0720E-09 -5.5360E-08 5.8020E-08  
19 -5.7470E-08 4.9120E-08 -1.1790E-07 -2.8960E-08 7.0740E-08 -7.9800E-08  
-6.6780E-09 7.4870E-  
08 -1.0320E-07 4.1950E-09 6.6720E-08 -9.9300E-08 -5.2580E-08 4.9110E-08  
-9.7960E-08 -4.2780E-08  
5.6150E-08 -8.2620E-08 3.8450E-07 -4.7520E-07 7.7250E-07 -4.7690E-08 6.1690E-08  
-1.3420E-07 -  
4.1570E-08 4.6490E-08 -5.7180E-08 3.2430E-08 -7.1680E-08 5.6860E-08  
20 4.2580E-08 -4.9390E-07 3.1400E-07 6.2640E-08 -4.9980E-07 3.4800E-07  
8.0520E-08 -5.0480E-07  
3.3580E-07 8.8750E-08 -5.1560E-07 3.4100E-07 4.5700E-08 -4.9870E-07 3.2980E-07  
5.2430E-08 -  
5.0080E-07 3.4270E-07 -4.7520E-07 4.1250E-06 -2.6770E-06 5.0790E-08 -4.8930E-07  
3.0460E-07  
5.2460E-08 -5.1050E-07 3.6130E-07 1.5480E-08 -1.1940E-07 8.8370E-08  
21 -1.0310E-07 3.3240E-07 -3.4360E-07 -9.3420E-08 3.2910E-07 -3.2530E-07  
-9.2200E-08 3.5110E-  
07 -3.4780E-07 -9.0500E-08 3.5570E-07 -3.5190E-07 -1.0020E-07 3.2650E-07  
-3.3310E-07 -9.6540E-08  
3.2410E-07 -3.2530E-07 7.7250E-07 -2.6770E-06 2.8060E-06 -1.0290E-07 3.4420E-07  
-3.5530E-07 -  
9.4150E-08 3.1370E-07 -3.1250E-07 3.4760E-09 2.8560E-08 -4.1260E-09  
22 -2.5930E-08 1.0260E-07 -1.1290E-07 -3.7650E-08 6.9940E-08 -1.1830E-07  
-4.7560E-08 5.5530E-  
08 -9.7000E-08 -5.2710E-08 5.3950E-08 -9.4960E-08 -2.7950E-08 9.8890E-08  
-1.2060E-07 -3.1880E-08  
8.7800E-08 -1.2350E-07 -4.7690E-08 5.0790E-08 -1.0290E-07 4.1500E-07 -6.1120E-07  
9.0640E-07 -  
3.2590E-08 9.1770E-08 -1.3640E-07 -2.2930E-09 5.2470E-08 -4.4760E-08  
23 9.5500E-08 -3.8640E-07 3.2250E-07 7.6080E-08 -4.5020E-07 3.1610E-07  
6.2610E-08 -4.7980E-07  
3.5340E-07 5.5080E-08 -4.8620E-07 3.5860E-07 9.1720E-08 -3.9470E-07 3.1060E-07  
8.4980E-08 -  
4.1600E-07 3.0620E-07 6.1690E-08 -4.8930E-07 3.4420E-07 -6.1120E-07 3.6240E-06  
-2.5980E-06  
8.2960E-08 -4.1090E-07 2.8570E-07 1.8210E-09 5.5290E-08 -8.7440E-09  
24 -8.9620E-08 3.4980E-07 -3.4220E-07 -1.1140E-07 3.0670E-07 -3.5940E-07  
-1.3550E-07 3.1810E-  
07 -3.5050E-07 -1.4620E-07 3.2890E-07 -3.5720E-07 -9.2030E-08 3.4080E-07  
-3.5300E-07 -9.9170E-08  
3.2500E-07 -3.5990E-07 -1.3420E-07 3.0460E-07 -3.5530E-07 9.0640E-07 -2.5980E-06  
2.9640E-06 -  
9.8210E-08 3.2440E-07 -3.7610E-07 -3.3980E-08 1.0200E-07 -8.5640E-08

25 -3.0600E-08 9.0780E-08 -1.0610E-07 -3.6200E-08 6.6190E-08 -1.0480E-07  
-4.1590E-08 5.6110E-08  
08 -9.1340E-08 -4.4410E-08 5.4100E-08 -8.9390E-08 -3.1500E-08 8.7340E-08  
-1.0950E-07 -3.3320E-08  
7.8900E-08 -1.0960E-07 -4.1570E-08 5.2460E-08 -9.4150E-08 -3.2590E-08 8.2960E-08  
-9.8210E-08  
4.0310E-07 -5.6860E-07 8.0280E-07 2.6990E-09 3.1260E-08 -2.2970E-08  
26 9.9980E-08 -3.7810E-07 2.9180E-07 6.9270E-08 -4.5720E-07 2.7360E-07  
4.7760E-08 -4.9990E-07  
3.2950E-07 3.5930E-08 -5.0710E-07 3.3620E-07 9.4000E-08 -3.8600E-07 2.7110E-07  
8.3380E-08 -  
4.1200E-07 2.6160E-07 4.6490E-08 -5.1050E-07 3.1370E-07 9.1770E-08 -4.1090E-07  
3.2440E-07 -  
5.6860E-07 3.6730E-06 -2.4020E-06 -1.0570E-08 7.6910E-08 -6.2960E-08  
27 -1.5160E-07 2.4110E-07 -3.2720E-07 -9.6300E-08 3.0330E-07 -2.6180E-07  
-5.9350E-08 3.5690E-08  
07 -3.4430E-07 -3.9530E-08 3.5740E-07 -3.4920E-07 -1.4050E-07 2.3820E-07  
-2.8410E-07 -1.2130E-07  
2.5730E-07 -2.5600E-07 -5.7180E-08 3.6130E-07 -3.1250E-07 -1.3640E-07 2.8570E-07  
-3.7610E-07  
8.0280E-07 -2.4020E-06 2.6220E-06 3.0190E-08 -1.3680E-07 1.2910E-07  
28 -4.0920E-09 -2.0060E-08 -5.8130E-09 1.3460E-08 8.7610E-09 1.1910E-08  
3.2250E-08 1.1230E-08  
-7.0520E-09 4.1350E-08 4.1440E-09 -3.6500E-09 -6.5150E-09 -8.2140E-09 -4.0320E-09  
1.7610E-09 -  
2.7190E-09 9.0720E-09 3.2430E-08 1.5480E-08 3.4760E-09 -2.2930E-09 1.8210E-09  
-3.3980E-08  
2.6990E-09 -1.0570E-08 3.0190E-08 3.8840E-06 -6.0960E-06 8.7320E-06  
29 6.5450E-08 1.6470E-07 -1.2590E-08 -4.5810E-09 -3.4990E-08 -4.1840E-08  
-7.0200E-08 -9.3710E-08  
08 6.7400E-08 -1.0350E-07 -9.0130E-08 7.0150E-08 6.4950E-08 1.0180E-07  
-2.1720E-08 3.6080E-08  
5.1150E-08 -5.5360E-08 -7.1680E-08 -1.1940E-07 2.8560E-08 5.2470E-08 5.5290E-08  
1.0200E-07  
3.1260E-08 7.6910E-08 -1.3680E-07 -6.0960E-06 4.1880E-05 -2.8400E-05  
30 -4.9070E-08 -1.0410E-07 2.4120E-08 4.7160E-09 2.4500E-08 5.2670E-08  
5.4770E-08 7.8660E-08  
-4.1590E-08 8.0740E-08 7.5310E-08 -4.4740E-08 -5.2420E-08 -5.8990E-08 2.3500E-08  
-2.8080E-08 -  
3.2280E-08 5.8020E-08 5.6860E-08 8.8370E-08 -4.1260E-09 -4.4760E-08 -8.7440E-09  
-8.5640E-08 -  
2.2970E-08 -6.2960E-08 1.2910E-07 8.7320E-06 -2.8400E-05 2.9880E-05

Covariance Matrix for the xyz OPUS Rover Position (meters^2).  
0.0000038840 -0.0000060960 0.0000087320  
-0.0000060960 0.0000418800 -0.0000284000  
0.0000087320 -0.0000284000 0.0000298800

Covariance Matrix for the enu OPUS Position (meters^2).  
0.0000030680 0.0000034253 -0.000000114



```

0.0000034253    0.0000063030    -0.0000043044
-0.0000000114   -0.0000043044     0.0000662730

```

```

Horizontal network accuracy = 0.00578 meters.
Vertical network accuracy   = 0.01596 meters.

```

		Vectors		
To	From	X	Y	Z
nywt	1071	127405.626	97335.720	69014.668
nydv	1071	12741.678	-45321.064	-50568.842
nylp	1071	-81236.123	-17323.673	-392.763
pwel	1071	-119464.609	-19135.059	5313.588
nymx	1071	113420.858	49708.489	24199.037
nywl	1071	74506.172	-4289.695	-22078.243
nyhb	1071	-82072.851	-52075.054	-36782.049
kngs	1071	77540.943	100324.990	84157.615
nywg	1071	81989.262	-44978.124	-66722.702

Covariance matrix of the 9 vectors

```

1  4.3326E-06 -6.7481E-06  9.6927E-06  3.8348E-06 -6.1024E-06  8.6449E-06
3.7986E-06 -6.1229E-06
8.6950E-06  3.7806E-06 -6.1156E-06  8.6931E-06  3.8722E-06 -6.0449E-06  8.6623E-06
3.8568E-06 -
6.0657E-06  8.6420E-06  3.7982E-06 -6.1343E-06  8.6745E-06  3.8645E-06 -6.0678E-06
8.7254E-06
3.8548E-06 -6.0509E-06  8.5993E-06
2  -6.7481E-06  4.5077E-05 -3.0772E-05 -5.9945E-06  4.1311E-05 -2.7964E-05
-5.9554E-06  4.1328E-05
-2.8013E-05 -5.9363E-06  4.1319E-05 -2.8011E-05 -6.0346E-06  4.1252E-05 -2.7984E-05
-6.0182E-06
4.1274E-05 -2.7962E-05 -5.9551E-06  4.1341E-05 -2.7992E-05 -6.0258E-06  4.1274E-05
-2.8048E-05 -
6.0164E-06  4.1260E-05 -2.7918E-05
3  9.6927E-06 -3.0772E-05  3.2655E-05  8.6222E-06 -2.8113E-05  2.9471E-05
8.5636E-06 -2.8143E-05
2.9549E-05  8.5347E-06 -2.8131E-05  2.9545E-05  8.6825E-06 -2.8022E-05  2.9500E-05
8.6578E-06 -
2.8055E-05  2.9467E-05  8.5631E-06 -2.8162E-05  2.9516E-05  8.6697E-06 -2.8056E-05
2.9599E-05
8.6547E-06 -2.8033E-05  2.9400E-05
4  3.8348E-06 -5.9945E-06  8.6222E-06  4.2420E-06 -6.6533E-06  9.5236E-06
3.8093E-06 -6.0395E-06
8.6384E-06  3.8022E-06 -6.0367E-06  8.6377E-06  3.8384E-06 -6.0086E-06  8.6252E-06
3.8324E-06 -
6.0171E-06  8.6174E-06  3.8092E-06 -6.0443E-06  8.6304E-06  3.8352E-06 -6.0172E-06
8.6499E-06
3.8316E-06 -6.0116E-06  8.6008E-06
5  -6.1024E-06  4.1311E-05 -2.8113E-05 -6.6533E-06  4.5812E-05 -3.0892E-05
-5.9629E-06  4.1512E-05

```

-2.8162E-05 -5.9290E-06 4.1499E-05 -2.8159E-05 -6.1024E-06 4.1368E-05 -2.8102E-05  
-6.0734E-06  
4.1408E-05 -2.8064E-05 -5.9623E-06 4.1535E-05 -2.8124E-05 -6.0873E-06 4.1409E-05  
-2.8220E-05 -  
6.0698E-06 4.1381E-05 -2.7984E-05  
6 8.6449E-06 -2.7964E-05 2.9471E-05 9.5236E-06 -3.0892E-05 3.2459E-05  
8.5837E-06 -2.8087E-05  
2.9525E-05 8.5665E-06 -2.8080E-05 2.9523E-05 8.6544E-06 -2.8014E-05 2.9495E-05  
8.6399E-06 -  
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8.6907E-06 -2.8115E-05 2.9460E-05  
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-2.8115E-05 -  
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8.6086E-06 -  
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2.9460E-05  
9.5276E-06 -3.0602E-05 3.2244E-05

Correlation matrix of the 9 vectors

1 1.0000E+00 -4.8287E-01 8.1489E-01 8.9451E-01 -4.3315E-01 7.2899E-01  
8.9006E-01 -4.3310E-01  
7.2877E-01 8.8625E-01 -4.3237E-01 7.2810E-01 8.9463E-01 -4.3173E-01 7.2931E-01  
8.9511E-01 -  
4.3224E-01 7.2894E-01 8.9000E-01 -4.3338E-01 7.2884E-01 8.9495E-01 -4.3267E-01  
7.2955E-01  
8.9499E-01 -4.3144E-01 7.2755E-01  
2 -4.8287E-01 1.0000E+00 -8.0207E-01 -4.3351E-01 9.0908E-01 -7.3106E-01  
-4.3262E-01 9.0631E-01  
01 -7.2791E-01 -4.3144E-01 9.0566E-01 -7.2734E-01 -4.3225E-01 9.1342E-01  
-7.3044E-01 -4.3303E-01  
9.1185E-01 -7.3121E-01 -4.3262E-01 9.0548E-01 -7.2916E-01 -4.3264E-01 9.1243E-01  
-7.2706E-01 -  
4.3307E-01 9.1208E-01 -7.3229E-01  
3 8.1489E-01 -8.0207E-01 1.0000E+00 7.3259E-01 -7.2685E-01 9.0522E-01  
7.3090E-01 -7.2511E-01  
9.0211E-01 7.2877E-01 -7.2443E-01 9.0138E-01 7.3069E-01 -7.2898E-01 9.0468E-01  
7.3190E-01 -  
7.2821E-01 9.0535E-01 7.3087E-01 -7.2470E-01 9.0335E-01 7.3133E-01 -7.2872E-01  
9.0147E-01  
7.3193E-01 -7.2806E-01 9.0603E-01  
4 8.9451E-01 -4.3351E-01 7.3259E-01 1.0000E+00 -4.7727E-01 8.1162E-01  
9.0205E-01 -4.3174E-01  
7.3171E-01 9.0078E-01 -4.3132E-01 7.3115E-01 8.9624E-01 -4.3369E-01 7.3390E-01  
8.9888E-01 -  
4.3333E-01 7.3459E-01 9.0205E-01 -4.3155E-01 7.3284E-01 8.9761E-01 -4.3362E-01  
7.3092E-01  
8.9907E-01 -4.3319E-01 7.3541E-01  
5 -4.3315E-01 9.0908E-01 -7.2685E-01 -4.7727E-01 1.0000E+00 -8.0110E-01  
-4.2968E-01 9.0302E-01  
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9.0742E-01 -7.2797E-01 -4.2965E-01 9.0239E-01 -7.2669E-01 -4.3353E-01 9.0806E-01  
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4.3339E-01 9.0737E-01 -7.2812E-01  
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9.0411E-01 7.3369E-01 -7.2530E-01 9.0343E-01 7.3052E-01 -7.3097E-01 9.0727E-01  
7.3259E-01 -

7.2987E-01 9.0836E-01 7.3482E-01 -7.2526E-01 9.0576E-01 7.3158E-01 -7.3032E-01  
9.0279E-01  
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7 8.9006E-01 -4.3262E-01 7.3090E-01 9.0205E-01 -4.2968E-01 7.3482E-01  
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8.0472E-01 9.0775E-01 -4.2797E-01 7.2957E-01 8.9265E-01 -4.3266E-01 7.3349E-01  
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7.2420E-01 -4.3278E-01 9.0459E-01 -7.2562E-01  
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9.0045E-01  
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9.0775E-01 -4.2552E-01  
7.2788E-01 1.0000E+00 -4.6331E-01 8.0007E-01 8.8928E-01 -4.3139E-01 7.3199E-01  
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7.2957E-01 -7.2385E-01  
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G-FILE for the vectors

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ITRF position of 1071 as determined by individual baselines

	X	Y	Z
nywt	989969.577	-4552738.011	4341415.632
nydv	989969.568	-4552737.996	4341415.592
nylp	989969.558	-4552738.002	4341415.599
pwe1	989969.577	-4552737.993	4341415.600
nymx	989969.574	-4552737.999	4341415.603
nywl	989969.587	-4552738.008	4341415.614
nyhb	989969.578	-4552737.991	4341415.619
kngs	989969.576	-4552738.024	4341415.643
nywg	989969.564	-4552737.967	4341415.584

Residuals of position determined by individual baselines from the final position

	X	Y	Z	East	North
Up					
nywt	0.003	-0.029	0.026	-0.003	-0.001
nydv	0.038	-0.006	-0.014	-0.009	-0.019
nylp	-0.001	-0.016	-0.020	-0.007	-0.016

	0.007					
pwe1	0.003	-0.011	-0.006	0.000	-0.012	
	0.005					
nymx	-0.000	-0.017	-0.003	-0.004	-0.013	
	0.010					
nyw1	0.013	-0.026	0.008	0.007	-0.013	
	0.026					
nyhb	0.004	-0.009	0.013	0.002	0.003	
	0.016					
kngs	0.002	-0.042	0.037	-0.007	-0.001	
	0.055					
nywg	-0.010	0.015	-0.022	-0.007	-0.005	
	-0.027					

STATE PLANE COORDINATES - U.S. Survey Foot  
SPC (3103 NY W)  
Northing (Y) [feet] 1156305.512  
Easting (X) [feet] 1375322.013  
Convergence [degrees] 0.58228333  
Point Scale 0.99999638  
Combined Factor 0.99997477

\*\*\*\*\* New Reference Frame Preview \*\*\*\*\*

We are replacing the nation's NAD 83 and NAVD 88 datums, to improve access and accuracy of the National Spatial Reference System. More at <https://geodesy.noaa.gov/datums/newdatums/>

Below are approximate coordinates for this solution in the new frames:

APPROX ORTHO HGT: 172.834 (m) [PROTOTYPE (Computed using xGeoid19B,GRS80,ITRF2014)]

dop from interpolation is 0.345  
scatter (mean square distance from rover) is 13991.922  
average edop for rover is 0.750  
average ndop for rover is 0.970  
average hdop for rover is 1.226  
average vdop for rover is 1.580  
average gdop for rover is 2.270

This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.

From: opus <opus@ngs.noaa.gov>  
Sent: Monday, November 15, 2021 8:31 AM  
To: David Zuber  
Subject: OPUS-RS solution : 10713\_4116\_315\_B.tps OP1636982958787

FILE: 10713\_4116\_315\_B.tps OP1636982958787

NGS OPUS-RS SOLUTION REPORT

=====

All computed coordinate accuracies are listed as 1-sigma RMS values.  
For additional information: <https://www.ngs.noaa.gov/OPUS/about.jsp#accuracy>

USER: dzuber@gdbgeospatial.com                      DATE: November 15, 2021  
RINEX FILE: 1071316r.21o                              TIME: 13:30:39 UTC

SOFTWARE: rsgps 1.38 RS293.pr1 1.99.3              START: 2021/11/12 17:57:25  
EPHEMERIS: igr21835.eph [rapid]                    STOP: 2021/11/12 18:34:10  
NAV FILE: brdc3160.21n                              OBS USED: 3681 / 3987 : 92%  
ANT NAME: TPSHIPER\_V                              NONE                      QUALITY IND. 4.56/ 23.84  
ARP HEIGHT: 2                                        NORMALIZED RMS: 0.447

REF FRAME: NAD\_83(2011)(EPOCH:2010.0000)                      ITRF2014 (EPOCH:2021.86510)

X:	989970.533(m)	0.011(m)	989969.570(m)	0.011(m)
Y:	-4552739.463(m)	0.032(m)	-4552738.080(m)	0.032(m)
Z:	4341415.687(m)	0.027(m)	4341415.661(m)	0.027(m)
LAT:	43 10 13.16917	0.007(m)	43 10 13.20305	0.007(m)
E LON:	282 16 3.76536	0.007(m)	282 16 3.73674	0.007(m)
W LON:	77 43 56.23464	0.007(m)	77 43 56.26326	0.007(m)
EL HGT:	137.921(m)	0.042(m)	136.769(m)	0.042(m)
ORTHO HGT:	173.409(m)	0.046(m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 18)	SPC (3103 NY W)
Northing (Y) [meters]	4783353.824	352442.599
Easting (X) [meters]	277906.386	419198.963
Convergence [degrees]	-1.87010833	0.58228333
Point Scale	1.00020682	0.99999638
Combined Factor	1.00018519	0.99997475

US NATIONAL GRID DESIGNATOR: 18TTN7790683353(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DI0628	NYWT WATERTOWN CORS ARP	N440141.658	W0755515.948	174555.1

DI1870	NYDV	DANSVILLE CORS ARP	N423256.093	W0774152.595	69090.9
DI0596	NYLP	LOCKPORT CORS ARP	N430954.854	W0784513.357	83063.6
DF5379	PWEL	PORT WELLER CORS ARP	N431412.202	W0791310.777	121104.0
DI0604	NYMX	MEXICO NY CORS ARP	N432812.379	W0761354.886	126177.8
DI0626	NYWL	WATERLOO CORS ARP	N425355.227	W0765107.302	77826.9
DI0458	NYHB	HAMBURG CORS ARP	N424302.663	W0785047.273	103926.3
DF5367	KNGS	KINGSTON CORS ARP	N441307.253	W0763102.143	152184.8
DK7408	NYWG	WATKINS GLEN CORS ARP	N422103.796	W0765233.300	114879.0

NEAREST NGS PUBLISHED CONTROL POINT					
OF2376	665	1A MCGS 1971	N430952.413	W0774357.160	640.9

OPUS-RS Extended Output, Level 2

FINAL COORDINATES (ITRF at epoch of observations)

nywt	1117375.201	-4455402.276	4410430.289
nydv	1002711.245	-4598059.019	4290846.741
nylp	908733.456	-4570061.673	4341022.855
pwel	870504.961	-4571872.979	4346729.137
nymx	1103390.425	-4503029.488	4365614.631
nywl	1064475.746	-4557027.670	4319337.362
nyhb	907896.728	-4604813.059	4304633.588
kngs	1067510.521	-4452413.005	4425573.241
nywg	1071958.840	-4597716.138	4274692.917
1071	989969.570	-4552738.080	4341415.661

Covariance matrix of the stations:

1	9.1830E-07	-2.5000E-06	2.3530E-06	-9.5760E-08	2.9260E-07	-2.9930E-07
	-1.2260E-07	2.5720E-07				
	-2.4800E-07	-1.3810E-07	2.5680E-07	-2.4700E-07	-7.5210E-08	3.7840E-07
		-8.3070E-08				
	3.4250E-07	-3.2310E-07	-1.2080E-07	2.3840E-07	-2.5220E-07	-8.4230E-08
		-2.9820E-07				
	8.7100E-08	3.5620E-07	-3.5710E-07	-9.7750E-08	3.4580E-07	-3.1670E-07
2	-2.5000E-06	8.8660E-06	-7.7650E-06	3.2090E-07	-1.1310E-06	9.3730E-07
	2.5500E-07	-1.3010E-06				
	1.1360E-06	2.1110E-07	-1.3210E-06	1.1520E-06	3.8720E-07	-8.7300E-07
		3.5720E-07				
	9.6710E-07	8.5640E-07	2.5790E-07	-1.3530E-06	1.1210E-06	3.7330E-07
		9.7350E-07				
	3.3590E-07	-8.9870E-07	7.3420E-07	-1.6420E-07	8.0560E-07	-6.4320E-07
3	2.3530E-06	-7.7650E-06	7.1780E-06	-2.8940E-07	9.5230E-07	-8.4800E-07
	-2.8620E-07	1.0780E-06				
	-9.6950E-07	-2.7650E-07	1.1070E-06	-9.9290E-07	-3.1220E-07	8.7790E-07
		-2.9850E-07				

8.9330E-07 -8.1650E-07 -2.8230E-07 1.0750E-06 -9.4810E-07 -3.2250E-07 9.3730E-07  
-9.0670E-07 -  
2.8390E-07 8.4480E-07 -7.5690E-07 -3.9780E-09 -1.6490E-07 1.1470E-07  
4 -9.5760E-08 3.2090E-07 -2.8940E-07 7.1510E-07 -2.4180E-06 2.0720E-06  
-5.9960E-08 2.9390E-07  
-2.4650E-07 -5.3370E-08 2.8350E-07 -2.3720E-07 -8.9970E-08 3.1360E-07 -2.7430E-07  
-8.0690E-08  
3.0390E-07 -2.5680E-07 -5.8550E-08 2.9180E-07 -2.3930E-07 -8.9560E-08 3.2060E-07  
-2.8990E-07 -  
7.6350E-08 2.8990E-07 -2.3840E-07 1.6160E-08 -3.3750E-09 1.0970E-08  
5 2.9260E-07 -1.1310E-06 9.5230E-07 -2.4180E-06 9.8090E-06 -8.1090E-06  
3.2050E-07 -1.3220E-06  
1.1020E-06 3.2540E-07 -1.3680E-06 1.1390E-06 2.8880E-07 -1.1260E-06 9.4520E-07  
2.8930E-07 -  
1.1410E-06 9.5440E-07 3.1730E-07 -1.3150E-06 1.0910E-06 3.0440E-07 -1.1810E-06  
9.9580E-07  
2.8050E-07 -1.1120E-06 9.2870E-07 7.5390E-08 -2.8010E-07 2.2740E-07  
6 -2.9930E-07 9.3730E-07 -8.4800E-07 2.0720E-06 -8.1090E-06 7.0030E-06  
-2.3730E-07 1.1420E-06  
-9.5320E-07 -2.2310E-07 1.1710E-06 -9.7670E-07 -2.8260E-07 9.2390E-07 -8.0530E-07  
-2.6160E-07  
9.3360E-07 -7.8050E-07 -2.3080E-07 1.1310E-06 -9.1860E-07 -2.9570E-07 1.0020E-06  
-9.1020E-07 -  
2.4210E-07 8.6800E-07 -6.9980E-07 2.7790E-08 -7.9730E-08 1.0670E-07  
7 -1.2260E-07 2.5500E-07 -2.8620E-07 -5.9960E-08 3.2050E-07 -2.3730E-07  
6.7220E-07 -2.3030E-06  
2.0110E-06 1.4950E-08 3.0260E-07 -2.4900E-07 -1.1210E-07 2.6790E-07 -2.6050E-07  
-8.9410E-08  
2.8670E-07 -2.3680E-07 -1.2660E-08 3.4710E-07 -2.5930E-07 -9.9420E-08 2.6680E-07  
-3.0310E-07 -  
7.9890E-08 2.5600E-07 -1.7880E-07 1.1850E-07 -3.3840E-07 2.9970E-07  
8 2.5720E-07 -1.3010E-06 1.0780E-06 2.9390E-07 -1.3220E-06 1.1420E-06  
-2.3030E-06 1.0750E-05  
-9.0380E-06 3.4170E-07 -1.4130E-06 1.2000E-06 2.6200E-07 -1.2990E-06 1.0950E-06  
2.7430E-07 -  
1.3040E-06 1.1170E-06 3.2670E-07 -1.3760E-06 1.1820E-06 2.7310E-07 -1.3170E-06  
1.0870E-06  
2.7530E-07 -1.3090E-06 1.1370E-06 1.2570E-07 -6.2200E-07 5.4040E-07  
9 -2.4800E-07 1.1360E-06 -9.6950E-07 -2.4650E-07 1.1020E-06 -9.5320E-07  
2.0110E-06 -9.0380E-06  
7.8750E-06 -2.7690E-07 1.1980E-06 -1.0250E-06 -2.4250E-07 1.1150E-06 -9.5580E-07  
-2.4080E-07  
1.0980E-06 -9.4720E-07 -2.6500E-07 1.1530E-06 -9.9210E-07 -2.5820E-07 1.1600E-06  
-9.8790E-07 -  
2.3380E-07 1.0750E-06 -9.3420E-07 -7.9350E-08 4.4330E-07 -3.6250E-07  
10 -1.3810E-07 2.1110E-07 -2.7650E-07 -5.3370E-08 3.2540E-07 -2.2310E-07  
1.4950E-08 3.4170E-  
07 -2.7690E-07 6.7960E-07 -2.2140E-06 1.9370E-06 -1.2460E-07 2.3440E-07  
-2.4360E-07 -9.3920E-08  
2.6860E-07 -2.1550E-07 1.3290E-08 3.7350E-07 -2.6360E-07 -1.0570E-07 2.3170E-07

-3.0440E-07 -  
8.0970E-08 2.2670E-07 -1.3350E-07 1.7660E-07 -5.3510E-07 4.7190E-07  
11 2.5680E-07 -1.3210E-06 1.1070E-06 2.8350E-07 -1.3680E-06 1.1710E-06  
3.0260E-07 -1.4130E-06  
1.1980E-06 -2.2140E-06 1.0990E-05 -9.2280E-06 2.6120E-07 -1.3280E-06 1.1230E-06  
2.7000E-07 -  
1.3420E-06 1.1450E-06 3.0410E-07 -1.4200E-06 1.2100E-06 2.6650E-07 -1.3350E-06  
1.1160E-06  
2.7070E-07 -1.3460E-06 1.1570E-06 8.9450E-08 -5.6700E-07 4.9010E-07  
12 -2.4700E-07 1.1520E-06 -9.9290E-07 -2.3720E-07 1.1390E-06 -9.7670E-07  
-2.4900E-07 1.2000E-  
06 -1.0250E-06 1.9370E-06 -9.2280E-06 8.0300E-06 -2.4120E-07 1.1380E-06  
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-1.0110E-06 -  
2.2940E-07 1.1050E-06 -9.5070E-07 -4.8870E-08 3.9780E-07 -3.2090E-07  
13 -7.5210E-08 3.8720E-07 -3.1220E-07 -8.9970E-08 2.8880E-07 -2.8260E-07  
-1.1210E-07 2.6200E-  
07 -2.4250E-07 -1.2460E-07 2.6120E-07 -2.4120E-07 8.7080E-07 -2.4850E-06  
2.2480E-06 -8.0630E-08  
3.3220E-07 -3.0460E-07 -1.1000E-07 2.4410E-07 -2.4370E-07 -8.4070E-08 3.6980E-07  
-2.9200E-07 -  
8.2960E-08 3.4020E-07 -3.2950E-07 -8.9150E-08 3.2490E-07 -2.9010E-07  
14 3.7840E-07 -8.7300E-07 8.7790E-07 3.1360E-07 -1.1260E-06 9.2390E-07  
2.6790E-07 -1.2990E-06  
1.1150E-06 2.3440E-07 -1.3280E-06 1.1380E-06 -2.4850E-06 8.9320E-06 -7.7080E-06  
3.4070E-07 -  
9.8370E-07 8.5070E-07 2.6870E-07 -1.3360E-06 1.0960E-06 3.5960E-07 -9.5620E-07  
9.6230E-07  
3.2060E-07 -9.1890E-07 7.4410E-07 -9.1610E-08 5.0020E-07 -4.0360E-07  
15 -3.2780E-07 8.5460E-07 -8.2780E-07 -2.7430E-07 9.4520E-07 -8.0530E-07  
-2.6050E-07 1.0950E-  
06 -9.5580E-07 -2.4360E-07 1.1230E-06 -9.7920E-07 2.2480E-06 -7.7080E-06  
6.9550E-06 -2.9150E-07  
8.7090E-07 -7.6980E-07 -2.5560E-07 1.0930E-06 -9.2600E-07 -3.2190E-07 9.2030E-07  
-8.9220E-07 -  
2.7240E-07 8.0740E-07 -6.8720E-07 1.5760E-08 -1.9360E-07 1.6130E-07  
16 -8.3070E-08 3.5720E-07 -2.9850E-07 -8.0690E-08 2.8930E-07 -2.6160E-07  
-8.9410E-08 2.7430E-  
07 -2.4080E-07 -9.3920E-08 2.7000E-07 -2.3660E-07 -8.0630E-08 3.4070E-07  
-2.9150E-07 7.9070E-07 -  
2.4560E-06 2.1400E-06 -8.7410E-08 2.6230E-07 -2.3770E-07 -8.5800E-08 3.4780E-07  
-2.8780E-07 -  
7.8740E-08 3.1480E-07 -2.8510E-07 -4.3910E-08 1.8450E-07 -1.5910E-07  
17 3.4250E-07 -9.6710E-07 8.9330E-07 3.0390E-07 -1.1410E-06 9.3360E-07  
2.8670E-07 -1.3040E-06  
1.0980E-06 2.6860E-07 -1.3420E-06 1.1290E-06 3.3220E-07 -9.8370E-07 8.7090E-07  
-2.4560E-06  
9.1900E-06 -7.7660E-06 2.8530E-07 -1.3210E-06 1.0800E-06 3.3650E-07 -1.0400E-06  
9.6430E-07



3.0050E-07 -9.8030E-07 7.9620E-07 -2.8330E-08 2.0060E-07 -1.6940E-07  
18 -3.2310E-07 8.5640E-07 -8.1650E-07 -2.5680E-07 9.5440E-07 -7.8050E-07  
-2.3680E-07 1.1170E-  
06 -9.4720E-07 -2.1550E-07 1.1450E-06 -9.6980E-07 -3.0460E-07 8.5070E-07  
-7.6980E-07 2.1400E-06 -  
7.7660E-06 6.8430E-06 -2.3100E-07 1.1140E-06 -9.1130E-07 -3.1420E-07 9.2920E-07  
-8.8850E-07 -  
2.5730E-07 8.0040E-07 -6.4790E-07 5.1690E-08 -2.5730E-07 2.4200E-07  
19 -1.2080E-07 2.5790E-07 -2.8230E-07 -5.8550E-08 3.1730E-07 -2.3080E-07  
-1.2660E-08 3.2670E-  
07 -2.6500E-07 1.3290E-08 3.0410E-07 -2.4570E-07 -1.1000E-07 2.6870E-07  
-2.5560E-07 -8.7410E-08  
2.8530E-07 -2.3100E-07 6.6330E-07 -2.2850E-06 1.9830E-06 -9.8590E-08 2.7080E-07  
-2.9990E-07 -  
7.7610E-08 2.5360E-07 -1.7300E-07 1.1600E-07 -3.2640E-07 2.9410E-07  
20 2.3840E-07 -1.3530E-06 1.0750E-06 2.9180E-07 -1.3150E-06 1.1310E-06  
3.4710E-07 -1.3760E-06  
1.1530E-06 3.7350E-07 -1.4200E-06 1.1890E-06 2.4410E-07 -1.3360E-06 1.0930E-06  
2.6230E-07 -  
1.3210E-06 1.1140E-06 -2.2850E-06 1.0930E-05 -8.9830E-06 2.6460E-07 -1.3670E-06  
1.0790E-06  
2.6450E-07 -1.3290E-06 1.1500E-06 1.7570E-07 -8.1740E-07 6.8920E-07  
21 -2.5220E-07 1.1210E-06 -9.4810E-07 -2.3930E-07 1.0910E-06 -9.1860E-07  
-2.5930E-07 1.1820E-  
06 -9.9210E-07 -2.6360E-07 1.2100E-06 -1.0140E-06 -2.4370E-07 1.0960E-06  
-9.2600E-07 -2.3770E-07  
1.0800E-06 -9.1130E-07 1.9830E-06 -8.9830E-06 7.6820E-06 -2.6100E-07 1.1540E-06  
-9.7670E-07 -  
2.2750E-07 1.0460E-06 -8.8370E-07 -5.7170E-08 3.7320E-07 -2.8270E-07  
22 -8.4230E-08 3.7330E-07 -3.2250E-07 -8.9560E-08 3.0440E-07 -2.9570E-07  
-9.9420E-08 2.7310E-  
07 -2.5820E-07 -1.0570E-07 2.6650E-07 -2.5190E-07 -8.4070E-08 3.5960E-07  
-3.2190E-07 -8.5800E-08  
3.3650E-07 -3.1420E-07 -9.8590E-08 2.6460E-07 -2.6100E-07 8.4640E-07 -2.5200E-06  
2.3560E-06 -  
8.7490E-08 3.4270E-07 -3.3030E-07 -6.1440E-08 2.3400E-07 -2.1910E-07  
23 3.7910E-07 -9.0990E-07 9.3730E-07 3.2060E-07 -1.1810E-06 1.0020E-06  
2.6680E-07 -1.3170E-06  
1.1600E-06 2.3170E-07 -1.3350E-06 1.1740E-06 3.6980E-07 -9.5620E-07 9.2030E-07  
3.4780E-07 -  
1.0400E-06 9.2920E-07 2.7080E-07 -1.3670E-06 1.1540E-06 -2.5200E-06 9.2070E-06  
-8.1130E-06  
3.3190E-07 -9.9000E-07 8.3550E-07 -8.9330E-08 4.6320E-07 -3.4200E-07  
24 -2.9820E-07 9.7350E-07 -9.0670E-07 -2.8990E-07 9.9580E-07 -9.1020E-07  
-3.0310E-07 1.0870E-  
06 -9.8790E-07 -3.0440E-07 1.1160E-06 -1.0110E-06 -2.9200E-07 9.6230E-07  
-8.9220E-07 -2.8780E-07  
9.6430E-07 -8.8850E-07 -2.9990E-07 1.0790E-06 -9.7670E-07 2.3560E-06 -8.1130E-06  
7.5460E-06 -  
2.7910E-07 9.3580E-07 -8.6160E-07 -8.6500E-08 1.9670E-07 -2.0780E-07

25 -8.7100E-08 3.3590E-07 -2.8390E-07 -7.6350E-08 2.8050E-07 -2.4210E-07  
-7.9890E-08 2.7530E-  
07 -2.3380E-07 -8.0970E-08 2.7070E-07 -2.2940E-07 -8.2960E-08 3.2060E-07  
-2.7240E-07 -7.8740E-08  
3.0050E-07 -2.5730E-07 -7.7610E-08 2.6450E-07 -2.2750E-07 -8.7490E-08 3.3190E-07  
-2.7910E-07  
7.6190E-07 -2.3800E-06 2.0250E-06 -2.3810E-08 1.1390E-07 -9.1550E-08  
26 3.5620E-07 -8.9870E-07 8.4480E-07 2.8990E-07 -1.1120E-06 8.6800E-07  
2.5600E-07 -1.3090E-06  
1.0750E-06 2.2670E-07 -1.3460E-06 1.1050E-06 3.4020E-07 -9.1890E-07 8.0740E-07  
3.1480E-07 -  
9.8030E-07 8.0040E-07 2.5360E-07 -1.3290E-06 1.0460E-06 3.4270E-07 -9.9000E-07  
9.3580E-07 -  
2.3800E-06 8.9940E-06 -7.4830E-06 -9.3320E-08 4.2930E-07 -3.9000E-07  
27 -3.5710E-07 7.3420E-07 -7.5690E-07 -2.3840E-07 9.2870E-07 -6.9980E-07  
-1.7880E-07 1.1370E-  
06 -9.3420E-07 -1.3350E-07 1.1570E-06 -9.5070E-07 -3.2950E-07 7.4410E-07  
-6.8720E-07 -2.8510E-07  
7.9620E-07 -6.4790E-07 -1.7300E-07 1.1500E-06 -8.8370E-07 -3.3030E-07 8.3550E-07  
-8.6160E-07  
2.0250E-06 -7.4830E-06 6.5330E-06 1.8070E-07 -7.1560E-07 6.6040E-07  
28 -9.7750E-08 -1.6420E-07 -3.9780E-09 1.6160E-08 7.5390E-08 2.7790E-08  
1.1850E-07 1.2570E-07  
-7.9350E-08 1.7660E-07 8.9450E-08 -4.8870E-08 -8.9150E-08 -9.1610E-08 1.5760E-08  
-4.3910E-08 -  
2.8330E-08 5.1690E-08 1.1600E-07 1.7570E-07 -5.7170E-08 -6.1440E-08 -8.9330E-08  
-8.6500E-08 -  
2.3810E-08 -9.3320E-08 1.8070E-07 7.1850E-06 -2.4740E-05 2.1690E-05  
29 3.4580E-07 8.0560E-07 -1.6490E-07 -3.3750E-09 -2.8010E-07 -7.9730E-08  
-3.3840E-07 -6.2200E-  
07 4.4330E-07 -5.3510E-07 -5.6700E-07 3.9780E-07 3.2490E-07 5.0020E-07  
-1.9360E-07 1.8450E-07  
2.0060E-07 -2.5730E-07 -3.2640E-07 -8.1740E-07 3.7320E-07 2.3400E-07 4.6320E-07  
1.9670E-07  
1.1390E-07 4.2930E-07 -7.1560E-07 -2.4740E-05 1.0020E-04 -8.5110E-05  
30 -3.1670E-07 -6.4320E-07 1.1470E-07 1.0970E-08 2.2740E-07 1.0670E-07  
2.9970E-07 5.4040E-07  
-3.6250E-07 4.7190E-07 4.9010E-07 -3.2090E-07 -2.9010E-07 -4.0360E-07 1.6130E-07  
-1.5910E-07 -  
1.6940E-07 2.4200E-07 2.9410E-07 6.8920E-07 -2.8270E-07 -2.1910E-07 -3.4200E-07  
-2.0780E-07 -  
9.1550E-08 -3.9000E-07 6.6040E-07 2.1690E-05 -8.5110E-05 7.4930E-05

Covariance Matrix for the xyz OPUS Rover Position (meters^2).  
0.0000071850 -0.0000247400 0.0000216900  
-0.0000247400 0.0001002000 -0.0000851100  
0.0000216900 -0.0000851100 0.0000749300

Covariance Matrix for the enu OPUS Position (meters^2).  
0.0000011110 0.000000986 0.0000044570

```

0.0000000986    0.0000019402    -0.0000094439
0.0000044570    -0.0000094439     0.0001792638

```

```

Horizontal network accuracy = 0.00305 meters.
Vertical network accuracy   = 0.02625 meters.

```

		Vectors		
To	From	X	Y	Z
nywt	1071	127405.631	97335.804	69014.628
nydv	1071	12741.676	-45320.940	-50568.921
nylp	1071	-81236.114	-17323.593	-392.807
pwel	1071	-119464.609	-19134.899	5313.475
nymx	1071	113420.855	49708.592	24198.970
nywl	1071	74506.176	-4289.590	-22078.299
nyhb	1071	-82072.842	-52074.980	-36782.074
kngs	1071	77540.951	100325.075	84157.580
nywg	1071	81989.270	-44978.058	-66722.744

Covariance matrix of the 9 vectors

```

1  8.2988E-06 -2.7422E-05  2.4364E-05  7.1708E-06 -2.4869E-05  2.1680E-05
7.0416E-06 -2.4954E-05
2.1838E-05  6.9681E-06 -2.4918E-05  2.1809E-05  7.2967E-06 -2.4616E-05  2.1663E-05
7.2436E-06 -
2.4715E-05  2.1632E-05  7.0459E-06 -2.5023E-05  2.1812E-05  7.2600E-06 -2.4617E-05
2.1795E-05
7.2195E-06 -2.4636E-05  2.1469E-05
2  -2.7422E-05  1.0745E-04 -9.2067E-05 -2.4252E-05  9.8543E-05 -8.3450E-05
-2.3982E-05  9.8715E-05
-8.3774E-05 -2.3830E-05  9.8640E-05 -8.3713E-05 -2.4514E-05  9.8021E-05 -8.3419E-05
-2.4403E-05
9.8227E-05 -8.3353E-05 -2.3991E-05  9.8859E-05 -8.3719E-05 -2.4436E-05  9.8021E-05
-8.3690E-05 -
2.4354E-05  9.8066E-05 -8.3017E-05
3  2.4364E-05 -9.2067E-05  8.1879E-05  2.1394E-05 -8.4220E-05  7.3861E-05
2.1108E-05 -8.4408E-05
7.4208E-05  2.0946E-05 -8.4328E-05  7.4143E-05  2.1672E-05 -8.3664E-05  7.3826E-05
2.1555E-05 -
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7.9945E-06 -2.7141E-05 2.3626E-05  
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2.1383E-05 -  
8.3429E-05 7.3380E-05 2.1042E-05 -8.3934E-05 7.3669E-05 2.1398E-05 -8.3217E-05  
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Correlation matrix of the 9 vectors

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8.3099E-01  
8.8634E-01 -8.2164E-01 8.3248E-01  
2 -9.1827E-01 1.0000E+00 -9.8153E-01 -8.3407E-01 9.0406E-01 -8.9053E-01  
-8.3810E-01 8.9906E-01  
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-8.9106E-01 -8.2903E-01  
9.0767E-01 -8.9185E-01 -8.3863E-01 8.9808E-01 -8.8554E-01 -8.2553E-01 9.0789E-01  
-8.8676E-01 -  
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3 9.3465E-01 -9.8153E-01 1.0000E+00 8.4289E-01 -8.8514E-01 9.0295E-01  
8.4505E-01 -8.8067E-01  
8.9732E-01 8.4459E-01 -8.7933E-01 8.9615E-01 8.3465E-01 -8.8915E-01 9.0340E-01  
8.3886E-01 -  
8.8796E-01 9.0407E-01 8.4564E-01 -8.8001E-01 8.9851E-01 8.3558E-01 -8.8774E-01  
8.9965E-01  
8.4041E-01 -8.8881E-01 9.0608E-01  
4 8.8743E-01 -8.3407E-01 8.4289E-01 1.0000E+00 -9.2322E-01 9.3559E-01  
9.0280E-01 -8.2693E-01  
8.3913E-01 9.0261E-01 -8.2558E-01 8.3795E-01 8.9056E-01 -8.3419E-01 8.4434E-01  
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8.3988E-01 -
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8.8930E-01 9.0549E-01 8.4726E-01 -8.8117E-01 8.9984E-01 8.3620E-01 -8.8882E-01  
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G-FILE for the vectors

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ITRF position of 1071 as determined by individual baselines

	X	Y	Z
nywt	989969.571	-4552738.068	4341415.661
nydv	989969.574	-4552738.092	4341415.667
nylp	989969.547	-4552738.039	4341415.627
pwe1	989969.565	-4552738.104	4341415.676
nymx	989969.572	-4552738.071	4341415.654
nywl	989969.574	-4552738.076	4341415.643
nyhb	989969.568	-4552738.036	4341415.620
kngs	989969.565	-4552738.069	4341415.663
nywg	989969.553	-4552738.019	4341415.614

Residuals of position determined by individual baselines from the final position

	X	Y	Z	East	North
Up					
nywt	0.002	0.012	-0.000	0.004	0.008
-0.008					
nydv	0.005	-0.013	0.006	0.002	-0.005
0.013					
nylp	-0.023	0.041	-0.034	-0.014	0.005

	-0.056				
pwe1	-0.004	-0.024	0.015	-0.009	-0.005
	0.027				
nymx	0.002	0.008	-0.008	0.004	-0.000
	-0.011				
nyw1	0.004	0.004	-0.019	0.005	-0.012
	-0.015				
nyhb	-0.002	0.044	-0.041	0.008	-0.001
	-0.060				
kngs	-0.005	0.011	0.001	-0.002	0.009
	-0.008				
nywg	-0.017	0.061	-0.047	-0.004	0.008
	-0.078				

STATE PLANE COORDINATES - U.S. Survey Foot  
SPC (3103 NY W)  
Northing (Y) [feet] 1156305.427  
Easting (X) [feet] 1375321.931  
Convergence [degrees] 0.58228333  
Point Scale 0.99999638  
Combined Factor 0.99997475

\*\*\*\*\* New Reference Frame Preview \*\*\*\*\*

We are replacing the nation's NAD 83 and NAVD 88 datums, to improve access and accuracy of the National Spatial Reference System. More at <https://geodesy.noaa.gov/datums/newdatums/>

Below are approximate coordinates for this solution in the new frames:

APPROX ORTHO HGT: 172.941 (m) [PROTOTYPE (Computed using xGeoid19B,GRS80,ITRF2014)]

dop from interpolation is 0.345  
scatter (mean square distance from rover) is 13991.923  
average edop for rover is 0.670  
average ndop for rover is 0.930  
average hdop for rover is 1.146  
average vdop for rover is 1.910  
average gdop for rover is 2.570

This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.

From: opus <opus@ngs.noaa.gov>  
Sent: Monday, November 15, 2021 8:32 AM  
To: David Zuber  
Subject: OPUS-RS solution : 10713\_4116\_315\_C.tps OP1636982981689

FILE: 10713\_4116\_315\_C.tps OP1636982981689

NGS OPUS-RS SOLUTION REPORT

=====

All computed coordinate accuracies are listed as 1-sigma RMS values.  
For additional information: <https://www.ngs.noaa.gov/OPUS/about.jsp#accuracy>

USER: dzuber@gdbgeospatial.com                      DATE: November 15, 2021  
RINEX FILE: 1071316s.21o                              TIME: 13:30:56 UTC

SOFTWARE: rsgps 1.38 RS292.pr1 1.99.3              START: 2021/11/12 18:36:20  
EPHEMERIS: igr21835.eph [rapid]                    STOP: 2021/11/12 19:09:20  
NAV FILE: brdc3160.21n                              OBS USED: 2943 / 3528 : 83%  
ANT NAME: TPSHIPER\_V                                QUALITY IND. 18.21/ 17.47  
ARP HEIGHT: 2                                         NORMALIZED RMS:            0.426

REF FRAME: NAD\_83(2011)(EPOCH:2010.0000)                      ITRF2014 (EPOCH:2021.86517)

X:	989970.529(m)	0.011(m)	989969.566(m)	0.011(m)
Y:	-4552739.433(m)	0.019(m)	-4552738.050(m)	0.019(m)
Z:	4341415.673(m)	0.014(m)	4341415.647(m)	0.014(m)
LAT:	43 10 13.16953	0.007(m)	43 10 13.20341	0.007(m)
E LON:	282 16 3.76547	0.007(m)	282 16 3.73685	0.007(m)
W LON:	77 43 56.23453	0.007(m)	77 43 56.26315	0.007(m)
EL HGT:	137.890(m)	0.024(m)	136.737(m)	0.024(m)
ORTHO HGT:	173.378(m)	0.030(m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 18)	SPC (3103 NY W)
Northing (Y) [meters]	4783353.835	352442.611
Easting (X) [meters]	277906.389	419198.965
Convergence [degrees]	-1.87010833	0.58228333
Point Scale	1.00020682	0.99999638
Combined Factor	1.00018519	0.99997476

US NATIONAL GRID DESIGNATOR: 18TTN7790683353(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DI0628	NYWT WATERTOWN CORS ARP	N440141.658	W0755515.948	174555.1





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-1.2840E-07 4.1340E-07  
-3.1130E-07 -1.2900E-07 4.0270E-07 -3.0180E-07 -1.2930E-07 4.7100E-07 -3.5410E-07  
-1.2940E-07  
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-3.3880E-07 -  
1.3090E-07 4.6530E-07 -3.6000E-07 -5.1950E-08 2.1380E-07 -1.5810E-07  
5 4.1220E-07 -1.6070E-06 1.1750E-06 -3.5680E-06 1.2590E-05 -9.3840E-06  
4.8260E-07 -1.5270E-06  
1.1490E-06 5.0440E-07 -1.5460E-06 1.1580E-06 4.1230E-07 -1.5780E-06 1.1800E-06  
4.2110E-07 -  
1.5420E-06 1.1810E-06 4.9100E-07 -1.5490E-06 1.1890E-06 4.2250E-07 -1.5790E-06  
1.1410E-06  
4.2250E-07 -1.5470E-06 1.2120E-06 2.6840E-07 -8.6830E-07 6.5620E-07  
6 -3.0610E-07 1.0860E-06 -8.2070E-07 2.6900E-06 -9.3840E-06 7.2750E-06  
-3.6410E-07 1.2560E-06  
-9.6120E-07 -3.7470E-07 1.2950E-06 -9.9170E-07 -3.1150E-07 1.0990E-06 -8.3640E-07  
-3.2330E-07  
1.1300E-06 -8.6500E-07 -3.6940E-07 1.2750E-06 -9.7860E-07 -3.1590E-07 1.1090E-06  
-8.3700E-07 -  
3.2480E-07 1.1350E-06 -8.7350E-07 -1.1480E-07 3.7960E-07 -2.6360E-07  
7 -1.0990E-07 3.5610E-07 -2.8580E-07 -1.2840E-07 4.8260E-07 -3.6410E-07  
1.0560E-06 -3.4750E-06  
2.6910E-06 -1.0530E-07 4.7630E-07 -3.7440E-07 -1.1820E-07 3.9200E-07 -3.0620E-07  
-1.2600E-07  
4.3920E-07 -3.3500E-07 -1.1690E-07 4.9860E-07 -3.8170E-07 -1.0720E-07 3.6760E-07  
-2.9890E-07 -  
1.3300E-07 4.6230E-07 -3.4410E-07 2.9060E-08 -1.6650E-08 1.0380E-08  
8 4.3140E-07 -2.0260E-06 1.4840E-06 4.1340E-07 -1.5270E-06 1.2560E-06  
-3.4750E-06 1.3640E-05  
-1.0480E-05 5.1170E-07 -1.3840E-06 1.0460E-06 4.1180E-07 -1.8960E-06 1.4440E-06  
3.9970E-07 -  
1.7090E-06 1.3600E-06 4.7750E-07 -1.3950E-06 1.1240E-06 4.4060E-07 -1.9160E-06  
1.3700E-06  
3.9050E-07 -1.6770E-06 1.3980E-06 4.3500E-07 -1.5340E-06 1.1990E-06  
9 -3.4260E-07 1.6160E-06 -1.1930E-06 -3.1130E-07 1.1490E-06 -9.6120E-07  
2.6910E-06 -1.0480E-05  
8.3210E-06 -4.0270E-07 1.0640E-06 -8.1250E-07 -3.2070E-07 1.4910E-06 -1.1460E-06  
-3.0440E-07  
1.3160E-06 -1.0600E-06 -3.6700E-07 1.0450E-06 -8.5620E-07 -3.5280E-07 1.5330E-06  
-1.1050E-06 -  
2.9000E-07 1.2680E-06 -1.0750E-06 -3.5540E-07 1.2580E-06 -9.6330E-07  
10 -1.0210E-07 3.0140E-07 -2.5370E-07 -1.2900E-07 5.0440E-07 -3.7470E-07  
-1.0530E-07 5.1170E-06  
07 -4.0270E-07 1.0330E-06 -3.4390E-06 2.6700E-06 -1.1430E-07 3.5680E-07  
-2.8300E-07 -1.2580E-07  
4.3220E-07 -3.2710E-07 -1.1180E-07 5.4180E-07 -4.1230E-07 -9.8720E-08 3.2600E-07

-2.8020E-07 -  
1.3530E-07 4.6360E-07 -3.3580E-07 6.7450E-08 -1.2640E-07 9.3120E-08  
11 4.4430E-07 -2.2300E-06 1.6300E-06 4.0270E-07 -1.5460E-06 1.2950E-06  
4.7630E-07 -1.3840E-06  
1.0640E-06 -3.4390E-06 1.4310E-05 -1.1080E-05 4.1580E-07 -2.0560E-06 1.5690E-06  
3.9420E-07 -  
1.8020E-06 1.4480E-06 4.7390E-07 -1.3470E-06 1.1030E-06 4.5310E-07 -2.0860E-06  
1.4820E-06  
3.7990E-07 -1.7520E-06 1.4860E-06 5.0930E-07 -1.8390E-06 1.4410E-06  
12 -3.5670E-07 1.8130E-06 -1.3310E-06 -3.0180E-07 1.1580E-06 -9.9170E-07  
-3.7440E-07 1.0460E-  
06 -8.1250E-07 2.6700E-06 -1.1080E-05 8.8410E-06 -3.2570E-07 1.6430E-06  
-1.2620E-06 -2.9970E-07  
1.3990E-06 -1.1390E-06 -3.6580E-07 9.8900E-07 -8.2830E-07 -3.6670E-07 1.6960E-06  
-1.2090E-06 -  
2.8000E-07 1.3330E-06 -1.1560E-06 -4.3340E-07 1.5620E-06 -1.2020E-06  
13 -1.0840E-07 2.9500E-07 -2.3530E-07 -1.2930E-07 4.1230E-07 -3.1150E-07  
-1.1820E-07 4.1180E-  
07 -3.2070E-07 -1.1430E-07 4.1580E-07 -3.2570E-07 1.0680E-06 -3.0350E-06  
2.3460E-06 -1.2440E-07  
3.6940E-07 -2.8190E-07 -1.2370E-07 4.3490E-07 -3.3280E-07 -1.0720E-07 3.0540E-07  
-2.4620E-07 -  
1.3090E-07 3.9110E-07 -2.9210E-07 1.3120E-08 -3.6020E-08 2.6420E-08  
14 2.4920E-07 -1.2050E-07 2.1320E-07 4.7100E-07 -1.5780E-06 1.0990E-06  
3.9200E-07 -1.8960E-06  
1.4910E-06 3.5680E-07 -2.0560E-06 1.6430E-06 -3.0350E-06 1.0370E-05 -7.8810E-06  
4.1410E-07 -  
9.9680E-07 7.0820E-07 4.3220E-07 -2.0860E-06 1.5440E-06 2.5440E-07 -3.5910E-07  
4.4580E-07  
4.6420E-07 -1.1630E-06 7.3630E-07 -4.3660E-07 1.5440E-06 -1.1750E-06  
15 -2.0220E-07 1.5300E-07 -2.1630E-07 -3.5410E-07 1.1800E-06 -8.3640E-07  
-3.0620E-07 1.4440E-  
06 -1.1460E-06 -2.8300E-07 1.5690E-06 -1.2620E-06 2.3460E-06 -7.8810E-06  
6.2590E-06 -3.1410E-07  
7.6470E-07 -5.5680E-07 -3.3110E-07 1.5660E-06 -1.1720E-06 -2.0920E-07 3.3640E-07  
-3.9340E-07 -  
3.4530E-07 8.6870E-07 -5.6480E-07 3.1040E-07 -1.0960E-06 8.5210E-07  
16 -1.2210E-07 4.0850E-07 -3.0740E-07 -1.2940E-07 4.2110E-07 -3.2330E-07  
-1.2600E-07 3.9970E-  
07 -3.0440E-07 -1.2580E-07 3.9420E-07 -2.9970E-07 -1.2440E-07 4.1410E-07  
-3.1410E-07 1.1190E-06 -  
3.2780E-06 2.4940E-06 -1.2900E-07 4.1070E-07 -3.1480E-07 -1.2120E-07 4.0130E-07  
-3.0080E-07 -  
1.3010E-07 4.2880E-07 -3.2990E-07 -3.4730E-08 1.3370E-07 -9.9250E-08  
17 3.2980E-07 -8.3160E-07 6.6880E-07 4.6020E-07 -1.5420E-06 1.1300E-06  
4.3920E-07 -1.7090E-06  
1.3160E-06 4.3220E-07 -1.8020E-06 1.3990E-06 3.6940E-07 -9.9680E-07 7.6470E-07  
-3.2780E-06  
1.1090E-05 -8.3680E-06 4.6390E-07 -1.8170E-06 1.3630E-06 3.3790E-07 -9.4110E-07  
7.7190E-07

4.4510E-07 -1.3370E-06 9.5480E-07 -9.0860E-08 3.7860E-07 -2.9340E-07  
18 -2.5080E-07 5.6860E-07 -4.8210E-07 -3.5100E-07 1.1810E-06 -8.6500E-07  
-3.3500E-07 1.3600E-  
06 -1.0600E-06 -3.2710E-07 1.4480E-06 -1.1390E-06 -2.8190E-07 7.0820E-07  
-5.5680E-07 2.4940E-06 -  
8.3680E-06 6.5830E-06 -3.5100E-07 1.4360E-06 -1.0830E-06 -2.5930E-07 6.8070E-07  
-5.8770E-07 -  
3.3790E-07 9.8490E-07 -6.9760E-07 1.1790E-07 -4.3710E-07 3.5730E-07  
19 -1.1760E-07 4.0680E-07 -3.1580E-07 -1.3030E-07 4.9100E-07 -3.6940E-07  
-1.1690E-07 4.7750E-  
07 -3.6700E-07 -1.1180E-07 4.7390E-07 -3.6580E-07 -1.2370E-07 4.3220E-07  
-3.3110E-07 -1.2900E-07  
4.6390E-07 -3.5100E-07 1.0900E-06 -3.6390E-06 2.7820E-06 -1.1510E-07 4.1180E-07  
-3.2230E-07 -  
1.3450E-07 4.8170E-07 -3.5940E-07 8.1210E-09 5.5920E-08 -4.0420E-08  
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4.9860E-07 -1.3950E-06  
1.0450E-06 5.4180E-07 -1.3470E-06 9.8900E-07 4.3490E-07 -2.0860E-06 1.5660E-06  
4.1070E-07 -  
1.8170E-06 1.4360E-06 -3.6390E-06 1.4460E-05 -1.0900E-05 4.7630E-07 -2.1250E-06  
1.4830E-06  
3.9360E-07 -1.7590E-06 1.4710E-06 5.4320E-07 -1.9030E-06 1.4650E-06  
21 -3.5600E-07 1.6730E-06 -1.2220E-06 -3.2020E-07 1.1890E-06 -9.7860E-07  
-3.8170E-07 1.1240E-  
06 -8.5620E-07 -4.1230E-07 1.1030E-06 -8.2830E-07 -3.3280E-07 1.5440E-06  
-1.1720E-06 -3.1480E-07  
1.3630E-06 -1.0830E-06 2.7820E-06 -1.0900E-05 8.4800E-06 -3.6620E-07 1.5900E-06  
-1.1340E-06 -  
2.9920E-07 1.3100E-06 -1.0950E-06 -3.6770E-07 1.3100E-06 -9.8860E-07  
22 -9.3790E-08 1.9510E-07 -1.7700E-07 -1.2810E-07 4.2250E-07 -3.1590E-07  
-1.0720E-07 4.4060E-  
07 -3.5280E-07 -9.8720E-08 4.5310E-07 -3.6670E-07 -1.0720E-07 2.5440E-07  
-2.0920E-07 -1.2120E-07  
3.3790E-07 -2.5930E-07 -1.1510E-07 4.7630E-07 -3.6620E-07 1.0140E-06 -2.9520E-06  
2.3170E-06 -  
1.3160E-07 3.7240E-07 -2.7010E-07 6.8210E-08 -2.0700E-07 1.5050E-07  
23 2.1980E-07 3.0720E-08 1.3510E-07 4.6110E-07 -1.5790E-06 1.1090E-06  
3.6760E-07 -1.9160E-06  
1.5330E-06 3.2600E-07 -2.0860E-06 1.6960E-06 3.0540E-07 -3.5910E-07 3.3640E-07  
4.0130E-07 -  
9.4110E-07 6.8070E-07 4.1180E-07 -2.1250E-06 1.5900E-06 -2.9520E-06 1.0210E-05  
-7.7920E-06  
4.5770E-07 -1.1280E-06 7.1170E-07 -5.1940E-07 1.7890E-06 -1.3400E-06  
24 -1.9950E-07 2.3200E-07 -2.8280E-07 -3.3880E-07 1.1410E-06 -8.3700E-07  
-2.9890E-07 1.3700E-  
06 -1.1050E-06 -2.8020E-07 1.4820E-06 -1.2090E-06 -2.4620E-07 4.4580E-07  
-3.9340E-07 -3.0080E-07  
7.7190E-07 -5.8770E-07 -3.2230E-07 1.4830E-06 -1.1340E-06 2.3170E-06 -7.7920E-06  
6.2600E-06 -  
3.2940E-07 8.6720E-07 -5.9940E-07 2.6530E-07 -9.3220E-07 7.0720E-07

25 -1.3200E-07 4.7510E-07 -3.4640E-07 -1.3090E-07 4.2250E-07 -3.2480E-07  
-1.3300E-07 3.9050E-  
07 -2.9000E-07 -1.3530E-07 3.7990E-07 -2.8000E-07 -1.3090E-07 4.6420E-07  
-3.4530E-07 -1.3010E-07  
4.4510E-07 -3.3790E-07 -1.3450E-07 3.9360E-07 -2.9920E-07 -1.3160E-07 4.5770E-07  
-3.2940E-07  
1.1690E-06 -3.4280E-06 2.5530E-06 -6.6830E-08 2.3800E-07 -1.7370E-07  
26 3.6300E-07 -1.0530E-06 7.9900E-07 4.6530E-07 -1.5470E-06 1.1350E-06  
4.6230E-07 -1.6770E-06  
1.2680E-06 4.6360E-07 -1.7520E-06 1.3330E-06 3.9110E-07 -1.1630E-06 8.6870E-07  
4.2880E-07 -  
1.3370E-06 9.8490E-07 4.8170E-07 -1.7590E-06 1.3100E-06 3.7240E-07 -1.1280E-06  
8.6720E-07 -  
3.4280E-06 1.1530E-05 -8.5660E-06 1.6200E-08 3.0820E-08 -4.4560E-08  
27 -2.6130E-07 5.9630E-07 -4.9070E-07 -3.6000E-07 1.2120E-06 -8.7350E-07  
-3.4410E-07 1.3980E-  
06 -1.0750E-06 -3.3580E-07 1.4860E-06 -1.1560E-06 -2.9210E-07 7.3630E-07  
-5.6480E-07 -3.2990E-07  
9.5480E-07 -6.9760E-07 -3.5940E-07 1.4710E-06 -1.0950E-06 -2.7010E-07 7.1170E-07  
-5.9940E-07  
2.5530E-06 -8.5660E-06 6.6630E-06 1.1420E-07 -4.2430E-07 3.6150E-07  
28 7.8920E-08 -7.2570E-07 4.6340E-07 -5.1950E-08 2.6840E-07 -1.1480E-07  
2.9060E-08 4.3500E-07  
-3.5540E-07 6.7450E-08 5.0930E-07 -4.3340E-07 1.3120E-08 -4.3660E-07 3.1040E-07  
-3.4730E-08 -  
9.0860E-08 1.1790E-07 8.1210E-09 5.4320E-07 -3.6770E-07 6.8210E-08 -5.1940E-07  
2.6530E-07 -  
6.6830E-08 1.6200E-08 1.1420E-07 1.0560E-05 -3.2850E-05 2.5300E-05  
29 -2.5610E-07 2.5150E-06 -1.6200E-06 2.1380E-07 -8.6830E-07 3.7960E-07  
-1.6650E-08 -1.5340E-  
06 1.2580E-06 -1.2640E-07 -1.8390E-06 1.5620E-06 -3.6020E-08 1.5440E-06  
-1.0960E-06 1.3370E-07  
3.7860E-07 -4.3710E-07 5.5920E-08 -1.9030E-06 1.3100E-06 -2.0700E-07 1.7890E-06  
-9.3220E-07  
2.3800E-07 3.0820E-08 -4.2430E-07 -3.2850E-05 1.1600E-04 -8.8350E-05  
30 1.9170E-07 -1.9100E-06 1.2510E-06 -1.5810E-07 6.5620E-07 -2.6360E-07  
1.0380E-08 1.1990E-06  
-9.6330E-07 9.3120E-08 1.4410E-06 -1.2020E-06 2.6420E-08 -1.1750E-06 8.5210E-07  
-9.9250E-08 -  
2.9340E-07 3.5730E-07 -4.0420E-08 1.4650E-06 -9.8860E-07 1.5050E-07 -1.3400E-06  
7.0720E-07 -  
1.7370E-07 -4.4560E-08 3.6150E-07 2.5300E-05 -8.8350E-05 6.9790E-05

Covariance Matrix for the xyz OPUS Rover Position (meters^2).  
0.0000105600 -0.0000328500 0.0000253000  
-0.0000328500 0.0001160000 -0.0000883500  
0.0000253000 -0.0000883500 0.0000697900

Covariance Matrix for the enu OPUS Position (meters^2).  
0.0000016792 -0.0000010951 0.0000099027

```

-0.0000010951    0.0000039131    -0.0000210104
 0.0000099027   -0.0000210104     0.0001907577
    
```

```

Horizontal network accuracy = 0.00428 meters.
Vertical network accuracy   = 0.02708 meters.
    
```

		Vectors		
To	From	X	Y	Z
nywt	1071	127405.636	97335.766	69014.651
nydv	1071	12741.680	-45320.971	-50568.906
nylp	1071	-81236.115	-17323.609	-392.805
pwel	1071	-119464.596	-19134.976	5313.523
nymx	1071	113420.859	49708.559	24198.994
nywl	1071	74506.178	-4289.606	-22078.295
nyhb	1071	-82072.844	-52074.974	-36782.089
kngs	1071	77540.960	100325.024	84157.610
nywg	1071	81989.272	-44978.069	-66722.747

Covariance matrix of the 9 vectors

```

 1  1.1429E-05 -3.4783E-05  2.6920E-05  1.0404E-05 -3.2450E-05  2.4917E-05
1.0342E-05 -3.2598E-05
 2  2.5121E-05  1.0312E-05 -3.2659E-05  2.5185E-05  1.0360E-05 -3.1908E-05  2.4596E-05
1.0394E-05 -
 3  3.2173E-05  2.4740E-05  1.0355E-05 -3.2671E-05  2.5120E-05  1.0319E-05 -3.1855E-05
2.4643E-05
 4  1.0416E-05 -3.2247E-05  2.4733E-05
 5  -3.4783E-05  1.2119E-04 -9.2558E-05 -3.1863E-05  1.1275E-04 -8.5734E-05
-3.1752E-05  1.1299E-04
 6  -8.6082E-05 -3.1696E-05  1.1309E-04 -8.6189E-05 -3.1793E-05  1.1182E-04 -8.5191E-05
-3.1850E-05
 7  1.1227E-04 -8.5434E-05 -3.1773E-05  1.1312E-04 -8.6077E-05 -3.1722E-05  1.1173E-04
-8.5276E-05 -
 8  3.1887E-05  1.1240E-04 -8.5419E-05
 9  2.6920E-05 -9.2558E-05  7.3437E-05  2.4642E-05 -8.6211E-05  6.7982E-05
2.4540E-05 -8.6445E-05
10 6.8309E-05  2.4490E-05 -8.6541E-05  6.8410E-05  2.4575E-05 -8.5342E-05  6.7471E-05
2.4628E-05 -
118.5768E-05  6.7700E-05  2.4561E-05 -8.6562E-05  6.8306E-05  2.4509E-05 -8.5255E-05
6.7549E-05
122.4664E-05 -8.5886E-05  6.7687E-05
134  1.0404E-05 -3.1863E-05  2.4642E-05  1.1809E-05 -3.6900E-05  2.8263E-05
1.0454E-05 -3.3085E-05
145  2.5502E-05  1.0416E-05 -3.3170E-05  2.5590E-05  1.0470E-05 -3.2156E-05  2.4794E-05
1.0517E-05 -
156  3.2513E-05  2.4989E-05  1.0474E-05 -3.3188E-05  2.5506E-05  1.0416E-05 -3.2083E-05
2.4854E-05
167  1.0548E-05 -3.2615E-05  2.4984E-05
178  -3.2450E-05  1.1275E-04 -8.6211E-05 -3.6900E-05  1.3033E-04 -9.8770E-05
-3.2619E-05  1.1688E-04
    
```

-8.9115E-05 -3.2488E-05 1.1716E-04 -8.9410E-05 -3.2670E-05 1.1375E-04 -8.6730E-05  
-3.2831E-05  
1.1495E-04 -8.7388E-05 -3.2683E-05 1.1722E-04 -8.9127E-05 -3.2489E-05 1.1350E-04  
-8.6933E-05 -  
3.2934E-05 1.1529E-04 -8.7370E-05  
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1.0406E-05 -3.2863E-05  
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-8.6506E-05 -  
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6.9317E-05 2.4757E-05 -8.7881E-05 6.9475E-05 2.4867E-05 -8.6014E-05 6.8012E-05  
2.4955E-05 -  
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6.8122E-05  
2.7912E-05 -9.6447E-05 7.5730E-05

Correlation matrix of the 9 vectors

1 1.0000E+00 -9.3461E-01 9.2920E-01 8.9553E-01 -8.4080E-01 8.3672E-01  
8.9984E-01 -8.3701E-01  
8.3059E-01 9.0107E-01 -8.3457E-01 8.2756E-01 8.9965E-01 -8.5005E-01 8.4378E-01  
8.9696E-01 -  
8.4670E-01 8.4131E-01 8.9804E-01 -8.3401E-01 8.2946E-01 9.0254E-01 -8.5087E-01  
8.4377E-01  
8.9454E-01 -8.4486E-01 8.4068E-01  
2 -9.3461E-01 1.0000E+00 -9.8112E-01 -8.4225E-01 8.9712E-01 -8.8411E-01  
-8.4838E-01 8.9098E-  
01 -8.7404E-01 -8.5059E-01 8.8751E-01 -8.6973E-01 -8.4789E-01 9.1483E-01  
-8.9750E-01 -8.4407E-01  
9.0738E-01 -8.9222E-01 -8.4620E-01 8.8677E-01 -8.7285E-01 -8.5205E-01 9.1648E-01  
-8.9664E-01 -  
8.4099E-01 9.0435E-01 -8.9164E-01  
3 9.2920E-01 -9.8112E-01 1.0000E+00 8.3679E-01 -8.8123E-01 9.0059E-01  
8.4234E-01 -8.7566E-01  
8.9100E-01 8.4425E-01 -8.7243E-01 8.8680E-01 8.4192E-01 -8.9692E-01 9.1313E-01  
8.3847E-01 -  
8.9045E-01 9.0824E-01 8.4030E-01 -8.7174E-01 8.8978E-01 8.4567E-01 -8.9838E-01  
9.1241E-01  
8.3563E-01 -8.8770E-01 9.0764E-01  
4 8.9553E-01 -8.4225E-01 8.3679E-01 1.0000E+00 -9.4061E-01 9.3369E-01  
8.9487E-01 -8.3576E-01  
8.2952E-01 8.9540E-01 -8.3390E-01 8.2723E-01 8.9446E-01 -8.4277E-01 8.3678E-01  
8.9291E-01 -  
8.4176E-01 8.3602E-01 8.9357E-01 -8.3348E-01 8.2854E-01 8.9622E-01 -8.4309E-01  
8.3718E-01  
8.9119E-01 -8.4063E-01 8.3545E-01  
5 -8.4080E-01 8.9712E-01 -8.8123E-01 -9.4061E-01 1.0000E+00 -9.8220E-01  
-8.4046E-01 8.8871E-  
01 -8.7255E-01 -8.4071E-01 8.8661E-01 -8.7003E-01 -8.4018E-01 8.9737E-01  
-8.8111E-01 -8.3903E-01  
8.9583E-01 -8.8005E-01 -8.3936E-01 8.8616E-01 -8.7152E-01 -8.4149E-01 8.9780E-01  
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8.8897E-01 8.3667E-01 -8.7165E-01 8.8611E-01 8.3580E-01 -8.8396E-01 9.0012E-01  
8.3434E-01 -

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7 8.9984E-01 -8.4838E-01 8.4234E-01 8.9487E-01 -8.4046E-01 8.3616E-01  
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9.3165E-01 9.0010E-01 -8.3518E-01 8.2828E-01 8.9808E-01 -8.4786E-01 8.4170E-01  
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8.4184E-01  
8.9372E-01 -8.4379E-01 8.3932E-01  
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-8.7597E-01 -  
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8.7665E-01 -8.3505E-01 8.9055E-01 -8.7508E-01  
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8.2828E-01 -8.6850E-01  
8.8338E-01 9.2908E-01 -9.8304E-01 1.0000E+00 8.2778E-01 -8.7137E-01 8.8740E-01  
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8.7191E-01 8.8755E-01 8.2751E-01 -8.6655E-01 8.8234E-01 8.2828E-01 -8.7149E-01  
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ITRF position of 1071 as determined by individual baselines

	X	Y	Z
nywt	989969.574	-4552738.060	4341415.663
nydv	989969.574	-4552738.078	4341415.666
nylp	989969.551	-4552738.032	4341415.632
pwe1	989969.555	-4552738.035	4341415.641
nymx	989969.580	-4552738.073	4341415.655
nywl	989969.577	-4552738.070	4341415.654
nyhb	989969.574	-4552738.069	4341415.660
kngs	989969.567	-4552738.063	4341415.666
nywg	989969.558	-4552738.044	4341415.647

Residuals of position determined by individual baselines from the final position

	X	Y	Z	East	North
Up					
nywt	0.008	-0.010	0.016	0.006	0.004
nydv	0.019	-0.028	0.019	0.002	-0.006
nylp	0.034	-0.015	0.018	-0.011	0.003

	-0.026				
pwe1	-0.011	0.015	-0.006	-0.008	0.007
	-0.017				
nymx	0.014	-0.022	0.008	0.009	-0.011
	0.023				
nyw1	0.011	-0.019	0.006	0.007	-0.010
	0.020				
nyhb	0.008	-0.019	0.013	0.004	-0.004
	0.023				
kngs	0.001	-0.013	0.019	-0.002	0.005
	0.022				
nywg	-0.008	0.006	-0.001	-0.006	0.004
	-0.006				

STATE PLANE COORDINATES - U.S. Survey Foot  
SPC (3103 NY W)  
Northing (Y) [feet] 1156305.466  
Easting (X) [feet] 1375321.938  
Convergence [degrees] 0.58228333  
Point Scale 0.99999638  
Combined Factor 0.99997476

\*\*\*\*\* New Reference Frame Preview \*\*\*\*\*

We are replacing the nation's NAD 83 and NAVD 88 datums, to improve access and accuracy of the National Spatial Reference System. More at <https://geodesy.noaa.gov/datums/newdatums/>

Below are approximate coordinates for this solution in the new frames:

APPROX ORTHO HGT: 172.909 (m) [PROTOTYPE (Computed using xGeoid19B,GRS80,ITRF2014)]

dop from interpolation is 0.345  
scatter (mean square distance from rover) is 13991.923  
average edop for rover is 0.700  
average ndop for rover is 0.950  
average hdop for rover is 1.180  
average vdop for rover is 2.060  
average gdop for rover is 2.740

This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.