

Final Survey Report

Kansas LiDAR Add-ons

AOI 2

15115



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2015





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Section 1: Narrative

1.1 Introduction

A survey was performed to support the acquisition of Light Detection and Ranging (LiDAR) data for the Kansas Department of Agriculture Kansas add-ons areas of interest (AOI). This report concerns the methods used for the ground control survey in AOI 2.

1.2 Applicable Standards

This Geodetic Control Survey was conducted so as to support Light Detection and Ranging (LiDAR) data in accordance with the National Digital Elevation Program (NDEP) and the American Society for Photogrammetry and Remote Sensing (ASPRS) guidelines.

Section 2: Ground Control Geodetic Network Survey

2.1 Ground Control Points

A GPS control network was performed for the purposes of establishing a three-dimensional coordinates on each of the base station locations. The control network included a combination of a National Geodetic Survey (NGS) Control Monuments (**GROVE and M 370**) and points set by Atlantic. A graphical representation of all the ground control points is provided in figure 1:



Figure 1: AOI 2 Ground Control Geodetic Network Points

2.2 Ground Control Station Collection

GPS observations at all ground control points in the network were made with Leica System 500 dual-frequency GPS-receivers with Leica AT502 antenna or a Topcon HiPER V on April 8, 2015. Session lengths were based upon the distance between points and were set for a minimum of one hour per every 10 km.

2.3 Ground Control Data Processing and Analysis

Data collected during each GPS session was processed using GrafNet 8.60.2105 with their respective GPS antenna type, and antenna height reading. Four (4) networks were processed in order to establish coordinates and height values for all points. The RMS values for the latitude, longitude and ellipsoid heights for all results were reviewed to ensure that they are within acceptable limits. Two adjustments were made during each network’s development. Each adjustment reports baseline RMSE and residual values at the control points.

2.3.1 Network Processing

The network development involved performing a minimally constrained network adjustment, holding NGS Monument (**GROVE**) as a horizontal and vertical control point. This minimally constrained adjustment allowed for blunders and errors to appear within the network. These blunders were analyzed and the baselines were rejected if they had high residuals against other redundant baselines. In all, a total of twenty-four (24) baselines were kept in the minimally constrained adjustment.

Two (2) control points within the network were then fully constrained for a final network adjustment, holding NGS Monuments (**GROVE and M 370**) as horizontal and vertical control points. Geoid12A was utilized during GPS processing. In all, twenty-four (24) baselines were kept in the fully constrained adjustment after the final network analyses. Final network control values were then assigned to control points (**CP04, CP05, CP07, CP08, CP09, CP10, and CP11**).

A tabulated summary of the final coordinates resulting from the network survey are listed in section 2.4.1.

2.4 Overall Network Final Coordinates

After analyzing all fully constrained final network adjustments, a tabulated summary of the final coordinates were established for all ground control points. These summaries are listed below.

2.4.1 AOI 2 Final Coordinates

UTM (zone 14) meters, NAVD88 (Geoid12A) meters

| Ground Control Points | | | |
|-----------------------|---------------------------|----------------------------|----------------------------|
| Point ID | UTM Easting (x) meters | UTM Northing (y) meters | Ellipsoid Height meters |
| CP04 | 710873.522 | 4341564.846 | 308.371 |
| CP05 | 712741.817 | 4336932.650 | 349.997 |
| CP07 | 712903.414 | 4345075.715 | 372.377 |
| CP08 | 716727.151 | 4331832.393 | 342.061 |
| CP09 | 712866.236 | 4326898.887 | 442.959 |
| CP10 | 712914.757 | 4331877.584 | 414.990 |
| CP11 | 712853.224 | 4333662.272 | 422.661 |

Section 3: Ground Cover Classification Survey

3.1 Ground Cover Classification Check Point Collection

GPS observations were conducted at each ground control point in order to conduct a Real Time Kinematic (RTK) survey. The purpose of this survey was to collect ground test points for use during the processing of the LiDAR data to ensure that the highest possible accuracy was achieved. GPS observations at each Real Time Kinematic (RTK) ground control point were made with a Leica SR530 dual-frequency GPS-receivers w/ Leica AT502 antenna. The GPS units were configured to log data at 1 Hz, and at 10 degrees mask. RTK test points collected to represent differing types of ground cover. All observations were conducted between March 2015 and April 2015.

The purpose of this survey was to collect ground check points for use during the processing of the LiDAR data to ensure that the highest possible accuracy was achieved.

A graphical representation of all the Ground Cover Classification Check Points is provided in figure 2.

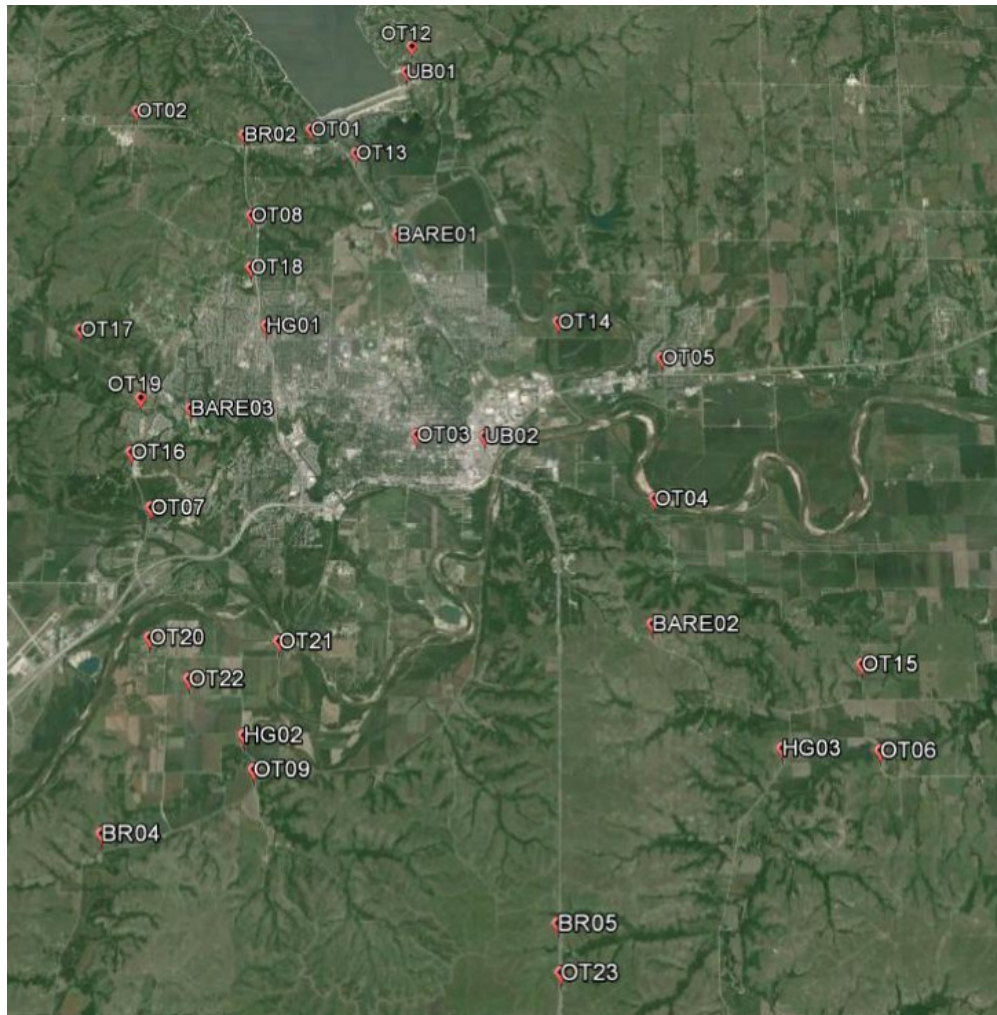


Figure 2: AOI 2 Ground Cover Classification Check Points

3.2 Check Point Data Processing and Analysis

Data collected was processed using Leica Geosystems GeoOffice 7.0 software using their respective GPS antenna type, and antenna height reading. Base station coordinates were derived from the secondary network processing. The final coordinates were output into HARN UTM 14 or UTM 15, NAVD Orthometric Height datum. A tabulated summary of the final coordinates resulting from the Ground Cover Classification Survey are listed in section 3.2.1

3.2.1 AOI 2 Ground Cover Classification Check Points

UTM (zone 14) meters, NAVD88 (Geoid12A) meters

| Ground Control Points | | | |
|-----------------------|---------------------------|----------------------------|----------------------------|
| Point ID | UTM Easting (x) meters | UTM Northing (y) meters | Ellipsoid Height meters |
| BARE01 | 708801.996 | 4344370.019 | 323.459 |
| BARE02 | 714739.591 | 4335457.884 | 421.233 |
| BARE03 | 704428.047 | 4340041.839 | 321.360 |
| OT01 | 706633.786 | 4346999.905 | 335.921 |
| OT02 | 702502.221 | 4347366.609 | 411.366 |
| OT03 | 709492.439 | 4339570.128 | 312.281 |
| OT04 | 714762.644 | 4338244.150 | 305.924 |
| OT05 | 714892.888 | 4341531.417 | 309.758 |
| OT06 | 719538.866 | 4332902.758 | 330.783 |
| OT07 | 703765.807 | 4337738.093 | 330.274 |
| OT08 | 705411.659 | 4344760.998 | 414.148 |
| OT09 | 706453.909 | 4332146.388 | 320.104 |
| OT12 | 708877.890 | 4349253.445 | 367.702 |
| OT13 | 707727.765 | 4346412.453 | 331.009 |
| OT14 | 712546.425 | 4342327.996 | 308.646 |
| OT15 | 719199.057 | 4334716.922 | 334.750 |
| OT16 | 703209.368 | 4338991.726 | 380.760 |
| OT17 | 701774.165 | 4341847.739 | 336.249 |
| OT18 | 705499.211 | 4343472.494 | 365.043 |
| OT19 | 703290.918 | 4340257.009 | 325.118 |
| OT20 | 704013.076 | 4334868.605 | 315.561 |
| OT21 | 706780.901 | 4334861.787 | 312.176 |
| OT22 | 704930.735 | 4334007.433 | 316.104 |
| OT23 | 712962.130 | 4328272.496 | 419.982 |
| UB01 | 708789.580 | 4348573.064 | 353.201 |
| UB02 | 710990.292 | 4339573.727 | 308.269 |

UTM (zone 14) meters, NAVD88 (Geoid12A) meters

| Ground Control Points | | | |
|-----------------------|---------------------------|----------------------------|------------------------|
| Point ID | UTM Easting (x) meters | UTM Northing (y) meters | Ortho Height meters |
| BR02 | 705081.758 | 4346817.424 | 356.872 |
| BR04 | 703414.757 | 4330752.004 | 327.890 |
| BR05 | 712879.292 | 4329226.661 | 404.674 |
| HG01 | 705964.110 | 4342056.796 | 337.253 |
| HG02 | 706191.699 | 4332851.567 | 316.397 |
| HG03 | 717485.123 | 4332891.969 | 334.345 |



Appendix A: Field Notes

15115 A01 2

Date: 4/8/2013

| Unit | B3 | T1 | B2 | B3 | B2 |
|----------|----------|----------|----------|----------|---|
| Date | 4/8/2015 | 4/8/2015 | 4/8/2015 | 4/8/2015 | 4/8/2015 |
| Station | CP02 | CP03 | CP19 | GROVE | CP19 |
| Ant Type | LEIATS02 | TPSHIPRV | LEIATS02 | LEIATS02 | LEIATS02 |
| Ant HT | 2.00 | 2.00 | 1.148 | 2.00 | 1.148 |
| Off Set | R0D | R0D | 0.36 | R0D | 0.36 |
| Ant ARP | 2.00 | 2.00 | 1.508 | 2.00 | 1.508 |
| Start | 12:44 | 13:02 | 13:18 | 16:32 | 17:58 |
| Stop | 16:05 | 21:12 | 17:47 | 17:38 | 20:26 |
| Total | 3:21:20 | 8:10 | 4:28:55 | 1:06:10 | 2:27:26 |
| Notes | C#6 | — | C#1 | C#5 | C#1 ^{BASE} C#2 ^{ROVER} |

| Unit | B2 | B2 |
|----------|---|---|
| Date | 4/8/2015 | 4/8/2015 |
| Station | CP03 | CP02 |
| Ant Type | LEIATS02 | LEIATS02 |
| Ant HT | 2.00 | 1.106 |
| Off Set | R0D | 0.36 |
| Ant ARP | 2.00 | 1.466 |
| Start | 21:20 | 12:32 |
| Stop | 22:35 | 16:01 |
| Total | 1:15:25 | 3:29:00 |
| Notes | C#5 ^{BASE} C#6 ^{ROVER} | C#1 ^{BASE} C#2 ^{ROVER} |



Appendix B: Data Sheets



The NGS Data Sheet

See file dsdata.txt for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.6.1

1 National Geodetic Survey, Retrieval Date = APRIL 8, 2015

KF0291 *****

KF0291 CBN - This is a Cooperative Base Network Control Station.

KF0291 DESIGNATION - GROVE

KF0291 PID - KF0291

KF0291 STATE/COUNTY- KS/GEARY

KF0291 COUNTRY - US

KF0291 USGS QUAD - SWEDE CREEK (1982)

KF0291

KF0291 *CURRENT SURVEY CONTROL

KF0291

KF0291* NAD 83(2011) POSITION- 39 03 44.15701(N) 096 32 00.63403(W) ADJUSTED

KF0291* NAD 83(2011) ELLIP HT- 411.141 (meters) (06/27/12) ADJUSTED

KF0291* NAD 83(2011) EPOCH - 2010.00

KF0291* NAVD 88 ORTHO HEIGHT - 441.159 (meters) 1447.37 (feet) ADJUSTED

KF0291

| | | | |
|--------|-------------------|-------------------------|---------------------|
| KF0291 | NAD 83(2011) X - | -564,289.663 (meters) | COMP |
| KF0291 | NAD 83(2011) Y - | -4,927,085.236 (meters) | COMP |
| KF0291 | NAD 83(2011) Z - | 3,997,945.773 (meters) | COMP |
| KF0291 | LAPLACE CORR - | -2.81 (seconds) | DEFLEC12A |
| KF0291 | GEOID HEIGHT - | -30.02 (meters) | GEOID12A |
| KF0291 | DYNAMIC HEIGHT - | 440.858 (meters) | 1446.38 (feet) COMP |
| KF0291 | MODELED GRAVITY - | 979,931.2 (mgal) | NAVD 88 |

KF0291

KF0291 VERT ORDER - SECOND CLASS 0

KF0291

KF0291 Network accuracy estimates per FGDC Geospatial Positioning Accuracy

KF0291 Standards:

KF0291 FGDC (95% conf, cm) Standard deviation (cm) CorrNE

KF0291 Horiz Ellip SD_N SD_E SD_h (unitless)

KF0291 -----

KF0291 NETWORK 0.76 1.51 0.35 0.25 0.77 -0.14995428

KF0291 -----

KF0291 [Click here for local accuracies and other accuracy information.](#)

KF0291

KF0291

KF0291.The horizontal coordinates were established by GPS observations

KF0291.and adjusted by the National Geodetic Survey in June 2012.

KF0291

KF0291.NAD 83(2011) refers to NAD 83 coordinates where the reference



KF0291.frame has been affixed to the stable North American tectonic plate. See KF0291.NA2011 for more information.

KF0291

KF0291.The horizontal coordinates are valid at the epoch date displayed above KF0291.which is a decimal equivalence of Year/Month/Day.

KF0291

KF0291.The orthometric height was determined by differential leveling and KF0291.adjusted by the NATIONAL GEODETIC SURVEY KF0291.in June 1991.

KF0291

KF0291.The X, Y, and Z were computed from the position and the ellipsoidal ht.

KF0291

KF0291.The Laplace correction was computed from DEFLEC12A derived deflections.

KF0291

KF0291.The ellipsoidal height was determined by GPS observations KF0291.and is referenced to NAD 83.

KF0291

KF0291.The dynamic height is computed by dividing the NAVD 88 KF0291.geopotential number by the normal gravity value computed on the KF0291.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45 KF0291.degrees latitude (g = 980.6199 gals.).

KF0291

KF0291.The modeled gravity was interpolated from observed gravity values.

KF0291

KF0291. The following values were computed from the NAD 83(2011) position.

KF0291

| | | | | | | |
|-----------------|-----------------|--------------|-------|------------|--------|----------|
| KF0291; | North | East | Units | Scale | Factor | Converg. |
| KF0291;SPC KS N | - 81,947.065 | 526,915.043 | MT | 0.99996223 | +0 55 | 40.3 |
| KF0291;SPC KS N | - 268,854.66 | 1,728,720.44 | sFT | 0.99996223 | +0 55 | 40.3 |
| KF0291;UTM 14 | - 4,326,581.888 | 713,404.132 | MT | 1.00016080 | +1 33 | 17.6 |

KF0291

| | |
|-----------------|--|
| KF0291! | - Elev Factor x Scale Factor = Combined Factor |
| KF0291!SPC KS N | - 0.99993550 x 0.99996223 = 0.99989773 |
| KF0291!UTM 14 | - 0.99993550 x 1.00016080 = 1.00009629 |

KF0291

| | | |
|-----------------|----------------------|-------------|
| KF0291: | Primary Azimuth Mark | Grid Az |
| KF0291:SPC KS N | - X 342 | 274 56 21.6 |
| KF0291:UTM 14 | - X 342 | 274 18 44.3 |

KF0291

| | |
|--------|--|
| KF0291 | ----- |
| KF0291 | PID Reference Object Distance Geod. Az |
| KF0291 | ddmmss.s |
| KF0291 | KF1032 WAMEGO MUN TANK APPROX.24.6 KM 0494048.8 |
| KF0291 | KF0292 GROVE RM 1 13.653 METERS 09436 |
| KF0291 | KF1038 MANHATTAN M W PIPE MICROWAVE APPROX. 5.2 KM 1351244.4 |
| KF0291 | KF0290 GROVE RM 2 13.121 METERS 26751 |
| KF0291 | KF0280 X 342 2755201.9 |
| KF0291 | ----- |



KF0291

SUPERSEDED SURVEY CONTROL

KF0291

KF0291

KF0291 NAD 83(2007)- 39 03 44.15719(N) 096 32 00.63473(W) AD(2002.00) 0

KF0291 ELLIP H (02/10/07) 411.147 (m) GP(2002.00)

KF0291 ELLIP H (08/16/04) 411.158 (m) GP() 4 2

KF0291 NAD 83(1997)- 39 03 44.15699(N) 096 32 00.63456(W) AD() B

KF0291 ELLIP H (12/22/97) 411.172 (m) GP() 4 1

KF0291 NAD 83(1986)- 39 03 44.16286(N) 096 32 00.63182(W) AD() 2

KF0291 NAD 27 - 39 03 44.17376(N) 096 31 59.62125(W) AD() 2

KF0291 NAVD 88 (12/22/97) 441.16 (m) 1447.4 (f) LEVELING 3

KF0291 NGVD 29 (??/??/92) 441.022 (m) 1446.92 (f) ADJ UNCH 2 0

KF0291 NGVD 29 (07/19/86) 441.02 (m) 1446.9 (f) LEVELING 3

KF0291

KF0291.Superseded values are not recommended for survey control.

KF0291

KF0291.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

KF0291.See file dsdata.txt to determine how the superseded data were derived.

KF0291

KF0291_U.S. NATIONAL GRID SPATIAL ADDRESS: 14SQJ1340426581(NAD 83)

KF0291

KF0291_MARKER: DE = TRAVERSE STATION DISK

KF0291_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT

KF0291_SP_SET: SET IN TOP OF CONCRETE MONUMENT

KF0291_STAMPING: GROVE 1970

KF0291_MARK LOGO: CGS

KF0291_MAGNETIC: N = NO MAGNETIC MATERIAL

KF0291_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO

KF0291+STABILITY: SURFACE MOTION

KF0291_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR

KF0291+SATELLITE: SATELLITE OBSERVATIONS - September 19, 2012

KF0291

KF0291 HISTORY - Date Condition Report By

KF0291 HISTORY - 1970 MONUMENTED NGS

KF0291 HISTORY - 1970 GOOD NGS

KF0291 HISTORY - 19970306 GOOD NGS

KF0291 HISTORY - 20080115 GOOD

KF0291 HISTORY - 20100504 GOOD KSDT

KF0291 HISTORY - 20120919 GOOD KSDT

KF0291

STATION DESCRIPTION

KF0291

KF0291'DESCRIBED BY NATIONAL GEODETIC SURVEY 1970 (CAA)

KF0291'THE STATION IS LOCATED ABOUT 16 MILES EAST-NORTHEAST OF

KF0291'JUNCTION CITY 8 MILES SOUTH-SOUTHEAST OF MANHATTAN, ON A

KF0291'SMALL HILL ON THE SOUTH RIGHT-OF-WAY OF INTERSTATE HIGHWAY

KF0291'70, IN THE SW 1/4 SECTION 28, T11S, R8E.

KF0291'



KF0291' TO REACH THE STATION FROM THE INTERCHANGE OF INTERSTATE
KF0291' HIGHWAY 70 AND STATE HIGHWAY 177 WHICH IS ABOUT 8 MILES
KF0291' SOUTH-SOUTHEAST OF MANHATTAN, (BM X 342 (AZIMUTH MARK) IS
KF0291' LOCATED AT THIS POINT), GO EAST ON INTERSTATE 70 FOR 0.25
KF0291' MILE TO THE STATION ON THE RIGHT.

KF0291'

KF0291' STATION MARKS ARE TRAVERSE DISKS STAMPED GROVE 1970. THE
KF0291' SURFACE DISK IS SET IN THE TOP OF A 12-INCH CYLINDRICAL
KF0291' CONCRETE MONUMENT WHICH IS FLUSH WITH THE GROUND SURFACE.
KF0291' IT IS 64 FEET SOUTH OF THE EDGE OF A CUTBANK, 4.3 FEET NORTH
KF0291' OF A BARBED WIRE FENCE AND 4.2 FEET NORTH OF A METAL WITNESS
KF0291' POST. THE UNDERGROUND MARK IS SET IN THE TOP OF AN IRREGULAR
KF0291' MASS OF CONCRETE WHICH IS 34 INCHES BELOW THE GROUND SURFACE.

KF0291'

KF0291' REFERENCE MARK 1, A STANDARD DISK STAMPED GROVE NO 1 1970,
KF0291' IS SET IN AN IRREGULAR MASS OF CONCRETE WHICH SUPPORTS A
KF0291' METAL FENCE POST. IT IS 44.3 FEET EAST OF THE WITNESS POST
KF0291' AND 0.3 FOOT NORTH OF THE BARBED WIRE FENCE.

KF0291'

KF0291' REFERENCE MARK 2, A STANDARD DISK STAMPED GROVE NO 2 1970,
KF0291' IS SET IN THE TOP OF A 12-INCH CYLINDRICAL CONCRETE MONUMENT
KF0291' WHICH PROJECTS 2 INCHES ABOVE THE GROUND SURFACE. IT IS
KF0291' 43.5 FEET WEST OF THE WITNESS POST AND 2.4 FEET NORTH OF
KF0291' THE BARBED WIRE FENCE.

KF0291'

KF0291' BM X 342 (AZIMUTH MARK), IS A STANDARD BENCH MARK DISK STAMPED
KF0291' X 342 1970. IT IS CEMENTED IN A DRILL HOLE IN THE NORTHEAST
KF0291' WING-WALL OF THE EASTBOUND OVERPASS AT THE JUNCTION OF
INTERSTATE

KF0291' 70 AND STATE HIGHWAY 177. IT IS 19.5 FEET NORTH OF THE
KF0291' CENTER LINE OF THE EASTBOUND LANES OF INTERSTATE 70, 2.8
KF0291' FEET SOUTHWEST OF THE SOUTH END OF AN IRON GUARD RAIL AND
KF0291' 0.8 FOOT NORTH OF THE CONCRETE GUARD RAIL.

KF0291'

KF0291' HEIGHT OF LIGHT ABOVE STATION MARK 2.85 METERS.

KF0291'

KF0291' STATION RECOVERY (1970)

KF0291'

KF0291' RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1970

KF0291' 13.2 MI W FROM ALMA.

KF0291' ABOUT 13.2 MILES WEST ALONG INTERSTATE HIGHWAY 70 FROM THE
KF0291' HIGHWAY OVERPASS OVER STATE HIGHWAY 99 AT ALMA, OR ABOUT 17.15
KF0291' MILES EAST ALONG INTERSTATE HIGHWAY 70 FROM THE HIGHWAY
OVERPASS

KF0291' FOR THE UNION PACIFIC RAILROAD AT JUNCTION CITY, 0.25 MILE EAST
KF0291' OF THE HIGHWAY OVERPASS FOR STATE HIGHWAY 177, ON THE TOP OF A
KF0291' 25-FOOT HIGH SHALEY ROCK CUT ON THE SOUTH SIDE OF THE HIGHWAY,
KF0291' 117 FEET SOUTH (SLOPE MEASUREMENT) OF THE CENTER LINE OF THE



KF0291'SOUTH LANES OF THE HIGHWAY, 45.1 FEET WEST OF A METAL BRACE POLE
KF0291'IN A FENCE, 4 FEET NORTH OF THE FENCE, 4.0 FEET NORTH OF A
KF0291'METAL WITNESS POST, ABOUT 25 FEET ABOVE THE LEVEL OF THE HIGHWAY,
KF0291'AND SET IN THE TOP OF A CONCRETE POST WHICH PROJECTS 0.3 FOOT.
KF0291'SEC 28, T11S, R8E NOTE-- THE MARK MAY ALSO BE REACHED BY GOING
KF0291'ABOUT 3.9 MILES NORTH ALONG STATE HIGHWAY 99 FROM THE CITY
KF0291'HALL AT ALMA, THENCE ABOUT 13.2 MILES WEST ALONG INTERSTATE
KF0291'HIGHWAY 70.

KF0291

KF0291 STATION RECOVERY (1997)

KF0291

KF0291'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1997 (CSM)

KF0291'THE STATION IS LOCATED ABOUT 25.7 KM (15.95 MI) EAST-NORTHEAST OF
KF0291'JUNCTION CITY, 12.9 KM (8.00 MI) SOUTH-SOUTHEAST OF MANHATTAN, ON A
KF0291'SMALL HILL ON THE SOUTH RIGHT-OF-WAY OF INTERSTATE HIGHWAY 70, AND
IN

KF0291'THE SW 1/4 OF SECTION 28, T 11 S, R 8 E. OWNERSHIP--KANSAS
DEPARTMENT

KF0291'OF TRANSPORTATION. TO REACH THE STATION FROM THE INTERCHANGE OF
KF0291'INTERSTATE HIGHWAY 70 AND STATE HIGHWAY 177 (EXIT 313), GO EAST ON
KF0291'INTERSTATE HIGHWAY 70 FOR 0.4 KM (0.25 MI) TO THE STATION ON THE
KF0291'RIGHT, ON TOP OF A CUT BANK AND NEAR THE RIGHT-OF-WAY FENCE. THE
KF0291'STATION MARK IS A STANDARD TRAVERSE STATION DISK SET IN THE TOP OF

A

KF0291'30 CM ROUND CONCRETE MONUMENT FLUSH WITH GROUND. LOCATED 19.51
M

KF0291'(64.01 FT) SOUTH OF THE EDGE OF THE CUT BANK AND 1.30 M (4.27 FT)
KF0291'NORTH OF THE RIGHT-OF-WAY FENCE AND FIBERGLASS WITNESS POST.

KF0291

KF0291 STATION RECOVERY (2008)

KF0291

KF0291'RECOVERED 2008

KF0291'RECOVERED IN GOOD CONDITION.

KF0291

KF0291 STATION RECOVERY (2010)

KF0291

KF0291'RECOVERY NOTE BY KANSAS DEPARTMENT OF TRANSPORTATION 2010 (KLR)

KF0291'RECOVERED IN GOOD CONDITION.

KF0291

KF0291 STATION RECOVERY (2012)

KF0291

KF0291'RECOVERY NOTE BY KANSAS DEPARTMENT OF TRANSPORTATION 2012
(RMS)

KF0291'RECOVERED IN GOOD CONDITION.

*** retrieval complete.

Elapsed Time = 00:00:02



The NGS Data Sheet

See file dsdata.txt for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.6.1

1 National Geodetic Survey, Retrieval Date = APRIL 8, 2015

KF0765 *****

KF0765 DESIGNATION - M 370

KF0765 PID - KF0765

KF0765 STATE/COUNTY- KS/RILEY

KF0765 COUNTRY - US

KF0765 USGS QUAD - KEATS (1992)

KF0765

KF0765 *CURRENT SURVEY CONTROL

KF0765

KF0765* NAD 83(2011) POSITION- 39 07 52.98806(N) 096 40 21.91477(W) NO CHECK

KF0765* NAD 83(2011) ELLIP HT- 287.522 (meters) (06/27/12) NO CHECK

KF0765* NAD 83(2011) EPOCH - 2010.00

KF0765* NAVD 88 ORTHO HEIGHT - 317.399 (meters) 1041.33 (feet) ADJUSTED

KF0765

KF0765 NAD 83(2011) X - -575,688.689 (meters)

COMP

KF0765 NAD 83(2011) Y - -4,920,797.382 (meters)

COMP

KF0765 NAD 83(2011) Z - 4,003,823.392 (meters)

COMP

KF0765 LAPLACE CORR - -3.21 (seconds)

DEFLEC12A

KF0765 GEOID HEIGHT - -29.87 (meters)

GEOID12A

KF0765 DYNAMIC HEIGHT - 317.186 (meters)

1040.63 (feet) COMP

KF0765 MODELED GRAVITY - 979,947.4 (mgal)

NAVD 88

KF0765

KF0765 VERT ORDER - FIRST CLASS II

KF0765

KF0765 Network accuracy estimates per FGDC Geospatial Positioning Accuracy

KF0765 Standards:

KF0765 FGDC (95% conf, cm) Standard deviation (cm) CorrNE

KF0765 Horiz Ellip SD_N SD_E SD_h (unitless)

KF0765

KF0765 NETWORK 1.20 2.04 0.56 0.38 1.04 -0.11001991

KF0765

KF0765 [Click here for local accuracies and other accuracy information.](#)

KF0765

KF0765

KF0765.The horizontal coordinates were established by GPS observations

KF0765.and adjusted by the National Geodetic Survey in June 2012.

KF0765

KF0765.NAD 83(2011) refers to NAD 83 coordinates where the reference

KF0765.frame has been affixed to the stable North American tectonic plate. See

KF0765.NA2011 for more information.



KF0765

KF0765.The horizontal coordinates are valid at the epoch date displayed above

KF0765.which is a decimal equivalence of Year/Month/Day.

KF0765

KF0765.No horizontal observational check was made to the station.

KF0765.

KF0765.The orthometric height was determined by differential leveling and

KF0765.adjusted by the NATIONAL GEODETIC SURVEY

KF0765.in June 1991.

KF0765

KF0765.The X, Y, and Z were computed from the position and the ellipsoidal ht.

KF0765

KF0765.The Laplace correction was computed from DEFLEC12A derived deflections.

KF0765

KF0765.The ellipsoidal height was determined by GPS observations

KF0765.and is referenced to NAD 83.

KF0765

KF0765.The dynamic height is computed by dividing the NAVD 88

KF0765.geopotential number by the normal gravity value computed on the

KF0765.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45

KF0765.degrees latitude ($g = 980.6199$ gals.).

KF0765

KF0765.The modeled gravity was interpolated from observed gravity values.

KF0765

KF0765. The following values were computed from the NAD 83(2011) position.

KF0765

KF0765; North East Units Scale Factor Converg.

KF0765;SPC KS N - 89,433.536 514,752.790 MT 0.99995901 +0 50 23.2

KF0765;SPC KS N - 293,416.53 1,688,818.11 sFT 0.99995901 +0 50 23.2

KF0765;UTM 14 - 4,333,935.793 701,158.456 MT 1.00009827 +1 28 09.2

KF0765

KF0765! - Elev Factor x Scale Factor = Combined Factor

KF0765!SPC KS N - 0.99995489 x 0.99995901 = 0.99991390

KF0765!UTM 14 - 0.99995489 x 1.00009827 = 1.00005316

KF0765

KF0765 SUPERSEDED SURVEY CONTROL

KF0765

KF0765 NAD 83(2007)- 39 07 52.98814(N) 096 40 21.91549(W) AD(2002.00) 0

KF0765 ELLIP H (02/10/07) 287.533 (m) GP(2002.00)

KF0765 ELLIP H (07/29/04) 287.539 (m) GP() 4 2

KF0765 NAD 83(1997)- 39 07 52.98796(N) 096 40 21.91554(W) AD() 1

KF0765 ELLIP H (03/07/02) 287.534 (m) GP() 4 2

KF0765 NAVD 88 (03/07/02) 317.40 (m) 1041.3 (f) LEVELING 3

KF0765

KF0765.Superseded values are not recommended for survey control.

KF0765

KF0765.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

KF0765.See file dsdata.txt to determine how the superseded data were derived.



KF0765

KF0765_U.S. NATIONAL GRID SPATIAL ADDRESS: 14SQJ0115833935(NAD 83)

KF0765

KF0765_MARKER: I = METAL ROD

KF0765_SETTING: 49 = STAINLESS STEEL ROD W/O SLEEVE (10 FT.+)

KF0765_SP_SET: STAINLESS STEEL ROD

KF0765_STAMPING: M 370 1986

KF0765_MARK LOGO: NGS

KF0765_PROJECTION: FLUSH

KF0765_MAGNETIC: I = MARKER IS A STEEL ROD

KF0765_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL

KF0765_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR

KF0765+SATELLITE: SATELLITE OBSERVATIONS - December 17, 2007

KF0765_ROD/PIPE-DEPTH: 14.0 meters

KF0765

| KF0765 HISTORY | - Date | Condition | Report By |
|----------------|------------|------------|-----------|
| KF0765 HISTORY | - 1986 | MONUMENTED | NGS |
| KF0765 HISTORY | - 20010427 | GOOD | MSAM |
| KF0765 HISTORY | - 20071217 | GOOD | INDIV |

KF0765

KF0765 STATION DESCRIPTION

KF0765

KF0765'DESCRIBED BY NATIONAL GEODETIC SURVEY 1986

KF0765'12.0 KM (7.45 MI) WEST FROM MANHATTAN.

KF0765'12.0 KM (7.45 MI) WESTERLY ALONG THE UNION PACIFIC RAILROAD FROM THE KF0765'STATION IN MANHATTAN, 13.2 M (43.3 FT) SOUTHEAST OF THE NEAR RAIL, 8.0 KF0765'M (26.2 FT) NORTH OF THE CENTER OF COUNTY ROAD 5700 WEST, AND 2.0 M KF0765'(6.6 FT) NORTHEAST OF A FENCE CORNER. NOTE--ACCESS TO DATUM POINT IS

KF0765'HAD THROUGH A 5-INCH LOGO CAP.

KF0765'THE MARK IS 0.3 METERS NW FROM A WITNESS POST AND FENCE

KF0765'THE MARK IS ABOVE LEVEL WITH THE ROAD.

KF0765

KF0765 STATION RECOVERY (2001)

KF0765

KF0765'RECOVERY NOTE BY MOUNTAIN SURVEYING AND MAPPING INC 2001 (KCH)

KF0765'RECOVERED BY MOUNTAIN SURVEYING AND MAPPING, INC. 2001 (WWS)

KF0765'

KF0765'THE STATION IS LOCATED ABOUT 10.46 KM (6.5 MI) SOUTHWEST OF

KF0765'MANHATTAN, KANSAS, 3.7 KM (2.3 MI) NORTH OF OGDEN, KANSAS. IT IS IN

KF0765'THE

KF0765'NORTHEAST CORNER OF THE INTERSECTION OF COUNTY ROAD

KF0765'2400 (WILDCAT CREEK ROAD), AND THE RAILROAD PARALLEL TO STATE

KF0765'HIGHWAY 18.

KF0765'

KF0765'TO REACH THE STATION FROM THE INTERCHANGE OF STATE HIGHWAY 113

KF0765'(SETH CHILD RD) AND STATE HIGHWAY 18 (FT RILEY BOULEVARD) IN

KF0765'MANHATTAN, KANSAS, GO 7.7 KM (4.8 MI), SOUTHWEST ON STATE ROAD 18 TO



Appendix C: Final Constraint



```

*****
* NETWORK - WEIGHTED GPS NETWORK ADJUSTMENT *
*
* (c) Copyright NovAtel Inc., (2014) *
*
* Version: 8.50.4320 *
*
* FILE: C:\Users\ben.kimbrough\Documents\Projects\2015\15115 Manhattan
Area\307_Control_Network\2015APRIL08\Data Processing\2015APRIL08.net
*****

```

DATE(m/d/y): Wed. 4/15/15 TIME: 21:39:28

```

DATUM: 'WGS84'
SCALE_FACTOR: 1.0000
CONFIDENCE LEVEL: 39.40 % (Scale factor is 1.0009)

```

INPUT CONTROL/CHECK POINTS

```

STA_ID TYPE -- LATITUDE -- -- LONGITUDE -- ELLHGT - HZ-SD V-SD
GROVE GCP-3D 39 03 44.15701 -96 32 00.63403 411.141 0.00010 0.00010
M370 GCP-3D 39 07 52.98806 -96 40 21.91477 287.522 0.00010 0.00010

```

INPUT VECTORS

```

SESSION NAME VECTOR(m) ----- Covariance (m) [unscaled] -----
DX/DY/DZ standard deviations in brackets
CP02 to CPO1 (1) -4949.4247 4.4837e-008 (0.0002)
4659.9015 4.2816e-008 1.5492e-007 (0.0004)
5090.1125 -8.7239e-009 -7.0223e-008 1.1913e-007 (0.0003)

CP03 to CP02 (1) -4710.4849 4.2001e-008 (0.0002)
5217.1037 4.0423e-008 1.5289e-007 (0.0004)
5660.3322 -1.1246e-008 -7.2138e-008 1.1971e-007 (0.0003)

```




CP03 to CP06 (1) -13079.5963 6.5000e-008 (0.0003)
6564.8642 5.3178e-008 2.2528e-007 (0.0005)
6237.8653 4.1107e-009 -7.7510e-008 1.4889e-007 (0.0004)

CP03 to CP15 (1) -13345.1834 3.4635e-008 (0.0002)
732.2751 3.1170e-008 1.3298e-007 (0.0004)
-1004.7836 -5.6317e-009 -6.3319e-008 1.0358e-007 (0.0003)

CP03 to CP19 (1) -5139.8500 1.7351e-008 (0.0001)
-2241.5330 8.9893e-009 7.1121e-008 (0.0003)
-3342.5383 -3.3594e-009 -3.4141e-008 5.5593e-008 (0.0002)

CP03 to CPO1 (1) -9659.9013 5.2438e-008 (0.0002)
9877.0227 3.3706e-008 1.4353e-007 (0.0004)
10750.4381 4.1802e-010 -6.6654e-008 1.6860e-007 (0.0004)

CP06 to CP02 (1) 8369.1098 4.7904e-008 (0.0002)
-1347.7695 4.2190e-008 1.6965e-007 (0.0004)
-577.5321 -6.5185e-009 -8.1425e-008 1.3999e-007 (0.0004)

CP06 to CP15 (1) -265.5850 1.9932e-008 (0.0001)
-5832.5918 1.1109e-008 8.9001e-008 (0.0003)
-7242.6582 -4.1037e-009 -4.2349e-008 7.2536e-008 (0.0003)

CP06 to CP19 (1) 7939.7483 6.1744e-008 (0.0002)
-8806.3998 5.2638e-008 2.9876e-007 (0.0005)
-9580.4015 -1.6261e-008 -1.2628e-007 1.8188e-007 (0.0004)

CP06 to CPO1 (1) 3419.6944 4.8849e-008 (0.0002)
3312.1561 2.4086e-008 1.3006e-007 (0.0004)
4512.5796 2.2418e-009 -3.3068e-008 1.3079e-007 (0.0004)

CP15 to CP02 (1) 8634.6965 6.9192e-008 (0.0003)
4484.8262 5.9522e-008 2.5807e-007 (0.0005)
6665.1223 -1.3318e-009 -1.3394e-007 2.4039e-007 (0.0005)

CP15 to CP19 (1) 8205.3307 2.0814e-008 (0.0001)
-2973.8147 1.1523e-008 8.9961e-008 (0.0003)
-2337.7473 -4.4222e-009 -4.5311e-008 7.9269e-008 (0.0003)

CP15 to CPO1 (1) 3685.2768 4.3379e-008 (0.0002)
9144.7370 1.9173e-008 1.7480e-007 (0.0004)
11755.2377 9.0864e-009 -1.0485e-007 2.1470e-007 (0.0005)

CP19 to CP02 (1) 429.3651 4.9852e-008 (0.0002)
7458.6327 4.5278e-008 1.7793e-007 (0.0004)
9002.8811 -9.4106e-009 -8.4574e-008 1.4305e-007 (0.0004)



CP19 to CPO1 (1) -4520.0601 7.8725e-008 (0.0003)
12118.5352 7.4993e-008 2.5570e-007 (0.0005)
14092.9955 -2.4738e-008 -9.4432e-008 1.7607e-007 (0.0004)

GROVE to CP06 (1) -8108.5459 1.6769e-007 (0.0004)
10712.2073 6.1809e-009 7.5874e-007 (0.0009)
11839.6360 -9.6225e-008 -5.2623e-008 1.0874e-006 (0.0010)

GROVE to CP03 (1) 4971.0561 1.2269e-007 (0.0004)
4147.3354 6.9677e-009 4.5467e-007 (0.0007)
5601.7573 -6.9545e-008 -5.4983e-008 4.9720e-007 (0.0007)

GROVE to CP15 (1) -8374.1313 9.3973e-008 (0.0003)
4879.6150 3.4858e-008 4.8739e-007 (0.0007)
4596.9809 -4.1052e-008 -1.7502e-007 2.6086e-007 (0.0005)

GROVE to CP19 (1) -168.8009 2.3201e-008 (0.0002)
1905.8009 1.0860e-008 1.1581e-007 (0.0003)
2259.2251 -1.0567e-008 -4.3607e-008 6.5838e-008 (0.0003)

M370 to CP15 (1) 3024.8859 4.5239e-008 (0.0002)
-1408.2163 -1.2850e-008 7.1972e-008 (0.0003)
-1280.6548 -3.4594e-008 5.7714e-009 1.1751e-007 (0.0003)

M370 to CP03 (1) 16370.0840 2.4172e-007 (0.0005)
-2140.5141 -6.7618e-008 4.1652e-007 (0.0006)
-275.8835 -2.0203e-007 -1.1324e-007 1.6011e-006 (0.0013)

M370 to CP06 (1) 3290.4855 1.5983e-007 (0.0004)
4424.3508 -4.5419e-008 2.5474e-007 (0.0005)
5961.9994 -1.2229e-007 2.0561e-008 4.1574e-007 (0.0006)

M370 to CP19 (1) 11230.2307 1.9340e-007 (0.0004)
-4382.0322 -5.4990e-008 3.0793e-007 (0.0006)
-3618.4119 -1.4799e-007 2.4873e-008 5.0274e-007 (0.0007)

M370 to GROVE (1) 11399.0270 1.7294e-007 (0.0004)
-6287.8425 1.6920e-009 5.4983e-007 (0.0007)
-5877.6379 -1.3010e-007 -1.6561e-007 8.6474e-007 (0.0009)

OUTPUT VECTOR RESIDUALS (East, North, Height - Local Level)



| SESSION NAME | -- RE -- | -- RN -- | -- RH -- | - PPM - | DIST - | STD - |
|-------------------|----------|----------|----------|----------|--------|--------|
| (m) | (m) | (m) | (km) | (m) | | |
| CP02 to CPO1 (1) | 0.0030 | 0.0053 | -0.0088 | \$ 1.259 | 8.5 | 0.0006 |
| CP03 to CP02 (1) | 0.0004 | 0.0026 | 0.0010 | \$ 0.310 | 9.0 | 0.0006 |
| CP03 to CP06 (1) | -0.0008 | 0.0032 | -0.0013 | \$ 0.225 | 15.9 | 0.0007 |
| CP03 to CP15 (1) | 0.0007 | -0.0023 | -0.0093 | \$ 0.713 | 13.4 | 0.0005 |
| CP03 to CP19 (1) | -0.0000 | -0.0006 | -0.0010 | \$ 0.183 | 6.5 | 0.0004 |
| CP03 to CPO1 (1) | -0.0028 | 0.0015 | 0.0107 | \$ 0.635 | 17.5 | 0.0006 |
| CP06 to CP02 (1) | 0.0018 | 0.0043 | -0.0054 | \$ 0.843 | 8.5 | 0.0006 |
| CP06 to CP15 (1) | -0.0009 | 0.0032 | -0.0040 | \$ 0.562 | 9.3 | 0.0004 |
| CP06 to CP19 (1) | -0.0014 | -0.0041 | -0.0029 | \$ 0.342 | 15.2 | 0.0007 |
| CP06 to CPO1 (1) | -0.0016 | -0.0055 | 0.0057 | \$ 1.233 | 6.6 | 0.0006 |
| CP15 to CP02 (1) | 0.0014 | 0.0015 | 0.0042 | \$ 0.393 | 11.8 | 0.0008 |
| CP15 to CP19 (1) | 0.0013 | 0.0002 | -0.0018 | \$ 0.240 | 9.0 | 0.0004 |
| CP15 to CPO1 (1) | 0.0006 | -0.0016 | 0.0012 | \$ 0.136 | 15.3 | 0.0007 |
| CP19 to CP02 (1) | -0.0000 | -0.0024 | -0.0078 | \$ 0.695 | 11.7 | 0.0006 |
| CP19 to CPO1 (1) | 0.0036 | 0.0009 | -0.0170 | \$ 0.909 | 19.1 | 0.0007 |
| GROVE to CP06 (1) | -0.0010 | -0.0048 | -0.0097 | \$ 0.604 | 17.9 | 0.0014 |
| GROVE to CP03 (1) | -0.0066 | 0.0068 | -0.0054 | \$ 1.275 | 8.6 | 0.0010 |
| GROVE to CP15 (1) | -0.0015 | -0.0036 | -0.0161 | \$ 1.549 | 10.7 | 0.0009 |
| GROVE to CP19 (1) | 0.0001 | 0.0028 | -0.0120 | \$ 4.165 | 3.0 | 0.0005 |
| M370 to CP15 (1) | 0.0082 | -0.0055 | 0.0082 | \$ 3.590 | 3.6 | 0.0005 |
| M370 to CP03 (1) | -0.0097 | 0.0195 | 0.0090 | \$ 1.428 | 16.5 | 0.0015 |
| M370 to CP06 (1) | -0.0083 | 0.0088 | -0.0029 | \$ 1.534 | 8.1 | 0.0009 |
| M370 to CP19 (1) | -0.0047 | 0.0020 | 0.0130 | \$ 1.113 | 12.6 | 0.0010 |
| M370 to GROVE (1) | -0.0014 | 0.0061 | 0.0179 | \$ 1.328 | 14.3 | 0.0013 |

RMS 0.0038 0.0056 0.0089

\$ - This session is flagged as a 3-sigma outlier

CONTROL POINT RESIDUALS (ADJUSTMENT MADE)

| STA. NAME | -- RE -- | -- RN -- | -- RH -- |
|-----------|----------|----------|----------|
| (m) | (m) | (m) | |
| GROVE | -0.0008 | -0.0000 | -0.0016 |
| M370 | 0.0009 | 0.0000 | 0.0016 |
| ----- | | | |
| RMS | 0.0009 | 0.0000 | 0.0016 |

OUTPUT STATION COORDINATES (LAT/LONG/HT)



```
STA_ID  -- LATITUDE -- -- LONGITUDE -- - ELLHGT -
CP02    39 11 38.41829 -96 32 34.24731 278.0447
CP03    39 07 40.90619 -96 28 54.67454 308.3955
CP06    39 12 00.67940 -96 38 27.14327 350.0111
CP15    39 06 59.32568 -96 38 10.04777 292.6165
CP19    39 05 19.33443 -96 32 16.63434 380.2425
CPO1    39 15 09.57689 -96 36 21.45877 349.5123
GROVE   39 03 44.15701 -96 32 00.63407 411.1394
M370    39 07 52.98806 -96 40 21.91473 287.5236
```

OUTPUT VARIANCE/COVARIANCE

2

```
STA_ID  SE/SN/SUP ----- CX matrix (m)-----
(39.40 %) (not scaled by confidence level)
(m)      (ECEF, XYZ cartesian)
CP02     0.0002 2.4996e-008
0.0002 9.3234e-009 6.9126e-008
0.0003 -6.6053e-009 -2.4027e-008 6.3393e-008

CP03     0.0001 1.9443e-008
0.0002 3.1017e-009 4.9658e-008
0.0003 -5.4299e-009 -1.4612e-008 4.8824e-008

CP06     0.0001 2.0322e-008
0.0002 3.0708e-009 5.1996e-008
0.0003 -5.7220e-009 -1.4116e-008 5.0896e-008

CP15     0.0001 1.6679e-008
0.0002 5.9572e-010 3.7274e-008
0.0002 -5.4745e-009 -8.3029e-009 3.8676e-008

CP19     0.0001 1.6270e-008
0.0002 1.7386e-009 4.1808e-008
0.0002 -5.2182e-009 -1.1265e-008 3.6928e-008

CPO1     0.0002 2.5220e-008
0.0002 7.2149e-009 6.5440e-008
0.0003 -5.4732e-009 -2.0617e-008 6.5192e-008

GROVE    0.0001 8.0175e-009
0.0001 -7.8624e-011 9.1220e-009
0.0001 -3.5529e-010 -1.5853e-010 9.1353e-009
```



M370 0.0001 8.0175e-009
 0.0001 -7.8624e-011 9.1220e-009
 0.0001 -3.5529e-010 -1.5853e-010 9.1353e-009

VARIANCE FACTOR = 186.4349

Note: Values < 1.0 indicate statistics are pessimistic, while
 values > 1.0 indicate optimistic statistics. Entering this
 value as the network adjustment scale factor will bring
 variance factor to one.



Appendix D: Real Time Kinematic Survey Results



| PointID | Easting | Northing | Elevation | Description |
|---------|------------|-------------|-----------|---------------|
| BARE01 | 708801.996 | 4344370.019 | 323.459 | Bare Earth |
| BARE02 | 714739.591 | 4335457.884 | 421.233 | Bare Earth |
| BARE03 | 704428.047 | 4340041.839 | 321.360 | Bare Earth |
| OT01 | 706633.786 | 4346999.905 | 335.921 | Open Terrain |
| OT02 | 702502.221 | 4347366.609 | 411.366 | Open Terrain |
| OT03 | 709492.439 | 4339570.128 | 312.281 | Open Terrain |
| OT04 | 714762.644 | 4338244.150 | 305.924 | Open Terrain |
| OT05 | 714892.888 | 4341531.417 | 309.758 | Open Terrain |
| OT06 | 719538.866 | 4332902.758 | 330.783 | Open Terrain |
| OT07 | 703765.807 | 4337738.093 | 330.274 | Open Terrain |
| OT08 | 705411.659 | 4344760.998 | 414.148 | Open Terrain |
| OT09 | 706453.909 | 4332146.388 | 320.104 | Open Terrain |
| OT12 | 708877.890 | 4349253.445 | 367.702 | Open Terrain |
| OT13 | 707727.765 | 4346412.453 | 331.009 | Open Terrain |
| OT14 | 712546.425 | 4342327.996 | 308.646 | Open Terrain |
| OT15 | 719199.057 | 4334716.922 | 334.750 | Open Terrain |
| OT16 | 703209.368 | 4338991.726 | 380.760 | Open Terrain |
| OT17 | 701774.165 | 4341847.739 | 336.249 | Open Terrain |
| OT18 | 705499.211 | 4343472.494 | 365.043 | Open Terrain |
| OT19 | 703290.918 | 4340257.009 | 325.118 | Open Terrain |
| OT20 | 704013.076 | 4334868.605 | 315.561 | Open Terrain |
| OT21 | 706780.901 | 4334861.787 | 312.176 | Open Terrain |
| OT22 | 704930.735 | 4334007.433 | 316.104 | Open Terrain |
| OT23 | 712962.130 | 4328272.496 | 419.982 | Open Terrain |
| UB01 | 708789.580 | 4348573.064 | 353.201 | Urban Terrain |
| UB02 | 710990.292 | 4339573.727 | 308.269 | Urban Terrain |
| BR02 | 705081.758 | 4346817.424 | 356.872 | Brush |
| BR04 | 703414.757 | 4330752.004 | 327.890 | Brush |
| BR05 | 712879.292 | 4329226.661 | 404.674 | Brush |
| HG01 | 705964.110 | 4342056.796 | 337.253 | High Grass |
| HG02 | 706191.699 | 4332851.567 | 316.397 | High Grass |
| HG03 | 717485.123 | 4332891.969 | 334.345 | High Grass |

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