Airborne GPS Processing Report
Vilas County LiDAR mission, May 2013

1.1 Base Station Network Design

The GPS base station network was designed to maintain consistent and redundant coverage across the Vilas County project area. A combination of WISCORS permanent base stations and temporary GPS base stations were used to collect GPS data during the LiDAR acquisition missions in May 2013. The network was designed such that the aircraft was within 30km of a base station throughout the mission. The majority of the county had redundant coverage from a nearby base or bases, which was used to ensure the mission was successful even if one base station was not recording during flight. No such issues were encountered during the Vilas County flights.

The base layout was done in coordination with the lidar experts at Aerometric (now Quantum Spatial) and Ayres Associates, who determined that the 30km baseline lengths provide more than adequate coverage for the flight block. For example, the Eagle River area has 2 base stations at 30km and 4 base stations at 35km, with 2 of those 4 bases having redundant bases (Rhinelander, Eagle River).

Although FEMA standards have recommended 20km baseline lengths in the past for high density lidar, we have found on other county-wide flights that good spatial coverage using 30km spacing is more than robust enough for the accuracy required for this project. The advancement of airborne GPS and IMU systems, such as the one paired with Leica ALS70, has reduced the amount of base stations needed to accurately calibrate the lidar data. The 7 bases used for the Oneida/Vilas LiDAR flight block is the densest network of base control we have used on projects of the same specification.

1.1.1 Vilas County Base Stations and Airport

For the Vilas County LiDAR mission, the flight crew mobilized the aircraft and sensor out of the following airport:

- Rhinelander Municipal Airport (RHER)

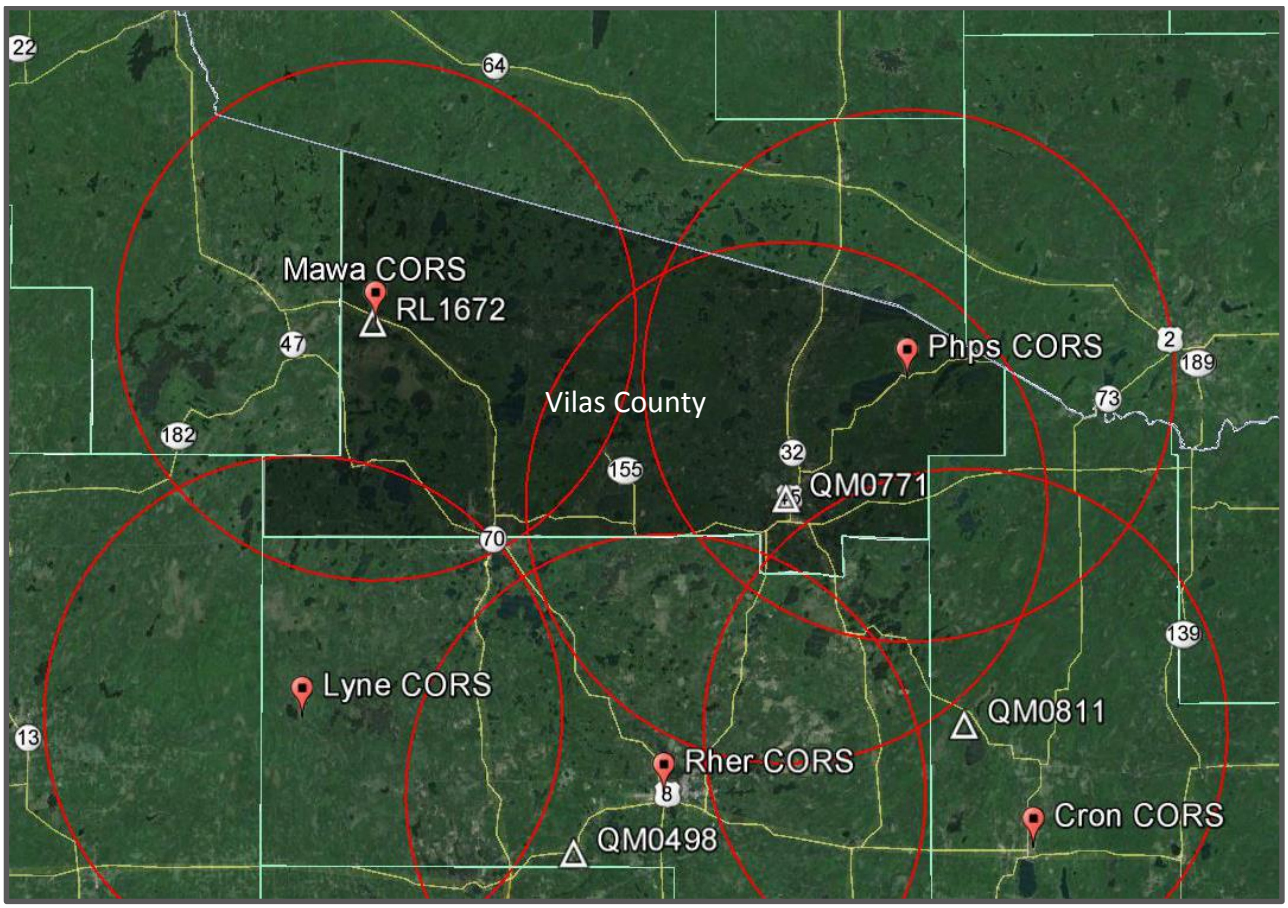
All base station locations for the Vilas County flight were tied into the existing WISCORS/NGS network. In order to provide the highest accuracy Airborne GPS (ABGPS), all airborne processing used the points established on existing NGS Monuments, as well as the CORS Network using Applanix POSMMS "augmented" Smartbase solutions. This allowed the creation of a virtual network over the entire AOI resulting in better GPS locks and more accurate data.

Table 1: Vilas County LiDAR base station locations

Name	Type	Location
Lyne	WISCORS	Willow, WI
Rher	WISCORS	Rhinelander, WI
Phps	WISCORS	Phelps, WI
Mawa	WISCORS	Manitowish Water, WI
Cron	WISCORS	Crandon, WI
QM0811	GPS base station	Hiles, WI
QM0771	GPS base station	Eagle River municipal airport
QM0779	GPS base station	Eagle River municipal airport

Flight crews were responsible for setting base stations at Rhinelander municipal airport. Trained survey crews were responsible for setting and maintaining the mobile base station units at Eagle River municipal airport and near Hiles.

The following graphic depicts the locations of the WISCORS base stations and GPS base stations that were used for the Vilas County flight, along with their associated 30km baseline rings:



The following pages include the listed information for each base station utilized on the flight:

- GPS base station data sheets from May 13-15, 2013 (pages 3-11)
- Field Notes for each GPS base station used (pages 12-14)
- OPUS Reports during flight for GPS base stations (pages 15-21)
- WISCORS data sheets (pages 22-26)

AYRES ASSOCIATES

GPS CONTROL SURVEY
FIELD DATA SHEET

PAGE:
1

JOB REFERENCE	POINT ID:	Oneida/Vilas Co Lidar 2013
2013 Lidar	Proj. No.:	

STATE	WI	COUNTY	Forest	Country	USA

OPERATOR	Jake Jensen

RECEIVER MODEL	Leica GX1230
RECEIVER S/N	464602

APPROXIMATE POSITION (C/A/CODE)

LATITUDE	45 42 09.97665(N)	477.818	HGT. MTS
LONGITUDE	088 59 46.25218(W)		

SESSION	DATE:	05/13/13	START TIME	07:07	Record Interval	X	U.T.C.
0	DAY OF YEAR	133	END TIME	18:40	1 sec.		LOCAL

ANTENNA HEIGHT (SLANT)

MTRS/FT				
	MEASURED		FIXED HGT.	

ANTENNA HEIGHT (VERTICAL)

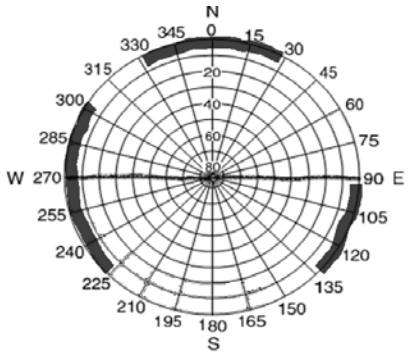
MTRS/FT	1.8		
	MEASURED	X	FIXED HGT

ANTENNA INFO

RADIUS (M)			0.000
S/N NUMBER	6380040		0.000
ANTENNA TYPE	Leica AX1202 GG		

TOP OF MONUMENT IS:		X	FLUSH
METERS/FEET			ABOVE GROUND
METERS/FEET			BELOW GROUND

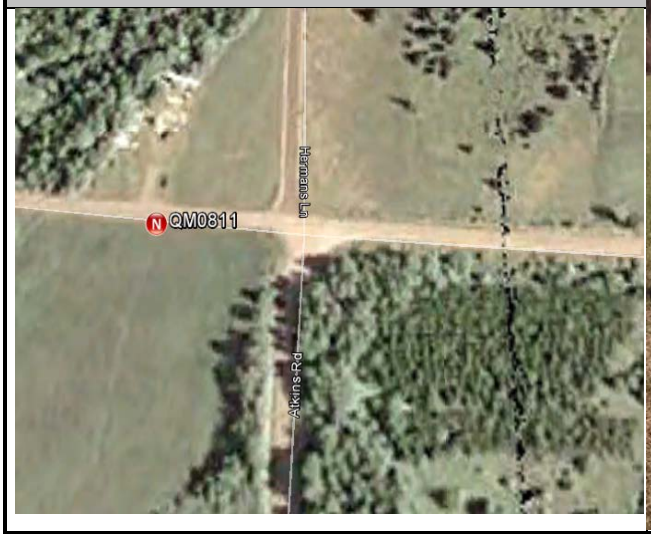
OBSTRUCTION DIAGRAM



	AERIAL TARGET			PHOTO I.D.
	PUB. BENCH MARK			NEW CONTROL
	PUB. CONTROL		X	BASE STATION

Ayres Description: PID= QM0811

Sketch



Photo

AYRES ASSOCIATES

GPS CONTROL SURVEY FIELD DATA SHEET

PAGE:
1

JOB REFERENCE	POINT ID:	Oneida/Vilas Co Lidar 2013
2013 Lidar	Proj. No.:	

STATE	WI	COUNTY	Forest	Country	USA

OPERATOR	Jake Jensen

APPROXIMATE POSITION (C/A/CODE)			
LATITUDE	45 42 09.97665(N)	477.818	HGT. MTS
LONGITUDE	088 59 46.25218(W)		

RECEIVER MODEL	Leica GX1230
RECEIVER S/N	464602

SESSION	DATE:	05/14/13	START TIME	06:58	Record Interval	X	U.T.C.
0	DAY OF YEAR	134	END TIME	18:15	1 sec.		LOCAL

ANTENNA HEIGHT (SLANT)				
MTRS/FT				
	MEASURED		FIXED HGT.	

ANTENNA HEIGHT (VERTICAL)				
MTRS/FT	1.8			
	MEASURED	X	FIXED HGT	

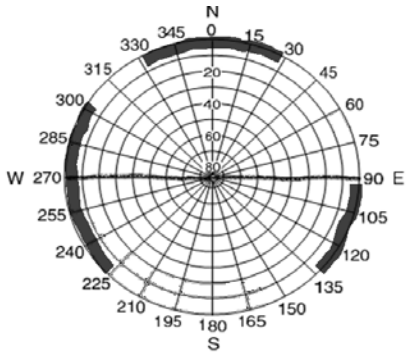
ANTENNA INFO			
RADIUS (M)			0.000
S/N NUMBER	6380040		0.000
ANTENNA TYPE	Leica AX1202 GG		

TOP OF MONUMENT IS:	X	FLUSH
METERS/FEET		ABOVE GROUND
METERS/FEET		BELOW GROUND

	AERIAL TARGET		PHOTO I.D.
	PUB. BENCH MARK		NEW CONTROL
	PUB. CONTROL	X	BASE STATION

Ayres Description: PID= QM0811

OBSTRUCTION DIAGRAM



Photo

Sketch

GPS CONTROL SURVEY FIELD DATA SHEET

AYRES ASSOCIATES

PAGE:
1

JOB REFERENCE	POINT ID:	Oneida/Vilas Co Lidar 2013
2013 Lidar	Proj. No.:	

STATE	WI	COUNTY	Forest	Country	USA

OPERATOR	Jake Jensen

APPROXIMATE POSITION (C/A/CODE)			
LATITUDE	45 42 09.97665(N)	477.818	HGT. MTS
LONGITUDE	088 59 46.25218(W)		

RECEIVER MODEL	Leica GX1230
RECEIVER S/N	464602

SESSION	DATE:	05/15/13	START TIME	07:10	Record Interval	X	U.T.C.
0	DAY OF YEAR	135	END TIME	22:18	1 sec.		LOCAL

ANTENNA HEIGHT (SLANT)				
MTRS/FT				
	MEASURED		FIXED HGT.	

ANTENNA HEIGHT (VERTICAL)				
MTRS/FT	1.8			
	MEASURED	X	FIXED HGT	

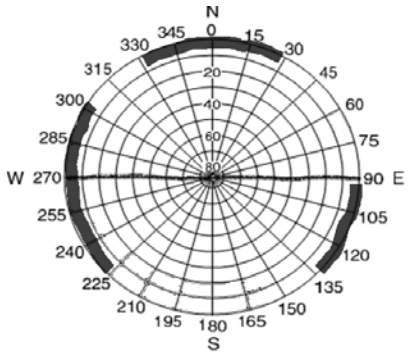
ANTENNA INFO			
RADIUS (M)			0.000
S/N NUMBER	6380040		0.000
ANTENNA TYPE	Leica AX1202 GG		

TOP OF MONUMENT IS:	X	FLUSH
METERS/FEET		ABOVE GROUND
METERS/FEET		BELOW GROUND

	AERIAL TARGET		PHOTO I.D.
	PUB. BENCH MARK		NEW CONTROL
	PUB. CONTROL	X	BASE STATION

Ayres Description: PID= QM0811

OBSTRUCTION DIAGRAM



Sketch

Photo

AYRES ASSOCIATES

GPS CONTROL SURVEY
FIELD DATA SHEET

PAGE:
1

JOB REFERENCE	POINT ID:	Oneida/Vilas Co Lidar 2013
2013 Lidar	Proj. No.:	

STATE	WI	COUNTY	Vilas	Country	USA

OPERATOR	Jake Jensen

RECEIVER MODEL	Leica GX1210
RECEIVER S/N	464398

APPROXIMATE POSITION (C/A/CODE)			
LATITUDE	45 56 03.83153(N)	467.505	HGT. MTS
LONGITUDE	089 15 48.30885(W)		

SESSION	DATE:	05/13/13	START TIME	06:05	Record Interval	X	U.T.C.
0	DAY OF YEAR	133	END TIME	19:25	1 sec.		LOCAL

ANTENNA HEIGHT (SLANT)				
MTRS/FT				
	MEASURED		FIXED HGT.	

ANTENNA HEIGHT (VERTICAL)				
MTRS/FT	1.8			
	MEASURED	X	FIXED HGT	

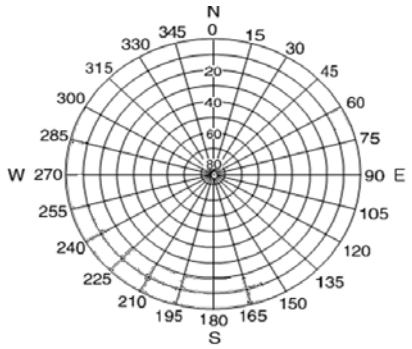
ANTENNA INFO			
RADIUS (M)			0.000
S/N NUMBER	6380076		0.000
ANTENNA TYPE	Leica AX1202 GG		

TOP OF MONUMENT IS:		X	FLUSH
METERS/FEET			ABOVE GROUND
METERS/FEET			BELOW GROUND

	AERIAL TARGET		PHOTO I.D.
	PUB. BENCH MARK		NEW CONTROL
	PUB. CONTROL	X	BASE STATION

Ayres Description: PID= QM0779

OBSTRUCTION DIAGRAM



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GPS CONTROL SURVEY
FIELD DATA SHEET

PAGE:
1

JOB REFERENCE	POINT ID:	Oneida/Vilas Co Lidar 2013
2013 Lidar	Proj. No.:	

STATE	WI	COUNTY	Vilas	Country	USA

OPERATOR	Jake Jensen

APPROXIMATE POSITION (C/A/CODE)			
LATITUDE	45 56 03.83153(N)	467.505	HGT. MTS
LONGITUDE	089 15 48.30885(W)		

RECEIVER MODEL	Leica GX1230
RECEIVER S/N	464803

SESSION	DATE:	05/14/13	START TIME	06:05	Record Interval	X	U.T.C.
0	DAY OF YEAR	134	END TIME	19:25	1 sec.		LOCAL

ANTENNA HEIGHT (SLANT)				
MTRS/FT				
	MEASURED		FIXED HGT.	

ANTENNA HEIGHT (VERTICAL)				
MTRS/FT	1.8			
	MEASURED	X	FIXED HGT	

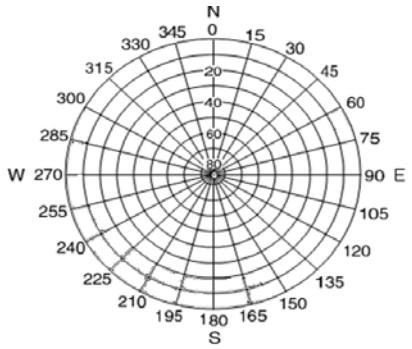
ANTENNA INFO			
RADIUS (M)			0.000
S/N NUMBER	6440109		0.000
ANTENNA TYPE	Leica AX1202 GG		

TOP OF MONUMENT IS:		X	FLUSH
METERS/FEET			ABOVE GROUND
METERS/FEET			BELOW GROUND

	AERIAL TARGET		PHOTO I.D.
	PUB. BENCH MARK		NEW CONTROL
	PUB. CONTROL	X	BASE STATION

Ayres Description: PID= QM0779

OBSTRUCTION DIAGRAM



Sketch

Photo

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GPS CONTROL SURVEY FIELD DATA SHEET

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JOB REFERENCE	POINT ID:	Oneida/Vilas Co Lidar 2013
2013 Lidar	Proj. No.:	

STATE	WI	COUNTY	Vilas	Country	USA

OPERATOR	Jake Jensen

APPROXIMATE POSITION (C/A/CODE)			
LATITUDE	45 56 03.83153(N)	467.505	HGT. MTS
LONGITUDE	089 15 48.30885(W)		

RECEIVER MODEL	Leica GX1210
RECEIVER S/N	464398

SESSION	DATE:	05/15/13	START TIME	06:20	Record Interval	X	U.T.C.
0	DAY OF YEAR	135	END TIME	00:20	1 sec.		LOCAL

ANTENNA HEIGHT (SLANT)				
MTRS/FT				
	MEASURED		FIXED HGT.	

ANTENNA HEIGHT (VERTICAL)				
MTRS/FT	1.8			
	MEASURED	X	FIXED HGT	

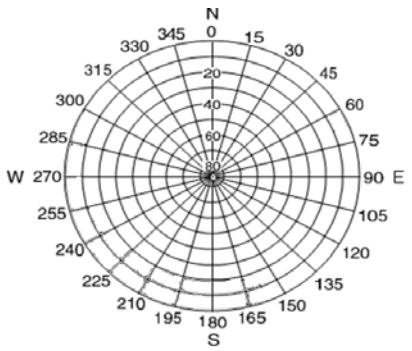
ANTENNA INFO			
RADIUS (M)			0.000
S/N NUMBER	6380076		0.000
ANTENNA TYPE	Leica AX1202 GG		

TOP OF MONUMENT IS:	X	FLUSH
METERS/FEET		ABOVE GROUND
METERS/FEET		BELOW GROUND

	AERIAL TARGET		PHOTO I.D.
	PUB. BENCH MARK		NEW CONTROL
	PUB. CONTROL	X	BASE STATION

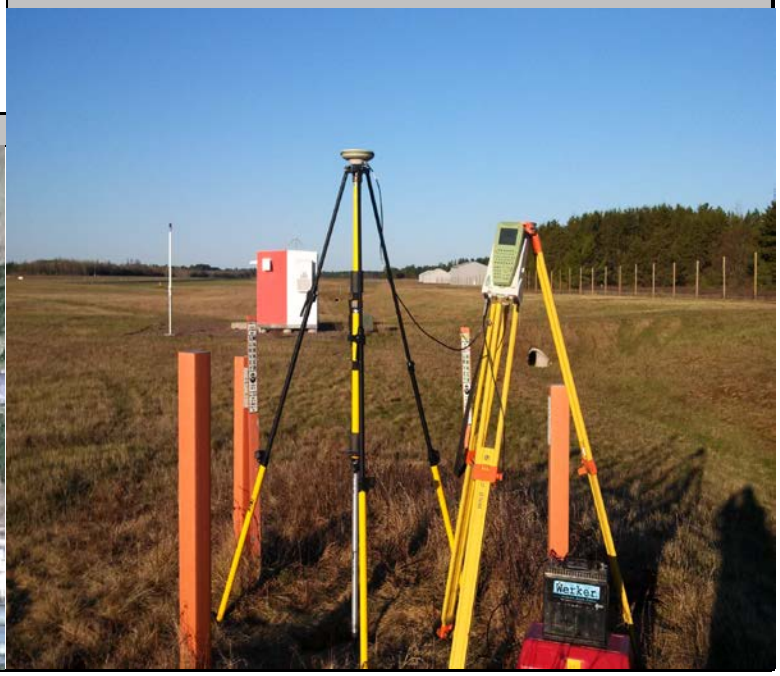
Ayres Description: PID= QM0779

OBSTRUCTION DIAGRAM



Sketch

Photo



AYRES ASSOCIATES

GPS CONTROL SURVEY FIELD DATA SHEET

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1

JOB REFERENCE	POINT ID:	Oneida/Vilas Co Lidar 2013
2013 Lidar	Proj. No.:	

STATE	WI	COUNTY	Vilas	Country	USA

OPERATOR	Jake Jensen

RECEIVER MODEL	Leica GX1230
RECEIVER S/N	464803

APPROXIMATE POSITION (C/A/CODE)			
LATITUDE	45 56 19.14391(N)	467.654	HGT. MTS
LONGITUDE	089 15 38.19627(W)		

SESSION	DATE:	05/13/13	START TIME	06:22	Record Interval	X	U.T.C.
0	DAY OF YEAR	133	END TIME	19:31	1 sec.		LOCAL

ANTENNA HEIGHT (SLANT)				
MTRS/FT				
	MEASURED		FIXED HGT.	

ANTENNA HEIGHT (VERTICAL)				
MTRS/FT	1.8			
	MEASURED	X	FIXED HGT	

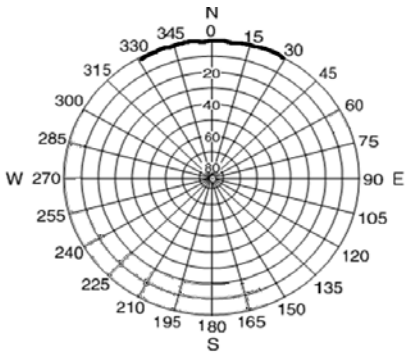
ANTENNA INFO			
RADIUS (M)			0.000
S/N NUMBER	6440109		0.000
ANTENNA TYPE	Leica AX1202 GG		

TOP OF MONUMENT IS:	X	FLUSH
METERS/FEET		ABOVE GROUND
METERS/FEET		BELOW GROUND

	AERIAL TARGET		PHOTO I.D.
	PUB. BENCH MARK		NEW CONTROL
	PUB. CONTROL	X	BASE STATION

Ayres Description: PID= QM0771

OBSTRUCTION DIAGRAM



Sketch

Photo

AYRES ASSOCIATES

GPS CONTROL SURVEY
FIELD DATA SHEET

PAGE:
1

JOB REFERENCE	POINT ID:	Oneida/Vilas Co Lidar 2013
2013 Lidar	Proj. No.:	

STATE	WI	COUNTY	Vilas	Country	USA

OPERATOR	Jake Jensen

RECEIVER MODEL	Leica GX1210
RECEIVER S/N	464398

APPROXIMATE POSITION (C/A/CODE)			
LATITUDE	45 56 19.14391(N)	467.654	HGT. MTS
LONGITUDE	089 15 38.19627(W)		

SESSION	DATE:	05/14/13	START TIME	06:22	Record Interval	X	U.T.C.
0	DAY OF YEAR	134	END TIME	19:31	1 sec.		LOCAL

ANTENNA HEIGHT (SLANT)				
MTRS/FT				
	MEASURED		FIXED HGT.	

ANTENNA HEIGHT (VERTICAL)				
MTRS/FT	1.8			
	MEASURED	X	FIXED HGT	

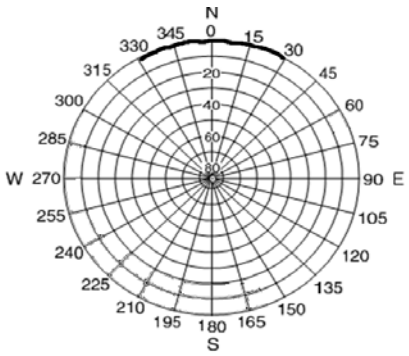
ANTENNA INFO			
RADIUS (M)			0.000
S/N NUMBER	6380076		0.000
ANTENNA TYPE	Leica AX1202 GG		

TOP OF MONUMENT IS:	X	FLUSH
METERS/FEET		ABOVE GROUND
METERS/FEET		BELOW GROUND

	AERIAL TARGET		PHOTO I.D.
	PUB. BENCH MARK		NEW CONTROL
	PUB. CONTROL	X	BASE STATION

Ayres Description: PID= QM0771

OBSTRUCTION DIAGRAM



Sketch

Photo

AYRES ASSOCIATES

GPS CONTROL SURVEY FIELD DATA SHEET

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2013 Lidar	Proj. No.:	

STATE	WI	COUNTY	Vilas	Country	USA

OPERATOR	Jake Jensen

APPROXIMATE POSITION (C/A/CODE)			
LATITUDE	45 56 19.14391(N)	467.654	HGT. MTS
LONGITUDE	089 15 38.19627(W)		

RECEIVER MODEL	Leica GX1230
RECEIVER S/N	464803

SESSION	DATE:	05/15/13	START TIME	06:30	Record Interval	X	U.T.C.
0	DAY OF YEAR	135	END TIME	00:27	1 sec.		LOCAL

ANTENNA HEIGHT (SLANT)				
MTRS/FT				
	MEASURED		FIXED HGT.	

ANTENNA HEIGHT (VERTICAL)				
MTRS/FT	1.8			
	MEASURED	X	FIXED HGT	

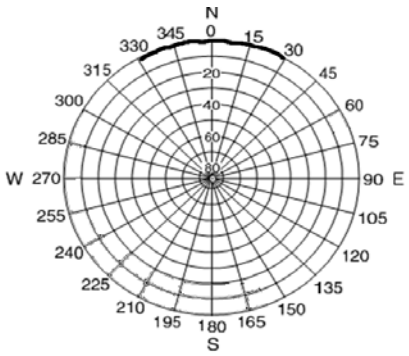
ANTENNA INFO			
RADIUS (M)			0.000
S/N NUMBER	6440109		0.000
ANTENNA TYPE	Leica AX1202 GG		

TOP OF MONUMENT IS:	X	FLUSH
METERS/FEET		ABOVE GROUND
METERS/FEET		BELOW GROUND

	AERIAL TARGET		PHOTO I.D.
	PUB. BENCH MARK		NEW CONTROL
	PUB. CONTROL	X	BASE STATION

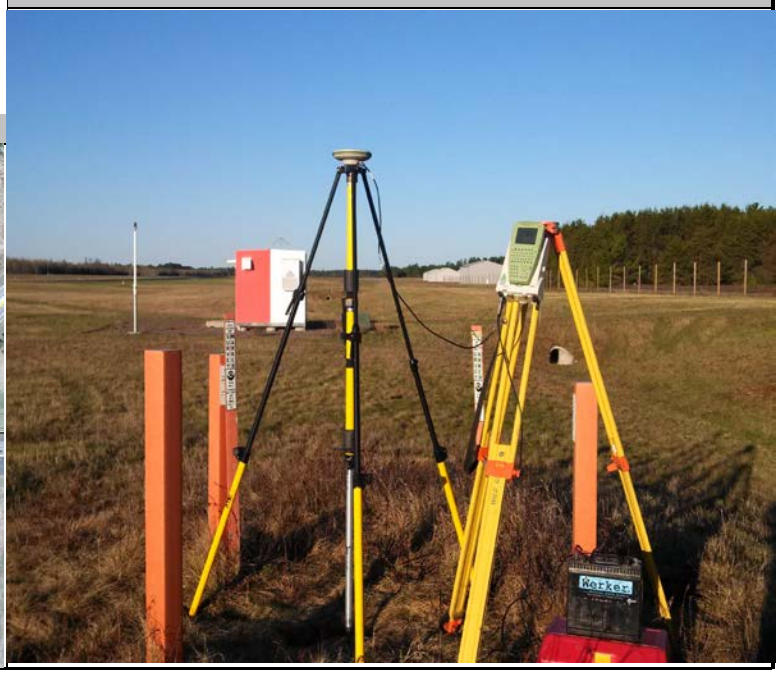
Ayres Description: PID= QM0771

OBSTRUCTION DIAGRAM



Sketch

Photo



5-13-13

EAGLE RIVER ALI MARK

Reciever GX1230 S# 464398

74.87 ANT. AX1202GG S# 06280076

1.8 M TO ARP

6:05 AM - 7:25 PM

5-13-13

EAGLE RIVER GPS

Reciever GX1230 S# 464803

74.95 ANT. AX1202GG S# 06440109

1.8 M TO ARP

6:22 AM - 7:31 PM

5-13-13

HILES

74.88 RECIEVER GX1230 S# 464397

ANT AX1202GG S# 06280040

1.8 M TO ARP

7:07 AM - 6:40 PM

5-14-13

EAGLE RIVER AZ MK (1)

±74.95

Reciever GX1230 S# 464803

100% Point occupation

ANT. 1202 GG S# 06440109

1.8 M TO ARP

6:06 AM - 7:13 PM

5-14-13

#74.87

EAGLE RIVER GPS (2)

RECIEVER GX1210 S# 464398

ANT. AX1202GG S# 06380076

1.8 M TO ARP

6:17 AM - 7:17 PM

5-14-13 (3)

#74.88

HILES

RECIEVER GX1230 S# 464602

100% Point occupation

ANT. AX1202GG S# 06380040

1.8 M TO ARP

6:58 AM - 6:15 PM

4

5-15-13

#74.87
~~#74.95~~
001

EAGLE RIVER AZ MARK 001
1.8M TO ARP
~~6:07~~ 6:20AM - 12:20AM
RECIEVER GX1210 464398
ANTENNA AX1202GG 06380076

74.95 GPS EAGLE RIVER GPS
1.8M TO ARP

6:30AM - 12:27AM 5-16-13
RECIEVER GX1230 464803
ANTENNA AX1202GG 06440109

HILES
1.8M TO ARP
74.88 7:10AM - 10:18PM
RECIEVER GX1230 464603
ANTENNA AX1202GG 06380040

FILE: 00081360.13o OP1369336221290

NGS OPUS SOLUTION REPORT
==========

All computed coordinate accuracies are listed as peak-to-peak values.
For additional information: http://www.ngs.noaa.gov/OPUS/about.jsp#accuracy

USER: tstentz@aerometric.com DATE: May 23, 2013
RINEX FILE: 0008136m.13o TIME: 19:19:47 UTC

SOFTWARE: page5 1209.04 master2.pl 0821123 START: 2013/05/16 12:17:00
EPHEMERIS: igr17404.eph [rapid] STOP: 2013/05/17 05:03:30
NAV FILE: brdc1360.13n OBS USED: 38910 / 40006 : 97%
ANT NAME: NOV702GG NONE # FIXED AMB: 109 / 161 : 68%
ARP HEIGHT: 2.00 OVERALL RMS: 0.014(m)

REF FRAME: NAD_83(2011)(EPOCH:2010.0000) IGS08 (EPOCH:2013.3722)

X:	42225.683(m)	0.004(m)	42224.851(m)	0.004(m)
Y:	-4468037.026(m)	0.007(m)	-4468035.704(m)	0.007(m)
Z:	4536804.062(m)	0.004(m)	4536804.020(m)	0.004(m)

LAT:	45 37 43.09998	0.004(m)	45 37 43.12982	0.004(m)
E LON:	270 32 29.27056	0.004(m)	270 32 29.23273	0.004(m)
W LON:	89 27 30.72944	0.004(m)	89 27 30.76727	0.004(m)
EL HGT:	454.955(m)	0.006(m)	453.995(m)	0.006(m)
ORTHO HGT:	486.847(m)	0.012(m) [NAVD88 (Computed using GEOID12A)]		

	UTM COORDINATES (UTM (Zone 16))	STATE PLANE COORDINATES (SPC (4801 WI N))
Northing (Y) [meters]	5055728.004	51489.236
Easting (X) [meters]	308361.543	642222.527
Convergence [degrees]	-1.75794914	0.39059634
Point Scale	1.00005154	0.99998933
Combined Factor	0.99998022	0.99991801

US NATIONAL GRID DESIGNATOR: 16TCR0836155728(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DK4193	YOU6 YOUNGSTOWN 6 CORS ARP	N431352.479	W0785811.265	875200.4
DF5374	PARY PARRY SOUND CORS ARP	N452018.759	W0800209.179	736576.2
DF5367	KNGS KINGSTON CORS ARP	N441307.253	W0763102.142	1031420.1

NEAREST NGS PUBLISHED CONTROL POINT

QM0773	RHINELANDER GPS	N453739.511	W0892744.928	326.5

FILE: GPS_1330.13o OP1371133428709

NGS OPUS SOLUTION REPORT
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All computed coordinate accuracies are listed as peak-to-peak values.
For additional information: http://www.ngs.noaa.gov/OPUS/about.jsp#accuracy

USER: tstentz@aerometric.com DATE: June 13, 2013
RINEX FILE: gps_133l.13o TIME: 14:29:00 UTC

SOFTWARE: page5 1209.04 master91.pl 082112 START: 2013/05/13 11:25:00
EPHEMERIS: igs17401.eph [precise] STOP: 2013/05/14 00:33:30
NAV FILE: brdc1330.13n OBS USED: 33415 / 35690 : 94%
ANT NAME: LEIATX1230GG NONE # FIXED AMB: 158 / 162 : 98%
ARP HEIGHT: 1.8 OVERALL RMS: 0.011(m)

REF FRAME: NAD_83(2011)(EPOCH:2010.0000) IGS08 (EPOCH:2013.3637)

X:	57341.457(m)	0.005(m)	57340.624(m)	0.005(m)
Y:	-4443177.960(m)	0.007(m)	-4443176.641(m)	0.007(m)
Z:	4560844.115(m)	0.005(m)	4560844.077(m)	0.005(m)

LAT:	45 56 19.14387	0.008(m)	45 56 19.17396	0.008(m)
E LON:	270 44 21.80379	0.005(m)	270 44 21.76592	0.005(m)
W LON:	89 15 38.19621	0.005(m)	89 15 38.23408	0.005(m)
EL HGT:	467.661(m)	0.002(m)	466.709(m)	0.002(m)
ORTHO HGT:	499.399(m)	0.007(m)	[NAVD88 (Computed using GEOID12A)]	

	UTM COORDINATES (Zone 16)	STATE PLANE COORDINATES (4801 WI N)
Northing (Y) [meters]	5089716.051	86068.071
Easting (X) [meters]	324763.805	657335.346
Convergence [degrees]	-1.62487613	0.53337431
Point Scale	0.99997752	0.99995330
Combined Factor	0.99990421	0.99987999

US NATIONAL GRID DESIGNATOR: 16TCR2476389716(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DI0208	MIIR IRON RIVER CORS ARP	N460449.371	W0883800.111	51074.1
DL6161	MIOT ONTONAGON CORS ARP	N465148.570	W0891758.486	102852.7
DH7129	MINW NORWAY CORS ARP	N454724.328	W0875505.747	105539.8

NEAREST NGS PUBLISHED CONTROL POINT

QM0771 EAGLE RIVER GPS N455619.143 W0891538.196 0.0

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.

FILE: AZ__1330.13o OP1371133767661

NGS OPUS SOLUTION REPORT
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All computed coordinate accuracies are listed as peak-to-peak values.
For additional information: http://www.ngs.noaa.gov/OPUS/about.jsp#accuracy

USER: tstentz@aerometric.com DATE: June 13, 2013
RINEX FILE: az__133l.13o TIME: 14:33:49 UTC

SOFTWARE: page5 1209.04 master13.pl 082112 START: 2013/05/13 11:06:00
EPHEMERIS: igs17401.eph [precise] STOP: 2013/05/14 00:25:00
NAV FILE: brdc1330.13n OBS USED: 34182 / 35881 : 95%
ANT NAME: LEIATX1230GG NONE # FIXED AMB: 148 / 155 : 95%
ARP HEIGHT: 1.8 OVERALL RMS: 0.011(m)

REF FRAME: NAD_83(2011)(EPOCH:2010.0000) IGS08 (EPOCH:2013.3637)

X:	57128.013(m)	0.005(m)	57127.180(m)	0.005(m)
Y:	-4443520.359(m)	0.009(m)	-4443519.040(m)	0.009(m)
Z:	4560515.143(m)	0.002(m)	4560515.104(m)	0.002(m)

LAT:	45 56 3.83078	0.008(m)	45 56 3.86084	0.008(m)
E LON:	270 44 11.69245	0.005(m)	270 44 11.65457	0.005(m)
W LON:	89 15 48.30755	0.005(m)	89 15 48.34543	0.005(m)
EL HGT:	467.463(m)	0.005(m)	466.510(m)	0.005(m)
ORTHO HGT:	499.215(m)	0.011(m) [NAVD88 (Computed using GEOID12A)]		

	UTM COORDINATES (Zone 16)	STATE PLANE COORDINATES (4801 WI N)
Northing (Y) [meters]	5089249.639	85593.297
Easting (X) [meters]	324532.663	657121.938
Convergence [degrees]	-1.62677916	0.53134819
Point Scale	0.99997852	0.99995360
Combined Factor	0.99990524	0.99988032

US NATIONAL GRID DESIGNATOR: 16TCR2453289249(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DH7129	MINW NORWAY CORS ARP	N454724.328	W0875505.747	105686.4
DI0208	MIIR IRON RIVER CORS ARP	N460449.371	W0883800.111	51430.1
DL6161	MIOT ONTONAGON CORS ARP	N465148.570	W0891758.486	103319.3

NEAREST NGS PUBLISHED CONTROL POINT

QM0779 EAGLE RIVER GPS AZ MK N455603.831 W0891548.308 0.0

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.

8002 The Opus solution for your submitted RINEX file appears to be
8002 quite close to an NGS published control point. This suggests that
8002 you may have set your GPS receiver up over an NGS control point.
8002 Furthermore, our files indicate that this control point has not
8002 been recovered in the last five years.
8002 If you did indeed recover an NGS control point, we would
8002 appreciate receiving this information through our web based
8002 Mark Recovery Form at
8002 http://www.ngs.noaa.gov/products_services.shtml#MarkRecoveryForm.
8002

FILE: HILE1330.13o OP1371133258063

NGS OPUS SOLUTION REPORT
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All computed coordinate accuracies are listed as peak-to-peak values.
For additional information: http://www.ngs.noaa.gov/OPUS/about.jsp#accuracy

USER: tstentz@aerometric.com DATE: June 13, 2013
RINEX FILE: hile133m.13o TIME: 14:24:25 UTC

SOFTWARE: page5 1209.04 master13.pl 082112 START: 2013/05/13 12:11:00
EPHEMERIS: igs17401.eph [precise] STOP: 2013/05/13 23:42:30
NAV FILE: brdc1330.13n OBS USED: 28060 / 30219 : 93%
ANT NAME: LEIATX1230GG NONE # FIXED AMB: 150 / 159 : 94%
ARP HEIGHT: 1.8 OVERALL RMS: 0.011(m)

REF FRAME: NAD_83(2011)(EPOCH:2010.0000) IGS08 (EPOCH:2013.3637)

X:	78176.277(m)	0.007(m)	78175.445(m)	0.007(m)
Y:	-4461673.840(m)	0.005(m)	-4461672.517(m)	0.005(m)
Z:	4542578.876(m)	0.002(m)	4542578.836(m)	0.002(m)

LAT:	45 42 9.97502	0.005(m)	45 42 10.00512	0.005(m)
E LON:	271 0 13.74796	0.007(m)	271 0 13.71058	0.007(m)
W LON:	88 59 46.25204	0.007(m)	88 59 46.28942	0.007(m)
EL HGT:	477.820(m)	0.002(m)	476.857(m)	0.002(m)
ORTHO HGT:	510.504(m)	0.008(m)	[NAVD88 (Computed using GEOID12A)]	

	UTM COORDINATES (UTM (Zone 16))	STATE PLANE COORDINATES (SPC (4801 WI N))
Northing (Y) [meters]	5062961.985	60078.542
Easting (X) [meters]	344606.258	678170.635
Convergence [degrees]	-1.42900451	0.72412562
Point Scale	0.99989688	0.99997808
Combined Factor	0.99982198	0.99990318

US NATIONAL GRID DESIGNATOR: 16TCR4460662961(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)

DK6955 MIST STEVENSON CORS ARP N452518.112 W0873558.603
113422.8
DI0208 MIIR IRON RIVER CORS ARP N460449.371 W0883800.111 50546.0
DH7129 MINW NORWAY CORS ARP N454724.328 W0875505.747 84443.1

NEAREST NGS PUBLISHED CONTROL POINT
QM0811 3712E09S GPS 0021 N454209.976 W0885946.252 0.0

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.

8002 The Opus solution for your submitted RINEX file appears to be
8002 quite close to an NGS published control point. This suggests that
8002 you may have set your GPS receiver up over an NGS control point.
8002 Furthermore, our files indicate that this control point has not
8002 been recovered in the last five years.
8002 If you did indeed recover an NGS control point, we would
8002 appreciate receiving this information through our web based
8002 Mark Recovery Form at
8002 http://www.ngs.noaa.gov/products_services.shtml#MarkRecoveryForm.
8002

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WISCORS Station Control Attributes

Show N/A | Print

Point Name	Crandon
Point ID	CRON
County	FOREST
CORS	WISCORS
Longitude Coordinates	88 53 30.43937 NAD83 (2011)
Latitude Coordinates	45 34 35.03906 NAD83 (2011)
Lat/Long Format	dd mm ss.sssss
Ellipsoid Height	465.379 meters NAD83 (2011)
Online Datasheet(s)	CRON

Report a disturbed or destroyed control station.

Contacts

Organization	Wisconsin Dept. of Transportation
Dataset Inventory Date	2013-03-22
Name	Elliot Smith
Title	DOT Geodetic Specialist
Email	elliot.smith@dot.state.wi.us
Phone	608-243-5992
Fax	608-245-8959
Address	3502 Kinsman Blvd Madison, WI 53704
Website	Access WISCORS System
Additional Information	Overview of WISCORS

WISCORS Station Control Attributes

Show N/A | Print

Point Name	Lynne
Point ID	LYNE
County	ONEIDA
CORS	WISCORS
Longitude Coordinates	89 58 56.42005 NAD83 (2011)
Latitude Coordinates	45 42 38.59434 NAD83 (2011)
Lat/Long Format	dd mm ss.sssss
Ellipsoid Height	450.209 meters NAD83 (2011)
Online Datasheet(s)	LYNE

Report a disturbed or destroyed control station.

Contacts

Organization	Wisconsin Dept. of Transportation
Dataset Inventory Date	2013-03-22
Name	Elliot Smith
Title	DOT Geodetic Specialist
Email	elliot.smith@dot.state.wi.us
Phone	608-243-5992
Fax	608-245-8959
Address	3502 Kinsman Blvd Madison, WI 53704
Website	Access WISCORS System
Additional Information	Overview of WISCORS

WISCORS Station Control Attributes

Show N/A | Print

Point Name	Manitowish Waters
Point ID	MAWA
County	VILAS
CORS	WISCORS
Longitude Coordinates	89 52 34.90733 NAD83 (2011)
Latitude Coordinates	46 07 20.41307 NAD83 (2011)
Lat/Long Format	dd mm ss.sssss
Ellipsoid Height	462.952 meters NAD83 (2011)
Online Datasheet(s)	MAWA

Report a disturbed or destroyed control station.

Contacts

Organization	Wisconsin Dept. of Transportation
Dataset Inventory Date	2013-03-22
Name	Elliot Smith
Title	DOT Geodetic Specialist
Email	elliot.smith@dot.state.wi.us
Phone	608-243-5992
Fax	608-245-8959
Address	3502 Kinsman Blvd Madison, WI 53704
Website	Access WISCORS System
Additional Information	Overview of WISCORS

WISCORS Station Control Attributes

Show N/A | Print

Point Name	Phelps
Point ID	PHPS
County	VILAS
CORS	WISCORS
Longitude Coordinates	89 04 46.06181 NAD83 (2011)
Latitude Coordinates	46 03 47.92813 NAD83 (2011)
Lat/Long Format	dd mm ss.sssss
Ellipsoid Height	514.381 meters NAD83 (2011)
Online Datasheet(s)	PHPS

Report a disturbed or destroyed control station.

Contacts

Organization	Wisconsin Dept. of Transportation
Dataset Inventory Date	2013-03-22
Name	Elliot Smith
Title	DOT Geodetic Specialist
Email	elliot.smith@dot.state.wi.us
Phone	608-243-5992
Fax	608-245-8959
Address	3502 Kinsman Blvd Madison, WI 53704
Website	Access WISCORS System
Additional Information	Overview of WISCORS

WISCORS Station Control Attributes

Show N/A | Print

Point Name	Rhinelander
Point ID	RHER
County	ONEIDA
CORS	WISCORS
Longitude Coordinates	89 26 37.85581 NAD83 (2011)
Latitude Coordinates	45 37 58.25273 NAD83 (2011)
Lat/Long Format	dd mm ss.sssss
Ellipsoid Height	460.834 meters NAD83 (2011)
Online Datasheet(s)	RHER

Report a disturbed or destroyed control station.

Contacts

Organization	Wisconsin Dept. of Transportation
Dataset Inventory Date	2013-03-22
Name	Elliot Smith
Title	DOT Geodetic Specialist
Email	elliot.smith@dot.state.wi.us
Phone	608-243-5992
Fax	608-245-8959
Address	3502 Kinsman Blvd Madison, WI 53704
Website	Access WISCORS System
Additional Information	Overview of WISCORS