

# OSCEOLA FL QL2 LIDAR 2016 INDEPENDENT CHECK POINTS

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SUBCONTRACT AGREEMENT NO. S/C-USGS-G10PC00013-PRI

**Reference:**

Client: USGS  
Contract 3: G10PC00013  
Task Order No.: G15PD00887  
Task Name: Osceola FL QL2 Lidar

**Prepared For:**

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**Osceola FL QL2 LiDAR 2016  
Independent check Points**

**TABLE OF CONTENTS:**

1.	Introduction	
1.1	Project Summary.....	3
1.2	Points of Contact(s).....	3
1.3	Project Area .....	4
2.	Project Details	
2.1	Survey Equipment.....	5
2.2	Survey Point Details.....	5
2.3	Network Design.....	5
2.4	Field Survey Procedures and Analysis.....	5-6
2.5	Adjustment.....	6
2.6	Data processing Procedures.....	6

**APPENDICES:**

1.	Project Network Control Monument Report.....	7-8
2.	Final Check Point Coordinates.....	9-12
3.	GPS Observation & Re-Observation Schedule.....	13-16
4.	Point Comparison Report.....	17-19
5.	Deliverables.....	Sent via Electronic Transfer
	Including: a) Ground Control Point Documentation Report – NVA.pdf and VVA.pdf	
	b) Final Coordinate List in Excel Format – ICP-Control.xls	
	c) NGS Data Sheets for Project Controls – NGS Datasheets.pdf	

## **1. INTRODUCTION**

### **1.1 *Project Summary***

Preble-Rish, Inc. is under subcontract to Dewberry Consultants, LLC, to provide a minimum of 65 Non-vegetated Vertical Accuracy (NVA – total number actually surveyed = 92), and 52 Vegetated Vertical Accuracy (VVA – total number actually surveyed = 73) check points for USGS in the State of Florida. A minimum of half (33) of the NVA points shall also be horizontal accuracy check points (total number actually surveyed = 35). Under the above referenced USGS Task Order, Preble-Rish is tasked to complete the quality assurance of high resolution LiDAR-derived elevation products. As part of this work, Preble-Rish, Inc. staff will complete checkpoint surveys that will be used to evaluate vertical accuracy on the bare-earth terrain derived from the LiDAR.

Existing NGS Control Points were recovered and surveyed to verify the accuracy of the RTK/GPS survey equipment with the results shown in Section 2.4 and Appendix 1 of this report.

As an internal QA/QC procedure, and to verify that the LiDAR check points meet the 95% confidence level, 68 of the NVA check points, and 53 of the VVA check points were re-surveyed and are shown in Section 5 of this report. For check points that were surveyed twice, an average of the two observations was computed to generate final coordinates and elevations.

Final horizontal coordinates are referenced to the Florida State Plane Coordinate System, NAD83, East Zone, U.S. survey feet. Final vertical elevations are referenced to NAVD88 in feet using Geoid model 2012B (Geoid12B).

### **1.2 *Points of Contact***

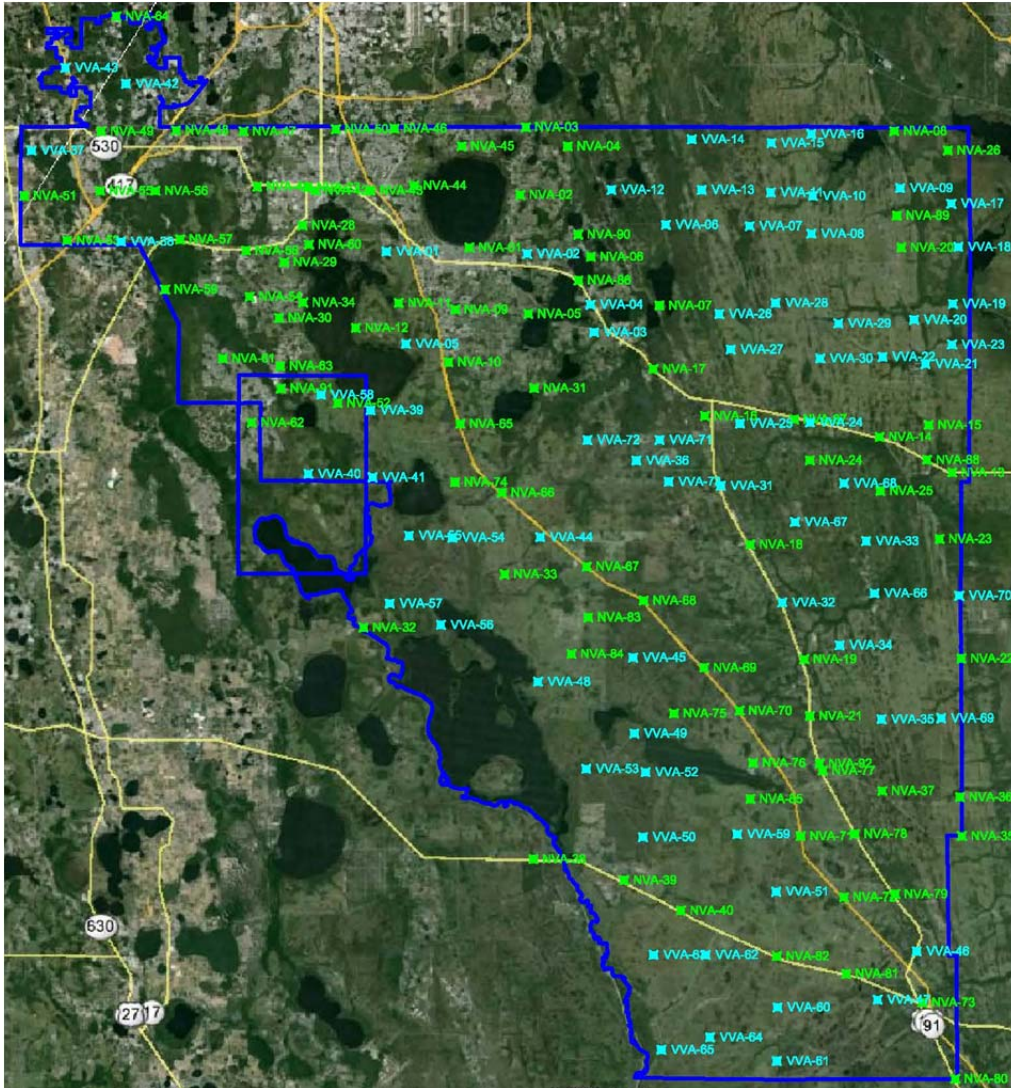
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Osceola FL QL2 LiDAR 2016  
Independent check Points

1.3 Project Area



OSCEOLA FL QL2 LIDAR 2016 – ICP LOCATIONS

## **2. PROJECT DETAILS**

### **2.1 *Survey Equipment***

In performing the GPS observations, Spectra Precision Epoch 80 GNSS RTK GPS receiver/antenna attached to a 6.56 foot (2 meter) fixed height pole was used, together with a Spectra Precision Ranger Data Collector equipped with SurveyPro Software (version 5.5.2), to collect GPS raw data for the field surveys.

### **2.2 *Survey Point Detail***

92 Non-vegetated Check Points, and 73 Vegetated Check Points were distributed throughout the project area.

A sketch was made for each location and a nail was set at the point where possible, unless said point was already located at a photo identifiable point. The LiDAR Check Point locations are detailed on the “Ground Control Point Documentation Report”, which is delivered via electronic transfer, see appendix 5a on sheet 2.

### **2.3 *Network Design***

The GPS survey performed by Preble-Rish, Inc. was tied to the Florida Permanent Reference Network (FPRN), a Real Time Network (RTN) managed by the Florida Department of Transportation. The FPRN consists of a series of approximately 100 continuously operating dual-frequency reference stations (CORS) located throughout Florida, which are tied to the National Geodetic Survey’s National CORS network. Each CORS site provides Global Positioning System (GPS) carrier phase and code range measurements in support of 3-dimensional positioning activities through Florida and surrounding states. All of the reference stations have been linked together, creating a Virtual Reference Station System (VRS).

### **2.4 *Field Survey Procedures and Analysis***

Preble-Rish, Inc. field surveyors used Spectra Precision Epoch 80 GNSS RTK GPS systems, which is a geodetic quality dual frequency GPS receiver, to collect data at each check point location.

**Osceola FL QL2 LiDAR 2016**  
**Independent check Points**

Nineteen (19) existing NGS monuments were located as an additional QA/QC procedure, for the purpose of verifying the accuracy of the VRS network. All NGS monuments used are published in the NSRS database, and represent the primary project control for this survey. Field GPS observations are detailed in the “Project Network Control Monument Report”, see appendix 1 on sheets 7-8.

A total of 68 of the NVA check point locations, and 53 of the VVA check point locations were occupied twice. All re-observations matched the initially derived station positions within the allowable tolerance of  $\pm 5\text{cm}$  or within the 95% confidence level. Each occupation utilized the VRS network, was occupied for approximately three (3) minutes in duration, and measured to 180 epochs. Field GPS observations are detailed in the “Ground Control Point Documentation Report”, and delivered via electronic transfer, see appendix 5a on sheet 2.

## **2.5    *Adjustment***

The survey data was collected using Virtual Reference Stations (VRS) methodology within a Virtual Reference System (VRS).

The system is designed to provide a true Network RTK performance, the RTK software enables high-accuracy positioning in real time across a geographic region. The RTK software package uses real-time data streams from the GPS system user and generates correction models for high-accuracy RTK GPS corrections throughout the network. Therefore, corrections were applied to the points as they were being collected, thus negating the need for a post process adjustment.

## **2.6    *Data Processing Procedures***

After field data is collected the information is downloaded from the data collectors into the office software. Text files are created that show the point number, northing, easting, elevation, and description (PNEZD format) for each point surveyed. Points are then entered into a Microsoft Excell spreadsheet, which contains formulas for calculating differences between published and field survey data, as well as, comparing differences between points surveyed multiple times. This data is used to confirm point accuracy and precision.

After review of the point data, an “ASCII” or “txt” file (PNEZD format) is created, which is the industry standard. Point files are loaded into our CADD program (AutoCAD Civil 3D) to make a visual check of the point data (Pt. #, Coordinates, Elev. and Description). For check points that were surveyed twice, an average of the two observations was computed to generate final northings, eastings, and elevations. The data can now be imported into the final product.

**Appendix 1:**  
Project Network Control Monument Report

OS1 FLDNR (B2 AK7103)-HV											
Date	Field Survey Data (F)			Published Data (F)			Differences (F)			RMSE	
	Northing	Easting	Elevation	Northing	Easting	Elevation	Delta N	Delta E	Delta Z	rmse <sub>N</sub>	rmse <sub>E</sub>
3/13/2016	1330578.438	599246.504	75.43	1330578.4200	599246.5000	75.4100	-0.02	0.00	-0.02	rmse <sub>N</sub>	0.015
3/13/2016	1330578.411	599246.506	75.266	1330578.4200	599246.5000	75.4100	0.01	-0.01	0.14	rmse <sub>E</sub>	0.040
3/12/2016	1330578.44	599246.503	75.568	1330578.4200	599246.5000	75.4100	-0.02	0.00	-0.16	Hrmse <sub>r</sub>	<b>0.043</b>
3/10/2016	1330578.437	599246.567	75.443	1330578.4200	599246.5000	75.4100	-0.02	-0.07	-0.03	Vrmse	0.111
3/14/2016	1330578.418	599246.428	75.283	1330578.4200	599246.5000	75.4100	0.00	0.07	0.13		
3/15/2016	1330578.436	599246.503	75.309	1330578.4200	599246.5000	75.4100	-0.02	0.00	0.10		

K 113 (B3 AF7643)-H											
Date	Field Survey Data (F)			Published Data (F)			Differences (F)			RMSE	
	Northing	Easting	Elevation	Northing	Easting	Elevation	Delta N	Delta E	Delta Z	rmse <sub>N</sub>	rmse <sub>E</sub>
3/13/2016	1262168.927	570148.143	61.923	1262168.9200	570148.1500		-0.01	0.01	-61.92	rmse <sub>N</sub>	0.026
3/16/2016	1262168.9560	570148.1010	61.871	1262168.9200	570148.1500		-0.04	0.05	-61.87	rmse <sub>E</sub>	0.035
										Hrmse <sub>r</sub>	<b>0.044</b>

Q 733 (B4 DL6642)-HV											
Date	Field Survey Data (F)			Published Data (F)			Differences (F)			RMSE	
	Northing	Easting	Elevation	Northing	Easting	Elevation	Delta N	Delta E	Delta Z	rmse <sub>N</sub>	rmse <sub>E</sub>
3/7/2016	1440218.9888	515785.2659	76.821	1440218.9700	515785.2200	76.8200	-0.02	-0.05	0.00	rmse <sub>N</sub>	0.033
3/7/2016	1440218.9760	515785.2550	76.799	1440218.9700	515785.2200	76.8200	-0.01	-0.04	0.02	rmse <sub>E</sub>	0.040
3/8/2016	1440218.9960	515785.2280	76.784	1440218.9700	515785.2200	76.8200	-0.03	-0.01	0.04	Hrmse <sub>r</sub>	<b>0.052</b>
3/11/2016	1440218.9990	515785.2530	76.858	1440218.9700	515785.2200	76.8200	-0.03	-0.03	-0.04	Vrmse	0.050
3/16/2016	1440219.0240	515785.2630	76.7370	1440218.9700	515785.2200	76.8200	-0.05	-0.04	0.08		
3/16/2016	1440219.0110	515785.2780	76.7510	1440218.9700	515785.2200	76.8200	-0.04	-0.06	0.07		

FLGPS 44 AZ MK (B5 AK6933)-HV											
Date	Field Survey Data (F)			Published Data (F)			Differences (F)			RMSE	
	Northing	Easting	Elevation	Northing	Easting	Elevation	Delta N	Delta E	Delta Z	rmse <sub>N</sub>	rmse <sub>E</sub>
3/9/2016	1432707.6550	655130.0730	66.008	1432707.6800	655130.0800	65.9900	0.02	0.01	-0.02	rmse <sub>N</sub>	0.023
3/10/2016	1432707.642	655130.085	65.979	1432707.6800	655130.0800	65.9900	0.04	-0.01	0.01	rmse <sub>E</sub>	0.020
3/10/2016	1432707.669	655130.119	66.052	1432707.6800	655130.0800	65.9900	0.01	-0.04	-0.06	Hrmse <sub>r</sub>	<b>0.030</b>
3/11/2016	1432707.649	655130.069	65.918	1432707.6800	655130.0800	65.9900	0.03	0.01	0.07	Vrmse	0.062
3/12/2016	1432707.672	655130.064	66.108	1432707.6800	655130.0800	65.9900	0.01	0.02	-0.12		
3/13/2016	1432707.678	655130.099	65.99	1432707.6800	655130.0800	65.9900	0.00	-0.02	0.00		

95 056A (B7 AB5482)-HV											
Date	Field Survey Data (F)			Published Data (F)			Differences (F)			RMSE	
	Northing	Easting	Elevation	Northing	Easting	Elevation	Delta N	Delta E	Delta Z	rmse <sub>N</sub>	rmse <sub>E</sub>
3/7/2016	1433053.737	604549.893	69.592	1433053.7800	604549.9500	69.8800	0.04	0.06	0.29	rmse <sub>N</sub>	0.036
3/9/2016	1433053.75	604549.99	69.567	1433053.7800	604549.9500	69.8800	0.03	-0.04	0.31	rmse <sub>E</sub>	0.048
										Hrmse <sub>r</sub>	<b>0.060</b>
										Vrmse	0.301

95 064 (B8 AB5503)-H											
Date	Field Survey Data (F)			Published Data (F)			Differences (F)			RMSE	
	Northing	Easting	Elevation	Northing	Easting	Elevation	Delta N	Delta E	Delta Z	rmse <sub>N</sub>	rmse <sub>E</sub>
3/7/2016	1405986.015	505940.911	74.79	1405985.9800	505940.8900		-0.03	-0.02	N.A.	rmse <sub>N</sub>	0.038
3/7/2016	1405986.021	505940.913	74.828	1405985.9800	505940.8900		-0.04	-0.02	N.A.	rmse <sub>E</sub>	0.022
										Hrmse <sub>r</sub>	<b>0.044</b>
										Vrmse	N.A.

FLGPS 53 AZ MK (B9 AK6935)-HV											
Date	Field Survey Data (F)			Published Data (F)			Differences (F)			RMSE	
	Northing	Easting	Elevation	Northing	Easting	Elevation	Delta N	Delta E	Delta Z	rmse <sub>N</sub>	rmse <sub>E</sub>
3/11/2016	1375220.924	678778.547	50.142	1375220.8300	678778.5200	50.1400	-0.09	-0.03	0.00	rmse <sub>N</sub>	0.090
3/12/2016	1375220.936	678778.582	50.098	1375220.8300	678778.5200	50.1400	-0.11	-0.06	0.04	rmse <sub>E</sub>	0.047
3/13/2016	1375220.866	678778.586	50.162	1375220.8300	678778.5200	50.1400	-0.04	-0.07	-0.02	Hrmse <sub>r</sub>	<b>0.102</b>
3/15/2016	1375220.886	678778.581	50.137	1375220.8300	678778.5200	50.1400	-0.06	-0.06	0.00	Vrmse	0.054
3/15/2016	1375220.923	678778.559	50.008	1375220.8300	678778.5200	50.1400	-0.09	-0.04	0.13		
3/14/2016	1375220.937	678778.522	50.159	1375220.8300	678778.5200	50.1400	-0.11	0.00	-0.02		
3/16/2016	1375220.9390	678778.5330	50.132	1375220.8300	678778.5200	50.1400	-0.11	-0.01	0.01		
3/16/2016	1375220.9250	678778.5780	50.198	1375220.8300	678778.5200	50.1400	-0.09	-0.06	-0.06		

95 058A (AB5489)-H											
Date	Field Survey Data (F)			Published Data (F)			Differences (F)			RMSE	
	Northing	Easting	Elevation	Northing	Easting	Elevation	Delta N	Delta E	Delta Z	rmse <sub>N</sub>	rmse <sub>E</sub>
3/7/2016	1409017.102	577659.624	76.725	1409017.0300	577659.5900		-0.07	-0.03	N.A.	rmse <sub>N</sub>	0.072
										rmse <sub>E</sub>	0.034
										Hrmse <sub>r</sub>	<b>0.080</b>
										Vrmse	N.A.

95 061A (AB5478)-HV											
Date	Field Survey Data (F)			Published Data (F)			Differences (F)			RMSE	
	Northing	Easting	Elevation	Northing	Easting	Elevation	Delta N	Delta E	Delta Z	rmse <sub>N</sub>	rmse <sub>E</sub>
3/16/2016	1374800.6940	631573.4030	75.129	1374800.6600	631573.4700	75.1900	-0.03	0.07	0.06	rmse <sub>N</sub>	0.055
3/16/2016	1374800.7300	631573.4750	75.14	1374800.6600	631573.4700	75.1900	-0.07	-0.01	0.05	rmse <sub>E</sub>	0.048
										Hrmse <sub>r</sub>	<b>0.073</b>
										Vrmse	0.056





**Appendix 2:**  
*Final Check Point Coordinates*

<b>Osceola FL QL2 LiDAR POINTS 2016</b>			
<b>POINT #</b>	<b>NORTHING (F)</b>	<b>EASTING (F)</b>	<b>ELEV. (F)</b>
NVA-01	1426776.418	565625.875	60.893
NVA-02	1440994.188	579330.214	78.979
NVA-03	1459261.461	580904.643	65.904
NVA-04	1454084.174	592213.745	74.370
NVA-05	1408943.436	581594.789	71.882
NVA-06	1424322.313	598467.454	68.801
NVA-07	1411173.529	616905.552	72.494
NVA-08	1458206.959	680277.203	25.680
NVA-09	1410057.983	561863.587	73.245
NVA-10	1395918.311	560058.254	69.167
NVA-11	1411849.680	546592.882	59.565
NVA-12	1405150.205	535074.666	57.943
NVA-13	1366146.809	695832.616	31.591
NVA-14	1375728.254	676234.735	51.593
NVA-15	1378938.400	689540.336	50.503
NVA-16	1381399.186	629145.099	77.521
NVA-17	1394069.206	615284.547	75.873
NVA-18	1346758.725	641402.609	67.203
NVA-19	1315830.771	655952.371	59.815
NVA-20	1426796.904	682128.639	48.011
NVA-21	1300530.283	657491.337	67.345
NVA-22	1316040.228	698328.515	38.465
NVA-23	1348242.713	692432.662	45.354
NVA-24	1369469.061	657499.425	55.481
NVA-25	1361219.916	676484.006	41.677
NVA-26	1452992.737	694693.508	14.201
NVA-27	1443061.856	522085.257	68.277
NVA-28	1432771.431	520681.603	61.516
NVA-29	1422849.321	515729.498	72.337
NVA-30	1407837.663	514358.051	70.349
NVA-31	1388919.043	583103.966	65.575
NVA-32	1324361.607	537140.612	54.296
NVA-33	1338723.080	575197.196	59.852
NVA-34	1411998.048	520814.726	61.070
NVA-35	1268129.507	698465.394	53.457
NVA-36	1278664.008	697937.786	48.414
NVA-37	1280363.485	676978.836	67.857
NVA-38	1261947.171	582923.719	55.381
NVA-39	1256262.813	607426.462	61.174
NVA-40	1248094.582	622714.472	65.610
NVA-41	1443236.958	508502.534	76.963
NVA-42	1442117.045	524184.005	63.163
NVA-43	1442156.820	539012.673	70.917
NVA-44	1443485.908	550794.945	63.369
NVA-45	1454137.853	563616.429	75.846
NVA-46	1458870.857	545474.069	82.048
NVA-47	1458105.584	504780.412	78.340
NVA-48	1458408.447	486615.226	88.930
NVA-49	1458111.537	466388.323	103.306
NVA-50	1458719.529	529685.335	83.649

**Appendix 2:**  
*Final Check Point Coordinates (Cont.)*

<b>Osceola FL QL2 LiDAR POINTS 2016</b>			
<b>POINT #</b>	<b>NORTHING (F)</b>	<b>EASTING (F)</b>	<b>ELEV. (F)</b>
NVA-51	1440753.617	445626.304	140.080
NVA-52	1384895.381	530202.336	63.179
NVA-53	1428683.554	457199.649	126.294
NVA-54	1413568.098	506420.564	74.231
NVA-55	1442092.480	466096.864	110.984
NVA-56	1442080.528	481064.365	77.162
NVA-57	1429032.220	487711.142	70.086
NVA-58	1425982.938	505472.813	70.676
NVA-59	1415513.442	483617.690	80.954
NVA-60	1427635.232	522397.991	58.590
NVA-61	1396913.885	499192.292	66.945
NVA-62	1379598.758	506972.824	63.631
NVA-63	1394884.673	514667.927	74.372
NVA-64	1489131.405	470492.214	99.789
NVA-65	1379284.909	563248.159	70.462
NVA-66	1360744.562	574467.193	63.770
NVA-67	1340812.641	597307.486	78.836
NVA-68	1331637.419	612687.613	82.887
NVA-69	1313534.037	628955.020	75.750
NVA-70	1301928.177	638519.767	72.662
NVA-71	1268128.145	655017.572	74.509
NVA-72	1251717.127	666636.134	72.646
NVA-73	1223295.675	687923.801	63.693
NVA-74	1363535.858	561780.820	59.920
NVA-75	1301209.082	620812.188	69.836
NVA-76	1287855.762	642218.873	71.905
NVA-77	1285817.761	660958.265	72.081
NVA-78	1268738.621	669585.975	75.227
NVA-79	1252539.825	680493.612	63.744
NVA-80	1202714.218	696679.141	72.126
NVA-81	1231060.502	667316.133	69.555
NVA-82	1235786.933	648549.159	69.783
NVA-83	1327127.568	597747.756	73.868
NVA-84	1317245.566	593185.928	67.293
NVA-85	1278163.370	641411.608	65.791
NVA-86	1417968.100	595102.265	70.783
NVA-87	1380482.352	653273.857	54.978
NVA-88	1369571.530	689079.578	48.589
NVA-89	1435413.301	680921.791	42.124
NVA-90	1430319.164	594959.849	70.748
NVA-91	1388826.742	514889.453	69.221
NVA-92	1287734.408	660094.227	70.951

**Appendix 2:**  
*Final Check Point Coordinates (Cont.)*

<b>Osceola FL QL2 LiDAR POINTS 2016</b>			
<b>POINT #</b>	<b>NORTHING (F)</b>	<b>EASTING (F)</b>	<b>ELEV. (F)</b>
VVA-01	1425707.697	543326.034	64.333
VVA-02	1425126.894	581252.546	75.999
VVA-03	1403963.199	599294.972	76.005
VVA-04	1411443.842	598331.001	71.847
VVA-05	1400802.925	548563.663	72.763
VVA-06	1432971.276	618620.792	70.180
VVA-07	1432616.081	641226.001	75.784
VVA-08	1430503.439	657890.871	63.101
VVA-09	1442827.793	681840.623	41.622
VVA-10	1440702.752	658314.138	54.508
VVA-11	1441659.775	646941.050	71.223
VVA-12	1442385.774	603999.674	63.047
VVA-13	1442353.535	628343.362	75.266
VVA-14	1455936.039	625661.327	72.324
VVA-15	1455012.577	647072.123	68.697
VVA-16	1457377.765	657877.722	56.412
VVA-17	1438651.964	695603.449	20.528
VVA-18	1426945.715	697486.584	16.593
VVA-19	1411629.635	696019.295	17.269
VVA-20	1407344.506	685587.397	55.555
VVA-21	1395428.951	688659.291	35.381
VVA-22	1397346.358	677106.928	40.596
VVA-23	1400643.692	695781.085	19.524
VVA-24	1379653.166	657543.514	55.785
VVA-25	1379389.604	638656.494	67.345
VVA-26	1408931.875	633025.653	70.995
VVA-27	1399357.782	636173.313	71.525
VVA-28	1411882.078	648197.235	74.129
VVA-29	1406366.495	665173.352	49.355
VVA-30	1396894.809	660244.734	62.779
VVA-31	1362615.443	633463.514	74.064
VVA-32	1331115.447	650062.351	57.892
VVA-33	1347677.308	672635.590	55.624
VVA-34	1319636.502	665545.430	47.784
VVA-35	1299658.266	676770.137	64.326
VVA-36	1369377.810	610688.671	81.419
VVA-37	1452956.562	447624.590	120.802
VVA-38	1428415.537	471771.328	94.039
VVA-39	1382967.076	539046.916	57.472
VVA-40	1365778.580	522220.915	66.695
VVA-41	1364856.993	539629.635	55.063
VVA-42	1470937.279	473080.190	91.743
VVA-43	1475254.645	456734.308	105.157
VVA-44	1348722.865	584805.068	68.247
VVA-45	1316289.250	609810.761	71.449
VVA-46	1237097.447	686274.317	58.328
VVA-47	1224032.945	675709.941	65.751
VVA-48	1309732.693	584143.948	55.112
VVA-49	1295836.492	610149.927	61.744
VVA-50	1267891.513	612462.319	60.859

**Appendix 2:***Final Check Point Coordinates (Cont.)*

<b>Osceola FL QL2 LiDAR POINTS 2016</b>			
<b>POINT #</b>	<b>NORTHING (F)</b>	<b>EASTING (F)</b>	<b>ELEV. (F)</b>
VVA-51	1253168.110	648388.295	67.266
VVA-52	1285374.998	613170.112	62.236
VVA-53	1286265.027	597176.447	51.827
VVA-54	1348639.578	561041.778	53.604
VVA-55	1349168.662	549406.096	55.113
VVA-56	1325094.298	557987.210	53.900
VVA-57	1330862.393	544225.786	62.675
VVA-58	1387129.728	525708.359	68.789
VVA-59	1268701.240	637909.670	65.365
VVA-60	1222007.138	648753.259	62.581
VVA-61	1207528.066	648560.334	68.331
VVA-62	1236125.572	629363.122	67.050
VVA-63	1236147.731	615361.783	61.973
VVA-64	1213924.531	630542.693	60.639
VVA-65	1210566.921	617438.175	51.511
VVA-66	1333605.899	674929.437	42.700
VVA-67	1352815.807	653458.505	64.022
VVA-68	1363256.799	666680.437	66.487
VVA-69	1299937.449	692927.738	46.771
VVA-70	1332998.684	697741.349	32.698
VVA-71	1374984.170	616979.039	79.577
VVA-72	1374945.635	597452.297	67.514
VVA-73	1363682.213	619411.221	80.224

**Appendix 3:**  
GPS Observation & Re-Observation Schedule

<b>Osceola FL QL2 LiDAR POINTS 2016</b>					
<b>POINT #</b>	<b>SURVEY DATE</b>	<b>JULIAN DATE</b>	<b>TIME</b>	<b>RE-SURVEY DATE</b>	<b>RE-SURVEY TIME</b>
NVA-01	3/7/2016	67	14:14	3/8/2016	7:36
NVA-02	3/7/2016	67	15:15	3/8/2016	6:03
NVA-03	3/7/2016	67	15:45	3/8/2016	9:33
NVA-04	3/7/2016	67	16:11	3/8/2016	9:49
NVA-05	3/7/2016	67	16:51	3/8/2016	10:14
NVA-06	3/8/2016	68	11:57	3/9/2016	10:56
NVA-07	3/8/2016	68	13:00	3/9/2016	9:51
NVA-08	3/9/2016	69	14:40	3/10/2016	9:47
NVA-09	3/8/2016	68	14:37	3/9/2016	8:34
NVA-10	3/8/2016	68	15:02	3/9/2016	8:52
NVA-11	3/8/2016	68	15:40	3/9/2016	7:30
NVA-12	3/8/2016	68	16:46	3/9/2016	7:50
NVA-13	3/12/2016	72	13:23	3/13/2016	10:47
NVA-14	3/12/2016	72	13:58	3/13/2016	11:03
NVA-15	3/12/2016	72	14:22	3/13/2016	10:35
NVA-16	3/13/2016	73	13:07	3/14/2016	8:29
NVA-17	3/13/2016	73	13:27	3/14/2016	7:55
NVA-18	3/14/2016	74	13:44	3/15/2016	9:16
NVA-19	3/14/2016	74	14:50	3/15/2016	10:00
NVA-20	3/11/2016	71	14:12	3/12/2016	9:20
NVA-21	3/14/2016	74	15:38	3/15/2016	10:19
NVA-22	3/15/2016	75	14:07	N/A	N/A
NVA-23	3/15/2016	75	13:37	N/A	N/A
NVA-24	3/15/2016	75	12:43	N/A	N/A
NVA-25	3/15/2016	75	17:55	N/A	N/A
NVA-26	3/12/2016	72	8:08	3/13/2016	8:44
NVA-27	3/17/2016	77	8:17	N/A	N/A
NVA-28	3/17/2016	77	8:37	N/A	N/A
NVA-29	3/17/2016	77	8:52	N/A	N/A
NVA-30	3/17/2016	77	9:03	N/A	N/A
NVA-31	3/16/2016	76	9:06	N/A	N/A
NVA-32	3/14/2016	74	12:54	3/14/2016	17:00
NVA-33	3/15/2016	75	9:57	N/A	N/A
NVA-34	3/9/2016	69	12:56	3/10/2016	12:45
NVA-35	3/13/2016	73	18:15	N/A	N/A
NVA-36	3/13/2016	73	17:53	N/A	N/A
NVA-37	3/13/2016	73	17:45	N/A	N/A
NVA-38	3/13/2016	73	14:23	N/A	N/A
NVA-39	3/13/2016	73	13:33	N/A	N/A
NVA-40	3/13/2016	73	13:25	N/A	N/A
NVA-41	3/7/2016	67	9:53	3/8/2016	7:20
NVA-42	3/7/2016	67	10:35	3/8/2016	7:52
NVA-43	3/7/2016	67	11:16	3/8/2016	8:10
NVA-44	3/7/2016	67	11:38	3/8/2016	8:25
NVA-45	3/7/2016	67	12:01	3/8/2016	8:46
NVA-46	3/7/2016	67	12:35	3/8/2016	8:59
NVA-47	3/7/2016	67	14:25	3/8/2016	10:05
NVA-48	3/7/2016	67	14:10	3/8/2016	9:15
NVA-49	3/7/2016	67	15:40	3/8/2016	10:34
NVA-50	3/7/2016	67	13:46	3/8/2016	9:30

**Appendix 3:***GPS Observation & Re-Observation Schedule (Cont.)*

<b>Osceola FL QL2 LiDAR POINTS 2016</b>					
<b>POINT #</b>	<b>SURVEY DATE</b>	<b>JULIAN DATE</b>	<b>TIME</b>	<b>RE-SURVEY DATE</b>	<b>RE-SURVEY TIME</b>
NVA-51	3/8/2016	68	11:22	3/9/2016	7:40
NVA-52	3/17/2016	77	9:50	N/A	N/A
NVA-53	3/8/2016	68	12:30	3/9/2016	8:51
NVA-54	3/9/2016	69	13:20	3/10/2016	11:28
NVA-55	3/8/2016	68	14:14	3/9/2016	9:38
NVA-56	3/8/2016	68	14:48	3/9/2016	10:00
NVA-57	3/8/2016	68	15:44	3/9/2016	10:30
NVA-58	3/8/2016	68	16:13	3/9/2016	11:43
NVA-59	3/9/2016	69	14:00	3/10/2016	13:40
NVA-60	3/8/2016	68	16:57	3/9/2016	11:09
NVA-61	3/9/2016	69	15:00	3/10/2016	8:39
NVA-62	3/9/2016	69	15:41	3/10/2016	8:08
NVA-63	3/9/2016	69	16:11	3/10/2016	12:13
NVA-64	3/11/2016	71	10:16	3/11/2016	14:17
NVA-65	3/11/2016	71	16:05	3/12/2016	13:40
NVA-66	3/11/2016	71	16:35	3/12/2016	13:24
NVA-67	3/11/2016	71	16:50	3/12/2016	13:14
NVA-68	3/11/2016	71	17:05	3/12/2016	13:08
NVA-69	3/11/2016	71	17:19	3/12/2016	12:59
NVA-70	3/11/2016	71	17:29	3/12/2016	12:53
NVA-71	3/11/2016	71	17:41	3/12/2016	12:45
NVA-72	3/11/2016	71	17:52	3/12/2016	13:36
NVA-73	3/11/2016	71	18:15	3/12/2016	11:58
NVA-74	3/12/2016	72	8:14	3/12/2016	14:17
NVA-75	3/12/2016	72	9:32	3/12/2016	15:11
NVA-76	3/12/2016	72	9:45	3/12/2016	15:25
NVA-77	3/12/2016	72	10:07	3/12/2016	15:43
NVA-78	3/12/2016	72	10:19	3/12/2016	15:52
NVA-79	3/12/2016	72	10:35	3/12/2016	16:00
NVA-80	3/12/2016	72	11:40	3/12/2016	16:30
NVA-81	3/12/2016	72	16:55	3/13/2016	16:53
NVA-82	3/12/2016	72	17:14	3/13/2016	16:47
NVA-83	3/13/2016	73	9:38	3/13/2016	7:35
NVA-84	3/13/2016	73	10:46	3/13/2016	7:29
NVA-85	3/13/2016	73	12:49	3/15/2016	11:10
NVA-86	3/17/2016	77	7:58	N/A	N/A
NVA-87	3/17/2016	77	8:30	N/A	N/A
NVA-88	3/17/2016	77	8:47	N/A	N/A
NVA-89	3/17/2016	77	9:46	N/A	N/A
NVA-90	3/17/2016	77	10:21	N/A	N/A
NVA-91	3/17/2016	77	9:20	N/A	N/A
NVA-92	3/16/2016	76	15:36	N/A	N/A

**Appendix 3:**  
GPS Observation & Re-Observation Schedule (Cont.)

<b>Osceola FL QL2 LiDAR POINTS 2016</b>					
<b>POINT #</b>	<b>SURVEY DATE</b>	<b>JULIAN DATE</b>	<b>TIME</b>	<b>RE-SURVEY DATE</b>	<b>RE-SURVEY TIME</b>
VVA-01	3/7/2016	67	13:25	3/8/2016	7:01
VVA-02	3/7/2016	67	14:45	3/8/2016	8:45
VVA-03	3/8/2016	68	10:51	3/9/2016	9:11
VVA-04	3/8/2016	68	12:30	3/9/2016	9:35
VVA-05	3/8/2016	68	16:15	3/9/2016	8:05
VVA-06	3/9/2016	69	11:45	3/10/2016	8:07
VVA-07	3/9/2016	69	12:23	3/10/2016	8:28
VVA-08	3/9/2016	69	13:25	3/10/2016	9:00
VVA-09	3/9/2016	69	14:00	3/10/2016	9:37
VVA-10	3/9/2016	69	13:40	3/10/2016	10:42
VVA-11	3/9/2016	69	16:35	3/10/2016	16:15
VVA-12	3/9/2016	69	12:23	3/11/2016	7:55
VVA-13	3/10/2016	70	13:40	3/11/2016	8:58
VVA-14	3/10/2016	70	14:45	3/11/2016	9:16
VVA-15	3/10/2016	70	15:45	3/11/2016	10:06
VVA-16	3/10/2016	70	16:00	3/11/2016	10:40
VVA-17	3/11/2016	71	12:36	3/12/2016	8:45
VVA-18	3/11/2016	71	15:00	3/12/2016	9:55
VVA-19	3/11/2016	71	16:29	3/12/2016	11:17
VVA-20	3/11/2016	71	17:13	3/12/2016	11:46
VVA-21	3/12/2016	72	14:45	3/13/2016	10:26
VVA-22	3/12/2016	72	15:24	3/13/2016	9:30
VVA-23	3/12/2016	72	17:04	3/13/2016	10:12
VVA-24	3/13/2016	73	12:07	3/14/2016	8:57
VVA-25	3/13/2016	73	12:50	3/14/2016	8:21
VVA-26	3/13/2016	73	15:03	3/14/2016	12:00
VVA-27	3/13/2016	73	16:00	3/14/2016	11:30
VVA-28	3/13/2016	73	17:14	3/14/2016	10:55
VVA-29	3/13/2016	73	17:36	3/14/2016	10:35
VVA-30	3/13/2016	73	18:03	3/14/2016	10:01
VVA-31	3/14/2016	74	13:20	3/15/2016	8:55
VVA-32	3/14/2016	74	14:30	3/15/2016	9:49
VVA-33	3/16/2016	76	10:03	N/A	N/A
VVA-34	3/14/2016	74	16:13	3/15/2016	11:35
VVA-35	3/14/2016	74	17:08	3/15/2016	12:10
VVA-36	3/16/2016	76	13:33	N/A	N/A
VVA-37	3/7/2016	67	16:38	3/8/2016	10:55
VVA-38	3/8/2016	68	12:57	3/9/2016	9:10
VVA-39	3/9/2016	69	16:58	3/10/2016	11:37
VVA-40	3/10/2016	70	9:40	3/10/2016	14:20
VVA-41	3/10/2016	70	11:10	3/10/2016	15:15
VVA-42	3/11/2016	71	9:23	3/11/2016	13:25
VVA-43	3/11/2016	71	9:50	3/11/2016	13:15
VVA-44	3/12/2016	72	8:33	3/12/2016	14:29
VVA-45	3/12/2016	72	9:05	3/12/2016	14:54
VVA-46	3/12/2016	72	11:04	3/12/2016	16:11
VVA-47	3/12/2016	72	17:42	3/13/2016	16:22
VVA-48	3/13/2016	73	10:11	3/13/2016	19:21
VVA-49	3/13/2016	73	10:45	3/15/2016	10:39
VVA-50	3/13/2016	73	14:45	N/A	N/A

**Appendix 3:***GPS Observation & Re-Observation Schedule (Cont.)*

<b>Osceola FL QL2 LIDAR POINTS 2016</b>					
<b>POINT #</b>	<b>SURVEY DATE</b>	<b>JULIAN DATE</b>	<b>TIME</b>	<b>RE-SURVEY DATE</b>	<b>RE-SURVEY TIME</b>
VVA-51	3/13/2016	73	12:30	3/15/2016	12:50
VVA-52	3/13/2016	73	15:08	N/A	N/A
VVA-53	3/13/2016	73	14:36	N/A	N/A
VVA-54	3/14/2016	74	9:25	3/14/2016	14:38
VVA-55	3/14/2016	74	10:05	3/14/2016	14:23
VVA-56	3/14/2016	74	10:35	3/14/2016	15:19
VVA-57	3/14/2016	74	11:16	3/14/2016	15:49
VVA-58	3/9/2016	69	16:33	3/10/2016	11:48
VVA-59	3/15/2016	75	12:05	N/A	N/A
VVA-60	3/15/2016	75	13:55	N/A	N/A
VVA-61	3/15/2016	75	14:09	N/A	N/A
VVA-62	3/15/2016	75	14:50	N/A	N/A
VVA-63	3/15/2016	75	14:29	N/A	N/A
VVA-64	3/15/2016	75	16:11	N/A	N/A
VVA-65	3/15/2016	75	16:46	N/A	N/A
VVA-66	3/16/2016	76	10:35	N/A	N/A
VVA-67	3/16/2016	76	13:42	N/A	N/A
VVA-68	3/15/2016	75	15:23	N/A	N/A
VVA-69	3/15/2016	75	13:26	N/A	N/A
VVA-70	3/15/2016	75	15:10	N/A	N/A
VVA-71	3/16/2016	76	9:45	N/A	N/A
VVA-72	3/16/2016	76	11:50	N/A	N/A
VVA-73	3/16/2016	76	12:55	N/A	N/A



**Appendix 4:**  
*Point Comparison Report*

<b>Osceola FL QL2 LiDAR POINTS 2016</b>				
<b>POINT ID</b>	<b>POINT CHK</b>	<b>DELTA N (F)</b>	<b>DELTA E (F)</b>	<b>VERT DIFF (F)</b>
NVA-01	NVA-01CHK	0.025	0.040	0.122
NVA-02	NVA-02CHK	0.000	0.014	0.094
NVA-03	NVA-03CHK	0.028	0.026	0.105
NVA-04	NVA-04CHK	0.005	0.036	0.032
NVA-05	NVA-05CHK	0.004	0.001	0.074
NVA-06	NVA-06CHK	0.019	0.030	0.000
NVA-07	NVA-07CHK	0.011	0.008	0.119
NVA-08	NVA-08CHK	0.019	0.028	0.027
NVA-09	NVA-09CHK	0.031	0.002	0.080
NVA-10	NVA-10CHK	0.068	0.019	0.083
NVA-11	NVA-11CHK	0.029	0.004	0.077
NVA-12	NVA-12CHK	0.008	0.017	0.054
NVA-13	NVA-13CHK	0.003	0.035	0.103
NVA-14	NVA-14CHK	0.017	0.024	0.026
NVA-15	NVA-15CHK	0.026	0.003	0.004
NVA-16	NVA-16CHK	0.001	0.008	0.047
NVA-17	NVA-17CHK	0.023	0.034	0.084
NVA-18	NVA-18CHK	0.104	0.029	0.101
NVA-19	NVA-19CHK	0.002	0.001	0.091
NVA-20	NVA-20CHK	0.018	0.058	0.102
NVA-21	NVA-21CHK	0.066	0.029	0.119
NVA-26	NVA-26CHK	0.023	0.044	0.118
NVA-32	NVA-32CHK	0.024	0.036	0.034
NVA-34	NVA-34CHK	0.025	0.040	0.080
NVA-41	NVA-41CHK	0.006	0.037	0.003
NVA-42	NVA-42CHK	0.059	0.009	0.026
NVA-43	NVA-43CHK	0.001	0.037	0.048
NVA-44	NVA-44CHK	0.029	0.002	0.026
NVA-45	NVA-45CHK	0.018	0.034	0.020
NVA-46	NVA-46CHK	0.019	0.059	0.057
NVA-47	NVA-47CHK	0.010	0.004	0.028
NVA-48	NVA-48CHK	0.001	0.038	0.038
NVA-49	NVA-49CHK	0.035	0.028	0.086
NVA-50	NVA-50CHK	0.021	0.032	0.020
NVA-51	NVA-51CHK	0.019	0.031	0.070
NVA-53	NVA-53CHK	0.012	0.022	0.008
NVA-54	NVA-54CHK	0.035	0.007	0.034
NVA-55	NVA-55CHK	0.002	0.006	0.138
NVA-56	NVA-56CHK	0.041	0.029	0.051
NVA-57	NVA-57CHK	0.036	0.044	0.043
NVA-58	NVA-58CHK	0.003	0.014	0.031
NVA-59	NVA-59CHK	0.060	0.049	0.119
NVA-60	NVA-60CHK	0.042	0.066	0.025
NVA-61	NVA-61CHK	0.004	0.014	0.103
NVA-62	NVA-62CHK	0.025	0.052	0.038
NVA-63	NVA-63CHK	0.055	0.033	0.111
NVA-64	NVA-64CHK	0.030	0.058	0.095
NVA-65	NVA-65CHK	0.079	0.035	0.067
NVA-66	NVA-66CHK	0.019	0.010	0.121
NVA-67	NVA-67CHK	0.050	0.015	0.026

**Appendix 4:***Point Comparison Report (Cont.)*

<b>Osceola FL QL2 LiDAR POINTS 2016</b>				
<b>POINT ID</b>	<b>POINT CHK</b>	<b>DELTA N (F)</b>	<b>DELTA E (F)</b>	<b>VERT DIFF (F)</b>
NVA-68	NVA-68CHK	0.055	0.004	0.049
NVA-69	NVA-69CHK	0.035	0.033	0.140
NVA-70	NVA-70CHK	0.020	0.002	0.038
NVA-71	NVA-71CHK	0.026	0.010	0.066
NVA-72	NVA-72CHK	0.065	0.011	0.010
NVA-73	NVA-73CHK	0.021	0.019	0.053
NVA-74	NVA-74CHK	0.018	0.022	0.022
NVA-75	NVA-75CHK	0.023	0.061	0.001
NVA-76	NVA-76CHK	0.047	0.055	0.132
NVA-77	NVA-77CHK	0.023	0.038	0.023
NVA-78	NVA-78CHK	0.022	0.008	0.038
NVA-79	NVA-79CHK	0.002	0.011	0.152
NVA-80	NVA-80CHK	0.028	0.014	0.155
NVA-81	NVA-81CHK	0.055	0.027	0.063
NVA-82	NVA-82CHK	0.057	0.031	0.133
NVA-83	NVA-83CHK	0.029	0.032	0.144
NVA-84	NVA-84CHK	0.008	0.016	0.080
NVA-85	NVA-85CHK	0.041	0.033	0.006

**Appendix 4:**  
*Point Comparison Report (Cont.)*

<b>Osceola FL QL2 LiDAR POINTS 2016</b>				
<b>POINT ID</b>	<b>POINT CHK</b>	<b>DELTA N (F)</b>	<b>DELTA E (F)</b>	<b>VERT DIFF (F)</b>
VVA-01	VVA-01CHK	0.028	0.089	0.147
VVA-02	VVA-02CHK	0.007	0.054	0.047
VVA-03	VVA-03CHK	0.022	0.016	0.088
VVA-04	VVA-04CHK	0.077	0.006	0.018
VVA-05	VVA-05CHK	0.002	0.015	0.114
VVA-06	VVA-06CHK	0.048	0.002	0.110
VVA-07	VVA-07CHK	0.025	0.013	0.015
VVA-08	VVA-08CHK	0.082	0.114	0.126
VVA-09	VVA-09CHK	0.116	0.047	0.007
VVA-10	VVA-10CHK	0.036	0.052	0.013
VVA-11	VVA-11CHK	0.000	0.041	0.127
VVA-12	VVA-12CHK	0.014	0.008	0.075
VVA-13	VVA-13CHK	0.040	0.046	0.051
VVA-14	VVA-14CHK	0.050	0.095	0.132
VVA-15	VVA-15CHK	0.024	0.013	0.025
VVA-16	VVA-16CHK	0.135	0.082	0.037
VVA-17	VVA-17CHK	0.030	0.037	0.115
VVA-18	VVA-18CHK	0.052	0.012	0.013
VVA-19	VVA-19CHK	0.043	0.043	0.027
VVA-20	VVA-20CHK	0.023	0.046	0.152
VVA-21	VVA-21CHK	0.069	0.026	0.130
VVA-22	VVA-22CHK	0.014	0.000	0.048
VVA-23	VVA-23CHK	0.008	0.025	0.158
VVA-24	VVA-24CHK	0.041	0.031	0.048
VVA-25	VVA-25CHK	0.047	0.018	0.042
VVA-26	VVA-26CHK	0.028	0.076	0.044
VVA-27	VVA-27CHK	0.041	0.049	0.061
VVA-28	VVA-28CHK	0.061	0.049	0.103
VVA-29	VVA-29CHK	0.116	0.009	0.086
VVA-30	VVA-30CHK	0.072	0.022	0.090
VVA-31	VVA-31CHK	0.035	0.002	0.005
VVA-32	VVA-32CHK	0.023	0.013	0.152
VVA-34	VVA-34CHK	0.077	0.111	0.035
VVA-35	VVA-35CHK	0.003	0.016	0.128
VVA-37	VVA-37CHK	0.042	0.012	0.077
VVA-38	VVA-38CHK	0.015	0.041	0.049
VVA-39	VVA-39CHK	0.014	0.007	0.110
VVA-40	VVA-40CHK	0.082	0.023	0.114
VVA-41	VVA-41CHK	0.045	0.114	0.021
VVA-42	VVA-42CHK	0.014	0.056	0.004
VVA-43	VVA-43CHK	0.048	0.056	0.048
VVA-44	VVA-44CHK	0.012	0.050	0.015
VVA-45	VVA-45CHK	0.034	0.019	0.143
VVA-46	VVA-46CHK	0.049	0.008	0.059
VVA-47	VVA-47CHK	0.096	0.109	0.123
VVA-48	VVA-48CHK	0.060	0.071	0.043
VVA-49	VVA-49CHK	0.016	0.014	0.018
VVA-51	VVA-51CHK	0.049	0.091	0.133
VVA-54	VVA-54CHK	0.034	0.048	0.094
VVA-55	VVA-55CHK	0.072	0.052	0.128
VVA-56	VVA-56CHK	0.109	0.019	0.025
VVA-57	VVA-57CHK	0.020	0.015	0.020
VVA-58	VVA-58CHK	0.015	0.149	0.022