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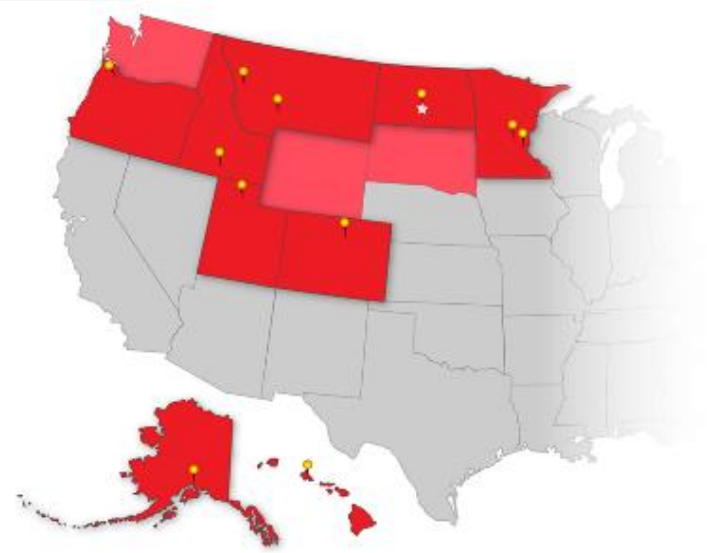
Trimble R12i – ProPoint & TIP Technology

About the Presenter



- 18 years with Frontier Precision/GeoLine
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- Based in Portland, OR

Agenda

- Evolution of RTK
- What is ProPoint Technology
- Benefits of ProPoint
- What is TIP Technology
- Benefits of TIP
- R12i test area details
- R12i test data analysis and results in high multipath environment

Evolution of Trimble RTK

Trimble 4000SE
1st *ever*
RTK system

1992

1997

Trimble 4800
1st "all-on-the-pole"
RTK system

Trimble R8 GNSS
GPS & GLONASS
R-Track (L2C & L5)

2005

2012

Trimble R10
HD-GNSS
Transcend fix/float

What is ProPoint?

Released in 2019 for R10-2, R12 & R12i

- Maxwell 7 processor and full GNSS constellation (672 channels)

Flexible signal management

- Mitigate the effects of signal degradation and provides GNSS constellation-agnostic operation. When individual frequencies and constellations are spoofed/jammed, the receiver continues to provide positioning using available measurements.

Improved approach to data signal filtering

- Combine all measurements together into a single filter and estimating the carrier integer ambiguities simultaneously with extended set of filter states to achieve optimal solution.

ProPoint cont.

Robust estimation techniques for detection of outliers

- Within the received input data, any measurement that does not match a stochastic model (probability distributions) is identified. The engine will either reject the measurement or adjust the stochastic model assigned to the measurement for correction.

Leverage CPU capacity in modern platforms

- Maxwell 7 processor allows positions to be delivered to control systems with minimal latency while also reducing overall power consumption.

ProPoint Benefits

Accuracy

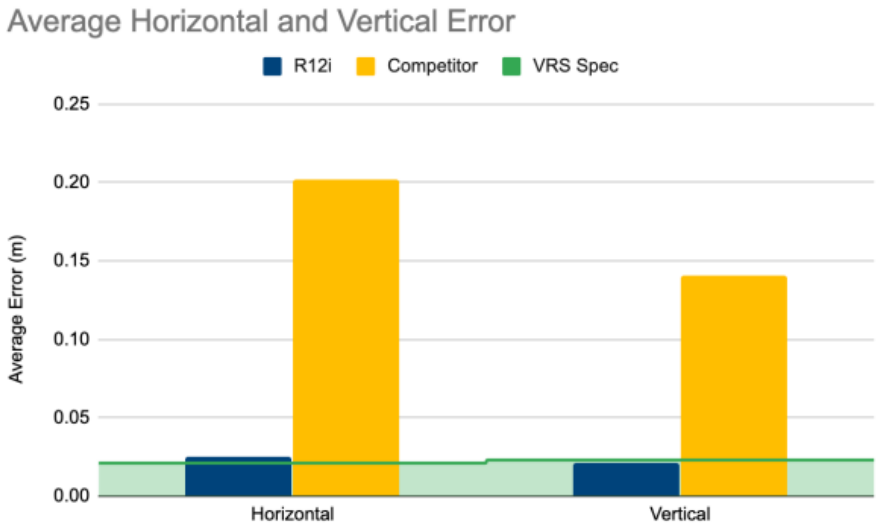
- Centimeter-level accuracy results in high multipath environments (tress, buildings) vs. decimeter (best case) in the past.

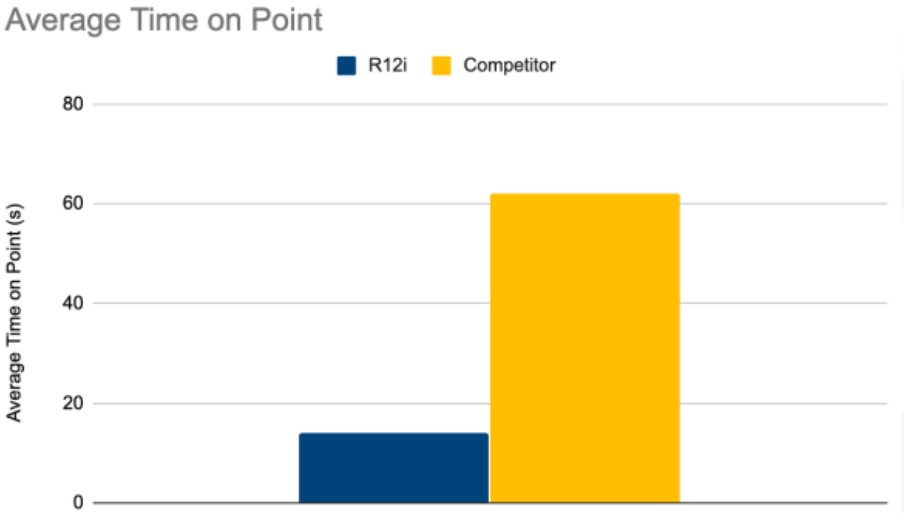
Integrity

- Providing accurate precision estimates for critical centimeter-level control.

Performance

- Superior GNSS improvement for magnitude/estimation of position errors

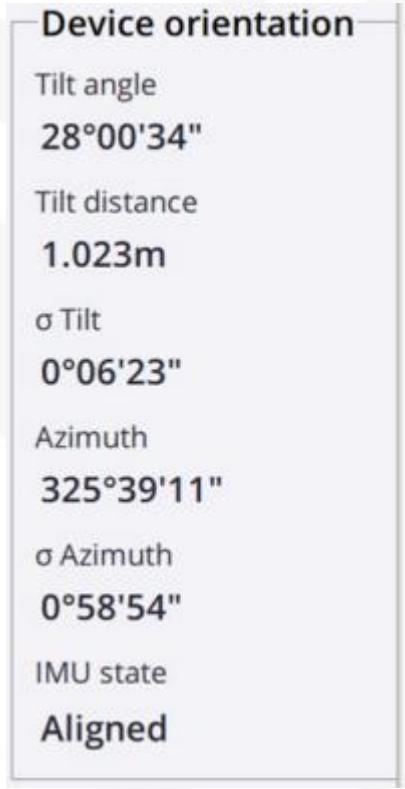




What is TIP?

Released in 2020 for R12i

- IMU (Interial Measurement Unit) designed by Trimble (Applanix) specifically for Interial Navigation.



Trimble Inertial Platform (TIP)

- IMU-based tilt compensation up to 30°.

Pole Bias Adjustment

- Calibrate for gross out-of-straightness in survey pole. The roll & pitch corrections are applied directly in Trimble Access (field software).

TIP Benefits

Simplicity

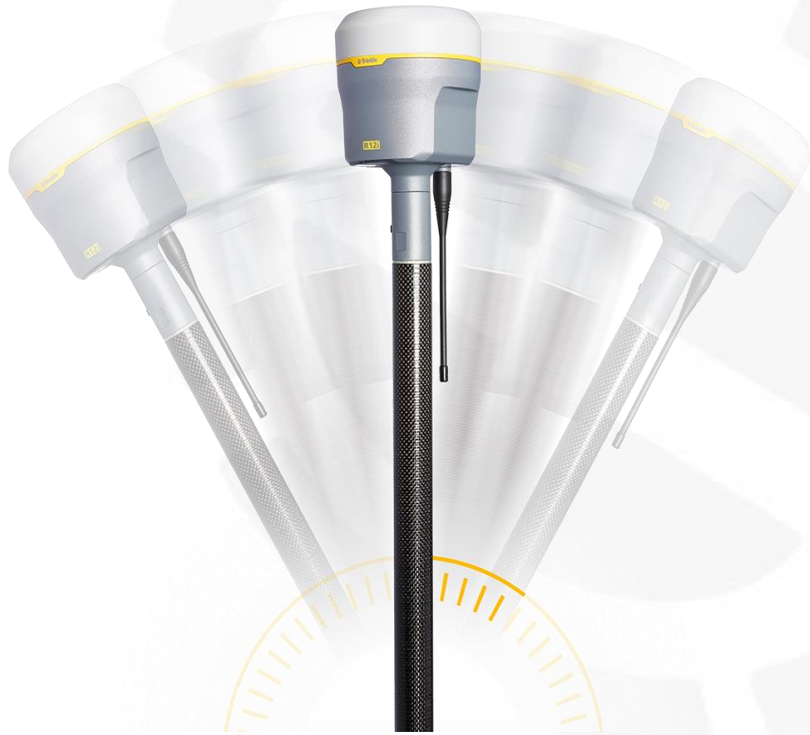
- Always on (forget the bubble, focus on the tip of the rod). Calibration-free & immune to magnetic interference. You can disable the IMU.

Productivity

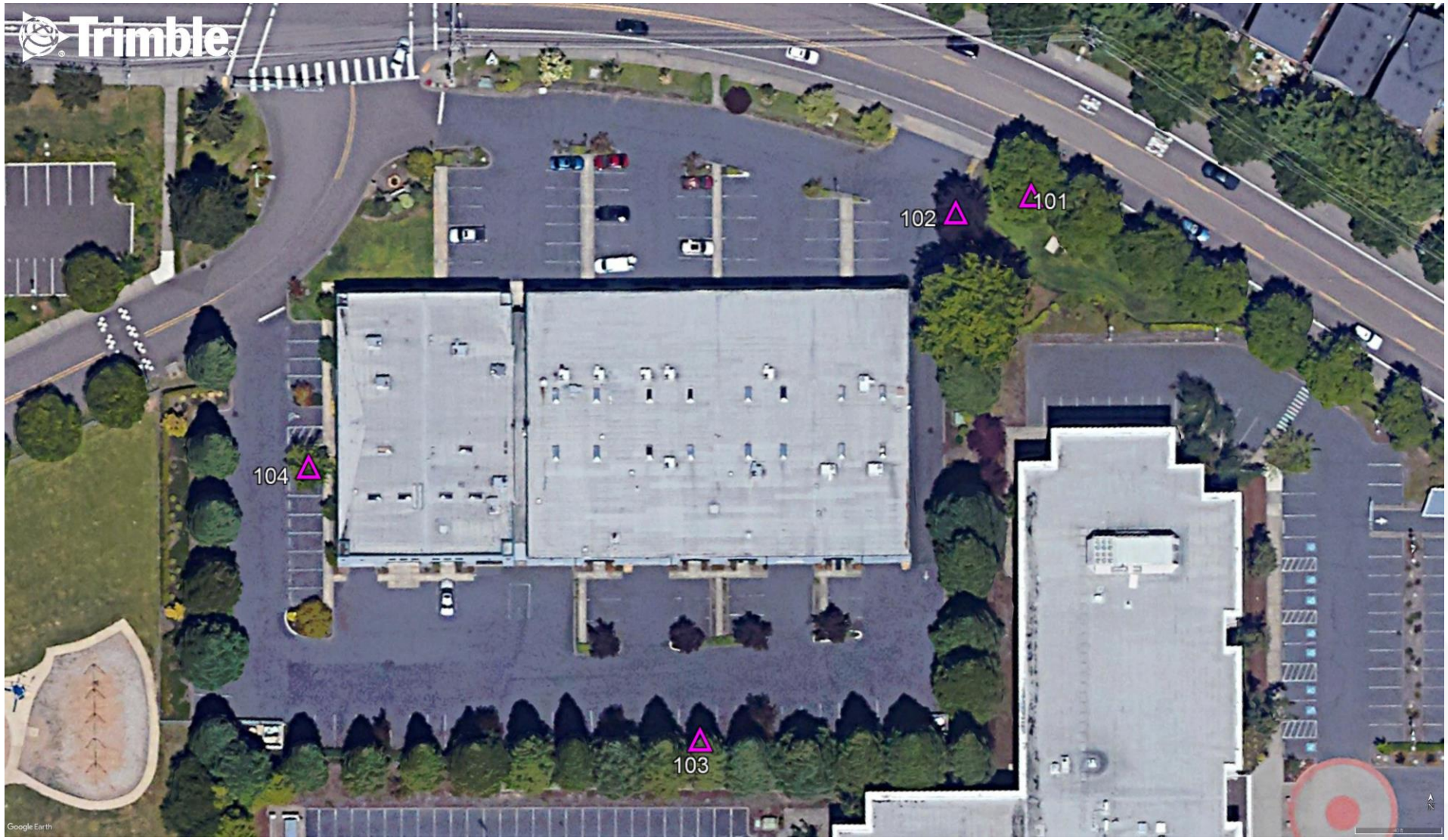
- No need to level (most things). Measure obstructed points (i.e. building corners, dense tree canopy measurements) with ease.

Integrity

- Automatic IMU status monitoring & alerts.



R12i Test Area



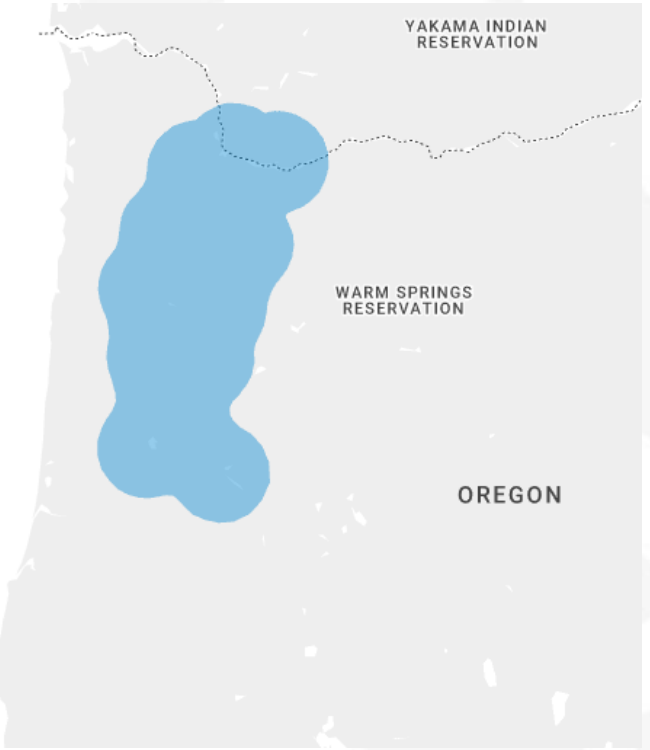
Test Area Control & RTK Data Stream

Coordinate System: OCRS-Portland Zone

Control: Set with S7 Total Station from OCRS-Portland GNSS Points

RTK Data Stream: Trimble VRS Now

Satellite Constellations: GPS, GLONASS, Galileo



As-Staked Details: Point 101

Vector ID	From Point ID	To Point ID	Solution Type	Status	GNSS Vertical Offset	PDOP	H. Precision (DRMS)	V. Precision (DRMS)	Satellites	Epochs	Vector Length	From Height	To Height	Start Time	Tilt Distance	Tilt Compensation	Tilt Direction
V4	PRS563133017871	101-A	RTK	Enabled	0.000	1.540	0.044	0.044	14	3	256.992	0.000	6.562	5/25/2022 11:57:04 AM	0.011	☑	227°24'01.8"
V5	PRS563133017871	101-B	RTK	Enabled	0.000	1.769	0.094	0.045	14	3	256.898	0.000	6.562	5/25/2022 11:58:57 AM	2.331	☑	25°45'27.4"
V6	PRS563133017871	101-C	RTK	Enabled	0.000	1.306	0.083	0.041	16	3	256.899	0.000	6.562	5/25/2022 12:00:14 PM	3.086	☑	11°04'47.1"
V7	PRS563133017871	101-D	RTK	Enabled	0.000	1.378	0.080	0.047	15	3	256.912	0.000	6.562	5/25/2022 12:01:17 PM	3.076	☑	45°21'26.3"

Tilt Distance	Tilt Compensation	Tilt Direction
0.011	☑	227°24'01.8"
2.331	☑	25°45'27.4"
3.086	☑	11°04'47.1"
3.076	☑	45°21'26.3"

PDOP	H. Precision (DRMS)	V. Precision (DRMS)	Satellites
1.540	0.044	0.044	14
1.769	0.094	0.045	14
1.306	0.083	0.041	16
1.378	0.080	0.047	15

As-Staked Results: Point 101

As-Staked Points

As-Staked Name	As-Staked Code	Design Name	Design Code	Design Northing	Design Easting	Design Elevation	ΔNorthing	ΔEasting	ΔElevation
101-A	101	101	CP	129051.070	326304.105	155.145	0.007	-0.066	-0.024
101-B	101	101	CP	129051.070	326304.105	155.145	-0.024	0.049	-0.069
101-C	101	101	CP	129051.070	326304.105	155.145	-0.013	0.045	-0.056
101-D	101	101	CP	129051.070	326304.105	155.145	0.022	0.033	0.072

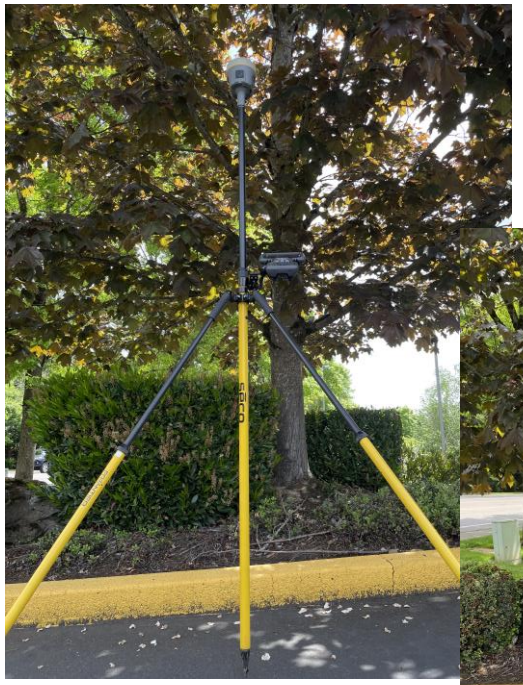
ΔNorthing	ΔEasting	ΔElevation
0.007	-0.066	-0.024
-0.024	0.049	-0.069
-0.013	0.045	-0.056
0.022	0.033	0.072

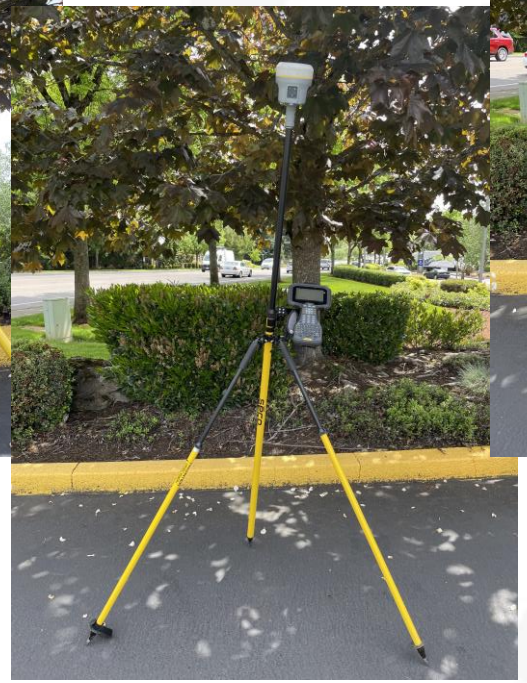
As-Staked Details: Point 102

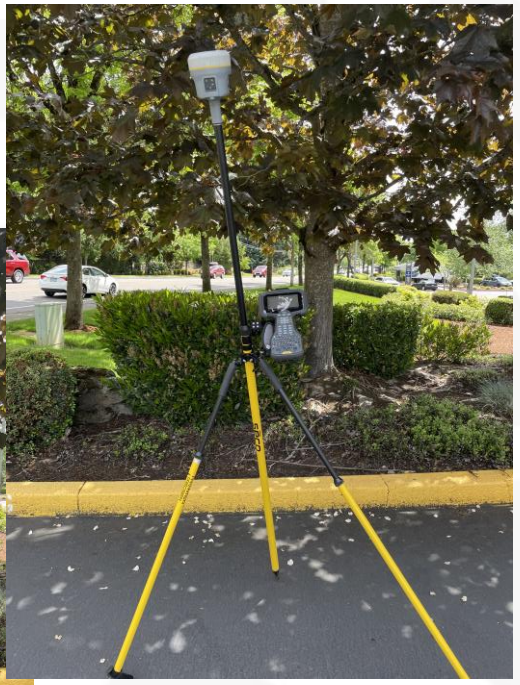
Vector ID	From Point ID	To Point ID	Solution Type	Status	GNSS Vertical Offset	PDOP	H. Precision (DRMS)	V. Precision (DRMS)	Satellites	Epochs	Vector Length	From Height	To Height	Start Time	Tilt Distance	Tilt Compensation	Tilt Direction
V9	PRS563133017871	102-A	RTK	Enabled	0.000	1.456	0.036	0.046	15	3	223.117	0.000	6.562	5/25/2022 12:07:06 PM	0.022	☑	117°25'28.8"
V10	PRS563133017871	102-B	RTK	Enabled	0.000	1.597	0.056	0.049	14	3	223.124	0.000	6.562	5/25/2022 12:08:24 PM	2.779	☑	292°45'50.1"
V11	PRS563133017871	102-C	RTK	Enabled	0.000	1.297	0.044	0.035	17	3	223.156	0.000	6.562	5/25/2022 12:10:35 PM	1.913	☑	272°49'01.5"
V12	PRS563133017871	102-D	RTK	Enabled	0.000	1.352	0.060	0.044	16	3	223.157	0.000	6.562	5/25/2022 12:11:52 PM	2.352	☑	308°06'33.9"

Tilt Distance	Tilt Compensation	Tilt Direction
0.022	☑	117°25'28.8"
2.779	☑	292°45'50.1"
1.913	☑	272°49'01.5"
2.352	☑	308°06'33.9"

PDOP	H. Precision (DRMS)	V. Precision (DRMS)	Satellites
1.456	0.036	0.046	15
1.597	0.056	0.049	14
1.297	0.044	0.035	17
1.352	0.060	0.044	16







As-Staked Results: Point 102

As-Staked Points

As-Staked Name	As-Staked Code	Design Name	Design Code	Design Northing	Design Easting	Design Elevation	ΔNorthing	ΔEasting	ΔElevation
102-A	102	102	CP	129043.309	326269.775	156.732	0.015	0.026	0.020
102-B	102	102	CP	129043.309	326269.775	156.732	-0.009	0.009	-0.106
102-C	102	102	CP	129043.309	326269.775	156.732	-0.023	0.001	0.014
102-D	102	102	CP	129043.309	326269.775	156.732	0.003	-0.010	0.039

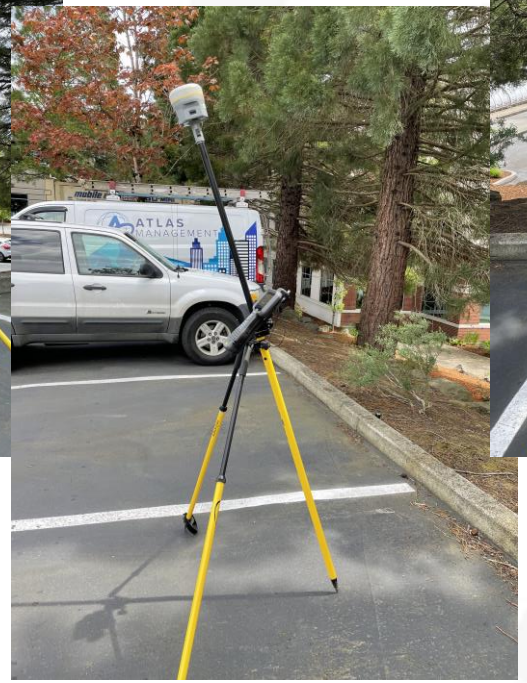
ΔNorthing	ΔEasting	ΔElevation
0.015	0.026	0.020
-0.009	0.009	-0.106
-0.023	0.001	0.014
0.003	-0.010	0.039

As-Staked Details: Point 103

Vector ID	From Point ID	To Point ID	Solution Type	Status	GNSS Vertical Offset	PDOP	H. Precision (DRMS)	V. Precision (DRMS)	Satellites	Epochs	Vector Length	From Height	To Height	Start Time	Tilt Distance	Tilt Compensation	Tilt Direction
V14	PRS563133017871	103-A	RTK	Enabled	0.000	1.395	0.037	0.047	16	3	154.960	0.000	6.562	5/25/2022 1:25:20 PM	0.046	☑	205°19'06.0"
V15	PRS563133017871	103-B	RTK	Enabled	0.000	1.287	0.049	0.042	18	3	154.941	0.000	6.562	5/25/2022 1:25:56 PM	2.434	☑	8°23'24.8"
V16	PRS563133017871	103-C	RTK	Enabled	0.000	1.303	0.054	0.045	17	3	154.930	0.000	6.562	5/25/2022 1:27:38 PM	2.558	☑	347°10'19.2"
V17	PRS563133017871	103-D	RTK	Enabled	0.000	1.279	0.059	0.043	18	3	154.960	0.000	6.562	5/25/2022 1:28:16 PM	2.760	☑	19°31'16.1"

Tilt Distance	Tilt Compensation	Tilt Direction
0.046	☑	205°19'06.0"
2.434	☑	8°23'24.8"
2.558	☑	347°10'19.2"
2.760	☑	19°31'16.1"

PDOP	H. Precision (DRMS)	V. Precision (DRMS)	Satellites
1.395	0.037	0.047	16
1.287	0.049	0.042	18
1.303	0.054	0.045	17
1.279	0.059	0.043	18



As-Staked Results: Point 103

As-Staked Points

As-Staked Name	As-Staked Code	Design Name	Design Code	Design Northing	Design Easting	Design Elevation	ΔNorthing	ΔEasting	ΔElevation
103-A	103	103	CP	128804.142	326153.358	158.629	0.045	-0.004	0.057
103-B	103	103	CP	128804.142	326153.358	158.629	0.029	-0.014	0.007
103-C	103	103	CP	128804.142	326153.358	158.629	-0.008	-0.064	-0.017
103-D	103	103	CP	128804.142	326153.358	158.629	0.045	-0.017	0.026

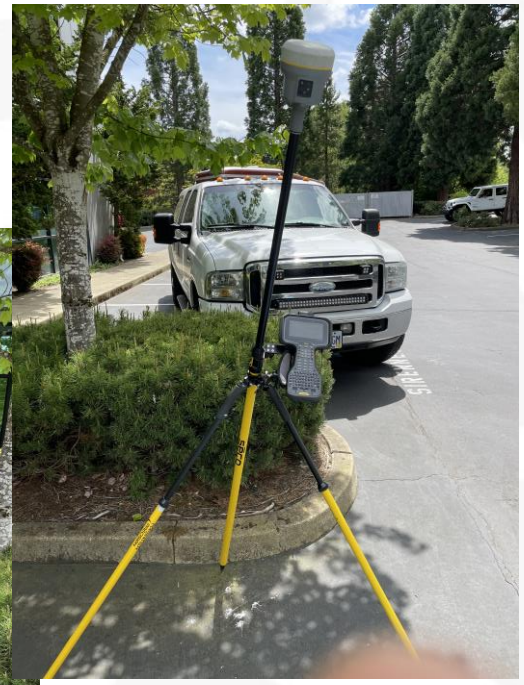
ΔNorthing	ΔEasting	ΔElevation
0.045	-0.004	0.057
0.029	-0.014	0.007
-0.008	-0.064	-0.017
0.045	-0.017	0.026

As-Staked Details: Point 104

Vector ID	From Point ID	To Point ID	Solution Type	Status	GNSS Vertical Offset	PDOP	H. Precision (DRMS)	V. Precision (DRMS)	Satellites	Epochs	Vector Length	From Height	To Height	Start Time	Tilt Distance	Tilt Compensation	Tilt Direction
V19	PRS563133017871	104-A	RTK	Enabled	0.000	1.657	0.030	0.043	15	3	107.650	0.000	6.562	5/25/2022 1:35:06 PM	0.013	☑	186°08'12.9"
V20	PRS563133017871	104-B	RTK	Enabled	0.000	1.580	0.050	0.054	15	3	107.604	0.000	6.562	5/25/2022 1:35:58 PM	2.152	☑	357°03'23.7"
V21	PRS563133017871	104-C	RTK	Enabled	0.000	2.053	0.062	0.052	14	3	107.583	0.000	6.562	5/25/2022 1:36:48 PM	2.901	☑	342°16'03.9"
V22	PRS563133017871	104-D	RTK	Enabled	0.000	2.022	0.064	0.060	14	3	107.585	0.000	6.562	5/25/2022 1:37:50 PM	3.001	☑	10°21'41.4"

Tilt Distance	Tilt Compensation	Tilt Direction
0.013	☑	186°08'12.9"
2.152	☑	357°03'23.7"
2.901	☑	342°16'03.9"
3.001	☑	10°21'41.4"

PDOP	H. Precision (DRMS)	V. Precision (DRMS)	Satellites
1.657	0.030	0.043	15
1.580	0.050	0.054	15
2.053	0.062	0.052	14
2.022	0.064	0.060	14



As-Staked Results: Point 104

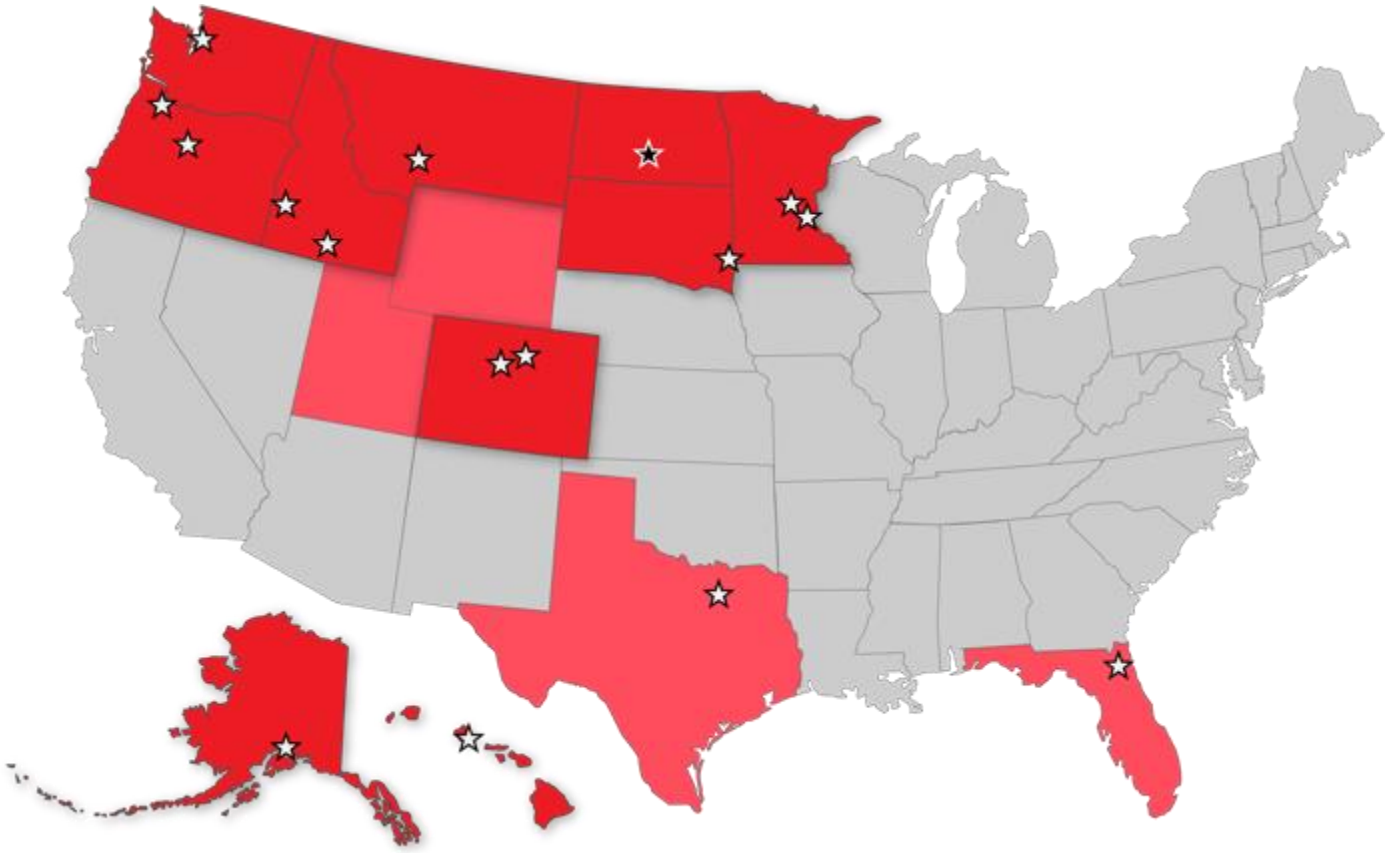
As-Staked Points

As-Staked Name	As-Staked Code	Design Name	Design Code	Design Northing	Design Easting	Design Elevation	ΔNorthing	ΔEasting	ΔElevation
104-A	104	104	CP	128927.909	325975.248	158.295	0.012	0.005	-0.021
104-B	104	104	CP	128927.909	325975.248	158.295	0.003	-0.039	-0.031
104-C	104	104	CP	128927.909	325975.248	158.295	0.023	-0.044	-0.092
104-D	104	104	CP	128927.909	325975.248	158.295	0.035	-0.053	-0.060

ΔNorthing	ΔEasting	ΔElevation
0.012	0.005	-0.021
0.003	-0.039	-0.031
0.023	-0.044	-0.092
0.035	-0.053	-0.060

Questions?

WHEREVER YOU ARE, **WE ARE**.



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