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Subject: Update for GNSS Observations on passive Wisconsin Height Modernization (Wi-HMP) Stations October, 2023, FINAL
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Date: 10/11/2023

This will be the final update, so I have put all of the data from the beginning in the OPUS Share Solutions and 10 Km hexagon tables below.

We began to collect GPS on BM observations in June of 2020 and now our long journey (made longer by multiple extensions) to provide data for the 2022 datum has been completed. The statewide efforts are phenomenal.

As noted in an earlier email, Wisconsin led the nation in shared observation in September, 2023 in addition to leading the nation in August, 2023. Great final push by all.

1330 observations shared by OPUS users in **September 2023**

782 observations
on **662** .

prioritized benchmarks

384 observations
on **254** .

other published marks

164 observations
on **108** .

new-to-NGS marks (not published yet)

Wisconsin (219) = most observations shared this month within one state

Wisconsin DOT (140) = most observations shared this month by one agency



Wisconsin finished with 5649 observations. That placed us third, just behind Florida. For reference, on September 8, 2020, we only had 66 total observations.

The top 5 states with GPS on BM observations as of September 30, 2023 are:

Minnesota	8855
Florida	5795
Wisconsin	5649
Illinois	3966
California	3444

We also had 283 observations on new stations not currently in the NGS database. The majority of these stations were in Brown, Oconto, Oneida, Sheboygan and Vernon Counties. These stations should be added to the NGS database when the 2022 datum is released, currently scheduled for mid-2025.

In early April, WisDOT created a list of stations where we determined that we would like an additional GPS on BM observation in 2023 for certain stations based on the following criteria. 1) Horizontal Wisconsin Height Modernization (WI-HMP) stations with no GPS on BM observations or were part not of an NGS bluebooked project since 2013. 2) Single observations of horizontal stations where the difference between the OPUS Share results and the published data was outside of our tolerances. 3) A station with multiple GPS on BM observations where the horizontal difference between observations was outside of our tolerances regardless of how it compares to the published coordinates.

There are about 500 stations on the list. The list was shared with agencies and

individuals who have contributed GPS on BM observations in the past, and all committed to getting another observation on a station on the list by the deadline. As of September 30, 2023, the 2022 datum deadline for observations, 464 stations were processed. This is over 93% of the 2023 reobservation list. Almost all stations not finished are vertical benchmarks that needed another observation to become a 3D mark with horizontal coordinates.

A link to the WisDOT GPS on BM status Map:

<https://wisdot.maps.arcgis.com/apps/webappviewer/index.html?id=9f00da9c32da4e519bd035591abc09c9>

In the Wisconsin Height Modernization (WI-HMP) Program, there are approximately 5,288 Vertical only stations and 3,553 stations with a Horizontal component for a total of 8841 stations

OPUS Share 2023 Reobservations (It was determined that 498 stations needed a 2023 Reobservation) A completed reobservation is a Shared OPUS observation where the results of multiple observations of a station match each other or a single observation matches NGS published values

Date	Reobservations Completed	% Completed
6/1/23	85	17.1
7/5/23	141	28.3
8/1/23	245	49.2
9/1/23	373	74.9
9/30/23	464	93.2

OPUS Share Solutions per NGS OPUS share Dashboard (Based on Observation Date)

Shared Observations prior to January, 2021	488
Shared Observations 2021	3448
Shared Observations 2022	1006
Shared Observations 2023 as of 9/30/23	707

Total 5649

OPUS Share Solutions per NGS OPUS share Dashboard (Based on Date observation was accepted by NGS)

Shared Observations prior to January, 2021	345
Shared Observations 2021	3292
Shared Observations 2022	1216
Shared Observations 2023 as of 9/30/23	796

Total 5649

Notes

- All shared observations by WisDOT and Partners
- Includes non-WI-HMP stations

Date	Total Shared Observations Based on NGS accepted date
September 8, 2020	66
December 3, 2020	157
January 4, 2021	345
February 1, 2021	430
March 1, 2021	606
April 1, 2021	755
May 1, 2021	971
June 1, 2021	1143
July 6, 2021	1443
August 4, 2021	1752
September 1, 2021	2299
October 1, 2021	2708
November 1, 2021	3000
December 1, 2021	3370
January 1, 2022	3643
February 4, 2022	3845
March 2, 2022	3970
August 8, 2022	4139
September 1, 2022	4208
October 3, 2022	4292
November 7, 2022	4414
December 1, 2022	4613
January 6, 2023	4883
February 2, 2023	4920
March 2, 2023	4922
April 4, 2023	4923
May 1, 2023	4954
June 1, 2023	5034
July 4, 2023	5101
August 1, 2023	5217
September 1, 2023	5458
September 30, 2023	5649

10 Km NGS GPSONBM Hexagons Completed

NGS has divided the entire nation into a series of 10 Km hexagons. One goal of the WisDOT's GNSS Observation on passive stations project is to get one observation in every Wisconsin 10 KM hexagon. There are 1843 hexagons in Wisconsin. Hexagons

that are DONE are a result of either an OPUS share station observation on a horizontal station within a hexagon, 2 observations on a vertical station within a hexagon or a station submitted to NGS via Bluebooking within a hexagon.

Date	10 KM Hexagons Completed	% Completed	10 Km Hexagons Remaining
September 8, 2020	447	24.3%	
November 30, 2020	571	31.0%	
January 4, 2021	584	31.7%	
February 1, 2021	609	33.1%	
March 1, 2021	718	39.0%	
April 1, 2021	760	41.3%	
May 3, 2021	897	48.7%	
June 3, 2021	978	53.1%	
July 2, 2021	1083	58.8%	
August 3, 2021	1300	70.6%	
September 2, 2021	1510	82.0%	
October 4, 2021	1618	87.8%	
November 1, 2021	1688	91.6%	
December 1, 2021	1737	94.3%	
January 4, 2022	1757	95.3%	86
February 3, 2022	1768	95.9%	75
March 2, 2022	1775	96.3%	68
August 8, 2022	1777	96.4%	66
September 7, 2022	1777	96.4%	66
October 17, 2022	1777	96.4%	66
October 31, 2022	1778	96.5%	65
November 28, 2022	1779	96.5%	64
January 3, 2023	1779	96.5%	64
January 31, 2023	1779	96.5%	64
February 21, 2023	1779	96.5%	64
March 20, 2023	1779	96.5%	64
May 1, 2023	1779	96.5%	64
June 1, 2023	1779	96.5%	64
July 4, 2023	1779	96.5%	64
September 1, 2023	1779	96.5%	64
September 30, 2023	1786	96.9%	57

The last minute gain in hexagon numbers was accomplished by those who got multiple observations on a vertical benchmark to complete a hexagon without a horizontal station.
 Note: All remaining hexagons contain non-Wisconsin Height Modernization NGS

stations, vertical only benchmarks or are have stations that are not GPSable.

GPS on BM PRIORITY MARK LIST (NGS)

NGS has produced a prioritized list of bench marks where additional GPS data would be helpful to help define the new 2022 Geoid model. Providing GPS on stations with leveled elevations will help to relate the GPS derived ellipsoid height with the leveled elevation of these marks. The stations on the Priority List are chosen by computer generated algorithms based on station location and metadata without regard to its status as a WI-HMP station. Currently, there are about 15,000 NGS benchmarks (both WI-HMP stations and non WI-HMP) in Wisconsin. Most non WI-HMP stations have relatively little current survey value, but may have important older surveys tied to them.

Date	Number of stations on list	Number of stations Completed	Percent of NGS Priority Marks Completed	Approximate % of 3553 Horizontal WI-HMP Stations
9/8/2020	2968	674	22.7%	19.0%
1/31/23	5812	3509	60.4%	98.8%
5/1/23	5813	3511	60.4%	98.8%
6/5/23	5815	3534	60.8%	99.5%

Not updated since 6/5/23

As you can see, there are not many horizontal WI-HMP stations remaining that do not have a GPS on BM observation. As part of the 2023 reobservation plan, we will get a GPS on BM observation on all horizontal Wisconsin Height Modernization stations or confirm that they are not GPSable

ORIGINAL HARN STATIONS (OR REPLACEMENTS) DONE

One goal of the WisDOT's GNSS Observation on passive stations project is to get two observations on all original HARN stations or their replacements in Wisconsin. There are 80 Stations in total. The original HARN stations are a higher accuracy station and provided the initial control from which all other horizontal stations in Wisconsin were surveyed from.

Date	HARN Stations Completed	% Completed
March 1, 2022	79	98.8%

Remaining (0): MILWAUKEE GPS has been destroyed.

List of Non-WisDOT Partners (that I am aware of) that have or are planning to submit OPUS Share observations

J.W. Austin Associates of Minocqua, Vernon County, LaCrosse County, Dodge County, Dunn County, Brown County, Sheboygan County, Washington County, Burnett County, Manitowoc County, Jackson County, Clark County, Sawyer County, Fond du Lac County, Oneida County, Washburn County, Lincoln County, Rock County, Oconto County, City of Madison, Landtech Surveying of Oconomowoc, Seiler Instruments, Leica Geosystems, Milwaukee Metropolitan Sewerage District, DJ Henkel and Associates, LLC, Northeast Wisconsin Technical College (NWTC), Ayres and Associates, Christopher J. Gregory, PLS

THANK YOU ALL,
Mick

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