

# Vertical Accuracy Report

Southeastern Wisconsin Regional Planning Commission (SEWRPC)

Milwaukee County High-Density Lidar Project 2020

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# Vertical Accuracy Report

#### **Project Information**

Prepared By: Ayres Project Name: Milwaukee County High-Density Lidar Project Sensor Info: Riegl VQ1560i Aggregate Nominal Pulse Density: 30 points per square meter (PPSM) Consultant Name: Ayres primary and Quantum Spatial as lidar acquisition partner Coordinate System and Datum: Wisconsin State Plane, South Zone, NAD83 (11), NAVD88 (12B) Units: US Survey Feet Date of Acquisition: Start: 4/2/2020 | Finish: 4/3/2020

#### **Report Information**

This report documents the absolute vertical accuracy of the lidar data collected for the Milwaukee County, WI, high-density lidar project. Independent vertical checkpoints were collected by SEWRPC land surveyors using survey-grade GNSS equipment connected to WISCRS base stations. The checkpoints were collected in April 2020.

The checkpoints were collected under various land cover types that are predominant in the County. Each land cover type falls into either the Non-vegetated Vertical Accuracy (NVA) or the Vegetated Vertical Accuracy (VVA) group. For this project, 11 NVA points and 12 VVA points were collected throughout the County.

The following report shows the final statistics for the NVA checkpoints compared against the raw swath point cloud and the bare earth DEM, and the VVA statistics compared against the DEM. Statistics are reported for LAS and DEM by NVA and VVA categories.

Vertical Accuracy Specifications per SEWRPC requirements and USGS Lidar Base Specifications v1.3 for Quality Level O Lidar:

#### LAS:

NVA equates to 5 cm (0.16 ft) RMSEz, or 9.8 cm (0.32 ft) at the 95% confidence level.

#### DEM:

NVA equates to 5 cm (0.16 ft) RMSEz, or 9.8 cm (0.32 ft) at the 95% confidence level. VVA equates to 15 cm (0.49 ft) at the 95th percentile.

The NVA and VVA statistics for this project are within the above stated specifications.

Lidar Acquisition Information: The lidar data was acquired using a fixed wing survey aircraft over the course of three lifts starting on April 2, 2020, and ending on April 3, 2020.

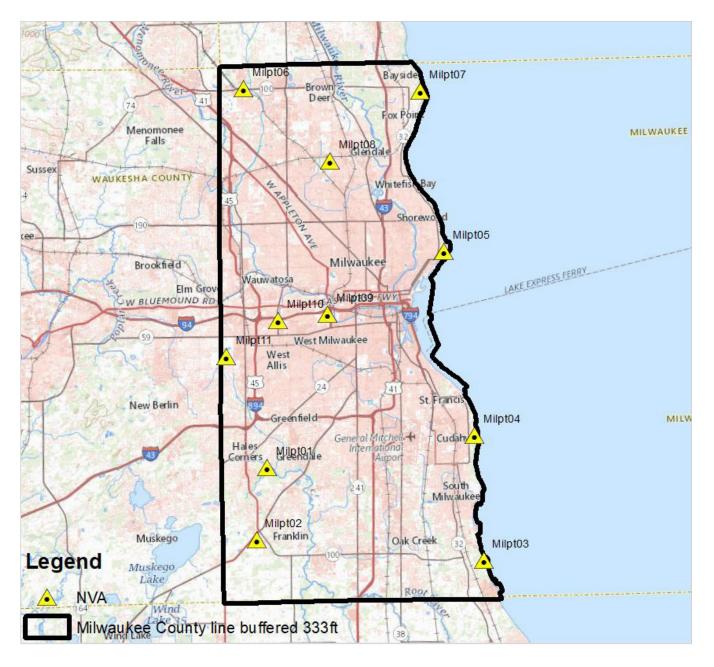
Lidar Calibration Control: The lidar was calibrated and then checked against 24 ground control points collected across the project area. The RMSEz of the lidar points compared to the calibration control points tested at 0.057 feet.

Lidar Processing Information: The calibrated lidar point cloud was edited and hydro-flattened to produce the following deliverable datasets: hydro breaklines (100-foot and greater streams, 2-acre and greater ponds), bridge breaklines, classified point cloud (classes 1, 2, 7, 9, 17, 18, 20), and digital elevation model (1-foot pixel). The deliverable tiling scheme is a 2,500 x 2,500 foot grid using SEWRPC naming scheme. The project area is countywide plus a 333-foot buffer.

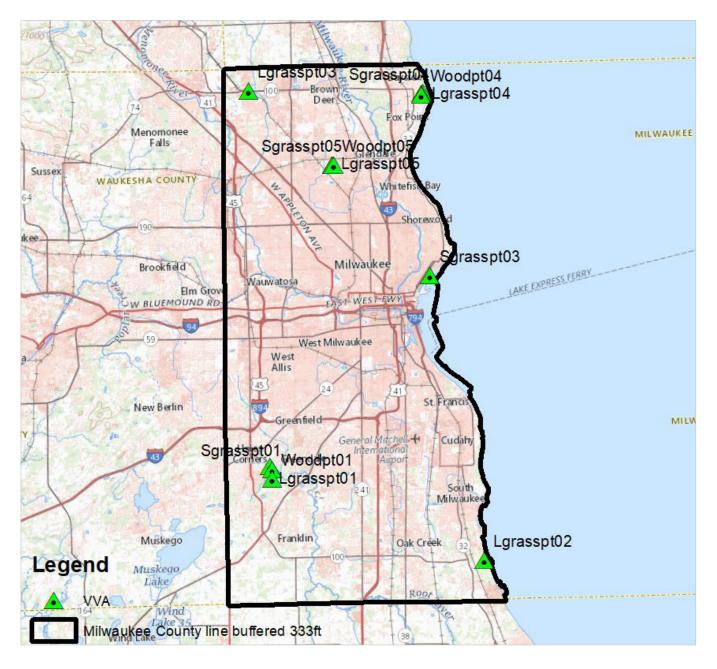
# Lidar Accuracy Assessment Summary

LAND COVER TYPE	# OF POINTS	NVA	VVA	RMSE Z
LAS		95% confidence	95th percentile	
NVA Total	11	0.154		0.078
DEM		95% confidence	95th percentile	
NVA Total	11	0.124		0.063
VVA Total	12		0.229	
TOTAL	23			

Units: U.S. Survey Feet



#### Map of NVA Checkpoint Locations



### Map of VVA Checkpoint Locations

# LAS

NONVEGETATED VERTICAL ACCURACY					
LAND COVER TYPE	NVA				
Minimum DZ	-0.010				
Maximum DZ	0.160				
Mean DZ	0.063				
Number Observations	11				
Standard Deviation DZ	0.052				
RMSE Z	0.078				
95% Confidence Level Z	0.154				
Units	U.S. Survey Feet				

### DEM

NONVEGETATED VERTICAL ACCURACY				
LAND COVER TYPE	NVA			
Minimum DZ	-0.038			
Maximum DZ	0.115			
Mean DZ	0.045			
Number Observations	11			
RMSE Z	0.063			
95% Confidence Level Z	0.124			
Units	U.S. Survey Feet			

VEGETATED VERTICAL ACCURACY					
LAND COVER TYPE VVA					
Minimum DZ	-0.295				
Maximum DZ	0.142				
Mean DZ	-0.005				
Number Observations	12				
95th percentile	0.229				
Units	U.S. Survey Feet				

## SEWRPC Survey Data Sheets - NVA Locations

Point ID	Milpt1
State	Wisconsin
County	Milwaukee
Photo ID	
Description	Whitnall Park - Parkway at College - North edge of
	concrete walk at grass

Coordinate System
NAD83 (2011)
Wisconsin South Zone
NAVD88
Geoid 18
US Survey Feet



Point ID	Milpt2		Coor	dinate System	
State	Wisconsin Milwaukee			83 (2011)	
County					
Photo ID			NAV		
Description	Showtime Cinema - MH cover in p	arking lot	Geoi		
	between theater and health			urvey Feet	
		Approximate NAD83 (20			
Northing:	328252.45	Easting:	2493559.86	Elevation:	801.99
	Milpt2		MI		

Point ID	Milpt3			Coordinate System	
State	Wisconsin			NAD83 (2011)	
County	Milwaukee			Wisconsin South Zone	
Photo ID	Wilwadkee			NAVD88	
Description	Bender Park, Oak Creek @ Lake N	1ichigan -Yellow		Geoid 18	
Description	painted arrow coming west o			US Survey Feet	
ļ	painted arrow coming west o			05 Sulvey leet	
		Approximate NA	AD83 (2011) Coordinates		
Northing:	323438.62	Easting:	2547627.51	Elevation:	589.06
	N ipt3				

	1				
Point ID				ordinate System	
State	Wisconsin		NA	D83 (2011)	
County	Milwaukee		Wis	sconsin South Zone	
Photo ID			NA	VD88	
	Cudahy Park Southend/Golf course	e - Storm drain in	Geo	pid 18	
	parking lot			Survey Feet	
		Approximate NA	AD83 (2011) Coordinates		
Northing:	353090.96	Easting:	2545395.52	Elevation:	684.19
	Milpt4			Alipt4b	

Point ID	Milpt5		С	Coordinate System	
State	Wisconsin		Ν	JAD83 (2011)	
County	Milwaukee		V	Visconsin South Zone	
Photo ID			Ν	IAVD88	
Description	White STOP Bar @ Lincoln Memoria	Dr, and Locust	G	Geoid 18	
	St - NE corner		L	JS Survey Feet	
Nearbhra	000700.00		D83 (2011) Coordinates		500.04
Northing:	396796.86	Easting:	2538219.24	Elevation:	599.64
	Milpt			Winderge of the second se	

Point ID	Milpt06	Coordinate System
State	Wisconsin	NAD83 (2011)
County	Milwaukee	Wisconsin South Zone
Photo ID		NAVD88
Description	Marathon Gas Station Brown Deer Rd. @ 107th St	Geoid 18
	Red Gas MH cover, East side of parking lot	US Survey Feet



Point ID	Milpt07			rdinate System	
State	Wisconsin		NAD	083 (2011)	
County	Milwaukee		Wis	consin South Zone	
Photo ID			NAV	/D88	
Description Schlitz Aug	lobon vistor center parking	g lot - straight	Geo	bid 18	
	arrow		USS	Survey Feet	
		•			
		Approximate NAD83 (201	1) Coordinates		
Northing:	434954.62	Easting:	2532582.56	Elevation:	680.59
	hilpt7			hilpt7b	

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690.21

Point ID	Milpt08	Coordinate System
State	Wisconsin	NAD83 (2011)
County	Milwaukee	Wisconsin South Zone
Photo ID	Hopkins and entrance to Havenwood - intersectioof	NAVD88
Description	concrete side walk - SE quad of intersection new	Geoid 18
	NW corner of building 4325	US Survey Feet

Approximate N	IAD83 (2011) Coordinates
Easting:	2511089.36





Elevation:

Point ID	Milpt09
State	Wisconsin
County	Milwaukee
Photo ID	
Description	Miller Park Northside east of Helfar Diamond -
	Yellow Painted #1 on parking lot pavement

Coordinate System	
NAD83 (2011)	
Wisconsin South Zone	
NAVD88	
Geoid 18	
US Survey Feet	

		Approximate NAD83 (20	011) Coordinates		
Northing:	381999.22	Easting:	2510542.32	Elevation:	606.18
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712.56

Point ID	Milpt10	Coordinate System
State	Wisconsin	NAD83 (2011)
County	Milwaukee	Wisconsin South Zone
Photo ID		NAVD88
Description	Statefair Park NW Corner of parking lot at 84th St	Geoid 18
	and I94 east bound onramp and frontage Rd.	US Survey Feet

		Approximate NAD83 (2	011) Coordinates
Northing:	380367.67	Easting:	2498736.92
	Aiilpt 0		



Elevation:

Point ID	Milpt11
State	Wisconsin
County	Milwaukee
Photo ID	Greenfield Park, 124th @ Lincoln - Childrens play
Description	area - intersection of concrete with blue foam
	covering

Coordinate System
NAD83 (2011)
Wisconsin South Zone
NAVD88
Geoid 18
US Survey Feet

		Approximate NAD83	(2011) Coordinates		
Northing:	371870.86	Easting:	2486404.27	Elevation:	776.33
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# SEWRPC Survey Data Sheets - VVA Locations

Point ID	LongGrassPt.1
State	WI
County	Milwaukee
Photo ID	
Description	
	Long Grass Point 1

Coordinate System
NAD83 (2011)
Wisconsin South Zone
NAVD88
Geoid 18
US Survey Feet

Approximate NAD83 (2011) Coordinates					
Northing:	346176.9	Easting:	2495548	Elevation:	720.98

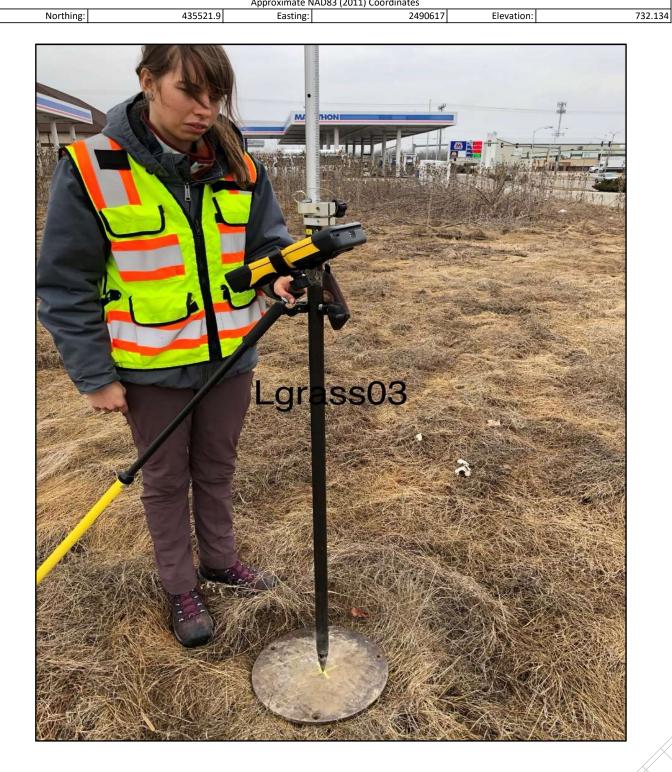


Point ID	LongGrassPt.2	Coordinate System
State	Wisconsin	NAD83 (2011)
County	Milwaukee	Wisconsin South Zone
Photo ID		NAVD88
Description		Geoid 18
	Long Grass Point 2	US Survey Feet

Approximate NAD83 (2011) Coordinates					
Northing:	323809.3	Easting:	2546659	Elevation:	671.433



Point ID	LongGrassPt.3	Coordinate System
State	Wisconsin	NAD83 (2011)
County	Milwaukee	Wisconsin South Zone
Photo ID		NAVD88
Description		Geoid 18
	Long Grass Point 3	US Survey Feet
	Approximato	AD82 (2011) Coordinatos



Point ID	LongGrassPt.4	Coordinate System
State	Wisconsin	NAD83 (2011)
County	Milwaukee	Wisconsin South Zone
Photo ID		NAVD88
Description		Geoid 18
	Long Grass Point 4	US Survey Feet

	Approximate NAD83 (2011) Coordinates					
	Northing:		Easting:	7537033	Elevation:	677.203



Point ID	LongGrassPt.5	Coordinate System
State	Wisconsin	NAD83 (2011)
County	Milwaukee	Wisconsin South Zone
Photo ID		NAVD88
Description		Geoid 18
	Long Grass Point 5	US Survey Feet



Point ID	ShortGrassPt.1			Coordinate S		
State	Wisconsin			NAD83 (2011		
County	Milwaukee			Wisconsin Sc	outh Zone	
Photo ID				NAVD88		
Description				Geoid 18		
	Short Grass Point 1			US Survey Fe	eet	
			33 (2011) Coordinates	1		
Northing:	345429.5	Easting:	2496	252 Ele	evation:	714.401
		Sgras				
						100 A

Point ID	ShortGrassPt.3		]	Coordinate System		
State	Wisconsin			NAD83 (2011)		
County	County Milwaukee			Wisconsin South Zone		
Photo ID			NAVD88			
Description	Description			Geoid 18		
	Short Grass Point	t 3		US Survey Feet		
		Approvimato N	AD83 (2011) Coordinates			
		Approximate in	AD85 (2011) Coordinates			
Northing:	391552.8	Easting:	2533788	Elevation:	593.726	

1	I	Approximate NAD83 (20	011) Coordinates		
Northing:	391552.8	Easting:	2533788	Elevation:	593.726
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Point ID	ShortGrassPt.4		dinate System
State	Wisconsin		83 (2011)
County	Milwaukee		onsin South Zone
Photo ID		NAVI	
Description		Geoio	
	Short Grass Point 4	US Su	urvey Feet
N		IAD83 (2011) Coordinates	Elevation. Coo r
Northing:	434872.9 Easting:	2531614	Elevation: 680.5
	<image/>		

Point ID State County	ShortGrassPt.5		Coord	linate System	
	Wisconsin			3 (2011)	
	Milwaukee			onsin South Zone	
Photo ID			NAVD		
Description			Geoid		
Description	Short Grass Point 5	;		rvey Feet	
		·	00.00		
Ni - stali	417002 6	Approximate NAD83 (2011)		Florenting	704.65
Northing:	417903.6	Easting:	2510543	Elevation:	704.65
		Sgrass			

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Point ID	WoodPt.4			rdinate System	
State	Wisconsin			083 (2011)	
County	Milwaukee			consin South Zone	
Photo ID				/D88	
Description				id 18	
	Wood Point 4		USS	Survey Feet	
		Approximate NAD83 (2	011) Coordinates		
Northing:	434654.7	Easting:	2531573	Elevation:	678.7

Point ID	WoodPt.5	Coordinate System
State	Wisconsin	NAD83 (2011)
County	Milwaukee	Wisconsin South Zone
Photo ID		NAVD88
Description		Geoid 18
	Wood Point 5	US Survey Feet

