



# Vertical Accuracy Report

Southeastern Wisconsin  
Regional Planning Commission (SEWRPC)

Milwaukee County High-Density Lidar Project  
2020

Ingenuity, Integrity, and Intelligence.

[www.AyresAssociates.com](http://www.AyresAssociates.com)



# 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 0 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.

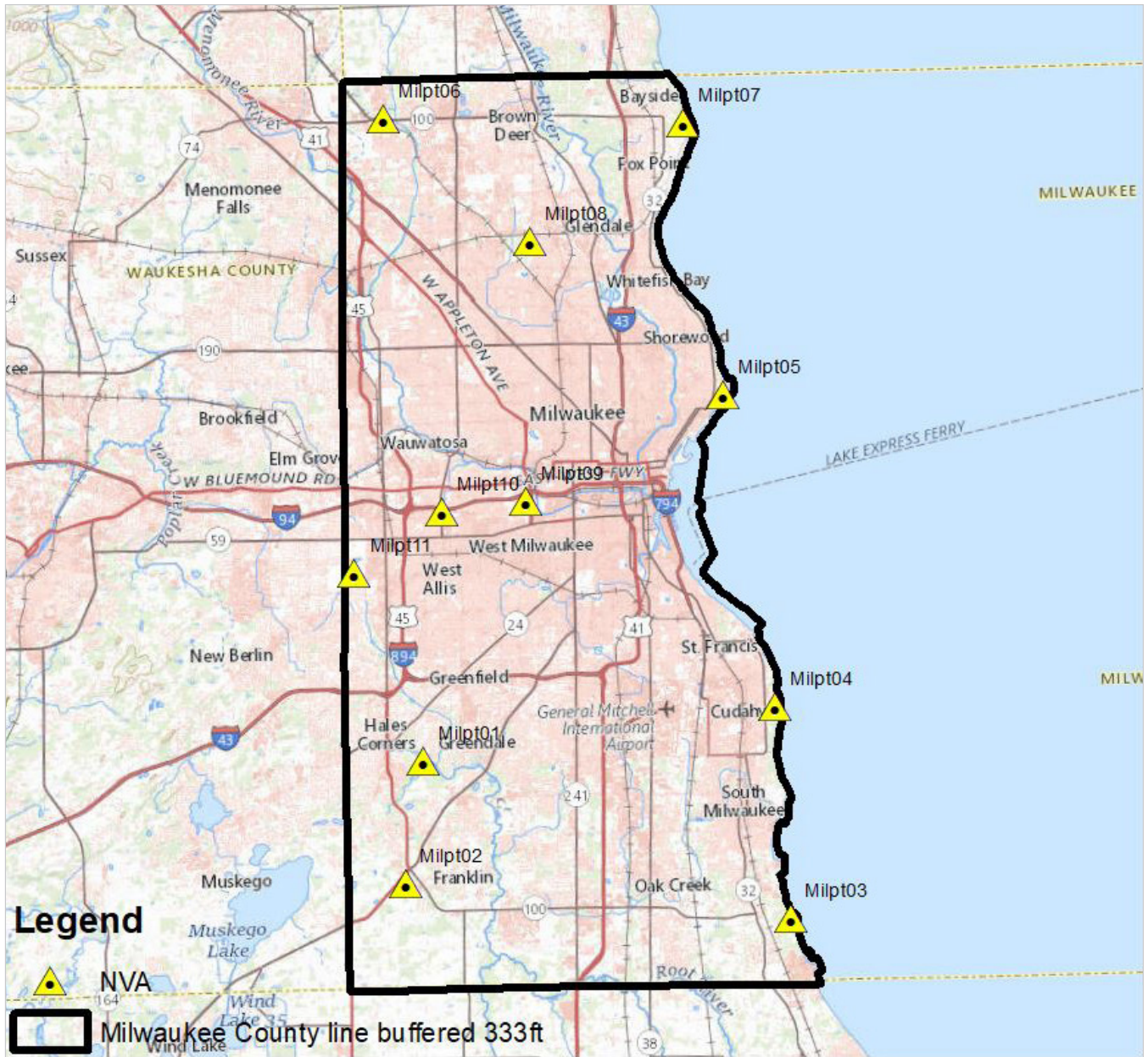
**Lidar Processing Information:** The calibrated lidar point cloud was edited and hydro-flattened to produce the following deliverable datasets: hydro breaklines (100-foot and greater streams, 2-acre and greater ponds), bridge breaklines, classified point cloud (classes 1, 2, 7, 9, 17, 18, 20), and digital 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

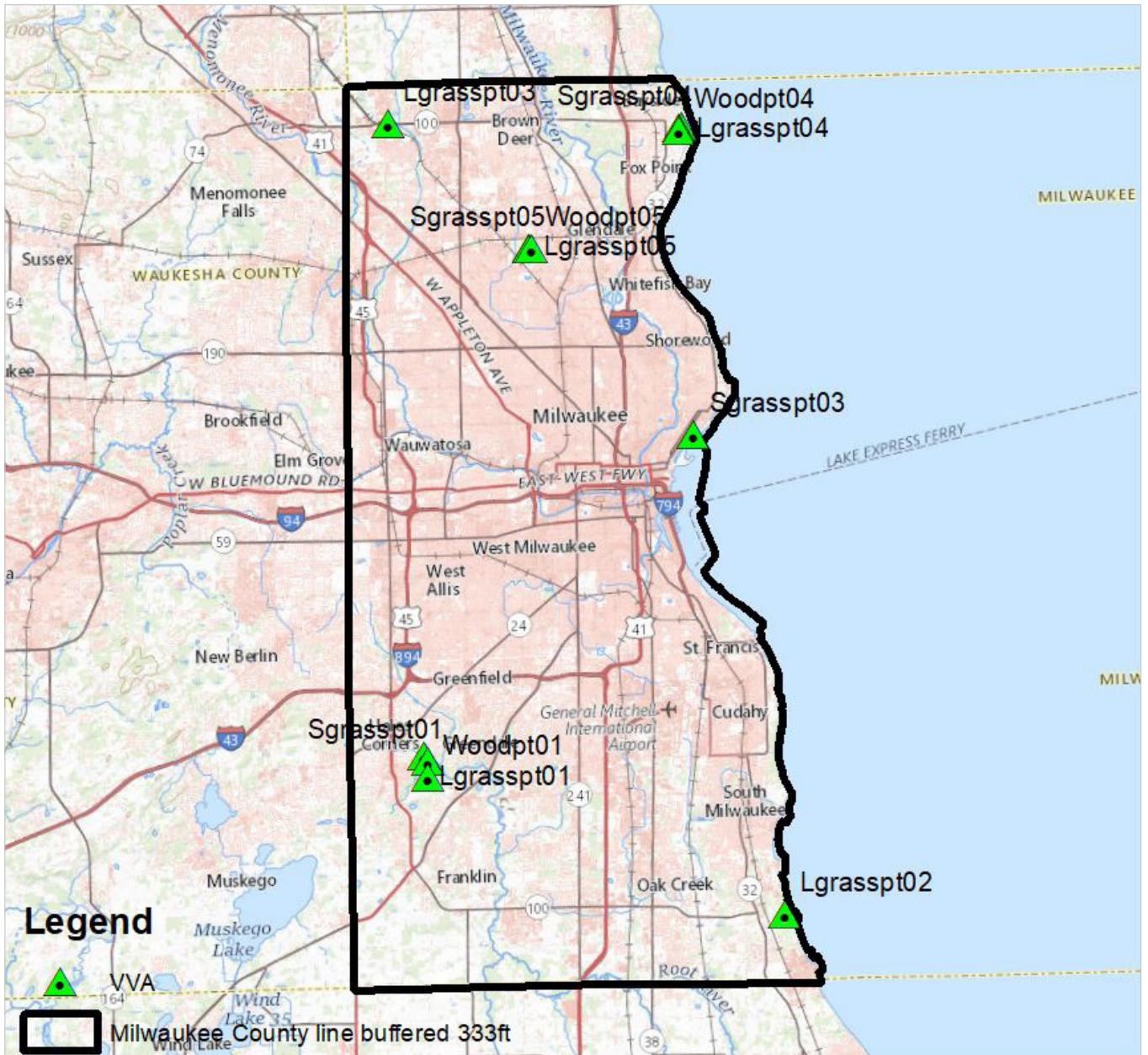
LAND COVER TYPE	# OF POINTS	NVA	VVA	RMSE Z
<b>LAS</b>		<b>95% confidence</b>	<b>95th percentile</b>	
NVA Total	11	0.154		0.078
<b>DEM</b>		<b>95% confidence</b>	<b>95th percentile</b>	
NVA Total	11	0.124		0.063
VVA Total	12		0.229	
<b>TOTAL</b>	<b>23</b>			

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

Approximate NAD83 (2011) Coordinates					
Northing:	345461.75	Easting:	2496154.02	Elevation:	716.15





Point ID	Milpt2
State	Wisconsin
County	Milwaukee
Photo ID	
Description	Showtime Cinema - MH cover in parking lot between theater and healthclub

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

Approximate NAD83 (2011) Coordinates					
Northing:	328252.45	Easting:	2493559.86	Elevation:	801.99



Point ID	Milpt3
State	Wisconsin
County	Milwaukee
Photo ID	
Description	Bender Park, Oak Creek @ Lake Michigan -Yellow painted arrow coming west out of water

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

Approximate NAD83 (2011) Coordinates					
Northing:	323438.62	Easting:	2547627.51	Elevation:	589.06



Point ID	Milpt4
State	Wisconsin
County	Milwaukee
Photo ID	
Description	Cudahy Park Southend/Golf course - Storm drain in parking lot

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

Approximate NAD83 (2011) Coordinates					
Northing:	353090.96	Easting:	2545395.52	Elevation:	684.19



Point ID	Milpt5
State	Wisconsin
County	Milwaukee
Photo ID	
Description	White STOP Bar @ Lincoln Memorial Dr, and Locust St - NE corner

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

Approximate NAD83 (2011) Coordinates			
Northing:	396796.86	Easting:	2538219.24
		Elevation:	599.64



Point ID	Milpt06
State	Wisconsin
County	Milwaukee
Photo ID	
Description	Marathon Gas Station Brown Deer Rd. @ 107th St. - Red Gas MH cover, East side of parking lot

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

Approximate NAD83 (2011) Coordinates					
Northing:	435514.74	Easting:	2490467.39	Elevation:	734.13



Point ID	Milpt07
State	Wisconsin
County	Milwaukee
Photo ID	
Description	Schlitz Audobon visitor center parking lot - straight arrow

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

Approximate NAD83 (2011) Coordinates					
Northing:	434954.62	Easting:	2532582.56	Elevation:	680.59



Point ID	Milpt08
State	Wisconsin
County	Milwaukee
Photo ID Description	Hopkins and entrance to Havenwood - intersection of concrete side walk - SE quad of intersection new NW corner of building 4325

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

Approximate NAD83 (2011) Coordinates					
Northing:	418337.73	Easting:	2511089.36	Elevation:	690.21



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 (2011) Coordinates					
Northing:	381999.22	Easting:	2510542.32	Elevation:	606.18





Point ID	Milpt10
State	Wisconsin
County	Milwaukee
Photo ID	
Description	Statefair Park NW Corner of parking lot at 84th St and I94 east bound onramp and frontage Rd.

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

Approximate NAD83 (2011) Coordinates					
Northing:	380367.67	Easting:	2498736.92	Elevation:	712.56



Point ID	Milpt11
State	Wisconsin
County	Milwaukee
Photo ID Description	Greenfield Park, 124th @ Lincoln - Childrens play 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



## 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
State	Wisconsin
County	Milwaukee
Photo ID Description	Long Grass Point 2

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

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



Point ID	LongGrassPt.3
State	Wisconsin
County	Milwaukee
Photo ID Description	Long Grass Point 3

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

Approximate NAD83 (2011) Coordinates					
Northing:	435521.9	Easting:	2490617	Elevation:	732.134



Point ID	LongGrassPt.4
State	Wisconsin
County	Milwaukee
Photo ID Description	Long Grass Point 4

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

Approximate NAD83 (2011) Coordinates					
Northing:	435136.3	Easting:	2532033	Elevation:	677.203



Point ID	LongGrassPt.5
State	Wisconsin
County	Milwaukee
Photo ID Description	Long Grass Point 5

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

Approximate NAD83 (2011) Coordinates					
Northing:	417782.6	Easting:	2510443	Elevation:	701.247



Point ID	ShortGrassPt.1
State	Wisconsin
County	Milwaukee
Photo ID Description	Short Grass Point 1

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

Approximate NAD83 (2011) Coordinates					
Northing:	345429.5	Easting:	2496252	Elevation:	714.401





Point ID	ShortGrassPt.3
State	Wisconsin
County	Milwaukee
Photo ID	
Description	Short Grass Point 3

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

Approximate NAD83 (2011) Coordinates					
Northing:	391552.8	Easting:	2533788	Elevation:	593.726



Point ID	ShortGrassPt.4
State	Wisconsin
County	Milwaukee
Photo ID Description	Short Grass Point 4

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

Approximate NAD83 (2011) Coordinates					
Northing:	434872.9	Easting:	2531614	Elevation:	680.511



Point ID	ShortGrassPt.5
State	Wisconsin
County	Milwaukee
Photo ID Description	Short Grass Point 5

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

Approximate NAD83 (2011) Coordinates					
Northing:	417903.6	Easting:	2510543	Elevation:	704.653



Point ID	WoodPt.1
State	Wisconsin
County	Milwaukee
Photo ID	
Description	Wood Point 1

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

Approximate NAD83 (2011) Coordinates					
Northing:	343133.2	Easting:	2496241	Elevation:	774.073



Point ID	WoodPt.4
State	Wisconsin
County	Milwaukee
Photo ID Description	Wood Point 4

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

Approximate NAD83 (2011) Coordinates					
Northing:	434654.7	Easting:	2531573	Elevation:	678.782



Point ID	WoodPt.5
State	Wisconsin
County	Milwaukee
Photo ID Description	Wood Point 5

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

Approximate NAD83 (2011) Coordinates					
Northing:	417896.5	Easting:	2510734	Elevation:	725.765

