Virginia Information Technologies Agency

Introduction to LiDAR in Virginia

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VITA ISP Wednesday Webinar Series
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LiDAR

Light Detection And Ranging

LiDAR uses laser pulses to determine distance to an object or surface. Three components are used:

- An aircraft-mounted laser pulse scanner to send/receive data
- Aerial GPS systems to determine precise aircraft positions
- An Inertial Measurement Unit (IMU) to measure aircraft attitude (pitch/yaw/roll).

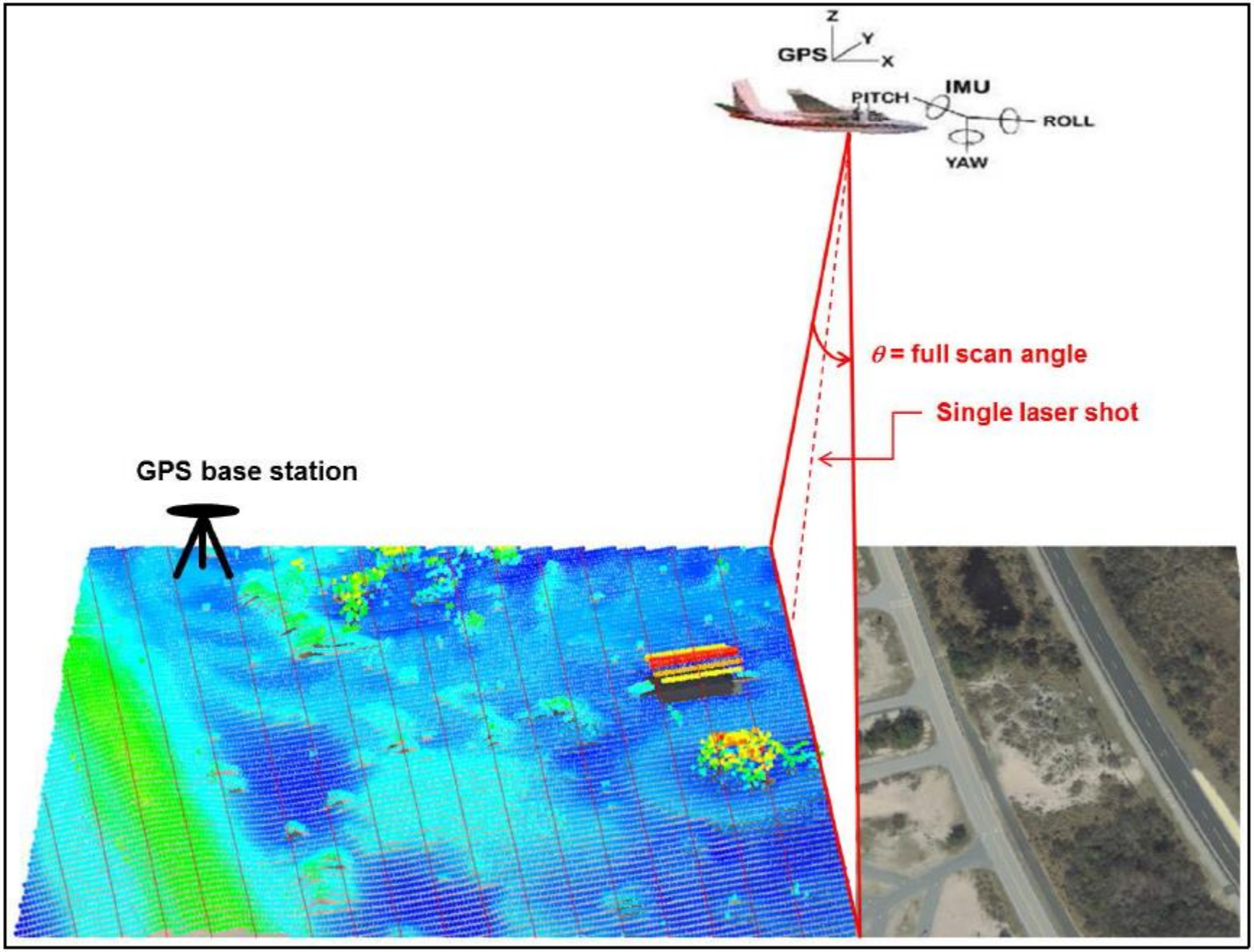


Figure 2-1. Schematic diagram of airborne lidar performing line scanning resulting in parallel lines of measured points (other scan patterns exist, but this one is fairly common)

Advantages of LiDAR

- Higher resolutions (1m or less data spacing)
- Centimeter vertical accuracies (v. meter vertical accuracies of old topo maps)
- Ability to penetrate vegetation and detect ground surfaces
- Detection of above ground objects (buildings, trees, forest canopy)

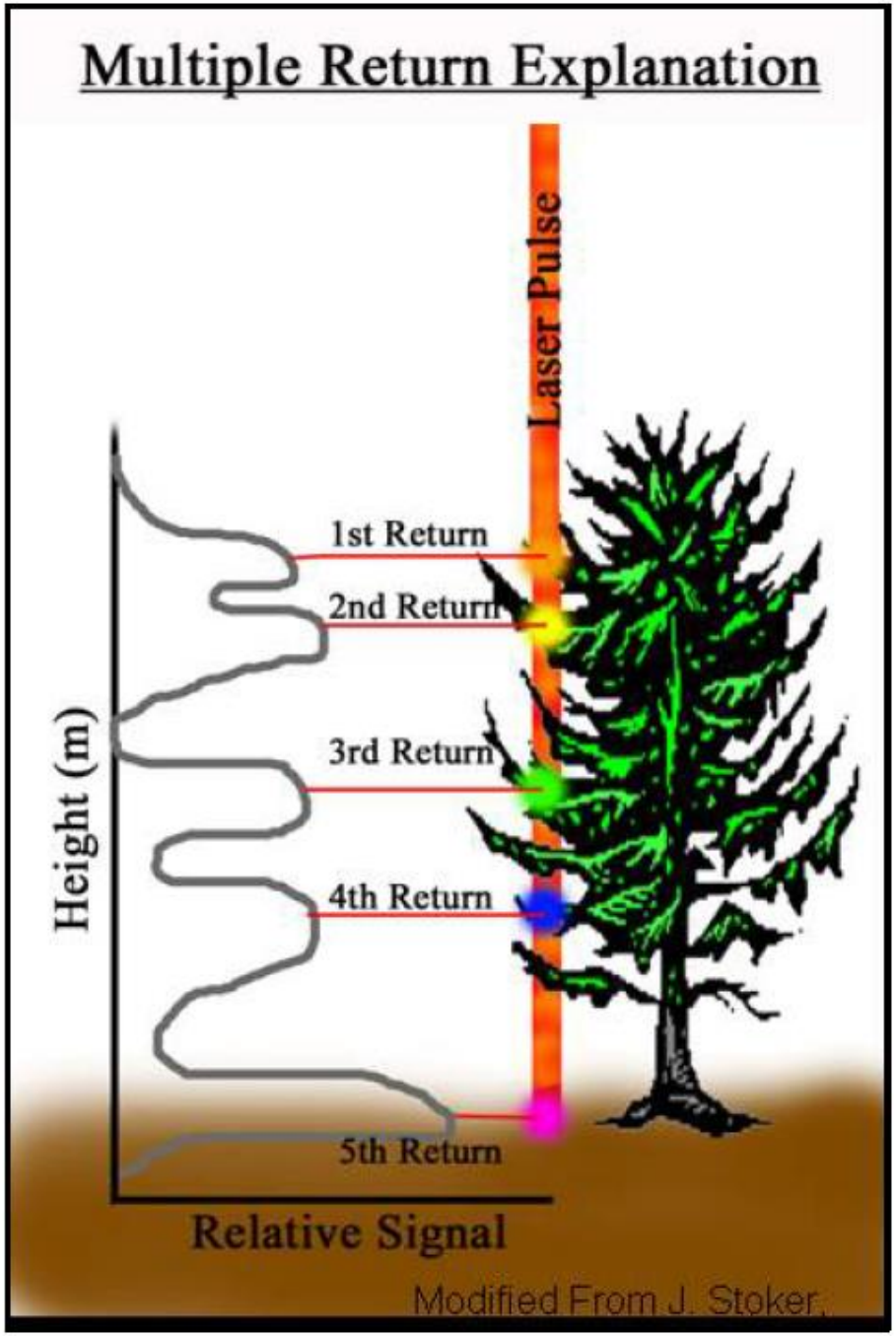
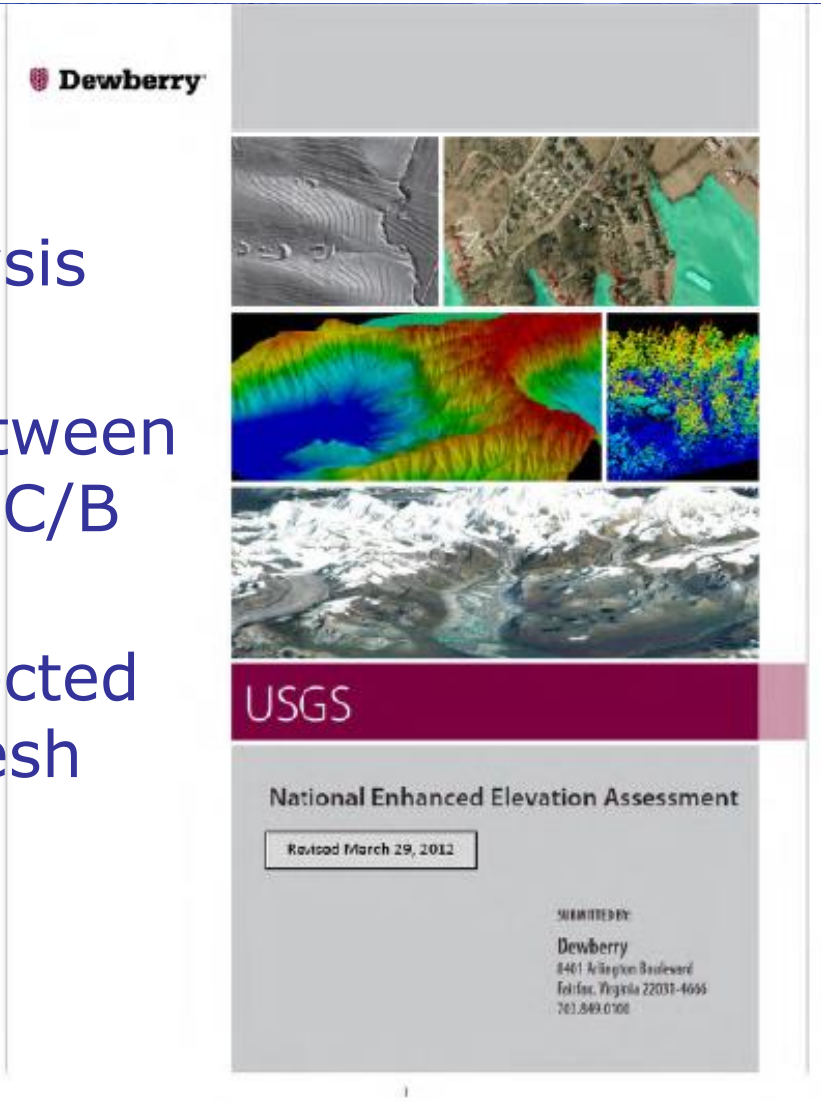


Figure 2-4. Multiple returns from single pulse

NEEA

- Nationwide cost-benefit analysis for LiDAR
- Estimated annual benefits between $1.2 and $12.9 billion, and a C/B ratio of 4.7+
- Recommended QL2 data collected nationwide on an 8-year refresh cycle



Virginia NEEA

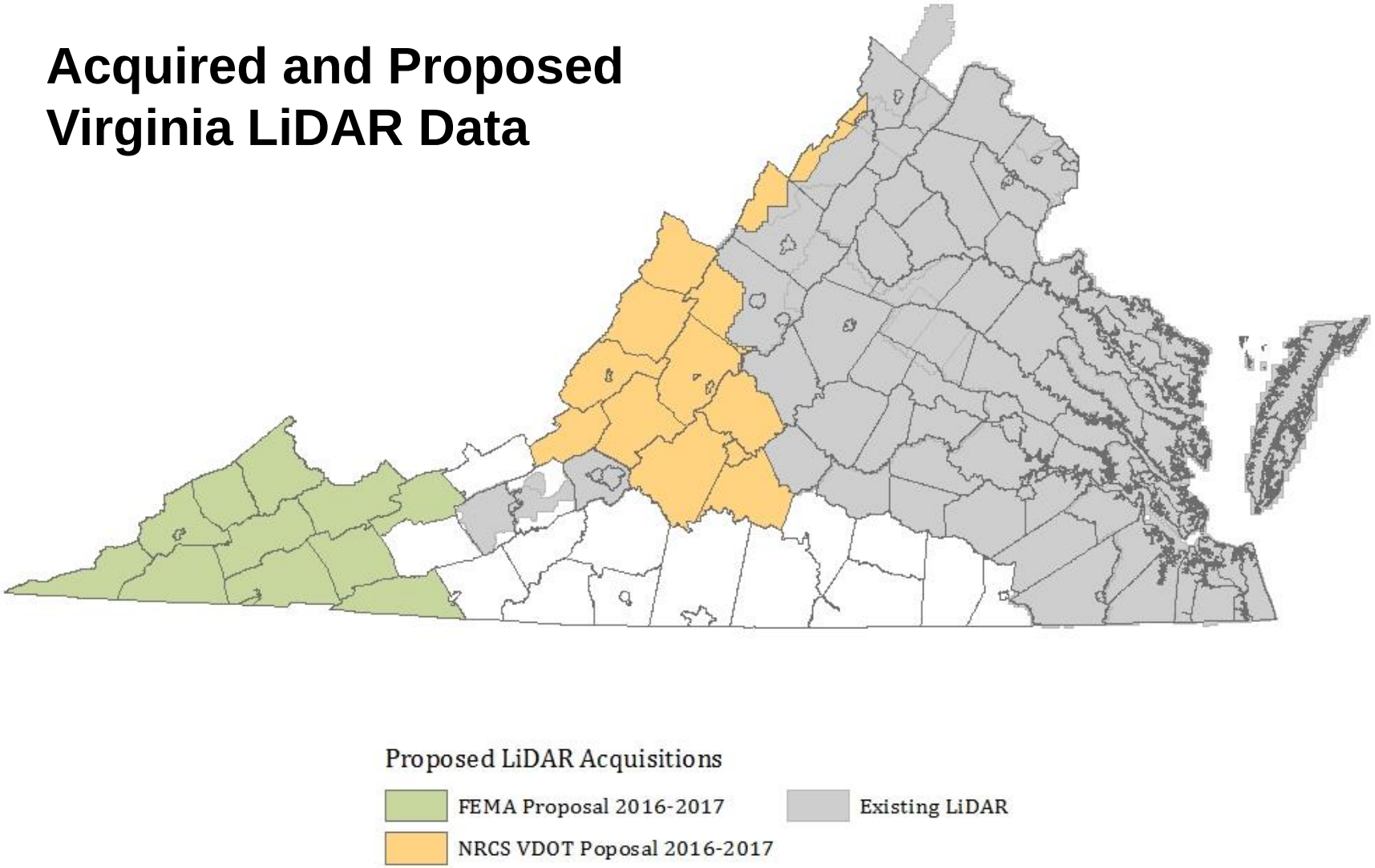
3DEP in Virginia by the Numbers

Expected annual benefits	$10.32 million
Estimated total cost	$13.50 million
Payback	1.3 years
Quality level 1 buy-up estimate	$8.59 million

Rank	Business use	Annual benefits (millions)
1	Urban and regional planning	$3.03
2	Natural resources conservation	1.75
3	Flood risk management	1.53
4	Agriculture and precision farming	1.11
5	Resource mining	0.76
6	Infrastructure and construction management	0.74
7	Geologic resource assessment and hazard mitigation	0.32
8	Water supply and quality	0.30
9	Forest resources management	0.29
10	Coastal zone management	0.17
	Other	0.33
	Total	10.33

Link to State Fact Sheet

Acquired and Proposed Virginia LiDAR Data



Completed and Funded Projects

Year	Sq. Miles	Cost
2010	4,096	$1,153,683
2011	5,003	$1,773,083
2012	2,819	$559,300
2013	1,147	$379,000
2014	7,054	~$2,200,000
2015	8,444	~$2,500,000
total	**28,566**	**~$8,565,000**

72% of the Commonwealth

Funding Partners

- USGS
- FEMA
- NRCS
- NGA
- DEQ
- DMME
- The Nature Conservancy
- UVA
- ODU
- Page County
- Fairfax County
- HRPDC
- HRSD

LiDAR Data Download

- 3DEP View

http://viewer.nationalmap.gov/basic/?basemap=b1&category=ned,nedsrc&title=3DEP%20View

- Virginia GIS Data Clearinghouse (under development)
  - State plane coordinates (if available)
  - ESRI compressed format (ZLAS)
  - Faster posting
  - FTP web folders
- Eastern Shore VA 2015 LiDAR http://arcg.is/1Uv1Shl

- Data download demonstration

LiDAR Data

- The native data are delivered as **points** (point clouds) than can be used directly or
- Processed into **surfaces** (DEMs or TINs)
- Surfaces can be **bare-earth** or **first-reflective surfaces**
- The surfaces can be used to produce **contours** (for cartographic purposes)

Bare-earth DEM

- Raster digital elevation models
- Uses LiDAR points classified as ground and 3D break lines derived from LiDAR
- Produces a "hydro-flattened" representation of the ground surface
- Provide a dense, higher accurate topography
- Can be used to produce contours

- DEM demonstration
- Contours

Point Clouds

- Large collections of 3D elevation points, with x, y, and z, along with additional attributes
- Elevations for the ground, buildings, forest canopy, highway overpasses, and anything else that the laser beam encounters during the survey constitutes point cloud data

Point Cloud Data Attributes

ASPRS LAS Format

1. X, Y, Z coordinates
2. Intensity
3. Return number
4. Number of returns
5. Point classification
6. Edge of flight line
7. *RGB*
8. GPS time
9. Scan angle
10. Scan direction

Viewing and Using LiDAR Data

- ESRI options
  - DEM rasters
  - LAS datasets for viewing & editing point clouds
  - Terrain datasets
  - Mosaic datasets (on-the-fly rasterization of point clouds)
- LiDAR-specific software
  - LP360
  - MARS
  - TerraSolid
  - Fusion
  - LASTools

- Point cloud demonstration
- LAS Datasets

USGS 3DEP

- Provides an opportunity to partner with USGS to acquire high-quality 3D elevation data
- Can either use the USGS contract or receive a grant
- Match varies with funds availability and interest of other federal partners
- Next opportunity will open July 25 with proposals due October 1
- Public webinars in August

USGS Data Standard

Heidemann, Hans Karl, 2014, Lidar base specification (ver. 1.2, November 2014): U.S. Geological Survey Techniques and Methods, book 11, chap. B4, 67 p. with appendixes,

http://dx.doi.org/10.3133/tm11B4

Virginia LIDAR Acquisition Plan

- Adopted in 2014
- Goal of statewide coverage
- Project coordination and data management (VGIN)
- Virginia-specific data requirements
- Data refresh plan (8-Year)

Additional Lidar Specifications

1. Collection areas – whole counties
2. Tiles – VBMP tiling scheme
3. DEM – 2.5 ft cell size
4. Tidal coordination - +/- 2hrs of low tide
5. Datums – most current NAD83, NAVD88, most current geoid
6. Coordinate System – Virginia State Plane

Thank You

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Feel free to contact me about

- Obtaining and using existing LiDAR
- Partnering for acquiring LiDAR
- General elevation data questions