Mobile LiDAR for Flood Risk Reduction and Risk Assessments

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Bob Murdock, P.E., CFM
Michael Baker Jr.
What is LIDAR

*LIDAR* (Light Detection And Ranging)

LiDAR is an optical technology that measures the properties of scattered light to determine range, elevations and other info.
Typical Ground LIDAR Collection
Point Reflection
Overview

- Optech LYNX Mobile Mapper™

Specifications

- Accuracy: ± 3cm
- Vertical Accuracies: < 0.1’
- Precision: < 7mm
- Range: 200m (235m corridor)
- Field of View: 360°
- Laser rotates: 9-15,000 RPM
- Measurement Rate: 200Khz
- Returns per Shot: 4 (1st, 2nd, 3rd, Last)
- Simultaneous LiDAR & imagery capture
- Digital Cameras: 2, 5 Mega-pixel
- Images Capture: < 3 frames/sec.
LiDAR leads to Digital Terrain Models (DTMs) – Which lead to efficiency in Floodmapping

- Automated Hydrology; Basin, Subbasin, Flow
- Automated Development of Hydraulic Models - Cross Sections and Parameters
- Automated delineation
Integrated Hazard Risk Management

1. Hazard Identification
2. Vulnerable Systems
3. Risk Assessment
4. Communication
5. Mitigation

Hazard Data
Built Environment Data, Critical Infrastructure, Socio-Economic Variables
Delaware River Basin

- Delaware
- Pennsylvania
- New Jersey
- New York

Approximately 330 miles long

With a population of 7.5 million

15 million depend on the water for drinking
Structure Inventory
- Depreciated Replacement Cost
- Assumed Content to Structure Ratios

Hydraulic Data
- High Water Marks
- Gage Data
- Flood Protection
- HEC-RAS

Economic Identifiers
- Stage Damage Curves
- Marshall & Swift Database
HEC FDA

- Allows user to access the potential benefit of mitigation projects
  - Import HEC RAS
  - Import structure data
  - Apply stage damage curves
  - Project area can be broken into reaches for detailed analysis
Stage Damage Curve
Evaluate Nonstructural Treatments

Legend
Nonstructural Treatments by Floodplain

FLOODPLAIN
- 50% ACE (2-yr Floodplain)
- 20% ACE (5-yr Floodplain)
- 10% ACE (10-yr Floodplain)
- 4% ACE (25-yr Floodplain)
- 2% ACE (50-yr Floodplain)
- 1% ACE (100-yr Floodplain)

Flood Zone
- A: 1% annual chance of exceedance
- X600: 0.2% annual chance of exceedance
- X: Outside 0.2% annual chance of exceedance
Change to summary, structural measures per community, community based options and results
jdeangelo, 9/1/2011
Pulling it all Together

- Elevating structure 2 feet reduces damage cost significantly on the curve.
- Especially powerful in high frequency events.
- 2 courses of block add less than 5 percent to construction costs; savings are almost immediately realized.
Outreach!

- Show community where the danger is today and where the danger might be in the future.
- Provide graphical and real examples ($) of the costs.
- Work with the community to inform the residents and future residents of the risks.
Data Collection Team
Point Capture from the Air
Aerial LIDAR Surfaces

(Source: George Vosselman)

International Summer School "Digital Recording and 3D Modeling", Aghios Nikolaos, Crete, Greece, 24-29 April 2006
Filtering
Dual Sensor System

- Minimize laser shadowing
- Optimize Field of View (FOV)
  - Sensor will see everything behind the vehicle
  - Sensor will see ~35º in front of vehicle
  - Full 360º area coverage

![Diagram of dual sensor system showing sensor coverage areas and vehicle positioning.](image-url)
Cross-Sections
Finished Floor Elevations (FFE)

- Quickly and Economically determine Finished Floor Elevations on a Regional Scale
- Minimize or Eliminate Right of Entry
Bossier City FFE Stats

- 1,367 Identified Structures
  - 267 more than previously known
  - 7 parcels had no information
- 29 “Deductive Reasoning” Addresses
- Field Collected in 2-Days
  - 70+ ground-control points
- 150+ Gb of Raw Data
- 64 Gb of Delivered Data
  - Split into 117 LAS files
Bossier City FFE – GIS Ready

Point Cloud

GIS Attributes

Digital Images
Risk Layers and Information Slide

Integrated Hazard Risk Management

North Carolina Floodplain Mapping Program
Integrated Hazard Risk Management (IHRM)

Fostering the transition from just “In or Out” flood management practices to “Graduated Flood Risk” management.

Develop data products – data, and tools targeted towards local government and private sector (CI/KR) decision makers.

Questions to Answer:
• What is the overall risk (Annual Loss Estimate)?
• What are efficient and effective strategies that will mitigate or prevent the likelihood and/or consequences?
• What is the Return on Investment from implementing such strategies?
Graduated Flood Risk

Estimated Threshold Return Period for Flooding

Legend
Estimated Flood Return Period
- 0 - 10
- 11 - 50
- 51 - 100
- 101 - 200
- 201 - 500
- 501 - 1000
- 100 YR Depth Grid (ft)
  - High: 25.35
  - Low: 0

*Image not to scale
Damage Estimates per Return Period Event
Website Hazard Risk Reports for Public
Citywide Manhole/Inlet/Outfall Surveys
Traffic Features, Pavement Condition
Utilities Systems
Thank You
rmurdock@mbakerCorp.com
Export to Google Earth