

# Innovative Approach to Facility Site Plan Development for Storm Water Permit Compliance

**Eddie Phillips, BNSF**  
**Keith Woodburne, TRC**  
**Carlisle Haworth, TRC**  
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# Outline

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- **Background on California Industrial General Permit for Storm Water**
- **Site Plan Requirements**
- **Compliance Challenges**
- **Data Collection Approach & Field Inspections**
- **Data Evaluation (Flow Paths & Drainage Areas)**
- **Site Plan Development**
- **Summary and Lessons Learned**

# California Industrial General Permit

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## Changes in the Industrial General Permit (IGP) as of July 1, 2015

- IGP includes design storm standards for Dischargers implementing treatment control BMPs
  - The design storm standards include both volume- and flow based criteria
- Dischargers required to submit and certify all reports electronically via the *Storm Water Multiple Application and Report Tracking System (SMARTS)*
  - Increased public scrutiny of facility storm water compliance

# SWPPP Site Plan Requirements

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## Key components of Site Plans:

- Industrial Activity Areas (IAAs) - Based on SIC Code
- Location(s) of municipal storm drain inlets
- Locations of storm water collection and conveyance systems and associated points of discharge
- Storm water drainage areas (*within the facility boundary*)
- Direction of surface water flow (*within those drainage areas*)
- Structural control measures that affect storm water discharges and run-on

# Compliance Challenges

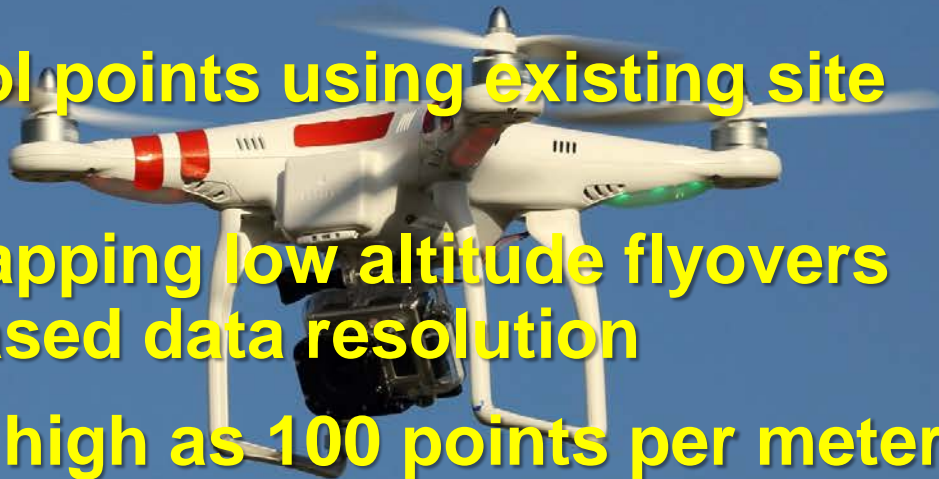
- Existing Site Plans did not meet IGP requirement to show drainage areas and flow direction
- Relatively flat railyard sites (*surface water flow patterns not well understood*)
- Urgency to complete SWPPP Updates (*by July 2015*)
- Multiple Sites across State
- Integration of mobile device data collection



# Aerial Topographic Mapping

## Data Collection via Drone-Based Aerial Survey

- **Faster, easier and safer GIS data collection**
- **Significant cost savings over airplane surveys**
- **Ground control points using existing site features**
- **Multiple overlapping low altitude flyovers provide increased data resolution**
- **Resolution as high as 100 points per meter (30 ppm standard)**
- **Topographic Contours at 1 foot (standard)**

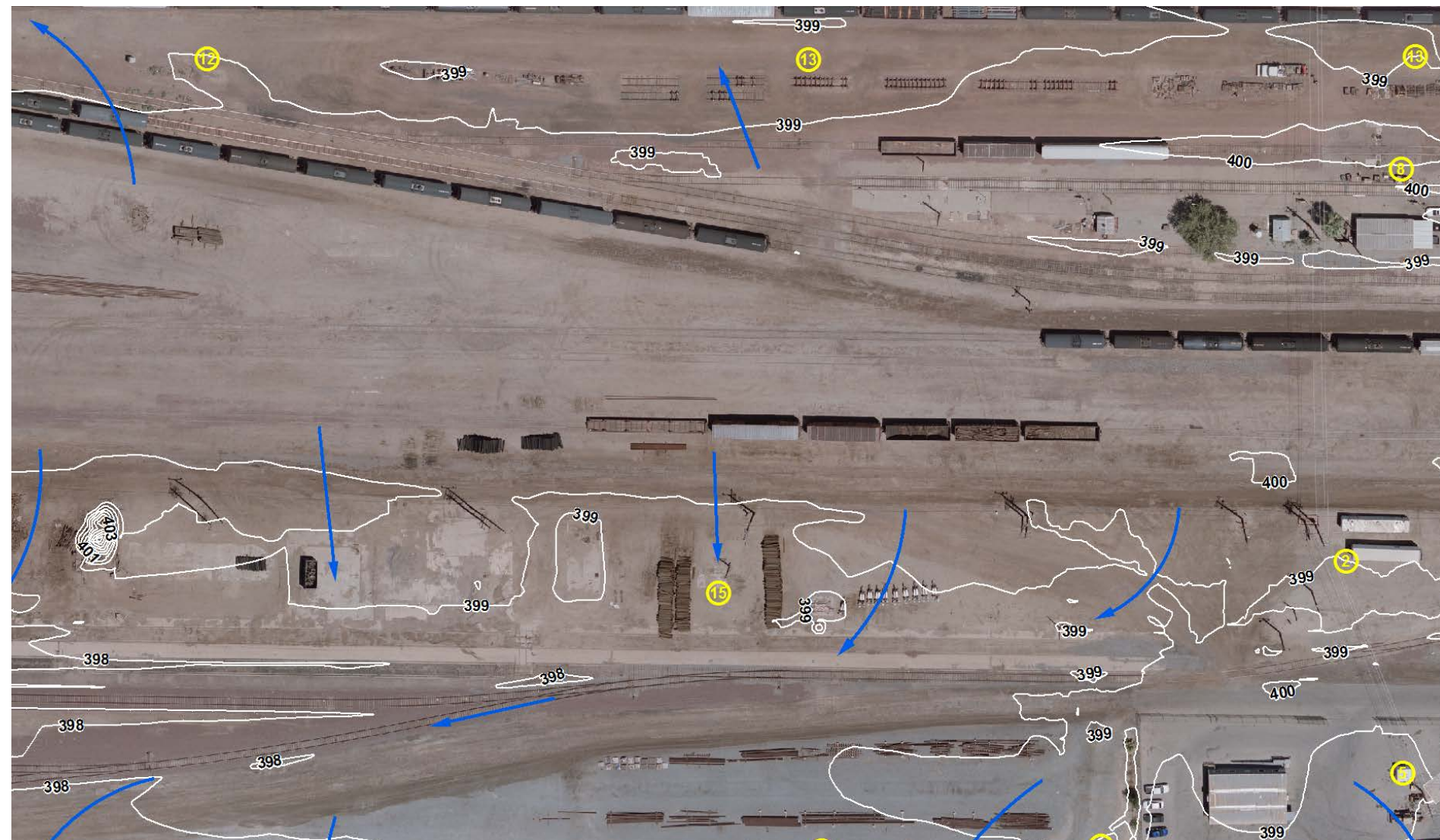


# Facility Compliance Inspections

- Set ground control survey points
- Ground-truth location of drain inlets and surface water diversion features
- Confirmation of Industrial Activity Areas (IAAs) with facility manager (*Based on Facility SIC Code*)
- Document localized surface water flows (*if observation possible during event*) and diversion structures



# Outdated Stormwater Mapping



# Innovative Approach to Mapping

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**Based on approach used for large rural areas**

**Software tools specifically for modeling hydrology**

**Major advancements in elevation data, acquisition (drones!), and processing techniques**

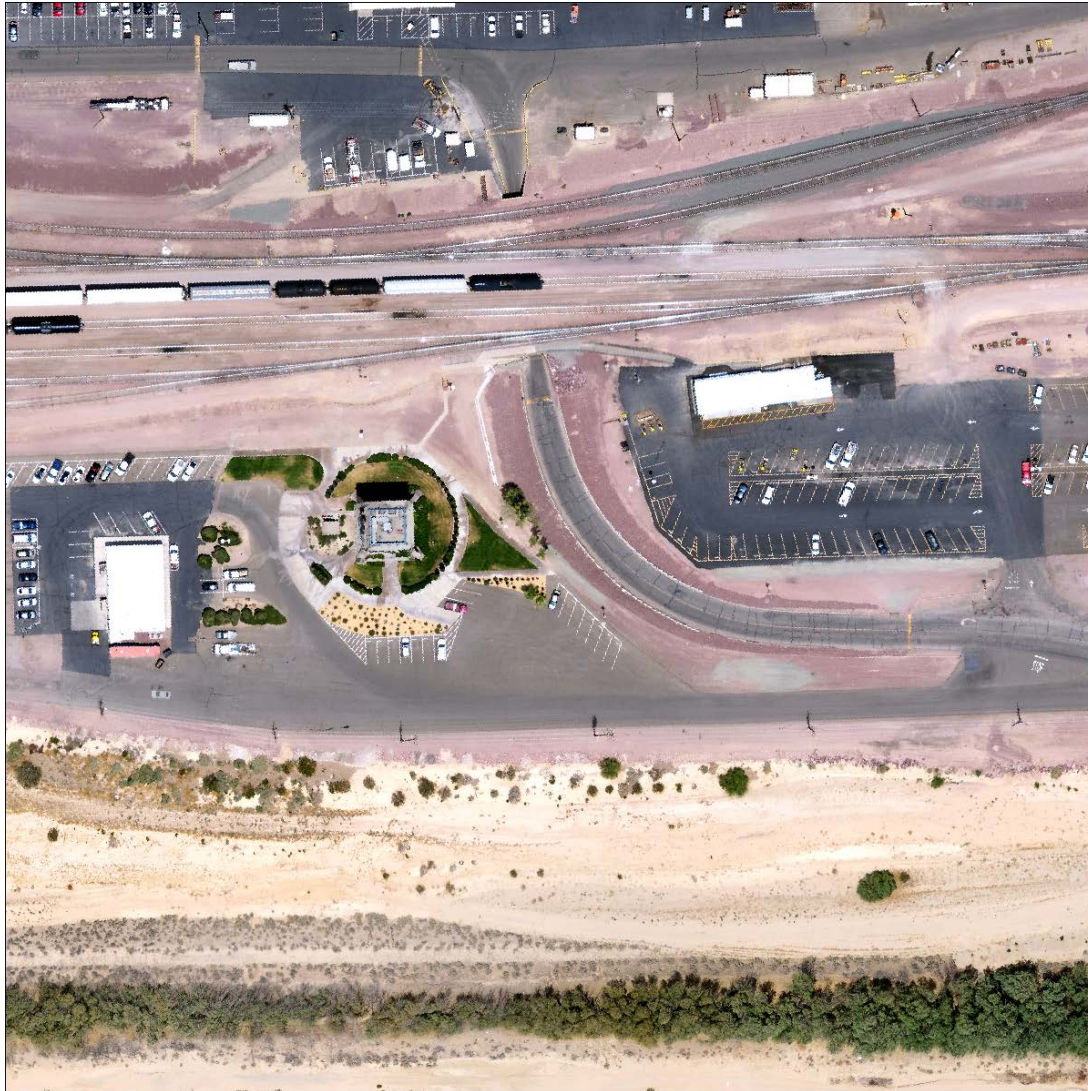
- **GIS / Cloud-based data**
- **Real-time integration with field data acquisition**

**Automation**

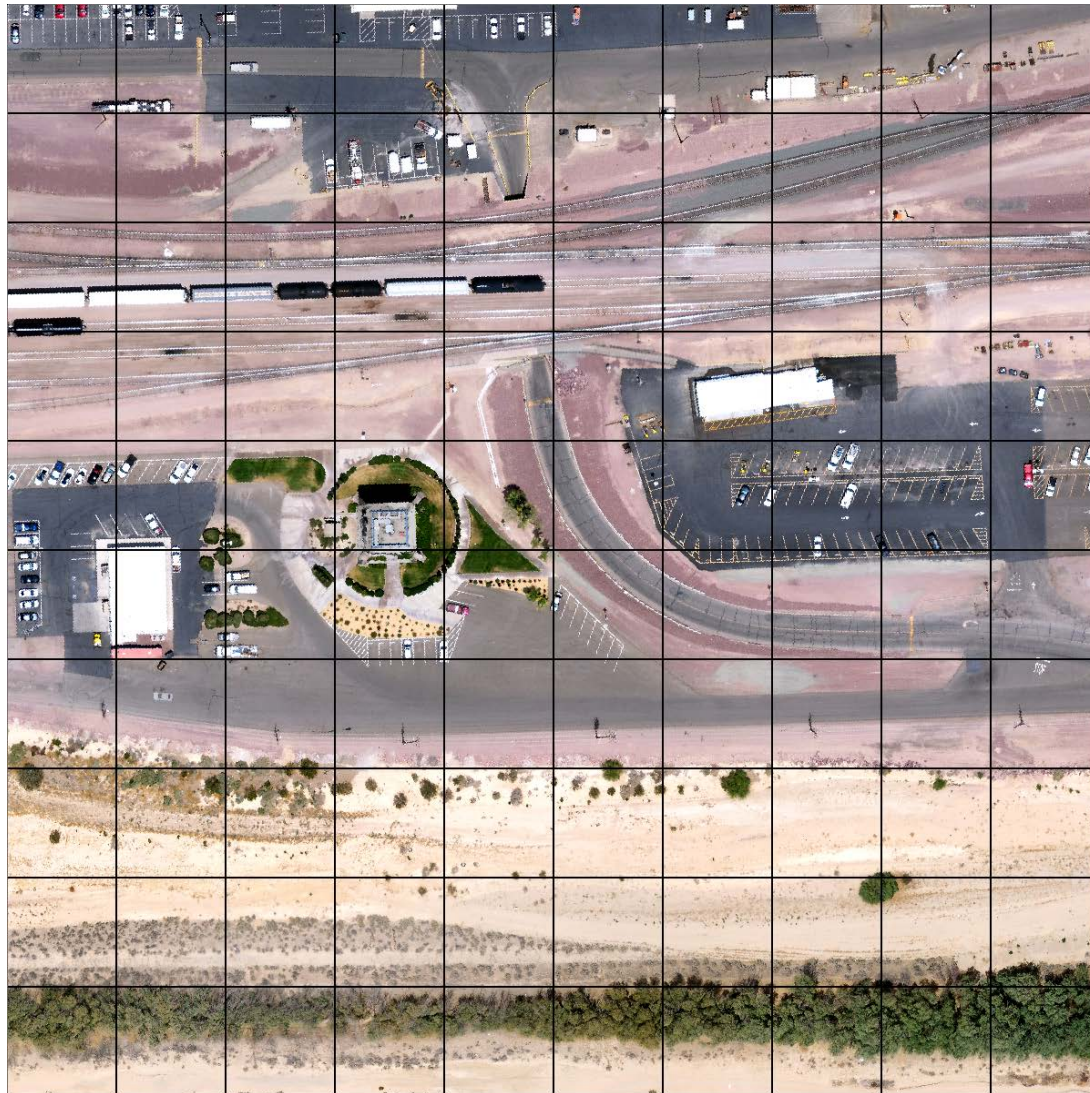
**How to account for urban complexity?**

- **Man-made surface features divert flow**
- **Sub-surface features**
- **Small drainage basins**

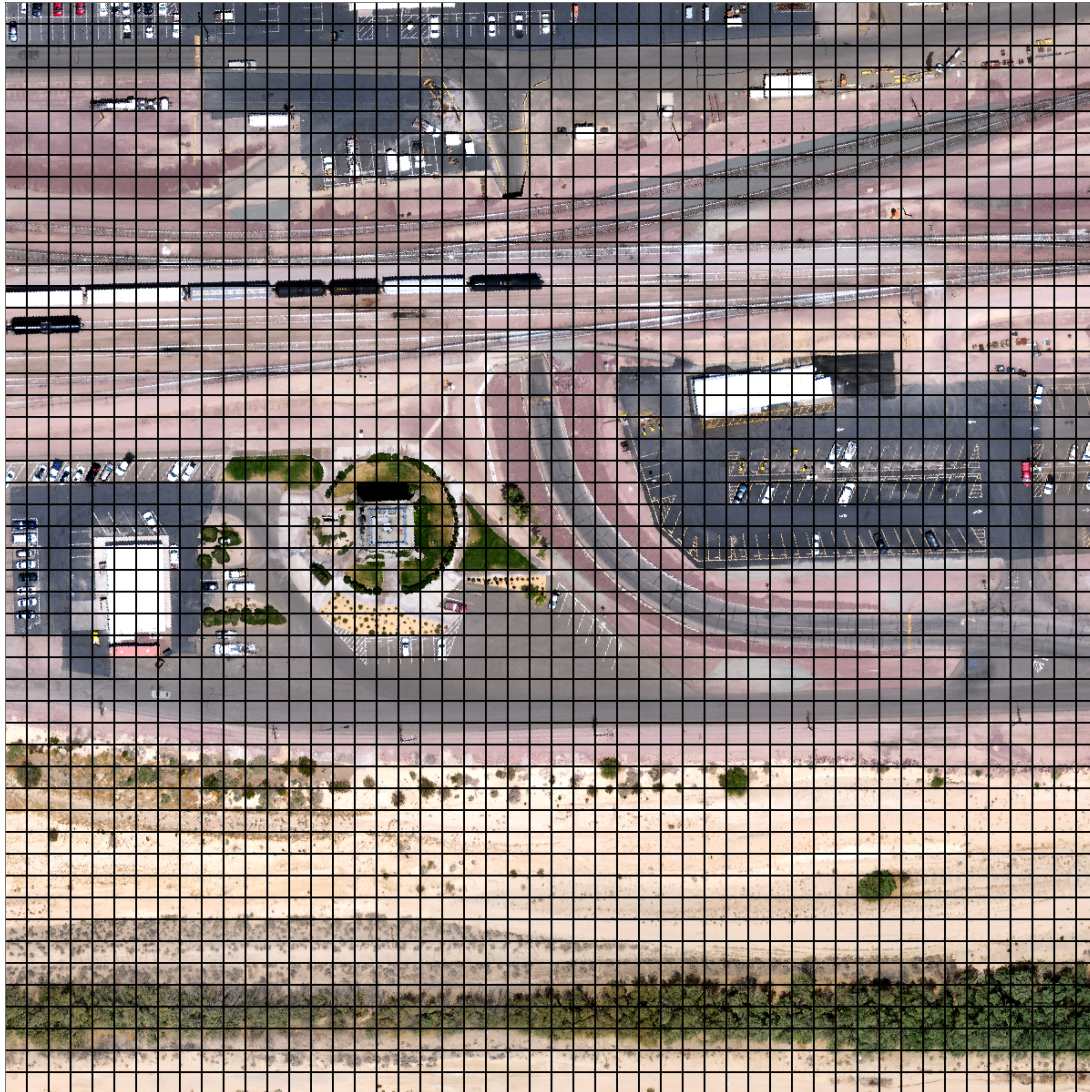
# Developing Flow & Drainage



# Divide Site Into a Grid



# A Very Fine Grid



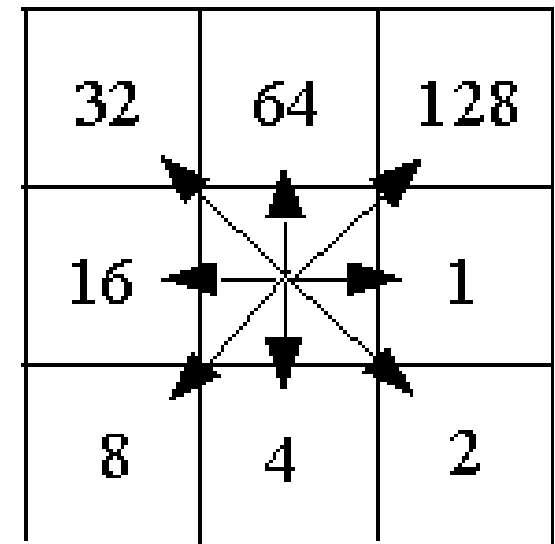
# Elevation Values

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78	72	69	71	58	49
74	67	56	49	46	50
69	53	44	37	38	48
64	58	55	22	31	24
68	61	47	21	16	19
74	53	34	12	11	12

# Downhill Flow Direction

78	72	69	71	58	49
74	67	56	49	46	50
69	53	44	37	38	48
64	58	55	22	31	24
68	61	47	21	16	19
74	53	34	12	11	12



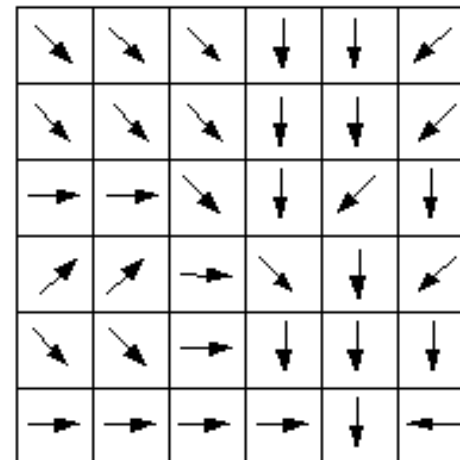
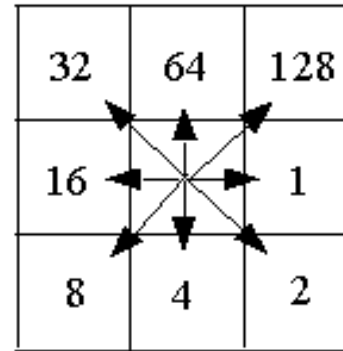
**D-8 Direction**

# Flow Direction

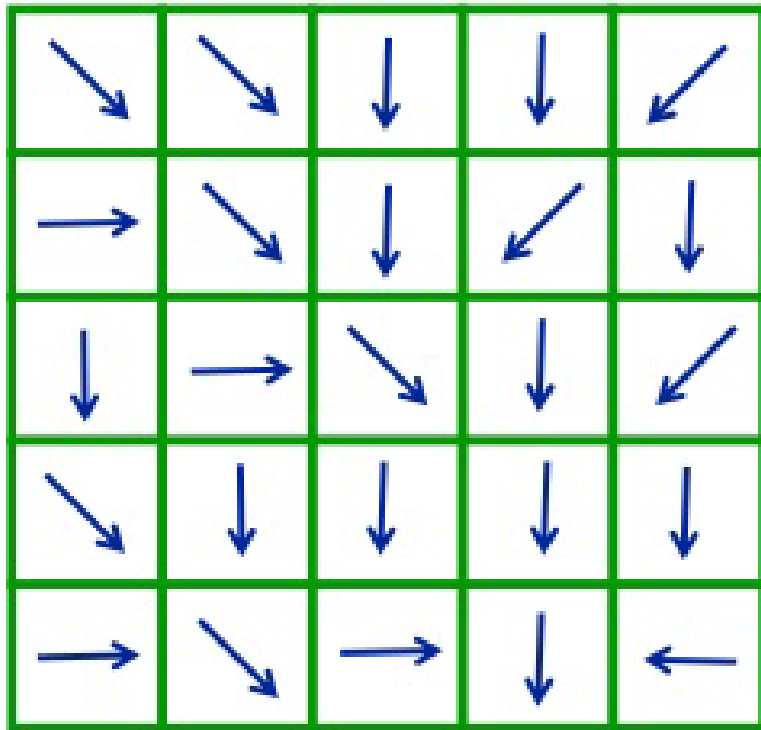
78	72	69	71	58	49
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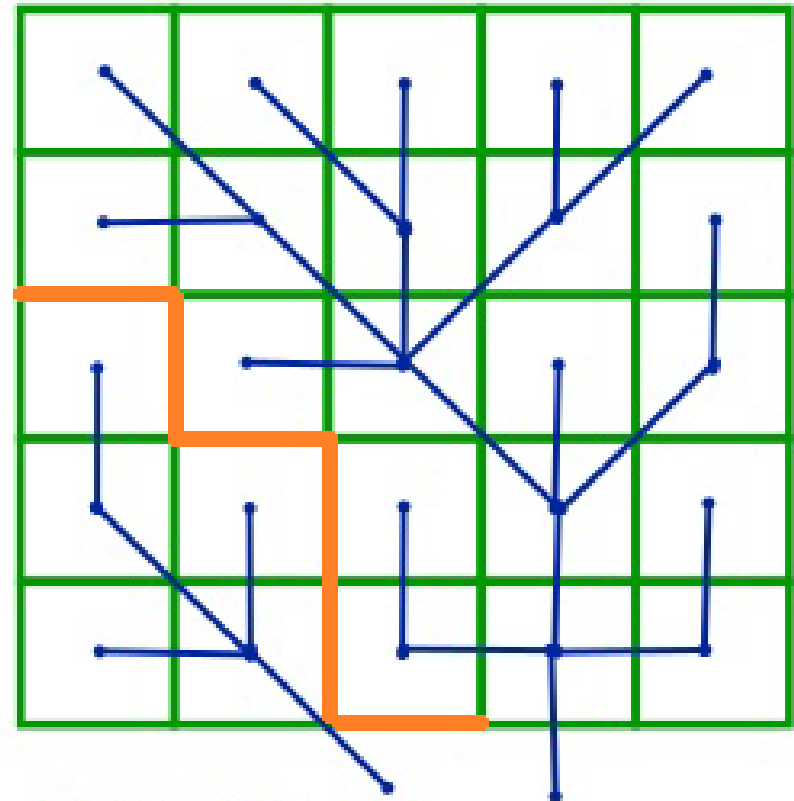
2	2	2	4	4	8
2	2	2	4	4	8
1	1	2	4	8	4
128	128	1	2	4	8
2	2	1	4	4	4
1	1	1	1	4	16



# Stream Linking

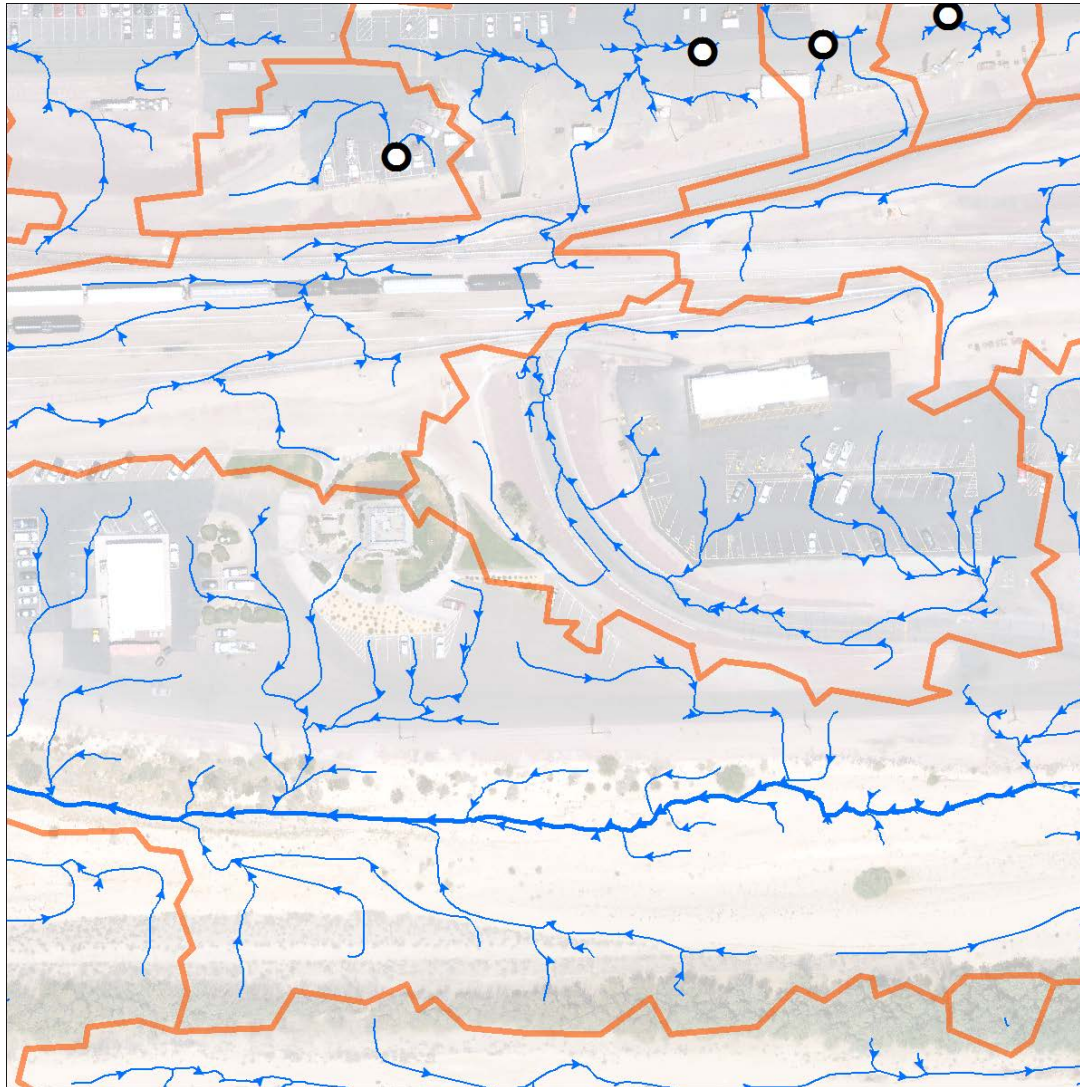


D8 for each cell

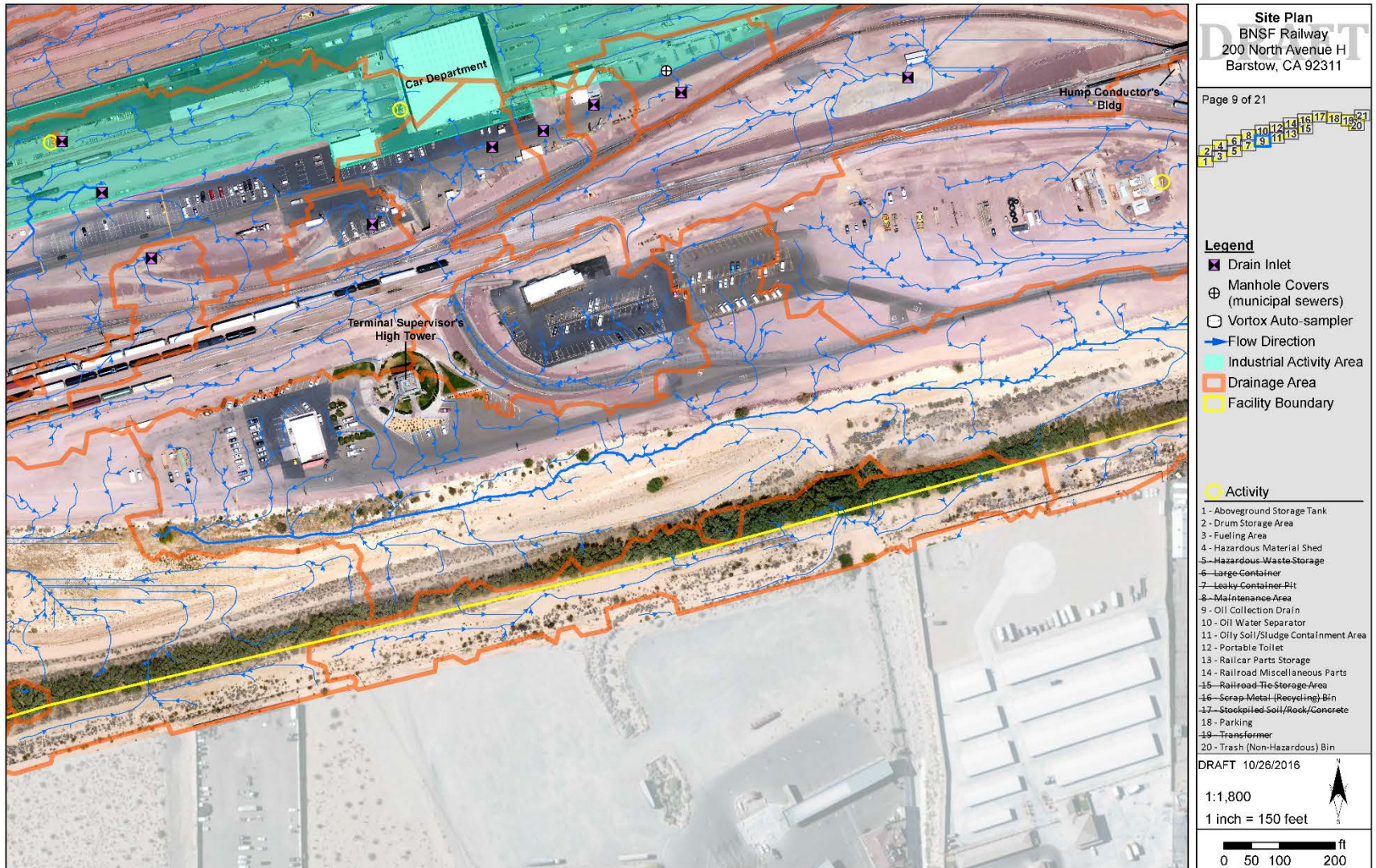


Stream link

# Result



# Updated Site Plan



# New Elevation Data

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## **Low Altitude Drone Flight ~ 400 ft.**

- Traditional airplane altitude ~ 15,000 – 25,000 ft

## **High Resolution Sensors and Cameras**

## **Easy Deployment**

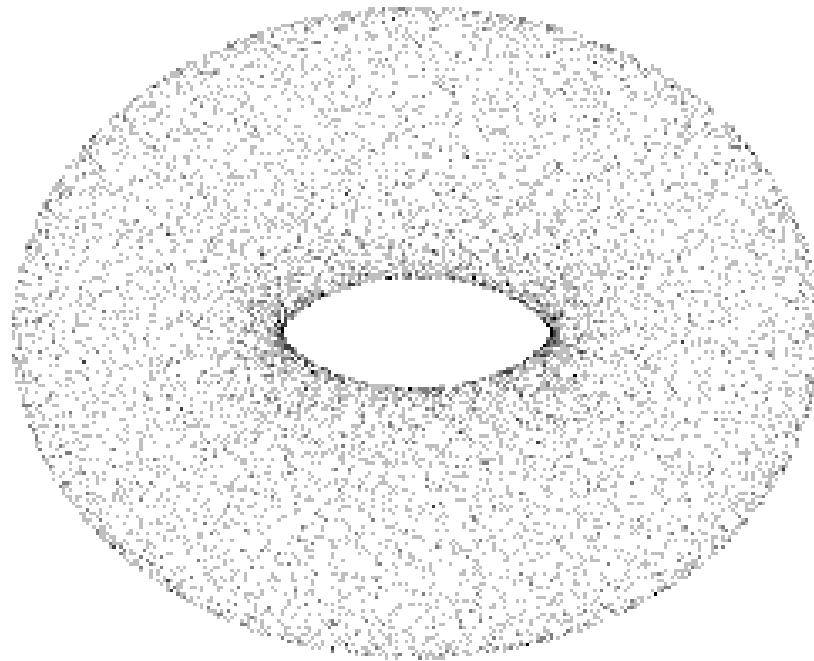
- Pre-programmed flight path

## **Rapid Data Delivery**

- 1 – 2 days

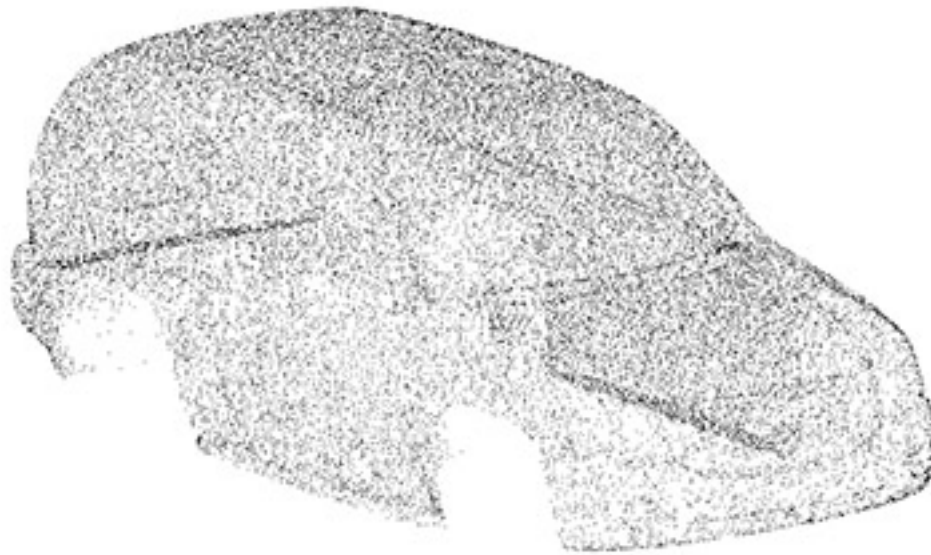
# 3D Point Cloud

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# 3D Point Cloud

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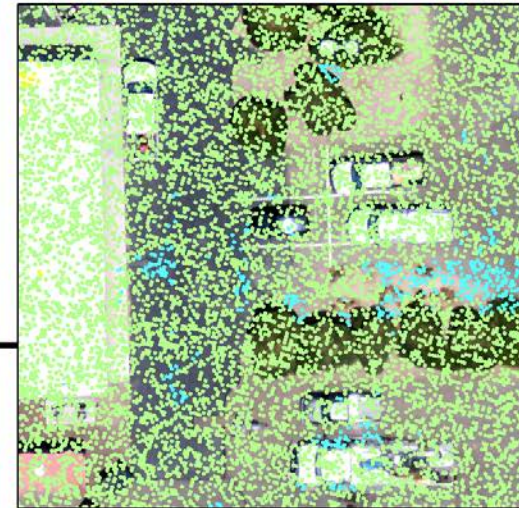
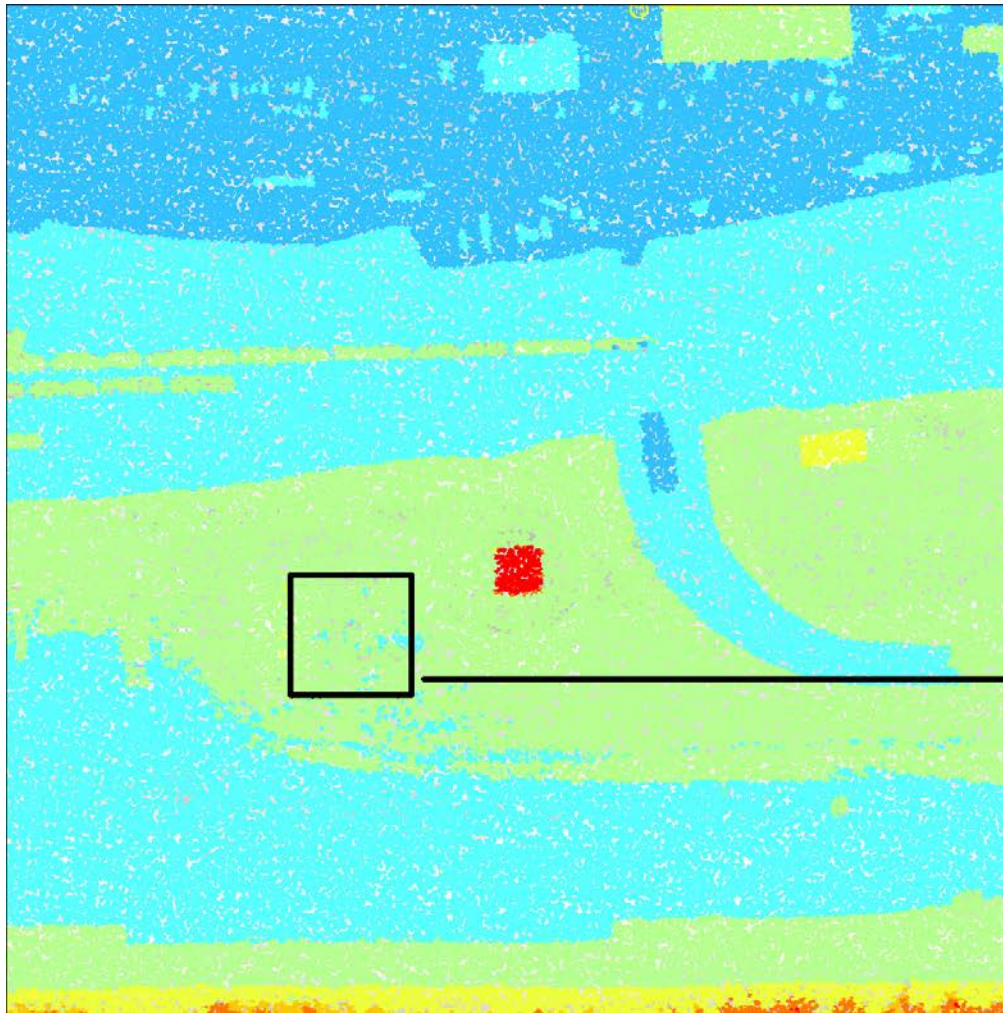


# 3D Point Cloud

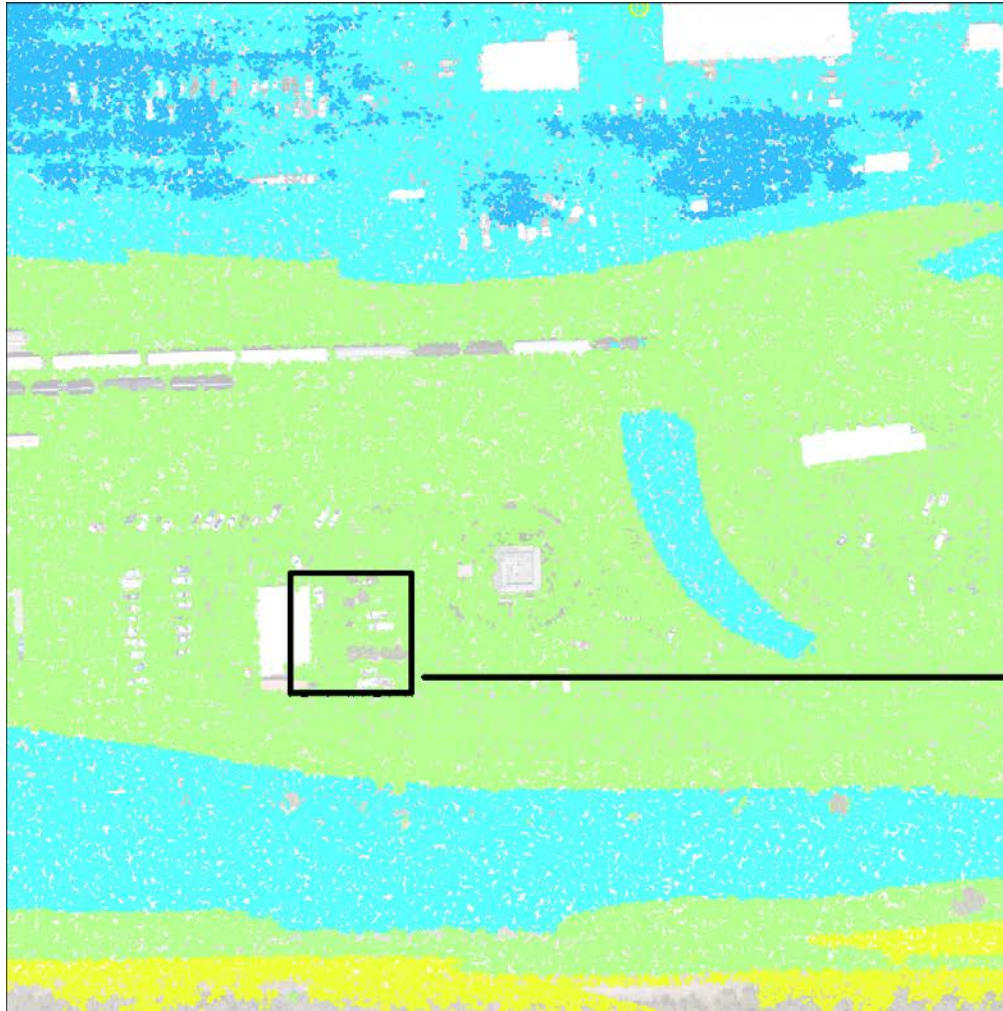
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# View of Point Cloud Data

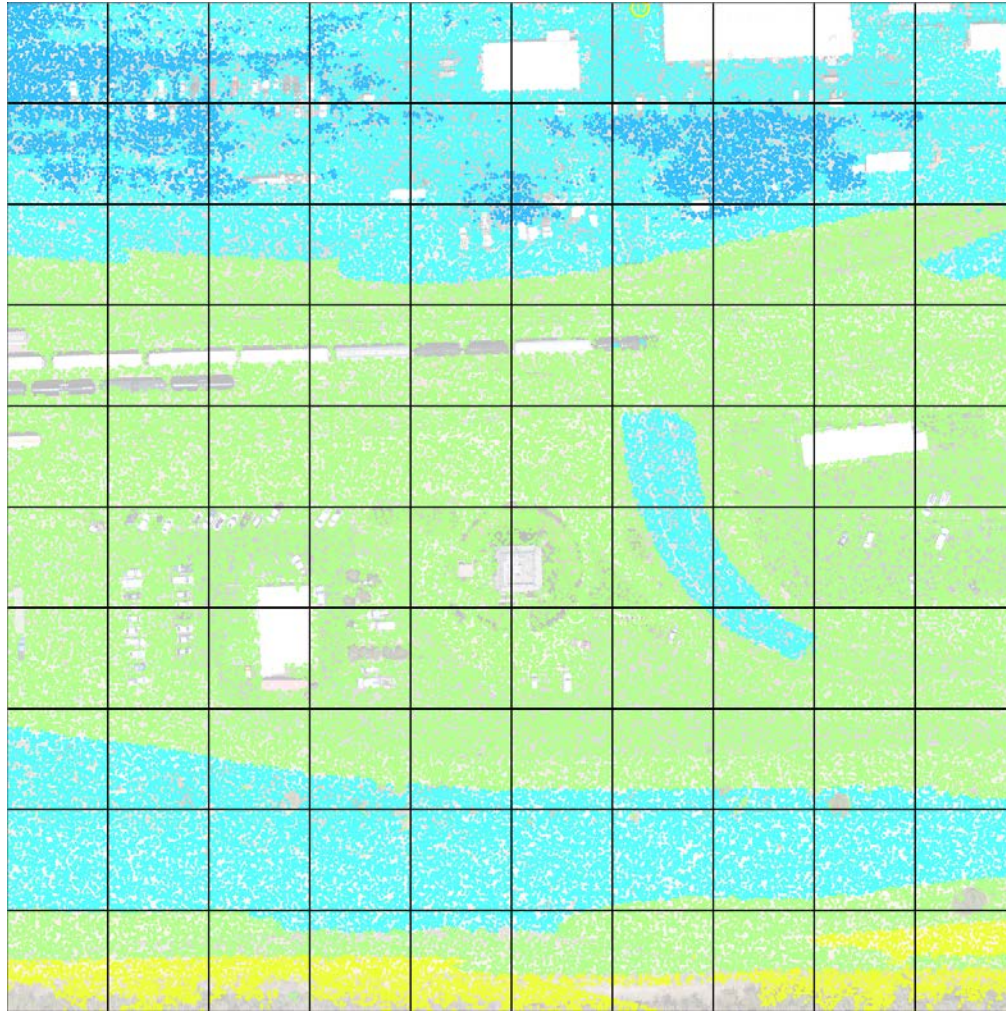


# Remove Cultural & Vegetation

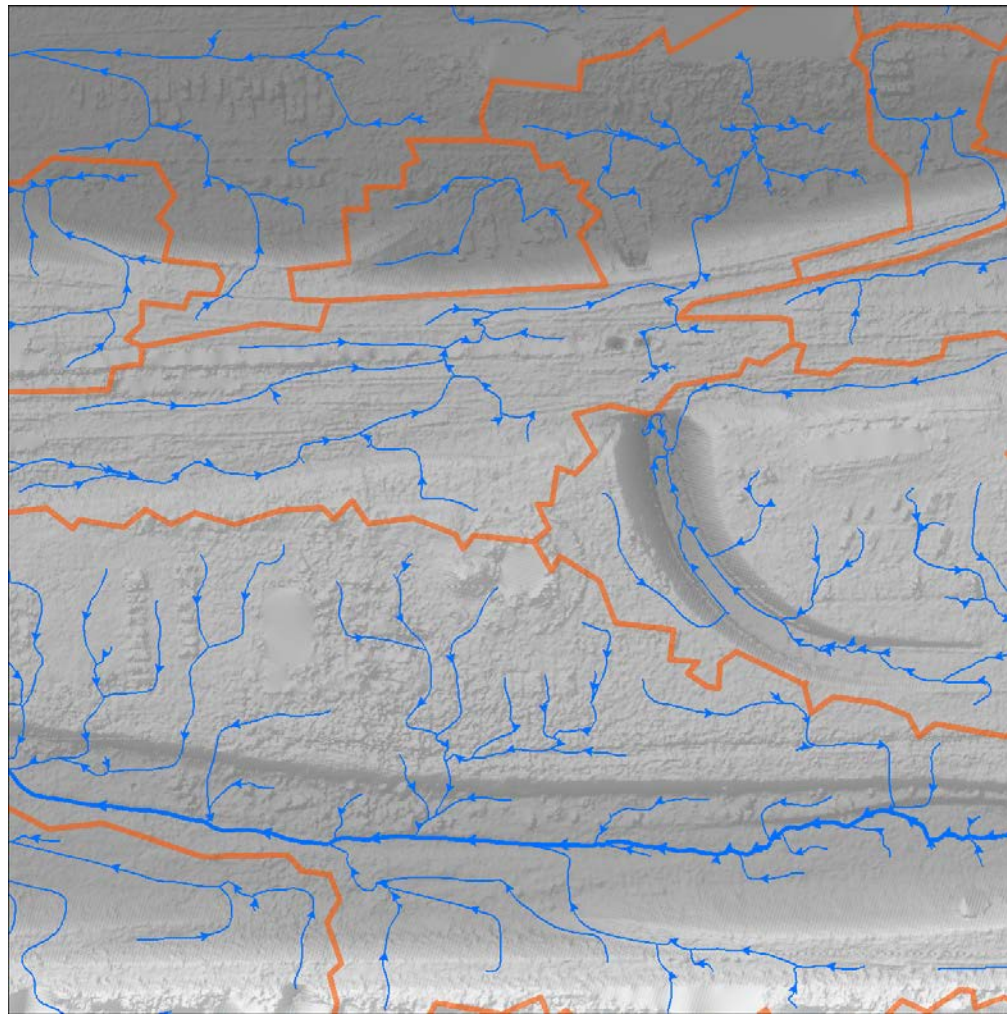


# Convert Points to Grid

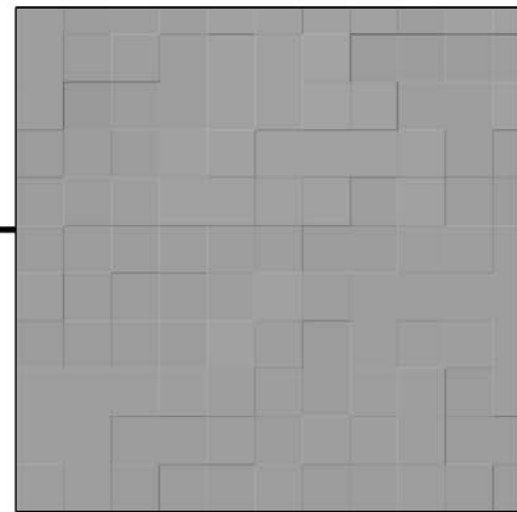
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# Digital Terrain Model



0 4 8 Feet



# Stormwater Mapping Comparison

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OLD ☹️	NEW 😊
Subjective	Objective and calculated (math!)
Incomplete story	Ridiculously complete
Manual	Automated
Static	Adjustable and configurable
Poor resolution	Amazing resolution
No drain inlets	Yes drain inlets
Greater environmental impact	Reduced environmental impact
Expensive(er)	Cheap(er)

# Summary

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## Advantages

- Drone-based survey faster and more cost-effective for data collection
- High resolution data available for multiple applications
  - **BMP Selection, Sizing, and Design**
  - **Engineering design for facility improvements**
  - **Linear Construction Project or Inspections**
  - **Transportation and Right-of-Way (Easement) Mapping**
  - **Hydrology and Hydraulic Design**
- Automation of evaluation process allows for consistent analysis and rapid revisions in response to changes in facility infrastructure

# Summary

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## Limitations/Challenges

- Management of size and complexity of data
- Limited integration of surface and subsurface flow
- Smaller surface flow diversions and linear features (i.e., rails) difficult to model
  - Complicates flow direction evaluation
  - Visual confirmation of flow patterns and diversion structures often required to complete evaluation



# Questions?

**BNSF**  
RAILWAY