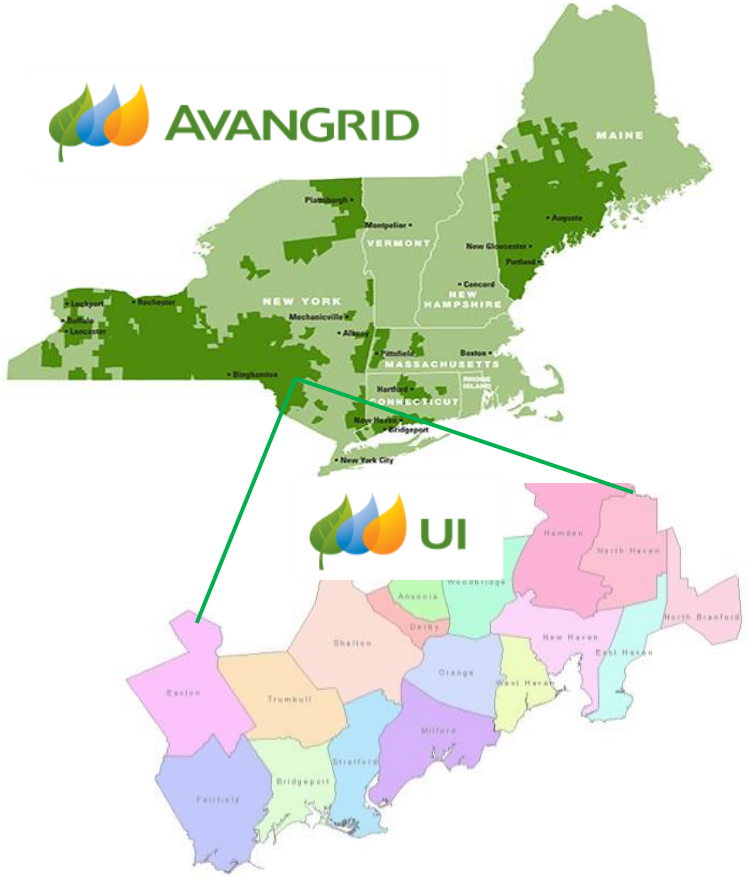
UI Resiliency Program

June 5, 2018

AGENDA

- A Look at Avangrid and UI
- Storm Activity in CT For The Past 7 Years
- Vegetation Management Program
- Step Down Bank Removal Program
- Perimeter Feeder Ties Program
- Coastal Substation Flood Mitigation Program
- Substation Getaway Rebuild Program
- Woodbridge Fuel Cell and Microgrid Project
- Improved Substation Security Measures
- Woodmont Grid Connected Battery Storage Project
- New Damage Assessment Tools
- Question and Answers

A LOOK AT AVANGRID AND UI



AVANGRID

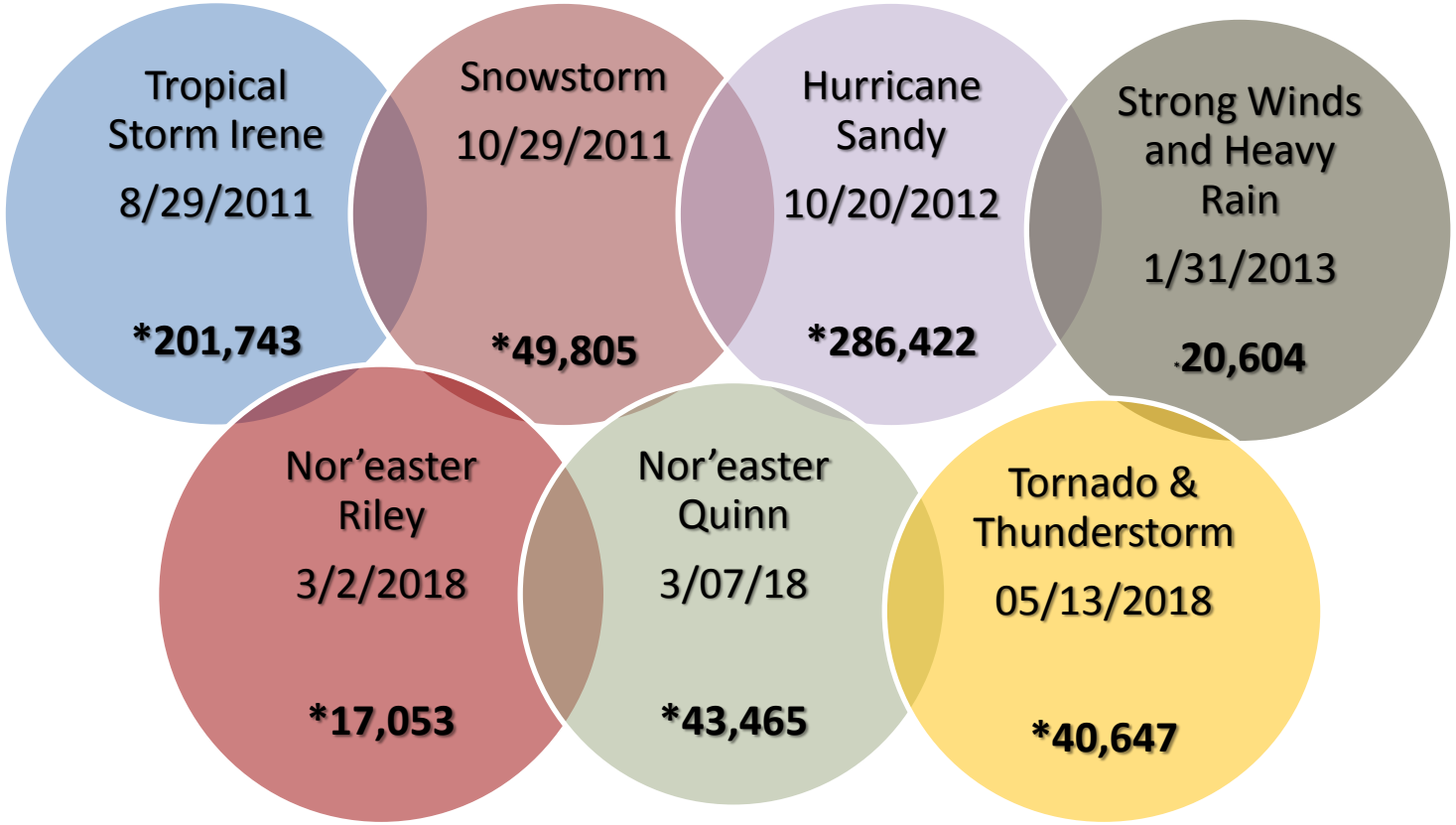
- Avangrid Networks combines the resources and expertise of eight electric and natural gas utilities with an $8.3 billion rate base serving 3.1 million customers in New York and New England.
- Berkshire Gas, Central Maine Power, Connecticut Natural Gas, Maine Natural Gas, New York State Electric & Gas, Rochester Gas & Electric, Southern Connecticut Gas, United Illuminating.

UI

- United Illuminating - Located in Central Coastal Connecticut.
- ~328,000 customers across 17 Municipalities.
- ~335 square miles.
- ~20% of CT's peak electric demand.

MAJOR STORM ACTIVITY IN CONNECTICUT FOR THE PAST 7 YEARS

*Total Meters Affected



VEGETATION MANAGEMENT PROGRAM ($160M OVER 10 YRS.)

- Establish the UPZ around UI's infrastructure.
- UPZ will improve storm resiliency 25-50%.
- Balance customer demand for reliable service with environmental benefits of trees.
- Implement a comprehensive, detailed and flexible plan.

Laws & Regulations

CGS16-234 & Docket No. 12-01-10

- Mandatory Tree Warden and DOT Permits.
- Abutting and Private Property owners may consent, object, or request a modification.
- Appeals of the Tree Warden's decision may be mediated before going to PURA.
- Tree work outside of the public right-of-way requires written consent.
- UPZ is the "starting point".
- Non-hazardous trees may be retained.
- Resolve objections at the local level.

STEP DOWN BANK REMOVAL PROGRAM ($34.5M)

- Convert 13 multi-customer 13.8/4.16 kV step down banks and associated 4.16kV overhead infrastructure to 13.8kV class equipment over a three year period.
- This conversion allows for circuit ties, increase back-up feeder ability, and remove single points of failure.
- Remove remaining 70 Step Down Banks by 2024

COMPLETED IN 2017 - $2.9M	
Location	**Capital Cost**
Stuyvesant Ave. Step Down Bank	$246,502
Grannis Rd. Step Down Bank	$136,262
Arch Str. Step Down Bank	$655,987
Evers Pl. Step Down Bank	$388,285
Branford Rd. Step Down Bank	$741,065

ENGINEERED FOR 2018 - $382,764	
Location	**Capital Cost**
Dunbar Hill Rd. Step Down Bank	$246,502
Orange Ave. Step Down Bank	$136,262

PERIMETER FEEDER TIES PROGRAM ($7.6M)

- Create nine additional feeder ties between substations to add backup capacity and increase resiliency.
- There are locations in the distribution system that are located at outlying portions of the system that do not have 13kV ties to adjacent circuits.
- Allow additional back-up ties to an average of 1,025 customers per location.
- Company completed 4 perimeter feeder ties and 2017 with at total capital spend of $2,369,720.

Done in 2017

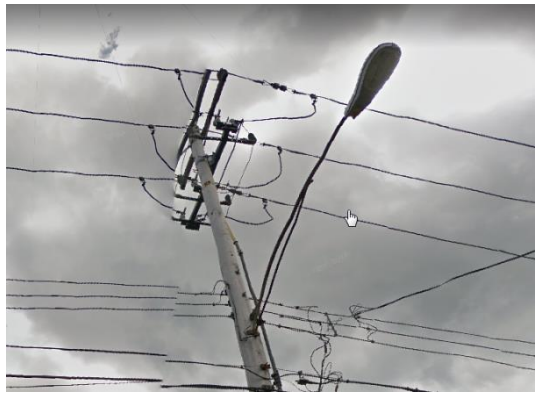
- Meadows End $938,460
- River Rd $218,215
- Fairfield Beach Rd $913,398
- New Haven Ave $299,647

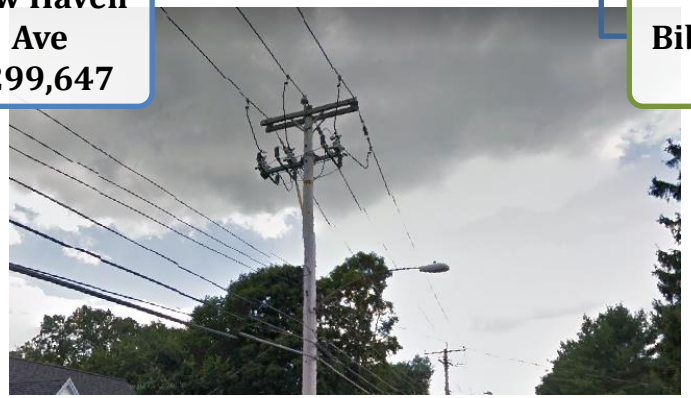
In Progress

- Mill Road
- Totoket Road
- Dunbar Hill Road

In Design

- Sport Hill Rd
- Kings Highway
- Adams Rd
- Bibbons Rd





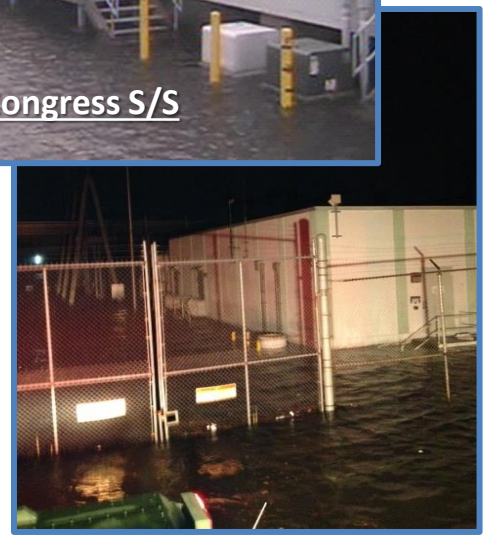
COASTAL SUBSTATION FLOOD MITIGATION PROGRAM ($35M)

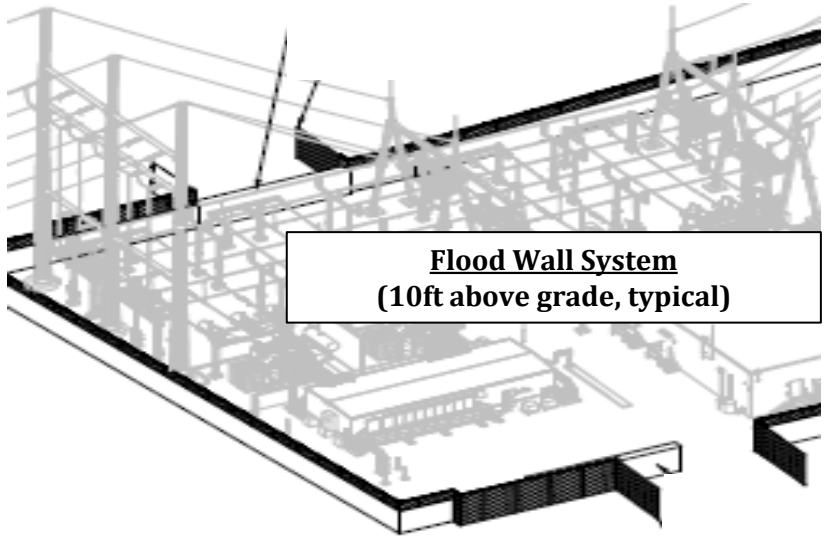
FLOOD MITIGATION

- Raise impacted equipment (individual components).
- Install Perimeter Floodwall System (access gates, pumps, etc.).
- Raise and rebuild adjacent (to existing substation).

UI Coastal Substations		
Substation	**Location**	**Station Type**
Ash Creek	Bridgeport, CT	115/13.8kV Substation
Congress St	Bridgeport, CT	115/13.8kV Substation
Pequonnock	Bridgeport, CT	115/13.8kV Substation
Singer	Bridgeport, CT	345/115kV Substation
East Shore	New Haven, CT	345/115/13.8kV Substation
Grand Ave	New Haven, CT	115kV Switching Station
Mill River	New Haven, CT	115/13.8kV Substation

Began 2017





SUBSTATION GETAWAY REBUILD PROGRAM ($22.7M)

OBJECTIVE:

- Convert overhead aerial cable feeders exiting distribution substations to underground feeders.
- Reduce outage exposure to approximately 15,517 customers by eliminating single point of failure.
- Reduce Pole Loads/Sail Effect.

WOODBRIDGE FUEL CELL AND MICROGRID PROJECT

Project Benefits:

- "Keep the Lights on" during prolonged outages and storm resiliency.
- Installation/operation of fuel cell helps meet RCP Class I renewable goals.
- Brings visibility to UI and Woodbridge as one of the first municipal community microgrids that utilizes fuel cell technology in Connecticut.
- Potential for increased sustainability and a reduced carbon footprint for the Amity School District.
- Gaining essential knowledge in the operational and technical issues associated with islanding a microgrid with inverter based generation.
- UI owned microgrid and generation ensures a safe and reliable operation, eliminates O&M concerns, and ensures seamless billing for the Town of Woodbridge and the Amity School District when in microgrid island mode.

Microgrid Program Summary

- Microgrid must include more than one Critical Facility.
- Program funds to be divided between small, medium, and large municipalities.
- Program funds cannot be used for generation or energy storage.
- Program development is collaborative effort between UI, Eversource, and DEEP.

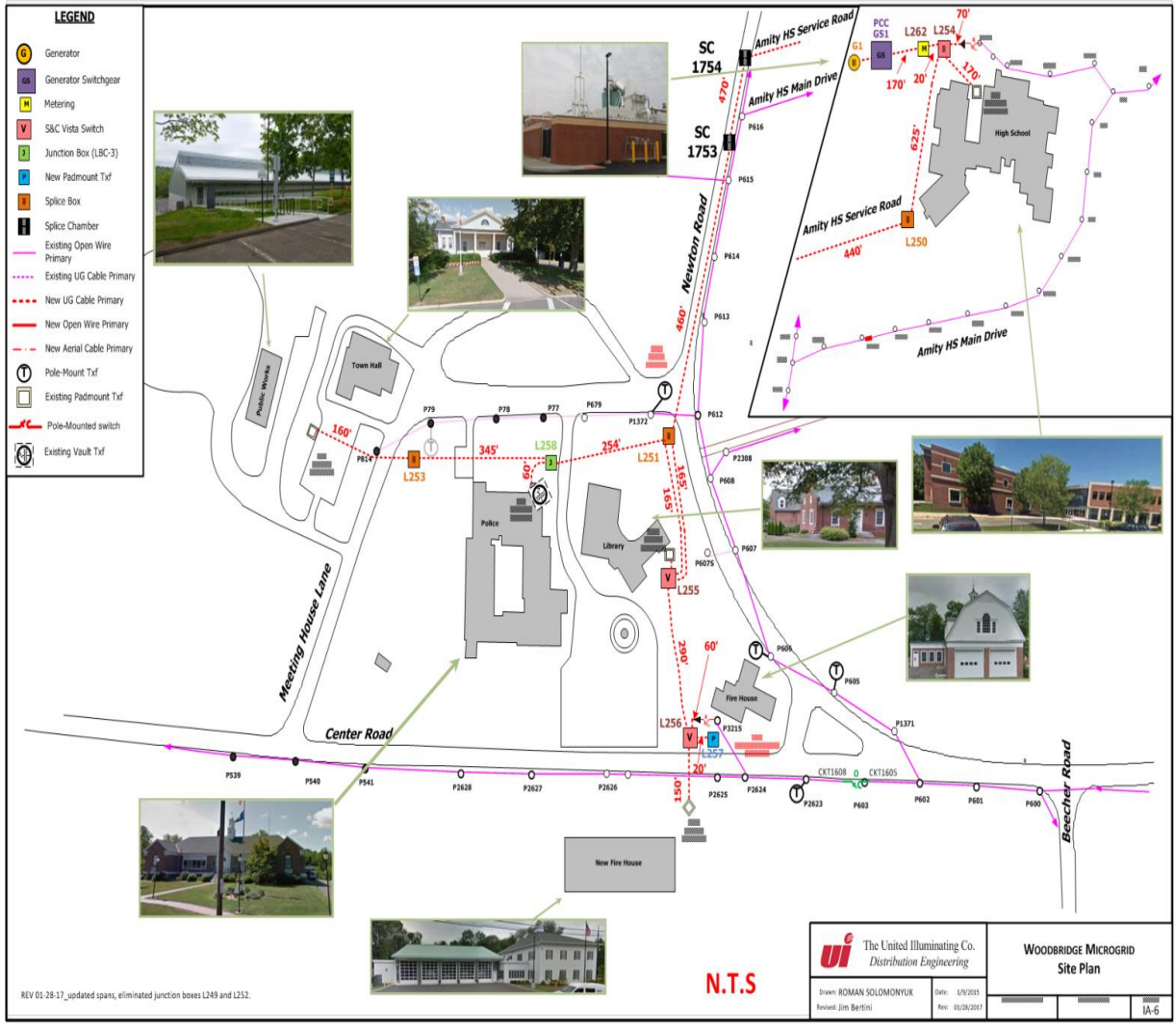
TECHNICAL CHALLENGES–INVERTER BASED MICROGRID GENERATION

- Transition to island mode:
  - Utilize an advanced microgrid controller & load leveler
  - Ability to energize transformers & pick up customer loads
  - Transitions must be made one customer at a time
  - Transition to and from island mode will be 'open transition'.
- Load following:
  - Fuel cells do not have the ability to follow system load changes
  - A load resistive bank (load leveler) is being used to smooth load transition
- Fault locating while in island mode:
  - Fault current issues
  - Additional PQ system required to detect faults
- Operational issues:
  - Fault detection if outage occurs in microgrid mode
  - New equipment and procedures unique to the Woodbridge microgrid
- Introduction of non standard equipment (special order 15kV switches)
- Communications:
  - Fiber optic cables required to connect equipment within the microgrid
  - Wireless communication between microgrid, fuel cell, and UI operations

WOODBRIDGE FUEL CELL AND MICROGRID PROJECT On-line

Progress to Date

- Round 1 (July, 2013) – Awarded $17.9M to 9 projects (UI 3, Eversource 5, Groton 1)
  - Woodbridge Town Center ($3M award)
  - Bridgeport City Hall ($2.97M award)
  - Fairfield – Public Safety ($1.2M award)
- Round 2 (Oct., 2014) – Awarded $5M to 2 Projects both in UI's territory
  - Milford ($2.9M award)
  - University of Bridgeport ($2.18M award)
- Round 3 (Dec., 2015) – $30M of funding available.
  - This Round now includes funding for the generation portion of a microgrid
  - None awarded in UI's territory.
- Round 4 (Sept., 2017 – Dec. 2017) – Applications currently under review
  - CTE&T (located at Bella Vista, New Haven) Application submitted.



IMPROVED SUBSTATION SECURITY MEASURES ($32M)

Install 14-foot tall fences

- Increased height impedes quick penetration thereby prolonging available window for response.
- Privacy slats – Obscures substation equipment from ballistic assault.
- Outward –angled barbed wire at top.

PA System

- Immediate communication to potential intruders.

Add Cameras, Motion Detection & Analytics

- Cameras to cover fence line and control rooms.
  - ✓ Able to detect activities outside and inside the substation.
  - ✓ Infrared imaging provides nighttime coverage.
- Enhanced Motion Detection/Video Analytics.
  - ✓ Improved detection and assessment of activities in and around the substation(s).

Enhanced Signage

- Deterrence.

(vary by substation)

WOODMONT GRID CONNECTED BATTERY STORAGE PROJECT

- Implement a 1.25 MW, 2.5 MWh battery solution that demonstrates the benefits of utility grid side battery storage ownership and operation Pending Regulatory Approval

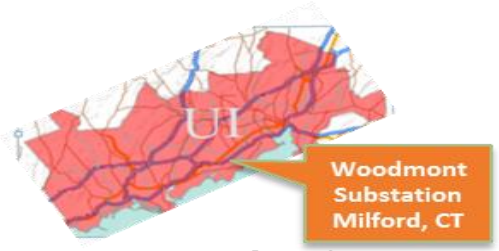
Primary Demonstration Use Cases

- **Peak Load Reduction**: Reduce summer peak load to defer distribution investment
- **Load Shaping**: Initiate daily load shaping/leveling
- **Secondary Use Cases**: Reliability, Hosting Capacity, Market Participation

Goals of Pilot

- Gain operational learning and develop operational protocols for future deployment of grid side battery storage
- Demonstrate the effectiveness of each Use Case

- Project resulted from Connecticut Public Act 15-5, Sec. 103
- Filed proposal with PURA in November 2017
- PURA Opened Docket #17-11-13;
- Moving forward with battery storage RFP in parallel with docket



In Service Date: TBD, ~18 Months after approval

Location: Woodmont Substation, Milford, CT

Estimated Costs

CAPEX: $4.3M
Annual O&M: $.2M

NEW DAMAGE ASSESSMENT TOOLS

Aggregated Outage Reporting

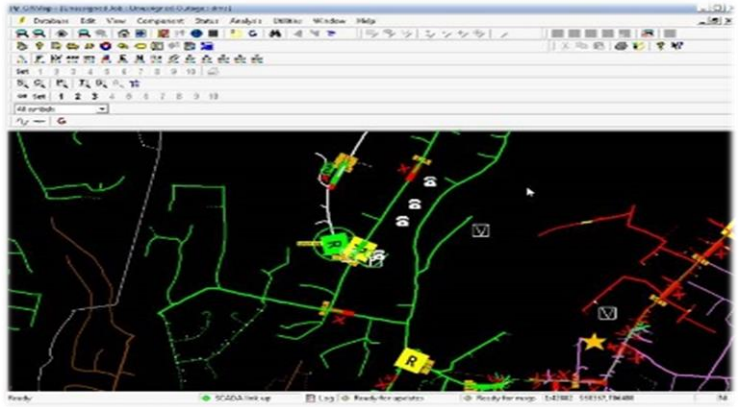
- Digital Customer Experience
- Remote Device Outage Notification

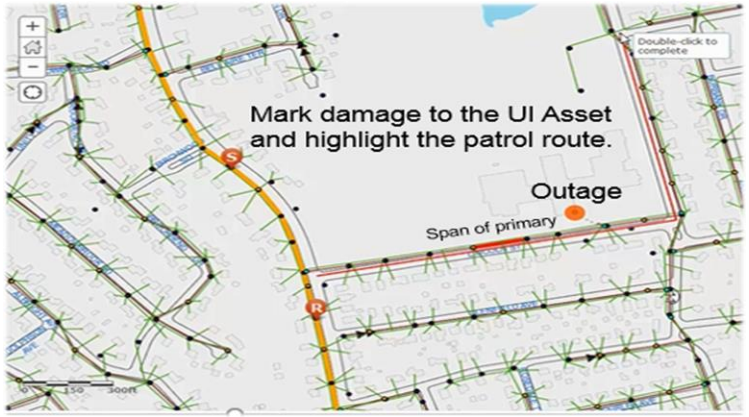
Intuitive Damage Collection

- On-Demand Training
- Mobile Capability
- Real-Time Updates

Efficient Planning and Communication:

- Safe and Achievable Restoration Plan
- Up To Date ETRs





Question & Answer