SESWA

SOUTH CAROLINA

- SPOTLIGHT -

Maximizing the Value of Disaster Recovery Efforts: How to Turn Natural Disaster Pain into Resiliency Gain

May 8, 2025 / 11:00 a.m. – 12:00 p.m.(Eastern)

www.SESWA.org

Today's Presenters

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- Disaster Recovery vs. Resilience Planning
- Helene and its Impacts
- ReWa and Resilience Planning – Pre-Helene
- ReWa Impacts and Post-Helene Response
- Walking through FEMA Public Assistance
- Key Takeaways

Resilience

| rə'zilyəns | *noun*

The ability to anticipate and adapt to changing conditions.....to withstand, respond to, and recover rapidly from disruptions.

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FEMA DISASTER RECOVERY PROCESS

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RESILIENCE VS. DISASTER RECOVERY
HOW THEY COMPARE

Aspect	Resilience	Disaster Recovery
Timing	Before (and during) disaster	After disaster
Approach	Proactive, adaptive	Reactive, restorative
Focus	Mitigation, continuity, adaptability	Restoration, relief, rebuilding
Goal	Minimize impact, maintain service	Return to pre-disaster condition
Examples	Green infrastructure, backup systems	FEMA aid, infrastructure repair

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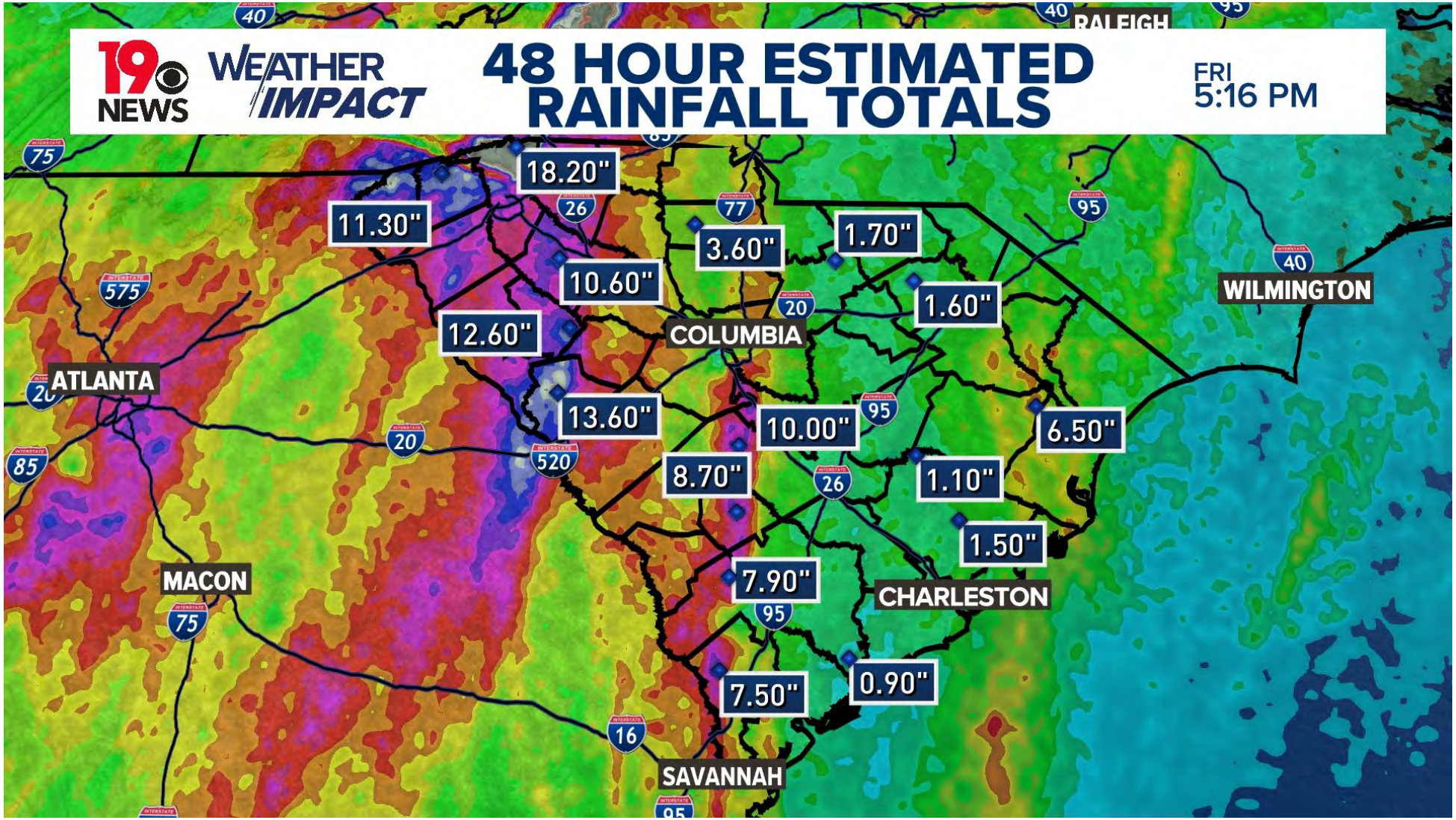
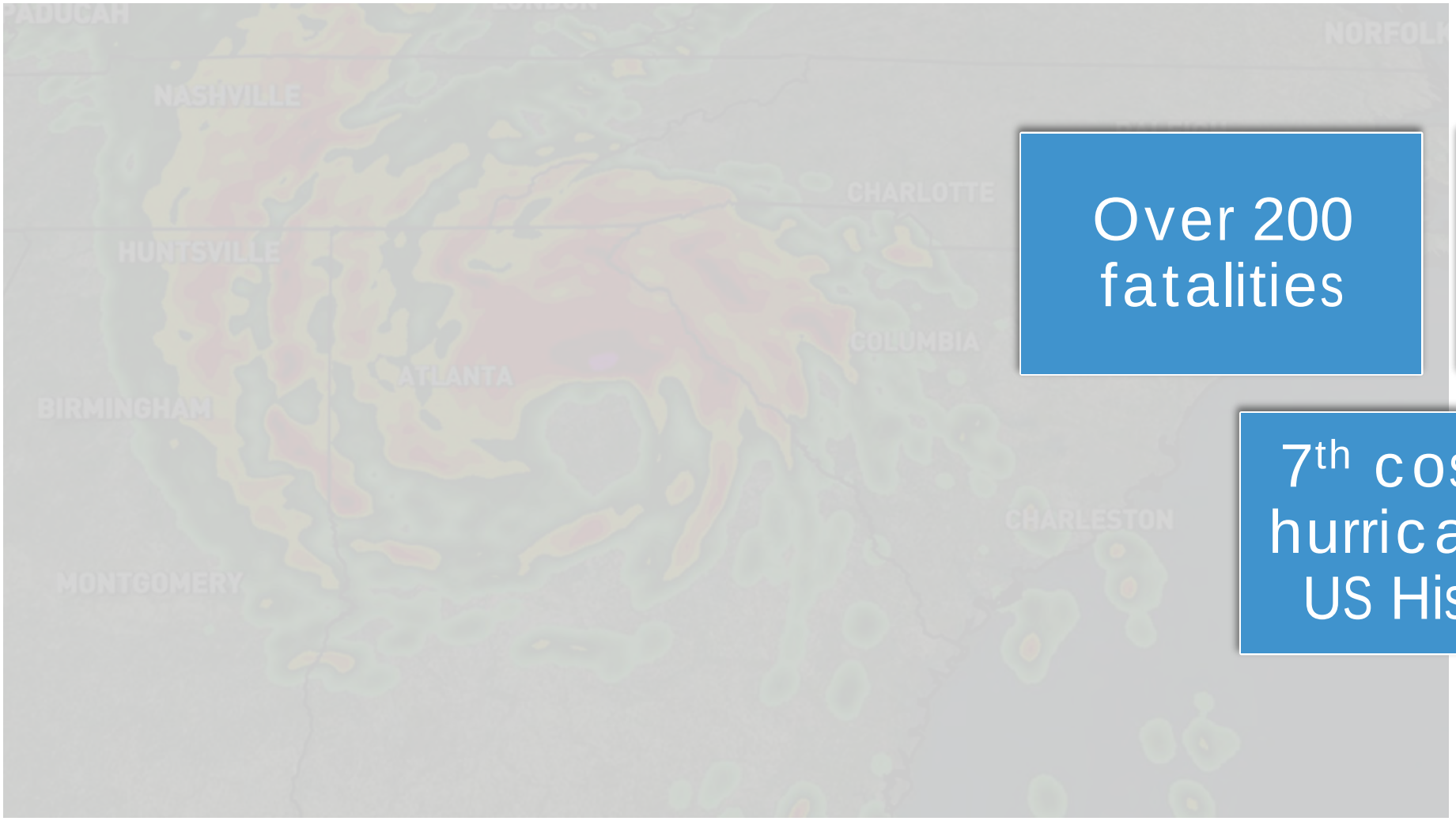
HURRICANE HELENE



HURRICANE HELENE



Over 200 fatalities

$78.7 Billion in damages

7th costliest hurricane in US History

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HURRICANE HELENE IN SOUTH CAROLINA

- 49 confirmed deaths in SC
- Record breaking river levels across the state
- Over 2 million people lost power
- 912 road closures
- More than 2500 homes with major damage or destroyed

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HURRICANE HELENE IN THE UPSTATE

- Significant rainfall and widespread wind damage causing flooding and tree damage
- 70% of the County without power


Crewmembers ponder their strategy to remove this tree down on a road on the south end of Greenville; the tree would flip onto a house if cut, so a crane was called in to pull the tree to a safer area.
SCARNG photo

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HURRICANE HISTORY IN UPSTATE SC

Hugo (1989)

Frances (2004)

Helene (2024)

PEOPLE HAVE SHORT MEMORIES

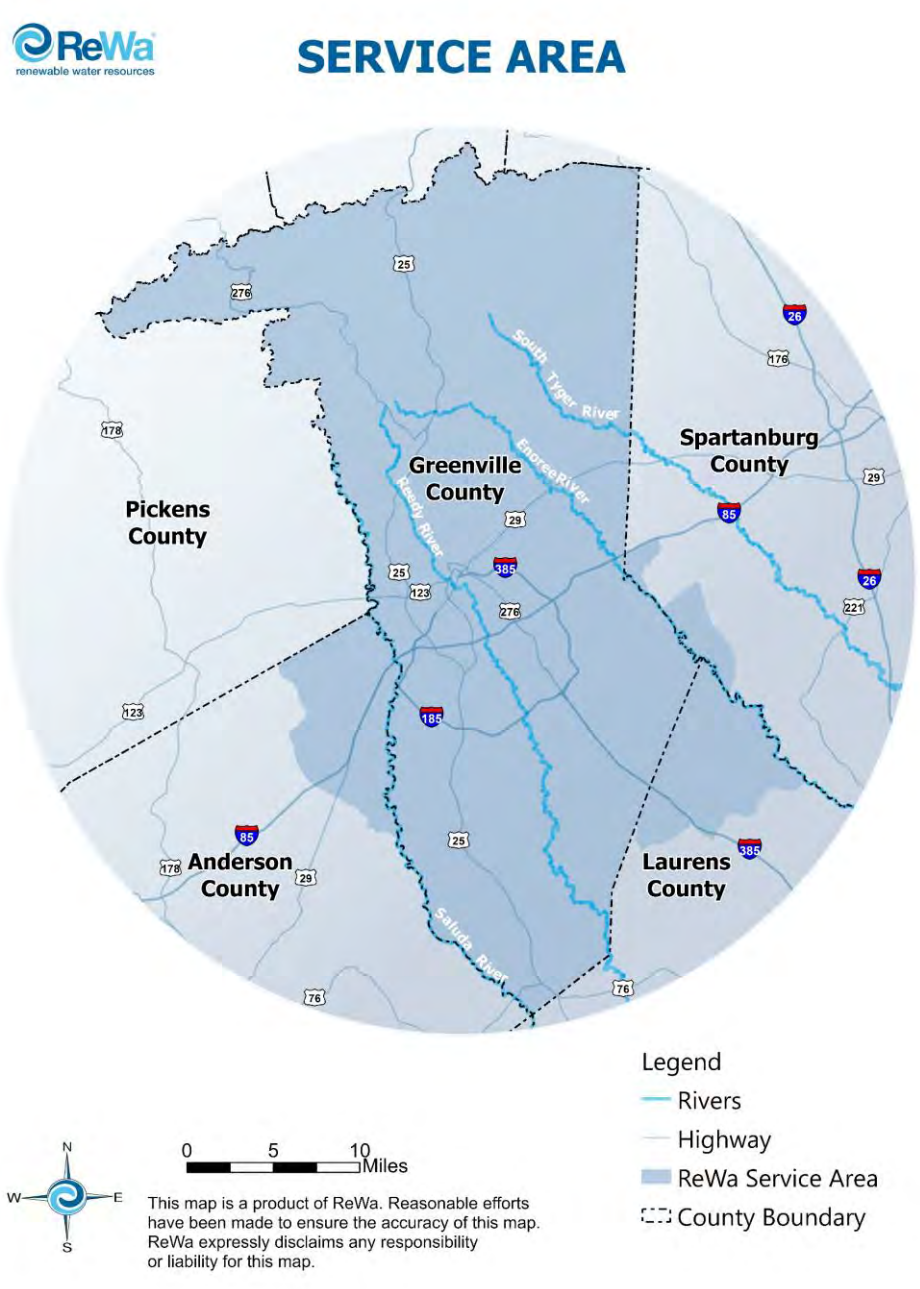
WHO IS REWA

Serves over 162,000 customer accounts – Residential, Commercial, Industrial

- Serving roughly 500k population
- 9 Water Resources Recovery Facilities
  - *89 MGD Permitted Flow*
  - *40 MGD ADF*
- 8 Sewer Subdistricts

Horizontal Assets:

- *919 sq mi service area (238,020 Hectares)*
- *84 Pump Stations*
- *9 Water Resource Recovery Facilities*
- *430+ miles of gravity and force mains (692 kilometers)*



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REWA'S RESILIENCE PLANNING (PRE-HELENE)

STREAMBANK ASSESSMENT & STABILIZATION PROGRAM (SINCE 2019):

- Based on data review, criticality, CMMS integration
- Moved from reactive riprap to natural channel design
- Annual capital funding committed
- Owner's Advisor role added

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THEN CAME HELENE…

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HELENE'S INFRASTRUCTURE IMPACTS ON REWA

- Pump stations overwhelmed or damaged
- Equipment failures at multiple sites
- Service maintained for customers
- Overflow events occurred due to system stress

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FEMA PUBLIC ASSISTANCE PROCESS

DAMAGE ASSESSMENT LOGISTICS

- Internal Staff & External Contractors deploy to assess
  - *Tracking via spreadsheet(s), texting photos to report back*
  - *19 Consultants from 5 Firms*
  - *34 ReWa Staff across 8 Diverse Teams*
- **"Can we get this in GIS?"** – Thursday, October 3, Director of Operations
  - to GIS via Director of Engineering

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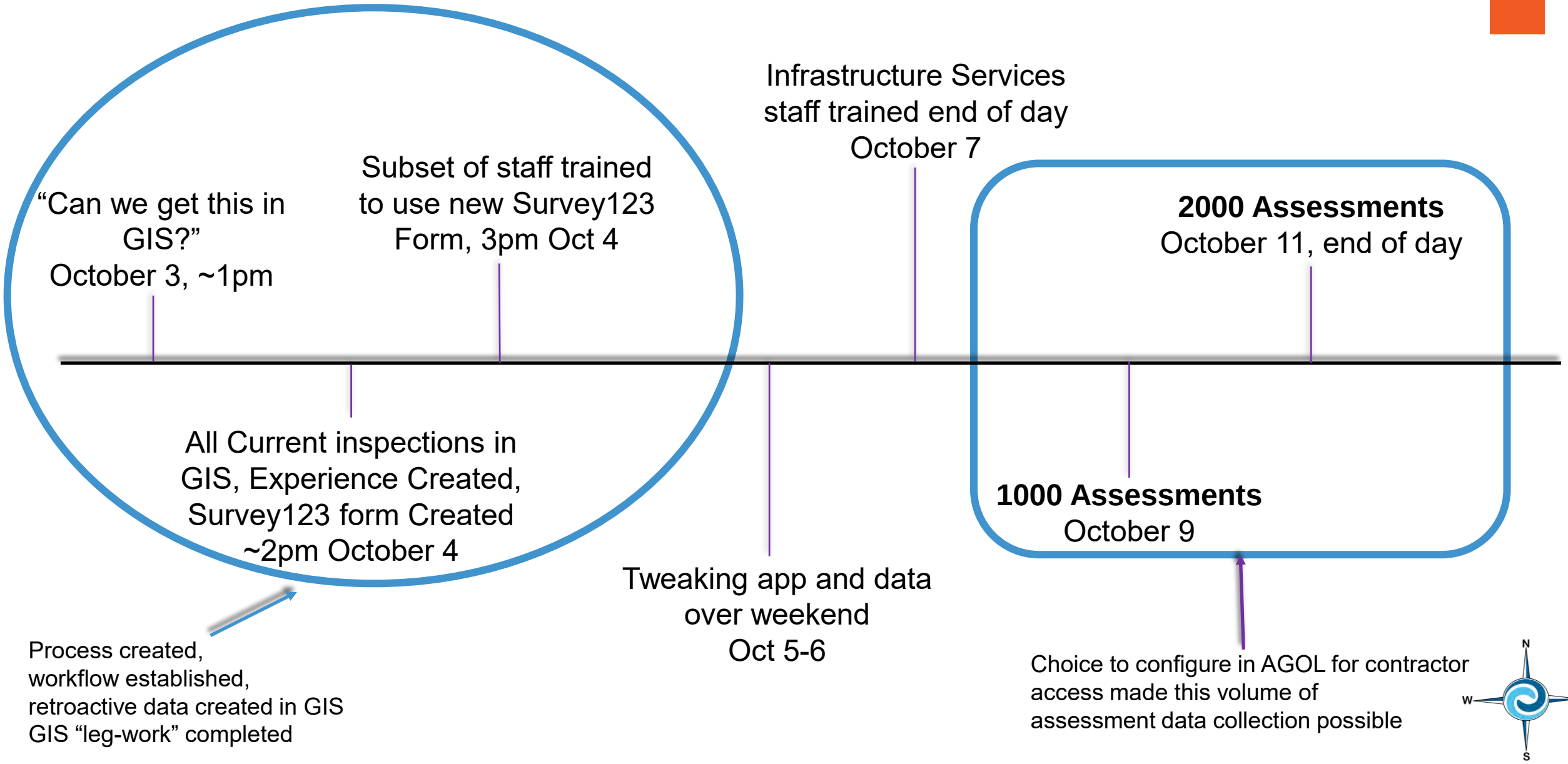
AFTER-ACTION TIMELINE



TYPICAL DAMAGE OBSERVED

Scoured Footings on Support Pillar

Dislodged Manhole Covers

Downed Trees in ROW

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TYPICAL DAMAGE OBSERVED

Scoured Stream Banks Adjacent to ROW

Failed Support Columns

Scoured Banks and Debris Jams

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TYPICAL DAMAGE OBSERVED

Loss of ROW due to stream migration

Slope Failures

Undermining of at-grade crossings

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ReWa Sewer Inspection_Photo View

ReWa Sewer Assessment

Find address or place

W Georgia Rd

300A Lower Reedy

Georgia Rd

Esri Community Maps Contributors, City of Greenville, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US C… Powered by Esri

DAMAGE ASSESSMENT TOOLS & FEMA PROCESS

Used pre/post photos and GIS apps

Completed FEMA worksheets

Identified varying levels of repair

Developed repair cost estimates by site

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STREAM REPAIR TECHNIQUES

Three levels of repair:

- Level 1: Minor grading, coir matting, riparian vegetation
- Level 2: Moderate grading, riprap, minor asset repair
- Level 3: Major stream work and structural asset repair

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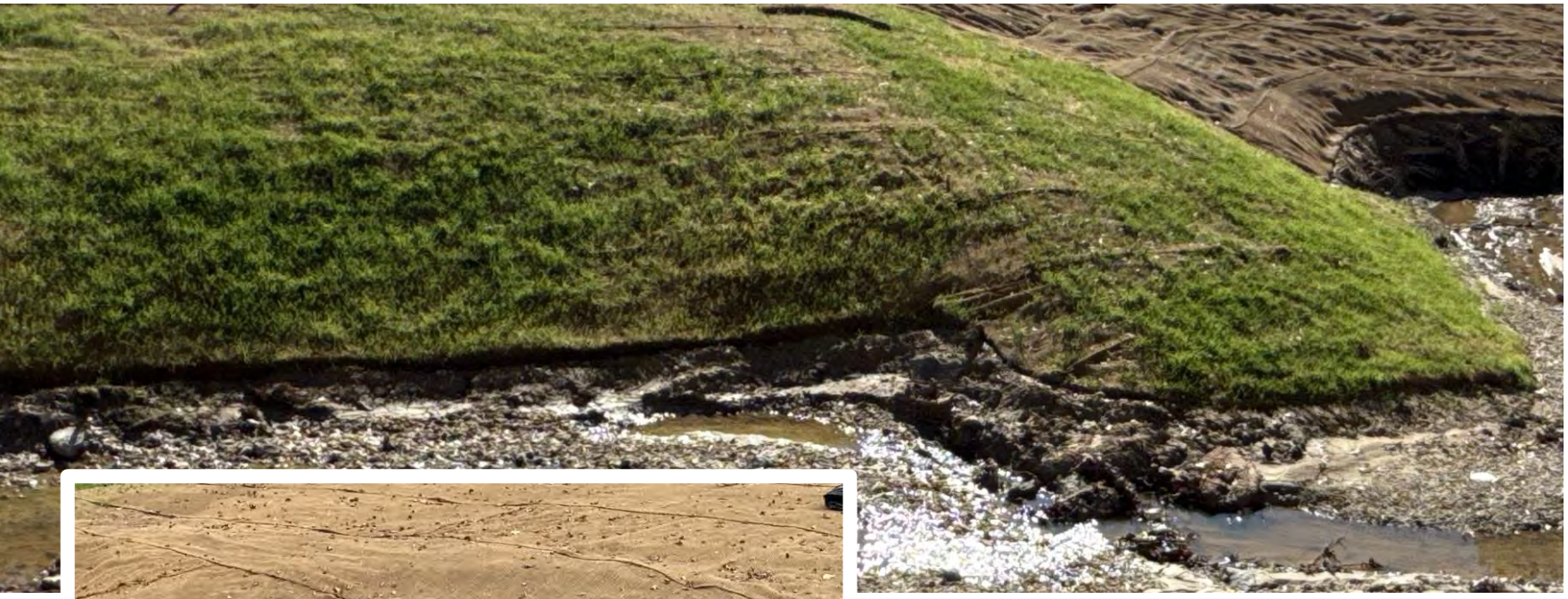
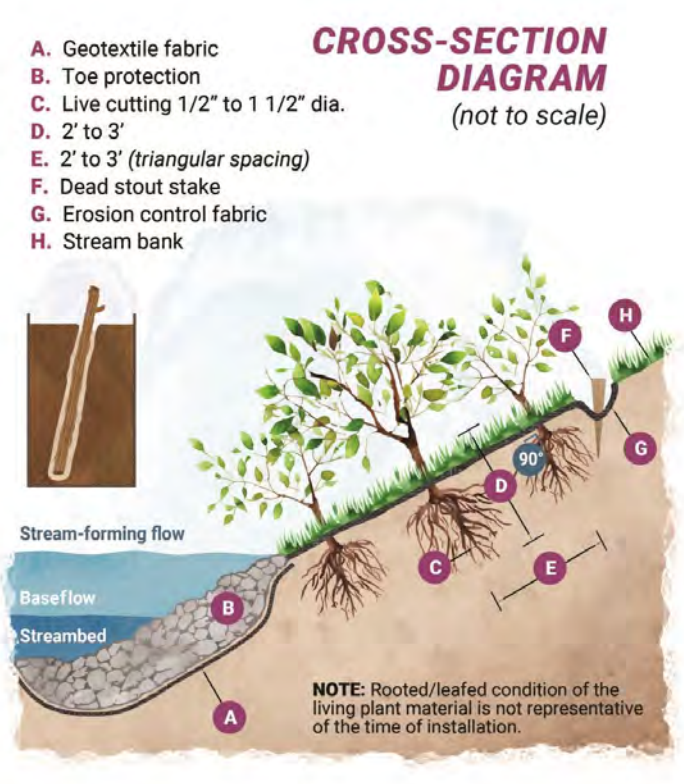
LEVEL 1 REPAIRS





Live Stakes

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LEVEL 2 REPAIRS

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LEVEL 3 REPAIRS

DAMAGE ASSESSMENT PROCESS

[1]Group ID's with the same value represent project areas have been grouped together based on proximity.
[2]Level of Repair Assessment - Description and Assumptions
Level 1 – Minor Channel Bank Grading / Coir Matting Installation / Riparian Vegetation Establishment
Level 2 – Moderate Channel Bank Grading / Riprap Stabilization / Minor Asset Repair
Level 3 – Significant Stream Work To Stabilize Channel and/or Asset Repair
[3]Estimated Cost to Repair ($) – Cost to repair values were calculated using the below assumptions.
Level 1 - $ 241.00
Level 2 - $ 533.00
Level 3 - $ 1,246.00
Per foot cost based upon 2021-2022 unit rates for similar work type performed for ReWa with inflationary adjustment of 16%. A 20% factor was added to account for engineering, permitting, and construction administration/observation.

Budgetary Cost Estimate Analysis (Per Linear Foot)

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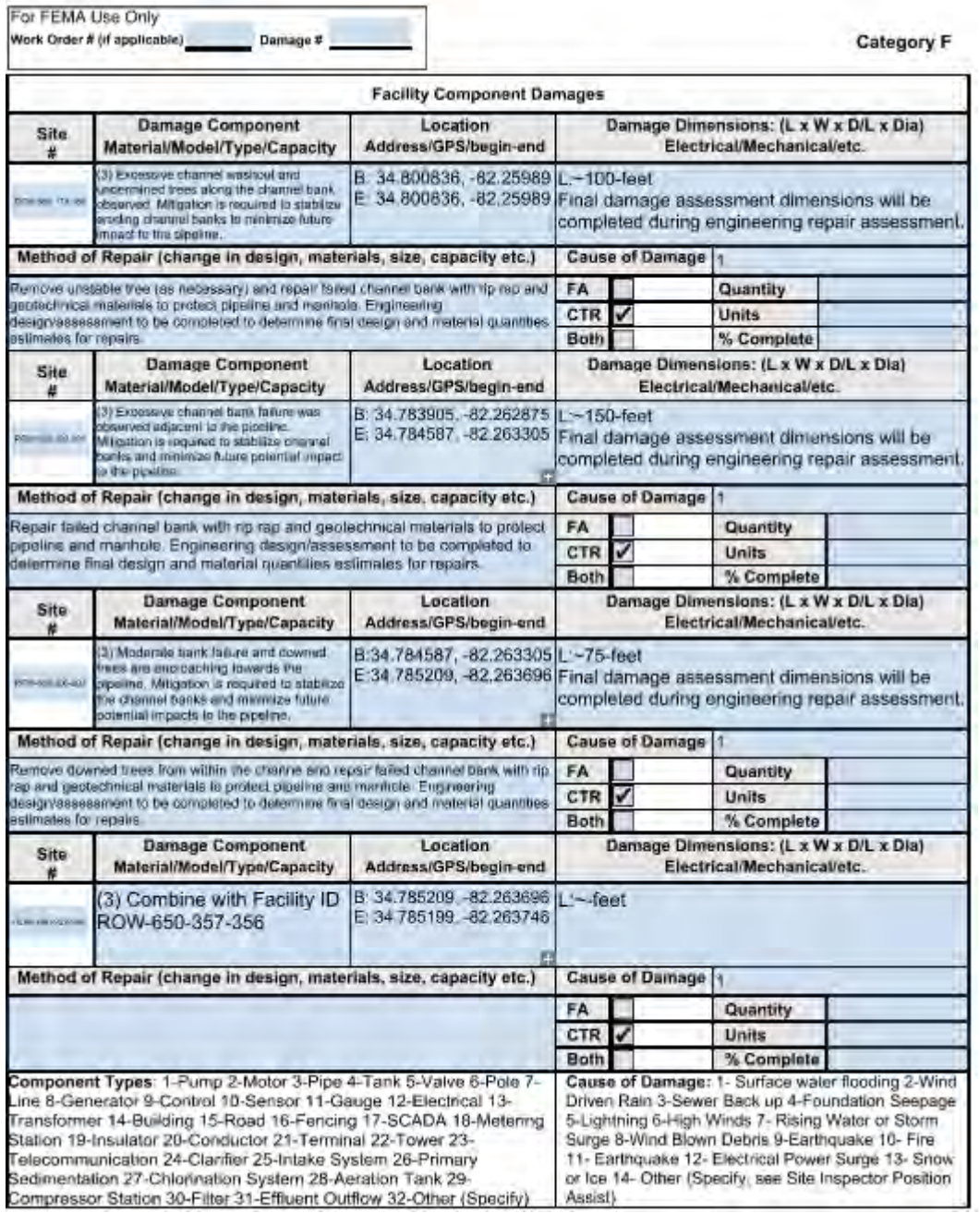
FEMA CAT-F-FORM

Key Information:

- Site Number
- Damaged Component of the System
- Location (Lat./Long.)
- Damage Area Dimensions
- Method of repair (Level 1, 2, 3)
- Cause of Damage (Wind/Flooding)
- Work completed (To-Date)
  - *Temporary*
  - *Permanent*



For FEMA Use Only
Work Order # (if applicable) _____ Damage # _____

Category F

Facility Component Damages

Site #	Damage Component Material/Model/Type/Capacity	Location Address/GPS/begin-end	Damage Dimensions: (L x W x D/L x Dia) Electrical/Mechanical/etc.
[redacted]	(3) Excessive channel washout and undermined trees along the channel bank observed. Mitigation is required to stabilize eroding channel banks to minimize future impact to the pipeline.	B: 34.800836, -82.25989 E: 34.800636, -82.25989	L:~100-feet Final damage assessment dimensions will be completed during engineering repair assessment.

Method of Repair (change in design, materials, size, capacity etc.)	Cause of Damage	1
Remove unstable tree (as necessary) and repair failed channel bank with rip rap and geotechnical materials to protect pipeline and manhole. Engineering design/assessment to be completed to determine final design and material quantities estimates for repairs.	FA ☐	Quantity
	CTR ☑	Units
	Both ☐	% Complete

Site #	Damage Component Material/Model/Type/Capacity	Location Address/GPS/begin-end	Damage Dimensions: (L x W x D/L x Dia) Electrical/Mechanical/etc.
[redacted]	(3) Excessive channel bank failure was observed adjacent to the pipeline. Mitigation is required to stabilize channel banks and minimize future potential impact to the pipeline.	B: 34.783905, -82.262875 E: 34.784587, -82.263305	L:~150-feet Final damage assessment dimensions will be completed during engineering repair assessment.

Method of Repair (change in design, materials, size, capacity etc.)	Cause of Damage	1
Repair failed channel bank with rip rap and geotechnical materials to protect pipeline and manhole. Engineering design/assessment to be completed to determine final design and material quantities estimates for repairs.	FA ☐	Quantity
	CTR ☑	Units
	Both ☐	% Complete

Site #	Damage Component Material/Model/Type/Capacity	Location Address/GPS/begin-end	Damage Dimensions: (L x W x D/L x Dia) Electrical/Mechanical/etc.
[redacted]	(3) Moderate bank failure and downed trees are encroaching towards the pipeline. Mitigation is required to stabilize the channel banks and minimize future potential impacts to the pipeline.	B:34.784587, -82.263305 E:34.785209, -82.263696	L:~75-feet Final damage assessment dimensions will be completed during engineering repair assessment.

Method of Repair (change in design, materials, size, capacity etc.)	Cause of Damage	1
Remove downed trees from within the channel and repair failed channel bank with rip rap and geotechnical materials to protect pipeline and manhole. Engineering design/assessment to be completed to determine final design and material quantities estimates for repairs.	FA ☐	Quantity
	CTR ☑	Units
	Both ☐	% Complete

Site #	Damage Component Material/Model/Type/Capacity	Location Address/GPS/begin-end	Damage Dimensions: (L x W x D/L x Dia) Electrical/Mechanical/etc.
[redacted]	(3) Combine with Facility ID ROW-650-357-356	B: 34.785209, -82.263696 E: 34.785199, -82.263746	L:~-feet

Method of Repair (change in design, materials, size, capacity etc.)	Cause of Damage	1
	FA ☐	Quantity
	CTR ☑	Units
	Both ☐	% Complete

Component Types: 1-Pump 2-Motor 3-Pipe 4-Tank 5-Valve 6-Pole 7-Line 8-Generator 9-Control 10-Sensor 11-Gauge 12-Electrical 13-Transformer 14-Building 15-Road 16-Fencing 17-SCADA 18-Metering Station 19-Insulator 20-Conductor 21-Terminal 22-Tower 23-Telecommunication 24-Clarifier 25-Intake System 26-Primary Sedimentation 27-Chlorination System 28-Aeration Tank 29-Compressor Station 30-Filter 31-Effluent Outflow 32-Other (Specify)

Cause of Damage: 1- Surface water flooding 2-Wind Driven Rain 3-Sewer Back up 4-Foundation Seepage 5-Lightning 6-High Winds 7- Rising Water or Storm Surge 8-Wind Blown Debris 9-Earthquake 10- Fire 11- Earthquake 12- Electrical Power Surge 13- Snow or Ice 14- Other (Specify, see Site Inspector Position Assist)

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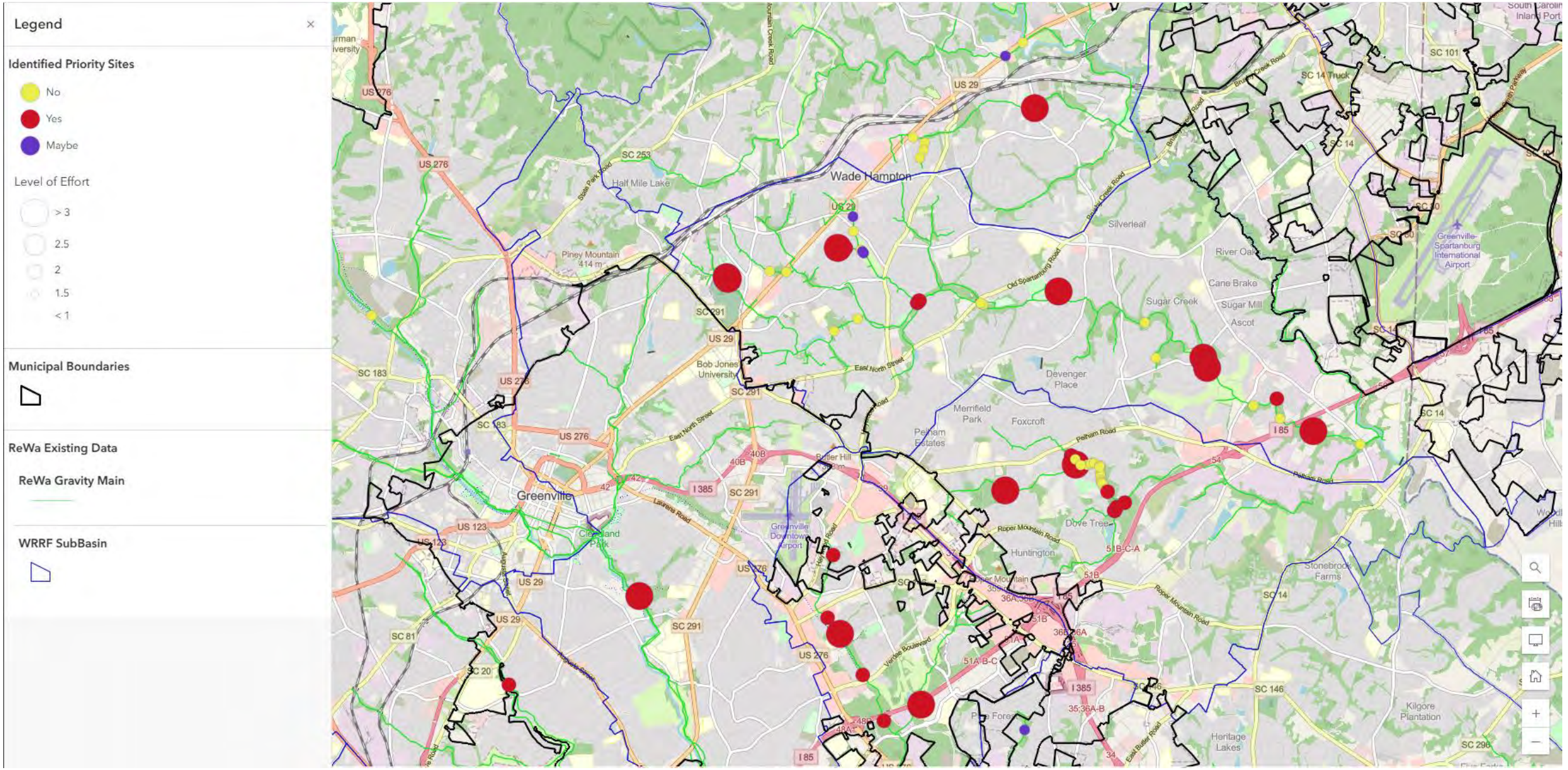
DAMAGE ASSESSMENT PROCESS

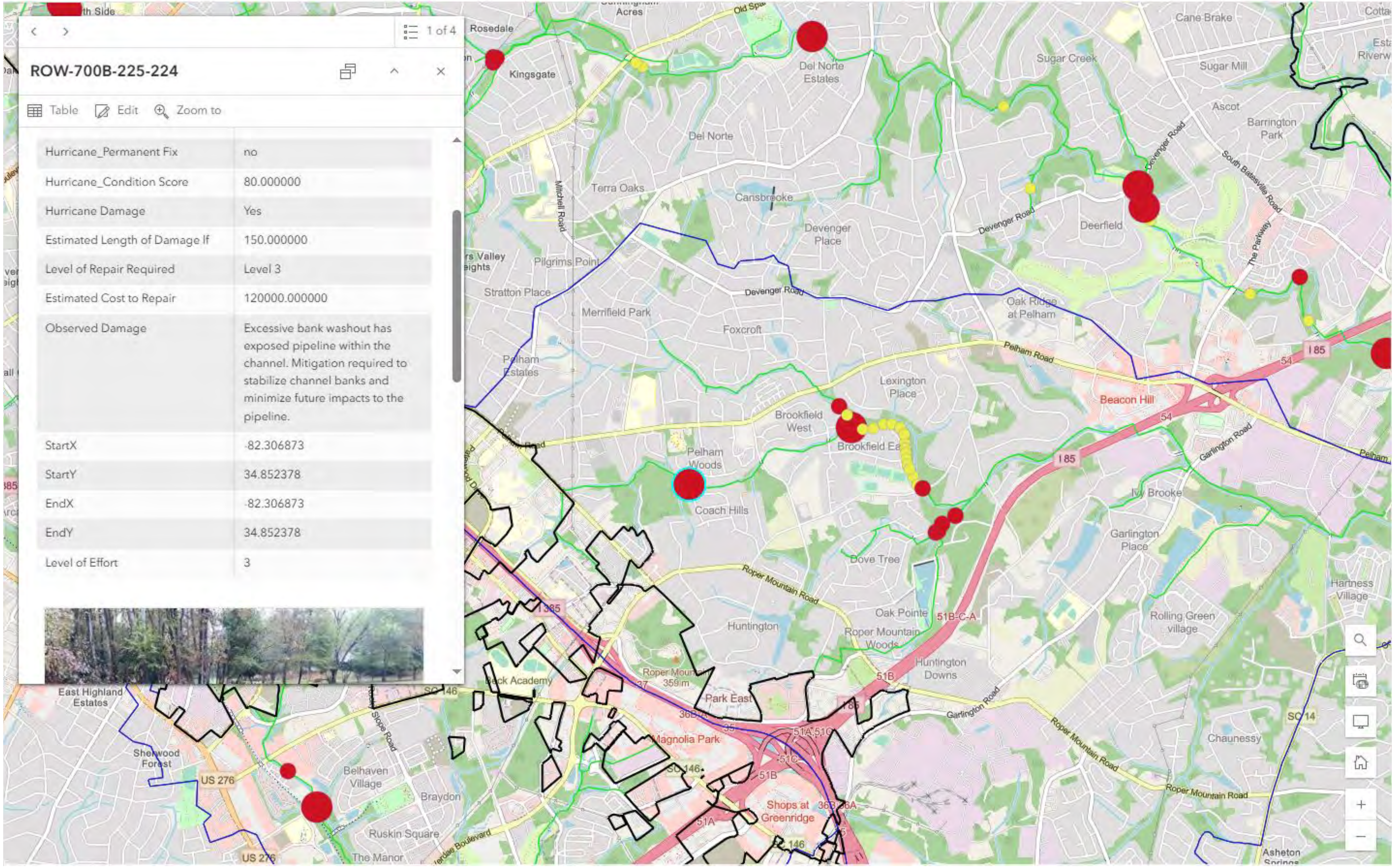
ReWa Assessment Data

- Facility ID
- Pipe Material
- River Basin
- Work Previously Completed (Temporary Repairs)
- Pre-Hurricane Condition Score
- Post-Hurricane Condition Score
- Hurricane Damage Observed (Yes or No)
- Estimated Length of Damage
- Level of Repair Required (Level 1, 2, or 3)
- Budgetary Cost Estimate
- Damage Observation Notes

FacilityID	Material	River Basin	Hurricane_Perman	PreHurricane C	Hurricane_Condition Score	Hurricane Damage	Estimated Length	Level of Repair Required	Adjusted Cost (Includes Mo	Observed Damage
ROW-300B-77-76	CON	Reedy Basin	no	80	60	Yes	110	Level 2	$87,945	(3) Channel bank failure was observed adjacent to the pipeline. Channel washout will continue to migrate towards the pipeline unless mitigation measures are implemented to stabilize channel banks.
ROW-400A-147-146	CON	Reedy Basin	no	82	80	Yes	50	Level 3	$93,450	(3) Aerial crossing concrete pillar has been undermined and collapsed into the channel. Concrete pillar should be reset and stream bed stabilized to mitigate against future failure of the pipeline.
ROW-400A-149-148	CON	Reedy Basin	no		36	Yes	25	Level 1	$9,038	(3) Downed trees observed within the ROW obstructing access and maintenance.
ROW-400B-283-282	CL	Reedy Basin	no	79	49	Yes	150	Level 2	$119,925	(3) Significant bank failure was observed and washout migrating towards the pipeline. Mitigation measures are required to stabilize the channel bank to minimize future potential impacts to the pipeline.
ROW-400C-515-514	DIP	Reedy Basin	no	87	84	Yes	50	Level 3	$93,450	(3) Aerial crossing has been impacted by failing channel banks. Channel banks are continuing to washout threatening to destabilize pipeline crossing. Mitigation required to stabilize channel banks within the ROW to prevent future impacts to the crossing.
ROW-400D-32-31	CL	Reedy Basin	yes	68	61	Yes	150	Level 1	$54,225	(3) Moderate bank failure was observed and washout migrating towards the pipeline. Mitigation measures are required to stabilize the channel bank to minimize future potential impacts to the pipeline.

PRE- & POST-DAMAGE ASSESSMENT TOOL





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ROW-700B-225-224

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Hurricane_Permanent Fix	no
Hurricane_Condition Score	80.000000
Hurricane Damage	Yes
Estimated Length of Damage lf	150.000000
Level of Repair Required	Level 3
Estimated Cost to Repair	120000.000000
Observed Damage	Excessive bank washout has exposed pipeline within the channel. Mitigation required to stabilize channel banks and minimize future impacts to the pipeline.
StartX	-82.306873
StartY	34.852378
EndX	-82.306873
EndY	34.852378
Level of Effort	3

1 of 4

ROW-700B-225-224

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SUMMARY OF IMPACTS

- ~6,500 linear feet of ROW Impacted
- 3 aerial pipeline crossings suffered structural damage to supports
- 6 pipeline exposures (~750 linear feet of pipe)
- ~300 linear feet of pipe uplifted and had to be replaced
- Tons of debris (downed trees) blocking ROW
- Total Damage Estimate (Stream/ROW Only)
  - ~$8 – $10 Million

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THE RESULTS OF THE DISASTER TEST FOR REWA....

- Tested resilience approach
- Immediate cross-department response
- Rapid field assessments covered miles of ROW
- 3 emergency repairs (500+ linear feet)
- More bank failures identified

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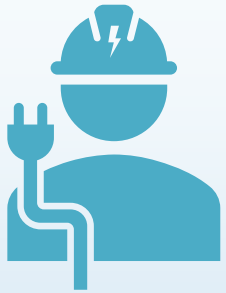
KEY TAKEAWAYS

Pre-disaster inspection/photos essential

Field staff stream knowledge improves risk mitigation

Natural channel designs = sustainable & cost-effective



Repairs must balance urgent needs & long-term resilience

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