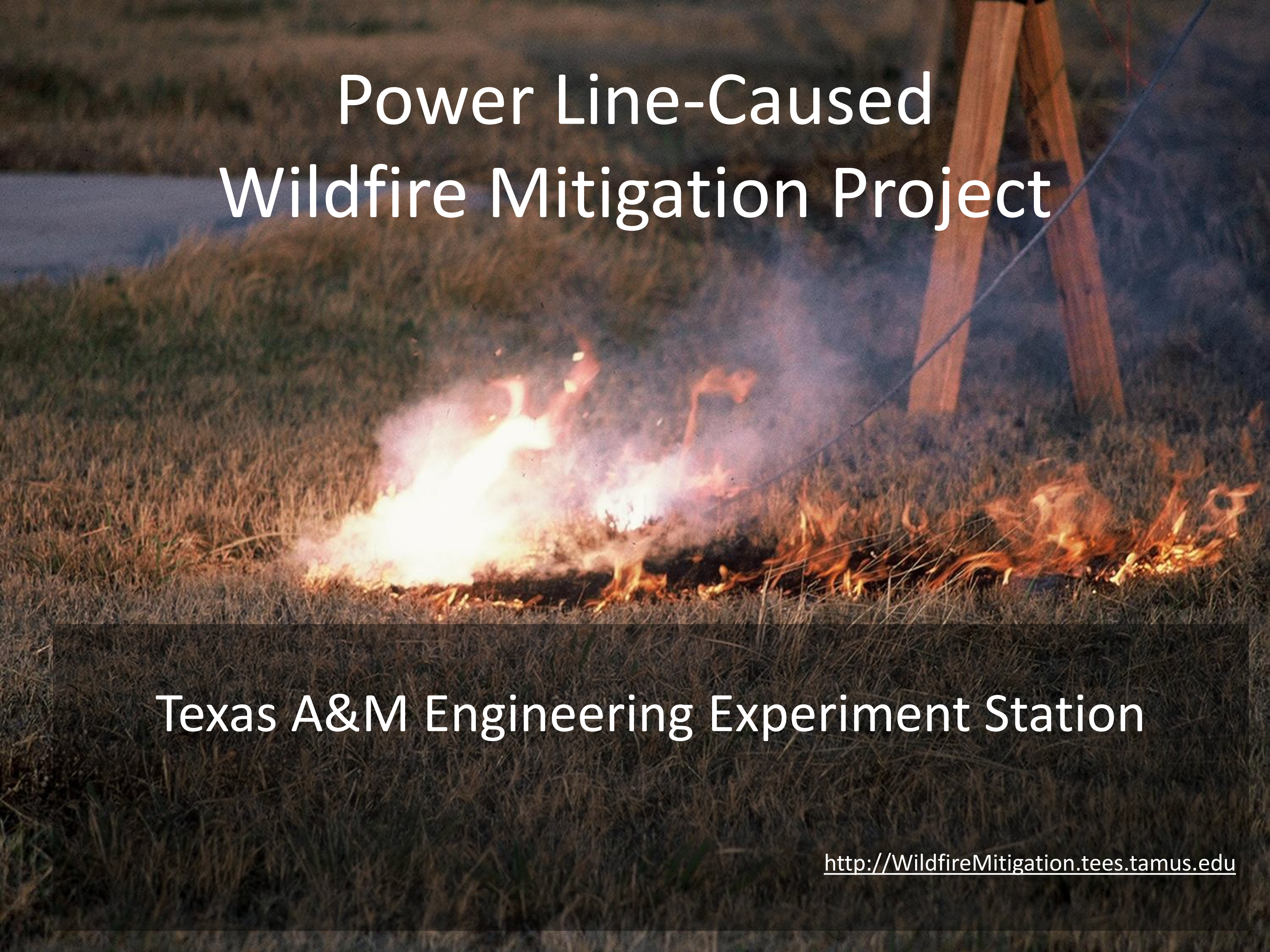


Power Line-Caused Wildfire Mitigation Project

Texas A&M Engineering Experiment Station

http://WildfireMitigation.tees.tamus.edu

Texas Wildfire Mitigation Project

Reducing the Risk of Wildfires Caused by Power Lines

Project Meeting Agenda

Thursday, December 12, 2013, Austin TX

10:00	Welcome and Introductions Representative John Otto
10:10	State Emergency Management Perspective Nim Kidd, Chief, Texas Division of Emergency Management
10:20	The Problem and the Opportunity Dr. B. Don Russell, Regents Professor, Texas A&M Engineering Experiment Station (TEES)
10:30	TFS Wildfire Risk Assessment Overview Tom Boggus, Director, Texas A&M Forest Service (TFS)
10:45	TEES Power Line Monitoring Technology Overview Carl L. Benner, Asst. Director, Power System Automation Laboratory, TEES
11:10	Project Methodology, Dr. B. Don Russell Discussion of Utility Participation
11:20	Q&A and Discussion, Dr. B. Don Russell
11:50	Next Steps, Dr. B. Don Russell
Noon	Adjourn

Texas Wildfire Mitigation Project

Reducing the Risk of Wildfires Caused by Power Lines

Introductions

Meeting Chair

John Otto, State Representative, District 18

Meeting Co-Hosts

Donna Howard, State Representative, District 48

Kyle Kacal, State Representative, District 12

Tim Kleinschmidt, State Representative, District 17

John Raney, State Representative, District 14

Kel Seliger, State Senator, District 31

State Agencies

Texas Division of Emergency Management

Public Utility Commission of Texas

Texas A&M Forest Service

Texas A&M Engineering Experiment Station

Texas Wildfire Mitigation Project

Reducing the Risk of Wildfires Caused by Power Lines

State Emergency Management Perspective

Nim Kidd, Chief

Texas Division of Emergency Management

Texas Wildfire Mitigation Project

Reducing the Risk of Wildfires Caused by Power Lines

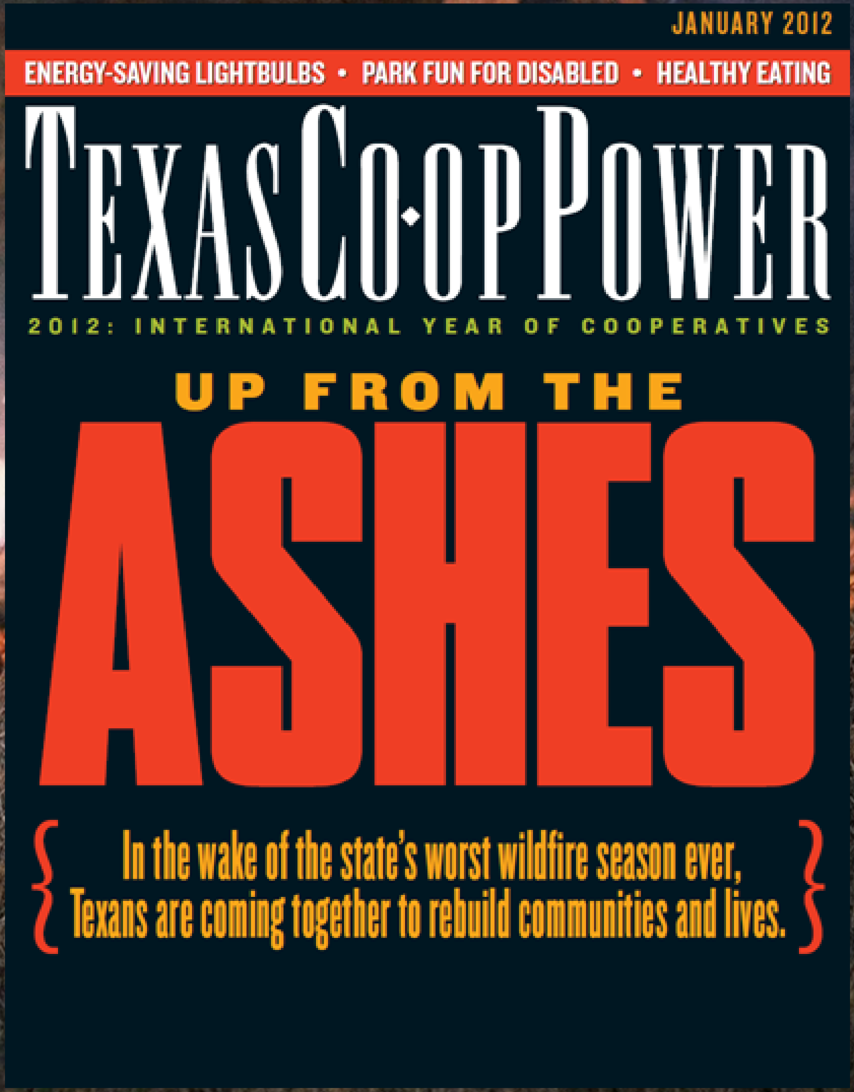
The Problem and the Opportunity

Dr. B. Don Russell, Distinguished Professor
Texas A&M Engineering Experiment Station

Vision Statement

To reduce wildfire risk and losses in Texas, using state-developed technologies to mitigate power line-caused wildfires.

Power Line-Caused Wildfire Mitigation



Wildfire Mitigation

The Problem

- In 3-1/2 years, more than 4,000 power line-caused wildfires have occurred in Texas, destroying more than 1,000 square miles. (Examples: Bastrop, Steiner Ranch)

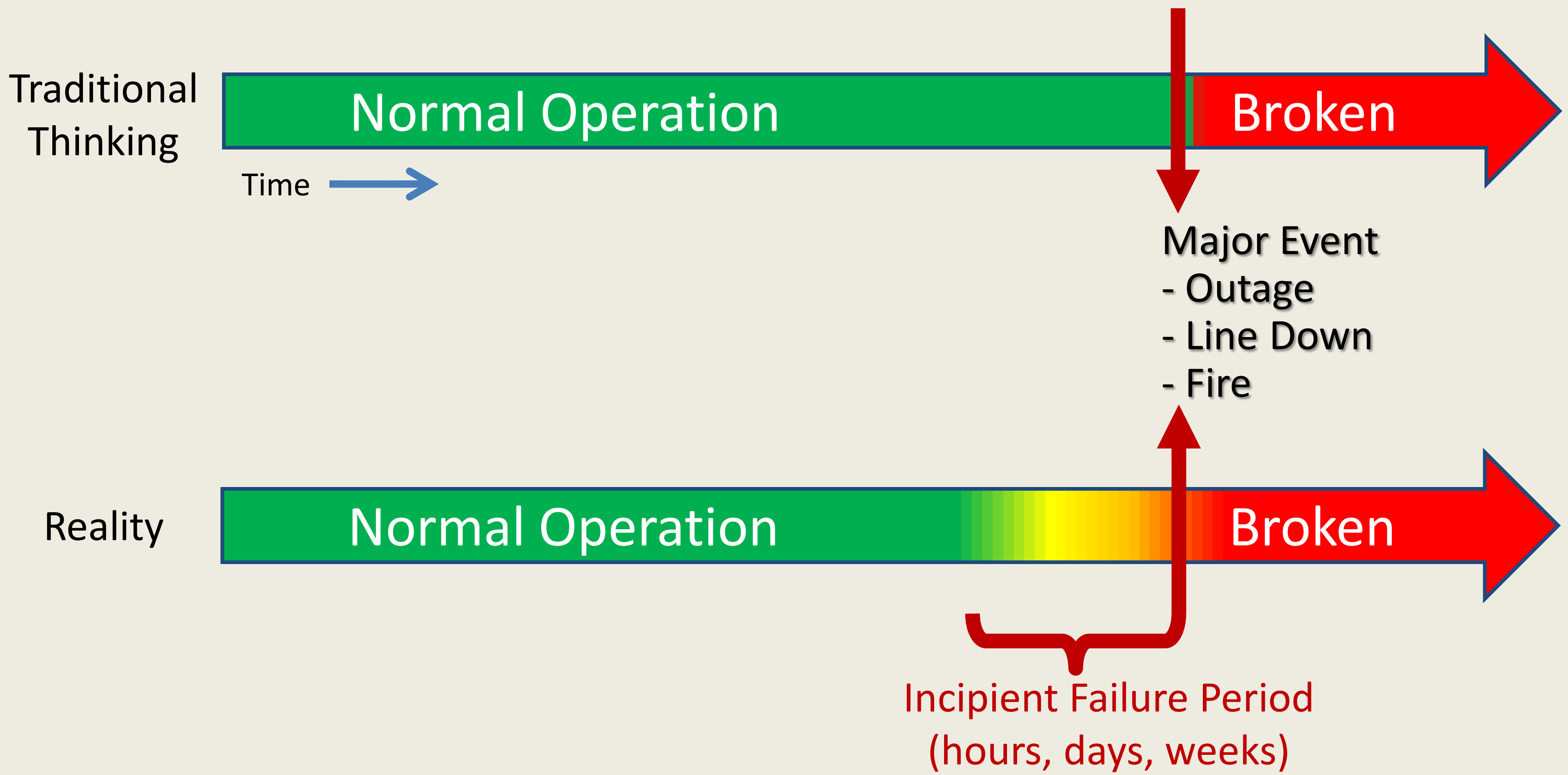
The Solution

- TEES has developed technology to detect power line ignition sources caused by apparatus failures and downed lines.
- TFS has developed technology to provide real-time geographic assessment of wildfire risk.

The Strategy

- Select utility partners and execute large-scale demonstration.

Electrical Feeder Operational Paradigms



Imagine detecting incipient failures and making repairs <u>before</u> major events occur.

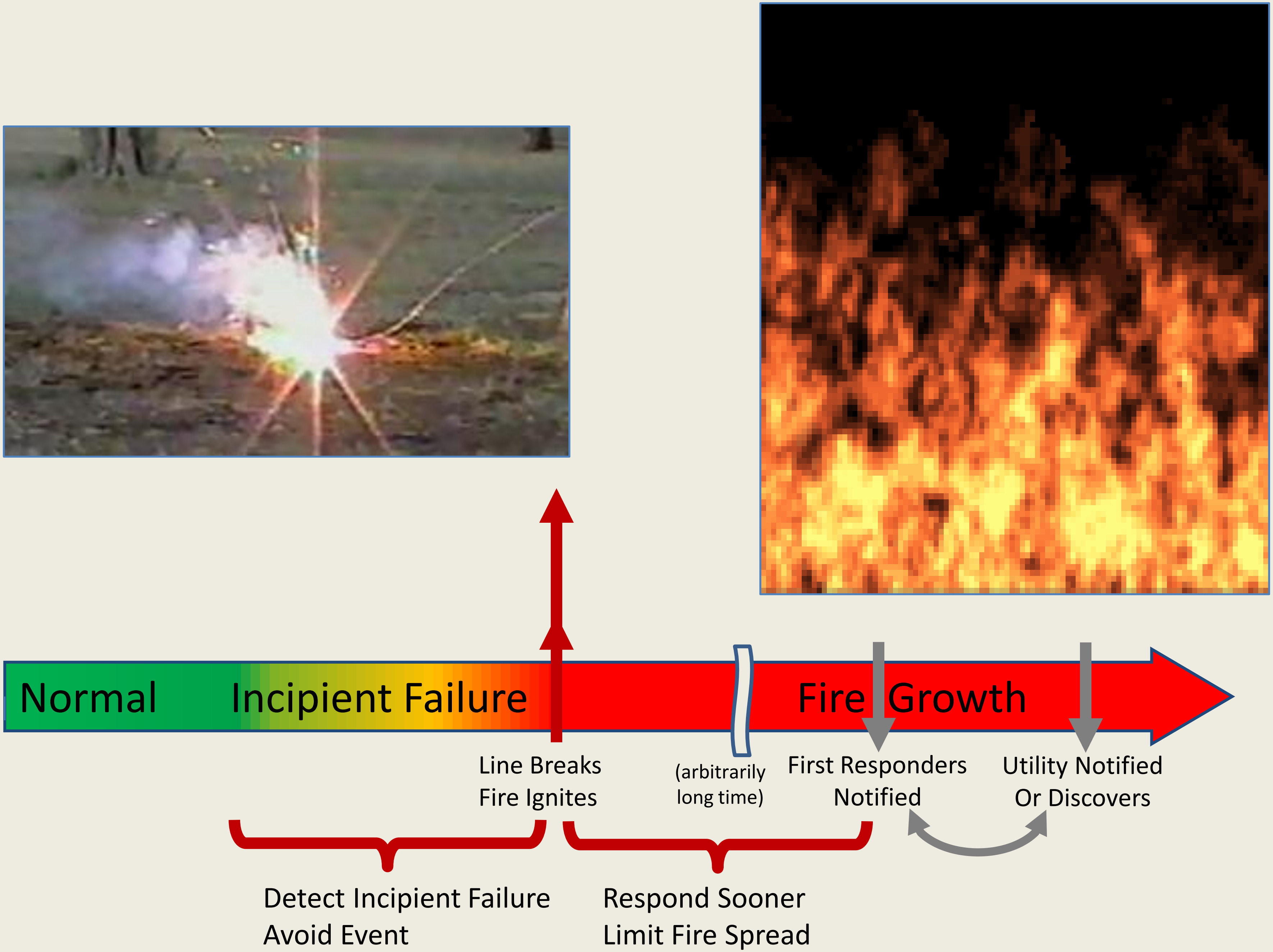
How Do Power Lines Cause Fires?


Downed Conductors


Clashing Conductors


Vegetation


Failing Apparatus


Normal
Incipient Failure
Fire Growth
Line Breaks
Fire Ignites
(arbitrarily
long time)
First Responders
Notified
Utility Notified
Or Discovers
Detect Incipient Failure
Avoid Event
Respond Sooner
Limit Fire Spread

Texas Wildfire Mitigation Project

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TFS Wildfire Risk Assessment Tool Overview

Tom Boggus, Director

Texas A&M Forest Service

Texas Wildfire Mitigation Project

Reducing the Risk of Wildfires Caused by Power Lines

TEES Power Line Monitoring Technology Overview

Carl Benner, Senior Research Engineer

Texas A&M Engineering Experiment Station

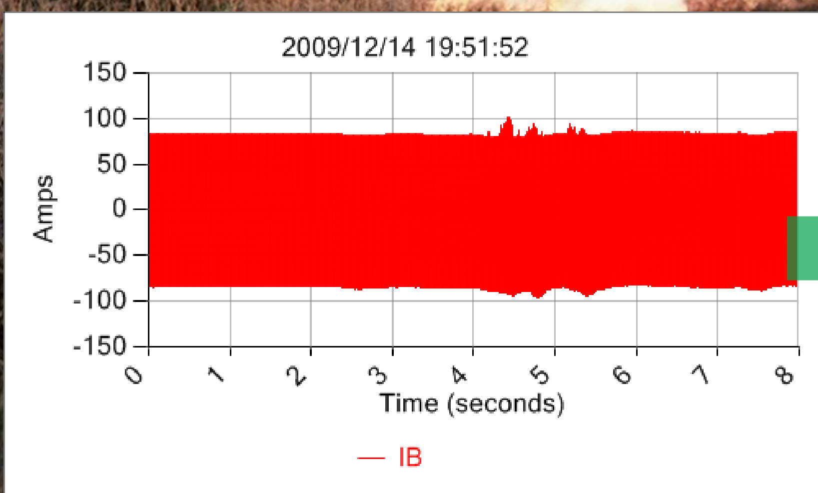
TEES Power Line Monitoring Technology Background

- A Decade of Research
  - Instrumented dozens of feeders at 10+ utilities
  - Created largest database of failure signatures in existence
  - Analyzed waveform anomalies and correlated with failure events
  - Discovered unique signatures for specific failures
  - Developed automated reporting to deliver actionable information
- Self-Imposed Constraints
  - Conventional sensors
  - Substation equipment only; distributed electronics not required
- Result: Improved power system reliability, operational efficiency, and safety enabled by advanced monitoring of electrical signals

Research Partners

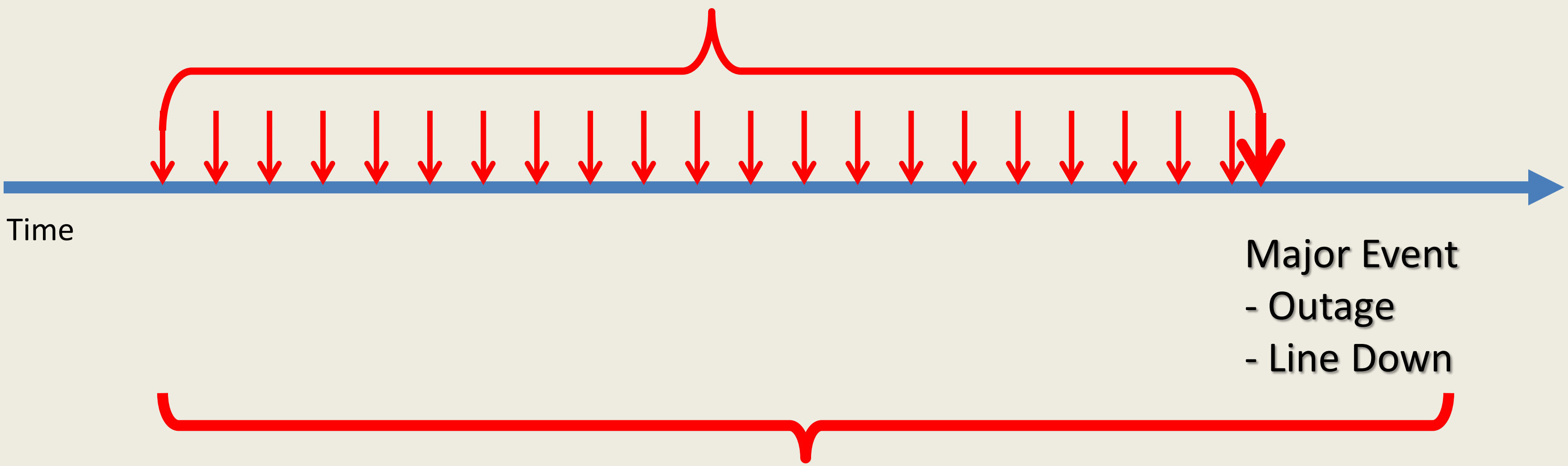
Fundamental Principle

- Graph shows current during "normal" feeder operations.
- Analytics report this specifically as a failing clamp. Failing clamps can degrade service quality, drop hot metal particles, and in extreme cases burn down lines.
- Conventional technologies do not detect incipient failures such as this one.



Example Scenario

2,333 Events in 21 Days
(Undetected Arcing Clamp)

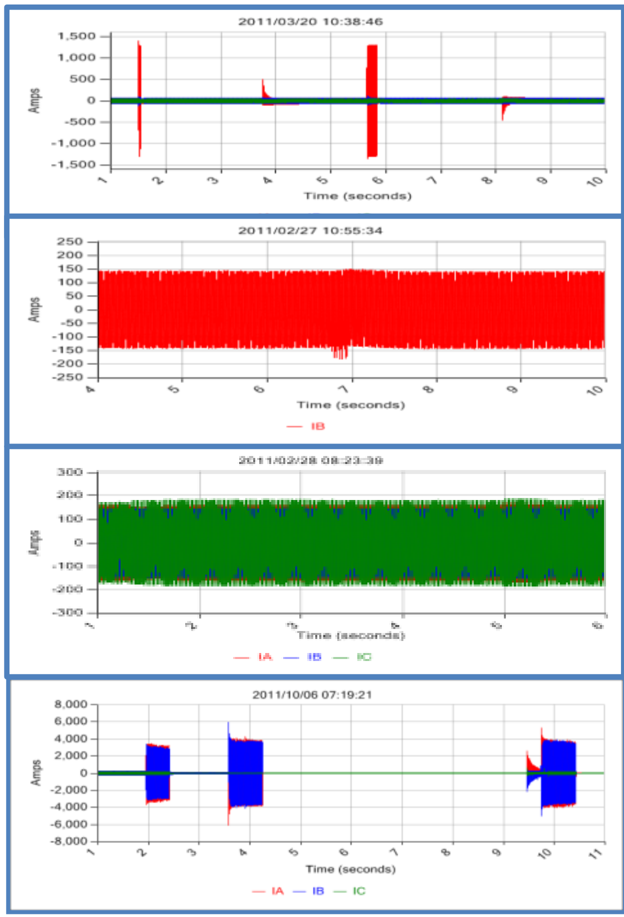


Possible Fire Ignition

Composite of
Actual Events

Waveform Analytics - How It Works

Inputs: Substation CT and PT Waveforms



Waveform Analytics

On-Line Signal Processing and Pattern Recognition Analytics

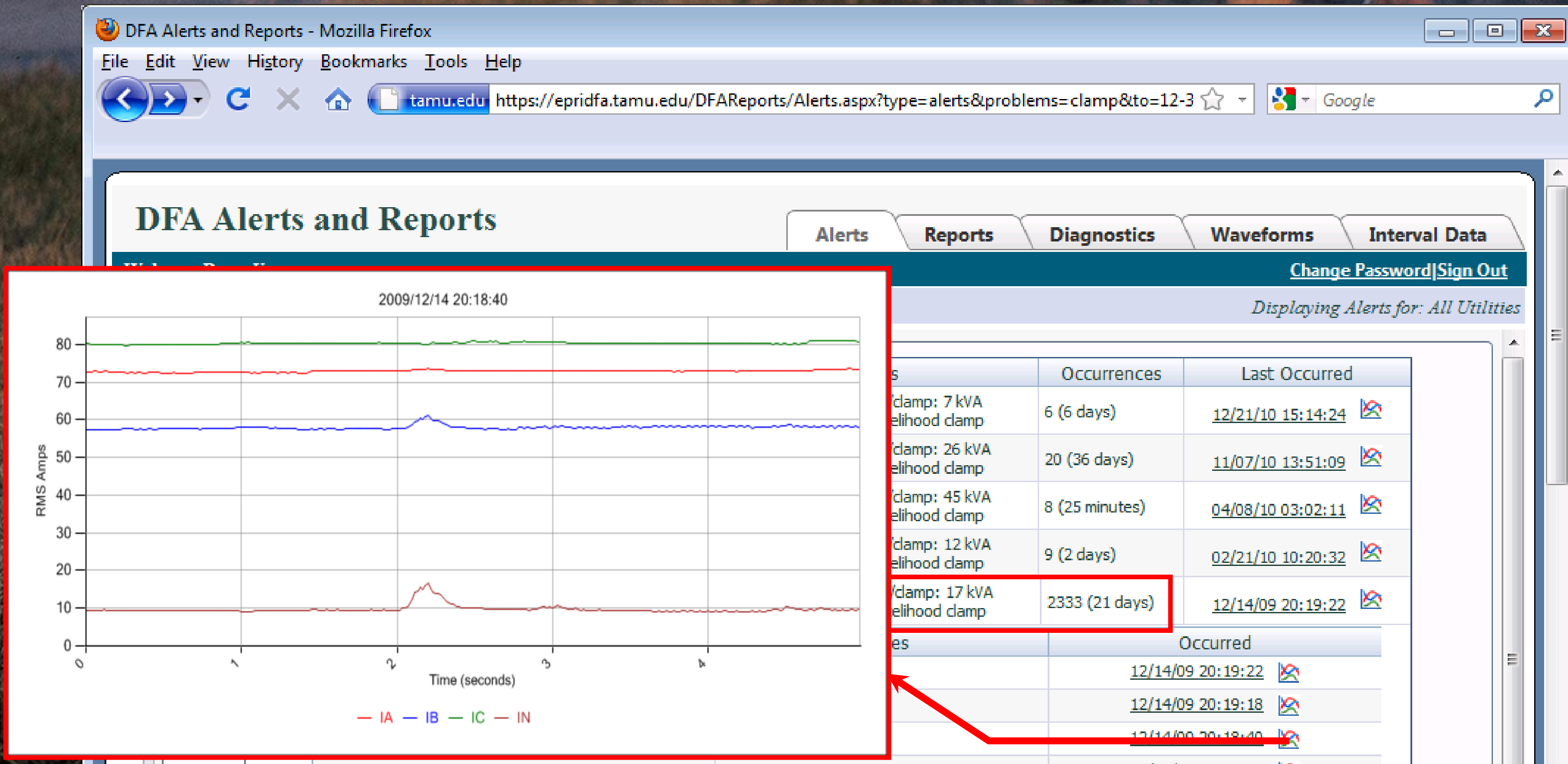
(Performed by Device in Substation)

Outputs

- Line recloser* tripped 8% of phase-A load twice, but reclosed and did not cause outage
- Failing hot-line clamp on phase B*
- Failed 1200 kVAR line capacitor* (phase B inoperable)
- Breaker lockout caused by fault-induced conductor slap

*Analytics applied to high-fidelity substation waveforms report on hydraulic line reclosers, switched line capacitors, apparatus failures, etc, without requiring communications to line devices.

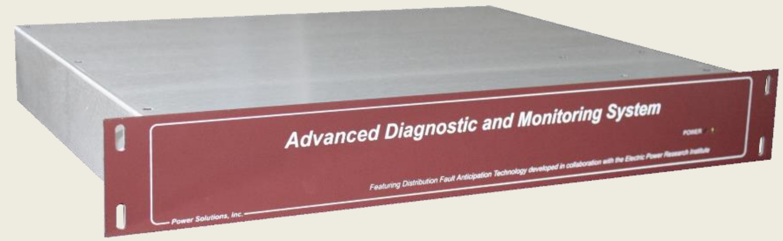
Waveform Analytics - Reporting



Incipient clamp failure causes minimal electrical variations, but waveform analytics diagnose the specific problem and enable targeted response.

Hardware Description

- Standard 19” rack-mount substation equipment
- One device per feeder
- Uses conventional CTs and PTs
- No distributed electronics or communication required
- Communicates with master station via Internet



19” Rack-Mount DFA (Distribution Fault Anticipation) Device

(Last updated August 2013. Subject to change without notice.)

<u>Connections (left to right, as viewed from rear)</u>

1. Threaded hole for standard ground screw (user-provided)

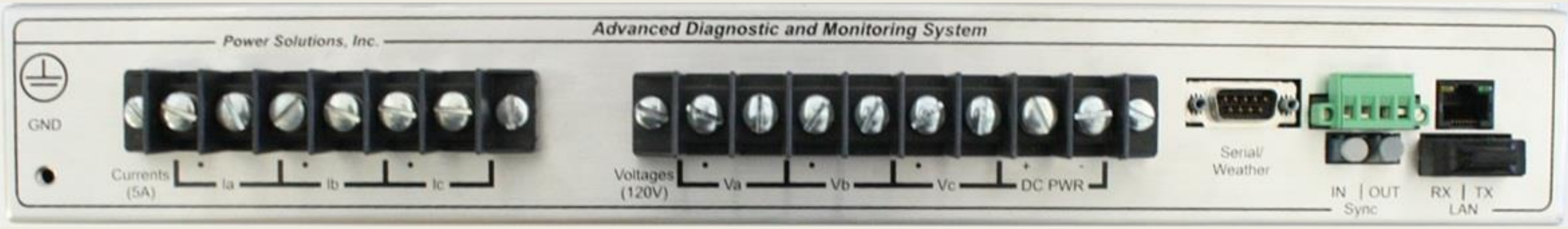
<u>First terminal barrier strip</u>

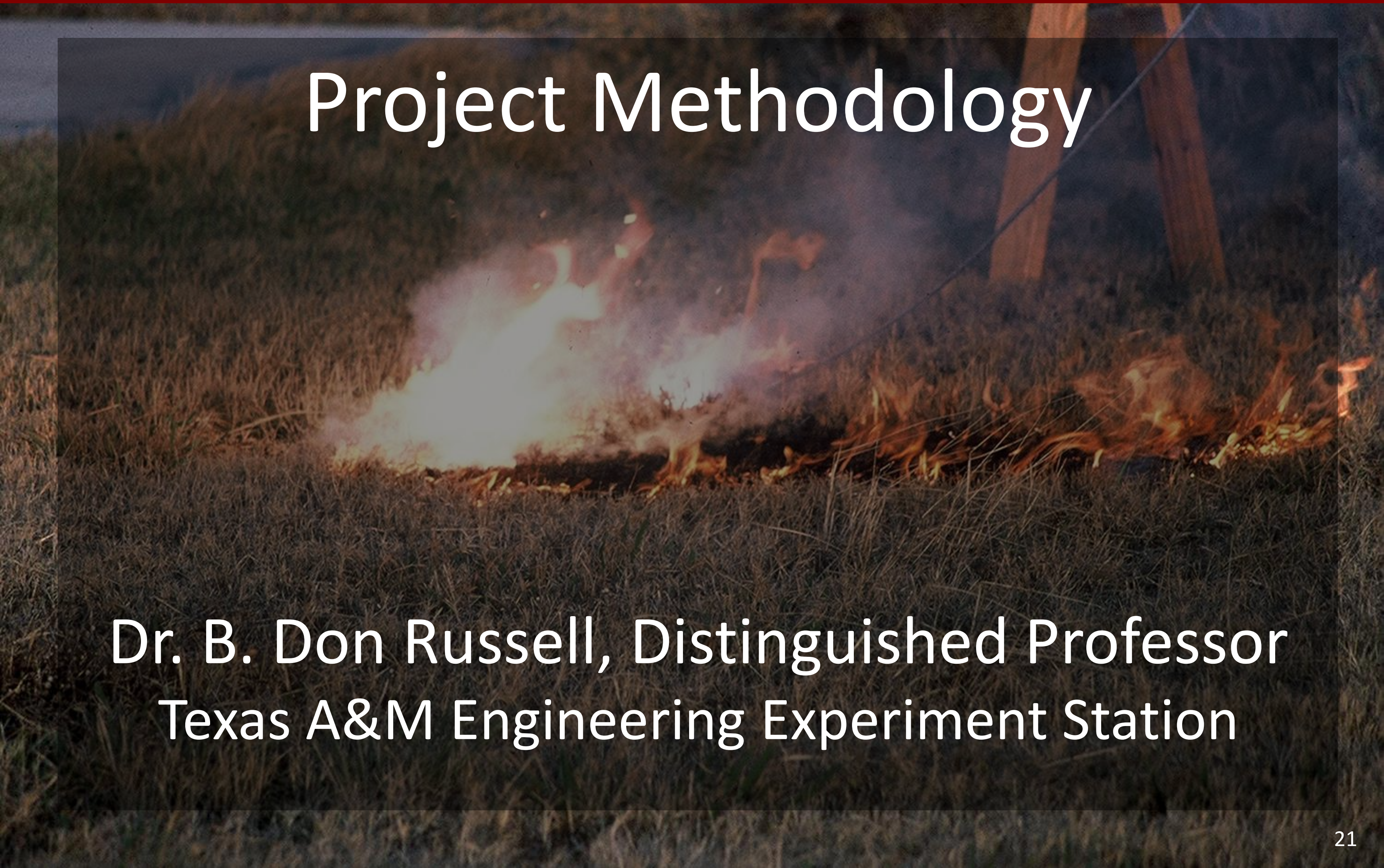
2. Ia
3. Ia return
4. Ib
5. Ib return
6. Ic
7. Ic return

<u>Second terminal barrier strip</u>

8. Va
9. Va ref
10. Vb
11. Vb ref
12. Vc
13. Vc ref
14. 12VDC unit power positive (+)
15. 12VDC unit power return (-)

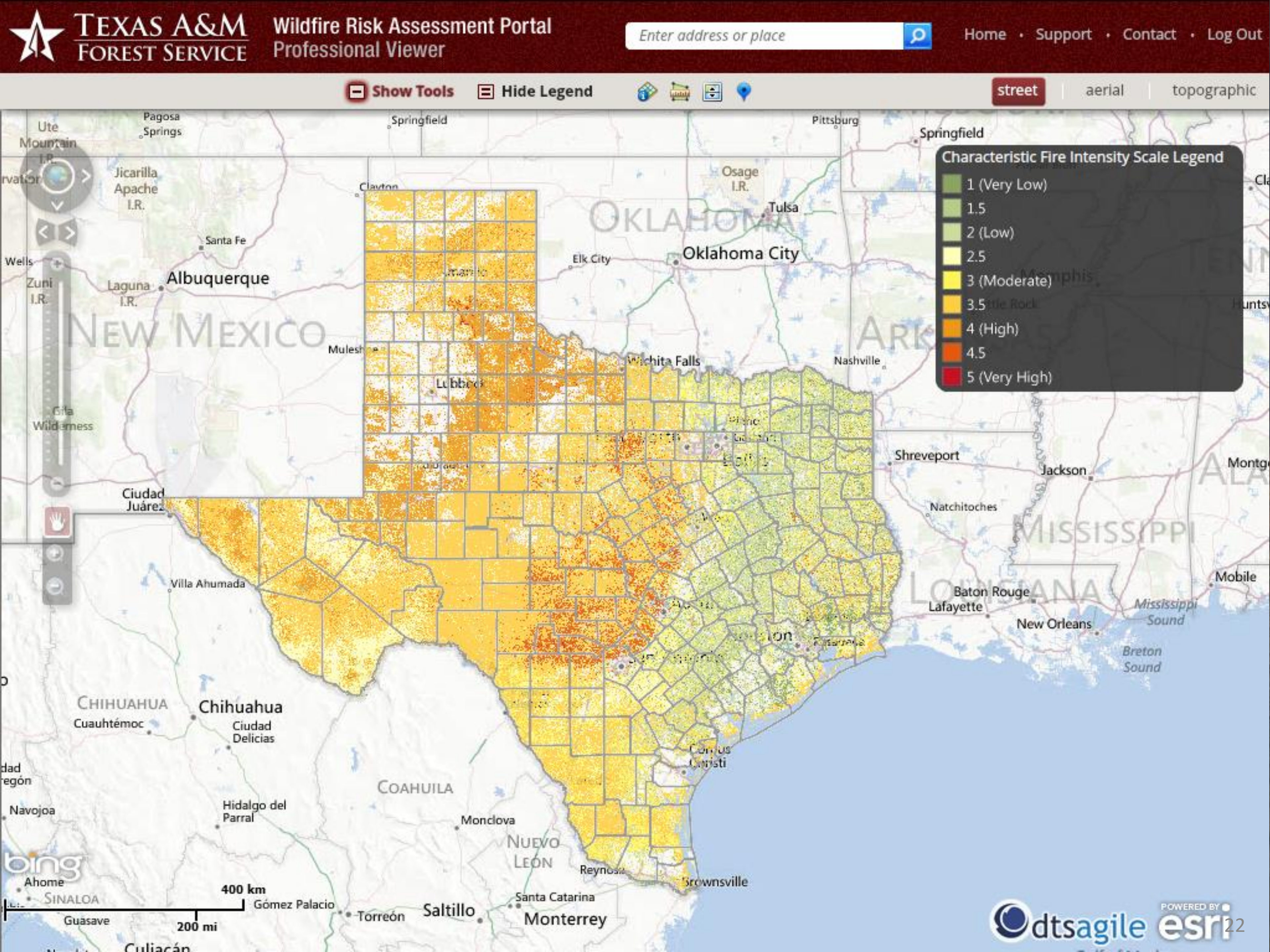
16. Port for connection to optional weather station (DB9 female)
17. Four-port connector for (optional) multi-device synchronization signals
18. LAN connector (RJ45 female)

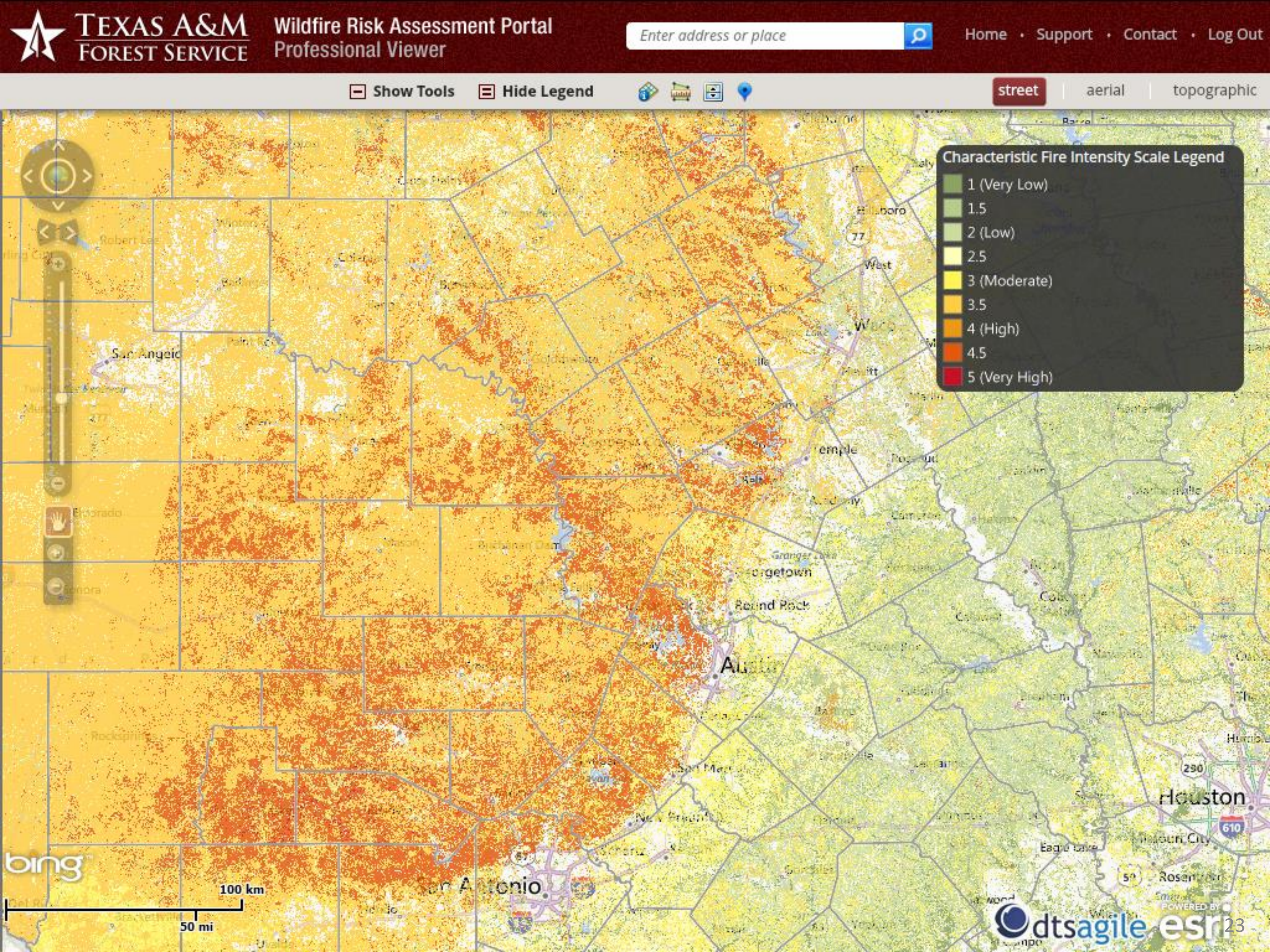




Project Methodology

Dr. B. Don Russell, Distinguished Professor
Texas A&M Engineering Experiment Station


Texas A&M Forest Service
Wildfire Risk Assessment Portal
Professional Viewer
Enter address or place
Home · Support · Contact · Log Out
Show Tools
Hide Legend
street
aerial
topographic
Characteristic Fire Intensity Scale Legend
1 (Very Low)
1.5
2 (Low)
2.5
3 (Moderate)
3.5
4 (High)
4.5
5 (Very High)
New Mexico
Oklahoma
Oklahoma City
Albuquerque
Shreveport
Jackson
Mississippi
Baton Rouge
Lafayette
New Orleans
Chihuahua
Coahuila
Nuevo León
Monterrey
Saltillo
Torreón
Brownsville
400 km
200 mi



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Wildfire Risk Assessment Portal
Professional Viewer
Enter address or place
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Show Tools
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street
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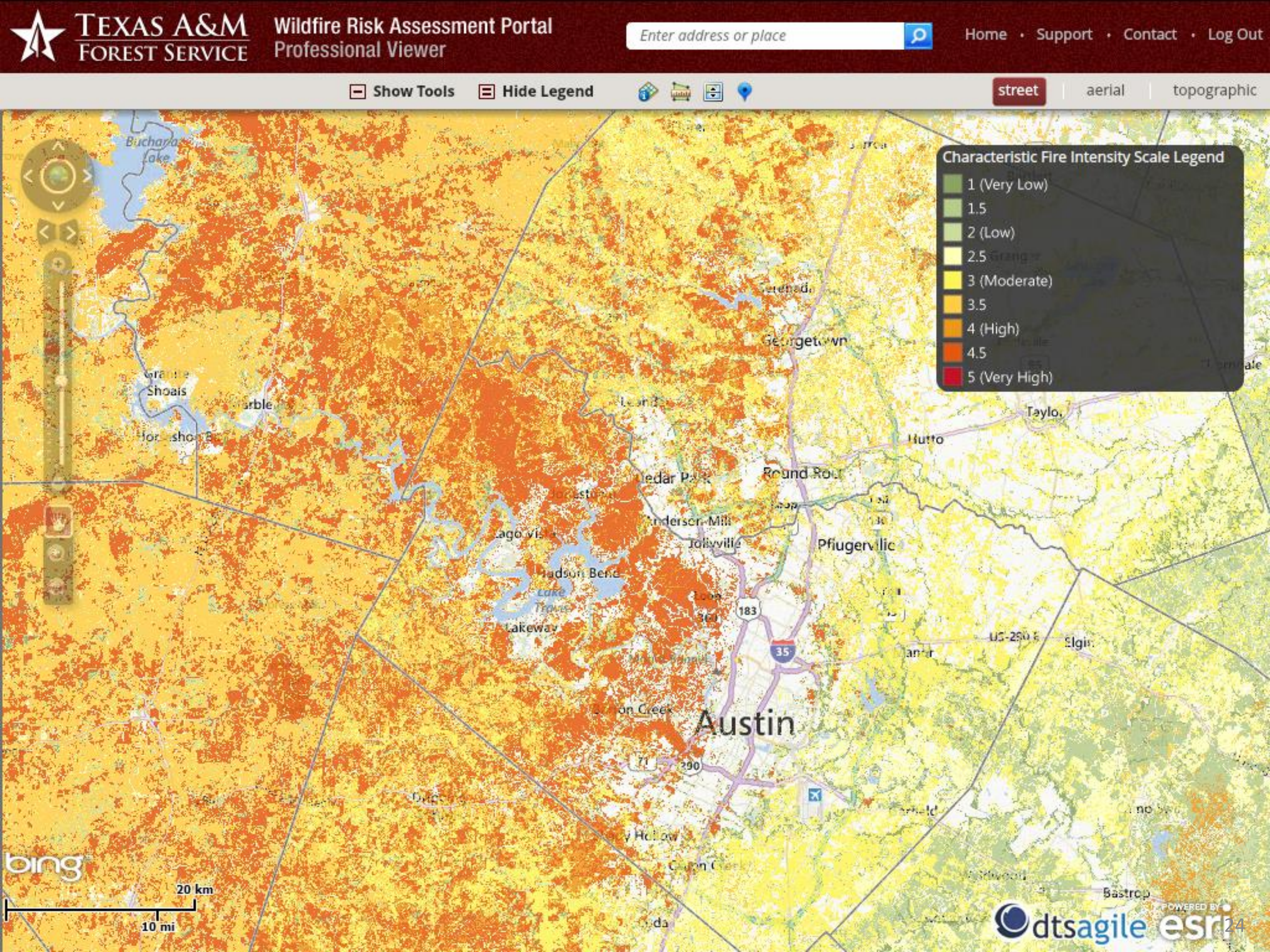
topographic
Characteristic Fire Intensity Scale Legend
1 (Very Low)
1.5
2 (Low)
2.5
3 (Moderate)
3.5
4 (High)
4.5
5 (Very High)
Hillsboro
West
San Angelo
Georgetown
Round Rock
Austin
San Antonio
Houston
100 km
50 mi
bing
dtsagile
esri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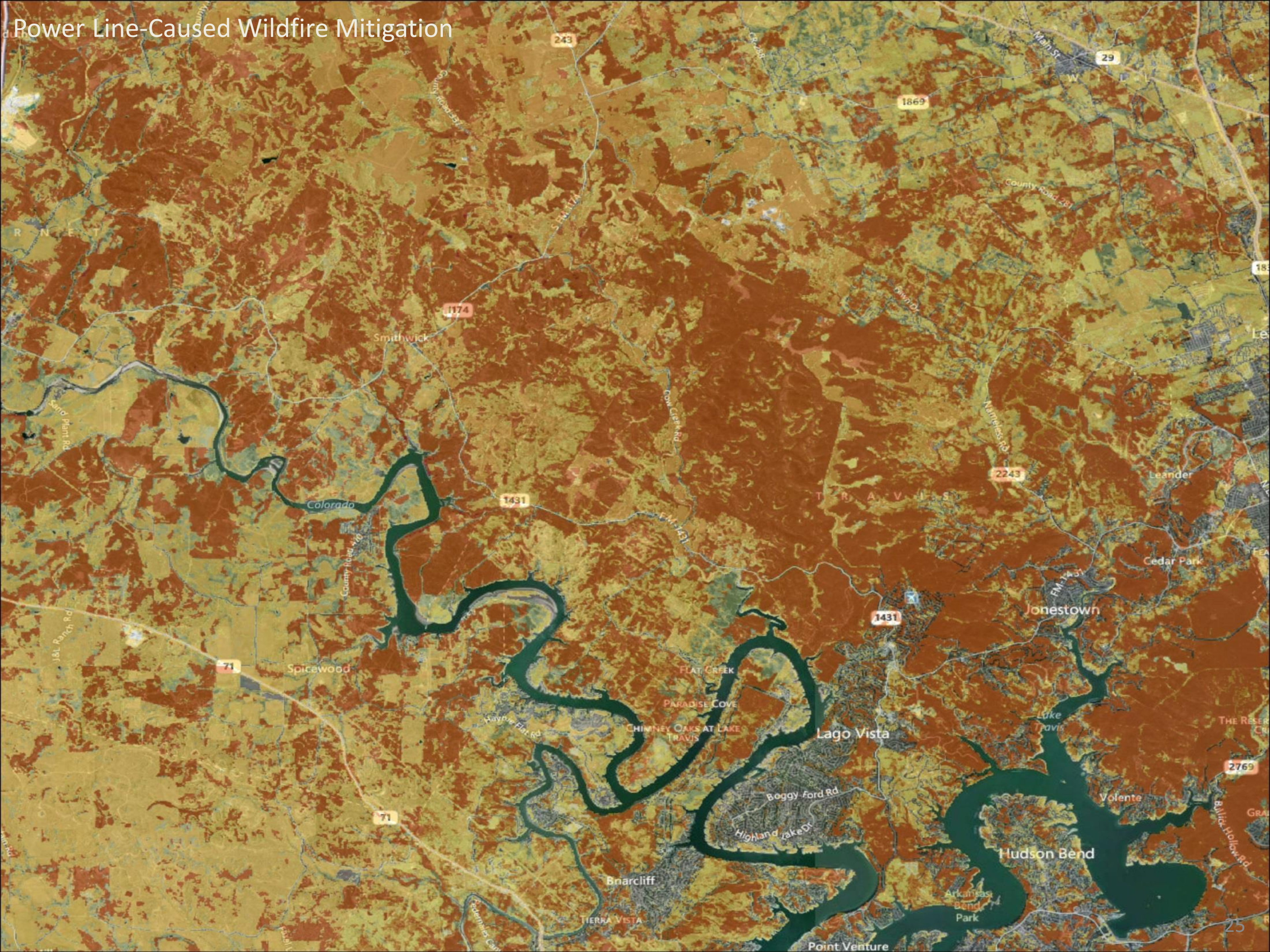
Characteristic Fire Intensity Scale Legend
1 (Very Low)
1.5
2 (Low)
2.5
3 (Moderate)
3.5
4 (High)
4.5
5 (Very High)
Buchanan Lake
Georgetown
Round Rock
Hutto
Pflugerville
Cedar Park
Jollyville
Hudson Bend
Lake Travis
Lakeway
Austin
Elgin
Bastrop
183
35
71
290
bing
20 km
10 mi
dtsagile
esri

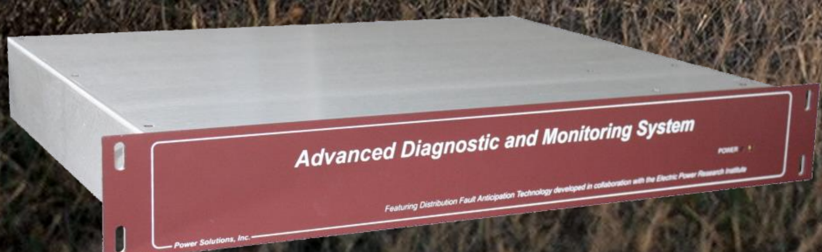
Power Line-Caused Wildfire Mitigation



Power Line-Caused Wildfire Mitigation

Project Overview

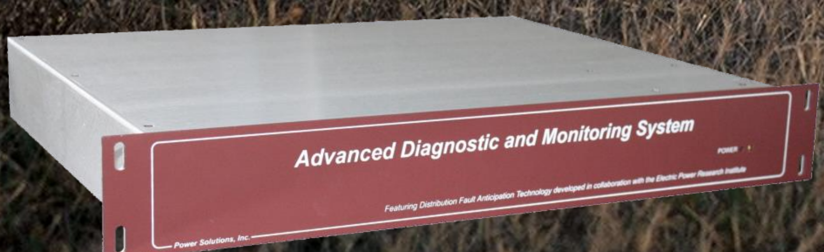
- TEES power line-monitoring technologies and TFS wildfire-risk technologies will be demonstrated and made commercial-ready.
  - Phase 1: Two-year, 100-feeder pilot demonstration on multiple utility company systems in areas of high wildfire risk (current project).
  - Phase 2: Making integrated TEES/TFS system available for statewide application.



Project Organization

<u>Advisory Council Participants</u>

- Individual utilities and related organizations
- Legislative representatives
- State agencies and emergency responders
- Texas A&M Engineering Experiment Station
- Texas A&M Forest Service



Texas Wildfire Mitigation Project

Reducing the Risk of Wildfires Caused by Power Lines

Discussion of Utility Participation

Dr. B. Don Russell, Distinguished Professor

Texas A&M Engineering Experiment Station

Utility Requirements for Participation

- Join advisory council
- Select appropriate feeders in fire risk areas
- Provide feeder maps
- Acquire and install hardware in substations
- Provide Internet access to substations
  (DSL, cable, cell modem, radio, …)
- Work cooperatively with investigators to respond to failure events and evaluate performance

Project Hardware and Support Costs

	Typical project cost structure	Wildfire demo project budget (per participant)
Support services (training; data retrieval and management; web-based data access; archiving; event consultation; user meetings; …)	$100,000	$0*
Field hardware (one monitoring device per feeder, installed at substation)	$10,000/feeder	Larger utility: 25 @ 7K** = $175K *Medium utility: 10 @ 7K** = $70K* *Smaller utility: 6 @ 7K** = $42K*
Total per-participant cost	Examples: 25 feeders = $350K 10 feeders = $200K 6 feeders = $160K	Examples: 25 feeders = $175K (50% decrease) *10 feeders = $70K (65% decrease)* *6 feeders = $42K (74% decrease)*

* State funding provides for support services. No funding is required from participants.

** Wildfire project pricing reflects a 30% hardware discount, enabled by state funding. This discounted pricing applies to the first 100 devices purchased for the wildfire project.

Other Benefits of Incipient Failure Detection
(Partial List)

Power quality and reliability

- Improved SAIDI and SAIFI (avoided outages)
- Improved PQ (avoided momentary interruptions, sags, etc.)
- Improved customer satisfaction
- Better support of economic development

System stresses and liability

- Reduced stress on line equipment
  (e.g., transformers, lines, connectors, switches, reclosers)
- Reduced damage and liability from catastrophic failures
  (e.g., conductor burn-down, fire, transformer explosion)

Operational efficiency and other labor impacts

- Daylight, fair-weather, straight-time failure location and repairs
- Improved worker safety (fair-weather, daylight work)
- More efficient troubleshooting (e.g., fewer no-cause-found tickets)

Texas Wildfire Mitigation Project

Reducing the Risk of Wildfires Caused by Power Lines

Q&A and Discussion

Dr. B. Don Russell, Distinguished Professor
Texas A&M Engineering Experiment Station

Texas Wildfire Mitigation Project

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Next Steps

Dr. B. Don Russell, Distinguished Professor

Texas A&M Engineering Experiment Station