

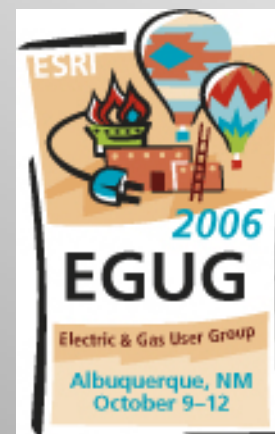
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# Radio Frequency Interference Application

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Utilities GIS Project Manager

**BASIN ELECTRIC  
POWER COOPERATIVE**



Partnering to Build Better Infrastructure

# Presentation Outline

- Basin Electric Operations
- Problem Definition
- Application Requirements
- Key Application Design Concepts
  - Demonstration
- Business Process Improvements
- Lessons Learned

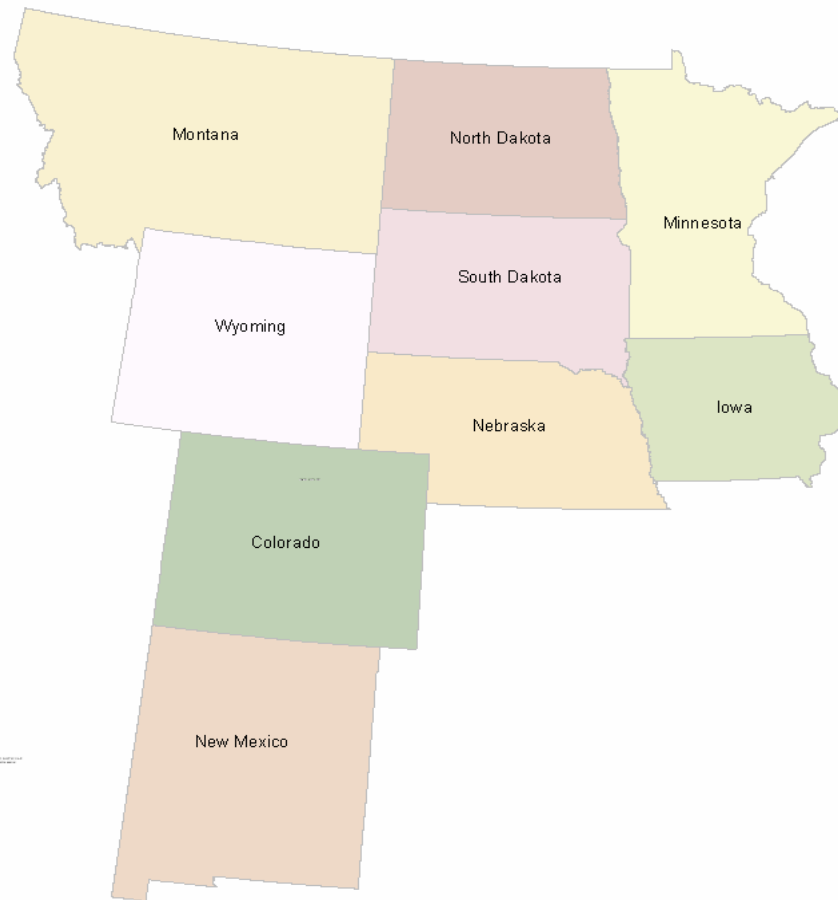
# Basin Electric Operations

- Core business is generating and delivering electricity to wholesale customers, primarily member systems.
- One of the nations largest electric generation and transmission cooperatives (G&T) in United States
- Generates and Distributes power to 120 member systems
- Very large service area - Provides power and services to 1.8 million consumers located in 9 states

# Other Basin Operations

- Natural Gas – Dakota Gas
- Coal
- Wind Energy

# Service Area Map



# Problem Definition

- Over 80 Radio Towers in place used for
  - General Communication via Microwave
  - SCADA data transmission
  - Telephone circuits
  - Management of remote communication devices
  - Mobile Radio
  - Control of member's Mobile radio
- Basin has experienced radio frequency **interference** with new tower locations (by outside companies, Coal Companies etc)

# Problem Definition

- New radio communication towers requires FCC approval. Public comment period used to determine possible conflicts is short
- Comsearch and other companies that were approved to do search failed with accuracy
- Existing system required GIS Analyst to be available to determine where existing Basin facilities are located and determine spatially that a conflict is possible – conduct analysis.
- Engineers unable to do their own analysis and waited for GIS Analyst information.

# Application Requirements

- Check new tower locations for Radio frequency **interference/**  
**conflicts** with existing Basin Towers
  - Electrical engineers get FCC notification for new tower locations (latitude and longitude)
  - Engineers conduct spatial analysis using web application - ArcGIS Server
    - 100, 125 Mile Spatial Buffer (with bearing/azimuths)
    - Frequency conflict values (+-10 MHz)
  - Complete two different levels of analysis
    - Transmission Stations
    - Microwave Maps
  - PDF maps produced to file documentation to the FCC

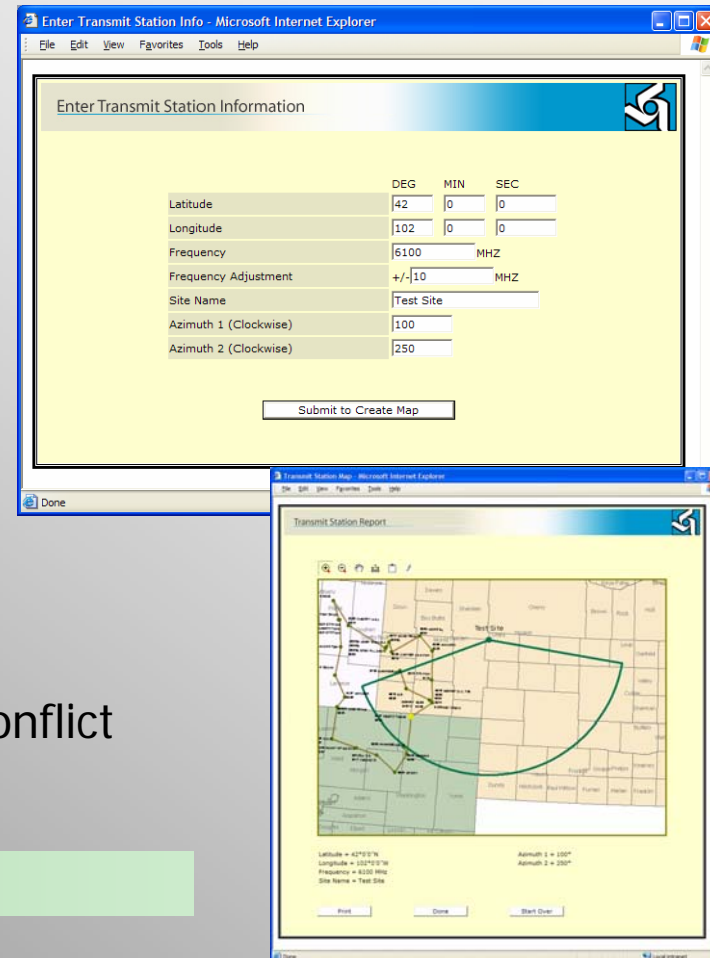


# Key Application Design Concepts

- ESRI ArcGIS Server Platform – Why Server?
  - Distributable over Intranet (IIS 6.0, WS 2003, .NET 1.1)
  - Server Based GIS (ArcGIS Server 9.1®)
  - Focused Spatial Analysis Operations Available
  - Used EDN for quick turn around
- Application must be available to Engineers
  - Removed bottleneck in GIS Staff Resources
- Interface must be simple and easy to use
  - Key input parameters only (lat, long, frequency etc.)
  - Map Tools (Zoom In, Zoom Out, Pan, Measure etc.)
- Enterprise GIS data to run spatial Analysis
  - ArcSDE® on Microsoft SQL Server
- Map output must be clear and easy to read

# Key Application Design Concepts

- Transmit Station
  - Input Parameters (validated on entry)
    - Lat, Long
    - Frequency
    - Frequency Adjustment
    - Site Name
    - Azimuth 1 Azimuth 2
  - Creates Station Map/Report
    - 125 Mile Buffer
    - Highlights potential interference/conflict
    - Export/Print Map to .pdf

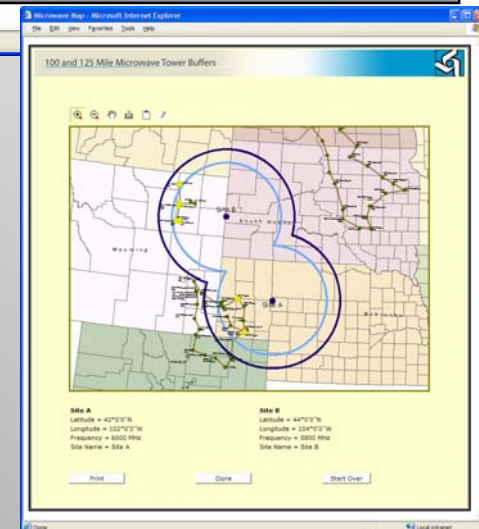


# Key Application Design Concepts

- Microwave Towers
  - Input Parameters (validated on entry)
    - Lat, Long
    - Frequency
    - Site Name
    - Frequency Adjustment
  - Creates Map/Report
    - 100 and 125 Mile Buffer (merged if necessary)
    - Highlights potential interference/conflict
    - Export/Print Map to .pdf

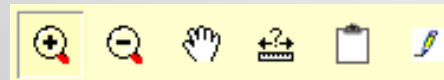
Enter Microwave Information

Point A			Point B		
DEG	MIN	SEC	DEG	MIN	SEC
Latitude	<input type="text"/>	<input type="text"/>	Latitude	<input type="text"/>	<input type="text"/>
Longitude	<input type="text"/>	<input type="text"/>	Longitude	<input type="text"/>	<input type="text"/>
Frequency	<input type="text"/>	MHZ	Frequency	<input type="text"/>	MHZ
Site Name	<input type="text"/>		Site Name	<input type="text"/>	
Frequency Adjustment for A and B			+/-10 MHZ		

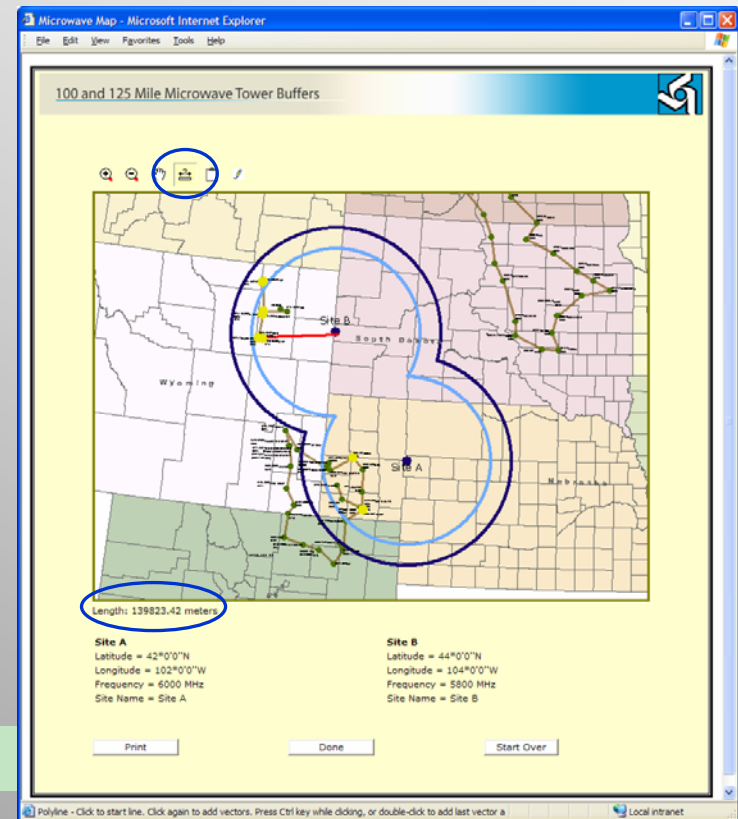


# Key Application Design Concepts

- Simple Mapping Tools



- Zoom In
- Zoom Out
- Pan
- Measure Line Distance
- Clear Line
- Toggle Site Labels On/Off



# Application Demonstration



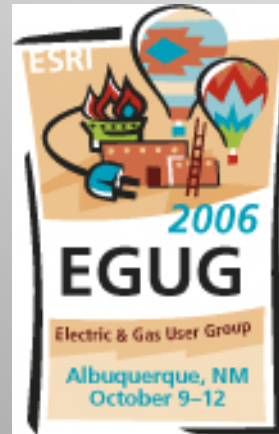
# Business Process Improvements

- End users do not need GIS experience
- Runs on a central server against a GIS repository to allow for standard spatial analysis and modification of the code
- Creates a quick study of the new tower locations to determine if a problem exists – then do detail studies/analysis
- Expedite **conflict/interference** checking process
  - “it is a great tool and...she (an electric engineer) had done 25 different checks that morning. That is more than I (a GIS analyst) could do in a full day.” – BASIN electric

# Lessons Learned

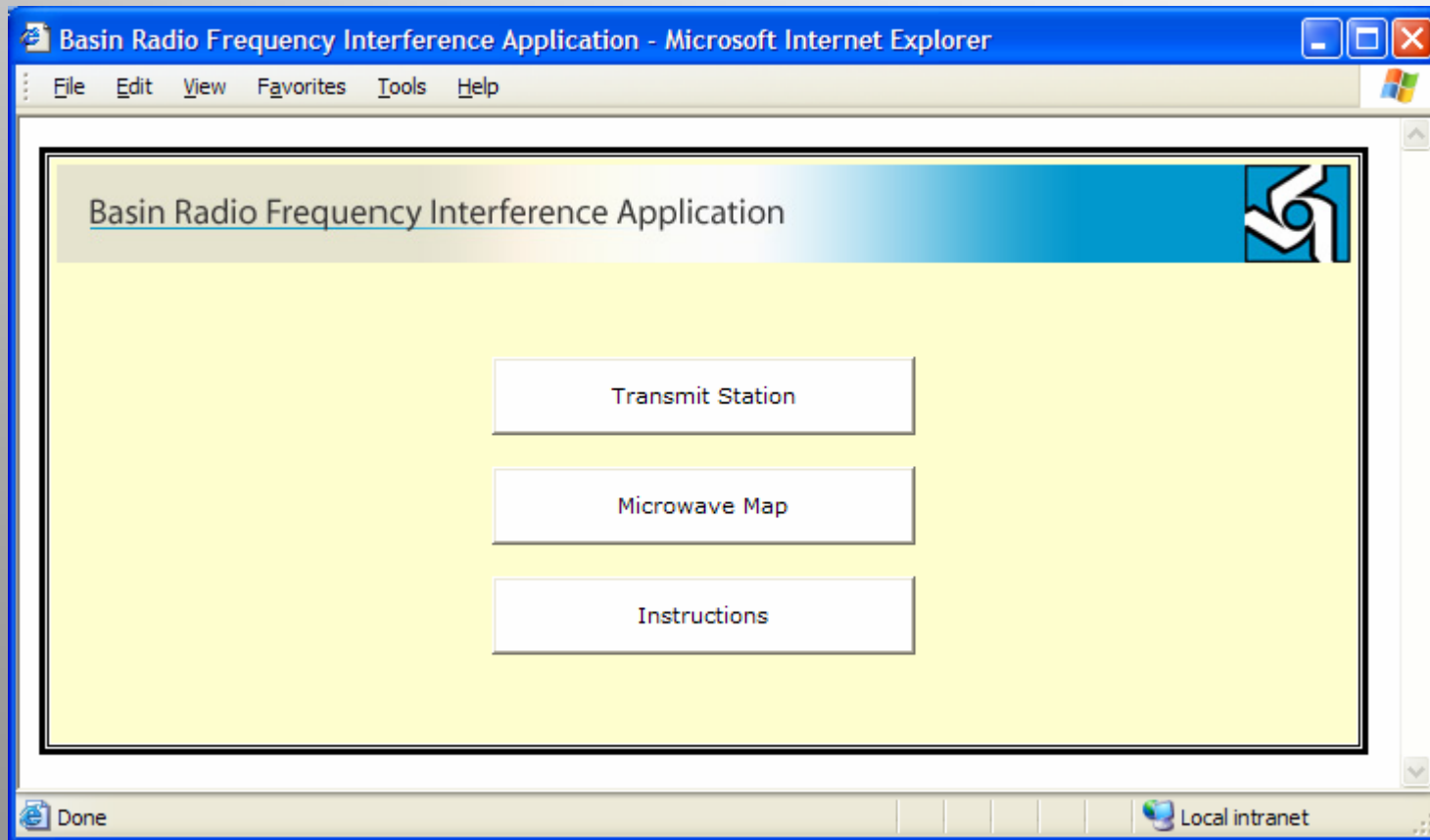
- ArcGIS Server® provides for quick deployment of the application
  - Total development time – one month
  - Code Adjustments easy to make
- Quick analysis and simple map products run great in ArcGIS Server
- Add-on Possibilities
  - Select new tower site on screen
  - Closest tower distances
  - Multiple and Flexible Buffer Distances

# Questions and Thank You !



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Enter Transmit Station Info - Microsoft Internet Explorer

File Edit View Favorites Tools Help

### Enter Transmit Station Information

	DEG	MIN	SEC
Latitude	<input type="text"/>	<input type="text"/>	<input type="text"/>
Longitude	<input type="text"/>	<input type="text"/>	<input type="text"/>
Frequency	<input type="text"/> MHZ		
Frequency Adjustment	+/- <input type="text"/> 10 MHZ		
Site Name	<input type="text"/>		
Azimuth 1 (Clockwise)	<input type="text"/>		
Azimuth 2 (Clockwise)	<input type="text"/>		

Done Local intranet

Enter Transmit Station Info - Microsoft Internet Explorer

File Edit View Favorites Tools Help

### Enter Transmit Station Information

	DEG	MIN	SEC
Latitude	42	0	0
Longitude	102	0	0
Frequency	6100 MHz		
Frequency Adjustment	+/- 10 MHz		
Site Name	Test Site		
Azimuth 1 (Clockwise)	100		
Azimuth 2 (Clockwise)	250		

Submit to Create Map

Done Local intranet

Transmit Station Map - Microsoft Internet Explorer

File Edit View Favorites Tools Help

### Transmit Station Report

Latitude = 42°0'0"N  
Longitude = 102°0'0"W  
Frequency = 6100 MHz  
Site Name = Test Site

Azimuth 1 = 100°  
Azimuth 2 = 250°

Print Done Start Over

Done Local intranet

http://patrickssoc/temp/\_ags\_map76f712c049454f068515b20cd74a106a.pdf - Microsoft Internet Expl...

File Address Links

66%

Pages Attachments Comments

Test Site


1 of 1

Done Unknown Zone

Enter Microwave Information - Microsoft Internet Explorer

File Edit View Favorites Tools Help

### Enter Microwave Information



	Point A				Point B		
	DEG	MIN	SEC		DEG	MIN	SEC
Latitude	<input type="text"/>	<input type="text"/>	<input type="text"/>	Latitude	<input type="text"/>	<input type="text"/>	<input type="text"/>
Longitude	<input type="text"/>	<input type="text"/>	<input type="text"/>	Longitude	<input type="text"/>	<input type="text"/>	<input type="text"/>
Frequency	<input type="text"/>		MHZ	Frequency	<input type="text"/>		MHZ
Site Name	<input type="text"/>			Site Name	<input type="text"/>		
Frequency Adjustment for A and B	+/-		<input type="text"/>	MHZ			

Done Local intranet

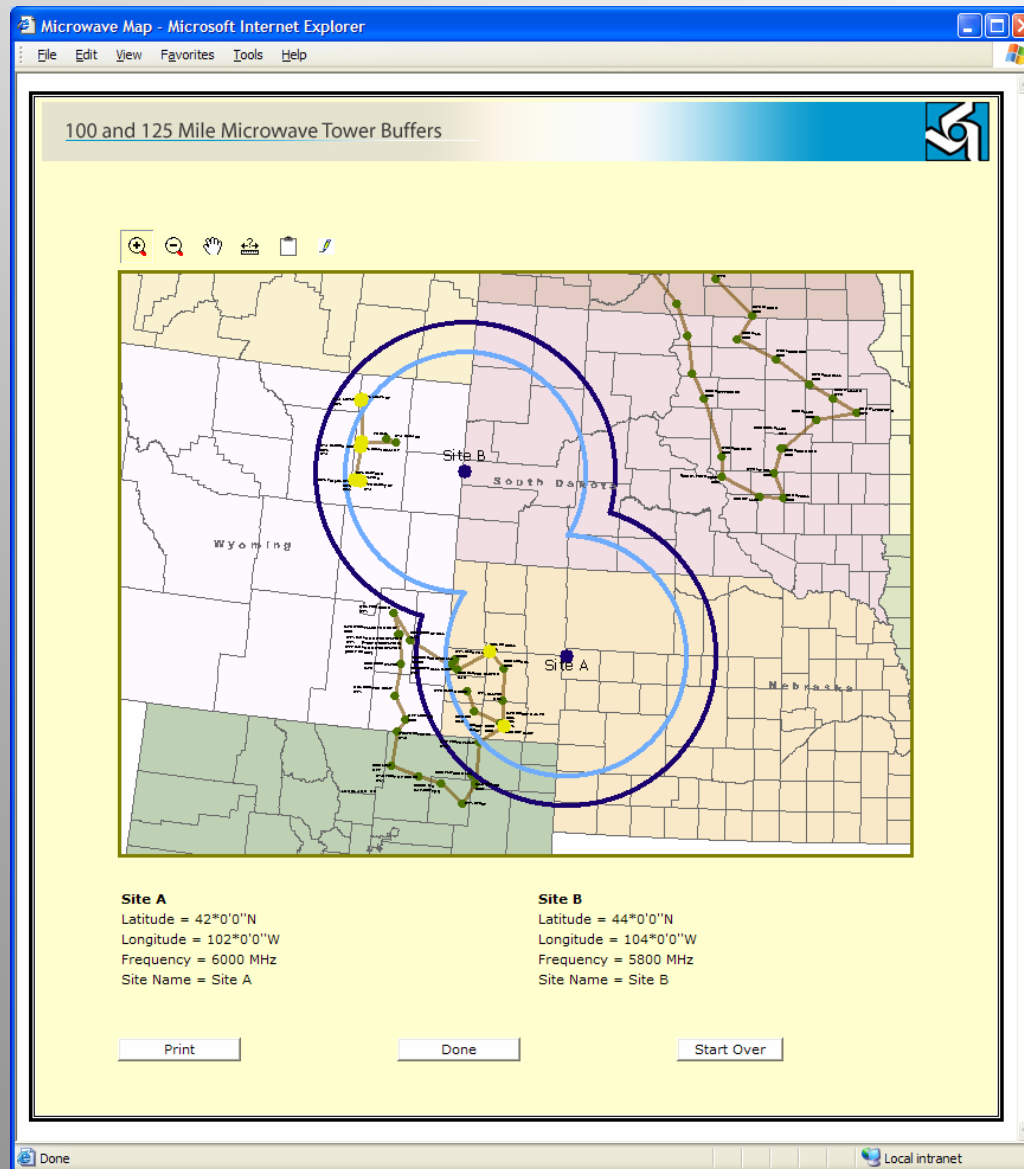
Enter Microwave Information - Microsoft Internet Explorer

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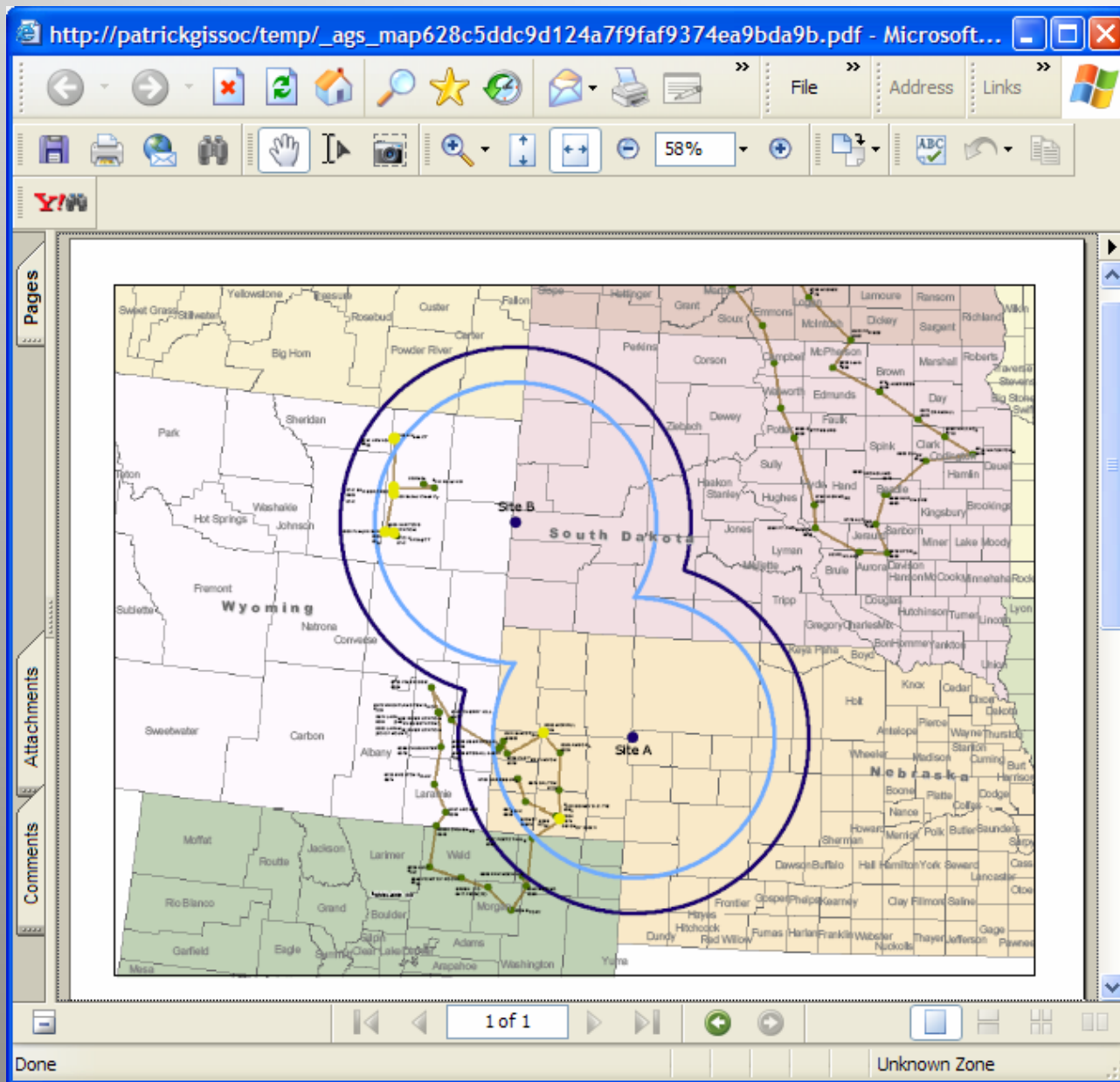
### Enter Microwave Information

Point A			Point B				
	DEG	MIN	SEC		DEG	MIN	SEC
Latitude	<input type="text" value="42"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	Latitude	<input type="text" value="44"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Longitude	<input type="text" value="102"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	Longitude	<input type="text" value="104"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Frequency	<input type="text" value="6000"/>		MHZ	Frequency	<input type="text" value="5800"/>		MHZ
Site Name	<input type="text" value="Site A"/>			Site Name	<input type="text" value="Site B"/>		
Frequency Adjustment for A and B	+/-		<input type="text" value="10"/>	MHZ			

Done Local intranet







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