SECTION 905 -- PROPOSAL (CONTINUED)

I (We) hereby certify by digital signature and electronic submission via Bid Express of the Section 905 proposal below, that all certifications, disclosures and affidavits incorporated herein are deemed to be duly executed in the aggregate, fully enforceable and binding upon delivery of the bid proposal. I (We) further acknowledge that this certification shall not extend to the bid bond or alternate security which must be separately executed for the benefit of the Commission. This signature does not cure deficiencies in any required certifications, disclosures and/or affidavits. I (We) also acknowledge the right of the Commission to require full and final execution on any certification, disclosure or affidavit contained in the proposal at the Commission's election upon award. Failure to so execute at the Commission's request within the time allowed in the Standard Specifications for execution of all contract documents will result in forfeiture of the bid bond or alternate security.

Bidder acknowledges receipt of and has added to and made a part of the proposal and contract documents the following addendum (addenda):

ADDENDUM NO.	**1**	DATED	**7/17/2017**	ADDENDUM NO.		DATED	
ADDENDUM NO	**2**	DATED	**7/18/2017**	ADDENDUM NO.		DATED	

Number	Description
1	Revised Table of Contents; Revised NTB No. 237; Add NTB Nos. 259, 260, 261, 262, & 263; Revised Bid Items; Amendment EBS Download Required.
2	Revised NTB No. 237; Amendment EBS Download Required.

TOTAL ADDENDA: **2**
(Must agree with total addenda issued prior to opening of bids)

Respectfully Submitted,

DATE _____

_____
Contractor

BY _____
Signature

TITLE _____

ADDRESS _____

CITY, STATE, ZIP _____

PHONE _____

FAX _____

E-MAIL _____

(To be filled in if a corporation)

Our corporation is chartered under the Laws of the State of _____ and the names, titles and business addresses of the executives are as follows:

_____
President Address

_____
Secretary Address

_____
Treasurer Address

The following is my (our) itemized proposal.

SP-9999-01(007)/ 107364301,302, & 303

Lee, Pontotoc, & Union County(ies)

Revised 01/26/2016

MISSISSIPPI DEPARTMENT OF TRANSPORTATION

SECTION 904 - NOTICE TO BIDDERS NO. 237 **CODE: (SP)**

DATE: 06/20/2017

SUBJECT: Tupelo Antenna Tower

PROJECT: SP-9999-01(007) / 107364301 – Lee, Pontotoc and Union County

Bidders are hereby advised that the following Antenna Tower specifications shall be required on this project. Work and materials not paid for under other pay items shall be included in the price bid for pay item number 907-675-A.

Tupelo Antenna Tower

Scope of Work: The Mississippi Department of Transportation desires to construct a 150-foot monopole Antenna Tower able to support four levels of antenna arrays including, but not limited to the tower, foundation, anchor bolts and templates, waveguide ladder, safety devices, power, lighting, painting, lightning rod, grounding system, ice bridge, Contractor-designed tower-mounted wireless system, attachment hardware and brackets. All structures must meet 2012 IBC and TIA 222-G Standards. The foundation and grounding system must meet Motorola R-56 Standards. The lighting system and paint must be in accordance with FAA and FCC rules and regulations, if applicable. The tower will be constructed at the MDOT District 1 Headquarters office located at 1909 N. Gloster Street, Tupelo, MS, 38804 near an existing monopole tower.

A new Communications Hut shall be installed near the new Antenna Tower while the existing 150-foot monopole Antenna Tower and existing Tower building shall be demolished and removed as part of this project. These shall be paid for under the associated pay items of Removal of Obstructions (202-A), Removal of Antenna Tower Communication Hut (202-B), and Communications Node Hut (SP 907-664-B).

A wireless communication system shall be designed and installed on the proposed Antenna Tower as part of the Antenna Tower pay item (SP 907-675-A). A preliminary Microwave Network Feasibility Assessment, including line of sight measurements, has been included in Appendix A for informational purposes. Not all project sites are included in the report and the report includes some sites that are not a part of the project. It is the Contractors responsibility to design and install a complete and fully functional wireless system based on actual conditions found in the field.

Project Location/Site: The proposed tower will be installed near the existing monopole tower at the MDOT District 1 Headquarters office. The proposed tower coordinates will be 34°17’28”N, 88°43’2”W.

Typical EIA soil conditions for this area of Mississippi should be used by the Bidder to determine the bid estimate for the tower foundation. MDOT will provide boring logs & soil

samples to the Contractor as an addendum to the project Bid Package. Based on the Final Geotechnical Soil Report provided by MDOT, the Contractor must submit a foundation design, certified by a professional engineer registered in the state of Mississippi, to the Project Engineer.

Design, Installation and Configuration: The foundation must be of a drilled pier design. The contractor is responsible for designing all components of the tower and for specifying the required concrete mix design.

Temporary Silt Fence and Solid Sodding shall be used at the Tower site to control erosion. Silt Fence shall be placed as directed by the Project Engineer to prevent runoff from the top of the hill upon which the Antenna Tower sits. This shall be paid for under the associated pay items of Solid Sodding (216-A), Watering (219-A), and Temporary Silt Fence (234-A).

The Contractor must provide, installed and working at the new tower, the following equipment:

1 - Contractor-designed, tower-mounted wireless system
1 - Waveguide ladder, at a minimum
1 - Climbing System with Fall Restraint System
1 - Lighting System, if necessary
1 - Ice Bridge to be placed between Tower and Point of Entrance to Communication Hut per the written Specifications

Demolition of Existing Tower: The Contractor will dismantle, remove and dispose of the existing 150 feet tall monopole tower once the MDOT and C Spire equipment has been installed on the proposed tower and all equipment has been removed from the existing tower. The existing tower foundation will be wrecked to a depth of two feet (2') below finished grade.

Coordination with Existing Carrier: The Contractor shall coordinate with C Spire to provide a proper schedule for C Spire to place equipment on the new Antenna Tower and remove equipment from the existing Antenna Tower.

Documentation: The Contractor must provide a Conceptual Tower Design. . Preliminary drawings and/or design documentation shall be provided to the Engineer as soon as possible after the award of the contract. The suitability of the proposed tower design will be verified by including complete tower and foundation construction drawings and detailed structural analysis and calculations in bidders pricing proposal. Drawings must include installation details for all assemblies provided. The tower foundation drawings must include requirements to verify concrete and rebar quality.

These documents shall contain sufficient detail such that MDOT could engage an independent engineering firm to conduct third party structural reviews of submitted tower proposals.

All drawings and calculations will be stamped by a professional engineer registered in the State of Mississippi. Any drawing errors encountered during construction of the tower shall be corrected and re-issued as "As-Built" drawing revisions prior to receipt of final payment.

All documents and drawings must be professionally drafted, clear, and legible. Contractor must provide an electronic copy of all documents and drawings.

The submitted documentation must clearly name the manufacture and model of safety climb system.

The Engineer will review the submittals and be prepared to discuss the submitted documentation before or at the preconstruction conference.

MDOT reserves the right to accept or reject the proposed Conceptual Design at its sole discretion.

References: The Contractor must be a reputable, established, and financially stable provider of Antenna Towers and provide a minimum of three (3) references for similar projects to the Project Engineer.

Microwave Network Feasibility Assessment

For

Gresham Smith and Partners

PRESENTED BY:

20331 Highland Road

Baton Rouge, Louisiana 70817

Prepared By: Wayne Kairdolf

For the incorporation of Microwave in the MDOT Tupelo ITS Project

July 17, 2017

Introduction

Deep South Communications (DSC) has conducted a wireless terrain analysis in support of the Intelligent Transportation System infrastructure in Tupelo, MS. The purpose of this analysis was to further examine the terrain and radio line of sight between the MDOT headquarters tower and the proposed connectivity locations. Also to recommend an approach for the wireless portion of the system that will provide a practical solution. This document will serve as a reference in the design of the transport infrastructure to ensure a functional communications system deployment. All of the locations in question and that were visited are specified throughout this document.

Based on many years of designing and maintaining wireless systems, we prefer to remain as agnostic as possible where equipment is concerned. Nevertheless, a predominately licensed full duplex wireless system is always the safest implementation. In this wireless analysis, due to the size and scope for this project it is relatively safe to say that an unlicensed system will be a useful solution. The main issues often afflicting an unlicensed platform is the experience of interference as time goes on and as population density increases. This is not to overshadow the fact that many clients in somewhat rural environments, such as these locations, have tremendous success using the unlicensed portion of the 5GHz band. There are several reasons for this. One major reason is that the band is so large that it can support many simultaneous paths nearby without jeopardizing each other in the form of interfering noise. Another major reason is that the band as a whole is at such a high frequency that it dissipates well in ground clutter, in a sense eliminating noise for other operators that may be just a few miles away in a slightly different location.

For the purposes of this wireless analysis the focus is predominantly considering the use of the 5GHz band. All things considered, the recommendation is an unlicensed radio that has a very wide range of frequency to choose from and preferably one that can operate anywhere within the entire 5GHz band, including the 4.9GHz range as well, all in one piece of hardware. The unlicensed band at the main tower location currently has spectrum availability in all of the 5GHz band ranging from 4.9 to 5.9GHz. The noise floor should be expected to be around a -100 after eliminating the antenna.

Please note that these links are fixed and the ability to overcome noise (interference), even if it was introduced into this environment, is likely to be possible by using interference mitigation, high gain multi polarized antennas, and multiple chains.

Technology Summary

There are many common types of wireless Ethernet implementations that systems such as intelligent transportation rely. Here are 3 of the more frequently used today.

-NLOS – NON LINE OF SIGHT – SHORTER PATHS / OBSTRUCTED TERRAIN - Using systems that incorporate very low frequencies. Sometimes these frequencies are licensed but they often are more widely used as unlicensed. An example of such frequencies would be 900MHz on the unlicensed side and 220MHz on the licensed side of things. Most, if not all of the 900 MHz systems on the market today will be lucky to get real world useable bandwidth of more than 2-3 Mbps. The 220MHz systems operate only in the 10-100 Kbps range. If a system's needs are to solely communicate with serial devices, then this is ample bandwidth. One thing end users should take seriously into account when being tempted to deploy these types of systems is the fact that they are often riddled with interference. Inherently these signals travel well through large objects. If that concept is taken one step further, the reasoning for all of the interference is obvious due to the more limitless nature of the signal. Higher frequencies that do not propagate nearly as well, have built-in interference resistance due to the ease of attenuation, thereby creating less noise.

- SISO LOS – LINE OF SIGHT – LONGER PATHS / UNOBSTRUCTED TERRAIN - Older technology SISO (Single Antenna, Single Polarization) type systems that incorporate licensed and unlicensed type frequencies in and around the mid to lower gigahertz range:

-2.4, 3.65, & 5.8 GHz range unlicensed
-2.5, 4.9, 6, 11, & 18 GHz licensed

Most, if not all, of the 2.4 GHz unlicensed systems are also riddled with interference. Not because of that particular frequencies ability to propagate, but more often because it is the default wifi access point frequency of choice. In summary, every residential and commercial entity and every WISP (Wireless Internet Service Provider) has some of these deployed, generating unpredictable and unprecedented amounts of noise for outdoor systems.

Considering the 3.65GHz range is a great choice but it is very limited where spectrum is concerned. To put it plainly, there just isn't much space in this band for everyone to live in harmony. Essentially, this works best in extremely rural environments using WISPs that were the first to deploy.

On the 5.8GHz side, the spectrum band has more range of frequency and there are far fewer deployments of this gear on the WISP side due to its inability to propagate as well as 2.4GHz. One of the drawbacks, however, is the need for good clear radio line of sight which includes Fresnel zone clearance. This means extra height is needed to ensure a minimal amount of obstructions between antennas.

Licensed equipment is always wildly popular due to the lack of concern where interference is an issue such as metro areas. The main negative for this gear is that it is far less used and far more expensive

because of it. The licensing also can cost much more than the equipment itself. Large companies with deep pockets such as oil companies often choose this option.

- MIMO near LOS – AVERAGE PATH / AVERAGE OBSTRUCTION - Very cutting edge technology that has been sourced enough to no longer be considered bleeding edge. This is by far becoming the most practical wireless gear on the market today. MIMO stands for multiple in and multiple out. To make a very long and complex story short, the use of multiple antennas and high speed processors are incorporated together to assist in exponential bandwidth and interference mitigation. This technology works across many licensed and unlicensed bands; however, it is most readily incorporated into the 5.8GHz unlicensed band. When used in 5.8GHz band properly, the transmission can experience 2.4GHz or even 900MHz like propagation without all of the other more problematic aspects of those lower bands. Having said all of that, these tower/base station deployments often require more technical equipment and highly experienced technicians for proper use. BUT, once the complex and complicated base equipment is installed, the implementation of subscribers can be less demanding than a typical SISO deployment. These systems are much more similar to LTE type cellular architecture than an old wireless bridge.

In summary there are many different wireless technologies. Far too many to list all of the categories, much less all of the equipment and protocols themselves. These listed above are what about 95% of the ITS systems in the US likely incorporate. Also important, each path to each signal pole has different topology and bandwidth needs. Some signals incorporate cameras, and other technologies that require high bandwidth connectivity. The bandwidth needs and the terrain of the path is going to be the most essential elements in determining which frequency in which technology is right for the application. The 5.8GHz MIMO is not a silver bullet and should NOT be used for all deployments but it is the most well rounded solution if you have the technical expertise to deploy it.

Approach

The terrain analysis discussed herein was conducted near the GPS coordinates outlined within this report. This wireless analysis was physically performed on September 19-21, 2016. An Anristu Sitemaster Spectrum Analyzer paired with an 18dBi panel antenna that was connected by a phase stable cable was used at the main tower. Every location was visited with a 75ft man basket. At each site surveyed a simple spotting scope was used for the verification of optical line of site. A spotter was lifted as high as necessary in order to verify the height that the optical line of site was no longer present between the remote site and the top of the headquarters tower where the Base Station antennas will ultimately be installed. Each intersection was also noted for the best placement of radio equipment to optimize for efficiency. In most cases this is done by scouting each quadrant of the intersection for the best unobstructed line of site as close to ground level as possible considering all structures present at that intersection, camera location, or DMS location. After the physical information was compiled the raw data was then used in conjunction with different software to verify the findings for accuracy and the best overall results. This information was then put into a report to aid in the actual construction of the

aforementioned system. The Fresnel zone was calculated based on antenna heights, a typical radio frequency, and distance between antennas.

Findings

Based on the wireless analysis results attained in September of 2016, a properly designed microwave communications system, implemented with the outlined frequency bands within this document, could provide reliable communications to all sites visited with only a few exceptions. Originally the system was examined from the perspective of a star topology whereby all locations homerun directly back to the main tower at the Department of Transportation's local headquarters. The exceptions are noted below:

Exactly one site was eliminated due to the extreme structure height needed to obtain connectivity at that particular SIGNAL ONLY location:

- SR178 (MCCULLOUGH BLVD.) @ COLEY ROAD an 80ft pole required

Three other CAMERA sites may have to be eliminated due to the requirements for an 80ft pole at minimum needed to obtain connectivity at these locations:

- SR145 @ EUCLAUTUBBARD RD (OLD 45) an 80ft pole required
- US45 @ EUCLAUTUBBARD RD (OLD 45) an 80ft pole required
- US78 @ SR9 (SHERMAN) an 80ft pole required

Nine alternate paths were recommended along with five repeater sites. Thereby reducing the structure height required at those nine locations within the confines of the existing parameters requested:

- SR145 @ CR814 via a repeater at SR145 @ PONOTOTOC PKWY / S. GREEN ST.
- SR145 @ SHELL STREET via a repeater at SR145 @ PONOTOTOC PKWY / S. GREEN ST.
- SR145 @ CLIFF GOOKIN BLVD via a repeater at SR145 @ VARSITY
- SR145 @ GARFIELD STREET via a repeater at SR145 @ VARSITY
- SR145 @ VARSITY via a repeater at SR145 @ MAIN
- SR145 @ NEW WALMART via a repeater at SR145 @ MAIN
- SR145 @ JEFFERSON STREET via a repeater at SR145 @ MAIN
- US45 BETWEEN MAIN & MCCULLOUGH STREET via a repeater at US45 @ SR178
- US78 BETWEEN MT. VERNON & COLEY ROAD via a repeater at US78 @ NATCHEZ TRACE

Four sites were not visited as they had existing connectivity. These are SIGNAL ONLY sites that are currently connected as Traffic Signal Slaves to the Traffic Signal Master at VARSITY :

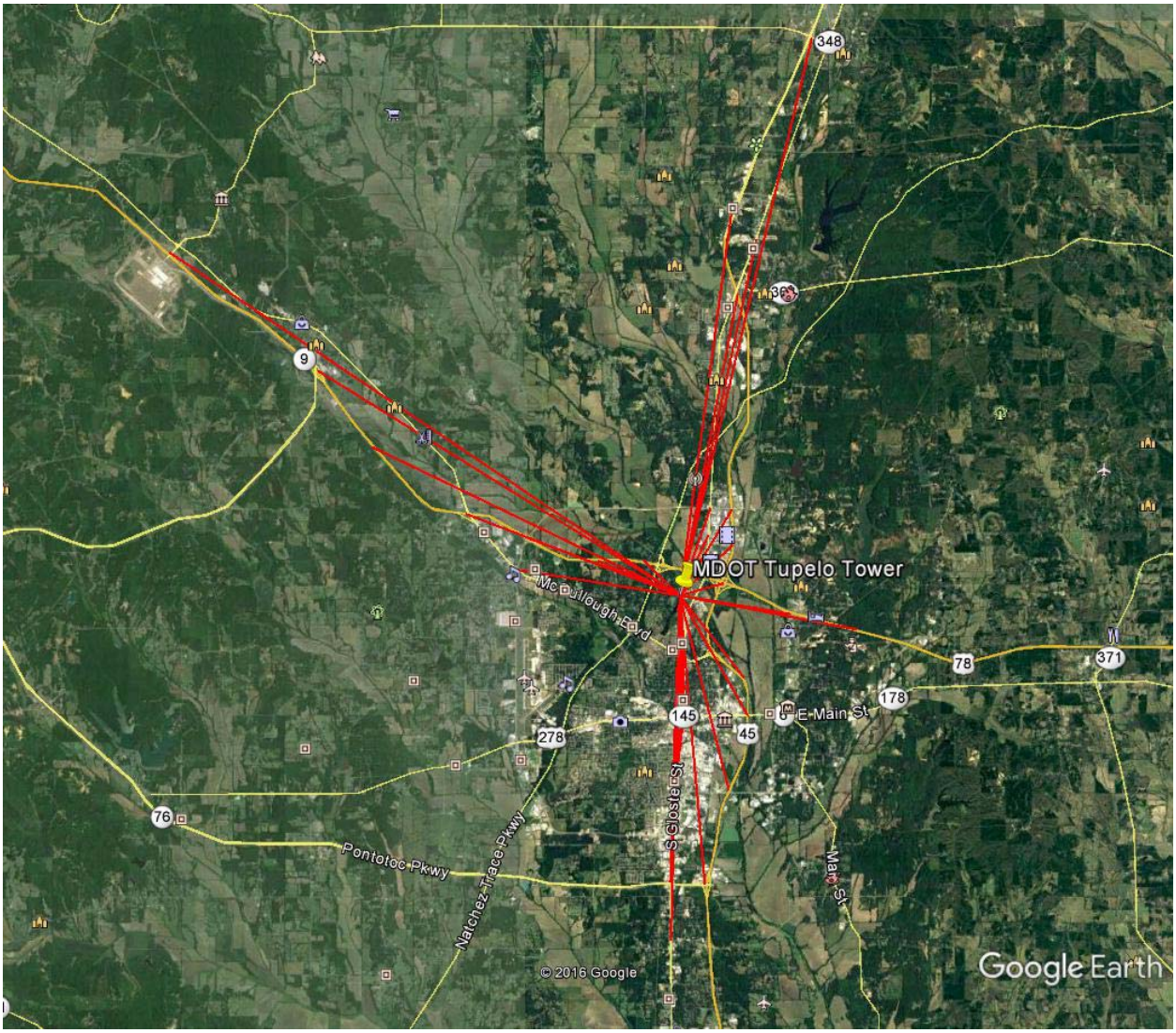
- SR145 @ CROSSOVER ROAD
- SR145 @ DAYBRITE DRIVE
- SR145 @ PRESIDENT AVENUE
- SR145 @ ROBERT E. LEE DRIVE

The report also summarizes and documents all proposed microwave transmission locations visited and outlines the clearance height needed for different radio architectures to achieve stability unless otherwise noted. The paths that do have some minor clutter in them where noted and specified accordingly.

Location - System Overview

The boundaries of the system being examined within this particular site survey's scope are all within a 12 mile radius of the main tower at the Tupelo Headquarters of the Mississippi Department of Transportation.

The Map Below is an overview map of the project path. Locations reviewed are indicative of where the forthcoming microwave system was surveyed.



In the above map the location names are turned off to prevent overwhelming clutter however the red lines depict each link in question. These links all start at the main tower and terminate at the exact physical location of all of the surveyed sites.

Survey Locations and Corresponding Summary

The ASR (Antenna Site Registration) for the EXISTING MAIN TOWER SITE located at the Tupelo MDOT Headquarters office (156ft Tall Including Appurtenances) and a photo of the tower are located on the following sheets.

This tower is 150ft tall and is grandfathered in to Tupelo's zoning restrictions. It has appurtenances that are registered as having a clearance of 6 feet above the top of the tower thereby making the entire structure 156ft tall overall. This structure will be replaced in an upcoming bid project.

Registration Detail			
Reg Number	1262064	Status	Granted
File Number	A0587278	Constructed	
EMI	No	Dismantled	
NEPA	No		
Antenna Structure			
Structure Type	TOWER - Free standing or Guyed Structure used for Commu		
Location (in NAD83 Coordinates)			
Lat/Long	34-17-27.2 N 088-43-01.5 W	Address	1917 N. Gloster
City, State	Tupelo , MS		
Zip	38804	County	LEE
Center of AM Array		Position of Tower in Array	
Heights (meters)			
Elevation of Site Above Mean Sea Level		Overall Height Above Ground (AGL)	
106.0		47.5	
Overall Height Above Mean Sea Level		Overall Height Above Ground w/o Appurtenances	
153.5		45.7	
Painting and Lighting Specifications			
None			
FAA Notification			
FAA Study	2006-ASO-6772-OE	FAA Issue Date	02/01/2007
Owner & Contact Information			
FRN	0001740950	Owner Entity Type	
Owner			
State of Mississippi Attention To: MDOT Radio Shop P.O. Box 1850 Jackson , MS 39216		P: (601)359-1513 F: E: ohosey@mdot.state.ms.us	
Contact			
Hosey , Obie W P.O. Box 1850 Jackson , MS 39216		P: (601)359-1513 F: E: ohosey@mdot.state.ms.us	
Last Action Status			
Status	Granted	Received	03/04/2008
Purpose	New	Entered	03/04/2008
Mode	Interactive		
Related Applications			
03/04/2008	A0587278 - New (NE)		
Comments			
Comments			
None			

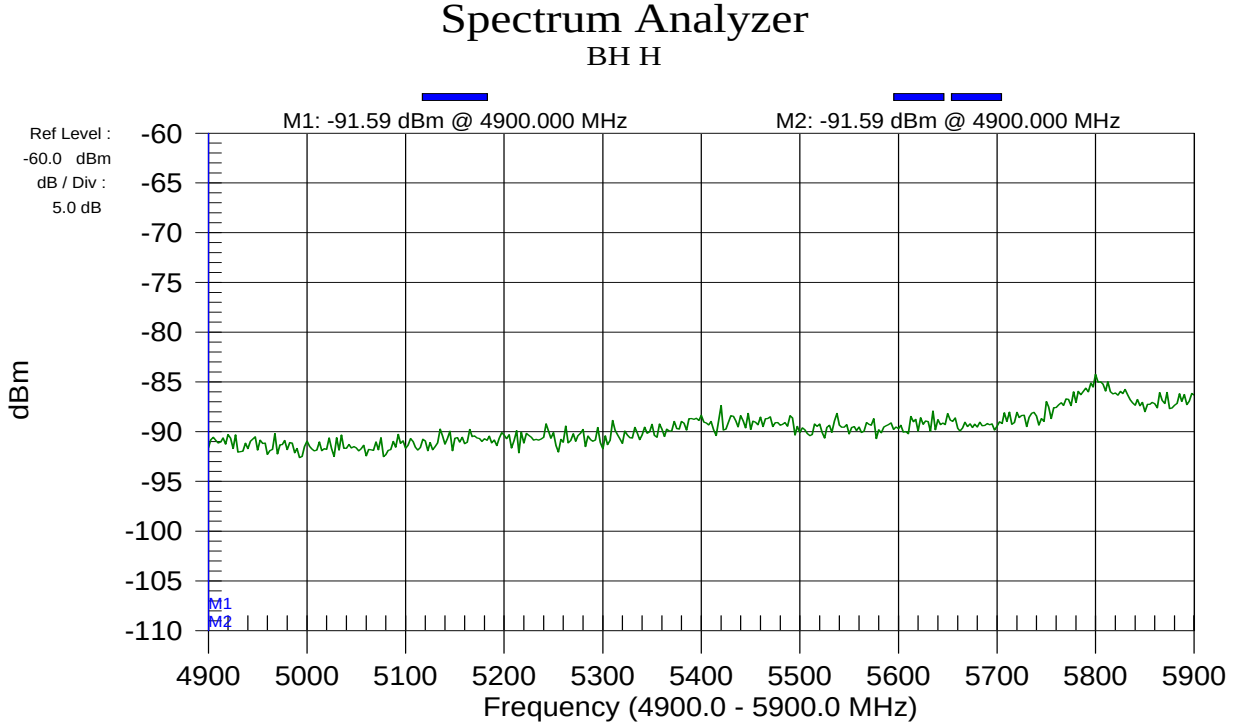
History	
Date	**Event**
03/10/2009	Construction Reminder Letter Sent
03/05/2008	Registration Printed
03/04/2008	New Application Received

Automated Letters	
03/10/2009	Construction Reminder, Reference 619560
03/05/2008	Authorization, Reference

PHOTO OF EXISTING MAIN TOWER SITE:

Spectrum Analysis – MDOT Tupelo Tower Horizontal Polarization

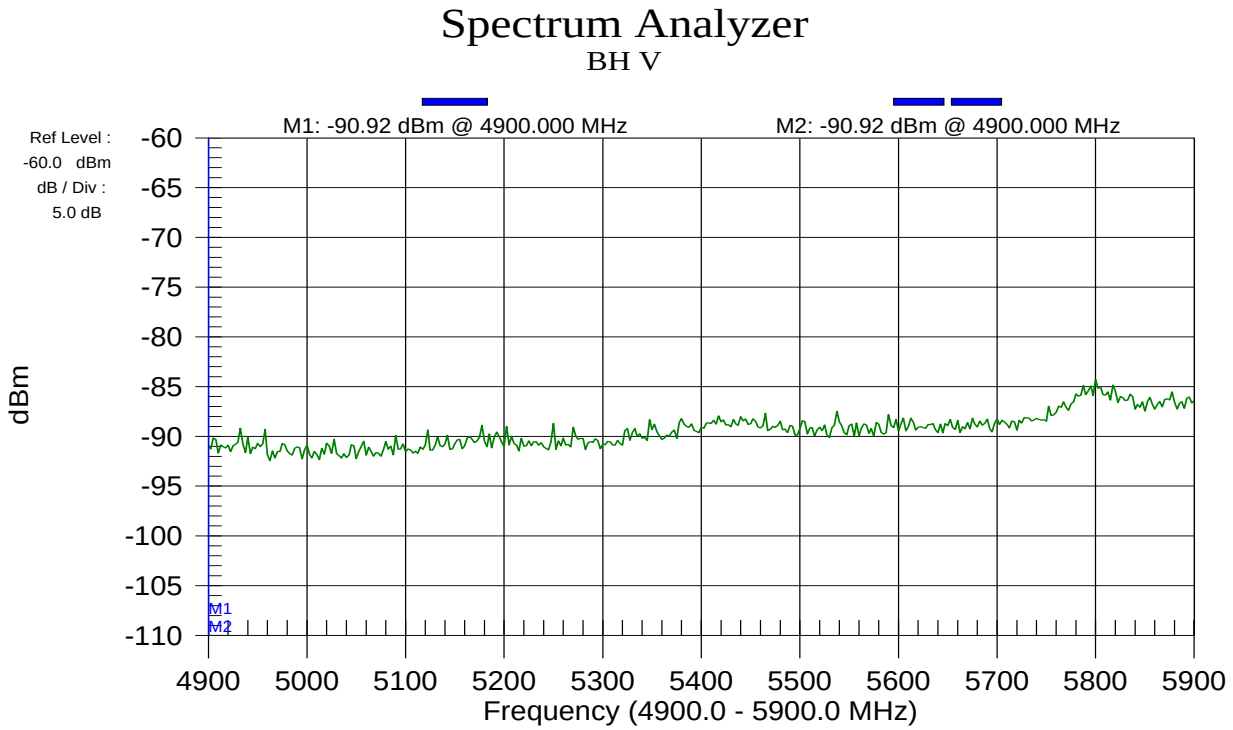
The Spectrum samples attained here look primarily clear for the immediate use of this band. There is one small gradual and expected hump peaking around 5800 MHz however it only rises to a -85 (considering the use of an 18dBi antenna during the survey) which with proper planning will be far from the signal range anticipated on these links. This particular max hold was attained with the antenna mentioned above oriented in a horizontal polarization pointed 360 degrees over roughly 15 minutes at approximately 75ft above ground level at the main tower location.



CF: 5400.0 MHz SPAN: 1000.00 MHz Attenuation: 0 dB
RBW: 1 MHz VBW: 300 kHz Detection: Pos. Peak
MaxHold: ON
Std:
Min Sweep Time: 1.00 Milli Sec

Spectrum Analysis – MDOT Tupelo Tower Vertical Polarization

The Spectrum samples attained here look primarily clear for the immediate use of this band. There is one small gradual and expected hump peaking around 5800 MHz however it only rises to a -85 (considering the use of an 18dBi antenna during the survey) which with proper planning will be far from the signal range anticipated on these links. This particular max hold was attained with the antenna mentioned above oriented in a vertical polarization pointed 360 degrees over roughly 15 minutes at approximately 75ft above ground level at the main tower location.



CF: 5400.0 MHz SPAN: 1000.00 MHz Attenuation: 0 dB
RBW: 1 MHz VBW: 300 kHz Detection: Pos. Peak
MaxHold: ON
Std:
Min Sweep Time: 1.00 Milli Sec

Deployment Location Analysis

Signal Site - SR145 at CR 814 (Main Street)

Site Name / GPS Coordinates	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
SR145 @ CR 814 (Main Street)	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°11'34.91"N / 88°43'11.44"W	Near Cabinet	6.7 miles	None	None	1	181
Note: 220 MHz to SR145 @ Pontotoc Pkwy / S. Green St.		1.1 miles	N/A	N/A	359	179

LOS (line of site) was not visualized all the way up to 80ft AGL during the survey. Due to the crane and pole size limitations that were within the given parameters of this analysis this will eliminate this location from having high speed connectivity.

An alternative solution is feasible at the existing traffic signal pole height with a low speed Serial/Ethernet radio operating in the 220 MHz licensed band with a 25 to 50KHz channel. This alternate path may have minor clutter present however this will not pose a challenge to the propagation characteristics of the 220MHz band.

Signal Site - SR145 at Pontotoc Parkway (SR6 / 76) / South Green Street

Site Name / GPS Coordinates	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
SR145 @ Pontotoc Pkwy (SR6/76) /S. Green	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°12'36.01"N / 88°43'11.94"W	West Pole	5.6 miles	10	32	2	182

LOS was visualized from ground level due to the high elevation of the entire intersection. Any of the 4 poles in the intersection should have connectivity however the West side of the intersection may have a slight advantage so it would be recommended to place a radio on either of the 2 west traffic poles. Because this location is nearly 6 miles from the tower, Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

High Speed connectivity is feasible to this existing signal pole height using a MIMO radio.

This location is a feasible solution as a repeater from the existing signal pole heights for serial connectivity to SR145 @ CR814 & SR145 @ Shell.

Signal Site - SR145 at Shell Street

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
SR145 @ Shell Street	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°12'56.23"N / 88°43'11.71"W	NE Pole	5.2 miles	35	57	2	182
Note: 220 MHz to SR145 @ Pontotoc Pkwy / S. Green St.		.38 miles	10	N/A	183	3

LOS was visualized from approximately 35ft AGL (above ground level) depending on the exact location of radio placement. Any location on the East side of the intersection should have connectivity. Because

this location is just over 5 miles from the tower, Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

An alternative solution is feasible at the existing traffic signal pole height with a low speed Serial/Ethernet radio operating in the 220 MHz licensed band with a 25 to 50KHz channel.

Signal Site - SR145 at South Green Street

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
SR145 @ S. Green Street	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°13'29.63"N / 88°43'11.53"W	NE Pole	4.6 miles	15	35	2	182

LOS was visualized from approximately 15ft AGL depending on the exact location of radio placement. Any location on the East side of the intersection should have connectivity. Because this location is nearly 5 miles from the tower, Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

High Speed connectivity is feasible to this existing signal pole height using a MIMO radio.

Signal Site - SR145 at Cliff Gookin Blvd. / Eason Blvd.

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
SR145 @ Cliff Gookin Blvd	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°13'49.99"N / 88°43'10.63"W	SE Pole	4.2 miles	34	54	2	182
Note: Near LOS from Pole Height to repeater @ SR145 & Varsity		1.4 miles	10	N/A	7	187

LOS was visualized at approximately 34ft AGL measured from above the existing utility / traffic pole combo. The South East side of the intersection seems best for connectivity. Because of this locations distance from the tower, Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

In an effort to use the existing pole structure as a mounting location, an alternate site was visualized that could act as a repeater for this location as well as others. That alternate location is the intersection of SR145 & Varsity. An additional base station type solution will need to be installed at SR145 & Varsity in order to accomplish this alternative option.

High Speed connectivity is feasible to this existing signal pole height using a MIMO radio.

Signal Site - SR145 at Garfield Street

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
SR145 @ Garfield Street	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°14'28.20"N / 88°43'4.03"W	SE Pole	3.4 miles	30	47	1	181
Note: Near LOS from Pole Height to repeater @ SR145 & Main		1.14 miles	10	N/A	7	187

LOS was visualized at approximately 30ft AGL measured from above the existing traffic pole. The South East side of the intersection appears best for connectivity. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

In an effort to use the existing pole structure as a mounting location, an alternate site was visualized that could act as a repeater for this location as well as others. That alternate location is the intersection of SR145 & Varsity. An additional base station type solution will need to be installed at SR145 & Varsity in order to accomplish this alternative option.

High Speed connectivity is feasible to this existing signal pole height using a MIMO radio.

NOTE: Regarding CROSSOVER ROAD, DAYBRITE DRIVE, PRESIDENT AVENUE, and ROBERT E. LEE DRIVE:

All of these locations are currently connected as slaves through the Master Site of Varsity Drive. All of these locations also have near line of site to Varsity Drive. Therefore the only site that was examined in this wireless analysis was the master site, Varsity Drive which is below:

Signal Site - SR145 at Varsity Drive

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
SR145 @ Varsity Drive	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°15'0.68"N / 88°42'59.37"W	SW Pole	2.8 miles	40	56	359	179
Note: LOS from Ground Level to repeater @ SR145 & Main		.51 miles	10	N/A	7	187

LOS was visualized at approximately 40ft AGL measured from above the existing southwest traffic pole. The Northeast side of the intersection appears optimal however due to the lack of space on that utility/traffic pole the survey was conducted from above the Southwest Pole. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

In an effort to use the existing southwest pole structure as a mounting location, an alternate site was visualized that could act as a repeater for this location as well as several other sites. That alternate location is the intersection of SR145 & Main Street. An additional base station type solution will need to be installed at SR145 & Main in order to accomplish this alternative option. Therefore, high Speed connectivity is feasible to this existing signal pole height using a MIMO radio.

ALSO this location is a feasible solution as a repeater from the existing signal pole height for high speed connectivity to SR145 @ Cliff Gookin & SR145 @ Garfield.

Signal Site - SR145 at New Walmart Entrance

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
SR145 @ New Walmart Entrance	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°15'15.74"N / 88°42'56.51"W	West Side of Int.	2.6 miles	65	81	358	178
Note: LOS from Ground Level to repeater @ SR145 & Main		.21 miles	10	N/A	3	183

LOS was visualized at approximately 65ft AGL measured from above the existing light pole on the east side of the road in front of the gas station. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

In an effort to use one of the existing pole structures as a mounting location, an alternate site was visualized that could act as a repeater for this location as well as several other sites. That alternate location is the intersection of SR145 & Main Street which is approximately 2 blocks away. An additional base station type solution will need to be installed at SR145 & Main in order to accomplish this alternative option. Therefore high Speed connectivity is feasible to this existing signal pole height using a MIMO radio.

Signal Site - SR145 at Main Street

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
SR145 @ Main Street	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°15'26.74"N / 88°42'55.52"W	NE Pole	2.3 miles	10	26	357	177

LOS was visualized at approximately ground level measured near the existing pole in the median of the northeast quadrant of the intersection. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation. High Speed connectivity is feasible from the existing signal pole height using a MIMO radio.

This site should also be considered as a possible location of a repeater base station similar to the main tower. With that in mind this site could act as a repeater for the following locations: SR145 &: Garfield, Varsity, Walmart, and Jefferson. Thereby allowing all of those locations to use their existing structures for connectivity rather than having to place taller structures at each site in order to accomplish links all the way back to the main tower. An important note when considering repeater sites: Because of all of the connectivity flowing through this site which also needs connectivity, it is best to make this locations primary feed to the main tower a Point to Point link rather than just another multipoint location.

Signal Site - SR145 at Jefferson Street

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
SR145 @ Jefferson Street	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°15'32.29"N / 88°42'55.73"W	SW Side of Int.	2.2 miles	None	N/A	358	178
Note: LOS from Ground Level to repeater @ SR145 & Main		.11 miles	10	N/A	359	179

LOS (line of site) was NOT visualized all the way up to 80ft AGL during the survey from the existing poles. Due to the crane and pole size limitations that were within the given parameters of this analysis this could eliminate this location from having high speed connectivity, however there is an alternative option. In an effort to use one of the existing pole structures as a mounting location, an alternate site was visualized that could act as a repeater for this location as well as several other sites. That alternate location is the intersection of SR145 & Main Street which is approximately 1 block away. Any pole at any side of the intersection will suffice. An additional base station type of solution will need to be installed at SR145 & Main in order to accomplish this alternative option. Therefore high Speed connectivity is feasible to this existing signal pole height using a MIMO radio.

Signal Site - SR145 at Jackson Street

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
SR145 @ Jackson Street	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°15'52.64"N / 88°42'55.94"W	NE Pole	1.8 miles	10	23	357	177

LOS was visualized at approximately ground level measured near the existing pole in the northeast quadrant of the intersection. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

High Speed connectivity is feasible from the existing signal pole height using a MIMO radio.

Signal Site - SR145 at Symphony Lane

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
SR145 @ Symphony Lane	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°18'28.77"N / 88°42'26.34"W	SW Pole	1.3 miles	10	23	205	25

LOS was visualized at approximately ground level measured near the existing pole in the southwest quadrant of the intersection. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

High Speed connectivity is feasible from the existing signal pole height using a MIMO radio.

Signal Site - SR145 at Barnes Crossing Road

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
SR145 @ Barnes Crossing Road	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°18'56.56"N / 88°42'23.50"W	Any East Pole	1.8 miles	10	23	199	19

LOS was visualized at approximately ground level measured near the existing pole in the southwest quadrant of the intersection. Any pole on the east or south side of the intersection should suffice. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

High Speed connectivity is feasible from the existing signal pole height using a MIMO radio.

Signal Site - SR178 (McCullough Blvd.) at Coley Road

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
SR178 (McCullough Blvd) @ Coley Road	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°17'54.16"N / 88°46'24.46"W	West Pole	3.2 miles	78	95	98	278

LOS was visualized at approximately 78ft AGL above the existing pole on the west quadrant of the intersection. Due to the crane and pole size limitations that were within the given parameters of this analysis this will likely eliminate this location. Also Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation. High Speed Connectivity is feasible considering such a tall pole for implementation. A solution that seems more feasible at this location would be a low speed Serial/Ethernet radio operating in the 220 MHz licensed band with a 25 to 50KHz channel. This type of radio will not provide enough bandwidth to sustain a video camera however it will provide enough connectivity for serial type communications required by a traffic signal cabinet.

High Speed connectivity is NOT feasible to this existing signal pole height.

Camera Site - SR145 at SR178 (McCullough Blvd.)

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
SR145 @ SR178 (McCullough Blvd)	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°16'21.10"N / 88°42'55.55"W	SE Side of Int.	1.3 miles	60	73	355	175

LOS was visualized at approximately 60ft AGL measured from above the existing light pole on the east side of the road on the south side of the intersection. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

High Speed connectivity is feasible using a 60ft AGL pole height and a high powered MIMO radio.

Camera Site - SR145 at Euclautubbard Road (Old 45)

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
SR145 @ Euclautubbard Rd (Old 45)	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°23'28.90"N / 88°41'27.22"W	South Side	7.1 miles	73	98	192	12

LOS was visualized at approximately 73ft AGL above the existing pole in the south quadrant of the intersection. Due to the crane and pole size limitations that were within the given parameters of this analysis this will likely eliminate this location. Also Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

Considering the long distance of this site, high speed connectivity is feasible using at least an 80ft AGL pole height and a high powered MIMO radio. Otherwise this site will have to be eliminated.

Camera Site - US45 at Pontotoc Parkway (SR6/76) / South Green Street

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
US45 @ Pontotoc Pkwy (SR6/76) / S. Green	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°12'35.01"N / 88°42'30.19"W	NW Side of Int.	5.6 miles	20	44	355	175

LOS was visualized at approximately 20ft AGL measured from above the stake placed on the northwest side of the intersection. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

High speed connectivity is feasible using a 50ft AGL pole height.

Camera Site - US45 at Eason Blvd

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
US45 @ Eason Blvd	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°14'10.76"N / 88°42'1.06"W	NW Side of Int.	3.9 miles	68	86	345	165

LOS was visualized at approximately 68ft AGL measured from above the proposed location on the northwest side of the intersection. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

High speed connectivity is feasible using at least a 70ft AGL pole height and a high powered MIMO radio.

Camera Site - US45 at Main Street

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
US45 @ Main Street	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°15'25.42"N / 88°41'37.15"W	SE Side of Int.	2.7 miles	30	46	330	150

LOS was visualized at approximately 30ft AGL measured from above the proposed location on the southeast side of the intersection. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

High speed connectivity is feasible using a 50ft AGL pole height.

Camera Site - US45 at SR178 McCullough Blvd.

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
US45 @ SR178 (McCullough Blvd)	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°16'30.53"N / 88°42'22.85"W	NE Side of Int.	1.3 miles	68	81	330	150

LOS was visualized at approximately 68ft AGL measured from above the proposed location on the northeast side of the intersection. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

High speed connectivity is feasible using at least a 70ft AGL pole height and a MIMO radio.

This site should also be considered as a possible location of a repeater base station, similar to the main tower. With that in mind, this site could act as a repeater for DMS 1. Thereby allowing DMS 1 to use a shorter structure for connectivity. An important note when considering repeater sites: Because of all of the connectivity flowing through this site, which also needs connectivity, it is best to make this locations primary feed to the main tower a Point to Point link rather than just another multipoint location.

Camera Site - US45 at SR78

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
US45 @ SR78	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°17'40.20"N / 88°42'7.49"W	NE Side of Int.	.9 miles	10	19	254	74

LOS was visualized at approximately ground level measured near the proposed pole location in the northeast quadrant of the intersection. Any pole in any quadrant of the intersection should suffice due to the short distance of this link but should be checked for clearance first. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

High speed connectivity is feasible using a 50ft AGL pole height.

Camera Site - US45 at Barnes Crossing Road

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
US45 @ Barnes Crossing Road	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°18'54.69"N / 88°41'57.31"W	SE Side of Int.	1.9 miles	10	23	211	31

LOS was visualized at approximately ground level measured near the proposed pole location in the southeast quadrant of the intersection. Any pole in any quadrant of the intersection should suffice due to the short distance of this link but should be checked for clearance first. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

High speed connectivity is feasible using a 50ft AGL pole height.

Camera Site - US45 at SR145 – Saltillo

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
US45 @ SR145 Saltillo	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°22'33.77"N / 88°41'50.21"W	SE Side of Int.	6.0 miles	43	65	190	10

LOS was visualized at approximately 43ft measured near the proposed pole location in the southeast quadrant of the intersection. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

High speed connectivity is feasible using a 50ft AGL pole height and a high powered MIMO radio.

Camera Site - US45 @ Euclautubbard Road (Old 45)

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
US45 @ Euclautubbard Rd (Old 45)	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°23'54.51"N / 88°41'58.38"W	SW Side of Int.	7.5 miles	75	100	188	8

LOS was visualized at approximately 75ft AGL above the proposed pole location on the west side of the intersection. Due to the crane and pole size limitations that were within the given parameters of this analysis this will likely eliminate this location. Also Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation. High Speed Connectivity is feasible considering such a tall pole for implementation. Given that this is a “camera only” site, a low speed NLOS solution is not feasible.

High speed connectivity is feasible using an 80ft AGL pole height and a high powered MIMO radio. Otherwise this site will have to be eliminated.

Camera Site - US45 at SR348 – Guntown

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
US45 @ SR 348 (Guntown)	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°26'52.85"N / 88°40'19.42"W	SE Side of Int.	11.1 miles	58	88	193	13

LOS was visualized at approximately 58ft AGL measured from above the proposed location on the southeast side of the intersection. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

High speed connectivity is feasible using a 80ft AGL pole height and a high powered MIMO radio.

Camera Site - US78 at Toyota Plant

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
US78 @ Toyota Plant	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°23'14.44"N / 88°53'28.32"W	N-NE Side Int.	12 miles	15	46	124	304

LOS was visualized at approximately 15ft AGL measured from above the proposed location on the northeast side of the intersection. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

High Speed connectivity is feasible using a 50ft AGL pole height and a high powered radio.

Camera Site - US78 at SR9 – Sherman

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
US78 @ SR9 (Sherman)	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°21'14.90"N / 88°50'25.54"W	SE-E Side Int.	8.3 miles	80	106	122	302

LOS was visualized at approximately 80ft AGL above the proposed pole location in the north side of the intersection. Due to the crane and pole size limitations that were within the given parameters of this analysis this will likely eliminate this location. Also Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

High Speed Connectivity is feasible using an 80ft AGL pole height and a high powered MIMO radio. Otherwise this site will have to be eliminated.

Camera Site - On US78 East of Sherman

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
US78 @ East of Sherman	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°19'57.96"N / 88°49'18.81"W	see coordinates	6.6 miles	40	63	116	296

LOS was visualized at approximately 40ft AGL measured from above the proposed location on the south side of the interstate. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

High Speed connectivity is feasible using a 50ft AGL pole height and a high powered radio.

Camera Site - US78 at SR178 (McCullough Blvd.)

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
US78 @ SR178 (McCullough Blvd)	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°18'50.35"N / 88°47'23.58"W	SW Side of Int.	4.5 miles	10	30	111	291

LOS was visualized at approximately ground level measured near the proposed location on the southwest side of the intersection. Any pole in any quadrant of the intersection should suffice due to the elevation of this link and the considerable distance to the first obstructions however this should be verified for clearance first before using an alternative position. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

High Speed connectivity is feasible using a 50ft AGL pole height.

Camera Site - US78 at Coley Road

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
US78 @ Coley Road	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°18'23.32"N / 88°46'7.21"W	SE Side of Int.	3.2 miles	10	27	110	290

LOS was visualized at approximately ground level measured near the proposed location on the south side of the intersection. Any pole in any quadrant of the intersection should suffice due to the elevation of this link and the considerable distance to the first obstructions however this should be verified for clearance first before using an alternative position. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

High Speed connectivity is feasible using a 50ft AGL pole height.

Camera Site - US78 at Natchez Trace

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
US78 @ Natchez Trace	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°18'3.39"N / 88°43'45.90"W	see coordinates	.98 miles	53	62	134	314

LOS was visualized at approximately 53ft AGL measured from above the proposed location on the far west side of the interstate. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

High Speed connectivity is feasible using a 50ft AGL pole height and a high powered MIMO radio.

This site should also be considered as a possible location of a repeater base station, similar to the main tower. With that in mind, this site could act as a repeater for DMS 2. Thereby allowing DMS 2 to use a shorter structure for connectivity. An important note when considering repeater sites: Because of all of the connectivity flowing through this site, which also needs connectivity, it is best to make this locations primary feed to the main tower a Point to Point link rather than just another multipoint location.

Camera Site - US78 at Veterans Memorial Blvd.

Link Information / Remote Site	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
US78 @ Veterans Memorial Blvd.	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°17'9.15"N / 88°40'45.70"W	SW Side of Int.	2.19 miles	10	25	280	100

LOS was visualized at approximately ground level measured near the proposed location on the south west side of the intersection. Any pole in any quadrant of the intersection should suffice due to the elevation and short distance of this link and the considerable distance to the first obstructions however this should be verified for clearance first before using an alternative position. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

High Speed connectivity is feasible using a 50ft AGL pole height.

DMS 1 – On US45 between Main Street and McCullough Blvd.

Link Information / Remote Site (DMS 1)	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
US45 @ Between Main St. & McCullough St.	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°16'4.24"N / 88°41'42.23"W	see coordinates	2.0 miles	NLOS	N/A	322	142
Note: LOS from Pole Height to repeater @ US45 & SR178		.82 miles	10	N/A	308	128

LOS (line of site) was NOT visualized all the way up to 80ft AGL during the survey from the proposed pole placement. Due to the crane and pole size limitations that were within the given parameters of this analysis this could eliminate this location from having high speed connectivity, however there is an alternative option. In an effort to use a shorter structure as a mounting location, an alternate site was visualized that could act as a repeater for this location. That alternate location is the nearby intersection

of US45 & SR178 which is less than a mile away. An additional base station type of solution will need to be installed at US45 & SR178 in order to accomplish this alternative option.

High Speed connectivity is feasible using at least a 25ft AGL pole height considering the alternative repeater option.

DMS 2 – On US78 between Mount Vernon Road and Coley Road

Link Information / Remote Site (DMS 2)	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
US78 @ Between Mt. Vernon & Coley Rd.	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°18'2.69"N / 88°44'41.39"W	see coordinates	1.72 miles	NLOS	N/A	113	293
Note: LOS from Pole Height to repeater @ US78&Natches Trace		.88 miles	10	N/A	89	269

LOS (line of site) was NOT visualized all the way up to 80ft AGL during the survey from the proposed pole placement. Due to the crane and pole size limitations that were within the given parameters of this analysis this could eliminate this location from having high speed connectivity, however there is an alternative option. In an effort to use a shorter structure as a mounting location, an alternate site was visualized that could act as a repeater for this location. That alternate location is the nearby intersection of US78 & Natchez Trace which is less than a mile away. An additional base station type of solution will need to be installed at US78 & Natchez Trace in order to accomplish this alternative option.

High Speed connectivity is feasible using at least a 22ft AGL pole height considering the alternative repeater option.

DMS 3 – On US45 between US78 and Barnes Crossing Road

Link Information / Remote Site (DMS 3)	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
US45 @ Between US78 & Barnes Crossing	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°18'18.84"N / 88°41'56.43"W	see coordinates	1.42 miles	10	22	226	46

LOS was visualized at approximately ground level measured near the proposed location. This is primarily due to the considerable distance to the nearest obstruction. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation.

High Speed connectivity is feasible using at least a 22ft AGL pole height considering the alternative repeater option.

DMS 4 – On US78 between Veterans Memorial Blvd. and Eason Blvd.

Link Information / Remote Site (DMS 4)	Other Details		Line of Site (in feet)		Azimuth (in degrees)	
US78 @ Veterans Memorial & Eason Blvd.	Survey Location	Path Distance	Optical	w/ Fresnel @ 5GHz	to Tower	to Site
34°16'53.28"N / 88°39'24.52"W	see coordinates	3.51 miles	38	55	281	101

LOS was visualized at approximately 38ft AGL measured near the proposed location. Fresnel zone clearance may be needed depending upon the wireless technology used in the final implementation. High Speed connectivity is feasible.

High Speed connectivity is feasible using at least a 38ft AGL pole height and a MIMO radio or at least a 55ft pole height and a SISO radio.

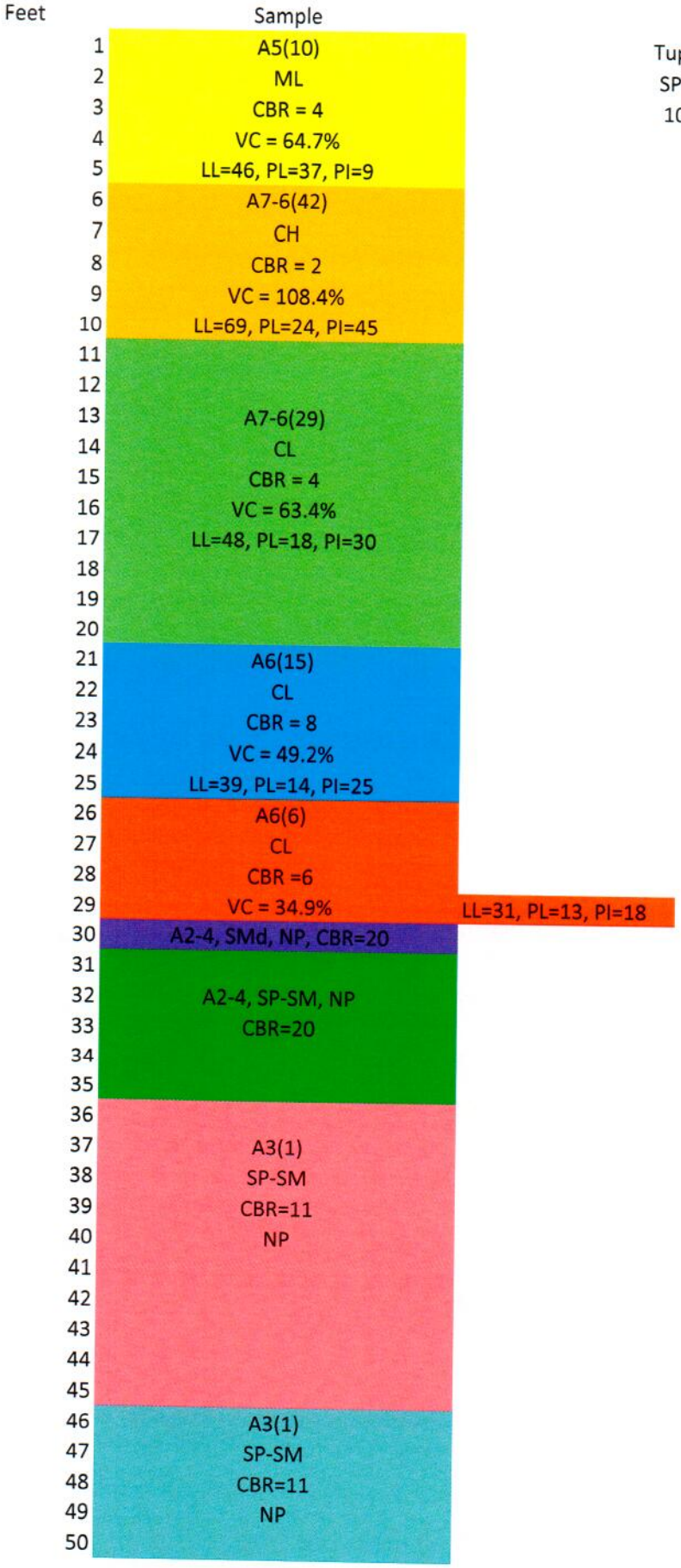
Recommendations

In conclusion we believe that it is safe to predict the desired outcome and longevity that can be anticipated along these paths provided that the implementation team uses the proper equipment and seasoned microwave engineers. As with any unlicensed link, there may be times when the configured center frequency may need adjusting due to noise such as nearby interference. However it is clear that these paths will produce desired results chiefly due to the fact that the signal on such paths traditionally has the ability to overcome noise issues well when the proper equipment and antennas are implemented. We are also recommending a high fade margin and high output power MIMO radio system so that if a single pole receives interference it can be expected that the other polarization can continue to operate unhindered and with high signal, thereby maintaining the link and again producing the desired results. MIMO systems using multiple polarities properly and in conjunction with one another actually multiplies the output power giving another added benefit to this architecture. As stated in the opening summary, Fresnel Zone Clearance was calculated for each path and depending on the distance of the path and the exact radio architecture installed, these calculations should be seriously considered. The use of a MIMO radio system will likely be best as these particular paths, when visually studied, have minimal to no clutter in them currently; however, due to various factors over time, such as vegetation growth and urbanization, the optical and radio line of site can be expected to be impacted. Lastly, the spectrum analysis performed in September of 2016 shows the majority of the unlicensed band being relatively clear at the tower site; however, this can change over time and, even considering the improbability of monitoring the spectrum at each and every site daily, this can and will also change over time.

The alternate frequency outlined often in this document is 220 MHZ and can be used as a very low bandwidth (or serial only) alternative when little to No Line of Site (NLOS) is present. These frequencies are licensed and operate in a similar manner to 900MHz radios without the high noise floor and corresponding interference.

Any future noise/interference introduced is out of the control of Deep South Communications and should be considered when implementing these links.

Considering all of the pertinent parameters these links should perform as expected and stated throughout this report.



Tupelo Tower Site
SP-9999-01(007)
107364-101000

MISSISSIPPI DEPARTMENT OF TRANSPORTATION

SOIL REPORT

Test Method AASHTO T11, AASHTO T27, AASHTO T88, And MT22

Contract ID	MTL-DISTRCT-OCA	Fed/State Proj. #	For Charging Tests to District		FMS Proj. #	DISTRICT1-OCA	
Sample Status	COMP			LAB ID	D1001	Sample ID	171130GLB0011
Revising Sample Number			Date Sampled	2017-06-05		Date Completed	2017-06-08
Material Code	070300153	Material Name	SOIL PROFILE(ORG)	Sample Test Number	1	Date Authorized	
Linked To Sample #							

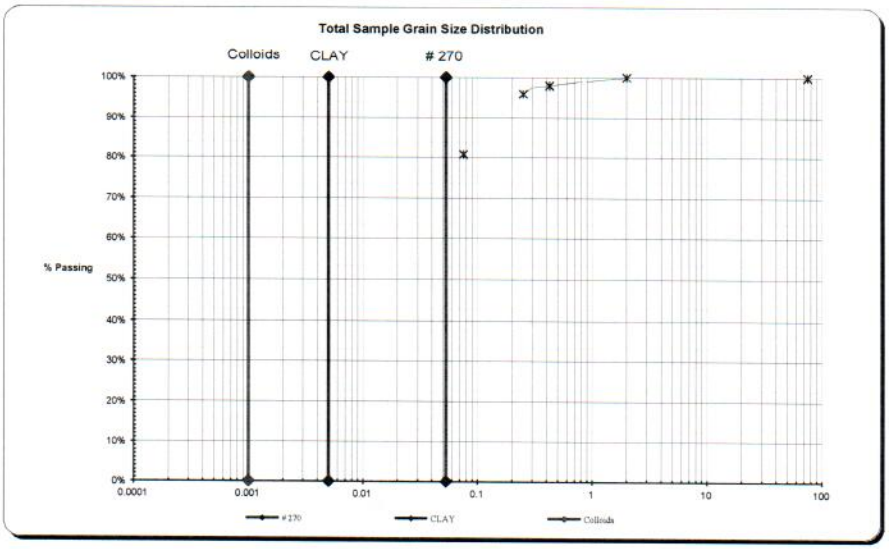
Sampled From: 0-5' tupelo tower — Distance From Grade:

Sample Station No.: — Station Offset: — Lot Limit - Beg.: — Lot Limit - End.:

Status: COMP — This material has been tested in accordance with MDOT specifications and is satisfactory for use in MDOT projects.

Sieve Designation	% Passing	Spec. Ranges MAX.	Spec. Ranges MIN.	Screen Result	REMARKS
3" (75 mm)	100				Sieve Gradation
1/2" (63 mm)					Lab #43865
2" (50 mm)					
1 3/4" (45 mm)					
1 1/2 (37.5 mm)					
1" (25 mm)					
1/2" (12.5 mm)					
3/8" (9.5 mm)					
#4 (4.75 mm)					
#10 (2.00 mm)	100				
Minus # 10 Results					
#40 (425 um)	98				
#60 (250 um)	96				
#200(75 um)	80.8				
#270(54 um)					
% Silt					Hydrometer
% Clay					
% Colloids					
Dust Ratio					
HCL reaction:					
Mica Content:					
Liquid Limit	46				
Plastic Limit	37				Atterberg Limits
Plasticity Index	9				Lab #43865
Shrinkage Limit	11.4				0-5'
Shrinkage Ratio	1.92				
Volume Change	64.7	60			
AASHTO	A5				FCH045
GROUP INDEX	10				
U. S. C.	ML				
Est. CBR	4				

TOTAL SAMPLE RESULT =



MISSISSIPPI DEPARTMENT OF TRANSPORTATION
SOIL REPORT

Test Method AASHTO T11, AASHTO T27, AASHTO T88, And MT22

Contract ID	MTL-DISTRCT-OCA	Fed/State Proj. #	For Charging Tests to District		FMS Proj. #	DISTRICT1-OCA	
Sample Status	COMP			LAB ID	D1001	Sample ID	171130GLB0012
Revising Sample Number			Date Sampled	2017-06-05		Date Completed	2017-06-08
Material Code	070300153	Material Name	SOIL PROFILE(ORG)	Sample Test Number	2	Date Authorized	
Linked To Sample #							

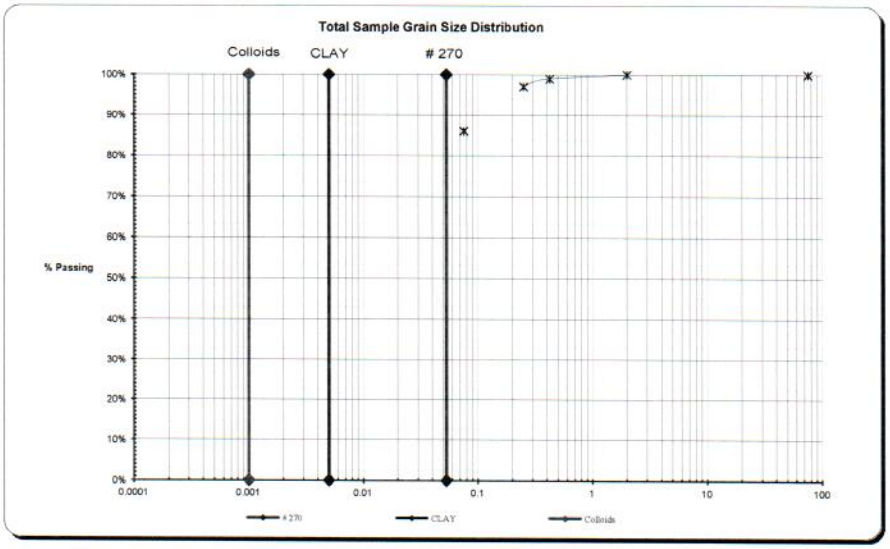
Sampled From: 6-10' tupelo tower Distance From Grade:

Sample Station No.: Station Offset: Lot Limit - Beg.: Lot Limit - End.:

Status: COMP This material has been tested in accordance with MDOT specifications and is satisfactory for use in MDOT projects.

Sieve Designation	% Passing	Spec. Ranges MAX.	Spec. Ranges MIN.	Screen Result	REMARKS
3" (75 mm)	100				Sieve Gradation
1/2" (63 mm)					Lab #43866
2" (50 mm)					
1 3/4" (45 mm)					
1 1/2 (37.5 mm)					
1" (25 mm)					
1/2" (12.5 mm)					
3/8" (9.5 mm)					
#4 (4.75 mm)					
#10 (2.00 mm)	100				
Minus # 10 Results					
#40 (425 um)	99				
#60 (250 um)	97				
#200(75 um)	86.1				
#270(54 um)					
% Silt					Hydrometer
% Clay					
% Colloids					
Dust Ratio					
HCL reaction:					
Mica Content:					
Liquid Limit	69				
Plastic Limit	24				Atterberg Limits
Plasticity Index	45				Lab #43866
Shrinkage Limit	12.5				6-10'
Shrinkage Ratio	1.95				
Volume Change	108.4	60			
AASHTO	A7-6				FCH045
GROUP INDEX	42				
U. S. C.	CH				
Est. CBR	2				

TOTAL SAMPLE RESULT =



MISSISSIPPI DEPARTMENT OF TRANSPORTATION

SOIL REPORT

Test Method AASHTO T11, AASHTO T27, AASHTO T88, And MT22

Contract ID	MTL-DISTRCT-OCA	Fed/State Proj. #	For Charging Tests to District		FMS Proj. #	DISTRICT1-OCA	
Sample Status	COMP			LAB ID	D1001	Sample ID	171130GLB0013
Revising Sample Number			Date Sampled	2017-06-05		Date Completed	2017-06-08
Material Code	070300153	Material Name	SOIL PROFILE(ORG)	Sample Test Number	3	Date Authorized	
Linked To Sample #							

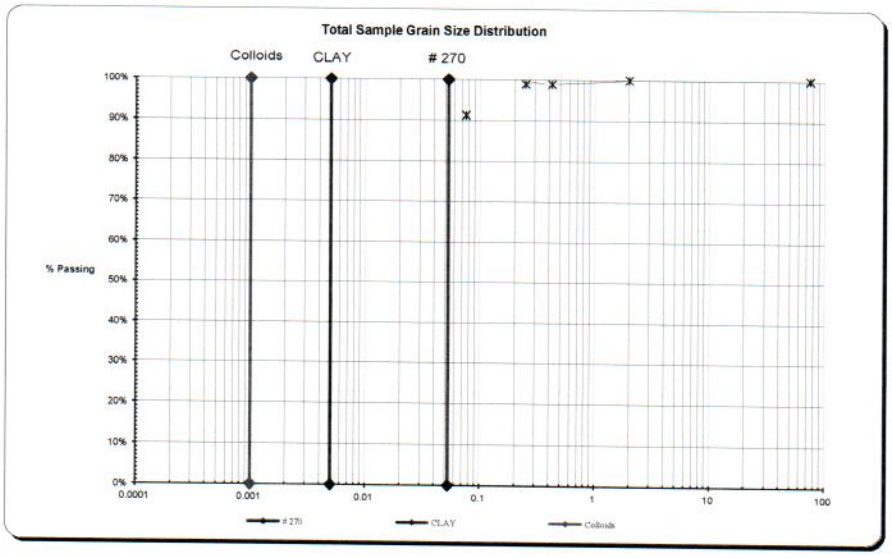
Sampled From: 11-15' tupelo tower — Distance From Grade:

Sample Station No.: — Station Offset: — Lot Limit - Beg.: — Lot Limit - End.:

Status: COMP — This material has been tested in accordance with MDOT specifications and is satisfactory for use in MDOT projects.

Sieve Designation	% Passing	Spec. Ranges MAX.	Spec. Ranges MIN.	Screen Result	REMARKS
3" (75 mm)	100				Sieve Gradation
1/2" (63 mm)					Lab #43867
2" (50 mm)					
1 3/4" (45 mm)					
1 1/2 (37.5 mm)					
1" (25 mm)					
1/2" (12.5 mm)					
3/8" (9.5 mm)					
#4 (4.75 mm)					
#10 (2.00 mm)	100				
Minus # 10 Results					
#40 (425 um)	99				
#60 (250 um)	99				
#200(75 um)	91.3				
#270(54 um)					
% Silt					Hydrometer
% Clay					
% Colloids					
Dust Ratio					
HCL reaction:					
Mica Content:					
Liquid Limit	48				Atterberg Limits
Plastic Limit	18				
Plasticity Index	30				Lab # 43867
Shrinkage Limit	14.4				
Shrinkage Ratio	1.86				
Volume Change	63.4	60			
AASHTO	A7-6				FCH045
GROUP INDEX	29				
U. S. C.	CL				
Est. CBR	4				

TOTAL SAMPLE RESULT =



MISSISSIPPI DEPARTMENT OF TRANSPORTATION
SOIL REPORT

Test Method AASHTO T11, AASHTO T27, AASHTO T88, And MT22

Contract ID	MTL-DISTRCT-OCA	Fed/State Proj. #	For Charging Tests to District	FMS Proj. #	DISTRICT1-OCA		
Sample Status	COMP		LAB ID	D1001	Sample ID	171130GLB0015	
Revising Sample Number			Date Sampled	2017-06-05	Date Completed	2017-06-08	
Material Code	070300153	Material Name	SOIL PROFILE(ORG)	Sample Test Number	4	Date Authorized	
Linked To Sample #							

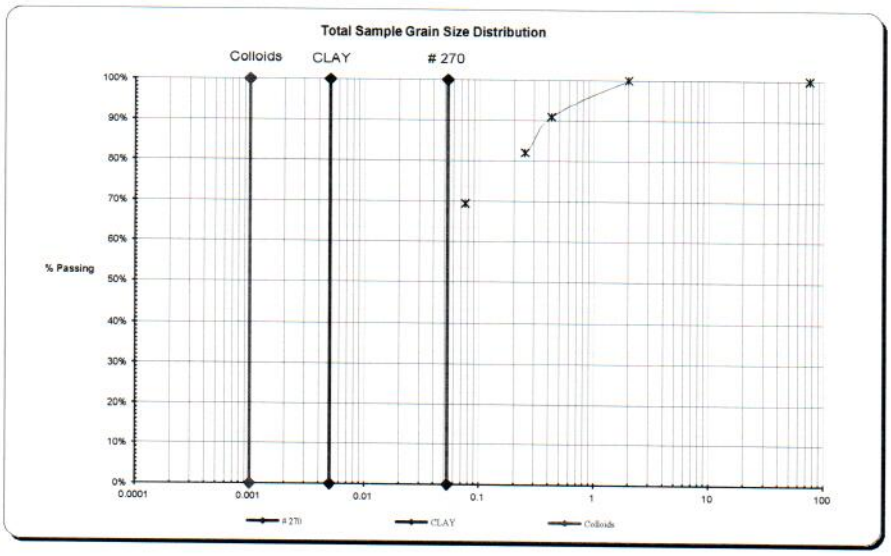
Sampled From 16-22' tupelo tower Distance From Grade

Sample Station No. Station Offset Lot Limit - Beg. Lot Limit - End.

Status COMP This material has been tested in accordance with MDOT specifications and is satisfactory for use in MDOT projects.

Sieve Designation	% Passing	Spec. Ranges MAX.	Spec. Ranges MIN.	Screen Result	REMARKS
3" (75 mm)	100				Sieve Gradation
1/2" (63 mm)					Lab #43868
2" (50 mm)					
1 3/4" (45 mm)					
1 1/2 (37.5 mm)					
1" (25 mm)					
1/2" (12.5 mm)					
3/8" (9.5 mm)					
#4 (4.75 mm)					
#10 (2.00 mm)	100				
Minus # 10 Results					
#40 (425 um)	91				
#60 (250 um)	82				
#200(75 um)	69.5				
#270(54 um)					
% Silt					Hydrometer
% Clay					
% Colloids					
Dust Ratio					
HCL reaction:					
Mica Content:					
Liquid Limit	39				
Plastic Limit	14				Atterberg Limits
Plasticity Index	25				Lab #43868
Shrinkage Limit	13.5				
Shrinkage Ratio	1.9				
Volume Change	49.2	60			
AASHTO	A6				FCH045
GROUP INDEX	15				
U. S. C.	CL				
Est. CBR	8				

TOTAL SAMPLE RESULT =



MISSISSIPPI DEPARTMENT OF TRANSPORTATION

SOIL REPORT

Test Method AASHTO T11, AASHTO T27, AASHTO T88, And MT22

Contract ID	MTL-DISTRCT-OCA	Fed/State Proj. #	For Charging Tests to District		FMS Proj. #	DISTRICT1-OCA	
Sample Status	COMP			LAB ID	D1001	Sample ID	171130GLB0016
Revising Sample Number			Date Sampled	2017-06-05		Date Completed	2017-06-08
Material Code	070300153	Material Name	SOIL PROFILE(ORG)	Sample Test Number	5	Date Authorized	
Linked To Sample #							

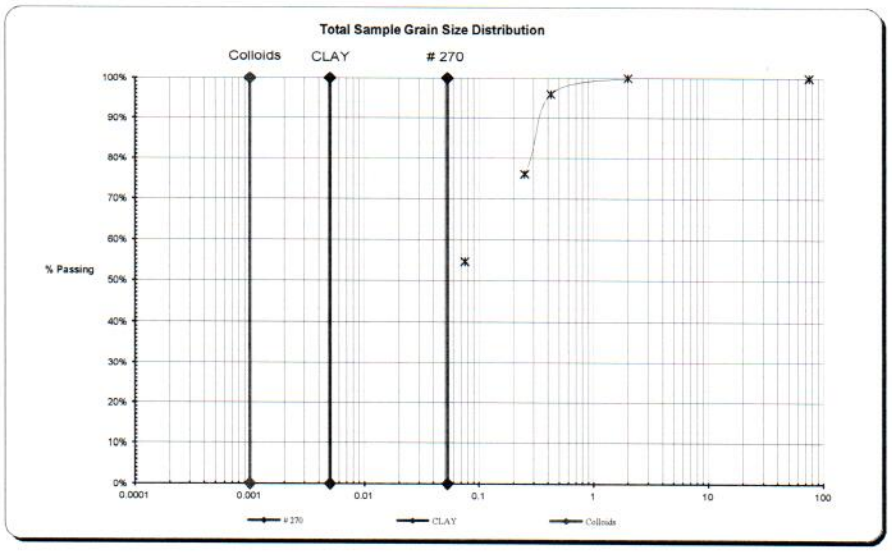
Sampled From: 23-30' tupelo tower — Distance From Grade:

Sample Station No.: — Station Offset: — Lot Limit - Beg.: — Lot Limit - End.:

Status: COMP — This material has been tested in accordance with MDOT specifications and is satisfactory for use in MDOT projects.

Sieve Designation	% Passing	Spec. Ranges MAX.	Spec. Ranges MIN.	Screen Result	REMARKS
3" (75 mm)	100				Sieve Gradation
1/2" (63 mm)					
2" (50 mm)					
1 3/4" (45 mm)					
1 1/2 (37.5 mm)					
1" (25 mm)					
1/2" (12.5 mm)					
3/8" (9.5 mm)					
#4 (4.75 mm)					
#10 (2.00 mm)	100				
Minus # 10 Results					
#40 (425 um)	96				
#60 (250 um)	76				
#200(75 um)	54.7				
#270(54 um)					
% Silt					Hydrometer
% Clay					
% Colloids					
Dust Ratio					
HCL reaction:					
Mica Content:					
Liquid Limit	31				
Plastic Limit	13				Atterberg Limits
Plasticity Index	18				LAB NO.43869
Shrinkage Limit	13.3				
Shrinkage Ratio	1.93				
Volume Change	34.9	60			
AASHTO	A6				FCH045
GROUP INDEX	6				
U. S. C.	CL				
Est. CBR	6				

TOTAL SAMPLE RESULT =



MISSISSIPPI DEPARTMENT OF TRANSPORTATION

SOIL REPORT

Test Method AASHTO T11, AASHTO T27, AASHTO T88, And MT22

Contract ID	MTL-DISTRCT-OCA	Fed/State Proj. #	For Charging Tests to District	FMS Proj. #	DISTRICT1-OCA		
Sample Status	COMP		LAB ID	D1001	Sample ID	171130GLB0017	
Revising Sample Number			Date Sampled	2017-06-05	Date Completed	2017-06-08	
Material Code	070300153	Material Name	SOIL PROFILE(ORG)	Sample Test Number	6	Date Authorized	
Linked To Sample #							

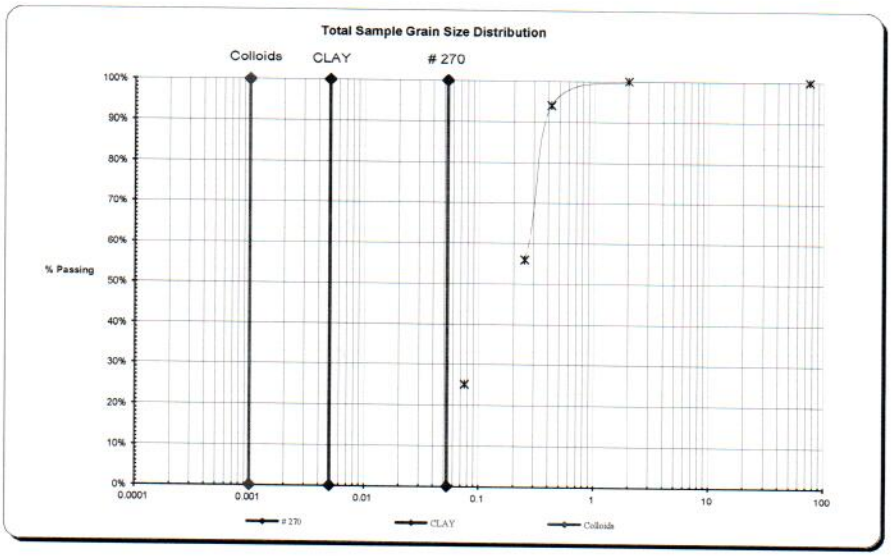
Sampled From: 31-35' tupelo tower — Distance From Grade:

Sample Station No.: — Station Offset: — Lot Limit - Beg.: — Lot Limit - End.:

Status: COMP — This material has been tested in accordance with MDOT specifications and is satisfactory for use in MDOT projects.

Sieve Designation	% Passing	Spec. Ranges MAX.	Spec. Ranges MIN.	Screen Result	REMARKS
3" (75 mm)	100				Sieve Gradation
1/2" (63 mm)					
2" (50 mm)					
1 3/4" (45 mm)					
1 1/2 (37.5 mm)					
1" (25 mm)					
1/2" (12.5 mm)					
3/8" (9.5 mm)					
#4 (4.75 mm)					
#10 (2.00 mm)	100				
Minus # 10 Results					
#40 (425 um)	94				
#60 (250 um)	56				
#200(75 um)	25.2				
#270(54 um)					
% Silt					Hydrometer
% Clay					
% Colloids					
Dust Ratio					
HCL reaction:					
Mica Content:					
Liquid Limit	OK				Atterberg Limits
Plastic Limit	---				
Plasticity Index	NP				LAB NO.43870
Shrinkage Limit					
Shrinkage Ratio					
Volume Change		60			
AASHTO	A2-4				FCH045
GROUP INDEX					
U. S. C.	SMd				
Est. CBR	20				

TOTAL SAMPLE RESULT =



MISSISSIPPI DEPARTMENT OF TRANSPORTATION
SOIL REPORT

Test Method AASHTO T11, AASHTO T27, AASHTO T88, And MT22

Contract ID	MTL-DISTRCT-OCA	Fed/State Proj. #	For Charging Tests to District	FMS Proj. #	DISTRICT1-OCA		
Sample Status	COMP		LAB ID	D1001	Sample ID	171130GLB0018	
Revising Sample Number			Date Sampled	2017-06-05	Date Completed	2017-06-08	
Material Code	070300153	Material Name	SOIL PROFILE(ORG)	Sample Test Number	7	Date Authorized	
Linked To Sample #							

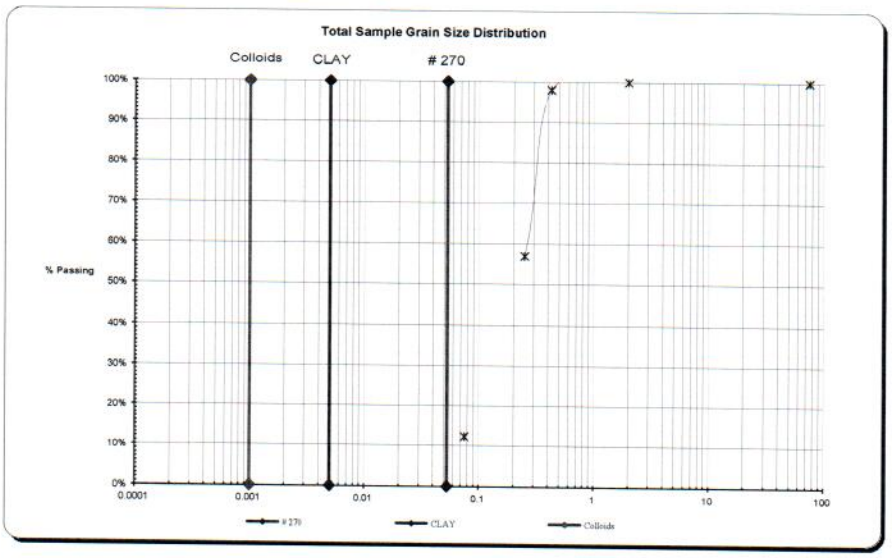
Sampled From: 36-45'tupelo tower — Distance From Grade:

Sample Station No.: — Station Offset: — Lot Limit - Beg.: — Lot Limit - End.:

Status: COMP — This material has been tested in accordance with MDOT specifications and is satisfactory for use in MDOT projects.

Sieve Designation	% Passing	Spec. Ranges MAX.	Spec. Ranges MIN.	Screen Result	REMARKS
3" (75 mm)	100				Sieve Gradation
1/2" (63 mm)					
2" (50 mm)					
1 3/4" (45 mm)					
1 1/2 (37.5 mm)					
1" (25 mm)					
1/2" (12.5 mm)					
3/8" (9.5 mm)					
#4 (4.75 mm)					
#10 (2.00 mm)	100				
Minus # 10 Results					
#40 (425 um)	98				
#60 (250 um)	57				
#200(75 um)	12.3				
#270(54 um)					
% Silt					Hydrometer
% Clay					
% Colloids					
Dust Ratio					
HCL reaction:					
Mica Content:					
Liquid Limit	OK				
Plastic Limit	---				Atterberg Limits
Plasticity Index	NP				LAB NO.43871
Shrinkage Limit					
Shrinkage Ratio					
Volume Change		60			
AASHTO	A2-4				FCH045
GROUP INDEX	0				
U. S. C.	SP-SM				
Est. CBR	20				

TOTAL SAMPLE RESULT =



MISSISSIPPI DEPARTMENT OF TRANSPORTATION

SOIL REPORT

Test Method AASHTO T11, AASHTO T27, AASHTO T88, And MT22

Contract ID	MTL-DISTRCT-OCA	Fed/State Proj. #	For Charging Tests to District		FMS Proj. #	DISTRICT1-OCA	
Sample Status	COMP			LAB ID	D1001	Sample ID	171130GLB0019
Revising Sample Number			Date Sampled	2017-06-05		Date Completed	2017-06-08
Material Code	070300153	Material Name	SOIL PROFILE(ORG)	Sample Test Number	8	Date Authorized	
Linked To Sample #							

Sampled From: 46-50' tupelo tower — Distance From Grade:

Sample Station No.: — Station Offset: — Lot Limit - Beg.: — Lot Limit - End.:

Status: COMP — This material has been tested in accordance with MDOT specifications and is satisfactory for use in MDOT projects.

Sieve Designation	% Passing	Spec. Ranges MAX.	Spec. Ranges MIN.	Screen Result	REMARKS
3" (75 mm)	100				Sieve Gradation
1/2" (63 mm)					
2" (50 mm)					
1 3/4" (45 mm)					
1 1/2 (37.5 mm)					
1" (25 mm)					
1/2" (12.5 mm)					
3/8" (9.5 mm)					
#4 (4.75 mm)					
#10 (2.00 mm)	100				
Minus # 10 Results					
#40 (425 um)	97				
#60 (250 um)	67				
#200(75 um)	9.3				
#270(54 um)					
% Silt					Hydrometer
% Clay					
% Colloids					
Dust Ratio					
HCL reaction:					
Mica Content:					
Liquid Limit	OK				
Plastic Limit	---				Atterberg Limits
Plasticity Index	NP				LAB NO.43872
Shrinkage Limit					
Shrinkage Ratio					
Volume Change		60			
AASHTO	A3				FCH045
GROUP INDEX	1				
U. S. C.	SP-SM				
Est. CBR	11				

TOTAL SAMPLE RESULT =