SUBSURFACE INVESTIGATION &
GEOTECHNICAL RECOMMENDATIONS

PROPOSED MONOPOLE CELL TOWER
INDIANAPOLIS, INDIANA
A&W PROJECT NO: 15IN0464

PREPARED FOR:
AAA DEVELOPMENT AND CONSULTING, INC
GREENFIELD, INDIANA

PREPARED BY:
ALT & WITZIG ENGINEERING, INC.
GEOTECHNICAL DIVISION

JULY 22, 2015

Alt & Witzig Engineering, Inc.
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July 22, 2015

AAA Development and Consulting, LLC
5151 West US Hwy 40
Greenfield, Indiana 46140
ATTN: Mr. Randy Hood

Report of Subsurface Investigation & Geotechnical Recommendations

RE: Proposed Monopole Cell Tower
Raven Broadcasting
4901 West 56th Street
Indianapolis, Indiana
Alt & Witzig File: 15IN0464

Dear Mr. Hood:

In compliance with your request, we have completed a subsurface investigation and geotechnical evaluation for the above referenced project. It is our pleasure to transmit herewith one (1) electronic copy of our report.

The purpose of this subsurface investigation was to determine the various soils profile components and the engineering characteristics of the materials encountered in order to provide information to be used for preparing a foundation for the proposed cellular tower and equipment building.

Project Description

It is anticipated that a new 150 foot tall monopole cell tower will be constructed at this site. A prefabricated equipment building will also be constructed at this site

The site is located south of West 56th Street and west of Georgetown Road near Indianapolis, Indiana (*Exhibit 1*). The site may be located using the Indianapolis West, Indiana 7½ minute topographic map in Section 7, Township 16 North, and Range 3 East.

Based upon the project plans provided by AAA Development and Consulting, LLC to Alt & Witzig Engineering, the ground surface elevation is 796.5' AMSL All depths referred to in this report and on the *Boring Logs* are referenced from the existing ground surface.

Exhibit 1: 2014 Aerial Photograph

Field Methods

The field investigation included a reconnaissance of the project site, performing one (1) soil borings (B-1) for the proposed tower and one (1) for the equipment building (B-2), performing standard penetration tests, and obtaining soil samples retained in the standard split-spoon sampler. The apparent groundwater level at the boring location was also determined.

The soil borings were performed with a tracked vehicle-mounted drilling rig equipped with a rotary head. Conventional hollow-stem augers were used to advance the holes. Representative samples of the soil were obtained employing split-spoon sampling procedures in accordance with ASTM Procedure D-1586. The advancement of the borings was temporarily stopped at regular intervals in order to perform standard penetration tests in accordance with ASTM Procedure D-1586. The standard penetration test involves driving a split spoon soil sampler into the ground by dropping a 140-pound hammer, thirty (30) inches. The number of hammer drops required to advance the split-spoon sampler one (1) foot into the soil is defined as the standard penetration value. The soil samples retained in the split-spoon sampling device as a result of the penetration tests were obtained, classified, and labeled for further laboratory investigation.

Laboratory Investigation

A laboratory investigation was conducted to ascertain additional pertinent engineering characteristics of the subsurface materials at the site of the proposed tower. All phases of the laboratory investigation were conducted in general accordance with applicable ASTM Specifications. The laboratory testing program included:

- Visual classification of soils.
- Moisture content determination in accordance with ASTM D-2216.
- Samples of the cohesive soil were frequently tested in unconfined compression by use of a calibrated spring testing machine.
- A pocket penetrometer was used as an aid in determining the strength of the soil.

The values of the unconfined compressive strength as determined on soil samples from the split-spoon sampling must be considered approximate recognizing the manner in which they were obtained since the split-spoon sampling techniques provide a representative but somewhat disturbed soil sample.

Site Specific Subsurface Conditions

At the ground surface, the borings encountered approximately three (3) inches of topsoil. Beneath the topsoil, stiff cohesive soil was encountered within the upper fifteen (15) feet. In boring B-1, the stiff cohesive soil was underlain by hard cohesive soil (Glacial Till) to the termination depth of forty-one (41) feet.

Detailed soil descriptions at the boring location have been included on the *Boring Logs* in the Appendix of this report.

Groundwater

Water level observations made during and upon completion of drilling operations indicated groundwater as shallow as fifteen (15) feet below the current ground surface. These measurements are noted on the *Boring Logs* presented herewith. The exact location at which water is encountered should be anticipated to fluctuate somewhat depending upon normal seasonal variations in precipitation and surface runoff.

It should be noted that the groundwater level measurement recorded on the individual *Boring Logs* in the Appendix of this report is accurate for the specific date on which the measurements was performed. It must be understood that the groundwater level will fluctuate throughout the year. The *Boring Logs* does not indicate these fluctuations.

Geotechnical Recommendations

Tower Foundation Recommendations

Information provided by AAA Development and Consulting, Inc. indicates that the proposed 190 foot monopole cell tower will be constructed in the general vicinity of soil borings B-1. An equipment building will also be constructed in the general vicinity of boring B-2. Our experience with this type of structure indicates that the structural loads of the tower will be supported by an extended mat foundation or a caisson system and the buildings will be supported by conventional spread footings and continuous wall footings. It is recommended that a representative of Alt & Witzig Engineering, Inc. be on-site to monitor the excavation and inspect the base of the tower foundation.

Extended Footing or Extended Mat Foundation

If spread footings are desired, they should be founded at a minimum depth of four (4) feet below existing grade. The soil parameters presented in *Table 1* may be utilized for the design of a shallow foundation.

Table 1: Shallow Foundation Soil Parameters

Soil Description	Depth Below Existing Grade (feet)	Allowable Bearing Pressure (psf) FS=3	Unit Weight (pcf)	C (psf)/ Φ (°)	Adhesion (psf)
Silty Clay	4-10	3,000 psf	120 pcf	1,500 psf	1,250 psf

It is anticipated that lateral wind loads and overturning moments will act on the spread footing. To help resist the overturning moment, it may be necessary to place a larger footing than necessary for bearing capacity. Also, any soil placed above the footing may be considered to help resist overturning moments if compacted to a minimum of 98 percent of the maximum dry density as determined from ASTM D-698 (Standard Proctor).

Groundwater difficulties are not anticipated during excavations for shallow footings. Depending upon the time of the year that the excavations are made, seepage from surface runoff may occur. Since these foundation materials tend to soften/loosen when exposed to free water, every effort should be made to keep the excavations dry should water be encountered. It is also recommended that concrete for footings be poured as soon as possible after the excavations are complete. A mud mat may be placed to provide the contractors a firm working surface and protect the exposed subgrade soils from softening.

Caissons/Drilled Piers

As an alternative to a shallow foundation system, a caisson type foundation system may be considered to support this tower structure. A straight shaft caisson/drilled pier may be considered. A caisson type foundation is also advantageous to use when it is necessary to resist large overturning moments such as those caused by wind loads against the proposed structure. If a caisson or drilled shaft is used to support the structure, it should be designed using the soil parameters provided in *Table 2*.

Table 2: Deep Foundation Soil Parameters

Soil Type	Depth Below Grade (Feet)	Allowable Skin Friction for Gravity Loads SF=2	Design End Bearing Pressure SF=3	Unit Weight (pcf)	C (psf)
Silty Clay	5-16	650 psf	NA	57.4 pcf*	1,500 psf
Glacial Till	16+	900 psf	7,500 psf	57.4 pcf*	2,500 psf

*The buoyancy effect must be considered on the unit weight of soils beneath the ground water table.

It is recommended that concrete be placed the same day excavations are made. It is also recommended that a representative of Alt & Witzig Engineering, Inc. be on site to inspect the material from the base of the caisson and monitor the placement of the concrete. The contractor should be provided with the *Boring Logs* prior to final bidding.

Equipment Building Foundation Recommendations

A net allowable bearing pressure of **2,000 psf** is recommended for dimensioning continuous wall footings at this site. The above-suggested bearing pressure is provided assuming the footings will be founded on medium stiff natural soils or properly compacted fill materials at a minimum depth of two and one-half (2½) feet below grade.

Equipment Building Slab Recommendations

This structure will be a slab-on-grade supported by natural soils and/or compacted fill materials. In those areas where the existing grade is lower than the design floor elevation, a well-compacted structural fill will be necessary to raise the site to the desired grade. The fill material shall consist of INDOT No. 53 Stone.

After the building areas have been raised to the proper elevation, a granular fill should be placed immediately beneath the floor slab. It is recommended that all material placed in the floor slab areas be compacted to a density of 100 percent of maximum dry density in accordance with ASTM D-698. Recommendations for proper filling procedures are presented later in the Appendix of this report.

Statement of Limitations

Our subsurface investigation was conducted in accordance with guidelines set forth in the scope of services and applicable industry standards.

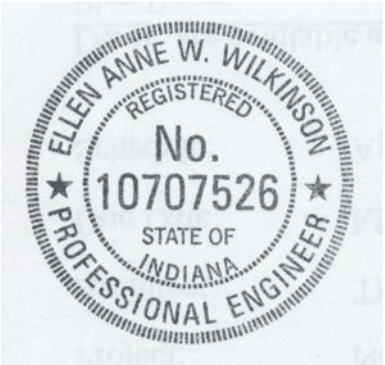
An inherent limitation of any geotechnical engineering study is that conclusions must be drawn on the basis of data collected at a limited number of discrete locations. The geotechnical parameters provided in this report were developed from the information obtained from the test borings that depict subsurface conditions only at these specific locations and on the particular date indicated on the boring logs. Soil conditions at other locations may differ from conditions encountered at these boring locations and groundwater levels shall be expected to vary with time. The nature and extent of variations between the borings may not become evident until the course of construction.

Often, because of design and construction details that occur on a project, questions rise concerning the soil conditions. If we can give further service in these matters, please contact us at your convenience.

Very truly yours,
Alt & Witzig Engineering, Inc.

David M. Shumate
Geologist

Ellen Anne W. Wilkinson, P.E.



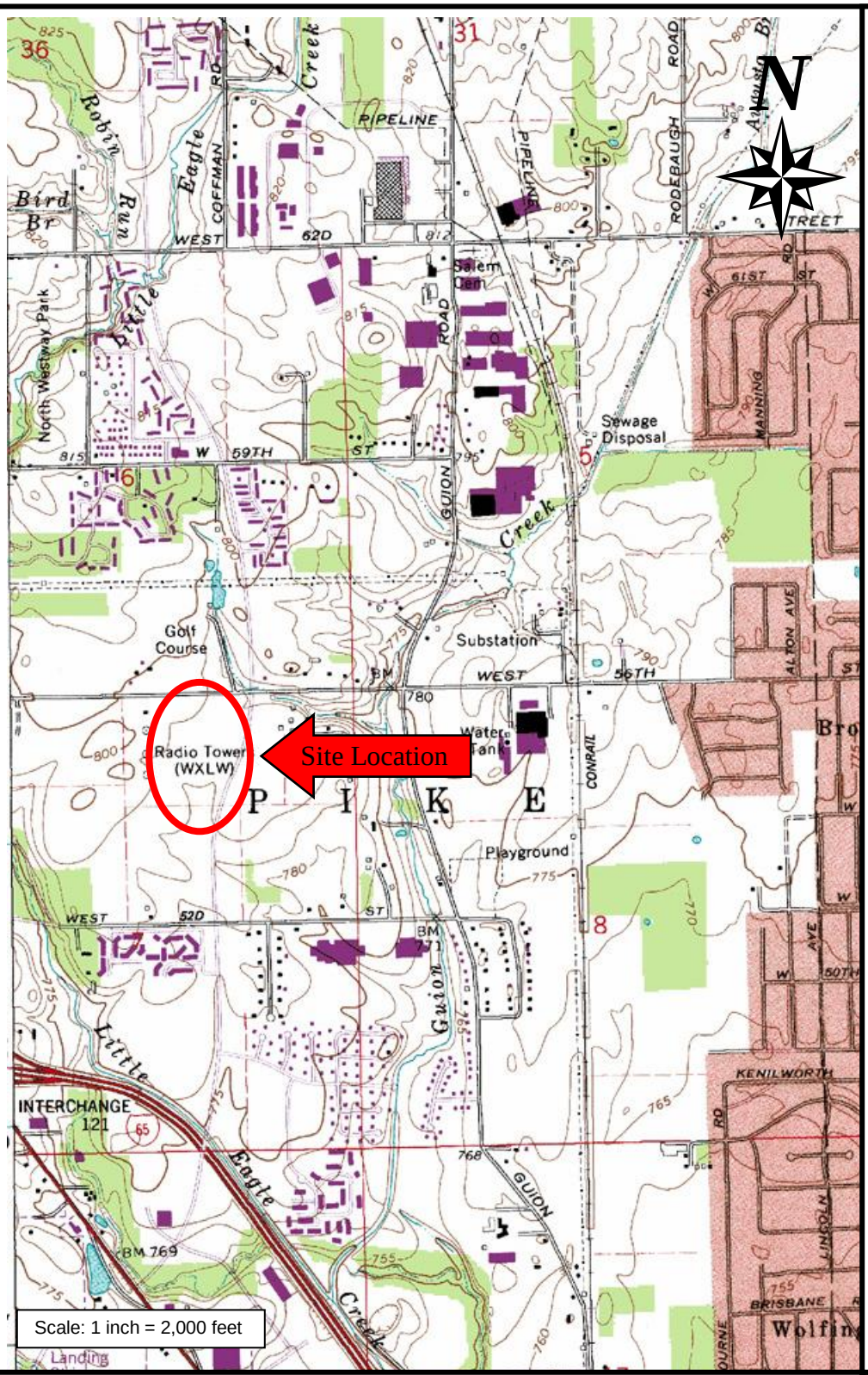
APPENDIX

Recommended Specifications for Compacted Fills and Backfills
Site Location Map
Boring Location Plan
Boring Logs
General Notes

RECOMMENDED SPECIFICATIONS FOR COMPACTED FILLS AND BACKFILLS

All fill shall be formed from material free of vegetable matter, rubbish, large rock, and other deleterious material. Prior to placement of fill, a sample of the proposed fill material should be submitted to the soils engineer for his approval. The fill material should be placed in layers not to exceed eight (8) inches in loose thickness and should be sprinkled with water as required to secure specified compactions. Each layer should be uniformly compacted by means of suitable equipment of the type required by the materials composing the fill. Under no circumstances should a bulldozer or similar tracked vehicles be used as compacting equipment. Material containing an excess of water so the specified compaction limits cannot be attained should be spread and dried to a moisture content which will permit proper compaction. All fill should be compacted to the specified percent of the maximum density obtained in accordance with ASTM density Test D-698 (100 percent of maximum dry density below and above the base of footing elevation). Should the results of the in-place density tests indicate that the specified compaction limits are not obtained; the areas represented by such tests should be reworked and retested as required until the specified limits are reached.

SITE LOCATION MAP



USGS Topographic Map:
Indianapolis West Quadrangle

Township: T 16 N.
Range: R 3 E.
Section: 7

PROJECT: **Proposed Monopole Cell Tower**
LOCATION: 4901 W. 56th St., Indianapolis, Indiana
CLIENT: **AAA Development**
A&W File No.: 15IN0464

Alt & Witzig Engineering Inc.
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Last Modified: 7/8/2015 8:18 AM

BORING LOCATION PLAN

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BORING LOG

Alt & Witzig Engineering, Inc.

CLIENT **AAA Development & Consulting, LLC** BORING # **B-1**

PROJECT NAME **Cell Tower @ Raven Broadcasting** ALT & WITZIG FILE # **15IN0464**

PROJECT LOCATION **Indianapolis, Indiana**

DRILLING and SAMPLING INFORMATION

Date Started **7/8/15** Hammer Wt. **140** lbs.

Date Completed **7/8/15** Hammer Drop **30** in.

Boring Method **HSA** Spoon Sampler OD **2** in.

Driller **J. Livingston** Rig Type **B-57 Truck**

STRATA ELEV. / SOIL CLASSIFICATION / SURFACE ELEVATION	Strata Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics / Recovery Graphics	Ground Water	TEST DATA: Standard Penetration Test, N - blows/foot	TEST DATA: Qu-tsf Unconfined Compressive Strength	TEST DATA: PP-tsf Pocket Penetrometer	TEST DATA: Moisture Content % / *Dry Unit Weight (pcf)*	Remarks
TOPSOIL *(Visual)*	0.6										
			1	SS			9		3.0	17.8	
Brown Silty CLAY		5	2	SS			9		1.5	11.6	
	8.5		3	SS			7	1.2	1.5	12.8	
Brown, Moist Silty CLAY	11.0	10	4	SS			22		0.5	14.6	
Brown, Moist Silty CLAY with Sand											
	16.0	15	5	SS		○	28		1.0	13.9	
		20	6	SS			59		4.0	9.3	
Gray LEAN CLAY with Gravel and Sand Seams *(Glacial Till)*		25	7	SS			19	3.3	2.0	10.4	
	31.0	30	8	SS			13				
Gray LEAN CLAY with Gravel *(Glacial Till)*	35.0	35	9	SS			26				
Gray, Wet SAND											
	41.0	40	10	SS			30				
End of Boring at 41 feet											

Sample Type

SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater

○ During Drilling *15.0 ft.*
▽ At Completion *ft.*

Boring Method

HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
MD - Mud Drilling

BORING LOG

Alt & Witzig Engineering, Inc.

CLIENT **AAA Development & Consulting, LLC** BORING # **B-2**

PROJECT NAME **Cell Tower @ Raven Broadcasting** ALT & WITZIG FILE # **15IN0464**

PROJECT LOCATION **Indianapolis, Indiana**

DRILLING and SAMPLING INFORMATION

Date Started **7/8/15** Hammer Wt. **140** lbs.

Date Completed **7/8/15** Hammer Drop **30** in.

Boring Method **HSA** Spoon Sampler OD **2** in.

Driller **J. Livingston** Rig Type **B-57 Truck**

STRATA ELEV.	SOIL CLASSIFICATION / SURFACE ELEVATION	Strata Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics / Recovery Graphics	Ground Water	Standard Penetration Test, N - blows/foot	Qu-tsf Unconfined Compressive Strength	PP-tsf Pocket Penetrometer	Moisture Content % / *Dry Unit Weight (pcf)*	Remarks
	TOPSOIL *(Visual)*	0.5										
				1	SS			15	4.8	4.5	13.2	
	Brown Silty CLAY		5	2	SS			8		2.0	44.8	
				3	SS			6	1.1	1.0	24.9	
		8.5										
	Gray, Soft LEAN CLAY with Gravel *(Glacial Till)*	10.0	10	4	SS			5			11.6	
	Gray Sandy CLAY	11.0										
	End of Boring at 11 feet											

TEST DATA

Sample Type
- SS - Driven Split Spoon
- ST - Pressed Shelby Tube
- CA - Continuous Flight Auger
- RC - Rock Core
- CU - Cuttings
- CT - Continuous Tube

Groundwater
- ○ During Drilling _____ *ft.*
- ▽ At Completion _____ *ft.*

Boring Method
- HSA - Hollow Stem Augers
- CFA - Continuous Flight Augers
- DC - Driving Casing
- MD - Mud Drilling

MATERIAL GRAPHICS LEGEND


CL: USCS Low Plasticity Clay


CL-ML: USCS Low Plasticity Silty Clay


CLS: USCS Low Plasticity Sandy Clay


SP: USCS Poorly-graded Sand


TOPSOIL

SOIL PROPERTY SYMBOLS

N: *Standard "N" penetration value. Blows per foot of a 140-lb hammer falling 30" on a 2" O.D. split-spoon.*

Qu: *Unconfined Compressive Strength, tsf* PP: *Pocket Penetrometer, tsf*

LL: *Liquid Limit, %* PL: *Plastic Limit, %* PI: *Plasticity Index, %*

DRILLING AND SAMPLING SYMBOLS

GROUNDWATER SYMBOLS

○ *Apparent water level noted while drilling.*

▽ *Apparent water level noted upon completion.*

▼ *Apparent water level noted upon delayed time.*

SAMPLER SYMBOLS


SS: Split Spoon

RELATIVE DENSITY & CONSISTANCY CLASSIFICATION (NON-COHESIVE SOILS)

TERM	*BLOWS PER FOOT*
Very Loose	0 - 5
Loose	6 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	>51

RELATIVE DENSITY & CONSISTANCY CLASSIFICATION (COHESIVE SOILS)

TERM	*BLOWS PER FOOT*
Very Soft	0 - 3
Soft	4 - 5
Medium Stiff	6 - 10
Stiff	11 - 15
Very Stiff	16 - 30
Hard	>31

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GENERAL NOTES

Project: Cell Tower @ Raven Broadcasting

Location: Indianapolis, Indiana

Number: 15IN0464