MSW Association Site Plan

Final Report

BAE 4012 – Senior Design

Meagan Armstrong, Rachel Cancienne, Megan Perry

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Introduction

The Muscogee-Seminole-Wichita (MSW) Baptist Association is a fellowship of Native American Baptist Churches from 11 Oklahoma counties. Founded in 1851, it was the first Association organized in Indian Territory. In October of 1956, the Association purchased 40 acres adjacent to the Yardeka Baptist Church grounds nine miles southeast of Henryetta, Oklahoma. They bought the land in McIntosh County for twenty dollars per acre and began constructing the Assembly Grounds in 1961. The Association holds several meetings at the Assembly Grounds throughout the year with the majority of activity during the summer months due to the week-long youth camp, adult church leadership camp, and Baptist Assembly.

Ralph Hight, the Chief of Engineering and Construction at the Tulsa District of the United States Army Corps of Engineers (USACE), hired PeAC Designs on behalf of the MSW Association in September 2005. The task presented to PeAC Designs was to create an improved site plan for the MSW Tribal Association Assembly Grounds. The site plan needed to improve safety, provide for potential growth, and maintain functionality while keeping within the economic constraints of the Association. The plan needed to include water and power distribution as well as wastewater collection and treatment.

Statement of Work

Site Description

The legal land description of the MSW Assembly Grounds is the SW ¼ SE ¼ Sec. 3 T10N R13E I.M. The property is bordered on all sides by private property. As shown in figure 1, there is a county road along the north edge of the property and a private road borders the eastern boundary.

The grade of the site is fairly level on the north half with a relatively steep, rocky downhill slope on the south half. The property elevation drops roughly 60 feet on the eastern edge and 30 feet on the western boundary, yielding an average downhill slope of 6 percent. This slope change roughly bisects the property with a vegetation change from grasses to trees occurring here, as well.

Information about the soils on the property was obtained from *Soil Survey of McIntosh County Oklahoma* (USDA-SCS, 1981). Soils on the site vary from the northern to the southern boundaries. The soil on most of the north half is a Linker fine sandy loam. In the middle portion of the property, the soils change to a Linker-Hector complex. Soil on the steep, south half of the property is made up mostly of an Enders-Hector association.

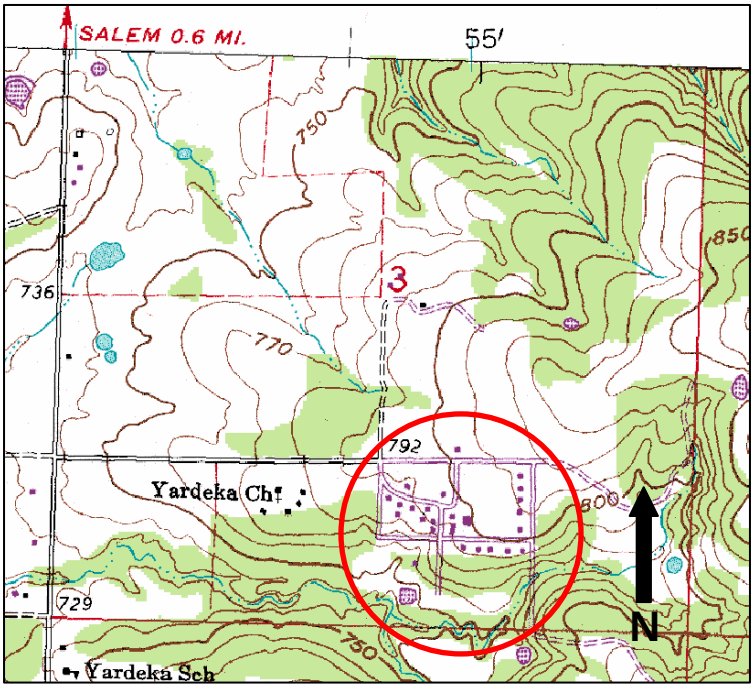

Figure 1. Topographic map with MSW property identified in red circle.

Structural Layout

PeAC Designs generated a layout of current structures on the MSW property using ArcView 3.2 (fig. 2). The layout was created referencing differential surveys provided by Marjorie Courtright of the USACE Tulsa District, and aerial photography downloaded from the United States Geological Survey (USGS) Seamless Data Distribution System.

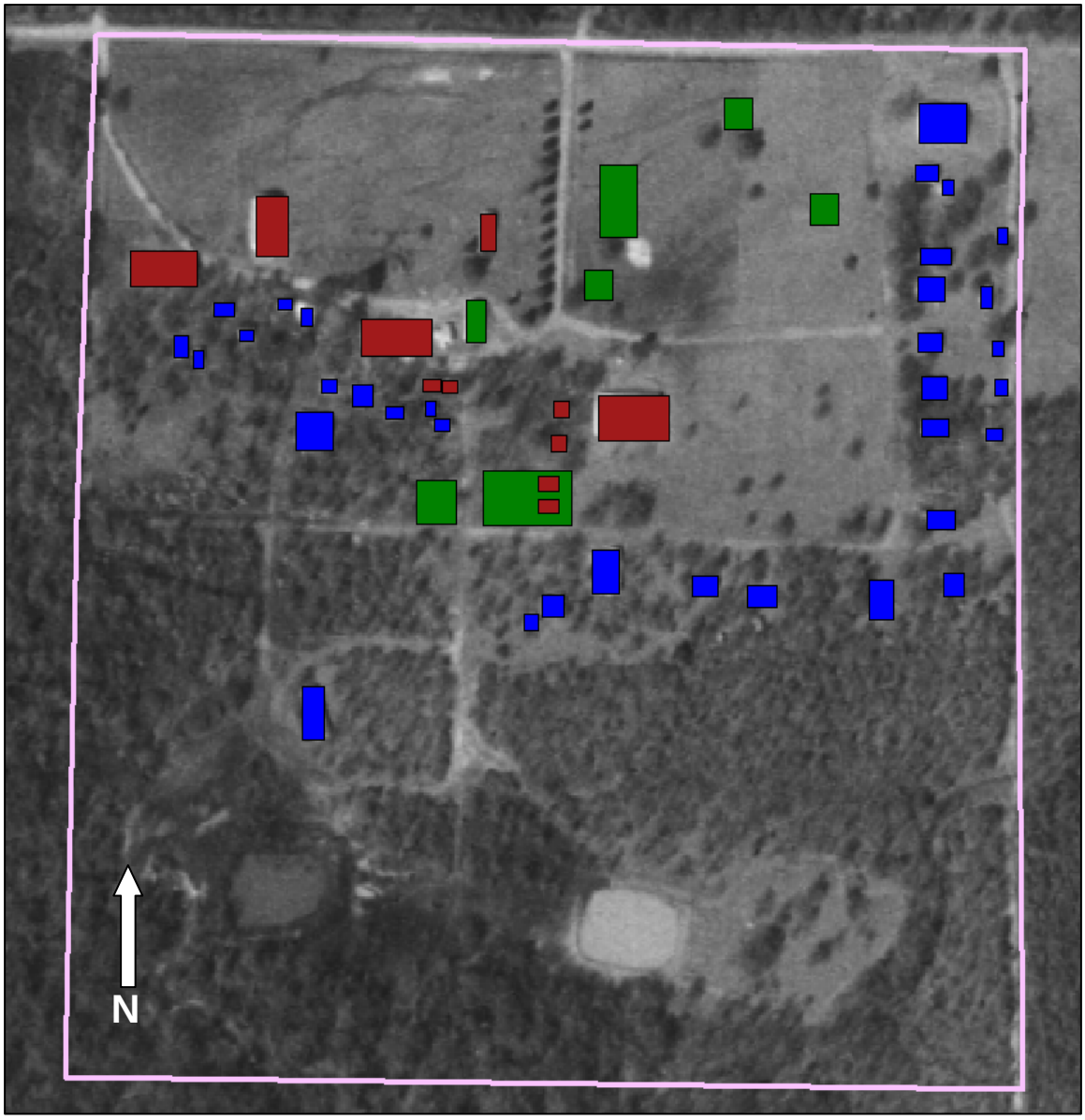

Figure 2. Current structural layout with all facilities highlighted.

Common Use Facilities

All common use buildings are located on the north half of the property. These buildings are identified in red in the general structural layout (fig. 2). As shown in figure 3, the common use buildings include:

1. Women's ministries building
2. Two-story Dormitory
3. Concession Stand
4. Cafeteria
5. Shower and Restroom Facilities
6. Nursery Buildings
7. Chapel

Figure 3. Common use facilities layout.

Private Use Facilities

The blue buildings in the general structural layout (fig. 2) represent small private church cabins and storage buildings. As shown in figure 4, numerous private church cabins skirt the eastern boundary of the north half of the property and bisect the Assembly Grounds from east to west along the slope change. A cluster of private cabins and storage buildings are also located on the northwest quarter of the property.

Figure 4. Private use facilities layout.

Open Air Facilities

The dark green objects in the general structural layout (fig. 2) represent open air facilities. All of these facilities are situated on the north half of the property and most are located where there is very little slope. As shown in figure 5, the open air facilities include:

1. Prayer Garden
2. Nursery Playground
3. Double-sided Carport
4. Open Pavilions
5. Basketball Court

Figure 5. Open air facilities layout.

Existing Utilities

PeAC designs gathered the information necessary to create current utility layouts from three sources; the differential survey provided by Marjorie Courtright, a water distribution and sewer collection layout provided by the MSW Association Planning Committee, and site visits.

Electrical Distribution

The Public Service Company of Oklahoma (PSO) provides electrical power to the MSW Assembly Grounds at single phase. The nearest three-phase line is at the intersection of 1138 and Salem County Roads. A general illustration of the current power distribution on the property is shown in figure 6. The power lines are shown in red and the twelve power transformers located throughout the site are identified as pink dots. All other power poles on the property are marked as light blue dots. Many of the small cabins obtain power by splicing into the power lines and stringing wires around poles and trees. Several of these wires hang dangerously low to the ground.

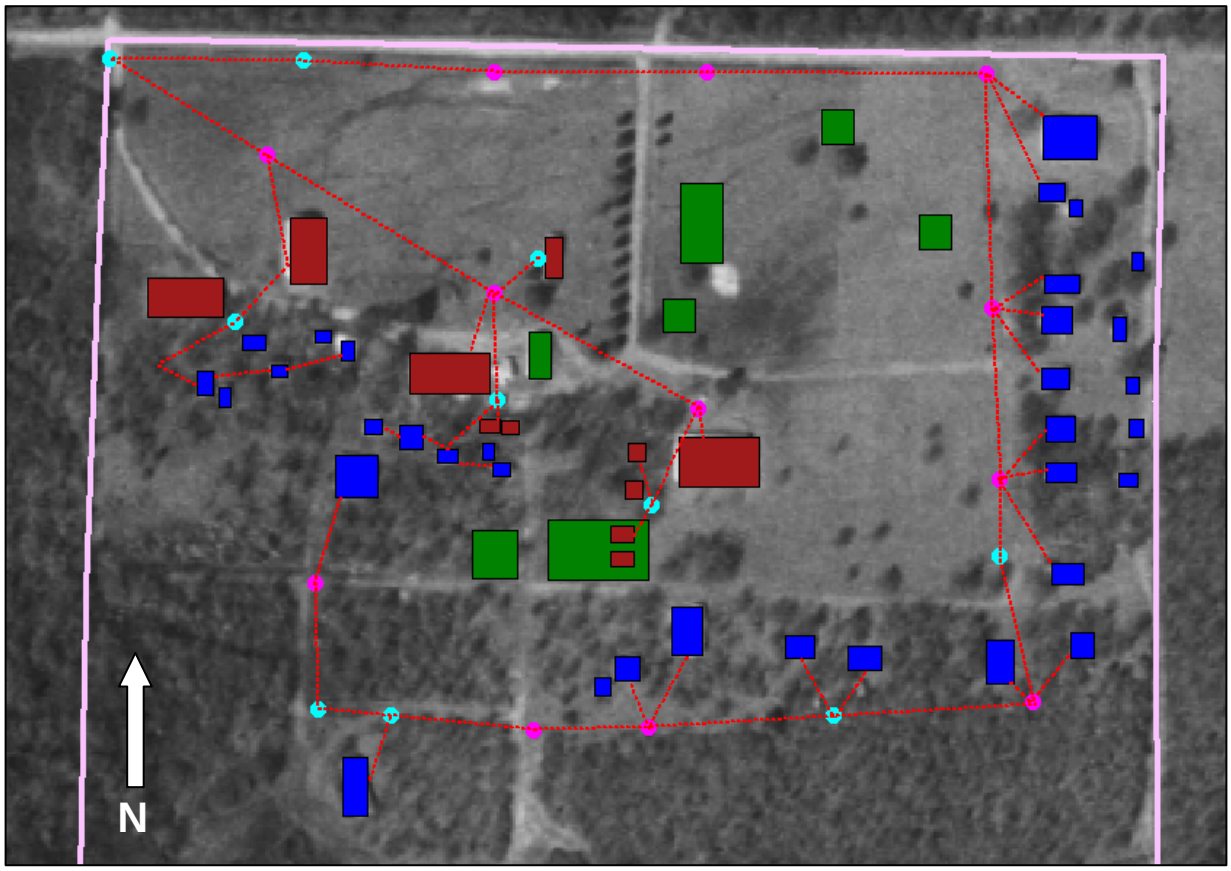

Figure 6. Electrical distribution with power poles, transformers, and power lines.

Water Distribution

McIntosh County Rural Water District #13 serves the facility. Two 1 ½ inch water meters are located on the north boundary of the property and are identified in figure 7 as red stars. A 3 inch line from the rural water district feeds the meter on the northwest corner and continues east to connect to the second meter in the middle of the property. This 3 inch line is identified in yellow in figure 7. The remaining water distribution on the property is through 1 ½ inch lines that are identified in figure 7 as lime green lines.

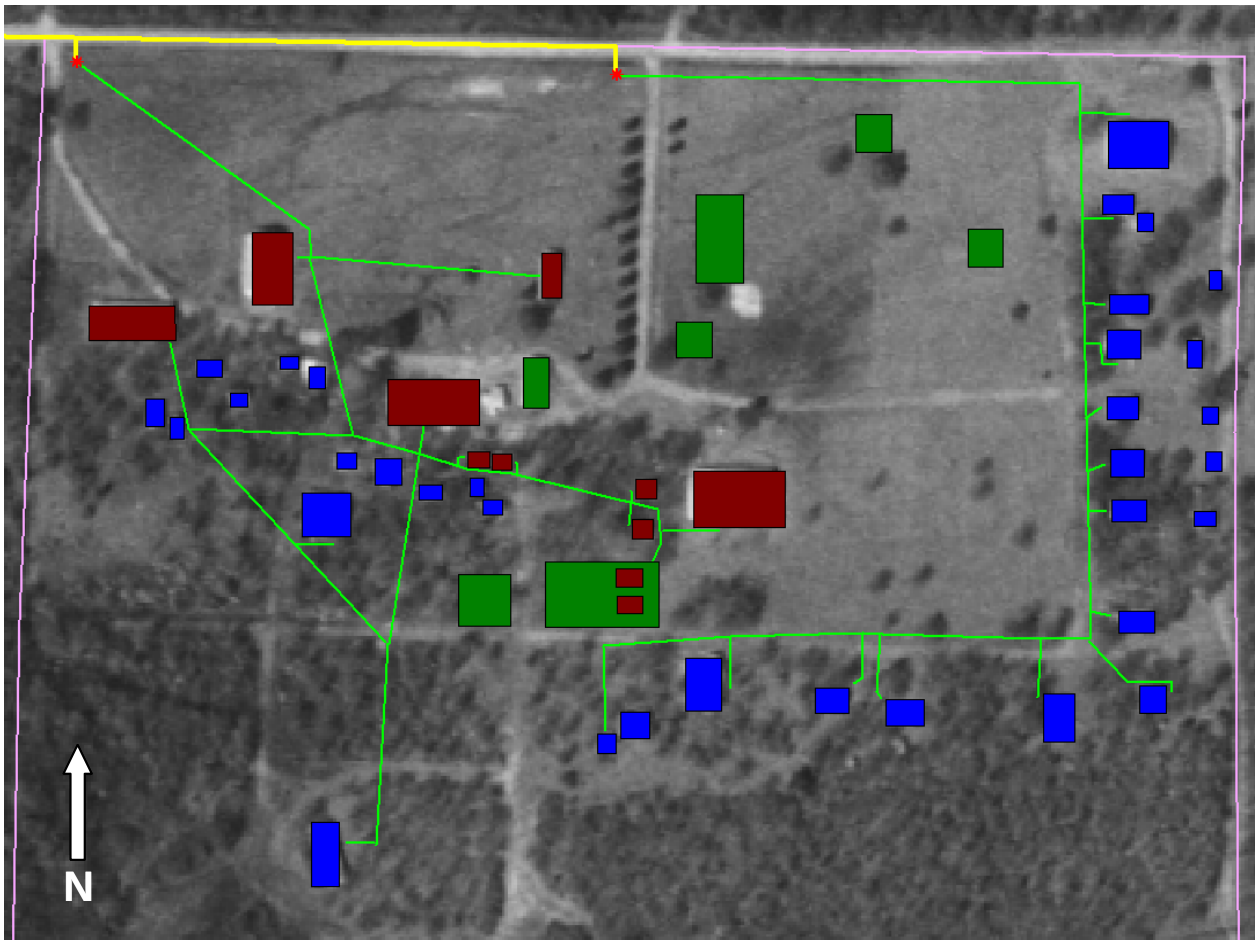

Figure 7. Water distribution layout

Sewer Collection

A layout of the sewer collection system can be seen in figure 8. Two 6 inch pipes serve as the main wastewater collection lines on the Assembly Grounds and are shown as lime green lines in figure 8. One of these lines runs southwest from the eastern edge of the property beginning at the slope change. This pipeline is fed by 4 inch collection lines from the private cabins on the eastern half of the property. The 4 inch lines are shown in orange in figure 8. The second 6 inch sewer line collects from 4 inch lines that serve all of the large buildings, as well as the cabins on the western side. This 6 inch line begins just south of the western cabins and runs due south to the wastewater lagoon on the southwest corner of the property.

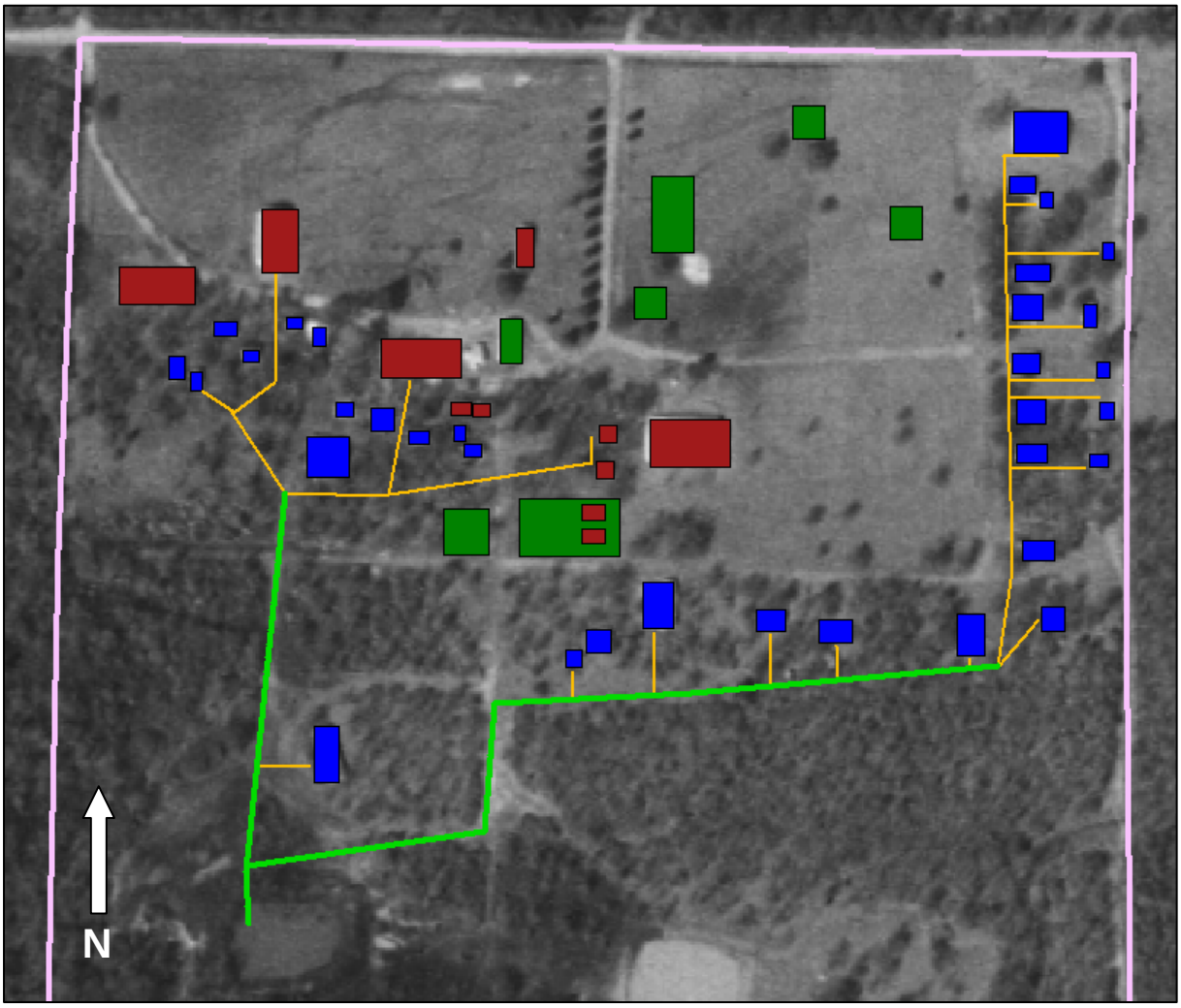

Figure 8. Sewer collection layout.

Site Expectations

PeAC Designs met with members of the MSW Association in order to determine their expectations for future growth on the Assembly Grounds. Both Linda Minter, current Director of the MSW Association and A.J. Tiger, member of the MSW Association Planning Committee, have played critical roles in providing PeAC Designs with insight to the wants and needs of their organization.

The MSW Association would like to see utilities improvements on their property as well as modifications to allow for growth. Currently, the dormitory houses between 100 and 150 youth in a single two-story building during the annual summer camp. The Association would like to accommodate upwards of 300 people in two gender specific dormitory facilities in the future.

Due to an inadequate water distribution system, there is unequal water pressure across the site. This issue will need to be addressed before the site can sustain a population increase. Also the Association would like to confirm that the current size of the wastewater lagoon is large enough to handle a population increase. For safety purposes, an underground power distribution network would be ideal. However, if underground power is cost prohibitive, a safely designed above ground network will be acceptable. More outdoor lighting is also needed within the distribution system.

Other modifications the MSW Association would like on the property include the addition of a small motel-style building to provide office space and sleeping quarters for traveling ministers and the creation of a designated camping area with RV pad sites. Other potential improvements to the site are a larger centralized prayer garden and a hiking trail.

Literature Review

In order to provide the MSW Association with an appropriate and complete site plan, PeAC Designs first performed a comprehensive literature review. The literature review included general layout planning and design, as well as specific recreational design considerations. This research served as a basis for PeAC Designs' education in planning theory.

Layout Planning

When considering the general idea of "site planning," it is necessary to think about the plan in its most basic terms. What type of layout will work best on this site? What shape or pattern is most convenient? According to Lynch and Hack (1984), several commonly used design methods, include *modular division* and *division by aspect.*

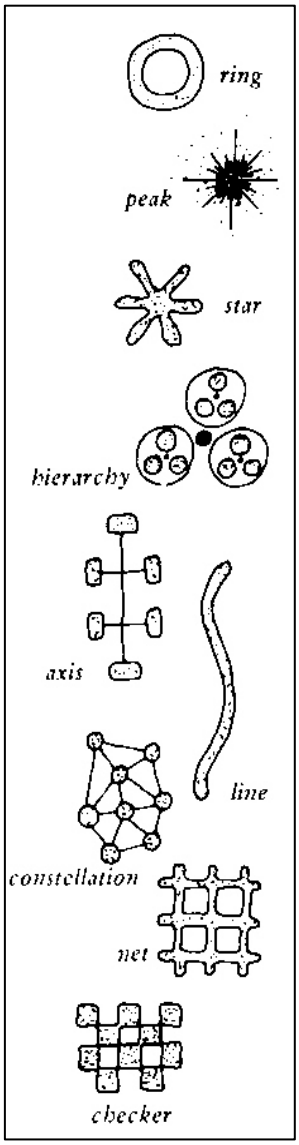

Figure 9. Site planning patterns

Modular division refers to dividing a site into distinct areas. This type of site development is seen throughout suburban America; a tract of land is separated into discrete regions that, if necessary, can be divided multiple times. This kind of division led to a popular Western U.S. layout, the grid. According to Campbell and Fainstain (1996), the grid has been used in modern times as a plan that neutralizes the environment.

Modular design can be a convenient planning method if the program, or site needs, are inclined to this sort of repetitive function. It is possible to integrate this style of spatial division with a little creativity to generate a plan that is not completely modular. The units can be created in different sizes and for different functions, leading to a less monotonous pattern.

Division by aspect is a method whereby the planner may regard the basic elements of site design separately (Lynch and Hack, 1984). First, the activities of the site must be considered. The needs of the site may be met by a formal pattern, such as ring, peak, star, etc. noted in figure 9 (Lynch and Hack, 1984).

If the designers choose this route, they must determine whether the pattern is applicable to the piece of land in terms of topography and hydrography.

The next piece considered in layout planning is circulation of the site. Circulation refers to roads as well as foot paths, and is often determined by the presence of passes, ridge and valley systems, or existing routes through the property. Various road arrangements may be tested, including general patterns such as "grid, linear, or concentric schemes" (Lynch and Hack, 1984).

Recreational Design Considerations

Hultsman et al., (1998) counsels recreational designers to consider the many problems they must address during projects. The authors start with their most fundamental point: water flows downhill. Water-caused erosion can have significant impacts on the environment. The text warns that rapid erosion frequently occurs under rooftops due to rainfall drainage and that the best way to protect these areas is with crushed stone.

Hultsman et al. (1998) also identified the importance of knowing the types of soil present at the site. This information can be found through the NRCS. According to the authors, vegetation is another vital aspect in crafting outdoor use areas. Cover planting is essential in the prevention of soil erosion and while shading is crucial for outside environments, the planner should not be afraid of cutting down trees.

The next major portion of this publication concentrated on campsite development. The book discussed how universal-type campsites are best because they align the tent pad, garbage can, and fire pit all on the passenger side of the site. The campsites are considered universal because there are no limits to wheel chair-bound or disabled campers since the entire site is level. This type of site also reduces maintenance costs by decreasing site deterioration.

The Design Process

When designing changes to any type of park or recreational area, a detailed plan is essential. Kelsey and Gray (1985) provide useful information for the detailed steps necessary to create functional, attractive recreational facilities. This reference details how to set forth objectives identified by the sponsoring agency. There should be resource goals to ensure effective and conservative use of land and water sites, as well as participant goals to ensure safety, equal opportunity, and limited costs to those utilizing the facilities.

Kelsey and Gray (1985) go on to discuss the necessity of preparing a supply analysis of the site to identify existing assets of the sponsoring agency, which range from buildings and scheduled events to natural resources. Next, the authors demonstrate the need to make population and demand analyses. They state that the planning of recreational areas “does not occur in a vacuum and the population served is most critical”. The demand analysis consists of polling the community to determine its desires.

Once the data collection process is completed, Kelsey and Gray (1985) suggest performing an expenditure analysis to achieve a financial cost estimate of each component of the plan, as well as creating a priority criterion ranking system to determine the specific importance of each recommendation.

Structural Layout Designs

After studying existing literature and considering the requests of the MSW Association, PeAC Designs presented two basic structural layouts for consideration.

Plan A

The first design employed the "star" planning pattern while still minding the rocky, sloping terrain of the south half of the property. Figure 10 shows the general structural layout for this design. To start, the main entrance of the Assembly Grounds is moved from the western edge of the property to the middle. The west entrance is designated for campers only and leads to an RV circle and a smaller loop with tent pad sites. The eastern-most road is used to access the private church cabins. This road also loops through the center of the property.

Changing the structural arrangement of the Assembly Grounds groups the cafeteria, chapel, dormitory, and women's ministry building in the center of the property. The small motel-style building requested by the MSW Association is added to the center structures for office space and traveling ministers' sleeping quarters. In order to accommodate more youths for the summer camps, the dormitory structure is modified to two buildings with a breezeway in between. All private church cabins, depicted in blue in figure 10, are arranged in an L-shaped pattern along the east side of the property.

The new design relocates all open air facilities except the basketball court. The nursery buildings and their associated playground are moved to just west of the centralized women's ministry building. The prayer garden is shifted to a more private location, southwest of its current position. A second, smaller prayer garden is added in the southeast corner of the property. In addition, a hiking trail is created on the southern half of the site. The trail consists of two separate loops that weave throughout the rocky, shaded terrain. One of the loops passes around the smaller prayer garden. The overall configuration of this design maintains the open fields on the north half of the property for youth sports activities. The facilities, as shown in figure 10, include:

1. Dormitories
2. Cafeteria
3. Office Building
4. Women's Ministry Building

5. Chapel
6. Restroom/Shower Facilities
7. Basketball Court
8. Nursery Buildings and Playground
9. Open Pavilions
10. Main Prayer Garden
11. Small Prayer Garden

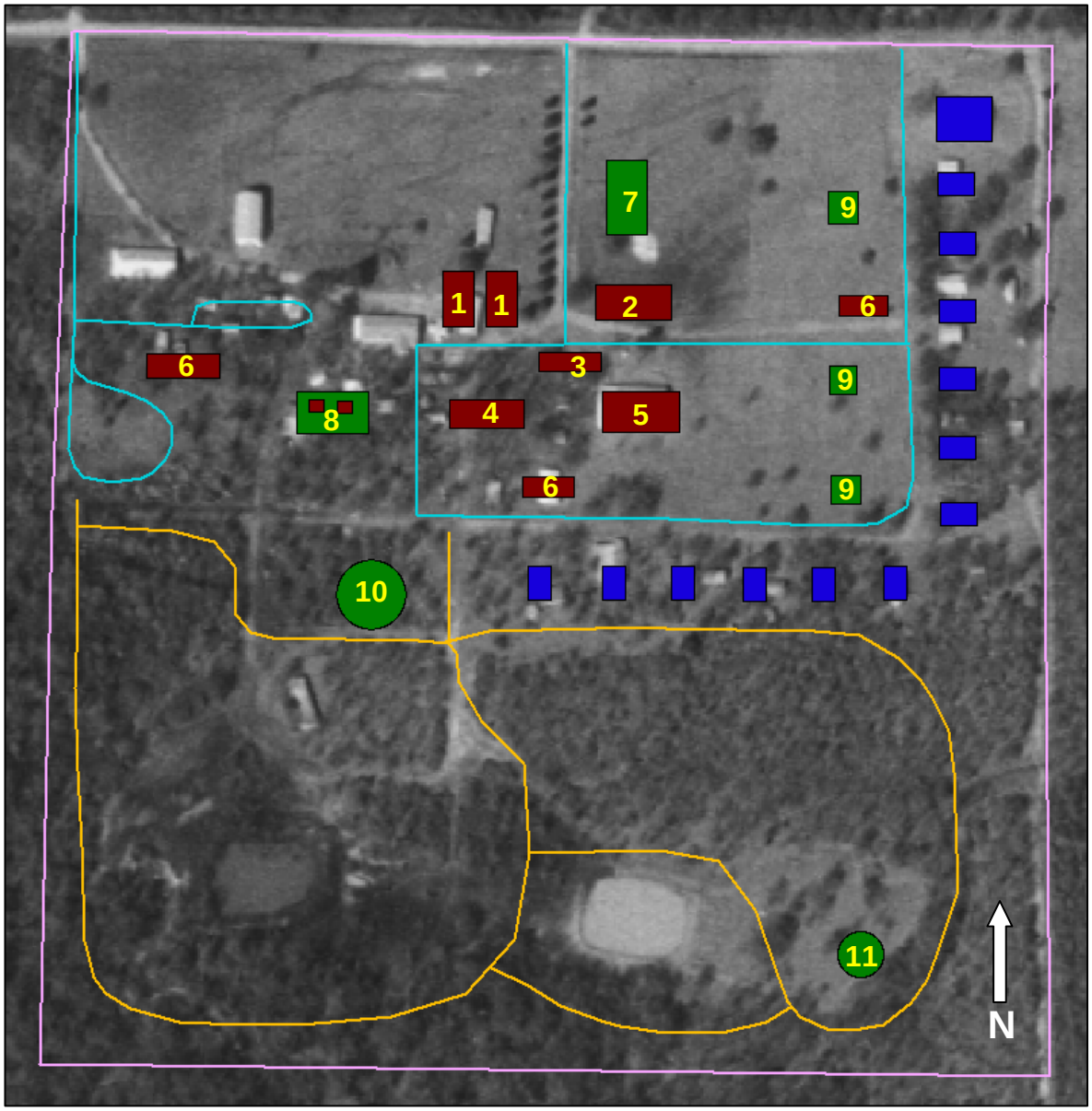

Figure 10. Plan A: Star pattern site plan.

Plan B

A second site plan created by PeAC Designs utilizes many aspects of the current structural layout on the Assembly Grounds. This plan makes use of all large permanent structures and a majority of the private church cabins currently on the site. As in Plan A, an additional dormitory building is included as well as the motel-style building for offices and sleeping quarters. The new dormitory is located adjacent to the existing one, with a breezeway in between and the new office building is situated just north of the cafeteria. Two restroom/shower facilities are added; one on each edge of the property.

As requested, designated RV and tent camping areas are on the western edge of the property. The main prayer garden and hiking trail are in the same locations as Plan A. As shown in figure 11, the additional buildings include:

1. Dormitory
2. Office Building
3. Restroom/Shower Facilities

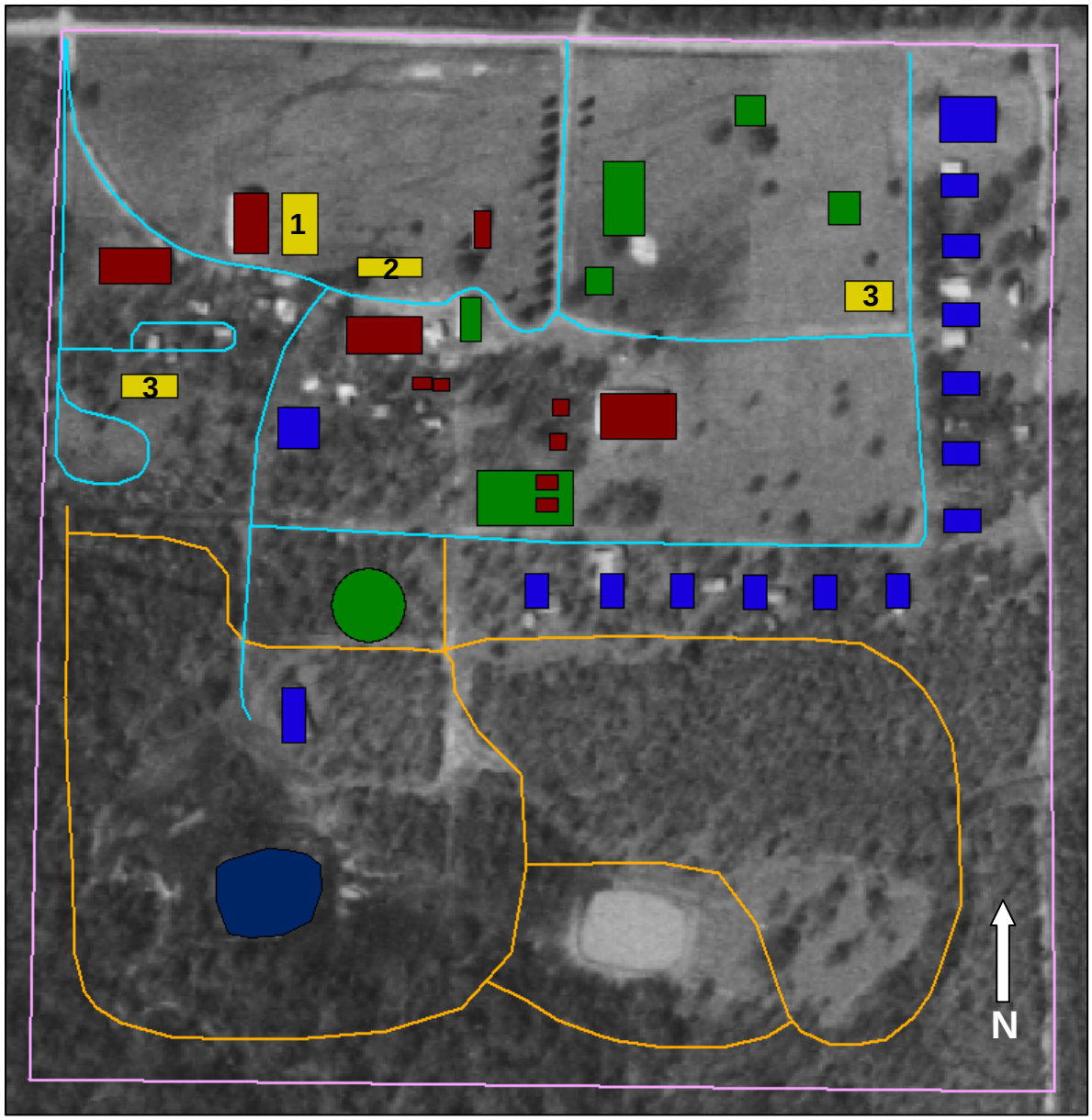

Figure 11. Plan B: Utilize current structural layout.

Feasibility of Structural Layout Designs

Plan A

Plan A centralizes common use facilities and employs the topography for outdoor recreation. The feasible developments of this plan include using the shaded area on the western edge of the property for RV and tent camping facilities. The gentle grade on this portion of the property is conducive to the minor leveling needed for RV and tent pad sites. The addition of hiking trails and prayer gardens make use of the undeveloped south half. These amenities can be implemented with minimal construction effort.

Many of the structural changes necessary for this design make it difficult and expensive to implement. In order to execute the "star" planning pattern, the cafeteria, dormitory, women's ministry building, nursery, and both sets of restrooms must be demolished and reconstructed in the center of the property. To adjust for the relocation of these buildings, new trenches must be excavated for water and sewer line connections. Although the Linker-Hector soil complex in this area is adequate for constructing buildings, the shallow soil depth to bedrock makes excavation extremely difficult and cost prohibitive. PeAC Designs believes utilizing as many existing utility trenches as possible will be the most cost effective solution.

Due to the Enders-Hector soil association on the south half of the property, PeAC Designs does not believe it is feasible to develop this area for anything other than recreational purposes. The shallow depth to bedrock, moderate to steep slope, and shrink-swell tendencies of the soil make excavation and construction impractical.

Plan B

Plan B maintains as much of the current structural layout as possible in order to limit the construction and excavation costs. It utilizes all feasible additions discussed in Plan A, which include designated camping areas, hiking trails, a larger prayer garden, and two new restroom facilities.

The main difference between the suggested site plans is that Plan B takes advantage of the current structural layout on the property. All large permanent structures are retained as well as most of the private church cabins. Maintaining the current structural layout allows utilization of the existing utility trenches which makes this plan more cost effective than Plan A.

Final Structural Layout Design

After researching layout planning and theory, considering the physical properties of the Assembly Grounds, and discussing possibilities with the MSW Association, PeAC Designs recommends implementing a variation of structural layout Plan B. This altered Plan B design is noted in figure 12. On the west side of the property, the Association would rather have a larger RV loop with eight to ten pad sites than the availability of both RV and tent camping sites. They would like to see electrical and water hook-ups to all of the RV pad sites. The MSW Association has already laid the foundation for the motel-style office building to the east of the existing dormitory, as depicted in the structural layout.

Although this plan does not centralize the common use buildings, it implements the cost effectiveness of Plan B because it does not entail the extreme construction associated with Plan A. The final selected design does allow for construction of the requested dormitory expansion and the supplemental restroom facilities but it locates them near existing utility trenches, therefore requiring less extensive excavation. PeAC Designs suggests a realistic location for the requested camping facilities and hiking trails. This plan also moves the redesigned prayer garden to a more suitable secluded location. Developing the southern and western portions of the property for outdoor activities makes best use of the soil and topographic limitations of the area.

While the altered Plan B is the MSW Association's ideal structural layout, further investigation of the utility infrastructure feeding the Assembly Grounds limits the extent to which immediate expansion can occur. Buildings shown in yellow in figure 12, which include the second dormitory and additional restroom facility on the east side of the property, are those which cannot be adequately served with the current infrastructure for reasons detailed in the following sections. Buildings in lime green are new expansions which can be sufficiently served.

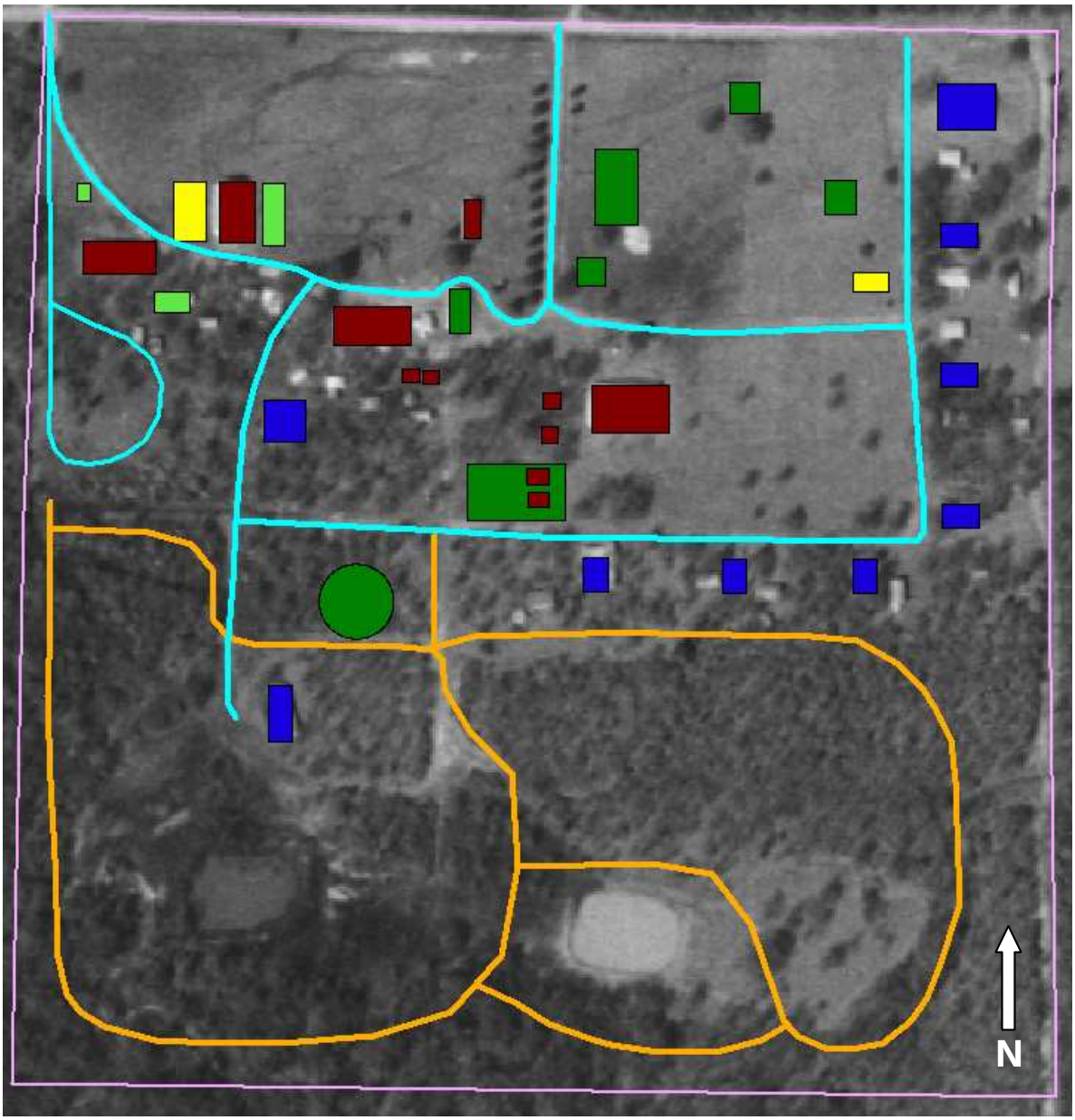

Figure 12. Final structural layout with immediate and secondary expansions

Final Utilities Design

Electrical Distribution

Upon visiting the site, PeAC Designs noted several areas of concern within the electrical distribution on the Assembly Grounds. Due to the scope of this project, only the major existing lines which pose a problem on the facility are addressed. However, PeAC designs offers recommendations for the additional concerns.

In order to provide the MSW Association with a safer facility, PeAC designs recommends relocating the power line that currently crosses the playing field, running from the northwest corner of the property to a transformer near the dormitory. The new path for the power line will follow the west entrance of the property, labeled as section A in figure 13. From this point, the line runs between the dormitory and women's ministry building and connects to an existing power pole which serves the center of the property. This section of line is labeled as section B in figure 13. An additional line near the west boundary of the property should be added to accommodate the installation of the RV loop and is labeled as section C in figure 13.

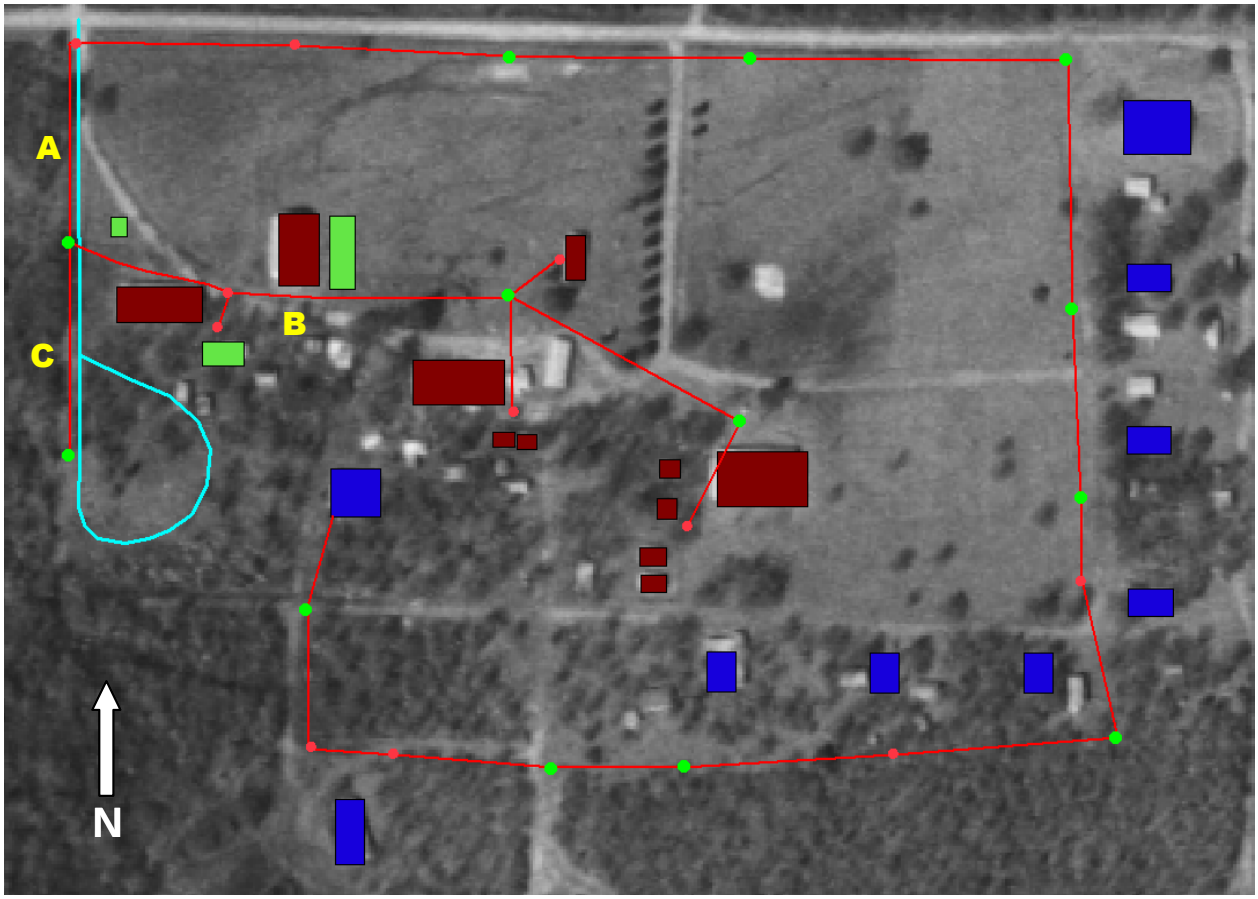

Figure 13. Final electrical distribution layout

This task requires moving a total of 550 feet of existing line and purchasing an additional 390 feet of new line. One power pole and one transformer from the original layout can be utilized in this design; however, the purchase of two power poles and one transformer is required. The total material needed is given in table 1.

Table 1. Electrical distribution necessities

Description	Length (ft)
Total line	940
Old line to be moved	550
New line needed	390
New transformers needed	1
Transformers/power poles to be moved	1
New power poles needed	2

Because many power lines which feed the private cabins were installed without proper guidance from PSO, PeAC Designs recommends the MSW Association consult PSO and a licensed electrician to properly install all service. After consultation with the electric provider, PeAC Designs determined that the infrastructure is adequate to supply power to all existing buildings. Although the MSW Association was concerned the power supply feeding the air conditioning unit at the dormitory was inadequate, the problem is actually an under-sized breaker box. The breaker box needs to be sized to the correct amperage.

According to the *National Electric Code* (NFPA, 2004),section 225.18 part 1, electric cables shall have a clearance of at least 10 feet above the finished grade, sidewalks, or any platform from which they might be reached where the voltage does not exceed 150 volts to ground and is accessible to pedestrians only. In addition, it specifies that there be a minimum clearance of 3 feet for all electrical lines above rooftops provided that those rooftops have slopes no less than 4 inches of vertical rise per 1 foot of horizontal run. These requirements are demonstrated as Figure 9-18 and Figure 9-15 in the *National Electric Code* (NFPA, 2004) and below as figure 14 and figure 15, respectively.

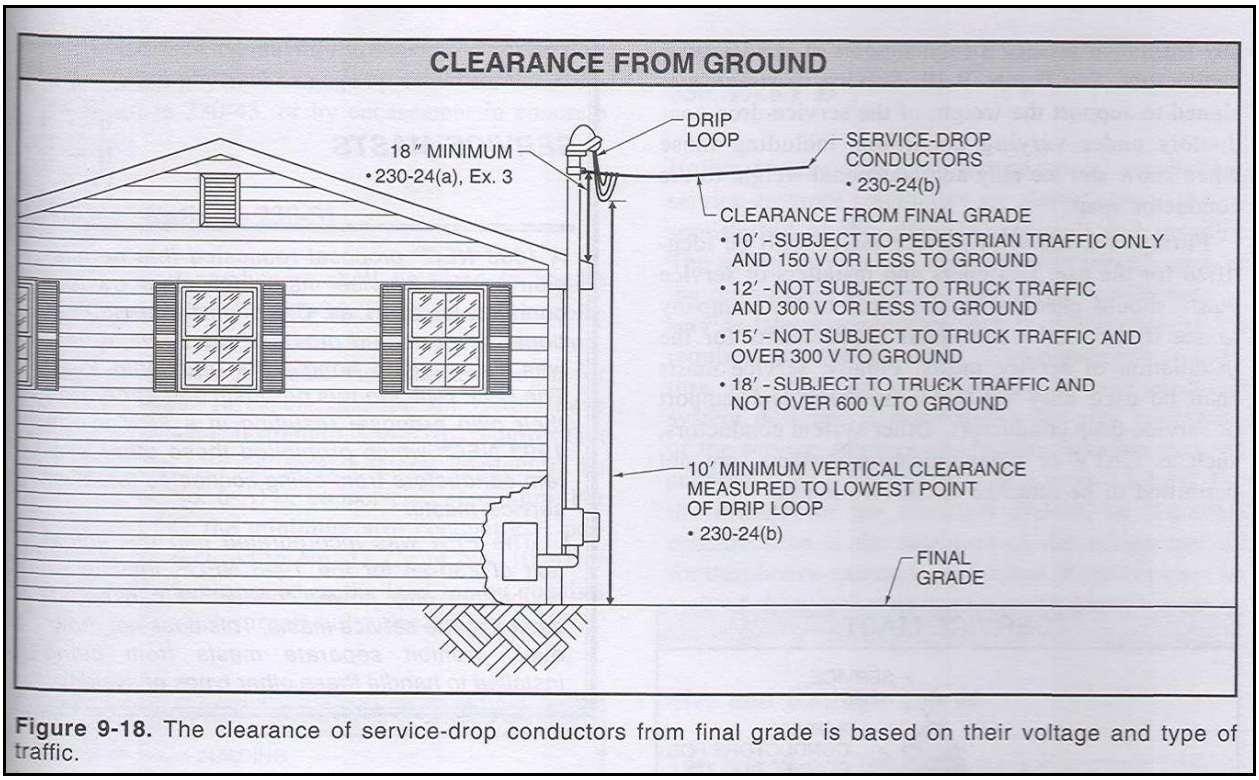

Figure 9-18. The clearance of service-drop conductors from final grade is based on their voltage and type of traffic.

Figure 14. Minimum ground clearance of electrical lines

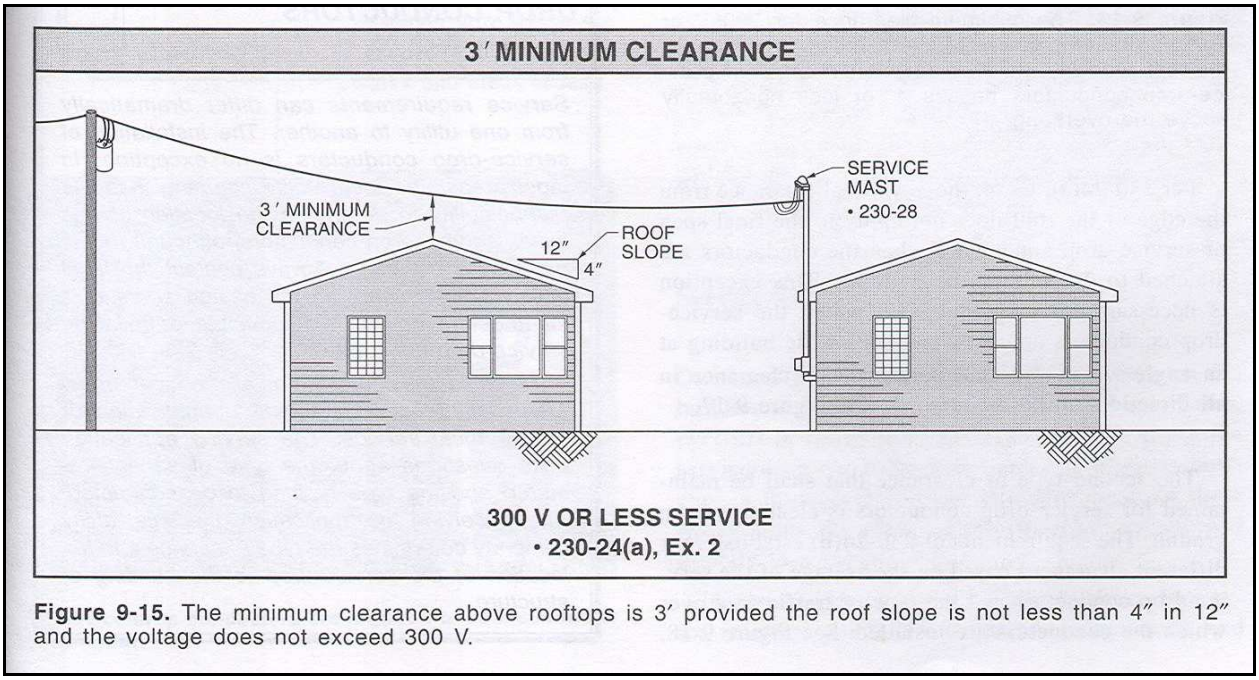

Figure 9-15. The minimum clearance above rooftops is 3′ provided the roof slope is not less than 4″ in 12″ and the voltage does not exceed 300 V.

Figure 15. Minimum clearance for electrical lines above rooftops

Water Distribution

The first step in redesigning the water distribution system for the MSW property was to determine the peak water demand. The goal of PeAC Designs was to design the system to adequately provide sufficient water pressure to all facilities, even during the morning and evening peak water demand periods. The calculated peak demand was based on the number and type of plumbing fixtures in each building, the rates of flow for each fixture, and the probable simultaneous operation of each fixture.

The number and type of plumbing fixtures on the property were determined by referencing Table 403.1 of *International Plumbing Code* (ICC, 2003). This table, listing the minimum number of required plumbing fixtures for different building types, does not have listings for recreational buildings nor does it list requirements for seasonal-use properties. Taking this into consideration, PeAC Designs altered the number and types of fixtures based on the current property layout with additions to accommodate only immediate expansions and educated guesses for the number of private cabins in use at any given time. Additions for immediate expansions included the new motel building with four private restrooms, expanding the restroom facilities in the existing dormitory, and constructing a new restroom facility on the west side of the property to accommodate the proposed RV camping loop. The number and type of plumbing fixtures are found in table 2.

Table 2. Plumbing fixtures in each buiiding

Facility	Kitchen Sinks	Toilets	Bathroom Sinks	Showers
Dorm	0	8	8	6
Cafeteria	3	1	1	0
Restroom 1	0	4	2	2
Restroom 2	0	4	2	0
Motel	0	4	4	4
WM	0	2	2	0
RV	0	0	0	0
Private	1	1	1	1

Once the number and type of plumbing fixtures were determined, each fixture was assigned a load value from *National Standard Plumbing Code* (PHCC, 1983), Table B.5.2. The load values were summed for each building and the corresponding peak demand, in gallons per

minute (gpm), was determined from Table B.5.3. of the same reference manual. The overall peak demand values, as well as the peak demand values for each building, are found in table 3.

Table 3. Peak demand values

Facility	Number of Buildings	Peak Demand (gpm)	Total Peak Demand (gpm)	Fixture Values
Dorm	2	37.71	75.43	80
Cafeteria	1	13.4	13.4	12
Restroom 1	3	20.8	62.4	32
Restroom 2	1	16.4	16.4	24
Motel	1	25.6	25.6	44
WM	1	10.4	10.4	14
RV	8	0	0	0
Private	9	8.6	77.4	11
Immediate Expansion Peak Demand			**212**	
Total Peak Demand			**281**	

The next step in redesigning the water distribution system was to determine the current water pressure on the property. This was done by two methods. One, the static water pressure in the center of the property was measured by PeAC Designs during a site visit. Two, the static pressure on the incoming rural water district line was measured by Johnnie Goodman of McIntosh Rural Water District # 13. The two measured pressures were similar. PeAC Designs measured between 35 and 38 pounds per square inch (psi) while the Rural Water District measured 40 psi. PeAC Designs chose to calculate the redesign of the water system based on the pressure measured on the main line.

After initial calculations using WaterCAD, a stand-alone software program used for water distribution modeling, it was apparent that a static water pressure of 40 psi from the main line would not provide adequate pressure to the buildings on site with a peak demand of 281 gpm and the current un-looped distribution system. These initial results, modeling the un-looped system with 1 ½ inch distribution lines, are located in Appendix A. From these results, PeAC Designs determined that all distribution lines on the property should be replaced with 3 inch lines in a looped system in order to achieve maximum efficiency.

PeAC Designs' first consideration to address the problem was to install a water tower with hydrostatic pressure great enough to supply the necessary demand at an adequate pressure. To provide enough pressure for the entire site, the tower would need to stand at least 100 feet

tall. This elevation was determined from the concept that 1 psi corresponds to 2.31 feet of water in a tower. To provide an initial pressure of 40 psi the tower needs to be 92.4 feet tall. However, this pressure will drop with every gallon used; therefore, the addition of 7.6 feet would maintain the ideal pressure for a longer period of time.

After studying this option, one major roadblock came to light. With a static pressure in the main line of 40 psi, it would not be possible to fill the tower without the aid of a pump. The size of pump necessary to pump water 100 feet in the air would require 3-phase power, which is unavailable on the site. In order to achieve 3-phase power, it would be necessary to install either a diesel or wind-operated generator. Both types of generators would have a sizeable initial investment and considerable maintenance costs.

The next design considered to address the water distribution problem incorporated a smaller potable water holding tank with a booster pump for distribution. The tank would be large enough to provide the peak water demand for up to an hour and the pump would be small enough to run on single-phase electric power. This design proved to be the better of the two options.

PeAC Designs used WaterCAD to accurately size the distribution lines, the water holding tank, and the booster pump, for the pressures and demands needed. Using this software, PeAC Designs modeled a looped distribution system with a more direct configuration for the property, noted in figure 16. Rather than bisecting the property at a diagonal from the northwest water meter and running haphazardly throughout, the configuration for the west side of the property is streamlined. The system modeled in WaterCAD was with 3-inch distribution lines throughout the property, a 10,000 gallon water storage tank, and a 7 ½ horsepower, motor driven pump. The modeled system was set to have the pump turn on when the system pressure dropped to 25 psi and then turn off when the system pressure reaches 40 psi. With this set up, the resulting pressures at the various junctions on the site proved adequate based on Table 15 from *Private Water Systems Handbook* (MWPS, 1979). This handbook recommends a minimum water pressure of 20 psi at a typical flush-valve toilet. The lowest pressure on the modeled system is 25.9 psi. A junction, pipe, pump, and tank report are found in Appendix B.

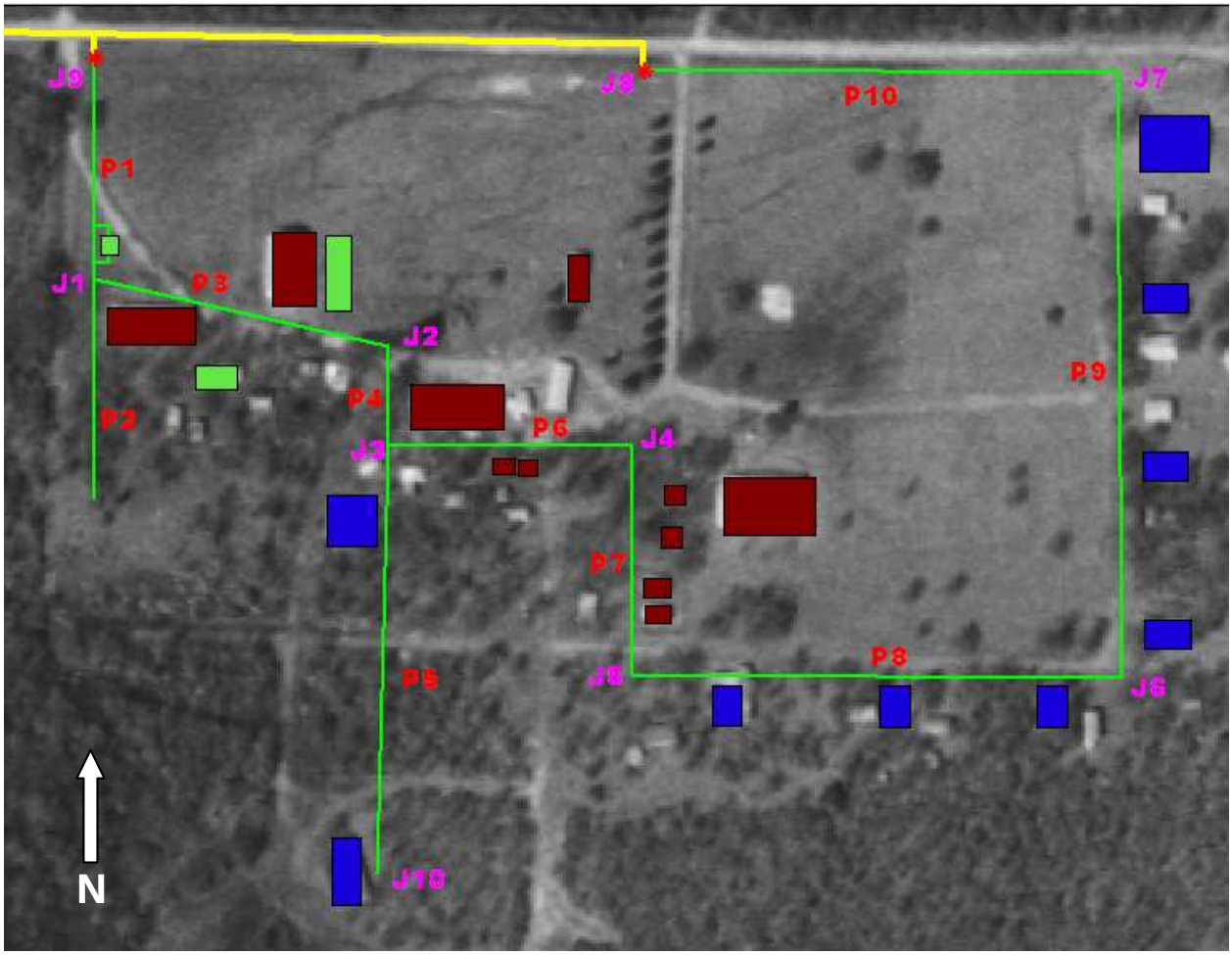

Figure 16. Final water distribution layout

In order to effectively implement this solution, PeAC Designs recommends the installation of at least two 220 gallon pressure tanks and a simple valving system. The pressure tanks should be installed parallel to one another and downstream from the distribution pump. They would act as a pressure buffer system, allowing the use of at least 60 gallons of water on the property before the pressure would drop below 25 psi, necessitating activation of the booster pump by a pressure switch. The valves necessary for the distribution system include a set of manual valves on either side of the pump, allowing the pump to be removed from the system for maintenance; a check valve in the line coming off the second water meter, allowing water to only flow into the system and not back into the main line; a check valve in the line between the two junctions where the line splits off to feed the tank and where the tank feeds back into the system, allowing water to only flow into the system and not back into the main line or circulate back into the tank. It will be necessary for the MSW Association to construct a building large enough to

house the holding tank, booster pump, and the two pressure tanks. The building needs to have a concrete foundation, be vented for air circulation, and be insulated to prevent freezing.

For future growth, including the addition of a dormitory, a restroom facility on the east side of the property, and providing water hook-ups to the RV sites, it will be necessary for the MSW Association to implement an additional holding tank and pump system.

Sewer Collection

The current sewer collection layout on the Assembly Grounds is both logical and appropriate for the needs of the MSW Association as per the Oklahoma Department of Environmental Quality Chapter 641, *Individual and On-site Sewage Treatment Systems* (Oklahoma, 2004). According to Appendix C of Chapter 641 (Oklahoma, 2004), 4 inch diameter pipes are applicable when the total average flow from buildings feeding the pipe is less than or equal to 2000 gallons per day (gpd); whereas, 6 inch pipes must be used for flows greater than 2000 gpd. PeAC Designs calculated the typical wastewater flowrates for each building on the property using Table 4-4 by Crites and Tchobanoglous (1998). All present sewer line sizes are suitable for the current structural layout except for segment A in figure 17. Using the lower limit for wastewater production because the Assembly Grounds is a seasonal facility, PeAC Designs computed that the flowrate for the dormitory, with 100 people using the building, is 2000 gpd. Because the dormitory sewer pipe is serviced by segment A, this line must be increased from a 4 inch to a 6 inch pipe. The MSW Association needs to verify that all sewer collection pipes are constructed from either acrylonitrile butadiene styrene (ABS) or polyvinyl chloride (PVC) of standards listed in Appendix C of Chapter 641 (Oklahoma, 2004), as well.

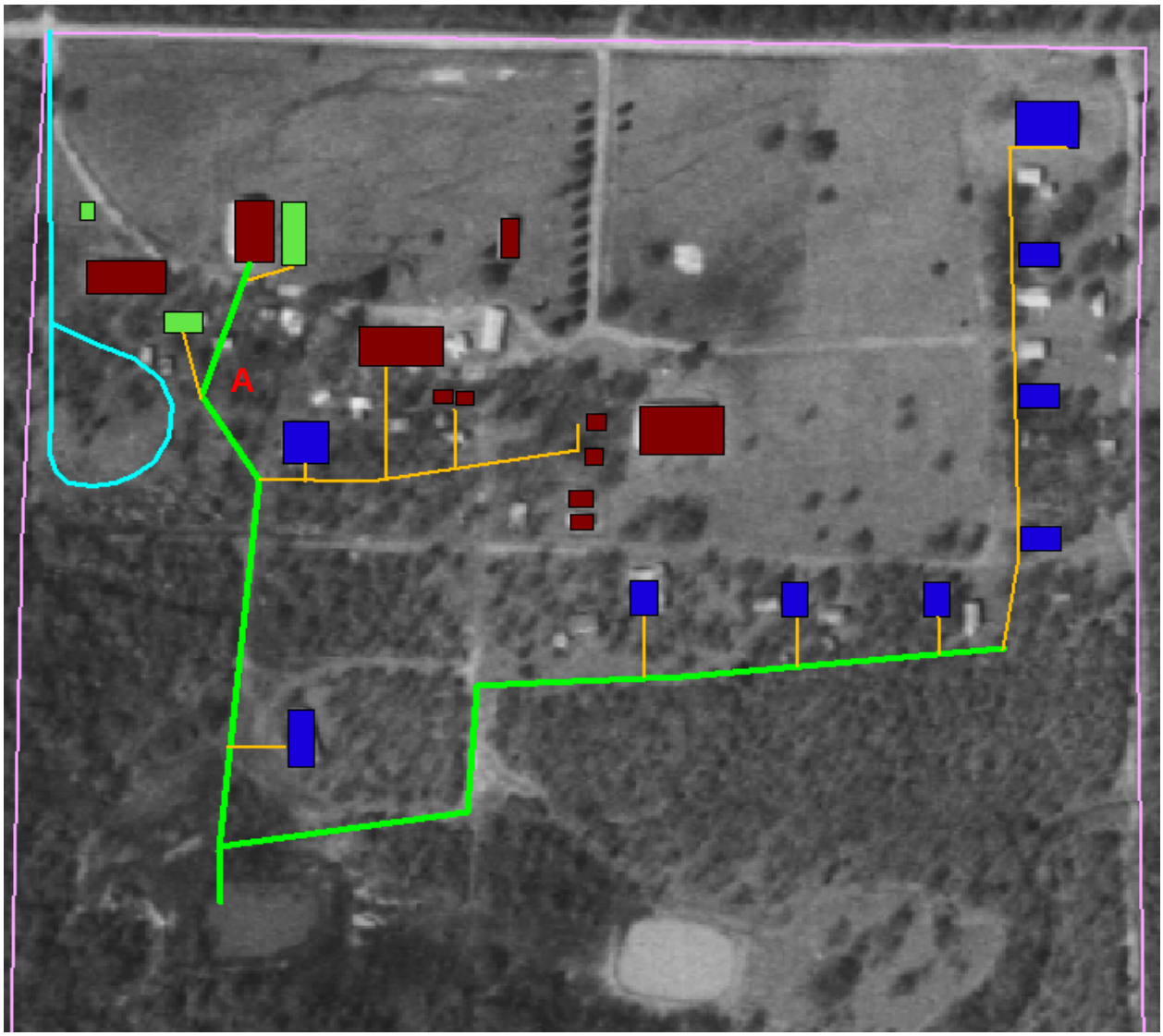

Figure 17. Final sewer design layout

To find proper dimensions for the wastewater lagoon, PeAC designs determined the maximum wastewater production on the site. Using wastewater flowrates for a "children's camp with central toilet and bath" as the facility type in Table 4-4 of Crites and Tchobanoglous (1998) and estimating a ceiling population of 400 people, the maximum daily wastewater production is 18,000 gallons. If the MSW Association holds three 5-day overnight meetings or camps in a row, the greatest necessary volume of the lagoon is 36,096 cubic feet.

The volume of the current lagoon on the Assembly Grounds is 69,520 cubic feet with a water-holding capacity of 53,531 cubic feet. This calculation was made using Pro/Engineer drawings created with the help of Ryan Haar, a fellow Biosystems Engineering student. These

drawings used the dimensions of the current lagoon having a trapezoidal shape with a longitudinal length of 146 feet and lengths of 124 feet and 106 feet along its western and eastern edges, respectfully. They also include a depth of 7 feet on the western side of lagoon with a gradual bottom gradient to 3 feet on the eastern edge. Assumptions were made for the models that the gradient was even across the lagoon. Additionally, current dike slopes of 1 foot vertical rise per 4 feet horizontal run (1:4) on all sides except a 1 foot vertical to 3 feet horizontal (1:3) slope on the eastern side are used in this calculation. Figure 18 demonstrates the varying depth across the current wastewater lagoon. This photograph was taken from the northeastern side looking southwest across the lagoon. It shows the deeper depth on the western side and shallow depth on the eastern side.

Figure 18. Current wastewater lagoon conditions

While the current volume of the lagoon is clearly large enough to accommodate the wastewater production of the Assembly Grounds, PeAC Designs suggests the MSW Association excavate the bottom of the lagoon to include a total maximum depth of 8 feet, as per the regulations in Chapter 641 (Oklahoma, 2004) of a minimum total depth of 7 feet with 1 foot of freeboard. PeAC Designs encourages this excavation should depth to bedrock permit. Also incorporating 1:3 dike slopes as required in Chapter 641 (Oklahoma, 2004), the lagoon volume

capacity becomes 85,979 cubic feet with 69,822 cubic feet of water-holding space. The Association needs to remove all woody vegetation from the top of the dikes and make sure the top of the dikes are at least 1 foot above the surrounding topography. Chapter 641 (Oklahoma, 2004) mandates this requirement and mandates that a six-foot woven wire fence surround all on-site lagoons located in public access areas.

Utilities Design Cost Analysis

The necessary materials and associated expenses for the renovation of the electrical, water, and sewer distribution system are described below. These prices are estimates and based on availability in the spring of 2006. PeAC Designs recommends that all utility installations be performed by licensed professionals.

Electrical Distribution

PSO estimates the associated costs for the changes in the power distribution to be $6200.00. This includes the relocation of the existing line, power pole, and transformer as well as the purchase of additional line, transformers, and power poles needed to complete the project. This fee does not include the installation of electrical hook-ups for the RV loop. However, the electrician installing the loop would be provided a "connection point" from PSO. This “connection point” would cost an additional $1000 and would include a transformer and a "drop" to the point of connection. A complete list of the material needed is listed in Table 1. A site visit from PSO is suggested in order to provide a more accurate cost analysis.

Water Distribution

The water holding tank that PeAC Designs recommends is a 10,000 gallon polyethylene fresh water tank which meets all National Sanitation Foundation requirements for potable water. This particular tank, made by Water Tanks.com of Columbus, OH, has an 11.75 feet diameter and is 13.3 feet tall.

The steel building required to house the water tank can be custom built. Estimated dimensions of the building are 16 feet long, 16 feet wide and 16 feet tall. These approximations were given by Brian Strader Construction of Stillwater, OK. The concrete foundation for this building must be 6 inches thick on the outer edges with a 4 inch thick center. Cowboy Concrete of Stillwater, OK provided this information.

An example of a pump-motor combination required for this project can be found in the Berkeley Pump Systems catalogue. PeAC Designs referenced a Model B2TPM pump with 7 ½ horsepower motor combination for this cost analysis. In order to start the pump-motor combination with the single phase power on the site and not overdraw power from the system, a

soft start controller is required. The controller operates at 30 amperes, 220 volts, and 7 ½ horsepower and can be obtained from Advanced Motor Power Systems of San Clemente, CA.

Pressure tanks necessary to prevent the pump from cycling on and off too frequently were priced through Yourwaterneeds.com which operates out of Tampa, FL. PeAC Designs priced the SR-PS220 Model, a 220 gallon-size bladder tank. Each of these tanks is 51 inches tall with a 24-inch diameter.

PeAC Designs estimates the new looped water distribution layout will require 4,020 feet of 3-inch Schedule 40 PVC pipe. Cost approximations for this product were obtained through Wilson's Pipe of Tulsa, OK. A trencher required to install the PVC pipe can be rented for a monthly or weekly fee from a company such as Pioneer Rental of Stillwater, OK.
All costs associated with water distribution are summarized in table 4.

Table 4. Water distribution cost estimates

Description	Quantity	Size	Cost/ unit	Total
Water tank	1	10,000 gal	$5,000.00	$5,000.00
Pump/Motor	1	2x2.5x6M	$2,600.00	$2,600.00
Controller	1	7.5 Hp	$470.00	$470.00
Pressure tanks	2	220 gal	$485.00	$970.00
PVC pipe	40.2	100 ft	$180.00	$7,236.00
Steel building	1	18x16x16	$4,500.00	$4,500.00
Concrete Foundation	1	16x18	$1,200.00	$1,200.00
Equipment Rental	1 month		$2,160.00	$2,160.00
			Total	**$24,136.00**

Sewer Collection

Although PeAC Designs has made several recommendations for improvement of the lagoon, it is difficult to provide accurate cost estimation without a site visit by a licensed professional. PeAC Designs can estimate a total lagoon excavation of 16,500 cubic feet and a total fence length of no less than 525 feet. At a cost of $6 per cubic yard, total excavation costs, without disposal, would be approximately $3700. This general excavation cost was provided by Carrier Construction of Stillwater, Ok. A 6-foot chain-link fence can be purchased from Lowe's in 50 foot increments at a total uninstalled cost of approximately $815.

Safety and Hazards Analysis

Supplementary safety analyses were performed for all utilities on the Assembly Grounds by Andrea E. Sebree, a Fire Protection and Safety Engineering student at Oklahoma State University. Her results and recommendations are located in Appendix C.

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Appendix A

Un-looped Distribution System

Junction Report

Label	Base Flow (gpm)	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-1	132	132	-832.14	-360.03
J-2	13	13	-935.25	-404.64
J-3	29	29	-957.58	-414.3
J-4	16	16	-963.42	-416.83
J-5	0	0	-440.29	-190.49
J-6	26	26	-440.29	-190.49
J-7	34	34	-404.67	-175.08
J-8	0	0	-273	-118.11
J-9	0	0	-268.56	-116.19
J-10	0	0	-272.96	-118.1

Pipe Report

Label	Length (ft)	Diameter (in)	Discharge (gpm)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)
P-1	230	1.5	-199	563.58	2,450.34
P-2	230	1.5	0	0	0
P-3	316	1.5	67	103.12	326.32
P-4	102	1.5	54	22.32	218.85
P-5	450	1.5	9	3.57	7.93
P-6	254	1.5	16	5.84	23
P-8	513	1.5	0	0	0
P-9	630	1.5	-26	35.61	56.53
P-10	495	1.5	-60	131.67	266

Appendix B

Looped Distribution System with Tank and Pump

Junction Report

Label	Base Flow (gpm)	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-1	84	84	83.18	35.99
J-2	13	13	71.34	30.86
J-3	29	29	67.31	29.12
J-4	16	16	63.79	27.6
J-5	26	26	61.56	26.63
J-6	34	34	59.92	25.93
J-7	0	0	59.92	25.93
J-8	0	0	59.92	25.93
J-9	0	0	18.76	8.12
J-10	9	9	67.2	29.07

Pipe Report

Label	Length (ft)	Diameter (in)	Discharge (gpm)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)
P-1	160	3	-109.48	4.43	27.69
P-2	225	3	0	0	0
P-3	325	3	127	11.85	36.45
P-4	135	3	114	4.03	29.84
P-5	410	3	9	0.11	0.27
P-6	250	3	76	3.52	14.08
P-7	245	3	60	2.23	9.09
P-8	515	3	34	1.64	3.17
P-9	630	3	0	0	0
P-10	495	3	0	0	0

Pump Report

Label	Shutoff Head (ft)	Design Head (ft)	Design Discharge (gpm)	Maximum Operating Head (ft)	Maximum Operating Discharge (gpm)	Discharge Pump Grade (ft)	Discharge (gpm)	Pump Head (ft)	Calculated Water Power (Hp)
PMP-1	123	102	100	65	275	90.18	211	78.55	4.18

Tank Report

Label	Base Elevation (ft)	Minimum Elevation (ft)	Initial HGL (ft)	Maximum Elevation (ft)	Tank Diameter (ft)	Inflow (gpm)	Current Status	Calculated Hydraulic Grade (ft)	Calculated Percent Full (%)
T-1	0.5	3.5	13.5	14	11.75	-101.52	Draining	13.5	95.2

Appendix C

Safety Report and Analysis

OKLAHOMA STATE UNIVERSITY
Fire Protection and Safety Technology FPST

SYSTEMS SAFETY
FPST 4333

BIOSYSTEMS ENGINEERING PROJECT

Fire and Safety Engineering Recommendations
for
PeAC Designs
Site Planning Consultants

By:
Andrea E. Sebree
Fire Protection & Safety Engineering

Introduction

This report on the fire and life safety concerns identified at the Muscogee-Seminole-Wichita Baptist Association Camp site in Henryetta, OK will pin point the major areas of concern, cite the regulating code or standard followed by corrective recommendations. Attached is a preliminary hazards analysis that was conducted after the site visit to help identify the key issues that presented a particularly complex or repeated exposure of a hazard (or hazards) to the occupants. The situation is further complicated by the desire to minimize impact of these urban upgrades on the rural environment. With these issues in mind the following items are listed violations for fire and/or life safety.

Electrical wires

Although this subject has already been discussed in PeAC's recommendations for utilities upgrade, the need to emphasize the fire and life safety concerns relating to this particular issue is evident. The recommendations for improved services are valid but do not supersede the requirement for electrical safety that abounds in the numerous electrical issues at the MSW camp.

The issue of low hanging electrical wires is a frequent occurrence at the MSW camp site. (See figure 1 & 2) This situation is a critical hazard and has the potential to become catastrophic with the remote chance of electrocution but the probable chance of fire, entanglement and electrical shock are crucial. This is an unacceptable risk when children are present on the property. The fire danger is further complicated by being located near the tree line in an area prone to drought and often under high fire danger.

NATIONAL ELECTRIC CODE (NFPA 70)

> NEC 225.18 (2) states the following:
> "Clearance to Ground. Overhead spans of conductors and open multiconductor cables… shall conform to… 3.7 m (12ft)- over residential property and driveways, and those commercial areas not subject to truck traffic…"

The recommendation for correction is that once electrical upgrades are made through the local electrical utility (PSO) ideally MSW should have the distribution wiring from the transformers and distribution poles to the individual buildings replaced and upgraded as well so to also comply with the requirements of NEC 230.52 Individual conductors entering buildings or other structures (Also figure 1), NEC 230.49 Protection of Open Conductors and Cables Against Damage – Aboveground (See figure 2) NEC 310.61-67 Thickness of Insulation for Conductors (See figure 3).

Water

In reference to the water supply on the site our concern is adequate flow fire protection use. There is a class III fire department stand pipe located on the north east corner of the property approximately 300 meters from the nearest structure. The stand pipe is marked, supervised (by a padlock) and grounded. However, the main that feeds the pipe is of PVC pipe and not suitable for direct fire department use. The stand pipe in its current state and position could only be used as a means of filling a tanker truck to provide a water supply for fire fighters to use in conjunction with a pumper truck.

With the proposed recommendation by PeAC Designs to install a 10,000 gallon water tank and pump in order to supplement the water supply demand it is also recommended that a fire department connection be added. A single 1 ½ - 2 inch stand pipe could be attached to the downstream line of the pump. The short fixture followed by a gate valve attached to the piping would have a small negligible effect on the pressure and flow of the pump and would be more beneficial than the current stand pipe. (See figure 4.)

The installation of a new fire protection stand pipe would require occasional attention of the owner/operator. According to the Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems (NFPA 25) 4.1 the owner is responsible for periodic inspections, tests, and maintenance to keep the equipment in good operating condition.

Life Safety

Several of the buildings on the site are of cinderblock construction however several of the structures are of sheet metal similar to the construction used for trailer homes. NFPA 501 Standard on Manufactured Housing is the code that should be applied to the mobile homes or trailers on the site even though they may be situated on a permanent 'foundation.' Access to the interior of most of the structures on the site was limited to an exterior inspection. The following is a list of recommended standards for the site owner/operators to review for compliance concerning the fire code and its application to manufactured housing.

Standard on Manufactured Housing (NFPA 501)
- 10.6 Heating appliances
- 10.8 Installation of appliances
- 11.3 Power Supply

It was observed that several breaker boxes and electrical feeder lines into manufactured structures on the site were loose and in one case in need of repair to conceal the contents of the breaker box.

According to NFPA 501:

> "11.8.13 Boxes, fittings, and cabinets shall be securely fastened in place and shall be supported from a structural member of the manufactured home, either directly or by using a substantial brace."

The multiple and mixed occupancies of the site along with its varied structures construction demonstrates a variety of the elements of life safety that must be established, defined and evaluated for compliance to the code. The Life Safety Code (NFPA 101) "…addresses those construction, protection, and occupancy features necessary to minimize danger to life from fire, including smoke, fumes, or panic." (NFPA 101 1.1.2) Since most the occupancy of the site is incidental or mixed according to the interpretation of the site's use, general 'safe egress' practices need to be used in accordance with the performance based option of the code. The owner/operator needs to evaluate each occupancy in the following ways:

- Are there two exits from each structure? (This can include a 1st floor window.)
- Are there adequate guards and hand rails for safe use of stairs in the case of smoke and/or fire?
- Are exits visible and marked?
- Are doors leading to exit(s) easy to open and kept unlocked during periods of occupancy? (To include doors needed to meet two exit requirement.)

The following are some recommended Life Safety Code standards recommended for review:

Life Safety Code (NFPA 101)
- Guards 7.1.8
- Means of Egress Reliability 7.1.10
- Existing Stairs 7.2.2.2.1 (Table 7.2.2.2.1(b))

General Fire Safety and Protection

It is recommended that smoke alarms be installed in all occupied spaces especially in dorm rooms, bedrooms and in path of egress. The National Fire Alarm Code (NFPA 72) 11.3 describes the requirements for smoke detectors fro this type of occupancy.

It is also recommended that fire extinguishers be installed in accordance with the Standard for Portable Fire Extinguishers (NFPA 10). Fire extinguishers should be chosen according to NFPA 10 4.2.1.1 Class A for general living spaces, NFPA 10 4.2.1.2 Class B fire extinguisher for protection in kitchen and NFPA 10 4.2.1.3 Class C for protection of the energized electrical equipment.

Along with a Class B dry chemical extinguisher in the kitchen of the dining facility- it is recommended that the stove hood ventilation system be upgraded. Installation of a UL listed grease removal device, inspection of the continuity of the welds at the seams and an air flow test is recommended to ensure safety and continued proper operation. (See figure 5) The Standard for Ventilation Control and Fire Protection of Commercial

Cooking Operations (NFPA 96) is the standard for industrial type kitchen stoves such as the one founding at the site dining facility.

Conclusion

In conclusion, the corrective recommendations for the more serious violations of the fire code need to be addressed to insure the safety of all occupants who use the Muscogee-Seminole-Wichita Baptist Association Camp site. The fire and life safety issue recommendations, to be reviewed by the owner/operator, are not required however are strongly recommended to maintain a level of fire and life safety. Some of these corrections may be considered costly however, there are many cost effective ways to accomplish the intent of the standard and recommendations. Compliance with proven standards of fire and life safety will ensure a safe and protected environment for campers and congregation members to enjoy.

Referenced Codes & Standards

National Fire Protection Association, Quincy,MA

Standard for Portable Fire Extinguishers NFPA 10, 2002 edition

Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems NFPA 25, 2002 edition

National Electric Code NFPA 70, 2002 edition

National Fire Alarm Code NFPA 72, 2002 edition

Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations NFPA 96, 2004 edition

Life Safety Code NFPA 101, 2003 edition

Standard on Manufactured Housing NFPA 501, 2005 edition

Figure 1: Low hanging electrical wire improperly attached/entering a building

Figure 2: Damaged fuse box in disrepair

Figure 3: Damaged conductor insulation covered with tape.

Figure 4: Current fire protection standpipe.

Figure 5: Current kitchen range hood with out any grease collection/removal device.

Preliminary Hazard Analysis

Hazard: Low hanging electric lines
Risk: Fire

	Severity			
Frequency	Catastrophic	Critical	Marginal	Negligible
Frequent				
Probable			X	
Occasional				
Remote				
Improbable				

Hazard: Low hanging electric lines
Risk: Electrocution

	Severity			
Frequency	Catastrophic	Critical	Marginal	Negligible
Frequent				
Probable				
Occasional				
Remote	X			
Improbable				

Hazard: Low hanging electric lines
Risk: entanglement

	Severity			
Frequency	Catastrophic	Critical	Marginal	Negligible
Frequent				
Probable				
Occasional		X		
Remote				
Improbable				

Hazard: Exposed electrical lines (no conduit)
Risk: Electrocution

	Severity			
Frequency	Catastrophic	Critical	Marginal	Negligible
Frequent				
Probable				
Occasional				
Remote	X			
Improbable				

Hazard: Exposed electrical lines (no conduit)
Risk: Fire

		Severity		
Frequency	Catastrophic	Critical	Marginal	Negligible
Frequent				
Probable		X		
Occasional				
Remote				
Improbable				

Hazard: Exposed electrical lines (no conduit)
Risk: Break in line

		Severity		
Frequency	Catastrophic	Critical	Marginal	Negligible
Frequent				
Probable				
Occasional		X		
Remote				
Improbable				

Hazard: Un-Serviceable Breaker Box(es)
Risk: Electrocution

		Severity		
Frequency	Catastrophic	Critical	Marginal	Negligible
Frequent				
Probable				
Occasional				
Remote	X			
Improbable				

Hazard: Un-Serviceable Breaker Box(es)
Risk: Fire

		Severity		
Frequency	Catastrophic	Critical	Marginal	Negligible
Frequent				
Probable	X			
Occasional				
Remote				
Improbable				

Hazard: Un-Serviceable Breaker Box(es)
Risk: Equipment Failure

		Severity		
Frequency	Catastrophic	Critical	Marginal	Negligible
Frequent				
Probable				
Occasional		X		
Remote				
Improbable				

Hazard: Un-fenced Sewage Lagoon
Risk: Health Hazard

		Severity		
Frequency	Catastrophic	Critical	Marginal	Negligible
Frequent				
Probable				
Occasional		X		
Remote				
Improbable				

Hazard: Un-Serviceable Breaker Box(es)
Risk: Drowning

		Severity		
Frequency	Catastrophic	Critical	Marginal	Negligible
Frequent				
Probable	X			
Occasional				
Remote				
Improbable				

MSW Association Site Plan

PeAC Designs

Site Planning Consultants

Meagan Armstrong

Rachel Cancienne

Megan Perry

Biosystems Engineering Senior Design

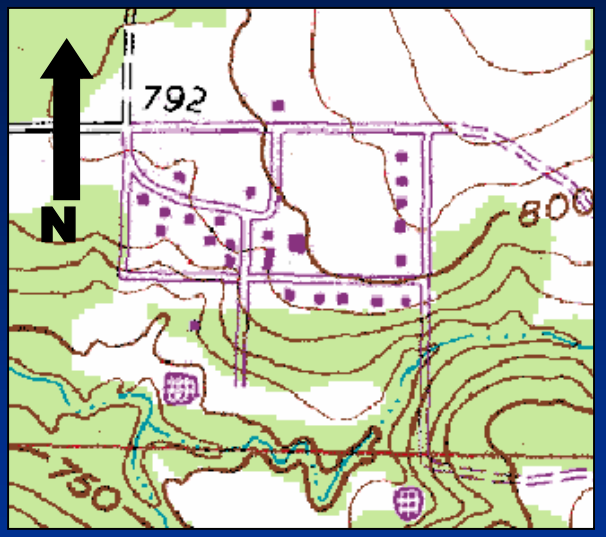
27 April 2006

BIOSYSTEMS & AGRICULTURAL ENGINEERING
Oklahoma State University

Introduction

- Muscogee-Seminole-Wichita Baptist Association
  - Founded in 1851
  - Purchased 40 acres southeast of Henryetta in 1956
  - Facility is used for meetings and church activities
- Acquired project through Ralph Hight, US Army Corps of Engineers Tulsa District
- PeAC Designs will create an improved site plan

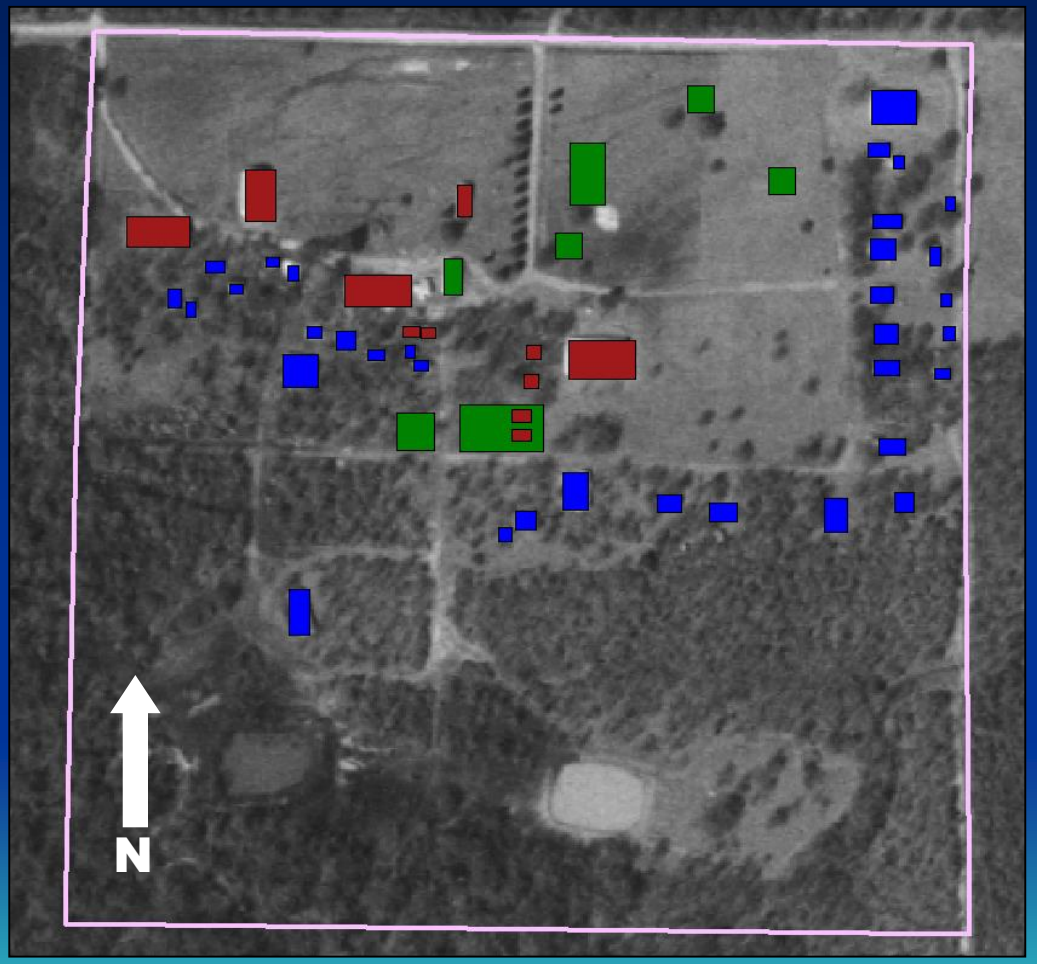
Site Description



- Grade varies throughout site
  - Fairly level on north half
  - Rocky, steep on south half
- Vegetation change along gradient
  - Grassy field on north half
  - Dense tree vegetation occurs on south half
- Soil properties vary throughout property
  - North half - Linker fine sandy loam
  - Middle property - Linker-Hector complex
  - South half - Enders-Hector association

Current Structural Layout

- All layouts created with ArcView 3.2



PeAC Designs

BIOSYSTEMS & AGRICULTURAL ENGINEERING
Oklahoma State University

Site Expectations

- Improve Existing Utilities
  - Electrical Distribution
  - Wastewater Distribution
  - Water Distribution

- Additional Facilities
  - Common Use Buildings
  - Designated Camping Area
  - Larger Prayer Garden/Hiking Trail

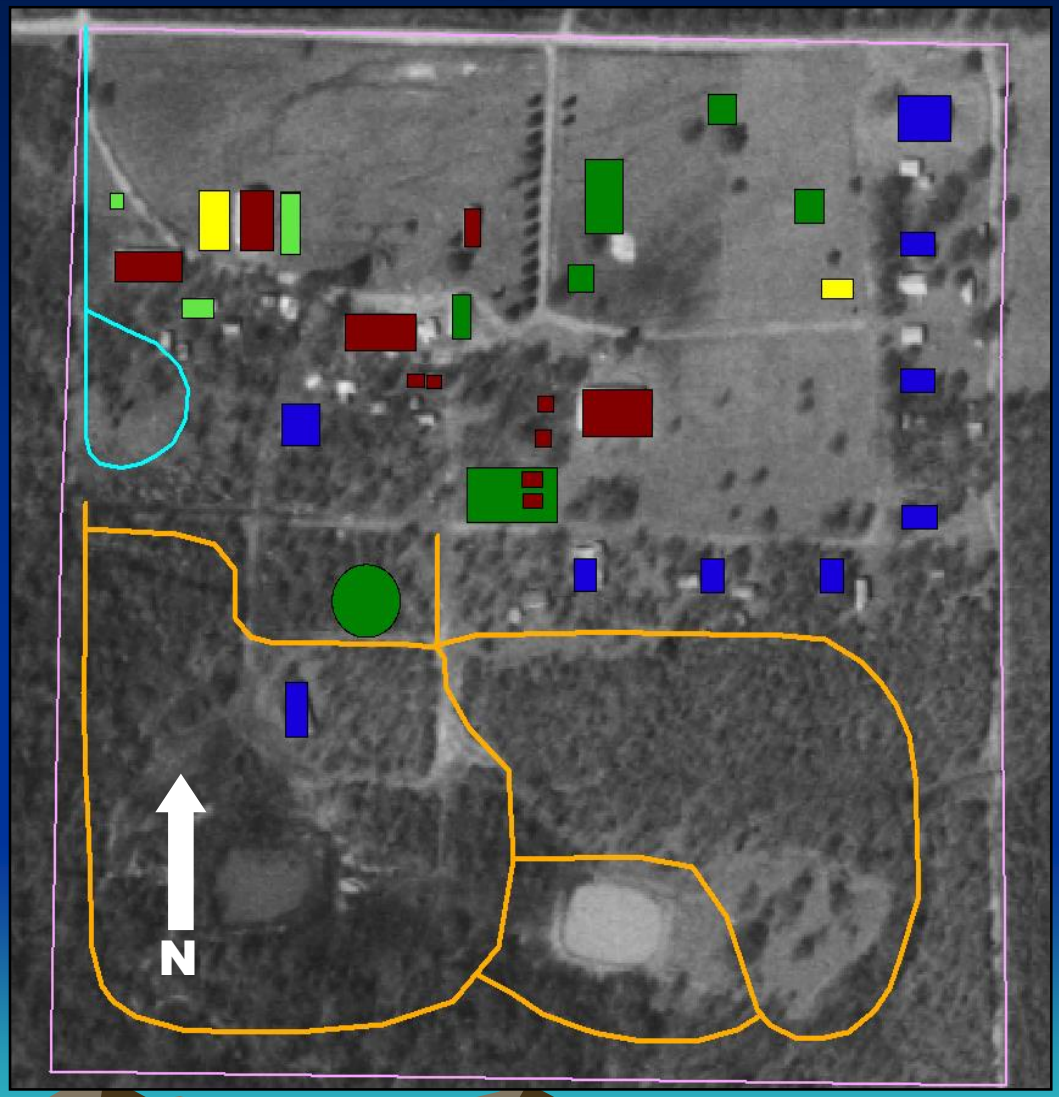
Final Structural Layout

- Utilizes aspects of current structural layout
  - Makes use of all large permanent structures
  - Eliminates unoccupied cabins and storage buildings
- Recognizes Site Expectations
  - Adds half of the requested buildings
  - Incorporates RV pad sites
  - Expands prayer garden
  - Includes hiking trail

Final Structural Layout

The facilities shown include:

- Common use
- Private use
- Immediate Expansion
- Future Expansion
- Hiking Trail
- RV Loop
- Open air



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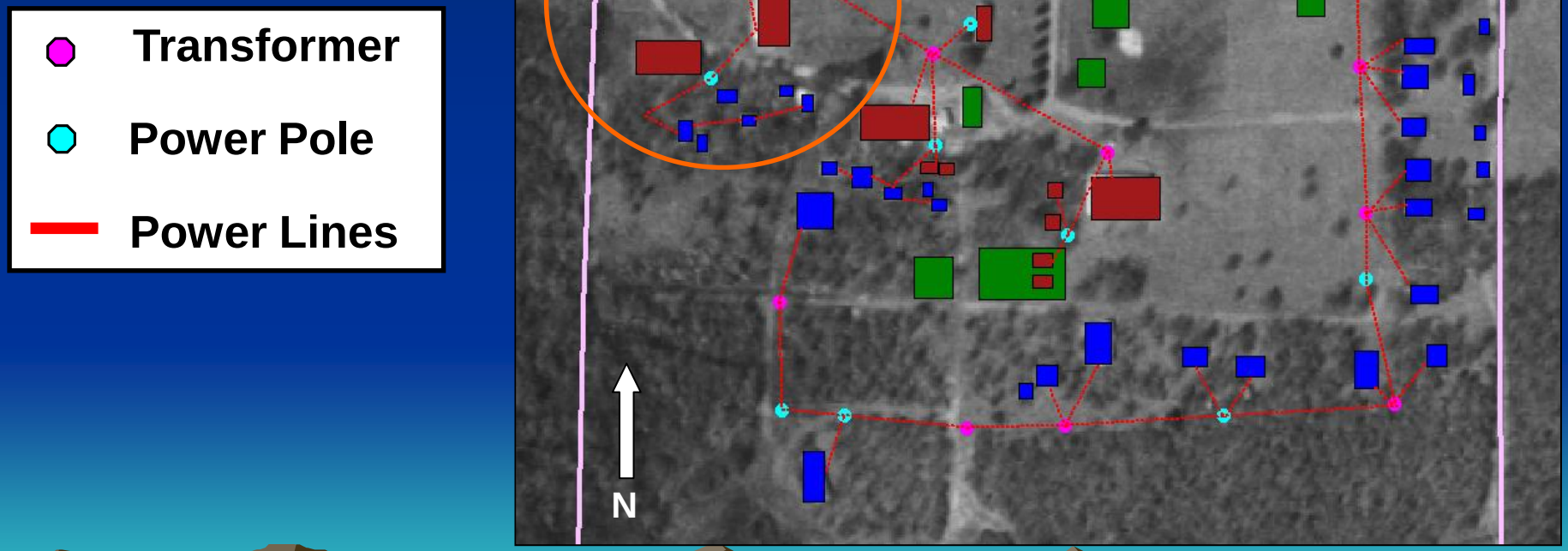
Current Electrical Distribution

- Main power utilities indicated by:



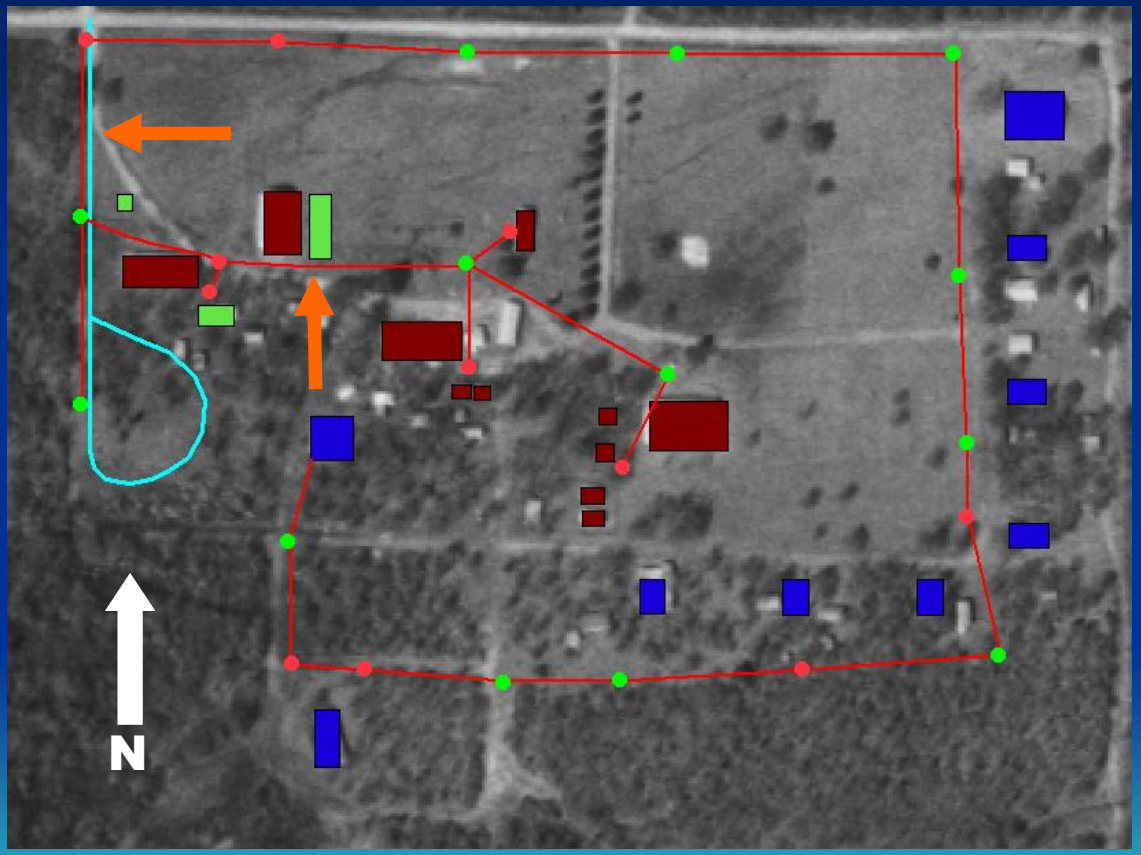
Final Electrical Distribution

- Utilizes aspects of current electrical distribution
  - Relocates power line from playing field
  - Allows for RV loop expansion

- Electrical Safety Recommendations
  - Consult a licensed electrician and PSO
  - Eliminate low hanging power lines
  - Follow National Electric Code guidelines

Final Electrical Distribution

- Main power utilities indicated by:



Current Sewer Collection

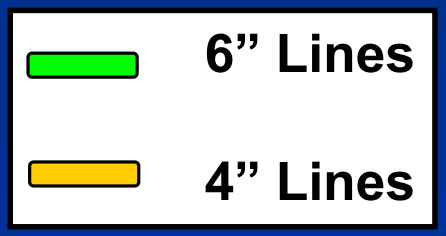
- Two sizes of wastewater lines

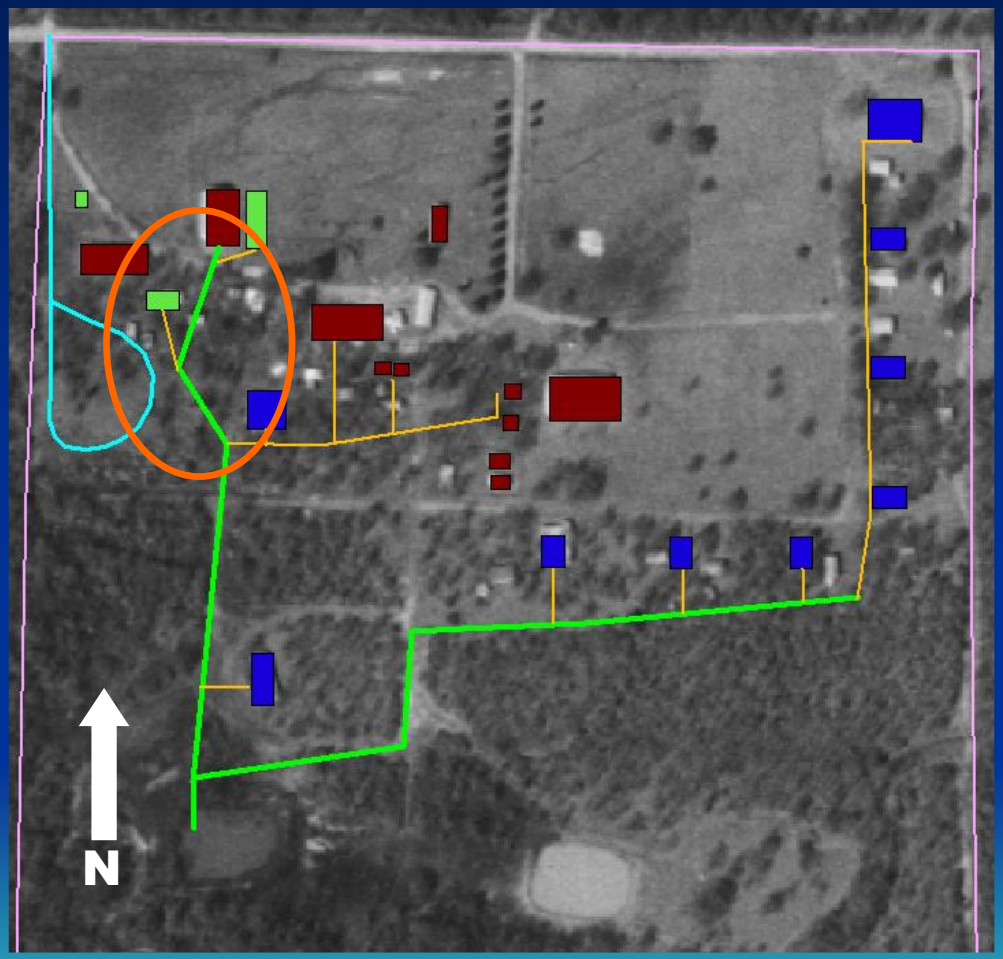
Final Sewer Collection

- Utilizes all of the existing pipe line
  - Allows for additional expansion
  - Upgrades two segments of pipe to 6” lines
- Recommendations for current lagoon
  - Follow Department of Environmental Quality Chapter 641 guidelines
    - Dredge to meet minimum depth
    - Install 6’ woven wire fence
    - Eliminate vegetation on berm

Final Sewer Collection

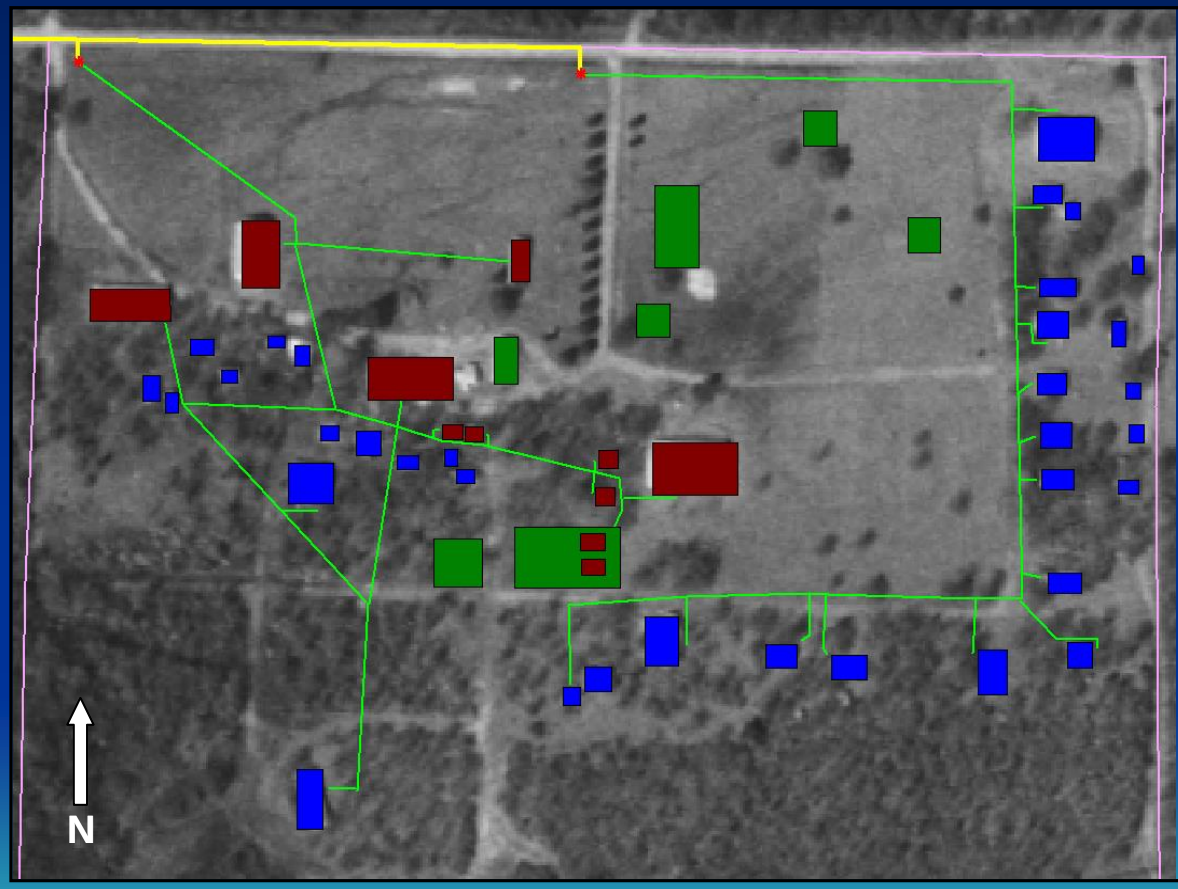
- Two sizes of wastewater lines





Current Water Distribution

- Two water meters on north edge
- Un-looped water distribution



Water Meter

3” Rural Main line

1.5” Distribution line

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Oklahoma State University

Redesigning Water Distribution

- Determine peak demand
  - Number and type of plumbing fixtures
  - Rates of flow
- Determine existing water pressure
- Limitations from Rural Water District
- Lower peak demand

Final Water Distribution

- Improves water pressure across site
  - Loops the system
  - Upgrades all water lines to 3” PVC
  - Incorporates a water holding tank
  - Utilizes booster pump
  - Follow Private Water Systems Handbook guidelines
  - Accommodates peak demand with immediate expansions

Final Water Distribution

- Two water meters on north edge
- Make all lines 3”

Water Meter

3” Rural Main line

3” Distribution line

Cost Analysis

- Electrical

Description	Length (ft)
Total line	940
Old line to be moved	550
New line needed	390
New transformers needed	1
Transformers/power poles to be moved	1
New power poles needed	2
Estimated Cost	**$6,200**

Cost Analysis

- Associated sewer costs
  - Excavation - $3,700
  - Six foot woven wire fence - $815
  - Handling and hauling excavated material

Cost Analysis

- Water

Description	Quantity	Size	Cost/ unit	Total
Water tank	1	10,000 gal	$5,000.00	$5,000.00
Pump/Motor	1	2x2.5x6M	$2,600.00	$2,600.00
Controller	1	7.5 Hp	$470.00	$470.00
Pressure tanks	2	220 gal	$485.00	$970.00
PVC pipe	40.2	100 ft	$180.00	$7,236.00
Steel building	1	18x16x16	$4,500.00	$4,500.00
Concrete Foundation	1	16x18	$1,200.00	$1,200.00
Equipment Rental	1 month		$2,160.00	$2,160.00
			Total	**$24,136.00**

Acknowledgments

Linda and Don Minter
Director of MSW Association

Ralph Hight, P.E.
Chief of Engineering and Construction
US Army Corps of Engineers Tulsa District

A.J. Tiger
MSW Association - Planning Committee

Dr. Michael Kizer
Team Mentor - Associate Professor, OSU

Dr. Paul Weckler
Assistant Professor, OSU

Dr. Dee Ann Sanders
Associate Professor, OSU

Dr. John Veenstra
Professor, OSU

MSW Association Site Plan

Fall Report

BAE 4012 – Senior Design

Meagan Armstrong, Rachel Cancienne, Megan Perry

December 8, 2005

Table of Contents

List of Figures

Introduction

The Muscogee-Seminole-Wichita (MSW) Baptist Association is a fellowship of Native American Baptist Churches from 11 Oklahoma counties. Founded in 1851, it was the first Association organized in Indian Territory. In October of 1956, the Association purchased 40 acres adjacent to the Yardeka Baptist Church grounds nine miles southeast of Henryetta, Oklahoma. They bought the land in McIntosh County for twenty dollars per acre and began constructing the Assembly Grounds in 1961. The Association holds several meetings at the Assembly Grounds throughout the year with the majority of activity during the summer months due to the week-long youth camp, adult church leadership camp, and Baptist Assembly.

Ralph Hight, the Chief of Engineering and Construction at the Tulsa District of the United States Army Corps of Engineers (USACE), hired PeAC Designs on behalf of the MSW Association in September 2005. The task presented to PeAC Designs is to create an improved site plan for the MSW Tribal Association Assembly Grounds. The site plan needs to improve safety, provide for potential growth, and maintain functionality while keeping within economic constraints of the Association. All plans must include water and power distribution as well as wastewater collection and treatment.

Statement of Work

Site Description

The legal land description of the MSW Assembly Grounds is SW ¼ SE ¼ Sec. 3 R13E T10N I.M. The property is bordered on all sides by private property owners. As shown in figure 1 there is a county road along the north edge of the property and a private road borders the eastern boundary.

The grade of the site is fairly level on the north half with a relatively steep, rocky downhill slope on the south half. The property elevation drops roughly 60 feet on the eastern edge and 30 feet on the western boundary, yielding an average downhill slope of 6 percent. This slope change roughly bisects the property with a vegetation change from grasses to trees occurring here, as well.

Information about the soils on the property was obtained from *Soil Survey of McIntosh County Oklahoma* (USDA-SCS, 1981). Soils on the site vary from the north to the south boundaries. The soil on most of the north half is a Linker fine sandy loam. In the middle portion of the property, the soils change to a Linker-Hector complex. Soil on the steep, south half of the property is made up mostly of an Enders-Hector association.

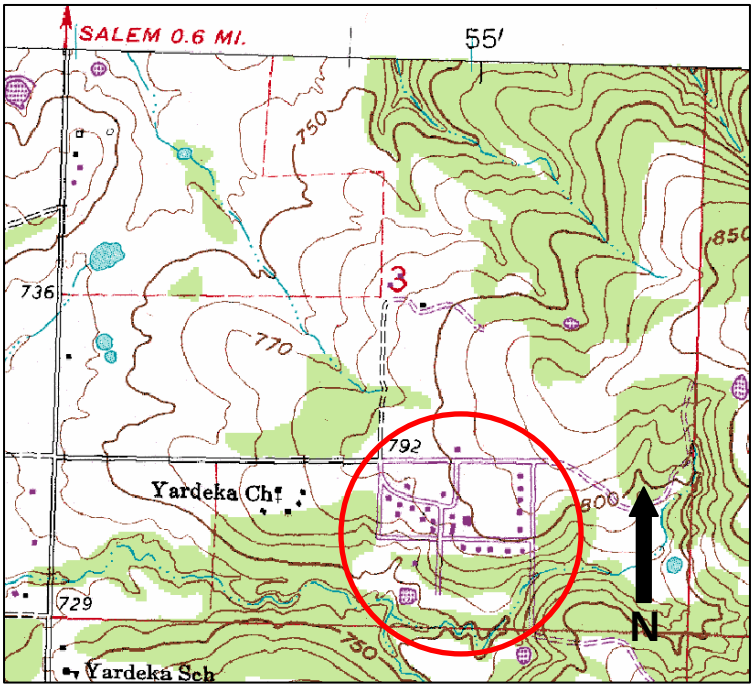

Figure 1. Topographic map with MSW property identified in red circle.

Structural Layout

PeAC Designs generated a layout of current structures on the MSW property using ArcView 3.2 (fig. 2). The layout was created referencing differential surveys provided by Marjorie Courtright of the USACE Tulsa District, and aerial photography downloaded from the United States Geological Survey (USGS) Seamless Data Distribution System.

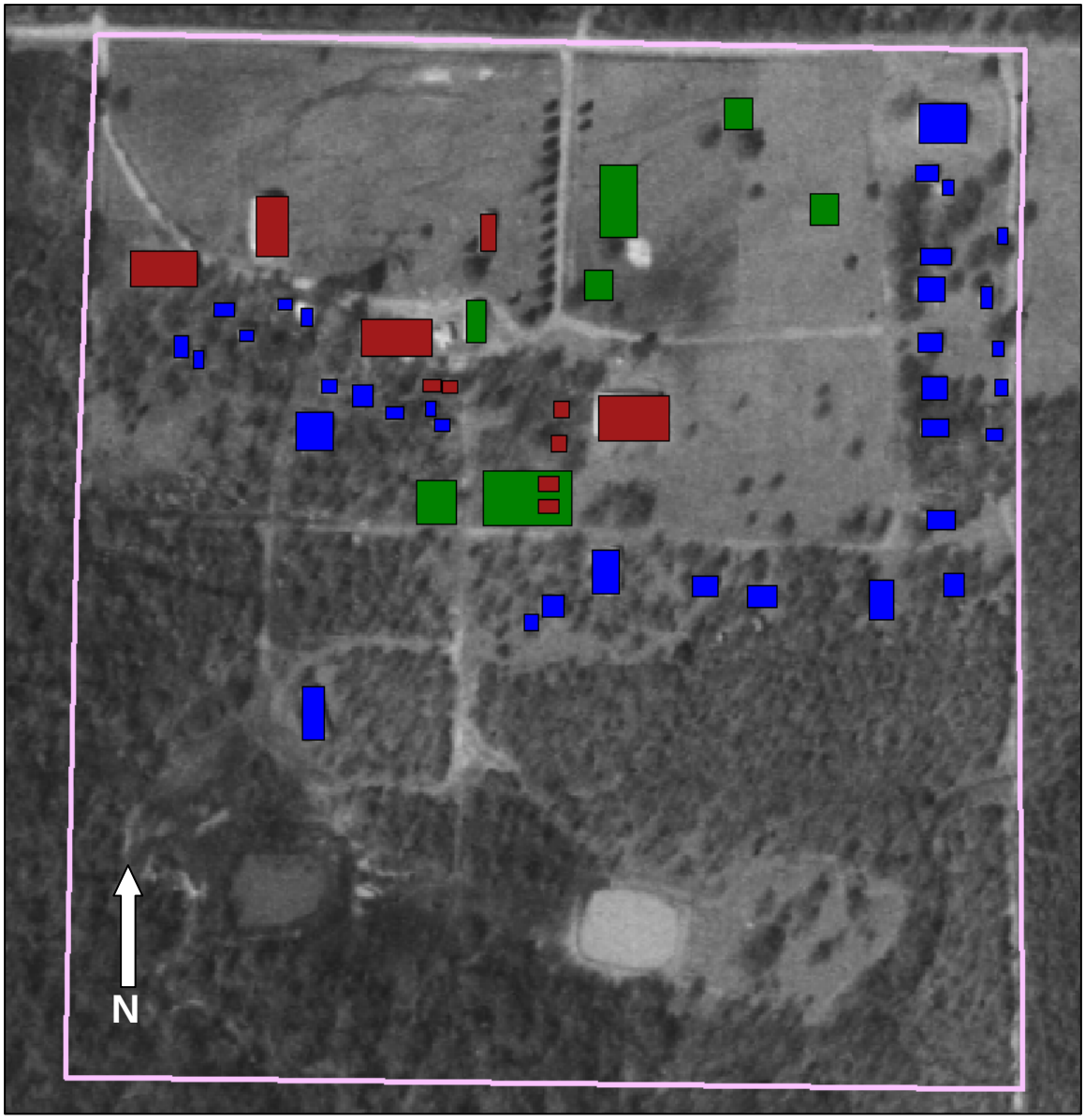

Figure 2. Current structural layout with all facilities highlighted.

Common Use Facilities

All common use buildings are located on the north half of the property. These buildings are identified in red in the general structural layout (fig. 2). As shown in figure 3, the common use buildings include:

1. Women's ministries building
2. Two-story Dormitory
3. Concession Stand
4. Cafeteria
5. Shower and Restroom Facilities
6. Nursery Buildings
7. Chapel

Figure 3. Common use facilities layout.

Private Use Facilities

The blue buildings in the general structural layout (fig. 2) represent small private church cabins and storage buildings. As shown in figure 4, numerous private church cabins skirt the eastern boundary of the north half of the property and bisect the Assembly Grounds from east to west along the slope change. A cluster of private cabins and storage buildings are also located on the northwest quarter of the property.

Figure 4. Private use facilities layout.

Open Air Facilities

The green objects in the general structural layout (fig. 2) represent open air facilities. All of these facilities are situated on the north half of the property and most are located where there is very little slope. As shown in figure 5, the open air facilities include:

1. Prayer Garden
2. Nursery Playground
3. Double-sided Carport
4. Open Pavilions
5. Basketball Court

Figure 5. Open air facilities layout.

Existing Utilities

PeAC designs gathered the information necessary to create current utility layouts from three sources; the differential survey provided by Marjorie Courtright, a water distribution and sewer collection layout provided by the MSW Association Planning Committee, and two site visits.

Electrical Distribution

PSO provides electrical power to the MSW Assembly Grounds at single phase. The nearest two-phase line is at the cross section of 1138 and Salem County Roads. A general illustration of the current power distribution on the property is shown in figure 6. The power lines are shown in red and the twelve power transformers located throughout the site are identified as pink dots. All other power poles on the property are marked as light blue dots. Many of the small cabins obtain power by splicing into the power lines and stringing wires around poles and trees. Several of these wires hang dangerously low to the ground.

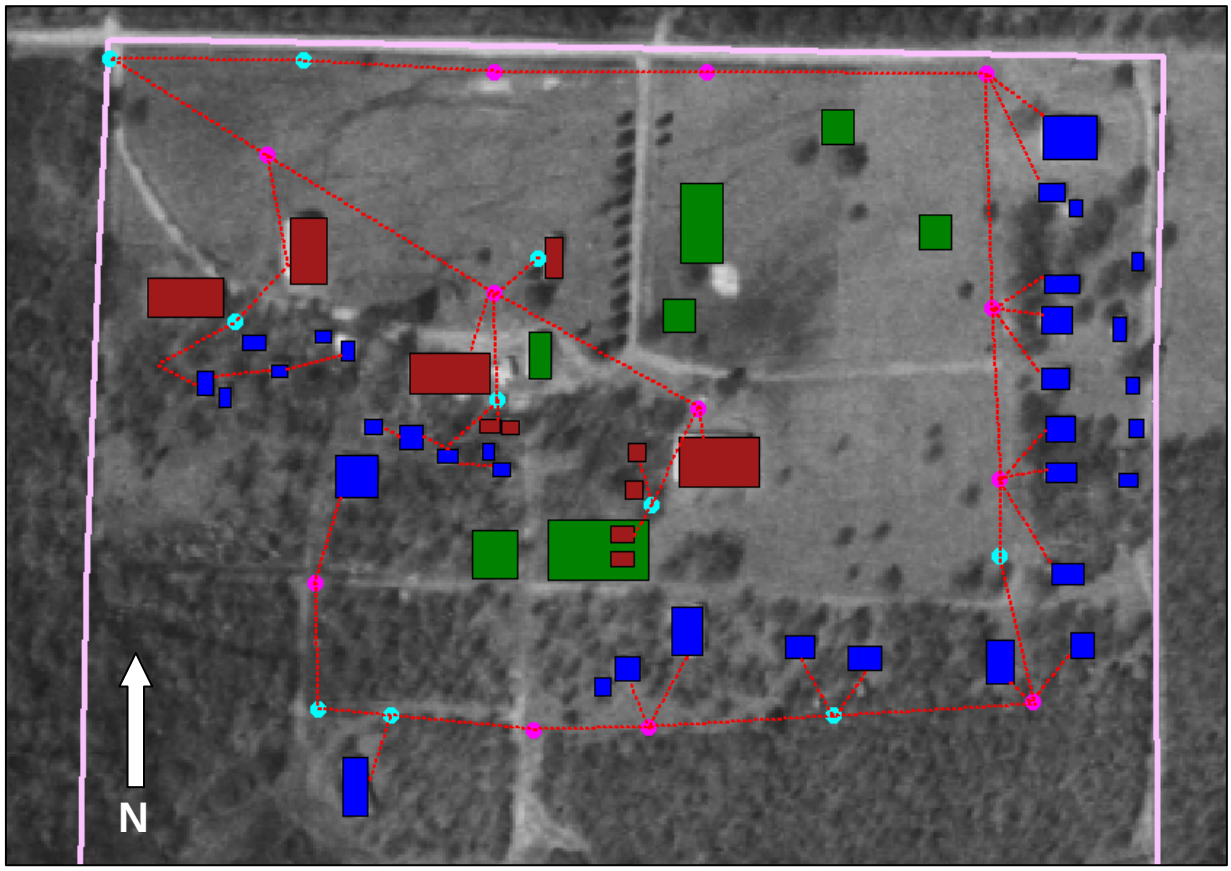

Figure 6. Electrical distribution with power poles, transformers, and power lines.

Water Distribution

McIntosh County Rural Water District #13 serves the facility. Two water meters are located on the north boundary of the property and are identified in figure 7 as red stars. A 3 inch line feeds the meter on the northwest corner and from there a 2 inch line runs east along the north edge of the site, connecting to the second meter. This 2 inch line is identified in black in figure 7. The remaining water distribution on the property is through 1 ½ inch lines and are identified in figure 7 as dashed red lines.

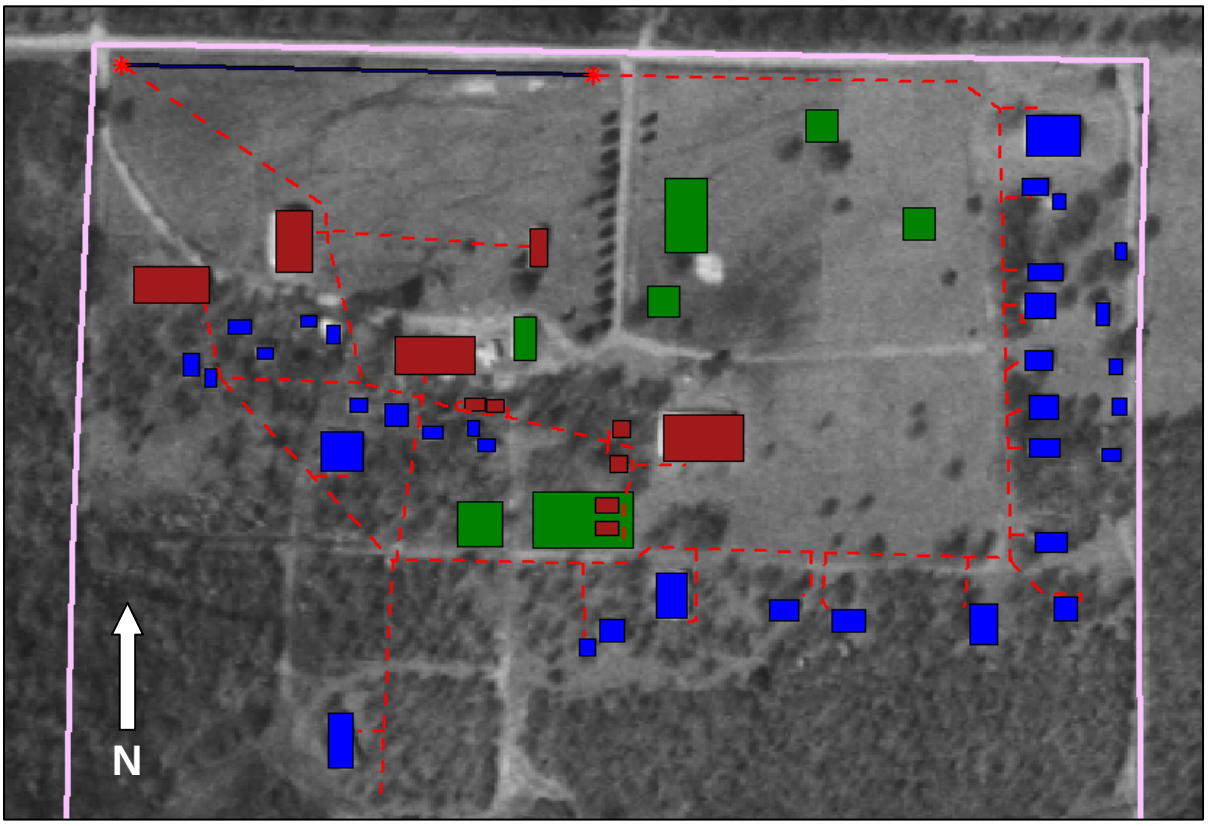

Figure 7. Water distribution layout.

Sewer Collection

A layout of the sewer collection system can be seen in figure 8. Two 6 inch pipes serve as the main wastewater collection lines on the Assembly Grounds and are shown as green lines in figure 8. One of these lines runs southwest from the eastern edge of the property beginning at the slope change. This pipeline is fed by 4 inch collection lines from the private cabins on the eastern half of the property. The 4 inch lines are shown in orange in figure 8. The second 6 inch sewer line collects from 4 inch lines that serve all of the large buildings, as well as the cabins on the western side. This 6 inch line begins just south of the western cabins and runs due south to the wastewater lagoon on the southwest corner of the property.

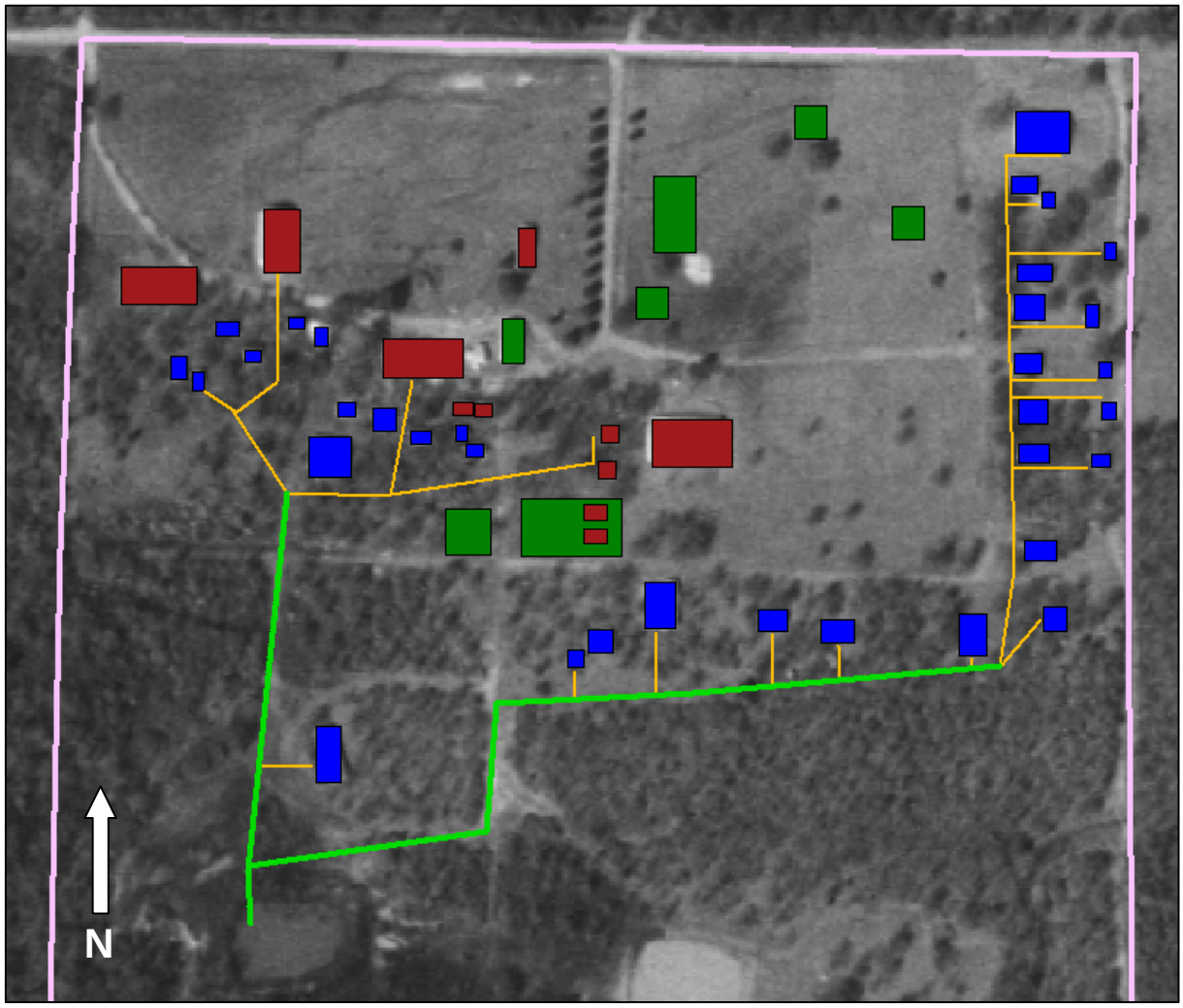

Figure 8. Sewer collection layout.

Site Expectations

PeAC Designs met twice with members of the MSW Association in order to determine their expectations for future growth on the Assembly Grounds. Both Linda Minter, current Director of the MSW Association and A.J. Tiger, member of the MSW Association Planning Committee, have played critical roles in providing PeAC Designs with insight to the wants and needs of their organization.

The MSW Association would like to see utilities improvements on their property as well as modifications to allow for growth. Currently, the dormitory houses between 100 and 150 youth in a single two-story building during the annual summer camp. The Association would like to accommodate upwards of 300 people in two gender specific dormitory facilities in the future.

Due to an insufficient water distribution system, there is unequal water pressure across the site. One cause of this problem may be a leaking water line which serves the cabins along the eastern edge of the Assembly Grounds. This issue will need to be addressed before the site can sustain a population increase. A study must be performed to ensure the current size of the wastewater lagoon is large enough to handle a population increase. For safety purposes, an underground power distribution network would be ideal. However, if underground power is cost prohibitive, a safely designed above ground network will be acceptable. More outdoor lighting is also needed within the distribution system.

Other modifications the MSW Association would like on the property include the addition of a small motel-style building to provide office space and sleeping quarters for traveling ministers and the creation of a designated camping area with RV pad sites. Other potential improvements to the site are a larger centralized prayer garden and a hiking trail.

Literature Review

In order to provide the MSW Association with an appropriate and complete site plan, PeAC Designs first performed a comprehensive literature review. The literature review included general layout planning and design, as well as specific recreational design considerations. This research served as a basis for PeAC Designs' education in planning theory.

Layout Planning

When considering the general idea of "site planning" it is necessary to think about the plan in its most basic terms. What type of layout will work best on this site? What shape or pattern is most convenient? According to Lynch and Hack (1984), there are several commonly used design methods, including *modular division* and *division by aspect*.

Modular division refers to dividing a site into distinct areas. This type of site development is seen throughout suburban America; a tract of land is separated into discrete regions that, if necessary, can be divided multiple times. This kind of division led to a popular Western U.S. layout, the grid. According to Campbell and Fainstain (1996), the grid has been used in modern times as a plan that neutralizes the environment.

Modular design can be a convenient planning method if the program, or site needs, are inclined to this sort of repetitive function. It is possible to integrate this style of spatial division with a little creativity to generate a plan that is not completely modular. The units can be created in different sizes and for different functions, leading to a less monotonous pattern.

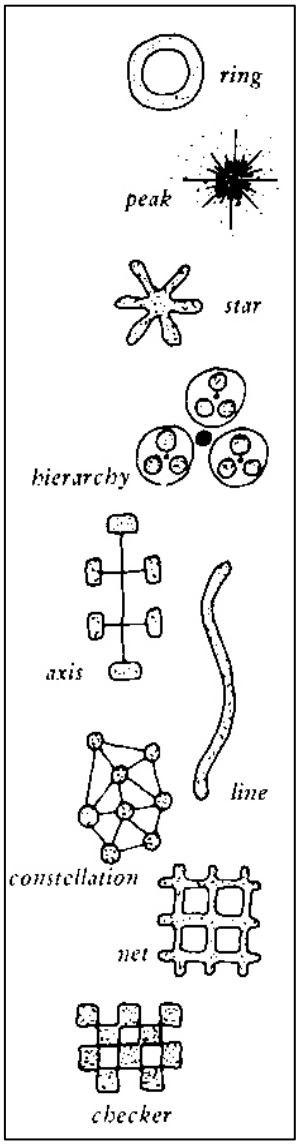

Figure 9. Site planning patterns

Division by aspect is a method whereby the planner may regard the basic elements of site design separately (Lynch and Hack, 1984). First, the activities of the site must be considered. The needs of the site may be met by a formal pattern, such as ring, peak, star, etc. noted in figure 9 (Lynch and Hack, 1984).

If the designer chooses this route, they must determine whether the pattern is applicable to the piece of land in terms of topography and hydrography.

The next piece considered in layout planning is circulation of the site. Circulation refers to roads as well as foot paths, and is often determined by the presence of passes, ridge and valley systems, or existing routes through the property. Various road arrangements may be tested, including general patterns such as "grid, linear, or concentric schemes" (Lynch and Hack, 1984).

Recreational Design Considerations

Hultsman et al., (1998) counsels recreational designers to consider the many problems they must address during projects. The authors start with their most fundamental point: water flows downhill. Water caused erosion can have significant impacts on the environment. The text warns that rapid erosion frequently occurs under rooftops due to rainfall drainage and that the best way to protect these areas is with crushed stone.

Hultsman et al. (1998) also identified the importance of knowing the types of soil present at the site. This information can be found through the NRCS. According to the authors, vegetation is another vital aspect in crafting outdoor use areas. Cover planting is essential in the prevention of soil erosion and while shading is crucial for outside environments, the planner should not be afraid of cutting down trees.

The next major portion of this publication concentrated on campsite development. The book discusses how universal type campsites are best because they align the tent pad, garbage can, and fire pit all on the passenger side of the site. The campsites are considered universal because there are no limits to wheel chair-bound or disabled campers since the entire site is level. This type of site also reduces maintenance costs by decreasing site deterioration.

The Design Process

When designing changes to any type of park or recreational area, it is important to follow a detailed plan. Kelsey and Gray (1985) provide useful information for the detailed steps necessary to create functional, attractive recreational facilities. This reference details how to set forth objectives identified by the sponsoring agency. There should be resource goals to ensure effective and conservative use of land and water sites, as well as participant goals to ensure safety, equal opportunity, and limited costs to those utilizing the facilities.

Kelsey and Gray (1985) go on to discuss the necessity of preparing a supply analysis of the site to identify existing assets of the sponsoring agency, which range from buildings and scheduled events to natural resources. Next, the authors demonstrate the need to make population and demand analyses. They state that the planning of recreational areas “does not occur in a vacuum and the population served is most critical”. The demand analysis consists of polling the community to determine its desires.

Once the data collection process is completed, Kelsey and Gray (1985) suggest performing an expenditure analysis to achieve a financial cost estimate of each component of the plan, as well as creating a priority criterion ranking system to determine the specific importance of each recommendation.

Structural Layout Designs

After studying existing literature and considering the requests of the MSW Association, PeAC Designs is presenting two basic structural layouts for consideration.

Plan A

The first design employs the "star" planning pattern while still minding the rocky, sloping terrain of the south half of the property. Figure 10 shows the general structural layout for this design. To start, the main entrance of the Assembly Grounds is moved from the western edge of the property to the middle. The west entrance is designated for campers only and leads to an RV circle and a smaller loop with tent pad sites. The eastern most road is used to access the private church cabins. This road also loops through the center of the property.

Changing the structural arrangement of the Assembly Grounds positions the cafeteria, chapel, dormitory, and women's ministry building to the center of the property. The small motel-style building requested by the MSW Association is added to the center structures for office space and traveling ministers' sleeping quarters. In order to accommodate more youths for the summer camps, the dormitory structure is modified to two buildings with a breezeway in between. All private church cabins, depicted in blue in figure 10, are arranged in an L-shaped pattern along the east side of the property.

All open air facilities, except the basketball court, are relocated in this new design. The nursery buildings and their associated playground are moved to just west of the centralized women's ministry building. The prayer garden is shifted to a more private location, southwest of its current position. A second, smaller prayer garden is added in the southeast corner of the property. In addition, a hiking trail is created on the southern half of the site. The trail consists of two separate loops that weave throughout the rocky, shaded terrain. One of the loops passes around the smaller prayer garden. The overall configuration of this design maintains the open fields on the north half of the property for youth sports activities. The facilities, as shown in figure 10, include:

1. Dormitories
2. Cafeteria
3. Office Building
4. Women's Ministry Building

5. Chapel
6. Restroom/Shower Facilities
7. Basketball Court
8. Nursery Buildings and Playground
9. Open Pavilions
10. Main Prayer Garden
11. Small Prayer Garden

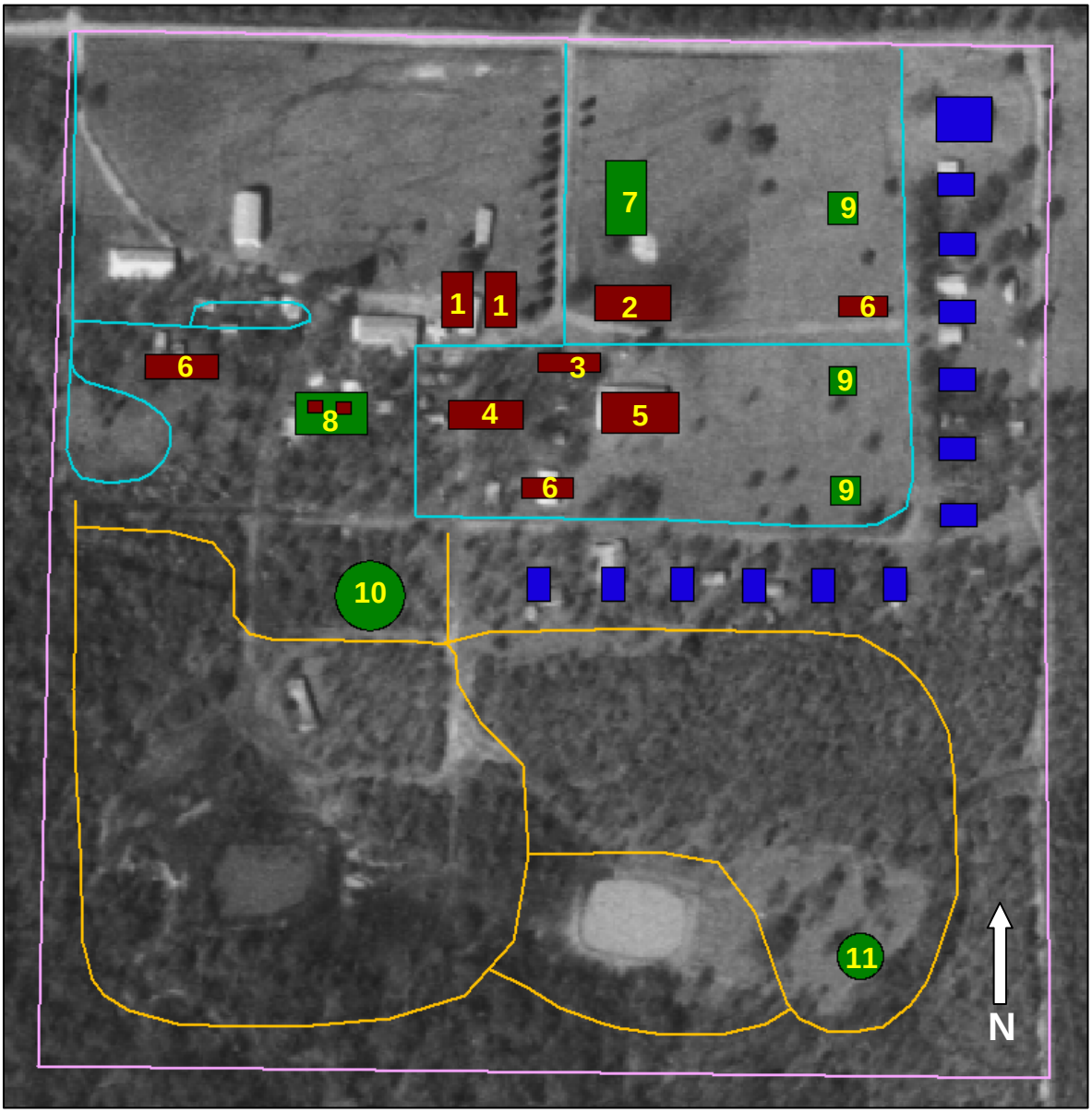

Figure 10. Plan A: Star pattern site plan.

Plan B

A second site plan created by PeAC Designs utilizes many aspects of the current structural layout on the Assembly Grounds. This plan makes use of all large permanent structures and a majority of the private church cabins currently on the site. As in Plan A, an additional dormitory building is included as well as the motel-style building for offices and sleeping quarters. The new dormitory is located adjacent to the existing one, with a breezeway in between and the new office building is situated just north of the cafeteria. Two restroom/shower facilities are added; one on each edge of the property.

As requested, designated RV and tent camping areas are created on the western edge of the property. The main prayer garden and hiking trail are developed in the same locations as Plan A. As shown in figure 11, the additional buildings include:

1. Dormitory
2. Office Building
3. Restroom/Shower Facilities

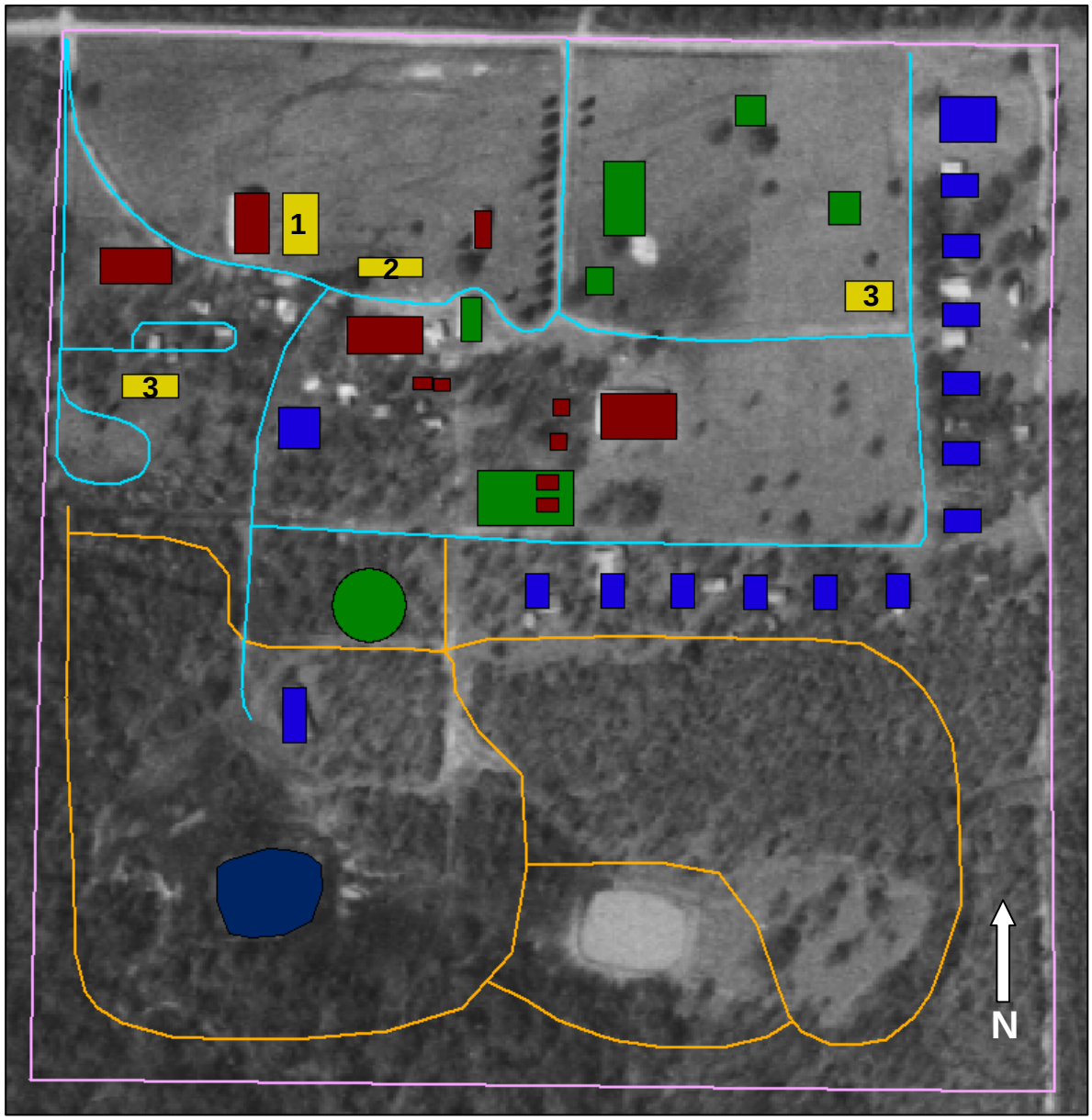

Figure 11. Plan B: Utilize current structural layout.

Feasibility of Designs

Plan A

This plan's purpose is to centralize common use facilities and employ the topography for outdoor recreation. The feasible developments of this plan include using the shaded area on the western edge of the property for RV and tent camping facilities. The gentle grade on this portion of the property is conducive to the minor leveling needed for RV and tent pad sites. The addition of hiking trails and prayer gardens make use of the undeveloped south half. These amenities can be implemented with minimal construction efforts.

Many of the structural changes necessary for this design make it difficult to implement. In order to execute the "star" planning pattern, the cafeteria, dormitory, women's ministry building, nursery, and both sets of restrooms must be demolished and reconstructed in the center of the property. To adjust for the relocation of these buildings, new trenches must be excavated for water and sewer line connections. Although the Linker-Hector soil complex in this area is adequate for constructing buildings, the shallow soil depth to bedrock makes excavation extremely difficult and cost prohibitive. PeAC Designs believes utilizing as many existing utility trenches as possible will be the most cost effective solution.

Due to the Enders-Hector soil association on the south half of the property, PeAC Designs does not believe it is feasible to develop this area for anything other than recreational purposes. The shallow depth to bedrock, moderate to steep slope, and shrink-swell tendencies of the soil make excavation and construction impractical.

Plan B

The purpose of this plan is to maintain as much of the current structural layout as possible in order to limit the construction and excavation costs. This plan utilizes all feasible additions discussed in Plan A, which include designated camping areas, hiking trails, a larger prayer garden, and two new restroom facilities.

The main difference between the suggested site plans is that Plan B takes advantage of the current structural layout on the property. All large permanent structures are retained as well as most of the private church cabins. Maintaining the current structural layout allows utilization of the existing utility trenches which makes this plan more cost effective than Plan A.

Final Design Recommendation

After researching layout planning and theory and considering the physical properties of the MSW Association Assembly Grounds, PeAC Designs recommends the implementation of Plan B. Although this plan does not centralize the common use buildings, it is the most cost effective of the two options because it does not entail the extreme excavation and construction associated with Plan A. Plan B does allow for construction of the requested dormitory expansion, the office building with sleeping quarters, and the supplemental restroom facilities but it locates them near existing utility trenches, therefore requiring minimal excavation.

PeAC Designs suggests a realistic location for the requested camping facilities and hiking trails. This plan also moves the redesigned prayer garden to a more appropriate secluded location. Developing the southern and western portions of the property for outdoor activities makes best use of the soil and topographic limitations of the area.

Project Schedule

A Gantt chart for the fall and spring semesters can be found in Appendix A. This schedule details the remaining tasks associated with creating the completed final design.

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Appendix A

MSW Association Site Plan

PeAC Designs

Site Planning Consultants

Meagan Armstrong

Rachel Cancienne

Megan Perry

Biosystems Engineering Senior Design

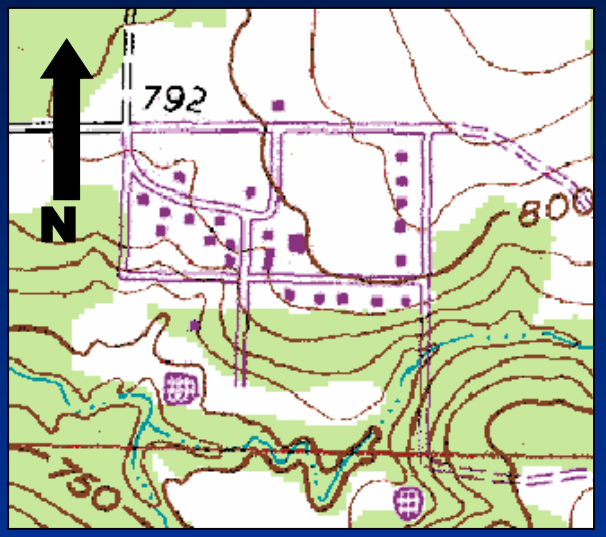
8 December 2005

BIOSYSTEMS & AGRICULTURAL ENGINEERING
Oklahoma State University

Introduction

- Muscogee-Seminole-Wichita Baptist Association
  - Founded in 1851
  - Purchased 40 acres southeast of Henryetta in 1956
  - Facility is used for meetings and church activities
- Acquired project through Ralph Hight, US Army Corps of Engineers Tulsa District
- PeAC Designs will create an improved site plan

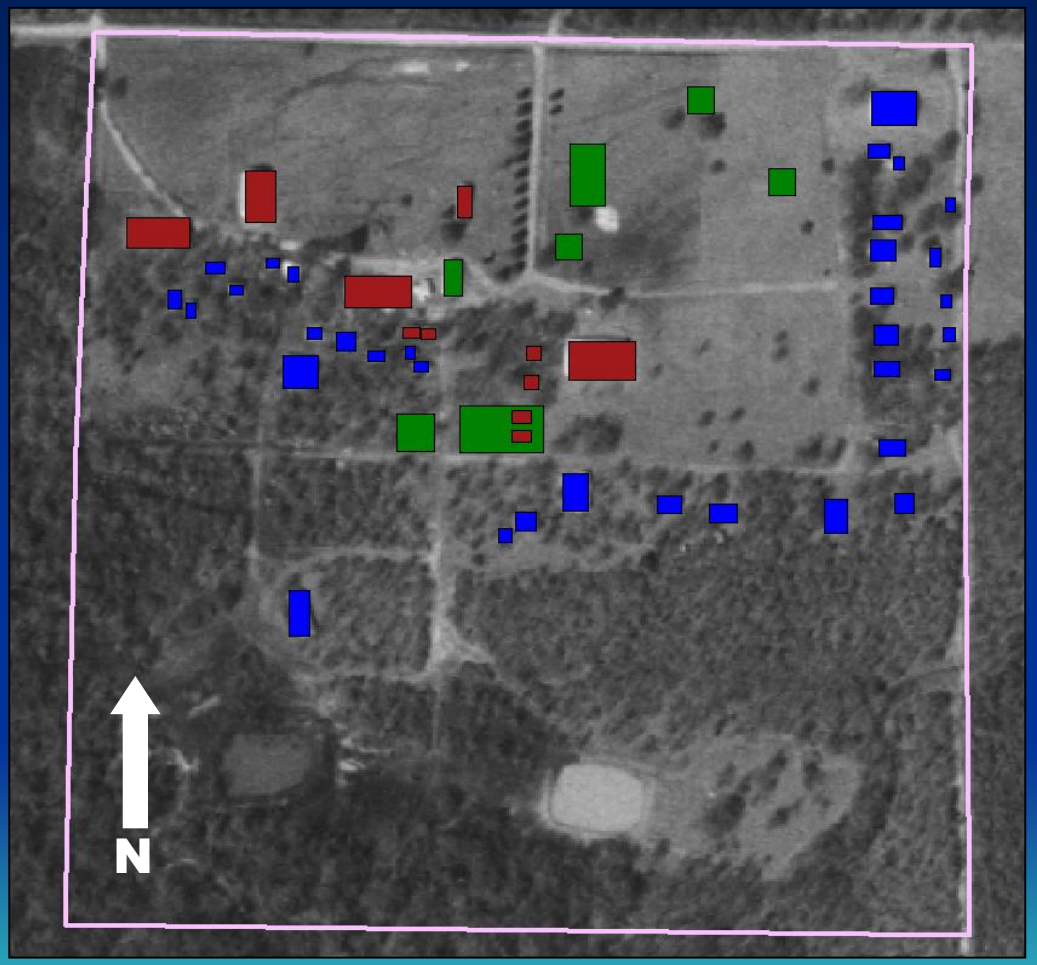
Site Description



- Grade varies throughout site
  - Fairly level on north half
  - Rocky, steep on south half
- Vegetation change along gradient
  - Grassy field on north half
  - Dense tree vegetation occurs on south half
- Soil properties vary throughout property
  - North half - Linker fine sandy loam
  - Middle property - Linker-Hector complex
  - South half - Enders-Hector association

Structural Layout

- All layouts created with ArcView 3.2
- Colors distinguish building types
  - Common use
  - Private use
  - Open air



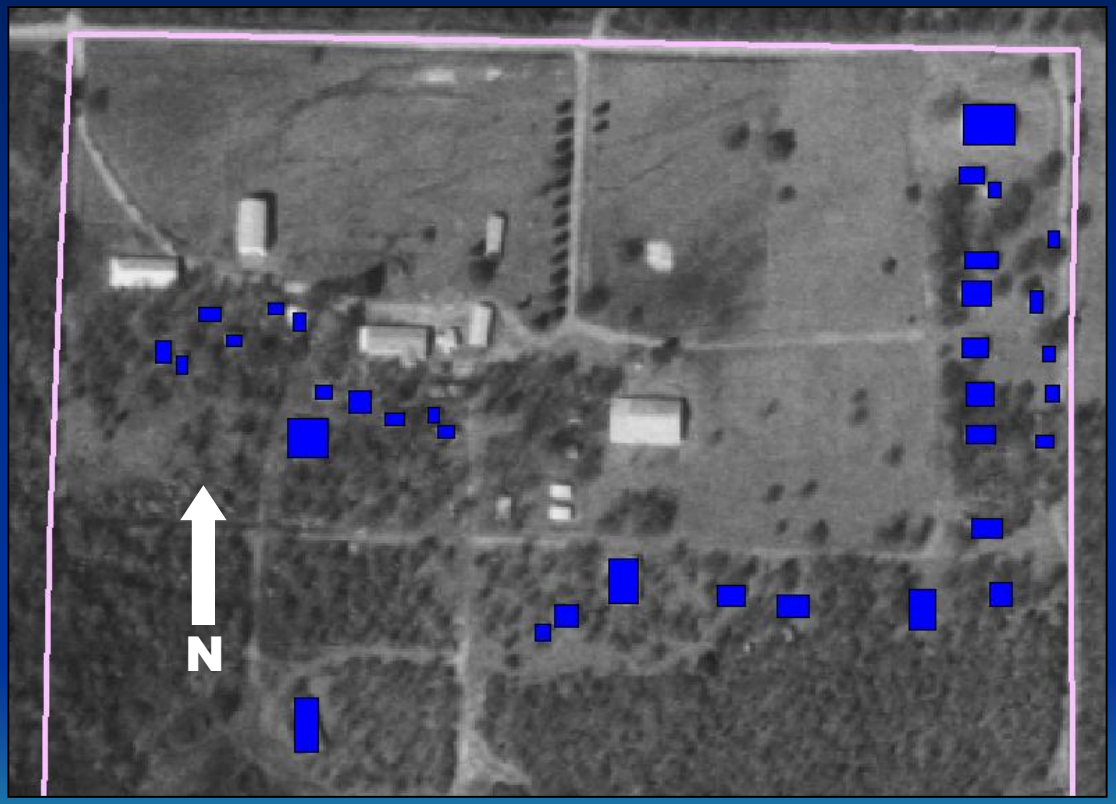
Common Use Facilities

- Located on north half of property

1. Women's Ministry
2. Dormitory
3. Concession Stand
4. Cafeteria
5. Showers/Restrooms
6. Children's Nursery
7. Chapel

Private Use Facilities

- Church cabins & storage buildings
  - Eastern Boundary
  - Bisecting Property
  - Northwest Cluster



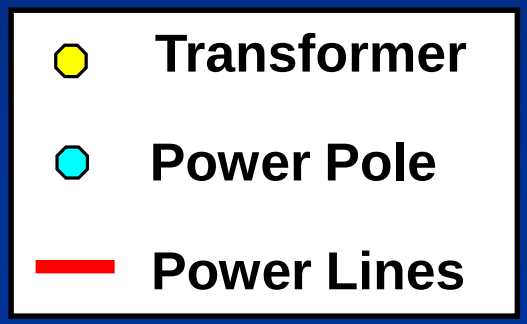
Open Air Facilities

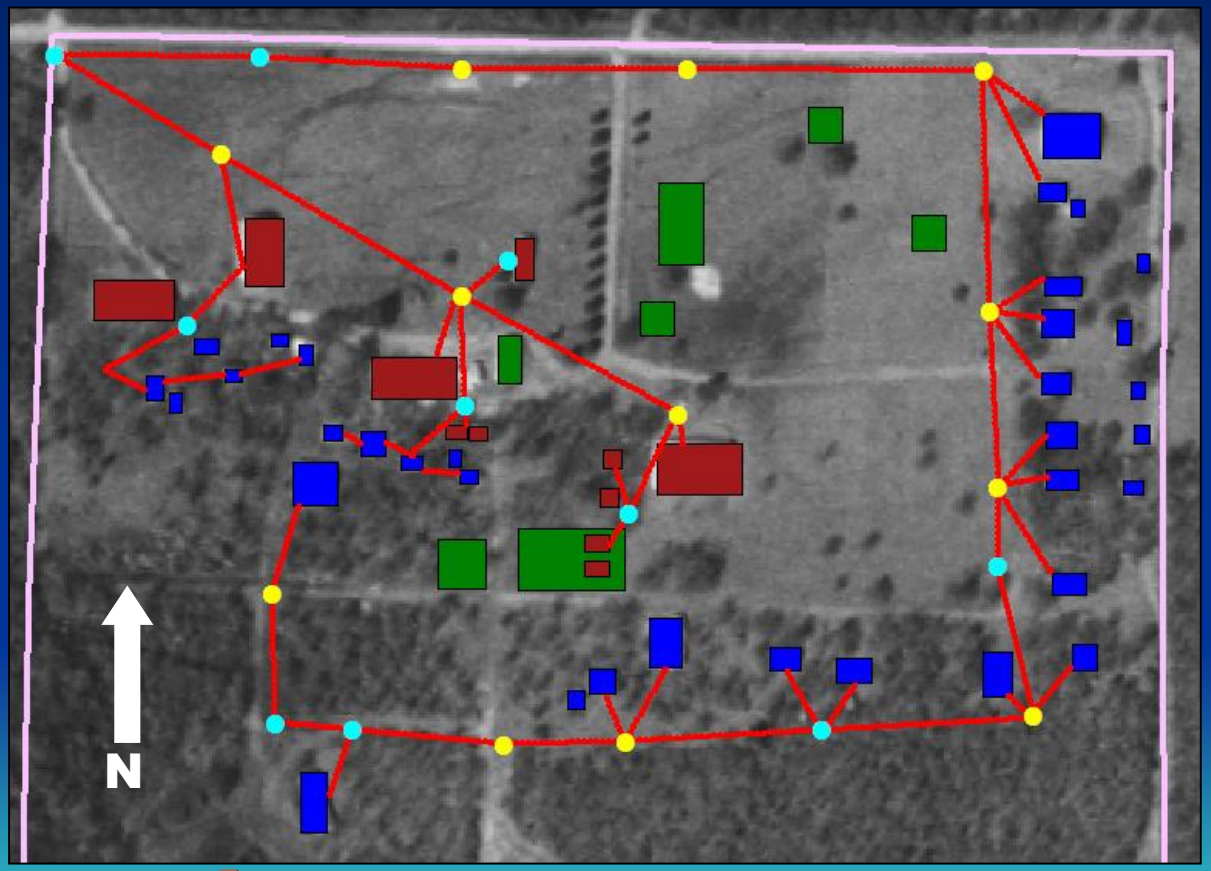
- All on north half of property

1. Prayer Garden
2. Nursery Playground
3. Carport
4. Open Pavilions
5. Basketball Court

Electrical Distribution

- Main power utilities indicated by:

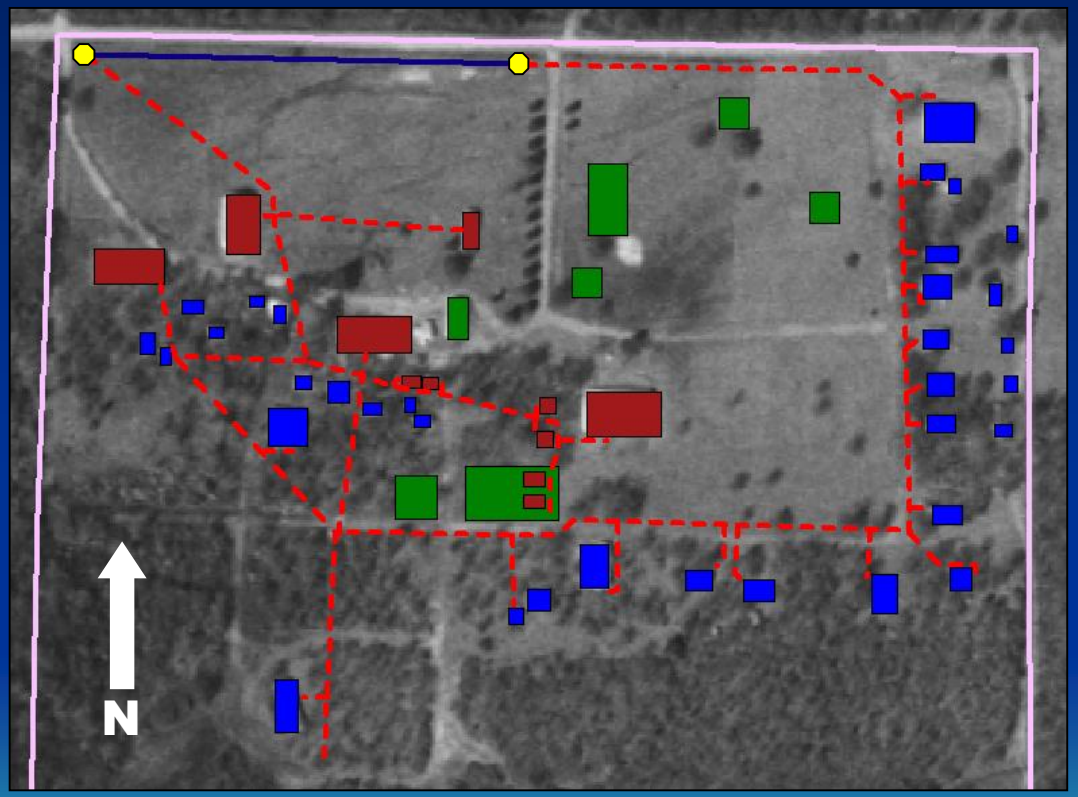




Water Distribution

- Two water meters on north edge
- Two sizes of water lines

	Water Meter
	2” Line
	1 ½” Line



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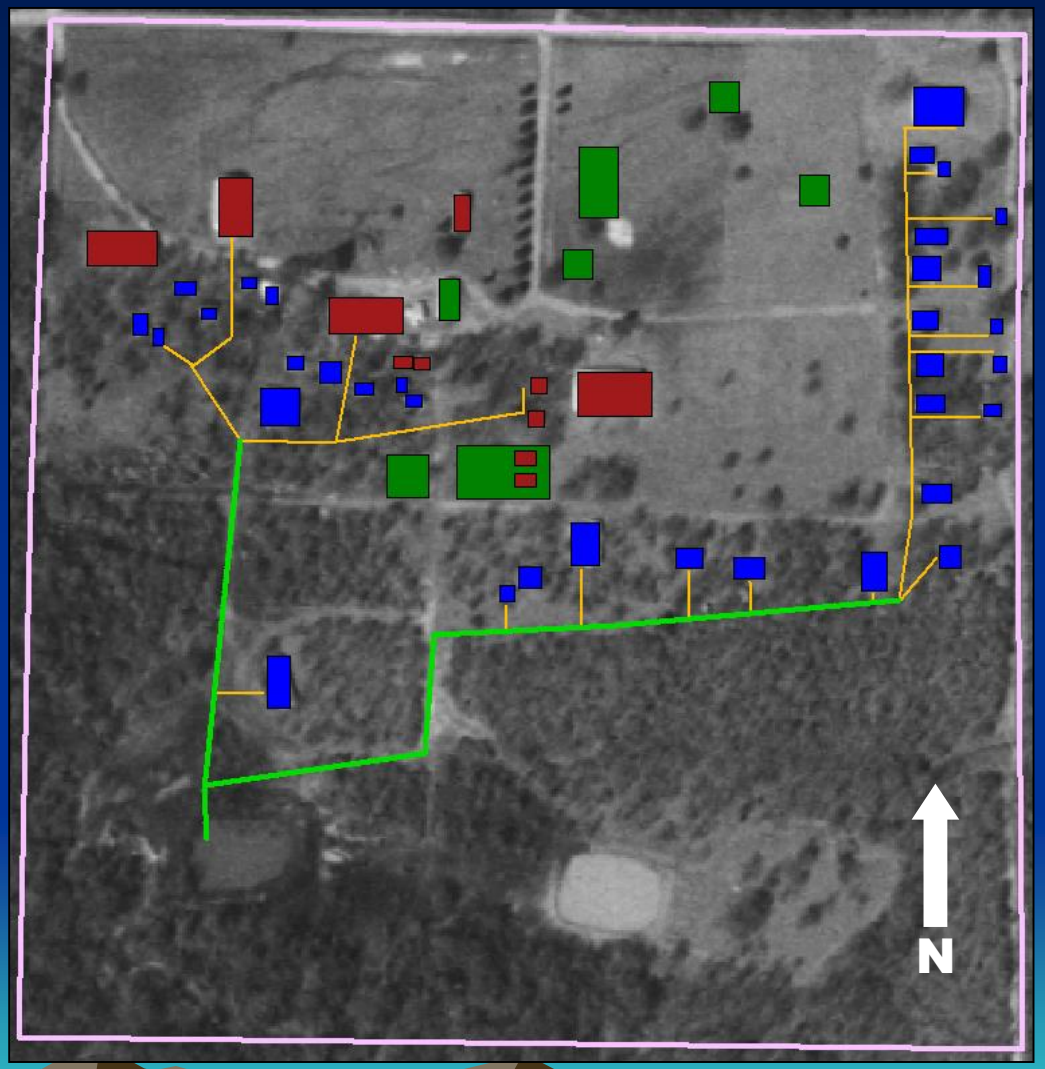
Sewer Collection

- Two sizes of wastewater lines



Site Expectations

➢ Utility Improvements

- Electrical Distribution
  - Improve safety
- Water Distribution
  - Increase water pressure
  - Size and replace lines
- Sewer Collection
  - Increase size of lagoon
  - Size and replace lines

Site Expectations

- **Additional Facilities**
  - Common Use Buildings
    - Additional Dormitory
    - Office/Sleeping Quarters
    - Restroom Facilities
  - Designated Camping Area
    - RV and Tent Pad Sites
    - Water and Electricity
  - Larger Prayer Garden/Hiking Trail

Literature Review

- Layout Planning
  - Researched different types of site plans
- Recreational Design Considerations
  - Studied methods to accommodate current land features
- Design Process
  - Determined steps to complete a functional design

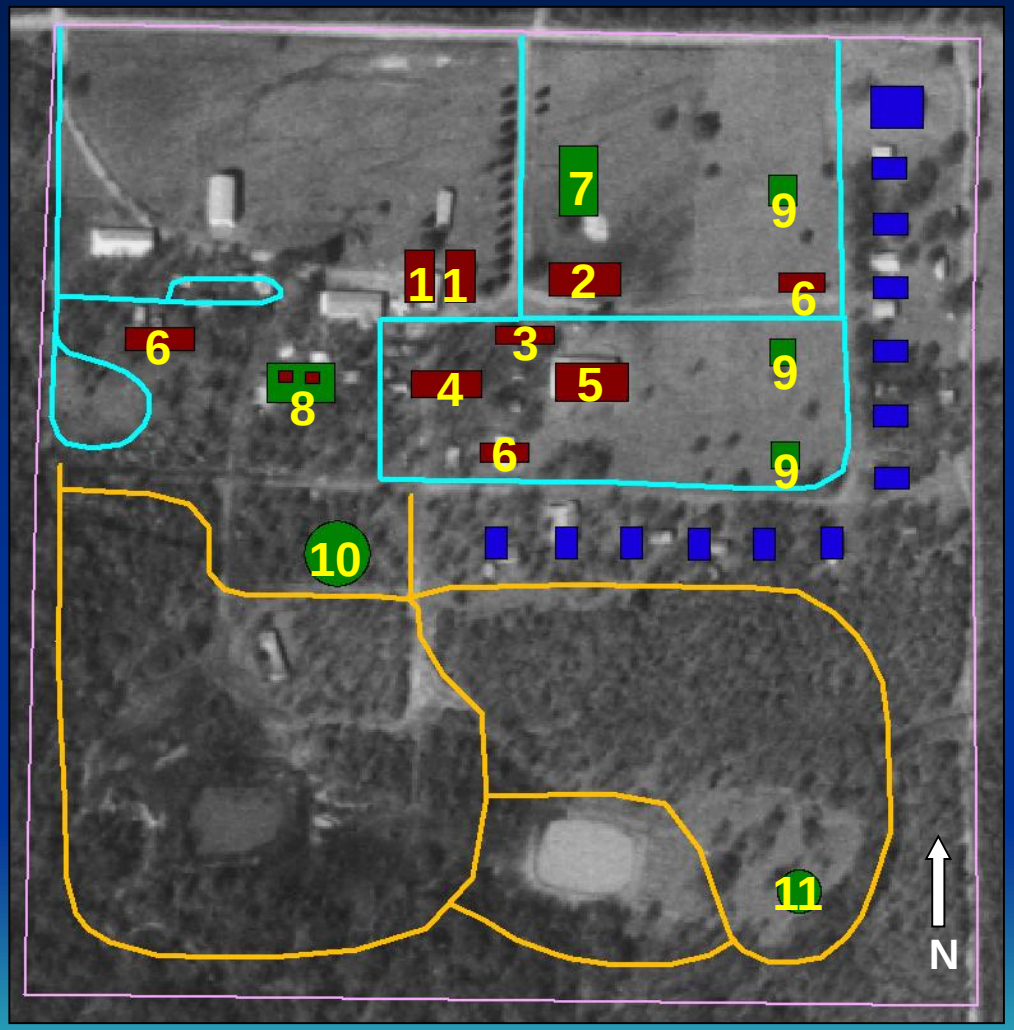
Structural Design – Plan A

- Uses "Star" Planning Pattern
  - Centralizes common use facilities
  - Moves main entrance
  - Relocates children's nursery
- Recognizes Site Expectations
  - Adds requested buildings
  - Incorporates RV and tent pad sites
  - Expands prayer garden
  - Includes hiking trail

Layout of Plan A

The facilities shown include:

1. Dormitories
2. Cafeteria
3. Office Building
4. Women's Ministry Building
5. Chapel
6. Restroom/Shower Facilities
7. Basketball Court
8. Children's Nursery
9. Open Pavilions
10. Main Prayer Garden
11. Small Prayer Garden



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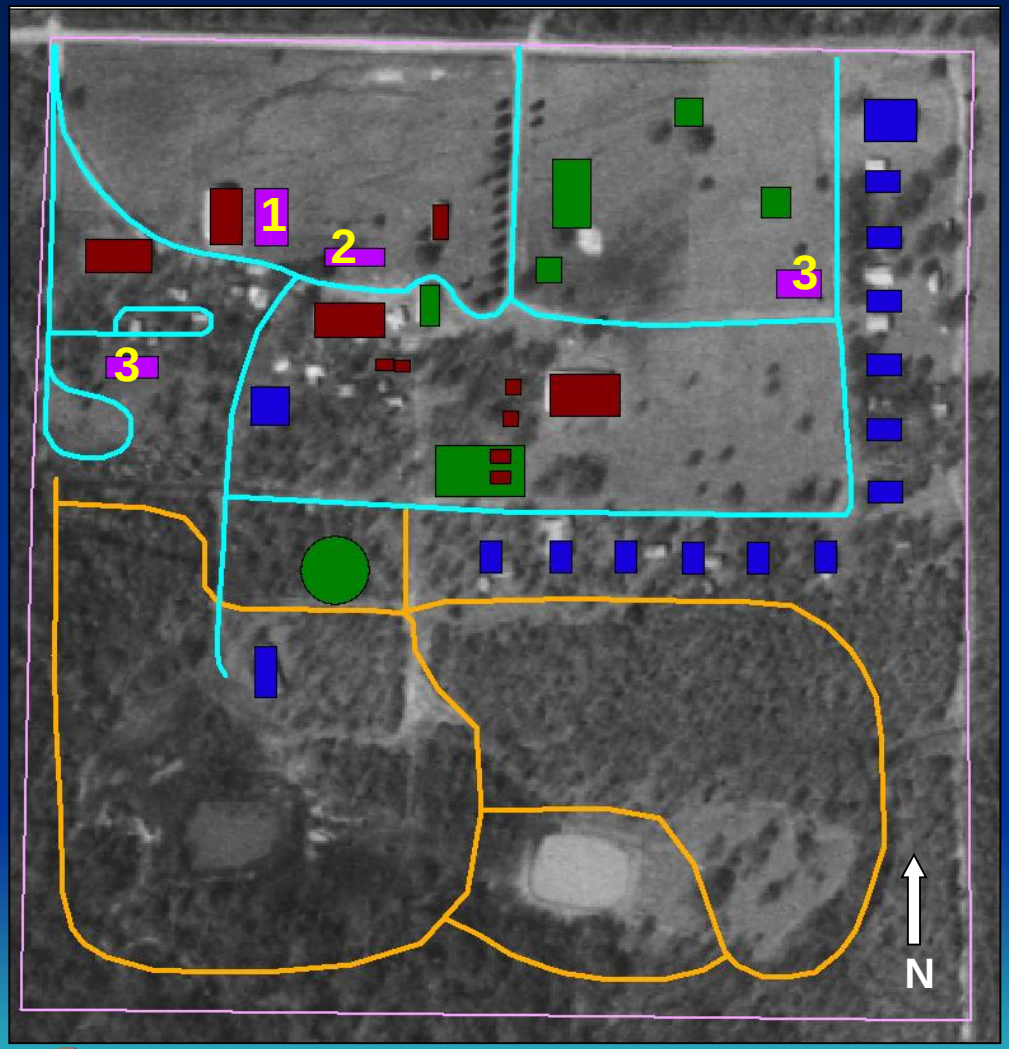
Structural Design – Plan B

- Utilizes aspects of current structural layout
  - Makes use of all large permanent structures
  - Eliminates unoccupied cabins and storage buildings
- Recognizes Site Expectations
  - Adds requested buildings
  - Incorporates RV and tent pad sites
  - Expands prayer garden
  - Includes hiking trail

Layout of Plan B

The facilities shown include:

1. Dormitory
2. Office Building
3. Restroom/Shower Facilities



Hiking Trail

Roads

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Feasibility of Design – Plan A

- Pros
  - Utilizes shaded, level area for RV and tent camping
  - Uses undeveloped land for hiking trails/prayer gardens
- Cons
  - Reconstruction of buildings will be costly
  - New trenches must be excavated for utilities
  - Shallow soil depth to bedrock makes excavation difficult

Feasibility of Design – Plan B

- Pros
  - Maintains a majority of current structural layout
  - Utilizes existing utility trenches to limit cost
  - Includes feasible additions as in Plan A
- Cons
  - Provides less organization

Final Recommendation: Plan B

- We estimate this plan to be the most cost effective
  - Does not entail extreme excavation and construction
- Includes all expansion requests of MSW Assoc.
- Makes best use of topography and soils

Acknowledgments

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A.J. Tiger
MSW Association - Planning Committee

Dr. Michael Kizer
Team Mentor - Associate Professor, OSU

Dr. Paul Weckler
Assistant Professor, OSU