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# North Carolina Department of Environment and Natural Resources

## Replacement Production Well #9 (Skyco Water Plant) Dare County, North Carolina

December 2003



12-03-03

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# Section 1
# Introduction

## 1.1 Authorization

This report was prepared for the North Carolina Department of Environment and Natural Resources (NCDENR) by CDM Missimer as part of the Agreement signed by the NCDENR on July 31, 2003.

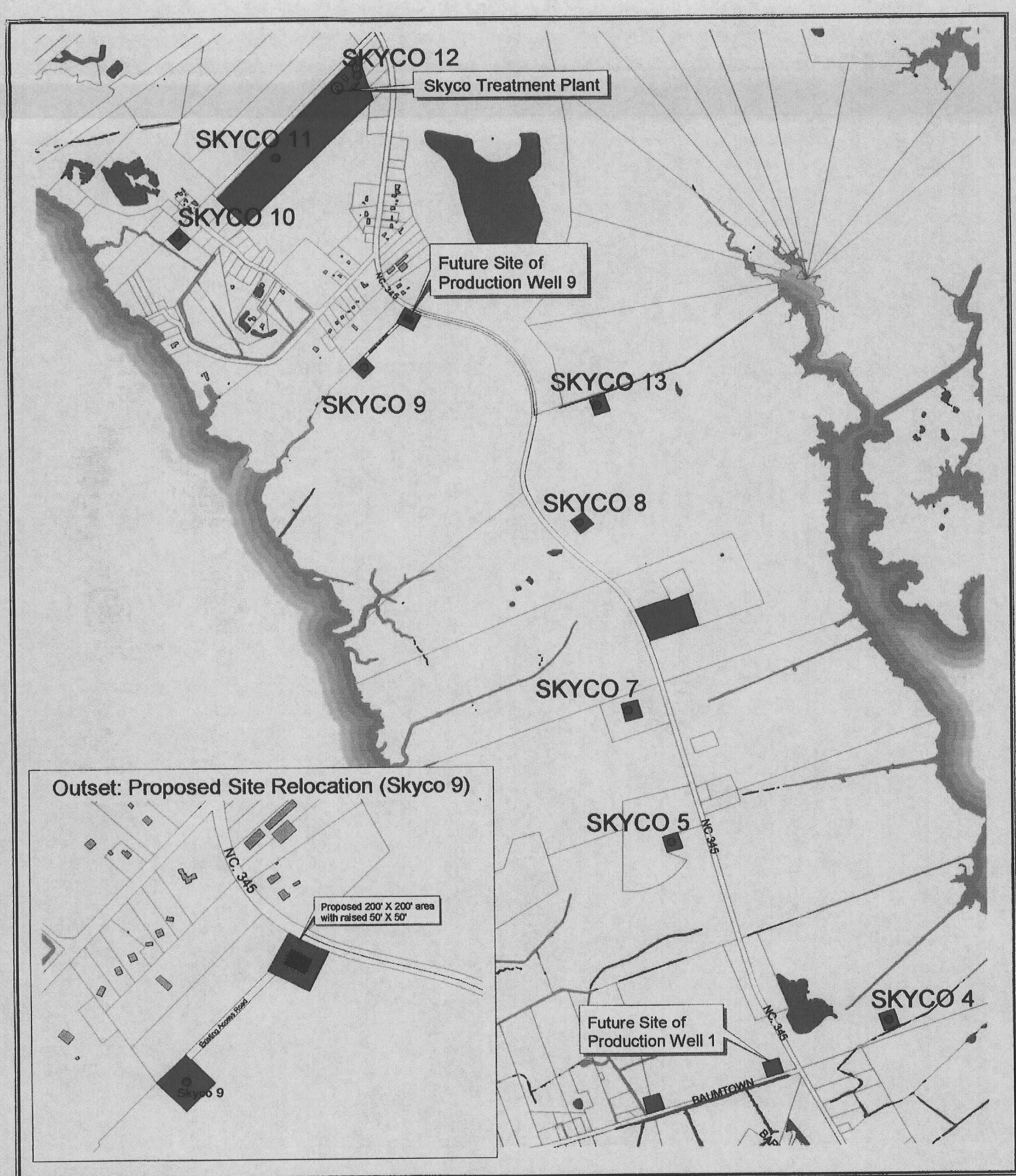
## 1.2 Background

The Dare County Water Department operates a water treatment plant (Skyco water plant) on Roanoke Island, North Carolina that produces potable water for public supply purposes. The raw water source for the plant is supplied by 9 active Upper Yorktown (Principal) aquifer production wells. The raw water supplied to the plant is fresh and an ion exchange process is used to treat the water. Currently, the plant has a maximum finished water production capacity of approximately 5 million gallons per day (MGD), with an average daily production of approximately 1.5 MGD. The typical pumping rate for each of the existing supply wells ranges between 400 and 500 gallons per minute (gpm).

The State of North Carolina is responsible for maintenance dredging of the Manteo to Wanchese and North navigation channels located just east of Roanoke Island. The NCDENR desires to use an upland area adjacent to NC Highway 345 near the Skyco water plant for disposal of the dredge spoils. Dare County production well #9 is located within the proposed disposal area. The NCDENR has agreed to pay Dare County to relocate well #9 approximately 800 feet east of its current location. The current and proposed future site of well #9 is shown on **Figure 1**.

CDM Missimer was authorized by the NCDENR to construct a test well on the proposed new well site east of existing production well #9. The purpose of the test well was to evaluate aquifer yield and water quality conditions within the Principal aquifer to determine the feasibility of relocating existing production well #9. The scope of the project included well construction, aquifer testing, water quality sampling, data analysis, and preparation of a summary report which was prepared and submitted to the NCDENR under separate cover.

The purpose of this report is to outline the requirements for: removal of the well pump and other salvageable equipment from the existing well; abandonment of the existing well; construction of a replacement production well and well house; installation of the well pump, piping, and electrical service to the new well site; and other tasks needed to bring the well on-line and ready for use. An opinion of probable construction costs for the well relocation project is also included with this report.




COUNTY OF DARE 1870 NORTH CAROLINA

DARE COUNTY WATER
GIS
MATTHEW HIBLER
JULY 23, 2003

Skyco Well Field
Wanchese, NC
400 0 400 800 1200 Feet

N
W E
S

LEGEND
- Skyco Plant
- Production Well
- Dare Property

**Figure 1**

**Detailed Site Map Showing the Water Plant and Wellfield Location**

## 1.3 Report Organization

Section 2 of this report summarizes the requirements for abandonment of the existing well and recommendations for construction of the replacement production well. Section 3 summarizes the features of the existing well pump and related equipment to be salvaged. Section 4 discusses site development considerations including permit requirements. Section 5 provides our planning-level opinion of probable construction costs for the project.

# Section 2
# Well Abandonment and Replacement Requirements

## 2.1 Well Abandonment

The existing production well #9 was constructed into the Upper Yorktown aquifer by Dare County in 1973 and has been in service for approximately 25 years. Information regarding the construction details of the well was obtained from a well record sheet completed for the North Carolina Department of Water and Air Resources by the Carolina Well and Pump Company. Materials of construction for this gravel-packed well include approximately 117 feet of 10-inch diameter steel casing. The steel casing is followed by approximately 50 feet of 8-inch 304 stainless steel screen with a slot size of .040 inches. Blank sections occur within the screened interval which extends from 120 to 190 feet below land surface. There may be an 8-inch diameter tail pipe that extends approximately 10 feet below the screen based on construction records of other wells in the wellfield. The total depth of well casing, screen, and tail pipe to be abandoned is approximately 200 feet.

The existing production well will be permanently abandoned in accordance with 15A NCAC 02C.0113 (Abandonment of Wells). This section of the North Carolina Administrative Code requires the following activities be performed for well abandonment:

- The entire depth of the well be sounded to ensure there are no obstructions in the well.
- The well is to be disinfected in accordance with 15A NCAC 02C.0111 (Disinfection of Water Supply Wells) which requires the well below the static waterline to be disinfected with 100 ppm of chlorine and the casing above the waterline be rinsed with the chlorine solution.
- Completely fill the well from the bottom to the top of the casing with cement grout or bentonite.

As a precaution to ensure that Dare County continues to have a reliable supply of water, we recommend that the existing well be abandoned (i.e. grouted) only after the new well has been successfully installed and all testing of equipment has been performed to ensure the new well is fully functional and ready for continuous operation.

We estimate that approximately 3.9 cubic yards (CY) of cement grout or bentonite will be required to satisfactorily abandon the existing well. This quantity is based on the lengths and nominal diameters of the well, screen, and tail pipe plus a safety factor of 15%.

## 2.2 Replacement Well Casing and Screen Design

Preliminary design criteria for the replacement well (based on the hydrogeologic report submitted by CDM Missimer under separate cover) are presented in **Table 1.** The casing and screen depths presented in the table are estimates that will be confirmed based on geophysical logging to be performed following construction of a pilot borehole for the production well.

Materials of construction for this gravel-packed well include SDR-17 PVC well casing and 304 stainless steel screens.

Table 1

Production Well No. 9 Replacement

| | Upper Yorktown |
|---|---|
| Aquifer Characteristics | |
| Approx. Top of Aquifer (ft-BGS) | 120 |
| Approx. Thickness of Aquifer (ft) | 100 |
| Casings | |
| Well- Nominal Dia. (in) | 10 |
| - Length (ft) | 160 |
| - Material | PVC SDR-17 |
| Screens | |
| Nominal Dia. (in) | 8 |
| Length (ft) | 70 |
| No. of Intervals | Continuous |
| Material | 304 SS |
| Slot Size (in) | TBD[1] |
| Gravel Pack Settings (ft-BGS) | 150 - 230 |

Notes:

1. TBD - To be determined during construction based on analyses of formation samples obtained during drilling. It is anticipated that a slot size of 0.030 to 0.040 inches will be utilized

# Section 3
# Process Mechanical and Electrical Issues

## 3.1 Existing Pump and Piping

NCDENR and Dare County have agreed to salvage the existing vertical turbine line-shaft pump and as much of the piping as possible for installation in the replacement well. The following summarizes features of this pump and motor:

- Motor: GE - 30 HP, Service Factor 1.15, RPM 1750, FL Amps 77/38.5, Volts 460, 3-Phase
- Pump Capacity: 440 gpm
- Column Pipe: 80 feet of 6-inch threaded and coupled carbon steel pipe

The existing piping in the well house is 6-inch ductile iron based on information available to CDM Missimer and our knowledge of similar wells supplying raw water to the Skyco Water Treatment Plant.

## 3.2 Auxiliary Drive

Discussions with Dare County Water indicate that the existing production well has an auxiliary power unit consisting of a 4-cylinder, gas powered, right angle drive.

The National Fire Protection Association's (NFPA) 37 - Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, governs the installation of gasoline engines inside structures. NFPA 37 sets forth installation criteria for the engine and fuel supply of stationary engines using Class 1 fuels. Class 1 fuels are fuels having a flash point below 100 °F. Gasoline is a Class 1 fuel as its flash point is commonly reported at -40 °F.

The installation criteria for fuel tanks containing Class 1 fuels require the tanks to be located either underground or aboveground outside of structures. If the County does not want to locate the fuel tank outside, the alternative would be to use an engine-mounted tank, which according to the Standard, shall not exceed 25 gallons capacity. Since the engine will likely be used during power outages, we have assumed the County will require a fuel supply of greater than 25 gallons.

Based on the above information, CDM recommends that the fuel storage capacity issue be discussed with Dare County during final design to determine how much storage they need for this well.

## 3.3 Electrical Requirements

CDM Missimer recommends that the existing electrical equipment be disconnected and relocated from the existing production well #9 site to the new well site location

where it will be installed. New wire, conduit and hardware will be provided to all of the equipment.

A new 480v, 3-phase, 4 wire service will be provided by Dominion North Carolina Power. Dominion North Carolina Power will provide the pole mounted transformer, power meter, current transformer (CT) cabinet and the secondary wire and conduit from the pole mounted transformer to the ct cabinet.

We propose that new fluorescent lighting fixtures be installed inside the building and a surface mounted, metal halide wall pack be provided above the door for outdoor lighting. We recommend new receptacles and light switches be provided in and around the new well house.

The existing RTU cabinet and antennae will be relocated and installed by the contractor. Control and instrumentation wiring terminations in the RTU cabinet and at the antennae will be performed by Dare County.

Once the new pump station is on line, a total demolition of the existing well house will be performed. All wiring, conduit and hardware will be demolished. All abandoned fixtures, switches, boxes, etc. will be removed and properly disposed. The 480 volt service will be disconnected and the meter and ct cabinets returned to Dominion North Carolina Power.

## 3.4 Well House

CDM Missimer recommends the existing well house be demolished after the new well pump has been successfully installed and tested to ensure that it is ready for continuous operation.

We recommend that the new well be housed in a 12'W x 20'L x 8'-8"H precast concrete building similar to that manufactured by Smith-Carolina Corporation. Appendix A includes examples of similar structures.

The following summarizes design criteria we have used for similar structures specified in coastal North Carolina. These criteria would need to be confirmed during final design:

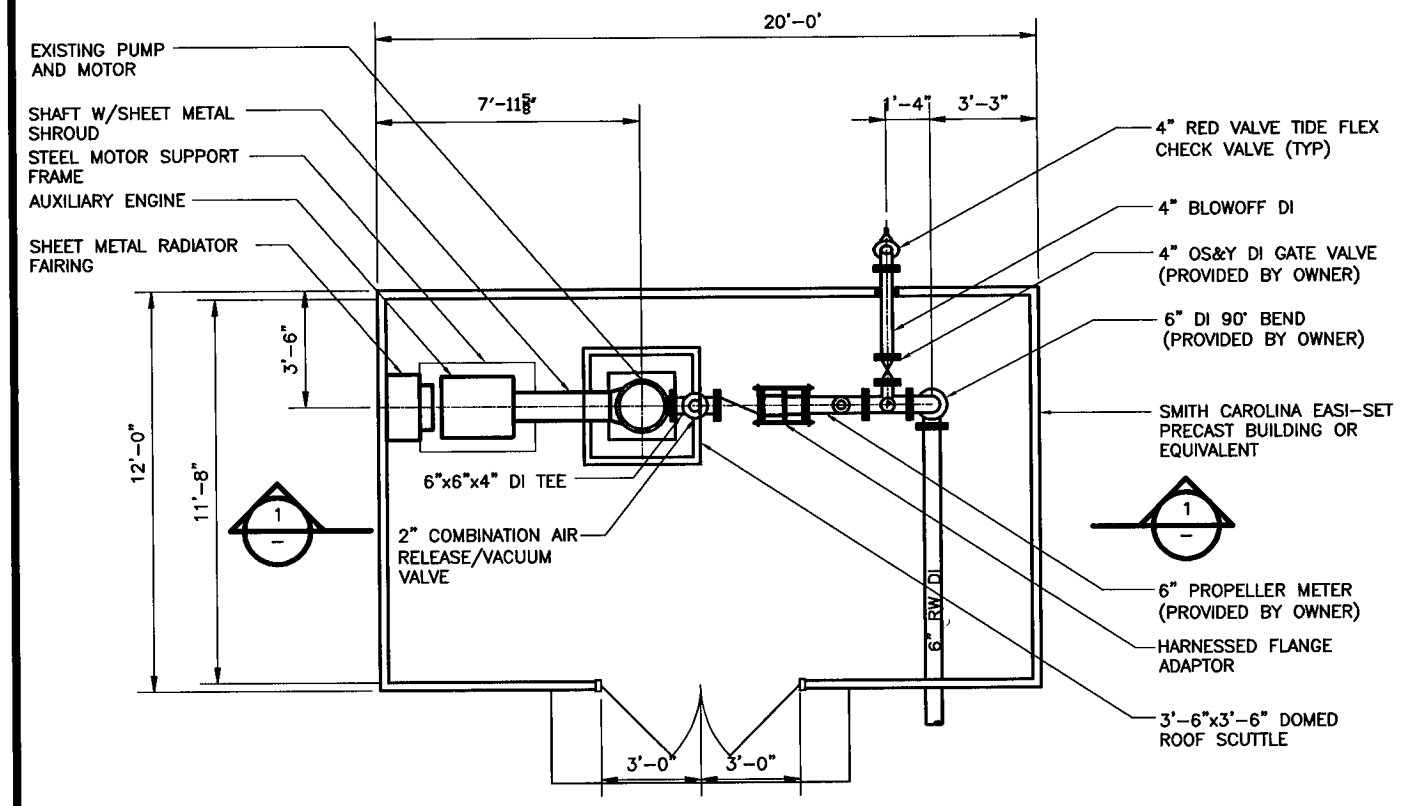
**Precast Concrete Building Design Criteria**

- Roof Live Load - minimum 20 psf.
- Snow Load
  - Ground snow load = 10 psf
  - Exposure factor = 0.8
  - Importance factor = 1.2
- Wind Load
  - Basic wind speed = 130 mph
  - Importance factor = 1.15
  - Exposure category = D

- Earthquake Load
  - Fa : 1.6
  - Fv : 2.4
  - Seismic Design Category: A
  - Seismic Importance Factor = 1.5
  - Seismic use group = III

## 3.5 Preliminary Mechanical and Electrical Plans

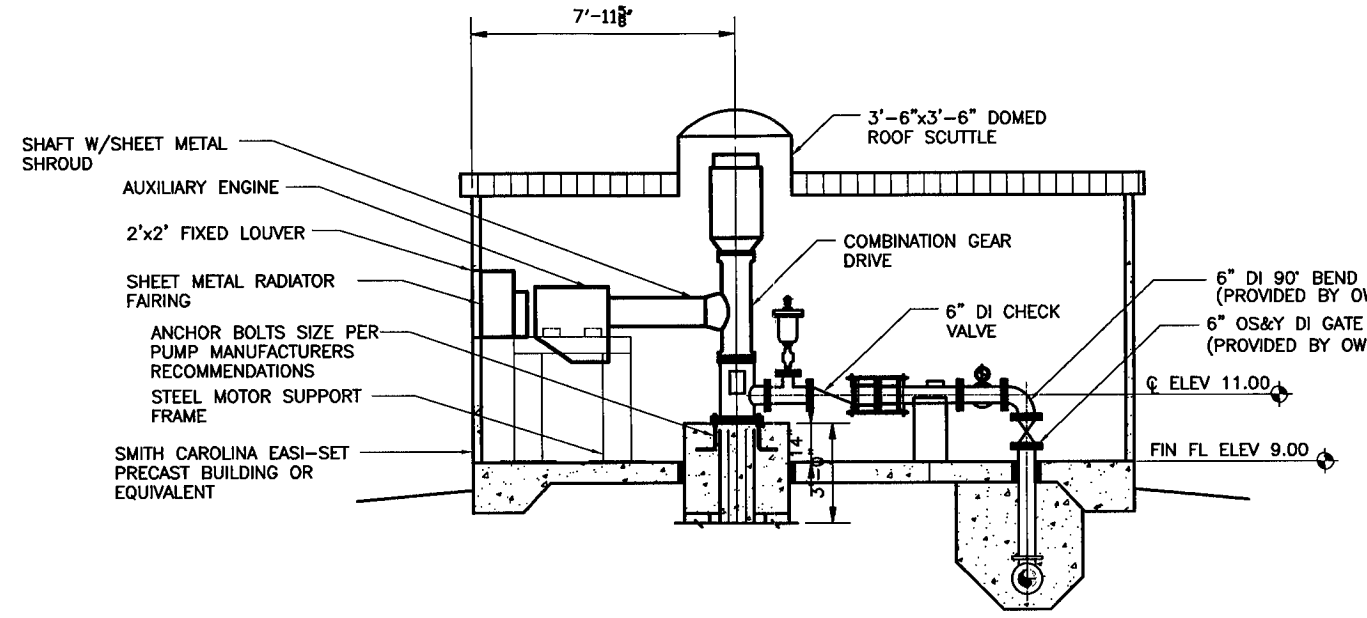
**Figures 2 and 3** present the preliminary mechanical and electrical plans we have developed for the proposed well.




SKYCO PRODUCTION WELL NO. 9

**PLAN**

NTS

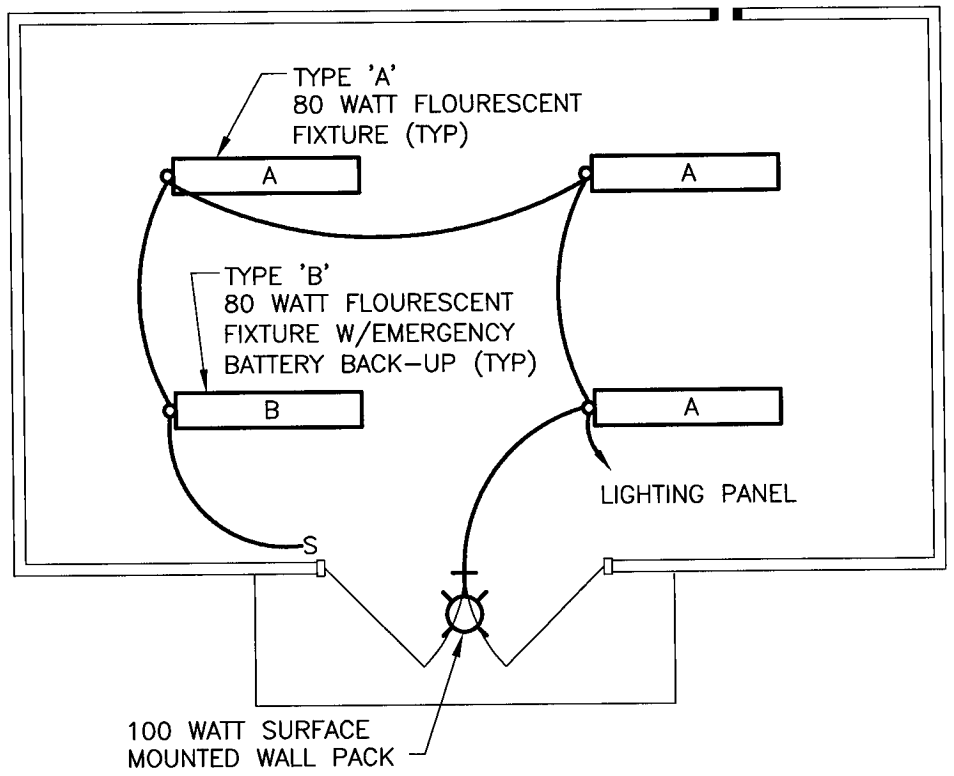



**SECTION** 1

NTS

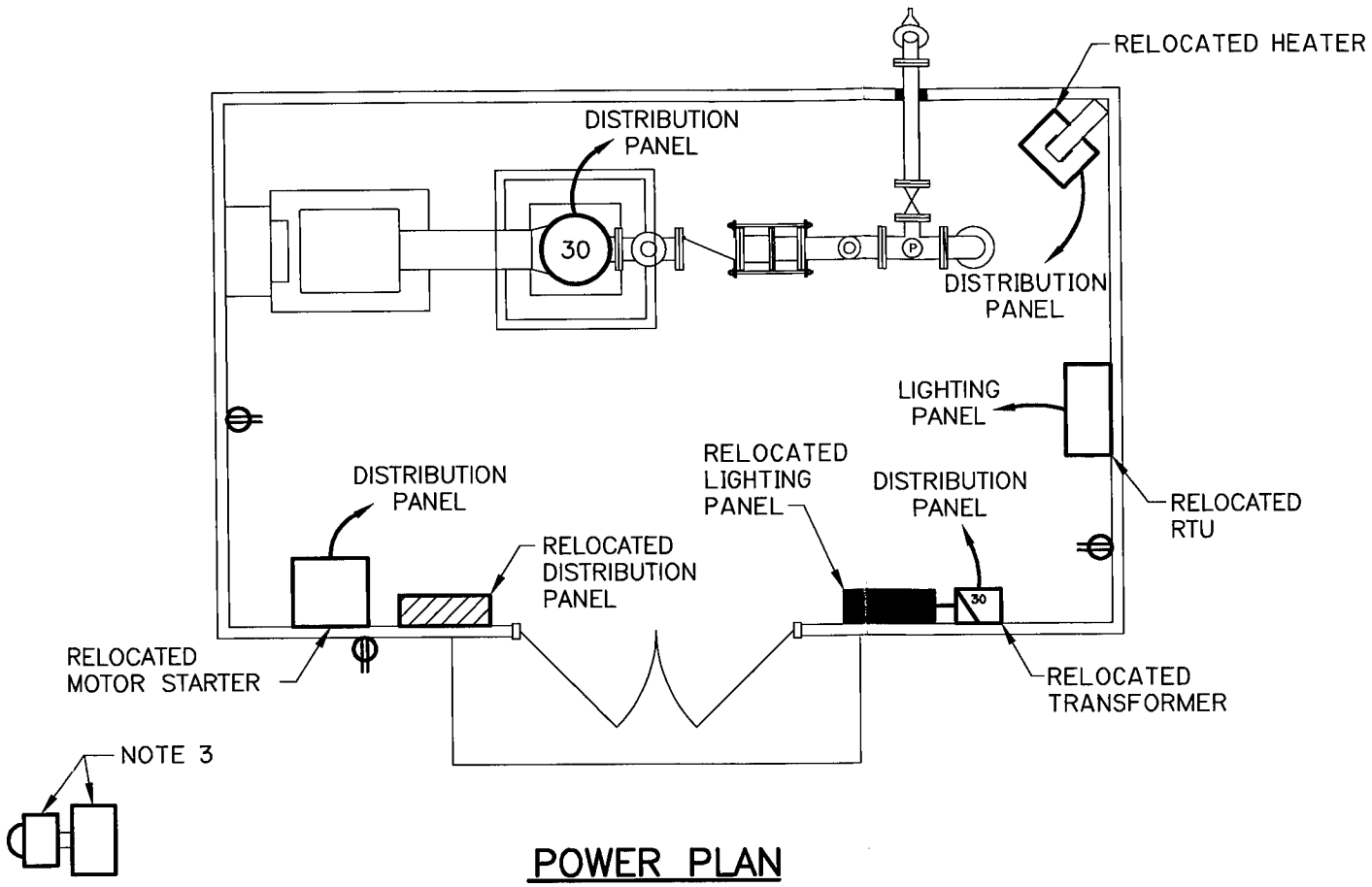
CDM Camp Dresser & McKee Inc.

Figure 2
Preliminary Mechanical Plan
Replacement Production Well Site #9



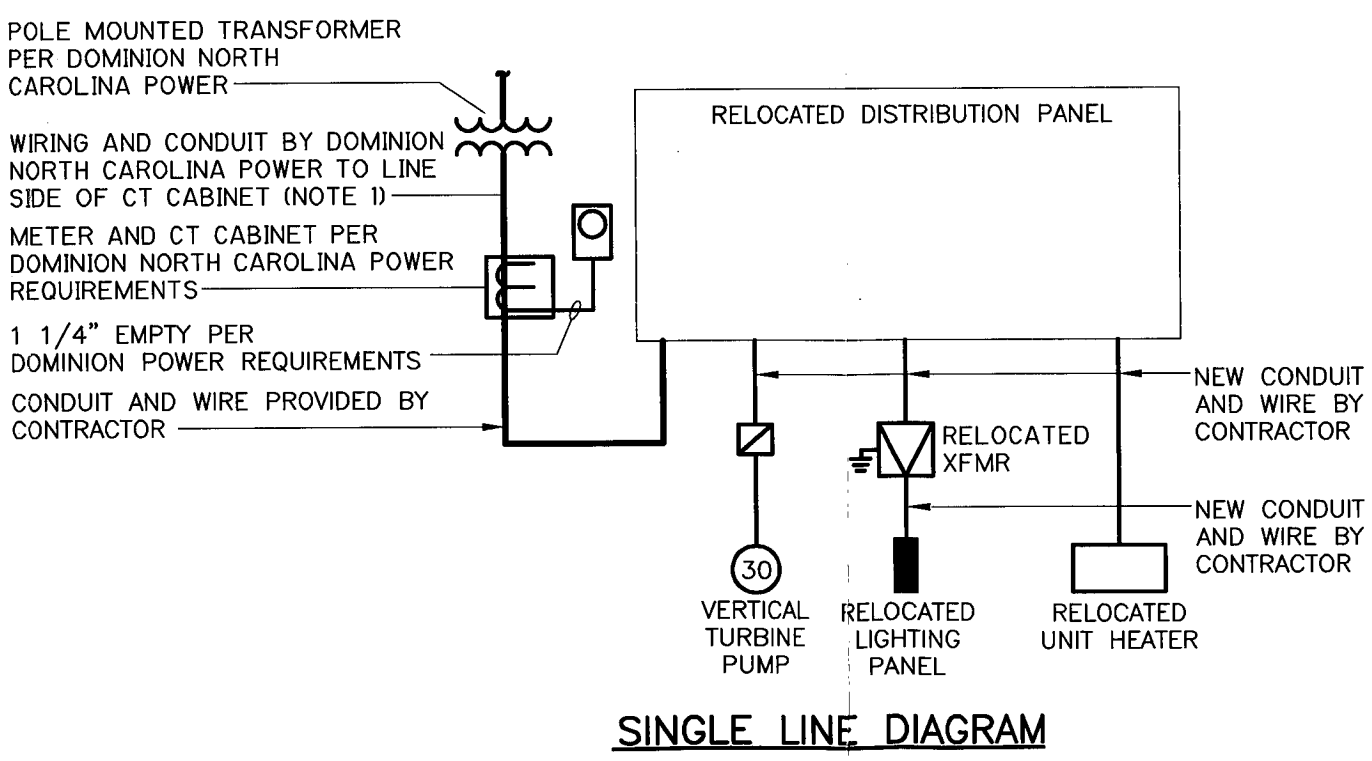

## LIGHTING PLAN

1/4" = 1'-0"




## POWER PLAN

1/4" = 1'-0"




## SINGLE LINE DIAGRAM

## NOTES:

1. PROVIDE SECONDARY CONDUIT AND CONDUCTORS FROM CT CABINET TO DISTRIBUTION PANEL. COORDINATE WITH DOMINION POWER FOR REQUIREMENTS. PAY ALL FEES ASSOCIATED WITH OBTAINING A NEW SERVICE.
2. PROVIDE NEW WIRE AND CONDUIT FROM RELOCATED DISTRIBUTION PANEL TO RELOCATE EQUIPMENT AS SHOWN ON THE DRAWINGS. PROVIDE ALL HARDWARE NECESSARY FOR A COMPLETE INSTALLATION.
3. METER AND CT CABINET TO BE PROVIDED BY DOMINION NORTH CAROLINA POWER AND LOCATED AND INSTALLED BY CONTRACTOR.

# Section 4
# Site Development Issues

## 4.1 Grading

The NCDENR requires that an area with a radius of at least 25 feet around the well head be above the 100-yr flood elevation. Based on a review of the FEMA flood insurance rate map for this area, CDM Missimer has determined that the 100-yr flood elevation is 9.0 feet.

Dare County's Chief Building Inspector has stated (for similar projects in the past) that all electrical panels must also be above the 100-yr flood elevation.

Based on the requirements listed above, we recommend establishing the finished floor elevation of the well house at 9.0 feet MSL and that the top of the concrete pad be finished off a minimum of 12 inches above the finished floor elevation.

It is our understanding that the State is currently performing all work to fill the site and that this work will be completed prior to final design.

The following summarizes other grading issues that will be addressed during final design:

- The site will be regraded to promote positive drainage away from the well house
- All clearing from construction will be restabilized with a natural seed mix for erosion control.

## 4.2 Geotechnical Investigations

CDM recommends a geotechnical investigation be performed prior to final design of the replacement well, to obtain the necessary data to provide geotechnical design and construction recommendations.

Data collection and analyses necessary to conduct a geotechnical engineering evaluation with respect to the foundation design and to estimate long-term and short-term settlements should consist of:

- A minimum of two 20-foot deep standard penetration test (SPT) borings within the approximate location of the building footprint.
- Laboratory tests should determine in-situ moisture contents
- Sieve analyses of soil samples

## 4.3 Survey Requirements

A topographic survey of the site needs to be performed during final design. We recommend that the limits of the topographic survey extend 100 feet beyond the boundaries of the well site property. Spot elevations should be taken by the surveyor sufficient to develop 1-foot contour intervals. A plat of the property with a metes and bounds description should also be developed for recordation.

The survey should also include:

- Property boundaries
- Above ground and buried utilities

## 4.4 Permits

Documentation from the NCDENR indicates that the property for the relocated well does not include wetlands. Therefore, the following summarizes the permits that will have to be obtained for this project prior to construction.

- Dare County Building Permit
- NCDENR Well Construction Permit
- NCDENR Water Supply System – Plans and Specifications Approval
- NCDOT Encroachment Agreement: for connection to the County's existing raw water main
- NCDOT Street and Driveway Access Permit: for entrance to NC 345

# Section 5
# Opinion of Probable Construction Cost

This section presents our planning-level opinion of probable construction costs for the relocation of Production Well # 9. This opinion of probable construction cost represents CDM Missimer's best engineering judgment based on the data we currently have. However, actual construction costs are largely dictated by market conditions existing at the time of bidding. Accordingly, CDM Missimer cannot guarantee that bids and actual construction costs will not vary from the opinion presented herein.

Table 2
Opinion of Probable Construction Costs

| COMPONENT | ESTIMATED CONSTRUCTION COST |
|---|---|
| Select Fill | N/A[1] |
| Well Construction and Testing | $75,000 |
| Concrete Foundation | $7,000 |
| Precast Concrete Well House 3.4 | $25,000 |
| Yard Piping | $5,000 |
| Site Work | $10,000 |
| Pull and Rehab Pump/Reinstall | $10,000 |
| Reconnect Auxiliary Drive | $3,000 |
| Electrical/Instrumentation Connections | $15,000 |
| Startup and Testing | $5,000 |
| Water Quality Testing | $3,000 |
| Demolish/Disposal Existing Building | $4,000 |
| Abandon Well 2.1 | $3,000 |
| **Sub-total Construction** | **$165,000** |
| Electrical Service Connection Allowance | $5,000 |
| Testing Allowance | $5,000 |
| **Sub-total Allowances** | **$10,000** |
| **Construction Contingency (20%)** | **$35,000** |
| **Total Estimated Cost[2]** | **$210,000** |

Notes:
1. Fill is being provided under a separate dredging contract per NCDENR
2. Does not include costs associated engineering, permitting, construction inspection, or real property acquisition.

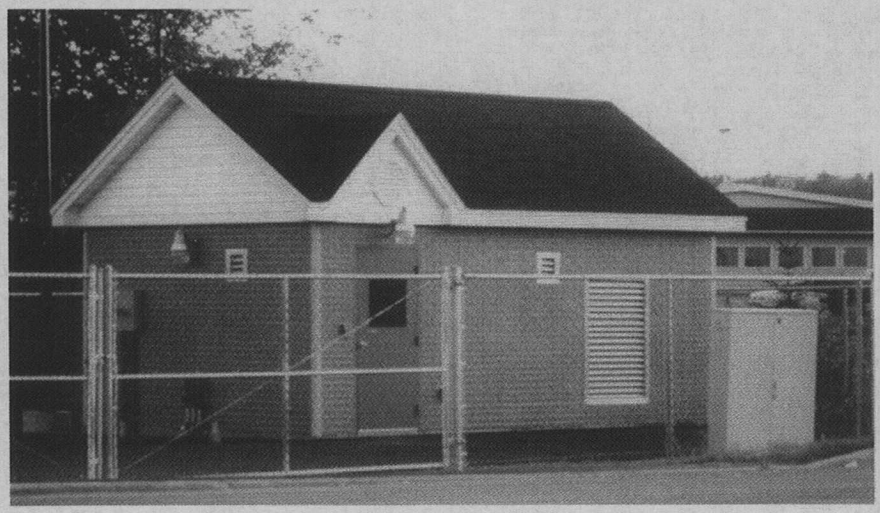
# Appendix A

Precast Concrete Well House Examples

## EASI-SET Precast Concrete Building 12' x 20'

### Hazardous Material Storage Building

- Containment curb and grating



### Generator Building

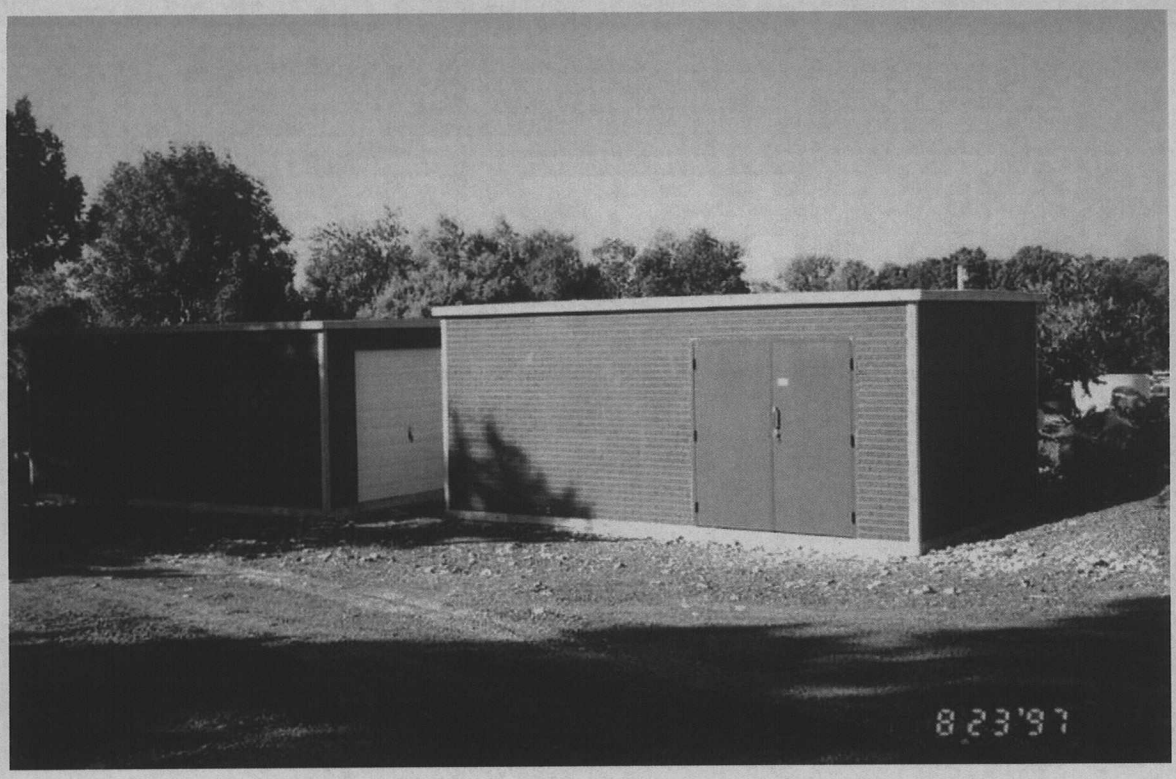
- Pre-assembled wood truss roof

### Substation Control Building

- Virginia Power

SMITH-MIDLAND

EXCELLENCE IN PRECAST CONCRETE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