

**BENEFIT-COST ANALYSIS METHODOLOGY
ROBESON COUNTY
RESILIENT POWER PROJECT
BACKUP GENERATORS FOR THE
MAXTON WTP AND LUMBER BRIDGE WTP**

SUBMITTED TO

FEMA BUILDING RESILIENT INFRASTRUCTURE AND COMMUNITIES

GRANT PROGRAM

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1.0 PROJECT OVERVIEW

This methodology report consists of information used to complete the benefit-cost analysis (BCA), using FEMA’s BCA toolkit, for the purchase and installation of seventeen (17) new backup generators within the Maxton and Lumber Bridge Water Treatment Plant systems in Robeson County. Providing backup power capabilities to these two plants will save the County valuable time, effort, and money during severe storms. Determined from information entered into the BCA toolkit, the combined project and maintenance cost of the project is **\$3,113,504** and the benefits provided to the County are **\$44,670,229**, resulting in a benefit-cost ration of **14.35**. Information provided to FEMA’s toolkit is broken down below to highlight the driving factors of this resiliency project and how Robeson County will greatly benefit from this project.

1.1 Project Background

The proposed project includes the installation of automatic backup power infrastructure throughout the systems of two water treatment plants in Robeson County. The Maxton WTP and Lumber Bridge WTP are the largest treatment plants operated by the County, rated for 12.000 MGD and 9.000 MGD, respectively. Each water treatment plant has a system of production wells that pump water directly to the plants for treatment. According to the most recent Local Water Supply plan, the Maxton WTP system has a total of seventeen (17) wells and the Lumber Bridge WTP system has thirteen (13) wells. **Table 1** below represents the capacities and coordinates of each water treatment plant.

Table 1. Water Treatment Plant Locations

Treatment Facility	Rated Capacity	Latitude	Longitude
Maxton WTP	12.000 MGD	34.776389	-79.330265
Lumber Bridge WTP	9.000 MGD	34.877820	-79.089385

1.2 Proposed Mitigation and Level of Protection

Robeson County will contract a qualified engineering and construction team to implement the proposed project. The Robeson County Resilient Power Project will entail the acquisition of generators for both the Lumber Bridge and Maxton water treatment plants and will result in maintained power during power outages at these key locations. These water treatment plants are stand-alone filter plants that are served by a network of designated wells. They are the water source, treatment, and distribution networks. The county will install nine (9) generators for the Lumber Bridge system and eight (8) generators for the Maxton location and its connected infrastructure.

At the Lumber Bridge Water Treatment Plant, seven of the generators will be located at well pump sites. Three of these will be 100KW generators (Well #26, Well #34, Well #41, and Well #54), one will be 80KW (Well #53), another will be 60KW (Well #27B), and one will be 50 KW (Well #58). The other two generators will be at the water plant itself, with one being 600KW and the other 100KW.

Within the Maxton Water Treatment Plant, seven of the generators will be located at well pump sites. There will be one (1) 130KW generator (Well #5A), four (4) that will be 100KW (Well #4A, Well #23, Well #24, and Well #46), two (2) will be 80KW (Well #40 and Well #48), and there will be an 800KW generator to be located at the water plant.

The exact locations of the well sites and the treatment plants are compiled in a list in **Appendix A**.

Having these generators will allow for an automatic alternative power source during natural disasters when power has been suspended due to fallen trees and flooded areas. If power lines are compromised due to debris and falling trees from high winds and flooding, then having the generators will re-establish power before adverse impacts are felt throughout the system.

2.0 HISTORIC EVENTS

Situated in the Southeastern portion of North Carolina, Robeson county has experienced major devastation during recent hurricanes. Most significant was the devastation caused by flooding events during hurricanes Matthew and Florence, attributable to the supercharging of rains resulting from climate change. This results in the frequent collapse of trees within the county's underdeveloped areas. The tree root systems are compromised due to the saturation of the soil from the substantial rainfall and strong winds. In these underdeveloped areas of the county, buried power lines are not considered cost-effective by the power providers. The power lines are located above ground and are then made vulnerable to the falling of trees and debris, eliminating power to vital infrastructure, including the water supply for the County.

According to the Robeson County Hurricane Matthew Resilient Redevelopment Plan there were 635 road closures during Hurricane Matthew, including the major east-west and north-south corridors. Hazardous road conditions during these natural disasters hinder service technicians from accessing water infrastructure to make needed repairs, which endangers more people. With the implementation of the Robeson County Resilient Power Project, which involves the installation of generators at the Lumber Bridge and Maxton water treatment plants, the danger to the public health of residents can be mitigated during crisis conditions. Similarly, having a reliable power source for these two plants alleviates safety hazards.

3.0 PROJECT AND MAINTENANCE COSTS

The total combined project cost for the backup generators is represented below in **Table 2**. Generator costs were obtained from a Caterpillar Representative during a meeting. A copy of the notes from the meeting is included in **Appendix C**. Combined annual maintenance cost for the seventeen generators totals up to approximately \$17,000, or approximately \$1,000/yr/generator. The maintenance cost includes proper upkeep, testing, and expected repairs for each generator.

Table 2. Generator Locations, Sizes, and Costs

Site	Generator Size (kW)	Generator Cost (\$)
Maxton WTP System		
Well #4A	100	\$125,000
Well #5A	130	\$160,000
Well #23	100	\$125,000
Well #24	100	\$125,000
Well #40	80	\$125,000
Well #46	100	\$125,000
Well #48	80	\$125,000
Maxton WTP	800	\$600,000
Maxton WTP Total Cost		\$1,510,000
Lumber Bridge WTP System		
Well #26	100	\$125,000
Well #27B	60	\$80,000
Well #34	100	\$125,000
Well #41	100	\$125,000
Well #53	80	\$125,000
Well #54	100	\$125,000
Well #58	50	\$80,000
Lumber Bridge WTP	600	\$450,000
Lumber Bridge WTP	100	\$125,000
Lumber Bridge WTP Total Cost		\$1,360,000
Total Project Cost		2,870,000

Table 3. Initial Capital Cost and Annual Maintenance Costs

Mitigation Activity	Project Cost	Annual Maintenance Cost
Maxton WTP Generators	\$1,510,000	\$8,000
Lumber Bridge WTP Generators	\$1,360,000	\$9,000

4.0 PROJECT USEFUL LIFE

The 2009 FEMA BCA Reference Guide Project Useful Life Summary Table attached in **Appendix B**, states that a generator project should have a standard useful life value of 19 years. Therefore, a standard useful life of 19 years was used for the Maxton and Lumber Bridge treatment plants, for calculations with the BCA Excel Tool. An export of the Benefit-Cost Analysis summary can be found in **Appendix A**.

5.0 SERVICE POPULATION

Robeson County has experienced increasing economic hardship in recent years as a result of various natural disasters and the COVID-19 pandemic. The County has the highest CDC Social Vulnerability Index score in the state at 0.99 and an average per capita income of \$20,294. Based on the 2020 Census data, the population of Robeson County is 116,530 persons. According to the North Carolina Department of Commerce NC Development Tier Designations Report from November 2021, Robeson County is defined as a Tier 1 economic county. The county is the second most economically distressed within the State of North Carolina and has the lowest median household income in the state at \$35,407.

Robeson County is home to many vulnerable communities of varying needs, with water being one of the most imperative. With 27.9% of Robesonians living in poverty and 27% of households in Robeson County being cost-burdened, having a safe, reliable water source is essential to those experiencing housing and poverty obstacles, as they are most affected by natural disasters.

Over 10,000 residents within the Towns of Maxton, Pembroke, Red Springs, St. Paul's, and Parkton are directly affected by water loss in times of natural disaster. These communities rely on the Lumber Bridge and Maxton water treatment plants as emergency connections. Providing access to reliable alternative power is critical to these communities which possess a poverty rate of approximately 12% to 42%.

Specifically, reliable water access is vital for those located at the University of North Carolina at Pembroke. The Maxton Water Treatment Plant services a crucial area of the institution, including a number of residence halls, University Student Health Services, and various educational buildings in times of emergency. Without reliable power to the plant, students, staff, and faculty are left without an emergency water supply. This disruption of water services endangers the lives of the university's community, especially those who shelter in place.

5.1 Maxton WTP and Lumber Bridge WTP Service Population(s)

According to the Lumber River COG (LRCOG) and Robeson County, the Maxton WTP and Lumber Bridge WTP serve a combined roughly 2/3 of the County's system. The most recent Local Water Supply Plan (LWSP) data reports show that the year-round service population for the County is 85,414 residents. If the percentage of the County served by the two plants is 66%, the number of residents served is approximately 56,900 people. Determining the exact service population of each plant is an extensive exercise, so for the purposes of the BCA, the populations were estimated based on the rated treatment capacity of each plant. The Maxton WTP is rated for 12.000 MGD and the Lumber Bridge WTP is rated for 9.000 MGD. Assuming the ratio of the treatment capacities is proportional to the size of the service populations, a simple linear relationship was utilized to assign service populations to each WTP:

$$x = \text{Lumber Bridge WTP Service Population}, y = \text{Maxton WTP}$$
$$x + y = 56,900; y = 1.333x \text{ (Maxton capacity is } \frac{12}{9} = 1.333x \text{ greater than Lumber Bridge)}$$

$$2.333x = 56,900$$

$$x = 24,386 \text{ Residents}$$

$$y = 1.333x = 1.333 * 24,386 = 32,514 \text{ Residents}$$

6.0 EFFECTS OF POWER OUTAGES

6.1 Cause of Power Outage(s)

The Maxton WTP and Lumber Bridge WTP have experienced power loss from two major events in the last 5 years, Hurricane Florence in September of 2018 and Hurricane Matthew in October of 2016. At the time of each event, both treatment plants lost primary power and were unable to provide Robeson County citizens with potable water due to a lack of backup power infrastructure. The water treatment plants were out of service for several days, causing pressure loss and water shortages throughout the County.

6.2 Service Impacts

During hurricanes Matthew and Florence, the Lumber Bridge and Maxton water treatment plants experienced power outages accompanied by loss of system pressure. As a result, these water treatment plants shut down, and county residents directly served by these two plants were without potable water. Furthermore, the Towns of Maxton, Pembroke, Red Springs, St. Pauls, and Parkton were left without emergency water connections. With the combined service area of the two plants being approximately two-thirds of the entire County, having reliable power is pivotal. Specifically, the Maxton Plant partially services the University of North Carolina at Pembroke through an emergency connection to University Road. Located on University Rd. is the English Jones Center, which has served as an operations hub for over 200 emergency personnel from the NC Army National Guard, FEMA, and the FBI who need reliable water. Students and staff were directly affected by the loss of water to their facilities and places of residence. Loss of water as a result of power outages causes significant disruption to emergency services and jeopardizes the health and safety of this population.

7.0 RESULTS

Using the benefit-cost analysis tool provided by FEMA GO through Microsoft Excel, the table below shows the Benefit-Cost Ratio for the Resilient Power Project. After all the information required was input into the provided BCA Tool, the determined benefit-cost ratio is 14.35. **Table 4 & Table 5** below show a summary of the total benefits and costs associated with the installation of backup generator systems for the Maxton and Lumber Bridge Water Treatment Plants.

Table 4. BCA Toolkit Results (7% Discount Rate)

Project	Benefits	Costs	Benefit-Cost Ratio
Maxton WTP	\$18,418,475	\$1,592,685	11.56
Lumber Bridge WTP	\$13,814,133	\$1,453,020	9.51
Project Total	\$32,232,608	\$3,045,705	10.58

Table 5. BCA Toolkit Results (3% Discount Rate)

Project	Benefits	Costs	Benefit-Cost Ratio
Maxton WTP	\$25,525,626	\$1,624,590	15.71
Lumber Bridge WTP	\$19,144,603	\$1,488,914	12.86
Project Total	\$44,670,229	\$3,113,504	14.35

The total benefits from the implementation of the Resilient Power Project approximately outweigh the cost of the project by over 14 times. Not only will the project provide an exceptional water distribution service to the areas served by each plant, but Robeson County will be able to provide potable water to its residents during the times when they are most in need.