Decommissioning Study and Decommissioning Obligation Cost Evaluation

Big Blue River Wind Farm, LLC

Big Blue River Wind Farm
Project No. 111778

5/20/2019

Decommissioning Study and Decommissioning Obligation Cost Evaluation

prepared for

Big Blue River Wind Farm, LLC
Big Blue River Wind Farm
Henry County, Indiana

Project No. 111778

5/20/2019

prepared by

Burns & McDonnell Engineering Company, Inc.
Kansas City, Missouri

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LIST OF ABBREVIATIONS

Abbreviation	Term/Phrase/Name
Burns & McDonnell	Burns & McDonnell Engineering Company, Inc.
BMPs	Best management practices
Developer	Big Blue River Wind Farm, LLC
kV	kilovolt
O&M	Operations and maintenance
Project	Big Blue River Wind Farm
Study	Decommissioning Cost Evaluation

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1.0 EXECUTIVE SUMMARY

1.1 Introduction

Burns & McDonnell Engineering Company, Inc. ("Burns & McDonnell") was retained by Environmental Design & Research, Landscape Architecture, Engineering, & Environmental Service, D.P.C. ("EDR") on behalf of Big Blue River Wind Farm, LLC (the "Developer") to conduct a decommissioning cost evaluation for the Big Blue River Wind Farm. The purpose of the decommissioning cost evaluation was to review the Project and provide a recommendation regarding the decommissioning cost and plan for retiring the facility at the end of its useful life.

1.2 Results

When it is determined that the Project should be retired, the above-grade steel structures and turbine nacelles are assumed to have significant scrap value to a salvage contractor, offsetting a portion of the cost to remove these items. However, the Project will also incur costs for removal and disposal of the blades, foundations, and other Project facilities, along with the costs for the restoration of the site following the removal of salvageable equipment.

The decommissioning cost estimate provided herein includes the costs to return the site to a condition compatible with the surrounding land and to conditions similar to those that existed before development of the Project. Included are the costs to retire the power generating equipment that is part of the Project as well as the costs to retire the Project's balance-of-plant facilities, with all equipment, structures, and supporting facilities removed to a depth of four (4) feet below grade.

The total cost to decommission the Project at the end of its useful life, based on the assumptions noted herein, is presented in Table 1-1. It is expressly noted that while the costs below are presented both in total and per turbine, a change in the quantity of turbines in a given layout may not cause the total decommissioning cost to increase or decrease by the per turbine cost, due to non-scalable differences in balance-of-plant costs and other similar factors.

Table 1-1: Summary of Total Estimated Cost for Project Decommissioning (2019$)

Turbine Layout	Decommissioning Cost	Cost per Turbine
38 x GE 2.82-127	$1,280,650	$33,701

2.0 PROJECT OVERVIEW

2.1 Project Summary

Burns & McDonnell Engineering Company, Inc. ("Burns & McDonnell") was retained by Environmental Design & Research, Landscape Architecture, Engineering, & Environmental Service, D.P.C. ("EDR") on behalf of Big Blue River Wind Farm, LLC (the "Developer") to conduct a decommissioning cost evaluation (the "Study") for the proposed Big Blue River Wind Farm (the "Project"). The purpose of the decommissioning cost evaluation was to review the Project and provide a recommendation regarding the decommissioning cost and plan for retiring the facility at the end of its useful life.

The proposed Big Blue River Wind Farm will be located in Henry County, Indiana, approximately 3 miles northwest of the city of New Castle. The Developer is considering 5 different turbine models, though it was determined to select 1 turbine model that would yield the most conservative results for the purpose of this Study. The Project is expected to include a quantity of 38 General Electric ("GE") GE 2.8-127 wind turbine generators. The GE 2.8-127 has a hub height of 89 meters and an aggregate nameplate capacity of approximately 2.82 megawatts ("MW").

Burns & McDonnell did not visit the Project site as part of this Study. The contents of this evaluation, including conclusions provided herein, are based exclusively upon desktop analysis, which is a typical approach for decommissioning studies performed early in the permitting process.

2.2 Project Facilities

The following sections provide an overview of the anticipated Project facilities.

2.2.1 Wind Turbines

The GE 2.82-127 turbines include 89-meter, conical, tubular, steel towers which support the turbine nacelles mounted on top. The nacelle of each turbine includes three (3) blades mounted to the nacelle rotor, each with a total blade length of approximately 62.2 meters. All turbines were assumed to be fully removed as part of this Study. The estimated salvage weights for the turbine model under consideration are summarized in Table 2-1 below.

Table 2-1: Summary of Turbine Salvage Weights, Per Turbine

Turbine Model	Steel [tons]	Copper [tons]	Aluminum [tons]
38x GE 2.82-127	267	5	4

2.2.2 Wind Turbine Foundations

Each wind turbine tower will be supported by a concrete foundation. No foundation design had been prepared for the Project at the time of this writing, so a single generic foundation design was assumed for the GE 2.82-127 turbine model consistent with typical foundation design practices for the expected turbine model and geographic area. The concrete foundation in the assumed design used in the estimate is mostly below-grade, consisting of a 4-foot-tall, 18-foot-diameter cylinder pedestal that rests on an octagonal, sloped base with a 60-foot bottom diameter.

As required by the Henry County Ordinance dated August 22, 2018, all underground facilities for the Project will be decommissioned to a depth of four (4) feet below grade. Thus, all foundations will be removed up to four (4) feet below grade as part of the decommissioning; the remaining foundation will be backfilled and left in place.

2.2.3 Site Roads

Each wind turbine will have an access road to support construction and allow for vehicle access to facilitate inspections and maintenance of the turbines and associated equipment during operation. Access roads were assumed to include a 10-inch-thick crushed rock surface with a final road width of 16 feet. A road layout was prepared by Developer for the Project layout consisting of 38 wind turbine positions, which is included in Appendix A. Based on this Developer-prepared layout, the total estimated access road length for the 38 turbines was approximately 60,432 feet.

2.2.4 Electrical Infrastructure

The Project will include an underground 34.5-kilovolt ("kV") electrical power collection system that will collect the electrical power from the pad-mount transformers located next to each wind turbine, and route it to a collector substation. This Project substation will increase the voltage from 34.5 kV to 138 kV; other voltage levels are being considered by Developer but are not expected to have a material adverse impact on the results provided herein. As this substation is located directly adjacent to the utility-owned switchyard for interconnection to the regional electric transmission grid, no transmission line for the Project was included in the estimate.

The collector substation was assumed to include typical equipment, including a main power transformer, breakers, disconnect switches, lighting masts, busbars, and a control building. Further, all underground collection cables were assumed to be buried at a depth of at least four (4) feet below grade, and therefore were assumed to be abandoned in place following decommissioning.

2.2.5 Maintenance/Warehouse Facility

The Project will include an operations and maintenance ("O&M") building. A generic design was assumed for purposes of this Study, consistent with similar facilities of this size and type. The building is assumed to be 120 feet by 48 feet with a 10-inch-thick concrete foundation. Crushed rock is assumed to cover the surrounding area of the O&M facility, extending approximately 10 feet away from each side of the building.

2.2.6 Meteorological Equipment

For the purposes of this Study, it was assumed that wind speed is measured on-site using two (2) meteorological towers. The towers were assumed to be free-standing, 89-meter-tall lattice-type towers. These towers were assumed to be fully removed as part of this Study, including foundations which were assumed to be two (2) feet below grade.

3.0 DECOMMISSIONING

3.1 Decommissioning Methodology

When it is determined that the Project should be retired, the Project equipment will be removed as noted herein. It is assumed that the Project will incur costs for removal and disposal of the blades, foundations, and other Project facilities, as well as for the restoration of the site following the removal of equipment, although the above-grade steel, aluminum, and copper equipment is expected to have significant scrap value to a salvage contractor. All recyclable materials will be recycled to the extent possible, while all other non-recyclable waste materials will be disposed of in accordance with state and federal law.

The wind turbine blades will be removed from the wind turbine nacelle rotors using a crane, cut into manageable-sized sections, loaded onto a trailer, and hauled to a local landfill for disposal; the wind turbine blades are constructed from a composite material that is assumed to have no salvage value at the time of decommissioning. The turbine nacelles will also be removed from the towers with a crane. The towers and nacelle will then be dismantled, cut onsite, and hauled off to a scrap yard.

All concrete wind turbine foundations will be removed to a depth of four (4) feet below grade in accordance with the Henry County Ordinance; the portions of the foundation that are greater than four (4) feet below grade will be abandoned in place. The recovered concrete will be demolished, loaded into a dump truck, and hauled to a local landfill for disposal. Voids left from the removal of the concrete footings will be backfilled with surrounding subsoil and topsoil and fine graded to provide suitable drainage.

The substation will be removed from the site, including all above-grade equipment (e.g., transformers, breakers, busbars, cabling), buildings, crushed rock surfacing, and fencing. Additionally, the foundations of the equipment will be removed up to four (4) feet below grade in accordance with the Henry County Ordinance. Voids left from the removal of the concrete footings, if applicable, will be backfilled with surrounding subsoil and topsoil and fine graded to provide suitable drainage.

All crushed rock surfacing will be removed. Areas where crushed rock surfacing has been removed will be fine graded to provide suitable drainage. In right-of-way and non-agricultural areas, the ground will be seeded to prevent erosion. The removed crushed rock will be loaded into dump trucks and hauled offsite. The cost to remove the crushed rock and load it into dump trucks will be at the expense of the Project. It is conservatively assumed that the Project will incur a cost to haul the crushed rock to the landfill but will not be charged for disposal since landfills are able to use the crushed rock as daily cover.

Prior to commencing activities associated with foundation removal, crushed rock surfacing removal, or any other earthwork, an approved erosion control plan will need to be developed by the demolition contractor. Best management practices ("BMPs") applicable at the time that decommissioning activities occur will need to be implemented by the contractor for control of storm water runoff; since decommissioning activities are not anticipated to occur for 20 years or more, BMPs may differ from current standards. However, consistent with typical industry practices of today, Burns & McDonnell would anticipate BMPs such as silt fencing and proper compaction, seeding, and mulching practices to be implemented. BMPs will need to be reviewed by the contractor prior to commencing decommissioning activities to determine appropriate BMPs at that time.

To the extent necessary, the Project or the contractor will need to obtain any permits relating to decommissioning activities, including permits from the Environmental Protection Agency and the United States Army Corps of Engineers. The costs included in this Study are sufficient for a demolition contractor to develop suitable plans for the control of surface water drainage and water accumulation, and, where appropriate, for backfilling, soil stabilization, compacting, and grading prior to commencing demolition activities.

All disturbed areas at the site will be returned to as close to predevelopment conditions as possible. This will allow all land disturbed by the construction of the Project to be returned to agricultural use at the end of the useful life of the Project. The cost estimates provided in the following section include activities and costs to return the land to a condition suitable for agricultural use subsequent to decommissioning of the Project.

Demolition of the site is estimated to require approximately 90 days; however, additional time is required for planning and post-demolition activities such as site restoration.

Additional time may be required for post-decommissioning activities including monitoring of new vegetation, however, this timetable and the cost estimates below should provide sufficient time and budget to comply with any applicable health and safety regulations.

3.2 Decommissioning Costs

The total estimated cost to decommission the Project at the end of its useful life, based on the assumptions noted herein, is presented in the table below. It is expressly noted that while costs below are presented both in total and on a per turbine basis, a change in the quantity of turbines in a given layout may not cause the total decommissioning cost to increase or decrease by the per turbine cost, due to non-scalable differences in balance-of-plant costs and other similar factors.

Table 3-1: Summary of Total Estimated Cost for Project Decommissioning (2019$)

Turbine Layout	Decommissioning Cost	Cost per Turbine
38 x GE 2.82-127	$1,280,650	$33,701

A breakdown of the costs shown in the preceding table is included in Appendix B.

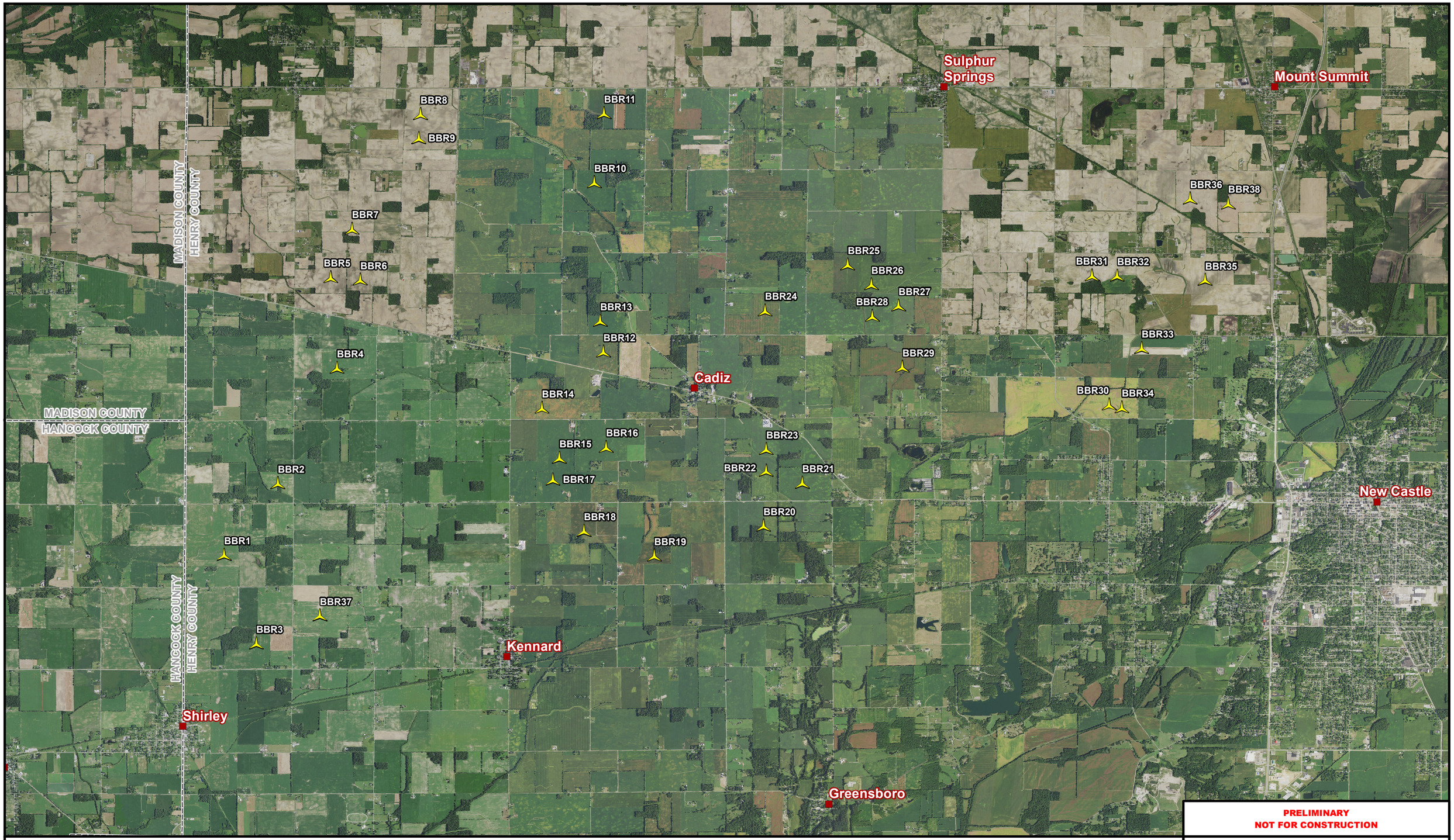
3.3 Decommissioning Assumptions

The following key assumptions were utilized for the decommissioning cost estimates presented herein:

1. All costs are presented in current (2019) dollars using the site cost index for Muncie, Indiana.
2. The decommissioning estimate is based on details and equipment defined through conversations with and documentation provided by Developer.
3. An offsite landfill is assumed to be used for disposal of demolition waste. Based on discussions with a local landfill (Hayes Landfill), the cost for disposal of debris and concrete is $66.60 per ton. The hauling distance to this landfill is approximately 16 miles from the Project site.
4. Where applicable, scrap values are based upon an average of monthly American Metal Market prices for January 2018 through December 2018 (i.e., one calendar year). These values include the cost to haul the scrap via truck and/or rail to the major market which provides the best price. Based on hauling and rail prices, the best market at the time of this Study was Chicago. Prices used include:
   - Steel scrap value of $319.26 per net ton.
   - Copper scrap value of $2.09 per pound.
   - Aluminum scrap value of $0.41 per pound.
5. Fluids located within the turbine nacelle, including oils, fuels, solvents and process chemicals, are assumed to be drained and disposed of offsite as part of the decommissioning.
6. It is assumed that all containers and chemical storage tanks owned by the Project will be drained and the material disposed of prior to demolition; these costs are excluded from the estimate.
7. All underground equipment will be removed to a depth of four (4) feet below grade in accordance with the Henry County Ordinance. All non-hazardous structures or foundations greater than four (4) feet below grade will remain and are excluded from the decommissioning estimate.
8. Collector and communication cables are assumed to be located at least four (4) feet below grade and will be abandoned in place.
9. Access roads, parking areas, storage yards, crane pads, and all other areas constructed from asphalt, concrete, gravel, or compactable fill will be removed, recycled, and reclaimed.

10. Crushed rock from roads, balance-of-plant areas, and turbine foundation areas are assumed to have value as a commodity for reuse. The cost of hauling crushed rock is included in the estimate, however, disposal is excluded and is assumed to be used by the landfill for auxiliary purposes.
11. Waste material and crushed concrete will be properly disposed of offsite.
12. No discussions with landowners have occurred regarding the condition of land after decommissioning. Therefore, it is assumed that all Project-specific access roads, fences, gates, and buildings will be removed as part of the decommissioning. Additionally, disturbed areas will be restored to original grade, reclaimed with native soils, seeded, and replanted with native vegetation consistent with surrounding land use.
13. Transformers will be removed and processed on-site. The cost to drain and dispose of transformer oil off-site is included in the decommissioning cost estimate.
14. It is assumed the GE 2.82-127 turbines have pad-mount transformers which are included in the estimate.
15. The Project substation is assumed to have one (1) station service transformer and one (1) main step-up transformer. The removal and salvage of these oil-filled transformers is included in the decommissioning cost estimate, including the cost to drain and dispose of the oil within each.
16. The removal of the Project substation equipment is included in the decommissioning cost estimate.
17. Cost estimates include five (5) percent indirects and ten (10) percent contingency.
18. Market conditions may result in cost variations at the time of contract execution.

APPENDIX A - SITE LAYOUT AND CONFIGURATION



LEGEND

- Proposed Wind Turbine
- Cities
- County Boundary

REFERENCE

0 0.5 1
MILES

0 0.5 1
KILOMETERS

N

PRELIMINARY
NOT FOR CONSTRUCTION

BIG BLUE RIVER WIND PROJECT
Site Layout

LOCATION:	Henry County, Indiana
CLIENT:	Big Blue River Wind Farm, LLC
PROJ. NO.:	111778
CREATED:	05/16/2019

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Path: Z:\Clients\BTS\Calpine\111778_BBRPermitStudy\Studies\Geospatial\Data\FlexArcDocs\111778_BBR_SiteLayout.mxd • Coordinate System: GCS WGS 1984 • Units: Degree

APPENDIX B - DECOMMISSIONING COST BREAKDOWN

Table B-1: Estimated Decommissioning Costs, 38 x GE 2.82-127 (2019$)

Wind Turbine Removal Cost		
Removal	$	1,439,000
Hauling & Disposal	$	371,000
Total	**$**	**1,810,000**
Scrap Value	**$**	**(2,436,000)**
Wind Turbine Foundation Removal Cost		
Removal	$	132,000
Hauling & Disposal	$	219,000
Total	**$**	**351,000**
Substation Removal Cost		
Removal	$	288,000
Hauling & Disposal	$	31,000
Total	**$**	**319,000**
Scrap Value	**$**	**(160,000)**
Civil Works Removal Cost		
Crushed Rock Removal	$	211,000
Hauling & Disposal	$	445,000
Grading & Seeding Costs	$	85,000
Total	**$**	**741,000**
O&M Facility Removal		
Removal	$	31,000
Hauling & Disposal	$	70,000
Total	**$**	**101,000**
Scrap Value	**$**	**(21,000)**
Met Tower Removal		
Removal	$	11,000
Hauling & Disposal	$	1,000
Total	**$**	**12,000**
Scrap Value	**$**	**(2,000)**
Other Costs		
Oils & Chemicals Removal & Disposal	$	57,000
Total	**$**	**57,000**
Total Estimated Cost	**$**	**3,391,000**
Owner Indirects (5%)	**$**	**169,550**
Contingency (10%)	**$**	**339,100**
Total Gross Cost	**$**	**3,899,650**
Total Scrap Value	**$**	**(2,619,000)**
Total Net Cost	**$**	**1,280,650**

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